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HEARING

ON

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2022

AND

OVERSIGHT OF PREVIOUSLY AUTHORIZED PROGRAMS

BEFORE THE

COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES

ONE HUNDRED SEVENTEENTH CONGRESS

FIRST SESSION

SUBCOMMITTEE ON STRATEGIC FORCES HEARING

ON

FISCAL YEAR 2022 PRIORITIES FOR NATIONAL SECURITY SPACE PROGRAMS

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FISCAL YEAR 2022 PRIORITIES FOR NATIONAL SECURITY SPACE PROGRAMS

HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON STRATEGIC FORCES,
Washington, DC, Monday, May 24, 2021.

The subcommittee met, pursuant to call, at 11:03 a.m., via Webex, Hon. Jim Cooper (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. JIM COOPER, A REPRESENTATIVE FROM TENNESSEE, CHAIRMAN, SUBCOMMITTEE ON STRATEGIC FORCES

Mr. COOPER. The hearing will come to order.

This is a meeting of the Subcommittee on Strategic Forces. And I would like to thank the distinguished witnesses. First, performing the duties of Assistant Secretary of Defense for Space Policy, Mr. John Hill; the Vice Chief of Space Operations, General David Thompson; the Director of the National Reconnaissance Office, Dr. Christopher Scolese; Associate Director of Operations for the National Geospatial-Intelligence Agency, Major General Charles Cleveland; and GAO [Government Accountability Office] Director of Contracting and National Security Acquisitions, Mr. Jon Ludwigson.

We are honored to have this level of expertise within the Department and intelligence community and to have them testify today at the hearing.

It has been 2 years since this subcommittee has had a hearing on space acquisition, and, in my opinion, hardly any topic in DOD [Department of Defense] is more important than this one. We have seen the overdue establishment of Space Force, the reestablishment of Space Command, and public acknowledgement of the many threats we face from abroad. I am hopeful that the Department will use this opportunity to accelerate and improve space acquisition within the Space Force.

General Hyten, the Vice Chairman of the Joint Chiefs of Staff, has pointed out that the next generation of OPIR [Overhead Persistent Infrared] is still planning on giving us, as he calls it, quote, "big, juicy targets" to orbit, instead of the more distributed, less vulnerable architecture that we could be choosing. And he personally has encountered numerous obstacles from DOD to having new and improved architectures. So, if the Vice Chairman of the Joint Chiefs of Staff has difficulties, I have difficulties. We have to make sure this works.

I will turn now to my ranking member, Mr. Turner, for any opening remarks he has, but I would like to take a point of personal

privilege. I am wearing my Predators tie. We won in double overtime last night. So it is an amazing thing for a Nashville-based hockey team to be doing so well again.

Mr. Turner.

[The prepared statement of Mr. Cooper can be found in the Appendix on page 29.]

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

Mr. TURNER. Mr. Chairman, thank you so much, and thank you for holding this important hearing.

I agree with you, this is one of the most important topics, perhaps besides nuclear modernization, that we are dealing with. We continually hear from General Raymond the issue of the provocative actions that China and Russia are taking in space, and we know that it is going to take not only our working defensively but also in the manner in which we deploy and design our architecture. I look forward to hearing from the witnesses today as to how they see that evolving.

Also, since the Biden administration is delivering its budget late May, we are going to be dealing, most likely, with a CR [continuing resolution]. And I would love to hear from the witnesses as to how this may affect their operations, knowing that in space so many of the things that we do are single projects and that they may be more particularly impacted by CRs than other functions.

With that, I will submit my written statement for the record, Mr. Chairman. Thank you.

[The prepared statement of Mr. Turner can be found in the Appendix on page 30.]

Mr. COOPER. The gentleman's comments are well taken.

Without objection, any opening statement is accepted for the record.

Let's now hear from our first witness, Mr. Hill.

STATEMENT OF JOHN D. HILL, PERFORMING THE DUTIES OF ASSISTANT SECRETARY OF DEFENSE FOR SPACE POLICY, U.S. DEPARTMENT OF DEFENSE

Mr. HILL. Chairman Cooper, Ranking Member Turner, distinguished members of the subcommittee, it is an honor to testify before you today along with my distinguished colleagues.

You have my written statement. I will summarize it and, with your permission, have it placed in the record.

Mr. COOPER. Without objection, so ordered.

Mr. HILL. Thank you.

This subcommittee well understands the importance of space-based capabilities to our national security in this era of destabilizing challenges from Russia and undeniable strategic competition with China.

The increasing threats to those capabilities are also well known. As Secretary Austin has testified, the growth of Chinese and Russian counterspace capabilities presents the most immediate and serious threats to U.S., allied, and partner space activities.

Moreover, Russia and China view space as critical to modern warfare and consider the use of counterspace capabilities as both a means of reducing U.S. military effectiveness and winning future wars.

As these developments portend, the United States must now be prepared for conflict to extend to or even originate in space. But, to be clear, such a conflict would not be a space war, distinct from terrestrial war, but would, rather, represent the extension of traditional armed conflict into the space domain of human endeavor.

Within the Office of the Assistant Secretary of Defense for Space Policy, we are focused on the integration of strategy, policy, plans, and appropriate capabilities to develop a space posture that contributes to integrated cross-domain deterrence by conveying clearly to competitors and any potential adversary the inadvisability of military aggression, including attacks on U.S. space capabilities or those of our allies and partners.

The 2020 Defense Space Strategy, which my office prepared, addresses these challenges of deterrence as well as the challenges of crisis de-escalation and warfare extending to space along four lines of effort.

First, we are building comprehensive military advantages in space. Second, we are integrating space into national, joint, and combined operations. Third, we are shaping the strategy environment to enhance domain stability and reduce the potential for miscalculation. And, fourth, we are enhancing space cooperation with our international partners, our commercial entities, and our interagency partners.

Finally, in support of the national security strategic guidelines, my office also leads DOD's participation in the U.S. Government's space diplomatic initiative, which currently center on establishing voluntary, nonbinding standards of responsible behavior and on exposing the disingenuous space arms control initiatives of Russia and China.

Mr. Chairman, I am honored to have played a part in the collaborative and bipartisan efforts of the executive and legislative branches over the past several years to strengthen our national security space posture. I look forward to continuing to work with Congress, with our interagency colleagues, U.S. industry, and our international allies and partners to secure the advantages of space for our national interests.

And I look forward to your questions. Thank you.

[The prepared statement of Mr. Hill can be found in the Appendix on page 32.]

Mr. COOPER. Thank you, sir.

Now General Thompson.

STATEMENT OF GEN DAVID D. THOMPSON, USSF, VICE CHIEF OF SPACE OPERATIONS, UNITED STATES SPACE FORCE

General THOMPSON. Chairman Cooper, Ranking Member Turner, and distinguished members of the subcommittee, thank you for the opportunity to testify today in my capacity as Vice Chief of Space Operations, United States Space Force.

On behalf of the Chief of Space Operations, General Jay Raymond, and joined by these outstanding national security space

leaders on the panel, it is a pleasure to provide you details today on the stand-up of the newest U.S. military service and inform you of our plans for the coming year.

I would like to begin by expressing my gratitude to Congress for its bipartisan support in establishing the U.S. Space Force on December 20, 2019, and your leadership in addressing the threats and challenges the Nation faces in space.

Year one of the Space Force's existence has been focused on standing up this new service. With purposeful outreach to and the collaboration of Congress, U.S. Space Force has made tremendous strides in the first year: establishing and resourcing the organizational blueprint for the service; moving aggressively in the areas of human capital, force design, acquisition integration; and providing the foundations to establish a truly digital service; all while executing our critical space missions around the clock and without fail.

General Raymond's direction for year two is the integration of the Space Force into the joint force, the interagency, and with our allies and partners, even as we continue to build out the service.

While we have completed the congressional requirement to establish a service within 18 months, build-out of the Space Force continues and will take several more years. We have established the first field command, Space Operations Command, and completed the organizational design of the remaining two, Space Systems Command and Space Training and Readiness Command, with anticipated stand-up of those two commands later this year.

Space Operations Command is responsible for preparing and presenting forces to U.S. Space Command and other combatant commands. Space Systems Command will develop and field world-class space capabilities for our Space Forces and drive agility and speed into the acquisition process. And Space Training and Readiness Command will recruit, develop, and train guardians to protect the high ground of space.

As part of year two's integration activities, the Space Force will place increasing emphasis on strengthening relationships with existing partners and establishing relationships with new partners. This starts with the organizations represented here today. It extends to the other services, combatant commands, and our allies and other international partners. The United States as a whole, and the U.S. Space Force in particular, are much stronger when these relationships are strong.

Next, General Raymond and the entire leadership of the Department of the Air Force remain committed and adamant that we must increase the pace of space acquisition. Maintaining program delivery timelines of the recent past will not outpace the threat. We must go faster.

The Space Force will continue to smartly leverage the 804 authorities granted by Congress, and we will partner with industry and academia to leverage technology and innovation of the commercial sector. Our adversaries have recognized the importance of such an approach to the national security space. In my opinion, the creativity, ingenuity, and innovation of the American mind is one of our greatest assets. We must leverage that fully in this endeavor.

Our people, our guardians, are critical to the success of the Space Force. We are adapting new and innovative human capital and talent management approaches for both civilians and military members alike under the authorities granted by Congress and with your assistance.

In addition, the recent release of the "Vision for a Digital Service" seeks to build the fluency of that workforce and prepare and posture them and the service to be more agile and innovative in the future.

Finally, the U.S. Space Force will continue to partner with other agencies in the executive branch and Congress to promote responsible behavior in space and a secure, stable domain accessible to all for peaceful purposes.

Our service's inception is an unprecedented opportunity. Our success today could not have been possible without a passionate and energetic group of guardians, a fully committed partnership with the Departments of the Air Force and Defense, and the support of Congress.

On behalf of General Raymond, thank you again for this opportunity, and I look forward to your questions and concerns today.

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

Mr. COOPER. Thank you so much, General.

Now we will hear from Dr. Scolese.

STATEMENT OF CHRISTOPHER J. SCOLESE, DIRECTOR, NATIONAL RECONNAISSANCE OFFICE

Dr. SCOLESE. Good morning, Chairman Cooper, Ranking Member Turner, and distinguished members of the subcommittee. I am glad to be here with strong partners General "DT" Thompson, Mr. Hill, Major General Cleveland, and Mr. Ludwigson.

It is a great honor to represent the people of the National Reconnaissance Office [NRO]. Our agency proudly develops, acquires, launches, and operates the Nation's reconnaissance satellites as a member of both the intelligence community and Department of Defense.

Mr. Chairman, please allow me to share a reflection on our past year.

While addressing the COVID health and safety protocols to protect our workforce and families, NRO ensured the mission continued to meet our commitments to intelligence analysts, warfighters, and policymakers. Due to the incredible efforts of our people and partners, I am pleased to report NRO systems maintained 100 percent of their capabilities throughout the pandemic.

During a challenging time, we accomplished 6 successful launches, delivering 12 payloads to orbit, many with first-ever capabilities, the most NRO launches in a single year since 1984.

On the business side, we achieved our 12th consecutive clean financial audit, a feat of financial management excellence unrivaled in the IC [intelligence community]. Last year, we also began our NRO Cadre Internship Program, establishing a key recruitment element in our workforce strategy.

Turning to today, we are bridging the innovative legacies of our past with cutting-edge vision for our future as we celebrate our

60th anniversary. Since its inception in 1961, NRO has taken quantum leaps in the evolution of overhead reconnaissance space and ground systems. Our success can be traced to NRO's end-to-end mission responsibility: developing, acquiring, launching, and operating mission systems.

We are a streamlined, flat organization that has a diverse workforce with an exceptional mix of skills, perspectives, and backgrounds. This enables us to deliver on acquisitions while developing next-generation capabilities and systems.

Adversaries are moving quickly, and so must we. NRO stays out front by developing advanced technologies, leveraging commercial solutions, strengthening government and international partnerships, adapting processes to innovate faster, and baking in resilience, from our assets on the ground to our systems on orbit.

Our work with IC, DOD, civil, industry, and academic partners enables the U.S. to maintain strategic advantage. NRO sensors give analysts and policymakers insights about activities in hard-to-reach and denied areas and enable indications and warnings. We have close relationships with the National Geospatial-Intelligence Agency and National Security Agency, who task our satellites to provide vital geospatial and signals intelligence that underpins the full spectrum of all-source analysis across the national and military intelligence communities.

Since the stand-up of the U.S. Space Force and U.S. Space Command, we have forged strong new relationships to mutually coordinate activities that assure that space-based systems that the Nation and our allies rely on can operate without disruption in an increasingly contested and congested space domain.

Our relationships are important to us. For example, NRO Deputy Director Major General Michael Guetlein and I have just returned from a 2-week visit to the U.S. Indo-Pacific Command in Hawaii and U.S. Forces Korea in South Korea. We met with our embedded NRO field representatives in INDOPACOM, U.S. Forces Korea, and component command senior leaders to listen to and understand their needs, priorities, and requirements of our customers.

During the trip, we gathered actionable feedback, watched how NRO data systems and tools are used in theater, and addressed future capabilities and collaborative opportunities. This engagement hit the mark, and we are already arranging follow-on directorate-level engagements.

By far, NRO's most important asset is its people. Our people make all the difference and will lead us to a future where we can, as we like to say with a nod to one of our founders, Edwin Land, see it all, see it well, see it now, and innovate faster.

Chairman Cooper, Ranking Member Turner, and members of the subcommittee, thank you for the opportunity to discuss NRO's unique value and capabilities. I look forward to your questions.

[The prepared statement of Dr. Scolese can be found in the Appendix on page 47.]

Mr. COOPER. Thank you very much, Doctor.

And we will hear from Major General Cleveland.

STATEMENT OF MG CHARLES H. CLEVELAND, USA, ASSOCIATE DIRECTOR OF OPERATIONS, NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY

General CLEVELAND. Good morning, Mr. Chairman, Ranking Member Turner, and distinguished members of the subcommittee. Thank you for the opportunity to appear before you today to share a little bit about NGA's [National Geospatial-Intelligence Agency's] mission in the space domain.

NGA and our predecessor organizations have a long history of supporting our Nation's space activities, and, as an organization reliant upon airborne and satellite imagery, we have always made a priority of being aware of activities in space and near-space.

At NGA, our efforts are spurred by the same sense of urgency that spurred the stand-up of U.S. Space Command. Namely, the Earth's orbit is no longer a benign environment, and the threat to U.S. national security interests from foreign space powers is real and growing.

Last year, we rolled out the moonshot initiative at NGA, a whole-of-agency effort to maintain and expand our GEOINT [geospatial intelligence] advantage in all realms, including space. We have developed a four-pillar strategy based on people, partnerships, and preparation for the missions of today and tomorrow.

The first pillar is people. NGA's workforce has been thriving in the space domain for decades. In fact, we helped map the Moon for the NASA [National Aeronautics and Space Administration] Moon landings in the 1960s and the 1970s. To maintain a competitive edge, we are increasing our investments in developing our tradecraft and training our workforce for the space domain. And to support our people, we are training our officers in big data management and analysis and growing our artificial intelligence expertise. Over time, this will provide a cadre of experts who can execute the warfighter and IC requirements and develop the next generation of space GEOINT professionals.

The second pillar is partnerships. NGA continues to strengthen our strategic partnerships while building new relationships with civilian components of government, with industry, and with our allied partners.

Within the space domain, NRO is our lead partner in advancing space GEOINT capabilities, including new commercial sources. And our partnership with the U.S. Space Force is deepening every day through information-sharing and collaboration. We are working with these partners to ensure no duplication of effort and to create efficiencies.

We also maintain embedded personnel through our NGA support teams, or NSTs, at DIA [Defense Intelligence Agency] headquarters, the National Air and Space Intelligence Center in Ohio, and the Missile and Space Intelligence Center in Alabama. And, in 2019, NGA established a SPACECOM [United States Space Command] NST, and we are continuing to grow the NST as SPACECOM becomes fully operational.

The third pillar is mission today. Space is vitally important to NGA's mission. It is the environment in which the sensors that provide most of our data operate. We recognize that our adversaries and near-peer competitors have the means to deny us that

resource, and so NGA extends the same level of commitment to our warfighters in space, and the recently established SPACECOM NST has embedded NGA's unique capabilities in the command.

The final pillar is mission tomorrow. Based on Earth and in space, one of the most critical missions NGA performs for the Nation is assured positioning, navigation, and timing, what we call Assured PNT. This is the foundation for our foundation. Everything that depends on knowing exactly where and when something is on or about the Earth uses this unique form of GEOINT.

NGA is the global leader in providing the geosciences that enable the accuracy and precision of DOD weapons systems, of safety and navigation efforts, and of economic and civil applications that use capabilities like GPS [Global Positioning System] and precision timing. Assured PNT is a mission imperative for us, and NGA plans to invest additional resources to ensure the integrity and resiliency of these capabilities.

Finally, I would like to say thanks to this committee for its support of NGA's safety of navigation mission. Your support helped modernize NGA's authorities and addressed our shift from paper to a digital and secure electronic delivery to support electronic-based navigation in all domains.

In conclusion, NGA has reacted aggressively to support space and is making progress in the domain. We are realigning to protect U.S. national security interests in the space domain to deter, protect, and defeat our adversaries in space.

Thank you, and I look forward to answering your questions.

[The prepared statement of General Cleveland can be found in the Appendix on page 53.]

Mr. COOPER. Thank you very much, General.

Now we will hear from Mr. Ludwigson.

STATEMENT OF JON LUDWIGSON, DIRECTOR, CONTRACTING AND NATIONAL SECURITY ACQUISITIONS, U.S. GOVERNMENT ACCOUNTABILITY OFFICE

Mr. LUDWIGSON. [Inaudible] I will summarize my written statement but submit it for the record.

DOD's space systems are important to our national security, facilitating communications, providing real-time global visibility, as well as serving other key roles. For decades, these systems provided the U.S. with unparalleled advantages.

Our past work has highlighted problems with DOD space acquisitions, including multibillion-dollar cost overruns, multiyear delays, and deferred capabilities. Fortunately, many of the programs that led us to these findings are now nearing completion. My written statement highlights the status of several programs. As you may have noted, many of the traditional programs are over budget and delayed, but some are not.

Our recent report also provides some insight. For example, our GPS report earlier this year highlighted that, despite having satellites capable of broadcasting a jam-resistant GPS signal for military users since 2005, DOD remains years away from widespread use of it. Similar disconnects between space and non-space elements have happened for other space systems.

I want to emphasize that, while DOD has already deployed numerous space-based systems, the space elements do not last forever, and systems require periodic updates to continue to meet mission needs.

In addition, some potential adversaries now have the means and intentions of holding our space-based capabilities at risk. As a result, we face important questions about how to mitigate the risks to current space systems, recapitalize our existing capabilities, and potentially add new ones.

Congress and DOD have taken steps aimed at improving acquisitions and oversight of space programs. In particular, there have been efforts to change acquisition authorities, including the creation of middle-tier acquisitions, which aim to produce a usable product within 5 years and provide administrative relief to do this.

My written statement highlights five of these programs, including two in the next-gen OPIR effort, which we issued a nonpublic report on earlier this year.

There are also efforts to provide acquisition authority specific to space programs. We shared our views on a draft Air Force proposal earlier this year and expect to do the same for a forthcoming DOD proposal.

In addition, DOD has undertaken a dramatic restructuring aimed at consolidating space oversight. The creation of the Space Force has captured headlines, but the reorganization moved multiple organizations into the Space Force and created new ones. Key among these are the new Space Development Agency and the Space Rapid Capabilities Office, both tasked with quickly developing new systems. Also, the stand-up of U.S. Space Command is designed to provide unified control over space operations.

Looking ahead, DOD faces several broad challenges.

First, the stand-up of the new Space Force and the related reorganization may streamline the DOD space enterprise and sharpen the focus on the development and operations of space systems but brings with it a variety of challenges. Only 2 years ago, we reported that DOD was unsure how many acquisition staff were working on DOD space programs. Moving people and organizations and establishing new lines of authority may bring growing pains that could distract from their mission if not managed well.

Second, paying for cost overruns for older systems while attempting to recapitalize and replace some or all of those systems could be challenging. Notably, DOD is developing or planning at least 10 space programs in nearly every mission area, including communications; missile warning; command and control; launch; and position, navigation, and timing.

Finally, balancing efforts to enhance acquisition authorities with ensuring opportunities for effective oversight will be important. The record on DOD space acquisitions is replete with examples of cost overruns and missed schedules. Oftentimes, people point to the ubiquitous paperwork as the cause of the slow process. However, I urge the subcommittee to consider what I call the first principles behind the paperwork. I would argue that we need agreement on a few things. These are the first principles to build strong programs and the ability to oversee them.

It is not a given that DOD will repeat its past mistakes. We have identified and shared leading practices to improve acquisition outcomes, including building strong oversights into programs, using data and demonstrable knowledge to anchor decisions, empowering program managers to make decisions but holding them accountable for their choices, and canceling unsuccessful programs. Adopting these leading practices could help DOD achieve faster delivery of new capabilities, especially if DOD balances new streamlined acquisition processes with sufficient oversight to help ensure program success.

Chairman Cooper, Ranking Member Turner, this concludes my statement. I would be happy to answer any questions the subcommittee members may have.

[The prepared statement of Mr. Ludwigson can be found in the Appendix on page 59.]

Mr. COOPER. Thank you very much. It is always good to hear from GAO.

We will now question the witnesses and try to limit every member to 5 minutes so that we can distribute the questions as much as possible.

Let me begin with Mr. Ludwigson. I think it was in 2016, there was a report from GAO that said there were some 60 people within DOD who had the power to say "no" over then-Air Force space programs, and most members of the Armed Services Committee thought that was way too many naysayers and could be one reason for the delay.

You mentioned that the new Space Force is somewhat streamlined. How many naysayers are there today? Are there still 60? Has the number gone up or down?

Mr. LUDWIGSON. We haven't updated that work at this point. But, as you know, the stand-up of Space Force is an ongoing process. Components have been moved around. I am not sure that the Space Force itself is in its final form.

As you may recall from that fragmentation report, there were a wide number of agencies who were involved in the decisionmaking process that went into space acquisitions, and not all of those have been moved into Space Force.

Even if the entities who are not going to move into Space Force remain independent, it is going to be important for the entities to coordinate their activities, because space is so connected, as a couple of the speakers mentioned. Especially in the context of multidomain operations, so much of it is connected to one another, both at the service level and—Space Force and NRO, for example, that is a relationship that is going to have to remain very strong.

Mr. COOPER. I think you and GAO have pointed out that there are some, what, 8,000 people involved, in 50 different organizations, and it has been kind of hard to even keep up with that part of things.

But I think the overall thrust here is, we need to be able to field systems that work and field them faster. I personally would love to see them under budget, but it is even more important that they be working systems, not like the 2005 disaster, where you have the capability we haven't been able to use, even though the satellite has been up there, ready to use it, all that time. Sometimes it is

satellite, sometimes it is ground stations, sometimes it is—people don't even know what it is.

But, in the effort to get things to move faster, I couldn't help but be impressed by the NRO's announcement, even during COVID, they were able to have 6 successful launches with 12 major payloads. That is pretty impressive.

And I know that is a mature organization, but that is the organization that I think most members of the Armed Services Committee had in mind when we were thinking about how the Space Force should be run—streamlined, flat, plenty of diversity, and gets the job done, oftentimes with little fanfare.

So I know that General Raymond is working hard on this, General Thompson, others, but—and I know there are going to be inevitable birthing pains, but—and aren't there something like 10 804 programs going on right now? And I hope they all yield great results, because I am certainly feeling the pressure from the foreign threats.

Mr. Hill, your excellent report mentioned that you have come up with two theories of deterrence: deterrence by denial and also deterrence by cost. Could you flesh those out a little bit more? To me, it sounds like one is absolute deterrence, and the other is more like situational deterrence. How would you describe those?

Mr. HILL. Chairman Cooper, yes, that was the report that we submitted last year to Congress.

So longstanding deterrence theory, you have always had deterrence by denying the benefits of attack, as well as deterrence by the potential imposition of unacceptable costs.

What we are describing in that report is, with respect to the space domain—and the focus of the report was supposed to be space deterrence—we said, in the space domain, the reliance of the United States on space means that adversaries see a potential benefit in attacking us in space. And so we have to very much focus on the mission assurance that will reduce the benefits of attack.

And what you are focused on is deterring military aggression overall. You don't want your adversary to see military aggression as an option, as a viable option, for pursuing their political objectives.

So we think that there may be cost imposition in other domains. There may certainly be reason to deny someone's use of a particularly threatening space capability. But, for the most part, the balance on deterrence with respect to space focuses on assuring our capabilities, which I think is exactly where you are going with your focus on getting our acquisition to move faster.

Mr. COOPER. Well, it sounds like, in plain English, our first choice is deterrence by denial, and then, if we can't get that, then we impose cost. So that is second-best or third-best deterrence, when we might not necessarily be able to eliminate any benefit they might get.

Mr. HILL. Yes. The point, though, I think, on imposing costs is, it is always there; it just might be in a different domain. This gets to the sense of the cross-domain and integrated deterrence.

Mr. COOPER. Well, certainly, modern warfare reaches many domains, and it will certainly always include space, I guess.

Let me turn now to the ranking member, see what questions he has.

Mr. TURNER. Thank you, Mr. Chairman.

I want to share your affinity for GAO. There has been a tremendous amount of important legislation and policy changes that have come out of GAO reports. I don't have a question for Mr. Ludwigson. I just want to comment that he had the best summation I have ever heard from GAO: They have some programs that are late and over budget; some are not. The good-news part of that was the "some are not" addition that I appreciated.

So I have two questions for General Thompson and General Cleveland.

I am going to start with you, General Thompson. General Cleveland states in his opening statement that Earth's orbit is no longer a benign environment. We have threats from foreign nations. It is basically an understanding that space is now becoming a warfighting domain.

Now, Mr. Hill talked about deterrence, which, of course, is a more difficult thing to accomplish because, you know, it is not just operational that is affecting the assessment by your adversary.

But will you talk about deterrence?

We talked about redundancy; we talked about resiliency. We now see threats to space from the ground, threats to space in space. We see in the future maybe threats from the ground from space. So, clearly, we must change. We are looking to, you know, ways in which we can also rely on commercial access.

What are the things that you think that we need to be doing immediately? And how fast, how quickly can we do them?

General Thompson.

General THOMPSON. So, Representative Turner, thanks so much for that. There are a whole host of answers to that question, but, certainly, in the interest of time, I will just limit myself to two.

The first is—and probably the most significant gaps and limitations we have had are specifically related to the fact that space has only recently become a warfighting domain.

The first is, we don't have a truly operational intelligence enterprise for space. We have, for years, done great work foundationally. The National Air and Space Intelligence Center is one of those centers that is set up foundationally, but extending that to our tactical units, our operational units, a deep understanding of the capabilities of our adversaries in the domain, what their tactics are.

Training intelligence professionals in that regard to be able to do that, that is one of the limitations we have. But we are moving out very rapidly.

I think as you are aware, here in January, we became the 18th member of the intelligence community. We have put together a plan to establish a national space intelligence center. We are rapidly building the capability to train our own space-focused intelligence professionals. And so we are moving out aggressively in that regard, but we have a lot of ground to cover.

The second area I will talk about is what I will call the test and evaluation enterprise. And that is, we know how to test our systems to operate effectively in space against natural hazards and for

a long period of time. We have never had to design and field and operate them in the face of threats.

And so building out a test and evaluation enterprise that allows us to, both in modeling and simulation and other means, understand that our systems will perform effectively and respond effectively in the face of attack and threat is another area that we have to move out and quickly. And I think we have work to do now and in the future.

Mr. TURNER. Well, General Thompson, I have had this conversation with General Raymond. As you indicated, intel being one of the most important aspects. One of the things that we don't want to do is cannibalize our existing systems. As we expand our operations, our capabilities and expertise, we certainly don't want to weaken those that we have.

So I am very concerned at the opportunity for stovepiping that might come as we expand those intel operations. So I will certainly be looking at that very closely and having that conversation with you.

General Thompson and General Cleveland, General Raymond has done a great job in making certain that the information that we do have about what our adversaries are doing is declassified. This is incredibly important for policymakers to be able to have open discussion but also so the general public and our allies can see what our adversaries are doing.

I always point out that our allies' legislative bodies do not have access to intelligence information or even a Congressional Research Service like we do. Getting information out in the public domain actually puts information in the hands of those parliaments and legislators.

I would like each of you to talk about the importance of making certain that we declassify this information. We are always so worried about means, methods, and techniques, but I think we also need to worry about ends, and that is, what are our adversaries attempting to do. And by identifying that, we can then empower you to fashion responses.

General Thompson, General Cleveland, if you could talk about the issue of declassification.

General THOMPSON. Representative Turner, just a few comments, and then I will pass it to General Cleveland.

You are absolutely right in that regard. I think our over-classification and tendency to over-classify is still a little bit of the vestige of the Cold War mindset and the fact that we had such incredible and exquisite capabilities that others didn't.

Because of the fact that we now need to operate more broadly in coalitions and we need to make sure that our leaders and the public are aware of our capabilities, our threats, and what we are doing about it, it really does drive the need to declassify.

I will also say that we have made some significant steps in that regard; more to go. But I would also say that both the National Air and Space Intelligence Center and DIA recently published some very, very good unclassified products on the threats we face. And they have been more forthcoming in those products than we have seen in many years. And I would start there as a great means to

[inaudible] our friends, our allies, the public, and others in terms of the threats that we face.

I will pass to General Cleveland.

General CLEVELAND. Sir, good morning again, and thank you for the question. I absolutely agree with the need to be publishing at an unclassified level or being prepared to declassify as needed.

I think, whether it is in space or whether it is in the broader efforts that we are doing as an agency, it is clear that we are, as a Nation, competing in the information environment on a daily basis. And we think that at NGA we have a huge role and quite a bit to contribute to that.

In some instances, I think it is an effort to declassify, but I think we also need to be focused on how can we publish at a level that can be released immediately and enable both policymakers and decisionmakers to share that information as needed.

In terms of our partners, of course, we maintain good, strong relationships with a number of allied partners. And the vast majority of the production that we provide is at a releasable level, at our Five Eyes level and at some of the other levels.

And so every step we take is a recognition that we are competing in the information environment, and we think that we do have a huge role in not only being prepared to declassify as needed but also to produce and to collect at an unclassified level to support our policymakers.

Mr. TURNER. Last question. Continuing resolutions have a tremendous effect on DOD and all of our operations across our agencies. Sadly, the fiscal year is statutorily set. Congress could move it to December 31, which I think every year would save DOD about 3 months of backlog. I have been an advocate for that.

I just wanted to take an opportunity—because I think that the area of space is probably even more particularly impacted by continuing resolutions—to give anyone who is on our panel an opportunity to chime in and to give us some additional thought around the evils and the effects to your operations and your area of continuing resolutions.

General THOMPSON. Representative Turner, General Thompson.

Just briefly, I would say, from the aspect of space and primarily speaking for the Space Force, there is an additional effect, for a couple of reasons.

One is, there has been mention of some of the programs we have ongoing, the authorities we are using, but, also, we are in the process of starting new programs. I will tell you that, while certainly we want folks to maintain their oversight of those programs, right now we are in pretty good stead in terms of the performance of the programs.

But because we are trying to start new programs with new capabilities specifically focused on defending and protecting and other things and because, in fact, some of the changes we need to make, some of the mission transfers and some of the establishment of new authorities, do require passage of law, we are probably more affected than others in a general sense, just because of the critical need to begin those programs focused on the shortfall of defending and protecting and because we need to continue to build out the

organizations and the capabilities required to act as a service focused on the warfighting domain of space.

Mr. TURNER. Anyone else?

Dr. SCOLESE. Yeah, I would add to what General Thompson said, in saying that it does delay the start of new programs, but it also has an impact on what we are doing with continuing programs that may delay, also, some of our ability to continue those programs on the pace that we had and may require some degree of reprogramming before we can go forward.

Mr. TURNER. Mr. Chairman, I saw Mr. Hill reach for the microphone. I don't know if we have any time remaining.

Mr. HILL. Just to underscore what General Thompson said and what, really, Ranking Member Turner, what you said as well about the problems of continuing resolutions.

Mr. TURNER. Thank you.

Mr. Chairman, I yield back.

Mr. COOPER. I thank the ranking member. Points well taken.

Before I yield to, first, Mr. Carbajal, then Mr. Wilson, Mr. Horsford, and Mr. Lamborn, let me point out the obvious, that all the growing pains of the Space Force, the various tasks that need to be done, were apparently things that the Air Force was not doing when they were in charge of this domain. So I am thankful that Space Force is doing it, but I am sorry that we are having to rebuild what probably should have been built before.

Mr. Carbajal.

Mr. CARBAJAL. Thank you, Mr. Chair.

And good morning to everyone. At least it is "good morning" in California; I know it is about to be lunch out there.

General Thompson, Vandenberg Air Force Base is located in my district. In the fiscal year 2021 National Defense Authorization Act, I requested a report outlining the requirements for sustaining and improving the physical infrastructure of space launch ranges.

The report noted that the diversity of launch providers, payload, customers, and weapons-systems testers are at an all-time high, which often requires infrastructure modifications, enhancements, and modernization to meet the mission needs of the customers.

My office has been trying to get additional information from the Space Force on a point in the report that states, "A challenge the ranges face is the limitation of commercial investment of mutually beneficial projects." The report says that the Space Force is seeking to address this challenge through changes to the commercial space launch cooperation statute.

Can you elaborate, what changes are you considering in this area?

General THOMPSON. Representative Carbajal, yes, I can. And, sir, if I may make a minor point of correction for you. As of May 14, Vandenberg Space Force Base is now a part of your district. We were able to rename that base on the 14th of May.

Yes, sir, as you stated—so we believe that launch and, absolutely, I think most believe that launch is a national security asset, but it is not just a matter of a national security asset for launching national security payloads; the economic and commercial aspects of launch also have important national security implications.

But the launch enterprise, as we understand it today, is in a period of growth and evolution, and we need to adapt some of our policies and procedures and processes to adjust.

Among them is what we call our Range of the Future initiative. And what we are doing in that regard is working hard to ensure that our Space Force processes for safety, for range operations, for support, to protect the public, are not inhibitors, first, in the way that launch providers need to provide their operations and, also, to reduce the costs that they incur when they come to our national launch ranges.

So the launch Range of the Future initiative seeks to do that. And, as you said, part of that effort is to find ways to be able to partner with those commercial activities to share the cost and, also, if they have specific desires and needs, to help upgrade the infrastructure to let them do that.

We will work with your office and with the OSD [Office of the Secretary of Defense] staff to provide you additional details in that regard. But it is a request to make some adjustments to the way costs are shared, costs are incurred, and investments are allowed with the commercial sector.

Mr. CARBAJAL. Great. I would appreciate it if your team can follow up with my staff.

General Thompson, just to continue, building off my previous question, I understand that ranges annually compete for facilities sustainment, restoration, and modernization funds to sustain, repair, and construct projects.

The focus on these efforts is to sustain existing infrastructure, rather than growing capability to meet the diverse user base of the launch ranges. To the extent the focus is to growing capabilities in addition to sustainment, does the Space Force require additional funds, or would it require a policy change?

General THOMPSON. Representative, I think I would refer back to the previous question.

Certainly, modernization and sustainment of our infrastructure is a challenge not just on the ranges but across the space enterprise. We have 134 locations worldwide, all with their own unique challenges. We seek to budget sustainment funds at the appropriate level to cover all and attack those challenges where the priorities lie.

As with all activities, more resources to help us work on those infrastructure challenges never hurt. I would say, adequate resourcing exists, but additional resourcing is never—there is always use for additional resources. But that, coupled with some of the potential policy changes we talked about in the last question, would definitely be helpful.

Mr. CARBAJAL. Great.

And, lastly, no response is needed, but I would be remiss if I didn't take this opportunity to urge you to consider Vandenberg Space Force Base to be the future home of STARCOM [Space Training and Readiness Command].

So, with that, Mr. Chair, I yield back.

Mr. COOPER. I thank the gentleman.

Now Mr. Wilson.

Mr. WILSON. Thank you, Chairman Jim Cooper and Ranking Member Mike Turner, for coordinating this very important hearing today.

And we are so grateful as to the dedicated personnel that we hear who are speaking, and thank you so much for your service to our country.

As a 31-year veteran of the Army National Guard myself and a grateful dad of three members of the National Guard, I strongly support a Space Force National Guard. And I am encouraged by reports that the force is working toward this creation. National Guard units have conducted space operations for the past 25 years and can provide the same sort of support to our space operations that it does to other domains.

With that, General Thompson, the fiscal year 2021 National Defense Authorization Act requires the Department to submit a draft plan to the House and Senate Armed Services Committees. What is the status of the plan? And what do you need from this committee?

General THOMPSON. Representative, thanks so much for that question.

I will tell you that, today, before we even talk about the future, in the past and today, both the Air National Guard and the Air Force Reserve have been critical members and a critical part of the space mission for decades, as you noted. Without them, we could not execute our full suite of missions today. They are an incredibly valuable partner.

We have taken this opportunity, however, to look at the Guard, Reserve, and regular construct and assess whether or not there is an approach that we could take that adjusts that for the future. We have been working closely with the Office of Secretary of Defense. I think we are close to approval of that report from the Secretary of Defense and submission to Congress.

I think it does two things. First of all, it relies on tried and true and proven capabilities that we have used in the past and structures that we have used in the past to great effect and we believe will be useful in the future. There is also an aspect of it, I think you will see, that increases our flexibility, increases our permeability, and allows us to both address force structure issues for the Space Force but the needs of our guardians over time as well.

That report is in final stage of coordination and, I believe, close to delivery, and we will look forward to working with Congress on the implementation of that report when it is delivered.

Mr. WILSON. Thank you very much, General. And, again, the capabilities of citizen soldiers can be so positive, as you know.

And then, General, you highlight the importance of multinational space war games in creating innovative deterrence and identifying how our capabilities complement those of our allies and vice versa. These exercises, common in other warfighting domains, require partners with developed operational concepts and commitment to force designs for their own space forces.

What is the current maturity of our allies' space capabilities? And are we doing everything we can to coordinate them in wargaming and experimentation?

General THOMPSON. Yes, sir. So, over the last—I am going to say over the last decade, our allies and partners have made tremendous gains, tremendous progress.

One of the things that we have done is, the Schriever Wargame that has been in place since around the turn of the century, around 2000, we have greatly expanded to include ally participation. We include participation at the policy level, at the ministerial level, and also in terms of operational capabilities, tactics, techniques, and procedures.

That has done a tremendous amount for them to open up their eyes in terms of the threats, in terms of the challenges, and specifically the capabilities that they need to provide and bring to the table to help us operate more effectively as a coalition and a set of nations.

We continue that activity today. And we are looking at increased investment from our Five Eyes partners—the U.K. [United Kingdom], Canada, Australia, New Zealand—but also the French, the Germans, the Japanese. All are looking to increase their investment and capability.

Mr. WILSON. And that is really encouraging. Also, Korea.

And, Secretary Hill, commercial satellite companies like SpaceX and Blue Origin are poised to introduce thousands of new satellites over the next decade. Ensuring appropriate oversight of the partnerships with our innovative private industry is a careful consideration of the committee.

What is the Department doing to reduce costs by embracing the military-commercial and public-private hybrid acquisition approaches to national space security challenges?

Mr. HILL. Thank you, Congressman.

Both in the Defense Department and, I think, our colleagues from the intelligence community would say is that we are focusing on using both the services, the new services that commercial space provides, launch area, space-based Earth imaging, satellite communications, and, of course, the broadband capabilities that you spoke about some of the people providing.

And we are also seeing so much innovation in the way they design their architectures. And that is being brought into the way we think about how to design our own architectures, giving a lot of new opportunities to diversify, add resilience, and reduce costs.

Mr. WILSON. Thank you very much.

I yield back.

Mr. COOPER. The gentleman's time has expired.

Mr. Horsford.

Mr. HORSFORD. Well, thank you, Chairman Cooper. It is great to be here. This is my first meeting for the Strategic Forces Subcommittee. And as one of the newest members on HASC [House Armed Services Committee], I am looking forward to working with all of my colleagues on these important issues.

Thank you also to our witnesses for testifying today.

As we know, the purpose of today's hearing is to explore national security space activities for the Department of Defense, including within the U.S. Space Force.

I actually had the honor of joining Acting Secretary of the Air Force John Roth 2 months ago when he visited Nellis Air Force

Base, located in my district. During Secretary Roth's visit, we were both briefed on our Nation's defense and training capabilities, including the Advanced Battle Management System [ABMS] and Red Flag exercises.

Warfighters at Nellis Air Force Base are helping the Air Force build a more integrated and lethal force through Advanced Battle Management System development, the Air Force's network solution to enable rapid decisionmaking that powers Joint All-Domain Command and Control.

So, as we modernize our Air Force, we must also find ways to process and share data faster than our adversaries. ABMS will allow the Air Force to transition its legacy command and control infrastructure into joint virtual systems that enable all equipment to communicate seamlessly, creating more agile and mobile warfighters.

So, General Thompson, you stated in your testimony that the Joint All-Domain Command and Control and ABMS are the most important efforts for the joint force to undertake to prepare for future conflicts. Can you elaborate on that for us just briefly for a moment?

General THOMPSON. Yes, sir. Absolutely.

And, as you described, the future of conflict, we believe, is the ability to sense rapidly, take the data that you need, formulate it, collate it, fuse it, put it in the proper place and format so that, either through machine learning and artificial intelligence or the decision of commanders and warfighters, that the appropriate action can be taken.

And we need to be able to do that rapidly, on the matter of seconds and minutes. And we need to be able to do it from sensors that are in space, in the air, at sea, and on the ground, and then apply the appropriate action, whether it includes weapons or other capabilities that the joint force brings to bear.

And, as you said, the foundational capability to do that is the connectivity between all of those sensors and shooters, the ability to share data, the ability to understand what the data is and understand who is using it. And, as you said, ABMS is a key part of that. A large part of that relay will need to occur through space.

And, in addition, as part of our contribution to both ABMS and Joint All-Domain Command and Control, the Space Force's primary contribution at this point is through our Unified Data Library. That is the data repository that will be the access point and the distribution point and the availability point of that sensor data, the ability connected to those shooters, and then apply machine learning, artificial intelligence, and human intervention to connect the information with the right decisionmaker, the right action arm, at the right time.

Mr. HORSFORD. Thank you very much.

Also, I just wanted to ask briefly about the DOD space acquisition workforce.

Mr. Ludwigson, you noted that the GAO, which issued a report in 2019, examined the acquisition workforce, focused on space programs, and there were some troubling findings. Can you elaborate on that?

And, Mr. Hill or General Thompson, what steps has the DOD taken to identify the number of acquisition personnel that are needed for Space Force?

Thank you.

Mr. LUDWIGSON. We did that work—we actually initiated that work before the stand-up of Space Force was formalized and planned. And we did it to understand whether the Department understood the range of locations and numbers of personnel working on space acquisitions.

As you noted, the findings were that there wasn't good understanding of all of the locations and all of the personnel. In fact, the Department wasn't able to provide that answer. We developed our own methodology and came up with the number of, I believe it was 8,100, a couple more. And that was probably a low estimate.

I think it was very helpful that we had done that work. With the stand-up of Space Force, it became important to—as they start to pull together the personnel, they need to make decisions. And so hopefully our work was helpful to the Department as they move down that path.

General THOMPSON. Yes, sir. It is General Thompson. I will add to that.

Absolutely, the work done by the GAO and Mr. Ludwigson regarding identifying some of those factors and concerns has helped, first of all, in our design of the acquisition organizations and the acquisition approach to Space Force; also, in ensuring that we have adequately captured our resource needs as we complete the build-out associated with that design.

The second thing I will add is, not just in terms of the acquisition workforce framework that the overall Department of Defense is using to increase the flexibility of managing its workforce today, we have already also applied some of the special authorities of Congress through the acquisition demonstration program that is long-standing to adjust the means by which we manage that workforce.

We have found, both in terms of our own analysis but others, that the members that are under this management program find that it is more rewarding. They feel like they are more appropriately recognized for their work and their attitudes toward the work they do in the organization area and are stronger than others across the force.

So all of those have combined, I think, to build us a good foundation for our acquisition organizations and our acquisition workforce going forward.

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

Mr. COOPER. We welcome the gentleman to the subcommittee and to the full committee. Appreciate your excellent questions. Thank you.

Mr. Lamborn. I think you are muted.

Mr. LAMBORN. There. Is that better? Okay. Thank you.

Thanks for having this hearing, Mr. Chairman. I want to say, if both of our hockey teams, the Colorado Avalanche and the Predators, continue to advance, we might have to place a bet on the outcome if they face each other.

And, Dr. Scolese, I want to congratulate NRO on its 60th birthday. NRO has come a long way in 60 years, from dropping film

from a satellite to be caught by a parachute by an airplane. You have come a long way since those days.

My first question, Dr. Scolese, is: We have heard concerns about the number of delivery-on-orbit and delivery-in-orbit launches that the NRO has purchased outside of the National Security Space Launch program. Can you walk us through why that is?

Dr. SCOLESE. Yes, sir.

We typically and principally use the national launch services as our principal means of going into space. And whenever we don't, we coordinate with the Air Force and now the Space Force to determine what the best means for delivery is.

Typically, when we have not used the national launch services, it is because it is typically a small research payload that we want to get up either in a unique orbit or on a short timeframe. But, as you will look and see, principally we use the national launch services for our missions.

Mr. LAMBORN. Okay. Thank you.

Changing gears, Dr. Scolese, there is a tremendous natural symmetry which exists in Colorado Springs between Space Command and our uniformed space warfighters on the one hand and the many intelligence and three-letter agencies on the other hand.

This is particularly true in the National Space Defense Center [NSDC] there in Colorado Springs, where the Joint Task Force-Space Defense conducts can't-fill missions 24 hours a day, 7 days a week. And NRO has an even greater presence on Buckley Air Force Base, which is an hour away by car.

So we know from the previous Missile Defense Agency's relocation from the capital region to Alabama that it suffered an 80 percent attrition from individuals who did not want to make that move.

Will NRO be requiring any of its employees to move if the Space Command relocation proceeds to Alabama? And, if so, what would an 80 percent attrition do to your workforce and your mission?

Dr. SCOLESE. Sir, we are located, as you said, on Buckley Air Force Base, which is an aero facility there that I wouldn't expect to be impacted. I would have to see what the changes would be. We do co-staff the NSDC, as you said. But I would have to see what that impact would be.

Mr. LAMBORN. Okay. Thank you. We will follow up on that.

General Thompson, we know that China is pursuing counterspace technologies such as satellite jammers, directed-energy and direct-ascent kinetic weapons. These developments will certainly further facilitate the militarization of space and could deny the U.S. and our allies access to space during a conflict or crisis.

So, from an organize, train, and equip perspective, General Thompson, where should investments be made to our space-based capabilities to ensure that we can prevail in a conflict against China?

General THOMPSON. Representative Lamborn, three quick answers to that question, first of all.

The first is, we have tremendous capabilities up there today. In many cases, they weren't designed to operate in a contested environment under threat like this. But we are in the process now, we have had a multiyear effort now, to build into them a limited set

of features that allow them to be defensible, to help in their own defense. But, also, we are in the process right now of developing capabilities to be able to defend them against these threats. And that is what I will call step number one.

Step number two is, as we move forward, both as part of our design activity, the force design activity we are establishing under our new Space Warfighting and Analysis Center, is, by the design of the architectures and the integration of those systems and capabilities, make them more resilient, make them more robust, make them less susceptible to attack and single-axis attack and make it less of an interesting target for the adversary in China to pursue.

And then the third piece of that and the foundational piece, really, in both cases is a much deeper understanding of the capabilities of those adversaries in the domain, where they are, what their capabilities are, what their tactics are, and, both in terms of active defensive capabilities and design, how do we best approach them to make sure they are ineffective in response.

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

Mr. COOPER. I thank the gentleman.

Mr. Garamendi.

Mr. GARAMENDI. Thank you, Mr. Chairman. I have a very bad connection here, so I am going to turn my video off, and hopefully it will be better. Okay?

Gentlemen, thank you very much. Appreciate your work and the complexity of the issues before us.

I want to go to an area which has been much talked about, and that is the utilization of commercial satellites of many different kinds, how those commercial operations might be integrated into the work that you do. In this discussion, please consider both the classified and the unclassified work.

So let's start with General Thompson, and we will go from there.

General THOMPSON. Representative Garamendi, two answers to that question, if I may.

The first is, we need to understand the services and capabilities that commercial providers can give to them, in and of themselves, whether it is communications, data relay, or remote sensing, and understand how we can most effectively use those services and the data they provide.

We have a commercial partnership office today at both Los Angeles Air Force Base as part of the Space and Missile Systems Center, soon to be Space Systems Command, as well as a commercial SATCOM [satellite communication] office at Fort Meade in Maryland. They are expanding their scope not just to look at satellite communications but all commercial services. And so using that and incorporating that into our force design activities is step one.

Step two is understanding the technologies of those commercial companies and how we might adapt them to the specific military needs and constellations of the future.

Now, one of the best approaches and techniques in using that is through the Space Development Agency, as they pursue their initial capabilities to provide a layer that does space data transport associated with the Advanced Battle Management System, as they do that for tracking, working with an integrated missile warning/missile tracking layer. They take military missions, look at these

new commercial capabilities, the technologies, and operating concepts, and see how we can adapt the technology and the approach to specific military purposes.

Mr. GARAMENDI. Thank you.

Mr. Scolese.

Dr. SCOLESE. Certainly. In addition to what General Thompson said, I would say that the NRO architecture already incorporates the commercial capabilities into it. It is either replace capabilities so that we can focus on those things that only the government can or should do, or it supplements those capabilities to provide additional resilience and coverage.

Further, as General Thompson said, we found great value in the commercial capabilities to speed the delivery of systems, as they have developed some very capable spacecraft that we can go off and use and perhaps adapt to the needs that we may have.

And then, finally, as was mentioned earlier, they have played an incredible role in communications and launch for us.

So commercial is baked into our current architecture, and it is a fundamental portion of our future architecture. And to assure that, we continue to work with the commercial providers across all domains to see how we can work together. We do that in cooperation with our partners, NGA, NSA [National Security Agency], the Space Force, to assure that we are working together.

Mr. GARAMENDI. Thank you very much.

General Cleveland.

General CLEVELAND. Sir, good morning.

We really do view commercial imagery, as well as services, as absolutely critical to the future of the agency as we move forward. We work that, of course, very closely with NRO and Director Scolese's team.

But we really believe right now that this explosion in commercial capability, first off, really provides us access that we may not otherwise have, so it allows us to look at more areas.

It also does provide, to some large degree, resiliency as well. In the event there are issues or challenges, oftentimes we can revert to a commercial capability.

We think it will provide us more persistence. Again, as we are able to work with the commercial industry to have more of these capabilities up, we think that we will be able to have persistence over a broader number of targets.

And then, finally, that drives for us speed and the ability to rapidly get that information into the hands of our decisionmakers as well as our warfighters.

And so, as we look at the broader fabric of sources of information and data really coming into our agency, we do think that commercial is going to play a significant role and it already does play a significant role for us today.

Mr. GARAMENDI. Very good.

My final comment would be for GAO to investigate this and make sure that we have all of the opportunities available to us.

Mr. Chairman, I yield back.

Mr. COOPER. I thank the gentleman.

And I thank all the members for participating. I know these Zoom conferences are not the easiest things to arrange.

But I most of all want to thank our distinguished witnesses and the important work you are doing for our national security. I know space isn't sometimes easy to understand or to explain, but it is absolutely vital to our national security. So I am grateful for your patriotism.

Thank you, Ranking Member. Appreciate the opportunity to work with you. Let's try to keep the committee focused on these important issues, and hopefully we can have improved space acquisition. That would be a great thing.

Unless there is another urgent question from members that they are unable to submit in writing for the record, then this hearing is about to be adjourned. But I don't want to cut anybody off who can't signal me any other way other than the video screen that they have an urgent question.

It looks like we are fine, so the hearing is adjourned. Thanks.

[Whereupon, at 12:15 p.m., the subcommittee was adjourned.]

A P P E N D I X

MAY 24, 2021

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MAY 24, 2021

Opening Statement of Hon. Jim Cooper
Chairman, Subcommittee on Strategic Forces
HEARING ON
Fiscal Year 2022 Priorities for National Security Space Programs
May 24, 2021

This hearing will come to order. First, I would like to take the opportunity to welcome our panel of esteemed witnesses; Acting Assistant Secretary of Defense for Space Policy, Mr. John Hill, Vice Chief of Space Operations, General David Thompson, Director of the National Reconnaissance Office, Dr. Christopher Scolese, Associate Director of Operations for the National Geospatial Intelligence Agency, Major General Charles Cleveland and GAO Director of Contracting and National Security Acquisitions, Mr. Jon Ludwigson. We are honored to have this level of expertise within the Department and Intelligence community testifying today on one of the most important topics we will cover this Congress.

It has been two years since this subcommittee has had a hearing on space acquisition. In that time, we have seen the overdue establishment of the Space Force, re-establishment of a Space Command, and a public acknowledgement that our space-based capabilities are actively being targeted by adversaries. With all of this focus on space, the Department has a unique opportunity to make real, impactful change in how they have done business in the past – which usually meant programs that came in well over budget, and years too late.

While I have optimism, I also am faced with the reality that some recent decisions look to be "more of the same", and across the space acquisition community there is reticence to any change. Whether it be the Next Generation OPIR program that will continue to put - as General Hyten would say - "big juicy targets" into orbit, the seeming reluctance to fully embrace commercial satellite imagery solutions, or modest org chart changes to the largest space acquisition organization within the Department of Defense that has overseen the failed programs of the past.

While we have come a long way since 2019, there is much work to do, and we have the opportunity now to make real change to an acquisition culture that has been mired in cost overruns, schedule delays, and delivery of systems that are not adequately protected to survive the environment they will have to operate.

Now I turn to my ranking member, Mr. Turner, for any opening remarks he may have.

Statement of Hon. Michael R. Turner
Ranking Member, Subcommittee on Strategic Forces
HEARING ON
Fiscal Year 2022 Priorities for National Security Space Programs
May 24, 2021

Thank you, Mr. Chairman. I would also like to extend a warm welcome to our panel of witnesses.

Thank you all for your service to our nation and for being here today.

As a nation, we have made some transformational changes in recent years when it comes to how we organize and operate in space. This subcommittee has been the driver of many of these changes and as we continue to work through them, its important that we remember our goal is not only secure our access to space but to outpace the ever-increasing threats posed by Russia and China.

General Raymond has previously said that Russia and China are continuing their provocative activities on orbit. I hope to hear an update on these activities today. They remind us that we must position our forces and give them the resources to not only deny and deter in space, but win should it come to that.

So, what does that mean for this committee? It means continuing to push the Department in a direction that gets the acquisition system right. To do so, we need to hear from you and we look forward to receiving your report on this very topic soon. It also means working with the Department to find ways to talk openly about both the threats we face and the capabilities we have, so that more of the American public, our allies, and frankly, some members of this body can best understand these issues and the threat picture we are up against.

We have heard constantly about the necessity to disaggregate our space systems, move away from large satellites, and vary the orbits we operate in. I am interested to hear how you are addressing these ideas, because from my perspective it does not seem like much has changed. Just this past May, the Space and Missile Systems Center awarded a $4.9B contract for 3 satellites to be placed into GEO for the Next Generation OPIR mission.

I have the same question for the witnesses from the NRO and NGA. Are you prepared to alter the contemporary thinking on this issue and move towards a more resilient and distributed architecture? Because right now, nearly every scenario we have seen involves our adversaries attacking us in space, first. The best way to deter the next conflict is to better prepare for it and convince our enemies that they cannot prevail.

Along these same lines, I am interested in how your organizations are thinking about rapid reconstitution of our space assets? I'm interested in both the launch portion and the payload side. How are you defining "tactical" when it comes to reconstitution and what are the timelines you are thinking about? I would expect these timetables to be measured in days and weeks, not months and years.

Finally, I have to say I am disappointed that we find ourselves here in late May and President Biden still has not submitted a full budget to the Congress—I

think my colleagues on both sides of the aisle would agree. This is not the way to give continuity of funding to our warfighters and only makes our jobs harder as we work together to write the NDAA. Given these delays, it is almost a certainty that we will begin the next fiscal year operating under a continuing resolution; yet, we regularly here from the Department how detrimental this is to our national security. I would like to hear from the witnesses today what the impact is of beginning the year under a CR and I look forward to getting the details of the President's Budget Request later this week.

Statement of Mr. John D. Hill
Performing the Duties of Assistant Secretary of Defense for Space Policy
Before the
House Armed Services Committee Strategic Forces Subcommittee (HASC-SF)
on National Security Space Programs
May 24, 2021

Introduction

Chairman Cooper, Ranking Member Turner, and distinguished Members of the Subcommittee, thank you for the opportunity to testify before you today on space security in an era of strategic competition. It is an honor to appear beside my distinguished colleagues on this panel.

When Congress passed the National Defense Authorization Act (NDAA) for Fiscal Year 2020, which established the U.S. Space Force (USSF) as a new branch of the Armed Forces, Congress also included Section 955, which required that one of the Assistant Secretaries of Defense would be the Assistant Secretary of Defense for Space Policy. As established by Section 955, the principal duty of the Assistant Secretary of Defense (ASD) for Space Policy "shall he the overall supervision of policy of the Department of Defense for space warfighting."

I am a 34-year career civil servant. For the past seven years, I have served as the Principal Director for Space Policy, and in that position, I am currently also performing the duties of the ASD for Space Policy. It is in that capacity that I appear before you today to address the space policy, space security, and related considerations of deterrence facing our nation in this era of destabilizing challenges from Russia and undeniable strategic competition with China.

Characteristics of Strategic Competition

As the Interim National Security Strategic Guidance states, the United States faces "a world of rising nationalism, receding democracy, growing rivalry with China, Russia, and other authoritarian states, and a technological revolution that is reshaping every aspect of our lives." The Interim Guidance describes China as "the only competitor potentially capable of combining its economic, diplomatic, military, and technological power to mount a sustained challenge to a stable and open international system."

More than just a competition between specific states, this is a competition between democratic systems of governance and authoritarian systems of governance. Authoritarian governments are working to reframe the current system in ways that reflect their authoritarian values, erode democratic norms and respect for human rights, and build relationships among states based on subservience rather than genuine partnerships or alliances among equals. We see their deliberate attempts to erode the rules-based international order, which has enabled all nations to develop and prosper for over 70 years, and has built the foundation for how countries interact at sea, in the air, and increasingly in space.

Competition between states promoting these different systems is playing out across the globe and in all domains. As noted however in the Interim Guidance, the fact of strategic competition between systems "does not, and should not, preclude working with China when it is in our

national interest to do so." At the same time, we must never lose sight of the fact that there is no moral equivalence between these two systems, and the competition between them is fundamental. We must continue to recognize that the open efforts by authoritarian states to undermine international laws, rules, and norms are antithetical to our security, our prosperity, and our continued advancement across all domains, including space.

Importance of Space Security

As we consider the growing challenges of space security, it is essential that we bear in mind the context of this strategic competition. Space security is not just about space itself. Instead, space security is about the benefits that space-based capabilities contribute to our modern economy, our democratic society, our military power, and our way of life – and space security is about the growing ability of others to deny those benefits, as well as to leverage the power of their own space-based capabilities to their own competitive advantage.

This subcommittee needs no reminder of how vital space is to the nation. On the other hand, most people have very little appreciation for how much of their daily life is intertwined with space, and how much of our national security power is based on an assumption of assured access to and use of space. Thus, it is worth considering the leading role of the United States, for more than 60 years, in exploring and using space to the benefit of humanity while simultaneously ensuring the safety, stability, sustainability, and security of space activities and the space environment.

DoD, together with our civil agency counterparts at the National Aeronautics and Space Administration and the National Oceanic and Atmospheric Administration, has been at the forefront of advancing the role of space in modern society. More recently, public-private partnerships and purely commercial ventures have taken ever-increasing and leading roles in expanding access to and use of space, and in transforming activities within and services delivered from space. According to research by Bryce Space Technologies, by 2019, the annual global space economy had grown to $366 billion. That figure includes the investments that governments and industries are making in new space capabilities, such as satellites, ground networks, and user equipment, and revenues they are generating through services they deliver from space, like broadband, television, radio, global navigation, and Earth imaging. It does not begin to capture the space-enabled activity rippling throughout other sectors of the economy – finance, transportation, agriculture, forestry, mining, manufacturing, health care, education, scientific research, and more. All these sectors use space-based capabilities to reduce costs, increase productivity, and improve the quality and delivery of their products and services to consumers.

Space-based capabilities are no less important to our national security, providing indications and warning of emerging threats and attacks; delivering the positioning, navigation, and timing signals that support rapid and precise global power projection; generating intelligence on operationally relevant timelines; and allowing national decision makers to anticipate risks, de-escalate crises, and simultaneously to command and control forces in multiple theaters around the globe, at both conventional and nuclear levels. These space-based capabilities underpin the

power of the Joint Force across all domains, they are integral to our deterrent capacity, and they have become a military center of gravity.

Threats to Space-based Capabilities

Of course, our strategic competitors also understand the importance of space-based capabilities. China and Russia each reorganized their militaries in 2015, emphasizing the importance of space and counterspace operations. Both have developed robust and capable space services, including satellite navigation, satellite communications, and space-based intelligence, surveillance, and reconnaissance. Each country has also made significant strides over the past two decades in developing counterspace capabilities.

As Secretary Austin has testified, "the growth of Chinese and Russian counterspace arsenals presents the most immediate and serious threats to U.S., allied, and partner space activities." Moreover, Secretary Austin further noted: "Chinese and Russian military doctrines also indicate that they view space as critical to modern warfare and consider the use of counterspace capabilities as both a means of reducing U.S. military effectiveness and for winning future wars."

Notable examples of Chinese and Russian counterspace developments include:

- China has deployed a satellite in geosynchronous orbit (GEO), the Shijian-17, which has a robotic arm that could be used for grappling other satellites in GEO.
- China and Russia have each developed multiple ground-based laser systems of varying power levels that could jam, blind, or damage satellite systems, and they continue to invest in new and improved systems.
- Russia has deployed multiple prototype antisatellite weapons in low Earth orbit (LEO) that could be used kinetically to destroy other satellites in LEO. These weapons include: COSMOS 2504 (SCC 40555), COSMOS 2536 (SCC 44424), and two sets of nested satellites, COSMOS 2519 (SCC 42798) (including COSMOS 2521 (SCC 42919), and COSMOS 2523 (SCC 42986)), and COSMOS 2542 (SCC 44797) (including COSMOS 2543 (SCC 44835)).
- Russia is developing the Nudol, a mobile ground-based missile designed to destroy satellites in low Earth orbit.
- China has operationally deployed the ground-based, kinetic-kill, anti-satellite missile that it used in 2007 in a destructive test that generated more than 3,000 trackable pieces of long-lived space debris and hundreds of thousands of smaller pieces of debris that are potentially lethal to other satellites.

Space and Integrated, Cross-Domain Deterrence

As these developments portend, the United States must now be prepared for conflict to extend to – or even to originate in or from – space. To be clear, such a conflict would not necessarily be a "space war" distinct from "terrestrial war," but would, instead, represent the extension of warfare

into the space domain of human endeavor. The motivations for an armed conflict that includes conflict in space likely would not be driven by competition or conflict over space-based interests, but would stem from the same types of political differences and power struggles among nations that have motivated human conflict in terrestrial domains throughout history. Such an extension of conflict to space would indicate one belligerent's calculation that it could gain military advantage by attacking its adversary's space center of gravity, but it likely would not be a distinct conflict from what might also be transpiring in air, maritime, land, and cyber domains.

Earlier this year, DoD submitted a report to Congress prepared by my office entitled, "Report on Deterrence in Space Pursuant to Section 1611 of the National Defense Authorization Act for Fiscal Year 2020, P.L 116-92." As the Department noted in that report, at its core, deterrence is about persuading an opponent not to take certain actions by altering the opponent's perception of the probability of success and the probability of significant negative consequences. Approaches to deterrence consist of two broad classes: (1) deterrence by denial; and (2) deterrence by cost imposition, including through both military and non-military means.

Within the framework of our national deterrence posture, effective space deterrence has two distinct dimensions. The first and narrower dimension is using the overall tools of U.S. national power to deter attacks against, and other forms of harmful interference with, U.S. space capabilities. The second and broader dimension is using U.S. space capabilities to contribute to deterrence of aggression in any domain.

At the Office of the ASD for Space Policy, we are focused on the integration of strategy, policy, plans, and appropriate means in order to develop a total space posture that conveys clearly to our competitors and any potential adversary the inadvisability of attacking U.S. space capabilities or those of our allies and partners. That is a posture which, first and foremost, demonstrates mission assurance of space capabilities commensurate with our reliance on those capabilities to meet strategic and operational objectives, including reliance on those capabilities to enable appropriate responses to any act of aggression against our national interests – or to the interests of our allies and partners – at a time, place, manner, and in a domain of our choosing. To the extent that a potential adversary sees degradation of U.S. space capability as a necessary task in a potential military campaign to achieve a geopolitical objective, a space posture of strong mission assurance can be an important contributor to deterring military aggression in any domain.

Space Strategy

As set forth in the June 2020 Defense Space Strategy – also prepared by my office – DoD is working along four lines of effort to develop the defense space posture we require in this era of strategic competition.

First, we are building a comprehensive military advantage in space. Notable here is the work of the USSF and the Space Development Agency to field assured space capabilities and capabilities that counter hostile use of space, as well as the USSF's efforts to develop the military doctrinal foundations of military spacepower and the associated space warfighting expertise and culture.

Our second line of effort focuses on integrating space into national, joint, and combined operations. Here, the establishment of U.S. Space Command (USSPACECOM) as a new Unified Combatant Command is particularly important to our ability to plan, exercise, and execute joint and combined space operations across the spectrum of conflict, in concert with operations across all domains and in coordination with the other combatant commanders.

Third, we must shape the strategic environment in ways that enhance domain stability and reduce the potential for miscalculations. There is much work to do here, including diplomatic work in partnership with the Department of State, as international views about space as a warfighting domain, and about what constitutes acceptable and unacceptable behavior in the space domain, are nascent or, in some cases, non-existent. We are also working in close partnership with the Department of Commerce and the Intelligence Community to strengthen space domain awareness and to improve our ability to identify and attribute threatening behavior.

Fourth, DoD must enhance space cooperation with commercial entities and with our allies and other international partners, many of whose space capabilities are already integral to collective security. In this regard, we already see important alignment regarding space security in the national space policies that several allies and partners have released. Likewise, through expanded information sharing, increased programmatic collaboration, and the development of combined operations, we are bringing to our activities in the space domain a culture of cooperation that will allow us to leverage the benefits of alliances and partnerships as we have traditionally done in the other domains.

Space Diplomacy

The Office of the ASD for Space Policy also leads DoD's participation in supporting the U.S. Government's space diplomatic initiatives. Here, we partner in advancing productive opportunities and in exposing disingenuous initiatives put forth by others. Notably, in the United Nations General Assembly, Russia and China regularly sponsor a resolution entitled, "No First Placement of Weapons in Outer Space," as part of their efforts, since 2008, to launch negotiations in the Conference on Disarmament on a "Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects." Russia and China depict these initiatives as good faith efforts to advance the objectives of a resolution regarding prevention of an arms race in outer space that was adopted at the United Nations General Assembly's 1978 Special Session on Disarmament. However, these initiatives, which, among other issues, lack the verifiability necessary to be either practicable or acceptable, serve mainly to distract attention from Russian and Chinese efforts, such as those noted previously, to develop and deploy weapons systems – both space-based and ground-based – capable of disrupting, disabling, and destroying systems in space.

In contrast, the United States has focused its multilateral space diplomacy on voluntary, non-binding measures such as transparency and confidence-building measures, best practices guidelines, and technical standards. By working with space operators from around the world, the United States has achieved considerable success in establishing multilateral guidelines regarding debris mitigation and the long-term sustainability of outer space activities. Through such

mechanisms, we have incrementally built common understandings among space operators about shared interests in space, and about what constitutes responsible behaviors in a shared domain. As human activity in space continues to flourish, further efforts in this regard that help us distinguish normal activities from those that might be suspect will be in the interests of DoD and of all space operators.

Conclusion

Mr. Chairman, let me conclude by underscoring that the attention and focus on the space components of our defense posture remains as intense today as it has been for several years. The changes in our nation's approach to space security over the past decade, including the landmark passage of legislation creating the U.S. Space Force, enabling the final structure of U.S. Space Command, and establishing the Assistant Secretary of Defense for Space Policy, all resulted from persistent bipartisan effort and good cooperation between the Executive and Legislative branches of our government.

I am honored to have played a part in those efforts, and I look forward to continuing to work with Congress, our interagency colleagues, U.S. industry, and our international allies and partners in a common cause to secure the advantages of space for our national interests.

John D. Hill
Performing the Duties of Assistant Secretary of Defense for Space Policy

Mr. John D. Hill is currently performing the duties of the Assistant Secretary of Defense for Space Policy with responsibilities for formulating and coordinating space-related national security and defense policies and strategies, including for the conduct of international space cooperation.

A Presidential Rank Award recipient and member of the career Senior Executive Service, Mr. Hill served as the Principal Director for Space Policy from 2013-2021 and has held a diverse variety of assignments in the Department of Defense (DoD) beyond the space portfolio. He was DoD's representative in negotiations with Afghanistan on the Security and Defense Cooperation Agreement that enabled a continuing presence of United States forces. Mr. Hill has held two prior Principal Director positions in DoD, overseeing defense policies and programs regarding Afghanistan, Pakistan, and Central Asia from 2010-2012, and holding similar responsibilities regarding the East Asia region from 2006-2010.

In previous assignments as the Director for Northeast Asia and as the Senior Country Director for Japan, Mr. Hill led DoD's management of U.S. alliance relationships with Japan and the Republic of Korea and oversaw security policies regarding the Korean Peninsula.

Mr. Hill's career includes extensive experienee across a wide range of international negotiations encompassing defense posture, status of forees, nuclear non-proliferation, defense industrial collaboration, international trade, and host nation support agreements. His early career highlights included roles in developing the longstanding U.S. policy on offsets in military exports and development and implementation of the Gulf War program under which coalition partners contributed $53 billion to defray U.S. costs.

As a member of the inaugural class of Mansfield Fellows, Mr. Hill served assignments on detail to the Japan Defense Agency, the Japan Federation of Economic Organizations (Keidanren), and Japan's Ministry of International Trade and Industry.

Mr. Hill joined DoD through selection to the Presidential Management Internship Program, serving assignments with the Army Security Assistance Command, the Office of Management and Budget, and the Office of the Secretary of Defense.

Mr. Hill received his Master of Arts in International Affairs from American University, and earned a Bachelor of Arts in Political Science at UCLA. He and his wife Lynn live in Fairfax, Virginia. They have three daughters who are embarked on their own professional careers.

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UNITED STATES HOUSE OF REPRESENTATIVES

DEPARTMENT OF THE AIR FORCE
UNITED STATES SPACE FORCE

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

SUBJECT: Fiscal Year 2022 Priorities and Posture of the U.S. Space Force

STATEMENT OF: General David D. Thompson, Vice Chief of Space Operations
U.S. Space Force

24 May 2021

NOT FOR PUBLICATION UNTIL RELEASED
BY THE SUBCOMMITTEE ON STRATEGIC FORCES
UNITED STATES HOUSE OF REPRESENTATIVES

INTRODUCTION

Chairman Cooper, Ranking Member Turner, and distinguished members of the Committee. Thank you for the opportunity to testify today in my capacity as Vice Chief of Space Operations, U.S. Space Force on Fiscal Year 2021 activities and plans for Fiscal Year 2022. On behalf of General John W. "Jay" Raymond, Chief of Space Operations, it is a pleasure to provide you details on the standup of the newest U.S. Armed Service and inform you of our plans for the future. Please note that my comments regarding Fiscal Year 2022 plans are circumspect due to the ongoing work with respect to the President's budget.

The United States is a space-faring nation. We have long understood that our nation is strongest economically, militarily, and diplomatically when we have access to, and freedom of action in space. Unfortunately, potential adversaries have taken note of the enormous civil, commercial, and national security benefits the United States and other nations are now deriving from the use of outer space, and they are developing capabilities aimed at denying that access and freedom of action in conflict. We have long since acknowledged we can no longer take this vital national interest for granted; **it must be secured.** The rapid advancements of potential adversaries' capabilities to threaten the use of space for the United States, as well as our allies and partners, must be countered with immediate improvements to our space systems, architectures, and defense capabilities.

The Space Force was established to organize, train, and equip space forces to preserve freedom of action, enable Joint lethality and effectiveness, and provide independent options to U.S. national leadership, allies, and the Joint Force capable of achieving national objectives. Our responsibilities include developing Guardians, acquiring military space systems, maturing the military doctrine for space power, and organizing space forces to present to our combatant commands (CCMDS) to ensure they can meet their objectives. U.S. space capabilities, coupled with international partnerships, have become a cornerstone of deterrence, not just in space, but in every domain. Without freedom to maneuver in space, our deployed forces, our homeland, and our allies across the globe are at greater risk. As Secretary of Defense Austin and Chief Raymond have stated:

> In space, for example, integrated deterrence would mean ensuring that capabilities such as our satellite-based Global Positioning System can continue even if adversaries attack it with missiles, cyber tools or space-based weapons.[1]

> Wargames have shown in any great power conflict, our alliances and partnerships are an essential factor to achieve success. **We will enable and defend our allies as they in turn provide capabilities that complement our own.**[2]

The Department of Defense (DoD) is currently undergoing the largest shift to its organization in generations with the standup of the Space Force and the ways we are accelerating and improving space acquisitions. Ensuring delivery of the space systems warfighters need at the speed of relevance is vital. To continue to outpace our adversaries, a new level of partnership between Congress, the Executive Branch, and the private sector is required to maintain the strategic advantages our space capabilities afford.

[1] Lloyd J. Austin III, (GEN, USA, Ret.), U.S. Secretary of Defense, "The Pentagon must prepare for a much bigger theater of war," Washington Post, 5 May 2021.
[2] John W. "Jay" Raymond, (Gen, USSF), Chief of Space Operations, "Chief of Space Operations Planning Guidance," November 2020.

SPACE THREAT ENVIRONMENT

The modern world is increasingly reliant on services provided by or through satellites, fueling a strategic competition for influence in the space domain that is only becoming fiercer. Both China and Russia are deeply engaged in this competition, aggressively and successfully pursuing newer, better, and more numerous space assets and counterspace weapons that demonstrate technological leadership, expand their share of the global space marketplace, and prepare them to negate U.S. space capabilities when called upon in war. China famously demonstrated the counterspace threat when it destroyed a weather satellite in 2007. Today China operates antisatellite missiles, lasers, and jammers, as well as a satellite in geostationary Earth orbit fitted with a grappling arm. Meanwhile, Russia has deployed lasers and jammers of its own, and beginning in 2019, has tested two antisatellite missiles, used a military "inspector" satellite to shadow U.S. platforms, and fired a projectile from the same "inspector" satellite, one of seven counterspace prototypes Russia has in low Earth orbit. Any one of these Chinese or Russian threats is potentially crippling if not accounted for, but the single greatest challenge lies in the need to counter all of them at once.

STATUS OF THE STANDUP OF THE U.S. SPACE FORCE

General Raymond's direction to build a lean, agile, and mission-focused force has been at the forefront of our planning. The design of our Space Force headquarters – the Space Staff – and Field Command structure aligns complementary functions and streamlines echelons of command in the deliberate pursuit of speed and agility. The **Space Staff** was rapidly established beginning with the establishment in law of the Space Force on 20 December 2019. Our smaller, more empowered force is reflected in a streamlined headquarters structure and has been designed to merge functions under four new offices (Chief Human Capital Office, Chief Operations Office, Chief Strategy and Resources Office, and Chief Technology and Innovation Office). The Space Staff will remain lean, agile, and mission-focused – planned to reach no greater than 600 billets, which is significantly smaller than the headquarters staffs of our Sister Services. We are able to stay lean by leveraging the support infrastructure and expertise of the Air Staff (e.g., Surgeon General, Judge Advocate, General Counsel, and Legislative Liaison), who remains a great partner in this endeavor.

Our first field command, **Space Operations Command**, stood up in October 2020 as the primary space force provider to CCMDS. We will establish the remaining two field commands before the end of 2021: **Space Systems Command (SSC)** will develop, acquire, and field operationally relevant space capabilities in resilient and defendable architectures, and **Space Training and Readiness Command (STARCOM)** will develop tactics, a testing enterprise, doctrine, and advanced operational training using a dedicated cadre of warfighting professionals. SSC and STARCOM will be established after nominated Space Force officers are appointed by the President and confirmed by the U.S. Senate to lead these two commands.

We have initiated planning for a **National Space Intelligence Center** to provide foundational scientific and technical intelligence, as well as operational space intelligence, to the Service, CCMDS, and the Intelligence Community (IC). The **Space Warfighting Analysis Center**, currently aligned under the Space Operations Command, is leading analysis, modeling, wargaming, and experimentation to generate new operational concepts and force design options for the Space Force, and has taken on the role of integrating these activities across the DoD and with the IC, as well.

SENSITIVE BUT UNCLASSIFIED

TOWARDS SPACE ACQUISITION OPERATING AT PACE

Approach

We face distinct challenges in the acquisition of our space systems due to technical complexity, low quantities purchased over long periods of time, and a unique operating environment. To build upon the successes and lessons learned from our current acquisition system, we need to streamline requirements validation; accelerate decision and contracting speed; maximize budget stability, flexibility, and efficiency; and increase program execution efficiency.

The DoD is taking a proactive approach to acquisition to reduce bureaucracy to more quickly deliver technologies and systems to the warfighter and has made many important changes to improve space acquisition, including fully embracing the authorities Congress has provided. The Department is working to implement these reforms and to measure their impacts. With the standup of the Space Systems Command and its close partnership with the Space Rapid Capability Office and National Reconnaissance Office, foundational elements are being laid for a flatter, more agile acquisition organization.

Following congressional direction in the Fiscal Year 2020 National Defense Authorization Act (NDAA), **the Space Force continues to work with Department of the Air Force (DAF) leadership on its relationship to the Assistant Secretary of the Air Force for Space Acquisition and Integration.** This includes the statutory responsibility of this position to assume Service Acquisition Executive responsibilities on 1 October 2022. Collaboration between the Department, the Space Force, and the Joint Requirements Oversight Council to utilize the flexibility of the Joint Capabilities Integration and Development System to focus on rapid validation for capabilities will continue to be an integral part of the acquisitions architecture. Furthermore, DAF will continue to leverage DoD's Adaptive Acquisition Framework.

One important area where we have seen tremendous progress in delivering swift and responsive capabilities to the warfighter is the use of Middle Tier of Acquisition (MTA) authorities to make targeted progress in a variety of key programs. MTA authorities allow us to rapidly identify, prototype, and field innovative materiel solutions for some of our most pressing operational challenges. Our approach to using these authorities is "speed with discipline." While **we are cutting bureaucracy**, there is deliberate effort to ensure **we build rigor into each program**.

Using MTA authorities, we are rapidly prototyping solutions to deliver the first resilient geosynchronous satellite for the Next-Generation Overhead Persistent Infrared satellite system to meet the warfighter's 2025 need date. Delivering this missile warning system is essential to the future force. These MTA authorities allowed the program to start quickly with a laser-focus on a set of well-understood requirements. These rapid prototyping authorities will potentially enable delivery of the satellite three and a half years faster than its predecessor.

There are many programs with innovative prototyping efforts across the National Security Space enterprise. The Electro-Optical/Infrared Weather System (EWS) prototype is one such example, and a model for future efforts. All three competing prototype vendors completed their Initial Design Reviews within ten months, and all three are scheduled to have their Final Design Reviews within eighteen months. EWS prototyping is a pathfinder for creating resiliency and savings for smaller sensors in proliferated low Earth orbit architectures, as the use of prototyping has opened up solutions that would have taken years longer to achieve, while maintaining transparency.

The Department is doing more than just harnessing prototyping to bring programs online more quickly and affordably. We are also increasing flexibility through non-traditional program approaches. DAF has a pathfinder program to pilot a revolutionary way of bringing budgetary flexibility to deliver software capabilities in an agile approach, which outpaces the adversary's delivery cycle. The Space Command and Control (Space C2) program utilizes this special authority, called Research, Development, Test, and Evaluation Budget Activity-08 to allow the program to develop, procure, operate, and sustain

software within a single budget line. This new acquisition approach flattens cumbersome budgetary processes unique to software-centric programs and is one of the many ways Space C2 is rapidly delivering capabilities based on prioritized warfighter needs.

In addition, wargaming and analytical studies show the most important effort the joint force can undertake to prepare for future conflicts is to ensure connectivity across all domains for all forces. DoD's effort in this areas is termed 'Joint All-Domain Command and Control (JADC2);' the Advanced Battle Management System (ABMS) initiative is a key Air Force and Space Force combined contribution to JADC2. JADC2 and ABMS seek a level of force integration and cross-domain C2 that our adversaries cannot match. When combined with the other Services' JADC2 initiatives, the resulting connection of the right data, right decision maker, and right shooter at speed and scale will provide decisive operational advantage. This is a prerequisite for winning future fights.

The Department has diligently worked to leverage non-traditional vendors, not only to expand the industrial base, but to find the most innovative and agile solutions. To improve upon the space enterprise and maintain our competitive advantage, we must accelerate innovation and procure next-generation technologies wherever we find them. The Space Force itself is a start-up, so it is a natural place for start-up businesses to contribute their ideas and technologies to national security. This includes the expansion of the Space Enterprise Consortium (SpEC), which provides an accessible, flexible avenue to increase non-traditional and small vendor participation in the National Security Space marketplace. Through this Consortium, we are minimizing the barriers small businesses face. It also allows for teaming arrangements between non-traditional and more traditional vendors. We are already using SpEC for some of our most critical capabilities, such as Space Domain Awareness; Position, Navigation, and Timing; satellite communications (SATCOM), and missile warning. For example, utilizing both MTA authorities and SpEC allowed the Department to bring protected tactical SATCOM operational capability three years sooner than the standard acquisition process.

The Department has also begun hosting Pitch Days, similar to commercial investment pitch competitions, to make it easier for start-ups and other non-traditional companies to work with the Department. These Pitch Days have included an initiative to bring in our **international partnerships**, with a highly successful International Space Pitch Day in 2020. Companies selected for awards came from **India, Australia, and the United Kingdom;** we look forward to sponsoring future events.

Ultimately, the Department is working through executing Congressional direction on how to accelerate space acquisitions, with many lines of effort being implemented to improve flexibility, speed, and efficiency. The Department is working through challenges while identifying which elements of these reforms are and are not working. We believe we are making huge strides in the delivery of systems across the space enterprise.

Space Systems Command

In the coming months, the Space Force will formally stand up the new SSC, one of three Field Commands of the Space Force. SSC was designed to achieve unity of effort in space acquisition by driving a holistic approach across development efforts while adopting enterprise-wide standards and solutions in launch, ground, and command and control. One of the Department's goals with the formation and standup of SSC continues to address many long-standing Government Accountability Office concerns of disparate space acquisition efforts and organizations across the DoD. SSC will interface and coordinate with the Space Acquisition Council, the Program Integration Council, and other space advocacy and oversight committees to ensure integration of space systems and programs across the National Security Space Enterprise. One example of SSC designing for unity of effort is the standup of the Assured Access to Space organization, which will bring together all launch and range-related activities, to include the current Launch Enterprise acquisition organization, Space Launch Deltas 30 and 45, and the Range of the Future capabilities, under the leadership of the SSC Deputy Commander.

SENSITIVE BUT UNCLASSIFIED

SSC's flat organizational structure will distribute staff responsibilities throughout the command in order to remain a lean organization, and provides an enduring, flexible framework to incorporate other Service organizations or programs into the Space Force in the future, such as the Mobile User Objective System, a current Navy narrowband satellite communications capability. SSC provides a foundational research lab arm that addresses unique space science and technology focused needs while leveraging the broader basic research investment across the DAF. SSC is custom-designed to meet the Chief of Space Operation's priorities and will deliver space capabilities at operationally relevant speeds.

Space Development Agency

Per the Fiscal Year 2020 NDAA, the Space Development Agency (SDA) will become an essential component of the Space Force in October 2022. SDA acts as a "constructive disruptor" for space acquisition. Its unique business model values speed and lowers unit costs by harnessing commercial development to achieve a proliferated architecture and enhance resilience.

When we talk about how to transform space acquisition, SDA's schedule-driven approach, combined with spiral development, serves as a model for how to do business differently in the future. The disruptive capabilities they demonstrate and deliver can help the broader space acquisition enterprise employ new and streamlined approaches, incorporate mature technologies on a rapid cycle, and build resilience into our space architecture.

THE WAY AHEAD

In conclusion, the U.S. Space Force will continue to promote and inform how we establish, partner, shape, and leverage responsible behavior in space. Our Service's inception brings the unprecedented opportunity to integrate organizational design, while creating new military options with the Joint Force, interagency, industry, and especially our allies and partners. As General Raymond has stated:

> We are forging a warfighting Service that is always above. Our purpose is to promote security, assure allies and partners, and deter aggressors by demonstrating the capability to deny their objectives and impose costs upon them. We will ensure American leadership in an ongoing revolution of operations in space, and we will be leaders within government to achieve greater speed in decision-making and action. We will partner with and lead others to further responsible actions in, and use of, space to promote security and enhance prosperity. Should an aggressor threaten our interests, America's space professionals stand ready to fight and win.[3]

I thank Congress for your leadership and support. We are eager to work with your committee to secure our Nation's vital interests.

[3] Ibid.

SENSITIVE BUT UNCLASSIFIED

General David D. Thompson

Gen. David D. Thompson is the Vice Chief of Space Operations, United States Space Force. As Vice Chief he is responsible for assisting the Chief of Space Operations in organizing, training and equipping space forces in the United States and overseas, integrating spaee policy and guidance, and coordinating space-related activities for the U.S. Space Force and Department of the Air Force.

The U.S. Space Force organizes, trains, equips and maintains mission-ready space forces that provide missile warning, space domain awareness, positioning, navigation and timing, communications and space electronic warfare for North American Aerospace Defense Command, U.S. Strategic Command, U.S. Space Command and other combatant commands.

Gen. Thompson was commissioned in 1985 as a graduate of the U.S. Air Force Academy. He is a career space officer with assignments in operations, acquisition, research and development and academia. Gen. Thompson has commanded operational space units at the squadron, group, and wing levels; he is also an Olmsted Scholar, graduate of the Senior Acquisition Course and Level III- Certified Program Manager. Prior to his assignment as Vice Chief of Space Operations, Gen. Thompson was the Vice Commander, U.S. Space Force.

EDUCATION

1985 Bachelor of Science, Astronautical Engineering, U.S. Air Force Academy, Colo.
1989 Master of Science, Aeronautics and Astronautics, Purdue University, West Lafayette, Ind.
1990 Squadron Officer School, Maxwell Air Force Base, Ala.
1993 Olmsted Scholar, Johannes Kepler University, Linz, Austria
1998 Air Command and Staff College, Maxwell AFB, Ala.
2000 Advanced Program Managers Course, Defense Systems Management College, Fort Belvoir, Va.
2001 Air War College, Maxwell AFB, Ala.
2005 Master of Science, National Security Industrial Policy, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.
2005 Senior Acquisition Course, National Defense University, Fort Lesley J. McNair, Washington, D.C.

ASSIGNMENTS

July 1985–May 1988, Experimental Rocket Propulsion Engineer and Chief, Motor/ Component Operations Section, Air Force Rocket Propulsion Laboratory, Edwards Air Force Base, Calif.
June 1988–July 1989, Graduate Student, Purdue University, West Lafayette, Ind.
August 1989-October 1992, Instructor of Astronautics, Assistant Professor and Executive Officer, Department of Astronautics, U.S. Air Force Academy, Colo.
October 1992–May 1993, Student, Defense Language Institute, Presidio of Monterey, Calif.
June 1993–July 1995, Olmsted Scholar, Johannes Kepler University, Linz, Austria
August 1995–July 1997, Program Manager, Advanced MILSATCOM Program, MILSATCOM Joint Program Office, Space and Missile Systems Center, Los Angeles AFB, Calif.
August 1997–June 1998, Student, Air Command and Staff College, Maxwell AFB, Ala.
July 1998–August 2000, Spaeelift Requirements Officer and Chief, Spacelift Vehicle Requirements Branch, Headquarters Air Force Space Command, Peterson AFB, Colorado Springs, Colo.
September 2000–April 2002, Deputy Director, Commander's Action Group, Headquarters Air Force Space Command, Peterson AFB, Colo.
June 2002–July 2004, Operations Officer and Commander, 2nd Space Launch Squadron, Vandenberg AFB, Calif.
August 2004–June 2005, Student, Industrial College of the Armed Forces, Fort Lesley J. McNair, Washington, D.C.
June 2005–July 2007, Commander, 45th Operations Group, Cape Canaveral Air Force Station, Fla.
July 2007–May 2009, Commander, Aerospace Data Facility - Colorado, Buckley AFB, Colo.
June 2009–June 2010, Director of Space Forces, U.S. Air Forces Central Command, Southwest Asia
July 2010–May 2011, Vice Commander, U.S. Air Force Warfare Center, Nellis AFB, Nev.
May 2011–March 2012, Director of Air, Space and Cyberspace Operations, Air Force Space Command,

Peterson AFB, Colo.
March 2012–January 2014, Deputy Director of Global Operations, U.S. Strategic Command, Offutt AFB, Neb.
January 2014–June 2015, Director of Plans and Policy, U.S. Strategic Command, Offutt AFB, Neb.
July 2015–July 2017, Vice Commander, Air Force Space Command, Peterson AFB, Colo.
July 2017–April 2018, Special Assistant to the Commander, Air Force Space Command, Peterson AFB, Colo.
April 2018–December 2019, Vice Commander, Air Force Space Command, Washington, D.C.
December 2019–September 2020, Vice Commander, U.S. Space Force, Washington, D.C.
October 2020–present, Vice Chief of Space Operations, U.S. Space Force, Washington, D.C.

SUMMARY OF JOINT ASSIGNMENTS
July 2007–May 2009, Commander, Aerospace Data Facility - Colorado, Buckley Air Force Base, Colo., as a colonel
March 2012–January 2014, Deputy Director of Global Operations (DJ3), U.S. Strategic Command, Offutt AFB, Neb., as a brigadier general and major general
January 2014–June 2015, Director of Plans and Policy (J5), U.S. Strategic Command, Offutt AFB, Neb., as a major general

BADGES
Command Space Operations Badge
Parachutist Badge
Master Acquisition Badge
Missile Maintenance Badge

MAJOR AWARDS AND DECORATIONS
Defense Superior Service Medal with oak leaf cluster
Legion of Merit
Bronze Star Medal
Defense Meritorious Service Medal
Meritorious Service Medal with two oak leaf clusters
Air Force Commendation Medal
Air Force Achievement Medal with two oak leaf clusters

OTHER ACHIEVEMENTS
2006 Outstanding Space Operations Crew, Air Force Association
2009 National Reconnaissance Office Gold Medal
2012 General Jerome F. O'Malley Distinguished Space Leadership Award, Air Force Association
2018 Peter B. Teets Government Award, National Defense Industrial Association
2019 Space Leadership Award, Federation of Galaxy Explorers
2019 Outstanding Aerospace Engineer, Purdue University

EFFECTIVE DATES OF PROMOTION
Second Lieutenant May 29, 1985
First Lieutenant May 29, 1987
Captain May 29, 1989
Major Aug. 1, 1996
Lieutenant Colonel May 1, 2000
Colonel Aug. 1, 2004
Brigadier General June 18, 2010
Major General Oct. 10, 2013
Lieutenant General April 4, 2018
General Oct. 1, 2020

(Current as of October 2020)

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Testimony of Dr. Christopher J. Scolese,
Director - National Reconnaissance Office

House Armed Services Committee, Subcommittee on Strategic Forces
Hearing on "Fiscal Year 2022 Space Priorities and Posture"

Monday May 24, 2021

EMBARGOED FOR PUBLIC RELEASE UNTIL HEARING DATE

60 YEARS | ABOVE AND BEYOND
1961-2021

Good afternoon Chairman Cooper, Ranking Member Turner, and members of the Subcommittee. It is a great honor to represent the people of the National Reconnaissance Office (NRO). Our mission is to develop, acquire, launch and operate the nation's reconnaissance satellites; we are a member of both the Intelligence Community (IC) and Department of Defense (DoD).

Mr. Chairman, before I address the NRO's capabilities and priorities, please allow me to briefly reflect on our past year. Like other agencies across the government, the COVID-19 pandemic presented challenges for us. Despite that, it was also a year of opportunity and achievement, and I would like to share just a few of these with members of the Subcommittee.

Meeting Mission, Overcoming Challenges

Due to the incredible efforts of our people and partners, I am pleased to report to the Committee that NRO's systems have maintained 100 percent of their capabilities throughout the COVID-19 pandemic. We ensured our customers received the intelligence they needed while protecting our workforce and their families by instituting health and safety protocols. During this period, the NRO experienced one of the most successful years in recent memory with six launches and twelve payloads delivered to orbit, many with first-ever capabilities. The launches included our first dedicated launch with Rocket Lab from New Zealand and our first dedicated launch from the NASA Wallops Flight Facility in Virginia. On the business side, our outstanding fiscal processes have earned us a reputation for financial management excellence. In 2020, the NRO achieved our 12th consecutive clean financial audit — a feat unrivaled in the IC. Also, last year, we inaugurated our NRO cadre internship program and continued our progress in the execution of our cadre workforce strategy to establish a reliable talent pipeline for the future. During these challenging times, the people of the NRO have been adaptable and have overcome numerous obstacles to meet commitments.

Sixty Years Above and Beyond

Turning to today, the NRO is bridging the innovative legacies of our past with a cutting-edge vision for our future during the NRO's 60th Anniversary celebration. Since 1961, the NRO has taken quantum leaps each decade in the evolution of our overhead reconnaissance space and ground systems to provide the timely, relevant, responsive global situational awareness that national security decision-makers and the military depend on for success in their missions.

The systems we build and operate collect geospatial intelligence (GEOINT) and signals intelligence (SIGINT) — enabling discovery, monitoring, and tracking of activities for a range of defense, intelligence, and civil applications, including:

- Maintaining global situational awareness
- Monitoring the proliferation of weapons of mass destruction

- Tracking international terrorists, drug traffickers, and other criminal organizations
- Developing highly accurate military targeting data and battle damage assessments
- Understanding the capabilities of competitors
- Supporting international peacekeeping, humanitarian relief operations, and natural disaster response and mitigation.

Our products and services are in high demand and support a wide range of national security requirements from the strategic to the tactical. The GEOINT and SIGINT information collected from our sensors deliver insights about activities in hard-to-reach areas, and our collaborative work with DoD and IC mission partners at NRO's ground stations are used for many purposes, including indications and warning.

NRO supports civilian agencies across the U.S. Government in support of their efforts to understand climate change, assess crop production, map endangered species habitats, study wetlands, and track damage from hurricanes, earthquakes, wildfires, floods, and other natural disasters.

Close relationships with the National Geospatial Intelligence Agency (NGA) and the National Security Agency (NSA), who task our satellites, provide the foundational pieces of the vital GEOINT and SIGINT that underpins the full-spectrum all-source analysis done at the Central Intelligence Agency, Defense Intelligence Agency, Department of State's Bureau of Intelligence and Research, and at the Combatant Commands. Since the stand-up of U.S. Space Force (USSF) and U.S. Space Command (USSPACECOM), we've forged strong relationships to mutually coordinate activities to assure that the space-based systems the U.S. and our allies rely on can operate without disruption in an increasingly contested and congested space domain.

The NRO is able to maintain U.S. space surveillance leadership because our organizational business model is flat, which encourages agility and innovation. The agency's end-to-end functional responsibilities allow us to develop what is needed from requirements through design and build to operations.

Focus on the Future

While the U.S. continues to lead the way in space-based surveillance, there has been growth in the number of competitors in the space domain. Adversaries are increasingly becoming aggressive and capable as they attempt to challenge the U.S. in space. Further, the COVID-19 pandemic has caused us to take a harder look at our supply chain to assess how global events, security vulnerabilities, and production limitations can impact the technologies and products we need for our systems. To meet the tough challenges of today and the future, we are expanding our commercial partnerships, strengthening our government and international partnerships, adapting processes to

innovate faster, baking in resilience from our assets on the ground to our systems on orbit, and recruiting and retaining a highly skilled, diverse workforce.

Leveraging the Commercial Marketplace

The NRO is taking a *whole of commercial approach* to address some of our mission areas and deliver additional capabilities for our customers. In areas such as commercial imagery, commercial launch services, and Cloud computing services, the growth and maturation of commercial space industry capabilities are allowing the NRO to securely and efficiently supplement or replace government systems. Commercial satellite capabilities are critical to future national security space architectures — and commercial constellations already provide actionable, timely, and shareable data to military units who were underserved in the past.

Leveraging the commercial marketplace allows the NRO to buy and adapt for our own purposes a new range of capabilities that expand our supplier base, lower costs, shorten timelines, and increase flexibility. In the not-too-distant future, the NRO envisions a proliferated and diversified overhead architecture comprised of national and commercial satellites, large and small constellations, electro optical and other phenomenologies. This hybrid model will provide greater capacity, capability and responsiveness.

Encouraging Faster Innovation

We continually create new capabilities by developing and employing new technologies, often with new partners. Through the Director's Innovation Initiative, our Directorate of Advanced Systems and Technology has created a risk-tolerant environment for non-traditional partners to bring forward proposals for disruptive and high-payoff concepts that could support NRO missions. We are expanding the number of academic institutions we work with to develop future capabilities and materials, and to create a pipeline of diverse, skilled, cleared talent for a sustainable future workforce.

Innovation on the ground includes unlocking the power of data-centric systems for faster, more efficient data access and curation. Additionally, the use of artificial intelligence and machine learning brings us real-time, shared overhead data awareness at faster speeds and provides automated tipping and queueing capabilities to support timely multi-INT anticipatory intelligence.

Building Resilience into Everything We Do

From our spacecraft design to our information technology infrastructure to our collection architecture, NRO teams take a cross-enterprise approach to ensuring mission resilience. We collaborated closely with industry, academic, and mission partners to design an overhead architecture that leverages small to large satellites and best-in-class government and commercial solutions to deliver a resilient, proliferated, and persistent constellation that can anticipate and adapt to current needs, emerging and future customer demands, and adversary threats.

The National Space Policy directed the Secretary of Defense and the Director of National Intelligence to protect and defend U.S. national security space assets through integration and synchronization of operational command and control capabilities and activities that foster seamless execution between the IC and DoD. Key relationships in this effort are among USSPACECOM, USSF and NRO. I am pleased to report that these ties continue to strengthen as we work together to protect and defend our assets. The NRO and the space community are coordinating and collaborating like never before.

Our People Make the Difference

I cannot mention enough the NRO's most important asset: Our people. The NRO is only successful because of the outstanding dedication of our workforce. Building and operating the NRO's advanced reconnaissance systems requires the talents of a team of engineers, scientists, financial managers, acquisitions professionals, space operators, and many other career fields. Making sure that we have the talent to compete and meet future mission demands is the driving force of the NRO's workforce strategy. As we mature the NRO cadre, which stood up just a few short years ago, we are invested in growing a highly skilled, diverse, and thriving workforce.

When the NRO was established in 1961, our challenge was best expressed by a Founder of the NRO, Edwin Land, who said our task is to: "*See it all, see it well, and see it now.*" Our people make all the difference and they are the reason we at the NRO can make the seemingly impossible — possible. It is the people of the NRO that will lead us to a future where we can, as we like to say with a nod to Edwin Land: "*Observe it all, observe it well, observe it now, and innovate faster.*"

Conclusion

Chairman Cooper, Ranking Member Turner, and members of the Subcommittee, thank you for the opportunity to share with you the unique value and capabilities the NRO brings to our military, intelligence analysts, and national decision-makers. I look forward to the Subcommittee's questions.

Dr. Christopher Scolese
Director, NRO

Dr. Christopher Scolese was appointed the 19th Director of the National Reconnaissance Office (DNRO) on August 1, 2019. The DNRO provides direction, guidance, and supervision over all matters pertaining to the NRO and executes other authorities specifically delegated by the Secretary of Defense and the Director of National Intelligence.

Dr. Scolese began his government career as a United States Naval Officer in 1978, supporting a variety of Naval Nuclear Propulsion Programs for the U.S. Navy and the Department of Energy.

In 1987, following a brief period of service working in government and industry, Dr. Scolese joined the National Aeronautics and Space Administration (NASA) where he was assigned to the Goddard Space Flight Center, located in Greenbelt, Maryland. During this period, he served in a variety of senior management positions including: Earth Observing System (EOS) Systems Manager, EOS Terra Project Manager, EOS Program Manager, and Deputy Director of Flight Programs and Projects for Earth Science.

In 2001, Dr. Scolese was assigned to NASA Headquarters in Washington, D.C. where he served as the Deputy Associate Administrator in the Office of Space Science. In this position, he was responsible for the management, direction and oversight of NASA's Space Science Flight Program, mission studies, technology development, and overall contract management of the Jet Propulsion Laboratory.

In 2004, Dr. Scolese went on to become the Deputy Director, Goddard Space Flight Center, where he assisted the Director in overseeing all activities, before returning to Washington, D.C. to become NASA's Chief Engineer in 2005. As Chief Engineer, he was responsible for ensuring all development and mission operations were planned and conducted on a sound engineering basis. In 2007, he was appointed the Associate Administrator, responsible for the oversight and integration of NASA's programmatic and technical efforts. From January - July 2009, Dr. Scolese served as NASA's Acting Administrator, responsible for leading the development, design and implementation of the nation's civil space program.

In 2012, Dr. Scolese went on to serve as the Director, Goddard Space Flight Center, where he led the nation's largest organization of scientists, engineers, and technologists responsible for building spacecraft, instruments, and new technology to study Earth, the sun, our solar system, and the universe. On July 31, 2019, he retired from NASA to become the DNRO.

Dr. Scolese holds a Bachelor of Sciences degree in Electrical and Computer Engineering from the State University of New York at Buffalo, Buffalo, New York; a Master's degree in Electrical and Computer Engineering from George Washington University, Washington, D.C.; and a Ph.D. in Systems Engineering from George Washington University, Washington, D.C. Originally from Buffalo, New York, Dr. Scolese and his wife, Dianne, currently reside in Springfield, Virginia.

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Testimony of

Major General Charles H. Cleveland, USA
Director of Operations
National Geospatial-Intelligence Agency

before the

House Armed Services Committee
Subcommittee on Strategic Forces

Hearing on

Fiscal Year 2022 Priorities for National Security Space Programs

Monday, May 24, 2021

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NATIONAL GEOSPATIAL-INTELLIGENCE AGENCY | NGA.mil

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Good morning Mr. Chairman, Ranking Member Turner, and distinguished members of the Subcommittee. Thank you for the opportunity to appear before you today to share a little about NGA's mission and priorities in the space domain.

NGA's Mission and Strategic Context

NGA, with our approximately 15,000 employees, is the nation's primary provider of geospatial-intelligence, or GEOINT, which is the use of imagery and geospatial information to describe and depict features, activities, and locations on and *about* the Earth. We help users visualize what is happening at a particular place, at a particular time.

NGA and our predecessor organizations have a long history of supporting our Nation's space activities. And, as an organization reliant upon airborne and satellite imagery, we have always made a priority of being aware of activities in space and near-space.

We've arrived at an historic inflection point for our agency, the GEOINT community, and our nation. A great power competition has reemerged as the central challenge to our shared prosperity and security, while at the same time technology and commercial changes are redefining GEOINT. Today, the barrier to entry into space is lower, and the price of admission is cheaper. The resultant proliferation demands a greater emphasis on space domain awareness.

Now, more than ever, that awareness—and how to respond to it—have been on the forefront of both the National Defense Strategy and NGA's own Strategy 2025. Last year, we rolled out the Moonshot Initiative at NGA, a whole-of-Agency effort to maintain and expand our GEOINT advantage, in all realms—including space.

At NGA, our efforts are spurred by the same sense of urgency that spurred the stand-up of U.S. Space Command. Namely, that Earth's orbit is no longer a benign environment, and the threat to U.S. national security interests from foreign space powers is real and growing. Our adversaries are not standing still, and neither is NGA.

The NGA Moonshot is intended to take all the capabilities that we know we need to develop in order to maintain GEOINT superiority—our mission imperatives—and shorten the timeline it takes to complete them. Our customers rely on us to "show the way"— literally, to get them from point A to point B, help illuminate options, inform decisions, and carry out actions with precision. To make decision advantage a reality, we've developed a four pillar strategy based on people, partnerships, and preparation for the missions of today and tomorrow.

People

NGA's workforce has been thriving in the space domain for decades. In fact, we helped map the moon for the NASA moon landings in the 1960s and '70s.

To maintain a competitive edge, we're increasing our investments in developing our tradecraft and preparing a purpose-built workforce for the space domain. And to fully support our people, it's necessary to train our officers to do many things that dovetail with NGA's modernization initiatives including big data management and analysis, and growing our artificial intelligence/machine learning expertise.

As a first step, we are looking at aligning training for space GEOINT professionals into a single curriculum for both NGA and military analysts. We have agreed informally with U.S. Space Force to co-develop curricula and cross-train our people. NGA is also creating GEOINT space domain-specific courses available through the NGA College. Starting this year, the first course will be available to GEOINT users both inside and outside of NGA.

Furthermore, we are discussing a military career path modeled on the SIGINT world, in which military analysts attend a series of schools and assignments in their service, USSPACECOM, and NGA to fully develop expertise. Over time, this will provide a cadre of experts who can execute the warfighter and IC requirements, and train and mentor the next generation of space GEOINT professionals.

Partnerships

NGA continues to strengthen our strategic partnerships, while building new relationships within the U.S. government, with industry, and with our Allied partners. As a combat support agency and an element of the Intelligence Community, NGA is diligently working to integrate GEOINT across DoD and the IC, so decision makers will have the best available information.

Within the space domain, NRO is our lead partner in advancing space GEOINT capabilities, including new commercial sources. Notably, our partnership with the U.S. Space Force is deepening every day through info sharing and collaboration. As space is a new warfighting domain, we are working with our partners to eliminate duplication of effort and create efficiencies.

We also maintain NGA embedded personnel through our NGA Support Teams, or NSTs, at DIA headquarters, the National Air and Space Intelligence Center in Ohio, and the Missile and Space Intelligence Center in Alabama. Similarly, in 2019, NGA established a USSPACECOM NST, as we have with each of the Combatant Commands and uniformed services. We are continuing to grow the NST as USSPACECOM becomes fully operationally capable.

Mission Today: Support to USSPACECOM

Space is vitally important to NGA's mission. It is the environment in which the sensors that provide most of our data operate. We recognize that our adversaries and peer competitors have the means to deny us that resource, which would be catastrophic to U.S. operations in all domains, from seabed to space.

NGA extends the same level of commitment to our warfighters in space. And, the recently established USSPACECOM NST has brought NGA's unique capabilities to the Command, and has a significant operational intelligence production capability—from unclassified to Compartmented Access Programs/Special Access Programs—directly embedded.

In fact, USSPACECOM does not maintain a separate GEOINT capability. Our NST's analysis division is dual-hatted as the Director of Geospatial Intelligence within the Command's organizational structure, and already accounts for half of all USSPACECOM's intelligence production. The NST also brings functional management authorities that the Command can leverage, as well as a reach-back capability into everything else NGA does.

In recent years, we've streamlined our analytic resources within NGA into a Space "Line of Business" and we've realigned agency resources to manage space collections within our Source directorate. We're also working with USSPACECOM to develop domain-specific collection orchestration and visualization tools.

Mission Tomorrow: Assured Positioning, Navigation, Timing and Targeting

Both terrestrially and in space, one of the most critical missions that NGA performs for the nation is assured positioning, navigation, timing and targeting, or what we call Assured PNT and Targeting. Assured PNT and Targeting and the geomatics that underpin it are the foundation for *our* foundation. Everything that depends on knowing exactly where and when something is on or around the Earth uses this unique form of GEOINT.

NGA is the global leader in providing the geo-sciences that enable the accuracy and precision of not only DoD weapons systems and Safety of Navigation efforts, but also economic and civil applications that use capabilities like GPS and precision timing. Assured PNT and Targeting is a mission imperative for us and as such, NGA plans to invest significant resources to ensure the integrity and resiliency of these capabilities.

In particular, NGA is modernizing our existing tools and systems, revitalizing our infrastructure, and recruiting and training the next generation of geomatics experts. We're also partnering with government, industry, and academia to better collect, transport, and process newly available large volumes of geodetic data, in areas such as Global Navigation Satellite Systems, elevation products, and more. Moreover—with the increased commercialization of space, and the recognition of space as a warfighting domain—NGA is postured to expand existing reference frames for Earth and the space around it.

Safety of Navigation

Finally, I would like to thank this committee for its support of NGA's Safety of Navigation mission—particularly its aeronautical and geomatics missions. The *Fiscal Year 2021 National Defense Authorization Act* included language to modernize NGA's authorities

and address the shift from paper to a digitally focused production and dissemination of legacy hardcopy products, and modern datasets, modeling and secure electronic delivery to support electronic-based navigation in the air, land, sea and space domains.

More importantly, the provision recognized a long-standing truth that GEOINT includes activities "on or about" the Earth vice "on" the Earth to better capture NGA's aeronautical and geomatics responsibilities supporting assured positioning, navigation and timing, and space activities.

Conclusion

NGA has reacted aggressively to support space and is making progress in the domain. We're "right sizing" for combat in, throughout, and from the Space Domain to deter, protect, and defeat our adversaries in space.

Thank you, and I look forward to answering your questions.

Major General Charles Cleveland
Associate Director of Operations
National Geospatial Intelligence Age

Major General Charles H. Cleveland, U.S. Army, assumed the duties as the National Geospatial-Intelligence Agency (NGA) Associate Director of Operations in January 2019. As the Director of Operations, he oversees the execution of NGA's mission across the Intelligence Community and the Department of Defense. He coordinates daily GEOINT operations within NGA, prioritizing assets to oversee crisis management, deployment of personnel, and capabilities.

MG Cleveland was commissioned in 1989 as a Military Intelligence Officer after graduating from Furman University. Since then, he has served in a variety of conventional and Special Operations organizations including the 82nd Airborne Division, the 75th Ranger Regiment, the U.S. Army Office of Military Support, and the Joint Special Operations Command. He commanded as a Captain, a Major, a Lieutenant Colonel, and a Colonel and held staff positions in both tactical and strategic assignments. Prior to assuming his current duties, MG Cleveland served as the Vice Director for Intelligence, Joint Chiefs of Staff.

MG Cleveland's awards and decorations include the Defense Superior Service Medal and the Ranger Tab. He is married and has two children.

United States Government Accountability Office

GAO

Testimony

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

For Release on Delivery
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SPACE ACQUISITIONS

DOD Faces Challenges and Opportunities with Acquiring Space Systems in a Changing Environment

Statement of Jon Ludwigson, Director,
Contracting and National Security Acquisitions

GAO@100

A Century of Non-Partisan Fact-Based Work

GAO-21-520T

GAO 100 Highlights

Highlights of GAO-21-520T, 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. Space systems can be expensive to acquire and field, costing billions of dollars each year. The U.S. Space Force was recently established as the sixth branch of the U.S. military. As planned, the Space Force will consolidate leadership, planning, and management for some DOD space programs, as appropriate and authorized.

This statement discusses the challenges and opportunities DOD faces as it acquires space systems amid changes to the acquisition environment. This statement is based on GAO reports issued over the past 10 years on DOD space programs. It also draws on recent work supporting GAO's 2021 annual report on the programs of major defense acquisition programs.

What GAO Recommends

GAO has made a number of recommendations in previous work to improve DOD's acquisition of space systems. DOD has agreed with and taken action on many of these recommendations. DOD should continue working to implement recent GAO recommendations related to leading practices for acquisitions, including that the Space Command and Control program develop a comprehensive acquisition strategy, and that DOD develop a plan to gain additional knowledge before starting a new wideband satellite communications program.

View GAO-21-520T. For more information, contact Joe Kasputys at (202) 512-4841 or kasputysj@gao.gov.

May 24, 2021

SPACE ACQUISITIONS

DOD Faces Challenges and Opportunities with Acquiring Space Systems in a Changing Environment

What GAO Found

The Department of Defense (DOD) is making changes to its space-related processes and organization that will present both opportunities and challenges to the way it acquires its space systems. GAO has reported over the past decades on challenges DOD faces in its space acquisitions—including schedule delays, multibillion-dollar cost increases, significant reductions in capabilities, and in some cases cancelation—and made recommendations that have improved program outcomes. For example, DOD took actions to implement a GAO recommendation to use an incremental approach to acquiring space launch services. DOD's modified approach reduced risk by allowing it to incorporate knowledge gained from early launch competitions to inform subsequent competitions.

Many of the most troubled programs are nearing completion, and DOD is starting new programs to develop the next generation of capabilities, some of which are being acquired under a streamlined acquisition process known as the middle-tier of acquisition pathway (see table below). Starting new programs is an opportunity to learn from past mistakes and take measures to put programs on successful paths. GAO's work has shown that in many cases, DOD is attempting to do so.

Selected New DOD Space Programs and Near-Term Estimated Costs

Dollars in billions

New program	Current estimated costs for 5-year middle-tier effort
Evolved Strategic SATCOM (ESS) Protected satellite communications	$1.4
Future Operationally Resilient Ground Evolution (FORGE) Ground control for Next Generation Overhead Persistent Infrared satellites	$3.0
Next Generation Overhead Persistent Infrared (OPIR) Block 0 Missile warning, infrared intelligence, surveillance, and reconnaissance	$8.4
Protected Tactical SATCOM (PTS) Protected satellite communications	$1.0

Source: Department of Defense (DOD) data. | GAO-21-520T

However, DOD faces challenges because it will be starting these new programs amid significant changes to the acquisition environment. Some of these changes are external to DOD, such as increased threats to on-orbit space systems. But over the past several years, DOD also initiated substantial organizational and acquisition process changes.

While the Space Force offers an important opportunity to streamline lines of authority, accountability, and decision-making and avoid duplication of effort, many details will require careful consideration. In addition, adopting leading practices for acquisition, as previously recommended, could help DOD achieve faster delivery of new capabilities, especially if DOD balances new, streamlined acquisition processes with sufficient oversight to help ensure program success.

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

Thank you for the opportunity to discuss the Department of Defense's (DOD) space system acquisitions. DOD's space systems provide extremely important capabilities that support U.S. military, civil, and commercial operations. These systems can cost billions of dollars and take many years to develop, produce, and launch. They can also involve associated ground control programs, and in some cases user terminals, which add significant development complexity and cost. For fiscal year 2021, DOD requested funding in the President's budget of $15.5 billion for space system development. Given the time and resource demands of DOD's space systems and the need to spend taxpayer dollars effectively, it is essential that DOD manage space system acquisitions carefully and avoid repeating past problems.

My statement will focus on (1) key changes facing DOD's space system acquisitions, (2) the current status and cost of major DOD space programs, and (3) broader challenges facing DOD in acquiring new space systems. This statement is based on our reports on space programs issued over the past 10 years and recent work performed in support of our annual weapon systems assessments. It is also based on our follow-up work monitoring the status and implementation of our past report recommendations and a number of recent developments. These developments include the December 2019 establishment of the U.S. Space Force and changes to the DOD acquisition system. More information on our objectives, scope, and methodology is available in each of the reports cited in this statement.

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.

DOD Is Acquiring Space Systems Amid Significant Changes

We have reported over the past 10 years on the longstanding challenges DOD faces in acquiring its space systems. These challenges include schedule delays of five or more years, cost increases of hundreds of millions or even billions of dollars, and program cancelations because of development problems. We have also reported that management and

oversight of DOD space organizations are fragmented.[1] This fragmentation has involved a lack of coordination that has contributed to acquisition problems and disconnects in fielding capabilities. We have made recommendations with the intent of improving DOD space program outcomes, and DOD has made changes based on some of these recommendations. For example, in 2018, DOD took actions to implement our recommendation to use an incremental approach to acquiring space launch services. DOD's modified approach reduced risk by allowing it to incorporate knowledge gained from early launch competitions to inform subsequent competitions.

Many of the most troubled programs currently underway are nearing completion, and DOD has begun new follow-on programs to develop the next generation of capabilities. Starting new programs is an opportunity to learn from past mistakes and take measures to put programs on successful paths. Our work has shown that in many cases, DOD is attempting to do this. However, these new programs are facing a number of changes that could affect their development processes, including increased threats to the space domain, changes in acquisition methods, and changes to governance over DOD's space enterprise.

One major change that DOD faced over the past few years is increasing threats to its on-orbit space systems. DOD and the Office of the Director of National Intelligence have highlighted that U.S. space systems are increasingly vulnerable to a variety of threats. Threats to orbiting space assets can be either intentional or unintentional—ranging from attacks and signal jamming by adversaries to electromagnetic radiation and collisions with space debris. Both types of threats have increased in recent years because foreign adversaries continue to pursue advanced capabilities and because the number of objects in space continues to grow. These increasing threats are adding pressure on DOD to not only deliver space systems more quickly, but also to increase the survivability and resilience of those systems. This situation is driving DOD to consider new ways of developing national security space assets and protecting the

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

capabilities they provide, including resilience measures and novel acquisition strategies.[2]

DOD has worked over the last several years to change how it acquires its space capabilities. These changes include:

- **New and realigned DOD space acquisition agencies.** In March 2019, DOD established the Space Development Agency (SDA) to unify and integrate efforts across DOD to define, develop, and field innovative satellite solutions. SDA is focusing on low-Earth-orbit constellations to provide satellite-based operational support for DOD. In addition, in 2018, Congress redesignated the Operationally Responsive Space Office as the Space Rapid Capabilities Office.[3] This office contributes to the development of low-cost, rapid reaction space systems to fulfill joint military operational requirements for space support, as well as to coordinate such efforts across DOD. Additionally, over the past several years, the Space and Missile Systems Center (SMC)—the acquisition center for Space Force space programs—underwent significant organizational changes to improve its ability to quickly develop new space systems. In April 2021, the Space Force announced that the Space Systems Command (SSC) is set to officially stand up in summer 2021 once required conditions are met to redesignate SMC at Los Angeles Air Force Base as the SSC headquarters, which according to the Air Force's announcement will elevate SMC's current responsibilities to that of a U.S. Space Force Field Command. The plan is for SDA and the Space Rapid Capabilities Office to be realigned under the Space Force.
- **Potential space-specific acquisition authorities.** Congress and DOD are exploring potential new acquisition authorities for space programs, with the goal of increasing the speed and efficiency with which these programs develop and field space capabilities. Space systems often do not fit into traditional acquisition processes for many reasons, including small quantities procured and unique operating

[2]In response to a provision in a report accompanying the John S. McCain National Defense Authorization Act for Fiscal Year 2019, we initiated a review of DOD's space protection acquisition efforts. H.R. Rep. No. 115-874 (2019) (Conf. Rep.). This work is temporarily on hold due to Coronavirus Disease 2019 (COVID-19) impacts, but we expect to restart this review in the fall of 2021. GAO is also reviewing DOD's space control readiness and force structure and expects to issue a classified report in the summer of 2021.

[3]See National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, § 1601(b) (2017).

environments, and space programs have frequently taken advantage of available opportunities to modify the acquisition processes. For example, the Secretary of the Air Force was to submit to the congressional defense committees a report on whether, and if so, how to implement an alternative acquisition system for space programs.[4] In its draft report, the Air Force proposed a number of changes to streamline and accelerate space system acquisitions, including legislative and DOD policy changes.[5] Additionally, the National Defense Authorization Act (NDAA) for Fiscal Year 2021 directed the Secretary of Defense to submit to the congressional defense committees by May 15, 2021 a report on the application of the adaptive acquisition framework to space programs, which may include additional information on how the DOD proposes implementing its changes.[6]

- **Streamlined and changing acquisition processes.** The overarching management principles that govern the defense acquisition system are described in DOD Directive 5000.01 and DOD Instruction 5000.02.[7] DOD Directive 5000.01 provides management principles and mandatory policies and procedures for managing all acquisition programs. DOD Instruction 5000.02 establishes the groundwork for the operation of the adaptive acquisition framework (AAF). Established in 2020, the AAF is comprised of six acquisition

[4]H.R. Rep. No. 116-333, at 1337 (2019) (Conf. Rep.). The Air Force briefed members of the House Armed Services Committee on recommendations in the Air Force's draft report in May 2020, as indicated in H.R. Rep. No. 116-442, at 238 (2020). Prior to the direction for that report, Congress directed the Deputy Secretary of Defense to develop a plan to establish a separate, alternative acquisition system for defense space acquisitions. National Defense Authorization Act for Fiscal Year 2019, Pub. L. No. 115-232, § 1601(b).

[5]While the draft report was shared with Congress, DOD officials noted that it remained in draft form, and additional work was planned through additional DOD internal coordination and reviews.

[6]William M. (Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Pub. L. No. 116-283, § 807. Additionally, under the same provision, we are to review this report and submit to the congressional defense committees an analysis and recommendations.

[7]Department of Defense Directive 5000.01, *The Defense Acquisition System* (May 12, 2003) (incorporating change 2, Aug. 31, 2018). DOD reissued and updated DODI 5000.02, *Operation of the Defense Acquisition System* (Jan. 7, 2015) (incorporating change 4, Aug. 31, 2018) on January 23, 2020, and it is now titled *Operation of the Adaptive Acquisition Framework*. See DODI 5000.02, *Operation of the Adaptive Acquisition Framework* (Jan. 23, 2020). DOD renumbered the 2015 DODI 5000.02 to DODI 5000.02T, and DODI 5000.02T will remain in effect with content removed as it is canceled or transitions to a new issuance.

pathways, each tailored for the characteristics and risk profile of the capability being acquired. Many of the older space programs that DOD has underway were developed following processes and procedures described in previous iterations of DODI 5000.02. However, in the NDAAs for Fiscal Years 2016 and 2017, Congress included numerous reforms that could help to streamline acquisition oversight and field capabilities faster.[8] One of these reforms altered roles and responsibilities for acquisition program oversight to give more authority for acquisition management to the military departments. Another set of reforms required the issuance of guidelines for middle-tier of acquisition (MTA) programs that were intended to be completed within 2 to 5 years. Programs following the middle-tier of acquisition pathway are generally exempt from many of DOD's traditional policies governing acquisition and requirements development.[9]

- **Modernizing the way DOD develops software-intensive systems.** DOD is also working to modernize and improve the way it develops software-intensive systems, and is beginning to integrate an iterative software development approach called Agile into its programs.[10]

In addition, governance over DOD's space enterprise is undergoing substantial organizational changes, including:

- **Establishment of the Space Force.** Enacted in December 2019, the NDAA for Fiscal Year 2020 established the Space Force as the sixth branch of the U.S. military, within the Department of the Air Force.[11] The Space Force as planned will consolidate leadership, planning,

[8]Pub. L. No. 114-92 (2015) and Pub. L. No. 114-328 (2016).

[9]The Middle Tier of Acquisition guidelines are outlined in DOD Instruction 5000.80, *Operation of the Middle Tier of Acquisition* (Dec. 30, 2019). Middle Tier of Acquisition (MTA) includes both rapid prototyping and rapid fielding. In this testimony, we refer to programs currently using the MTA pathway as "MTA programs," although some of these programs may also plan to subsequently use one or more other pathways before fielding an eventual capability.

[10]Agile development is a flexible, iterative way of developing software that delivers working capabilities to users earlier than the traditional, incremental approach DOD has used in the past. DOD established a software-specific acquisition pathway under its Adaptive Acquisition Framework to deliver rapid and iterative delivery of software capabilities. See GAO, *Agile Assessment Guide: Best Practices for Agile Adoption and Implementation*, GAO-20-590G (Washington, D.C.: September 2020).

[11]See National Defense Authorization Act for Fiscal Year 2020, Pub. L. No. 116-92, §§ 951-961, (2019) (codified at 10 U.S.C. § 9081).

and management for some DOD space programs, as appropriate and authorized. We and others have long highlighted the fragmented nature of the organization of space leadership groups and have noted that this is an area in need of improvement. At this point, the ultimate makeup and organization of the Space Force is still to be determined, though in its initial form it consists predominantly of former Air Force personnel, both military and civilian. The Space Force is setting up a process to enable personnel transfers from the other services, and the Space Force has commissioned its first academy graduates as well as enlisted new recruits to the service.

- **Establishment of United States Space Command and potential change of location.** In August 2019, the Secretary of Defense, at the direction of the President, announced establishment of the United States Space Command (USSPACECOM) as a unified combatant command. USSPACECOM conducts operations in space and plays a key role in defending U.S. national interests, including meeting the threats described above. In January 2021, the Air Force announced that after a period of study, it had decided to move USSPACECOM from Peterson Air Force Base in Colorado Springs, Colorado to Redstone Arsenal in Huntsville, Alabama. According to the Air Force, this decision is preliminary pending results from the required environmental impact analysis, with a final decision expected in spring 2023.[12]
- **Establishment of the National Space Council.** In 2017, the President revived the National Space Council to provide a coordinated process for developing and monitoring the implementation of national space policy and strategy. The Council—comprised of the heads of federal agencies, including the Secretaries of State, Defense, Commerce, and Transportation—advised and assisted the President on national space policy and strategy. The Council recommended the establishment of the Space Force. In March of this year, it was reported that a National Security Council spokesperson stated that the administration would continue the Council, providing important continuity for coordinated space leadership.

The organizational and acquisition process changes described above are not insignificant. Indeed, any single one of them represents an impactful change for the national security space community. Working in an environment where so many large changes are happening within a short

[12]In response to a March 2021 request from a member of Congress, we initiated a review of the Air Force's decision-making process for this move. We expect to issue a report in early 2022.

amount of time is both a management challenge and a considerable opportunity to make lasting improvements to some of the areas we and others have been reporting on for decades. As with all large scale changes, however, effective and comprehensive planning will be key to making them as successful as they can be, and implementation of the plans will have to be closely monitored and adjusted as necessary to achieve improvements to the status quo.

Current Status of Space Acquisition Programs

Many of DOD's space acquisition programs are major defense acquisition programs (MDAP) acquired following the procedures and practices described in previous iterations of DODI 5000.02, and began development a decade or more ago.[13] Our prior work has shown that many of these programs experienced significant cost increases and schedule delays resulting from development challenges, such as using immature technologies and underestimating risks. For instance, the total program cost for the Space Based Infrared System (SBIRS)—a missile warning satellite program—grew 260 percent from its original estimate and the launch of the first satellite was delayed roughly 9 years. Further, costs for the Global Positioning System (GPS) Next Generation Operational Control System—a command and control system for the modernized GPS satellites—have increased by 73 percent, and its schedule is delayed by almost 5 years.

Not all programs are overrunning their costs, however. Space Fence Increment 1, a ground-based radar program for detecting objects in space, was operationally accepted last year and cost less to acquire than its original estimate. In addition, cost growth for programs was not always attributed to management problems or program delays. For example, the National Security Space Launch program shows over 200 percent cost growth, but some of this is due to factors outside of the program's control. These factors include decreases in the demand for commercial launches that caused an increase in estimated government launch prices for future contracts, along with the total cost of the program, and an increase in quantities of launch services required by the program. Table 1 provides highlights of the current status of the space acquisition programs that are

[13]MDAPs are generally programs designated by the Secretary of Defense as such or that are currently estimated to require eventual total expenditure for research, development, test, and evaluation of more than $525 million, or for procurement of more than $3.065 billion, in fiscal year 2020 constant dollars. These programs currently follow the major capability acquisition pathway of the AAF. DODI 5000.85 *Major Capability Acquisition* (Aug. 6, 2020)

MDAPs being acquired under DOD's major capability acquisition pathway.

Table 1: Status of DOD Space Programs That Are Categorized As Major Defense Acquisition Programs

Program	Total program cost and percentage change from first full estimate to current estimate (in fiscal year 2021 billions of dollars)	Quantity	Schedule change (in months)
Advanced Extremely High Frequency (AEHF) Protected satellite communications	**$16.1** **116%**	original: 5 current: 6	44
Enhanced Polar System-Recapitalization (EPS-R) Protected satellite communications	**$1.2** **0%**	original: 2 current: 2	0
Global Positioning System (GPS) III Positioning, navigation and timing	**$6.0** **29%**	original: 8 current: 10	41
Global Positioning System (GPS) IIIF Positioning, navigation and timing	**$9.7** **-1.0%**	original: 22 current: 22	-23
Global Positioning System Next Generation Operational Control System (GPS OCX) Command and control system for GPS III satellites	**$6.7** **73%**	original: 1 current: 1	58
Military GPS User Equipment (MGUE), Increment 1 GPS receiver	**$1.5** **-8.0%**	original: N/A current: N/A	N/A
National Security Space Launch (NSSL) Launch	**$65** **217%**	original: 181 current: 192	8
Space Based Infrared System (SBIRS) Missile warning, infrared intelligence, surveillance, and reconnaissance	**$20.7** **261%**	original: 5 current: 6	107
Space Fence Ground-Based Radar System Increment 1 Space object detection	**$1.6** **-8.3%**	original: 1 current: 1	8
Wideband Global SATCOM (WGS) Wideband satellite communications	**$5.0** **260%**	original: 3 current: 11	49
Weather System Follow-on (WSF) Weather	**$1.0** **0.0%**	original: 2 current: 2	0

Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-520T

Cost and schedule growth in DOD's space programs is sometimes driven by the inherent risks associated with developing complex space technologies. However, for many DOD space programs, we identified a number of other management and oversight problems that worsened the situation. These include making overly optimistic cost and schedule estimates, pushing programs forward without sufficient knowledge about technology and design, and 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 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 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.

Cost and schedule growth have 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 ground control system for SBIRS satellites was not deemed fully capable for operations until 2019, about 8 years after the launch of the first satellite.
- Over 90 percent of the capabilities provided by the five Mobile User Objective System satellites, the first of which was launched 9 years ago, are not effectively utilized, largely because of development challenges with the ground system and user terminals.
- Delays in the delivery of the GPS Next Generation Operational Control System and GPS user terminals means that jam-resistant signal capabilities of GPS satellites launched over 15 years ago still cannot be fully used for military operations.

When space capabilities are not delivered in a coordinated manner or are delivered partially, the warfighter may not have certain capabilities available when expected or may have to develop short-term solutions while waiting for the expected capability. Additionally, such disconnects result in the government getting less operational life out of a satellite, and wasting valuable public resources.

As noted earlier, some of DOD's newer space programs are following a more streamlined acquisition pathway known as the middle-tier of

acquisition (MTA). In addition, some software programs are incorporating new methods of software development that differ from what was used in previous software acquisition programs. Because middle-tier acquisitions are subject to different reporting requirements than major defense acquisition programs, we included them in a separate table. Table 2 shows current cost and schedule estimates for the space programs operating under the MTA pathway. These acquisitions generally may not exceed 5 years after program start. Additional funding and time may be planned through another acquisition pathway to complete the system. Many of these MTA programs are follow-on programs to systems listed in table 1. For example, Evolved Strategic SATCOM is a protected satellite communications program that is a follow-on to the Advanced Extremely High Frequency satellite program, and the Next Generation Overhead Persistent Infrared program is a missile warning system that is a follow-on to the SBIRS program.

Table 2: Status of DOD Space Programs—Middle-tier Programs

Program	Total cost estimate for current 5-year middle-tier effort (in fiscal year 2021 billions of dollars)	Planned initial delivery of operational capability
Evolved Strategic SATCOM (ESS) Protected satellite communications	$1.4	Fiscal year 2031
Future Operationally Resilient Ground Evolution (FORGE) Ground control for Next Generation Overhead Persistent Infrared satellites	$3.0	September 2024
Next Generation Overhead Persistent Infrared (OPIR) Block 0 Missile warning, infrared intelligence, surveillance, and reconnaissance	$8.4	2025
Protected Tactical Enterprise Service (PTES) Ground system for protected satellite communications	$0.4	First quarter of fiscal year 2024
Protected Tactical SATCOM (PTS) Protected satellite communications	$1.0	June 2024

Source: GAO analysis of Department of Defense (DOD) information. | GAO-21-520T

Note: Program acquisition quantities are not listed here because for many programs, the end result of the current MTA effort is not a functional system but a prototype or a software program, so quantities are not easily determined.

Our recent work has highlighted concrete actions where DOD sought to put its space programs on a better footing. But we have also reported on continuing challenges. Details of our recent work are below.

- **GPS Modernization.** In January 2021, we found that DOD is closer to being able to use the more secure signal—called military code or M-code—for the GPS satellites.[14] However, M-code remains years away from being widely fielded across DOD. One reason for this is that to utilize M-code, DOD will need to integrate multiple components—including special circuit chips, receiver cards, and receivers—into different types of weapon systems. Integration of these across DOD will be a considerable effort involving hundreds of different weapons systems.

  While DOD is almost finished developing and testing one M-code card for use on the Marine Corps Joint Light Tactical Vehicle and the Army Stryker vehicle, many other cards are still in development. M-code card development delays have had ripple effects on GPS receiver modernization efforts and the weapon systems that intend to use them. For example, an Air Force receiver modernization effort that depends on the new technology will likely exceed its current schedule and incur additional costs because of the delay. Additionally, other weapon systems that had planned to incorporate that receiver will no longer do so because of the delay.

- **Analysis of Alternatives (AOA) for Wideband Communications Services.** In December 2019 we found that DOD's AOA for Wideband Communications Services was a comprehensive assessment that thoroughly addressed a wide range of possible satellite system alternatives.[15] DOD concluded in its analysis that integrating military and commercial systems into a hybrid architecture would lead to a more cost-effective result than pursuing either a military or commercial acquisition approach alone. However, it also concluded that DOD needed more information on how to select its next satellite communications architecture and made a number of recommendations for further study, including:

  - **Develop an enterprise satellite communications terminal strategy.** This was the first time that DOD studied and consolidated department-wide costs for SATCOM user terminals. DOD found that the magnitude of replacing user terminals to work

[14]GAO, *GPS Modernization: DOD Continuing to Develop New Jam-Resistant Capability, But Widespread Use Remains Years Away*, GAO-21-145 (Washington, D.C.: Jan. 19, 2021).

[15]GAO, *Satellite Communications: DOD Should Develop a Plan for Implementing Its Recommendations on a Future Wideband Architecture*, GAO-20-80 (Washington, D.C.: Dec. 19, 2019). An AOA is a study to identify and assess potential solutions for meeting user need.

with new systems was challenging and that more information on emerging technologies and possible changes to terminal acquisition approaches would help address this challenge.

- **Invest in commercial cybersecurity technologies.** DOD found that it lacked detailed technical information on commercial systems' cyber protections and that additional information on such protections would help DOD determine the extent to which they would meet DOD's needs.

We found that these and other AOA recommendations aligned with our acquisition leading practices for acquiring knowledge to make informed decisions and have the potential to improve the department's satellite communications acquisitions. However, we also found that DOD lacked a plan to guide implementation and coordination of these recommendations and we recommended that DOD develop such a plan. DOD concurred with our recommendation but has not yet completed the plan.

- **Space Command and Control (C2) program.** In 2019, we reported that DOD continued to face longstanding challenges developing software systems, in particular space situational awareness and space C2 systems.[16] The Air Force started the Space C2 program to deliver a unified command and control system for national security space assets that could be used in a conflict that extended into space. In part, Space C2 is to develop some capabilities that the previous space command and control effort—the Joint Space Operations Center Mission System (JMS)—failed to deliver. The Air Force started JMS in 2009 to meet its command and control and space situational awareness data needs and replace another aging system, but it encountered significant development challenges and ended the program in 2018 without delivering many of its planned capabilities. However, we found that with the Space C2 program, as well as other software-intensive programs in the department, DOD was making an effort to change the way it develops software and attempting to use new, modernized software development processes such as Agile.

  DOD also brought in software development experts from outside the government to assist with developing new methods and processes. These are positive steps. But while the Space C2 program reported delivery of some software capabilities, we found that many challenges

[16]GAO, *Space Command and Control: Comprehensive Planning and Oversight Could Help DOD Acquire Critical Capabilities and Address Challenges*, GAO-20-146 (Washington, D.C.: Oct. 30, 2019).

remained for the program, including developing some of the more difficult parts of the system, dealing with complex and as-yet undefined requirements, and integrating multiple types of software. Consequently, we recommended that DOD ensure that the Air Force develops a comprehensive acquisition strategy for the program, and that it conducts periodic independent reviews of the program's software development approach and progress. DOD concurred with our recommendations.[17]

In March 2021, we issued a sensitive but unclassified report on the Next Generation Overhead Persistent Infrared satellite program, and we plan to issue a public version of this report later this year.[18] We are also planning to issue a report on our review of the Mobile User Objective System later this year.[19] Both reports will discuss the status of the efforts and the extent to which DOD is addressing any challenges. In addition, on May 10, 2021, we published a technology assessment on alternative position, navigation, and timing (PNT), which highlights several technologies being explored to provide an alternative to DOD's reliance on GPS.[20] We also have work underway to further assess DOD's efforts to develop alternative PNT capabilities, and expect to issue a report on this topic in late 2021.

Broad Challenges Remain for DOD in Acquiring Space Systems

DOD faces broad challenges in acquiring space systems as it undertakes many new programs and works within the new administrative and management structures of the Space Force. Most of these challenges are or are related to longstanding issues that we and others have reported on in the past. The exception is the establishment of the Space Force and the challenges and opportunities that come from this action. In creating a new service, DOD has the opportunity to organize it in a way that might

[17]In response to a provision in Section 1613 of the National Defense Authorization Act for Fiscal Year 2020, we are reviewing the Space C2 program's annual reports to Congress for fiscal years 2021 and 2022 and will brief congressional defense committees on our findings.

[18]GAO, *Missile Warning Satellites: Comprehensive Cost and Schedule Information Would Enhance Congressional Oversight*, GAO-21-218SU (Washington, D.C.: Mar. 11, 2021).

[19]Our review of the Mobile User Objective System is in response to a provision in the Senate Armed Services Committee report to accompany the National Defense Authorization Act for Fiscal Year 2020.

[20] GAO, *Defense Navigation Capabilities: DOD is Developing Positioning, Navigation, and Timing Technologies to Complement GPS*, GAO-21-320SP (Washington, D.C.: May 10, 2021).

help mitigate some past problems in leadership and organizational authorities.

Challenges Implementing the New Space Force

The ongoing and planned substantial changes to the organizational structure of the DOD space enterprise—particularly the establishment of the Space Force—offer a significant opportunity to streamline and clearly define acquisition lines of authority, accountability, and decision-making; and avoid duplication of effort. However, many details will require careful consideration for carving a new force structure out of existing space functions and equities while at the same time minimizing inefficient gaps and overlaps in space acquisition governance. This is because the use of space capabilities is ubiquitous across the department. Each military service and a number of defense agencies have space-related programs and offices for acquiring capabilities—such as terminals for satellite communications; user equipment for positioning, navigation, and timing; and satellites for imaging—or for conducting space science and technology development efforts. The extent to which the personnel and programs from these organizations will be transferred to the Space Force remains to be seen. In a report provided to Congress in February 2020 on the planned organizational structure of the Space Force, the then-Secretary of the Air Force noted that the plan is to complete the transfer of Air Force space missions and forces to the Space Force by fiscal year 2021, and if authorized, transfer appropriate space-related missions and forces from the other military services and DOD organizations in fiscal year 2022.[21]

Determining the movement of groups within the other services to the Space Force will not be easy. For example, to what extent will Army and Navy satellite communication terminal acquisition programs transition to the Space Force? And to what extent will space-related science and technology efforts being conducted across the department—such as in the Naval Research Laboratory or in the Defense Advanced Research Projects Agency—be affected? In addition, with the reorganizing of existing space acquisition agencies and establishment of the new Space Force and the Space Development Agency, there is the possibility for overlap in the responsibilities of these organizations. How they will work with one another and other space acquisition groups remains to be determined.

[21]United States Air Force, *Comprehensive Plan for the Organizational Structure of the U.S. Space Force* (February 2020).

Resource Limitations for Conducting a Large Number of New Acquisition Efforts

As older acquisitions near completion, DOD has begun a number of follow-on programs to develop the next generation of capabilities. Recapitalizing systems is an opportunity to incorporate lessons learned as well as use new development approaches. Notably, DOD has at least 10 new programs under development in numerous mission areas, including wideband communications; protected communications; missile warning; launch; weather; command and control; and positioning, navigation, and timing.

Having so many new programs starting over the course of a few years raises the question of whether DOD resources and expertise will be of sufficient quantity and quality to handle the load. Any workforce has a finite amount of knowledge and technical expertise, and each of these programs will need to be well-managed to provide important defense capabilities. We have reported over the years on the importance of workforce management and found that having the right workforce with the right skill sets is critical to achieving DOD's mission. In 2019, we found that DOD did not have comprehensive information about its space acquisition workforce, and we noted that this information could be helpful in planning efforts as changes are made to space acquisition organizations.[22]

The Secretary of the Air Force's February 2020 report to Congress on the organizational structure of the Space Force states that as part of the standup of that service, there will be a focus on space training and education devoted to growing a cadre of space warfighting professionals, as well as space-specific acquisition training. As part of this focus, the Space Force stood up a provisional Space Training and Readiness Command and the full Command is expected to be stood up sometime this year. Acknowledging the need for space-specific training for Space Force professionals is an encouraging step.

In addition, a number of these new programs are software-intensive. While DOD is attempting to modernize its software development practices to better match what is done in leading private sector companies, our past work has raised questions as to the amount of expertise in these new methods that is available to DOD.[23] Multiple new software programs may

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

[23]GAO-20-146.

have to compete with one another as well as the private sector for the best software developers.

Furthermore, establishing the new Space Force and Space Development Agency will likely consume a significant amount of funding. Funding multiple new programs—many of which are attempting to accelerate development—while continuing to request funding for older programs nearing completion has the potential to place a financial strain on DOD. Good management of the transition to the Space Force and of the new programs will be key to keeping these costs under control.

Balancing Knowledge-Based Decision-Making with Streamlining Acquisitions

Many of the new space programs that we monitor are using the MTA pathway. The guidance on middle-tier of acquisition requires programs that meet certain estimated dollar thresholds to develop documentation such as a cost estimate, approved requirements, and an acquisition strategy.[24] This is in line with recommendations we made in a 2019 report focusing on acquisition reforms establishing these new middle-tier of acquisition pathways and restructuring oversight for major defense acquisition programs.[25] In that report, we found DOD had made progress in implementing the acquisition oversight reforms, and as a result of one of these reforms DOD had shifted decision-making authority for many major defense acquisition programs from the Office of the Secretary of Defense to the military departments. However, we concluded that there was uncertainty about how DOD would implement the middle-tier of acquisition pathway.

The adaptive acquisition framework and the middle-tier of acquisition pathway represent a significant shift in how DOD oversees and manages its efforts to develop and field capabilities. For all programs, though, it will be important and challenging to strike the right balance between trying new development methods and working within a knowledge-based acquisition framework with enough oversight to help ensure cost, schedule, and performance goals are met. For example, some programs in DOD's portfolio, such as SBIRS, were started under a previous effort to

[24]DOD Instruction 5000.80, *Operation of the Middle Tier of Acquisition* (Dec.30, 2019). Programs that meet the threshold to be considered a major system have these documentation requirements. Major systems are those that are currently estimated to require an eventual total expenditure for research, development, test and evaluation of more than $200,000,000 or for procurement of more than $920,000,000 (in fiscal year 2020 constant dollars). DODI 5000.85, *Major Capability Acquisition* (Aug. 6, 2020).

[25]GAO, *DOD Acquisition Reform: Leadership Attention Needed to Effectively Implement Changes to Acquisition Oversight*, GAO-19-439 (Washington, D.C.: June 5, 2019).

streamline acquisition, known as Total System Performance Responsibility (TSPR). TSPR gave a contractor total responsibility for the integration of an entire weapon system and for meeting DOD 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 and thus DOD lost oversight into the acquisition process. This reduction in DOD oversight and involvement magnified problems related to unstable requirements and poor contractor performance.[26]

In conclusion, it is essential that DOD manage space acquisitions carefully and avoid repeating past problems. Over more than 2 decades, we have identified knowledge-based leading practices to improve acquisition outcomes, including 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; and empowering program managers to make decisions on the direction of the program but also holding them accountable for their choices. Knowledge-based leading practices, even in the streamlined environment, can help DOD achieve its goals for faster delivery of new capabilities, especially if DOD balances new, streamlined acquisition processes with sufficient oversight to help ensure program success.

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions that you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff have any questions about this testimony, please contact Jon Ludwigson at (202) 512-4841 or ludwigsonj@gao.gov. Contact points for our Office of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Rich Horiuchi, Assistant Director; Laura D. Hook, Analyst-in-Charge; Peter W. Anderson; Marie Ahearn; Laura Greifner; and Edward J. SanFilippo. Key contributors for

[26]Leading 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; and not allowing development to proceed until certain thresholds are met. See GAO, *Space Acquisitions: DOD Faces Significant Challenges as it Seeks to Address Threats and Accelerate Space Programs*, GAO-19-482T (Washington, D.C.: Apr. 3, 2019).

the previous work on which this statement is based are listed in the products cited.

Related GAO Products

Missile Warning Satellites: Comprehensive Cost and Schedule Information Would Enhance Congressional Oversight. GAO-21-218SU. Washington, D.C.: March 11, 2021.

GPS Modernization: DOD Continuing to Develop New Jam-Resistant Capability, But Widespread Use Remains Years Away. GAO-21-145. Washington, D.C.: January 19, 2021.

Space Acquisitions: DOD Faces Significant Challenges as it Seeks to Address Threats and Accelerate Space Programs. GAO-19-482T. Washington, D.C.: April 3, 2019.

Satellite Communications: DOD Should Develop a Plan for Implementing Its Recommendations on a Future Wideband Architecture. GAO-20-80. Washington, D.C.: December 19, 2019.

Space Command and Control: Comprehensive Planning and Oversight Could Help DOD Acquire Critical Capabilities and Address Challenges. GAO-20-146. Washington, D.C.: October 30, 2019.

Global Positioning System: Updated Schedule Assessment Could Help Decision Makers Address Likely Delays Related to New Ground Control System. GAO-19-250. Washington, D.C.: May 21, 2019.

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.

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

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.

Defense Satellite Communications: DOD Needs Additional Information to Improve Procurements. GAO-15-459. Washington, D.C.: July 17, 2015.

Related GAO Products

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

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Jon Ludwigson is a Director in GAO's Contracting and National Security Acquisitions (CNSA) team. In that role, Jon oversees work spanning a variety of areas, including weapons systems acquisitions, Army modernization, the F-35 Joint Strike Fighter, and oversight of DOD research and development on related technologies.

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Jon earned a master's degree in public policy from Georgetown University and a bachelor's degree in business administration from the University of Colorado at Boulder.

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QUESTIONS SUBMITTED BY MEMBERS POST HEARING

MAY 24, 2021

QUESTIONS SUBMITTED BY MR. LANGEVIN

Mr. LANGEVIN. The Department is currently undertaking a number of initiatives, including Agile pilot programs and DevSecOps pathfinder efforts, to achieve more rapid acquisition of DOD software. What is the status of these OSD and Space Force pilot efforts?

Mr. HILL. The Department of Defense is pursuing a number of initiatives to achieve more rapid software acquisition. The DOD developed the Software Acquisition Pathway, approved in September 2020, as a tailor-made pathway enabling modern software development best practices within the Adaptive Acquisition Framework. The USSF is executing the Space Command and Control (C2) program as a "DevSecOps Pathfinder" and is now transitioning the program to utilize the Software Acquisition Pathway. By using this agile-based delivery model, the program can iteratively plan and deliver cyber-resilient warfighting capabilities quickly. Thus far, the program has delivered nine operationally-accepted applications to the Combined Space Operations Center and National Space Defense Center in just over two years. The Space C2 program is on track to meet its highest priority requirement: the replacement of all Space Defense Operations Center functions by the end of FY22.

Mr. LANGEVIN. I'm extremely excited about the Space Force's focus on upskilling its workforce and prioritizing digital literacy through the establishment of the Digital University. General Thompson, how does the Space Force plan to incentivize Guardians to complete these courses and how do you plan to keep Digital University content updated with the latest developments in these fast-moving fields?

General THOMPSON. In line with our Vision for a Digital Service, the U.S. Space Force (USSF) has created a foundational set of courses through Digital University that will become a mandatory training requirement to establish digital fluency for every Guardian, as well as specialty training in coding, networking, software development and product management, and other related areas. The specialty training will be required for certain duty positions, but available for any and all Guardians who wish to pursue increased knowledge and expertise for personal or professional reasons. Further incentives derive from achievement of commercial badging, certificates, and academic degrees earned through Digital University. These achievements will tie into personnel systems and can be leveraged by Guardians when pursuing positions and unique opportunities like elite software development teams.

In order to keep content current and relevant, Digital University partners with world-class commercial vendors and academic institutions. Because there are external incentives for these entities to provide up-to-date and quality educational materials, the USSF takes on the role of evaluator and curator instead of content creator. We work closely with these entities to inject material more relevant to the USSF into already built courses, such as including projects that use data collected by space mission units. Any organic material can then be focused toward topics specific to USSF needs that can't be found elsewhere, making it much more manageable.

Mr. LANGEVIN. How does the Space Force plan to incorporate directed energy weapons in its force design and employment concepts?

General THOMPSON. The National Space Policy makes clear that unfettered access to and freedom to operate in space remains a vital national interest. It further provides that the U.S. Space Force will present forces to enable prompt and sustained offensive and defensive space operations to defend U.S. national interests. These operations can take any number of forms and include all elements of military and national power; the Space Force is pursuing multiple approaches and I welcome the opportunity to brief you on them at the appropriate level of classification. Potential adversaries should be on notice that the United States will be ready to respond to any purposeful interference with or attacks on U.S. or allied space systems at the chosen time, place, manner and domain.

Mr. LANGEVIN. The Department is currently undertaking a number of initiatives, including Agile pilot programs and DevSecOps pathfinder efforts, to achieve more rapid acquisition of DOD software. What is the status of these OSD and Space Force pilot efforts?

General THOMPSON. The Department is pursuing a number of initiatives to rapidly deliver more software acquisitions. The DOD developed the Software Acquisition Pathway, approved in September 2020, as a tailor-made pathway enabling modern software development best practices within the Adaptive Acquisition Framework. The USSF is executing the Space Command and Control (C2) program, also called Kobayashi Maru, as an OSD "DevSecOps Pathfinder" and is preparing the program to transition to the Software Acquisition Pathway. By using this agile-based delivery model, the program can iteratively plan and quickly deliver cyber-resilient joint warfighting capabilities; so far, the program has delivered nine operationally-accepted applications to the Combined Space Operations Center and National Space Defense Center in just over 2 years. The ability for the Space C2 program to rapidly ingest lessons learned and incorporate changes to processes and development priorities are a critical asset to meet the program's highest priority requirement of replacing Space Defense Operations Center functions.

Mr. LANGEVIN. I'm concerned about the cybersecurity and functionality of our ground stations. Two major projects, GPS and OPIR, have ground segments that are behind schedule and over cost. Delaying these systems means delaying needed cybersecurity and anti-jamming capabilities. As we continue to expand and upgrade our space architecture, what is the Space Force doing differently to ensure these systems are on schedule and secure?

General THOMPSON. GPS and OPIR provide critical mission capabilities for the Space Force and the nation. We strive to meet cost and schedule expectations to continue to meet warfighter needs and remain responsible stewards of taxpayer dollars for these programs. The Defensive Cyber Operations for Space (DCO–S) capabilities to detect, identify, respond/recover, and protect are "baked in" to current ground segments such as Future Operationally Resilient Ground Evolution (FORGE), Enterprise Ground Services (EGS), and the Next Generation Operational Control System (OCX). These ground segment system architectures are being designed to operate in a cyber-contested environment with modern protection technologies, tools, processes, functions, and cyber best practices.

QUESTIONS SUBMITTED BY MR. TURNER

Mr. TURNER. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities to related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspectives on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

What unique equities might IC agencies have when it comes to high Mach platforms—whether for ISR collection or for space launch? Do you believe any structural changes are needed to ensure that the IC has a seat the table in development and planning for operational use of these technologies?

How will high Mach platforms enhance the tactically responsive space mission? Do you believe your respective services and agencies are properly resourced to pursue development on published timelines? Are there any additional resources or authorities this committee might provide to support development?

The commercial sector is currently making an ambitious push to develop and field high Mach aircraft in the 2030 timeframe. As you know, many of these technologies—from propulsion to materials to test facilities—are dual use and could significantly advance DOD efforts to field their own aircraft. How is DOD working with NASA to leverage these advances? Are there any current restrictions that limit cooperation?

Much of the commercial and defense work on high Mach flight is occurring in allied countries. What steps have been taken to explore partnership opportunities with allied nations? Are there any restrictions—such as export controls—that are limiting valuable collaboration?

Mr. HILL. Hypersonic applications straddle the air and space domains. For example, our ability to reconstitute critical space-based assets rapidly is constrained, in part, by a limited number of rockets operating from a limited number of launch sites. A notional future hypersonic aircraft could serve as the first stage of a two-stage-to-orbit launch system to deliver up to 20,000 pounds of payload to low Earth orbit. An aircraft-based approach to space launch would allow for flexible runway-reliant basing, safer launch abort capability, and improved airspace integration. High-speed and hypersonic aircraft could also support replenishment of space-based assets and mission assurance efforts in more lethal, non-permissive future environ-

ments. Additionally, a number of contractors are now providing flexible sub-sonic air launch options for small and medium satellite payloads to low Earth orbit.

While OSD Policy does not represent the IC, we recognize that, the ability to perform penetrating, responsive collection with a highly survivable platform could fill key gaps. Those gaps primarily reflect ISR needs. Penetrating hypersonic aircraft serving as on-demand collection platforms could provide an unpredictable, survivable, and responsive alternative or adjunct to more traditional ISR capabilities. Additionally, a hypersonic aircraft acting as the first-stage of a two-stage-to-orbit launch system could provide a responsive space reconstitution capability.

The primary effort, which is currently in the development community, encompasses goals and objectives for future DOD and Intelligence Community missions, and includes Intelligence Community input. While OSD Policy does not represent the IC, we nevertheless look forward to continued DOD–IC collaboration as the focus shifts over the next decade to operational considerations.

The Department of Defense does not have requirements for high Mach platforms in the tactically responsive space mission. However, as the Department identifies space requirements for responsive launch, acquisition of these capabilities may have greater significance and will be appropriately reflected in the Department's overall space strategy and budget. A notional future hypersonic aircraft could serve as the first stage of a two-stage-to-orbit launch system to deliver up to 20,000 pounds of payload to low earth orbit, though high Mach or hypersonic capability is not necessarily required for an air-launched capability. An aircraft-based approach to space launch would allow for flexible runway-reliant basing, safer launch abort capability, and improved airspace integration. High-speed and hypersonic aircraft would be reusable, supporting replenishment of space-based assets and mission assurance efforts in more lethal, non-permissive future environments.

DOD has developed and regularly updates a technology roadmap for reusable systems in collaboration with the National Aeronautics and Space Administration (NASA). The roadmap includes an ambitious goal of developing and demonstrating a reusable hypersonic aircraft by the early- to mid-2030's. The basic elements of that roadmap are currently funded.

Recently, there has been a renewed interest in both the public and private sector on the utility of hypersonic aircraft for responsive point-to-point transportation. Per the national hypersonics roadmap, the Department of the Air Force collaborates with the Office of the Under Secretary of Defense for Research and Engineering and with NASA to develop dual-use technologies for High Mach and Hypersonic Aircraft. This strategy includes pursuing key enabling technologies that will provide for both commercial and military application of future hypersonic reusable systems.

There are no restrictions that currently limit DOD and NASA collaboration on future reusable hypersonic aircraft and the level of technology development applicable to both military and civilian application. There are limitations on the application of NASA human and fiscal capital directly to development of DOD systems; however, those limitations do not pose any impediment on either agency to meeting our respective needs.

Governments and industries in many countries are investing in research and development to enable future reusable hypersonic aircraft. Some of those countries are allies and some are not. DOD is working to make sure we fully understand the scope of that work to identify areas of mutual benefit and interest with our allied partners and to assess the risks of the efforts of our potential adversaries. As we pursue our roadmap we are looking for collaborative opportunities with our allies, with propulsion being a key area that has potential.

No, DOD has the necessary authorities to pursue collaboration when we determine it is the best approach. Collaborative research, development, and production can add programmatic complexity, particularly associated with requirements regarding information security, intellectual property protection, and claims. However, collaboration can also leverage diverse sources of expertise, promote common standards and interoperability, and generate net savings as partners pool requirements and share fiscal burdens. Over a long history of successful collaboration with partners, DOD has shown we are able to leverage our authorities and overcome the complexities to deliver mutually beneficial outcomes.

Mr. TURNER. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities to related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspectives on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

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Much of the commercial and defense work on high Mach flight is occurring in allied countries. What steps have been taken to explore partnership opportunities with allied nations? Are there any restrictions—such as export controls—that are limiting valuable collaboration?

General THOMPSON. The Department of the Air Force, from a military service perspective, is unable to answer on behalf of specific Intelligence Community (IC) agencies on unique equities for ISR collection or space launch on high Mach platforms. The Office of the Director of National Intelligence (ODNI) would be best positioned to facilitate discussion and insight from IC agencies tasked with monitoring and assessing foreign high Mach platforms.

While I cannot speak authoritatively for the IC or IC agencies, it is possible there may not be any structural changes required to ensure involvement in the development and planning for operational use of high Mach platforms. The current research and development process for high Mach platforms is examining multiple mission areas and is already facilitating collaboration between engineers, fielding and testing organizations, and the intelligence community.

There has been renewed interest in both the public and private sectors for responsive launch; there are many concepts under consideration, to include use of hypersonic aircraft as the first stage of a two-stage system. The benefits of an aircraft-based space launcher include flexible basing and launching locations, and less restrictive public safety requirements. The Space Force's Rapid/Agile Launch Initiative is currently investigating more responsive launch options.

I am not able to speak for the IC and their equities, but with regard to tactical responsive spacelift—there are many concepts under consideration, to include use of hypersonic aircraft as the first stage of a two-stage system. While there is no formal program to use hypersonics for this purpose, we continue analysis on the costs and benefits of such an approach and are working with OSD (R&E) and NASA to develop a national strategy for hypersonics. This effort could provide technologies to enable the aircraft-based hypersonic space launch by 2040, should analysis warrant.

We currently do not need additional resources for hypersonics in FY22.

The Department of the Air Force (DAF) and NASA have worked together for many years successfully especially in the science and technology arena. There are various ways the DOD and NASA are partnering to leverage hypersonics, as was recently detailed in a March 26, 2021 article in Air Force magazine titled, "Catching Up on Hypersonics." These include: Experimenting with a concept called SkyRange, which uses unmanned aircraft to clear the hypersonic test space and relay telemetry in an effort to accomplish more with the range space already available. For high Mach numbers coupled with intense heat, there is only one tunnel—a NASA asset—that can create the environment. Also, DAF is bringing NASA into Vector Prime, a hypersonic aircraft effort. The collaboration with NASA includes sharing facilities and models. On the facility side, DAF is bringing in NASA and industry in on a MILCON study for national R&D facility specifically for early technology readiness level (TRL) needs.

With the standup of Space Systems Command, the U.S. Space Force will be postured to take advantage of commercial developments in hypersonic technologies to quickly deliver capabilities. We will seek every opportunity to collaborate with private and public partners, while also working through appropriate legal and ethical standards of conduct. I am not aware of any current restrictions that limit cooperation as we move forward. If any restrictions do arise, I will work with the Department of the Air Force to ensure we have the necessary authorities to enhance cooperation.

The Department of the Air Force (DAF) is committed to exploring opportunities in bilateral and multilateral forums to increase development of hypersonic tech-

nologies with Allies and international partners. For example, the DAF has over a 15-year relationship with the Australian Department of Defense developing and testing hypersonic technologies, and we recently began a new project to develop and test air-launched, air-breathing flight test vehicles capable of cruising at hypersonic speeds. The DAF is also currently discussing potential collaboration in hypersonic technologies with other Allies.

We must continue to follow International Traffic in Arms Regulations, and comply with the Missile Technology Control Regime, but I am not aware of any instances where these regulations impose significant limitations on our existing or planned collaboration on hypersonics with allies and partners.

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Dr. SCOLESE. We will continue to work closely with the DOD to explore future opportunities to utilize numerous emerging technologies to meet our objectives. In addition to advancements in our traditional launch methods, hypersonics may provide additional methods for responsive transport to the space domain.

Speaking for the NRO, we are interested in any technologies that may further our collection mission or launch of our systems. Our end-to-end functional capabilities have us positioned to develop, based on our requirements and the requirements of our customers, innovative solutions to customer needs.

The NRO does not foresee any need to restructure to respond to new technologies.

We continue to work closely with our DOD partners to find opportunities to address their warfighting challenges, including building a tactically-responsive space architecture. Space launch options using hypersonics hold opportunities to meet this and other needs. The NRO works closely with our partners to prioritize initiatives to meet our broad customer's needs and mission requirements.

We are interested in any technologies that may further our collection mission or launch of our systems. Our end-to-end functional capabilities have us positioned to develop, based on our requirements and the requirements of our customers, innovative solutions to customer needs.

While not currently pursuing collaboration with regard to high-Mach flight with our allies, the NRO seeks collaborative development where possible to further capabilities of all participant while still protecting sensitive technologies.

Mr. TURNER. Demand for commercial imagery, data and services is greatly increasing and I understand that we will soon see that reflected in requirements from the COCOMs and Services. Will the NRO FY22 budget reflect a greater degree of commercial procurements in line with the advancements of the commercial space industry? Additionally, it's critical this imagery gets in the hands of our warfighters. What is your commitment to ensuring that the flow of Commercial Imagery to the Services and Combatant Commands is not interrupted?

Dr. SCOLESE. The NRO is committed to providing high-quality and high-capacity GEOINT support to hundreds of thousands of users, including COCOMs and Services. As the quality and volume of commercial providers of GEOINT continue to increase, the NRO will ensure that we are continually leveraging our domestic providers. The NRO's next generation of commercial imagery contracts is responsive to

requirements from the COCOMs and Services to the extent that they were included in the GEOINT Functional Manager's (NGA's) draft Statement of Capabilities (SOC) for Commercial Imagery. We expect that the SOC will be validated this summer by both the Intelligence Community and Department of Defense, at a level that fully meets users' needs. We also expect that the Independent Cost Estimate and budget will be sufficient to satisfy those requirements.

With regard to the flow of commercial imagery to warfighters, NGA is responsible for dissemination via various mechanisms; from a contractual standpoint, however, NRO confirms that there will not be any gap in support as we transition from the current operational contracts to the new commercial imagery contracts. Current contracts will be extended, as required, until the new contracts are in place.

Mr. TURNER. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities to related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspectives on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

What unique equities might IC agencies have when it comes to high Mach platforms—whether for ISR collection or for space launch? Do you believe any structural changes are needed to ensure that the IC has a seat the table in development and planning for operational use of these technologies?

How will high Mach platforms enhance the tactically responsive space mission? Do you believe your respective services and agencies are properly resourced to pursue development on published timelines? Are there any additional resources or authorities this committee might provide to support development?

The commercial sector is currently making an ambitious push to develop and field high Mach aircraft in the 2030 timeframe. As you know, many of these technologies—from propulsion to materials to test facilities—are dual use and could significantly advance DOD efforts to field their own aircraft. How is DOD working with NASA to leverage these advances? Are there any current restrictions that limit cooperation?

Much of the commercial and defense work on high Mach flight is occurring in allied countries. What steps have been taken to explore partnership opportunities with allied nations? Are there any restrictions—such as export controls—that are limiting valuable collaboration?

General CLEVELAND. NGA's role in space ISR involves tasking, processing, exploiting, and disseminating data collected from NRO satellites. NGA has the authorities it needs to meet challenges in the space domain. We are closely tied with the NRO and likewise leverage the Geospatial Intelligence Committee (GEOCOM) executive steering structure to coordinate Geospatial Intelligence (GEOINT) needs across the interagency, the Intelligence Community (IC), and Combatant Commands. NGA works closely with our commercial, interagency, IC, and DOD partners to meet the needs of the warfighter. For space launch and space operations, NGA defers to NRO for research, development, acquisition, launch, and the operation of imagery intelligence satellites. NGA's FY22 budget request and current authorities meet the Agency's needs as the GEOINT functional manager. Although NGA does not have any equities related to fielding aircraft, we are partnered with NASA on a range of technologies, most recently focused on potential lunar and cislunar operations, and Global Navigation Satellite System (GNSS). At this time, there are no restrictions limiting cooperation between NGA and NASA.

Mr. TURNER. Demand for commercial imagery, data and services is greatly increasing and I understand that we will soon see that reflected in requirements from the COCOMs and Services. Will the NRO FY22 budget reflect a greater degree of commercial procurements in line with the advancements of the commercial space industry? Additionally, it's critical this imagery gets in the hands of our warfighters. What is your commitment to ensuring that the flow of Commercial Imagery to the Services and Combatant Commands is not interrupted?

General CLEVELAND. NGA continues to coordinate closely with NRO to inform commercial procurement. NGA is thoroughly committed to providing uninterrupted, real-time support to the warfighter and leverages all available sources to accomplish this, including commercial imagery. NGA works with both commercial imagery providers and military customers to ensure that warfighter requirements are clearly understood and delivered to meet the needs and specifications of the military user. Our paramount goal is to support warfighters at the tactical edge in as effective and timely a manner as possible, while ensuring that the highest priority operational requests take precedence.

Mr. TURNER. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities to related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspectives on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

What unique equities might IC agencies have when it comes to high Mach platforms—whether for ISR collection or for space launch? Do you believe any structural changes are needed to ensure that the IC has a seat the table in development and planning for operational use of these technologies?

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Much of the commercial and defense work on high Mach flight is occurring in allied countries. What steps have been taken to explore partnership opportunities with allied nations? Are there any restrictions—such as export controls—that are limiting valuable collaboration?

Mr. LUDWIGSON. We have not assessed DOD's short or long-term hypersonic strategy, including activities related to reusable hypersonic flight, transport, ISR and strike, and responsive space access, outside of identifying the breadth and scope of their current efforts in the past and the next few years into the future. DOD has initially focused most resources on developing and proving offensive weapon prototypes. Most of the estimated $15 billion for hypersonic weapons and related technologies from fiscal year 2015 through fiscal year 2024 has been used or is planned to be spent on offensive weapons that will potentially turn into programs of record. Future efforts that may influence reusable hypersonic flight, ISR, and defense applications are at earlier stages of development. If successful, they have the potential to evolve into future programs that may shape DOD's portfolio and hypersonic strategy and open up the types of platforms that can carry hypersonic weapons or utilize the technology. Given the breadth of these activities and their potential expansion to include additional organizations within DOD, formalizing coordination for effective achievement of DOD's objectives will be important.

For our report examining hypersonics, we obtained information on acknowledged research efforts and formal programs, but did not explicitly seek to identify others. However, to the extent IC agencies have equities in hypersonic platforms, it might be important for them to be included in efforts to formalize coordination in hypersonic weapons development efforts.

We have not done work to assess the relationships of high Mach platforms with the space mission to understand resource requirements needed to support published timelines or to inform authorities this committee may consider.

DOD and NASA have agreements in place that support DOD using NASA testing facilities. NASA shares subject matter expertise in hypersonic technology, such as at NASA Langley. DOD, in some cases, reimburses NASA for use of its wind tunnels. In some instances NASA officials said that NASA waives the reimbursement costs because it is able to acquire data from testing it would not be able to obtain on its own because it would be too expensive. We have not done work to assess whether there are any current restrictions that limit cooperation.

Our report on efforts to develop hypersonic weapons and related technologies included information on some partnership efforts between DOD and allied countries. However, we have not done comprehensive work to assess the extent to which work on hypersonic flight is occurring in allied countries, steps DOD has taken to explore partnership opportunities, or export controls that may be inhibiting collaboration.

Mr. TURNER. Demand for commercial imagery, data and services is greatly increasing and I understand that we will soon see that reflected in requirements from the COCOMs and Services. Will the NRO FY22 budget reflect a greater degree of commercial procurements in line with the advancements of the commercial space industry? Additionally, it's critical this imagery gets in the hands of our warfighters. What is your commitment to ensuring that the flow of Commercial Imagery to the Services and Combatant Commands is not interrupted?

Mr. LUDWIGSON. We have begun a review of the National Reconnaissance Office's (NRO) Commercial Systems Program Office (CSPO) in response to a provision in the House report accompanying a bill for the Intelligence Authorization Act for Fiscal Year 2021 and a subsequent letter from the Chairman and Vice Chairman of the Senate Select Committee on Intelligence. CSPO is the office in NRO responsible for purchasing commercial satellite imagery on behalf of DOD and the Intelligence Community. Our review is looking into how NRO is leveraging commercial imagery for DOD and the Intelligence Community, including how they are meeting Congressional direction to engage the commercial satellite remote sensing industry to the maximum extent practicable. While the scope of our review focuses on CSPO, it will also include information from stakeholders throughout DOD and the IC, including combatant commands and military services. We anticipate providing a draft report to DOD and the IC for comment in early 2022.

QUESTIONS SUBMITTED BY MR. LAMBORN

Mr. LAMBORN. Recently, China and Russia recently announced that they have entered into a MOU on establishing a lunar International Research Station. Although this was publicized as a scientific effort, some perceive this as a thin veil for military cooperation on the moon. Currently, NASA is the only government organization tasked with establishing a presence on the lunar surface with the Artemis program.

Is the DOD taking any actions to look ahead at potential military needs and capabilities beyond our traditional orbits and near the lunar region?

Mr. HILL. Whether in traditional orbits or beyond, DOD operations in space are and will remain fully compliant with U.S. obligations under international law, including the Outer Space Treaty of 1967, and with U.S. law and policy. In this regard, DOD does not intend to establish military bases, installations, or fortifications, test any type of weapons, or conduct military maneuvers on the Moon or on other celestial bodies.

This approach remains consistent with our longstanding national security interests, and does not prevent DOD from pursuing emerging national security interests beyond traditional orbits or from extending our space situational awareness and other activities to the lunar regime. For example, the Defense Advanced Research Projects Agency (DARPA) is developing the Demonstration Rocket for Agile Cislunar Operations (DRACO) to demonstrate a nuclear thermal propulsion (NTP) system above low Earth orbit in 2025. The system would demonstrate rapid maneuver capability in cislunar space, which can be important in various national security space applications.

Mr. LAMBORN. Follow-up on the question: 'From an "organize, train and equip" perspective, where should investments be made to our space-based capabilities, to ensure we can prevail in a conflict against China?'

In addition to the answer you provided (upgrading/modifying existing systems, making things "less interesting" in the design phase, and developing a deeper understanding of adversary capabilities), can you discuss which specific programs or capabilities the DOD or Space Force currently have or are developing to fill those roles or meet that criteria?

General THOMPSON. Key to prevailing in a conflict against China and other potential adversaries is our ability to modernize our capabilities to protect what we have on orbit today, evolve to more resilient architectures, develop warfighting capability, and grow new space missions. Most of the important details in each of these areas is classified; I welcome the opportunity to brief you on all of them at the appropriate classification level.

In addition to the categories above, we must also improve our ability to assess and understand our adversary's activity, which is accomplished through space domain awareness. The budget includes $127M for the Space Based Surveillance System (SBSS) follow-on known as SILENTBARKER which will provide timely detection and custody of on-orbit threats in order to protect U.S. high-value assets in space. The Unified Data Library investment facilitates universal data access for all-domain space domain awareness data sharing from all sensors to support space-focused battle management and command and control ($17.1M)

The Ground Based Optical Sensor System (GBOSS) is an upgrade to the existing Ground-based Electro-Optical Deep Space Surveillance System (GEODSS) that enables monitoring of small, closely-spaced, and advanced threats in low, mid, high, and geostationary orbits ($56.2M). Finally, we are investing $123M on a Deep Space Advanced Radar Concept that will deliver radar sensors that can monitor satellites and space debris in geostationary orbits.

QUESTIONS SUBMITTED BY DR. DESJARLAIS

Dr. DESJARLAIS. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspective on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

Mr. HILL. Hypersonic flight offers solutions that straddle the air and space domains. For example, our ability to reconstitute critical space-based assets rapidly is constrained, in part, by a limited number of rockets operating from a limited number of launch sites. A notional future hypersonic aircraft could serve as the first stage of a two-stage-to-orbit launch system to deliver up to 20,000 pounds of payload to low Earth orbit. An aircraft-based approach to space launch would allow for flexible runway-reliant basing, safer launch abort capability, and improved airspace integration. High-speed and hypersonic aircraft could also support replenishment of space-based assets and mission assurance efforts in more lethal, non-permissive future environments.

Dr. DESJARLAIS. The commercial sector is currently making an ambitious push to develop and field high Mach aircraft in the 2030 timeframe. As you know, many of these technologies—from propulsion to materials to test facilities—are dual use and could significantly advance DOD efforts to field their own aircraft. How is DOD working with NASA to leverage these advances? Are there any current restrictions that limit cooperation?

Mr. HILL. Recently, there has been a renewed interest in both the public and private sector on the utility of hypersonic aircraft for responsive space launch and responsive point-to-point transportation. The Department of the Air Force is working with Office of the Under Secretary of Defense for Research and Engineering and with NASA to develop a national strategy for High Mach and Hypersonic Aircraft that will provide technologies for aircraft-based, responsive space launch by 2040. This strategy includes the key enabling technologies and sub-systems that will provide for both commercial and military application of future hypersonic reusable systems.

There are no restrictions that currently limit DOD and NASA collaboration on future reusable hypersonic aircraft and the level of technology development applicable to both military and civilian application. There are limitations on the application of NASA human and fiscal capital directly to development of DOD systems; however, those limitations do not pose any impediment on either agency to meeting our respective needs.

Dr. DESJARLAIS. Much of the commercial and defense work on high Mach flight is occurring in allied countries. What steps have been taken to explore partnership opportunities with allied nations? Are there any restrictions—such as export controls—that are limiting valuable collaboration?

Mr. HILL. Governments and industries in many countries are investing in research and development to enable future reusable hypersonic aircraft. Some of those countries are allies and some are not. DOD is working to make sure we fully understand the scope of that work to identify areas of mutual benefit and interest with our allied partners and to assess the risks of the efforts of our potential adversaries. As we pursue our roadmap, we are looking for collaborative opportunities with our allies, with propulsion being a key area of potential cooperation. Export controls and other restrictions do not prevent DOD from using its authorities to pursue collaboration when we determine it is the best approach. Collaborative research, development, and production can add programmatic complexity, particularly associated with requirements regarding information security, intellectual property protection, and claims. However, collaboration can also leverage diverse sources of expertise, promote common standards and interoperability, and generate net savings as partners pool requirements and share fiscal burdens. Over a long history of successful collaboration with partners, DOD has shown we are able to leverage our authorities and overcome the complexities to deliver mutually beneficial outcomes.

Dr. DESJARLAIS. The Office of the Secretary of Defense recently released a hypersonics roadmap that covered a range of activities related to reusable hypersonic flight, including transport, ISR and strike, and responsive space access. According to OSD, these technologies are well into development and could reach initial operating capability (IOC) in the 2030s. I would like to get your perspective on how these high speed capabilities might be used to achieve your current objectives and how they might influence long-term changes in strategy.

General THOMPSON. Hypersonics are a critical technology with broad impact across the national security landscape. There has been renewed interest in both the public and private sectors for responsive launch—there are many concepts under consideration, to include use of hypersonic aircraft as the first stage of a two-state system. The benefits of an aircraft-based space launcher include flexible basing and launching locations, and less restrictive public safety requirements. The Space Force's Rapid/Agile Launch Initiative is currently leveraging more responsive launch options. We are working with OSD (R&E) and NASA to develop a national strategy for High Mach and Hypersonic Aircraft that could provide technologies to enable the aircraft-based hypersonic space launch by 2040.

One additional area where the Space Force has a role is in detecting and tracking hypersonic missiles. That mission is challenging. The Space Force is presently conducting analysis on new capabilities to provide hypersonic missile warning from space.

Dr. DESJARLAIS. How will high Mach platforms enhance the tactically responsive space mission? Do you believe your respective services and agencies are properly resourced to pursue development on published timelines? Are there any additional resources or authorities this committee might provide to support development?

General THOMPSON. As the DOD identifies space requirements for responsive launch, acquisition of these capabilities will be appropriately budgeted for and reflected in our overall strategy for space. The current budget for U.S. space launch addresses the current requirements, but we anticipate the Department will request additional funding for these efforts as additional requirements are identified.

Dr. DESJARLAIS. How will high Mach platforms enhance the tactically responsive space mission? Do you believe your respective services and agencies are properly resourced to pursue development on published timelines? Are there any additional resources or authorities this committee might provide to support development?

Dr. SCOLESE. We continue to work closely with our DOD partners to find opportunities to address their warfighting challenges, including building a tactically-responsive space architecture. Space launch options using hypersonics hold opportunities to meet this and other needs. The NRO supports the FY 2022 President's Budget.

Dr. DESJARLAIS. How will high Mach platforms enhance the tactically responsive space mission? Do you believe your respective services and agencies are properly resourced to pursue development on published timelines? Are there any additional resources or authorities this committee might provide to support development?

General CLEVELAND. NGA works closely with our commercial, interagency, Intelligence Community, and DOD partners to meet the needs of the warfighter. NGA does not have or provide any space launch capabilities. The NGA FY22 budget request and current authorities meet the Agency's needs as the GEOINT functional manager.

QUESTIONS SUBMITTED BY MR. KHANNA

Mr. KHANNA. How is the United States Space Force working to bring in new commercial capabilities, to include additive manufacturing, to support the goal of a dynamic and responsive launch capability? In your opinion, is the Space Force doing enough to increase the purchase of small launch providers to support and prove this requirement for responsive launch?

Mr. HILL. Yes. The U.S. Space Force has a dedicated office for enhanced coordination with the U.S. commercial space launch industry and is actively pursuing opportunities to leverage innovation. DOD is exploring how to pair its requirements with cutting-edge domestic space technology—some of which may utilize responsive launch opportunities. The USSF currently has eight small launch providers on-contract through its SRP–4 and OSP–4 agreements, and is currently on-ramping other new providers. Space Force also expects to on-ramp new vendors every year to continue to leverage industry innovation.

Mr. KHANNA. What is your assessment of the report on the "State of the Space Industrial Base 2020" which concluded (among other things) that ""The very long schedules of many DOD space programs limit the opportunities for short design-build-test projects that stimulate interest and innovation within the U.S. workforce. Many new small launch vehicles are coming into service. An increased rate of space experiments and prototypes by DOD would enhance the viability of these small launchers providers." How is Space Force working with those in acquisition to decrease the timelines for DOD space programs and increase the rate of space experiments and prototypes for small launch? How are you supporting new U.S. satellite companies working to gain entry into the DOD market?

Mr. HILL. DOD is engaging in a broad-based effort to leverage commercial technology for the fulfilment of its space requirements. This includes reducing the timelines that have been typical in traditional programs that meet military requirements not typically addressed in commercial space and diversifying acquisition approaches to leverage commercial innovations that can offer new solutions and new capabilities on much shorter timelines. From the Space Development Agency, to the Defense Advanced Research Projects Agency, to the Space Rapid Capabilities Office, to the Air Force Research Laboratory, and to the Space and Missile Systems Center, DOD using rapid prototyping and other innovations in research, development, and acquisition programs that are providing opportunities to leverage the agility and flexibility of emerging commercial launch and satellite providers. The U.S. Space Force has also established a dedicated office for enhanced coordination and alignment to meet these growing needs for small launch and pair programs with the best launch opportunities.

Mr. KHANNA. With the DARPA launch challenge concluding without a winner, what other space related programs focusing on responsive launch is Space Force interested in? What is the Space Force's plans to engage with new launch companies going forward to develop a responsive launch capability?

Mr. HILL. The U.S. Space Force has two programs dedicated to engaging launch companies. The National Security Space Launch program handles traditional launch vendors and supports new entrants into future phases. The Department's Rocket Systems Launch Program manages the Tactically Responsive Launch Program Element, which leverages three available contract strategies to utilize emerging small launch providers to support DOD space requirements. The Department has and is continually looking to utilize responsive launch capabilities, and explore opportunities to enhance DOD responsive space launch requirements.

Mr. KHANNA. How is the Space Force planning to utilize tools such as additive manufacturing, and would Space Force's mission benefit from the integration of new space companies utilizing new manufacturing techniques such as additive manufacturing—in order to meet the Space Force requirement to launch within 24 hours as part of the tactically responsive launch requirements?

Mr. HILL. [No answer was available at the time of printing.]

Mr. KHANNA. As SDA, DARPA, Space RCO and others continue to advance new capabilities within DOD, including satellite servicing and the deployment of satellite constellations, what is the strategy to engage and work with new launch partners who may be able to provide access to precise orbits at a lower cost point than traditional launch providers? More specifically, how is the Space Force team incorporating the Spacepower doctrine's call to provide "dynamic and responsive" launch to the arsenal?

Mr. HILL. [No answer was available at the time of printing.]

Mr. KHANNA. The Director of the Space Development Agency, Dr. Derek Tournear has not yet made a decision about which launch company or companies will take on the Tranche 1 mission. During a recent discussion he stated that it was unclear if it would be feasible to utilize SMC or the National Security Space Launch program due to budget constraints. Would you and your team support efforts to broaden the scope of available launchers to include new responsive launch capabilities being developed by newer entrants into the launch market? How is the NRO and NGA working to engage and increase competition in the launch market as well?

Mr. HILL. [No answer was available at the time of printing.]

Mr. KHANNA. The Air Force and Space Force have expressed support for new economic development to spur the space economy forward, increase launch cadences, and bring on new commercial capabilities. Both the rocket systems launch program for space and the tactically responsive space launch lines support this effort. Does the budget for these lines reflect the urgency of maintaining the U.S. commercial and national security edge in space?

Mr. HILL. [No answer was available at the time of printing.]

Mr. KHANNA. How is the United States Space Force working to bring in new commercial capabilities, to include additive manufacturing, to support the goal of a dynamic and responsive launch capability? In your opinion, is the Space Force doing enough to increase the purchase of small launch providers to support and prove this requirement for responsive launch?

General THOMPSON. Yes. The U.S. Space Force (USSF) has a dedicated office for enhanced coordination with the U.S. commercial space launch industry. The DOD is exploring how to pair DOD requirements with cutting edge domestic space technology—some of which may use responsive launch opportunities. The USSF currently has eight small launch providers in our Orbital Services Program (OSP)-4 contract pool, and is currently on-ramping other new providers. We also plan to on-ramp new vendors every year to continue to leverage industry innovation. The De-

partment already uses space launch services from U.S. space industrial base entities that use additive manufacturing, such as 3D printing.

Mr. KHANNA. What is your assessment of the report on the "State of the Space Industrial Base 2020" which concluded (among other things) that "The very long schedules of many DOD space programs limit the opportunities for short design-build-test projects that stimulate interest and innovation within the U.S. workforce. Many new small launch vehicles are coming into service. An increased rate of space experiments and prototypes by DOD would enhance the viability of these small launchers providers." How is Space Force working with those in acquisition to decrease the timelines for DOD space programs and increase the rate of space experiments and prototypes for small launch? How are you supporting new U.S. satellite companies working to gain entry into the DOD market?

General THOMPSON. The DOD is engaging in a cohesive effort across responsive small satellites, ground systems, requirements, policy, and other critical aspects in the responsive space architecture to increasingly use commercial technologies that support space-to-terrestrial warfighting requirements. On the small satellite front, programs like Space Safari are enabling quick turn capabilities for operational use. Experiments and prototypes have a tailored board process to receive DOD sponsorship and ensure support, minimize timelines and leverage launch industry capabilities. Additionally, programs like Space System and Prototype Transition (SSPT) directly leverage commercially available technology and utilize non-traditional contracting approaches such as other transaction authorities to attract non-traditional vendors to accelerate acquisition timelines to deliver prototypes with residual operations capability. For example, Blackjack is integrating a military payload onto a commercially commoditized satellite bus. The U.S. Space Force utilizes the Mission Manifest Office (MMO) as the front door for all satellites leading to enhanced coordination and alignment across the DOD and mission partners. The Rocket Systems Launch Program (RSLP) procures small launch services and the MMO utilizes excess launch vehicle performance to maximize on-orbit capability, providing the U.S. Space Force the ability to employ multiple innovations to maintain responsiveness and assured access to space.

Mr. KHANNA. With the DARPA launch challenge concluding without a winner, what other space related programs focusing on responsive launch is Space Force interested in? What is the Space Force's plans to engage with new launch companies going forward to develop a responsive launch capability?

General THOMPSON. The U.S. Space Force has two programs dedicated to engaging with launch companies. The National Security Space Launch program handles our traditional launch vendors and supports new entrants into future phases. The Department's Rocket Systems Launch Program (RSLP) manages the Tactically Responsive Launch Program Element, which leverages three available contract strategies to use emerging small launch providers to support DOD space requirements. RSLP has awarded 5 small space launch contracts to 6 different small launch providers; providing 19 small space launches and over 700 suborbital launches going back to 1972. RSLP's current primary launch contract mechanism has eight different providers, on-ramps new providers and procures launch services annually, and has procured one launch service to-date. The Department continues to look to use responsive launch capabilities and explore opportunities to enhance DOD responsive space launch requirements.

Mr. KHANNA. How is the Space Force planning to utilize tools such as additive manufacturing, and would Space Force's mission benefit from the integration of new space companies utilizing new manufacturing techniques such as additive manufacturing—in order to meet the Space Force requirement to launch within 24 hours as part of the tactically responsive launch requirements?

General THOMPSON. The Department already uses space launch services from U.S. space industrial base entities that use additive manufacturing, such as 3D printing. Commercial innovation is a key component of ensuring U.S. preeminence in space, and the Department enthusiastically supports commercial efforts to rapidly develop reliable and responsive space capabilities.

Mr. KHANNA. As SDA, DARPA, Space RCO and others continue to advance new capabilities within DOD, including satellite servicing and the deployment of satellite constellations, what is the strategy to engage and work with new launch partners who may be able to provide access to precise orbits at a lower cost point than traditional launch providers? More specifically, how is the Space Force team incorporating the Spacepower doctrine's call to provide "dynamic and responsive" launch to the arsenal?

General THOMPSON. The USSF Launch Enterprise is responsive to our customers' needs across the spectrum of small and large launch. For example, in 2019, we worked with our National Security Space Launch (NSSL)-class commercial partners

to increase rocket performance less than 4 months before launch to provide more on-orbit resiliency. By using the NSSL Phase 2 contract, we can order and launch a mission in 12 months. For small launch, we have contractual vehicles in-place that can rapidly award launches to eight different vendors currently, several of which can already launch within six months of award. Many of the small launch providers are non-traditional defense contractors. We also plan to on-ramp new vendors every year to continue to leverage industry innovation.

Mr. KHANNA. The Director of the Space Development Agency, Dr. Derek Tournear has not yet made a decision about which launch company or companies will take on the Tranche 1 mission. During a recent discussion he stated that it was unclear if it would be feasible to utilize SMC or the National Security Space Launch program due to budget constraints. Would you and your team support efforts to broaden the scope of available launchers to include new responsive launch capabilities being developed by newer entrants into the launch market? How is the NRO and NGA working to engage and increase competition in the launch market as well?

General THOMPSON. The Space Development Agency, in coordination with the Office of the Under Secretary of Defense for Acquisition & Sustainment and Department of the Air Force, is still assessing launch requirements for the Tranche 1 series of satellites. The National Security Space Launch (NSSL) approach achieves the lowest overall costs to the government across the full spectrum of mission needs with commercial-like pricing for commercial-like launches. Further, the NSSL approach cuts the prices for the most demanding missions by over 50 percent. However, the DOD may consider alternative launch options should it be beneficial to the Department, national security, and the U.S. taxpayer. Considering new providers, the DOD is interested in the capabilities of new NSSL class launchers as we prepare for our efforts beyond the Phase 2 contract for launch services procured in FY25. Additionally, we are already engaging in several efforts to use space launch providers who offer small and/or responsive launch capabilities. I am supportive of these efforts and believe the growth of the commercial space launch sector will directly support DOD's agility and strength in space. I am aware our counterparts in the NRO have procured launches outside the launch enterprise. However, the DOD coordinates closely with the IC to incorporate their requirements into our launch acquisition strategies, and we are committed to fostering competition in the industrial base.

Mr. KHANNA. The Air Force and Space Force have expressed support for new economic development to spur the space economy forward, increase launch cadences, and bring on new commercial capabilities. Both the rocket systems launch program for space and the tactically responsive space launch lines support this effort. Does the budget for these lines reflect the urgency of maintaining the U.S. commercial and national security edge in space?

General THOMPSON. As the Department of Defense identifies space requirements for responsive launch, acquisition of these capabilities will be appropriately budgeted for and reflected in the Department's overall strategy for space. I believe the current budget for U.S. space launch requirements addresses the current requirements, but anticipate the Department will request additional funding for these efforts as additional requirements are identified.

Mr. KHANNA. As SDA, DARPA, Space RCO and others continue to advance new capabilities within DOD, including satellite servicing and the deployment of satellite constellations, what is the strategy to engage and work with new launch partners who may be able to provide access to precise orbits at a lower cost point than traditional launch providers? More specifically, how is the Space Force team incorporating the Spacepower doctrine's call to provide "dynamic and responsive" launch to the arsenal?

Dr. SCOLESE. For specific questions on the Space Force team's implementation of their Spacepower Doctrine, please contact USSF. The NRO predominantly utilizes Space Force's Launch Enterprise Directorate to procure our launch services and leverages their R&D investment in launch systems addressing Space Mobility and Logistics objectives described in the USSF doctrine. However, the NRO recently awarded a Streamlined Launch Indefinite Delivery/Indefinite Quantity (IDIQ) Contract (SLIC) for risk tolerant payloads, which leverages commercial processes and growing competition among emerging launch service providers. Maximizing commercial practices to the greatest extent possible can reduce both cost and timelines from contract award to launch.

Mr. KHANNA. The Director of the Space Development Agency, Dr. Derek Tournear has not yet made a decision about which launch company or companies will take on the Tranche 1 mission. During a recent discussion he stated that it was unclear if it would be feasible to utilize SMC or the National Security Space Launch program due to budget constraints. Would you and your team support efforts to broad-

en the scope of available launchers to include new responsive launch capabilities being developed by newer entrants into the launch market? How is the NRO and NGA working to engage and increase competition in the launch market as well?

Dr. SCOLESE. The NRO has broadened the scope of available launch providers and competition through our recently awarded Streamlined Launch Infinite Delivery Infinite/Quantity Contract (IDIQ). New entrants can onboard onto the contract and be eligible for award of a risk-tolerant launch service or rideshare, after one successful orbital launch.

Many of our missions, however, require higher rocket performance, government insight and mission assurance, and are more complex from an integration and security perspective than commercial missions, driving additional costs. USSF and NRO share these costs so that National Space Security (NSS) unique costs do not encumber our domestic launch providers' commercial pricing. Adding more launch service providers to the National Security Space Launch Program (NSSLP) as it is currently structured, would increase fixed costs to the NRO and USSF.

The NRO fully supports an open competition among all qualified launch service providers for NSSLP Phase 3. We are currently working with USSF to develop an appropriate acquisition strategy that reflects the diverse needs of NSS missions and the likely state of the launch industry in 2025 and beyond.

Mr. KHANNA. The Air Force and Space Force have expressed support for new economic development to spur the space economy forward, increase launch cadences, and bring on new commercial capabilities. Both the rocket systems launch program for space and the tactically responsive space launch lines support this effort. Does the budget for these lines reflect the urgency of maintaining the U.S. commercial and national security edge in space?

Dr. SCOLESE. While the NRO does not comment on other agencies' budgets, the NRO is leveraging innovative commercial industry to supplement and in applicable, warranted cases, replace certain government systems through commercial imagery, launch services and cloud computing service, which will allow a whole new range of technologies to help expand our supplier base, potentially lower the cost, and possibly shorten program timelines with increased flexibility.

Mr. KHANNA. As SDA, DARPA, Space RCO and others continue to advance new capabilities within DOD, including satellite servicing and the deployment of satellite constellations, what is the strategy to engage and work with new launch partners who may be able to provide access to precise orbits at a lower cost point than traditional launch providers? More specifically, how is the Space Force team incorporating the Spacepower doctrine's call to provide "dynamic and responsive" launch to the arsenal?

General CLEVELAND. NGA does not have or provide any space launch capabilities.

Mr. KHANNA. The Director of the Space Development Agency, Dr. Derek Tournear has not yet made a decision about which launch company or companies will take on the Tranche 1 mission. During a recent discussion he stated that it was unclear if it would be feasible to utilize SMC or the National Security Space Launch program due to budget constraints. Would you and your team support efforts to broaden the scope of available launchers to include new responsive launch capabilities being developed by newer entrants into the launch market? How is the NRO and NGA working to engage and increase competition in the launch market as well?

General CLEVELAND. NGA does not have or provide any space launch capabilities

Mr. KHANNA. The Air Force and Space Force have expressed support for new economic development to spur the space economy forward, increase launch cadences, and bring on new commercial capabilities. Both the rocket systems launch program for space and the tactically responsive space launch lines support this effort. Does the budget for these lines reflect the urgency of maintaining the U.S. commercial and national security edge in space?

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Mr. LUDWIGSON. We have not reviewed efforts related to engaging with new launch partners or incorporating responsive launch into national security space programs.

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Mr. LUDWIGSON. We have not reviewed agency efforts to broaden the scope of available launch providers or increase competition outside of or within the National Security Space Launch (NSSL) program. In our August 2017 report on space launch coordination mechanisms, we found that federal agencies who acquire launch services—DOD, NRO, and NASA—spend over a billion dollars per year on space launch. While DOD and NASA use some of the same providers for their launches, each agency has separate acquisition processes and launch requirements. We found in the past that interagency coordination in space launch acquisitions has the potential to help leverage the governments buying power and eliminate the potential for redundancy and duplication. This past work found that coordination is important for operations and maintenance of launch ranges, scheduling launch missions, and government-wide strategic planning for launch. We found that opportunities exist for improving longer-term, government-wide planning for launch programs and for space programs in general. Acquiring launches outside of the current contract—the Phase 2 Launch Service Procurement—could sub-optimize the NSSL program's strategy to leverage the U.S. government's buying power to achieve the lowest overall cost of maintaining assured access to space. However, there are circumstances where using NSSL's larger launch vehicles (and associated costs) may not be justified, such as for experiments using small satellites.

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Mr. LUDWIGSON. We have not reviewed the extent to which the budget lines for the Rocket Systems Launch Program or Tactically Responsive Space Launch program support efforts to spur the space economy. However, in our May 2019 report on commercial space launch, we found that the industry was growing as U.S. launch providers capture a greater share of the global commercial market. We also found that the Federal Aviation Administration was expanding its workforce in anticipation of growth in the commercial launch industry but needed better information for long term planning. In our December 2020 report on options for supporting U.S. launch infrastructure, we examined FAA efforts to assess options to facilitate and promote greater investments in space transportation infrastructure. We found that FAA's assessment was limited and did not include a range of options that could better promote space transportation infrastructure to support national security, civil government, and commercial space customers at minimal cost to the federal government. We recommended that FAA examine a range of potential options to support space transportation infrastructure, including the necessary trade-offs of different potential approaches.

QUESTIONS SUBMITTED BY MR. MORELLE

Mr. MORELLE. For what reasons might organizations choose to acquire their own launches, rather than use the NSSL Phase 2 approach? How often has this happened? Is DOD paying more for NSSL launches because of programs seeking to launch their satellites outside of the NSSL contracts? How might this affect the Phase 2 launch service procurement plan?

Mr. HILL. [No answer was available at the time of printing.]

Mr. MORELLE. For what reasons might organizations choose to acquire their own launches, rather than use the NSSL Phase 2 approach? How often has this happened? Is DOD paying more for NSSL launches because of programs seeking to launch their satellites outside of the NSSL contracts? How might this affect the Phase 2 launch service procurement plan?

General THOMPSON. There may be limited instances (security reasons as an example) where other factors override the significant impacts to NSSL Phase 2 and future Government buying power. Any of these limited instances should be evaluated for negative impacts to the larger enterprise even if there are isolated benefits to individual programs. Procuring missions outside NSSL reduces future buying power across the NSSL-class spectrum and will affect the ability to maintain or improve on Phase 2 pricing in future procurements, especially for higher performance re-

quirements. National Security Space Launch (NSSL) has an unprecedented record of mission success with 87 consecutive successful launches. The NSSL approach achieves the lowest overall costs to the government across the full spectrum of mission needs, including assured access to space, demanding orbits, and complex satellites. NSSL Phase 2 dramatically reduced launch prices over Phase 1 and provides cost effective launch services for unique government requirements. The Department encourages maximum use of the NSSL Phase 2 contract. The significant impacts in acquiring NSSL-class capability outside the NSSL contracts include forfeiting the NSSL provided Mission Assurance, limiting the flexibility provided by the Phase 2 contract (assured-access to space through two providers, up to 1-year mission acceleration, fixed-price mission unique capabilities), and reducing future Government buying power.

Mr. MORELLE. There are reportedly 32,000 objects on-orbit, including roughly 7,000 active and retired satellites. Does DOD have sufficient space situational awareness to monitor and assess risks to space systems and what are the risks of space congestion to DOD operations?

General THOMPSON. The United States Space Force operates a variety of ground- and space-based sensors that track and characterize space objects. While this system of systems has been adequate to the track objects in the past, in an era of rapidly expanding space actors, from commercial actors to countries, we are seeing more satellites and associated debris than ever before. To ensure the Space Force is able to maintain our Space Domain Awareness (SDA) in a congested space environment, we are investing in new technologies and pursuing new data sources to enhance our capability to detect smaller objects and more of them. This includes incorporation of data from the rapidly expanding commercial SDA market and collaboration with Allies and partners to share information and sensors, as authorized, in a coalition approach to SDA.

Mr. MORELLE. For what reasons might organizations choose to acquire their own launches, rather than use the NSSL Phase 2 approach? How often has this happened? Is DOD paying more for NSSL launches because of programs seeking to launch their satellites outside of the NSSL contracts? How might this affect the Phase 2 launch service procurement plan?

Dr. SCOLESE. In rare cases, the NRO has the ability to use alternative methods to procure launch services depending on the satellite program's objectives, and when doing so, will still seek input from the USSF. In selecting an NSS Launch Program (NSSLP) or non-NSSLP launch strategy, program objectives are balanced across all program factors including national security policy, cost, schedule, and performance objectives. NRO procured launch vehicles outside of the NSSL procurement were previously approved and not included in the procurement plan. We defer to USSF on the costs of NSSL launches and any potential to impact future pricing for Phase 3 launches.

Mr. MORELLE. There are reportedly 32,000 objects on-orbit, including roughly 7,000 active and retired satellites. Does DOD have sufficient space situational awareness to monitor and assess risks to space systems and what are the risks of space congestion to DOD operations?

Mr. LUDWIGSON. GAO has not done work to verify the count of objects tracked on-orbit, nor has GAO specifically assessed the overall sufficiency of DOD's space situational awareness (SSA) systems. We have reviewed SSA programs for over a decade, including an in-depth review on SSA funding in 2015. Our past work has shown that SSA data are provided by a variety of sensors and systems from across the commercial, civil, military, and intelligence communities. As space continues to become more congested and contested, SSA systems are key to ensuring safe operation of space assets for the U.S. government. As such, DOD has made investments in SSA, such as the Space Fence radar system, which significantly increased the number of objects that the U.S. can track in space, and the Space Command and Control (Space C2) program, which is expected to significantly improve processing and dissemination of SSA data. U.S. Space Force documentation also emphasizes the importance of information on orbiting objects. For example, in its Space Power Space Capstone Publication, U.S. Space Force identifies Space Domain Awareness (SDA) as one of its five core competencies. The Capstone defines SDA as the effective identification, characterization and understanding of any factor associated with the space domain that could affect space operations and thereby impact the security, safety, economy, or environment of our Nation. It goes on to emphasize that to maintain awareness of spacecraft orbiting in the domain, space forces need to know not only orbital trajectory but also mission related details such as missions, intentions, system capabilities, patterns-of-life, and the status of consumables and expendables. Whether DOD's investments are sufficient to meet the needs of the rapidly-changing space paradigm is not something we have examined but the an-

swer appears unclear at this time. For example, in 2019, we found that DOD faced a number of challenges in developing new command and control capabilities under its Space C2 program, including management issues and technical complexity. We also found that the DOD faced limits in processing the increased amount of SSA sensor data with current data systems. DOD concurred with recommendations we made for addressing such challenges. We are continuing to monitor the development of SSA capabilities. Specifically, we are reviewing Space C2 program annual reports in response to a provision in the National Defense Authorization Act for Fiscal Year 2020. Additionally, beginning this year we plan to initiate a review of the National Space Defense Center's SSA needs and role in integrating SSA data in response to a provision in the House report to a bill for the Intelligence Authorization Act for Fiscal Year 2021.