THE LAWS OF STAR WARS—THE NEED FOR A 'MANUAL OF INTERNATIONAL LAW APPLICABLE TO SPACE WARFARE'

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Unless otherwise noted, the conclusions expressed herein are solely those of the author, writing in his personal capacity. They are not intended and should not be thought to represent official ideas, attitudes, or policies of any agency of the Government of Australia. The author has used publicly available information in the researching and presentation of this work.

Acronyms and Abbreviations

ABM	Anti-Ballistic Missile
ADF	Australian Defence Force
AFB	Air Force Base
AFSPC	(United States) Air Force Space Command
AMW	Air and Missile Warfare Manual
API	Protocol I Additional to the Geneva Conventions of 1949
ASAT	Anti-Satellite
BMD	Ballistic Missile Defense
CD	Conference on Disarmament
ICOC	(Draft) International Code of Conduct for Outer Space Activities
COPUOS	Committee on Peaceful Uses of Outer Space
CTBT	Comprehensive Test-Ban Treaty
EMP	Electromagnetic pulse
EMS	Electromagnetic Spectrum
EO	Earth observation (satellite systems)
ESA	European Space Agency
EU	European Union
FOBS	Fractional Orbital Bombardment System
GEO	Geo-synchronous orbit
GGE	Group of Government Experts
GNSS	Global Navigational Satellite System
GSO	Geo-stationary orbit
HAND	High Altitude Nuclear Detonation

HEO	Highly Elliptical Orbit
ICAO	International Civil Aviation Organisation
ICBM	Inter-Continental Ballistic Missile
ICC	International Criminal Court
ICJ	International Court of Justice
ICRC	International Committee of the Red Cross
IHL	International Humanitarian Law
ITU	International Telecommunications Union
JSpOC	Joint Space Operations Center
LC	Liability Convention
LEO	Low Earth Orbit
LOAC	Law of Armed Conflict
MA	Moon Agreement
MDA	(United States) Missile Defense Agency
MEO	Mid-Earth Orbit
NASA	(United States) National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
OST	Outer Space Treaty
PAROS	Prevention of an Arms Race in Outer Space
PNT	Position, Navigation and Timing
PPWT	(Draft) Prevention of the Placement of Weapons Treaty
PTBT	Partial Test-Ban Treaty
RC	Registration Convention
RRA	Rescue and Return Agreement

SSA	Space Situational Awareness
TTP	Tactics, Techniques and Procedures
UK	United Kingdom
UN	United Nations
UNGA	UN General Assembly
UNOOSA	UN Office of Outer Space Affairs
UNSC	UN Security Council
US	United States
USAF	United States Air Force
VCLOT	Vienna Convention on the Law of Treaties
WGS	Wideband Global Satellite communications
WMD	Weapons of Mass Destruction
WWI	World War I
WWII	World War II

Table of Contents

Abstract

Today there are over 1,000 active satellites in orbit and the number of States directly involved in launching or operating satellites has increased substantially since the dawn of the space age. Even States that have no direct involvement in launching or operating satellites rely heavily on such space infrastructure: for television, radio, banking, communications, transport, agriculture, mining, and especially for modern military services. Yet, those same satellites are under increasing threat from 100,000s of pieces of space debris and the actual or potential proliferation of weapons and other means capable of destroying or disrupting satellites. There is also increasing competition for use of the limited radio frequency spectrum that is essential for the operation of such satellites.

Concurrently, there are a range of factors unsettling global security generally and the dominance of the US and Europe specifically. The proliferation of nuclear weapons and ballistic missiles, as their means of delivery, is a significant concern. Ballistic missiles have a trajectory through space and ballistic missile defence also rely on space-based infrastructure. Financial and other constraints have made global powers more inward-looking, less likely to deploy forces globally, except through the sort of 'remote reach' capabilities that rely on space infrastructure for their effectiveness (such as uninhabited aerial vehicles and cyber warfare). So space-based infrastructure is a key element in global security, yet it is also increasingly vulnerable to the threats described above – including space weapons. Warfare in space is becoming a real possibility.

Outer space is not, though, a new, wild and lawless frontier. There is a legal framework of growing complexity. However, the treaties specific to the space domain, as well as recent initiatives to augment those treaties, barely contemplate warfare. The law of war is applicable to the space domain and potentially provides a comprehensive set of norms of State behaviour that restrains the recourse to force by States in the space domain. There is considerable uncertainty about how particular rules of the laws of war apply to the space domain. It would be in the strategic interests of all States to have a clear and authoritative statement on how the rules of the law of war apply to the space domain. The question is how to achieve such a clear and authoritative statement.

Useful analogies can be found in the process and success of the San Remo Manual on International Law Applicable to Armed Conflict at Sea, the Harvard Manual on International Law Applicable to Air and Missile Warfare and the Tallinn Manual on International Law Applicable to Cyber Warfare. These manuals have been drafted by globally-recognised legal and technical experts in each domain expressing personal opinions on the *lex lata*. They have avoided many of the challenges of State negotiations on similar topics, yet the manuals have had a significant impact in each of their domains. There now needs to be a 'Manual of International Law Applicable to Space Warfare'.

Résumé

Aujourd'hui, il ya d'autres 1.000 satellites actifs en orbite et le nombre d'États directement impliqués dans le lancement ou l'exploitation de satellites a augmenté considérablement depuis l'aube de l'ère spatiale. Même les États qui n'ont pas d'implication directe dans le lancement ou l'exploitation de satellites comptent beaucoup sur cette infrastructure spatiale: la télévision, la radio, les banques, les communications, les transports, l'agriculture, l'exploitation minière, et en particulier pour les services militaires modernes. Pourtant, ces mêmes satellites sont sous la menace croissante de 100.000 s de morceaux de débris spatiaux et la prolifération réelle ou potentielle d'armes et autres moyens capables de détruire ou de perturber les satellites. Il existe également une concurrence pour l'utilisation du spectre des fréquences radio limitée qui est essentiel pour le fonctionnement de ces satellites.

Parallèlement, il existe une série de facteurs déstabilisant la sécurité mondiale en général et la domination des États-Unis et en Europe en particulier. La prolifération des armes nucléaires et des missiles balistiques, en tant que de leurs vecteurs, est une préoccupation importante. Les missiles balistiques ont une trajectoire à travers l'espace et de la défense contre les missiles balistiques compter également sur l'infrastructure spatiale. Les contraintes financières et d'autres ont fait des puissances mondiales plus introvertie, moins susceptibles de déployer des forces dans le monde, sauf par le genre de capacités »portée à distance» qui s'appuient sur l'infrastructure spatiale pour leur efficacité (tels que les véhicules aériens sans pilote et la cyberguerre). Alors infrastructure spatiale est un élément clé de la sécurité mondiale, mais il est aussi de plus en plus vulnérables aux menaces décrites ci-dessus - y compris les armes spatiales. La guerre dans l'espace devient une possibilité réelle.

L'espace n'est pas, cependant, une nouvelle, sauvage et anarchique frontière. Il existe un cadre juridique de complexité croissante. Toutefois, les traités spécifiques au domaine de l'espace, ainsi que les récentes initiatives pour augmenter ces traités, à peine contempler la guerre. Le droit de la guerre est applicable au domaine de l'espace et fournit potentiellement un ensemble complet de normes de comportement de l'État qui restreint le recours à la force par les Etats dans le domaine spatial. Il existe une incertitude considérable sur la façon dont les règles particulières des lois de la guerre s'appliquent au domaine de l'espace. Il serait dans les intérêts stratégiques de tous les États à avoir une déclaration claire et faisant autorité sur la manière dont les règles du droit de la guerre s'appliquent au domaine de l'espace. La question est de savoir comment parvenir à une telle déclaration claire et faisant autorité.

Analogies utiles peuvent être trouvés dans le processus et le succès du Manuel de San Remo sur le droit international applicable aux conflits armés sur mer, le Manuel de Harvard sur le droit international applicable à

antiaérienne et antimissile guerre et le Manuel Tallinn le droit international applicable aux cyberguerre. Ces manuels ont été rédigés par des experts juridiques et techniques mondialement reconnues dans chaque domaine exprimer des opinions personnelles sur la *lex lata*. Ils ont évité les nombreux défis de négociations de l'Etat sur des sujets similaires, mais les manuels ont eu un impact significatif dans chacun de leurs domaines. Il doit maintenant être un «manuel de droit international applicable à la guerre de l'espace».

Acknowledgements

> God grant me the serenity to accept the things I cannot change; courage to change the things I can; and wisdom to know the difference.
>
> *Reinhold Niebuhr*[1]

I do not accept that war in space is inevitable. However, strategic competition in space and the conditions that tend to lead to war are inevitable. I cannot change that. But, if I can convince others to support the idea of clarifying the rules of war as they would apply to space warfare, then I believe that the process itself, as well as the product, will reduce the likelihood of space warfare and will smooth the path to peace if space warfare does erupt. If I am right to accept the inevitability of strategic competition in space, if I am courageous in advocating for a 'Manual of International Law Applicable to Space Warfare' and if I am wise in believing that the development and completion of such a manual could reduce the likelihood of war in space at all, or the severity if it does occur, then it is because I have been granted such acceptance, courage and wisdom, not by chance or serendipity (although that has played a small part), but by the words, thoughts, support and encouragement of many people and the events that brought me to them and them to me. I owe them my thesis, my acknowledgement and my gratitude and I thank God for them.

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1 Reinhold Niebuhr, *The Essential Reinhold Niebuhr: Selected Essays and Addresses* (New Haven: Yale University Press, 1987), 251.

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Thank you Annabelle and Eloise, my two wonderful daughters, for somehow understanding and accepting, despite your early years, that Daddy often wasn't available, even when I was physically there. Thank you also for staring up at the stars with me.

God, who owes me nothing, brought my wife Danielle into my life more than 13 years ago. I'm not sure if completion of my thesis was some part of God's plan, but I do know that it could not have happened without the support that Danielle has given me throughout and that support is a large part of the responsibility I feel to do this topic justice. However, there is undoubtedly more to the plan than this and I very much look forward to devoting much more of my time to you, Danielle and to other plans that God may have for us.

One wants to reach great heights. There may be challenges.

Per ardua ad astra!

Preface

I have written the argument in this thesis, that there is a need for a 'Manual of International Law Applicable to Space Warfare', to appeal to two very diverse groups. First, there are many of my Defence colleagues and others in Australia and elsewhere, who take a very realist approach to space security and believe that the State should preserve its military options in space to the maximum extent possible and that any attempt to develop the applicable law is not in the State's best interest. If you are one of those and you are reading this, then you will find that I have taken a robust strategic approach, which leads to the conclusion that clarifying the law of war applicable to the space domain will reflect States' strategic interests generally. Secondly, many in the space security community are very concerned to ensure that outer space maintains its status as a 'sanctuary' – in some cases defining that as prohibiting military activity entirely. If you are one of those and you are reading this, then please read on. Even though I argue for the centrality of States' strategic interests, I also argue that this ultimately leads back to the concept of outer space as a sanctuary.

I have also written this thesis to inform my advocacy of the need for a 'Manual of International Law Applicable to Space Warfare' with international organisations, universities, think-tanks and the like. As at the date of submission of this thesis, there is a current application for a government grant to fund a project to develop the manual, in which I will play a significant part.

I have written this thesis using an Australian English dictionary, which appears to be largely the same as Canada. I have applied the Canadian style guide for legal citation – also known as 'The Red Book'. It is not comprehensive, especially in respect of international law. With help from Milan Pluecken and Patrick Schwomeyer, I wrote the EndNote style file for the Red Book and we made some editorial decisions to fill the gaps in the guide. Where the Red Book is silent, I have tried to be consistent throughout.

This thesis was submitted on 13 August 2013. There undoubtedly have been many changes to the relevant law and facts in the mean time. It is, to the best of my knowledge, correct as at the date of submission.

1 Introduction

> States Parties to the Treaty shall carry on activities in the exploration and use of outer space, including the Moon and other celestial bodies, in accordance with international law, including the Charter of the United Nations, in the interest of maintaining international peace and security and promoting international cooperation and understanding.
>
> *Article III, Outer Space Treaty*[1]

> You must know there are two ways of contesting, the one by the law, the other by force; the first method is proper to men, the second to beasts; but because the first is frequently not sufficient, it is necessary to have recourse to the second.
>
> *Niccolo Machiavelli*
> *Chapter 18, 'The Prince', 1515*[2]

> War holds a great place in history, and it is not to be supposed that men will soon give it up – in spite of the protests which it arouses and the horror which it inspires – because it appears to be the only possible issue of disputes which threaten the existence of States, their liberty, their vital interests. … It may be said that independently of the international laws existing on this subject, there are to-day certain principles of justice which guide the public conscience, which are manifested even by general customs, but which it would be well to fix and make obligatory. … it is not sufficient for sovereigns to promulgate new laws. It is essential, too, that they make these laws known among all people, so that when a war is declared, the men called upon to take up arms to defend the causes of the belligerent States, may be thoroughly impregnated with the special rights and duties attached to the execution of such a command.
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> *Gustave Moynier*
> *Preface to the Oxford Manual 1880*[3]

This thesis advocates for the preparation of a 'Manual of International Law Applicable to Space Warfare'. The reference to 'space

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1 *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, 27 January 1967, 610 UNTS 205, [1967] ATS 24 (entered into force 10 October 1967).

2 Niccolo Machiavelli, *The Prince*, translated by W K Marriott (Florence: Antonio Blado d'Asola, 1515).

3 Gustave Moynier, ed, *The Law of War on Land* (Oxford: Institute of International Law, 1880), 1.

warfare' may seem odd, given the orthodoxy within the legal framework for outer space that space must be used for peaceful purposes.[4] Article III, *Outer Space Treaty* not only states that outer space shall be used "in the interest of maintaining international peace and security", but reiterates that it shall be used "in accordance with international law". Yet, it is also axiomatic that States have, do and will consider recourse to force where other States threaten their vital interests and where the law is insufficient to restrain them, even if this ethic seems so typically Machiavellian. A far more humanitarian figure, Gustave Moynier, one of the co-founders of the Red Cross movement and of the *Institut de Droit International*,[5] also observed the unfortunate inevitability of war, except that he resolved to work for the development of new law and observance of existing law to restrain the recourse to force. That restraint is both in terms of the decision to resort to war at all, and prevention of the worst horrors of war when it does occur. Moynier's sentiment, in the preface to the Oxford Manual 1880 is that if the law appears to be "not sufficient" to restrain the recourse to force, then it is not simply a matter of making new laws, but of making new and existing laws known and clear in their application to the recourse to force. It is especially important to make them known and clear to decision-makers and practitioners of military campaigns and to do so before war occurs. Moynier, and other members of the *Institut de Droit International* could not make new international law, but they could clarify and make known existing laws about the recourse to force, and they did this by drafting the Oxford Manual 1880, also known as 'The Laws of War on Land'. The influence of the manual that he and other international law experts produced was said to be at least equal to the outcomes of one of the most significant diplomatic conferences of that

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4 For an authoritative exploration of the meaning of the phrase 'peaceful purposes' in the context of space law, see Bin Cheng, "Properly Speaking, Only Celestial Bodies Have Been Reserved for Use Exclusively for Peaceful (Non-Military) Purposes, but Not Outer Void Space" (2000) 75 International Law Studies, United States Naval War College 81.

5 *History of the Institute of International Law* (webpage accessed on 9 August 2013) <http://www.idi-iil.org/idiE/navig_history.html>.

time on the same topic – the Brussels Declaration 1874.[6] The example of the Oxford Manual 1880 has subsequently been followed in the maritime, air and cyber domains[7] with significant impact, but not yet in the space domain.

The success of these other manuals does not necessarily dictate that a similar manual should be drafted for the space domain. However, in this thesis I argue that the space domain is increasingly contested, and in part because outer space provides essential support in respect of any contest in the terrestrial domain. The recourse to force is an option that is, undoubtedly, 'on the table' for some space-faring States.[8] I argue that the existing legal framework directly applicable to outer space is insufficient to restrain the recourse to force to resolve the contests. Furthermore, the application of the broader corpus of existing international law to outer space, especially the law of war, has been relatively neglected, so that it is unclear and largely unknown. This neglect is equally true of diplomatic attempts to develop new law for the domain, which have assiduously avoided any detailed consideration of the application of the law of war to outer space, because of the political controversy of discussing something so apparently at odds with the orthodoxy of the peaceful use of outer space. This is in spite of the threat to States' vital interests in outer space that these contests potentially present.

The law of war has always been a balance between military necessity – or the pursuit of States' interests through military means – on the one hand, and broader considerations of humanity on the other. The application of the

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6 Gregory P Noone, "The History and Evolution of the Law of War Prior to World War II" (2000) 47 Naval Law Review 176, 194, quoting Howard S Levie, *Terrorism and War: The Law of War Crimes* (New York: Oceana Publications, 1993), 17.

7 International Institute of Humanitarian Law, *San Remo Manual on International Law Applicable to Armed Conflicts at Sea* (San Remo, Italy: Cambridge University Press, 1995); Program on Humanitarian Policy and Conflict Research, *HPCR Manual on International Law Applicable to Air and Missile Warfare* (Cambridge, MA: Harvard University, 2010) ; Michael N Schmitt, ed, *Tallinn Manual on the International Law Applicable to Cyber Warfare* (New York: Cambridge University Press, 2012).

8 See, for example, United States, Department of Defense & Office of the Director of National Intelligence, *National Security Space Strategy: Unclassified Summary* (January 2011) (Washington, DC: Department of Defense, 2011) (Secretary of Defense & Director of National Intelligence: Robert M Gates & James R Clapper), 10.

law of war to the space domain involves a balance between protecting and promoting States' vital interests in space-based capabilities on the one hand and the orthodoxy of the peaceful use and exploration of outer space for the benefit of all humanity on the other. Such a balance is the essence of the art and science of 'strategy'. That is not to say that the correct application of the law of war to the space domain is determined by strategy – it is a matter of law, not strategy – but when the law is unclear, understanding the strategic balance helps in the discovery of what the law is and to clearly explain its application, especially to decision-makers and practitioners of military campaigns. Therefore, this thesis necessarily takes a strategic perspective to: contests and military strategic interests in the domain; the recourse to force as an option considered by States; the balance confronting decision-makers; the discovery and explanation of the application of the law of war to the space domain and, ultimately, the need for a manual for the space domain.

In addition to explaining the perspective adopted in this thesis and before setting out the structure, it is necessary to delimit the scope of the thesis. The key phrase – 'international law applicable to space warfare' – determines what is covered and not covered. First, it relates to international law and any references to domestic law are incidental. Secondly, it relates to warfare. However, 'warfare' is defined broadly to encompass more than activities that amount to a 'threat of use of force' within the meaning of Article 2(4) of the *Charter of the United Nations*.[9] It also encompasses activities between States that might be described as 'unfriendly' or 'hostile', but which do not amount to a 'threat or use of force'. Nevertheless, to come within the meaning of 'warfare' such activities must still be undertaken to achieve military strategic ends – so unfriendly activities undertaken for economic purposes would not fall within the meaning of 'warfare'. An example would include temporarily dazzling a spy satellite to prevent it from

9 *Charter of the United Nations*, 26 June 1945, 1 UNTS XVI (entered into force 24 October 1945).

observing military manoeuvres.[10] It follows that the relevant international law is not just *jus ad bellum* and *jus in bello*, but also international law applicable to hostile activities short of the use of force. It includes, for example, the law of State responsibility. Finally, such warfare is not confined to activities in outer space itself, but includes warfare to space, from space, through space and directly supported by space-based capabilities. The relevant international law encompasses law applicable to the space domain generally, even outside the context of warfare. This is important because the law applicable to warfare is an exception to the law that applies to normal, peacetime activities and the exception can't be properly understood without considering the foundational law that applies in times of peace.

The thesis is divided into three broad parts. The first part considers strategy in relation to war, law and outer space. It considers strategic interests in the space domain broadly – not just military use of space, but also civil and commercial use of space. This includes some space power theories – that is, approaches to the space domain to optimise a State's overall national benefit. The first part also considers current strategic challenges in the domain. The solution to those challenges may be technical, diplomatic or legal, but this thesis focuses on the latter. So the first part also considers what attributes a legal solution would need to present an effective solution to the strategic challenges in the domain.

The second part then considers whether the current legal framework for the space domain exhibits those attributes. The second part starts with the basic principles of space law especially in relation to space warfare. However, they are more generally relevant because they form the foundation against which international law applicable to space warfare sits as an exception. The second part also considers existing legal instruments and other measures designed to prevent space warfare, as well as proposals to

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[10] It has been suggested that the Chinese used satellite laser range-finders to dazzle US spy satellites in 2006; Anonymous, "Satellite Laser Ranging in China" (2007) UCS Technical Working Paper (Cambridge, Massachusetts: Union of Concerned Scientists).

develop legal instruments and other measures. The second part then specifically explores the application of *jus ad bellum* and *jus in bello* to the space domain. The second part concludes that much of it is unclear and unknown and therefore contributes little to restraining the recourse to force. The second part therefore ends with the question of what can be done to clarify and publicise international law applicable to space warfare.

The third part addresses that question. It examines the production of manuals applicable to warfare in other domains – maritime, air and cyber. In each case, the third part focuses on the process undertaken to develop each manual, the institutional or other support that was instrumental to its development, and the impact the manual has had – especially its clarity and utility to military decision-makers and practitioners. The proposed title of a manual for the space domain – 'Manual of International Law Applicable to Space Warfare' – is meant to follow the pattern of the other manuals: the 'Manual of International Law Applicable to Armed Conflict at Sea', facilitated and published by the International Institute of Humanitarian Law at San Remo in Italy in 1994;[11] the 'Manual of International Law Applicable to Air and Missile Warfare' facilitated and published by the Program on Humanitarian Policy and Conflict Research at Harvard University in 2010 (the 'Harvard Manual');[12] and the 'Manual of International Law Applicable to Cyber Warfare' facilitated and published by the Cyber Defence Centre of Excellence of the North Atlantic Treaty Organisation (NATO CDCoE) in Tallinn, Estonia in 2013 (the 'Tallinn Manual').[13]

Those three parts contain the premises supporting my contention that there needs to be a 'Manual of International Law Applicable to Space Warfare'. The conclusion summarises the premises. If the argument is accepted, the next step is to determine which institution or city would put its name to such a manual.

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11 International Institute of Humanitarian Law, *San Remo Manual*, *supra* note 7.
12 Program on Humanitarian Policy and Conflict Research, *Harvard Manual*, *supra* note 7.
13 Michael N Schmitt, ed, *Tallinn Manual, supra* note 7.

2 Strategy, war, law and outer space

This part considers strategic interests in the space domain – not just the typical military use of space, but also civil and commercial use of space. It includes a short examination of theories on space power – that is, on how a State should use outer space to optimise its national benefit. This informs an understanding of the current strategic challenges in the space domain. This part then ends with a section on the contribution that law could make to addressing those challenges and therefore establishes criteria by which to assess the adequacy of the current legal framework for outer space – especially in the context of warfare.

2.1 Strategic interests in outer space

There are a number of elements to a full understanding of strategic interests in outer space. First, it is necessary to understand the advantages and disadvantages of operating in space. This section starts with a brief discussion of the physical nature of space. Secondly, several schools of strategic thought have arisen, which each provide organising principles on how to use outer space to achieve a State's strategic objectives. Then, this section considers military, civil and commercial uses of outer space from a strategic perspective.

2.1.1 The physical nature of outer space and its military utility

Perhaps the most obvious strategic advantage of outer space is that it offers the user visibility of an area of the Earth that is broader than any field of view achievable on Earth (the further from Earth, the broader the field of view). With the right sensors, a satellite can see a very wide area or a narrow area, with a resolution theoretically down to five centimetres.[14] A satellite can gather a wide variety of data (not just visual data) and, with

[14] For an explanation of 'resolution' relative to spy satellites, see Pat Norris, *Watching Earth from Space: How Surveillance Helps Us - and Harms Us* (New York, NY: Springer Science & Business Media, 2010), 3–7.

analysis, can draw very useful conclusions about, for example, the weather (currently and in the future), the suitability of the soil for certain types of agriculture, the presence of resource minerals or the disposition of the forces of another State. It is difficult to hide from a satellite, no matter where you are on Earth and no matter what the weather.[15] Therefore, another State cannot surprise you, but with superior information, should you need to, you can seize the initiative, surprise your enemy, concentrate force at decisive points and do so with economy of force. A satellite can broadcast television and radio signals, private communications or positioning data over a large area or to a very defined area. Effective communications facilitates military cooperation, in order to flexibly apply force and seize the initiative and it incidentally helps to maintain the focus and morale of military forces. Another aspect of the wide field of view of satellites is the crucial role that GPS satellites play in broadcasting a timing signal throughout the world, without which land, air and sea navigation services, banking, stock markets, telecommunications, the internet and many other services may fail, at least temporarily.[16]

The military often refers to such characteristics in a terrestrial context as having the 'high ground'. The analogy cannot be taken too far,[17] but it does extend to more than just oversight. It is far more difficult to attack upwards than it is to attack downwards, and this holds true with respect to satellites. They have the physical advantage. In theory, a suitably manufactured object released from a satellite could destroy terrestrial targets without the necessity of propulsion, based on kinetic energy alone (no explosives required) and it could do so with very little warning and very

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15 *Ibid*, 15–17.

16 James Carroll & Kirk Montgomery, "Global Positioning System Timing Criticality Assessment - Preliminary Performance Results" (Paper delivered at the *40th Annual Precise Time and Time Interval (PTTI) Meeting*, Reston, Virginia, 1-4 December 2008), 486–489.

17 James E Oberg, "Toward a Theory of Space Power" (Lecture delivered at the *Defining Principles for US Space Policy Seminar*, Washington, DC, 20 May 2003), 1 – 2 (arguing against the 'high ground' analogy).

quickly.[18] Conversely, building and launching a rocket, or some other weapon, with the capability to destroy or disrupt a satellite (or other space-based object) is beyond the capability of all but a handful of States and even then, at great expense and to a very limited extent.[19] Outside the military context, outer space is also insulated from the vagaries of terrestrial weather and is unaffected by geographic obstacles like mountains or oceans. Thus, one's own forces remain secure.

Space-based objects are also insulated from other disadvantages of terrestrial infrastructure. National borders do not bind them and it is difficult for a State that did not put a satellite there in the first place to exert any control over it. At any time there is likely to be another State's satellite over the top of you (able to 'sense' you in some way), no matter where you are on Earth. Space is inherently international in nature. The use and exploitation of space is also international in very many cases, because launching something into space is an expensive endeavour and so States have often collaborated in placing satellites in space. Therefore, much of the space-based infrastructure has mixed-nationality in one way or another.[20] While this adds to the security of your space-based infrastructure, it complicates selection of targets in

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18 David Wright, Laura Grego & Lisbeth Gronlund, *The Physics of Space Security: A Reference Manual* (Cambridge, MA: American Academy of Arts and Sciences, 2005), 89 – 96. The authors establish that it would be far more cost-effective to pre-place ballistic missiles at strategic sites, than to base missiles in space. These would have a similar capacity to strike anywhere on Earth, quickly and with little warning. However, to this point, long-range ballistic missiles have only had nuclear warheads – a significant over-reaction for the sorts of targets contemplated. The US has sought to develop a prompt global strike capability using a conventional warhead, possibly with a maneuverable, glide flight path in the terminal phase, although the risk of strategic misunderstanding (about the nature of the warhead and its target) is a significant obstacle. See United States, Congressional Research Service, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues* (10 January 2013) (Washington DC: CRS, 2013) (Specialist in Nuclear Weapons Policy: Amy F Woolf).

19 Cesar Jaramilo, ed, *Space Security Index* (Ottawa: Project Plougshares, 2012), 139 – 145.

20 Union of Concerned Scientists, *UCS Satellite Database* (webpage accessed on 24 March 2013) <http://www.ucsusa.org/nuclear_weapons_and_global_security/space_weapons/technical_issues/ucs-satellite-database.html>. By applying selective filters to the database you can get a very good idea about the mix of nationalities in individual satellites and constellations as well as the satellite fleet globally.

space and slows down your decision-making cycle. It also complicates establishing and maintaining military coalitions.

Space is also international in that, paradoxically, prime positions are quite limited and one State's activities with respect to those prime positions potentially affects many other States.[21] This is because in spite of the infinite nature of space, the manoeuvrability of space objects around the Earth is restricted. It is incredibly complex and very expensive to get an object to a desired spot relative to Earth or some other object in space. Such efforts to position a space object uses the very limited fuel that satellites can generally carry with them. In the absence of an abundance of power available for propulsion in space, objects are usually launched into fixed orbits. This means that you cannot easily hide a satellite, thereby making it vulnerable to targeting and intelligence-gathering.[22] Once in a fixed orbit, the space objects only have to use a small amount of fuel to maintain those orbits.[23] After the fuel runs out, the satellite will generally drift in a way that makes them useless thereafter. Different fixed orbits are useful for different applications. For example, Low Earth Orbit (LEO) is good for Earth observation, because the closer the satellite, the better the data. However, generally a satellite cannot be kept above a desired position on Earth – a satellite might pass over that desired position for only a couple of minutes and not return for several days. The exception is geo-stationery orbit (GSO), where a satellite stays in an

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21 Brian C Weeden & Tiffany Chow, "Taking a common-pool resources approach to space sustainability: A framework and potential policies" (2012) 28 Space Policy 166, 168.

22 But see *ibid*, 160 – 61 (describing some of the difficulties in determining the orbit of a satellite and tracking it). Space objects are required to be registered with the United Nations – see Art IV, *Convention on Registration of Objects Launched into Outer Space*, 14 January 1975, 1023 UNTS 15, [1986] ATS 5 (entered into force 15 September 1976) and registration requires the disclosure of orbital parameters, yet some satellites, particularly reconnaissance satellites, are never registered, often for reasons of national security. Many active satellites appear in the database when one applies a 'no' filter for UN registration against the index at United Nations Office of Outer Space Affairs, *Register of Space Objects* <http://www.unoosa.org/oosa/en/SORegister/index.html>. Yet amateur astronomers and others can often fill in the blanks – thus satellites listed as unregistered with the UN may nevertheless appear, with all their orbital parameters in the database at Union of Concerned Scientists, *UCS Satellite Database* (webpage), *supra* note 20.

23 David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18, 12.

apparently fixed position above the Earth. GSO is particularly popular for satellite broadcasting.[24] Prime orbits such as GSO and LEO become vulnerable to congestion.

To avoid radio-frequency interference or even catastrophic conjunctions, States have to cooperate in the use of these prime orbits.[25] Space objects cannot effectively operate for their intended purpose without wireless communications. States communicate with their satellites using the radio frequency (RF) spectrum in order to track and control their satellites, to get information on the 'health' or functional status of their satellites and to send and receive the data for which the satellite was manufactured and launched (for example, a communications satellite obviously needs to be able to receive and send the communications that its clients seek to put through it).[26] Only certain frequencies can support signals that are able to reach satellites in space and back to Earth.[27] If two satellites in close proximity use the same frequency, their signals may interfere with one another. This dependence on RF is a vulnerability that may be exploited in any contest between States and is a potential source of strategic competition for limited bandwidth in the RF spectrum.[28] This dependence also means that satellites are, in a sense, tied to ground stations that need to be located within their field of view on Earth, given their orbital path – although space-based relay satellites can reduce this dependency.

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24 For a description of different types of orbits and their utility, see *ibid*, 40 – 45.

25 Consider, for example, the havoc caused by the Galaxy 15 satellite in geo-synchronous orbit in 2010 when IntelSat lost control of the satellite and the need for cooperation between competitors in order to avoid potential destruction of another satellite. Stephen Clark, *Zombiesat has three more satellites in its crosshairs* (webpage accessed on 29 March 2013) <http://www.spaceflightnow.com/news/n1007/25galaxy15/>.

26 David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18, 112 – 15.

27 A good explanation of the deleterious effects of space and terrestrial weather on RF signals is provided at John Kennewell & Andrew McDonald, *Satellite Communications and Space Weather* (webpage accessed on 29 March 2013) <http://www.ips.gov.au/Educational/1/3/2>.

28 Ram S Jakhu & Karan Singh, "Space Security and Competition for Radio Frequencies and Geostationary Slots", Ch 11, in Ajey Lele & Gunjan Singh, eds, *Space security and global cooperation* (New Delhi: Academic Foundation, in association with the Institute for Defence Studies and Analyses, 2009), especially 79 – 81.

Space objects are also vulnerable to the effects of space weather. Solar flares, cosmic rays and meteorites could all disrupt or potentially destroy a satellite. Furthermore, for low Earth orbits (LEO), the Earth's atmosphere does extend into those orbits and expands and contracts with the influence of the Sun, so that more fuel must be expended to overcome the slowing effect of air resistance. Gravitational and magnetic fields also vary, the temperature can get much colder and much hotter than on Earth and space is a near vacuum. Space objects must be able to respond or withstand those conditions in order to remain useful, yet there is a need for constant compromises to limit the weight of an object at launch.[29]

Finally, there is more to space than the Earth orbits on which most attention has focused so far. The Earth orbits are the gateway to potentially limitless quantities of untapped resources, scientific discovery and even other sentient beings.

2.1.2 Theories on the strategic use of outer space

Many different strategic theories or organising principles have been espoused in relation to how States should use outer space, taking into account the physical nature of space, as discussed above.[30] Lupton summarised these theories into four schools of thought that conveniently cover the field.[31] Different schools of thought are distinguished by the degree to which they focus on the services that space-based infrastructure provides terrestrially, as opposed to outer space and the infrastructure itself. The schools of thought are also distinguished by reference to how benign versus weaponised the domain should be.

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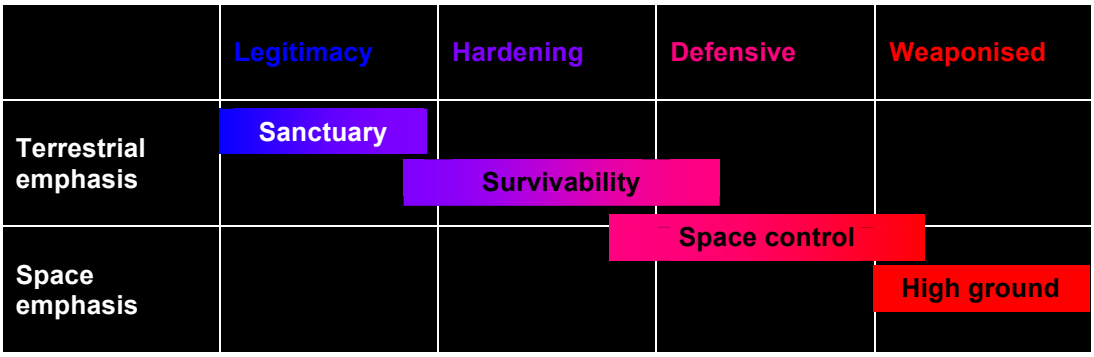
29 David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18, 36 – 40.

30 The field of space power theory is still quite nascent. A comprehensive collection of approaches to developing space power theory can be found in Charles D Lutes & Peter L Hayes, eds, *Toward a Theory of Spacepower: Selected Essays* (Washington, DC: Institute for National Strategic Studies, National Defense University, 2011).

31 LtCol David E. Lupton, *On Space Warfare: A space power doctrine* (Maxwell Air Force Base: Air University Press, 1998).



In the first of Lupton's four schools of thought there are those who advocate for outer space as a sanctuary.[32] According to this theory, States may launch objects into space without any fear of human threats to their continued operation. A legal and more broadly normative framework prohibits activities in outer space that undermine the idea of space as a sanctuary. At one extreme, this would include any activities with a military connection, although many advocates readily accept that the use of space is and was, from its genesis, militarised, but are concerned to ensure that it does not become weaponised.[33] Space objects are protected by States' concern for their own legitimacy. The emphasis is on services that space-based infrastructure provides terrestrially and on the maintenance of those services.

Second, there are those who argue that the possibility of human threats to space-based infrastructure cannot be dismissed and that such infrastructure ought to be hardened for survivability against, for example, directed energy weapons (DEW) or an electro-magnetic pulse (EMP) from a high altitude nuclear detonation (HAND).[34] Such hardening might even go so

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32 The pros and cons of space as a sanctuary are debated at *Expanding the Debate on Space Weaponization* (webpage accessed on 18 April 2011) <http://www.opendebateengine.com/>. See also Lucy Stojak, *The Non-Weaponization of Outer Space*, report for International Security Research and Outreach Programme, International Security Bureau (Ottawa: Department of Foreign Affairs and International Trade, 2002).

33 There is an authoritative and comprehensive discussion of this point in Bin Cheng, "Peaceful purposes" *supra* note 4. For a short description of the evolution of space law (including the influence of military uses) see Jonathan F Galloway, "The Revolution and Evolution in the Law of Outer Space" (2009) 87 Neb L Rev 516, 516 – 18.

34 For a good discussion of the considerations in respect of hardening and survivability, see Michael Krepon, Theresa Hitchens, and Michael Katz-Hyman, 'Chapter 20—

far as to allow for self-protective mechanisms on satellites against co-orbital anti-satellite (ASAT) weapons or simply against space debris (natural or man-made). The emphasis remains largely terrestrial, but begins to focus on activities in space itself.

Third, advocates of the space control school of thought point to the strategic advantages that accrue to a State with comprehensive access to space-based infrastructure, especially if that same access is denied to an adversary State in the midst of a conflict – even if the conflict is entirely terrestrial. It would be foolhardy, they say, not to develop the means to secure their own access to space-based infrastructure (such means would generally be categorised as defensive space control) and the means to deny access of an adversary to space-based infrastructure (such means would generally be categorised as offensive space control).[35] Clearly, there is a lot of emphasis here on space itself. However, the focus ultimately remains on the services that space-based infrastructure provide terrestrially, especially to military operations being conducted on and slightly above and below the surface of the Earth.

Finally, there are those who point out that space offers the opportunity for a technologically-advanced State to truly dominate militarily

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Preserving Freedom of Action in Space: Realizing the Potential and Limits of U.S. Spacepower' in *Charles D Lutes & Peter L Hayes, eds, Theory of Spacepower*, *supra* note 30.

35 Current US military doctrine for the operational use of outer space predominantly reflects the space control school of thought. The doctrine has a heavy focus on space control and tends to understate 'force application', which would be more consistent with a high ground approach. See Joint Publication 3-14—*Space Operations* (United States Joint Forces: J3 and J7 US STRATCOM, 2009; Directive 3100-10—*Space Policy* (United States Department of Defense: Assitant Secretary of Defense (C3I), 1999; Air Force Doctrine Document 3-14.1—*Counterspace Operations* (United States Air Force: Air Force Doctrine Center, 2004; Air Force Doctrine Document 3-14—*Space Operations* (United States Air Force: Air Force Doctrine Center, 2006). See also Lance W Lord, "Space Superiority", *High Frontier*, Winter 2005, 4. General Lord was Commander, Air Force Space Command from April 2002 to April 2006. In this article he stated: "Space superiority is the future of warfare. We cannot win a war without controlling the high ground, and the high ground is space." The emphasis is on controlling the high ground, rather than on using the high ground for force application.

against any adversary, by holding the ultimate high ground.[36] From space, such a State could strike terrestrial targets with ubiquity and impunity. For so long as it remains possible for competing States to dominate the ultimate high ground, international relations will remain inherently unstable. It is incumbent on a State, acting with a mix of self-interest and a desire to bring a benign peace through invincibility, to dominate the high ground as quickly as possible, starting as soon as possible. A responsible State, holding the high ground, could bring regulation to the space domain for the common interest of all. In this school of thought there is a very much greater emphasis on space itself and on activities conducted from and in space.

2.1.3 Military use of outer space

Having considered the physical nature of outer space from a strategic perspective and theories on the strategic use of outer space, it is now possible to understand current and potential military uses of outer space in the context of these theories. For the most part, military space capabilities are focused on support to terrestrial domains. Much of this is benign and uncontroversial. The description below of military uses of outer space provides more detail about weapons than about more benign uses, but this is because it is controversial, rather than because it is the predominant military use of space.

2.1.3.1 Space-based support to military capabilities on Earth

Perhaps the most well known of all satellite constellations is the US Global Positioning System (GPS). This is one example of a category known generically as Global Navigation Satellite Systems (GNSS). In addition to GPS,

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[36] See Everett C Dolman, Astropolitik: Classical geopolitics in the Space Age (London: Frank Cass Publishers, 2002). See also Everett C Dolman and Henry F Cooper, Jr, 'Chapter 19—Increasing the Military Uses of Space' in Charles D Lutes & Peter L Hayes, eds, *Theory of Spacepower, supra* note 30.

the European Union, Russia, China, India and Japan are all developing GNSS of their own.[37]

The GPS, operated by the US Air Force (USAF), provides any end-user who has a terminal capable of receiving a GPS signal, with a precise fix of his, her or its position. The system almost always exceeds its performance target of ±7.8 m with 95% confidence and when used with augmentation systems, which are widely available around the world, GPS receivers can fix their position within a few centimetres in real time and within a few millimetres post-mission.[38] Furthermore, subject to the limits of the receiver, the position can be updated continuously (for example, as often as 20 times per second) so that it can also be used to track movement with extreme accuracy. It also provides precise timing, which is a technical necessity for the system to work.[39] Thus, GNSS are said to provide Position, Navigation and Timing (PNT).

The original impetus for the development of GPS was accurate targeting with nuclear ballistic missiles,[40] although the Navy and Air Force had been separately developing less ambitious systems simply to provide positioning for maritime and aviation navigation. Complementary to the precision positioning systems, the satellites have always had sensors that improve accuracy by allowing for atmospheric conditions that may affect the signal. Those sensors are enhanced to also detect atmospheric anomalies caused by nuclear detonations.[41] The GPS constellation is therefore a valuable capability in monitoring treaty compliance.

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37 Executive secretariat, *Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentations Systems*, report for International Committee on Global Navigation Satellite Systems (New York: United Nations Office of Outer Space Affairs, 2010).

38 Navigation National Coordination Office for Space-Based Positioning, and Timing, *GPS Accuracy* (webpage accessed on 12 August 2013) <http://www.gps.gov/systems/gps/performance/accuracy/>.

39 Brian C Tichenor, ed, *Space Primer* (Maxwell AFB, AL: Air University Press, 2009), 218.

40 United Kingdom, Ministry of Defence, *The UK Military Space Primer* (Shrivenham, UK: Development, Concepts and Doctrine Centre, 2010) (Fellow at the Development Concepts and Doctrine Centre: Gerry Doyle), para 331.

41 Brian C Tichenor, ed, *Space Primer, supra* note 39, 218.

Apart from ensuring precise targeting of ballistic missiles, GPS enables precision targeting of all sorts: artillery, mortar, air-to-ground, naval gunfire, cruise missiles and so on (collectively known as Precision Guided Munitions or PGMs). This includes cooperative targeting in which one element identifies a target and passes the information to another element or even direct to a weapon in flight.[42]

A little known but crucial use for GNSS is the timing that enables the internet. When a computer communicates over the internet, messages are split into 'data packets.' In order for those data packets to come together, each packet needs a time signature. These time signatures need to be synchronised around the world and GNSS provides the best way to do this. If the timing signal from the GPS constellation of satellites were partially disrupted, it may have unpredictable, perhaps even devastating, effects on the communications systems necessary, for example, to banking, stock markets, travel sites, remote control of all manner of industrial sites, everyday commerce and communications.[43]

In addition to PGMs and timing for effective communications, the military also uses GPS for logistics, vehicle navigation, aerial navigation (including, precision airdrop, rendezvous for air-to-air refuelling and to precisely define air corridors, for example), ship navigation (especially through restricted or disputed waters), minefield marking (land and sea), search and rescue and orbital rendezvous between space systems. It also has an increasingly wide array of civilian applications, such as vehicle navigation, package tracking and recreation.[44]

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42 Nathan A Canestaro, "Legal and Policy Constraints on the Conduct of Aerial Precision Warfare" (2004) 37 Vand J Transnat'l L 431, 451 – 52. For a critical analysis of claims of precision in targeting, see Maja Zehfuss, "Targeting: Precision and the production of ethics" (2011) 17:3 European Journal of International Relations 543.

43 James Carroll & Kirk Montgomery, "GPS Timing Criticality", *supra* note 16, 486 – 89, 492 – 99.

44 Initially, the GPS signal was to be available only to the military, but even before it became operational President Reagan mandated that it be made freely available to civilian users. This was apparently a response to the shooting down of Korean Airlines flight 007, which strayed off course and into Russian airspace. Up until May 2000 the signal available to civilian users was deliberately degraded to reduce accuracy, but this

One problem with GNSS is the weakness of the signal. The GPS signal has been compared to a car headlight seen at 20,000km – easily 'drowned out' if there are other lights around. Civilian systems lack protection against frequency interference (deliberate or inadvertent). Using Electronic Warfare (EW), specifically Electronic Attack (EA), GNSS signals can be jammed (preventing reception altogether) or spoofed (causing an incorrect signal to be received) and, unlike a purely ballistic projectile, when a PGM is off-target, the error can be disproportionately significant. The military does, though, have access to a second signal from the GPS satellites, which provides some Electronic CounterMeasure (ECM) capabilities (anti-jamming and anti-spoofing) and makes military access slightly more accurate (this is known as the Precise Positioning Service or PPS, as opposed to the Standard Positioning Service or SPS).[45] However, civilian systems have access to a wider array of augmentation systems that often make civilian GPS receivers more precise than their military counterparts.[46]

The most common artificial satellites in orbit are communications satellites (SATCOM). Apart from their use in television broadcast and facilitating other forms of civilian communication, they provide military communications at the tactical to strategic levels. The demand for SATCOM over the past two decades has risen exponentially. One of the biggest contributors to this rise in demand is uninhabited aerial vehicles (UAVs).[47] Having this capability means, for example, that a UAV can be piloted in the continental US and flown in Afghanistan.[48]

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system of 'selective availability' was turned off and newer GPS satellites will lack the means to degrade the signal at all. Navigation National Coordination Office for Space-Based Positioning, and Timing, *GPS Accuracy* (webpage), *supra* note 38.

45 Brian C Tichenor, ed, *Space Primer, supra* note 39, 222 – 224.

46 Navigation National Coordination Office for Space-Based Positioning, and Timing, *GPS Accuracy* (webpage), *supra* note 38.

47 Joseph N Pelton, *Satellite Communications* (New York: Springer, 2012), 99 – 100.

48 Markus Wagner, "Autonomy in the Battlespace: Independently Operating Weapon Systems and the Law of Armed Conflict", Chapter 4, in Dan Saxon, ed, *International Humanitarian Law and the Changing Technology of War* (Leiden: Martinus Nijhoff, 2013), 103.

When most people think of satellites and military forces they probably think of 'spy' satellites. Satellites are especially good at keeping watch over a large area and/or for a long period of time in order to identify patterns and changes (surveillance). Further analysis of the data can help military professionals draw conclusions about capability, preparedness and intent of a potential adversary (intelligence). Satellite imagery can also be used to gain situational awareness of a defined area of more immediate interest (reconnaissance).[49] This intelligence, surveillance and reconnaissance (ISR) can contribute to an overall visual representation of a battlefield, fused with data from many sources to produce a Common Operating Picture (COP). The 'picture' upwards, or into space, known as Space Situational Awareness (SSA), is becoming just as important as the terrestrial picture to which space-based ISR contributes.[50]

However, its use in a tactical context is limited by its lack of persistence over an area of interest.[51] Potential adversaries know this and issue satellite vulnerable warnings (SATVUL) to their forces in order that moves or changes can be made undetected, at least for a while. The US has sought to address this limitation by developing a capability for responsive launch, re-location or re-tasking of satellites (ORS or operationally-responsive space). For example, satellites weighing only a couple of kilograms could be set aside for placement in support of individual military units moving into an area of operations not already well supported by existing ISR satellites.[52]

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49 Brian C Tichenor, ed, *Space Primer, supra* note 39, 167 – 80. This reference provides an excellent unclassified description of the capabilities (and limitations) of spy satellites. See also Pat Norris, *Watching Earth*, *supra* note 14, chapters 8 and 9.

50 See, for example, Frank A Rose, "Remarks of United States Deputy Assistant Secretary, Bureau of Arms Control, Verification and Compliance" (Paper delivered at the *AGI's Japan Space Situational Awareness Seminar*, Tokyo, 27 February 2013) [unpublished].

51 For a discussion of factors such as ground track, altitude and revisit rate, see Ministry of Defence, *The UK Military Space Primer*, *supra* note 40, 3-52 – 3-55.

52 Joint Operationally Responsive Space Office, *Operationally Responsive Space* (webpage accessed on 11 April 2013) <http://ors.csd.disa.mil/about-ors/>. Read, in particular, 'Background' under 'About' and read also 'The Three Tiers'.

The movies tend to suggest that these satellites produce images as the eye would see something. In fact, this is more the exception rather than the rule. Most ISR satellites gather data from spectra other than the visual spectrum.[53] This is especially important for missile warning, such as space-based detection of nuclear ballistic missile launches or tests.[54] Recent developments have taken remote-sensing satellites a step beyond detection, to potentially tracking a ballistic missile and cueing an interceptor missile on to it.[55]

Earth observation satellites also include weather-monitoring satellites. Their civil application is obvious, but their military significance may not be immediately apparent. Military operations over air, land and sea are all heavily affected by weather and military history is replete with accounts of the effects of weather on battlefield success.[56]

Earth observation satellites can be crucial to the battle for legitimacy that invariably precedes modern conventional battles. Satellite imagery is often combined with legal concepts in order to strengthen the case for, or wording of, a United Nations Security Council resolution, to garner the support of the domestic constituency, to secure the commitment of troops and equipment by coalition partners, to convince adjacent States to host military forces and to undermine the support for an adversary – domestically and internationally.[57] The battle for legitimacy starts prior to the

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53 Pat Norris, *Watching Earth*, *supra* note 14, chapters 8 and 9.

54 Brian C Tichenor, ed, *Space Primer, supra* note 39, 227 – 30.

55 United States Office of the Assistant Secretary of Defense (Public Affairs), 082-13, "Aegis Ballistic Missile Defense Intercepts Target Using Space Tracking and Surveillance System-Demonstrators Data" (13 February 2013).

56 John M Lanicci, "Integrating weather exploitation into airpower and space power doctrine" (1998) 12:2 Airpower Journal 52. The author provides several accounts of the impact of weather on battlefield success and advocates for exploitation of known terrestrial and space weather effects as part of operational planning. See also Brian C Tichenor, ed, *Space Primer, supra* note 39, 201 – 13.

57 Simon Chesterman, "Shared Secrets: Intelligence and Collective Security" (2006):10 Lowy Institute Paper (Sydney: Longueville Media), 41. The author discusses the presentation of satellite imagery to the UN Security Council in February 2003 by Colin Powell, then US Secretary of State, regarding the presence of weapons of mass destruction in Iraq. Many other examples exist of the power of satellite imagery, some far less controversial, as when military forces are provided to other nations to assist

conventional battle, but it is not conclusively won or lost at that time. Being able to attribute putatively illegitimate actions to an adversary (through ISR and SSA) is a powerful capability at any point in a military campaign, whether those actions occur on land, sea or air or in some other domain. Furthermore, with the impact of the establishment of *ad hoc* international criminal tribunals and the permanent International Criminal Court, attribution is a potentially significant capability after a military campaign has ended. Civil society appears to be leading the way in the use of space-based infrastructure for criminal attribution in order to influence armed conflicts – although not to influence the outcomes of armed conflicts, but rather the ways in which they are fought.[58]

Apart from the impact of UN Security Council resolutions, coalition partners, foreign bases, popular support and the potential for criminal culpability on the initiation and conduct of hostilities, a State's reputation for legitimacy also matters in peacetime in order to maintain an acceptable peace. Thus, States have accepted the importance of verification of their treaty commitments about, for example, nuclear weapons and associated infrastructure. That verification comes through 'national technical means of verification' (NTM), a phrase that encompasses Earth observation satellites of various capabilities. Such NTMs have become so central to maintaining a level of trust and confidence between nuclear-capable States that targeting them would be strategically foolish in almost all conceivable circumstances.[59]

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with disaster relief and satellite imagery is made publicly available as evidence of the extent of devastation.

58 For example, the 'Satellite Sentinel Project', popularised by actor George Clooney and others, aims to gather evidence of war crimes, particularly in Sudan, through satellite imagery. See *Satellite Sentinel Project - Our Story* (webpage accessed on 19 April 2013) <http://www.satsentinel.org/our-story>.

59 United States, Congressional Research Service, *Arms Control and Nonproliferation: A Catalog of Treaties and Agreements* (2 May 2011) (Washington DC: CRS, 2011) (Specialist in Nuclear Weapons Policy: Amy F Woolf with Mary Beth Nikitin and Paul K Kerr), 9 and 19; Pat Norris, *Watching Earth*, *supra* note 14, 21; Michael P Gleason, *Space Policy Primer: Principles, Issues, and Actors* (United States Air Force Academy, CO: Eisenhower Center for Space and Defense Studies, 2010), 16; Philip J Baines & Adam Côté, "Promising confidence and security-building measures for space security" (2009):4 Disarmament Forum 5, 11; Roger G Harrison, Deron R Jackson & Collins G

There are three types of intelligence derived from satellite remote-sensing: imagery intelligence (IMINT), signals intelligence (SIGINT) and measurement and signature intelligence (MASINT). IMINT is derived from visual photography, multi-spectral or hyper-spectral sensors, infrared sensors, lasers, electro-optics, and radar sensors such as synthetic aperture radar.[60] These various sources mean that much more can be discerned than simply what is obvious to the eye. For example, these systems, often used in conjunction with one another, may be able to see objects at night and through cloud, determine the temperature of an object, the chemical composition of its reflective surface and its three-dimensional structure. The best resolution currently available, according to public sources, is 0.31m.[61] The National Geo-Spatial Intelligence Agency (NGA) manages IMINT data collected for the US military. SIGINT is the collection of broadcasted transmissions from anything transmitting a signal in the EMS. SIGINT may provide information about the object emitting the signal (for example, location and frequency, crucial for Electronic Attack (EA) techniques such as jamming), about the content of the signal (for example, voice or data communications) or even, in conjunction with other sources, the person responsible for the transmission. MASINT predominantly relates to the analysis of data, although it may also involve collection of emitted or reflected waves in the EMS other than the visible or radio parts of the spectrum and other types of anomalies. By combining measurements and identifying signatures MASINT can, for example, locate and determine the yield of a nuclear detonation.[62]

Surveillance is the continuous collection of data over a relatively wide area by one or a variety of sensors in order to produce intelligence

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Shackelford, "Space Deterrence: The Delicate Balance of Risk" (2009) 3:1 Space and Defense 1, 19. See generally Jana K Hettling, "The use of remote sensing satellites for verification in international law" (2003) 19:1 Space Policy 33.

60 Brian C Tichenor, ed, *Space Primer, supra* note 39, 168.

61 DigitialGlobe, *WorldView-3* (webpage accessed on 12 August 2013) <http://www.digitalglobe.com/about-us/content-collection#worldview-3>.

62 Brian C Tichenor, ed, *Space Primer, supra* note 39, 179 – 80.

about one or a variety of targets or areas. Reconnaissance is more limited in time and scope and LEO or MEO satellites at lower orbits and higher resolutions may be well-suited to the task because national borders or battle lines generally pose no problem and a 'snapshot' in time is all that is required. A good example is collecting information after a strike on a target to provide a measure of combat effectiveness to determine whether a target still poses a threat and may need to be re-struck – this is also known as battle damage assessment (BDA).[63] In the US the National Reconnaissance Office (NRO) oversees all "satellite and overflight reconnaissance projects whether overt or covert" across the whole of US government, not just the military.[64]

Satellites are not generally suited to real-time applications, such as situational awareness and tactical targeting, because of their short dwell times over desired areas of the Earth's surface. However, a constellation of satellites in a low orbit can provide near real-time data, satellites in highly elliptical orbit (HEO) have long dwell times over certain areas due to the shape of their orbit and GSO/GEO satellites are high enough to have a one-third view of roughly the same portion of the Earth's surface at all times. The higher orbit diminishes their utility for ISR generally, but HEO and GSO/GEO are useful for missile warning.

Missile warning could be treated as a subset of ISR, except that it involves a specialised suite of capabilities to protect North America from ballistic missile attack, which generally implies nuclear attack. The US has had various iterations of space-based missile warning systems. The current system is in transition between the old system, known as the Defence Support Program (DSP), and the new system, known as the Space-Based Infrared System (SBIRS). The old DSP satellites, which have continued to perform past their initial life-expectancy, are being integrated into the new SBIRS framework. Both systems use infrared sensors in conjunction with a

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63 *Ibid*, 167 – 168.

64 National Reconnaissance Office, *Vigilance From Above: Past, Present, and Future* (webpage accessed on 1 July 2011) <http://www.nro.gov/about/nro/index.html>.

variety of other sensors to detect and track missile launches and the heat from atmospheric drag as the missile passes through the atmosphere. This is at its greatest in the initial, 'boost', phase and the missile becomes harder to track after the boost is completed and the missile is simply following a ballistic arc. To achieve the ideal of full-time, global coverage there is a small constellation of satellites (including extras for redundancy) in GEO and a new SBIRS satellite planned for HEO. These orbits are also useful for the associated tasks of predicting the missile's impact point and ongoing communication.[65]

The 'holy grail' of missile warning is to be able to track a ballistic missile from 'cradle to grave' and to provide that information to an interceptor missile to facilitate the destruction of the ballistic missile. A demonstration system, the Space Tracking and Surveillance System (STSS) recently achieved the tracking component with two satellites in LEO in a highly regulated test. An effective system would require a large constellation of such satellites. The US military Missile Defense Agency (MDA) has a budget to fund further development of this capability in the years to come.[66]

Finally, it is worth mentioning space-based solar power generation for terrestrial use, notwithstanding that no such capability yet exists. If it did, though, the logistical consequences could be transformative. It offers the possibility of being able to receive power anywhere, all-terrain, all-weather, 24 hours a day with nothing more than a lightweight laser or microwave receiver and in quantities greater than the capacity of current mobile fossil-fuel engines. The technology already exists – solar power is the most common form of power generation for satellites, but the cost is currently prohibitively high for terrestrial use given the energy conversion rate

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65 Brian C Tichenor, ed, *Space Primer, supra* note 39, 227 – 29.

66 Samuel Black & Victoria Samson, *Space Security Programs of Interest in the Fiscal Year (FY) 2011 Department of Defense Budget Proposal*, report for Secure World Foundation and Stimson Center (Washington, DC: Secure World Foundation, 2010) 7 – 8.

relative to the mass of the required space-based infrastructure and the cost of launching it.[67]

2.1.3.2 Deploying and sustaining space-based capabilities

In order to deploy satellites in space and sustain them, the military has to have certain capabilities on Earth, but which are essential to space-based operations. These are: spacelift, satellite operations and reconstitution of space forces.

Spacelift refers to the launch vehicles and associated infrastructure and organisations as well as the launches themselves, undertaken predominantly to deploy or reconstitute satellites, but also to sustain satellites and their payloads with material and fuel for military or national security objectives. Spacelift is sometimes done in conjunction with other nations, including carrying satellites for other nations. Even though big US companies have manufactured the rockets, they have been manufactured to military specifications for military purposes and the US military have managed the launches themselves from their own launch-sites. However, US Congress has mandated that US government agencies make use of all aspects of commercial spacelift.[68] The latest US National Security Space Strategy (NSSS) also foreshadows use of commercial spacelift for some military and national security satellites and payloads.[69]

'Satellite operations' predominantly refers to those actions at ground control segments necessary for the ongoing operation of a satellite. These ground control segments must interact with the satellite as often as every 100 minutes, for as long as 15 minutes per cycle. They track the satellite, monitor the performance of its systems, direct the satellite's self-maintenance to the extent that it can be maintained remotely, keep it on its

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67 Emmet Cole, "Space-based solar farms power up" (2013):27 February, BBC Future.

68 United States of America, White House, *National Space Policy of the United States of America* (28 June 2010) (Washington, DC: White House, 2010) (President: Barack Obama), 10 – 11.

69 Department of Defense & Office of the Director of National Intelligence, *NSSS*, *supra* note 8, 9.

orbit when it strays due to environmental perturbations and maintains the correct attitude so that the antennas and sensors are pointing in the right direction. These functions, known as telemetry, tracking and control (TT&C) are a critical contributor to space situational awareness (SSA). They also monitor and command the satellite payload in order that it is able to collect the desired data. The network of ground control segments are known as the Air Force Satellite Control Network (AFSCN). Apart from a number of satellite operations centres, the AFSCN includes remote tracking stations (RTS) – antennas strategically-placed around the world to achieve maximum duration of contact with a maximum number of orbits and maximum frequency of contact. Most are near the equator and apart from Diego Garcia, just south of the equator, the AFSCN lacks an RTS in the southern hemisphere. The AFSCN is a critical element in space operations that is more susceptible to attack than the space segment.[70]

There are also elements of satellite control in space. First, there are satellites that can act as a relay between the ground control segment and a satellite with which it is ultimately trying to communicate, although most satellites are not configured this way. Secondly, satellite operations may involve rendezvous and proximity operations between a satellite and some other spacecraft in order to assemble, inspect or service the satellite.[71] Finally, the military has begun exploring the value of satellites orbiting in close proximity to one another, known as 'formation flying', which is expected to have benefits such as the ability to form larger, virtual sensors that are more sensitive and satellite 'swarms' that can adapt responsively to operational requirements, but remain dispersed to make them harder to target. Formation-flying involves a substantially higher level of technical complexity and risk of simply creating space debris.[72]

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70 Michael P Gleason, *Space Policy Primer*, *supra* note 59, 19 - 20; Brian C Tichenor, ed, *Space Primer, supra* note 39, 141 and 273.

71 Brian C Tichenor, ed, *Space Primer, supra* note 39, 142.

72 Ellie Zolfagharifard, "Formation flying satellites" (23 May 2011) *The Engineer* (London: The Engineer, 2011).

SSA is a critical element of every space mission. It is especially important with respect to the issue of space debris. Essentially, SSA is about knowing the location of all the objects in Earth orbit and the man-made objects in deep space, their movement, especially relative to each other, what they are doing and how the space environment might affect any active satellite. There are four objectives of SSA: to ensure space operations and spaceflight safety, to verify compliance with international treaties and arrangements and to attribute responsibility if a state acts contrary to its obligations, to protect US and friendly state space capabilities and to facilitate other missions of space control by providing a space common operating picture and associated ISR. SSA uses ISR and environmental monitoring capabilities, predominantly ground-based, but looking into space, to detect and track objects and identify or predict space events such as satellite manoeuvres, anticipated and unanticipated launches, re-entries, and any space weather that may affect a mission. [73]

The organisation undertaking the most significant work in SSA is the Joint Space Operations Center (JSpOC) and it not only generates the space COP, but manages a catalogue of space objects that is regarded as the most comprehensive and reliable source of information on space objects currently available. The catalogue is used with predictive orbital analysis tools to anticipate threats to satellites and safe mission windows. The US government currently believes that it is in their interest to provide warnings to any State, whether allied or not, of anything that might damage their satellites.[74] The work of JSpOC also provides an insight into adversary use of space capabilities, their intent and specific details of their threat to US space capabilities.

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73 Brian C Tichenor, ed, *Space Primer, supra* note 39, 249 – 258.

74 Patrick M Schwomeyer, *The US outer space situational awareness sharing law: Sharing information about SSA and the need for global cooperation* (Master of Laws, Institute of Air and Space Law, McGill University, 2011) [unpublished, archived at McGill University Law Library], 60 – 62. To this end, JSpOC issued 677 warnings in the period May 2010 to May 2011 – see Frank A Rose, "Defining Space Security for the 21st Century" (Paper delivered at the *Space Security Through the Transatlantic Partnership Conference*, Prague, Czech Republic, 13 June 2011) [unpublished].

The JSpOC depends on a network of sensors collectively known as the Space Surveillance Network (SSN) composed of radars, optical sensors and other sensors, such as electronic sensors to detect signals from satellites, lasers to measure distance very accurately, infrared sensors to detect heat and specialised radars that can generate a three-dimensional representation of a space object. Some of the sensors are dedicated to the SSN, but for many of them SSA is a secondary task – such as sensors dedicated to the Ballistic Missile Early Warning System. The biggest component of the SSN, which is set to expand,[75] is the Air Force Space Surveillance System (AFSSS, also known as the 'space fence'). The AFSSS involves a number of antennas stretched along the thirty-third parallel within the US. They act collaboratively to transmit an electro-magnetic 'fence' that extends approximately 24,000km into space. Anything that passes through the fence will be illuminated by the electro-magnetic energy, a portion of which will be reflected back to a receiving station. If the object is big enough that the receiving stations will detect the reflected signal and if it is detected by more than one, then an accurate position of the object can be determined.[76]

On current capability the SSN can detect things as small as 10cm in LEO and no smaller than 1m in GEO.[77] It cannot track every object continuously, but rather it involves an element of predicting where space objects should be and periodically confirming or updating the prediction.[78] The SSN sensors have to be prioritised and high-interest missions and space objects in unstable orbits get the highest priority.[79] In order to improve the

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75 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 45.

76 Brian C Tichenor, ed, *Space Primer, supra* note 39, 249 – 58.

77 International Interdisciplinary Congress on Space Debris, edited by Ram Jakhu, *Towards Long-term Sustainability of Space Activities: Overcoming the Challenges of Space Debris*, report for United Nations Committee on Peaceful Uses of Outer Space (Vienna: 2011) 12

78 "All they need to do is track many thousands of man-made space objects, traveling at about 9 times the speed of a bullet, and residing in a search volume 220,000 times the volume of Earth's oceans." Defense Industry Daily staff, "Don't Touch Their Junk: USAF's SSA Tracking Space Debris" (blog entry on 23 July 2013) *Defense Industry Daily*, online: Defense Industry Daily <http://www.defenseindustrydaily.com/Air-Force-Awards-First-Phase-of-Next-Generation-Space-Fence-05511/>.

79 Brian C Tichenor, ed, *Space Primer, supra* note 39, 256 - 57.

current capability, in addition to expansion of the space fence, the USAF recently launched the first in a constellation of satellites to be known as space-based space surveillance (SBSS). These will use optical sensors to look into space. There has already been a technology demonstrator in orbit for over 10 years, called 'space-based visible' (SBV) and SBSS will replace this aging capability.[80]

In the event that space capabilities are lost or diminished by natural forces or deliberate action, US forces will coordinate other missions as necessary, such as spacelift, in order to replace the capability or satellite operations, in order to reposition and reconfigure surviving assets and augment capabilities with civil and commercial capabilities.[81] This is closely related to the 'Operationally Responsive Space' (ORS) mission.

The idea of ORS is to be able to respond rapidly to emerging operational needs to exploit, augment or reconstitute space force enhancement or space control capabilities. The first option is to re-configure existing space assets, something that will engage those responsible for the satellite operations mission. If that is not possible, the next option is to rapidly assemble, integrate, test and deploy affordable, small satellites with a preference for those that are closest to field-ready.[82] This will engage the spacelift, satellite operations and reconstitution missions for the benefit of space force enhancement or space control capabilities. Where the previous two options are not possible, the third option involves *ab initio* development of a solution, although with a time limit of one year, the development is necessarily limited.[83] The ORS is a relatively nascent mission, although it has already had some successes.[84]

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80 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 44.

81 *JP 3-14—Space Operations supra* note 35, II-5.

82 Joint Operationally Responsive Space Office, *Operationally Responsive Space* (webpage), *supra* note 52.

83 *JP 3-14—Space Operations supra* note 35, Appendix G.

84 Joint Operationally Responsive Space Office, *Operationally Responsive Space* (webpage), *supra* note 52. While the actual mission of the USAF X-37 spacecraft is classified, it has been suggested that the mostly likely missions include operating as an ORS sensor

2.1.3.3 Weapons IN Space

High launch costs are a recurring theme and a limitation in the utility of any space weapons. However, as in the air, land and sea environments, crude, purely kinetic weapons can be effective in space, such as a satellite whose orbit is adjusted to collide with another satellite (co-orbital ASAT).[85] Achieving such interception deliberately, though, is far more complex than in the air, land or sea environment. For this reason, early anti-satellite weapon development sought to disable satellites by causing a nuclear explosion in proximity to the satellite, such that even if the blast did not destroy it, the EMP would.[86] Another solution is DEWs, such as lasers and microwaves. Given that the photons move at the speed of light and are relatively unaffected by gravity, interception is easier, but these are so energy dependent, that we have not yet seen viable, space-based DEWs (significant advances in space-based solar power generation could change that).[87]

However, gaining the upper hand in the space domain does not require that one belligerent destroys the satellites of another. In fact, this has undesirable consequences, such as littering preferred orbits with debris.[88] It may be far better to simply disrupt an adversary's satellite, or better still, convert it to your use. Mobile satellite servicing (refuel / repair / maintenance / reconfiguration) has been suggested as a way to prolong the life of satellites and enhance their return on investment. However, mobile satellite servicing faces a strategic hurdle in that it represents a potential

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platform - see Sharon Weinberger, "X-37B: Secrets of the US military spaceplane" (25 November 2012) *BBC* (London: BBC, 2012).

85 Ministry of Defence, *The UK Military Space Primer*, *supra* note 40, 3-70.

86 Clayton K S Chun, "Shooting Down a 'Star': Program 437, the US Nuclear ASAT System and Present-Day Copycat Killers" (2000):6 The College of Aerospace Doctrine Research and Education (CADRE) Papers (Maxwell Air Force Base, AL: Air University Press).

87 Laura Grego, *Short History of US and Soviet ASAT Programs*, Paper summary (1 April 2003; David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18, 123 – 33.

88 The Chinese test of an ASAT in January 2007 produced over 3,200 pieces of space debris - Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 33.

hostile capability for other States (to reconfigure, disrupt or simply spy on other satellites).[89]

Finally, in respect of weapons in space, there is the possibility in the near future of further crewed missions beyond Earth orbit.[90] This could give rise to competition to exploit the resources of outer space, to be the first to occupy and colonise and the possibility of first contact with other life forms. Will such missions carry weapons and, if so, will the crews be subject to any rules about their conduct in the use of such weapons?[91]

2.1.3.4 Weapons TO Space

Weapons need not be in space in order to affect space-based infrastructure. Terrestrially-based weapons can affect space-based infrastructure by targeting space objects directly, by targeting ground stations that undertake essential daily control to ensure that the space object continues to fulfil its desired function, or by targeting the link (electromagnetic radiation) that carries instructions and data to and from the space object.

Targeting the ground segment is no different to any conventional attack on a surface target. The link segment can be attacked through electronic warfare (focussing on the waveforms of the electromagnetic radiation) or cyber warfare (focussing on the code used to transmit the data or instructions).[92] The space segment can be attacked with terrestrially-based DEWs. Unlike DEWs in space, there has been some development of lasers to dazzle, disrupt, shift, tumble or destroy a space object; but again, generating a laser beam of sufficient power is difficult, due to the energy

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89 Alanna Krolikowski & Emmanuelle David, "Commercial On-Orbit Satellite Servicing: National and International Policy Considerations Raised by Industry Proposals" (2013) 1:1 New Space 29, 33 – 39.

90 The United States, Russia, China, India, Japan and the European Space Agency have all expressed intents to send astronauts beyond Earth orbit within a decade or so. Christopher C Miller, "To the Moon & Beyond: The United States and the Future of International Space Law" (2012) 35 Suffolk Transnat'l L Rev 121, 127.

91 Just think of your favourite space-based, science-fiction movie!

92 Brian C Tichenor, ed, *Space Primer, supra* note 39, 274 – 76.

involved. Thus, Russian, Chinese and American DEWs for space attack seem to be only developmental or just conceptual at this stage.[93]

That is certainly not the case with direct-ascent ASAT weapons. Early development of these weapons by both the US and USSR involved HANDs in the vicinity of a target space object to overcome the challenges of achieving interception for a direct kinetic kill. The HAND was found to cause an EMP that not only affected satellites in the vicinity, but resulted in dangerous current and voltage surges over 100's of square kilometres of the Earth's surface under the HAND.[94] In respect of space-based targets, though, guidance systems on interceptor missiles have improved and direct-ascent ASAT weapons developed more recently are designed to actually hit their targets or explode very close to them. Russia, China and the United States have demonstrated kinetic, direct-ascent ASAT capabilities and India is close to completing its development of such a capability.[95] Furthermore, kinetic, direct-ascent ASAT capabilities are very similar to ballistic missile defence (BMD) capabilities.[96] The US has been seeking to expand its BMD globally over the past decade by providing allies with BMD systems or components of it.[97] Therefore, there are several US allies that currently or shortly will have something that could be readily converted to use as a direct-ascent kinetic ASAT.

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93 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 141 – 45.

94 Clayton K S Chun, "Program 437" *supra* note 86.

95 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 140 and 143. See also Arvind K John, "India and the ASAT Weapon" (2012):41 ORF Issues Brief (New Delhi: Observer Research Foundation) and Rajeswari Pillai Rajagopalan, "Will China Conduct Another ASAT Test?" (blog entry on 16 January 2013), Cam Schinhan, moderator, *EurasiaReview*, online: EurasiaReview <http://www.eurasiareview.com/16012013-will-china-conduct-another-asat-test-analysis/>.

96 Mark A Gubrud, "Chinese and US Kinetic Energy Space Weapons and Arms Control" (2011) 35:4 Asian Perspective 617.

97 United States, Federal, Senate, Armed Services Committee, "Statement of Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy", *Ballistic Missile Defense Policies and Programs*, 112th (25 April 2012) (Dr Brad Roberts) (Chair: Bill Nelson), 5 – 7.

2.1.3.5 Weapons FROM Space

Weapons from space are currently a matter of fiction, rather than reality. Kinetic 'rods from heaven' and laser beams from space have frequently been promoted as the ultimate high ground weapons – able to strike anywhere, with very little warning, no hope of defence and largely immune from counter-attack. However, they would require large constellations of satellites (or a mobile, space-based platform) and very sophisticated guidance systems to account for orbital dynamics and atmospheric effects. The expense of launching these systems into space merely as a contingency does not appear to be currently viable.[98]

2.1.3.6 Weapons THROUGH Space

States can achieve a devastating effect on a surface target, even thousands of kilometres away, by propelling a warhead upwards (boost phase, reaching as fast as Mach 20) and then letting it fall along a ballistic trajectory (mid-course and re-entry phases). Ballistic missiles that reach over 100km in altitude (approximately) could be regarded as being in outer space during their mid-course phase, even though they do not enter orbit.[99] The advantage of propelling these missiles beyond the atmosphere is that they can travel much further without the effects of atmospheric drag. Such a trajectory would involve a range of at least 200km, although inter-continental ballistic missiles extend to 14,800km and about 30 minutes of

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98 David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18, 89 – 101. For counter-arguments see Independent Working Group, *Missile Defense, the Space Relationship & the Twenty-First Century*, report for Institute for Foreign Policy Analysis (Washington, DC: Institute for Foreign Policy Analysis, 2009).

99 The upper limit of air space and the beginning of outer space is not well defined. It could be defined by reference to the density of the atmosphere. The 'Karman line' is the point at which the air density is so thin that effectively any winged aircraft would have to be going at orbital velocity to get sufficient lift, except that it would then be in orbit and would not need lift, provided that it maintains its velocity. That point has been estimated as 100km, but air density changes constantly due to a number of factors. The issue is discussed in detail in Dean N Reinhardt, "The Vertical Limit of State Sovereignty" (2007) 72 J Air L & Com 65.

flight.[100] The longer the range, the smaller the warhead as a proportion of the rest of the missile and the less accurate the weapon. This is not just a function of the extra initial propulsion required, but because of the extra hardware associated with re-entering the atmosphere with all of the heat and sudden deceleration that that generates, plus decoys and measures designed to confound and penetrate enemy defences (such as Multiple Independent Re-entry Vehicles or MIRVs). Taking these and other factors into account, a nuclear warhead suited the rationale for such long range, but prompt strikes during the Cold War, and so long range ballistic missiles have only ever carried nuclear warheads.[101]

A single, five-megaton warhead that detonates at surface level has the following effects within approximately 1000 m of 'ground zero':

- 5.5 billion kWh of x-rays;
- a fireball (spreading out to 4.5 km);
- 7,760°C;
- 250 G of lateral acceleration;
- 350,000 kg/m^2 of pressure;
- 5,600 km/h winds;
- debris weighing as much as 910 kg impacting at 400 km/h; and
- an average depth of 51 cm of debris after the event.

For a 20 megaton airburst, most of the people within 1.2 km of the blast would die of the radiation, if not from other effects, within a couple of months.[102] This does not take into account the long-term effects.

A nuclear weapon seems grossly disproportionate to any threat except another nuclear weapon. Yet, the only current option to achieve an effect on a target thousands of kilometres away within tens of minutes is a ballistic weapon, which currently, invariably carries a nuclear warhead. The

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100 Ministry of Defence, *The UK Military Space Primer*, *supra* note 40, 3-3 and 3-5.

101 Congressional Research Service, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, *supra* note 18, 6.

102 Most of the detail in the accompanying paragraph is taken from Brian C Tichenor, ed, *Space Primer, supra* note 39, 235 – 48.

US has focused efforts to develop a capability known as conventional prompt global strike (CGPS). The same effect as weapons from space could be achieved by lofting a projectile into space as needed. If that projectile could then be guided and propelled at high speeds, such as by means of a hypervelocity jet, then CGPS would become a reality. Hypervelocity jets have thus far, though, only been able to maintain flight for seconds, rather than minutes.[103]

2.1.4 Civil use of outer space

Strategic interests are about much more than military power. There are three broad ways in which the civil and scientific space sectors may be strategically significant. First, civil and scientific achievements in the space sector support other national objectives, apart from military objectives. On the other hand, and secondly, civil and scientific achievements may actually have military application. Finally, civil and scientific achievements in the space sector may do much to address the strategic challenges that, left unchecked, could reduce a nation's options to what is invariably the worst of all strategic options – the use of military force.

The importance of space use and exploration from a civil and scientific perspective are articulately stated by NASA at its website:

> "Earth is the only planet we know to be capable of sustaining life. It is our lifeboat in the vast expanse of space. Over the past 50 years, world population has doubled, grain yields have tripled and economic output has grown sevenfold. Earth science research can ascertain whether and how the Earth can sustain this growth in the future. Also, over a third of the US economy – $3 trillion annually – is influenced by climate, weather, space weather, and natural hazards, providing economic incentive to study the Earth."[104]

The work of NASA, and similar civil space agencies, contributes to more rational use of Earth's resources – thereby reducing competition for

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103 See generally Congressional Research Service, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, *supra* note 18, and especially 35 – 36.

104 *Earth* (webpage accessed on 12 August 2013) <http://science.nasa.gov/earth-science/>.

resources and potentially also reducing strategic friction. Furthermore, understanding how the solar system and wider universe works and the search for life-sustaining planets offers the possibility of an alternative home for humanity.

The civil sector also contributes more directly to the everyday safety and security of life on Earth. For example, the civil sector is partly responsible for developing new applications of GPS, something that has become ubiquitous throughout civil, military and commercial sectors of society. However, to the extent that GPS is becoming indispensible, it represents a strategic vulnerability, especially for the States that do not own and operate the system – thus the expressed desire of other States to develop their own GNSS.[105] Another example is the provision of emergency and disaster-relief services, such as search and rescue satellite-aided tracking (SARSAT) systems[106] and the charitable provision of imagery to relief organisations in the event of a large-scale disaster in accordance with the *International Charter on Space and Major Disasters*.[107]

The development of all the elements necessary to a civil space program – launch services, space transportation, satellite communications, optics, image processing and so on – provides 'spin-offs'[108] for civil society, many of which are subsequently commercialised, and provides the military sector with redundancy. Just about anything that can be used for a civil purpose can also have a military purpose. Any remote sensing capability can be used for ISR or missile warning. Any SATCOM can be used by the military, for something as humanitarian as telemedicine for locals during disaster relief operations overseas or for directing fire on the enemy. Scientific deep

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105 Executive secretariat, *Current and Planned Global and Regional Navigation Satellite Systems and Satellite-based Augmentations Systems*, *supra* note 37.

106 Brian C Tichenor, ed, *Space Primer, supra* note 39, 67.

107 *Charter on Cooperation to Achieve the Coordinated Use of Space Facilities in the Event of Natural or Technological Disasters*, 20 October 2000, (entered into force 1 November 2000). See also Lalin Kovudhikulrungsri, *Legal Issues - Using Earth Observation Satellite for Pre-Disaster Management* (LLM thesis, Institute of Air and Space Law, McGill University, 2009) [unpublished, archived at McGill University Law Library].

108 *NASA Spinoff* (webpage accessed on 12 August 2013) <http://spinoff.nasa.gov>.

space probes that may help us to determine the viability of human habitation on a celestial body, could also be used to support the establishment of a military presence on a celestial body. Also, developing rendezvous and docking operations provides some of the necessary technology for one satellite to interfere with another. Any satellite is a potential KE ASAT. Any space launch vehicle is a potential ballistic missile. Therefore, the advances of potential adversaries in space technology and especially rockets, have always been of great strategic interest.[109] Eleven states are capable of independent orbital launch, three states are capable of independent human space flight, one state has landed a person on a celestial body (although, as discussed above, several are keen to follow), seventeen states are capable of sub-orbital launches and approximately sixty states have placed satellites in space.[110]

Given the high cost of the use and exploration of outer space, it makes economic sense to share the burdens and benefits with other nations and other sectors. International cooperation is also strategically important in its own right in that it fosters interdependence, creating disincentives for unilateral actions that upset global stability. It also reduces competition between sectors and States for scarce radiofrequency and orbital slots. However, this cooperation complicates the space domain in the event of a conflict. The dual-use nature of many civil programs makes them potential targets in a military conflict, notwithstanding the involvement of third States. From the defender's perspective, civil and multi-national space-based infrastructure could 'shield' the military capability from targeting, although one would hope that this is not a deliberate strategy.

2.1.5 Commercial use of outer space

The commercial space sector manufactures rockets, satellites, launch sites, ground segments and link segments. It also operates these things and applies the services derived from them. The sector also includes insurers that

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109 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 145 – 48.
110 *Ibid*, 72 – 79.

provide launch and on-orbit insurance. Some in the commercial space sector are relatively small sub-contractors, focusing on the manufacture of a specific component or the provision of a specific derived service, and others are more comprehensive, major contractors that manage projects and put it all together.

The global commercial space industry was worth almost US$230 billion last year (three times the size of the non-commercial sectors, by financial value), including $51 billion worth of ground equipment used directly by consumers (such as satellite navigation, satellite radio and mobile satellite broadband devices).[111] It employed several hundreds of thousands of people worldwide.[112] A significant majority of the almost 1,100 active satellites in orbit are purely or partly commercial (that is, including satellites operated commercially for government purposes) – more than one third are purely commercial communications satellites.[113] Most (52) of the launches globally were commercially-procured.[114] In the future, with the advent of space tourism and the possibility of commercial space mining, these already impressive figures are likely to grow substantially.

The vitality of the commercial space sector offers great strategic potential, but this must be balanced with the strategic challenges that an active commercial space sector can create. The pursuit of national objectives relative to space through the commercial sector should drive down costs, distribute benefits and costs fairly through a 'user-pays' system, rather than through taxation, encourage innovation and make the economy more self-sustaining. The commercial sector has led cost-saving and technological innovations such as more capable, but smaller satellites, the use of hosted payloads and rockets launching multiple payloads. Like in the civil sector,

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111 Mariel John, Michah Walter-Range & G Ryan Faith, *The Space Report 2013: The Authoritative Guide to Global Space Activity*, report for Space Foundation (Colorado Springs: Space Foundation, 2013) and The Tauri Group, *State of the Satellite Industry Report*, report for Satellite Industry Association (Washington, DC: SIA, 2013).

112 The Tauri Group, *SSIR*, *supra* note 111.

113 Union of Concerned Scientists, *UCS Satellite Database* (webpage), *supra* note 20.

114 The Tauri Group, *SSIR*, *supra* note 111.

cooperation between commercial and military sectors reduces competition for scarce resources, reduces potential congestion in space and provides potential redundancy for the military space sector. Again, though, it complicates the space domain in the event of hostilities. It also spreads technology and product of strategic significance. For example, using commercial remote-sensing, a potential adversary can assess your critical vulnerabilities, can make deductions about the threats that you perceive and what you think are the critical vulnerabilities of your adversary, can analyse the limits of your capabilities, your intent and so on.[115] Yet, the ownership and control of commercial entities involved in the space industry is typically multi-national, making government regulation of them complicated.

2.2 Current strategic challenges in the space environment

In spite of the significant strategic interests in the pursuit of civil and commercial objectives in a safe and secure space environment, there are equally significant, current challenges to international peace and security generally and in maintaining safety and security in the space environment specifically. The second part of this thesis will examine the adequacy of the legal framework for outer space in restraining the recourse to force in the face of these challenges.

2.2.1 Global factors providing impetus towards conflict

> The superpowers often behave like two heavily armed blind men feeling their way around a room, each believing himself in mortal peril from the other, whom he assumes to have perfect vision. Each side should know that frequently uncertainty, compromise, and incoherence are the essence of policymaking. Yet each tends to ascribe to the other a consistency, foresight, and coherence that its own experience belies. Of course, over time, even two armed blind men can do enormous damage to each other, not to speak of the room.
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> *Henry Kissinger, 1979*[116]

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115 Pat Norris, *Watching Earth*, *supra* note 14. See also Youssef Sneifer, "The Implications of National Security Safeguards on the Commercialization of Remote Sensing Imagery" (1996) 19 Seattle U L Rev 539.

116 Henry Kissinger, *The White House Years* (Boston: Little Brown & Co, 1979) .

Thankfully the two superpowers never directly came into armed conflict, although they certainly came close. Henry Kissinger's analogy demonstrates, though, that it is difficult to be definitive about the factors that tend to lead to conflict. Nevertheless, there are several theories on the causes of war. A comprehensive analysis of the global strategic situation is not the purpose of this section, nor is it necessary. I will briefly consider the application of those theories to select States – specifically, those with the greatest space capabilities. I will not consider non-State actors because only States have the capability to engage in space warfare to any significant extent and because States are ultimately, legally responsible for all national activities, whether by government agencies or not – as will be discussed below.[117]

The ancient Greek historian, Thucydides, explained the causes of war quite simply as based ultimately on three emotions: interest, fear and honour. Of course, it is difficult to attribute emotion to the modern State (as opposed to leaders in ancient Greece), however, in the broadest terms those three emotions do conveniently cover the theories on the causes of war.

Many realists believe that aggression, or taking the initiative by force to further State interests where an opposing State cannot be coerced into a preferred course of action, can be worthwhile, as long as the assessment of the prospects of success is accurate. The immediate purpose may be economic – to secure access to resources, for example, or it could be more complex, such as asserting sovereignty over territory. Whatever the immediate purpose, ultimately the objective is to maximise the State's power, especially relative to other States – for most realists, relative gains are essential, not just absolute gains.[118] Such aggression has not been particularly prevalent for some time, with the notable exception of Iraq against Kuwait in 1990, and one explanation that liberal theorists would support (and that

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117 Article VI, *Outer Space Treaty*, *supra* note 1.

118 Jack S Levy & William R Thompson, *Causes of war* (Chichester, West Sussex, UK: Wiley-Blackwell, 2010), 28 – 30.

realists would oppose) is the impact of law – something discussed in more detail below.

Fear appears to be a more prevalent factor in the current international system. States that are seeking only their own security and that would prefer to avoid conflict can still inadvertently find themselves in conflict primarily because of uncertainty about the intentions of other States (the 'blind men' to which Kissinger referred). One State perceives a threat, whether true or not, and this leads that State to take actions to increase its security, such as by investing in new military capabilities. This inadvertently leads to a reaction by the potential adversary. Both regard the other's actions as threatening and the States spiral towards conflict. While this might seem counter-productive, some realists believe that the solution is greater deterrence and that any appeasement simply invites aggression. They say that winning the arms race, through capabilities that have a greater deterrent effect than those of the adversary, is the only way to ensure stability. The problem, as Kissinger identifies, is the imperfection of information and erroneous assumptions about the quality of the decision-making by the adversary.[119]

On the path to an eventual conflict three reasons undermine the ability of States to reach a *détente*. First, they may flounder on an issue that is indivisible – the interests of both States cannot be accommodated. This could conceivably be the case, for example, about the right to an orbital slot in the GEO belt.[120] Secondly, there is information asymmetry about the prospects of either of them being successful in a subsequent conflict. Neither State can be certain about its assessment of whether it would win or lose, whereas certainty would be more likely to compel compromise. States are therefore prone to strategic miscalculation. This is a significant risk in the space

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119 *Ibid*, 28 – 31.

120 Consider, for example, the dispute between France and Iran about a GEO slot for either EutelSat or Zohereh-2 – see Peter de Selding, "Iran's Claims About Satellite Service Try International Regulatory Regime""Space News (8 April 2011) online: <http://www.spacenews.com/satellite_telecom/110408-iran-claims-sat-regulatory-regime.html>.

domain without effective SSA, because it can be very difficult to get an accurate account of what space-based capabilities a State has, what they can do and what they are doing. One of the invariable lessons from space wargames is the challenges arising from the difficulty of attribution. If a State does not know the source or scale of an attack, it is more prone to strategic miscalculation. Finally, neither State will necessarily trust the other entirely, so that neither State can make credible commitments about what it will or won't do.

Before it gets to conflict, though, many theorists argue that States engage in balancing behaviour. No State should be allowed to dominate and have absolute mastery in the international system. A bipolar world, such as during the Cold War, is relatively stable because there is less uncertainty – there are only two States involved. However, in a multi-polar world – such as might be characterised by the rise of China, India, and possibly the EU, Turkey and Iran, the increasing militarisation of Japan and the resurgence of Russia – balances against the power of a hegemon fail to form early because no one State is prepared to unilaterally spend its national wealth to balance against the hegemon. Therefore, global domination can rise unchecked until one or more States feel compelled to do something and then relatively drastic action is required.[121]

There does not appear to be any overt, current concern about balancing against the power of the US. Theorists disagree about whether States tend to balance against power, or against actual threats. Some States may be benign or not proximate enough to be a real concern. The US has global reach, but currently it can only achieve that promptly with nuclear-tipped ballistic missiles and the use of nuclear capability is not credible, except in the most dire circumstances. For financial reasons, for reasons of domestic politics and sensitivity to combat casualties, the global reach of the US with conventional land forces does not represent a great threat. However,

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121 Jack S Levy & William R Thompson, *Causes of war*, *supra* note 118, 32 – 33, 38 – 43.

a Conventional Prompt Global Strike weapon could significantly change that assessment, particularly if the US is shielded from any counter-attack by, for example, a ballistic missile defence shield.[122] Thus, theorists point out that technology can change the equation. Some technology may be offensive in nature and gives advantage to the State that strikes first. The threat to other States increases if the first State has long-range weapons and expeditionary capabilities. On the other hand, capabilities that are more inward-looking and defensive do not lead to conflict. For example, US capabilities in outer space are relatively out-of-sight and there is nothing overtly offensive about them – with the exception of ASAT weapons, such as the SM-3 anti-ballistic missile interceptor.[123] Other realists point out that any defensive weapon can be used offensively. This is true of US establishment of a missile defence shield. Ballistic missile interceptors can easily become ASATs and furthermore, the success of a missile defence shield could embolden the US – something that clearly concerns China and Russia.[124] In short, any weapons build-up is likely to produce a conflict spiral.[125]

Still other theorists say that an imbalance of power or threat is quite stable – rather instability arises as one State transitions to power parity or beyond against another State. The most dangerous situation is where a rising State is dissatisfied with the status quo and begins to approach the power of the global or regional hegemon. China has certainly expressed dissatisfaction with the status quo (especially its just share of resources, such as in the South China Sea and the Senkaku Islands),[126] although it is still a long way off power parity with the US and the basics of its economy and geopolitical

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122 Congressional Research Service, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, *supra* note 18.

123 *Ballistic Missile Defense Policies and Programs*, *supra* note 123.

124 Wu Riqiang, "Global Missile Defense Cooperation and China" (2011) 35:4 Asian Perspective 595.

125 33 – 36.

126 Marianne Lavelle & Jeff Smith, "Why Are China and Japan Sparring Over Eight Tiny, Uninhabited Islands?" (26 October 2012) *National Geographic News* (New York: National Geographic Society, 2012).

circumstances suggest that it will struggle to ever achieve power parity.[127] Nevertheless, in situations of a potential power transition there can be a temptation to strike now while the hegemon is still in a strong position. The nuclear powers have been particularly concerned about other States seeking to join the 'nuclear club' – establishing a capability to develop weapons-grade nuclear material and missile technology for delivery. Israel made a preventative strike against the Osiraq nuclear reactor Iraq in 1981, for example, and it is alleged that Israel and the US developed the Stuxnet virus to significantly disrupt the Iranian nuclear program.[128] Some developments in Chinese strategy suggest an asymmetric approach – they may be a long way off power parity, but they can hurt, embarrass, blind and initially confuse the US enough to make the US think twice – by focussing on its eyes, ears, command and communication – specifically its cyber and space capabilities.[129] On the other hand, the US itself is precedent for the rise of a superpower without overt, large-scale conflict.[130] In the medium term, small-scale conflicts by proxy (such as in the Middle East), might become more common, as they were in the Cold War.

Finally, the honour of the State manifests itself in domestic support, alliances and the deterrent credibility of its military power. A government with relative autonomy and authority within its borders can efficiently channel resources to build-up military capability and engage in conflict. It might do so to bolster domestic support, to assuage particularly powerful domestic actors, to make its deterrent effect more credible or to influence the terms of an alliance. Population pressures, and particularly a demographic bulge of fighting-aged males, are factors in respect of domestic support. If

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127 George Friedman, *The next 100 years: a forecast for the 21st century* (New York: Random House, 2009), 88 – 100.

128 David E Sanger, "Obama Order Sped Up Wave of Cyberattacks Against Iran" (1 June) *New York Times* (New York: 2012) A1.

129 Baohui Zhang, "The Security Dilemma in the US-China Military Space Relationship" (2011) 51:2 Asian Survey 311, 312. See also United States, US-China Economic and Security Review Commission, "Prepared Statement", *The Implications of China's Military and Civil Space Programs* (11 May 2011) (Barry D Watts) (Chair: William A Reinsch), 10.

130 Jack S Levy & William R Thompson, *Causes of war*, *supra* note 118, 44.

this is also coupled with a sense of exploitation and injustice in the distribution of the world's resources, under-employment and religious or patriotic zeal, then there is a real danger of conflict.[131] In contrast to the current unemployment in many countries, current trends suggest that developed nations will struggle to maintain population growth at a level sufficient to maintain production to meet the demands and expectations of the citizens. Labour will be in high demand and there will be large diasporas in developed nations – and they will be a significant part of the domestic support that politicians seek. This could have a moderating influence in foreign policy, but could also be a destabilising factor internally.[132]

The truth about the causes of conflict is undoubtedly more complex than any one particular theory. Suffice to say that there are many current circumstances that could conceivably push States towards conflict. It is a real possibility that should not be dismissed.

2.2.2 Specific challenges in the space domain

Three C's are typically used when talking about strategic challenges in the space domain: space is congested, contested and competitive.[133] There is another important C-word describing the current strategic challenges in the space domain: it is difficult to arouse the global public 'conscience'. This section will discuss all four, although the primary emphasis is on the increasingly contested nature of outer space. As with most things, these challenges are manifestations of a range of inter-related issues, such as the laws of physics, the pace of technological change and the economic drivers of commercial enterprise. Important as these issues are, it is not possible to consider them thoroughly in this thesis, but it is necessary to consider them

131 *Ibid*, 37.
132 George Friedman, *The next 100 years: a forecast for the 21st century*, *supra* note 127, 52 – 61.
133 Department of Defense & Office of the Director of National Intelligence, *NSSS*, *supra* note 8.

in sufficient detail to understand what legal structures may be adequate to address them.

2.2.2.1 Congested

There are 115 States with their own satellite or a share in one[134] and then there are still more States with arrangements for access to the services that those satellites provide. Even if there are some States with no formal arrangements to benefit directly from space-based services, it is still fair to say that every State does derive some benefit and could be expected to aspire to greater benefit.[135] In addition to the approximately 1,100 active satellites already in orbit, there are expected to be more than 1,000 satellites launched in the decade ahead (many of them replacing existing satellites).[136] However, the aspirations of all States cannot be met within the limitations of physics, economics and the current state of technology.

In the first place, the best orbits, especially those in GEO, are already taken. As will be discussed briefly later, this is tied to management of the radio-frequency (RF) spectrum. Different frequencies are allocated to different orbits and functions (for example, telemetry, tracking and control on the one hand, and transmission of data on the other). However, the RF spectrum is limited and, in order to make economical use of it, there must be a high degree of cooperation in the use of frequencies by satellites. Furthermore, if a nation is granted an allocation of a frequency and is not using it, efficiency demands that the nation give it up for other nations to use – something that has led to at least verbal disputes between nations,[137] and could lead to worse. Most interference with another nation's use of the RF

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134 Union of Concerned Scientists, *UCS Satellite Database* (webpage), *supra* note 20.

135 Megan C Ansdell, Laura M Delgado & Daniel B Hendrickson, "Analyzing the Development Paths of Emerging Space Nations: Opportunities or Challenge for Space Sustainability?" (Report delivered at the *Secure World Foundation event*, Washington, DC, 22 August 2011) [unpublished].

136 EuroConsult, *Satellites to be Built & Launched by 2021: World Market Survey*, report for EuroConsult (Paris: EuroConsult, 2012).

137 Peter de Selding, "Iran's Claims About Satellite Service Try International Regulatory Regime" (8 April 2011) *Space News* (Washington, DC: 2011).

spectrum is inadvertent, but it is not difficult to frustrate any effective use by a State of its satellite through deliberate interference. The US National Space Policy overtly emphasises protection of its interest in use of the RF spectrum against purposeful interference, but also emphasises the need for a stable regulatory system and for cooperation to identify sources of interference.[138]

As the space domain becomes more congested – with active satellites, rockets, the occasional rogue (out of control) satellite, spacecraft carrying tourists (such as Virgin Galactic and others), and natural and artificial space debris – managing the traffic in space becomes increasingly complex. This is exacerbated by the growing problem of space debris.

Ever since Sputnik, outer space has been littered with discarded rocket bodies, old satellites, astronaut gloves and the detritus from collisions between objects. In addition to the approximately 1,100 active satellites, there are more than 21,000 pieces of space debris that can be tracked (larger than 10cm in size in LEO) and 100,000s of pieces that are too small to track, but which are still capable of destroying or severely damaging a satellite.[139] This is in addition to the natural threats from the harsh space environment, including asteroids. From the beginning of 2010 to mid-2011, government and commercial satellite owners/operators have had to reposition their satellites more than 100 times in LEO just to avoid the debris that China created in 2007 with the destruction of one of its satellites in an anti-satellite-weapon test. This has included closes miss on the ISS.[140] The problem could get worse with the growing popularity of small satellites. Space weaponisation could also increase space debris. One solution may be to harden satellites, although avoiding space debris altogether would be better.

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138 White House, *National Space Policy*, *supra* note 68, 3, 9.

139 NASA Orbital Debris Program Office, *Orbital Debris Frequently Asked Questions* (webpage accessed on 12 August 2013) <http://orbitaldebris.jsc.nasa.gov/faqs.html #3>

140 Frank A Rose, "Defining Space Security", *supra* note 74.

In addition to the problem of space debris in space itself, objects returning to Earth present a threat terrestrially. On average, one piece of space debris falls to Earth every day.[141] While these objects rarely pose a threat, it is not always obvious whether an object streaking towards your territory is space debris, or an incoming missile.

Space Situational Awareness (SSA) can potentially help with all the challenges of congestion. It involves not just keeping track of satellites, but also keeping track of use of the electro-magnetic spectrum. It means that a State can launch a satellite or a tourist spacecraft with greater confidence that it is not going to collide with debris or another satellite. It can provide warnings to satellite operators of an impending collision, in order that they can move their valuable satellite. The US has the most comprehensive SSA network, followed by Russia and the EU. The US shares its SSA data, subject to some restrictions, with select countries, including Australia and France. It also makes its SSA data available to the private sector, through the Space Data Association (SDA). However, the data provided to SDA is incomplete – the US deliberately excludes select national security satellites, presumably accepting responsibility itself for ensuring that these satellites are not involved in any collisions.[142]

2.2.2.2 Competitive

As more States become engaged in the use of outer space, there is greater economic competition for the elements necessary for profitable supply of space-based services: the best orbital positions, frequency allocation, technology, knowledge, skilled labour, launch vehicles and launch windows. Competition is positive on the one hand, because it drives down

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141 NASA Orbital Debris Program Office, *Orbital Debris Frequently Asked Questions* (webpage), *supra* note 139.

142 Patrick M Schwomeyer, *SSA sharing law*, *supra* note #. See also, "Accord franco-américain pour surveiller les débris spatiaux," *Le Monde,* 8 February 2011. SDA was established to improve the safety and proficiency of space operations, providing a proximity assessment for more than 60% of all operational satellites in geosynchronous Earth orbit. "SDA Now Performs Conjunction Screening for More than 300 Satellites," Space Daily, 24 January 2011.

costs and forces greater resource efficiency and provides redundancy and resilience in the space sector. However, it is also a potential source of tension between States. There is some inequity in that developing States are following the path of developed States only to find that the best of everything has already been secured by the developed States and they are not sharing. Furthermore, the developed States create extra 'hurdles', apparently for reasons of national security, by, for example, limiting the flow of technology and expertise.[143] Sometimes the protection of domestic industry can be more overt, but still linked to national security, such as where US domestic legislation requires the US government to use commercial enterprises for launch services and space-derived imagery – specifically US commercial enterprises.[144] The justification is that indigenous capacity in these services is essential to the security of the nation and ownership and control must be maintained domestically.

2.2.2.3 Contested

This chapter has previously established the many strategic benefits that may be derived from space, especially in the military sector. Any State with space-based infrastructure would prefer to enjoy those benefits uncontested. Unfortunately, this is not the case.

Space support and the terrestrial domain

The majority of modern, terrestrial weapons platforms (ships, aircraft, tanks) have a direct space dependency. In many cases this is for positional and navigational data, but also such weapons platforms are increasingly networked, relying on satellite communications to link with other platforms, in the same and other domains, with sources for intelligence, surveillance, tracking, acquisition and reconnaissance (ISTAR) and with command and control systems. In the future, this could include space-based

143 Megan C Ansdell, Laura M Delgado & Daniel B Hendrickson, "Emerging Space Nations", *supra* note 135.

144 White House, *National Space Policy*, *supra* note 68, 10 – 11.

solar power generation. In theory, there is no reason why military space-based systems for GNSS, ISTAR, environmental monitoring, missile warning and space-based solar power generation from many different States cannot co-exist, subject to the challenges of congestion and competition. Similarly, the means to deploy and sustain (space lift, satellite operations, SSA and reconstitution) of many different States, should be able to co-exist, again, subject to the challenges of congestion and competition.

However, in the first place, those two challenges cannot be easily assumed-away. Secondly, the development of space-lift capabilities is very similar to the development of ballistic missiles – as demonstrated by the global reaction to North Korea's putative satellite launch in January 2013. Similarly, capabilities for the control of a State's own satellites – from Earth and in space – can potentially be used to interfere with another State's satellites. Thirdly, some elements of SSA can be used to cue interceptor missiles onto their target.[145] Finally, and perhaps most fundamentally, is it realistic to expect that a State, in the midst of a major conflict, would not seek to deny its adversary the significant benefits that the adversary derives from its space-based infrastructure?

Electro-magnetic interference and directed energy weapons

Several States expressly eschew any 'weaponisation' of space in their doctrine. However, there are nuances on the meaning of 'weaponisation'. For example, Russia and China have repeatedly advocated for a ban on 'space weapons', yet they both have capabilities for electro-magnetic interference with satellites and for the use of directed energy against satellites and China has allegedly used lasers against US spy satellites. The US overtly has counter-space doctrine that includes, among the resources for Offensive Counter-Space operations: EW, network warfare (cyber warfare) and

145 "Aegis Ballistic Missile Defense Intercepts Target Using Space Tracking and Surveillance System-Demonstrators Data", *supra* note 55.

DEWs.[146] The obvious advantage of these sorts of capabilities (whether labelled 'weapons' or not)[147] is that they are less overt than kinetic-energy weapons and less attributable.

States can 'harden' their space infrastructure to make it more survivable against deliberate, non-kinetic activities to deny them use of their space capabilities, as well as against natural threats. The US, Russia and other States have considered and implemented a wide range of options for resilience.[148] This is a positive step, because it reduces the pressure to escalate – instances of minor interference can be tolerated and dealt with at a diplomatic level.

Active, space-based defence and offence

However, not all means of hardening are purely defensive. Consider, for example, the US Joint Space Protection Program, which is a joint program within the Department of Defense to develop options to actively respond to threats to national security space infrastructure.[149] There is some suggestion that an experimental and highly-classified spacecraft is a part of this program. A 2006 edition of USAF doctrine referred to a 'common aerospace vehicle' (CAV) as a future space system to "deliver combat effects to terrestrial and space targets".[150] The X-37 Orbital Test Vehicle (OTV) is a USAF technology demonstrator and experimental, reusable, space-launch vehicle that has been deployed in orbit for long, but undisclosed missions on a number of occasions.[151] It would appear to fit the description of the CAV.[152]

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146 *AFDD 3-14.1 Counterspace Operations supra* note 35, 33 – 35.

147 Duncan P Blake & J Salvatore Imburgia, " 'Bloodless Weapons'? The Need to Conduct Legal Reviews of Certain Capabilities and the Implications of Defining them as 'Weapons'" (2010) 66 AFL Rev 157.

148 Cesar Jaramilo, ed, *Space Security Index 2012, supra* note 19, 129 – 136.

149 United States, Department of Defense, *Space Protection Program - 2012 Budget Bid Justification* (February 2011) (Washington, DC: Congress, 2011) (Secretary of Defense: Robert Gates).

150 *Space Operations supra* note 35, 32. See also United States, Senate, Committee on Armed Services, "Strategic Forces", *Department of Defense Authorization for Appropriations for Fiscal Year 2009*, 110, 394 (1 April 2008) (Michael Vickers) (Chair: Carl Levin) where it is mentioned as a potential 'prompt global strike' capability.

151 Sharon Weinberger, "X-37B: Secrets of the US military spaceplane", *supra* note 84.

Weapons from space are regarded as unfeasible at present.[153] Furthermore, US military doctrine on the space force application mission area is not very detailed,[154] reflecting not just the sensitive nature of these types of missions, but also that fact that the US, like all states, has no assets to support these missions[155] – with the possible exception of the X-37. Furthermore, like other satellites, they would themselves be vulnerable to attack by a variety of means and for this reason, have sometimes been regarded as a 'first-strike' weapon encouraging pre-emptive attack.[156] In spite of this, there are strategists who would like to see this situation change – they would especially like to see space-based ballistic missile defence.[157]

Ballistic missile defence

The procurement or development of ballistic missiles with a trajectory through space by one State undoubtedly leads to some contest with other States, but it might be said that the contest need not necessarily extend to the space domain itself. Yet, it would be somewhat disingenuous to say so. Fundamentally, a conflict in which ballistic missiles are being launched by States against one another is, in all likelihood, a conflict of national survival and, quite probably, one in which the survival of the whole human species is at stake. At that time, if there is a possibility that the conflict could be ended by extending the contest to the space domain, then that possibility should be considered. Space is integral to ballistic missiles, not just because they have a trajectory through space, but because space-based missile warning and ballistic missile defence (BMD) systems – that intercept

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152 Walter Pincus, "Pentagon Has Far-Reaching Defense Spacecraft in Works" (16 March 2005) *Washington Post* (Washington, DC: Washington Post, 2005).

153 David Wright, Laura Grego & Lisbeth Gronlund, *Physics of Space Security*, *supra* note 18.

154 There are just four lines at *JP 3-14—Space Operations supra* note 35, II-10.

155 Brian C Tichenor, ed, *Space Primer, supra* note 39, 142. Apparently, the Russians deployed a Nudelman air-to-air cannon on Salyut-3!

156 Zhang Hui, "China's ASAT Capabilities: As a Potential Response to US Missile Defense and 'Space Control' plans," in Panel on Weapons in Space, *Ensuring America's Space Security*, report for the Federation of American Scientists (October 2004).

157 See, for example, Independent Working Group, *Missile Defense, the Space Relationship & the Twenty-First Century*, *supra* note 98.

ballistic missiles in the mid-course or space phase – are corollaries to ballistic missiles themselves. It is difficult to account for all the ballistic missiles throughout the world and the systems already in existence or being developed to defend against them. For the purposes of this thesis, it will suffice to observe that ballistic missiles and BMD systems are prolific.[158] In respect of the latter, the proliferation of BMD systems is partly because it is an express policy of the US to make its systems available to allies in order to build an effective, global shield.[159]

On the one hand, effective, rival, national missile defence shields could change the paradigm from mutually-assured destruction (MAD) to mutually-assured survival. This assumes, though, that BMD systems of potential adversaries are symmetrically-effective. However, there are no longer two, diametrically-opposed nuclear powers – nuclear weapons have proliferated more widely. Furthermore, Russia argues that the establishment of a global US BMD shield would entirely negate the MAD doctrine of the Cold War and leave the US in the position of being able to act with impunity – without balancing by any other power. This is especially the case if the US is successful in developing CGPS – able to strike anywhere on Earth within 60 minutes with a low collateral damage, kinetic energy weapon.[160]

There is the additional issue that BMD, whether space-based, land-based or sea-based, is contrary to the idea of space as a sanctuary. This applies to land-based and sea-based BMD because they are also an ASAT capability.[161]

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158 See the Wikipedia entry on 'ballistic missile defence'.

159 United States, Deparment of Defense, *Ballistic Missile Defense Review* (1 February 2010) (Wasington, DC: Government Printiing Office, 2010) (Secretary of Defense: Robert Gates), 12 – 13, 34. See also *Ballistic Missile Defense Policies and Programs*, *supra* note 123.

160 Wu Riqiang, "Global Missile Defense Cooperation and China" *supra* note 124.

161 Mark A Gubrud, "Chinese and US Kinetic Energy Space Weapons and Arms Control" *supra* note 96.

Kinetic energy anti-satellite weapons

Thus, every State that has a BMD system on its soil (whether developed indigenously or provided by another State), effectively has an ASAT capability. Apart from BMD systems, Russia and the US developed specific kinetic energy ASAT missiles in the late 1970s and early 1980s. For some time they were alone in possessing this capability, but in 2007 the Chinese demonstrated their system when they destroyed one of their own weather satellites, thereby creating a large and enduring cloud of space debris. Subsequently, the US re-asserted its capability in 2008 when it used an SM-3 missile, launched from a warship, to destroy one of its satellites – in that case, all of the space debris had apparently, entirely de-orbited within six months of the event.[162] Then, in 2009 a defunct Russian satellite, Cosmos 2251 collided with an Iridium satellite, causing another large and enduring cloud of space debris, suggesting that any satellite can be used as a co-orbital ASAT, even if this was not the intent of Russia. Subsequent to these events China has continued to develop its ASAT capability and has again tested its missile (this time without creating any debris).[163] India has also begun to develop an ASAT capability.[164]

2.3 Strategy and law

The idea of a relationship between the law and strategy is not given much specific attention in the literature. The law is rarely considered, for example, as a contributor to the national power of a state.[165] Yet there are many ways in which it can contribute to national power.

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162 Jesse Oppenheim, "Danger at 700,000 Feet: Why the United States Needs to Develop a Kinetic Anti-Satellite Missile Technology Test-Ban Treaty" (2013) 38 Brook J Int'l L 761, provides an historical account of ASAT weapons at 775 – 80.

163 Joan Johnson-Freese, "China's Anti-Satellite Program: They're Learning" (blog entry on 12 July 2013) *China US Focus*, online: China US Focus <http://www.chinausfocus.com/peace-security/chinas-anti-satellite-program-theyre-learning/>.

164 Arvind K John, "India and the ASAT Weapon" *supra* note 95.

165 Some commentators do discuss the law in the context of discussions about national power, but in the view of this author, the concept deserves far greater attention than

- The law can coordinate other elements of national power. Consider a law that integrates the diverse objectives inherent in the establishment of commercial space launch services: (1) development of the state's physical infrastructure for commercial as well as (2) potential military purposes, (3) development of the population's technical expertise, (4) 'export' of launch services for commercial reasons while (5) maintaining national security and (6) maximising the state's geo-strategic location without (7) endangering international relations through over-flight. The strategic challenges facing the space domain involve complex interaction of different elements of national power and the law is an appropriate means to coordinate those various elements to address the challenges.
- The law can constrain and shape one's own national power, as well as the national power of other states. Those legal constraints may be imposed externally (such as arms control treaties) or they could be internal. For many (especially realists), a State should never willingly constrain its strategic options and a law that does so is a law that may be exploited (consider the possible Chinese strategy of 'unrestricted warfare' that seeks to exploit the legal sensitivity of western nations).[166] However, sometimes internal constraints may be an integral part of a coordinated approach to achieving grand strategic ends (such as internal implementation of nuclear strategic agreements and arrangements by the US and the former USSR).
- The law can be used to preserve or enhance other elements of national power (such as protectionist trade laws, cultural protection

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the relevant literature accords to it. However, a comprehensive analysis is beyond the scope of this thesis.

166 Qiao Liang & Wang Xiangsui, *Unrestricted Warfare*, translated by CIA's Foreign Broadcast Information Service (Beijing: PLA Literature and Arts Publishing House, 1999).

laws or laws on national security restriction on the sale of commercial remote-sensing imagery[167]).

- It can be used to create norms of state behaviour, 'triggers' or 'bright lines' that may not be crossed by States without risking a potentially devastating response (such as the *Anti-Ballistic Missile Treaty*). Such norms reduce the information asymmetry between States and enhance the credibility of commitments by States (whether to undertaken certain activity that is a legitimate response to the breach of a norm, or to refrain from certain activity that would be a breach of a norm), so that resolution of disputes by negotiation (rather than by force) is more possible. Given the current strategic challenges in the space domain, norms of responsible State behaviour seem particularly important.[168]
- It can be used to enhance 'soft power', by building on an existing foundation of a reputation for legitimacy, to set the international agenda or frame the international debate consistent with the State's own national interests. Using power smartly ('smart power'), a State can define the terms used to determine the legitimacy of other states' actions. [169] For example, if the US were to assert a developing legal norm against the creation of long-term space debris, it could concurrently isolate States that have, or may consider options

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167 See, for example, *Remote Sensing Space Systems Regulations*, SOR/2007-66 (Can).

168 "The discussion of space and security is still tied to terms used to discuss nuclear weapons, at least within Indian policy circles. So when one talks about 'responsible space behavior,' the Indians look at it from a proliferation perspective: their take is that since no one is proliferating space technology unduly, no one is acting irresponsibly. Alternatively, they raised the idea several times that, outside of the Chinese ASAT test, no one has acted irresponsibly in space since the Cold War ASAT tests held by the United States and the then-Soviet Union. This logic brings home the need for the international community to develop some sort of accepted definition of what responsible space behavior is, and why it helps space powers like India to be part of that discussion." Victoria Samson, "India and Space Security" (9 May 2011) *The Space Review* (nc: edited by Jeff Foust, 2011).

169 Joseph S Nye, *The Future of Power* (New York, NY: PublicAffairs Books, 2011), 82. "Legitimacy is a power reality. Competitive struggles over legitimacy are a part of depriving or enhancing of soft power, and this is particularly true of the information age of the twenty-first century."

creating long-term space debris, undermine those States' national power and bolster its own reputation for legitimacy. thereby garnering international support.

- The law can maintain the order necessary to the integrity of the State as well as the social cohesion that comes from the sense that the laws of the State and their application generally provide just outcomes.[170] Warfare against such a State is more formidable, because the people, the government and the military (Clausewitz's trinity) are relatively unified.
- The legitimacy of a State, its order, stability and the expectation of generally just outcomes can 'attract' other States and non-State actors to the first State's territory, to its values and to its causes. Rules have co-optive power. Any contest involving that State is less likely to become warfare.

There is often a lot of cynicism about whether the law actually works in international relations – frequently, cynics refer to the fact that rules are often broken and there are few consequences. However, there are four important factors that need to be considered. First, the impact of the law is often in terms of actions not taken, as opposed to actions that are taken. It is far more likely that government officials would record the reasons for deciding to take action, than that they would record the reasons for deciding not to take a certain action. Thus, if a government official dismisses a course of action because of a rule of international law to the contrary, there is unlikely to be a record of that decision. Many such decisions are so unremarkable that they just don't draw much attention. It is therefore difficult to show how often the law works. Secondly, when a rule is broken, if the rule-breaker is widely criticised by reference to the rule, it tends to reinforce the existence of the rule and the expectation that States will comply

170 *Ibid*. Again, to use the language of international relations theory and 'smart power', the law has co-optive power. It is not that people are coerced into obeying the law, but that they make a preference to obey the law, because doing so provides order, stability and an approximation of justice in the context of social interaction.

with it. Thirdly, even if the State suffers no more than criticism initially, such criticism often coalesces into adverse United Nations resolutions authorising economic action or even force against it, into coalitions against it, into less favourable trade terms, lack of credibility in international negotiations, difficulty sourcing military equipment and bases and so on. Rule-breaking can and frequently does have painful consequences. Finally, the lack of such norms can cause some strategic paralysis in strategic decision-making in that it can be difficult, without such norms, to definitively settle on a justifiable response. It is even more difficult within a coalition of States than it is wholly within a State.

None of this works effectively though, if a rule is open to wide interpretation, if its application to the circumstances is uncertain, if the rule is not widely accepted, or if compliance and non-compliance with the rule (and its application in the circumstances) is not readily amenable to verification. It must be conceded that international law is somewhat 'malleable'. It is malleable in the sense that it is within the direct power of States to make the law. Internally, the State is the law-maker and externally there is no real over-arching legislature to confine the treaties into which it may enter. Neither is there much in the way of limits analogous to the constitutional limits on law-making within a State. Any existing international law that might confine the State is susceptible to wider variance in interpretation than domestic law, because it is generally expressed in less concrete terms, because there are a wider range of sources from which to draw than domestic law, thereby creating greater complexity in the potential interpretation, and because there is only very limited judicial interpretation available to clarify international law. Furthermore, a central precept in international law is the sovereignty of the State and it follows from this precept that what is not prohibited is permitted,[171] although there is

[171] *France v Turkey (SS Lotus)* [1927] PCIJ (ser A) No 10, 18.

considerable disagreement over the extent to which a State can be restrained by implied limitations.

This 'malleability' may seem inconsistent with a naturalistic ideal of law as humanitarian, universal and a reflection of international and inter-generational equity. That the law is an expression of the will of the sovereign should not be a surprise, nor should this reality be necessarily thought of as inconsistent with such ideals. These ideals often do form at least some part of a State's policy on the law it wishes to develop or the interpretation it adopts (a constructivist perspective), even if it is just the rhetoric that accompanies a State's position (the realist's counter). Political dicta that start as mere dicta often consolidate into laws that are closer to the ideal, especially where the ideals are the common ground between States, rather than their narrow national interests (a liberal perspective). Civil society is a growing influence in binding States to their political dicta. This is part of what is sometimes called 'the secret life of international law' and describes, in a practical sense, how State practice becomes customary international law through *opinio juris*. Strategy unarguably also has a strong normative element to it – military personnel are notorious for fastidiously setting and applying norms, rules, orders, directions, procedures and so on. There is a normative element within strategy and this can be reflected in the law and enhanced by it. Furthermore, an order or system that allows States to largely control their obligations to other States individually or collectively is an order that states can accept,[172] and with this order as a foundation (a liberal realist perspective),[173] states can then pursue higher ideals, on their own initiative

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172 Scott Burchill et al, *Theories of International Relations*, 3rd ed (London: Palgrave, 2005), 93 – 98.

173 Lassa Oppenheim, *International law: a treatise* (London: Longmans Green and Co., 1905), 73: "An equilibrium between the various powers which form the family of nations is, in fact, essential to the very existence of any international law. In the absence of any central authority, the only sanction behind the code of rules established by custom or defined in treaties, known as 'international law', is the capacity of the powers to hold each other in check. If this system fails, nothing prevents any state sufficiently powerful from ignoring the law and acting solely according to its convenience and its interests."

or with the considerable pressure from others. As a matter of practice, rather than theory, a rule that is widely accepted and therefore effective, is a rule that is reflective of the interests of States (whether those interests are purely unilateral or the common ground between States or heavily influenced by civil society).

There are limits, though, on the 'malleability' of the law. States will sometimes try to stretch the limits of a rule through disingenuous exceptions, but international condemnation often follows to the extent of the State's disingenuousness and this is increasingly the case with the growing influence of civil society. The fact of the condemnation, as well as the State's attempt to justify their breach by reference to some supposed legal exception, both serve to reinforce the authority of the law. Such breaches are the exception and States do generally comply with the law.[174] However, condemnation is less likely and, if it occurs, will have less impact, where the rule is uncertain and in that case, if the subject State refers to the rule at all, it is less likely to be making exceptions and more likely to simply formulate the supposed rule in its favour.

2.4 Conclusions

Space is not a sanctuary in spite of many compelling reasons why it might be better if it were. Humanity's reach into outer space was born of strategic competition as much, if not more, than any other motive. That concept is reflected in the first and continuing uses of the space domain. This chapter has described the strategic advantages that have already, and may in future, be derived from space-based infrastructure – in the military, civil and commercial sectors. In a future conflict or in anticipation of it, any State with the capacity to do so will consider what it can do to neutralise the strategic advantages that its adversary derives from space-based infrastructure.

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[174] John Baylis, James J Wirtz & Colin S Gray, eds, *Strategy in the Contemporary World: An Introduction to Strategic Studies*, 3rd edn (New York: Oxford University Press, 2010) 110.

States have not deliberately set out to undermine the concept of space as a sanctuary, nor to start an arms race. The contested nature of the domain arises inadvertently, because of information asymmetry, fear and a failure of credibility. States, reasoning logically from the foundations of their strategic culture, have developed capabilities that other States, also reasoning logically from the foundations of their strategic culture, perceive as a threat (at least potentially, if not actually), regardless of what the first State may say about the defensive nature of its capability.

In contrast with the contested nature of the domain, the strategic challenges of congestion and competition may seem strategically benign. Yet, limited orbital slots and associated frequencies, collisions creating further space debris and inequities in access to space and its advantages are all sources of significant strategic friction.

Given these challenges, the idea of one responsible State holding the ultimate high ground and bringing order and regulation to the domain may seem attractive, but which State would the international community passively accept as appropriate to fulfil that role? The pursuit of such dominance is likely to accelerate the path to war and even if it were achievable, it is a state of affairs that very few other States would be willing to accept. The technologies to support a high ground approach to outer space are decades away at best.

The extent of military (and civil and commercial) dependence on space is so significant that it is unrealistic to think that space-based infrastructure would not be a target in the event of a conflict. Furthermore, space is a domain of technology, most of which can be used to achieve military strategic ends. Technology contributes to ease of conquest and gives an advantage to he who strikes first. The advantages derived from space-based infrastructure are also technological in nature and ubiquitous throughout society, contributing to our communications and the convenience and efficiency of our everyday lives. Warfare in the space domain is likely to affect a lot of people a little, rather than a few people a lot. Yet it is out-of-

sight for most people and hostile activities in the domain, especially of a non-kinetic nature, can be difficult to attribute to a particular State. Furthermore, a State can maintain political rhetoric opposing weaponisation in the domain, while developing such non-kinetic or terrestrially-based capabilities. For all these reasons outer space commends itself to the strategic interests of States as a domain for hostile activities. Enhancing the survivability of satellites may counter this trend to some extent, but it would only ever be a partial solution.

Finally, the space control approach to coordinating effort and resources in the space domain would likely exacerbate the arms race. This, in turn, spirals towards conflict because of a level of paranoia between States, in addition to being a huge waste of resources. Given the global factors providing impetus towards conflict and their current prevalence, there is a real danger of warfare in the space domain – something that is unlikely to be in the interest of any State, even the State initiating hostilities in the space domain.

An adequate legal framework for the space domain could improve the strategic calculus. Widely accepted, authoritative, unambiguous, verifiable norms of responsible behaviour applicable to the decision to use force and to the conduct of hostile activities in the space domain would restrain the recourse to force in the first place and ameliorate the consequences if space warfare does happen. Furthermore, compliance can be effectively enforced where consequences are an integral part of the norm, where the norm and the consequences broadly reflect the strategic interests of States (regardless of how such strategic interests came to be realised) and where States themselves are the enforcers of the norms. If the space domain is subject to such an international order, then States can make credible commitments based on concern for their own legitimacy, act with greater certainty about the activities of other States and move towards a paradigm in which the all the benefits derived from space can be realised cooperatively.

Does the current legal framework for outer space meet these ideals?

3 Legal framework for the use of outer space

Pursuant to Article III, *Outer Space Treaty* (OST),[175] State Parties are to carry on their activities in outer space in accordance with the whole corpus of international law, including (expressly) the *Charter of the United Nations*.[176] It is clear then, in spite of what the developments of the previous chapter might suggest, that outer space is not a wild, lawless, new frontier. Neither is it a sanctuary. Nevertheless, notions of outer space as the ultimate high ground and outer space as a sanctuary, and notions in between, influence the laws applicable to the space domain. This chapter will examine those laws, especially in the context of the initiation or conduct of hostilities. In addition to LOAC itself (the final section), this includes the treaties specific to the space domain (the first section) and some 'legal' measures intended to prevent conflict in outer space from occurring at all (the middle section).

3.1 Foundational principles of space law

There are four well-subscribed treaties specific to activities in outer space and none of them deal, in any depth, with the development or use of weapons of the space domain. The four treaties are: OST, *Rescue and Return Agreement* (RRA),[177] *Liability Convention* (LC)[178] and *Registration Convention* (RC).[179] There is a fifth multi-lateral treaty specific to the space domain, the *Moon Agreement* (MA),[180] but only 15 States have ratified it[181] and therefore its terms could not be said to represent widely-accepted principles of law. It

175 *Outer Space Treaty*, *supra* note 1.
176 *UN Charter*, *supra* note 9.
177 *Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space*, 22 April 1968, 672 UNTS 119, [1986] ATS 8 (entered into force 3 December 1968).
178 *Convention on International Liability for Damage Caused by Space Objects*, 29 November 1971, 961 UNTS 187, [1975] ATS 5 (entered into force 29 March 1972).
179 *Registration Convention*, *supra* note 22.
180 *Agreement Governing the Activities of States on the Moon and other Celestial Bodies*, 18 December 1979, 1363 UNTS 3, [1986] ATS 14 (entered into force 11 July 1984).
181 For ratification information on the space treaties, see United Nations Office of Outer Space Affairs, *Status of International Agreements relating to Activities in Outer Space* <http://www.unoosa.org/oosa/SpaceLaw/treatystatus/index.html>.

is more convenient to deal with these treaties by principle, rather than by treaty.

All States are free to use and explore outer space (including celestial bodies), provided that they do so without discrimination and in accordance with international law (Art I, OST). States' activities in outer space are expressly limited by reference to international law, including the *Charter of the United Nations* (Art III, OST), although there is not currently a lot of clarity about how the broader corpus of international law applies to outer space, especially in the context of hostilities.

States' activities in outer space are also to be undertaken "in the interest of maintaining international peace and security" (Art III, OST) and this concept is often more widely expressed as a requirement to use space for peaceful purposes. The wording leaves open significant debates about the extent to which weaponisation is consistent with international space law. At one extreme there are those who insist that any military presence in outer space is inconsistent with international space law. At the other extreme there are those who insist that international space law expressly supports any action, even hostile action provided that it is in accordance with the *Charter of the United Nations* and "in the interest of maintaining international peace and security" (thus, acting under a UN mandate or in national self-defence or generally in a non-aggressive manner is permissible).[182]

The *Outer Space Treaty* does specifically mention weapons, but only to say that weapons of mass destruction (as opposed to other sorts of weapons) cannot be placed in orbit, installed on celestial bodies or otherwise stationed in space and also to say that the testing of any type of weapon, as well as military "bases, installations and fortifications" and manoeuvres on celestial bodies are forbidden. However, military personnel (including the equipment and facilities used to sustain and protect them) may be used incidentally, as necessary for scientific research and peaceful exploration

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182 For an excellent discussion of the issue, see Bin Cheng, "Peaceful purposes" *supra* note 4.

(Art IV, OST). Thus, it appears that weapons that aren't WMDs are permissible in void space, WMDs may transit through void space, so long as they don't achieve orbit,[183] and any weapons of any nature are permitted on celestial bodies, provided that they aren't there to be tested, they aren't associated with "bases, installations and fortifications", but rather they are used incidentally for peaceful purposes, including exploration.[184]

This should, however, be read in conjunction with a somewhat ephemeral concept of equity that pervades all of the space treaties and non-legally binding instruments.[185] Space is "the province of mankind", for "use by all States without discrimination of any kind, on the basis of equality" and "for the benefit and in the interests of all countries, irrespective of their degree of economic or scientific development" (Art I, OST). A degree of controversy exists about what this 'equity' practically requires and this controversy is largely responsible for the low rate of ratification of the *Moon Agreement*, with its reference to space as the "common heritage of mankind" and to "equitable sharing" of the benefits derived from the resources of celestial bodies. Regardless of this controversy, it appears that a State whose military activities (including development and use of weapons) in outer space are not conducted "on the basis of equality" and "for the benefit and in the interests of all countries" (whatever those phrases mean), would be acting unlawfully.[186]

No part of outer space can be appropriated by a State, or any other entity, whether such purported appropriation is by claim, use or occupation (Art II, OST). That is not to say that a part of space cannot be occupied to the

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183 *Ibid*, 98-99.

184 This interpretation is consistent with decisions of the International Court of Justice concerning the freedom and sovereignty of States specifically with respect to weapons in *Nicaragua v United States (Military and Paramilitary Activities in and against Nicaragua)*, Merits [1986] ICJ Rep 14, 135 and *Legality of the Threat or Use of Nuclear Weapons Case*, Advisory Opinion [1996] ICJ Rep 226.

185 See, for example, Preamble and Art I, OST; Preamble and Art XII, LC; Preamble and Art VI, RC; Preamble and Arts 4, 6, 11, MA.

186 See generally Ram S Jakhu, "Legal Issues Relating to the Global Public Interest in Outer Space The Vision for Space Exploration: A Dedicated Issue" (2006) 32 J Space L 31, and especially 87-88.

exclusion of others – it may – but the party doing so cannot ground their right to do so in proprietary interests.[187] There must be some other basis.[188] Conversely, samples of material removed from celestial bodies may be the subject of proprietary interests.[189] Furthermore, proprietary interests established in space objects and their component parts before they are launched into space are unaffected by their subsequent launch and presence in space and return to Earth. Jurisdiction and control over space objects is a little more complex. A State that launches, procures the launch or from whose territory or facility a space object is launched naturally has a degree of jurisdiction and control over the space object prior to launch. This might describe more than one State. However, the State that subsequently registers the space object (there may be lawfully only one) formally retains jurisdiction and control of the space object once launched, notwithstanding that there might be supplementary agreements concluded between States involved in a launch on the question of jurisdiction and control (Art VIII, OST and Art II, RC).

That scheme for jurisdiction and control extends to "personnel of a spacecraft" (Art VI, OST, Art II(2) RC and RRA generally), although there is nothing in the space law instruments that affects their nationality. 'Astronauts' enjoy a special status as "envoys of mankind" (Art V, OST), but the consequences of that status are unclear and it is equally unclear whether 'astronauts' and "personnel of a spacecraft" are entirely synonymous. Whatever their status, pursuant to the RRA, States are obliged to render assistance to them when they are in distress, including rescuing them, notifying the UN and the launching authority and cooperating where practical. Astronauts are to be returned to the State of registry of their parent spacecraft, whereas personnel are to be returned to the "launching authority" – that term is not well defined. Astronauts also enjoy the protection of an

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187 Francis Lyall & Paul B Larsen, *Space Law: a treatise* (Farnham, UK: Ashgate, 2009), 184.

188 Such as scheme for allocation of orbital slots established by the member States of the International Telecommunications Union under the *Radio Regulations*.

189 Francis Lyall & Paul B Larsen, *Space Law: a treatise*, *supra* note 187, 188.

obligation on all States to provide proactive warning of any danger and, furthermore, astronauts are obliged to render one another assistance, where possible, in carrying out even their regular space activities (Art V, OST).

Apart from cooperation with respect to astronauts and personnel, the space treaties express an aspiration of cooperation, more generally, in all aspects of the use and exploration of outer space. The aspiration is manifested in a plethora of provisions about sharing results, providing notification and consulting. Specifically, there is an obligation to pay "due regard to the corresponding interests of all other States" in the use and exploration of outer space. This extends to avoiding harmful contamination and adverse changes to the space and terrestrial environment as a result of space activities. States are also specifically obliged to undertake appropriate, prior consultation with other States if it "has reason to believe that an activity or experiment planned by it or its nationals in outer space, including the Moon and other celestial bodies, would cause potentially harmful interference with activities of other States Parties in the peaceful exploration and use of outer space" (Art IX, OST). This is not to be confused with the obligation of States to avoid harmful interference to other users of the radio-frequency spectrum and to use their allotted frequencies rationally, economically and efficiently as a limited natural resource under the *Constitution of the International Telecommunications Union* (ITU Constitution)[190] and the subordinate *Radio Regulations*.[191] This need to de-conflict use of the RF spectrum is what lies behind the role of the ITU in the allocation of orbital slots to those wishing to place a satellite in orbit.[192]

States that fail to pay due regard to the interests of other States to the extent of actually causing damage may be held liable. The LC defines the liability of a 'launching State' for damage caused by its 'space objects' and

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190 Arts 44 and 45, *Constitution of the International Telecommunications Union*, 22 December 1992, 1825 UNTS 331, [1994] ATS 28, [1996] BTS 24 (entered into force 1 July 1994).

191 Art 1 (1.169), Art 4, Art 15 (Section VI), *Radio Regulations Edition of 2012*, 17 February 2012, WRC-12 (entered into force 1 January 2013).

192 Art 22, *ibid*.

establishes a regime for claiming compensation and settling such claims. The 'launching State' covers States that launch, procure the launch and States whose territory or facilities are used for the launch (Art I, LC) and this equally applies to international organisations (Art XXII, LC). Furthermore, States "bear international responsibility for national activities in outer space … whether such activities are carried on by governmental agencies or by non-governmental entities, and for assuring that national activities are carried out in conformity with the provisions set forth in the [OST]", which would appear to extend States' liability to the activities of its non-State entities (Art VI, OST). This provision on State responsibility is in addition to the effect of the law of State responsibility in this context.[193] However, the scope of the term 'national activities' and the State responsible for them (the 'appropriate State', according to Art VI, OST) is not defined and literature on the topic has not clarified this. Also, the relationship between "responsibility" for the purposes of Art VI, OST and liability is not clear.[194] Once a State is linked to the space object it cannot escape responsibility and liability by simply abandoning a space object, although the link might be severed by a change of ownership (Art VIII, OST) and possibly by transfer of registration to another State (not covered in international space law) or by another State exercising continuing supervision over the space object (Art VI, OST). Otherwise responsibility and potential liability continues in perpetuity.[195]

The foundational principles of space law established in the space treaties may influence the application of law in the context of armed conflict. It is important, though, to be clear about the extent to which the treaties may

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193 See James Crawford, *The International Law Commission's Articles on State Responsibility: Introduction, Text and Commentaries* (Cambridge: Cambridge University Press, 2002).

194 For a good examination of the responsibility of States in the space treaties, see Ronald L Spencer, *Implementing international standards for 'continuing supervision'* (LLM thesis, Institute of Air and Space Law, McGill University, 2008) [unpublished, archived at McGIll University Law Library].

195 These issues are particularly problematic in the context of space debris. See Yaw Nyampong, "Protecting the Environment of Outer Space: Space Law, International Law and the Problem of Space Debris" (Paper delivered at the *Third Authors Workshop, Cologne Commentary on Space Law*, Bonn, 2 June 2012) [unpublished] 11-13.

be suspended on the outbreak of hostilities. Portions of the five space treaties may be suspended between the belligerents for the duration of any armed conflict, at least to the extent necessary for the lawful conduct of the conflict. Obligations to the non-belligerent parties to those treaties will, however, remain. Where the terms of the treaties are clearly at odds with armed conflict and are not specifically meant to survive such conflict, those provisions can be suspended.[196] It is difficult to imagine in advance all the situations that may arise and so it is only possible to consider individual provisions on a case-by-case basis in the context of actual events. Nevertheless, examples of provisions that may be suspended during armed conflict in space could include the current prohibition on the harmful contamination of space, as well as any liability for damage caused by a space activity when that activity was conducted in self-defence.[197]

3.2 'Legal' measures to prevent conflict in outer space

The foundational legal principles were endorsed by the United Nations General Assembly in 1963 following negotiation within the Committee on the Peaceful Uses of Outer Space (COPUOS).[198] This committee was first established informally in 1957 in the wake of the launch of Sputnik and the first intercontinental ballistic missile (ICBM). It was formally established in 1959 and it managed to draft and gain widespread acceptance

196 This is consistent with International Law Commission, *Draft Articles on the Effects of Armed Conflicts on Treaties*, ILC, 63rd Sess, REP A/66/99 (2011). This document identified the modern view that armed conflict does not *ipso facto* terminate or suspend treaties.

197 The is consistent with the doctrine of sovereign immunity in response to claims against a State or its agents for acts done within the scope of the law of armed conflict in the context of an armed conflict; but see Art 91, *Protocol Additional to the Geneva Conventions of 12 August 1949 relating to the Protection of Victims of International Armed Conflicts (Protocol I)*, 8 June, 1125 UNTS.

198 Committee on the Peaceful Use of Outer Space, *Declaration of Legal Principles Governing the Activities of States in the Exploration and Use of Outer Space*, GA, Res 1962(XVIII), 13 December (1963).

of four treaties in its first 17 years.[199] Such a rate of treaty-making is additionally remarkable because these four space treaties, unlike similar treaties in other domains, did not simply codify existing, widely accepted, long standing practices, but rather they created new law. In many cases, the treaties settled on legal rules well ahead of capabilities to give such rules clear application (for example, there is still no current technology sufficient to build military fortifications on celestial objects, but in 1967 this was concept was drafted into Art IV, OST). The rationale for the rash of treaty-making between the 1960s and 1980s lies in the strategic competition between the United States and the Soviet Union. Following the RC in 1976, COPUOS continued to be prolific in its drafting up until the late 1990s, but since 1976 its instruments have either not gained legal status or, in the case of the MA, have only a small number of State parties.[200] Yet, the security challenges of the space domain have now proliferated to more States, along with the weapons of space. As previously mentioned, outer space is increasingly congested, contested and competitive and, perhaps most significantly, these and other strategic irritants could lead to conflict in the space domain, so that resolution of these challenges has become more and more pressing. This section describes some of the legal and quasi-legal efforts by States, through a variety of mechanisms, including COPUOS, to prevent the sort of conflict that would involve the space domain – both existing measures and new measures under serious consideration.

3.2.1 Existing 'legal' measures

For the most part the MA reflects the foundational principles of space law, but elaborated for the Moon. Art 1 extends the provisions of the MA to other celestial bodies in the solar system, their orbits and trajectories

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199 For a short history of COPUOS, see United Nations Office of Outer Space Affairs, *United Nations Committee on the Peaceful Uses of Outer Space: History and Overview of Activities* <http://www.unoosa.org/oosa/en/COPUOS/cop_overview.html>.

200 For an authoritative account of 'law-making' within COPUOS, see Sergio Marchisio, "The Evolutionary Stages of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS)" (2005) 31 J Space L 219.

to or around them. The reference to 'trajectories' is clearly important for ballistic missiles. In respect of the possibility of hostilities in outer space, Art 3 prohibits the threat of or actual hostile acts on or using the Moon and specifically prohibits weapons of mass destruction. In addition to the extensions already mentioned, this also extends to use in the Moon. There are only 15 State parties that are legally bound by these provisions, but it is worth noting that the MA received the endorsement of the UN General Assembly[201] and of all the controversies raised by the MA, the controversy about these terms on hostile use of the Moon is perhaps the least.[202] Thus, there may be some prospect that these could be accepted as customary international law in due course.

COPUOS has also drafted principles on direct television broadcasting, remote sensing, nuclear power sources and international cooperation,[203] all of which have implications for space security. However, while they have been endorsed by the UN General Assembly as principles, they have not been enacted into treaties. Currently, there are many items on the agenda for the Legal Subcommittee of COPUOS with implications for space security,[204] notably space debris mitigation.[205] The ever more challenging congestion,

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201 Committee on the Peaceful Use of Outer Space, *Agreement Governing the Activities of States on the Moon and Other Celestial Bodies*, GA, 89th Plenary Meeting, Res 34/68 (1979).

202 For two accounts of controversies arising from the terms of the MA, see Ram Jakhu, "20 Years of the Moon Agreement: Space Law Challenges for Returning to the Moon" (Paper delivered at the *United Nations/Brazil Workshop on Space Law*, Rio de Janeiro, 22 - 25 November 2004), in United Nations Office of Outer Space Affairs, ed, *Disseminating and Developing International and National Space Law - the Latin America and Carribean Perspectice* (New York: United Nations, 2005) and Michael Davis & Ricky Lee, "Twenty Years Later - The Moon Agreement and Its Legal Controversies" (1999) Austl Int'l LJ 9.

203 See United Nations Office of Outer Space Affairs, *United Nations Treaties and Principles on Space Law* <http://www.unoosa.org/oosa/en/SpaceLaw/treaties.html>.

204 Committee on the Peaceful Uses of Outer Space, *Provisional Agenda*, Legal Subcommittee, 52nd Sess, Agenda A/AC.105/C.2/L.288 (2013).

205 In 2007 the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space adopted the 'Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space' after many years of consideration. They are largely based on the work of the Inter-Agency Space Debris Coordination Committee (IADC) in its 'Space Debris Mitigation Guidelines' and the COPUOS document actually refers back to the IADC. The guidelines were subsequently adopted by COPUOS itself and endorsed by the General Assembly. As the name suggests, the Guidelines are not legally-binding

competition and contest in outer space is broadly recognised, yet COPUOS has not seemed to rise to those challenges as promptly as it has in the past. Perhaps the most significant factor in that regard is the view of many States that security and disarmament issues are not matters for COPUOS, even if they do relate to outer space, but are instead matters for the Conference on Disarmament (CD).[206] States likely feel that, where national security interests are so prevalent, they do not wish to find themselves bound to treaties that are elaborations on the foundational principles of space law, but prefer to start from a broader foundation of State sovereignty and an inherent right of national self-defence.

National security interests predominate in the CD. The CD is, apparently, "the single multilateral disarmament negotiating forum of the international community".[207] It has had some early success with disarmament treaties,[208] including some of relevance to outer space. The *Environmental Modification Treaty*[209] expressly extends to outer space and prohibits "military or any other hostile use of environmental modification techniques having widespread, long-lasting or severe effects as the means of destruction, damage or injury to any other State Party".[210] A predecessor to

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and are stated in relatively general terms. The work of the Legal Subcommittee is focused on national regulatory implementation of the Guidelines. The commitment of States to such implementation and the approach they each take has implications for the national security interests of all space-enabled States. The official version of the Guidelines is: Committee on the Peaceful Uses of Outer Space, *Space Debris Mitigation Guidelines of the Committee on the Peaceful Uses of Outer Space*, GA, 62nd Sess, Annex, A/62/20 (2007).

206 See, for example, Committee on the Peaceful Uses of Outer Space, *Report of the fifty-fifth session*, GA, 67th Sess, Supp 20, A/67/20 (2012), para 45.

207 CD Secretariat, *An Introduction to the Conference* <http://www.unog.ch/80256EE600585943/(httpPages)/BF18ABFEFE5D344DC1256F3100311CE9?OpenDocument>.

208 For example, the *Biological Weapons Convention* and the *Chemical Weapons Convention*.

209 *Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques*, 18 May 1977, 1108 UNTS 151 (entered into force 5 October 1978).

210 Art 1 of ENMOD prohibits military or hostile use of environmental modification techniques having widespread (encompassing an area of several hundred square kilometres), long lasting (lasting for a period of months or approximately a season), or severe effects (involving serious or significant disruption or harm to human life, natural and economic resources, or other assets) for purposes of destroying, damaging, or injuring another State. The parenthetical interpretation of the terms 'widespread', 'long-

the CD was the forum for some of the negotiation of the *Partial Test-Ban Treaty* (PTBT), which bans nuclear tests and other nuclear explosions in outer space, among other places, but not within a State's own territory.[211] The CD was also heavily involved in the *Nuclear non-Proliferation Treaty* (NPT),[212] which limits proliferation of "nuclear weapons or other nuclear explosive devices" rather than "the means of their delivery". However, ballistic missiles are closely associated with nuclear weapons so that the NPT makes the proliferation of ballistic missiles more challenging.[213] Subsequent to these early successes, the CD has been deadlocked, almost invariably failing each year to adopt a programme of work. Nevertheless, States have unilaterally and sometimes cooperatively managed to make significant submissions during CD sessions and taken significant action as a result of discussions in CD sessions. Notably, the draft *Comprehensive Test-Ban Treaty* (CTBT) was submitted to the UN General Assembly by Australia in 1996 in spite of a failure to reach consensus in the CD. If, or when, the CTBT enters into force, it would ban all nuclear explosions, everywhere.[214]

Outside the CD there have been many nuclear strategic bi-lateral treaties and other measures, mostly between the US and Russia (or USSR previously),[215] although, like the NPT, their effect on the regulation of

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lasting' and 'severe' are provided in an understanding of the Consultative Committee of Experts, which is provided in the Annex to ENMOD. Such widespread, long-term or severe effects in space are prohibited in peacetime and in armed conflict.

211 *Treaty banning nuclear weapon tests in the atmosphere, in outer space and under water*, 5 August 1963, 480 UNTS 45, [1963] ATS 26 (entered into force 10 October 1963).

212 *Treaty on the Non-Proliferation of Nuclear Weapons*, 1 July 1968, 729 UNTS 169 (entered into force 5 March 1970). For an account of the negotiation of the NPT, see Bertrand Goldschmidt, "The Neogitation of the Nuclear Non-Proliferation Treaty" 22:3/4 *IAEA Bulletin* (Vienna: International Atomic Energy Agency, 1980).

213 There are currently only five non-parties to the NPT: India, Israel, North Korea, Pakistan and South Sudan. It is unlikely that South Sudan has any objection to the NPT, but the other four States certainly do. Those four States each possess ballistic missiles with a trajectory through space and the real or apparent capability to produce nuclear weapons. The NPT therefore cannot be said to have been effective in respect of those States.

214 *Comprehensive Nuclear-Test-Ban Treaty*, 10 September 1996, UN Doc A/50/1027, [1998] ATNIA 17 (not yet in force).

215 Such as the *Strategic Arms Limitation Treaty* (I and II), the *Intermediate-range Nuclear Forces Agreement*, the *Strategic Arms Reduction Treaties* (I, II, III and 'New'), the *Strategic Offensive Reductions Treaty*, the *Missile Technology Control Regime* and the

potential hostilities in outer space activities has been incidental, effectively limiting the quantity of nuclear-tipped ballistic missiles that might be used as weapons through space. Had the *Anti-Ballistic Missile Treaty* (ABM) continued,[216] it would have restricted the deployment of anti-ballistic missiles (ABMs), including those ABMs that are very similar to ASATs, intercepting ballistic missiles in the 'mid-course' or space phase. It would also have restricted the development, testing or deployment of space-based ABMs. Withdrawal from the ABM allows the US and Russia to develop ABMs and associated systems relatively unrestricted. There is also the *Hague Code of Conduct against Ballistic Missile Proliferation* (HCOC) under which subscribing States are politically bound (not legally bound) to provide transparency in respect of ballistic missiles and space-launch vehicles, including policies, sites, the missiles and vehicles themselves and pre-launch notification and to refrain from providing assistance to other States in the development of ballistic missiles. The HCOC expressly provides that this should not exclude States from utilising the benefits of space for peaceful purposes.[217]

A similar sentiment was recently expressed in another important quasi-legal context outside the CD, specifically in a UN Security Council resolution,[218] the first time that a Security Council resolution has expressly referred to space law in a security context. Given the mandate of the Security Council for the "maintenance of international peace and security"[219] and for

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Wassenaar Arrangement. For a comprehensive list and summary description of all the instruments, see Congressional Research Service, *Conventional Prompt Global Strike and Long-Range Ballistic Missiles: Background and Issues*, *supra* note 18.

216 *The Limitation of Anti-Ballistic Missile Systems Treaty*, 26 May 1972, 944 UNTS 14, 24 UST 1439 (entered into force 3 October 1972, no longer in force due to US withdrawal, effective 13 June 2002).

217 *International Code of Conduct against Ballistic Missile Proliferation*, intergovernmental arrangement between Afghanistan and 131 other states, signed on 25 November 2002, [unpublished, obtained from Austrian Foreign Ministry].

218 *Non-proliferation/Democratic People's Republic of Korea*, SC, 6904th Meeting, Res 2087 (2013).

219 *UN Charter*, *supra* note 9, Art 24.

armaments,[220] this is significant. On the other hand, the General Assembly, through its annual Prevention of an Arms Race in Outer Space (PAROS) resolutions, has recognised the inadequacy of the current legal regime in preventing an arms race in outer space, the necessity of consolidating and reinforcing the regime and the necessity of "further measures with appropriate and effective provisions for verification" in order to "avert a grave danger for international peace and security". The General Assembly has repeatedly called on the CD to establish a working group to negotiate further measures for PAROS.[221] However, as previously stated, the CD has not been able, in recent years, to even agree upon a work programme. In a separate resolution, in 2010, the General Assembly established a Group of Government Experts (GGE) to study transparency and confidence-building measures (TCBMs) for outer space based on the same concerns expressed in the PAROS resolutions.[222] Whereas a working group under the CD might negotiate drafts of further measures, the GGE's mandate is to study TCBMs and presumably to make proposals. The GGE is soon to deliver its report.[223]

3.2.2 Developing new 'legal' measures

The two most significant potential instruments to be considered by the GGE are the draft *Prevention of the Placement of Weapons Treaty* (PPWT) submitted to the CD in 2008 by Russia and China jointly[224] and the *Code of Conduct for Outer Space Activities* drafted by the Council of the European

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220 *Ibid*, Art 26.

221 For the latest General Assembly PAROS resolution, see *Prevention of an Arms Race in Outer Space*, GA, 67th Sess, 48th Meeting, Res 67/30 (2012), especially paragraphs 2, 3 and 6.

222 *Transparency and confidence-building measures in outer space activities*, GA, 65th Sess, 60th Meeting, Res 65/68 (2011). This is the second time that a group of government experts has been established by the UNGA to consider confidence-building measures – the first reported to UNGA in 1993.

223 For an authoritative account of these initiatives, see Paul Meyer, "The Judgement of PAROS: How best to prevent an arms race in outer space" (2012):19 Simons Papers in Security and Development (Vancouver: School for International Studies, Simon Fraser University), especially 14 – 15.

224 CD, China & Russia, *Draft "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT)"* (29 February 2008) CD/1839.

Union in 2008 and submitted to other States for consultation. The latter has more recently been endorsed by non-EU States such as the United States and Australia as a draft for negotiation of a final text, to be known as the *International Code of Conduct for Outer Space Activities* (ICOC).[225] These two potential instruments represent two different approaches to space security and the dangers of hostilities in outer space: (1) the arms control approach involving restrictions on technology that could undermine space security (the PPWT); and (2) the behavioural approach involving restrictions on State behaviour that could undermine space security (the ICOC).

The draft PPWT would prohibit 'space weapons' which it defines as:

> "… any device placed in outer space, based on any physical principle, which has been specially produced or converted to destroy, damage or disrupt the normal functioning of objects in outer space, on the Earth or in the Earth's atmosphere, or to eliminate a population or components of the biosphere which are important to human existence or inflict damage on them;" (Art I(c))

Thus, the PPWT would extend beyond WMD, but would not extend to weapons to space. Placement in outer space includes not only being in orbit or otherwise permanently located in outer space, but also for a section of an orbit (Art I(d)). The PPWT would also prohibit any threat or use of force against an object in outer space, which is defined as 100km above sea level (Art I(a)). It expressly preserves the right of States to use and explore outer space for peaceful purposes under the OST and the right of a State to defend itself under Art 51, *Charter of the United Nations* (Art V). The PPWT does not

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225 EU, Council of the European Union, *Draft Code of Conduct for Outer Space Activities* (9 December 2008) Document No 17175/08. The draft was revised in 2010 – see EU, Council of the European Union, *Revised Draft Code of Conduct for Outer Space Activities* (27 September 2010) Document No 14455/10. The current draft was released coincident with the beginning of formal negotiations on the Code – see EU, Council of the European Union, *Revised Draft International Code of Conduct for Outer Space Activities* (5 June 2012) Document No 1696642/12. There has apparently been further negotiation of the Code, possibly leading to an international conference at which participating States will be asked to formally subscribe to the Code. Further details can be found at European External Action Service, *The EU launches negotiations on an International Code of Conduct for Outer Space Activities* (webpage), (European Union, 2012) online: European Union <http://eeas.europa.eu/non-proliferation-and-disarmament/outer-space-activities/index_en.htm>.

contain provisions on verification, which has been cited by some States as a reason to reject the current draft. There is also concern that it would lead to very technical distinctions about when an object is a 'space weapon'.[226]

In addition to the States of the European Union that proposed the ICOC, several other States have expressed a preference for this less technical, behavioural approach. A Subscribing State under ICOC would accept four broad, politically-binding obligations: to avoid causing damage or destruction to space objects (clauses 4.1, 4.2 and 4.4), to refrain from the creation of long-term space debris (clauses 4.2 and 4.3), to promote respect for existing space law (clauses 3 and 7) and to cooperate with other States (clauses 6, 8–13). Like the PPWT, the ICOC preserves the inherent right of national self-defence (clauses 2 and 4.2). It also recognises that imperative safety considerations may sometimes compel damage or destruction to space objects (clause 4.2).[227] Many non-EU States have not warmed to the ICOC proposal. In part, this appears to be a procedural issue – they were given no part in developing the proposal and feel that the development of the proposal so far has lacked transparency. This, in turn, leads to a fear that the proposal is a 'western ploy' to limit the access of other States to outer space. It potentially limits States' freedom of action, something States might be willing to accept if they could be confident that all States relevant to their space security concerns were similarly limiting their freedom of action. To create that confidence, the ICOC would need to have teeth to enforce compliance – it does not.[228] However, it is important to note that there is a political expectation of domestic implementation of the code, including in respect of non-State entities within the jurisdiction and control of the State, and such domestic

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226 See, for example, CD, United States, *Comments on the draft "Treaty on the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force Against Outer Space Objects (PPWT)"* (26 August 2008) CD/1847.

227 The cited clauses are based on EU, *Draft ICOC 2012*, *supra* note 225.

228 For a good summary of critiques of ICOC, see Rajeswari Pillai Rajagopalan, "The Space Code of Conduct Debate: a view from Delhi" (2012) 6:1 Strategic Studies Quarterly 137.

implementation could give it legal effect domestically and extra-territorially.[229]

A third significant new measure, more practical than legal, is the sharing of space situational awareness (SSA) data. The UN Register of Space Objects[230] does not provide a reliable account of the position of all space objects, because many States have not complied with the RC, because the registration information quickly becomes inaccurate due to space weather effects or other changes and there is no obligation to update the register and because it does not account for space debris. Yet congestion and the risk of collision represents a real danger to peaceful use of outer space. An agreement to share SSA data between States provides transparency and a level of assurance that each State and also third parties are acting consistent with expected and acceptable behaviour in outer space. It may also be an important means of verification in due course, such that sensors contributing to international SSA gain a special status, like 'national technical means' in the context of nuclear strategic agreements, or like UN observer status in the context of peacekeeping operations. The US, which operates the most comprehensive space surveillance network, has signed SSA Statements of Principles with France, Canada and Australia.[231]

3.3 Clarifying the application of the Law of Armed Conflict

In spite of all this effort, Pandora's Box has now been opened and some evils cannot be put back in the box. The development and even demonstration of some capabilities will be perceived as a threat by some States and represent a potential hazard to all States, especially in the context of hostilities. The opportunity to clarify the application of LOAC is now, in a

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229 Duncan P Blake, *Traversing l'Étoile: Domestic Legal Implementation of the European Union draft Code of Conduct for Outer Space* (20 April 2011) [unpublished, on file with the author].

230 United Nations Office of Outer Space Affairs, *Register of Space Objects* (webpage), *supra* note 22.

231 Most recently, see Frank A Rose, "Remarks of United States Deputy Assistant Secretary, Bureau of Arms Control, Verification and Compliance", *supra* note 50.

time of peace, rather than when hostilities have opened. Yet there is sensitivity to the idea of the application of LOAC to outer space, in that recognising such application might legitimise weaponisation and thereby exacerbate the very problem to which the efforts described above have been addressed. Conversely, failing to recognise its application may encourage a 'wild west' approach to outer space in response to perceived threats or actual hostilities from adversaries. This section discusses the application of both *jus ad bellum* and *jus in bello* to outer space. The section provides a snapshot of issues to demonstrate that a lot of questions about if and how LOAC applies to outer space remain unanswered – perhaps dangerously so.

3.3.1 *Jus ad bellum*

The actions of a potential adversary in any domain can, in theory, be characterised against a spectrum of behaviour described by *jus ad bellum* – from international harmony to wars of national survival. Conversely, *jus ad bellum* limits the circumstances and ways in which a State may legitimately react to such behaviour. Thus, a State may act with retorsion to the actions of another State that are merely unfriendly or it may simply take self-help steps to mitigate the effect. Spy satellites are a good example and action by a sensed State to momentarily dazzle such a satellite to prevent it from seeing a sensitive site are probably on the borderline of what is merely unfriendly, as opposed to unlawful.[232]

However, interfering in another State's affairs, violating its sovereignty is unlawful.[233] Any interference or violation of another State's

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232 Consider, for example, the suggestion in 2006 that the Chinese used satellite laser range-finders to dazzle US spy satellites; Anonymous, "Satellite Laser Ranging in China" *supra* note 10. The reaction of US Defense officials suggested that even deliberate actions by China to dazzle a spy satellite for the duration that it passes over China were not a significant concern.

233 It is a foundational principle of international law that all States are sovereign and that no restriction on their sovereignty can be presumed, but the corollary is that no State may interfere in the affairs of another State. See *Lotus case*, *supra* note 171, 18.

sovereignty, even the minor or trivial, is an internationally wrongful act.[234] Pursuant to the OST, States are free to use and explore outer space, even for spying,[235] albeit in accordance with international law, and actions that deprive a State of this freedom would be unlawful, even if they do not involve the threat or use of force.[236] The obvious legal remedy to unlawful interference is to bring an action against the State in an appropriate court or tribunal. There are many reasons why this may not be the preferred course of action (such as delay, not wanting public awareness of a vulnerability, difficulty of enforcing judgement), but perhaps the most significant factor is that States may not want a precedent set on what is unlawful as opposed to merely unfriendly, because they do it too, or wish to do so.

The principles of State responsibility preclude wrongfulness of a response to another State's actions where the response "was the only means of safeguarding an essential interest of the State against a grave and imminent peril".[237] Thus, if a State were unable or unwilling to prevent a station on its territory from jamming another State's satellite, where that satellite was an essential component of the second State's ballistic missile defence system, and in the context of an imminent threat of nuclear attack, then a unilateral act to destroy the station might be in the scope of necessity and, therefore, lawful.

The principles of State responsibility also permit countermeasures – actions taken by one State that would otherwise be unlawful, but not involving the threat or use of force, aimed at bringing the other State back

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234 International Law Commission, "Draft Articles on Responsibility of States for Internationally Wrongful Acts with Commentaries" (2001) II:2 Yearbook of the International Law Commission, 56 at para (6) and 87 at para (1).

235 Christopher M Petras, "'Eyes' on Freedom - A view of the law governing military use of satellite reconnaissance in US homeland defense" (2005) 31 J Space L 81, 87 – 90.

236 It is doubtful though, that this freedom could be read as extending to a right to 'look' in a certain direction for intelligence on another State's sensitive sites – the sensing State could continue to freely use and explore outer space with its spy satellite by simply 'looking' away from the sensitive site.

237 International Law Commission, "Draft Articles of State Responsibility" *supra* note 193, Art 25.

into compliance.[238] A State that jams transmissions to or from the satellite of another State potentially violates Art 45 of the *Constitution of the ITU* concerning 'harmful interference'.[239] In addition to legal process and the processes for resolving harmful interference under the *Radio Regulations*,[240] the victim State could take effective countermeasures directed against the State's satellite jamming efforts to stop the jamming, so long as the countermeasures are commensurate with the injury suffered, and only after the offending State is properly notified of the international wrong (i.e., the satellite jamming) and given an opportunity to cease.[241] A cyber attack limited to the station causing the jamming and which actually stops the jamming, without causing any physical damage, might be appropriate, even if the station is on the territory of the other State. In other circumstances, such a cyber attack would likely violate the principle of State sovereignty itself.

A threat or use of force by one State against the "territorial integrity or political independence" of another State is, with very few, but very relevant exceptions, unlawful.[242] What amounts to a 'threat or use of force' is as much a vexed question in the space domain as it is in the cyber domain, except that in the latter context a group of eminent experts has recently published guidance (in the Tallinn Manual) on the issue and that guidance can be applied, by analogy, to the space domain. In short, they say, it depends

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238 *ibid*, Art 49.

239 *ITU Constitution*, *supra* note #, Art 45. See also *Radio Regulations Edition of 2012*, *supra* note #, Art 15.1, which prohibits signals that are superfluous, or Art 15.2, which prohibits signals at a greater strength than necessary. The term 'harmful interference' is defined at *ibid*, Art 1.169. See also Zachary T Eytalis, *International Law and the Intentional Harmful Interference with Communication Satellites* (Master of Laws, Institute of Air and Space Law, McGill University, 2012) [unpublished] generally on rights and freedoms associated with broadcasting and when jamming might be lawful, and see especially 11 – 22 on 'harmful interference'.

240 *Radio Regulations Edition of 2012*, *supra* note #, Art 15, Section VI.

241 *The Case Concerning the Gabcikovo-Nagymaros Project (Hungary v Slovakia)* [1997] ICJ Rep 7, 55 - 57. See also International Law Commission, "Draft Articles of State Responsibility" *supra* note 193, Arts 51 and 52.

242 *UN Charter*, *supra* note 9, Art 2(4). The exceptions are the threat or use of force consistent with the exercise of the inherent right of national self-defence, as recognised by Art 51 of the *Charter of the United Nations* and the threat or use of force in accordance with a UN Security Council resolution authorising it.

on the "scale and effects"[243] of an activity by a State and more fully, one should consider at least the following factors: severity, immediacy, directness, invasiveness, measurability, military character, State involvement and presumptive legality.[244] An important difference in the space context is Art VI, OST, which provides that the State bears international responsibility for the activities of even non-governmental entities in space. Another State cannot, with the one exception discussed below, respond with a threat or use of force, but it would be open to the other State to take countermeasures, even if a non-governmental entity is acting entirely independently of the State. However, the same restrictions apply ('proportionality', notification and opportunity to cease).

The exception is national self-defence. If a State suffers or anticipates an imminent 'armed attack', the State is justified in responding with force to defend itself.[245] Existing space law does not limit the inherent right of national or collective self-defence, but clearly preserves it. Furthermore, in proposed new instruments to expand on the existing legal framework, such as PPWT and ICOC, negotiations suggest that States are unwilling to accept any limitation on that right. The terms 'use of force' in Art 2(4) and 'armed attack' in Art 51 of the *Charter of the United Nations* are not synonymous. The International Court of Justice (ICJ) has stated, in its *Military and Paramilitary Activities in and against Nicaragua* opinion (*Nicaragua* case), that not all threats or uses of force will amount to armed attacks – it depends on the "scale and effects" of the activity.[246] However, the ICJ has also recognised that an attack on a single item (in the case before it, an oil platform) could qualify

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243 Michael N Schmitt, ed, *Tallinn Manual, supra* note 7, Rule 11, para 1 citing *Nicaragua (Military and Paramilitary Activities) case*, *supra* note 184, para 195.

244 Michael N Schmitt, ed, *Tallinn Manual, supra* note 7, Rule 11, para 9.

245 *UN Charter*, *supra* note 9, Art 51. For a discussion on the scope of 'anticipatory' or 'interceptive' self-defence see Yoram Dinstein, *War, Aggression and Self-Defence*, 5th edn (Cambridge: Cambridge University Press, 2011), 201–206.

246 *Nicaragua (Military and Paramilitary Activities) case*, *supra* note 184, paras 191 and 195.

as an armed attack.[247] Given the strategic significance of many satellites to a State, the substantial investments they represent and their relatively limited quantity, an attack on a single satellite could quite conceivably qualify as an armed attack. In many cases, the significance of an attack on a single satellite would be measured not in terms of the simple destruction of equipment in outer space, but in terms of the loss of its services and the consequent second, third and subsequent order effects. The extent to which such effects may be taken into account is not clear, but the International Group of Experts responsible for the Tallinn Manual have suggested that 'reasonable foreseeability' is the relevant measure.[248] There are too many uncertainties about the application of Art 51 in the space domain to mention here, but one very important question should be highlighted. If a State is responsible for all national activities, regardless of the status of the entity involved (as per Art VI, OST), could the independent actions of a rogue non-State actor in outer space trigger a response in national self-defence by a victim State against the State in some sense responsible for the non-State actor?

Another question is worth mentioning, not because of its significance, but because it is fascinating – and we should be thankful that it is only fascinating and not significant. No State or other entity has a mandate for planetary defence. Yet a deliberate armed attack could come from an extra-terrestrial source. How would the law limit the unilateral response of a State against an extra-terrestrial attack?

3.3.2 *Jus in bello*

Let us return to Earth where there are certainly limits on the conduct of hostilities. There are reasonable questions about whether LOAC applies to hostilities in outer space and it is important to address those first. Then this section considers how LOAC applies to outer space and it does so in a broad manner, by reference to the four fundamental principles of: necessity,

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247 *Islamic Republic of Iran v United States of America (Oil Platforms)* [2003] ICJ Rep 161, paras 57, 61.

248 Michael N Schmitt, ed, *Tallinn Manual, supra* note 7, Rule 13, paras 10.

distinction, proportionality and unnecessary suffering. It is necessarily broad in manner because a comprehensive examination of the application of LOAC has not been conducted anywhere, leaving many important questions dangerously open and it is not the purpose of this thesis to resolve all of those questions.

There is no limitation on the spatial application of LOAC. Common Art 2 of the *Geneva Conventions* (incorporated into *Additional Protocol I to the Geneva Conventions* (GPI) by Art 1 of that protocol)[249] states that the provisions of those Conventions "shall apply to all cases of declared war or of any other armed conflict which may arise between two or more of the High Contracting Parties, even if the state of war is not recognized by one of them."[250] There is some suggestion in Art 49 of GPI of a spatial limitation. Paragraph 3 of Art 49 deals with the application of some of the most important provisions and refers only to "land, air or sea warfare which [*sic*] may affect the civilian population, individual civilians or civilian objects on land." However, other paragraphs of Art 49 make it clear that it was not intended to limit the application of LOAC. Furthermore, the commentary to Art 35, GPI, in discussing the relationship between the reference in paragraph 3 to "widespread, long-term and severe damage to the natural environment" and very similar terms in ENMOD, suggests that the negotiating States intended GPI to extend to the space environment.[251]

Yet, there are important differences between the space domain and more conventional domains and these differences affect the application of LOAC. Just as in any other domain, combatants may not use weapons of the

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249 *Protocol Additional to the Geneva Conventions of 12 August 1949 relating to the Protection of Victims of International Armed Conflicts (Protocol I)*, 8 June 1977, 1125 UNTS 3 (entered into force 7 December 1978).

250 See, for example, *Geneva Convention relative to the Protection of Civilian Persons in Time of War*, 12 August 1949, 75 UNTS 287 (entered into force 21 October 1950).

251 Yves Sandoz, Christophe Swinarski & Bruno Zimmerman, eds, *Commentary on the Additional Protocols of 8 June 1977 to the Geneva Conventions of 12 August 1949* (Geneva: Martinus Nijhoff Publishers, 1987), paras 1450–56. For further discussion on this issue, see Michael N Schmitt, "International Law and Military Operations in Space" (2006) 10 Max Planck UNYB 89, 115.

space domain to cause unnecessary suffering to other combatants. Unlike more conventional domains, this principle has limited application in the space domain itself because there are very few humans in outer space, or to use an emerging maxim in space security law, "satellites have no mothers". It is unclear whether astronauts who are also members of the armed forces should be regarded as combatants or not. If they are, astronauts ejecting in distress might be accorded the same protection as combatants parachuting from an aircraft in distress.[252] There is also the question of the application of LOAC to a hostile alien encounter – are human combatants prohibited from using weapons that could be expected to cause unnecessary suffering to aliens. It is important, though, not to be distracted by a seemingly insignificant issue (at least in the foreseeable future). Ultimately, LOAC is concerned with the humanitarian impact of the hostile use of weapons of any domain and wherever that impact is felt. There is no doubt that weapons of the space domain are capable of causing significant, negative humanitarian consequences.

Those consequences should be limited, as far as possible, to legitimate military objectives. The principle of military necessity gives commanders the latitude, in conducting military operations, to select targets that offer a definite military advantage, provided that the targets are not protected by LOAC (such as civilian objects). Article 52(2) GPI defines a military objective as: "those objects which by their nature, location, purpose or use make an effective contribution to military action and whose total or partial destruction, capture, or neutralization, in the circumstances ruling at the time, offers a definite military advantage." 'Nature' refers to "all objects used directly by the armed forces." 'Location' refers to "a site which is of special importance for military operations in view of its location." 'Purpose' is "concerned with the intended future use of an object." Finally, 'use' is

252 *Additional Protocol I*, *supra* note 249, Art 42.

"concerned with [the object's] present function."[253] Thus, a foreign satellite being used by a belligerent for its military SATCOM may satisfy either the 'nature' or 'use' definitions and therefore may become a valid military objective. Conceivably, certain orbits or celestial bodies could be legitimate military objectives in the context of hostilities by reason of their 'location' through the creation of debris as an area denial weapon, but how would the *Environmental Modification Treaty* (and a similar principle in Art 35(3) GPI) apply to such a means or method of warfare? A commercially owned and controlled Earth observation satellite could be a legitimate military objective due to its 'purpose', notwithstanding that its current 'use' is benign.[254] The difficulty in respect of much of space infrastructure is its widespread dual use, its military potential and the multi-national interests that inhere within it.[255] Such challenges might be addressed by opting for partial neutralisation, rather than destruction, to the extent that that is possible. LOAC would encourage that approach and it would seem consistent with the concept of outer space as "the province of all mankind".[256]

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253 Yves Sandoz, Christophe Swinarski & Bruno Zimmerman, eds, *Commentary on the Additional Protocols, supra* note 251, paras 2020–22.

254 For example, the US Department of Defense and Central Intelligence Agency are required, by executive mandate, to source at least some imagery for national security purposes from commercial remote sensing entities. They are even required to coordinate with commercial remote sensing entities to determine, in advance, how commercial remote sensing infrastructure will be used to meet national security needs. See United States, Whitehouse, *Commercial Remote Sensing Policy* (25 April 2003) (Washington, DC: Whitehouse, 2003) (President: George W Bush). This appears to provide strong evidence that the "future intended use" of US commercial remote sensing satellites includes making an "effective contribution to military action" of the US. The same laws are likely to apply even if the satellite is owned and registered by a neutral State: see Elizabeth Seebode Waldrop, *Integration of Military and Civilian Space Assets: legal and national security implications* (LLM thesis, Institute of Air and Space Law, McGill University, 2003) [unpublished, archived at McGill University Law Library], 94–96. For an interesting discussion of 'use' versus 'purpose' in the context of military use of commercial communications satellites, see Richard A Morgan, "Military Use of Commercial Communication Satellites: a new look at the *Outer Space Treaty* and 'Peaceful Purposes'" (1994) 60 J Air L & Com 237, 318.

255 For a good indication of the multi-national and dual-use of many satellites see Union of Concerned Scientists, *UCS Satellite Database* (webpage), *supra* note 20.

256 *Additional Protocol I*, *supra* note 249, Art 57(3) and *Outer Space Treaty*, *supra* note 1, Art I OST. Also, of the 'global public interest' in outer space, see generally Ram S Jakhu, "Global Public Interest" *supra* note 186.

People may be legitimate targets too, even in space. However, for the foreseeable future, there are unlikely to be many people in the space domain. There are few people in space and space law regards them as 'envoys of mankind', but is this sufficient to change the status of a member of the armed forces of a State (from whence astronauts often come) from combatant, in the context of a conflict, to something else? Furthermore, what is the status of civilians engaged in launching and controlling a satellite in response to an immediate operational need (or, to take a scene from sci-fi movie, what was the status of the construction workers on the second Death Star when it was destroyed)?[257]

Belligerents are obliged to "distinguish between the civilian population and combatants and between civilian objects and military objectives and accordingly … direct their operations only against military objectives."[258] Means or methods of warfare that cannot be specifically directed at legitimate military targets or limited to legitimate military targets are indiscriminate and therefore prohibited. Thus, it would seem that creation of space debris as an area denial weapon or the creation of an EMP would, in most circumstances, be prohibited in the context of armed conflict. The same could be said of any destruction or neutralisation of space infrastructure by a weapon, means or method of warfare that necessarily causes reasonably foreseeable second, third or subsequent order effects against civilian objectives, notwithstanding that such effects may be quite removed spatially and temporally.

Distinguishing between civilian objects and military objectives is made difficult by the lack of an effective regime of identification or marking. There is an obligation to register satellites as soon as practical, but there are many instances where satellites have not been registered at all. Even for those that have been registered, the required information is hardly

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257 Randal Graves, "Death Star Construction Workers", Movie, directed by Kevin Smith, scene in *Clerks* (United States: Miramax, 1994).

258 *Additional Protocol I*, *supra* note 249, Art 48.

comprehensive and there is no firm obligation to keep it up-to-date. States are required to disclose the general function of a satellite, but it is not clear that a satellite's connection to military operations needs to be disclosed in any way. Nor is there any distinctive marking regime.[259] Belligerents are obliged to "endeavour to remove … civilian objects under their control from the vicinity of military objectives",[260] but given the dual use nature of much of space infrastructure, this is just not possible in many cases. In spite of all this, if a belligerent begins to use a commercial remote sensing satellite extensively in the context of an armed conflict, does it become perfidious not to somehow identify the significant new role of the satellite?[261]

Civilians and civilian objects may be killed, injured, damaged or destroyed as a collateral effect of an attack directed at a legitimate military objective, provided that the collateral effect is not "excessive in relation to the concrete and direct military advantage anticipated".[262] As an example, assume that the enemy is using only a few transponders on a civilian communication satellite to communicate with its forces and that most of the transponders are used for civilian communications. An attack on that satellite that affects all the transponders may be lawful, in spite of the presence of the civilian transponders, depending on the significance of the military communications facilitated by the satellite. Again, reasonably foreseeable second, third and subsequent order effects of a loss of civilian communications facilitated by the satellite should also be taken into account, but the effects must be in the nature of death, injury, damage or destruction –

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259 *Registration Convention*, *supra* note22, Arts IV and V. Michel Bourbonnière & Ricky J Lee, "Legality of the Deployment of Conventional Weapons in Earth Orbit: Balancing Space Law and the Law of Armed Conflict" (2008) 18:5 Eur J Int'l L 873, 892–896.

260 *Additional Protocol I*, *supra* note 249, Art 48.

261 Elizabeth Seebode Waldrop, *Integration of Military and Civil*, *supra* note #, 20–22 (discussing the conflation of military and civil use of remote-sensing satellites generally), 95–100 (discussing neutrality implications and implications for civilian operators as potential unlawful combatants). Michel Bourbonnière & Ricky J Lee, "Balancing Space Law and LOAC" *supra* note 259, 894–896 (discussing perfidy).

262 *Additional Protocol I*, *supra* note 249, Art 51(5)(b).

the commander is not obliged to take account of mere inconvenience.[263] An attack that causes such space debris as to make any position within a particular orbit dangerous may cause 'mere inconvenience' to the satellite operators that have to relocate their satellites. Yet, arguably the instruments of space law give outer space a special status, involving international and inter-generational equity, so that rendering an orbit unusable is an effect that must be taken into account in any collateral damage estimation.

The application of LOAC to the space domain involves this and many other important, but unanswered questions. The discussion above is a just short selection of issues, hopefully sufficient to demonstrate that there is currently a dangerous lack of clarity in the sense that a belligerent could assume that there is little to restrict its military space activities in the context of hostilities. At the very least, such an assumption violates good conscience.

3.4 Conclusions

Space is not a 'lawless frontier'. At the dawn of humanity's reach into outer space, the two opposing superpowers, the Soviet Union and the United States, settled upon legal principles to regulate States' activities in the domain. The first section of this chapter described those principles, which have been enunciated in a number of treaties specific to outer space and have become accepted throughout the international community. In many cases these principles are ahead of current technology – owing to the foresight of strategic mistrust between superpowers. Thus, the concerns about weaponisation of the space domain are not new, but those concerns are more acutely felt as development and proliferation of weapons technology makes the concerns more real. For all their foresight about technological developments, the space law principles have not clearly anticipated and comprehensively covered the possibility of armed conflict involving the space domain. Their delicate balance between different space power theories

263 *Ibid*, Art 57(2)(a)(iii) refers to "… loss of civilian life, injury to civilians, damage to civilian objects, or a combination thereof …".

and the interests they reflect has left a raging controversy about whether the regulation of hostilities in outer space should even be considered, as opposed to regarded as simply prohibited.

There should be no doubt that the foundational principles of space law are, at least, influential in determining the law applicable in a potential armed conflict involving the space domain. Armed conflict is an aberration from the usual, preferred state of affairs and from the legal foundations that preserve that state of affairs. There are limitations on the extent to which armed conflict can be used to justify a departure from that state of affairs. Thus, understanding the legal foundations that apply in peace is essential to understanding the *lex specialis* that applies in the context of hostilities, and it is likewise with these foundational principles of space law in respect of armed conflict in the space domain.

The concept of outer space as a sanctuary is reflected in the foundational principles, some more faintly than others, but in the midst of the Cold War strategic competition contemporaneous with the genesis of these foundational principles, the OST can also be seen as an arms limitation treaty, as much as an instrument espousing fine notions of peaceful, scientific investigation. As strategic competition between the superpowers subsided, the impetus for treaty-making also subsided, but new challenges have emerged within and outside the domain. Legal and quasi-legal efforts to prevent outer space becoming a new domain for conflict continued in parallel, and they continue today. Just as the foundational principles influence the application of LOAC to the space domain, so too do these efforts influence LOAC, in particular *jus ad bellum* and weapons law. The second section of this chapter considered 'legal' measures to prevent conflict in outer space. However, these new and proposed developments have not and do not appear certain to fill in 'gaps' or uncertainties in the existing legal framework.

The final section of this chapter considered the application of LOAC itself to outer space in light of the developments described in the previous chapter, in light of the foundational principles of space law and in the light of

'legal' measures to prevent a conflict in outer space. The final section demonstrated that there are many unanswered questions about the application of LOAC to outer space.

The norms of *jus ad bellum* and *jus in bello* are widely-accepted, reflective of States' strategic interests and enforceable by States themselves. However, their application to the space domain is unclear, involving many ambiguities. There is a need for an authoritative statement of the application of the norms to the space domain. Other domains – maritime, air and cyber – provide a useful analogy for how that might be achieved.

4 Analogies from other domains

The apparent horrors of war in ancient and more recent history give the impression that the law of war is a relatively recent innovation. Yet, accounts of codes or rules moderating the conduct of warfare appear in some of the world's oldest historical texts (such as the Old Testament of the Bible) and from a variety of cultures that span the globe. However, it was not until the nineteenth century, with advances in the printing press, transport, international trade and commerce and the advent of the war correspondent, that the excesses of war became so apparent to the general civilian population. Those men and women, in the midst of a transition from the late renaissance and enlightenment period into the industrial age, were appalled by what they read and heard and resolved to take an enlightened approach – by committing hitherto unwritten codes and rules to paper so that all may know and observe them. The reaction of Professor Francis Lieber, whose own sons were mortally and seriously wounded on opposite sides of the American civil war, was to draft a code for the conduct of the Union Army in the conflict, at the behest of President Lincoln. Although this was unilateral, he based this on what he saw as the pre-existing customary international law regulating the conduct of the armed forces of all nations. 'General Order No. 100—*Instructions for the Government of Armies of the United States in the Field*' became known as the 'Lieber Code'.[265]

Across the Atlantic, Henri Dunant, a travelling, international businessman who happened upon a bloody slaughter at the Battle of Solferino and its even more bloody aftermath, founded (with several others) the International Committee of the Red Cross (ICRC) in 1863, the same year that the Lieber Code was published in the United States. Dunant's reaction to what he saw was not just to recognise the existing law, such as it was, but to develop new rules, especially in relation to wounded soldiers and the

[265] Gregory P Noone, "The History and Evolution of the Law of War Prior to World War II" *supra* note 6, 182 – 192.

protection of medical personnel on the field of battle. He advocated for and succeeded in bringing twelve European States together to sign a treaty – the *Convention for the Amelioration of the Condition of the Wounded in Armies in the Field*, signed at Geneva, 22 August 1864.[266]

In spite of Dunant's immediate success, humanitarianism was largely muted by national interests and strategic concerns in the decades that followed. The Russian Czar was the impetus behind the attempts to develop international humanitarian law in those decades and the dominance of national interests and strategic concerns was likely a reaction to his approach – focusing on limitations to particular weapons, means and methods of warfare, rather than on the conduct of the forces themselves. The aim was laudable – to prohibit the use of weapons that "uselessly aggravate the sufferings of disabled men". Couched in these terms, the first example, the *1868 Declaration of St Petersburg Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight* was an unqualified success. However, when the Czar proposed an expansion on this approach in the context of a broader treaty on the laws and customs of war in 1874, the British refused to even send a delegate, unless naval warfare was taken off the agenda. The text was confined to the law of war on land, as requested, yet Great Britain and several other States refused to sign the 1874 Brussels Declaration, through scepticism about the Czar's true motives, and so it never gained legal status.

This was a pivotal moment in the evolution of the law of war and the genesis of three trends. First, the law of war was bifurcated into 'Geneva' law – focusing on the conduct of armed forces – and 'Hague' law – focusing on weapons, means and methods of warfare. Second, national interests and strategic concerns have continued to inhibit efforts to conclude treaties in the Hague stream more heavily than the Geneva stream. One need only observe the relatively universal ratification of Geneva stream instruments, compared

266 *Ibid*, 190 – 193.

to instruments focusing on weapons, means and methods of warfare. Finally, in both streams, formal attempts to regulate warfare other than on land have seldom been successful.

In 2013, almost 140 years later, one finds those three trends repeated in the attempts to achieve strategic stability in the space domain through legal means. Most States prefer an approach focused on conduct in the space domain, like the draft ICOC (initiated by the Council of the European Union in Brussels), rather than an arms limitation approach, such as the draft PPWT (proposed by Russia together with China). Even though States may prefer something like the draft ICOC, most are reluctant to commit to anything legally-binding that restricts their strategic options in response to hostilities in or associated with outer space. The prospects of any effective regulation of hostilities, should they break out in the space domain, appears dim.

However, there are three good reasons to be hopeful. First, peaceful activities in the maritime, air and even space domains have been quite successfully regulated by, respectively, the *United Nations Convention on the Law of the Sea*,[267] the *Convention on International Civil Aviation*[268] and, at least until the current challenges of the space domain, the *Outer Space Treaty*. As stated above, the law of war is an aberration from the usual, preferred state of affairs and the corpus of the law of war as applied to a particular domain can only be completely described by understanding the peacetime legal framework as the foundation against which the law of war exists as a limited exception. Secondly, the law of war on land has not been static. It has experienced steady and detailed development, even if not as quickly and comprehensively as the champion of international humanitarian law, the ICRC, might like. Even though it is not directly applicable to warfare in other domains, the law of war on land offers great potential for the identification of

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267 *United Nations Convention on the Law of the Sea*, 10 December 1982, 1833 UNTS 396, [1994] ATS 4 (entered into force 16 November 1994).

268 *Convention on International Civil Aviation*, 7 December 1944, 15 UNTS 295 (entered into force 5 March 1947).

principles of general application, independent of domain. Thirdly, there was another trend that started almost 150 years ago in reaction to the constraints of State negotiations – a trend that has resulted in significant progress in clarifying the application of the law of war in the maritime, air and cyber domains.

4.1 Oxford Manual 1880—The Laws of War on Land

This fourth trend started in 1880 with Gustave Moynier, one of the co-founders of the ICRC, and its president from 1864 to 1910. He was appalled at the lack of compliance with the *1864 Convention for the Amelioration of the Condition of the Wounded in Armies in the Field* during the 1870-71 Franco-Prussian War. In 1873 he joined ten other of the world's most renowned international lawyers to form the Institute of International Law, an organization that is and always has been the most prestigious and influential of international law organisations. When the Brussels Declaration was not signed by the European delegates, the Institute of International Law resolved, as one of its first tasks, to build upon it, as well as the Lieber Code to expressly state, in written and easily accessible form, the rules and customs of war. Moynier drafted and the Institute adopted a 'manual' in 1880, the purpose of which Moynier describes in his own words, in the preface.

> "It may be said that independently of the international laws existing on this subject, there are to-day certain principles of justice which guide the public conscience, which are manifested even by general customs, but which it would be well to fix and make obligatory. … The Institute attempts this although the governments have not ratified the draft issued by the Conference at Brussels … The Institute … does not propose an international treaty, which might perhaps be premature or at least very difficult to obtain; but, being bound by its by-laws to work, among other things, for the observation of the laws of war, it believes it is fulfilling a duty in offering to the governments a 'Manual' suitable as the basis for national legislation in each State, and in accord with both the progress of juridical science and the needs of civilized armies. Rash and extreme rules will not, furthermore, be found therein. The Institute has not sought innovations in drawing up the 'Manual'; it has contented itself with stating

> clearly and codifying the accepted ideas of our age so far as this has appeared allowable and practicable. By so doing, it believes it is rendering a service to military men themselves. … It is essential, too, that … these laws [are] known among all people, so that when a war is declared, the men called upon to take up arms to defend the causes of the belligerent States, may be thoroughly impregnated with the special rights and duties attached to the execution of such a command. The Institute, with a view to assisting the authorities in accomplishing this part of their task, has given its work a popular form, attaching thereto statements of the reasons therefor, from which the text of a law may be easily secured when desired."
>
> *Gustave Moynier*
> *Preface to the Oxford Manual 1880*

The Oxford Manual 1880 is said to have been at least as influential as the 1874 Brussels Declaration, because of its source (eleven of the world's most renowned international lawyers).[269] It is also relevant to note that the Institute was founded on the principle that its members should be independent of any government influence. Therefore, the Manual can be said to be a genuine statement of what the world's most renowned international lawyers believe the current international law to be, rather than an instrument that represents a compromise between the self-serving national interests of States in international negotiations. Nevertheless, it is apparent that the Oxford Manual 1880 did influence subsequent international negotiations at the First Hague Peace Conference of 1899 – resulting in, among other things, the *Hague Convention (II) on the Laws and Customs of War on Land, 1899* – and at the Second Hague Peace Conference of 1907 – resulting in, among other things, the *Hague Convention (IV) on War on Land and its Annexed Regulations, 1907*.[270]

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269 Gregory P Noone, "The History and Evolution of the Law of War Prior to World War II" *supra* note 6, 194, quoting Howard S Levie, *Terrorism and War: The Law of War Crimes* (New York: Oceana Publications, 1993), 17.

270 Charles Garraway, "The Use and Abuse of Military Manuals" (2004) 7 Yearbook of International Humanitarian Law 425, 428.

4.2 Oxford Manual 1913—The Laws of Naval War

There were many efforts to apply the work done in respect of war on land to war at sea in the five decades following the *1864 Convention for the Amelioration of the Condition of the Wounded in Armies in the Field*. However, the efforts were inhibited by significant national interests, resulting in piecemeal instruments that were somewhat haphazard and dissonant and often never entering into force. The delegates at the Second Hague Peace Conference of 1907 resolved "that the preparation of regulations relative to the laws and customs of naval war should figure in the programme of the next Conference". The Institute of International Law saw that they could once again make a significant contribution to the development of the law of war by drafting a Manual for naval warfare, similar to the Oxford Manual 1880 in its approach. The resulting Oxford Manual 1913 consolidated a lot of work already undertaken in earlier instruments, some of which had entered into force, but it also brought over concepts from its Oxford Manual 1880 and other sources applicable to land warfare and it put them all together in one comprehensive and internally-consistent text. Again, it was a statement of what the experts believed to be the settled law at the time. Also, as with the earlier manual, the purpose was partly to guide military forces in the conduct of hostilities, but also to serve as a model for national legislation and for further efforts towards a comprehensive, legally-binding document.

The Manual was at once more and less influential than could have been hoped. The next peace conference never came – the process was interrupted by two world wars. No treaty on the law of naval warfare has ever been drafted. Instead, for the next 80 years the Oxford Manual 1913 remained the definitive text on the matter, influencing trials, commissions of inquiry, associated treaties (notably the *United Nations Convention on the*

Law of the Sea), national laws, national military manuals, textbook writers and, perhaps most importantly, military commanders.[271]

4.3 San Remo Manual 1994—International Law Applicable to Armed Conflict at Sea

The drafting of international manuals on the law of war experienced a hiatus for just over 80 years and in that time the Oxford Manual 1913 became out-dated. There were major changes in naval technology and in the naval capabilities of the major maritime powers. The Oxford Manual 1913 did not cover submarines, sea mines (an ICRC hospital ship was sunk by a sea mine in 1995), sea-launched long range missiles or aircraft. There were major changes in the way in which commanders used military forces (military strategy), and in particular, the armed services became more joint in their approach to warfare. There were major events that brought into question the continuing clarity about the application of the law of naval warfare, such as the use of exclusion zones in the Falklands/Malvinas conflict, attacks on neutral shipping in the Iran/Iraq conflict, the shooting down of an Iranian commercial airliner by the USS Vincennes and the establishment of a blockade during the second Gulf War without formally designating it as such. There were also major developments in the law of war and in other, related areas of international law generally (such as the *Charter of the United Nations*, the *United Nations Convention on the Law of the Sea*, air law and environmental law). However, even though the rules of the law of war on land had become much more comprehensive, they could not be simply transplanted into the maritime domain. Without national borders in the high seas, for example, the separation of neutral and belligerent interests is far more complex than on land. Several States drafted new editions of

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271 W J Fenrick, "Legal Aspects of Targeting in the Law of Naval Warfare" (1991) 29 Canadian Yearbook of International Law 238, 238-239; Charles Garraway, "The Use and Abuse of Military Manuals" *supra* note 270, 428-429; Louise Doswald-Beck, "San Remo Manual on International Law Applicable to Armed Conflict at Sea" (1995):309 International Review of the Red Cross 583, 584.

national military manuals on the law of naval warfare, but clearly these lacked international authority.[272]

In response to a growing consensus on the need to update the Oxford Manual 1913, the San Remo Institute of International Humanitarian Law gathered together a group of widely-respected governmental personnel and academics who, in spite of their affiliations, attended the Institute's premises in San Remo in a personal capacity. The group of experts agreed that it would be premature to seek to draft a new treaty, but a manual would help clarify the law and demonstrate sufficient agreement to form conclusions about the customary international law status of certain rules and sufficient agreement for the potential, future codification of rules in a legally-binding form. With support from the ICRC, several national Red Cross societies and a couple of universities, the San Remo Institute of International Humanitarian Law organised and funded a series of annual meetings over six years to draft a modern equivalent of the Oxford Manual 1913. In addition to the broad group of experts discussing and settling upon the content of the rules, there was a smaller group of rapporteurs who prepared texts for discussion, facilitated discussion, recorded the discussion and drafted the eventual text and accompanying commentary. The rules themselves are predominantly a succinct statement of what the experts believe the existing law to be, although they do involve some progressive development. The purpose of the commentary was to demonstrate the sources for the rules, to detail controversy about the content of a rule and to expressly acknowledge where a rule involved some element of progressive development of the existing law.[273]

It is relevant to note some of the specific content of the San Remo Manual because of the analogy it provides for the space domain. The experts were particularly keen to clarify the law applicable to neutral shipping engaged in belligerent acts, such as facilitating communication or collecting

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272 Louise Doswald-Beck, "San Remo Manual (Background)" *supra* note 271, 583 – 586.
273 *Ibid*, 586 – 588.

intelligence for the enemy. The application of the principle of distinction would also be particularly important in respect of satellites. It is also relevant to note that the San Remo Manual covers more than just *jus in bello*, it also covers some of the legal framework specific to the domain (law of the sea) and *jus ad bellum*. Louise Doswald-Beck, the editor, noted that it was not easy to recognise certain military necessities while respecting, as far as possible, the terms of the law of the sea.[274]

Since 1994 the Manual has been extensively cited as authority in journal articles. Both the United States and Iran cited the manual as authority in their memorials in the *Oil Platforms* case.[275] The Manual was relied upon extensively by the Panel of Inquiry established by the UN Secretary General in respect of the Israeli naval blockade of Gaza and the boarding of the *Mavi Marmara* in 2010.[276] A number of states adopted the Manual for their naval forces verbatim or copied it substantially.[277] In this author's own experience, many naval commanders with Australian and allied forces carry a copy of the Manual on their warships. Like the Oxford Manual 1913, most importantly, the Manual has influenced decisions by military commanders. It is, undoubtedly, a very influential text, despite not being legally-binding.

4.4 Harvard Manual 2010—International Law Applicable to Air and Missile Warfare

Like the Oxford Manual 1880 and the Oxford Manual 1913, the Harvard Manual had its genesis in an attempt to settle upon binding rules of

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274 *Ibid*, 592.

275 *Oil Platforms case*, *supra* note #. See particularly *Counter-memorial and Counter-claim by the United States of America* submitted on 23 June 1997 http://www.icj-cij.org/docket/files/90/8632.pdf, particularly footnote 292 in which the United States describes the Manual as largely reflective of customary international law; *Rejoinder of the United States of America* submitted on 23 March 2001 at http://www.icj-cij.org/docket/files/90/8634.pdf; *Further Response to the United Sates Counter-claim by the Islamic Republic of Iran* submitted on 24 September 2001 http://www.icj-cij.org/docket/files/90/8636.pdf, particularly paragraph 7.4 in which Iran describes the Manual as carrying a certain authority, by reason of the expertise and diversity of the group.

276 Sir Geoffrey Palmer et al, *Report of the Secretary-General's Panel of Inquiry on the 31 May 2010 Flotilla Incident*, SG (2011).

277 Charles Garraway, "The Use and Abuse of Military Manuals" *supra* note 270, 429.

warfare applicable to the domain – an attempt that ultimately failed to result in the entry into force of the relevant document. In the case of the Harvard Manual, it was the draft 1923 Hague Rules of Air Warfare (HRAW).

The application of air power in WWI was haphazard and, at times, horrific. Whereas the nature of land and sea power was such that civilians could generally remove themselves from the field of battle, the speed and reach of aircraft meant that civilians were now often the unfortunate victims of military operations – specifically aerial bombardment. It was not clear whether air warfare was regulated by laws of war on land or naval war or both or neither. In response to WWI a conference was convened in Washington in 1921 to consider arms limitations in respect of, among other things, aircraft. However, a treaty limiting the production and possession of aircraft was unlikely, because of the great commercial interest in and utility of aircraft, noting that commercial aircraft could easily be converted to military use in times of war. The delegates at the Washington Conference recognised the technical nature of aviation and therefore their own inadequacy in attempting to tackle the problem. Therefore, they called for a Commission of Jurists to consider whether existing rules adequately covered air warfare or whether new rules ought to be drafted. The Commission of Jurists convened at The Hague and immediately decided that new rules needed to be drafted, although they should not contradict existing rules for land and naval warfare. The Commission also conceded the need to balance military necessity with humanitarianism, because without an adequate balance, no State would commit to the rules. The outcome was widely applauded. Other jurists recognised the rules as consistent with existing rules in other domains and endorsed the draft.

However, the States were not so enthusiastic. Aircraft were very much a technological work-in-progress and no State wanted to bind itself before the capabilities of these machines could be fully appreciated. They pointed out that aircraft had the potential to significantly shorten a war, thereby achieving humanitarian ends. Many reasons for not ratifying were

given by States and the outcome was that the rules never entered into force. Yet, in WWII both sides proclaimed their adherence to the draft Hague Rules of Air Warfare and accused the other side of violations.[278]

For 80 years the HRAW remained the only significant international attempt to clarify the application of the law of war to the aerial domain. In 2003, at a meeting of experts on the law of war generally at Harvard University (specifically the Program for Humanitarian Policy and Conflict Research or HPCR), it was observed that, although the HRAW had had a considerable impact, they were not binding and there had been a lot of technological change in the interim. For example, the HRAW did not even consider missiles. Air power had led a revolution in military strategy due to its success in recent conflicts around the Arabian Gulf, over Kosovo, in Iraq and in Afghanistan. On the other hand, a hijacked airliner had been used as a weapon of terrorism. There had also been, in the intervening 80 years, significant developments in the law of war, but they only incidentally touched upon air and missile warfare. Furthermore, one of the most significant instruments, *Additional Protocol I*, was not ratified by the world's sole superpower – the United States – which also maintains that it is not reflective of customary international law in all respects. Therefore, there was a need to clarify customary international law as it is applicable to air and missile warfare. The experts gathered at the HPCR resolved to develop a manual, similar in style to the San Remo Manual, to assist military lawyers in advising commanders and providing training and to give operators confidence in their decision-making in a rapidly-changing environment.[279]

The HPCR was assisted with funding from the Swiss Federal Department of Foreign Affairs. Also, regional meetings were partly funded by the governments of States – particularly Australia, Belgium, Canada, Germany, the Netherlands and Norway. The meetings were predominantly

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278 Richard H Wyman, "First Rules of Air Warfare" (1984) Air University Review 1, 1 – 9.

279 Program on Humanitarian Policy and Conflict Research, *Harvard Manual*, *supra* note 7, 1-3 (of the Commentary).

facilitated by the HPCR, although several other institutes assisted from time-to-time.[280]

Like the San Remo Manual, the Harvard Manual took six years to produce. A broad group of experts settled on the black letter rules by consensus, representing their views on the *lex lata* (the law as it exists at the time), rather than on whatever they might advocate as *lex ferenda* (the law as it ought to be). The group started by individually producing a series of research papers on specific topics, but which collectively covered the field. The first draft was then produced as a result of the experts considering those papers in plenary. Subsequently, a core group drafted a commentary on the rules with the objectives of revealing the underlying reasoning and sources for each of the rules, to address controversial issues and differences between experts and to indicate which rules were also applicable in non-international armed conflict. The Harvard Manual involved more engagement with government than did the San Remo Manual. According to the Introduction to the Commentary, the rationale was to ensure that the Manual would be largely accepted by governments and used, although the experts were equally adamant that this should not undermine their independence and focus on the *lex lata*. Thus, government representatives were invited to observe proceedings, but not to participate in proceedings. However, a special session was held to specifically discuss the draft with government representatives and some substantive changes were made as a result of their critical comments. This consultative process ensured that the manual was not immediately rejected by States, although the HPCR did not seek government endorsement of the manual, nor did governments give their endorsement of it.[281]

It is important to acknowledge some of the content of the Manual because of its potential application to space warfare and because of the analogy it provides. The experts considered it necessary to tie in several

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280 *Ibid*, iii (of the Commentary).
281 *Ibid*, 1 – 5 (of the Commentary).

areas of law, not just the law of war and therefore extensive reference was made to the *Chicago Convention* and the *United Nations Convention on the Law of the Sea*. However, the law of outer space was not covered because the experts considered it most effective to cover space warfare in a separate study in the future.[282] Nevertheless, it does define airspace by reference to satellites and orbits, and it does refer to rockets and ballistic missiles in describing missiles.[283] There are also many rules that could be applied by analogy to the space domain. Unlike the San Remo Manual, the Harvard Manual does not cover *jus ad bellum*. Finally, the experts acknowledge that the law is not static and therefore the manual will have to be revised in due course.[284]

It is difficult to assess the impact of the Manual this early in its existence. Nevertheless, this author can say that military lawyers in Australia and in many other countries have found the Manual very useful. The HPCR have partnered with some other organisations to deliver a training program to military personnel throughout the world on the Manual and having observed one such course, this author can also attest that participants have found the Manual practical, accessible and relevant. A search on Google Scholar for "Manual of International Law Applicable to Air and Missile Warfare" results in approximately 100 hits, many of them relating to topical issues of uninhabited aerial vehicles and robotic warfare, where the authors have cited the Manual as authority for propositions in their papers.[285] At least one author, though, has been critical of the Manual, finding it imprecise in parts.[286]

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282 *Ibid*, 5 (of the Commentary).
283 *Ibid*, Rules 1(a) and 1(z).
284 *Ibid*, 4 (of the Commentary).
285 Search conducted on 22 July 2013.
286 Jordan J Paust, "A Critical Appraisal of the Air and Missile Warfare Manual" (2012) 47:2 Tex Int'l LJ 277.

4.5 Tallinn Manual 2013—International Law Applicable to Cyber Warfare

The destructive potential of hacking has been a growing concern for governments for approximately two decades. However, in 2007, comprehensive and coordinated cyber attacks were perpetrated on, not just individuals or individual companies, but on government infrastructure and allegedly by Russia or with Russian government sponsorship. It became apparent that cyber attacks could be a cheap and difficult-to-attribute means for one State to forcefully exert its will over another. This concern was reinforced by the cyber attacks on Georgian government infrastructure in 2008 in the conflict between Russia and Georgia. Again, it is not certain whether the Russian government directly perpetrated the attacks or whether they were perpetrated by patriotic hackers. Nevertheless, it was clear that cyber attacks could be a very effective means to achieve military and grand strategic ends in the lead up to, and during the actual conduct of, hostilities of a more conventional nature. The Stuxnet virus in 2010, precisely aimed at a very strategic target (the Natanz nuclear plant in Iran allegedly involved in the production of weapons-grade uranium), seemed to achieve everything that could be hoped of a military weapon, apart from the lack of overt hostilities and the big bang normally associated with conventional weapons.[287] One author claims that some American, Israeli and European officials have admitted, off the record, that the Stuxnet virus was produced by American and Israeli governments to do exactly what it did – shut down centrifuges at the Natanz facility and only that facility – in such a way that the centrifuges were actually damaged.[288] In addition to these relatively overt instances of cyber attacks, the current concern in respect of cyber espionage and all manner of fraud by cyber means is well publicised.

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287 For a discussion on whether cyber capabilities should be characterised as weapons, see Duncan P Blake & J Salvatore Imburgia, "Bloodless Weapons" *supra* note 147.

288 David E Sanger, "Obama Order Sped Up Wave of Cyberattacks Against Iran", *supra* note 128.

The evident threat to national security in all its facets (military, economic, social, political, and so on) is so significant that the US, Russia, the UK (among others) and NATO have ranked the threat among the highest that those nations face, individually or collectively.[289] NATO established the Cooperative Cyber Defence Centre of Excellence (CCDCOE) in May 2008 to facilitate cooperative cyber defence through education, research and development, lessons learned and consultation.[290] On 23 June 2009 the US Secretary of Defense directed the Commander of US Strategic Command to establish Cyber Command, to be headed by a four-star general, with offensive, as well as defensive cyber missions.[291]

All of the nations mentioned above have, in various forms, advocated for a clear normative framework for cyber activities by nations to cover, among other things, unfriendly or even hostile acts between States. This indicates an acceptance that weaponisation is a strategic reality for cyberspace, even though that reality is unfortunate and undesirable.

In September 2009 a small group of international legal scholars was invited to meet in Tallinn at the CCDCOE in order to consider the legal normative framework applicable to unfriendly and hostile activities in the cyber domain. The group unanimously concluded that, contrary to some views expressed elsewhere, the cyber domain was not a new, lawless frontier in desperate need of the invention of new rules. Rather, the legal normative framework was to be discovered and clarified by the application of extant legal norms to new forms of inter-State activity. Relevant legal frameworks included *jus ad bellum* and *jus in bello*, as well as State responsibility, law of the sea and environmental law.

There are some elements of the cyber domain that are already directly regulated, such as telecommunications standards that facilitate the operation of the internet, largely through the International

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289 Michael N Schmitt, ed, *Tallinn Manual, supra* note 7, 2.

290 *Mission and Vision* (webpage accessed on 12 August 2013) <https://www.ccdcoe.org/11.html>.

291 *US Cyber Command*, Fact Sheet (25 May 2010).

Telecommunications Union. Furthermore, substantive efforts are already under way to address the security of private citizens using the internet, including the *Convention on Cybercrime*,[292] which has already entered into force, and the World Summit on the Information Society, which would seek to address security in the context of internet governance. However, none of this directly addresses the normative framework for the conduct of States, between themselves, especially in respect of more hostile activities.

Therefore, the group that met at Tallinn in 2009 proposed to focus on warfare – a threshold above the use of force. In particular, they proposed a project to draft a manual in the same style as the recent San Remo Manual and Harvard Manual. This group immediately drafted a rough table of contents and, based on that work, the CCDCOE convened a larger group of international legal practitioners, scholars and technical experts to draft the substantive text. Over the following two years the larger group, which included the initial group, met in plenary eight times, focusing on the precise wording of the rules and the broad content of the accompanying commentary. The ICRC and the US Cyber Command, among others, were invited to the meetings, but only as observers. Subsequently, a smaller editorial group filled out the commentary, focusing on its clarity and accurate representation of the views expressed and reference to sources. The editorial group met twelve times. Once the draft was relatively complete, it was sent to expert reviewers for their comments.

In all cases the gathered scholars, practitioners, experts and reviewers participated in their personal capacities, regardless of their affiliations by employment or otherwise. They focused on identifying the *lex lata*, not the *lex ferenda*, while acknowledging that there was no treaty law directly applicable to warfare in the cyber domain and given the recency of the internet phenomenon, there is little *opinio juris*. Nevertheless, there is a relatively comprehensive treaty and customary international law framework

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[292] *Convention on Cybercrime*, 23 November 2001, CETS 185 (entered into force 1 July 2004).

applicable *in bello* and *ad bellum* and the experts drew well-informed conclusions about the application to the cyber domain. They also drew on related legal frameworks – such as State responsibility, law of the sea and environmental law – where relevant. They aimed for consensus wherever possible and drafted rules broadly where necessary to allow for uncertainty about the application of certain rules in the cyber domain. Different positions are reflected in the commentary, together with the sources relied upon and some discussion of the practical implications of a rule.

The Tallinn Manual is a particularly apt analogy for clarifying the legal framework applicable to space warfare for a number of reasons. Like the high seas and airspace, cyber space and outer space are also global commons.[293] Cyber space is relatively new and although outer space has several decades on cyber space, outer space is relatively new to most States. Both domains involve high technology, especially telecommunications technology and use of the radio-frequency spectrum. In fact, the domains are interdependent – one facilitates the effective operation of the other. Finally, many of the desired strategic effects in both domains may be achieved by non-kinetic means. While the analogy is useful, there are substantive and very relevant differences between the domains.[294] Outer space is more tangible than cyber space (and therefore kinetic weapons can be quite effective), yet it is more out-of-sight than cyber space and the human impact is less direct. Outer space is more susceptible to environmental effects, both natural and man-made and these are more enduring. So the analogy must be applied with caution.[295]

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293 For a detailed discussion of the status of outer space as a global commons, or as a common pool resource, see Brian C Weeden & Tiffany Chow, "Taking a common-pool resources approach to space sustainability: A framework and potential policies" *supra* note 21.

294 Lorenzo Valeri, "Countering Threats in Space and Cyberspace: A Proposed Combined Approach" (Paper delivered at the *Making the Connection: The Future of Cyber and Space*, London, 24 January 2013) [unpublished].

295 Brian C Weeden & Tiffany Chow, "Taking a common-pool resources approach to space sustainability: A framework and potential policies" *supra* note 21.

Nevertheless, any clarification of the law applicable to space warfare should take into account what the Tallinn Manual says in analogous areas. For example, the Tallinn Manual discusses sovereignty, jurisdiction and control in cyber space and some similar propositions are likely to apply in outer space. The application of *jus ad bellum* and the laws of state responsibility in outer space and cyber space is likely to bear significant similarities. Given the mixed-use nature of both domains (military/commercial/civil/international), rules applicable to neutrality, perfidy and distinction will also bear significant similarities.

It is too early to say what impact the Tallinn Manual has had. Initially, it has certainly caught the attention of the industry media and generated a lot of discussion on industry blogs – seemingly far more than the Harvard Manual. In particular, the idea that a hacker could be a legitimate target for attack has, understandably, raised the ire of those who have or feel some association with hackers.[296] It is important to note some criticism from scholars too. Some of the criticism arises from the pursuit of consensus among the experts, which may have robbed some rules of the detail that they might otherwise have had. For one author, some of the rules and their associated commentary stopped short of providing a practical guide for operators, probably because of this pursuit of consensus.[297] Yet, on the other hand, the same author and another article suggested that the group of experts should have been more globally-representative[298] – which would have made it even more difficult to settle on anything substantive. Other criticism has been that it did not quite grasp the significance of damage to

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296 Kevin Jon Heller, "Does the Tallinn Manual Allow States to Kill Hackers? Not Really." (blog entry on 25 March 2013) *Opinio Juris*, online: Opinio Juris <http://opiniojuris.org/2013/03/25/does-the-tallin-manual-allow-states-to-kill-hackers-not-really/>.

297 Dieter Fleck, "Searching for International Rules Applicable to Cyber Warfare—A Critical First Assessment of the New Tallinn Manual" (2013):26 June 2013 Journal of Conflict and Security Law 1, 5.

298 Rain Liivoja & Tim McCormack, "Law in the Virtual Battlespace: The Tallinn Manual and the *Jus in Bello*" (2013) 15 Yearbook of International Humanitarian Law 15 pages (forthcoming), 4; Dieter Fleck, "Searching for International Rules Applicable to Cyber Warfare—A Critical First Assessment of the New Tallinn Manual" *supra* note 297, 3.

data;[299] that the non-application of the principle of distinction to military operations short of 'attack' (allowing for military operations against non-military objectives) is a minority view;[300] and that generally it should have covered inter-State hostile activity short of the use of force threshold.[301] Nevertheless, these criticisms appear to picking at the periphery of a document that is regarded as critics as a very useful document, one that is likely to become a standard text and the typical foundation from which to launch a more detailed exploration of specific rules.[302]

4.6 … Manual 20XX—International Law Applicable to Space Warfare

Like in other domains, the issue in the space domain is not one of a lack of relevant law, but a lack of relevant clarity about the application of the existing law. Attempts to address such uncertainty by international negotiations on a treaty have always been a difficult path. Naturally, much of the negotiations involve States trying to find common ground in their strategic interests. The advantage of existing, customary international law is that, effectively, the common ground in State's strategic interests has already been determined. The common ground represents an acceptable balance between maintaining strategic options and restraining other States' freedom of action by reducing the 'malleability' of the law. Where there is already a large body of customary international law that is applicable to the domain, a new treaty that simply declares that law may be unhelpful – because customary international law is binding on all States, whereas a treaty is binding only on the parties to it, and because a treaty would not necessarily

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299 Rain Liivoja & Tim McCormack, "Law in the Virtual Battlespace: The Tallinn Manual and the *Jus in Bello*" *supra* note 298, 8.

300 *Ibid*, 9.

301 Dieter Fleck, "Searching for International Rules Applicable to Cyber Warfare—A Critical First Assessment of the New Tallinn Manual" *supra* note 297. That project is currently under way!

302 Rain Liivoja & Tim McCormack, "Law in the Virtual Battlespace: The Tallinn Manual and the *Jus in Bello*" *supra* note 298, 12.

clarify the existing customary international law, but could add to the uncertainty about its application.[303]

So, in the maritime domain, the air domain and the cyberspace domain the San Remo Manual 1994 (and before it, the Oxford Manual 1913), the Harvard Manual 2010 and the Tallinn Manual 2013 respectively have provided an effective, alternative means to consolidate authoritative statements of the application of the law of war to the domains in a single reference. They have been effective because they avoid the difficulties inherent in international negotiations for a treaty. Individuals who are globally recognised for their legal and technical expertise in the domain express independent opinions on the application of the existing law to the domain and provide sources and reasoning. The San Remo Manual has been very influential and, in spite of some criticism, the Harvard Manual and the Tallinn Manual seem likely to have a similar impact. In the 'secret life of international law', that impact may, in due course, include assisting in the development of new treaty law.

The content of a Manual of International Law Applicable to Space Warfare should at least cover four topics that are key to addressing some of the generic global factors providing impetus towards conflict and specifically, the challenges in the space domain that tend to exacerbate those global factors. The Manual should elucidate:

(1) the legal thresholds for the use of force,

(2) the limits on the legitimate exercise of the right of national self-defence,

(3) the conduct of hostilities in relation to mixed-use and multi-national space infrastructure, and

(4) the limits on collateral effects in the space domain from the conduct of hostilities.

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303 This was a problem experienced in response to the 1907 *Hague Conventions* in WWI. See Richard H Wyman, "First Rules of Air Warfare" *supra* note 278, 2.

As described above, interest, fear and honour broadly provide an impetus towards the use of force. Resource security (especially energy) is a matter of great national interest, especially in prospective global powers, such as China, seeking to meet the expectations of a huge and increasingly affluent society through a continually growing economy. Potentially significant energy resources are available in disputed territories – resources that could be secured by a bold, military initiative. Fear plays a part too. If you wait too long to take the initiative, then the US, and possibly others, could, in the meantime, build an effective BMD shield and concurrently develop conventional prompt global strike weapons or weapons from space. This gives them the ability to strike at long distance, with impunity – without concern about wasting lives and huge national resources. A bold initiative in the space domain could be out-of-sight, out-of-mind, blinding, deafening and muting a potential adversary at least long enough to present the world with an acquisition of territory as a *fait accompli* (no doubt legitimised as an appropriate response to a grievance by another State). The same bold initiative could demonstrate the capability of the initiating State to make any counter-attack at least unpalatable and in the midst of legal uncertainty in a domain that is out-of-sight and out-of-mind, it remains too easy to characterise any response to the bold initiative as illegitimate, reactive and grounds for further grievance. Alternatively, this could be exactly the strategic miscalculation that leads to widespread hostilities in the space domain and elsewhere.

A manual that clearly sets out the legal thresholds enables States to make credible commitments (thereby avoiding strategic miscalculation) – both in respect of what those States won't do (such as an 'internationally wrongful act', or a 'threat or use of force' or an 'armed attack') and in respect of how it will react to other States that cross the thresholds. For example, Rule 9 of the Tallinn Manual[304] makes it clear that a State may respond with

[304] Michael N Schmitt, ed, *Tallinn Manual, supra* note 7.

countermeasures to an internationally wrongful act. The commentary discusses what amounts to an internationally wrongful act and describes the conditions for lawful countermeasures in the cyber domain. Rules 10 – 12 are of similar effect in relation to a threat or use of force and rules 13 – 17 are of similar effect in relation to an armed attack and a response in national self-defence. A Manual of International Law Applicable to Space Warfare would need to have similar rules for the space domain.

Unilateral decisions by States on the legitimate exercise of the right of national self-defence in the space domain are inherent in the development of BMD and in the development of defensive counter-space capabilities. Thus, those developing BMD must have considered when they would intercept a rocket launched out of North Korea, for example, where it is unclear whether the rocket is a ballistic missile or a satellite launch.[305] Those States that have an existing ASAT capability, or which have developed an ASAT capability, must have considered when they would use such a capability. It would be better if those decisions were based on transparent consensus among independent, international experts on the law applicable to the exercise of the right of self-defence. Like Section 2 of the San Remo Manual[306] and Chapter II, Section 2 of the Tallinn Manual, this could be set out in a Manual of International Law Applicable to Space Warfare.

It would likewise be better that the standards for attribution and identification of targets were based on transparent consensus among independent, international experts on the relevant law – especially the application of the principle of distinction to the conduct of hostilities in relation to mixed-use and multi-national space infrastructure. Civilian objects may not be targeted, but objects "which by their nature, location, purpose or

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305 While the UNSC condemned the latest rocket launch by North Korea, it also overtly recognized the freedom of all States to use and explore outer space. *Non-proliferation/Democratic People's Republic of Korea*, SC, 6904th Meeting, Res 2087 (2013). While international condemnation of the development of ballistic missile technology by North Korea was important, it did not help States to determine, in the 30 minutes after launch, whether the rocket was a ballistic missile carrying a warhead of some description or really just a satellite launch, as North Korea claimed.

306 International Institute of Humanitarian Law, *San Remo Manual*, *supra* note 7.

use make an effective contribution to military action and whose total or partial destruction, capture, or neutralization, in the circumstances ruling at the time, offers a definite military advantage" may be characterised as legitimate military objectives.[307] Thus, commercial remote sensing satellites that contribute to a belligerent's intelligence, surveillance, target acquisition and reconnaissance could conceivably be lawfully targeted. Likewise, commercial communications satellites used to facilitate a belligerent's command and control could also, conceivably, be lawfully targeted. The complicating factor, especially in the very multi-national space domain, is neutrality. Rule 174 of the Harvard Manual[308] describes certain activities that "may render a neutral civilian aircraft a military objective", including: "Being incorporated into or assisting the enemy's intelligence gathering system, e.g., engaging in reconnaissance, early warning, surveillance or command, control and communications missions." The commentary goes on to explain what may amount to incorporation and assistance and what would not. A similar rule should appear in a Manual of International Law Applicable to Space Warfare.

Finally, if a space-based object could be regarded as a legitimate military objective, could an attack be prohibited nevertheless because of the collateral effects of such an attack? The San Remo Manual does not consider the special status of the high seas as a common pool resource and certain areas as "the common heritage of mankind".[309] Although that phrase is not used in respect of outer space generally, there are compelling arguments that outer space has been reserved for the global public interest.[310] The deliberate, hostile creation of space debris in certain orbits may be akin to mine-laying in international straits, a matter that is dealt with at paragraphs 80 – 91 of the San Remo Manual. For example, paragraph 89 states that international straits "shall not be impeded unless safe and convenient

307 *Additional Protocol I*, *supra* note 249, Art 52(2).
308 Program on Humanitarian Policy and Conflict Research, *Harvard Manual*, *supra* note 7.
309 *United Nations Convention on the Law of the Sea*, *supra* note 267, Art 136.
310 Ram S Jakhu, *supra* note 186.

alternative routes are provided". The drafting of a Manual of International Law Applicable to Space Warfare could result in the recognition of a rule that, in the absence of an alternative to GEO, the conduct of hostilities resulting in spreading debris in the GEO belt is prohibited.

4.6.1 International Code of Conduct for Outer Space Activities

It might be suggested that the draft ICOC provides the framework for a prospective Manual of International Law Applicable to Space Warfare. For example, the draft contemplates meetings of Subscribing States that could consider "additional measures"[311] to the ICOC. A Manual of International Law would be complementary to the objectives and several of the provisions of the draft ICOC (especially Section 4 on space debris mitigation). The Manual could bolster the force and credibility of the ICOC, especially in response to the concern about the references, in the draft ICOC, to the inherent right of national self-defence. Some commentators have expressed concern that such references potentially give States *carte blanche* to take (and justify) actions that undermine the peaceful use of outer space – notwithstanding that the right of national self-defence is an immutable legal fact. The Manual could assuage concerns by clarifying the limited circumstances in which a State could engage in activities in the space domain in national self-defence.

On the other hand, the drafting of the ICOC is exactly the sort of process that the Manual would deliberately avoid. The ICOC is not an expression of *lex lata*, although it does make reference to a list of existing laws, something that, as discussed previously, is not particularly helpful in the clarification of customary international law. Furthermore, the prospective ICOC will be the subject of negotiation, seeking compromises to meeting the national strategic interests of Subscribing States. It is not the product of a group of independent, international experts. In spite of the progress on the draft ICOC, there remains a compelling need for an independent Manual of International Law Applicable to Space Warfare.

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311 *Revised Draft ICOC* (5 June 2012), *supra* note 225, paragraph 10.1.

5 Conclusion

> Space science, like nuclear science and all technology, has no conscience of its own. Whether it will become a force for good or ill depends on man, and only if the United States occupies a position of pre-eminence can we help decide whether this new ocean will be a sea of peace or a new, terrifying theater of war. I do not say that we should or will go unprotected against the hostile misuse of space any more than we go unprotected against the hostile use of land or sea, but I do say that space can be explored and mastered without feeding the fires of war, without repeating the mistakes that man has made in extending his writ around this globe of ours. There is no strife, no prejudice, no national conflict in outer space as yet. Its hazards are hostile to us all. Its conquest deserves the best of all mankind, and its opportunity for peaceful cooperation may never come again.[312]
>
> *President John F Kennedy*
> *12 September 1962*

Since 1962 there are now more states operating in space or actively interested in doing so and they have greater aspirations. Yet there is already significant congestion in orbital slots and associated frequencies. Space is already a hazardous domain, but space debris and increasing space traffic are adding to the hazards. Technical feats of greater and greater complexity have been achieved, although cooperation has been limited. The "best of all mankind" has not been unified towards a common goal of exploration and conquest, but rather those technical feats have most often been mastered unilaterally, so that the US and other space powers cannot now assume unchallenged pre-eminence. Space is increasingly competitive. Unfortunately, man has repeated the mistakes of the past – space was militarised from the beginning, at least in a relatively benign sense – there are weapons designed to go to space, fly through space and perhaps even operate in space and from space to Earth.

Space is not a sanctuary. States derive significant strategic benefits from space-based infrastructure in the civil, commercial and military sector.

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312 United States of America, Federal, Whitehouse, *Moon Speech* (12 September 1962) (Rice University: National Aeronautics and Space Administration, 1962) (President of the United States: John F Kennedy). To see a video of the speech, go to: <http://www.youtube.com/watch?v=ouRbkBAOGEw>.

Those benefits could quite conceivably be the difference between victory or defeat in a terrestrial conflict and it follows that States will seek to neutralise the strategic advantages of adversaries in outer space. That is not to say that States could or should pursue a high ground approach to the use and exploration of outer space. Even supposing it was feasible, the pursuit of such dominance would, at least in the short term, destabilise global space security even further. A survivability approach to the use and exploration of outer space, by hardening satellites against natural and artificial threats, is only a partial solution – it could not prevent a deliberate kinetic attack, for example. Therefore, States with capacity to do so are strategically compelled towards a space control approach. Their rhetoric may be to the contrary, but howsoever they might refer to terrestrially-based ASATs and non-kinetic means of disrupting adversary space systems, the reality is that several of the major space-faring States have taken a space control approach. Such an approach is in danger of becoming a self-fulfilling prophecy as an arms race in outer space spirals towards conflict, because of information asymmetry between States and their inability to make credible commitments to one another.

The possibility of armed conflict in the space domain must be contemplated. Current geopolitical circumstances suggest growing strategic instability as balances change between the world's major powers. Apart from those broad factors undermining peace in the current global security environment, space itself is increasingly competitive, congested, contested and even weaponised. Moreover, it is an attractive domain in which to push one another's boundaries – out of sight and difficult to attribute actions to one another.

It is said that good fences make good neighbours, but in space there are few clear physical boundaries. The proliferation of weapons of space raises serious concerns about whether there are effective normative boundaries for the use of outer space or whether it remains wild and lawless. It is not sufficient to simply state, as Article III, *Outer Space Treaty* does, that

international law generally applies to the space domain. The norms must be expressly stated with the maximum possible clarity in a form that is authoritative, broadly reflective of States' strategic interests and widely accepted. The norms must be verifiable and there should be consequences for breaches of the norms, which the States themselves enforce.

The foundational principles of space law were settled in the context of Cold War strategic mistrust. They involve a delicate balance between space power theories, preserving the strategic options of a State as much as possible, while concurrently restraining the strategic options of the adversary. Thus, the foundational principles involve concepts like 'peaceful use of outer space', which could be described as rhetorical in practice, given that there is wide variance in its legal interpretation. The prohibition on weapons of mass destruction in orbit and restrictions generally on weapons on celestial bodies are slightly more detailed, but far short of a comprehensive set of norms applicable in times of tension and actual hostilities in the space domain. Nevertheless, the foundational principles of space law do shape the *lex specialis* for armed conflict in its application to outer space.

The creation of treaty law specifically for the space domain stalled after the *Registration Convention*. However, there are many instruments within the broader framework of international law that have some application to the space domain, even in the context of hostilities. Consider the *Environmental Modification Treaty*, the *Nuclear non-Proliferation Treaty* and bilateral treaties, such as the *New Strategic Arms Reduction Treaty*. There are also less formal, non-binding initiatives, such as the annual 'Prevention of an Arms Race in Outer Space' resolutions of the UN General Assembly and the work of a Group of Government Experts to consider what transparency and confidence-building measures should be developed to help prevent an arms race in outer space and to prevent it from spiraling towards conflict. There is also the proposal by Russia and China for a treaty specifically prohibiting space weapons (PPWT) and the development of the International Code of

Conduct on Outer Space Activities (ICOC). The former seems unlikely to gather significant support in the near future, in part because of the difficulties of settling on a definition of 'space weapon' that is widely acceptable. States appear to prefer the behavioural approach of ICOC, although, as a non-legally-binding instrument it has been criticised as having no 'teeth'.

In short, none of the existing legal framework for outer space, nor any of the prospective legal and political framework provides effective norms of responsible behaviour in periods of tension and in actual hostilities. Yet, *jus ad bellum* and *jus in bello* are *lex specialis* for specifically that context. They provide a widely accepted, comprehensive set of norms developed over centuries, closely reflecting States' strategic interests and enforceable by States themselves. It is exactly this area of law that must be clear in order to restrain the recourse to force by States in the space domain. Yet there are many uncertainties about the application of *jus ad bellum* and *jus in bello* to the space domain and relatively little in the way of scholarly research and national statements.

Now is the time to seek clarity in the application of the law of war to the space domain, not when a conflict happens. Developing a manual, similar to the San Remo, Harvard and Tallinn Manuals, is not about legitimising conflict in outer space, but about setting clear, normative boundaries, given the reality of States' strategic interests in the space domain. It is about protecting the civil and commercial utility of space, predominantly for terrestrial services. It is about recognising the critical role of space in avoiding nuclear conflict. It is necessary because of the challenges of congestion, competition and the contested nature of outer space.

It is true that there is "no national conflict in outer space as yet." It is still possible "that space can be explored and mastered without feeding the fires of war". Whether this possibility, this glimmer of hope, will fade; "whether this new ocean will be a sea of peace or a new, terrifying theatre of war" depends on States, and their commitment to giving the rule of law a

position of pre-eminence. That does not mean that States must "go unprotected against the hostile misuse of space", but it does mean that States accept all of international law that regulates their behaviour in outer space, even accepting that there are limits on their behaviour in the context of tension and hostilities and it would mean giving those laws clear expression in their application to outer space.

The precedents exist for a 'Manual of International Law Applicable to Space Warfare' and, in fact, the Harvard Manual specifically foreshadowed a such a manual. What must happen next is the identification of an institution to fund the work and give a name to the manual and to set a date for its completion.

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