CesiumAstro: Developing Plug and Play Phased Arrays for Satellite Communications

CesiumAstro is a great example of the renaissance of the space industry enabled by affordable rocket launches. Shey Sabripour, who started his career at Lockheed Martin Space Systems, realized that affordable launches of small satellites in low Earth orbit (LEO) would lead to a myriad of space-based communications, imaging, scientific and military applications. Orbiting the globe every 90 minutes, LEO satellites need antennas with agile beams to focus service and capacity where it's needed as they orbit—the perfect application for an active electronically steered array (AESA).

Seeing an opportunity, Sabripour founded CesiumAstro to provide "plug and play" AESAs for satellites and airborne systems. CesiumAstro provides the "full stack": antenna, RF front-end, up-/down-converters, software-defined radio, computer and power conditioning. The AESA only requires power and Ethernet from the satellite and includes application software to control the array and manage the link.

With seed funding and a small team, CesiumAstro started designing the modules, each the size of a credit card. The team also designed a Ka-Band AESA for the NASA and 5G non-terrestrial network spectrum. To ensure the high reliability needed for space, the designs use "careful COTS" ICs, meaning automotive grade and either radiation tolerant or radiation hardened. These standard modules qualified for space are manufactured and assembled into a complete AESA payload, reducing the development risk and cost while improving time to market for new platforms.

CesiumAstro plans to develop modules for all satellite bands from L- through V-Band and has developed multiple flight payload architectures using its modular approach. Nightingale provides a high data rate, time-division duplex satellite link covering 24.5 to 29.5 GHz. Comprised of the phased array antenna and digital back-end, it generates a single, steerable (±60 degrees) beam. Another payload, VIREO, provides multiple beams with fast beam hopping, beam sequencing and storage of beam weights to support multi-user connectivity from LEO.

Since its founding in 2017, CesiumAstro has raised nearly $90 million—most recently in its $60 million Series B round from investors including Airbus Ventures and L3Harris Technologies—to bolster in-house engineering, manufacturing and test. A 10,000 square-foot facility in Austin houses CesiumAstro's new product introduction (NPI) line, consisting of end-to-end surface-mount assembly, machined parts fabrication, module and mechanical assembly, electrical/RF/antenna testing and environmental testing, with a home-grown automated test software architecture capable of controlling instrumentation across multiple locations and labs. Testing capabilities include a near-field anechoic antenna test range, EMI chamber and the pyroshock, vibration, thermal vacuum and thermal cycling test systems required for space. The NPI line is designed for rapid prototyping and low volume production. High volume production is supported by a network of tier-1 AS91000 contract manufacturers.

CesiumAstro recently announced an extension of its business model for companies that need a complete satellite in addition to the AESA payload. A new division in Broomfield, Colo., will integrate the AESA in a 150 kg satellite ready for launch. This will aid customers without the capability to integrate a phased array on their own satellite bus.

Having grown to a staff of more than 100, CesiumAstro is poised to achieve its vision of supplying the best AESAs circling the planet. Several launches have been announced that will feature CesiumAstro payload modules, and their own satellite is planned to fly in early 2024. Sabripour says, "It's the perfect timing for this technology."

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