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SPACE AND U.S. SECURITY

HEARING

BEFORE THE

STRATEGIC FORCES SUBCOMMITTEE

OF THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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CONTENTS

CHRONOLOGICAL LIST OF HEARINGS

2009

	Page
HEARING:	
Wednesday, March 18, 2009, Space and U.S. Security	1
APPENDIX:	
Wednesday, March 18, 2009	29

WEDNESDAY, MARCH 18, 2009

SPACE AND U.S. SECURITY

STATEMENTS PRESENTED BY MEMBERS OF CONGRESS

Tauscher, Hon. Ellen O., a Representative from California, Chairman, Strategic Forces Subcommittee	1
Turner, Hon. Michael, a Representative from Ohio, Ranking Member, Strategic Forces Subcommittee	2

WITNESSES

Armor, Maj. Gen. James, USAF (Ret.), Owner and CEO, The Armor Group, LLC	9
Krepon, Michael, Co-founder, The Henry L. Stimson Center	7
MacDonald, Bruce W., Author of Recent Council on Foreign Relations Study on China, Space Weapons, and U.S. Security	4

APPENDIX

PREPARED STATEMENTS:	
Armor, Maj. Gen. James	56
Krepon, Michael	45
MacDonald, Bruce W.	33
DOCUMENTS SUBMITTED FOR THE RECORD:	
[There were no Documents submitted.]	
WITNESS RESPONSES TO QUESTIONS ASKED DURING THE HEARING:	
[There were no Questions submitted during the hearing.]	
QUESTIONS SUBMITTED BY MEMBERS POST HEARING:	
[There were no Questions submitted post hearing.]	

SPACE AND U.S. SECURITY

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
STRATEGIC FORCES SUBCOMMITTEE,
Washington, DC, Wednesday, March 18, 2009.

The subcommittee met, pursuant to call, at 1:00 p.m., in room 2212, Rayburn House Office Building, Hon. Ellen O. Tauscher (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. ELLEN O. TAUSCHER, A REPRESENTATIVE FROM CALIFORNIA, CHAIRMAN, STRATEGIC FORCES SUBCOMMITTEE

Ms. TAUSCHER. Good afternoon. This hearing of the Strategic Forces Subcommittee will come to order.

Today, in open session, we will review three broad issues related to space and U.S. security. First, do we have the right policy to ensure the security of our space assets? Second, do we have the right investment strategy? And finally, what role can diplomacy play in ensuring the security of our space assets?

We have three nongovernmental witnesses with us today. Each participated in a special Council on Foreign Relations (CFR) study on these subjects commissioned not long after the Chinese anti-satellite (ASAT) test.

First, Mr. Bruce MacDonald, the author of the Council study, is here with us. From 1995 to 1999, he was Assistant Director for National Security at the White House Office of Science and Technology Policy, as well as Senior Director for Science and Technology on the National Security Council (NSC) staff. He is also a former House Armed Services Committee staffer.

Next, Mr. Michael Krepon, co-founder of the Henry L. Stimson Center. Mr. Krepon is a longtime advocate for rules of the road in space. He is also a diplomat scholar at the University of Virginia, where he teaches in the politics department.

Finally, retired Air Force Major General James Armor, owner and Chief Executive Officer (CEO) of the Armor Group. General Armor's last job in the military was as Director of the National Security Space Office. He also served as the head of the National Reconnaissance Office's (NRO's) Signals Intelligence (SIGINT) operation.

I want to welcome each of our distinguished witnesses. It is a pleasure to have you before the subcommittee today.

This subcommittee has been eager to have a public discussion of these complicated, often classified subjects, and the Council report provides just that opportunity.

I was particularly impressed by the depth and breadth of the advisory committee for this report. The committee included Admiral Dennis C. Blair, now the Director of National Intelligence (DNI); Air Force Lieutenant General David A. Deptula; Mr. Keith R. Hall, former Director of the National Reconnaissance Office; and Ms. Theresa Hitchens of the Center for Defense Information.

Before we begin, I wanted to highlight one report recommendation from each of the three areas we will discuss today.

In the policy arena, the Council report recommends that the President and the National Security Council should modify national space policy to allow negotiated restrictions on the basis of verifiability and U.S. interests.

In the programmatic realm, the report states that the Department of Defense (DOD) should evaluate all future space programs and initiatives in terms of their contribution to stability and deterrence in addition to its other criteria, and place greater emphasis on survivable ground-based offensive capabilities with reversible effects than on space-based capabilities.

In the diplomatic arena, the report recommends that the State Department and DOD should expand dialogue with China to establish rules of the road, codes of conduct, and other confidence-building measures, as well as to build upon current military-to-military dialogue on space issues.

As you can see, the Council report has given us plenty to talk about this afternoon.

With that, let us begin, and let me turn to my very good friend and our distinguished Ranking Member from Ohio, Mr. Turner, for any comments he may have.

STATEMENT OF HON. MICHAEL TURNER, A REPRESENTATIVE FROM OHIO, RANKING MEMBER, STRATEGIC FORCES SUBCOMMITTEE

Mr. TURNER. Thank you, Madam Chairman.

So many times when we have hearings or issues that we are looking at, and it is always in context of the news of the day, and I feel like I can't go past the news of the day without recognizing that the Associated Press (AP) is reporting that the Obama Administration is indicating its choice for Under Secretary of State for Arms Control and International Security to be none other than our own Chairman, Ellen Tauscher. We wish her well in that, and I congratulate you on that.

Ms. TAUSCHER. I am going to send your tax returns to the Federal Bureau of Investigation (FBI), if you don't mind.

Mr. TURNER. Well, you certainly have a tremendous amount of experience that we have as evident in this subcommittee, and we wish you well in that.

Ms. TAUSCHER. Thank you very much.

Mr. TURNER. With that, then, I also want to thank Mr. MacDonald, Mr. Krepon, and General Armor for being with us today. The Council of Foreign Relations report, which forms the basis of our discussion today, is a first-rate product, and I want to commend Mr. MacDonald for his work on it.

Today's discussion focuses on the policies and capabilities that best provide for the security of our space assets. The current space

policy, for the first time, recognized space assets as vital to U.S. national interests. Space is critical to modern-day military operations and contributes over $200 billion annually to the economy.

This subcommittee, largely in part due to the efforts of my predecessor Mr. Everett and our Chair, soon to be Under Secretary, sought to promote a greater understanding about the importance of space assets and the potential consequences of their loss.

An array of potential threats can hold our Nation's space capabilities at risk and degrade U.S. advantages in space. A prime example, according to the Pentagon's annual China military report, is China's pursuit of a multidimensional program to limit or prevent the use of space-based assets by its potential adversaries. This includes the direct-ascent ASAT China tested in 2007.

The expansion in the number of space-faring nations and satellites launched each year also increases the risk of accidental collisions, such as the one we saw last month between a commercial satellite and a Russian spacecraft.

We have a nexus of challenges before us. First and foremost, I believe we have considerable gaps and shortfalls in space intelligence and in our knowledge of foreign space capabilities and intent. Robust space intelligence is a prerequisite for Space Situational Awareness (SSA) and protection, and it also greatly influences decisions made about our space policies and posture.

I would ask our witnesses to provide their assessment of our Nation's space intelligence capabilities, and also any thoughts on whether our intelligence enterprise is adequately organized and managed to fulfill future capabilities and challenges in this area.

Second, what changes in policy do you recommend to increase our security in space? I am particularly interested in how we apply the model of deterrence to space. What capabilities will we need? How would we demonstrate the credibility of such a deterrent? And how would we manage escalation when the U.S. may have more to lose than a potential adversary?

Third, a greater emphasis on Space Situational Awareness and space protection capabilities has been strongly supported by this committee. In the 2008 defense bill, we required the defense Intelligence Communities (IC) to develop a space protection strategy. In your view, what are the next steps to implement the strategy, and where do we still have gaps and shortfalls?

Fourth, our current national security space architecture is comprised of relatively few, and very complex monolithic systems. The loss of one satellite, whether by intent or accident, could have widespread consequences for battlefield users reliant on its capabilities. Do you have thoughts on how we might change our acquisition strategies to increase the survivability and resiliency of our space architecture?

And lastly, securing our interests in space requires a "whole of government" approach that also includes diplomatic efforts, as highlighted in Mr. MacDonald's report; however, space is a challenging area that requires balancing our desire to protect our most sensitive cutting-edge technologies with promoting greater international cooperation in space. Often these are complementary, but sometimes they are not. What space security topics are the most

promising candidates for greater diplomatic efforts? We appreciate your comments there.

The desire to seek a space-weapons ban treaty was featured as part of President Obama's defense agenda. Defining space weapons and establishing an effective verification regime are incredibly problematic. I also remain skeptical that China, in particular, would halt its space programs, when reports of their across-the-board counterspace capabilities and investments suggest otherwise.

An alternative approach that establishes rules of the road has been suggested by one of our witness. Collision avoidance may be a logical first step; however, I would like a greater understanding of what these would entail, and would also ask that you consult with our military commanders to elicit their views. My immediate concern is that we do not disadvantage U.S. space capabilities.

One also has to consider how much transparency about space assets we want. Imagine if we were required to report on the location status of our nuclear submarines.

Thank you for being with us today and providing your critical thoughts on the issue of space security. I look forward to a candid discussion and thank you for being here. And thank you, Madam Chair, for your leadership.

Ms. TAUSCHER. Thank you very much, Mr. Turner, for those kind remarks, and thank you for your statement.

We will begin with Mr. MacDonald. Bruce, the floor is yours, as we received your formal statement. We look forward to brief remarks, and we entered your statement in the record, and the floor is yours.

STATEMENT OF BRUCE W. MACDONALD, AUTHOR OF RECENT COUNCIL ON FOREIGN RELATIONS STUDY ON CHINA, SPACE WEAPONS, AND U.S. SECURITY

Mr. MACDONALD. Thank you very much, Madam Chair, Ranking Member Turner, and members of the subcommittee. It is really a privilege for me to be here today to talk about this vital issue.

I want to make clear at the outset, I am speaking purely in a private capacity and not on behalf of the Strategic Posture Review Commission, U.S. Institute of Peace, or the Council on Foreign Relations.

The subcommittee has posed three excellent questions for this hearing: One—and I will give short answers to each and then elaborate just a bit—do we have the right national policy to ensure the security of our space assets? I think our policy is deficient in doctrine and strategy, and needs urgent attention to avoid major problems.

Do we have the right investment strategy for protecting and defending critical space assets? Briefly, I have only modest confidence in this, but I have to say mostly because a few of the details of the strategy are publicly known, so it is hard for me to say.

What role can diplomacy play in assuring the security of our space assets? I think diplomacy has a vital role to be played, but unfortunately it alone cannot solve our space issues.

The rivers of information and services that our space assets provide allow our decisionmakers and weapons both to be more effec-

tive than ever before, giving us vital advantages in our economy and our conventional and strategic nuclear strength.

The threats to our space assets come in many forms, some hostile and some not. I have often said that Murphy's Law and Mother Nature pose some of the biggest threats that we can face sometimes in a lot of areas. One of the biggest threats is what we just don't know about objects in space, the intentions of those who put them there, and the very strategic landscape of space itself.

Our overall goal in space, I believe, should be space stability. We have an overriding interest in maintaining the function of our space assets and to see that the huge benefits they provide are always there. But our space assets are exposed and fragile. They can't run, they can't hide, they can't defend themselves, and we depend on them more so than any other country. And these assets face three major and growing threats.

One, with the proliferation of space and other technologies, especially anti-satellite capability demonstrated two years ago, China could exploit our space dependence to seriously threaten our space assets within a decade if it chose to do so.

Second, space traffic is heavier than it has ever been and getting more so, but there is no Federal Aviation Administration (FAA) for space.

And third, space debris poses a growing threat to all space assets, as the recent collision between the U.S. satellite and an old Russian Cosmos illustrates. At current rates of debris accumulation, the debris threat could grow 1,200 percent over the next 25 years. I am concerned that current space policy does not answer key stability issues.

In 2006, the new policy declared for the first time that U.S. space assets are a vital national interest. This policy reserves the right to deny adversaries the use of space capabilities hostile to U.S. national interests. But attacking other space capabilities invites attacks on our own vital national interests, we have said. This, to me, is contradictory. Why would we want to threaten actions that invite retaliation against our vital national interests where we have more at stake than our adversaries? But this contradiction is never explained.

It could make sense if our space doctrine seeks only to deter attacks, not initiate them, but our policy says not a word on this. There is inherent risk of strategic and crisis space instability in the next decade or so, it seems to me, if we are not careful.

I am one who believes that the United States can and should remain preeminent in space, but I believe we are currently incautious in our military space policy. The United States needs a space protection strategy that focuses on stability, deterrence, and a space architecture with backups in case we lose services.

Now, the difficult question about offensive space capabilities in space. If it is possible to establish a space regime where no one had offensive space capability, we should certainly do so. If we can maintain space deterrence by other than offensive means, we should certainly do so. We must think long and hard, I think, before deploying space offense. But if no alternative to it exists, then we should develop some offensive capability, but in a deterrence context.

The United States and China, and to some extent Russia as well, have already crossed the space Rubicon of sorts. Anti-satellite capabilities already developed cannot be uninvented, and missile defense with inherent anti-satellite capabilities is here to stay. U.S. space capabilities must be preserved and, while defensive steps can help, and we should distribute our space capabilities across many more platforms to reduce the vulnerability of any one, that may not be enough.

We must be careful, though, as we acquire offensive capabilities, not to create a self-fulfilling prophecy, stimulating the very threat that worries us most. Above all, we should escape the space policy and doctrinal vacuum I believe we are now in, where as result it seems that our space acquisition seems to shape our policy, rather than our policy shaping acquisition. We should seek a posture not of space dominance, but of space preeminence, which would assure that we remain the space leader with more advanced space capabilities than anyone. We would continue to derive more military and economic benefit from space than others, and we would leverage this preeminence in better weapons, better intelligence and, I would argue most of all, better military decision-making made possible by the superior space-enabled information and communications that we get.

I saw a while back that General Tom Moorman, the retired Air Force Vice Chief of Staff, said that in addition to planning and programs, it is important to encourage a debate on space power to include development of a space deterrent theory. We need something similar to the intellectual ferment that surrounded nuclear deterrence. I think General Moorman, unfortunately, confirms here that this kind of thinking is not happening today. So we are drifting into an increasingly unstable space environment.

Another major drawback of our policy is its rejection of space arms control. The past few years the United States was alone in the world in opposing space arms control issues. There was one vote in the United Nations where the vote was 162 to 1, and we were the 1. All of our North Atlantic Treaty Organization (NATO) allies were on the other side. This allowed Russia and China to credibly mischaracterize our stance as hostile.

Diplomacy and arms control alone cannot solve our space problems, but they can help. Our space arms control allergy should end. Review of space diplomacy and arms control should be an Administration priority. One option that deserves special attention is the ban on debris-producing space actions, especially kinetic energy anti-satellite tests.

In conclusion, we are entering a new era in space, but we don't seem to understand its strategic landscape, so we are stumbling into the future. Let us take steps now to reduce the risks that are coming right at us. Thank you.

Ms. TAUSCHER. Thank you, Mr. MacDonald.

[The prepared statement of Mr. MacDonald can be found in the Appendix on page 33.]

Ms. TAUSCHER. Mr. Krepon, the floor is yours.

STATEMENT OF MICHAEL KREPON, CO-FOUNDER, THE HENRY L. STIMSON CENTER

Mr. KREPON. Madam Chairman, thank you for convening us.

My quick answers to your three hard questions: I don't think we have a sound strategy now. There are some missing pieces, and I will talk about one of them.

I am not that well qualified to answer your second important question about an investment strategy, but General Armor is well qualified to answer that question, and the answers he has come up with make a whole lot of sense to me.

And the third question, the role of diplomacy, is the one I really want to focus on.

I should say I spent a fair amount of time in my youth in this room and learned a lot here, but you sure don't look like L. Mendel Rivers.

Ms. TAUSCHER. Thank you.

Mr. KREPON. Satellites are as vulnerable as they are invaluable, and are becoming more vulnerable and more invaluable all the time. So how do we gain confidence that these essential satellites will be available when needed?

No satellite has been damaged or destroyed in a crisis or in conflict yet. And so, if and when this happens, it is going to be a big event, and it is most likely not going to be an isolated event. Warfare in space is likely to be accompanied by warfare on the ground. The U.S. will still win if our space assets are damaged, but victory will be very costly, and there will be huge collateral damage to the people we are fighting.

So, put another way, everybody suffers if warfare in space occurs, including all major powers that have assets in space. And if there is uncontrolled escalation as a result of warfare in space, then the losses will be incalculable.

Many deterrent strategists—and, Mr. Turner, this goes to your question about deterrence—there are some really smart people who worked on deterrence and nuclear deterrence, and they came up with library shelves' worth of books on escalation control and escalation dominance and, fortunately, none of these theories were tested. But, at least to me, these plans were not very convincing.

And so, I ask you, how much trust can you and the members of this subcommittee place on plans for escalation control and escalation dominance in space when it is so easy to mess up space, or at least parts of it, and they happen to be the parts we care about the most?

So, shooting our way out of this dilemma of satellite vulnerability, it is a last option, and even then it may not be a wise option, in my view. But that means we still have to deter unwise decisions by other folks to start this game going. And so how do we best deter attacks on U.S. satellites? Our experience with nuclear deterrence isn't the best guide.

To signal deterrence—nuclear deterrence—we and the Soviets tested on the average of one nuclear weapon a week, from the Cuban missile crisis to the fall of the Berlin Wall, to signal deterrence. And to signal deterrence, we and they deployed large numbers of weapons and launches ready for use on short order. Now is this what we want for space? To deter somebody else in space?

Deterring warfare in space has taken very little effort so far. There have been several dozen anti-satellite tests during the whole history of the space age, just a handful of tests with destructive effect creating debris fields. Just a handful. Unfortunately, two of these tests have happened pretty recently. The Chinese test; a U.S. test, which was not a debris-causing event, but it was using a satellite for target practice; and we haven't heard from the Russians, and we may hear from the Russians.

So a small number of dedicated anti-satellite weapons have been deployed in the past during the Cold War, but they were mothballed. They weren't very operationally useful. And our military, and even the Soviet military, didn't put too much stock in these weapons.

In my view, one reason why superpower competition didn't extend very far with dedicated anti-satellite weapons and ASAT tests is because they were not needed. We, and they, had so many different ways to mess up satellites using capability that was designed for other purposes. That is still the case. We don't need to use satellites for target practice to convince other folks that we have the means today to affect their satellites if they mess with ours.

I think another reason why we and the Soviets didn't go so far down this path was because these satellites then, as now, are connected to nuclear forces. And do you really want to open that Pandora's box?

So I actually have some confidence that, looking forward, we can again avoid the use of weapons against satellites during crisis or in wartime, which would vastly be to our advantage. I think we can do this.

I don't think we need to carry out more ASAT tests to reinforce a deterrence message. But we are missing a diplomatic piece, because remember, during the Cold War, deterrence, which was a clenched fist, also needed reassurance, which was what we then called arms control. And deterrence without reassurance makes people very uneasy. And not just abroad, but also at home.

So how do we fit these two pieces together? Our primary enemy up there is debris. Debris does not recognize U.S. preeminence in space. It doesn't. Debris is our enemy. Debris is also the enemy of other major space-faring nations. This problem we just had with the International Space Station, with three spacefarers scrambling into an escape module, we are going to see this again. It is going to happen.

We have actually lost a shuttle because of debris, a different kind of debris, the debris from the foam on an external fuel tank which punctured the Columbia, which we found out about on reentry. But that is a different kind of a problem, but debris is going to threaten manned space operations to a much greater extent, and our satellites that are essential for our warfighters.

So, two ideas for you to consider about debris. One is a very narrow-banded treaty that would be a verifiable treaty that bans destructive methods against man-made space objects. Nothing in this world is totally verifiable, but a ban against destructive methods which create debris fields is something we can see. And since the more debris that is up there, the more disadvantaged we become,

but also the more disadvantaged everybody becomes who relies on satellites. This one could have traction. It could have traction. I would ask to you consider this.

The second possibility for you to consider is a code of conduct that would have one of its provisions pledges against harmful interference against space objects—space objects, the satellites themselves. A code of conduct like the Incidents at Sea Agreement that our Navy follows, or the Dangerous Military Practices Agreement that our Army and our Air Force follows, they are rules of the road. You know, the rules in peacetime are different from the rules in wartime; but even in war, there are some rules that are in our advantage to follow.

And I would urge you to think long and hard about the diplomatic piece that deals with this debris problem, which is a clear and present danger to our preeminence in space.

Thank you, Madam Chairman.

Ms. TAUSCHER. Thank you, Mr. Krepon.

[The prepared statement of Mr. Krepon can be found in the Appendix on page 45.]

Ms. TAUSCHER. General Armor, the floor is yours.

STATEMENT OF MAJ. GEN. JAMES ARMOR, USAF (RET.), OWNER AND CEO, THE ARMOR GROUP, LLC

General ARMOR. Madam Chairwoman, Ranking Member Turner, members of the subcommittee, I am very pleased to be here today to testify on the vital issue of space and U.S. security. I am also happy to be at the table with two very thoughtful and far more experienced and well-spoken policy professionals, Mr. Bruce MacDonald, with whom I had the privilege of working on the subject report, and Mr. Krepon, who I have had some edifying discussions both here and abroad on space treaties and rules of the road.

Today, I am speaking purely in a private capacity. My comments do not represent the views of the United States Air Force, with which I proudly served for 34 years, or any of my current professional affiliations.

I understand today's hearing is about space security, but I want to take a step back and put a broader context on the state of the United States space program and motivate why today's hearing is so important.

As my fellow witnesses have pointed out, the U.S. is exquisitely dependent on space. But it is not just for warfighting and intelligence, it is for economic well-being, our technological vitality, and our international standing and leadership. This bears repeating often because, while the U.S. currently leads the world in space, there are numerous problems other than simple security threats that jeopardize our continued leadership.

We face near-term mission gaps in our important space capabilities, both military and civil. Our space industry and workforce is losing its competitive edge. Our engagement and influence in international space activities has declined, and there is widespread program overreach.

In many respects, I think all of the Nation's space sectors are in worse condition today than they were a decade or more ago. To a point, as our security and well-being has grown more reliant on

space capabilities, they have become increasingly vulnerable to breakdown and disruption, as well as to attack. It is with this sense of urgency that I now return to today's timely discussion about space security.

You have my written testimony, so let me just summarize the main points, briefly addressing each of the three broad issues that you stated in your invitation.

While I think I am more in agreement with Mr. MacDonald than it will on the surface appear, do we have the right national policy to assure security of our space assets? I think the answer is fundamentally yes, we do. Since the beginning of the space age, each President has issued a national space policy, and each policy has been remarkably consistent in its broad goals. The space policy issued in October 2006 gave me, as a military and intelligence space professional, the policy guidance I needed, and it was totally consistent with policies from earlier Administrations.

However, I must acknowledge that the rest of the world clearly thought its language quite provocative, and it became a major distraction to any positive discussions on any of a number of space issues that I engaged in. I, therefore, think we might generally benefit from a change in tone in the written policy, and I fully expect the Obama Administration, typical of every new Administration, to do just that. But I don't think the fundamental policy objectives will or need to change.

The real problem is not the policy, it is the lack of means to implement the policy. We are missing a national space strategy to define the means and set the priorities among those policy objectives, and we are missing a governance structure for implementation and oversight of that policy.

During last year's campaign, President Obama discussed the need for a National Space Council, and I think that is an important decision. The Administration needs to establish an effective White House focal point and apparatus within the Executive Office of the President, such as the Space Council, to actively establish direction, set priorities, provide management oversight, and coordinate actions across the agencies. Good policy is not self-actualizing. A national space strategy, and leadership and oversight mechanism are needed.

I must also add, Madam Chairwoman, that the Congress shares many of the same stovepipes in its committee structure across the space sectors and technical disciplines, and I might recommend that you seriously consider reviving a bipartisan, bicameral Congressional Space Caucus to promote cross-committee space discussions.

The second issue is, do we have the right investment strategy for protecting and defending critical space assets and capabilities? No, I don't believe we do. Up to now, we have designed and built our space capabilities assuming space is, essentially, a sanctuary. But in the last 15 years, space has become both a contested and a competitive domain with a blossoming number of space-faring entities and potential threats, both intentional, like China's ASAT, and unintentional, like spectral interference and debris.

My answer for needed investment boils down to three interrelated recommendations. Number one, Space Situational Aware-

ness. I think we are in great agreement there. Our current space surveillance network is not fully chartered or resourced to support civil, commercial and allied operations. The Space Situational Awareness system that the U.S. needs is one that is capable of prompt and unequivocal attribution of any space incident to a cause or agent, whether that be something bad or just bad space weather that day. This includes not only the orbital elements, but satellite operating status, space weather conditions, spectral interference, debris cognizance, and more.

Closely related to Space Situational Awareness is the need for foreign space intelligence. And I heard Mr. Turner bring this up. The U.S. gave us most of its space intelligence capability in the 1990s, and it requires significant reinvestment. I watched it fade, and it was a heartbreaking thing to see those professionals disappear over the decade.

The capability for situational awareness with attribution is the basis of any international discussions about the space environment, debris, space operating conventions, or rules of the road. It is also foundational to any space deterrent regime that we might discuss.

The second investment shortfall is our current satellite architectures. Every critical space system and support infrastructure, civil and military, needs to be recapitalized to ensure that it can operate in a contested domain, at least to the extent that it would be needed during a crisis. There is no silver bullet here. There is a number of good options, small satellites, mixed space and terrestrial systems. There is good protection technology in some cases and many others.

Each constellation needs to develop its own approach, but it needs to do so in the context of an integrated national space strategy, which we don't really have, and sound assessment of specific natural and man-made threats by space intelligence.

I may surprise you here, but the third vital investment need is for the commercial space segment. As a 34-year national security space professional, I am not really willing to compromise U.S. security but, as a student of history, I am convinced that a robust commercial space regime will enhance both global stability and U.S. security.

Mahan's famous theory of seapower was, fundamentally, not about battleships; it was about sea lines of commerce and maritime industry. Therefore, I recommend direct investment and space technology and other incentives toward growing a robust U.S. commercial space industry. I believe an essential part of this is to begin making progress toward a space traffic management system. Currently, however, there is no organization assigned responsibility for space traffic management.

The Air Force operates a space surveillance system. The FAA Commercial Transportation Office grants launch and reentry licenses, the Federal Communications Commission (FCC) grants orbital location and spectrum, and there are other organizations as well. So joint study by these agencies to develop an investment framework for a space traffic management system might be useful, and I would be happy to answer any more questions you might have on that.

Working toward a commercially secure space operating environment is an opportunity for U.S. global leadership that could address significant portions of space security, and it will let me segue back to the committee's third and final question, the role of diplomacy.

I think diplomacy plays an essential role in ensuring the security of our space assets and in global U.S. space leadership. The U.S. must be actively engaged in discussions at all levels if it expects to help set a productive agenda. But, as Mr. MacDonald pointed out, diplomacy and arms control cannot, by themselves, solve all of our space security problems. So I would recommend that U.S. space diplomacy have three features.

The first one is just set a good example and positive precedents in space. Now, note, this implies that the U.S. is actively conducting the full range of space activities. You can't really set a good example from the bench.

The second is to engage in wider discussions about space rules of the road, but be forthright about limiting expectations on unverifiable agreements that might unnecessarily restrain both space commerce or U.S. civil and national security freedom of action.

Finally, third, help establish a concrete foundation of technical standards and operating protocols that will encourage a safe, legal space operating regime. I believe the most productive near-term effort is being done by all the major space agencies in the multinational Consultative Committee for Space Data Systems, which is part of the International Standards Organization. A future space traffic management system can build on the technical confidence and the professional and civil agencies there, similar to what the International Civil Aviation Organization, ICAO, and the FAA do for air traffic management.

In summary, the space enterprise is critical to the Nation, and its security is essential. It is on a declining trajectory, I believe, that puts the U.S. leadership at risk and requires sustained strategic leadership, investment and diplomatic initiative by the Administration and Congress.

This concludes my remarks, and I look forward to your questions and discussion.

Ms. TAUSCHER. Thank you, General.

[The prepared statement of General Armor can be found in the Appendix on page 56.]

Ms. TAUSCHER. Mr. MacDonald, in your testimony you observe that the debate the over the United States' Offensive-space capabilities has often resulted in simplistic answers on both sides of the question. Can you give the subcommittee a couple of examples where you think offensive capabilities are appropriate and, alternatively, where they may be counterproductive?

Mr. MACDONALD. Let me maybe take the second one first, if I may.

Ms. TAUSCHER. Sure.

Mr. MACDONALD. My sense is that offensive capabilities are something that we should only do if there really isn't another approach to do it. The key goal, again, should be deterrence and stability in space.

I came to the conclusion and my recommendation about offensive capabilities somewhat reluctantly, I must admit. When I started my study, I was pretty much thinking that wasn't a good idea, but I saw the need that we had—that we had to deter. But there are some ways that we could do that that I think would be counterproductive.

To pick an extreme example, a nuclear burst up in the ionosphere or Lower Earth Orbit (LEO) would be a tremendously effective ASAT weapon, but it would have horribly self-destructive, collateral side effects. So that would be going to one extreme.

But areas where it might be, is if we had—and I listed in my report and, I think, in my full statement, at least seven conditions or requirements, and one very much would be that any effects should be temporary and reversible so that there is no physical damage—permanent physical damage, and that there is not a tremendous loss. Those satellites, as has been pointed out, can be extraordinarily expensive. But I think that if we need to respond to somebody else's first use, for example, I think that there could be merit, potential merit, in such capabilities.

But again, the idea is that the effect should be temporary, not permanent. I would leave it at that, but we could talk more if you would like.

Ms. TAUSCHER. Sure. Mr. Krepon, your testimony describes the national security benefits to the United States of establishing a space code of conduct. Could you expand on why you think it might be more appropriate to pursue the development of rules of the road rather than a formal arms control agreement banning destructive ASAT testing?

Mr. KREPON. Madam Chairman, I don't think the two are mutually exclusive. I think one could go into a forum being open to both possibilities.

The idea of an all-encompassing ban on weapons in space, to me, poses insuperable problems—problems of verification, problems of definition. But if I hone in on destructive effects against man-made objects in space, I may well need to invest, as General Armor has stated, in improving my ability to watch the heavens.

But when there is a debris cloud where there was once a singular orbital body, I think we can reasonably infer that that body has broken up, and we have to figure out the reasons for it. And there will be preceding actions to help us come to a logical conclusion about why that orb has become a mutating debris cloud.

So I would say let us be open to both, but a key element has to be debris. Whichever way you go, it has to be debris, which is why the notion of traffic management, collision avoidance is so essential at this moment in time. So the code of conduct piece that, I think, deserves a lot of attention is traffic management. If you will, we need an FAA-type body for space. Even if we hate the notion of a small international body dealing with this problem, the consequences of major debris events are so profound and so long-lasting that I hope we will be open-minded toward this.

Now, one last point, and then I will shut up. The Bush Administration placed a lot of emphasis on bottom-up approaches to come up with rules of the road. I think this was part of the allergy to diplomacy. And we did succeed with a bottom-up approach that

produced voluntary debris mitigation guidelines, and it was just—this deal was done just last year, was finalized, I think, in the United Nations (U.N.) General Assembly last year. It took 14 years to do that, 14 years to do that, during which the debris population doubled. That is the trackable debris population. The small stuff, which can also kill you, there is a lot more of it up there.

Ms. TAUSCHER. Let me ask if you there is an analogy to a homeowners' association. Since we apparently think we all own it, that there would be clear guidelines. You know, you have to mow your lawn, you have to clean up after yourself, you are responsible for this. There is a sense of transparency.

I think that there is an FAA piece here, because traffic obviously is a component of management. But what I hear you saying, I think, is that there is nothing mutually exclusive about codes of conduct and moving forward into some more formal agreements but, in the basics, you have to agree that you like the neighborhood, and you want to keep the neighborhood a certain way, very much like when you decide to buy in a neighborhood, you are meant to add value, not detract value.

Mr. KREPON. If there are no rules, there are no rule-breakers.

Ms. TAUSCHER. That is very good. General Armor, in your testimony you recommend determined Science and Technology (S&T) investment and other incentives toward growing a robust United States commercial space industry. In this context, can you talk about how the United States should balance its responsibilities to prevent the export of sensitive technologies and the need to develop a globally competitive United States space industry?

General ARMOR. Yes, ma'am, Madam Chairwoman. That is a very tough trade to make. We do need to be careful about technology transfer in general. We need to be precise in protecting critical technology proliferating to parties we especially don't want to have. But on the other hand, we need an open commerce, international commerce, because the world has gone global.

Right now some of the—I believe some of the trade restrictions have prevented our own industry from expanding like it should. Our second- and third-tier parts vendors are basically dying right now. And, in fact, there was a recent article about counterfeit parts, that the National Aeronautics and Space Administration (NASA) is having engineers look, because we were having to import more overseas parts instead of our own. I think that traces back to some of our own trade restrictions.

So, yes, we do need to be very careful and pick the regime on technology to protect, but industry moves very fast, and so I think we need a mechanism that keeps up with that technology and protects what needs to be protected.

Ms. TAUSCHER. Thank you.

I would like to turn to Mr. Turner, Ranking Member. The floor is yours.

Mr. TURNER. Thank you, Madam Chairman. Thank you again for your discussion. And one of the things that is really, really helpful is the concepts that we are dealing with in these policy discussions you so eloquently are able to describe. And I am going to ask you to embellish some of the discussion you have been having because

I think it is real important. And as we do a forum like this, it is good to get from you the descriptions of these elements.

When you are talking about a space weapons treaty versus rules of the road, many of you were discussing the issues of verification and definition. Could you embellish that for a moment so that people can get an understanding of what are some of the problems in verification and in definition? Because we know what the different areas that a satellite can be challenged with, and it would be great to hear your descriptions of those as we try to balance that issue of rules of the road versus space weapons treaty.

Mr. Krepon, starting with you.

Mr. KREPON. Yes. As Bruce has said, I can use a nuclear weapon to destroy satellites. In 1962, before a limited test ban treaty was completed by President Kennedy, we carried out a weapons test over one megaton that killed or destroyed every satellite that was in Low Earth Orbit. There weren't many, and they weren't all ours.

We learned a very important lesson from that. So we can use nuclear weapons to kill satellites. We can use ballistic missiles if they have enough legs. So a Medium-range Ballistic Missile, an ocean-spanning ballistic missile can be adapted for use against satellites. Defense interceptors can be used, adapted, against satellites. We demonstrated that last year. Lasers, jammers, there are a lots of things out there that have vital military uses that can all serve as anti-satellite weapons.

Do we ban them all? Do we prohibit them all? How do we verify if somebody is not hiding one in the basement?

So this all-encompassing treaty may not be such a good idea.

Mr. TURNER. And in that we are a country that clearly, in the area of verification, we are going to comply, so we always have to have a concern as to what our ability is to verify others' compliance. Let us continue down the way as you talk about the issue of a space weapons treaty versus rules of the road, verification, and definition.

Mr. MACDONALD. If I could, picking up on what Michael was saying, I think the key thing here, and it is a problem the previous Administration did an excellent job of identifying, and that is I think that bans on weapons can be problematic, unlike, for example, an Intercontinental Ballistic Missile (ICBM) or strategic bomber or a missile-firing submarine, which are very big, and there are ways that we can monitor those.

The kinds of things that could do—perform an anti-satellite test first very often are smaller to begin with, and then because they are multipurpose, it is easy to claim that we didn't build it as an anti-satellite weapon, we built it for some other reason. But as Michael alluded to, actions in space are a lot more visible.

I think a more productive approach to take is to seek to put constraints on harmful actions, not necessarily on weapons. To use maybe what is probably a bad analogy: under the right circumstances, guns are not illegal, but shooting somebody with a gun is. What is at issue is not the possession of the gun, but, rather, how it is used.

So in the same way I think that the most productive approach from an arms control perspective would be one that seeks to inhibit

or limit actions unless somehow there is something that is so big or prominent that you can address it.

Mr. TURNER. General.

General ARMOR. Well, as Mr. MacDonald knows, I have had difficulty looking at space in the sense of nuclear deterrence. To me, space is by far a more conventional domain, not a nuclear one. So I have trouble with the nuclear analogy right off the bat.

That said, defining an ASAT is very difficult; therefore, you know, doing some sort of treaty for no ASATs, I think, is unverifiable and not a productive path.

If I can address one thing Mr. Krepon said, I do believe that it took a long time to get some of these earlier lower-level agreements, but that was because there was no compelling reason. Now with some of the collisions and other things that have happened in space, that has stepped up tremendously. And I do believe that some of the rules of the road discussion that he is proposing would also help accelerate some of the more technical discussions as well. So I am in favor of that.

I also agree with Mr. MacDonald that maybe treaties against harmful actions, not things, may be a more productive line of logic.

Mr. KREPON. Mr. Turner, because we have all of these other latent capabilities to punish others in space, it seems to me we have an insurance policy, and we are not going to let go of that insurance policy. If we focus in on destructive methods, actions that produce debris clouds, we have an insurance policy against noncompliance. We can respond in kind, but we don't have to respond in kind.

So I would urge you to be open to this narrow-banded approach, which is a verifiable treaty approach. The Administration may decide not to go there for whatever reason but, to me, it would be in the net interest of the United States to pursue this.

Mr. TURNER. Well, that takes me to the other area of your discussion, and the issue of deterrence, when you were discussing it. Yesterday, we had General Chilton, Commander of the U.S. Strat Command before us, and we were asking him, if someone attacks our satellite, what are the consequences? And you look at deterrents. There are two main components—there are other components, but two main components. And one is that there are consequences if someone should attack our satellite systems, and/or that there may be mechanisms whereby they might not be successful in attacking them. You can have defensive systems, or you can have just policies that indicate what the consequences would be.

I would be interested in your discussion, Mr. Krepon. You started with the concept of deterrence isn't that effective. If you could just discuss a little bit on the concept of how you see—what are we not doing besides just diplomacy that we ought to be doing as you look at our space assets in the area of deterrence?

Mr. KREPON. Just to be clear, I think deterrence is essential in space. We don't want people messing with our satellites, especially in crisis or when our troops are in harm's way. So deterrence is a key piece, and I am trying to argue that we have the means to deter, we have the means to punish. We can punish on the ground. We can punish in space. It is our choosing what works best for us.

So please don't misunderstand me. Deterrence is crucial.

How do we reinforce deterrence? General Armor has some excellent ideas. I don't know a single person in this field who is—maybe my knowledge is limited—but I don't know anybody who is arguing that we ought to invest hugely in a small number of wonderful satellites that can do everything. I don't think—nobody is arguing that case.

Mr. TURNER. What I am interested in, what are we missing? If there are things that you think we need to be doing that we are not doing that would be significant, I would appreciate your perspective there.

Mr. KREPON. The piece that is most missing, to my way of thinking, is better Space Situational Awareness. Who did what to whom? Who may collide with whoever else? And the diplomacy piece.

Mr. MACDONALD. To continue along that line, I agree. I think that deterrence, though, unfortunately from a doctrinal point of view, deterrence is missing. One thing when I was writing my report for the Council on Foreign Relations, I was searching. There has to be something in here about deterrence; I guess I am not looking in the right places. And I finally found an article that was written by one former Bush Administration person who was literally on the way out the door, retiring, worked as a Deputy Under Secretary of Defense. And I went to him and I said, where is this better developed? And he said, you are it. I practically fell on the floor. I could not believe it.

I am not trying to tout myself, but he said on the inside, he didn't see any discussion of how deterrence works in space, how we would want to operate. If you take a look at space war games—I have heard that it is beginning to change a little bit—but if you ever take part in a war game, it is kind of a classic thing. There is always a phase of it that there is the crisis buildup, but everybody just wants to get through that to where the real action is, which is when the war starts. And I was saying, no, no, you want to focus on the crisis, because you want to try to avoid a conflict in space in the first place.

So I think one of the things we crucially need is more development of what our doctrine should be in space and how does it work. What are the dangerous areas? What are the areas where there are opportunities? Which, by the way, is not to short what my colleagues have said; I think space intelligence is crucially important. Space Situational Awareness, we need to know what is going on.

What does it say, for example, and Michael briefly alluded to it, the smallest objects we can reliably track are 10 centimeters in diameter, yet people know that objects 1 centimeter or more can be lethal to satellites, and there are 17,000 or so pieces that are 10 centimeters in diameter. There are hundreds of thousands that are one centimeter or more. So there are hundreds of thousands of lethal objects growing at a rate of 10 percent a year whizzing around there, and we don't know where they are. I mean, I am just flabbergasted by that.

There are technical approaches to deal with that, but—I know you hear this all the time—that takes resources, and somehow the requirement for that kind of Space Situational Awareness always seems to fall off the table, there are other priorities. And if we are experiencing one or two incidents a month now, imagine 25 years

from now when we will be experiencing two or three incidents or four incidents a week, or even almost daily. So we need to be more active in those areas as well.

General ARMOR. Yes, sir. One of the difficulties I have with talking about space deterrence is that none of our adversaries depend on space the same way we do. So I think Mr. Krepon was on the right track here about responding in kind. If they are attacked, responding in kind is probably going to be ineffective, so a deterrence regime would have to go beyond the space domain, I think, right off the bat.

Let me say that another reason for an offensive space capability might be the converse argument, that if there was a potential adversary that held advantage over us in some other area, that we might want to respond out of kind with a space offensive capability. I am not advocating that. I am just saying that is in the realm of discussion here.

As far as what we are not doing, I will go back and harp on the Space Situational Awareness and space intelligence again. I will foot-stomp on that. But the one I really want to get across, again, is that we are not organized to address the space domain. My beloved Air Force is focused on using space for military purpose. They are not really resourced or chartered to secure the space domain for all legal use. And it is sort of unfair at this point to hold them accountable for collisions or anything else because it is just not in their job jar.

I think we need a strong executive branch national strategy that says, hey, look, securing the space domain for all legal use is an important part of our policy objectives, and here is the organization that I am going to hold accountable for seeing that it is done, and here is a budget, and, you know, work with the State Department so that we can collaborate with all of our international partners and allies and other space-faring entities.

Mr. TURNER. Thank you, Madam Chairman.

Ms. TAUSCHER. Thank you, Mr. Turner.

I am happy to yield five minutes to the gentleman from New Mexico, Mr. Heinrich.

Mr. HEINRICH. Thank you, Madam Chair.

Mr. MacDonald—and forgive me, my voice is failing today—but given the successful anti-satellite test from China, the unpredictability of the debris problem—or maybe I should have the predictability of the problem that debris creates, what kind of satellite replacement capabilities do we currently have in place? And can you speak to the importance and need for rapid reaction satellites or other—I think you used the phrase "backups"?

Mr. MACDONALD. Yes. My understanding of the kind of capabilities we have today, Congressman, fall into two categories. One is the backups on the ground, and the other is backups already orbiting in space. And I think that those are wise steps to take.

There is an initiative called Operationally Responsive Space (ORS), which is another way to get things up quickly that might be damaged. The only drawback, everyone acknowledges, to Operationally Responsive Space is that satellites are expensive, of course, even the smaller, leaner ones, so it is not cheap to have a few spares hanging around in your warehouse. But nonetheless,

when you think about how much value they deliver, steps like that are very good.

I am worried about the—again, the growth of debris and other things that could pose a real threat to these. Another thing we need as well, is when a satellite is either injured or disabled, we need some mechanism or way that we learn that it is disabled or injured, some kind of self-awareness capability, if you will, on the satellite that can transmit back to Earth so that we know what is going on up there. Once again, we don't have that.

And I take onboard what General Armor says about it is not in the Air Force's job jar. The problem is that it is not in anybody's job jar. God bless the Air Force, they have done a remarkable job just in letting people know what is out there that is 10 centimeters in diameter. The whole world can access this information on the World Wide Web. They not only can access it, they do access it, and operators overseas very much depend on it.

So I think there are a number of steps that we can take, and we are taking, but I am not convinced so far that we have as much as we need.

Mr. HEINRICH. Thank you.

General Armor, do you have any thoughts on the role of Operationally Responsive Space in sort of creating a resiliency in our entire system?

General ARMOR. Yes, sir. I do believe that a responsive or smallsats are a part of the answer, but they are not a silver bullet. I mean, they are one part of making all of our constellations a little more robust so that there is a deterrent effect. You are not going to take it out with a single shot.

Keep in mind that most of these smaller satellites are far less capable than the ones that they might replace. If you put these on orbit and had two or three or four flying, you make the targeting a lot harder and the payoff smaller if anybody attacks them. There are a number of trades that you can do here, and Operationally Responsive is one.

Mr. HEINRICH. Mr. MacDonald, I think you said earlier that there are some technical approaches to dealing with the—or potential approaches to dealing with the debris issue, and I don't want to mischaracterize what you said. But in addition to the need for a ban on behaviors that worsen the debris problem, are there—and what are they if there are—the technical approaches that might address moving the ever-growing problem with debris in the other direction?

Mr. MACDONALD. Well, this is a case where an ounce of prevention is worth a ton of cure, because it is very expensive to get a vacuum cleaner up in space. I was just over at the Defense Advanced Research Projects Agency (DARPA) a few weeks ago, and I was talking about concepts, and we were kicking a few back and forth, but we all agreed this would be very expensive.

And so the whole emphasis—and here I will give the Bush Administration good marks—I think they were seized with the importance of the issue of debris. But we absolutely need to continue it.

So most of the technical means I am thinking of really involve prevention as opposed to—I mean, I could talk about possible cleanup options, but it will be a long time before that becomes

practical. And there are guidelines that we have worked out with other countries on how to minimize this.

I was speaking—in fact, there was a wonderful event here about a year ago here in this building, I believe, and the chairman of the international group that coordinated space debris was there. And I asked him, I said—and the Chinese have been, to their credit, very active participants in this—and I asked him, how did the Chinese react after their space test? And he said, "oh, they were very embarrassed." They were not, needless to say, informed about this, and, in fact, so much so that the Chinese basically—the next meeting was supposed to be in Beijing, and they suddenly became ill and deferred it for three months.

So the Chinese can be good participants, but this was a case within China where the People's Liberation Army (PLA) was not talking to the others in the civilian side.

Mr. HEINRICH. You might say it is hard to use a vacuum in a vacuum.

But to that point that you brought up about the Chinese, are we going to see—was that a case where the PLA just didn't think about the ramifications that that debris field might have on their own infrastructure?

Mr. MACDONALD. Well, I have heard some stories. I have had some interactions with the Chinese, and the story that I have heard that I put the most credibility by is that the scientists and engineers in the PLA who have been working on this have been working on it for a long time, and like scientists and engineers anywhere, they wanted to do the test to see if it worked, you know, one, because scientists and engineers like to do that; and secondly, they wanted to be able to justify all the money that they have been spending in this area.

And they knew they had to tell—according to the story—they had to tell the Foreign Ministry, so they did what any good bureaucrat would do—and remember, the Chinese invented bureaucracy 4,000 years ago, so they are really good at it—and that is, I am told that they informed the Foreign Ministry in advance about this, but they informed in such a technical, obscure way that nobody at the Foreign Ministry understood what they were being told. This allowed the PLA people to say, did you inform the Foreign Ministry? And they checked the box that said "yes," but, in fact, nobody understood the significance of this.

But I am told that, in fact, China was really shocked by the very strong worldwide reaction, and I think that kind of worldwide reaction had a beneficial effect. I don't think the PLA, in general, is as open to the rest of the world as other parts of the Chinese government are. So I think that—I hope that they have learned a good lesson, but we will have to see how that plays out in the future.

Mr. HEINRICH. Madam Chair, I yield back the balance of my time.

Ms. TAUSCHER. Thank you, Mr. Heinrich.

I yield five minutes to the gentleman from Texas, Mr. Thornberry.

Mr. THORNBERRY. Thank you, Madam Chair.

I appreciate the work that each of you has done to put more intellectual vigor and effort into space strategy and space policy.

I am struck by Mr. MacDonald's comment that our strategy comes from our acquisition; basically we buy what we can and then figure out a strategy on how to use it, rather than getting the strategy first and having our acquisition come from there.

So, General, I want to kind of get to a little more practical, I guess, because this committee, as well as the Intelligence Committee, at least has had a very difficult time with space acquisition and mounting costs and delays. And certainly the country's strategy comes, in part, from our inability to have a successful acquisition strategy.

I know you talked about smallsats in previous answers, but give us some more assistance about how our government, our country, can do better on the acquisition side if we are going to have a strategy we still have got to implement.

General ARMOR. Yes, sir. There have been some recent acquisition studies, and I don't recall who they were, I think Tom Young did one, and I think there was another one—I am sorry, I am at a loss to recall—that really covered those answers very well. And I am sorry, I didn't really come prepared to talk about that today.

But from my view on the inside over the last 15 years, watching the professional acquisition corps and the scientific technical engineering and math-skilled people in the service and acquisition corps disappear in the 1990s, to me it was an inevitable result that we would have these kind of problems with our complex system acquisition not just in space, but across the board. And I think, sir, I will stop there.

Ms. TAUSCHER. Mr. Thornberry, if you will yield, I think this is an excellent—as usual you come up with some of the best questions—I think this is an excellent question. I think what we would try to do is empower our staff to, at a minimum, if not a hearing, come up with a briefing where we could start to tease away some of this issue. I think you are right. We have been troubled for a long time trying to get the horse before the cart, and why don't we try to work with you on that. I think this is a very good level of interest on your part, and I know we all are interested in that.

Mr. THORNBERRY. I appreciate it, Madam Chair.

It does occur. As we were talking about strategy and space policy and what is possible with diplomacy and so forth, none of that is going to matter unless we can buy stuff on a reasonable time frame, and it is going to do what we want it to do. And we have enormous difficulties there, so I appreciate it.

Mr. MacDonald, a while ago General Armor said, and I will paraphrase, we can't get into a tit-for-tat on "your satellite versus our satellite" because we are so much more dependent upon space than anybody else. Do you agree with that? And how does that help inform us on what deterrence means when we put it in—when it includes at least—not limited to, but includes a space context?

Mr. MACDONALD. Well, it is a very important point that General Armor makes and that you have repeated. I address this a little bit in the Council on Foreign Relations report. While it is true today that we depend far more on our space assets than other countries, China is generally considered to be moving up fast, and if this were a classified hearing, I could say a little more. But let me leave it to say there will come a time when China is going to

be dependent on its space assets as well, and there would be more of that dynamic.

But one thing about deterrence, and I will take onboard what Michael Krepon has said, that we should not, were any of our assets to be attacked, we should not feel constrained that the only way that we could respond would be relative to space. Sometimes, attacking U.S. space assets is called an "asymmetric attack" because it would have a disproportionate effect on our force, but we should have our own asymmetric ways of attacking as well, of responding.

But I think the whole idea that when you are dealing with a country like China, fortunately, while China is not exactly our best friend, we are not bitter enemies either. And we are almost getting to the point of such mutual dependency where neither one—the only issue where we could see coming to blows would be over Taiwan, and we are hoping, of course, that that is not going to happen.

But I think the short answer is that we need not feel constrained to respond in ways related to space. But China is going to become a lot more dependent on space assets pretty soon, and that would provide a way of—offensive capabilities there would provide one way of deterring such attacks.

Mr. THORNBERRY. I would just say I hope we don't limit our space policy to what China does and being responsive to them. They are not the only folks out there in the world. And just for me, I would want to be careful.

Ms. TAUSCHER. Thank you, Mr. Thornberry.

I am happy to yield to the gentleman from Rhode Island, Mr. Langevin, for five minutes.

Mr. LANGEVIN. Thank you, Madam Chair.

Gentlemen, thank you. I appreciate your testimony here today.

My question first is for Mr. MacDonald, and if this has come up already, I apologize. I came from another hearing a little bit late. Recently, the Chinese have announced that they plan to further develop their space program by building a new space station in 2011. As with our early program, China's is run through their military, and news reports have noted that the purpose of the station would be for scientific and military research.

Do you think this is a move by China to increase their strategic military capabilities in space? And if so, what are the strategic implications for the U.S., our national security, and for the peaceful development of space? And as a follow-on to that, should the U.S. be moving more aggressively to bring China in as a partner in space exploration in an effort to dissuade them from focusing their efforts on military space technology, and what efforts could our Nation take to increase this cooperation?

Mr. MACDONALD. Thank you, Congressman. Two very good questions. Let me take the second one first.

I think we should be actively exploring ways to cooperate with China wherever possible. Eleven years ago we had the problem of technology being transferred improperly to China, which led to a very strong response that we have now had for 11 years. I have heard from a lot of people that say that our response was too strong, and that we ought to take another look at those restrictions that were placed on technology transfer and interaction with China, and let us hold to the ones that make sense, but either the

ones that are outdated or just don't work, we should consider dropping or modifying so that we can interact with them more. China is not our enemy on this. I think we ought to see ways that we could bring them in, if you will.

On the question of their proposed space station, we had seen this coming for some time. My take is that their space station itself would not pose an important strategic problem for the United States, but it would in the sense of what it signified that their capabilities would be and what they might be able to do, not with the space station itself, but with other systems they could develop.

There are all kinds of technologies that might be relevant to capabilities that would be somewhat worrisome. Proximity operations; i.e., what do you do when you are very close to something? We heard this from the Soviets back in the ASAT discussions we had with them back in the late 1970s when they accused our space shuttle of being a potential anti-satellite weapon. We had to go around the mulberry tree on that one.

The concern I would have is more the capabilities that such a space station would demonstrate that they have, rather than an intrinsic threat from the space station itself.

Mr. KREPON. Sir, if I may add, the Chinese presence in space, not just with the space station, but their manned missions, makes them more vulnerable to the debris problem. We have had to change out the windows on the space shuttle over 70 times because of very small debris hits, paint flecks that have left, thankfully, shallow craters on the windows of the space shuttle.

So for whatever reason, the Chinese carried out the most irresponsible anti-satellite test the world has ever seen, which will endanger their space operations as well as their satellites.

So I am of the view that it may be possible to carve out a zone of cooperation in this area, preventing debris-producing anti-satellite tests in the future.

Mr. LANGEVIN. This is maybe a good follow-on to my next question, Mr. Krepon. Unlike nuclear deterrence, space deterrence works on the principle of preventing the addition of weapons into space. With anti-satellite capabilities increasing worldwide, the U.S. clearly has the most to lose strategically and financially in the space arena, which is why I believe we have to ensure that space doesn't become a battlefield. And I believe that the solution lies in the whole-government approach to space security.

So can you provide us with some specific steps that the U.S. can take to ensure that not only our interests are preserved, but that access to space for peaceful research remains open for the U.S. and other nations?

Mr. KREPON. Well, the point Mr. Thornberry made, I think, is just foundational. If we can't get our act together to get the assets we need into space in a timely, cost-efficient manner, then we are just going to be scrambling. So that is just key.

But we need to have a better sense of what is going on up there, especially with this debris population. We are the best in the world, but we are still deficient. And you will be making some investment decisions that matter with respect to Space Situational Awareness.

And as I said, maybe before you came in, we have all sorts of ways to mess up satellites now. So that is part of the deterrence

piece. But what we have been missing over the last eight years has been a reinforcing diplomatic piece, and I am hopeful that we will add that to the complement.

Mr. LANGEVIN. I agree. Thank you.

Ms. TAUSCHER. Thank you, Mr. Langevin.

I am going to yield to the Ranking Member, Mr. Turner, and then I am going to go to Mr. Lamborn.

Mr. Turner.

Mr. TURNER. Thank you so much.

I wanted to put a footnote down here that I appreciated the comments of General Armor and Mr. MacDonald concerning the industrial base and our ability to support it both on export restrictions and its impact and in our acquisition policies. Yesterday General Chilton raised the same issue with us, with Rick Larsen raising it as an important issue, and, of course, Mr. Langevin raising it today. This is an issue that the committee is interested in, and Madam Chairman has indicated an interest in. So I appreciate that you mentioned it as we go through our issues of vulnerability, because it is one that is important.

Ms. TAUSCHER. Mr. Lamborn for five minutes, the gentleman from Colorado.

Mr. LAMBORN. General Armor, I would like to ask a question of you, but anyone else who wishes to comment is welcome to also. There are some commercial operators who provide things like optical imaging in the space architecture, and to some degree there are public and private partnerships going on, contracts where these optical images are being purchased. So with this growing commercial capability, I believe that there is less—that that is a way of sharing the risk and broadening out the risk, because private investors, at no cost to the taxpayer, are starting to put up satellites, and, even more so, that the military or Intelligence Community can directly use.

So what do you see that the future should be for sharing—for having these kind of partnerships in the future? And should that be part of our strategy to consciously and expressly rely, to some extent, on commercial operators?

General ARMOR. Yes, sir, Congressman Lamborn. I generally agree with what you are saying. And my earlier testimony, I am an advocate for constructing a strong commercial space business in the United States. The methods that you are talking about are definitely a good way to do that. I mean, even when the government deployed the Global Positioning System (GPS), they had really no idea of all the commercial applications that spun off of that, and now it is part of our infrastructure.

The imagery sharing, public-private financing, that is a way. I would find other incentives, whether it is tax breaks or whatever, to incentivize it even further. I know NASA is using the Commercial Off-the-Shelf (COTS) program to buy launch vehicles and other resupply. Yes, I believe that there is a broad spectrum of government-commercial practices and acquisition techniques that could help stimulate that.

And if I could go back a little bit to Madam Chairwoman's analogy, to the homeowner analogy, you know, maybe part of the licensing process for the growing commercial business is that they

take care of their own orbits, just like you have to clean your own sidewalks and make your neighborhood look nice, so that they would be held accountable, either by insurance or some commercial mechanism, or they would be penalized or fined if they mess up their orbital regime that has been assigned to them by the FCC or other government traffic management authority.

I digressed a little bit there, but I think I answered your question, sir.

Mr. LAMBORN. Thank you.

Either of you other two gentlemen?

Mr. MACDONALD. If I could just add to that a little bit, and I don't want to beat the homeowner analogy to death, but if you take one step up from that, I think if you were a small businessman, and you wanted to locate the town, you would want to make sure that it had appropriate police and fire protection, and sewage and water, and that sort of thing.

In the same way, I think that the potential for the private sector in space is really exciting and, as General Armor said, it is amazing how the private sector has figured a way to leverage off the GPS satellites. But I think private operators would count on the fact that there is some basic infrastructure support, like the Space Situational Awareness, that they could inform private operators where the debris is, what to watch out for, and that there is kind of a kind of traffic cop role, the traffic management, so that they don't end up losing an investment, that kind of thing.

But I think that there is—and that is a way in which government can be very helpful is in providing that basic infrastructure support to allow the private sector to go full-speed ahead and take advantage of it.

Mr. KREPON. Our Armed Forces never have enough pictures, so I am totally in support of this.

Mr. LAMBORN. Are there any policies that you would advocate to make sure that this happens, or should we just continue as we are now where it is pretty informal?

General ARMOR. My understanding, and I am a year or so out of date, was that there already is policy that encourages the use of commercial systems. It has been a matter of, you know, implementing that policy. And I am back to my "we need a national strategy and a mechanism to implement it" argument. So——

Mr. LAMBORN. Thank you.

Ms. TAUSCHER. Thank you, Mr. Lamborn.

I am happy to yield five minutes to the gentleman from Arizona, Mr. Franks.

Mr. FRANKS. Thank you, Madam Chair.

May I go ahead and take this opportunity to congratulate you on the news that the Administration has tapped you for a very important position. I know that there is probably a lot of things to still do, and I don't even know what your own conclusions are, but it is certainly an honor for any Member to be tapped by a Presidential Administration for something as significant as that.

Ms. TAUSCHER. Thank you, Mr. Franks.

Mr. FRANKS. General Armor, following the Iridium satellite incidents, we were all impressed with the survivability of the Iridium constellation in terms of being able to function relatively uninter-

rupted, even with the loss of one of its members, as it were. I wonder, relating to our other defense satellites systems and constellations, do you think we have enough redundancy, or enough system redundancy, in some of those to accomplish the same thing, or is this something we should be focusing on significantly more?

General ARMOR. I don't think we have robust enough constellations, and we are looking at gaps in many of our capabilities coming up. I wouldn't necessarily, you know, say that all of them could take the same approach that Iridium does. It has sort of a unique 66-ball satellite constellation, whereas with an imagery system, for example, you can't do it that way yet. Maybe in the future there may be a technique for a large, dispersed matrix kind of imagery approach to doing business, but that technology isn't here today.

And some things are done at geostationary, where it is a different—you know, laws of physics in effect here. But the Iridium approach is effective, it is very robust, and you can have accidents, and it is commercially sound so they didn't upset too many customers, and they are happy with that.

Mr. FRANKS. General Armor, I guess everybody probably asked you this already, but what is your assessment of the root cause of the February 2000 Iridium incident? What do you believe happened, and do you think it was preventable?

General ARMOR. I guess, technically, it was preventable if we had assigned the resources and the intellectual capacity to do that. There is a law of large numbers in effect here. There is a lot of stuff out there, and statistics is going to get you at some point. Again, had we focused attention that particular conjunction, yeah, maybe we could have maneuvered that particular Iridium satellite. But it really was an outside event. I mean, it was a law-of-large-number event here.

Mr. FRANKS. Mr. MacDonald, did you have a thought?

Mr. MACDONALD. Yes. One dimension of that is the Air Force does a wonderful job, as I said earlier, in putting information out about these 17,000 different orbiting objects, but it is not their job responsibility, and it would cost them a lot more money if they were to go through the complex calculations to try to figure out possibilities for collisions.

Right now the policy—and I am not faulting the Air Force at all on this—is here is the information, but if you have a problem, you have got to figure it out. One possible service we could do would be to provide the kind of capability that would allow this—and the technical term for is it is "conjunction analysis"—sounds like a grammatical term, but it is not—basically where you would analyze to see where collisions might happen. But right now the Air Force isn't given the resources and doesn't do that kind of thing. And the Iridium people, for whatever reason, didn't figure it out, and so we unfortunately had this accident. But we did have the backup capability.

And I wanted, too, just if I could, to take this chance to point out something that this committee did 16 years ago when, over the objections of the Air Force, it funded the Defense Support Program (DSP) 23, the last missile launch detection satellite, and said, no—Space-Based Infrared System (SBIRS), the new system, is coming online, but it may not come on as fast as we think. Guess what?

It has not come on as fast as we thought, and so that DSP 23 satellite, it ought to have "Courtesy of the House Armed Services Committee" on the decal on the side of it. And it was very thoughtful and a lot of foresight on the part of this committee to ensure that we have the backup for that absolutely crucial capability that our Nation depends on.

Mr. FRANKS. Thank you.

Mr. Krepon, I was impressed with your emphasis on the space junk, and I am wondering now—this is not one of my official questions—but when you are going to invent some type of a satellite that will come along in parallel orbit and pick this stuff up and load it and bring it back to Earth?

Mr. KREPON. This stuff is traveling at 10 times the speed of a rifle bullet.

Mr. FRANKS. I know it is. I am talking about a parallel orbit, just got to come alongside it.

Mr. KREPON. Right now we have one proven method, and that is the atmosphere.

Mr. FRANKS. We are looking for you to invent something.

Mr. KREPON. Just let me tag on to your last question, Mr. Franks, because this may be a problem of the law of large numbers. But with every collision, the numbers grow big time. And I am not technically qualified here, but I have read people who are technically qualified who are warning us that we can expect a collision every couple of years now. So this is a serious problem.

Mr. FRANKS. Thank you, Madam Chair.

Mr. MACDONALD. Just to build on that, the estimates I have seen is that the space debris is growing at about 10 percent a year. And if you just do the math on that, that is why I mentioned in my statement that 25 years from now the debris problem will be 1,200 percent greater than it is right now. And Michael is exactly right, the problem will be far worse. Some are worried that you could set up a slow chain reaction where, because a collision creates more debris, and you could get into a chain reaction situation if you are not careful.

Mr. FRANKS. So an arithmetic addition of objects means a geometric increase in collisions, for example. Scary situation.

Thank you, Madam Chair.

Ms. TAUSCHER. Thank you, Mr. Franks.

Gentlemen, let me thank you on behalf of the committee and the people that we represent, the American people, for your individual and collective service to this country, and especially your presence at the committee today. It is invaluable to us to have your expertise and your significant pedigrees.

You always respond, and we can't thank you enough for what you do for the American people. It is very, very important work. Space, it is a big place cosmically and physically, and obviously we have some very, very important issues to work on to make sure that we get this right. You have aided us significantly today, and on behalf of my subcommittee, I want to thank you very much.

And the subcommittee stands adjourned.

[Whereupon, at 2:35 p.m., the subcommittee was adjourned.]

A P P E N D I X

March 18, 2009

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MARCH 18, 2009

Testimony of Bruce W. MacDonald

Before the Strategic Forces Subcommittee
House Armed Services Committee
March 18, 2009

Madame Chairman, Ranking Member Turner, and members of the Subcommittee, I am privileged to testify here today on the vital issue of space and U.S. security. I am speaking purely in a private capacity, and my comments do not necessarily represent the views of the Congressional Commission on the Strategic Posture of the United States, the U.S. Institute of Peace, or the Council on Foreign Relations.

This subcommittee has posed three excellent questions for this hearing:

1. Do we have the right national policy to ensure the security of our space assets, particularly those supporting the warfighter and national intelligence collection? My short answer is that at best our policy is deficient in doctrine and strategy and needs serious and timely attention if we are to avoid major problems.
2. Do we have the right investment strategy for protecting and defending critical space assets and capabilities? Briefly, based on the public statements of the last few years, and the private credible complaints of insiders, I have at best only modest confidence in the adequacy of our current investment strategy for protecting our space assets. There is little unclassified information available on this issue, and therein lies a problem: how can Congress and others assess and provide responsible oversight and opinion in such an information vacuum?
3. What role can diplomacy play in ensuring the security of our space assets? I believe diplomacy has a vital supporting role to play, much more than we have exercised in the past, but it cannot by itself solve our space security problems.

I elaborate on these answers below, with the theme that there is much we should know and understand, but do not, about this new space-enabled military era we have recently entered.

Introduction and Overview

While America has been a space-faring nation for over 50 years, the essential and growing role that space plays as a foundational feature in our conventional military superiority, our strategic nuclear strength, and our civilian economy is too little understood. The rivers of information and other services our space assets provide allow our military decision-making and weapons to be far more effective than in the past, vital advantages across the spectrum of potential conflict. It is no wonder that current U.S. space policy for the first time calls our space assets "vital to our national interests."

Yet more serious than this lack of public understanding about space is the serious shortfall in understanding within the military space community of the larger implications of this space importance. The threats to our space assets, and hence to our vital national interests, come in many forms, some hostile, some not. One of the biggest threats we face is what we just don't

know: about objects in space, the intentions of those who put them there, and the very strategic landscape of space itself – how it operates, where it poses strategic dangers, and what we need to look out for. And this is dangerous.

The Strategic Problem

Our overall goal should be to shape the space domain to the advantage of the United States, and to do so in ways that are stabilizing and enhance U.S. security. The U.S. has an overriding interest in maintaining the safety, survival, and function of its space assets so that the profound military, civilian, and commercial benefits they enable can continue to be available to the United States and its allies.

These vital space assets face three forms of threats, all of them worrisome and growing:

1) With the proliferation of space and other technologies, and specifically with the anti-satellite (ASAT) capability China demonstrated two years ago, there is a risk that China or another adversary could exploit this fast-growing U.S. dependence on space in a war to greatly weaken U.S. military and economic power. China could do so and thus pose a serious threat to U.S. space assets within a decade if it chose to do so. China is also pursuing other programs that have important ASAT implications, and other nations are interested in ASAT as well. The 2008 U.S. shoot-down of an errant satellite demonstrated the ASAT capability inherent to missile defense systems, ours and others. Last week Russia indicated renewed interest in ASAT weapons when their deputy defense minister, General Valentin Popovkin, stated that Russia is working on ASAT.

2) Space "traffic" is heavier than it has ever been and getting worse, both in terms of physical vehicles and communications. Yet there is no "FAA for space" and even just the monitoring, much less the management, of space objects is widely seen as far less than needed. There is a great need for space traffic management capabilities, including enforceable rules of the road, codes of conduct, and space situational awareness that would inform a "space FAA" management capability.

3) Space debris poses an insidious and growing threat to all space assets. Debris in space does not quickly fall to the ground, as on earth; at all but the lowest orbits, debris can stay aloft for centuries and more. In addition to the 17,000 orbiting objects the Air Force can track, there are hundreds of thousands of potentially lethal objects in orbit, and millions of smaller objects that pose at least some risk. The recent collision between a U.S. Iridium satellite and an old Russian Cosmos dramatically illustrated the problem.

Our space assets are exposed and fragile. They can't run, they can't hide, and today they can't defend themselves. One small object traveling at orbital speeds can destroy them. Unless we take proactive measures, all these threats will grow, and we must bear in mind that the U.S. depends more on space than our potential adversaries. If we are not careful, the way we are currently thinking, planning, and investing, our space capabilities may only be available in peacetime, or against non-peer adversaries. We could lose them just when we need them most. At a minimum, we need far greater space situational awareness and space intelligence (SSA/SI) capabilities than today. Responsible officials have been saying this for years, but SSA/SI has never received the priority it deserves. If this fails to change, we can

expect more frequent space collisions and growing instability in space.

I will focus on the hostile threat dimensions of our overall military space challenges, though orbital debris and space traffic management also deserve priority attention.

Current U.S. Space Policy Raises but Does Not Answer Key Space Stability Issues

In 2006, the Bush Administration issued a revised space policy that declared for the first time that U.S. space assets are a "vital national interest," in recognition of the extraordinary and growing U.S. military and economic dependence on them. The phrase "vital national interest" carries much heavier national security implications than has ever been attributed to space. This policy also reserves the right to deny adversaries "the use of space capabilities hostile to U.S. national interests." But attacking others' space capabilities invites attacks on our own, which our policy calls a "vital national interest," and on which we depend far more than anyone else. Evolving technology guarantees both that: 1) we will depend even more on these assets in the future; and 2) these vital assets will likely face greater threats than today.

This dimension of U.S. space policy is contradictory: why would we want to threaten actions that would invite retaliation against "vital national interests," and where we have more at stake than our adversaries? This contradiction was never explained. Such a policy contradiction could make sense if:

- the governing U.S. space force doctrine is deterrence -- that we would have offensive capability strictly to deter attacks on our assets, and we would not initiate them – but there is no indication that this is the case; or
- the U.S. could maintain space dominance, which the policy tacitly implies, but such a posture would not be sustainable; or
- such attacks were limited and localized, i.e., tactical, not strategic, though there would be serious risks of escalation.

There is an inherent risk of strategic instability when relatively modest defense efforts create disproportionate danger to an adversary, as with space offense. And there is a serious risk of crisis instability in space when "going first" pays off – destroying an adversary's satellites before he destroys yours. We don't know what would happen in a crisis, but the potential for space instability seems high and likely to grow. But our policy is silent on this.

I believe the United States can and should remain pre-eminent in space, but that we are currently being incautious in some dimensions of our military space policy due to the absence of both a clearly thought-out space doctrine and a coherent national security space strategy. Many issues are begging to be addressed, including:

- How does deterrence function in space? Could limited counterspace attacks remain limited, or would they inevitably escalate into all-out space conflict?
- How can countries with less to lose in space than we be deterred? Are there asymmetric means available to us for deterrence?
- Is space deterrence possible without offensive space capabilities? If so, how? If not, what kinds of capabilities are most stabilizing?

- What U.S. space strategy, and resulting acquisition strategy, in that order, would promote U.S. security interests and reduce space instability over the longer term?
- How do China, Russia and others see space stability? How will this shape China's space doctrine, acquisition, strategies, and diplomacy?

We don't know the answers to these questions, and we are doing far too little to answer them. The United States needs a stabilizing space protection strategy that would:

- Focus on stability, deterrence, escalation control and transparency
- Incentivize nations to avoid destabilizing, irreversible actions in space
- Provide a U.S. military space architecture with "defense in depth" and terrestrial, airborne, and other backups to assure availability of key space services in the event fo space outages from whatever causes, benign or hostile
- Reduce adversary incentives and ability to target U.S. space capabilities
- Maintain "strategic ambiguity" over our responses to adversary actions
- Encourage agreements that constrain the most destabilizing dimensions of space competition and provide ground rules for normal space operations; and
- Expand dialogue among U.S., China, and others to promote better understanding and reduce chances for misunderstanding and miscalculation, always dangerous in a crisis

Creating a stable space domain requires the United States to respond to space threats in a responsible manner, one that ideally does not provoke other nations to greater counter space efforts than they would otherwise pursue. The United States must be careful to avoid creating a self-fulfilling prophecy and should refrain from activities and public communications (such as an Air Force advertisement describing space as a future battleground) that invite the buildup of other nations' counterspace capabilities. The United States should proceed cautiously with offensive counterspace initiatives. We must recognize that other nations depend less on space than we and, therefore, the destruction of their space capabilities is of lesser relative value to us as long as this is true.

China and Space Conflict

There is a sizable Chinese military (PLA) literature on space conflict, but it is unclear how well this reflects Chinese government thinking, any more than U.S. military journals reflect official U.S. policy. However, China's ASAT test and this literature demonstrate a PLA awareness of the importance of offensive counterspace (OCS) capabilities and suggest that such capabilities are part of China's larger plans for the future. It is also unclear whether this reflects PLA interest in OCS for warfighting or just for deterrence.

Should China choose to deploy its demonstrated ASAT system, or a more advanced versions of it, U.S. space assets and the military and economic infrastructures they support will be in jeopardy. Furthermore, China reportedly has other offensive space programs under development, including lasers, microwave- and cyber-weapons. We also face the twin realities that defending space assets is more difficult than attacking them; and while advancing technology will help both defense and offense, the offense is likely to benefit more. **One thing is certain – more clarity on PLA and Chinese government thinking on**

space deterrence, doctrine, space stability, and related issues – and Russian thinking, too -- are urgently needed and are important to U.S. security.

Should the U.S. Have Offensive Space Capabilities?

This is a question that lends itself to simplistic answers on both sides of the question. If it is possible to establish a space regime where no one had offensive space weapons, we should certainly do so. If we can maintain space deterrence by other than offensive means, we should certainly do so. We must think long and hard before we deploy a major offensive space capability. But if there are no feasible alternatives, then we should develop a limited offensive capability, in a deterrence context. Limited, tactical applications may also be possible but must be fully understood first.

The U.S. and China have already crossed a space Rubicon of sorts. ASAT capabilities already developed cannot be un-invented, and missile defense, with inherent ASAT capabilities, is here to stay. This is reality. U.S. security crucially depends on space and will do so even more in the future, and such capabilities must be preserved. Defensive steps can help, but ultimately it is difficult to protect space assets. We also can and should decentralize our space assets, putting our space eggs in more baskets to reduce our vulnerability, which would help, but likely not resolve, our problem. Arms control and other diplomatic steps certainly have a larger role to play and can help limit some of these threats. But verification issues make a comprehensive diplomatic-only solution seem improbable at present, which means the U.S. may need at least some offensive space capabilities, though we should tread carefully and thoughtfully into this new, highly uncertain world. We need to know where the pitfalls are, and not just develop space weapons now and worry about the implications later. The real question is what kind abd level of offensive capability might we need, and to what purpose? Any offensive space capability should have at least seven characteristics:

1. Effectiveness – they should be able to negate hostile space assets to differing levels.
2. Temporary and reversible effects – the space targets should not be permanently destroyed, only rendered ineffective during the conflict.
3. Survivability – the systems themselves should be largely invulnerable to attack, and thus stabilizing in a crisis, which would tend to favor ground-based systems.
4. Cost-effectiveness – it should be cheaper to add a unit of offense than for the adversary to defend against it.
5. Resilience – systems should be capable of performing in multiple scenarios.
6. Credibility – systems must appear credible to an adversary. A space nuclear burst would be a very effective ASAT, but it would be so damaging to U.S. space assets that it would have no credibility as a U.S. weapon.
7. Minimal collateral damage – systems should have little/no effect on other satellites.

We should not seek offensive counterspace capability at the expense of effective steps to protect U.S. space capabilities. We must be very careful, if we acquire offensive capabilities, to do so in a manner that other nations will find as unthreatening as possible. Otherwise, we could create a self-fulfilling prophecy: as nations like China or Russia see evidence of U.S. attempted space hegemony, they would accelerate their own efforts, just as we would if the roles were reversed. Above all, we want to avoid the space policy and doctrinal near-vacuum

we currently are in, where our space technology seems to shape our policy, rather than our policy shaping technical solutions.

Space Pre-Eminence, Not Dominance, Should Be the U.S. Obective

It would be unwise for the United States to seek space dominance. There are many ways to attack space assets, and it is easier and cheaper to attack than to defend them, which would likely frustrate any sustained attempt at dominance and leave us worse off than we are now. In trying to maintain dominance, we would be at the mercy of unpredictably advancing space technologies that could favor China or others as well as us. In the face of likely Chinese and other resistance to such a provocative posture, we would constantly be trying to stay ahead technologically to maintain this dominance, demanding large expenditures. It would also be very unstable, especially if China achieved a breakthrough that threatened our dominance.

Rather than dominance, a posture of space pre-eminence would seek to assure that the U.S. is the clear space leader, a non-hegemonic "best-in-class" posture with more advanced space capabilities than other countries. We would continue to derive substantially more military and economic benefit from space than others, and we would continue to leverage this space pre-eminence in our weapons, our enhanced intelligence, and the superior military decision-making enabled by superior space-supported information. An analogous posture between the U.S. and China already exists today in the strategic nuclear arena, where the U.S. is pre-eminent over China but China retains deterrent capabilities sufficient to its needs.

We Need a Better Understanding of Space Deterrence, Doctrine, and Stability

To date there has been almost no thoughtful discussion of what our national security space doctrine should be. Too often, space specialists have spoken about U.S. offensive space capabilities as if they were just one more weapon in the arsenal, to be used when military judgment deems best. In such discussions the word "deterrence" is rarely to be seen, and to my knowledge there is almost no work that has been done in this area.

Last year I was both heartened and disappointed to read an article on military space by General Tom Moorman, the retired Air Force Vice Chief of Staff, in which he stated:

> **"In addition to planning and programs, it is important to encourage a debate on space power to include development of a space deterrent theory. We need something similar to the intellectual ferment that surrounded nuclear deterrence."**
>
> General Tom Moorman, Retired VCS, USAF
> "Military Space – Its Origins and Future,"
> *Aerospace America*, March 2008, p. 29

General Moorman is right on the mark, further confirming the sad reality that this kind of thinking and planning has not taken place in the U.S. We must understand the new strategic landscape of space. How does deterrence in space work? What are its instability points? How do we "signal" the other side? What are tactical offensive counterspace's risks of escalating into strategic conflict? How do third-party space assets complicate the strategic

space challenge in crisis or conflict situations? There has been little U.S. thinking on this "vital national interest" area – and that is worrisome. This is reminiscent of the early nuclear era, before modern deterrence theory was developed, when too many thought of nuclear weapons as just a bigger bang in the U.S. arsenal. Our much greater dependence on space, and advancing space technology, has changed everything except our way of thinking, so we are drifting into an increasingly unstable space environment.

Diplomacy and Arms Control

One important drawback of current U.S. space policy is its explicit rejection of space arms control. The U.S. literally was alone in the UN and elsewhere on space arms control issues, which eroded our international leadership in this area with our allies and allowed Russia and China to credibly mischaracterize our stance as provocative and hostile. The Bush administration was interested in voluntary steps on code of conduct, rules of road, and especially space debris, which was commendable but needed more emphasis than it received. My colleague Michael Krepon has done fine work on the code of conduct issue over the years; I highly recommend it to this Subcommittee and believe it offers a good early opportunity for U.S. diplomatic leadership in space.

The space dependence of our military power suggests we could gain from diplomatic attempts to limit space threats, yet we have done little. The choice was never arms control vs. unilateral programmatic and other steps to protect our space assets: we need both approaches, and more. Recall that the Reagan Administration was quite successful in its dual track strategy of combining military programs with arms control, and there is no reason to think such a strategy would not continue to be a useful guide to policy today. While diplomacy and arms control cannot by themselves solve our space security problems, they can help mitigate our risks. Our space arms control allergy should end, and U.S. diplomacy should have a stronger role in the future. 1996 U.S. space policy set two requirements for space arms control agreements that remain relevant today:

- They should promote U.S. security interests, and
- They should be verifiable

Interagency review of space diplomacy and arms control should be a priority of the Obama Administration. One option deserving special attention is a ban on any space testing that creates significant debris, explicitly including kinetic energy ASAT (KE-ASAT) weapons. A logical extension of concerns over space debris, this option would seek to discourage the development of KE-ASAT weapons by banning testing against orbiting objects. Carefully crafted language need not constrain missile defense testing.

Clearly more review of space arms control options is needed, but there is ample room to move forward, with broad civilian and commercial backing, in the areas of space traffic management and space debris. Such steps would be an affirmative U.S. response to China's and Russia's largely unrealistic space arms control proposals at the UN and would position us to take the lead in shaping a more responsible space regime. Further, by making realistic space arms control proposals, the U.S. would remove one of China's arguments they have

used in the past to deflect action on a fissile materials cut-off treaty, which the U.S. has long supported but China opposes.

Observations and Conclusions

- We are entering a new era in space, and we do not understand the strategic landscape of space well at all. We can stumble into the future, or we can plan for it. Yet little thinking on the strategic landscape of space is underway.
- PLA writings make clear what China's diplomats don't: the PLA envisions conflict in space and is preparing for it. But PLA writings are not Chinese government policy.
- We can expect to see Russia playing a larger role in military space than in the past.
- Current U.S. space policy embodies a key contradiction: the reserved U.S. right to attack others in space conflicts with the stated belief that our space assets are a vital national interest. This only makes sense if:
  - U.S. could somehow successfully dominate space on a sustained basis; or
  - Right to attack others is anchored in a policy of deterrence, not war-fighting; or
  - Attacks are limited, tactical in nature (but can escalation be controlled?)
- A doctrine of space deterrence potentially offers the most benefit for U.S.
- The U.S. is unlikely to maintain the degree of space monopoly we have had to date. The issue is what kind of space regime we should seek that best serves U.S. security interests.

Recommendations

The United States needs to take important policy, programmatic, and diplomatic steps to protect and strengthen U.S. security interests in space, and accordingly should:

Policy

- Develop a space security strategy that emphasizes space stability and deterrence
- Develop/enunciate deterrence framework principles for U.S. counterspace policy and encourage public discussion of these issues
- Open up national space policy to allow/encourage negotiated agreements on the basis of U.S. national interest and verifiability
- Establish a Space Directorate within the National Security Council to address the many space security and other space issues that so strongly affect U.S. security

Programs

- Develop a layered suite of defensive capabilities commensurate with space's importance to U.S. military posture
- Enhance U.S. space situational awareness and space intelligence capabilities
- Develop if necessary selected capabilities in a deterrence context to negate adversary space capability that meet certain criteria in a deterrence context
- Diversify how we provide space information and services to reduce vulnerability
- Ensure our counterspace acquisition programs are driven by a coherent and sustainable space policy and doctrine – our programs should not drive policy

Diplomacy

- Consult with our allies to develop a united front on military space issues

- Build upon current U.S.-China military-to-military dialogue to see what can be accomplished in the space arena, and accord high foreign policy priority to this
- Give arms control an appropriate role in addressing space security
- Strengthen space dialogue on "rules of road" on a multilateral basis
- Seek a kinetic energy ASAT testing moratorium or ban
- Expand civil space cooperation with other space-faring nations

DISCLOSURE FORM FOR WITNESSES
CONCERNING FEDERAL CONTRACT AND GRANT INFORMATION

INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(4), of the Rules of the U.S. House of Representatives for the 111th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants) received during the current and two previous fiscal years either by the witness or by an entity represented by the witness. This form is intended to assist witnesses appearing before the House Armed Services Committee in complying with the House rule.

Witness name: Bruce W. MacDonald

Capacity in which appearing: (check one)

X Individual

___ Representative

If appearing in a representative capacity, name of the company, association or other entity being represented: _____

FISCAL YEAR 2009

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
n/a	n/a	n/a	n/a

FISCAL YEAR 2008

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
US Institute of Peace/Strategic Posture Review Commission	Dept. of Defense	10,000.00	U.S. Strategic Posture
USIP/Strategic Posture Review Commission	Dept. of Defense	217,550.00	U.S. Strategic Posture

OGA	OGA	5,000.00	space

FISCAL YEAR 2007

Federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
Strategic Analysis Inc.	NSF	5,415.00	International science and technology

Federal Contract Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) with the federal government, please provide the following information:

Number of contracts (including subcontracts) with the federal government:

Current fiscal year (2009): 1 ;
Fiscal year 2008: none ;
Fiscal year 2007: none .

Federal agencies with which federal contracts are held:

Current fiscal year (2009): DOD ;
Fiscal year 2008: ;
Fiscal year 2007: .

List of subjects of federal contract(s) (for example, ship construction, aircraft parts manufacturing, software design, force structure consultant, architecture & engineering services, etc.):

Current fiscal year (2009): U.S. Strategic Posture ;
Fiscal year 2008: ;
Fiscal year 2007: .

Aggregate dollar value of federal contracts held:

Current fiscal year (2009): 217,550.00 :

Fiscal year 2008:_____;
Fiscal year 2007:_____.

Federal Grant Information: If you or the entity you represent before the Committee on Armed Services has grants (including subgrants) with the federal government, please provide the following information: **n/a**

Number of grants (including subgrants) with the federal government:

Current fiscal year (2009): _____;
Fiscal year 2008: _____;
Fiscal year 2007:_____.

Federal agencies with which federal grants are held:

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

List of subjects of federal grants(s) (for example, materials research, sociological study, software design, etc.):

Current fiscal year (2009):_____;
Fiscal year 2008: _____;
Fiscal year 2007:_____.

Aggregate dollar value of federal grants held:

Current fiscal year (2009): _____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

TESTIMONY OF MICHAEL KREPON
CO-FOUNDER, THE HENRY L. STIMSON CENTER
BEFORE THE HOUSE COMMITTEE ON ARMED SERVICES
SUBCOMMITTE ON STRATEGIC FORCES

SPACE SECURITY
MARCH 18, 2009

Dear Madame Chair, and members of this Subcommittee,

Thank you for asking me to express my views about how to strengthen U.S. national security. You have asked me whether the United States has had the "right national policy to ensure the security of our space assets." I regret to say that, in my view, we have not had a sound strategy to assure the use of these vital national assets when needed. I do not feel qualified to answer your second question about a proper investment strategy to improve matters - except in the most general terms. I do propose to focus on your third question - on the role that diplomacy might play in improving U.S. space security.

It's clear that U.S. security requires assured access to space and the proper functioning of satellites that save lives, strengthen our economy, and support national security. Without the assured use of satellites, police, fire fighters, and first responders would be hampered; satellite phones would not work during emergencies; global financial transactions would be disrupted; and U.S. troops in harm's way would be less able to defend themselves.

Satellites are as vulnerable as they are invaluable. Nations that depend heavily upon satellites also have the means to damage them. No nation benefits more from space or has more to lose if space becomes a shooting gallery than the United States. What, then, is the most appropriate strategy to ensure that essential satellites will be available for use when needed?

Because of America's great dependency on satellites, some have advocated the testing of anti-satellite (ASAT) weapons and their use during crises or warfare. In this view, the United States needs to dominate space to deter the use of space weapons by potential foes and to win wars decisively on the ground. Advocates of this view believe in two underlying assumptions: that warfare in the heavens is inevitable and that the United States can succeed in dominating space with ASAT weapons.

The desire by some to the high ground of space" by testing and deploying weapons in space has outlasted the Cold War. But conditions have changed radically since the Soviet Union dissolved. Old-fashioned arms races have been

replaced by asymmetric warfare. Washington's space budgets will continue to dwarf those of Beijing and Moscow, but China and Russia do not have to be America's equal to nullify U.S. attempts to dominate space. Even a few ASAT weapons can do great damage to essential satellites, as was evident when China tested an ASAT weapon in January, 2007. This irresponsible test created a large, mutating debris field that will last for perhaps a century in low-earth orbit, placing human space flight and hundreds of satellites at risk - including those belonging to China.

Space debris poses a common threat to all space-faring nations. Space debris travels at ten times the speed of a rifle bullet in low-earth orbit. A piece of debris the size of a child's marble could strike a satellite with approximately the same energy as a one-ton safe dropped from a five-story building. The worst debris fields in space can be caused by actions that pulverize satellites - whether by ASAT tests or satellite collisions, such as the one that occurred last month. The three worst man-made debris fields in the history of the space age all occurred in the last two years. (In addition to the Chinese ASAT test and the U.S.-Russian satellite collision, the upper stage of a Russian Proton rocket broke up in 2007.)

The Reagan administration carried out a destructive ASAT test in 1985 that generated 300 pieces of trackable debris, one of which came within one mile of the newly launched International Space Station - fourteen years later. It took nineteen years for the last piece of debris from the 1985 ASAT test to burn up in the earth's atmosphere. China's 2007 ASAT test created the worst-ever man-made debris field in space, generating approximately 40,000 pieces of lethal debris, and an estimated two million debris fragments overall. Because the Chinese ASAT test was conducted at such a high altitude - half again as high as the 1985 U.S. test - its lethal debris field may remain in low-earth orbit for over a century. Even very small pieces of debris can be worrisome because they can't be tracked but can still penetrate the thin outer skin that protects satellites. The windows on the U.S. Space Shuttle have needed to be changed more than 70 times because of tiny debris hits. The United States now tracks more than 17,000 pieces of space debris.

Space dominance is extremely hard to achieve in a debris-strewn environment, and it is not difficult for weaker adversaries to create debris fields in space. The Bush administration's space policy refused to consider diplomatic initiatives that might limit the U.S. military's freedom of action in space - including any limitations on ASAT testing. Has U.S. space security improved as a result of this stance? The evidence strongly suggests otherwise: We have much less assurance today that our vital satellites will be available for use when needed than we did eight years ago. The continued testing or use of destructive ASAT weapons is likely to result in even worse space assurance.

An alternative approach to space security holds that the uniquely hostile and fragile nature of outer space makes cooperation not only possible but mandatory. This view rests on the assumptions that no major power will accept actions to achieve space dominance by another major power, and that a war in space between them cannot be won and must not be fought. Presidents Ronald Reagan and Mikhail Gorbachev reached exactly the same conclusion about nuclear warfare, and then reached path-breaking threat reduction agreements. Throughout the Cold War, the United States and the Soviet Union reached tacit agreements and signed treaties protective of satellites. This track record of restraint can be extended because satellites are more essential than ever before, and because major powers have less to fight about than in previous decades.

In my view, U.S. advantages in space and U.S. national security can best be advanced by seeking to stop destructive ASAT tests and, more broadly, by establishing stronger protections against acts of purposeful, harmful interference against satellites. The most clear-cut way to establish agreed protections of satellites is by means of a treaty - and the most verifiable treaty is one that bans the testing and use of destructive methods against man-made space objects. But treaties can entail lengthy and difficult negotiations. In addition, the consent of two-thirds of the United States Senate is required for treaty ratification. This will be a difficult hurdle unless the Pentagon reassesses the Bush administration's position that, on balance, the right to conduct additional destructive ASAT tests overrides the consequences of additional testing of this kind by others.

Another approach to increase space security would be for the United States to join with our European allies and other countries with significant space capabilities to negotiate a Code of Conduct affirming norms for responsible space-faring nations. "Rules of the road" exist for ships, planes, and many military activities. A Code of Conduct could also be negotiated for activities in space, clarifying irresponsible actions and facilitating appropriate responses against rule-breakers. In my view, a key element in a Code of Conduct would be a pledge not to engage in harmful interference against satellites. Low-earth orbit is now a far less hospitable environment for satellites that are essential for our personal, economic and national security. The magnitude of the debris problem requires our attention. The collision last month between a revenue-producing Iridium satellite and a dead Cosmos satellite constitutes another wake-up call to strengthen space security. The Stimson Center's proposed "rules of the road" for a space Code of Conduct seek to address this problem. We propose that all responsible space-faring nations accept "the responsibility to share information related to safe space operations and traffic management and to enhance cooperation on space situational awareness."

The timing is right for Washington, Beijing and Moscow to reconsider their approaches to ASAT tests and space security. The United States has more agenda-setting powers than any other country, but no single nation can create conditions for successful space diplomacy. The United States, China and Russia have many competitive pursuits, but we all need to utilize space. The challenge facing major space-faring nations is how to align their space diplomacy with their common interests.

I urge members of this Committee to consider diplomatic initiatives that are protective of satellites and that advance our personal, economic and national security. A draft of one such initiative - Stimson's Code of Conduct - is attached to my testimony for your review.

MICHAEL KREPON

Michael Krepon is the co-founder of the Henry L. Stimson Center, a Washington-based non-governmental organization that focuses on security issues. He is also a Diplomat Scholar at The University of Virginia, where he teaches in the Politics Department. He served as founding president and CEO of the Stimson Center for eleven years before stepping down in 2000 to focus on programming interests, teaching and writing. Krepon worked in the Arms Control and Disarmament Agency at the State Department during the Carter administration. Before that, he worked for two Members of Congress: Norm Dicks (D-WA., Defense Appropriations) and Congressman Floyd Hicks (D-WA., Armed Services). Krepon is the author or editor of three books on space-related topics: *Space Assurance or Space Dominance, The Case Against Weaponizing Space* (The Henry L. Stimson Center, 2003); *Open Skies, Arms Control and Cooperative Security* (St. Martin's Press, 1992); and *Commercial Observation Satellites and International Security* (Palgrave Macmillan, 1990). Krepon's newest book, *Better Safe than Sorry, The Ironies of Living with the Bomb*, was published by Stanford University Press in January, 2009. He serves as a consultant to Sandia National Laboratories.

Model Code of Conduct for Responsible Space-Faring Nations

Released by the Stimson Center October 24, 2007

Central Objective of this Code of Conduct:
To preserve and advance the peaceful exploration and use of outer space.

Preamble:
We the undersigned;

Recognizing the common interest of all humankind in achieving progress in the exploration and use of outer space for peaceful purposes;

Reaffirming the crucial importance of outer space for global economic progress, commercial advancement, scientific research, sustainable development, as well as national, regional and international security;

Desiring to prevent conflict in outer space;

Reaffirming our commitment to the United Nations Charter;

Taking into consideration the salience of Article 2(4) of the Charter, which obliges all members to refrain in their international relations from the threat or use of force against the territorial integrity or political independence of any state, or in any other manner inconsistent with the purposes of the United Nations;

Taking special account of Article 42 of the Charter, under which the United Nations Security Council may mandate action by air, sea, or land forces as may be necessary to maintain or restore international peace and security;

Recognizing the inherent right of self-defense of all states under Article 51 of the Charter;

Reinforcing the principles of the Outer Space Treaty of 1967, including:

- the exploration and use of outer space, including the moon and other celestial bodies, shall be carried out for the benefit and in the interests of all countries,

- outer space, including the moon and other celestial bodies, shall be free for exploration and use by all States without discrimination of any kind, on a basis of equality and in accordance with international law,
- outer space, including the moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means, in the exploration and use of outer space, States Parties to the Treaty shall be guided by the principle of co-operation and mutual assistance and shall conduct all their activities in outer space with due regard to the corresponding interests of all other States Parties to the Treaty;
- State Parties to the Treaty undertake not to place in orbit around the Earth any objects carrying weapons of mass destruction;
- the moon and other celestial bodies shall be used by all States Parties to the Treaty exclusively for peaceful purposes.

Recalling the importance of space assets for non-proliferation, disarmament and arms control treaties, conventions and regimes;

Recognizing that harmful actions against space objects would have injurious consequences for international peace, security and stability;

Encouraging signature, ratification, accession, and adherence to all legal instruments governing outer space, including:

- 1967 Outer Space Treaty
- 1968 Rescue Agreement
- 1972 Liability Convention
- 1976 Registration Convention
- 1984 Moon Agreement

Recognizing the value of mechanisms currently in place related to outer space, including the 1994 Constitution of International Telecommunications Union; the 1963 Partial Test Ban Treaty; the 1988 Intermediate-Range Nuclear Forces Treaty; the 1994 Strategic Arms Reduction Treaty; and the 2003 Treaty on Strategic Offensive Reductions.

Recognizing the dangers posed by space debris for safe space operations and recognizing the importance of the 2007 Space Debris Mitigation Guidelines of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space;

Recognizing the importance of a space traffic management system to assist in the safe and orderly operation of outer space activities;

Believing that universal adherence to this Code of Conduct does not in any way diminish the need for additional international legal instruments that preserve, advance and guarantee the exploration and use of outer space for peaceful purposes;

Declare the following rights and responsibilities:

Rights of Space-Faring States:

1. The right of access to space for exploration or other peaceful purposes.
2. The right of safe and interference-free space operations, including military support functions.
3. The right of self-defense as enumerated in the Charter of the United Nations.
4. The right to be informed on matters pertaining to the objectives and purposes of this Code of Conduct.
5. The right of consultation on matters of concern and the proper implementation of this Code of Conduct.

Responsibilities of Space-Faring States:

1. The responsibility to respect the rights of other space-faring states and legitimate stakeholders.
2. The responsibility to regulate stakeholders that operate within their territory or that use their space launch services in conformity with the objectives and purposes of this Code of Conduct.
3. Each state has the responsibility to regulate the behavior of its nationals in conformity with the objectives and purposes of this Code of Conduct, wherever those actions occur.
4. The responsibility to develop and abide by rules of safe space operation and traffic management.
5. The responsibility to share information related to safe space operations and traffic management and to enhance cooperation on space situational awareness.
6. The responsibility to mitigate and minimize space debris in accordance with the best practices established by the international community in such agreements as the Inter-Agency Debris Coordination Committee guidelines and guidelines of the Scientific and Technical Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space.
7. The responsibility to refrain from harmful interference against space objects.
8. The responsibility to consult with other space-faring states regarding activities of concern in space and to enhance cooperation to advance the objectives and purposes of this Code of Conduct.
9. The responsibility to establish consultative procedures to address and resolve questions relating to compliance with this Code of Conduct, and to agree upon such additional measures as may be necessary to improve the viability and effectiveness of this Code of Conduct.

The Model Code of Conduct was completed by experts from NGOs in Canada, France, Japan, Russia and the United States in October 2007. The group included Setsuko Aoki of Keio University, Alexei Arbatov of the Carnegie Moscow Center, Vladimir Dvorkin of the Center for Policy Studies in Russia, Trevor Findlay of the Canadian Centre for Treaty Compliance, Katsuhisa Furukawa of the Japan Science and Technology Agency, Scott Lofquist-Morgan of the Canadian Centre for Treaty Compliance, Laurence Nardon of the French Institute of International Relations, and Sergei Oznobistchev of the Institute of

Strategic Studies and Analysis. NGO participants worked on this project in a personal capacity. Their support for the model Code of Conduct therefore does not reflect endorsements by their institutions or governments

DISCLOSURE FORM FOR WITNESSES
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INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(4), of the Rules of the U.S. House of Representatives for the 111th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants) received during the current and two previous fiscal years either by the witness or by an entity represented by the witness. This form is intended to assist witnesses appearing before the House Armed Services Committee in complying with the House rule.

Witness name: MICHAEL KREPON

Capacity in which appearing: (check one)

✓ Individual

___Representative

If appearing in a representative capacity, name of the company, association or other entity being represented:_____

FISCAL YEAR 2009

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant

FISCAL YEAR 2008

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant

FISCAL YEAR 2007

Federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
N/A			

Federal Contract Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) with the federal government, please provide the following information:

Number of contracts (including subcontracts) with the federal government:

Current fiscal year (2009): 0 _____ ;
Fiscal year 2008: 0 _____ .
Fiscal year 2007: 0 _____ .

Federal agencies with which federal contracts are held:

Current fiscal year (2009): _____ ;
Fiscal year 2008: _____ ;
Fiscal year 2007: _____ .

List of subjects of federal contract(s) (for example, ship construction, aircraft parts manufacturing, software design, force structure consultant, architecture & engineering services, etc.):

Current fiscal year (2009): _____ ;
Fiscal year 2008: _____ ;
Fiscal year 2007: _____ .

Aggregate dollar value of federal contracts held:

Current fiscal year (2009): _____ ;
Fiscal year 2008: _____ ;
Fiscal year 2007: _____ .

Federal Grant Information: If you or the entity you represent before the Committee on Armed Services has grants (including subgrants) with the federal government, please provide the following information:

Number of grants (including subgrants) with the federal government:

Current fiscal year (2009): _____:
Fiscal year 2008: _____:
Fiscal year 2007: _____.

Federal agencies with which federal grants are held:

Current fiscal year (2009): _____:
Fiscal year 2008: _____:
Fiscal year 2007: _____.

List of subjects of federal grants(s) (for example, materials research, sociological study, software design, etc.):

Current fiscal year (2009): _____:
Fiscal year 2008: _____:
Fiscal year 2007: _____

Aggregate dollar value of federal grants held:

Current fiscal year (2009): _____:
Fiscal year 2008: _____:
Fiscal year 2007: _____.

Testimony of James B. Armor, Jr.
Before the Strategic Forces Subcommittee, House Armed Services Committee
18 March 2009

Madam Chairman, ranking member Turner, members of the sub-committee, I am very pleased to be here today to testify on the vital issue of space and U.S. security. I am also happy to be able to use this forum to continue discussions on space security with two very thoughtful space advocates Mr. Bruce MacDonald, with whom I had the privilege of working on the CFR report, "China, Space Weapons, and US Security"; and Mr. Michael Krepon with whom I've had some edifying discussions both here and abroad, on space treaties and rules of the road. Today I am speaking purely in a private capacity, and my comments do not necessarily represent the views of the United States Air Force, with which I proudly served for 34-years, or any of my current affiliations.

Let me start by giving top-line answers to the subcommittee's three broad issues questions.

1. Do we have the right national policy to ensure the security of our space assets, particularly those supporting warfighters and national intelligence collection? Yes. The real problem is that there is no national strategy or authoritative mechanism for effective implementation or oversight of the policy. I would further agree that the policy might benefit from a change in tone appropriate to evolving global circumstances and events, and that is typical of any change of administration.
2. Do we have the right investment strategy for protecting and defending critical space assets and capabilities? No, I don't believe we do. Up to now, we have designed and built our space capabilities assuming space to in essence be a sanctuary. But in the last 15-years space has become both a contested and competitive domain with a blossoming number of space-faring entities and potential threats, both intentional – like China's ASAT – and unintentional – like spectral interference and debris. Finally,
3. What role can diplomacy play in ensuring the security of our space assets? I think diplomacy plays an essential role in global US space leadership. The US must be actively engaged if it expects to help set a productive agenda in international discussions. As Mr. MacDonald points out, "diplomacy and arms control cannot by themselves solve our space security problems". In this sense, US diplomatic leadership means both (1) setting a solid foundation for concrete technical standards and conventions that will encourage a robust and safe commercial space regime, and (2) limiting expectations for unverifiable agreements that might restrain space commerce or unnecessarily constrain US civil and national security space freedom of action.

I understand today's hearing is about space security, but I believe it is important to take a step back and place a broader context on the state of the US space program in general, and thus motivate why today's hearing is so important. As my fellow witnesses have pointed out, the US is exquisitely dependent on space for not only warfighting and intelligence, but for our economic well being and technological vitality, as well as our overall global leadership and international standing. This bears repeating. Space is a critical element of our national infrastructure for banking, finance, telecommunications, public utilities, transportation, homeland security and even agriculture. Capabilities such as GPS have fundamentally enabled the information revolution around the world. Intelligence and satellite communication systems have not only enabled a revolution in military affairs, but become critical for disaster preparedness and global consequence management. Weather satellites are essential to extreme weather and global climate change prediction. When the world thinks of space, it looks to America. This is a priceless "smart-power" tool.

While the U.S. currently leads the world in space, there are numerous problems other than simple security threats that jeopardize our continued leadership. We face near-term mission gaps in important space capabilities, our space industry and workforce is losing its competitive edge, our engagement and influence in

international space activities has declined, and there is widespread program overreach – that is, there are more government space programs than the federal budget can support. In many respects, all of the nation's space sectors – commercial, civil, defense, and intelligence – are in worse condition today than they were a decade or more ago. To the point, as our security and well-being has grown more reliant on space capabilities they have become increasingly vulnerable to breakdown, disruption and attack. It is with this heightened sense of urgency that I now return to today's timely and vital discussion about space security. Let me address each of the three main questions.

First, do we have the right national policy? Fundamentally, yes. Since the beginning of the space age, each President has issued a national space policy and each policy has been remarkably consistent in terms of its broad goals. These include strengthening U.S. space leadership, national security, economic competitiveness, science and technology base, international cooperation, and a long standing commitment to the peaceful uses of outer space. Let me digress for a second and say that although the particular language of the Bush Administration space policy issue in October 2006 gave me as a military and intelligence space professional the policy guidance I needed and was totally consistent with policy from earlier Administrations, I must acknowledge that the rest of the world clearly thought its language quite provocative and it became a major distraction to any positive discussion on any of a number of space issues. I therefore think we might generally benefit from a change in tone in the written policy, and I fully expect the Obama Administration, typical of any new administration, to do that; but I do not think the fundamental policy objectives will change.

But, while national space policy is adequate, putting it into practice has fallen short. What's been lacking is not policy but a national space strategy to define the best means and set priorities to achieve policy goals and objectives. The US is the only major space power that by law puts space in different segments – civil, national security (consisting of military & intelligence), and commercial. Despite this policy separation, all four are inextricably interconnected by the same technology, infrastructure and people. Organizational stovepipes however prevail, and there is no strategy or governance structure that incentivizes unity of effort. For example, when NASA picked its next generation manned launch system it impacted the USAF EELV program and US commercial launch industry. When DoD decided it wouldn't put civil search & rescue beacons on next generation GPS satellites for technical reasons, it left future beacons only on Chinese and Russian satellites which deeply affected worldwide perception of US leadership. NPOESS weather satellite acquisition delays not only affect NOAA science and weather operations, but NPOESS was part of a larger agreement with the EU and is critical to meeting DoD weather requirements as well. Export restrictions on commercial satellite technology for valid technology proliferation reasons have significantly, adversely impacted the US 2nd & 3rd tier industrial base leaving US satellites dependent on foreign sources of parts, and also embarrassingly constrained U.S. collaboration on civil and military space projects with our allies. Disagreement between the USAF and NRO on a Space Radar program resulted in no program at all. The point is, when you pull the string on one sector of US space enterprise you pretty quickly discovered it's connected to all the others, and often has profound diplomatic implications. Good policy is not self actualizing: a national space strategy is needed.

Intimately related to the lack of a National Space Strategy is the lack of a governance structure. There have been a number of Executive and Legislative Branch reviews of the state of the nation's space enterprise over the past decade, like the recent congressionally directed "Allard Commission". They have all consistently recommended a comprehensive space governance overhaul, with the essential, common element being priority and leadership from the White House – the only place where all space sectors come together. During last year's campaign, President Obama discussed the need for a National Space Council and I think that's an important decision. The Administration needs to establish an effective White House focal point and apparatus within the Executive Office of the President, such as a Space Council or equivalent, to actively establish direction, set priorities,

provide management oversight, and coordinate actions across the agencies and which includes regular cabinet-level and senior White House engagement.

I must say that Congress shares some blame here with committee stovepipes of its own across space sectors and technical disciplines. I would recommend, Madam Chairman, that you revive a bi-partisan, bi-cameral Congressional Space Caucus to promote cross-committee discussions about space.

The second question was do we have the right investment strategy for protecting and defending critical space assets and capabilities. The answer is no. The answer is complex but I'm going to boil it down to three interrelated recommendations.

Investment shortfall number one is Space Situational Awareness (SSA). Our current Space Surveillance Network, controlled by Strategic Command (STRATCOM) and developed by AF Space Command (AFSPC), is not fully chartered or resourced to support civil and commercial operations. Current space surveillance systems were designed for the cold war and, although capable of very precise tracking of a specific event, are basically not capable of sustaining an active catalog of satellites and debris in the tens of thousands. Even now it can take days or weeks to notice and find a space object that moved. Further, the US Air Force (USAF) does not have the resources to predict or analyze the consequences of all the burgeoning activity in space, so they focus on monitoring manned missions and critical US satellites. In particular, the USAF has the lead but not the resources to conduct the Congressional directed Commercial and Foreign Entities (CFE) support. (CFE support was moved to the USAF from NASA several years ago.) Recent complaints by commercial satcom operators about un-warned movement of DoD satellites and lack of support for moving commercial satellites at GEO, as well as the Iridium Satellite collision with a defunct Russian Cosmos satellite are indications of inadequate resources and lower priority for CFE. The SSA system the US needs is one capable of prompt and unequivocal attribution of any space incident to a cause or agent. This includes not only orbital elements, but satellite operating status, space "weather" conditions, spectral interference and geo-location, debris cognizance, cyber-space characterization, and physical ground-station and terminal locations and operating status. It must be forensic quality knowledge with positive custody tracking of space objects that maneuver or break-up. This is not easy. Did a satellite cease functioning because of a software glitch or a cyber attack? Did a satellite change orbits because of an intentional maneuver, an upper atmospheric change, or a debris strike? As is apparent from my description of SSA capability the US needs, this is tightly coupled with foreign space intelligence. The US gave up most of its space intelligence capability in the 90's and it requires significant re-investment. The capability for situational awareness with attribution is the basis for any international discussion about the space environment, debris, and space operating protocols and conventions – the "rules of the road". It is also foundational to any space deterrence regime.

The second investment shortfall is our current satellite architecture. Every critical space system and support infrastructure needs to be recapitalized to insure it can operate in a contested domain to the extent that it will be needed during critical military, intelligence or homeland security crisis operations. There are a number of good options: small satellite augmentation and reconstitution; mixed space and terrestrial systems; protection technology; and more. There is no single best answer or "silver bullet". Each constellation should develop its own optimized approach. There are several architectural analyses ongoing, for example for the congressionally mandated study on the future of the US electro-optical imagery architecture led by Paul Kaminski. But by the same token, each mission must not evaluate its needs in isolation of an integrated national space strategy. Furthermore, we currently lack the firm basis of foreign space intelligence such that we can make rational satellite architecture determinations based on a sound assessment of the specific threats.

I may surprise you here, but the third vital investment need is for the commercial space segment. As a 34-year national security space professional I am not willing to compromise U.S. security; but as student of history, I am convinced that a robust commercial space regime will enhance both global stability and US security. Mahan's famous theory of sea-power was fundamentally not about battleships, it was about sea lanes of commerce and maritime industry. Therefore, investment number three is determined S&T investment and other incentives towards growing a robust US commercial space industry within a burgeoning global commercial space industry. I believe an essential part of this is to begin to make progress towards a predictable space operating environment within a space traffic management system.

Currently there is no assigned organizational responsibility for space traffic management. GPS however may serve as an instructive model. GPS started as a strictly USAF military system but rapidly grew to have vastly more civil and commercial applications that are now critical to national and even global infrastructure. Although the USAF at first balked, there is now a DoD and DoT co-chaired National Executive Committee with joint oversight over GPS as well as the FAA space-based and USCG (DHS) terrestrial augmentation systems, to insure an integrated national Positioning, Navigation, and Timing (PNT) architecture. The National Security Space Office (NSSO) maintains the joint agency architecture. For managing space, currently the FAA Commercial Space Transportation Office grants launch and re-entry licenses, the FCC grants orbital locations and spectrum, while the USAF operates the Space Surveillance system. Synchronizing these agencies to jointly start studying a space traffic management investment framework might be productive. Working towards a commercially secure space operating environment is an opportunity for global US space leadership that addresses a huge portion of space security. This is also where discussions about rules of the road might be beneficial. This will let me segue back to the Committee's third and final question, the role of diplomacy.

Diplomacy must play a role in ensuring the security of our space assets. I am skeptical that the difficulty of generating and approving a treaty will be worthwhile, especially since the concept of a "space weapon" is difficult to define, making any binding arms agreement difficult to verify. I am however comfortable with the idea of discussions about "rules of the road", especially if the US fortifies civil and commercial initiatives to work with our allies and likeminded space-faring nations, and reviews US trade restrictions that hamper them. The most productive near term efforts would be establishing common technical standards and protocols, as is being done by the major space agencies of the world in the multi-national Consultative Committee for Space Data Systems (CCSDS). Building on the technical confidence of professional and civil agencies there, discussions could move to concrete protocols, similar to what the International Civil Aviation Organization (ICAO) and FAA do for air traffic management.

In summary, the space enterprise is critical to the nation and its security essential. It is on a declining trajectory that puts US leadership at risk, and requires sustained strategic leadership, investment, and diplomatic initiative by the Administration and Congress. This concludes my remarks and I look forward to your questions and discussion.

DISCLOSURE FORM FOR WITNESSES
CONCERNING FEDERAL CONTRACT AND GRANT INFORMATION

INSTRUCTION TO WITNESSES: Rule 11, clause 2(g)(4), of the Rules of the U.S. House of Representatives for the 111th Congress requires nongovernmental witnesses appearing before House committees to include in their written statements a curriculum vitae and a disclosure of the amount and source of any federal contracts or grants (including subcontracts and subgrants) received during the current and two previous fiscal years either by the witness or by an entity represented by the witness. This form is intended to assist witnesses appearing before the House Armed Services Committee in complying with the House rule.

Witness name: James B. Armor, Jr.

Capacity in which appearing: (check one)

_X_ Individual

___Representative

If appearing in a representative capacity, name of the company, association or other entity being represented:_____

FISCAL YEAR 2009

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
Consultant sub-contract	SMC, Los Angeles AFB	10,000.00	USAF Space Systems Planning
to IDA (FFRDC)			

FISCAL YEAR 2008

federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
NONE			

FISCAL YEAR 2007

Federal grant(s) / contracts	federal agency	dollar value	subject(s) of contract or grant
NONE			

Federal Contract Information: If you or the entity you represent before the Committee on Armed Services has contracts (including subcontracts) with the federal government, please provide the following information:

Number of contracts (including subcontracts) with the federal government:

Current fiscal year (2009): 1;
Fiscal year 2008: 0;
Fiscal year 2007: 0.

Federal agencies with which federal contracts are held:

Current fiscal year (2009): Space & Missile Systems Center, Los Angeles AFB ;
Fiscal year 2008: 0;
Fiscal year 2007: 0.

List of subjects of federal contract(s) (for example, ship construction, aircraft parts manufacturing, software design, force structure consultant, architecture & engineering services, etc.):

Current fiscal year (2009): USAF space systems planning;
Fiscal year 2008: n/a;
Fiscal year 2007: n/a.

Aggregate dollar value of federal contracts held:

Current fiscal year (2009): $10,000.00;
Fiscal year 2008: n/a;
Fiscal year 2007: n/a.

Federal Grant Information: If you or the entity you represent before the Committee on Armed Services has grants (including subgrants) with the federal government, please provide the following information:

Number of grants (including subgrants) with the federal government: **0**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

Federal agencies with which federal grants are held: **n/a**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

List of subjects of federal grants(s) (for example, materials research, sociological study, software design, etc.): **n/a**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

Aggregate dollar value of federal grants held: **n/a**

Current fiscal year (2009):_____;
Fiscal year 2008:_____;
Fiscal year 2007:_____.

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