Constellations Podcast

Episode 95 – Flat Panel Antennas, Adapting to the Mega-Constellations and the Lego Analogy

Speaker: Carl Novello, Chief Technology Officer, NXTCOMM - 22 minutes

John Gilroy: Welcome to constellations the podcast from Kratos. My name is John Gilroy, and I'll be your moderator. Our guest today is Carl Novello, Chief Technology Officer at a company called NXTCOMM. N-X-T-C-O-M-M. Today we will discuss the growing push into low Earth orbit with new non-GEO satellite mega-constellations that are bringing flat panel antennas to the forefront. Not a new technology, these fast switching antennas historically have been used only by the military due to their complexity and cost. Joining today is Carl Novello to provide some perspective. Carl is the Chief Technology Officer at NXTCOMM. This is a company formed by antenna veterans in the aviation and satellite sectors, and they're taking a different approach to the flat panel antenna challenge. Well, Carl, y'all ready to rock and roll?

Carl Novello: Yes, sir.

John Gilroy: Great, great, great. Went to LinkedIn, saw your background. I went to YouTube, listened to a couple of interviews. And you've been in the antenna game a long time. In fact, I think your work won... Was it the Satellite Technology of The Year Award at the Satellite Show? So can you tell me a bit about yourself and what led you and NXTCOMM to tackling this flat panel antenna challenge?

Carl Novello: Well, first of all, thank you for having us on today. Really appreciate the opportunity to speak with you. I'm actually a big fan of your podcast and don't miss Constellations ever. So also, I got to thank you for reminding me that I've been doing this for a long time and I got the gray hairs to prove it.

John Gilroy: You're a puppy compared to me. But go on, Carl.

Carl Novello: When I look back, it's been interesting. I've been in the industry over 20 years now. And when I first started the satellite industry, didn't count the same number of users as it does today. And that's always something that's driven me. How do we build products to enable growth in the market? Because when I started, if it wasn't haze gray, oil and gas-related, or a cruise ship, you didn't have mobility VSAT services. And realistically, that's one of the key areas for the satellite industry. So how do you unlock the potential in those markets? And what brought me to NXTCOMM was one, the challenge. How do you do that, like you mentioned, in this new non-geostationary world, with the LEOs, with the MEOs, the mega-constellations, all of these things that were in concept

even 20 years ago, when we looked back at the history with the likes of iKO or Teledesic, for those of us who are old enough to remember those, the idea was there, the technology to enable that wasn't there.

Carl Novello: And it wasn't just about antenna technology. It was about the technology related to the delivery of the overall service. So if I'm a user, like we all are today, addicted to data users, do we really care about the technology that gets us emails and Twitter on our phone? Probably not, only the geeks among us do. When you wear your user hat, you just want it to work. That's part of the challenge that appealed to me coming to NXTCOMM, how do we build products to enable the connectivity that we've been talking about for 20 years in a market environment that now needs it and requires it?

John Gilroy: Yeah, that sounds interesting. I'm trying to put this in perspective. So you kind of grew up in a stationary world everything's changing and you're responding to that change with new technology. Is that a pretty good summary?

Carl Novello: Exactly. And that new technology has got to be enabling technology. And what I mean by this is the mobility products and services offerings of yesterday, they don't appeal to the data-centric mass-market user of today. Not so very long ago, relatively speaking, 64 kilobits was considered broadband. My children don't understand the concept of a data connection that isn't measured in hundreds of megabits. And that's the challenge. How do we broaden the base of our users? How do we broaden the reach of our markets? And the way you do that is by building products that people actually want to buy. And again, I'm using product as, that which you pay for not necessarily the box of the hardware, but the overall delivered solution.

John Gilroy: You know, Carl I'm just thinking about electronically steerable antennas, and a lot of companies putting money, time, throwing smart people at this problem. So maybe you can give us some of the challenges you have in this whole area.

Carl Novello: Well, when you think of challenges, it's probably useful to break them out into three buckets. There's the technology challenges, because this stuff is really, really hard. And if it wasn't, you wouldn't have to devote copious amounts of people and money to do it, but there's also the production challenges. How do you manufacture? How do you scale? How do you do all of that? And then the last one is the commercial set of challenges that cover, hey, can users buy it? Is there a market for your product? Are you enabling markets for the product? And oftentimes as a techie, we like to start with the technical challenges, and that's kind of the wrong way around. We really need to understand the problems we're trying to solve, and that starts with the market. So when you

look at the market and the commercial challenges, when you're trying to scale, it's all about delivered performance and price.

Carl Novello: And when we look at the potential of the mega-constellations, for example, and all this work going on in the non-geostationary space, we see that in order to recoup the investment or monetize the potential of this, you need to get into user counts that are in the millions, if not tens of millions. And that's a space that the satellite market is only ever played with before in the TV broadcast. So start with a market, you have a set of challenges. How do you build to a price point? That's got a zero or two after it, instead of a few zeros after it. And that's the framework that needs to guide you through the technical challenges.

I mean, just to highlight a few of the technical challenges, hey, stuff is expensive. RF components of any sort, whether we're talking about a parabolic antenna with waveguide, or whether we're talking about the newest, latest, and greatest research and development technology, that's trying to find a fit in the satellite space. That's expensive. So how do you build something that scales down to unlock the volumes and the potential? That's one, the other stuff is the technology challenges of putting it all together.

Oftentimes we find ourselves, in the satellite industry, having to invent ways to solve a problem. And the old saw about invention, can't be scheduled well, invention also can't be budgeted very well. Then when you take those into consideration, you're looking at how do I build this stuff? And that's been a challenge for us in the satellite space as well.

John Gilroy: I'm involved in the world of software, and that word scale just tossed out there. Well, we'll fire up some VMware and bang, and off we go and scale up zip-zip-zip. But when it comes to physically hands-on products, this whole idea of scaling, I think you touched on it. It's not as easy as another instance on S3 or something, isn't it?

Carl Novello: Oh, exactly. And that's one of the things that really hurts us. Great strides in software. And you talk about one of my favorite trends and that of virtualization, everything going into the cloud, the beauty of software is, that is a bit, build it to support a certain number of connections or users. And then just fire up a few more virtual machines in the cloud. We have hands-on and boxes and hardware and all that other things that make it messy.

John Gilroy: You know Carl, thousands of people from all over the world have listened to this podcast, go to Google and type in constellations podcast, get to our show notes page, here you can get transcripts for all 94 interviews. Also, you can sign up for free email notifications for future podcasts. You know, Carl, I've been to a few

trade shows and I've seen flat panels, and I don't want to delve into nomenclature here but, you would think that they're a couple inches thick, but not all flat panels are alike. There are differences across these types of flat panels, aren't there?

Carl Novello: Oh, absolutely. Depending on the technology and depending on the use case that your product is trying to solve, they can be from an inch or two on the way up to 6, 7, 8, 10, 12 inches. So flat is a relative term, definitely flatter than a meter parabolic. Sure. But flat isn't yet paper-thin anywhere, flat more describes the orientation of the top,

John Gilroy: When you said the word meter parabolic I thought of a Hummer driving down the street with someone's big antennas on top, that kind of ridiculous, or a boat or a plane. So you got to have some kind of a solution that's portable, don't you.

Carl Novello: Oh, absolutely. And that's really one of the primary drivers for the electronically steerable or the flat panel approach is it allows you to reduce that swept volume. It allows you to bring down the profile of everything. And if you do that right, it expands and enables the market because hey, there's more places to put it on.

John Gilroy: Satellites constellations are getting so popular. The Washington Post actually did a whole study on it at the end of the year. And they talked about the influx of LEO and MEO constellations coming online. And because it's thousands of them going to be online. They're going to need a new type of agile antenna to unlock all this bandwidth. And so what's so distinctive about these constellations that require a different antenna approach.

Carl Novello: Well, that's a great question. So fundamentally whether you're talking LEO or MEO, what differentiates them from the bulk of what we've been doing until now in the satellite industry is the fact that with reference to the earth, the satellite and the LEO or a MEO was moving. Whereas in the traditional geostationary arc, hey, it's geostationary for a reason, a point on the Earth to the satellite, with reference to the satellite that’s fixed in space. So when all of a sudden your satellite is moving, your user can be moving. And there's the requisite handoff between satellites and beams and channels. Then all of a sudden you need a really, really smart antenna who's able to track and reacquire sometimes even tracking and communicating with two different satellites or three different satellites at the exact same time. And that's one of the difficulties in the mega-constellation approach.

You need more satellites because users are hungry for data they're starved for data. So how do you get more data, more throughput? Well, you put up more

satellites, again, speaking in broad strokes, putting up more satellites means, hey, you got to find a way of managing whether that's from the antenna itself or the terminal on the ground to the satellite, but also a set of challenges is how do you hand-off between satellites and space? And that's the big discussion between optical links or other approaches for inter-satellite communications, how does that drive your architecture on the ground? How many hub stations do you need or teleports or gateways to support this and so on. And all that increases the overall technical complexity of a system architecture, and the antenna needs to know about that. So in a parabolic antenna approach, you can roughly only communicate with one satellite at a time.

Carl Novello: If you wanted to communicate to multiple satellites because of the positioning requirement, you would need multiple parabolic apertures to be tracking those different satellites. And that's what we do in the space today. For example, with the O3b solution from SES, requires multiple stabilized antennas, if you're looking at a cruise ship or multiple tracking antennas if you're doing something on the ground. Those take up space and space drives down your addressable market, but they're also costly. They're also relatively complex to maintain, relatively. They've gotten much, much better over the years. So the beauty of a flat panel in particular an electronically steered antenna is that beam from the face of the antenna can move very, very rapidly and you can support multiple beams of the same aperture. What does that mean for the user? That means the user takes it, makes sure it has an unobstructed view to the sky and he doesn't worry about all the rest of that geek-speak I just spewed.

John Gilroy: Yeah. That's amazing. You know, earlier in the discussion you talked about, instead of focusing on technology, focusing on solving the problem, that sounds like out of a marketing 101 textbook. So, which markets are ready to take advantage of LEOs and MEOs first?

Carl Novello: So I think it's going to follow what we see classically in new technology. The first wave adopters are going to be the high-value niches. I think the obvious ones, there are, the government markets, the defense-related markets, as well as of course, the airline use case, how do I connect an airplane better? So I think those are going to be the ones that'll take advantage of the LEOs and MEOs first and within each one of those, there's a wide range of markets. When we talk about the defense-related, that can move from the classic, hey, who are my frontline forces to forward operations and down the chain. And those can describe a variety of different use case verticals, whether that's comms on the move on the land, whether that's comms on the pause for a military user, or whether that's a real on the move, in an airplane or on a boat of some sort or a ship supporting the mission.

And then likewise, when we talk about the aviation industry, we have a wide range, the solution and the compatibility, or the deliverable, sorry, for a commercial airline versus a private jet versus a military aircraft, are similar but different enough that there's going to be some differences in how they consume or ingest the LEO or MEO service capacity.

John Gilroy: You just used the phrase "Comms On The Move", a very military type phrase. And they're very interested in scalability and modularity and systems. And I've heard that NXTCOMM and people like you describe your antenna scalability, using a Lego's analogy. So that's pretty simple, I think most folks aren't rocket scientists and maybe they can understand this. So, a Lego's analogy for antennas. Does this make sense?

Carl Novello: Yeah, so I like to use the Lego analogy one because hey, even in my advanced age, I like playing with toys, but the modularity of a Lego is brilliant. What do I mean by this? You have a basic unit of building block, the basic Lego, the most popular Lego brick there is, is the two by four. And by two by four, everybody's familiar with the Lego, I refer to the connection point matrix. And you can take those things and using other bits and pieces, you can make them bigger and smaller. That's our idea with scalability, and certainly, other companies have had the same approach where the technology building block is a Lego. In our case, we refer to it as a sub-array and you can take multiple sub-arrays, put them together to meet your different use cases. And what that does for us is that reduces our cost and our time to build application or use case-specific products.

And even on the user's perspective, hey, if I need a relatively low amount of data, relatively, I could say, take one, sub-array, one Lego brick. And I can put that in my comms on the move platform, or I can put that in my vehicle. But all of a sudden, when I'm moving to a larger installation or a larger vehicle, I can take multiples of that one sub-array. And what's the benefit? The more surface area you have, the faster you go, the more efficient your utilization of the satellite capacity is. So that's what we mean by the Legos. Make it start off with one unit, make it bigger as you need.

John Gilroy: So 25 by 25 centimeter, you just pop on a few more. All of a sudden it's 50 by 50. So it gives the choice, the customer can pick and choose what level they need. It gives them all kinds of flexibility, doesn't it?

Carl Novello: Exactly. And there's no reinventing of the wheel when you do that. It's not like I have to go back to the drawing board with our engineering staff and say, okay, I need one just like the one we did only twice as big. And that means another item on our development roadmap. Just plug them in.

John Gilroy: I always look at past technology, look forward to future technology. So Carl, what will it take to make the next generation of antennas more widely available and mainstream? Everyone who is listening to this might have read the NSR report. It talks about hurdles like cost and technical complexity. So what's going to take to move forward on this?

Carl Novello: Well you're really going to have to work on the overall manufacturability of the deliverable. Instead of using esoteric production methods or esoteric technologies, it's got to get down to the point where it's absolutely simple. And that's pretty much making it look like a standard PCB, printed circuit board. Where you take all the manufacturing know-how and innovation that's happened in that front. And you bring that down to a level where it's manufacturable in crazy volumes for us on the satellite side, for example, can you print a million circuit boards a month? Absolutely. Can you push out a million parabolic reflectors in a month? I don't think there's an organization in the world that could do that. So that's going to be the important side of it. And then what scale unlocks in volume is price point. The more you manufacture of something the lower the price goes, the lower, the price, the more people who can buy it, that's a big one.

And of course, it's how do I ensure the reliability and the technical capability when doing that? So cost and technical complexity are hands in glove. The more complex my architecture is, the more expensive it is. And really all of this is saying that we have to have the perfect storm. What do I mean by that for the next generation of antennas to be widely available, mainstream, we need something to make them usable. And that means a mega-constellation launched. That's usable. That's affordable. That works for customers that is supported by hardware that allows them to do even more.

John Gilroy: About a hundred years ago, there was this guy named Henry Ford and he figured out a little bit about manufacturing and he actually reduced the price of his car. Didn't he? So he reduced the price of the car. It means more and more people, more and more areas. People on farms had cars. And I think that if you can overcome this hurdle here, manufacturing, that should open up huge opportunities for upgraded connectivity of buses, trains, connected car. Makes sense doesn't it.

Carl Novello: Oh, absolutely. And it really is a bit of a green field. I mean, think of it today. So many different devices, whether it's the onboard computer in your car or the cell phone in your pocket or everything in between, heck your TV, your toaster, your refrigerator, everything wants to be connected nowadays. So the connectivity on the more passenger-based, or enterprise-based transportation

methods, you mentioned like trains and buses, that one, sure. And I think those will be a market that will adopt earlier.

Carl Novello: And then the Holy Grail of this in terms of the volume market is connecting anything with four wheels. The consumer car level. But in order to get there, I think we'll progress from as I said, the more enterprise uses, buses, trains, freight, as in maybe even trucking or high-value cargo. And then as things, progress and scale in that market will move down towards the connected car, first on an industrial level, and then moving towards consumer entertainment. And that's exciting because that's millions and millions that makes us important and relevant as an industry to consumers. And from there, what's after. After you connect the car, it's not a stretch to connect the house.

John Gilroy: When it comes to connection I think what our audience is interested in here is ground connectivity. And so from your perspective, where do you see the market headed for ground connectivity in the next few years?

Carl Novello: Well, I think that one's an interesting one. Where it makes sense for satellite, I think satellite has a fantastic opportunity. There's going to be an inflection point and that's one of the big potentials for all of these mega-constellations, where it'll be more cost-effective to put the infrastructure in space, to support users on the ground, and more terrestrial and fixed settings, than it is to trench or run fiber optic cable. And that's going to be very, very interesting because then you have even another order of magnitude, maybe even two larger in addressable market. And I think that's what it takes to start seeing some payback. If you will, on the mega-constellations, you need to have the user volumes that make it more akin to a terrestrial telco market than what we've been looking at in the past as a satellite-based market.

John Gilroy: Wow. Carl you gave us some good fodder to think about innovation in the world of antennas. And when I think of innovation, I think of this guy, Clayton Christensen and he famously created the phrase “disruptive innovation”. From listening to this conversation. It looks like you folks have read his book and applied it to the antenna business. I'd like to thank our guest, Carl Novello, chief technology officer at NXTCOMM.