

061419 Air Force Association Mitchell Institute for Aerospace Studies “Space Power to the Warfighter” Seminar with Fred Kennedy, Director of the Space Development Agency, on “Space Development Agency: A Review”

(For additional information on Air Force Association seminars contact Peter Huessy at [phuessy@afa.org](mailto:phuessy@afa.org)).

MR. PETER HUESSY: Good morning, everybody. On behalf of the Mitchell Institute for Aerospace Studies and the Air Force Association, my name is Peter Huessy and I want to thank you for being here at the next in our series of “Space Power to the Warfighter” seminars.

I’d like to make a few notes. On June 20<sup>th</sup> we’re going to have Colonel Steve Purdy, who is the Director of the Space Superiority Systems Directorate of the Space and Missile Systems Center. Also on the 18<sup>th</sup> of June we’re going to have John Harvey, former deputy assistant secretary of defense for nuclear, chemical and biologicals, and he’ll talk about maintaining and improving and strengthening the consensus on New START and nuclear modernization. That will be followed by Susan Koch and Paula DeSutter, who will talk about verification and violations of arms control treaties, as well as the New START Treaty.

Then we are honored to have on the 26<sup>th</sup> of June the chief of staff of the Air Force, General Goldfein, who will speak to us. That will be followed July 2<sup>nd</sup> with Admiral John Richardson, the CNO, which interestingly in the 1,700 some-odd seminars we have done since 1983, this is the first time we’ve had the CNO, which will be quite interesting.

I also want to say hello to our dear friend and chairman of our board, Witt Peters, former secretary of the Air Force. Thank you for being here. And of course, Nina Armagno, general, thank you for being here. She has been a speaker previously as well.

Today we’re honored, as you know, to have Dr. Fred Kennedy. He is the Director of the Space Development Agency. Before that he was the director of the Tactical Technology Office, the Defense Advanced Research Projects Agency. Prior to joining DARPA he served as the senior policy adviser for national security space and aviation at the National Security and International Affairs Division in the White House Office of Science and Technology Policy.

With that, would you give a warm welcome to our friend, Dr. Fred Kennedy?

(Applause).

DR. FRED KENNEDY: Just to be clear, I was also in the Air Force for some 23

years. How are you all doing today? I admit to a bit of trepidation coming to speak to the Air Force Association, given that the official position of the Association is that it opposes the establishment of the agency I am directing. So, I'm just looking for knives.

(Laughter).

I'll dodge if necessary. So, here's what I'd like to do. I'd propose that we make this as much of a dialogue as we can. I find a dialogue to be much more interesting than me pontificating.

So, if that's acceptable then I'll just talk really briefly about what we're trying to do and why. Hopefully I'll be able to give you a sense of the problem we're trying to solve and maybe convince you that it might be worth investing a little bit in an alternate theory of the case. At that point I'd really like to open it up to questions, and everything is fair game.

You can make fun of my lack of hair or anything at all. I really don't care. But let's talk and discuss what it is we're trying to do and why it's so important, and why we have a golden opportunity to go do something very interesting in space right now.

I really want to thank the Air Force Association and the Mitchell Institute for bringing me here. This is very enjoyable. I got to give a talk up at MITRE earlier this week. That was also fun. I think we had good dialogue up there, and so like I said, I'd really just like to talk with all of you and have you talk back. That's how we actually make progress.

The way I'd like to describe the problem is that we have a burgeoning threat and a very interesting opportunity. It's that confluence of threat and opportunity that makes what we're trying to do with a new agency valuable. What's the threat?

We have a couple of near peers -- call them peers, call them near peers, call them adversaries -- we have a couple of near peer competitors out there who long ago twigged to the fact that space gives us significant advantages in our various war fighting domains. I don't think anybody would argue with that. We all understand it. We all understand the various capabilities that we bring to bear that allow U.S. war fighters to go do their jobs and do them very effectively.

But here's the thing. The Chinese and the Russians are now building out capabilities to negate our systems in space, and evade and avoid the capabilities that we bring to bear. That makes perfect sense, because if you look up, you see what we can do and you see how it changes the tenor of combat operations for us, how it makes us dominant, so why wouldn't you go after those capabilities?

So the reason you're seeing the Chinese building hypersonic glide vehicles is because they recognize that they're hard to detect and track by the systems we employ today. If the situation were reversed, we'd do the same thing. In fact, we're going to

build hypersonic glide vehicle because they're hard to detect and track, and they're very fast.

Again, you've seen our adversaries doing some very commonsensical things. We should be concerned. They're going to negate our capabilities and they're going to avoid them.

So you have to ask yourself, given that that is the case -- and I don't think we have to go into great detail on that point -- but given that that is the case, what do we do about it? Well, we should obviously create countermeasures and other capabilities to ensure that we remain dominant. How do we do that?

Well, we could ask the existing organizations we have today to go out and build those capabilities. Here's the rub. We have wonderful organizations within this government, and we have wonderful contractors in the community, and they are more than able to go off and build exactly those kinds of things. But, we have a bit of an issue and the issue is this. We tend to be a little slow and we tend to be a little expensive.

Now, why is that? Generally speaking, it's because we build small numbers of things and they have to work. It's true, right? We build a few. We build a few over a period of 20 years and we'd like them all to work. That makes perfect sense.

So, how do you make things work? How do you ensure that? Well, you do more reviews. You do more testing. You go into thermal vac, you find something wrong with some bolt, and you do it again.

You go into a vibe test, something falls off your satellite and you can't find it, so you go back and do vibe again. If you carry 2,000 people for two years through system test, that tends to cost a lot of money. What if you didn't have to do a system test at all? What if you just tossed the satellite up and started operating it? That would be an interesting way to do business, but with an asset that costs billions of dollars you're probably not going to risk that.

But - the very reason it costs billions of dollars was because you did all those tests and reviews. So, what's the opportunity? This is the interesting part.

We have an historic chance to do better, to do something different, to invest in a different way to get to the end. We have private sector capital, we have energy, we have innovation, rushing into the space community right now. To do what? To put up new capabilities on orbit for commercial value because people are seeing massive opportunity.

You can argue whether those commercial business cases are real, whether mega-constellations will ever actually make a dime. But the Bransons and the Musks and the Bezoses are already there. They're putting their money where their mouth is and they're going to go put capability up.

So the question you have to ask is, if all of these folks believe that there is some commercial value to this, to mass producing lots and lots of things and putting them on orbit, is it worth the DOD's time and maybe a little bit of investment to see if that case makes sense for us as well? And if it does, will there be value to us to go leverage it?

I would argue yes, and I would argue there are historical precedents to this. How did we win World War II? I was up in Boston at MITRE earlier this week talking about this, and I offered that perhaps if you go back and look at it you might decide that we won on the basis of our manufacturing prowess. We were able to build 2,700 Liberty Ships in a few years. Eighteen shipyards, one design. Somehow we managed to allow that to happen and no intellectual property rights got in the way.

We also built over 12,000 B-17s. We might be able to do that again today. I don't know, I don't know. We overwhelmed our enemies with capability.

Now, was the Liberty ship the best ship on the planet? You can go Google the thing. They came apart. You can see pictures of them literally coming apart at the seams.

Their welds didn't hold. There were issues after the war ended. People were furious, "how dare you build us these crappy ships?" But, they built 2,700 of them and it helped us win the war.

In the same way, we need to look at the value of mass production applied to space. It has been applied to the automotive industry. It has been applied, obviously, to shipbuilding, to airplanes, cell phones, computers. And you know what, most satellites really are not much more than glorified computers and cell phones. Most of what you put in a satellite is similar.

I'm willing to bet we'll be able to leverage the vast majority of the wonderful manufacturing achievements of the past 20 or 30 years if we just decide we want to go do so. So what we're offering with the Space Development Agency is the leveraging of that confluence threat and opportunity. Let's move away from an exquisite approach that gives us capability in decades, to something that might give us some less exquisite capability on the order of a year or two.

Now, will it be perfect after a year or two? No, no it won't. But, I would argue the first iPhone wasn't great either. The one I've got now is pretty good, in fact I'm pretty impressed, and that's just a few generations of improvements over a little more than a decade.

So, we can make a lot of progress with an iterative innovative cycle. If you learn faster, if you apply Moore's Law to space -- I know it sounds a little cliché -- but if you actually apply Moore's Law to space, we might be able to make some incredible progress very quickly. That would be very interesting and that would get after the rapidly evolving nature of our threat, or our adversary's attempt to negate and avoid our

capabilities.

If we don't do that, I don't think our answer should be, don't worry by 2030 we'll have a new capability in place. That's great, but the adversary will have had four or five generations to think about that and will be up with their countermeasure in advance. I don't think that's the right answer.

So, the Space Development Agency is an attempt to get at the agile, responsive capability we know we're going to need to defeat a rapidly evolving threat and leverage the power of commercial capabilities that is just absolutely extant and wonderful to see. In fact, I don't know about you, but I am excited to see the amount of interest in the young folks who are coming out of the woodwork to come and work in our industry. We've been aging out for quite a while, but there is interest in the younger community to go work space again. Why would we not want to capitalize on that?

Frankly, if it helps the commercial sector to bring a little DOD and other government money to bear, why not? The government knows how to help build infrastructure. Why wouldn't we go do that, and give ourselves a national security advantage at the same time?

So, that's what the SDA is supposed to go do, and I would argue that that's part of a balanced portfolio that our department should consider investing in. I think that's kind of the way we're going to get there. It's not putting all our eggs in one basket either.

I don't know if it's going to work. I can't tell you that two, four or six years from now the capabilities that we're going to put out are the ones we need. I don't know that yet. We could fail, but I think we're worth the hedge of that. We're not asking for \$14.5 billion a year.

So, that's where we are. I've been very interested watching the Hill in terms of what they've been thinking with regard to our agency and how we'll interact with all the other activities in the space community. I'm actually heartened by what I've seen.

There is skepticism, but I think skepticism is always warranted. I think people should question. Especially when you want to stand up something new in the Defense Department, you should very much question why someone would want to do that. At the same time, I believe listening to folks on the Hill, staffers and members, that they have been very interested in our approach and what it brings to bear; and also very interested in the application of commercial capabilities and best practices.

So, with that, that's where we are. I'm waiting to see how things pan out here in the next few months. Just to give a quick status check, I have exactly one government employee at this time, and that employee is not me.

There are now four government people working for the SDA. Three are detailees from other organizations in DOD, and it so happens I'm one of them. We have actually

managed to finally hire our first government employee as of Monday. That shows you how long it takes us just to hire government employees.

We've now got about 25 other folks from FFRDCs (Federally Funded Research and Development Centers) and UARCs (University-Affiliated Research Centers), helping us put together a refined architecture that we intend to bring to the Acting Secretary of Defense at the end of the summer – something we can say: Here is what we intend to go build. Here is how I'm going to solicit for it. Here is the money I need to go do it. Let's go.

So, we are poised to start the minute appropriations show up in FY '20 and we're going to move very quickly. We are devoted to the idea of getting capability out, and we're going to put our first capability up in 2022, with on-orbit demos next year. Think about that. Before the end of FY '20 we are going to put capability on-orbit. That's pretty quick.

And then operational capability, the first tranche of operational capability by 2022. That's our target. It's more than our target. If we don't get there I feel we've failed.

If I have to come back to you all in 2023 and say there's a delay, I've already blown the case. The whole point of this was to use an agile methodology, to use mass production to our advantage to put up something quickly, and then iterate and iterate and iterate and watch as that improves over time.

So, that's about all I've got. But, what I'd love to do is chat with all of you, and so I'm happy to take questions, comments, advice, withering criticisms, it doesn't matter. So please, anybody want to start?

(Applause).

MR. MARK STONE: Mark Stone, independent missile defense consultant. Any thoughts on the possibility of a Kessler Syndrome? If there's too much stuff up there, and it may be low quality stuff, bad things happen.

DR. KENNEDY: Yeah, I saw the movie "Gravity" too. And I liked Sandra Bullock, she did a great job. I guess what I would say to that, and I don't want it to sound too glib, is that space is big, it's very big.

If you assume a population -- and I hate doing public math -- but if you assume a population of 500,000 objects in LEO of a centimeter in diameter or greater (and we'll just stop there because I think some people have estimated 190 million objects a millimeter in diameter or greater) it turns out you've got about 10 to the eighth cubic kilometers of empty space around each one of those objects. So adding 10,000 or 12,000 new objects to that, it's just hard for me to say just a priori what's going to happen.

I am not going to tell you that there is no possibility of a Kessler Syndrome. But at the same time, I don't think we have the math right now to say what's going to occur. I do know, though, that space is big. There's a lot of room up there. Mostly what we're talking about is bubbles of uncertainty overlapping.

So, if I have a satellite with a 20 kilometer bubble around it that I can't have anybody intrude into, and somebody else with a 20 kilometer bubble bumps into that, do I have to maneuver? I don't know. I would say probably not. I think we may be a little too risk adverse on that front. Take a look at our freeways outside, say, I-95, in terms of what daily collision risks we're willing to accept on the planet, or in the air.

MR. STONE: It's once you have a few collisions --

DR. KENNEDY: I know, I get it.

MR. STONE: -- it's the debris that causes the cascading --

DR. KENNEDY: I understand the concept. What I'm telling you is I don't think the math is there to say that that is going to happen, and that adding a couple thousand additional objects in LEO would do it. I'd be happy to look at anybody's studies to suggest it, but the studies I've seen from Aerospace [Corporation] don't suggest that.

They usually say something like 10 percent additional likelihood of conjunctions, and that means overlapping bubbles. That does not mean collisions. How many extra collisions will we get? I don't see a lot of good math on that.

MR. HACKMEIER: Thank you, Dr. Kennedy. My question is, I think industry is more than interested in participating in everything your department wants to pursue.

DR. KENNEDY: Put your money in!

MR. HACKMEIER: Well, there's money there. The idea, though, is that as the growth of this opportunity happens, is it happening equally in all areas? Are we just sending a lot of satellites up, or is the Department also looking at how the ground infrastructure necessary for that emerging architecture is evolving just as rapidly? Right now, I think the Air Force Satellite Control Network has something like 180 satellites, or something like that, and they're having challenges managing that. Is the Department looking at it across the board and understanding it's not just the satellite but also the infrastructure and the training and the people that are necessary for that piece as well?

DR. KENNEDY: Kurt, I'm glad you asked that question. The truth is that the sexy part is the satellites. The users are all down here. The reason we want to build out this architecture is to provide perishable data to the war fighter, perishable data to the war fighter, closing kill chains quickly. How do we defeat a hypersonic glide vehicle?

That's all happening on the ground. The defeat is happening here. It's happening

in the air, it's happening in the maritime environment, it's happening on the ground. So, yes, we have to worry that piece: user terminals, radios, phased array antennas, whatever you're going to use, laser comm links, ground command and control. I would tell you that what I see the real value here is, is not that people are about to go mass produce satellites, that's all well and good. The real win here is that they're about to go mass-produce terminals. The iPhone I've got will be able to pick up a nav signal, comm signal, whatever you want, and I'll be able to get that commercially.

So, what I'd like to do is go back to the services and say, you need to stop developing your own gear. You should not be building out your own radios. You should be procuring those from the commercial sector, ruggedizing them as necessary.

I think someone in a recent article in Space News said they were worried that I didn't understand that if you dropped a radio in the mud it might not work. Look, I get that. We are going to have to do some level of ruggedization to any commercial product that we decide to bring into DOD. Every service will have its own unique requirements, and I'm hoping they don't overdo [those], because it will take us to a bad place.

We've lived in a bad terminal development place for a long time. I've had several representatives from the Services come in and say, "I love what you're trying to do, but your terminal synchronization problem is a nightmare. How do you ensure that the systems you put on-orbit will interface with all of my legacy radios stretching back to what Marconi built?"

We're not going to do that. You're going to have to come forward as a Service and you're going to have to purchase radios that actually work on that network. We are not going to be backwards-compatible with everything you've ever built.

So, I think there's an enormous opportunity to figure out how to go do that, and to do it efficiently. But I do think that it's going to work that way. We are not going to go off and do a bunch of new terminal development programs because if we do, we'll wait a decade.

MR. JOSEPH PARLMUTTEN (ph): Is your model the government owned, government operated constellation, and if so is there any view of the actual co-funding with commercial organizations? Have you looked at that? If it's the latter, I want to know what your thoughts are on reforms in the regulatory arena, FCC and NOAA. How we can help bring about a better insurance market for commercial space.

DR. KENNEDY: I may be able to only track one of these [questions].

MR. PARLMUTTEN: Okay. Finance, insurance and regulatory and commercial.

DR. KENNEDY: Let me start with the first, which is, what is the model? What is the case in terms of how we interact with commercial? We don't know yet.

It could be a commercially-owned capability that we lease. I would love that. I would be very happy to simply lease commercial services from these mega-providers and just say, this is great.

Services, go buy your radios. Do your job. We'll put some nodes on those networks, we'll build out tracking satellites and other things that will talk to that network.

But we can't just lease that data transport layer, that critical mesh network, that space Internet, and just go. It may not work out quite that easily. There may be some co-funding. There may be some co-ownership. There may be things we need to do with that network that will not quite translate to the commercial market.

But the more that I can leverage commercial the better off we are. So, I would rather be closer to the lease services model than to ownership. I really don't want to live there unless we have to.

I recognize, though, and my boss has said it, if we've got to go there we will go where we have to go in order to assure we meet our national security objectives. But I believe that given the amount of energy and the alignment with commercial goals -- essentially low-latency comms are low-latency comms, whether you're financial arbitrage, whether you're doing gaming, or whether you're somebody trying to shoot (at them?). Low-latency comms is goodness for all of us. So, we may be able to leverage a lot of that without a lot of extra work.

What else do you want to talk about?

MR. PARLMUTTEN: Regulatory, finance, insurance.

DR. KENNEDY: What regulatory concerns are you particularly worried about?

MR. PARLMUTTEN: FCC and NOAA.

DR. KENNEDY: Well, if the folks are already making the filings, if the commercial sector has already gone out there and said we're going to use this spectrum, then I would be very happy to let them go worry that problem for me. I will use whatever bandwidth I can that has already been filed for. I don't see any reason for me to go out and worry that problem.

I really would love someone else to do that for us. We spend way too much time on that problem. So, if commercial has already got those filings in place, let's use their bandwidth, and we'll pay for it.

In terms of NOAA, remote sensing, I'm going to put up capabilities that will do remote sensing. That's the idea. SDA will go work several problems in that arena. For much of that -- Doug [Loverro], do I really care what NOAA thinks of my remote sensing payloads?

MR. LOVERRO: They're down to about 93 days right now.

DR. KENNEDY: So, we will certainly verify we're OK -- like the laser clearinghouse, like any of these things, we will still work with them. But again, I'm working towards a solution that minimizes that impact. And I don't think I'm going to have a lot of problems putting up infrared cameras to spot hypersonic glide vehicles. I think things like that are probably going to sail through.

MR. STEVE MCCALL (ph): Steve McCall, Congressional Research Service. I had a couple of reports published the past couple of months on the difference between the SDA and the SMC. Will you take missions from SMC and what are the capabilities you'd want?

DR. KENNEDY: Let me note, J.T. Thompson, the SMC commander, is just a wonderful man, a fantastic commander of that organization, and I'm very proud to be working with him on all the problems we face. The work he's doing to put SMC 2.0 in place is important. Here's what I would tell you.

The kinds of things the SDA is doing, purposely, is to go after gaps that will not be easily solved through the more deliberative processes we use today. When I talk about the hypersonic glide vehicle threat, that's something that other agencies and other organizations can certainly get after, but the timeframes will be longer. So what I'm trying to do is go after threats.

This is a threat-driven agency and architecture to get after threats that have materialized but may not yet have become validated requirements. We're going to try to attack those in a one- to two-year period. That is a little different than what the larger acquisition structure, the more deliberative communities, focus on. They're going to go after not so much emerging threats as sustained threats, things we know that are out there, that have been out there. We're going to keep working those.

But to get after the new threat, we believe this is an opportunity to go do that. So, I don't think it gets in the way of what SMC is doing. I really don't. SMC has a long-term mission, to go off and worry the very specific problems they've long been concerned about, whether that's in navigation or early warning or communications. What we're talking about is, as the emerging threat pops up, we're going to try to knock it down, and do that in one or two years. And we think that's actually complementary and compatible with the kinds of things that SMC is doing, NRO, et cetera.

MR. : (Off mic) -- Systems Planning and Analysis. Can you discuss, please, how you envision the roles and responsibilities and authorities of the Space Development Agency vis-à-vis the Air Force, DARPA, NOAA and any other agencies that apply here in this space?

DR. KENNEDY: I'll try. The acting secretary established the Space

Development Agency back in March, and there's an associated memo that explains the authorities. By the way, I'm very pleased with the authorities granted because it allows us to go fast. They make the SDA director a component acquisition executive. That provides a lot of responsibilities to the individual running that organization.

Frankly, I was telling Debra [Facktor] this earlier, I really need a lawyer. The establishment memo was fantastic, but there's a lot to absorb and a lot to go get done. So, I'm trying to make sure that I can exploit my authority to the fullest. We're working on that right now.

In terms of relationships, we have said we're standing up inside the Office of the Secretary of Defense, under the Undersecretary for Research and Engineering. The thought process has always been, ever since this got hatched, to move this to a Space Force if and when a Space Force is created. Then the question becomes on what glide slope you would actually bring the agency in, and we have been talking with the folks who have been working the Space Force to determine when that would happen.

I was initially arguing for something on the order of two or three years to give us a good glide slope, so you don't try to jam everything in all at once and stand everything up and create even more chaos. You don't need that. But the bottom line is, that may be out of our hands. We'll wait and see what Congress decides they wish to do. If they say, "SDA, you're going to come under a Space Corps or Force, and that's going to happen in 2020," then we'll do what we've got to do. I'm not worried about that.

In terms of other relationships, we've already talked about SMC. I also want to have a very positive and effective working relationship with the NRO. There will be seams that we will need to address between doing things like foundational intelligence and pushing perishable data to the war fighter – targeting information, specifically. It's an interesting little place to play, right? There will be questions over who does what, so that's one application space for certain that we'll get some interest from multiple parties.

NOAA, I'm not sure yet. I need to think through that one. I think our team does. But there will be, of course, an interface with NOAA.

Weather, in all its forms, is of interest to DOD. Exactly how that is going to get tackled in the future is not quite certain. It's not one of my eight priorities that I was asked to go deliver on, but I've had multiple people coming in and saying, would SDA like to work the weather problem? I'm just not going to comment on that. It's a tough problem.

Did I miss something?

MR. : I'm trying to understand it between the Air Force, in particular, and Space Command and how this whole interface will work, what do you see as the authorities and responsibilities of the two different agencies?

DR. KENNEDY: In terms of the authorities, the SDA is being stood up as an independent agency to go develop and actually deploy space capabilities against a rapidly emerging threat. That is what we're going to go do. We have the authority to go do that and to do that quickly.

In terms of working with the Air Force to go do that, I would like to very much be out of the way of the classical mission set. I don't wish to do the classical mission set, I don't wish to duplicate it, and we have already been talking with the Air Force on how to make sure that doesn't happen. I've been working with folks -- again, J.T. Thompson, D.T. Thompson and others -- to talk about how we're going to relate in the future. It's still early days, so give us a little bit of time to work out the details.

MS. VICTORIA SAMSON: (Off mic) -- keep assets down the road 25 years?

DR. KENNEDY: I think we want to keep space as clean as we can. I know the commercial sector is very interested in doing this. Every one of them, if you ask them, will tell you they have plans to de-orbit everything they put up, because they're going to need to put up new capabilities, and having a debris field in the way is not exactly value added to them. It's not value added for us, either. So, we will work with them.

The bottom line is, we're as interested as commercial in ensuring we de-orbit material as fast as we can. If we're going to be putting up capability every two years, we need to be bringing down capability in that same timeframe, at the same rate.

MR. LOVERRO: I know everybody is trying to be nice to one another, but some of the U.S.'s most rapid development in space consisted of three programs, [NRO's] Program A, B and C competing with each other.

DR. KENNEDY: What do you know?

MR. LOVERRO: Can you talk about how you view competition.

DR. KENNEDY: "Coopetition." Actually, I was talking with General Raymond of Space Command, and soon U.S. Space Commander, recently, on this very point. I hope he doesn't mind me saying this. He told me, "Fred, you've got to be provocative."

That's coming from him. You should not be surprised by that. He wants this organization to be poking at the status quo. We need that.

This gets back to Doug's point. We need to shake things up a little bit. We need to be looking at new ideas. We need to think about how to change our adversary's calculus.

Here's the problem we've got right now. We're very predictable. We're very predictable. We've got all of our eggs in one basket, we've got Battlestar Galacticas in GEO and a few other orbital regimes.

The adversary knows how to go after those to get them. What should we do about that? What is our logical countermeasure?

Well, I'd say it's "protect and defend what you've got because you've put so much money into it." Classic sunk cost. I've got an aircraft carrier and I'm going to defend it. I've spent \$14 billion to get it there, I put 5,000 people on it, I don't want to think about another way to do it. I want to think about making sure the way I'm doing it today is protected and defended so I can keep doing it.

Well, the Chinese get that too. They get that. So this, SDA, represents an orthogonal approach. The idea is, let's put the Chinese and the Russians off, make them stand back a little bit and say, we're not quite sure what the U.S. strategy is. The U.S. strategy looks difficult to ascertain. Huh!

They're going to go off in a different direction. They're not going to do a basic protect and defend. They're looking at other options.

I think we want that to happen. We want the Chinese to step back and say, huh, the Americans are thinking differently, and they will have to change their calculus.

This is about cost imposition. We don't want to impose it on ourselves. We could, we're good at that. We know how to do that.

How do you impose costs on a very, very intelligent and capable adversary who may have more money and more engineers than we do? It's a tough question. I'm not sure we have an answer yet. But I think we should be poking at it from a number of vantages and we should be willing to listen to innovative ideas and invest a bit in them to see if they'll work.

Does that sort of answer it?

MR. THOMAS KARAKO: Tom Karako of CSIS. This is an incredibly important set of problems that you've been tasked to solve, and a very daunting set of missions that you have to support for the entire joint force. Both SDA, which has been described as the Missile Defense Agency for space --

DR. KENNEDY: No, no.

MR. KARAKO: Okay, alright, MDA reports to Mike Griffin.

DR. KENNEDY: Yes.

MR. KARAKO: You mentioned you have a wonderful couple of detailees.

DR. KENNEDY: And 25 more people.

MR. KARAKO: And 25 more people coming.

DR. KENNEDY: They're here.

MR. KARAKO: So, would you speak to the relative location of the sensor payload, what's now called HBTSS [Hypersonic and Ballistic Tracking Space Sensor], it used to be called SSL [Space Sensor Layer] and all these other things? In the interest of going fast, just as you have a desire for other folks to worry a particular problem, wouldn't it make sense to have MDA or some sort of missile defense centric organization, figure out that sensor and then hand it to you to put it up there?

DR. KENNEDY: That's kind of a really good idea, actually. I actually like that idea a lot. Let me just toss this out to you and you can see what you think. Here's the thing, MDA is on-track to deliver a HBTSS sensor around the 2025 timeframe. They know missile defense and I'm sure they will come up with their vendors with a fantastic sensor.

Now, it may get delivered in 2025 or it may wait until 2026, but sometime in the middle of the decade. Let's hope for the best. I've said that SDA was stood up to deal with a rapidly emerging threat. What I'd like to do is put up a sensor that may be nowhere near as good as HBTSS by 2022, and probably do a demo of that sensor next year.

We'll also get another bite of that apple in 2024 when I put up another round, and maybe another on in 2026, while HBTSS may be coming up at about the same time. So, we'll have some ideas now about what's the right sensor, what's the mix. Maybe it will be a hybrid approach, some HBTSS, some of this, some of that, that's where we're headed.

But this gives us an opportunity to get ahead of that 2025 timeframe because we already see the threat now, folks. The threat is out there now. The Chinese have not just developed this capability, it's out there. It's extant. What are we going to do about that?

So, we're saying let's get at it now. Will I or SDA or our vendors, will we give you the right capability in 2022? I'm guessing no. I'm guessing we'll be short on sensitivity, resolution, any number of things. But what I can do right now is critical, so that's the idea.

I'm going to put it out there, a minimum viable product, make sure it works, try again, try again, try again. And then, come 2025, 2026, when MDA walks in and says, here we go, this is a great sensor, well, then let's propagate that thing all over the architecture if it makes sense to do so. Now, if it costs \$250 million a pop we may have to talk. I think cost is going to be a very interesting point of contention for all this. So, I don't want the exquisite sensor at that cost. We're either going to have to think about how to make some trades to ensure we get capability, but we don't remain with a risk

averse, exquisite mindset that is killing us.

MR. : (Off mic) -- from Johns Hopkins University. It's clear to me that you're focused on space assets, low cost, fast, mass produced and all that. Are you looking at all at low cost rapid access to space?

DR. KENNEDY: Yes, we are. In order to do this right, and I'm sorry for abridging the architectural discussion because I didn't know how much you all wanted to get into it. Obviously, ground command and control is critical. A proliferated ground command and control is key. An ability to leverage the user segments that are going to be out there to service consumer needs is going to be key. But also, we're going to have to need to get after access, and that's for several reasons.

We're going to have to be able to constitute these constellations. They'll be big. So much the better if commercial actually manages to do it for us. But at the same time we have to RE-constitute.

Now, we may have to reconstitute just due to obsolescence. Or, we may be reconstituting on the basis of attack. So, we need to get after rapid launch, and it probably won't be coming out of those traditional ranges and sites, because those traditional ranges and sites are probably going to be held at risk by an adversary.

So how are we going to get after that problem?

The good news is, just like in the commercial satellite arena, where we're seeing mass production techniques, 3D printing and all the rest being applied, those same capabilities are coming into play at the launch sites. We have an upsurge in small launch. When I was at DARPA we decided we wanted to address this through the DARPA Launch Challenge. I believe we're still on track for an event in the beginning of calendar 2020. The idea there was, do I need to call you up and have you put a capability on orbit in 72 hours or a week, whatever it might be? Can you do that?

A lot of people said, that's crazy. There's no utility for that. No, no, there is great utility for that. The only question is, is it a value added for the commercial sector or are we distracting them from what they would otherwise do?

I would argue there should be a time to market story for commercial as well. I think the value of rapid launch – maybe commercial hasn't seen it yet – but the value to us is clear. So yes, we are tackling that and we're trying to get that community to come forward and say, yeah, we could launch out of Kodiak in one week with a payload you just gave us, and we can march down to Spaceport Camden [Georgia] the next week and do it again. And by the way, those locations? They're purely hypothetical. Those are not necessarily the places from which we'll fly.

MS. DEE ANN DIVIS: When people talk about the near-peer threat, navigation is usually in the first sentence. I'm curious about how your organization meshes with the

existing plans, for example, spoofing rapidly emerging threats?

DR. KENNEDY: Yes, and just denial in general, just jamming.

MS. DIVIS: Is there a signal enhancement that has been discussed, but it's kind of down the road? It sounds perfect for your organization, but it's also already in process.

DR. KENNEDY: I'm so glad you asked that.

MS. DIVIS: Please go on.

DR. KENNEDY: I will. One of our priorities is to build out an alternate navigation capability, an alternate PNT, position, navigation and timing capability. When I say alternate, I mean truly alternate. I don't mean one that relies on GPS, I mean one that's independent of GPS.

Now, you could argue they're already out there: GLONASS, Baidou. My guess is we don't want to rely on those. Some might want to use them. But rely on them?

Anyway, the answer is yes, it's one of our priorities. Let me just give you a taste of what we're thinking right now. Imagine optically cross-linked satellites on-orbit. We get the delays between the satellites nailed down, we get good clock into that constellation so that I have de facto navigation satellites throughout that constellation, and I push that data down, that nav data, I push that nav signal down multiplexed in with the comm signal that's already going to everybody with a handheld.

So they're just going to get that signal. They're going to get that nav signal as long as they're a subscriber to the network they're going to get it. There's some broadcast issues we could talk about, but the bottom line is the network a commercial provider might put up may actually help us get there very quickly. We just have to get good clock for the constellation and we have to propagate it around the constellation in order to understand the delays.

If we can do that, we believe we can build an alternate navigation capability or maybe even more than one. Because wouldn't it be great to have two or three, that the commercial sector was just providing sort of because it could? Maybe they'll even charge you for it. I don't know if there's a commercial case for that or not. But I imagine there may be car companies with, I don't know, autopilots, that may want to know more accurately where their cars are, and things like that. There could be reasons why people want to sell that kind of hyper-fidelity to the GPS market.

MS. DIVIS: Are you talking about putting clocks in the commercial system or a separate system making --

DR. KENNEDY: Both. It could be both or neither. It could be either one. We

could ask the commercial folks to actually put the clock on and to propagate using optical crosslinks to ensure we've got the delays in. Or, we could put up our own navigation satellites that may look a lot like the commercial birds for comms. We just pull some of the commercial equipment off, throw in some nav gear, and go. It could be either one of those or it could be both. But that's the thought, and the idea is now I have an alternate navigation source. If GPS is denied, and it will be denied, that's okay because I've got one, two or three alternate sources sitting out over here.

MS. DIVIS: (Off mic).

MR. KENNEDY: No, definitely not.

MS. DIVIS: What's your timeframe?

MR. KENNEDY: 2022. It sounds crazy, right? That's what we're shooting for. Now, what will I have in 2022? Probably some optical cross-links, just some very basic gear, just to prove out the concept. Why don't we start with that?

We're not going to start with everything. Minimum viable product, what can I get to quickly? And then '24 hopefully looks a lot better. We could decide we don't want to do it, right? I'm open to either. But if we are allowed to continue to iterate, I'm willing to come back and buy you a steak dinner if by 2028 we don't have an amazing alternate navigation capability.

MS. DIVIS: I'm from Nebraska so -- (off mic).

DR. KENNEDY: I understand. If you were from Missouri, I'd have to show you, right?

MS. : This is more of an organizational question. (Off mic) -- can you explain the relationship --

DR. KENNEDY: Between us?

MS. : (Off mic).

DR. KENNEDY: Sure. The new assistant director [AD] for space is Derek Tournear. It turns out he's an old friend of mine. He worked at DARPA with me over a decade ago. We get along pretty well.

I guess the way I would describe it is this. The AD for space is going to be interested in roadmaps and technology development that will support capabilities like the ones we're trying to push out. What you'll see the AD for space doing is working with the SDA and others in the space community writ large to say, what technology should we be investing in, in terms of what is commercial missing that we would normally need? And then, make sure that we're invested in that for those capabilities. That sounds like

MDA and HTBSS, so there's going to be things like that where we're going to go invest in.

That is not the SDA's job. I do not want to have to have essentially a research lab arm that goes off and works that problem. So the AD for space, you're going to be watching each of these mission areas and saying, what do these organizations need in order to be effective, and then invest at the 6.1, 6.2 level of investment to ensure that work is coming along. So then in 2028 we actually have an optical comb or something that can go do amazing work for our PNT. Does that help?

MS. : Yes.

DR. KENNEDY: Okay.

MR. WHIT PETERS: Whit Peters, former Secretary of the Air Force. My impression was that an executive agency for space was the worst thing possible because everybody can put in a requirement. We've got a B-21 in development right now. By 2028 it might be flying. How are its radios going to connect with what you're doing? What is the end-to-end, what you're doing to the user terminals, to the airplanes? Who is going to put up the money to put new radios that you need in an F-16, which costs \$5 or \$6 million up front just to open up the software?

DR. KENNEDY: I think that's a great question. The first thing I would say is, I actually think the worst thing is being a national security space architect when you have no money and all sorts of moral authority that gets you nowhere. But I get the point.

This is about cultural change, so it doesn't matter how good my data is coming off some wonderful sensor we have in 2026 if nobody wants to hear from it. I will tell you. though, and I don't mean this to sound like a copout, I do not want to build those terminals and I don't want to be responsible for going to every one of those SPOs [System Program Offices] and figuring out how to slap on a radio. What I do want to do is ensure that the protocols and standards are there so that when the services do go buy a conformal phased array antennae, they know enough about it to be confident they can put it on a B-21.

So, that discussion has to be ongoing. When will it start? How will we decide that we're real?

MR. PETERS: It will probably not be immediately.

DR. KENNEDY: Which will not be immediately, right? But perhaps in the next year or two, and certainly by 2022 if we put up a tranche of capabilities, I think at that point I will say that -- I think you've got a corner case there with the Air Force. It's going to be tough. The Army is probably the easiest in terms of getting dismounted soldiers some radios, because those radios are going to look a lot like the radios [those soldiers] probably bought down at the Apple Store or something. So, that's the place

where I think we'll have an easier entry point. For planes for ships, it's going to be trickier, but we have to start somewhere.

MR. PETERS: For example, everybody has these Android systems now. Is DOD compatible with Android?

DR. KENNEDY: Again, what I would say is I want to be very careful about projecting whether or not I'll be compatible with any legacy system. The minute I say I'm compatible with one, I will get pinged with being compatible with all. So what I want to do is I want to review which ones make sense to be compatible with and ensure there are translators for that.

I'll just take this as an example. We've been talking about missile defense. Obviously there is an early warning component. There may be value added if I'm bringing down missile defense information if we're seeing hypersonic glide vehicles. I'm willing to bet that the early warning community is going to want some of that data.

The question becomes, how do I get it to them? Well, that's a rat hole, okay? My intent is to put out the data, and then to say, do you want to see hypersonic glide vehicles? If you do, you'll come find out how to use this data. If the data is not of interest to you, then don't worry about it. But I believe there has to be a discussion, because I do not want to be involved with any of that community thinking about how to build out their formats, respond to their particular validation requirements, because that will take me 10 years right there.

MR. PETERS: I get that. The problem here is that you've got millions of soldiers on the ground and in the Navy. You have a dollar problem with the numbers. With airplanes and ships, you have a huge dollar problem because all of that stuff is expensive. It's already there, so I'm wondering if -- my sense is the biggest problem we have with space is the end-to-end. So the Navy would put up a satellite and maybe we could buy the terminals for the Air Force, so you'd buy the terminals. What the department really needs, it seems to me, is more coordination rather than more agencies, frankly.

DR. KENNEDY: I'm with you on that. I like the idea of sun-setting agencies. I think agencies get old and they need to be retired. We don't do that very well.

I think the right answer is for us to stand up things we need to in order to do the new. Honestly, organizations have trouble doing the new. It's a classical problem and we've seen it forever. Something like what we're doing is intended to be provocative and intended to be disruptive. In 10 years if we're done and we're no longer disruptive and useful, I'm the first to say let's sign off and stop.

But in particular this issue of terminals, I think you need to tackle it now. I think we need to start talking in the department in a coordinated way. If we're going to be using commercial grade terminals and ruggedizing them, we need to start talking now

about what that means.

The services are going to have to procure [those terminals] and figure out how they're going to put them onboard. Honestly, I would much rather have that phased array antenna on an F-22 than not. I'd want to be able to talk to all these resources that are sending out their particular signals.

MR. : Is somebody in the department, your boss, worrying it?

DR. KENNEDY: My boss is definitely worrying it. His deputy is definitely worrying it. She's also talking about 5G and any number of other things. There's a whole discussion going on along these lines right now.

So, yes, but is it coordinated yet? I would say not quite. But what we need to do is, as this matures, and again, over the next two years, if it becomes apparent that this is the way to go, I think the Services need to start talking and saying, what are the protocols, what are the standards, what other requirements are going to be imposed on a commercial grade terminal and/or antenna in order to get this job done?

What do we need to do in band? It's a critical part. Synchronization has always been the bane of everything we've done. We always get there late with the terminals.

But the good news now is, we've actually got the commercial folks trying to make money on the terminals. What do you use? We just have to figure out how.

MR. : They may not work in an airplane.

DR. KENNEDY: Right, or in the mud, or underwater. But there is good reason to believe that if we start the discussion now and not wait 10 years (because that's what we would normally do - we would wait for commercial to figure it out and come back in a decade and say, "can you now modify all of your systems to accommodate this level of jitter, etc.?"). I think that's what we should do. We should have the discussion now.

Commercial is working this now. They're making their decisions now. Why don't we get in there while they're still at the table talking about it, while we might be able to influence some of those trades to make sure if I do drop the damn thing in the mud, or I do have to put it on the side of a hypersonic weapon, the antenna isn't going to strip off and do something useless.

We need to talk about that. Now is the time because we're not going to be able to reasonably talk about it in a decade because we'll be a pimple on the back of a monstrous commercial enterprise and they will not care what we have to say, and we will have to go back and build our own.

MR. HUESSY: With that, Dr. Kennedy, that was an extraordinary job. Thank you very much.

(Applause).

We are having a roundtable with Dr. Kennedy around 9:30 a.m. Please say hello to him, but he does need to be over in that room in a few minutes. Thank you, and those of you who join us, please do.

I also want to say, I don't do this by myself. There are two young ladies here, Jordan and Nikki, who work a lot to put this series together, sending out invitations, doing the registration, helping with getting the support. Nikki and Jordan, thank you.

(Applause).

Out on the table is a whole series of reports that the Mitchell Institute has produced on a variety of issue on space, on bombers, which I hope you take so Nikki and Jordan and I don't have to take them back to the office. They're all on the table there. Please, take them.

Again, I wanted to also thank Secretary Peters. Thank you very much. General Armagno, thank you very much for being here.

I want to thank our sponsors. You make this possible and you make it available to this kind of a group like this and help inform the community, particularly the Hill, and others. Thank you.

Again, on our web site we have the schedule of upcoming events. Thank you for doing that. Again, Dr. Kennedy, that was extraordinary. We look forward to hearing you again at some point down the road hopefully. We look forward to the second session. And again, thank you again all of you for coming here today.

(Applause).