Meeting Customer Needs with Tailored GEO, LEO and Hybrid Network Solutions

By Toby Robinson, Chief of Strategy & Business Development, Avanti Communications

Satellite customers and their requirements are diverse and complex

Of all the segments of the global communications and connectivity market, the satellite sector has an unparalleled degree of diversity in its customers and their requirements. Customers range from residential consumers, schools, hospitals and small and medium-sized businesses through to multi-national enterprises, telecommunications companies, maritime and aero users, and governments and defence forces. Services are provided to both fixed sites and moving vehicles on land, sea and air. Individual customers have specific requirements for bandwidth, equipment, integration, reliability, operational assurance and security, requiring tailored solutions and managed services.

The new space revolution and the emergence of multi-orbit strategies, in particular with the advent of low earth orbit (LEO) satellite constellations, has provided customers with a new wave of options, choices and complexity.

GEO and LEO satellite constellations have fundamentally different architectures

By their very natures, geosynchronous (GEO) and LEO satellite constellations have very different architectures. GEO satellites are geosynchronous – they orbit at a specific height of 35,786 km above the earth's surface, at the same speed as the earth and so they appear to be stationary in the sky, giving a fixed line of sight between both the user and the satellite and also the satellite and the gateway station.

LEO satellites operate at much lower altitudes and so orbit much more quickly than the earth rotates, appearing to fly past a user on the ground. For example, Starlink satellites orbit at c. 550 km above the earth's surface, orbiting the earth every 90 minutes, at a speed of some twenty seven thousand kilometres per hour. This means the user only sees the satellite for 3 to 5 minutes, before the satellite passes by and the signal must be transferred to another satellite. A Starlink user terminal checks for the nearest satellite to connect to every 15 seconds, and if necessary establishes a new connection.

Figure 1: Comparison of Architectures of GEO vs LEO[1] Constellations

[1]Specific example given is Starlink LEO constellation.

Customers receive very different service propositions from GEO and LEO satellites

As a result, GEO and LEO satellites offer customers very different standalone service propositions. In general, GEO satellites are best for carrier-grade reliability, security, latency variability, compliant ground network, range of terminals and platforms and space sustainability. While individual LEO constellations (e.g. Starlink, Amazon Kuiper, Eutelsat OneWeb and Telesat Lightspeed) have subtle but important differences in architecture, in general LEO satellites are better for latency, global coverage and capacity density.

Satellite Service Attribute	GEO	LEO
Carrier-grade reliability	BEST	
Security	BEST	
Latency		BEST
Latency variability	BEST	
Global coverage		BEST
Capacity density		BEST
Compliant ground network	BEST	
Range of terminals & platforms	BEST	
Space sustainability	BEST	

Figure 2: Comparison of Key Attributes of GEO vs LEO Standalone Services

The key service attributes impact the type and quality of service the customer receives. Different attributes will have different importance given the customer use case requirements:

- **Carrier-grade reliability:** End-to-end network quality of service, committed information rate, service and operational level commitments backed up by the necessary operational support and maintenance capability;
- **Security:** ensuring customer data and the underlying connection are secure from interception, hacking or jamming by bad actors;
- **Latency:** the round-trip time the signal takes to travel from the user terminal to the satellite and back to the ground station on the earth's surface (possibly via an inter-satellite link in the case of LEO constellations). Some applications require low latency, or network acceleration, to function effectively;
- **Latency variability:** the variability of the latency over time; this is of particular importance when integrating services which expect packets of data arriving at constant intervals, such as real time voice and video;
- **Global coverage:** some customer use cases, particularly mobility for aero or maritime connectivity, require international or global connectivity;
- **Capacity density:** the density of bandwidth capacity delivered to a location (e.g. a site, a city or a country) – drives the total data throughput that can be achieved;
- **Compliant ground network:** some high-security government and defence customer use cases require that all the data and voice traffic through the satellite be delivered to a ground station at a known location, potentially in-country, or that the ground infrastructure is physically "air gapped" to minimise potential security vectors and provide full operational control;
- **Range of terminals and platforms:** some use cases require highly specialised terminals and antennas or hubs – this may be to support specific size, weight and power needs, regulatory approval for particular vendor products, compatibility with existing networks, or support for mandated security standards such as TRANSEC or tactical waveforms;
- **Space sustainability:** there is increasing focus on ensuring the use of outer space for peaceful purposes and socioeconomic benefit now and in the long term, particularly regarding space debris, carbon footprint and electromagnetic interference.

The key architectural differences driving these service attributes are as follows:

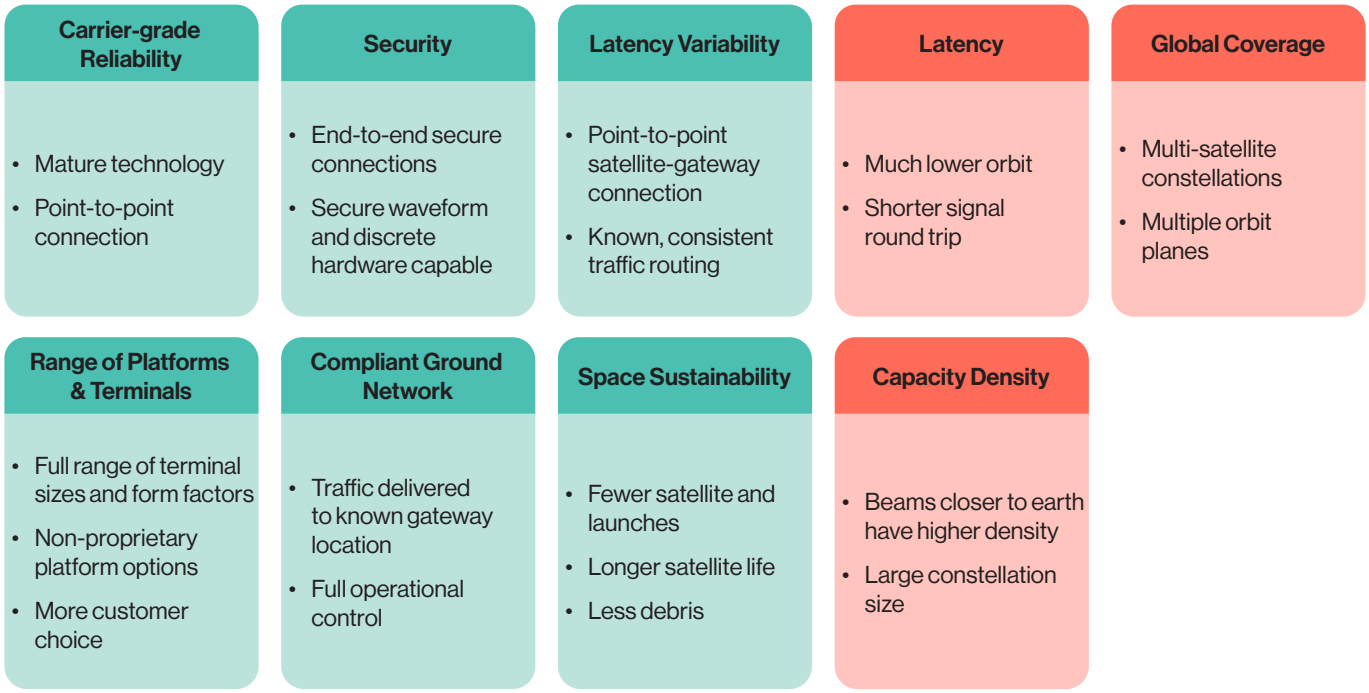

Figure 3: Key Attributes of GEO vs LEO Standalone Services

Avanti can now offer its customers a GEO, LEO or Hybrid Network Solution

As we have seen, GEO and LEO satellite constellations have very different architectures, driving very different service attributes. In simple terms, GEO is best at some things while LEO is best at other things. Our role at Avanti is to engage with our customers to understand their requirements in order to design, recommend and deliver the best GEO or LEO solution. For some customers a Hybrid Network solution (combining GEO and LEO services) may be the most appropriate.

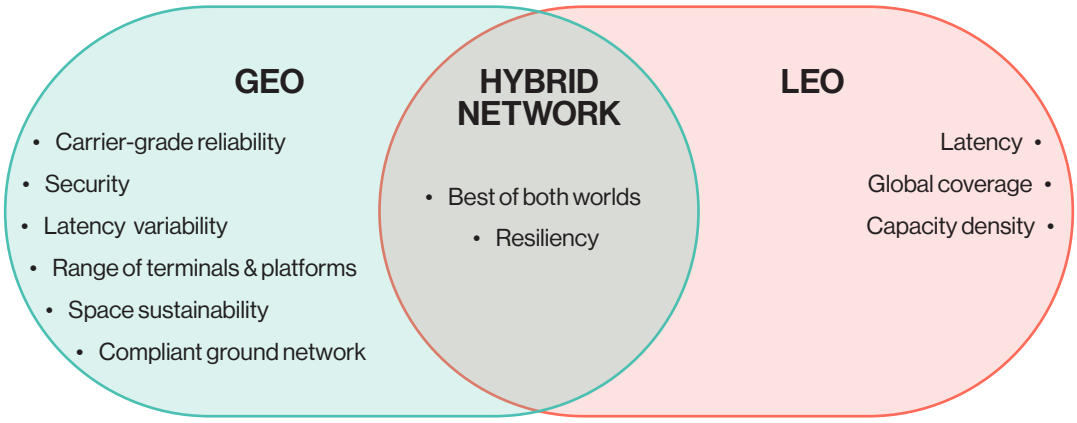

Figure 4: GEO vs LEO vs Hybrid Network Propositions

With Hybrid Networks, GEO and LEO services can be combined into a single service offering (on different sites or on the same sites) to offer the best of both worlds, for example combining high reliability with low latency, and/or offering resiliency across multiple satellite bearers. Whether we are delivering our customers using solutions based on GEO, LEO, or Hybrid Networks, the solution includes an integrated Avanti service wrapper, single point of contact for customer support and integrated monitoring and reporting.

To illustrate some of the possibilities, below we describe three current customer case studies.

1. Carrier/ Civil Government: Emergency Services Network (ESN)

Customer: European Emergency Services Network

Requirement: Our direct customer is the national telecom operator providing the data and communications solution for the national Emergency Services Mobile Network.

The core satellite cellular backhaul solution must support a guaranteed high service availability, committed information rate (CIR), stringent operational assurance levels, end-to-end secure transmission of services and strict landing and routing on sovereign soil. The operator also requires high-capacity commercial services with less stringent requirements and lower cost to be supported within the solution.

Role for GEO

GEO connectivity is deployed at every site, landing voice and data traffic at an in-country gateway to meet government requirements and to underpin the high service availability, CIR bandwidth, and stringent operational assurance levels required. The solution is end-to-end encrypted and accelerated to enable high data rate applications and use cases.

Role for LEO

LEO connectivity is deployed alongside GEO on every site to provide access to high volume burst capacity for commercial services at a lower cost.
GEO and LEO services are integrated via the Avanti Magic Box (SD-WAN), incorporating encryption, acceleration and optimisation, and the steering of traffic in real time between the GEO and LEO bearers.

2. Enterprise: South African Bank

Customer: Major South African Bank

Requirement: Provide resilient satellite communications links for mission-critical business and customer applications for both the HQ office and their medium to large branches, if fibre networks fail due to fibre outages.

Critical applications include management and control, large batch files for payment clearance and CCTV.

Role for GEO

Reliable, “ultra-high availability”, high-capacity point-to-point using GEO links with committed information rate CIR between the branches and South African HQ building; HQ and the Teraco data centre in Johannesburg, plus an international link between Teraco data centre and the Group’s data centre in London, UK for international payment processing.

Role for LEO

LEO services provide modular and cost-effective scaling of best effort capacity with lower latency for latency-sensitive applications.

GEO and LEO services integrated via a single Avanti Magic Box, which triages the data traffic in real time between the GEO and LEO bearers.

3. Defence: Military Air Transport Fleet

Customer: NATO Military Air Transport Fleet

Requirement: Military strategic-lift aircraft are used by NATO forces to transport critical equipment, munitions and people anywhere in the world. The heavy-lift aircraft are required to move the most important troops and kit into conflict zones in times of tension. SATCOM links are crucial to provide two-way/multi-way voice, data and video traffic. Because the aircraft are designed to operate in hostile environments, they must be able to counteract jamming and interference of radio frequencies across large areas.

Role for GEO, MEO and LEO

Walk-on, hatch-mounted, flat-panel Electronically Steerable Antenna can be installed in aircraft in minutes making them multi-orbit SATCOM capable. These antennas, coupled with smart traffic routers, allow the aircraft to switch between LEO, MEO and GEO services automatically and maintain connectivity even in heavily contested or congested radio environments, including areas with active signal jamming.

Conclusion

Of all the segments of the global communications and connectivity market, the satellite sector has an unparalleled degree of diversity in its customers and their requirements. GEO and LEO satellite constellations have very different architectures and so offer customers very different standalone service propositions. This provides customers with a new wave of options, choices and complexity.

Our role at Avanti is to engage with our customers as a trusted advisor to understand their requirements in order to design, recommend and deliver the best GEO or LEO solution. For some customers a Hybrid Network solution (combining GEO and LEO services) may be the most appropriate.

Find out more:

www.**avanti**.space

contact@avanti.space