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COMMITTEE ON
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TO RECEIVE TESTIMONY ON SPACE
FORCE, MILITARY SPACE
OPERATIONS AND PROGRAMS

Wednesday, May 26, 2021

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U.S. Senate
Committee on Armed Services
Subcommittee on
Strategic Forces
Washington, D.C.

The committee met, pursuant to notice, at 4:30 p.m. in Room SR-232A, Russell Senate Office Building, Hon. Angus King, chairman of the subcommittee, presiding.

Committee Members Present: King, Rosen, Kelly, Fischer, Rounds, Cramer, and Tuberville.

OPENING STATEMENT OF HON. ANGUS KING, U.S. SENATOR FROM MAINE

Senator King: The Subcommittee on Strategic Forces will come to order for a hearing on testimony about Space Force, military space operations, policy, and programs. Let me first thank our witnesses for appearing with us today at today's hearing on the Department of Defense's effort to ensure that the United States has freedom to navigate and use space for peaceful purposes.

Space is becoming a congested and contested domain. There are more than 2,000 satellites in orbit. SpaceX deploys 60 satellites at a time for global internet coverage. The Department of Defense Combined Space Operations Center tracks over 33,000 objects in orbit, including 13,000 pieces of debris that can impact other satellites and the International Space Station.

It is also becoming a contested domain. Both China and Russia are reported to have systems that can threaten U.S. military and civilian satellites.

In response to the increasing importance of space and the threats to it, the fiscal year 2020 National Defense Authorization Act created a new Title 10 service, the U.S. Space Force, to train and equip personnel to protect our space assets and ensure space is integrated into our national security strategy. Likewise, the Unified Command

Plan was modified to stand up the U.S. Space Command with an area of responsibility of 100 kilometers above the Earth's surface. I love the idea of an AOR 100 kilometers above the Earth's surface.

Today's hearing will examine the efforts of the Department of Defense to implement the strategy laid out in the fiscal year 2020 Authorization Act.

Ms. Costello, you are responsible for Air Force acquisition, including space. The fiscal year 2020 National Defense Act creates a new space service acquisition executive to consolidate disparate space acquisition functions inside and outside the Air Force. I want to know how that is progressing and issues you may face implementing this consolidation.

Mr. Hill, the act also created an Assistant Secretary of Defense for Space Policy, to assure that there was a senior civilian in the Secretary's office with oversight of the Space Force and the Department's interested in space, especially with respect to norms of behavior. I want to know what actions you are taking on oversight and with the interagency to promote responsible norms of behavior in space.

General Thompson, your job is to stand up a new Title 10 force. I want to know what issues you face in training and equipping the Space Force and integrating its operations

across the Department of Defense, especially with the combatant commands.

Again, let me thank everyone for appearing today. After Senator Fischer's opening statement each witness will have 5 minutes for their opening statements and then we will alternate with members for 5-minute rounds of questions.

Before turning it over to Senator Fischer, I want to say that I had an excellent visit to Colorado Springs less than 2 weeks ago at the Space Force facilities at Cheyenne Mountain, and many of the men and women who are leading this country's effort in space. It was a very impressive visit, and please take back my compliments to those people, particularly those young people who are standing on guard for us, and how much this committee appreciates what they are doing.

Senator Fischer.

OPENING STATEMENT OF HON. DEB FISCHER, U.S. SENATOR FROM NEBRASKA

Senator Fischer: Thank you, Senator King, and I join you in welcoming our witnesses today. We appreciate your service and for you appearing before us today.

As the chairman noted, this is the subcommittee's first hearing on space since the creation of the Space Force, and I look forward to hearing the witnesses' assessments about the progress that has been made in this regard. The chairman also points out that space is congested, contested, and also competitive. While I appreciate the effort that the Department has made to educate members of this subcommittee about the activities of our adversaries in this emerging domain, more must be done to educate the American people about the threats that our nation faces in space.

The desire to classify information is understandable, but it can also lead to a false sense of security, and then that would hamper our work to ensure that military space operations, policies, and programs are keeping pace with the changing threat environment. Simply repeating the same refrain -- congested, contested, and competitive -- is not sufficient. We need the Department's help to tell a better story about the changing character of the space domain.

Thank you, Mr. Chairman.

Senator King: Mr. Hill?

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

Mr. Hill: Thank you, Chairman King and Ranking Member Fischer, and distinguished members of the committee. It is an honor to testify before you today with my distinguished colleagues here. You have my full written statement, and with your permission I will summarize it and ask that it be included in the record.

Senator King: Without objection.

Mr. Hill: As this committee well understands, the importance of space-based capabilities to our nation and to our national security in this era of destabilizing challenges from Russia as well as undeniable strategic competition with China. As Secretary Austin testified, the growth of Chinese and Russian counterspace capabilities presents the most immediate and serious threats to U.S. allied and partnered space assets and activities. Moreover, Russia and China views space as critical to modern warfare and see the use of counterspace capabilities as both a means of reducing U.S. military effectiveness and winning future wars.

So as these developments portend, the United States must now be prepared for the possibility that conflict would extent to or originate in space. And to be clear, as we have said on many occasions, this would not be a space war

distinct from terrestrial war. This represents the extension of traditional armed conflict into the space domain of human endeavor.

So within the Office of the Assistant Secretary of Defense for Space Policy we are focused on the integrity of strategy, policy, plans, and appropriate means to develop a space posture that contributes to integrated cross-domain deterrence, by conveying clearly to potential adversaries as well as competitors the inadvisability of military aggression, to include 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 challenges of crisis de-escalation and warfare extending to space along four lines of effort.

The first line of effort we describe as building a comprehensive military advantage in space, and that has much to do with the work of the U.S. Space Force in standing up the capabilities and organizing, training, and equipping.

The second line of effort we describe as integrating space into the national and combined operations, and that has much to do with the work of the U.S. Space Command.

The third line of effort is shaping the strategic environment in ways that enhance domain stability and reduce the potential for miscalculation. A fair amount of that

comes to our office in the Office of Secretary of Defense, working with the rest of the Department enterprise.

And fourth, we are enhancing space cooperation with commercial entities, with our interagency partners, and with our international allies and partners.

Finally, in support of the National security strategic guidelines, my office leads the Department of Defense's participation in the U.S. Government's space diplomatic activities, and those activities are centered, as your opening remarks noted, on establishing nonbinding, voluntary norms of responsible behavior, as well as on exposing quite disingenuous space arms control proposals of others, notably Russia and China.

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

[The prepared statement of Mr. Hill follows:]

Senator King: Thank you, Mr. Hill. Ms. Costello, please.

STATEMENT OF DARLENE J. COSTELLO, ACTING ASSISTANT SECRETARY OF THE AIR FORCE FOR ACQUISITION, TECHNOLOGY, AND LOGISTICS

Ms. Costello: Chairman King, Ranking Member Fischer, and distinguished members of the subcommittee, it is an honor to appear before you today. General Thompson and I have submitted our statement for the record, but I would also like to take a few moments and discuss specific items that you included in the letter that invited me here, that may not have been in that statement.

First, the Department is taking a proactive and clean-sheet approach to reducing bureaucracy so that we can deliver technologies at the speed of relevance. This includes stand up of the space system's command, the close partnership with the Space Rapid Capability Office and the National Reconnaissance Office, and multiple efforts to bring stakeholders together across the space enterprise.

We are also optimizing space acquisition by streaming requirements validation, accelerating decision and contracting speed, maximizing budget stability within programs and flexibility within portfolios, and increasing program execution efficiency. The Department is continuing to work daily towards implementing the congressional direction on the stand-up of the Assistant Secretary of the Air Force for Space Acquisition and Integration, including

the responsibilities and duties of the Service Acquisition Executive for the U.S. Space Force, that, as specified in law, will begin on October 1, 2022. I remain a committed steward of our space acquisitions until that time.

Across the department, we continue to emphasize flexibility and collaboration between the Space Force, the Joint Requirements Oversight Council, and other stakeholders. This includes efforts to rapidly validate capabilities, leverage the DoD's adaptive acquisition framework, and utilize new authorities such as mid-tier of acquisition.

While we are cutting bureaucracy where it makes sense, there is a deliberate effort to maintain rigor in each program and achieve speed with discipline. Many of our programs do benefit from these authorities, including several in the satellite communications portfolio. We are continuing to develop efforts to build disaggregated strategic and tactical communications systems to meet emerging threats over the next decade. Disaggregating the mission allows the Department of the Air Force to capitalize on commercially developed advancements and best practices in order to improve capacity and flexibility for the warfighter.

The Navy has also turned over the management and acquisition of the Mobile User Objective System, MUOS, and

future narrow-band communications systems to the U.S. Space Force, and two additional MUOS satellites will be acquired beginning in FY 2022. The replacement for the Advance Extremely High Frequency Strategic Mission, known as the Evolved Strategic SATCOM, will begin operationally augmenting the protected strategic SATCOM constellation while adding resiliency and cybersecurity capabilities by the targeted need date of FY 2032.

The U.S. Space Force is both expanding and deepening its relationship with the commercial space sector to ensure combat effectiveness across all domains. In FY 2022, the U.S. Space Force is planning to award a first-of-its-kind contract delivering all available commercial capabilities from new, low-earth orbit suppliers. Capabilities may include weather, space domain awareness services, voice data internet, alternate positioning navigation and timing services, intelligence surveillance and reconnaissance, and backhaul services to provide rapid data transmission.

For future wideband, the Department is exploring a hybrid capabilities set that will blend contributions across military purpose-built systems, commercial systems, and international partnerships.

The last year has demonstrated the need for increased missile warning, missile defense, battlespace awareness, and technical intelligence capabilities that are more survivable

against emerging adversary threats. The first resilient geosynchronous satellite for the next-generation, overhead-persistent, infrared satellite system remains on track to meet the warfighter's 2025 need date, and has met every major milestone on time.

Additionally, the ground system development, known as the Future Operationally Resilient Ground Evolution, or FORGE, remains on track and has a robust risk reduction effort to ensure the required initial launch capability is supported on time. Delivering this missile warning system is essential to the future force, and Section 804 accelerated acquisition authorities are critical to enable delivery of the satellite in 2025. By using that authority, we saved at least 18 months compared to using traditional major program acquisition processes just for that effort.

The global positioning system, GPS, remains the gold standard for precise positioning navigation and timing, for not only the United States military but for the world. New capabilities are being brought online for enhancements to the GPS constellation that will benefit warfighters and civilians. The Department is refreshing the constellation to enhance anti-jam performance and looking into the development of alternative position navigation and timing technologies, not to replace GPS but to augment GPS.

In conclusion, the Department is optimizing space

acquisitions. This optimization require reform in many areas, to include requirements, budget, and acquisition processes. We are pursuing ways to accelerate delivery of operational capability, reduce program risk, and enhance the nation's ability to respond to an evolving and ever-more-capable threat.

We thank you for the recent authorities such as Section 804 middle-tier acquisition. We will continue to work with the Office of the Secretary of Defense, the Executive branch, and the Congress to optimize these processes while increasing transparency of our actions, to enable the Department to operate with speed and agility in the face of evolving and pacing threats.

I thank Congress for your leadership and support. We are eager to work with your subcommittee to secure our nation's vital interests, and I look forward to your questions.

[The joint prepared statement of Ms. Costello and General Thompson follows:]

Senator King: Thank you, Ms. Costello. I think you packed more information into that 5 minutes than I have encountered in a lot of congressional hearings. That was a lot of data. Thank you so much.

General Thompson.

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

General Thompson: Chairman King, Ranking Member Fischer, and distinguished members of the committee, thank you for the opportunity to testify today in my capacity as the Vice Chief of Space Operations, United States Space Force, and on behalf of our Chief of Space Operations, General Jay Raymond, and joined by these national security space leaders on the panel today, it is a pleasure to provide you with an update on the details of 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 for your leadership in addressing the threats and challenges that face the nation in space.

Year one of the Space Force's existence has been focused on standing up the new Service. With purposeful outreach to and the collaboration of Congress, U.S. Space Force has made tremendous strides in this first year, establishing and resourcing the organizational blueprint for the Service, moving aggressively in the area of human capital, force design, and acquisition and integration, as well as providing foundational support for a truly digital

service, all of this while executing our critical space missions around the clock and without fail.

General Raymond's direction for year two is integration of the Space Force into the Joint Force and within the interagency, while we continue to build out the Service. We have completed the congressional requirement to establish the Space Force within 18 months, but build-out of the service will continue. We have established the first field command, Space Operations Command, and completed design and resourcing of the remaining two, Space Systems Command and Space Training and Readiness Command, with anticipated stand-up of these two organizations later this year.

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

As part of year two integration, the Space Force will place increasing emphasis on strengthening relationships with existing partners and establishing relationships with new ones. That includes the other services, combatant commands, the intelligence community, our allies, and other

international partners. The United States as a whole, and the U.S. Space Force in particular, are that much stronger when the relationships with these other agencies are strong.

Next, General Raymond and the entire leadership of the Department of the Air Force remain 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 leverage, smartly, the 804 authorities that have been granted by Congress, and will partner with industry and academia to leverage technology and innovation of those sectors. Our adversaries have recognized the importance of such an approach to national security space. In my opinion, the creativity, ingenuity, and innovation of the American mind is one of our greatest assets. We must fully leverage that asset in this endeavor.

Our people, our Guardians, are critical to the success of the Space Force. We are adopting new and innovative human capital and talent management approaches for civilians and military members alike, under the authorities granted by Congress and with your assistance. In addition, the recently released Vision for a Digital Service seeks to build the fluency of that workforce and posture the Service to be agile and innovative far into the future.

Finally, the U.S. Space Force will continue to partner

with other agencies in the Executive branch and Congress to protect U.S. interests in space, promote responsible behavior in the domain, and ensure that it is secure, stable, and accessible for peaceful use by all.

Our Service's inception is an unprecedented opportunity. Our success to date could not have been possible without the passionate and energetic efforts of a small group of Guardians, fully committed partners in the Departments of the Air Force and Defense, and the support of Congress.

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

Senator King: You mentioned it a couple of times. I learned in Colorado Springs that we have airmen in the Air Force, sailors in the Navy, soldiers and Army, and guardians in the Space Force. Is that correct?

General Thompson: Yes, sir, that is correct, and it reflects longstanding heritage of Air Force Space Command, where we were known as "guardians of the high frontier."

Mr. Kendall: Thank you. Let me just, just to get sort of an update which you have provided, where are now in terms of end strength of the Space Force? How many personnel, civilian and uniformed, and where do you expect that to go in the next couple of years?

General Thompson: Yes, sir. Today our end strength stands in, I will say, three categories. The first is uniformed military members today is about 6,400 members. About 6,000 of those transferred in from the Air Force in the last year. We are in the process now of bringing in inter-service transfers from the Army and the Navy as well. We have about 6,000 civilians assigned to the Space Force as well. Like the Department of the Navy, all U.S. Navy and U.S. Marine Corps civilians are Department of Navy civilians, but 6,000 of those civilians are specifically assigned to the Space Force.

Senator King: And how is recruiting? I know that General Raymond, I think is at the Air Force Academy today. I have a feeling he is also fishing for top graduates for the Space Force.

General Thompson: Yes sir, he is. In fact, today 218 members of the class of 2021 from the Air Force Academy joined the Space Force. That includes the top two graduates in the graduating class. So our recruiting has not been a challenge. Our challenge has been ensuring that we find the right set of high-caliber officers, enlisted, and civilians to join the Force.

Senator King: Thank you. Mr. Hill, you mentioned, I think, there was one treaty for space that goes back to 1967, and one of the things you mentioned in your testimony

was norms and standards. Where do we stand on trying to establish international norms? What are the bodies that are working on that? Are we taking a leadership role? Is there any interest in the other space-faring countries like Russia and China in trying to establish some kind of rules of the road for space?

Mr. Hill: Yes, Senator King. So the treaty you referred to, the 1967 Outer Space Treaty, how it is known, it is one of four that the United States is a member of, but that is the fundamental bedrock treaty in the international space law.

And with respect to what we are focused on today in nonbinding, voluntary standards, the first place I would point to is there is a Committee on Peaceful Uses of Outer Space, as part of the United Nations organization, that is actually the organization that originally created the Outer Space Treaty. But that is the organization that has developed the debris mitigation standards that are in use today, guidelines on space sustainability that were produced a few years ago, 21 guidelines, that came out of really a user's consensus group of commercial and government, civil, military, that participated in that. Slow processes in the United Nations. It took about 10 years to do that, and a lot of these things have to do with simple facts of what certain information --

Senator King: Don't blow up satellites --

Mr. Hill: Well, there is a good one.

Senator King: -- and leave the debris --

Mr. Hill: And don't leave the debris all over the place. And when you get in the military world, that is clearly one of the ones that people are looking at.

Senator King: So are there active discussions? Is this a live process or is it moribund?

Mr. Hill: Within the arms control world there are proposals, but what tends to be proposals is -- the United States has pushed that very point. What gets pushed back is proposals such as Russia and China saying, "We will not be the first to put weapons in space." Well, as we have noticed, as we have noted in many places, Russia and China tested weapons in space. Russia tested one near one of our satellites just a few years ago. So that is when I refer to the disingenuous proposals of saying we will not be the first nation to put a weapon in space; don't mind our satellite that is near one of your satellites, that might be testing weapons.

So the process is easier when you are dealing with the basic peace-time types of operations. It is obviously much harder when you get to something like the example you offered, sir.

Senator King: Thank you. We will have a second round.

Ms. Costello, we will talk about acquisition. Senator Fischer.

Senator Fischer: Thank you, Mr. Chairman. I would like to follow up with you first, Mr. Hill, when you were talking about Russia and China perhaps being disingenuous in space. In your statement that you prepared and that has been entered into the record, you were pretty adamant about the efforts that we are seeing from Russia and China in space. Can you go into a little detail there?

Mr. Hill: Certainly. So I just referenced one example, which was a test of a satellite in low-earth orbit that is sort of, what we call a nesting-doll structure. It has within it another satellite and then a third one that can release a kill vehicle, an interceptor. That is an example of a Russian satellite being developed. Both countries have tested anti-satellite missiles. Both countries are developing ground-based laser capabilities to dazzle satellites or damage satellites. These would be some examples that we can now talk about publicly.

The mention earlier about declassification, there is both declassification, what we do, which needs to be updated, or reclassification up to date, but we also need to be realistic. There are more things we can talk about, about what adversaries do, educating the public, to your point earlier.

Senator Fischer: Right. Thank you for noticing that in my opening statement. I think it is extremely important that the press gets this information out to the public, and thank you for the couple of examples that you have put forth there. It is, I think, necessary that the public understands the threats that we do face as a nation, and that these threats are very serious.

I understand that we have been very supportive of an effort that is led by the United Kingdom regarding acceptable behavior in space domain. Can you speak to that a little bit?

Mr. Hill: Yes. So last fall at the United Nations, when Russia and China were once again putting forward their proposal for the treaty I mentioned on preventing the placement of weapons in outer space, the United Kingdom and the United States and other countries looked forward and said, "What can we do that is a little more productive than that, and not just vote no but offer something as an alternative?" The United Kingdom put forward a proposal that ultimately passed with large numbers, to have nations submit their ideas on what should be some norms of responsible behavior in space. I think about 25 countries did put in submissions at the beginning of this month. The United States was one of those. And certainly the notification of our operations, the debris mitigation, the

safe trajectories that we fly, safe distances we maintain were all some examples that we provided in that report, and they are all filed with the United Nations and posted now.

Senator Fischer: You know, we have talked a lot about deterring hostile activity in space over the years and moving to a more defendable satellite architecture system. But do you believe that a defense-only approach will be successful in the space domain?

Mr. Hill: Senator Fischer, I like to refer to mission assurance. Defense is one piece of mission assurance. But it is better to start off with architectures that do not require so much defense in the first place. What we face today is the legacy of having designed architectures in an era when we did not face the kinds of threats we face today, and transitioning to a new era.

If you look at all the other domains, they have gone through this before, where yesterday's system became vulnerable to tomorrow's threat, but we found a new way to be resilient. We also found a way to reconstitute capabilities if they are lost. All three of those pieces go into mission assurance.

Senator Fischer: Thank you. General Thompson, I have been on this subcommittee for 9 years and I feel like every year we have a debate about space launch. But sometimes this debate distracts from the significant progress that has

been achieved in this area through the years. The Phase II awards were announced last August and they, I think, demonstrated how far we have come, from a single provider to a four-way competition that produced two winners, saved the taxpayers money, and it provided assured access to space.

Can you give us your view on the progress that has been made, and please speak to how this competition has enabled a stronger industrial base for us, and then touch on why it is important to space launch.

General Thompson: So, Senator Fischer, you characterized it incredibly well, and I am not sure if I can add to that, but I will. You are correct. We are in the final stages. We have, in fact, the ability to have two providers who can deliver our national security satellites to any orbit required for mission performance is incredibly important. In fact, I have been part of the space launch community for more than 25 years, and I can tell you, back at the turn of the century, we had a tremendous problem with the ability to deliver those payloads because we had a series of launch failures. And so the importance of two fully qualified providers to do that is a vital part of national security access to space. The fact that we have done that and it is coupled with not just a strong national security market but a commercial market as well, increases our security, not from a military standpoint alone but also

from an economic standpoint.

And I think, finally, the last key feature is we are now in a path here in the next couple of years to get finally off of the Russian RD-180 engine and have two launch vehicles that are fully owned and produced and operated from the industrial base of the United States. I think it is absolutely a measure of the success of the strategy that we followed. It is paying off. There is still some fragility, and so we need to continue with the Phase II approach. But very quickly here, in the next several years, we will begin looking to beyond that and how to further strengthen the base and the competition associated with national security.

Senator Fischer: Very good. Thank you, sir. Thank you, Mr. Chairman.

Senator King: Channeling our former chair, John McCain, he would be delighted to hear you say we are getting off the RD-180. I can assure you of that.

Senator Rosen, via Webex.

Senator Rosen: Well, thank you, Chairman King, of course Ranking Member Fischer. It is really an important hearing that we are having today on U.S. military space policy programs, and I really appreciate all the witnesses here for your service.

And so, of course we think about our cyber mission as it relates to our space programs, and it is no secret that

our adversaries, of course, see the value of the space domain and they are developing counter-space capabilities to undermine our interests, including the cyberattacks. You have to look no further than the news probably every day about that.

So cyberattacks on our space systems could result in the loss of data or services that are provided by our satellites, which could have a widespread effect, catastrophic effect, if used against a system such as our GPS systems.

So General Thompson, could you speak to how Space Force is working to keep our space-based assets, including satellites, safe from these kinds of cyberattacks that we have seen, specifically in recent weeks against things like the Colonial Pipeline, SolarWinds, and the like?

General Thompson: Senator Rosen, you characterized that threat very well. I will briefly tell you three things that we are doing to protect our space systems from the cyber threat.

The first is existing systems, as Mr. Hill explained, were not really designed with a cyber threat in mind, but we have gone through a series of assessments on all of them, understood the security challenge that we face, and while I will call them "bolt-on capabilities," we have still added cyber defensive and cybersecurity aspects to them when and

where and how we can.

The second aspect of that is from here forward absolutely designing our systems with cybersecurity in mind from the very beginning. Reverting back to my days as an Air Force member, you do not choose, in an airplane, whether you are going to have an engine or wings. You require both to execute the mission. Cybersecurity is now a fundamental part of everything we need for our systems.

And then the third piece is we are building out what we call mission defense teams. Those are cyber defense teams for every system, for every operational organization who understands the cyber capabilities, are highly trained in defense and hunting and finding threats, and addressing them and providing that first line of defense.

So it is those three things -- covering down on the vulnerabilities of current systems, designing in cybersecurity, and fielding these teams to protect the systems, are three aspects of what I will call cybersecurity and cyber defense.

Senator Rosen: Well, thank you. I was going to ask you about being sure you do that in future acquisitions and how you are using machine learning and artificial intelligence, but I am going to actually move forward into talking about a few bills I had in the NDAA that you say you are building up your cyber workforce. I had a bill for

JROTC to provide a STEM track for those young men and women who want to serve, so they can begin their service in the cyber field in so many ways. And we have the PROMOTES Act, another piece of bipartisan legislation that is going to do some of those things.

So I would like to ask General Thompson and then Mr. Hill, how could things like the JROTC STEM program help the Space Force carry out its mission, and how do you plan to grow the Space Force STEM outreach program so we create the workforce, because we are going to have to incorporate artificial intelligence, machine learning, quantum computing, and all of what we do in our future acquisitions going forward. So General Thompson and then Mr. Hill, please.

General Thompson: Senator Rosen, STEM is critical to everything that the Space Force does. We are focused on mission only, which means we do operations intelligence acquisition in cyber, and as you understand, those are all very focused on STEM training and STEM education. And we cannot just wait for STEM-qualified applicants to come and ask to join the Space Force.

So working with the Air Force recruiting service, working through the ROTC program, and working through some of those other organizations like Junior ROTC and some other younger STEM outreach programs, we are doing an outreach

program to go to specific areas, look for those areas where those STEM specialties are, and go recruit, starting from, for example, high school, get that talent interested, offer them opportunities for education, either through an ROTC program or civilian through a special college training program, if they choose STEM degrees and commit to a career in the Space Force. Those are just a couple of things that we are doing and we have begun to do as part of our efforts.

Senator Rosen: Well, thank you. I see that my time is just about up, but as we do think about how we have to grow in so many ways we have to have the human capacity in order to fulfill our missions as well, so I am glad you are looking towards that.

Thank you, Mr. Chairman.

Senator King: Thank you, Senator Rosen. Senator Rounds.

Senator Rounds: Thank you, Mr. Chairman. I appreciate you putting this together today and having this discussion. Thank you to all of our witnesses as well for taking the time to come in and brief us with your expert testimony.

Let me just begin by clarifying one item with regard to the Russian-made RD-180 motors that we were using to do some of our space launch in the past. Are we using the RD-180s today?

General Thompson: Senator, we are. We have

congressional authorization for use for those motors for up to 18 more launches. Our current plan has us using those motors for 6 launches, and by the time we have done that the new motor for the Vulcan launch system should be operational and we should finally be off of that.

Senator Rounds: So at that time we will then have two separate companies with launch capabilities that are not reliant on the RD-180 engine anymore.

General Thompson: That is correct, Senator.

Senator Rounds: Great. Thank you. I think that would make John McCain very happy to hear.

Let me also just, next, with General Thompson, the sensitivity for these special programs seems critical. How critical is it for the Space Force to adopt and field a rapid acquisition model in order to build capabilities at the speed of relevancy today?

General Thompson: Senator, while we remain the best in the world in terms of developing and fielding capabilities, adversaries, particularly China, are rapidly catching up. By our current acquisition baselines, they have cycle times to be able to field two generations of new systems every time we field one, and at that pace that means that not only will we be outpaced but they will begin accelerating away from us. So it is important to have a more rapid acquisition and prototyping process in order not just to

keep pace with the threat but actually to maintain our lead.

Senator Rounds: You are talking about specific military applications, in terms of their capabilities.

General Thompson: I am, yes, sir.

Senator Rounds: Are you talking about applications that are for defensive purposes or for offensive purposes, or both?

General Thompson: So in this case I am specifically talking about defensive purposes, but not just defensive purposes. Really, the importance of space is what it delivers to soldiers, sailors, airmen, Marines. If it does not matter to them, it does not matter to us. And especially those capabilities must continue to keep pace, and we have got to defend them and ensure they are there in all phases of conflict.

Senator Rounds: I think sometimes we think about space as being the location where we have the ability to observe, to monitor, to detect, but that is changing rapidly, at least it would appear to me that it is. And it is very similar to what -- and I think we have talked about in the past -- in World War I, with the primitive aircraft that we had at that time. At first they were used for observation. Then they figured out that they could drop a bomb from one, or toss a grenade over the side. And then pretty soon it became a case of one aircraft defending the folks that were

on the ground from another aircraft, and you had fighter aircraft being developed. And then you had fighter aircraft developed to shoot down bombers.

Where are we at right now with regard to space? It would appear to me that we are entering that phase right now where we have seen that China has already demonstrated, irresponsibly, that they could blow up a satellite in low-earth orbit. They left debris all over the place. Now they did it to their own, but they did it, nonetheless. They knew that we could see it. Are we to the point right now where, when we talk about the different domains -- air, land, sea, space, and cyberspace -- would it be fair to say that we are in that position to where we not only are observing from space but we are preparing to actually wage war in space?

General Thompson: Senator, I think the analogy is very good. What you described happened over the period of about 8 months, in early 1914 and 1915, in World War I, while it took 60 years or more to get to that case in space. Space has been used for observation, for surveillance and reconnaissance, to provide services for a long time. As you stated, Russia, China, and others are attempting to take those capabilities away from us. As a result, we are proceeding rapidly to do several things. The first is defend those capabilities, and the second is, as Mr. Hill

noted, field new architectures that are resilient under attack, that are not as sensitive to those sorts of threats.

Senator Rounds: They recognize that the kinetic attack that the Chinese did to their own satellite was one that brought international challenge to them, and some embarrassment, perhaps, to them as well, for their irresponsibility. Would it be fair to say that in the future we are going to see directed energy weapons as one of the alternative sources, not only being space-based in terms of attacking ours but probably with regard to their own systems in space being able to use directed energy weapons systems to damage our systems as well, and that we are pretty close to that today?

General Thompson: Senator Rounds, the future is now with respect to ground-based directed energy weapons, absolutely, and there is no reason that technology would not allow folks to examine other basing opportunities.

Senator Rounds: Thank you. Thank you, Mr. Chairman. My time has expired.

Senator King: Senator Kelly.

Senator Kelly: Thank you, Mr. Chairman, and before I turn to our witnesses I would like to thank you for holding today's hearing. And I have been fortunate enough to see the promise and also the opportunity of space exploration, more directly I guess, than most, and I am glad now to be

part of this committee, focused on ensuring that we can defend U.S. interests and promote stability and security in this increasingly contested domain.

Arizona has always played a critical role in our nation's defense, and I am proud to say that that is going to continue with Arizona supporting one of the first 10 JROTC Space Force units in the country. Pretty exciting. It is at Shadow Mountain High School in Phoenix.

And I want to now follow up a little bit on what Senator Rounds was saying. The destruction of that satellite, that Chinese satellite, by their own forces, presented an interesting problem for me. I was the commander of the Space Shuttle on the very next shuttle mission to launch, and it became an issue. I had to maneuver the Space Shuttle out of the way of some of that debris, and it presents an increasingly complex hazard for us, and not only those thousands of objects but there are tens of thousands of others. And as space becomes more congested, I think our ability to cooperate with other nations is going to become more important.

So this question is really for all three of you. How do each of you propose that we work with our allies, and our adversaries, to maintain stability in this domain and ensure that space is usable and operational and functional for us and our allies?

General Thompson: Senator Kelly, I will start briefly and pass to Mr. Hill, because his organization leads a lot of the activities we have with allies and partners.

First of all, we have had a longstanding relationship with many close allies in the past. It begins with some of our closest allies, European allies and Australia as well as NATO partners. Understanding the threats and challenges of the domain, understanding how we need to work together, and understanding how collectively we can create a deterrence and security effect has been an ongoing activity that we have seen.

The second thing I would like to add, though, is with the creation of the Space Force we have seen other nations, who have not been traditional military allies, express interest in relationships and beginning talks. I will give you two examples -- Brazil and India. They have engaged us. In fact, our first bilateral exchange with any nation in the Space Force was with the nation of Brazil. They see this, and we see this, as an opportunity to pursue common interests, especially focused on security and stability. And as you would note, we will pursue that opportunity with any country who is interested in peaceful use and security and stability.

And then finally, I think it is incumbent on us friends, third parties, and potential adversaries alike is

we have to have a discussion of rules of engagement, norms of behavior, and how to behave responsibly.

Senator Kelly: General, so with regards to LEO in particular, do you, as we are tracking relatively small objects, there are thousands of them. When you get a state vector on those and you can see that it is going to approach not only our allies but sometimes our adversaries, you know, satellites on orbit, do we share that information? Because there is also benefit for us to make sure that even somebody who is not necessarily on our side, that this does not become an issue for them because it will further increase the problem if there is an impact.

General Thompson: Senator Kelly, through our 18th Space Control Squadron and the Combined Space Operations Center, we do that deconfliction with all objects we track, and we will advise any owner or operator, friend, foe, or disinterested third party, and have done so in the past.

Senator Kelly: Mr. Hill?

Mr. Hill: Senator Kelly, to pick up on that question, most all space operators that we contact, that the squadron contacts, are very glad to engage with us. There are two countries that often do not pick up the phone or answer the email, and what we are trying to focus on is your basic safety. We have data. We do not have the perfect information. What do you have from your satellite

operations? Do we have a potential conjunction/collision here or not? It may be debris. It may be an active satellite and a dead satellite, or International Space Station, in your case. So that is a basic principle. Communicate, and when you have data, most data can be shared and used for these safety reasons.

Senator Kelly: Well, thank you for doing that. I think it is a thing that we need to continue to do, because if we do not -- you know, as you know, these objects reenter eventually. We have just got to make sure we are not adding more than is coming back into the atmosphere. Thank you.

Senator King: Which are the two countries that do not answer the phone?

Mr. Hill: Our good friends Russia and China. We have established communications in some circumstances. It is not 100 percent. But with most people we know who is the operator to contact, so we end up having to use diplomatic channels, and it is much more complicated process. So you would want to be able to work on basic safety and flight operations.

Senator King: Thank you.

Senator Kelly: Mr. Chairman, could I just follow up for a second?

Senator King: Please.

Senator Kelly: So the Russian Space Agency, I mean you

should have a direct line to the TsUP, the Russian Mission Control Center in Moscow, for their Space Agency. So they do not respond when there is a conjunction?

Mr. Hill: Mak Vympel is the name of the organization that we would reach out to, and they do not respond. So we will work through their defense attaché, our defense attachés, and so forth, through diplomatic channels, and eventually establish it. But we have not been able to establish just this basic kind of safety of operations type of communication, not strategic communications at all, simply seeing something of concern that might be happening.

Senator Kelly: Thank you.

Senator King: Thank you. I want to call on Senator Cramer but I also, if I recall, Senator Cramer, you were one of the early and passionate advocates for the Space Force, so I am sure this hearing is especially meaningful.

Senator Cramer: It is, thank you. Yeah, I was, and am. General Thompson, good to see you again.

One of the things I would like to just testimony to myself a little bit, when you talk about recruitment. What I have noticed, in my trips to Grand Forks, for example, to the university or to the base, but especially to the university, where both General Raymond and General Dickinson have spoken to the ROTC cadets, they are quite enthusiastic about Space Force, not just because it is sort of the cool

thing, which is, I think, part of it, but also because of the upward mobility that they see, the opportunities that they see in Space Force that open up opportunity that they do not see probably in the Air Force, or at least they do not perceive that they see it.

But I also learned the same thing, have seen the same thing, from guardians when I go up to Cavalier. They have chosen that force specifically because, again, of upward mobility opportunities that they perceive and are experiencing.

One of the issues, General Thompson, as you know, that I visit a lot with General Raymond about is the flatness of the organization. When we went through this process to stand up a force, one of the things that we had to say over and over and over again to ourselves, and to be convinced, that we were not going to create a quagmire, a big, bureaucratic quagmire that the other services have created for themselves over the course of decades, or centuries in some cases. And so far I have been pretty impressed, and I know just as recently as last week, General Raymond mentioned that you were able to avoid at least two layers of middle management, right? Could you maybe just elaborate a little bit on that and how you think it is going? And I think this is an issue that I will probably press for as long as I have anything to do with it, just to keep us all

on track.

General Thompson: Senator, absolutely. We have absolutely designed the organization with that in mind, as you stated, compared to the organization that we inherited from the Air Force, which was very well designed for the operational needs of the Air Force. We redesigned it for the needs of the Space Force and removed, in this case, two echelons of command.

On the headquarters side, I will tell you that leanness is both an opportunity and a challenge. We have less than 600 people when we are fully resourced in our headquarters, and I will give you an example of what that looks like. We have an office that does intelligence operations, sustainment, communications, and our nuclear command and control communications mission. Our staff in that organization has 4 executive leaders, three general officers and a senior executive. The average number of senior leaders in every other Pentagon staff dealing with those matters is 37. So we are incredibly lean, it makes us agile, but rather than day-by-day deciding who is going to attend meetings in the Pentagon, the question is can we afford to attend meetings in the Pentagon.

So it is both a challenge and an opportunity, but it is the final design, it is our expectation, and we have people moving fast, by design but also by necessity.

Senator Cramer: Well, you know, Senator Rounds and I have similar flat organizations. We each represent about 800,000 people and they all have our cell number, and it is really very efficient but it can be a burden.

That said, the one area that I have noticed, you know, back to sort of our job and our relationship with you all is the one thing the Space Force does not have that is specific to the Space Force is a legislative liaison. And I think for a developing organization, that is even more important than for a well-established organization. And I know that the Marine Corps does, and I would just suggest to take a little bit of the burden off of the organization and the leadership it might pay to have a legislative liaison shop within Space Force.

General Thompson: Yes, sir. Today the legislative liaison shop is organized under the Secretary, so it provides support to both. But we have definitely noticed recently a need to add resources and focus for the Space Force, and we will continue to look at that.

Senator Cramer: I look forward to that. Thank you. Thank you, Mr. Chairman.

Senator King: I was there 2 weeks ago. It is fascinating.

You mentioned you are agile. I hesitate to say this in front of a professional football coach but my old high

school coach said he wanted players who were agile, mobile, and hostile, so that is not a bad definition. And with that, Senator Tuberville.

Senator Tuberville: I think I have used that a few times, Mr. Chairman, in my life. We are always looking for that kind. And speaking of recruiting, being new, General, are we sharing our STEM curriculum that we are going to need for Space Force all over the country with our universities? It is more marketing than anything else.

General Thompson: Yes, sir. The curriculum is not the challenge, as you said. It is getting the word out. But I will tell you that we have a special opportunity. One of the reasons is because we are so small, our needs for any given year number in the hundreds rather than the thousands or tens of thousands. So we are in the process of establishing relationships with some specific universities that have outstanding STEM programs that are world class in terms of research, that have ROTC programs, that we want to use as the foundation for training and educating our military and civilian workforce, so that we can ensure that we are getting high quality, we have a reliable pipeline, and they understand our needs and are providing that for us.

Senator Tuberville: Ms. Costello, I will wake you up over there. Nobody is bothering you. You know, the DOJ just updated its China initiative. In 80 cases they found

Chinese theft of trade secrets from multiple U.S. aviation aerospace companies. You know, does it make sense for us to spend $164 billion in R&D and then let it slip through the back door? I am just asking.

Ms. Costello: Certainly that is not something that we intentionally do, and we are continually working with our industry partners to make sure that they do have appropriate security measures in place. So that has happened on occasions. We have gotten much better, and continue to challenge our industry partners and work with them on our cybersecurity, on our intellectual property rights, being able to make sure that our programs are owned by us and we get to continue to work with them.

Industry does not want that going out the door either, so that is a shared interest on our parts with industry, and they are actively working it too.

I welcome all ideas on how to improve that, though, because it is a hard challenge, and we have, you know, people who would like that information, who are going to spend their days trying to figure it out. So we have our best working on it, industry has their best working on it, and we are working very hard so that does not continue to happen.

Senator Tuberville: And this might be a question for all three of you. Being from Alabama, we have got 1,000

subcontractors in Huntsville. The big companies, corporations, can afford cyber. They can afford to watch their back. But a lot of the smaller companies that really do the bottom-line work, that come up with the inventions, they cannot afford that. They cannot afford it for their bottom line. How do we help those people overcome the problems they are having, because if they have to pay for all that overhead they cannot make any money.

Ms. Costello: So we do have several of our large companies who are taking an active role in creating modules, if you will, that will help the smaller companies when they are onboarding and already have a platform they can use that is cyber secure. So that is one area where larger industry has recognized that problem and is working to help us.

The OSD is also working on measures that will help smaller companies not have to do all the same levels of protection. But as many of us in this room know, all you need is one enabling capability to get through and it is a problem. So we cannot go too loose on that. We still have to put controls in place. But I think it is going to be a partnership of how we develop our capabilities, our software, designing cyber in from day one into those processes as we write code, letting the smaller companies be able to connect with standards so that we are protecting capability along the way instead of everybody having access

to everything along the way.

Senator Tuberville: Thank you. General, Alabama is proud to host the main launch provider for the National Security Space Launch Phase 2 program, ULA, and its new vehicle engine provided by Blue Origin. What do you think the main challenge is for us to assure U.S. access to space? What are we going to do about it, because we are going to have problems.

General Thompson: Senator, I think our launch sector is actually in the best shape that it has been in in many years, but you are right, it is still a bit of a fragile point. I think the most important thing that we need to do in the near term is follow through on the strategy that created Phase 2 that has just begun, so that we have two reliable partners, as you said, one SpaceX and the other is ULA.

I think what we need to do is continue to provide opportunity for those and other providers to launch responsibly and reliably in the future. One of the things that we are doing at our launch range, Cape Canaveral and Vandenberg, is to lower the costs that are incurred on them to be more flexible and responsive in letting them launch. I think those activities, as well as helping to facilitate lower cost for them is what we can do to continue to sustain a market in those sectors.

Senator Tuberville: Mr. Chairman, can I ask one more?

Senator King: Please.

Senator Tuberville: Okay. You know, space, by 2040, is going to cost us $2 trillion, our taxpayers. You know, that is a lot of money. Of course, it might not be that much, you know, by the time we get to 2040. But usually conflict follows money. I would like to ask Mr. Hill this, you know, just being new on this committee. The American taxpayers are going to have to foot a lot of bill, big bills, for space, and, of course, that is probably where the next big conflicts are going to come from.

How do our allies feel about all this? Are they on board? Are they going to help? Are we going to be in it alone, like we normally are? Where are we at on that?

Mr. Hill: So our history with national security space is a history where we have done a lot ourselves, for reasons of the security of the programs that we did in the past. The downside of that is that with the exception of the Five Eyes allies, who are closely intertwined with some of that, we did not have a lot of sharing with our allies. On the other side of it, though, it meant that some of our allies were investing in their own space capabilities because they were not able to partner with us. Now that we are at an era where there is a lot more than people can do, and the economics of space have changed too, we have more allies who

are coming into it, and they are approaching it from the perspective that they know they cannot do the program themselves. They are not going to design the U.S. space architecture.

So their question is pretty uniformly to us, where can we make an impact that, as allies, can contribute to combined capability, like we do in the other domains? And we are at the point, with things like the Space Development Agency architecture, for example, or in satellite communications and hosted payloads, where there are opportunities to actually do this partnering with allies, as well as on the operational side. Sharing the previous question about debris in space domain awareness, sharing that information that allies also collect from their systems is an area. So it is a growth opportunity.

Senator Tuberville: Thank you. Thank you, Mr. Chairman.

Senator King: Ms. Costello, I am concerned about redundancy of acquisition. We have got the intelligence community, we have got the commercial satellite community, we have got the Air Force, we have got now the Space Force, we have got Space Command. Talk to me about rationalizing the acquisition process to be sure that we are maximizing the benefit and minimizing the cost.

Ms. Costello: So acquisition authorities start from,

in our case, the Secretary of the Air Force, and they roll down right now through the acquisition executive, currently SAF/AQ. At the point at which we have a second SAE, by law right now October 1 of 2022, those authorities will go down two pathways, but not all authorities. Certain authorities are limited to one person within a service.

So we are working through some of those details to make sure we have the right efforts in the right support mode for when we stand up the new Assistant Secretary of the Air Force for Space.

Senator King: And isn't there an acquisition executive council or something like that? Is that up and running? Will that help in this regard?

Ms. Costello: There is a Space Acquisition Council that has been stood up, and right now I am chairing that until there is an Assistant Secretary of the Air Force for Space Acquisition and Integration. At their arrival, they will then chair that forum. And that does bring all of these groups together to talk about force structures and issues going on, so that we can align our efforts and not duplicate, certainly not duplicate programs and not duplicate technology efforts that are going on, align our budgets better, get on a similar roadmap. That will be very helpful.

Senator King: And a huge part of the development in

space now is commercial. To what extent do we piggyback on commercial space activities? It seems to me if we want to do a GPS satellite, and Amazon or somebody else already has one up there, can we save the taxpayers money by utilizing commercial satellites?

Ms. Costello: Absolutely. Our Space and Missile Center is very actively involved with startup companies, industry, commercial. They have their Space Enterprise Consortium of about 500 companies, many of which are, almost all, 70 to 80 percent, are not traditional space providers. And they get ideas from there. They get their innovations. They are able to use that maybe to develop prototypes, test things out. So they are actively working with industry, and also working with our international partners, in order to figure out where we can leverage what they are doing too, because we do not need to duplicate there on many capabilities.

Senator King: Well, it is also a strategic advantage. A lot of small satellites are harder to take out than one big one. Is that correct?

Ms. Costello: Absolutely. depending on the mission and what you are trying to accomplish. We are at a point where we have so many tools in our toolbox right now that we have that flexibility. And as we talk about picking the right path for providing the capability, it is not just the old

traditional one way to do an acquisition program. What is it we need to do there? And the disaggregation that is going on enables us to do some things as prototypes, some things as major programs if it makes sense, some things as just a software pathway, and then also doing partnerships with our international allies.

Senator King: I agree with Senator Tuberville. I think this is a ripe area for partnerships and spreading the burden, to some extent, to those who will be benefitting by this architecture.

Mr. Hill, nobody wants to talk about offensive weapons in space. However, is it necessary to have a capability that will deter our adversaries from exercising offensive weapons against our satellites? In other words, our whole national security strategy rests upon deterrence, and do we need to develop capabilities and communicate them to our adversaries in order to have an effective deterrent?

Mr. Hill: Senator King, first, the thing about the weapons, of course, whether it is offensive or defensive, is often in the intention of the user. One person's act of defense is another person's offense, for example. The ability to assure a capability, to deny somebody the benefit of attacking a capability, is part of a deterrence. The ability to impose costs on someone else if they take action is also part of a deterrence.

And it gets to understanding what is important to someone else, to the adversary, the aggressor you are concerned about. If their capability in space is really not that important to them then there is not particular deterrent value in holding it at risk. But if taking down our space capability is very important to their military strategy, then assuring our military capability in space may be very important to our deterrence calculus. Figuring out these pieces of where does the space domain fit into the totality of deterring aggression is one of the key questions that we have to work on with the new organizations.

Senator King: When I was in Colorado Springs and having these briefings, the first thing that came into my mind is that this is literally 3D chess. We are dealing in a three-dimensional process of defense and countermeasure.

Senator Fischer?

Senator Fischer: Mr. Hill, when you are talking about the dual nature of the technology that is available, whether it is going to be offensive or defensive, isn't it a grappling arm can be used to fix a satellite or it can also be used to take one down?

Mr. Hill: Perfect example.

Senator Fischer: So it is not necessarily some advanced military weapon that we are talking about in space. It could be as simple as that.

Mr. Hill: And that is part of the point. The designing of the satellites, the old era where you had so much capability aggregated to do so many missions from one platform, very high-value target. And the modern capability of something very simple to take it down, that is a bad equation. So how do we switch to architectures as described here, many small satellites, many more targets, not as much value in each target.

Senator Fischer: Right. When we talk about behavior in space, what do you think about the challenges that we have in trying to establish some kind of norms or some kind of treaties when it comes to that behavior?

Mr. Hill: Yeah, I think treaties are a long ways away, much less getting it through the negotiating table, much less through the United States Government processes for treaty ratification, and many other government processes as well. This is why our focus has been on more voluntary, nonbinding measures.

But to the point that Senator King made earlier, even the one that we have proposed at different places, of don't do debris-generating tests of satellites, don't blow up satellites, even that is one that people are very careful about talking about because of what they might have in their own plans. But having the user community together, and by that I mean the total user community of space operators,

beyond just the military, creates a larger group of voices to push these issues.

Senator Fischer: And if and when we are able to move forward on some kind of treaty in space, how are you going to verify compliance?

Mr. Hill: Verification is one of the reasons that we have objected to what the Russians have proposed, in addition to the point that the Russian proposal does not address ground-launched anti-satellite missiles. So we have capabilities in space to observe other people's satellites, but we are a long ways away from having the kind of verification that you would want to have for that.

Senator Fischer: Right. General Thompson, I would like to ask you about the Overhead Persistence Infrared satellite program. Before we had a Space Force, the Air Force was going to move forward on that in a very aggressive manner, and I think it has been a poster child for "go fast." Can you talk about the progress that has been made on that so far, and what is your level of confidence that we are going to be able to reach the 2025 target on that? That is, I guess, looking to see if funding is going to be provided.

General Thompson: So, Senator Fischer, that is exactly correct. It is an example of using authorities provided by the Congress from 804 to rapidly prototype and prepare to

field capabilities. The challenge, the technical challenge in that system, the next-generation missile warning satellite, was the sensor to detect those missile launches. And so using those authorities and acting immediately, our acquisition arm went out and started prototyping those capabilities right away. We also aggressively went to find the funds we need. The program is currently fully funded. It is currently on track for 2025. From the day the date was established, it was a very aggressive schedule, but I will tell you today we are on cost, we are on schedule, and we expect that our acquisition communities, Space Missile Systems Center, will deliver it for launch by 2025.

Senator Fischer: Is there a backup plan to provide for a missile warning if the first satellite is not launched?

General Thompson: Yes, ma'am. The backup plan is, in fact, the quality of the systems that our formerly airmen and now guardians have produced in the past. The current set of capabilities, space-based infrared system, the current missile warning program has been designed and engineered so well that it is lasting longer than required. In fact, the defense support program, the series of satellites before SIBRs, we still have functioning satellites on orbit.

And so because every single day those satellites continue to function and function effectively and perform

the mission beyond their design life, each day that passes we gain more margin in the ability not to have to deliver these satellites in 2025 and still meet the missile warning mission. We remain on schedule. The team is absolutely adamant that they are going to deliver in 2025, but we fully expect there will be enough capability in our missile warning constellation at that time. If, in fact, we suffer a slip, we will still be able to fully execute the mission.

Senator Fischer: Okay. Thank you.

Senator King: Thank you, Senator Fischer. Senator Kelly.

Senator Kelly: Thank you, Mr. Chairman. I just wanted to get an update from you on issues regarding just heavy lift, LEO. Do you guys track development of SLS and also with the long-term need of rocket engines and development of engines? Is that something you are looking at as part of Space Force, as you build out? I see on -- you know, you have a Space Systems Command that not yet established but will eventually. Is this going to be part of the purview of Space Force as well?

General Thompson: Yes, sir, it is. Space Systems Command, in fact, the core of Space Systems Command will be Space and Missile System Center today. They are the providers of our launch capability.

Specifically related to SLS and the utilization of that

system and that capability in the Space Force, we are not, but we work very closely with NASA on launch capabilities in general, specific technologies of interest, absolutely, including crossover technologies between SLS and some of our launch needs. And then the other piece of that is as we prepare to go into the next phase of National Security Space Launch -- we are in Phase 2 right now -- we are currently looking for our own needs but also for the needs of the entire U.S. Government on specific technologies that may be of value or of importance, and to determine whether or not we need some research and development technology initiatives to pursue that. And we do that routinely with NASA and with the National Reconnaissance Office.

Senator Kelly: Yeah, I think there are opportunities here with incredible synergy, with private-public partnerships. But at the same time, we are just developing a lot of new systems in parallel, you know, for commercial space flight that could be ultimately adopted for uses for Space Force and the U.S. military, in general. And I think that is a positive thing and it could bring down the cost.

I often feel like we are currently where we were in the 1930s in aviation. You know, in the 1930s, the DC-3 was built. It was the first airplane that was able to take a decent number of people a decent distance and do it relatively safely and efficiently without very high cost.

And we are starting to see something like that with all the commercial capabilities being developed to orbit. And if we work in conjunction with private industry, this could benefit DoD.

General Thompson: Senator, I think the opportunity to do that, for all of us right now, is as we begin to prepare for that Phase 3. We, the U.S. Space Force, will be purchasing our first launches in the next phase of the program, in 2025. That means right now is about the time when we start to look at those things. We look in the commercial sector. We work with the NRO, we work with NASA. So I think you are exactly right. Now we are on the cusp of the ability to do that specifically.

Senator Kelly: Thank you, General, and I yield back.

Senator King: Senator Tuberville?

Senator Tuberville: I have got one more question. General, in your opinion where do we stand with R&D compared to Russia and China right now? In just our country, where do we stand?

General Thompson: Sir, what I need to do is get you some metrics. I have seen in the past that -- I am trying to recall off the top of my head. What I will tell you is with respect to the energy and the investment in China, we probably are a bit challenged. We have established what I will call a floor, in terms of science and technology

investment inside the Department of Defense, and the level of that investment right now is probably barely adequate. But in terms of the numbers of companies, the amount of money that is invested, and the number of people that are entering, for example, STEM career fields and engaging in R&D, we have a challenge in the numbers game, one that we can probably never fully compete with in terms of pure numbers. But partnering with other nations and ensuring that we at least have enough to adequately address what we have to do is probably a focus that the nation needs to pursue.

Senator Tuberville: Thank you.

Senator King: We are all set with questions, Senator Fischer? You are okay?

I want to thank our witnesses, and one last comment. You mentioned Section 804 several times and the authority. Since this is a new, evolving organization, please let us know if there are inadequacies in the 804 authorities that we might be able to patch in the upcoming national defense bill. If there are things that you have discovered that are obstacles to your movement forward, now is the time. So please convey those to the committee and we will be glad to consider them.

Again, thank you for your testimony today. Thanks for your wonderful work on behalf of this country. With that,

the hearing is adjourned.

[Whereupon, at 5:53 p.m., the subcommittee was adjourned.]