Research Essay

Space Policy

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> Countries that fail to adapt soon enough or well enough to the changing character of warfare are condemned to fail or succeed at unnecessary cost and loss of life.
>
> Colin S. Gray[1]

INTRODUCTION

Operation Desert Storm, the Gulf War of 1990/91, has been described as the first space war.[2] The United States Army Center for Lessons Learned while reviewing the same war referred to space as "the ultimate high ground."[3] Colin Gray refers to space as the "latest variant of the high ground that doctrine often advises military commanders to seize and hold."[4] These terms imply that there was a fundamental change in the conduct of warfare during the Gulf War. In fact, some scholars would suggest that the change was so important that it should be viewed as the start of a revolution in military affairs (RMA).[5] The question as to whether Operation Desert Storm was or was not an RMA is not at issue in this paper. What is at issue is the technology that was used in the Gulf War to achieve Coalition victory in such a decisive manner. That technology is based on satellites and the associated use of the information they provide and transmit from space.

During the Gulf War, satellites were used to provide communications, surveillance, ballistic missile warning, navigation and geographic support; as well they

[1] Colin S. Gray, "The Influence of Space Power on History," Comparative Strategy Vol 15 (1996): 293.
[2] Peter Anson and Dennis Cummings, "The First Space War: The Contribution of Satellites to the Gulf War," RUSI Journal Winter 1991: 45.
[3] US Army Combined Arms Command, Space Support to the Army: Lessons from Operations DESERT SHIELD and STORM, No. 91-3 Oct 91: Title page.
[4] Colin Gray 300
[5] Eliot Cohen, "A Revolution in Warfare," Foreign Affairs March/April 1996: 54.

were the means to transmit the details of the war into homes around the world.[6] The capabilities displayed in the Gulf War have since been embraced by all services in the United States military.[7] An example of this new thirst for technology, can be found in the forward to FM 100-18, Space Support to Army Operations. In this manual the US Army Chief of Staff, General Gordon R. Sullivan, states "space and space-related capabilities are essential contributors to Army modernization objectives", and "the Army's future is inextricably tied to space."[8] The US Navy is also embracing space. This is as a result of the fact that "the naval warrior is always at the end of the thin thread for information exchange. This information exchange must happen exclusively through the medium of satellite communications…"[9]

These are strong words that clearly show the direction that the US Military will take with regards to space. This approach is mirrored in the US national military space policy. The United States military has not only identified the importance of space and space-related technology but is fashioning its forces to make maximum use of this fourth dimension in warfare.

[6] Anson and Cummings 45. The word surveillance is used in this context vice intelligence as satellites provide raw data that can become intelligence once properly analysed.
[7] All US Military services less the Marine Corps have established their own component Space Commands.
[8] Department of the Army, FM 100-18, Space Support to Army Operations (Washington: Department of the Army, July 1995) Forward.
[9] World Wide Web. Navy Space Command, Commander Austin Boyd, "The Heart of the "War Beast."" 1and 2.

Canada too has interests in space. Canada was the third nation to have a satellite in space with the launch of Alouette 1 on 29 September 1962.[10] Since that time Canadian involvement in space has continued but has not followed a consistent development effort.[11] Although there is a Canadian Space Agency, there are Canadian astronauts and the CANADARM goes into space aboard each shuttle, Canadians do not appear to have embraced space with the same vigour as their American neighbours to the south. Certainly, our military forces do not seem to be forward-looking in an attempt to make full use of space.

This paper will examine the current and forecast use of space by military forces. It will show that the Canadian Forces (CF) space policy is not aggressive in identifying global trends in space and equipment shortfalls, and does not look to the future, in concert with emerging doctrine, to provide the direction necessary to support CF, coalition or joint operations in the future.

This paper will begin with a review of American military space policy, showing it to be positive, forward thinking and dynamic, while the Canadian policy, although hopeful, is vague and non-definitive. A review of the current and emerging technology will show that warfare has the potential to change quickly and dramatically and that the

[10] Brian MacDonald ed, Space Strategy: Three Dimensions (Toronto: Canadian Institute of Strategic Studies, Spring 1989) 2. MacDonald quotes the opening comments of Mr. D.B. Dewar, the Deputy Minister of National Defence to the annual Military and Strategic Studies conference.
[11] Department of National Defence, Space Indoctrination Handbook (Winnipeg: Canadian Forces School of Aerospace Studies, undated) 3-1.

Canadian Forces (CF) must be poised to take advantage of it or risk being left behind. Finally, the paper will demonstrate that unlike the United States, Canada is not developing doctrine that will take advantage of the technology that is available. In short, the CF will be acquiring some capability for which it has no validated purpose. The CF will not be capable of "tying developments together and build[ing] doctrines, strategies, and tactics that take advantage of their technical potential."[12]

SPACE POLICY

One of the most important documents in the United States military today is Joint Vision 2010. This document provides "the conceptual framework for how America's Armed Forces will channel the vitality and innovation of [their] people and leverage technological opportunities to achieve new levels of effectiveness in joint warfighting."[13] The technologies and processes associated with space are evident throughout Joint Vision 2010. Global positioning, ballistic missile defence, multispectral sensing, electromagnetic technology, telecommunications and fusion of all-source intelligence are all expected to work in harmony in order to ensure "dominant battlespace awareness" and "order of magnitude improvement in lethality."[14] The emerging operational concepts presented in this vision are dominant maneuver, precision engagement, focussed logistics, and full-dimension protection. These in turn lead to "full spectrum

[12] Joseph S. Nye Jr. and William A. Owens, "America's Information Edge" Foreign Affairs Vol 75, No. 2, (1996): 23.
[13] Department of Defence, Joint Vision 2010 (Washington: Joint Chiefs of Staff, 1996) 1.
[14] Joint Vision 2010 13.

dominance."[15] Joint Vision 2010 stresses the need for joint doctrine to shape the military of the future. It states that "joint doctrine is a critical ingredient for success because the way in which leaders think and organize their forces will be as important as the technology we use to conduct future joint operations."[16]

The Commander in Chief, United States Space Command (USSPACECOM), as the Unified Commander in Chief responsible for Space, is primarily responsible for the implementation of United States military space policy. This policy is embodied in USSPACECOM's Vision for 2020. The policy falls out of Joint Vision 2010 and is structured to show how the space policy is subordinate to, yet supporting of, the over-arching vision. Space power is shown to be vital to attaining operational concepts enunciated by the Chairman of the Joint Chiefs. Satellites will be used to assist the maneuver of forces and weapon systems dispersed in time and space, locate, monitor and select critical targets while providing protection of friendly forces from conventional, ballistic missile and cyber attacks, in order to maximise the effectiveness of United States forces.[17]

The vision for USSPACECOM is one of "dominating the space dimension of military operations to protect US interests and investment" while "Integrating Space Forces into warfighting capabilities across the full spectrum of conflict."[18] This vision is based on four tenets: control of space, global engagement, full force integration and

[15] Joint Vision 2010 26.
[16] Joint Vision 2010 29.
[17] United States Space Command, Long Range Plan (Colorado Springs: March 1998) 7-10.
[18] United States Space Command 10.

global partnerships. Control of space ensures that the United States and her allies will be able to operate freely in space while denying that capability to adversaries. Global engagement is the combination of real time global surveillance and ballistic and cruise missile defensive systems. In time, space-based weapons may be used for offensive and defensive roles. Full Force Integration is the critical role of ensuring all forces have access to, and can make use of, all available information. Global partnerships are the way ahead as opportunities, costs and risks are shared between business, industry, governments and the military.[19]

The most recent version of the Canadian military space policy, approved on 14 September 1998, supersedes the 1992 version. In the covering letter, the Chief of the Defence Staff, General Maurice Baril, and the Deputy Minister of the Department of National Defence (DND), Jim Judd, state that this updated policy was required as a result of the 1994 Defence White Paper and the 1996 renewal of the NORAD agreement.[20] The policy delineates the DND and CF goals in space and details how these goals will be pursued. Like the 1992 version, the latest space policy is based largely on the Gulf War and "underscored the crucial role of space assets in assuring a nation's security and survival…"[21] In short, DND and the CF space goals, as articulated in the policy, are to protect national security and sovereignty interests from threats making use of space and

[19] United States Space Command 10-13.
[20] Department of National Defence, Department of National Defence Space Policy (Ottawa: DND, 14 September 1998)
[21] David B. Dewitt and David Leyton-Brown, eds, Canada's International Security Policy (Scarborough: Prentice-Hall, 1995) 121.

by using space technology whenever appropriate.[22]

In pursuing these goals DND and the CF will, where appropriate, use space to protect Canadian security and support CF operations world wide, develop a capability to monitor space and acquire and assess space data, support arms control and participate in space-supported search and rescue systems.[23] The policy enunciates the capabilities that the CF will pursue as follows; data acquisition and exploration, command, control and communications, including navigation, surveillance and warning systems.[24] In times of financial constraint, the leveraging of our relationships with allies, particularly the United States, and development with industry will be exploited to the benefit of the CF.[25]

The space policy rightfully acknowledges the role that NORAD has played in space development. The NORAD agreement currently focuses on Canada's involvement in aerospace warning and control. In part, this entails the monitoring of all man-made objects in space and warning of attack against North America by weapons using or travelling through space.[26] This agreement will be discussed in more detail later in this paper.

The Canadian military space policy is supported by the Canadian military space strategy. This strategy, published by the Deputy Chief of the Defence Staff, reviews the

[22] DND Space Policy 2/8.
[23] DND Space Policy 2-3/8.
[24] DND Space Policy 4/8.
[25] DND Space Policy 4/8.
[26] Captain Don Nicks, Corporal John Bradley, and Chris Charland, Air Defence of Canada 1948 - 1997 (Ottawa: Gilmore Printing, 1997) 201.

current policy framework, identifies capability requirements, details the equipment programs that will be pursued, and suggests certain enabling activities. The strategy depends to a large degree on the good graces of the United States. Defence Planning Guidance 1998 acknowledges this fact with the statement, "[i]n light of the limited resources allocated to space in the CF Long Term Capital Plan, cooperative participation in US programs is considered a key component in the development of a modest space capability for the CF."[27] The strategy acknowledges the following key capability requirements; space-based surveillance, weather monitoring, geomatics, surveillance of space, warning and defence, navigation and communications. The rationale for acquiring many of these capabilities is based on lessons learned during the Gulf War.[28]

The major equipment acquisition projects detailed in the strategy are estimated to cost DND $1.72 Billion over the next 15 years. The more costly projects are for military satellite communications ($646 Million), a global positioning system (GPS) for select CF aircraft ($152 Million), and an enhanced search and rescue capability ($64 Million).[29] This level of funding is less that 2 percent of the military budget.[30] In addition it comes at a time when the CF is considering drastic cuts to the overall program to address a perceived funding shortfall of $1.5 Billion per year. As a result services are more

[27] Department of National Defence, Defence Planning Guidance 1998 (Ottawa: DND, 1998) Art 207.2.
[28] Department of National Defence, A Canadian Military Space Strategy: The Way Ahead for DND and the Canadian Forces (Ottawa: NDHQ, 6 May 1998) 4-6/11.
[29] DND, Space Strategy 8-10/11.
[30] The figure is based on the assumption that the current level of funding for DND, some $9 billion per year, will continue for the next 15 years.

focussed on their own funding problems than on addressing the issue of funding for space programs.

On 12 May 1958, an Exchange of Notes between Canada and the United States resulted in the creation of the North American Air Defence Command (NORAD). The creation of NORAD acknowledged the requirement to have "in existence in peacetime an organization, including the weapons, facilities and command and control structure that could operate at the outset of hostilities in accordance with a single air defence plan approved in advance by national authorities.[31] The NORAD agreement is reviewed every five years and although the wording of the agreement has remained essentially the same over the years, NORAD has adjusted to changes in the strategic environment. Recently, these changes included the end of the Cold War, an increase in drug trafficking and the increasing importance of Space. In 1981, the official name of the agreement was changed to reflect more clearly the space environment. NORAD became the North American *Aerospace* Defence Command (NORAD) (author's italics).[32] In the 1996 renewal of the NORAD agreement, the importance of space was clearly recognized with the phrase "space has become an increasingly important component of most traditional military activities…[and] the role of space will take on added significance."[33]

The 1996 renewal saw a re-articulation of the NORAD missions. The present missions are aerospace warning and control for North America. These missions were

[31] Nicks, Bradley and Charland 193. A complete copy of the original Note is reproduced starting on this page.
[32] Nicks, Bradley and Charland 196.
[33] Nicks, Bradley and Charland 200.

defined to include the provision of surveillance of the aerospace environment and control of the airspace of Canada and the United States. The renewal went on to state that the "expansion of binational cooperation on other aspects of the aforementioned missions should be examined and could evolve if both nations agree."[34] This wording could be interpreted to mean that Canada might, at some point, be willing to discuss a ballistic missile defence (BMD) system with the United States as part of the NORAD agreement. This idea is supported by the 1994 Defence White Paper which states, "Canada is interested in gaining a better understanding of missile defence through research and in consultation with like-minded nations…but in conjunction with the evolution of North American and possible NATO-wide aerospace defence arrangements."[35]

In summary, the unique relationship between Canadian and the United States military forces, as reflected in the NORAD agreement, is extremely important to Canada. NORAD has allowed Canada unparalleled access to US space technology for a very small investment. NORAD is an excellent example of the leveraging that General Baril speaks of in the military space policy. The NORAD relationship has done a great deal to promote the Canadian military's interest in space. As such, it will continue to receive special attention and could form the basis of future co-operative work in areas such as ballistic missile defence.[36]

A comparison of the two space policies shows the United States policy is written

[34] Nicks, Bradley and Charland 201.
[35] Department of National Defence, 1994 Defence White Paper (Ottawa: DND, 1994) 25. Additional information concerning BMD can be found in an article by James Fergusson, "Getting it Right: The American National Missile Defense Programme and Canada" Canadian Defence Quarterly, Summer 1998, 20-24.
[36] DND Space Policy 7/8.

in an aggressive and active tone, and is forward looking and dynamic. Words and phrases such as 'full spectrum dominance', 'battlespace awareness', 'global engagement', and 'Full Force Integration', lend credence to General John M. Shalikashvili's words in Joint Vision 2010, "we will move towards a common goal: a joint force - persuasive in peace, decisive in war, preeminent in any form of combat."[37] It is clear that the American policy is written for warfighters; for a nation's military that cannot afford failure and must ensure the pre-eminence of the United States on the world stage. The Canadian policy on the other hand cannot be read with the same passion. Canadian policy uses phrases such as 'confidence building measures', 'cost-effective', 'affordable', and 'framework for educating'. This type of language is bland and uninspiring. However, it is similar to language found in other Canadian policy statements. The 1994 Defence White Paper speaks of "developing a space-based surveillance system…subject to a variety of military, financial and technological considerations."[38]

TECHNOLOGY

What are the space-based systems and technologies that are expected to profoundly change future warfare? In the introduction to this paper some general issues were mentioned that arose from the Gulf War. This section of the paper will explore the available and emerging technologies in more detail. It is important to remember, however, that the important aspect of any new technology is how it can contribute to an overall strategy.

[37] Joint Vision 2010 2.
[38] DND, 1994 Defence White Paper 25.

Communication satellites played a critical role in the Gulf War. Prior to the start of the conflict there were only about 70 commercial voice circuits available out of the Gulf. This number rose to more than 1,400 circuits, serviced by 12 satellites and 140 ground stations, by the end of the conflict some six months later.[39] This vast array of satellites and ground stations was not put together overnight. In some cases satellites had to be moved from their reserve positions, in others new experimental satellites were launched and extensive commercial augmentation was used.[40] In still others, realignment of antennas provided increased capacity.[41]

In addition to the communications satellites that supported military operations in the Gulf, 20 surveillance satellites also supported the Coalition.[42] These surveillance satellites can be grouped into two general categories. The first group contains what are commonly referred to as reconnaissance satellites and the other group has satellites that provide information on weather and terrain. Both groups of satellites were important and their contributions to victory were equally applauded. The French Minister of Defence believed that the results of the War were attributed in large part to the fleet of US surveillance satellites, while US personnel noted the contribution of the French SPOT earth observation satellites.[43] This self-congratulation by members of the coalition was

[39] Anson and Cummings 46.
[40] Army Lessons Learned 16.
[41] Anson and Cummings 46.
[42] Anson and Cummings 49.
[43] Anson and Cummings 50.

understandable given the nature of their victory. The important point, however, is how did this technology assist in the victory.

Information dealing with US reconnaissance satellites is highly classified, however, some data does appear in open sources. The National Reconnaissance Office recently unveiled the latest Lacrosse satellite. It and its associated geosynchronous orbit[44] relay satellites were developed as a result of deficiencies identified during the Gulf War.[45] The Lacrosse series of satellites uses radar imaging to produce pictures taken through clouds, foliage and darkness with one-metre resolution.[46] This technology is not cheap; the latest Lacrosse satellite costs $1.5 billion US and the launch vehicle will cost another $500 million US.[47] US spy satellites were invaluable in assessing battle damage. By comparing "the more accurate photographic reconnaissance by day with night radar images, interpretation staff were able to assess the discrete damage caused by precise 'smart' weapons, a facility that would otherwise have required reconnaissance aircraft over flights."[48]

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[44] John M. Collins, Military Space Forces (Washington: Pergamon-Brassey's,1989) 17. There are several different types of satellite orbits. LEO altitudes range from 90-500 miles and are used for weather, reconnaissance and surveillance, and earth resource satellites. GEO (satellite remains over one point on the earth) has an altitude of 22,300 miles and is used for communication and some surveillance satellites. Molniya orbits are elliptical and varying from 25,000 miles at apogee to 300 miles at perigee. Molniya orbits enhance communications in northern regions. See Space Support to Army Operations, page 44, and Space Indoctrination Handbook, page 2-4 and 2-5, for further details.

[45] Craig Covault, "Secret Relay, Lacrosse NRO Spacecraft Revealed" Aviation Week & Space Technology, 23 March 1998: 26.

[46] Anson and Cummings 50. Resolution of 5m is required to detect military ground units while resolution of less than 1m is need to distinguish between individual weapons systems such as artillery and tanks. While the US Government has released no official data, it is believed that the US spy satellite network provides world-wide coverage to a resolution of .25m.

[47] Covault 27.

[48] Anson and Cummings 51.

Weather and terrain sensing satellites proved vital in preparing the battlefield in the Gulf War. Weather data was provided with spatial resolutions that varied from 10 to 0.6 kms. Geostationary satellites, civilian and military, provided macro-level weather data, refreshed every 30 minutes, similar to that seen on the evening news. Meanwhile satellites in polar orbits provided more refined data every 12 hours.[49] The poor resolution data from the geostationary satellites actually proved more useful to planning staffs, as they were able to watch trends, and therefore, were able to forecast more accurately. Large weather systems were tracked and predictions were made based on this data. The more precise data on winds, temperature and moisture from the polar-orbit satellites, particularly the Defence Meteorological Satellite Program, was important in the accurate employment of weapon systems.[50]

Terrain information was provided by two civilian systems, Landsat, operated by the US Department of Commerce, and SPOT, a commercial French system. Both systems provided "images obtained simultaneously in a number of discrete bands (specific sections) of the electromagnetic spectrum."[51] The difficulties in using this information were based primarily on applying this technology to standard military cartographic procedures and actually acquiring the original data. For example, all SPOT data had to be bought commercially and due to royalty issues could not be shared. As a result, the Army was unable to use data purchased by the Air Force because they were not properly funded for this purchase.[52]

[49] Army Lessons Learned 5.
[50] Army Lessons Learned 7.
[51] Army Lessons Learned C-1.
[52] Army Lessons Learned 11.

This technology is fine in its own right, however, the cost of these systems are high. Therefore the return on investment must justify budgetary allocations. Current developments in the United States indicate that the investment in space technology is warranted. James Kitfield noted in 1996, that the "Pentagon's commitment to advanced electronics and communications systems as a 'force multiplier' means that systems in this category represent some of the few bright spots on a generally bleak horizon for military procurement."[53]

In the United States Army a great deal of time and effort is going into Battle Management Systems (BMS). This development has been from the top down enjoying favour with the senior leadership of the Army.[54] The aim of BMS is the merging of multiple components "into a single system, achieving a synergism which is far greater than the simple sum of the various parts…to provide soldiers with a more accurate awareness of their situation, digitally shared across entire formations."[55] This development is not limited to the United States Army. The British and German Armies are also developing BMS, although, their more restricted budgets have resulted in more modest research programs.[56]

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[53] James Kitfield, "Technology Sharpens Battlefield Awareness" Government Executive Aug 1996: **114?**
[54] Major M. Kampman, Breaking the Chain: Battle Management Systems and Future Armies (Canadian Forces College: Exercise Leonardo, 20 December 1994) 4.
[55] Kampman 3. The components referred to are such things as weapon sights, laser rangefinders, GPS, vehicle sensors, digital maps, message data pads, and combat net radios.
[56] Kampman 8 and 10.

The aim of this emerging technology is "[b]attlefield awareness…so complete, and precision weapons so widely-available and effective, that enemy ground-based combat systems will not be able to survive…"[57] To date, the successes of BMS have been significant. The United States Army has conducted exercises at the Task Force and Divisional levels in 1997, using fully 'digitized' formations. The result of these exercises has led to the "largest and most ambitious force modernization in a peacetime Army."[58]

The development of BMS and digitization are not the only projects being considered to support the Army on future battlefields. The United States Army Space Command (ARSPACE) has recently demonstrated eight operational and research capabilities. These include the Global Broadcast Service (GBS), the Small Terrain Visualization Device, and the Hyperspectral Sensor Concept. The GBS provides information including maps, video, friendly and enemy positions, voice and imagery, all in real-time, and at multiple levels of the fighting formations. The Small Terrain Visualization Device allows commanders to build a virtual three-dimensional model of a chosen route on a laptop computer. The Hyperspectral Sensor Concept will use space-based sensors to look through the pollutants caused by chemical and biological weapons and by the effects of radiation and high-energy weapons on the future battlefield.[59]

All of the emerging technology systems discussed above share one common and

[57] Lieutenant-Colonel Ralph Peters, "The Future of Armored Warfare." Parameters Autumn 1997: 53. An interesting continuation of this thesis is available in Peters' fictional work The War in 2010.
[58] Captain Chris Muench, "Preparing for Digitization: Surviving the Army before the "Army after Next"" Military Intelligence Apr-Jun 1998: 21.
[59] Lieutenant-Colonel Tim Mishkofski, "Space Support to the Infantry" Infantry Jul-Dec 1997: 18. This paper discusses eight emerging technologies that will support infantry soldiers on the battlefield.

fundamental requirement in order to operate effectively; that is space. These systems all rely on the use of satellites to either provide information or to move information around the battle space. Without the use of space and satellites none of these systems will function. It is for this reason that the leadership of the US Army is positive on the continuing development of space based assets.

Space research is certainly not limited to the United States Army. The United States Air Force, in conjunction with major think tanks such as the RAND Corporation and industry, are conducting research and operational analysis on space related topics. This is being done in an effort to determine which technologies "showed the greatest potential for enhancing space operations, and which of their embedded technologies have the highest leverage in making high-value systems a reality."[60] Using a value model based on Joint Space Doctrine the analysis identified seven important systems. These are a transatmospheric vehicle (TAV), spaced-based high-energy lasers (HEL), a global surveillance, reconnaissance and targeting system, an orbital transfer vehicle, kinetic energy weapons, a high powered microwave system and particle beam weapons. Of these seven systems, the first two were considered to be the most important. The TAV was seen to ensure easy access to space and the HEL contributed to most force application and some surveillance tasks.[61]

Tm(base7cept h(warib)Tj12 0 0 1.9233.46126 157.0201 Tmeib)Tj12 0 0 1.9215170016 157.0201 Tm

considered essential to achieving the dominance of space because it will directly address the limitations of the current launch programs. At present, preparation time for a launch vehicle varies from 15 to 180 days, while the payloads vary from 1,000 to 50,000 pounds. The space shuttle, which can lift the largest payloads into orbit, takes about 90 days to be prepared for launch.[62] It is forecast that the TAV will be capable of launch in a matter of hours putting heavy payloads, of up to 45,000 pounds, into low earth orbit.[63]

While there has been some research and development activity in Canada it has not been on the scale of that seen in the United States. The Canadian military has been active in only three main, space-related ventures in the last 13 years. These ventures are in the areas of search and rescue, communications and surveillance. The search and rescue program was initially undertaken in conjunction with the United States, Russia and France but has now expanded to include 70 countries and coverage of 81 percent of the globe.[64] The second project dealt with communications in the Extremely High Frequency (EHF) band in an effort to guarantee communications using small terminals. Although work has stagnated in Canada, other NATO countries are forging ahead.[65] The third venture dealt with Space-Based Radar (SBR). This project, started in 1985,was initially conceived to be an extension of and eventually a replacement for the North Warning

[62] Daniel Gonzales et al, Proceedings of the RAND Project AIR FORCE Workshop on Transatmospheric Vehicles (Washington: RAND, 1997) xv. These figures are independent of the actual costs of launch using the systems available.
[63] Gonzales 17.
[64] Dewitt and Leyton-Brown, 122. John Kirton in his article, "A Renewed Opportunity: The Role of Space in Canadian Security Policy" provides a good overview of recent developments in Canadian space policy. In particular he notes that support of the SAR project was an easy political choice, as to do otherwise, (not to be able to find lost Canadians) would be politically damaging.
[65] Dewitt and Leyton-Brown, 123. The size of an antenna is determined by the frequency and bandwidth used. Therefore, frequencies in the EHF range would need a smaller antenna. An additional benefit is a degree of jamming protection. For additional information see "Powerful Battlefield Forces Exploit Space-Based Access" Signal, March 1996.

System (NWS). The NWS was to provide continuous coverage of Canada's northern regions, guarding against a manned bomber and cruise missile threat. Canada's involvement in SBR has made little progress over the years, although, recent discussions between the military and the Canadian Space Agency may yet see an SBR on board Radarsat 3 at some point in the future.[66]

I believe difference between the military space research and development programs of the United States and Canada is obvious. Like the American policy, the research programs are dynamic, ambitious and pursued with vigour. They focus on those systems that are most likely to enhance the application of military power, not necessarily now, but in the future. In addition, the programs are, and have been, fully supported by the American senior leadership. This is not at all like the Canadian case.

Research and development in Canada has been limited and not particularly successful. In part this has been due to the lack of funding and also to a lack of support from the senior leadership in the DND. Canadian senior military leaders are just now starting to speak on the subject of space. It was only in April 1998, that the Deputy Chief of the Defence Staff, Lieutenant-General Ray Crabbe, as the departmental space advocate, published the Canadian Military Space Strategy, which detailed the way ahead for space development.[67] In May 1998, Vice-Admiral Gary Garnett addressed the annual general meeting of the Navy League of Canada. In his speech he said, "[s]pace systems,

[66] Dewitt and Leyton-Brown 125. The SBR would likely incorporate phased array technology and would meet strategic, tactical and arms control needs.
[67] DND, Canadian Military Space Strategy.

for either surveillance, communications or position location, need to be considered as an integral part of a modern C3I [command, control, communication and intelligence] network that extends from sensors to analysts to decision-makers, to the soldiers, sailors and aircrew."[68]

That Canadian military senior leaders are starting to address space issues is a good sign. It indicates that they are becoming comfortable with the issue and are prepared to discuss it in public. What is not as clear is whether these same leaders have a clear understanding as to how space technology should be used to enhance the effectiveness of the CF? In the next section the issue of space doctrine will be examined.

DOCTRINE

United States military doctrine is reasonably mature in regards to space. All three services had space commands. These commands report both to the applicable service Chief as well as the Commander in Chief USSPACECOM. The United States Army has published FM 100-18, Space Support to Army Operations. This manual focuses the attention of the Army on space. It examines the impact of space on Army operations and details how space and space-based assets will be used to make the Army more effective. "The efficiencies resulting from the use of these space capabilities can have a dramatic effect on Army operations: reducing uncertainty, facilitating battle command, and

[68] 2Lt Peter Magwood, "Vice-chief of the Defence staff looks to the CF of the Future," Maritime Forces Atlantic Trident 7 May 1998: 5.

moderating the effects of friction and fog of war."[69] The way ahead for the United States is clear. Space is the key to success.

Canadian space doctrine is virtually non-existent. The CF manual, Canadian Forces Operations, devotes only one chapter (two pages) to space. The majority of the two pages is devoted to restating the CF Space Policy and providing a shopping list of the principle uses of space. The chapter concludes with the statement, "TFCs [Task Force Commanders] and their staffs must be aware of the potential of Canadian and allied space assets and capabilities and integrate these, when allocated, into their military operations."[70] The lack of direction on the use of space at the operational or strategic level of war is striking.

Canadian air force doctrine is equally vague with regards to space. Although entitled Out of the Sun: Aerospace Doctrine for the Canadian Forces the air force doctrine manual has less to do with *aerospace* and *aerospace power* and more to do with *airspace* and *air power*.[71] Space is only mentioned in one paragraph in the manual, which deals with aerospace surveillance and reconnaissance. It states that different types of sensors can be used to collect information and those sensors can be mounted in various

[69] FM 100-18 14.
[70] Department of National Defence, Canadian Forces Operations (Ottawa: DND, 15 May 1997) 26-2.
[71] The Concise Oxford Dictionary defines aerospace as "Earth's atmosphere and outer space" while airspace is defined as "air above [a] country."

vehicles "(for example, manned and unmanned air vehicles and space-based systems.)"[72] This is hardly a ringing endorsement of the role of space in the air environment of the CF.

The army in its keystone manual Canada's Army… is only slightly more cognisant of the role of space in military operations. In the chapter entitled 'Future Conflict' words and phrases more expected in an American publication, such as revolution in military affairs, digitization, precision fires, and information operations, can be found.[73] Information operations are seen as the way ahead and the effect of technology on such things as command and control systems are discussed. However, space *per se* is not mentioned.

Clearly the United States military is focussed on the future. United States military personnel at all ranks are thinking, researching, planning and writing doctrine to prepare for future conflict. Perhaps it is because as the world's only superpower defeat by any enemy cannot be considered an option. Success on the battlefield must be achieved today and tomorrow. Regardless of the reason, the United States is aware that the "revolutionary information technologies of the future are so fast-moving that they suggest the need for dramatic changes in planning, budgeting, and acquisition if [they] are to continue to compete successfully."[74] Indeed, the doctrine and visions presented by the various services show clearly that they are on the leading edge of change and preparation.

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[72] Department of National Defence, Out of the Sun: Aerospace Doctrine for the Canadian Forces (Winnipeg: Craig Kelman & Associates, 1996) 103.
[73] Department of National Defence, Canada's Army: We Stand on Guard for Thee (Ottawa: 1998) 111-120.
[74] Lieutenant-General Jay W. Kelley, 2025 Executive Summary (Maxwell AFB: Air University, August 1996) 18.

Space has taken an increasingly important role in joint operations. These changes lead one to question the effect of these changes on America's allies. In his article "Victory Misunderstood", which examines the lessons to be gained from the Gulf War, Stephen Biddle argues that:

> If new technology offered tremendous military power to any who acquired the new systems (and reformed their military doctrine to exploit them), this implies a powerful incentive for radical change: those who realize the full potential of the new era would enjoy enhanced security and influence, while those who do not do so would risk being left behind.[75]

This is a clear message that allies of the United States must keep current with technical advances if they are to remain part of the team.

As space serves all branches of all services and enhances the application of force it is only right that it should enjoy a more prominent place in current doctrine. Conflict between services has been reduced if not eliminated by the allocation of specific portions of the space pie to individual services. For example, the Army is responsible for ballistic missile defence while the Navy is responsible for certain long-range communications. This allocation of responsibilities assists in retaining the support for space of all services.

The same cannot be said for the CF. Military space policy in Canada appears to provide only lip service to this most important area. While space is clearly a force enabler and therefore an important tool, the CF appears to be unable to wrestle with how

[75] Stephen Biddle, "Victory Misunderstood: What the Gulf War Tells Us About the Future of Conflict" International Security 21:2 (1996) 176.

to acquire or as a minimum exploit the technology. Space based systems would allow the CF to overcome some limitations caused by previous political decisions and geography.[76] However, it appears difficult to get the issue of space onto the policy agenda of the DND.

BMD is another example of the lack of strategic direction. Canada, and particularly the DND, through its involvement in NORAD have been invited to participate in BMD. Although no commitment has been made to date, the NORAD agreement and the 1994 Defence White Paper can be interpreted to show that Canada is interested in exploring BMD. However, the official Canadian position is also reflected in the 1994 White Paper. The policy states that "Canada welcomes the decision by the American government to adhere to the strict interpretation of the 1972 *Anti-Ballistic Missile Treaty*."[77] Meanwhile the United States is proceeding with a National Missile Defence System to protect the "United States against a limited ballistic missile threat by a rogue nation."[78] The requirement is considered so important that "an additional $1 billion has been allocated to the US Department of Defence to step up development of its theatre and national missile defence systems…[as] a response to recent ballistic missile launches

[76] Dewitt and Leyton-Brown 124. Canada decided to see what the US would propose for the design of the SBR system while both nations continued the development of the NWS. The SBR, which was not built, had been expected to extend coverage to include all Canadian territory and waters. In fact, much of Canada's north was left outside of radar coverage. This created subsequent problems exercising Canadian sovereignty.

[77] DND, 1994 Defence White Paper 25. Article III of the *Anti-Ballistic Missile Treaty* limits BMD systems to an area surrounding the nation's capital as well as the number of missiles and warning radars allowed. See Collins, 182 for full details of the *Treaty*.

[78] Major L. Brian Guimond, A NATO BMD Role in the Next Millennium: Does Canada Have an Option? (Canadian Forces College: Exercise New Horizons, 1997-98) 4/9.

by Iran and North Korea."[79] Canada meanwhile, has yet to decide if she is in or out of the BMD of North America.

CONCLUSION

The results of the Gulf War have focussed the attention of most militaries on the importance of space and space related activities. A tremendous amount of effort has been expended in the United States developing vision statements for the type of forces that will be required to fight on future battlefields. These vision statements are supported by research into the types of technologies that will enhance the effectiveness of all forces. Finally, doctrinal manuals are now in place that will guide the efforts of commanders on the complex battlefields to come. The Americans expect that their allies will be able to participate with them in coalitions. In order to do so a minimum level of interoperability will be required. To have no capability or the wrong capability will make any potential partners irrelevant.

Canada has a space policy that is weak with regards identifying global trends. In many ways this is due to the wants of the very services that would most benefit from having space technology. The ability to acquire space technology is hampered by the competing environmental service demands on the DND budget. In the words of then Major-General Huddleston, as Associate Assistant Deputy Minister (Policy), "Space is not gaining ready acceptance in the Canadian military establishment because it's

[79] Bryan Bender, "USA to put extra $1b into missile defence systems" Jane's Defence Weekly, Volume 030, Issue 017, 28 October 1998: 2. This is in addition to the $25b allocated annually to US space development. See Craig Covault, "$25-Billion Federal Effort Leads Advanced Space Development" Aviation Week & Space Technology 23 Mar 1998: 70.

competing with other things and the desirability of having those other things to satisfy the commitments which demand those systems is well entrenched."[80] With the growing influence that space is having on the conduct of joint operations, it seems reasonable to assume that the CF must embrace and harness this technology. "Common battlespace awareness, location certainty for friendly and adversary forces, and real-time dissemination of information create the basis for seamless, joint operations."[81] This line of reasoning must be applied to Canadian policy and doctrine if we are to remain relevant and capable of operating with our present allies at the end of the current RMA.

DND must quickly develop a strong and aggressive space policy appropriate for the next millennium. It must be cognisant of the evolution of NORAD and the changing focus of NORAD and USSPACECOM towards space issues. Additional funding must be found to supplement that which has already been allocated to support the space strategy. The DND and CF must be more aggressive in pursuing this most vital capability.

[80] Brian MacDonald 84.
[81] Daniel Goure and Christopher M. Szara, Air and Space Power in the New Millennium (Washington: Centre for Strategic & International Studies, 1997) 10.

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