



## Episode 130 – The intersection of LEO and 5G, Phased Array Antennas and Capabilities Brought by Lower Power Connectivity

Speaker: Bill Ray, VP Analyst, Gartner Research – 20 minutes

**John Gilroy:** Welcome to Constellations, the podcast from Kratos. My name is John Gilroy, and I'll be your moderator. Today, we will be interviewing Bill Ray, Vice President Analyst for Gartner Research, and part of Gartner's emerging technologies and trends office. He also runs Gartner's internal space technologies interest group. Space, as we all know, is the next frontier, in fact, it's the next growth frontier. From interplanetary travel, to setting up broadband networks in the sky, to LEOs with the aim to connect everyone to a better future. Bill, we are interested in learning more about what you see as emerging technologies in space. Let's start off with this LEO stuff I just mentioned. Can you give us a sense of the size of the LEO constellations market?

**Bill Ray:** Yeah, I think it depends on how you count it, obviously in terms of number of satellites, this is unprecedented. We're seeing thousands of satellites deployed in an industry where, previously, one or two satellites would have a significant impact. And this is partly because they're closer to the earth for communication purposes, you need more of them. But also, if we think of it in terms of the impact it's going to have on telecommunications, we're not going to see fiber optic disappear. This isn't completely swamping the telecommunications industry, but it's going to have a very big impact on certain areas. So, I think in terms of the telecommunications industry, it's a relatively small thing, but in terms of things like earth observation, and the amount of information we know about the planet we live on, it's absolutely huge and unprecedented. So it's going to have a big impact even if it's not actually compared to the telecommunications industry. Globally, it's not a huge deal.

**John Gilroy:** When you look at the intersection of LEO constellations with 5G, how may that affect the impact on telecom as a whole?

**Bill Ray:** Well, 5G came in with a lot of very big promises, and frankly, it over promised and under delivered. So when 5G came in, we were told that it would provide ubiquitous coverage, that it would connect a lot of low power sensors and an internet of things, in addition to providing us with very high bandwidth. Now it's achieved the last of those things, 5G does get you very high bandwidth, if you can find coverage, but the other two, ubiquitous coverage and low powered connectivity for IoT, 5G just doesn't do very well. The reasons for that are quite

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technical, from the 5G radio standard, it's really bad at low power connectivity. It was designed for streaming video and holographic displays, or whatever. It really wasn't designed for the kind of low power connectivity that we think of with the IoT.

Bill Ray:

Meanwhile, coverage wise, the use of millimeter wave frequencies and higher bands means the range is significantly lower than previous technology, such as 4G or 3G, needing more base stations. The coverage is actually still quite poor. Meanwhile, for satellites, from a low power point of view, we've got companies like Myriota, and Astroscale, or Astrocast, and Swarm Technologies, creating global IoT networks where you can have a sensor with a battery license of five years feeding data up to a satellite. And they're working extremely well. From a coverage point of view, a lot of the satellite networks are truly global. So a lot of the things that 5G said it would do are actually coming with satellites. 5G itself will be important, don't get me wrong it's not going to disappear, but it's not been the revolution that people thought it might be. And that's not going to happen anytime soon.

John Gilroy:

Well, I'll use an American expression here, and you can try to figure it out. So is LEO going to put 5G in work boots and actually make it accomplish some of its goals?

Bill Ray:

I think there's going to be some of that if we look at things like coverage in remote areas. When we talk about remote areas, we often talk about Sub-Saharan Africa or India, but you can also talk about rural Kansas. You haven't got network coverage there. By providing back haul via low earth orbit satellites, you can immediately and cheaply deploy base stations, and that's going to increase coverage and make 5G, and other things, quickly available, and that's going to really be important. KDDI in Japan has already signed a deal with Starlink to put up 1,400 base stations using Starlink's back haul. It's not the ideal network for it, but it's going to get them coverage across Japan in rural areas where they wouldn't be able to any other way, and that's really going to change telecommunications. When you can assume global connectivity, that's a world changing thing.

John Gilroy:

I think this report is very insightful because I've talked to high level people at, let's say T-Mobile, and they're already talking about the next G, 6G. Well, make sure maybe this G is working before you, but they're already talking about it. "Because every 10 years we have a new G and when 6Gs are going to have-", it seems like they're looking in a mirror but don't see that they're missing a neck tie or parts here. They really all just speed ahead, don't they?

Bill Ray:

Yeah, and it's all about faster, the very concept of enough speed doesn't really seem to occur to the telecommunications industry. But in fact, if we take a mobile phone, you have a standard sort of rectangle of plastic and glass that we consider to be a smartphone. Once you get beyond above 50 or 60 megabits per

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second, you can't do anything with it. And yes, technically with 5G, you can get a gigabit per second to a mobile phone, but there's no value to it. You can't display more video.

Bill Ray:

Now, if we talk about holographic displays, smart glasses, self-driving cars, sure, then you can start to use that kind of bandwidth. But with smartphones, as we understand it today, 5G is not delivering any differential or improved experience. But, if you can get coverage everywhere, like if I can take out my phone and get 5G in the middle of the desert, in the middle of anywhere, that really changes things. And if I can rely on that connectivity, it's much more useful to have 10 megabits per second of absolutely reliable connectivity than it is to have a gigabit per second of occasional connectivity. And that's something the satellite industry can deliver that mobile phone networks are not.

John Gilroy:

I have to tell you, Bill, I have a next door neighbor who has a 400 horsepower Mustang and he gets it out in a 25 mile per hour street. I mean, that's the street he's on, and he can go to the Giant and come back in a mile. It just seems like it's good bragging rights, but it's not that practical, so it's interesting. And I think people are so wrapped up in the next technology they forget to take a look at optimizing what they have now. And as trendy as the word "optimize" is, it's not used that often. Let's go back to some satellite talk here. So satellites and LEO are creating new options for global internet access, what are these options?

Bill Ray:

At Gartner, we're very concerned with helping our customers realize these technologies and get value out of them. So, when we talk about global connectivity, if we talk about connecting up Sub-Saharan Africa and Nigeria, huge populations who are not on the internet now, and we start to think about what's going to happen when those people arrive and how that's going to change. You know, Nigeria has an average revenue per user of \$4 a month, which is not very high, but it's still a lot of people. A Facebook user in Nigeria, we estimate it's worth about \$11 a year to Facebook, that's quite a value. If you can get those connected, then you can really draw value out of that. And what we are telling our customers is they need to create applications suitable for those people.

Bill Ray:

They can't just take the existing Facebook and Snapchat and so forth, they're not necessarily going to work there. They need to think about how they can harness these new people and provide services that are suitable for this crowd and that can really deliver value, a great example of this is Nokia Life Tools. This was a product that Nokia released a few years ago in India, it was low cost at a couple of dollars a month. It provided weather information, crop pricing, and cricket scores, because in India, you've got to have cricket. It gave 10% to 15% of improvement in productivity from the farms, just with those bits of information delivered over SMS. And that's the kind of application we need to be looking at for these new regions where you can deliver a lot of value with small amounts of connectivity.

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- John Gilroy: Believe it or not, I'm kind of familiar with internet access in rural parts of Africa, and you used the word reliable earlier. I think if in the UK, or maybe the United States, faster is better, speed, speed, speed, blah, blah, blah. But that word reliable, that's what people are searching for over there. Reliable is everything over there where you may have a day with nothing. And so, just the concept reliable, you've got to put that in the front part of your billboard, you're convincing people this technology rivals everything in many, many parts of the world.
- Bill Ray: Absolutely. And much better to have 10 megabits per second that always works rather than a gigabit per second that sometimes works.
- John Gilroy: Boy, there's no doubt about that. So, Bill, can you tell us the key technical advances that are driving the evolution of the LEO constellations market?
- Bill Ray: Well, I think there's a few things, obviously, launch capacity has increased, launch has gotten much cheaper, we've seen government investment, which has helped SpaceX. And now we're seeing that in China, of course, the Chinese launch market is, I was going to say taking off, but that would be a poor pun. But a lot of Chinese startups have allowed a lot of new rockets to derive there. And again, the Chinese government is investing in a way that they haven't before, obviously because they've seen what's happened with SpaceX and thought, "We'd like to do that here." No problem there. So we're seeing a lot of innovation in launch capacity. Also, things like phased array antennas, these self configuring antennas. Now phased array means that instead of having to take a dish and point it at the satellite, you actually have a dish which points itself at the satellite. It sounds very simple but it's actually incredibly complicated.
- Bill Ray: Starlink has done a very impressive job in getting cheap phased array antennas. Amazon is now following suit with their Kuiper project and you know, we'll see the others as well. They're not quite as good as a dish, but their configuration, in fact, you can just take them out, sit them on a flat surface and then instantly log onto the satellite. It's very valuable. They are getting cheaper, they will continue to get cheaper, but that simplicity of operation has been a really important factor. So we'll see that happening more. So I think that's the key thing, of course, phased array is also used on the satellite itself. That's been the case for a long time, but the cost being down, being able to use phased array at both ends of the connection has been a really important innovation.
- John Gilroy: Bill, 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, you work for Gartner. Let me state the obvious, Gartner is a big company, very well known here in the United States. All of our listeners have heard of Gartner and Gartner has researched, and continues to research, the impact and growth of early stage

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innovations in new space satellite technologies and applications. So, Bill, can you provide us any top level insights about this research you can share with our audience today?

Bill Ray:

Yeah. We've been looking at investment and obviously investment in space technology is definitely increasing. One of the issues of course is a lot of it is internal, so obviously things like Starlink are privately held. So we don't have that much public data, but we can still draw some fairly interesting conclusions. And if we look at the public investment, the startups, the venture capital investment, we can see it's now becoming quite focused on industry verticals. So specifically, obviously agriculture, the ability to see wide areas of fields, particularly in satellite photography and earth observation. We see sustainability and environmental issues, of course being very important, but we also see things like mining, natural resources. But we are seeing companies invest in those verticals rather than investing in satellites or investing in launch vehicles. They're now starting to invest in companies that analyze the data, that actually exploit that data. So the investment is definitely shifting perhaps away from hardware and towards services to extract value from space.

John Gilroy:

Well, you're a guy who can analyze data fairly well or you wouldn't be in your position. So, what does the data tell you about the future of small constellations, and what else outside of the 5G market is coming?

Bill Ray:

I think the low power constellations are very interesting, the IoT stuff. There are plenty of radio frequencies to use, and there's a wide variety of models being deployed there. So we see people using 2.4 gigahertz, which is the unlicensed wi-fi band. You can use that in one direction, you can collect data, but you can't transmit from a satellite in that frequency. We see people like Lacuna Space using 900 megahertz, again, one way communications, but we see other people using license bands. So, I think I mentioned at the beginning, five year battery life attached to a water tower to tell you how much water's in that tower. That's very valuable. And it just sits there for five years, sending out its data, reporting back. And I think we undervalued how much that's going to change things, when we have that visibility.

Bill Ray:

I'd say the killer application for this stuff is asset tracking. Being able to know where everything is. And when I say everything, I'm not talking about little things like dogs or lost suitcases, we're talking about railway carriages or generators or combine harvesters, generators all over the U.S., and you've got, I don't know, 10,000 generators and you hire them out. Being able to have a map where you can see where every single one of those is all the time. That's incredibly valuable. That can really change your business, improve your efficiency. And that's the kind of thing that satellite IoT is delivering already, and will continue to deliver.

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John Gilroy: I'm going to bounce back to Gartner here. Gartner has published material on how satellite photography will revolutionize business. So, what do they mean by that?

Bill Ray: When we think about satellite photography, initially, we tend to think about military applications and obviously being able to see the enemy. And then we start to think about environmental applications, such as disappearing sea ice and things of that type. But what we're now seeing is the business applications. And this obviously is a much larger market. So we'll take a very simple example. If you are thinking of opening a supermarket these days in a town, the first thing you do is you go on and you can buy satellite photographs of the car park of every other supermarket in town every day for the last year. You feed it into a very basic AI. It counts the cars and it tells you how many people go to a supermarket in that town every day. That is an incredibly valuable piece of information. You're planning on opening a supermarket and it's information that five years ago you could not have got, nobody could provide you with that unless you actually put people sitting outside the supermarkets, counting the cars, you couldn't have got that data.

Bill Ray: And the great thing is there are companies now collecting that data without being asked to, so that data's already there. You're not going to have to go to somebody and say, "I want to start collecting data." You can go and say, "You've already got the data I want. I'd like to buy it from you." And that really changes things. So we have this incredible insight into what's going on in the world and what has already happened in the world. We talk to financial companies who, they're loaning money on the basis of farm crops. And the farmer comes to them and says, "Oh yes, I'd like to borrow some money. Last year's crop was fantastic." Well, now they're able to go back and look at a photograph of last year's crop and maybe they'll come back and say, "Yeah, that was fantastic." And maybe they'll come back and go, "Actually I can see an empty field."

Bill Ray: Information they couldn't have got a few years ago. It really changes their business. So it's revolutionizing things. If we look at mining, you can look at a spoil heap. You can measure the height of the spoil heap on your mine, or more importantly, your competitor's mine. You can see how much material they're pulling out. We have some companies who say they can tell how much a boat has been loaded using synthetic departure radar. They can actually measure the displacement. They can see how much cargo is loaded onto a ship. That's an incredible amount of information, which just wasn't available. And one of the things that we expect to see is not only are you going to have to worry about, or not only are you going to want to gather information about your competitors, but you're going to have to start to think about how to conceal information about your own business. You know, during the war, the British built inflatable aircraft, which they put on the beaches in Norfolk to make it look like they had an invasion force. Maybe we'll see a business doing that. Maybe we'll see you artificially creating spoil heaps or loading boats with ballast to make it look like

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your business is different because there's going to come a time when your competitors, or your competitors can already see what your business is doing. And you might want to conceal that.

John Gilroy: I was just going to ask you, give me a for instance, but you just gave me like 20 for instances there, everything from spoil heaps to, I guess there's going to be, I don't want to use this term, it's bandied about too much, but misinformation and disinformation, and what's true and what's not true. And, all of a sudden, this is a chess game. And you know and I know, Bill, once a competitor knows someone is doing something, they're going to have a counter move and then, Bill, you have back and forth and back and forth. So I can see this as a new aspect of the MBA classes at Harvard. The class is on deception because of the satellite, because they know as much about your industry as, possibly, you know.

Bill Ray: Absolutely. And you've got to assume that some of your competitors are already doing that. This isn't science fiction, this isn't something we're talking about in the future. It's still relatively expensive, but it's getting cheaper and it's getting better. So you should be preparing for it now.

John Gilroy: And so from an international perspective, there's really no guidelines or ethics for this either. It's the wild west, as we say in the United States, it's the wild west out there and people are just trying to figure it out, what's fair, what's not fair, everything's fair.

Bill Ray: Yeah. I mean obviously the governments do provide guidelines on places they don't want photographs taken for a few military bases where you'll find that the photographs are slightly pixelated. Fewer than you might think, actually in general, the military tend to assume that the opposition have got decent satellites anyway. And so having civilian photographs of submarine bay, or something like that, actually isn't that dangerous because the enemy's got it anyway. But from a business point of view, that's going to be different.

John Gilroy: Bill, I think it's obvious here, you focus on emerging technologies. Last year, a report came out saying that 60% to 70% of space company funding was directed at LEO Endeavors. But now it's being suggested that the space industry is pivoting over to lunar. Investment in lunar has been on a steady upward trajectory. What's driving this change?

Bill Ray: Obviously the government investment is the key here and we're talking about lunar, we are generally talking about governments at the moment. Private companies will go there, obviously tourism, and when I say tourism, not necessarily human beings going there, but we've seen things like remote control vehicles, how much would you pay to drive a robot on the moon, perhaps to the virtual reality rig. People will pay for that. And there will be companies offering

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that kind of service, but that's going to be relatively small. Then there's support for those operations. So things like positioning, I was going to say navigation GNSS, but of course it's not really because there's lunar, but lunar positioning systems. And that kind of thing are going to be successful because they're going to be able to sell services both to tourists and to government operations. The key thing is where the revenue's going to come from.

**Bill Ray:** And that's something we are always paying attention to. Obviously, at Gartner, we are a business organization. We don't do space for fun, lovely as it is. And there has to be a revenue opportunity. Other materials on the moon is the helium three and, are there other materials which we could mine from the moon? If there are, then very quickly that will take off. Once we have the capacity to get there at low cost, then it'll be very quick to exploit the resources if they're there. But in the moment we don't know quite what's there and we need to do more research and governments have to pay for that because companies can't take that long term investment.

**John Gilroy:** Well, I've got a terminology question for you here. In the United States, you're talking about rare earth elements, and so would you find the same elements up on the moon? Are there rare lunar elements or is it going to be pretty hard to find? I mean, we're running out of them here on earth, aren't we?

**Bill Ray:** The weird thing about rare earth elements is they're not rare, they're actually incredibly common. It's just, they're hard to find and they're mixed with other things. So when we talk about rare earth elements, in fact, I think one of the biggest rare earth elements makes up about 20% of the Earth's core. So there's a lot of it, but it's probably finding it and having access to it. On the moon, there are some materials, helium three is a great example, but there are other materials which may be available there, which aren't necessarily available elsewhere. Also, it's a very good radio environment. Obviously the dark side of the moon just has no radio interference so radio telescopes can be set up there, research establishments. It's a great place for a radio telescope. So I think we'll see some research. The Chinese already said they're planning to build one, there may be an international cooperative arrangement because there's very little reason to have multiple ones there. So we'll see some research there as well.

**John Gilroy:** This has been a great interview. You know, Bill, you have given our audience fantastic insight on everything from LEO to lunar and beyond. I'd like to thank our guest, Bill Ray, Vice President Analyst emerging technologies at Gartner Research. Thanks, Bill.

**Bill Ray:** Thank you very much for the opportunity. It's been great speaking to you.