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SATELLITE MOBILITY WORLDsm

Highlighting Disruptive, New, Mobility-Focused Satellite Ventures and Technologies



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Cover: Ramon Space Solar Mission

With Hagay Katz, Gilat's Chief Product and Marketing Officer...

Can LEOs Capture the Satellite Backhaul Market?

Satellite backhaul is a major focus of LEO operators. To assess the satellite backhaul potential for these new constellations, we went to Gilat. Not only are they the acknowledge leader in this application, they have developed a unique non-geostationary (NGSO) focused ground infrastructure, SkyEdge IV.

In this exclusive interview with Gilat's Chief Product and Marketing Officer, Hagay Katz, you'll learn about the technical and business challenges for ground infrastructure associated with the deployment of NGSOs in satellite backhaul applications and Gilat's innovative solutions.

SMW: Hybrid or NGSO networks will require hub and modem infrastructure enhancements. What are the significant challenges in accommodating LEO and MEO infrastructure? I understand you have two products, SkyEdge II-c, and SkyEdge IV. What is the difference between these two platforms, and has Gilat deployed them commercially?

Hagay Katz (Hagay): Let's start with our platforms. SkyEdge II-c is a leading multi-service platform, delivering high-quality multi-service capabilities and an enhanced user experience.

Gilat's SkyEdge II-c has been deployed for over ten years, and is the market leader for 4G cellular backhaul over satellite with an estimated 74% market share.

As we were nearing hardware limitations related to the new demands from the NGSO and SDS, Gilat decided to go for a revolution rather than an evolution.

SkyEdge IV is our next-generation platform that will extend our offering for MEO (with SES' O3b mPOWER). It's the platform of choice for VHTS GEO. Among the unique attributes of SkyEdge IV is its superior 10x capacity and speed compared to the industry, the widest Hub receiver (500 Mbps), the most efficient FEC via Gilat's XDC (delivering 15% better than LDPC), our new family of very high speed and performance Aquarius VSATs and our Elastix Total NMS.

The emergence of LEOs presents several challenges because the satellites are in motion.

- **Doppler:** Due to the high speed at which satellites move, there is a need for new pre-compensation mechanisms for the Doppler effect. Gilat has integrated into our

platforms calculation of the real-time position of the satellites based on Two-Line Element (TLE) as well as calculation of the Doppler effect, which is critical for signal acquisition.

- **Updated satellite position:** There is a deviation in the satellite orbits. A dynamic over-the-air update mechanism to periodically distribute TLE files was developed.
- **Pointing:** Several satellites can be visible at the same time. The new complex boot process of the terminals needs to enable the VSAT to access to an updated database and select the correct satellite based on many parameters. Leveraging our experience serving the IFC market, we have perfected this capability on our platforms.
- **Variable latency:** Unlike GEO, the latency of the MEO and LEO link is constantly changing throughout the satellite pass. The system needs to accommodate this variability.



- **Roaming between NGSO and GEO:** There is a need to support a full database of relevant use cases.

Seamless migration between the satellite platforms is expected. The topic above related to latency is very relevant to roaming and presents a challenge as to how to roam from 10s of msec (LEO) or sub 150 msec (MEO) to a round trip delay of 500 msec (GEO.) An algorithm is used based on link conditions and input of the Satellite Resource Manager (SRM).

- **New gateway redundancy schemes:** GEO schemes are rather straightforward – redundant equipment at the gateway, redundant gateways, backup data center, and secondary NOC. With NGSO systems, Gilat developed new redundancy architectures. For example, now, a gateway sees a minimum of two satellites during handovers; with LEO, typically more. Another example is that GEO normally has

a fully redundant chain at the gateway with a backup antenna. With NGSO systems, we now need to support new backup approaches on top of the legacy redundancy mechanisms.

- **High-end platforms:** A major potential market for NGSO is high-end terminals such as those on cruise ships. These vessels will consume any bandwidth that can be made available.

With new NGSO constellations, the aspiration is to provide Gbps speeds. Demand for speed has led Gilat to develop new high throughput, high-speed terminals with extreme processing power.

- **Satellite Resource Manager (SRM):** NGSO and SDS constellations are very dynamic. The expected mode of operation is that the configuration of all elements of the satellites – beam forming, power allocation, channelizer – must be modified in real-time.

These changes are orchestrated by the Satellite Resource Manager. The SRM needs to access the ground segment frequently to

gather telemetries and reconfigure. Gilat's ground segment TotalNMS for GEO constellations has been upgraded significantly. Now called the Elastix TotalNMS, it supports the new interfaces to the SRM. In addition, the system can be reconfigured on the fly without having to reboot.

SMW: Gilat serves these markets with GEO satellites. Now, NGSOs are emerging. These include SES mPower with its new O3b infrastructure, consumer-grade LEOs from Starlink and OneWeb, and ultimately, enterprise-grade LEOs from Telesat and possibly project Kuiper. How will each of these NGSOs impact the satellite backhaul market?

Hagay: NGSO constellations disrupt the industry with their low latency capabilities and high-performance specifications. However, for CBH applications, LEO constellations face several challenges:

- 99.99% availability cannot be achieved due to full coverage issues and lack of proper redundancy mechanisms.
- The cost of antennas and their site

installation and maintenance is a barrier to the Total Cost of Ownership (TCO) for CBH links that are under 10-20Mbps.

In addition to the fundamental differences between GEO and NGSO antennas, there are additional factors related to the TCO, such as:

- **Antenna Wind Load:** CBH over satellite solutions that provide Telco-grade services often use special antennas designed for high wind loads (e.g., Japan.) If and when full ESA is available, the wind load may not be an issue; however, to date, such antennas either do not exist for some constellations or are very expensive.
- **Field of View:** Antennas for GEO backhauling are normally mounted on the side of a cellular tower or the ground, close to the tower's base. In most cases of LEO constellations, the terminal would need to have a cone-shaped field of view of the sky to track the satellites over the different planes



at different elevation degrees over a 360-degree azimuth.

The tower itself will cause an obstruction for most constellations at most sites with a varying severity (depending on the distance between the antenna and the tower when installed on the ground and the number of satellites in the field of view). Two antennas are considered for some applications to provide 'make before break' connectivity, thus driving up the TCO.

The advantage of LEO operators is their low latency compared to GEO. However, With Gilat's Embedded GTP acceleration, for which we hold a worldwide patent, users will not see the difference between GEO and LEO

unless they are in real-time gaming applications or similar critical low latency applications. For typical network browsing and streaming of video and voice, our GTP acceleration provides a comparable experience.

GEO operators need to compete with NGSO based on TCO to remain relevant, meaning they

need to offer competitive capacity pricing. I predict that GEO, MEO, and LEO will be used by carriers based on TCO and coverage.

In the next 12-24 months, GEO will still be the leader and LEO operators will need to overcome their coverage, antenna and TCO challenges.

MNOs will evaluate the backhauling performance over LEO constellations and probably run beta sites. The results of these tests will be instrumental in determining the future of backhauling over LEO.

Given the LEO gaps mentioned above, although LEO constellations will certainly gain CBH market share, there will still be many cases where GEO satellites and MEO constellations will remain the constellation of choice.

SMW: We understand that neither Starlink, or OneWeb can offer guaranteed bandwidth or uptime under an SLA. Will their inability to provide guaranteed performance restrict their entry into other segments such as CBH and IFC?

"I believe that their inability to provide guaranteed uptime and bandwidth is due to two main factors: 1) incomplete coverage that causes low/no availability and 2) missing technical features.

Addressing these issues by adding more satellites, improving or adding Inter-Satellite Links (ISL), and improving antenna performance and costs will require material, commercial and technical investments that will take time to develop and implement."

Hagay: I believe that LEO's inability to provide guaranteed uptime and bandwidth will be a significant barrier to entry. It's due to two main factors: 1) incomplete coverage that causes low/no availability and 2) missing technical features.

They must add more satellites, improve or add inter-satellite links (ISLs) and improve antenna performance and costs. Adding these upgrades will require material, commercial and technical investments and will take time to develop and implement.

Tier 1 MNOs expect a high level of attention from their vendors at all levels. Gilat has invested many resources over the years in conducting extensive testing with our customers in the field and in labs verifying flawless functionality over many types of equipment by multiple vendors– ePC, eNodeB, UEs.

We learned how to optimize the hundreds of parameters of the ground segment to minimize jitter, manage the QoS, support handovers, and other attributes.

SMW: Within the satellite community, significant doubts exist regarding the capacity of Starlink, and OneWeb. In a study by Messrs. Ogutu B. Osora and Edward J. Oughton 1, College of Science, George Mason University, Fairfax, VA, and Oxford University, they demonstrate the limitation of LEO capacity. They estimate a mean per user capacity of 24.94 Mbps, 1.01 Mbps, and 10.30 Mbps for Starlink, OneWeb and Kuiper, respectively, in the busiest hour of the day.” Given their conclusions, are these LEOs a viable alternative for satellite backhaul?

Hagay: I cannot speak to the specific numbers above. However, with Gilat GTP acceleration, we achieved 400Mbps to the handset in capacity allocation scenarios that take advantage of TDMA (capacity sharing).

Although NGSOs will aim to provide similar performance, it doesn't appear that there will be a big difference between GEO and NGSO in user

experience.

In my opinion, even if the mean capacity figures quoted above are accurate, they will not necessarily be a critical or differentiate the user experience from GEO backhauling.

SMW: How is mPower different than Starlink and OneWeb? Can SES mPower deliver sufficient capacity to serve the satellite backhaul market? Will they be a significant player in that market?

Hagay: SES' mPower will provide CBH to high-speed/throughput links that justify the TCO.



With SkyEdge IV, it will be possible for SES to provide GEO-MEO coverage as required and the needed availability and QoS. It is assumed that lower speeds will be served over GEO and higher speeds over MEO.

SES O3b has a proven business case with

enterprise and trunking applications. The full constellation will support 30,000 beams; as such, there is practically no limitation in optimizing coverage per demand. I believe that capacity will not be an issue in most regions.

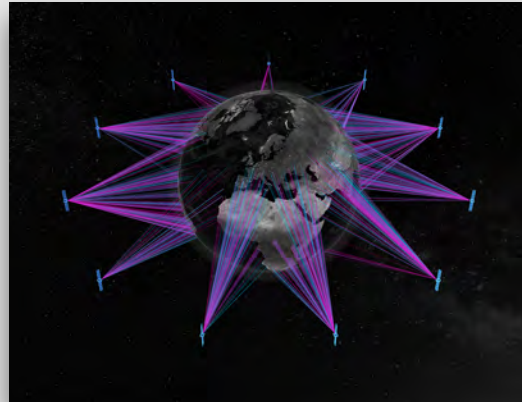
SES'mPower will be a significant player for the following reasons:

- It's the first NGSO that addressed the enterprise .
- Partnership with Gilat dramatically reduces risks and integration efforts.
- SES' and Gilat's current install base and relationships with MNOs

SMW: OneWeb and Starlink's satellites have a five-year life expectancy. To justify the investment needed to refresh their constellation with new satellites, these LEOs must demonstrate significant revenue growth, or they will fail. Is Gilat or its

customers concerned about the risk of service termination?

Hagay: As previously mentioned, TCO will be the key decision-making factor for MNOs regarding the satellite technology they choose to use.



With a life expectancy of 15-20 years, GEO has an advantage over LEO. However, there is continuous advancement in LEOs, and the owners of Starlink and Amazon are investing what is required to make their TCO competitive.

This New Space Era, that we at Gilat call the Elastix Era, is good for the entire industry. NGSOs are investing more and more money and bringing exposure

to an industry that was once considered a niche. Satellite is becoming a mainstream platform.

SMW: GEO satellite technology is evolving. New satellites will have beamforming capabilities, resulting in significantly improved efficiency. Compared to GEO, do you believe LEOs will be

cheaper, roughly equal, or more expensive?

Hagay: The cost of new LEO constellations ranges between \$5b - \$10b. Once launched, there are additional costs of constellation refresh due to the shorter life span.

Indirectly, LEO constellations have contributed to a reduction in operating costs of GEO satellites due to cheaper launch services and more efficient satellite manufacturing. Typical GEO VHTS network accounting for both the space segment and full ground segment is budgeted below \$1b.

Therefore, I think that the capacity prices that GEO VHTS will be able to provide will be as aggressive as LEO and MEO. I predict that GEO VHTS pricing will go down by as much as 10x compared to what is offered today. Competition will accelerate the rate of this price decrease even more. Ultimately, the decisions of MNOs and mobility users will be based solely on superior user experience and services.

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About Hagay Katz:

Hagay serves as Gilat's Chief Product and Marketing Officer.

Prior to joining Gilat, Hagay served as VP Strategic Accounts - Cyber Security at Allot Communications (Nasdaq - ALLT) where he was instrumental in transforming Allot to be the market leader of network-based cyber-security as-a-service for communication Service Providers.