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Space domain awareness 24/7

Plus:

- Testing antennas in new environments
- Restoring connectivity in a crisis
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● ● Greg Caicedo, Vice President of Space Domain Awareness and Space Superiority at Kratos

Satellite Evolution Global

Q&A

Space domain awareness

24/7 ●●

Space is becoming ever more congested and contested, making space domain awareness (SDA) essential for mission success. Kratos has created a global radio frequency (RF) sensor network managed by a network operations center and supported by the company's state-of-the-art software platform. The RF SDA network operates in all-weather, day-and-night, and provides precise tracking for close space operations, communication signals linking satellites with Earth, and ground infrastructure. We interviewed Greg Caicedo, Vice President of Space Domain Awareness and Space Superiority at Kratos to find out more about how this technology protects space assets and adds additional value beyond traditional radar and optical systems.

Crispin Littlehales, Executive Editor, Satellite Evolution Group

Question: How does your previous experience come into play in your current role as Vice President of Space Domain Awareness and Space Superiority at Kratos?

Greg Caicedo: I've got a good mix of background experience that helps me understand what's happening in the industry and how it applies to our customers. I spent 20 years in the military working primarily as an acquisition officer for the National Reconnaissance Office, Air Force Space Command, and within the Space and Missile System Center. That experience laid the foundation for my understanding of who our customers are, how they operate, and what their needs are. It was all about helping to bring a capability to support missions and address threats.

I've been in industry for just about the same amount of time working in space domain awareness and have experience with intelligence, surveillance, and reconnaissance. I've also worked in operations, business development, and now in execution and delivery.

Question: What sets Kratos apart from competitors when it comes to supporting ground and spacecraft users dependent on satellite communications?

Greg Caicedo: Kratos has been around for decades, and the company has significant expertise in both signal processing and the RF domains. Developing those capabilities over time and employing people who have a passion for SATCOM, space, and ground capabilities defines who we are. Kratos has developed specific targeted capabilities for satellite communications, space domain awareness, and command and control space-to-ground capabilities.

Over the years, we've developed an ability to have commercial products in advance of where we think the customers are headed. We continue to make investments over time and one of those is in what we call OpenSpace. OpenSpace is a completely software-defined ground



system and an evolutionary approach to a digital and virtualized capability. Instead of needing to deploy a bunch of hardware around the world, you can easily spin up a software capability in the cloud, perform your operations, and then tear it down. That means you don't have as big a footprint or a security vulnerability that can be attacked by an adversary. This approach has changed the way we do business and in the way our customers do business.

Another example is our global RF sensor network. To date, Kratos has deployed more than 190 sensors at 21 different global sites. This allows us to perform RF SDA as a service, as opposed to having our government and commercial customers deploy those systems themselves. We can do data collection, command and control, and electromagnetic interference (EMI) monitoring. There are several different services supported by that network which enable Kratos to be different from its competitors. We are not limited to selling a purposeful capability or end product, we can actually provide a service as well.

Question: Space Domain Awareness is critical to the protection of space assets as well as enhancing the ability to respond to threats. What do you see as SDA's biggest challenges and how is Kratos addressing them?

Greg Caicedo: We see our adversaries as being much more aggressive. There's been a militarization of space that we haven't seen in the past. We are seeing many more spaceborne threats as well as terrestrial threats. These include jamming as well as other ways to interfere with communications. Not only has our military become very dependent on space, but our entire global economy is also dependent on space. Threats are out there, either active or latent, and in the event that there's conflict, we need to be prepared to generate a response to those threats.

The proliferation of LEO constellations is underway with Starlink being the most obvious example. However, a number of countries are also launching assets in LEO which

makes LEO much more congested and much more contested. Kratos continues to develop multi mission capabilities that can track threats, be they accidental or intentional, to ensure they aren't creating an environment where it's impossible to operate.

SATCOM has traditionally been held at the GEO orbit but now we are seeing much more presence in LEO with the MEO region gaining popularity as well. Kratos is adapting OpenSpace to serve all those environments from a single pane of glass where you can do remote operations for multiple orbits and missions. Not only will users be able to move between orbital regimes, but they will also be able to operate in those regimes simultaneously and leverage different capabilities and the benefits inherent to each one.

Question: How do Kratos RF SDA services interact with legacy systems?

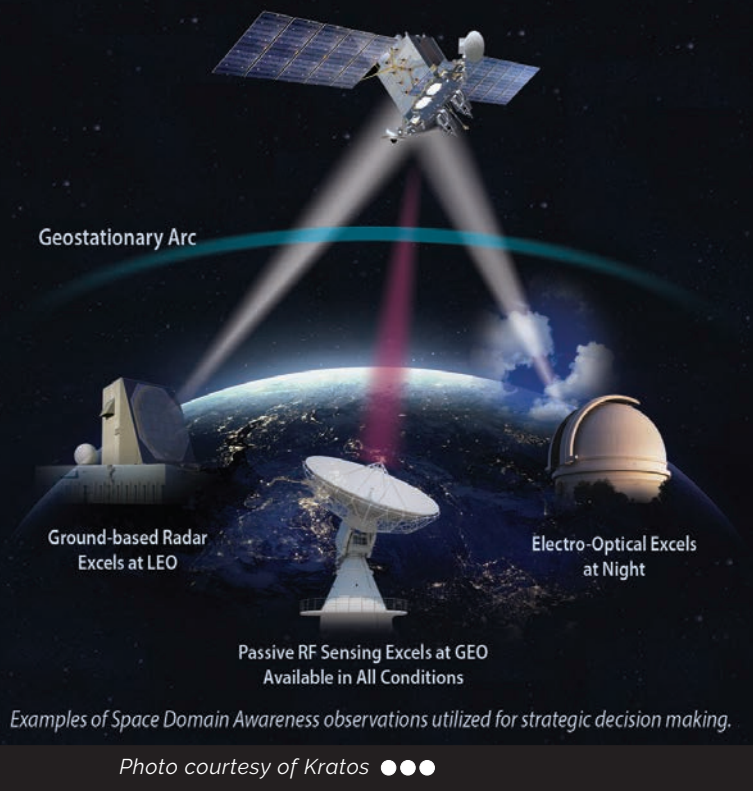
Greg Caicedo: The military is slow to change for good reason but also because the acquisition bureaucracy that is in place takes a long time. As a result, they are still operating on a lot of legacy systems. Kratos is ready to support the new capabilities, and we do that primarily in the commercial world, but we also help the military transition to these new capabilities and show them that they are safe and stable. We have the right solutions for them to be able to operate in that transition phase as we continue to support those legacy systems. That includes services through our global sensor network, including EMI and geolocation, that the military can take advantage of now.

There are adversaries that have jammers to prevent communications from happening. Kratos is able to look for quality of service on those links to make sure that people aren't accidentally pointing their antenna in the wrong place.

By monitoring and revisiting all the different links, the transponders, and the beams on those satellites, we can tell what's happening. We can also determine if a commercial operator is providing the best service for its customers and thereby maximize their revenue. For the military, we can ensure that they have clean communication links and can perform operations. Kratos monitors all of that for them and identifies where there is interference and also can show where there are good links that they can shift to and if they've got some different options on those links. While that's primarily on GEO satellites, we're making the transition to LEO and MEO as well.

RF passive ranging is another service that we offer. Kratos is able to give high accuracy positional data to our GEO customers, which allows them to see where they are in relation to other satellites for safety of flight during proximity operations and to understand where there may be another satellite that's getting close. We don't look at debris that's not operating but if a satellite has a signal, whether a command and control or payload signal, we can use that to do a reverse geolocation.

Kratos also does signal survey and characterization. Because we collect free-to-air signals, we can tell what that signal looks like; what frequency band it's operating; and what modulation type it is when a carrier or terminal is



up on a particular area of the transponder. We can also tell where it's operating within that transponder, how long it's up, and when it's down. That information is important to establish a pattern of life and normal operations.

We know when something does go wrong or there is some sort of impact. We can also tell how many carriers are on there, what kind of modems they're using, and all sorts of other things that are important to those who need to understand how to operate within a particular space. While our primary emphasis is on the GEO belt, we are doing some work within LEO and MEO with plans to increase our capacity in those orbits.

Question: Who are some of Kratos' customers?

Greg Caicedo: We have a good blend of federal and commercial customers. We work with a number of countries that have their own satellites and are their own satellite owner operators. As a result, we perform a number of different services and sell products for telemetry as well as command and control for space domain awareness. We do a lot of business within Europe and in Asia, as well as in the United States.

We support customers on the defense side. For example, we work with the Space Force in both the acquisition and operational as well as testing communities. Space Systems Command (SSC) and the Air Force Research Lab are also major customers, and we work with the intelligence community.

Question: Can you provide a couple of real-world examples of how Kratos' SDA services and virtualized ground system are being used?

Greg Caicedo: The first example is about tracking SATCOM activities in Ukraine. We were monitoring some of the satellites in that area and we saw a significant uptick in SATCOM usage several weeks before Russia invaded. Then, by monitoring one of the Russian satellites, we were

able to see along the border that there was a three-fold increased usage in that area. We were able to convey that insight to some of our customers as an indication of where some conflict might take place so that they could be prepared.

The other thing that we've seen is a significant amount of jamming of SATCOM that the Ukraine military is using for operations. Specifically, every time a Ukrainian general came on the air for a press conference, we would see the adversaries actively jamming that signal, and the jamming signal happened to originate from a Russian Defense Ministry location. Indeed, the Russians have been very obvious about their jamming activities and doing it outside of international norms.

The next example focuses on Luch/Olymp2, a Russian communication relay satellite. Typically, a communication satellite would just sit in a GEO orbital slot and would not necessarily traverse the GEO belt. We tracked the satellite using our RF passive ranging service and could see it move from one orbital slot to another. We tracked it for about two months as it moved from one slot 2 degrees east to 9 degrees east and then we were able to watch it maneuver closely to one of Intelsat's commercial satellites. The Russian satellite got so close to the commercial satellite that it was inside what is considered safety of flight. You don't want to come within 100 kilometres of another satellite, and they were within 10 kilometres for a long period of time. That was obviously a very dangerous proximity operations move that the Russian satellite performed.

This situation clearly demonstrates one of the great advantages of using Kratos' RF global sensor network. We have the ability to monitor these events 24/7 while electro optical sensors and the telescopes on the ground can't follow it during certain hours. Electro optical needs to operate with darkness so that it can track the light on the satellite. Clever adversaries can actually maneuver during those blackout periods.

Question: How do you see Kratos evolving over the next 1 to 5 years?

Greg Caicedo: Wayne Gretzky once said that he wants to skate to where the puck is going to be, not to where it is. Kratos is also skating to where the puck is going to be. We do that from an investment standpoint. You can see that from how we approached the development of OpenSpace which targets where the market is moving. As the satellite world develops into these more proliferated LEO constellations, the new high throughput satellites (HTS) are reaching orbit. Kratos is positioned to support those customers in this new space world.

We have already started investing in these multi-mission, multi-orbit applications. These HTS satellites also have many smaller, more concentrated beams on the globe, so we've enhanced our edge capabilities to make it more cost efficient and safer to deploy out to those edge nodes. That's where I see Kratos being able to really help the market evolve into this new world where we've got the ability to support those customers from an RF, a command and control, and a space domain awareness mission area. ●