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Satellite Evolution

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Gilat Satellite Network Headquarters. Photo courtesy of Gilat

Electronically steered antenna terminal makes headway in support of in-flight connectivity

Electronically steered antennas (ESA) are seen as the answer to the mobility connectivity challenges of the future as increasingly large numbers of MEO and LEO constellations come online. Gilat demonstrates the first-ever in-flight operation on commercial aircraft over Ka-band, as outlined by Doreet Oren, Director Product Marketing & Corporate Communications at Gilat Satellite Networks.

On 11 December 2019, Gilat Satellite Networks became the first in the industry to successfully achieve in-flight connectivity (IFC) using an electronically steered antenna (ESA). The flight, which took place on a Honeywell Boeing 757 commercial test aircraft, demonstrated full gate-to-gate connectivity over the Ka-band capacity of Telesat's Telstar 19 VANTAGE GEO HTS satellite.

The 18 passengers, which included Gilat, Honeywell, and Telesat engineers, were part of a barrier-breaking test that successfully demonstrated broadband connectivity throughout the flight enabled by Gilat's ESA terminal. The passengers on board concurrently used broadband applications, including streaming 4K and Full HD YouTube videos, surfing the web, and listening to streaming music services. In addition, with the flight cruising at 37,000 feet, a high-quality live-streaming video call was conducted from somewhere over the Caribbean Sea to Gilat's North American offices. Impressively, the ESA demonstrated broadband connectivity with download speeds of 21.8Mbps and upload speeds of 8Mbps.

Passengers were able to remain connected from the time they left the gate until the plane landed several hours later,

Honeywell's test aircraft

including during takeoff and landing. Connectivity was uninterrupted by bank turn manoeuvres, repeated triangular flight paths, rain on the ground, in-air turbulence, and flying in and out of beams.

Taking IFC to the next level

Recognizing the limitation of on-the-move antennas, Gilat's team developed and successfully deployed the world's first electronically steered antenna (ESA) flying on a commercial aircraft over Ka-band. The ESA doesn't have moving parts, which reduces the risk of mechanical failure to nearly zero. Its construction allows for faster beam tracking performance than the mechanical on-the-move antenna, and it features full electronic beam steering and a flat panel with an extremely low profile.

While the plane is in motion, the ESA system steers the beam electronically and maintains simultaneous receive and transmit tracking of the satellite. The new ESA technology is more adept at handling fast changes in either the moving platform, in this case the plane, or with the target satellite. For instance, it can handle fast beam switching, as well as continue to track both LEO and MEO satellites as the plane continuously moves across the sky. It can also switch between GEO/LEO/MEO satellites in an instant.

As demonstrated during the test flight, passengers were able to maintain their Internet connections regardless of external forces. Rain, manoeuvres, flight paths, turbulence and flying in and out of beams were unable to disrupt the passengers' online experience. Throughout the flight, the user experience remained unchanged, as HD videos continued to stream throughout the flight.

The importance of IFC ESA on non-Geostationary orbit (NGSO) constellations

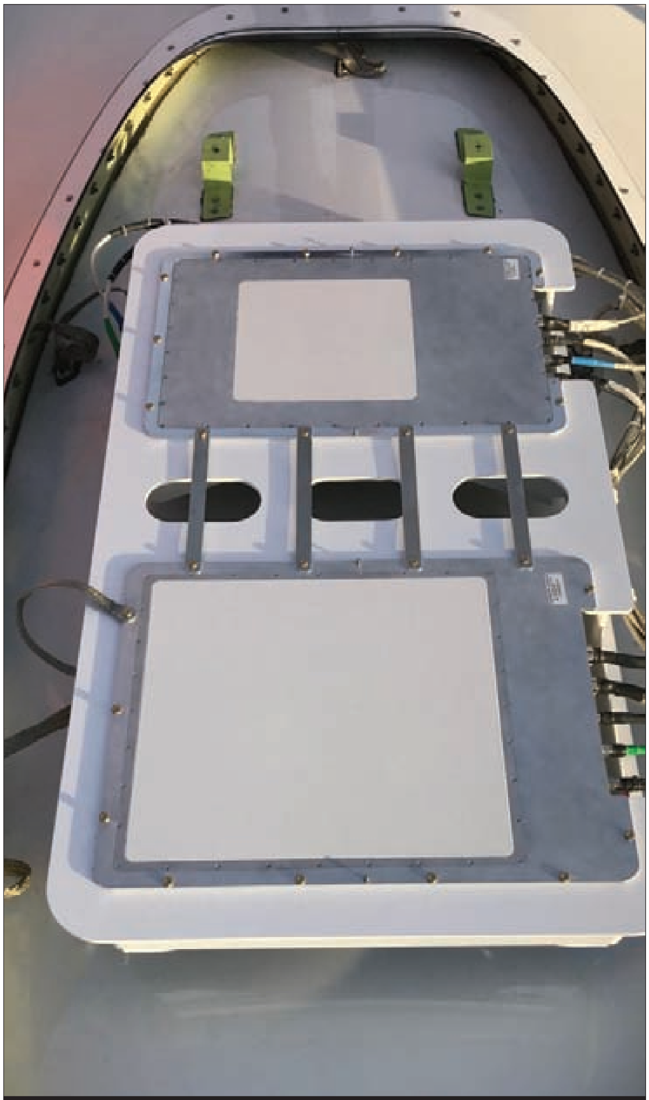
ESA technology is particularly important to connect with lower-orbiting, next-generation, NGSO constellations. These lower orbiting LEO and MEO constellations while being the solution to latency-sensitive applications pose further tracking challenges on the tracking terminal.

NGSO satellites are continuously orbiting the planet, and not maintaining a constant geolocation overhead, such as GEO satellites. In the case of LEO constellations, a single satellite may be seen overhead for a few minutes at a time. Hence the constellations are made of tens of such satellites for MEO and hundreds and even thousands for LEO, with the antenna needing to switch between the dawning one and the rising one, many times during the flight. These satellites are naturally in opposite beam looking locations for the antenna. The ESA terminal switches between two beams instantaneously, with no mechanical limitations to the switching time. Therefore, it can switch between two orbiting LEO satellites immediately and negate the interruption.

Inside the ESA technology

Gilat installed its industry-leading IFC modem and the latest generation of its phased-array innovative ESA terminal into the Honeywell plane.

The Ka-band RFIC chipset is the core building block in



Gilat achieves ESA industry milestone

Gilat's ESA offering and allows airlines to meet the increasing communication needs of its passengers. It's designed to meet and leverage the advances in the newest satellite constellations.

For example, it was built to handle multi-beams, seamlessly transition from one satellite to the next, and allow for mobility, which are just some of the features that will be supported on upcoming LEO and MEO satellites. The Gilat ESA terminals are built for efficiency, as they achieve high performance and throughput rates while maintaining low power consumption.

The ESA Ka-band aero-terminal features an ultra-low-profile phased array fuselage-mounted antenna, for GEO and NGSO constellations. Its full electronic beam steering is capable of ultra-fast switching, at less than 1msec. With no moving parts, the antenna is highly reliable. It contains high gain, software-defined transmit and receive arrays, built with Gilat's end-to-end in-house technology. The system includes Gilat's industry-leading aero modem, integrated RF and antenna, which are powered by Gilat's advanced third generation RFIC core.

One of the biggest advantages of the ESA system is that the only aircraft LRUs (Line Replaceable Units) are the fuselage-mounted antenna unit and the modem. There are no additional KRFU or KANDU units, which are heavy LRUs associated with mechanically steered solutions. This makes the ESA solution robust and lightweight, and its installation on aircraft is fast, easy and considerably less expensive. The weight, robustness and fast installation are all extremely appealing to any airline, as it greatly reduces a jetliner's time on the ground.

The need for ESA has never been greater

The successful test flight meets the communication needs of the aero market including both commercial jetliners and smaller jets that until now could not be served efficiently by existing solutions and opens up great opportunity for Gilat both over GEO satellites and NGSO constellations.

Now, with a successful in-flight test completed, Gilat has proven that its ESA can meet the needs of the commercial airlines and its passengers. As Gilat looks ahead, there are several different applications for this technology, over both GEO and NGSO constellations.

Both business and the military are driving a surge in the need for mobile satellite connectivity. In addition to commercial airplanes and private business jets, many other platforms require internet connectivity that can keep up with its need for high speed, low latency communications. Naval vessels and cruise ships, which traverse oceans and seas far from cell towers as well as high-speed trains and automobiles are all looking for improved broadband connectivity solutions.

Gilat believes that using its innovative technology, the ESA can deliver high-speed connectivity to a range of mobility platforms and applications in the air, on land, or at sea. Its system architecture is fully scalable in both size and performance, which allows it to meet the needs of the different stakeholders.

Gilat's first-to-flight ESA terminal achieves another industry-first

Gilat's first-to-flight Electronically Steered Antenna (ESA) terminal achieved yet another industry-first with in-flight connectivity over NGSO, that nicely positions Gilat to win the vast opportunities available in the ESA market. The demonstration showed high performance and instantaneous Ka-band switchovers between and operating on Telesat's Phase 1 LEO satellite and its Anik-F3 GEO satellite, onboard Honeywell's Boeing 757 commercial test aircraft, across several flight tests.

Gilat's high throughput and small form factor ESA operated continuously over GEO then instantaneously switched connectivity to operate on LEO when it came into view, and back to GEO after operating on LEO. The ESA terminal demonstrated high performance, with broadband throughput of up to 58 Mbit/sec on both FWD and RTN, round trip delay as low as 18msec and robust operation at low elevation angles of down to 20 degrees.

Gilat's ESA is a no moving parts, full electronic beam steering flat panel antenna with an extremely low profile. Gilat's innovative design combines the benefits of ESA with the advantages of Ka-band, as highlighted by the performance achieved in this testing. The ESA terminal serves both GEO and NGSO constellations and as such opens the market to low latency real-time applications.

Gilat's multi-orbit ESA switchover capabilities will enable airlines to future-proof their connectivity decisions," said Michel Forest, Director of Systems Engineering for the LEO Program at Telesat. "Airlines will be able to access high-performing Ka-band connectivity today, and easily incorporate LEO low-latency connectivity without replacing terminals. Our ongoing development efforts with our valued partner Gilat will ensure airlines have flexibility and ability to meet their inflight data requirements of the future."

"Gilat's innovative ESA terminal opens up great opportunities in the commercial and business aviation markets with a winning proposition that addresses the two major ESA industry growth dynamics: mobility, with emphasis on in-flight connectivity, and the upcoming NGSO constellations," said Roni Stoleru, Vice President Antenna Products & Strategy at Gilat. "We are appreciative of the collaboration with our long-standing partners, Honeywell and Telesat and look forward to continued cooperation."