GEO vs LEO – Quick facts

Avanti's Fleet of GEO Satellites

Technology and innovation are the beating heart of Avanti. In 2010, we were the first British company to launch a Ka-band satellite, HYLAS 1, and the first satellite operator to provide Ka-band services across the UK and Europe. Today, we own and operate a fleet of five high-throughput GEO satellites covering EMEA. We have a fully authorised, resilient and secure ground network comprising of seven earth stations strategically located across EMEA, an international fibre ring and a cross-connected fibre network.

GEO vs LEO - The Basics

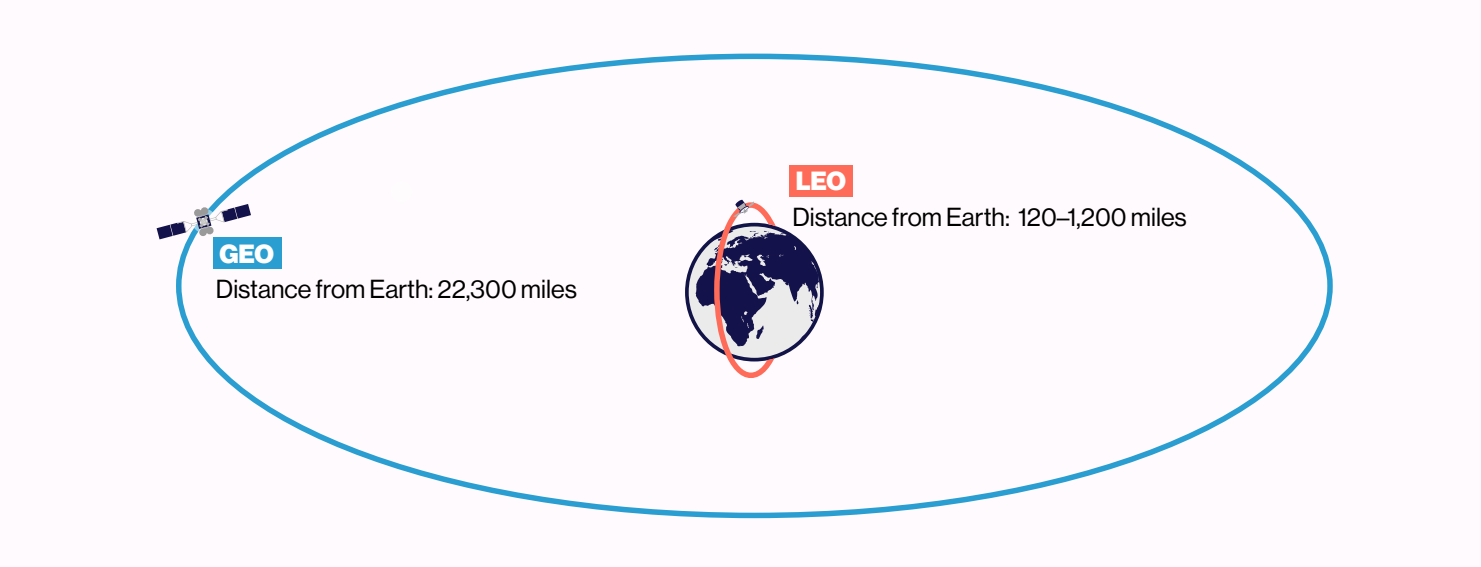
GEO — Distance from Earth: 22,300 miles

GEO satellites have been in orbit for more than 50 years. These high-orbit satellites travel at the same angular velocity as the Earth, remaining stationary over the same spot (hence the name geostationary). A satellite antenna on the ground can therefore face a fixed point in the sky. From 36000km above the equator, a GEO satellite can provide services to any location on the visible side of the earth. Additionally the orbit environment is much less challenging including less radiation and orbital perturbations making them the perfect candidate for long term large scale telecommunications missions.

LEO — Distance from Earth: 120–1,200 miles

LEO satellites operate closer to Earth (less than 1,200 miles of altitude), therefore their coverage is much smaller (circa 1,200-1,900 miles diameter) and that's why we talk of LEO constellations as it requires a large number of LEO satellites to cover a large area and require more complex ground system. LEO systems operate in a much harsher environment compared to GEO including radiation and atmospheric drag that results in a much shorter lifetime (circa 5 years). Therefore, constant replacement of satellites is required to maintain the constellation population in good working order in the long run.

While there are several LEO constellations in operation today from companies like Iridium, Globalstar, and Orbcomm, that primarily serve low-throughput voice and data applications, the coming wave of LEO satellites intends to serve different markets, specifically those that require high-throughput connectivity. This generation of LEO satellite constellation has not been launched yet and will take years to become operational.



How do GEO and LEO compare on the following key elements:

Coverage

Many LEO satellites must work together to offer sufficient coverage to a given location, while just one GEO satellite could cover the same area. Additionally a LEO satellite constellation can only provide service in an area where there is a local gateway earth station. This is because the ground coverage is defined as the area where the satellite is visible at the same time from the users location and the gateway (typically 1000km around the gateway). Therefore, even if there could be enough satellites in the constellation to provide coverage of a ground location 24/7 unless there is a gateway located in that small region service cannot be provided in the absence of a local gateway.

In comparison, GEO satellites have major gateway earth stations located strategically in the coverage providing full coverage from day one of the operation.

Efficiency

Because LEO satellites are constantly moving relative to earth at a given moment, they tend to spend a lot of time over oceans and other unpopulated areas, making them less efficient in that sense. GEOs stay in one location relative to a specific spot relative to earth. This makes GEOs more efficient for smaller, more specific regions.

Additionally due to the size and power limitations GEO satellites can carry significantly more traffic compared to the localised LEO service.

Cost

Although smaller LEO satellites are less expensive to manufacture than GEO, more are typically needed at one time to have effective communication operations. LEO satellites get very complex and expensive when looking at the number of gateways required on the ground to operate. This drives the total cost of the overall system up. Antennas for GEO satellites, especially for KA-band, are much simpler and cheaper than the ones required for other systems.

Complexity

LEO systems are far more complex to design and operate. Real time tracking antennas as well as efficient satellite hand-over systems are required to complete the service. This added complexity increases the challenge in providing critical applications like cellular backhaul making LEO systems more suitable for less critical applications consumer broadband.

Frequency spectrum

LEO satellites are constantly overlapping each other geographically. This makes managing their frequency synchronization complex between systems, because there are many different LEOs traveling all around the world.