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The Deloitte On Cloud Podcast

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Title: **LEOcloud is taking cloud to space. Find out how and why.**

Description: Cloud in space? Yes, and it's a booming market. In this episode, David Linthicum talks with LEOcloud Founder and CEO Dennis Gatens about how and why LEOcloud is taking cloud into space. The how includes taking custom-built software and edge computing into environments such as the International Space Station. The why is about advancing R&D capabilities, AI-based analytics, and AI-based autonomous operations. They also discuss the future of cloud in space and who the major players might be.

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David Linthicum:
Welcome back to the On Cloud podcast. Today on the show I'm joined by Dennis Gatens, founder and CEO of LEOcloud. How are you doing, Dennis?

Dennis Gatens:
I'm doing well. It's been a great, productive week, and I'm feeling really good about the direction and pace at which LEOcloud is progressing.

David Linthicum:
Yeah. It's a new learning experience for me. We're going to talk about things that I know about, but a lot of the things you talk about I don't know anything about. That is really compute in space, cloud in space. Our listeners have asked for some new and interesting topics. It doesn't get much more new and interesting than this. So, give us your story, an introduction to you, how you got to LEOcloud, what you've been doing in the past, things like that.

Dennis Gatens:
I'm happy to. I started out graduating from Virginia Tech, EE, and I stepped right into some really interesting technology-driven, leading-edge engineering projects. It really became a common thread throughout my career, emerging technologies into emerging markets, delivering complex solutions into a range of market segments or environments, from avionics to space to commercial communication service providers, cloud service providers. So, it's really been an exciting ride. Along the way, I started out as an engineer. I always found myself thinking more about the big picture or the strategy. I transitioned from product management into marketing, strategy sales, channel partner, management, senior leadership. So, I really acquired a pretty broad experience base and set of tools that set me up naturally to step into starting, launching a company at a point in time, which really was nicely aligned with an emerging market, which is the commercial space.

David Linthicum:
Tell us about LEOcloud.

Dennis Gatens:
LEOcloud, the genesis for it was as I began to see the commercial space economy evolving in the way that it was, where the communications infrastructure was beginning to move closer to the terrestrial technologies and capabilities and more into building out network strategies, and even to the point of becoming an IP infrastructure, that's the direction it was taking. It became clear that in order for the economy in space to really meet its potential and realize its potential, the communications and cloud infrastructure were going to have to evolve into space. So, I took it from there and focused on: How do you bring this to market? I focused on really the value proposition of edge computing. If you think of space, it's the ultimate edge. In the value proposition, it really has tremendous value and benefit in space, particularly as humans move further away from Earth, LEO, the lunar or region of the moon, and then beyond, Mars, all plans that are right in front of us and are being worked on.

So, it started there, the fundamental benefit being that you move the resources, the compute, the cloud services as close as possible to the sources and users of data. Well, that certainly applies in space. So, from there, I thought about it as there's a lot of point products. There's a lot of single-core computers, multi-generations of them, some rad-hardened to deal with the harsh environment, some commercial repackage that really present a reliability and availability challenge. So, I thought about: How do you deliver this to an operator of a spacecraft or a constellation when it's pretty far from their subject matter expertise, whether it's building communications infrastructure or imaging satellites or building commercial space stations?

So, bring them a service. Bring them a managed service that enables the cloud services that exist on Earth to be extended into space, and scale it from satellites where there's very low power available, a very low power budget, very small volume, and a very harsh environment. Scale it from there to the relatively large volume of a commercial space station, or we envision eventually orbiting datacenters in LEO and the lunar region around the moon. So, that became the strategy, a managed service, basically a managed infrastructure-as-a-service that extends across services as we use them today in a ubiquitous way into space.

David Linthicum:
People are listening to this and they go, "Cloud in space? We don't get that." The reality is you're putting an infrastructure in space, storage, compute, things like that, which is closer to where you're gathering the data. As we are launching commercial uses of space, all you have to do is look at the headline news with all the companies out there, and not just the government, that are getting into this space. The ability to process information and have compute capability is something that's going to be an exploding need, at least the way I see it. So, tell us about the growth of space, where the economy is going, and what you see as the use case for this in the next few years.

Dennis Gatens:
There's a fairly strong consensus around it being a trillion dollar market within a decade. We seem to be on that trajectory. If you look at the value chain of a space economy, from the launch services, the range of launch services, from heavy lifts to relatively small lifts, from small satellites to large satellites, the emergence of commercial space stations that eventually will replace the International Space Station, it's all moving forward. The use cases for whether it's running an operation in space that might provide a commercial service or have military or government applications or R&D, there's a clear demand for having a presence in space, both man and machine.

That's just LEO [lower earth orbit]. If you go to the lunar region, it's the same. There's a lot of focusing and effort in establishing an industrial base and a government military presence in the lunar region, including on the surface of the moon. So, the value chain is evolving rapidly. The cost is coming down. It's still high. For example, taking R&D up to the space station today is pretty expensive, but there's clearly a benefit to the cost associated with it. After ten years of the ISS National Lab being available, for example, there's been at least a billion dollars of venture funds flowing into—

David Linthicum:
The International Space Station. Is that right?

Dennis Gatens:
Yes, the International Space Station or ISS.

Dennis Gatens:
There's been over a billion dollars of venture funding that has flowed into startups that did basic research on the ISS. The demand for those resources today, the ISS National Lab facilities, which is an allocated portion of the ISS, outstrips the availability of resources. So, there's clearly a market being incubated just in the R&D space for the next generation of commercial space stations.

David Linthicum:
Why can't I just take a commoditized cloud server and stuff it into a spacecraft, and shoot it off into space and just have it function in space?

Dennis Gatens:
You can. You need to cross your fingers, cross your toes, because it comes down to resiliency, reliability, and availability, whether it's a pressurized environment or a non-pressurized environment, pressurized being inside a space station where it's human rated, non-pressurized being bolted on to satellite bus. Harsh environments. The ride is a rough ride getting there. If you're going to rely on these capabilities, it will fail when you really need it. That's a bad scenario on Earth when we lose one of our services. It could be a very dangerous situation in space. That's why we look at it from you can't fly COTS [commercial off-the-shelf software].

You can't repackage COTS. It will not have a predictable, useful life. So, we're building our system from literally the silicon layer up, as a space-hardened platform that has a lot of design and analysis that predicts with high confidence a useful life of ten years. In addition, it has layers of resiliency and health monitoring built in, so that we can allocate resources offline before they might become an issue. So, it really comes down to you have to build a platform for the environment, which is a pretty basic requirement for any development of a product. What we like to say is you can't roll a truck in space. On Earth, we roll trucks to service equipment in small businesses, large enterprises, datacenters. You can't do it in space. So, it comes down to that. Our customers talk about availability. They want to hear about the resiliency. They want to hear about the rad-hardening techniques and analysis that goes into resulting in a predictive life for a platform.

David Linthicum:
Yeah. I think the mother of all capabilities or trust, if you're going to put something into space for ten years, it has to be in a way that's going to function. You can't go into a datacenter and replace it like we can right now. So, it's got to be a different level of play in terms of reliability, in terms of durability, in terms of the ability to have remote management capabilities, the ability to have self-healing capabilities. Let's talk about the use cases for space. Why are we doing this?

Dennis Gatens:
All the above to what you just said, 100 percent. We look at use cases in two fundamental groups. One is R&D. I mentioned it briefly. The second is a range of operations, data analytics, AI-based analytics, and AI-based autonomous operations. Let's start with R&D. I mentioned the International Space Station National Lab that has been in existence for ten years and provides research facilities in the microgravity environment. The microgravity environment has real value for certain types of research, everything from manufacturing fiber that is purer than what we can manufacture on Earth. The range of use cases or types of research range from biomed to cancer treatments, tissue engineering. I mentioned fiber pharma, crystal development, 3D printing, semiconductor development.

All these types of areas of research are taking place in space today and have been taking place on the International Space Station for ten years now, both inside the facility, where it makes sense, and then outside the facility on what are called R&D platforms that are bolted onto the Space Station, where they can deliver materials, for example, for understanding the impact of the environment on whatever the material might be, and then bringing the results back.

What's become a very common requirement and has not been fulfilled yet is the need for local compute and data storage. Thus, we're addressing it with the next-generation commercial space station players. So, there's a broad range of R&D. I mentioned the funds, the venture funding that's flowed into startups, the uses, commercial, government, some military, and universities. So, there's a lot of basic research that's taking place today in space, taking advantage of the microgravity environment. That environment will also have benefit to manufacturing as well. The fact that you can be manufacturing in space enables you to have waypoints for manufacturing as we go deeper into space as well.

David Linthicum:
What changes when I'm supporting a computer storage system in space, whether that's in the aircraft or outside the aircraft? In zero gravity, obviously the environment is different and it went through a rough ride to get there. But what is better for the device and what's worse for the device, in terms of its existing in space or on a spacecraft?

Dennis Gatens:
There are a number of considerations. There's thermal cycling that occurs that you have to manage. There is the power budget that you have to manage. There's relatively limited power resources in space, so you have to design highly efficient, power-managed platforms. Then there's the radiation dosage, the understanding of what the electronics will tolerate, predicting it through analysis, and then design implementation, predicting to what extent it will survive in that environment and for what length of time. You have to have systems in place to recover from single-event latch-ups, for example. You have to have completely autonomous capabilities to diagnose a platform, restart it, decommission resources where there's processing or memory, so that the platform continues to operate. So, one of the things, for example, is you have margins.

You have memory margins. You expect a certain level of memory, but in reality there is 1.x memory available, so you can anticipate some loss of memory over time. These are all the considerations that have to be taken into the design, requirements and design analysis and testing. In terms of advantages, it's hard to really place any real advantage that a piece of electronics can realize running in the harsh environment. It's more about adapting it to survive and perform in the environment.

David Linthicum:

Where is this going? Let's talk about the future of cloud in space. Obviously, computers are not new to space. We've had all kinds of computing and more primitive kinds of things that we've supported over the years. Now we're going to have more up there and we're going to have more use of these particular systems and the ability to support compute and storage in kind of a more traditional way, as we're doing it very much like we do it on-premise, but doing so with different equipment. Where is this stuff going? Where should we watch the industry mature over time?

Dennis Gatens:
There are multiple segments to watch. I'll speak to it from how we segment to market. Satellite data suppliers, they develop a tremendous amount of raw data. It all comes back to Earth. It takes time. It takes a lot of time, and it costs a lot of money. They are security issues once it lands on Earth. If you move the compute onto the satellite, which is going to intersect their roadmaps here in the near future, you can now process the data and deliver your product from space, your imaging product, standard product offering. You can also allow your customers to run their applications, their workloads in space, so that they're getting the results directly from satellite directly to the user.

A real advantage, a real cost advantage, a real advantage in latency. So, you're upselling to your customer. Commercial space stations, we'll begin to see first launches as early as '25, more likely '26 and '27. They're already developing their funnel for customers, particularly in the R&D area. So, you'll begin to see the emergence of the commercial space stations that will eventually replace the ISS. They all see the need for on-prem we can call it on-prem I guess—on-prem compute that they can offer to their customers as a service. So, we deliver that capability for that. R&D platforms. R&D platforms today collect a lot of data. When I say an R&D platform, I'm referring to a platform that's attached to the ISS today that's external, where a lot of research takes place. There's no compute resources there.

All the data has to be delivered back to Earth via relatively slow communications channels that you have to have your time scheduled on it. So, it really inhibits the delivery of data back to Earth. Some data from the Station comes back on memory sticks. That's where they're at today. So, moving the resources onto these platforms enables, again, the customer to have in-situation or local compute to iterate with the data with the research. This saves time. Time is money when it comes to research in space. It's very expensive. We anticipate that in the next few years, as well.

Then the lunar region. The lunar region is just an amazing concept of, one, establishing a presence 50-plus years later, but two, the concept that the value and the necessity of local compute is even greater, again, the further away you are from Earth. So, we envision that market segment to evolve or begin to exist within a couple of years. We're really excited because we have ongoing activity and are beginning to develop delivery commitments very quickly, very soon into those segments, those market segments.

David Linthicum:
It's funny. I think as cloud pros we're used to free networking. In other words, It's almost free. It's very fast, very low latency. Therefore, it's not a problem to ship huge imaging files and huge other binary files across and do the analysis locally. But that's not an option. So, that's, to me, kind of the killer application. So, if you're going to leverage these systems to provide satellite imaging, you're on the satellite, your ability to process it at the time when you obtain the image, when you obtain the data is going to be a huge performance advantage over shipping things back to Earth. Can we do that today? Or do we do a lot of processing of images at the source, within the satellites?

Dennis Gatens:
No. It's all raw data coming back to Earth. What's really sort of a throwback is that you have to fight over a ground station. They do it on a routine basis, and you get a 15-minute window of downloads. If you don't download all the data, you wait until you have the flyover at the next ground station. That's a level of latency that many of us here on Earth have never experienced. It's akin to the mail. But yeah, there's tremendous advantages of eliminating what we call inside the terrestrial loop of compute on Earth and moving it into space.

David Linthicum:
Yeah, the fact that you're focusing this at a particular set of use cases, there's a need for it. It's an architectural reality in terms of how it's able to communicate. Latency, reliability, durability of these various systems. I think it's a huge growing space right now. It's kind of exciting if you think about it, the ability to, in essence, put edge-based systems at space and have the capabilities there that you wouldn't have if you're shipping everything back to Earth. You're not going to be able to ship everything back to Earth. So, you're able to do things faster, absorb more data, make decisions based on the data, even have AI knowledge bases processing the data at the point. Is that kind of the vision?

Dennis Gatens:
Absolutely. The deep data fusion capability of cloud in space has tremendous advantage, most notably within Space Force. For them, it's all about gaining a warfare advantage. So, if you can process the data in space that you're collecting in space, for example, imaging, and sensing, and monitoring, and running the analytics and then delivering the results directly to the end user, the person in need, that's a tremendous advantage. Particularly, you eliminate the latency of coming back to Earth, so inside the terrestrial look concept. You strengthen the security around the delivery of the results. You reduce the costs.

So, there's real advantage of this architecture that we believe is going to evolve, having the underpinning of communications infrastructure that's evolving, where satellites can bring data, relay data back to an orbiting datacenter. That orbiting datacenter can collect data from many sources in space. Think of a cell tower on an orbiting datacenter providing communications access for many sources, many constellations. You now have the ability to collect all the data in space, use it, deliver the results without any of the touching of it.

David Linthicum:
Where can we find out more about yourself, more about LEOcloud. Also, where can we learn more about how this technology is evolving?

Dennis Gatens:

I try to maintain a presence on LinkedIn. I think LinkedIn is a great tool for communicating and conveying information. I have the opportunity to speak at a number of conferences routinely through the year. There is no Web presence for LEOcloud. We are just a startup. So, it's really whoever wants to have a conversation with me, I'm on LinkedIn. So, just message me or follow,and we'll start a dialog.

David Linthicum:
That's exciting stuff. If you think about it, there's a great use case for this. There's a growth in the market in our ability to understand how to do this stuff in a reliable way. It's just kind of taking edge computing to the next level. You have to plan for something that's going to be in place and in production for many, many years, and we're not used to that now. You can always drive out to a remote site and things like that. You can't do that with these things. So, if you enjoyed this podcast, make sure to like us, rate us, and subscribe. You can also check out our past episodes, including those hosted by my good friend, Mike Kavis. Find out more at DeloitteCloudPodcast.com, all one word. If you'd like to contact me directly, you can e-mail me at dlinthicum@deloitte.com. So, until next time, best of luck with your cloud journey. You guys stay safe. Cheers.

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