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TRANSCRIPT

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FEATURING

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Tom Karako

All right, folks. Well, welcome back to the second panel of our conference today on Homeland Cruise Missile Defense. We've got a number of great speakers to kind of give us an update on where things stand on the issue now, and maybe some outside perspectives on the CSIS report you heard about earlier. I'm going to turn this over to Jen Judson from Defense News to moderate us.

Great, over to you, Jen.

Jen Judson

All right. Thank you so much. Is my mic on? It sounds like it. OK. Hello and welcome to the Center for Strategic and International Studies Homeland Cruise Missile Defense Conference's third panel of the day. Well, we had one speaker, so we did miss out on that first panel today. But this is a focus on the government's perspective. And my name is Jen Judson, and I'm the land warfare reporter for Defense News, but I do focus as well on missile defense.

Today we have Brigadier General Paul Murray, the deputy director of operations at North American Aerospace Defense Command, or NORAD. Stan Stafira, chief architect at the Missile Defense Agency. Colonel Tony Behrens, deputy director at the Joint Integrated Air and Missile Defense Organization. And Dr. Peppi DeBiaso, nonresident senior associate with the CSIS Missile Defense Project. I'll open it up for remarks and then we'll get going with questions. And we'll start with you, General Murray.

Paul J. Murray

OK. Great, thank you. So I'll just be perfectly honest and speak probably for many of the people – at least, the two to my left – this is a fraught time for us to come speak about a topic like this, right? We're in the middle of budget seasons, NDAAs. It was a very detailed and good report, but to the extent that, you know, we have plans that are similar to this, unfortunately, we really can't get into a lot of those details.

So, what I thought what I would do then is kind of set this in a broader context for some of my remarks. You know, we nailed down very quickly here into the cruise missile defense portions of it. And we at NORAD and NORTHCOM are very in tune with that. And we have plans and designs along a similar thing. But this fits into a broader, more multidomain capability that actually the Venn diagrams overlap.

So, the threats that we face are not just from cruise missiles, right? They're – we have threats from the sea floor all the way up to space, and even beyond, into outer space, if you will – deeper space, in the near future. And so, we need to think through how cruise missile defense fits into the cyber domain and into the information domain when we here think about this problem set. So that's kind of part number one. So, with that in mind, let me tell you a little bit about how we at NORAD and NORTHCOM think through a defense design like this type of what CSIS did.

So, first off, what is a defense design, right? We had to ask ourselves that question. Well, it's not a strategy, right? A strategy is broader than this level of planning. It includes theater security cooperation. It includes human capital. So we're not talking about a strategy. So we can't pull that, you know, recipe book off the shelf. It's not a plan, right? An operational plan or a CONPLAN. That's how we fight today with the stuff we have now. So a defense design is really a set of concepts, as you see here. It's a set – it's aspirational. It's in many ways a roadmap for how we get to how we want to fight, how we have to fight now with what we have to how we would want to fight in the future, in and from the homelands.

And so – and it's also not a series of wish lists, right? A defense design isn't just a series of systems that we'd like to buy or capabilities we'd like to have, although those are part of it. In fact, what really the defense design does is informs all of those things. It's a series of concepts that informs your strategy for tomorrow, it informs you plans for today, and it informs your – the capabilities that you would like to see, from our perspective, the department procure and present to the combatant commanders.

So, with that, we deliberately didn't use any of those normal processes that one does when we built the defense design, often because those are long processes. To build a strategy under the normal Department of Defense process is a two-year process. Our commander only had three years. You know, most of these four-stars get three years in their command. And to take two of it just to build a defense plan was not what we – you know, what was acceptable.

So, we looked into other ways of how to – how to do this. And we actually – we went to a software development type of mentality. If any of you have heard of agile, it's not hierarchical, it's certainly not sequential and waterfall. And the idea is that you put a team of experts together from across your organization – in our case, from across the Napoleonic, you know, J-1, J-2, J-3 operations, plans, and everything. You put one – you don't really even put one person in charge. You put kind of a conductor out there. And you iterate very quickly on the concepts that you're trying to build.

And that's what we did about two years ago, and General VanHerck came in right around that time. We put this team together. It was my predecessor who led it. And they did a quick iteration on what type of capabilities do we know how to do? How do we want to defense the nation – the continental nation, if you will, in the future? And we picked three time epochs – a 2030 time epoch, which you can imagine really is – or, excuse me – a 2025 time epoch, which at that time was just a couple years away, five years away, and the principal military threat for that time epoch was, and obviously still is, Russia.

We took a quick look at the 2030 time epoch, and there we see – as we look out into the future we see the Chinese threat growing in the type of capabilities that we're talking about today and the type of capabilities that we see in the future. And maybe to some type of parity perhaps at that time epoch. And then also a 2035 time epoch. And that's that road map that I talked about, or how we get – I think – I think, Tom, your team called them phases. We call them time epochs in kind of how we get out and think about out in the future, the capabilities that we need.

OK. So, once you've got that basic scaffolding, what we did next was we looked a deep dive into that 2025 time epoch. So that – we did the one sprint kind of does – it leads into a bunch of other agile sprints to flesh out the bones of that – of that time epoch, and really put some meat on it. So what do I mean by that? Well, we take a deep dive into the threat. Instead of a broad threat across 15 years, we take a very detailed threat. We get detailed with the intelligence community, with the intelligence inside of ours, and we really think deeply about it, so that we understand it. So that we, one, don't ask for capabilities that the threat maybe doesn't present and, two, that we can compare that to capabilities that we already have that might be able to counter that threat today.

The next thing we do – or, other types of ways we go into the details, is that we survey the domain awareness landscape. You've heard it said many times, if you can't – if you can't see the threat, you can't defend against it, right? And so, one of the sprints that we did was to look across the entire department interagency and how are ways that we can gain domain awareness about detect the threat and maintain custody of it. And then, of course, you've all heard the cliché that, you know, amateurs do tactics, professionals do logistics. And we did and entire sprint just on what would be the logistics requirements of the type of capabilities that were in this report, as well as the way we were thinking about the threat?

And in that 2025 epoch, we kind of came up with four big ideas. First off, we found there's a need for foundational capabilities, and the team today talked about that. Before we even think about kinetic defense in some of these instances, there's foundational capabilities that we need to lay, and we came up with four of them. Our commander, the last time he was here, talked about it, so I won't go into the details. But they are domain awareness, first and foremost, talked a lot about today. Information dominance. So once you make – once you've sensed everything with domain awareness, how do you make sense of that? How do you use that information? And how do you bring it all together? And here, we're thinking things like single plate of glass.

And then, OK, you've got – you've got data, you've presented it well. How do you make better decisions with that? And for that is our third main big idea

that we came out of it, which was decision superiority. How do you make better decisions? How do you make faster decisions at the speed of relevance with things like AI and ML? That was another foundational capability. And then finally, how do you do all that on a global scale? And that's global integration. And that's actually the effort that Nomad mentioned that he was a big part of when he was in our team with the global information dominance exercises. And those were foundational.

The other thing that we found was we need policy. This sprint told us that we need to continue the work similar to what CSIS has done. We need policy on what to defend – i.e., the places that you want to defend in the United States, perhaps, is one way to say it. And then what do you want to defend against. From – and it's been mentioned today – from do you want to defense against UASs all the way up to hypersonic cruise missiles to hypersonic glide vehicles? Or where in between there? Those are policy questions that I think we ought to talk a little bit about here. And then finally, the final big idea, the final big thing we learned after we kind of studied this in the 2025 timeframe is we need culture change. And that was one of the very first things that was talked about here today. We need an understanding – a common understanding of the threat, of the vulnerabilities of our homeland, and that the homeland is no longer a sanctuary.

So we worked on that. We worked on that for a while in and out of the building. And about the time the new administration came in, and was really starting to get underneath their feet, is about the time we were also starting to look at that next time epoch. We were going to do a deep dive into the 2030 time epoch. Obviously with a new administration comes new policy. So as many of you I'm sure aware, a new MDR, new NPR, new NDS. And so, we had to kind of update both the previous epoch and this epoch, if you will, for the administration and the policy that they were going to set. And, you know, I'm happy to say that this administration has gone a long way in that and has really helped us as we get ready to take that next step of designing defense design as CSIS showed today.

Other things that happened, integrated deterrence obviously came in with the new administration. So we had to think deeply about that. What does that mean for homeland defense? And it's already been alluded to today, but this balance between deterrence by cost imposition and deterrence by denial, right? And so we in the homeland defense realm see ourselves in the deterrence by denial business and improving integrated deterrence in that way. But even inside deterrence by denial, you need to think there's another balance inside there that you need to think about, and that is denial by defense and denial by resilience.

So denial by resilience is you will not achieve your objective, because whatever you strike in the homeland is so resilient, it's redundant, it's

hardened, it's whatever it is that you won't achieve your objectives. And then after all those kind of discussions and scoping, if you will, of the problem, we in NORAD and NORTHCOM need to denial by defense, which was the topic of what we talked about today. Again, it's hard to go into details of the specific conclusions that we've come to, because I don't want to give any impression that – first off, we did not participate in this – in this very detailed report. But we have done this level of detail as well.

But let me say a couple of things about what it takes – where we have to go now. Where we have to go now with this – let's say we had this level of detail that it's within the department or through policy, or whatever. The types of things now that we have to do – and this is the first thing the commander said to me when I briefed him on the 2030 time epoch – was, all right, Dino – that's my call sign, like Nomad's – Dino, it's time to go out and defend the design. You've created the design. This is the way we – this is the way that we propose to defend the nation in these types of regards. Go out and engage key stakeholders and defend the design.

So what does that mean? So the next steps, as we think going forward is, first off, modeling and simulation. It's great to think about a whole lot of capabilities. You know, we can all sit here and list a whole bunch of interceptors, effectors, if you will, a whole bunch of sensors and a whole bunch of C2 systems. But if you don't have the data behind it to defend what it is, the architecture that you're trying to build, then you really don't have a defendable design. And here, in this regard, we have been partnering – NORTHCOM has been partnering with a lot of people: MIT; Lincoln Labs has helped us with a lot of this; the FFRDCs; MITRE; and of course, the rest of the department. MDA has an extensive modeling and sim capability that we leveraged, as well as the services.

The next thing, or another thing you need to do as you think about defending a design like this, is experimentation, right? It's not enough to just say, my computer crunched the numbers, buy me these capabilities. You know, you have to – you have to have demonstrated those capabilities. And again, here we don't have those capabilities – the capability to do that inside NORAD and NORTHCOM. And we've partnered with many of the people here on the stage to include MDA for some of the experimentation that we've done with combinations of effectors and sensors, and even C2 and integrated fire control systems. We've also partnered with the Joint Staff in a lot of this. And some things – Tony was here for us, can probably talk about it, things they call nimble fire and other types of exercises in which we go out and we try to – we try to get the data behind all this.

And then finally war gaming, right? You've got the data. You've got the experimentation. And now you're ready to war game it and to exercise it. And in this regard, we had a very deliberate process that we went through as

we – as we thought about particularly the 2030 time epoch. It started with that sprint, which produced a white paper that we – that we used to kind of, again, bring substance to it. That white paper was the basis of a war game that we played in NORAD and NORTHCOM called Vista Rampart that we played in early March into April. And we were refined this homeland defense design that we built, and we took it outside the headquarters to a war game called Globally Integrated War Game, which was just recently conducted, and we brought those concepts to the war game, and we war gamed them at a broader level with the other service – with the other combatant commands, as well as that.

OK. There's still more parts that we have to do to turn this defense design, like the one that was briefed today, into a reality, and that is the organize, train, and equip piece of this. Excellent discussion today about the types of capabilities that we would need. But we also have to remember that some service has to man that, right? Some service has to build an organization to – and if it's the Air Force, then – you know, which I'm familiar with – there's got to be a wing. Which means you've got to have a wing commander, right? Or traditional way of thinking. There's got to be a training. You know, so there's your structure all the way down to the squadron. There has to be a training infrastructure that goes all around that. And of course, you know, it has to be – these types of concepts have to get into education and the other pieces of it.

So, and then finally, if you really want to do this right and you really want to do it on a global scale, you have to at some point integrate your homeland defense design, whether it be for cruise missiles or for the broader, with your partners and allies that you expect to fight with in the future. So, in our case, we have a built-in partner for NORAD, the binational command with Canada that we have. So we – I guess I'll say it this way: When we think about homeland defense, by defending the homeland we actually think of defending the homelands, with an S. Immediately, for us, it's Canada and the United States but, again, to this idea of a successful homeland defense design that you want to integrate globally, you need to bring in your other partners and whatever conflict that you think, so that you don't – one, so that you get synergistic effects, right?

There are things that maybe one of our partners, like Australia, can do in a forward conflict from a homeland defense perspective, that would be complementary to us. And there's things that we could do to complement theirs. So, with that, I think I'll turn it over. I probably went over my time. But happy to discuss to the extent that I can any specifics on – or, try to discuss any more specifics on our homeland defense design. But hopefully that process that we've already gone through will help you kind of understand the way we think about it. And then some of those guideposts that I put out for how we need to move forward will also help as we – as we

refine and perfect this idea of cruise missile defense of the homelands. Thank you.

Stan Stafira

OK. All right. I guess I'm up next. So first I want to thank you guys for inviting me to participate in this event today, and on this Aegis panel. I know all these guys, and it's awesome to up here with you and talk about this today. And let me talk about some of those critical missile defense issues that are – and challenges that we face today. You know, our vision at the Missile Defense Agency is to earn our nation's confidence by developing an effect homeland and regional ballistic missile defense capabilities. So whenever I talk about what we do over at the Missile Defense Agency, I always start with the threat.

You know, our adversaries are building diverse, expansive ranges of modern offensive missile systems, and we see them – we see them in the news every day. They're developing new missiles and improving existing systems. These systems have increased precision strike capability, they have penetration aids like decoys and jamming. They're capable of maneuvering in the midcourse and the terminal phases of their flight, like maneuvering reentry vehicles, multiple independent reentry vehicles, hypersonic glide vehicles, and cruise missiles. We see that right now, and these threats are, you know, just getting more and more sophisticated.

These threats are flying further. They're more complicated to track. And they're not just – they're really just not ballistic anymore. The threats that we're facing are just not ballistic anymore. And so I think our competitors, our adversaries, believe that these threats are an asymmetric advantage that they – that they have. And we know that they're trying to use their systems in more complex combinations and ways to avoid our defensive capabilities. So the mission of the missile defense agency is to defend the United States, our deployed forces, our allies, our friends against – from missile attacks in all phases of flight. And the primary focus of the Missile Defense Agency remains homeland defense.

You know, our job is to protect the U.S. from ballistic missile attacks from rogue nations, as well as our forces from regional threats. However, as already mentioned, the threats continue to evolve. So we're working to evolve and continue to improve our ability to detect, control and engage these kind of threats against the U.S., our friends, our allies, and our forces overseas. Now, if you go back and look at how we got involved in this topic, this discussion – the cruise missile defense of the homeland – we go back basically to a number of missile defense executive board meetings that took place in the 2019 timeframe.

During that time, we were asked, and we took the initiative to work with NORAD and NORTHCOM to evaluate architecture options that focused on

homeland cruise missile defense. That's really what we were doing. NORAD/NORTHCOM, as General Murray was talking, is concerned about potential adversaries using conventional cruise missiles to attack critical targets in the homeland. And so we felt that we had a new capability that we could help them as they started and as they tried to look through that problem. So, in the end they asked the Missile Defense Agency to work with NORTHCOM, to be in system engineering and architecture analysis for homeland cruise missile defense.

Given our background, MDA is uniquely postured to support this joint cruise missile defense of the homeland effort. We put together joint capabilities to do missile defense already. And that's where we come from. And we look at – we look at those kind of architectures from a joint perspective. So MDA's worked closely with NORAD/NORTHCOM to connect cruise missiles defense of the homeland kill chain analysis, technical architecture development, and specifically we've been working with NORAD/NORTHCOM to develop system architectures that integrate existing service capabilities and new technology has crossed the kill chain from domain awareness/detect, information dominance, control, and decision superiority engaged to defeat mechanisms to be able to handle these threats.

Now, MDA has met with NORAD/NORTHCOM representatives a lot. I mean, we – I think we have a really good relationship with NORAD/NORTHCOM, making sure that we understand what their requirements are and what they're looking for, and to discuss that overall architecture that they're kind of looking at, and what our architecture approach/analysis approach should be. We analyze it on multiple architectures, looking at capabilities to identify risk, developing initial cost estimates to support any of the – any department budgeting process if we decided to go look further into that.

We're working with NORAD/NORTHCOM and the Air Force in developing the initial government-referenced concepts for over the horizon radar capabilities. We're looking for that domain awareness and information superiority. MDA's performed an initial sensor and weapon coverage analysis for cruise missile defense of the homeland in a limited defense role that, for NORTHCOM's preferred proposed defended assets. We've worked with them to say, where are places that you think that we should be looking at defending, so that we could look at how you would put a defended capability in those areas.

And we continue to work with the community on additional iterations of sensor weapons laydowns and in close coordination with NORAD/NORTHCOM and the department, to make sure that we're looking at all the capabilities and doing a good job at trying to evaluate those. The results of these could be used to determine weapons mix, and sensor types, and weapon types that could be used with cost analysis and support, the

definition of this limited area defense capability – architecture to support the defense of those critical assets. So we've got – that kind of architecture work is continuing, and it's there, and it's ready to support the department as it looks at this critical issue.

In addition to the architecture work, MDA was tasked also to conduct some live virtual demonstrates using joint tactical integrated fire control capability to leverage capabilities we've seen in existing demos and work to integrate capabilities together to provide an enhanced capability to defend the homeland from cruise missiles. So in the end, MDA is looking to aid in the development of more integrated joint architectures that enable the war fighter to better command and control the system in order to use the right sensors, paired with the right capability, engaging at the right threat, at the right time. And with that, I'll close my comments and pass it to the next.

Tony Behrens

Well, good afternoon. Can you hear me? OK, sorry. Good afternoon. First, I want to start by thanking Jen, you personally, for being here and for moderating today. Also, Tom and the team for inviting all of us. We are all actually teammates. We've been working together quite a bit just in the recent months on this very problem. And much of what you're going to hear from, I think, all of us, is going to be somewhat repetitive, but from our various perspectives. But, again, to Jen and Tom, your analysis and your many works of articles and studies and the research that you do, and the interviews that you do, highlight the complexity and the challenging role of integrated air and missile defense.

It's certain to me that without such articles or the report that you all reviewed today, that IAMD missions and the resources required to perform those missions and sustain them would not probably come about. At least, not to the level that we need as a nation. I also appreciate your work because you offer opportunities for us to look at the problems in different ways, and for us to see ourselves, and to ensure we're doing right by the citizens of our nation. I'm honored to be included among some of the great strategic minds of our business in defending the homelands.

So let me start by setting your minds at ease. If you were here at the earlier session, I'm a lawyer. So I have no vegetables and I have no Costco trips. I'll leave that to the wickedly smart team who conducted the valuable research that I think is quite useful. Just a bit about me. I've spent about 27 years of my life as an Army air defense soldier. I've operated IAMD capabilities in every AOR where IAMD operators are deployed and stationed today. I fought the first configuration three-pack, three-Patriot battery in OIF and employed the first Patriot remote launch capability in early 2003. I don't say that for any other reason than to give you the context and the lens that I look through, and that's the eyes of an operator on the ground, who volunteers to put their life at risk for the defense of our nation.

I've spent the last seven years directly involved in the sustainment and modernization of our IAMD force, where I finally landed on the Joint Staff. JIAMDO, the Joint Integrated Air and Missile Defense Organization, on the Joint Staff under the J-8, serves as the chairman's IAMD mission manager and subject matter expert on behalf of the joint IAMD force. JIAMDO has five critical functions. First, concept development. How we fight in joint multidomain operating environments by applying and refining the principles of IAMD. Analysis and experimentation, how can we fight better and what do we need in terms of capability to support our national strategies? What capabilities prove stronger? What capacity is necessary? How do we integrate and converge multiservice capabilities to achieve strategic and operational advantage over our adversaries?

Third, requirements development. Understanding the combatant commander's needs and developing sound requirements that are prioritized across the entire IAMD enterprise. These requirements become the basis for proposed solutions. Fourth, capability development. JIAMDO applies a modest budget to the development of promising technologies that we later hand off to an interested service with Title 10 authority to further develop and integrate the capability. And finally, JIAMDO is assigned the role of advocacy or advocate for the war fighter. The war fighter can be defined in a few ways. Some point solely to the combatant commander. However, we have the task to help balance the capability and capacity across the globe and among missions, IAMD and non-IAMD, and we take all viewpoints into consideration when executing our advocacy role.

So in October, the Joint Requirements Oversight Council, or JROC, you may be familiar with, approved the IAMD capability portfolio management review, CPMR, process. Now, I'll be the first to acknowledge any concerns about bureaucracy. What better way to counter bureaucracy than with a new process? But this is unlike any process I've seen in my almost 30 years as a warrior. This process will enable flexible and a holistic approach to determining and prioritizing IAMD requirements. It established a priority framework that the combatant commands and joint force will help us review annually in developing what we're calling a joint integrated air and missile defense portfolio priority list, a holistic approach to the entire IAMD enterprise.

This list will assist senior decisionmakers in balancing budgetary needs and synchronizing cross-service and DOD agency support for vital missions, such as air and cruise missile defense of the homelands. In the case of the homelands, interagency policy and support between DOD and non-DOD authorities, and even industry and commercial participation, will be critical. Defense of the homelands is critical to our national survival, and to enable our global military power projection in order to support any integrated

deterrence strategy by imposing great risk to any adversary that would consider attacking the United States.

The change in the threat over the last decades is imposing a need to reassess our IAMD priorities. Yes, adversary cruise missiles have improved in range, countermeasures, and lethality. But also, our adversaries have invested in the development of these threats through hypersonic technology, subsurface maritime capability projection – where cruise missiles can come at the homelands from any direction and across multiple directions simultaneously.

They'll likely integrate threat systems with other means of attack that may not be affected by active IAMD capabilities. They will employ space-based targeting, jamming, and spoofing technologies, decoy employment, a wide spectrum of threat capabilities that are and will continue to drive up the cost of active, layered, and integrated air and missile defense. Simply, our leaders have tough decisions ahead of them as they attempt to balance a fully resourced integrated deterrent and defeat effort.

So, assume for the sake of argument – which is probably not true – that we see no force structure growth and no reduction. In other words, we're not getting larger, we're not getting smaller – which is probably likely not the case. Let's say for the next 10 years a steady state. We don't get bigger. We don't get smaller. But a conclusion might be that the United States would have to balance the addition of mission with the IAMD of Guam, for example, or other existing IAMD missions in locations around the world to protect our national interest and U.S. forces.

So how are we to do that without a line and prioritizing the entire IAMD enterprise? By applying integrated deterrence and balancing strategic and operational risk. So I want to emphasize a component of capability development that has not gotten a lot of press, and it doesn't make its way into a lot of discussions. But General Murray did discuss it. It generally costs more than the defense acquisition of the warfighting battlefield system. It's called DOTMLPF-P. It's one of those DOD acronyms that doesn't really even sound like something you'd probably want to talk about.

D for doctrine, O for organization, T for training, M for materiel – which is what we talk a lot about – leadership and education, P for personnel, F for facilities and P for policy. So what is DOTMLPF-P to us? DOTMLPF-P are all of the resources that, when combined, offer a complete and employable capability. Systems are not the entirety of a capability. You need authorization of a military force structure, which does not come cheap. People are costly. It's costly to recruit, to assess, to educate, to train, to develop those people, to pay their wages, and to care for their families when they willingly risk their lives for liberty.

There are costs to train our warriors for a new mission or to develop the doctrine by which they now must fight. There are costs in terms of funding, time, and analysis of a test program or to establish confidence in a safe and employable capability. There are always facilities to be built. There are always environmental studies to be completed. Managing the talent and the human resources side of the capability can be extremely challenging for a function that has a very low density of operators, such as integrated air and missile defense.

How do you provide a trained and ready force and sustain that force for the life of a mission, for years or decades even? While much of the joint force has returned to a steady and predictable deployment schedule after closing operations in Iraq and Afghanistan, this simply is not the case with many of our IAMD forces. If anything, their op tempo and demand continues to increase. This is just one indication of that. In some cases, the IAMD force is expanding, but likely not enough for all of these new missions.

So let me acknowledge here that these are not new requirements. We've been discussing them for years. We've watched the threat develop, and we've – and our action is necessary to place success in our favor. Analysis from this report that we discussed today, I think, is worth consideration. That's why I'm really encouraged to see that CSIS has taken on some of this in the report, at least by acknowledging a greater cost to any of these types of missions to offer our strategic leaders an opportunity to balance these tough, critical missions. It's something that we're putting greater emphasis on in the JROC as it seeks to meet its Title 10 responsibilities by validating requirements and determining if recommended solutions will actually meet those requirements.

Areas that we see critical to the success of the homelands, first, include an array of layered fire control sensing capability, whether space, airborne, elevated, or ground capabilities. All are likely necessary. Wide area active and passive sensors to provide a resilient and redundant network. Second, a challenging component of a credible defense capability is the inclusion and mix of kinetic and non-kinetic effectors. Interceptors, directed energy, and other technologies that expand our capability to defend strategic assets. Simply put, extravagant missiles are not enough, and will not alone protect our national interests.

And finally, a term that is, I believe, overused in many ways and at times assumed away, integration. Integration, the ability to share data, is no longer enough to maintain the tactical edge we need. The introduction and application of an optimal, resilient, mesh network across the combined and joint force goes beyond data sharing. A joint and integrated fire control capability lays upon our developers to fully open the architecture, allowing

the command-and-control platforms that we use across all services, to actually control multiservice sensors and effectors. This will reduce the costly C2 footprint and a requirement for operators of multiple C2 platforms. Bridging systems, while an encouraging first step, will not fully introduce a resilient capability.

As the JROC continues to balance global requirements in accordance with its Title 10 responsibilities, it will soon provide guidance on next steps in support of NORAD and U.S. NORTHCOM's mission to deter, protect, and defend the homeland. General Roper's comment provide us a framework to tackle this difficult problem. It begins with credible, global, integrated, deterrence at home and abroad. The idea of campaigning, as he mentioned, displaying a deterrent effect by improving and maintaining our capability and capacity, resiliency, hardening and redundancy, domain awareness globally, sensor to shooter and sensor to decision maker.

I submit that by integrating offensive and defensive capabilities and doctrine, enabling the dynamic targeting of multidomain threats, either left of first launch or using the first launch to target a delivery platform, we can leverage our capabilities in a way that places our adversaries at grave risk. We are pursuing multidomain A2/AD strategies to put adversary actions at risk as they target our interests. We are refining how we fight as a combined and joint force, and we are working to balance the regional and homeland battlefields.

In closing, it remains important to remember the warriors who volunteer to serve, to train, and operate in a mission such as these. Cooperation and collaboration between the United States and our international partners becomes even more critical to leverage a credible integrated deterrence and defense capability. And lastly, it is true, we cannot afford to do everything. Which is why the convergence of systems to enable a fully immersive joint multidomain operating environment is a no-fail mission essential task. I look forward to our discussion today. Thank you very much.

Peppi DeBiaso Great. I think I'm going to follow Tony and give my remarks up here. First of all, I want to thank Tom and CSIS for inviting me to participate in this panel with a group of incredibly knowledgeable colleagues that I used to formerly work with. And I thank Jen Hudson (sic; Judson) for moderating this. I want to be clear; these remarks are my own and I'm not affiliated with any institution, you know, that I may be part of.

I think to some extent – I think Tony may have mentioned it – you know, there's a – you may hear some remarks where there's a little bit of overlap. And that may be a good thing. I mean, perhaps, you know, there's an embryonic consensus starting to form around this issue about sort of the right set of – the right set of ideas. The CSIS report I think makes an

important contribution to the dialogue on addressing growing missile threats to the homeland, right? The topic, of course, is receiving heightened attention due in no small part to the changes in the strategic environment that raise new questions regarding the policy of defending the homeland against cruise missiles from our strategic competitors, Russia and China.

I think the report does a good job of outlining a framework, right, which takes an approach to CMD – homeland CMD that really is different from those considered over, quite frankly, the past 30 years or so. I think one way to think about this, as I'm going to frame it up in this following way, is that – is to look at the old problem that homeland CMD sought to solve in the past, and contrast that with the new problem that CMD seeks to address.

Briefly, the old problem. With the exception of minimal air defense in the national command region, sort of arising from concerns about another 9/11-type attack, the United States throughout most of the post-Cold War period assessed that the risk of cruise missiles strikes against the homeland from large powers did not warrant establishing a policy that would, in term, drive new programs, capabilities, and resources supporting a more expansive national cruise missile defense capability.

This view was clearly anchored in the judgements over the past three decades that the prospect of a Chinese or nuclear cruise missile strike that occurred apart from a wider nuclear attack on the United States was low, and therefore strategic nuclear deterrence was deemed sufficient. There were a number of other related considerations associated with CMDH during the Cold War period that tended to inhibit progress on this matter.

First was cost. If enemy cruise missiles strikes were to be part of a broader strategic attack on the United States, and thus likely employed in extraordinarily large numbers, this would drive up, right, CMD architectural and system requirements. If the United States needed to cover large numbers of assets in the homeland with large numbers of air defense sites and systems, the cost would be substantial. CMDH studies conducted throughout the 1990s and 2000s, over about a 20-year period – you know, suggested as much.

There was also an interesting political issue that sort of inhibited, I think, progress in the past three decades on this. Throughout this timeframe, the issue of what should be defended remained largely unsettled. Should CMD protect military targets? Should it protect nuclear command, control, and communication? Should it protect leadership? Should it protect populations? Should it protect a little bit of each? Should it protect all? Those were the questions that were dealt with for several decades. Perhaps most importantly, the question of protecting population centers was bedeviled by insolvable debates over which population centers should be protected.

Due to the political difficulty of prioritizing which population centers within the U.S. should – would be protected, and those, you know, should be not, the discussion over – during the time, right, the Department of Defense looked at these issues in the 1990s and beyond – often defaulted to a position of examining CMD for the United States on a wide area or territorial basis. Again, the notional CMD architectures turned out to be prohibitively costly. So overall, the absence of a clear and compelling threat, combined with ill-defined policy on what CMD should defend and why, including how it related to U.S. homeland defense and deterrence objectives, contributed really to a lack of progress on this matter for about three decades.

So what's the new problem? Let's turn to that, because I think the CSIS report kind of begins to get at this. With regard to CMDH today, I think it's important to recognize changes are occurring that present a new strategic context, right? A new set of issues, different from the unresolved debates of the past. The most consequential of these is highlighted in the 2022 National Defense Strategy factsheet, which the administration released a number of months ago, which calls attention to this new context.

Quote, "recognizing growing kinetic and non-kinetic threats to the United States homeland from our strategic competitors, the department will take necessary action to increase resiliency, our ability to withstand, fight through, and recover quickly from disruption," end of quote, right? The NDS 2022 factsheets. Very important statement, I mean in my judgement. One particularly significant development related to, quote/unquote, "the growing kinetic threats," is Russia and China's pursuit of advanced long-range cruise missiles, right? We've heard about this almost in every panel and in the report and from our colleagues, both now and earlier.

Right? These can be launched from air and sea to hold at risk targets within the United States essential to its ability to project conventional power into Europe and the Indo-Pacific region to support our overseas military operations and alliance security commitments. The longstanding American operating model, predicated on the uninterrupted flow of forces from a secure and uncontested homeland, in order to allow the U.S. to rapidly intervene in a crisis or conflict appears to be eroding, right? Russia and China are extending their anti-access and area denial missile strike capabilities, which we're familiar with in the regional context, right? They're beginning to extend those to the U.S. – the U.S. homeland.

This development provides them opportunities to conduct comparatively small or limited conventional strikes against the homeland, below the threshold of nuclear weapons use, and we've heard that, I think, mentioned at least a couple of times. The objective of these attacks, possibly delivered in conjunction with other non-nuclear strategic attacks – either arising from

counter-space or cyber – would be to erode both American political resolve and its military capacity necessary to respond or halt aggression in a regional conflict. Such attacks may in fact be a precondition for Russia and China in order to secure a local regional military victory.

In light of these evolving strategic vulnerabilities to the homeland, it seems prudent and timely to reexamine and to reframe CMDH efforts so that they're better aligned to deterring and defending against limited kinetic strikes, directed at degrading American power projection. The focus of the CMD strategy should be clear on what we are defending and why, what we need to protect to get our forces forward that can be crippled kinetically by conventional cruise missile attack, in numbers that could be reasonably launched from sea-based or air-based platforms.

Tailoring CMD to the particular goals and objectives of our opponent – that our opponents seek in carrying out such limited threats I think creates a different context for the discussion over the scope and scale of CMDH. This approach probably rules out large or larger territorial-wide requirements. Rather, the goal would be to preserve power projection capabilities, as we've heard, right, from kinetic interference by limiting damage to critical military facilities and transportation hubs, and possibly command and control nodes. This is probably essential if we are to credibly contemplate projecting military power across oceans to engage great-power rivals on their doorstep.

With this – within this context, the prospective deterrence and defense contributions of CMDH would be clear. First, to strengthen deterrence of limited attacks by degrading and complicating our opponents' offensive missile A2/AD campaign plans, in turn eroding confidence in the successful execution of those plans. And second, if deterrence fails, contain the scope and damage – the scope and scale of damage to critical power projection assets, sufficient to carry out those features of our conventional military plans flowing from the homeland.

Orienting CMDH around these deterrence and defense goals could provide additional benefits that impeded previous discussions over how to proceed. First, by focusing CMDH around the defense of a comparatively narrow set of assets to enable the flow of general-purpose forces from the homeland opens up the possibility of steering clear of the, quite frankly, paralyzing political debates over, you know, city or regional defenses that plagued this discussion in the past.

Second, CMDH focused along these lines provides clear limits on the scope and scale of the defense objectives in making explicit that the purpose of defense is not to chase the cruise missile threat or to protect every rock across the nation. Again, another attribute that doomed the discussion of the homeland CMD for almost 30 years. You know, under these conditions

CMDH operates within a broader framework that integrates the tools, capabilities, and forces needed to deter, withstand, and fight through Russian and Chinese growing capacity to threaten this type of limited warfare against the United States.

To wrap up, while important questions will have to be addressed over the particular details and attributes of homeland CMD – and the CSIS study provides us, I think, good food for thought, you know, on this question – it seems to me the benefits of some defense capability here to deny Russia and China an unchallenged pathway to threaten the United States would appear to be compelling. Thanks.

Ms. Judson

Thank you so much. Can you hear me? Thank you so much for your very thorough remarks. So we're going to dive into questions and if anyone has a question who's sitting in the audience, if you go onto the CSIS website to the event page, there's a button there that you can click on to ask a question. We won't be taking questions from the audience via microphone. So please feel free to submit. I'm receiving them right here, hopefully. (Laughs.) If everything works as planned.

I wanted to just jump in and ask: You know, why is the government just beginning to really seriously address cruise missile defense of the homeland? I mean, there's been attempts in the past. This has been identified in the MDR as a necessary. And it sounds like, based on your remarks, General Murray, that you are getting close to having somewhat of an idea on your architecture, potentially, that you're now going to be war gaming, et cetera. So talk about, first, why it is that we're – what's lighting the fire now? And then kind of where you are a little bit more in detail. Anyone can jump in on the first half of that question.

Col. Behrens

I guess I'll start. So, first, like I said in my comments, it's a very complex problem. My first observation would be that I think that the department and our partners have been studying this problem for a long time. And there have been – there have been challenges associated with the resources involved in something like this, as well as – some of the stuff that I talked about earlier is our forces aren't necessarily structured to do something like this, or at least haven't been for some time, where some time ago we used to have, for example, Nike Hercules batteries, you know, at various different sites in the U.S., and those types of things.

We're now – we've been structured for a long time and focused abroad for a long time. And so now as we really start to look at this problem, and I think we see the weight of the threat and the concern of that threat, and now to even more recent, you know, observations of the willingness to actually put that threat into action, is what's really kind of causing us to gravitate towards some action here.

But there is still a lot in terms of, you know, how do we – how do we actually resource this, and how do we – how do we balance it among, you know, a homeland defense home game verses an away game, per se? And how do you – how do you go about making sure that we're not taking undue risk in other areas that, quite frankly, could impact the homeland just as gravely as if we don't do something in the homeland? So I think that's part of it. I think the other part of it is we're seeing, you know, the national strategy kind of drive us in this direction, which I think is very helpful as well.

Gen. Murray

Yeah, I would just add I think Peppi had a great point about – and laid out what has paralyzed this debate in the past. But as far as why I think we're at a place where we're more open to looking at it is the confluence of the things that you talked about, but also the adversary gets a vote, right? So it's actually only in these past, let's just say five, six, few years, that we have seen our adversaries build the capabilities to actually deliver a conventional munition to – and demonstrate those capabilities. So that, I think, has also put a sense of urgency in this, in addition to what's been mentioned before. In the past, it was basically just maybe a one or two type of capabilities that would be delivered from one adversary, perhaps Russia. Now we see a multitude of capabilities to deliver from multitudes of weapons platforms from multitudes of domains, to include space.

Ms. Judson

OK. And you also mentioned, you know, you have a sense of where you need to go. And you talked about getting to 2030. Does that mean that we have the potential to see a big ramp up in funding in the base budget request in '24? I know that's just – you're just beginning the cycle there, but what's on the – what has to happen? Do you need to have exponentially more funding next year and in the following years than you've applied in FY '23, which really wasn't all that much when you lump in Guam, what you're doing there, potentially? That adds in. But talk to me about what needs to happen if you're looking at getting at a more robust cruise missile defense capability for the homeland by 2030?

Gen. Murray

Now, there's certainly a funding piece to this, and a policy decision to fund. But at the same time, we also need a lead organization, as we alluded to earlier, to drive this – to drive this effort forward, because all of the services care about this. All the services are building capabilities that could be used in this space. What we need is one lead organization to bring those together, to build the architecture, and to drive the program forward.

Ms. Judson

OK. You alluded to, I think, something that's kind of been a standing request for a while within the NDAA and also within the MDR, to identify an acquisition authority for this particular mission. Can you say potentially how close you all are on making a decision on who's going to take ownership for this? It would likely need to happen soon, I would think. (Laughs.)

Gen. Murray — I'm not going to try to predict the processes that are in route, say, but I will say that the department is taking this very seriously and has plans. And in fact, is meeting almost as we speak to make this decision.

Ms. Judson — OK. I wanted to ask all of you what you felt was the strongest point in the report that has come out from CSIS today, but what you still feel needs some more development in terms of – I think logistics and also manning is something that was mentioned here. So, if you can unravel that a little bit more. That's open to anybody here. I'll let you decide who wants to jump in.

Cdr. Stafira — Yeah, so from my perspective the strongest point in the report was the look at the systems and the capabilities that you need to include to try to look at this. Kind of looking at a layered capability to be able to handle those kind of threats. I think, as mentioned before, where it's easy to throw the capabilities out. It's then how do you employ those capabilities, how you manage the capabilities. I think those are – those are those things you still need to – you still need to look at, is when you go through this. But, again, you need to start with something. So being able to start with a capability and a look at that and say how can I defend against these kind of threats, and then move to those other more detailed questions, I think from my perspective that was what was well and short in the report.

Dr. DeBiaso — From my perspective, somebody who's spent 30 years working, sort of, defense strategy issues, the recognition of the changes in the nature of adversaries' sort of warfighting capabilities, the move towards limited-warfare concepts, right, to undermine American conventional superiority attributes, right, and the way they may get around to do this I thought was an important contribution to the discussion to help sort of shift our thinking, as my comments noted, from getting away from the old problem to focus on the new problem. The challenge will be – you know, the good side, the downside – the challenge will be, writ large – is continuing to calibrate homeland cruise missile defense in a way that doesn't bring us down a path of where we've been for the past 30 years, right, that there isn't mission creep, that we don't continue to expand what we want from homeland cruise missile defense in ways that will sort of undermine the chance of any consensus being built around it. Homeland CMD has to be tailored around the specific objective that our adversaries seek in carrying out these attacks against the United States, and we've got to stay on point on that regard or else we're going to repeat the past mistakes of three decades and I think end up with nothing.

Ms. Judson — OK, anyone else?

Col. Behrens — You know, I would say what I was really pleased to see is the amount of thought that went into the sensing and layered capability in terms of

sensors, not just ground sensors, not just space sensors but elevated sensors, but even higher elevated sensors. I mean, you need that layered, resilient kind of capability, I think, to start. And again, I was pleased and encouraged to see, you know, some thought put into the operational and sustainment cost of such of a mission.

There are two things that I think, going forward, you know, probably still requires more consideration. One is, you know, once you really put those capabilities in place, it kind of goes back to that command and control capability, and one of the areas that we've seen from a DOTMLPF-P perspective that is really driving up the resource needs in a lot of these missions is that you have – let's just say, in this particular case, you have Army capability and you have Navy capability; maybe you'll have some Air Force capability too, but probably in a different – you know, serving in a different capacity. But in terms of IAMD, let's just say Army and Navy, but yet you still have to work through the integration or convergence of those capabilities because I think that that's what will allow us to synchronize the DOTMLPF-P issues and resources necessary. If we don't do that synchronization up front, then we're really kind of taking ourselves down a road where we're going to grow the mission to something that might not be sustainable, and so we just have to really work through that.

And sometimes I get a lot of comments that I talk about DOTMLPF-P too much, but, you know, I'm passionate about it because I've been on the receiving side of those, you know, decisions, and – many of us have, and we kind of see where that takes us, if we're not careful about it and we don't have people really thinking through that and trying to synchronize those.

Gen. Murray

Two quick things that I took – that I thought were great about it. One is the set of principles. You know, being a concepts guy, I really like those set of principles that allow you to kind of take the next step. The second would be the tailorability of this. We could all sit down – and believe me, we've done it; the permutations are endless – sit down and say, I'm going to put this there, that there, this there, that there, but really, that's a policy decision on where we set that dial, how much risk we're willing to take, and how much we want to defend individual given areas, but if you can build a construct that's tailorable to that risk, that policy decision, then you're not stuck with "you get what you get and you don't throw a fit," which I tell my kids. So, thanks.

Ms. Judson

All right. I wanted to ask about Guam. I think that there are potential lessons learned from Guam that you could apply to homeland defense, cruise missile defense of the homeland. However, Guam is just in the form of now a defined architecture; it's not been implemented. I'm sure there will be far more lessons learned as you move forward. But what are you hoping you can apply from Guam when you consider cruise missile defense for the homeland? And what just isn't going to be applicable coming from Guam?

Cdr. Stafira

So, when you look at the Guam problem set, it's really a multi-missile defense problem set. It started with ballistic hypersonic cruise missiles; how do I defend the island – that critical island against those kind of threats? And so, as we started looking at that, how do you bring capabilities together and join them together, integrate them, so that you can have an integrated defense against those type of – all those type of threats, because, really, as you look at those threats, they're kind of – they have been individually looked at. So how do you bring that capability together? I think, as we develop the Guam architecture, working with the Army, working with the Navy, working with the joint staff and the services, I think we'll learn a lot from that of how we want to operate that integrated kind of defense, and that – you know, that area is kind of the size of what you're looking at in trying to defend, say, a limited area in the CONUS. Now, you wouldn't need all that capability because you certainly – here we're looking at cruise missile defense of the homeland, but you could bring those lessons in and hopefully be able to bring capabilities in if you need more capability in that, and I think that's where Guam comes in.

Ms. Judson

Anyone else want to comment? All right. (Laughs.)

I wanted to also ask, in terms of what industry can help you with now – I mean, we're talking a lot about using things that are already developed, already in the inventory in some ways, radars from other – interagency sharing of data and sensors, but where can industry really help fill in some of the gaps in order to create some kind of architecture for cruise missile defense of the homeland that may not be fleshed out yet? Where are you hoping to see industry work?

Cdr. Stafira

From my perspective, as you said, there's a lot of capability out there, and all the services have developed capabilities to defend against cruise missiles. They've got capabilities, that point-defense capability to defend against cruise missile threats: there's sensors, there's – there are command and control systems, there's effectors that are looking at that, but as we look at this and trying to get the best capabilities, how do you combine those together and so that they operate together? And I think that's kind of where I think we would like to probably see more industry help on that, is how do you do that, because a lot of these capabilities are also made by different industry partners. And so how do you integrate different industry partners' assets together to do that? Because, you know, a lot of times, the keys to the kingdom are, you know, those algorithms and those things that are done inside the fire control capabilities of those systems to be able to operate, so how do we better integrate them across? And I think that's where I would see a lot from industry.

Col. Behrens — You know, so as a capability manager for the last few years, what I've seen that's extremely encouraging is the cooperation among industry partners. That's something – it's not new but it certainly, I think, has increased on their side. What helps us now from the aspect of building requirements is sometimes we don't know what we don't know, and we don't know what might be the best way to do something, and so our industry partners are putting a lot of investment into solving a lot of these problems that they see and that they know that we have, and so our engagement with them is very important to help us understand, really, what those problems are and what the possibilities of technology might bring us. Then that allows us to kind of build requirements associated with, how do we actually solve that problem? And so that's been very helpful too, and I think that, as long as we continue to encourage that, that's something that I've seen that has been very useful.

Gen. Murray — The other piece that I would add is automation – really bring in the AI and the ML into this piece because, as you probably heard today, the DOTMLPF piece, if you will, the manning the piece, in a zero-sum world of manning, we have to find ways to do this less manpower-intensive, but yet still have the reliability that our decision makers expect of us when we're talking about defending the homeland from a cruise missile and making sure – one of the reasons that it is very manpower-intensive right now is that nobody wants to shoot down an airline, and rightfully so. So how do we bring in AI and ML but yet still be – have the predictability and the reliability that will give us, our leaders the confidence that we can employ these systems?

Ms. Judson — OK, I wanted to also follow up on something Colonel Behrens mentioned about priority list for air missile defenses, as well as cruise missile defense, kind of the whole portfolio, if you will. Now, I care about this as a journalist. Are we going to see this in a public way? And how are you going to be sort of unveiling or coming out with a priority list in a public way, if at all?

Col. Behrens — We're probably not going to do it here at CSIS.

Ms. Judson — Not today. (Laughs.)

Col. Behrens — So, I think what we'll see – this is our first attempt at it, so for many, many years, decades even, USSTRATCOM has really held the responsibility of a missile defense integrated priority list.

Technical Administrator — Colonel Behrens, turn your mic on.

Col. Behrens — It's on. Testing, testing. Anybody? OK, I'll keep talking just in case.

Technical Administrator — It is on.

Ms. Judson Here, just pass a new one.

Col. Behrens There we go. Or maybe it's just –

Ms. Judson Maybe it's just you? (Laughs) Sorry. It's just switching off in front of in front – is it all the –

Col. Behrens I think it must be me. OK, so – this is what integration gets us. (Laughter.)

So, as we have started the work of transitioning that responsibility to the joint staff, JIAMDO will do the, you know, kind of the coordination of that work, but it's not solely a joint staff mission or a JIAMDO mission. We've recently brought the representatives from each of the combatant commands, all 11 combatant commands, to the area to start to help us work through the methodology. We want to make sure we get that methodology correct and in a way that will allow us to ensure that we're seeing and we're weighting the voice of the combatant commanders in terms of what they need operationally. And so the more combatant commanders who ask for the same things, then you'll start to see that capability requirement, you know, kind of move its way up on the list, because we don't want to lose sight of what is really necessary for a campaign to be successful, through the eyes of a combatant commander. And so we're working towards that methodology now. Starting in 1 October timeframe, we'll start the actual work of then bringing everyone together to start to build this consolidated IAMD enterprise list.

So before, where the missile-defense aspect of the list was really for missile-defense capabilities and nothing else – while they were mentioned and they were accepted and they were understood what those requirements were, they weren't necessarily tied to resourcing or to a priority or integrated. And so what you'll see – about the March timeframe is when we think we're going to be able to push this first list out – is a full spectrum of IMD capability requirements, whether it's counter-UAS requirements, or it's defense against hypersonics requirements, but is largely going to depend on what those combatant commanders say that they need that year to build that prioritization. From there on out, it probably, you know, will be tweaking that list, more so than rebuilding it every single year, but it is going to be an annual effort.

In terms of your question of, you know, will it be fully public release or, you know – I think there will be different aspects of it, right, and so we may be able to provide some categorization of what the department is recommending in terms of prioritization; obviously we'll want to keep close hold that – you know, the true capability requirements that are going to drive capability development and resourcing into the future and allow

Congress the time that it needs to, you know, assess that prioritization and determine what's important.

Ms. Judson — Absolutely. I'm just going to ask one question from the audience; I know we're basically out of time. This comes from Arch Macy. What capabilities are being considered to deal with potential internal threats in the U.S., i.e., commercial or private aircraft used in the 9/11 scenario? Just to close. Who wants to take that one? (Laughs, laughter.)

He's throwing the microphone back at you. You can take mine.

Gen. Murray — Capabilities. Well, first off, let me say that this remains – the counter-VEO threat, preventing another 9/11 remains a top priority of the command, so even though we recognize the growing peer threat, we are still also laser-focused on that piece of the threat. So, I can't talk about specifics, but I will say this: We are constantly and continue to upgrade our capability to counter and defeat that threat, whether it be with material solutions – i.e., it could be missiles; it could be whatever – and with nonmaterial solutions like new and updated tactics, techniques, and procedures, but it remains a primary focus of ours.

Ms. Judson — Well, with that, we are out of time. I wish we had another couple of hours. (Laughs.) Thank you so much for sitting in the hot seat here for the last hour or so. And thank you also to CSIS and to Tom Karako for rolling out this really interesting report today. And we'll turn it over to Tom.

Dr. Karako — Thank you, Jen. We really do have a significant fraction of the nation's brain power on these issues here. Thank you all, gentlemen, for coming out. I think we might have to update our report; the microphone issue will require an eighth principle of redundancy and resilience, but you managed to make it through.

Thanks again. We're going to take a quick break and we'll come back for our last panel on the defense industry. So, thanks, everybody. (Applause.)