The viability of space sovereignty depends on the partnership path

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Space sovereignty activities are increasing worldwide, but these endeavours inevitably focus on how governments can benefit from owning low-Earth orbit (LEO) satellites for communications, Earth observation (EO), direct-to-device (D2D) and other applications. In an era where ownership matters to national interests, sovereign LEO satellite constellations promise national autonomy and strategic control over digital infrastructure. However, in order to realise this vision for space, governments must navigate the technical constraints of LEO systems and the commercial realities of capital-intensive deployment. And these are non-trivial matters affecting any government aiming to operate independently in LEO. How can a government implement a sovereign LEO strategy when significant technical and economic matters make this so challenging? A viable and diverse partnership strategy will likely make all the difference.

One national example is Saudi Arabia, where space ambitions include extending broadband to remote regions as well as fostering a self-sustaining regional space economy. This is in line with the country's 'Vision 2030'[1] initiative, which focuses on diversifying the economy and enhancing technological capabilities.

This article draws on a detailed simulation study that Analysys Mason conducted using its *Non-GEO Constellations Analysis Toolkit* (NCAT5).[2] This analysis explores the viability of a hypothetical sovereign LEO architecture focused on Saudi Arabia[3] in order to highlight the complex balance between autonomy, efficiency and economic sustainability.

Designing a sovereign LEO network: constraints and trade-offs

Unlike geostationary (GEO) satellites, LEO systems cannot linger over one geography. LEO satellites move quickly around the Earth, requiring worldwide deployments even when only local service is needed. Even for countries with medium-sized populations such as Saudi Arabia, this global footprint means that only a small fraction of the satellite capacity is 'visible' and the availability of this capacity over national airspace is even lower at any given time.

To study this trade-off, we modelled a minimal yet functional network using NCAT5. Analysys Mason selected architecture that prioritises uninterrupted national coverage while minimising satellite count—an inherently difficult balance. Our simulations show that a system of 120 satellites that are evenly distributed across 8 orbital planes will ensure that at least 2 satellites will always be in view from anywhere in Saudi Arabia. The

[1] For more information, see *Saudi Vision 2030*.

[2] Analysys Mason used the following NCAT5 tools to undertake this analysis: 'settings', 'visibility', 'capacity',' heatmap' and 'non-GEO business case'.

[3] All information presented in this article is based on publicly available sources; no confidential or proprietary data was used. NCAT users that are interested in replicating the simulations or adapting the parameters for Saudi Arabia or other countries are encouraged to contact Analysys Mason. Upon request, an expanded report is available, including detailed simulation documentation, satellite payload specifications and output data files in CSV format.

simulation assumes that the satellites will be equipped with beam-hopping, regenerative broadband RF payloads and optical inter-satellite links (OISLs), which diminishes the need for, and cost of, domestic gateways.

Figure 1: NCAT simulation parameters for LEO constellations, Saudi Arabia

Parameter	Value/description
Satellite altitude	1100 km
Orbital inclination	30 degrees
Orbital planes and satellites per plane	8 planes, 15 satellites each (total: 120 satellites)
User terminal elevation angle	Minimum 25 degrees
Payload model and satellite mass	Like Starlink V2 and Qianfan G60 (~55 Gbit/s per satellite, steerable beams)
Service plan	50Mbit/s downlink, 10:1 overbooking (5Mbit/s effective)
Targeted population density	0.1–300 inhabitants/km^2 across 7713 high-resolution grid cells
Market capture assumption	0.025% (dense areas) to 1.2% (least dense remote areas), linearly interpolated
Simulation timespan	24-hour measure (accelerated 300x using NCAT5)

Source: Analysys Mason

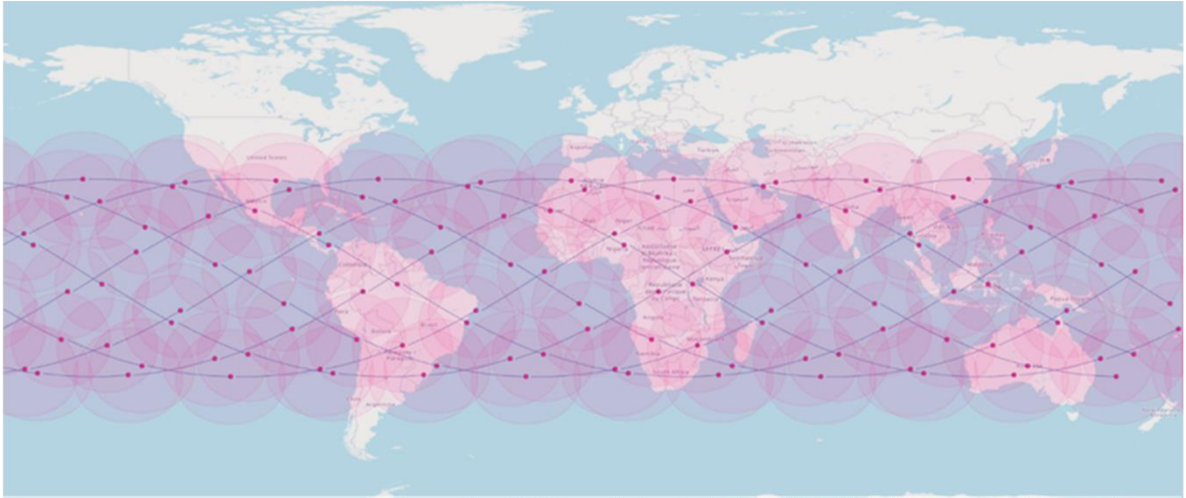
The result was a technically viable constellation, capable of supporting more than 40 000 concurrent user terminals and an estimated 213 000 connected residents, with total usable capacity over Saudi Arabia reaching approximately 275Gbit/s during peak satellite visibility.

However, this outcome also reveals a fundamental inefficiency: the constellation's total capacity exceeds 6.6Tbit/s, yet only about 3–4% of that is usable within Saudi Arabia at any moment. This mismatch between global supply and localised demand underscores a central challenge of sovereign LEO strategies. This dilemma is described in Analysys Mason's *Capabilities and Limitations of Non-GEO Constellations* as the "blessing and curse" of sovereign-only constellations; their low orbital altitude enables high-frequency reuse and dynamic spot-beam targeting, but each satellite's field of view is severely limited, which constrains how much capacity can be directed to any one geography at a time.

The commercial viability of sovereign-only constellations hinges on utilisation, not just coverage

Even with optimal resource use over Saudi Arabia (that is, capacity is only utilised within Saudi Arabia), the business case for a sovereign-only constellation is severely constrained. To understand these constraints better, Analysys Mason undertook an NCAT5 business case sensitivity analysis, based on manufacturing and launch cost data points from Analysys Mason's *Satellite manufacturing and launch services: trends and forecasts 2023–2033* (within the Space Infrastructure research programme). We found that the breakeven bandwidth cost would exceed USD200 per Mbit/s per month, which is several times higher than the costs that can be achieved by leading commercial mega-constellations.

Figure 2: LEO satellite breakeven cost analysis, Saudi Arabia



Source: Non-GEO Constellations Analysis Toolkit 5 (NCAT5) | OpenStreetMap contributors

My LEO constellation: average capital cost per usable Mbit/s

Manufacturing cost per satellite
USD1.95 million

Launch costs per Kg
USD20 234

Satellite weight
1055 Kg

Parameter	Value
Weight	120 Kg
Lifetime	5 years
Aggregate throughput	55Gbit/s (down + up)
Addressability	3% of global coverage
Target capture	100% of addressable area

Breakeven price per usable Mbit/s per month **USD236**

Source: Analysys Mason's Non-GEO Constellations Analysis Toolkit. Output is based on the average value of model inputs. Assumes investment in space assets (including manufacturing and launch), gateway stations and other items (such as insurance), when applicable. The breakeven price calculation for capacity excludes operating costs and the time value of money.

The problem is not technical, it is structural. Most satellite capacity is unused unless it is also monetised in other markets. Without international access or commercial partnerships, a sovereign constellation carries significant financial inefficiencies. Conversely, expanding the service footprint – even partially – across regional or allied nations dramatically improves asset utilisation and cost efficiency.

Sovereignty requires strategy, and strategy requires partnerships

LEO satellites can support sovereign digital infrastructure, but autonomy comes at a cost. As shown in the scenario for Saudi Arabia, a global system is required to cover a single country, which highlights the paradox at the heart of space sovereignty: independence depends on interdependence. Sovereign LEO viability is therefore highly related to a successful partnership strategy, especially outside of the domestic market, that generates maximum efficiency of inherently inefficient global LEO constellations.

Key insights

- **Technically feasible, structurally inefficient**. A Saudi Arabian-focused constellation can function independently but must maintain global satellite coverage, which inevitably dilutes national capacity utilisation.
- **Financial sustainability needs scale**. Without regional market expansion or open access to additional users, the cost per Mbit/s is too high to compete with commercial alternatives.
- **Partnerships are not optional, they are strategic**. Viable space sovereignty depends on partnerships that enable international service provision, shared infrastructure or co-operative regulatory alignment.

The future of sovereign LEO systems will not be decided solely in engineering labs or policy circles. It will be shaped by how countries choose to partner with each other, and how these countries navigate the balance between independence and interconnectedness.