

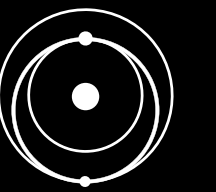
STARLINK

PROGRESS 2024



STARLINK

CONNECTING THE UNCONNECTED



Expanding Boundaries for Humans on Earth

A third of humanity remains offline, and many more only have basic connectivity, which is often slow, intermittent, and unaffordable. Starlink is working hard to close the digital divide by quickly expanding access to high-speed internet all around the world, especially for those in rural and remote areas.

Fast, reliable internet for many people means access to healthcare, the ability to take online classes, work from anywhere, and communicate with friends and family in real time—and it can even help save lives.





In just over five years, SpaceX designed, deployed, and activated high-quality internet, which is now available for over 2.8 billion people around the world, including for those who live in some of the most remote places on Earth.

While our mission to connect as many people as possible is far from complete, we are sharing Starlink's progress to date. This is a shared mission, and we're proud to work with so many around the world — from educators and emergency responders to commercial airlines and cruise ships to the millions of Starlink customers. We are grateful for your support.

This year, SpaceX focused on four core areas of development and innovations:

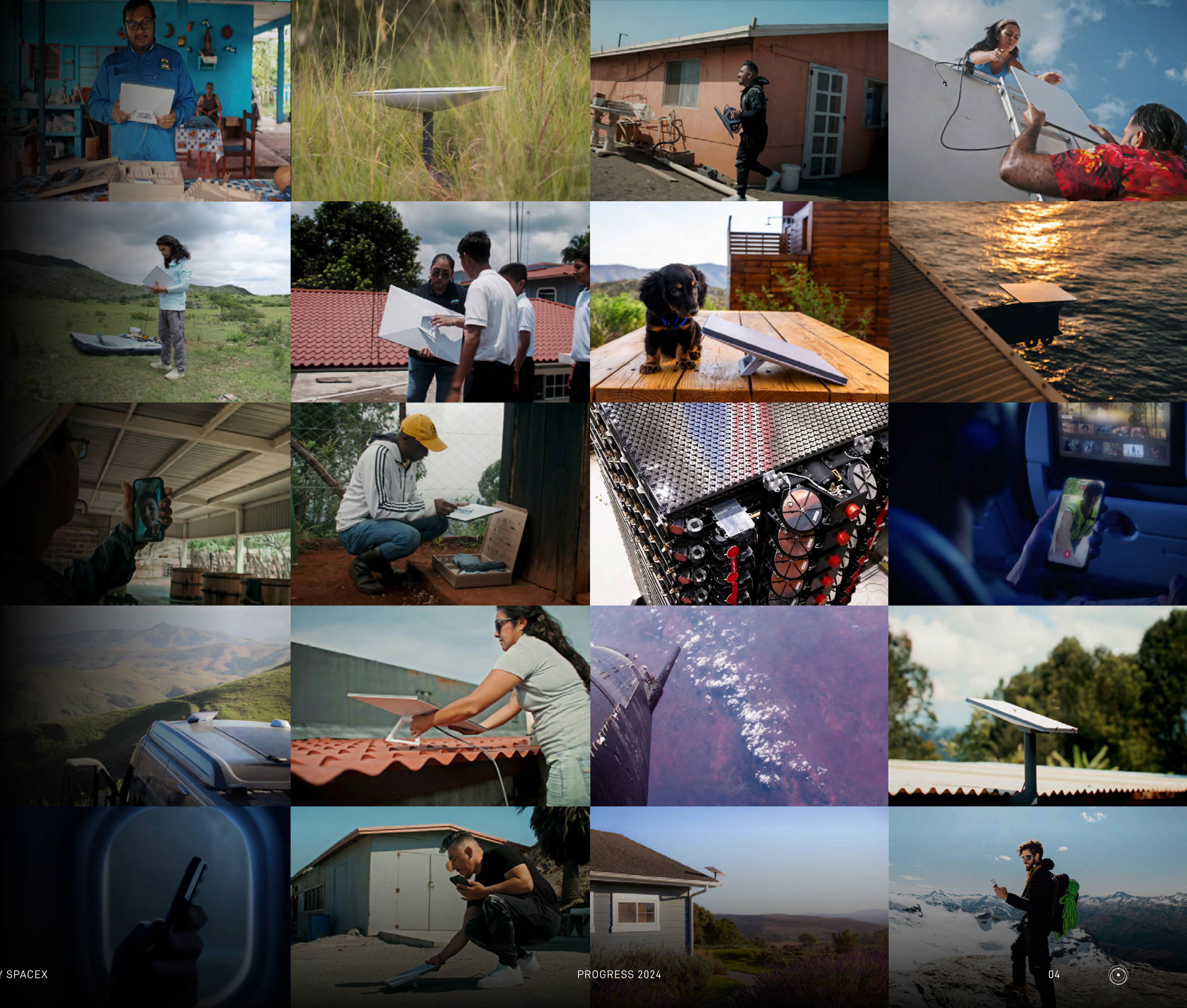
- **Technology:** we improved our launch vehicles, satellites, ground stations, customer kits, app, and production systems
- **Coverage:** we deployed updated infrastructure, gained a significant number of regulatory approvals, and activated service in 27 new markets —adding more than 500 million people to Starlink's accessible market
- **Customers:** we established relationships with millions of people using Starlink, often in the most hard-to-reach areas of the world
- **Safety and sustainability:** we enhanced our commitment to keeping space safe, sustainable, and accessible to all



SpaceX has completed more than 200 Starlink launches, placing more than 7,000 Starlink satellites in orbit. With each launch, Starlink adds more capacity to the constellation and continues to expand its coverage, connecting even more people in underserved and hard to reach areas around the world.

This progress report highlights several remote communities where Starlink is providing fast, reliable, and affordable internet. Rural school districts, counties, and tribal governments are now able to offer online access to education, telemedicine, and many other critical services—in some cases, for the first time ever.

We look forward to furthering Starlink's impact in the coming years as we work to expand access to high-speed internet all around the world, and beyond.



Starlink is connecting

4.6M+



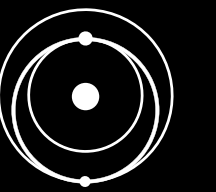
Over five years, the Starlink team has worked tirelessly to design, launch, and activate internet from space that's now available to over 2.8 billion people around the world.

SpaceX opened a 700,000 square foot production facility in Bastrop, Texas for kit production. In the first 10 months, Starlink produced one million of our new Standard kits. Two years ago, this facility was an empty field in Texas; now Bastrop teams are producing tens of thousands of customer kits each week that can be shipped around the world in days.



STARLINK

PROGRESS FOR CUSTOMERS



PROGRESS FOR CUSTOMERS

At its core, Starlink's cutting-edge technology exists to serve humanity. Today, Starlink proudly supports our first 4.6 million+ customers—individuals and organizations who are pioneering global connectivity by bringing Starlink into their communities. We are deeply grateful to these early adopters who have trusted us and are already using Starlink to transform lives in countless ways: advancing conservation efforts, improving education, fostering entrepreneurship in remote areas, supporting small business needs, driving scientific discovery, enhancing responses to disaster relief efforts, expanding access to healthcare, supporting sustainable farming, facilitating work-from-anywhere lifestyles, and even encouraging reverse migration to rural areas.

Beyond land-based applications, Starlink is also meeting the demands of aviation, rail, and maritime industries, as well as supporting communication needs in space exploration. These remarkable customers are demonstrating how connectivity can unlock opportunities, bridge divides, and empower communities worldwide. We are honored to work with these pioneers in building a more connected, resilient, and inclusive future.





PROGRESS FOR

01

CONSERVATION

At the Mara North Conservancy in Kenya, rangers from the Mara Elephant Project (MEP) employ cutting-edge technology to safeguard Kenya's elephants and their habitat. The conservancy borders farmlands, and when elephants venture beyond its boundaries, conflicts can arise with farmers striving to protect their crops. Starlink enables various technologies to work in harmony, helping the rangers effectively mitigate these conflicts and protect both wildlife and farmers' livelihoods.





PROGRESS FOR

02

EDUCATION

Paul Akwabi is a tech enthusiast from Mombasa, Kenya, who has dedicated his life to teaching children vital tech skills. A self-taught hacker since age 11, Paul now runs a community lab called Tech Kidz Africa where kids explore computers, robotics, 3D printing, and drones. With Starlink, Paul can finally offer a reliable internet connection, giving students stable access to global resources and information that had previously been out of reach. This connectivity empowers them to foster a new generation of tech-savvy innovators in eastern Kenya, setting the stage for a technology-driven future led by the nation's youth.





PROGRESS FOR

03

SMALL BUSINESSES

Javier, a third-generation rancher in rural Mexico, has transformed his family's 74,000-acre farm with Starlink internet. This connectivity has revolutionized their mezcal production, allowing them to showcase their traditional distillation process globally. They now market directly to international customers, communicate with distributors, and access real-time market information. This has opened new opportunities for growth and innovation, while preserving their rich heritage.





PROGRESS FOR

04

SCIENCE

Throughout the history of research in Antarctica, communication has been a challenge. Early explorers were disconnected for months, or years, at a time; by the 1930s, audio broadcasting was possible, and in the 1960s, basic two-way communication via Telex was possible. Expensive, large-scale satellites were installed in the 1980s and 1990s, but a thousand seasonal workers at McMurdo Station shared a 17 Mbps connection. Now, with Starlink, researchers are able to collaborate with remote colleagues by the terabyte, and residents are able to seamlessly stay connected to families at home. Now, the world has a much greater window into Antarctic stories and science.





PROGRESS FOR

05 DISASTER RELIEF

In 2024, Starlink helped people around the world connect when other means of communication were unavailable. Whether it was the result of flooding, wildfires, earthquakes, hurricanes, cable cuts, or other crises when communication was impacted, the Starlink team worked with governments and key responding organizations to rapidly restore connectivity. These responses spanned North and South America, the Caribbean, Europe, Asia, and Africa.

When Hurricane Helene affected a wide region of the southeast United States, communities were disconnected from transportation and communication. Starlink was used by first responders to facilitate communication, search and rescue teams, hospitals, schools, local police patrols, and fire trucks. Residents could connect with friends,

family, and work, supported by free Starlink service for the rest of the year.

In a first, Starlink's Direct to Cell service was activated, allowing people to connect via LTE devices and send and receive more than 300,000 text messages. Hundreds of emergency alerts were also delivered via Direct to Cell to people in the affected areas, messages that otherwise wouldn't have been able to be received.

Although the Starlink team responds as rapidly as possible to every crisis, in times of disaster, minutes matter. So the best case scenario is that Starlink is already available and in the hands of responders and individuals. This was the case in Vanuatu, where Starlink became available in October 2024. When an earthquake struck in December, individuals were able to immediately use their Starlinks to support search and rescue efforts, and Starlink worked with our local resellers to send more kits to supplement.





PROGRESS FOR

06

HEALTH

Forty health centers across Rwanda have been equipped with Starlink as part of a trial with the Tony Blair Institute for Global Change. "We work much faster now, and patients no longer wait long for services. Previously, we relied on books and handwritten lab results ... now, everything is digitized," said Immaculée Nyinawibambe, head of Kajevuba Health Centre in Ntarabana Sector.

In Zimbabwe, Tawanda Njerere of the ZimSmart Villages initiative said, "Our doctors can conduct video consultations with near in-person clarity, seeing fine visual details essential for accurate diagnoses."





PROGRESS FOR

07

FARMING

Adriana Luna is a Mexican biologist and entrepreneur who has transformed organic farming practices using Starlink connectivity. Inspired by her daughter's pesticide-related illness, she now shares her expertise in organic soil nutrients and pesticide-free crop management with farmers across Mexico, including remote communities. Through this network, Adriana has fostered a collaborative community where farmers share experiences, learn new techniques, and improve crop health without harmful chemicals, opening up opportunities for growth in once-isolated areas.





PROGRESS FOR

08

WORKING ANYWHERE

Jason Runo, a comedian from Nairobi, has traded city life for beekeeping in rural Kenya. Seeking a deeper connection with nature, Runo now manages multiple hives in the countryside. He uses Starlink to bridge his remote location with the digital world, allowing him to stream educational videos and learn more about beekeeping practices. This reliable internet connection enables Runo to access online resources and share knowledge with local farmers, blending traditional methods with modern information. His journey showcases how improved connectivity can support unconventional career shifts and foster rural development, even in remote areas.





PROGRESS FOR

09

IN MOTION

Starlink Roam services expanded connectivity for customers on the move, delivering reliable, high-speed internet across vehicles, boats, and RVs worldwide. Starlink's in-motion terminals enable seamless internet access with download speeds of up to 220 Mbps and low latency, making streaming, video calls, and work-on-the-go effortless. Portable, customer-friendly devices automatically connect to satellites, maintaining stable connections even in remote areas.

From travelers exploring off-grid locations in RVs to remote workers staying connected while on the move, Starlink ensures customers stay online wherever their journeys take them, bridging the gap between connectivity and freedom of movement.





PROGRESS FOR

10

AVIATION

In 2024, Starlink installed service to 450 aircraft across all aviation customer segments while serving over 4.6 PB of data to passenger devices. Hawaiian Airlines began to offer transcontinental Starlink connectivity with daily flights over the Pacific Ocean, including destinations in Australia and Japan.

Qatar Airways began global service on its Boeing 777-300 aircraft. United Airlines and Air France announced their plans to install Starlink on their entire fleets, joining other airlines adopting the service, including Hawaiian Airlines, Qatar Airways, Air New Zealand, Zipair, airBaltic, and JSX. Starlink is now on contract for installation on over 2,000 additional aircraft.





PROGRESS FOR

11

MARITIME

In 2024, Starlink Maritime connected more than 75,000 vessels, including 300+ cruise ships, serving over 10 million cruise passengers annually—30% of the global total. We provide reliable internet for passengers and crew, supporting streaming, video calls, and communication in even the most remote waters. Shipping companies like Maersk, Hapag-Lloyd, and Mitsui O.S.K. Lines use Starlink to improve operations with real-time data and diagnostics, while cruise operators enhance onboard experiences with high-speed Wi-Fi. Starlink Maritime is transforming connectivity at sea for both travel and industry.





PROGRESS FOR

12

RAIL

In 2024, Starlink made significant strides in improving internet connectivity for train passengers across various regions. Florida's Brightline became the world's first passenger rail service to implement Starlink, offering free, uninterrupted Wi-Fi on trains between Miami and Orlando. Similarly, ScotRail introduced Starlink on its Far North Line trains in the Scottish Highlands, providing reliable internet on remote routes to Inverness, Thurso, and Wick. These advancements enhance passenger comfort and operational efficiency, addressing long-standing connectivity challenges in underserved areas.





PROGRESS FOR

13

EXPLORERS

In 2024, Starlink's Direct to Cell technology made it possible for explorers in remote areas to use their mobile phones where they never could before. By linking phones directly to satellites, it removes dead zones, letting adventurers send messages and stay safe in places far from towns or cell towers. With text services already available and more features like data and IoT tools coming, Starlink Direct to Cell is helping people explore with better tools and peace of mind.





PROGRESS FOR

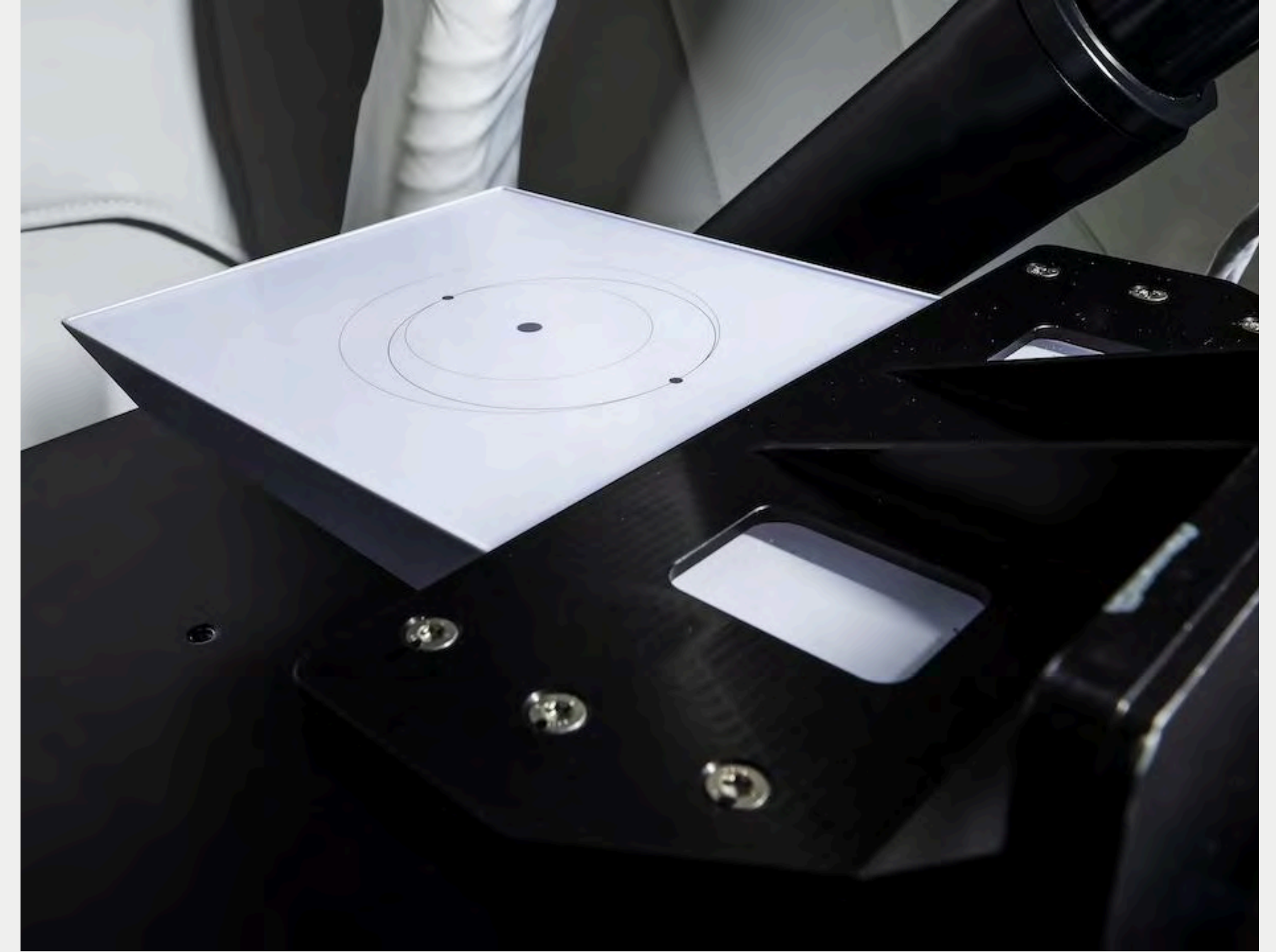
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SPACE EXPLORATION

During the Polaris Dawn mission in September 2024, the crew used Starlink aboard Dragon to communicate with people on Earth—a first for this technology. The Polaris Dawn crew not only spoke with relatives, but also sent photos and messages from orbit. Mission Specialist Sarah Gillis even transmitted a violin rendition of "Rey's Theme" from Star Wars via Starlink. During their five-day mission, the crew also used Starlink's high-speed capabilities to send real-time data collected from their ~40 science and research experiments conducted on-orbit to mission control.

The Starlink network even supported a more than 40-minute, live video call and Q&A between the Polaris Dawn crew and SpaceX employees in Hawthorne, California. For nearly half an orbit of Earth, Starlink's laser mesh network and high-bandwidth, low-latency connection to the SpaceX Dragon spacecraft – with both the Starlink satellites and Dragon spacecraft moving at more than 17,500 mph in orbit – enabled an uninterrupted, live, high-definition video conference to and from space.





PROGRESS FOR

15

SPACE EXPLORATION

SpaceX is looking to extend its connectivity service offerings via a commercially available Plaser product. Like the Polaris Dawn mission, Plaser will allow future human spaceflight crews to use lasers and a connection over the Starlink laser mesh to access their vehicle at virtually any time. Vast's Haven-1, scheduled to launch as early as 2026, will be the world's first commercial space station to use this new service.

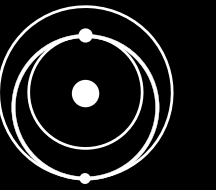
“Hello Earth — We are so grateful for all the support! Please enjoy two recent photos from our mission and stay tuned for our next message. Sent to you from space over a beam of Starlink laser light.”

POLARIS DAWN CREW



STARLINK

TECHNOLOGY



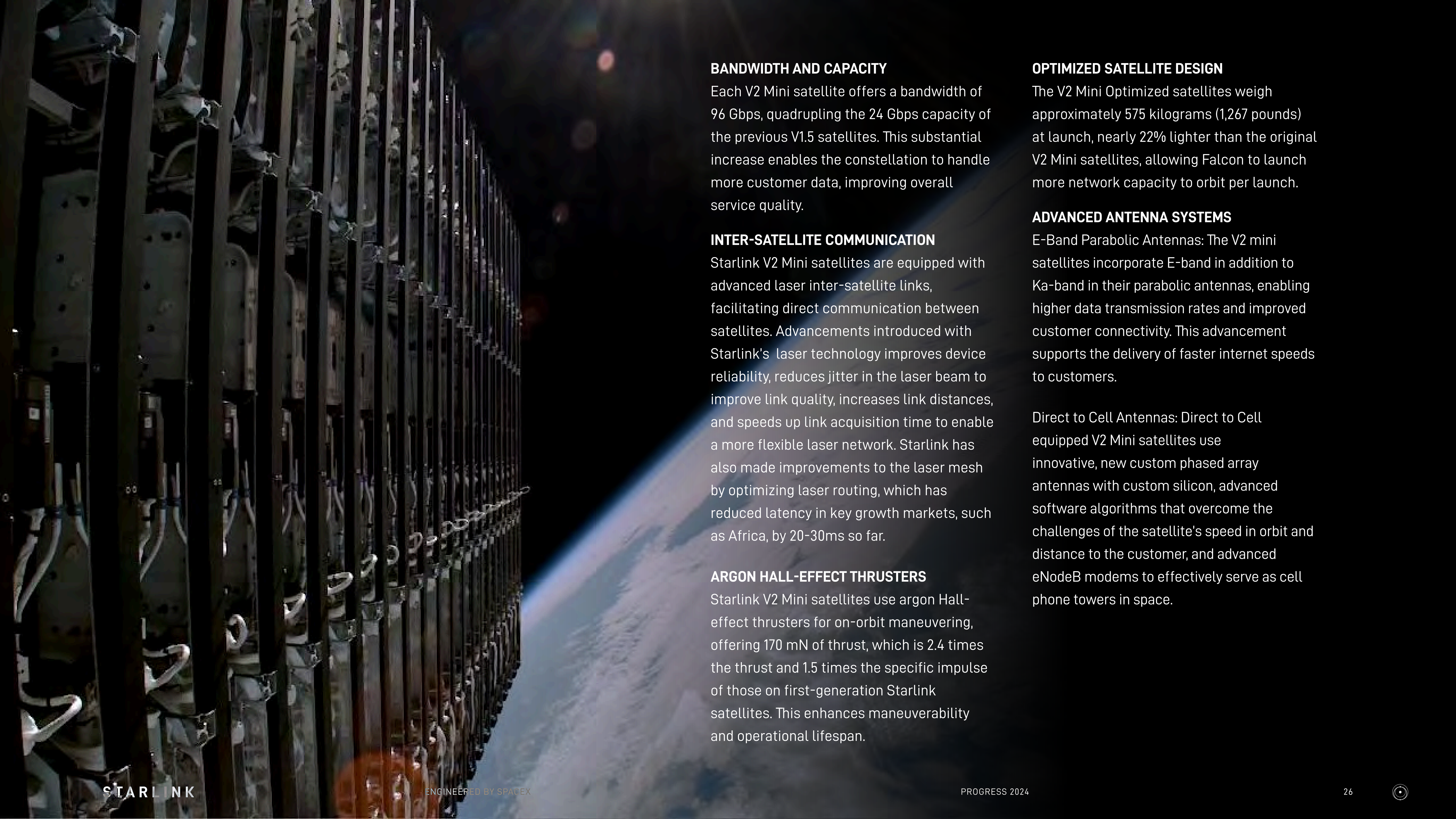
SATELLITES

A New Generation of Satellites Advancing Starlink's Global Connectivity

The V2 Mini satellites, introduced in 2023, enhance performance with quadrupled bandwidth capacity (96 Gbps per satellite), advanced laser inter-satellite links for global coverage, and improved argon-based propulsion systems for better maneuverability and lifespan. Equipped with E-band parabolic antennas, they deliver faster speeds and higher capacity, marking a pivotal leap in Starlink's mission to provide reliable, high-speed global internet access.

In 2024, Starlink introduced an optimized version of the V2 Mini satellite. These satellites have a new backhaul antenna powered by a SpaceX-designed and built dual band chip, called Doppio. The satellites have upgraded avionics, propulsion, and power systems, and are mass optimized for Falcon 9 to allow up to 29 satellites to launch on each mission – six more satellites per launch than the original V2 Mini design.





BANDWIDTH AND CAPACITY

Each V2 Mini satellite offers a bandwidth of 96 Gbps, quadrupling the 24 Gbps capacity of the previous V1.5 satellites. This substantial increase enables the constellation to handle more customer data, improving overall service quality.

INTER-SATELLITE COMMUNICATION

Starlink V2 Mini satellites are equipped with advanced laser inter-satellite links, facilitating direct communication between satellites. Advancements introduced with Starlink's laser technology improves device reliability, reduces jitter in the laser beam to improve link quality, increases link distances, and speeds up link acquisition time to enable a more flexible laser network. Starlink has also made improvements to the laser mesh by optimizing laser routing, which has reduced latency in key growth markets, such as Africa, by 20-30ms so far.

ARGON HALL-EFFECT THRUSTERS

Starlink V2 Mini satellites use argon Hall-effect thrusters for on-orbit maneuvering, offering 170 mN of thrust, which is 2.4 times the thrust and 1.5 times the specific impulse of those on first-generation Starlink satellites. This enhances maneuverability and operational lifespan.

OPTIMIZED SATELLITE DESIGN

The V2 Mini Optimized satellites weigh approximately 575 kilograms (1,267 pounds) at launch, nearly 22% lighter than the original V2 Mini satellites, allowing Falcon to launch more network capacity to orbit per launch.

ADVANCED ANTENNA SYSTEMS

E-Band Parabolic Antennas: The V2 mini satellites incorporate E-band in addition to Ka-band in their parabolic antennas, enabling higher data transmission rates and improved customer connectivity. This advancement supports the delivery of faster internet speeds to customers.

Direct to Cell Antennas: Direct to Cell equipped V2 Mini satellites use innovative, new custom phased array antennas with custom silicon, advanced software algorithms that overcome the challenges of the satellite's speed in orbit and distance to the customer, and advanced eNodeB modems to effectively serve as cell phone towers in space.



LAUNCH VEHICLES

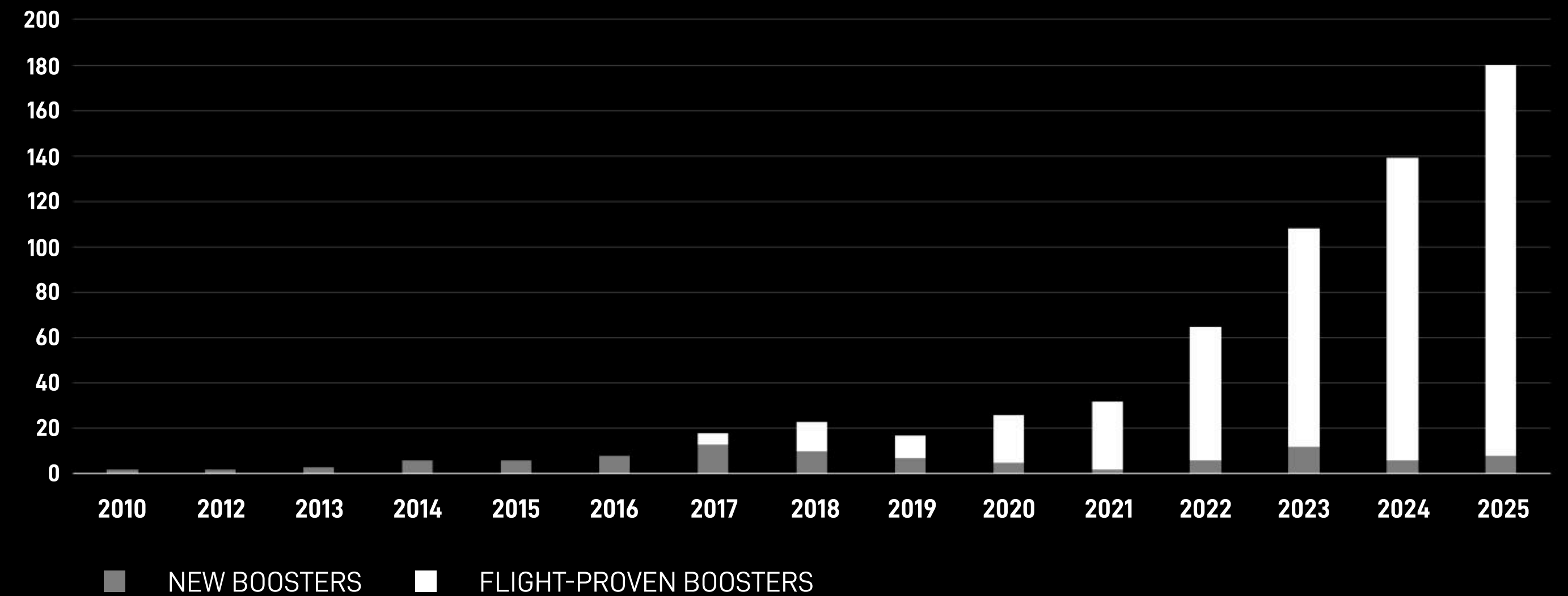
SpaceX's Breakthroughs in Reusability Propel Starlink's Expansion

In 2024, SpaceX significantly increased the deployment of Starlink satellites and achieved new levels of launch frequency. In 2024, we conducted 134 Falcon launches, with 89 dedicated to expanding the Starlink constellation. This accelerated launch cadence has resulted in over 7,000 active Starlink satellites orbiting Earth, substantially enhancing global internet coverage. These advancements underscore our commitment to providing high-speed internet access worldwide.

Reusing Falcon's first stage booster and payload fairings was a pivotal breakthrough that substantially reduced the cost of access to space. The majority of the launch cost comes from building the rocket, which historically has flown only once.

While most rockets are designed to burn up on reentry, SpaceX rockets are built with reusability in mind, reentering the atmosphere and landing at sea or on land before they support another mission.

FALCON LAUNCH RATE



TECHNOLOGY

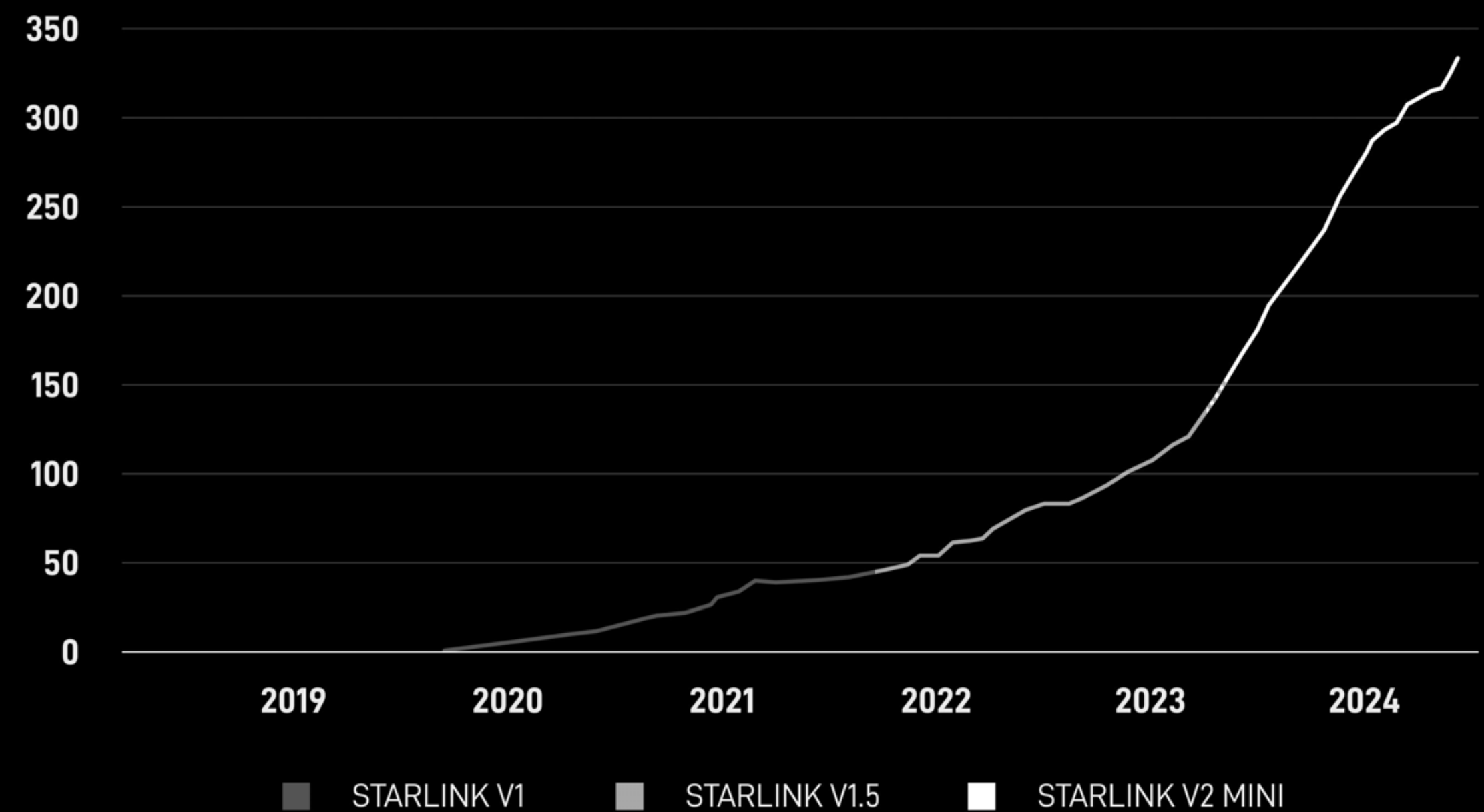
Pioneering a New Era of Connectivity

Starlink's new generation of satellites and terminals are enhancing global internet access. The Starlink V2 Mini satellites can handle four times more data and communicate with each other using improved laser beams compared to previous Starlink satellite versions. The V2 Minis are equipped with SpaceX's KA+E-band backhaul technology, including our Doppio Dualband antenna: a Radio Frequency payload that leverages SpaceX-designed silicon chips.

The Starlink V2 Mini design and Falcon 9's increased launch cadence enabled us to add more than 300,000 Gbps of capacity to the network and grow the number of Starlink customers from 2 million to more than 4.6 million in 2024.

STARLINK CAPACITY LAUNCHED

CUMULATIVE CAPACITY (TBPS)



A wide-angle view of Earth from space, showing the curvature of the planet and the atmosphere. Several Starlink satellites are visible in orbit, connected by a network of thin, glowing blue lines representing laser links. The satellites have large, rectangular solar panels. The background is the dark void of space with some stars visible.

TECHNOLOGY

Starlink's global petabit laser mesh of more than 13,000 bidirectional laser links enables truly globally coverage – both on and off the Earth. Advances in technology and added capacity to the network allowed us to achieve a low latency of 26ms and download speeds of ~100 Mbps this year across the Starlink network. Starlink even supported high-bandwidth, uninterrupted communication with Starship as it re-entered the atmosphere.

Complementing these satellites are Starlink's new terminals: the Standard kit and the portable Starlink Mini.

The Standard kit delivers even faster internet speeds and better performance in all weather conditions. The Starlink Mini is perfect for people who need internet on the go - it's easy to carry and still gives you great internet service. These devices are making fast internet available to more people, helping improve education, healthcare, and business opportunities in places that never had good internet before.

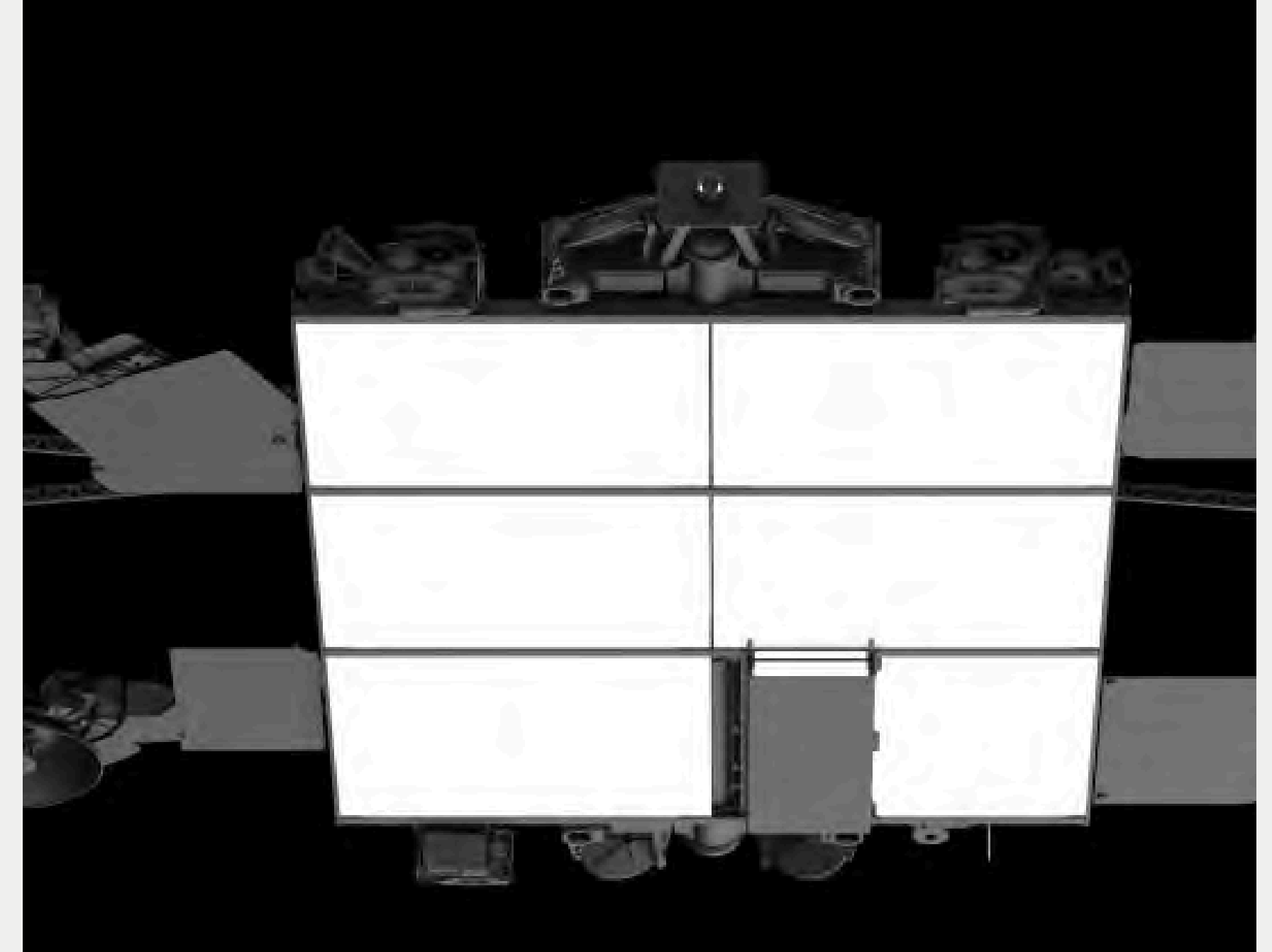


ENABLING TECHNOLOGIES

Starlink is the world's first and largest satellite constellation operating in low-Earth orbit to deliver broadband internet capable of supporting streaming, online gaming, video calls, and more.

Leveraging advanced satellites and on-orbit operations, Starlink is able to serve customers around the world with high quality, low-latency internet, with more efficiency than previous satellites.

Our advanced satellite design also ensures that each Starlink satellite is built to be fully demisable, meaning they completely burn up upon reentry, posing no risk to people on the ground, in the air, or at sea.



01

LESS MASS, MORE COMPACT

Each satellite features a compact, flat-panel design that minimizes volume, allowing for a dense launch stack to take full advantage of SpaceX's Falcon 9 rocket's launch capabilities.





ENABLING TECHNOLOGIES

02

STAR TREKKERS

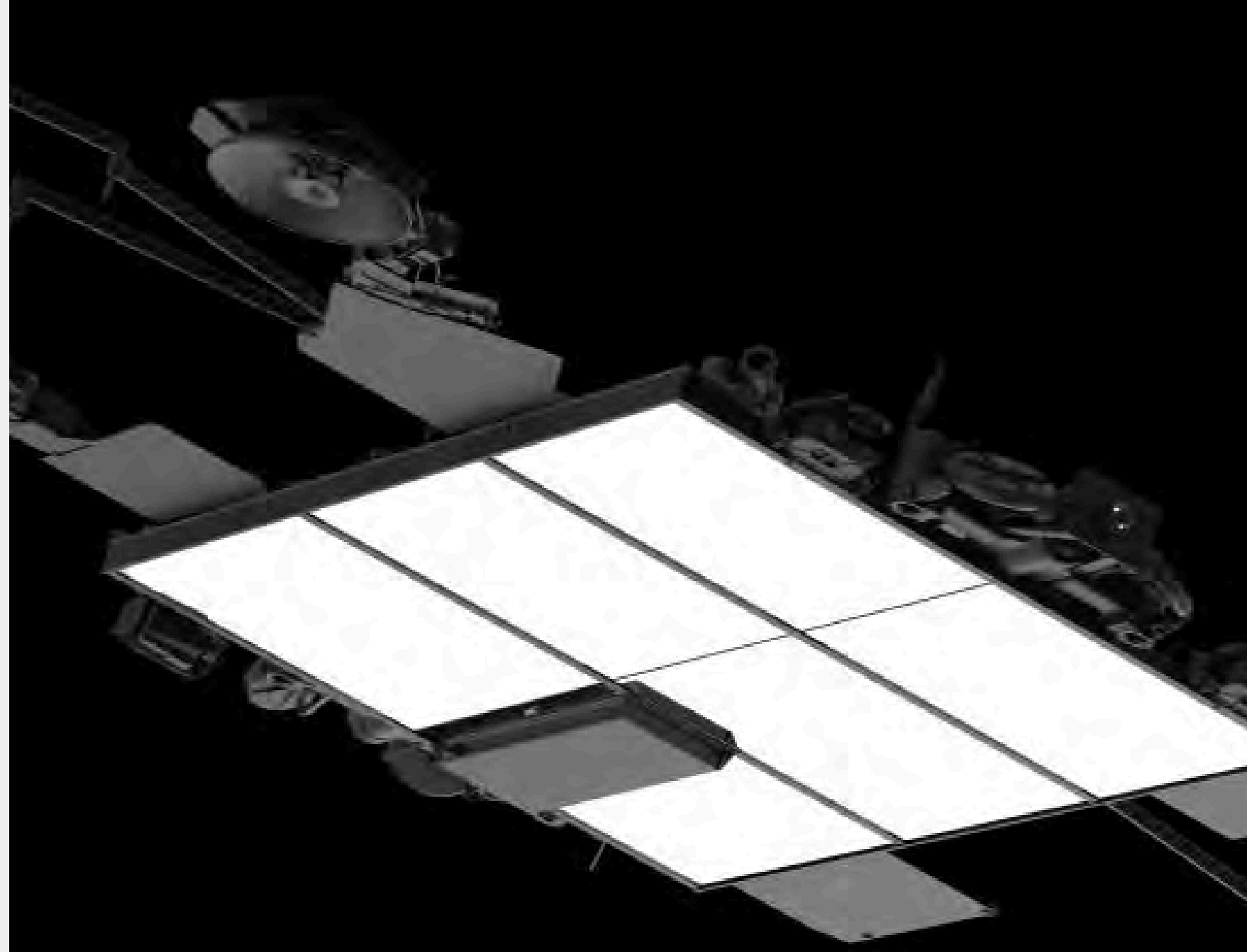
Starlink's custom-built navigation cameras survey the stars to determine each satellite's attitude, enabling precise placement of broadband throughput and an accurate understanding of its future location in low-Earth orbit.

03

OPTICAL SPACE LASERS

Each Starlink satellite contains three space lasers (Optical Intersatellite Links, or ISLs) operating at up to 200 Gbps, which together across the constellation of over 13,000 lasers form a global internet mesh that can connect customers anywhere in the world.





ENABLING TECHNOLOGIES

04 ANTENNAS

Each Starlink satellite uses five advanced Ku-band phased array antennas and three dual-band (Ka-band and E-band) antennas to provide high-bandwidth connectivity to Starlink customers.

Starlink's Direct to Cell equipped satellites use innovative, custom silicon phased array antennas and advanced software algorithms to overcome the challenges of phone-to-space communications. These include a satellite's speed in orbit, the requirement for a seamless handoff between satellites, and accommodations for Doppler shift and timing delays.

05 ION PROPULSION SYSTEMS

Efficient argon thrusters enable Starlink satellites to orbit raise, maneuver in space, and deorbit at the end of their useful life. Starlink is the first argon propelled spacecraft ever flown in space.

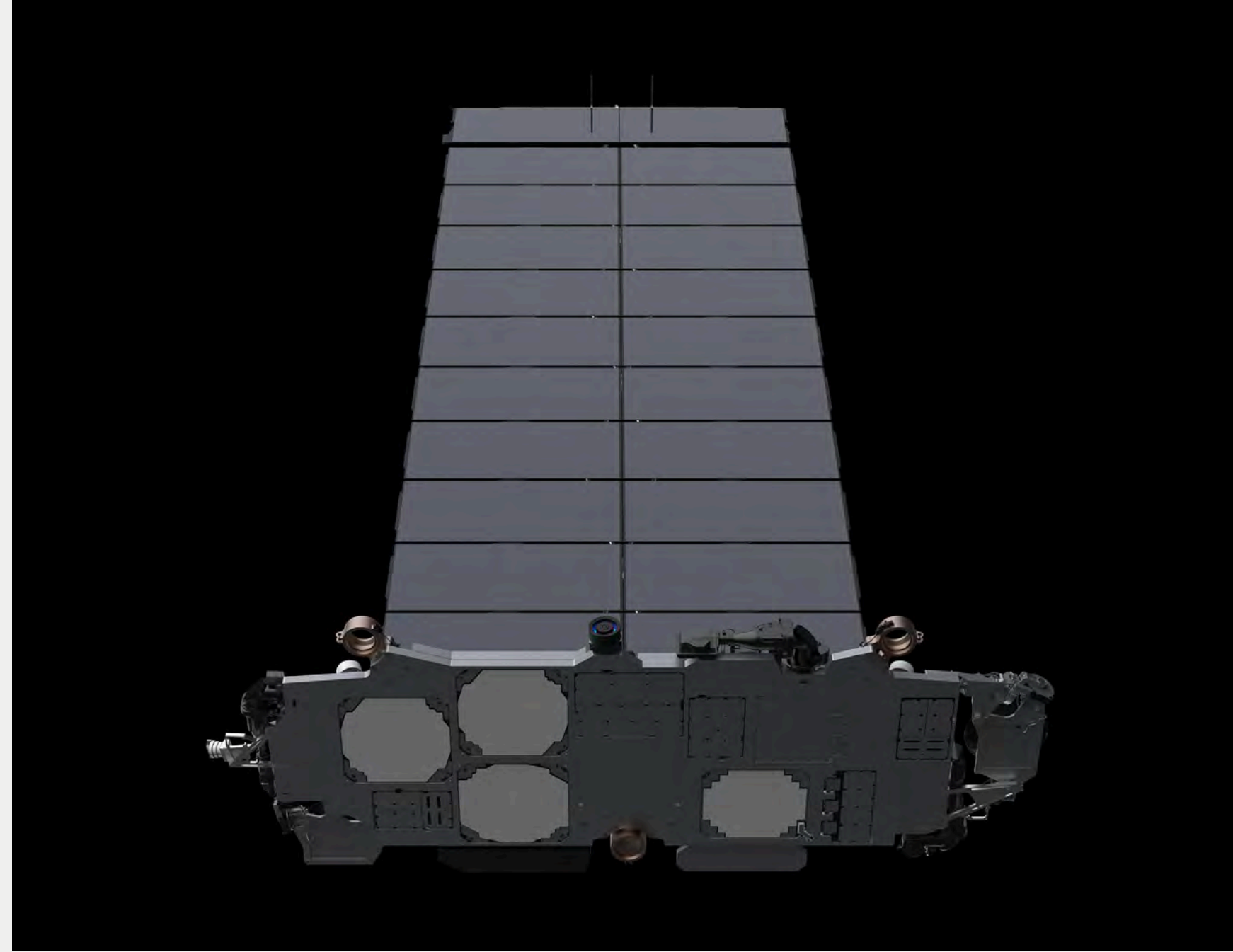


ENABLING TECHNOLOGIES

06

POWER SYSTEM

Starlink satellites feature a dual solar array and high capacity battery to provide power to the payloads. The two solar arrays are also aero-neutral which enable more robust on-orbit maneuvering and control.



07

REACTION WHEELS

Four reaction wheels provide agile attitude control for the vehicle. The hot-spare configuration ensures high reliability operation, and its aluminium flywheel is designed to be fully demisable at end-of-life.





To meet increasing global demand, Starlink has significantly enhanced its production capabilities. The opening of a 700,000-square-foot manufacturing facility in Bastrop, Texas, marked a major milestone, quickly scaling to produce 70,000 customer kits a week locally and 110,000 across the United States—equivalent to an annual capacity of 5.5 million units. By September 2024, the facility also emerged as a leading hub for printed circuit board (PCB) production, critical for Starlink terminals. SpaceX President Gwynne Shotwell noted the plant's trajectory to becoming the largest PCB factory in the United States, underscoring SpaceX's commitment to vertical integration and domestic manufacturing.

PRODUCTION SCALABILITY

Across all production facilities in 2024, SpaceX produced and sold 3.9 million customer kits. To further strengthen its production scalability, SpaceX is more than doubling the size of its Bastrop production facility (opening in 2025). This will add production capability of millions of customer kits each year to meet the growing demand for high-speed, low-latency internet from space that people can take with them wherever they go. This commitment reflects SpaceX's proactive strategy to scale efficiently while maintaining robust supply chain operations, ensuring the timely delivery of Starlink hardware to its expanding global customer base.





TERMINALS

STARLINK MINI

In June 2024, we announced the Starlink Mini, delivering on our mission to provide affordable internet in underserved regions. Starlink Mini is a compact and portable customer kit designed for on-the-go internet connectivity. Measuring approximately 11.75 by 10.2 inches and weighing less than 2.5 pounds, Starlink Mini fits easily into a backpack, making it ideal for travelers and remote customers. It offers max download speeds over 100 Mbps and can be powered by a 100W USB-C battery pack, providing flexibility for off-grid usage. Starlink Mini is available in select regions, with plans for broader distribution.





STARLINK STANDARD

In early 2024, we introduced several upgrades to enhance usability and portability for our Starlink Standard kit. The Standard kit requires manual alignment, eliminating motors for automatic aiming, which simplifies the hardware and reduces potential failure points. It features a reversible cable design with improved connectors for easier installation and a compact form factor with a kickstand mount, enabling the kit to fold down to just 1.5 inches thick for convenient storage and transport.

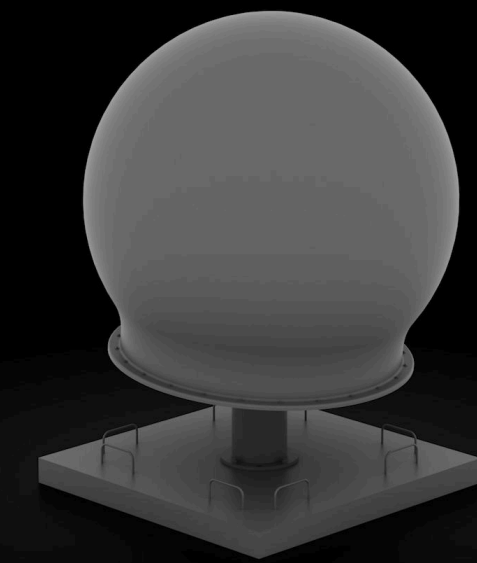


Accompanying the Standard kit is the Starlink Gen 3 Wi-Fi Router, which enhances connectivity with Wi-Fi 6 technology, tri-band support for reduced congestion, and expanded coverage up to 297 square meters (3,200 square feet). It supports up to 235 devices simultaneously and includes two Ethernet ports for wired connections. This router is compatible with Starlink Mesh WiFi Routers, allowing customers to expand their network coverage seamlessly, making the system both robust and versatile.



COMMUNITY GATEWAYS

Fiber-like speeds from space to the most remote places on Earth.



Speed matters, no matter where you are. Starlink's Community Gateways bring high-speed, low-latency internet to the remotest communities on Earth. Community Gateways connect to Starlink satellites to deliver fiber-like speeds of 10 Gbps from space – fast enough to serve thousands of customers. Local providers then distribute this connection to homes, businesses, and governments using various methods like fiber cables and wireless networks.

Our first Community Gateway serves the residents of Unalaska, a remote island in Alaska. In 2024, Starlink installed seven operational Gateway sites, including Nauru and Iqualuit, Canada. We also installed our first Community Gateway on a cruise ship, overcoming the technical challenges of using a Community Gateway on a moving ship.



DIRECT TO CELL

A technology that effectively eliminates cellphone dead zones

Starlink's Direct to Cell technology enables normal LTE phones to connect even when beyond the coverage of cell phone towers. Direct to Cell satellites integrate advanced eNodeB modems, functioning as cell phone towers in space. This enables seamless integration with existing LTE phones and requires no hardware or software changes. Direct to Cell will enable access to texting and lite data, and eventually voice calls, and even browsing wherever people may be on land, lakes, or coastal waters. In addition to expanding mobile coverage, Direct to Cell will enable Internet of Things (IoT)

connectivity outside of terrestrial coverage, connecting millions of cars and devices across critical global industries. These advancements collectively allow Starlink to provide unprecedented mobile and IoT connectivity in remote regions, effectively eliminating dead zones for good with participating telcos.

Our current Direct to Cell partners, offering reciprocal access across all partner nations, include: T-Mobile (USA), Optus (Australia), Rogers (Canada), One NZ (New Zealand), KDDI (Japan), Salt (Switzerland), Entel (Chile), Entel (Peru), and Kyivstar, among others.



DIRECT TO CELL

It's like a cellphone tower in space that offers peace of mind in areas where communication was previously impossible.

Enhanced safety:

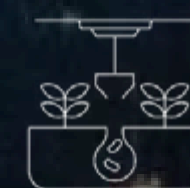
By providing connectivity to LTE devices in remote regions, Direct to Cell offers peace of mind in areas where communication was previously impossible.

No hardware changes:

Direct to Cell works with existing LTE phones, requiring no special equipment or modifications.

IoT connectivity:

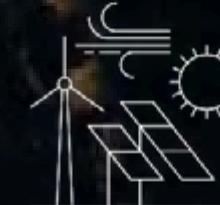
Direct to Cell will enable Internet of Things (IoT) connectivity outside of terrestrial coverage, which can benefit various industries and applications.



AGRICULTURE



AUTOMOTIVE



ENERGY



ASSET MANAGEMENT



MARITIME



ENVIRONMENT





DIRECT TO CELL

In January 2024, SpaceX successfully sent and received the first text messages using T-Mobile's network spectrum through newly launched Direct to Cell equipped Starlink satellites. This technology aims to provide standard LTE service to cell phones on the ground, overcoming challenges such as the high relative speed of satellites and the low antenna gain and transmit power of mobile phones.

In October 2024, SpaceX received emergency authorization to temporarily activate Direct to Cell service for T-Mobile customers in regions of the U.S. southeast affected by hurricanes Helene and Milton. People were able to send and receive more than 300,000 text messages that they otherwise wouldn't have been able to while the terrestrial cellular network was down.



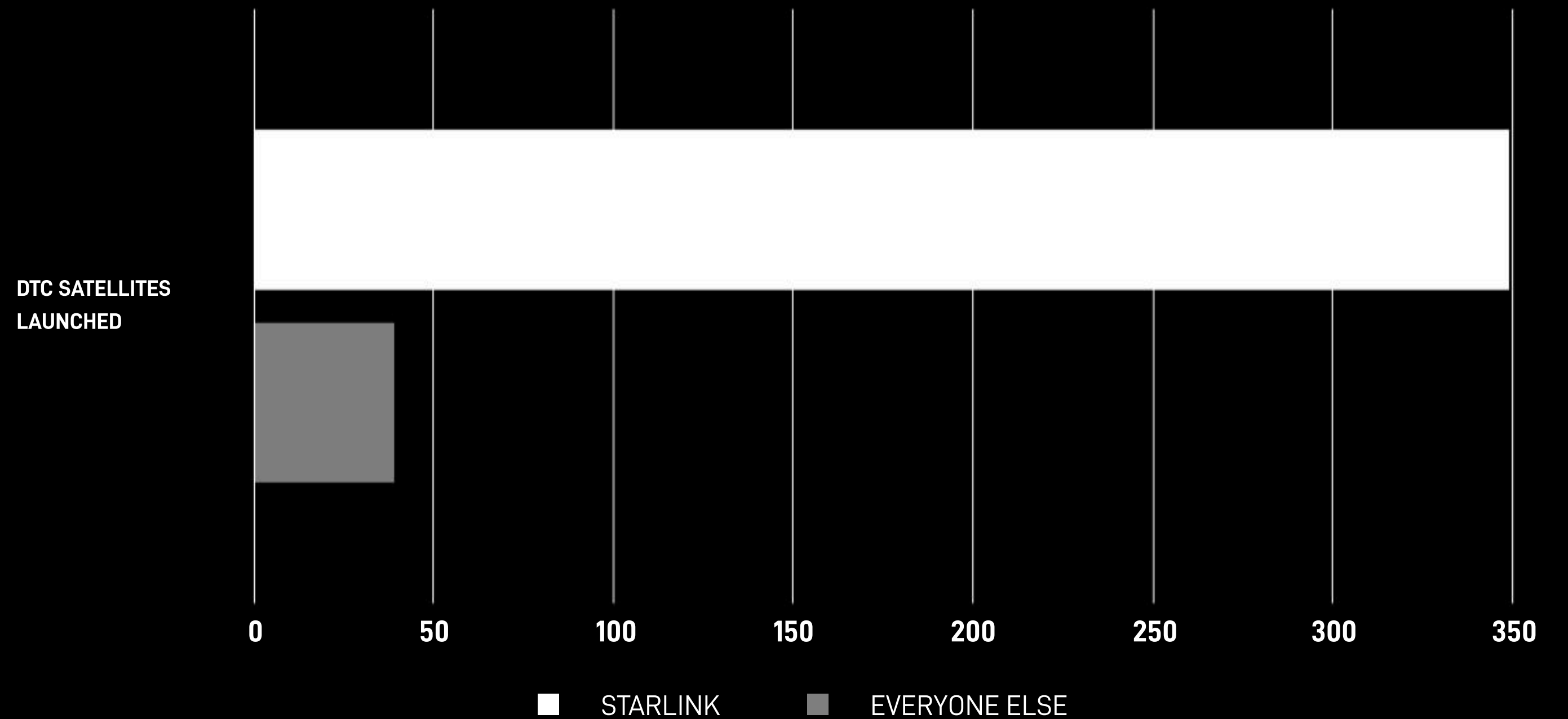
DIRECT TO CELL

Starlink Direct to Cell is powered by a satellite network unmatched in scale, with nearly 350 satellites—almost 10 times more than all other operators with a similar capability. This extensive infrastructure ensures reliable service in remote areas, enabling mobile phones to work where they never have before.

All of SpaceX's approximately 350 Direct to Cell satellites currently in orbit were launched in 2024, with plans to double the number of Direct to Cell Starlink satellites by mid-2025.

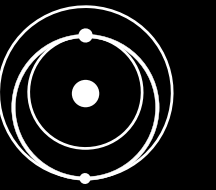
STARLINK DIRECT TO CELL

NEARLY 10X MORE LAUNCHED TO ORBIT THAN THE REST OF THE WORLD COMBINED



STARLINK

COVERAGE



COVERAGE

Starlink now serves more than 118 countries, territories, and other markets, covering a global area home to 2.8 billion people.



**A GLOBAL
SPEED BOOST**

Over the past year, Starlink has made significant advancements in internet speeds across various regions worldwide. In Lithuania, customers have reported median download speeds of 166 Mbps, while Australia follows with speeds of 140 Mbps. In the United States, median download speeds are approximately 104 Mbps, and in Germany, around 85 Mbps. These improvements underscore Starlink's ongoing efforts to deliver reliable, high-speed internet access, particularly benefiting customers in underserved and remote areas.



DOWNLOAD SPEEDS

Starlink customers in Botswana have avg. download speeds of 255 Mbps. Previously, the fastest avg download speed in Botswana was 11.43 Mbps.

Botswana

11.43 → **255**
Mbps → Mbps
before now



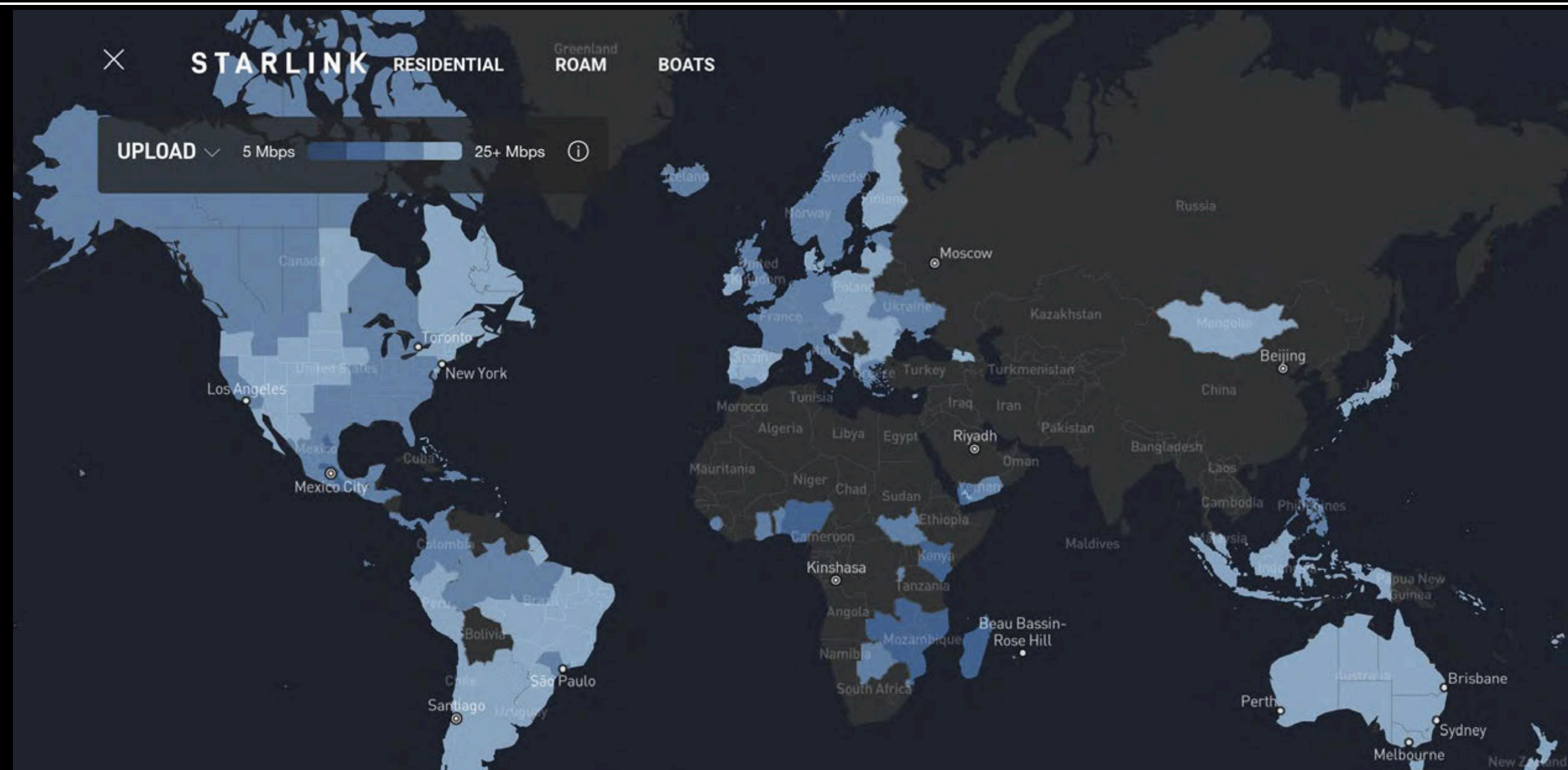
COUNTRIES AVERAGE SPEEDS

UPLOAD SPEEDS

Starlink customers in the Galapagos Islands now have upload speeds up to 23 Mbps. Previously, the best upload speeds averaged 9.88 Mbps.

Galapagos

9.88 → **23**
Mbps → Mbps
before now



LOW LATENCY MATTERS

In March 2024, Starlink's engineering teams achieved significant reductions in network latency, enhancing customer experience globally. In the United States, median latency decreased by over 30%, from 48.5ms to 33ms during peak usage hours, while worst-case latency dropped by more than 60%, from over 150ms to less than 65ms. Internationally, median latency improved by up to 25%, and worst-case latencies by up to 35%. (PCMag) These improvements enable smoother video calls, faster online gaming, and more reliable access to cloud-based services, bringing customers in underserved or remote areas closer to the seamless connectivity typically available in urban centers, thereby fostering greater digital inclusion and productivity worldwide.



AVIATION

This year, Starlink expanded service from regional and business jets to narrowbody and widebody commercial aircraft including the Airbus A321NEO, Airbus A330-200 and the Boeing 777-300. These aircraft models are equipped with two Starlink antennas bringing up to 1Gbps of peak throughput to airline passengers on these models.

With an installed weight of less than half that of conventional single-antenna systems and the ability to be installed overnight, these two-antenna Starlink installations can provide airline passengers simultaneous access to a frictionless at-home-like broadband experience including streaming and gaming while unlocking compelling operating and installation economics for our airline partners.





AVIATION

"Of course I tested the internet in ways that the average passenger would not. For example, I decided to download Titanic, a 03h16m film with a size of 1.48 GB. It took me just three minutes to download the entire movie in high definition. Now imagine trying to do that on a typical aircraft WiFi connection."

**TOM BOON, QATAR AIRWAYS PASSENGER,
OCT 22, 2024**

"Feedback's been great... both from guests and flight attendants... they've really been impressed with the quality of the signal."

EVAN NOMURA, HAWAIIAN AIRLINES DIRECTOR OF IN-FLIGHT ENTERTAINMENT AND ONBOARD PRODUCTS

"Everything you can do on the ground, you'll soon be able to do onboard a United plane at 35,000 feet, just about anywhere in the world"

UNITED CEO SCOTT KIRBY



AVIATION

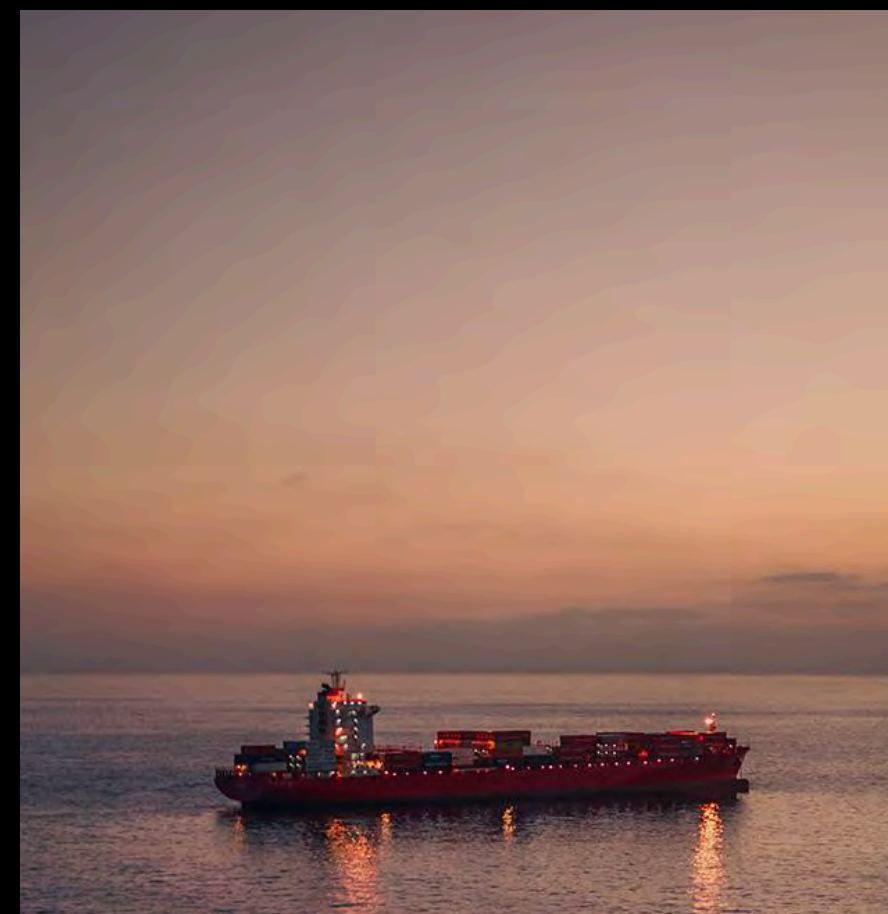
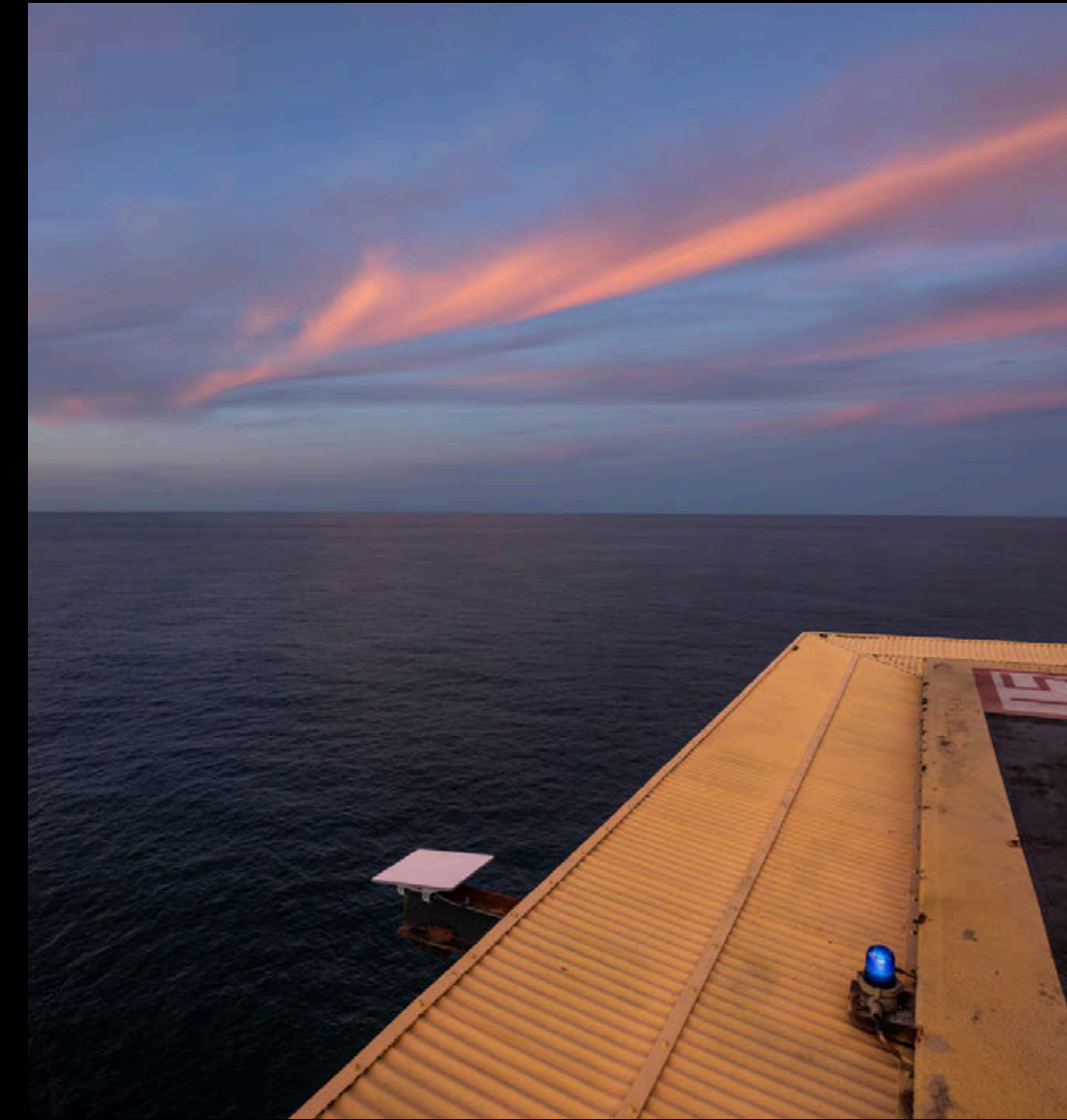
We made significant strides in transforming in-flight connectivity for executive aviation. In the business jet segment, Starlink certified its system on 20 aircraft models made by Bombardier, Gulfstream, Embraer, and Textron. Many of these models, such as the Bombardier Global Express, received additional validation from EASA, TCCA, and ANAC in addition to the FAA certification, with other models also in progress. Gulfstream also announced its support for Starlink, including installations at its company-owned service centers. Additionally, more than 30 independent service centers became Authorized Starlink Dealers in 2024, providing global installation support for Starlink business jet customers.



MARITIME

We are now serving over 75,000 vessels, consuming 50 PB of data monthly at sea. Companies like Maersk, Hapag-Lloyd, and Mitsui O.S.K. Lines have integrated Starlink across their fleets, among other companies and private boats. Offering speeds up to 220 Mbps with low latency, Starlink enhances crew welfare through better communication with families and supports advanced maritime operations like real-time monitoring and diagnostics, even in the most remote regions.

For cruise lines, Starlink is serving more than 300 cruise ships globally, providing 3 Gbps per cruise ship of connectivity to ~10 million cruise passengers annually.



RAIL

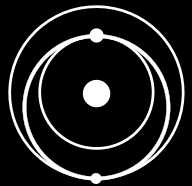
We are expanding services in the rail industry, enhancing passenger connectivity on the move. Florida's Brightline became the world's first passenger rail service to implement Starlink, offering complimentary, uninterrupted Wi-Fi on trains between Miami and Orlando. This initiative is part of Brightline's digital transformation, focusing on delivering a passenger-first experience.

In 2024, Starlink expanded its service into the high-speed rail market: Upon receiving certifications for rail compatibility in the EU, Starlink has partnered with two rail resellers, Clarus and Icomera, in addition to serving passengers in Italy for the first time. Starlink has the capability of assuring passengers' connectivity on their journeys. Reliable connectivity is crucial for rail operators who benefit from real-time monitoring, remote diagnostics, and onboard systems management, all of which contribute to safer and more efficient rail operations.



STARLINK

SUSTAINABILITY





Commitment to Space Sustainability and Safety

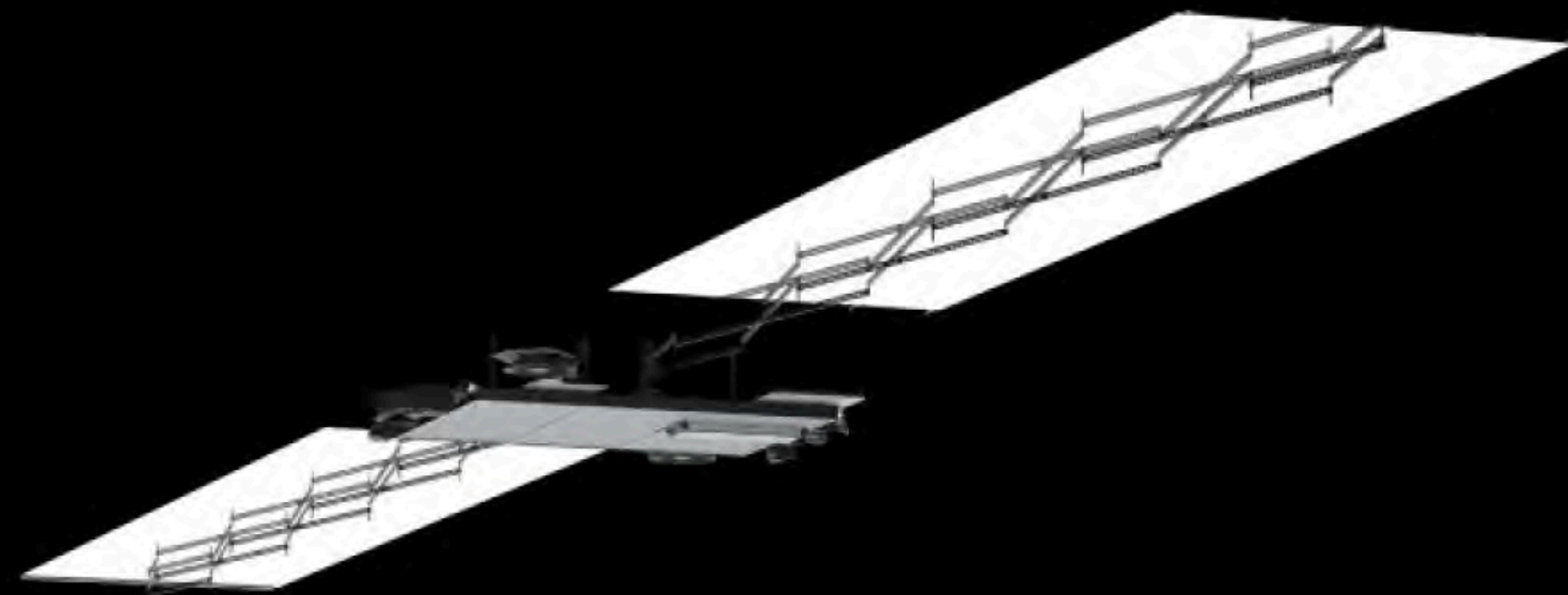
Starlink satellites operate in low-Earth orbit below 600 km altitude, ensuring that atmospheric drag will naturally deorbit a satellite within five years or less if it becomes non-maneuverable. We also deploy Starlink satellites into lower orbits at first so that any satellite that becomes non-maneuverable early in a mission will reenter the atmosphere in a matter of days or weeks. Starlink satellites are designed to be fully demisable by design, meaning they burn up upon reentry, posing no risk to people on the ground, in the air, or at sea.

In orbit, Starlink satellites navigate using on-board position and velocity estimates and their Star Trekker cameras for attitude information. Knowing where each Starlink satellite is and where collision hazards are allows each Starlink satellite to autonomously plan future maneuvers to ensure the safety of the Starlink constellation and other operator's satellites.

SpaceX's philosophy is not only the safe use of space, but the sustainable use of space as well. This means being good neighbors... not only to the other satellites in orbit, but to the astronomy community on the ground. Bright, reflective satellites in orbit can interfere with ground-based astronomy, and SpaceX is committed to making satellite designs as dark as possible. In our second generation of Starlink satellites, we found the most effective way to minimize brightness was to cover the bottom of satellites with a dielectric film that more effectively reflects sunlight away from observers on the ground, significantly reducing the impact to ground-based astronomy. Furthering this commitment, we are working with the radio astronomy community on a data-sharing framework that provides real-time observation information for radio astronomy observatories to the Starlink network. This enables each Starlink satellite passing near an observatory to autonomously steer its communication beams away from a telescope's line-of-sight and ensure no interference with astronomer's observations while supporting continuous Starlink service to those around the observatory.



SATELLITES



AERO-NEUTRAL SOLAR ARRAYS

In the past year, SpaceX has continued to enhance the design of Starlink satellites, particularly focusing on the implementation of aero-neutral solar arrays. These arrays are engineered to minimize aerodynamic drag while maintaining optimal power generation, a crucial feature for satellites operating in low-Earth orbit (LEO). The aero-neutral configuration allows for more efficient on-orbit maneuvers, reducing fuel consumption and extending the operational lifespan of the satellites. This design advancement contributes to the overall efficiency and sustainability of the Starlink constellation, enabling faster deployment and improved service quality for customers worldwide.





Beyond individual customers, Starlink engages with several key stakeholders to ensure the sustainability and safety of its satellite operations:

KEY STAKEHOLDERS COLLABORATION

Astronomical Community: Starlink collaborates with astronomers to mitigate the impact of its satellites on astronomical observations. This includes working with radio astronomers to share real-time observation information so Starlink satellites can autonomously steer their communication beams, which can interfere with radio astronomy signals, away from a telescope's line-of-sight. This allows astronomers to conduct unimpeded observations while simultaneously allowing Starlink satellites to provide service to areas immediately surrounding a telescope's location.

Satellite Operators: Starlink coordinates with other satellite operators to prevent collisions and manage space traffic effectively. Starlink satellites autonomously plan future burns to ensure the safety of the Starlink constellation and other operators' satellites.



SpaceX is advancing humanity's understanding of our world and beyond.

RADIO ASTRONOMY

As a result of years of coordinated work with the radio astronomy community, in particular the National Science Foundation (NSF) and the National Radio Astronomy Observatory (NRAO), SpaceX and NRAO have developed new techniques to ensure Starlink's advanced satellite constellation can provide critical connectivity options near radio telescopes while simultaneously protecting their important scientific research of the cosmos.

Engineers from SpaceX and NRAO have determined, through years of collaborative experiments, that the direct transmissions from satellites towards the eye of radio telescopes may pose a significant risk of interference to astronomical research. To mitigate this risk, the teams from SpaceX and NRAO have developed techniques that enable Starlink satellites to avoid transmissions into the line-of-sight of radio telescopes by leveraging Starlink's advanced phased array antenna technology, which can dynamically steer satellite beams away from telescopes in milliseconds.

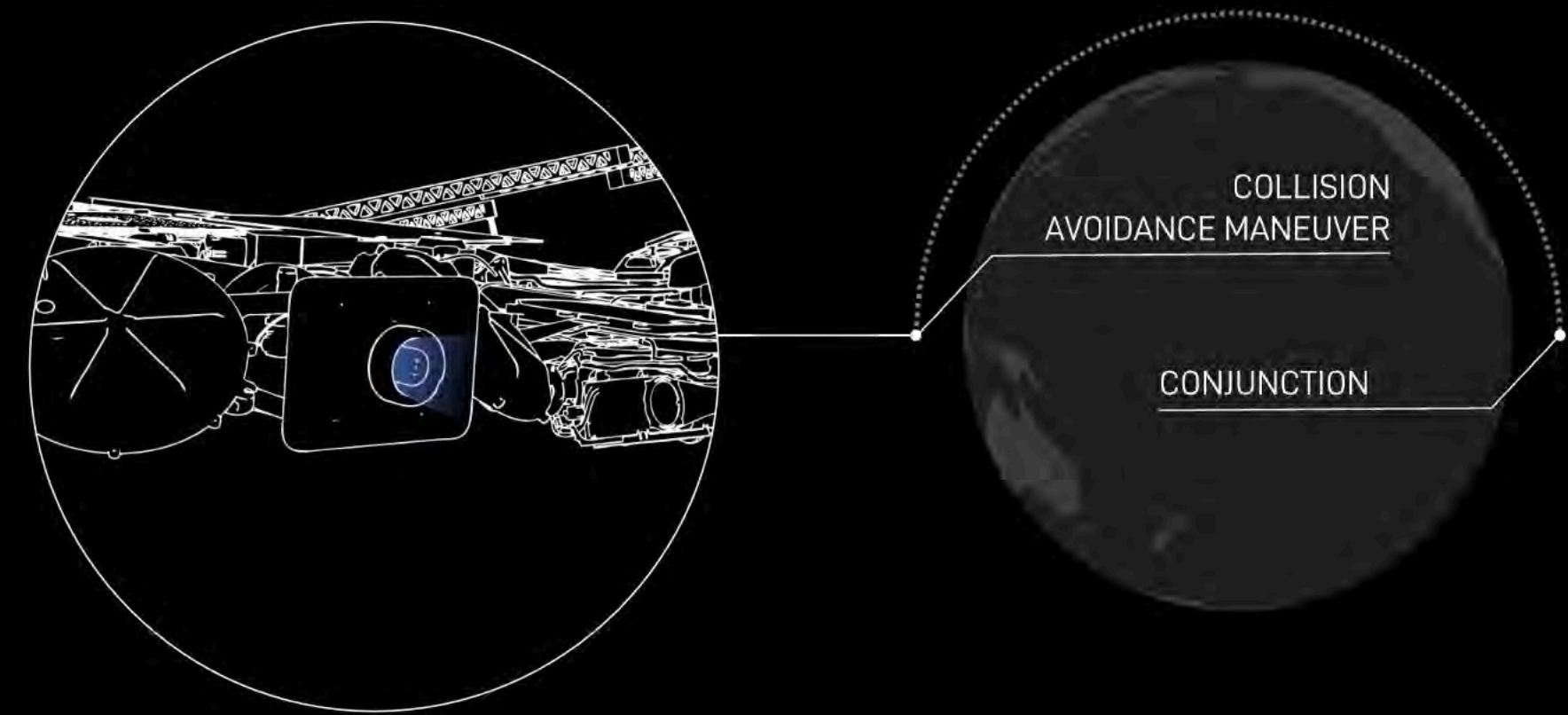
These techniques are made possible by a real-time data sharing framework between radio astronomy observatories and Starlink that provides the Starlink network with a telescope's planned observation schedule, including the telescope's pointing direction (aka "boresight") and its observed frequency band. With this information, the Starlink network can ensure that satellites passing near the boresight of a telescope autonomously and dynamically redirect their beams away from the telescope.



Safely operating a fleet of more than 7,000 satellites in low-Earth orbit means knowing where each Starlink satellite is and where it is going, maintaining continuous communication with each satellite, and ensuring that each satellite knows the position of other satellites – both Starlink satellites and satellites from other operators.

To keep space safe and sustainable, Starlink uses position information from each Starlink satellite's on-board GPS/GNSS receiver to ensure that the entire constellation knows where each Starlink satellite is and where it will be in the future. Starlink's space safety screening process calculates how close each Starlink satellite will come to each other in the future and safely commands a satellite to change its orbit if the probability of collision is greater than $1e-6$ – a factor of safety more than 1,000 times greater than the standard used by other operators. This same safety screening and collision avoidance process is used by Starlink for all other tracked space objects.

COLLISION AVOIDANCE



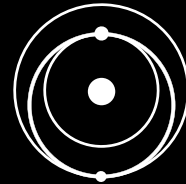
SPACE TRAFFIC COORDINATION APIS

Starlink has introduced Space Traffic Coordination APIs, enabling satellite operators to submit ephemeris data for screening against the Starlink constellation. The system provides rapid screening results, which can be integrated into Starlink's autonomous collision avoidance system. Starlink updates its satellite states approximately every 30 minutes to help ensure the most accurate possible data is available for collision avoidance screening.



STARLINK

THE NEXT CHAPTER



FUTURE

Nearly 3 billion around the world lack access to reliable or affordable high speed connectivity.

Our team has made tremendous progress connecting people all around the world with high-speed internet, and we're just getting started.

With relentless innovation in satellite technology, we will continue to make Starlink better—expanding coverage, increasing speeds, and lowering latency.

We'll continue to expand the boundaries of what's possible, building a better, faster, and more connected future.



VIEWS BY STARLINK



In October 2024, SpaceX reached a groundbreaking milestone by catching the Starship Super Heavy booster with "Mechazilla," the mechanical arms on its launch tower. This innovation paves the way for Starship, a next generation launch system, to redefine how we access space and the amount of payload we can bring to space. With unparalleled payload capacity and full reusability, Starship will be able to deploy our more advanced V3 Starlink satellites, revolutionizing global connectivity.

FUTURE

SpaceX's achievement with Starship is more than a technical triumph—it's a transformative leap forward that unlocks greater advancements in connectivity, cost efficiency, and sustainability for Starlink as the constellation scales to meet the world's growing demand for connection.

This advancement also means Starlink can serve as the communication backbone of humanity's missions to the Moon and Mars.



FUTURE

V3 STARLINK SATELLITE

The V3 Starlink satellite will be optimized for launch by SpaceX's Starship vehicle. Each Starlink V3 launch on Starship is planned to add 60 Tbps of capacity to the Starlink network, more than 20 times the capacity added with every V2 Mini launch on Falcon 9.

Each V3 Starlink satellite will have 1 Tbps of downlink speeds and 160 Gbps of uplink capacity, which is more than 10x the downlink and 24x the uplink capacity of the V2 Mini Starlink satellites.

The V3 satellite will also have nearly 4 Tbps of combined RF and laser backhaul capacity. Additionally, the V3 Starlink satellites will use SpaceX's next generation computers, modems, beamforming, and switching.





Thank you to our
first 4.6M+
customers—

Our journey has
just begun.

Starlink's journey has just begun and is powered by the trust and vision of its first 4.6 million+ customers—pioneers who are shaping the future of global connectivity. From advancing education and healthcare in remote areas to supporting disaster relief, sustainable farming, and scientific discovery, they are proving the transformative power of reliable internet access.

This progress wouldn't be possible without the dedication of our teams, the support of our partners, and the collaboration of stakeholders around the world. Together, they make this vision a reality day after day, ensuring Starlink continues to connect communities, foster innovation, and help close the digital divide.

To everyone who is part of this journey: thank you. Together, we're building a more connected world for the billions of people on Earth.

To Mars and beyond.

GATEWAY TO MARS

