A POTENTIAL POLICY FOR AUSTRALIAN MILITARY SPACE

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JUNE 2007

Wing Commander Stephen B Cook

The Air Power Development Centre

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Preface

This paper is a copy of a thesis presented in June 2007 by Wing Commander Cook to the faculty of the School of Advanced Air and Space Studies, Air University, Maxwell Air Force Base, Alabama, for completion of graduation requirements.

The Air University has given formal approval for the APDC to reproduce this paper. The document is essentially the same as that presented to the School of Advanced Air and Space Studies, with only minor editorial changes to reflect Australian and ADF spelling and terminology.

A copy of the edited paper was sent to the author for comment and endorsement before publication.

Keith Brent
Editor
Air Power Development Centre
Canberra
October 2013

About the Author

Wing Commander Stephen B Cook joined the Royal Australian Air Force in 1981. On graduation from pilots course in 1982 he went on to fly helicopters, both as a pilot and a qualified flying instructor. During his tour on helicopters, he spent six months flying as part of the Australian Contingent Multinational Force and Observers (MFO) in the Sinai, Egypt. In 1991 he was posted to fly F-111 aircraft, followed by a staff tour as an aircraft accident investigator at the Directorate of Flying Safety – Australian Defence Force. After completing Command and Staff Course in 1999, he was posted as Executive Officer at No 79 Squadron in Perth where he helped introduce the Hawk 127 lead-in fighter into service. On promotion to Wing Commander, he was posted to the newly formed Air Combat Group, where he was responsible for capability development of the F-111 and Hawk aircraft. During this tour, he served in East Timor for six months as the Chief of Air Operations for the United Nations security forces. Wing Commander Cook's last posting, prior to his attendance at the School of Advanced Air and Space Studies, was as the Commanding Officer of No 79 Squadron, in Perth, Western Australia. Wing Commander Cook has over 4300 flying hours on helicopters, F-111s and Hawks, and a Masters Degree in Defence Studies from Canberra University.

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Importantly, I wish to express my appreciation to my wife, Janine, for her patience and support during the production of this paper. Last, but not least, I wish to thank my two boys, Alex and Nick, who had to remain in Australia at university and school while their Dad and Mum had a 'holiday' overseas.

Abstract

Space is a critical vulnerability for Australia and its allies. This thesis seeks to identify a potential space policy for Australia as it attempts to address its space vulnerability. The guiding question answered in this thesis is 'how is Australia vulnerable in space and what can be done to mitigate this vulnerability?'

This thesis comprises an analysis of contemporary issues affecting the international use of space and identifies a potential space policy for Australia. The author outlines the importance of the current outer space regime and identifies how the regime affects the behaviour of states in space, particularly with regard to the weaponisation of space. It concludes that the current regime can be a critical factor in reducing the vulnerability of space assets. The writer next discusses the history of Australian use of space and concludes that Australia is dependent on space for civilian and military purposes. This dependence has resulted in a number of vulnerabilities that need to be addressed if Australia is to ensure its continued ability to use space. The paper also identifies the vulnerabilities of space assets and highlights the need for Australia to work with allies to reduce those vulnerabilities. One of the most promising methods to reduce space vulnerability is by developing an operationally responsive space capability. The author outlines how this capability can be realised. Another important aspect of reducing vulnerability in space is through developing a space assurance regime. The writer identifies the elements required in a space assurance regime and provides a method for building such a regime. The final chapter identifies how Australia can build up its space capability by working with industry and allies, and outlines the basis of a space policy.

The most important and immediate step that Australia needs to take is to improve the space knowledge of senior Defence personnel.

Abbreviations and Acronyms

AAP	Australian Air Publication
ADF	Australian Defence Force
ADO	Australian Defence Organisation
APDC	Air Power Development Centre
ASAT	anti-satellite
ASIC	Air and Space Interoperability Council
DSCO	Defence Space Coordinating Office
DSTO	Defence Science and Technology Organisation
FPDA	Five Power Defence Arrangements
GPS	Global Positioning System
ISR	Intelligence, Surveillance and Reconnaissance
LEO	low earth orbit
microsat	micro-satellite
NCW	Network Centric Warfare
ORS	operationally responsive space
OST	Outer Space Treaty
RAAF	Royal Australian Air Force
RPDE	Rapid Prototyping, Development and Evaluation
UAV	unmanned aerial vehicle
UN	United Nations
WRESAT	Weapons Research Establishment Satellite

Contents

Chapter 1
Introduction

International use of space is growing rapidly and the technology to exploit space is disseminating just as rapidly. Space is involved in every aspect of daily life, from communication to banking and navigation. Use of space is important in the civil sphere as it allows for persistent communication of data around the world and communication with places that are not easily reached by terrestrial methods. The introduction of the Global Positioning System (GPS) for positioning, navigation and timing (PNT) has also allowed greater navigation accuracy in the aviation community, where accurate navigation is critical for the safe operation of aircraft. Use of GPS has also developed to the stage where aircraft can conduct instrument approaches without the need for ground-based navigation systems, allowing instrument approaches into remote areas, even in poor weather. For example, GPS approaches are used in some regions of the world that could not afford terrestrial instrument approach systems, and this greatly improves the wider international community's access to these regions. Many civilian uses of space, such as the use of GPS for commercial aviation, are originally derived from military space programs. GPS is a military system owned and operated by the US Air Force that has a wide array of military applications, as well as civilian and commercial applications.[1]

Military forces around the globe now rely on space more than ever before and the trend is towards even higher dependence. Military forces worldwide depend on satellites for communications and many modern military systems require GPS and other satellite navigation systems for PNT data and weapons guidance. Satellites are also used for Intelligence, Surveillance and Reconnaissance (ISR) and weather satellites provide critical information for targeting and the conduct of operations. The improved communications available from satellites also enable Network Centric Warfare (NCW) concepts. NCW aims to improve data sharing among all aspects of a military force to greatly improve the situational awareness of all friendly forces involved in a conflict.[2] Terrestrial alternatives, such as unmanned aerial vehicles (UAVs), can provide improved communications, but only satellites can achieve the required persistence. While the use of UAVs can help Australia augment its communications capacity, UAVs themselves rely on satellites for their operation and navigation.

The current outer space regime, based largely on the 1967 Outer Space Treaty, governs all space activities. Stephen D Krasner defines regimes as the 'principles, norms, rules, and decision-making procedures around which actor expectations converge in a given

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1 For a history of GPS, see Michael Russell Rip & James M Hasik, *The Precision Revolution: GPS and the Future of Aerial Warfare*, US Naval Institute Press, Annapolis, MD, 2002.

2 On NCW, see Paul T Mitchell, *Network Centric Warfare*, Adelphi Papers, vol. 46, issue 385, Routledge/IISS, London, 2006.

issue-area'.[3] The outer space regime consists of a number of treaties and conventions that will be discussed in greater detail later in this paper. It is important that these treaties and conventions constitute a regime, as this means that even countries that have not signed the agreements are still expected to abide by them if they are to maintain a credible standing within the international community. One of the overriding expectations of the outer space regime is that space is used for peaceful purposes.

There is considerable international debate on whether this use for peaceful purposes precludes the deployment of weapons in outer space.[4] US space policy contends that the current regime does not preclude the use of weapons to defend satellites.[5] Problems arise with the type of weapons deployed, as many weapons employed for self-defence can also be used offensively, which many contend would violate the intent of the current regime to use space for peaceful purposes.

While many countries have space programs, and therefore a well-developed understanding of the uses and vulnerabilities of space systems, Australia, due to its limited space capability, lags behind much of the world. Australia is a large continent with widely spread communities, especially in the interior and western part of the country. Given the large distances separating parts of Australia, satellite communication provides an ideal way for various communities to remain connected with the rest of Australia and the international community. The difficulty and cost of developing and maintaining a robust terrestrial communication network means that space communication provides a cost-effective way for all of Australia to remain connected. While Australia currently has very few actual space assets, the number of Australian-owned satellites will certainly grow. For now, Australia relies largely on commercial satellites.[6] The use of space by Australia has developed in a relatively ad hoc manner, resulting in a lack of understanding of Australia's vulnerability to an interruption of space services. The absence of a coherent Australian policy on space contributes to the nation's failure to appreciate its vulnerability. The Royal Australian Air Force (RAAF) has begun work on developing a space policy and published *The Future*

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3 Stephen D Krasner, 'Structural causes and regime consequences: regimes as intervening variables', International Organization, vol. 36, no. 2, Spring 1982, p. 185.

4 United Nations, 'Disarmament – Secretary General's Message to the 2007 Session of the Conference on Disarmament', Geneva, 22 January 2007, viewed June 2007, <http://www.unog.ch/unog/website/disarmament.nsf/(httpPages)/09901593FEE671F2C125726B0044D6E0?OpenDocument>. See also Reaching Critical Will, 'Statements made at the 2006 Session of the Conference on Disarmament', viewed June 2007, <http://www.reachingcriticalwill.org/political/cd/speeches06/topics.html>.

5 Robert G Joseph, 'Assuring vital interests drives US space policy', Speech by US Under Secretary for Arms Control and International Security, Center for Space and Defense Forum, Colorado Springs, CO, 11 January 2007, viewed June 2007, <http://www.spacewar.com/reports/Assuring_Vital_Interests_Drives_US_Space_Policy_999.html>.

6 There have only been a handful of Australian satellites such as the Optus A to C series (communication satellites) and the research satellites WRESAT and FedSat-1.

Air and Space Operating Concept (FASOC)[7] in March 2007, which outlines the Australian Defence Force's concept for space. Yet, without a space program, Australia is struggling to understand how its military and wider society are vulnerable to disruption in and from space. Australia knows that it is vulnerable, and that is an important step towards addressing this deficiency. The hardest steps remain to articulate the vulnerabilities and then take measures to reduce vulnerability.

As already stated, the use of space is now entrenched in almost every facet of Australian life and any interruption in space services would have a deleterious effect. The ways in which Australia is vulnerable in space are outlined below and will be discussed in greater detail later in this paper. For now, the vulnerabilities of space assets can be broken down to physical attack, electronic interference, and environmental effects. Both civil and military space assets may be vulnerable to attacks by an adversary who may wish to reduce the effectiveness of Australian military forces or cause economic problems for Australia. This enemy does not necessarily have to be a space power but may achieve his desired effect by using simple methods, such as hacking into information systems, which does not require significant resources. Simple environmental effects could also degrade Australia's space capability, be it radiation or damage caused by space debris.

Without doubt, Australia relies heavily on space for the general conduct of civil life and the defence of the country. This thesis aims to identify how Australia is vulnerable in space and then outline a suggested military space policy for the future. The adoption of a coherent space policy could also protect Australian civil and commercial space infrastructure and assets. This thesis will firstly examine the current space regime, it will then outline the history of Australian space and then discuss the vulnerability aspects of space. The thesis will then identify what is meant by operationally responsive space and how it is relevant to Australia, outline a space assurance regime and, finally, identify how a space policy for Australia should be developed. This thesis does not address the manned aspects of space exploration as this endeavour is presently well beyond Australia's reasonable expectations.

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7 The Future Air and Space Operating Concept (AAP 1000–F) was officially released on 19 March 2007 and forms part of the Royal Australian Air Force air power doctrine. Other publications in the series include The Air Power Manual (AAP 1000–D) and The Australian Experience of Air Power (AAP 1000–H).

Chapter 2
Current Outer Space Regime

The outer space regime is an important factor in controlling how states conduct themselves in space. Because the regime influences how states act in space, it has an impact on the vulnerability of space assets and controls how space can be developed. Because the outer space regime comprises a number of treaties and conventions that are sponsored by the United Nations (UN), individual nations can influence how the regime affects space operations by participating in the various UN space forums.

A number of treaties and conventions make up the outer space regime. Even though some of the conventions have not been ratified by all countries, the fact of their existence, and the length of time that they have been in force, leads to an expectation that all countries will abide by them. All of the treaties and conventions originated during the Cold War period when the USSR and USA were the dominant space powers in the world, and are still in force and adhered to despite radical changes in the strategic environment.

Five UN treaties directly relate to the conduct of activities in space and form the basis of the current space regime.

Outer Space Treaty

The most prominent of the treaties relating directly to outer space is the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies (1967)—otherwise known as the Outer Space Treaty (OST). This treaty came into force on 10 October 1967 and provides the overarching framework for how states should conduct themselves in outer space.[8] The treaty comprises a total of 17 articles. The first article (Article I) of the treaty identifies that the exploration and use of outer space, including the moon and other celestial bodies, shall be for the benefit and in the interests of all mankind.[9] Article II goes on to state that outer space, the moon, and other celestial bodies, are not subject to claims of sovereignty by any nation.[10] Article III restricts state activity to operations in accordance with international law and in the interest of maintaining international peace and security.[11] One of the most significant aspects of the OST is contained in Article IV, which prohibits the placing of nuclear weapons and weapons of mass destruction in space. Likewise, this article also prohibits the placement of military bases, the conduct of military exercises, and the testing of weapons on celestial bodies.[12] Article V of the OST requires parties to the

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8 United Nations, *United Nations Treaties and Principles on Outer Space*, United Nations, New York, NY, 2002, viewed June 2007, <http://www.unoosa.org/pdf/publications/STSPACE11E.pdf>.

9 ibid., p. 4.

10 ibid.

11 ibid.

12 ibid.

treaty to render assistance to any state's astronauts that are in distress.[13] Articles VI, VII and VIII identify that states are responsible for all activities in space and that they are liable for any damage caused to another state because of their activities. They further identify that states retain jurisdiction and control of any objects they have placed in outer space.[14] All states are to consider the activities of other states when conducting exploration or use of outer space, and avoid harmful interference with the activities of other states (Article IX).[15] Articles X to XII concern the sharing of information between states and allow for states, with appropriate agreement, to observe each other's activities and to allow representatives to visit stations and facilities maintained in outer space.[16] The articles also require states to provide the United Nations Secretary-General, to the maximum extent possible, with details on their activities in outer space.[17] The final articles of the treaty allow states to propose amendments or to withdraw from the treaty with appropriate notice.[18]

Moon treaty

UN General Assembly Resolution 34/68 ratified the Agreement on Activities of States on the Moon and Other Celestial Bodies.[19] This resolution was later amended to the Agreement Governing the Activities of States on the Moon and Other Celestial Bodies[20]—the Moon Treaty (1979)—but only 12 states agreed to this amendment, and none of these states were major space-faring nations.[21] Even though none of the major space-faring states have signed the 1979 Moon Treaty, none of these states have gone against any of the provisions included in the agreement.[22] The Moon Treaty expands on the provisions of the OST, reinforces the requirement to use the Moon for peaceful purposes only, and reiterates that nuclear weapons or weapons of mass destruction are not to be placed on or around the Moon.[23] Also, military bases are not to be placed on the Moon and the Moon is not to be used for the conduct of military exercises or the testing of weapons.[24] The agreement reinforces the expectation that the exploration and use of the Moon is to be for the benefit of all mankind.[25] The US refuses to ratify the agreement because of the provision that

13 ibid., pp. 4–5.

14 ibid., p. 5.

15 ibid., p. 6.

16 ibid., pp. 6–7.

17 ibid., p. 6.

18 ibid., pp. 7–8.

19 Everett C Dolman, *Astropolitik: Classical Geopolitics in the Space Age*, Frank Cass Publishers, London, 2002, p. 130.

20 United Nations, *United Nations Treaties and Principles on Outer Space*, pp. 27–35.

21 United Nations, 'Treaty Signatures', viewed June 2007, <http://www.unoosa.org/oosatdb/showTreatySignatures.do>.

22 Dolman, *Astropolitik*, p. 133.

23 United Nations, *United Nations Treaties and Principles on Outer Space*, p. 28.

24 ibid.

25 ibid.

declares that the use of the Moon is to be for the benefit of all mankind, regardless of a country's scientific and economic development.[26]

The Moon Treaty calls for the establishment of a regime for the exploitation of any natural resources found on the Moon once that exploitation becomes feasible.[27] The regime is to include measures for the equitable sharing among all states of any resources derived from Moon exploitation.[28] Everett Dolman argues that this last requirement has significant implications for major space-faring nations. If a state or organisation expends significant amounts of money in developing ways to exploit the Moon's resources, any requirement to share those resources with other states that have not expended their own money, will result in a significant disincentive to exploration.[29] While the OST and Moon Treaty are the major treaties making up the outer space regime, a number of other agreements and conventions also shape the current regime.

Other Agreements and Conventions

The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space (1968) fosters a spirit of mutual support in outer space. This agreement outlines the requirement to assist astronauts in distress, even though they may be from other states. The agreement also lays down the requirement to return astronauts and space objects to the launching state.[30] This agreement complements the Convention on International Liability for Damage Caused by Space Objects (1972).[31]

The Convention on International Liability for Damage Caused by Space Objects lays the foundation for compensation of any damage caused to another state by the launching of space objects, regardless of whether the damage is caused to terrestrial property or property in outer space.[32] This convention is particularly relevant because it implies that states can be held responsible for the damage caused by debris they create in space. In order to determine which state launched an object that subsequently causes damage, the UN maintains a register of space objects with information obtained under the auspices of the Convention on Registration of Objects Launched into Outer Space (1976).[33]

The Convention on Registration of Objects Launched into Outer Space outlines the requirement for states to register any objects launched into outer space with the UN

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26 Steven Lambakis, *On the Edge of Earth: The Future of American Space Power*, The University Press of Kentucky, Lexington, KY, 2001, p. 67.

27 United Nations, *United Nations Treaties and Principles on Outer Space*, pp. 31–32.

28 ibid.

29 Dolman, *Astropolitik*, pp. 136–141.

30 United Nations, *United Nations Treaties and Principles on Outer Space*, pp. 9–12.

31 ibid., pp. 13–21.

32 ibid., pp. 13–14.

33 ibid., pp. 22–26.

Secretary-General, who will maintain a record of space objects.[34] States are also required to maintain their own registry of indigenous space objects.[35] The Convention requires states to provide, at a minimum, a designator for the space object, date and location of launch, basic orbital parameters, and a general outline of the function of the object.[36] Launching states may provide any other relevant information, at their own discretion.[37] Even though this convention is intended to provide information on satellites, most nations manage to keep the details of classified programs secret; therefore, it has little impact on classified military programs. In addition to the five UN treaties directly related to space conduct, there are a further three treaties and one convention that contribute to the current space regime.

The Anti-Ballistic Missile Treaty of 1972 (no longer in force), the Limited Test Ban Treaty (1963), and the Non-Proliferation Treaty have a limited application to space, with the major factor being that the Limited Test Ban Treaty prohibits the explosion of nuclear devices in space.[38] This is especially significant when discussing the vulnerabilities of satellites as the detonation of any nuclear weapon in space can degrade or destroy satellites in orbit.

The Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (1977) prohibits the development of devices that can modify the environment in order to cause damage to another state.[39] The main aspect of this convention, as it relates to space, is that states may not act in such a way in outer space as to cause deliberate damage to the terrestrial environment in an attempt to cause damage to an enemy state.

Impact of Outer Space Regime

The current space regime has served the world's nations well, even though it only bans weapons of mass destruction in space, not all weapons. Except for some experimentation with anti-satellite (ASAT) weapons by the USSR and USA during the Cold War, space has remained free of weapons. The one exception to this was the recent ASAT missile test by China on 11 January 2007. The Chinese fired a ground-based medium range ballistic missile against an ageing Chinese weather satellite to test their ability to destroy a satellite in orbit. The missile achieved a kinetic kill of the satellite and resulted in the generation

34 ibid., p. 23.

35 ibid.

36 ibid., pp. 23–24.

37 ibid., p. 24.

38 Glenn H Reynolds & Robert P Merges, *Outer Space: Problems of Law and Policy*, 2nd ed., Westview Press, Boulder, CO, 1997, pp. 58–59.

39 Dolman, *Astropolitik*, p. 134.

of significant space debris.[40] The USSR and USA discontinued testing of their ASAT systems by tacit consent during the latter part of the Cold War.[41] If Russia and the USA engage China in a meaningful way then perhaps China can be persuaded to see the sense in discontinuing their current trend towards testing kinetic weapons against targets in space, without the need for a new and separate treaty.

The recent activity by China to test their ASAT capability does not mean that the current treaties need to be abandoned in favour of stricter treaties. Rather than design a new treaty, all the major space-faring nations must focus their energy on persuading China that the testing of kinetic kill weapons in outer space is not in accordance with using space for the good of all mankind, as required by the OST. The debris created from testing kinetic kill weapons is a hazard to everyone's space assets and the Chinese are just as likely to be effected as other countries with satellites in outer space. If Australia was more actively engaged in space operations then it could also use its influence with China to dissuade them from further testing such weapons.

Australia presently has no wholly owned space assets, although this will change if a purely Australian owned satellite communications capability is fielded in 2010.[42] Even though Australia does do not presently own any satellites, it does rely heavily on the assets of other countries.[43] It therefore behoves Australia to support the current space regime to ensure that Australia's ability to use space assets continues. To lend greater credibility to its right to contribute to the debate on the outer space regime, Australia must demonstrate its ability to contribute in a meaningful way. To demonstrate such ability, Australia needs, at a minimum, a trained core of people with significant knowledge of space who can participate in the international space forums. Ideally, Australia will not just train personnel but will become much more active in space. To gain this ability, Australia needs to be on the cutting edge of technology and it should look for areas where it can develop its own space capability, even if, for example, it is just the design and construction of micro-satellites.[44] There are also opportunities for Australia to work in partnership with other countries to develop its space capability and this will be discussed in subsequent chapters. While Australia takes the first steps towards improving its space capability, there is currently active

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40 Dennis Shanahan & Rowan Callick, 'China missile strike fuels fear of new arms race', *The Australian*, 20 January 2007, viewed 20 January 2007, <http://www.theaustralian.news.com.au/printpage/o,5942,21088182,00.html>.

41 Michael Krepon & Christopher Clary, *Space Assurance or Space Dominance?: The Case Against Weaponizing Space*, The Henry L. Stimson Center, Washington, DC, 2003, p. 17.

42 Department of Defence, *Defence Capability Plan 2006 – 2016: Public Version*, Defence Capability Group and Defence Materiel Organisation, Canberra, 2006, viewed June 2007, <http://www.defence.gov.au/dmo/id/dcp/dcp.cfm>.

43 Senator Grant Chapman, *Space: A Priority for Australia*, Senate Printing, Canberra, 2005, p. 11, viewed June 2007, <http://www.asicc.com.au/publications.htm>.

44 For a definition of micro-satellites see Chapter 5.

debate on what sort of military assets should be deployed in outer space, and these debates could alter the current space regime.[45]

Weapons and the current space regime

There is significant international interest in developing a treaty to ban all weapons from outer space. A number of states have been using the UN Conference on Disarmament to press for a total ban on weapons in space; however, they have not identified any measures to verify that states abide by this proposed new treaty.[46] The US is understandably reluctant to sign up to any treaty to ban weapons without some form of verification process.[47] The disadvantage for the US in any treaty banning space weapons is that they are a relatively open society and therefore any overt weapons development quickly becomes known to the international community. There are, however, a number of countries with closed societies that could more effectively hide their weapons development from the international community. While the US would probably abide by any new treaty, a number of other states could conceivably use the treaty to hobble the US while continuing to develop and test their own weapons to reduce the space advantage currently enjoyed by the US. The US correctly maintains their right to defend their space assets and to do this they would probably have to develop some form of space weapon, albeit a capability that may not necessarily be based in space.[48] The difficulty for the US, and any other country trying to protect their space assets with deployed weapons, is convincing the international community that the weapons are for defensive purposes only. A treaty that bans all weapons without a solid verification process would potentially prevent the US from being able to defend its assets. The challenge for the US is to develop defensive measures in space that are not overtly offensive as well. By operating in space on a clearly defensive footing, the US could maintain the support of the international community. The international community is more concerned about the potential deployment of weapons in space that could strike terrestrial targets (space-to-earth weapons) than those that would damage other spaceborne objects.

Australia's capabilities in space are presently very limited and it is unlikely to field any weapons in space for the foreseeable future; therefore, the debate on whether there should

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45 These debates have been conducted in various books and articles such as: Dolman, *Astropolitik*; Krepon & Clary, *Space Assurance or Space Dominance*?; and John B Sheldon, 'Space as the fourth environment: for warfare or a supporting role?', *RUSI Journal*, October 1999.

46 United Nations, 'Disarmament – Secretary General's Message to the 2007 Session of the Conference on Disarmament, Geneva, 22 January 2007, viewed June 2007, <http://www.unog.ch/unog/website/disarmament.nsf/(httpPages)/09901593FEE671F2C125726B0044D6E0?OpenDocument>. See also Reaching Critical Will, 'Statements made at the 2006 Session of the Conference on Disarmament', viewed June 2007, <http://www.reachingcriticalwill.org/political/cd/speeches06/topics.html>.

47 Robert G Joseph, 'Assuring vital interests drives US space policy', Speech by US Under Secretary for Arms Control and International Security, Center for Space and Defense Forum, Colorado Springs, CO, 11 January 2007, viewed June 2007, <http://www.spacewar.com/reports/Assuring_Vital_Interests_Drives_US_Space_Policy_999.html>.

48 ibid.

be a treaty to ban weapons in space is only relevant to the extent that it impacts on the vulnerability of space assets. In addition, the present debate about treaties to ban weapons only relates to weapons in space, not weapons that can be launched terrestrially to target objects in space. This means that space assets would still be vulnerable to attack from earth and, therefore, still of concern to the US. Australia's best option is to support the US policy and continue to promote the use of space for peaceful purposes.

Australia participates actively within the various United Nations space forums, even though it does not have a significant space capability. Australia was one of the first nations to launch a satellite from its own territory and, as it starts to develop a credible space capability, it is useful to examine the history of its participation in space.

Chapter 3
Australian Space – Past, Present and Future

Space History

The outer space regime is an important factor in influencing how nations conduct themselves in outer space and the regime began to form when countries first reached outer space. The USSR was the first country to venture into outer space with the launch of *Sputnik I* on 4 October 1957. Although *Sputnik* was very basic, essentially an orbiting transmitter, it presaged a race in space that continued for the next 30 some years.[49]

The launch of *Sputnik I* was also important because it established the right of over-flight of sovereign territory from space; a principle the USSR may have contested if the US had launched the first satellite.[50] This principle of freedom of space later allowed the US to solve the problem of surveillance of closed USSR territory, when it developed its first *Discoverer* reconnaissance satellites.[51]

The US followed closely behind the USSR when it launched its first satellite, *Explorer 1*, on 31 January 1958. *Explorer* was more useful than the Russian *Sputnik* as it relayed scientific data back to Earth and led to the discovery of the Van Allen radiation belts.[52] The third country to launch its own satellite was France when it launched its *Astérix* satellite on 26 November 1965.[53] The fourth country to launch a satellite from its own territory was Australia.

Australian Space History

Australia launched a Weapons Research Establishment Satellite (WRESAT) from the Woomera Test Range in South Australia for the first and last time in 1967.[54] This launch meant that Australia was the fourth country to conduct a space launch from its own

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49 Steven Lambakis, *On the Edge of Earth: The Future of American Space Power*, The University Press of Kentucky, Lexington, KY, 2001, p. 13.

50 Walter A McDougall, *... the Heavens and the Earth: A Political History of the Space Age*, Basic Books, New York, NY, 1985, p. 134.

51 David N Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, Air University Press, Maxwell AFB, AL, 1998, p. 152.

52 ibid., p. 53.

53 The Satellite Encyclopedia, 'Satellite Fact Sheet – Astérix', viewed 18 March 2007, <http://www.tbs-satellite.com/tse/online/sat_asterix.html>.

54 Australian Space Research Institute, 'Australia's First Satellite in Orbit', viewed June 2007, <http://www.asri.org.au:81/ASRI/satellites/wresat/index.jsp>.

territory.[55] Since that time, Australia's involvement in space operations has been relegated to one of observer status, even while its dependence on space has continued to grow.[56]

Admittedly, the 1967 launch resulted from a sequence of fortuitous events. The US, with the help of Australia and Great Britain, were using the Woomera Test Range in South Australia to conduct research on the effect on warheads of high-speed atmospheric re-entry.[57] At the conclusion of the testing a decision was made to use the one remaining launch vehicle to launch a satellite built by scientists from the Australian Weapons Research Establishment. The satellite was designed and built over a period of only 11 months.[58] WRESAT was designed to collect scientific information on the upper atmosphere, measure solar radiation, and measure the ultraviolet halo that surrounds the Earth at night. The satellite was powered by batteries, which resulted in WRESAT operating for only two weeks. WRESAT burned up on re-entering the Earth's atmosphere on 10 January 1968.[59] The launch of the 1967 satellite was a complete success; so why has Australia remained disengaged in space operations since then?

Australia's space history has unfortunately followed the path of its aviation industry. At one time in its history, Australia designed and produced indigenous aircraft; however, the last aircraft produced was the Nomad in the 1980s. Since that time, Australia has not successfully conducted any further basic aircraft design work.[60] Australia's indigenous development of satellites has followed the same unfortunate path. How can Australia expect to remain relevant in the information age when it does not continue to produce innovative space technology? Australians are capable of thinking on the cutting edge; all they need are the resources to translate their ideas to reality. While Australia lags behind most of the world in space capabilities, it can still become a space power.

Australia has started to take the first steps towards regaining its position as a leader in space, particularly as it relates to military use. The first tentative step towards this goal has been the establishment of the Defence Space Coordinating Office (DSCO) in Air Force Headquarters. The Australian Defence Force (ADF) realises that if Australia is to ensure its

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55 Wing Commander Chris Miller, 'Australia's moment in the starlight', *Air Force*, vol. 47, no. 8, 19 May 2005, viewed 18 March 2007,<http://www.defence.gov.au/news/raafnews/editions/4708/history/story01.htm>.

56 Another satellite was launched from Woomera in 1971; however, this was essentially a purely British venture that launched the British *Prospero* satellite. Daphne Burleson, *Space Programs Outside the United States: All Exploration and Research Efforts, Country by Country*, McFarland & Company Inc., Jefferson, NC, 2005, p. 312.

57 Australian Space Research Institute, 'Australia's First Satellite in Orbit'.

58 ibid.

59 ibid.

60 Australian Heritage Council, 'Linking a Nation: Australia's Transport and Communications 1788–1970', viewed June 2007, <http://www.ahc.gov.au/publications/linking-nation/chapter-8.html#aircraft>.

access to space and space assets then it needs to increase education on space operations.[61] In some ways, the delay in realising the need for centralised control of Australia's space operations has followed the same path as the US military. The US military took a significant period of time to come to grips with the need for centralised control of military space. It was only after the USAF realised the potential of space and took steps to establish a Space Command that coherent doctrine began to emerge.[62]

The Australian Defence Force has taken action to regain space credibility for Australia amongst the wider international community. In February 2006, the ADF Chiefs of Staff Committee (COSC) established a Space Review Team to develop Defence Space Policy. The review was subsequently extended to examine Defence space structure and management. The review team found that the ADF is potentially vulnerable in space but there is little understanding within the ADF of what this means. The review also characterised the development and management of space-related activities as fragmented and uncoordinated. The final finding of the review team was that the ADF lacked a space culture, policy, or management framework. As a result of their findings, COSC established the DSCO on 1 September 2006.[63]

Defence Space Coordinating Office

The primary role of the newly formed DSCO is to become the centre for space expertise within the ADF. The office is also responsible for coordination of space strategic planning, space support to operations, space engagement with Defence partners, space personnel management, and some aspects of common space specific capability development. The formation of the DSCO will allow a more focused approach to space-related activities and will improve the general space knowledge of ADF personnel. During the lead up to the establishment of the DSCO, the RAAF worked on developing *The Future Air and Space Operating Concept* (FASOC), which has more of a focus on space than previous doctrine.

FASOC clearly identifies that the RAAF requires a high-capacity communications network, surveillance and reconnaissance that is more persistent, and an integrated and adaptive command and control system.[64] Terrestrial and air-breathing assets can provide some, but not all, of these capabilities. Space-based assets will be required to provide the remaining capability. FASOC identifies this trend towards more reliance on space assets and raises the potential use of leased commercial systems, space systems of Australian allies, and

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61 Briefing outlining the establishment of the DSCO as directed by the Australian Defence Force Chiefs of Staff Committee (COSC). One of the aims of the DSCO is 'General and higher levels of space knowledge throughout Defence'.

62 Spires, *Beyond Horizons: A Half Century of Air Force Space Leadership*, pp. 202–207.

63 Information obtained from a MS PowerPoint briefing outlining the establishment of the DSCO as directed by the Australian Defence Force Chiefs of Staff Committee (COSC).

64 Royal Australian Air Force, Australian Air Publication 1000–F—*The Future Air and Space Operating Concept*, Air Power Development Centre, Canberra, 2006, pp. 2–3.

indigenous space assets.[65] This higher reliance on space systems will result in an increase in Australian vulnerability in space, unless it takes active measures to reduce its vulnerability. While the ADF has identified the need for a coherent approach to space, the civilian sector is also moving to establish a national space strategy.

Australian Civilian Sector

Senator Grant Chapman, a Liberal Senator for South Australia, established a Space Policy Advisory group in 2005 to help develop a national space policy. His submission, titled *Space: A Priority for Australia*, was completed in December 2005 and identified a number of issues with which Australia must come to grips. The paper clearly identifies that Australia is dependent on space for military and civilian uses. The biggest concern raised by Senator Chapman is the lack of space knowledge in Australia and the subsequent vulnerability that lack of knowledge entails. The paper recommends that Australia formulate a national space policy, that it review its national space interests, reduce its vulnerability, improve its capability to validate space data and products, assure its access to space data and products, contribute to reducing international tension resulting from space competition, make it more difficult for foreign powers to collect intelligence on Australian activities, review its self-sufficiency, and increase Australian involvement in international dialogue on space issues.[66] The ADF has commenced action to achieve some of these recommendations with the establishment of the DSCO, but otherwise there is still no clear path ahead.

Australian Defence Space

Australia already makes significant use of space capabilities but it can do more to improve its space access and reduce its vulnerability in space.[67] The ADF uses satellites for communication and relies on space assets for ISR. It will depend on space systems even more once the reconnaissance F-111 is retired in 2010. The F-111 will be replaced by the F/A-18F Super Hornet, but the author does not know details of any reconnaissance capability for the F/A-18F at this time.[68] At present, much of Australia's space ISR requirements are satisfied by the US[69], but this becomes a vulnerability for Australia if the US needs to use its scarce assets in an area of higher priority, making them unavailable to Australia. One suitable strategy for improving space access is to develop a niche capability in space. This niche capability can then be used to trade information and capability with

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65 ibid., p. 23.

66 Senator Grant Chapman, *Space: A Priority for Australia*, Senate Printing, Canberra, 2005, viewed June 2007, <http://www.asicc.com.au/publications.htm>.

67 Royal Australian Air Force, AAP 1000–F—*The Future Air and Space Operating Concept*.

68 Air Marshal GD Shepherd, *Update from the Chief of Air Force*, 7 March 2007; and Patrick Walters, '$6bn for 24 Super Hornets', *The Australian*, 7 March 2007, viewed 19 March 2007, <https://www.newstext.com.au/>.

69 Department of Defence, *Australia's National Security: A Defence Update 2005*, Department of Defence, Canberra, 2005, pp. 13–14, viewed June 2007, <http://www.defence.gov.au/update2005>.

the US to ensure Australia has continued access to larger US capabilities. The best way for Australia to reduce its other space vulnerabilities is to pursue a space assurance strategy but, because of the costs involved, this would require the support of the US.

Chapter 4
Space Vulnerabilities

Australia as a nation should be concerned about the vulnerability of space assets, even though it presently has no significant indigenous satellites, because it does rely on the capabilities available from other countries and from the commercial sector. Aside from the civil sector reliance on satellites for communication, earth sensing, navigation, and weather, the ADF needs satellites for command and control, ISR, navigation, and meteorology. The ADF reliance on space-based systems will become more important as the concept of network centric warfare continues to mature.[70]

There are a number of ways to interfere with or destroy satellites in orbit. Identifying the various vulnerabilities of satellites is an important step in finding ways to reduce satellite vulnerability. The vulnerability of space assets can effectively be broken down into three distinct areas: anti-satellite (ASAT) weapons, conventional attacks, and environmental effects. Anti-satellite weapons include ASAT missiles, space mines, and directed energy weapons. Conventional attacks include such measures as jamming, spoofing, hacking, and attack on ground segments. Space debris and solar radiation are examples of environmental effects. All nations depend on satellites, and given this fact, they must find ways to defend their satellites as a priority. ASAT weapons are one of the most apparent and often discussed vulnerabilities of satellites.

ASAT Weapons

The most obvious ASAT weapon is the ASAT missile. There are essentially two ways that ASAT missiles may be used to attack satellites in orbit. The first is direct attack from land-based, sea-based or air-launched missiles (direct ascent). These types of ASAT missiles are launched from the land, sea or from an aircraft and rely on carrying out an intercept of a satellite as it passes overhead. The other method of using missiles to attack a satellite is to place a missile in a co-orbit with the satellite and then pursue the satellite until the missile achieves a kill. ASAT missiles traditionally use either kinetic energy (direct impact) or the use of an explosive warhead to achieve a kill.[71] Some ASAT missiles, such as ballistic missiles, are multiple-use systems and are not dedicated ASAT systems, although they do require modification to perform the ASAT task.

Space mines are satellites placed in orbit near their intended victim. They loiter until commanded to attack the target satellite and achieve a kill either kinetically or by the use of an explosive warhead. Space mines can be placed in co-orbit or in an orbit that will intersect

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70 Royal Australian Air Force, Australian Air Publication 1000–F—*The Future Air and Space Operating Concept*, Air Power Development Centre, Canberra, 2007, p. 22.

71 Steven Lambakis, *On the Edge of Earth: The Future of American Space Power*, The University Press of Kentucky, Lexington, KY, 2001, pp. 121–122.

the orbit of the target satellite. They can achieve a kill by either direct impact with the target satellite or by deploying small objects that will impact and disable or destroy the target.[72]

Directed energy weapons are another feasible method of destroying a satellite and they can be terrestrially or space-based. Lasers can destroy or disable the target satellite by focusing their energy on vulnerable parts of the target. In addition to destroying or permanently disabling a satellite, lasers can dazzle or blind imagery satellites temporarily.[73]

Another method of destroying and disabling satellites in orbit is by detonating a nuclear weapon in low earth orbit (LEO). The electromagnetic pulse (EMP) from the detonation could disable any satellites within range and the radiation from the detonation would remain in orbit and continue to degrade, and eventually disable, any satellites that pass through the resulting belt of trapped radiation.[74] Satellites in medium earth orbit (MEO) and geostationary Orbit (GEO) are less susceptible to nuclear detonations due to the greater distances involved, therefore, reducing the chance of an intense electron belt.[75]

In addition to attacking satellites with weapons, conventional means may also be used to make satellites unusable.

Conventional Attack

Jamming is used to interfere with satellites without actually destroying the target. The most obvious use of jamming is to block the signal from a satellite so that the controlling country cannot obtain information or use the satellite for the purpose for which it is normally used.[76] The other type of jamming is uplink jamming. This type of jamming prevents the controlling country from exercising control over the satellite and, as a result, the satellite may not be operated as required.[77] This type of jamming is particularly effective against imagery satellites that need to be pointed in order to obtain the imagery for which the satellite was intended. Uplink jamming also prevents controllers from issuing commands to keep the satellite in its planned orbit, resulting in the satellite drifting into an ineffective orbit.[78]

Satellite spoofing is carried out by providing false information to the satellite operator. Instead of the correct signal reaching the operator, the original signal is corrupted and replaced with a false signal with the intent of providing the satellite operator with false

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72 ibid., p. 123.

73 Michael Krepon & Christopher Clary, *Space Assurance or Space Dominance?: The Case Against Weaponizing Space*, The Henry L. Stimson Center, Washington, DC, 2003, p. 65.

74 Lambakis, *On the Edge of Earth*, pp. 123–124.

75 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 66.

76 Lambakis, *On the Edge of Earth*, p. 126.

77 Krepon & Clary, *Space Assurance or Space Dominance?*, pp. 68–69.

78 John J Klein, *Space Warfare: Strategy, Principles and Policy*, Routledge, Abingdon, 2006, p. 96.

information.[79] This type of operation is closely related to hacking and requires hacking skills to achieve specific effects.

Hacking of satellite networks is essentially the hacking of computer networks. The aim of such hacking can be to deny the service of a satellite or to obtain intelligence information. For example, hacking into a communications satellite network can provide signals intelligence, while hacking into imagery satellites can provide an adversary with intelligence on friendly operations.[80] As well as using electronic means, ground forces are used to attack ground installations.

Either conventional or special forces can deny satellite services by attacking the ground segment. Irregular forces, as used by a number of terrorist organisations, may also target ground stations as they wage asymmetric warfare. Destroying the ground segment will degrade a nation's ability to control the satellite or use the satellite for its intended purpose.[81]

In addition to deliberate attack, satellites are also vulnerable to environmental effects.

Environmental Effects

Satellites in LEO travel at approximately 7000 metres per second, which makes them especially susceptible to any debris in space. Given the speed at which satellites and space debris travel, a very small mass of space debris can cause significant damage to a satellite, especially if they are travelling on different vectors. Debris threatens all satellites in orbit and is generally a side effect of space launches, although a country could deliberately place debris in orbit to disrupt satellite operations, if so inclined. ASAT missiles and space mines can also generate debris when they achieve a kinetic kill.[82] Directed energy weapons and nuclear detonations also turn functional satellites into debris when they permanently disable or destroy their targets.[83]

In addition to space debris, naturally occurring meteoroids can also damage satellites in orbit. Natural sources, such as comets, generate meteoroids as they pass through our solar system. These meteoroids are often travelling at speeds of 158 000 miles per hour, making even the smallest of particles deadly to any satellite in their path.[84] Apart from impact damage, satellites operate in a very harsh environment.

Outer space subjects satellites to extremes of temperature and low pressure, as well as solar radiation. This radiation can damage electronic circuitry, either temporarily or permanently

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79 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 7.

80 ibid., pp. 23–24.

81 Lambakis, *On the Edge of Earth*, pp. 125–127.

82 ibid., pp. 117–118.

83 Antony Milne, *Sky Static: The Space Debris Crisis*, Praeger, Westport, CT, 2002.

84 ibid.

damaging the satellite. The simple extremes of pressure and temperature can also damage sensitive satellite components.[85]

Australia's Problem

Australia can do little to mitigate against a number of the vulnerabilities identified above; therefore, it needs to focus efforts on areas where it can make significant improvements. A space launch capability would allow Australia to recover more quickly after an attack by ASAT weapons, as it would allow rapid replacement of damaged satellites. The ability to replace satellites in a short time frame is probably the best defence against ASAT weapons.[86] For the areas where it can do little, Australia needs to work closely with the US and other allies to assist them in developing solutions to the vulnerability problem.

Australia uses satellites for both civilian and military purposes. Civilian uses include communications, earth sensing and imaging, GPS timing signals for, among other things, banking and mobile phone networks, meteorology, and many other purposes. The ADF use satellites for purposes such as imagery, communications, navigation, meteorology, and the future control of unmanned aerial vehicles (UAVs).[87] Civilian satellites, many belonging to other countries, meet a number of the ADF's communication needs. For space imagery, the ADF relies heavily on the good graces of the United States, as much of Australia's imagery requirements are allegedly met by US assets.[88] With the imminent retirement of the F-111, space imagery will become even more vital, especially for targeting purposes. This dependence on US imagery is a vulnerability for Australia. The US may be focusing its resources on one part of the globe while Australia needs imagery elsewhere and the US may not be able to satisfy both imagery needs. To mitigate this vulnerability, Australia is considering the acquisition of UAVs to provide imagery to the warfighter, and satellites could be used to cue the UAVs to areas of interest. The nation could also obtain imagery by collaborating with regional partners, such as Singapore or Japan. There are also options available for Australia within the commercial realm, as a number of international companies are capable of providing commercial satellite imagery.[89]

One way to commence collaborative space efforts with regional partners may be under the auspices of the Five Power Defence Arrangements (FPDA). The FPDA provides for defence cooperation and an Integrated Air Defence System (IADS) between Australia,

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85 ibid.

86 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 72.

87 UAVs, such as the Predator UAV, typically require some form of satellite control. US Air Force, 'MQ-1 Predator Unmanned Aerial vehicle', January 2007, viewed June 2007, <http://www.af.mil/factsheets/index.asp>.

88 Jeffrey T Richelson & Desmond Ball, *The Ties That Bind: Intelligence Cooperation between the UK/USA Countries – the United Kingdom, the United States of America, Canada, Australia and New Zealand*, Allen & Unwin, Sydney, 1985.

89 John C Baker & Dana J Johnson, 'Security implications of commercial satellite imagery', John C Baker, Kevin M O'Connell & Ray A Williamson (eds), *Commercial Observation Satellites: At the Leading Edge of Global Transparency*, RAND, Santa Monica, CA, 2001, pp. 106–109.

Malaysia, New Zealand, Singapore and the United Kingdom. The agreement has been in place since 1971 and was established for the defence of Malaysia and Singapore.[90] Given the history of cooperation already demonstrated by the FPDA, further cooperation on space-related technology may well be possible. By establishing space-related capabilities under the FPDA, Australia may be able to reduce some of its vulnerability caused by extensive reliance on the US. Other opportunities for international cooperation are discussed later in the paper.

Australia relies on space systems for military and civilian use. This reliance results in Australia being vulnerable to a disruption of space services. One significant way in which Australia can reduce space vulnerability is by supporting the development of an operationally responsive space (ORS) capability.

90 Department of Foreign Affairs and Trade, 'Australian Treaty Series 1971 No 21', Department of Foreign Affairs, Canberra, 1971, viewed June 2007, <http://138.25.65.50/au/other/dfat/treaties/1971/21.html>.

Chapter 5
Potential of Operationally Responsive Space

The US leads the world in the use of space with an estimated space budget of approximately 20 billion dollars per year[91] and most other nations cannot hope to match this level of spending. The US space program is traditionally characterised as 'big space'. Long lead times for satellite design, construction, and launch are the usual characteristics of 'big space'. Another defining characteristic of 'big space' is the size of the various satellites, usually in excess of 1000 kilograms. For example, some of the US Defense Support Program satellites (used for ballistic missile early warning) weigh in excess of 2300 kilograms and cost as much as 400 million dollars to field.[92] Most countries cannot afford 'big space' programs and must seek to develop cheaper ways to establish and maintain their space capabilities. Even the US recognises that the cost of its military space program is high and it is actively examining ways in which to reduce costs. This has been one of the driving factors for the development of operationally responsive space (ORS) and has resulted in a move to involve coalition partners in space development.

ORS Defined

There has been considerable academic discussion on the meaning of ORS. For the purpose of this paper, ORS is defined as the ability to respond quickly to the space needs of military commanders. This includes having the ability to design, build and launch satellites quickly, as well as being able to achieve the capability for orders of magnitude less (in dollar terms) than that currently required for 'big space'. Many nations such as Israel, UK, US, France and Russia are pursuing ORS capabilities. These capabilities include smaller satellites and launch vehicles which utilise air-, sea- and quick-launch facilities—all of these capabilities must also concentrate on reducing the cost of each launch. Reducing the cost of launch will allow more satellites to be launched and potentially pave the way for development of micro-satellite constellations.

The concepts of ORS differ slightly between the UK and US. The UK does not have a launch capability for its satellites but is concentrating on making satellites smaller and more responsive to theatre commanders. The US is concentrating on more responsive launch capabilities, in addition to developing smaller satellites.

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91 Federation of American Scientists, *CRS Report for Congress – U.S. Military Space Programs: An Overview of Appropriations and Current Issues*, Congressional Research Service, The Library of Congress, Washington, DC, 7 August 2006, viewed June 2007, <http://fas.org/sgp/crs/space/RL33601.pdf>.

92 US Air Force, 'Fact Sheet: Defense Support Program Satellites', March 2003, viewed June 2007, <http://space.au.af.mil/factsheets/dsp.htm>.

Smaller Satellites

One of the most promising technological developments with the potential to allow true ORS has been the development of smaller satellites than those traditionally used by space-faring nations. These smaller satellites can be broken down into a number of classes. Small satellites generally weigh less than 1000 kilograms, mini-satellites weigh under 500 kilograms, micro-satellites (microsats) weigh around 100 kilograms, nano-satellites (nanosats) are less than 10 kilograms in weight, and pico-satellites (picosats) weigh in at around 100 grams. While nanosats and picosats are still very much in the experimental stage, microsats have already been launched and are providing real capability. Surrey Satellite Technology Limited (SSTL) leads the field in microsat technology and they have already launched a microsat with military potential, designated as *TopSat*, for the UK.[93]

SSTL launched *TopSat* in October 2005 to demonstrate microsat technologies and the UK Ministry of Defence (MOD) has found its capabilities useful. The satellite was designed to capture imagery with a resolution of approximately 2.5 metres that, although not sufficient for many defence requirements, demonstrates the potential of the capability. Slightly larger future microsats will have resolution capability down to 1 to 1.5 metres.[94] Due to memory and data link limitations, *TopSat* can only capture and download five images per day but a future system is likely to be much more capable. Theatre commanders are interested in the ability to control *TopSat* from a mobile ground station carried on a Land Rover and trailer.[95]

Reduced Time Frames

To be truly responsive to the needs of the warfighter, ORS must include the capability to launch satellites into outer space quickly. To achieve this, launch vehicles need to be developed that can be rapidly fitted with a satellite (or a number of satellites) and launched into space. To take advantage of faster launch cycles, lead times must also be reduced for the design and manufacture of satellites. Traditional 'big space' capabilities currently require a number of years to design, build, and launch a satellite. The goal of ORS is to reduce this period down to a couple of years or even months. Ideally, industry and defence would design and build satellites before they are needed, and store them until needed. The satellites could then be launched in a matter of days following a launch request.[96]

Smaller satellites often have shorter on-orbit lifetimes, mainly due to limited fuel capacity. For example, *TopSat* is designed to have a one-year lifespan. This reduced lifetime means that it must cost significantly less to design, build, and launch ORS systems than current 'big space' systems for this approach to be a cost-effective alternative.

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93 Bill Sweetman, 'Satellite micro-revolution offers the potential for broader vision', *Jane's International Defence Review*, September 2006, p. 40.

94 ibid.

95 ibid.

96 Michael Krepon & Christopher Clary, *Space Assurance or Space Dominance?: The Case Against Weaponizing Space*, The Henry L. Stimson Center, Washington, DC, 2003, p. 72.

Australian Experience

Australia has experience in rapidly fielding a satellite. Australia's scientific community developed and launched the nation's first and only indigenous satellite, WRESAT, within 11 months of the decision being made to launch a satellite.[97] While the original organisation that developed the satellite is now the Defence Science and Technology Organisation (DSTO), given the appropriate resources, DSTO would be an appropriate organisation to begin designing microsats. Apart from designing satellites indigenously, there are other opportunities for Australia to realise an ORS capability.

The US has acknowledged the need to involve coalition partners in the development of space capabilities. The most recent US national space policy outlines its willingness to work with partners in space development.[98] The building of a robust ORS capability is an area where Australia can contribute to the US effort. ORS, by definition, requires more cost-effective methods for developing space capabilities. Due to the intent to reduce costs, Australia, even with its limited defence budget, can contribute in a meaningful way, especially in developing tactical satellites. Colonel Tom Doyne of the office of the Director of Defense Research and Engineering in the US Department of Defense, has outlined the possibility of developing Coalition Operationally Responsive Space (C-ORS). He believes the US could work with coalition partners to develop tactical satellite constellations. As evidence of cooperative coalition space work, he cites the partnering work done to develop the Joint Strike Fighter.[99] A C-ORS effort could use this model to coordinate the cooperative contributions of coalition partners.

There are two other examples of close defence cooperation with the US that may present opportunities for Australia in space. Australia is a member of the Air and Space Interoperability Council (ASIC), established in 1948 as the Air Standardization Coordinating Committee (ASCC) between Australia, Canada, New Zealand, the United Kingdom and the US, to enable these countries' Air Forces to fight together in joint and combined operations. ASIC aims to standardise doctrine and equipment and facilitates the exchange of technical information between the member countries.[100] This organisation could also address space matters, especially as Australia develops a more robust space capability.

Like the Air Force, the Australian Army is also part of a cooperative arrangement with the United States military. In 1947, America, Britain and Canada formed the ABC Armies program to standardise equipment and doctrine among the three countries' Armies. Australia joined the organisation in 1963 and the name became the ABCA Armies'

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97 Australian Space Research Institute, 'Australia's First Satellite in Orbit', viewed June 2007, <http://www.asri.org.au:81/ASRI/satellites/wresat/index.jsp>.

98 Office of Science and Technology Policy, *U.S. National Space Policy* (Unclassified), 6 October 2006, p. 7, viewed June 2007, <http://www.ostp.gov/html/US%20National%Space%20Policy.pdf>.

99 Colonel Tom Doyne, 'Coalition ORS: the 100 satellite solution', *Space News*, 29 January 2007, p. 18.

100 Air and Space Interoperability Council, 'Overview', viewed June 2007, <http://www.airstandards.com/ascc/index.php>.

Program. New Zealand joined the program as a full partner in 2006, although the name has remained unchanged.[101] Although focused on army interoperability, this organisation, like ASIC, could play an important role in Australia's space development through the exchange of technical information and the development of doctrine and operating procedures.

US space policy identifies possibilities for Australia to work with the US on space development. C-ORS, ASIC, and ABCA represent mechanisms where space cooperation can be put into practice. Regardless of the level of cooperation achieved between the US and Australia, there are other opportunities for Australia to work with other partners.

Coalition Potential

On 14 March 2007, Australia and Japan signed a security cooperation declaration. This is the first such declaration Japan has signed with a country, other than the United States, since World War II.[102] Japan has an active space program and has invested heavily in the development of its reconnaissance Information Gathering Satellites (IGS)[103], potentially making it a perfect partner for Australia as it attempts to improve its space capability. The agreement currently allows for cooperation in areas such as counterterrorism, border security and humanitarian relief, and allows both countries to conduct military exercises together.[104] Space capabilities can enhance these areas of cooperation and provide an excellent opportunity for further cooperation in space endeavours. The United States and Japan approached Australia, after it signed the security cooperation declaration with Japan, to include India in a four-way security agreement.[105]

Including India in a four-way security agreement would present Australia with another potential partner for space cooperation. Like Japan, India also has a robust space program, from which Australia could learn much. India's program includes remote sensing satellites, as well as a satellite communications constellation.[106]

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101 Robert L Maginnis, 'ABCA: a Petri dish for multinational interoperability', *Joint Force Quarterly*, no. 37, 2nd Quarter 2005; and ABCA, 'History', viewed June 2007, <http://www.abca-armies.org/History/Default.aspx>.

102 Peter Alford & Dennis Shanahan, 'Pact lets Diggers train with Japanese', *The Australian*, 14 March 2007, viewed 14 March 2007, <http://www.theaustralian.news.com.au/story/0,20867,21378290-31477,00.html>.

103 *Eiichiro Sekigawa, 'Recce recovery', Aviation Week & Space Technology*, vol. 162, issue 6, 7 February 2005, viewed 21 March 2007, <http://proquest.umi.com/pqdweb?did=791292731&Fmt=3&clientId=417&RQT=309&VName=PQD>. See also Joan Johnson-Freese & Lance Gatling, 'Security Implications of Japan's Information Gathering Satellite (IGS) System', *Intelligence and National Security*, vol. 19, no. 3, Autumn 2004, pp. 538–552.

104 Alford & Shanahan, 'Pact lets Diggers train with Japanese'.

105 Dennis Shanahan, 'Pacific allies to enlist India', *The Australian*, 15 March 2007, viewed 15 March 2007, <http://www.theaustralian.news.com.au/story/0,20867,21384779-31477,00.html>.

106 *Anil Ananthaswamy,* 'Going it alone', *New Scientist*, vol. 185, issue 2487, 19 February 2005, viewed 21 March 2007, <http://proquest.umi.com/pqdweb?did=803087441&Fmt=7&clientId=417&RQT=309&VName=PQD#fulltext>.

Regardless of what opportunities are available, Australia can benefit from the development of ORS capabilities. The nation needs access to space to exploit these opportunities and must work with the United States to assure this access.

Chapter 6
Space Assurance

The United States is arguably Australia's major defence partner, as evidenced by the Australia, New Zealand and the United States (ANZUS) Security Treaty. Australia even invoked the treaty following the September 11 2002 attacks on the US.[107] This dependence on the US means that Australia must support it to ensure access to space for all nations. This chapter focuses on what the US can do to assure space access and identifies areas where Australia can help.

As discussed in Chapter 4, space assets are vulnerable to a multitude of threatening activities, such as ASAT weapons. The impact of aggressive attack on any country's space assets can significantly impair both civil and military activities. Weaponisation of space, while a threat to space activities, can also be used for defence of space assets. Benjamin S Lambeth of RAND provides a workable definition of space weaponisation as 'things intended to cause harm that are based in space or that have an essential element based in space'.[108] Apart from nuclear weapons and other weapons of mass destruction (WMD), weapons in space are not specifically outlawed under the current space regime; however, they are internationally controversial.

The Threat of Weaponisation

The author believes the threshold for weaponising space is the permanent deployment or testing of weapons in outer space and, once space is weaponised, it is arguably no longer being used exclusively for peaceful purposes. Once the threshold is crossed, many nations may feel compelled to deploy their own weapons.[109] Testing and development that is conducted behind closed doors should not cross this critical threshold. This form of weaponisation hedging is available to the US and it should develop weapons technologies behind closed doors so that it can react quickly if another country crosses the weaponisation threshold.[110] At the same time, the US should attempt to bolster the current regime and encourage other space-faring nations to do the same. If all current space-faring nations are of a like mind, then any attempt by a rogue state to disrupt space operations can be dealt with from a common stance. The recent Chinese ASAT test has demonstrated the

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107 Department of Foreign Affairs and Trade, *Department of Foreign Affairs and Trade Annual Report 2001–2002*, Australian Government Publishing Service, Canberra, 2002, viewed June 2007, <http://www.dfat.gov.au/dept/annual_reports/01_02/pdf/dfat_ar_full.pdf>.

108 Benjamin S Lambeth, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space*, RAND, Santa Monica, CA, 2003, p. 112.

109 Bruce M DeBlois, Richard L Garwin, R Scott Kemp & Jeremy C Marwell, 'Space weapons: crossing the U.S. Rubicon', *International Security*, vol. 29, no. 2, Fall 2004, pp. 67–81.

110 Michael Krepon & Christopher Clary, *Space Assurance or Space Dominance?: The Case Against Weaponizing Space*, The Henry L. Stimson Center, Washington, DC, 2003, p. 82.

potential for nations to disrupt space operations; therefore, states will need some means of minimising this impact.

Space Schools of Thought

Several schools of thought have emerged from debates over the merits and potential pitfalls of space weaponisation. There are two fundamental sides to the space weaponisation argument, with one side arguing for space as a sanctuary, and the other for the US to lead the way in developing space weapons. The debate can be further broken down into six schools of thought ranging from the extremes of both arguments.[111]

The sanctuary supporters can be identified as idealists, internationalists and nationalists, while the pro-weaponisers can be broken down to space racers, space controllers, and space hegemonists. Space idealists are at the dove end of the argument, while space hegemonists are at the hawkish end, with the other schools of thought falling between the two.[112]

Space idealists oppose all weapons in space and believe that the US should lead the way by demonstrating restraint and not deploying weapons in space. Space internationalists are opposed to weapons in space on the basis that weaponising space would result in an arms race and a resultant decline in international stability. Space nationalists oppose weapons in space because they believe the US has the most to lose if its satellites are destroyed, due to its high dependence on space systems. The schools of thought favouring space weapons oppose these sanctuary arguments.[113]

Space racers are on the milder side of the pro-weapons camp. They argue that the weaponisation of space is inevitable and that the US should lead the way to avoid becoming vulnerable. Space controllers believe that the US should weaponise space as soon as there is a military advantage to do so. The most extreme of the weaponisers, the space hegemonists, believe that the US should weaponise space to make the US military position unassailable. Space hegemonists also believe that space weapons will remove, or significantly reduce, the need for the US to maintain terrestrial weapons.[114] Closely aligned with the different schools of thought and the weaponisation argument are the two positions of space assurance and space dominance.

Michael Krepon and Christopher Clary defined these positions in the following manner: space assurance provides a way to maintain space as a sanctuary while space dominance leads to the weaponisation of space.[115] In developing future space strategy, the US should align with one of these positions.

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111 Karl P Mueller, 'Totem and taboo: depolarizing the space weaponization debate', *Astropolitics*, vol. 1, no. 1, Spring 2003, pp. 8–16.

112 ibid.

113 ibid.

114 ibid.

115 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 3.

Everett C Dolman in *Astropolitik* identifies the extreme form of space dominance. Dolman argues that the US should seize control of lower earth orbit and then control who can launch objects into outer space. In this way, the US could maintain its space dominance and exert control over all space activities.[116]

Two problems with the space dominance approach are immediately evident. First, taking a dominant or hegemonic position would harm US stature in the international community, as many countries would see the US position as a threat to their space capabilities. The other problem is the cost involved in placing weapons in space when terrestrial means can achieve the same, or better, effects more efficiently.[117] Space assurance, it is argued, is more politically acceptable and a more cost-effective strategy for the US to pursue, rather than space dominance.

Countries such as Australia, in conjunction with the United States, can mitigate space vulnerability without weaponisation through the establishment of a comprehensive space assurance regime. One of the most important aspects of building a space assurance regime is an enhanced space surveillance capability.

Space Surveillance

An enhanced space surveillance capability will require a combination of both ground-based and space-based assets using all currently available surveillance technology such as radar, optical, infra-red, and hyper-spectral imaging as well as electromagnetic sensing. Improved surveillance will allow early detection of developments and activities in space and allow better tracking of space debris for collision avoidance.[118] Effective ground-based surveillance will require sites around the globe and Australia can play a significant role in helping the US establish a comprehensive surveillance network.[119] Other aspects of a space assurance regime will involve the direct protection of satellites by methods such as hardening and shielding.

Satellite Protection

Satellite hardening can provide some protection for satellites against kinetic or explosive impact. Satellite hardening is difficult to achieve simply because of the tremendous energy involved in any impact in space due to the speeds involved. In addition, hardening a satellite adds significant weight and this then requires more energy to launch the satellite into orbit,

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116 Everett C Dolman, *Astropolitik: Classical Geopolitics in the Space Age*, Frank Cass Publishers, London, 2002, p. 157.

117 DeBlois et al, 'Space weapons: crossing the U.S. Rubicon'.

118 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 72.

119 ibid., p. 73.

increasing the cost of each launch.[120] Similar to satellite hardening, shielding is required to protect satellites against radiation and electromagnetic interference.

Satellite shielding against electromagnetic pulse (EMP), electrons, and radiation is possible, with an attendant increase in satellite weight and cost, as well as increased launch costs. Any nuclear explosion in low earth orbit (LEO) will increase radiation levels in the orbit which may take as long as 18 months to dissipate, degrading or destroying any non-shielded satellites over a period of time, ranging from weeks to months.[121] Other measures available to help protect satellites are stealth, manoeuvrability, and self-protection measures.

By reducing the visibility of satellites to radar, optical and other sensors, satellites can be made difficult to track and, therefore, target by direct means such as ASAT missiles and directed energy weapons.[122] One problem with this approach is that stealth may undermine any space assurance regime by removing some of the transparency of space operations, thereby increasing space instability. Manoeuvrability can also protect satellites from attack, although this measure requires superior space surveillance measures so that an impending attack can be detected. One downside to using manoeuvrability is that it will also use up fuel, which may reduce the useful life of the satellite.[123]

Satellite self-protection devices can also assist in defeating an attack. Self-protection could include devices such as explosive charges or small homing missiles to destroy any incoming ASAT missile.[124] Those who employ such self-protection measures walk a fine line between defending their assets and preserving space for peaceful purposes, as most satellite defensive measures could also be used on the offensive against other satellites.[125] Regardless of whether weapons are deployed in space, the current space regime is an important factor in shaping the behaviour of states in space, as explained in Chapter 2.

Regime Reinforcement

A space assurance strategy needs to reinforce the current space regime. This regime calls for the use of space for peaceful purposes and for the good of all mankind. The current regime bans nuclear weapons and weapons of mass destruction in space but falls short of banning all weapons in outer space. This clearly leaves open the possibility of developing self-protection measures for the protection of space assets, even though some self-protection measures may be classified as space weapons.

While the current regime allows self-protection measures, any bolstering of the regime with new treaties to ban the deployment of all weapons in outer space will be useless without

120 ibid., pp. 69–70. See also Steven Lambakis, *On the Edge of Earth: The Future of American Space Power*, The University Press of Kentucky, Lexington, KY, 2001, pp. 128–129.

121 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 69.

122 Lambakis, *On the Edge of Earth*, p. 130.

123 ibid., pp. 131–132.

124 ibid., p. 133.

125 Krepon & Clary, *Space Assurance or Space Dominance?*, p. 71.

some form of agreed verification process. The current outer space regime calls for the use of space for peaceful purposes; it is therefore important to establish when the threshold has been crossed and space is no longer being used solely for peaceful purposes.

Space Assurance and ORS

The development of new microsats has opened the way for the establishment of microsat constellations. Microsats do not have the same capability as many larger satellites, but they may be able to achieve similar capabilities to their larger cousins if they operate in constellations. Operating satellites in constellations will also allow for a graceful degradation of capability if some of the microsats are lost to adversary action, or even to natural events such as collisions with space debris. A number of countries have investigated ways for microsats to operate in formation[126], and this has highlighted the potential for microsats to work together for greater resolution (in the case of imaging satellites) than is available from a single microsat. A robust operationally responsive space (ORS) capability could also reinforce an emerging space assurance regime.[127]

ORS could permit the realisation of microsat constellations or formations for a reasonable cost. ORS will also make it easier to replace individual satellites that are destroyed or are degraded. With the development of relatively cheap microsats, replacements could be maintained on the ground for rapid launch if required. By keeping microsats on the ground, but available for a fast cycle into orbit, satellite upgrades can be carried out easily as scientists and engineers develop new technology.[128]

Even though the current space regime limits certain activities in space, the US has continued to develop better space capabilities in existing areas. Known and acknowledged US space capabilities are surveillance, communication, weather observation, and navigation.[129] At present, there are no known conventional weapons in space, even though the current regime does not specifically prohibit them.

Building a Space Assurance Regime

Space assurance is best described as a hedging strategy against other states gaining dominance in space. To create a space assurance regime, the US will have to improve its situational awareness in space, reduce the vulnerability of space assets, develop space weapons technology behind closed doors, bolster the current international space regime, and establish an ORS capability.[130]

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126 Colonel Tom Doyne, 'Coalition ORS: the 100 satellite solution', *Space News*, 29 January 2007, p. 18.

127 Simon P Worden & Randall R Correll, 'Responsive space and strategic information', *Defense Horizons*, no. 40, April 2004.

128 ibid., p. 5.

129 Lambakis, *On the Edge of Earth*, pp. 13–24.

130 Krepon & Clary, *Space Assurance or Space Dominance?*, pp. 58–59.

The most important aspect of space assurance that the United States needs to develop is space situational awareness. An improved space surveillance capability can enhance situational awareness greatly. Improved space surveillance will allow the United States to monitor the activities of other states without being overtly aggressive. Improved surveillance will potentially allow warning if another state places weapons in space, giving the US a chance to counter such action in a timely manner. Improved surveillance will also allow better tracking of space debris, therefore, minimising the risk of damage to space assets by collision with uncontrolled objects.[131] Parallel to an improved surveillance capability, the United States will need to maintain a space weapon technology research and development program. As a close ally of the US Australia could play an important role in research and development. Australia is also in a position to help the US with its space surveillance program due to the location of the Australian continent, as there currently no space surveillance sensors in the Southern hemisphere.[132] Space surveillance facilities established in Australia could help the United States build a more comprehensive ground-based surveillance network.

Space assurance does not mean that the US should not conduct research into space weapons, but it does mean that they should not conduct testing in the open. By continuing to research space weapons behind closed doors the US will not cross the critical threshold of deploying weapons in space. If the US establishes a robust space surveillance capability, it should have warning of any deployment of space weapons. The US should then be able to quickly deploy any weapons developed behind closed doors and counter emerging threats to US assets. The United States can preserve its soft power by not crossing the space weapons threshold first, and this restraint may keep other states from developing their own weapons.[133] Any space assurance program should also include strategies to protect US space assets.

Current US space assets are vulnerable to attack and damage in a number of ways such as sensor blinding or dazzling, anti-satellite weapons, space debris, or radiation. A space assurance strategy will require the US to develop ways to reduce satellite vulnerability.[134] While kinetic damage to satellites is difficult to prevent, protection from other forms of damage or interference is possible with measures such as hardening, resistance to jamming, and stealth.[135] While difficult to defeat, kinetic damage to satellites may be mitigated by strategies such as system redundancy, satellite agility, and developing an operationally responsive space (ORS) capability.

ORS is critical in reducing space asset vulnerability. ORS is essentially the ability to develop and launch satellites on a reduced time scale compared to that currently required for 'big space' capabilities. Under the ORS concept, satellites would be small and inexpensive and

131 ibid., pp. 72–73.

132 ibid., p. 73.

133 ibid., pp. 78–83 and 89.

134 DeBlois et al, 'Space weapons: crossing the U.S. Rubicon', pp. 57–62.

135 Krepon & Clary, *Space Assurance or Space Dominance*, pp. 68–72.

the launch vehicles would allow rapid launch while remaining relatively inexpensive.[136] Clustering of these smaller satellites could achieve similar functionality to large satellites and overall vulnerability may be reduced, as the destruction of a single satellite would not eliminate the capability provided by the cluster.[137]

If the United States pursues ORS, it cannot afford to neglect 'big space' as, for the foreseeable future, there are some capabilities that can only be achieved using larger and more expensive satellites.[138] The other risk of ORS is that it may encourage unrealistic expectations of space power. Many warfighters currently lack an understanding of what is achievable from space. Theatre commanders may never have exclusive use of satellites, even with cheaper satellites and more responsive launch times. Without significant warning of conflict, even the most optimistic launch time frames will not allow satellites to be launched in response to a short-notice conflict. Also, to provide any sort of 24/7 coverage of a region, the number of satellites needed in low earth orbit would be prohibitively expensive when compared to the use of other available terrestrial assets, such as UAVs.[139] ORS is an excellent concept and should be pursued vigorously by the United States, but military commanders need to be educated so they gain a realistic understanding of what ORS can achieve.

The fourth side to the quadrangle of a new space assurance strategy is fortifying the current outer space regime. To prevent the weaponisation of space and reduce US susceptibility to surprise in space, the US should bolster the current treaties and conventions that make up the space regime. By leading the way and reinforcing the current regime, the US will demonstrate its intent to preserve space for peaceful purposes, as originally envisioned by President Eisenhower.[140] If the US were to go one step further and extend the Outer Space Treaty to prohibit all operational weapons in space, the US may be able to reduce its vulnerability in space. In addition, by extending the Outer Space Treaty to ban all weapons, the US would gain insight into the intent of other states, as any state that declined to ratify the change would signal their probable intent to develop space weapons.[141] The difficulty with this approach is that verifying compliance, especially amongst the countries that have closed societies, is probably not plausible. The international community will therefore have a difficult time achieving consensus on the definition of a space weapon and an equitable means of verification. Without international consensus, the United States could still develop space weapon technologies behind closed doors to provide a hedge against other states violating the new regime to gain space dominance.

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136 Worden & Correll, 'Responsive space and strategic information', pp. 1–6.

137 ibid., p. 5.

138 Arthur K Cebrowski & John W Raymond, 'Operationally responsive space: a new defense business model', *Parameters*, vol. 35, no. 2, Summer 2005, p. 73.

139 Lt Col Edward B Tomme, 'The myth of the tactical satellite', *Air & Space Power Journal*, vol. 20, no. 2, Summer 2006, pp. 89–102.

140 Lambakis, *On the Edge of Earth*, p. 217.

141 Krepon & Clary, *Space Assurance or Space Dominance?*, pp. 101–116.

Chapter 7
A Potential Space Policy for Australia

This paper has covered the current outer space regime, outlined the history of space use, identified the vulnerabilities inherent in the use of space, detailed the requirements of operationally responsive space, and proposed the adoption of a space assurance strategy. Australia must account for these factors when developing an Australian space policy.

Australia relies on space technology for both civil and military uses. To be relevant, and to have a legitimate say on international space security issues, Australia needs to have some capability to exploit space. While it is unlikely that Australia can develop an independent space capability, there are significant areas in which it can contribute to an international space effort. The reducing cost of satellite development, brought on by microsats, and Australia's advanced technology industry should allow Australia to develop satellites that meet its own specific needs. Australia should also be able to offer some niche capability to the United States, particularly if Australia develops satellites for use in the Asia and Pacific regions. Australia is heavily dependent on the US for its space needs and, if it is to continue to have influence with the US, it must contribute capabilities to the space environment. This will require Australia to increase spending on space capabilities, even if it is at the expense of other systems.

Australia has a unique geographic position in the world and has a number of potential launch sites. Woomera, in South Australia, has already launched a satellite, and civilian studies have been conducted into developing a launch facility at either Darwin, in the Northern Territory, or on Cape York Peninsula, in Queensland.[142] Even though the studies have been conducted, and some work has gone into the feasibility of such launch sites, there appears to be a general lethargy when it comes to making an Australian launch site a reality. The author believes this lethargy is probably caused by a fear of the potential costs involved in establishing a site. Having an indigenous launch facility would contribute significantly to Australia's space prestige and security and could also be a useful source of income to the Australian economy, as well as enhancing its technical capability. Establishing a launch site has even reached the stage where agreements have been signed with other countries to establish a site in Australia, but still little has happened. Australia and Russia signed an agreement in 2001 to establishment a spaceport at Woomera in South Australia. This agreement would have contributed to a planned Asia-Pacific Space Centre on Christmas Island[143]; however, the agreement does not appear to have progressed to a real capability. One hopeful note for the re-introduction of space launches from Australian territory is the award of a NASA contract to Rocketplane Kistler, a US-based company. NASA awarded the contract to Kistler in 2006 to conduct launches from Woomera to service the

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142 Jane's Information Group, 'Launch sites', *Jane's Space Directory 2004–2005*, Jane's Information Group, Coulsdon, 2004, p. 191.

143 Senator Grant Chapman, *Press Release: Australia-Russia Space Agreement*, 21 May 2006, viewed 27 November 2006, <http://www.senatorchapman.com/pcaust.htm>.

international space station, starting in 2008.[144] The development of the Woomera site could also lead to the launch of space tourism flights from Australian soil by companies such as Virgin Galactic and Rocketplane Kistler.[145]

Whether or not Australia establishes a space launch facility, it can still design and build microsats. The Defence Science and Technology Organisation (DSTO) is a government organisation that conducts scientific research and develops technology. DSTO is capable of developing innovative satellite technologies, if funded to do so. Consistent with previous technology transfer arrangements, DSTO could transfer the technology to civilian companies for production and further development.

DSTO also has a history of satellite design and construction. The Weapons Research Establishment, in South Australia, built Australia's first satellite (WRESAT) and this organisation later became DSTO. In addition to DSTO, a number of leading Australian companies possess the capability to build satellites. Many of the Australian companies have partners that are already involved in satellite development, particularly in the USA and UK. For example, Boeing, Lockheed Martin, Raytheon, and BAE Systems all have subsidiaries in Australia. These companies are well-established satellite manufacturers, making it easier to impart space knowledge to Australia.[146] Commitment from the Australian Government, in particularly the military sector, could accelerate acquisition of satellite technology.

The Australian Minister for Defence, Brendan Nelson, recently announced a new industry policy for Australia aimed at sustaining its defence industry. The policy provides a framework for civilian companies and the Government to invest in critical defence capabilities.[147] This new policy could be used by the ADF to kick-start investment on space capabilities for Australia and the Rapid Prototyping, Development and Evaluation (RPDE) Program could assist this effort.

The Australian Government established the RPDE Program in February 2005 with a stated mission 'to enhance ADF warfighting through accelerated capability change in the Network Centric Warfare (NCW) environment'.[148] RPDE is a think tank involving Australian Defence, industry and academia, aimed at developing solutions to Defence problems and improving ADF warfighting capability. RPDE aims to develop partnerships between Defence and industry to identify rapid solutions to Defence issues, particularly

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144 Government of South Australia, 'Major Projects: Major Developments in South Australia', viewed 17 March 2007, <http://www.majorprojects.sa.gov.au/public/content/project_profile.asp?xcid=1134&f_category_id=44&f_project_title=Kistler%20Rocket%20Launch%20Site%20at%20Woomera>.

145 Peter Hackett, 'Woomera may get Virgin spaceport', *The Advertiser*, 4 November 2006, viewed June 2007, <http://www.news.com.au/adelaidenow/story/0,22606,20697628-910,00.html>.

146 Federation of American Scientists, 'World Space Guide: Space Companies', viewed June 2007, <http://www.fas.org/spp/guide/usa/corp/index.html>. BAE Systems Homepage, viewed June 2007, <http://www.baesystems.com>.

147 Gregor Ferguson, 'Australia's new industry policy "more doable"', *DefenseNews*, 5 March 2007.

148 Rapid Prototyping, Development and Evaluation official website, 'RPDE Corporate Brief', viewed 31 March 2007, <http://www.rpde.org.au>.

in the area of NCW, an area where space can play a critical role.[149] Acknowledging that Australia probably cannot afford an autonomous 'big space' capability, the most effective and productive way for Australia to become involved in space operations will be with the establishment of a niche capability and international cooperation.

Australia can develop niche space capabilities in a few areas, from satellites focusing on the Asia-Pacific region, to space surveillance facilities, to space launch capabilities. If Australia develops niche capabilities, it can use its unique relationship with the United States to ensure its access to the US capabilities that Australia cannot afford. Australia is situated in the Asia-Pacific region and, therefore, has a more focused strategic interest in this area compared to the US. By launching satellites that focus on the Asia-Pacific region, Australia can gather information to support its regional interests. This information can then be shared with the United States in exchange for information on other regions of the world, particularly those areas where Australia has an interest but not the assets required. Australia can also help the United States to bolster their space surveillance capabilities by establishing facilities within Australia that contribute to a global surveillance network. Improving the global surveillance network will help Australia identify any threats to its space-based assets and improve its chances of countering them, probably with the assistance of the USA.

The Australian Defence Organisation (ADO) currently lacks sufficient knowledge of space operations. The ADF has taken steps to improve its knowledge by establishing the Defence Space Coordinating Office (DSCO), but it needs to continue educating military personnel by participating in international forums on space. Increasing ADO knowledge and participation in space operations is essential if Australia is to have meaningful engagement with the international space community. With an improved space capability, Australia could have more influence on the international space regime.

The various treaties making up the current space regime may be sufficient to ensure that space is used for peaceful purposes and that space remains accessible for all countries; however, Australia needs to make sure that all countries abide by the current treaties by monitoring compliance or participation in a verification process. To do this, Australia needs a credible presence and capability in space. If all major space-faring nations work towards the same goals, then they can present a common front and take collective action should a rogue state violate regime norms. The United States is the leading space-faring nation in the world today. If a rogue state, such as North Korea or Iran, attempted to disrupt US space systems, the United States would need allies, such as Russia and China, in order to prevent further attacks by taking collective action against any rogue state. A space active Australia could also support the US in countering rogue states. If the United States took unilateral action then it could be seen as a bully acting in its own interests. By uniting with others states, the US could be seen as helping reinforce international norms rather than acting merely in its own interests.

Australia can take a number of steps to develop a space policy. First, Australia needs to improve space knowledge within the ADO. The next step is to develop niche space

149 ibid.

capabilities that can leverage the greater capability of the United States. Australia is capable of producing niche space capabilities, especially if it works with other regional powers. With increased knowledge and capabilities in space, Australia should use its international power to bolster the current outer space regime. Finally, Australia should work with the United States to establish a more robust space assurance strategy by improving the international space surveillance network and, if necessary, cooperatively develop systems to protect space assets. These actions can help Australia become a true space power, albeit a minor one.

Chapter 8
Conclusion

The Soviet Union effectively kicked off the space age in 1957 with the launch of their satellite, *Sputnik I*. This launch laid the foundation for the current outer space regime, as it established the first important principle, the right of flight over foreign territory from space. With the advent of space flight, a number agreements and conventions were drafted, under the auspices of the United Nations, to govern behaviour in space. Once signed by participating states, the outer space regime was effectively established. The overriding principle of the outer space regime is that space is to be used for peaceful purposes. Current discussions on the regime now centre on what is meant by peaceful purposes and what is meant by space weaponisation.

Australia became the fourth state to launch an indigenous satellite from its own territory when it launched WRESAT in 1967. Since that time, Australia's participation in space has languished, even while it has become more dependent on space for every aspect of civilian and military life. The ADF is now taking steps to become more actively engaged in space operations, and established the Defence Space Coordinating Office (DSCO) for this purpose. Australian space knowledge, however, is still lacking, particularly its knowledge of how it is vulnerable in space.

Space vulnerabilities can effectively be broken down into three separate areas: ASAT weapons, conventional attack, and environmental effects. Australia and its allies face major challenges overcoming these vulnerabilities. One potential method for reducing vulnerability in space is by developing an operationally responsive space (ORS) capability.

ORS could reduce vulnerability by establishing cheaper and faster launches of satellites. This gives a capability to replace damaged assets in orbit quickly. ORS also involves the development and production of smaller, cheaper satellites. Smaller satellites could populate satellite constellations that degrade gracefully if individual satellites fail or are damaged. In conjunction with ORS, a space assurance strategy can reduce Australia's vulnerability to disruption of space services.

A space assurance strategy could be the most effective method to reduce Australia's vulnerability in space. Improved surveillance of space is the most important measure required in a space assurance strategy. The strategy also requires states to improve protection of satellites and reinforcement of the current outer space regime. While Australia cannot achieve a space assurance strategy alone, partnering with the United States may allow the development of a strategy satisfactory to both nations. One particular area where Australia could contribute is by the establishment of a space surveillance facility in Australia. The current outer space regime, space vulnerabilities, and methods of reducing vulnerability must all be taken into account as Australia develops a strategy for space.

The first step in an Australian space strategy is to become more involved in space operations. Australia has the inherent industrial base and capability to design and build satellites, for both domestic and international markets, and this presents an opportunity

for Australia to become more engaged in space. Australia can also become an international launch site since several potential launch sites lie in Australian territory. Developing one or several of these sites could build the nation's space knowledge and capability, as well as provide a source of income to the Australian economy.

With the establishment of a satellite manufacturing capability and development of potential launch sites, Australia needs to acquire some niche capabilities to use as leverage to ensure continued access to US products. As an example, Australia could develop a niche capability for communication and surveillance satellites for the Asia-Pacific region. Such capabilities focused within Australia's region could not only meet Australia's needs, they could also provide opportunities to share information with allies, especially those with less well-developed capabilities. Australia will have a stronger voice in the international space community if it takes these steps, and this could help it influence the strengthening of the current outer space regime to help further reduce Australia's vulnerability in space.

Bibliography

Books and Monographs

Baker, John C, Kevin M O'Connell & Ray A Williamson (eds), *Commercial Observation Satellites: At the Leading Edge of Global Transparency*, RAND, Santa Monica, CA, 2001

Burleson, Daphne, *Space Programs Outside the United States: All Exploration and Research Efforts, Country by Country*, McFarland & Company Inc., Jefferson, NC, 2005

Chapman, Senator Grant, *Space: A Priority for Australia*. Senate Printing, Canberra, 2005, viewed June 2007, <http://www.asicc.com.au/publications.htm>

Department of Defence, *Australia's National Security: A Defence Update 2005*, Department of Defence, Canberra, 2005, viewed June 2007, <http://www.defence.gov.au/update2005>

Department of Defence, *Defence Capability Plan 2006 – 2016: Public Version*, Defence Capability Group and Defence Materiel Organisation, Canberra, 2006, viewed June 2007, <http://www.defence.gov.au/dmo/id/dcp/dcp.cfm>

Department of Foreign Affairs and Trade, *Department of Foreign Affairs and Trade Annual Report 2001–2002*, Australian Government Publishing Service, Canberra, 2002, viewed June 2007, <http://www.dfat.gov.au/dept/annual_reports/01_02/pdf/dfat_ar_full.pdf>

Dolman, Everett C, *Astropolitik: Classical Geopolitics in the Space Age*, Frank Cass Publishers, London, 2002

Klein, John J, *Space Warfare: Strategy, Principles and Policy*, Routledge, Abingdon, 2006

Krepon, Michael & Christopher Clary, *Space Assurance or Space Dominance?: The Case Against Weaponizing Space*, The Henry L Stimson Center, Washington, DC, 2003

Lambakis, Steven, *On the Edge of Earth: The Future of American Space Power,* The University Press of Kentucky, Lexington, KY, 2001

Lambeth, Benjamin S, *Mastering the Ultimate High Ground: Next Steps in the Military Uses of Space*, RAND, Santa Monica, CA, 2003

McDougall, Walter, *… the Heavens and the Earth: A Political History of the Space Age,* Basic Books, New York, NY, 1985

Milne, Antony, *Sky Static: The Space Debris Crisis*, Praeger, Westport, CT, 2002

Mitchell, Paul T, *Network Centric Warfare*, Adelphi Papers, vol. 46, issue 385, Routledge/IISS, London, 2006

Reynolds, Glenn H & Robert P Merges, *Outer Space: Problems of Law and Policy*, 2nd ed., Westview Press, Boulder, CO, 1997

Richelson, Jeffrey T & Desmond Ball, *The Ties That Bind: Intelligence Cooperation between the UK/USA Countries – the United kingdom, the united States of America, Canada, Australia and New Zealand*, Allen & Unwin, Sydney, 1985

Rip, Michael Russell & James M Hasik, *The Precision Revolution: GPS and the Future of Aerial Warfare*, Naval Institute Press, Annapolis, MD, 2002

Royal Australian Air Force, Australian Air Publication 1000–F—*The Future Air and Space Operating Concept*, Air Power Development Centre, Canberra, 2007

Spires, David N, *Beyond Horizons: A Half Century of Air Force Space Leadership*, Air University Press, Maxwell AFB, AL, 1998

United Nations, *United Nations Treaties and Principles on Outer Space*, United Nations, New York, NY, 2002, viewed June 2007, <http://www.unoosa.org/pdf/publications/STSPACE11E.pdf>

Articles and Speeches

Alford, Peter & Dennis Shanahan, 'Pact lets Diggers train with Japanese', *The Australian*, 14 March 2007, viewed 14 March 2007, <http://www.theaustralian.news.com.au/story/0,20867,21378290-31477,00.html>

Ananthaswamy, Anil, 'Going it alone', *New Scientist*, vol. 185, issue 2487, 19 February 2005, viewed 21 March 2007, <http://proquest.umi.com/pqdweb?did=803087441&Fmt=7&clientId=417&RQT=309&VName=PQD#fulltext>

Baker, John C & Dana J Johnson, 'Security implications of commercial satellite imagery', John C Baker, Kevin M O'Connell & Ray A Williamson (eds), *Commercial Observation Satellites: At the Leading Edge of Global Transparency*, RAND, Santa Monica, CA, 2001, pp. 101–133

Cebrowski, Arthur K & John W Raymond, 'Operationally responsive space: a new defense business model', *Parameters*, vol. 35, no. 2, Summer 2005, pp. 67–77

DeBlois, Bruce M, Richard L Garwin, R Scott Kemp & Jeremy C Marwell, 'Space weapons: crossing the U.S. Rubicon', *International Security*, vol. 29, no. 2, Fall 2004, pp. 50–84

Doyne, Colonel Tom, 'Coalition ORS: the 100 satellite solution', *Space News*, 29 January 2007, p. 18

Elhefnawy, Nader, 'Four myths about space power', *Parameters*, Spring 2003, pp. 124–132

Ferguson, Gregor, 'Australia's new industry policy "more doable"', *DefenseNews*, 5 March 2007

Hackett, Peter, 'Woomera may get Virgin spaceport', *The Advertiser*, 4 November 2006, viewed June 2007, <http://www.news.com.au/adelaidenow/story/0,22606,20697628-910,00.html>

Jane's Information Group, 'Launch sites', *Jane's Space Directory 2004–2005*, Jane's Information Group, Coulsdon, 2004

Joseph, Robert G, 'Assuring vital interests drives US space policy', Speech by US Under Secretary for Arms Control and International Security, Center for Space and Defense Forum, Colorado Springs, CO, 11 January 2007, viewed June 2007, <http://www.

spacewar.com/reports/Assuring_Vital_Interests_Drives_US_Space_Policy_999.html>, viewed June 2007

Krasner, Stephen D, 'Structural causes and regime consequences: regimes as intervening variables', *International Organization*, vol. 36, no. 2, Spring 1982, pp. 185–205

Maginnis, Robert L, 'ABCA: a Petri dish for multinational interoperability', *Joint Force Quarterly*, no. 37, 2nd Quarter 2005

Miller, Wing Commander Chris, 'Australia's moment in the starlight', *Air Force*, vol. 47, no. 8, 19 May 2005, viewed June 2007, <http://www.defence.gov.au/news/raafnews/editions/4708/history/story01.htm>

Mueller, Karl, 'Totem and taboo: depolarizing the space weaponization debate', *Astropolitics*, vol. 1, no. 1, 2003, pp. 4–28

National Science and Technology Council, *Fact Sheet: National Space Policy*, 19 September 1996, viewed June 2007, <http://www.ostp.gov/NSTC/html/fs/fs-html>

Office of Science and Technology Policy, *U.S. National Space Policy* (Unclassified), 6 October 2006, viewed June 2007, <http://www.ostp.gov/html/US%20National%Space%20Policy.pdf>

Sekigawa, Eiichiro, 'Recce recovery', Aviation Week & Space Technology, vol. 162, issue 6, 7 February 2005, viewed 21 March 2007, <http://proquest.umi.com/pqdweb?did=791292731&Fmt=3&clientId= 417&RQT=309&VName=PQD>

Shanahan, Dennis, 'Pacific allies to enlist India', *The Australian*, 15 March 2007, viewed 15 March 2007, <http://www.theaustralian.news.com.au/story/0,20867,21384779-31477,00.html>

Shanahan, Dennis & Rowan Callick, 'China missile strike fuels fear of new arms race', *The Australian*, 20 January 2007, viewed 20 January 2007, <http://www.theaustralian.news.com.au/printpage/o,5942,21088182,00.html>

Sheldon, John B, 'Space as the fourth environment: for warfare or a supporting role?', *RUSI Journal*, October 1999, pp. 51–56

Shepherd, Air Marshal GD, *Update from the Chief of Air Force*, 7 March 2007

Sweetman, Bill, 'Satellite micro-revolution offers the potential for broader vision', *Jane's International Defence Review*, September 2006, pp. 40–45

Tomme, Lt Col Edward B, 'The myth of the tactical satellite', *Air & Space Power Journal*, vol. 20, no. 2, Summer 2006, pp. 89–102

United Nations, 'Disarmament – Secretary General's Message to the 2007 Session of the Conference on Disarmament', Geneva, 22 January 2007, viewed June 2007, <http://www.unog.ch/unog/website/disarmament.nsf/(httpPages)/09901593FEE671F2C125726B0044D6E0?OpenDocument>

Walters, Patrick, '$6bn for 24 Super Hornets', *The Australian*, 7 March 2007, viewed 19 March 2007, <https://www.newstext.com.au/>

Worden, Simon P & Randall R Correll, 'Responsive space and strategic information', *Defense Horizons*, no. 40, April 2004, pp. 1–8

Websites

ABCA, 'History', viewed June 2007, <http://www.abca-armies.org/History/Default.aspx>

Air and Space Interoperability Council, 'Overview', viewed June 2007, <http://www.airstandards.com/ascc/index.php>

Australian Heritage Council, 'Linking a Nation: Australia's Transport and Communications 1788–1970', viewed June 2007, <http://www.ahc.gov.au/publications/linking-nation/chapter-8.html#aircraft>

Australian Space Research Institute, 'Australia's First Satellite in Orbit', viewed June 2007, <http://www.asri.org.au:81/ASRI/satellites/wresat/index.jsp>

BAE Systems Homepage, viewed June 2007, <http://www.baesystems.com>

Department of Foreign Affairs and Trade, 'Australian Treaty Series 1971 No 21', Department of Foreign Affairs, Canberra, 1971, viewed June 2007, <http://138.25.65.50/au/other/dfat/treaties/1971/21.html>

Federation of American Scientists, 'World Space Guide: Space Companies', viewed June 2007, <http://www.fas.org/spp/guide/usa/corp/index.html>

Federation of American Scientists, *CRS Report for Congress – U.S. Military Space Programs: An Overview of Appropriations and Current Issues*, Congressional Research Service, The Library of Congress, Washington, DC, 7 August 2006, viewed June 2007, <http://fas.org/sgp/crs/space/RL33601.pdf>

Government of South Australia, 'Major Projects: Major Developments in South Australia', viewed 17 March 2007, <http://www.majorprojects.sa.gov.au/public/content/project_profile.asp?xcid=1134&f_category_id=44&f_project_title=Kistler%20Rocket%20Launch%20Site%20at%20Woomera>

Rapid Prototyping, Development and Evaluation official website, 'RPDE Corporate Brief', viewed 31 March 2007, <http://www.rpde.org.au>

Reaching Critical Will, 'Statements made at the 2006 Session of the Conference on Disarmament', viewed June 2007, <http://www.reachingcriticalwill.org/political/cd/speeches06/topics.html>

The Satellite Encyclopedia, 'Satellite Fact Sheet – Astérix', viewed 18 March 2007, <http://www.tbs-satellite.com/tse/online/sat_asterix.html>

US Air Force, 'Fact Sheet: Defense Support Program Satellites', March 2003, viewed June 2007, <http://space.au.af.mil/factsheets/dsp.htm>