Constellations Podcast

Episode 30 – Satellite refueling, life extension and the future of Small Sats

Speaker: Carolyn Belle, Senior Analyst at Northern Sky Research – 23 minutes

John Gilroy: Here we are again at the SmallSat Conference in lovely downtown Logan, Utah. The megapolis here, you know, big, big city, bigger than New York City, I think. Other guests on this podcast have provided in depth analysis of specific issues in the small sat industry.

Our guest today is Carolyn Belle, a senior analyst at NSR, and she will give an overview, maybe from 40,000 feet, maybe higher, an overview of many of these topics. And we need that perspective. As we've been hearing in earlier podcasts here at the conference the small sat industry is growing in so many directions. New streamlined manufacturing techniques, more launch options, a plethora of emerging applications. Carolyn's job at NSR is to focus on satellite manufacturing, launch, in space activity, and the trends surrounding creations of diversified space architectures. Carolyn built NSR's practice in small satellites and emerging markets, engaging with startups globally to create a robust research based on new applications and ways of leveraging space. What a great background.

So Carolyn, let's get started here.

Carolyn Belle: Great.

John Gilroy: Here's the magic number, 5,000, and I don't know if this is a rumor or an accurate number or a guess, but some reports identify growth of the small sat market with 5,000 satellites potentially launching within the next decade, with a cumulative revenue of 25 billion dollars. Wow. Any of those numbers correct?

Carolyn Belle: They sound pretty good. We've actually seen more growth, and we now anticipate about 6,000 satellites launching within the next decade moving forward towards 2027, generating quite a bit of revenue definitely in that greater than $25 billion range for manufacturing and launch providers.

John Gilroy: That is just an incredible number. I mean, six years ago could you have predicted that? That's an incredible number.

Carolyn Belle: We've seen a lot of growth in the industry over the last few years, so we've certainly known it's going on, this positive trajectory, and as we have more advancements on the capabilities that you can put into a satellite as well as more developments on the market side, it's certainly not a surprise that we're seeing this much growth moving forward.

John Gilroy: Yeah. Well, we're based in Washington DC, and you're based in Denver. In Washington I think about government activities and you maybe think about commercial activities. So, this big fancy number… how many is government, how many is commercial, where does it balance out? What's the distribution?

Carolyn Belle: It's very much a commercial market. We see about 20% of those satellites being from government or military entities around the world, not just in the US, but we see activity in every other region as well. Many government players are interested. But it's really dwarfed by that commercial activity. We have university and public organizations that are active as well. They are about 10% of the market. So really you're left with about 70% of the market, just under 70% of the market, coming from commercial providers.

John Gilroy: I have to tell you, we're broadcasting from the floor of SmallSat, and right before we started there's a Marine that walked by. Did you see a Marine walk by? There are guys from Navy here, Air Force, Army. There's a recruiting booth up there for the Naval Academy.

Carolyn Belle: Absolutely.

John Gilroy: They have interest in this. This is something that has a lot of application for many military applications as well, doesn't it?

Carolyn Belle: It absolutely does, and we've seen a lot of adoption growing over the last few years, especially within even the last six months on the military side, of seeing the opportunities that small sats can provide, the way that small sats can work in tandem with their larger satellites that are much more capable, have many different instruments on them. But by including small sats in the architecture, you really get additional capabilities, a more robust set of assets in orbit.

John Gilroy: Well, we're going to go back a few years to 1996 with Tom Cruise's movie Jerry Maguire and he talked about show me the money. Remember that? Show me the money. I'm going to ask you the money question here. Show me the money, Carolyn. The government typically has had money for investing in space, but now the money is from Silicon Valley. Do you think that's going to continue? Or do you think there is going to be a pause in the way these investments are playing out?

Carolyn Belle: We do see ongoing interest from Silicon Valley and other venture based investors around the world. There are different funds being set up, even in the UK we see some venture activity growing for investing in the space industry. So while it is very much focused in the Valley, it is a broader set of investors, and we do see that continuing. I think we might be approaching a bit of a slow down on the investment side. There has been very rampant growth the last few years

and investment, but potentially as investors look for the early companies that were funded, the Planets, the Spires of the world that were very successful coming out and garnering this interest in this early investment, there might be a bit of a wait to see how do those perform, how much revenue do we get back, what is really the exit looking like before there's a fresh range of investment.

John Gilroy: I think that may impact the types of investment. In the software business you can have rapid return on software as a service product, but some of these products here, I don't know if they have the appetite for the return they're going to come with this market. It may not be as rapid as in software world.

Carolyn Belle: In some cases no, but for some aspects of the space industry, you can get a reasonable return for the timeline. Traditionally the space industry has been a very long timeline business, but with small sats, really the scale at which you're operating, you are able to take something from design to testing to implementation in a much shorter period. That then reduces the amount of time that an investor needs to wait for their return.

John Gilroy: Well, you walk around the small sat, and there's lots of optimism here, lots of young people. Maybe the older people have seen failure and know what it's like to beat their head against a brick wall. Many of the people are tremendously optimistic about the constellations that are going to go up there.

Carolyn Belle: Right.

John Gilroy: Let's assume that one of these is successful. Wild assumption. What impact will it have on the big guys and the large satellite folks?

Carolyn Belle: Well, that depends really on which sort of application you're talking about. If we're looking at small sats for earth observation, it's a different potential impact then if we're talking about the communication side of thing, which is really what's been getting a lot of interest and a lot of discussion in the industry, given that communications is the largest segment of the satellite industry on the commercial side of things. That's where the GEO operators, the big guys, as you put them, are fairly nervous about what's happening with small sat constellations. With this handful of mega constellations that are in development, the One Web, the SpaceX, the Leosat, the Telesat, should one of those be successful, they're a little bit nervous.

We've already seen an impact in that market where none of these systems have been deployed, but the GEO guys are already holding off on ordering replacement satellites. They're not sure how much of their market is going to be taken by one of these Leo small sat players. They're also getting more creative with what they do. They're taking a few more risks in orbit to provide a more

robust set of capabilities that may be better able to compete with one of these new small sat players. So I think we're definitely seeing a response of hesitancy, but then looking for creative ways to move ahead and still do well.

John Gilroy: We did an interview with Dr. Pat Patterson right at this table here yesterday, and he was very optimistic about everyone getting together. But in my experience there's going to be winners and losers and who is going to make the right bets. Are these guys in Silicon Valley going to make the right bets? Perhaps. Some of the large satellite operators are going to maybe work in partnership with some of the more successful, young small sats. I mean, this is a horse race that no one knows who to bet on.

Carolyn Belle: I would say that's absolutely true. There are some that make more sense than others. We see investors really making plays for a wide variety of applications. Some are investing on the hardware side, some on the satellite operators who want to put a constellation into orbit. It's not a case where all of them can be successful. We're absolutely going to see some failures in this market. Some applications may be ripe for development, some might be slower to develop. We already see some saturation where there are too many players going after the same thing. So it is a question of which horse have you bet on and are they well positioned to succeed.

There are many different layers feeding into that. It's not just what market do you go after, it's how do you design your system to do that, how much early financing do you have, how much R&D do you have to face to get there, what is the regulatory side of things? There are a lot of challenges that these players are facing. It'll be interesting to see who is successful.

John Gilroy: Before the podcast I was chatting with you, and you showed me your metal water carrier, your little water bottle there. I'm in a classroom all the time and my students have metal water carriers, water bottles. It's because it's environmentally correct, John, with a paper cup in front of you there. And I think about being environmentally correct. Let's talk about this in perspective with what's going on with small sats. What's going to be the environmental impact of all these new 5,000, 6,000 satellites all up in space? Everyone's going to get along? I mean, what's the impact going to be with that?

Carolyn Belle: That's something that people are certainly getting nervous about as to what this will do to the space environment when you have more satellites potentially being launched than we currently have in orbit right now. More than double that many will be launched in the coming years. It's turning to this new environment where there's going to be a lot of responsibility continuing to be placed on a satellite operator to treat the spectrum environment very carefully. Spectrum is a limited resource, so we have to think about interference coming from these satellites, because of course you have communications up and down

all the time. You also have to look at what will happen for avoiding potential collisions in orbit. Because you have space traffic management that's really an issue coming to the… [sic].

John Gilroy: That's what the old guy in me, says look, there's going to be collisions up there. People are going to make mistakes.

Carolyn Belle: Hopefully not. Operators are certainly aware of that risk, and they're working to mitigate it as much as possible. We have new solutions being provided by manufacturers as well. One of those elements is propulsion. Not all small sats right now are being outfitted with propulsion, which really limits their ability to respond in orbit when there is a potential collision event with either another satellite or with a piece of debris. That sort of capability will help them to respond more quickly. It potentially enables both parties to be able to respond rather than if there's only one with propulsion.

You also have growth in development of de-orbiting devices, so that as soon as the satellite is no longer operational, it can more quickly exit the space environment rather than waiting for this 25-year rule of slowly de-orbiting.

John Gilroy: I was walking around the show here talking to people. I talked to a university up in the next level, and they had a 1U, little small sat. I said, so what happens? Well, it leaves and then it just tumbles - that's the phrase - it just tumbles through space. And I said to myself, what could possibly go wrong? I mean, there's no propulsion, there's no control. It seems like many tumbling events like this could cause trouble.

Carolyn Belle: They could cause trouble but the other important element is where the satellites are placed. Operators are careful to place satellites at low enough orbit where they will de-orbit more quickly, so that reduces the risk of how long they are potentially tumbling in space. And they're also, as you were talking about, a 1U, that's a fairly small satellite, so it presents different risks as well.

John Gilroy: Talking about different topics here. Satellite refueling, life extension, and salvage. It seems like these could be auxiliary markets to this big huge satellite market as well. I mean, there could be lots of different markets that develop here.

Carolyn Belle: Absolutely. And we see a lot more diversity coming from small sats than we had with large satellites to begin with. I mean, communications has been the main application in the '90s. There was more commercial observation that reached the market. But with small sats it's a huge variety of applications, services, sets of data that players are looking to provide. And then of course, yes, on the side

of that is this potential for satellite servicing, robotic work in space. And small sats could be a piece of that.

Right now, plans in development, some are focused on larger satellites to really be able to manipulate the large satellites that we have in orbit now, the GEO players. But we do see some activity on the small sat side as well. Some university projects right now looking to develop robotics from a fairly small profile satellite to interact with others in orbit.

John Gilroy: Mechanical engineers are getting involved the computer sciences getting involved, the aerospace people get involved, all kinds of different skill sets. One little robot in space, that would attract a lot of students, I would think.

Carolyn Belle: It certainly does. There's a lot of interest from the student community now, especially because it's so much more possible with small sats for them to get hands on experience while they're in university or even high school, or even there are middle schoolers at the conference this year.

John Gilroy: You're right.

Carolyn Belle: So it's really showing how STEM is much more hands on now. Previously space was something that you didn't really touch until your first job post grad.

John Gilroy: You saw a picture of the satellite, right, yeah.

Carolyn Belle: You saw a picture of the satellite, maybe you were lucky enough to see a launch-

John Gilroy: Remember they had the white jackets and the white jackets and here's the satellite. Wow.

Carolyn Belle: But right now you can hold it, you can build it, and know that you put something in space.

John Gilroy: It kind of makes me jealous, you know? Wow. That would've been so much fun to put in your hand and going wow, look at this, we can pop it up there. That's great.

In the software world I live in. They used to talk about killer apps, this is a killer app, and that's a killer app. Is there such a thing as a killer app maybe in the horizon for small sats? Anything that you can see?

Carolyn Belle: There are certainly players looking to find that killer app and some who think they have. I'm of the opinion that there's no single killer app for small sats. I

think that there is a lot of different value that can be provided by small sites, both with capabilities that they have today as well as those in development. But it's certainly a topic of discussion. I ran a panel this week where that was exactly what we were talking about. What are the future applications for small sats? What are the ones that are the most commercially viable as well?

John Gilroy: Situation awareness might be one.

Carolyn Belle: Absolutely. Situational awareness is one, whether that's on the military side or on the civilian side. Also interest in internet of things in tracking pretty much everything that's going on on earth. Imagery has been an application of small sats now is one of the leading ones we've seen so far deployed, but now we're seeing other types of earth observation being pursued, where SAR is now something that small sats are looking to do, which has been a challenge technically. Other types of atmospheric data being collected, financial applications of using small sats, the security of space, leveraging that, entertainment, marketing.

There are a lot of different things that people are looking to do with space. It's really a question of how rapidly they can develop those markets, whether there's enough downstream potential, and really building out the distribution network that's needed to tap in to those potential customers, convince them to use the service, and really enable that to happen quite easily that we haven't really seen enough of that development to enable these new applications yet.

John Gilroy: Yesterday I sat for an interview with guy named Stan Kennedy, and I quoted you. I quoted Carolyn Belle, and it was a great lead in conversation. So I think it's only fair that I quote you in your podcast. So I'm going to quote you here. You wrote that small sats are simply another piece to the value creation puzzle. That's a good perspective on, isn't it?

Carolyn Belle: It is. It's something that I like to keep in mind because very often, especially at events like this, people come and are working on small sats, very focused on the capabilities provided by small sats, which yes, have increased significantly in recent years. But I think it's important to remember that the space industry is much broader than just the small sat industry, and we still have very viable capabilities being provided by large satellites in GEO, large satellites in LEO, and using those assets together can potentially provide more value then only looking at them in isolation.

While small sats do offer an interesting element of value, they aren't the entire picture, and potentially you can get a lot more if you keep that in mind and take a more cohesive approach to what you're doing.

John Gilroy: Here we are in lovely Logan, Utah, and I flew here. I imagine I could have driven here, and maybe someone could have bicycled here or walked or hitchhiked or something. Small sats of different options for getting up in the air too, don't they? And they're expanding. Right now it's going to be hitchhike. Hitchhike a ride on something else, or different ... What are options people have to get up in space besides the traditional hitchhike? A ride share, I've used the term.

Carolyn Belle: Yeah. The traditional hitchhike or ride share is still the dominant way for small sats to launch into orbit. You have some small sats that are able to have a dedicated launch. That's fairly limited now, mostly due to cost as well as availability of vehicles that are really the right size to do that. We've seen that with some commercial players on the government military side as well, but it's been quite limited to date, so it's mostly been ride share.

And then we've also seen deployments from the International Space Station. Satellites are going up on a cargo vehicle to the ISS and are then deployed out of the airlock. That's been a great way, especially for university projects who are given funding my NASA or other international space agencies to actually get into orbit.

But launch has been one of the bottlenecks that we've seen for the industry in that it's challenging to get a launch, period. That's getting much better. But it's also challenging to get the right launch. So are you launching when you want to, is there a delay, which of course no one wants to face that, and are you launching where you want to? Often with ride shares, you're not given the choice to go to your exact orbit and so you end up somewhere-

John Gilroy: We're going to Montana. Oh, I'm going to San Francisco. I don't care. We're going to Montana on this train. This train's leaving.

Carolyn Belle: It's more of this bus mindset that you get on the bus and you get dropped off and then you have to figure out how to get from there to wherever you want to actually operate. That ties back into the importance of propulsion capabilities, because those can help you maneuver that gap. But that has been a challenge for players.

We now have a huge array of startups looking to address that issue with launch and provide dedicated small sat launchers at a more reasonable price and at a higher level of availability for these commercial operators who are looking for more control over their launch so that they can say, yes, I'm going to launch on this schedule and I'm going to go to this orbit, and maybe I have to pay more than for a ride share, but it's worth it to me because then I get the operational flexibility that I really value.

John Gilroy: Walking around the floor here at small sat I see that NASA has a really big presence just the next level up. I think NASA is coming up with something called the venture class launch services that maybe could answer the question about launch capabilities for small sats. Is that what you think is going to change the launch situation at all?

Carolyn Belle: It could, it could. NASA has awarded three BCLS contracts to date, and these are players who are trying to provide those dedicated small sat launches. It certainly helps when you have government investment. We saw that on the larger launch side with NASA funding that was provided to SpaceX for development of the Falcon 9 for cargo deliveries. That can have an impact in this market as well. But we really need more private investment.

We've seen quite a bit of private investment to date going into launch, but that's not the only challenge. There's certainly a technical challenge that's faced, and NASA's work on BCLS helps along the way. But we need to see a lot more advancement there as well.

It doesn't mean all the companies that received that funding will succeed. We've already seen some face challenges. But it's a piece of the puzzle.

John Gilroy: These small satellites, like the one you size, don't have any internal propulsion. Some people talking about electric propulsion. Is this something to consider? What's your take on this whole concept?

Carolyn Belle: Propulsion in general, I think, is a capability that we need to see more of for small sats, and it's something that many players are looking to develop. Even at the conference here, there are many propulsion players walking around. It's important for the collision avoidance, it's important for optimizing the launch. And in terms of electrical, there's an array of electrical solutions, there's an array chemical solutions as well. And I really wouldn't pick a winner in that race, because it's very unique to the mission requirements.

For some missions, some types of propulsion are better than others. It's a question of what sort of mass you're moving, to where, and how quickly do you want to get there? So there are certainly trade-offs along the way.

John Gilroy: Well here we are at Small Sat and I don't want to be negative here, because everyone's so positive and optimistic about this. But from a detached perspective, or 40,000 feet up, or maybe two, three miles up, do you think small sats will ever live up to the hype? Oh, I got in trouble there. You may have chairs thrown at you.

Carolyn Belle: I think it's a question of hype for who. There's been a lot of hype around this market, both within the space industry as well as more broadly within the mainstream media. There were a lot of promises made and commitments from small sat players about the sort of value that could be created by small sats. And I think we're still really waiting to see that attention.

We've seen consistent delays in terms of which constellations are deployed. We still really only have one constellation that's fully operational today. And it's still building out their business. We've seen small sat operators who've had to adjust their business plans in response to the market, because of course they're dealing with a constantly changing market, and it's also an environment where you have startups that find different ways to adapt and provide different solutions to the problems you're noting or noticing new problems entirely. I think we're still waiting for that big change that small sats were really promised to deliver.

Some of that hype was overblown before. But that being said, I think small sats really have a lot of value to offer to the industry, and we're only starting to scratch the surface of what that might mean moving forward. There are a lot of drivers that are feeding into that, that'll help us get to that position. But certainly the people who are at the conference this week are working on many different elements of really bringing that hype to fruition.

John Gilroy: Right and what conversation will we have in two years? I mean, we don't know. It's just so exciting to be here with all these changes and new ideas.

Carolyn, unfortunately here we're running out of time. I'd like to thank our guest, Carolyn Belle, senior analyst, NSR.