

Final Report

“Spacepower for a New Millennium: Space and U.S. National Security”

Doolittle Hall, USAF Academy
Colorado Springs, CO
29-30 July 1998

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USAF Institute for National Security Studies
“Spacepower for a New Millennium: Space and U.S. National Security”
29-30 July 1998

Table of Contents

I. Executive Summary

II. Summary of Conference Proceedings and Discussion

Panel Presentations

- Panel 1: Current Military Space Issues
- Panel 2: Space and Ballistic Missile Defense
- Panel 3: Organizing for Military Space Missions
- Panel 4: Future Military Space Issues

III. Keynote Address – General Howell M. Estes III

- Agenda
- Program
- Address

IV. Banquet Presentation – Major General (Select) Marshal Ward

- Agenda
- Program
- Address

V. Conference Agenda

VI. List of Participants

VII. Administrative Materials

- Letters of Invitation
- Conference Registration Forms

- Conference Map

VIII. Appendices

Appendix A

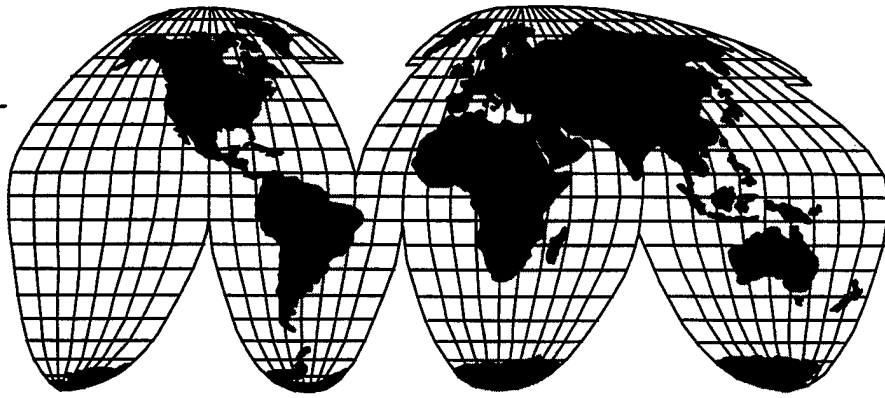
- Biographies of Authors

Appendix B

- Biographies of Discussants

Appendix C

- Panel Slides



Executive Summary

EXECUTIVE SUMMARY

Opening Remarks

The USAF Institute for National Security Studies (INSS), in cooperation with HQ USAF Nuclear and Counterproliferation Directorate (USAF/XON), sponsored its 6th Annual Topical Conference, entitled "Spacepower for a New Millennium: Space and U.S. National Security," 29-30 July 1998. The conference was held at the USAF Academy, Colorado Springs, Colorado. The purpose of the conference was to examine how military uses of outer space can contribute to U.S. national security and how the USAF might best organize to meet security challenges in space and exploits its military potential.

Opening remarks were made by Major General (Select) Ward, HQ USAF/XOO, who welcomed participants on behalf of Maj Gen Neary, HQ USAF/XON, who was unable to attend the conference. Maj Gen (S) Ward asked that participants stretch beyond their "niche" expertise to contribute to the broader concept of spacepower for a new millennium, a concept which he feels needs to be integrated within other aspects of the Air Force, rather than viewed as an end in itself. He also encouraged participants to actively engage in the discussions so that the edited volume, which will result from the conference, reflects sound viewpoints.

Introductory remarks were made by Lt Col Pete Hays, outgoing Director of the Institute for National Security Studies (INSS). Lt Col Hays welcomed participants on behalf of INSS, HQ AF/XON, and the Dean of the USAF Faculty.

Background

The conference included presentations by the chapter authors of the forthcoming book *Spacepower for a New Millennium: Space and U.S. National Security*, which addresses the Long Range Plan. Following the chapter authors' presentations, invited discussants presented comments based on their review of the chapters. For the purposes of the conference, the book was divided into four panels:

1. Current Military Space Issues;
2. Space and Ballistic Missile Defense;
3. Organizing for Military Space Missions; and,
4. Future Military Space Issues.

Each panel consisted of 3-5 experts, including a Panel Chair. Following brief presentations by each panelist, the group engaged in discussion. While all presentations were made for the record, panelists' remarks do not constitute official government or institutional position on any specific issue.

Maj Gen (S) Ward gave a banquet address for all participants on Wednesday, 29 July 1998. General Howell M. Estes III, CINC, USSPACECOM, addressed the participants at a luncheon, held Thursday, 30 July 1998.

Panel Discussions

Panel 1: Current Military Space Issues

Lt Col Pete Hays chaired the first panel, which focused on current military space issues. The panel was comprised of Mr. Bob Preston of RAND, Maj William Russell of the Commanders' Action Group at the Space Warfare Center, and a discussant, Dr. James Logsdon, Director of the Space Policy Institute at George Washington University.

Mr. Preston presented the paper he co-authored with Lt Gen Roger DeKok on the acquisition of space power. The paper outlined the evolution of acquisition related to space and suggested that the key to the acquisition of spacepower for national security in the future is partnerships. The authors advocate the following order of priority for these partnerships: (1) partnership between the military and intelligence communities; (2) partnerships with commercial space aspects; and (3) partnerships with the civil sector. He also suggested that all partnerships should eventually be expanded to include international players.

Maj Russell presented the paper he co-authored with Maj Gen (Select) Glen W. Moorhead, III, entitled "Space Technology to Support the Warfighter." The presentation and chapter were organized around five major themes: building the base through education; supporting the decision-makers; exploiting the positive; minimizing the negative; and looking towards the future. The primary thrust of the presentation focused on the need for educating the warfighter, since all the technology in the world will be of little use unless operators understand its potential, know how to use it, and integrate it into their warfighting plans.

Dr. Logsdon commented on both the papers, complimenting them for their insights. Dr. Logsdon suggested that the paper on acquisition also had applicability in terms of developing a space strategy; however, he questioned whether or not the U.S. might not already be taking such an approach. Secondly, he wondered whether international partnerships were realistic. In terms of "Space Technology to Support the Warfighter," Dr. Logsdon agreed with the focus on education, but suggested the author might want to expand the view to other aspects. Finally, he commented that neither papers addressed the potential drawbacks of increased use of commercial technology, such as control issues and adversaries' access to it.

Panel 2: Space and Ballistic Missile Defense

The second panel was facilitated by Maj Alan Van Tassel and included Dr. J. David Martin, Ballistic Missile Defense Organization; Ambassador Henry F. Cooper, Chairman of High Frontier; Mr. John E. Pike, Spokesperson for the Federation of

American Scientists; and Col Frank Klotz, Council on Foreign Relations. Discussants included: Professor James Wirtz, Naval Postgraduate School, and Col Klotz.

Dr. Martin presented Lt Gen Lyles' chapter. The chapter emphasizes the urgent need for missile defense, provides a historical overview of the U.S.'s ballistic missile defense program (BMD), and shows how vital space is to BMD.

Ambassador Cooper presented his paper, entitled "Space Defense: An Idea Whose Time Has Come?". Ambassador Cooper's paper also emphasized the urgent need for missile defense and provided a critical review of the politics that have prevented further progress in BMD development in the U.S. He urged the acceleration of the Navy Theater-wide system and a greater focus on space-based systems, which would necessarily require the U.S. to revisit the Anti-Ballistic Missile (ABM) Treaty.

Mr. Pike took an alternative view, presenting his chapter entitled "Keeping Space Weapons-Free." His chapter argues that the U.S. "mislearned" many lessons from the Persian Gulf War related to BMD. Thus, the U.S. is basing policy on incorrect assumptions. He opposes "weaponizing" space and investing significantly in BMD systems that, in his opinion, simply have not proved their value.

Col Klotz presented the Honorable Curt Weldon's chapter entitled "Charting a New Course on Missile Defense." Representative Weldon's chapter presents a case for making missile defense a high priority issue for U.S. national security and is critical of current Administration policies which have not emphasized it to the extent he believes the threat warrants.

Prof. Wirtz commented on Lt Gen Lyles' chapter, praising it for providing a good overview of the past and present evolution in missile defense programs, as well as an informed opinion on the future. His major criticism of the chapter was that it tends to read as "official policy" and thus avoids engaging in issues which Wirtz feels should be addressed, even though they might be controversial—such as the Theater High Altitude Air Defense (THAAD) failure and the ABM Treaty.

Col Klotz commented on both Ambassador Cooper's chapter and Representative Weldon's chapter. He found both to be compelling and interesting, but suggested some stylistic suggestions for all chapter authors, such as ensuring the chapters are understandable by a wider audience and do not assume too much background knowledge. He also recommended adding a chapter specifically on the ABM Treaty.

Panel 3: Organizing for Military Space Missions

The third panel, which convened on day two, focused on organizational issues and was chaired by Lt Col Guy M. Walsh. The panel consisted of Dr. Dana J. Johnson and Dr. Ken Reynolds from RAND, Dr. Daniel E. Hastings, Chief Scientist of the Air Force, and General Howell M. Estes III, CINC, USSPACECOM. Discussants included: Mr. Albert DiMarcantonio, Assistant Deputy Under Secretary of Defense for Space

Integration, Maj Gen (S) Marshal Ward, HQ USAF/XOO, and Mr. Dwayne Day of the Space Policy Institute at George Washington University.

Dr. Johnson and Dr. Reynolds presented the paper they co-authored on "Shaping the Battle Space." While they feel the Long Range Plan contributes significantly to discussions on organizational change, they questioned whether USSPACECOM has the authority it would require to realize the vision outlined in the Plan. They developed a typology to categorize alternative national security strategies vis-à-vis space and examine the types of organizational structures that would be required to support each. The authors suggest that the Air Force and those involved in space focus on a number of issues, such as strengthening relations among U.S. space sectors, clarifying organizational boundaries and authority, and others.

Next on the agenda, Dr. Hastings presented his chapter entitled "Future Military Space Technologies," which aims to provide a framework for deciding which of the many technologies the USAF should invest in, given limited funding. Based on this framework, he recommended that the USAF should spend 60% of its funding on mid-term technologies related to integrated ISR, global energy delivery, and space control technology; another 20% should go to less "doable" but high-payoff technologies; and, 20% of funds to more revolutionary ideas, such as distributed satellite swarms or nontraditional propulsion.

General Estes presented his chapter on "The Aerospace Force of Today and Tomorrow: Transforming Our Service to Control the Vertical Dimension." General Estes believes that the USAF is at a crossroads: it must either fulfill its stewardship to the space mission or it will lose it. General Estes added, however, that the Chief of the Air Force believes that the decision has been made and the USAF is moving toward the new mission; thus, discussion of a separate force is moot. He challenged participants to embrace the new mission and fully integrate space with the air mission. General Estes believes it is imperative that the Air Force transform itself into an *Aerospace* Force.

Mr. DiMarcantonio reviewed Dr. Hastings' chapter on "Future Military Space Technologies." He commented that the chapter suggests a practical approach, but was concerned that Dr. Hastings, as well as other chapter authors, have not addressed the many barriers to the commercial sector taking the lead in the space arena. From his experience in the private sector, he has seen first-hand some of the frustrations private companies face in working with the U.S. Government (USG) and DoD. Mr. DiMarcantonio also agreed with other presenters regarding the need to streamline the organizational structure related to space to leverage efforts.

Maj Gen (S) Ward offered a critique of "Shaping the Battle Space." He supported the idea of using a typology of national space strategy themes as an organizing tool, but felt the categories might require review. As to the organizational issues, he saw three possibilities— from retaining the status quo to moving to USSPACECOM model, to creating a separate Service— and offered comments on both the advantages and drawbacks of each.

Mr. Day concluded the panel by offering the final review on General Estes' chapter. While he agreed with the overall perspective presented, he was not sure whether General Estes' vision of a "seamless" aerospace force was in accord with the Long Range Plan. He was also concerned that the leadership would not embrace such a vision, since it will always prioritize air-breathing assets. Finally, he suggested that a significant part of a transition to space emphasis must involve the operators and using new technologies. In these terms, other Services are outpacing the Air Force.

Panel 4: Future Military Space Issues

The final panel focused on future military space issues and was chaired by Dr. James M. Smith, incoming Director of INSS. Panelists included: Col Simon P. Worden, Deputy for Battlespace Dominance, HQ USAF/XORB, Mr. John B. Sheldon, University of Hull, England, and Dr. Brian R. Sullivan. Discussants included Mr. Marc Berkowitz, Assistant Deputy Under Secretary of Defense for Space Policy and Professor James Wirtz from the Naval Postgraduate School.

Col Worden opened the panel by presenting his draft chapter entitled "Space Control for the 21st Century: A Space 'Navy' Protecting the Commercial Basis of America's Wealth." His chapter argues that there will be an increasing need to protect US commerce in space, necessitating creation of a strong space military presence, just as the increase in sea commerce created the need for the U.S. Navy. Communications and commercial endeavors are heavily reliant on space assets today, a trend that will only increase in the future. Thus, he sees that the U.S. will need to protect key nodes—namely satellites—and deny their use by an adversary. Protection, rather than warfighting will be essential. Towards this end, he recommends the U.S. prioritize investing in acquiring the capability to have a presence in space and in those technologies which can "embargo" bad actors.

Mr. Sheldon presented the paper he co-authored with Dr. Colin Gray's paper on "Spacepower and the Revolution in Military Affairs: A Glass Half Full." The thrust of the chapter is to caution the broader community from: too closely aligning space with the Revolution in Military Affairs (RMA) and overemphasizing technology and forgetting other aspects of space. In addition, the chapter recommends not dismissing space too lightly but understanding that spacepower is a reality, paying attention to the fact that the key enabler for spacepower is space control, and recognizing that while strides have been made, the glass of U.S. spacepower remains "half-full." While the Long Range Plan has advanced a vision and a mission, shortfalls remain that need to be addressed.

The final presenter was Dr. Sullivan who opted not to present his chapter, but rather added his insights related to spacepower and America's future. He cautioned against the use of the terminology of space control, since he believes it is misleading and incorrect – the sole reason for controlling space is to exert greater control over the earth, not space. He disagreed that spacepower is an extension of airpower and cautioned against exaggerated claims related to space. Dr. Sullivan also questioned how realistic the Long Range Plan is, given limited funding. Finally, he expressed concern that

emphasizing spacepower could create a need for genetic engineering as an unintended consequence of expanding the battlefield into space.

Mr. Berkowitz offered a review of Col Worden's paper, endorsing its basic premise — that space will provide a place for commerce. However, he felt that the concept could use additional explanation, especially for an Air Force audience. He also suggested that Col Worden might want to address additional areas, such as expanding the section, which analogizes space infrastructure to other infrastructure, and addressing the issue of space control more fully.

Prof. Wirtz provided the final review, commenting on both Mr. Sheldon and Dr. Sullivan's presentations. He expressed support for debating "what is space?" and suggested it deserve even greater discussion. He also agreed with the Sheldon/Gray chapter and Dr. Sullivan that space should not be too closely tied to the Revolution in Military Affairs (RMA) since he believes space is bigger than an RMA, and that RMAs are not always positive.

Luncheon Address

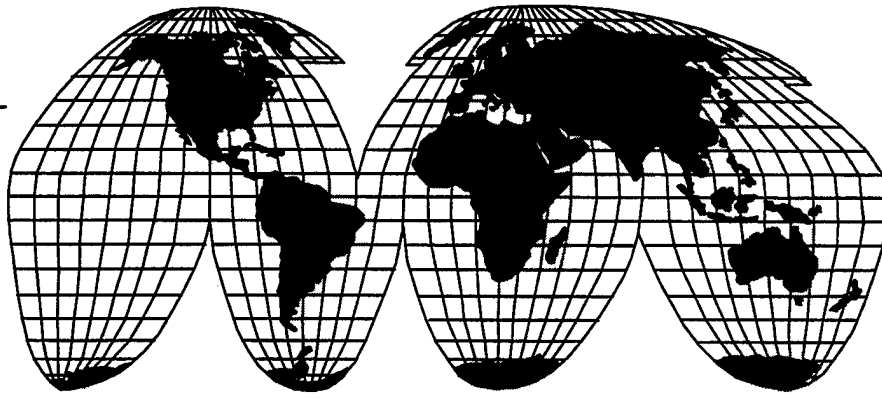
General Estes discussed the accomplishments that have been made at the North American Aerospace Defense Command (NORAD), the US Space Command (USSPACE), and the Air Force Space Command (AFSPC) during his tenure. The discussion outlined the major challenges that Gen Estes faced when he took command. Gen Estes concluded his remarks by extending an invitation to those who may want to conduct research and analysis in the area of space to do so.

Banquet Address

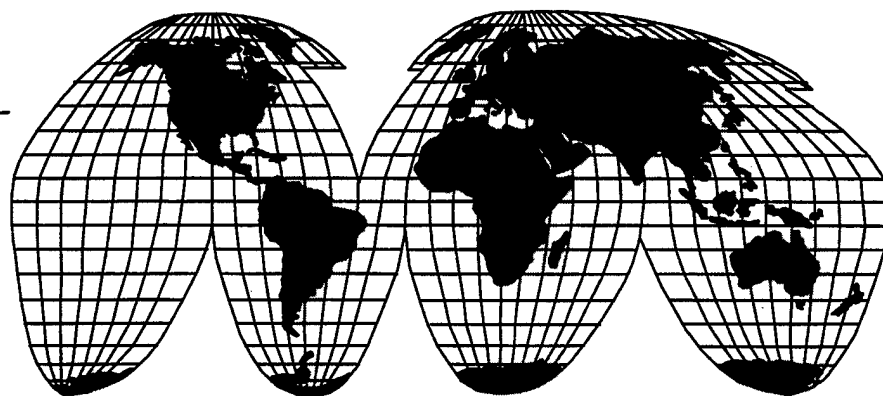
Maj Gen (S) Ward presented a speech focusing on how the USAF should organize, train, and equip in support of the Joint Forces Commander (JFC). Maj Gen (S) Ward closed his remarks by stating that space is not a mission, but a place. The USAF should therefore focus more on mission effects and less on the medium from which missions are operated.

Closing Remarks

Dr. James M. Smith of INSS offered closing remarks, thanking participants for their involvement in the conference and their contributions to the draft chapters. Dr. Smith also expressed appreciation to the panelists and discussants. Finally, he reiterated that INSS is seeking input on the draft chapters and that participants could submit further comments, either directly to the authors or through INSS.



Conference Proceedings



Panel I

**Lieutenant Colonel Pete Hays, Chair
Mister Bob Preston
Major William Russell
Professor John Logsdon**

PANEL 1: CURRENT MILITARY SPACE ISSUES

Chair: Lieutenant Colonel Pete Hays

Participants: Mr. Bob Preston, RAND
Major William Russell, Commanders' Action Group, Space Warfare Center

Discussants: Professor John Logsdon, Director, Space Policy Institute, George Washington University

PANEL PRESENTATIONS:

"Acquisition of Space Power," Mr. Bob Preston

Mr. Preston thanked INSS for the opportunity to present the paper he co-authored with Lt Gen Roger DeKok. To Mr. Preston, acquisition is the "core" of space, underlying all of the possibilities outlined in the Long-Range Plan (LRP). According to the LRP, there are three compelling circumstances setting the stage for the vision outlined in the plan:

- A period of strategic pause without a peer competitor.
- The emerging dependence on space as an essential utility in the 21st century (the "center of gravity" idea).
- The potential for space capabilities to become a revolution in military affairs (RMA).

If the first of these three is true, then acquisition will set the pace and scale of developments. However, DeKok/Preston are doubtful. Even though a strategic pause may be occurring, a budget "pause" is not. The military is competing with other national interests in the budget, and modernization budgets are severely constrained. If the second point is true, then the DoD could radically reform acquisition in such that many of the capabilities outlined in the Plan could be acquired, despite budget constraints. Commercial forces driving this "essential utility" may enable the needed acquisition change, but this will only happen if DoD can change to exploit it. A real danger exists that if the DoD cannot make the needed changes, it will not only be outpaced by commercial developments, but that opposing forces could employ better technology, acquired from commercial markets. The last point (the potential for space to become an RMA) is a very real possibility, provided DoD is able to exploit the opportunity.

Mr. Preston outlined the historical roots of space acquisition, as well as today's policies and programs. Originally there were two main sectors, civil and national security, the latter of which included intelligence assets. The third, and newest sector of US space activity, is commercial space.

Many of today's policies and programs provide the basis for the LRP's strategy of global partnerships since many represent the type of cooperation across sectors that is needed to optimize limited government resources. To note a few: the National Polar Orbiting Environmental Satellite System (NPOESS), the space-based infrared system (SBIRS), the National Space Communications Program (NSCP), and others. However, Mr. Preston noted that while these are good examples of partnerships, each is still stovepiped within a community. Progress has only been made within existing mission stovepipes. Opportunities to consolidate and integrate architectures across missions, as well as sectors, still need to be exploited.

The most glaring impediment to integrating architectures comes from organizational issues, such as the division between intelligence and military space organizations. However, procedural issues also make integration difficult; these include procedure on programmatic development and contracts which make it hard to change course midstream. In terms of opportunities to integrate across sectors, there is still significant potential for cooperation with the commercial space industry. However, concerns over commercial licensing of some data and related regulatory issues would need to be overcome if commercial entities are to assume the risk, as well as other barriers for further integration.

The most valuable opportunities for acquiring space power for the new millennium will come from the commercial space sector. Mr. Preston showed the group a projection chart of future space revenues. According to the chart, the major revenue growth will occur in "value added" products, rather than in the manufacturing, launch, or related services associated with the satellites themselves. Secondly, communications development will be the driving force behind this growth. This is logical, Preston explained, because the communications sector is more closely tied to consumers, rather than the military sales side. To drive this point home, he also displayed a chart comparing government to commercial sales related to satellites and launch manufacturing. The chart showed that the commercial satellite industry could soon dominate.

With such dramatic growth in the commercial space industry, we are likely to see qualitative changes in the commercial space sector, which would make it even more advantageous relative to military development of capabilities. It is important that the USG understand that these changes position itself to react to them appropriately. To note a few:

- Capacity. Total constellation powers will significantly outpace current DoD systems.
- Private capital is increasingly stable and agile, in comparison to DoD funding, which is normally locked in for two years, and programs stretched or folded.
- Cycle time is decreasing. Mr. Preston cited the Iridium case as an example; at only 36 months, it stands as a benchmark for space system development and acquisition.
- Product line evolution is continuous, rapid, with clear decision criteria;

architectural diversity related to altitudes, sizes, connectivity, spectrum, and applications.

Given these advantages, the LRP's choice of the term "Global Partnerships" is apt. Partnerships, in DeKok/Preston's view, are the key to acquisition of spacepower for national security. The authors advocate the following order of priority for such partnerships:

- Partnership between military and intelligence space.
- Partnership with commercial space.
- Partnership with the civil sector.

All partnerships should also eventually involve international partners.

"Space Technology to Support the Warfighter," Major William Russell

Maj Russell explained that his chapter is co-authored with Major General (Select) Glen W. Moorhead, III. The chapter focuses on how to "bring space technology" to the warfighter level and addresses the questions: What does space mean for the warfighter? How can it be used? The thesis of the chapter is that space systems are crucial to the US's ability to wage war. Indeed, space-based systems have become so powerful that no operational commander would consider fighting without them; yet, much education is required to ensure that the technology is used optimally.

The premise of the chapter is that technology is advancing at breakneck speeds; the military must keep pace. It is vital to ensure that personnel, especially at the warfighter level, understand and are prepared to use this technology. Moreover, the US must keep in mind that the adversary has some space capabilities; hence the warfighter will need to know how to respond to these emerging adversaries' capabilities.

The chapter is organized around five organizational themes; each is elaborated below.

--Build the base. Moorhead/Russell view education as critical. Space technology will not be exploited at the warfighter level until the warfighter and operators understand it and know how to exploit it. Modeling and simulation will be a critical piece of this education since it allows the warfighter to get a hands-on idea of its potential and exercise its use. Currently, there is a gap between capabilities and use. To illustrate the shortfall, Maj Russell pointed out that in Strategic Force 95, a wargame to fight the Persian Gulf War in 2000, operators actually used less space assets than were actually used in 1991.

--Support the decision-makers. It is especially important that senior leadership understand the potential of space assets. No one can be an expert in everything, but leaders must at least grasp space's potential and have access to expertise on how to tap into it. The expertise in the field needs to be built through a building block approach. Programs towards this end include: AFSST (base input teams);

“W” prefix officers (to bring integration to the warfighter from the National Reconnaissance Office); and TENCAP, the program to support technology and deliver it to the field, which is evolving.

--Exploit the positive. The authors believe that the US must use space systems to maximum advantage. Again, to be able to do this requires that operators understand space’s potential and be aware of how it can be exploited to advantage.

--Minimize the negative. The US needs to recognize that space advances are a two-sided coin: they can enhance our capabilities, but they can also augment our adversaries’ capabilities. The US needs to focus attention on countering adversaries’ advantages by analyzing their access to commercial space technology in a systematic way. Also, as the US comes to rely more and more on space, the military will need to protect the full range of those assets that contribute to US capabilities in space, including space, ground, communications, and personnel.

--Future. Finally, Moorhead/Russell believe that the US military needs to ensure that technology addresses the warfighters’ needs. Areas which deserve increased attention include: space battlelab, modeling and simulation, new technologies, missile defense, and protection from man-made space objects.

PANEL DISCUSSIONS:

Critique of “Acquisition of Space Power for the New Millennium” and “Space Technology to Support the Warfighter,” Professor John Logsdon

Dr. Logsdon complimented the chapters for outlining strategic approaches to space. Dr. Logsdon does not believe that the US has a space strategy in place; thus, any recommendations for developing such a strategy add to the debate.

While the subject of the DeKok/Preston chapter is acquisition, Dr. Logsdon suggested that even more so, it is about strategy (both the need for a US space strategy and a potential framework for one). As the draft suggests, the strategy should be based on developing strategic partnerships.

Dr. Logsdon pointed out, however, that other countries might argue that the US already has such a coordinated approach. Europeans, for example, would cite GPS as evidence of the US’s coordination with industry. Does the US need to develop military-industry partnerships or does the US already have such relationships? What is the character of the existing military-commercial partnership and how can the US build on it? Or, do new partnerships need to be developed from scratch?

The DeKok/Preston chapter recommends that the US leverage commercial developments to ensure US space superiority for security purposes—and that it work more closely with the intelligence and civilian communities. Dr. Logsdon found this premise convincing. He also concurred with the chapter’s point that such partnerships would enhance not only US military security, but, by strengthening the economy, they

would augment US power. Although space-related sectors are a relatively small portion of current GDP, they are not that small, and are growing.

Finally, Dr. Logsdon stated that while Preston's recommendation to broaden partnerships, and possibly even include coalition partners, might be provocative and even accurate, how realistic is it? How would one get leaders to translate a vision to a coordinated strategic effort at the national, and even international level? How would such a vision be implemented? For example, it is one thing to advocate that the civilian realm takes the lead on launch, but how would this happen? DeKok/Preston's paper would benefit from including implementing actions on how to achieve their recommended acquisition strategy.

Dr. Logsdon briefly commented on Maj Russell's presentation. While the title of the Moorhead/Russell chapter is "Space Technology for the Warfighter," in Dr. Logsdon's view, the draft focuses on education as a fundament of strategy. Education is used as the vehicle to convince leadership at the operational level that space holds significant advantages for the warfighter. Dr. Logsdon agreed, but wondered if the focus might be too narrow. He also questioned the seeming discrepancy with the Preston/DeKok paper. Moorehead/Russell seem to "stovepipe" the operator away from the partnership idea. How deep would Preston/DeKok's partnerships need to penetrate below the strategic level to the operational and tactical levels to be successful?

On a more general note, Dr. Logsdon felt that neither author addressed the downside of commercial space technology (that adversaries can buy sophisticated capabilities with few resources). How should both the warfighter and the acquisition decision-maker address the spread of technology that may give adversaries advantages? Should the United States Government (USG) take the lead in negotiating restrictions on the availability of technology or react defensively as other countries acquire US space capabilities? What are the negatives to the explosive growth in US commercial space advances?

Finally, Dr. Logsdon asked the panelists whether space objectives are linked closely enough to other objectives. And, if not, should they be?

Mr. Preston's Response. Mr. Preston agreed with Dr. Logsdon's comment that the chapter could probably use more "how to" discussion. As for how to develop a DoD-intelligence-civilian partnership, Mr. Preston does not see a simple prescription, given the differing bureaucratic interests involved. However, strong leadership in that direction would help. As for creating commercial-government partnerships, Mr. Preston felt that the USG must first educate itself on industry incentives, business structure, licensing, regulations, and other related matters. Right now, the USG does not appreciate the concerns businesses have. Industry is beginning to enter the launcher field, but testing, licensing restrictions, and infrastructure development remain to be a problem.

Maj Russell's Response. Maj Russell agreed with Dr. Logsdon that a key thrust of the chapter is education, but felt the emphasis is appropriate since it is a prerequisite to using space at the operational level. To date, space is not weighed in the mind of the warfighter. While it was used some in Desert Storm, it has yet to be truly integrated into war plans, base support plans, etc.

As to the threat emanating from the availability of commercial space capabilities, Maj Russell sees it as a concern. Adversaries can acquire significant capabilities at very limited cost. US strategic planners need to address this issue. Maj Russell agreed with Dr. Logsdon's recommendation that his chapter would benefit from a discussion of how the "partnership" concept might work at the operational levels. Operators will rely to an ever-greater degree of commercially owned space assets and thus need to know how to function in this new partnership environment.

General Discussion

Mr. John Sheldon, speaking from the British point of view, commented that while international partnerships are good in theory, European space efforts (let alone space integration) are in their formative stage. Who might be appropriate international partners for such an effort? Who would initiate these partnerships and what efforts have been made to reach out to coalition partners to date? Mr. Sheldon feared that DeKok/Preston might be overestimating overseas interest, since the attitude tends to be that military space assets are too expensive. Thus, allies are willing to rely on the US to provide such capabilities. Finally, Mr. Sheldon questioned Mr. Preston's expression of skepticism over "space as a center of gravity." Europeans, at least, have the perception that the US would not be able to fight effectively without space assets.

Preston said that in the chapter manuscript, Canada, the UK, and Australia are suggested as potential partners since they are the US's traditional partners in intelligence-sharing. However, the US needs to develop a clearer understanding of its space strategy before expanding to include partners. Dr. Logsdon added that while Mr. Sheldon is correct that European space policy is nascent, it is not non-existent.

Dr. Fred Tarantino asked Mr. Preston whether DeKok/Preston might be overestimating the extent to which industry would supply DoD's needs independent of USG initiatives. For example, there is little market for directed energy, absent DoD funding. Preston agreed that not all capabilities would develop commercially, especially capabilities related to weaponization that would necessarily continue to fall within the DoD. However, more work is needed to determine which technologies can be leveraged from in-place commercial infrastructure.

Mr. Albert DiMarcantonio questioned whether the chart in Preston/DeKok's chapter, which breaks down the overall percentage of space in the GNP, does not underestimate the importance of space in the national economy. Mr. DiMarcantonio expressed concern that if the book were circulated to a mass audience, industry might be discouraged from entering such a small market. Second, Mr. DiMarcantonio

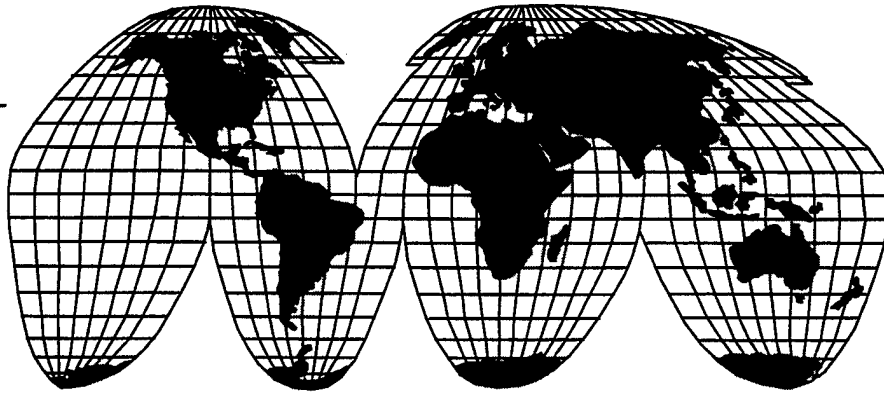
recommended that the US determine discriminators in space. How does the US balance economic interests of selling technology overseas while retaining some discriminating technology as its own?

Mr. Preston explained that the chart was not meant to convey that impression, and if it does, they will revisit it. As for discriminators, he agreed that the issue needs to be addressed in a logical and integrated manner, perhaps in a forum such as a revived National Space Council. Clearly some forum is needed to make those types of decisions.

Mr. Craig Baker felt that while the partnership idea is a good one, the USAF has paid little attention to commercial capabilities since they do not carry funding streams, and thus have no "champions." He asked Mr. Preston how the United States Air Force (USAF) would use commercial assets (not just merely in a technology sense, but in terms of building partnerships, models, and working collaboratively) when there is no funding associated with such a move (e.g., there is no POM line for developing partnerships).

Mr. Preston agreed with Mr. Baker's point that the USAF concentrates on assets it controls and could see commercial offerings as more of a threat than a positive. However, the USAF is beginning to shift its focus as commercial development is successful, e.g. the Iridium collaboration. To some extent, however, the issue remains money v. access. The USAF has access to its own system, but must pay to gain access to commercial systems; thus, it tends to rely on USAF satellites.

Dr. George Gibson asked Maj Russell about the emphasis on education in the Moorhead/Russell chapter. While this is part of the picture, Dr. Gibson felt the chapter should provide a broader view. Maj Russell responded that he feels education is the most critical first step, but he agrees that more needs to be done and explained that this is why there are five recommendations in the chapter.



Panel II

Major Alan Van Tassel, Chair
Doctor J. David Martin
Ambassador Henry F. Cooper
Mister John E. Pike
Colonel Frank G. Klotz
Professor James Wirtz

PANEL 2: SPACE AND BALLISTIC MISSILE DEFENSE

Chair: Major Alan Van Tassel

Panelists: Dr. J. David Martin, Ballistic Missile Defense Organization,
presenting for Lieutenant General Lester Lyles
Ambassador Henry F. Cooper, Chairman, High Frontier
Mr. John E. Pike, Spokesman, Federation of American Scientists
Colonel Frank G. Klotz, Council on Foreign Relations, presenting for
Honorable Curt Weldon

Discussants: Professor James Wirtz, Naval Postgraduate School
Colonel Frank G. Klotz, Council on Foreign Relations

PANEL PRESENTATIONS:

“Space and Ballistic Missile Defense Programs,” presented by Dr. J. David Martin

Dr. Martin introduced Lt Gen Lyles’ chapter by explaining the urgency of the need for missile defense. He asked the participants, just for a moment, to imagine what would have happened if, instead of a Scud, an attack on Dhahran had involved a weapon of mass destruction (WMD). Casualties would have been significantly higher than they were. This is the challenge the US faces. Many nations either have the potential or actual capability to attack the US with WMD. This fact, coupled with intent and cultural and power differentials that could decrease the effectiveness of deterrence, means that the US is facing an urgent and pressing danger.

To address this problem, the US has adopted a three-tier strategy:

- Stop/slow the spread of WMD technology to other nations. However, as recent events show, the US cannot stem the tide 100%.
- Emphasize deterrence. Again, while the US has a strong deterrent posture, deterrence can nevertheless fail.
- Defending against WMD use.

Lt Gen Lyles’ chapter focuses on the third aspect of the strategy.

The extent to which space should play a role in this defense is shaped by the answers to four key questions: Is the use of space for ballistic missile defense (BMD) necessary, feasible, affordable, and/or desirable? Lt Gen Lyles’ explores these questions by looking at BMD programs in play. Some functional areas, such as surveillance, detection, tracking, discrimination, kill assessment, and BM/C3 fall in the area of “force enhancement,” and others, such as engagement and destruction, are more tied to “force application.” While some of these functions can be accomplished on the ground or in the air, for others the use of space is critical.

To set the stage, Dr. Martin provided the audience with a brief historical review of the BMD program. Following WWII, when intercontinental ballistics missiles (ICBMs) were developed, the US initiated an effort to protect against them. The Johnson Administration emphasized the Sentinel to provide limited defense of the US from Russian and Chinese missiles. The Safeguard Anti-Ballistic Missile (ABM) System quickly supplanted this system. With the ABM Treaty, however, the US started to move towards a greater reliance on Mutually Assured Destruction (MAD), so the Safeguard System was de-activated after ten months; the new policy was to emphasize deterrence rather than defense. Nevertheless, the technology developed for that system continued to be used in industry, and the labs continued to push the technology further. We are seeing many of the fruits of that research today.

At the beginning of the Reagan Administration, President Reagan visited the North American Aerospace Defense Command (NORAD) and asked about the state of US missile defense capabilities. He was told that the US could not defend against even one missile. At that point, the President made the decision to rejuvenate missile defense and as a result the Strategic Defense Initiative (SDI) was born. Initially, the emphasis was on multi-layered defenses with directed energy weapons (DEWs). The architecture emphasized space-based and endo-atmospheric weapons. This phase was followed up with the Strategic Defense System (SDS) phase, without DEWs. However, with the shift in geopolitics, the US moved toward an emphasis on Global Protection against Limited Strikes (GPALS).

Now, as the threat has become increasingly dispersed, the US has moved away from SDI to BMDO, which emphasizes the need for a "family of systems," including, theater missile defense (TMD), national missile defense (NMD), and Brilliant Pebbles. The new objective is to be able to protect military forces operating anywhere in the world. While BMDO seems to invest in a large array of systems, Dr. Martin believes they are all necessary to thwart adversaries' interest in using ballistic missiles.

The NMD system includes a variety of elements, including Space-based Infrared System (SBIRS)-Low, Defense Support Program (DSP), and others. The strategy is one of "3+3:" to develop the system and make a decision in 2000 as to whether to deploy it. The system and the decision have received significant attention in recent months—and will probably continue to receive attention (given the recent report regarding missile proliferation).

Dr. Martin also outlined ways that Lt Gen Lyles views space as essential to BMD efforts:

- Intelligence satellites.
- Weather satellites.
- Navigation satellites.
- Early warning satellites.
- Missile tracking satellites.
- Communications satellites.

In Dr. Martin's assessment—echoed in Lt Gen Lyles' chapter, space is absolutely critical to field current and future systems. Both believe that space will only grow in import to BMD. Space-based lasers, space-based directed energy, and other technologies are being developed that could greatly enhance US ability to counter ballistic missiles.

To summarize Lt Gen Lyles' chapter, in the past, missile defense and space played a significant role in force enhancement. However, it is highly likely that tomorrow will bring a returned emphasis on force application.

“Space Defense: An Idea Whose Time Has Come?” Ambassador Henry F. Cooper

Ambassador Cooper initiated his presentation by explaining that space for defense is not a new idea. It can be traced back to studies in the 1960s, if not earlier. BAMBI, a forerunner to the SDI program and space-based laser was proposed in 1960, but technology was not advanced enough to sustain development.

Missile defense has had a relatively turbulent history, but, Cooper explained, the US has a new opportunity to take advantage of its potential. The time is ripe because: 1) technology is maturing; 2) cost effective systems are finally becoming available, given commercial development of components; and 3) either the threat is increasing or the US is beginning to have a new appreciation of the threat. The fundamental problem to taking advantage of this technology, however, will be and has been a combination of politics and an emphasis on arms control. Whether these elements will stop progress has yet to be seen.

Ambassador Cooper discussed the evolution of technology related to missile defense. Even though SDI spent as much on ground-based technology development as it did on space-based development, it was the space aspect that captured the Russian's attention and led to a number of treaties being adopted. Some argue that it also hastened the end of the Cold War.

The principal innovation of SDI was the space-based interceptor system. Brilliant Pebbles was the first acquisition program of SDI. Had TRW/Hughes/Martin Marietta been allowed to proceed, the US would likely have paid \$7-8 billion for putting 800-1,000 Pebbles in orbit by now, with the capability to defend against missiles that are launched over 300 miles. All of the SCUDs in the Persian Gulf War could have been intercepted, and the NMD and TMD mission would be able to be accomplished in a single system. Part of the reason that Brilliant Pebbles could have done so well was the special acquisition process; it would be a good case history of how DoD might exploit techniques to build capabilities faster and more cheaply. Unfortunately, the technology produced by that program is being used more by commercial rather than DoD entities.

But politics have prevented the US from taking advantage of Brilliant Pebbles technology and others. As Ambassador Cooper explained, when he left the Pentagon, there were a number of significant and robust programs in place that could have vastly reduced US vulnerability. However, the BMDO was directed to focus away from

pursuing space-based to ground-based systems. A partial reason for the emphasis was the ABM Treaty, but it also had to do with Clinton's objections to military activities in space. In short, current BMD architectures are more the result of politics than possibilities.

As a result of these decisions, we are considering developing systems that are extremely expensive because they rely on ground rather than space. Most recent cost estimates by GAO project that NMD will cost between \$18-\$28 billion; others have suggested figures as high as \$25-\$35 billion. If the US would consider "going to space," the costs could be significantly reduced.

Ambassador Cooper believes that recently, Congress has begun to "fight back" against the Clinton Administration's restrictions on using space and its insistence on strict adherence to the ABM Treaty. Major fights have been brewing around several systems:

- Navy Theater-wide. Cooper feels that had the Clinton Administration should not insist on "dumbing down" the system's capabilities to make it more ABM Treaty-compliant, the system would be further along and be significantly more powerful.
- Brilliant Eyes/SBIRS has stalled some. But for congressional intervention on its behalf, this program would likely have been shelved altogether.
- NMD. The program is being sold as costing a figure that Cooper feels is significantly low compared to what he believes will be much higher actual costs. The program is neither robust nor headed towards promise.

Politics aside, the threat is growing. Ambassador Cooper recommends that the US respond to this growing threat by concentrating first on sea and then on space. He believes that Navy Theater Wide (NTW) is vital to shore up US capabilities. The Navy operates in International waters, so it is not constrained by over-flight issues nor problems of access, both of which constrain the PATRIOT system. The Navy system could defend the US, if it were not dumb-downed. NTW, combined with space systems, such as SBIRS-low and space-based laser, could be a very powerful defensive option if pursued aggressively. But political resistance by the Administration is high.

The Administration has allowed the ABL and SBL to proceed, since there is no immediate deployment decision required. However, the President vetoed Clementine, a program that could contribute to US security significantly in the short term. USAF's response to the line item veto has been timid at best.

Looking ahead, Ambassador Cooper sees some major issues that will force decisions. These include:

- The threat is increasing, especially with Russian and Chinese modernization.
- The number of nations that could threaten the US with ballistic missiles in the next 5 years is growing. Moreover, the Rumsfeld Report noted that nations are developing "bomblets" or "singlets" that could defeat all major programs the BMDO is currently pursuing.

--Costs of projected systems will outstrip estimates; and testing failures of THAAD have been critical.

Ambassador Cooper recommends accelerating the Navy Theater-wide system and then focusing on space systems. He also recommends looking into abandoning the ABM Treaty and the doctrine of MAD, upon which the Treaty is based. Most importantly, Ambassador Cooper believes that it is time for the US to think seriously about space control: what it means and how we accomplish it.

“Keeping Space Weapons Free,” Mr. John E. Pike

Mr. Pike thanked INSS for inviting him and allowing him to present a different perspective. He explained that his chapter focuses on what he sees as the myths or “mislearned” lessons that emerged from the Persian Gulf War, relative to BMD.

Myth #1: “Star Wars” worked, as demonstrated by the Patriots.

Mr. Pike believes that the real truth is that ballistic missile defense (BMD) was not effective. He asked the audience whether or not one can argue that the Patriot system shot down even one incoming low-tech Scud. BMD is extremely difficult. Countermeasures can be extremely effective; it is hard to discriminate targets; and computers fail. All of these critiques of BMD were proven in the Gulf War.

To date, we have spent \$60 billion on missile defense, and, in Mr. Pike’s opinion, we have absolutely nothing to show for it. For the same price, the US could have purchased 12 aircraft carriers, or invested in stealth bombers. Maybe it cannot be done. In Pike’s words, “maybe physics is just trying to tell us something.” Lockheed Martin has spent \$3.8 billion and has no intercepts to show for it. Indeed, “Star Wars” does not work.

Myth #2: Rogue states cannot be deterred using traditional deterrence.

According to Mr. Pike, that cannot be concluded from Hussein’s invasion of Kuwait. Deterrence did not fail, in Mr. Pike’s eyes. Instead, the US failed to apply deterrence. The US never sent clear, unambiguous signals as to how the US would respond should Hussein attempt to seize Kuwait.

Secondly, deterrence did work, to a limited extent. Iraq did not use all of its capabilities against US troops, since, by then, the US had made it clear that to do so would mean massive retaliation.

Myth #3: The primary threat is from rogue states.

Mr. Pike believes that the US should focus more -- and spend more -- on counterterrorism. Terrorist incidents have been numerous; while attacks by rogue states have been rare. Moreover, terrorism is not amenable to deterrence solutions; thus,

counterterrorism is required.

Myth #4: Counterforce is ineffective.

Again, Mr. Pike believes the US mislearned the lessons from the Gulf War. Many critics point to the fact that not many missile launchers were destroyed through counterforce. But one can interpret this as a positive. The US did not kill many launchers, but that is because they did not have the opportunity to use their capabilities. There was, instead, a "virtual attrition" rate in the sense that SCUD operators did not want to get blown up, so they either hid or ceased shooting for fear of being targeted. Thus, when the US conducted counterforce missions, SCUD launches declined. The effective objective was achieved.

Myth 5: The intelligence community is well organized to focus on special weapons.

Mr. Pike sees this as a blatant fallacy. The US intelligence community is not well organized with regard to special weapons. Not having advance notice of India's testing was a colossal intelligence failure. The intelligence community is not focusing to the extent it should on special weapons because no one entity is responsible for it; many entities have a "piece" of the puzzle, but no one has sole responsibility for dealing with the highest priority problem facing the US today. Pike feels that the US needs a National Special Weapons Intelligence Agency as a correlate to the Threat Reduction Agency.

Myth 6: The US is well organized, in terms of using space assets.

Mr. Pike disagrees. He believes that the primary reason the US did so well in Desert Storm was because the US was facing a third rate adversary. In his opinion, the US is not well organized in terms of its space assets and operators. As currently organized "satellite drivers," rather than those who use satellites, are in charge. Pike disagrees with the entire concept of "aerospace," since he does not see air/space as a single seamless medium. Pike advocated creation of a separate "Space Force."

"Charting a New Course on Missile Defense," presented by Colonel Frank G. Klotz for the Honorable Kurt Weldon

Col Klotz presented the Honorable Curt Weldon's chapter. Rep. Weldon's paper stresses the imminent need for missile defense in the current Post Cold War threat environment. As Col Klotz explained, Rep. Weldon believes that the question is neither one of technology nor means, but rather, of political will. While everyone hoped that the end of the Cold War would bring peace, diverse threats make BMD even more pressing. The purpose of the chapter is to address issues driving the missile defense debate, the obstacles which must be overcome to reach a consensus, and a new strategy for achieving the goal of defending America against the near-term threats.

Col Klotz explained that U.S. Rep. Weldon's chapter first presents a compelling case for making missile defense a high priority issue. The US needs to be concerned about the countries that already possess long-range missiles capable of reaching the US, as well as those seeking to acquire that capability. Russia and China both have extensive nuclear arsenals, which could be purposefully or accidentally launched. Russia's fragile state makes accidental launch a very real possibility. China has shown its willingness to threaten the use of missiles to flex its political muscle. Rep. Weldon's chapter cites a number of specific incidents that support this claim. Moreover, at least twenty nations already have or may be developing WMD and means of delivering them. This proliferation, especially by "rogue" nations makes the world particularly dangerous.

The 1995 National Intelligence Estimate (NIE) significantly underestimated the threat, according to Rep. Weldon. Nevertheless, the Clinton Administration continues to use it to frame policy. Despite the NIE, Congress has tried to respond to what it sees as an imminent threat by committing the US to deploy a national missile defense system, capable of defending the US against limited, unauthorized, or accidental attacks by the year 2003. Clinton vetoed this legislation and has, instead, adopted a "3+3" approach that would complete development in three years; at which time a decision on whether to deploy within the next three years would be made, based on threat estimates. However, Rep. Weldon believes that this approach is merely "a veneer for a hollow missile defense plan." Although the Administration has had to concede on some congressional efforts to increase funding and accelerate timelines, Rep. Weldon remains concerned.

As Col Klotz explained, Rep. Weldon does not feel that the Administration is strongly committed to theater missile defense. As evidence, Rep. Weldon cites the Administration's lack of response to General Gary Luck's plea to bring a theater system (such as the theater high altitude area defense (THAAD)) on line as soon as possible. He also points to the continual "budget shaving" of missile defense. While opponents of missile defense point to THAAD's recent intercept failures, Rep. Weldon believes that the system would be viable, given sufficient political and financial backing.

The chapter also addressed the space controversy. Rep. Weldon believes that whether interceptors are positioned in space or not, the US will need to rely on space for early warning and surveillance. Programs that promote the development of new early warning satellite systems are vital, as are space-based laser programs. Control of space is critical; yet, Rep. Weldon sees Clinton's actions as undermining attempts to move in that direction. As evidence, the chapter cites the Administration's attempt to terminate the Kinetic Energy Anti-Satellite (KEASAT) program, the spaceplane program, and others.

Despite the NIE and claims by the Clinton Administration that the US is secure, the Rumsfeld Commission, an independent commission formed to assess the ballistic missile threat, concluded that the threat is real and near-term. Moreover, the Commission concluded that policymakers would have little or no warning as to when an operational capability by a rogue state would come on line.

In his analysis, Rep. Weldon also questions the wisdom of the President's actions to multilateralize the ABM Treaty and the recent demarcation agreement with Russia. Rep. Weldon believes that these steps merely serve to provide those who do not have long-range missiles currently a chance to acquire them while locking the US into a defenseless position.

Rep. Weldon recommends the following:

- Commit to deploy a limited national missile defense and initiate discussion with Russia to end the ABM Treaty.
- Support a robust missile defense budget.
- Insist on execution of missile defense programs and directives.
- Insist on congressional oversight of negotiated agreements impacting missile defense programs.
- Pursue Joint US-Russian missile defense initiatives.
- Strengthen nonproliferation laws and oversight of arms control activity.

PANEL DISCUSSIONS:

Critique of "Space and Ballistic Missile Defense Programs," Professor John Wirtz

Professor Wirtz complimented Lt Gen Lyles' chapter for offering an excellent overview of the past and the present in missile defense programs, as well as an informed opinion on the future. However, he felt that the chapter reads somewhat like an "official document." Thus, it either does not or cannot answer the four questions it poses: Is ballistic missile defense (BMD) in space feasible, affordable, necessary, and desirable? These are the questions, according to Prof. Wirtz, which lie at the heart of the debate between the panelists: it is a political rather than technical debate.

According to Prof. Wirtz, Ambassador Cooper and Mr. Pike are engaged in a political debate as to whether or not the USG should move toward increased use of space for military purposes, whereas Lt Gen Lyles' chapter is more of an overview of the gradual progress in technology towards that goal. In some ways, Prof. Wirtz sees the forward march of technological progress as inevitable. Only if disaster were to strike, does Prof. Wirtz foresee a radical shift away from such a course. The disaster could cut either way—either a disaster that proves we need space-based BMD or a catastrophic failure that proves, as Mr. Pike says, "the physics just don't work."

To some extent, Theater High Altitude Air Defense (THAAD) is providing something close to such a disaster; even such diverse personalities as Amb. Cooper and Mr. Pike can agree on its failure. Prof. Wirtz recommended that Lt Gen Lyles' chapter address THAAD's failure more starkly and assess why it has failed. Is it, as Mr. Pike argues, that "hit-to-kill" is simply too hard? Or, has THAAD failed, as Amb. Cooper argues, because Lockheed Martin let us down? Or, perhaps, as the Weldon chapter might suggest, does THAAD not work because there has been uneven political support for the

project?

Prof. Wirtz believes that Lt Gen Lyles' chapter also fails to address the Anti-Ballistic Missile (ABM) Treaty directly. While it mentions economic, strategic, and technical constraints stemming from the ABM, Lt Gen Lyles does not suggest whether it should be retained or abandoned. Prof. Wirtz finds US actions somewhat surreal. On the one hand, the US has a treaty in place that it claims to support; on the other, the US is developing a number of technologies that seem to contradict this position. In Prof. Wirtz's view, it appears that we are not quite "leveling with ourselves."

Prof. Wirtz expressed concern that the US does not think strategically enough about space and our vulnerability there. Strategically, we depend on space, but we do not think about adversaries' "outweaponizing" us in space.

Critique of "Charting a New Course on Missile Defense," and "Space Defense: An Idea Whose Time Has Come?" Colonel Frank G. Klotz

Col Klotz praised the Weldon chapter for presenting an articulate and thoughtful picture of missile defense. He agreed with Mr. Weldon's point that the US needs to commit to this course of action more fully than it has to date. Similarly, Col Klotz found Amb. Cooper's chapter to be clear, straightforward, and compact. However, Col Klotz made some stylistic suggestions to both of these authors, as well as other authors in the book.

First, the authors need to be clear on the intended audience for the edited volume. Since it is intended to be a primer, as well as to reach a more general public, the authors should guard against assuming too much knowledge on the part of the reader. Second, Col Klotz recommends that the authors be careful not to include too many current events. Given the usual lag time, this volume will likely not be published for a number of months. Thus, any reference to "current" debates could quickly date the book.

On a more general note, Col Klotz suggested that either a separate chapter of the book be added to address the ABM Treaty, or that one of the authors include a more extensive section on it, since it is so vital. Finally, Col Klotz felt that the authors tend to use Revolution in Military Affairs (RMA) as more of a technology advance or "how to" issue. He recommended the authors apply Lawrence Freedman's definition of RMA as more of a "why and under what circumstances" certain capabilities might be used, as opposed to treating it as a technological advance issue.

Dr. Martin's Response. Dr. Martin agreed that the ABM is dealt with in more of a tangential than a direct way in the chapter, but was not sure if more extensive coverage would result in making the ABM too dominant of an issue in a book devoted to spacepower.

As for the four questions on whether extending weapons into space is necessary, affordable, feasible, and desirable, those questions are treated in the summary of the chapter that discusses the future. He could suggest to Lt Gen Lyles that they be treated more fully, but Dr. Martin does not believe there are any easy answers, nor has the US reached any conclusions yet.

Dr. Martin also responded to some of the other panelists' discussions on system capabilities. He does not believe that the Patriot was a failure; instead, it was a political success. The Patriots kept the coalition together. The system was not a technical failure either. Given the state of technology, it performed fairly well. Moreover, the US learned valuable lessons from using it in the Gulf War. For example, in its use in Saudi Arabia, the US learned how to deal with countermeasures; in Israel the US learned the amount of lead-time it takes to set up the system. Most importantly, the US learned that one system is not enough; a family of systems is required.

Dr. Martin defended THAAD, disagreeing that it has been a failure. Even though it has yet to intercept a missile, it has had other successes. As to the problem with THAAD, Dr. Martin believes that THAAD's setbacks have been caused by some lack of management oversight, such as inadequate ground testing. Hit-to-kill is not impossible, it is just very difficult. The concept has been proven in other demonstrations, such as ERINT. Finally, Dr. Martin expressed his belief that even though the missile defense program has been costly, he feels that the public demands protection and the President needs options.

Amb. Cooper's Response. Amb. Cooper thanked the discussants for their comments and agreed with Prof. Wirtz's comments that politics is the point. The state of technology is not the results of "physics trying to tell us something" anymore than early flying failures proved it was impossible for man to fly. The question is one of political will and management oversight. According to Amb. Cooper, Lockheed Martin has the capability to get THAAD right. Hit-to-kill is not the problem (although it is difficult). THAAD failed at the subsystem levels, not at the hit-to-kill level.

Amb. Cooper also responded to a number of other points:

--As for the ABM, Amb. Cooper believes that it should be abandoned. The US adheres to it for historical reasons that are no longer valid in today's world.

--While significant amounts have been invested in developing missile defense technology, the investment has been a good one in yielding valuable research. Moreover, if, as some say, it annotated the Cold War by 5 years, then it saved almost \$160 billion.

--Amb. Cooper agreed that the Patriot system made a valuable political contribution to the Gulf War. No one expected it to perform perfectly, especially since it had not even been tested prior to its use on the battlefield.

--Amb. Cooper disagreed with Mr. Pike that we should rely solely on deterrence. While it is our first line of defense, deterrence sometimes fails. The US needs options. Second, analysts need to consider who is the "deterree." Could a rogue

or other ally deter US entrance into a war absent defenses?

--Finally, Amb. Cooper agreed with Mr. Pike on two points: 1) the intelligence failure in the recent India nuclear testing was colossal; and 2) consideration of a separate space force that includes more intelligence would be worthwhile.

Mr. Pike's Response. Mr. John Pike expressed his belief that, counter to what many might think, he agrees with the limited utility of the ABM Treaty (but for different reasons). While many of the panelists oppose it as being outmoded, he believes it has been watered down too much. Mr. Pike likened the Treaty to the Montreaux Convention; it has been "creatively" interpreted to the point of meaninglessness. The ABM Treaty restricts very little US action today. For example, the ABM Treaty originally restricted sensors, interceptors, etc. Now, it only applies to interceptors in space. Thus, systems, such as Brilliant Pebbles and SBIRS, that would have been prohibited under the old interpretations, are now acceptable. He cited other examples, such as changing the criteria from "one-on-one" to "force-on-force" and changing language to read "tested in an ABM mode." All of these loopholes render the ABM somewhat irrelevant.

As to Amb. Cooper's point about the US being deterred from action, Mr. Pike thinks that "self-deterrence" is central to the debate. If China were determined to liberate Taiwan, would we risk WWII? Probably not. But it is also unlikely that China would risk its survival by attacking Los Angeles with nuclear weapons. This deterrence assessment is the fundament of US nuclear strategy. If nuclear weapons don't deter, why does the US maintain them? Moreover, if the President believed that there was a possibility that China would attack the homeland with nuclear weapons, would he risk the possibility of even one leaker getting through, even if the US had BMD? No. Deterrence works in both directions. During the Gulf War, the coalition limited its war objectives and did not threaten Hussein's life. Hussein, on the other hand, did not use everything in his arsenal for fear of retaliation. Missile defense would not change that dynamic.

Amb. Cooper disagreed. If the US invested in reliable systems, the President would have more options. Moreover, adversaries would be aware of US capabilities and be less likely to make such threats or even attacks.

General Discussion

Mr. DiMarcantonio asked Mr. Pike about accidental launch or escalation. Doesn't missile defense have an important role to play in these situations? For example, if China moved into Formosa, the US would want more options than to rain nuclear weapons on China. Mr. Pike responded that he is concerned about China, but not because of a lack of BMD. Rather, his fears stem from his view that the US has not made clear signals regarding its security commitment to Taiwan, following a similar path as it did regarding Iraq and Kuwait. If deterrence fails, it would be because the US failed to deter.

Mr. Sheldon questioned Mr. Pike on the issue of counterterrorism. Mr. Pike recommended that the US invest more in counterterrorism than BMD since it is the more likely threat. However, Mr. Sheldon is afraid that such a move might actually spark an increase in terrorism. Mr. Pike agreed that if handled incorrectly, it could have the perverse effect of increasing terrorist attacks. Many of the right-wing extremists could see greater surveillance as evidence of greater government control, especially if the DoD absorbed more of these duties from police departments. Mr. Pike is disturbed that the bright line distinction between domestic and international defense is becoming blurred.

Maj Astore asked the panelists to address the traditional argument against BMD—that it would be destabilizing and fueling an arms race. Maj VanTassel responded on behalf of Lt Gen Lyles. He noted that there are two stability issues: crisis stability and arms control stability. During the Cold War, BMD may have created crisis stability issues vis-à-vis the Soviet Union. However, there are no countries likely to engage in first strike considerations based on the US adopting missile defense. As for arms control, which countries are likely to instigate arms races with the US? Perhaps China, and maybe Russia, but Maj VanTassel felt that the stability argument no longer holds.

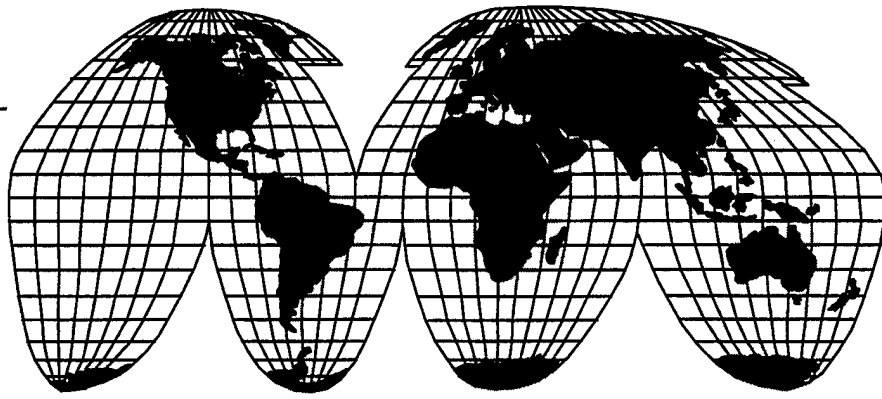
Mr. Pike disagreed, especially regarding China. He believes the US is at a critical juncture with China. Adopting a national missile defense system could lead to an arms race.

Amb. Cooper believes the theory has always been and remains flawed. The ABM Treaty did not slow the arms race between the US and the Soviet Union. Instead, it fueled one. The adversaries continued to build offensive weapons. In Amb. Cooper's opinion, the optimal means of ensuring crisis stability is to build survivable deterrent systems and defenses. Amb. Cooper agreed with Mr. Pike that China and the US are at a critical point in their relationship, but disagreed with Mr. Pike's prescription. China would be less likely to build offensive weapons if the US had a strong defensive system in place.

Both Col Klotz and Prof. Wirtz expressed skepticism at the extent to which the US-China relationship is in trouble. Prof. Wirtz believes that if we "energized the relationship" in a positive way, perhaps the US could avoid crisis instability.

Mr. DiMarcantonio questioned the panelists focus on "us v. them." To what extent are relationships more than bilateral in today's world? Also, to what extent are the panelists focusing on intent over capabilities? Prof. Wirtz responded that many studies have shown that relationships, despite power differentials, tend to remain bilateral. Amb. Cooper suggested that, contrary to some views, studies show that multi-polar worlds tend to be more stable. However, he does not believe that only structure matters; politics and intentions count as well.

Lt Col Walsh asked the panelists their views regarding a separate "space force." With the current emphasis on jointness, does it make sense to develop another separate force? Amb. Cooper felt that such a move could be necessary unless the USAF begins to see its space role as supporting military rather than political objectives. In the past, USAF space efforts were tied to the NRO, rather than being aimed at a warfighting strategy. Amb. Cooper has been frustrated with the inability of the USAF to make space a part of the military strategy.



Panel III

Lieutenant Colonel Guy M. Walsh, Chair

Doctor Dana J. Johnson

Doctor Ken Reynolds

Doctor Daniel E. Hastings

General Howell M. Estes III

Mister Albert DiMarcantonio

Major General (S) Marshal Ward

Mister Dwayne Day

PANEL 3: ORGANIZING FOR MILITARY SPACE MISSIONS

Chair: Lieutenant Colonel Guy M. Walsh

Panelists: Dr. Dana J. Johnson and Dr. Ken Reynolds, RAND
Dr. Daniel E. Hastings, Chief Scientist of the Air Force
General Howell M. Estes III, CINC, USSPACECOM

Discussants: Mr. Albert DiMarcantonio, Assistant Deputy Under Secretary of Defense for Space Integration
Major General (Select) Marshal Ward, HQ USAF/XOO
Mr. Dwayne Day, Space Policy Institute, George Washington University

PANEL PRESENTATIONS:

“Shaping the Battle Space,” Dr. Dana J. Johnson, Dr. Ken Reynolds

Dr. Johnson and Dr. Reynolds complemented the Long-Range Plan (LRP) as contributing significantly to discussions on organizational change. However, their chapter presents an alternative organizational framework. Many of the insights in the chapter were garnered from their work on the Aerospace Integration Task Force.

The problem, in Drs. Johnson/Reynolds' view is that USSPACECOM does not have total authority or direct enough control to realize the vision outlined in the LRP, especially to operationalize the concept of “global partnerships.” At least three things would have to happen, organizationally, to make the LRP a reality:

- USCINCSpace would need to inform national policies and policy-making processes to “shape the future battle space,” taking the broader view.
- The US and USAF would have to clarify the overlapping and unclear authorities and responsibilities at multiple levels and among the many organizations operating in the space arena.
- A concerted effort would be needed for the military to clarify its own vision. Currently, different entities have distinctive visions related to space. For example, the vision outlined in the LRP differs somewhat from the USAF vision. The fact that these visions are not the same is concerning and would need to be resolved.

Shaping the battle space would occur within the context of alternative national space strategies. Drs. Johnson/Reynolds outlined a typology to categorize potential national strategies. For example, there is an “Imperialist” strategy, whereby the US military dominates space, and a “Federalist” strategy, which has a commonwealth of space-faring nation-states with integrated space forces. Other strategies include “Incremental Change,” which most closely describes current policy, and “Isolationism.”

Drs. Johnson/Reynolds used this typology to explore the impact that each “theme” or strategy might have on organization. For example, in an Isolationist strategy, CINCs would likely fade in importance. When applying this methodology to the LRP, one finds that the LRP could only work if, organizationally, the US had a “top-down” approach to space. This would require vertical integration and direct control. The only national strategy or theme that lends itself to these organizational qualities is the Imperialist strategy, whereby the military dominates and “protects” commercial assets. The Federalist world implies cooperative organizational relationships with less top-down imposition of authority.

Drs. Johnson/Reynolds pointed out that they are not advocating any of these organizational schemes or strategies, but that the perspective is telling. In short, existing organizational relations are not conducive to either the Federalist or Imperialist world because there are too many organizations not functioning in a cooperative or coordinated manner. If progress were to be made, especially towards the LRP, USSPACECOM would need to proactively shape these organizations and how they interact. Today, there are too many redundant functions, inefficiencies, overlapping capabilities, and stovepipes for the LRP or even a more Federalist strategy to be adopted.

Beyond shaping the domestic environment, the speakers believe that the US military would also need to become more active in non-traditional forums, if its vision is to be achieved. For example, what happens in areas such as treaties and agreements, economic activities and trade, and in Congress will all impact space significantly. But the major players operating in these entities today have distinctive views from that of the military. Finally, Dr. Johnson and Dr. Reynolds complimented the LRP’s assertion of the need to develop partnerships, but suggested that, organizationally what happens “in” versus “out” of house will have ramifications that need to be thought through carefully.

To summarize, Dr. Johnson and Dr. Reynolds recommended focusing on the following issues and challenges:

- Strengthening relations among US space sectors, especially military and intelligence.
- Strengthening space policymaking at interagency levels (maybe resurrecting the National Space Policy Council).
- Clarifying organizational boundaries and authority.
- Recognizing and addressing effects of conflicting organizational visions on institutional change.
- Increasing the military’s role in non-traditional arenas since decisions made in those areas will influence military capabilities to execute its mission.

“Future Military Space Technologies,” Dr. Daniel E. Hastings

Dr. Hastings explained that his chapter aims to provide a framework for deciding which of the many technologies the USAF should invest in, given limited funding.

Today, there are a variety of potentially fruitful technologies in which to invest, but, as always, there is limited funding for these investments. Thus, the USAF must use its limited funds wisely and invest in a strategic manner.

In order to formulate such a strategy, Dr. Hastings posited some assumptions about the 21st Century. Specifically, he believes the following will hold true:

- Space assets will be seen to provide economic power.
- There will be many inexpensive commercial space assets.
- Many space-enabled services will be internationally available.
- There will be a broadly available global information net.
- Proliferation of biological weapons will continue.
- Proliferation of rapidly launchable missiles will also continue.
- US forces will operate primarily out of the Continental US (CONUS).
- The pace of war will continue to quicken.
- Expansive urbanization will continue.

A number of hypotheses regarding how war will be fought follow from these premises about the 21st Century, including:

- The emphasis will be on integration of information and speed of execution.
- The US's dependence on communication links and information operations will make these two likely places for adversaries to attack.
- The pace and effectiveness of war will increase.
- The cost of war using new systems will decrease due to widespread use of commercial systems.
- Operations from CONUS and the increasing pace of war will put a premium on rapidly deployable, zero footprint forces.

The upshot is that how the US conducts business vis-à-vis space must and will continue to change. For example, in the recent past, there have been few launches using highly expensive satellites; the lag time from taking a concept to a capability has been quite long; the government has dominated space; and others. Now (and increasingly in the future) commercial space growth will be explosive, with multiple satellites launched; commercial entities will dramatically outpace government developments, and communications, imagery, and launch services will become commodities.

The change that will most dramatically affect US national security and shape its technology investment strategy is the commercial revolution in space. Today, space is government-dominated and largely US-owned. However, as space moves to the commercial sector, costs will go down and more and more countries will have access to

higher capabilities at lower prices, e.g., one meter imaging will be able to be ordered with an overnight delivery time.

In this context, US strategy should be to obtain as much as possible from the commercial world and focus R&D money on military unique technologies. It makes little sense for the US to invest in any areas where industry is likely to invest, such as technologies for efficient spacecraft operations, high performance electronics and computers, and others. Instead, the US should focus on technologies that help accomplish core capabilities: global awareness (intelligence, surveillance, and reconnaissance – ISR), global reach, and global power.

The challenge is to achieve these capabilities using both current and commercial assets and plausible future assets. In deciding how best to accomplish these functions, the planner must keep in mind the four new modalities in operations:

- Using space assets will necessarily mean using assets that are inherently global. Two implications follow from this modality: First, these assets go beyond current boundaries; and second, the assets may have commercial dual uses that are so important economically that the military eventually loses control over the assets, e.g., Global Positioning System (GPS).
- Space assets are also information assets.
- Many space assets will be commercial. This has two implications. First, the military will probably have to protect themselves via massive diversity rather than secure links or hardening. Second, the cycle of change will be very rapid.
- Finally, space warfare will likely be surrounded by noncombatants; thus, “destroying” an adversary’s assets may simultaneously destroy civilian capabilities.

Dr. Hastings added that the US must be cognizant of protecting against a nuclear burst since this could destroy significant capability, especially if the US comes to rely heavily on space assets. In short, the incentives to use nuclear weapons against US space assets are high, provided that the military is highly dependent on them.

As an excursion, Dr. Hastings outlined what he believed to be “doable” within the constraints of technology, finances, policy, mission, and organizational issues. For example, in the mid-term (by 2012), he believes that innovations such as prompt global attack, data relay, lower cost space launch, kinetic national missile defense, and others, are all easily doable. Other innovations, such as global energy delivery and ground moving target imaging (GMTI), could become realities with a technological push. In the long term (by 2020), he sees stealthy GMTI and responsive, two stage to orbit, as easily doable, with global energy delivery (SBL), and on orbit maintenance (GEO/MEO), among the innovations what are possible, given a technological push.

Within the changing commercial world of space and in light of the military functions we are hoping to achieve, Dr. Hastings outlined four doable paths for the USAF to follow. First, he recommended the use of commercial options. More specifically, he suggested aggressively buying communications and launch services. However, in the

area of weather and navigation, the USAF will likely have to continue to lead the way. Second, the USAF should focus on technologies related to ISR, particularly in technologies that help in integration. A third path for the USAF to explore is technology leading to the delivery of directed energy from or through space. The technology for this could be available by 2012, given focused investments. Finally, he recommends the USAF follow a path of investing in technologies related to space control, particularly defense of commercial, as well as military assets.

Instead of investing in technologies along these paths, however, Dr. Hastings believes that the USAF is spending the bulk of its S&T funds on "doing better what we do today," rather than on innovations that could significantly change the future. The majority of USAF S&T dollars are currently allocated to non-space technologies (only \$160 million of \$1,283 million are spent on clearly space-related innovations that are not congressionally directed). The USAF research lab is committed to changing this, but more could and should be done.

Dr. Hastings recommends that the USAF focus its S&T investment portfolio on enabling technologies for strategic thrust in synergy with DoD, the Intelligence Community, NASA, and the commercial world. More specifically, he believes the USAF should spend 60% on mid-term technologies related to integrated ISR, global energy delivery, and space control technologies. Another 20% of funds should be directed at those technologies that may be less doable, but would have a high pay-off if achieved. Finally, he recommends the USAF focus its remaining 20% of funds on "revolutionary" technologies that fall outside of the scope of "doable" or on the US's immediate horizon, such as distributed satellite swarms or nontraditional propulsion.

In summary, Dr. Hastings concluded that there are doable paths for the USAF to follow. If the USAF invested wisely by 2012, it would have:

- An evolved stewardship role whereby it would buy many services as commodities.
- Strong integrated air and space elements to provide a comprehensive ISR.
- A demonstrated ability to deliver militarily significant amounts of laser energy through space to targets.
- A robust space surveillance capability and attack warning capability for satellites.

"The Aerospace Force of Today and Tomorrow: Transforming Our Service to Control the Vertical Dimension," General Howell M. Estes III

General Estes believes that the USAF is at a dawn of a new era. The Fall 97 CORONA directed that the USAF fully exploit space. This was met with resistance. Some of the resistance came from traditionalists who see the Air Force as an Air Force first, with a secondary mission of space. Other resistance came from those who felt that space should fall under a separate force. Some of the cultural resistance remains, despite CORONA 98, which emphasized the need for the USAF to control the vertical dimension

and become an Aerospace Force. The decision has been made that space will not fall into a separate force. Now, the culture must change to embrace the mission. The USAF has laid out a roadmap and a plan to integrate the medium to be seamless. The words are there, but a cultural change is required to make it happen. That is not to say that air will be supplanted with space; rather, the USAF needs to become a steward for both.

The Air Force is at a crossroads, according to General Estes; either it fulfills its stewardship to the space mission or it will lose it. Superiority in space is vital to US national security. The USAF needs to break its cultural paradigm and embrace the new mission. General Estes added, however, that the Chief of the Air Force disagrees with him. According to the Chief, the decision has been made and the USAF is moving toward the new mission; the Chief believes that any discussion of a separate force is moot.

General Estes asserted his belief that this is not the first time that a Service has had to transform itself or lose a mission. To bolster his point, he cited the Army/Army Air Corps transition period. Now is the time for visionaries. Rather than wringing our hands and focusing on the past, leaders in the USAF need to look to the future. While the process is slow, he sees the Air Force as finally moving in the right direction. General Estes also admonished those who see air/space as a zero sum game, such that money spent on space means less funding for aircrafts. General Estes strongly disagrees; the USAF does not want to lose control of the space mission, which he sees as a critical complement to the air mission. The USAF needs to fully integrate the two. It is time, in General Estes' opinion, that the USAF recognizes this and quit making excuses or they risk losing space to a separate Service.

A key pillar to this integration process should be to educate aerospace warriors. General Estes sees a strong need to eliminate stovepipes between intelligence (NRO) and space. Currently a "black/white" Service exists; this must be eliminated, just as the distinction between air/space needs to be eliminated. General Estes expressed confidence that the NRO head, Keith Hall, is open-minded to this idea. Only by such a coordinated, rather than stovepiped approach, will the warfighter receive the intelligence he needs. General Estes sees the problem not as one about sensor or data-collection, but of integration – getting the data to the right people in useable form.

General Estes concluded his presentation by again emphasizing the urgent need to make an Aerospace Force happen and asking those in attendance to be the changing agents to break the old paradigm.

PANEL DISCUSSIONS:

Critique of "Future Military Space Technologies," Mr. Albert DiMarcantonio

Mr. DiMarcantonio praised Dr. Hastings' chapter for laying out a practical approach to selecting appropriate areas for investment. However, Mr. DiMarcantonio questioned not only Dr. Hastings', but also many of the authors' assertions that the

commercial sector would take the lead in innovation and development, particularly because he sees many barriers to such a transformation.

As a former employee of a high technology company, Mr. DiMarcantonio has experienced the frustration of working with the USG and DoD. There are still many aspects of business that the government fails to understand. These would need to be addressed if a true partnership were to develop. For example, there are issues about overseas markets, competition, cost v. value pricing, anti-deficiency funding restrictions, and others.

The military remains distinctive because the bottom-line is not necessarily the driving factor in its decision-making. Moreover, it is unlikely that the commercial sector would be willing to pay for basic research. Businesses stress application-oriented research. Similarly, they tend to focus on high pay-off technology. Thus, many issues would need to be resolved before such partnerships and reliance on commercial entities could occur.

Mr. DiMarcantonio made a number of other suggestions:

- Before the US can collaborate effectively with industry, it must collaborate better across agencies. A taxonomy of needs should be developed so agencies can "speak the same language" and decide where to invest.
- DoD needs to develop more creative and open-ended ways of writing RFPs, so the process allows more room for innovation by companies responding.
- A joint S&T is needed so that customers can understand an integrated space force.
- Metrics must be developed so the process can be gauged objectively. As IDTs are developed, the process needs to be institutionalized with plans, evaluations, and information in place, so we move away from a personality-driven policy.
- Now may be an opportune time to build such partnerships since the Administration is pressing for increased cooperation in the area of emergency and disaster preparedness. The Pacific Disaster Center, for example, represents a positive collaboration. Similarly, it might be possible to suggest to Congress that dual application technology receive offset credits, so there is a greater incentive to collaborate and develop dual-use technology.

Finally, Mr. DiMarcantonio expressed his concern that the organizational structure related to space is confusing and needs streamlining. Currently, there are few clear-cut lines of responsibility and authority; there is significant functional overlap; and no one has a clear understanding of what others are pursuing related to space. A coordinated investment strategy that is transparent to all involved is required. This coordination would need to be worked at three levels:

- The scientists level.
- Program managers.
- Budget managers.

This would allow scientists to leverage work of other scientists; program managers to team and ensure that duplication of programs was not occurring; and would allow budget management to more wisely use limited resources.

Critique of "Shaping the Battlespace," Major General (Select) Marshal Ward

Maj Gen (S) Ward complimented Dr. Johnson and Dr. Reynolds for a well-written, well-presented chapter. Maj Gen Ward (S) was supportive of using the typology of national space strategy themes as an organizing tool. However, he thought a few of the categories required a second look. For example, the Imperialist v. Federalist appeared to be similar. Also, he was not sure if Dr. Reynolds' and Dr. Johnson's description of a world in which commercial sectors take specific direction from the USG would ever be very realistic.

As to the organizational issues, Maj Gen (S) Ward sees three potential organizational constructs, in light of US national security strategy:

- Retain the status quo (Maj Gen (S) Ward took issue with the assertion that there is significant overlap in authority and responsibility).
- Move to a SPACECOM model, whereby USSPACECOM has some budget authority.
- Create a separate Service.

While the third option is strongly possible, there are drawbacks to such an approach. Primarily, having a separate entity to handle space could create a separate target; it would be very vulnerable. Similarly, if the "space service" were strongly integrated and distinct from other service branches, then the USAF, for example, could not remove its assets in case of budget cutbacks, etc. However, there are problems with placing responsibility for space under the USAF. Does it spread the USAF too thin? For example, General Estes is triple-hatted. Does he have enough time to concentrate on all three areas to the extent required? If he prioritizes his time, he defaults to the most important responsibility (that of CINC). We need a four-star General who advocates for space full-time. While the aircraft side of the house has one, space is still without such a champion.

General Discussion

Col (S) Jim Painter expressed concern with Drs. Johnson and Reynolds' interpretation of the LRP. The LRP has no intention of treading on Title 10 responsibilities or blurring the distinction. Second, the system-specific orientation of the plan was deliberate since the authors of the LRP felt that not to approach it in this manner would seem to indicate a lack of endorsement of these systems by the LRP. The next version of the LRP will be more effects-oriented rather than systems-oriented in order to get away from the Title 10 issues.

Mr. Sullivan agreed that there is enormous potential for military space systems, but asked Dr. Hastings whether developing such systems would leave the US vulnerable to countermeasures and systems that could easily be destroyed with nuclear weapons.

Dr. Hastings responded that such a scenario was possible and that is why he advocates that 20-30% should be spent on "revolutionary technology." Dr. Hastings explained that new weapons systems come about either through revolutionary and unanticipated breakthroughs or through steady progressions. At one time, for example, lasers were revolutionary. Now, improvements in lasers are more gradual and evolutionary. Thus, one approach is to develop technology to address the countermeasures, e.g. make systems hardened. While this is expensive, revolutionary or evolutionary breakthroughs could lower the cost. Also, system solutions are another answer, e.g., putting in place enough back-up systems, that taking down one satellite in a cluster would not significantly degrade capability. Maj Gen (S) Ward agreed that the USG must go forward despite vulnerabilities. Even though nuclear weapons could destroy ships, planes, etc., it does not mean the US should not develop those capabilities.

Critique of "The Aerospace Force of Today and Tomorrow," Mr. Dwayne Day

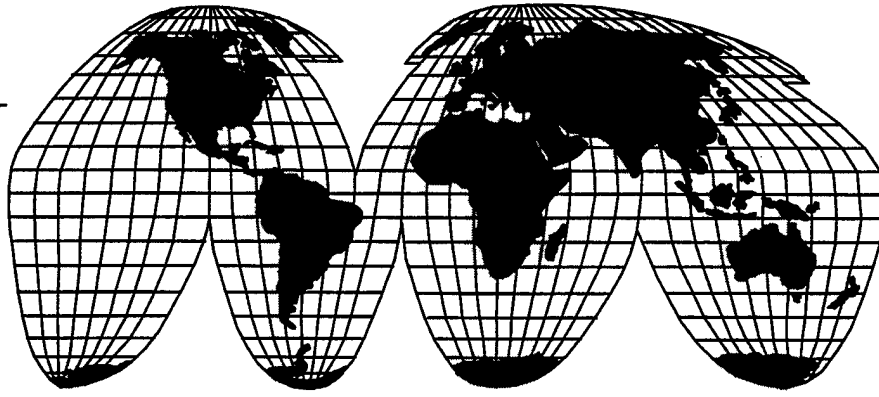
Mr. Day opened his critique by explaining that he generally agrees with General Estes' overall perspective. However, the vision General Estes presented, of a "seamless aerospace force," seems slightly different than the air and space force the LRP envisions. Mr. Day expressed skepticism regarding the extent to which the USAF leadership will embrace such a vision. In the early days of space exploration (post Sputnik), the top USAF leadership was very enthusiastic about the space mission, but when the dollars they expected did not come through, their interest waned. It is important then to tone down the rhetoric of how much the USAF will and won't do. It is a fairly safe bet that the USAF will never spend more on space than on air-breathing assets.

Mr. Day then posed the question: How much of the transition from air to space should, or even could, be controlled by USSPACECOM and how much could be controlled by the USAF itself? Day believes that USSPACECOM has limited influence, and that the USAF will likewise be limited. What matters is not just to develop and adopt systems, but to ensure that USAF operators use those systems. For example, GPS was developed but few, if any, Air Force pilots carry one in their survival kit. This failure to adopt technology not only hurts the USAF vis-à-vis itself and USSPACECOM, but also relative to other Services which have exploited the new technology to greater advantage. Both the United States Navy (USN) and the United States Army (USA) have used commercial contracts, as well as the equipment extensively. The other Services are moving quickly, outpacing the Air Force. The Air Force must make an effort, and not wait for USSPACECOM. It should create benchmarks for moving towards the aerospace ideal, such as the number of pilots carrying GPS.

Mr. Day recognized the difficulties that the USAF will have in moving towards these benchmarks. First, defense budgets will continue to decline in the future. Thus, it is unlikely that space allocations could grow without taking resources away from

traditional areas. Second, explosive commercial growth is a double-sided coin. While the military will be able to exploit cheap technology, the Air Force will also lose significant control. For example, with GPS applications so widespread, the USAF no longer can control this technology. What will happen when the military gets out of the launcher business? Third, and finally, expanding commercial space could be analogous to oil resources: it could increase the area of US interests that need to be protected by the Services.

General Estes' Response. The LRP pointed out many of the problems with transitioning from an Air Force to an air and space force, particularly absent policy or guidance. While there is a national space policy, a national military space policy needs to be developed. It is not clear, for example, whether an attack on a US satellite constitutes an attack on US sovereignty/the homeland; little guidelines are in place. These are frustrating facts, given how long the US has been trying to move in this direction. However, the answer is not to get frustrated, but to fix the problems. We need a truly new paradigm that is addressed by all levels in the Air Force, from the operator to the leadership.



Panel IV

Doctor James M. Smith, Chair

Colonel Simon P. Worden

Mister John B. Sheldon

Doctor Brian R. Sullivan

Mister Marc Berkowitz

Professor James Wirtz

PANEL 4: FUTURE MILITARY SPACE ISSUES

Chair: Dr. James M. Smith

Panelists: Colonel Simon P. Worden, Deputy for Battlespace Dominance, HQ USAF/XORB
Mr. John B. Sheldon, University of Hull, England, presenting for Professor Colin S. Gray
Dr. Brian R. Sullivan, Author

Discussants: Mr. Marc Berkowitz, Assistant Deputy Under Secretary of Defense for Space Policy
Professor James Wirtz, Naval Postgraduate School

PANEL PRESENTATIONS:

“Space Control for the 21st Century: A Space “Navy” Protecting the Commercial Basis of America’s Wealth,” Colonel Simon P. Worden

Col Worden explained that he was going to provide a different perspective related to space, concentrating more on its economic aspects and the defensive role it will necessitate for the military. He began his discussion by differentiating between two fundamentally distinctive military roles:

- Offensive warfighting; and
- Defense/protection of US commerce.

It was the latter role that led to the creation of the Navy. Protecting merchant ships at sea was of prime import to the early American economy. In more recent years, however, the Services have focused less on the second role than the first. This focus has “spilled over” into the space arena, where planners primarily argue over space control. However, Col Worden believes that the second role will become increasingly central in the future as the US and its economy come to depend more and more on space.

Increasingly, conflict will arise out of the need to protect commercial space assets. To illustrate his point, Col Worden discussed a recent case where Tonga and Indonesia both claimed the same GEO satellite communications slot. The lesson from this disagreement is that while both of these countries are relatively technologically underdeveloped, one had the will and means to interfere with another state’s critical space-based architecture.

Col Worden explained that the world is entering what he believes is an era of “shared global utilities,” which are increasingly space-based. Just as non-space based systems are subject to attack which can devastate capabilities, so too are space-based utilities. Attacks against the integrated economic and commercially reliant infrastructure will become more likely. Col Worden highlighted some of these important critical shared

utilities that are and will be vulnerable to attacks.

Almost all communications today are heavily reliant on space-systems. The majority of long-haul communications are space-based, using high altitude geosynchronous (GEO) satellites. Low-earth orbit (LEO) satellites increasingly are being used as well. The Teledesic, the most ambitious of the LEOs, will place high-rate trunk services into space. Obviously, these assets are vulnerable to either terrorist or adversary attack, with significant consequences. Even small disruptions could have major economic and military impacts.

The Global Positioning System (GPS), which was initially a military utility, has come to be the key to an \$8 billion industry per year. Its applications are many, but it has high potential to be disrupted in the area of timing. To illustrate this fact, Col Worden cited a recent case where a small manual input error resulted in the broadcast of a time error. While this did not effect navigation (the systems correct at frequent intervals), it did cause many cellular sites to fail for many hours. New systems will be even more time-sensitive and the results of their failure potentially more devastating.

In the future, it is likely that there will be even more shared utilities. The US has already started to deploy a global space-based system known as Space-based Radar (SBR). While this has significant military applications, it also has potentially far-reaching commercial implications. It will be able to act as a "traffic cop" for all types of goods and services across the globe. Another "shared utility" will come about in the area of energy. Within two decades, Col Worden believes that the US will be able to transmit energy through space. When that happens, global energy grids can "go to space," such as solar power or space-based nuclear power plants.

Looking even farther into the future (to 2050 and beyond), one can anticipate an entire range of new ideas that will enter the economic realm, such as products made from moon resources or use of lunar sites to conduct hazardous experiments. In short, space will provide an area of immense economic benefits, commerce, and wealth, all of which will require protection from the US military.

Naval forces grew out of the need to protect trade vital to a nation's prosperity, and secondarily, to deny it to an adversary. The analogy holds regarding space. Putting in place good security mechanisms is the only reliable defense – which can then serve as a deterrent. For example, when SLOCs were cut off, the US re-flagged tankers as US assets, thereby preventing their interdiction. The key, however, is to have fast, flexible, and armed ships, as well as a strong and visible presence.

This is true for space as well. The US will need to be able to protect key nodes—namely satellites and deny their use by an adversary. There are different ways to accomplish this goal, but the most acceptable is either to deny its use or degrade its performance since destroying it would be considered an offensive move. Thus, Col Worden recommends ensuring the US has the capabilities to accomplish in space actions akin to blockading and embargoing. This will require the US to have sophisticated space

awareness capabilities, as well as flexible and maneuverable systems.

Col Worden concluded by saying that the key will not be warfighting issues, but rather, protection. Col Worden advocates two priorities. First, that the US invest in acquiring the capability to have a presence in space, e.g., by putting sensors in place or having sensor-type escorts with commercial assets. This need suggests that the US invest in highly maneuverable or very responsive launch vehicles, such as spaceplanes or space operations vehicles (SOVs). Second, the US should consider what technologies it will need in order to have the capability to embargo "bad actors" from going to space. Besides exerting a strong presence, the US may want to develop small "microsats" that can interfere with satellite operations. Such microsats could potentially "shade" the solar panels and create a power deficit.

"Spacepower and the Revolution in Military Affairs: A Glass Half-Full," presented by Mr. John P. Sheldon

Mr. Sheldon thanked INSS for giving him the opportunity to present his and Dr. Colin Gray's paper. The chapter aims to examine the question of whether spacepower constitutes an RMA.

Gray/Sheldon's paper first points out the discrepancies within the LRP on this question. In the Summary portion of the LRP, the authors suggest that space capabilities play an enabling role for an RMA. However, in the Introductory section, the authors refer to the potential for space capabilities to become an RMA. Gray/Sheldon support the latter view, with the caveat that they do not believe that an RMA can affect a fundamental change in warfare. Instead, they believe that space will become another medium of warfare. They caution against hitching space too tightly to the RMA debate, since space is too important to be held hostage to the debate or to rise and fall based on conclusions reached in that arena.

As Mr. Sheldon explained, space is, strategically, just another environment for conflict, although not a geographical one. This is primarily because threats do not emanate from space in the same way they emanate from regions. While asteroids or aliens could threaten the US, the true purpose of the use of space for strategic purposes emanates from threats on earth. Space happens to be just another environment of human conflict. To clarify, Mr. Sheldon outlined some of the key points in the chapter:

- Strategically, spacepower is similar to landpower, seapower, and airpower.
- The strategic history of spacepower will likely follow that of sea and airpower.
- Space is geographically distinctive, but so too are these other environments.
- Humans have only one "natural" environment, land.
- Because humans live on land, military and strategic behavior and impacts only matter as they relate to land.
- The logic of strategy is universal.
- The unique geography of space must find expression in unique technologies, but not necessarily unique strategies.

There is nothing about the space environment that renders it "beyond strategy." The fact that technology is immature does not discredit its importance. Just as skepticism over the potential and efficacy of seapower were unfounded, so too, are similar rejections of space. Boats had to "overcome" their limitations of being separated from land, as did airpower assets. There is nothing geo-tactically unique about outer space. While the details must be fitted to each environment, strategic approaches do not.

Just because the US does not currently have the technology to be militarily effective in space, it does not render it immune to the general logic of strategy. In terms of how to approach space, Gray and Sheldon believe it should be viewed as another generator of strategic effectiveness. A second perspective is to apply land, sea, and air ideas to space, since space is the newest environment to be plumbed. While some of these may be applicable, it is valuable to move beyond current notions to take advantage of space potential. The trick is to see spacepower within the context of strategy, but also approach space warfare uniquely as space rather than sea or air warfare. The third way to view space is as a wholly unique geographical environment that requires total respect on its own geostrategic terms, involving a space-derived tactical and operational thinking.

As Dr. Gray and Mr. Sheldon argue, the logic of spacepower is identical to the logic of military seapower and airpower. But it suffers from early, exaggerated claims, unsupported by the technology of the time. However, the phenomenon is not unique to space. For example, many have made claims that gunpowder artillery was the coming force in land warfare almost a century before that was the case. More important, for the purpose of the chapter, much of the current literature on spacepower mixes up tactics and strategy, as well as policy and vision. It is foolish to base one's argument on spacepower solely on current technical, tactical, and operational capabilities or challenges, since they will change over time. Rather than exaggerated claims about the future, integrating space in strategy requires that ideas be grounded in possibilities, not tied to expectations of technological advances.

The strategic logic of spacepower, as Mr. Sheldon explained, dictates that the greater our desire and reliance on space for military advantage, the greater our adversaries' motivation to deny it. Here, analogies to sea and air are apt. Thus, while everything about spacepower is debatable, the strategic logic that our attempts to exploit it will be met with adversaries attempting to either deny exploitation or its effectiveness is not debatable. The only case in which this would not hold is if true political peace were achieved and sustained.

Mr. Sheldon went on to address his and Dr. Gray's beliefs as to whether space constitutes an RMA. While they believe it might be considered either an RMA or a Military-Technical-Revolution (MTR), it is much more than that. These are merely intellectual constructs, whereas spacepower is an evolving physical reality. Given its likely enduring nature, they caution against hitching spacepower too closely to the RMA star. The reality is that space has moved from an add-on to a necessity. As Mr. Sheldon explained, for better or worse, the era of space-system dependency has arrived.

Space is not the only revolutionary activity, but it is moving one of the most radical and irreversible changes in military affairs. At least eight other candidate "revolutions" have been suggested in recent years, including information-led warfare, true information warfare, and mature airpower. Of these, clearly spacepower is the most revolutionary. While some commentators argue that spacepower is merely an enabler, Sheldon/Gray disagree.

Spacepower, like the three other candidates mentioned, also has the characteristics of a MTR. However, technology itself is not an effective weapon. For spacepower to constitute an RMA, there must be military-cultural, institutional, and doctrinal changes, as well. Here, the LRP accurately equates spacepower with these types of revolutions: a revolution in strategic affairs, in security affairs, and in political affairs.

Mr. Sheldon concluded his remarks by summarizing his and Dr. Gray's viewpoint. First, while viewing space as an RMA has some advantages, one must be careful. RMA is merely an intellectual construct that can neither be true or false. Second, nowhere does technology matter to the extent it does in space. However, even for space, technology is but one dimension of the overall strategic picture. Space warfare, like war in all environments, is a human affair. Third, space cannot be dismissed upon desire; spacepower is a reality. Fourth, the key enabler for spacepower is space control. Fifth, as the title of the presentation suggests, "the glass of US spacepower is probably half full." The LRP has advanced a vision and a mission; however, shortfalls remain in the areas of equipment and space forces required to make spacepower a reliable strategic factor in future conflict.

Director's Note: Unfortunately, Dr. Sullivan felt compelled to use the occasion of this panel to make public allegations of plagiarism of his earlier work on space against Professor Gray and Mr. Sheldon for alleged improprieties in their paper as presented to this conference. The specific case presented had to do with a reference in the Gray/Sheldon paper to advances from galley warfare as prelude to their more pointed discussion of the current Revolution in Military (Space) Affairs that is the subject of their paper here. While Dr. Sullivan has not furnished the conference organizers with a full accounting of his allegations, we found the galley reference in the Gray/Sheldon paper to be fully and appropriately referenced. In light of the seriousness of the allegation and the open forum in which it was aired, Dr. Gray subsequently furnished the conference organizers with a detailed explanation of his earlier work involving galley warfare, including a 1980s report for the U.S. Navy and a subsequent chapter, "The Age of Galley Warfare," published in his 1992 book *The Leverage of Sea Power*. These publications predate Dr. Gray's receipt of certain works by Dr. Sullivan that also used galley analogies as background to space issues. Copies of Dr. Gray's letter and book chapter have been sent to members of the Future Military Space Issues panel. INSS regrets this incident and apologizes to panelists and attendees, and particularly to Dr. Colin S. Gray and Mr. John B. Sheldon. We believe that the Gray/Sheldon chapter is fully and appropriately documented, and we deeply regret that our conference was the occasion for such an allegation of impropriety. We have asked Dr. Sullivan to address any further issues with Dr. Gray's work to Dr. Gray personally, and hopefully to resolve them in a less public

and contentious manner.

“Spacepower and America’s Future,” Dr. Brian R. Sullivan

Dr. Sullivan opted not to initially present his chapter, but first added some thoughts to those presented by Mr. Sheldon. He felt that the use of “space control” is probably misleading, if not unjustifiable. Space is too large. No one expects the US to achieve “mastery of the universe.” Moreover, he believes the idea of spacepower is inaccurate. The point of developing space capabilities is not to control space, but rather to control the earth. Unlike land and sea or air power, which are based on the proper exploitation of the environment, in which they are used, earth power is derived from space. The intention of spacepower is not to exert power outward into space, but rather to control the earth.

Dr. Sullivan also asserted his belief that spacepower is not an extension of airpower. Space/air are not halves of the whole but are distinctive. Operations in and from space are applicable not only to land, air, and sea, but also allow coordination of the other three forms of power. Earthpower will allow joint operations to reach full potential. All four forms of military power will become so mutually dependent and intertwined that eventually it will be hard to distinguish between them. Eventually, Dr. Sullivan believes, they will all merge into a “military power.”

The transfer of so many aspects to space/orbital platforms will create both opportunities and problems, in Dr. Sullivan’s view. Someday the US may become interested in actual spacepower – that is, expanding outward beyond the solar system. That time will likely come about after the US has placed persons in space and has developed capabilities to discover objects of value in the solar system. At that point, the ability to carry out military operations between planets will take on major significance.

Dr. Sullivan also cautioned against making exaggerated claims about space. The LRP undermines its credibility to an extent by making such assertions. Just as Alred Thayer Mahan and Giulio Douhet “over” relied on sea/air power, those advocating space capabilities have the potential to make the same mistakes. Dr. Sullivan does not say this to diminish the importance of earthpower, but rather to caution against placing so many expectations on its import to national security that they cannot be fulfilled. Such claims could lead to public disillusionment or even worse, fatal errors.

Regarding the LRP, Dr. Sullivan believes that if the US could achieve the full integration of land, air, sea, and space/earth, then it would have achieved immense capability. However, to concentrate on space at the expense of integration, is to jeopardize US security. The space playing field is leveling rapidly. Forces in space will become increasingly vulnerable. Regardless of how powerful our equipment and tools are, the “fog of war” will still exist. Finally, Dr. Sullivan questioned whether LRP realistically understands the limited dollars available; space is competing for extremely limited resources. The LRP should have prioritized its visions based on a realistic assessment of what can be delivered, given shrinking defense budgets.

Dr. Sullivan summarized his thinking related to earthpower by outlining five factors that are interrelated and will impact how earthpower evolves:

- Technological factor: Ability to enter and exploit the area immediately above atmosphere and deny to others. This factor will evolve even more rapidly than we can even begin to anticipate.
- Operational: Activities carried out where access is available.
- Policy and strategy factor: Aim of activities. This is a part of the LRP that is of concern to Dr. Sullivan. While the US intentions may be positive, others will not appreciate the use of the word "space control;" others will perceive it a desire by the US for space dominance.
- Profit/politics/philosophical factor: Ascent and dedication of those who build on earth/space and their desires for rewards.
- Interactivity and mutual activity of human and physical realities. This is the idea that earthpower, unlike land, sea, and air is more "unknowable" to humans today. As capabilities change so humans can grasp it more, they will come to think of earthpower differently.

Finally, Dr. Sullivan addressed his ideas related to whether spacepower will constitute a revolution in military affairs (RMA). He believes that it will not, essentially he does not believe that RMAs are possible. MTRs, however, do exist. Dr. Sullivan disagreed with Dr. Gray and Mr. Sheldon regarding their assertion that these are merely intellectual constructs. He felt it was necessary for those who use the terms to look to their genesis in Russian history to understand their true meaning. RMA is a profound transformation related to war; MTR merely is a profound change in the way wars are fought.

Space constitutes an MTR. Today's system is based on ever more powerful computers, delicate sensors, and increasing adversarial capabilities that will place the US in a return to a defense dominated position. The very basis of US power—offensive capabilities—will end. What are the US's options? One option would be to revert to offense dominant warfare in terrestrial areas, since that would bolster the US's advantage. But that course of action would involve having to place thousands of soldiers in space, functioning under extremely stressful conditions. This type of manpower would be hard to find; thus, the likely way to recruit these soldiers would be through genetic engineering to create "machines." Thus, Dr. Sullivan believes that an unintended consequence of earth/spacepower will be to create a whole new species of soldiers, letting genies out of the bottle.

PANEL DISCUSSIONS:

Critique of "Space Control for the 21st Century: A Space "Navy" Protecting the Commercial Basis of American's Wealth," Mr. Marc Berkowitz

Mr. Berkowitz endorsed the basic premise of Col Worden's paper (that space will provide a place for commerce), and thus the Navy analogy seems appropriate. However, he felt the analogy could use more explanation, especially for an Air Force audience. What are the implications for expanding space activities? How should the US deal with these implications?

Beyond this general comment, Mr. Berkowitz had specific suggestions for the chapter:

--Col Worden's treatment of space control should be more comprehensive. The LRP and others refer to space control, but the term is misleading. Col Worden could do a great service by explaining the term in a more comprehensive way. Does it mean more than dominating the surveillance arena?

--Col Worden appropriately emphasized defense and protection, since too often offensive weapons in space are the focus of the major space debates. While commercial aspects would need to be protected, as Col Worden rightly asserts, the US would also become vulnerable militarily. If space becomes a locus for information gathering, adversaries would have an incentive to disrupt US space surveillance capabilities, using asymmetric threats and actions. Space policy analysts have not paid enough attention to this arena. For example, the US does not have enough sensors in place to even know if one of our satellites has been attacked. Mr. Berkowitz feels that Col Worden's paper would benefit from more discussion of how to address these vulnerabilities and develop guidelines.

The US has a poor understanding of the relationship between space infrastructure and other types of infrastructure, such as power, water, etc. Mr. Berkowitz recommended that Col Worden address these relationships in his chapter.

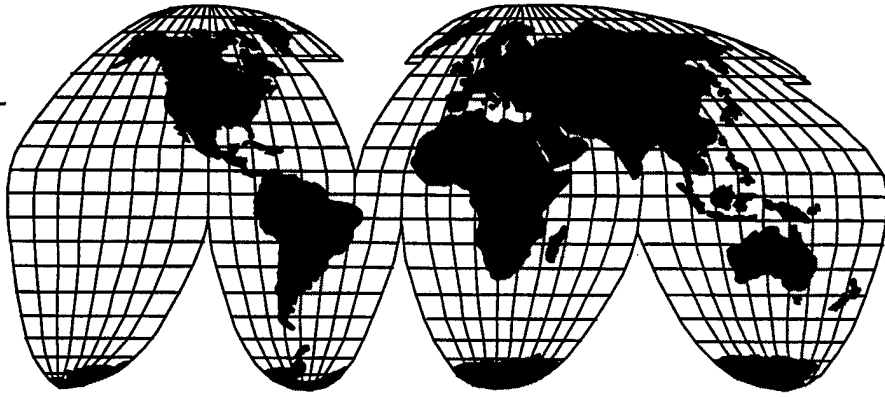
Finally, a major challenge for the US is to protect not only our technology, but also our assets in space from being used against us by an adversary. For example, how do we protect space lines of communication for military and economic purposes? Further discussion on this point would be helpful.

Critique of "Spacepower and the Revolution in Military Affairs: A Glass Half-Full" and "Spacepower and America's Future," Professor James Wirtz

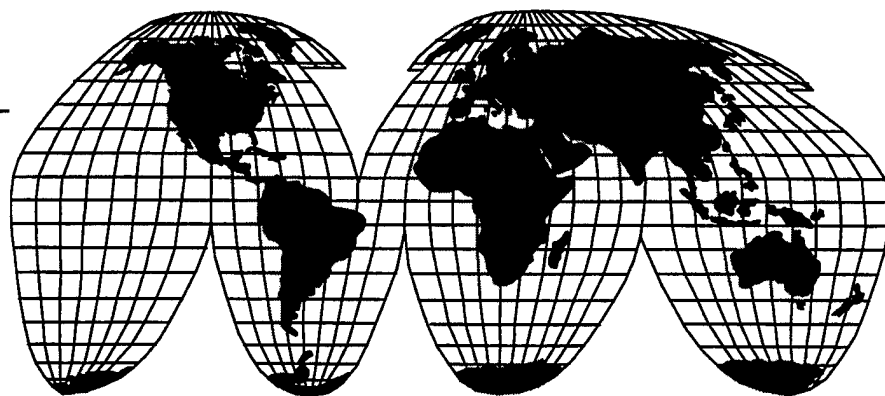
Prof. Wirtz thought both papers were thought provoking and expanded space thinking beyond its traditional arguments. Moreover, he thought the debate over "what is space?" was useful. Is it a new geography? A medium? A battlefield? Or a cause for battle?

He also agreed with both the Sheldon/Gray and the Sullivan chapters that space should not be tied completely to the RMA train. In Prof. Wirtz's opinion, space is "bigger" than an RMA. Generally, revolutions are not considered positive; they wreak havoc and cause difficult, resisted change. Moreover, they are rarely "controllable." Thus, there are few advantages to calling space an RMA.

The most plausible way space could be considered an RMA is if it were a catalyst for major reorganization, similar to when nuclear weapons and air were merged into the USAF. However, is it really likely that an Aerospace Force mandate a completely separate career path? Would pilots no longer be the backbone of the Force? If instead, the career path were similar to today's, but had dedicated personnel drawn from either the regular force (or even other Services), then space could not be considered an RMA. Instead, it would mean more of a Military-Technical-Revolution (MTR), similar to the organizational shift that occurred when the Navy introduced aircraft carriers.



Keynote Address



Agenda



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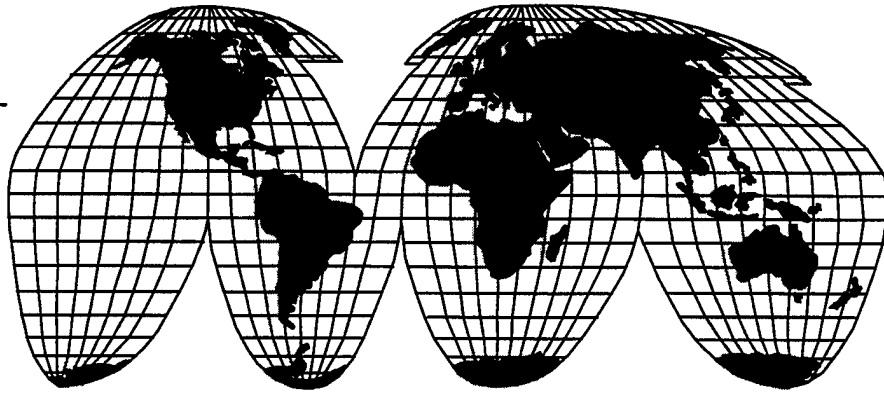


30 July 1998

--LUNCHEON AGENDA--

THURSDAY, 30 JULY

- 1130** Lunch is served
- 1200** Introduction: Major General (Select) H. Marshal Ward, Director of Operations, Training, and Space Integration, AF/XOO
- 1205** Keynote Address: General Howell M. Estes III, Commander in Chief, North American Aerospace Defense Command (CINCNORAD) and United States Space Command (USCINCSpace), and commander, Air Force Space Command (COMAFSPC).
- 1240** Closing Remarks: Dr James M. Smith



Program

**THE POLICY DIVISION OF THE USAF NUCLEAR AND
COUNTERPROLIFERATION DIRECTORATE**

&

THE USAF INSTITUTE FOR NATIONAL SECURITY STUDIES

6TH ANNUAL TOPICAL CONFERENCE

**“SPACEPOWER FOR A NEW MILLENNIUM: SPACE AND U.S.
NATIONAL SECURITY”**

USAF Academy, Colorado

29-30 July 1998

Luncheon and Keynote Address

Program

Lunch **USAF Academy Officers' Club**

Banquet

Introduction of Speaker **Major General (S) H. Marshal Ward**

Keynote Address **General Howell M. Estes III**

Closing Remarks..... **Dr James M. Smith**

LUNCHEON MENU

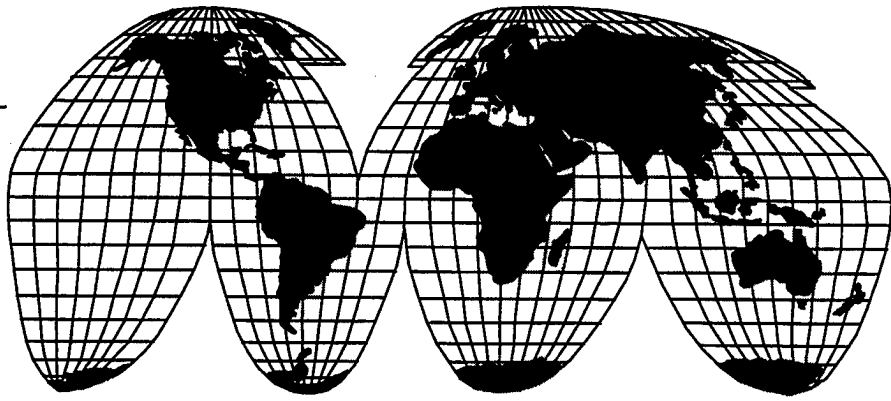
Sautéed Chicken Breast

Roasted New Parsley Potatoes

Beef Stroganoff Over Buttered Egg Noodles

Chef's Choice of Vegetables

General Howell M. Estes III is commander in chief, North American Aerospace Defense Command (CINCORAD) and United States Space Command (USCINCSpace), and commander, Air Force Space Command (COMAFSPC), headquartered at Peterson Air Force Base, CO. As CINCORAD, General Estes is responsible for the air sovereignty of the United States and Canada, as well as for providing tactical warning and attack assessment. As USCINCSpace, he commands the unified command responsible for directing space control and support operations including theater missile defense. As COMAFSPC, he directs satellite control, warning, space launch and ballistic missile operations missions through a worldwide network of support facilities and bases. The general entered the Air Force in 1965 as a graduate of the USAF Academy, holds an M.A. in Public Administration from Auburn University, and is a graduate of the Air Command and Staff and National War Colleges. He has commanded both operational and maintenance squadrons, the Air Force's only stealth fighter unit, an air division and numbered air force. Prior to his current position, he served as director for operations (J-3), the Joint Staff, the Pentagon, Washington, D.C. The general is a command pilot with more than 4,500 flying hours in the A-7, F-16, F-4, F-117, and EC-135 aircraft, and he flew 169 combat missions as an F-4 pilot during the Vietnam conflict. During the Gulf War he served as deputy chief of staff for operations, Strategic Air Command. General Estes and his wife, Jordana, have a son.



Address

Keynote Address
30 July, 1998

General Howell M. Estes III, CINCNORAD, USCINCSpace, COMAFSPC, presented the luncheon address at the 6th Annual INSS Topical Conference in Colorado Springs, CO. He discussed the accomplishments that have been made at the North American Aerospace Defense Command (NORAD), the US Space Command (USSPACE), and the Air Force Space Command (AFSPC) during his tenure.

General Estes began by outlining the major challenges that he faced when he took command. First, he had to determine whether NORAD was still relevant in the post-Cold War security environment. Second, he had to determine whether USSPACE was ready to move space integration to the next level. Finally, General Estes had to determine whether AFSPC was providing the proper mix of space and missile forces.

In order to address these difficult challenges, General Estes employed a four step analytical approach, which he recommended to conference participants. First, he explained that one must assess the overall environment. Second, one must revalidate the missions, jobs, and responsibilities of the command under one's leadership. Third, one must establish a new vision. Finally, a comprehensive plan must be developed to aid in the realization of the specified vision.

General Estes explained that in his determination of the relevancy of NORAD, he made six underlying assumptions: 1) homeland defense remains relevant; 2) new and unorthodox threats exist on the horizon; 3) critical infrastructures exist within US borders; 4) adversaries are more inclined to challenge the US homeland; 5) the US military must be prepared to provide answers to adversarial challenges; and 6) NORAD has the responsibility for homeland defense. General Estes thus concluded that NORAD remains highly relevant in the post-Cold War security environment.

He added that the United States, in particular, must shift its focus from the Cold War to that of new emerging threats. General Estes cautioned that the current threat against US deployed forces may eventually shift to the continental United States (CONUS). He explained that NORAD is prepared to address this challenge by providing early warnings on potential missile attacks on the CONUS.

In his overall assessment of USSPACECOM, General Estes examined the existing plan for achieving the Space Command's vision and attempted to harmonize it with Joint Vision 2010, the vision of the Joint Chiefs of Staff. He explained that the goal was to treat space as part of the overall space vision. He even suggested the possibility of reorganizing USSPACECOM in order to implement the space vision as part of Joint Vision 2010. However, General Estes cautioned that as the US Air Force moves toward aerospace integration, it must be prepared to accept greater responsibilities, such as defending against cruise and ballistic missile attacks. Additionally, as information and technology become increasingly important to national security, General Estes recommended that perhaps a new Commander-in-Chief should be assigned solely to the

responsibility of information warfare since past experimental attacks conducted by the National Security Agency have demonstrated that US information systems are highly vulnerable.

General Estes concluded his remarks by extending an invitation to those who may want to conduct research and analysis in the area of space to do so. The goal would be to generate discussions and dialogues, and possibly find answers to the difficult questions posed by space.

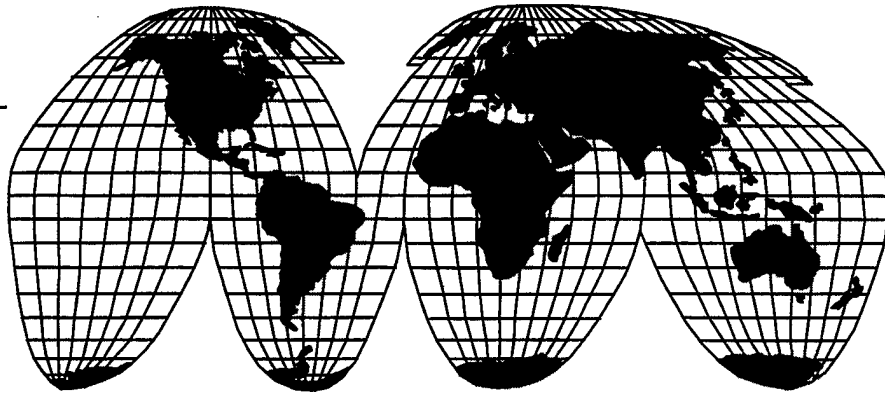
Open Discussion

In general non-attribution discussions, one participant inquired about the role of the National Guard. General Estes explained that the National Guard's mission was to protect the borders of the US homeland. Additionally, the US Army was employing National Guardsmen in the role of missile defense within the context of homeland protection.

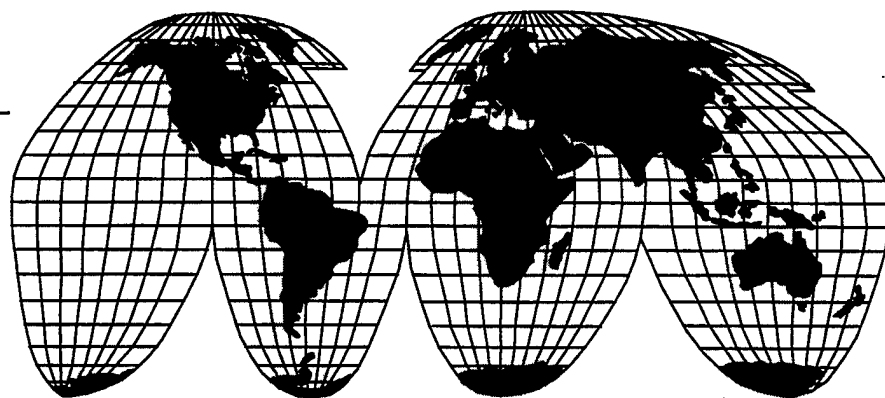
Another conference participant inquired about the cost and feasibility of basing a national missile defense (NMD) program at sea with an eye toward space deployment in the future. General Estes replied that a ground-based NMD program would cost approximately \$15 to 30 billion if it were properly implemented. He added that it would be better to focus on why adversaries may want to develop and use their nuclear arsenals against the US rather than on where a NMD program would best be located. General Estes did concede, however, that a NMD program would definitely be useful in defending against adversarial missile attacks.

Several participants then asked about the transition from an air force to an aerospace force. General Estes commented that any official title change in the US Air Force would have to originate from the Chief of Staff of the Air Force, General Michael E. Ryan. He further stated that the Air Force needs to make improvements in the way that it currently trains pilots to fly in both air and space. General Estes believed that a "cultural change" was necessary for Airmen to be able to operate effectively in both the air and space domains.

The question of space infrastructure was raised next. Specifically, one participant inquired about the role of the military in protecting critical space infrastructures. General Estes replied that the role of the military should be to protect satellites, ground stations, and communications. He recommended providing satellites with maneuverable vehicles so that their orbits would not be predictable. Additionally, he suggested placing sensors on new and existing satellites to improve collection of critical information.



Banquet Presentation



Agenda



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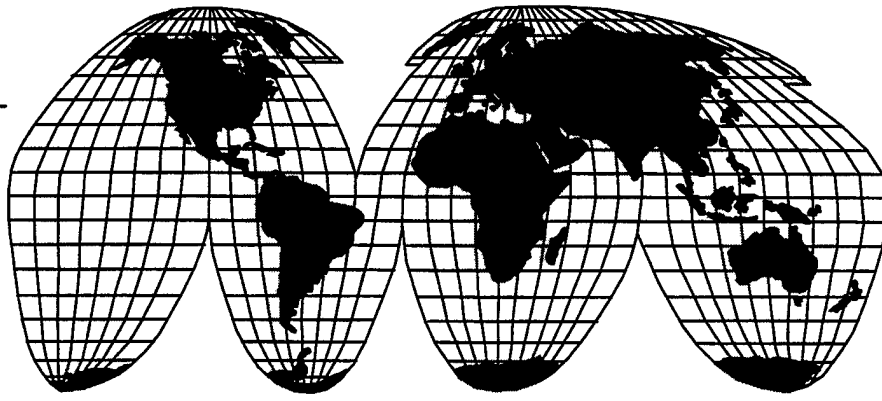


29 July 1998

--BANQUET AGENDA--

WEDNESDAY, 29 JULY

- 1900** No-host reception at the USAF Academy Officers' Club
- 2000** Welcome: Dr James M. Smith
- 2010** Dinner is served
- 2040** Introduction: Colonel Robert L. Smolen
- 2045** Speech: Major General (Select) H. Marshal Ward, Director of Operations,
Training, and Space Integration, AF/XOO
- 2115** Closing Remarks: Dr James M. Smith



Program

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29-30 July 1998

Banquet and Speech

Program

No-Host Reception USAF Academy Officers' Club

Banquet

Introduction of Speaker Colonel Robert L. Smolen

Speech Major General (Select) H. Marshal Ward

Closing Remarks..... Dr James M. Smith

BANQUET MENU

Shrimp Scampi

Chicken Cordon Bleu

New York Steak

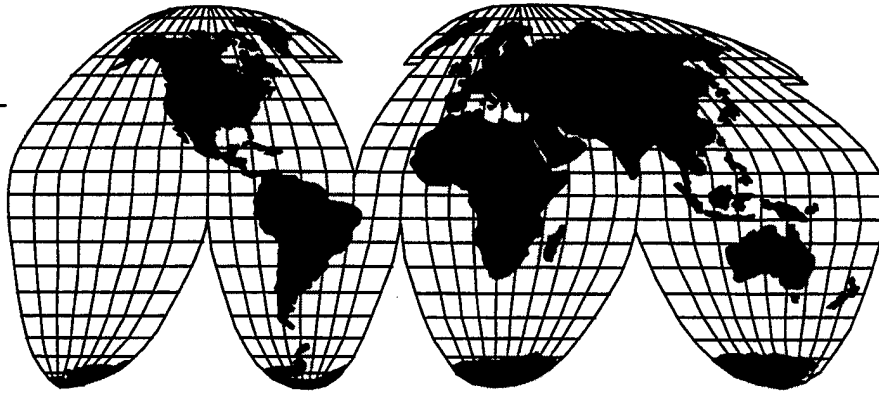
Vegetarian

Seasonal Fresh Vegetables

Baked Potato

Dessert

Major General (Select) H. Marshal Ward is director for operations, training, and space integration, deputy chief of staff, air and space operations, Headquarters USAF, the Pentagon, Washington, D.C. This directorate consists of more than 500 military and civilian members in ten divisions and four field operating agencies responsible for every aspect of Air Force current operations and training. The general enlisted in the Air Force in 1966 and moved quickly through the ranks to staff sergeant during his first 11 months of service. He completed college through the Airman Education and Commissioning Program and was commissioned following honors as a distinguished graduate of Officer Training School in 1969. He held a variety of assignments in both rated and non-rated fields including weather forecasting, hurricane reconnaissance, airlift operations, command and control operations, acquisition program management, communications, space and missile plans and policy, and operational requirements. He is a senior pilot and master space operator with more than seven years in joint-duty assignments. The general has an M.B.A. from Auburn University and is a graduate of the Industrial College of the Armed Forces.



Address

Banquet Address
29 July, 1998

Major General Marshal Ward, Deputy Director for Operations and Training, AF/XOO, presented the banquet address at the 6th Annual INSS Topical Conference in Colorado Springs, CO. His speech focused on how the USAF should organize, train, and equip in support of the Joint Forces Commander (JFC).

Major General Ward began by explaining that education should precede training. He believed that the USAF was on the right track in educating its people to utilize the entire vertical dimension. He cited the examples of warfare centers, field exercises, and battlelabs as evidence of proper education. However, Major General Ward cautioned that Airmen needed to alter their mindset to focus more on ways to deliver combat effects rather than on the platforms themselves.

Within the Joint arena, Major General Ward believed that airpower provided range, speed, and flexibility in a devastating combination, which the other Services lacked. However, he provided a caveat to his remarks by stating that joint warfare should not be a battle between the Services. Instead, it should comprise of the individual strengths that each Service brings to the Joint arena, which could collectively achieve military success.

Major General Ward then addressed the issue of space to warfighting. He explained that even though many senior officials have begun to focus on the importance of space, the issue nevertheless required further address since US grand strategy was often not understood by those responsible for implementation. Major General Ward added that perhaps the USAF Vision should serve as an example of the criticality of space.

In discussing the USAF's transition from an air and space force to a space and air force, Major General Ward believed that the Service may be headed for a clash of cultures. He viewed the possibility for a cultural debate within the budget arena, and stressed that the USAF must leave behind all platform-oriented thinking. Instead, Major General Ward advocated for the creation of a new aerospace culture to emerge within the Service.

Major General Ward also addressed the issue of an Expeditionary Air Force (EAF). He explained that the EAF concept was vital for several reasons. First, tremendous uncertainty and variability existed within the geopolitical arena, which have resulted in some withdrawal of forward-deployed forces. Second, the military budget continued to diminish and force structures were being reorganized to accommodate this reduction. Third, internal problems with personnel shortages, operation tempo, aging equipment, and antiquated information infrastructure all challenged the viability of force preparedness. Thus, establishing an EAF was the ideal alternative to traditionally organized forces.

Additionally, Major General Ward explained that expeditionary forces within all of the Services may need quick access to information for achieving missions with minimal footprints. He therefore suggested the adoption of network-centric warfare since it could provide global reach and timely response. Major General Ward envisioned a system built on the Global Command and Control System (GCCS), which would connect sensor networks to processing networks, and eventually to shooter networks through some type of command and control function. He believed that the USAF could carry the concept of EAF to new heights if this concept of information sphere could be realized. Moreover, Major General Ward predicted that the USAF would be able to find, fix, track, target, and engage (F2T2E) any target of significance by the end of the first quarter of the 21st century within this information sphere.

Major General Ward also believed that the USAF would be dramatically different in the 21st century. The goal for the Air Force now should be to shape long-term thinking and to embrace the Revolution in Military Affairs (RMA). He recommended that the USAF depart from its traditional adherence to platforms and focus instead on weapons systems modernization and their operational effects. He added that the USAF cannot continue to operate in the same way as in the past. Instead, Major General Ward advised that the Air Force should continue on the path of reform, and to posture itself, its organizations, its processes, and its budgets to take full advantage of the RMA.

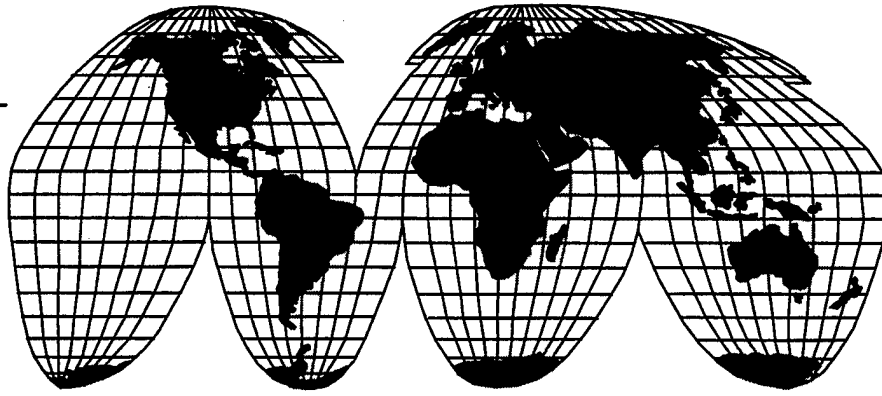
Major General Ward closed his remarks by stating that space is not a mission, but a place. The USAF should therefore focus more on mission effects and less on the medium from which missions are operated.

Open Discussion

The first question raised in general non-attribution discussions focused on the Air Force's role in joint experimentation. Major General Ward explained that the USAF embraces and supports this concept and its associated battlelabs. He added that the Air Force should create an environment that is conducive towards experimentation.

Another participant asked for Major General Ward's opinion about the "short circuited" flow of technology within the acquisition process. Major General Ward replied that administrative reform must occur, along with the adoption of new business processes.

The final question addressed the issue of the National Secretary Space Architect. Specifically, the participant wanted to know if Major General Ward believed that one was necessary. The General's response was no.

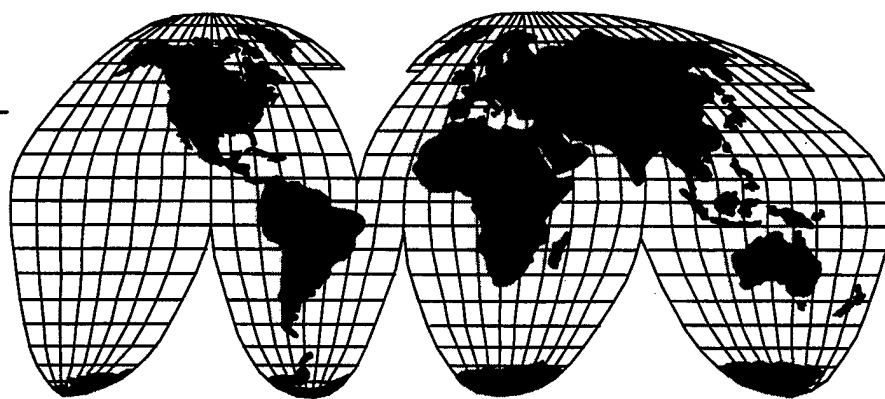


Conference Agenda

- 1030-1130 *Discussant and audience questions*
Professor John Logsdon, Director, Space Policy Institute, George Washington University
- 1130-1300 Lunch at USAF Academy Officers' Club
- 1300-1630 Panel 2: Space and Ballistic Missile Defense; Chair: Major Alan Van Tassel
- 1300-1420 Dr. J. David Martin presenting for Lieutenant General Lester L. Lyles (Director, Ballistic Missile Defense Organization)
Space and Ballistic Missile Defense Programs
Ambassador Henry F. Cooper (Chairman, High Frontier)
Space Defense: An Idea Whose Time Has Come?
Mr. John E. Pike (Spokesman, Federation of American Scientists)
Keeping Space Weapons Free
Colonel Frank G. Klotz presenting for Honorable Curt Weldon (U.S. Congressman, Pennsylvania)
Congress and BMD
- 1420-1440 Break
- 1440-1620 *Discussants and audience questions*
Professor James Wirtz, Naval Postgraduate School
Colonel Frank G. Klotz, Council on Foreign Relations
Dr Donald Baucom, BMDO Historian
- 1620-1630 Conclusion of First Day
- 1900-2130 Reception and Dinner at USAF Academy Officers' Club
Featured Speaker: Major General (Select) Marshal Ward

THURSDAY, 30 JULY

- 0830-0900 Arrival and morning snack at Doolittle Hall
- 0900-1130 Panel 3: Organizing for Military Space Missions; Chair: Lt Col Guy M. Walsh
- 0900-1000 General Howell M. Estes III (CINC, USSPACECOM)
The Aerospace Force of Today and Tomorrow: Transforming Our Service to Control the Vertical Dimension
Dr. Dana J. Johnson and Dr. Ken Reynolds (RAND Corporation)
Alternative Military Space Organizations
Dr. Daniel E. Hastings (Chief Scientist of the Air Force)
Future Military Space Technologies



List of Participants

**SPACEPOWER FOR A NEW MILLENIUM: SPACE AND U.S. NATIONAL SECURITY
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29-30 JULY 1998**

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29-30 JULY 1998**

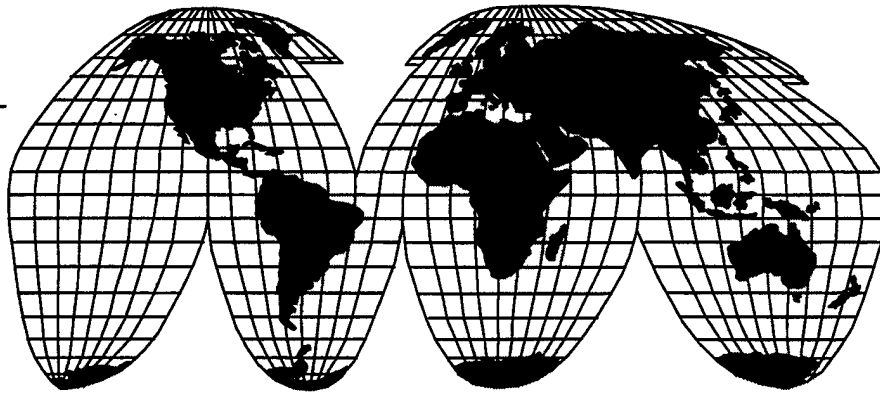
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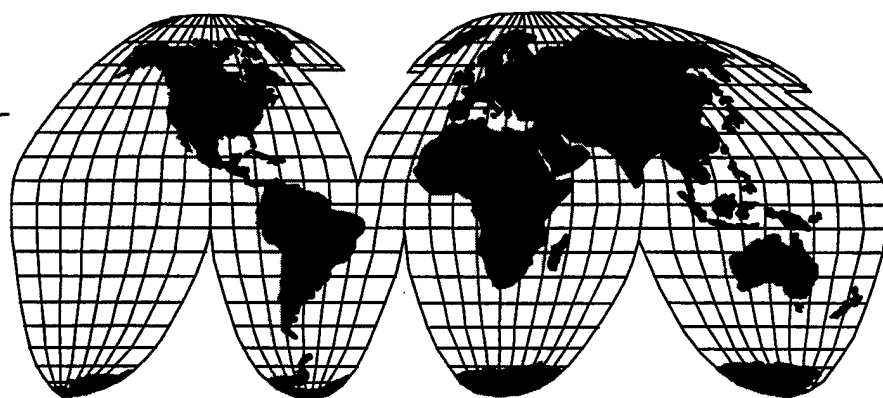
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Administrative Materials



Letters of Invitation

17 June, 1998

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XXXX
XXXX
XXXX
XXXX

Dear XXXX:

It is my pleasure to invite you to attend the Headquarters Air Force National Security Studies Conference, "Spacepower for a New Millennium: Space and U.S. National Security," to be held 29-30 July 1998 at the USAF Academy in Colorado Springs, CO. The conference is being sponsored jointly by the Policy Division of the Nuclear and Counterproliferation Directorate (XONP) and the USAF Institute for National Security Studies (INSS). The purpose of this conference is to examine how military uses of outer space can contribute to U.S. national security and to focus on how the United States and the USAF might best organize and prepare to meet security challenges in space and to exploit its military potential.

The conference is organized around presentations by the chapter authors in the forthcoming book *Spacepower for a New Millennium: Space and U.S. National Security*. This book has been designed to discuss key concepts in the *Long Range Plan: Implementing USSPACECOM Vision for 2020* report released by CINCUSPACE in March 1998. As listed on the attached agenda, many of the top active duty military space decision makers have committed to writing a chapter in the book and presenting their views at the conference. These views will be balanced by presentations from the key civilian space policy analysts who are also authors of chapters in the book. The book will be divided into four panels for purposes of the conference. Following the chapter authors' presentations, invited discussants will present prepared comments based on their review of drafts of the chapters.

Morning and afternoon snacks and refreshments will be provided on 29 and 30 July. A buffet-style lunch has been arranged at the USAF Academy Officers' Club on both days. A reception and dinner will be held on the evening of 29 July beginning at 1845 at the USAF Academy Officers' Club. The dinner will feature a presentation by Mr. Keith R. Hall, Director of the National Reconnaissance Office.

The conference will be held in Doolittle Hall (the Association of Graduates Building), located near the Officers' Club on Academy Drive of the USAF Academy in Colorado Springs, CO. It will begin at 0830 Wednesday, 29 July and will conclude by 1630 on Thursday, 30 July. Participants are asked to convene in Doolittle Hall on both 29 and 30 July.

There is no charge for the conference for in-town guests, other than actual costs of meals. Lunches are \$10 each, and the cost of the reception and dinner is \$25, for a total of \$45 for all meals. Please bring either a check or cash, which will be collected on the morning of 29 July. All checks should be made payable to "INSS Conference Fund." More details on the logistics for the conference and a registration form are provided as attachments to this letter

I sincerely hope that you are able to join us. The chapter authors represent our nation's "brain trust" on military space strategy and are exceptionally well-qualified to discuss the issue. The conference promises to be an interesting, challenging, and stimulating experience. Please contact Stan Kowalski (703-556-7117) or Jennifer Williams (703-734-5822) of Science Applications International Corporation by 30 June 1998 to confirm your attendance. I hope to see you in July.

THOMAS D. MILLER, Colonel, USAF
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DCS/OPS

Attachments

1. Conference agenda
2. USAF Academy information
3. Registration form

17 June, 1998

XXXX
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Dear XXXX:

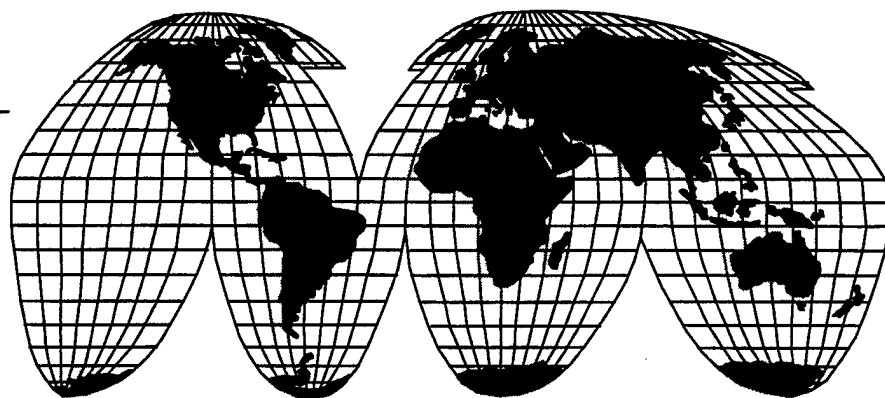
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The conference is organized around presentations by the chapter authors in the forthcoming book *Spacepower for a New Millennium: Space and U.S. National Security*. This book has been designed to discuss key concepts in the *Long Range Plan: Implementing USSPACECOM Vision for 2020* report released by CINCUSPACE in March 1998. As listed on the attached agenda, many of the top active duty military space decision makers have committed to writing a chapter in the book and presenting their views at the conference. These views will be balanced by presentations from the key civilian space policy analysts also included in the book.

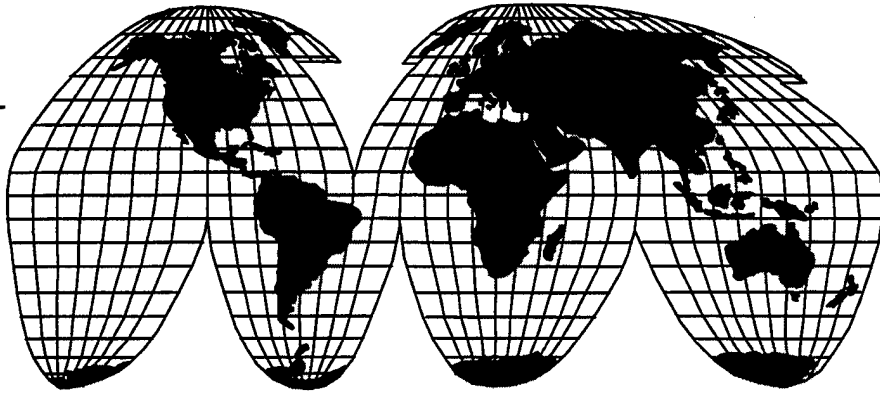
The conference will be held in Doolittle Hall (the Association of Graduates Building) at the USAF Academy in Colorado Springs, CO. It will begin at 0900 on Wednesday 29 July and will conclude by 1600 on Thursday the 30th. A block of hotel rooms has been reserved at the x (first come, first served until y). More details on the logistics for the conference as well as a registration form are provided as attachments to this letter.

I sincerely hope that you are able to join us. The chapter authors represent our nation's "brain trust" on military space strategy and are exceptionally well qualified to discuss this issue. The conference promises to be an interesting, challenging, and stimulating experience. We look forward to meeting with you at the end of July.

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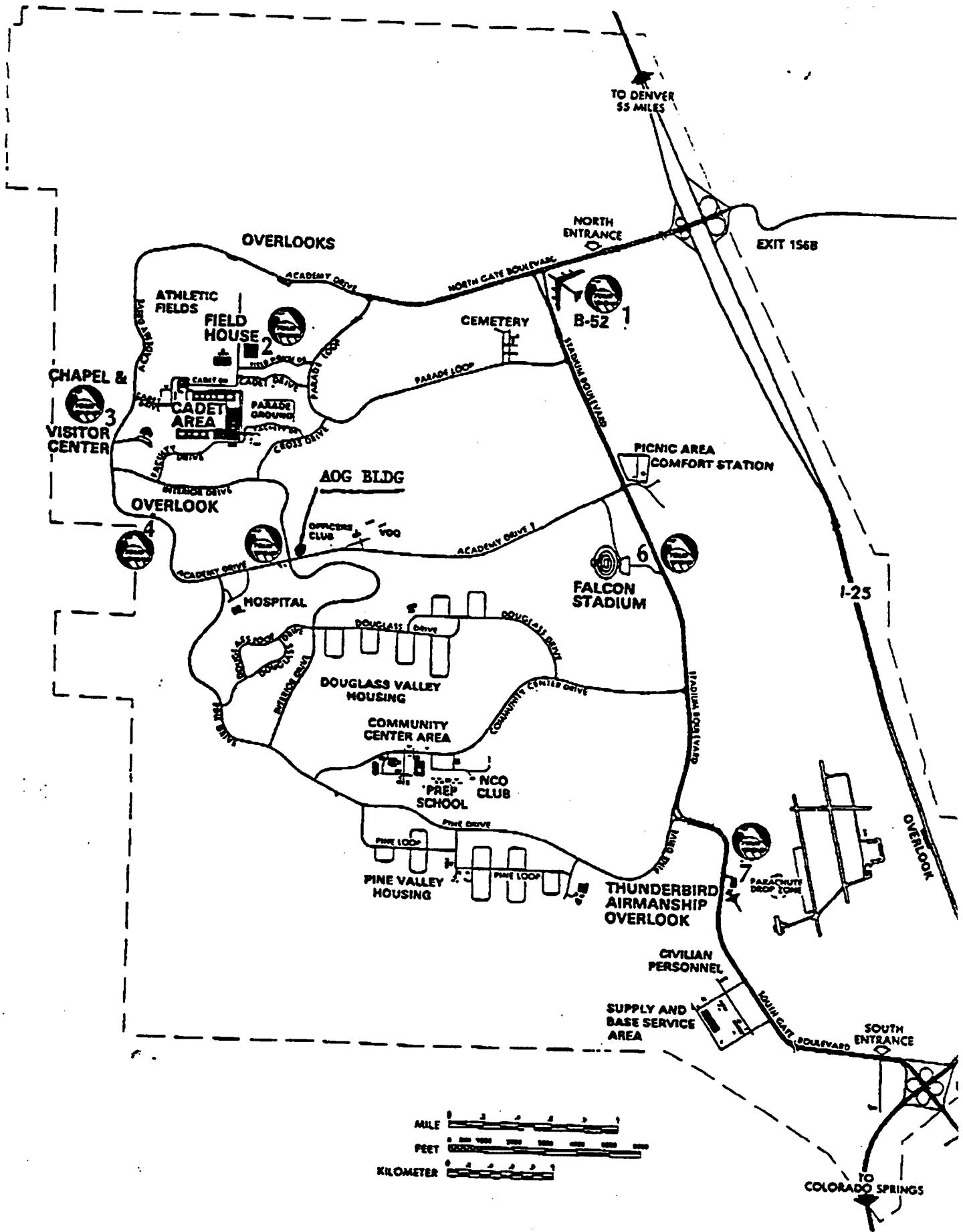


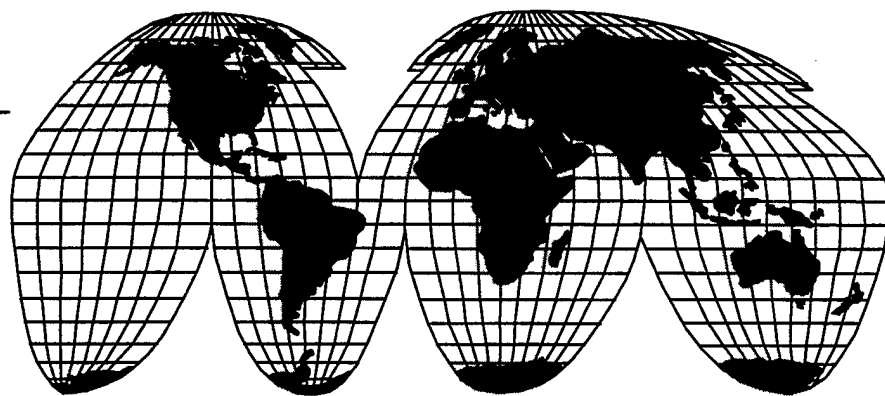
Conference Registration Forms



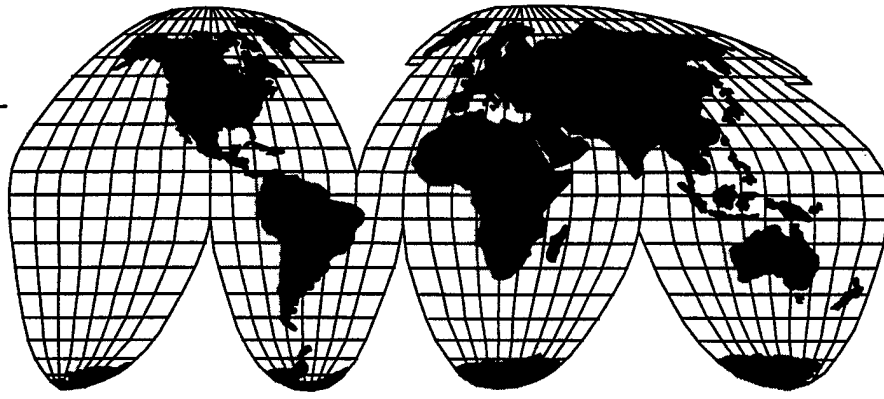
Conference Map

AIR FORCE ACADEMY





Appendices



Appendix A
Biographies of Authors

**SPACEPOWER FOR A NEW MILLENNIUM:
SPACE AND U.S. NATIONAL SECURITY¹**

Edited by Peter L. Hays, James M. Smith, Alan R. Van Tassel, and Guy M. Walsh
(New York: McGraw-Hill, forthcoming)

Foreword.....Bernard A. Schriever

Preface

Acknowledgments

Chapter 1 Introduction and Overview.....Hays, Smith, Van Tassel, and Walsh

The time has come to address, in both warfighter and national policy-making circles, the emergence of space as a center of gravity for both DoD and the nation. Sufficient planning and resources must be committed to protect and enhance our access to and use of space (ix).

Part I: Current Military Space Issues

Chapter 2 U.S. National Space Policy and the Military.....Marc J. Berkowitz

Our space policy objectives include deterring threats to our interest in space and defeating hostile efforts against US space assets if deterrence fails (1).

Chapter 3 Space Architectures to Support the Warfighter.....Robert S. Dickman

By 2020, a robust and wholly integrated suite of space and ground capabilities will provide total situational understanding of the space region along with the ability to assure access to, through, and from space while defending against hostile threats. It will require the development of new systems, CONOPS, and organizations to achieve and maintain space dominance (20)

Chapter 4 Acquisition of Spacepower for the New Millennium

...Roger G. DeKok and Bob Preston

¹ All page numbers cited in this prospectus refer to *Long Range Plan: Implementing USSPACECOM Vision for 2020* and its *Executive Summary* (Peterson AFB, CO: U.S. Space Command, Director of Plans, March 1998).

Global Partnerships is a concept for leveraging domestic and international resources.... Space stovepipes will be greatly diminished as a result of mission-based, integrated systems approach to acquisition decisions. Buying commercial space services instead of building, operating, and maintaining our own, will streamline military space forces to focus on core capabilities (100-101)

Chapter 5 Space Technology to Support the Warfighter.....Glen W. Moorhead III

Space systems are crucial to this nation's ability to wage war. Space based systems...have become so powerful that no operational commander would consider fighting without them. Full force Integration is USSPACECOM's strategy to seamlessly weave space capabilities into all dimensions of warfare (73).

Part II: Space and Ballistic Missile Defense

Chapter 6 Space and Ballistic Missile Defense Programs.....Lester L. Lyles

Today, we're emphasizing defense against theater ballistic missiles. National Missile Defense considers defense against large ICBMs and SLBMs....The space segment won't have to do it all. Instead it will be part of a worldwide, integrated system...operated in tiers to serve all commanders and will engage missiles in all phases of flight (64).

Chapter 7 Space Defense: An Idea Whose Time Has Come?.....Henry F. Cooper

Missile Defense restores the margin of safety for our homeland, allies, and vital interests. Integrating missile defense technologies may be the greatest challenge....To defend against missiles, we must find a way to detect threats quickly in land, sea, air, and space environments, as well as during all kinds of weather (64).

Chapter 8 Keeping Space Weapons Free.....John E. Pike

At present, the notion of weapons in space is not consistent with US National Policy. Planning for this possibility is (necessary) should our civilian leadership later decide that the application of force from space is in our national interest. (65).

Chapter 9 Charting a New Course on Missile Defense.....Curt Weldon

Eventually, leaders may need to review national policy on space-based weapons, particularly related to the ABM Treaty. Politics after the Cold War make this

difficult, but emphasizing the benefits of coalition action and collective security should gradually build support for it (63-64).

Part III: Organizing for Military Space Missions

Chapter 10 The Aerospace Force of Today and Tomorrow: Transforming Our Service to Control the Vertical Dimension.....Howell M. Estes III

New organizational relationships and partnerships among the Civil, military, and commercial communities must develop if we are to integrate all systems into our military's use of space. USSPACECOM's recent partnerships with the NRO and NASA are significant steps in the right direction (73)

Chapter 11 Alternative Military Space Organizations....Dana Johnson and Ken Reynolds

Early in the 21st Century, space issues will be solved via streamlined interagency decision-making process resulting from the creation of a national space coordinating body. Similarly, a strong, centralized organization will emerge with the DoD to represent US military concerns about space at the national level (100).

Chapter 12 Organizing for Space-Based Intelligence Gathering.....Keith R. Hall

Improved partnering between the operational military and the builders and collectors of intelligence is clearly in order. Commercial space sensors (will) also improve reconnaissance and surveillance (122).

Part IV: Future Military Space Issues

Chapter 13 Future Military Space Technologies.....Daniel E. Hastings

Given the continuing dynamic nature of the space environment and the long lead times necessary to develop and field space capability, there is a sense of urgency to articulate future requirements today (Executive Summary, 2)

Chapter 14 Space Control for the 21st Century: A Space "Navy" Protecting the Commercial Basis of America's Wealth.....Simon P. Worden

Our nation's increasing dependence on space capabilities-both military and economically-produces a related vulnerability that will not go unnoticed by adversaries. US interests and investments in space must be fully protected to ensure our nation's freedom of action in space (Executive Summary, 3).

Chapter 15 Spacepower and the Revolution in Military Affairs: A Glass Half-Full
.....Colin S. Gray and John B. Sheldon

*Rapid advancement of technology will create revolutionary breakthroughs.
Commercial interests will drive most technology development, especially within
space and information processing (2).*

Chapter 16 Spacepower and America's Future.....Brian R. Sullivan

*Space capabilities are becoming absolutely essential for military operations,
national commerce, and everyday life....Life on earth is becoming inextricably
linked to space (4).*

Chapter 17 Summary/Conclusions.....Hays, Smith, Van Tassel, and Walsh

EpilogueRonald R. Fogleman

About the Contributors

Marc J. Berkowitz is Director for Space Policy in the Office of the Deputy Assistant Secretary of Defense, Command, Control, Communications, Intelligence, Surveillance, Reconnaissance and Space Systems within the Office of the Secretary of Defense. He holds a B.A. from George Washington University and an M.A. from Georgetown University. He has previously held positions as director of space studies at National Security Research, Inc., Fairfax, VA and on the professional staff of SRI International in Arlington, VA. He is published in *Airpower Journal*, the *Naval War College Review*, *Strategic Review*, *Armed Forces Journal International*, and *US Naval Institute Proceedings*.

Henry F. Cooper is Chairman of High Frontier, Chairman of Applied Research Associates, Senior Associate of the National Institute for Public Policy, and Visiting Fellow at the Heritage Foundation. During the Bush Administration, Ambassador Cooper served as Director of the Strategic Defense Initiative Organization (now called the Ballistic Missile Defense Organization). During the Reagan Administration, he served as Ambassador and Chief U.S. Negotiator at the Geneva Defense and Space Talks, Assistant Director of the Arms Control and Disarmament Agency, and Deputy Assistant Secretary of the Air Force. Ambassador Cooper holds Bachelor's and Master's degrees from Clemson University and a Ph.D. from New York University, all in mechanical engineering.

Roger G. DeKok, Lieutenant General, USAF, is commander, Headquarters Space and Missile Systems Center, Air Force Materiel Command, Los Angeles Air Force Base, CA. He is responsible for managing the research, design, development and acquisition of space launch, command and control, and satellite systems. The general entered the Air Force as a distinguished graduate of the Reserve Officer Training Corps program in June 1968. He has the Master Space Badge and has served in a variety of space plans and operations positions from detachment level to space policy work in the White House and has commanded two space wings. While serving at the Pentagon in 1983, he coordinated the Air Force Space Plan. During his assignment to the White House National Security Council, he developed and coordinated the U.S. National Space Policy that was signed by President Ronald Reagan in January 1988. Prior to assuming his current position, he served as director of operations at U.S. Space Command, Peterson Air Force Base, CO. The general holds a B.A. from the University of Wisconsin, an M.S. from the Air Force Institute of Technology, is a distinguished graduate of the Air War College, and received the James V. Hartinger Award for Military Space Achievement in 1995.

Robert S. Dickman, Major General, USAF, is the director, Office of Plans and Analysis and System of Systems Architect, National Reconnaissance Office, Washington, D.C. The general was born in Brooklyn, NY, and grew up in New Jersey. He entered the Air Force in June 1966 as a distinguished graduate of the Reserve Officer Training Corps program at Union College, NY. The general has the Master Space Badge and has had a varied career in space operations, acquisition and planning, including headquarters

assignments at the Pentagon, North American Aerospace Defense Command, U.S. Space Command and Air Force Space Command. He served in the Air Force Office of Scientific Research and the Air Force Satellite Communications System Program Office. He also was the first vice commander of the 2nd (now 50th) Space Wing, commander of the 45th Space Wing and director of the Eastern Range, Patrick Air Force Base, Fla. Before assuming his current position, he was the Department of Defense space architect. General Dickman holds an M.S. in space physics from the Air Force Institute of Technology, a Master's Degree in Management from Salve Regina College, and is a distinguished graduate of both Air Command and Staff College and the Naval War College.

Howell M. Estes III, General, USAF, is commander in chief, North American Aerospace Defense Command (CINCNORAD) and United States Space Command (USCINCSpace), and commander, Air Force Space Command (COMAFSPC), headquartered at Peterson Air Force Base, CO. As CINCNORAD, General Estes is responsible for the air sovereignty of the United States and Canada, as well as for providing tactical warning and attack assessment. As USCINCSpace, he commands the unified command responsible for directing space control and support operations including theater missile defense. As COMAFSPC, he directs satellite control, warning, space launch and ballistic missile operations missions through a worldwide network of support facilities and bases. The general entered the Air Force in 1965 as a graduate of the USAF Academy, holds an M.A. in Public Administration from Auburn University, and is a graduate of the Air Command and Staff and National War Colleges. He has commanded both operational and maintenance squadrons, the Air Force's only stealth fighter unit, an air division and numbered air force. Prior to his current position, he served as director for operations (J-3), the Joint Staff, the Pentagon, Washington, D.C. The general is a command pilot with more than 4,500 flying hours in the A-7, F-16, F-4, F-117, and EC-135 aircraft, and he flew 169 combat missions as an F-4 pilot during the Vietnam conflict. During the Gulf War he served as deputy chief of staff for operations, Strategic Air Command.

Ronald R. Fogleman, General, USAF (Ret.) is the former chief of staff of the U.S. Air Force, Washington, D.C. who retired in September 1997. As chief, he was the senior uniformed Air Force officer responsible for the organization, training and equipage of 750,000 active duty, Guard, Reserve and civilian forces serving in the United States and overseas. As a member of the Joint Chiefs of Staff, he and the other service chiefs functioned as military advisers to the secretary of defense, National Security Council and the president. The general is a 1963 graduate from the USAF Academy, holds a Master's Degree in Military History and Political Science from Duke University, and is a graduate of the Army War College. A command pilot and a parachutist, he has amassed more than 6,800 flying hours in fighter, transport, tanker and rotary wing aircraft. He flew 315 combat missions and logged 806 hours of combat flying in fighter aircraft. In early assignments he instructed student pilots, performed combat duty as a fighter pilot and high-speed forward air controller in Vietnam and Thailand, taught history at the Air Force Academy and conducted flight operations in Europe—including duty as an F-15 aircraft

demonstration pilot for international airshows. He commanded an Air Force wing, an air division, a numbered air force, a major command and a unified command.

Colin S. Gray is Professor of International Politics and Director of the Centre for Security Studies at the University of Hull, England. He is the author of *American Military Space Policy* (1983), and of many studies and articles on spacepower. Dr. Gray was the founding President of the National Institute for Public Policy, a defense think tank, held a Presidential appointment for five years on the General Advisory Committee on Arms Control and Disarmament, and has served recently in Britain on the Panel of Experts on the Strategic Defense Review. His next book is *Understanding Modern Strategy* (Oxford: Oxford University Press, 1999).

Keith R. Hall is assistant secretary of the Air Force for space, the Pentagon, Washington, D.C., and director of the National Reconnaissance Office, Chantilly, VA. As assistant secretary he is responsible for overall supervision of Air Force space matters, with primary emphasis on policy, strategy, and planning. As NRO director, he is responsible for the acquisition and operation of all U.S. space-based reconnaissance and intelligence systems. Mr. Hall was commissioned in the U.S. Army and served in various signals and human intelligence positions from 1970 to 1979, including two tours as commander of overseas operational intelligence units. He began his civilian career at the Office of Management and Budget as a budget examiner for the Central Intelligence Agency. From OMB, he moved to the Senate Select Committee on Intelligence, advancing to the position of deputy staff director where he supported committee members in the budget authorization process for intelligence activities. Mr. Hall served as the deputy assistant secretary of defense for intelligence and security in the Office of the Secretary of Defense from 1991 to 1995. His responsibilities included policy development, resource management and oversight for all defense intelligence, counterintelligence and security activities. In this position, he served as chairman of the National Counterintelligence Policy Board and co-chairman of the Intelligence Systems Board. Mr. Hall served as the executive director for intelligence community affairs from 1995 to 1996, reporting directly to the CIA director. He provided advice and assistance in planning and executing intelligence community management responsibilities. He was the principal architect and co-chairman of the intelligence program review process and co-chaired the task force that led to the creation of the National Imagery and Mapping Agency. Mr. Hall has a B.A. from Alfred University and an M.A. in Public Administration from Clark University.

Daniel J. Hastings is currently Professor of Aeronautics and Astronautics at the Massachusetts Institute of Technology (MIT) and Chief Scientist of the Air Force. As Chief Scientist, he is the senior adviser to the Chief of Staff and Secretary of the Air Force on science and technology. He received his Ph.D. in 1980 from MIT in Aeronautics and Astronautics. From 1980-1985 he worked for Physical Sciences Inc. and Oak Ridge National Laboratory in the fields of laser-material interactions and fusion plasma physics. He has some 30 publications in these areas. In 1985 he joined the Aeronautics and Astronautics faculty at MIT as an Assistant Professor. His research has concentrated on issues related to spacecraft-environmental interactions, space propulsion,

and lately space systems engineering. He has published some 50 papers in the field of spacecraft-environment interactions and several papers in space propulsion. Dr Hastings is widely recognized for his work on tethers, plasma contactors and high voltage arcing on solar arrays. He has recently formed a group of students at MIT to look at the issues associated with distributed satellite systems and led an effort to establish a lean space initiative at MIT. He is a Fellow of the AIAA and serves as a member of the NASA Space Station Advisory Committee and the NASA Space Science Advisory Committee. He has been a member of the Air Force Scientific Advisory Board and recently chaired a major study on the future of space technology for the Air Force. Dr. Hastings has also served as chair of the NRC Committee on Advanced Space Technology, on the NRC Aeronautics and Space Engineering Board, on the DDR&E Technical Area Review of DOD work in space technology, and as a consultant for various think tanks and aerospace corporations.

Dana J. Johnson is currently a national security policy analyst at RAND in Washington, D.C. Since joining RAND in October 1988, Dr. Johnson has participated in a number of RAND studies on space policy and programs including space control and antisatellite policy, the contribution of space systems to theater operations, and the relationship of commercial space policy and programs to military space activities. She is currently co-principal investigator of a study for the Air Force on the integration of USAF space operations into mainstream military operations. In 1994-1995 she led RAND's team to analyze the space issue for the Commission on Roles and Missions of the Armed Forces. She has also written on the impact of international law and treaties upon military space operations. Dr. Johnson has co-authored three books: *Joint Air Operations: Pursuit of Unity in Command and Control 1942-1991*, with James A. Winnefeld (Naval Institute Press, 1993); *A League of Airmen: U.S. Air Power in the Gulf War*, with James A. Winnefeld and Preston Niblack (RAND, 1994); and *Space: Emerging Options for National Power*, with Scott Pace and C. Bryan Gabbard (RAND, 1998). Prior to RAND, Dr. Johnson was a senior policy analyst at General Research Corporation (1985-1988); a member of the technical staff at Rockwell International's Satellite Systems Division (1981-1985); and a research analyst and consultant at Science Applications, Inc. (1980-1981). She also was a diplomatic historian at the U.S. Department of State (1975-1980).

Lester L. Lyles, Lieutenant General, USAF, is director of the Ballistic Missile Defense Organization (BMDO), Department of Defense, the Pentagon, Washington, D.C. The BMDO is presidentially chartered and mandated by Congress to acquire highly effective ballistic missile defense systems for forward-deployed and expeditionary elements of the U.S. Armed Forces. Additionally, BMDO will develop options and if directed, acquire systems for ballistic missile defense of the United States. As director, General Lyles is the acquisition executive for all ballistic missile defense systems and programs. The general entered the Air Force in 1968 after completion of the Air Force Reserve Officer Training Corps program as a distinguished graduate. He has served in a variety of assignments, including program element monitor of the short-range attack missile, Headquarters USAF, Washington, D.C., in 1974, and special assistant and aide-de-camp to the commander of Air Force Systems Command (AFSC) in 1978. In 1981 he returned

to Wright-Patterson Air Force Base, Ohio, as avionics division chief in the F-16 Systems Program Office. He has served as director of tactical aircraft systems at AFSC headquarters, and director of the Medium Launch Vehicles Program and Space Launch Systems Offices. He became AFSC's headquarters assistant deputy chief of staff for requirements in 1989, and deputy chief of staff for requirements in 1990. In 1992 he became vice commander of Ogden Air Logistics Center, Hill Air Force Base, Utah. He served as commander of the center from 1993 until November 1994, and then was assigned to command the Headquarters Space and Missile Systems Center, Air Force Materiel Command, Los Angeles Air Force Base, CA. He served in this capacity until August 1996, when he assumed his current position. The general holds a B.S. in mechanical engineering from Howard University, an M.S. in mechanical and nuclear engineering from the Air Force Institute of Technology, and is a graduate of Armed Forces Staff College and National War College.

Glen W. "Wally" Moorhead III, Major General (Select), USAF, is commander, Air Warfare Center, Nellis AFB, NV. In his previous assignment, he was the commander of the Space Warfare Center, Air Force Space Command, Schriever Air Force Base, CO. The Space Warfare Center is the centerpiece of Air Force Space Command's efforts to integrate space more fully into the daily operations of the Air Force. The center develops new techniques and procedures to apply space-based capabilities to military training, exercises, plans and operations in support of the DOD's front-line warfighters. The general was born and raised in Smackover, AR. In July 1964 he was selected to attend the USAF Academy Preparatory School and he graduated from the Academy in 1969. He completed undergraduate pilot training as a distinguished graduate in 1971. He then completed two Southeast Asia combat tours as an attack pilot with more than 350 missions. He has commanded a space wing, an F-15E operations group, two tactical fighter squadrons, the Warrior Preparation Center in Europe and was instrumental in the initial development and operational flight testing of two major weapons systems: the A-10 and F-117. He also served as special assistant to the Supreme Allied Commander, Europe and as Joint Task Force Provide Promise chief of staff in Naples, Italy. General Moorhead holds a Master's Degree in Aeronautical Science from Embry-Riddle Aeronautical University and is a graduate of Army War College.

John E. Pike is Director of the Space Policy Project at the Federation of American Scientists. In this position, he coordinates research, analysis and advocacy on military and civilian space policy, and other national security issues. A former political consultant and science writer, Mr. Pike is the author of over 200 studies and articles on space and national security, and co-author of the book *The Impact of US and Soviet Ballistic Missile Defense Programs on the ABM Treaty*. In 1983 Pike initiated the Space Policy Working Group, consisting of public interest and Congressional staff working on space and national security issues, and chaired the Group through 1984. He was active in the formation of the National Campaign to Save the ABM Treaty, and served on its Executive Committee. He currently serves on the Board of the *Bulletin of the Atomic Scientists*, the Scientific Advisory Board of the Peace Research and European Security Studies Center, and the Advisory Board of the Verification Technology Information

Center of London. He is a Fellow of the British Interplanetary Society, and a member of the Council on Foreign Relations. In 1991 he participated in the NASA International Near-Earth Object (NEO) Detection Panel, and currently serves as a consultant to the NEO Working Group of the International Astronomical Union. He has served as a Technical Consultant to the United Nations Group of Government Experts on Confidence Building Measures in Outer Space, as well as to a variety of other government and corporate clients, including Cable News Network, National Public Radio, Universal Studios and the British Broadcasting Corporation. He advised the 1984 Mondale campaign, the 1988 Dukakis campaign, and the 1992 Clinton campaign on defense and space policy issues. He is frequently called on by print and broadcast media for commentary, and by Congressional Committees for testimony, on space and national security issues. In 1991 he received the Public Service Award of the Federation of American Scientists and in 1994 he was named one of the 25 "Rising Stars Who Will Lead us into the Next Space Age" by the National Space Society's *Ad Astra* magazine.

Bob Preston is a researcher at RAND in Washington, D.C., working in Project Air Force. Prior to joining RAND, he completed a twenty-five year career in the Air Force, retiring as a Colonel. He holds a B.S. degree in electrical engineering from Michigan State University and a M.S. degree in aeronautics and astronautics from the Massachusetts Institute of Technology. His Air Force experience includes assignments in space research and development, acquisition, operations, planning, and policy. He is the author of *Plowshares and Power: the Military Use of Civil Space* (1995).

Kenneth (Ken) J. Reynolds is currently a policy analyst at RAND in Washington, D.C. Dr. Reynolds served in the United States Air Force as a combat qualified pilot, maintenance officer, associate professor of economics at the United States Air Force Academy, and as a policy analyst for the Office of Secretary of Defense, Program Analysis and Evaluation. He is also an adjunct professor in the Department of Economics at George Mason University and has also taught at the University of Colorado at Colorado Springs. He received his Ph.D. in Economics from the Pennsylvania State University in 1989. Upon early retirement from the Air Force, Dr. Reynolds began work for RAND as a policy analyst primarily in DOD acquisition and logistics. Specifically, he developed economic contracting models and new organizational structures that brought greater efficiencies and effectiveness to both aircraft depot level maintenance and procurement. His models achieved this by economizing on the transaction costs of assimilating, analyzing, and acting upon both communication and information. Currently, as a study co-principal investigator, Dr. Reynolds is using these skills to analyze and develop a framework to assist the Air Force in integrating space and air capabilities into Air Force operations.

John B. Sheldon, B.A. (Honors), M.A., is a doctoral research candidate at the Centre for Security Studies, University of Hull, UK. He is researching the application of strategic theory to spacepower under the supervision of Colin S. Gray. John's other research interests include missile defenses, military space policy and doctrine, asteroid defense, Anglo-American relations, diplomatic history and the geopolitics of the Mediterranean

and Central Asia. A former member of the British Diplomatic Service, John has extensive experience and knowledge of Whitehall and British national security machinery. He is also an independent outside consultant for Ranger Associates in Bethesda, MD.

Brian R. Sullivan writes on military history and national security. On graduating from Columbia College in 1967, he served as a forward observer, infantry platoon leader, and intelligence officer with the 1st Marine Division in Vietnam and received the Silver Star and Purple Heart. He completed his Ph.D. in history from Columbia University. Dr. Sullivan has taught military history at Yale University, 1984-88; as Secretary of the Navy Fellow and Member of the Strategy and Policy Department at the Naval War College, 1988-91; and as Senior Research Professor in the Institute for National Strategic Studies at National Defense University, 1991-97. During Operations Desert Shield and Desert Storm, he advised the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict on deception and psychological operations. He is the author of over 100 articles; wrote *Il Duce's Other Woman* (1993); edited Romeo Bernotti's *Fundamentals of Naval Tactics and Strategy* (Naval Institute Press, forthcoming); and is editing with A.J. Bacevich *The Limits of Technology in Modern Warfare* (Cambridge University Press, forthcoming). In 1997, Dr. Sullivan accepted USSPACECOM's offer to write a book on space power theory, to be published shortly.

Curt Weldon (R-PA) was elected to represent the Seventh Congressional District of Pennsylvania for a sixth term in 1996. A Member of the House of Representatives since 1987, Weldon has taken leadership roles on a wide variety of issues, ranging from national security to the environment. A senior member of the House National Security Committee, Weldon is the Chairman of the Military Research and Development Subcommittee, overseeing the development and testing of key military systems, weapons programs, and technologies that fulfill military needs. Weldon has used that position to ensure that our national security needs are met while encouraging the funding of dual use technologies. He is a leading Congressional advocate of ballistic missile defense systems. Weldon majored in Russian Studies and has made improving relations with Russia one of his primary goals in the House. He has worked with Russian leaders on a variety of issues, including efforts to improve Russia's energy supply, correct environmental damage, and protect both nations from ballistic missile attack. Weldon is currently leading an effort to improve the dialogue between Congress and the Duma, Russia's national legislature. Weldon is a strong proponent in Congress for lower government spending. His record of fiscal restraint and pro-growth policies has won him acclaim from the Concord Coalition, Citizens Against Government Waste, the Watchdogs of the Treasury, the U.S. Chamber of Commerce, and the National Federation of Independent Business. Representative Weldon was born in Marcus Hook, Pennsylvania on 22 July 1947, the youngest of nine children. He received his Bachelor of Arts degree from West Chester University in 1969. Prior to becoming a Member of Congress, Weldon worked as a teacher at local schools in Delaware County and volunteered as a firefighter in Marcus Hook. Married in 1975, Weldon now resides with his wife Mary Gallagher Weldon and their five children in Aston, Pennsylvania.

Simon P. Worden, Colonel, USAF, is the Deputy for Battlespace Dominance, Directorate of Operational Requirements, office of Deputy Chief of Staff for Air and Space Operations, Headquarters, United States Air Force. He is responsible for operational requirements in the areas of space and reconnaissance, command and control systems and precision engagement. He also coordinates cross-cutting operational issues related to the integration of air and space operations. He was commissioned in May 1971 after receiving a bachelor of science degree from the University of Michigan, and entered the Air Force in May 1975 after graduating from the University of Arizona with a Ph.D. in Astronomy. Colonel Worden served throughout the 1980s and early 1990s in every phase of the development, international negotiations, and implementation of the Strategic Defense Initiative, a primary component in ending the Cold War. He has twice served in the Executive Office of the President. As the staff officer for initiatives in the Bush Administration's National Space Council, he spearheaded efforts to revitalize our civil space exploration and earth monitoring programs, and was the architect of the "better, faster, cheaper" approach now adopted throughout the U.S. space program. He served as Commander of the 50th Space Wing responsible for over 60 of DOD's satellites and over 6,000 people at 23 world-wide locations and most recently was Deputy Director for Requirements, Headquarters, Air Force Space Command. Colonel Worden has authored or co-authored over 150 scientific technical papers in astrophysics, space sciences and strategic studies. He was scientific co-investigator for two NASA space science missions.

About the Editors

Peter L. Hays, Lieutenant Colonel, USAF, is a Professor of Comparative Military Studies at the School of Advanced Airpower Studies, Maxwell AFB, AL. In his previous assignment at the USAF Academy, he was an Associate Professor of Political Science, division chief for the international relations and defense policy curriculum, and Director of the USAF Institute for National Security Studies (INSS). He holds Ph.D. and M.A.L.D. degrees in international relations from the Fletcher School of Law and Diplomacy at Tufts University and an M.A. in defense and strategic studies from the University of Southern California. A 1979 honor graduate of the USAF Academy, Colonel Hays is a command pilot with over 3,200 hours of flying time, primarily in the C-141 Starlifter. He has focused his studies and research on U.S. military space policy by developing an Air Force Academy course on space policy, serving as a research assistant at the White House Office of Science and Technology Policy and at the National Space Council, and writing a dissertation on U.S. military space doctrine. Colonel Hays is a coeditor and contributing author for *Countering the Proliferation and Use of Weapons of Mass Destruction* (1998) and for the seventh edition of *American Defense Policy* (1997).

James M. Smith, Lieutenant Colonel, USAF (Retired), is an Associate Professor of Military Art and Science, adjunct Associate Professor of Political Science, and Director of the Institute for National Security Studies at the USAF Academy. He holds a Doctorate in Public Administration (Public Policy) degree from the University of

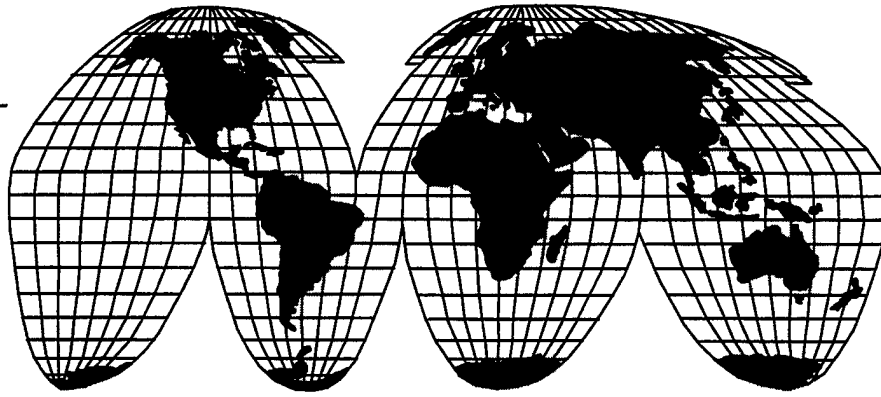
Alabama and a master's degree in systems' management from the University of Southern California. A 1970 graduate of the USAF Academy, Dr Smith's active-duty career included flying and plans assignments in the C-130 aircraft, as well as non-flying duty in USAF special operations. He also directed and taught the national security policy curriculum at the Air Command and Staff College. His final assignment was as a USAF Academy exchange professor in political science at the U.S. Military Academy, where he also served as West Point's Associate Dean for Academic Research. He is coeditor and contributing author for *Introduction to Air and Space Theory and Doctrine* and *Introduction to Joint and Multinational Operations*. He is also the author of two INSS Occasional Papers, *Environmental Federalism and US Military Installations* (1997) and *USAF Culture and Cohesion* (1998).

Alan R. Van Tassel, Major, USAF, is a political-military affairs officer assigned to the Strategic Relations Deputate at the Ballistic Missile Defense Organization. He holds a Ph.D. in government and politics from the University of Maryland and a master's degree in political science from Wichita State University. Prior to his current assignment, Major Van Tassel was an associate professor of political science and Deputy Director of INSS. Originally a launch control officer for intercontinental ballistic missiles, Major Van Tassel also has worked as a research assistant at the Office of the Secretary of Defense, U.S. Space Command, and the Air Staff. He is a coeditor and contributing author for *Countering the Proliferation and Use of Weapons of Mass Destruction* (1998) and for the seventh edition of *American Defense Policy* (1997).

Guy M. Walsh, Lieutenant Colonel, USAF, is the J-3 (Air Operations) for United States Central Command, McDill AFB FL. He was the National Defense Fellow (NDF) assigned to INSS during the 1997-98 academic year. Colonel Walsh came to INSS after serving as the Operations Officer and Squadron Commander for the 358th Fighter Squadron at Davis-Monthan AFB, AZ. He is a Command Pilot with over 3,300 hours in fighter aircraft and over 2,000 hours in the A/OA-10. In 1990 he received the Anthony C. Shine Award as the top fighter pilot in the USAF. Colonel Walsh is a graduate of the USAF Academy; U.S. Army Command and General Staff College, Fort Leavenworth, KS; and holds a master's degree in International Relations and Strategic Studies from the University of Southern California. He is a graduate of the Space Applications Senior Officers Course and his NDF research project focuses on how the USAF is transitioning to a space and air force.

BOOK PRODUCTION SCHEDULE

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29-30 July	Authors present chapters at INSS Conference, Doolittle Hall, USAF Academy, CO
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Appendix B

Biographies of Discussants

Donald R. Baucom is the Ballistic Missile Defense Organization (BMDO) Historian. He holds a B.S. from the USAF Academy and an M.A. and Ph.D. from the University of Oklahoma. He has held positions in the Air Force's communications-electronics career field, as a historian in the Air Force Office of History, served on the faculties of the USAF Academy and Air War College, was director of research at the Airpower Research Institute, and the editor of the *Air University Review*. He is the author of numerous articles and the book *The Origins of SDI, 1944-1983* (1992).

Marc J. Berkowitz is Director for Space Policy in the Office of the Deputy Assistant Secretary of Defense, Command, Control, Communications, Intelligence, Surveillance, Reconnaissance and Space Systems within the Office of the Secretary of Defense. He holds a B.A. from George Washington University and an M.A. from Georgetown University. He has previously held positions as director of space studies at National Security Research, Inc., Fairfax, VA and on the professional staff of SRI International in Arlington, VA. He is published in *Airpower Journal*, the *Naval War College Review*, *Strategic Review*, *Armed Forces Journal International*, and *US Naval Institute Proceedings*.

Dwayne A. Day, Research Associate, is a doctoral candidate in political science at George Washington University. He is currently researching his dissertation on Presidential control of the national security bureaucracy. His recent publications include: *Eye in the Sky: The Story of the Corona Spy Satellites* (1998); Co- Editor, *External Relations: Selected Documents in the History of the U.S. Civil Space Program*, (1996), edited by John M. Logsdon, with Dwayne A. Day and Roger Launius; Editor, "Military Space Programmes," *Journal of the British Interplanetary Society*, June 1997; "A Failed Phoenix: The KH-6 LANYARD Reconnaissance Satellite," *Spaceflight*, May 1997; "Those Magnificent Spooks and Their Spying Machines," *Spaceflight*, March 1997; "Department of Defense Returns to Space Shuttle," *Spaceflight*, February 1997; "Life on Mars?" *Spaceflight*, October 1996; "Science Marches On...Into the Darkness?" *Space Times*, September-October, 1996; and "A Strategy for Space: Donald Quarles, the CIA, and the U.S. Scientific Satellite Programme," *Spaceflight*, September 1996.

Albert L. DiMarcantonio, is currently serving as Assistant Deputy Under Secretary of Defense for Space Integration. He is on detail from the National Aeronautics and Space Administration (NASA) where he serves as Deputy Associate Administrator for Business Management in the Office of Space Flight. A former naval aviator with over 3000 hours flying time and a systems engineer, Mr. DiMarcantonio is charged with improving the economies, efficiency, and effectiveness of DOD space infrastructure and with enhanced synergy across the intelligence, civil, and industry space sectors. As such, his office focuses on science and technology, training, business practices, operations, civil applications, innovative concepts, and plans and requirements. Mr. DiMarcantonio is a graduate of the College of Aeronautics and of Columbia University.

Frank G. Klotz, Colonel, USAF, is a Military Fellow at the Council on Foreign Relations. He is writing a monograph on "Space, Commerce, and National Security" for the Institute for National Security Studies (INSS) at the USAF Academy. Prior to his fellowship, Colonel Klotz was Director of Logistics for Headquarters Air Force Space Command at Peterson Air Force Base, CO. He was previously Commander, 91st Missile Wing at Minot Air Force Base, ND. In addition to command experience, he has a broad background in space and missile operations and logistics. Colonel Klotz is a graduate of the USAF Academy, holds a Master's and Doctoral degree in Political Science from Oxford University, England, and is a graduate of the National War College.

John M. Logsdon, is a Professor of Political Science and International Affairs, Director of the Center for International Science and Technology Policy, and Director of the Space Policy Institute at George Washington University. He holds degrees in physics and political science and has taught at George Washington since 1970. Dr. Logsdon has been one of the world's leading space analysts and historians of space policy for over a quarter century. Prominent among his many publications is the definitive study of NASA's early history, *The Decision to Go to the Moon: Project Apollo and the National Interest*. His articles have also appeared in *Science*, *Scientific American*, *Issues in Science and Technology*, *Public Administration Review*, *Technology Review*, *The Scientist*, *Air & Space*, *Space Policy*, and numerous other publications. He is a Fellow of the American Association for the Advancement of Science, an Associate Fellow of the American Institute of Aeronautics and Astronautics, and a Member and Trustee of the International Academy of Astronautics. He was a member of the Aeronautics and Space Engineering Board of the National Research Council until July 1996 and has served on several National Academy of Sciences and National Academy of Engineering Committees. During 1992, Dr. Logsdon was a member of the Vice President's Space Policy Advisory Board, which supported the work of the National Space Council. Dr. Logsdon was the first holder of the Chair in Space History of the National Air and Space Museum and has served on the museum's Research Advisory Committee. He has also been a member of NASA's Earth and Space Sciences and History Advisory Committees and Chair of the Advisory Council of the Planetary Society. Professor Logsdon serves as the General Editor for the NASA History Series, *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program*. Volume three in this series, *Using Space*, was published in 1998.

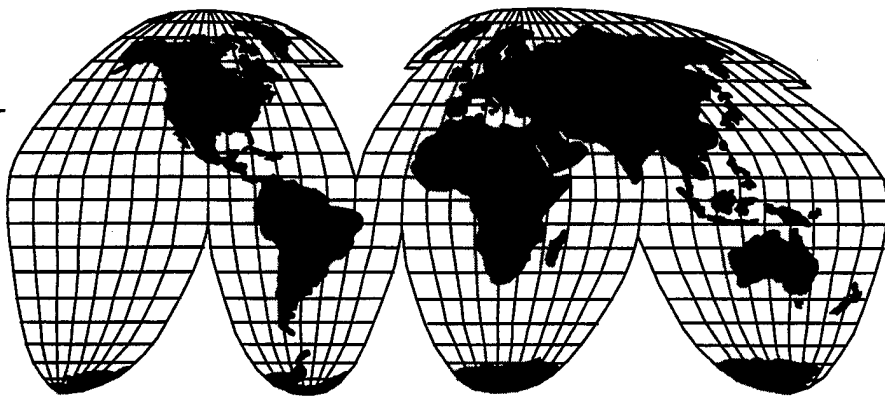
J. David Martin is Deputy for Strategic Relations in the Ballistic Missile Defense Organization (BMDO). In that capacity, he is responsible for the international affairs aspect of BMDO, BMDO's support for various arms control negotiations, public affairs, congressional liaison, and coordination with other Department of Defense and government offices involving BMD policy. He also is the chair or cochair of numerous international committees and steering groups on the subject of theater missile defense cooperation. Prior to joining the Strategic Defense Initiative Organization—BMDO's predecessor—in 1985, Dr. Martin served as Director of Nuclear Planning on the international staff at NATO Headquarters, Director for Theater Nuclear Force Programs in the Office of the Secretary of Defense (OSD), and a staff member in OSD's Office for

Strategic Forces and Arms Limitation. Dr. Martin received his doctorate in theoretical and applied mechanics from the University of Illinois.

William D. Russell, Major, USAF, is the chief, Commanders Action Group, Space Warfare Center, Schriever AFB CO. He holds a Masters Degree in Computer Information Systems from Boston University and undergraduate degrees in Mechanical and Aerospace Engineering from the Illinois Institute of Technology. Major Russell is a master navigator with over 1500 hours in the EC-130H including 175 hours of combat support time. He is a coeditor and contributing author for the *Aircrew Combat Information Guide*, *Multi Command Manual 3-1* Vol. 26 and the *Integrated Electronic Combat Planning and Execution Guide*.

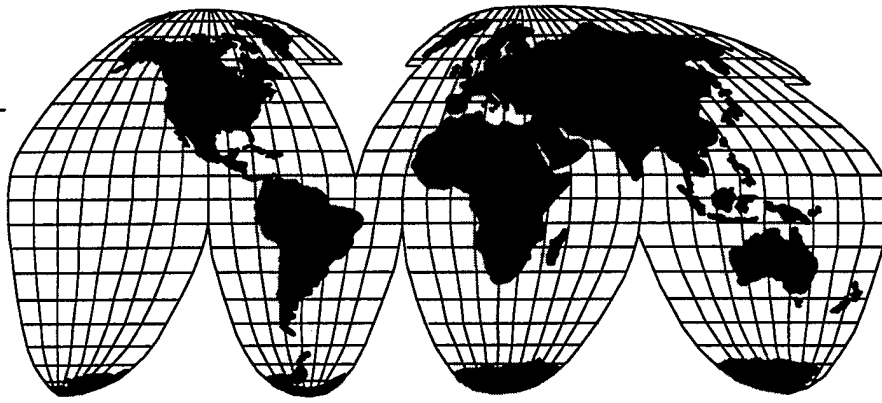
H. Marshal Ward, Major General select, USAF, is director for operations, training, and space integration, deputy chief of staff, air and space operations, Headquarters USAF, the Pentagon, Washington, D.C. This directorate consists of more than 500 military and civilian members in ten divisions and four field operating agencies responsible for every aspect of Air Force current operations and training. The general enlisted in the Air Force in 1966 and moved quickly through the ranks to staff sergeant during his first 11 months of service. He completed college through the Airman Education and Commissioning Program and was commissioned following honors as a distinguished graduate of Officer Training School in 1969. He held a variety of assignments in both rated and non-rated fields including weather forecasting, hurricane reconnaissance, airlift operations, command and control operations, acquisition program management, communications, space and missile plans and policy, and operational requirements. He is a senior pilot and master space operator with more than seven years in joint-duty assignments. The general has an M.B.A. from Auburn University and is a graduate of the Industrial College of the Armed Forces.

James J. Wirtz is an associate professor of national security affairs at the Naval Postgraduate School in Monterey, CA. He completed his master's degree at the University of Delaware and his Ph.D. at Columbia University. He was also a John M. Olin Fellow at the Center for International Affairs, Harvard University. His recent publications include the article "A Joint Idea: An Antisubmarine Warfare Approach to Theater Missile Defense," in the Spring 1997 edition of *Airpower Journal*. His work on national security issues has been published in a number of other journals. Professor Wirtz's books include *The Tet Offensive: Intelligence Failure in War* (1991) and contributing coeditor for *The Absolute Weapon Revisited: Nuclear Arms and the Emerging International Order* (1998).



Appendix C

Panel Slides



Bob Preston, RAND

1997 Research Conference

Acquisition of Space Power

Roger DeKok, LtGen, USAF, SMC/CC
Bob Preston, RAND

USAF INSS Conference
Spacepower for a New Millennium
July 29, 1998

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Outline

- Introduction
- Historical roots & current policies / programs
- Future context
- Global Partnerships
- Strategies / Prescriptions

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Introduction

- Three "compelling circumstances" of LRP
 - Strategic pause
 - Space as essential utility
 - Potential for space as "revolution in military affairs"
- Acquisition
 - Budget "pause" doubtful - acquisition change may help
 - Commercial forces driving "essential utility" may enable the needed acquisition change - if DoD can change to exploit
 - Changes in scale and kind of space enterprises point to RMA via LRP's Global Engagement

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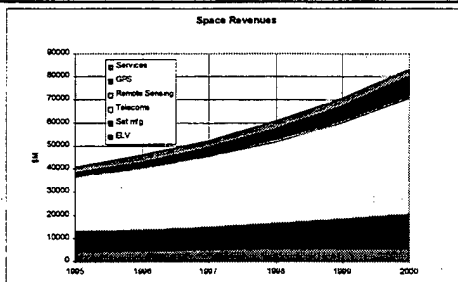
Historical Roots Current Policies / Programs

- Sectors: First two - now three
 - National Security (military & intel components)
 - Civil
 - Commercial
- Programs: NSCP across sectors (NPOESS, SBIRS, EELV, NSCP)
- Architects: architectures across missions & stovepipes
- Commercial Space

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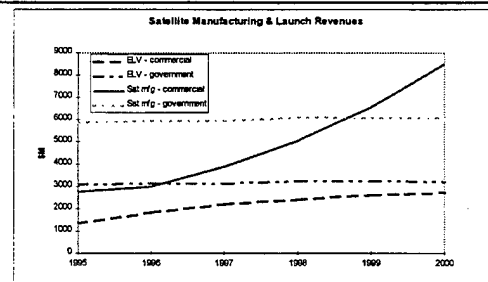
Space Revenue Projection (KPMG, SpaceVest, 1997)



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Commercial Space Government / Commercial Comparison



Preston, USAFAINSS 6 11/1798 P:43

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Future Context

- Commercial forecast
- Industry attributes
 - Capacity - megawatt constellations
 - Private capital - stable, agile
 - Cycle time - competition driven & decreasing
 - Product line evolution - continuous, rapid, clear decision criteria
 - Architectural diversity - altitudes, sizes, connectivity, spectrum, applications

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Global Partnerships

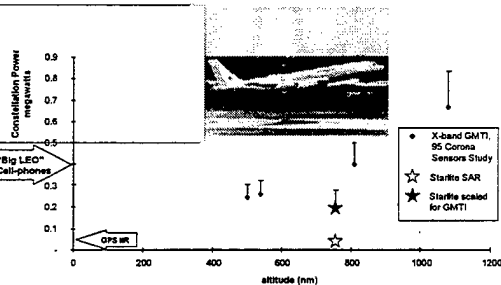
- Enabler for Global Engagement
 - Defense / Intel Space partnership
 - Imagery
 - GMTI
 - AMTI
 - Commercial space industry
- Element of Space Control
 - "Center of Gravity" recognition doubtful
 - If recognized, international acquiescence to US enforcement questionable
 - Analogies to terrestrial, maritime, air experience need careful examination before prescribing means
 - However, partnership all the more valuable

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GMTI: How Big a Job from Space?

On the order of 400 kW prime power
on orbit for JSTARS-like surveillance function.

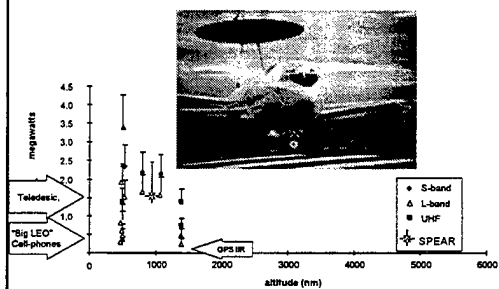


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AMTI: How Big a Job from Space?

On the order of 500 kW to 1 MW prime power
on orbit for AWACS-like surveillance function



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Strategies / Prescriptions

- Acquisition reform - exploit commercial space industry!!
- Requirements reform - cross-sector
- Partnership
- Partnership
- Partnership

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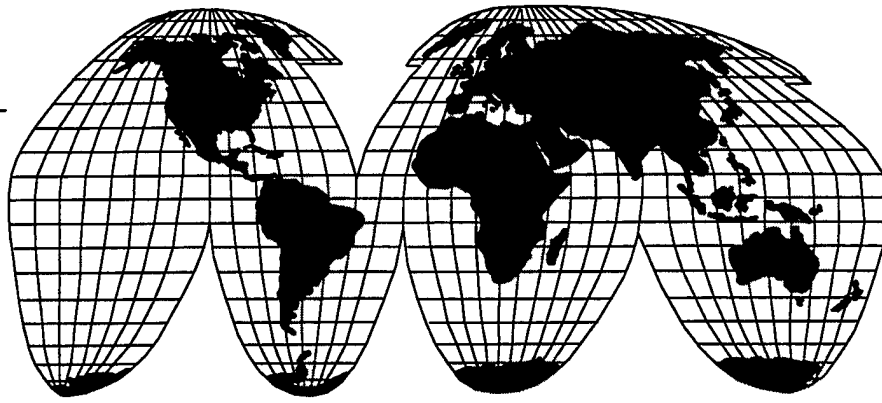
Preston, USAFARNSS 11 11/17/98 9-43

Conclusion

- Space can be defining in national security affairs
 - well beyond revolution in *military* affairs
- LRP: an excellent beginning, this chapter draft
 - identified some issue with underlying assumptions, e.g., "strategic pause"
 - exposed critical issues with concepts of "Center of Gravity" and Control of Space
 - confirmed/quantified Global Engagement
 - endorsed partnership as essential strategy

R

Preston, USAFARNSS 12 11/17/98 9-43



General Howell M. Estes III
NORAD

1997 Research Conference

THE AEROSPACE FORCE OF TODAY AND TOMORROW:

Transforming Our Service to Control the Vertical Dimension

General Howell M. Estes III
 Commander-in-Chief, NORAD
 Commander-in-Chief, USSPACECOM
 Commander, AFSPC

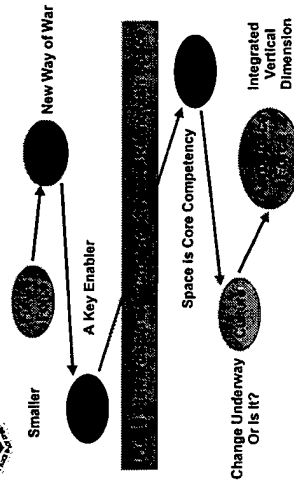


Dawn of a New Era

- CORONA Fall 97
 - Fully Exploit Space
- Cultural Resistance
 - Air and Space Force or Space and Air Force
- CORONA Top 98
 - Control the Vertical Dimension
 - Become an Aerospace Force



Air Force at a Crossroads



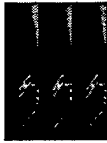
Air Force at a Crossroads

- Been Here Before
 - Army / Army Air Corps
- Wringing Our Hands Today
 - Focus Tends to Be On Past Heritage, Not Future Vision
 - Air/Space Zero Sum Game
 - Readiness Bells
- Time To Step Up To the Plate
 - Space Is AF Mission
 - Fully Integrate
 - No More Excuses
- or
- Space Will Become Separate



Educate Aerospace Warriors: The Pillars

- Space Important In Past to Military Operations ... More Important in the Future
- On the Verge of an Explosion In Commercial Space
- Space Critical to Military & Economic Instruments Of Power ... Emerging Area of Vital National Interest
- Since Space Is Growing Source of National Power ... It Will Be Challenged



Educate Aerospace Warriors: The Pillars

- US Military Must Ready Itself: When Challenged In Space, Leadership Will Turn To Us
- Responsibility Falls to USSPACECOM to:
 - Ensure Access to Space
 - Protect US Interests & Investments
- Organize, Train, & Equip Space Forces In Support of USCINCSPACE



USSPACECOM Long Range Plan

- Joint
- Not Built In Isolation
- A Tool to Assist Resource Decisions
- Service Inputs are Backbone of LRP
- Living Document
- Provides Advice to Services

11 Mission Areas 4 Operations Concepts

Provide Aerospace Resources

Resolve Policy Issues

- Appropriate Level of Response to Attacks
- Deny Adversary Use of Space
 - Commercial Imagery
 - Use of GPS by Hostile Entities
- Protect Non-Military Assets
- National Debate on Space Force Application

Reorganize to Become an Aerospace Force

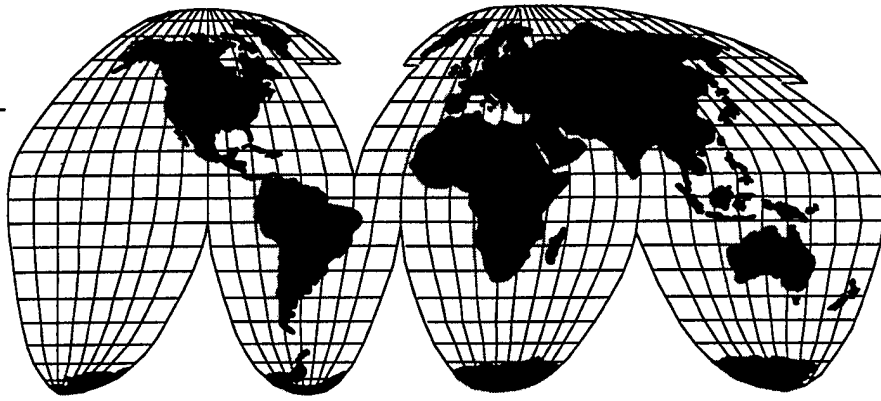
- Must Provide Responsive Joint Warfighting Capability
- Assess Viability of Present Command Structure
 - AFSPC -> Space Combat Command?
 - AFSPC & ACC -> Aerospace Combat Command?

Reorganize to Become an Aerospace Force

- Must Provide Responsive Joint Warfighting Capability
- Consider:
 - Space Combat Command
 - Aerospace Combat Command

The Future

- Preponderance of Aerospace Capabilities Will Be Space-Based
- Aerospace Personnel Will Control the Vertical Dimension
- Aerospace Power Will Be the Cornerstone of Warfighting Doctrine
- Our Service Will Become the United States Aerospace Force



Dr Daniel Hastings, AF/ST

1997 Research Conference



Future Military Space Technologies

Dr. Daniel Hastings
AF/ST
July 1998

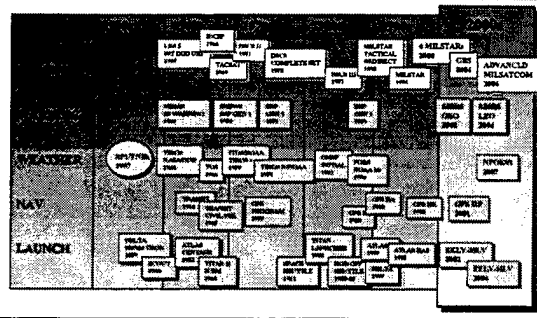


Outline

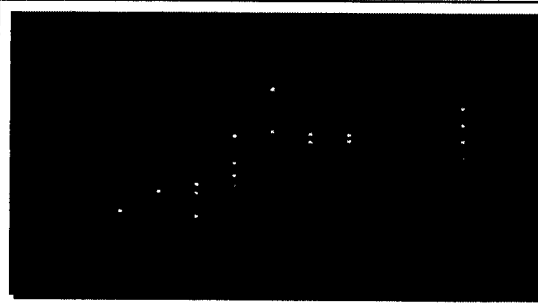
- Introduction
- Review of next Air Force in Space
- Likely future world context
- Doable Paths
- Technology Investments
- Summary



THE NEXT AIR FORCE IN SPACE



AF SPACE INVESTMENT (PLANNED VS. PROVIDED)



The World in the 21st Century

- A consistent model of the world in the 21st Century is as follows:
 - » Space assets will be seen to provide economic power
 - » There will be many relatively inexpensive commercial space assets
 - » Many space enabled services will be internationally available
 - » There will be a broadly available global information net
 - » Proliferation of biological warfare agents will continue
 - » Proliferation of rapidly launchable missiles will also continue
 - » United States (US) forces will operate primarily out of Continental United States (CONUS)
 - » The pace of war will continue to quicken
 - » Expansive urbanization will continue



Warfare in the 21st Century

- The implications for warfare (defined as imposing one's will on someone else) in this world are:
 - » With information widely available, there will be an emphasis on integration of information and speed of execution
 - » Our high dependence on communication links and information operations will make these two likely places to attack us.
 - » The pace and effectiveness of war will increase by emphasizing integrated air, space and information operations
 - » The cost of war using space and information operations will be reduced by making widespread use of commercial systems
 - » Operations from CONUS and the increasing pace of war will put emphasis on rapidly deployable, zero footprint forces



Space Paradigm Shift

- **OLD WAY**
 - » Few launches
 - » Few, expensive satellites
 - » Concept to capabilities takes decades
 - » Strict compartmentation
 - » Dominated by Government
 - » Strategic Emphasis
- **NEW WAY**
 - » Growth of Commercial Space
 - 1,000 new Satellites (1997-2007)
 - \$0.5 Trillion Invested (1995-2000)
 - Rapid Manufacturing capability (26 days)
 - Concept to capabilities 2-5 years
 - » Systems of systems
 - » Government smaller player (6% of launches)
 - » Increasing warfighter emphasis
 - » Space becomes
 - Economic center-of-gravity, e.g., GPS, comm
 - » Users will expect to be information rich during conflict
 - » Communications, Imagery and Launch Services likely to become commodities
 - » Greater dependence on space superiority

The Space World is Changing!



A Commercial Revolution in Progress: Space for Everyone

- One meter imaging
 - » On order and overnight delivery time
 - » Multiple suppliers, several Nations
- Communications rich environment
 - » > 900 Gbps globally to small terminals by 2003
 - » Direct broadcast anywhere
 - » Traditional GEO-synchronous Earth Orbit (GEO) robust growth
 - » Low Earth Orbit (LEO) mobile exponential growth (pocket phones)
 - » LEO multi-media - next revolution (small terminals)
- Commercial Launch Beyond Expectations
 - » Over 30 Space Ports being worked
 - » Over 20 GEO launchers competing
 - » Over 15 LEO launchers existing and proposed
 - » Over 5 Reusable Launch Vehicle (RLV) concepts started
- Navigation and timing are becoming global utility



Strategy for Military Space Technology Development

- Obtain as much as possible from commercial world
- Focus investment on military unique technologies
 - » evolutionary technologies
 - » revolutionary technologies



Technology Developments in the Commercial World

- Technologies for manufacturing many identical spacecraft.
- Technologies for efficient spacecraft operations.
- Low cost high performance electronics and computers.
- Technologies for commercial global communications.
- Space launch systems.
- Systems-level simulation-based design.
- Technologies for automated spacecraft checkout



Military Functions for the Future

- Within a taxonomy of Global Awareness, Global Reach and Global Power, an initial list of military functions is:
 - » **Global Awareness**
 - » Intelligence, Surveillance and Reconnaissance (below ground, on the ground, in the air and in space)
 - » **Global Reach**
 - » Delivery and retrieval of space assets
 - » **Global Power**
 - » Target specific, precision strike (below ground, on the ground, in the air, in space, in cyberspace)
 - National Missile Defense
 - Information and Communications defense and attack (in real space as well as in cyberspace)



Four Important Modalities

- Space Assets are inherently global
 - » Strategic View
 - » Dual Use
- Space Assets are also information assets
- Many space assets will be commercial
 - » Massive diversity
- Space warfare will be surrounded by noncombatants
 - » Multiple use
 - » Orbital Debris
- ACHILLES HEEL: Nuclear Blast



Doable Definition

- For mid-term, (2010-2012) doable is the intersection of:
 - » Technology
 - » Finance
 - » Policy/Legal
 - » Mission/Doctrine
 - » Cultural/Organizational
- Viable only with appropriate strategic partnerships
 - » Must be scoped for the things we want to do
 - » Two types: Developers and Users
- Doable depends on system of systems perspective
 - » Include all systems (National and Commercial)
- For mid-term (4 doable paths):
 - » Technically possible with focused investment
 - » Fiscally likely on the order of 30% increase (~\$1 B/yr) in space investment through 2012
 - » Lowered cost launch: big difference
- Long-term:
 - » Restructure S&T investment to meet 30-year vision
 - » Be aware of revolution (SAR challenge)



Future Capability: Technically Doable vs. Time

- Mid Term (2012)
 - » Easily Doable
 - Lower cost space launch
 - more capable GPS
 - Kinetic NMD
 - Satellite Attack Warning
 - Prompt Global Attack (CBM)
 - GMTI (Non-Stealthy)
 - HSI
 - Data Relay
 - Space based space surveillance
 - Space maneuver vehicle
 - » Doable with Tech Push
 - Global Energy Delivery
 - Integrated ISR
 - GMTI (Stealthy)
 - AMTI (Non-Stealthy)
 - Responsive, two stage to orbit
- Long Term (2020)
 - » Easily Doable
 - GMTI (Stealthy)
 - AMTI (Non-Stealthy)
 - Responsive, two stage to orbit
 - » Doable with Tech Push
 - On Orbit Maintenance (GEO/MEO)
 - Responsive, Single Stage to Orbit
 - AMTI (Stealthy)
 - Global Energy Delivery (SBL)



Four Parallel Doable Paths

- (1) Commercial Options
- (2) Integrated ISR
- (3) Global Energy Projection
- (4) Space Control



Path 1: Commercial Options

- Buy following commodities from commercial world (launch services, communications, imagery, etc.) [Think about other commodities]
 - » Integrated architecture must be defined
 - Do not state requirements in the context of expected system
 - » Air Force role must be aggressively explored:
 - Leadership role
 - "Core" national security functions
 - "Fee for Service" options?
 - » Protect by massive diversity (risk assessment necessary)
 - » Graceful adoption of capability
- Continue support of weather (NPOESS)
 - » Evaluate other capabilities missions-to-task



Near-Term Actions

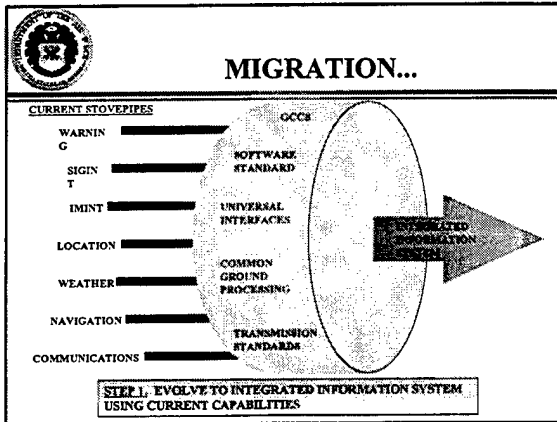
- "Champion" space navigation "utility" for warfighting - GPS III in place of GPS IIF option 2 (minimal expenditure of money route)
 - » Current system is "Wright Flyer" prototype
 - Much better accuracy (0.3m and 1 ns) can be done everywhere
 - » Explore options that implement this early
 - » Anti-jam and Robustness are critical
 - May save net TOA dollars
- Aggressive study: Role for AF in:
 - » Communications
 - » Launch services
 - Consider commercial turn key approach
 - Consider use of two stage RLV concepts as "spaceplanes"
 - » Information services



Path 2: Integrated ISR

System of Systems approach: DoD, Intelligence, Commercial, Civil, Satellites, Terrestrial Assets

- Satellite Features:
 - » Global Access
 - » Large Coverage Area
 - » Low Vulnerability to Air Defenses
- Uninhabited Air Vehicle (UAV) Features:
 - » Continuous Coverage of Tactical Area
 - » Deployable Worldwide relatively quickly
 - » Easily Reconfigured for Specialized Missions



Integrated ISR (cont.)

- Integrated ISR (with focused investment):
 - » IMINT, MASINT, and SIGINT
 - » Space-based Infrared System (SBIRS) High/Low
 - » Ground-based Moving Target Indicator (GMTI)
 - » Air Force Hyper-spectral air & space
 - » Space-based air search radar
 - » UAV air engagement radar
 - » Supporting C2/Battle Management (BM) system on ground
- Cost = \$5-15B for additional space-based assets
- Terrestrial segment costs could be significant
- Technical long poles: Antenna mass, large deployable antennas, power on-orbit, on-board processing

Near-Term Actions Integrated ISR

- Reinforce strategic partnership with NRO and form joint efforts:
 - » SBIRS and National Systems Integration
 - » GMTI as next step in Future Imagery Architecture (FIA)
 - » Hyperspectral Imagery analysis
 - » Consistent information infrastructure, communication and networks
 - » Responsive space operations
- Foster cooperative space efforts with NASA and Commercial organizations
- Refocus S&T funds towards space:
 - » Focus a strategic thrust in the ISR/C2BM area in AFRL leveraging DARPA, NRO, AIA, DIA, commercial enterprises, ...
 - » Make appropriate strategy and portfolio adjustments
- Tie the integrated ISR system with ASC2A
 - » C2 Agency to work IC on integrated information system

Path 3: Global Energy Projection

- Technically possible to deliver militarily significant amounts of laser energy globally
- Can be an option for NMD
 - » Minuteman option - technically possible near term option
 - » DE weapon offers hope of boost-phase intercept of ICBMs
- Explores through space have other uses
 - » Explore possible revolutionary new capabilities
 - Psyops target designation
 - Remote active sensing
- Space-based laser (SBL) based on BMDO technology
 - » Current concepts are too heavy
 - » Cannot be ready by 2005

Global Energy Projection

- Do not start on any demonstrator yet
 - » Focus investment on technology:
 - Large light-weight, deployable optics and their control
- SAB look at DE technical alternatives
- On the 2010 timescale, investment in advanced deployable optics will enable "fighting mirrors"
 - » Any demonstrator(s) ~ \$2B
 - TMD and NMD implications
 - Legal and policy implications
 - » Technically easier to demonstrate than putting a high energy laser in conjunction with optics

Near-Term Actions Global Energy Projection

- "Fighting Mirrors"
 - » Combined with source will lead to capability to extend range of source
 - » Explore synergies with NASA and NRO, for example:
 - Space objects surveillance
 - Deep space exploration
 - High resolution/large area imagery
- Devote significant work on concept of operations
 - » Military utility of global energy delivery
 - » Need 20+ satellites for minimal global coverage at ~ 1,300 km altitude
 - Nominal cost ~ \$30B for full coverage
 - » Significant protection problem
 - Optics are very easy to damage



Path 4: Space Control

- Growing number of US and Allied space assets constitute a military and economic center-of-gravity
 - » Potential threats - Information Warfare, Radio Frequency and laser attacks first, physical threat much less likely
- Focus on surveillance of space and warning of attack
- Current system is ground-based surveillance
 - » Optical
 - » Radar
- Develop an overall concept of operations for the battlespace
 - » Ground options - appropriate upgrades
 - » Space options
 - » Limits of requirements (very small objects; details on satellites; AF role and liability)



Space Control

- Space-based, space object sensing technically possible
 - architecture studies necessary on requirements/cost trades
 - » Expanding SBIRS/Low requirements set is an attractive option
 - » Separate space-based EO network is an expensive option
- Warn of attack from RF and laser sources (most likely)
 - » Lightweight, low-power sensors to warn of attack
 - » Develop for all satellites (military and commercial)
 - » Technically possible and relatively cheap
- EO, IR and RF ground-based jammers technically feasible and not expensive – military utility?
- Space based jammers are technically feasible

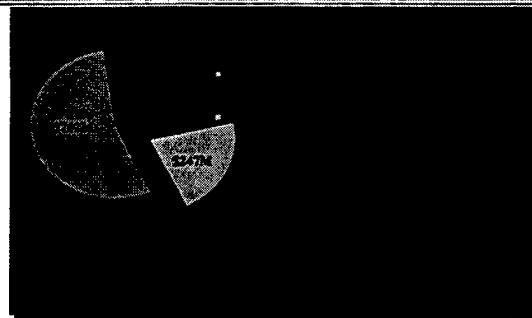


Near-Term Actions Space Control

- Invest now in space surveillance systems
 - » Develop an overall concept of operations for the battlespace
 - Right mix of ground and space
 - Review requirements set in time for SBIRS Low definition
- Invest now in low cost attack warning systems
 - » Need appropriate Science and Technology (S&T) investment
 - » Need development for all satellites and be required for all US government satellites
- Invest now in ground-based jammers



Air Force Space S&T Funding: We're spending on doing better what we do today, not on the future.




Actions in S&T to enable Doable Paths

- FOCUS S&T investment portfolio on enabling technologies for strategic thrusts in synergy with DoD, Intelligence Community (IC), NASA & commercial world
 - » Mid-term things (50% nominal)
 - Integrated ISR
 - Space-based radar technologies (antennas & power systems)
 - Air Force Hyper-spectral imaging (HSI) analysis technologies
 - C2/BM technologies (knowledge fusion, knowledge flow to human)
 - Global energy delivery
 - Very large, lightweight, deployable optics
 - Autonomous alignment and calibration technologies
 - Large aperture atmospheric correction technologies
 - Space control technologies
 - » Technically hard things with high payoff (20%)
 - Technologies to enable responsive, two stage to orbit vehicles
 - » Revolutionary things (20%)
 - Distributed satellite swarms, microtechnologies for satellites, non-traditional propulsion




Summary

- World in 2012:
 - » Many widely available commercial space services
 - » Commercial space spending dwarfs government spending
 - » Threat will be global and varied
- "Doable" paths exist for Air Force in 2012 to have:
 - (1) Evolved stewardship role by buying many services as commodities from commercial space world
 - (2) Integrated air and space-based elements to provide a comprehensive Intelligence Surveillance & Reconnaissance (ISR), and Command & Control (C2) capability
 - (3) Demonstrated the ability to deliver militarily significant amounts of laser energy through space to targets
 - (4) Developed robust space surveillance capabilities and attack warning capabilities for all satellites


 *Space Technology to Support the Warfighter*

Space systems are crucial to this nations ability to wage war. Space based systems...have become so powerful that no operational commander would consider fighting without them. Full force integration is USSPACECOM's strategy to seamlessly weave space capabilities into all dimensions of warfare


 *Premise*

Technology Is Advancing at Breakneck Speed


- The Military Must Keep Pace and Maintain It's Technology Edge
- Our People Must Understand Technology and Employ It to Keep the Advantage
- We Must Maximize Our Capabilities and Minimize the Adversaries
- We Must Plan for the Future

 *Organization*


- Build the Base
- Supporting the Decision Makers
- Exploit the Positive
- Minimize the Negative
- Future

 *Build the Base*

- Education Is the Key to Understanding and Exploiting Space Technology
- Modeling and Simulation Allow Us to Exercise (and Therefore Educate) the Force in Space Technology

 *Supporting the Decision Makers*

- No One Person Is an Expert in Everything--but Senior Leaders Must Understand the Capabilities and Have Access to the Expertise
- Expertise in the Field Is a Building Approach
 - AFSST
 - "W" Prefix Officers
 - OSO
- TENCAP - Program to Support Space Technology in the Field

 *Exploit the Positive*

- Must Use Our Space Systems to Maximum Capability
- Description of Types of Space Systems



Minimize the Negative

- **Protect Our Space Assets**
 - Space Segment
 - Ground Segment
 - Communications Segment
 - Personnel Segment
- **Understand an Adversaries Access to Space - Commercial**



Future

- **Space Battlelab - Innovation**
- **Modeling and Simulation**
- **New Technologies**
- **Theater Missile Defense**
- **Protection From Man-Made Space Objects**