Constellations Podcast

Episode 173 – Satellite Industry Softwarization, On-Board AI and Flying Routers in Space

Speaker: Sethu Saveda Suvanam, Founder & CEO, ReOrbit – 25 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 Sethu Saveda Suvanam, CEO and founder of ReOrbit. On today's podcast, we'll discuss the market drivers influencing the digital transformation of the satellite industry, onboard computing, and how software-defined satellites can fundamentally change the way data moves in space.

Sethu Saveda Suvanam, CEO and founder of ReOrbit, joins us to discuss what's driving these big changes in satellites. Well, Sethu, hang onto your hat, because we got a bunch of questions here. So, what are some of the digital transformation drivers and softwarization trends in the satellite industry, and how are those affecting satellite development?

Sethu Saveda Suvanam: Firstly, thanks for having me here, John. I'm grateful, I appreciate it. So typically if you look at how the satellite industry has been evolving since last 60 or 70 years, it's been primarily focused on hardware, and developing subsystems, and also developing and standardizing hardware.

The last, let's say, three or four years, we are now seeing a lot of companies that are moving more towards software. So, as an example, we are now talking about a lot of machine learning, a lot of AI that's coming onboard the spacecraft, where there's a lot of software associated with it.

And also, I'd say there are companies like us, where we are also now trying to get to the bottom of it, where we are developing not just the top application layers as machine learning or the artificial intelligence kind of applications, but we are going into the more operating system, and trying to standardize the whole operating system for the satellite industry. I'm happy to unwrap that as we go along.

John Gilroy: That's kind of a transition that took place in data centers maybe 10 or 15 years ago, and now it's slowly impacting the satellite and space world. So, let's go back and look at some traditional things here. So, how does data move to and from a traditional satellite, and comparatively, if you can, how does it move to and from a software-defined satellite?

Sethu Saveda Suvanam: Typically, I would say probably in 99% of all the satellites that are flying today, the data moves point to point. Meaning that you have a satellite, you have a ground segment, and the data just moves between two points.

So, you could sort of sum it as satellite as a single source of data, and single sink of data. So, you can just shoot it out or receive the data. And that is sort of very counterintuitive, actually, if you start looking how technologies have evolved on ground, right?

Today, even the very fact that we both are talking here, that we are connected over a digital world where the data is flowing very seamlessly on computers, on mobile networks, on cars, on fighter jets, on aviation, that sort of trend is missing in satellite industry today. And that's what the software enabled satellites or software-defined satellites would sort of break that.

So, when you have a satellite that's largely software-defined, like let's say your traditional PC, then you could start designing a satellite like a flying router. You could have multiple sources of data coming into your satellite, and also multiple sinks of data from your satellite.

So, your satellite is not sort of put in a boundary of one point, but your satellite can now start connecting with all the satellites that are around, within the same orbit or in multi-orbit. And also, those can then connect back to your ground segment. So, you are now sort of opening up a Pandora box of applications, where you can do things that you can never achieve with the satellites that are there today.

John Gilroy: Wow. A flying router. That should be the name of this interview. How amazing. 10, 15 years ago, when you and I were learning networking terminology, people used to say, "Maintaining a router is like maintaining a refrigerator. It just sits there all day long."

Sethu Saveda Suvanam: Exactly.

John Gilroy: But today, increasingly, routers are almost software-defined too, aren't they?

Sethu Saveda Suvanam: Yes.

John Gilroy: There's flexibility everywhere in these systems. It's hard to believe.

Sethu Saveda Suvanam: True. I mean, flexibility is the key. And I mean, it's always quite intriguing for me that if you look at industry verticals that are very similar to satellite, like computers, automotives, and cell phones, all these industries have understood probably 30, 40 years ago that the core is actually software intelligence. That's where the whole core of the innovation comes in.

And it's very hard for me or intriguing for me to understand why the space industry hasn't still sort of figured it out. But it's good that now things are moving in the right direction, where there is a lot of emphasis on software intelligence, rather than hardware in itself.

John Gilroy: Well, that's an opportunity for you, Sethu, isn't it?

Sethu Saveda Suvanam: Yes, definitely.

John Gilroy: So, my question is, what does onboard processing enable within the satellite? What does it specifically do to improve the movement and collection of data?

Sethu Saveda Suvanam: There are multiple things here. So, when we are talking about moving data, then you need to have onboard processes that are capable of basically... Okay, well, probably I'll take a step back.

Let's say if you have a satellite that's designed as a router, so you are having different sources of data that's coming into your satellite. So, one, your satellite should be capable of basically identifying, what are these different sources of data that's coming in? What are the use cases of these different sources of data?

For instance, you might have an Earth observation satellite constellation connected to a telecom constellation, and then you are sort of working out on a completely different application. So, your satellite should be able to process all these different kinds of data coming in. And then the onboard processor definitely becomes quite critical there.

But then, once you have that kind of an architecture, we could also start doing distributed computing in space, where you could start adding up the sum of all these processing capabilities. Because at any given point of time today, not all the processing capability of a satellite is fully utilized. But when you have all these satellites that are connected, and the data is freely flowing between your satellites, then you could start tapping into all those unused capacity of your processing power within a satellite.

So, you could then start basically running all your core applications. Let's say now you take a raw image. What happens today is that the raw image is sent over to the ground, you process it on ground, and then build the applications on top of that. Rather, if you can do all that in space, onboard the satellite, then you could save a lot of time, which could then in turn open up a lot of applications, such as defense and national security, and also critical applications such as flood monitoring or forest fires.

So, the onboard processing, basically you should look at it in multiple layers, where one, it is computing and distribution data in itself. And two, utilizing basically the unused capacity of different satellites as a whole to do advanced processing.

John Gilroy: Well, you just shared with us this technology that allows real-time data delivery from space. But my question is, even if you do distributed processing in a data center right in front of your face, that's complex, isn't it? I mean, that's a complex process.

Sethu Saveda Suvanam: Yeah. It's quite complex. Yes, definitely. It's very complex, and I mean, space in itself is quite complex. So, definitely it is quite complex.

But again, given how the trend has been evolving... Or I could say, the more space industry becomes dominant in day-to-day life, there'll be more satellites flying up. There'll be more data that'll be generated.

So, it is a trend that is surely bound to take place, and this is something that will happen anytime soon. So, it's just a matter of time that we'll be able to put high processing capable processors onboard a satellite, and then start putting this software and everything on top of it.

I think we are at the stage where we could compare it to 80s or 90s in the computer industry, where the computers have become commoditized. It sort of opened up to larger masses, and also it sort of went into different use cases.

Then you started seeing all these companies like Microsoft or others coming in, building those applications and software. So, I think we are at that point in the space industry. So, it's an engineering challenge, so someone will solve that, but at least the trend is showing clearly towards that direction.

John Gilroy: Well, Sethu, let's unpack this idea of data collection movement a little bit more. So, it seems to me that if you can allow for data collection and movement between satellites, it seems to me that would open the door for the adoption of artificial intelligence and machine learning algorithms onboard the satellites themselves. Everyone's talking about AI. What does it really mean?

Sethu Saveda Suvanam: Yeah. Today, again, a lot of people are talking about the AI. And today, largely when they mean AI, it's about ability to process data, right?

Again, I'll go back to the value chain that I mentioned. So, today what happens is when you take a picture, you cannot process the whole picture, because the picture is in a raw format when you capture that picture. You cannot process that whole raw format of picture into a useful data or useful intelligence.

So, the magic actually happens on ground. The magic doesn't happen in the satellite. The only thing the satellite does today is to capture the raw data.

So, what we are actually looking after is that useful intelligence, right? And when we now talk about AI and machine learning, we are basically trying to bring all that magic that's happening on ground today onboard the platform, so that we could capture a picture, we could process all that data, we could build useful information, and send it directly to the end user on an app, so that they could do useful things.

So, as an example, let's say there is some sort of a pirate ship, which is 400 kilometers from your shore. And today, what happens is, even if you capture that data, the time it takes for this data to go to a Coast Guard is probably a few hours, or more than a few hours, or even sometimes it's a few days. And by the time it goes to the Coast Guard, basically this ship has done what it has to do and has already left.

So, although we got useful information, it has not been used for the purpose it was sent. Whereas now, if you could actually have a satellite where all this data is actually processed onboard the satellite within a matter of minutes or probably seconds, and directly sent to a Coast Guard, then the Coast Guard can react within, let's say, 15 minutes. Then that's a useful data. So, basically having artificial intelligence onboard can unwrap a lot of applications that are not possible today.

John Gilroy: Well, Sethu, you mentioned the ground. Let's maybe explore that topic a little bit here. So, what are some of the most important technology factors critical to a ground system in supporting a software-defined satellite?

Sethu Saveda Suvanam: Let's say, the core use case that the software-defined satellite brings is actually high data rates. Right? So, a software-defined satellite should be able to move high possible data rates.

And one of the critical technologies today that enables the high data rates is actually the laser terminals, or the ISLs. It does satellite to satellite, but satellite to ground as well. The laser terminals, right?

So, on the ground segment, what I see is lacking today is the ability for the ground segment to receive the optical data through an LCT or the laser terminal.

So, we could already now... Talking with different providers, we are already seeing a lot of the providers on the ground segment are investing into physical infrastructure to capture data using an LCT. And that's a trend I think we'll see more and more.

And also, just to complement that, I mean, we have already seen the investments that are going from the SDA as well into that direction. So, I think that's probably one of the biggest trends that we will see, complementary to the software enabled or software-defined satellites on the ground segment.

John Gilroy: Well, Sethu, there's trade-offs with everything in the world. If you want to buy a car, one with good mileage is not going to hold five people.

Sethu Saveda Suvanam: Yes.

John Gilroy: So, you have to make a compromise or something. So, there's trade-offs also in selecting software-defined versus traditional payloads. So, what are maybe the pros and cons of each, or how do you even select it?

Sethu Saveda Suvanam: Yeah. So, maybe I could say traditionally when people mean software-defined satellites, then it's actually referring to the payload, as you said. But whereas purely, at least in ReOrbit's context, when we say software-defined satellites, it's not just referring to payload, but it's an end-to-end software-defined satellite. So, all the way from the spacecraft till the payload, and also probably extend it to the application layer. So, I'll just probably take that as a clarification, and then come to your question, John.

Let's say software-defined spacecrafts typically are expensive as compared to the traditional payloads. So, it's basically a cost versus what you require as a technology.

So, there might be certain users where they don't have to have pretty advanced high data processing capabilities, high data rates, and so on and so forth. Probably those are not the applications where you would request software-defined satellites. You might be better off going with a traditional satellite.

Whereas there might be applications where you need high data rates. Let's say, for instance, national security or defense or critical communications. So, these are applications where you need these kind of features. So, software-defined satellites could be the way to go today.

But again, that being said, I would definitely say, within 10 to 15 years, every satellite will be a software-defined satellite. I cannot see a use case for traditional satellites in the next 15 years.

Again, it's like asking a user today, "Do you want to buy the grand old Nokia phone or the iPhone?" People will say “I would buy iPhone”. But when the iPhone came, there was still a debate, why do you need an iPhone? I remember having that debate to myself. Should I spend 5,000 euros or krones to buy an iPhone or 500 to buy a Nokia? But today, no one is talking about this grand old Nokia phone, right?

John Gilroy: Yeah. You know, in current culture, everyone talks about sustainability. It is a big deal here in current culture, but I think this also applies to your world. So, what role do software-defined satellites play in improving space sustainability?

Sethu Saveda Suvanam: The base is that at least in the near foreseeable future, we will not stop launching satellites. So, let's now take it for granted that we will keep launching satellites, because space is opening up a lot of things on ground.

Now, the way we would actually enable space sustainability is making sure that we optimize the resources or utilization of resources in an optimal manner. As I said, again, today, not all satellites are fully a hundred percent utilized, so some of their capacity is not fully utilized. Right?

So, once you have the ability for a satellite to be connected with each other, to exchange data between each other, to share information between each other, you could then start building architectures that are much more distributed. Therefore, you could start tapping into the unused resources of some of the physical infrastructure that's already there in space. So, thereby effectively reducing the number of satellites that we would launch.

But I for sure believe that at least in the near future, we will not stop launching satellites. So, then, we will have to come up with solutions where, how can we better utilize the resources that's already there? And software-defined satellites are one of the ways where you could start also incentivizing the customers to be more sustainable. Right?

If you go to a customer and say that I will penalize to be sustainable, no one is going to do it. And that's the way we are doing it today. Today when you talk about all the debris removal and everything, we are sort of putting a way where we are sort of penalizing a customer to be sustainable. And I don't think that's a sustainable way to be sustainable.

So, one of the ways you could encourage the companies to be sustainable is that you incentivize customers to be sustainable. And the way is, at least I believe, that there is a lot of untapped resources in space, and if you could enable that or open up that resources, then we will effectively launch lesser satellites than what we are doing today.

John Gilroy: Earlier in the interview, you mentioned flying routers, and I think you even wrote about it in an article in SpaceNews back in August of 2023. Let's go back to this concept of flying routers. So, you already defined it, but really, how does the software-defined satellite change security for these satellite networks for the routers out there?

Sethu Saveda Suvanam: Let's say today, again, the emphasis is largely on hardware, right? Today, if you go through any manufacturer, the architecture is largely hardware based. And also tied to that, the cybersecurity is thought as an aftermath. So, today, cybersecurity, barring certain defense and critical applications, in general, cybersecurity is always taken as an aftermath.

Whereas once you have a software-defined or a software-enabled architecture, where your software is at the core of your architecture, you could now start thinking cybersecurity as a part of your design. So, cybersecurity is actually sitting within your architecture, rather than having it as a separate element that you would put it on top for a particular customer.

You still can expand the cybersecurity as big as you want for users, or as small as you want for certain users. But that block is always sitting within your software stack, which is inside your operating system. Therefore, a software-enabled satellite will always see cybersecurity as a part of design, rather than an afterthought, which is seen today.

So, satellites would become largely, let's say, safer when it comes to software-defined satellites. But also, there is a counterargument that if systems are largely hardware, it's hard to even hack that, right? Whereas now, if you have a big software flying up, maybe it's prone to more hacking.

So, of course there are different things, and the more this technology becomes matured, I think that particular concept would also mature. But as a baseline, at least the way we see it, is that software-defined satellites would have the cybersecurity layer as a part, inbuilt part of its operating system already. And then that could be expanded, or kept as it is, depending on the user's requirement.

John Gilroy: Well, let's get your crystal ball out here and look forward here. So, what do you think the role of satellites will be in 5G and maybe even 6G networks?

Sethu Saveda Suvanam: One of the core applications of 6G that we are all talking about and waiting for is connected automotives. Or even I can actually go 30, 40 years into the future. Basically, what these 6, 7, 8G would enable is that every digital entity in the world would be connected.

And once you have a world where every digital entity is connected, then you cannot basically depend on purely the terrestrial networks. So, you need to have both your non-terrestrial networks and your terrestrial networks working seamlessly on top of a standard architecture. Again, when I said the way we see a software-defined satellite is that it's not just the payload, but we see end-to-end from the satellite until the application.

So, once you have, let's say, a broad software base, then you could start either sitting on top of the protocols of your terrestrial network. So, you could basically make it end-to-end seamless between your non-terrestrial and terrestrial. Or, you could actually bring your terrestrial network protocols on top of the software-defined architecture of a non-terrestrial network. The bottom line is that both non-terrestrial networks and terrestrial networks have to seamlessly coexist for everything beyond 6G.

John Gilroy: Well, Sethu, you have a good idea of what's going to happen with 5G and 6G. Let's take our crystal ball and focus it on Earth orbit networks. So, as we move forward in the digital transformation of satellite operations, space is becoming more and more like a network. We mentioned that. So, how do you see Earth orbit space networks evolving in the future?

Sethu Saveda Suvanam: As I said within the Earth orbit networks, I would say already we are now talking about multi orbit architectures, where your MEOs, GEOs and LEOs are all connected.

Probably today, we are just purely talking within the framework of defense and security. But soon, I would say we would see both multi-orbit and multi-domain, meaning that your remote sensing satellites with different sensors would be connected with your communication satellites, will be connected to your scientific satellites. So, that's a trend that's definitely coming.

And again, I said I'm a very keen follower of how technologies evolved, and I can give you one of the examples now. So, today, if I travel, let's say, from Sweden to the U.S. I wouldn't physically go with my mobile network to connect to a mobile network in the U.S.. My mobile network straightaway connects to the network that's in the U.S., mainly because all the networks are interconnected in the world, and there is seamless connectivity and protocols that are shared, standardized. And the space networks would go into that way.

Today, every time a user has to buy some data, they have to go and buy a SAR data from a SAR user or a SAR operator. They have to go buy and hyperspectral data from a hyperspectral operator.

Once you have this multi-domain, multi-orbit kind of a network, then you could start seeing new companies that are coming in between the end user and the operators, who will start developing these software applications, where they could start selling these data. Where users can just go there, start developing applications on these software applications, and then they don't have to bother where the data is coming from. They will have all the data there.

It'll become like this app store. Today, in an app store, users don't bother if the app is running on an Nokia phone or a Samsung phone. They just develop it on a standard software and it's just running. So, again, this will open up a huge Pandora box of applications, which would ultimately enable us as humanity to move into a better world. Right?

John Gilroy: Good. Sethu, abstract concepts like software-defined satellites are always difficult to articulate, but I think you did a real good job for our audience today. I would like to thank our guest, Sethu Saveda Suvanam, CEO and founder of ReOrbit. Thank you.