



## Episode 14 – New Space, Old Space and Government Space

Speaker: Kay Sears, Vice President, Strategy & BD, Lockheed Martin – 21 minutes

John Gilroy: Welcome to Constellations, the podcast from Kratos. My name is John Gilroy. I'll be your moderator today. Our guest today is Kay Sears, Vice-President of strategy and business development at Lockheed Martin. Kay, how are you?

Kay Sears: I'm doing great. Thank you very much.

John Gilroy: I'm glad you came from those beautiful mountains down to the swamp here in Washington DC just for this interview.

Kay Sears: Well, I grew up in Washington, so it has a place in my heart.

John Gilroy: So you know humidity.

Kay Sears: I do.

John Gilroy: That's great. Graduate of George Washington University just down the road.

Kay Sears: That's right.

John Gilroy: Great, great, great.

Kay Sears: That's right. I did that at night while I was at the Commerce Department.

John Gilroy: Wow. Really good. Now you're working for Lockheed Martin. Lockheed Martin, as a provider in advanced traditional satellites, what's their relationship to new space, and especially some of the proposed new LEO constellations?

Kay Sears: You might not know this, but of the 800 satellites or so that we've built, about 150 of those have been actually small satellites, so small sats aren't new. It's something we've actually been doing for quite a long time, so primarily in a lot of our space exploration area, those are traditionally smaller satellites. And we obviously don't necessarily subscribe to the differential between new space and old space. We kind of just think of it as space. We've been around for over 100 years, so we are clearly an older company in this business, but we're innovating all the time, really creating new manufacturing techniques and new technologies. We're building a new gateway center. You might've heard. We're spending about \$300 million on the factory of the future, so that is clearly a new space kind of thing, so we can bridge that gap pretty well.

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- John Gilroy: Especially, I went to your Twitter feed and it talks about #nextfrontier. That's you.
- Kay Sears: That's right. That's right. Next frontier, and we're doing that with our space exploration, but we're also doing some revolutionary things. For example, we recently announced an open space concept. And this is really to reach out to all those new entrants in space and get them excited about leveraging our platforms. We published our interface and technical documents so that they could really look at what we were doing from a platform perspective and use some of the key technologies that they're developing to get to space. We want to get them to space.
- John Gilroy: Kay, here we are at the Satellite 2018. I was walking around talking to people and they talked about this bus, this interface you have. And also, they're recognizing 20 startups. There are a lot of startups on the floor here. So sounds like you're working well with the startup community.
- Kay Sears: We are. We feel like we have a really great role to play with the startups, primarily in helping them understand some of the mission areas that we are kind of deep in and we've been serving for quite a long time, leveraging their technology into that mission space. Sometimes it's not as easy to deal with the government as it is to deal commercially, so we can really make that bridge for them.
- John Gilroy: Much small sat attention has been focused on Earth observation. Do you see a much larger role for small sats with respect to DOD applications?
- Kay Sears: Absolutely. We see both our LM 50 platform, which is kind of a nano sat platform, being extremely important for things like demonstrations, maybe advancing the technology readiness level of a payload. You could fly it on one of these nano sats and kind of get it space qualified before you would invest in putting it on a larger spacecraft. Our LM 50 platform, in addition, our LM 400 platform, which is slightly larger than the nano sat, it's about a 500 kilogram platform. We see that being used from everything from remote sensing to commercial coms and military coms, really augmenting some of the larger satellite constellations that the DOD is invested in.
- John Gilroy: Upstairs at 2018 I heard the keynotes this morning. There were about four or five people up there. Go back to #nextfrontier, they talked about next generation constellations. And the podcast is named Constellations. So I've got to ask what your thoughts are about next generation constellations.
- Kay Sears: Well, there is certainly a huge investment taking place both commercially as well as with the government. Almost every mission area that we are working

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with our military customers is going to be recapitalized essentially in the next five to 10 years. So there's a huge amount of architecture work going into that. How are these new constellations, what's the con ops behind them? How are we going to build resiliency? And then on the commercial side, you see a lot of the LEO operators talking about their new constellations, which again are going to be complementary to some of the government systems, so we really see a mix of orbits, a mix of size of spacecraft, as the future solution.

John Gilroy: I think we title this interview, new space, old space, and government space.

Kay Sears: That's right.

John Gilroy: We're covering them all right here. Aren't we?

Kay Sears: We are. And I think there will be a mix of all of those when you look at a constellation. There'll be some government assets. There'll be some commercial assets. There'll be different sizes of space craft. And they'll all be part of the mission area.

John Gilroy: Okay. We're broadcasting from the floor of SATELLITE 2018. People are walking by here talking about satellites, Satellite 2018. We had a gentleman from Made In Space walk by here. And he said, "Hey, Made in Space." And I said, "We've got Kay coming by later on." He said, "We work with you guys already," so even before we even started this conversation, you're reaching out to this dynamic, really innovative company that manufactures 3D things in space.

Kay Sears: That's a great example of the role that Lockheed Martin can play. Again, looking at these new entrants and figuring out how their technologies really play a role in our key government missions. We've done the same with Terran Orbital. We invested in their nano sat technology. We've also invested in Rocket Lab. These are all new companies into space, but they don't know quite how to navigate the government area, and we don't want to burden them with a lot of the government contracting approaches. So this is the role that Lockheed can play. We can help those companies and direct them into mission areas and really use their technology.

John Gilroy: I'm very familiar with the startup community here in Washington DC. There's a startup here called Urban Stems and they deliver flowers. Now delivering flowers is one thing. Delivering satellites is something slightly different, and whether the startup's going to succeed in four or five years, sometimes they have to either partner with or work together with larger organizations, take them under their wing because there are a lot of concepts here that they may not even be aware of.

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Kay Sears: Right. I'll give you an example of something we do with Tyvak. Tyvak is a nano sat provider. We call them the LM 50. We're really leveraging their bus and then we are actually providing the payload, so it's a slightly different arrangement than what people are used to. So we're developing payload technology that would ride on their nano sat bus, and that has been a great combination for us. They can produce things cheaply and they have a different process than we do, lower costs, and so we're using that and leveraging that for our government missions.

John Gilroy: The small sat industry is popular all over the show floor here. And they've been quick to embrace miniaturization and additive manufacturing made in space, along with virtualization ground systems, all these new concepts. Have manufacturers of traditional large satellites does this as well?

Kay Sears: We have. In fact, just last year we have produced over 4000 3D printed parts, and over 2000 of those were actually space qualified. You're going to start to see us fly some of those satellites. In fact, we put one of those 3D printed parts on one of our Juno missions, one of the spacecraft that's going to Jupiter. So it is absolutely part of this modernization in the manufacturing world, something that we've invested in and something that we're using across our manufacturing facilities. Not just 3D printing, either, we're using robots, for example, in our solar panel manufacturing area. We've taken the human element out by about 80%. And if you walked into the factory today, you'd see a bunch of robots that work 24 hours a day in very meticulous ways building these solar panels, so that just gives you an example of how we're leveraging technology.

Artificial intelligence is another one, machine to machine learning. We're starting to see the benefits of that, especially on the ground, in the ground systems area and the ground software area. And just one other thing I really want to describe because it's very cool is something we call the CHIL It's the Collaborative Human Immersion Laboratory, the CHIL. And what that is, it's a virtual reality area where our program teams can go and actually plan out the satellite itself. Instead of doing an actual 3D model on the ground, we can actually do it in virtual reality. And so that allows us to have program reviews with our customers where they can actually look at the design of the satellite before we go build it, and identify places and areas where we might run into any kind of issues. And we can correct those designs before we actually print hardware or bend metal.

John Gilroy: It's a virtual prototype.

Kay Sears: It is.

John Gilroy: And it saves money.

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- Kay Sears: It's a virtual prototype. And you can use it to save money when things happen, maybe down the road, that you didn't expect. How are you going to get at a particular piece of hardware that's inside? You can plan all of that out. You can plan upgrades out as well. If we wanted to insert technology, how would we do that? We need to build all of those things into the design at the very beginning, and the CHIL helps us do that.
- John Gilroy: I want to take you back to your days at George Washington University. Imagine back then we would be talking about robot manufacturing, 3D printers in space, and virtual prototypes before we print them. We just said that, oh yeah, we're going to have a virtual prototype and then print it.
- Kay Sears: It is. We're looking at tanks. We're going to be printing tanks, fuel tanks, here soon. So this takes like 60% to 80% of the cost and schedule out of certain components and parts. That's huge when you have a government customer and commercial customers alike that want low cost, they want affordability, but they want value. So this really helps us deliver that value.
- John Gilroy: I teach at Georgetown, and I told my students about Made In Space. They're all excited about it. But the accountants are excited too. The accountants are saying, "Yes. We like Made In Space because it saves us money and all of a sudden we can produce competitive contracts and really respond ourselves to the federal government very well." Can't you? It's both sides of the equation love these new technologies.
- Kay Sears: They absolutely do. And again, we can help bridge them into that government space. The challenge we have with some of the missions is, as you're well aware, some of our adversaries in space are doing quite some remarkable things and we need to catch up. We have to stay ahead of that game.
- John Gilroy: I want to talk about congested space and contested space. Congested, contested, you know? As space becomes more and more contested, can small satellites play the role of pawns in a chess board, kind of like king, queen, bishops of space? This is another funny concept you never thought of.
- Kay Sears: It's definitely not a concept we haven't thought of. I think there are a lot of roles for small sat with our different mission areas. I've already mentioned how small sats are contributing to space exploration. That's been going on for decades. But we also see a lot of advantage of small sats with our military missions as well. We think they will be an augmentation to the government constellations, especially in the area of communications and remote sensing. So think about a small sat constellation that can kind of blanket the Earth with imaging at the half meter resolution, which is something that is approved by our regulatory establishment. And they can provide all those images to the NGA. And then we

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can focus on the more exquisite systems to do some of the things that we need to do beyond that. So very complimentary in terms of small sats for remote sensing. On the communications side, it's the exact same thing. We can provide low latency communications that can augment some of the more protected and resilient communications that the DOD has to go invest in.

**John Gilroy:** We're here in Washington DC. Hop in a cab, go across the river. The Air Force is right there. Air Force General, David Goldfein stated that we'll be fighting from space in a matter of years. So how do you see the role of companies like Lockheed, Boeing, and others in helping our friends across the river prepare for this eventuality? It's going to happen.

**Kay Sears:** I know. Well, first of all, we need to deliver outstanding capability for space that really give our military a decisive advantage. And we need to do that with agility, with affordability, and with resiliency. But we also need to look at the bigger picture. We really need to connect the dots. We have a division that focuses on satellites, but we also have a group that's focusing on ground systems, and it's really important that we think about the space and the ground as a single network now, especially as we want resiliency going forward and really rapid decision making. What our military leaders are asking for is, they're asking for systems that can help them make decisions in seconds versus minutes. And so you can imagine the challenge there. We have to connect a whole lot of things together that give them the situational awareness in order to make really good military decisions. And so that's what we're focused on.

**John Gilroy:** The military decisions, contested space, is there anything you can share with us about Lockheed's space based infrared satellites, which provide accurate missile warning and infrared surveillance information? I think there's three or four out there. Is that right?

**Kay Sears:** There is. In fact, we launched the four SBIRS satellite on January 19th, and it enters a constellation of others that really completes the initial missile warning systems. Those SBIRS satellites, as well as the ground systems that go with them are delivering now faster collection times. They're delivering improved threat detection, improved targeting, and infrared information that really enables the troops to see dimmer targets. So this really gets at what you and I were just talking about. These are the step changes that are needed to be ready to fight a war in space.

**John Gilroy:** The military community understands SBIRS very well. Maybe the commercial folks don't understand this, but this is a very powerful, sophisticated technology you have here.

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Kay Sears: It is, and yet we were able to save the government a billion dollars in the SBIRS program on the last order that they placed with us. So again, we're driving that cost curve down to try to be agile, affordable, and resilient, and provide that step changing capability. So SBIRS is a national asset and it has delivered time and time again for our war fighters.

John Gilroy: You walk around the show floor here at Satellite 2018, there's a lot of optimism when it comes to constellations. I mean very, very... people talking about, this is going to happen in three [sic] ... And they have it planned out three and four years down the road. Let's just say, want to propose major LEO constellations goes into orbit. So what are the implications for space situational awareness, space debris, our leadership in space? Someone from your perspective may see this in a more detached view.

Kay Sears: Well, certainly we have seen a huge increase in space objects. Most of those objects that go into space are planned and launched by very reputable companies and people that care about space as well. If you think about the nano sats, those are also being launched at a record number in space. So we're exacerbating a problem that exists already, which is, we have a very congested space environment. So there is a role for the space traffic management. We talk about a space cop and the need for a space cop. I will say that most of the LEO operators that we're working with, they are very much in tune with this. They're going to have maneuverable satellites. They're going to have a plan for de-orbiting. So they're not going to be a willy-nilly operator, so that's the good news.

But at the same time, we have to deal with the space traffic issues. One of the things the Air Force would like to do is create a space traffic management that is outside of the military, maybe at the FAA, similar to the way we manage the aerospace area and planes. And that would allow them, the military then, to focus on war fighting versus focusing on being a traffic cop. So we're giving them ideas on how to do that, and we're certainly building our satellites to be responsible objects in space.

John Gilroy: I've raised three kids, and in the teenage years there's a phrase that came up. It was unintentional consequences. Bad things happen with the best intent. And I think with some of these LEO and GEO satellites, there could be interference. But not intentional, it could be completely benign, but it also could be intended. Now we'll go back to the Air Force people and worrying about this contested space.

Kay Sears: That's right. And rather than track all objects in space, let's track the objects that we're most interested in. So again, a nice role for something outside of the military to be a traffic cop.

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John Gilroy: This is going to be a King Solomon question here. And I don't know how to make a decision here. I'll have you make the decision. You know there are all kinds of advances in new space by SpaceX and Blue Origin. We know those names. Is it too much of a stretch to say that private industry rather than government is driving space development? I mean, chicken or egg here, who's really driving it?

Kay Sears: So I think it depends on the development. I think certainly commercial development is happening with new entrants, SpaceX, Blue Origin, and others. They're driving a lot of the economics of space. They're driving: What is the art of the possible? It's extremely excited. We're excited to see the energy around it, the investment around the new entrants. As we talked about, we're embracing some of those new entrants. But then you look at something like Orion. There's nothing that stretches the imagination more than the Orion vehicle and building a new manned spacecraft that's going to go to Mars and that's going to return from Mars. So I think it's a little bit of both.

I think you see the government investing in key places that are for national missions and for deep exploration missions. And then we have a very vibrant commercial community that's also investing and moving technology forward, so it's a nice crossover. One of the great things that Lockheed, because we're both in the commercial and we're in the government world, we can see some of those synergies and we can actually leverage those. If you think about common products or a common bus, we can build those and we can put them in both the commercial community and we can put them in the military community, and that saves everybody money.

John Gilroy: Earlier today I sat with a company and the CEO had a PhD in computer science. So talk about computer science here.

Kay Sears: Right.

John Gilroy: And you pick up a magazine, you read a blog about computer science. You hear software has a service, platform has a service, infrastructure has a service, launch has a service. This model, is it going to work for the federal government?

Kay Sears: I think it will. I think there are definitely capabilities that the government will purchase as a service. If you think about data, the geospatial intelligence agencies are interested in data, so they're going to purchase data as a product. I think we think about services in the communications area. There are definitely bandwidth services that the military has relied on that are supplied by the commercial community, and that's been going on for decades. I think there are remote sensing areas too, where there could be a service. I think operations, there are places where they could outsource operations. But there will always



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be some critical mission capabilities that our government customers are going to have to own and operate themselves.

**John Gilroy:** On the floor here, there are a lot of new satellite operators. We know that. They are going to have to adapt to or create new market and competitive dynamics. So how are traditional satellite manufacturers adapting to fit into this new space model?

**Kay Sears:** I guess if the new space model is kind of vertical integration, maybe that is one of the trends we're starting to see. There could be a little danger in vertical integration. I think one of the reasons we're so successful is, we look for best in breed solutions. And if we have partners that have technology, then we're going to embrace that technology. Back to the new entrants, we see some really promising technologies there. So you don't want to get too vertically integrated because then you close your mind in terms of what else is out there. So I think you have to really have the solution in mind. What are you driving to provide? And then you have to look for the best partners out there.

Having said that, we are investing in things like commonality. I mentioned commonality among the bus platform, being able to really drive down the cost of those common components. We opened up our interface so that we could get really interesting ideas on the payload side. But that commonality helps us start with a very affordable bus.

**John Gilroy:** I did my homework. Lockheed Martin, founded in 1912, and so they can represent traditional technology fairly well, also representing, according to your previous remarks, new space collaboration. So what can you tell us about a new initiative to attract aspiring space technologists? Human beings here, not robots.

**Kay Sears:** Yes. Yeah, the challenge of talent, I think we're doing quite well there. We're starting to really tell the story about space and how space is really exciting. There is competition for top talent, but when you think about the missions around Orion, when you think about some of the things we're doing on the ground, software side, we're hiring as many software providers as we are engineers. So there's a real nice opportunity when you come to Lockheed Martin because you can work everything from the next spacecraft to Mars, all the way down to something that is around a ground terminal. So it's a very interesting place to work because we can move you around into all kinds of engineering challenges.

**John Gilroy:** Well, you've mentioned Mars twice, so you're begging the question. I've got to ask the question. This is the final question here. And we'll put this answer in granite and in five years, we'll make sure it's correct or not. So the question is:

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Who is going to be the first to take humans to Mars, and safely bring them back, Lockheed Martin or Space X?

Kay Sears: So I'm going to go with a third answer.

John Gilroy: Whoa.

Kay Sears: It's going to be NASA.

John Gilroy: Really?

Kay Sears: NASA continues to set the standard for exploration. They're the ones that have forged a lot of the international partnerships and made this possible. They're certainly the one that put forward the astronauts that are going to go to Mars and going to come back. We're leading the way with some other deep space exploration missions like Juno, the Mars curiosity rover, and many more. But really, it's NASA's leadership. I think they're just passion for space exploration, they're going to be the ones to do it first.

John Gilroy: All kinds of optimism here. You know? Constellation providers and even with NASA. Well Kay, unfortunately here, we are running out of time. I'd like to thank our guest, Kay Sears, Vice-President, strategy and business development, Lockheed Martin.