



Low Earth Orbit Space Internet Constellations
Synergies with Telecom Operators

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Low Earth Orbit (LEO) satellite constellations are progressively being positioned as a welcome addition to the complex telecom services landscape that includes GEO/MEO satellites, mobile, fixed wireless access, FTTx and submarine, among others. Their success hinges on finding the right synergies between the satellite and terrestrial infrastructure for an optimal end user services delivery.

These LEO constellations have existed for decades, but a new generation of satellites is being launched at the moment, taking advantage of the drastic reductions in the costs of building nanosats, launching them and operating them. The LEO constellations being designed or launched at the moment come in different shapes or forms in terms of number of satellites, altitudes and functionalities. They are also targeted at specific market segments including residential broadband, enterprise broadband connectivity, mobile operators backhaul services, IoT services with either direct device to satellite connectivity or via a gateway connectivity based on 3GPP or LPWA standards, as well as various LEO/5G based voice/data connectivity models and space-based fiber paths for long distance connectivity. They differ in how they are built and operated, but in almost all cases, they are framed as a complement to terrestrial 5G networks, data center and cloud architectures and fiber networks. As such, how they would work together is of the highest importance.

In fact, the new LEO satellite networks being designed at the moment bring in a whole new set of opportunities for telecom operators, taking advantage of the low latency, broad reach and high capacity of such networks. In some cases, they may also be seen as threats depending on the specific market segment, regional applicability and the state of wireline/wireless ground infrastructure. Threat or opportunity will have to be assessed on a case-by-case basis.

A review of state of the art points to dozens of new LEO constellations being designed at the moment, driving the overall value chain with it, from chipsets to devices to satellites to integration solutions. It is progressing at a rapid pace, with significant funding behind. We expect a few of these constellations to get to commercial stage over the next 2-3 years.

Yet, various technical and business challenges still need to be addressed over the coming years, and the success of some of these initiatives will depend on them. These include:

- Addressing the cost structures of LEO constellations and in particular the pricing points and pricing models of end user devices and the end to end deployment TCO (Total Cost of Ownership), including power, operations and management aspects
- Fashioning technology standards and regulations for LEO networks, taking into account that standards bodies have already been addressing the various regulations required for the deployment of large-scale LEO networks.

- Finalizing interoperability mechanisms with 3GPP and specifically 5G standards to ensure seamless operations of some of the services, extending terrestrial 3GPP services
- Evolving QoS and Traffic Management Mechanisms for data path resources management and the design and dimensioning of oversubscription models over LEO space segments
- Reconciling SDN (Software Defined Networking) and Operational Systems given that LEO space networks are global, distributed and dynamic
- Tailoring state-of-the-art cyber-security mechanisms, where cyber-security for data and control paths would require rethinking to accommodate the characteristics of space segments given the constrained functionalities on the satellites
- Growing Next-Generation IoT networks leveraging LEO connectivity, given that the IoT gateways and backend architectures in use today would benefit from interfacing with the control and management plane of LEO networks.

With the foreseen likelihood of seeing some of these constellations rapidly succeed, there is a clear opportunity for telecom operators to leverage LEO networks for various internet service offering. These include:

- Augmenting the set of options to serve enterprise customers complementing the existing terrestrial wireline, wireless and satellite GEO alternatives
- Providing new mobile backhaul alternatives with different latency, bandwidth, and cost dynamics for 4G and 5G networks, with a focus on sub-urban, rural and lightly connected regions of the world
- Extending edge cloud services connectivity to leverage LEO constellations, where the distributed data centers would interface directly with satellite connectivity
- Extending the reach of existing IoT networks, leveraging IoT centric LEO networks
- Complementing terrestrial fiber and submarine fiber routes in specific cases, including for redundancy, load balancing and disaster recovery scenarios
- Providing alternate connectivity models to Wireless Internet Service providers, on top of the license and unlicensed spectrum-based connectivity models in place
- Augmenting the reach of global Mobile Virtual Network Operations (MVNOs) given the large-scale geographical nature of LEO networks and their underlying economics.

The new generation of LEO constellations provides an opportunity for the telecom terrestrial ecosystem to assess synergies. Extending the reach of IoT networks, broadband and backhaul deployments in rural and unconnected regions, complementing submarine fiber and synergizing with edge cloud deployments are some examples of that. Finding the right synergies is a win-win to both LEO and Telecom operators.