

- Mr. Riki Ellison: Good morning, everyone. I'm Riki Ellison. I'm the founder of Missile Defense Advocacy Alliance. It's a nonprofit organization that was founded 16 years ago and our mission is all about the development and deployment of missile defenses. We believe that having missile defense globally makes the world a safer place today. We're very fortunate to have the speakers that we have today. It is the 15th anniversary of the C2BMC. This is our 23rd Congressional Roundtable and the C2BMC is the blueprint, the architecture that goes first before all the fancy sensors and shooters that go forth and often mis-looked and not taking a real good viewpoint of or understanding of. So we're here today to try and educate this issue and how important it is today.
- Mr. Riki Ellison: I would say that we're at a flexion point with Missile Defense Agency, a flexion point with Missile Defense, globally, a flexion point with our allies of expansion of missile defense and what it's doing today for our homeland, but also coming down in the lower tier for cruise missile defense and fixed wing drone defense to be integrated into that picture.
- Mr. Riki Ellison: And we're also moving into space with that aspect of it. So the critical thing is having this capability, the C2BMC to be able to bring and fuse all the sensors that you can, cross domain, and all the shooters that you can, cross domain, and be able to apply that very quickly to the threats that we were going to be facing in the future of today.
- Mr. Riki Ellison: So I'd like to start off with our first speaker, Lieutenant General, retired, Trey Obering. Trey Obering was the Missile Defense [Agency] director from 2004 to 2008. I think his legacy is the godfather and the creator of C2BMC. He did some remarkable, remarkable work at NASA and with the Air Force before becoming the director. The AOCs that around the world today, use his C2BMC in those.
- Mr. Riki Ellison: And what he did ... and I think as we in today's Congress are looking at these long acquisition cycles of 14 years, Trey Obering put a system, our ground-based missile defense system, in the ground in under four years. And that system could not have worked without the C2BMC behind that because the first time we were able to use assets, sensors in space, sensors on the sea, sensors on land that were 6,000 miles and put it into a system that gave us our first ever ballistic missile defense capability in the United States of America. He created that. And that's what we are celebrating today and recognizing today, that great achievement and where it came from and where it's going to go. So I'd like to hand it off to a good friend, Trey Obering.
- Lt. Gen. (Ret) Trey Obering: Well, thank you very much Riki. I appreciate that. Thank you for the kind introduction. I'm very happy to be here this morning. I think it's a very important milestone we're marking here and I think we don't do enough of this to look back and say, "What were the results of decisions made? What were the results of actions that were taken in the past and what happened because of that?" Because oftentimes we don't do that enough.

Lt. Gen. (Ret) Trey Obering: Let me take you back a little bit in history. It was December of 2001. The US at the time was winding down it's a response to the 9/11 attacks, called Operation Enduring Freedom in Afghanistan. I was on the air staff. I had just reported to the Ballistic Missile Defense Organization (BMDO), as it was known at the time, or BMDO, from the air staff where I had responsibility on the air staff for things like Global Hawks, Predators, [inaudible 00:00:04:40], AWACS and other programs that we were using very heavily in Afghanistan at the time.

Lt. Gen. (Ret) Trey Obering: But as I was winding up, I was asked to come over to the BMDO. Now as a former fighter pilot space, throttle engineer, and a program manager there was one thing for certain when I walked in the door. I knew nothing about missile defense. But it was to become the most important assignment in my 35 year career in the Air Force. Now Lieutenant General Ron Kadish was the director of BMDO at the time and he asked me to come there for two reasons. The first one was, he wanted help with one of his visionary tasks, which was to help him transform the very research oriented BMDO into a new Missile Defense Agency that would have responsibility for research development as well as acquisition and start to get capability out into the field. And secondly and most importantly, to help him develop the first operational, integrated layered missile defense system that this nation has ever had.

Lt. Gen. (Ret) Trey Obering: So with respect to my BMDS, my ballistic missile defense system task, the first one he asked me to do was to create the command and control program for the entire system, which is why we're here celebrating today. Now when you think about it, it was really a major challenge because normally when we fight wars or conflicts, like in Afghanistan, it's pretty much within an area of operations of a single combat command. So they have the ability to situation awareness, battle management, shop de-confliction, et cetera, within that one, as we talk, AOR Area of Responsibility. That's not true of missile defense. If a missile's fired from North Korea towards the United States, that, first of all, crosses US forces Korea, the Japanese, the US forces in Japan, Pacific Command, Northern Command. All of those commands come into play. So giving situation awareness and battle management capability simultaneously across multiple time zones to individual combat commanders was a real challenge.

Lt. Gen. (Ret) Trey Obering: And when you combine the potential strikes against the United States with strikes that would most likely occur against our allied forces, Japan, Guam, et cetera, you can see the challenges that we had. We also had to move quickly due to the threat. I remember distinctly there was an intelligence assessment that came out in about the 1998 timeframe from the CIA said very, very definitively the North Koreans would not be able to launch a multistage long range missile for at least eight to 10 years. Three months later they launched a Taepodong-1. And so it was that kind of surprises that we were getting almost on a regular basis from the North Koreans, also from the Iranians, that added a sense of urgency to what we were doing. So we knew that if we use the classic acquisition approach ... the DOD 5000 and the JSIDs for requirements ... we

knew if we did that, we would not be able to catch up and not get nearly ahead of this threat.

Lt. Gen. (Ret) Trey Obering: And so we decided that, first of all, we had to do things differently. So we were one of the first organizations to use what we call OTAs or other transactional authorities to try to get non-typical defense contractors ... and even with typical defense contractors to get new ways of doing business ... into the process and to be able to move quickly. We also knew that we could not afford a two or three year competition for this. So we really looked out over the landscape and we saw that Lockheed Martin was frankly the best company position with their experience and previous programs for the Air Force ... they did a lot of command and control systems for the Air Force ... that they would lead a collective team from across the industry. So we had Northrop and Boeing and General Dynamics, Raytheon and Lockheed, but they were all on this team and they were headed up by Lockheed Martin. We called it the national team B because we also had a national team S which was doing the system engineering integration for the agency.

Lt. Gen. (Ret) Trey Obering: I was the first government C2BMC program manager. The current one, John Bier is sitting here to my left, Mr. Rich Ritter, as many of you may know, was my deputy at the time that at MDA and the first Lockheed program manager was a gentleman named, Reese Delorey who was just an outstanding and very individual for Lockheed. We had a very small government team. We wanted to keep it small. And the contractor's team was also small. It was about 100 to 150 folks on the contractor side.

Lt. Gen. (Ret) Trey Obering: And, again, with the speed of delivery in mind, we used a technique that ... we call it X Labs back then, I think it's still in use today, but it was a technique that I actually had learned up at Hanscom Air Force Base in Air Force where we would set up three different laboratories, co-located with the war fighters, with the users. And in the first lab you'd be working on the fielded system of the capability that you had. The next lab would be the next version of that system that was in development. And the third lab was a generation after next. So you had this continuous stream of input from the users as the developers are developing the software for the system.

Lt. Gen. (Ret) Trey Obering: And if you go back in time, at that time it was very unusual for software development to be timely. It usually was the long pole in the tent for a lot of weapon system development. We were actually putting out software versions faster than the war fighter could train on them and they started complaining about that. Then we actually had to slow down a little bit. Also, with this idea of speed in mind, instead of having a lot of formal requirements, documents passed back and forth between the contractor, we would collaboratively come up with a spiral content agreement for each version of the software to get it out there. And that really was phenomenal in being able to keep up the speed of delivery and if that capability didn't make it in one version, we just rolled it into the next version that's coming out.

Lt. Gen. (Ret) Trey Obering: And we also knew that we had to crawl, walk, and then run in delivering the system. So we first provided basic situation awareness and then increasingly added command controls capabilities as we matured. Our goal was to ... which was not achieved in my time as a product manager ... but our goal was to be able to get fire control, quality capabilities across the entire system so that we could exploit the full effectiveness of the system. And I'll give you one example. If you look at an Aegis ship, to defend Japan against North Korea, it takes at least three ships to cover all the defended area. When you're using the Aegis interceptor with Aegis radar. If you take the Aegis interceptor and you marry that to the TPY-2 radar that's on land in Japan, you can cover all of Japan with one ship.

Lt. Gen. (Ret) Trey Obering: So that's the power of integration that you get in being able to tie command and control capabilities and fire control capabilities into the system. We first became operational in 2004. We had a full C2BMC defense system at Schriever Air Force base in Colorado and Fort Greeley in Alaska. We then began to expand across the globe. We put one in the Pentagon. We put a situation awareness display in the White House. We put one at Offutt Air Force base for STRATCOM, all the way to Hickam Air Force base in Hawaii and finally to Ramstein Air Base in Germany. We also integrated more and more sensors and shooters into the overall capability with radars in Alaska, California, the United Kingdom, Greenland, Japan, along with a mobile based Sea-Based X-band radar to the silo based interceptors in Alaska and California and then the Aegis ships interceptors and so on and so on.

Lt. Gen. (Ret) Trey Obering: So it was adding layer and layer as we could. We also had invented what we call the external sensors lab in Colorado Springs so that we can experiment with getting different feeds from different sensors and from different national organizations around the US and other locations. And I understand ... and we may hear more about it from John ... that some of that is still in work today. Also at the time, we were planning to deploy ground-based midcourse interceptors to Poland and a large X-band radar to the Czech Republic. We integrated C2BMC with the NATO Air Command and Control System or ACCS, at the time. And so we were able to do that in that same timeframe. I believe it's important to note that the entire C2BMC development effort was accomplished under budget and on schedule, keeping pace with the advancing integrated missile defense system expansion from the Pacific to Europe.

Lt. Gen. (Ret) Trey Obering: Now I want to end on, in the summer of 2007, I was the director of MDA, at the time. I was invited to Camp David by President Bush to meet with him, Vice President Cheney, Secretary of State Condoleezza Rice, along with the Deputy Secretary of Defense at the time, Gordon England, the Chairman of the Joint Chiefs and others to discuss the future of missile defense. And it was while we were in route on the helicopter into Camp David, that I was talking with Deputy Secretary England, and he told me at the time that he thought that MDA C2BMC program was the best planned and executed program in the Department of Defense. I told him I wholeheartedly agreed with him.

Lt. Gen. (Ret) Trey Obering: So in closing, I just want to express, Riki said that I did this and I did ... I didn't do this. It was the men and women of the Missile Defense Agency that did this and the contractors that support them. They're the ones that put in all the hard work, the dedication, the sacrifice, the missed birthdays and missed vacations, you name it. And that takes a toll on folks. But they did it because they knew the national importance of the program. And I believe that today we're in that same environment. We were trying to get missile defense capability out because the emerging rogue nation threats, I think today we've got to have the same sense of urgency to address the hypersonic threats, supersonic cruise missile threats, et cetera, that are coming to this nation. So with that, I'll close and I'll look forward to taking any questions from you. Thank you very much.

Mr. Riki Ellison: Thanks Trey. Appreciate it. I'd say you'd be like the head coach, right? That led those teams. All of those teams did one team, one fight. Our next speaker, John, and he just reminded me, we first met at the THAAD test down at White Sands way back in 2004, 2005 when he was program manager.

Mr. John Bier: No, sir. I was the chief engineer at the time.

Mr. Riki Ellison: Chief engineer of the THAAD and he moved on to become the deputy manager for the GMD system and now he is the current program manager for C2BMC. But what's amazing that's happened under his watch, certainly we've got to talk about the March salvo test, where it really goes right with the MDR and being able to bring in all these assets that we've never been able to do before. The F35, MQ9s, our space capabilities, our Aegis radars, all fuse together to have a remarkable shot ... one shot that hit it, another shot that hit the smallest ... the next piece of debris ... validating the raw ability of the system that we have today that's protecting our homeland from North Korea. And he's also, I think, greatly responsible for what we've done in Aegis in expanding that capability with SM3 Block IIA engage on remote. They proved that out.

Mr. Riki Ellison: So now the defended area is probably four times bigger than it was because of that capability. Expanding the THAAD engage on remote with MSE. That's part of his portfolio. The Patriot, THAAD integration, the EPAA that's now moved forward, Aegis Ashore sites that are fully go, these are all integrated areas that C2BMC plays into. And globally, putting all that together to make our nation and the world a safer place. So he is the man that leads the team that's a really making our world a safer place. So John.

Mr. John Bier: Thank you, Riki, and thank you for all those kind comments and General, thank you for setting up that infrastructure before I got there. Like you said, I'll pick up with what we do today with what we call the C2BMC X lab. And we did rename the external sensors lab to enterprise sensors lab. But that's where we bring in the new space sensors, whether we bring in, like Riki talked about, F35, whether we bring in different versions of sensors and it's about the power of integration

in integrating ... There's cliches out there, any sensor, any shooter, but you got to be the right sensors with the right shooters.

Mr. John Bier: And so we experimented this, like Ricky mentioned, with FTG-11 using one of the strings, the processing strings inside the X lab. We brought that F35 data in, we merged it with other overhead IR data. And then we pushed that data over to the X lab portion, the C2BMC side. And then we sent that data down to the Aegis lab there on the West Coast for them to do simulated engagements while Major Pigman here, she'll get into the actual operations on the floor on FTG-11, but we were able to separate the data with the experimental side while we're doing a full blown test. And in the meantime, the system's doing ... supporting operations. Because during that time of the flight test, we still had to worry about operational for Homeland Defense, for North America and also for PACOM.

Mr. John Bier: So with the new C2BMC as we've grown, so we're ... I was looking here in a roadmap. We put out eight versions of C2BMC since the 2004. We're on what we call our current spiral. We use spiral developments and we're on our current spiral that brought in the engage on remote in support of EPA[A] phase three. We did that as planned for C2BMC before the close out of ... in December of 2018. But that gives that Aegis ... I like to use seven because I like to go back to, if I compare a organic Aegis to a Aegis platform that has the SM3-IIA coupled with C2BMC in the forward based TPY-2, it gives them a seven X improvement when you take that. So that's a big area when you talk about defense of Europe and then those missions. And then defense with regards to Guam and Japan where there's other ships.

Mr. John Bier: But it's that ability as we ... years ago it was very closed system. We've now migrated out to very open architecture and we have our own standards. In fact, when a new sensor comes on like the long range discrimination radar that it will be operational in a couple of years, we hand them a software development tool. They go off and build that interface and then we come back and test from lab to lab. So that ability to test early, find those problems, is how you do that speed to keep moving. So we're bringing on ... so our next build of software in system will be fielded in the 2021 time frame for enhanced homeland defense. We're bringing the long range discrimination radar.

Mr. John Bier: But one of the things that you started, sir, when you're still there at the end of your C2BMC tour and as the deputy was, we should integrate all the future sensors into C2BMC. So we are doing that again with regards to LRDR. When the Hawaiian defense radar comes online, that'll be integrated into C2BMC. So we've gone now from having ... We're geographically located, our big processing centers are in four Air Force centers around the globe. We have army sensor managers controlling the forward base TPY-2s and in three COCOM areas. We're now going to bring air force sensor managers in to control the LRDR radar that'll be up at Clear Alaska and then the Hawaiian radar when that comes on. So now

we have air force, we have army, we distribute our data through the maritime operations center. So we are that joint system that ...

Mr. John Bier: C2BMC grew up in a joint organization as you stood up BMDOs. We transitioned from BMDO to MDA under your leadership. But it was that environment that took down all the service walls, gave us the environment and rapid acquisition decision authority that allowed us to make those builds. And that's why I said we filled at eight different variances over these past 15 years and we've reduced our footprint by 50% with this present architecture. We can do combined operations test and training all off the same platform with this architecture we have today. And it just continues to grow and grow in the future. By having all that data into C2BMC, we then can start looking at unique discrimination techniques that every little individual sensor doesn't have because they don't know what everybody else is doing relative to air, land, sea and space sensors.

Mr. John Bier: So it's been great. I've been doing this for the last 10 years. Best job I've ever had, sir. I know you pushed me along the way. Time to get out of THAAD and move to GM. That was under you and so forth. So thank you for setting the environment for us and it's been a great team and teaming with the national teams through Lockheed Martin, Boeing, Raytheon, Northrop Grumman, General Dynamics. I've always said to my counterparts, it's a badge less team, right? And that's been very successful with that acquisition environment. Our teams are most split between Colorado Springs and Huntsville, so two great supporting environments there. It's been a great past 10 years for me and I'm looking to the future where this is where the growth in missile defense capability is, through C2BMC as we take on hypersonics, as we take on cruise missile defense and those decisions will be made in the future. But the ability to integrate the right sensors and the right shooters through C2BMC is just awesome integration capability.

Mr. Riki Ellison: Thanks, John. Our next speaker is from NORTHCOM. General O'Shaughnessy has been very aggressive and very upfront with bringing integrated air and missile defense to the US homeland, not only from the GMD system but from cruise missile, future hypersonics and been a very strong advocate for that within our military community. Major Robyn Pigman has been here in Washington a couple times at the JDOC, which is the missile defense for the National Capital Region, and that is a very complex environment with a lot of things flying in the air, FAA and so forth. And she has been a key component of that experience. She now is the Missile Defense Officer for NORTHCOM. She advises and educates our flag officers at NORTHCOM on missile defense. So Major Pigman.

MAJ Robyn Pigman: Thank you. Good morning everyone. Like he said, I'm Robyn Pigman. I'm one of five missile defense officers at USNORTHCOM. I've been a missile defense officer there for about two and a half years now and came from here in the area and was happy to get away from the traffic, as I imagine everyone here can understand. But when I went to NORTHCOM, I was really surprised by the actual situational awareness that a command center has on what is going on in the

homeland. As was previously spoken, we have FAA assets, we have [DISCA 00:24:48], so we have that situational awareness for national emergencies that are going on in the United States. We're looking at air breathing threats. So we have all of these different air pictures that we see on our ops floor, which is a 24 hour, seven day a week operation. We always have at least one person, usually multiple people, in every domain advising the senior leaders of what's going on in our homeland.

MAJ Robyn Pigman: But what is important to note, I think, about our ops floor is that our C2BMC capability is one that every senior leader demands to have access to 24 hours a day. And it's a very, very valuable tool that we use on our ops floor to provide the senior leaders that real time ballistic missile defense, situational awareness. So they can make crucial decisions on what we are going to do when it comes to a potential threat missile entering into our homeland. And that system, as was mentioned, is really a valuable integrated system where we are taking air pictures from all around the world to determine what is actually a viable and credible threat to our homeland.

MAJ Robyn Pigman: So we are very happy in the NORTHCOM J31, which is the ... with the division that I am in and the NORTHCOM side of the house from the NORAD, NORTHCOM partnership, that we are able to use and have such a good working relationship with the ladies and gentlemen that work for the Missile Defense Agency and provide us that C2BMC capability that is crucial for real time decision making for our senior leaders.

MAJ Robyn Pigman: And I know I had ten minutes, but-

Mr. John Bier: You were going to talk about your FTG-11.

MAJ Robyn Pigman: Oh that's right. Oh yeah. FTG-11. That was so exciting. So I had the opportunity to be the missile defense officer on duty the day that we did FTG-11 and it was phenomenal.

MAJ Robyn Pigman: There were so many people in our ops floor there to kind of witness it and we had everything up on the screen, so we were seeing real time what was getting ready to happen. And as it got closer and closer, the ops floor got quieter and quieter and quieter until you could hear a pin drop. And then when it was successful it was just a, "Yeah!" I can imagine like the space landing. Yeah. Everybody was high fiving and clapping and hugging and I can only imagine if we weren't so successful, what the reaction would have been like. I would not have wanted to be the MDO on duty that day. But yeah, it was a highly successful test. Everyone was so proud to be a part of ... I was proud to be a part of that experience.

MAJ Robyn Pigman: On the ops floor, we want to do our job, but at the same time, we really don't want to do our jobs. I mean do we really want to be the person testifying in front of Congress saying, "Yeah, we had to push the proverbial button. That was

me that day." So yeah, we're trained to do that, but at the same time, the deterrence that we provide kind of speaks for itself and the success of our ballistic missile defense program. So the GTD 11 was great.

MAJ Robyn Pigman: It was 11.

Mr. John Bier: FTG 11.

MAJ Robyn Pigman: FTG 11. Yeah. So yeah, that was a great experience and I look forward to your questions. Thank you.

Mr. Riki Ellison: Thanks Robyn. Our next speaker, I wanted to bring in a civilian to talk about what's been done at Wall Street. Tony was a former chief financial officer for Virtue, a \$2.5 billion company that is probably the leading stock exchange in the world today. They were the big movers of going from analog to digital and being able to process billions of bits of information in milliseconds to make decisions on from all over the world. Tony also is a former ADA officer, a West Point graduate, and he is on our board. So Tony.

Mr. Tony Manganiello: Great.

Mr. Tony Manganiello: Let me see, is this on? Yes. Okay.

Mr. Tony Manganiello: Well thank you. Thanks for inviting me, Riki. I'm out of the financial firm and with another firm now. I'll explain that here in a second. And I've been down range for a while so I haven't heard this briefing, but I'm very impressed with everything that I've heard in that it mirrors exactly what happened on Wall Street in terms of how we changed from analog trading to electronic trading. I retired from the military in 1998 and started working on Wall Street and with the Y2K experience that was out there. And I was surprised to see when I went into ... because that was both air defense acquisition, went with the range battalion, places like that in the military. So I had a lot of experiences across the military and I go into Wall Street thinking that everything was top-notch and everyone was working on spreadsheets. So it was a spreadsheet based type of organization.

Mr. Tony Manganiello: And the firm that I worked with, Goldman Sachs at the time, a forward looking company and very big on technology said, "Look, we don't want to walk in on January 1st and everybody's spreadsheet that they're going to do trades is going to break." So fortunately for me, my job was to go ahead and go into every single unit at Goldman and pull up everyone's personal spreadsheet that they use for trading and change from a two digit year to a four digit year. Scan it and change it and do all that stuff. Great job, actually, for me in terms of learning what everyone was doing in a big financial firm like that. But that helped us out in this era where we were going from floor based trading to electronic trading because right after the turn of the century was when it started to go ahead and happen.

Mr. Tony Manganiello: So the leadership and the managers started to go ahead and say, "This is what we have to go ahead and do. These are the things that we have to take care of. It's no longer yelling and screaming in a pit. It's going to be done digitally and it's going to be done quick." And the interesting part about the electronic trading phase that we went through in the very beginning was it was really done by a small group of people. It was a small group of individuals, young guys and gals, who got together and they defined the set of principles that we use. Very similar to what I'm hearing today in that you give that software tool and say, "Here's what you have to go ahead and do to go ahead and integrate with us." So it was defining that set to go ahead and say, "If you want to go ahead and trade across exchanges across the globe, here's a set of data principles that you need to go ahead and adhere to, or else you're not going to play the game." If you don't play the game on Wall Street, you with money and you're not ... Why exist? So that the ... It wasn't where everyone can go ahead and do their own thing within their own company, but to go ahead and play in the game, they had to go ahead and follow those data principles. So that was defined by a small group.

Mr. Tony Manganiello: The other thing that that happened was after that, and we saw what's going on, we ... I just want to make sure I don't miss anything. We started ... Another West point graduate said, "You know, the firms are going to need market makers, the electronic firms." So we started an electronic market-making firm and that firm grew to VIRTU Financial, which was trading in over 400 exchanges at one time in 38 countries and 12,000 different financial instruments, diverse financial instruments. Across the globe, we had, I think it turned out to be six hours where you're not trading for the entire time. We do those trades in milliseconds.

Mr. Tony Manganiello: That was done again by adhering to the data principles, the data principles that was set forth in the American environment, in the Americas, I should say, and the European environment and the Asian environment. We had to go ahead and integrate all that together into our own system to go ahead and do the analysis, the data ingestion, the analysis, and then the decision-making across the spectrum to go ahead and make the trades. Before we went public, we had only 145 people across the globe, and we traded more than JP Morgan did in US equities in the day with just those people because of the efficiency and the capacity of the software developers that we use.

Mr. Tony Manganiello: The thing that's interesting that I think is similar, is we put our developers right next to our traders, so our traders, just like you had mentioned before, Sir, you put your developers right next to your traders. It used to be where there were two discrete points, a trader and a developer, and they threw things over the wall. But when you start to go ahead and trade electronically now, the trader starts to go ahead and understand what the development cycle is. The developer starts to understand what the trader needs and does and then they collaborate during that entire day and night. And they fix problems for them. They fix problems short term and they fix problems long term right then and there.

Mr. Tony Manganiello: So that's extremely similar, and that works. That's the only way to go ahead and do that. What happened was a couple of years ago, some of my classmates from the Academy and others who are now flag officers, and anytime they come to New York, they'd want to go in and go and get some good Italian dinner. We'd go ahead and they'd go ahead and take them out, and we'd bring them up to our firm and we'd show them. They said, "Wow, just can't believe what you guys are doing with data in milliseconds. How about how about you come and help us?"

Mr. Tony Manganiello: So we formed a firm, Striveworks. I just recently left the trading firm, and now I work full time on Striveworks, which goes down range and sits next to the user and does data analytics, data science, development to go ahead and help them at the tip of the spear in the problems that they go ahead and have. Very similar to what you guys have done. So pretty impressed with your approach and that's the only way to go ahead and do that. Now we look at certain problems that we have that you are all facing as well.

Mr. Tony Manganiello: One of them is latency and we need to talk about latency because the OPTEMPO of data ingestion and analysis and then decision-making is, with the amount of sensors that are out there, the networks that we go on, and I'm talking now big military across all five domains. That OPTEMPO of data ingestion is much slower than the OPTEMPO of what the battle is. It has to catch up. It's kind of like when I was in Desert Storm and you had the Abrams and the Bradleys able to go 60 miles an hour. But the engineering support that needed to clear the obstacles was going 12, 15 miles an hour, and they always had to go ahead and wait for them to go ahead and catch up.

Mr. Tony Manganiello: Well, what we're experiencing now is, in certain parts of the battle, is the OPTEMPO of that data is, that latency's too slow for the OPTEMPO of the battle that we have to go ahead and fight. It's exasperated in your domain in terms of the speed at which the air picture and the air battle and the missile battle is going to have. It's refreshing to hear that you guys are attacking that and taking care of that problem.

Mr. Tony Manganiello: The other aspect is that we needed to take, and this goes for the trading firm and it goes for the firm that I'm working in now, and I see it's going with the same way we see C2BMC. We need to take an entire system approach. So everyone talked on Wall Street about getting the fiber from New York to Chicago and they'd drill a hole through a mountain that you could go ahead and save a couple of milliseconds, and everybody would go ahead and buy it. We bought a couple of strands of that fiber. Maybe \$5 million or whatever it was. But you know, you made money because you saved a couple of milliseconds.

Mr. Tony Manganiello: What many other people didn't realize is it's the total speed of the entire system, right? It's the hardware that you have. It's the network equipment that you have. It's the algorithms that you have, that you have to go to measure. It's not just that one path that goes back and forth. It's the entire thing. So you need

an entire system approach to go ahead and achieve the speed at which you need to go to again, ingest the data, analyze the data, and then make the decision.

Mr. Tony Manganiello: The other thing that we have to go ahead and battle with and see is that once, now that we have big data, a tremendous amount of data, and we have digital health to go ahead and help us, algorithms that now have the hardware and the computing capacity to go ahead and solve it, we're going to come up with decisions that are not intuitive to the human being. I also sit on the Army Science Board, and one of the things that we discuss is how do we go ahead and get that commander, not for us, for me, former life in the trading world, if we lost money, we'll make money the next day.

Mr. Tony Manganiello: But in battle, we don't want to lose our precious treasure, which is American lives. So how are we going to go ahead and start to go ahead and increase that confidence level in the decisions that are made with the man on the loop, the human on the loop, to go ahead and say, "Hey, this is a decision that doesn't feel, it doesn't kind of feel right to me," and build that confidence of him, that risk management that we have to go to do. That's something that we have to go ahead and think of as we go through, especially command and control systems.

Mr. Tony Manganiello: Let me make sure I hit on everything I wanted to go ahead and talk about. Oh, yeah, the other part of it that I saw that was similar was your ability to go ahead and expand with new sensors and new systems that come on board. That was key to our development about our electronic market-making firm, VIRTU. And it's key to our, what we're doing now with the military down range, both in the Middle East and Pacific and Europe, is that every day on our side, new sensors come available. They have to be integrated into the system. Every day new weapon systems come available. They have to be integrated in the system. So you need ... We needed to go ahead and make sure that in the trading world, new markets come on board, we'd go ahead and go into different countries.

Mr. Tony Manganiello: New financial instruments were being created. We had to have the capacity and the ability to go ahead and put that into the system. Again, adhering to the data principles and adhering to our principles so that we can go ahead and expand and still achieve that latency and that OPTEMPO to go ahead and participate in the battle of the trading floors or the trading exchanges or in the battle on the field. So having the ability to go ahead and do that, the capacity and the flexibility is key. So it was refreshing to go ahead and hear this. I'm pretty impressed with ... It's a good thing you done here, everyone. [crosstalk 00:41:51] the C2BMC.

Mr. Tony Manganiello: I didn't have to take them out to dinner to an Italian meal. So I'm open to any questions about any of the things that I talked about both in the financial world, the trading world and in what we're doing now down range with our soldiers.

- Mr. Riki Ellison: Thanks, Tony. That was great. It was awesome. I'm going to kick it off, and we'll open it up. I'm going to ask the first question. I ask it to you, John. As we move now and putting space discriminators up in space and to some point having a global discrimination constellation up there, who's in charge of the architecture for all of this, that's not only for missile defense, but for other applications? How are you going to be able to bring it down and regional nodes or how does this all get fused together? Is the MDA in charge of this or is it big military or where is that going because you are the best in the world right now, with using those cross domain capabilities, and nobody else seems to have done it like you. So where are we going with it?
- Mr. John Bier: So at least I'll start first with the sensors. So as we know is we want to, we need to what we call keep custody of these hypersonic threats as they come online with the adversary. So we know that we want to go to space. We want to put up multiple satellites up there in space that provide that global custody of hypersonics because obviously they know where the large radars are. You know, those large radars are there for a reason, but there's not enough land to put enough radars out there. So you got to go to space. You go to space and then you want to bring that data down and integrate it with the radar data. But you know, MDA has already has a charter provided by DOD Leadership that's called Integrated Air and Missile Defense Architecture.
- Mr. John Bier: So expanding on that responsibility that's been handed to the Missile Defense Agency, MDA's systems engineering architect is responsible for laying out that architecture that will bring in these multi-domain space sensors that are supporting both the early warning side and also for missile defense. Then C2BMC is the integrating element for missile defense. We'll integrate that data and task those sensors to support this growing mission of ... We started with ballistic missile defense. We're now really the ... We've dropped the B off of ballistic and now focusing in on not only ballistic, but also the hypersonic threats that start off as a ballistic threat but then do their maneuvers and then scream across at hypersonic speeds at lower altitudes than space.
- Mr. John Bier: So you got to be able, you got to be flexible with that architecture that looks at both ballistic and hypersonic threats and then integrate in with also air threats. C2BMC has got that global presence. You were talking, Tony, yo were talking about there must be something. There's a six hour gap out there in the world. So C2BMC has a footprint from the Korean peninsula over into the Middle East. I use a saying, you know, "We're 24/7 across 18 times zones." So that dead zone there in between the middle part of Asia must be similar for Wall Street to missile defense.
- Mr. John Bier: But you have that global environment today. C2BMC is very expandable and we've demonstrated over the, with the support of Congress over the last year, we brought in a unique sensor, integrated it in within 18 months, and it's operational today. So, it's that type of evidence that we've continued to deliver that keeps this program on the forefront.

- Mr. Riki Ellison: Thanks, John. I'd like to open it up to any questions from the audience.
- Dong-Hyun Kim: Good morning, sir. I'm a reporter from Voice of America Korean Service. I was just wondering, unlike Japan, South Korea is not integrated to the missile defense of the United States and while regarding C2BMC, it may be effective. But do you have any concern about the alliance not being integrated to the missile defense of the United States? Also there are recent report that North Korea may not be capable of launching their ICBM on a TEL? How do you assess this recent report?
- Mr. John Bier: So, with regards to the mission for Missile Defense Agency is defense of the homeland, defense of deployed forces, and our friends and allies. So as part of that charter that Congress and DOD has provided the Missile Defense Agency, we're there on the peninsula there, integrating the THAADs that's there, the patriots that's there. We want to prevail to provide. Just like for Major Pigman here, for that common integrated picture for homeland defense there for North America, we also provide that common integrated picture there for United States Forces Korea for both the, for use there by US operators and South Korea and operators there. So it is integrated there in the peninsula and it's again, it's using that common data that's shared and distributed globally.
- Steve Trimble: Hi. Steve Trimble with Aviation Week. You mentioned the F-35 plan, and the missile defense review obviously had called for integrating the sensor and an interceptor capability with the F-35 and ballistic missile defense. I think it also talked about the submitting of something like an implementation plan report within the six months after the review was completed. So is that report complete? Has it been socialized and what is the implementation plan for putting that capability in the F-35?
- Mr. John Bier: So we're still going through those reports and finishing them up and briefing them up to the DOD leadership. But you know, it is ... What we demonstrated in a FTG-11 was again a challenge that within less than six months, that we were able to integrate that platform and track the outbound interceptors that were launched from Vandenberg. We took advantage of F-35 program office's test wing out there at Edwards, you know, able to use them on the West Coast and just turn them around and use them as tracking the outbound GBI interceptors that were launched during that particular mission.
- Mr. John Bier: But those, the reports, as you referenced, the missile defense review asked that several agencies pull together responses to those particular tasks in the MDR. Those are ongoing right now and about to wrap up.
- Steve Trimble: Just if I could very quickly follow up, I mean, is there any details you can say at this point about what sensor isn't? Is it the radars of the EODS and the paths that would be integrated? How would it be integrated and has anybody talked about what the interceptor would be?

Mr. John Bier: Yes. So again, intercept sensor wise, we'd want that ... There's, I won't go into the details, but that's a very sophisticated platform, and we want to take advantage of all sensors on that platform.

Steve Trimble: And the interceptors?

Mr. John Bier: Interceptors are all part of architecture studies. They're ongoing.

Paul Pfahler: Sir, Paul Pfahler with Lockheed Martin. So as you sit here on the 15 year milestone supporting the Warfighter, what would you like your comments or what do you envision your comments will be 10 years from now when you're sitting here at the quarter of a century milestone?

Lt. Gen. (Ret) Trey Obering: Let me take a shot at that. Just like at the time we started fielding C2BMC, we were using the state of the art technology. A lot of that technology was being generated within the defense industry, within the national labs, etc. But that's not the case anymore. I think in 10 years we're going to look back and say, "Oh, my God, we were on the cusp of a revolution in the technology." If you look at just ... I'm sure many of you in here use Uber. The technology in Uber alone, if you apply that to the missile defense mission is incredible. You combine that with artificial intelligence, with a nanosecond technology that's coming out with the commercialization of space, machine learning, I think you're going to see a revolution in the technology, where you're going to see command and control and what I call C2BMC at the edge, where you really are going to be able to operate faster and faster and faster. You're going to be able to sort enormous amounts of data. The F-35 sweeps up enormous amounts of data. That's just one sensor, right?

Lt. Gen. (Ret) Trey Obering: You begin to combine those in ways that we never even thought possible. I think, and that applies to going to space as well. So I think we're going to look back in 10 years and say, "Oh, my gosh, this was an inflection point," as Riki mentioned earlier, and we really are going to go to the next level. And a lot of that technology is coming out of Silicon Valley. In fact, there's a conference right over here at the Reagan Center, Reagan Building this week that's Invidia Artificial Intelligence Conference, where they're talking about some of that capability. Of course, they came out of the gaming industry. So we're turning around looking at who would think coming out of gaming industry you'd be able to apply other than just, you know, like warfighter training, but the actual technology embedded in that now can revolutionize what we're doing in the defense systems.

Mr. Tony Manganiello: Now if I could-

Mr. John Bier: Go ahead, [Tony].

Mr. Tony Manganiello: Oh, sure. I think I got this on. Two things about that and I completely agree, sir, about the computing or let's call it "AI at the edge," if you want to call that as

just using another buzzword. It's going to, but it's going to allow ... There's going to be two things that we have to worry about and we see this in the finance community. I see this in the ground-based units that we support now is you're going to have to start, we're going to have to go ahead and make sure that we understand the tiering of what decisions can be made at those different tiers at the edge, at the cloud, let's say, and then the fog in between, right? Battalion brigade and division level. And what data it gets passed up and what metadata gets passed up and down. And then what's the speed at which they can go ahead and do that.

Mr. Tony Manganiello: So that has to be built into the architecture that we have to go ahead and do. Just very similar to what we were doing and the different exchanges around the world and the trades that we were making. One for, you know, you trade oil in one part of the country and you trade oil equities and another part of the country, and you trade oil futures somewhere else. You do a lot of ... so you have to go ahead and mix all that up. That's number one. Number two, the thing that we have to also go ahead and think about and battle with is what happens when we fight in a degraded communications environment?

Mr. John Bier: Right.

Mr. Tony Manganiello: The communications go down and then the communications come back up. You experience that again back in the trading community. You go ahead and lose connection with a couple of exchanges that you had some trades in, and then it could be milliseconds. It could be a minute. You have to go ahead and then reconstitute your situational awareness. That in terms of having a lot of data, a lot of sensors coming in there and then marrying that back up. Hey, I was tracking that particular target and it was over here, and now I don't see it at all. Was it destroyed? Where is it? How can I go ahead and go and find it? So the reconstitution of your situational awareness in a degraded environment is a challenge, especially when you're, we're now have computing and decision-making along the edge of the fog in the cloud. So these are things that we have to go ahead and worry about.

Mr. John Bier: So one of the things that C2BMC is responsible for is what's called the BMDS communication node. So that's ... You're going through your fiber stories there on Wall Street. Our biggest threat for day to day operational availability is the Tracko, right? They go out there, they dig and they dig a fiber.

Mr. Tony Manganiello: Yeah. That's right.

Mr. John Bier: But we partner with the defense information system agencies, better known as DISA. They provide our long haul comm, and we do that just because they have the entire global defense infrastructure there for fiber. Through them, they can reroute systems. Tony, we do ... You know, for us, we have to have that redundancy diversity, and then we also get into, we also want at our larger

locations that are more critical assets who would bring in space communication. It's through that diversity that this program's responsible for, is eye opening.

Mr. John Bier: We did a test last December where we used the C2BMC mission node over in Europe located at Ramstein with the 10th AAMDC sensor army sensor managers controlling a radar that was located on Wake Island as this air launch target in the Middle Pacific was flying towards Hawaii. So we took the data from the ... on Wake Island, sent it all the way back to Europe, and then sent it all the way back to Hawaii where the Aegis Ashore site was located. We're doing this as part of our claiming flight test for EPA[A] phase three. You know, where we do the, what's called that Aegis "engage on remote," where we get that large increase in defended area. But that speed of data is important, but when you're reaching across three quarters of the globe and executing this mission, data is timely. Microseconds and milliseconds is dollars in your world. For us, it's getting that data in the right place at the right time for those weapons to engage.

Mr. Riki Ellison: Clay.

Clay Davis: Hey, good morning. I'm Clay Davis, ASRC Federal and former C2MBC alum. It's basically like the technology we're talking about, and as it pertains to planning, obviously the services, COCOMs, different elements of the BMDS or MDS, a lot of different planning systems. Certainly the ability to try to integrate those been timed along server locations. But where is the program as you see it to try to really, again, take advantage of a lot of the current emerging technologies to get a more integrated, real time interactive planning system that it can be more responsive and reduce the long planning cycles and really be more reactive to the battle as it may play out in real time?

Mr. John Bier: Right. So, Clay, as we have the planner that serves as the strategic planner for either for the COCOM, so that planner will begin. Set the assets, locate those assets where they should be in the respect of area of responsibility for each of the COCOMs. We're now working to go back and connect down to the lower levels, down to the Aegis planners, to the THAAD planners, to the army's planners as they roll out their next generation of command and control. But we've got to do that. We got to connect them with standard interfaces, and then have that ability to transmit those plans back and forth so that, it's only those tactical units know that, wait a minute, that's a swamp. He can't put me there. Or you got to move me over here, where I can operate this ship.

Mr. John Bier: So those, we are continuing to evolve that. Our planners are becoming more flexible, more agile as we bring in again, and we need to be, as we bring in more and more sensors. We can't wait five years for the next version of a planner to be fielded. We got to be flexible and bring those capabilities in earlier.

Lt. Gen. (Ret) Trey Obering: Hey, Riki. Can I give a war story?

Mr. Riki Ellison: Go ahead.

Lt. Gen. (Ret) Trey Obering: Okay. What it reminded me that when you field C2BMC capability, it's got to be flexible, and it's got to be adaptive. When we were in the middle of Iraq, Operation Iraqi Freedom, the army, as they were marching on Baghdad, they had never envisioned moving the patriots as quickly as they were. They were having to actually having to reach back to us at MDA to give them planning information for them to be able to locate their systems to optimum against the [inaudible 00:59:01] missiles and everything they were facing. So it's a key part of C2BMC is it's got to be flexible and adaptable to adapt to a very changing situation.

Mr. Riki Ellison: Hey, John, and Trey. The capacity growth that you may get as being executive agent for Integrated Air and Missile Defense is tremendous. That's going across all services, just on cruise missile defense, let alone the future of what's going to happen in space. How are we processing all this information? We've taken the DAF codes out, we've take a human decision-making out of this now with this kind of volume. If you add in directed energy, is that just another weapon? Does that complicate the whole issue and how do you bring it down to a single Warfighter, wherever he is in the world to do this?

Mr. John Bier: So obviously as the processing improves year after year, the capability and you move from just iron clad processors to more of a virtual environment, that that allows you to further expand the capability. But it goes back to you TTPs, techniques, tactics and procedures, and it depends on that AOR. Certain AOR's, you have the minutes to make those human in the loop decisions. Some AOR's, you have seconds. Those are practiced using proper training devices and exercise through several planned exercises, to where the warfighter then knows what he can hand over to the machines to make those decisions as you get into automated battle engagements and directed engagements. Or you have to, if there's not going to be enough time for a weapons release when you look into in some of the CENTCOM AOR and EUCOM AOR, those get handed down to the lower level commanders to where they can make those decisions based on their prior exercise TTPs.

Mr. John Bier: But when you get into a mass raid, then you got to get into where you got to turn it over to the system, let the system take the most optimized trajectories and try to ratchet those back as you try to handle fight through that raid. Well, maybe Major, you can talk a little bit about how you guys exercise those TTPs.

MAJ Robyn Pigman: So one of the responsibilities that I've had in the past is training and educating our senior leaders on the C2BMC itself, what they're seeing, what kind of information that they can get from the system to help them make their informed decisions. Like we talked, like we just talked about, you may have minutes and you never, never really know how long. So we do this daily. So the senior leaders don't always participate, but they have a requirement to participate fairly often. But from a crew perspective, daily, we exercise our TTPs and we display our C2BMC for everyone on the Ops Floor to see.

MAJ Robyn Pigman: So when we are doing these exercise runs, everybody on floor has a situational awareness of what's going on in missile defense, ground-based midcourse defense, for our purposes. So everybody has a really good understanding from a C2BMC perspective, of what we bring to the fight when it comes to homeland defense. We do that every single day, every single crew. So oftentimes, our senior leaders will participate in that and they'll do it from different locations to exercise our backbone, our communications capability and our architecture just to make sure that everything that we are doing is simulating something that might actually happen real time. You know, even in the military, you train as you fight and that's what we try to do every single day.

Lt. Gen. (Ret) Trey Obering: So, Ricky, let me add just a few things, a couple of things. Number one, do I believe ... One of your questions was are humans going to be in the loop? The answer to me is humans will always be in the loop for the command decision. As John alluded to, there's a lot of the tactical, controller tactical decisions that machines can actually make. In fact today, the systems that we have, typically the human enables the system and then the system reacts autonomously to the threats. It takes the optimum shots. In fact, in our testing, our flight testing, we actually sub-optimize that because of in-safety procedures, we have to shrink down what the parameters that the system can take the shot in for in-safety. So we're actually making it harder for the system than it would be in a normal operational mode. For the near term, in terms of artificial intelligence, I don't believe that... There is an issue with... Technology is great, but it also has its challenges.

Lt. Gen. (Ret) Trey Obering: So one issue right now we have with AI is, we cannot replicate why it made a decision. We can't do that, so think about that. If there's a forensics that has to be done for an accident, if you told that AI take care of everything, we can't go back and figure out why it made the decision it made. So I think for that reason and that reason only, you're not going to see it in real-time fire control.

Lt. Gen. (Ret) Trey Obering: What it can do is enable the warfighter, especially you mentioned direct energy systems. Directed energy systems are very different than kinetic weapons, because their ranges typically are much longer. And so figuring out on a modern battlefield, where you could have clear fields of fire, with all the amount of things that are going on, that is perfect for AI. That's something AI can enable a tactical decision aid for the warfighter, say, "Yes you can take the shot," or "Wait till now," or that kind of thing. Those are the things. But actually having the AI say, "I will take the shot." I think we're quite a ways away from that.

Mr. Riki Ellison: Okay. Go ahead.

Mr. Garrett Peterson: Yeah, I'm from office of Congresswoman Jackie Walorski back here, and so I just had a question, I'm not too familiar with this topic, but are you guys hoping to get like probabilities back for people on like multiple decisions to be made, like different routes or opportunities? What do you guys see that as like kind of

going on, based off your AI. Is there a certain amounts of probability you guys want to see in order to make a decision that you're hoping to get back from the system? Or is it more just like a yes, no. Have you guys kind of explain on that a little bit? I'd appreciate that. Thank you.

Mr. John Bier: So yes, probability of... What we call probability of engagement is a key factor that the war fighter looks for us to generate. You know, based on, you know that goes into your setup of your defense design. So you'll set up your defense design, they'll set those parameters up that you'll accept this, you know, this particular engagement capability with these particular weapons for interceptors, and sensors in that distributed environment.

Mr. John Bier: But then we, we look at... As the battle unfolds and that's when one key thing is that C2BMC is that system, that monitors and directs that battle as it's going on, and it gives you those probabilities of, you know from my original defense design that I should've picked up this particular threat by now. And then it has its pre predicted sensor coverage, and then actually when the real sensor data comes in, it puts it on top of that predicted line. And so that's... You see how how tight you are relative to the original defense design. But no, we... As part of their pre-planning, the warfighter uses probability of engagement success, of quite heavily as a plan. How many shots should be taken, this particular threat from this particular country.

Steve Traver: I'm Steve Traver. I'm retired congressional staff. I was fortunate enough to be at a briefing... I'm just going to stand up here. Briefing this morning from Air Force Chief of Staff. And General Goldfein gave us a couple of charts. First one was the now annual bleed chart of what happens with the CR [Continuing Resolution]. For the air force, it's \$12 billion down the drain next year if we have a full time CR.

Steve Traver: Which leads me to ask you guys from a process standpoint, particularly with battle management... Oh actually, the other good news was kind of... Riki you start off by alerting everybody to the fact that battle management as it applies to a cruise missile defense, is sort of the long pole in the tent, and the other tasker, that's on John now, is incorporating new space sensors and stuff. The good news for you guys is number one and number two on the General Goldfein's list is battle management in space.

Steve Traver: So that's top priority for the Air Force which... But the connectivity with the CR, and the 12 billion down the drain is we're going to have to go through another one of these exercises. And my question is about the coordination now, between MDA and the services, with regard to setting priorities. With regard to keep this going at 100%, and taking it out of this program's hide. Within BMDO, where... BMDO boy am I going ancient.

Steve Traver: Well, you were the one that said, you know you're the one that started it. How is the oversight now with regard to telling you your battle management work

has to be coordinated with the battle management work being done over here, and the battle management... If you guys decide to slow yours down, it affects everybody else, but you don't want to screw up a production line, you know the whole exercise there.

Steve Traver: How in OSD right now, are they providing you with guidance, with regard to, let's just focused on the battle management, making sure that you don't mess up a schedule for everybody else. And we're sorry you're going to have to screw up this contract over here, but who's making those decisions for you?

Steve Traver: So that in Congress we can ask the person who told you to do that, how they went about making that decision.

Mr. John Bier: So is MDA that has talked earlier, being responsible for the integrated air and missile defense architecture. We put in these hooks as we develop a program that says, we want to interface with this particular next version of capability, but we also put it in requirements that we have to be backwards compatible. So in the event that that scenario happens, where one's moving forward, and the other one is held back for, you know, whether it's funding, whether it's development challenges or fielding decisions or so forth like that, we always have to have that backwards compatibility to allow one program to move forward, and that's part of that charter.

Mr. John Bier: Also, you know that the MDA works with the, with the three services, with the services, Air Force, Army and Navy, as part of that the charter that was given to us. Then we get our top level requirements through STRATCOM today, through what's called the warfighter improvement program process, where they give us every year the priorities of where they want us to go, and then MDA responds back to them how we're acquiring those capabilities.

Lt. Gen. (Ret) Trey Obering: And what I'll add Steven, I enjoyed working with you when you were on the Hill that was a pleasure actually. I can't say that of everybody I've worked with on the hill. The other thing that we did that... We set up services boards of directors in MDA, and I think they're still doing, they're still doing that today.

Mr. John Bier: We still use those today.

Lt. Gen. (Ret) Trey Obering: I would have a meeting with the acquisition executive for the air force, the acquisition executive for the army, the acquisition executive for the navy. They would have their staffs there, I'd have my staff there. And we would work through issues, just like you described about looking at the programs. Because even back then, while we were not as tightly integrated as we will be with an integrated air and missile defense structure, we still had dual use sensors. For example, the radars in California, and Alaska, and United Kingdom in Thule Greenland.

Lt. Gen. (Ret) Trey Obering: Those were dual use radars, they were used for missile warning as well as missile defense. Which, that was, missile warning was an air force mission. So we had to tightly couple the development of the software packages from both of those missions to make sure that we weren't tripping over each other. So that's what we use those services, boards of directors for.

Mr. Riki Ellison: Go ahead.

Mr. Tony Manganiello: No, I know you were going to ask.

Mr. Riki Ellison: I was going to ask it. No, go ahead-

Mr. Tony Manganiello: I was going to... I wanted to just make a comment on probabilities to the gentleman that was talking about that. Because in both worlds that I'm in, first the financial world, and now with the going downrange, we are talking about risk management. Sometimes a user or the person who holds the purse strings, doesn't really understand that. When you go ahead and say, okay. You know when you're dealing with it, artificial intelligence, you're dealing with... How many false positives are you willing to go ahead and accept, and how many false negatives are you willing to accept?

Mr. Tony Manganiello: How are you going to go ahead and manage that risk? And that debate goes on back and forth, and our users who define the requirements, and the people who hold the purse strings, need to go ahead and get into the arena as we did in the financial community in terms of am I a risk averse person, and how much money am I willing to go ahead and risk in this trade, or not? That's a discussion that goes on all the time down in the financial industry, and it should go on.

Mr. Tony Manganiello: It should go on now at all levels in terms of... I think the statistic is 95% of car accidents, fatalities, are human error. So what's that probability that you're willing to go ahead and accept for an automated car, for maybe only gets down to 20%. Is everybody okay with that, or do we want to go ahead and keep on? Because lowering that probability to 0% is going to affect cost, schedule, and scope of the project that you're going to go ahead and have.

Mr. Tony Manganiello: But we never have that discussion about what's from the requirements generator, in terms of what are they willing to go ahead and accept in a situation like that? I would say 20% is okay, I mean 75% of those people won't die. Right? But maybe somebody turns around and says 10%. So that debate needs to happen, in terms of what are we going to be willing to accept in different types of combat environments. A full blown war, something against a non-state actor, those kind of things.

Mr. Garrett Peterson: So this is something we want to like integrate into the system, the human choice of probability, as what to accept.

Mr. Tony Manganiello: I'm sorry. Was that a question?

Mr. Garrett Peterson: Yeah. So yeah, so going off this probability, and using the system, we want. It's going to be human choice as what we choose, as the probability that the system uses as the cutoff. Does that make sense?

Mr. John Bier: Yeah, it is. We use probability, and we use what's called a digital environment. A models and sim environment, to run those many millions of cases in trajectories, and off off axis engagements, that help build the confidence that we use when we go through what's called a a capability declaration decision.

Mr. John Bier: Then when we hand over a capability over to the warfighter. So it's that we use that probability of success, that we generate from, when we say take all threats from any particular area, or all areas, and what combination of sensors and shooters and command and control capabilities. That's how we apply that probability in our world.

Mr. Riki Ellison: I wanted to ask one question here. This C2BMC is very complex, and we own it. We're never going to, I don't think, fight a war without allies. They have their own defense designs. We have our own defense designs. There's foreign disclosure issues. How do we truly leverage those assets from our allies that could fit into this, without jeopardizing our security? Or are we going to just bilateral, give them information of what's coming and hope they do their own defense design on its own.

Mr. Riki Ellison: What's the future, John and Trey, of where we're going to bring our allies into the fight? Whether it's in NATO, or Japan, or Korea, bilateral. How you bring them into this circle, C2BMC?

Mr. John Bier: Well Riki there is misconception there. We are integrated today with Israel, NATO, Japan, you know. Those through through C2BMC. So we exchange that data, and yes those were bilateral agreements worked between state, you know, OSD and the COCOM you know, on the data transfer. But we use their data also. That's up to C2BMC to correlate that data, and then provide that to that common picture out.

Mr. John Bier: So as we move forward, we're looking for the other countries that contribute to... That's the, and they are-

Mr. Riki Ellison: Whats the best things that they can contribute to you? Giving you more sensory capability or, is your shooter thing out, or... What for a foreign country to better play with us, or we play with them better, what's the...

Mr. John Bier: It's a little bit of both. It's a little bit dependent upon the AOR. So you'd have to look between the PACOM, EUCOM, and CENTCOM architectures. But obviously the key is you're always sensor poor, right? So that's the first capability we'd want to take on. Several of our foreign partners have Patriot today. They're starting to... UAE has THAAD today. Saudi Arabia is buying THAAD systems also.

So as as as those systems are deployed and stood up, then we want to take advantage of that data also to cover those particularly large COCOMs.

Mr. Riki Ellison: And we're just going to fault... So the fire control decisions for those countries are on their own. Would we give them fire control decision, or just data?

Mr. John Bier: Well that's worked out relative to the local COCOMs. We go through deliberate exercises with those countries, in those AORs to work out those tactics and procedures to take advantage of the additional firepower.

Mr. Riki Ellison: And there's a lot of growth in that.

Mr. John Bier: Definitely. Definitely a lot of growth in the contributions of our foreign partners.

Speaker 2: Hi. [Inaudible], a consultant at origin, former chief scientist for defense intelligence. I'm just wondering, is there a worst case operational rate environment, in which you are designing to defeat? Or are you just trying to do the very best that the technology will allow at the moment? Or both?

Mr. John Bier: It's both, and as General Obering will testify that we have an engineering group that wants to break us, right? We want to break it, the system, before we field it. As we go through a series of... I talked a little bit earlier about digital, you know models and simulations. We get into, before we field a missile defense capability, we'll take it through a series of ground tests. And this ground test series may take up to 18 months or so, to actually go through. But there's where we just overload... We're trying to load the system up, load the sensors up, load the communications up, the processing. To where we know where the knee in the curve is on this particular capability that we're going to field in the future.

Mr. John Bier: Then we take all that data, and you go through the analysis, and we provide the warfighter capabilities and limitations. This is what the integrated system can perform, and then they use that in building their future tactics and techniques.

Lt. Gen. (Ret) Trey Obering: Now think about the challenge there. Because remember at the beginning when I talked about a shot cutting across the different COCOMs? Think about the modeling challenge there. So you're going to start not just one missile, but many many missiles being launched. You're going to model the environments, you're going to model the sensor characteristics, and you're going to have to be compatible between the models, both for GMD, as well as C2B, or as well as Aegis, et cetera, and that's what John's referring to. They're very rigorous modeling and simulation that we do, to stress the system to see where it breaks and how it breaks, and that type of thing.

Speaker 2: I'll take it offline.

Lt. Gen. (Ret) Trey Obering: Okay.

- Harris Fried: Good morning, my name is Harris Fried, Citadel Analytics. We've discussed broadly integration, and I'm just curious about one thing that we see happening in real time. More a matter of disintegration if you will. I know question's a little political, but with regard to Turkey, and being in NATO, and buying modern weapons systems from Russia, how does that sort of correlate with the idea of integration?
- Mr. John Bier: So as these, the COCOMs work with their respective countries, they'll bring that capability into discussions. And then we'll... US government will step in, and from the engineering, from the integration sides, and see if there's improvements in capabilities and look at those weapons that are available.
- Mr. John Bier: There's obviously... I'm not going to touch on the Turkey example you gave, but if it is a capability that expands the missile defense capability then we'll set up that, what we call an interface control document with those particular weapon systems. That's how we manage the capabilities between US government, and a foreign participant.
- CPT Laura Cannon: Morning. Captain Laura Cannon, I'm a defense fellow with Senator Schatz and an air defender by trade. Just wondering what's next on the schedule for you? Whether it's a joint exercise, bilateral integration, anything you can share with us regarding flight tests, anything to that matter.
- Mr. John Bier: So we just came off the FTG-11. Big test back in March, this past March. We have future tests that will be coming up there in the Pacific, more the... We're doing a lot of THAAD, Patriot advanced integration right now. Those series of flight tests are ongoing. Those fill up most of the next of this FY-20 window, is with more THAAD and Patriot engagements and Aegis. You know, filling in some of their battlespace with additional shots.
- Steve Trimble: Hi, Steve Trimble, with Aviation Week again. I just wanted to follow up on that [inaudible 01:24:28] question, because I want to make sure I understand properly. I mean, is there any scenario where an ally or a foreign partner with an S-400 type system, or S-300. I guess Greece might be an example there, could integrate into C2BMC, or is that, just too much?
- Mr. John Bier: Right now we're not looking at any of those integrations.
- Dong-Hyun Kim: Quick question. You talked about the real time latency, being judgment. The timings real important, and South Korea and Japan is right now on the negotiation with whether to extend GSOMIA or not. You know? How do you see that, although on missile defense capability? Do you think that South Korea extending GSOMIA with Japan is effective?
- Mr. John Bier: I'm not going to get into that discussion, but that's worked with the US Forces Korea, and US Forces Japan.

- Mr. Riki Ellison: All right, you got one more?
- Steve Traver: One more. One of the really tough nuts we are trying to understand now is defense of Taiwan, and one of the things about Taiwan is that one's a knife fight. Hundreds of miles, not thousands of miles. A particular problem related to the BMCQ, for us, is that because of political restrictions, we can't play with Taiwan very much, and in very much detail.
- Steve Traver: So if that worst case situation were to happen, that's going to be a come as you are fight. Does the effort with regard to designing our integrated BMCQ system incorporate the flexibility, so that if we're put into a situation where we, and this also applies to India case, other ones that we're looking at. And we're put into a situation where all of a sudden the tasking is go help and do the best you can, do we practice that much where we're just going in with the BMCQ system that we've got. It's not integrated with anything else, but we're protecting a bunch of people, and it's a high priority to do the best we can.
- Steve Traver: So in other sort of, that sort of come as you are situation, is that something we've been tasked to start looking at how to use this system in that kind of scenario.
- Mr. John Bier: Several of our partners use a US NATO approved standard called Link 16, Yar 3011 we have various standards. But in the event that country X is wanting to be integrated in, because of a particular increase in threat, and so forth like that. We turn it over to the local [Jiccos 01:27:56], which are these phenomenal individuals that will take a comms from over here, and a comms from over here, and combine those two together, to get that power of integration. Now of course we got to work through the data that this particular country X is producing.
- Mr. John Bier: But then we would go back into our laboratories, and see if we need to put a translator in between those two connections, or we need to a that's unique for that interface to take advantage of that data that they publish, or if it's a standard that's common between the two, then that's a little bit of an easier integration.
- Mr. John Bier: But we use our laboratories like that, to do that rapid integration in testing, to understand the capability there, It's the men and women that make these Jiccos up around the globe that are just phenomenal, on what data they can bring in for us when they need to.
- Steve Traver: And you're tasked to practice exercises like that periodically?
- Mr. John Bier: Periodically, yes. We do that in our test environments, and there's more in our exercises that we set up for the COCOMs.

Lt. Gen. (Ret) Trey Obering: Okay. I'd like to make one final point if I may. And just to take advantage of where we're sitting. C2BMC would not be here. Missile defense would not be here. We would not have any of the capabilities we have today, had we followed some of the wrong leadership on the hill here.

Lt. Gen. (Ret) Trey Obering: There were people back in the early two thousands that fought tooth and nail to put any missile defense out in our warfighters. Tooth and nail. It was a knife fight, as you said. And thank God we didn't listen to them, and thank God we followed the path that we're on.

Lt. Gen. (Ret) Trey Obering: Because that's what we're wrestling with today. As you look forward, what decisions are being made right now today, in this area, that are going to affect what we can do 10 years from now? I think it's very important as Americans, we remember that.

Mr. Riki Ellison: Thanks Trey. I'd like each of you... That's your statement, Trey?

Lt. Gen. (Ret) Trey Obering: That's my statement, yep.

Mr. Riki Ellison: Just a real quick summary of today's discussions, if you could just give us a couple words.

Mr. John Bier: Sure, sure. I'll pick it up here Ricky. But no, it's been great. Thanks for attending today. And C2BMC is a very complicated system. It doesn't have the big flash and bang, right? As I've transitioned over my years from close combat weapons, tactical weapons, army side, THAAD and GMD, and now C2BMC. It's that integrating element, and I use a cliché. It's the brains of the system.

Mr. John Bier: So I mean, think about it. You got your sensors are your eyes, your hands are your weapons, but up here that cranial... behind that is your brain, and that brain, you train that brain, and you exercise that brain, and that's where you get your improvement. And that's where the return on investment for missile defense is in the future. Is now taking advantage of all the data that's available, and use it in a smart manner. So I appreciate the support that Congress has for C2BMC over the years, and looking forward to continue to partner in our future capability.

Mr. Riki Ellison: Thanks John, Major Pigman.

MAJ Robyn Pigman: Well even though no one had a question for me, I think I'm very glad that I was able to come here. We just mentioned that, you know, C2BMC isn't the flash bang, and my Colonel told me I couldn't make any kind of sound effects, so I'll spare you the sound effects even though I really want to. But C2BMC provides us additional radar capability into our architecture that we would not have when it comes to ground-based midcourse defense.

MAJ Robyn Pigman: It's also that a really important tool, that visual that allows the senior leaders to really visualize what's going on when it comes to protection of the homeland from a threat missile, from a threat country. So it's very important, and if you've ever seen it, it's pretty flashy. So I don't know why you don't give yourself enough credit for the flash bang. But it's a good tool, and we appreciate having it in our command center.

Mr. Tony Manganiello: So we were able to go ahead and change the world in terms of trading to go from floor based trading, to electronic trading, and trading in milliseconds. It's actually unethical, if you took grandma's money and you called in down to the floor to go ahead and make a trade because she'd be losing a lot of money in the milliseconds that would go ahead and pass by.

Mr. Tony Manganiello: We were able to do that from establishing standards and principles, and compromise and working together across various countries, various agencies within the trading environment to go ahead and do that, and coming up with a solution that you're able to trade any instrument across any domain, given that you abide by those things.

Mr. Tony Manganiello: We need to go ahead and do that now, we talked a lot about integration. We need to go ahead and have the integration, really of all the parties involved.

Mr. Tony Manganiello: The purse holders, the Congress that needs to understand, the military leaders need to go ahead and not say, "Well you know, I'm just the, I'm just a soldier who carries a pack and I really don't understand any of this technology. You guys go ahead and figure it out." And of course our partners in industry, who are providing the great technology to go ahead and show them what they can go ahead and do and how quickly they can go in and get to it.

Mr. Tony Manganiello: So that integration has to go ahead and happen. And I think it's happening here in this particular case, and you see that, but it has to continue as the technology gets faster, and the world gets more complex, and the battle gets more dangerous. So I think, I think we're on a good path here.

Mr. Riki Ellison: Yeah, thanks Tony. A great interest in C2BMC. I didn't think it was going to be this interesting and great participation. But guys, ladies and gentlemen, C2BMC is going to lead missile defense. Not the fancy sensor, not the the new bullet, not the directed energy. C2BMC is leading it to a new environment, a new way to look at our missile defense capabilities.

Mr. Riki Ellison: That's what's forced expansion of MDA, is forcing expansion of MDA, and of cruise missile defense, hypersonic and space. It's not the weapons they got, it's the brains they got, and that's where we're heading. That we've got, I think the biggest thing, and they'll get it, besides the AI that's going to process, is being able to make this able for our allies, so we can leverage all of their capabilities, and we're not leveraging those yet today.

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Mr. Riki Ellison: But the future is phenomenal for this, and you should be getting the best and the brightest in this mission. So thank you very much for attending. We're off to Asia next week and we'll be back. But we really appreciate your insight, your willingness to be educated on this very complex subject.

Mr. Riki Ellison: Thank you very much.

ENDS [01:35:11]