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LEO Satellite Broadband Expectations Need to Come Back to Earth

By Jeff Johnston

Lead Economist

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Key Points:

- Low Earth Orbiting (LEO) satellites are being touted as a solution to bridge the digital divide, as they will be able to reach remote parts of the country with high-speed data connectivity.
- Key proponents of the LEO solution include Elon Musk’s SpaceX and Amazon’s Project Kuiper, which are also two of the leading LEO satellite operators.
- An estimated 3.8 billion people around the world do not have access to the internet, which offers a large, untapped market. And as the cost to build and launch LEO satellites comes down, there are reasons for optimism.
- However, there is no shortage of headwinds facing the industry including bankruptcies that could reduce access to private capital, competition in urban and suburban markets, and space junk issues.
- If there is a market for LEO satellite broadband networks, Amazon is well-positioned to succeed given its access to capital, bundling opportunities, and existing ground station infrastructure.

Introduction

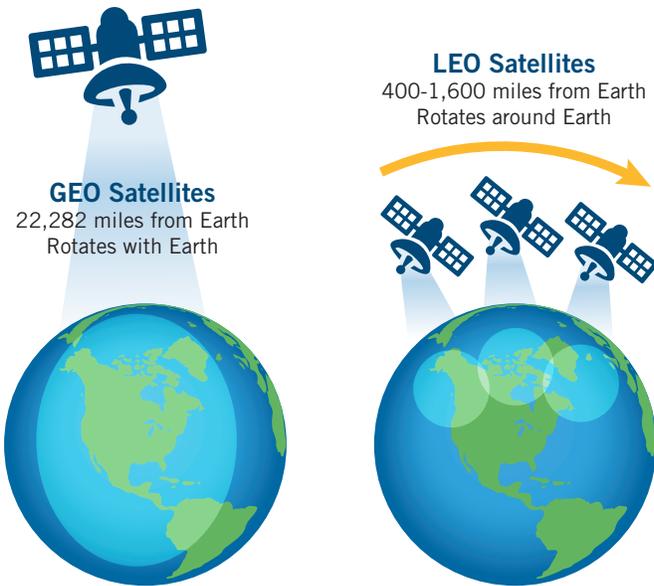
Satellite-based internet has been around for several years, but for the most part it has failed to gain traction due to slow data speeds and pricey rate plans with data caps (*Exhibit 1*). Most of the satellites in these networks are geostationary, which have inherent disadvantages compared to LEO satellites. High-speed broadband connectivity powered by LEO satellites is generating a buzz thanks to investments made by Amazon and Elon Musk’s SpaceX. They promise to provide fiber-like data speeds for those living in remote parts of the world, and as such are being touted as a solution to bridge the digital divide. But with most new technologies, the devil is in the detail. In this report we look at the feasibility of LEO satellite broadband networks and what business model is best positioned for success.

EXHIBIT 1: Satellite vs. Cable Pricing

Provider	HughesNet	Viasat	Optimum
Technology	Satellite	Satellite	Fiber/Hybrid Fiber Coax
Service Area	New York	New York	New York
Packages	Price/Data Cap/Speed \$69.99-month/20GB/25Mbps/3Mbps \$99.99-month/30GB/25Mbps/3Mbps \$149.99-month/50GB/25Mbps/3Mbps	Price/Data Cap/Speed \$100-month/35GB/12Mbps/3Mbps \$150-month/45GB/12Mbps/3Mbps \$200-month/65GB/12Mbps/3Mbps	Price/Data Cap/Speed \$69.99-month/no cap/1Gig

Source: CoBank

EXHIBIT 2: Geostationary vs. LEO Satellite Coverage



Source: Satellite Phone Review

Satellite Overview

Geostationary satellites are located 22,300 miles above the Earth’s surface and move in geosynchronous orbit on the plane of the equator, and remain stationary in relation to a fixed point on earth. They were first launched in 1964 and are essential networks for television broadcasting, weather forecasting, communications, and defense and intelligence applications. One of their main disadvantages

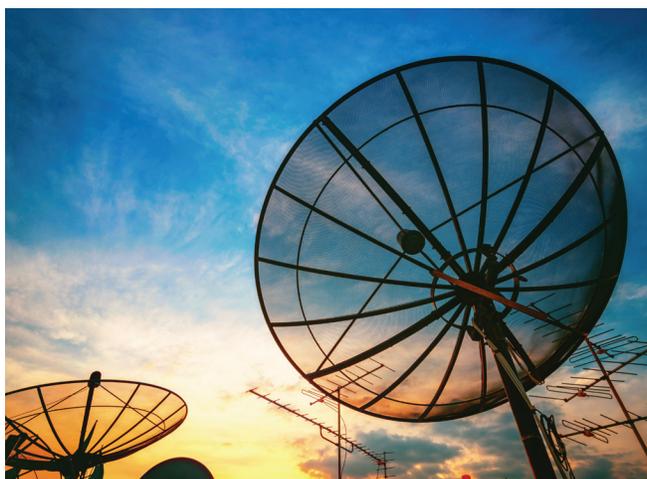
is a result of their high altitude: radio signals take about .25 of a second to reach and return from a satellite. This results in connection speeds that typically peak at 25Mbps/3Mbps.

LEO satellites orbit much closer to the earth’s surface – think 100 miles to 1,200 miles. Unlike geostationary satellites, they do not remain stationary to a fixed point on earth. Given their closer proximity to earth, LEO satellites are able to offer faster data speeds, but thousands more are needed to ensure coverage (*Exhibit 2*). While LEO satellites’ launch costs are much cheaper than geostationary satellites, their ground costs are higher.

Primary LEO Satellite Operators

Amazon (Kuiper)

Amazon has yet to share much detail regarding its LEO satellite ambitions, but the company has announced that it plans to deploy 3,236 satellites. Amazon has also stated that its satellites will “provide low-latency, high-speed connectivity to unserved and underserved communities around the world.” Amazon founder Jeff Bezos is particularly interested in space exploration and has invested billions of his own money into Blue Origin – a competitor to Elon Musk’s SpaceX – which Bezos hopes one day will take people to the moon.



SpaceX (Starlink)

Starlink is a satellite constellation being created by SpaceX that will provide broadband internet access. To date, SpaceX has deployed over 400 LEO satellites with approval to launch up to 12,000. According to SpaceX, the cost to deploy the constellation is pegged at \$10 billion and is projected to generate up to \$50 billion in annual revenue once it's operational. Beta tests for the service are expected to start this year.

Telesat

Headquartered in Ottawa, Canada, Telesat operates both geostationary and LEO satellites with plans to begin its LEO broadband service in 2022. Telesat is privately held and its principal shareholders are Canada's Public Sector Pension Investment Board and Loral Space & Communications Inc. The company plans to have 200 LEO satellites orbiting in 2022 and 300 in 2023.

Other players in the market include Facebook and traditional operators such as Inmarsat Plc, Eutelsat SA, and the Hongyun Project in China.

Reasons for Optimism

Proponents of LEO satellite broadband argue that previous attempts to commercialize the technology fell victim to high costs and slow speeds – think early days of Iridium's

66 LEO satellites deployed in the late 1990s and early 2000s. Indeed, the cost to deploy LEO satellites has come down precipitously over the last 20 years. For example, between 1970 and 2000, the average cost to deploy an object into space was about \$18,500 per kilogram. Today, that cost has dropped to approximately \$2,720. Additionally, LEO satellites have gotten a lot lighter over the years. Original Iridium satellites launched in the late 1990s weighed 689 kilograms, while today's Starlink satellites weigh only 227 kilograms.

On the addressable market front, there are an estimated 3.8 billion people in the world who do not use the internet. Some simply may not have interest, but lack of access could be the barrier for many others. This assumption makes for an attractive addressable market. But even beyond servicing the underserved, satellite bulls point to opportunities in the Internet of Things (IoT) market and backhaul solutions for remote 5G base stations in rural markets.

Why it's Not so Easy

Funding Concerns

Satellite research and analytics firm Quilty Analytics has a bearish view on VC-backed satellite companies in light of COVID-19. Out of the six space sectors the firm believes are most vulnerable, it cited the LEO segment as having the highest risk. Access to private funding is critical to developing the technology and network ecosystem.

This bearish outlook is reinforced by the recent bankruptcy filing of LEO satellite operator OneWeb as its largest investor, Softbank, decided not to shore up the company's balance sheet. Softbank did not comment on its decision, but it does call into question the viability of the LEO satellite broadband business model. OneWeb, had raised \$3.4 billion, launched 74 satellites, and had completed or was in development with half of its 44 ground stations. Expectations are that either SpaceX or Amazon will acquire the assets out of bankruptcy, with the company's spectrum being the most attractive asset.



Space Junk

The space industry is concerned about the Kessler syndrome, a theoretical scenario where the density of LEO satellites reaches a critical mass leading to a chain reaction of collisions creating more debris leading to more collisions. In light of this, Amazon provided the FCC with failure rate data for its planned 3,236 LEO satellites. According to the filing, if 10% of its satellites fail in orbit, there is a 12% chance that one of these satellites collide with a piece of space debris. With a 5% failure rate – the same rate SpaceX saw in its first tranche of Starlink satellites – the collision risk drops to 6%. According to John Crassidis, and expert on orbital debris at the University of Buffalo, “6% is huge.”

Amazon recognizes that failures rate of 5%, 10%, or 15% are unacceptable and is planning for much lower rates. Nonetheless, this is yet another headwind the industry needs to overcome.

Competition

Being able to penetrate the urban and suburban markets is probably an important consideration for the LEO satellite broadband business case, but this will not be easy. Broadband incumbents have legacy infrastructure that has been amortized and capable of eventually providing 10GB speeds. These broadband networks have rich margins, giving providers the flexibility to cut their price to preserve market share. Also, LEO satellite users would need to install a satellite dish on their property.

These dishes currently cost over \$1,000, but are expected to get cheaper over time. So the question is why would a user want to spend several hundred dollars on customer premise equipment to replace their existing broadband provider that doesn't have these costs?

The growth in rural wireless broadband networks is expected to increase thanks to government financial incentives, new business models enabled by spectrum sharing (think CBRS), and commitments made by T-Mobile. For example, in order to get its merger approved with Sprint, T-Mobile agreed to cover 96% of rural Americans with 5G by 2024. And given T-Mobile's aggressive pricing strategy, LEO satellite providers may find it difficult to gain market share. However, in all fairness, if the satellite industry can live up to the high-speed claims, it would be a good bit faster than T-Mobile's rural 5G network.

FCC is Skeptical

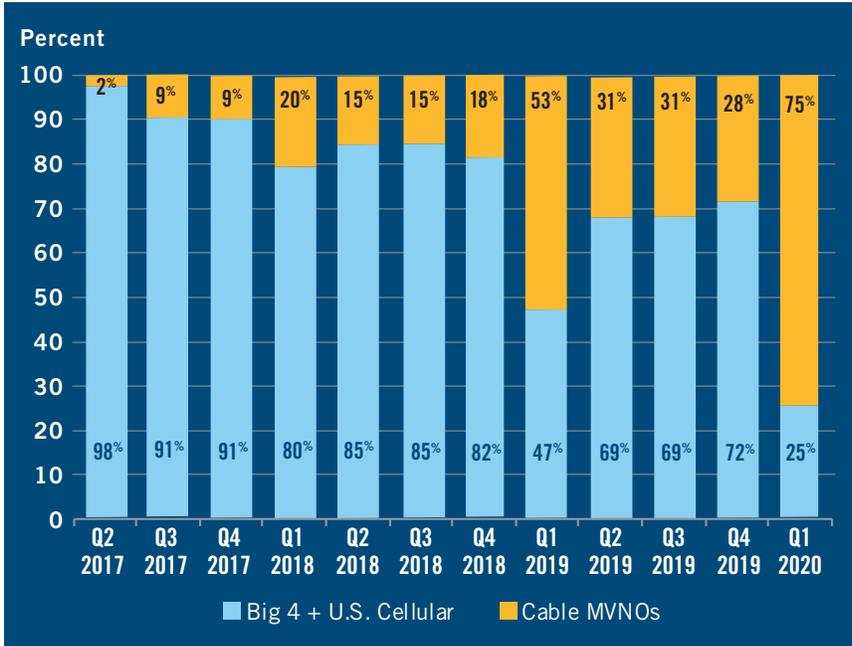
The FCC plans to limit satellite operators to lower speed and higher latency tiers in the upcoming Rural Digital Opportunity Fund (RDOF) reverse auction. This is a setback for the industry as it suggests the FCC is unconvinced that LEO satellite operators will deliver on their speed and latency claims. And as such, is not willing to give them the benefit of the doubt when it allocates federal money for new broadband builds.

In its draft order, the FCC wrote “[W]e do not find it prudent to authorize bidding for performance tier/latency/technology combinations that lack a proven track record that deployment at the speeds and latencies we expect will actually occur.” Being restricted to lower speed and latency tiers reduces a bidder's chance of securing federal money.

Amazon: Last Man Standing?

Unlike VC-backed firms, access to capital is not an issue for Amazon's Kuiper. But beyond this, Amazon has go-to-market advantages over SpaceX or Telesat, and Kuiper can be used to support other parts of Amazon's business.

EXHIBIT 3: Cable as a Percentage of Wireless Industry Post Paid Phone Net Additions



Source: MoffettNathanson; CoBank

As Amazon branches out beyond its core internet business, bundling satellite internet with other services could offer value and be a differentiator. In the enterprise market, satellite broadband could be bundled with Amazon Web Services. A connectivity and cloud offering would be an attractive bundle, especially in rural markets where cloud adoption is low.

On the consumer side, Amazon has several services it could bundle. Some possibilities include a broadband service that includes a discounted Prime subscription and enhanced rewards program, or a package with discounts at Whole Foods or on selected products offered through Amazon.

Cable operators have demonstrated that bundling can help new entrants take market share. Three years ago, cable operators started entering the wireless market via wholesale agreements with Verizon. These wholesale

agreements, commonly referred to as Mobile Virtual Network Operators (MVNO), have historically struggled to compete in the market given their lack of ownership economics and scale. Cable operators are bucking the trend and have gained impressive market share in a short period of time (*Exhibit 3*). We attribute this to attractive broadband/wireless bundling, and believe the market could see a similar response to an Amazon satellite broadband bundle.

The other asset Amazon has to leverage is its datacenters. LEO satellites require significantly more ground stations compared to geostationary satellites, and are therefore an important network cost component. Datacenters can act

as ground stations which will reduce Amazon’s network costs. And finally, Amazon could use Kuiper to support its future drone delivery service.

Conclusion

In theory, LEO satellite broadband networks would be an elegant solution to bridge the digital divide. With high-speed connectivity reaching remote parts of the world from space, many of the cost impediments to building rural networks would be overcome. But at this point, the path to a viable commercial network is littered with uncertainty and funding challenges, especially if meaningful share gains are needed in urban and suburban markets to make the numbers work. We continue to believe that if there is a business case to be made for LEO broadband services, Amazon is the best positioned for success given its access to unlimited capital and bundling opportunities. ■

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