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**SPACE WARFIGHTING READINESS:
POLICIES, AUTHORITIES, AND
CAPABILITIES**

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

ONE HUNDRED FIFTEENTH CONGRESS

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HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
Washington, DC, Wednesday, March 14, 2018.

The committee met, pursuant to call, at 10:03 a.m., in room 2118, Rayburn House Office Building, Hon. William M. “Mac” Thornberry (chairman of the committee) presiding.

**OPENING STATEMENT OF HON. WILLIAM M. “MAC” THORN-
BERRY, A REPRESENTATIVE FROM TEXAS, CHAIRMAN, COM-
MITTEE ON ARMED SERVICES**

The CHAIRMAN. The committee will come to order.

Last month, when Secretary Mattis testified on the new National Defense Strategy, he said, quote, “Our competitive edge has eroded in every domain of warfare: air, land, sea, space, and cyber,” end quote.

That statement has two relevant points to today’s hearing. First, space is a domain of warfare, not just an enabler. Second, we are falling behind where we should be when it comes to space. Today’s hearing will discuss how we catch up.

As we refocus our defense efforts on strategic rivals, it is clear that they are putting significant effort into space. I believe the American people still do not fully realize how dependent our country is on space, not just for military and intelligence purposes, but in our everyday lives as well. That dependence creates a vulnerability, which, like in the other domains, we must count on the American military to protect.

This committee is focused a lot on readiness and rebuilding our military. When it comes to space, there are a number of questions that need answers. For example, where should we be making our investments? Are we attracting and developing the right kind of space warfighters? Perhaps most crucially to me, are we putting the appropriate intellectual effort into space as a warfighting domain? We look forward to the insights that our witnesses today can give us.

Finally, I would point out that this committee has been very active in trying to prepare the military and the Nation for the challenges of space. We have streamlined Air Force acquisition authorities, eliminated red tape, empowered a single accountable organization for space forces within the Air Force, and empowered the Deputy Secretary of Defense to oversee Air Force space reform efforts among other things. But we will not relax our efforts. This topic is just too important.

I would yield to Mrs. Davis as the acting ranking member.

[The prepared statement of Mr. Thornberry can be found in the Appendix on page 43.]

**STATEMENT OF HON. SUSAN DAVIS, A REPRESENTATIVE
FROM CALIFORNIA, COMMITTEE ON ARMED SERVICES**

Mrs. DAVIS. Thank you, Mr. Chairman. General Kehler, Mr. Loverro, and Mr. Harrison, we all welcome you, and we thank you for being here. We look forward to your insights on adapting space's contested domain and how we can protect our assets and deter a war in space.

I ask unanimous consent to submit Mr. Smith's remarks for the record.

The CHAIRMAN. Without objection.

[The prepared statement of Mr. Smith can be found in the Appendix on page 44.]

Mrs. DAVIS. Thank you.

The CHAIRMAN. We appreciate each of you being here. We are joined by General Robert Kehler, former Commander, U.S. Strategic Command; Mr. Doug Loverro, former Deputy Assistant Secretary of Defense for Space Policy; and Mr. Todd Harrison, Director of the Aerospace Security Project for the Center for Strategic and International Studies. Obviously, more complete bios are in the materials on each of these gentlemen. Without objection, each of your full written statements will be made part of the record. And we look forward to your comments as well as your answers to our questions.

General Kehler, the floor is yours.

**STATEMENT OF GEN C. ROBERT KEHLER, USAF (RET.),
FORMER COMMANDER, U.S. STRATEGIC COMMAND**

General KEHLER. Thank you, and good morning, Mr. Chairman, Representative Davis, distinguished members of the committee. I am honored to be here with you today to present my views on space warfighting readiness. I am especially pleased to be here with my two long-time colleagues, and I want to thank the members of the committee for your leadership on these important matters. As a reminder, Mr. Chairman, the views I express today are mine. I am not here representing the Department of Defense or Strategic Command or the United States Air Force.

Mr. Chairman, the United States is perilously close to losing the significant advantages that come from being the world's leading spacefaring Nation, and time is not on our side. Decades of dedicated investment in space have yielded important warfighting and intelligence collection benefits for the United States and our allies and partners. But our adversaries and our potential adversaries have noted these significant benefits and have moved aggressively to field forces that can challenge our space capabilities from the ground, through cyberspace, and in space.

As always, deterrence is the preferred outcome, and our ability to deter a conflict that begins in or extends to space is based on our readiness to fight such a conflict. I believe classic deterrence theory applies to space. Adversaries will be deterred if they believe they cannot achieve their objectives, will suffer unacceptable consequences if they try, or both. This is not the first time the U.S.

has had to consider challenges to our space capabilities, but today's problem is potentially far greater in impact.

Given our dependence and that of our allies and partners on space, the loss of critical assets today could prove decisive to our ability to successfully prosecute a military campaign. As a result, the United States has to be prepared to plan and conduct complex operations in space that involve joint interagency and combined, or allied, capabilities and forces in the context of broader commercial, nongovernmental, and international actors and interests. Space operations must integrate seamlessly into multidomain operations. We should not be preparing to fight (and deter) an isolated "space war" as some headlines would suggest. Space is an integral component of our warfighting structure, and challenges to our space capabilities must be addressed within the context of that structure.

As you pointed out, Mr. Chairman, there is a lot of work underway to address the shortfalls, much of it stimulated by your interest and that of Chairman Rogers and his subcommittee. So let me take just a moment to highlight a few areas that I believe deserve special attention.

First, national leadership has to align on a comprehensive plan of action as well as the ends, ways, and means to implement such an action plan. The national security space enterprise exists within the overall national space enterprise, and its success is linked to the viability and vitality of that enterprise. The current National Security Strategy recognizes that unimpeded access to and use of space is a vital national interest and notes that the United States will respond to threats to our vital national interests in space "at a time, place, manner, and domain of our choosing." To effectively deal with a conflict that begins or extends into space, this general policy has to be implemented in a manner that is helpful to commanders and operational planning and execution.

Second, given the multiplicity of actors involved in today's military operations, including space, it is important to clarify the relationships and responsibilities among the commander of U.S. Strategic Command, other U.S. Government space operators, and other actors, like commercial space operators, to ensure that we have unity of effort. Regarding acquisition authorities, I think it is important to align authorities with service responsibilities and delegate those authorities to the lowest feasible level.

Third, countering an adversary's efforts to deny our space capabilities begins with an operational concept, or CONOPS [concept of operations]. Bringing the ongoing space CONOPS work to conclusion and updating joint force CONOPS to account for degraded or denied space capabilities are complementary and high-priority activities.

Next, in my view, today's joint warfighting structure is both appropriate and adequate to prepare for and fight a space-related conflict. The commander of U.S. Strategic Command has the necessary responsibility and authority to organize his command for warfighting effectiveness, and, by the way, those changes are underway, to develop plans to conduct exercises to establish relationships over which he doesn't have command authorities, and, basically, to do the things necessary to make sure that we are prepared. This is the same process we use for the other domains and the other

commands, and if we use that same process, that is going to help us ensure integration of space with other efforts.

Finally, space and other forces have to be equipped and trained to fulfill their mission responsibilities in the face of determined adversary action against space assets. Capability architectures, not just space architectures, but capability architectures have to become more resilient and defensible, and all forces have to be prepared and equipped to operate in an environment that assumes space assets will be degraded. Rapid acquisition, aggressively leveraging commercial capabilities, better integration with allies and coalition partners, and realistic training all play a role in addressing these issues.

Mr. Chairman, you asked for my perspective on the current readiness of U.S. forces to succeed and successfully operate in a conflict that begins in or extends to the space domain. In summary, we are not yet where we need to be, but I am encouraged by the focus, commitment, and sense of urgency I see from all parties. Fortunately, we are not starting from scratch. The young men and women that make up our space forces and their leaders provide the solid foundation we need to meet the challenge.

Following Desert Storm, the United States Air Force and others made great progress in bringing space support to national leaders and the warfighters. Now it is time to shift from a mindset that presumes space superiority to a mindset prepared to gain and maintain space superiority as a first condition of providing that support. From acquisition to operational execution, the U.S. needs to field a force that is ready for space conflict.

Thanks again for inviting me, and I look forward to your questions.

[The prepared statement of General Kehler can be found in the Appendix on page 46.]

The CHAIRMAN. Thank you.

Mr. Loverro.

STATEMENT OF DOUG LOVERRO, FORMER DEPUTY ASSISTANT SECRETARY OF DEFENSE FOR SPACE POLICY, DEPARTMENT OF DEFENSE

Mr. LOVERRO. Chairman Thornberry, Mrs. Davis, members of the subcommittee, I am pleased to be here today to join General Kehler and Mr. Harrison to talk to you about an issue that is critical for the Department of Defense [DOD] and for our Nation and, as you have already said, DOD space warfighting readiness.

Space is vital to our national security. It underpins DOD capabilities worldwide at every level, from the engagement in humanitarian assistance, to conventional conflict, and up to and including nuclear war. As importantly, space provides a lifeblood to U.S. economic vitality empowering the lives of our citizens worldwide, and it increasingly represents one of those rare industrial sectors in which the U.S. continues to hold and expand its unqualified advantage.

In all three space sectors, national security, civil, and commercial, the U.S. leads the world. Let's make no mistake about that. But while our leadership in both civil and commercial space remain secure, our leadership and our capabilities in national security sec-

tor are being actively and aggressively challenged just as General Kehler has stated.

Our adversaries know that the U.S. military relies on space to empower its operations and to wield an overwhelming military advantage, and they don't like it. That understanding was succinctly stated by Chinese strategist Wang Hucheng two decades ago, when he wrote that "for countries that can never win a war with the United States by using the methods of tanks and planes, attacking U.S. space system may be an irresistible and most tempting choice." His observation was not just idle speculation. It became the basis for Chinese and Russian strategy, which they have been working on ever since, and which they will soon bring to fruition.

Understanding all this, the question posed by the hearing today, are U.S. space warfighting forces ready, becomes particularly pertinent to understand. Unfortunately, my answer is not that different from General Kehler's answer. No, we are not ready. Or more properly, I don't believe we are on the firm path to be ready. Before we discuss why, let me make two things emphatically clear. First and most critically, this is absolutely not an indictment of the incredible members of our military armed services and intelligence community charged with this responsibility. They stand ready to maintain U.S. space capabilities in every way humanly possible, given the tools at their disposal. It is the tools that are not up to the task.

Second, no adversary should mistake that statement as an invitation to attack. The fact is that U.S. space forces are robust. And faced with any attack that could be mounted today, I am fully confident they will continue to provide the U.S. with the warfighting edge to assure an adversary's defeat. But the harsh reality is that our current ability to withstand an adversary attack is based not on our warfighting readiness but, rather, their lack of a fully developed and operationalized threat. If that threat did exist, then I feel the answer would be quite different.

In your invitation to appear here today, you cited several elements that must be assessed to gauge our warfighting readiness. Those elements included policies, current and future capabilities, allied and commercial integration, and our organizational structure. In my written statement, I have addressed each one, and I would ask that those all be included in the record.

Finally, before I close, let me add two more thoughts. First, to echo General Hyten and General Kehler have stated over and over again, deterrence and war do not occur in isolated domains, rather it is at the sum of our capabilities and actions across all domains that leads to deterrence during peace and victory during war. But the role that space plays in this equation is paramount, because losing space degrades not only our space capability, but degrades our capability in the three other terrestrial domains as well. Assuring space forces survive assures the ability of those terrestrial forces to succeed, and that leads to the deterrence we seek.

Simultaneously, we must accept that no capable adversary will hesitate to exercise their sovereign ambition to eliminate the U.S. space advantage. Regardless of how ready our space forces are, that readiness will not deter a determined attack. Therefore, we must make certain that our space forces can withstand such an onslaught.

Second, while the question of space warfighting readiness is made up of many elements, I want to elevate one of them above all others. That is, the human capital element, or, more specifically, the people. In my testimony, I have pointed to several areas where we need to reassess our plans, our budget, and our strategy. And I know that if we want to, we can reshape those plans and our budget and close the short-term readiness gap.

But in the long term, we must face the fact that to remain ahead over the next half century, we are going to need to grow the kind of space leaders that can think doctrinally, technically, and operationally for space in the same way we grew those leaders in the 1930s and 1940s for air. We could have not done it for air from within the constraints of the pre-World War II Army personnel system. Likewise, we would not be able to do it for space from within the constraints of our first pre-war Air Force personnel system.

In 1937, General Frank Andrews, for whom Andrews Air Force base is named, wrote, "I don't believe any balanced plan to provide the Nation with an adequate, effective Air Force can be obtained without providing an organization individual to the needs of such an Air Force." The creation of the United States Air Force propelled changes in air power that moved our Air Force from the equal of its contemporary counterparts to a modern force that is, hands down, the best in the world.

The same will be true for space. If we are to assure U.S. space warfighting readiness far into the future against the rising threats we see today and those that we will face tomorrow, we must establish, either within or outside the Air Force, an organization individual to those space needs.

Thank you, and I look forward to your questions.

[The prepared statement of Mr. Loverro can be found in the Appendix on page 58.]

The CHAIRMAN. Thank you. Mr. Harrison.

STATEMENT OF TODD HARRISON, DIRECTOR OF AEROSPACE SECURITY PROJECT, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES

Mr. HARRISON. Chairman Thornberry, Representative Davis, and members of the committee, I want to begin by thanking you for the opportunity to testify today on this important and timely topic. I also want to thank my CSIS [Center for Strategic and International Studies] colleagues who have contributed to our work in this area, especially Zack Cooper, Kaitlyn Johnson, and Thomas Roberts. While the thoughts I am sharing today draw from the work our team has done, the opinions I express are not intended to represent those of my colleagues or CSIS.

The United States is critically dependent on space across the full spectrum of conflict from counterterrorism operations to high-end combat against a near-peer adversary. This dependence on space creates a vulnerability because our space systems are not protected across the full spectrum of threats. Conflict that begins or extends into space, particularly if it becomes kinetic, will not end well for anyone. Our primary focus should therefore be on deterring conflict in space, and I believe there are three main areas where we can

do more to improve our deterrence posture and the readiness of our space forces.

First, we need a clearer understanding and articulation of the thresholds for escalation in space, especially at the lower end of the spectrum of conflict. Ambiguous escalation thresholds can invite grey zone aggression in space as we are seeing occur in other domains today. Adversaries are probing at the seams and finding ways to advance their own ambitions without triggering direct, overt conflict with the United States. What is different about the space domain is that we have little history to draw upon or widely accepted norms of conduct to serve as reference points. It is, therefore, in our interest to work with international and commercial partners to establish sensible norms of conduct and to abide by them.

Another complicating factor is that adversaries can use methods of attack against our space systems that are difficult to detect and attribute and may have reversible effects, such as jamming, lasing, and cyberattacks. It is nearly impossible to deter an attack if you cannot attribute the source of the attack, or know with confidence that the effects being experienced are, in fact, malicious. We cannot establish clear and credible thresholds without the ability to detect and attribute threats to our space systems in a timely manner.

A second area where we should be focusing more effort is the development of innovative space capabilities. We are in the midst of a renaissance in commercial space, but it is difficult for the military to stay attuned to these advances if acquisition officers are rotating into space programs with little, if any, prior space experience. One potential remedy is for the Air Force to create a dedicated cadre of space acquisition professionals, both civilian and uniformed military, that are managed separately from the rest of the Air Force acquisition workforce. This would allow for more specific training, a deeper level of technical knowledge, and more relevant career experiences.

The slow pace of the budgeting process is also a major roadblock to improving capabilities. Under the normal budget process, it takes about 2 years to move from having an idea to having funding to pursue that idea. Given the pace of innovation, especially in software and electronics, that is simply too long. One potential solution is to create something like a working capital fund for space innovation with greater flexibility and authorities. This would be particularly helpful for smaller prototyping and rapid response programs.

A third and final area I believe needs more attention is the problem of communicating our thresholds and capabilities. While certain aspects of our national security space systems must remain secret to be effective, too often the U.S. military and intelligence community default to over-classification. Secrecy invites suspicion among our allies and partners and does little to deter our adversaries. The over-classification of information inhibits our ability to work with international partners and commercial firms, both of which can play an important role in improving the resilience of our space systems. And just as important, over-classification is effectively an overhead tax on all our space activities, adding complexity and time to everything we do.

Another way to improve the communication of thresholds is to be more explicit with commercial space operators about how attacks on their systems will be treated. Without such clarity, commercial space operators may not be willing to accept the risk of doing business with the government in the event of a crisis. One approach to consider is an indemnification program for commercial satellite operators that will cover losses incurred due to a conflict in exchange for commitment by these firms to prioritize U.S. Government customers in a crisis.

In conclusion, much remains to be done to improve the readiness of our national security space forces for the wide range of threats we face today. I commend the committee for focusing attention on these issues and holding the Department of Defense accountable for strengthening our deterrence posture in space.

I look forward to answering your questions.

[The prepared statement of Mr. Harrison can be found in the Appendix on page 79.]

The CHAIRMAN. Thank you all.

Mr. Loverro's statement really got my attention where he says not only are we not ready, we are not on the path to be ready. Now, this committee deals with lots of issues that we are not going to solve all of a sudden. But I think a lot of times, the question for us are we on the right path? Are we getting there? Now, we may have differences sometimes about the sense of urgency, how quickly and so forth. But if we are not on the path to be ready, I think that is a pretty significant thing that should require us to rethink our path.

General Kehler, do you agree that we are not on the path to be ready?

General KEHLER. I think it depends on what he means. I don't quite understand—so I am not going to speculate. I will just say, I am not aware of—I don't think I am aware, as an outsider now, of everything that is going on. What I am aware of, though, I think, is significant. And if we break this down and say are we doing the warfighting things that are necessary, plans, courses of action, establishing command relationships, all of those things, I believe those steps are underway. That is because we fight with combatant commanders, and we have a combatant commander focused on this. And so, A, I think the warfighting steps that are necessary are underway in order for us to have better plans and exercises and all the things that go with that.

In terms of organizing, training, and equipping, I think that the—again, from what I have seen, I think that some significant decisions have been made in terms of architectures, et cetera. I am not clear that the acquisition has caught up with that, and I would question whether our acquisition processes are sufficient to do what needs to be done in the near term.

Beyond that, I would not blanket say that we are not on the right pathway. But I respect Doug Loverro's views on this, and I would be interested in hearing more about why he thinks that. I might agree with him. But as a blanket statement, I don't.

The CHAIRMAN. Okay. Mr. Harrison, do you have an opinion if we are on a path to be appropriately ready for warfighting in space?

Mr. HARRISON. I would have to lean more towards Mr. Loverro on this one. I would say that—to what General Kehler said, in terms of operations and our operational readiness today, I think we are making good progress, as far as I can tell as an outside observer. I think when it comes to long-term readiness, though, which depends much more on the space architectures that we are building and how we are thinking about operations in the future and how we are moving out towards acquiring the capabilities that we need, I don't think we are on the right track there. I think we have been stalled for several years now. For almost a decade, we have been stalled in transitioning to more resilient space architectures. And so in that sense, I think that we are not on a good path. We could do much better.

The CHAIRMAN. Okay. Mr. Loverro, do you want to add to your statement?

Mr. LOVERRO. Yes, Mr. Chairman, I would be pleased to.

So, first of all, let me echo what both General Kehler and Mr. Harrison have said. We are working the warfighting plans. We are integrating space into those warfighting plans. That is active, ongoing. It began, really, under General Kehler, under his leadership, and has continued ever since. And, again, with the tools we have at hand, our warfighters and our war planners are doing the best they have.

The problem we have is that, while we have an excellent vision for what we do need, and, in fact, General Hyten, who appeared before this committee earlier, last week, created what he called the space enterprise vision. And that vision is excellent and comprehensive. We can argue whether or not it is perfect, but it is a very good vision.

But the plan that the Department of Defense submitted to this Congress, which is called the budget, doesn't reflect that vision. It does not reflect the elements necessary to make that vision happen. And I will point to three specific areas that are missing.

Number one, the space enterprise vision includes extensive cooperation with allied and commercial, as both General Kehler and Mr. Harrison have said. And yet, there is zero investment in that commitment in the budget.

Second, everybody in space understands that in order to operate in space effectively and to learn how to operate in space, you are going to need to exercise and exercise extensively. That requires test assets. That requires test infrastructures.

In my written testimony, I speak to the Red Flag exercises that occur at Nellis Air Force Base. The Air Force spends a lot of money practicing operational tactics and doctrine. We do not have an investment that represents that in space.

And lastly, the things that are in the budget represent more old school space architectures that are fundamentally almost impossible to assure the new space architectures that would lead towards assurance, and they are 10 years late. We have a SATCOM [satellite communications] jamming threat today. Today, if we went to war in the Pacific, our PACOM [U.S. Pacific Command] commander would be hard-pressed to communicate, and yet we have nothing on the books until about 2027 to solve that problem for him. And by that time, the adversary will have gone through two or three

generations of his capability. That is what I mean by not being on the path.

The CHAIRMAN. Okay. I think there is a lot to follow up on, and I know members will want to.

Mrs. Davis.

Mrs. DAVIS. Thank you, Mr. Chairman. And thank you to all of you. In many ways, I think you just addressed part of that, Mr. Loverro, of, you know, where are the gaps. I mean, what is it specifically? And, Mr. Harrison, if you could, perhaps, pick up on that, whether it is the way the Pentagon is organized on some levels. We have talked about refining even what kind of unified or sub-command there is. What—are there authorities that are missing? Is it culture? Often it is. We know that there is a slow pace sometimes to move ahead in a risk-adverse culture.

Can you help us define a little bit more of what is slowing that down and what, at this point, if, in fact, you are suggesting that we really haven't planned that for the budget, what is it that specifically could be done with some of those authorities?

Mr. HARRISON. Well, first, I think a lot of it is culture, that you have got a space community that many of the people grew up in an environment where space was considered to be more benign. I would argue it was never benign. There are always threats. The difference, though, was that we were more confident in our ability to deter threats in the past, and so we were willing to assume sanctuary. We had that posture for so long, I think we forgot that it was an assumption. And now, we are facing proliferation of threats, not just, you know, with adversaries like Russia and China that have pretty sophisticated space programs themselves, but all the way down to the level of nonstate actors that can use jamming equipment. They can acquire it. They can build it. They can operate it. And I think we have been very slow because of the culture they built up over time to respond to that.

Part of it also is the acquisition culture. And, you know, I worked in this as a contractor, and I can tell you that, you know, we have built up institutions within the Air Force and the other services as well, to a lesser extent, though. We have built up institutions within our military, within our FFRDCs [federally funded research and development centers] that support the military, and even within our defense industry. And those institutions are centered around the types of capabilities that we needed in the past when deterrence was more assured.

They are very slow to adjust. Those institutions are very slow to adjust to the threats that we are facing today. And so, I think that is where we need to light a fire under people.

Mrs. DAVIS. Could you be just a little more specific about that?

Mr. HARRISON. So, for example, we got into a mindset of building highly aggregated, very expensive satellites in small numbers. And it has proven incredibly difficult over the past decade to get the Air Force and the specific program offices to break out of that mindset, that maybe we cannot be building these exquisite Battlestar Galactica satellites where we aggregate as many things on them as possible. There were good reasons to do that in the past. Those reasons don't exist anymore, and that is actually a vulnerability. We need to figure out how to build more resilient, more dispersed ar-

chitectures. And I think people are just slow to make that transition because they grew up in an environment where it was all about aggregation.

Mrs. DAVIS. Is there an alternative to that? Anybody want to—in that domain that you would suggest?

General KEHLER. Well, there are. First of all, I agree with what is being said. I think we are where we are not because people have slapped their forehead and said we don't know this, but for lots of reasons. Part of it has been priorities. When our priorities are elsewhere, and we see that not only in space, but we see that in the nuclear forces, we see that in other parts of the Department of Defense where our priorities have been elsewhere. I do think there are cultural issues. I do think there are other things that contribute to this. Resources and how many resources we have put to these issues, et cetera.

I do think there is a cultural issue. I do think that we have the pieces in place to address those cultural issues. I think that we have been slow to try to address some of those. I would like to see us pull those pieces together, and I would like to see us give some of the current leadership more authority to move faster. And I think we must deal with our acquisition issues.

Mrs. DAVIS. Yeah. Thank you very much.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Wilson is recognized for 5 minutes.

Mr. WILSON. Thank you, Mr. Chairman. And I very much—and thank each of you for being here. I very much appreciate the focus that the Department of Defense is putting forth on this space area of responsibility, and I am particularly grateful for the leadership of the domain of space by Chairman Mike Rogers and Ranking Member Jim Cooper and their very visionary sponsorship of legislation in this field now has been adopted by President Donald Trump. So they are very effective individuals.

As we continue to advance our own technologies, we have to understand and be prepared for the expansion of capabilities of our adversaries across all four orbits of outer space. And in particular, can you identify, the best you can, the capabilities and challenges that other nations have identified for their activities in space, beginning with General Kehler?

General KEHLER. Sir, I think that—at least what I have observed, both in uniform and now subsequent to that, is that our near-peer competitors—if you single out Russia and China in particular, they have developed strategies that are specifically intended to diminish our ability to project power, diminish our ability to have global awareness, to fracture us from our allies. All of the things that we see them doing at the strategic level have a space component to them. And they have been aggressively pursuing capabilities that allow them to execute that kind of a strategy. It is part of what we would talk with the Chinese about—talk about the Chinese in terms of anti-access/area denial strategies. With the Russians, we talk about their interest to dominate in the near abroad. They have escalation strategies that they believe involve space, et cetera.

And so, I think we need to make sure we understand their strategic approach and how space fits into that in order to be able to counter it.

Mr. LOVERRO. Congressman Wilson, let me add to what General Kehler said. And I agree exactly with what he said. Let me change the discussion less from the strategic side and more to the material side, if I might. And if you will permit me, I would like to just correct something that you mentioned, because it is a misconception almost everybody has.

You talked about the four orbits that we have. Kepler defined an infinite number of orbits. We choose to use four. That is a foolish choice. Back in the 1960s, we launched satellites that today sit halfway between the Earth and the moon to observe nuclear tests on the face of the Earth. We knew how to do that in the 1960s. We understood that they were safer and more resilient that far away, and we could still conduct our mission.

The adversary has seen how we operate in the four orbits that you talked about. They are ready to target every one of them, and they will target them in such a way that it will be very difficult for us to defend our capabilities. We are not constrained by gravity or physics to those placements. And yet culturally, we have a hard time moving away from them. And it is a very important strategic concept to understand. It is one of those blind spots that we don't allow our people to think about, because being in geosynchronous orbit for communications is convenient. But the Army doesn't march on the sides of ridge rather than in the valley because it is convenient. They march on the sides of ridge rather than the valley because it is more protected.

For military capability, we may be convenient to be in geosynchronous orbit, but it is not militarily wise to be in geosynchronous orbit. And we can launch satellites in other orbits that are far harder for an adversary to attack, much more easily to attribute the attack once the attack occurs, and much more easy to go ahead and have a proliferated constellation of capability.

Mr. HARRISON. Thank you for the great question.

You know, I think we are seeing our adversaries do several things. So first of all, they see the great advantage space provides us. And in some cases, they are trying to copy us and build similar space systems for themselves. We also see many of our adversaries trying to counter us and to blunt our advantage in space by developing counterspace weapons.

And, you know, to build on what Mr. Loverro said, we shouldn't just think about counterspace weapons as kinetic ASAT [anti-satellite] weapons, missiles that go up, blow up a satellite, create a bunch of debris. Those are troubling, but we can attribute those very quickly. We know where they come from. And it is an overt act of war if someone does that.

So I think we are better able to deter those types of threats and respond to them. What I am concerned about are the non-kinetic types of threats that we face in space.

Mr. WILSON. Thank you very much, and I look forward to identifying who nonstate actors are, too.

Thank you.

The CHAIRMAN. Mr. Larsen.

Mr. LARSEN. Thank you, Mr. Chairman.

I don't think anyone on the panel would say our space policy is a disaster and we don't know what we are doing, and so on. But it seems like we are at an inflection point a little bit where we need to move faster than we are to change. Sort of like the guy on The Ed Sullivan Show. He is spinning 17 plates at the same time trying to keep them all up and unable to prioritize, because you can't. You have to keep all of them up instead of running around trying to do this. And I feel that we are kind of at that inflection point in space policy, like we are moving around from plate to plate to keep them all up in order to move to that next step.

And so I don't know how timely my question is, because I think one of the plates that is getting spun here has to do with the workforce side of it and what kind of workforce do we need in the future. But if we don't have an idea of policy, then we don't know what kind of workforce we need in space and what kind of warfighter we need for space.

But having said that, maybe you can help answer some of those questions, like the kind of capabilities and qualifications that are needed now, and whether it is test pilots or space acquisition professionals or satellite communications specialists. Who do we need in our military and civilian side of the world and the Pentagon to implement whatever we are moving towards?

General, have you given some thought to that over the last 4 years and—3 years in retirement or—

General KEHLER. It might surprise you to know that, yes, I have. And especially the last couple of days, before coming here.

And, by the way, all the way back to 2001, when then the Space Commission reported out that developing what they called the space cadre was going to be one of the critical things that needed to happen as we went forward. So if we were looking at the kind of space talent that we need in the future, I would say it is mixed. We are going to need people in uniforms who understand the basics and fundamentals of joint warfighting, while at the same time having expertise in the space domain and the technical requirements that go along with it. Think about submariners and submarines and the underwater environment here as a model for what we need. Those are warfighters, but they operate in a unique domain with unique platforms that can do things by themselves as well as operate with task forces, et cetera, et cetera. I think it is a good model for us to think about.

We need civilians who work in the Department of Defense and come to work every day with the deeper technical expertise and savvy in order to be thinking about how do we bring commercial opportunity in as well as do government development. We need good researchers and development kind of people. We need that as an instrument as well. And we need an industry that can support what is needed in the future, and we need to leverage the talents and skills and entrepreneurial spirit that we find in the commercial world.

So it is a blend of all those things, sir. I think that uniform people have a specific job to do here, and a skill set that is required that is a little different than those others, because they are the ones that actually have to go employ forces in combat. But it is a

broader set of questions, and we need a team that covers this skill set. By the way, cyberspace is a huge part of all of this, and so we need people that are very smart there as well.

Mr. LARSEN. Mr. Loverro.

Mr. LOVERRO. Yes. Thank you.

So I want to echo again what General Kehler said and expand it.

So what he described—when I listen to what he described, that describes a space-smart force for the Nation, a force made of civilians and military and the industrial base that supports it. Let me not talk about the industrial base as much as the folks that are inside the DOD.

Space is a different kind of domain than air in the same way that undersea is a different domain than surface combatants. The Navy actually allows its three fundamental mission areas to grow separately. The career path for a submariner is different than the career path for a surface warrior is different than the career path for a naval aviator, as it should be. Those domains are different. They require different skills, different training, different experience.

The same is true for space. Space is a different kind of domain than air. We don't need to move it out of the Air Force in order to go ahead and create the space-smart civilian and military force that we need. But we need to allow it to grow differently than the way we would grow air officers, because those are different skill sets, different domain experiences, different technical requirements, and different operational and tactical problems.

Mr. LARSEN. Yeah. Thank you.

I will send a few more questions for the record.

Thank you, Mr. Chairman.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. Thank you, Mr. Chairman. I really appreciate you all being here. Talking about this is very important, raise awareness of the concerns that we have, the threats that we face. It is unfortunate, as Mr. Harrison talked about, that we have over-classification of a lot of this information. The American people need to know it, the Congress needs to know, which is why I am glad you are here, about these threats, our vulnerabilities, and how we have to get after this.

I was also pleased to see on social media a few minutes ago that Secretary Wilson, Heather Wilson, is testifying before the House Appropriations Defense Subcommittee this morning. The first question that Chairman Granger gave her was about President Trump's call for a space force. She politely said, "We look forward to the conversation."

But I do look forward to this conversation. We are in my wheelhouse right now, and I appreciate all of you-all. You are all very sharp people.

General Hyten at STRATCOM [U.S. Strategic Command] and General Harris at PACOM have told us that in just a relatively short period of time, both China and Russia have become our peers, not our near peers, our peers in space and, moreover, are on a trajectory to surpass our capabilities soon, because they are putting

a larger percentage of their defense assets against this capability. And they have organizationally restructured.

Do you share that opinion? Is that your view as well, that unless we do something dramatically different, that we are going to be surpassed by China and Russia in that domain?

General KEHLER. Yes.

Mr. ROGERS. Mr. Loverro.

Mr. LOVERRO. Sir, I would hate to ever disagree with General Hyten; he is a good friend and I have known him a long time. I disagree that they are our peers. I do agree with him that they are on a path to surpass us if we don't go ahead and get our act together.

Mr. ROGERS. Mr. Harrison.

Mr. HARRISON. I think that Russia and China, we have to view them as differently, because they have different histories, so they are coming from different trajectories. Russia was a great space superpower back in the day under the Soviets. They degraded significantly after the fall of the Berlin Wall. But in recent years they have made a lot of efforts to regain a lot of their space capabilities, and they can still draw on that technical heritage that they had in the past, especially in terms of counterspace weapons that they had developed during the Cold War. They have that know-how. They have that expertise. It is not that difficult for them to field it again, and understand how to use it operationally.

China is a different situation. They were not a great space power in the past. They are catching up. But I would agree with the sentiment that if they are not a peer today, they will be in the near future if both countries continue on the trajectory they are now.

Mr. ROGERS. And will surpass us if we don't make some changes.

Mr. HARRISON. If we don't make some changes, it would not be hard at all for them to surpass us.

Mr. ROGERS. And would you agree that we have become heavily dependent on space to fight and win wars?

Mr. HARRISON. Absolutely. As I said in my oral and written testimony, we are heavily dependent on space across the full spectrum of combat. It is not just, you know, nuclear war. It is not just high-end combat. It is—even peacetime presence activities, we would not be able to operate as effectively as we do today without space.

Mr. ROGERS. So, again, leading questions. So would you agree that not making dramatic changes to get after this is not an option?

Mr. HARRISON. I would agree it is not an option. We desperately need to make a change in course, and where we are headed today.

Mr. ROGERS. When you look at the Air Force budget in the last decade for space programs, would you say it represents, or reflects, that the Air Force views space as a priority?

Mr. Harrison.

Mr. HARRISON. I think it reflects that we have stalled in our thinking. We have gotten frozen with fear, and we have not been able to make up our mind as an Air Force and as a nation on how we are going to move out to address these threats. So I think it has been stalled.

Mr. ROGERS. Mr. Loverro, same question. Does their budget reflect space being a priority?

Mr. LOVERRO. I don't think so, sir. The DOD budget this last year went up by 16 percent. The space budget went up by 7 percent.

Mr. ROGERS. Same question, General Kehler.

General KEHLER. So I was part of that. And what I would tell you is you have to be careful here, because the Air Force went through a time where almost every single space asset was recapitalized, from missile warning to GPS [Global Positioning System] to communications to the infrastructure that supports it. And so there was an investment time in the Air Force where that consumed a significant part of the Air Force's budget.

Since then, no. And, again, I think acquisition problems, saving the programs of record has been a real problem. And, by the way, I would agree, to just put a finer point on it, yes, if we don't act, there will be consequences for us in the future with Russia and China. But I also agree that—or I do not agree that they are necessarily our peers right now.

Mr. ROGERS. Okay.

The CHAIRMAN. Mr. Cooper.

Mr. COOPER. Thank you, Mr. Chairman.

I will not let you off as easily as Chairman Rogers did. I would like each of you to answer two questions. Number one, what did the President mean yesterday when he said space force? And, number two, what should he have meant in his remarks?

General KEHLER. I notice my good colleagues were looking in my direction, sir.

Well, I don't know what he meant, sir, to be honest with you. I am not an insider, and so I don't have the benefit of knowing sort of what conversations have been held with the Commander in Chief on this. So I really don't know.

What should he have meant is really another question about what we should do. And I would tell you that while I think steps are necessary beyond what has been taken to date, to me, this is a matter of degree. If you are going to do something dramatic, then I think there is more than one model you could follow. And I would be urging that you carefully consider those, because there are pros and cons to each one of those models.

When I commanded Air Force Space Command before I commanded U.S. Strategic Command, I thought I was commanding most of the Nation's military space forces. And so I think you have choices you can make here about what needs to happen next, and I would just urge you to be sensitive and thoughtful to what those are and what the pros and cons are of each.

Mr. LOVERRO. So, first of all, I don't know what the President meant, although many people have blamed me for making him say it, so—but that is not the case.

Let me tell you what I think he should have meant. We have a military service whose sole mission it is to prepare this Nation to go ahead and win in the sea. We have a military service whose sole purpose is to prepare this Nation to win on land. We have a military service in this Nation whose sole purpose is to win in the air, and to protect our interests in the air. And we now have at least a unified command whose sole purpose is to make sure we stay ahead and win in cyberspace. We lack that focus for space, one of

our major five warfighting domains. And I may be biased, but I think one of the most important.

That focus is necessary to create the long-term dynamic to keep us in the lead. And so when I think about a space force, I think about not just what is in Air Force Space Command today. I think about what is in the Missile Defense Agency. I think about the Army Space and Missile Defense Center. I think about the Naval Research Laboratory. I think about all of the components that create the ability to protect U.S. interests in, from, and through space. That should be our focus. What is the right organizational structure to create a service whose sole responsibility is to protect U.S. interests in, from, and through space. And I don't believe we have that today.

Mr. HARRISON. You know, as my fellow panelists here said, I am not sure exactly what he meant. I saw the video, as I am sure you did as well. It appeared that he was thinking kind of off the cuff, and he had not looked into the history. I would not presume that the President had read things like the Allard Commission Report, or the Rumsfeld Commission Report, that looked at these issues in the past.

This is something that has been an ongoing discussion for at least two decades. I think what he should have meant, and there is some hints of this in his remarks, is that given the increased emphasis we are placing on space, and the investments that are going into space, that we need to look at reorganizing our military around this domain, so we can operate more effectively in this domain.

And, you know, as I was sitting here thinking about this, I looked right here in front of us is a little plaque with Article I, Section 8 of the Constitution. And as you read that, you know, it gives Congress the power to, you know, raise an Army and to maintain a Navy. It doesn't mention air. Of course, there was no air domain at that time. And, you know, that is just proof that we have to evolve our organizations. We have to evolve our thinking over time. And I think that we have reached that point now with space as a fourth physical domain. And then thinking of cyber as well as a fifth virtual domain, and that it is time that we rethink some of our major organizational structures around that.

So I think that is what he should have meant and, you know, should then lead to deeper discussion about how do we do that and how do we make this transition.

The CHAIRMAN. That plaque also reminds us what our job is in this, and sometimes it is easy for us to just look to the Pentagon to give us the answers. But that is not what the Constitution says.

Mr. Conaway.

Mr. CONAWAY. Thank you, Mr. Chairman.

Gentlemen, thank you. As China and Russia get close to where we are now and/or exceed us, at what point is an opportunity for a Geneva Convention-like agreement as to how we would conduct ourselves in a fight like this, and then should that go forward, who starts it and how does that work? And then how would we try to leak in nonstate actors who could also have access to certain things that could be disruptive.

So is there a Geneva Convention codicil in the works somewhere?

Mr. LOVERRO. Sir, I think the need for that is absolutely clear. Let me point back to January 2007 when the Chinese shot their own satellite and created thousands of pieces of debris in space. We all remember that date.

When that happened, the entire world said that is unacceptable. Creating that much debris in space is unacceptable. And even the Chinese admitted it was unacceptable, because they have never done it again.

I believe that we should be negotiating with our adversaries, that there is some kind of space weapons, just like chemical weapons on the land, or just like bombardment from the air. You know, these kind of weapons are not acceptable. We know you are going to attack our space stuff. Fine. Go for it. But let's not go ahead and create indiscriminate harm to other actors and to the environment while we do it.

I actually believe we could get that agreement with China, probably with Russia after China, and then with the international community. I think that that would be something that is in our national interest and their national interest to do.

General KEHLER. And, sir, I agree that it is in our national interest, I think, to agree, in the international community, on some kind of, what we called for a long time, rules of the road. I think if you take other steps beyond that and start talking about formal arms control agreements and that sort of thing, those are very difficult. For a long time, we have struggled with just the concept of what constitutes a weapon in space. You can take almost anything that is in space today and use it as a weapon against something else that is in space if you have enough fuel to do it.

So I think there are—it would certainly benefit. It would help our commanders and our policy makers understand things like what constitutes hostile intent? What constitutes a hostile act? How do you know if someone is threatening you or not? I think this is going to be even harder when commercial interests go to orbit to do close-proximity servicing, for example. Those are going to be difficult challenges for us, and there needs to be some structure around how we operate in space.

Mr. CONAWAY. Mr. Harrison.

Mr. HARRISON. I would just echo those comments, but also add that, you know, in the long-term, we do need something through United Nations, Geneva Convention. The things we need to, you know, get clarified are what is considered a combatant versus a noncombatant in space, when these are all, for military purposes, are unmanned platforms. What is a proportionate response to an attack in space? You know, we reserve the right to respond at the time, place, and domain of our choosing. If someone does something against a critical U.S. satellite, is it proportionate to do something on the ground that causes the direct loss of life. You know, I think those are questions we need to search through.

In the near term, though, I think what we can do is have discussions with our allies and our partners about norms of conduct. You know, what are the rules of the road? What are the right ways to act? And if we set those and start following them ourselves, which I don't think would be hard to do, and get our allies and partners on board as well, even if adversaries do not want to follow those,

we at least have some basis of comparison to look at their actions. And it is complicated in space because of orbital mechanics. But, you know, simple things like how close of an approach to another uncooperating satellite is too close. It can get very complicated. But I think we need to work down through those questions and try to come to some sort of a consensus, at least within the United States.

Mr. CONAWAY. Thank you.

General, real quickly. The uniformed space corps, uniformed space fighter, warfighter, is that group big enough to provide career longevity, career advancement, career challenges that would allow that to not be a dead-end career path?

General KEHLER. I don't think so. I think that developing the uniformed piece of this is an important question as we go forward. I think that, you know, the services across the board have said they need to be bigger for lots of reasons. I think space falls into that category. I think that there are more uniformed people that are needed. And I think that, you know, the points here earlier about making sure that there is a career progression, I think that there are models out there that we can use and we can follow. And again, a lot of the pieces are in place; we just need to go do it.

Mr. CONAWAY. Thank you.

The CHAIRMAN. Ms. Bordallo.

Ms. BORDALLO. Thank you very much, Mr. Chairman. General Kehler and Mr. Loverro and Mr. Harrison, thank you all for being here.

General, the United States Strategic Command has identified an urgent need to rapidly reconstitute and replenish critical space capabilities to preserve continuity of operational capability. So can you please speak to some of the investments in low-cost responsive launch options that you would recommend the Department pursue to fulfill this need?

General KEHLER. I would say, first of all, that, in general terms, the Department hasn't invested enough in the entire concept of operationally responsive space. How much should be invested in each of the parts, I think, is getting a pretty thorough review right now. What encourages me the most now is the launch developments that have occurred in the commercial world, because I think that the commercial activity here promises to be a game changer and in many ways has been a game changer to this point.

So I would be looking to leverage commercial opportunities and low-cost commercial opportunities, first, before I went down the pathway of investing a lot more government money in government-sponsored kind of new launch capabilities, small launch capabilities. So that would be part one.

Part two, what is done in operationally responsive space concepts needs to fit in with what my colleagues were talking about earlier with the new architecture approach to what we do on orbit. Things that are being talked about now inside the Department, inside the Air Force, inside U.S. Strategic Command, different architectural approaches, whether those are smaller payloads that are replenished sooner, whether it is ridesharing, whether it is leveraging commercial, all of those things that need to go into an overall architecture approach that I think then helps define where we need to invest, what we need to invest in.

In my experience in the past, one of the issues has been you can deploy and buy small satellites; it is what you put on them that turns out to be the long pole in the tent, the payloads that go on them. So I think there is investment that is required. I don't know exactly where we should invest, but I would be careful about investing in small launch vehicles because I think commercial is going to get us there and in many cases has taken us there now.

Ms. BORDALLO. Thank you. My second question is, today, nearly all U.S. national security satellites are launched from fixed coastal U.S. launch sites that could easily be disrupted. So these fixed sites also provide predictable locations from which adversaries could glean clues to discern U.S. capabilities and other gaps. DOE [Department of Energy] developed more diverse launch sites using new commercial capabilities to address these weaknesses and support rapid, responsive, and resilient polar launch capability.

General KEHLER. There have been alternative launch sites in existence for quite some time. For lots of reasons, they haven't really taken hold. I think this is another opportunity where I would like to see commercial enterprise take us there. But I agree with you, we ought to be more diversified in getting to orbit, whether that is leveraging allied activities as well or making sure that we are leveraging where commercial is going, to include alternative means of launching, maybe taking things aloft on aircraft, et cetera. And a lot of those are underway right now in various commercial settings.

Ms. BORDALLO. Yes. Well, General, I represent Guam, and there have been interested individuals out there trying to launch—doing their launch operations and have visited our Air Force and also our commercial airport—our international Guam airport.

General KEHLER. SpaceX was on Kwajalein for a little while as well. And, you know, we have done launches from other places. I think it is a matter of—I would like to see commercial take us there, and my colleagues have views on this as well, I know.

Ms. BORDALLO. Would anyone like to add to that?

Mr. LOVERRO. Let me go ahead and add to that, if I could, ma'am. So first of all, I absolutely agree we need more diversity in launch, although I always try to remind us that launch is part of getting the mission started, not the mission in and of itself.

I am very excited by what I see in the commercial world in terms of small launch, whether that is Rocket Lab launching from New Zealand, Virgin Orbit with their plane that can launch from anywhere in the world, Stratolaunch trying to do the same kind of thing. These are commercial capabilities that we don't need to invest in, but we need to embrace.

Ms. BORDALLO. Right.

Mr. LOVERRO. And that is the key that we have to understand. There is never going to be a time where we have the luxury of unlimited resources. We need to embrace these commercial and allied capabilities so that we can invest in the pointy end of the spear, not on the back end of the spear.

Ms. BORDALLO. Thank you. Mr. Chairman, I yield back.

The CHAIRMAN. Mr. Lamborn.

Mr. LAMBORN. Thank you, Mr. Chairman. And thank all of you for the service that you give to our country in various ways. I sure appreciate it. I think we all do.

Mr. Loverro, you said in your written testimony, quote, “a key element of any future space strategy is the ability to operationally test that strategy under real life conditions,” end quote. And you use an example that after losses in Vietnam, the Air Force created Red Flag, and that helped staunch the flow of losses. And we were talking about this yesterday.

Could you follow on that? And because Representative Bordallo has mentioned her district, I will mention my district. We have had some Space Flag exercises in Colorado Springs, and I think that is a good precedent here for this kind of testing that we need to do. Could you elaborate on that, please?

Mr. LOVERRO. Absolutely, sir, I would be pleased to. So, you know, when we talk about testing and training environments within the DOD, we can mean anything from what is called the tabletop exercise, where nothing is actually happening other than written pieces of paper going back and forth, to full Red Flag exercises where we have people who are simulating aggressor tactics and aggressor-like aircraft against our own forces and actually trying to win the fight. And everywhere in between: simulators, computer-driven exercises.

In the air world, in the sea world, in the land world, we cover that entire gamut because we understand to actually become an expert in that kind of warfighting, you must cover that entire gamut.

In space, we are limited to computer simulations and tabletop exercises. Those are important, but insufficient. We need an investment in on-orbit assets that our warfighters can use to simulate tactics in space, try out the plans they have developed. Did that work? Were we able to observe the adversary movement in the timeliness and thoroughness that we thought we would be able to? You can't know that from a computer.

The computer will always tell you, yes, you observed it, because it is programmed to do that. You have to try that in space with real assets. That is a critical investment area, we know it is a critical investment area, but we are not investing there because it is, quite frankly, expensive and we are spending money elsewhere. As Mr. Harrison has suggested and I suggested and I think General Kehler would agree, we can allow the commercial world to pay for a lot of the things that we are investing in ourselves so we can invest in things that the commercial world won't invest in, like test assets that we are going to fight in space. Those are a peculiar military need that we should be focused on.

Mr. LAMBORN. General Kehler or Mr. Harrison, can you add anything about the need for more space warfighting training?

General KEHLER. You need to take a page from every other domain, every other military service. If you want to have an effective warfighting force, you have to train, educate, exercise, test, simulate, do all those things. And for lots—again, for lots of reasons, over the years, we have shortchanged space on many of those things.

I will tell you that space is part of Red Flag. If you were to go to Red Flag, space is part of Red Flag. It is different to hold a space

Red Flag. It is a little bit different focus. We have done one of those, I am told, here fairly recently. The mechanisms are in place to do these things. I think it is a matter of focus and attention, and at some level, it is a matter of resources. If you want to have simulators and training and test assets and those kind of things, it costs money.

Mr. HARRISON. I would add that one thing that we should try to do differently in space and do better than we do in the other domains is how we measure readiness. And, you know, our traditional approach to readiness is not serving us well because many of our measures are based on the inputs. Do we have enough people? Do we have enough people of the right training level? You know, how much training did we do in the past year? And it is more of a checkbox approach to get your swords ratings, then go into the readiness system, that then get aggregated and presented to Congress. That is not sufficient in the other domains; it is certainly not sufficient in space.

If you want an adequate picture of readiness, you need to do these exercises, you need to do these tests, and you need to measure performance. So, for example, as I said in my testimony, the ability to quickly detect and attribute different types of attack is important. Let's test that. Let's use whatever resources we have. Let's have a simulated attack. Let's see how long it takes to detect it and to attribute it to the right source. Let's measure those things and let's report those as measures of readiness, not did we do the training or not or did we have, you know, the certain number of people.

Mr. LAMBORN. Well, let's all move forward together on better and more advanced space warfighting training.

Thank you, Mr. Chairman. I yield back.

The CHAIRMAN. Mr. Carbajal.

Mr. CARBAJAL. Thank you, Mr. Chair. Thank you all for being here today.

The Department of Defense is conducting a study known as analysis of alternatives [AOA] on how to best meet the exponentially increasing demand for satellite communications connectivity for military and government users. Even if the DOD completes its study on time, the timeline for providing increased satellite capacity would be no earlier than the late 2020s, resulting in a gap of time where military demand for connectivity could exceed supply. This means our military could face diminished communications capability while they are executing critical missions if the DOD does not procure additional space craft or capability.

The current threat calls for more anti-jam capable satellites to provide assured communications for the warfighter in contested space. How should the Air Force plan to meet this need now, to all three of you?

General KEHLER. Sir, the very best architecture studies and the very best pathway to the future will continue to run headlong into an acquisition process that doesn't allow you to get there before the late 2020s or the early 2030s, unless we add some rapid acquisition capabilities to space, which I think is an urgent need to have happen.

There needs to be an architecture that—an updated architecture was mentioned here by the panel before, that talks about communications that involves high-end protected communications that the government will need to do for itself, followed by the commercial communications that can be leveraged for government use, of which there are a lot of options out there and more coming every day. And then we need to change the model for how we go buy it.

Your point about an analysis of alternatives that takes years to complete and posits answers way in the future is not going to be acceptable. It is going to put us way behind. And I think it is one of the urgent issues that needs to get addressed in terms of what have we got to do to help ourselves out of this problem we have with space.

Mr. LOVERRO. So let me add two thoughts to what General Kehler said, and one that may surprise members of this committee. I actually, quite frankly, recoil when I hear the fact that the problem is the acquisition problem. I think that is a shorthand for saying the real problem is the decision process of which the acquisition process is part.

We have to decide what to buy. Now, don't get me wrong, we are slow at buying things using normal defense planning, and we should be faster at that. But we canceled the TSAT [Transformational Satellite Communications System] program, the anti-jam capable system that we intended to build in the early part of this century. We canceled it in 2009. We have yet to decide what to replace it with, much less begin the program. That is not an acquisition problem; that is a decision problem. And that decision problem exists because there are too many people who can have an opinion in that debate.

Regardless of AOAs, regardless of all the thinking, the Air Force doesn't get to make that decision themselves. I think if they did, the Air Force would have decided. I can't tell you if they would have decided right or wrong, but I can tell you they would have decided, a program would be underway. We would all be worried about how long the program was taking, but the program would already be there. We have a decision process within DOD because we have not centralized thinking about space in the same way we centralize thinking about air, land, and sea.

So the second question, how do we get there faster? You know, we have—there are 450 commercial communication satellites in the geosynchronous belt. There are going to be, in the next 10 years, upwards of 4,000 to 5,000 communication satellites in the Earth's orbit belt. We should be actively investing in those capabilities today.

In fact, the official Air Force plan is to not buy another communication satellite like the wideband global satellite but rather to invest in those commercial companies to have them field the capabilities we need in terms of anti-jam. And yet, that program has not been funded adequately since the Air Force first presented it over 7 years ago. That program would have already yielded significant capability in space and we wouldn't need an AOA to come to the conclusion that knowledgeable people already have that that is the best way to get that.

We should be investing today in cyber hardening of all of these LEO [low Earth orbit] constellations so that we can use them for our warfighters, because they are going to be up there in 4 or 5 years and our warfighters will not be able to depend upon them because their ground systems will not have the cyber protections necessary that we could pay for by pennies on the dollar as these systems are developed. Those kind of decisions are decision problems—I don't like to call them acquisition problems, because they are a decision to act. They will be an acquisition problem beyond that. Let's decide to act first, and that is where we have really fallen down is in deciding to act.

Mr. CARBAJAL. Thank you. I yield back, Mr. Chair.

The CHAIRMAN. Mr. Harrison, is there something briefly you want to add to this question?

Mr. HARRISON. I would briefly add to that, that part of it is that we have built up institutions around certain mission areas and doing missions in a certain way. You know, we have a wide—we have had a wideband program office, the Space and Missile Systems Center. Their job has historically been to acquire wideband satellites. Now we are looking at an era where we don't need to acquire them; we can buy it as a service. Well, buying SATCOM as a service has been the responsibility of DISA [Defense Information Systems Agency], an entirely different organization, an entirely different chain of command, and an entirely different budget.

When your organization is fractured like that, it is hard to make a good decision and be able to make adequate tradeoffs. And so that is why I think we see the military struggling with this analysis of alternatives. It is just the institutions that we built aren't fit for the needs that we have today.

Mr. CARBAJAL. Thank you. And thank you, Mr. Chair, for the additional time.

The CHAIRMAN. Mr. Scott.

Mr. SCOTT. Thank you, Mr. Chairman. Gentlemen, thank you for being here.

And, Mr. Loverro, I listened closely to what you said about canceling a mission that they were—or a platform they were about to purchase in 2009, and here they are, they still haven't decided what they are going to use to replace the mission. The JSTARS [Joint Surveillance Target Attack Radar System] mission comes to mind as I listen to that. And as I look at us becoming more and more dependent on space, it seems to me that the acquisition process, the decision, if you will, becomes more complex and perhaps takes longer to actually field the items that we need than an airplane or a tank or something along those lines.

But to read directly from your remarks, make no mistake in all three U.S.-based sectors, national security, civil, and commercial, the U.S. continues to lead the world. It talks about others catching us, but—so you say that we lead the world, but yet we are totally dependent upon the acquisition of Russian rockets to launch our space-based capabilities. And those two things seem to be in conflict with each other.

How is it that we dominate, but we don't have the ability to launch our own capabilities? And if you were sitting in the Rus-

sians' shoes, wouldn't you simply take away that ability from the U.S. if you saw that they were about to launch a great system?

Mr. LOVERRO. Sir, that is a very difficult question you have posed for me there. Number one, I don't think we should be dependent upon Russian rockets, and we could have made decisions way in the past to change that.

Mr. SCOTT. Absolutely.

Mr. LOVERRO. In fact, there was direction from three successive acquisition chiefs in the Pentagon to make that not happen and it was ignored, unfortunately, every time, starting as far back as 2004. That is a reliance that we should not have and we should correct that. And we are on the path to correct it, but we should have corrected it long ago.

Number two, will the Russians go ahead and eliminate their provisions of those engines for strategic reasons? I don't know what is in their mind. I find it hard to understand—

Mr. SCOTT. Do you agree that they could?

Mr. LOVERRO. They could. And that is a vulnerability we can't stand.

Mr. SCOTT. Sure.

Mr. LOVERRO. We know how to build rocket engines in the United States of America. We built the most powerful rocket engines ever developed in the world in the United States of America. And we have, not only through NASA [National Aeronautics and Space Administration] and through the Air Force, but also through commercial world we have the most robust launch infrastructure of any nation in any time in history today. I really do want to salute the DOD for changing their tune on things like SpaceX, and I want to salute ULA [United Launch Alliance] for making the changes they have made.

Mr. SCOTT. I am down to about 2 minutes. If I may, one of the things that has been talked about is the difficulty of defending our space-based capabilities, the jamming of equipment that is available, which is of serious concern to me, and the ability to break our communications if we become too dependent on space and don't have redundant communication systems. Where does that leave us? And how vulnerable do we become by becoming dependent with no redundant system to communicate without it?

And it brings me to a question for you, General Kehler. If our space-based capabilities are attacked, can you speak to the ability to reconstitute those capabilities along with the anticipated timeline and what this would mean operationally for continued war-fighting, assuming we have no redundancies?

General KEHLER. Yes. Well, you nailed it, I think. This is an architectural question. We can't be in a position where our forces can't operate without space. And by the way, I don't think we would be. What happens, though, is that it is like a time machine: The more space you take away, the farther back in time our forces go in terms of how they would operate. So I think we have some significant issues about connectivity for nuclear command and control and other things that rely very heavily on space. So we can't find ourselves in that position.

Mr. SCOTT. As a general, if you are in a battle and you lose your space-based communications and you have no redundancy and you had to repair the space-based communications—

General KEHLER. We do not have the wherewithal today to quickly replenish in a significant way what we could lose in terms of a determined adversary attack on space.

Mr. SCOTT. All right. My concern is that the battle would be over, and potentially the war, before we could ever get—I am out of time, Mr. Harrison.

Mr. Chairman, I think he had a comment.

The CHAIRMAN. Do you have something you want to add? I get more flexible as time goes on.

Mr. HARRISON. I will take advantage of that then.

I would just add that we may not want to focus too much on rapid reconstitution. That is one way to improve mission assurance. But it is really—you know, if you think through it in a war crisis type exercise, it is only good for a limited set of circumstances. So depending on the type of attack, you may not want to reconstitute right away, because you would just be launching another billion dollar satellite that will just get destroyed again. Also, if it is—you know, you may have created a lot of debris, you might not want to launch into that orbit. But also, if it is a nonkinetic attack, particularly a reversible attack, like jamming, they are just going to jam that one as well.

So I think what we really ought to be looking at, first and foremost, is how to avoid getting in that situation where we would need to reconstitute. How do we develop systems that degrade more gracefully? How do we develop systems that are just harder to attack, so that someone, instead of attacking in space, they will choose to attack in another domain, through another vector?

The CHAIRMAN. Mr. Norcross.

Mr. NORCROSS. Thank you, Mr. Chairman.

Actually, I just want to expand on some of the discussion you just had. Over the last few years, our NATO [North Atlantic Treaty Organization] agreement started to address the cyber. It is not as clear; when soldier come at you, you know who it is. In space, you talked about the jamming issue.

Let's talk about kinetic strikes. What is our ability to track where that attack came from, A, from the physical standpoint, and then who is controlling what happened? Oh, I am sorry, General.

General KEHLER. Sir, if I understand your question correctly, you are asking—

Mr. NORCROSS. If there was an attack, physical attack in space on one of our assets.

General KEHLER. Right. Well, it is not nearly what it needs to be. We are very good at tracking rockets and missiles of certain classes and sizes that get launched from the face of the Earth. We are very good at that. Once things are on orbit, though, we have significant deficiencies in how quickly we can detect if something has maneuvered, how quickly we can detect that something might be approaching an asset of high value, and the list goes on.

Mr. NORCROSS. In terms of tracking debris or satellites.

General KEHLER. Yep. And it is true across the board with debris or hostile actors or other satellites that happen to be up there. And

this is why the—certainly, the military has been arguing for quite some time that we need to invest more in what they call space situational awareness. We need to get from a time where they are basically maintaining a catalog of what is up there and checking it periodically to see what changes, to real-time situational awareness like we would have in the air if we were in a conflict.

Mr. NORCROSS. Funny you should mention that. We have an off-the-shelf piece that we have been discussing for a number of years. But that will show you where the asset is versus the other asset in terms of an actual attack.

General KEHLER. Right.

Mr. NORCROSS. How do you track that?

General KEHLER. And then there is being able to track in sort of close proximity to one another and there is deciphering what actually happened to you, whether what happened is a technical problem or some hostile act. Those are all things that need to be worked, because we aren't nearly where we need to be in all of those areas.

Mr. NORCROSS. In terms of debris. Debris is a relative term. Some accidental, some very deliberate. If there was an intentional—and this is under the guise that we are going to have a very bad day, but debris is probably one of the easiest things to put up there to disrupt us. Maneuverability is short term for our assets to get out of the way. How would you rate our ability to do that today?

Mr. LOVERRO. Sir, I am going to—let me address the question in two ways. First of all, if you want to attack something in a military effective way, debris isn't a particularly good way to do it. Debris is a long-term problem, but not a short-term preferred method of attacking, because space—we don't understand how big space really is. So we could move out of the way of debris, we do it all the time. The space station does it all the time. Air Force Space Command tracks the debris and the space station maneuvers if it believes it is going to be too close. And we can do that for most of our satellites that are in a debris area, which are our low Earth satellites. Some of our older satellites, no, but most of our satellites that have been launched in the last 20 years could do that.

The big problem is we—what might look like debris may actually be a deliberate attack. That is the harder problem to deal with. And some CubeSat that has minimal propulsion could easily go ahead and impact into a multibillion dollar satellite and destroy it, and that might just—and it would be very difficult for us to detect that movement and very difficult for us to attribute who caused that to occur.

Mr. HARRISON. I would add to that that part of the problem with debris is it has indiscriminate long-term effects, right? And so it is going to affect anyone in a similar orbital regime. You know, in terms of maneuverability, the real question is, you know, how feasible is it to maneuver out of the way of a homing warhead of some kind. So something that is not an unguided piece of debris, but something that is trying actively to steer its way into you. That is a very tough problem in physics because that warhead is small, the amount of propellant it needs to maneuver is exponentially smaller because of the weight. And it is willing to expend 100 percent of

its propellant to hit you, whereas your satellite, you are large, you are lumbering, you are slow moving, you have limited propellant reserves on board and you do not want to expend much of that propellant because that will ultimately shorten the life of your system. So maneuverability in many cases is just not a feasible option against any kind of homing warhead.

Mr. NORCROSS. Thank you. I will yield back.

The CHAIRMAN. Mr. Coffman.

Mr. COFFMAN. Thank you, Mr. Chairman.

To all the panelists, in fiscal year 2018, Congress authorized advanced procurement for SBIRS [Space-Based Infrared System], space vehicle 7 and 8. However, the Air Force is no longer interested in procuring SV 7 and 8. Instead, the Air Force would like to disaggregate strategic and tactical payloads from one another. However, the Air Force is still planning to use the same spacecraft buses, the same, quote/unquote, big, juicy targets, as General Hyten calls it.

Does this approach initiate risk by cutting short the program of record, especially before it has reached full operational capability? Please explain why or why not.

General, let's start with you.

General KEHLER. So, Congressman, here is where I would agree with them. I would agree that we should not continue to do business as usual. The alternative, though, I am not clear yet on whether the alternative is substantially a different approach. If it is, then I would support it. If it isn't, then I would continue to have the same question that General Hyten has.

And so I would listen very carefully to kind of where the combatant commander comes out on this to assess whether he thinks his warfighting capabilities are being materially improved by an action that the service is taking. So they should be in lockstep on this, and I don't know if there is some issues about having to transition some way or I don't know what the other factors are that they considered. But I do agree that business as usual is not the way to go forward on that and other constellations as well, and they need to come up with alternative ways to make themselves more resilient and defensible.

Mr. COFFMAN. Mr. Loverro.

Mr. LOVERRO. Yes, sir. I agree wholeheartedly with General Kehler. First of all, I don't think we should build any more SBIRS. We have enough SBIRS and DSP [Defense Support Program] satellites to last us well to the end of the next decade. What we need to do is build a more resilient missile warning architecture than we have today. And as best I can tell from the budget documents, what has been specified is not any more resilient than what we have today. It may be new, but it is not more resilient because it is using the same bus, as you already stated. It still remains the big, juicy target that is going to still take 8 to 10 years to develop. That is unacceptable.

We have alternatives today—they have been proven, they have been flown, they have been shown to be effective—that we could easily launch within 3 years, 5 years at the outside, given the budget process. And yet we sure have chosen not to do that because, as Mr. Harrison has said, culturally we don't think about

the problem that way and they would be far more resilient than what we have today.

Mr. COFFMAN. Mr. Harrison.

Mr. HARRISON. I would agree that I am not sold on the new path forward on SBIRS. I think disaggregating the strategic and tactical missions onto different satellites that are basically the same as what we have today, I don't think that that improves resilience or deterrence against an adversary because are they really going to believe what is on what satellite.

I think we need to break up that mission, break it open, and look at it more broadly. And I think that there is a good case to be made for our tactical missile warning needs, that they could be better met in low Earth orbit with a large constellation of smaller satellites in low Earth orbit that are used not just for detection of a launch, but for tracking and target discrimination in midcourse.

If you talk to folks in Missile Defense Agency, they will tell you that the single most important thing we could do to improve the effectiveness of our theater and national missile defense systems is better tracking and target discrimination in midcourse. That is what they need. We can do that with a constellation in low Earth orbit.

Mr. COFFMAN. Would it be more prudent and responsible to incorporate a new start after seven and eight, to include the option of augmenting capabilities through a payload? I don't have a lot of time, but, General?

General KEHLER. It depends, I think, on how quickly and whether it is affordable and whether we have enough agility to actually make a big transition now. If you can, then I would transition. If you can't, then this is the first rule of wing walking, don't let go until you are holding on.

Mr. COFFMAN. Okay.

General KEHLER. So we just want to make sure we are cautious about how we did it.

Mr. COFFMAN. Mr. Loverro.

Mr. LOVERRO. Sir, I do not believe that we should buy seven and eight under any conditions. It is the wrong strategic tool for our warfighters, and that should drive our thinking, not our fear of something new. And we know how to apply things better if we want to. We have got to go ahead and overcome that fear. And I am fully confident we have enough time, given the six SBIR satellites we have already bought and the classified number of DSP satellites that are still in operation.

Mr. COFFMAN. Mr. Chairman, may I finish?

Mr. Harrison, can you respond, quickly?

Mr. HARRISON. I would quickly add and say that I think in terms of the strategic missile warning mission, more payloads in more places is better. That will make us more resilient. So if we can take the payloads, similar to what is on our SBIR satellite, and put them just in more places, if we can host payloads, we have done the commercially hosted infrared payload experiment in the past, more of that will help make the system more resilient. So I think that would be a good use of funding.

Mr. COFFMAN. Thank you, Mr. Chairman. I yield back.

The CHAIRMAN. Mr. Bacon.

Mr. BACON. Thank you, gentlemen, for being here. I appreciate all your expert testimony. And I used to work with General Kehler when I was the one-star at Offutt Air Force Base and he was the four-star STRATCOM commander. I have a funny memory I just have got to share real quick. My four-star boss was at Langley Air Force Base, Virginia, and I remember General Kehler saying, your dad may be at Langley, but I am your great uncle, and I talk to your dad all the time.

General KEHLER. I remember that.

Mr. BACON. So it is good to be with my great uncle here.

So we look at having a new space force and having a debate. I think a couple of things we need to look at, one of them is acquisition and the decision-making process, as you say. I think Mike Rogers does a great job showing all the duplication that goes on there, a bunch of the services, and that there may be a—there has got to be a better way to do it. But the one that concerns me more is the culture and building of warfighting space culture. And when our space warfighter lieutenants come in and our airmen come in, I think we need to have that thought process that they are the very best. They can achieve service chief 35 years later.

And I don't know that we can say that today with the Air Force. I think we have to be honest, it is a fighter pilot oriented culture, 80 percent anyway. I mean, we have bomber pilots and air lifters. But by and large, it is a fighter pilot culture. If you look at our service chiefs going back a couple decades, with maybe one exception, you know, it has been a fighter pilot. And I have got to tell you, General Goldfein is the best of the best. I think he is an outstanding leader. I think he is onto this problem too, how do we build a space warrior culture within the Air Force? The Navy has obviously done it. They have submariners, surface, aviators, all of them compete equally for that service chief's job or the CNO [Chief of Naval Operations] position.

So my question to you three today would be, how does the Air Force work to getting a culture where the space and the air domain, the fighter pilot culture becomes equal? How do we change that to become more like what the Navy has today? Is it doable? And I will say I know General Goldfein is committed to this, but I think it is a hard task. And I embrace his desire, but how does this happen? And I turn the floor over to you.

General KEHLER. Congressman, I was really glad that this wasn't some retribution for me commenting about being your uncle.

So first, I think I would ask myself, is it feasible? Is it feasible for the United States Air Force to do what it is that needs to be done? I am a non-pilot in the United States Air Force for 39 years. I believe it is feasible for the United States Air Force to do what needs to be done here. And I think what needs to be done is there needs to be a conscious effort to over-nurture space for a time until it gains that kind of traction that we are talking about here.

I think that—and that is a step, by the way. It may be that we need to go to a separate space corps or a separate space force or something in the future, but those are really, really big steps that bring with them other things that we ought to think about carefully, I believe. I do think that the pieces are in place there today in the Air Force. We haven't sat there idly over the last 20 years.

As a matter of fact, since Desert Shield and Desert Storm, there is a lot that has been done inside the Air Force.

But what has not happened, I think, is that it has not gotten the consistent priority treatment that it needs, to include a management of personnel that makes non-aviators warfighters through the processes that the warfighters go through, that the aviators go through as well, similar processes to that. I think it is doable. I think it requires a deliberate action on the part of the Air Force. And I think it involves helping this hybrid command called Air Force Space Command that has the pieces that it needs to grow up some more too with some acquisition authorities and other things.

So I think it is feasible. I think it is possible. In the near term, my preference would be to see that, because we have urgent matters that need to be solved. I would hold the people in those jobs accountable for solving them, instead of coming up with something new that could be a distraction. So I am not opposed, but I would be careful about how we go forward here.

Mr. BACON. Thank you, General Kehler. And I know General Goldfein is committed to that. I have talked to him personally.

Mr. Loverro.

Mr. LOVERRO. Yes, sir. So General Kehler and I have argued about this before, and it is a question of do you peel the Band-Aid off slowly or do you rip the Band-Aid off. I am ready to rip the Band-Aid off. The Air Force space corps needs an identifiable existence within the Air Force. Today, the Air Force space corps is made up of 2,000 individuals who are called space operators. They have a specific identification code. There are 2,000 of them, that is all there ever will be. You can't build the corps out of that.

There are another 3,000 who use space acquisition who are not identified as space warriors who should be because they have the skills there that are distributed between the NRO [National Reconnaissance Office] and the Space and Missile Systems Center. There are another several hundred who are in space intelligence officers, space maintainers, space thinkers, all of—none of these people are identified as space people and, therefore, we cannot get to the requisite number of space smart folks who have the variety of those experiences necessary to build that space warrior in the future.

The path that leads to a pilot doesn't include Wright-Patterson Air Force Base. The path that leads to a space warrior probably does include the NRO and the Space and Missile Systems Center. There are two different paths. There are different kind of career progressions, and the Air Force is unable to go ahead and manage that within their current personnel system.

Mr. BACON. Thank you. I defer to the chairman if we get one more answer in. Thank you.

Mr. HARRISON. I would add one more thing. I think it actually is a larger issue than just space within the Air Force. I think it is a broader issue that Congress needs to address of DOPMA [Defense Officer Personnel Management Act] reform. And the personnel system overall needs to be updated, quite frankly, that some parts of the career model that were built in decades ago are no longer working very well. Things like the up-or-out promotion system and all of the joint service requirements and all the educational requirements that we put on folks. I think that is contrib-

uting to the pilot shortfall in the Air Force, quite frankly. I think it is also contributing to the lack of ability to create a viable space cadre within the Air Force. So I think this is a bigger personnel reform issue that I am hopeful Congress will tackle.

Mr. BACON. Thank you. And thank you, Mr. Chairman.

General KEHLER. Mr. Chairman, could I—I know that I am probably violating some terrible rule here. Could I just add one other thing?

The CHAIRMAN. Of course.

General KEHLER. Five of the last four-star commanders of Air Force Space Command have been non-pilots. The other one was a pilot, but he was also a three-time shuttle pilot. He qualifies, as far as I am concerned. Anybody who has been a satellite I think is okay to command Air Force Space Command. Three of those six have become the commander of U.S. Strategic Command, the combatant commander. In the last couple of times that the Air Force has considered senior officers to be the chief of staff, I know that some of those officers were actively considered to be the chief of staff.

So I think that to suggest that somehow that there has been no progress here is not a good way to think about this. I do think there are problems that need to be addressed. And I think that there are issues for the Air Force to address that have been laid out for quite some time that can be addressed. But I just wanted to point out that there are some things here that I think you should take note of.

The CHAIRMAN. Mr. Hice.

Mr. HICE. Thank you, Mr. Chairman.

Mr. Harrison, I would like to follow up on a comment you made that you are more concerned with the nonkinetic threats in space right now. I would like to expand a little bit more on that, specifically in regard to, is the concern that it is harder to attribute the attacks? Is it that it is harder for us to counter the attacks? Is it a threat to our satellites? All of the above or whatever? If you could just go further with it.

Mr. HARRISON. I am more concerned about the nonkinetic types of threats because I think they are harder to deter for a variety of reasons. And so when I say nonkinetic, I am talking about electronic forms of attack, like jamming or spoofing a signal where you fool a receiver into thinking, you know, what they are receiving is really from the satellite, when it is not. Also, nonkinetic forms of physical attack where you can do physical damage to the satellite without actually touching it, like lasing a satellite; lase an imagery satellite, you can potentially blind it or at least temporarily dazzle it. High-power microwave weapons can cause the electronics on a satellite to be disrupted, cause computers to reboot, or can actually fry the circuits in a satellite if it is a strong enough attack and they are not well protected.

Then, of course, there are cyberattacks. Cyberattacks can be many different forms. At the lowest level, someone could just get into your network and be able to snoop on packets, who's talking to whom. They may be able to crack into encryption and actually read the data and exploit that for military purposes. At the most extreme level of a cyberattack, they could get into your data

streams and manipulate the data. Worst attack you can imagine would be if someone gets into your command and control uplink and takes control of your satellite, then they can effectively destroy it, at least make it not usable to you.

Now, our military satellites have protections against some of these, but not all of these, and it varies by the type of system. And so, you know, I am concerned about these threats because, one, an adversary may think that they could use an attack that they don't think we can attribute to them and get away it. So they may use it even before a conflict on Earth begins. It may be part of their conditioning of us or trying to prepare the battlefield. Also, an adversary may use something like jamming that is a reversible form of attack. They may view it as being below threshold that they can do it and we will know that they can turn it off. And so they can just negotiate with us.

We may not view it the same way. You know, our protected satellite communications systems, they are used for nuclear command and control as well as tactical missions. An adversary may miscalculate and they may think that we would, you know, view it as less below a threshold when we actually view it as being above a threshold.

The other complication is that our allies and partners may not view the same type of attack the same way that we do. And so I know there are some ongoing discussions. I think there need to be more ongoing discussions, and it is at this lower end of spectrum of conflict where I think it gets very murky and that is when it concerns me. Not to discount the kinetic ASAT attacks; those, yes, have very devastating consequences, but I think we need more attention in the nonkinetic side.

Mr. HICE. Mr. Loverro.

Mr. LOVERRO. Yes. Mr. Hice, I want to add to what Mr. Harrison has said. And this is a critically important point. As we put together our policies and our thinking about resilience, one of the key goals was to force the—if the adversary wanted to take away your space capabilities, was to force him to a higher level of attack, i.e., kinetic attack, to take away the so-called cheap shot of a laser or a jamming attack, remove that from the thinking so that you would clearly have an act of war if he tried to attack your satellites.

We know how to build jam-resistant satellites. We know how to build architectures of satellites that cannot be jammed individually or collectively. We know how to go ahead and build jam-resistant GPS. We know how to go ahead and build satellites that can't be blinded by lasers from the ground. We know how to do all of these things. We need to be doing them so that the only option an adversary has is to go ahead and attack us kinetically. And then we need to build architectures where the loss of a single satellite attack kinetically doesn't affect us militarily, but now gives the President the wherewithal to act. So these are critically important strategic, architectural questions that we have to address and we are not doing.

Mr. HICE. So are there any policy decisions on our end that need to be implemented?

Mr. LOVERRO. The policy that I just told you exists. It is written. It was delivered in 2014 to the White House as part of our overall

ability to resist these—or to contend with these problems. We are not—we are not building the capabilities. There is always more policy work to be done—don't get me wrong there. You know, otherwise, I would be out of business. But the fact of the matter is the fundamental policies we need to understand what to do are there; we have to act on these policies.

Mr. HICE. Okay. Thank you. I yield back, Mr. Chairman.

The CHAIRMAN. Whose job is it to make those architectural decisions?

Mr. LOVERRO. Sir, that is the key issue, and that is why I say it is not an acquisition issue; it is a decision issue. In the 20 years that spanned 1990 to 2010, we basically allowed that decision to be made by the acquisition chain in the AT&L [Acquisition, Technology and Logistics]. That was never that individual's job, but since nobody else would make a decision, he or she did. Before that, back in the 1960s and the 1970s, it was the responsibility of the DDR&E, the Deputy Director for Research and Engineering. In the 1980s, late 1980s and 1990s, it was the responsibility for the Assistant Secretary of Defense [ASD] for C-Cubed-I [Command, Control, Communications, and Intelligence (3CI)]. They were the person in the OSD [Office of the Secretary of Defense] staff who would listen to the services come in and say, we would like to seek to do this, and they would basically say yes or no.

I often tell the tale that when I was running the GPS program and I didn't believe we were on the right path, I walked into John Stenbit's office, he was the ASD (3CI). I sat down with him for 3 days and explained what we need—we needed. He said, yes, you are right. Let's take it to the deputy. I was at the deputy's office a week later. In less than 2 months we had changed the entire course of the GPS program. Today, I would have to go talk to 20 different people in the Pentagon; none of them have the ability to go ahead and make that decision. That is the problem that we have to go ahead and solve.

The Air Force, I believe, will come up with excellent ideas if we give them the responsibility to do that. And they should have the responsibility to do that, and then they should be responsible for bringing that to the individual in OSD who can say yes or no. And they either get a yes, or no, go back and work it again. But that will create the kind of pace of change that we need, rather than the current structure.

Mr. HARRISON. I would add to that that, you know, I would choose to interpret some recent changes that Congress made in a way. And I don't know that folks within the Pentagon would agree with this, but I think it was fiscal year 2017 NDAA [National Defense Authorization Act] that split up AT&L and gave more acquisition authority to the services. So the acquisition authority devolved to the services for many of these programs. And then in last year's fiscal year 2018 NDAA, it clearly gave the commander of Air Force Space Command the sole authority for recruit, training, equipping space forces.

I would then interpret that as the commander of Air Force Space Command should be the one who can make these decisions and move out on it.

General KEHLER. He doesn't have all the authority he needs to do that. I mean, I take the point about the decision process and the acquisition process; to me it is kind of tomato, tomato. I think that there—this is all rolled together. What has happened with the fragmentation of acquisition in larger sense has impacted space as well.

I agree. I think that the commander of Air Force Space Command has responsibility here to develop space architectures. I had that responsibility when I sat out there, and what I didn't have was the responsibility to develop the Department's communications architecture. I could do the space piece of it, but I didn't have the wherewithal to do the rest. That was somebody else's responsibility. And once I had what I thought I needed to do, my responsibility was to take it into the Air Force and get it programmed.

So I think that channel is there. I think that channel is still there. Again, I think this is about priorities. If these are national priorities, then I think it gets looked at differently in the program process when we are trying to decide what to fund and what not to fund.

The CHAIRMAN. Mr. Rogers.

Mr. ROGERS. I just want to again thank the panel. This is a very important discussion for us to have. I hope that people take away from this hearing that the one thing that came out early and has recurred throughout it and that is we can't keep doing what we have been doing. We have to do something dramatically different, better, more efficient, and more effective.

As you all know, I believe that we have to segregate those 5,000 people that Doug Loverro described into a separate service, the space force, in the Department of the Air Force in order to get that culture and educational system and career development that we need to make space a priority. And the point being, and one of the reasons why General Kehler and I kind of [diverge] on this, is I believe that in order for us to ever correct this, that the people that come to work every day and work on space have to know that it is their number one priority. It is the organization's number one priority. And the Air Force will always have air dominance as its number one priority culturally. And it should; it is the Air Force.

So we just have to recognize no organization can have two number one priorities. And I think that is going to be the—because General Kehler is right, it could possibly happen, but it is probably not going to happen. If it would have been likely, the Air Force would have done it by now. They are humans, and it is just hard to do what we are asking them to do in their current construct. And one evidence would be when you talked about the four-stars space professionals who were considered for chief, they didn't get chief.

But you did make a point that I agree with that in the interim, between now and when I think we are going to have a space force, like our Commander in Chief said yesterday—I like him even better today—but between now and then, I think General Kehler is exactly right, the Department of the Air Force should make space a high, very high priority, and fund it appropriately and give it inordinate attention. That means resources, a different acquisition construct, and maybe a space professional as the next chief of staff,

like John Hyten or somebody else. Those would be great signals to the Congress, they are finally getting it.

But I still think we are going to have to make this evolution to a separate segregated service. And I think this hearing goes a long way to putting that information on the record, and I thank you all for being a part of it.

I yield back.

The CHAIRMAN. Last question, is there something that jumps to any of your minds that has been written in the last few years that, not technical, but would be helpful for Congress to read in thinking about space as a warfighting domain? I am just curious.

Mr. LOVERRO. Sir, it is not the last few years, but it is 2001, written by the Rumsfeld Commission. We all were part of it, at least I guess—I know General Kehler and I were part of it. I am not sure about Todd. But I don't think a more thorough description of the problem or the solution exists than that report. It is—it is prescient in its understanding of what was going to happen because everything it perceived to happen has happened. It spoke about the fact that we need to get on the path for a space corps then—now 19 years later, we are still not on that path—because it saw that the only way to go ahead and deal with this problem was to get on that path early.

I still find it to be the bible for most of this thinking, and if you care to read all of the appendices, all of the details spring out at you. So I would heartily recommend a review of that report.

General KEHLER. I would agree there, there have been a lot of studies done. I think that is the best one, if you were parachuting in to take a look at this. I think that one, it sets the conditions, and I think it lays out the issues in a very, very good way.

I would say, though, that some things have changed between then and now. I think the threat that got talked about there has arrived. And I think that we just need to be cautious here that in going forward—and by the way, I do not disagree that somebody should come to work every day thinking about space as a full-time job. That was my job, as a matter of fact, in Air Force Space Command. And I think that that is necessary. I do believe that there are things that have to be done here just like we have been talking about.

What I am concerned about, though, is how far you go and how fast you get there, because my experience with major organizational changes is that they always take longer and cost more than we think. And so I don't think we have the luxury of a lot of time. I think we have people in place today who have organizations that can be responding and we need to make them do it.

Mr. HARRISON. One book that comes to mind is *Crowded Orbits* by Clay Moltz. I think that is a good reading and it is a little more contemporaneous. I also agree, though, that the Rumsfeld Commission report is a great read, especially when it comes to the organizational aspects that we have discussed much today. And as someone who writes and publishes for a living, I can't miss the opportunity to promote one of my own reports, but we published a report last fall called "Escalation and Deterrence in the Second Space Age." So if you don't have a copy, we will be glad to get you one.

The CHAIRMAN. I appreciate that.

I think just like in cyber, there are elements of this—of space as a warfighting domain that are challenging for members to think about. Because while you can draw analogies to underwater and other things, there are differences. And so that is part of the reason I asked the question.

I think this has been very helpful today. I thank each of you for being here.

The hearing stands adjourned.

[Whereupon, at 12:01 p.m., the committee was adjourned.]

A P P E N D I X

MARCH 14, 2018

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MARCH 14, 2018

**Statement of Chairman William M. “Mac” Thornberry
House Armed Services Committee Hearing:
Space Warfighting Readiness: Policies, Authorities, and Capabilities
March 14, 2018**

Last month when Secretary Mattis testified on the new National Defense Strategy, he said “our competitive edge has eroded in every domain of warfare – air, land, sea, space, and cyber.”

That statement has two relevant points to today’s hearing. First, space is a domain of warfare, not just an enabler. Second, we are falling behind where we should be when it comes to space. Today’s hearing will discuss how we can catch up.

As we refocus our defense efforts on strategic rivals, it is clear that they are putting significant effort into space. I believe that the American people still do not fully realize how dependent our country is on space, not just for military and intelligence purposes, but in our every day lives as well. That dependence creates a vulnerability, which, like in the other domains, we must count on the American military to protect.

This Committee has focused a lot on readiness and rebuilding our military. When it comes to space, there are a number of questions that need answers. Where should we be making our investments? Are we attracting and then developing the right kind of space warfighters? Perhaps most crucially, are we putting the appropriate intellectual effort into space as a warfighting domain? We look forward to insights that our witnesses today can give us.

Finally, I would point out that this committee has been very active in trying to prepare the military and the nation for the challenges of space. We have streamlined Air Force acquisition authorities, eliminated red tape, empowered a single accountable organization for space forces within the Air Force, and empowered the Deputy Secretary of Defense to oversee Air Force space reform efforts, among other things. But we will not relax our effort. This topic is just too important.

**Statement of Ranking Member Adam Smith
House Armed Services Committee Hearing:
Space Warfighting Readiness: Policies, Authorities, and Capabilities
March 14, 2018**

Thank you Mr. Chairman.

General Kehler, Mr. Loverro, Mr. Harrison, welcome. I look forward to your insights on adapting to space as a contested domain and how we can protect our assets and deter a war in space.

New threats in space are emerging rapidly and we must ensure that we are adequately postured to address this change. Our committee, under Chairman Rogers and Ranking Member Cooper's leadership in the Strategic Forces Subcommittee and in dialog with Deputy Secretary of Defense Shanahan, has spent a lot of time thinking about making changes to address this threat and ensuring that the Department of Defense has the focus, expertise and resources it needs to start addressing the threat effectively, and to prioritize space accordingly. I commend Chairman Thornberry for continuing this discussion and we are grateful for your views to inform how best to achieve effective results, and what policies, capabilities, authorities and organizational structure are needed.

The National Defense Authorization for Fiscal year 2018 required changes within the Air Force to better align and consolidate responsibility for space under the Air Force Space Command, including the authority to organize, train and equip our forces to address new threats in space.

DOD and AF particularly needed change in organization to elevate and coordinate space. Improvements to acquisition and research and development investments are also needed, particularly as Air Force investment in space had until recently been at a 30-year low.

As we look at reorganization and improving existing authorities, understanding deterrence as it applies to space must be one of our highest priorities in terms of policy considerations. A conflict in space would disproportionately affect US assets as we have relied on space for decades, not only for military capability but for everyday life. ATMs for example depend on the Global Positioning System (GPS). So we must develop and implement policies to enhance deterrence and reduce the risk of miscalculation. Making policy decisions about sending clear signals to our adversaries and engaging in dialog as this domain evolves to one where conflict may occur is a necessary and important element of reducing the risk of unintended escalation.

We must also increase resilience of our space assets. This entails improving our systems, but also increasing cooperation with our allies, for example increasing the use of hosted payloads and relying on allied systems. This is also an opportunity to increase reliance on commercial capability and American ingenuity

and innovation to increase defense capacity, from improving automation and change-detection, to improving space situational awareness, to taking advantage of small satellites and lower-cost and rapid launch.

Thank you for being here and I look forward to your insights.

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THE HOUSE ARMED SERVICES COMMITTEE

STATEMENT OF
GENERAL C. ROBERT KEHLER
UNITED STATES AIR FORCE (RETIRED)
BEFORE THE
HOUSE ARMED SERVICES COMMITTEE
14 MARCH 2018

NOT FOR DISTRIBUTION UNTIL RELEASED BY
THE HOUSE ARMED SERVICES COMMITTEE

Chairman Thornberry, Ranking Member Smith, and distinguished members of the committee, I am honored to join with you today to present my views on space warfighting readiness. I am especially pleased to be here with my two long-time colleagues and want to take this opportunity to thank the members of the committee for your leadership on these important matters. As I begin, I want to stress that the views I express today are mine and do not represent the Department of Defense, United States Strategic Command, or the United States Air Force.

Mr. Chairman, the United States is perilously close to losing the significant advantages that come from being the world's leading spacefaring nation, and time is not on our side. Decades of dedicated investment in space have yielded important warfighting and intelligence collection benefits for the United States and our allies and partners. As I often said while in uniform, space is woven into the fabric of our scientific endeavors, information age economy, and national security. Space capabilities make it possible for US policymakers to know critical things about our world and adversaries that they would otherwise not know. Space capabilities enable the American way of warfare by making it possible for US military commanders and forces to see the battlespace more clearly, communicate with certainty, navigate with accuracy, and strike with precision.

However, our adversaries and potential adversaries have noted these significant advantages and have moved aggressively to field forces that can challenge our space capabilities from the ground, through cyberspace, and in space. From simple (and widely available and affordable) GPS jammers in the hands of extremists to highly sophisticated anti-satellite (ASAT) weapons in the hands of near-peer competitors like Russia and China, today's

military commanders are facing serious threats in a domain that is increasingly congested, contested, and competitive. Our space advantages have eroded and will continue to do so if action is deferred or delayed.

No one should be surprised. The threat that the intelligence community and military commanders have warned of for many years has arrived and is growing. It may have come a bit faster than some predicted, but it arrived nonetheless and, while there are many reasons for why we are seemingly behind in our response, our energy and resources must be focused on making the necessary improvements in a timely way.

Deterrence is always the preferred outcome, and our ability to deter a conflict that begins in or extends into space is based on our readiness to fight such a conflict. While the US has never sought to wage war in space, deterrence credibility is diminished if adversaries believe they can gain an advantage by attacking US space assets. I believe classic deterrence theory applies to space; adversaries will be deterred if they believe they cannot achieve their objectives, will suffer unacceptable consequences if they try, or both.

This is not the first time the US has had to consider challenges to our space capabilities. During the Cold War, we expected and planned for the Soviet Union to employ its significant capabilities (to include a direct ascent ASAT) to disrupt or destroy our space assets. Although there are lessons to be applied from that era, today's problem is far more complex and potentially far greater in impact. Given our dependence and that of our allies and partners on space, the loss of critical assets today could prove decisive to our ability to successfully prosecute a military campaign. It is also possible (perhaps highly likely) that hostilities might

begin in space or against ground-based space assets in an ambiguous way, and as a precursor to terrestrial or conventional action. In any case, adversaries are developing counter-space capabilities as part of sophisticated strategies designed to degrade or deny US advantages in global awareness and power projection.

As a result, the US must be prepared to plan and conduct complex operations in space that involve joint, interagency, and combined (allied) capabilities and forces in the context of broader commercial, non-governmental, and international actors and interests. While being mindful of the unique needs associated with space, space operations must integrate seamlessly into the multi-domain operations US military commanders will have to conduct to achieve their objectives. We should not be preparing to fight (and therefore, deter) an isolated “space war” as some headlines would suggest. Space is an integral component of our warfighting structure and challenges to our space capabilities must be addressed within the context of that structure.

I think it’s helpful to frame today’s space challenges in non-space terms. For example, I believe we can find and adopt a conceptual way ahead for space. If we examine past challenges to our air or maritime superiority. Broadly speaking, in those cases the US formed effective policies and strategies, assigned the problem to a responsible warfighting commander with appropriate authorities, and turned to the military departments to provide forces ready to fight and win in the face of the new threat. This formula for success is well known and understood and applicable to the threats we are facing for space.

As the committee knows, there is a lot of positive work underway to address the shortfalls; much of it stimulated by your interest. I know many steps have been taken over the

last several years and more are underway. What follows is my perspective with acknowledgement that many, perhaps all, of these steps are already in work at some level.

Policy and Strategy: National leaders in the Executive and Legislative Branches must align on a cogent, comprehensive plan of action as well as the ends, ways, and means to implement that action plan. The national security space (NSS) enterprise exists within the overall national space enterprise and its success is linked to the viability and vitality of that enterprise. A focused, balanced (government and commercial), and energetic national program is the foundation to ensure the US retains its space leadership role and its ability to provide the cutting-edge capabilities needed for national security, scientific and technological advancement, and economic growth.

Consistent with prior administrations of both political parties, the current National Security Strategy recognizes that unimpeded access to and use of space is a vital national interest and notes that the US will respond to threats to our vital national interests in space “at a time, place, manner, and domain of our choosing.” While sound policy, to effectively deal with a conflict that begins or extends into space this general policy must be implemented in a manner that is helpful to commanders in operational planning and execution.

Policymakers must work with commanders to develop strategic intentions and political-military objectives that drive space planning and course of action development, provide views on matters like hostile intent and actions, and concepts of collective self-defense and responsibility to protect. Further, policymakers and commanders must assess whether modifications are needed to the national and military planning and decision-making processes

to enable operations with relevant speed and agility. Finally, given the interagency (and, increasingly, commercial) nature of the US national security space enterprise, policymakers must carefully identify and address barriers to effective planning and execution to include security policy, clearance processing, and information sharing.

Authority and Responsibility: Typically, two categories of authorities are discussed related to space: operational and acquisition. Regarding operational authorities, given the multiplicity of actors involved in today's military operations (including space) it is important for commanders to achieve a common understanding of authorities vertically across organizations and horizontally across mission partner organizations to achieve unity of effort. It is also important to ensure space operational authorities are "normalized", so space forces are fully integrated into the joint force with appropriate rules of engagement. To ensure unity of effort, it is also important to clarify the relationships and responsibilities among the Commander, US Strategic Command and other US government space operators once hostilities in space are imminent or underway. Regarding acquisition authorities, it is important to align authorities with service responsibilities and to delegate those authorities to the lowest feasible level.

Operational Concepts: Countering an adversary's efforts to deny our space capabilities within or even outside a conflict begins with an operational concept (CONOPS). Such a CONOPS would address the critical missions and tasks, the broad ways and means the force will use to accomplish them, organizational relationships, supporting and supported relationships (interagency, joint, multi-national), and information flow and exchange requirements. Ultimately, a CONOPS is the critical element in the planning process, is inextricably linked to planning, and drives the formulation of technical solutions, capability development, and

resource allocation. Bringing the ongoing space CONOPS work to conclusion and updating joint force CONOPS to account for degraded or denied space capabilities are complementary, high priority activities.

Organizational Structure for Warfighting: In my view, today's joint warfighting structure is appropriate and adequate to prepare for and fight a space-related conflict. It is in the combatant commands where all the pieces are brought together that form the nation's warfighting capability. As a Combatant Commander, the Commander US Strategic Command has the necessary responsibility and authority to organize his command for warfighting effectiveness, develop plans and courses of action, conduct exercises, exercise command authority over assigned forces and establish relationships with entities over which he doesn't have command authority (unity of effort). Most importantly, this is the same process used for land, air, and sea. Collaborative planning between Combatant Commands and among the relevant US government and commercial space organizations is a critical step that must be pursued with high priority. Updated plans can then be trained and exercised with realism; including allies and commercial entities.

Capability Development and Acquisition: Forces must be equipped and trained to fulfill their mission responsibilities in the face of determined adversary action against space assets. Capability architectures (not just space architectures) must become more resilient and all forces must be prepared and equipped to operate in an environment that assumes some degradation of space assets (e.g., communications and GPS). Faster acquisition, leveraging commercial capabilities, better integration with allies and coalition partners all play a role in addressing today's shortfalls.

In my view, we should move quickly to create a rapid acquisition process for space and continue to increase resources devoted to space situational awareness, C3, protection and resilience as a matter of national priority. The services must collaborate to develop and deploy resilient and defensible mission architectures and fully leverage commercial capabilities and opportunities.

Mr. Chairman, you asked for my perspective on the current readiness of US forces to succeed and successfully operate in a conflict that begins in or extends to the space domain. In summary I think we are not yet where we need to be, but I am encouraged by the focus and commitment I see from the Congress and the Executive Branch, and by the sense of urgency I see from my uniformed colleagues. But getting to where we need to go requires a priority shift and a long-term commitment of energy and resources.

Fortunately, we are not starting from scratch. As usual, I am most encouraged by the talent and commitment of the young men and women that make up our space forces and their leaders. They are the foundation we need to meet the challenge and increasing their readiness is a high priority. While the US Air Force and others have made great progress since Desert Storm in bringing space support to national leaders and the warfighters, the military services must now shift from a culture that presumed space superiority to a culture prepared to gain and maintain space superiority as a first condition of providing that support. From acquisition to education and training to operational planning and execution, the US needs to field a space force—and a joint force—that is ready for space conflict.

Thank you for inviting me, and I look forward to working with you in this effort.

General C. Robert Kehler, USAF (Ret.)

General C. Robert Kehler, U.S. Air Force (Ret.), is the former commander, U.S. Strategic Command (USSTRATCOM). In this role, he was directly responsible to the President and Secretary of Defense for the plans and operations of all U.S. forces conducting strategic deterrence, nuclear alert, and Department of Defense space, cyberspace, and associated operations. Previously, as commander of Air Force Space Command, he was responsible for the development, acquisition, and operation of the Air Force's space and missile systems. He retired from the Air Force on Jan. 1, 2014, after over 38 years of distinguished service.

Secretary of Defense Chuck Hagel praised Gen. Kehler's uncompromising standards and tireless efforts to "build and maintain the space, cyber, and missile defense capabilities that USSTRATCOM needs for today's security environment" and dedication to maintaining a "safe, secure, ready, and effective nuclear deterrent force."

Over his career, Gen. Kehler served in a variety of important operational and staff assignments and was among the few to command at the squadron, group, wing, major command, and combatant command level. As commander of USSTRATCOM, his forces directly supported combat operations and participated in numerous global contingencies. He also directed the National Security Space Office where he integrated the activities of a number of space organizations on behalf of the Under Secretary of the Air Force and Director, National Reconnaissance Office. He was also assigned to the Secretary of the Air Force Office of Legislative Liaison, where he was point man on Capitol Hill for matters regarding the President's ICBM Modernization Program.

His military career began in the R.O.T.C. program at Pennsylvania State University, where he earned a bachelor's degree in education. In addition to his command and management training, he holds master's degrees in national security and strategic studies from the Naval War College and in public administration from the University of Oklahoma. Gen. Kehler completed the Program for Executives at Carnegie Mellon University, the National Security Leadership Course at the Maxwell School of Citizenship and Public Affairs at Syracuse University and the program for senior executives in National and International Security at the John F. Kennedy School of Government at Harvard University.

Gen. Kehler's numerous awards and decorations include the Defense Distinguished Service Medal, the Distinguished Service Medal with oak leaf cluster, the Defense Superior Service Medal, the Legion of Merit with two oak leaf clusters, the Defense Meritorious Service Medal, the Meritorious Service Medal with three oak leaf clusters, the Air Force Commendation Medal and the French Legion of Honour.

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Space Warfighting Readiness: Policies, Authorities, and Capabilities

STATEMENT OF

MR. DOUGLAS L. LOVERRO
FORMER DEPUTY ASSISTANT SECRETARY OF DEFENSE
FOR SPACE POLICY

BEFORE THE
HOUSE ARMED SERVICES COMMITTEE

March 14, 2018

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THE HOUSE ARMED SERVICES COMMITTEE

Introduction

Chairman Thornberry, Ranking Member Smith, Members of the Subcommittee, I am pleased to have been invited here today to join Gen Kehler, and Mr Harrison to talk to you about an issue that is critical for the Department of Defense and for our nation—DoD Space Warfighting Readiness. As you are keenly aware, space remains as vital today to our national security as ever. It continues to underpin DoD capabilities worldwide at every level of engagement, from humanitarian assistance, conventional conflict, and nuclear war. And as General Hyten stated in his testimony before the House Armed Services Strategic Forces Subcommittee last week, space capabilities are not just crucial for when we enter the fight, but are indeed a critical supporting element of US deterrent strategy to prevent that fight from starting.

Further, space provides a lifeblood to US economic vitality, serving as an interconnected infrastructure which empowers the lives of our citizens worldwide, and increasingly represents a business area in which the US continues to hold and expand its unqualified advantage. Make no mistake, in all three US space sectors—national security, civil, and commercial—the US continues to lead the world. But, while our leadership in both civil and commercial space is secure, our leadership, and in fact our capabilities, in the national security sector are being actively and aggressively challenged.

Our adversaries are aware that the US military relies on space to empower its operations and to wield an overwhelming military advantage—and they don't like it. That understanding was best summed up by the Chinese strategist Wang Hucheng nearly two decades ago when he wrote that, "...for countries that can never win a war with the United States by using the method

of tanks and planes, attacking the U.S. space system may be an irresistible and most tempting choice.”¹

Unfortunately, Hucheng’s observation was not just idle speculation—rather, it became a firm basis for China’s and Russia’s anti-access, area denial strategy, one which they have been working ever

...for countries that can never win a war with the United States by using the method of tanks and planes, attacking the U.S. space system may be an irresistible and most tempting choice.

since and which they will soon bring to fruition. As Director of National Intelligence Daniel Coats warned in his February 13th Worldwide Threat Assessment, “Russian and Chinese destructive ASAT weapons probably will reach initial operational capability in the next few years.”² He went on to observe that all US space capabilities are at risk and that both Russia and China would likely target those capabilities if future conflict were to occur. Understanding all this, the question posed in this hearing, “Are US Space Warfighting Forces Ready”, becomes particularly pertinent to understand.

US Space Warfighting Readiness

Unfortunately, the answer is “No”—we are not ready, or more properly, we are not on a firm path to be ready. Before I explain why, let me first make two things perfectly clear: First and most critically, this is absolutely not an indictment of the incredible members of our military armed services and intelligence community charged with this responsibility—they stand ready to maintain US space capabilities in every way humanly possible given the tools at their disposal—it’s the tools that are not up to the task. And second, no adversary should mistake that statement

¹ Wang Hucheng, ‘The US Military’s “Soft Ribs” and Strategic Weaknesses’, Liaowang, vol. 27, reprinted in Xinhua Hong Kong Service, 5 July 2000, in FBIS-CHI-2000-0705, 25 July 2000.

² Daniel R. Coats, Director of National Intelligence, “Statement for the Record, Worldwide Threat Assessment of the US Intelligence Community”, February 13, 2018, pg 13

The fact of the matter is that US space capabilities are robust and, faced with any attack that could be mounted today,... will continue to provide the US with sufficient warfighting edge to assure an adversary's defeat. But as we move into the future, ...that calculus could change.

as an invitation to attack. The fact of the matter is that US space capabilities are robust and, faced with any attack that could be mounted today, I am fully confident that they will continue to provide the US with sufficient warfighting edge to assure an adversary's defeat. But as we move into the future, as our adversaries begin to close the gap in other warfighting domains, and as they continue to field and expand their counterspace capabilities, that

calculus could change. The unfortunate fact of the matter is that our current ability to withstand an adversary attack is based not so much on our space warfighting readiness, but rather their lack of a fully developed and operationalized threat. If that threat did exist; if their forces were at the state of capability and readiness they seek, then I fear the answer would be quite different. In some cases, such as satellite communications (SatCom) jamming, they are already there; and the unwelcome news is that they are working aggressively to make that the case for every mission area. Meanwhile, our dilemma is that we are failing to respond fast enough and robustly enough to prevent that from happening. So, while I am not worried today, I am worried about tomorrow; and I fear tomorrow is not all that far away.

Elements of Readiness

In your invitation to appear here today, you cited several elements that sum to assess our warfighting readiness and importantly, our ability to deter attacks on US space assets. Those elements include policies and authorities, current and future capabilities, integration of allied and commercial capabilities, our organizational structure, and the overall direction of our national

security space enterprise. You also asked what additional policy considerations would be necessary to successfully signal our adversaries and deter conflict in space. You're your indulgence, I'll try to summarize my assessment of each of these elements in the paragraphs below.

Space Deterrence

Before I do, I would like to make sure that we understand a very important fact--deterring space attack cannot be considered in isolation any more than conflict in space can be viewed in isolation. As Gen Hyten, the commander of US Strategic Command, has repeatedly stated in speeches and in testimony, deterrence and war do not occur in isolated domains. Rather it is sum of all our capabilities and all our actions across all warfighting domains that lead to deterrence during peace, and victory during war. But the role that space plays in this equation is key because losing space degrades not only our space capability, but our capability in the three traditional terrestrial land, sea, and air domains as well. So, assuring that our space forces survive assures the ability of those terrestrial forces to succeed, and that then leads to the deterrence effect we seek. On the other hand, we must also realize that no capable adversary will hesitate to exercise their sovereign need to attempt to eliminate the US space advantage. Regardless of how ready our space forces are, that readiness cannot deter a determined attack; therefore, we must make certain that our space forces can withstand such an onslaught.

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Policy and Authorities

US National Space Policy is remarkably clear and is succinctly summed up in the President's most recent National Security Strategy:

“The United States considers unfettered access to and freedom to operate in space to be a vital interest. Any harmful interference with or an attack upon critical components of our space architecture that directly affects this vital U.S. interest will be met with a deliberate response at a time, place, manner, and domain of our choosing.”³

Perhaps surprising to some, this policy position has remained almost completely unchanged throughout the history of US space efforts and through both Republican and Democratic administrations at least as far back as the 1960s. So, at the highest level there is no doubt about what the policy of the US is—we consider space to be our vital interest and we will choose to respond to attack should its use be threatened.

As a statement of overall policy, this is a good start. But it's insufficient to guide actions and outcomes that we expect from our space forces. To fill that void, the US's 2010 National Space Policy, and more recently updated 2016 Department of Defense Space Policy both clearly articulate that it is the policy of the US to “Increase [the] assurance and resilience of mission-essential functions...by developing the techniques, measures, relationships, and capabilities necessary to maintain continuity of services...[including] enhancing the protection and resilience of selected spacecraft and supporting infrastructure.”⁴

³ “National Security Strategy of the United States of America”, December 2017, pg 31

⁴ “National Space Policy of The United States of America”, June 2010, pgs 4, 9

... the National Security Strategy's focus on response to attack, along with the National Space Policy's focus on being able to withstand an attack, create the policy essentials for deterrence...I find no fundamental elements missing from their pages. So, it is my opinion that our current policies fully support space warfighting readiness.

fundamental elements missing from their pages. So, it is my opinion that our current policies fully support space warfighting readiness.

There continue however to be some questions when it comes to authorities. Authority for US space forces is, in general, centered in the space warfighting combatant command, USSTRATCOM. However, over the history of space activities, that authority has been seen to wax and wane when it comes to decisions to employ active space control measures and in the governance of US space intelligence forces, specifically those of the National Reconnaissance Office (NRO). The establishment of the National Space Defense Center is one notably positive response to this second authorities problem and speaks to the ability of leaders to act when necessary.

So, while the absence of precise top-level decisions on authorities is troublesome, leaders both within and outside the Department have been able to work through these issues and US warfighting effectiveness has not suffered. But that condition fundamentally represents the nature of yesterday's threats which were slow acting and therefore afforded time for

Taken together, the National Security Strategy's focus on response to attack, along with the National Space Policy's focus on being able to withstand an attack, create the policy essentials for deterrence and act as bookends to encompass each lower level of policy decision. While some of those lower levels are classified, and therefore prevent me from going into more detail, I find no

bureaucracies to grind out an answer. In any future great power contest in which war has extended to space, the element of time is unlikely to be on our side and therefore, the questions of authorities become more critical.

I do not want to overstate this concern—I do not see authorities as a fundamental constraint upon our space warfighting readiness—those constraints lie elsewhere as I will soon discuss. But, when and if we address those other issues, the lack of clear authorities could end up being deterministic to our success. I

should also hasten to add, that while internal US policy is clear and adequate to support our readiness, there are some international policy decisions that are less robust and would benefit from clear,

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unambiguous US leadership—I will discuss some of those briefly in the concluding thoughts below.

Current and Future Capabilities

I stated earlier that the members of our space military and intelligence communities stand ready to make every effort that is humanly possible to maintain our space capabilities with the tools they have—the problem is that they just don't have the right tools. And that's not just my assessment. In a recent statement following another Chinese ASAT test, Gen Hyten said, "We have very old space capabilities too, very effective space capabilities, but they are very old and not built for a contested environment,"⁵ This is not new news—it has been stated publicly by every Pentagon and National Security Space witness for the last 5 years. The real problem is, we

⁵ Gertz, Bill, The Washington Free Beacon, "China Carries Out Flight Test of Anti-Satellite Missile", August 2, 2017

are failing to address it adequately as we head to the future. Let me be clear—this is not an acquisition issue—it is a planning and strategy issue. It's not about how we will buy something, it's deciding what we need.

More than anything else, it is this fact that concerns me. The chasm between what our

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warfighting space commanders will need to win the space war, and the capabilities that we intend to develop and deploy, continues to grow even as the threat becomes more robust and more urgent. Leaders like Gen Hyten and many before him have made it clear that they do not need, in fact they do not want, large, expensive, non-proliferated, non-diversified space architectures. From both the military and civilian defense leadership we continue to hear the same—that they intend to build the resilient and responsive space architectures called for in our National Space Policy and our DoD Space Policy. And yet, as I review the President's 2019 Space Budget I continue to find descriptions that have little in common with those stated desires. For example, the Air Force has made it clear in this year's budget that they intend to replace the

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aging and non-resilient first-generation Space Based Infra-Red System (SBIRS) with a next generation Overhead Persistent Infra-red (OPIR) System. Yet, as we examine the budget justification document it becomes clear that while this new system may include some better on-board protections than the current system, it is

still certain to be an expensive, large, and sparsely populated constellation of satellites, the loss of any single one of which would significantly impair US missile warning capabilities. And to be clear, strategically and practically, there is no way to protect a single satellite against the determined attack of an aggressive adversary, especially if that satellite is in a fixed geosynchronous orbit regardless of on-board or off board defensive measures. To make matters worse, according to that same budget documentation, the earliest we're likely to see this evolved system is somewhere in the latter half of the next decade, and this prediction is before the development even begins.⁶ History would suggest it will be much later.

Similarly, despite years of statements from defense space leaders espousing the virtues of disaggregation, we find that the 2019 President's budget continues to articulate its intent to field an aggregated Evolved Strategic SATCOM (ESS) System. And like its missile warning counterpart, the system is significantly delayed with Milestone B not occurring until 2022 at the earliest, a nearly 18-month delay from the same program schedule in 2018⁷. So, while China and Russia are driving through generations of ASAT systems every three to five years, it is taking us over a decade to even begin to field a system responsive to their first-generation threat. Stated more clearly, when it comes to strategic missile warning and nuclear command and control, the evolved US response to the ASAT threat we see being deployed today will be ready near the end of

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⁶ Air Force FY 19 RDT&E Justification Book, Vol II, pgs 1014 - 1018

⁷ Air Force FY 19 RDT&E Justification Book, Vol II, pg 442 versus Air Force FY 18 RDT&E Justification Book, Vol II, pg 328

the next decade; meanwhile the threat will have leapt forward two more generations, and likely made our response moot.

This situation stands in stark contrast to the DoD's stated goals in their interim report in response to your Section 1601 direction in which they would aim to reduce development timelines for space systems from "typical eight-year development to three years"⁸. The problem with that goal is that it is unattainable if the item being developed is a large, expensive, space system that is planned to be developed once and produced several times. On the other hand, there are many ways to accomplish that goal, and even more importantly to meet the stated warfighting and policy needs for resilient, defendable architectures, but not by following the normal space development methods that have characterized the last 30 years—and it is there where we find the greatest issues.

These two examples are just the tip of the iceberg of what is lacking in our future space planning and budgeting. A key element of any future space strategy is the ability to operationally test that strategy under real life conditions. The Air Force knows this to be true for Air Operations and is why they created the Red Flag exercises at Nellis AFB following the failures of Vietnam Air Combat. Red Flag training was crucial to the development of air tactics and doctrine and has assured US air dominance ever since, honing not just current airpower skills, but testing future air combat tactics that drive next generation capability. We know that we need this same kind of training for space warfighters—but once again, it is basically absent from the budget. We can blame some of that on the fact that there is not enough budget to go around—yet we fail to embrace elements of any sensible plan that would make that budget go much further. Such is the case for allied and commercial integration.

⁸ DoD Interim Report on Organizational and Management Structure for the National Security Space Components of the Department of Defense; March 2018, pg 5

Integration of Allied and Commercial Capabilities

The recently released National Defense Strategy Summary States that,

“Mutually beneficial alliances and partnerships are crucial to our strategy, providing a durable, asymmetric strategic advantage that no competitor or rival can match. ...By working together with allies and partners we amass the greatest possible strength for the long-term advancement of our interests, maintaining favorable balances of power that deter aggression and support the stability that generates economic growth.”⁹

Nowhere is this sentiment more apropos than for space. Of the top 21 space faring nations (by number of satellites), 15 are close US allies or partners, and, in general, they are also the most advanced. It has been a central element of our space resilience doctrinal thinking since the release of the 2010 National Space Policy to aggressively pursue these space alliances to face

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the growing Russian and Chinese threat—and yet for over a decade we have failed to define any substantial allied contribution to our space architecture. Not only is this fiscally indefensible, it is strategically myopic. Today, adversaries need target solely US DoD or Intelligence space assets to effectively eliminate our space advantage, and the

advantage those capabilities provide to our allies as well. The lack of integration of Allied space warfighting capabilities into our basic force structure is a serious and inexcusable oversight within the current DoD space budget—it conflicts with our National Defense Strategy, our National and DoD Space Policies, and frankly our approach to cooperative defense in every other domain—plus, it slows us down and costs us money. Similarly, as I mentioned in my

⁹ Summary of the 2018 National Defense Strategy of the United States of America, Jan 2018, pg 8

introduction, the commercial space revolution represents a singular American advantage for the US, and yet other than for launch, our defense space budgets and plans act as if they barely exist.

To be fair, USSTRATCOM and the OSD Space Policy Office have been committed to combined space operations for nearly 6 years under the so called Combined Space Operations (CSpO) initiative and I want to congratulate them for continuing to expand that forum. But those efforts have failed to yield any true cooperation in future capability fielding, an activity under CSpO just as important as combined operations.

None of this results from not understanding the problem—we do. Again, leaders across the space divide espouse in speech after speech the role of allied and commercial space—we just fail to fund it. Your committee has been clear on its desire to address both these issues pushing the DoD to pursue satellite communication pathfinders and multi-global navigation satellite system receivers—yet the DoD continues to drag its feet. As a result, it remains highly doubtful that the next generation of GPS user equipment (GPS M-Code Increment 2) will incorporate the requirement to receive signals from the multitude of allied or foreign sources they could use; and it is also highly likely that the first generation of large low-earth-orbit (LEO) satellite communication constellations from

OneWeb, SpaceX, Telesat, and the like will launch without any real input from DoD on our cybersecurity needs, much less our investment to make those needs a reality. And this is where I find our planning most lacking. Through the use of allied and commercial capabilities we

Through the use of allied and commercial capabilities we could dramatically hasten the pace and power of resilience plus significantly reduce the cost to get there, while in the process, greatly adding to the complexity of the technical and strategic problem our adversaries must face—we know this, but we are failing to do it. It is our policy, just not our plan.

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Organizational Structure

Some will ask how much these problems have to do with organizational structure, a topic that this committee spent much time pursuing last year, versus just normal bureaucratic inefficiencies that we might find across the Department. From my perspective, they are intrinsically linked. The ability of our space leaders to understand the strategy of space deterrence and space warfighting and how to address those issues directly by understanding all the tools at their disposal results from our ability to grow space-smart leaders who can think and act in response to long-term and short-term changes and challenges to the domain.

It is not enough to have two or three senior leaders such as Gen Hyten or Gen Raymond or Gen Kehler who understand the issue. It must be understood at the Captain, Major, Lieutenant Colonel and Colonel level. It must be something the entire force comprehends as they go about their daily job of defining requirements for the next generation system, exercising those capabilities in flag-like exercises, conceiving of the next elements of a resilient architecture, or driving doctrinal alternatives that eventually change the way we fight. It is not something you can learn without committed long term focus on space force development. Unfortunately, that focus is still lacking.

The Air Force continues to avoid defining a true space career path, separate and distinct from its Air-focused pattern, that is responsive to the peculiar needs of space leader development. It's a different path than the path for Air leaders due to the differences inherent in

the domain. For example, no space warrior will ever actually operate in space—rather he will act at a distance. That distance drives a differing level of domain understanding than if he was a pilot in the front seat of a fighter aircraft. You learn about Air doctrine from flying planes. But you do not learn about space doctrine by flying satellites—and yet the Air Force views them as the same. As long as that is so, we will fail to grow the space smart leaders we need in sufficient number to truly effect change.

It is not a given that such career planning requires a separate service—I could argue either side of that issue. But it is clear that it requires a separate career path than that of its parent service. Whether that is under a separate service, a Marine Corps like structure, or an Army Air Corps structure is argumentative and beyond the scope of this particular hearing. But if we are to address the problems discussed above, if we are truly to embrace space warfighting readiness, we must address the personnel issue above all else.

Concluding Thoughts

The issues discussed above do not answer the full question of assuring US Space Warfighting Readiness, but they are a good start. There are hundreds of additional elements to address: The need for a separate Space Unified or sub-unified Command, International policy changes (such as whether the US should seek to ban debris causing weapons), civil space elements (the fate of space traffic management), and advanced technology elements. Each will need to be addressed fully to assure that tomorrow's warfighters are able to expect the same qualitative advantages they get from space, that allow them to dominate our adversaries, as they do today. As I view the current DoD glide slope, I do not find that we are on pace to address these issues and as such, our space capabilities are at risk. We do have time, but that time is quickly being spent. We can close the gap in the short term by embracing elements of the

strategy that we have so far avoided—allied and commercial integration, smaller, proliferated, and disaggregated systems, and investment in exercise and training assets to truly support a Space Flag-like event. But in the long term we must face the fact that to remain ahead over the next half century, we're going to need to grow the kind of space leaders that can think doctrinally, technically, and operationally for space in the same way we grew them in the 1930s and 40s for the Air. That could not have occurred within the constraints of the pre-World War II Army personnel system—nor can it occur within the constraints of our pre-first space war Air Force personnel system.

Today's budget and space planning strategy can be fixed to address the threats of the next decade and I would encourage the Congress and the Department to work to execute those changes by embracing the planning prescriptions discussed above. But for the long-term solution we must look beyond simple budgets and programs—we must look to the people. In 1937, Gen Frank Andrews, a revered Air Force pioneer for whom Andrews Air Force base is named, wrote:

“I don't believe any balanced plan to provide the nation with an adequate, effective Air Force... can be obtained, within the limitations of the War Department budget, and without providing an organization, individual to the needs of such an Air Force. Legislation to establish such an organization...will continue to appear until this turbulent and vital problem is satisfactorily solved” (emphasis added)¹⁰

By heeding Gen Andrew's call, and creating the United States Air Force, Congress and the President propelled changes in Air Power that moved the United States Air Force from the equal of its international counterparts, to a modern Air Force that is hands down, the best in the world. The same must be true for space. If we are to assure US space warfighting readiness far

¹⁰ Wolk, Herman S, Planning and Organizing the Post War Air Force 1943-1947, Office of Air Force History, USAF, Wash DC, 1984, pg 1

into the future, against the rising threats we see today, we must establish, either within or outside the Air Force, an *organization individual to those needs*.

Douglas L. Loverro

- President, Loverro Consulting, LLC: 2017 - Present
- Deputy Asst Secretary of Defense, Space Policy: 2013 – 2017
- Executive Director, Space and Missile Systems Center (SMC) and Deputy Program Executive Officer for Space: 2007 – 2013
- Deputy Director for System Engineering, National Reconnaissance Office (NRO): 2006 – 2007
- Program Director, Future Imagery Systems, NRO: 2002 – 2006
- Program Director, GPS, SMC: 1999 – 2002
- Program Director Advanced Systems, SMC: 1997 – 1999

Mr. Douglas Loverro is a highly regarded senior DoD space thinker and leader. While on active duty, he led multiple programs within DoD and the NRO including the AF's GPS program, NRO's Future Imagery Program, and all AF Space Control programs. As a civilian he served as Deputy for System engineering at the NRO, Executive Director for the AF's Space and Missile System Center as well as the Deputy PEO for Space, and most recently, as DoD's Deputy Assistant Secretary of Defense for Space Policy.

He holds a Master's Degrees in Physics from the University of New Mexico, a Master's of Political Science from Auburn University, and an MBA from the University of west Florida in addition to his BS in Chemistry from the US Air Force Academy. He was a distinguished graduate from the Air Force's Air Command and Staff College and Squadron Officer School, and was the #1 graduate from DoD's Industrial College of the Armed Forces.

He is the recipient of multiple prestigious awards including the Secretary of Defense's Medal for Outstanding Public Service, the Lifetime Achievement Award from the Federation of Galaxy Explorers, the Society of Satellite Professional Engineers Stellar Award, and the AFCEA Benjamin Oliver Gold Medal for Engineering amongst many other civilian and military honors.

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Witness name: Douglas L. Loverro

Capacity in which appearing: (check one)

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

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

2018

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
SMC/SY Horizon Contract			
FA881915-F-0001	Dept of Defense	\$12,750	Space Defense

2017

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
None			

2016

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant
None			

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2018

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
None			

2017

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
None			

2016

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment
None			



**Statement Before the
House Committee on Armed Services**

***“Space Warfighting Readiness: Policies,
Authorities, and Capabilities”***

A Testimony by:

Todd Harrison

Director, Aerospace Security Project; Director, Defense Budget
Analysis; and Senior Fellow, International Security Program
CSIS

March 14, 2018

2118 Rayburn House Office Building

Chairman Thornberry, Ranking Member Smith, and Members of the Committee, I want to begin by thanking you for the opportunity to testify today on the important and timely topic of space security. Space security and understanding the dynamics of escalation and deterrence in space is an important part of our research program at CSIS. I want to thank my CSIS colleagues who have contributed to these efforts, especially Zack Cooper, Kaitlyn Johnson, and Thomas Roberts. While the thoughts and ideas I am sharing today draw from the work our team has done in this area, I am testifying in my personal capacity and the opinions I express are not intended to represent those of my colleagues or CSIS.

Much has changed in the space domain over the past thirty years, but it is important to remember that not everything is new. Space was a contested domain from the beginning. The first test of an anti-satellite weapon occurred in 1959, just two years after Sputnik. Throughout the Cold War, both the United States and the Soviet Union developed and tested a variety of anti-satellite weapons. Thankfully, none of these were used in anger, but the threat was ever-present. What has changed is our confidence in the ability to deter attacks against our space systems.

Deterrence in space is not as clear today as it was during the Cold War. As Mr. Loverro and others have written eloquently about before, throughout much of the Cold War national security space systems were protected by the cloak of nuclear deterrence because these systems were primarily used to support nuclear forces. But today our national security space systems are used across the full spectrum of conflict, from peacetime presence activities to counter-terrorism operations to high-end combat against a near-peer adversary. Space systems give the U.S. military global reach, power, and influence.

Our dependence on space across the full spectrum of conflict creates a vulnerability because our space systems are not adequately protected across the full spectrum of threats. Conflict that begins or extends into space, particularly if it becomes kinetic, will not end well for anyone. Our primary focus should therefore be on deterring conflict in space, and I believe there are three main areas where we can do more to improve our deterrence posture and the readiness of our space forces.

Clarifying Thresholds

First, we need a clearer understanding and articulation of the thresholds for escalation in space. Based on my experience participating in and conducting space crisis simulations and war games, the escalation thresholds for conflict in space are often ambiguous, particularly at the lower end of the spectrum of conflict. As in other domains, thresholds depend on the broader context of a conflict, and each side can have differing views of their own thresholds and their perception of the other side's thresholds. What is different about the space domain is that we do not have much history to draw upon or widely accepted norms of conduct. The United States should continue to lead in this area by working closely with international and commercial partners to establish sensible norms of conduct and to abide by them.

Another complicating factor is that adversaries can use forms of attack against our space systems that are difficult to detect, attribute, and deter. Some types of attack, such as jamming, are

temporary in nature, while other methods of attack, such as using a laser to blind a satellite's sensors, are not visible to others. And many methods of non-kinetic attack against space systems, including cyber attacks against ground stations, can be difficult to attribute in a timely manner. It is nearly impossible to deter an attack if you cannot attribute the source of the attack or know with confidence that the effects being experienced are in fact malicious in nature. We therefore need to improve our ability to detect and attribute these types of threats because this is where thresholds are most uncertain.

This ambiguity and lack of common understanding about thresholds can lead to escalation by miscalculation. Miscalculation can occur when an adversary believes that its actions are below the threshold that will trigger a strong military response from the United States when in fact we may view those actions as crossing a major threshold. Ambiguous escalation thresholds can also invite grey zone aggression in space. We already see this occurring in other domains today, where adversaries are probing at the seams and finding ways to create problems for us or advance their own ambitions without triggering direct, overt conflict.

Improving Capabilities

A second area where we should be focusing more effort is the development of advanced and innovative space capabilities. We are in the midst of a renaissance in commercial space, with many firms making advances to do things that used to be the exclusive domain of governments. The surface of the Earth and the space environment itself are becoming more transparent—whether we like it or not. Overall, I believe this is a positive development for U.S. national security because the United States is at the center of this commercial space revolution. The challenge for the military is to stay attuned to advances in commercial space so that it can leverage the technology, systems, and services created by these companies when possible. It is difficult to be attuned to advances in space technology if acquisition officers are rotating into space programs with little if any prior space experience. One potential remedy is for the Air Force to create a dedicated cadre of space acquisition professionals, both civilians and uniformed military, that are managed separately from the rest of the Air Force acquisition workforce. This would allow for more specific training, a deeper level of technical knowledge, and more relevant career experiences.

The speed of innovation is also a prime concern. DoD and this committee are rightly focusing efforts on how to improve the speed of defense acquisitions overall and space acquisitions in particular. But it is not just the speed of the acquisition process that is the problem—the slow pace of the budgeting process is also a major issue. The planning, programming, budgeting, and execution system used by DoD to develop its budget request and the authorization and appropriations process used by Congress to provide funding and oversight are too slow. Even when these processes work as intended and we are not under a continuing resolution for half the fiscal year, it takes about two years from having an innovative idea to having money available to put on a contract. In that amount of time, the commercial space industry will have already progressed to a new generation of technology. Moreover, the window of opportunity for some things, like hosting a military payload on a commercial satellite, may only last a few months. Innovation is not just about having great ideas and new technologies; it is also about being prepared to take advantage of opportunities when they materialize.

A potential solution I would encourage you to consider is creating something akin to a working capital fund for space innovation. This approach would not be appropriate for major defense acquisition programs, but it could be valuable for smaller prototyping and rapid response programs. The idea is to create a pot of funding with greater flexibility and authorities and to pre-fund the account so that money is available before needs arise. Congress could do this by appropriating a relatively steady rate of funding in each year's budget to replenish the working capital fund and by transferring unobligated funding from other accounts. DoD would be allowed to spend the funding within the constraints defined by Congress, including reporting requirements throughout the year as funding is obligated.

Improving Communications

A third and final area I believe needs more attention is the problem of communicating thresholds and capabilities. Communication is a critical part of deterrence and our ability to manage escalation in a crisis. We must be mindful that space is becoming more transparent by the day, and some of the capabilities and operations that we were able to keep secret in the past may not be secret any longer.

Secrecy invites suspicion among our allies and partners and does little to deter our adversaries. While certain aspects of our national security space systems must remain secret to be effective, too often the U.S. military and intelligence community default to over-classification. I believe that this is a systemic and cultural problem that must be addressed immediately. It was an encouraging first step when DoD declassified the existence of the Geosynchronous Space Situational Awareness Program (GSSAP) in 2014. I believe that this disclosure enhances our security and helps deter aggression in space because the world is now on notice that we are watching what others are doing in geosynchronous orbit. I would like to see us go a step further to name and shame bad actors in space—those who conduct irresponsible, aggressive, or hostile activities—and back it up with hard data.

The over-classification of information also inhibits our ability to work with international partners and commercial firms, both of which can play an important role in improving the resilience of our space systems. Classification issues can make it difficult to even discuss escalation thresholds with other nations, even some of our closest treaty allies. Lowering classification levels, where appropriate, would ease the integration of more allies and partners into our space operations. Similarly, over-classification makes it difficult to work with many commercial firms, especially those that are new to working with the government and may not have cleared personnel. Over-classification effectively serves as an overhead tax on all our space activities because it more complexity and time to everything we do.

Another way to improve the communication of thresholds is to be more explicit with commercial satellite service providers about how attacks on their systems will be treated. The National Security Strategy says that the United States will "consider extending national security protections to our private sector partners as needed." That is a step in the right direction, but more clarity is needed. The U.S. military is already dependent on commercial operators for satellite communications, imagery, and other capabilities. An adversary may seek to attack these commercial systems as a way of signaling intent or resolve, believing its actions are below the threshold for military conflict. Without clarity on how such attacks would be treated by the

United States, commercial space operators may not be willing to accept the risks of doing business with the government in the event of a crisis. One approach I would urge the committee to consider is an indemnification program for commercial satellite operators that would cover losses incurred due to an act of war in exchange for a commitment by these firms to prioritize U.S. government customers in a crisis.

Conclusion

In conclusion, much remains to be done to improve the readiness of our national security space forces for the wide range of threats we face today. I commend the committee for focusing attention on these issues and holding the Department of Defense accountable for making progress. I am hopeful that over the coming months and years the Congress and all the various departments and agencies that play a role in national security space will continue to work together to strengthen our deterrence posture in space. As I have noted in my testimony today, I believe these efforts should focus on three areas: clarifying our escalation thresholds in space, improving our space capabilities and the speed at which we innovate, and improving how we communicate our thresholds and capabilities to others. I look forward to answering your questions.

Todd Harrison

Todd Harrison is the director of Defense Budget Analysis and the director of the Aerospace Security Project at CSIS. As a senior fellow in the International Security Program, he leads the Center's efforts to provide in-depth, nonpartisan research and analysis of defense funding, space security, and air power issues. He has authored publications on trends in the overall defense budget, military space systems, civil space exploration, defense acquisitions, military compensation, military readiness, nuclear forces, and the cost of overseas military operations.

He frequently contributes to print and broadcast media and has appeared on CNN, CNBC, NPR, Al Jazeera English, C-SPAN, PBS, and Fox News. He teaches classes on military space systems and the defense budget at the Johns Hopkins School of Advanced International Studies. He is a member of the National Oceanic and Atmospheric Administration's Advisory Committee on Commercial Remote Sensing and a member of the Defense News Advisory Board.

Mr. Harrison joined CSIS from the Center for Strategic and Budgetary Assessments, where he was a senior fellow for defense budget studies. He previously worked at Booz Allen Hamilton where he consulted for the U.S. Air Force on satellite communications systems and supported a variety of other clients evaluating the performance of acquisition programs. Prior to Booz Allen, he worked for a small startup (AeroAstro Inc.) developing advanced space technologies and as a management consultant at Diamond Cluster International. Mr. Harrison served as a captain in the U.S. Air Force Reserves. He is a graduate of the Massachusetts Institute of Technology with both a B.S. and an M.S. in aeronautics and astronautics.

**DISCLOSURE FORM FOR WITNESSES
COMMITTEE ON ARMED SERVICES
U.S. HOUSE OF REPRESENTATIVES**

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2018

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2017

Federal grant/ contract	Federal agency	Dollar value	Subject of contract or grant

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2018

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2017

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment

2016

Foreign contract/ payment	Foreign government	Dollar value	Subject of contract or payment

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

MARCH 14, 2018

QUESTIONS SUBMITTED BY MR. ROGERS

Mr. ROGERS. What structural changes would you recommend be made to how we organize for joint space warfighting in the future?

General KEHLER. [The information was not available at the time of printing.]

Mr. ROGERS. As you know, we dissolved the PDSA last year and the Deputy Secretary of Defense has retained those authorities. I know we also have an OSD office that has space policy. But where is the broader space policy and budget oversight in the Department of Defense currently? And where should it be?

Mr. LOVERRO. [The information was not available at the time of printing.]

Mr. ROGERS. One of the issues that I have had with demonstrating how seriously we take space is that a significant portion of the budget for space is classified. Should we reconsider how much of that budget is unclassified to be more accountable and perhaps even to message our adversaries?

Mr. LOVERRO. [The information was not available at the time of printing.]

Mr. ROGERS. Which programs seem to be the most egregious in space acquisition failures? What is the common denominator in these programs?

Mr. HARRISON. [The information was not available at the time of printing.]

Mr. ROGERS. What do you believe is the root cause for these space acquisition failures? GAO has repeatedly said it was fragmented leadership decision making?

Mr. HARRISON. [The information was not available at the time of printing.]

QUESTIONS SUBMITTED BY MR. LARSEN

Mr. LARSEN. What does the recruiting and training pipeline look like for space operators?

General KEHLER. [The information was not available at the time of printing.]

Mr. LARSEN. What sort of personnel capabilities/qualifications are needed and how will they be acquired/reorganized? (E.g. test pilots, space acquisition professionals, satellite communications specialists.)

Mr. LOVERRO. [The information was not available at the time of printing.]

Mr. LARSEN. What does a career path look like for a space warfighter?

Mr. HARRISON. [The information was not available at the time of printing.]

QUESTIONS SUBMITTED BY MR. TURNER

Mr. TURNER. Last year's NDAA FY18 Conference Report terminated the position and office of the Principal Department of Defense Space Advisor (PDSA) and transferred duties, responsibilities, and personnel to a single official selected by the Deputy Secretary of Defense. How does this new change impact the Air Force, the Department, and our readiness in the space warfighting domain?

General KEHLER. [The information was not available at the time of printing.]

Mr. TURNER. In the past year you've made statements stating that creating a new service, for space, would not fix but instead distract us from resolving issues with acquisition. Recently we have received the DSD's Space Organization Interim Report which highlights acquisition as a major focus in order for us to move at the speed of relevance with incorporating innovation into the space acquisition process. How important do you think the final report will be in relation to deciding the direction of our space program and other relevant decision making?

General KEHLER. [The information was not available at the time of printing.]

Mr. TURNER. As you have also noted in your publications, the NDAA FY18 conference report eliminates the PDSA, the Defense Space Council, and the newly created A11 and replaces them with a single official selected by the Deputy Secretary of Defense. Does that change reduce administrative burdens or increase them given the new change in direction?

Mr. HARRISON. [The information was not available at the time of printing.]

QUESTIONS SUBMITTED BY MR. BANKS

Mr. BANKS. The space launch industry is innovating in some pretty incredible ways that could increase capability and reduce costs. Reusability of rockets is one example, with all U.S. launch providers moving toward reusable launch vehicles in some way. SpaceX has already launched 9 previously flown rockets, including for NASA. How can the Air Force plan to integrate reusability into its launch program?

General KEHLER. [The information was not available at the time of printing.]

Mr. BANKS. Our adversaries in space are aggressively pursuing technologies and capability to exceed U.S. capability. What steps is the Air Force taking to move more quickly to work with the private sector to win this contest? We hear that things are at the working level, like procurement timetables and certification activities in launch continue to be painfully slow. How can DOD best address this?

General KEHLER. [The information was not available at the time of printing.]

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Mr. LOVERRO. [The information was not available at the time of printing.]

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Mr. LOVERRO. [The information was not available at the time of printing.]

