SPACENS
Agile GEO communications satellites

A Strategic Imperative in the New Space Telecommunications Landscape

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Table des matières

1 Introduction 1
2 GEO: A Systemic Transformation of the Space Environment 2
3 A Market Reshaped Around Multi-Orbit Architectures 2
4 Structural Limitations of the Traditional GEO Model 3
5 Mini GEO: A Paradigm Shift 3
6 Resilience and New Space Architectures 3
7 A Rapidly Structuring Market Opportunity 4
8 A Key Sovereignty Imperative 4
9 Conclusion 5

1 Introduction

The satellite telecommunications sector is currently undergoing a profound transformation, driven by technological, economic, and geopolitical factors. The rapid growth of Low Earth Orbit (LEO) constellations, combined with the rise of multi-orbit architectures and the progressive militarization of space, is reshaping the balance of power established over several decades. In this rapidly changing environment, Geostationary Orbit (GEO), historically dominant, is seeing its traditional model challenged without losing its relevance. It is now becoming part of a hybrid architecture, in which each orbital regime addresses specific and complementary requirements.

However, this evolution also highlights the structural limitations of the traditional GEO model, based on large, costly satellites with long development cycles. In response to these constraints, a new

category of satellite is emerging: the Mini GEO. At the crossroads between established models and approaches inspired by New Space, Mini GEO satellites embody a profound transformation of the traditional paradigm.

2 GEO: A Systemic Transformation of the Space Environment

Space has now become a contested strategic domain. Demonstrations of anti-satellite capabilities, proximity operations in geostationary orbit, and the emergence of capabilities to manipulate or neutralize satellites reflect a profound evolution in military doctrines.

In this new context, space-based telecommunications infrastructure is no longer merely a technical enabler, but a critical asset at the heart of modern military operations, the functioning of essential civilian infrastructure, and the economic sovereignty of states.

The historical model, relying on a limited number of high-value GEO satellites, therefore appears inherently vulnerable. A single satellite can concentrate several hundred million euros in investment and carry a significant share of the communications of a country or organization. This concentration of capabilities creates systemic risk that is increasingly incompatible with today's resilience requirements.

The issue is therefore no longer solely one of satellite performance, but rather of the overall robustness of space architectures.

3 A Market Reshaped Around Multi-Orbit Architectures

The rise of LEO constellations has profoundly changed the standards of the satellite telecommunications market. By offering low-latency, high-capacity services with global coverage, these systems have opened up new applications, particularly in broadband, mobility, and mission-critical communications.

At the same time, sovereign initiatives such as the European IRIS^2 programme illustrate the determination of states to safeguard their strategic autonomy in a domain that has become essential.

These architectures rely on a combination of different orbits, each providing specific advantages. However, these constellations also present significant constraints. Their deployment is complex, their infrastructure costs are high, and their operation is heavily dependent on sophisticated ground segments. In addition, their limited service life requires frequent satellite replenishment, placing further pressure on their economic model.

Against this backdrop, GEO satellites retain significant structural advantages, particularly in terms of wide-area coverage, link stability, and the relative simplicity of ground terminals. Nevertheless, the traditional GEO model, characterized by heavy and inflexible platforms, appears increasingly ill-suited to a market seeking greater agility.

4 Structural Limitations of the Traditional GEO Model

The historical GEO model is based on long development cycles, very high unit investments, and a logic of capacity pooling. While this approach has long optimized performance and profitability in a stable environment, it is now showing signs of strain, notably as the market shifts from direct-to-home broadcasting toward point-to-point communications.

From an economic perspective, operators are facing increasing difficulties in financing satellites whose cost can exceed €300 million. This constraint limits the number of projects and slows innovation.

From a technological standpoint, development cycles of up to five years for defense satellites can no longer keep pace with the speed of technological change. Satellites can therefore sometimes be technologically outdated as soon as they enter service.

From a strategic perspective, concentrating capabilities on a limited number of platforms creates a critical vulnerability. The loss or degradation of a single satellite can have major consequences for service continuity.

Furthermore, the expected replacement of several hundred GEO satellites by 2035 represents a considerable industrial and financial challenge, while at the same time creating a window of opportunity for alternative models.

5 Mini GEO: A Paradigm Shift

Against this backdrop, Mini GEO introduces a profound transformation of the geostationary model. It is not merely an incremental evolution, but a genuine reinvention of GEO.

By significantly reducing mass, costs, and production lead times, Mini GEO satellites make it possible to consider more agile and modular architectures. They are based on a logic of serial production and incremental deployment, breaking away from the traditional single-satellite approach.

This evolution makes it possible to move from a centralized platform model to a distributed fleet model. Capabilities are no longer concentrated in a single critical asset, but distributed across multiple satellites, thereby providing greater resilience and flexibility.

Mini GEO also makes it possible to better address specific requirements by offering satellites dedicated to a particular customer, region, or mission. It thus paves the way for more accessible economic models better suited to the diversity of applications.

6 Resilience and New Space Architectures

Resilience has become a central criterion in the design of space infrastructure. Modern architectures increasingly prioritize redundancy, dispersion, and dynamic reconfiguration capabilities.

From this perspective, Mini GEO appears to be a particularly relevant solution. A fleet of intermediate-sized satellites can absorb the loss of one or several elements without compromising the system as a whole. It also makes it possible to redistribute capacity according to changing requirements, thereby ensuring continuity of service.

This approach, already adopted in certain military doctrines, represents a paradigm shift: system robustness no longer depends on the performance of a single asset, but on the intelligence of the architecture as a whole.

7 A Rapidly Structuring Market Opportunity

The Mini GEO market is currently undergoing rapid development. Global demand is shifting toward solutions that are more flexible, faster to deploy, and financially accessible. Many states are seeking to strengthen their communications sovereignty while maintaining control over their investments.

Mini GEO addresses these expectations by lowering the entry cost and simplifying access to satellite capabilities.

Contrary to a still widespread perception, this market is no longer merely emerging: it is already being captured by international players, particularly in the United States. However, its business model still needs to be validated, with two key questions in particular:

- the ability of these new manufacturers to deploy reliable satellites in the demanding GEO environment, within controlled development and production timelines;
- the availability of launch solutions suited to the size of these satellites, the required launch cadence, and the targeted economics.

8 A Key Sovereignty Imperative

Beyond economic and industrial considerations, Mini GEO addresses a fundamental sovereignty issue. In a world where space infrastructure has become critical, dependence on foreign systems represents a major strategic risk.

Military communications, energy networks, financial systems, and crisis management increasingly rely on satellite capabilities. Ensuring strategic autonomy therefore requires access to national or European solutions that can be fully controlled.

Mini GEO offers an appropriate response to this imperative by enabling the rapid deployment of sovereign, flexible, and resilient capabilities.

9 Conclusion

The transition toward multi-orbit architectures, combined with growing requirements for sovereignty and resilience, is profoundly reshaping the balance of the space sector.

Within this new paradigm, Mini GEO is emerging as an essential building block, complementing both LEO constellations and traditional GEO satellites.