Episode 211 – Technology, Competition and the Tactically Responsive Space

Speaker: Jiral Shah, Vice President of Business Development, Gravitics – 23 minutes

John Gilroy: Welcome to Constellations, a podcast from Kratos. My name is John Gilroy and I'll be your moderator. Today, we will explore how emerging technologies in satellite design, modular platforms and rapid deployment are shaping the future of space operations and national security. Our guest is Jiral Shah, Vice President of Business Development at Gravitics, a company at the forefront of next-generation space structures and modular space station platforms. Gravitics was recently recognized by SpaceWorks, the US Space Force's commercial outreach arm, for its work on tactically responsive space systems. Well, Jiral, that's quite a mouthful. What does tactically responsive space mean from a technology standpoint and how does it reshape satellite design and deployment timelines?

Jiral Shah: Yeah, it's a pretty loaded question. I mean, when we think about how we can conduct war in some of the other domains, land, maritime, air, everything is really optimized around this concept of rapid response. Our jets, our carriers, our missiles, tanks, they're all designed to maintain positive control over a battle space. Over time those technologies have evolved to be force multipliers, so meaning they can do more than just a single function. And those innovations have allowed us to maintain space superiority, and that's really the core of what tactically responsive space is.

Unfortunately, when we look at the space domain, China, and to a lesser extent, Russia have begun conducting dogfighting exercises with satellite. They've grown very advanced and aggressive in demonstrating maneuvers around refueling, robotics, taking out our satellites, and it's directly putting those assets at risk, both commercial and military assets. So this term “tactically responsive space,” is really focused around addressing threats to our nation's most critical space infrastructure. And so the technology required to fight a war in space has to be on a timeline that aligns with operational tempos, which is in hours, not days, not weeks, not months. And so that term “tactically responsive space” is really around bringing to life the technologies that can address those threats in a very timely manner.

And just kind of zeroing in on just a little bit more of that, when we think about space, it seems so unattainable. So far, we're always envisioning what a fight in space would look like and so the technologies that we're focusing on, building strong logistics chains. The same way that we fight wars in the other domains, logistics is the key, and being able to forward deploy those assets instead of launching them, which can take time to prep. The other aspect is focused on

mobility. I think there's a lot of time and energy that the DOD has put into that area, but we have to move faster. And so those are kind of the two technology areas that I really see we want to improve on in order to help improve the kill chain for tactically responsive space.

John Gilroy: Yeah, let's talk about that word faster there. So what innovations in space station structures are enabling faster mission turnarounds and responsiveness to these emerging threats?

Jiral Shah: Yeah, I mean those two innovations that I had zeroed in on, being able to move in space and being able to kind of pre-position these assets, forward deploy those assets, I think those are going to be the key things. And what we're doing here at Gravitics to enable that is employing orbital carriers. You can think of these as large hangars on orbit. The non-space term that I like to use for people that are not in the space industry is a satellite vending machine. It essentially allows you to pre-position something and deploy it on demand, and it has to be in tactically relevant timelines. So in hours, not days, not weeks, but having that capability on orbit really allows us to have that unfair advantage that our adversary doesn't have because we gain the time advantage.

John Gilroy: So you mentioned a pre-position that seems to be important word for this discussion. So how does the evolution of a pre-position launch pad in space support the Space Force's need for launch on demand and dynamic reconstitution?

Jiral Shah: Yeah, John, our launch pads, you can think of them as really the gateway to space and it is the only way we're going to get there today. And so we've got several spaceports in the US that can launch like a medium class vehicle, notably those are Cape Canaveral and Vandenberg, you can add Wallops to that conversation as well as Rocket Lab starts to build that out. But when conflict breaks out, those spaceports are an immediate target. So in the time of war, you can't operate at the same level of confidence that you can in peacetime, and it doesn't take much to even just disrupt operations at these launch pads. You can consider a non-kinetic effect like jamming that can severely disrupt availability of that launch pad, and that can delay our speed of war, if you will. So by pre-positioning assets in orbit, you can instill a higher level of resiliency and you can still ensure that our assets in space are protected when a terrestrial launch pad is not available.

That is a complete game changer, because what it allows us to do, it allows us to ensure that whether we need to reconstitute a satellite, like GPS, satcom, we need those to fight through the war, we need imagery to inform the war. If those assets are not available or not protected, we cannot win that war. There's no doubt in my mind because today, a jet does not leave an airfield without satellite coverage. A ship does not leave the port without coverage. And so

being able to protect those assets is going to be incredibly important. And so you can consider a space-based launch capability or a pre-positioned launch pad in space as the next layer of resiliency in order to protect our space domain.

John Gilroy: There are people listening to this all over the world, maybe they're imagining this whole concept of a space platform and let's maybe dive into that a little bit. So what are some of the core engineering challenges in designing these space platforms and how can they be integrated and launched on really short timelines?

Jiral Shah: Yeah, it is not an easy feat. Anytime you're launching something in space and you're dwelling in space for a long time, you have to consider the effects of the space environment, an incredibly difficult thermal environment, the radiation environment, and now with micrometeorites and orbital debris, it becomes very challenging to start to piece together every subcomponent. So the solve problems are satellites. We've designed satellites in a way that allow us to operate in a space for a long time, but translating that into a larger architecture, how do you keep orbital vehicles in orbit with propellant inside that's ready to go for a long period of time? And so we're spending a lot of time both within our teams and our partners to start to answer those questions and start to figure out the technology that's needed to overcome those challenges of dwelling in space for long periods of time, and then being available on a moment's notice to deploy out.

And then in general, for the space industry, I think a big push recently has been around mobility. So I'll bring up two concepts or two technologies that are always going to be in demand, which are mobility, which is the ability to move something from point A to point B, and power. So those two, if we can provide more mobility and more power, you can do more. And so from a KPI perspective, you can use those two technology areas to baseline the capability. Oh, our adversary has more mobility capability than we do, that means they're going to outmaneuver us. They have more fuel than we do, they can move faster than we can. And then on the power side, the power is the basic commodity of anything in orbit. The more power you have, the more you can do, the more applications you can run, the more compute you can get after. So I think as an industry in general, we're going to continue to solve mobility and power and continue to improve on those two.

John Gilroy: Yeah, yeah. And I think another word is flexibility, and I think that's what I want to ask you about now. So I know there's challenges in the whole idea of space platform. So what challenges exist in creating satellite platform systems that can both deploy quickly and also remain flexible for multiple mission types? Because you don't know what's coming around the corner, do you?

Jiral Shah: Absolutely. I think that's actually the key. You nailed it, which is you don't know what kind of threat you're going to go up against at any given time. Maybe you can predict, but you can't have one response to a wide variety of threats, and that is going to be the fundamental problem. So when you look at space, what kind of threats do you have that are driving some of the need for flexibility? You look at threats like, and this is all kind of on class, but kinetic threats like anti-satellite weapons, grappling or robotic arms that can de-orbit our satellites. And you could even look at non-kinetic applications like close inspection. Is an adversary satellite getting really, really close to ours and taking pictures or collecting signals, or are they kind of offensive, non-kinetic? So directed energy, weapons, lasers to kind of blind our sensors, jamming from an RF perspective, those are real threats and they're all different threats. You can't use the same response.

So I think mission flexibility is paramount if we want to succeed. And indeed, it is very important to have the right response to a specific threat. And so for us at Gravitics, the way that we're thinking about that with our orbital carrier is we want to have different types of response vehicles on orbit pre-positioned. So just like, and pulling that vending machine analogy in here, some days you might want FUNYUNS, but some days you might need Doritos or something else. So you have to be ready for what is being anticipated in that moment. And so I think having that pre-positioned on orbit and flexible mission types is really getting after a unique architecture.

John Gilroy: Yeah. Well, it seems a lot of challenges just in developing a space platform today. And looking into the future, I imagine the word autonomous is going to be floating around somewhere in the future that can respond quickly and not have to worry about much human intervention, but there's problems involved in that too. So looking down the road, how might this kind of platform evolve to fully support an autonomous rapidly deployable space architecture, that's got to be in the future, isn't it?

Jiral Shah: Not as future as you think, John. I mean, today, if you think about satellites, they are in some way, sense or form almost fully autonomous. We're looking at new startups that are coming out that are talking about constellation management through their software defined platforms. And we're living through this golden age of autonomy and AI that's coming in, when you think about, I'm going to overlay kind of a DOD scenario here, you think about a kill chain in space, being able to, number one, detect what's happening, decide what's happening, and then deploy a solution set. The more that we can do in a shorter amount of time helps us shorten that kill chain.

I think one application of, and I'm going to kind of overlay autonomy, kill chain and space all in one. I think the first thing that comes to the tip of everyone's tongue today is Golden Dome, or missile defense. When we look at the

technology stack needed to address space-based missile defense, you're really talking about this integrated autonomous system that's got three kind of elements to it.

Number one, it's embedded within the information layer. And we've got that, right? If you think about sensors today, our sensors are incredibly advanced. We've got the communications network, so it's number two. That information layer is going to drive the need to process that information and disseminate that information so that we can number three, act on it. And so the third element here is you need an autonomous system that can deploy an effect, so think about space-based interceptors. So the technology stack needed to execute that in space is still being worked through right now, but I think autonomy is going to be a part of how all of that gets implemented, and it's going to be the success... The successful implementation of this is going to be, hey, you can do the full kill chain in a very rapid amount of time. I don't think you'll be able to take humans entirely out of that loop, but the more that we can do to help inform that human that's making that decision, it's going to be value added.

John Gilroy: Let's touch on maybe some commercial aspects of this too. So how do modular space platforms contribute to lowering barriers for commercial organizations to access space and participate in emerging space markets?

Jiral Shah: Yeah, absolutely. I think modularity, I'll talk about modularity in kind of space station modules, which is kind of what our core focus is. When I think about, three years ago, John, if you went out to the marketplace and you said, "I want to buy a space station module," And I don't know where you could go. You'd be hard-pressed to find a supplier. And when you do find that supplier, you'll realize that it was a single source of foreign supply chain. And the fundamental problem kind of in this, and it's important to frame the problem so we can understand what the solution set might be. But the fundamental problem in this space station, modular space station industry is that it took NASA decades to build the International Space Station and it was all done in this cost plus fixed fee manner. Now that doesn't really bode well in helping commercialize a technology. If NASA says, "Go and build this," that's what you went and did. It's not optimized for mass production.

And so what we're doing here at Gravitics, like bringing in the modularity aspect to this, is we're building these common core platforms, these modules for the entire industry, from space stations to orbital carriers and everything in between. And by focusing on manufacturing a common chassis and manufacturing for scale, we're actually able to bring the cost of a module down and increasing the access to space real estate.

So now something very special happens when you give this industry a new way of thinking about space, they start to come up with their own ideas on how to

use that. Case in point, you look at what SpaceX did, they completely removed that barrier of access to space. And from there on it was like, "Oh..." I'm not going to say John can go off the street and buy, but John can go off the street and build his own satellite and get it launched now, that wasn't possible 30 years ago. You needed a lot of money, you need a lot of technology. Now, I don't have to become an expert in rockets to make that happen. And rockets are a good kind of example because they are dual use.

When I think about space infrastructure, they're absolutely going to be dual use. The first use case that everybody thinks about when you think about a space station module is human-rated habitats, the International Space Station. That's great, we're actually moving in that direction. But for the first time, the DOD is starting to take note. And over the last three decades while the International Space Station was being built by NASA under the banner of civil space, DOD never really participated in it because it was mostly a NASA thing, it was a civil space thing. But now the DOD is coming in here and they're taking concrete actions towards moving towards large infrastructure and space with our orbital carrier. But in their eyes, this was always a civil space area of responsibility. So lowering the barrier for commercial organizations is great, and you do that by building for an industry. You do that by building a common core interface that a lot of people can come and bring their ideas to. So that's kind of how I view that.

John Gilroy: Jiral, you mentioned the supply chain. I was taking notes and I thought about the supply chain, not going east and west, but going to space. Okay, so let's talk about the supply chain all the way out to space. So what role does in orbit assembly or servicing play in the broader vision for responsive space, and how is technology evolving to make that supply chain go of LEO or MEO, huh?

Jiral Shah: Oh, absolutely. So responsive space is one aspect, but I think the servicing play is going to actually help the entire industry. I think the DOD is going to lead the need, the requirement. And so today, servicing is absolutely in play with tactically responsive space. The DOD is actively working with commercial companies that are starting to bring that capability to life. And so being able to repair a satellite on orbit, being able to extend the life of an asset by refueling it, those are going to become the standard tactics that the DOD employees, it's going to become part of the TTPs, the OPLAN. And so the DOD is already moving in that direction. I think we need that technology to mature. We need more shots on goal. We need more companies to come and bring that access to those technologies down. So servicing is definitely in play.

What's even more interesting is in orbit assembly. So that's something that historically has been led by civil space, I think the DOD is starting to pay attention now, but what can we expect of our sector in the next five years is the ability to build infrastructure that we cannot launch. So the reason why you wouldn't be able to launch it is, number one, it doesn't fit in a rocket or number

two, it might not survive launch. So you can imagine with in orbit assembly or manufacturing, you could theoretically 3D print and assemble large antennas that you might not be able to launch or solar panels, assemble solar panels that aren't fully assembled because it's too difficult to get that infrastructure launched in the first place. But I think it will change the game, but we have to continue to reduce the cost. We have to continue to de-risk a lot of the technology. We need to get more power up there, more core common infrastructure to enable those applications, but it's definitely a very exciting part of the future.

John Gilroy: I'm trying to combine the four or five threads we've discussed so far, put them in one question and kind of all questions lead to this one. So how do advancements in rapid deployment and reconfigurable satellites like you mentioned, how do they open opportunities for commercial partnerships and dual use missions in this growing space economy?

Jiral Shah: Yeah, that's a good question. When I go back to some of the answers that I gave you, some of the topics that we touched on, automation, I think that wave will help us do more with less. Being able to have systems that bring flexibility, that ultimately become force multipliers, I think that's always going to be a need and I think that's going to be a driving force behind reconfigurable satellite systems. I think commercial partnerships will forge because of that.

For example, automation today is largely coming from this wave of AI. It's software developers that have become embedded within different markets that traditionally weren't. And so maybe 10, 20 years ago, the shipping might not have cared about automation and software the way that they do today. And being able to understand what's happening and make actionable decisions is going to continue to be something that both commercial industry will need and the military industry will need. And I think that partnerships will be forged because you're merging two different disciplines. You're applying software, you're applying automation into a specific industry. And so I think that's how I view that unfolding is automation will bring a new wave of thinkers, doers, builders, into this industry that we didn't have before.

John Gilroy: Let's try to look into the future here, Jiral. So what's just one, just one development in the next 5 to 10 years that you think will change the trajectory of the space industry?

Jiral Shah: That is a tough one, just one. My first instinct is to think about Starship from SpaceX being able to lift heavier and things, but I actually think my answer is going to be nuclear power in space. I mentioned it earlier, I think power is the commodity in space. You cannot do anything without power and access to reliable, large amounts of power is going to be incredibly important, unlocking what both civil applications and military applications are looking at. And I think

it's actually achievable within the next 5 to 10 year horizon. I think nuclear technology right now is going through a big push with this current administration that's taking a look again at the regulation that's kind of held this industry back. So I think that nuclear power will be the thing that fundamentally changes everything.

John Gilroy: Yeah, I think that's true for all kinds of software developers and data centers especially. So it's going to be a brave new world. All the power engineers are going to be very popular in the next 5 to 10 years. I think you're right about that, that's good insight. But Jiral, I think you've given our listeners a real good perspective on this whole idea of responsive space. I'd like to thank our guest, Jiral Shah, Vice President of Business Development at Gravitics.

Jiral Shah: Thanks, John. Thanks for having me.