Photo courtesy of LeoSat Enterprises

Why LEO satellites are key for telecom operators in search of growth

Geostationary (GEO) satellites have been utilized for decades now, providing connectivity on an unprecedented scale to remote and rural regions. New innovations like medium Earth orbit (MEO) and low Earth orbit (LEO) satellite constellations are set to shake the established GEO satellite industry to its core, with advantages like low latency heralded for applications across the board. Ronald van der Breggen, Chief Commercial Officer at LeoSat Enterprises, outlines how LEO satellite constellations will offer a whole host of new opportunities in the future.

New developments in satellite constellations are leading to innovative services that can greatly benefit telecom operators. As much as services from geostationary Earth orbit (GEO) and medium Earth orbit (MEO) satellites have been improved, satellite is still often perceived as a last choice for network connectivity when terrestrial infrastructure is not available. Now, with the new low Earth orbit (LEO) constellations, opportunities are available for telecom operators which will give them access to previously unavailable levels of network performance combined with worldwide reach.

Typically, mobile operators have had four options for standard backhaul: Copper, fibre, microwave and satellite. Previously, when mobile (telecom) operators were looking for service expansion in more remote areas, they found solutions by complementing the terrestrial network in urban areas with satellite service for the semi-rural and rural locations. This has allowed them to expand to previously unconnected areas. For some operators, even full out-of-country capacity is based on satellite service. Satellite has therefore been used both as standard operations or as a redundancy solution where other (fixed) solutions did not provide the redundancy required.

Growth for mobile operators in coverage areas and services has led to increasing bandwidth demand. This has developed to a point where satellite

	Fibre	Microwave	Traditional Satellite GEO/MEO	LEO HTS Satellite
Capacity	Unlimited	1-2 Gbps (or multiple)	50-100 Mbps (GEO) 100-800 Mbps (MEO)	1-5 Gbps very low latency
Latency	Low latency	Low latency	High latency 400ms (GEO) 135ms (MEO)	Low latency
Regulatory	Access to local infrastructure (above or below ground)	Spectrum	Earth Stations License	Earth Stations License
Cost drivers	Variable cost per km Long deployment time	30-50km w/o Repeater Fixed cost per link + repeater	Fixed cost - Fast deployment High variable cost per Mbps Independent of distance	Fixed cost - Rapid deployment Low variable cost per Mbps Independent of distance
Terrain	Trenching outside urban terrain costly	Impact on number of repeaters required Cost for maintenance	No impact	No impact

Table 1. LEO HTS satellite option provides connectivity with similar characteristics as fibre or microwave solutions

could not provide the solutions to improve a business case. Alternatives were found in microwave solutions or, in urban areas, fibre was used as a backhaul. While this alternative solution certainly addressed the issue of capacity, it also introduced new obstacles: Long lead times to install, a significant issue with customer implementations and high upfront costs.

Now, with the new developments in satellite constellations, there is a better alternative for (mobile) telecom operators in search of growth and customer network implementations. The benefits of high speed, low latency and rapid deployment are now available via LEO satellite connectivity.

Ronald van der Breggen, Chief Commercial Officer at LeoSat Enterprises

New satellite architecture

It is recognized that today the world is increasingly data-driven, cloud-based and trans-national, creating an ever-growing demand to move large quantities of data quickly and securely around the globe. In the last 10 years, data usage has exploded, with more data created in the past two years than in the entire previous history of the human race. And by the year 2020, about 1.7 megabytes of new information will be created every second for every human being on the planet.

With these developments in mind, there is a clear focus in the satellite sector on offering better data services. Traditional GEO satellite operators are adding power to their spacecraft to facilitate high throughput satellite (HTS) capabilities, further facilitated by deploying spot beams allowing that power to be more concentrated in smaller areas.

To further improve data services, latency has to be reduced as well, which has led to the (planned) deployment of constellations in lower orbits: MEO (12km – latency within beam 135ms) and a new generation of constellations are being prepared for even lower orbits such as LEO (1.2 – 1.5km). The lower orbit allows for high throughput and latencies (within beam) below 30ms. The newest innovation is adding inter-satellite connections that allow for low latency on long distances (> 6km). Using this architecture, which is fundamentally different from satellite's traditional 'bent-pipe' architecture, there is no need to downlink to gateways in order to terminate traffic. If beyond the inter-satellite links the space is also equipped with routing and switching capabilities, then a direct point-to-point spatial MPLS network can be deployed in a very short timeframe. With these capabilities, native IP is supported in a MPLS configuration.

LeoSat Enterprises is preparing to launch this type of constellation to offer High Throughput Low Latency link services (HTS-LoLa). The LeoSat solution can deliver 1Gbps (combination of links up to 10x is possible) with latency below 30ms for domestic links (within the satellite beam area). For distances above 6,000km, the total latency is better than the capabilities offered via fibre connections. This is the result of the lower propagation delay of the signal in free space than through fibre. Traditional GEO satellite links have a 'domestic' latency of around 500ms. The latest generation MEO is closer to Earth and

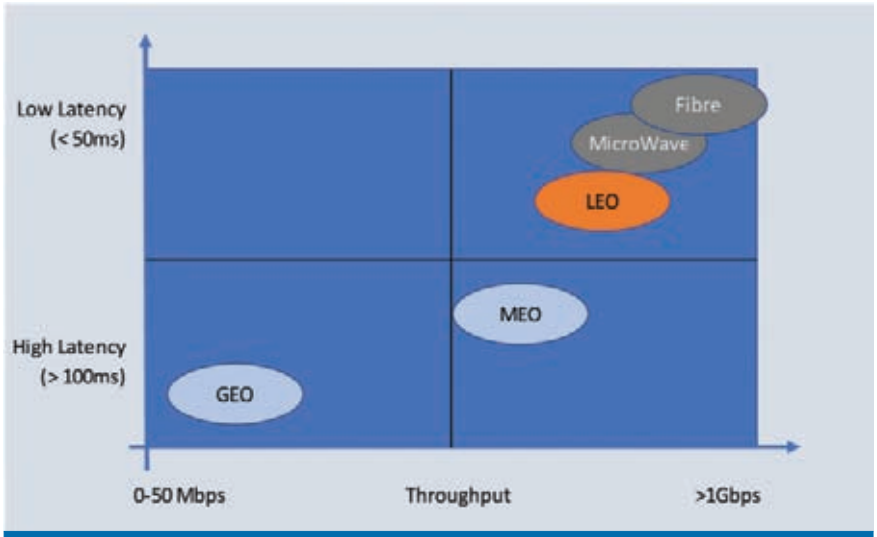


Image courtesy of LeoSat Enterprises

can therefore achieve better latency (130ms) when compared to GEO satellites. The LEO constellations are even closer, and are therefore in a position to operate with latency below 30ms.

The LeoSat constellation is designed to have inter-satellite connectivity via laser links. This offers additional advantages over other LEO constellations in terms of latency, as the inter-satellite connectivity provides a direct link to an adjacent satellite. Alternative LEO solutions are using the traditional bent pipe connection which requires a link with a ground station/hub to connect to the next satellite. Not only is the inter-satellite solution providing better latency performance, it also guarantees a much better level of security by avoiding ground stations. Low latency is important for two main reasons. Firstly, it enables the higher throughput (note that the effective throughput of a 1Gb link with 500ms latency is effectively much lower than 1Gb) and secondly, it allows for native mode IP, which reduces processing power and the use of standard modems/routers, saving both equipment and operational costs

New opportunities

The focus on growth for (mobile) telecom operators has initially been targeted at growing the size of the coverage areas and thus the size of the addressable market. Additionally, new services have been introduced to increase usage and revenue per subscriber. Also, incremental services have been developed to become a full ICT provider in the footprint. Now one of the key drivers for maintaining the customer base and ARPU is customer experience and expanding where possible along with the introduction of new generations of telecom standards (4G, LTE, 5G).

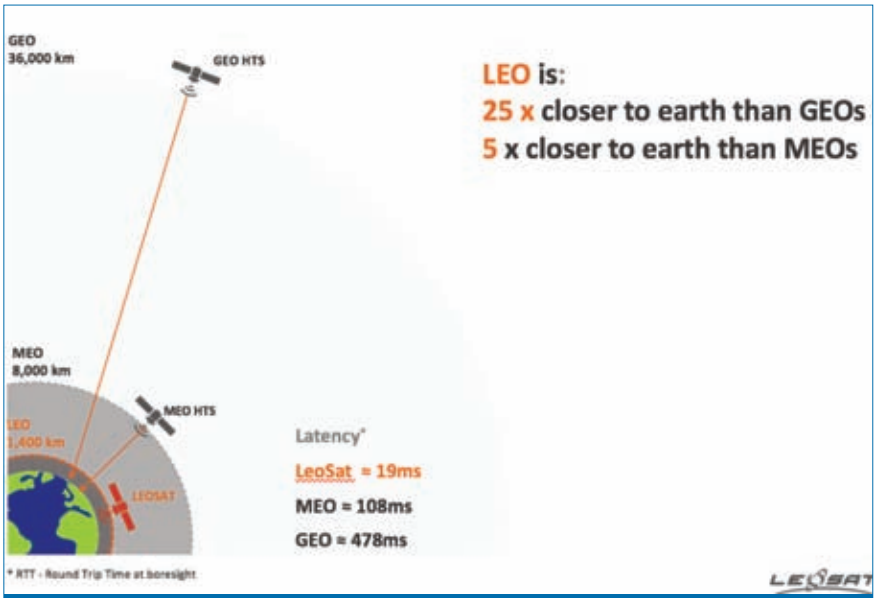
Backhaul to 'islands'

Backhaul towards remote locations: Satellite services have been used to support the revenue development in remote areas until lower cost alternatives such as microwave solutions for rural or semi-rural areas or fibre for urban locations became available. Thus, leaving satellite links only to be used for connecting very long distances or very remote areas (e.g. islands in the Pacific). With the development of HTS solutions, these more remote areas will now also be able to enjoy mobile services beyond 2G. The continuously growing demand, typical for the mobile industry with its growing penetration rates of Smartphones, will require mobile operators to further expand their capacity.

Backhaul towards mobile base stations: A typical network has base stations on fixed locations. Specific (large) customer requirements could be served through a local infrastructure that is (semi) mobile (e.g. open mining sites which are moving during the course of operations). Very often the large scale operations employ a workers community that is large enough to make a viable business case for mobile operators. While the base stations can be easily moved along, the required backhaul capacity typically cannot. Using a satellite link, mobile operators can now consider moving their backhaul capacity along with the base stations as part of changing the location of the operation.

Event ready backhaul and seasonal hotspots

When in support of specific events or



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busy seasons when a surge in capacity is expected, mobile operators have used cell on wheels (COWs) to cover for this. For concerts, sports events, etc., the customer expects the same quality of service as he normally receives, arguably even more, given that more online interaction with social media is to be expected during such events. These high expectations can be met using a satellite link that can backhaul large amounts of traffic. On top of that, these satellite services can be deployed rapidly, totally fitting the nature of these events. As with the COW's, the capacity can be mobilised to support existing hotspot locations in times where no events are on the calendar.

Service hubs

Service hubs is another area where a satellite solution with low latency and high throughput could be considered. Mobile operators that operate in different markets have most likely centralised specific services. For example, provisioning certain services or price plans and real-time charging. Using the very low latency offered by LeoSat, the location of the service centre can be completely flexible. Centralising for rapid deployment is one aspect. Redundancy and fast recovery when something goes wrong in one specific location or another. This can be achieved by having two service centres operating as fully redundant operations.

For operations that currently have multiple hubs, there is an opportunity to create additional redundancy for existing services and/or create a platform for rapid deployment into new markets of new services in a test market. These flexible opportunities to create service centres wherever is best for the operator to support its business, and a first step towards software defined networking.

(I)PLC to business customers/ enterprise backhaul

Telecom operators offering ICT services to larger business customers have also used mobile networks to provide data access services in specific verticals. To grow the service revenue from this developing business segment, more high throughput services cannot be provided via existing 3G/4G networks as it leads to service degradation, mostly felt by consumers at the business locations. Operators are finding alternatives in local point to (multi) point wireless solutions.

Edge caching support in semi-rural areas

Caching is key to optimise both trunking and backhaul capacity. Growing into LTE and later towards 5G, in dense areas, caching even closer to the customer will be required to meet the quality of service expected by the customer. This will bring new bandwidth challenges, and as such, opportunities for satellites to create specific hotspots with flexible, high-quality backhaul characteristics.

Comparing the alternatives for backhaul

Next to copper, two alternatives are being used for linking the different network elements (backhaul) of a mobile telecoms network operator: Microwave and fibre links. With the trend towards new and superior capabilities in satellite and the further decrease in price per Mbps, there is now an opportunity to re-consider satellite services to be put on top of the list.

In Table 1, we see that with the developments of capacity and latency, it is now clear that the LEO HTS satellite option provides connectivity with similar characteristics as fibre or microwave solutions, but with the added benefit of fast deployment at any location independent of the distance between the connected points.

The LEO HTS satellite option additionally provides high throughput and low latency as required in a network design for (mobile) operators, with satellite advantages being independent of distance and terrain. For specific links, it is clear that satellite connectivity is the better solution to provide the operator with carrier-grade service, rapid deployment and low maintenance costs.

The future is LEO

Connecting base stations to a next generation mobile network - 4G/LTE and beyond - using satellite connectivity, has become a viable option now that the specifications are in line with standard microwave and fibre links.

Looking at the different solutions currently deployed by mobile operators and the expected developments in the (mobile) telecoms industry via LTE to 5G, a LEO satellite solution will become a must for those situations where high throughput, low latency, operator grade security and mobility is expected, especially in combination with rapid deployment.

LeoSat's LEO satellite solution provides the mobile operator with a sustainable growth path towards a future with high bandwidth demand and flexible 4G and 5G technologies.

Photo courtesy of LeoSat Enterprises