LEO Satellites: A Technology to Revolutionize Global Connectivity?

By: Thibault Werlé, Udit Pandey, Farid Rejeb, and Marwan Maalouf
Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we work closely with clients to embrace a transformational approach aimed at benefiting all stakeholders—empowering organizations to grow, build sustainable competitive advantage, and drive positive societal impact.

Our diverse, global teams bring deep industry and functional expertise and a range of perspectives that question the status quo and spark change. BCG delivers solutions through leading-edge management consulting, technology and design, and corporate and digital ventures. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, fueled by the goal of helping our clients thrive and enabling them to make the world a better place.
<table>
<thead>
<tr>
<th>01</th>
<th>LEO Satellites: a technology to revolutionize global connectivity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>02</td>
<td>LEO Satellites: an opportunity to bridge the connectivity divide?</td>
</tr>
<tr>
<td>03</td>
<td>Driving Adoption: unlocking value through B2B and B2G use cases?</td>
</tr>
<tr>
<td>04</td>
<td>Beyond Connectivity: LEO satellites, a missing piece of a broader connected ecosystem?</td>
</tr>
<tr>
<td>05</td>
<td>Key takeaways for decision makers</td>
</tr>
<tr>
<td>06</td>
<td>About the authors</td>
</tr>
</tbody>
</table>

**Contents**
LEO Satellites: A Technology to Revolutionize Global Connectivity?

The telecommunication industry has consistently endeavored to provide higher speeds and lower latency levels when it comes to connectivity solutions for retail, commercial, and government customers. Satellite technologies, introduced in the latter half of the 20th century, have played an important role in providing communication services globally, especially when existing terrestrial infrastructure is weak.

Historically dominated by geosynchronous (GEO) satellite technology, the satellite communication market is now expected to shift towards Low Earth Orbit (LEO) satellite technology. LEO satellites are located approximately 50 times closer to Earth, and typically offer low latency (less than 30 ms), coverage with relatively high throughput levels (approximately 100 Mbps\(^1\)) in comparison to GEO satellites.

By 2030, BCG estimates that the Middle East LEO satellite market will be valued at approximately $110 million\(^2\), however, the overall economic value that this technology can unlock is far greater. In addition to non-terrestrial data services which will remain its primary market, LEO technology is part of a broad and dynamic ecosystem that encompasses Earth Observation (EO) and several other use cases. This article aims to answer three key questions pertaining to LEO satellites and their applicability in the Middle East:

- **LEO Satellites: An opportunity to bridge the connectivity divide?**
- **Driving Adoption: Unlocking value through B2B and B2G use cases?**
- **Beyond Connectivity: LEO satellites, a missing piece of a broader connected ecosystem?**

1. **Based** on Starlink operating satellites, source: Starlink website, CNBC (2021)
2. At current conservative projections, global SATCOM market size expected to reach $40Bn by 2030; LEO expected to contribute $16Bn of this market; ME market size for LEO based SATCOM services expected to be ~1% of global market.
LEO Satellites: An Opportunity to Bridge the Connectivity Divide?

The COVID-19 pandemic has forced the world to embrace digital transformation at an accelerated pace. However, the pandemic has also highlighted that billions of people remain without internet access, a universal right. According to an International Telecommunication Union (ITU) report, the internet penetration rate is 87% in the developed world but just 47% in developing countries, and 19% in the least developed countries. Consequently, ‘Connecting the Unconnected’ emerged as a key theme during the 2020 G20 Riyadh Summit and led to the publication of the Roadmap for Digital Cooperation – a plan to achieve universal connectivity by 2030 and ensure digital inclusion for all.

Geographic accessibility and the high cost of building physical infrastructure (such as the laying of fiber optic cables) are two key barriers in providing ubiquitous broadband internet access. LEO satellites can address these challenges by providing global coverage and low latency broadband connectivity. Moreover, connecting to LEO satellites does not require large on-premise ground infrastructure – a portable end-user terminal, that can be self-assembled, is sufficient to gain access to the internet.

From a technology perspective, LEO is a viable solution to address the digital divide and provide accessibility, however, the business case for its commercialization is still weak. Notably, while subscription fees can be tailored to match market and profitability needs, the cost of end-user terminals is currently estimated to be at least $1,000 (approximately three times more expensive than GEO terminals and seven times more expensive than non-satellite modems). Experts believe that the beta version of end-user terminals released by Starlink in October 2020, at $499 per device, is heavily subsidized to drive adoption and while industry leaders are actively working on addressing this challenge, as seen in recent announcements from Starlink and Kuiper, the cost of end-user terminals could remain a major constraint.

BCG estimates that the cost of end-user terminals will reach approximately $130-300 per device by 2030, with the lower figure representing an optimistic scenario. Mapping against per capita personal disposable income across regions, and using Starlink’s beta release as a reference, shows that additional measures (in the form of R&D investments, subsidies, or deployment of community WiFi) are needed to position LEO technology as an affordable solution toward bridging the connectivity divide.

---

3. COVID-19 exposed the digital divide. Here’s how we can close it; World Economic Forum (WEF) January 2021
4. “Lowering Starlink terminal cost, which may sound rather pedestrian, is actually our most difficult technical challenge” – Elon Musk, CEO SpaceX (Nov 2020)
5. “We set a goal of that [the customer antenna] couldn’t be just 10% or 20% less expensive. We were looking for 5 to 10 [times] decrease in cost, & we now have a path to that” – David Limp, SVP of Devices and Services, Amazon
Driving Adoption: Unlocking Value Through B2B and B2G Use Cases?

The global satellite communications service market is expected to reach $40 billion by 2030, growing at approximately 7% annually. As the market is still nascent, consensus estimates on its growth and size are difficult to arrive at, and the market has the potential to grow at even faster rates over the next decade. Most of the growth is expected to be driven by LEO technology, forecasted to account for approximately 40% of the overall market by 2030, given its high service quality and enhanced coverage in areas where terrestrial connectivity infrastructure is not easily available.

In addition to improvements in military capabilities for defense, Middle Eastern countries can leverage LEO technology for commercial and government use cases that contribute to the successful delivery of national transformation programs, such as Saudi Arabia’s Vision 2030 or Abu Dhabi Economic Vision 2030. Primarily focused on economic diversification and socio-economic development, these programs typically include three elements – technology, transportation, and connectivity – that could directly benefit from LEO technology.

In terms of technology, LEO can promote business digitalization and Internet of Things (IoT) adoption, particularly in the oil and gas sector. By providing high-quality connectivity to remote oil fields (offshore and onshore), LEO technology can enable oil companies to enhance their digital capabilities, machine learning, and security initiatives at remote sites.

Exhibit 2 | LEO Terminal Price is Expected to Range Between $130 and $300 by 2030

<table>
<thead>
<tr>
<th>$/unit</th>
<th>Subscribers (Mn)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2020</td>
</tr>
<tr>
<td>100</td>
<td>2021</td>
</tr>
<tr>
<td>200</td>
<td>2022</td>
</tr>
<tr>
<td>300</td>
<td>2023</td>
</tr>
<tr>
<td>400</td>
<td>2024</td>
</tr>
<tr>
<td>500</td>
<td>2025</td>
</tr>
<tr>
<td>600</td>
<td>2026</td>
</tr>
<tr>
<td>700</td>
<td>2027</td>
</tr>
<tr>
<td>800</td>
<td>2028</td>
</tr>
<tr>
<td>900</td>
<td>2029</td>
</tr>
<tr>
<td>1,000</td>
<td>2030</td>
</tr>
</tbody>
</table>

Terminal base case — Terminal optimistic case — LEO subscribers

1. LEO terminal devices currently cost ~$1000 per device as compared to ~$300 for GEO terminal devices.

Note: Market data based on financial valuation model (Base Case) and 40% B2C market share assumption.

Source: Expert interviews; BCG analysis.

6. Oil and Gas account for approximately 50% to Saudi Arabia’s GDP and makes up approximately 30% of UAE’s GDP as per OPEC member country profiles.
Similarly, the transportation sector is proving to be a key enabler for economic and social activity, driven by the emergence of mega-city development projects such as NEOM. Governments have set ambitions to develop aerial, maritime, and inland transport infrastructure around these cities to develop logistics hubs as well as encourage tourism. **LEO technology can help national carriers capitalize on the planned increase in passenger traffic** by offering high-quality in-flight connectivity. LEO connectivity services also represent a sizeable opportunity for the maritime market given the high density and scale of maritime traffic passing through the region (notably driven by oil flows). Future developments of LEO technology are also expected to play a role in inland transport by enabling autonomous vehicles.

Finally, **LEO technology can provide enhanced connectivity and enable the development of megacities and their digital ambitions** by providing an alternative that minimizes investment in-ground infrastructure, and by acting as a backup for always-on connectivity to ensure business continuity in the case of terrestrial infrastructure failure.

### Beyond Connectivity: LEO Satellites, a Missing Piece of a Broader Connected Ecosystem?

Because of its CapEx intensive nature, we expect that the LEO satellite internet market will be highly concentrated and dominated by a handful of global players. Starlink, which launched its beta service in the US in late 2020, has the first-mover advantage, but it is expected to face competition from OneWeb and Telesat as they near the launch of their respective commercial operations. Additionally, Amazon’s Project Kuiper is expected to launch around 2026 and invest heavily to catch up with the rest of the competition.

Despite this promising race, the LEO satellite business case remains uncertain given its broad range of underlying risks. First and foremost, since no full LEO constellation has been completed yet, the number of use cases remains limited. From a commercial perspective, the lack of awareness and potentially prohibitive prices, as a result of high end-user terminals cost, could translate into insufficient uptake or penetration of services. From a regulatory perspective, the compliance requirements imposed by the international community as well as local authorities could jeopardize service continuity.

Against this backdrop, rather than being established as a silo, we believe LEO technology should be leveraged to enable the development of connected business ecosystems for technology companies, owing to various adjacent strategic benefits. For instance, by providing high-speed internet connectivity, SpaceX’s Starlink could enable Tesla connected cars and advance the development of use cases such as autonomous vehicles. Similarly, Project Kuiper could enable several services provided by Amazon, including further growth in the global e-commerce market and feeding Amazon Web Services (AWS) with large volumes of data captured through satellites, thus expanding its cloud services business.

---

7. E.g., Abu Dhabi Economic Vision 2030 aims to reach 30 million passengers by 2030, Saudi Arabia aims to attract 100 million tourists by 2030
8. Inmarsat “2017 Inflight Connectivity Survey”: 42 per cent of respondents rank high quality Inflight Connectivity (IFC) as a top 3 driver of airline choice, 52 per cent would stop using preferred airline if offered poor quality IFC
9. Based on US Energy Information Administration (EIA) 2019 “The Strait of Hormuz is the world’s most important oil transit chokepoint” report, daily oil flow through the Strait of Hormuz averaged approximately 21 million barrels per day (approximately 21 per cent of global petroleum liquids consumption)
10. OneWeb likely to launch global commercial service by 2022 (December 2020 press release) and Telesat expected to start commercial services in second half of 2023 (February 2021 press release)
11. Commercial launch expected by 2026 - as per Federal Communications Commission (FCC) approval, Amazon must launch half of the 3,236-satellite constellation by 2026 and remaining satellites by 2029
Additionally, as evidenced by Eutelsat’s acquisition of a 24% stake in OneWeb in April 2021, GEO players are increasingly seeing value in complementing their capabilities with those of LEO satellites. With its expertise in navigation and satellite constellation, Eutelsat could leverage LEO to enhance its value proposition by increasing ubiquity and lowering latency.

As established private players in the developed markets continue to compete in the LEO market, China could emerge as a disruptor with its own planned mega-LEO satellite constellation project announced in October 2020 – it has filed an application with ITU for approximately 13,000 LEO satellites. This network could potentially further China’s national, regional (South East Asia), and global (Africa, Latin America) strategic agenda and promote the growth of state-owned enterprises (operating in autonomous vehicles and e-commerce markets, for example).

12. OneWeb, the global communications network powered from space, announces today that it has secured $550 million in funding from Eutelsat Communications (Euronext Paris: ETL), bringing OneWeb’s total funding to $1.9 billion in fresh equity: https://www.oneweb.world/media-center/oneweb-secures-550-million-in-new-funding-eutelsat-to-take-significant-equity-stake-in-the-company

**Exhibit 3 | LEO Satellite: a Missing Piece of a Broader Ecosystem**

*Source: BCG analysis*

**Connected cars use case**

LEO satellites could complement other technologies such as 5G to meet the requirements of connected cars, such as better network redundancy, improved localization and live traffic visualization.
Key Takeaways For Decision Makers:

As LEO technology emerges as a prominent technology, four anticipated developments and enablers must be highlighted for Middle Eastern countries:

• **Near-term applications of LEO are expected to be relegated to wholesale B2B or B2G**

  End-user terminal and subscription pricing are expected to remain prohibitive in the near term, limiting mass adoption of LEO-based connectivity. Globally, while R&D emphasis is being placed on reducing costs of end-user terminals, B2C applications are limited to providing connectivity to remote areas in countries with high levels of disposable income.

• **International inter-government organizations expected to regulate and enable the LEO technology**

  Established under the United Nations, ITU has emerged as a critical regulatory body for LEO technology. Its scope of action has primarily focused on establishing and enforcing a regulatory framework that ensures rationale, equitable and efficient use of satellite-orbit resources globally. From setting the principles of orbit spectrum use to allocating orbital slots, and managing space traffic, ITU remains the primary regulatory agency of LEO technology. We anticipate ITU to continue to enhance its scrutiny of new applications for LEO technology orbits as slots becoming increasingly scarce.

• **Governments as ‘financial sponsors’ of satellite communication services**

  Beyond policies and regulations, governments have turned into ‘financial sponsors’, which strategically invest in LEO satellite companies to support their business case and enable their operations. For example, the Government of Canada finalized a $600 million agreement with Telesat in November 2020 to deliver LEO satellite-based internet to rural areas in the country. The United Kingdom’s government acquired a 45% stake in OneWeb in July 2020, after the company collapsed into bankruptcy amid the Covid-19 pandemic. Given the uncertainty in the commercial market, government acquisition of satellite communication services will remain a critical enabler of the future network.

• **LEO satellites will pave the way forward for technological disruptions in the future**

  New technologies such as High-altitude Platform Systems, or pseudo-satellites (HAPS), including balloons, airships, and airplanes could emerge as disruptive technologies that capitalize on the connectivity revolution initiated by LEO. HAPS are radio stations located in the stratosphere, approximately 20km above ground level. They are composed of an unmanned aerial vehicle as well as a payload that houses all communication equipment required to connect users on Earth. HAPS transmit internet signals to ground stations, homes, workplaces, or directly to personal devices. While several HAPS projects have been canceled or put on hold by leading tech players failing to find a sustainable business model (such as Google’s Project Loon and Facebook’s Project Aquila), they have gained significant attention from global aerospace companies, including Lockheed Martin and Thales and Airbus, which are currently working on their development (e.g., Airbus’ Zephyr, Thales’ Alenia and Space’s Stratobus).

  Traditional technologies such as GEO will also continue to evolve and contribute to disrupting the overall connectivity ecosystem by establishing hybrid networks. Next-generation of GEO satellites (VHTP) will also emerge as leading technologies for mobility use cases such as maritime and air transport. Thus, the global connectivity revolution could only be described as being in its infancy with LEO satellites paving the way for more technological disruptions in the future.
About the Authors

**Thibault Werlé** is a Managing Director and Partner in the firm’s Middle East office. He is a core member of BCG’s Technology, Media & Telecommunications practice. You may contact him by email at Werle.Thibault@bcg.com

**Farid Rejeb** is a Consultant in the firm’s Middle East office. You may contact him by email at Rejeb.Farid@bcg.com

**Udit Pandey** is a Project Leader in the firm’s Middle East office. He is a core member of BCG’s Technology, Media & Telecommunications practice. You may contact him by email at Pandey.Udit@bcg.com

**Marwan Maalouf** is an Associate in the firm’s Middle East office. You may contact him by email at Maalouf.Marwan@bcg.com
Boston Consulting Group partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG was the pioneer in business strategy when it was founded in 1963. Today, we help clients with total transformation—inspiring complex change, enabling organizations to grow, building competitive advantage, and driving bottom-line impact.

To succeed, organizations must blend digital and human capabilities. Our diverse, global teams bring deep industry and functional expertise and a range of perspectives to spark change. BCG delivers solutions through leading-edge management consulting along with technology and design, corporate and digital ventures—and business purpose. We work in a uniquely collaborative model across the firm and throughout all levels of the client organization, generating results that allow our clients to thrive.