090418 Missile Defense Advocacy Alliance (MDAA) Congressional Roundtable Discussion with Undersecretary of Defense for Policy John Rood; Undersecretary of Defense for Research and Engineering Michael Griffin; Missile Defense Agency Director Lieutenant General Samuel Greaves; and Riki Ellison, Founder and Chairman of MDAA, on "Space Based Missile Defense"

MR. RIKI ELLISON: Good afternoon, ladies and gentlemen. We're going to start this. Welcome to our 20th Congressional Roundtable on missile defense.

My name is Riki Ellison. I'm the founder and chairman of the Missile Defense Advocacy Alliance. We have one mission statement, we firmly believe that the world is a safer place with the deployment and development of missile defense, and we advocate around the world and throughout our country.

I also have been engaged with missile defense since 1980, when our nation did not have a missile defense capability, and now we do. We've had a phenomenal movement from those days to where we have a limited capability today that is, I believe, protecting 1.3 billion people. That is all the United States, that is Japan, that is Korea, that is the Middle East, that is Israel and that is Europe.

The world is a safer place. Because of those deployments, those allied partnerships, we're able to do things that we haven't been able to do before. Certainly the Korean situation is stabilized.

So as we go forward to look at how best we can improve this capability -- cheaper, more effective, more capable -- we're going to open up a public education here today on what we can do in space, why we need to go to space, and what is space-based missile defense? We have probably the world's top three experts today, to be able to discuss this with you and educate you on this really revolutionary and very positive movement that I think our nation is going to make happen.

The format is basically a very open discussion. Each of our speakers will give about a 10 to 15 minute presentation, and we'll open it up for questions after that. John Rood, the Undersecretary, will have to leave at 2:30 p.m., and our program will end at 3 o'clock this afternoon. I'd like to introduce our first speaker, a good friend.

Undersecretary of Defense for Policy John Rood serves as the United States Undersecretary of Defense for Policy. He assumed this position on January 9, 2018. In this role he serves as the principal adviser to the secretary of Defense for defense policy and leads the formulation and coordination of national security policy within the Department of Defense. Mr. Rood overseas the integration of defense policies and plans to achieve the desired objectives. He is responsible for efforts to build partnerships and defense cooperation with U.S. friends and allies. Ladies and gentlemen, welcome

Undersecretary John Rood.

SEC. JOHN ROOD: Thank you, Riki, for those kind words. The real missile defense experts, of course, are to my left, Mike Griffin and General Greaves, who will talk about it. Looking around the room, there are so many people over the years that have been involved in missile defense I feel a little sheepish presenting some of them, like General Obering and others, who have usually been educating me on the topic. But it's great to be with you in this room.

A couple of things to mention at the beginning, it has become an overused statement for people like myself to say that the security environment in which we find ourselves right now is the most dynamic and complex in our lifetime. But if you stop and think about that for a minute and what does that mean for a half century or so about the range of threats, the complexity of them, how quickly they're changing, and the degree of the threat to the United States and our allies, it certainly is the case. One of the things that we have sought to do in the Defense Department with our new National Defense Strategy is really emphasize the growth of that complexity in the security environment, and the fact that strategic competition amongst the great powers in the world has returned.

Whether we might like that to be the case or not, the reality is that countries like China and Russia are working to create a different international order than that which has existed since the end of World War II. The post-World War II structures and approach to international security that the United States and our allies constructed is increasingly under threat and being challenged by these authoritarian regimes. You add to that mix what's going on in places like North Korea and Iran, in addition to this continuing threat that we face from terrorism, and you start to have a very dynamic environment.

At the department level where we are making trades across those areas, the National Defense Strategy is a clear guide to that, and prioritizes this great power competition, prioritizes and makes hard choices, about where we will spend resources. In the area of missile defense and missile threat, I think that certainly fits in this broader trend, unfortunately, of a growing level of threat, growing complexity, a dynamism from different directions. So as I look across the morning read that I have of intelligence or other things about where are we concerned about hot spots, it would be unusual not to see ballistic missiles or cruise missiles as part of that concern: whether that be in places you might not expect, like in Yemen where the Houthis, armed by the Iranians, are conducting missile attacks on allies; whether that's in Syria where you see persistent conflict; whether with the Iranians with yet another large-scale missile exercise in the Gulf, Great Prophet, a series of these activities; North Korea where we continue to have concerns about the missile threat; and then certainly at the very high end with the activities that Russia and China are undertaking, and not just in ballistic missiles.

Of course today any discussion of the missile threat would also include the cruise missile threat, and looking not too far ahead, unfortunately, the threat from hypersonic systems. Others to my left are more expert and can describe the hypersonic threat to a

degree that I can't. But I think that looking further ahead, that's one of the real threat areas that we face.

I mentioned in China's case that that is a particular concern to us, the broader strategic environment. With regard to missiles, of course, a key component of China's military modernization has been the growth in its missile capabilities, whether that's short- medium- or inter-mediate range missiles, or certainly intercontinental range missiles, both based on land and at sea. These activities are all part of China's attempt to create more options with respect to its neighbors, whether that's Taiwan or regional neighbors, but also certainly to complicate U.S. military access to and support for our allies and partners in the Pacific, the Indo-Pacific region.

As I mentioned, Russia is a concern in the missile sphere. That is certainly the case. Russia is developing a new generation of advanced ballistic and cruise missiles that support its anti-access area denial strategy. And as I mentioned, hypersonic missiles are being developed by both China and Russia. These are separate programs, separate countries pursuing separate activities, but nonetheless we're concerned about both.

Over the past decade we've also seen the growth in North Korea's capabilities, which is very noteworthy. Certainly we're engaged in diplomacy, as you know, with the North Koreans. I see some of our friends are here from the media and they've been covering this story rather extensively with the president meeting with Chairman Kim and our diplomatic efforts continuing there. But from a defense perspective, of course missile defenses are about dealing with capabilities, and the North Koreans possess substantial capabilities that have grown in recent years.

Of course, these are not only fixed land-based missiles, but road mobile, and pursuit of a submarine-launched ballistic missile capability. So it's a very sophisticated effort there. That sophisticated effort has produced quite a few systems which have been featured in various parades and other activities by the North Korean regime to show the world what their capabilities are, but they've also conducted six ICBM and SLBM tests in recent years, not to mention the six nuclear tests that North Korea conducted. So all of that shows a substantial capability that we need to be prepared to deal with.

Iran is another area, of course, of great concern and they continue to develop sophisticated missiles with improved accuracy, range and lethality. They field an array of increasingly capable short- and medium-range missiles, and of course they're working on longer range missiles, mostly in the guise of space launch vehicles that could threaten the United States. So what are we doing about it?

In this strategic environment, we're increasing the scale of our missile defense effort through the deployment of additional capabilities. General Greaves and Mike can discuss that, of course. But we're also looking at how we might adjust our approach.

We're in kind of an interesting period where we need to assess the missile defense capabilities that we have and weigh them against this projected threat environment in a

way that is more dynamic than I think if I was sitting here three, four or five years ago. This is always a consideration, year after year, of those that are veterans of the Defense Department annual program and budget reviews. But I think this year it is more-so the case than in past years.

In line with that National Defense Strategy that we put forward, we have to ensure that our missile defense investment strategy and priorities enable us to meet the most dangerous missile threats we face today. Our policy approach is that we keep pace or exceed the capabilities of the threat. We don't want to be in a situation where we are dependent only on offenses in order to provide deterrence.

After all, missile defenses are part of modern day deterrence. They're part of deterring someone from considering an attack, from pursuing capabilities and ultimately conducting it. But they're also part of assuring your allies that you have the capability and the means to fight, to assure them of your ability to meet your defense obligations to them, and if necessary to defeat that attack. After all, if you can postulate a case where a country like North Korea might launch an attack, or a country like Iran or any aggressor, the ability to not only defeat the attack but to follow up with offensive capabilities, all these things as a whole strengthen deterrence. Occasionally I'll hear people say, why don't we rely on deterrence instead of missile defenses? Missile defenses are a part of contemporary deterrence.

We're here to talk about space and the contribution that space-based assets can play. I'll just mention a couple of things and then turn it over to two more expert panelists to talk about some of the specifics. I will say as you get to the case where we have sophisticated larger scale threats, the advantages from a space-based defense are one of the things that we're looking at.

Certainly the president's National Strategy for Space highlights the importance of space to us as a national security matter. We've got to protect our assets there. We have to protect the ability to utilize space for our activities here on Earth, for the capabilities that those assets bring to our force, but also for scientific advancement. Missile defense in space can not only strengthen your ability to deal with a missile threat, but they can also strengthen your ability to protect your space assets.

The 2018 National Defense Authorization Act required DOD to develop a plan and proposals for a space-based layer, that is to say both sensors and interceptors. So one of the things with the passage of that legislation is, as directed, we have been looking at that question and trying to examine what the appropriate capability mix would be. Some of just the generic advantages of space is that space-based sensors and interceptors provide persistent, continuous coverage. They can engage missiles launched by any adversary anywhere on Earth.

Also, if the technologies in intercept layer were cost-effective and affordable, they could provide you the ability to do boost-phase defense, which is very attractive because it both avoids debris but also begins to thin out the missile threat before your midcourse

and terminal defenses have to deal with it. So that's another reason we're looking at this capability. Of course there are certainly strategic policy questions that would need to be answered in this area, but I will say space as a general matter is something which we are very focused on in the department.

Another initiative, of course, is the president has discussed a vision for a space force, a sixth branch of the U.S. military. We have submitted a report recently to Congress in which the department has talked about a progression towards that vision. One of the initial focus areas will be the establishment of a four-star space command that will be led by a general officer.

What that will bring is a focus on war fighting for space, someone whose entire role is operational coordination to deal with this increasingly contested domain that we must be prepared to defend and utilize. So you'll see us move forward with the creation of a Space Command. That report to Congress also talked about a space development agency, so you speed the progression at which the department can develop and field capabilities, get them into the hands of this war fighting or operational, I guess would be a better way to describe it, command that we would have at Space Command.

The specifics of how we structure for that and do it remain to be determined, and obviously there's a relationship with what the Missile Defense Agency would do in space-based capabilities, so we're sorting through those kinds of questions. But I guess one of the things that I'll leave you with is space is an increasing focus at the Defense Department. It's something that, as directed by the Congress, we're looking very seriously at capabilities that could be employed for space-based missile defenses, whether that be sensors or other capabilities. And there are inherent advantages from space that we need to look very seriously at.

That's probably a good place for me to leave it and allow my more learned colleagues here, Dr. Griffin and Sam Greaves, to discuss in greater detail. Thank you, Riki, for having me and convening this group.

MR. ELLISON: Thank you, John.

(Applause).

MR. ELLISON: We have one of the great experts on missile defense. I think Dr. Griffin has been involved with it from an early time, and he's one of the very few that began the program with SDIO, and where he's at in his new role. Let me introduce him formally.

Dr. Michael Griffin is the Undersecretary of Defense for Research and Engineering. He is the department's chief technology officer and is responsible for the research, development and prototyping activities across the DOD enterprise, and is mandated with ensuring technological superiority for the Department of Defense. He oversees the activities of the Defense Advanced Research Projects Agency, DARPA, the

Missile Defense Agency, the Strategic Capabilities Office, Defense Innovation Unit, the DOD Library (ph) Enterprise, and the Undersecretary of Staff focused on developing advanced technology and capability for the U.S. military.

Dr. Griffin.

(Applause).

DR. MICHAEL GRIFFIN: Thanks, Riki, and thanks to all of you who are here today. You were talking about the length of time I've been involved with missile defense. A little while ago, as it happened, a reporter asked me how I would -- if I had to sum up my career briefly -- my first reaction was I'm not done yet. But after that, I said, I guess if I had to put it on a bumper sticker it would be manned space flight and missile defense. He said, those two don't have much in common, and I said well, that's not my problem. But that's how I would sum it up.

My roots in missile defense go back to late 1984 after Lieutenant General Abrahamson, as the first director of the then-SDIO, now the Missile Defense Agency, was insubstantiated. I was lucky enough, with folks who are actually here in the audience, to be involved in a number of early proof of concept tests that we somewhat amazingly did quickly. Possibly because we were quick, they were also done well. Because of those two things, I find where I am today. If they had been failures no one would have ever heard of me.

So space and missile defense, it is long past time to recognize that missiles from theater to intermediate to strategic range seem to be the method of choice for adversaries to reach out and touch someone. Yes, we used to hear all the arguments about how well we can put bombs in container ships or we can do this or we can do that, and all those things can be done. But what people actually do is as soon as they can they start to develop missiles to go after those they wish to aggress against. I just note that that's the way the world seems to be, and so we need to respond to what is rather than what it might be or could be.

Secondly, the number of nations and societies which are capable of so doing, seems to be increasing all the time, and there's still only one of us. Certainly we just can't do what we need to do in missile defense without space. The ground missile defense program, which Sam currently leads, Trey Obering has led -- I don't know if there are any other former directors in the audience, many of us have had many years of involvement with that -- is effective at what it does, which is to handle a limited size raid in midcourse.

It cannot affect global persistence on the surveillance side. The missile defense system we have today from the sensor side detects an incoming threat after it is well inbound. It is not set up to detect hypersonic threats. It's not set up to detect short- or inter-mediate range threats.

And on the interceptor side, it is capable of going after objects in midcourse, but that's all. It's very good at what it does. I have reason to know that our statistics these days are quite good, but it only does what it was designed to do.

It is, in brief, not a system -- we today do not have systems which give us globally comprehensive, persistent, timely, multimode awareness of what is going on on Earth, everywhere all the time. We don't have that. John Hyten, a longtime friend and today close colleague, remarked a few weeks ago at the Space and Missile Defense Conference in Huntsville, that we will never hit a target we cannot see coming, and that the Chinese hypersonic threat in particular is one that in today's world we can't see coming until it's too late. That alone would cause me to want to go to space for a space sensor layer.

I would add that if we wish to have our own hypersonic strike capability, and I think we do, that we have to know where the targets are. And if the targets are mobile, I need to know not where the targets were a week ago or even yesterday, I need to know where the targets are right now. I need to know where they're going to be 15 minutes from now or the best hypersonic strike capability in the world, which might be capable of offsetting what China can do, is of no value. I need to know where the targets are and I need to know from where the threat is coming and when.

Those requirements alone, if it did nothing else for us, would drive me towards a space sensor layer. John Rood -- and John, I don't concede that I have more expertise than you. I might concede that we have different expertise, but I will be strongly in favor of being guided by you in the policy arena. Not my thing.

If we wish to effect comprehensive missile defense, we have to be able to go after the boost phase. If you wait to the midcourse, you've given the enemy a free shot. You've given them a free layer. Why would we do that?

Our de facto capability and de facto policy since the end of World War II, has been that if your -- whoever you are -- if your airplane is in the air it's because in the long run we permit it be there; because we have the capability to make you not be in the air if we want to, as when we decide to enforce a no fly zone. If your vessel is sailing upon the water, it's there with our tacit permission. If we didn't want that vessel on the water, it would not be there.

The costs to the United States and our Western allies and partners of making something like that go away are significant. There are significant political costs and you have to get over a high threshold before we decide as a nation and as an alliance, that you shouldn't be there. But interestingly, the costs to us are political. The costs to the other side are existential. You're not around to participate in the discussion anymore, if we decide that you have to go away.

That was the kind of power projection that the United States has enjoyed since World War II. We've paid a lot of money and many lives for it. It has led to the creation of a rules-based order which has held for over three generations now.

As John mentioned earlier, the National Defense Strategy is today all about recognizing that there are threats to that rules-based order, and that the world is not likely to do better under a different regime than it does today. So it is up to us to defend that, and in order to defend that order we must now go to space.

Our entire space architecture, our entire suite of space capabilities, was designed in an era where it was a U.S. sanctuary. It is no longer. Our entire defensive posture was centered for decades around the idea that the U.S. homeland was a sanctuary. It is no longer.

If we are to deal with these facts on the ground, and the facts of adversaries who wish to upset, as I said, the rules-based order which has held for now three and more generations, then we have to go to space, both for the sensory layer and the ability to project power. That is fundamentally what it is all about.

I'll close by noting that I am very, very, very, very tired of people who say that we cannot afford it. Let me offer just a trial balloon kind of a number. I get tired of hearing how it would cost $100 or more billion to put up a space-based interceptor layer.

If I use as a reasonable, an entirely reasonable number based on experience, of $20,000 per kilogram delivered FOB low orbit, and if I were to say that I would be content with a layer of 1,000 interceptors -- which seems to me like a lot, and each of them weighs a metric ton, 1,000 kilograms, which would seem to me like a lot -- then the entire cost of that would be $20 billion. We've paid a lot more and gotten a lot less in the Defense Department over the years.

I am impatient with discussions of life cycle costs because the life cycle cost of anything is infinite. The life cycle cost for me to own golf balls is infinite, because I keep hitting them into the water. As long as the nation exists it will have defenses. It's assumed that we're not going out of business as a nation very soon, so the discussion about life cycle costs is to me less relevant than the cost of entering the game and being in the game and being on top of the game. If the United States is not on top of the game, then I don't know what becomes of the world, but I submit that it will not be a pretty place.

Thank you.

(Applause).

MR. ELLISON: Thank you, Dr. Griffin. The next presenter is the Director of the Missile Defense Agency, Lieutenant General Sam Greaves. His mission is to develop, test and field an integrated layered ballistic missile defense system to defend the United States, its deployed forces, allies and friends, against all ranges of enemy ballistic missiles in all phases of flight.

Sam.

GEN. SAM GREAVES: Good afternoon, Riki. It's a great pleasure to be here with you, and of course with Secretary Rood and my direct boss Dr. Griffin, to talk about something which I believe -- and you've heard quite eloquently -- to be of significant importance to the nation.

I've got about seven charts to just lay the groundwork for what I believe we're going to talk about today. From where I sit, it's how do we get this done now that we understand the strategy and the guidance and the set of expectations, as just laid out. The question is, how do we do this? Let me go to the first chart.

I always start with the mission of the agency, because I think it's important to ground this in why we're here, why the Missile Defense Agency exists. It's essentially to develop and deploy a layered ballistic missile defense system to defend not only the United States, our deployed forces, our allies and friends from ballistic missile attacks of all ranges in all phases of flight. You've gotten some good indications here that we are seriously going after the "all phases of flight" portion of that mission statement.

So today the system is globally deployed. Some of the artifacts you can see on the bottom left to right, all the way from Ground Based Interceptors to the Aegis weapons system on ships, to the golden nugget within the ballistic missile defense system, the command and control battle management system, the multi-domain command and control system. You may have heard that term in other environments, everything from space assets that we're going to talk about that we leverage today to the Terminal High Altitude Air Defense System, the THAAD, the ground-based radars and our sea-based X-band radar, as examples of the overall missile defense system. Next chart.

This chart is pretty important because there tends to be significant focus on the Aegis, whether or not it's the SM-3, Standard Missile 3, the Ground Based Interceptor, everything in the middle swim lane on that chart. But the really, really important takeaway from this chart is the architecture, the capability that pulls the sensors together with the shooters to deliver an effective missile defense capability. So in the top swim lane that you see there, you can see that term C2BMC, command and control battle management systems. The vision is, and actually the reality today, is marrying the sensor with the shooter within the appropriate environment to deal with the appropriate threat.

You can see the sensors on the bottom, all the way from leveraging sub-sensors, such as the Advanced Extremely High Frequency Satellite System that the United States Air Force deploys and operates, to the Space Based Infrared System, which the Air Force also deploys and operates. There's the ground-based radars, the TPY-2 radar in forward-based mode. There's the upgraded early warning radars that the Air Force operates, the Navy's Aegis weapons system, and of course the sea-based X-band radar.

Together with the elements that formulate the shooters in the middle swim lane, the command and control battle management system knits them all together and provides

them the true power within the BMDS for this global capability. So it's the architecture, and not strictly the components. Next chart.

Priorities are very, very key for the agency. The topline message here is that these priorities are formulated in support of the National Defense Strategy, and they are (on the ?) chart. The top priority that we have today is to focus on (maintaining ?) reliability and to build confidence in the combatant commander in these systems that we've got deployed today. Whether it's NORTHCOM or STRATCOM, DAECOM, EUCOM, CENTCOM, the combatant commanders need to be able to state repeatedly with confidence that they can rely on the ballistic missile defense system that we've got in the ground today, and on the oceans and in the air.

The second priority is to increase our engagement capability and capacity. The United States Congress and the administration were very supportive last year in providing us significant additional funding to do both of those items, to increase both our capacity, as in buying more Ground Based Interceptors as an example, more Standard missiles and more THAAD rounds. Capability is also something we're going after as part of that second priority.

The third priority is, of course, rapidly addressing the advanced threat. I emphasize this because the threat is coming. We know it is, it's not fantasy. Those with access to reliable intelligence information have seen and know that the threat is demonstrating itself and will be operationalized very soon.

So today, as was mentioned earlier, the deployed ballistic missile defense system meets today's threat, but additional capability and capacity are needed to stay ahead of that threat. I'll foot stomp again what you heard earlier, our goal is to stay at a minimum at pace but definitely in advance of that threat that we know is coming. Next chart.

This is a space discussion, and I'm using this chart as a reminder to all of us that the missile defense capability and missile defense interest has been in, around and about space for a very, very long time. It's not something that is new. You can look at how the missile defense capability leverages what is provided in the missile warning area.

It was the Defense Support Program and the Space Based Infra-Red System, secure communications, whether it's Milstar or Advanced EHF, and the wideband global SATCOM data pipes that we use to transfer information. We're big users of position, navigation and timing, primarily provided by the Global Positioning System. And then, going all the way back to the early '90s, a series of missile defense experiments, beginning with the miniature seeker technology integration experiment back in the early '90s, essentially paving the way to assess how well we can do tracking, as an example, of ballistic missiles from space.

It's the Deep Space Program science experiment better known as Trinatime (ph) and its electro-optical laser ranging sensors that were on it. Also initiating and blazing the path for the systems that we've got today and the systems that we intend to deploy in

the future: MSX and Infire (ph) and Airfield experiment in 2007, all the way to the Space Tracking and Surveillance System demonstration system that we've got flying today. Those systems essentially demonstrated the capability to do everything from tracking to discrimination to cueing from space. So it's not a matter if we can do this, we have demonstrated the ability to do it.

With STSS a few years ago, along with industry, we actually demonstrated the ability to send tracking information of high enough quality to initiate an SM-3 launch from an Aegis ship, what we call launch on remote. So it's not a matter if we can do it, the matter is how much and how fast.

The next chart is a notional representation of what the space sensor layer should look like. It's information rich, so I'll go fairly slowly on it. Everything in orange that you see there are capabilities that would directly support the missile defense mission, as well as what's in blue there.

On the Y axis, the vertical axis, you've got threat altitude. Range is on the bottom. Those two red dash lines, the top one illustrates the ballistic threat that we know of today, and we'll talk about that in a second. The bottom dash line is an attempt to illustrate the hypersonic threat, flying at much lower altitudes in and out of the atmosphere, which requires a different type and degree of sensing capability.

So if you go from left to right on the chart, it begins with a launch. The bell ringer system that we currently leverage today that is flown by the United States Air Force, the Space Based Infrared System, does global scanning and alerts and characterization. So it essentially wakes the system up and says, something is coming our way.

What's new on this chart, and what is going to be really important for dealing with not only the ballistic missile threat but more importantly the hypersonic threat, are the next two systems, one that does regional staring to do detection, warning and cueing. What's key about this is it's looking down at the warm Earth, which is a very different problem than the next system you see, with a field of view system that's looking against the cold background of space. So to effectively deal with the hypersonic threat we need to ensure we know what it's doing from birth to death. The phrase we use is birth to death tracking, because it's able to maneuver, unlike a ballistic threat where you throw a baseball in that direction towards the camera and it lands near the camera. The maneuverability of the hypersonic threat is of significant concern, so we must maintain custody of that threat from birth to death.

Looking down on the warm Earth you've got things to consider such as clutter, the relative motion of the target, things that make it somewhat difficult to very difficult to track it. So you need one type of sensor to track the target. We're working with such agencies as DARPA, the United States Air Force and the other services, to take a look at what that architecture would be like.

We have a government reference architecture, but that is not the predisposition answer. We need to see what, for instance, DARPA's Blackjack Program, the delivery as far as capability and timing of that, to see whether or not that is the answer. We're working very closely with my boss here, Dr. Griffin, on making sure we understand the pros and cons of what the government reference architecture currently recommends versus what we've been able to gather from industry.

You all out there, with what you've told us, we're looking at what you've got in various orbits, whether it's GEO, whether it's MEO, whether it's low Earth orbit, to make a decision hopefully later on this year as to which architecture we go after. But we've done quite a bit of work over the last year working with industry to narrow down the options and provide a robust discussion with Dr. Griffin as we head towards making the selection.

The next satellite system is going after what's happening in midcourse, above the atmosphere, the cold background of space, a very different sensor that is needed for that to do what we call discrimination, the separating of countermeasures that the threat may deploy from the actual threat re-entry vehicle. Off to the right what you'll see here is the kill assessment capability that we believe is very, very important to support the optimization of our limited number of weapons to essentially let us know, let the combatant commander know, whether or not we have in effect killed or destroyed the threat, or have merely just damaged it. That's another system that we are experimenting with as we speak.

So again, it's the architecture. Both Dr. Griffin and Secretary Rood previously explained why it's important to do this from space. We don't have enough ground radars to populate distance from any threat to the defended area, to do it with confidence. Space offers us the vantage point and the opportunity to do that. As I mentioned earlier, I think it's really important.

Again, this is not something new for the missile defense community. It's not something for the Missile Defense Agency. We have been leveraging and operating, at times, capabilities from space. So this is something we can do with confidence. Next chart.

I'm not going to go through all the details, but I would not miss an opportunity with any audience. To deliver any capability, going from left to right, this is what's required to do it within the system we've got. The acquisition system we've got is very robust, a very disciplined set of activities that are involved in delivering any capabilities.

So our goal is to under-promise and over-deliver. Another way to put it is to deliver on our promises, to ensure that we don't over speculate early on in the acquisition process and then four or five or six years later have to show up either within the Department of Defense or over here on the Hill, and explain why we were late, over budget or behind schedule. So it all begins, of course, with working with the intelligence community, because they help us define what the threat is and what and how we need to

design our defenses against. That's on the left side of the chart in the middle.

The Missile Defense Agency also works very closely with the war fighters, as in the combatant commanders, be it STRATCOM or NORTHCOM or CENTCOM or EUCOM. They work very closely with the services. We have regular meetings at the senior level, and we also work within the JROC structure.

The intent of everything to the left of that arrow is to say that the Missile Defense Agency does not invent what it's doing. It's not off on its own doing what it's doing. It's receiving a significant amount of input and guidance and collaboration across the community.

Then you get to the middle part of that chart, which is a standard acquisition flow for any major program, whether or not it's technology development or product development. Testing is probably the most visible portion of what we do, and at times it has attempted to be summed up as failure or non-failure. I will tell you that those are very, very simplistic descriptions.

Even when we do not achieve the objective, even when that is classified as a failure, we learn a tremendous amount from going through the testing event and the process event. I tell folks that if the enemy is learning as much about their systems and its capabilities as we learn when we fail, we all ought to be worried, because we learn a tremendous amount.

You've got production next. Then over to the right near the bottom, the folks that we interface with, whether or not it's Congress, within the defense industry, the press, with the public directly, or with organizations that provide oversight to the agency, such as the GAO, the IG and the operational testers in DOT&E. So if you go from left to right, that's how we deliver and deploy any of our systems, and it's all underpinned by that systems engineering process and products line on the bottom of the chart. It's very disciplined and very robust, going all the way from planning associated with the National Defense Strategy all the way through delivery of these systems, and then there's a feedback loop.

So you will hear the agency talk about, as I mentioned, we absolutely need to get to space, as both General Hyten and Dr. Griffin mentioned. If you can't see it you can't shoot it. If you don't know where it is, I don't really care how many interceptors you've got, they're totally ineffective. The best place to do that, from what we can see as the threat matures, especially the hypersonic threat, is from space.

This process that you see behind me is the robust disciplined process that we intend to use to deliver on our promise. So when the expectations come in of delivering something in three years and you hear me and the organization say no, look at the background. This is why I believe we should stick to this process. This is why it cannot be done. So remember that as we go through our discussions now and in the future on the space layer.

I'll wrap it up with a summary chart. Things you already know: space provides the high ground to address the advancing threat. It was mentioned that space provides access and persistence to many areas of the globe that are denied to us. The bottom there tells you just about every task we can do from space, and it's not something we're taking a guess at, it's something we've already demonstrated. So we're very confident in it and the way we'll need to do this is with the architecture, tying the shooters with the sensors together with the command and control battle management system.

Thank you very much.

(Applause).

MR. ELLISON: Thanks, Sam. John and Mike and Sam, I think this is probably the first time we're at this level to broach missile defense in space. It's to your leadership, to your competence in the environment we are in today technically, politically, to broach and educate our public on why we need to go there. What is it? So I commend you on coming together today, if the world, as you effectively said, has changed to a domain we now have to defend and protect.

I'm going to open it up for questions. If there's any more clarification or understanding of what we're doing, this is the time to do that. We have microphones on either side, so I'd ask you to use the microphone to do that.

I'm going to start with Mark Montgomery, who is at the Senate Armed Services Committee, to kick it off.

MR. MARK MONTGOMERY: Thanks, I have a question for Secretary Rood and a question for Secretary Griffin. For Secretary Rood, will we see these sorts of capabilities thrown out in the Ballistic Missile Review when we get it, and could you give us some kind of indication when we might see the Ballistic Missile Review this fall? For Dr. Griffin, not to question the $20 billion -- I'll stipulate that as correct -- Secretary Mattis is supposed to have a flat budget generally speaking over the FYDP. Have you identified areas where either mission sets or systems where we can now take risks and maybe reduce or mitigate the procurement because we're now doing this space-based approach to sensors and potentially interceptors?

SEC. ROOD: Mark, with respect to the Ballistic Missile Defense Review or the Missile Defense Review, we are focusing that review to cover missile threats from all domains, whether that's ballistic missiles, cruise missiles or certainly the hypersonic threat. So we've been working for some time on the Missile Defense Review across the Defense Department, with different organizations and different parts of that large enterprise working on it, including the two gentlemen to my left. We hope to have that out in the very near term, the next few weeks, as we are just wrapping up some of the remaining items. So it will be coming soon to a theater near you, hopefully to your theater first, given that your committee and others were the ones that required us to do

this review. So we will meet that intent.

With respect to the second part of your question, will it cover these kinds of questions, it will. That's one of the things that we set about trying to answer for ourselves, what's our policy framework? What are the developments in the international security arena that have led us to make alterations to our approach? How are we approaching it in terms of working with friends and allies, looking at the other trades across the department for competing needs or competing ways to address some of the security concerns. In some cases they're not competing, they're complementary, but taking that holistic approach.

And then, what would we put forward for the department in terms of our policy intent going forward in our plans? So the Missile Defense Review is hopefully, fingers crossed, not too far out. I'm very desirous of pushing it out as soon as we can, believe me, on a personal level I am. So hopefully we'll get through the final hurdles in the department to do that very soon.

MR. ELLISON: Did you want to answer the other question?

SEC. GRIFFIN: Mark, the answer to your question is no, not yet.

MR. ELLISON: Thank you, Mark.

Rebecca.

MS. : Thank you all so much for being here. Riki, this is especially kudos to you because this is great. I think if I could do anything to make it better, it would be to have somebody from the State Department here.

So my first question is probably one that can't be answered, maybe for John but I think probably Dr. Griffin might be the most willing to answer it. That is, what do we say to China and Russia? They're not going to be happy with the United States having a space sensor layer, as we can get at hypersonic and then of course with a space-based interceptor layer. So if you could just kind of navigate that question, if you could.

And then the second question is a little bit more technical. That is, a lot of opponents of space-based interceptors say it's going to be hundreds of billions of dollars. Dr. Griffin addressed this a little bit, but isn't it possible to start off with even providing a limited constellation looking at a particular part of the globe, for instance carrier defense, and then expanding it over time if we wanted to do that? Is there not multiple ways that we can do this depending on the threats that we're most concerned about in the near term?

SEC. GRIFFIN: Well, the second part of your question is the easier part. Of course you can always start small and scale up. In practice, that's what you do anyways and should never deploy any new capability all at once everywhere. So, of course you're

correct.

With regard to what Russia and China would say, and of course I represent the Defense Department not the State Department, you were just keying that up to have fun, right? I mean, I won't be outlandish with my answer. When you have President Putin getting on TV and bragging about how his multi-thousand kilometer hypersonic nuclear strike weapon, and when you have a track record that in the last decade the Chinese have now done, I'll just say, several dozen successful hypersonic strike tests, when you have that, that's a great power competition.

When you have North Korea bragging about its successes, and Iran working vigorously to produce its own capability, somewhere well down on my priority list is caring about what other people think. We just cannot afford to do that. By creating a geopolitical policy environment where those kinds of considerations are surfaces, by even allowing ourselves to be drawn into that discussion we do ourselves and our allies and partners a disfavor.

SEC. ROOD: Mike, God love him, his role is the development of new capabilities to defend the United States. So when he says he doesn't have time to concern himself with the views of other nations, that's because it's policy (control ?). We do spend a lot of time concerning ourselves with those kinds of questions. So consider his comments from that point of view, Rebecca.

But with regard to your narrow question, if the United States pursues a space-based sensor layer, how might we explain this to others? First of all, start with what it does. It is a space-based sensor layer. It watches, it detects, what others are doing.

I don't regard it as a provocative act to observe the missile flights of missiles that are potentially threatening to the United States. It's just a part of providing information. It's not all that different.

Sam Greaves showed charts that showed our ability to track missile launches that we've had for decades in the United States. So in that sense, is its basic capability different? No, I think the degree to which it allows you to do that obviously would be new, and the type of missile threats we face would be new, but at the end of the day it's having the ability to warn ourselves of attack to take the necessary preparations here in the United States.

And if North Korea or Iran are a state of concern were to undertake an attack, to have the ability to deal with it, certainly that's smack dab in the middle of what we want to have the capability to do.

So, I mean, I guess that'd be the start at how I would explain it to them. Ideally, our activities have been with friends and allies. This has been something that we've done at NATO. NATO has made a decision to defend the territory of NATO states against missile attack. They're increasing capabilities. It's not something that would be a U.S.

only endeavor in the sense that while the programs we might pursue for space-based sensors, we're going to do this in collaboration with friends and allies, and they also have capabilities that they can bring to the mix. So while you certainly don't want to understate what the significance of the capability would be to us technically, I don't think having a sensor capability is a sea-change for the United States. It's just the sensing capability that's an improvement.

MR. ELLISON: Thanks, John. If we could direct the questions to John, because John is going to leave pretty quickly. So if we could focus on policy questions?

MS. SANDRA ERWIN: Thank you very much. Sandra Erwin with Space News. To follow up, Secretary Rood, on your points about the policy concerns for the sensor layer, the interceptor layer really would be a separate issue. Dr. Griffin said it would be something that should be pursued. Do we have an effort now in DOD to study that? Secretary Rood, wouldn't that be considered an offensive capability in space that would cause some reaction? Thank you.

SEC. ROOD: Well, as I mentioned in my opening remarks, the 2018, last year's National Defense Authorization Act, contained a provision that required us at the Defense Department to look at space layer sensors and interceptors. So we have explored it as an examination since that period, in conformity with the law. We're not yet in a position where we would announce some programmatic changes or movements forward. I think we're in the examination phase of this activity, and that's appropriate given that this is relatively recent.

But the Congress required us to do that. It's also something that, given the progression in space technology, it's in our interest periodically. The gentlemen to my left are more learned about the technical capacity that we could harness for this effort, but certainly it's something that -- just as a lay person seeing the progression in space technology -- it's rather dramatic what has occurred over the past couple of decades. And so we look at that. I think the latter part of your question, those are bridges yet to be crossed sometime away, given the level of examination, given the questions thus far.

MR. ELLISON: Thanks, John. Next.

MR. : Dr. Griffin, I really enjoyed your point on not caring what others think. I've tried that with my wife over the course of 33 years, and I'm still trying to work on that. But hopefully that works better with the Russians and Chinese.

All three of you pointed out that the NDS is really the underlying foundation for what we're doing here. The NDS is very clear in stating that Russia and China are the two principal threats to the U.S. There is no dancing around calling them competitors or anything like that. It's very, very clear. So I wonder, for Secretary Rood, if that suggests that U.S. policy has changed or is going to change to ensure that protecting the homeland is done in a way that's sized to Russian and Chinese threats, and not rogue threats or accidental launches?

SEC. ROOD: As you know, our main effort has been focused on providing a defense against countries like North Korea and Iran to the United States. That's our focus today, and continues to be. Certainly you're right that the National Defense Strategy talks about a broader competition that's occurring well beyond missile defense in the world in terms of China's objectives and Russia's objectives. They're very different, separate challenges, certainly not the same thing.

But in looking at those challenges to the global order, looking at those challenges to specific states and their security, whether that be in Asia, given the concerns that we see whether it's in North Asia or in the southern part of the Pacific Ocean, depending on where you're at. For instance, the Indonesians refer to that as the North Matuma Sea (ph). In Beijing they refer to it as the South China Sea. But certainly those are areas that are increasingly ones of friction.

With the Russians in Europe, I think we're seeing a lot of that, and in the Middle East, whether it's our concern about the use of chemical weapons against the people of the UK or elsewhere. So while we see a broader competition, while we see broader concerns with those countries, our missile defense efforts are really focused on North Korea and Iran for the homeland. That's where we have seen the threat of greatest concern.

And I should hasten to add, defenses are an important part of this equation. They're not the only part. We still retain our nuclear deterrent, which is the primary means that we rely upon for deterrence with China and Russia. And of course we've gone through a cycle now in the Congress where we're pleased that the authorization bills provide the funding we requested, or the authorization for the funding we requested, and the modernization of the nuclear triad, and pursued some new capabilities like a low yield ballistic missile launched from a submarine. So nuclear deterrence is certainly a part of the equation, and the primary means that we use to deal with threats from countries like Russia and China.

MR. ELLISON: John, are you ready to go? You can go if you want. Go ahead, one more. Let's get one for John. Anybody for John? He said one more, so I'm going to give him one more.

MR. : This is for Mr. Rood. You mentioned that last year's NDAA requited a report on the space-based intercept layer. This year's NDAA, though -- and you're acting accordingly and studying it -- this year actually mandated the creation of a space-based interceptor layer. I'm curious to know if the wheel is starting to turn now in DOD to address that?

SEC. ROOD: Particularly in this house, I'll say we take direction from the Congress very seriously. Of course, you're pointing to the NDAA, and it was just signed here in the past week or so, 10 days I think it was, so obviously we're taking that seriously and we're in the process of spinning out to go pursue that. I don't want to

overstate the level of progress we've made in the period of time since the signing, but certainly we take that seriously.

MR. ELLISON: Thank you, John.

(Applause).

MR. STEVE TRIMBLE: Hi, I'm Steve Trimble with Aviation Week. I was curious about the sensor layer itself and the decision to use and rely on EO&IR as the primary sensors. Is there any openness to looking at other sensors and is there any concern about how countermeasures or other -- especially with hypersonic threats -- how those sensors would stand up to that?

SEC. GRIFFIN: The answer is we have not made the final decision yet. It's not an over-reliance, but we were pointed to EO&IR as demonstrated capability to go after that threat. But I would not want to get ahead of my boss' decision here on what the architecture is going to look like and what the sensor suites are going to look like. But the direction we have started off in, we are looking at the EO&IR.

GEN. GREAVES: I'll just chime in and say that question is not answered yet. That's a real interesting technical question. I would also say that as we evolve towards more robust sensor layers, every spacecraft doesn't have to have the same payload on it. I think we would be wise to consider giving the adversary as many different difficult problems to solve as we can give them. So those decisions we're just well away from making any sort of final decision on what sensing mode we'd use.

MR. : This is for General Greaves. Given that the ballistic missile defense system that we currently have is predominantly based on roughly a dozen large radars and several dozen smaller radars, TPY-2s and Aegis, and that the development of hypersonic glide vehicles by both Russia and China are designed to defeat ballistic missile defense systems, not to replace their ballistic system, are we spending enough money protecting our radars from hypersonic glide vehicles?

GEN. GREAVES: I will say that is something I know the secretary of Defense has interest in, and we are looking at that. We are looking at options, whether it's with NORTHCOM or the commander of NORTHCOM, commander of STRATCOM, to assess the vulnerability of those sites and take some mitigating steps to protect them. There are a few activities that are ongoing or about to kick off which will demonstrate that capability. So we are aware and we are taking those mitigating steps. That's what I'd like to say about that.

MR. OTTO KREISHER: Otto Kreisher with Sea Power Magazine. This is probably one for Mr. Griffin. If we get into space-based interceptors, it seems the most likely thing would be directed energy rather than kinetic instruments. This gets into the question of, can we get enough power out of a space-based satellite to give you a kill level of directed energy. Given the trouble we experienced with the Airborne Laser

attempt with the atmospheric interference with your beam, is it possible that a space-based laser, directed energy, would work against hypersonic, which would be down in the atmosphere?

SEC. GRIFFIN: Let's see, there were a couple of questions in there. The development of -- the problem with a group like this is I'm on the record for decades on certain policy positions and technical positions here, so directed energy to me is where we want to go in the long run. I would like the long run to be as short as possible, and we will be pushing advances in directed energy forward for the next few years, at least as long as I'm in this position. So we want to make actual progress in directed energy. I think it is the path to the future.

I believe the answers to your technical questions are yes, we can do it. We can develop space power systems that will provide what we need, but belief is an opinion held without benefit of facts. So it's our job to go out and do the experiments and the prototyping to generate those facts. I view my job as being to develop arrows for the quiver, if you will, and it is up to other disciplines, policy and diplomacy and all of that, to decide when and where they're used. But first we have to know that we can.

The second part of your question was about directed energy with respect to hypersonics. Not so much. That does not, to me, seem to be a promising tactic for going after a hypersonic glide vehicle.

MR. ELLISON: I'd like to follow up with just a quick question to you. I understand the last program record for a space-based interceptor was research and development of Brilliant Pebbles in '91 and '92. Is that still something that we can draw from for an interceptor?

SEC. GRIFFIN: Well, the nice thing about space-based defense, if you do it right irrespective of the kill mechanism, the dead carcass falls on top of the people who launched it, or close to it, not on us. That's a nice feature. I don't know, I don't recall whether or not the last space-based interceptor architecture we examined was Brilliant Pebbles or something after that. I don't recall.

I was heavily involved in that effort at the time, and it went back before '91 and '92. As John pointed out, the Congress has directed us to study these things, and I will tell you that the shift in Congressional policy from my early days to now is both quite dramatic and very refreshing. So we will again start to study these issues and we'll try to take advantage of things we looked at a generation or more ago. But a lot has changed in the technology world since then and I just can't be more specific because if I do I'm probably just going to make a mistake.

MR. DOLPH RUBIN (ph): I'm Dolph Rubin. I have two questions, if I may. First with regard to the development of a space capability, a lot of effort is being made in developing and improving ground-based and sea-based capabilities. Does a space-based capability mean that these systems will be obsolete in 10, maybe 50 years? That's the

first question.

The second is on the importance of the architecture, as you mentioned, general. As you know, the maritime missile defense (form is dependent ?) on the development of an architecture of integrated air and missile defense as well. Do you see possibilities to combine these two architectures into an air and missile defense and space-based missile defense?

GEN. GREAVES: To the question of the future of ground-based and sea-based architecture, those are components of the overall architecture for which I believe a space-based capability fits into it. So as Dr. Griffin mentioned, it's the goal of making the problem the most difficult for the threat community, and not making it as easy as you can. So it's the integrated capability that both space and ground provides where you're not single (streaming ?) with any one capability that supplies power to the missile defense system.

As far as the architecture, where we are headed, of course, is to an integrated air and missile defense architecture. We're bringing those two somewhat separated communities together as we speak, and ensuring things like whatever the integrated command and control system is for the air can at least be interoperable with what we're using for missile defense. For instance, you set the interfaces, you get the data format right, you pass the data back and forth, and we can demonstrate it like we did last year in Formidable Shield '17. We're going to do it again in FS '19 and demonstrate the ability of actual assets on the ground to operate (together ?).

I do believe that when we achieve a true IAMD capability it will be as a result of combining the ground, sea and space and cyber capability in the future. That's the path that we're on.

MS. : A two part question for Dr. Griffin. Given the stop-start history of U.S. hypersonics research over the years where we do a program that fails, we do another one, we do one like the X-51 that's successful, it stops and nothing happens for a few years, what is different now in the strategy for hypersonic weapons? Likewise, on the China and Russia side, we've heard a number of references today about the progress they've made, about Putin bragging about things. But what is the actual evidence? Given where the U.S. is of having just a few minutes of hypersonic flight, is there actual intelligence that China and Russia are that much ahead, or is this based on Putin's bragging?

SEC. GRIFFIN: Well, second question first, I'm not going to comment on things that I know from intelligence sources at all. I would simply say that our reading of the publicly available literature in the defense and aerospace press would convince anyone that China has made considerable progress on operationalizing or weaponizing the research that the United States pioneered.

I'm going to refer again to a remarkable good speech, in my opinion, that General Hyten gave a few weeks ago. He pointed out that if we go to war today we win. The

adversary knows we win. We know we win.

Our job is to make sure that statement stays true in coming generations. So when it is literally the case that self-declared adversaries -- and let me point out the United States doesn't wish to have adversaries, others declare themselves to be our adversaries -- when they have done literally dozens of tests that we have not done, that's a concern and we need to respond. We did the groundbreaking research, they've chosen to weaponize it. We need to respond.

When a foreign president takes to the television to talk about a new system that they have in development, I believe we need to take that very seriously. In response to an earlier question, they don't seem to care what we think. So I think we need to take that very seriously, and we are.

You referred to the stop-start nature of hypersonic research in the United States. It has been stop-start. That, I think, is unfortunate. I think we're going to fix it.

But bear in mind what I said a few minutes ago. We did this research. We did not choose to weaponize it. Others have chosen to weaponize it and we must respond.

MR. : A question for Dr. Griffin. You threw out the number of 1,000 interceptors. Overall, realistically, you're looking at global threats, how many interceptors, space-based sensors, early warning satellites, realistically would you need to address the threats from China, Russia and North Korea?

SEC. GRIFFIN: I have -- I won't say I have no idea. I was doing what engineers do, which is trying to bound the problem. Riki mentioned Brilliant Pebbles studies, things like that, that have been done before, about how many do you need for global coverage and about how much do they have to weigh? I was trying through my remarks to put a rough order of magnitude estimate on the problem.

I can't figure out a way to make it cost more than a couple of tens of billions of dollars, whereas we see people bandying about number in the hundreds of billions. I can't get there, and that's the argument that I was making. The details of how many in what orbit, how they're architected, all that, is to be determined.

In fact, as we go forward and carry out our instructions from the Congress to study this problem, we will produce answers. But we don't have them today.

MR. ELLISON: I'd like to ask a question following that up. You talk about reducing costs, can you walk through the difference between the low Earth orbit hundreds of satellites possibly, to a very few in mid-range? And bring in how commercial launches help reduce those costs and how that works in putting capability in sensors or interceptors?
I also wanted to ask Sam on the kill assessment successes they've had recently.

GEN. GREAVES: Thanks, Riki. What Riki is talking about is the demonstration constellation that we've just about completed deploying. It will be completely deployed by the end of the year to essentially assess and demonstrate our ability to do kill assessments. It was on the right side of the chart I had up there.

The success is our ability to work with industry very, very quickly to support industry timelines, the acquisition process using the authorities that are resident in the Missile Defense Agency to go all the way. If you remember the other chart I had, it shows how we develop and deliver capability, going from left to right, on that entire chart in a couple of years. We're just about done with the deployment of that capability.

Both the space and the communications and the ground system will be part of the architecture. We've been demonstrating the architecture, the ground force of the architecture, as part of a flight tests for the last few years. We've been simulating the projection of the space capability into that ground architecture and ensuring that the ground architecture can process it and deliver it to the command and control battle management system. So with the deployment of the space-based piece before the end of the year, we'll be using the entire system, at a minimum, as part of a flight test to demonstrate the value of doing a post-intercept assessment -- that's the official term for it -- but doing a kill assessment.

We're working with the combatant commanders, primarily NORTHCOM in this case, to demonstrate the value of that information as they make their determination as to whether or not to, as an example, to take a second shot or save those rounds for another threat coming in. It's something that so far has been a significant success, both in the deployment of the capability as well as experience working with industry and working cooperatively and at the speed of industry to deliver capability. So it's something we're very proud of and you'll hear a lot more about it.

SEC. GRIFFIN: For my part of that, the costs of space launch, and indeed the cost of constructing space hardware, we believe they are going to go down as a result of increasing commercial activity in space, and we hope to leverage that. We kind of hope that in the future our government cost models will have some new data to work with and that the answers will be more favorable going forward.

MR. : Thanks you for your continued service, Riki, and thanks for putting this on. Dr. Griffin, to pull on that thread a little bit, and seeing how I'm a recovering programmer from the United States Air Force POM cycle, you talked about the life cycle costs. During a down cycle that Admiral Montgomery briefly mentioned earlier, those became a big bill for us. Can you expand a little bit on -- you're not worried about the life cycle costs, and yet I know during our discussion in the build-up of a POM in DOD, those are huge discussion items, sustainment.

SEC. GRIFFIN: Sustainment does matter, and we have to design systems that are capable of being sustained over time and that produce a favorable cost-benefit ratio, if you will, for their sustainment. The frustration that I was expressing earlier is I often talk

to people who talk about the life cycle cost of a system to be maintained for X number of decades and it ends up being very high. You really don't have any idea what the technology would be decades out, and I can make the cost as high as I want by going out as far as I want.

What's important to look at is the sustainment cost on a refresh window, and to do it more realistically. If I'm looking at an airplane I want to know the cost per flight hour over time. I want that to be as low as possible. But I can make the life cycle cost of an F-16 -- I can make it be as high as I want it to be by saying I'll have X number of airplanes for Y number of decades. Look how much that costs.

Well, yeah, it does, but it's not a useful measure of comparison when I have to do my programming, because I really am looking at I have a certain number of airplanes this year that I'm going to fly for so many hours and it cost so many dollars per hour to fly. Here's my fleet size, and can I afford that and does it provide a benefit that I would like to have in exchange for those dollars?

GEN. GREAVES: Let me add one thing on that. In addition to what Dr. Griffin said. Every time a cost model is presented to me I ask two basic questions. One, what were the assumptions; and two, what were the initial conditions that you came up with? For instance, how did you get to the quote for direct labor as part of that cost assessment? What did you assume? Most everything else are factors based on work hours or FTEs, whatever you want to call it, and then you've got estimates for material.

But what I've found is once you start digging deeper then you start to see someone decides that the top layer within the organization needs X percentage above the direct labor cost to do oversight, and then each successive supplier and sub puts the same thing. Then you start cutting it out because that's the level of detail you need to go to because it's exactly what Dr. Griffin said. You come back with (unobtainable ?). You come back with, this is way too expensive to afford per life cycle, so let's not even look at it. That's not the real issue that we should be going after, so I just wanted to add that.

MR. ELLISON: Time for one last question.

MR. PETER HUESSY: Thank you, Riki, for putting this on, I really appreciate it. I'm Peter Huessy with the Air Force Association. Just a question for both General Greaves and Secretary Griffin. As someone who engages in public diplomacy in this town, you have audiences, the media, non-governmental organizations, industry, government bureaucracy, foreign allies -- the challenges to get the message adopted. What are your biggest challenges that you think with those groups in terms of getting a space-based sensor and a space-based interceptor system deployed?

GEN. GREAVES: Actually, if you had asked me this question a year ago my answer would have been very different than it is today. The phrase I use within the last year, year plus is the threat has voted, primarily the North Koreans very, very visibly and the Iranians also. So it has become much less of a challenge to convince just about

anyone.

And when you integrate in the unfortunate situation such as what happened over in Hawaii with the false alarm, the American public, at a minimum the folks that were on that island, got a sense of what it feels like to not know what's going to happen next. While they were feeling that, the national command authority had full knowledge that it was not a threat. So today it's a whole lot easier and the challenge, if you will, is making that culture shift, that shift in thinking, between a few years ago and today, if not within the Department of Defense because as you saw on that chart there are a number of stakeholders who are honestly looking at the issue and trying to make the best decisions, but informing them.

I will tell you, it's orders of magnitude easier today than it was, because it's very visible what the threat has done and we know what's coming and we've got time. So time is my biggest challenge, if you want to get right down to it, initiating activities as we described here to meet and exceed our ability to deal with that threat. I have great hope with the leadership that we've got in place to keep pressing the tests and speaking plainly to ensure that working with the administration and the Hill we can make the right decisions to get the resources we need to deliver a capability.

SEC. GRIFFIN: My bosses, the secretary and the deputy secretary, continue to stress that we need to act at the speed of relevance, one of the secretary's favorite phrases. When we look at the threat, that is what they are doing. So when you ask, what is the biggest difference between today and/or what is the biggest impediment going forward today, again the policy environment we're living in is not one I have experience with.

The Congress is asking us today to evaluate space layers, to press forward on missile defense. Now in the end the Congress has to appropriate the money and we have to have a stable policy environment for a lengthy period of time. We, the Department of Defense and the nation's industrial base, frankly, can react to a stable set of requirements from Congress and the funding to implement what they ask of us. So I hope that the environment we're in now lasts for a while, because in that environment I believe we can deliver.

MR. ELLISON: Thank you, Dr. Griffin, thank you, Lieutenant General Greaves.

(Applause).

We've had a great discussion, very informative. Thank you for the honor of all of you who have spent some time with us this afternoon. I look forward to seeing you again. Thank you very much.