Understanding the SpaceX-Era Economy

Part 2: Starlink and the Billionaire Broadband Battles

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SN Intelligence FROM SPACENEWS

On the cover: Starlink satellites pass overhead near Carson National Forest, N.M., in February 2022.
(Credit: M. Lewinsky/Creative Commons Attribution 2.0)

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SpaceX has already rewritten the rules of launch. With Starlink, it is attempting to reinvent global connectivity from low Earth orbit (LEO).

What started in 2019 as a consumer broadband service for remote households has expanded into aviation, maritime, government, defense and other growing space markets that were once the preserve of giants in geostationary orbit (GEO).

Starlink's LEO network now accounts for two-thirds of all active satellites in orbit, and its reach is growing with nearly every Falcon 9 flight.

That dominance has attracted a wave of billionaire-backed challengers.

Jeff Bezos, who has already shadowed SpaceX's Elon Musk in the race for launch reusability with Blue Origin, is preparing to go head-to-head in communications through Amazon Leo (formerly Project Kuiper). If Amazon Leo can overcome its delayed launch campaign, Bezos' vast retail and cloud empire could bundle broadband with consumer devices and data centers in ways that directly threaten Starlink's market share.

In the nascent market for delivering space connectivity direct-to-device (D2D) without specialized hardware, SpaceX had faced competing with Charlie Ergen, chairman of geostationary operator EchoStar, who until recently had plans for a $5 billion LEO constellation.

But in September, SpaceX agreed to buy spectrum that includes the S-band radiowaves underpinning that D2D constellation in a deal worth more than $17 billion, marking one of its biggest-ever acquisitions, which it helped catalyze by lobbying the U.S. Federal Communications Commission against EchoStar's spectrum rights.

Weeks earlier, EchoStar sold $23 billion worth of spectrum to AT&T as regulatory scrutiny mounted, ending its bid to operate as a traditional U.S. mobile carrier in a market now reckoning with the prospect of competing with Musk.

Flush with cash, EchoStar is looking for ways to expand its communications business as an asset-light growth company. It is also obtaining SpaceX stock as part of its arrangement with the company.

"If I could make one investment other than ourselves, it would be in SpaceX, because they've got 90% of the launch capability in the world today and I think that lead will grow with the Starship," Ergen told reporters during a Sept. 15 press conference. "They have a manufacturing capability that's highly automated and built from the ground floor up."

Two months later, EchoStar sold more spectrum to SpaceX in exchange for $2.6 billion worth of the company's stock.

Of course, a global broadband contest backed by billions does not stop there. Launches for two Chinese megaconstellations are well underway as Europe makes sluggish progress with its sovereign multi-orbit network.

Analysts from Analysys Mason counted 100 constellations in some form of development as of October to deliver communications from space.

Other legacy players have spent $14 billion on mergers in recent years to stay relevant, as GEO operators that once dismissed LEO broadband as a niche consumer play redesign networks and business strategies around Starlink. Regulators, too, are scrambling to update spectrum rules and market frameworks in response to SpaceX's unprecedented scale.

Yet no operator can currently match SpaceX's pace. With Starship advancing test flights and upgraded V3 Starlink satellites on the horizon, Musk is betting on another order-of-magnitude leap in scale.

SpaceX is in pole position for the $600 billion space economy's two main growth drivers, as outlined by Novaspace during World Space Business Week in September: Expanding defense budgets and the race for D2D services.

And the stakes are high as Starlink becomes a critical piece of strategic infrastructure for both global markets and governments. This includes Starshield, the militarized version of Starlink that underlines its evolution into a dual-use system with growing U.S. national security relevance.

As Part 2 of this report explores, SpaceX's network sits at the center of a contest over scale, sovereignty and security that is shaping the future of the internet. (Read Part 1 of this report for an analysis of SpaceX's drive to extend its lead in the launch market, and how rivals are adjusting to meet evolving commercial ambitions and government priorities amid a returning Trump administration, shifting geopolitical dynamics and Musk's sway in Washington.)

SpaceX has announced the start of Starlink services in 30 additional markets so far this year.

STARLINK

Commercial Dynamics in Satellite Communications

Key Takeaways

- Starlink is now available in about 150 countries, territories and markets.
- Over 8,500 Starlink satellites are in orbit and counting, more than all objects launched from 1957 to 2018.
- Starship to shift its sprawling LEO network into higher gear as early as next year.

SpaceX lofted its 10,000th Starlink satellite Oct. 19, during a launch so routine it barely stood out amid the company's relentless pace of deployments.

Starlink is by far the largest satellite network ever built, thanks to an aggressive launch strategy that deployed 145 of them across six missions in a single week this summer.

SpaceX is also making rapid progress in gaining the regulatory approvals needed to roll out commercial services worldwide, with a handful of exceptions such as North Korea, China and Russia.

Consider the numbers: So far this year, SpaceX has announced the start of Starlink services in 30 additional markets, bringing its total to more than 150 after entering 35 markets in 2024.

The company boasted more than seven million Starlink customers in August, about 2.5 million more than at the end of 2024.

Somewhere around 1 million people also now use Starlink Roam, a premium service launched last year that enables travelers, remote workers and other customers to connect from almost anywhere via portable terminals.

Quilty Space analysts project Starlink consumer subscribers will reach 8.2 million by the end of 2025, delivering 67% of the $10.8 billion in total revenues they expect the constellation to generate this year.

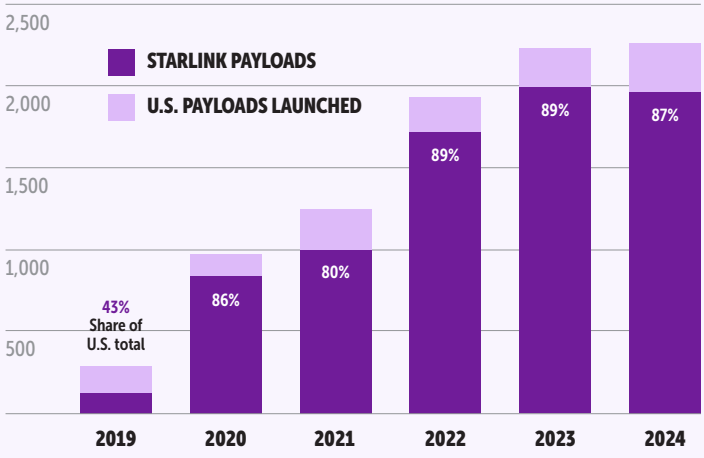
From an estimated $7.6 billion in revenue in 2024, Quilty Space CEO Chris Quilty said Starlink is on track to cross the $10 billion mark less than six years after LEO deployments got underway.

"And to put that in context, that would make them the fastest corporate sprint to $10 billion, even faster than Amazon, Google and Facebook," Quilty said Sept. 25 during a webinar it hosted on Starlink's finances.

Quilty also noted that it took Viasat and EchoStar-owned Hughes about 15 years to get to 2.2 million subscribers for their residential geostationary

Launch Driver

Starlink has become the backbone of SpaceX's manifest, accounting for the vast majority of all U.S. payloads launched each year since 2020.



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SOURCE: SPACENEWS ANALYSIS / JONATHAN MCDOWELL'S SPACE ACTIVITIES IN 2024 REPORT, JAN. 24, 2025

broadband business in the United States, where Starlink has already claimed two million subscribers.

The boutique research firm forecasts Starlink's profitability margins to hit around 70% in 2026, coming close to the 85-90% range traditionally seen with satellite capacity wholesalers, even though the business sells directly to customers.

This profitability is the result of Starlink so far being able to operate largely without LEO competition or the need to advertise, Quilty said.

"Even with projected 2026 [estimated capital expenditure] of $6.1 billion, we're forecasting this business to throw off about $5 billion of free cash flow," he added. "That free cash flow is about equal to the revenue of their launch business."

Average revenue per user (ARPU) though will be pressured as Starlink's expansion takes it to markets such as India with far less spending power, making growth from other types of customers more important.

Companies like Hughes that have been disrupted by Starlink are instead increasingly looking beyond residential broadband toward enterprise and government customers for growth.

Consumer broadband systems "eat a lot of capacity for the amount of capital you invest," Paul Gaske, chief operating officer of EchoStar, said Sept. 15 during World Space Business Week in Paris, "so when we look at it today, we don't see that growing.

"It has competitive pressures from the LEO world, but it also has regulatory pressures [from terrestrial fiber] subsidies rolling out, and then lastly it has natural economic pressures from the cellular operators that actually can offer the fixed wireless near their towers." Still, Hughes disclosed plans in November to refer customers to Starlink as it warned it could run out of cash over the next 12 months.

Beyond consumers

SpaceX has made serious headway in winning aviation and maritime business — high-growth enterprise segments where legacy GEO operators are seeking to expand after largely conceding the consumer broadband market.

Inflight internet is one of the most intensely contested areas. Traditional GEO-based providers such Gogo and consolidated players Viasat-Inmarsat and SES-Intelsat have dominated this market, but Starlink has already disrupted the status quo by signing major airlines.

Among the latest are Emirates, Flydubai and the International Airlines Group (IAG), which announced plans Nov. 6 to install Starlink on more than 500 aircraft from next year across Aer Lingus, British Airways, Iberia, LEVEL and Vueling fleets.

In August, Alaska Airlines announced plans to swap out SES (formerly Intelsat services) and add Starlink across its entire fleet by 2027. Alaska-owned Hawaiian Airlines was the first major airline to sign up with Starlink in 2022.

Air France is rolling out Starlink across its entire fleet of over 200 long-haul and regional aircraft, while United Airlines has started adding Starlink to more than 1,000 planes in its international fleet as it bumps off multiple GEO operators.

Qatar Airways notably retrofitted its entire widebody fleet of 54 Boeing 777s in just nine months, nearly 50% faster than planned.

About 1,000 commercial planes in total were equipped and operational with Starlink in-flight Wi-Fi connectivity as of July, according to SpaceX, double the figure five months earlier.

And U.K.-based Valour Consultancy projected Starlink will be installed in more than 10,000 aircraft by 2034.

Aviation today accounts for only 4-6% of Starlink revenues, according to Quilty Space figures, but is its fastest growing mobility vertical, outpacing maritime by a factor of 10 as talks with other major airlines and government customers continue.

Fight for the skies

Starlink is forcing legacy players to rip up business models that were built around higher latency services as airlines become the latest frontline in the satellite internet wars.

A Starlink satellite photobombing an image taken overhead by a Maxar satellite, which remains an extremely rare occurrence despite the network's prevalence.

MAXAR

Viasat and Inmarsat, two of the largest GEO operators in aviation connectivity, candidly acknowledged the substantial competitive pressure from Starlink's rapid in-flight expansion during regulatory reviews of their merger, which they announced in 2021 and closed in 2023.

That admission was an early sign of the market realignment now rippling across airlines and service providers.

All of SES' legacy air-to-ground systems are slated to be phased out on U.S. regional jets by the end of 2025 in a shift toward higher-bandwidth satellite connectivity.

Nonetheless, legacy players are making inroads here as they upgrade technologies and turn to partnerships. In April, Air Canada became the first airline to launch multi-orbit inflight services combining SES' GEO satellites with Eutelsat's OneWeb LEO network.

Gogo has also partnered with OneWeb in business aviation, and acquired competitor Satcom Direct last year to better position itself against Starlink's aviation push.

Competition remains fluid even among traditional GEO operators. Delta Air Lines, for example, is swapping out SES-provided Wi-Fi for Hughes' GEO service on more than 400 aircraft.

Navigating rough seas

Legacy GEO operators are also being forced to adjust their strategies at sea. SES has formed a rare partnership with Starlink for multi-orbit cruise ship connectivity. Meanwhile, maritime satellite capacity resellers such as KVH Industries are stomaching tighter margins as they lean on Starlink for growth.

Once the backbone of maritime connectivity, GEO capacity is increasingly being relegated to backup or niche uses as ship operators embrace the lower latency and higher throughput of LEO services.

Starlink has also started bifurcating its approach, Quilty Space research analyst Kimberly Burke said during the firm's Sept. 25 webinar, replacing a $25,000 a month, unlimited global maritime plan for the commercial shipping sector with a $2,500 a month, mobile priority unlimited package.

"For recreational and smaller vehicles, unlimited packages were completely phased out in favor of a tiered data bucket that's running anywhere from $250 [per terabit per month] up to about $1,000," Burke said.

"Hardware costs have also collapsed in parallel. A terminal that once debuted at $10,000 now sells for closer to $2,500, versus the $15,000-$20,000 for the cheapest GEO options."

Quilty Space expects Starlink to have 130,000 vessels connected by 2026 with a billion-dollar revenue run rate, in stark contrast to an Inmarsat maritime business it said peaked below $600 million in 2015.

Leveling up

Having conquered scale, SpaceX is now chasing performance as it seeks to transform the network from a crowded broadband service into a global platform with gigabit-class reach.

Aggressive global expansion has strained Starlink's network, leading to congestion issues and extra charges for high demand areas, even as every launch of satellites significantly improves capacity.

Since February 2024, SpaceX has added hundreds of additional terabits of overall network capacity by deploying upgraded V2 Mini Starlink satellites, weighing around 800 kilograms each, up from 300 kilograms.

An operational Starship (see Part 1 of this report) would enable the deployment of full-sized, 2,000-kilogram V2 Starlinks, designed to dramatically improve bandwidth and overall network performance and further widen SpaceX's lead over competitors.

An optical backbone

SpaceX has shifted the bulk of its inter-satellite backhaul to laser cross-links on newer Starlink generations, using optical mesh routing in space to divert traffic away from congested gateways and shorten end-to-end paths.

Each satellite now carries three space lasers operating up to 200 gigabits per second (Gbps), greatly reducing the company's need for ground stations.

Compared with radio frequencies, optical links can deliver orders of magnitude more bandwidth with lower latency, thanks to their tighter beams, lack of spectrum licensing constraints and faster propagation in space.

SpaceX has also developed a "mini laser" it says can connect third-party satellites and space stations into the Starlink constellation, designed to achieve link speeds of 25 Gbps at distances up to 4000 kilometers.

Space-to-ground communications, though, still primarily rely on radio frequencies for the time being.

Vertically integrated powerhouse

Building the vast majority of Starlink spacecraft in-house gives SpaceX tight control over cost, schedule

and design iteration, enabling it to rapidly scale production in ways traditional satellite operators cannot.

The tradeoff is SpaceX is exposed to the full burden of manufacturing, supply chain risk and capital investment, which competitors can mitigate by spreading work across outside suppliers.

Nevertheless, heavy vertical integration has become one of SpaceX's strongest differentiators.

Amazon is the only other player with the financial resources to pursue a similar model. However, Amazon Leo must legally operate at arm's length from Blue Origin to avoid conflicts of interest, and its greatest execution risk has become its dependence on external launch providers, despite having several under contract.

By contrast, SpaceX says it is currently building Starlink satellites at a clip of 280 per month at its facility in Redmond, Washington. According to Quilty Space, the company is on course to increase that rate to about 310 per month by 2026.

To put this flood of satellites to use, SpaceX said its facility in Bastrop, Texas, was churning out 70,000 user terminals every week by March, after starting from zero less than two years earlier.

And Quilty Space estimates the company will expand a network of about 350 gateways worldwide to 470 in 2026, with half of that growth needed to support expansion plans across Asia Pacific.

The analysts also expect SpaceX to finish upgrading gateways next year, transitioning from nine antennas each to mega sites with 32-50 antennas to significantly improve capacity, along with E-band spectrum capabilities to alleviate network congestion.

Meanwhile, SpaceX is pressing ahead with another leap in capability with a V3 generation of Starlink satellites that would be roughly the size of a Boeing 737 and deliver gigabit-class internet connectivity.

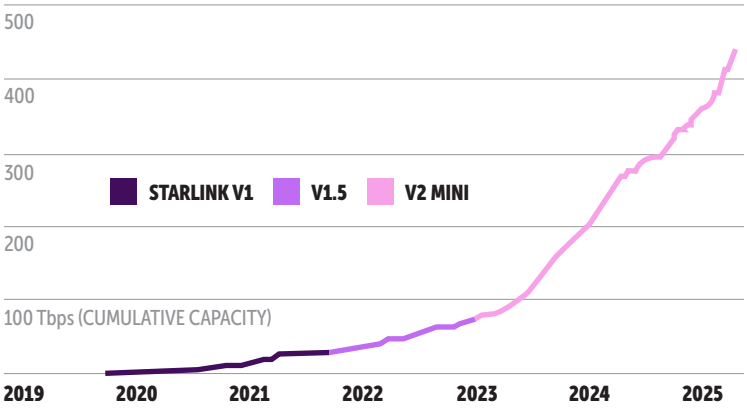
Each V3 "would be designed to add 60 tera-bits-per-second of downlink capacity to the Starlink network," the company said Oct. 13, "more than 20 times the capacity added with every V2 Mini launch on Falcon 9." Musk also has ambitions to use scaled-up V3 satellties as orbiting data centers.

Permission to expand

On the regulatory side, the FCC tracks Starlink by constellation "generations," which are distinct from the V1, V2 and V3 hardware designations.

Starlink Capacity Launched

Upgraded V2 Mini satellites have added hundreds of terabits of capacity since early 2024, helping SpaceX ease congestion as Starlink's user base grows.



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SOURCE: SPACEX JULY 14, 2025, NETWORK UPDATE

SpaceX has permission to operate up to 4,408 Gen 1 satellites. In late 2022, the FCC authorized 7,500 satellites under Gen 2, while reserving the possibility of expanding that framework to nearly 30,000 satellites in total.

Hot on the heels of its push for EchoStar spectrum, which is pending regulatory approval, SpaceX sought permission for up to 15,000 low and very low Earth orbit satellites to upgrade its D2D service. Each spacecraft would weigh around 2.5 tons, compared to 1 ton for the first generation.

Upgraded D2D satellites would orbit much lower than the rest of the constellation at between 326-335 kilometers above Earth to improve latency. SpaceX also said in a regulatory filing that it is considering "creating a hybrid satellite/terrestrial network to expand the coverage and capacity of these services."

Last year, the FCC allowed SpaceX to use T-Mobile's cellular frequencies on up to 7,500 Gen 2 Starlink satellites, while also giving the go-ahead to operate Gen 2 between 340 and 360 kilometers. That's down from 525-535 kilometers.

This decision came after SpaceX got permission to deploy upgraded Starlinks under the Gen 1 license with technology developed for Gen 2, enabling them to provide broadband with narrower beams to boost network efficiency and capacity.

New capabilities, new services

Key Takeaways

- There are more than 650 Starlink D2D satellites in orbit.
- Starlink claims to be the world's largest 4G coverage provider, with over 6 million users connected.
- SpaceX says EchoStar spectrum enables 20-fold increase in D2D throughput.

Starlink's next leap is more than faster broadband. The company has been turning satellites into cell towers with D2D technology that lets ordinary smartphones connect directly to orbit without special equipment or terrestrial infrastructure.

In the United States, this capability is currently being enabled through a partnership with T-Mobile, which is providing the cellular frequencies SpaceX needs to connect smartphones outside the reach of terrestrial cell towers in the country.

SpaceX has been rolling out this capability across its fleet since early 2024 and hailed the completion of its first-generation a year and a half later. According to the company, space-enabled text messaging, emergency alerts, voice, video and other data services on certain apps are available in the U.S., Canada, Chile, Peru, Ukraine, Japan, Australia and New Zealand.

Ultimately, SpaceX aims to use these payloads to facilitate broader and higher data services even in the most remote regions lacking conventional mobile coverage, with upgraded satellites using EchoStar spectrum enabling a major increase in throughput to the user.

This fledgling D2D market, which some analysts say could pull in more than $100 billion in cumulative revenue between 2023 and 2033 just from consumers, remains highly competitive.

U.S.-based ventures AST SpaceMobile and Lynk Global are progressing with constellations initially using frequencies from mobile operator partners to connect unmodified phones. Both have also been amassing their own space-approved spectrum.

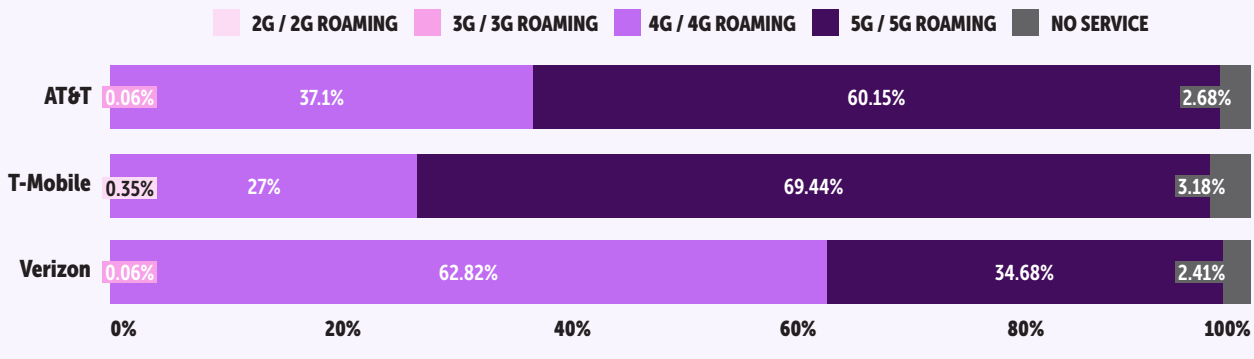
In July, AST struck a deal to bankroll bankrupt GEO operator Ligado Networks' legal settlement with Viasat over their long-running spectrum dispute. The move enabled Ligado to preserve access to L-band frequencies over North America while granting AST long-term rights to use them for its own D2D constellation. The Texas-based venture also struck a $64.5 million deal for global S-band rights, subject to country-by-country approvals.

In August, the company said it had secured all funding needed to deploy the 45-60 satellites necessary for continuous D2D coverage in the United States, in partnership with AT&T and Verizon.

According to AST, combining cellular and space

Time Spent Without Service in 2024

Most mobile users in the United States spent the majority of their time last year at home, in offices, coffee shops and other places well served by around 651,000 cell sites across the country, according to Ookla Speedtest data.



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SOURCE: OOKLA

spectrum is key to meeting its goal of enabling broadband speeds of up to 120 megabits per second for unmodified smartphones beyond the reach of terrestrial networks. The operator has five Block 1 BlueBird satellites in LEO but plans to provide continuous coverage in the U.S. and other key markets through 13 more launches over the next year and a half of larger, more capable spacecraft.

Each Block 1 BlueBird spans about 64 square meters, carrying the largest commercial antenna ever deployed in LEO, but the planned Block 2 satellites are expected to be more than three times larger.

Despite SpaceX's mammoth spectrum deal, B. Riley analyst Mike Crawford said AST remains "the clear leader in the race to enable true D2D broadband connectivity to unmodified phones, given what we see as greater capabilities and greater bandwidth enabled by [the company's] large, novel satellite architecture."

Meanwhile, SES has become the largest strategic investor in Lynk, giving the more cash-strapped D2D player access to space-approved spectrum bands and orbits beyond LEO.

Ramu Potarazu, a former SES executive who took over as Lynk's CEO last year, outlined plans to begin testing these capabilities with its pizza-box-size satellites in an exclusive interview with *SpaceNews*. On Oct. 22, Lynk agreed to merge with S-band spectrum holder Omnispace, which SES had also invested in, to gain access to even more spectrum.

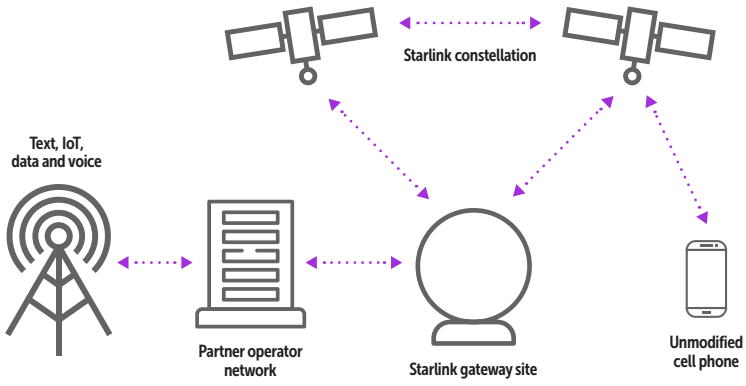
On the other end of the D2D market, Mobile Satellite Service (MSS) operators such as Viasat and Globalstar are currently only leveraging radio frequencies already approved for use from space to connect devices. Previously, they could only use these frequencies to serve bulky, specialized handsets, but are now adapting the latest mobile industry standards to reach the mass market.

But even here the line is blurring as long time MSS advocate Viasat pushes a shared infrastructure model that could one day welcome terrestrial frequencies (see Equatys on page 32).

The industry has for years debated which end of

Cell Towers in Space

Each Direct-to-Cell (D2C) payload carries an onboard eNodeB for D2D, the same base station technology used in 4G/LTE towers, enabling ordinary smartphones to connect via satellite as if roaming on a partner network. SpaceX's D2C satellites connect to the broader Starlink network via laser links, enabling global coverage.



SN Intelligence SOURCE: SPACEX

Starlink and T-Mobile to the Rescue: T-Mobile says Starlink's direct-to-cell service connected hundreds of thousands of people during recent U.S. disasters, delivering emergency alerts and enabling messaging even when terrestrial networks were down.

Disaster Event	People Connected	SMS Messages Sent	Wireless Emergency Alerts Delivered
Hurricanes Helene & Milton *Sept. and Oct. 2024*	~1,000,000	650,000+	200+
Los Angeles Fires *Late 2024*	410,000+	250,000+	~157
Oregon Wildfires *Early 2025*	~6,800	~24,500	7
Texas Floods *Mid-2025*	~93,700	~287,000	125

SN Intelligence SOURCE: T-MOBILE JULY 23, 2025

During a Sept. 16 D2D panel at World Space Business Week, AST president Scott Wisniewski said SpaceX's spectrum push validates its own strategy.

the D2D spectrum strategy would prevail. Partnerships with mobile operators allow satellites to serve unmodified phones already out in the market, but they can raise concerns about interference with terrestrial networks. Dedicated satellite spectrum is already approved for use from space, but requires handsets with upgraded radios to connect.

A hybrid approach from SpaceX, AST and Lynk seeks the best of both worlds.

SpaceX aims to begin testing D2D services using the newly acquired spectrum as soon as the end of next year, pending a new generation of satellites with payloads compatible with that spectrum. The company also needs partnerships with other firms so that devices can use it.

"This is the start, by the way, of a huge amount of work," SpaceX president Gwynne Shotwell said at the World Space Business Week conference Sept. 16.

"We're working with chip manufacturers to get the proper chips in phones."

SpaceX was already working with mobile network operators under earlier plans to use terrestrial mobile spectrum for D2D services, but now that it owns spectrum, "we want to work with them almost providing capacity, kind of wholesaling capacity to their customers," Shotwell said.

She argued that the effort will be more efficient than negotiating with individual mobile operators for spectrum rights.

"When we cross a border into another country, we now need to leverage a different licensed spectrum, so it's very clunky," she said. By contrast, the EchoStar S-band spectrum is cleared globally.

Asked on the Sept. 10 All-in Podcast whether Starlink could become a global carrier that does away with the need for a traditional regional carrier like AT&T, Musk said: "That would be one of the options."

Yet not all analysts are convinced satellites are a threat to terrestrial wireless and cell tower operators networks. Ric Prentiss of Raymond James said D2D is better viewed as a complement where cellular towers are uneconomical.

Even "the most bullish estimates of satellite constellation size would produce a tiny fraction of the capacity of a single cellular network," Prentiss said Sept. 23 in a note to investors.

Signals from space also struggle indoors, latency is fundamentally longer and adoption is set to take years as compatible handsets trickle into the market, he added.

"Generally speaking, we have seen this movie before," he continued, "and there is a significant amount of hype around the Total Addressable Market (TAM) of [D2D], with many players attempting to go after this market, but it remains to be seen how reality will compare with expectations and how many long-term players the [D2D] market can support.

"And regarding the $17 [billion] SpaceX Starlink spent on this spectrum, we think it was trying to create a dominant position in the nascent market, and if the business case does not ultimately play out, the spectrum could be sold to the wireless operators."

Space-based D2D might one day compete with terrestrial wireless in certain markets, AT&T CEO John Stankey was cited telling the Goldman Sachs Communacopia + Technology Conference a day before.

However, he cautioned that satellite signals still lag in an artificial intelligence era demanding ultra-low latency and heavy workloads, in addition to providing relatively weak indoor coverage.

Analysts have speculated that SpaceX could launch a standalone outdoor cellular service as a bundle with its Starlink broadband offering, partnering with T-Mobile in the U.S. to address the indoor shortfall.

Starlink's current U.S. service utilizes just 10 megahertz of similarly situated spectrum, but with 50 MHz under its first deal with EchoStar the company expects to achieve 20 times the throughput with its second-generation D2D service.

"This should enable the service to be closer to the 5G service that terrestrial cellular networks currently offer," William Blair analyst Louie DiPalma said.

The November deal for 15 MHz of unpaired, uplink spectrum across the U.S. would give another boost.

For now, user adoption remains unclear as T-Mobile only started charging subscribers in July for a Starlink-enabled T-Satellite service offering texting and multimedia messaging for $10 per month.

According to Ookla Speedtest data, mobile users in the United States are within reach of a cellular network most of the time. Yet the 2.79% of time it says the average U.S. user isn't connected could also be when connectivity is most crucial, such as during an emergency in a remote area.

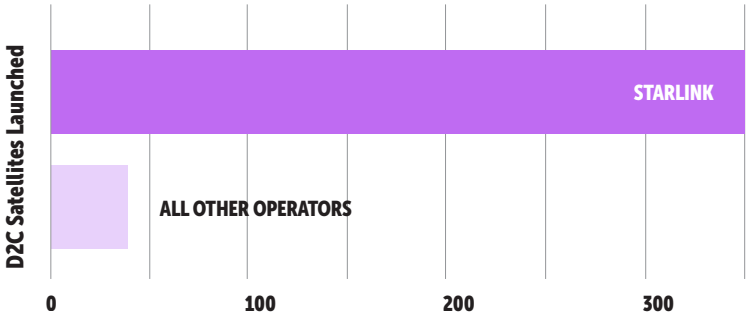
Ookla pointed to a survey showing that more than 60% of roughly 1,000 smartphone users would pay at least $5 per month for some kind of satellite D2D service, representing about $3 billion in potential annual revenue for the U.S. wireless industry.

The Global Mobile Suppliers Association (GSA) trade body in September counted D2D service launches in 12 countries, with 24 trials or licensed projects underway.

As many as 64 operators across 42 countries are investing in related technology, according to GSA.

Towering Above Rivals

SpaceX's D2C fleet was at least 10x larger than all other operators pursuing a similar capability combined at the end of 2024, a lead it largely maintains today following little progress from others.



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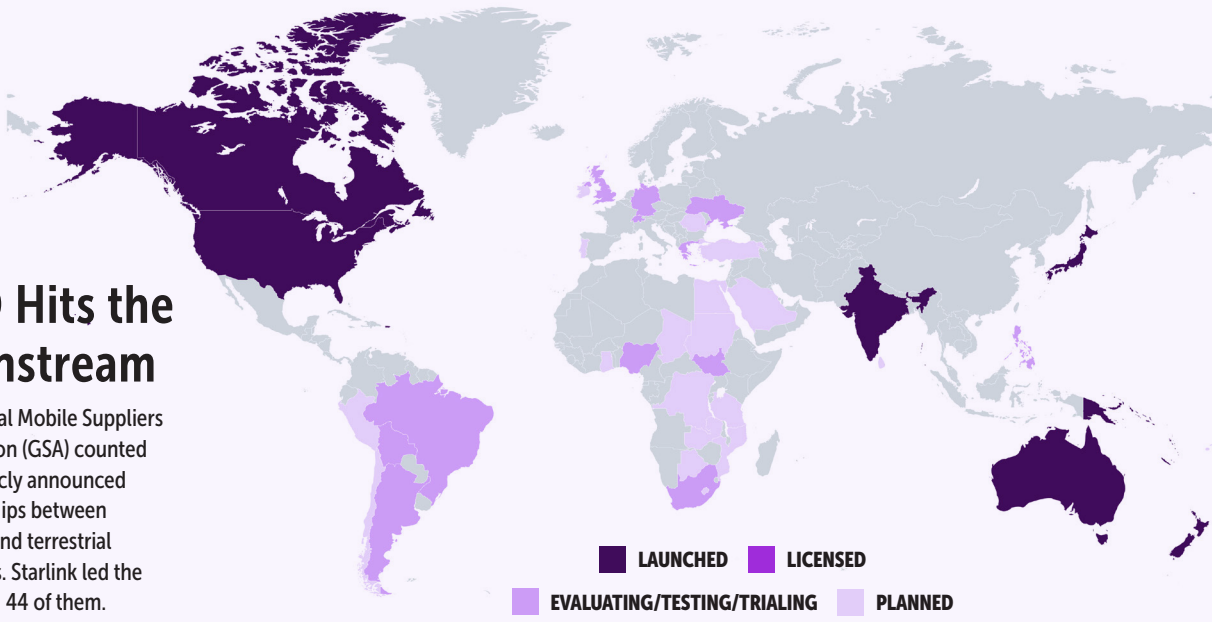
SOURCE: SPACEX

D2D Hits the Mainstream

The Global Mobile Suppliers Association (GSA) counted 170 publicly announced partnerships between satellite and terrestrial operators. Starlink led the pack with 44 of them.



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SOURCE: GSA 5G SATELLITE CONNECTIVITY REPORT, SEPTEMBER 2025

Notable LEO Broadband Players

	QUICK FACTS	TARGET MARKETS	STRENGTHS	WEAKNESSES
Eutelsat *France*	Completed first-generation rollout with more than 650 OneWeb satellites deployed at ~1,200 km in polar orbit, augmented by 34 GEO spacecraft.	Enterprise and government connectivity via wholesale partners.	Operational LEO broadband system was first to deploy after Starlink. Strong government support from France and United Kingdom.	Limited funding compared to deep-pocketed rivals amid GEO declines. Ground delays continue to hold back global LEO coverage.
Amazon *United States*	Kicked off deployments for 3,232 Amazon Leo satellites at ~600 km. Targeting initial services in five countries early next year.	Consumer, enterprise and government broadband via Amazon's expansive ecosystem.	Massive resources with more than $10 billion committed and Amazon's expertise in consumer devices/distribution. Potential for low-cost user terminals at scale and bundled connectivity with cloud giant Amazon Web Services.	Far behind Starlink in deployment. Faces an FCC milestone to deploy 50% of the constellation by July 2026 that will be tough to reach, especially with reliance on mostly new launchers.
Telesat *Canada*	Aims to start serial deployments for 198-satellite Lightspeed network early 2027 at ~1,300 km polar orbit. Initial global service slated for later that year. Lists 13 GEO satellites, with no firm plans to replenish.	Enterprise and government broadband trunking (cellular backhaul, military comms, aviation, etc.), delivered through managed network services.	Leverages Telesat's decades of GEO experience and existing customer base. Receiving strong Canadian government support and interest in non-U.S. LEO options.	Late to market and much smaller constellation than planned following past funding challenges. Weighed down by declining GEO business.
Rivada Networks *United States*	German subsidiary proposes nearly 600 Outernet satellites at ~1,050 km. Signed a $2.4 billion contract with Lockheed Martin-owned Terran Orbital to build the first 300.	Enterprises and governments via wholesale capacity leasing.	Touts more than $17 billion in early agreements with potential customers.	Tight regulatory timeline to deploy 288 satellites by mid-2026, full funding remains unclear and its initial license for priority Ka-band spectrum was rescinded last year.
Spacesail *China*	Deployments for 14,000 Qianfan satellites technologically modeled on Starlink underway since August 2024.	Telcos, governments and enterprise users in countries aligned with/courted by China's Belt and Road initiative.	China-sponsored efforts have advantage in countries where Western services are restricted. Expected to integrate tightly with China-built 5G/6G terrestrial networks.	Early satellites have shown higher defect rates compared to Starlink. Perceived lack of transparency, and likely reluctance from Western-aligned nations to adopt a Chinese-controlled broadband network.

Honorable Mentions

	QUICK FACTS	TARGET MARKETS	STRENGTHS	WEAKNESSES
SES *Luxembourg*	Hybrid GEO-MEO operator with access to OneWeb capacity after acquisition of GEO operator Intelsat. An investor and strategic partner for LEO D2D ventures Lynk Global and Omnispace.	Mainly provides GEO TV broadcast and multi-orbit broadband and managed wholesale services for telecom operators, cruise lines, airlines and governments.	Pioneered multi-orbit architecture with longstanding government and enterprise partnerships worldwide.	GEO business challenges amid declining legacy TV services. Technical issues cloud initial batch of upgraded MEO satellites.
Viasat *United States*	Very high-throughput GEO satellite broadband operator has bought a large chunk of OneWeb and Lightspeed LEO capacity to take on Starlink.	Enterprises, governments and consumer broadband services targeting rural areas. Provides services through a mix of direct-to-consumer and partnership models.	Nearing deployment of massive ViaSat-3 satellites capable of delivering a terabit per second of capacity. Established worldwide customer base and radio frequency rights boosted by recent Inmarsat acquisition.	User equipment and installation costs are relatively high, Starlink is eating into multiple growth markets and services from the first ViaSat-3 satellite have been downsized following a major antenna failure.

Expanding beyond residential consumers

Key Takeaways

- Rivals say Starlink's consumer roots put it at a disadvantage in enterprise and government markets.
- Starlink now advertises 99.9% uptime as it pushes toward formal service-level guarantees.

Starlink began early services in 2019 for consumers, and while it has successfully expanded into government and enterprise markets, competitors say the origins of its network put it at a disadvantage for customers requiring specialized, guaranteed service-level agreements.

"Starlink have definitely turned the industry on its head," said Ian Canning, CEO of OneWeb's business in the U.S., during a *SpaceNews* webinar on SpaceX alternatives in April.

"It's great for all of us to look inward and be a bit more innovative and a bit more dynamic in the industry, but we are ... very much, focused on the enterprise, complex solutions, rather than a consumer internet service."

Telesat is also quick to emphasize how its Lightspeed LEO network is being developed from the outset with enterprise and government needs in mind.

"It's a LEO technology but it has almost nothing to do with what Starlink is doing", Telesat chief commercial officer Glenn Katz said during the webinar.

"We purposely designed our network to provide services to enterprise, government, maritime, aviation customers — not consumer, and that's important in terms of how you develop your technology."

At its core, Telesat and others steering clear of commercial customers are focusing on what's known as Layer 2 connectivity — direct, private links between sites — rather than Layer 3, which relies on dynamic routing across the public internet with no performance guarantees.

"The use cases, therefore, are for companies that require that type of technology," Katz said.

"It's not a 'best effort, internet Layer 3-type' of technology. That's the fundamental differentiator."

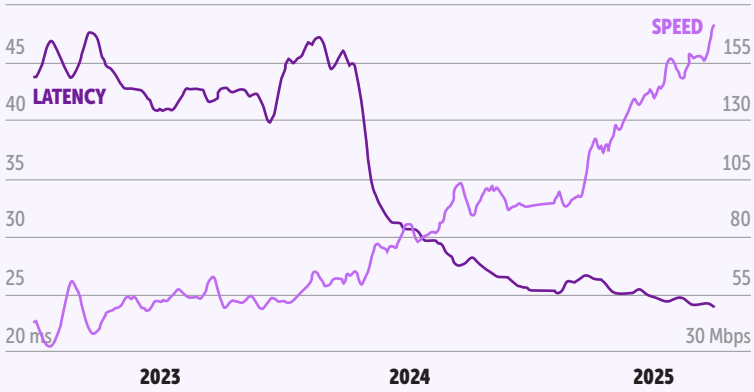
Whether Starlink could one day guarantee bandwidth, uptime and availability under service level agreements remains to be seen.

"Our offering right now is really compelling and the uptime has been amazing," SpaceX CFO Bret Johnsen said March 12 during the Satellite Conference, adding that he is pushing its sales team to incorporate service guarantees.

That seems to have been what the team needed. Starlink marketing now touts "high-speed, low-latency internet with 99.9% average uptime" and weather-resilient antennas. Network specialists such as MTN of Florida also offer a third-party Layer 2 service for Starlink.

Starlink Network Improvements

Starlink engineering teams say they are nearing a goal of delivering service with a stable 20-millisecond median latency and minimal packet loss.



SN Intelligence

SOURCE: SPACEX JULY 14, 2025, NETWORK UPDATE

Favorable regulatory winds

Key Takeaways

- FCC under Chairman Brendan Carr has boosted Starlink's competitive standing.
- SpaceX helped push EchoStar out of D2D and traditional mobile operator market.
- Tech-neutral rural broadband program shift brings limited gains for LEO.

Starlink's ability to win over enterprise customers is only part of the story. Its rapid ascent has been fueled by policy tailwinds

and diplomatic backing that have helped open doors in new markets.

Citing internal State Department cables, the *Washington Post* reported in May that the United States had pushed Lesotho and India to approve Starlink services as they faced tariffs imposed by U.S. President Donald Trump.

On the home front, the FCC has taken several favorable regulatory actions that benefit Starlink under Chairman Brendan Carr, a vocal Musk supporter.

Since Trump's return to office and Carr took the agency's reins, the FCC has approved a power boost for SpaceX's D2D service and Starlink dishes, as well as a broader review of power limits for LEO satellites, despite interference concerns raised by geostationary competitors.

The FCC has also begun exploring new uses for upper C-band frequencies held by GEO operators, which SpaceX has expressed interest in.

SpaceX's FCC lobbying played a key part in EchoStar's decision to part with valuable spectrum assets.

The office started probing EchoStar's spectrum licenses after Starlink claimed it had detected a failure to meet regulatory milestones, an allegation the company denied.

EchoStar had even floated the prospect of bankruptcy protection as the regulatory scrutiny mounted.

After announcing the sale to SpaceX, EchoStar said the FCC decided to drop its investigations into the company.

And while the EchoStar deals require regulatory approval, these are likely sooner than later given Carr has already determined it is a "potential game changer" for American consumers.

The EchoStar saga is just another tell of how fluid the spectrum landscape has become in the U.S.

Last year, the FCC dismissed SpaceX's attempt for access to the radio spectrum MSS operator Globalstar uses to connect Apple iPhones and smartwatches from space, forcing the company to go through a lengthy rule-making process.

But in June, SpaceX returned with a fresh application for those same bands, arguing the previous "decision appears to have been made in error given the Commission continues to evaluate applications for new systems in the bands filed both before and after SpaceX's application was dismissed."

SpaceX has also sought permission to use frequencies held by Viasat-owned Inmarsat and Ligado, contending they are being underused and could be shared thanks to advances in interference mitigation.

Rural broadband headaches

It certainly hasn't all been clear sailing for SpaceX on regulatory matters.

In June, the U.S. Department of Commerce's National Telecommunications and Information Administration (NTIA) announced it would apply a technology-neutral approach in awarding subgrants under a $42.5 billion Biden-era funding program to combat the country's digital divide.

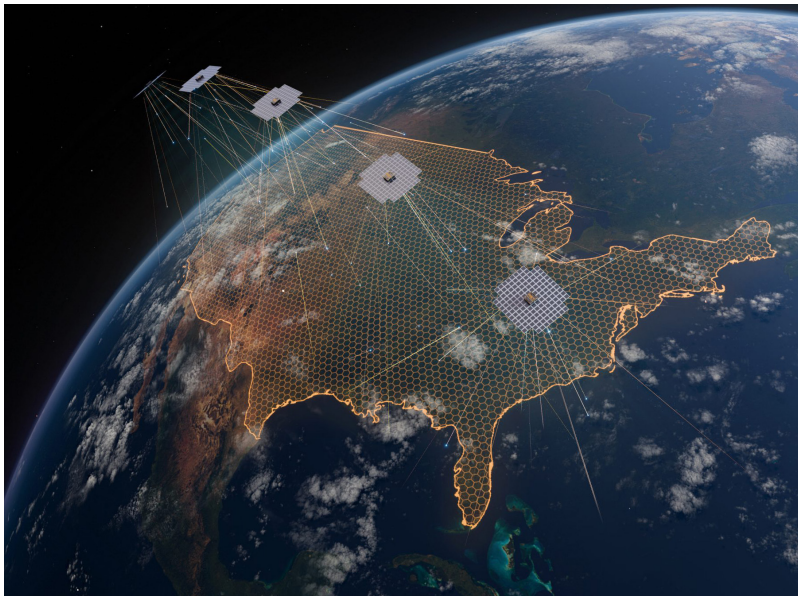
Previously favoring fiber deployments, the move eased restrictions on Starlink and other satellite providers for access to the funds.

Even so, fiber still dominated final proposals from states and territories submitted to NTIA in terms of funding for BEAD, or Broadband Equity, Access, and Deployment. NTIA had approved 29 of them at the time of writing.

Despite SpaceX protests, fiber players such as Comcast and AT&T had won 86% of the funding and 65% of the locations as of Dec. 4, according to New Street Research director Vikash Harlalka, with satellite technologies getting 4% and 21%, respectively.

However, reports citing an NTIA memo show how the agency is heavily scrutinizing proposals deemed unreasonably expensive, pushing them toward lower cost alternatives that potentially include satellite.

Fiber's advantage stems from its ability to deliver gigabit-class connections at scale, often at a lower



A render of AST SpaceMobile's constellation over North America, its key anchor market.

AST SPACEMOBILE

The OneWeb gateway in Svalbard, Norway, where the company has 14 operational antennas that are vital to delivering connectivity to the Arctic.

cost per household than Starlink's typical $120 monthly service. Satellites can be deployed far faster, but analysts say their coverage is better suited to scattered, remote locations rather than the dense clusters that make up most BEAD-eligible areas.

According to a Vernonburg Group analysis, no more than 26% of BEAD-eligible premises can be efficiently covered by LEO, even though Starlink offers services as low as $80 a month in some areas (not including upfront hardware).

"While LEO satellite service is likely the most cost-effective option for project areas with low populations densities, standard LEO satellite beams lack sufficient network capacity to meet the BEAD program's minimum speed requirement of 100/20 Mbps in denser areas," the Vernonburg Group wrote.

Still, Starlink and Amazon Leo won more locations than any wired operator, according to New Street Research analysis, at 464,000 and 410,000, respectively. SpaceX was allocated 3% of the total funding, with Amazon's share close to half of that.

It is worth recalling the precedent set under the previous Trump administration.

In 2020, SpaceX was provisionally awarded nearly $900 million under the FCC's Rural Digital Opportunity Fund (RDOF), only to see it revoked two years later by a Biden-era FCC that ruled Starlink had failed to demonstrate it could meet performance requirements.

Carr, who criticized that decision at the time, said after being nominated by Trump to lead the FCC in November 2024 that he did not expect the subsidy to be reinstated.

The regulatory picture is colored by a chicken-and-egg dynamic. Critics argue that SpaceX's broadband ambitions depend on scaling Starship to sustain Starlink's deployment pace — a capability not yet proven, while Amazon Leo is getting BEAD funds despite its lack of commercial service.

SpaceX has sent letters to protest state decisions that sidelined satellites in favor of fiber as NTIA aims to begin releasing funds before the end of the year.

The company is also pressing the FCC to include Starlink in its annual broadband progress report, which serves as a benchmark for how well the U.S. is closing the digital divide.

By treating satellite service on par with fiber in this official scorecard, SpaceX hopes to strengthen its case for future subsidy programs and regulatory recognition. Such a move could undermine efforts to expand fiber in rural areas, according to critics, by lowering the bar for what counts as "advanced" broadband access.

Broader regulatory winds may be shifting, however. On Oct. 28, the FCC proposed overhauling satellite licensing and spectrum rules, after Carr declared October "Space Month" to head off mounting Chinese competition.

EUTELSAT

Building scale to compete

Key Takeaways

- Starlink prompts $14 billion legacy operator consolidation wave.
- Global OneWeb services nearing takeoff after ground segment delays.
- SES to deploy upgraded MEO satellites on shorter cycles.

A wave of consolidation has swept across the satellite communications industry, aimed in part to achieve the scale needed to compete effectively against Starlink's disruption.

Viasat opened the floodgates when it announced plans in 2021 to buy Inmarsat to broaden its global network, specifically targeting high-value mobility and government markets.

Legacy GEO operator Eutelsat soon followed by snapping up OneWeb, a LEO broadband operator promising to galvanize its pivot away from a declining television broadcast business.

While OneWeb has grappled with ground infrastructure setbacks that have delayed plans to provide global coverage since early 2024, it remains Starlink's only meaningful operational LEO broadband competitor after completing the space segment of the network.

"We do still have a few ground stations to get over the line but are nearly there and for the final ones — the coverage is mainly improving maritime coverage, a Eutelsat spokesperson told *SpaceNews* Sept. 25.

"Today, we are operational in 180 countries and expect global services in 2026."

Regulatory hurdles, notably in India, are among the last big obstacles left to clear.

SES, a pioneer of multi-orbit architectures with operational GEO and MEO constellations, has also doubled down on scale. It recently acquired Intelsat, a GEO heavyweight that had already partnered with OneWeb to complement its portfolio with LEO coverage.

That merger consolidates two of the sector's largest operators, strengthening SES' ability to market integrated services across enterprise, mobility and government markets.

At the same time, SES is preparing to expand O3b mPower satellite upgrades to maintain a differentiated MEO layer alongside GEO and LEO, CEO Adel Al-Saleh told *SpaceNews*.

SES provided more details about its "meoSphere" strategy in September, including plans to deploy a satellite co-developed with Californian manufacturer K2 Space early next year.

Rather than the traditional model of large, infrequent deployments, SES is moving to an iterative approach with modular, software-defined spacecraft upgraded on shorter cycles.

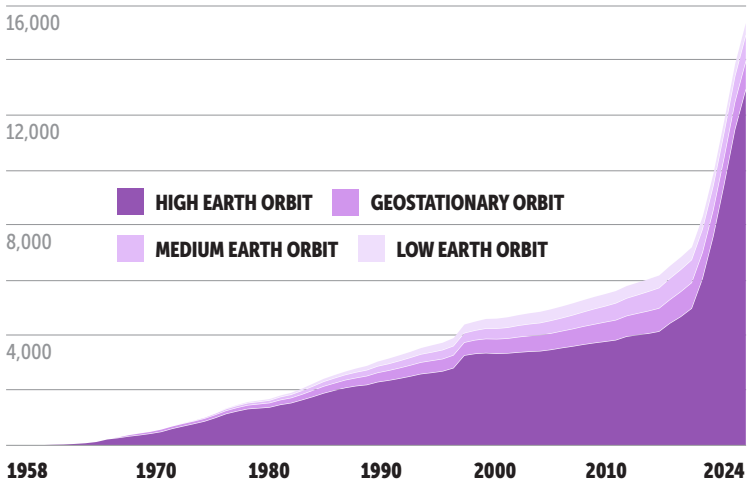
The company has not said whether meoSphere includes Boeing, which is currently building the last three of 13 next-generation O3b mPower MEO satellites for the operator. Each O3b mPower spacecraft is designed to deliver more than ten times the throughput of SES' original 20-satellite MEO fleet, although the first six experienced post-launch power issues that now appear to be resolved.

The Luxembourg-based operator said future development will be split across the U.S. and Europe, with SES adding a flexible number of new MEO satellites annually in line with customer demand to smooth out capital investment peaks.

While meoSphere would still serve the operator's key aviation, maritime, enterprise and government markets, it could also provide data relay and space situational awareness services, while hosting third-party payloads.

Payloads and Rocket Bodies in Space

SpaceX's vertically integrated business has enabled the company to deploy Starlink satellites at unprecedented scale, reshaping Earth's orbit as others wait in the wings.

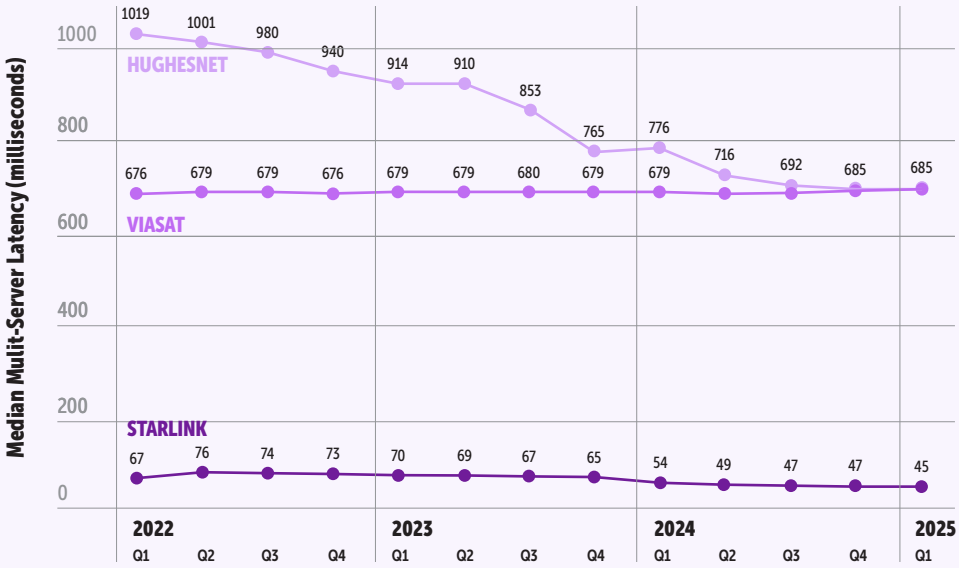


SN Intelligence

SOURCE: U.S. SPACE FORCE/OUR WORLD IN DATA

GEO Versus LEO Latency

Despite improvements, GEO satellites from EchoStar's HughesNet and Viasat have been unable to match Starlink's LEO network on latency and download speeds. Network speed testing service Ookla says its latency value is based on median multi-server latency, covering device to speedtest servers and internet, including the usual Wi-Fi hop in the home.



SN Intelligence

SOURCE: OOKLA

SES also recently announced a partnership with French firm Cailabs to test laser communications technologies that could enhance security and throughput for future satellites.

Beyond broadband, SES has positioned itself for the emerging D2D opportunity as the largest strategic shareholder in Lynk Global, whose satellite-to-phone technology provides another potential entry point into LEO.

Lynk aligns with SES broader relay strategy to interconnect GEO, MEO, LEO and D2D networks into a unified multi-orbit fabric.

Multi-orbit competition

Key Takeaways

- GEO is still optimal for 40-60% of traffic despite LEO latency-sensitive dominance.
- Still, Eutelsat projects LEO to account for up to 80% of satcom revenues within 6-7 years.
- Multi-orbit antenna breakthroughs could open up new markets.

To compete with Starlink, legacy operators are turning to multi-orbit strategies, promising extra redundancy, broader geographic coverage and more tailored connectivity solutions for diverse applications.

LEO satellites offer faster response times than those in GEO because they are much closer to Earth, making them ideal for latency-sensitive applications such as video calls, online gaming and cloud-based virtual tools.

Unlike their geostationary counterparts fixed above the equator, LEO satellites can also reach polar regions — important for keeping airlines connected during long-haul international flights, for instance.

However, GEO satellites excel at delivering large volumes of capacity to densely populated areas, helping to alleviate network congestion in an increasingly connected world.

Sitting between LEO and GEO, MEO satellites offer a middle ground that balances coverage, latency and throughput.

"Relying on any single vertically integrated provider exposes enterprises to critical risks instead of harnessing the unique strengths of" multiple orbits, notes Cynthia Harty, senior vice president of corporate strategy at multi-orbit network technology specialist ST Engineering iDirect. Multiple orbits offer "diverse capabilities, superior security, resilience and tailored performance," she said.

GEO is better suited for 40-60% of global data traffic, Harty said, and "when mixed with LEO for more latency sensitive applications the service providers ensure the optimal customer experience."

GEO fleet operator Telesat aims to enter the multi-orbit market in 2027 with its Lightspeed constellation. Others are leveraging LEO partnerships to get into the multi-orbit arena, including GEO-forward player Viasat, which has capacity agreements with OneWeb and Lightspeed.

"We are seeing more and more [Requests for Proposals (RFPs)] come out with a requirement for multi-orbital capabilities," Intelsat's outgoing CEO told the Satellite 2025 conference in March, shortly before the company completed its sale to SES.

Multi-orbit and multi-spectrum bands for redundant and resilient communications networks are highly prized by governments and large enterprises, Canning said during the *SpaceNews* webinar.

"You don't want to put all your eggs into one basket, into one capability," he added.

"I don't think necessarily that any one company has the solution for everybody, and it's how we can actually shape those solutions to actually best fit customer need."

The latest terminals can tap into multiple orbits to deliver greater resiliency and flexibility, though some warn they also centralize risk in one device.

In June, Kymeta claimed a first by simultaneously operating across both Ku and Ka bands in a single compact antenna, laying technical groundwork for seamless connectivity across satellite networks.

But even advocates of multi-orbit solutions acknowledge that LEO networks will dominate future growth. Eutelsat has projected that LEO services will account for approximately 75-80% of the overall satellite communications market within six to seven years, though GEO platforms will continue to play significant supporting roles.

Recent earnings from publicly listed legacy GEO operators underline the trend:

- SES is leaning heavily into non-geostationary government and mobility demand, while media revenues tied to GEO continue to slide.
- Eutelsat's GEO declines are weighing on a surge in LEO revenues.
- Telesat's upcoming LEO constellation has already secured a backlog larger than the company's entire GEO fleet.

Single Orbit/Provider Risks

Limited Flexibility
A single-provider solution is constrained by the provider's autonomous priorities, leaving customers with little leverage when requirements change. A single orbit confines enterprise users to a finite solution, eliminating viable alternatives.

Reduced Support and Scalability
A "one-size-fits-all" model may leave enterprise customers without the high-touch service, value-added benefits, or tailored solutions they require.

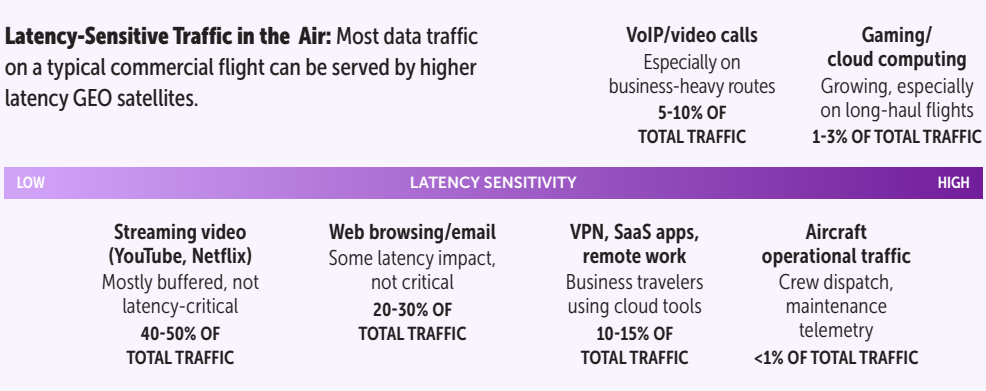
Not Future-Proof
Proprietary systems hinder interoperability, restricting seamless integration with other networks, such as the telcos that underpin global connectivity. Sustainability concerns may also arise, affecting enterprise Corporate Social Responsibility (CSR) commitments.

Service Restrictions
A single provider may fail to offer the right coverage due to congestion, regulatory or licensing issues, or a lack of agreements with sovereign nations for operation.

SN Intelligence

SOURCE: ST ENGINEERING

Latency-Sensitive Traffic in the Air: Most data traffic on a typical commercial flight can be served by higher latency GEO satellites.



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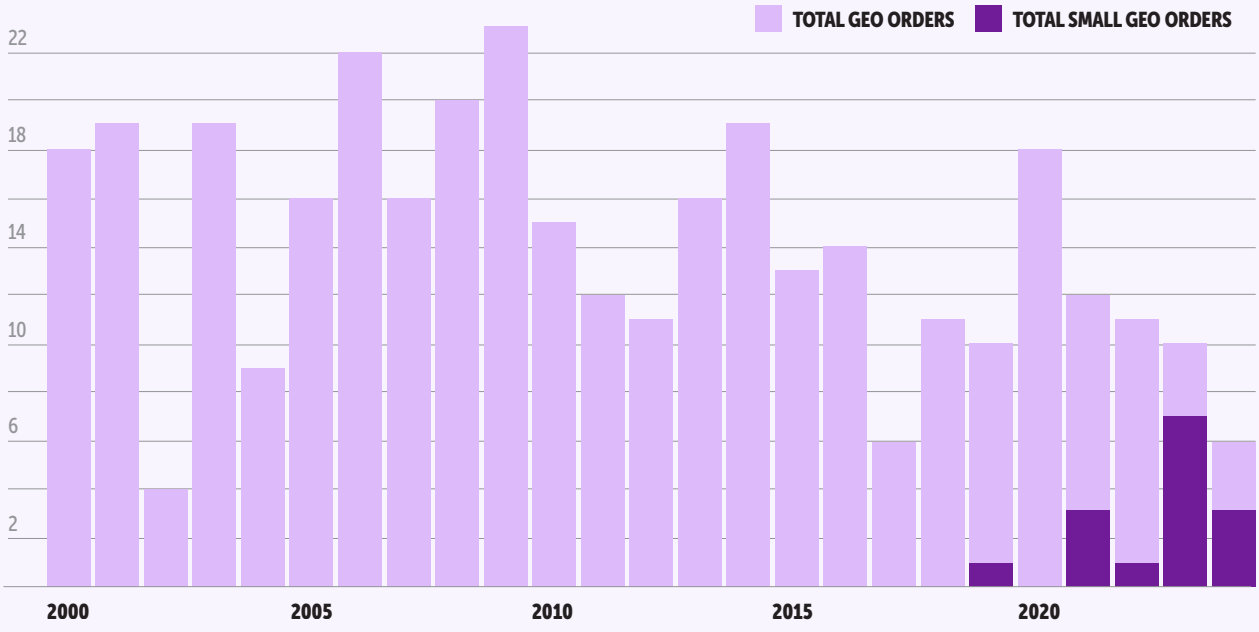
SOURCE: ST ENGINEERING

GEO Orders

Analysts have tracked 350 GEO comsats ordered worldwide between 2000 and 2024, averaging to roughly 14 per year.



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SOURCE: NOVASPACE

The diminishing GEO market itself is changing shape as operators increasingly opt for smaller, cheaper spacecraft built by a new breed of geostationary manufacturer such as Astranis and Swissto12. These companies are moving away from the traditional model of multi-ton, billion-dollar satellites that take years to design and launch, offering instead compact, software-defined GEO platforms that can be delivered faster and at a fraction of the cost.

Of the six commercial GEO communications satellites ordered in 2024, the lowest annual tally in two decades, half were around the size of a dish-washer at 1,000 kilograms or less.

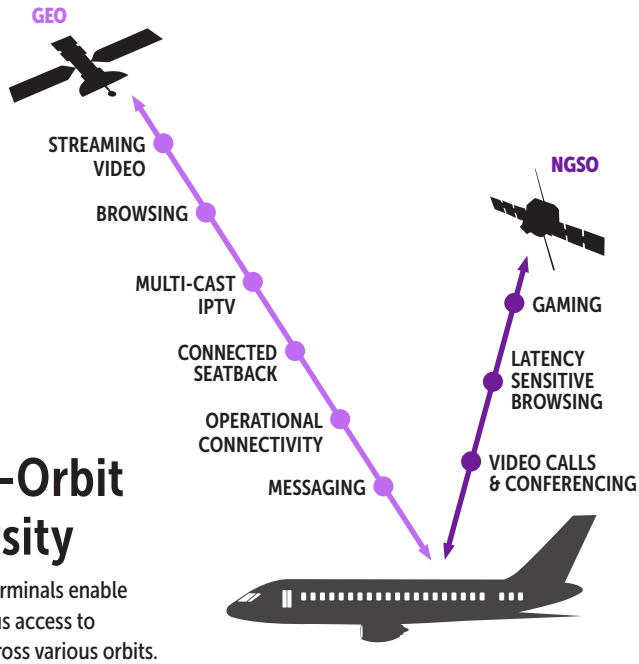
This marks a sharp departure from the era when operators routinely competed for 15 to 20 orders a year of school bus-sized spacecraft weighing several tons.

These smaller GEOs are extending the life of the orbit by lowering costs and shortening build cycles, repositioning the market as a leaner, more targeted complement to LEO and MEO networks.

Viasat and SES have small GEOs on order from Swissto12, while Astranis has so far had more luck with regional GEO operators such as Thaicom.

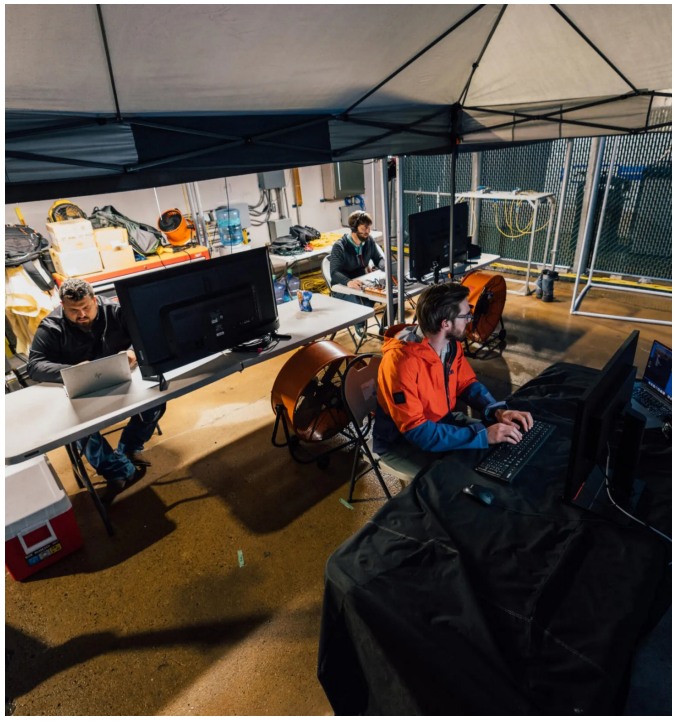
Multi-Orbit Diversity

Multi-link terminals enable simultaneous access to satellites across various orbits.



SN Intelligence

SOURCE: VIASAT



Left: Amazon Leo satellites liftoff aboard ULA's Atlas V rocket during the KA-03 mission. Right: Amazon said engineers at its test site in McAllen, Texas, were able to validate all key technologies for Amazon Leo within 30 days of launching two test satellites in 2023.

Incoming U.S. arch rival

Key Takeaways

- Amazon needs 1,616 satellites launched by July 2026 to meet FCC milestone.
- More than $10 billion is committed to Amazon Leo, with contracts for 90+ launches across mostly new rockets.
- Australia chose Amazon over Starlink despite development risks.
- Multi-LEO marketplace to challenge the multi-orbit business case.

In its home market, Amazon Leo is emerging as a formidable direct LEO competitor to Starlink, leveraging its parent company's extensive cloud computing and retail ecosystem to potentially bundle and aggressively price services.

More than 2,000 people at Amazon are working to make its LEO business a reality.

Despite being months away from even initial services for early adopters later, the network has already proven competitive on the policy and commercial fronts.

In the United States, Amazon had captured a third of the $959 million in BEAD grants going to LEO as of Dec. 4, according to New Street Research, even besting Starlink in states such as California and Colorado for rural broadband funding.

And in September, JetBlue became the first airline to partner with Amazon Leo, choosing it over both multi-orbit operators and Starlink to start providing passengers with LEO connectivity from 2027.

Overseas, Australia's state-backed National Broadband Network (NBN) recently chose Amazon Leo to connect more than 300,000 rural and remote locations starting in mid-2026.

That decision followed years of dissatisfaction with Sky Muster, the country's billion dollar pair of GEO satellites launched in the mid-2010s that quickly became congested and steadily abandoned once Starlink entered the market.

Even after a 750 million Australian dollar ($489 million) network upgrade to ease pressure on Sky Muster, NBN concluded it needed LEO capacity to meet customer expectations.

Like SpaceX, which has leveraged billions in private capital, government contracts and subsidy programs to expand Starlink, Amazon brings

ULA; AMAZON LEO

formidable financial firepower to its LEO network.

That backing enables Amazon to mirror SpaceX's vertically integrated approach with satellites and antennas built in-house, and to bankroll a multibillion-dollar, multi-provider launch campaign.

Another example of Amazon's financial firepower expanding its constellation's global reach came in July, when local reports highlighted a $570 million investment in Vietnam to establish operations there.

A key difference is that while SpaceX relies exclusively on its own rockets, Bezos-owned Blue Origin must operate at arm's length from Amazon Leo, treating contracts as third-party transactions because its parent company's board is legally required to avoid conflicts of interest.

At the time of writing, SpaceX and United Launch Alliance (ULA) had launched 153 operational Amazon Leo satellites following missions in April, June, July, August, September and October.

But even with massive resources, Amazon Leo faces significant challenges meeting FCC rules requiring half the constellation, or 1,616 satellites, to be deployed by July 2026, and the rest by July 2029.

Amazon had initially planned to deploy its first batch of operational satellites in the first half of 2024, following successful tests with two prototypes in LEO, enabling beta trials with Verizon, Vodafone and other potential customers later that year.

The company has not commented on a reason for the yearlong delay, or a Bloomberg report earlier this year that claimed there had been slow progress in building satellites at its Kirkland, Washington.

Five more Atlas 5s are contracted as part of the LEO network's massive launch arrangement.

But much of Amazon's deployment schedule relies on nascent rockets that have yet to prove their reliability at scale: 38 ULA Vulcan Centaurs, 18 Arianespace Ariane 6s and up to 27 New Glenn rockets from Blue Origin.

Vulcan, tasked with carrying the bulk of Amazon Leo satellites, suffered an upper-stage anomaly on its second mission in October 2024, returning to flight nearly a year later in a successful mission for the U.S. Space Force.

Ariane 6, which followed up its first commercial flight in March 2025 by launching European satellites in August and November, is only expected to fly one more time this year. Its operator Arianespace has said that mission, carrying two Galileo navigation satellites, will once again use Ariane 62, the version of the rocket equipped with two solid rocket boosters.

Arianespace confirmed in October that the inaugural flight of Ariane 64, a more powerful version with four solid rocket boosters to be used for Amazon Leo launches, had slipped into 2026.

David Cavaillolès, Arianespace's recently appointed CEO, said the company expects to "more or less double" its launch rate in 2026 to about eight missions. Arianespace is also exploring ways to lift a current ceiling of 10 launches a year.

Meanwhile, a long-awaited second flight for New Glenn launched Nov. 13, carrying NASA's ESCAPADE twin spacecraft to Mars, following an investigation into a failed booster landing during its debut mission early this year.

Germany's Rivada Networks also faces a fast-approaching regulatory deadline requiring the launch of 288 satellites by mid-2026 to secure priority spectrum rights, amid ongoing financial and regulatory questions.

"My biggest problem right now ... is not the satellites," Ricky Freeman, president of Amazon's Leo for Government (formerly Kuiper Government Solutions) division, said Sept. 15 during World Space Business Week in Paris.

"It's launch. I need more launch. In fact, if you have a slingshot, I'd probably buy it right about now, because we do need the resource there."

Nevertheless, Freeman said performance testing with satellites that have been deployed have exceeded expectations, with downlink speeds reaching up to 1.8 Gbps and uplinks around 450 Mbps.

He said the constellation has also established 100 Gbps optical inter-satellite links in just a few seconds of acquisition.

Freeman outlined plans to have approximately 200-plus satellites by the end of the year — "not exactly where we wanted to be, but again, making great progress."

That would put the company at around 12% of the satellites it must deploy by mid-2026. Freeman did not address the potential need for a waiver from the FCC.

By the end of the first quarter of 2026, he said the constellation "will have a continuous coverage through and be able to offer services for the United States, Canada, United Kingdom, Germany" and France.

"By the end of 2026, we will be in approximately 26 countries," he continued.

"We will incorporate our land and maritime mobility services in 2027 — we will have ... full global coverage to the equator. About 54 countries will incorporate our aerial mobility services in 2028. We will have full global coverage, including the poles, in approximately 88 to 100 countries, and we will begin launching our Gen 2 constellation of an additional 3,200 satellites."

Although Amazon Leo got off to a slow start, analysts at Analysys Mason say its total downlink capacity has already surpassed the 3.6 terabits per second OneWeb currently provides.

China's countermove

Key Takeaways

- Starlink clone plans 14,000 satellites, but only ~108 have launched since August 2024.
- China nets early Belt and Road satellite agreements, including countries with Starlink.
- Launches ramping up for Guowang national security network.

China is progressing with two state-backed constellations intended to provide non-Western alternatives to Starlink: Qianfan and the far more secretive Guowang network.

Spacesail operates Qianfan, which is pitched as a commercial rival to Starlink though it is not initially targeting consumers.

Backed by the Shanghai municipal government and Chinese Academy of Sciences, the program envisions as many as 14,000 satellites. To date, only about 108 have launched since August 2024, and expectations for roughly 500 more ahead of a 2025 service rollout look increasingly unlikely amid reports that a launch tender went unfilled.

According to statistics maintained by astrophysicist Jonathan McDowell, 14 of the satellites have also failed to raise their orbits, which are decaying.

China is racing to address bottlenecks. A flurry of new rocket development programs have been announced to meet growing constellation demand as many parts of the country's industrial base is retooled around mass satellite deployment.

These national efforts are being mirrored at the provincial level, with Guangdong recently unveiling plans to build out major commercial space capabilities, including manufacturing capacity to support large-scale constellations.

Getting in on D2D

Beijing has also signaled its intent to compete head-on in the rapidly emerging global market for D2D services.

In late August, China's Ministry of Industry and Information Technology (MIIT) issued guidelines to promote phone-to-satellite connectivity and Internet of Things (IoT) applications, targeting large-scale adoption by 2030.

The policy calls for seamless integration with existing mobile networks under a "no SIM swap, no number change" approach, while encouraging partnerships between major telcos and satellite providers.

Soon after, MIIT granted China Unicom a license to provide satellite mobile services, joining China Telecom, while China Mobile has submitted its own application.

Guowang steps into focus

More notable constellation deployment progress has been made with Guowang, a planned network of nearly 13,000 satellites.

Often compared to SpaceX's Starshield because of its opaque governance and presumed national security applications, China aims to have 400 Guowang broadband satellites in LEO by 2027.

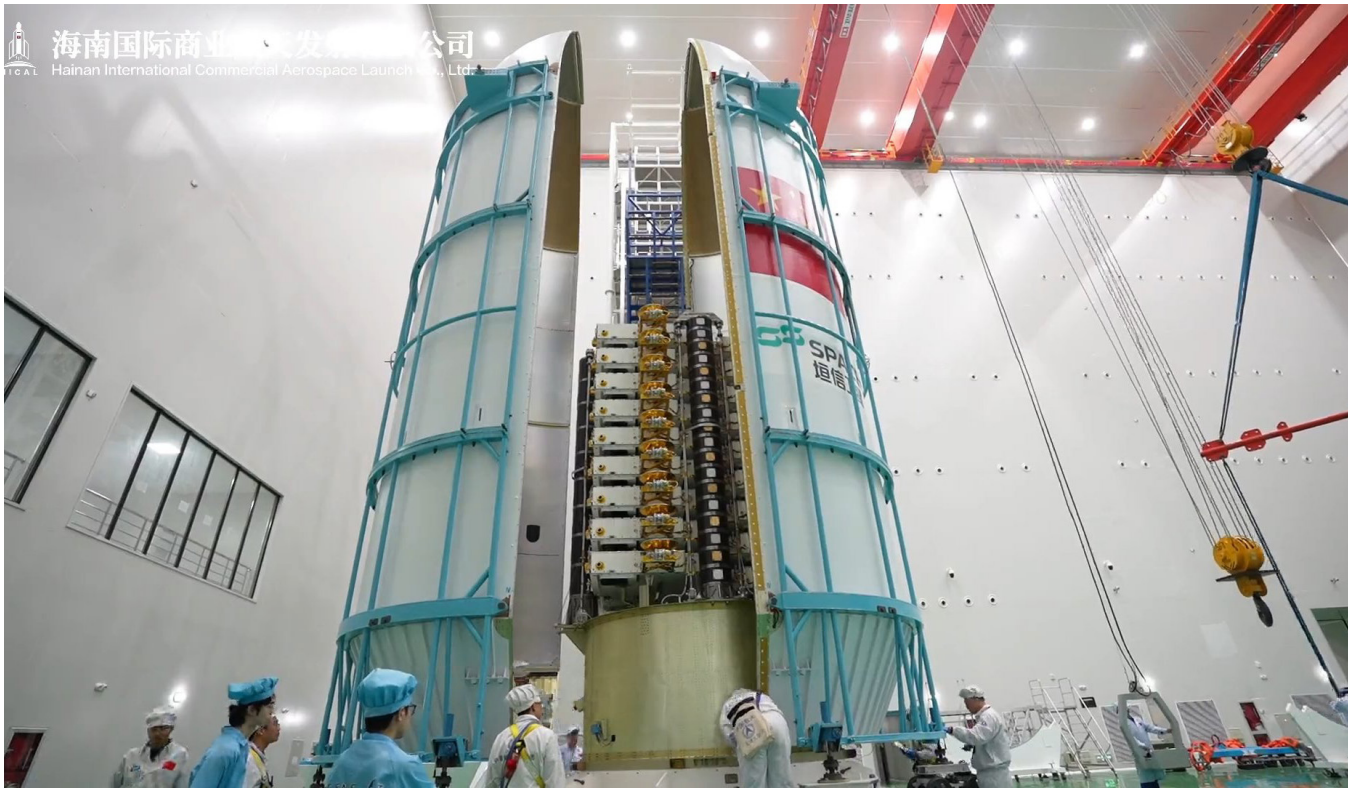
The country deployed its 13th batch of broadband satellites for the constellation Nov. 9, likely taking the number of operational Guowang satellites in LEO to around 104 as its launch cadence ramps up.

Chinese media has quoted officials saying the first generation of over 100 satellites will be completed by year-end to support diplomatic and emergency uses, although the technical framework for a larger second-generation constellation has not yet been finalized.

Together, Spacesail and Guowang are part of a broader geopolitical counterstrategy that aims to leverage LEO broadband for economic development and military reach.

China began launching satellites for its 14,000-strong Qianfan broadband constellation in earnest in August 2024.

CCTV



A batch of Qianfan satellites being prepared for launch on a Long March 8 rocket.

According to French space situational awareness firm Aldoria, they are part of a drive toward digital sovereignty and militarization, intended to do far more than reduce global dependence on Western infrastructure.

"The fact that these initiatives are directly supported by the Chinese state heightens fears that they could be used for military purposes and mass surveillance," Aldoria said in a May report on the country's space activities.

"China is not content simply to catch up with the United States; it is actively deploying systems capable of disrupting, neutralizing and monitoring adversary infrastructures," the report added.

A Chinese Starlink

Internationally, Spacesail has been more outward-facing, signaling negotiations with roughly 30 countries and announcing early agreements in Brazil, Malaysia, Thailand and Kazakhstan.

These deals help establish regulatory goodwill and position China to extend its Belt and Road influence into digital infrastructure. Analysts expect Beijing to focus on emerging markets across the Global South, aligned with the global infrastructure and influence campaign the country launched more than a decade ago.

Starlink is already active in Brazil, Malaysia and Kazakhstan, while permission to serve Thailand has come up against ownership hurdles. OneWeb is active in most of these same markets, though its rollout in

Spacesail's Strategic Announcements

Although Spacesail is gaining traction with international MoUs, key commercial elements like term sheets, pricing and binding contracts have yet to emerge.

Brazil
NOV. 2024
Signed a cooperation agreement with Brazil's Ministry of Communications, covering satellite communications, 5G, digital infrastructure and broadband access.

Malaysia
FEB. 2025
Signed an MoU with flagship geostationary operator Measat to collaborate on LEO broadband services, direct-to-device communications and Internet of Things (IoT) solutions.

Thailand
APRIL 2025
Secured a strategic cooperation agreement with Thailand's Ministry of Digital Economy and Society, potentially leading to pilot programs in rural provinces.

Kazakhstan
JUNE 2025
Established a local subsidiary at a Kazakhstani financial hub in Astana, with a capital investment of $17 million.

SN Intelligence SOURCE: PUBLIC PRESS RELEASES

HAINAN INTERNATIONAL COMMERCIAL SPACE LAUNCH

Malaysia has been delayed pending approvals.

As for how all of this shakes out, industry experts point to the parallels with terrestrial telecoms: just as China's Huawei and ZTE reshaped global wireless markets, Chinese LEO constellations may appeal to countries less aligned with the West.

"Most Western countries will avoid Qianfan due to its Chinese heritage, as they avoid [Chinese equipment vendor] Huawei for their terrestrial networks," noted Armand Musey, a space industry analyst and founder of the advisory firm Summit Ridge Group.

Likewise, Musey expects many Eastern-aligned or non-Western countries to adopt the Chinese constellation while steering clear of Western options, much as they currently resist Nordic telecom vendors like Ericsson and Nokia.

"Then there will be a fight over countries in the middle, particularly developing countries, which will seek to pit the two sides against each other to get the best deal," he added.

Blaine Curcio, a senior advisor at boutique consultancy Novaspace, said it makes sense for Chinese telecom vendors to fold satellites into future 6G plans if satellites become a significant part of telco networks, especially given their foothold in many Belt and Road countries.

Starlink, however, has already partnered with telcos in places like Indonesia and the Philippines, where Huawei and ZTE equipment underpins much of the existing infrastructure.

"From a Chinese soft power perspective, it would seem a real shame to let all that Huawei and ZTE-built 3G/4G/5G infrastructure get superseded by Starlink," Curcio said.

In the near-term, analysts see little risk to Western constellations from Qianfan, as their primary markets rarely intersect.

Spacesail and Guowang also face hurdles familiar to Western rivals. Bureaucratic friction and launch capacity limits threaten to hamper growth, amid reports of higher satellite failure rates than Starlink's fleet.

For now, Starlink retains a commanding lead in scale, reliability and brand awareness. Yet China's state-backed constellations, buoyed by financing and policy support, could complicate the picture in markets where digital sovereignty and geopolitical alignment weigh as heavily as speed or cost.

Unlike regional GEO systems, LEO broadband networks are global by design. Satellites at low altitude cover only small areas as they move across Earth, requiring operators to field hundreds or thousands of them to maintain seamless coverage. Sustaining such vast constellations depends on maximizing international subscriber numbers, which makes market access a geopolitical as well as commercial priority.

As U.S.-China tensions deepen, a wider global LEO footprint also offers leverage in diplomacy, defense and digital influence. What remains uncertain is how aggressively China will seek to block Starlink, OneWeb and other Western operators from establishing footholds in regions where it is promoting its own services.

"Starlink is ahead of Qianfan, but if the Chinese government subsidizes it significantly, that will be a challenge for Starlink," Musey said.

Also of note is China's Geespace, or Zhejiang Spacetime Daoyu Technology Co., Ltd., which announced a $281 million investment from local investors in September to accelerate deployment of its IoT constellation. Geesatcom has about 52 satellites in orbit for IoT, with plans to complete the first phase of the constellation this year with 64 spacecraft.

However, the group has previously outlined plans to provide broadband connectivity with a 5,000-plus satellite constellation, in addition to enhanced precision navigation signals for applications, such as autonomous driving.

And a Russian Starlink?

Russian leaders have also said they are moving to develop an alternative to Starlink, which is used heavily by Ukrainian forces that have been fending off the country's invasion for more than three years.

Russia's state-owned news agency TASS in October cited Dmitry Bakanov, head of the country's space agency, saying that serial LEO deployments will start as early as December, joining six satellites already in orbit.

Bakanov is the former head of Gonets, a much smaller Russian communications constellation mainly used for government purposes.

In September, Reuters said Russian aerospace company Bureau 1440 is working on the global LEO broadband system. Reuters also cited Bakanov as saying Russia had learned from past mistakes that included dismissing an attempt by Musk in 2002 to buy an intercontinental ballistic missile for a space mission. According to Ashlee Vance's 2015 biography of Musk, Russia's refusal to take him seriously spurred the creation of SpaceX as a lower-cost alternative to the country's dominant launch industry at the time.

Government Dynamics in Satellite Communications

Key Takeaways

- Ukraine shows how critical LEO has become for modern warfare.
- Pentagon's PLEO program expanded from $900 million to $13 billion, with most early contracts awarded to Starshield.
- 212+ Starshield satellites are in orbit, according to Quilty Space, with 550 related service contracts.

As the commercial market and Starlink have evolved, so too has the Pentagon's thinking on satellite communications.

The U.S. Defense Department is increasing its projected spending on LEO internet services more than tenfold in response to surging demand from across the military.

The military's Proliferated Low Earth Orbit (PLEO) Satellite-Based Services program, launched in 2023 with a $900 million ceiling, has been expanded to $13 billion by the Defense Information Systems Agency (DISA) and the Space Force's Space Systems Command.

The PLEO program is an Indefinite Delivery Indefinite Quantity (IDIQ) contract and has so far selected 20 vendors to compete for specific task orders over a five-year base period, with an option for an additional five years.

Before this increase, the PLEO contract had already spent about $660 million of its original ceiling.

Of the contracts awarded thus far, most have gone overhelmingly to Starshield, SpaceX's militarized Starlink system, while OneWeb and others have received much smaller portions.

Quilty counts 212 Starshield satellites in orbit and has identified 550 unclassified contracts that provide Starshield-as-a-service across at least 50 U.S. agencies, from embassies to the Federal Emergency Management Agency (FEMA).

These include 350 contracts where SpaceX is a subcontractor. Viasat-owned Inmarsat, for instance, has about 60 delivery orders that bundle Starlink with their service for the Navy.

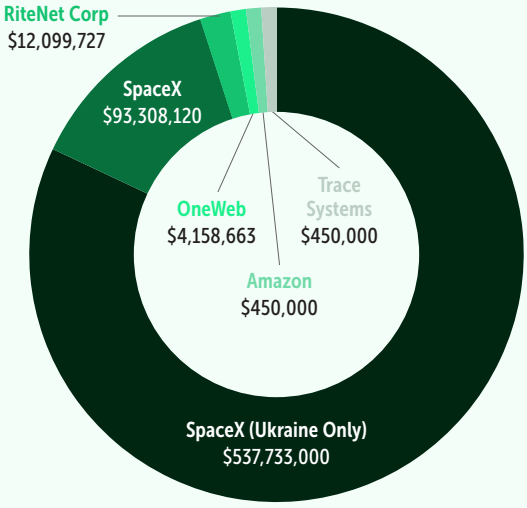
The Pentagon's push into PLEO is not limited to buying commercial services. In parallel, the Space Development Agency (SDA) is rolling out Proliferated Warfighter Space Architecture (PWSA), a government-owned network of hundreds of satellites designed to provide resilient communications and missile-tracking capabilities.

Structured around regular, competitive "tranches" of procurements, the PWSA has become a cornerstone of the Space Force's future architecture.

The effort was thrust into the political spotlight this summer after the Trump administration proposed

PLEO IDIQ Awards

The pLEO budget expansion was partly motivated by the prospect of Amazon Leo coming online and a desire to diversify LEO vendors, according to Quilty Space.



SN Intelligence

SOURCE: QUILTY SPACE

suspending funding for Tranche 3 of the PWSA's Transport Layer in favor of MILNET — a SpaceX-built constellation of 480 satellites leveraging Starshield technology to be operated by the National Reconnaissance Office (NRO).

Senate appropriators rejected the proposal, instead approving $500 million to keep Tranche 3 on track, citing the need to protect competition.

The move underlines growing unease over Pentagon reliance on a single commercial vendor.

During a May Senate Armed Services Committee hearing, Sen. Kevin Cramer (R-ND) revealed that the Defense Department is also considering incorporating Starshield directly into the SDA's Transport Layer.

The Department of the Air Force later clarified that no decision has been made, but even the prospect highlights the tension between SpaceX's unmatched scale and the SDA's years-long effort to cultivate a diverse supplier base that includes Lockheed Martin, Northrop Grumman, L3Harris and York Space Systems.

In 2021, the NRO contracted SpaceX to build and launch dozens of next-generation surveillance satellites developed in partnership with Northrop Grumman. A Falcon 9 launched another batch of these spy satellites in September, pushing the fleet of operational spacecraft past 200 in orbit.

Dominance worries

Key Takeaways

- Musk's shutdown of Starlink in Ukraine raised alarms over private influence in war.
- European officials warn of dependency on U.S. commercial infrastructure.
- Starlink/Starshield outage highlights the risks of embedding military ops in commercial systems.

Starlink's effectiveness during the war in Ukraine helped reshape the conversation for governments about satellite communications. It demonstrated the strategic value of resilient LEO connectivity and accelerated global military adoption of commercial satellite broadband.

The conflict showed how quickly satellite internet infrastructure has shifted from a supplemental capability to an essential strategic asset, influencing international policy toward securing and diversifying satellite communications.

This new reliance has also sparked unease as Starlink's dominance raises policy questions across both sides of the Atlantic.

Musk's ability to make unilateral decisions about Starlink service in conflict zones has added to these concerns. In July, Reuters reported that Musk personally ordered a shutdown of Starlink service as Ukrainian forces attempted to retake Russian-occupied territory, laying bare the awkward reality of a billionaire directly influencing the course of a war.

In 2023, Musk revealed he had denied a request to activate Starlink over Crimea the previous year to support a Ukrainian drone strike.

"If I had agreed to their request, then SpaceX would be explicitly complicit in a major act of war and conflict escalation," he said Sept. 7, 2023, on X.

Although Musk later pledged Starlink would not be turned off in Ukraine, uncertainty around long-term support buoyed Eutelsat's stock after the French operator confirmed talks to provide additional services to the country. OneWeb lacks the capacity to replace Starlink there entirely.

Funding for Starlink services in Ukraine also recently came into question after Poland's president vetoed legislation that underpinned subsidies for terminals provided to Kyiv, raising the prospect that government-backed support could lapse.

Meanwhile, Reuters cited the Pentagon in August saying the U.S. State Department has approved the

A Ukrainian soldier sets up a Starlink terminal.

UKRAINE MILITARY CENTER

potential sale of Starlink services and related equipment, alongside Patriot air defense sustainment, to Ukraine. The move suggests Washington is seeking a more formal, government-backed arrangement for Starlink in the conflict, mitigating some of the risks of ad hoc support while further cementing the system's role in military operations.

Yet, as Starlink becomes deeply embedded in European defense communications, concerns are mounting over reliance on a single commercial provider outside Europe's control. Policymakers and military leaders are now less focused on proving its effectiveness, and more on contingency planning should the service become unavailable or politically untenable.

"In the Ukraine war, we are dependent on communication by a privately owned communications system — the only one that is survivable right now," Martin Haunschild, business development manager for space and institutional affairs at optical technology specialist Mynaric, said May 29 during the SmallSat Europe conference.

"And it's sometimes not easy to handle this guy who owns it."

Congress, too, has taken notice as some in the U.S. defense community worry about over-reliance on a single private company for critical national security infrastructure.

In late 2024, U.S. House lawmakers in both parties grilled defense and NASA officials about SpaceX's influence, from potential foreign investment in SpaceX to whether national security missions have adequate backups if SpaceX were unavailable.

A rare Starlink outage in July 2025 that also disrupted Starshield showed the risks of embedding military operations in a commercial system.

Nonetheless, SpaceX currently has an outsized share of the defense LEO market by virtue of being first with an extensive network.

"Starlink is now seen as an indispensable asset throughout the entire government sector, from U.S. embassies to the battlefield," noted analysis from Quilty Space last year.

"Starlink's government sector momentum shows no sign of a slowdown."

So far, the Pentagon's answer has been that leveraging Starlink is worth the risk of dependency, given the huge leap in capability it offers.

Propping up non-US Starlink alternatives

Key Takeaways

- France doubled its stake in Eutelsat as Canada throws weight behind Telesat Lightspeed.
- Europe's troubled $11 billion IRIS^2 sovereign constellation targets service in 2031.
- NATO pledges 5% of GDP to defense by 2035, catalyzing space investments.
- EU's 800 billion euro defense plan to also benefit space.

Geopolitical shifts are increasing demand for alternatives to Starlink outside the U.S. Political turbulence, ranging from the war in Ukraine to the U.S. reassessing its global security role, are reinforcing the importance of national or regional alternatives.

Sovereignty has always been a strong growth driver for communications, Telesat's Katz noted during the *SpaceNews* webinar in April, but recent geopolitical events have underscored the need for competition and secure networks in space.

"That's super important for customers with or without these situations that we're seeing, whether it's in Ukraine or even in the United States, in terms of the political turmoil that's going on," he said.

"So that hasn't changed, but what has changed a little bit, I would say, is there's been an exclamation point. So geopolitical situations have just sort of become a proof point to these governments that we've been having discussions with, to reinforce ... there's a real need for competition.

"In the Ukraine war, we are dependent on communication by a privately owned communications system — the only one that is survivable right now. And it's sometimes not easy to handle this guy who owns it."

—Martin Haunschild, business development manager for space/institutional affairs at optical technology specialist Mynaric

"There's a real need for the ability to create private networks in space, as opposed to utilizing the same type of technology that was underutilized before."

Analysys Mason estimates governments spent over $100 billion on space in 2024 across civil and military.

Europe steps up

Nowhere is this push for greater sovereignty in space more visible than in Europe.

"The era of the peace dividend is long gone," European Commission President Ursula von der Leyen said March 18, as she was unveiling an 800 billion euro ($872 billion) initiative to bolster defense as the U.S. reassesses its global security role.

"The security architecture that we relied on can no longer be taken for granted ... We must buy more European."

Details of the ReArm Europe/Readiness 2030 plan are still emerging, but space executives on the continent expect a major boost for their industry thanks to the increasing role satellites play in national security.

Europe also continues to push for IRIS^2, a proposed multi-orbit sovereign broadband constellation designed to reduce reliance on foreign systems, envisioning more than 290 satellites entering service by early 2031.

On Oct. 16, the European Commission presented a working plan to track progress and deliver key defense capabilities by 2030, outlining a "European Space Shield" among four flagship programs.

Space Shield would integrate IRIS^2 with Europe's Galileo navigation constellation and other dual-use systems, supporting space domain awareness, anti-jamming/spoofing and in-space operations/services such as refueling. The European Commission plans to launch the program in the second quarter of 2026.

In November, Europe signed off a record 22 billion euro, three-year budget for the European Space Agency, with most of the new money to flow into telecom, Earth observation, navigation and launch programs. The budget included European Resilience from Space (ERS), a dual-use surveillance and secure-communications initiative tied to IRIS^2.

Contracts for IRIS^2 were signed in late 2024 after an industrial consortium called SpaceRISE — led by Eutelsat, SES and smaller Spanish operator Hispasat — agreed to co-fund its more than $11 billion cost.

SpaceRISE is due to pick suppliers for building IRIS^2 satellites before the end of the year, following an RFP stage.

Ukraine's freedom is Europe's freedom, European Commission President Ursula von der Leyen stressed during her State of the Union address Sept. 10.

EUROPEAN COMMISSION

Europe is recognizing "that there's been probably underinvestment and under-focus on some of these alternate technologies in the past," OneWeb's Canning said.

"And I think we are at that tipping point ... we need to do things more differently, and the industrial base is stepping up."

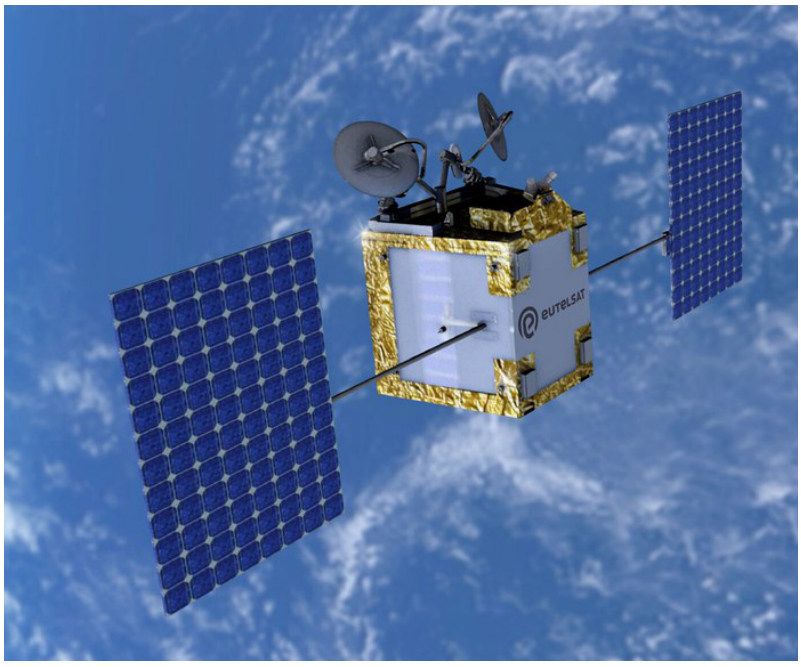
In a talk at the SmallSat Europe conference May 27, former Arianespace CEO Stéphane Israël argued IRIS² was essential for Europe in a time when SpaceX's Starlink holds an increasingly dominant position in the market.

"I'm totally convinced that IRIS² is a key opportunity for Europe," he said. "It is really something we must do all together."

"Europe needs IRIS² because we are in a moment of geopolitical disruption," Israël said. "There is a new race for orbital dominance and there is a necessity for Europe not to be reliant on non-European capacity."

However, skepticism remains over IRIS²'s timeline and ability to keep pace with Starlink and others amid ongoing bureaucratic and financial challenges.

And even as Brussels champions sovereignty, national approaches vary.



A rendering of a OneWeb broadband satellite, part of the world's only operational LEO broadband alternative to Starlink.

Is IRIS² enough?

Despite Europe's collective investment in IRIS², Bloomberg has reported that Italy is considering a $1.6 billion deal for secure Starlink connectivity, while Germany's armed forces are preparing to establish a new satellite system of their own to reduce dependence on Musk's network. German Defence Minister Boris Pistorius announced plans Sept. 25 to invest 35 billion euros in the country's space programs over the next five years, while warning about Russia and China's space warfare capabilities.

"The conflicts of the future will no longer be limited to the Earth's surface or the deep sea," he said. "They will also be fought openly in orbit."

The investments span communications, security, situational awareness, launch vehicles and a dedicated military satellite operations center.

"I think IRIS² is dead in the water, frankly," said Sven Meyer-Brunswick, principal at venture capital fund Alpine Space Ventures, during the SmallSat Europe conference in May.

"It's not a competitive program. It should have been started completely differently."

Meyer-Brunswick said Europe should have followed the approach the U.S. Space Force's Space Development Agency is taking with its missile tracking and communications constellations, developing them in tranches and awarding contracts to multiple suppliers.

Since 2019, Europe has attracted about 20% of global venture capital for upstream space businesses like satellite manufacturers and launch providers, according to Dealroom. That's second only to the U.S. but still roughly three times behind.

While keeping pace with the home of Silicon Valley is no small feat, Europe's progress continues to be hampered by bureaucratic hurdles, a more cautious investment culture and fragmented access to both talent and capital.

That said, SpaceX's headturning EchoStar spectrum deals for D2D could be the catalyst for investment boosts across multiple corners of the space industry.

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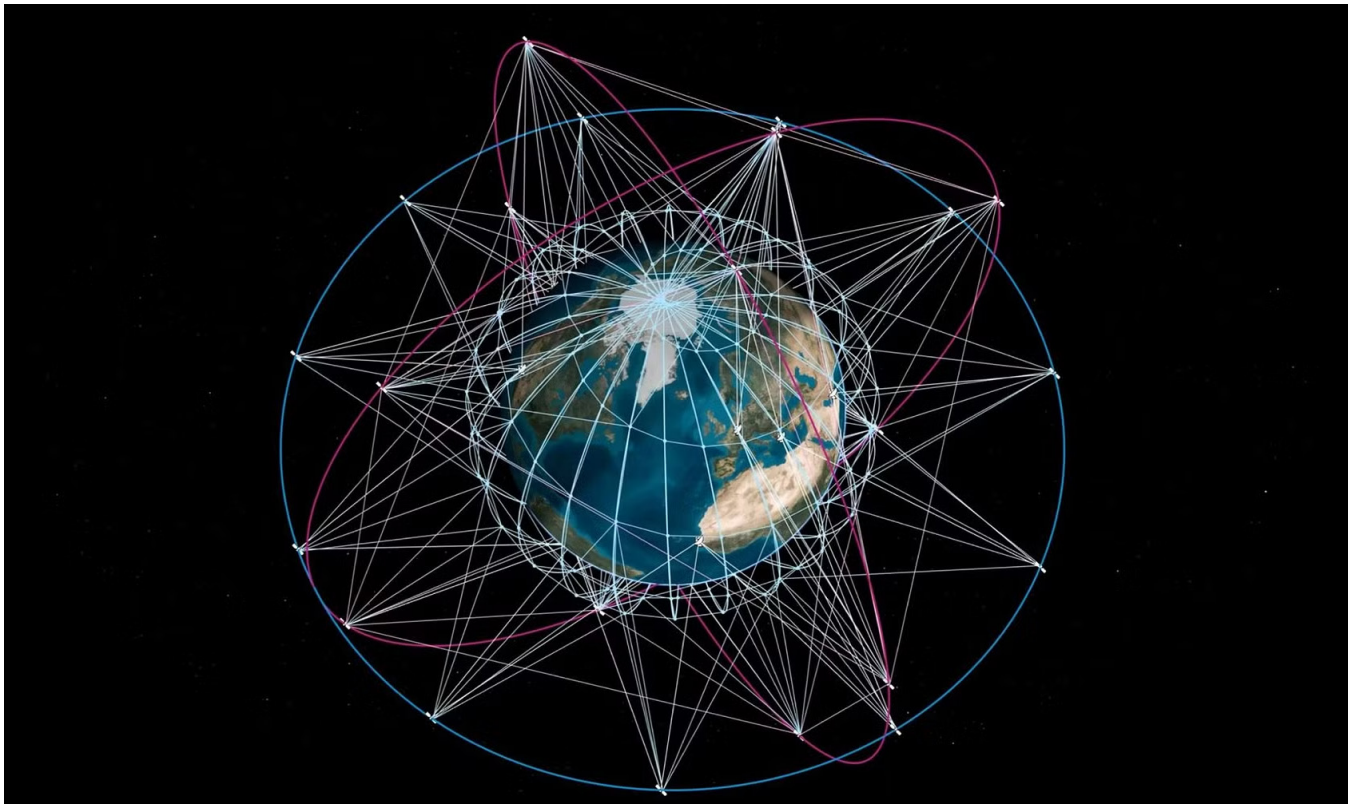


A rendering of IRIS², Europe's proposed sovereign multi-orbit broadband constellation.

Governments have already been stepping in to shore up strategic players, where they have them.

France has pledged to lead a $1.5 billion capital increase that would more than double its stake in Eutelsat to nearly 30%, strengthening the operator's plans to refresh its OneWeb constellation. The British government is also contributing, reflecting its continued role in OneWeb after selling the company to Eutelsat following its rescue from bankruptcy.

Canada, one of the countries most prominently targeted by U.S. trade policies during the Trump administration, has also injected billions into Telesat's Lightspeed constellation to bolster domestic LEO capabilities.

"We wouldn't be where we are today if it wasn't for the Canadian government," said Katz. "Funding these large infrastructure types of projects is probably the hardest hurdle to get over."

In addition to direct financial support, Katz pointed to how Canada's 1,400 global trade commissioners are actively facilitating Lightspeed's entry into international markets.

During World Space Business Week Sept. 15, Telesat CEO Dan Goldberg even pitched Lightspeed as a stopgap to IRIS², given the LEO constellation is set to come online at least three years before Europe's sovereign network.

Many other other countries outside the United States are also ramping up defense budgets, with much of that investment flowing into space.

NATO's recent commitment to raise defense spending to 5% of GDP by 2035 marks a significant shift in strategic priorities, noted Mark Boggett, CEO of British early stage investor Seraphim Space.

"Over recent years, space has become an indispensable domain in modern defence, from satellite-enabled intelligence and communications to orbital surveillance and early warning systems," Boggett said.

"This increased investment will catalyze innovation across the space tech ecosystem, fostering a more secure and responsive defence infrastructure as private companies and governments continue to collaborate towards shared objectives."

There has also been recent talk in Europe of scaling up IRIS². Laurent Jaffart, European Space Agency director of connectivity and secure communications, has urged member states to provide more funds to strengthen the program's resilience by maturing enabling technologies, such as low-cost, multi-orbit satellite terminals.

Altogether, ESA estimates these projects would cost around 600 million euros.

SES

New security threats

Key Takeaways

- A cyberattack on Viasat in 2022 showed vulnerabilities in ground infrastructure.
- SpaceX is strengthening encryption and anti-jamming for Starshield.
- Growing subsea cable sabotage is reinforcing the shift of critical infrastructure to orbit.

Escalating geopolitical tensions have heightened awareness of cybersecurity vulnerabilities in space infrastructure.

The 2022 cyberattack on Viasat's ground infrastructure at the onset of Russia's invasion of Ukraine underlined these risks, which officials say have persisted with ongoing malicious activities across the industry, even if they don't always generate headlines.

SpaceX has strengthened encryption protocols in response, empowering Starshield with advanced anti-jamming capabilities tailored to military users.

Would-be competitors such as Rivada say there is plenty of room for improvement.

"In the land of the blind, the one-eyed man is king," Rivada CEO Declan Ganley said during the *SpaceNews* webinar in April. "And there are a lot of things that customers, including enterprise and government customers, want — and they'd rather take what's on offer from Starlink and others than what they'd ideally like to have, but haven't got an opportunity to get yet."

Ganley said Rivada's vision for an "outernet" communications network would entirely bypass the internet and use intersatellite links to avoid gateways and relays on the ground.

"It means that you can contractually guarantee and provide service level agreements for complete data sovereignty, data residency and data security," Ganley said.

Growing attacks on subsea internet cables highlight the need to move more critical communications infrastructure off Earth, Ganley said. He added that Rivada is receiving increasing funding interest from sovereign wealth funds.

A sovereign wealth fund investor that prefers to remain private has already "put in a very substantial investment" into the network, he said.

But without any details disclosed and a regulatory deadline approaching, Rivada's true financial footing remains opaque, attracting persistent questions about whether it can deliver on its ambitious plans.

Sovereign D2D

Naturally, the sovereign thread also runs through the space industry's emerging D2D capability.

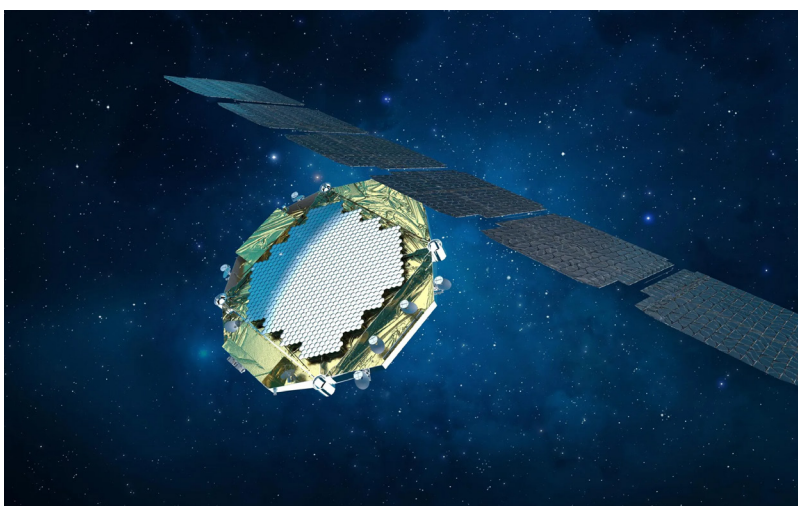
Despite efforts from Lynk (via SES) and AST to set up D2D operations abroad, it is not lost on the space industry that companies leading the charge to bring this capability to market all hail from the U.S., though Spain's Sateliot and OQ Technology of Luxembourg are making advances.

The same day Starlink and EchoStar unveiled their first mammoth spectrum deal, Europe's Thales Alenia Space said it had won government funds to lead a group to study improving D2D services using space-approved spectrum.

The group, which includes SES, plan to test connectivity compliant with terrestrial 3GPP mobile standards from LEO by early 2028 that could support fuller 5G services, not just basic text and emergency alerts like those Apple currently offers via Globalstar's L and S-band spectrum.

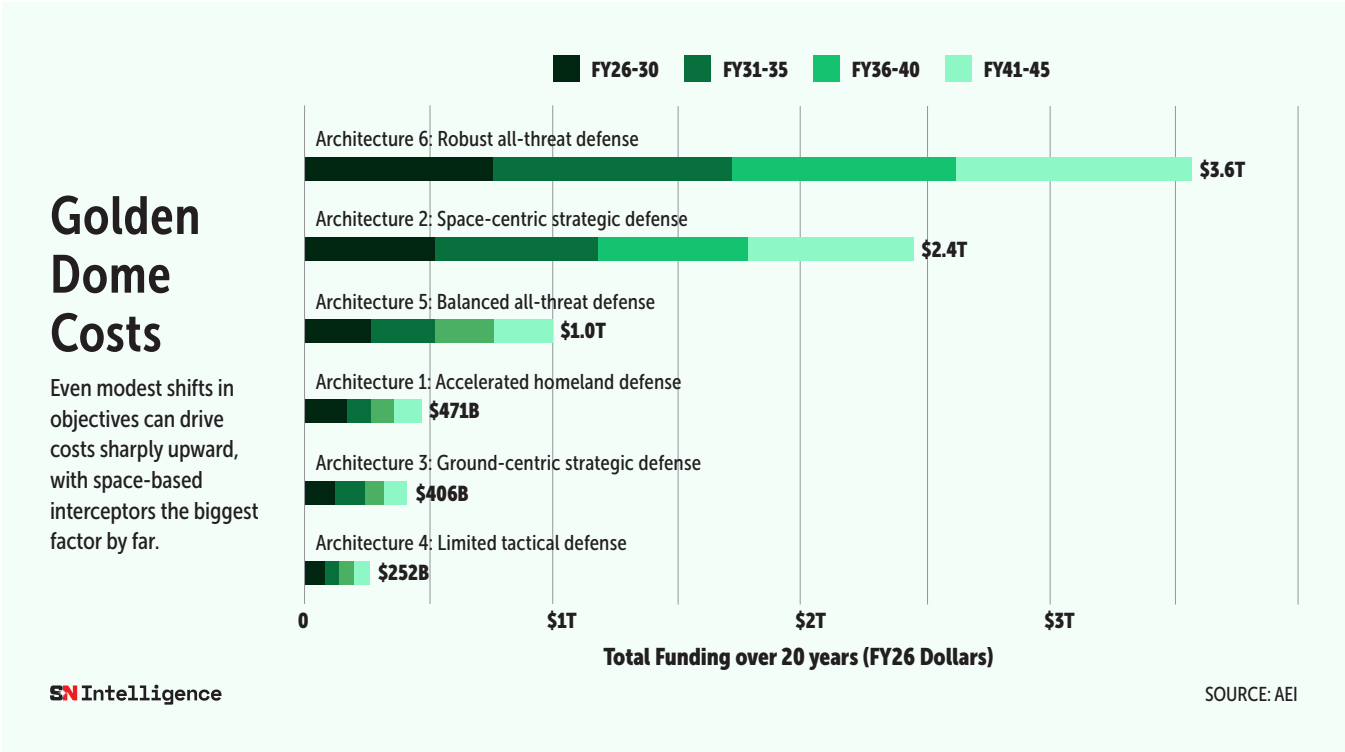
Barely a week after SpaceX's spectrum boost, Viasat also announced a joint venture with its UAE-based MSS peer Space42 to form Equatys, an independent satellite operator aiming to combine their L- and S-band frequencies for D2D within three years.

Equatys would control more than 100 megahertz of MSS spectrum already allocated across over 160 countries, boasting the world's largest coordinated block of D2D frequencies. The group would leverage



Rendering of the 5G Skytower low Earth orbit demonstrator satellite for the U DESERVE 5G project.

THALES ALENIA SPACE



Viasat and Space42's existing GEO fleets, as well as potentially other tenants, alongside new LEO satellites in the years ahead.

Its investment model mirrors that of cell tower companies, pooling spectrum and satellite assets under a neutral entity to lower unit costs, while using a partner-led funding framework to attract infrastructure investors seeking stable, long-term returns.

But more than that, Equatys is being positioned as a sovereignty-friendly D2D alternative, committing to work within national spectrum allocations and in closer coordination with governments to offer them access to a global system on their terms.

Starlink, meanwhile, has faced backlash in countries such as Iran over the availability of its service outside formal approvals.

"It's a scary thing for countries to think that anybody in their country with a cell phone can completely bypass national infrastructure in terms of all the compliance requirements," Viasat CEO Mark Dankberg said Sept. 16 during a press conference.

"So one of the ways to do that would be to extend the notion of shared infrastructure to a national carrier that is trusted by that country to operate it."

Equatys is also being designed to accommodate spectrum beyond L- and S-band, including terrestrial frequencies where regulators allow.

Golden Dome, golden opportunity

Key Takeaways

- Trump's missile defense initiative could cost up to $3.6 trillion over 20 years.
- $24.4 billion already allocated, including $5.6 billion for space-based interceptors.
- SpaceX, Palantir and Anduril seen as key commercial players in early frameworks.

The next frontier of the Pentagon's LEO strategy is missile defense.

Under the banner of Golden Dome, the Trump administration is exploring architectures that could fuse commercial constellations, AI-powered data analytics and autonomous defense systems.

Multiple firms are maneuvering to pitch what they could contribute, with the goal of demonstrating technology before the end of Trump's term.

But while advocates say Golden Dome's commercially led architecture could accelerate capability

development, critics warn it risks placing the most sensitive national security functions in the hands of a few private providers.

Early proposals reportedly placed SpaceX at the center of the effort, pairing its satellite infrastructure with Palantir's data analytics and Anduril's autonomous defense technologies.

Yet the situation seemingly remains fluid. A Reuters report in July indicated that alternative architectures to SpaceX are now under review, following Musk's public falling-out with Trump a month before.

Even still, the influence of SpaceX's vertically integrated, commercial-first model on Golden Dome remains unmistakable. In September, the Space Force's procurement arm opened a competition for companies to design a compact radio frequency communications terminal that would allow a satellite to connect directly to Starlink as part of part of Golden Dome.

Golden Dome's complexity lies as much in integrating vast streams of data as it does in launching interceptors, an area where SpaceX's vertically integrated satellite network gives it a natural advantage.

During an August *SpaceNews* panel, defense industry leaders stressed that the program's mission definition, whether to defend the homeland, provide tactical coverage or counter hypersonics globally, will fundamentally reshape its cost and design. Artificial intelligence is expected to be central, with officials calling for AI-enabled systems to prioritize threats at machine speed, a capability SpaceX already advertises through Starshield's secure, in-orbit processing.

The scale of Golden Dome's budget is equally striking. Between the administration's fiscal 2026 budget request and the "One Big Beautiful Bill" (BBB) reconciliation act passed in July, the Space Force is projected to receive $40.2 billion in FY26 — a 40% year-on-year increase, noted the Aerospace Corporation.

Roughly 16% of BBB defense funding has already been directed to Golden Dome, or $24.4 billion, including:

- $9.2 billion for pre- and post-launch threat tracking
- $8.7 billion for terrestrial missile defense systems and radars
- $5.6 billion for space-based missile interceptors
- $910 million for launch and test range infrastructure

Trump has suggested the program could ultimately cost as much as $175 billion over three years. The Congressional Budget Office projects the space-based interceptor element alone could cost between $161 billion and $542 billion, depending on whether coverage is limited to continental defense or expanded to global tactical operations.

And according to a 51-page report published Sept. 12 from Todd Harrison, a senior fellow at the American Enterprise Institute (AEI), Golden Dome could ultimately cost anywhere from $252 billion to $3.6 trillion over 20 years, depending on which threats it counters and where it provides coverage.

The vast range for the most comprehensive cost estimate for the program to date shows how many questions remained unanswered eight months after Trump announced the initiative.

Still, as structured today, Golden Dome embodies both the promise and peril of leaning heavily on commercial providers. Leveraging private-sector speed and scale could deliver capabilities at unprecedented tempo, but concentrating critical defense functions within a handful of companies, or a single vendor like SpaceX, introduces strategic vulnerabilities.

That risk is not lost on others. Telesat has begun actively positioning its forthcoming Lightspeed constellation as a complementary Golden Dome component, stressing its enterprise-grade design and sovereign alignment with U.S. allies.

The Canadian operator recently proposed offering the Pentagon pre-allocated blocks of Lightspeed bandwidth, rather than the more common wholesale or managed service models, as a way to build resilience and reduce dependence on any single commercial provider.

Across the Atlantic, Germany and France signed an implementation agreement Oct. 15 for Odin's Eye, a satellite-based missile warning system with a more modest budget.

U.S. President Donald Trump announced the country's Golden Dome missile defense system May 20, 2025.

WHITE HOUSE

Active Satellites Now Drive Orbital Crowding

Debris levels remain high but relatively stable as the relative risk environment shifts more toward congestion from functioning satellites rather than just debris clouds.

Year	Active Payloads	Dead Payloads	Alt. Payloads	Rocket Bodies	Op. Debris	ASAT Debris	Collision Debris	Other Debris	Spurious	Total
2014	1,294	2,527	12	1,683	1,446	3,321	1,698	5,782	0	17,763
2015	1,406	2,559	13	1,721	1,453	3,248	1,580	6,394	0	18,374
2016	1,508	2,608	12	1,754	1,465	3,223	1,542	6,448	0	18,560
2017	1,817	2,694	12	1,785	1,491	3,207	1,514	6,424	0	18,944
2018	2,042	2,789	16	1,846	1,543	3,192	1,490	6,598	0	19,516
2019	2,286	2,918	16	1,874	1,568	3,207	1,481	6,911	1	20,262
2020	3,259	3,098	17	1,895	1,587	3,182	1,501	7,461	0	22,000
2021	4,752	3,234	20	1,925	1,661	4,916	1,482	7,542	0	25,532
2022	6,728	3,315	28	1,964	1,624	3,470	1,363	8,175	0	26,667
2023	9,006	3,255	20	1,993	1,568	3,050	1,173	7,851	1	27,911
2024	10,818	3,136	20	2,000	1,481	2,850	995	8,197	1	29,498

SN Intelligence

SOURCE: JONATHAN MCDOWELL'S SPACE ACTIVITIES IN 2024 REPORT, JAN. 24, 2025

The environmental threat

Key Takeaways

- At least one Starlink satellite burns up in the atmosphere each day
- Starlink V2 Mini brightness averages magnitude 5.16–6.24, still above astronomy's recommended threshold of 7.
- Guowang (mag 5.07) and Qianfan (5.76) also exceed limits, intensifying light pollution concerns.

Despite the growing need for hundreds of thousands of broadband satellites from Starlink and others, the increasingly crowded LEO environment poses critical space sustainability questions.

At the top of the list of concerns is the so-called Kessler effect, a cascade of collisions that could render key orbits unusable for generations if debris levels grow unchecked.

SpaceX coordinates with other satellite providers to avoid potential collisions, publishes position data and reserves fuel so a Starlink can be actively de-orbited at the end of its roughly five-year operational life. Yet experts also warn of "top-down pollution" as unprecedented amounts of human-made debris ultimately fall back to Earth.

At least one Starlink satellite falls back to Earth each day, according to McDowell, with Amazon and Chinese constellation deployments now underway set to exacerbate congestion and debris risks.

The U.K.'s National Space Operations Centre tracked 92 objects re-entering the atmosphere in April, comprising 80 satellites and 12 rocket bodies. That same month, 118, mostly Starlink spacecraft were added to the official U.S. satellite catalog.

SpaceX has taken steps to improve sustainability. It has received permission to lower Starlink satellites closer to Earth as it seeks to go lower still, which cuts latency but also ensures defunct satellites deorbit more quickly, reducing long-term debris risk.

The company has also proactively deorbited older satellites after identifying maneuverability issues.

But progress has been uneven when it comes to light pollution, according to a recent study published in June from astronomers affiliated with the International Astronomical Union's Centre for the Protection of the Dark and Quiet Sky from Satellite

Constellation Interference (IAU CPS).

The study found that nearly all operational broadband constellations are falling short of the industry pledge to keep satellites no brighter than magnitude 7 at altitudes of 550 kilometers or less, a threshold meant to protect professional astronomy. The worst offenders are AST's BlueBird satellites, with an average brightness of magnitude 3.3, and occasionally flaring brighter than magnitude 2, making them visible to the naked eye even in light-polluted skies. However, AST's proposed constellation is also far smaller than Starlink and other megaconstellations.

None of SpaceX's Starlink spacecraft meet the magnitude 7 limit, according to the analysis. The current generation of V2 Mini Starlinks have average apparent magnitudes between 5.16 and 6.24, which is dimmer than BlueBird, but still above the recommended threshold.

SpaceX has tried mitigation measures, such as darker coatings and VisorSats, but lowering satellites to reduce orbital debris risk has also made them appear brighter from the ground, partly offsetting those gains.

China's Qianfan satellites average magnitude 5.76 and Guowang satellites magnitude 5.07, even though both operate at higher altitudes of around 1,000 km.

The analysis did not include Amazon Leo, which began launching its first operational satellites in April and were still climbing to operational orbits around 600 km at the time of the study.

At a conference in August, industry officials said the magnitude-7 goal remains worthwhile but "really, really difficult" to achieve because of the technical trade-offs involved in satellite design and the need to preserve performance.

Regulatory gaps

Environmental review under U.S. law is also emerging as a point of friction.

Under the 1967 National Environmental Policy Act (NEPA), federal agencies have been required to assess the environmental impacts of major actions.

But the FCC has routinely invoked categorical exclusions to bypass comprehensive environmental impact analyses for satellite expansion plans, to the ire of astronomers and environmental groups.

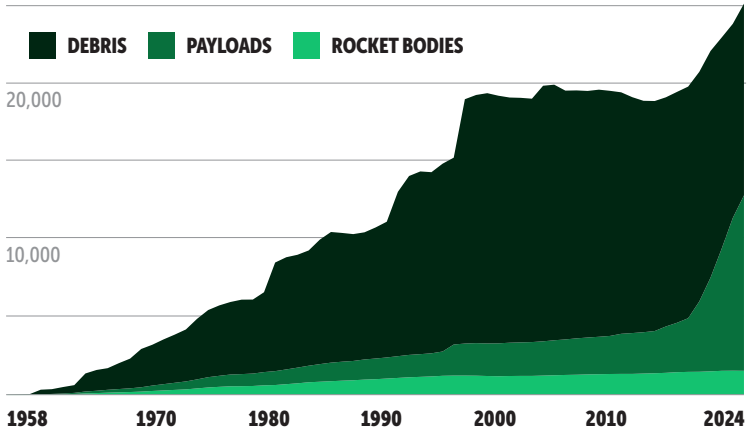
Three years ago, a U.S. appeals court shot down Viasat's attempt to force an environmental review on Starlink's expansion plans. Viasat had argued that the NEPA exemption was implemented decades before debris and other environmental risks posed by massive constellations could come to light.

In August, the FCC officially proposed excluding space-based operations from NEPA "because they are 'extraterritorial activities' with effects located entirely outside of the jurisdiction of the United States."

The regulator is seeking comments on the proposal, which has received support from companies including SpaceX, Amazon and AST.

Tracked Objects in Low Earth Orbit

The vast majority of space debris is too small track, with the European Space Agency estimating in 2021 that there were more than 130 million objects larger than one millimeter.



SN Intelligence

SOURCE: U.S. SPACE FORCE/OUR WORLD IN DATA

Starlink at the Crossroads

Starlink has shown the satellite industry how quickly scale can change what is possible. It has forced legacy players to consolidate, pushed regulators to rethink spectrum policy and prompted militaries to reimagine communications in the era of proliferated LEO.

With V3 satellites on the horizon, Starship edging closer to service and new government programs like Golden Dome taking shape, SpaceX is extending its model of vertical integration into new frontiers.

But Starlink's dominance also comes with vulnerabilities: spectrum battles that remain unresolved, risks of overreliance by militaries and governments and a growing environmental footprint in orbit.

Competitors such as OneWeb, Amazon Leo, Lightspeed and others may be behind, but their strategies are designed to highlight the weaknesses in SpaceX's "one-size-fits-all" approach, leveraging multi-orbit capabilities, deeply integrated terrestrial telco partnerships and their own state-backed advantages in home markets.

And then there's China.

A Goldman Sachs report released in March counted as many as 70,000 LEO satellites slated to launch between 2025 and 2031.

More than two-thirds of those satellites are likely to be from China, according to Allen Chang, head of the Greater China Technology Research team at Goldman Sachs.

The investment bank sees the mainstream use case for satellite internet technology converging with the rollout of 6G in the next decade, even as near-term growth targets the 2.5 billion people who remain offline.

Under its base-case forecast, Goldman Sachs expects the satellite market is on track to jump sevenfold to $108 billion by 2035, though the market could be worth as much as $457 billion under its most optimistic scenario.

Even with such expansion, commercial deployments alone are unlikely to close the digital divide.

The United Nations estimates it will take up to $2.8 trillion to achieve universal connectivity by 2030. Starlink is part of that solution, but isn't the whole answer. Whether SpaceX sustains its momentum will depend on Starship, regulatory decisions and on whether the company can balance Musk's Mars ambitions with the needs of customers on Earth.

Starlink has become more than an internet service. It is a test case for how private infrastructure can become public-critical, reshaping geopolitics in addition to global markets. The question now is whether the rest of the world will accept that future or insist on alternatives.