Space Support in Terrestrial Military Operations.

Implications for Emerging Thinking on the Future Airpower

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Resumo

O Apoio Espacial nas Operações Militares Terrestres. Implicações para o Pensamento Emergente sobre Poder Aéreo Futuro

É intenção deste ensaio fazer um estudo analítico de duas guerras contemporâneas relevantes, a primeira Guerra do Golfo e a Operação *Enduring Freedom*, onde o apoio do espaço foi decisivo para o estado final desejado. Tendo em consideração este estudo e as teorias e doutrina contemporâneas relativas ao espaço, será confirmado que, apesar da utilidade relativa de trazer à liça a *armamentização*, todas as escolas de pensamento apresentam sérias limitações em estabelecer uma estratégia para as operações espaciais. De acordo com a perspectiva do autor, o uso militar do espaço apenas como multiplicador do Poder Terrestre não exige uma teoria que reflicta sobre a sua utilização. A criação de uma verdadeira estratégia, política e doutrina espacial, que regulamentarão as operações espaciais poderão resultar de dois factores capitais: a necessidade de proteger os interesses vitais no espaço e a capacidade de produzir efeitos letais e não letais a partir deste meio. Esses factores poderão também desequilibrar a balança a favor da criação de uma Força Espacial como Ramo independente.

Abstract

This essay intends to make an analytical study of space support in two relevant contemporary wars, First Gulf War and Operation Enduring Freedom, where its role was decisive to the final outcome. Taking in consideration these two case studies, and today´s space theories/doctrine, it will be confirmed that, despite the relative utility of bringing the space weaponization to the debate arena, all the current schools of thought have serious limitations while establishing a strategic framework for space operations. According to the author's perspective, military use of space just for terrestrial force enhancement does not really demand a theory of space power. The creation of a truthful space strategy, policy and doctrine that will regulate space operations might result from two main factors: the vital need to protect the ever-growing interests in space and the ability to provide kinetic space-to-ground, space-to-air and/or space-to-space effects. Those factors might also tip the scales in favour of a dedicated and separate space Service.

> "…space warfare is a certainty in the future because the use of space in war has become vital."[1]
>
> Colin S Gray

Introduction

In spite of the important progress that space military capabilities had during the 1950s and 1960s, little advances were made since then. One can say that by the late 1960s the United States (US) already had fielded a comprehensive space reconnaissance, a space based military communication system and launched a variety of vehicles to space. Moreover, at that time, the US also had well developed projects to construct spaceplanes and space-based defence systems. However, four decades after that *golden era*, we still miss truly military capabilities based in space.

In contrast, aircraft that started to be developed in the first decade of the 20th century, immediately played a decisive military role in the *battlefield*. Just one decade after their *birthday*, aircraft were able to conduct almost all forms of warfare, from intelligence gathering to force application. Their performance was so trustworthy and influential that much effort was soon expended to control the airspace. That became the primary objective of the air forces and it was unquestionable that the outcome of the sea and land warfare would be hugely dependent on the existing level of control of the air. Since then, the technologic and doctrinal advances enabled the aircraft to be even more precise and powerful in their effects, that we just entered the 21st century with the aircraft being the first option to solve nearly all varieties of contingencies.

If the control of the air is a pre-requisite to winning a military battle, that has no correlation in space matters. Apart from some Anti-Satellite (ASAT) warfare capabilities that some countries possess, the actual space posture shows almost no means to truly control the space, either by denying its use to an adversary, or protects it for our own use. This lack of progress in developing true military space capabilities is not only due to technology limitations. Perceptions, high costs associated with space programs and political controversy are also at the root of the problem. In addition, in spite of the attempts made by several authors, such as Lupton, Oberg, Dolman or more recently Klein, the quest for a space power enduring theory that will fully explain the nature of space and will predict the nature of space operations is still in progress.

1 Gray, Colin S., *Another Bloody Century – Future Warfare* (London: Phoenix, 2005), p. 307.

Despite not being the decisive warfare element in today's conflicts, space has become *the key* enabler for all military components and the actual concept of war includes a huge amount of space systems support. This is the framework where we are going to challenge the current space military operations and to analyze its actual performance and future expectations.

In order to answer the first proposed research question – Are the boundaries between terrestrial military operations and space military operations becoming blurred? – it is the essay's intention to make an analytic study of two relevant contemporary wars where space support was a contributor to the final outcome. The first case-study will be the First Gulf War – Operation Desert Storm (ODS), for many also labelled as the first true space war. The second case-study, separated ten years apart from the first one, will be the Operation Enduring Freedom (OEF), a joint and combined operation led by the US to fight the Taliban militias, seen as the Al Qaeda effective support in Afghanistan. Due to the long duration of OEF, this study focuses, predominantly, on the space contribution to the joint and combined operations from 7 October 2001, through to March 2002. This approach will permit us, at the end of the first section, to identify the evolution of space activities and operations.

The second section of this essay will focus its attention on the contemporary thinking on the future airpower. Taking into consideration the results obtained from the two case-studies and the analysis done in this section, the author will try to finally answer the second assigned question – What implications might this have for emerging thinking on the future airpower?

Operation Desert Storm

In August 1990, Iraqi military forces invaded Kuwait, seizing its oilfields and creating a security threat to the Middle East region. In order to re-establish Kuwaiti sovereignty and to expel the Iraqi forces from Kuwait, a multinational coalition, empowered by the United Nations Security Council, deployed their military forces to the region. The US led multinational coalition started its offensive campaign on 17 January 1991 with a wave of coordinated air strikes against Command and Control (C2) centres, Integrated Air Defence Systems (IADS) while demoralising and devastating ground forces along with their supply infrastructure.

By 28 February, same year, coalition ground forces, supported by a persistent airpower, accomplished the desired end-state – expelling Saddam Hussein's ground forces from Kuwait. The military defeat of the Iraqi forces in just a 43-day campaign, was premised heavily on the well coordinated, devastating and highly precise use

of airpower. In spite of the Stealth technology, the Precision Guided Munitions (PGM) used in coordination with targeting systems that reduced the numbers of sorties needed to strike each target, the contribution of space-based assets was also a decisive factor that enhanced the allied overpowering success.

The Gulf War was not the first serious employment of space-based assets while carrying out military operations. This had already happened during the Vietnam War, when remote sensing and communication satellites made an important contribution supporting the US operations – providing weather, reconnaissance and C2; however, in the ODS, new and more updated technologies, better integration and greater understanding of the space-based products changed the general opinion over the future role that these type of assets can play in military operations.[2]

The Gulf War clearly confirmed the growing potential of space-based assets for multiplying the effects produced by other military technologies. The space contribution allowed better C2[3] and more detailed and accurate identification of critical military capabilities. In addition, it also provided a navigational system of stunning accuracy and a quick and more precise assessment of the damage inflicted by the coalition attacks (Battle Damage Assessment – BDA). In other words, more efficiency in C2 and a targeting process with less human exposure to enemy fire – the BDA performed by space assets reduced pilot casualties in air reconnaissance missions.

However, despite the military space-based assets' precious contribution, some major deficiencies were exposed by the heightened tempo of war. Space assets immediate availability and flexibility was not at the level expected by some coalition commanders. As an example, General Horner, the Joint Force Air Component Commander (JFAC), requested area expanded coverage by additional reconnaissance satellites or by moving others to a position that would allow better surveillance of the battlefield and would increase the flexibility of the air operations. The answer was that it would take probably six months to one year for such a deployment. Nonetheless, additional satellites were placed in orbit (all had been scheduled long before the crisis started), some intelligence satellites were re-orientated to cover the battlefield and supplementary data was purchased from the French SPOT image sensing satellite that frequently scanned the area.[4]

2 Handberg, Roger, *Seeking New World Vistas – The Militarization of Space* (London: Praeger, 2000), p. 88.

3 'Space enabled a fully secure and effective trunk and tactical communication network, large enough to support a 400,000-strong army, to be established in-theatre in a few weeks.' – Campen, Alan D. (ed.), *The First Information War* (Fairfax: AFCEA, 1992), p. 121.

4 Handberg, Roger, op. cit.,p. 90.

Another factor that affected the performance of military space assets' outcome was the lack of operational *field* experience and corresponding doctrine. Those issues induced additional pressure on operators that were forced to stretch the technology's limits and become creative in resolving the problems induced by this high tempo war. On the one hand, this ad hoc creative experience exposed the need of written doctrine and Standing Operating Procedures (SOPs) that would enhance the management and operation of the assigned assets. On the other, it created the foundation for doctrine being written out of a real live scenario, where the rapid tempo of operations, the combat pressure and the technologic problems encountered in the missions, played a genuine effect of unravelling preconceived notions.

After this short introduction, this essay will present a brief summary of relevant facets of space operations and activities in this first Gulf War, focussing upon five broad areas: intelligence operations, weather, navigation and positioning, C2 and early warning.

Intelligence Operations – As far as intelligence operations are concerned, they included the two conventional forms of reconnaissance surveillance – the imagery and electronic intelligence collection. The first problem related to this matter, came in that US space-based intelligence assets were orientated toward observation and data collection of former Cold War's *enemies* – gathering intelligence regarding nuclear strategic capabilities. The sort of data provided by those spy satellites, mainly designed to detect camouflaged missiles silos and other hided infrastructures, had limited applicability in the tactical environment. Consequently, the intelligence cycle had to be accelerated because the tactical intelligence value of the data acquired decayed rapidly. On the one hand, it is well recognized that true tactical intelligence provided by space-based assets did not exist and that gap had to be fulfilled by other conventional means of acquisition; on the other, the detailed information proved to be fundamental to the initial planning of the air campaign, targeting and BDA all through the end of this endeavour.[5]

An unexpected space contribution that proved to be fundamental to the support of allied operations was the terrain mapping prior to operations. During the ODS preparation, it was discovered that area mapping could be an issue if not tackled adequately. Some parts of the area were not covered by mapping and the existent maps were outdated or had an inadequate quality for military planning. Therefore, commercial remote-sensing satellites that acquired imagery sufficiently detailed

5 ibid., p. 95.

to allow effective planning, were used in order to help the field commanders throughout the campaign.

In terms of electronic intelligence, it proved to be unwieldy, mainly due to organizational problems. Intelligence operators and warfighters had different perspectives about the real purpose of the data to be collected and the information process timings. This caused real frictions and possibly reduced military commanders' already wobbly confidence in their information gatherers – the warfighters lived in the immediate crisis while the intelligence operators worked in a much longer timeline.[6]

Weather – Accurate weather information is an essential requisite for military planning and execution. In the ODS, the weather data was provided by both military and civilian weather satellite systems, such as the Military Defence Meteorological Satellite Program (DMSP), the National Oceanic and Atmospheric Administration's (NOAA) TIROS polar-orbiting satellites, the GOES geostationary satellite, among others. If accurate weather data is fundamental to the success of friendly military operations, its denial to the enemy is also very important. However, total blockage was not possible due to commercial sources being provided by some of Iraq's friendly countries.[7]

The detailed weather data provided by the space-based assets had a special relevance to the air operations, since the use of laser guided weapons and smart munitions is mainly conditioned by the obligatory existence of clear weather on the target areas. Additional hazards, such as sandstorms and smoke from burning oil wells were also spotted from space and reported to the field commanders.[8] In all, this operational enabler proved to be very effective contributing to the overall success of this military campaign.

Navigation and Positioning – The ability to know the precise location of friendly and enemy forces in the battlefield has been a persistent problem through military history. One the one hand, its knowledge allows better precision and discrimination against enemy targets; on the other, it reduces the risk of friendly fire incidents – Blue-on-Blue situations. In spite of all the technologic capabilities available in theatre, ODS was not an exception to this last tragic occurrence, with a lot of allied troops being wounded or killed due to friendly fire.

6 ibid., p. 97.
7 ibid., p. 98-99.
8 Campen, Alan D. (ed.), op. cit., p. 131.

Since 1970s, a network of NAVSTAR Global Positioning System (GPS) satellites was able to provide precise geographic coordinates to all military forces; however, in this operation, the necessary equipment was not widely distributed among troops on the ground. Taking the geographic environment into consideration, the desert, it is easy to identify the importance of a GPS locator system in an area without distinctive physical features or markers. In order to tackle the GPS receiver *gap*, civilian equipments were then purchased and enhanced with better accuracy – selective filters were removed for the duration of the conflict.[9] This procedure was possible just because the adversary lacked an equivalent capability. In summary, the Gulf War showed the vital importance of the GPS capabilities in the military environment throughout the entire spectrum of operations.

C2 – The combination of a land and space-based communication system was the foundation of a robust, flexible and responsive allied C2 system. The coalition forces' communications network had in its inventory the Defence Satellite Communication System (DSCS) and satellites from the Fleet Satellite Communication (FLTSATCOM), NATO III and British Skynet. Some commercial satellites were also included in the list, augmenting the coalition communication capabilities and permitting to an unprecedented extent, the allied commanders and troops being wired, simultaneous, to all levels of warfare – strategic, operational and tactical. However, the operational demands requested an even greater communication capacity and showed, once again, the importance of additional satellite availability.

In contrast, the Iraqi forces had no military space-based assets, although they did enjoy access to commercial international networks such as Intelsat and Inmarsat. In addition, the use of Arabsat, which operates two satellites in the area, was also possible in the early days of the war; however, its exploitation was denied after an allied strike against its ground station in Baghdad.[10]

Despite the Iraqi inabilities to electronically *jam* or physically disrupt allies' communication network, the vital importance to conveniently engage this vulnerability in future operations is well acknowledged.

Early Warning – The early warning of modified Iraqi Scud missiles launched against Saudi Arabia and Israel became the most visible symbol of the military

9 'The NAVSAT GPS system provides two signals. One very accurate (within 30 feet), is restricted to military users, while the second is available to all other receivers, albeit with an inaccuracy of about 200 feet.' – Handberg, Roger, op. cit., p. 100.

10 Campen, Alan D. (ed.), op. cit., p. 122.

space activity in the public domain. The Iraqi strategic objective with this ballistic missile strikes was crystal clear – to undermine the alliance cohesion by provoking an Israeli response to the attacks. The integrated use of US Defence Support Program (DSP) satellites providing early warning of Scud launches, with US Patriot anti-missile systems became the critical allied capability to face that threat. The Scud hunt and kill chain was composed by three main steps: the DSP satellites area monitoring, using an Infra Red (IR) telescope; the missile's plume signature relaying to a ground controller that would correlate and identify the signal as a Scud; and finally, the missile's trajectory and timing relaying via satellite communication to Patriot batteries in Saudi Arabia and Israel.[11] In all, this early warning military space-based activity became another brick in the wall of the coalition's technological superiority.

The measurement of the space *component* effectiveness in this campaign can only be achieved by comparing the initial objectives delineated for the operation with the final outcome. In this particular case, one can say that space operations were a success, particularly because the pre-established objectives were much more modest – their main aim was just to enhance the other military technologies in order to make them more lethal and effective.[12] It is not consensual among the military thinkers that ODS was truly the first space war. However, quoting a British defence chief "The Gulf taught us that space has changed the whole nature of warfare."[13]

After everything said so far, the time has come to analyse OEF and to evaluate if ten years of technological evolutions and concept developments had much impact within the military operational context.

Operation Enduring Freedom

It can be said that 9/11 2001 Al Qaeda (AQ) attacks on the world superpower of today, the US, will change forever our western concept of security. In spite of all US security measures implemented to prevent terrorist attacks in its own territory, the AQ organization found a sophisticated way to deliver the desired *effects* by using several civilian hijacked aircraft to strike deeply at the heart of the nation.

11 ibid., p. 129.
12 Handberg, Roger, op. cit.,p. 93.
13 Quoted in Campen, Alan D. (ed.), p. 133.

In order to prevent similar events from happening, the US implemented a military campaign (Global War on Terror – GWoT) to engage the Afghan Taliban militias, identified as the AQ effective support in Afghanistan.

The multinational, joint and combined operations, led by the US, began on 7 October 2001, with two main objectives: changing the Taliban regime and fighting the active Taliban, AQ cells and militias in Afghanistan. The first objective was achieved successively after 63 days of operations, but the second, had become such a demanding and difficult task to be accomplished that is, presently, still in progress. Being the first military response of the GWoT, OEF is considered by Lambeth as '…a battle laboratory for testing, in live combat setting, some of the most significant airpower[14] developments to have appeared in more than two decades.'[15]

In terms of air operations, the OEF showed, alongside with the even more widespread use of precision weapons, the innovative use of remote controlled Intelligence Surveillance Target Acquisition and Reconnaissance (ISTAR) assets, such as the Predator MQ-1, striking enemy targets by its own means – using Hellfire missiles. In addition, some innovative forms of military services integration have been established, such as the use of airpower in coordination with Special Operations Force teams. However, the focus of our analysis will be set on the use of space-based technology in support of the operations, which permitted a constant pressure on the enemy.

As well as in the Desert Storm's analysis, the essay will focus attention in the same five broad areas; however, this time, spotlighting mainly the evolution either in technological or doctrinal terms.

Intelligence Operations – The ISTAR umbrella over Afghanistan was composed, mainly, of a network of Unmanned Air Vehicles (UAVs) and by nearly 100 satellites. Those assets provided near-real-time situation awareness to all OEF players at both C2 and execution levels. In order to augment the imaging satellite network, a third KH-11 satellite was placed on orbit two days before the start of OEF to join the two others that had been launched in 1995 and 1996. Although its launch had already been scheduled for that period of time, it was apparently delayed to fulfil the needs of OEF in Afghanistan. Additionally, a new Operational Support Office was established in the National Reconnaissance Office (NRO), the main

14 Airpower: 'The ability to project military force in air or space by or from a platform or missile operating above the surface of the earth.' – *Future Air and Space Operational Concept* MOD (DAS, 2005), p. 1.

15 Lambeth, S. Benjamin, *Air Power Against Terror – America's Conduct of Operation Enduring Freedom* (Santa Monica: RAND, 2006), p. 339.

US operator of intelligence-gathering satellites, in order to maximize those assets exploitation.[16]

For the first time in a military operation, operators were able to view, in the field, its requested information near-real-time. The prototype BRITE (Broadcast Request Imagery Technology Experiment) system enabled land forces to relay coordinates of possible targets to satellites, which then imaged the area of interest and transmitted high-resolution imagery back down to the requesting agency. During daylight and clear weather, the system used Electro-optical imaging to process the request; at night and through all weather conditions, radar imaging was then used to provide the needed data.[17]

As mentioned before, satellite remote controlled UAVs, from distant locations, such as Pakistan, provide near-real-time video, also transmitted via satellite, to track, identify and on some occasions strike, targets of interests on the ground. However, in some areas of Afghanistan where the satellite coverage was poor, the UAVs video feed faded in and out.

Aside from of the technological evolutions that enhanced the military operations, OEF also demonstrated a high demand for bandwidth. ISTAR systems, such as Predator and Global Hawk, were by far the highest consumers of military bandwidth. As a comparison, a single Global Hawk consumed about 500 megabits of bandwidth per second during its operation, approximately five times the overall consumed bandwidth used by all US military forces during ODS at its peak. It was not possible, with the available means, to provide the requested bandwidth to all the six Predators and two Global Hawks assigned to the theatre. As a consequence, only two Predators and one Global Hack were able to operate simultaneously. Moreover, OEF also highlighted the need for better management of existing bandwidth. Satellites fully devoted to ISTAR platforms were a waste of resources when those assets were not in operation.[18]

Weather – As well as in ODS, OEF also beneficiated from commercial, National Aeronautics and Space Administration (NASA) and NOAA weather satellite data. Consequently, NASA's Quick Scatterometer (Quickscat), SeaWiFS and MOdis spacecraft were able to provide all the required data (sea surface wind speed and direction, wind, fog, dust, and cloud conditions at specific altitudes and geographic locations) to efficiently plan air operations. In addition, the technological evolution

16 ibid., p. 274.
17 ibid., p. 276-277.
18 ibid., p. 278-279.

of those space-based assets permitted the differentiation of low clouds from fog – important information for low-level helicopter operations.[19]

Navigation and Positioning – OEF reconfirmed the vital importance of the GPS use in military operations. The integrated use of the GPS satellite constellation with locator systems and targeting devices permitted unprecedented levels of precision and discrimination. On the one side, the widespread use of navigational GPS kits among troops allowed improved battlefield situation awareness, better campaign synchronization and fewer risks of friendly fire incidents; on the other, the generalized use of smart weapons using GPS signals, such as the Joint Direct Attack Munition (JDAM)[20], to precisely strike ground targets, allowed reduced levels of collateral damage – a critical issue in the today's globalized world. The GPS accuracy was so refined that JDAM's average miss distance to half the expected one. This fact is even more relevant if we take in consideration that we are "fighting among the people", in urban and difficult scenarios where the enemy is sometimes difficult to discriminate.

Another space-reliant military device that came into view in OEF was the Blue Force Tracker, a satellite based identifier which allows the identification of forces as friendly or foe. This equipment was operationally tested in OEF in order to be further disseminated and used in the Operation Iraqi Freedom. The results of the experiment were clear – an unprecedented level of situation awareness, reduced chances of fratricide incidents and increased flight safety, amongst other important contributions.

C2 – In terms of C2, a brigadier general from Air Force Space Command was assigned to the Combined Air Operations Centre (CAOC) in order to guarantee that CENTCOM would have all the needed support from the US space-based assets. In counterpart to the CAOC's Air Tasking Order (ATO), a closely integrated daily Space Tasking Order (STO) was also implemented by the 14th Air Force's space operation centre in order to better synchronize the planning, tasking and control of space-based assets. In all, the space Air Operation Centre's (AOC) mission had the following tasks: manage the bandwidth available to the CENTCOM by repositioning the defence communications satellites; supply information about GPS performance for strike planning; perform area watch for IR events; provide space-based IR support

19 ibid., p. 277.

20 During Operation Allied Force (1999), only the B-2 was configured to use the JDAM; in OEF nearly every US strike platform was equipped with that capability. – ibid., p. 339.

for BDA; and support CENTCOM critical missions, such as special operations and Combat Search and Rescue (CSAR), among others. Showing great level of flexibility, the STO allowed short-notice re-tasking within its 24-hour execution cycle in order to face urgent requests made by the supported commanders.[21]

In addition to the C2 structure described in the above paragraph, a still-embryonic Mission Management Centre for space support to the CAOC was created in order to track all the friendly forces movements throughout the entire area of operations. Its contribution, via the use of space-based assets, was vital to support CSAR operations and to confirm occasional collateral damage inflicted on non-combatants and Afghan civilian infrastructure. The SWC's contribution to OEF is highlighted in its Commander, Major General Thomas Goslin, statement – "… [Multisensor compiled data] improve knowledge of where the bombs landed. It gives us a better awareness of how the strike went – where the weapons actually hit as compared to where we wanted them to go."[22]

Early Warning – This area of operation did not have the same importance as it had in ODS. The counter-insurgency scenario presented in Afghanistan was far from being the ideal battlefield for this space-based application. However, the capacity of monitoring the signs of attacking long-range aircraft and missiles, either toward the US mainland or within the OEF area of operations was operative during OEF. The DSP satellite network, using IR sensors, continued to provide early warning and assessment capabilities for attacks done by long-range intercontinental ballistic missiles (ICBMs). The Space Based Infrared System (SBIRS) – Highly Elliptical Orbit satellite – is the follow-on program to DSP and will bring additional capabilities.

Taking in consideration the two case studies, it is easy to conclude that modern warfare is not conducted by a single service and that space-based support is no longer a nice to have capability. The space technological and doctrinal advances available in the studied ten-year period, clearly demonstrated that the synergy achieved by the integrated use of all services, supported by space-based assets, is much more than the simple sum of individual Service's military capabilities. The way we will fight future wars will be critically determined by the support given by existing space resources. A former US Secretary of the Air Force acknowledged this idea stating that "We look at space capabilities like oxygen. If you have it you

21 ibid., p. 275-276.

22 Scott, William B., *Improved Milkspace Key to Antiterrorism War*, Aviation Week and Space Technology, December 2001, p. 36.

take it for granted. If you don't have it, it's the only thing you want".[23] However, despite the 10-year technological and doctrinal evolutions that enable better and more precise support, space power provided just its initial supportive role.

After everything said so far, the time has come to answer the question – Are the boundaries between terrestrial military operations and space military operations becoming blurred? There is no simple answer to the question, but one can say that the Services' space dependency reached such proportions, that future military force application without the correspondent space support is difficult to foresee. Therefore the answer to the question would be a qualified *yes* – qualified by the reservations indicated in this paper.

In the next section of this essay, the author will focus its attention on the contemporary thinking on the future airpower, the broad term that includes space assets, in order to establish the links between the actual space operations and those thoughts. However, due to the limitations imposed to this essay, only the thoughts related with space matters will be analysed.

Contemporary Thinking on the Future Airpower

In terms of space strategy, policy and doctrine that regulates the space operations and its weaponization, there are presently four *schools of thought*: sanctuary, survivability, high-ground and control. Even if it is recognized that individuals could incorporate one or more aspects of the described schools to form their opinion, the four categories prove to be a valid tool when contemplating space strategy through the military lens.

Sanctuary – The sanctuary school states that the main value of space assets is their ability to, legally, perform ISTAR within the boundaries of other nations and that space should be considered a war and weapon free sanctuary. That will promote stabilization among the international community because it will be possible to verify arms control compliance between the superpowers.[24] However, on the one hand, the lack of regulation of this third dimension plus (3D+), leads procurement of military space systems and their employment being framed by Law of Armed Conflict, in

23 Lord, Lance W., *Congressional Testimony of General Lance W. Lord, USAF*, Astropolitics, Vol 3, No 2, Summer 2005, p. 215.

24 Klein, J. John, *Space Warfare – Strategy, Principles and Policy* (London: Routledge, 2006), p. 17.

particular the right of self defence. On the other hand, the threat assessment and the perception that each state has about self defence, leads nations, as the US, to recognize space's vital importance to their national strategy and the inherent right to protect and defend it in case of need. Not even the Outer Space Treaty[25] of 1967 established the legal framework for space issues. In fact, it does not limit the legitimate use of space, just the manner in which is delivered.[26] Within this framework, it will be difficult to promote space as a weapons free sanctuary.

Survivability – The second school holds that space systems have less survivability capabilities then the terrestrial ones. This thought is based in three main pillars: the idea that space assets are vulnerable to long range weapons, the assumption that space systems can not hide or manoeuvre in order avoid enemy attacks, and finally, the thought that states would probably not retaliate over the destruction of a space asset due to its lack of political importance. In all, this school claims space as a good medium to base some military capabilities; however, it also acknowledges that essential warfare functions should not depend exclusively on space systems due to its low survivability.[27] As we identified in the two case studies, modern warfare is highly dependent on space systems in order to produce the desired effects with high levels of precision and reduced collateral damage.

High-ground – The high-ground approach advocates state that domination of high-ground leads to control of the lower lying areas. Moreover, the combination of space systems characteristics, such ubiquity and presence, with additional offensive capabilities (weaponization) will provide overall defence against ICBMs or deter an enemy's aggressive intentions. In other words, this school recognizes space forces' dominant influence in the military operations and sees them as the key feature for future campaigns.[28] It is clear that the kinetic effects provided by space assets will provide a full spectrum of targeting abilities with relative levels of impunity. This will affect the enemy's morale and diminish the collective will to fight, especially in asymmetric warfare where the enemy does not have capacity to

25 The Outer Space Treaty has four major provisions: all countries have free access to space with liability for damaged caused; space will be used for peaceful purposes; no weapons of mass destruction will be placed in orbit around the Earth or on the Moon; and all space objects must be registered with the UN. – AP 3000, 3rd Edition, *British Air Power Doctrine*, MOD (DAS), (London: HMSO, 1999), p. 2.4.10.

26 Klein, J. John, op. cit., p. 143.

27 ibid., p. 17.

28 ibid.

counter the space effects. That milestone will truly extend the battlefield to the space and create additional demands in terms of space control. However, to succeed this main objective, political controversy around this issue will have to cease, the costs associated with space programs will have to decrease dramatically and military space capabilities will have to evolve technologically. Space weaponization policy adopted by one state, such as the US or China, whether for offensive or defensive purposes, will probably lead to a space *race*, with other states accelerating their own programs in order to counter this space capability or identify other means to deny its use. However, the costs associated with this weaponization *race* will probably drain away nations' impetus and desire to run such a program. In terms of costs, taking in consideration today's costs to boost a payload into low Earth orbit, approximately $10,000 per pound, the use of a *smart weapon*, weighting 500 pounds, from space would cost $5 million – five times as much as the most expensive cruise missile just to be placed in orbit.[29] In all, if space weaponization is the correct course, states will have to have the political appetite to invest hugely in space weapons investigation and development, either alone or with selected partners that can share the huge economic burden.

Control – The last doctrinal approach, control, emphasises the outer space's inherent value by comparison with both air and naval strategies. Analogies of space control with control of the air and space lanes of communication with sea lanes were made by this model's advocates that see space as a vital tool to achieve military success.[30] Despite being a promising space doctrine, the control school also fails to fully encompass the freedom required to develop a space theory. Space, air and sea are distinct operational and tactical mediums, not only with respect to the laws of physics, but also in regard to systems employment and constrains.

In terms of military space operations doctrine, the US Joint Publication 3-14 includes four primary space mission areas: space control, force enhancement, space support and force application. Comparing the US doctrine with the above described space theories, it is easy to identify many communalities in the ideas, concepts and limitations – it seems that the bases of both are mainly the same.

29 Binnendijk, Hans (ed.), *Transforming America's Military* (Washington: NDU Press, 2002), p. 184.
30 Klein, J. John, op. cit., p. 17.

Conclusion

As we previously identified in the analysis done, space has become *the key enabler* for all military components and the actual concept of war includes a huge amount of space systems support. However, some doubts exist if its relevance justifies, already, the materialisation in a new military service alongside the existing ones. The actual affiliation that space has with airpower and with the air forces, nominally in the US, could deny further advances in the terms of fighting for its own independence. Former CINCSPACE General Howell M. Estes III tried to highlight this fact by describing the Air Force of the late 1990s as standing "at a crossroads much like the one encountered earlier this century between land forces and airpower advocates. The result of the Army's inability to make the necessary culture change was decades of delay, higher costs and casualties, and finally a separate service."[31]

Taking in consideration the two case studies and the space theories/doctrine, it is clear demonstrated that, despite the relative utility of bringing the space weaponization to the debate arena, all the actual schools of thought have serious limitations while establishing a strategic framework for space operations. Further space operational maturity and creativity of thought is required to achieve parity with the high standards of land and air doctrines and theories. Additionally, the creation of a Space War College to study deeply space theories, strategies, principles and doctrines might bring a *breath of fresh air* to this important issue – the military use of space.

According to the author's perspective, military use of space just for terrestrial force enhancement does not really demand a theory of space power. The creation of a truthful space strategy, policy and doctrine that will regulate space operations might result from two main factors: the vital need to protect the ever-growing interests in space and the ability to provide kinetic space-to-ground, space-to-air and/or space-to-space effects. Those factors might also tip the scales in favour of a dedicated and separate space Service. As a final conclusion, one can say that the quest for all those issues is in progress and their fulfilment is possible in the near to medium future. The future could be uncertain, but one thing is for sure – space is just limited by our imagination.

31 Quoted in Lambeth, Benjamin S., *Mastering the High Ground* (RAND: 2003), p. 53.

Bibliography

Military Pamphlets

Air Force Doctrine Document 2, *Organisation and Employment of Aerospace Power*, (USAF, 1998).

AP 3000, 3rd Edition, *British Air Power Doctrine,* MOD (DAS), (London: HMSO, 1999).

AP 3002, *Air Warfare,* MOD (Media Services HQSTC, 2006).

AP 3003, *A Brief History of the Royal Air Force,* MOD (HMSO, 2004).

Future Air and Space Operational Concept, MOD (DAS, 2005).

Joint Doctrine Note 1/05, *The UK Military Effects-Based Approach,* MOD (JDCC, 2005).

Joint Doctrine Note 4/05, *The Comprehensive Approach,* MOD (JDCC, 2005).

Joint Doctrine Note 7/06, *Incorporating and Extending the UK Military Effects-Based Approach,* MOD (DCDC, 2006).

Joint Doctrine Publication 01, *Joint Operations,* MOD (JDCC, 2004).

Joint Publication 3-14, *Joint Doctrine for Space Operations* (Washington: USSC, 2002).

Joint Warfare Publication 3-00 2nd Edition, *Joint Operations Execution,* MOD (JDCC, 2004).

Books

Bekey, Ivan, *2010-2030+ – Advanced Space System Concepts and Technologies* (El Segundo: The Aerospace Press, 2003).

Binnendijk, Hans (ed.), *Transforming America's Military* (Washington: NDU Press, 2002).

Campen, Alan D. (ed.), *The First Information War* (Fairfax: AFCEA, 1992).

Dolman, Everett C., *Astropolitik – Classical Geopolitics in the Space Age* (London: Frank Cass, 2002).

Gates, David, *Sky Wars: A History of Military Aerospace Power* (London: Reaktion Books Ltd, 2003).

Goure, Daniel and Szara, Christopher M. (eds.), *Air and Space Power in the New Millenium* (Washington: The Centre for Strategic & International Studies, 1997).

Gray, Colin S., *Another Bloody Century – Future Warfare* (London: Phoenix, 2005).

Gray, Peter W (ed.), *Air Power 21: Challenges for the New Century* (London: HMSO, 2000).

Griffin, Dr Stuart, *Joint Operations: A Short History,* (MOD, 2005).

Hallion, Dr Richard P (ed.), *Air Power Confronts an Unstable World* (London: Brassey's, 1997).

Handberg, Roger, *Seeking New World Vistas – The Militarization of Space* (London: Praeger, 2000).

Hays, Peter L., Smith, James M., Tassel, Alan R. Van and Walsh, Guy M. (eds.), *Space Power for a New Millennium – Space and U.S. National Security* (Nd.: The McGraw-Hill Companies, Inc., 2000).

Jasani, Bhupendra (ed.), *Peaceful and Non-Peaceful Uses of Space – Problems of Definition for the Prevention of an Arms Race* (London: Taylor & Francis, 1991).

Khalilzad, Zalmay and Shapiro, Jeremy (eds.), *United States Air and Space Power in the 21st Century* (Santa Monica: RAND, 2002).

Klein, J. John, *Space Warfare – Strategy, Principles and Policy* (London: Routledge, 2006)

Lambeth, S. Benjamin, *Air Power Against Terror – America's Conduct of Operation Enduring Freedom* (Santa Monica: RAND, 2006).

Lambright, E. Henry (ed.), *Space Policy in the 21st Century* (London: The Johns Hopkins University Press, 2003).

Masson, Tony, *Air Power – A Centennial Appraisal* (London: Brassey's, 1994).

Olsen, John Andreas (ed.), *A Second Aerospace Century* (N.d.: The Royal Norwegian Air Force Academy, 2001).

Olsen, John Andreas (ed.), *From Manoeuvre Warfare to Kosovo* (N.d.: The Royal Norwegian Air Force Academy, 2001).

Organization for Economic Co-operation and Development, *Space 2030 – Exploring the Future of Space Applications* (Nd.: OECD, 2004).

Peach, Stuart (ed.), *Perspectives on Air Power* (London: HMSO, 1998).

Singh, Jasjit (ed.), *Air Power and Joint Operations* (New Delhi: Knowledge World, 2003).

Smith, Gen Sir Rupert, *The Utility of Force: The Art of War in the Modern World,* (London: Penguin/Allen Lane, 2005).

United Nations Institute for Disarmament Research, *Common Security in Outer Space and International Law* (Geneva: UN, 2006).

Winnefeld, James A. and Jonhson, Dana J., *Joint Air Operations: Pursuit of Unity in Command and Control, 1942-1991* (Santa Monica: RAND, 1991).

Periodicals

Fredriksson, Lt Col Brian E., *Space Power in Joint Operations – Evolving Concepts* Air & Space Power Journal, Summer 2004, pp. 85-95.

Scott, William B., *Improved Milkspace Key to Antiterrorism War*, Aviation Week and Space Technology, December 2001.

Shull, Maj Todd C., *Space-Operations Doctrine – The Way Ahead* Air & Space Power Journal, Summer 2004, pp. 96-102.

Lord, Lance W., *Congressional Testimony of General Lance W. Lord*, USAF, Astropolitics, Vol 3, No 2, Summer 2005, pp. 213-231.