Constellations Podcast

Episode 117 – Software-Defined Satellites, New Business Cases and Massive Growth Opportunities

Speaker: Dallas Kasaboski, Analyst, Northern Sky Research – 22 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 Dallas Kasaboski, a consultant from NSR, or as we call it Northern Sky Research. Today, we'll talk about the emergence of software-defined satellites and the massive growth opportunity being driven by the need to be more flexible in the market. Software-defined satellites are projected to be an $86 billion cumulative revenue opportunity by decades, what a number. This is all according to Northern Sky Research, NSR's recently released report on the topic.

John Gilroy: During this episode, we welcome Dallas Kasaboski, a consultant from NSR, to discuss the global demand for software-defined satellites, the applications that will benefit the most from this capability, the implications for the ground segment, the key players in the industry, and crystal ball time, the outlook for the future. As the co-author of the recent NSR report entitled, “Software-Defined Satellites”, Dallas is well qualified to speak on this topic. His areas of expertise at NSR cover earth observation, flat panel antennas, satellite constellations, space tourism, and in-orbit servicing markets. Dallas, that's a pretty wide range of topics you have to cover, isn't it?

Dallas Kasaboski: Yes, they've moved me around quite a lot in NSR. Lots of interesting topics.

John Gilroy: Wow. A lot of hardware here, but space tourism, that's the curve ball in there. Let's just grab the bull by the horns and we go straight with it here. So, I mentioned software-defined this, and so what does it mean for satellite to be software-defined? What does that mean?

Dallas Kasaboski: So, we hear that term a lot. And something that we had to do was try to come up with a single definition that worked across the industry. So, the simplest definition is that a software-defined satellite is a satellite that can be changed or adopted driven by software. That's a pretty high level detail, but essentially most satellites that go up, they have a peer mission, they have some flexibility in their capabilities. They can, whether they have certain components on or off, etc., but for a satellite to be software-defined, you must be able to upload new software and have it completely change its operation.

Dallas Kasaboski: Now, this is something we might talk about in a later question, but it depends on application as to how the satellite is defined. So, at a high level, if you can

completely change your satellite's mission based on new software, that it's likely that your satellite is software-defined.

John Gilroy: Dallas, I think you're in Europe now, but there are data centers all over the world, Microsoft, Amazon, and they regularly do updates in remote centers all the time. So, I don't think this is really an earth breaking concept in terms of satellites, but some people may find it original in the satellite world here. So, a software-defined satellite really is just applying a lot of things that have worked consistently in the earth to different types of hardware.

Dallas Kasaboski: Definitely is. You'll find that space is hard, right? And one of the reasons that it is, is because in order to make a change for something that happens in space, it's difficult. You're not there, there's a lot of other considerations. So, yeah, in one way, this is just satellites catching up to the terrestrial space, in one way.

John Gilroy: Okay. So, we got software-defined satellites. Great. Is there any demand for it or how much demand is there for software-defined satellites in GEO and non-GEO?

Dallas Kasaboski: Yes. So, I'll answer both, first question again and the second one. In the communication space, for example, there are specific requirements for a satellite to be software-defined. It has to be able to, so communication satellites, right? If you imagine them as, depending on your listeners viewpoint, GEO satellites are usually fixed, they have wide or spot beams that are focusing on one area of the earth. One aspect of software-defined satellites is that they can steer those beams. Another one is they have some digital channelizer, some kind of internal ability to cut the beam up, reprioritize it, refocus it in a different way. And the third is that they have some ability to change their onboard power or spectrum. Now, this is all really technical and very, very specific, but the reason we talk about it is, it goes directly into your question about demand.

Dallas Kasaboski: So, GEO satellites are just slightly beginning to engage in software-defined satellite architectures. Part of it is they are looking to technologies on the horizon. Most of it is that they want additional levels of flexibility. A very common use case is, well I've been selling video services with my satellites for years, but I'm seeing that that market is shifting or decreasing. I'm not quite ready to switch over to something entirely new. So, I want the ability to start with video, then maybe in a few years, shift to another type of application. So, we're seeing that as a growing use case.

Dallas Kasaboski: And as such in GEO, we're seeing it's roughly a 50/50 split between something that is bent pipe, which is non software-defined, it's not that flexible, it's rather traditional, versus something that has any level of flexibility, whether it's just steerable beams, or all the way down to power and spectrum configuration, digital channelization, and so on.

Dallas Kasaboski: In non-GEO, the story is very different. Being able to steer beams is almost 100% a requirement in non-GEO. Depending on your network configuration, you may be able to get by without steering beams, but it's really inefficient. These satellites are moving very quickly, they need to coordinate, they need to change their look angle depending on the horizon. So, steerable beams is almost a prerequisite, which means that most non-GEO satellites are some level of software-defined by definition.

Dallas Kasaboski: In terms of full flexibility though, there's only a few players that are really going full flexible, but it's a growing process. And as we see it in terms of orders, it's about 95% of all satellites that are going to be ordered in the next decade, will have some level of flexibility. But because of the pricing dynamics there, 84% of the manufacturing revenues associated with those satellites, will be for partial or fully flexible satellites.

John Gilroy: You mentioned the use case of video. So, is that one application that'll maybe benefit the most from these new types of satellites?

Dallas Kasaboski: Certainly, yes. That's one that a lot of GEO operators quote, is the potential need to shift from video to another application. Video has brought a lot of revenue generation in GEO for quite a long time, but that market is changing, there are a lot of operators that are moving toward a more data-centric focus. And so the ability to have something that led to you pivot is the use case.

Dallas Kasaboski: Another use case, which could work for many applications, including broadband, backhaul, and mobility is this ability to not only steer beams, but reconfigure them. So, a good example might be, you have a GEO satellite in one area, but you see that your traffic patterns are changing seasonally or even daily. And if you had a more software-defined satellite, you might be capable of redistributing the spectrums so that you can make the most use of it. You're not wasting any, you're not blanketing an area that doesn't need that demand right now, or you're not low in capacity for an area that suddenly spikes in demand. So, all these, this great need for flexibility and different efficiencies, whether it's cost or performance efficiency, these are certain applications and use cases that are looked in seriously at software-defined satellites.

John Gilroy: Earlier in the interview, we talked about space tourism in a somewhat facetious manner. Let me tell you something, Dallas, my feet are firmly on the ground here. I'm not going out into space. So, let's talk about the ground segment here. How will these new software-defined satellite capabilities impact the ground segment of your business?

Dallas Kasaboski: Yes, quite a lot. Excellent question. We often call the ground segment, the forgotten link of the satellite network, because often everybody's so excited about manufacturing hardware, different funding and investment, and then the

ground segment often lags behind. And now that is changing quite a lot. In terms of how it's going to impact the ground segment, there's a push-pull trade off that we're seeing. Because on the one hand, satellites are becoming more flexible, they're becoming more capable. It's allowing them to have greater flexibility within their network management. On the other hand, when you're on the ground, you have to manage that network.

Dallas Kasaboski: So, depending on your configuration as a ground segment engineer or network configuration, it might be beneficial for you. You could say, "Great, these satellites are more capable now, I can use them more specifically, I can integrate them to my network better." On the other hand, now you have a more complicated component of your network. The satellite part is becoming smarter, it's becoming more flexible, and it's becoming more complicated, which requires more effort on both the hardware and software side.

John Gilroy: Dallas, about two months ago, I had the opportunity to interview a Swedish guy. Some of his concepts were the foundation for 5G. And T-Mobile, they're all talking about 5G. It's a pretty big deal here. So, what about 5G and what role will 5G play in these software-defined satellites?

Dallas Kasaboski: Yes, 5G, there's a reason that everybody's talking about it. It's going to be affecting every part of the system. So, in general, 5G is both hardware and a network protocol that needs to be considered. So, if your satellites are wanting to be compatible with 5G, then they have to speak that language of that protocol. Potentially they have to have 5G enabled or compatible hardware on board. And any software-defined satellite that's going to look into these applications, and I mentioned backhaul, broadband, mobility, they should really be paying attention to the 5G space in terms of how to better integrate it.

Dallas Kasaboski: For numerous reasons, 5G is becoming the way forward for a lot of, you mentioned the ground network strategies, integrating satellite into terrestrial, into cellular. Software-defined satellites, the goal with them is of course, to make them more flexible and capable, but those new capabilities will mean less if they're not interoperable if they're not integrated into other networks.

Dallas Kasaboski: So, you can stand on your own as a software-defined satellite, but 5G is another way of bringing these networks together. And that's where we see the impact, is that the operators, the ground network, the manufacturers, they're all working more closely together to make systems that are capable of communicating efficiently with each other, able to reconfigure at the same pace. And that's how 5G is going to impact software-defined satellites and vice versa.

John Gilroy: Dallas, thousands of people from all over the world have listened to this podcast. Go to Google and type in “Constellations Podcast” to get to our show notes page. Here, you can get transcripts for all 100 plus interviews. Also, you

can sign up for free email notifications for future episodes. Well, Dallas, I like to put my up in the role of a listener to this podcast. And people are listening to this and they hear about these capabilities and flexibility, and they're all asking the same question. The Tom Cruise question of show me the money. And so, how do these software-defined capabilities affect pricing and performance?

Dallas Kasaboski: In short, hardware costs are going down, software costs are going up. The strategy of manufacturers here is to create a more software capable satellite, and one of the ways of doing that is by standardizing the hardware. So, what we've seen, actually, and this is something we track very closely at NSR, is the pricing and performance dynamics of satellite capabilities, is that depending on how you approach it, some manufacturers were purposely pursuing software-defined satellites, and in doing so, they shifted the complexity of the satellite from the hardware to the software. And as such, in some cases, the hardware costs have gone down, and as I said, the software costs have gone up. Now, overall, in terms of the overall satellite, what's interesting is that the hardware depreciation of costs is going down faster than the increase in costs of the software. So, the overall result is that software-defined satellites are actually cheaper in many cases.

Dallas Kasaboski: Now there are other factors that are laying into that. Sometimes a more flexible satellite can be smaller, and that has its own advantages, especially on launch. But yes, essentially what we've seen is that software-defined satellites are, if you go from a completely bent pipe traditional satellite to a software-defined satellite, there's usually a price increase because it's a more capable system, it's a newer architecture, maybe there's some risk involved. Once you look at the difference between partial and full flexibility, that's really interesting because we've actually seen cases where fully flexible satellites have actually come out cheaper than partially flexible satellites. And that's again, a result of a lot of different factors, but mostly through standardization of the hardware and the growing but not outpacing costs of the software.

John Gilroy: Now Dallas, when it comes to technology, there's always the early adopters, they'll jump on anything. The first version, the first edition, when it comes to phones, anything. So, imagine we have early adopters for this technology. And so who are they and how they plan on using this new capability?

Dallas Kasaboski: Some of the ones that'll be very familiar for your listeners, some of the operators, SES. SES-17 is a very flexible satellite constructive by Boeing off of their 702X platform. There's a number of offerings as well. Intelsat has ordered software-defined satellites. I believe those are based off of Airbus' OneSat on our platform. You've also seen a lot of orders recently from Astromist and the new satellites that are going in that direction. So, in GEO, these are some of the players that are really jumping on board early. But we've also seen some from Eutelsat, Inmarsat as well, and they're all seeing the same things they're seeing, Optus is another. They're seeing the need for flexibility in space. And again,

maybe you don't handle that on the satellite itself, maybe you handle that on the ground, or you do it through 5G protocols or something. But generally speaking, the capability is growing in satellites, and some of these operators are either taking risks or they're trying to mitigate risks by having some bridging solution, like we talked about earlier.

John Gilroy: Someone may be listening to this podcast and think that, "Well, it's across the board. Everyone in the world is all interested in software-defined satellites." But is there maybe a regional interest or certain areas it's more applicable to, or certain areas that may resist this? So, from a regional perspective, who has this interest in software-defined networks?

Dallas Kasaboski: Yes, that's a great question. So yes, regionally speaking, it's probably no surprise we're seeing a lot of interest from north America, we're seeing more orders from Europe and Asia. Really, those are the three that dominate in this space. And, I would say Europe, north America, and then probably in the later years in Asia as well, we're seeing more orders coming from those spaces for different levels of flexibility. And the reasons are that partially, those regions have operators who are maybe ready to invest in another generation of satellites or maybe they have networks that are more complicated that need bridging, maybe they have the funding to be able to afford it. It's also because of that point I just mentioned, about how they have a greater need for flexibility.

Dallas Kasaboski: Depending on the region in middle east or in Latin America, for example, some operators are more or less satisfied to have a traditional bent pipe solution. They're generally cheaper, they work very well. And maybe their levels of flexibility required are not substantial. We've also seen other factors though that impact this. For example, there was a satellite... Trying to remember the region. It was in Asia, actually. An operator in Asia, was considering a software-defined satellite for some time, but they actually decided to go with bent pipe because the technology wasn't quite there yet, and they believed that they could get a bent pipe satellite manufactured more quickly than a software-defined one. And so sometimes the reason comes down to technology or requirement, and sometimes it comes down to marketing, timing and business strategy.

John Gilroy: Dallas, you just used the word manufacturing. So my question to you is... So who are the main manufacturers to consider and what platforms are currently available?

Dallas Kasaboski: Yes, we've got, so in GEO there's a number of specific platforms that we've looked at. We actually started looking at that to try and get a better understanding of their capabilities and some of these definitions. So Airbus, I mentioned, they have their OneSat platform. Lockheed Martin has SmartSat, Thales Alenia Space has Inspire, Boeing has their 702X platform. And there's a number of other variations around that, but those are some of the main ones in

GEO, especially Astromist. We just talked about that system. So these ones have been developed over the last few years with varying levels of investment from both governments and commercial players. And in terms of their capabilities, they all have varying capabilities ranging along the definitions I mentioned earlier. So steerable beams, digital channelization, flexible coverage, power and spectrum flexibility.

John Gilroy: Wait, now this is such a dynamic field. It feels like the ink is just not even dried on your report and things are changing. So, how can you project ahead? How can you project eight to 10 years ahead? How do you think the satellite industry will have changed because of these new capabilities?

Dallas Kasaboski: Yes, so in terms of how we can make the projections ahead, it's always a balance between what has been done and innovation. We look to what the markets have been ordering or how they've been acting within the recent historical period, gives us an idea of how things have grown or shifted. It also gives us an idea as to how certain markets have adapted to technology that was new to them at that time, that gives us an idea of their adoption, their willingness to switch, the cost of adoption, et cetera.

Dallas Kasaboski: And then looking ahead, we have to gauge the progress we believe that technology will develop, the progress that pricing will develop, different service offerings, and how disruptive or innovative that technology will be, how easy is it to adopt. We've talked about the great capabilities of software-defined satellites, but there's a reason that in GEO it's still a 50/50 process, in terms of who's ordering bent pipe versus who's ordering software-defined. And the reason is that it is expensive and it is challenging to integrate these new capabilities into your system. It's not always plug and play.

Dallas Kasaboski: So, in terms of how we see things going forward, we see GEO shifting toward a software-defined side of things, but not fully. Most of the orders we predict, we estimate will be in the partially defined, which for us means that they have one, but not all of those capabilities I mentioned earlier. For example, steerable beams is the low hanging fruit of software-defined satellites. And they require some level of software flexibility on the satellite. An operator who wishes to maybe be able to change their direction of their spectrum based on different market changes, they might go for a bent pipe plus steerable beams that have a slightly partial satellite.

Dallas Kasaboski: In non-GEO, we also see partial flexibility as the key. And the reason is that a lot of players don't need full flexibility, especially for a constellation that they're going to have to replenish in five or seven or 10 years. So, what they do is they make them as complicated or as sophisticated as possible without going over the top, because they know they're going to have to spend that CapEx in another five or seven years. So partial flexibility is where we see the market

shifting in that direction, and the majority of orders we see over the next 10 years to be placed there.

John Gilroy: Dallas, abstract concepts, like software-defined satellites are very difficult to articulate, but I think you did a great job, and you get a lot of information for our listeners.

John Gilroy: I'd like to thank our guest, Dallas Kasaboski, a consultant from NSR.

Dallas Kasaboski: Thank you very much for having me and I'm happy to speak here today.