Constellations Podcast

Episode 156 – Big Demand, Smallsat Manufacturing and New Satellite Services

Speaker: Mike Kaplan, VP of Business Development, LeoStella – 28 minutes

John Gilroy: Welcome to Constellations, the podcast from Kratos. My name is John Gilroy, and I will be your moderator. Our guest today is Mike Kaplan, Vice President of Business Development for LeoStella. The smallsat industry is growing by leaps and bounds. Euroconsult estimates that one ton per day of smallsats will be launched on average over the next 10 years. With this insatiable demand in the market, how is the manufacturing of smallsats keeping pace? To shed some light on this question, we have with us today, Mike Kaplan, Vice President of Business Development for LeoStella, a specialized satellite constellation design and manufacturing company. Mike is an expert across multiple space domains, with extensive experience in both government and commercial industries, previously holding senior leadership positions at NASA, Boeing, Raytheon Technology, Ball Aerospace, and Space Systems Loral. Wow, that's a pretty wide background, huh, Mike?

Mike Kaplan: Yeah, I did miss a couple of the other usual suspects along the way, but there's still time left in my career. Right?

John Gilroy: Well, it's like playing for a top five baseball team or something. Not a bad way to learn the game, and you know the game. Let's jump right into these numbers. They're just fascinating. I can't even believe the numbers here so let's jump right in. According to Euroconsult, the smallsat manufacturing market value will quadruple over the next decade to $56 billion, with a B. What is driving this rapid-growing demand?

Mike Kaplan: I would go back in time a little bit and look at where we were as a space industry about a decade ago. We had only a few launch providers, and with launch costs probably a factor of four, at least four dedicated launchers, higher than they are, we see the emergence of commercial launch has basically shrunk launch costs, where it enables business cases to close where they otherwise wouldn't close. The other dynamic going on here is we all use our mobile phones every day, cell phones. Those have gotten incredibly more capable, but along the same lines, the capabilities of what you can do with smallsats have been growing leaps and bounds. So, when you combine the forces of lower-cost launch, much more capability able to be performed, missions, wider variety of missions performed by small satellites, I said business cases closed, and there's just a huge demand for small satellites both in the commercial sector and the government sector as well.

John Gilroy: How is the increase in government demand for smallsats driving the innovation in this industry? Or is it just commercial drive?

Mike Kaplan: Well, initially, I think, the big player in the smallsat world inside the beltway is the space development agency. They're really charting a new course to provide proliferated low-Earth orbit constellations. Look, there are more things they're doing than in LEO, but they initially looked to leverage emerging commercial small satellite capabilities to accomplish their missions and to create more resiliency, redundancy, to provide their customers, the Warfighter, with a greater sense of mission reliability and survivability overall.

Initially, it's been an interesting dynamic. They started exploring what we can do to create the transport layer, which is sort of the government version of emerging commercial systems like Starlink, and OneWeb, and Kuiper, and so forth, and also do imaging as well. But as their requirements have evolved, they've required satellite providers to provide more power and also, as usual in the government, they've added additional capabilities they want to fly.

So, what's happened is they've driven commercial small satellite providers to be able to support higher, what we call, SWaP, higher payload SWaP. That's size, weight, and power. That's what SWaP means, for those who don't work in this industry. So, it was maybe several years ago that if you provided a smallsat that could support 100 kilograms of payload and a couple hundred watts of power, that was good enough. Now, to play in the game, you got to be more in the kilowatt on orbit average power, with about more than two kilowatts peak, and probably 200 to 250 kilograms of payload power.

In return, this demand from the government, which has stimulated that innovation in smallsat manufacturers has now folded back into the commercial world. I'm in communication with several emerging commercial constellation customers who want a kilowatt of power on-orbit which is average power now that the government has said, "You guys got to meet our needs and provide this." There's this really interesting, very healthy, synergistic relationship between government and commercial customers and where it's driven our industry.

John Gilroy: Well, we play off in this government-commercial game here, this theory. Washington, DC area, kind of flat. You're on a bicycle here, it's pretty easy. It's flat. Towpath, you've been on it yourself. Go out to Colorado, where you live, bike a hundred miles, there's a lot of hills, a lot of challenges. I see these challenges are there in the smallsat market as well. Smallsat market seems to be facing a growing number of challenges, kind of like the hills out where you live. Could you talk maybe about these challenges?

Mike Kaplan: Well, if you want to avoid the challenges, typically, where I live on the Front Range, you just head east and you just go on slowly. I think, in this case, there's really a couple of challenges that I see the industries facing. One is, many companies start off with building CubeSats, and the way you design a CubeSat and the choice of subsystems and the boundary conditions of how you solve a customer's problem, although they're much more powerful than was available even a couple of years ago, it's very different than how you'd approach a three or 400 kilogram small satellite. We've seen some companies struggle. It's not a linear path to go from building CubeSats to building smallsats.

The other challenge that we see is there are companies that start off with a smallsat, but a single mission, one of a kind. When you're designing a satellite and you're only going to build one of them, or just a very small number, the choices you make in how you design it are different than the choices you make if you're designing a satellite that's intended from the beginning to be manufactured at scale.

Those are the two principle challenges. One, the leap from CubeSats to smallsats presents challenges and, two, the challenges from going single unit, which is really where our industry started, there are only a handful of exceptions more than five years ago, where folks really were intending to build a constellation. So, that scale up, that's the other challenge.

John Gilroy: Well, this is the part of the podcast where I dazzle you with big numbers, because this number's even too much for my little brain to handle. Now, here's the estimate, okay, there's an estimated 18,500 smallsats will be launched between 2022 and 2031. How is your company contributing to this effort? And what is your approach to this constellations construction at that scale?

Mike Kaplan: Right. When you look at those numbers, to a certain extent, a lot of that is dominated by what I believe to be a handful of players, Starlink, Kuiper, OneWeb, a lot of these emerging commercial mesh networks in space. If you take that out of the equation, there's still a significant number of what's left. LeoStella, we're designed, we were set up from the very beginning, and I'm going to also connect this question to the previous question you just asked, is we were designed from the very beginning to build small satellites, not CubeSats, but small satellites at scale.

One is to succeed in the market, in some cases, that may be the shortest path to success, because we've gone from zero to we now have 19 satellites in orbit in five years, and these are 100 kilogram and fast satellites. So, we're set up to build dozens of satellites per year for multiple customers. Other companies are set up to build hundreds of satellites per year, maybe for one customer, maybe for more, while others are struggling to get to the scale point. The contributions that we make are focused more on the customers that want dozens, and I would call it, under 50 on orbit. We think that's the most important part of the

market, because that's where we see the most innovation occurring is on those customers that want dozens of satellites on orbit.

John Gilroy: But when you build to scale, it's going to be different than doing a bespoke model. How is your organization refining its manufacturing techniques to meet this increasing demand?

Mike Kaplan: One other point is, I guess, background. LeoStella is organized in an unusual way compared to other small satellite providers. We are a joint venture between BlackSky and Thales Alenia Space. When we were set up, as I mentioned before, we were set up to build constellations at scale. Thales Alenia Space, who's a very large aerospace company based in Europe, but they support global customers, we leveraged their expertise, so they designed our production facility with scale in mind. So, Building satellites to scale is really part of our DNA. That was one advantage of our organizational structure and how it gave us a running start to supporting constellations.

The other piece of this is our other owner is also currently our biggest customer, which is BlackSky. We co-designed the satellites and manufacture BlackSky's satellites for them. The other thing that we see in the industry, which is also why I made the earlier comment, that dozens of satellites per year is where we think the sweet spot is, where the innovation is, it's because what we've observed is, and you look at the BlackSky constellation, satellites six and seven may be identical, but nine and 10 may be different, and 13 and 14 might be different from those.

Because what happens is, at least in the Earth observation part of the small satellite business, our customers are learning, as the satellite's on orbit, what additional capabilities they want the satellites to have. Some of these capabilities, of course, can be introduced by software updates, but in some cases there's hardware changes that you want to make. So, at our basic production rate, our basic production rate's about four satellites a month, we're able to make changes in the production line to accommodate customers' desires to add or alter capabilities of satellites on orbit, which they're learning from, in this case, imagery, and then getting feedback from their end user customers on what additional features they want that, of course, are related to the imagery that we take.

John Gilroy: Yeah, I think software development, iterative development, is exactly what you're describing here.

Mike Kaplan: Right. This is where if you're ever building up production line, you're building hundreds of satellites per year that's supporting a mesh network. Companies that set up production lines to accommodate quick changes, that are needed to support learning based on what's coming down, it can be harder to make those

changes. So, our process is sort of a combination of very lean hands-on and automated processes. It's a combination of both. We think we found a sweet spot. We think it's a competitive advantage. So, we're real proud of that. The end result is our site, we have 32 years of operational heritage, and we're most proud of the fact that our satellites are available more than 99% of the time to support our customers, and we think that's an industry-leading mission-availability KPI.

John Gilroy: The Constellations Podcast was launched back in 2017. It was a small step for man, but a giant leap for podcasting. Today, thousands of people from all over the world listen to Constellations, and thanks to you, we've grown into more than just a podcast. Sign up for the Constellations newsletter to receive articles on current industry issues, podcast summaries and contributed blog posts at constellationspodcast.com.

John Gilroy: Mike, I've got a background on radio, and I like this phrase, “the phrase that pays,”and when you said image, I wrote that down, "Oh, there's the phrase that pays, image." So, let's go from manufacturing to mission. What types of missions are smallsats being built to support today, and how's that changing over time?

Mike Kaplan: Well, what I'm seeing right now, of course, is we have communications, providing internet access from space. We have remote sensing, and that's both active and passive. Active in terms of radar, passive in terms of electro-optical imaging. We have, I would call it, the CondoSat industry, where a company, like one of our customers is Loft Orbital, and they offer their satellites as a platform, as a test bed, or in some cases a platform as a small constellation for their customers.

There are also some, I would call them, emerging use cases of orbital transfer vehicles. Because what's very common in the industry right now is for many small satellite customers to seek ride-shares to get their satellites on orbit. When you’re dropped off in a ride-share, either you have a propulsion capability to take you to where you want to be in orbit, or you have to rely on what's called an orbital transfer vehicle to take you to the last mile. That's an emerging capability.

Then there are, I would call them, market adjacencies to OTVs, which would include satellite servicing, being able to refuel and do life extension. There's propellant depots, which would be gas stations in space that provide the ability for these orbital transfer vehicles to not be disposable or to be able to fly multiple missions by going back and refueling. The ones I just mentioned are more in the, I would call them, emerging class of smallsat capabilities.

The other trend we're seeing is some of these use cases aren't just in LEO, they're up in GEO, geostationary orbit. That represents challenges because you can't just take a satellite that's designed to work in low-Earth orbit, and easily modify it to work in geostationary orbit. You're in a different radiation environment. There are subsystem solutions that you use in a LEO satellite, like torque rods, which wouldn't even function in GEO to maintain your attitude control.

This is, on first watch, you think, "Well, I build LEO satellites, let's go service the GEO industry." You really need to almost redesign the satellite to provide similar capability in GEO. Up in GEO, we're seeing potential use cases for life extension, space situational awareness, things of that nature.

John Gilroy: Well, there's just so many flexibilities. I mean, all kinds. When I listen to you talk about this, I spent about four hours yesterday reading, catching up on 5G. What they're doing in 5G is they're maximizing the flexibility of that, and they're putting together private networks. When you said a small network, I'm thinking it's very parallel to what they're trying to do, because some organizations want to have their own little private network, and you can accommodate so many different ways. When I think of the GEO, I think of this big refrigerator up there, and you're like a guard in the NBA, kind of loose and flexible, and what do you want? We can be fast, we can jump, we can stop, we can move. What does Mike Kaplan do? Well, in general, there's a lot of things depending on the need. So, it's more flexible than I ever thought, isn't it?

Mike Kaplan: It is. Actually, there's another use case that just popped in my head as well, which is there's a market demand for commercial or alternate, what's called PNT, precision, navigation, and time. Most people hear that term and go what is that? Well, that's like GPS. And there are government-provided GPS systems, there's several that are currently in operation, but there's interest in commercial PNT as potential backups, should the government-provided GPS be degraded by an adversary, jamming or so forth. But also there's interest in a much higher resolution, much higher ground location accuracy to support such future use cases as autonomous driving, for example. That's an emerging capability.

I think it's safe to say that virtually everything that's being done in space that has been performed by larger satellites, there's a long, hard look at, can we do it with small satellites? Usually, you can, and usually it involves a constellation. When you look at all that, I think that's what drives that big number of 18,000 smallsats that you were just referring to earlier. I would think in the not-too-distant future, the norm will be doing missions with small satellites and the exceptions will be doing them with very large satellites.

John Gilroy: Well, we gotta ask a government question here. What impact do you see the US government constellations having on the commercial satellite industry? Are they changing it or are they just following what commercial is doing?

Mike Kaplan: Well, I'll dive a little bit deeper. Again, SDA is a great example. SDA started with the intent of leveraging existing commercial smallsat capabilities, meaning, hey, we'll take the commercial smallsats that are being offered and we'll use them to meet military needs. As we've seen over time, and this is typically what, having spent 17 years in the government, we used to do this, this is what we do all the time, is we get excited about what we can do, and then we add capability to what we want the contractors to do that are building our systems.

What we've seen over time is that there's been an interest in adding additional functionalities to SDA satellites. So, if you look at the requirements, for example, for the transport layer between Tranche 0 and Tranche 1, and the recently released DRAFT RFPs for transport Tranche 2, there's a number of additional mission capabilities that are required.

When you add all that up, what that means is that the satellite has to provide more power and support a heavier payload, because all these additional capabilities require additional payload boxes, additional antennas, or whatever is required to do that mission. So, the government, in many ways, has been driving, I would say it's been driving the higher end size of the smallsat market. And I expect that to continue. The commercial market I think is going to take advantage of that, because as these more capable satellite buses are developed and produced for government customers, of course, the providers of those satellites, companies like myself and my competitors, will be able to then offer those same higher capability satellites to commercial customers as well. So, I see the government really driving, in many ways, the performance capabilities of small satellites.

John Gilroy: Oh, 17 years in the government. I'm sure that during your time in the government, there's been a change in what they're looking at. So, instead of doing it themselves, what they're doing is they're reaching out to commercial organizations. I guess, that's because of all the advances in technology you just mentioned. When I was in college, I'd put a water pump in my car, now I'm going to hire someone to do that. It's just that back in the day, you maybe built it yourself, but at a certain time in a maturity cycle, you go, "No, no, I'm going to have Mike's son come over and paint my kitchen," or something. So, I see this change in NASA is more and more openness to commercial.

Mike Kaplan: Yes. There's also another shift as well with the emergence of some of these commercial constellations, what we're seeing is the government is understanding that the traditional model of acquiring a capability, It used to be the default was, we're going to buy a bunch of satellites and then we're going to launch them, and we're going to operate them. What we're seeing are

commercial companies are, and many of them are offering complete solutions, where the government can basically just buy the services, buy the use. In other words, I don't need to own the satellites.

For example, BlackSky. BlackSky owns and operates a satellite constellation to provide not just imagery, but processed imagery products to government customers. What we're seeing is government customers, like the NRO, and the Army, and other customers are basically buying images. Either one or multiples at a time are finished products. This is more of a service, data as a service, product as a service. So, we're seeing that happen more and more with government customers, and this is a trend, I think, that's just going to continue over time. Right now, a lot of it is in the remote sensing ISR markets, but I think we'll see it broadened into comms, and other applications as well.

John Gilroy: Final question. I'm going to go back to the magic number, 18,500 smallsats. Now, it seems to me that the manufacturing industry of satellites is going to have to change and adapt. How do you see your industry is going to adapt for this tremendous forecast and demand in the next few years? How are you going to change?

Mike Kaplan: Well, I think the first is to understand, if you're a smallsat provider, I don't think you can be all things to all customers, because there are some customers that are going to want a very large constellation. In most cases, those constellations are going to be virtually identical platforms. Of course, they'll be upgraded with block changes over time. For them, a highly automated manufacturing process fits well with a cookie-cutter product, where virtually every satellite off the line is the same. That's probably the best way to squeeze, get the most efficiency, and provide the best value to their customer.

There are other constellation customers which are operating on the other end of the spectrum, dozens of satellites per year, but also wanting to maybe have a less mature payload, which is very common in the industry, from what I'm seeing. They're going to want to iterate the design and co-engineer the solution, because putting a payload on a satellite is very different from having your PC and trying to decide, do I want a brand A hard drive or brand B hard drive? They're virtually identical, so it really doesn't matter.

Payloads are not like hard drives. Everyone is very different, and even payloads from the same company are going to evolve over time. So, when you're serving customers like that, you need to have a very collaborative co-engineering process, where maybe the first 70% of the design of the satellite is common, and then that last 30% is basically adapted in a collaborative, co-engineering environment with your customer. That way, what comes out provides them the best value. That's a lot more hands-on. Are you in one space or are you in the other space? I think regardless of where you are, I think you need to understand where the market's going and where you want to be.

John Gilroy: Mike, I think you've given our listeners a refreshing perspective on some of the challenges and opportunities in the smallsat market. I'd like to thank our guest, Mike Kaplan, Vice President of Business Development for LeoStella. Thanks, Mike.

Mike Kaplan: Thank you.

Speaker 2: Thanks for listening to Constellations, the podcast from Kratos. If you liked this interview, please subscribe, tell a friend, and give us a review.