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HEARING
ON
NATIONAL DEFENSE AUTHORIZATION ACT
FOR FISCAL YEAR 2020
AND
OVERSIGHT OF PREVIOUSLY AUTHORIZED
PROGRAMS
BEFORE THE
COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES
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FIRST SESSION

SUBCOMMITTEE ON STRATEGIC FORCES HEARING
ON
**FISCAL YEAR 2020 PRIORITIES FOR
NATIONAL SECURITY SPACE PROGRAMS**

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**FISCAL YEAR 2020 PRIORITIES FOR NATIONAL
SECURITY SPACE PROGRAMS**

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON STRATEGIC FORCES,
Washington, DC, Wednesday, April 3, 2019.

The subcommittee met, pursuant to call, at 2:27 p.m., in room 2118, Rayburn House Office Building, Hon. Jim Cooper (chairman of the subcommittee) presiding.

Ms. HORN [presiding]. Good afternoon. Welcome, everybody. Thank you for being here. Kendra Horn. I am sitting in for Mr. Cooper for a few moments. I would like to welcome the witnesses and thank you all for being here today.

And I am going to offer Mr. Cooper's opening statement for the record. If you would like for me to share it, I am happy to do so, if you find that helpful. Otherwise, I will just submit it for the record.

[The prepared statement of Mr. Cooper can be found in the Appendix on page 25.]

Ms. HORN. And as the vice chair of this committee, I want to say that I am happy that you are all here today, eager to have this really critical conversation about the priorities and end posture for our national security space enterprise, which is clearly critical to our Nation's overall security in maintaining superiority in this space and look forward to your testimonies.

And I don't—the ranking member is—Mr. Rogers.

Mr. ROGERS. Yeah.

Ms. HORN. Yeah. There you are. I offer an opportunity for the ranking member to make a few comments as we begin.

Mr. ROGERS. I thank you. Thank the chair, vice chair.

I appreciate our witnesses being here. This is a, as you know, a very important topic for our country. This is going to get a lot of attention this year in the NDAA [National Defense Authorization Act], as it should. We have put a lot of work into this. And it is going to be monumentally important for our Nation. This is very important stuff. And so I am glad the committee is taking it up. I look forward to working with you on it. And I yield back.

Ms. HORN. Okay. All right. I will now turn it over to the witnesses to give their opening statements. You will each have 5 minutes, and then of course your written statements will be submitted for the record.

Mr. Rapuano.

STATEMENT OF HON. KENNETH RAPUANO, ASSISTANT SECRETARY OF DEFENSE FOR HOMELAND DEFENSE AND GLOBAL SECURITY, DEPARTMENT OF DEFENSE

Secretary RAPUANO. Chairman Cooper, distinguished members of the subcommittee, it is a pleasure to—it is on. Sorry. It is a pleasure to appear before you along with General Raymond and Ms. Chaplain today.

The U.S. is at a strategic inflection point in an era of renewed great power competition. Our reliance on space is at an all-time high and expanding. Our way of life and national defense rely on space, yet our posture was built for a permissive space environment. At the same time, potential adversary threats are also at an all-time high and expanding.

China and Russia understand the essential role of space to our way of war. They see this reliance as our Achilles heel, and they are developing offensive military capabilities, doctrine, and organizations intended to place U.S. and allied space systems at risk.

They are developing, testing, and fielding a full suite of antisatellite weapons, including ground-launched missiles and directed-energy weapons, and continue to launch experimental satellites that conduct sophisticated, on-orbit activities to counter space capabilities.

I cannot emphasize enough how serious these challenges are. This is not about space for space's sake. This is about life here on Earth. Our national defense and the lives of our soldiers, sailors, airmen, and Marines rely on space. To be clear, we are currently ahead in space, but we are not postured for the emerging strategic environment we are facing and risk steadily losing our margin of advantage.

Department of Defense space professionals are the best in the world, but we are not currently postured to maintain our comparative advantages in the emerging strategic environment. Our challenges stem from decentralized advocacy, fragmented responsibilities across multiple services and agencies, and nascent space warfighting doctrine capabilities and expertise.

We have put considerable thought and analysis into studying the problem, and it is time for action, and we need your support. To compete, deter, and win in space is a complex, massive, and enduring undertaking; therefore, we must fundamentally change our approach to space from a key support function in a benign environment to space as a critical and contested warfighting domain.

This requires changes in policies, strategies, capabilities and, yes, organization. A new armed force is foundational to our approach. Last month, the Department provided Congress with a legislative proposal for the establishment of the U.S. Space Force as a new branch of our Armed Forces.

The U.S. Space Force will catalyze the transformation of space as a warfighting domain. It will provide the undivided attention, advocacy, and leadership necessary to develop the people, the doctrine, and the capabilities to maintain our unfettered access to and ability to fight and win in space. This will ensure continued U.S. dominance in space.

We will also establish a combatant command, the United States Space Command, to focus joint warfighting in space. It will plan

and conduct space operations to enhance deterrence and assure allies and partners and defeat threats to U.S. national interests. Essential to the success of USSPACECOM will be the doctrine, equipment, and trained personnel presented to it by the United States Space Force.

The U.S. Space Force, Space Command, the Space Development Agency, and other vital reforms will put the U.S. on the right path to enhance deterrence in space. The Department greatly appreciates the work of this committee, the focus you have provided on national security space, and highlighting the need for a strategic paradigm shift and structural change.

Thank you again, and I look forward to your questions today.

[The prepared statement of Secretary Rapuano can be found in the Appendix on page 28.]

Ms. HORN. Thank you very much.

General Raymond.

**STATEMENT OF GEN JOHN W. RAYMOND, USAF, COMMANDER,
AIR FORCE SPACE COMMAND**

General RAYMOND. Congresswoman Horn, Congressman Rogers, members of the committee, distinguished members of the committee, I am absolutely honored to appear before you today. I think this is my third time as the Commander of Air Force Space Command. I appreciate your support. And on behalf of the 26,200 men and women that make up Air Force Space Command—simply the world's best—we thank you for your leadership.

Today, consistent with our National Security Strategy and our National Defense Strategy, there is an unprecedented alignment that space is a warfighting domain just like air, land, and sea. While we have become comfortable declaring space as a warfighting domain, the implications of this declaration are significant and driving tremendous change.

With your strong support, we have developed a strategy, resourced that strategy, and have made significant advances in the national security space enterprise. This fiscal year 2020 budget builds on our efforts over the past 2 years and proposes a 17 percent increase in space funding over the previous fiscal year, in total a \$14 billion investment.

With my posture statement in the record, let me summarize just a few points, if I could. First of all, our primary focus is on enhancing lethality and readiness in this warfighting domain. We have invested in new, defendable architectures. We have invested in space situational awareness and command and control capabilities necessary to operate in a warfighting domain.

We have funded training infrastructure to develop our joint space warfighters and the cadre that is so critical to our Nation's success. We have enhanced and expanded our partnerships with the intelligence community, our allies, and with commercial industry, to include nontraditional partners.

And I would just, if I could, take a moment from the script. The last five times I have testified here I have had Betty Sapp at my side. And yesterday Betty Sapp retired as the Director of the NRO [National Reconnaissance Office]. And I will tell you, she has been a spectacular partner, and the work that we have done together

has provided great advantage to our Nation. I am going to miss her.

You will see, in these partnerships, we have enhanced our partnerships with the National Reconnaissance Office. It is the best we have ever been. And we have hosted payloads on allied partners' satellites, which is also a significant step forward.

Finally, we have focused on capitalizing on innovative business practices. We have retooled the Space and Missile Systems Center, and it is something we call SMC-2.0. We have established, based on the recommendations of the NDAA last year, a space RCO [Rapid Capabilities Office] that is up and running at Kirtland Air Force Base. And we are adopting open architectures and standards to drive innovation across a broader commercial base, which has been so important to the space domain.

Let me close by reiterating that we do not want a war to extend into space. Our mission is to deter that. But the best way to deter that is to be prepared to fight and win that war if deterrence were to fail, and we are.

Thank you again for the opportunity to be here. I greatly appreciate it, and I really look forward to your questions. Thank you.

[The prepared statement of General Raymond can be found in the Appendix on page 39.]

Ms. HORN. Thank you, General.

Ms. Chaplain, look forward to hearing from you.

STATEMENT OF CRISTINA T. CHAPLAIN, DIRECTOR, CONTRACTING AND NATIONAL SECURITY ACQUISITIONS, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Ms. CHAPLAIN. Vice Chair Horn, Ranking Member Rogers, and members of the subcommittee, thank you for inviting me today to discuss DOD [Department of Defense] space programs.

Space is at a pivotal point right now. In the face of growing threats and lengthy development cycles, DOD is embracing new approaches to help speed up the acquisition process, establish better partnerships with the commercial sector, and change its acquisition culture.

There is also a proposal before Congress on strengthening leadership for space. Bringing about this broad span of change will be challenging to say the least and not without risk.

More specifically, while DOD is undertaking this change, it will need to concurrently focus on completing older programs that are still struggling. The ground system for GPS [Global Positioning System], known as OCX [Next Generation Operation Control System], for example, is 5 years late. And while the contractor has improved the pace of building and testing software, we still see a lot of schedule risk.

The Air Force also recently stopped development work on JMS [Joint Space Operations Center Mission System], a ground system for processing space situational awareness data, because it didn't deliver as expected. We are also still faced with long gaps between delivery of satellites and ground systems needed to make use of their capabilities.

Moreover, there are a myriad of challenges facing space programs that are just getting underway. First, even with the new

space proposal, there are still a lot of open questions about leadership. For example, at this time, it appears that there will be a number of space acquisition activities outside the Space Force, including the Missile Defense Agency, the NRO, and some military space service activities.

But so far, it is uncertain what the overall governance structure for space will be. If there are conflicts in requirements, funding, or priorities between agencies that are not in the Space Force, who resolves them and makes a final decision?

There is also a new entity being rolled out, the Space Development Agency [SDA], which has very worthwhile goals of adopting innovative technologies for space. But at this time, it is unclear how it will mesh with similar agencies, and also still unclear who is in charge of future architectures for space. These questions may well be resolved as details for the Space Force and SDA get worked out, but new programs will be operating with uncertainty for the time being.

Second, while streamlining may help speed up space programs and change the culture, we know from past efforts to streamline space that there is also a risk of inviting programs to move too quickly and disregard the engineering and acquisition discipline that is so very important to space.

Keep in mind that space is different than other types of weapons. You cannot easily fix satellites once they are in orbit. We consistently see programs suffer major setbacks because one quality procedure was not followed or one small flaw and one small part was not detected. This does not mean streamlining cannot be done or should not be done. It just means we should heed lessons from the past, maintain good insight, oversight, and expertise, and be prepared to cancel programs that falter.

Third, there is a question about DOD's capacity to manage multiple new programs concurrently. Yes, there is a healthy increase being proposed for space, but consider at least nine significant programs are getting underway. They will likely require heavy investments upfront, and that DOD will also be seeking money for a new Space Force, for space protection, for new Space Development Agency, a new missile defense space layer, as well as priorities outside of space such as the nuclear triad.

There are also questions about workforce capacity. We recently reported that just tracking who is in the space acquisition workforce is a challenge, and there are gaps in technical expertise that could be stretched with multiple new programs.

Moreover, all these new programs will be software intensive, but DOD has challenges managing software. We recently found space software programs struggle to effectively engage system users, which is critical to their success. We understand many new programs are attempting to be more agile and to use more modern tools, but it remains to be seen how successful DOD can be in adopting these new ways.

Again, good things are happening in space. There is attention from the highest levels of government, more resources, and a recognition that different approaches and cultures are needed. What is key to making them happen is not to lose focus on improving ac-

quisition management and oversight, building capacity as we speed up programs, and continuing to reduce fragmentation.

This concludes my statement, and I am happy to answer any questions you have.

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

Ms. HORN. Thank you. I appreciate all three of you being here today.

And I am going to start with, I think, what is one of the obvious questions, and I know many of us on this committee and the committee as a whole have begun to address it, and that I think is alignment of our priorities and the realignment of space in the form of a Space Force or some other realignment, which it is clear, I think, to me and to, I would say, most of us or everyone on this committee certainly that space as a contested area is unquestionable and it is undoubted, and we have a lot of adversaries increasing their presence, their investment, and the work that they are doing in this arena so that we have to, I think, be smart about how we move forward.

And I asked a couple of these questions to General Dunford the other day, and I think I want to hear from you today. And I am going to start with Space Force and how we structure that. And first of all, your sense of whether or not this is an alignment that needs to be—that needs to have a direct report up to the Joint Chiefs or what that looks like.

And I would like to start, General Raymond, because you are currently there, with your sense of how this realignment would impact, and do you see the need for Joint Chiefs?

General RAYMOND. Thank you.

Let me first say that I fully support the standup of a Space Force underneath the Department of Air Force. I do so for several reasons: First of all, it will elevate space to the level of importance that it is for our—to our Nation and to our joint force; secondly, it will align and unify space activities that are currently spread out across the Department under one force; thirdly, it will provide a four-star that will come to work every day focused on that domain, which I think is really, really important; and then, finally, by putting the Space Force underneath the Department of the Air Force, we do so in a very efficient manner. And so, for all of those reasons, I think it is structured properly in the way the legislation—legislative proposal came forward, and I am supportive.

Ms. HORN. Thank you.

Mr. Rapuano.

Secretary RAPUANO. I agree wholeheartedly with General Raymond's response. I would simply add that, as a major warfighting domain, space is a vast, physical domain. It requires the time and attention and undivided focus of senior leadership in the Department in the form, consistent with our proposal, with the Chief of Staff of the Space Force who will be a member of the Joint Chiefs of Staff, as well as a vice, who will be the four-star vice to the Chief of Staff.

It is that focused attention on the mission, and it is the—per the Goldwater-Nichols structure, it is that organize, train, and equip function that will present the trained personnel, the doctrine, and

the expertise as well as the equipment in the form of the architecture to the U.S. Space Command, which will then leverage those capabilities in the day-to-day employment of the joint space forces.

Ms. HORN. Thank you.

Following on that a little bit, it is clear that we have some challenges with identifying acquisition development, development timelines as China, Russia, some of our other adversaries are beginning to put more time and resources into this domain that we need to streamline. And so I have a couple of questions following on the identification and the cost and/or relative cost savings that this might impact.

So, in the recent GAO [Government Accountability Office] report that looks at what we know about space, having it in so many different places across DOD, and I understand that the proposed Space Force plan would still have—we would still have some programs under the intelligence community umbrella.

Setting that aside to a certain extent, the fact that we still have areas that we just don't know where acquisition is going and we are not quite clear on all of the workforce issues, General Raymond, I think I want to know what steps—as we put this plan into place but in the interim, what steps the DOD will be taking and Space Command will be taking to identify the number of acquisition personnel that are needed so that when we stand—when this is stood up or we do this realignment that we don't—you don't find ourselves in that same position.

General RAYMOND. Yeah. So this committee has helped over the years just discuss how important it is that we reduce the timeline from requirements to acquisition, so we have to get this right.

Today, we have rearchitected SMC-2.0, and we have elevated the stature of the human resource capital manager of that. Our personnel numbers at SMC today are the best it has ever been. They are about 85 percent manned. Our midlevel managers are the highest it has ever been as well and have pretty significant capability.

One of the things that we are looking at and addressing is, there is about—I think in your report you mentioned about 8,000 acquisition professionals that are dealing with space. And one of the things that we have studied over this past year and we are putting together an office to manage that broader enterprise look at acquisition officers spread out across the Department that have space expertise, and so we are going to put mechanisms in place to be able to track that and develop that towards the end of being able to move fast and deliver critical capabilities for our Nation.

Ms. HORN. Following on that with space workforce development, and I have—I will have a question for you in just a moment about the GAO report, with the 2-year rotations occurring, 2-year rotations, do you see that the current structure as challenging to develop and retain the expertise in the DOD workforce in the space domain?

General RAYMOND. I am pretty comfortable with our ability to develop expertise in the space domain. I think we have got a level of expertise that is greater than when I first got into this job, and I am comfortable. I think there is—you know, there is cost benefits. There is goodness of moving people as well to get different exper-

tise and bringing in outside talent to help us, and so I am comfortable we have it about right.

Ms. HORN. In the transition to a new architecture, do you think that would help to recruit and retain even if they are moving within Space Force but to develop and retain that expertise in a way that is more focused? And perhaps that is a better way that I could describe that question.

General RAYMOND. Yeah. So I would tell the subcommittee, it is an exciting time to be in this business. There are a lot of people knocking on our doors wanting to come to work for us. It is really an exciting time, and we have had no problem recruiting talent to come our way.

And I think the way we restructured SMC, it provides some opportunities to get people in, build that talent, and then actually, as you mentioned, move them around to different areas of expertise to help grow them for the future.

Ms. HORN. Thank you.

And one final question for you, Ms. Chaplain. Could you specify—you have summarized well the GAO report—the biggest area of challenge that you identified, specifically around the lack of knowledge about where all of the acquisition pieces are that you found in your GAO report.

Ms. CHAPLAIN. Yeah. I would like to say it is not just unique to space. The way DOD tracks its acquisition professionals in general focuses on certain skill sets like program managers, engineers, and not necessarily the mission area or platforms that they work on. So we found that DOD couldn't really tell us who was in the space acquisition workforce because of the way their systems track.

But it is a good idea to maybe change the system so that you can track at least for space. If you are talking about bringing together organizations, you want to know who is out there to draw on. And then it would help you do more analysis in terms of types of expertise that you might need more of, which I think has been an issue for a long time.

Ms. HORN. Thank you, all.

We have been joined by our chairman. I want to thank you all, the witnesses, for your testimony and questions, and I will turn it over to Chairman Cooper.

Mr. COOPER [presiding]. Sounds like you were doing a great job. I am happy for you to stay there, if you would like.

Who is the next questioner? I don't want to interfere in the line of questioning. Mr. Rogers, I would be honored to recognize my friend from Alabama.

Mr. ROGERS. I thank my friend from Tennessee.

This is great stuff. Something that Mr. Rapuano said a few minutes ago I think this committee should be sure and take note of. You know, General Raymond listed some of the significant impacts of having a separate Space Force. But the fact that we are going to have a four-star Chief of Staff and a four-star vice chief of—no, not chief—yeah, General Hyten, two space professionals in the tank advocating for space is huge as we try to have a new service.

You know, one of the problems that we found with this committee is that space was being starved in the Air Force. It is not going to be starved anymore under this new construct, and it is

going to get the kind of resources we need to be successful. So I am excited about that, and I want everybody to take note of that because that is a big deal in this organizational structure.

I also want to note, Ms. Chaplain did the work that helped focus this committee on this. A lot of folks in the government don't get the attention they ought to get, but she ought to be recognized for the hard work she did in helping me and Jim Cooper and the rest of this committee recognize the foundation that had been laid by the Rumsfeld Commission, Allard Commission, several reports that her office had done. This Space Force idea did not come up out of me and Jim Cooper. It came through the work of those commissions and the GAO studies, and I appreciate what you have done.

To that point, Ms. Chaplain, looking back over the last 30 years at the Rumsfeld Commission, the studies you have done, the Allard Commission, what do you think—where do you think we are now given what they were saying we needed to be doing? Are we following through on the path that they pointed us toward?

Ms. CHAPLAIN. I think we are. We have had a lot of attempts since those commissions to do things, but they were mostly on the edges, or they were reforms that didn't work very long. And now we have something before us that can make lasting change, which is one of the important ingredients that those commissions brought out. Some of them envisioned even more dramatic changes that are being proposed right now. They envisioned an independent Space Force.

And one of the commissions that was done under this committee also envisioned a giant national space security organization that would include the NRO. But they all also admitted that maybe you need these interim steps in between.

Mr. ROGERS. Exactly.

Ms. CHAPLAIN. And I think that is where we are now is the interim step.

Mr. ROGERS. Yeah. Back a few minutes ago I was trying to refer to the term "vice chairman" talking about General Hyten. And that is when he suggested to this committee in briefings is that this is an evolutionary process. We don't have to go from where we are now without a Space Force to this full-blown construct that has all the IC [intelligence community] in it and in a separate department. Just like the Air Force didn't evolve out of the Army to be what it is today; it went through iterations, and that is what I envision here.

Ms. Chaplain in her opening statement, General Raymond, made reference to some confusion about the role of SMC versus Space Development Agency. And you made some reference to it. How do you see those two working—in my view, I don't know why we would need an SMC once we have a full-blown Space Development Agency. So tell me how you see that working out.

General RAYMOND. First of all, I don't think there is any argument at all that we have to get faster.

Mr. ROGERS. Yeah.

General RAYMOND. And we have talked about this for years. The time from requirement to capability has to get shortened. And so, with the help of this committee and with Congress last year, we, for example, stood up a Space Rapid Capabilities Office to get after

that. We have rearchitected the Space and Missile Systems Center to get after that. We have had partnerships with the Air Force RCO. We have had partnerships with the NRO, and it is all in my written statement.

So everybody is moving out fast to work to shorten that timeline. And I think that is a national imperative. The Space Development Agency is doing the same thing, and I—that there is all goodness in what we say that they are going to do. The details of that, as I understand, are still being worked.

And so what we are going to have to do is I am going to have to—and I look forward to working with Dr. Griffin as we go forward to make sure that these are synchronized activities and not competing, and I think we can do that.

Mr. ROGERS. Great. In talking with my friend Chairman Cooper about this and others, we are a little concerned that the proposal that came over from the Defense Department has some cross-jurisdictional problems that need to be cleaned up.

We want to make sure you understand that, while we want and expect and are determined to see the standing up of a separate Space Force, the version—the proposal that you all sent us is not going to be the final product because we are going to have to clean up some of those things.

Just from a legislative standpoint, this committee, meaning the HASC, the House Armed Services Committee, and our counterpart on the Senate side should be the committee that decides this, and I think you are going to see some changes made.

And I hope you understand this is a process. You all make proposals. We make—come back—counter proposals, and we get to a place where we have something good. But I do want you to know we see some pretty glaring problems that are going to have to be cleaned up in that proposal.

And, with that, I thank the chairman for the time, and I yield back.

Mr. COOPER. I thank the gentleman from Alabama.

Let me ask unanimous consent that the members of the full committee, such as Mr. Lamborn, be able to ask questions at the end of subcommittee questioning.

Hearing no objection, that will be approved.

Next questioner will be Mrs. Davis.

Mrs. DAVIS. Thank you, Mr. Chairman.

Thank you to all of you for being here.

Mr. Rapuano and General Raymond, I think it is pretty clear, I am sure to all of us in the room, where you stand on this now. I appreciate that. And yet I am also wondering, you know, from an outside perspective, where you think there is some redundancy.

I mean, from an outsider, Space Force, Space Command, new Space Development Agency sort of sounds like, do we have to do all that? And yet some redundancy is always good. Some of it is probably over the top. What—

General RAYMOND. I think—thank you for the question.

I think if you go back to Goldwater-Nichols back in the 1980s, it was kind of two functions that were laid out. One function is an organize, train, and equip function and that is the function of serv-

ices. The other function is a warfighting function, and that is the function of combatant commands.

And so they actually have two different roles. So, if you look at the proposals being talked about with the Space Force and the combatant command, the Space Force would provide organized, trained, and equipped professionals to U.S. Space Command to be able to employ. So there is actually two different functions, and it works—it has been working very well since the 1980s.

Mrs. DAVIS. Did you want to comment, Mr. Rapuano?

Secretary RAPUANO. I would just add to General Raymond's response that it really is fundamental to the way that the Department of Defense operates with regard to how do we organize, man, train, and equip for warfighting domains. And having the undivided attention of a dedicated service with senior leadership who are only thinking about space has been one of the missing pieces.

And if you look at the studies all the way back to Rumsfeld, that is a consistent theme, is the disaggregation and the lack of elevation associated with space. And that is why the Space Force, from our perspective, is such a fundamental component.

Mrs. DAVIS. Thank you. And yet it has taken us a while to get there.

Secretary RAPUANO. Yes, it has.

Mrs. DAVIS. Yeah.

Ms. Chaplain, I know you spoke about that the DOD is not able to track professionals in the same way. But where do you come in on this then when it comes to the professionals themselves and whether or not we are able to—you suggested maybe we need to have a different kind of system for doing that, a different kind of analysis for where people should be in their—those pathways.

Ms. CHAPLAIN. You know, when I was talking about a different system, I actually meant the IT [information technology] system that tracks acquisition professionals. But one issue that has been pertinent to space for a long time is maintaining and increasing expertise in certain areas. And if you are going to move to the Space Force construct, it is a good opportunity to really look at your workforce and see the types of professionals you need.

It was mentioned just earlier about 2-year rotations for programs in terms of officers managing them. The best practice is actually to have longer tenures and people maybe even on the civilian side, more of them so that you can really develop that deep expertise. I think that is something the NRO has been trying to do over the past few years and has been pretty successful. So I think there are things we can do for the space acquisition workforce now that we have an opportunity to do.

Mrs. DAVIS. Do we risk some protective measures for our workforce in enabling these kinds—the establishment of the Space Force? I mean, are there some things that, down the road, that we suspend and that come back and bite us later on?

Ms. CHAPLAIN. There is a big question, I think, in terms of where your committee has had is on the authorities being proposed for the Space Force under the DOD proposal. It is an area I don't know too much about, but there are some authorities that other intelligence agencies have that I think were envisioned for this, that people have concerns about. But it is an area worth exploring.

Mrs. DAVIS. So maybe it is worth looking at, yeah.

And to all of you, I just have a few seconds, what challenges does the Department of Defense face that threaten the improvement of cybersecurity of our weapons systems, any one high-priority concern?

Secretary RAPUANO. So really what we have been focusing on in the last 2 years has been integrated approach to cyber throughout the Department and a systemic approach to understanding vulnerabilities, and that is of currently deployed capabilities as well as the full life cycle from birth associated with how do we bake in cyber resilience and security from the very beginning. And they are two very different challenges, but we have to do both particularly for our more critical systems.

Mrs. DAVIS. And when it comes to our work with our allies with NATO, do they share the same concerns?

Secretary RAPUANO. They do.

Mrs. DAVIS. Thank you very much.

Mr. COOPER. I thank the gentlelady.

Mr. Brooks from Alabama.

Mr. BROOKS. Thank you, Mr. Chairman.

Assistant Secretary Rapuano, according to the Space Force proposal, quote, as necessary, Department of Defense components may retain organic space capabilities uniquely required to support the core mission of that military service or defense agency, end quote.

Can you please describe and elaborate on what happens to Army Space and Missile Defense Command, the Navy Space and Naval War Systems Command, and the community involved with user equipment under the Department of Defense's Space Force proposal?

Secretary RAPUANO. So, again, per that guidance, the organic capabilities within a service that are necessary for the execution of their missions will stay within the service. Those capabilities that are global and pertain to beyond the unique mission of the service, for example, global GPS, global comms, they will go to the Space Force.

Mr. BROOKS. Second question, and first, background, as you may know, Redstone Arsenal has a long history in commercial military and even adversary space capability development and analysis.

To give just a few examples, Army organizations at Redstone Arsenal are currently developing a space layered sensor suite for the ballistic missile defense system and low-Earth orbit communications and imagery satellites to support the tactical warfighter.

The Department of Defense's fiscal year 2020 budget request seeks approximately \$105 million in research, development, testing, and evaluation funding, and approximately \$44 million in operations and maintenance funding for the Space Development Agency.

What is the expected impact of this funding to present space capability development providers, and how is the Space Development Agency expected to leverage the expertise that already exists at places like Redstone Arsenal?

Secretary RAPUANO. So the intent of the Space Development Agency is not to replace or displace existing institutions working on space development and acquisition. It really is to augment and

complement. This is a growing field, as you are well aware, just from the budget numbers including this year's.

We see the need for more of these capabilities, and we simply want to ensure that they are working in an integrated way to achieve strategic outcomes. So we don't see these current capabilities or institutions or facilities being replaced or moved as a general proposition.

Mr. BROOKS. And final issue, last week India conducted an anti-satellite test. Can any of you speak to the dangers of such tests—this is for the whole panel—particularly the problems that can be caused by space debris created by antisatellite tests?

Secretary RAPUANO. Well, let me just take a start, and then I will hand it over to General Raymond. We, as the lead spacefaring nation in the world, have a lot invested in the ability to safely conduct space operations, and debris is a significant concern. So we certainly have consistently favored minimizing potential for debris.

We, of course, are the stewards of the space traffic management as well as space awareness, and we facilitate those kinds of safety measures throughout space. So we work with our allies and partners as well, who have—share the same understanding and priority with regard to the space debris example.

General RAYMOND. Yes. We are aware that that was going to happen. We immediately detected the launch. We immediately detected the successful intercept. We started tracking pieces of debris. Today we are tracking about 270 pieces of debris.

We act as the space traffic control for the world. We do all the analysis to determine if any two objects in space are going to collide, and then we provide warning. We take great care in providing that warning to the world, and we also take great care in making sure that the astronauts on the International Space Station are safe.

Mr. BROOKS. If I understand correctly, you stated that you were aware that it was going to happen. Was there anything done to discourage India from creating so much space debris?

Secretary RAPUANO. We have expressed concerns to all our partners and allies with regard to debris and looking to minimize debris to the maximum extent possible.

Mr. BROOKS. Are we pretty much limited to tracking this debris and trying to avoid collisions thereafter, or is there anything that can be done about the debris that is already up in space?

General RAYMOND. There is not a lot today that can be done about the debris problem that we face in space. We track about 23,000 objects. The way that we tackle that problem is to quit creating debris in the first place, until we provide that warning for the world, to keep the domain safe for all.

Mr. BROOKS. Thank you, Mr. Chairman.

Mr. COOPER. I thank the gentleman.

Now the gentleman from California, Mr. Carbajal, is recognized.

Mr. CARBAJAL. Thank you, Mr. Chairman.

General Raymond, how would you describe the Air Force's progress towards ending reliance upon the RD-180?

General RAYMOND. The Air Force has a three-prong launch strategy. First and foremost, we must have assured access to space. That is critical, critical to our Nation. In fact, it is a vital national

interest, as articulated in the National Security Strategy. The second thing we want to do is increase competition. And the third thing, as mandated by law, we are to get off the RD-180 engine.

Our launch strategy is working on all of those fronts. We have had 76 for 76 successful launches. We have had a 24 percent reduction in launch costs since 2012, and we are on track to get off the RD-180 engine by the statutory limits.

Mr. CARBAJAL. When you say “statutory limits,” you mean fiscal year 2019?

General RAYMOND. The law describes not procuring any more additional engines past fiscal year 2022.

Mr. CARBAJAL. 2022. Thank you.

What are the risks if this is delayed since the Air Force has asked for backup options in the case of delay?

General RAYMOND. I am not—I am sorry. Can you clarify the question for me?

Mr. CARBAJAL. If we don’t meet that deadline, it is my understanding the Air Force has asked—is considering options in case we are not able to meet that statutory deadline.

General RAYMOND. We are going to meet the statutory deadline.

Mr. CARBAJAL. Great. Well, that is good to hear.

General Raymond, how are you ensuring that all companies that are able to compete for phase 2 of the launch services acquisition are able to and are on a level playing field?

General RAYMOND. It is critical, absolutely critical that we have fair and equitable competition, and, again, that is the second prong of our strategy. I am very comfortable with where we stand today, that we have that fair and equitable competition, that we have—we now have companies that are mature enough to be able to launch the full spectrum of launches that the United States military requires. And I am very comfortable going forward with our strategy.

Mr. CARBAJAL. Not to be redundant, but are the risks that the LSA [Launch Service Agreement] approach down-selecting to two providers will exclude competitors for at least 5 years, what are you doing to ensure we retain competition?

General RAYMOND. Again, competition is critical to our strategy. It is a little bit of a nuance. It is not a down-select from—to two. We are having a full and open competition for two, and so everybody can compete for that. We are comfortable that there is companies that—many companies that can compete and win that. We think that the playing field is level.

And if you look at the manifests that are projected over the next 5 years, the manifests really support two companies, and so we think we are on the—on firm and solid footing on this strategy.

Mr. CARBAJAL. Thank you, General.

Ms. Chaplain, what are your recommendations on ensuring fair and open competition for launch?

Ms. CHAPLAIN. We have not had recent work on EELV [Evolved Expendable Launch Vehicle] or the new launch program, but we have always been very much of a proponent of ensuring competition to the extent you can. And I do believe General Raymond is right that the manifest for phase 2, that there won’t be quite the demand from DOD to support three providers, but there has been

a concern that those—some of the providers getting money now as part of technology maturation efforts won't be able to be a player for that period of time.

It is difficult to keep competition in launch. You are always at risk of maybe losing competition because one of the companies may not be able to stay in business. So it is—to the extent that you can keep other players in the game, it is beneficial.

Mr. CARBAJAL. Thank you.

General Raymond, General Hyten has noted that, quote, I will not support buying big satellites and make juicy targets—that make juicy targets, end quote. However, in replacing the missile warning satellites, the Air Force is investing billions of dollars on a similar architecture of a handful of satellites.

What are you doing to complicate the adversary's incentive to target these satellites, for example, investing in a disaggregated architecture and taking advantage of hosted payload opportunities?

General RAYMOND. Let me just say that General Hyten is a good friend, and we are in great alignment on this topic. There are lots of things that we are doing to enhance the resiliency of our architectures, and what I would like to do, if possible, is take that conversation and the specifics in a classified hearing. But let me give you some top bullets.

We are focusing on, again, having more defendable architectures. We are developing tactics, techniques, and procedures to be able to respond to threats and be able to fight through threats. We are working hard to develop the joint space warfighters that can operate successfully in a contested domain.

And then, finally, we are also expanding our—and enhancing our partnerships with our allies in commercial industry and intelligence community. And this budget, for example, we are placing a couple payloads on allied satellites to, again, do some more dispersal. So there is a long strategy, and I will go into more specifics in a classified hearing. Thank you.

Mr. CARBAJAL. Thank you, General.

I yield back.

Mr. COOPER. I thank the gentleman.

And now yet another gentleman from Alabama, Mr. Byrne.

Mr. BYRNE. It is Alabama day on the subcommittee.

General, I want to go back to the launch vehicle issue, if you don't mind. To what extent will the new launch vehicle prototypes DOD is investing in be ready by the time they are needed, and can you talk about the technical risks and how they are being mitigated?

General RAYMOND. We are working very closely, Congressman, with those companies, as you would expect. We are very comfortable with the level of maturity where they are. We are comfortable what their plans of what they have to do here over the next year and are confident, completely confident that they will be ready to execute our missions when it is time.

Mr. BYRNE. Okay. And how do you balance mission assurance and innovative technology development of space launch?

General RAYMOND. You know, I have been in the space launch business for a long time, and I was in the space launch business on a staff back in the 1990s when we didn't have a lot of success.

We were blowing up significant amount of rockets, and we have taken great, great care in turning that around.

And as I talked about in my opening statement, we are 76 for 76, and every launch is a new launch that we are focused on. There is room for innovation. I think the way you do that innovation is you have a close partnership and relationship with the folks that are innovating, and we enjoy that today.

And there are some innovative things that are happening. For example, this year we are going to use reusable boosters for the first time. So there is room for innovation. We work side by side. We make sure that we do it smartly and that we are 77 for 77 and 78 for 78.

Mr. BYRNE. Good.

Mr. Secretary, I wanted to first congratulate you and the administration. You are the first administration to recognize space as a warfighting domain, and that in and of itself was a big step forward.

But try to give me a little more general sense—I know there are some things you can't tell me in a nonclassified setting, but can you describe what our adversaries are doing or have the capability of doing in space and compare and contrast that with us?

And, General, if you need to jump in, that would be good too.

Secretary RUPANO. Yes. I can certainly go into greater details in the closed session. But really since the Gulf war, our principal potential adversaries have been extremely focused on the enablers that have provided a wide range of highly exquisite capabilities to the United States military in terms of targeting, positioning, locationing, communications. The list does go on.

And they have been very focused, and the Chinese in particular have made massive investments in their space capabilities, and they are developing counterspace capabilities and deploying those capabilities.

They are looking to denigrate our advantage that we have in terms of our space-based capabilities and enabling functions. So we are very mindful of that. And this really is what forced the transition of understanding of space versus an enabling zone for capabilities as a warfighting domain.

And the architecture that we have right now was not designed for a nonpermissive environment. So that is where we are focused. That is where we have a sense of urgency with regard to how do we accelerate these capabilities, how do we better organize and equip. And, ergo, the organizational structuring, in terms of having that center of gravity, institutionalizing the advocacy of space, the development of doctrine, the training of personnel, is critical to being able to present that force to the combatant command that will then be operating the joint space forces on a daily basis.

Mr. BYRNE. General, do you want to add anything to that?

General RAYMOND. I agree with all that. I would just say that—and kind of as a teaser for the classified session. At an unclassified level, I would say that, you know, there is a spectrum of activity that we are concerned about, everything from low-end reversible jamming of communication satellites and GPS satellites, for example, all the way up to a high-end direct-ascent ASAT as demon-

strated in 2007. And I can give you the specifics on that spectrum at a classified hearing.

Mr. BYRNE. Thank you. I yield back.

Mr. COOPER. The gentleman from California is recognized.

Mr. GARAMENDI. Just a couple of things. I was going through the suggested questions by the staff. Extraordinary set of questions, most of which are not going to be able to be answered in this setting, and I would recommend that they be answered for the record because they are—each and every one of them are very, very important. Maybe 20 percent of them have actually—are going to be able to be asked here, so I would ask that.

The second thing really has to do with the Space Force itself. I have been going back and forth on that. I have been trying to visually see how this thing works. And here we are with a year in which we are supposed to make a decision, and there is no organization chart. Presumably you have one. If it is a secret, maybe we can get it in the next session, in the secret session. If so, I would probably ask, why is it secret?

We heard that from one of our—my colleagues that there is this Redstone facility. Each of the services have their own space programs. How are those to be integrated into this Space Force, or are they going to be kept separate, as you indicated the Redstone situation would continue to be separate?

Secretary RAPUANO. As I noted, those capabilities that are unique to the organic mission of the service will stay under the service. The global or joint capabilities will fleet up under the Space Force. So that is a process that will—in terms of the details of where these delineations are made, will be taking place going forward. But if you have, for example, a global communications system run by one service, that set of capabilities and that responsibility would revert to the Space Force so it can be leveraged for the entire—

Mr. GARAMENDI. So could you give an example of a service that has such a global communications system and it would be transferred from whatever service that was to the Space Force?

Secretary RAPUANO. I don't have the details, but I believe the Navy has a global SATCOMs [satellite communications]. General Raymond probably—

Mr. GARAMENDI. And so you think they maybe might be willing to transfer that to the Air Force. That will be an interesting switch. We have seen some turfing examples in the past. This entire thing is fraught with turf.

Secretary RAPUANO. That is really the very point of institutionalizing space, the warfighting domain, and the development of the organize, train, and equip function in a service model because of the disaggregated approach that we have taken, and, again, that was in an era where space was not contested. It was not a warfighting domain.

So the focus was on maximum enablement of service warfighting mission capabilities. You didn't need as much of that integrated approach where you are looking at an architecture in space that is resilient and that which we can defend or reconstitute rapidly in a conflict.

Mr. GARAMENDI. I am going to really wait until the classified section. I just draw my final point to the questions that have been raised by the chairman. Seven-year unlimited authority to transfer funds from here to there and everywhere, really think that is going to happen? And why would it be necessary to happen?

Secretary RAPUANO. We are looking forward to working with Congress on—

Mr. GARAMENDI. Given what the Department of Defense and the administration is doing with transfers right now, like the Air Force has endured two strategic bases, one I think you are familiar with, General Raymond, Offutt and Tyndall, maybe \$6 billion, \$7 billion of repair of those bases. And the Department of Defense has transferred \$1 billion that was unused by the Army to the counter-narcotics so that they could build a couple of walls someplace. What in the hell is the priority here? Is it to rebuild Tyndall or maybe Offutt, or is it to build 100 miles of fence?

Mr. Rapuano, what is the priority at the Department?

Secretary RAPUANO. Well, we have multiple priorities.

Mr. GARAMENDI. No, that is not the question. Okay. What are the priorities? What are the multiple priorities?

Secretary RAPUANO. We have readiness priorities, and we have priorities when it comes to responding to lawful direction with regard to other national security priorities of the Nation.

Mr. GARAMENDI. So would you classify a fence in El Paso as more important than getting Offutt, the home of STRATCOM, up and running?

Secretary RAPUANO. I am not in a position to make that trade, Congressman.

Mr. GARAMENDI. I asked you not for the trade, but what is your priority? What is your advice?

Secretary RAPUANO. The Department's priority is to respond to lawful direction when the priorities are coming from above.

Mr. GARAMENDI. From whom? Lawful direction from whom? From the President?

Secretary RAPUANO. From the President with regards to barrier.

Mr. GARAMENDI. Who decides that that wall is more important than getting Tyndall Air Force Base back up and operating, which is a key base, and STRATCOM, a key base? A fence is more important? I think not. I yield back.

Mr. COOPER. I thank the gentleman.

And now the gentleman from Colorado, the patient gentleman from Colorado.

Mr. LAMBORN. Well, thank you, Mr. Chairman. Thank you for having this hearing.

And in response to the last set of questions, I will just say that I believe our military has the capability to walk and chew gum at the same time. I think we can handle multiple priorities simultaneously and do them right and do them well.

General Raymond, I was so pleased to see you nominated to be the first Commander of the reactivated U.S. Space Command. We in Colorado Springs are very proud of you, and I am very excited about what it means to our Nation to have such a dedicated leader and experienced warfighter overseeing the pointed end of the spear.

As you know, it is my great honor to represent the airmen of Air Force Space Command and so many of our space warfighters. As we move forward into plans to establish U.S. Space Command, can you describe for us relative to the threat of our near-peer adversaries that they pose to our space assets, why is it important that we act now without delay?

General RAYMOND. First of all, thank you. I am honored to be nominated. And it is just that, a nomination, and there are still things that have to happen.

And I will just tell you from an Air Force Space Command point of view, it is really critical that we embrace that space is a warfighting domain. Everything that we do in space, everything that we do as a joint force is enabled by space, everything. There is not—you can't come up with anything that we do as a joint force that isn't.

And it is very important that we have the ability to protect and defend those capabilities so the sailors, soldiers, airmen, and Marines that have come to rely on those always have them. It is like the light switch that you turn on. It is always on. That is our job.

Mr. LAMBORN. Thank you.

Now, in the context of warfighting, what does warfighting in space—what does readiness mean?

General RAYMOND. So I don't consider it warfighting in space. I consider it just warfighting. It is just a war. And it is not just—I don't want to—that came out wrong. It is war, and it is important, but it is an event that a country can choose to fight it on the land, they can choose to fight it in the sea, they can choose to fight it in space or in the air. And so it is just another domain of where military activity—military activity occurs.

What we call for that is to make sure that we have the ability to protect and defend those critical satellites and those critical capabilities to make sure that our forces and our Nation and our coalition and allied partners always have those capabilities and to be able to hold our adversaries at risk. We want to deter this. This is all about deterrence, and the way you deter is you change that calculus.

Mr. LAMBORN. Thank you.

And now I am going to drill down and ask a couple of really specific questions. After spending \$500 million in years of development, GAO recently reported that operational testing in 2018 found that the Joint Space Operations Center Mission System Increment 2—that is a mouthful—was not operationally effective or suitable.

I understand that future increments have been canceled, and now that they are—now that there is a new program called Space C2, which is supposed to be using agile software development to deliver capabilities to the warfighters every 90 days, how will this be structured to succeed where JMS failed?

General RAYMOND. First of all, thanks for the question.

You know, any commander that is responsible for operations in any domain has a couple must-haves. You have to have the ability to have awareness of the domain that you are operating in, and you have to have the ability to command and control capabilities.

This C2 system that you talked about, our new program, is that system for space. Of all the things that I have submitted to the

record in my report, this is the program that has my highest attention. I meet on this at least monthly.

The way we are doing this that is different, completely different than what we did with JMS, first of all, we started with a prototype, and we had the Air Force RCO develop a prototype of this capability because they had already built a similar prototype. So we are using leveraging work that had already been done in another domain.

We have developed open standards, called OMS [Open Mission Systems] and UCI [Universal Command and Control Interface], that will allow companies to innovate to meet those standards and will allow multidomain integration. We have built industry consortium to make sure we have the industry's voice in this program with us.

We are building this to be coalition friendly from the front because, just like in any other conflict, we expect that we will partner with our coalition and our allies. We have developed a data library so we can—a cloud-based data library, if you will, so we can ingest more data, including commercial, intelligence, and DOD data.

And then, finally, and probably most importantly is that we are adopting agile software—best practices in agile software development. It is not good enough to take 5 years to develop software and then test it and see if it works. We are doing it in much quicker sprints, 90-day sprints, and we are already getting the capability delivered to the floor.

Mr. LAMBORN. Thank you.

Mr. Chairman, I still have questions on COMSATCOM [commercial satellite communications], overhead persistent infrared system, and weather satellites, but I will save those for the classified session.

Mr. COOPER. I thank the gentleman for his questions.

I hope that as many members as possible can join us in HVC-301 [House Visitors Center room 301] for the classified session.

Let me ask unanimous consent that the ranking member's opening statement be inserted for the record.

Hearing no objection, so done.

[The prepared statement of Mr. Turner can be found in the Appendix on page 26.]

Mr. COOPER. So this subcommittee hearing is adjourned, and let's move in the next 10 minutes to the classified session. Thank you.

[Whereupon, at 3:30 p.m., the subcommittee proceeded in closed session.]

A P P E N D I X

APRIL 3, 2019

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

APRIL 3, 2019

Opening Statement by Chairman Jim Cooper
Subcommittee on Strategic Forces
Hearing on
Fiscal Year 2020 Priorities for National Security Space Programs
April 3, 2019

I would like to welcome the witnesses to this hearing. We appreciate Assistant Secretary of Defense Kenneth Rapuano, General John Raymond, and GAO Director of Acquisition and Sourcing Management, Christina Chaplain, joining us today.

The written testimony that we have received is a study in contrasts. Secretary Rapuano gives us a lengthy but vague pep talk. General Raymond is far more specific and focused, as befits the Air Force Space Commander, but only gives us the “glass half full” summary of a wide range of military space activities. Ms. Chaplain gives us a hard-hitting, “glass half empty” summary of a wide variety of space program failures and disappointments, along with a litany of refusals of the Air Force and DoD to improve their space management practices.

I encourage all subcommittee members to read the GAO testimony in detail because it builds on years of similar work by the GAO, work that numerous DoD officials and Congresses have systematically ignored. I can assure you, however, that our potential adversaries have not ignored the GAO’s findings. In fact, they have probably celebrated them. Many of our colleagues in this Congress, particularly in the U.S. Senate, are the last to know.

In brief summary, the Rumsfeld Commission in 2001 warned us of a “Space Pearl Harbor.” In 2008, the Allard Commission found that “no one is in charge” of our military space programs. In 2016, the GAO concluded that there are 60 different stakeholders in DoD, each with the power to cripple a space program but none with the ability to lead. In the GAO’s current report, the GAO documents numerous satellite program failures, delays, and cost-overruns, in addition to refusing to even “routinely monitor the size, mix, and location of its space acquisition workforce.” We always hear the military praise the troops, so this is a jarring critique if the GAO determines we don’t really know what our space acquisition workers are doing.

In response to this damning criticism, the Pentagon eliminated its Space Command in 2002, gradually substituting the position of a PDSA, or Space Advisor. I am sure that really scared the Russians and Chinese. Now, I am thankful that we are returning, belatedly to a Space Command, but we also need unchallenged space superiority. That is what this hearing is about.

I encourage this subcommittee to become expert on all the issues relating to a Space Force or a Space Corps, whatever you want to call it. We simply must improve our satellite and space capabilities, NOW.

Opening Remarks
Honorable Michael R. Turner
Ranking Member, Subcommittee on Strategic Forces
House Armed Services Committee
Hearing on the FY20 Priorities for Department of Defense National Space
Security Enterprise
April 3, 2019

Thank you Mr. Chairman. I would also like to extend a warm welcome to General Raymond, Mr. Rapuano, and Ms. Cristina Chaplain. Thank you all for your service to our nation and for being here today.

We are at a strategically important fulcrum for our national security space enterprise. We have to start with the recognition that space enables our economic well-being and our national security superiority. For years this subcommittee has recognized that our global economy is facilitated by space-based assets like the Global Positioning System which is acquired and operated by the United States Air Force. Financial transactions, local infrastructure, and power networks all rely in space-based timing. Additionally, we recognize that our soldiers, sailors, airmen, and Marines start every operation here on Earth with a weather brief that is also provided by space-assets. The entirety of our economic system and national security apparatus is enabled by space-based capabilities.

We also need to be cognizant of the driving changes in the space environment. There are currently thirty-eight countries or multinational organizations that operate intelligence, surveillance, reconnaissance, and remote sensing satellites. As of last week, there are four countries in the world that have demonstrated an active direct ascent anti-satellite capability, with India being the latest.

Russia and China continue developing anti-satellite weapon capabilities to hold our national security space systems at risk at an alarming pace. Both these countries are rapidly developing ground- and space-based weapons. They are also developing systems that can attack space-based assets using jammers, lasers, and other kinetic kill constructs. It is clear that Russia and China will continue investing in the development of active anti-satellite technology to deny us the advantages we derive from space systems.

While we undoubtedly have the best space operators in the world, we also have room for continued improvement. I'd like to highlight a few areas of this year's President's Budget Request that this subcommittee will continue to provide rigorous oversight for.

First, this Administration is the first to acknowledge space as a warfighting domain. In fact, my friend and the current Secretary of the Air Force, Heather Wilson, was one of the first individuals to recognize this in a public statement. We need to ensure that our military is ready to fight and win in this domain. Part of that is making sure that we have space organizations that are fully manned, and

have the aligned authority and responsibility to acquire next generation space systems.

Second, with a number of our on-orbit space systems approaching end-of-life it's important to look at how future space architectures are being developed. The Department of Defense continues to talk to us about "disaggregation" of strategic and tactical requirements across multiple orbital planes to increase operational resilience. But that discussion is too technical. Space sometimes suffers from that old Albert Einstein adage—"if you can't explain it simply you don't understand it well enough."

We have to do things differently in space. We have to buy different things, possibly in different ways, and even from different people. You can call that disaggregation, or you can call it space acquisition reform—I call it logic. And I think this kind of logic works on next generation missile warning, next generation communications, the future of Space Situational Awareness, and even space launch.

Lastly, I want to address the Administration's proposal for Space Force. Last week we heard some honest perspectives from Gen Hyten about his support of the establishment of United States Space Command as well as his perspectives on the President's proposal for the establishment of a Space Force within the Department of the Air Force. I appreciated his candor and value his advice. I agree that we must move forward in a way that minimizes duplication of effort and eliminates bureaucratic inefficiencies in how we organize, train, and equip space forces in the future.

There is a lot going on in space, but I'm most concerned about what is going on here on earth in this budget request to make sure that we get capabilities to our warfighters that increase their agility and lethality. To all the witnesses thank you again for being with us today and I look forward to your testimony.

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THE HOUSE ARMED SERVICES COMMITTEE

STATEMENT OF
THE HONORABLE KENNETH RAPUANO
ASSISTANT SECRETARY OF DEFENSE FOR HOMELAND DEFENSE &
GLOBAL SECURITY
BEFORE THE
SUBCOMMITTEE ON STRATEGIC FORCES
HOUSE ARMED SERVICES COMMITTEE

APRIL 3, 2019

Chairman Cooper, Ranking Member Turner, and distinguished members of the subcommittee, it is a pleasure to appear before you along with General John Raymond, Commander of Air Force Space Command; and Ms. Cristina Chaplain, Director, Acquisition and Sourcing Management at the Government Accountability Office. I serve as the Assistant Secretary of Defense for Homeland Defense and Global Security. In this capacity I oversee and guide the development and implementation of the Department of Defense's strategy and policy to achieve its space mission.

Space is integral to the U.S. way of life and the U.S. way of war. Although United States space systems have historically maintained a technological advantage over those of our potential adversaries, those potential adversaries are now advancing their space capabilities and actively developing ways to deny our use of space in a crisis or conflict. Without change, the United States is at risk of losing its comparative advantage in space. A loss of freedom to operate in space would undermine our Nation's prosperity and would erode the ability of the joint force to deter aggression, to defend the homeland from attack, and to project power abroad.

While the U.S. would prefer that the space domain remain free of conflict, we must recognize rising challenges, and be prepared to meet and overcome them. The Department must accelerate, and is accelerating, its response to the changing dynamics of space. We are adapting our organizations, policies, doctrine, and capabilities to more effectively deter aggression and protect our interests.

Earlier this month the Department provided Congress with a legislative proposal for the establishment of the United States Space Force as a new branch of our armed forces. If authorized, the Space Force would transform our approach to space, increasing our responsiveness in this warfighting domain. The proposal maximizes warfighting capacity and advocacy for space, while minimizing bureaucracy and potential risks. Establishing a sixth branch of our military with dedicated leadership will unify, focus, and accelerate the development of space doctrine, capabilities, and expertise to outpace future threats; institutionalize advocacy of space priorities; and further build space warfighting culture.

The Department looks forward to working closely with this committee and all of Congress on ensuring we maintain our freedom of operation in space in order to support our national security and our economic prosperity.

NATIONAL SECURITY STRATEGY & NATIONAL DEFENSE STRATEGY

The Department's approach to space is aligned and nested within our broader national strategies. Space is a warfighting domain, and just as in air, land, sea, and cyberspace, the Department of Defense must ensure it is prepared to address threats to our national security in the space domain.

The National Security Strategy and the National Defense Strategy recognize space as a priority domain and an operating area from which capabilities are employed and forces are enabled, and recognizes the potential for conflict to extend into space. These strategies direct that we compete as necessary to deter potential adversaries and, when necessary, win any conflict that begins in or extends into space. Our ability to operate and leverage space to advance scientific knowledge, promote prosperity, and secure the freedoms of our citizens and allies and partners must remain unimpeded. We will compete, we will deter, and, if called upon to fight, we will win.

The National Security Strategy, published in December 2017, provides a plan to (1) protect the American people, the homeland, and the American way of life; (2) promote American prosperity; (3) preserve peace through strength; and (4) advance American influence. Each aspect of this plan is fortified and supported by the advantages our nation gains from space capabilities.

Our 2018 National Defense Strategy (NDS) charts the course for how DoD will contribute to each of the National Security Strategy's four national interests. Under the NDS, long-term strategic competitions with China and Russia are the principal priorities for the Department, and because of the magnitude of the threats they pose to U.S. security and prosperity today, and the potential for those threats to increase in the future, require both sustained focus and investment. Space is a key arena in which this competition is occurring. Addressing the challenges posed to our preeminence as a space power is fundamental to our efforts.

To meet the challenge of great power competition, the Department is broadly pursuing three lines of effort – increasing the lethality of our forces, strengthening our alliances and partnerships, and reforming the Department to ensure affordability and delivery of capabilities at the speed of relevance. These approaches are as applicable to the space domain as they are to any other Department endeavor.

STRATEGIC ENVIRONMENT

Space underpins the U.S. way of life and U.S. way of war. Space provides an unparalleled vantage point and medium for rapid, global information collection and dissemination. Space-based capabilities facilitate the flow of people and goods worldwide, while guiding military forces to their positions and weapons to their targets. Satellites enable individuals worldwide to communicate from remote corners of the globe and allow national authorities to command and control forces in multiple theaters simultaneously. Small businesses and multinational corporations alike rely on space-based imagery and other sensing to plan their daily operations, while military commanders understand the security environment through information gathered by intelligence, surveillance, and reconnaissance satellites.

Our nation's interests in space are expanding. New investments and new technology are fueling opportunities for an expanding ecosystem of space systems and services. Advanced technologies are revolutionizing accessibility to space and space-derived capabilities at dramatically reduced costs. Technology continues to progress rapidly in areas such as 3-D printing, artificial intelligence, and machine learning, while advances in electronics are enabling ever-smaller form factors. Space system developers are leveraging all of these trends. Many of yesterday's cutting-edge technologies are mere commodities today, greatly reducing the economic barriers to entry into space. Significant amounts of private financing is pouring into commercial space, fueling a growing space industry. We are witnessing advances in high-throughput communication satellites and the development of commercial plans for mega-constellations offering new capabilities in low-Earth orbit. The commercial sector, enabled by traditional aerospace companies as well as entrepreneurs and venture capitalists, is driving down the cost of access to space through the development of re-usable launch vehicles and other techniques. These developments together are planting the seeds from which future economic and commercial opportunities may grow.

This growth demonstrates that space is no longer the purview of only superpowers or even a handful of nations; participation in space activities is growing more diverse. Space-derived information services such as imagery, weather, communications, and intelligence, traditionally reserved to the governments of just a few space-faring nations, are becoming more attainable to non-State entities, companies, and individuals. This presents new challenges for the Department as new States, non-State actors, and commercial entities, both foreign and domestic, are able to provide services and capabilities once only available to the U.S. Government and a

few other space-faring nations. The pace of technological expansion and growing accessibility are forcing our military to think and plan differently, as potential adversaries leverage increased capabilities to observe our force movements, track our activities, and communicate with their own forces at efficiencies, data rates, and levels of security not previously available.

The United States also faces serious and growing challenges to its freedom to operate in space. China and Russia have studied how the U.S. joint force operates and have embarked on major efforts to develop, test, and field counter-space capabilities in order to destroy or disrupt U.S. and allied space capabilities in a crisis or conflict. These strategic competitors view space as an area where they could weaken our advantages and cause cascading impacts on our sea, air, land, and cyber systems that rely on space-based capabilities. Both have reorganized their militaries in 2015, emphasizing the importance of space operations, and making denial of space advantages a key component of their strategy. As a result, the United States no longer enjoys the freedom to develop and leverage space systems without deliberate regard to other nations' counterspace capabilities.

These same countries, recognizing the value of space capabilities, are also expanding their use of space to support the lethality and effectiveness of their military forces in other domains. As noted in a recent Defense Intelligence Agency report "Both [China and Russia] have developed robust and capable space services, including space-based intelligence, surveillance, and reconnaissance. Moreover, they are making improvements to existing systems, including space launch vehicles and satellite navigation constellations. These capabilities provide their militaries with the ability to command and control their forces worldwide and also with enhanced situational awareness, enabling them to monitor, track, and target U.S. and allied forces."¹

These emerging threats, in and from space, place our nation's security at ever-increasing risk and drive the U.S. imperative to strengthen its space posture and integration and synchronization of combat power across multiple domains. This includes both the ability to assure and defend our space-based capabilities from attack and the ability to protect our terrestrial forces from space-enabled attacks.

SPACE STRATEGY AND POSTURE

¹ Challenges to Security in Space, Defense Intelligence Agency, February 2019

This new environment highlights the role of space in changing the character of warfare and presents new challenges and opportunities to military space forces. No longer do space systems simply support terrestrial forces to fight and win wars; actions in space also will directly contribute to the outcome of future crises or conflicts. In order to preserve peace and deter aggression, the Department of Defense (DoD) must adapt. The DoD must be prepared to assure freedom of operation in space, to deter attacks, and, when necessary, to defeat space and counterspace threats to the national security interests of the United States and its allies and partners.

Policy and Strategy

In addition to the National Security Strategy and the National Defense Strategy, the Department's efforts for Space are guided by the National Strategy for Space, which was signed by the President in March 2018. The National Strategy for Space builds on the other strategies by emphasizing peace through strength, and maintaining U.S. leadership, preeminence, and freedom of operation in the space domain. The space strategy encompasses all aspects of our nation's space interest. It is composed of a strategic framework and implementation plan outlining four key strategic objectives. The first is to strengthen the safety, stability, and sustainability of space activities. The second is to deter and, when necessary, defeat adversary space and counterspace threats used for purposes hostile to the national security interests of the United States and its allies and partners. The third is to maintain U.S. commercial industry as the leading provider of traditional and innovative space technologies, goods, and services on the international space market while limiting potential adversaries' access to critical technologies and capabilities. The fourth is to maintain and extend U.S. human presence and robotic exploration beyond Earth to transform knowledge of ourselves, our planet, our solar system, and our universe. The implementation plan describes four lines of effort: mission assurance; deterrence and warfighting; organizational support; and creating conducive domestic and international environments for U.S. space objectives. The lines of effort represent the key priorities of the strategy and, along with the supporting tasks, describe the ways and means necessary to achieve our strategic objectives.

The first line of effort focuses on mission assurance. We are accelerating the transformation of our space architecture by deliberately moving systems from the research and

development phase to the actual fielding of capabilities. As a result, our space systems will be more resilient and more defensible. We are also looking to expand the ability to reconstitute space capabilities to reestablish lost functionality and we are exploring on-orbit satellite servicing capabilities. Fundamental to our strategy is our mission to deter, prepare for, and, if directed, prevail in any conflict, in any environment, against any threat.

The second line of effort focuses on deterrence and warfighting. Our strategy recognizes that – due to actions by our competitors and potential adversaries – the space domain is not a sanctuary. This line of effort seeks to develop options to deter potential adversaries from aggression, including extending conflict into space. It entails a refocus of strategic guidance and doctrine; operational plans, authorities, capabilities, and culture; and rules of engagement to prepare most effectively for space as a warfighting domain.

The third and fourth lines of effort focus on organizational support and fostering a conducive environment. We will pursue improved foundational capabilities, structures, security classification guidance, and processes in order to enable more effective space operations and will foster a conducive environment both at home and abroad. Domestically, this includes streamlining the regulatory environment to leverage and support U.S. industry more effectively, taking into account national security and public safety. Internationally, this includes promoting burden-sharing and marshalling cooperation against threatening adversary actions.

The United States does not fight alone. Cooperation and partnership in the space domain are essential, just as cooperation and partnership benefit our military on land and sea and in the air and in cyberspace. Our defense strategy depends on sustaining and building international alliances and partnerships. The work in this area is critical to advance our common and shared strategic and operational interests of deterrence and lethality. U.S. allies and partners provide an asymmetrical advantage that no competitor can match. We are developing partnerships with the aim to develop and deploy more capable, more assured space architectures and, where appropriate and mutually beneficial, develop a combined operational capacity.

For several years we have had a Combined Space Operations (CSpO) initiative including the United States, United Kingdom, Canada, Australia, and New Zealand. CSpO is identifying operational and programmatic cooperation opportunities, as well as common approaches to understanding and addressing threats in space. Last month we invited France and Germany to join this initiative. In 2018, our annual Schriever Wargame, examining conflict extending to

space ten years into the future included robust participation from all the CSpO partners, plus France, Germany and Japan. As a result of wargames such as Schriever, our allies have come to understand the real and significant threats to their space infrastructure and are galvanized along with the U.S. to ensure our collective freedom of action in space.

We will leverage past successes and achieve new ones, such as cost-sharing agreements, hosting U.S. national security payloads on foreign systems, and data-sharing arrangements to bolster shared space situational awareness. The Department of Defense, working with the Department of State, strengthens our leadership and international relationship through participation in international governing bodies and with multilateral and bilateral arrangements.

To achieve these strategic objectives and secure our vital interest of unfettered access to and freedom to operate in space, the Department must fundamentally transform its approach to space from a support function to a warfighting domain – one in which we are prepared for a domain of competition and potential conflict. Space superiority is something to be gained and maintained, and cannot be taken for granted in future crisis or conflict.

Posture and Organization

The President's \$14 billion budget request for space in Fiscal Year 2020, outlined in Major Force Program-12, puts the Department on a course to build a more lethal force. It advances the lines of effort captured in the *National Strategy for Space* and integrates space into a multi-domain approach designed to deter potential adversaries and defeat hostile activity should deterrence fail. This request, sustains our on-going space operations and support to the joint force while developing and fielding critical capabilities.

The current organization of space within the DoD has enabled the United States to maintain its position as the most lethal force in the world. These structures, however, must evolve with the changing environment. No branch of the Armed Forces has been created since the U.S. Air Force was established in 1947 – over 70 years ago. The world has changed significantly in that time. If authorized by Congress, a new Armed Force dedicated to space will develop space forces prepared to meet emerging security challenges.

The trends and threats we face demand a new approach in order to outpace potential adversaries. This requires an approach that that DoD institutionally elevate space consistent with its role in national security; unify, consolidate, and integrate space forces from across the DoD;

increase focus in leadership, expertise, personnel, culture, and capabilities for a distinct domain; accelerate our posture to space as a warfighting domain; and deliver dominant warfighting capacity for space while minimizing bureaucracy and cost.

Space Policy Directive 4 was signed by the President in February 2019, and outlines the policy approach to establishment of the U.S. Space Force. Under the proposal, the U.S. Space Force (USSF) and the U.S. Air Force (USAF) would exist within one Military Department while organizing, training, and equipping their forces for two distinct warfighting domains and mission sets. The Secretary of the Air Force would be responsible for organizing, training, and equipping two separate Military Services: the USSF and USAF, each with a uniformed Military Service Chief with equal membership on the Joint Chiefs of Staff (JCS). This model is similar to how the U.S. Navy and U.S. Marine Corps exist within the Department of the Navy. Additionally, a new Under Secretary of the Air Force for Space, to be known as the Under Secretary for Space, will provide dedicated civilian supervision of the USSF, under the authority, direction, and control of the Secretary of the Air Force.

The vast majority of initial Space Force resources – personnel and budget authority – would be transferred from the existing Military Services. The stand-up of the Space Force would be phased over five years – FY 2020 to FY 2024 – and would require \$72 million in FY 2020 to establish the headquarters with approximately 200 people.

Over the following years, as missions are transferred to the Space Force, existing personnel and budget authority will transfer into the Space Force from the existing Military Services. By the end of the transition period, more than 95% of the Space Force annual budget is estimated to consist of resources that will have been transferred from existing DoD budget accounts, along with an estimated 15,000 transferred personnel. Additional resources will be dedicated to building out the Space Force headquarters and establishing and maintaining new support elements such as education, training, doctrine, and personnel management centers.

Once the Space Force is fully established, these additive costs are estimated to be \$500 million annually, which would represent approximately 0.07% of the annual DoD budget. The total additional cost growth over the next five years is estimated to be less than \$2 billion, or approximately 0.05% of the DoD budget for the same period. Because of the lean implementation and modest total costs, the Future Years Defense Program topline is sufficient to fully fund the U.S. Space Force.

Complementing a military service focused on developing space forces, is a space warfighting command focused on employing the joint force. Consistent with U.S. law, DoD is taking steps to establish a United States Space Command (USSPACECOM) as a unified combatant command focused on planning and executing space warfighting operations to protect U.S. national interests, and those of our allies and partners. Establishing USSPACECOM will bring full-time operational focus to securing the space domain, and will streamline command and control for time-sensitive operations.

Additionally, the DoD has undertaken a series of space acquisition reforms to ensure the joint forces has the capabilities necessary to deter and defeat threats. This includes the Space and Missile Systems Center (SMC), "SMC 2.0" initiatives, which have begun to remove bureaucracy and empower new program executive officers to acquire space capabilities more efficiently and effectively. Rapid acquisition prototyping authorities have been aggressively leveraged with the Space Rapid Capabilities Office, which initiated several new programs in the past year. These acquisition reforms will continue with the establishment of a joint Space Development Agency dedicated to rapidly developing, acquiring, and fielding next-generation military space capabilities. This organization will have a development mindset and will be focused on experimentation, prototyping, and accelerating fielding, as well as leveraging commercial technologies and services. These entities will transition to the Space Force, if authorized by Congress, to strengthen the foundation for space acquisition.

CONCLUSION

Space is a warfighting domain – albeit a nascent and evolving one. It is no longer a question of whether the character of warfare is changing, but rather how the United States should strategically re-orient itself to deter aggression and be prepared to fight and win future wars. The Department has a plan to maintain U.S. leadership in this key domain of competition and potential warfare. The Department asks for your support, including our legislative proposal, so we can move out in this critical domain.

The Department's partnership with Congress is and will remain absolutely critical to our success. To that end, I remain grateful for this committee's strong support and interest in this vital area, and its advocacy to deter aggression and ensure a lethal and effective force with the unmatched ability to prevail in, from, and through the ultimate high ground.

Kenneth P. Rapuano
Assistant Secretary of Defense for Homeland Defense and Global Security

Mr. Kenneth P. Rapuano is the Assistant Secretary of Defense for Homeland Defense and Global Security. Previously Mr. Rapuano was a Senior Vice President at the ANSER Corporation, and the Director of the Studies and Analysis Group which provided multi-disciplinary studies and operational analysis for a broad array of government clients in the national security, homeland security areas. Up until November of 2016, Mr. Rapuano Directed the Homeland Security Studies and Analysis Institute (HSSAI), a Federally Funded Research and Development Corporation (FFRDC) operated by ANSER, a mission oriented not-for-profit organization.

Prior to joining ANSER Mr. Rapuano was the Director of Advanced Systems at the MITRE Corporation. He was responsible for guiding crosscutting strategic national and homeland security mission initiatives, with particular focus on counterterrorism, intelligence, aviation security, crisis management/decision support, national preparedness, and CWMD.

Previously, Mr. Rapuano served at the White House as Deputy Homeland Security Advisor to President George W. Bush from 2004-2006. He was responsible for managing the development and implementation of homeland security policies among departments and agencies, chaired the Homeland Security Council Deputies Committee, and co-chaired the White House Counterterrorism Security Group. He left the White House in 2006 to volunteer for deployment as a Marine Corps officer to Afghanistan with a Joint Special Operations Task Force, establishing and directing a targeting fusion center tracking high-value terrorists and insurgents. He also served in Iraq in 2003, commanding the Joint Interrogations and Debriefing Center of the Iraq Survey Group established to conduct the mission of surveying and exploiting possible weapons of mass destruction activities across Iraq.

In 2003, Mr. Rapuano was appointed Deputy Under Secretary for Counter Terrorism at the Department of Energy, responsible for nuclear counter terrorism, homeland security, emergency response, and all related special access programs for DOE and the National Nuclear Security Administration. Previous to that, he was the National Security Advisor to the Secretary of Energy. Mr. Rapuano has also served as Special Assistant to the Assistant Secretary of Defense, International Security Policy. He served 21 years on active duty and in the reserves as a Marine Corps infantry officer and intelligence officer.

Mr. Rapuano has also served as a Distinguished Research Fellow at the National Defense University's Center for the Study of WMD, as a member of the Defense Science Board Task Force on the Role of DoD in Homeland Defense, the Pacific Northwest National Lab's National Security Advisory Committee, the FBI's Weapons of Mass Destruction Directorate Advisory Group, the DHS Quadrennial Homeland Security Review Advisory Committee, and the DHS Science and Technology Advisory Committee.

Mr. Rapuano received a bachelor's degree in Political Science from Middlebury College, a master's degree in National Security Studies from Georgetown University, and has attended the Marine Corps Air-Ground Task Force Intelligence Officer Course at the Navy and Marine Corps Intelligence School.

HOUSE ARMED SERVICES COMMITTEE
UNITED STATES HOUSE OF REPRESENTATIVES

DEPARTMENT OF THE AIR FORCE

PRESENTATION TO THE
SUBCOMMITTEE ON STRATEGIC FORCES
HOUSE ARMED SERVICES COMMITTEE
UNITED STATES HOUSE OF REPRESENTATIVES

SUBJECT: Fiscal Year 2020 Priorities and Posture of the National Security Space Enterprise

STATEMENT OF: General John W. Raymond
Commander, Air Force Space Command
Joint Force Space Component Commander

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INTRODUCTION

Chairman Cooper, Ranking Member Turner and distinguished Members of the Subcommittee, I'm honored to appear before you today in my capacity as Commander of Air Force Space Command (AFSPC). I have the distinct privilege to lead and represent the 26,200 dedicated men and women of AFSPC who underpin successful operations for our joint force and the Nation. In the past year we have seen tremendous change and progress in the National Security Space arena with the Nation's on-going efforts to address the reality that strategic competitors have made space a warfighting domain. Among these initiatives are the President's issuance of four Space Policy Directives, direction to establish a space-focused combatant command – U.S. Space Command, and the Department of Defense proposal for a new branch of the armed forces -- the U.S. Space Force. We expect this next year will be equally full of progress across these and other National Security Space endeavors.

STRATEGIC SITUATION

Today, great power competition from a revisionist China and Russia continues to be the primary challenge to U.S. and global security. Both of these nations seek to challenge peace, stability and U.S. superiority in all domains: land, sea, air, cyberspace, and space. In the space domain in particular, these competitors are seeking to deny the U.S. and its Allies freedom of action, while also developing their own space capabilities to enable power projection and enhance military strength.

Fortunately, this comes at a time when our National Security Strategy, National Defense Strategy, national and military leadership, and Air Force Space Command plans, programs and operations are in unprecedented alignment. The National Security Strategy mandates we must maintain leadership and freedom of action in space, while advancing space as a priority domain. It also declares unfettered access and freedom to operate in space to be a vital interest. Our National Defense Strategy establishes five priority missions: (1) defend the homeland, (2) provide a safe, secure, and effective nuclear deterrent, (3) defeat a powerful conventional enemy, while we (4) deter opportunistic aggression, and (5) disrupt violent extremists in a cost-effective manner. Our space capabilities play a vital role in each one of the missions, supporting our joint warfighters and our allies and partners around the globe. Our national and military leadership declare in unison that space is a warfighting domain, like land, sea, and air. Our goal remains to

deter conflict from extending to space, and the best way we know how to do this is to be prepared to fight and win a conflict that extends to space should deterrence fail. My testimony will focus on how our activities are aligned with Department of Defense (DoD) priorities to build a more lethal force, strengthen alliances and attract new partners, and reform the Department's business practices.

BUILD A MORE LETHAL FORCE

We are increasing the combat readiness of Space Operators to increase joint warfighter lethality by investing to build multi-domain Airmen to fight and win as part of the Joint Force.

Developing our Warfighters

Foundational to building a more lethal force is the development of joint warfighters. The Air Force is transforming the way we develop our space combat tacticians and acquisition professionals, and laying the foundation for a trained, ready crew force. We have taken a number of actions to do so. For example, we directed a significant increase in rigor and content in the initial training of our space operators, known as Undergraduate Space Training, to meet the demands of current and emerging challenges to national security space. This revised "UST Next" is on track to start on 1 October 2019 and includes an additional 34 training days to cover evolving space threats and U.S. responses in greater depth. We have also expanded our Operational Training Infrastructure to produce a more relevant training environment, which allows weapon systems and operators to interact in a highly dynamic, threat-representative, realistic manner, including aspects of multi-domain command and control. The Air Force has approved \$74.8 million in funding to advance our space training simulators along these lines.

Additionally, AFSPC and the Air Force Weapons School established an Enlisted Space Warfighter Advanced Instructor Course and have selected the first class of students. This new course, held at Nellis Air Force Base, will provide advanced academic and tactical training for enlisted space professionals, and is a stepping stone for incorporating our enlisted operators into the existing Air Force Weapons School.

Advanced Space Operations School Re-designated as the 319th Combat Training Squadron

Air Force Space Command re-designated the Advance Space Operations School as the 319th Combat Training Squadron (319 CTS) on 28 August 2018 in an effort to normalize the squadron with the Air Force's 16 other combat training squadrons that have similar training missions. As a combat training squadron, this unit will prepare space professionals for real-

world operations in an increasingly contested space domain through exercises such as SPACE FLAG. The 319 CTS will provide training to tactical units with the purpose of developing critically-thinking operators who have mastered their weapon system to a degree such that they are able to fight through all levels of conflict.

Schriever Scholars

The Air Force is growing a cadre of strategic space leaders through the Schriever Scholars program at Air Command and Staff College. This new space concentration program for field grade officers consists of a demanding curriculum spanning space history, policy, strategy, and doctrine. The program also provides unique opportunities for engagement with senior DoD leadership and unprecedented access to top-level policymakers, including representatives at the White House, State Department, Department of Commerce, Department of Transportation, and NASA. This initial class of thirteen students graduate in June and will be prepared to ensure American advantage in the space domain for decades to come.

SPACE FLAG

SPACE FLAG is AFSPC's premier in-domain space protection exercise. This year we have expanded this advanced training to three times a year, providing space operators the experience of planning and executing space operations in a contested, degraded, and operationally-limited environment against a thinking adversary. In August 2019, we plan to incorporate our coalition partners in SPACE FLAG for the first time.

STRENGTHEN ALLIANCES AND ATTRACT NEW PARTNERS

AFSPC has made significant progress in expanding interagency, commercial, and international partnerships that enhance our position across the national security space portfolio. Recognizing that it is impossible to accomplish our mission alone, AFSPC is committed to identifying new partners and solidifying existing relationships as a core activity.

Joint Space Operations Center to Combined Space Operations Center

This year we have accelerated our efforts and increased our coalition footprint to conduct combined space operations. On 18 July 2018, the Joint Force Space Component Command (JFSCC) transitioned the Joint Space Operations Center (JSPOC) to a Combined Space Operations Center (CSpOC). The transition formalized our ongoing, decade-long effort to integrate Allied and partner nation personnel and capabilities into our space enterprise. We have also established persistent connectivity with partner space operations centers in Australia,

Canada, and the United Kingdom, and together we are working to identify additional tools to improve information sharing between our respective centers. In late 2019, we plan on expanding more classified operations and planning efforts with our FVEY partners through the establishment of a Combined Technical Operations Cell (CTOC).

Schriever Wargame

AFSPC annually conducts the Schriever Wargame, a scenario-based wargame designed to explore critical space issues in depth, investigate military utility of new space systems, identify solutions to common challenges shared by all participants, and advance space doctrine to better align with and support air, land, sea, and cyberspace doctrine. This annual wargame also helps increase international cooperation and integration among space-faring allies. This year's wargame included our FVEY partners (Australia, Canada, New Zealand, and the United Kingdom) along with France, Germany, and, for the first time, Japan. The outcomes of the Schriever Wargame Series continue to inform future AFSPC requirements, examine organizational constructs, and provide a venue for advancing space operational concepts and procedures. For example, it was the first time the participants employed a combined command and control (C2) cell for Special Access Programs (SAP). As previously mentioned, it is through this effort that participants agreed to stand up the first ever CTOC, the real world SAP C2 cell at the CSpOC, by the end of this year.

As a related effort, the Multinational Space Collaboration (MSC) Office at Vandenberg Air Force Base provides the means for direct dialog with multiple international partners extending beyond combined space operations, supporting strategic engagement objectives via bilateral and multilateral collaboration. Eight countries were initially invited to participate: Australia, Canada, France, Germany, Italy, Japan, New Zealand, Republic of Korea, and the United Kingdom. The MSC office currently includes liaisons from three partner nations: France, Germany and the United Kingdom, and MOUs are pending with Italy, Japan and the Republic of Korea.

Allies in Training

In coordination with Air Education and Training Command, AFSPC is working to increase coalition participation in its space courses. This fiscal year, AFSPC will offer Space 100 (foundational level space) to a growing coalition audience including: Australia, Brazil, Canada, Chile, Colombia, France, Germany, India, Israel, Italy, Japan, NATO, New Zealand,

Republic of Korea, Sweden, Thailand, and the United Kingdom. Space 200 (operational level space) is now open to New Zealand, and participation from the other FVEY partners has doubled with 20 allied personnel scheduled to attend this year. Space 200 will also open to France, Germany, and Japan with mobile classes available in 2019 and in-residence classes available in 2020. Finally, Space 300 (strategic level space) will have its first FVEY partner course in April 2019 with Australia, Canada, and United Kingdom personnel in attendance.

Hosted Payloads and Future Allied Partnerships

The Space and Missile Systems Center (SMC) is leveraging new business practices and methodologies to more rapidly field critical capabilities by placing hosted payloads on Allied satellites. Specifically, Norway will integrate Enhanced Polar System Recapitalization (EPS-R) payloads on two space vehicles and launch both satellites into a highly elliptical orbit in December 2022. EPS-R will provide protected communications for military tactical and strategic forces, as well as other users in support of Joint and Allied Force operations above 65 degrees north longitude.

Under the leadership of the Air Force Chief of Staff, we will host an international Air Chiefs Space Conference at the Space Symposium in Colorado this April. With 12 countries expected to participate, this inaugural event represents the first-ever global meeting of Air Chiefs to discuss partnering in the space domain. This demonstrates our commitment to pursue international relationships that promote common values and at the same time send a clear message to strategic competitors that cooperation between space-faring nations will complicate any pursuit of hostile action.

U.S. Government Partnering

Our partnering focus includes efforts within the United States government as well. Our teaming relationship with the National Reconnaissance Office (NRO) has never been stronger; we have worked together across a spectrum of projects, to include development of a strategy to protect and defend our space capabilities, shared Concepts of Operations (CONOPS) to realize that strategy, and partnerships on an enterprise space architecture and individual programs for mutual benefit. An example of the latter is our collaborative work on the space-based space surveillance effort called SILENTBARKER. While the Space-Based Space Surveillance Follow-On program remains under Air Force Service Acquisition Executive authority and control, it contributes funding and personnel to the NRO for executing SILENTBARKER.

SILENTBARKER, with Air Force support, increases mission capability and is more cost-effective. The Air Force and the NRO will mutually invest in non-recurring engineering costs, enabling the potential for a larger initial constellation buy and lowering unit costs. The Air Force is requesting an increase in funding across the Future Years Defense Program for expanded coverage across the geosynchronous belt and updating mission data processing and scheduling for the ground segment to leverage the full capability of the National Space Defense Center (NSDC).

In accordance with the President's direction in Space Policy Directive 3, we are teaming with the Department of Commerce to transfer the responsibilities for space traffic management (STM) to that Department. Together we will strengthen STM for all, while improving space situational awareness (SSA) data interoperability and enabling greater SSA data sharing.

REFORM THE DEPARTMENT'S BUSINESS PRACTICES

AFSPC has embraced an atmosphere of profound change, bringing forth business reforms that govern how we procure critical space assets in concert with our industry partners. This represents a culture change that is more agile and less risk-averse. To achieve our goals we must be willing to break down bureaucracy and embrace smart risk in order to accelerate capabilities development to meet the threat.

COMSATCOM Procurement Authority Transfer

To comply with the 2018 National Defense Authorization Act, responsibilities for DoD procurement of commercial satellite communications (COMSATCOM) services transferred from the Defense Information Services Agency to AFSPC on December 2018. Beginning on 20 December 2018, AFSPC started to bring together both government and industry partners to chart a way forward to both enhance satellite communications (SATCOM) provisioning and our ability to provide SATCOM in a contested environment. We are using this transfer as a mechanism to improve military and commercial SATCOM support across the board and the AFSPC team is finalizing the first of a series of concepts and strategy documents that will shape our SATCOM investments.

Space and Missile Systems Center 2.0

The Space and Missile Systems Center has embarked on a transformation to deliver resilient, war-winning space capabilities more quickly. SMC 2.0 removes layers of bureaucracy, linking program leadership directly to acquisition decision authorities in order to speed decision

making. The strategic outcome of SMC 2.0 will be to dominate with superior lethality throughout the space domain, aggressively deliver warfighter needs from a resilient, integrated enterprise, and drive innovation in a way that outpaces adversarial threats.

Space Rapid Capabilities Office (SpRCO)

The SpRCO was created through the Fiscal Year 2018 National Defense Authorization Act (NDAA), with subsequent authorities defined in the Fiscal Year 2019 NDAA. The office is governed by a Board of Directors, chaired by the Secretary of the Air Force, and consists of the Air Force Chief of Staff, Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics, the AFSPC Commander, and USSTRATCOM/JFSCC Commander, with authorities and processes outlined in an approved charter. AFSPC continues to grow the SpRCO and make progress with AFSPC's ability to rapidly field space capabilities. The Board of Directors signed the governing charter on 1 November 2018 and USSTRATCOM validated five SpRCO programs through the JFSCC. The initiation of three out of the five programs was formalized by the Board of Directors on 31 January 2019. Acquisition, security, and contracting authorities have all been codified and infrastructure, personnel, and security resources are in place to initiate these programs. Interim acquisition and security authorities are being provided by Air Force Rapid Capabilities Office Director; authorities will transition to the newly hired SpRCO Director by April 2019.

Prototyping: Space Enterprise Consortium

The Space Enterprise Consortium (SpEC) is a team of industry leaders, academic research institutions, and innovative early-stage and start-up companies working together to develop next generation space technologies. Prototyping awards now broadly represent many of our most critical warfighter requirements, to include protected satellite communications, missile warning, missile defense, space situational awareness, and standardized satellites, payload and commanding interfaces.

A RESILIENT SPACE ENTERPRISE

AFSPC has made significant progress across all mission areas that span the breadth of our space capabilities. Execution of the Department's strategy to protect and defend our space capabilities is persistent, ongoing, and present across all mission areas.

Command and Control

For operational level C2, Enterprise Space Battle Management Command and Control (ESBMC2) provides the C2 and SSA capabilities to gain and maintain space superiority. It also serves as the Air Force space system element of Air Force Multi-Domain Command and Control efforts. Our early ESBMC2 prototypes have demonstrated initial interoperability with Air Combat Command (ACC), the Intelligence Community, and the Missile Defense Agency to synchronize operations. We continue to support Air Force efforts to advance interoperability with ACC's Airborne Battle Management System.

One of the more important aspects of ESBMC2 is its open architecture. ESBMC2 uses Open Missions Standards (OMS) as its architecture standard and the Universal C2 Interface (UCI) as its communication standard to enable interoperability amongst the entire DoD space portfolio. We have seen success of this approach in early ESBMC2 prototypes allowing integrated C2 on timelines that the JSpOC Mission System could never have provided. This open approach also encourages companies to develop applications and compete in an environment in order to foster innovation. The price of entry for commercial companies to develop applications for ESBMC2 is simply to adhere to OMS and UCI specifications.

Space Situational Awareness

SSA is the foundation upon which the Department maintains spaceflight safety, provides warning, assesses intentions, and attributes adversary actions towards U.S., Allies, and commercial partner satellites. Coupled with operational intelligence to complete the SSA operating picture, competency in this area is critical in protecting our space assets, informing the design of future architectures, and fostering access and responsible use of space for all space-faring nations. The following key efforts represent SSA capabilities necessary to protect U.S. Government satellites and interests in space.

The new Space Fence is an S-Band radar designed for space surveillance located on the Kwajalein Atoll, Republic of Marshall Islands, 2,100 nautical miles southwest of Honolulu, Hawaii. It is expected to increase the number of tracked objects in space from 23,000 to more than 60,000, as well as increase the accuracy of orbit predictions, and improve our ability to characterize previously untracked objects and conduct collision avoidance analysis for all objects in space. Expected to achieve initial operational capability (IOC) within the next year, Space Fence will be the largest dedicated space surveillance radar operated by AFSPC.

The National Space Defense Center

The NSDC continues to mature its partnership between the DoD and Intelligence Community as we push to improve our nation's ability to rapidly detect, characterize, attribute, warn and defend against threats to our nation's vital space systems. In January 2018, the NSDC transitioned from an experimentation-focused entity to limited 24/7 operations. The fiscal year 2020 budget request supports efforts to leverage the full capability of the NSDC and I am pleased to report that the NSDC has continued to mature throughout the year and has now taken on all Protect and Defend responsibilities previously executed by the CSpOC.

The Air Force Research Lab has been working to deliver a Joint Emerging Operational Need (JEON) effort for the NSDC to provide capabilities to integrate systems and information at a "system high" level. By operating at the highest security levels throughout the operations center, the NSDC will become a singular center for the full picture of space activities. The completion of JEON-associated work in June 2019 will mark the delivery of a functioning prototype capability and then transition to an initial operational capability by year's end.

Position, Navigation, and Timing

The first Global Positioning System (GPS) III satellite was successfully launched in December 2018 on the SpaceX Falcon 9 rocket. Ultimately, GPS III will provide signals that are three times more accurate and provide up to eight times more anti-jam resilience for the warfighter than previous generations. The GPS Next-Generation Operational Control System (OCX) Block 0 supported GPS III Space Vehicle (SV) 01 launch and the team is completing early orbit checkout without issue. The OCX program addresses cyber vulnerabilities through a robust information assurance architecture and is on-track to deliver its full capability by April 2022.

The GPS III program is preparing GPS III SV 02 to support a summer 2019 launch and continues to assemble, test, and integrate the remaining eight satellites. In addition, SMC awarded the GPS III Follow-on (GPS III F) contract for 22 satellites in September 2018. This year's budget request includes full funding for SV 13 and continued incremental RDT&E funding for GPS III F SVs 11 and 12.

Missile Warning

In the fiscal year 2019 budget request, the Air Force took the bold step to stop procurement of Space-Based Infrared System (SBIRS) vehicles 7 and 8 in acknowledgement of

their inability to survive in today's contested space environment. The Next-Generation Overhead Persistent Infrared system will succeed the current SBIRS system by providing improved missile warning, missile defense, battlespace awareness, and technical intelligence capabilities that are more survivable against emerging adversary threats. The Air Force is applying acquisition authorities (per Section 804 of the Fiscal Year 2016 NDAA) to manage the program's largest risks through competitive prototyping, and to significantly improve execution speed. Using these authorities, and with funding support from Congress, the program let two prime contracts within three months, posturing the Air Force to reduce the time to IOC by three and a half years. This pace setter proves that a five year acquisition timeline to deliver resilient missile warning capability, versus a ten or fifteen year timeline, is possible. Additionally, the Air Force has aligned the fiscal year 2020 budget request to support program execution and as expected deliver the first resilient geosynchronous satellite to meet warfighter needs by 2025.

Environmental Monitoring

Every DoD operational mission begins with a weather briefing; either space weather, terrestrial weather, or both. Although the data required to generate forecasts for our warfighters is largely dependent on complex models, approximately 95 percent of the data that feeds these models comes from either space-borne assets or ground-based observatories looking at space. Our ground-based infrastructure consists of unique assets strategically situated around the globe to observe the sun and the ionosphere from below and collect the data we need to complement the space-borne information. The data required for DoD missions is often unique and necessitates 24/7 global ability to forecast weather in austere and denied environments.

Weather is also a partnership business. We continue to leverage the outstanding contributions of NOAA, NASA, our European EUMETSAT colleagues, and Japan. As an example, we will also soon accept a NOAA geostationary satellite, repurposed for our DoD mission, and relocate it over the Indian Ocean.

We are currently updating the space piece of the overarching Air Force weather strategy for both terrestrial and space weather support. Our long term vision, in addition to the avenues we already have, is to determine how commercial ventures could add to and diversify our ability to collect our required data from space. This is a very new and potentially beneficial partnership, which we will be able to more completely characterize after we do some investigation and development of their abilities.

Satellite Communications

The Advanced Extremely High Frequency (AEHF) satellite constellation provides protected tactical and strategic, nuclear-hardened communications for the President and other decision makers. With three operational satellites on orbit, a fourth is undergoing on-orbit checkout and will be operational in July 2019. The final two satellites are scheduled to launch in fiscal years 2019 and 2020 respectively. Ongoing Space Modernization Initiative efforts include AEHF expanded spacecraft resilience features and enhanced ground cyber protection. The Air Force is currently pursuing the next generation of protected, strategic communications with the acquisition of the Evolved Strategic SATCOM system which utilizes Section 804 authorities to deliver capability two years sooner than a traditional acquisition. The Air Force is currently preparing the release of a request for proposal for rapid prototyping for this next generation of protected strategic communications.

The Protected Tactical Enterprise Service effort has been enabled by Section 804 authorities to deliver prototype capability for two Navy carrier strike groups 18 months early. This ground system will provide worldwide, anti-jam, Low Probability of Intercept communications for tactical warfighters. The Protected Tactical Satellite Communications (PTS) effort will save about 36 months of schedule by implementing rapid acquisition via Section 804 authorities. PTS will provide advanced tactical SATCOM capabilities to enable tactical operations in anti-access/area denial environments. PTS awarded 13 prototyping projects using SpEC Other Transaction Authority (OTA) to help design and reduce risk of critical technologies.

Enhanced Polar System (EPS) hosted payloads launched in 2015 and 2017 and will provide tactical protected communications in the North Polar Region; EPS will achieve full operational capability in late fiscal year 2019. However, the need for tactical communication capabilities in the North Polar Region is anticipated to expand as U.S. and allied military and commercial needs continue to grow. As previously mentioned, the Enhanced Polar System – Recapitalization (EPS-R) is the protected SATCOM follow-on to the EPS, providing a 24/7 protected SATCOM capability to the North Polar Region. EPS-R payloads on two separate Space Norway spacecraft remain on track for a dual launch in fiscal year 2023 and will provide continuity of protected satellite communications services and bridges the gap between the current system and EPS at a significantly reduced cost.

Wideband Global Satellite (WGS) Communications SVs 8 and 9 entered operations in 2017 and SV 10 successfully launched on 15 March 2019. As the primary wideband satellite communications capability for DoD, SV 10 will extend functional availability to 2028. Per the Consolidated Appropriations Act of 2018, the Air Force is acquiring and further developing a funding plan for launch and operation and maintenance activities for a modernized WGS satellite with a digital payload comprising twice the capacity of the current version.

Assured Access to Space

For the first time in 20 years, the Air Force is prepared to meet all national security launch needs through competition among multiple viable launch providers. With unprecedented mission success in placing National Security Space (NSS) assets into orbit, the National Security Space Launch (NSSL) program, formerly known as the Evolved Expendable Launch Vehicle (EELV) program, provides assured access to space for our most important national security satellites, while demonstrating good stewardship of launch funds. Our priority remains to ensure the Air Force can launch all NSS payloads when and where we need to, utilizing launch services from certified domestic, commercial launch providers in a viable competitive market.

As the Air Force moves to recapitalize the NSSL program and end the use of the Russian-built RD-180 engine, AFSPC has entered into public-private partnerships, the best way to ensure emerging commercial launch solutions meet our most stressing NSS launch requirements. The SMC Enterprise Directorate awarded three Launch Service Agreements to develop domestic, commercially viable launch systems. The three agreements went to Blue Origin's New Glenn rocket, Northrop Grumman's OmegA rocket, and United Launch Alliance's Vulcan rocket. These partnerships leverage commercial launch industry investment to deliver launch capabilities ahead of the RD-180 procurement deadline of 2022. NSSL Phase 2 launch contracts will facilitate full and open competition to procure launch services from fiscal year 2020 through 2024 for launch starting in 2022.

Last year Congress recognized the prospect of cost savings associated with launch vehicle reusability; the Air Force has embraced this concept and is actively evaluating the risks, benefits, and potential costs or savings from reusable launch vehicles for future missions. With launch service providers demonstrating success at a rapid pace, reusable launch systems could offer higher reliability, increased responsiveness, and greater flexibility in support of NSS missions. In an effort to lean forward on reusing hardware for launch, SMC and SpaceX

completed a contract modification allowing the reuse of the Falcon Heavy side core boosters for the Air Force's Space Test Program-2 mission. This first mission with a re-used booster further demonstrates our commitment to balance risk with increased responsiveness and flexibility.

In 2019, the DoD Space Test Program partnered with SMC's Enterprise Corps and Defense Innovation Unit to pursue the first launch of a venture-class small launch service through the Rapid Agile Launch Initiative (RALI). Under this partnership, the Air Force procured five small launch services through venture-class launch service providers using OTA agreements. RALI demonstrates rapid procurement and the responsiveness of commercial launch, dedicated launch for small payloads to militarily-relevant orbits, on-demand responsiveness, and increased operational tempo over legacy national launch architecture. RALI leverages an expanding commercial market and launch opportunities to increase DoD's access to space.

AFSPC places a high priority on streamlining space launch operations and identifying opportunities to improve our speed, innovation and resiliency to improve efficiency, satisfy national security needs, and increase safety. This includes an architecture transformation across both launch ranges that started in 2019 and will continue through 2023. Changes in flight and ground systems will put us on a path to support a 2025 implementation of the Autonomous Flight Safety System for all commercial space launches. This enables us to increase the pace of launch, reduce costly infrastructure, and maintain public safety.

Cyberspace Defense of the Space Enterprise

To protect our space enterprise from cyber threats, Headquarters AFSPC and SMC, together with our federally funded research development centers, will implement a full lifecycle effort for space and associated ground systems, applying robust cyberspace and defensive security protocols that will include adaptable, upgradable, hardened products and other best practices "baked in" at the time of product delivery. AFSPC is leading the Air Force, implementing a Defensive Cyber Operations for Space (DCO-S) strategy and organizational construct across a tiered defense posture to execute cyber defense in depth for space mission assurance.

Air Force Space Command is working with U.S. Cyber Command, joint partners, the Intelligence Community, research labs, and industry to develop and deploy cyberspace security and defense solutions to protect the space enterprise from cyber threats. AFSPC continues to

develop and educate cyber protection and defense personnel who work alongside space mission system operators to detect and respond to system vulnerabilities and adversarial activity. To rapidly enable DCO-S capabilities, AFSPC is executing a rapid acquisition approach to prototype and field improved technologies that will protect critical systems, investigate cyber events, respond to cyber incidents, and accomplish cyberspace security and defense objectives across the space enterprise.

THE WAY AHEAD

The fiscal year 2020 budget request strengthens the considerable gains AFSPC has made over the previous fiscal year with a proposed \$14 billion investment in our space portfolio, a 17 percent increase over our fiscal year 2019 budget. This budget request supports our warfighting approach to the space domain and supports changes to how we prototype and field innovative space technologies in order to stay ahead of our competitors.

I thank the Committee for your leadership and support; together we will build a resilient and ready National Security Space enterprise that will continue to serve as the foundation to our desire to maintain our military advantage and promote American prosperity.

General John W. "Jay" Raymond

Gen. John W. "Jay" Raymond is Commander, Air Force Space Command, Peterson Air Force Base, Colorado. As Commander, AFSPC, General Raymond is responsible for organizing, training, equipping and maintaining mission-ready space forces and capabilities for North American Aerospace Defense Command, U.S. Strategic Command and other combatant commands around the world. The command comprises approximately 30,000 space professionals worldwide. As the Joint Force Space Component Commander, he directs assigned and attached USSTRATCOM space forces providing tailored, responsive, theater and global space effects in support of national objectives.

General Raymond was commissioned through the ROTC program at Clemson University in 1984. He has commanded the 5th Space Surveillance Squadron at RAF Feltwell, England, the 30th Operations Group at Vandenberg AFB, California, the 21st Space Wing at Peterson AFB, Colorado, and the 14th Air Force, USSTRATCOM, Joint Functional Component Command for Space. He deployed to Southwest Asia as Director of Space Forces in support of operations Enduring Freedom and Iraqi Freedom. The general's staff assignments include Headquarters AFSPC, USSTRATCOM, the Air Staff and the Office of Secretary of Defense.

Prior to assuming command of AFSPC, General Raymond was the Deputy Chief of Staff for Operations, Headquarters U.S. Air Force, Washington, D.C.

EDUCATION

1984 Bachelor of Science, Administrative Management, Clemson University, Clemson, S.C.
 1990 Squadron Officer School, Maxwell AFB, Ala.
 1990 Master of Science, Administrative Management, Central Michigan University, Mt. Pleasant
 1997 Air Command and Staff College, Maxwell AFB, Ala.
 2003 Master of Arts, National Security and Strategic Studies, Naval War College, Newport, R.I.
 2007 Joint Forces Staff College, Norfolk, Va.
 2011 Combined Force Air Component Commander Course, Maxwell AFB, Ala.
 2012 Joint Flag Officer Warfighting Course, Maxwell AFB, Ala.

ASSIGNMENTS

August 1985 - October 1989, Minuteman Intercontinental Ballistic Missile Crew Commander; Alternate Command Post; Flight Commander and Instructor Crew Commander; and Missile Procedures Trainer Operator, 321st Strategic Missile Wing, Grand Forks Air Force Base, N.D.
 October 1989 - August 1993, Operations Center Officer Controller, 1st Strategic Aerospace Division, and Executive Officer, 30th Space Wing, Vandenberg AFB, Calif.
 August 1993 - February 1996, Chief, Commercial Space Lift Operations, Assistant Chief, Current Operations Branch, Headquarters Air Force Space Command, Peterson AFB, Colo.
 February 1996 - August 1996, Deputy Director, Commander in Chief's Action Group, Headquarters AFSPC, Peterson AFB, Colo.
 August 1996 - June 1997, Student, Air Command and Staff College, Maxwell AFB, Ala.
 June 1997 - August 1998, Space and Missile Force Programmer, Headquarters U.S. Air Force, Washington, D.C.
 September 1998 - April 2000, Chief, Expeditionary Aerospace Force Space and Program Integration, Expeditionary Aerospace Force Implementation Division, Headquarters U.S. Air Force, Washington, D.C.
 April 2000 - June 2001, Commander, 5th Space Surveillance Squadron, RAF Feltwell, England
 June 2001 - July 2002, Deputy Commander, 21st Operations Group, Peterson AFB, Colo.
 July 2002 - June 2003, Student, Naval War College, Newport, R.I.
 June 2003 - June 2005, Transformation Strategist, Office of Force Transformation, Office of the Secretary of Defense, Washington, D.C.
 June 2005 - June 2007, Commander, 30th Operations Group, Vandenberg AFB, Calif. (September 2006-January 2007, Director of Space Forces, Combined Air Operations Center, Southwest Asia)

June 2007 - August 2009, Commander, 21st Space Wing, Peterson AFB, Colo.
 August 2009 - December 2010, Director of Plans, Programs and Analyses, Headquarters AFSPC, Peterson AFB, Colo.
 December 2010 - July 2012, Vice Commander, Fifth Air Force, and Deputy Commander, 13th Air Force, Yokota Air Base, Japan
 July 2012 - January 2014, Director of Plans and Policy (J5), U.S. Strategic Command, Offutt AFB, Neb.
 January 2014 - August 2015, Commander, 14th Air Force (Air Forces Strategic), AFSPC, and Commander, Joint Functional Component Command for Space, U.S. Strategic Command, Vandenberg AFB, Calif.
 August 2015 – October 2016, Deputy Chief of Staff, Operations, Headquarters U.S. Air Force, Washington, D.C.
 October 2016 – present, Commander, Air Force Space Command, Peterson AFB, Colo.

SUMMARY OF JOINT ASSIGNMENTS

June 2003 - June 2005, Transformation Strategist, Office of Force Transformation, Office of Secretary of Defense, Arlington, Va., as a colonel
 July 2012 - January 2014, Director of Plans and Policy (J5), U.S. Strategic Command, Offutt AFB, Neb., as a major general

OPERATIONAL INFORMATION

Badges: Master Space Operations Badge; Master Missile Operations Badge
 Systems: Counter Communications System; Deep Space Tracking System; Minuteman III

MAJOR AWARDS AND DECORATIONS

Distinguished Service Medal with oak leaf cluster
 Defense Superior Service Medal with oak leaf cluster
 Legion of Merit with oak leaf cluster
 Meritorious Service Medal with four oak leaf clusters
 Air Force Commendation Medal
 French Order of Merit

OTHER ACHIEVEMENTS

2007 General Jerome F. O'Malley Distinguished Space Leadership Award, Air Force Association
 2015 Thomas D. White Space Award, Air Force Association
 2016 Peter B. Teets Government Award, National Defense Industrial Association
 2017 James V. Hartinger Award, National Defense Industrial Association

EFFECTIVE DATES OF PROMOTION

Lieutenant July 20, 1984
 First Lieutenant July 20, 1986
 Captain July 20, 1988
 Major July 1, 1996
 Lieutenant Colonel July 1, 1999
 Colonel July 1, 2004
 Brigadier General Aug. 1, 2009
 Major General May 4, 2012
 Lieutenant General Jan. 31, 2014
 General Oct. 25, 2016

(Current as of August 2018)

United States Government Accountability Office



Testimony
Before the Subcommittee on
Strategic Forces, Committee on
Armed Services,
House of Representatives

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SPACE ACQUISITIONS

DOD Faces Significant Challenges as it Seeks to Address Threats and Accelerate Space Programs

Statement of Cristina T. Chaplain, Director,
Contracting and National Security Acquisitions

GAO Highlights

Highlights of GAO's report, a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

DOD space systems provide critical capabilities that support military and other government operations. They can also be expensive to acquire and field, costing billions of dollars each year.

As DOD seeks to replenish its satellite constellations, it faces a number of challenges to ensuring funds are used effectively. Because space-based capabilities are fundamental to U.S. national security and global operations, it is essential that DOD manage its space system acquisitions carefully and avoid repeating past problems.

This statement provides an update on DOD's space acquisitions, focusing on challenges facing acquisitions of new space systems.

This statement is based on GAO reports issued over the past 10 years on DOD space programs. In addition, it draws on recent work performed in support of GAO's 2019 annual reports on the progress of major defense acquisition programs as well as duplication, overlap, and fragmentation across the federal government, among other sources.

What GAO Recommends

Past GAO reports have recommended that DOD adopt acquisition best practices to help ensure cost and schedule goals are met. DOD has generally agreed and taken some actions to address these recommendations.

More info: GAO-19-001. For more information, contact Collins Chapman at (202) 512-4841 or chchapman@gao.gov.

April 3, 2019

SPACE ACQUISITIONS

DOD Faces Significant Challenges as it Seeks to Address Threats and Accelerate Space Programs

What GAO Found

DOD is simultaneously undertaking new major acquisitions to replenish its missile warning, protected communications, navigation, and weather satellites. At the same time, it is boosting efforts to increase space situational awareness and protect space assets. Such widespread acquisition activities could face a wide range of resource and management challenges that GAO has reported on, including:

- Growing threats to satellites.** Threats to satellites from both adversaries—such as jamming and cyber attacks—and space debris are increasing. DOD is making changes to how it designs its space systems to increase the resilience and survivability of space capabilities. But it has been challenged in adopting new approaches, such as using commercial satellites to host payloads, and in prioritizing cybersecurity for all of its weapon systems. For hosted payloads, GAO recommended, and DOD concurred, that the department bolster and centralize collection and analysis of cost, technical, and lessons learned data.
- Implementing leadership changes.** DOD is planning major changes to leadership for space. It recently proposed legislation to establish a United States Space Force—initially to be housed within the Department of the Air Force—that would, according to the President's Space Policy Directive, consolidate existing military space activities and minimize duplicative efforts across DOD. GAO found in July 2016 that changes are needed to reduce fragmentation that has negatively affected space programs for many years. But open questions remain about governance as new programs get underway and whether the changes themselves may result in further fragmentation. For example, it is unclear at this time how the new Space Development Agency will mesh with organizations currently involved in testing and acquiring new space technologies.
- Having the right resources and know-how.** While there is increased attention on funding for space and building the Space Force, new programs can still face resource challenges. DOD has begun over 9 new space programs at a time when it is also seeking increased investments in ships, aircraft, and the nuclear triad, among other programs. Moreover, it is unclear whether DOD has a sufficient workforce to manage its new programs. GAO issued a report last month that found DOD does not routinely monitor the size, mix, and location of its space acquisition workforce. Further, DOD has difficulty attracting and retaining candidates with the requisite technical expertise. GAO recommended that DOD collect and maintain data on its space acquisition workforce. DOD did not concur, but GAO maintains that DOD should have better information on such personnel, especially in light of its proposal for establishing the Space Force. GAO also found in March 2019 that selected software-intensive space programs often did not effectively engage users to understand requirements and obtain feedback. GAO recommended, and DOD concurred, that the department ensure its guidance addressing software development provides specific, required direction on the timing, frequency, and documentation of user involvement and feedback.

United States Government Accountability Office

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee:

I am pleased to have the opportunity to discuss the Department of Defense's (DOD) space system acquisitions. DOD's space systems provide critical capabilities that support military and other government operations and can take years to develop, produce, and launch. These systems can also be expensive to acquire and field, amounting to billions of dollars each year. Given the time and resource demands of DOD's space systems and the need for funds to be used effectively, and because space-based capabilities are fundamental to U.S. national security and civilian activities, it is essential that DOD manage space system acquisitions carefully and avoid repeating past problems.

My statement will focus on (1) the current status and cost of major DOD space programs and (2) challenges facing acquisitions of new space systems.

This statement is based on our reports on DOD space programs issued over the past 10 years and recent work performed in support of our annual weapon systems assessments to be issued later this year. It is also based on space-related work in support of our forthcoming 2019 annual report on duplication, overlap, and fragmentation across the federal government; and our updates on cost increases, investment trends, and improvements in the last year. More information on our objectives, scope, and methodology is available in our related products, which are listed at the end of this statement.

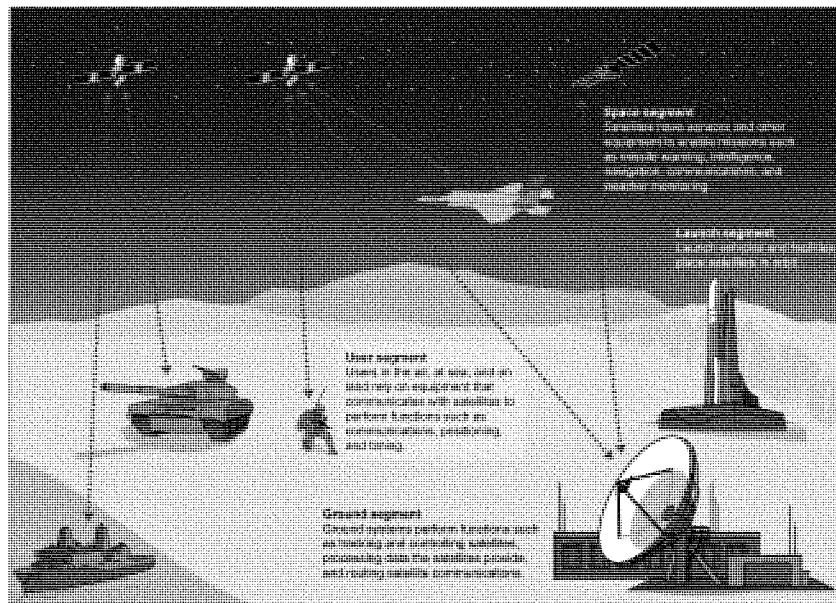
More detailed information on our objectives, scope, and methodology for our work can be found in the issued reports. We conducted the work on which this statement is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Status of Major Space Systems

DOD space systems support and provide a wide range of capabilities to a large number of users, including the military services, the intelligence community, civil agencies, and others. These capabilities include positioning, navigation, and timing; meteorology; missile warning; and secure communications, among others. Space systems can take a long

time to develop and involve multiple segments, including space, ground control stations, terminals, user equipment, and launch, as figure 1 below shows. DOD satellite systems are also expensive to acquire. Unit costs for current DOD satellites can range from \$500 million to over \$3 billion. The associated ground systems can cost over \$6 billion to develop and maintain and the cost to launch a satellite can climb to well over \$100 million.

Figure 1: The Segments of Space Systems



Source: GAO analysis of Department of Defense (DOD) documentation. | GAO-19-482T

Table 1 provides highlights of the current status of DOD's major space programs. As the table shows, DOD is also in the beginning phases of acquiring several constellations of new satellites and ground processing capabilities—including for missile warning, protected communications, space-based environmental monitoring, and space command and control. We have work underway to assess the Air Force's space command and control development efforts and examine DOD's analysis of alternatives for wideband communication services. For a more complete description of these major space programs, see appendix I. In addition, DOD is exploring alternatives for acquiring wideband satellite communications as well as funding development of new launch vehicles as it pursues a new acquisition strategy for procuring launch services.¹

Table 1: Status of Major Department of Defense (DOD) Space Acquisitions

Program	Cost and percentage change from first full estimate (in FY 2019 billion dollars)	Quantity	Associated new programs
Advanced Extremely High Frequency (AEHF) (satellite communications)	\$15.5 116.7%	Original: 5 Current: 6	Evolved Strategic SATCOM (ESS); Protected Tactical SATCOM (PTS); Protected Tactical Enterprise Service (PTES)
Enhanced Polar System (EPS) (satellite communications)	\$1.5 -0.9%	Original: 2 Current: 2	Enhanced Polar System Recap (EPS-R)
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) Command Post Terminals (CPT) (satellite communications terminals)	\$1.9 7.2%	Original: 95 Current: 109	FAB-T Force Element Terminals (FET)
Global Positioning System (GPS) III (positioning, navigation, and timing)	\$5.8 31.8%	Original: 8 Current: 10	GPS IIIIF
Global Positioning System Next Generation Operational Control System (GPS OCS) (command and control system for GPS III satellites)	\$6.2 68.1%	Original: 1 Current: 1	Not determined
Joint Space Operations Center Mission System (JMS) Increment 2 (space situational awareness data system)	\$0.5 42.0%	Original: 1 Current: 1	Space Command and Control (C2)

¹We have work underway to examine the Air Force's space command and control programs as well as DOD's analysis of alternatives for wideband communications. We expect to issue the results of that work by fall 2019.

Program	Cost and percentage change from first full estimate		Quantity	Associated new programs
	(in FY 2019 billion dollars)			
Military GPS User Equipment (MGUE), Increment 1 (GPS receiver)	\$1.5 -5.1%	Original: N/A Current: N/A		MGUE Increment 2
Mobile User Objective System (MUOS) (satellite communications)	\$7.1 -6.0%	Original: 6 Current: 5		Not determined
National Security Space Launch (NSSL) (launch)	\$57.0 193.2%	Original: 181 Current: 161		Not determined
Space Based Infrared System (SBIRS) (missile warning, infrared intelligence, surveillance, and reconnaissance)	\$19.9 265.0%	Original: 5 Current: 6		Next Generation Overhead Persistent Infrared (Next Gen OPIR); Future Operationally Resilient Ground Evolution (FORGE); Enterprise Ground Services (EGS)
Space Fence Ground-Based Radar System Increment 1 (space object detection)	\$1.6 -5.7%	Original: 1 Current: 1		Not determined
Wideband Global SATCOM (WGS) (satellite communications)	\$4.2 ^a 216.3%	Original: 3 Current: 10		To be determined following Analysis of Alternatives
Weather System Follow-on (WSF) (weather)	\$0.5 N/A	Original: 2 Current: 2		Electro-Optical/Infrared Weather Systems (EWS); Electro-Optical/Infrared Weather Systems Geostationary (EWS-G)

Source: GAO analysis of Department of Defense information ; GAO-19-482T

Note: Dollar figures are rounded to the nearest tenth and reported in fiscal year 2019 dollars based on the programs' original and most recent Selected Acquisition Reports or program office updates.

^aThis value does not include the cost of 2 satellites funded by international partners.

Our prior work has shown that many major DOD space programs have experienced significant cost increases and schedule delays. For instance, the total program cost for the Advanced Extremely High Frequency (AEHF) satellite program, a protected satellite communications system, has grown 117 percent since the program's original cost estimate and its first satellite was launched more than 3.5 years late. For the Space Based Infrared System (SBIRS), a missile warning satellite program, the program cost grew 265 percent from its original estimate and the launch of the first satellite was delayed roughly 9 years. Both programs moved to the production phase where fewer problems tend to surface, and where there is typically less risk of significant cost and schedule growth. A more recent major satellite program, Global Positioning System (GPS) III, has

seen an almost 4-year delay due to technical issues and program cost growth of about 32 percent.

Cost and schedule growth has also been a challenge for satellite ground systems and user equipment. Ground system delays have been so lengthy, that satellites sometimes spend years in orbit before key capabilities can be fully exploited. For example,

- The command and control system for GPS III satellites, known as the Next Generation Operational Control System, or OCX, is approximately 5 years behind schedule. As a result, the Air Force has had to start two separate back-up efforts to modify the current ground system to ensure the continuity of GPS capabilities and to make anti-jamming capabilities available via Military Code, or M-code, until OCX is delivered. Our ongoing review of GPS includes an assessment of OCX schedule risk and potential impacts on OCX delivery, acceptance, and operation. We expect to issue our report on GPS in spring 2019.
- Development of GPS user equipment that can utilize the M-Code signal has lagged behind the fielding of GPS M-code satellites for more than a decade, due to prolonged development challenges. In December 2017, we found that while DOD had made some progress on initial testing of the receiver cards needed to utilize the M-code signal, additional development was necessary to make M-code work with the over 700 weapon systems that require it.² We also found that DOD had begun initial planning to transition some weapon systems to use M-code receivers, but significantly more work remained to understand the cost and schedule of transitioning to M-code receivers across DOD. Further, in December 2017, we found that multiple entities were separately maturing their own receiver cards. We recommended that DOD assign responsibility to a single organization to collect test data, lessons learned, and design solutions so that common design solutions are employed and DOD could avoid duplication of efforts. DOD concurred with the recommendation, but has not yet taken action on it.
- We have previously reported that over 90 percent of the capabilities to be provided by Mobile User Objective System communications satellites—currently, five satellites are in orbit, the first of which

²GAO, *Global Positioning System: Better Planning and Coordination Needed to Improve Prospects for Fielding Modernized Capability*, GAO-18-74 (Washington, D.C.: Dec. 12, 2017).

launched in 2012—are being underutilized because of difficulties with integrating the space, ground, and terminal segments and delays in fielding compatible user terminals.³

- Largely because of technical and management challenges, the Joint Space Operations Center Mission System (JMS) Increment 2 program—intended to replace and improve upon an aging space situational awareness and command and control system—was almost 3 years behind schedule and 42 percent over budget before the Air Force stopped development work last year. Last month, we reported that operational testing in 2018 found that JMS Increment 2 was not operationally effective or suitable due, in part, to missing software requirements, urgent deficiencies that affected system performance, and negative user feedback.⁴

Cost and schedule growth in DOD's space programs is sometimes driven by the inherent risks associated with developing complex space technology; however, over the past 10 years we have identified a number of other management and oversight problems that have worsened the situation. These include making overly optimistic cost and schedule estimates, pushing programs forward without sufficient knowledge about technology and design, and experiencing problems in overseeing and managing contractors, among others. We have also noted that some of DOD's programs with operational satellites, such as SBIRS, were also exceedingly ambitious, which in turn increased technology, design, and engineering risks. While SBIRS and other satellite programs provide users with important and useful capabilities, their cost growth has significantly limited the department's buying power at a time when more resources may be needed to protect space systems and recapitalize the space portfolio.

³GAO, *Space Acquisitions: DOD Continues to Face Challenges of Delayed Delivery of Critical Space Capabilities and Fragmented Leadership*, GAO-17-619T (Washington, D.C.: May 17, 2017).

⁴GAO, *DOD Space Acquisitions: Including Users Early and Often in Software Development Could Benefit Programs*, GAO-19-136 (Washington, D.C.: Mar. 18, 2019).

Challenges Facing Acquisitions of New Space Systems

DOD faces significant challenges as it replenishes its satellite constellations. First, DOD is confronted with growing threats in space, which may require very different satellite architectures and acquisition strategies. Second, DOD is in the midst of planning major changes to its leadership for space. While these changes are designed to streamline decision-making and bring together a dispersed space workforce, they could cause some disruption to space system acquisition programs. Third, in fiscal year 2016, Congress required DOD to establish guidance to speed up acquisition timeframes by streamlining acquisition processes and oversight for certain acquisitions. GAO is examining DOD's application of streamlining to its weapons programs. For space, challenges with past streamlining efforts may offer some lessons learned. And fourth, DOD may face resource and capacity challenges in taking on multiple space acquisitions at one time. For example, our work and other reports point to potential gaps in the space acquisition workforce and ongoing difficulties managing software development.

Growing Threats to Satellites Require New Approaches

According to Air Force Space Command and others, U.S. space systems face intentional and unintentional threats that have increased rapidly over the past 20 years. These include radio frequency interference (including jamming), laser attacks, kinetic intercept vehicles, and ground system attacks. Additionally, the hazards of the already-harsh space environment (e.g., extreme temperature fluctuations and radiation) have increased, including numbers of active and inactive satellites, spent rocket bodies, and other fragments and debris. According to a February 2019 Defense Intelligence Agency report, China and Russia in particular are developing a variety of means to exploit perceived U.S. reliance on space-based systems and challenge the U.S. position in space. The report also states that Iran and North Korea have demonstrated some counterspace capabilities that could pose a threat to militaries using space-based services.

In response, recent governmentwide and DOD strategic and policy guidance have stressed the need for U.S. space systems to be survivable or resilient against such threats and DOD has taken steps to be more resilient in some of its new programs. As we found in October 2014, one way to do this is to build more disaggregated systems, including dispersing sensors onto separate satellites; using multiple domains, including space, air, and ground to provide full mission capabilities; hosting payloads on other government or commercial spacecraft; or some

combination of these.⁵ With capabilities distributed across multiple platforms, rather than centralized onto just a few satellites, it may be more difficult for an adversary to target all assets to attack full system capabilities, and if an attack does take place, the loss of one smaller satellite or payload could result in less capability loss than damage to, or loss of, a large multifunctional satellite. In addition to disaggregation, DOD could make satellites more maneuverable and build in defense capabilities to protect themselves as a means to increase survivability.

We also found in October 2014 that some of these options could have beneficial impacts on acquisition.⁶ For example, acquiring smaller, less complex satellites may require less time and effort to develop and produce. This may be in part due to improved requirements discipline, as more frequent production rates may allow program managers to delay new requirements to the next production cycle instead of incorporating them into ongoing timelines midstream. Building more, less-complex satellites might also provide DOD the opportunity to use commercial products and systems that have already been tested in the market. At the same time, however, addressing the need to make satellites more resilient could introduce complications. For example, DOD may need to acquire higher quantities of satellites, which may make it more difficult to manage acquisition schedules. In addition, potentially more development and production contracts may result in more complexity for program offices to manage, requiring increased oversight of contractors. Adding more satellites and new technologies may also complicate efforts to synchronize satellite, terminal, and ground system schedules, limiting delivery of capabilities to end users.

Our work has also found potential barriers to making satellites more resilient. For example, in October 2014, we found that disaggregation could require DOD to make significant cultural and process changes in how it acquires space systems—for instance, by relying on new contractors, relinquishing control to providers who host government payloads on commercial satellites, using different contracting methods, and executing smaller but more numerous and faster-paced acquisition programs.⁷ It will likely require DOD to be more flexible and agile when it

⁵GAO, *DOD Space Systems: Additional Knowledge Would Better Support Decisions about Disaggregating Large Satellites*, GAO-15-7 (Washington, D.C.: Oct. 30, 2014).

⁶GAO-15-7.

⁷GAO-15-7.

comes to satellite acquisitions, especially with regard to coordinating satellite delivery with interdependent systems, such as user equipment. Yet, as we have previously found, DOD's culture has generally been resistant to changes in space acquisition approaches, and fragmented responsibilities have made it very difficult to coordinate and deliver interdependent systems.⁸ Senior leaders have recognized the need to change the space acquisition culture, and as discussed below, changes are being made to space leadership and acquisition approaches.

More recently, in July 2018, we found that two factors have contributed to DOD's limited use of commercially hosted payloads.⁹ First, DOD officials identified logistical challenges to matching government payloads with any given commercial host satellite. For example, most of the offices we spoke with cited size, weight, and power constraints, among others, as barriers to using hosted payloads. Second, while individual DOD offices have realized cost and schedule benefits from using hosted payloads, DOD as a whole has limited information on costs and benefits of hosted payloads. Further, the knowledge DOD obtained is fragmented across the agency—with multiple offices collecting piecemeal information on the use of hosted payloads. The limited knowledge and data on hosted payloads that is fragmented across the agency has contributed to resistance among space acquisition officials to adopting this approach. We recommended, and DOD concurred, that the department bolster and centralize collection and analysis of cost, technical, and lessons learned data on its use of hosted payloads.

Lastly, in October 2018, we found that DOD faced mounting challenges in protecting its weapon systems—satellites and their ground systems included—from increasingly sophisticated cyber threats.¹⁰ We reported that this was due to the computerized nature of weapon systems, DOD's late start in prioritizing weapon system cybersecurity, and DOD's nascent understanding of how to develop more secure weapon systems. In operational testing, DOD routinely found mission-critical cyber vulnerabilities in systems that were under development, yet program

⁸GAO-17-619T.

⁹GAO, *Military Space Systems: DOD's Use of Commercial Satellites to Host Defense Payloads Would Benefit from Centralizing Data*, GAO-18-493 (Washington, D.C.: July 30, 2018).

¹⁰GAO, *Weapon Systems Cybersecurity: DOD Just Beginning to Grapple with Scale of Vulnerabilities*, GAO-19-128 (Washington, D.C.: Oct. 9, 2018).

officials GAO met with believed their systems were secure and even discounted some test results as unrealistic. Using relatively simple tools and techniques, testers were able to take control of systems and operate largely undetected, due in part to basic issues such as poor password management and unencrypted communications. DOD has recently taken several steps to improve weapon system cybersecurity, including issuing and revising policies and guidance to better incorporate cybersecurity considerations. Further, in response to congressional direction, DOD has also begun initiatives to better understand and address cyber vulnerabilities.

Space Leadership Changes Are a Positive Step, But Have Some Risk

We and others have reported for over two decades that fragmentation and overlap in DOD space acquisition management and oversight have contributed to program delays and cancellations, cost increases, and inefficient operations. For example, in February 2012 we found that fragmented leadership contributed to a 10-year gap between the delivery of GPS satellites and associated user equipment.¹¹ The cancellations of several large programs over the past 2 decades were in part because of disagreements and conflicts among stakeholders.

In July 2016, in response to a provision of a Senate Report accompanying a bill for the National Defense Authorization Act for Fiscal Year 2016, we issued a report that reviewed space leadership in more depth and concluded that DOD space leadership was fragmented.¹² We identified approximately 60 stakeholder organizations across DOD, the Executive Office of the President, the Intelligence Community, and civilian agencies. Of these, eight organizations had space acquisition management responsibilities; eleven had oversight responsibilities; and six were involved in setting requirements for defense space programs. At the same time, many experts stated that no one seemed to be in charge of space acquisitions. Our report highlighted the pros and cons of various options to reorganize space functions recommended in prior congressionally-chartered studies. The issue has taken on more importance in recent years, as DOD has realized satellites are highly

¹¹GAO, *2012 Annual Report: Opportunities to Reduce Duplication, Overlap and Fragmentation, Achieve Savings, and Enhance Revenue*, GAO-12-342SP (Washington, D.C.: Feb. 28, 2012).

¹²GAO, *Defense Space Acquisitions: Too Early to Determine if Recent Changes Will Resolve Persistent Fragmentation in Management and Oversight*, GAO-16-592R (Washington, D.C.: July 27, 2016).

vulnerable to attacks and needs to make dramatic changes in space system architectures and operations. We have found that leadership has not been focused enough to overcome interagency rivalries and resistance to change, and it has not been able to get concurrence on future architectures.

The President's Administration and DOD have taken significant steps to change space leadership. Most recent is the President's Space Policy Directive-4, issued on February 19, 2019, and DOD's subsequent legislative proposal submitted on March 1, 2019, to establish a United States Space Force as a sixth branch of the United States Armed Forces within the Department of the Air Force.¹³ The Policy Directive states that this is an important step toward a future military department for space and that the Space Force will (1) consolidate existing forces and authorities for military space activities, as appropriate, to minimize duplication of effort and eliminate bureaucratic inefficiencies; and (2) not include the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Reconnaissance Office, or other non-military space organizations or missions of the United States Government.

According to the Policy Directive, the Space Force would include the uniformed and civilian personnel conducting and directly supporting space operations from all DOD Armed Forces, assume responsibilities for all major military space acquisition programs, and create the appropriate career tracks for military and civilian space personnel across all relevant specialties. Pertaining to organization and leadership, the Policy Directive states that there should be a civilian Under Secretary of the Air Force for Space, to be known as the Under Secretary for Space, appointed by the President, and establishes a Chief of Staff of the Space Force, who would serve as a member of the Joint Chiefs of Staff.

Furthermore, the Policy Directive states that as the Space Force matures, and as national security requires, it will become necessary to create a separate military department, to be known as the Department of the Space Force. This department would take over some or all responsibilities for the Space Force from the Department of the Air Force.

¹³Space Policy Directive-4, 84 Fed. Reg. 6049 (Feb. 25, 2019); *Legislative Proposal to Establish the U.S. Space Force* (Mar. 1, 2019), available at <https://media.defense.gov/2019/Mar/01/2002095010/-1/-1/1/UNITED-STATES-SPACE-FORCE-LEGISLATIVE-PROPOSAL.PDF> (last visited Mar. 15, 2019).

The Policy Directive requires the Secretary of Defense to conduct periodic reviews to determine when to recommend that the President seek legislation to establish such a department.

Our past work has identified fragmentation in space leadership, but because implementation has not yet occurred, it remains to be seen whether this policy directive and proposed legislation would resolve these issues. In implementing these changes there are many complexities to consider. For example, because space capabilities are acquired and used across the military services and defense agencies, it will be important to address many details on how to implement a Space Force among these equities. Our past work suggests that without close attention to the consequences of the compromises that will inevitably have to be made to carve out a new force structure from existing space functions, there is risk of exacerbating the fragmentation and ineffective management and oversight the Space Force is intended to address. For instance, in March 2019, DOD established the Space Development Agency to unify and integrate efforts across DOD to define, develop, and field innovative solutions.¹⁴ But it is unclear how this new organization will mesh with the Air Force Space and Missile Systems Center, which acquires satellites, the Defense Advanced Research Projects Agency, which creates breakthrough technologies and capabilities, and similar organizations.

Moreover, even if changes are implemented effectively, they are only a first step toward addressing space acquisition problems. As we discuss below, programs will still need to embrace acquisition best practices, such as using demonstrable knowledge to make decisions. Our prior work has found that they will also need to be open to flexible and innovative approaches, and work effectively with a very wide range of stakeholders, including those that will not be part of the Space Force, such as the intelligence agencies, civilian space agencies, the current military services, as well as entities within the Office of the Secretary of Defense who help oversee and manage acquisitions.¹⁵ Senior leaders have acknowledged that additional changes are needed and have taken steps to help bring them about, such as the restructuring of the Air Force's Space and Missile Systems Center, which is designed to break down stovepipes and streamline acquisition processes.

¹⁴DOD, *Establishment of the Space Development Agency* (Washington, D.C.: Mar. 12, 2019).

¹⁵GAO-18-493, GAO-16-592R, and GAO-17-619T.

Past Streamlining Efforts Offer Lessons Learned

DOD is managing a number of new space acquisition programs using a new authority, established under Section 804 of the National Defense Authorization Act for Fiscal Year 2016, which is to provide a streamlined alternative to the traditional DOD acquisition process. Specifically, the programs—which include follow-on missile warning and protected communications satellites, among others—will be exempted from the acquisition and requirements processes defined by DOD Directive 5000.01 and the Joint Capabilities Integration and Development System.¹⁶ Instead, program managers are encouraged to use a tailored approach to documentation and oversight to enable them to demonstrate new technologies or field new or updated systems within 2 to 5 years. We have ongoing work looking across the military departments at how middle-tier acquisition authority is being implemented, including for the Air Force's space acquisition programs, and plan to issue a report later this spring.

GAO and others have highlighted lessons learned from past efforts to streamline, specifically with an approach adopted for space systems in the 1990s known as Total System Performance Responsibility (TSPR). TSPR was intended to facilitate acquisition reform and enable DOD to streamline its acquisition process and leverage innovation and management expertise from the private sector. Specifically, TSPR gave a contractor total responsibility for the integration of an entire weapon system and for meeting DOD's requirements. We found in May 2009 that because this reform made the contractor responsible for day-to-day program management, DOD did not require formal deliverable documents—such as earned value management reports—to assess the status and performance of the contractor.¹⁷ As a result, DOD's capability to lead and manage the space acquisition process diminished, which magnified problems related to unstable requirements and poor contractor performance. Further, the reduction in DOD oversight and involvement led to major reductions in various government capabilities, including cost-estimating and systems-engineering staff. This, in turn, led to a lack of technical data needed to develop sound cost estimates.

¹⁶DOD Directive 5000.01, the Defense Acquisition System (Aug. 31, 2018); and Chairman of the Joint Chiefs of Staff Instruction 5123.01H "Charter of the Joint Requirements Oversight Council (JROC) and Implementation of the Joint Capabilities Integration and Development System (JCIDS)" (Aug. 31, 2018).

¹⁷GAO, *Space Acquisitions: DOD Faces Substantial Challenges in Developing New Space Systems*, GAO-09-705T (Washington, D.C.: May 20, 2009).

Best practices that we identified in the aftermath of TSPR include retaining strong oversight and insight into programs; using quantifiable data and demonstrable knowledge to make decisions to proceed, not allowing development to proceed until certain thresholds are met, empowering program managers to make decisions on the direction of the program but also holding them accountable for their choices, and canceling unsuccessful programs. Similarly, in its study of TSPR programs, the Defense Science Board/Air Force Scientific Advisory Board Joint Task Force emphasized the importance of managing requirements, sufficiently funding programs, participating in trade-off studies, and assuring that proven engineering practices characterize program implementation, among other actions. See appendix II for a more complete list of the best practices we have identified for developing complex systems.

DOD May Face Resource and Capacity Challenges in Taking on Multiple Programs at One Time

DOD is simultaneously undertaking new major acquisition efforts to replenish its missile warning, protected communications, GPS, and weather satellites. At the same time, it is boosting efforts to increase space situational awareness and protect space assets. It is also helping to fund the development of new launch vehicles, and it is considering additional significant acquisitions in wideband satellite communications and in support of missile defense activities. While there is increased attention within DOD on funding for space and building the Space Force, such widespread acquisition activities could still pose resource challenges. For example:

- Funding requests for space system modernization have in the past 10 years represented a small percentage (3.9 to 5 percent) of total weapon system modernization funding DOD requested. Space is competing with ships, aircraft, and the nuclear triad, among other programs for funding. This can be challenging, because over the past 2 years, DOD has begun over 9 new space acquisition programs to recapitalize current space capabilities and enhance system resiliency.¹⁸ In the past, we have found that it has been difficult for DOD to fund multiple new space programs at one time, particularly

¹⁸These programs include Electro/Optical Weather System, Enhanced Polar System Recapitalization, Evolved Strategic SATCOM, GPS III Follow-on, Military GPS User Equipment, Increment 2, Next Generation Overhead Persistent Infrared (OPIR) – Ground, Next Generation (OPIR) – Space, Protected Tactical Enterprise Service, Protected Tactical SATCOM, and Space Command and Control.

when it was concurrently struggling with cost overruns and schedule delays from its legacy programs. For example, OCX system development challenges have resulted in a \$2.5 billion cost increase and approximate 5-year delay to the system becoming operational—using more resources for a longer time—at a cost to other programs.

- It is unclear whether DOD has a sufficient workforce to manage multiple new space programs. We issued a report last month that found DOD did not routinely monitor the size, mix, and location of its space acquisition workforce.¹⁹ We collected and aggregated data from multiple DOD space acquisition organizations and found that at least 8,000 personnel in multiple locations nationwide were working on space acquisition activities at the end of 2017. Echoing concerns raised in our prior work, we also found that DOD had difficulty attracting and retaining candidates with the requisite technical expertise. Officials from the Air Force's Space and Missile Systems Center were concerned that there are not enough experienced mid-level acquisition personnel and also expressed concern that the bulk of military personnel assigned to program management positions were more junior in rank than the Center was authorized to obtain. We recommended that DOD (1) identify the universe of its space acquisition programs and the organizations that support them, and (2) collect and maintain data on the workforce supporting these programs. DOD concurred with our first recommendation but not the second.²⁰
- Software is an increasingly important enabler of DOD space systems. However, DOD has struggled to deliver software-intensive space programs that meet operational requirements within expected time frames. Although user involvement is critical to the success of any software development effort, we found in our report issued last month on DOD software-intensive space programs that the programs we reviewed that experienced cost or schedule breaches often did not effectively engage users to understand requirements and obtain feedback.²¹ Program efforts to involve users and incorporate feedback

¹⁹GAO, *Defense Space Systems: DOD Should Collect and Maintain Data on Its Space Acquisition Workforce*, GAO-19-240 (Washington, D.C.: Mar. 14, 2019).

²⁰In response to DOD's non-concurrence with our second recommendation, we stated that we continue to believe that taking steps to identify military and civilian personnel supporting space acquisition programs would support DOD's strategic workforce planning, particularly considering DOD's recent legislative proposal for establishing the United States Space Force.

²¹GAO-19-136.

frequently did not match plans. The lack of user engagement has contributed to systems that were later found to be operationally unsuitable. The programs we reviewed also faced challenges in delivering software in shorter time frames, and in using commercial software, applying outdated tools and metrics, as well as having limited knowledge and training in newer software development techniques. DOD acknowledged these challenges and is taking steps to address them, including identifying useful software development metrics and ways to include them in new contracts. We recommended, and DOD concurred, that the department ensure its guidance addressing software development provides specific, required direction on the timing, frequency, and documentation of user involvement and feedback. Moreover, it should be noted that software development has been a struggle for other non-space weapons programs as well. The Defense Innovation Board recently reported that the department's current approach to software development is broken and is a leading source of risk to DOD—it takes too long, is too expensive, and exposes warfighters to unacceptable risk by delaying their access to the tools they need to assure mission success.

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee, this concludes my statement. I am happy to answer any questions that you have.

GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this statement, please contact me at (202) 512-4841 or chaplainc@gao.gov. Contacts for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. Individuals who made key contributions to this statement include Rich Horiuchi, Assistant Director; Erin Cohen (Analyst in Charge); Emily Bond; Claire Buck; Maricela Chervenky; Susan Ditto; Burns C. Eckert; Laura Hook; and Anne Louise Taylor. Key contributors for the previous work on which this statement is based are listed in the products cited.

Appendix I: Status of Major Department of Defense Space Acquisitions

Table 2: Current Status of Major Department of Defense (DOD) Space Acquisitions

Program	Cost and quantity change from first full estimate (in FY 2019 billion dollars)	Current status	Associated new programs
Advanced Extremely High Frequency (AEHF) (satellite system to provide survivable, jam-resistant, worldwide, secure satellite communications for strategic and tactical operations)	Cost and percentage change: \$15.5 billion, 116.7% Original quantity: 5 Current quantity: 6	Four satellites have been launched. The 5th and 6th to be launched in 3rd quarter fiscal year 2019 and 2nd quarter fiscal year 2020. The program's first launch was delayed by more than 3.5 years.	Evolved Strategic SATCOM (ESS); Protected Tactical SATCOM (PTS); Protected Tactical Enterprise Service (PTES)
Enhanced Polar System (EPS) (satellite system to provide protected, extremely high frequency satellite communications in polar region)	Cost and percentage change: \$1.5 billion, -0.9% Original quantity: 2 Current quantity: 2	Operational testing for the second payload is scheduled to begin by 3rd quarter fiscal year 2019, with initial operational capability scheduled for 4th quarter fiscal year 2019.	Enhanced Polar System Recap (EPS-R)
Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) Command Post Terminals (CPT) (user terminals to provide protected and survivable satellite communications for airborne and ground-based users)	Cost and percentage change: \$1.9 billion, 7.2% Original quantity: 95 Current quantity: 109	As of December 2018 the contractor had delivered 22 terminals and the program had installed 5 to begin testing. The program expects to reach initial operational capability by June 2021, an 18 month delay from its previously reported estimate	FAB-T Force Element Terminals (FET)
Global Positioning System (GPS) III (system to provide positioning, navigation, and timing to military and civil users)	Cost and percentage change: \$5.8 billion, 31.8% Original quantity: 8 Current quantity: 10	The first satellite launched in 2018 and a second will be available for launch in mid-2019. The third satellite is expected to be launched in late fall 2019. The program continues to face delayed deliveries of certain satellite components which could affect the schedules for satellites 4 through 10.	GPS IIIIF
Global Positioning System Next Generation Operational Control System (GPS OCX) (ground system to provide command and control for current and new GPS III satellites)	Cost and percentage change: \$6.2 billion, 68.1% Original quantity: 1 Current quantity: 1	A new cost and schedule baseline was approved in September 2018. The program has yet to fully mature the critical technologies that underpin the full OCX system.	Not determined

**Appendix I: Status of Major Department of
Defense Space Acquisitions**

Program	Cost and quantity change from first full estimate (in FY 2019 billion dollars)	Current status	Associated new programs
Joint Space Operations Center Mission System (JMS), Increment 2 (provide applications, net-centric services and databases, and dedicated hardware to improve space situational awareness)	Cost and percentage change: \$0.5 billion, 42.0% Original quantity: 1 Current quantity: 1	While the program had planned to deliver the full capabilities in Increment 2 by 2016, the program ended development in October 2018 and only delivered a limited number of capabilities. Requirements that were not met by JMS were deferred to the follow-on program, Space Command and Control (C2)	Space Command and Control (C2)
Military GPS User Equipment (MGUE), Increment 1 (military-code capable GPS user equipment)	Cost and percentage change: \$1.5 billion, -5.1% Original quantity: N/A Current quantity: N/A	It is unclear when M-code capable receivers will be fielded. The program expects to complete operational testing in April 2021.	MGUE Increment 2
Mobile User Objective System (MUOS) (satellite system to provide worldwide narrowband satellite communications)	Cost and percentage change: \$7.1 billion, -6.0% Original quantity: 6 Current quantity: 5	Constellation complete with four satellites and an on-orbit spare. The program did not pass operational testing in 2015. Another operational test is planned to begin in May 2019.	Not determined
National Security Space Launch (NSSL) (provides spacelift support for DOD, national security, and other government missions with viable domestic launch service providers)	Cost and percentage change: \$57.0 billion, 193.2% Original quantity: 181 Current quantity: 161	The program awarded launch service agreements to 3 companies in October 2018 to develop launch system prototypes that will be able to launch national security space missions beginning in fiscal year 2022.	Not determined
Space Based Infrared System (SBIRS) (satellite and ground system to provide missile warning, infrared intelligence, surveillance, and reconnaissance)	Cost and percentage change: \$19.9 billion, 265.0% Original quantity: 5 Current quantity: 6	Planned launch dates for GEOs 5 and 6 planned for early 2021, and 2022, respectively. The baseline program was delivered about 9 years later than planned. GEOs 5 and 6 are at risk for delay.	Next Generation Overhead Persistent Infrared (Next Gen OPIR); Future Operationally Resilient Ground Evolution (FORGE), Enterprise Ground Services (EGS)
Space Fence Ground-Based Radar System, Increment 1 (detect and track objects in low and medium Earth orbit in support of DOD's space surveillance network)	Cost and percentage change: \$1.6 billion, -5.7% Original quantity: 1 Current quantity: 1	The program plans to conduct operational testing in Spring 2019, and expects to reach initial operational capability by July 2019.	Not determined

Appendix I: Status of Major Department of Defense Space Acquisitions

Program	Cost and quantity change from first full estimate (in FY 2019 billion dollars)	Current status	Associated new programs
Wideband Global SATCOM (WGS) (worldwide communications services to U.S. warfighters, allies, and other special users)	Cost and percentage change: \$4.2 billion, ^a 216.3% Original quantity: 3 Current quantity: 10	Funding for the Air Force to procure two additional WGS satellites was included in the Consolidated Appropriations Act, 2018. Analysis of Alternatives (AoA) to identify options for providing capabilities beyond WGS completed its analysis phase in June 2018.	To be determined following AoA
Weather System Follow-on (WSF) (satellite to provide remote sensing of weather conditions using polar-orbiting satellite)	Cost and percentage change: \$0.5 billion, N/A Original quantity: 2 Current quantity: 2	Program is to enter development in March 2019. First satellite expected to be launched late 2023.	Electro-Optical/Infrared Weather Systems (EWS); Electro-Optical/Infrared Weather Systems Geostationary (EWS-G)

Source: GAO analysis of Department of Defense information | GAO-19-482T

Note: Dollar figures are rounded to the nearest tenth and reported in fiscal year 2019 dollars based on the programs' original and most recent Selected Acquisition Reports or program office updates.
^aThis value does not include the cost of 2 satellites funded by international partners.

Appendix II: Best Practices GAO Has Identified for Space and Weapons Systems Acquisitions

Our previous work on weapons acquisitions in general, and space programs in particular, identified best practices for developing complex systems. We summarize these best practices in table 3, below.

Table 3: Summary of Best Practices GAO Has Identified to Address Space and Weapons Acquisition Problems

Before undertaking new programs

Prioritize investments so that projects can be fully funded and it is clear where projects stand in relation to the overall portfolio.

Follow an evolutionary path toward meeting mission needs rather than attempting to satisfy all needs in a single step.

Match requirements to resources—that is time, money, technology, and people—before undertaking new development efforts.

Research and define requirements before starting programs and limit changes after they are started.

Ensure that cost estimates are complete, accurate, and updated regularly. Commit to fully fund projects before they begin.

Ensure that critical technologies are proven to work as intended before programs begin. Assign more ambitious technology development efforts to research departments until they are ready to be added to future generations (or increments) of a product.

Use systems engineering to close gaps between resources and requirements before launching the development process.

During program development

Use quantifiable data and demonstrable knowledge to make decisions to proceed, covering critical facets of the program such as cost, schedule, technology readiness, design readiness, production readiness, and relationships with suppliers.

Do not allow development to proceed until certain thresholds are met—for example, a high proportion of engineering drawings completed or production processes under statistical control.

Empower program managers to make decisions on the direction of the program and to resolve problems and implement solutions.

Hold program managers accountable for their choices.

Require program managers to stay with a project to its end.

Encourage program managers to share bad news, and encourage collaboration and communication.

Hold suppliers accountable for delivering high-quality parts for their products through activities including regular supplier audits and performance evaluations of quality and delivery.

Source: GAO | GAO-19-482T

Related GAO Products

DOD Space Acquisitions: Including Users Early and Often in Software Development Could Benefit Programs. GAO-19-136. Washington, D.C.: March 18, 2019.

Defense Space Systems: DOD Should Collect and Maintain Data on Its Space Acquisition Workforce. GAO-19-240. Washington, D.C.: March 14, 2019.

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