

Aerospace Advantage – Ep. 217 – It’s All About Munitions: New Perspectives – Transcript (AI-Assisted)

Heather "Lucky" Penney: [00:00:00] Welcome to the Aerospace Advantage Podcast brought to you by PenFed. I'm your host, Heather "Lucky" Penney. Here on the Aerospace Advantage, we speak with leaders in the DoD, industry and other subject matter experts to explore the intersection of strategy, operational concepts, technology, and policy when it comes to air and space power.

In a recent speech, the head of DoD Acquisition, Dr. Bill LaPlante, laid out a pretty ambitious goal for the U. S. defense community. We are going to need to have more political will to mobilize. Now, his comments were focused on munitions. He explained that Putin is spending between 10 and 15 percent of Russia's gross domestic product on defense.

Now, that's commitment. And as LaPlante commented, he's tripled his production across the board. This is not what other people have done, including us.

Nor is the production threat restricted to large countries. Laplante highlighted that the Houthis are doing technical things that only the advanced countries can do, and they're producing them at scale. So, if we overlay that in [00:01:00] a China scenario, it's clear we've got serious issues that risk us, the U. S., from being outproduced on the war materiel front. And it's especially in munitions.

And that's why Laplante concluded, every U. S. and allied defense company should be saying what it would take to go five times my production rate.

So, what would it take to go five times? That's a massive scale. So, with those comments as a scene setter, we're going to dive into this topic and help answer Dr. Laplante's question about how the U. S. industrial base could expand its production capacity while also working to deliver new capabilities that allow aircrew the ability to secure a broad range of combat effects. And, to be clear, it's no mystery to our regular listeners. We've been talking about munitions a lot in recent episodes.

But that's because we are in total agreement with what Dr. LaPlante said regarding the need to press aggressively for a new innovation and production paradigm. We cannot be complacent, building a few hundred munitions a month, when the air tasking order will call for tens of [00:02:00] thousands over that same period of time.

We know our stockpiles are at a record low levels, so we need to get real about rebuilding and sustaining to meet this new demand signal. So, joining us today to discuss this is Anduril's Steve Milano from their Strike and Air Dominant sector and our very own Major General Larry "Stutz" Stutzriem.

So Steve, thank you so much for being here.

Steve Milano: Yeah, thanks for having me, Lucky.

Heather "Lucky" Penney: And Stutz, you too. It's always a pleasure to have you.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Of course, lucky. It's great to be here again. We're going to have some fun with this one. Very interesting topic by the way.

Heather "Lucky" Penney: Oh, no, it totally is. And one that's near and dear to our hearts because we like to make things go boom.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Yes, we do, don't we?

Heather "Lucky" Penney: All right, so first and foremost. You know Stutz, what we're really talking about and what I think Dr. Laplante is talking about is a real world appraisal of what it would take to from a materiel perspective, to fight in a major theater conflict. We talk a lot about the technologies and the CONOPS, but this is about the actual stuff that blows things up.

So, given the alignment that we've seen between China, Russia, Iran, and North Korea [00:03:00] there might be concurrent conflicts specifically designed to stretch us to a breaking point. You grew up in the last decade of the Cold War, so help us get our heads around what that world looks like. This is kind of a back to the future moment.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): It really is. Yeah, lucky. Let's do a little history with this and I'll get to your point. And, at the end of this, we have to think about, uh, where we were, for example, 30 years ago with Desert Storm, which was, the last large scale, operation that we had.

And, you know, we're talking about hundreds of sorties, thousands of bombs each day. And we were living off some really big stockpiles from World War II, Korea, and so forth. And, uh, when we fast forward about 10 years to OEF, we

had what 90 percent of that was, perhaps precision munitions, not that old stockpile kind of stuff.

And really, the numbers of sorties weren't that much, I mean, compared to Desert Storm. And we've been in a period [00:04:00] of time now for 30 years where the numbers have been really low, but when we talk about a China Taiwan scenario, we're going back to that Cold War size level of sorties. Maybe, you know, we've done some studies, a very good study recently where we're talking about maybe more than ten thousand aim points the we have to service. And our analysis says we're going to run out of, munitions probably in about a week if we don't do something about that.

So, really the demand for a truly a peer conflict is something, we haven't experience for quite a while.

Heather "Lucky" Penney: Yeah, 10,000, uh, aim points. That is a significant amount of aim points and it requires an even greater number of munitions. Steve, I'd like you to weigh in here. What are your thoughts regarding this picture that Stutz is painting?

Steve Milano: Yeah. I agree that like, as you came out of the Cold War and we entered into kind of the, Gulf era and then the GWOT kind of following that, it drove requirements for munitions and kind of different ways from and from a [00:05:00] perspective of like needing the, uh, the munitions to do different things.

But ultimately it drove the same behaviors and kind of the ecosystem. So, the requirement systems were the same. The modalities through which the services engaged with industry were very much the same. And so despite the fact that there were larger inventory requirements and buildups, leading into the Cold War and then coming out of it, and the fact that we were kind of churning through, uh, different munitions sets, uh, through GWOT. It still had, we still had the same mechanism that was rep replying that was replenishing those, those capabilities.

And so what I think that we saw was essentially the creation of like these black holes of requirements for the very exquisite capability, but not necessarily the continuation or maturation of like, how do we deliver, munitions in a way that actually meets the current need. Whether that's numbers, exquisite capability or some blending of the two.

Heather "Lucky" Penney: Exactly, Steve. And so in GWOT, we weren't dropping a whole lot of weapons. Um, we were still, we were refining, I think, a lot of the [00:06:00] weapons that we did have regarding precision munitions and also decreasing the size of the explosive capability.

So, there was minor incremental changes, but I think from a production capacity, that's really where we took for granted the fact that we weren't expending a tremendous amount of munitions, and we were really cutting down on those yearly buys. And that has an impact on what industry is going to size to. What they're going to build their plants in their facilities for and also all the raw materials and how they're going to mobilize their entire army of suppliers, right?

All the mom and pop shops that build the small things that then they then put together on the factory floor. Stutz, you helped run the war during Southern Watch and Afghanistan. So, from this targeting munitions perspective, what were your considerations?

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Yeah, when we got to Operation Enduring Freedom, as I was saying earlier, you know, we were now in a GPS guided munition age and that's what we're [00:07:00] ramping up to buy, but we we didn't have the ability in the first couple of weeks to really deliver those effectively. Uh, we couldn't find maps and we didn't yet have devices that could actually tag locations. And so, here we were in a new age dropping a GPS guided bombs. Later, incredibly effective, much preferred. But once again, you look at, as you said Lucky, you go back, after Desert Storm and you didn't really have a constituency for munitions. So in the Air Force across the Department of Defense as well, if there is a need to pull some money to pay for something else, it came out of munitions.

Heather "Lucky" Penney: And there was no cost to the operator because we just weren't expending them at a high rate.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Correct. There was no demand signal on that at the time. So, it really required, somebody thinking ahead to what could happen. And as you know, in the nineties and early 2000s there wasn't the thought that we're going to have a peer [00:08:00] adversary.

Heather "Lucky" Penney: Oh it was the "end of history." It was a unipolar world. There was never never going to be another bad guy.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): So, here we are. There was a quote just recently in the news. A personality said, "hey, industry has got to step up and build a surge capacity." Well, unless the military is going to buy munitions, there's no incentive to keep a very expensive surge capacity on board. So, we're looking at a very different future where we need to have the stockpiles of munitions to do something better than a week.

Otherwise, uh, a peer adversary like China is going to just outweigh us in terms of.

Heather "Lucky" Penney: Well, they're going to outproduce us and outstock pilots. I mean, we were talking, um, before this recording about, uh, the change of paradigms where we moved from a stockpiling mentality that we had during World War II, in Korea, and Vietnam because those people lived through the early years of World War II where we did not have those stockpiles. We did not have those reserves.

[00:09:00] And today now it's just in time logistics, right? Just in time delivery. But that's not how war works. War is inefficient. So, if you want to be effective, you have to build that up, but we are not, we're not sized for that and we're not budgeted for that.

Steve Milano: I think that we live somewhere on that spectrum though. From the stockpiling modality all the way to the just in time iterations, like, you have to live somewhere where your munitions are able to be surged quickly. And that you can stockpile the needs so that you have the munitions necessary to be able to satisfy the early, you know, the early expenditures.

Heather "Lucky" Penney: While you search that production.

Steve Milano: Exactly.

Heather "Lucky" Penney: How do we build that elasticity into our production? I mean, traditional industry primes are not, that's just not how they function. It would take years for them to facilitate, to train the workforce, to build up the raw materials, to do all the things they would need to do to really meaningfully make a step change in their production.

Steve Milano: You have to take the exquisite nature out of the materials, the processes, and [00:10:00] the manufacturing modalities to be able to allow industry to respond in a meaningful way so that you can provide that adaptiveness. If a factory takes 12 months to build, well then the munition takes

12 months plus whatever the time is to actually build the thing. So, as you take out the complexity of sourcing the materials, the complexity of testing, the complexity of like just putting the things together, you create this ability to kind of move more quickly throughout the process of development, production and fielding of systems.

And you can be more responsive to requirements as they change.

Heather "Lucky" Penney: So, how did Anduril decide to enter this part of the industrial base equation? Because you and your team, you're relative newcomers. What made you think that you could make a difference in overcoming this munitions challenge?

Steve Milano: So, you framed it pretty well. And we like to say that, look at the munitions that we have. The existing munitions portfolio that the Air Force and other services are planning to go to, war with, if necessary. And we look at the quantities and the ability to procure and that combined [00:11:00] with the timelines for replenishment created an environment where we will be out of munitions in a relatively short period of time. Less than a week by some estimates and by the study that, that you all have done.

Heather "Lucky" Penney: Which, by the way, we'll put in the show notes. It's, I mean, it's an evergreen study, Affordable Mass by Mark Gunzinger.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Right.

Steve Milano: Yeah. Yeah, great, great piece of work. I really enjoyed reading through that. So, we saw the existing environment, we saw where the industry was on. We knew what we could do, right? Anduril is a company, it's in our DNA to solve hard problems. This looked like a really hard problem. We were told kind of early on that this was, you know, this was something that was going to be challenging. And if we were going to do it a different way by self investing, by doing the things where we test early and kind of, you know, fail fast is kind of the model.

Um, that it was going to be challenging and it was, but it's the type of challenging that, uh, that Anduril in general finds really rewarding. And so, uh, dive into it, understand what the problems [00:12:00] and complexity are. And I think that we have some, some novel, constructs, but really it's about just doing the things that we knew needed to be done in the industry.

Um, and that is investing ahead of the need, creating modular manufacturing modalities. Those types of things that enable you to be responsive. So, you look at the model of the existing industrially industrial base and you pivot and you do things that are differently. Sometimes that different is painful.

Sometimes you don't get the reciprocity from the services, but you do what's right. You start delivering and that's kind of where we're at now we're starting to see some of those early investments of time, resources, effort, and communication pay dividends in the representation that the services are coming to us. Particularly the Air Force looking at us and saying, this is a model that we want to replicate.

Heather "Lucky" Penney: So Steve, you talked about reciprocity from the service, and that's really kind of the demand signal that the Air Force Munitions Directorate would place on industry, right? This is, these are the types of munitions we need, what we need to [00:13:00] buy. I'm guessing what they're asking for is a lot different from what they have wanted in the past decades.

Is there an inflection point where you saw the demand signal change? And is that reciprocity, is that demand signal really meeting what you think where it needs to go in order to get us healthy again?

Steve Milano: I don't know that the demand signal has necessarily changed dramatically, which may be surprising. Because I, I've lived and worked with, the Armaments Directorate, in the Air Force for a number of years now and I've worked through different integrations of an attempt to try and, accomplish this agile munitions requirements development and fielding, over the past, 10 years or more.

I'm certain that there's going to be listeners that say, I was working this 20 years ago. Okay.

Heather "Lucky" Penney: It just goes to show how hard the problem is, right?

Steve Milano: Exactly. Exactly. So, I don't think that demand signal that we're receiving is much different than we've received in the past. I think the environment is changing to expose the ability to actually get after problems that we knew needed solutions.

And so I think that the Air Force and other services really [00:14:00] are looking at this and saying, this is a time and place where we've got commercial industry and tech startups and international industry that's willing to come

together and actually help solve this problem. And we've also got this confluence of regulatory revisions that are happening where we're actually able to do things faster, buy things quicker.

And so, the acquisition environment is better than it's been. It could always get better. But the demand signal has been fairly sufficient and it's getting, it's getting more and more clear as it gets more and more informed. And we start to get some cycles on that iterative process about what works for us as industry. What works for delivering capabilities to the services and how that process can become more efficient beneficial

Heather "Lucky" Penney: So, you've also, earlier mentioned that Andrews looking at this problem from a different perspective. When you evaluated the challenge of how you surge production, how did you create responsive industry when it comes to munitions production. What's different in what you saw? As opposed to how industry has traditionally been approaching this challenge.

Steve Milano: So, there's [00:15:00] a pretty common, terminology designed for manufacturing, so I don't mean to say that.

Heather "Lucky" Penney: Let's geek out! Let's go all the way!

Steve Milano: So, so when, when, I hear design for manufacturing. I can't help but hear it as like a bumper sticker that I feel like a lot of defense industry partners will like throw around is this is something that we're doing because it sounds good. It sounds like something that you want to hear. Well, I'm designing for manufacturing, so obviously it should be easily manufactured.

That's not always the case. So what design for manufacturing actually looks like it needs to look like is that I understand the sensitivities of everything that I'm doing before I ever cut metal. Before I ever do anything in a factory, before I lay out a factory floor plan, I know what my design is going, what impact my design is going to have on the future materials that are necessary, the processes that are necessary, the testing that is necessary. Because all of that impacts my ability to surge capacity, turn around and be flexible to the needs of requirements and capacity.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Well, Steve, let's, uh, talk [00:16:00] about network operations. We know that Anduril's well known for things like it's lattice software, which, helps tie sensors, processing power, and the effectors themselves across the battle space. Yeah, I'd have to contrast that with the past where we had the idea of a missile having its own seeker. It was

executing a pretty organic, uh, kill chain. I mean, you could say that an F 16 closed the kill chain loop all by itself. But you and your team are taking a very different approach. Mind explaining that approach and then what that means for production?

Steve Milano: Yeah, start on the, I think, the operational side first.

The problem's not an easy one, because I, grew up developing systems that were reliant on the probability of single system kill, right? The ability for one system to be able to track to a target and be able to engage that target and get the intended need. So, the idea that you could disaggregate that and [00:17:00] actually get a more cost effective, effect whether through the system of systems, is something that I'm still wrapping my head around. But the enablers that we have in place today that didn't exist 10, 15, 20 years ago are allowing us to think about problems differently.

And so as we think about those problems differently and we network capability across multiple systems, we no longer need the exquisite seeker that can do all of the things that were necessary. And so I won't go into the specifics of an individual seeker, but as you do kind of different modalities in a single, you know, in a single space.

You're going to create an environment where the complexity of testing goes up, the complexity of materials goes up, and so your production aspects are impacted by that. But also, it doesn't give you the flexibility as an operator to be able to scale the, to scale the effect that you're actually looking for. You're always going to get the effect that you get out of a single system kill type of system. Whereas if you're if you're disaggregating that into a heterogeneous mix of things [00:18:00] that you're sending out, you're able to share kind of those different modalities.

And so one may have a laser seeking modality, one may have RF, one may have IR, and just being able to share across the different, the assets across the everything that's in that ecosystem in that salvo. Will allow you to, uh, will allow you to have a greater mission effect than the single system.

Heather "Lucky" Penney: Well, and also when you've got the different modalities, um, individually packaged, right? You don't have to layer modalities on top of each other in that specific munition. You're decreasing costs. So, you're creating resilience across that salvo. So, the family, when you're shooting it out there, and let's just be honest, it's ammunition.

So, it's a one way deal, right? It's not coming back. So you need to make sure that you maximize your cost per effect. Um, and so it also, it decreases cost within that family of systems when it's a heterogeneous salvo like that.

Steve Milano: That's absolutely correct. And that's the way that we look at it is like the net, the net cost of the effect that you're trying to achieve.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): And we're also talking about geographic space. I mean, [00:19:00] these, these pieces of that kill chain can be very well separated in, in space, right?

Steve Milano: Yeah, I think that's another aspect that we're slow to respond to as a as an ecosystem, both industrialized and service. And, and what does autonomy and having all of these autonomous things in the air do for you? Because, we're talking about munitions today, but really what we're talking about is autonomous air vehicles, whether that's a larger CCA, smaller munitions. If it's in the air, it is a node. If it's a node, you have the ability to connect to it. So, I don't know that we're necessarily taking advantage of that adaptive web that we're creating to the greatest effect. And I think that we'll see that over the next handful of years that the maturation of the linkage of those effects is going to give us greater CONOP ability.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Yeah.

Heather "Lucky" Penney: I know. So I'd like to dig in that a little bit more, Steve, because, uh, obviously with the lattice software of Anduril, I mean, AI is a huge player in that.

So, could you speak more to how you see the family of systems evolving [00:20:00] regarding the networked nodes, if you will, uh, not just within the munitions, but across the portfolio?

Steve Milano: So mission autonomy, the way that it's baked into munitions today is, it's kind of a service in the software and it's not doing service to the munitions that or the capability that you're offering up. Where you think about software as it's running on, uh, any individual munition. It is a, it's an aspect of what the munition is actually trying to go do, but it's not a mission system today.

So like as, as the way that we think about advanced effects, the way that we think about munitions is that, mission autonomy is a mission system. And it's a domain space that you can interact with. It's a domain space that you need to be

able to take advantage of. And so as we integrate this into the base layer, we're taking behaviors from other places and integrating them into munition systems and sharing those behaviors back and forth.

Lucky, I think, I think that you actually saw a demonstration out.

Heather "Lucky" Penney: I did. I did. That was, that was pretty awesome. I mean, like, so one of the things [00:21:00] that's very interesting about your approaches, you're not having to reinvent that mission autonomy for every individual platform that you have out there.

You're basically taking that, foundation, that baseline, and that's going to increase your effectiveness overall because you have a lot more data points, but it also going to decrease the cost because you're amortizing it.

Steve Milano: That's right. That's right. And it does become a little bit of an acquisition, uh, not problem, but it's something that, that I think we, we need to like look at because we buy software. Or the defense industry provides software, the services buy software, but how they acquire software for different systems is different. So, mission autonomy is, should be viewed as the mission system for all of these platforms.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): So, let me, go back to the, I guess you'd say CONOP. How does the approach you're talking about evolve? You know, depending on the threat environment, there's going to be times when jamming is extreme and that's the jamming of links that bring all this together.

Other times [00:22:00] will be more permissive. So, how do your munitions architectures adjust given those variables?

Steve Milano: Yeah, it it's physical and software, right? So, the modularity that we, that we bake into all of our systems, both at the software packet level and at the hardware level enables us to adapt to those different those mission spaces.

And I think that the modularity allows us to pick and choose and provide option, optionality. So, that you can go and achieve the effects that you're looking for. For a given mission, but also having the software baseline and understanding what the understanding what your integration capability is so that you have that flexibility across all of those hardware platforms, is what gives you is what gives you that flexibility.

So, we're only able to be adaptive and responsive to those requirements as they change because we built it in as part of our foundation.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): You know, one of the keys to enhance production is not to overdesign everything. Of course, [00:23:00] you want to meet the operational demands, but anything more than that's going to boost cost and drive timelines, right?

Steve Milano: Yeah, that's right. And as we talked about, having the modularity to be able to pick and choose four different mission sets and being able to disaggregate, a very complex seeker into an, on average, lower cost seeker per effect. The same thing is true for the cost of your munition stores.

So, having the modularity allows you to buy X number of secret modalities, X number of payloads, X number of propulsion systems and being able to switch them in and out. And that's a little bit of an oversimplification of kind of the Lego bricks that built up capability.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): I like this approach.

Steve Milano: I'd love for it to be that simple and we're getting there, but yeah, it's something that we're, we're working towards, but having that flexibility allows you to, you know, not have to keep everything on the shelf all the time and be able to keep costs low. Because then when you really do need that exquisite capability, you have the ability to plug it in, but you don't need tens of thousands of them on the shelf and use them for what they're really intended for.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Good point. Good point.

Heather "Lucky" Penney: [00:24:00] Speaking of developing all of that, let's pivot back to the Air Force. A few years ago, they launched their Enterprise Test Vehicle effort, which sought to harness a lot of these design attributes we've been talking about. And you were part of that program. So, I don't think a lot of people really know what Enterprise Test Vehicle is and how it started, because it certainly evolved against something so much more.

Steve Milano: Yeah, absolutely. And a shout out to anybody listening that's worked on these efforts in the past that will appreciate the, the little bit of history here. Uh, but the Enterprise Test Vehicle is not the first time that the Air Force has looked at this kind of agile weapons development and employment.

Uh, so the GB, GBUX program, the Global Precision Attack Weapon Program, all had fits and starts where they added to the baseline of what eventually became the Enterprise Test Vehicle Program. And what that is essentially a, uh, an autonomous air vehicle that is designed to prove out, uh, mission systems that will ultimately be fielded in a future capability.

The Enterprise [00:25:00] Test Vehicle Program is broken up into design cycles where we add iterative capability into the platform. And prove out those different mission systems that ultimately lead to a capability. And where Enterprise Test Vehicle, the Enterprise Test Vehicle program has gotten, uh, this right, where others have not been able to see it all the way through to completion, is that, this program has an end state operational effect in mind.

That they're working towards and it's the affordable mass missile. And so, that iteration and what those mission systems actually look like are going to be parts of the design cycle that get iterated into the platform, flown, tested, iterated on before we actually move into production.

The, uh, the Enterprise Test Vehicle Program will yield this affordable mass missile that will then be modular manufacturing capable. Insensitive to different supply chains, so I should, we should be able to move, the affordable mass missile production to anywhere in the world. Not have counterdependent and [00:26:00] codependent supply chains so that you don't have that same type of pressure that you have across the munitions base now where if I ramp up one program, it impacts another.

So that's one of the core themes of actually delivering this affordable capability.

Heather "Lucky" Penney: I did not know that. That's super interesting. So, is this, is this something that we could share with partners and allies in terms of the industrial base and production?

Steve Milano: Yeah, the intent of being the baseline intent of the Enterprise Test Vehicle Program is to expand. Expand the manufacturing footprint in an expeditionary basis, and the design modality is such that it's designed for export ability. There's nothing in the baseline platforms and having the modularity in the mission systems allows us to kind of work independently, share those resources with our partners and allow them to develop their own mission systems and integrate into that ecosystem.

And so, again, not easy going back to the Lego building blocks, and now we're talking about different blocks from different players. But, um, but [00:27:00]

that's the end goal of what we're working with the Air Force to try to accomplish here.

Heather "Lucky" Penney: Yeah, you need to make sure that all the interfaces and data message sets and all of that, all those standards are interoperable.

Steve Milano: That's right.

Heather "Lucky" Penney: As well as physically integratable, right?

Steve Milano: Yeah, there, there is a software aspect of it and there's a hardware aspect of it. Both are, equally difficult. If you've ever been in Asia and tried to buy a light bulb for a US lamp, you've run into the type of hardware interface problem that, we're up against.

Heather "Lucky" Penney: Or traveling to Europe and you got to go buy the brick of the different, uh, electrical sockets.

Steve Milano: Exactly, right.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Oh, that's right. That's right.

Heather "Lucky" Penney: So if, I was to go out on a flight line, what would an ETV look like?

Steve Milano: Ah, yeah, so the employment of an enterprise test vehicle in its current instantiation is going to be a cargo airplane launch.

So, like a C 17 or C 1 30. It will be extracted from the back of the cargo aircraft via parachute. And it'll, uh, it'll hang under parachute until it gets to [00:28:00] a certain altitude and then, uh, a number of, a number of these Enterprise Test Vehicles, affordable mass missiles, will uh, be deployed from the bottom of the carriage system. They'll gain stable flight and they'll fly off and perform their mission.

Heather "Lucky" Penney: So, kind of like Rapid Dragon?

Steve Milano: So, Rapid Dragon was the test instantiation for the actual carriage system and the release to prove that, uh, I could, you could take off and land with something on board. You could take off an air drop something, uh,

out of the back that the carriage system actually worked, that you could deploy an existing system.

Uh, but going back to the availability of munitions, why Anduril got into the munition space, uh, is that if you were to load existing munitions onto a Rapid Dragon. That pallet becomes very, very expensive. And so, if you're looking at the effect per pallet, you're, you would like to be able to transition that down to a lower cost thing.

And so, the Enterprise Test Vehicle Program has a target of \$150,000 per base, uh, base [00:29:00] munition.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Well, Steve, I really want to get to the stuff that's really interesting for, uh, Lucky and I. Which is, uh, opening up that can of beat them up, you know, special delivery to the bad guy. Uh, no, where, where do you currently stand in your munitions portfolio?

What do you, what are the main products you're working on?

Steve Milano: Yeah, so, this past year or earlier this year at AFA, we went public with our Barracuda line of, um, autonomous air vehicles. Those are air breathing, cruise missile type capability, our Barracuda and our Barracuda M, which is the munition variant.

The Barracuda 100 is, roughly 70 inches long, 6 inches in diameter, the range of about 140 miles. And its form factor is kind fitted for, rotary wing, soft insertion type of thing, uh, those types of, uh, utilizations. Our Barracuda 250 is slightly bigger than that, uh, greater than 200 nautical miles of range. Similar size, [00:30:00] 72 inches, about seven or eight inches in diameter, kind of in that STB2 like form factor.

And then our Barracuda 500, the larger, 144 inch, eight to 10 inch, form factor, 500 nautical mile endurance. That's base platform for our, Enterprise Test Vehicle.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): All cool stuff.

Heather "Lucky" Penney: Yeah. So, again, within the Barracuda family, it's both scalable in size and range, uh, and, and explosive payload. But you also have that foundation of software, right? So, you're, you are taking this Lego approach to the Barracuda family.

Steve Milano: That's right. Anduril at its heart is a software defined, hardware enabled company. So, um, so everything that we do and it's tough for me to say that as a munitions person. Like I said, I've only, worked munitions my entire career.

So, but I do believe that, what it, what actually enables us to go fast is that everything is software defined. And so having vehicle management systems, guidance navigation, and control that's common across, not just [00:31:00] our autonomous air vehicles, but all of our platforms. We get that learning that we talked about earlier across the different platforms and the families of systems so that no one program is burdened with the learning or the investments necessary to prove out any one capability.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): And it's interesting that the family that you just described, I mean, it spans quite a broad range of tactical situations, right?

Heather "Lucky" Penney: Yeah, absolutely. So, this entire approach from the family of systems to how you, you share software across a variety of different programs, that's got to be challenging, not just from a programmatic approach, cause you're, crossing different programs and different services, but for the testing approach as well. So how are you testing these products? How are you testing the software?

Steve Milano: So, the way the Andrew approaches development is essentially to develop and test ahead of need. And so a lot of our baseline is, uh, is looking at the sensitivities of what we know the capability set is going to need to be delivered. And so we will [00:32:00] pivot, test, and do these things that are necessary that we know that are necessary to deliver the end capability.

And then once we're referring back to the programmatic, once we're on program, once we're executing on a specific ground, contract. It's easy for us to tailor from that, baseline that we've already proven out. One of the things that we, tend to do very well and quickly is, we fell fast, we test fast, and we, we test again and test again.

And so, we have our own test ranges. We have our own pilots. These are the things that enable us to go very quickly in a lot of these test isms. But doing those things ahead of, need, flying the software capability, flying these different, in these different environments allows us to do that learning at a much faster pace.

Heather "Lucky" Penney: So, are you seeing the government accepting your test points, even though it wasn't done underneath their oversight?

Steve Milano: So, I'm going to answer two questions. One that you asked, one that you didn't ask, uh, and the answer is so far, yes. In the early stages, as we start to develop some of these capabilities, they're actually very appreciative of [00:33:00] our ability to move quickly and and kind of offer solutions.

And the test architecture is kind of one of the one of the things that we do well. And one of the things that moves that helps us move quickly. But it is really just the nature of going quickly, working, but working and partnering with, the customer organizations. And to answer the question you didn't ask, which was how do you actually move quicker through those processes and those test processes?

The answer's kind of the same. it's partnering early. It's having those conversations because there's a legitimate need for the Air Force Equal Organization. For example, uh, the legitimate need for NSA certification of certain capabilities. There's a legitimate need for FAA certifications for test ranges and safety.

And so as we go through those processes, it's not about how do you work around them or how do you bypass them? It's that how do we in this new environment of having to go faster than the traditional acquisition and fielding process has allowed. How do we work with you to go faster? How do we bring the same innovative vigor that we have in our design and testing protocol [00:34:00] to these processes that have tended to slow programs down in the past?

Heather "Lucky" Penney: No, I've always said that the third offset is really about time. Whoever is able to move fast and iterate more quickly is who's going to win the combat advantage because no longer does the US have a monopoly on innovation and engineering.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): So, I'm very curious, what aircraft have you certified these munitions on from Anduril?

Steve Milano: So, for the Barracuda 100, we're targeting kind of the rotary wing aircraft. It's flying on our test ranges right now. Certification wise, we're working through that process with the Army for rotary wing aircraft. As well as some fixed wing.

For the Barracuda 250, intended for internal carriage, external carriage on fixed wing. We're working through kind of the wickets of the UAI integration and all of your typical kind of safety protocol and those types of things. So, flying that platform as well, but, certification wise, it's not quite there.

But we're working through those processes and the Barracuda 500, has been launched at our test site. We flew it, about two months ago [00:35:00] now, off of one of our externally carriage cells. We were talking about earlier about how the cells will kind of come out of the back of a C 17 ish thing.

And so, we launched off of the back of that. And so, as far as direct certification on existing platforms, we're working through that. That is a timely process. And it goes back to what I was talking about before is that we're learning a lot about what the safety review boards require to get certified. Some of the things there's good findings and bad findings and there's there's ways that we can help them with their process.

There's ways that they can help us with our process. What I found is a very receptive community to changing processes where there's room to, to actually change and accelerate. So, hopefully 25 is flush with announcements of, you know, declared operational capability.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): We're looking forward to that. Neat stuff.

Heather "Lucky" Penney: So, let's talk then about production and the production enterprise, right? We've read articles Anduril's plans for hyperscale manufacturing and arsenal. So, what does [00:36:00] that mean when you, rubber to the road. What does this mean?

Steve Milano: So, hyperscale manufacturing starts at the very base of how you're doing things. So, if you come out to our headquarters in Costa Mesa, what you will see is a modularized manufacturing cells. And so it is this low scale early manufacturing setup. That scale is the same thing that you will see at our 5 million square foot Arsenal One facility that should be announced in 2025.

The location of where that's going to be, we're not waiting for that, to actually be built and up and running in 2025. We're actually already breaking ground on the initial manufacturing capability that will be done by the end of 2025, but that ground breaking has already occurred.

And so, we're leaning into build fast. We need space to go build these things. That's you can't get away from physics. It takes space to build munitions. Go figure. And so, we're leaning ahead in building those things out. But what we're [00:37:00] proving out now is, the design sensitivity that I mentioned earlier that we can understand.

Do we have the model for manufacturing scalability set in our smaller facility? That we can just duplicate that again and again, again, incorporate learnings as we go through the process. And so, we've gotten a lot of good learning out of these initial builds. We understand our processes and we're feeling really good about how we hyperscale into these new facilities.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Well you've got some good learning. It sounds like it's hard, to put this all together. So, what are some of the big lessons so far you've learned?

Steve Milano: The big lessons that we have learned so far in the munitions manufacturing realm is that don't automate too quickly. Understand your processes, understand where your actual sensitivities to production workflows and the impact that it has on your ability to deliver.

Look at your material handling and supply chain organization. Just in time is great. Just like we talked about the just in time delivery of [00:38:00] munitions, just in time delivery of material is great sometimes. But if you have unexpected long leads, those types of things, so the way that we've developed our approach is such that it, it's adaptable to the elasticity of the supply chains, the elasticity of demands and requirements and being able to stretch and flex within those.

So, not documented or not overly automating, the process too early on. Understanding where you have that flexibility and that allows you to, allows you to be nimble and then you can start to move quickly once you have a baseline for repeatability. I think that was one of the early things that, uh, I can't take credit for that.

We have a lot of great people that work at Anduril, but I believe it because I built a lot of missiles in my life. And I've seen, uh, I've seen automation come too quickly. Having robots running around the factory is really interesting.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): This is so interesting what you're saying.

Steve Milano: It's, it's really interesting and it's counterintuitive to say, nope, nope, get rid of the robots. And actually, you know, humans faster and better at doing this. Um, but sometimes that's the case. Maybe it's not, it won't always [00:39:00] be the case, for different processes. But understanding that and not having this kind of sunk cost fallacy of just like, nope, we invested in this testism and we're going to use this test thing. Or this manufacturing modality, or it looks really neat.

Heather "Lucky" Penney: The shiny factor isn't always the reason to go do something, right?

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): That's true.

Heather "Lucky" Penney: It's interesting how you say that humans end up being the most adaptive and cross taskable, right? Uh, you can train someone to do one task and then also then retrain them to go do something else entirely different, or even do those same tasks, but just in a different way. So it's interesting, you also mentioned the need to be flexible, and that's going to be key as we move into future munitions. I, I view munitions as having a much more rapid modernization cycle and innovation cycle than, for example, larger aircraft.

Uh, and so in many ways they could be the leading edge of capability. And I think that a lot of what you've been talking about is doing that. So, in the real world environment, like Ukraine or the Houthis or new capabilities that we're seeing fielded by China. How are those shaping your thinking and what are the key trends that we [00:40:00] should watch in this modernization cycle and cat and mouse game?

Steve Milano: Yeah. We talked about it a little earlier in the flexibility and requirements generation. So, so, you're making me think really hard about how to articulate this efficiently but the idea that munitions tend to be at the forefront of the necessity of cutting edge technology is true, but the requirement cycles are the same as larger, longer period, acquisition programs.

And so how do you square that corner, right? And part of that is having some adaptability and flexibility in how you define and execute on requirements. And so that learning that we get from seeing what's happening kind of Ukraine with the Houthis and around the world and kind of like that responsiveness that we get, it helps us understand the requirements we're willing to take on and how we negotiate those with the services.

And so, as we get into these different contracting mechanisms and as we have these relationships with the different services. It's, it's defining. You may want this capability now, but what happens if [00:41:00] this one real world situation changes? Now does that completely change your requirements baseline? Because I don't want you to be locked in to me delivering something for a war that's over.

Heather "Lucky" Penney: Yeah.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): No, that's a tremendous, tremendous, character, benefit, from your company is that you would, because you're so global, innovative, that you bring that back to that discussion, kind of a negotiation.

And there are a lot of bad lessons, you know, that are being learned from Ukraine that folks are maybe, uh, persuaded by and they're just not relevant necessarily in the next turn. In the battle space.

Steve Milano: Yeah. it's a great point. And it's something that we were keeping our eye on, but I think that more importantly, as a nation we're keeping our eye on. Is that just because lessons are being learned, doesn't mean those are the lessons that we need to carry into the next peer fight.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Well said. Very well said.

Heather "Lucky" Penney: No, it's really interesting about how we need to be more flexible in our requirements in terms of the requirements generation for you to be able to design to, because typically what we hear from industry is we need stable [00:42:00] requirements. Because engineering change orders and in requirements creep ends up driving a lot of cost and driving more time into the design and the development and the production.

And so, how do we then become more responsive to the changing, to the changing battle space? At the same time, providing the right signals to industry and the right resources to industry in order to enable you to be there and to scale at the rate that we need?

Steve Milano: Maybe this is where another area where Anduril is uniquely positioned as you know, as an early and it's a nontraditional company coming in with kind of a tech startup type of mentality of things.

The way that we look at problems is to look at problems and solve for that problem. Not necessarily wait for that problem to be contracted because like, by the time you've waited for the problem to be contracted, the operator is like, well, I've already solved it with the things that I have, right?

There's a bubble gum and shoelace type of solution that they've already figured out. And then 10 years later I show up with this, that [00:43:00] solution. That just doesn't work. And so I don't think that it's in our DNA to like, operate that way and I think, that leaning ahead of the need, investing ahead of the need, doing the things we as Anduril kind of like, just do naturally is going to be what's necessary.

So, uh, I don't know that, we're going to have too much of a problem with identifying kind of this fluid requirements space and like having to adapt to these fluid requirements, uh, derivations. I think that the, in general, the defense industrial base will have to adapt to that because we live in an ecosystem and not everyone in that ecosystem is on board with flexible requirements generation.

Heather "Lucky" Penney: Build it and they will come. And actually, that's really what Kelly Johnson originally did with U2 and the SR 71 and, but we've migrated a long way away from that. And it sounds like we need to get back to that because, you know, unsolicited, proposals, I think we need to be open to that.

If we're going to enable companies like yourself to be able to move fast in that way.

Steve Milano: It would allow us to take the risk, right?

Heather "Lucky" Penney: It rewards the risk takers.

Steve Milano: That's [00:44:00] right.

Heather "Lucky" Penney: Problem solvers.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): So, you know, we've had a great discussion here, but I have to ask you, where do you want the company to be in about five years?

And, you know, if we look at where are you going to be along the way, how can we grade you? What should we be looking for? Uh, five years from now.

Steve Milano: Yeah. So five years from now. The existing programs we talked about, the Barracuda systems, in full rate production, and seeing what that scalability and that actual, like, increase to scale looks like across our existing facilities and what our Arsenal 1 will look like. If we're able to adapt to those requirements, because the requirements we get today are not going to be the 2029 requirements, and so as we're reflecting back, will we be able to look and say there's about 15 different variants that they pumped out of the same factory and they didn't skip a beat?

I think that that's going to be the scorecard that we should be measured against, at least for the Barracuda line. The other thing that I think that would be, um, would be good to kind of look at any organization like Anduril, but Anduril in particular in my advanced effect organizations [00:45:00] organization, um, is it where else can we apply these modalities?

So, is the air-to-air domain right for this type of revolution in requirements, generation, production, and those types of things? Where are also the really hard problems in the munition world that we can go after. So, in five years, if we're looking back and the only thing that we've done is disrupted the Barracuda, you know, the air breathing, uh, munitions capability set, that's interesting.

But probably doesn't, make a dent in the overall problem that we have. So, I think that if we look back in five years, I'd like, I would have liked to have said that, we have a holistic, we built a holistic plan about how we help the industrial base. But the way that we iterate and change and do things, I think that if anything I predict today is going to be different five years from now, you're going to be like.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Yeah, no, I hear that.

Well, we're going to be watching, we're going to be watching and, uh, really hopeful because you are an incredibly innovative company.

Heather "Lucky" Penney: Yeah. And the Air Force is on really on the verge of total transformation. So, this is really exciting. And thank you for being here today.

Steve Milano: Yeah, I appreciate you having me.

It's [00:46:00] great.

Heather "Lucky" Penney: With that, I'd like to extend a big thank you to our guests for joining in today's discussion.

I'd also like to extend a big thank you to you, our listeners, for your continued support and for tuning into today's show. If you like what you heard today, don't forget to hit that like button and follow or subscribe to the Aerospace Advantage. You can also leave a comment to let us know what you think about our show or areas you would like us to explore further.

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Okay. All right. That's

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): fantastic, dude. I

Heather "Lucky" Penney: totally want to come out and see one of those are some, I know

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): we're always trolling for a visual aid. So

Steve Milano: we, uh, well, I'm not sure if I should say where, which window I look out, but if I look out a window, I can, I can see trucks moving around and, and, uh, I call them, uh, the mini arsenals [00:47:00] because while arsenal one is the, you know, the big, the big factory, the big 5 million, 5 million square foot.

Uh, facility that's being built. Uh, it's the same. Kind of like instantiation. So there's other facilities that are being built up for this capability. And it's, it's really interesting to see how quickly we move

Heather "Lucky" Penney: there. I used to have a coworker and actually flew with them. Uh, predator Doherty. Oh yeah. So, so predator used to say, cause you know, you're only as smart as your last trip to the plant because things were always changing and, and, and to get to talk to the folks that are actually doing the work, um, and, and interface with the engineers.

And so the opportunity to come out and see everything that you're doing, um, So I've been down to the test site in the middle of nowhere, Texas.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): I wouldn't say nowhere, it takes a little to get out there. No, no.

Heather "Lucky" Penney: Well, okay. I'm a Westerner, right? So like, I love, I love the desert. It was great. But I mean, if you were like three, four hours away from Midland, Texas, you're pretty much nowhere.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Yeah. But every 16 has their [00:48:00] own brisket recipe. And it involves some form of alcohol. I'm on board.

Heather "Lucky" Penney: Yes. I am on board. And we may or may not serve that

Steve Milano: on a regular K 5 food record out there at our test site. Well,

Heather "Lucky" Penney: you just, you just uncovered my absolute favorite food, so there we go. Oh, there

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): you go. No, it's, it's really exciting to see what you're doing.

Yeah,

Steve Milano: it's been a lot of fun. Like I said, I've been in this industry for 16 years now and just like the amount that I've learned in the year or so that I've been at and roll not quite a year. We, we, uh, we

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): were at

Steve Milano: a

Heather "Lucky" Penney: reception, sorry, go ahead. Yeah,

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): we were at a reception, uh, and Andrew was there, had some, uh, um, mock ups and that kind of thing.

It was amazing how it, the crowd was bristling with, you know, just this energy. And of course you had your iconic leadership there. Everybody got gathered around to listen to the, the, uh, you know, the font of everything. And, you know, it was really fun to be in that environment. Very youthful, very energetic.

Heather "Lucky" Penney: Yeah. The youth [00:49:00] was what I was going to talk about. Like going out to the test site, it was really exciting, not only to see Um, to see the test site, to see, to see the artifacts and to watch the demonstration, but interfacing with engineers, like, they're all like, I don't know, 17. Oversteating. But it's, but they're young and they're vigorous and they're exciting.

It was kind of like how I envisioned the Apollo program was back in the day, right? Because all these kids are, you know, working 20 hours they're at a test. essentially a deployed location, right, uh, for, for a portion of the time, because not all the families are moving out there. And it was just, it was just really invigorating and, and hopeful, to be honest.

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): It's interesting.

Steve Milano: Yeah. It's, it's definitely an environment, right? Yeah. There's the environment needs to be right. And it attracts the right type of people. Uh, yeah, it's a lot of fun.

Heather "Lucky" Penney: Awesome. Well, thanks for joining us. Yeah,

Steve Milano: this is great. Thanks

Maj. Gen. Larry "Stutz" Stutzriem, USAF (Ret.): Lucky. That was great.