Virtual CRT: Threats/Opportunities in Near/Border Space for Terrestrial Operations, Friday 22 May

Good morning and good afternoon from a beautiful sunny day in May in Tucson, Arizona at the campus of the University of Arizona in the prelude of Memorial Weekend. I am Riki Ellison. I am the founder and chairman of the Missile Defense Advocacy Alliance.

It's an alliance that we formed in 2002 after 911, and I have been involved with missile defense since 1978. This is our 101st congressional roundtable, and it is very appropriate that it is near Memorial Day, since we are here at the University of Arizona-where there is a memorial of the ship at Pearl Harbor and the anchors of that ship are in this university. It is appropriate that this act is something we as a nation have come very close with what happened in Epic Fury, with what happened to our bases forward that had adversary capabilities come in undefended, undetected, and took out billions and billions of dollars of our radars, our planes, and our bases, but most importantly some of our soldiers. And so, we recognize that.

We are here to discuss the future that's coming upon us right now with mass automated drones we are seeing employed, and it's real. Last week, Russia fired a couple thousand in a night or two at Kiev and Ukraine. This is just the biggest amount ever fired over the last three years.

This is a real problem, and not one of our cities, not one including Washington DC, not one of our bases, not one of our forward operating bases can defend against an attack that just happened of thousands of systems coming into Ukraine. We have to get this solution correct, and when you're looking at mass you've got to look at other ways of detecting it, of being able to negate it, and most of all, being able to coordinate and share data, share data across all agencies, all nations, and your allies, and to be able to do it outside of the baseline, to be able to have no gaps. So we are here at this center, at this university, where innovation happens for our 101st virtual roundtable on threats and opportunities for near space and border space for terrestrial operations.

We are bringing in experts to help us evolve this discussion going forward. I'm very honored to have two of our Board Members here, and I'm honored to have the Dean of Engineering for Arizona with us. And I think we start with the advanced technologies, and there's no one better on this topic than Shotgun Browning from my perspective, given his ability to articulate what those challenges are.

But for everyone that does not know, that's his nickname as a fighter pilot, F-15 pilot, he served as the Deputy Chief Technology Officer for mission capabilities for the Department of Defense and following transition of his position, he performed the duties of the first ever Assistant Secretary of Defense for Mission Capabilities, responsible for maintaining U.S. technology superiority through the rapid transition of new technologies and military capabilities. I mean, there's no one better or more qualified than Shotgun on that. So we're honored to have you.

He's, he's living across from us in New Mexico. Great friend, great person, and a great leader. Shotgun, it's all yours.

Shotgun: Hey Riki, appreciate the opportunity to join and even more so the opportunity to be part of this team with the University of Arizona to move all of this forward. I'm actually going to give at least the opening remarks, I'm going to wander through a few maybe more strategic questions than necessarily immediately before getting into the technical part. And I'm going to start, you started with threat, so I'm going to start with threat as well.

And I think if, if Ukraine-Russia conflict has shown us nothing else, it's shown us that what used to be the realm of very highly funded nation-states, meaning very long range, very precise, very lethal ordnance is no longer a fact. And the reality is that any nation-state can afford very long range, very accurate weapons to impose pain on somebody else. So probably point number one is, you know, the problem we're facing is the fact that with relatively modest resources, Russia can send literally thousands of, of weapons against another nation at one time.

But so could Al-Qaeda, so could a cartel. And so the first thing I'd like to say, and Riki's heard me beat this drum alot, is that if we do homeland defense, if we are looking for securing our border, and we try to separate that which is military and that which is counterterrorism, and that which is counter-criminal, we are going to make a mistake. Because when that thing is coming across the border, it doesn't give a crap whether we think it's a terrorist or a criminal or another nation-state.

And so we've got to figure out a way in our nation to preserve human, preserve, you know, the privacy of our citizens, to keep a free and open society, but at the same time, be able to, as a military, leverage law enforcement tools, and as law enforcement leverage military tools, or there's going to be holes in this sieve that we are just not going to be able to plug. So that's kind of number one, is I'd love to make this a real simple military problem. It just is not.

And it's because we live in a free society. And I'm really excited about that. But technology has advanced to the point where I think we can address those problems as opposed to having a solid brick wall between the two.

Number two is, you know, again, I would love to just focus on sensing. But one of the most important things I learned, looking at real complex problems about this, is when you break the problem down into individual parts and have different entities and different organizations work on those individual parts, it doesn't come together anymore. Technology has just advanced too quickly.

And the speed with which you need to make decisions against an adversary is very rapid. Great friend of mine, Dr. Jim Galambos came up with something that we call the rubric. And no matter which part you're looking at it, you need to think of it this way.

And that is that any kill chain, kill web, however you want to look at it, has to be built on a common architecture of three things. And that's command and control; communications; position, navigation, and timing. And then you need to have integrated weapons, platforms, and sensors that you plug into the architecture.

So as much as I'd love to talk sensors without talking C2, if those sensors don't feed the C2, if that C2 does not direct those sensors, you're lost. Love to talk about weapons alone. If those weapons cannot be commanded by the right leader, if those weapons can't leverage the right sensor, we're out of there.

And by the way, if the bad guy denies GPS, or the bad guy takes away our ability to communicate, we're out of there. It all needs to be one intertwined rubric, if you will, of weapons, sensors, and platforms that leverage communications, battle management, command and control, and position navigation, and timing. You know, a joke that we had, that I think is real important when you think about sensing is “perfect surveillance never killed anybody.”

So back to your Pearl Harbor idea. If on Pearl Harbor, we had invented the radar, and we had ubiquitous satellites, and we watched the Japanese come, and we were not prepared to do anything about it. We're just Howard Cosell talking about a football game.

Sensing is really important, sensing by itself is absolutely insufficient. Okay, so let me get to the tech part. And I'll try to get through this pretty quick.

But on the sensing part, we need to cheat like hell. I know we're talking near space, specifically on part of this. But we need to leverage it all.

I need to leverage terrestrial, I need to leverage airborne, I need to leverage near space, I need to leverage space. Those all need to be in the same comprehensive system, talking to each other, synchronizing with each other. And, you know, fused with each other, I can't have different entities, running and command and controlling different sensing modalities, and then try to tie those all together.

And don't forget the information domain, I think, to a very large degree, we're learning more and more that the first person who sees bad action might actually be somebody who's sending their friends, you know, a post on Twitter. Understanding how to leverage that information domain in synchronization with the more traditional sensing modalities is real important. As we go to platforms, I do think near space walks you into balloons, and balloons, I think are an underappreciated opportunity.

We have many, many studies in the past that show as you get up to the higher altitudes, you can do an pretty amazing job with station keeping on very long endurance balloons. It's not, you're not stuck with purely tethered. Tethered is an awesome opportunity because it removes your power challenges.

And which is probably the most important weight and power challenges. But do include and think about untethered aerostats, untethered balloons. Over a year, am I going to station keep? No.

But if I have some sort of indications and warning a week to a month, being able to station it in one area to do persistent sensing is absolutely within the realm of high-altitude balloons today. That also walks you into high altitude, long endurance unmanned vehicles. We have solar vehicles, as you know, because of great battery storage can stay up there pretty much forever.

Now that doesn't mean that they have a whole lot of excess energy. I've got an energy problem for my sensors and for my communications. But don't think that balloons are the only answer.

I think there's a lot of interesting concepts for fixed wing. And then the final one in that near space is suborbital. So again, an area that is increasingly explored is putting things up in that transition area.

Now that's probably for the shortest period of time, but it is a way to get sensing over an area for, say, you know, X number of degrading orbits until it comes out of the sky. There's a lot of opportunity. As you get to non-tethered, though, the most challenging part is going to be your sensors.

And the challenging part of those sensors is going to be the power that they demand. So getting enough power on the satellite and getting the weight of the sensor or rather, again, whether it's a balloon, a satellite or a high-altitude aircraft, weight and then the energy draw of that payload is going to not be your friend. Now, granted, down on the southern border, we have beautiful days most of the time, but understanding sensing modalities that can work in inclement weather ends up being important.

While visual and IR are fantastic, leaning into radar, which is going to be your worst friend with respect to weight and energy, is important. And then one the military leverages a lot, but we tend to leverage less commercially is electronic sensing. So, you know, being able to pull up the electronic signals and turn that into an understanding, triangulating that understanding where adversaries, to include the unmanned vehicles, may be transmitting.

I'm going to stop right there because I know we're going to go into question and answers, but there's also a lot on the weapons themselves as well, but over to you, Riki.

Riki: Thanks, Shotgun. Great.

I'm going to ask two questions for you, but I just had meetings this morning with the Joint Interagency Task Force Counter Cartel. As you said, and we got the ACC right next door, these different entities that are doing different collections and not doing, why is our government, why is this so difficult? Why haven't we thought this through? Why are we in 20 years of stovepipe and $20 billion IBCS? Stuff that we're riding the same over in Europe with acts that have been failures. And why can't we, why aren't we smart enough to do it? What's wrong with the culture? Tell me why this is happening.

Shotgun: Why can't we figure this out? They're two different. Let me tackle the first part first. And that's this, again, this idea of interagency.

And I'm giving you my opinion right now. I'm not speaking on behalf of the US government, but we, for a long time have very proudly, I think as a nation, prevented our military from quote, spying on American citizens. So we don't use our satellites to look in the CONUS, even if I'm looking for, you know, embedded Russian soldiers in the US, for the most part, there is, and actually the law is not this black and white for what it's worth, but we tend to

treat it as black and white that the moment I get to the border of the United States of America, I do not collect as a military.

And furthermore, if I am collecting outside of the borders of the United States of America, and it's very clear to me, someone'sf an American citizen, I do not collect. And like I said, I'm making it sound more black and white than the law is. But it's funny, because this is something I saw in the military a lot is that we tend to think of bureaucratic or legal problems as also technical problems.

And certainly, if I want to respect that law, it is a technical problem. But I would argue, and here's what I really think should be the truth, as we go forward with respect to this specific problem set, and that is, I believe that AI and computer security is good enough, where internal to the data structure, I can include US citizens data. And I can create it in a way where it is not decipherable, not removable by a human being, unless it proves valuable to that operation.

The idea is government data to intertwine. But I don't allow those individual sources to be pulled out. Instead, I only allow the fused architecture to be pulled out.

This deep desire to make sure that I maintain a division between the two has led to some kind of Rube Goldberg and very expensive technical solutions that I think technology has gotten to the point where we can look for better ways of solving that problem.

Riki: My next problem or next issue is, let's talk about the mass and being able to effectively and efficiently take that out. Directed energy, I want to talk about both non-kinetic and kinetic, but directed energy, speed of light weapons, cost effectiveness, is that doable? I mean, we're advancing, and then are we overlapping Golden Dome? Or is Golden Dome overlapping what we're trying to do in terms of at this lower level, how does that fit in? Can you talk to us about that? Yeah.

Shotgun: Let's say kinetic versus non-kinetic. Yeah. So again, I'm going with my opinion.

It is my opinion. You are never going to make missiles cheap enough and numerous enough to where very large raids like 1,000 plus platforms are going to be targetable by just missiles. So absolutely, we need to look at alternatives.

One of the things Ukraine has weaponized very well is getting adequate information on the inbound things to be able to align just bullets. And bullets are nice and cheap, so that's definitely a good one. I know they are starting to play with directed energy.

Lasers are absolutely an alternative. There are drawbacks. I don't know when that laser energy stops, so Elon Musk may not like it very much.

And if I'm trying to kill a drone and I accidentally kill a satellite, that might bother people. I know that's part of the challenge. I will say one other one, though, is all of those, to even include the laser, even though light's really fast, are one-on-one effects.

And I think looking at alternatives and opportunities for broader effects, and there are a couple of ideas. So very high-powered RF energy is an option that could go reasonably broader than airspace, which is an idea. The other one that I think is very lucrative that you've seen Russia and Ukraine do is crushing their position, navigation, & timing.

For the most part, that just means jamming GPS. Obviously, we can do that. We can jam it ourselves.

We lose the opportunity to use it. But when you look at really expensive drones to a really large degree, now technology's changing where people are using optical and other things, but if there was an Achilles heel to most inexpensive ordnance, long-range ordnance, it's a reliance on space-based navigation. And that is something pretty easy to mess with, and we would be able to mess with a large volume of drones or small weapons simultaneously.

Riki: This is a real quick one. In your career, what roles do universities play in this equation? What are their strengths for the Department of War? Can they go faster than what the Department of War is doing? Why would you partner with a university to get advanced innovation?

Shotgun: Great question. And it was part of the stump speech and is part of the stump speech at DARPA.

So, I served at DARPA for a little under eight years. And so, what I would say is at the lower levels of technological readiness. So, we do TRLs in the government from one to nine.

One is things like lasers, nine is a paper bag, but kind of going across that spectrum. And what I would say is towards those more innovative, less mature technologies, universities are where it's at. I mean, it's where eager brains are today.

And frankly, what we have found is when you try to classify technologies at the lower levels, you so grossly reduce the number of intelligent brains working on the problem that it just sits in a corner and gets stale. So, being able to go open source, being able to go with universities is the right way to inspire the future. But honestly, it's where the freaking brain power is, and it's where people are really eager to embrace new ideas and new concepts.

So, I would argue even before we started this program, the government has done a pretty darn good job of leveraging university brain power to assist with the government. What I know pisses off the students who work on it is, as you go from that initial technological development phase, and you get into actually fielding a product, and I won't get into all this, I'm happy to get into it during the program, but there's a lot of bureaucracy and a pain that you can have a proven, just amazing technology, and it's going to take a really long time and a lot of money to turn that into an actual product that the warfighter's using, which is frustrating, but it's part of the system we have today. Thanks.

Riki: Thank you, Tom. All right, now we're going to go right to the university perspective on it, and it's an honor. It's always about being the right place at the right time for the right reasons, and we've really pondered this and set this up here at Tucson, where you're close to the southern border, where all the action is happening, and the technologies that you have are really exceptional in what you do.

So, adding to this conversation now, I'm going to introduce the Dean of Engineering for the University of Arizona, David Hahn.

David Hahn: Thank you very much, Riki, and thank you, Shotgun, for your very sharply focused comments on setting up some of these problems. You know, the interactions that we've had in the College of Engineering with Riki and the Missile Defense Advocacy Alliance go back three, four years now, and I think back to April of 2024, so almost two years ago, we hosted here on campus a near-space domain forum, and I know our next guest was there, and we had a really good discussion about an interesting domain that, you know, technically goes from about 12 miles, 60,000 feet, to the von Karman line in space, 62 miles above the earth, and so that's an interesting space.

We're above regulated airspace, what nations claim as their airspace, but we're below space, and so this unregulated, uncontrolled region provides lots of opportunities for adversaries to come in and for us to put up balloons, dirigibles, and sense and affect change, so that kind of started a conversation that now has advanced over the last few years, and time has been on our side on this, because that's now, we realize that that's an important region, and we're still going to focus on that, but notice in this conversation, we've added the word terrestrial, because we realize that we need to bring this all the way down to the surface of the earth, because the drone can come in at treetop level, and so we've expanded this to take a near-space down to terrestrial space, and tie this into this conversation about national security, and that led us to a lot of what Shotgun just talked about, this integration of technologies. You know, universities are blessed with a breadth of knowledge, and a breadth of experts, and a breadth of eager students that go from engineering, to space, to astronomy, to optics, and what we have here at the University of Arizona is all those technologies, and all those brains, and so this has led us today to make an announcement that we're going to be starting a program called AETOS, named after the Greek golden eagle, who was a messenger to the gods, and so we're going to leverage that idea of sensing, and messaging, and integration to a program, and AETOS stands for Advanced Education in Terrestrial Operations in Space, and the goals of the AETOS program are consistent with everything you've heard so far today, and you will hear in the remainder of this podcast. It's about collaborating with MDAA and national defense experts to really bring together the critical needs and technologies to protect the homeland.

It's a non-political, it's a non-partisan effort, it's an American effort, and it's an effort that we feel really is important to bring maybe the nimbleness of academia, and the expertise, but it's a partnership in this training and education program. We bring people in from the armed forces, we bring people in from other agencies that are tasked with protecting the homeland, we may bring people in from our neighbors to the north and south to really have this collaborative team, and this program as it progresses over the next nine months, we'll have formal education. We take our experts to help train them in conversations about the fundamental knowledges of space domain awareness, optics, acoustics, drones, aerostats, hypersonics, and directed energy, but then we in parallel are working towards Capstone design projects, where the teams of students that are participants, they're innovating the entire way, working towards a project which will be a thesis on certain incorporation of technologies, implementation of new ideas, all towards homeland security of this country, wrapped in some of the context of Golden Dome for America.

It's a really exciting time to bring those things together, and I'll just give one example that you and I talked about earlier, Riki, which is, you know, here at the University of Arizona, in our college, we have hypersonic wind tunnels. So, we work up to Mach 5, we work with collaborators like Raytheon, we can test real relevant designs, but we also work on directed energy. So, last year, with funding from the Department of War, we actually put our lasers in our wind tunnels, we were running a hypersonic flow over an airfoil, we hit it with energy from our laser, we disrupted that boundary condition, which can create aerodynamic instabilities, and that's the first steps towards maybe misdirecting a hypersonic weapon that's coming in at the speed of light, to make stabilities that make it uncontrollable.

We got those neat ideas here, a lot of students involved in that work, and it's exciting how we can bring all of these pieces together, and I think do something that's real good for this country. That's an excellent way. I think our Department of War is investing quite a lot on how to defeat a hypersonic glider.

Riki: Absolutely. Well done on that. So, as a university, what are your specialties? I've noticed that you've done some investment in quantum, you've done some investment in acoustics, you've done some investment on elevated aerostat aspect of it, and can you speak to what your research grants are, and so the coupling, what's the federal government giving you to research on that applies to this?

Dean Hahn: Yeah, you know, we have, there's two great offices from an academic perspective out of the Pentagon.

One is the Joint Hypersonics Transition Office, and one is the Joint Directed Energy Transition Office. Both of those offices were set up to fund universities to transition technology. You know, we talk a lot about fundamental research and applied research.

This is alot toward applied research. You know, let's take our brainpower, but let's transition these technologies out to the warfighter, to the field, and so those programs have funded specific efforts around directed energy, both source development and interactions with materials. On the hypersonics front, we're doing a lot of actual aerodynamic testing.

You know, we have good predictive simulation codes, but they're not perfect when you get into these high shock environments and very dynamic systems, so we need to validate them in wind tunnels, so we do a lot of that work. We work on the high temperature materials that we need for hypersonics, and let's talk about drones and acoustics. What I think is a real exciting avenue that we're just moving into is to taking a nice example of an acoustic network.

It's going to pick up a lot of noise, and so how do you process that noise? On the back end, you start to use AI, but what if you also, on top of that, bring some of the fundamental aerodynamic principles involved? What are the sound waves and acoustic fields that come off of an actual drone? Tie that technology into the sensor network on the back end, put these open communication lines, and suddenly we're filtering at a very high level that can pick up a drone and not a leaf blower. You can also pick up the sound of a hypersonic. Absolutely. It's not picked up by human error. Absolutely. Again, a lot of this is using fundamental engineering knowledge on the back end to guide that.

We're going to be in a position where we're going to demand a prototype in 12 months, or 10 months. That's why we're doing this.

Riki: Have you any success in creating a brand new idea and getting a prototype out in six months, and are you confident we can do this in this program?

Dean Hahn: We often hear, and you've hinted at it, Riki, that the government, big defense contractors are slow and not so nimble.

Their programs take years, and the threat is changed when they get to the solution. Academia can work a little more nimbly on those kinds of things. Yes, we have been able to take specific projects and tasks from companies to say, hey, can you get me a prototype in six months? We can work towards that.

We have 3D printing capability, metal 3D printing capability, advanced testing and stuff. Yes, the idea that we can put prototypes together quickly is what we do. I'll just give you a concrete example.

Capstones. Every engineering student does a nine-month capstone project. They start with an industry-sponsored idea.

Nine months later, they deliver a prototype. That is what we do. It's in our blood.

Riki: It's exciting to bring some of that to this. We've got a great one. Mark, I think he's coming from Ukraine.

Mark Montgomery, first off, graduated from the University of Pennsylvania and Oxford University. He completed the U.S. Navy's nuclear propulsion training. He was director of operations at U.S. PACOM.

He's been a commander of Strike Group 5. He's the deputy director of plans, policy, and strategy at U.S. PACOM. The coolest thing is his relationship with our great Senator John McCain and his dad's relationship with him. Mark was the policy director for Senator John McCain as he was the chairman of the Senate Armed Services Committee.

Mark's got a great perspective, especially on the aerostats aspect of it. Going to Mark on the bigger problems, i.e. defeat mass on mass and where we're at. It's just awesome to have him with us.

Mark: Hey, Riki. How are you doing? Good to be here with you.

I'm in D.C. now. I'm back from Europe. I want to pick up on something that Shotgun was talking about and also getting in the tune with what is happening right now, which is a lot of good missile defense ideas that were generally left on the table by the U.S. Army over the last 10 to 15 years are really making a comeback.

One is aerostats. I think you're right. Aerostats, dirigibles, balloons, you take your mix.

I think almost everyone understands the physics of an airborne radar and the range and the quality of the track that you can get from it. Obviously, you make trade-offs between tethered versus non-tethered power, how you get your power, how secure your data link is, how guaranteed your data link is. These are tough things versus how you avoid weather obstacles.

I think we recently lost a tethered balloon on the southern border, and that's okay. You operate these things to achieve something. We have planes crash, balloons get cut, and sometimes even in the case of JLENs, they get underway.

In general, balloons don't kill people. Planes kill people. I just feel that there's a strong argument here for every sensor, every shooter, and dirigibles, aerostats, balloons should be part of it.

I hope General Guetlein is thinking about how he manages the underlayer. The beauty of balloons is they can get there in the real underlayer, but they can get in that near-space region where they're in the interstitial layer kind of thing between space and and interstitial and really make a difference, lower the cost of space-based sensing, but also enhance the performance of terrestrial-based sensing and shooting. I'm excited about this.

I think there's opportunity. First, I want to say I'm glad to see the Army taking a turn on this and starting to think about it. The second is what you've been working for so long, which is how do we use unclassified systems, generally open-source unclassified information.

I recently was in the Fusion Center for Ukrainian Counter Drone Detection. They have a number of them spread throughout the country. I'll just say that they have thousands of sensors, and you know the acoustic ones very well, but they also have cheap localized radars.

They have electronic warfare detection. They have video cameras, and they have 10,000, 12,000, 15,000 sensors feeding into a picture that feeds into a cloud that presents a picture that allows the operators to pick an electronic warfare or a kinetic solution or possibly do nothing if a drone doesn't present the exact threat. The good news for them is their counter drone interceptors are so cheap, doing nothing is an infrequent answer because it doesn't cost much to do something.

But to me, the idea of the work that you've pushed, and as you know, SHIELD 24, I think our second iteration of the SHIELD classes, produced an exceptional dirigibles Capstone report that explained the history of dirigibles and aerostats, explained the value of high altitude versus medium altitude versus low altitude, described the cost that it was, but the cost that it offset in terms of manned aircraft, and then the risks of utilizing it, and then finally the non-military advantages of emergency communications and other things that you can strap to the aerostat or dirigible to provide to FEMA or other federal agencies. So very good discussion in there. In my mind, long-term, aerostats and dirigibles are going to work.

And here's a good signal. There's one country that works missile defense as hard as the United States in terms of procurement and employment, and that's Israel. And what's the country right now operating an aerostat in a combat environment? Israel.

And I believe their aerostat is doing exceptionally well in helping identify and sort the air picture in terms of attacks from both Iran, IRGC proxy states in Iraq and Syria, Lebanon, and the Houthis in Yemen. So real good advertisement for the value of aerostats and dirigibles. As you know, the polls have bought some, so I'm really looking forward to this.

And in the cloud environment, I'm hoping that Shotguns work can get us there. In my mind, there's this good opportunity when you're thinking about non-standard dual-use sensors and detection devices for improving our basic air missile defense. One last thing, we said this previously, but I think it warrants saying every time we talk for the next couple of months, in the 40 days of combat with Iran, the U.S. demonstrated a hole in its swing.

We were like a great batter that couldn't hit a curveball. That curveball was a slow-moving, long-range drone. And whether it was fired—in fact, frankly, it hurt us more in that shorter-range application at 80 or 90 miles in Kuwait, Bahrain, and Qatar, but it still did damage.

And I think throughout Saudi Arabia and the United Arab Emirates as well. I'm hoping the United States has the humility—the United States Army has the humility and the grace to rapidly learn from our Ukrainian partners and work with our Arab ally, our Arab partners in Saudi Arabia, UAE, Qatar, Oman, Bahrain, and Kuwait, and install the systems necessary. Take the risks associated with an unclassified network operating, potentially not linked with our classified network, to defend our air bases, our ground units, our radar systems, and our operating centers from future attacks.

So, Riki, I see some great opportunity in dirigibles and aerostats. I see great opportunity in the unclassified network that General O'Donohue and his team are pushing that you've advocated for five years now. And if people look at our SHIELD program, you'll see one to two capstones each year that feed this system.

So that's why I'm excited that we're starting to work with David Hahn and his team to ensure that we have another set of academic capstones coming online to solve these scientific problems. So, Riki, good news, good stuff, and I'll pass it back over to you for questions.

Riki: Thanks, Mark. And for everybody that doesn't know the SHIELD, it's a USC program that we built five years ago. It's had five years of programming, 107 graduates. And Mark, that program also did the acoustics that went to the Hawaii program, ARTEMIS, to produce ocean sea-based microphones in the water that are going to be deployed.

It's phenomenal what has happened. We're looking at this university kind of the same way as what we did there. But Mark, just before we get into the big stuff, what's your answer against mass on the effectors? Besides the GPS stuff, how in the heck are we going to be able to have effectors to take down thousands and thousands of drones? It's going to be, you know, this is 2026, but 2036 or 2046, I mean, it could be hundreds of thousands.

What are we doing? I want to push you a little bit, because that unified command that we're looking at about having, an automated command, to be able to handle this. How do we handle this problem? And how does this university, how do we look at figuring it out a little bit? I'll get back to you. I'm glad, I'm glad you were able to draw USC and University of Hawaii in as I drew in University of Arizona.

Mark Montgomery: Probably by the end of this, you'll forget how to mention Old Dominion. But first of all, and by the way, I want to validate that these academic programs are an absolute, you know, being able to marry military, you know, active servicemen, people from defense industrial based companies with a strong academic environment with faculty and labs to produce a high quality product. You know, as you and I both know, two to three of the Capstones from our first program at USC each year, evidence themselves in either executive branch products or legislative and public law changes.

So that's validation. And I hope we'll see the same from Hawaii and I hope we'll see the same from Arizona over time. Okay.

To answer your question, well, look, I'm going to break this up into two things. I still am a believer in terms of ballistic, cruise, hypersonic defense, I believe space-based is where you're going to be able to handle mass in a cost-effective way. And I know people are jamming on General Guetlien because it's $1.2 trillion.

You know, you have to read the fine print on all of these things. You know, I can make any number you want for any program you want by setting assumptions like, how long is this going to cost over 20 years? Oh, 20 years. Well, $1.2 trillion.

How much is that a year? $60 billion. Okay. Our defense budget over that time is going to average $1.4 trillion or $1.5 trillion.

What is $60 billion of that? 3.2 percent. Maybe the ballistic missile and hypersonic and cruise missile defense of the United States and all its forward station forces merits 3.2 percent. I don't know.

But don't just say $1.2 trillion and mic drop. I mean, you know, you got to put math on here. And I think Mike Guetlien is very good at math.

Let him explain it to you and I think we'll be in a better place. I think I still believe in space-based interceptors. If you're talking about autonomous systems here, look, we're going to have to work with—I'm not saying every Ukrainian counter-interceptor drone that exists today is not going to be valid five years from now.

It would be considered dated and not useful. I don't want to say, oh, buy Mirops or buy Octopus or buy—no. What I'm going to tell you is buy into the concept that you're going to have a low-cost drone interceptor program operating on a highly unclassified system that can be shared with law enforcement, Department of Homeland Security assets, and the rest of the federal government because we may not be responsible—even state and local governments.

Because we, the U.S. military, are trying not to sign up for defense of the University of Arizona's football stadium during an NCAA football game. We're hoping that some Police Department in Arizona signed up for that, or worst case, the FBI or Department of Homeland Security. We've got to figure this out.

And look, what the Ukrainians figured out, what you figured out with your work with acoustics is that you want to get down to unclassified. You want to be able to just push data and say, I've got 100 sensors detecting this. If the bad guys have compromised four sensors, we're just going to have to figure out those four are compromised and rely on the other 96.

And that's what the Ukrainians do. They're like, yeah, if the Russians get into a radar, they get into a radar. That's life.

But you run this unclassified network. Now, we do at some point—the military is going to insist, and so will the FAA, by the way. The Federal Aviation Administration is going to have the same concerns and questions about counter-interceptor drones flying around that the U.S. Air Force, the CAOC, the Air Operations Center commander, feels about that.

We are going to have to figure out how this broad, unclassified, widely data-shared network allows for ground-based drone interceptors to get rid of a threat at the most efficient and effective moment. How it also can communicate with a classified network that's controlling—or a sensitive network, if it's not classified, that's controlling—civilian aviation and military aircraft at the same time. Here is the good news.

This country is full of geniuses. We will figure that part out. What's been harder is it's been hard to figure it out in three weeks on the fly in the Middle East.

My gut reaction is, if we'd listened to the Ukrainians a year and a half ago, we would be already set on this. I think this is a less-than-year-long solution to get to it, to figure out how these systems interface. I think General Donohue's already most of the way there, but we'll see what happens.

So, Riki, the answer to these two questions is space-based for the really excquisite stuff, counter-drone interceptors whose names I do not know and, in fact, do not yet exist for five to seven years from now. And we're going to have to find centers of excellence, like maybe a partner like Taiwan, a partner like Ukraine, a partner like Israel, a partner like the United States, who each build different variants of this, and they build enough for everyone. And that way, if those countries are isolated in the future conflict, they can accelerate the building for themselves.

I think Taiwan and Ukraine and Israel all feel that way, and the United States could be the center of gravity moving them. And those are three countries who are pretty kick-ass at microelectronics, unmanned vehicles, and fighting bad guys.

Riki: I know Tom's going to answer that, but I want one more question for you, Mark, because you're right.

We've been right. We have been right. And one of the biggest things that are happening in our country right now is look at the change of roles and responsibilities of missile defense, which we did a paper on three years ago, which started, I think the last one is 1948 and down in Key West Florida, where they created that.

What is the answer now, Mark, as you look at it today for the roles and responsibilities, with all this stuff that's bigger than just the services? That has to be looked at and throw your

voice a little bit. Is the unified command the way to go? Is there a missile defense command? How do you get each component commander of all these COCOMs to have this capability? Do we just keep going the same way we're doing this? Because it doesn't sound like it's working very well where we're at. I just want to throw that, and Shotgun, you can come at it after that.

But no, it's been a good fight, Mark, and we've been on top of this. I just want to get your thoughts on it, because I think we're going to have to end up doing another paper on that, or updating what we did.

Mark Montgomery: Well, listen, I thought John, Rood, and you and me, and Ty did a good job, and others did a very good job.

Corky did a very good job putting that paper together. I think we laid out the risk of the status quo, and we have now seen the failure in the status quo, right? The status quo being to allow the Army to be in charge of defending by the ROC. But it's also that the Air Force has got something to do with this, too.

I mean, just don't blame it all on the Army. No, no. What I'm saying is, we were saying the status quo was that this was an Army, that defense of ground-based units was an Army mission.

But we also acknowledge the Army had not been doing it for 25 years, you know, since, you know, somewhere after Desert Storm. Somewhere during the post-Cold War, the mission atrophied, and we needed to actually identify, you know, have the Vice Chairman of the Joint Chiefs and the Deputy Secretary of Defense clearly articulate who should do what. And that was not happening.

It did not happen. And, you know, now you've got these bases. I mean, those bases, as you've seen over there, you were actually visiting some of the bases.

They did not do well. That did not reflect well on us executing our required operational capabilities correctly. I mean, that's a clear fact.

And I thought we laid out a good way forward that was broadly ignored. And, you know, the result was the result we saw.

Riki: Shotgun, can you say anything on this, on what Mark's comments were, last couple?

Shotgun: Sure.

Hey, just whether it is GPS or not, I want to do one more shout out on countering electronic signatures. And that is what we have seen in Ukraine and Russia is real early in the conflict that one way, you know, fire and forget drones did not work. That's why they're all, you know, very deeply involved in FPV drones on the front, you know, on the front edge.

Because unless I have some ability to get, whether it's GPS or whatever else, unless I have some ability to control the thing, and that means I am going to send electronic signals to it, and it is going to talk to me then they deeply lacked effectiveness. So, if you look at these

thousand, you know, drone raids against Ukraine, Russia is talking to a lot of those drones during its flight and would have significantly less lethality if they were not able to talk to those drones during its course of flight. So, I really do think, you know, denying RF, inflicting pain on RF, forcing them to constantly change the way they're guiding their drones.

And it gets back to Mark's point, and Mark's spot on, that this game is not a game where you buy a hangar full of drones, throw them in there, and we're going to help Taiwan 10 years from now with it. That's lunacy. This is a thinking, evolving, very rapidly creating, very rapidly deploying game that, you know, technologically is exciting.

But just this idea that I got hangars full of stuff that's going to be good for 10 years needs to go away. So, I still think attacking their ability to communicate with or listen from their drones is huge, even on the less expensive stuff. The moment it's going to go long range, where it's got to continue to decide what it wants to kill and continue to decide where it's going, there's opportunity space there.

On the second part, and I know this gets a little bit less technical, but when you talk about the command and control world, and Riki's sick of hearing me say this, but, you know, our joke was we asked for Joint All-Domain Command and Control, and we got" sad C2 service all-domain command and control." But right now, and I am not blaming these senior leaders, but every service is creating their own command and control architecture and communications architecture. Every COCOM, independent of the services, is creating their own command and control, their own sensing architecture, coming up with their own stuff.

And, you know, I jokingly say that when I was at the United States Air Force Academy, they did not ask me what I wanted for lunch or dinner. I showed up, I sat down, and I ate what they gave to me, or I decided not to eat. And so whether I actually think a drone command, and again, you know that I feel this way, Riki, but how one senses, how one shoots, how one command and controls in the modern era is not affected by whether you live on the water, you live on the land, you fly airplanes, or you fly satellites.

We've got to get over this idea that separating the services, and each of them have their own special way to do RF, or their own special way to launch the same missile is crazy. Is that what Mike Guetlien is doing? That's what the Golden Dome is supposed to do, right? Is that what it's supposed to do, or how does that separate from what we're talking about down at the lower end of this? So, yeah, and I don't want to get into specifically what I think they are or aren't doing. What I would say is that with the existence of Golden Dome, there has been no change that I detect from individual services and COCOMs, independent of Golden Dome, doing development on sensing, development on integration of that into a picture, development and command and control and communication.

So, we still are fragmented and fractured across the architecture. And I'm not saying you just want to grab one vendor or one idea and run with it. So, diversity in thought is a good thing.

Diversity in focus is not. And I believe that there is— Just your answer to the roles and responsibilities. You heard Mark, what is that answer? Yeah, so we need to—I don't care who it is.

We need to select a single entity, independent of domain, and independent of geography. And that may be a new office. That could be MDA.

That could be a brand-new office. That could be the Strategic Capabilities Office. That could be the United States Air Force.

I actually don't care. We are all facing the exact same technical problem, whether you're on a boat, on an airbase, or on an Army post. It's just not different enough, anymore.

And the response at scale is so similar that we've got to figure out a way to aggregate it. So, picking—and you can have Mike Guetlien be that person as well. The problem right now is we have subdivided into underlayer and overlayer.

We've subdivided in defense of the United States and defense of CENTCOM and defense of INDOPACOM. And again, everybody is trying to do the right thing and do their job well. That's resulting in alot people doing the exact same things in parallel in a way that I think is inefficient and negatively effective.

Hopefully that helps. Let me hit on one technical thing that I at least didn't emphasize enough that I think is important. When you get in that subspace, near-space area, I think the long pole in the tent—and I kind of said this, but I want to emphasize it—is power production or power storage.

Figuring out ways of getting energy to a platform, producing that energy on a platform, or just starting off with enough energy so I don't need to ask. When I'm doing sensing, when I'm doing communications, even if I'm carrying weapons and want to launch those weapons, even on the weapons, that is the long pole in the tent. So, energy density, energy production are the Achilles heel on almost all of these things.

So, off the soap box.

Riki: Yeah, thanks for bringing it back technical, but I want to go and hit a professor from the outside world here on the roles and responsibilities of missile defense. You just heard that discussion. So, do you have any thoughts on what we're saying from an outside viewpoint on how we can get this right?

Dean Hahn: I mean, I think two points that just are crystal clear from everyone thats spoken is we must leverage a non-classified open-source communications network, and you said it wonderfully. If they grab something here or there, so what? We've got 25,000 streams of data coming in. If one or two gets tapped or nabbed, you have—and that is a take-home.

That speaks to us because that allows us a place to play and participate, right? When we get all wrapped around having to be on all these high-level comms and secure networks, it takes us out of the equation. And so, having the ability for us to tap in, let's prototype our own sensors, put them right into the network, that is huge. That's a massive takeaway.

And then the second one—and we struggle with this as well in parallel problems—is you can't—everyone can't reinvent the wheel. And so, having common platforms and a common approach. So, spot on.

Riki: All right, we're going to wrap it up. I just want to go around the room and what your dream position is six months from now or nine months from now with these Capstones. What do you think is the best thing that we can come out of the Arizona AETOS to help our country? Just from the top and any comments you want to have. You want to go, Mark?

Mark: Yeah, I got to go because I got to go. But look, first of all, I think that there are ones where we have professors who can guide and well, write? So, we got to have it. We got to frame it around guidance, and we got to have topics that combatant commanders and functional commanders can send the students to the courses they really want. So, that's a framework.

You got to frame around that. And then within that, it's looking forward. You know, I think this is the kind of place where you're looking forward three, five, seven years from now for what are the kind of the operational capabilities that will make missile defense more effective, whether it can be sensor, it can be C2, it can be shooter.

I don't know. But I'm excited about the opportunity that we're going to have over the next, you know, with this, you know, Riki, you know, my opinion, we got a lot of classes going. But, you know, this one has the opportunity, has a unique engineering background, I think, to really drive some technical solutions. So, thank you very much.

Riki: Thank you, Mark. We look forward to you being a part of it.

Shotgun: I look forward to it too. I'm just looking for that direct flight right now. Okay. Hey, building on something Mark said earlier, and that I also kind of piled on a little bit is, you know, if there's one thing that I think we're all hopefully waking up to is the era of 20-year development programs to buy something that we're going to use mostly unaltered for the next 100 years are over. So, what I would say is as you're looking at technologies and thinking about stuff, build and think about technologies that are evolvable, that are malleable, and buy into the fact that, you know, your good idea today has a half-life in single-digit years, not in double and triple-digit years. And so, aggressively pursuing new ideas, limiting complexity, limiting the length of time to development to enhance it.

Probably, you can get it in the hands of the men and women, you know, defending our country. And again, whether they're wearing a policeman's badge or a soldier's uniform, doesn't really matter. So, being aggressive, being excited, thinking outside the box, but also thinking about, you know, one to five years, not 20 to 100 years, is the key to actually having what you're doing turned into something real.

Riki: That's right. Any just off-the-cuff Capstone that you would like or just for these guys that would be the most beneficial for our country to have at the end of it?

Shotgun: Yeah, you know, it's funny. I'm going to wimp out and not answer that, but it's not because I don't have ideas.

You know me well enough, Riki. It's because I don't want to stem new innovative thought, right? So, I would much rather, as much as the students of this program may not like it, I'd much rather crap on their ideas than limit those ideas to start with.

We'll pick your mind later, Shotgun, I think.

Shotgun: Amen. Yeah, I really think, you know, I know we got to go fast, but starting, you know, starting with outside-the-box thinking initially and then allowing folks like me with a lot of experience to help hone and focus that thought is better than me throwing a North Star out for them up front, I think.

Riki: Perfect. Awesome. Thanks, Shotgun. Thanks, everyone.

Your final thoughts? I think it's an exciting time, a great conversation, a lot of expertise, as you said, Shotgun, to help guide us, but let's let our students and our participants come up with some ideas. Think big. Dream big.

Be big. Thanks. Thanks, everybody.

It was a wonderful discussion. We have opened up another academic partnership that's going to create Capstones, going to create courses of action, going to make this world and our nation a safer place and certainly the borders and certainly the state of Arizona. So, I'm excited about it, and I look forward to the launch of our program.

Defense wins. Thank you. Bye.