WIKIPEDIA
The Free Encyclopedia

Starlink

Starlink is a satellite internet constellation operated by American aerospace company SpaceX,[3] providing coverage to over 60 countries. It also aims for global mobile phone service after 2023.[4] SpaceX started launching Starlink satellites in 2019. As of August 2023, Starlink consists of over 5,000 mass-produced small satellites in low Earth orbit (LEO),[5] which communicate with designated ground transceivers. In total, nearly 12,000 satellites are planned to be deployed, with a possible later extension to 42,000. SpaceX announced reaching more than 1 million subscribers in December 2022[6] and 1.5 million subscribers in May 2023.[7]

The SpaceX satellite development facility in Redmond, Washington, houses the Starlink research, development, manufacturing, and orbit control teams. The cost of the decade-long project to design, build, and deploy the constellation was estimated by SpaceX in May 2018 to be at least US$10 billion (equivalent to US$10.73 billion in 2021).[8] SpaceX expects more than $30 billion in revenue by 2025 from its satellite constellation, while revenues from its launch business were expected to reach $5 billion in the same year.[9][10]

Astronomers have raised concerns about the effect the constellation can have on ground-based astronomy and how the satellites will add to an already congested orbital environment.[11][12] SpaceX has attempted to mitigate astronometric interference concerns with measures to reduce their brightness during operation.[13] The satellites are equipped with Hall-effect thrusters allowing them to orbit raise, station-keep, and de-orbit at the end of their life. Additionally, the satellites are designed to autonomously and smoothly avoid collisions based on uplinked tracking data.[14]

Starlink

60 Starlink satellites stacked together before deployment on 24 May 2019

Manufacturer	SpaceX
Country of origin	United States
Operator	SpaceX
Applications	Internet service
Website	starlink.com (https://www.starlink.com/)
	Specifications
Spacecraft type	Small satellite
Launch mass	v 0.9: 227 kg (500 lb) v 1.0: 260 kg (570 lb) v 1.5: ~306 kg (675 lb)[1] v 2 mini: 800 kg (1,800 lb) v 2.0: ~1,250 kg (2,760 lb)[2]
Equipment	Ku-, Ka-, and E-band phased array antennas Laser transponders (some units) Hall-effect thrusters
Regime	Low Earth orbit Sun-synchronous orbit
	Production
Status	Active

STARLINK

History

Background

Constellations of low Earth orbit satellites were first conceptualized in the mid-1980s as part of the Strategic Defense Initiative, culminating in Brilliant Pebbles, where weapons were to be staged in orbit to intercept ballistic missiles at short notice. The potential for low-latency communication was also recognized and development offshoots in the 1990s led to numerous commercial megaconstellations using around 100 satellites such as Celestron, Teledesic, Iridium, and Globalstar. However all entities entered bankruptcy by the dot-com bubble burst, due in part to excessive launch costs at the time.[15][16]

In 2004, Larry Williams, SpaceX VP of Strategic Relations and former VP of Teledesic's "Internet in the sky" program, opened the SpaceX Washington DC office.[17] That June, SpaceX acquired a stake in Surrey Satellite Technology (SSTL) as part of a "shared strategic

vision".[18] SSTL was at that time working to extend the Internet into space.[19] However, SpaceX's stake was eventually sold back to EADS Astrium in 2008 after the company became more focused on navigation and Earth observation.[20]

In early 2014, Elon Musk and Greg Wyler were working together planning a constellation of around 700 satellites called WorldVu, which would be over 10 times the size of the then largest Iridium satellite constellation.[21] However, these discussions broke down in June 2014, and SpaceX instead filed an ITU application via the Norway telecom regulator under the name STEAM.[22] SpaceX confirmed the connection in the 2016 application to license Starlink with the Federal Communications Commission (FCC).[23] SpaceX trademarked the name *Starlink* in the United States for their satellite broadband network;[24] the name was inspired by the 2012 novel *The Fault in Our Stars*.[25]

Design phase (2015–2016)

Starlink was publicly announced in January 2015 with the opening of the SpaceX satellite development facility in Redmond, Washington. During the opening, Musk stated there is still significant unmet demand worldwide for low-cost broadband capabilities.[26][27] and that Starlink would target bandwidth to carry up to 50% of all backhaul communications traffic, and up to 10% of local Internet traffic, in high-density cities.[28][29] Musk further stated that the positive cash flow from selling satellite internet services would be necessary to fund their Mars plans.[30] Furthermore, SpaceX has long-term plans to develop and deploy a version of the satellite communication system to serve Mars.[31]

The SpaceX satellite development facility, Redmond, Washington, in use from 2015 to mid-2018

Starting with 60 engineers, the company operated in 2,800 m^2 (30,000 sq ft) of leased space, and by January 2017 had taken on a 2,800 m^2 (30,000 sq ft) second facility, both in Redmond.[32] In August 2018, SpaceX consolidated all their Seattle-area operations with a move to a larger three-building facility at Redmond Ridge Corporate Center to support satellite manufacturing in addition to R&D.[33] In July 2016, SpaceX acquired an additional 740 m^2 (8,000 sq ft) creative space in Irvine, California (Orange County).[34] The Irvine office would include signal processing, RFIC, and ASIC development for the satellite program.[35]

By October 2016, the satellite division was focusing on a significant business challenge of achieving a sufficiently low-cost design for the user equipment. SpaceX President Gwynne Shotwell said then that the project remained in the "design phase as the company seeks to tackle issues related to user-terminal cost".[36]

Start of development phase (2016–2019)

In November 2016, SpaceX filed an application with the FCC for a "non-geostationary orbit (NGSO) satellite system in the fixed-satellite service using the Ku- and Ka- frequency bands".[37]

In March 2017, SpaceX filed plans with the FCC to field a second orbital shell of more than 7,500 "V-band satellites in non-geosynchronous orbits to provide communications services" in an electromagnetic spectrum that has not previously been heavily employed for commercial communications services. Called the "Very-low Earth orbit (VLEO) constellation",[38] it was to have comprised 7,518 satellites that were to orbit at just 340 km (210 mi) altitude,[39] while the smaller, originally planned group of 4,425 satellites would operate in the K_a- and K_u-bands and orbit at 1,200 km (750 mi) altitude.[38][39] By 2022, SpaceX had withdrawn plans to field the 7518-satellite V-band system, superseding it with a more comprehensive design for a second-generation (Gen2) Starlink network.[40]

In September 2017, the FCC ruled that half of the constellation must be in orbit within six years to comply with licensing terms, while the full system should be in orbit within nine years from the date of the license.[41]

SpaceX filed documents in late 2017 with the FCC to clarify their space debris mitigation plan, under which the company was to:

> "...implement an operations plan for the orderly de-orbit of satellites nearing the end of their useful lives (roughly five to seven years) at a rate far faster than is required under international standards. [Satellites] will de-orbit by propulsively moving to a disposal orbit from which they will re-enter the Earth's atmosphere within approximately one year after completion of their mission."[42]

In March 2018, the FCC granted SpaceX approval for the initial 4,425 satellites, with some conditions. SpaceX would need to obtain a separate approval from the International Telecommunication Union (ITU).[43][44] The FCC supported a NASA request to ask SpaceX to achieve an even higher level of de-orbiting reliability than the standard that NASA had previously used for itself: reliably de-orbiting 90% of the satellites after their missions are complete.[45]

Falcon 9 lifts off from Cape Canaveral Air Force Station (CCAFS), Florida, delivering 60 Starlink satellites to orbit on 11 November 2019

In May 2018, SpaceX expected the total cost of development and buildout of the constellation to approach $10 billion (equivalent to $10,730,000,000 in 2021).[8] In mid-2018, SpaceX reorganized the satellite development division in Redmond, and terminated several members of senior management.[33]

In November 2018, SpaceX received U.S. regulatory approval to deploy 7,518 V-band broadband satellites, in addition to the 4,425 approved earlier;[46][47] however, the V-band plans were subsequently withdrawn by 2022.[40] At the same time, SpaceX also made new regulatory filings with the U.S. FCC to request the ability to alter its previously granted license in order to operate approximately 1,600 of the 4,425 Ka-/Ku-band satellites approved for operation at 1,150 km (710 mi) in a "new lower shell of the constellation" at only 550 km (340 mi)[48] orbital altitude.[49][50] These satellites would effectively operate in a third orbital shell, a 550 km (340 mi) orbit, while the higher and lower orbits at approximately 1,200 km (750 mi) and approximately 340 km (210 mi) would be used only later, once a considerably larger deployment of satellites becomes possible in the later years of the deployment process. The FCC approved the request in April 2019, giving approval to place nearly 12,000 satellites in three orbital shells: initially approximately 1,600 in a 550 km (340 mi) – altitude shell, and subsequently placing approximately 2,800 Ku- and Ka-band spectrum satellites at 1,150 km (710 mi) and approximately 7,500 V-band satellites at 340 km (210 mi).[51] In total, nearly 12,000 satellites were planned to be deployed, with (as of 2019) a possible later extension to 42,000.[52]

In February 2019, a sister company of SpaceX, SpaceX Services Inc., filed a request with the FCC to receive a license for the operation of up to a million fixed satellite Earth stations that would communicate with its non-geostationary orbit (NGSO) satellite Starlink system.[53]

First launches (2019–2020)

After launching two test satellites in February 2018, the first batch of 60 operational Starlink satellites were launched in May 2019.[54]

In June 2019, SpaceX applied to the FCC for a license to test up to 270 ground terminals – 70 nationwide across the United States and 200 in Washington state at SpaceX employee homes[55][56] – and aircraft-borne antenna operation from four distributed United States airfields; as well as five ground-to-ground test locations.[57][58]

By late 2019, SpaceX was transitioning their satellite efforts from research and development to manufacturing, with the planned first launch of a large group of satellites to orbit, and the clear need to achieve an average launch rate of "44 high-performance, low-cost spacecraft built and launched every month for the next 60 months" to get the 2,200 satellites launched to support their FCC spectrum allocation license assignment.[59] SpaceX said they will meet the deadline of having half the constellation "in orbit within six years of authorization... and the full system in nine years".[51]

On 15 October 2019, the United States FCC submitted filings to the International Telecommunication Union (ITU) on SpaceX's behalf to arrange spectrum for 30,000 additional Starlink satellites to supplement the 12,000 Starlink satellites already approved by the FCC.[60] That month, Musk publicly tested the Starlink network by using an Internet connection routed through the network to post a first tweet to social media site Twitter.[61]

In November 2020, Starlink beta internet service was opened to the public.[62] Starlink beta testers reported speeds over 150 megabits per second, above the range announced for the public beta test.[63]

Commercial service (2021–)


Early Starlink user terminal with dish, as shipped in early 2021

In February 2021, SpaceX opened up pre-orders to the public.[64] SpaceX completed raising an additional $3.5 billion in equity financing over the previous six months,[65][66] to support the capital-intensive phase of the operational fielding of Starlink, plus the development of the Starship launch system.[65] In April 2021, SpaceX clarified that they have already tested two generations of Starlink technology, with the second one having been less expensive than the first. The third generation, with laser inter-satellite links, is expected to begin launching "in the next few months [and will be] much less expensive than earlier versions".[65]

On 6 November 2020, Innovation, Science and Economic Development Canada announced regulatory approval for the Starlink low Earth orbit satellite constellation.[67]

The FCC initially awarded SpaceX with $885.5 million worth of federal subsidies to support rural broadband customers through the company's Starlink satellite Internet network. SpaceX won subsidies to bring service to customers in 35 U.S. states.[68] The $885.5 million aid package was revoked in August 2022, with the FCC stating that Starlink "failed to demonstrate" its ability to deliver the promised service.[69] SpaceX later appealed the decision saying they met or surpassed all RDOF deployment requirements that existed during bidding and that the FCC created "new standards that no bidder could meet today".[70]

In March 2021, SpaceX submitted an application to the FCC for mobile variations of their terminal for vehicles, vessels and aircraft.[71][72]

In May 2021, SpaceX announced agreements with Google Cloud Platform and Microsoft Azure to provide on-ground compute and networking services for Starlink.[73] Viasat made a legal attempt to temporarily halt Starlink launches.[74] In June 2021, SpaceX applied to the FCC to use mobile Starlink transceivers on launch vehicles flying to Earth orbit, after having previously tested high-altitude low-velocity mobile use on a rocket prototype in May 2021.[75]

By 1 October 2021, SpaceX had sold 5000 Starlink preorders in India,[76] and announced that Sanjay Bhargava, who had worked with Musk as part of a team that founded electronic payment firm PayPal, would head the tech billionaire entrepreneur's Starlink satellite broadband venture in India.[77] Three months later, Bhargava resigned "for personal reasons" following the Indian government ordering SpaceX to halt selling preorders for Starlink service until SpaceX gains regulatory approval for providing satellite internet services in the country.[76]

In 2022 SpaceX announced the *Starlink Business* service tier, a higher performance edition of the service. It provides a larger high-performance antenna and listed speeds of between 150 and 500 Mbit/s with a cost of $2500 for the antenna and a $500 monthly service fee.[78] The service includes 24/7, prioritized support.[78] Deliveries are advertised to begin in the second quarter of 2022.[79] The FCC also approved the licensing of Starlink services to boats, aircraft, and moving vehicles.[80] Starlink terminal production being delayed by the 2020–present global chip shortage led to only 5,000 subscribers for the first two months of 2022 but this was soon resolved.[81]

On 26 February 2022, Musk announced that Starlink satellites had been activated over Ukraine after a request from the Ukrainian government to replace internet services destroyed during the 2022 Russian invasion of Ukraine.

In May 2022, Starlink entered the Philippine market, as the company's first deployment in Asia, due to a landmark legislative change (RA 11659, Public Services Act) about all-foreign allowance of company ownership in regards to utility entities such as internet and telco companies. Starlink was able to obtain a provisional permission from the country's Department of Information and Communication Technologies (DICT), National Telecommunications Commission (NTC) and Department of Trade and Industry (DTI) and soon began commercial services, aimed at regions with lower internet connectivity.[87]

Also in May 2022, Chinese military researchers published an article in a peer-reviewed journal describing a strategy for destroying the Starlink constellation if they threaten national security.[88][89][90] The researchers specifically highlight concerns with reported Starlink military capabilities. Musk later announced that "Starlink is meant for peaceful use... to mend the fault in our stars",[91] referencing a quote from Julius Caesar, "Men at some time are masters of their fates: The fault, dear Brutus, is not in our stars, But in ourselves, that we are underlings." Suggesting Starlink could enforce peace by taking strategic initiative. The head of Russia's space agency, Dmitry Rogozin, had earlier warned Musk that "you will have to answer in an adult way, Elon, no matter how you play the fool".[92]

Number of Starlink subscribers over time

Month	Number of subscribers	Source
February 2021	≈ 10,000	[82]
June 2021	≈ 100,000	[83]
February 2022	≈ 250,000	
May 2022	≈ 400,000	
June 2022	≈ 500,000	[84]
September 2022	≈ 700,000	[85]
December 2022	≈ 1,000,000	[6]
May 2023	≈ 1,500,000	[86]

In 2022, SpaceX unveiled new variants of the Starlink service. On 23 May 2022, SpaceX rolled out *Starlink For RVs*, a service that lets customers pay more to skip waitlists to connect to its broadband satellites without a fixed address, although connection speeds for other users will be prioritized.[93] On 7 July 2022 SpaceX announced *Starlink Maritime*, to help support users, and companies, on the ocean. Only working on the water, unable to work on land, the advertised speed for the service is set up to 350 Mbit/s. However it comes at the one time price of $10,000 for the two user terminals, and $5,000 monthly price.[94][95]

In August 2022, SpaceX secured its first contract for services in the passenger shipping industry. Royal Caribbean Group has added Starlink internet to Freedom of the Seas and plans to offer the service on 50 ships under its Royal Caribbean International, Celebrity Cruises, and Silversea Cruises brands by March 2023.[80] Starlink services on private jet charter flights in the US by JSX are expected to begin in late 2022, and Hawaiian Airlines has contracted to provide "Starlink services on transpacific flights to and from Hawaii in 2023."[80]

In September 2022, SpaceX sent out an email to users with pre-orders about a service called *Best Effort*. It allows those still waiting in a full capacity cell to receive the unused bandwidth of their cell, while still being on the waiting list for more prioritized service. The price and equipment are the same as the residential service coming in at $110 per month.[96][97] In December, a monthly 1TB data cap was introduced to subscribers.[98]

According to internet analysis company Ookla, Starlink speeds degraded during the first half of 2022 as more customers signed up for the service. SpaceX has said that Starlink speeds will improve as more satellites are deployed.[99]

On 1 December 2022, the FCC issued an approval for SpaceX to launch the initial 7500 satellites for its second-generation (Gen2) constellation, in three low-Earth-orbit orbital shells, at 525, 530, and 535 km altitude. Overall, SpaceX had requested approval for as many as 29,988 Gen2 satellites, with approximately 10,000 in the 525–535 km altitude shells, plus ~20,000 in 340–360 km shells and nearly 500 in 604–614-km shells. However, the FCC noted that this is not a net increase in approved on-orbit satellites for SpaceX since SpaceX is no longer planning to deploy 7518 V-band satellites at 340 km (210 mi) altitude that had previously been authorized.[40]

In March 2023, the company reported that they were manufacturing six Starlink "V2 Mini" satellites per day as well as thousands of users terminals. The V2 Mini has Gen2 Starlink satellite features while being assembled in a smaller form factor than the larger Gen2 sats. The Gen2 satellites require the 9-meter-diameter Starship in order to launch them. The Starlink business unit had a single cash-flow-positive quarter during 2022, and is expecting to be profitable in 2023.[100]

In June 2023, a license to offer internet services in Zambia was granted to Starlink by the Zambian Government through its Electronic Government Division – SMART Zambia, following the completion of many prosperous trial projects throughout the nation.[101][102][103]

In July 2023, the Mongolian government issued two licenses to SpaceX to provide internet access in the country.[104]

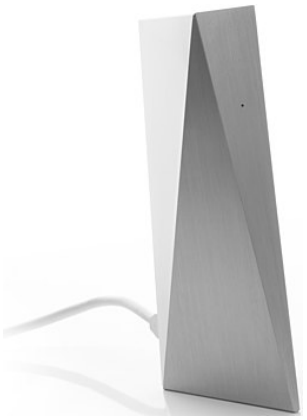
Services

Satellite internet

Starlink antenna dish (user terminal), assembled, 2021

Starlink provides satellite-based internet connectivity to underserved areas of the planet, as well as competitively priced service in more urbanized areas.[105]

In the United States, Starlink charged, at launch, a one-time hardware fee of $599 for a user terminal and $120 per month for internet service at a fixed service address location.[106] An additional $25 per month allows the user terminal to move beyond a fixed location (*Starlink For RVs*) but with service speeds deprioritized compared to the fixed users in that area.[107] Fixed users are told to expect typical throughput of "50 Mbps to 150 Mbps and latency from 20 ms to 40 ms",[108] a study found users averaged download speeds of 87 Mbps in 2022.[109] A higher performance version of the service (*Starlink Business*) advertises speeds of 150 to 500 Mbit/s in exchange for a more costly $2,500 user terminal and a $500 monthly service fee.[78] Another service called *Starlink Maritime* became available in July 2022 providing internet access on the open ocean, with speeds of 350 Mbit/s, requiring purchase of a maritime-grade $10,000 user terminal and a $5,000 monthly service fee.[94][95]



Starlink WiFi Router

Sales are capped to a few hundred fixed users per 20 km "service cell area" due to limited wireless capacity. Starlink alternatively offers a *Best Effort* service tier allowing homes in capped areas to receive the current unused bandwidth of their cell while they are on the waiting list for more prioritized service. The price and equipment are the same as the residential service at $110 per month.[96][97] To improve the service quality in densely populated areas, Starlink introduced a monthly 1TB data cap for all non-business users which became enforced in 2023.[98]

In August 2022 SpaceX lowered monthly service costs for users in select countries.[110] For example, users in Brazil and Chile saw monthly fee decreases of about 50%.[111]

In February 2023 it was reported that Starlink had 95,000 subscribers in Australia.[112] As of May 2023, Starlink reported over 1.5 million active subscribers.[86]

Satellite cellular service

For a future service, T-Mobile US and SpaceX are partnering to add satellite cellular service capability to Starlink satellites. It will provide dead-zone cell phone coverage across the US using existing midband PCS spectrum that T-Mobile owns.[113][114] Cell coverage will begin with messaging and expand to include voice and limited data services later, with testing to begin in 2023. T-Mobile plans to connect to Starlink satellites via existing mobile devices, unlike previous generations of satellite phones which used specialized radios, modems, and antennas to connect to satellites in higher orbits.[4] Bandwidth will be limited to approximately 2 to 4 megabits per second total, split across a very large cell coverage area; so limited to approximately 1,000 voice callers in a cell. The size of a single coverage cell has not yet been publicly released, but the satellites are 7 meters long, and the antenna would fold out to be "roughly 25 square meters".[113]

In March 2023, SpaceX confirmed that they remain on track to begin testing the service in 2023.[100]

In April 2023, One NZ (formerly Vodafone New Zealand) announced that they would be partnering with SpaceX's Starlink to provide 100% mobile network coverage over New Zealand. SMS text service is expected to begin in 2024, with voice and data functionality coming in 2025.[115][116] In July 2023, Optus in Australia announced a similar partnership.[117]

Military satellites

Elon Musk and four-star general Terrence J. O'Shaughnessy in April 2019

Future Under Secretary of Defense Research and Engineering Michael D. Griffin meets with Elon Musk and Larry Williams, former VP of Teledesic in 2005.

SpaceX also designs, builds, and launches customized military satellites based on variants of the Starlink satellite bus, with the largest publicly known customer being the Space Development Agency (SDA).

In 2018 the SDA was formed as part of a Trump Administration effort to resurrect the Reagan-era Strategic Defense Initiative (SDI).[118][119] SDA accelerates development of missile defense capabilities using industry-procured low-cost low Earth orbit satellite platforms.[120] The program was conceived and instituted by Under Secretary of Defense (R&E) Michael D. Griffin (who had decades earlier joined Musk on his trip to Russia to examine ICBMs as part of SpaceX's founding).[121] A few months after Space Development Agency was announced, SpaceX Chief Operating Officer Gwynne Shotwell was asked by the United States Air Force, given the nature of the program, whether SpaceX would launch weapons into space for the US military. She affirmed "we would if it's for the defense of this country."[122]

In October 2020, SDA awarded SpaceX an initial $150 million dual-use contract to develop 4 satellites to detect and track ballistic and hypersonic missiles.[123] The first batch of satellites were originally scheduled to launch September 2022 to form part of the Tracking Layer Tranche 0 of the Space Force's National Defense Space Architecture.[124] The launch schedule slipped multiple times but eventually launched in April 2023.[125][126]

The NDSA will be composed of seven layers with specific functions: data transport, battle management, missile tracking, custody/weapons targeting, satellite navigation, deterrence, and ground support.[127][128] Historically, space-based missile defense concepts were expensive, but reusable launch systems have mitigated costs according to a 2019 Congressional Budget Office analysis.[129] NSDA leverages existing commercial satellite bus development such as Starlink to reduce costs, including free-space optical laser terminals for a secure command and control mesh network.[130] The 2019 Missile Defense Review notes space-based sensing enables "improved tracking and potentially targeting of advanced threats, including HGVs and hypersonic cruise missiles".[131] However, the Union of Concerned Scientists warns developments could escalate tensions with Russia and China and called the project "fundamentally destabilizing".[132] The Carnegie Endowment for International Peace later advocated for a treaty halting development to prevent an arms race in space.[133]

Since 2021, Starlink's military satellite development is overseen internally at SpaceX by retired four-star general Terrence J. O'Shaughnessy.[134][135] O'Shaughnessy advocated before the United States Senate Committee on Armed Services for a layered capability with lethal follow-on that incorporates machine learning and artificial intelligence to gather and act upon sensor data quickly.[136]

SpaceX was not awarded a contract for the larger Tranche 1, with awards going to York Space Systems, Lockheed Martin Space, and Northrop Grumman Space Systems[137].

Starshield program

In December 2022, SpaceX announced **Starshield**, a program to incorporate military or government entity payloads on board a customized satellite bus (potentially based on Starlink Block v1.5 and v2.0 technology[138]). These satellites are heavier, with twice the area as a single Starlink v1.5 and have two pair of solar arrays as opposed to one on Starlink Block v1.5.[139] While Starlink is designed for consumer and commercial use, Starshield is designed for US government use, with an initial focus on three areas, namely, earth observation, communications and hosting payloads.

Designed to meet diverse mission requirements, Starshield satellites are advertised as capable of integrating a wide variety of payloads, offering unique versatility to users. Starshield satellites will be compatible with, and interconnect to, the existing commercial Starlink satellites via optical inter-satellite links.[140]

In January 2022, SpaceX deployed four national security satellites for the US government on their Transporter-3 rideshare mission.[138][141] In the same year they launched another group of four U.S. satellites with a single on-orbit spare Globalstar FM-15 satellite in June.[142][138][143][144] Their purpose was not disclosed at the time of launch, but was considered likely either technical demonstration, communications, earth observation or signals intelligence.

It is suspected as per the images,[145] that the two SpaceX-built Starlink derived Space Development Agency Tranche 0 Flight 1 Tracking Layer infrared imaging satellites launched on 2 April 2023 are also based on the Starshield satellite bus.[146][145]

Military communications

In 2019, tests by the United States Air Force Research Laboratory (AFRL) demonstrated a 610 Mbit/s data link through Starlink to a Beechcraft C-12 Huron aircraft in flight.[147] Additionally, in late 2019, the United States Air Force successfully tested a connection with Starlink on an AC-130 Gunship.[148]

In 2020, the Air Force utilized Starlink in support of its Advanced Battlefield management system during a live-fire exercise. They demonstrated Starlink connected to a "variety of air and terrestrial assets" including the Boeing KC-135 Stratotanker.[149]

Expert on battlefield communications Thomas Wellington argues that Starlink signals, because they use narrow focused beams, are less vulnerable to interference and jamming by the enemy in wartime than satellites flying in higher orbits.[150]

Use in Ukraine

Starlink was activated at first during the Russian invasion of Ukraine, after a request from the Ukrainian government.[151][152] Ukraine's military and government rapidly became dependent on Starlink to maintain Internet access.[153][154][155] Starlink is used by Ukraine for communication, such as keeping in touch with outside world and keeping the energy infrastructure working.[156][157]

Vitali Klitschko, Mayor of Kyiv, and his brother Wladimir Klitschko with Starlink terminals shipped to Kyiv during the 2022 Russian invasion of Ukraine

The service is also notably used for warfare. Starlink is used for connecting combat drones, naval drones, artillery fire coordination systems and attacks on Russian positions.[158][159] SpaceX has expressed reservations about the offensive use of Starlink by Ukraine beyond military communications and restricted Starlink communication technology for military use on weapon systems.[160] SpaceX however kept most of the service online.[161][162] Its use in attacking Russian targets has been criticized by the Kremlin.[163]

Musk has warned that the service was costing $20 million per month, and a Ukrainian official estimated SpaceX's contributions as over $100 million.[164] In June 2023, the DoD signed a contract with SpaceX to finance Starlink use in Ukraine.[165][162]

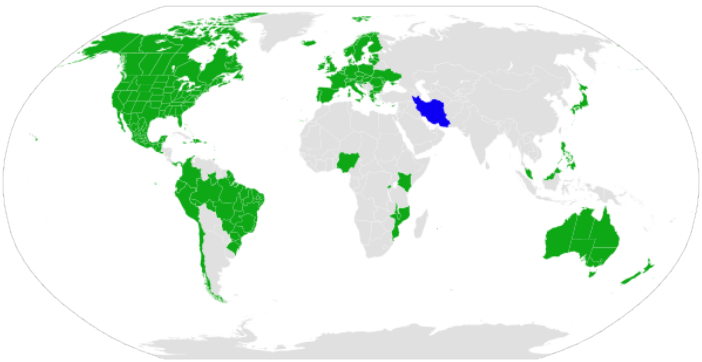
Availability and regulatory approval by country

In order to offer satellite services in any nation-state, International Telecommunication Union (ITU) regulations and long-standing international treaties require that landing rights be granted by each country jurisdiction, and within a country, by the national communications regulators. As a result, even though the Starlink network has near-global reach at latitudes below approximately 60°, broadband services can only be provided in 40 countries as of September 2022.[166] SpaceX can also have business operation and economic considerations that may make a

difference in which countries Starlink service is offered, in which order, and how soon. For example, SpaceX formally requested authorization for Canada only in June 2020,[167] the Canadian regulatory authority approved it in November 2020,[67] and SpaceX rolled out service two months later, in January 2021.[168] As of September 2022, Starlink services were on offer in 40 countries,[166] with applications pending regulatory approval in many more.[169]

Japan's major mobile provider, KDDI, announced a partnership with SpaceX to begin offering in 2022 expanded connectivity for its rural mobile customers via 1,200 remote mobile towers.[170]

On 25 April 2022, Hawaiian Airlines announced an agreement with Starlink to provide free internet access on its aircraft, becoming the first airline to use Starlink.[171] By July 2022, Starlink internet service was available in 36 countries and 41 markets.[172]



In May 2022, it was announced that regulatory approval had been granted for Nigeria, Mozambique,[173] and the Philippines.[174][175] In the Philippines, commercial availability began on February 22, 2023.[176]

Countries

#	Continent	Country/Territory	Debut	Notes
1	North America	United States Puerto Rico United States Virgin Islands	Limited trials August 2020,[177] public beta November 2020[62]	First authorized region, The FCC approved SpaceX's proposed modification of its license in 2021.[178]
2	North America	Canada	January 2021[168]	
3	Europe	United Kingdom Pitcairn Islands	January 2021[179]	Service expanded to Pitcairn Islands in November 2022.[180]
4	Europe	Germany	March 2021[181]	
5	Oceania	New Zealand	April 2021[182]	[183]
6	Oceania	Australia	April 2021[184]	
7	Europe	France Saint Martin Saint Barthélemy Guadeloupe Martinique	Original debut May 2021,[185][186] Revoked April 2022,[187] Re-approved June 2022[188]	Approval originally given in February 2021 but the Conseil d'État annulled that Decision on 5 April 2022 due to lack of public consultation.[187] Approval was given again after consultation was completed on 2 June 2022.[188] Service expanded to Saint Martin and Saint Barthélemy in July 2022.[172] Service expanded to Martinique and Guadeloupe in September 2022.[189]
8	Europe	Austria	May 2021[185]	
9	Europe	Netherlands	May 2021[190]	
10	Europe	Belgium	May 2021[191]	
11	Europe	Ireland	Limited trials April 2021,[192] public beta July 2021[193]	
12	Europe	Denmark	July 2021[194]	
13	Europe	Portugal	August 2021[195]	
14	Europe	Switzerland	August 2021[196]	
15	South America	Chile Easter Island	Limited trials July 2021,[197] public beta September 2021[198]	Service expanded to Easter Island in November 2022.[180]

#	Continent	Country/Territory	Debut	Notes
16	Europe	Poland	September 2021[199]	
17	Europe	Italy	September 2021[200]	
18	Europe	Czech Republic	September 2021[201]	
19	Europe	Sweden	October 2021[202]	
20	North America	Mexico	November 2021[203]	
21	Europe	Croatia	November 2021[204]	
22	Europe	Lithuania	December 2021[205][206]	
23	Europe	Spain	January 2022[207]	
24	Europe	Slovakia	January 2022[208]	
25	Europe	Slovenia	January 2022[209]	
26	Oceania	Tonga	February 2022[210]	Emergency relief provided one month after the 2022 Hunga Tonga–Hunga Ha'apai eruption and tsunami, ground station established in neighboring Fiji for six months
27	South America	Brazil	January 2022[211][212]	
28	Europe	Bulgaria	February 2022[213]	
29	Europe	Ukraine	February 2022[151][214][152]	Initially supplied as emergency relief in response to the 2022 Russian invasion of Ukraine. See Starlink satellite services in Ukraine.
30	Europe	Romania	April 2022[215]	
31	Europe	Greece	April 2022[216]	
32	Europe	Latvia	April 2022[217]	
33	Europe	Hungary	May 2022[218]	
34	Europe	North Macedonia	June 2022[219]	
35	Europe	Luxembourg	July 2022[172]	
36	North America	Dominican Republic	July 2022[220]	

#	Continent	Country/Territory	Debut	Notes
37	Europe	Moldova	August 2022[221]	
38	Europe	Estonia	August 2022[222]	
39	Europe	Norway	August 2022[223]	
40	Europe	Malta	September 2022[166]	
41	Asia	Iran	September 2022[224]	Activated in response to Iranian censorship as a result of Iranian protests against compulsory hijab.[225]
42	Asia	Japan	October 2022[226]	First in Asia.
43	North America	Jamaica	October 2022[227]	
44	Europe	Finland	November 2022[228]	
45	South America	Peru	January 2023[229]	
46	Africa	Nigeria	January 2023[230]	First in Africa.
47	South America	Colombia	January 2023[231]	
48	Europe	Iceland	February 2023[232]	
49	Africa	Rwanda	February 2023[233]	
50	Asia	Philippines	February 2023[234][235]	Second in Asia, first in Southeast Asia.
51	North America	Haiti	March 2023[236]	
52	South America	Ecuador	March 2023[237]	
53	North America	El Salvador	April 2023[238]	
54	North America	Panama	May 2023[239]	
55	Africa	Mozambique	June 2023[240]	
56	South America	Trinidad and Tobago	June 2023[241]	
57	Europe	Cyprus	July 2023[242]	

#	Continent	Country/Territory	Debut	Notes
58	North America	Guatemala	July 2023[243]	
59	Africa	Kenya	July 2023[244]	
60	Asia	Malaysia	July 2023[245]	Second in Southeast Asia.
61	Africa	Malawi	July 2023[246]	
62	North America	Bahamas	August 2023[247]	

Technology

Satellite hardware

The Internet communication satellites were expected to be in the smallsat-class of 100 to 500 kg (220 to 1,100 lb)-mass, and were intended to be in low Earth orbit (LEO) at an altitude of approximately 1,100 km (680 mi), according to early public releases of information in 2015. In the event, the first large deployment of 60 satellites in May 2019 were 227 kg (500 lb)[54] and SpaceX decided to place the satellites at a relatively low 550 km (340 mi), due to concerns about the space environment.[248] Initial plans as of January 2015 were for the constellation to be made up of approximately 4,000 cross-linked[249] satellites, more than twice as many operational satellites as were in orbit in January 2015.[29]

The satellites will employ optical inter-satellite links and phased array beam-forming and digital processing technologies in the Ku and Ka microwave bands *(super high frequency [SHF] to extremely high frequency [EHF])*, according to documents filed with the U.S. FCC.[250][251] While specifics of the phased array technologies have been disclosed as part of the frequency application, SpaceX enforced confidentiality regarding details of the optical inter-satellite links.[252] Early satellites were launched without laser links. The inter-satellite laser links were successfully tested in late 2020.[253][254]

The satellites will be mass-produced, at a much lower cost per unit of capability than previously existing satellites. Musk said, "We're going to try and do for satellites what we've done for rockets."[255] "In order to revolutionize space, we have to address both satellites and rockets."[29] "Smaller satellites are crucial to lowering the cost of space-based Internet and communications".[256]

In February 2015, SpaceX asked the FCC to consider future innovative uses of the Ka-band spectrum before the FCC commits to 5G communications regulations that would create barriers to entry, since SpaceX is a new entrant to the satellite communications market. The SpaceX non-geostationary orbit communications satellite constellation will operate in the high-frequency bands above 24 GHz, "where steerable Earth station transmit antennas would have a wider geographic impact, and significantly lower satellite altitudes magnify the impact of aggregate interference from terrestrial transmissions".[257]

Internet traffic via a geostationary satellite has a minimum theoretical round-trip latency of at least 477 milliseconds (ms; between user and ground gateway), but in practice, current satellites have latencies of 600 ms or more. Starlink satellites are orbiting at $1/105$ to $1/30$ of the height of geostationary orbits, and thus offer more practical Earth-to-sat latencies of around 25 to 35 ms, comparable to existing cable and fiber networks.[258] The system will use a peer-to-peer protocol claimed to be "simpler than IPv6", it will also incorporate end-to-end encryption natively.[259]

Starlink satellites use Hall-effect thrusters with krypton or argon gas as the reaction mass[54][260] for orbit raising and station keeping.[261] Krypton Hall thrusters tend to exhibit significantly higher erosion of the flow channel compared to a similar electric propulsion system operated with xenon, but krypton is much more abundant and has a lower market price.[262] SpaceX claims that its 2nd generation thruster using argon has 2.4x the thrust and 1.5x the specific impulse of the krypton fueled thruster.[263]

User terminals

The system does not directly connect from its satellites to handsets (like the constellations from Iridium, Globalstar, Thuraya and Inmarsat). Instead, it is linked to flat user terminals the size of a pizza box, which have phased array antennas and track the satellites. The terminals can be mounted anywhere, as long as they can see the sky.[249] This includes fast-moving objects like trains.[264] Photographs of the customer antennas were first seen on the internet in June 2020, supporting earlier statements by SpaceX CEO Musk that the terminals would look like a "UFO on a stick. Starlink Terminal has motors to self-adjust optimal angle to view sky".[265] The antenna is known internally as "Dishy McFlatface".[266][267]

SpaceX board member Steve Jurvetson holding a Starlink user terminal in June 2020

In October 2020, SpaceX launched a paid-for beta service in the U.S. called "Better Than Nothing Beta", charging $499 (equivalent to $519.7 in 2021) for a user terminal, with an expected service of "50 Mbps to 150 Mbps and latency from 20 ms to 40 ms over the next several months".[108] From January 2021, the paid-for beta service was extended to other continents, starting with the United Kingdom.[268]

A larger, high-performance version of the antenna is available for use with the *Starlink Business* service tier.[78]

In September 2020, SpaceX applied for permission to put terminals on 10 of its ships with the expectation of entering the maritime market in the future.[269]

In august 2022 and in response to an open invitation from SpaceX to have the terminal examined by the security community, security specialist Lennert Wouters presented several technical architecture details about the then-current starlink terminals: the main control unit of the dish is a STMicroelectronics custom designed chip code-named *Catson* which is a quad-core ARM Cortex-A53-based control processor running the Linux kernel and booted using U-Boot. The main processor uses several other custom chips such as a digital beam former named *Shiraz* and a front-end module named *Pulsarad*. The main control unit controls an array of digital beamformers. Each beamformer controls 16 front-end modules. In addition the terminal has a GPS receiver, motor controllers, synchronous clock generation and Power over Ethernet circuits, all manufactured by STMicroelectronics.[270]

Ground stations

SpaceX has made applications to the FCC for at least 32 ground stations in United States, and as of July 2020 has approvals for five of them (in five states). Till February 2023 Starlink used the Ka-band to connect with ground stations.[271] with the launch of v2 mini they added frequencies in the E band range.[272]

A typical ground station right now has nine 2.86 m antennas in a 400 m^2 fenced in area.[273]

According to their filing, SpaceX's ground stations would also be installed on-site at Google data-centers world-wide.[73]

Satellite revisions

MicroSat

MicroSat-1a and MicroSat-1b were originally slated to be launched into 625 km (388 mi) circular orbits at approximately 86.4° inclination, and to include panchromatic video imager cameras to film images of Earth and the satellite.[274] The two satellites, "MicroSat-1a" and "MicroSat-1b" were meant to be launched together as secondary payloads on one of the Iridium NEXT flights, but they were instead used for ground-based tests.[275]

Tintin

At the time of the June 2015 announcement, SpaceX had stated plans to launch the first two demonstration satellites in 2016,[276] but the target date was subsequently moved out to 2018.[277] SpaceX began flight testing their satellite technologies in 2018[277] with the launch of two test satellites. The two identical satellites were called **MicroSat-2a** and **MicroSat-2b**[278] during development but were renamed **Tintin A** and **Tintin B** upon orbital deployment on 22 February 2018. The satellites were launched by a Falcon 9 rocket, and they were piggy-pack payloads launching with the Paz satellite.

Tintin A and B were inserted into a 514 km (319 mi) orbit. Per FCC filings,[279] they were intended to raise themselves to an 1,125 km (699 mi) orbit, the operational altitude for Starlink LEO satellites per the earliest regulatory filings, but stayed close to their original orbits. SpaceX announced in November 2018 that they would like to operate an initial shell of about 1600 satellites in the constellation at about 550 km (340 mi) orbital altitude, at an altitude similar to the orbits Tintin A and B stayed in.[49]

The satellites orbit in a circular low Earth orbit at about 500 km (310 mi) altitude[280] in a high-inclination orbit for a planned six to twelve-month duration. The satellites communicate with three testing ground stations in Washington State and California for short-term experiments of less than ten minutes duration, roughly daily.[276][281]

v0.9 (test)

The 60 Starlink v0.9 satellites, launched in May 2019, have the following characteristics:[54]

- Flat-panel design with multiple high-throughput antennas and a single solar array
- Mass: 227 kg (500 lb)
- Hall-effect thrusters using krypton as the reaction mass, for position adjustment on orbit, altitude maintenance, and deorbit
- Star tracker navigation system for precision pointing
- Able to use Department of Defense-provided debris data to autonomously avoid collision[282]
- Altitude of 550 km (340 mi)
- 95% of "all components of this design will quickly burn in Earth's atmosphere at the end of each satellite's lifecycle".

v1.0 (operational)

The Starlink v1.0 satellites, launched since November 2019, have the following additional characteristics:

- 100% of all components of this design will completely demise, or burn up, in Earth's atmosphere at the end of each satellite's life.[283]
- K_a-band added[284]
- Mass: 260 kg (570 lb)
- One of them, numbered 1130 and called DarkSat, had its albedo reduced using a special coating but the method was abandoned due to thermal issues and IR reflectivity.[285][286]

- All satellites launched since the ninth launch at August 2020 have visors to block sunlight from reflecting from parts of the satellite to reduce its albedo further.[287][288][289][290]

v1.5 (operational)

The Starlink v1.5 satellites, launched since 24 January 2021, have the following additional characteristics:

- Lasers for inter-satellite communication[291]
- Mass: ~295 kg (650 lb)
- Visors that blocked sunlight were removed from satellites launched from September 2021 onwards.[292]

Starshield (operational)

These are satellites buses with two solar arrays derived from Starlink v1.5 and v2.0 for military use and can host classified government or military payloads.[293]

v2.0 (initial deployment)

SpaceX was preparing for the production of Starlink v2.0 satellites by early 2021.[294] According to Musk, Starlink v2.0 satellites will be "... an order of magnitude better than Starlink 1" in terms of communications bandwidth.[295]

SpaceX hoped to begin launching Starlink v2.0 in 2022. As of May 2022, SpaceX had said publicly that the satellites of second-generation (Gen2) constellation would need to be launched on Starship, as they are too large to fit inside a Falcon 9 fairing.[272] However, in August 2022, SpaceX made formal regulatory filings with the FCC that indicated they would build satellites of the second-generation (Gen2) constellation in two different, but technically identical, form factors: one with the physical structures tailored to launching on Falcon 9, and one tailored for the launching on Starship.[113][296] Starlink v2.0 is both larger and heavier than Starlink v1 satellites.

Starlink second-generation satellites planned for launch on Starship have the following characteristics:[297][296]

- Lasers for inter-satellite communication[298]
- Mass: ~1,250 kg (2,760 lb)
- Length: ~7 m (23 ft)
- Further improvements to reduce its brightness, including the use of a dielectric mirror film.[299]
- On 2,016 of the initially licensed 7,500 satellites:[300] Gen2 Starlink satellites will also include an approximately 25 square meter antenna that would allow T-Mobile subscribers to be able to communicate directly via satellite through their regular mobile devices.[113] It will be implemented via a German-licensed hosted payload developed together with SpaceX's subsidiary Swarm Technologies and T-Mobile.[300] This hardware is supplemental to the existing K_u-band and K_a-band systems, and inter-satellite laser links, that have been on the first generation satellites launching as of mid-2022.

Further, in October 2022, SpaceX redefined some early v2.0s so there are 3 different busses of v2.0s:[301]

- **Bus F9-1 (planned)**, 303 kg mass, having roughly the same dimensions and mass as the current V1.5 satellites.
- **Bus F9-2 (initial deployment)** (sometimes called "V2 mini"[113]), 800 kg mass and measuring 4.1 m (13 ft) by 2.7 m (8 ft 10 in) with a total array of 120 m^2 (1,300 sq ft). The Solar arrays are 2 in number. It could offer around 3-4 times more usable bandwidth per satellite.[302] They are smaller than Starlink's original ones (and so can be launched from existing rockets), have four times the capacity to the ground station to increase speed and capacity. This is due to a more efficient array of antennas and the use of radio frequencies in the E band range.[272]

- **Bus Starship (planned)**, 2000 kg mass.

Launches

Between February 2018 and February 2023, SpaceX successfully launched 4002 Starlink satellites into orbit, including prototypes and satellites that later failed or were de-orbited before entering operational service.[303] In March 2020, SpaceX reported producing six satellites per day.[304]

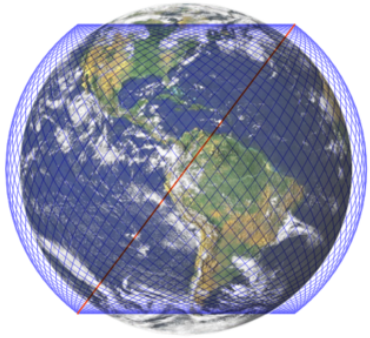
The deployment of the first 1,440 satellites was planned in 72 orbital planes of 20 satellites each,[305] with a requested lower minimum elevation angle of beams to improve reception: 25° rather than the 40° of the other two orbital shells.[49]:17 SpaceX launched the first 60 satellites of the constellation in May 2019 into a 550 km (340 mi) orbit and expected up to six launches in 2019 at that time, with 720 satellites (12 × 60) for continuous coverage in 2020.[306][307]

Starlink satellites are also planned to launch on Starship, an under-development rocket of SpaceX with a much larger payload capability. The initial announcement included plans to launch 400 Starlink (version 1.0) satellites at a time.[308] Current plans now call for Starship to be the only launch vehicle to be used to launch fewer of the much larger Starlink version 2.0.

Constellation design and status

First Generation

Contains all v0.9 and first generation satellites. Tintin A and Tintin B as test satellites are not included.



The Starlink constellation, phase 1, first orbital shell: 72 orbits with 22 each, therefore 1584 satellites at 550 km altitude

Phase	Group designation	Orbital shells		Orbital planes[309]			Committed completion date		Deployed satellites 23 June 2023[310]	
		Altitude (km)	Authorized satellites	Incli-nation	Count	Satellites per	Half	Full	Active	Decaying/ deorbited
1[311]	Group 1[312]	550 km (340 mi)	1584[313]	53.0°	72	22	March 2024 (aimed) 1 August 2022 (achieved)[314]	March 2027	1457	268
	Group 2	570 km (350 mi)	720	70°	36	20			404	4
	Group 3[315]	560 km (350 mi)	348	97.6°	6	58			233	10
	Group 4	540 km (340 mi)	1584	53.2°	72	22			1567	70
		560 km (350 mi)	172	97.6°	4	43			0	
2[316][a]		335.9 km (208.7 mi)[a]	2493	42.0°			November 2024	November 2027	0	
		340.8 km (211.8 mi)[a]	2478	48.0°					0	
		345.6 km (214.7 mi)[a]	2547	53.0°					0	

a. SpaceX plans to abandon the approved phase 2 configuration.

Early designs had all phase 1 satellites in altitudes of around 1,100–1,300 km (680–810 mi). SpaceX initially requested to lower the first 1584 satellites, and in April 2020 requested to lower all other higher satellite orbits to about 550 km (340 mi).[317][318] In April 2020, SpaceX modified the architecture of the Starlink network. SpaceX submitted an application to the FCC proposing to operate more satellites in lower orbits in the first phase than the FCC previously authorized. The first phase will still include 1,440 satellites in the first shell orbiting at 550 km (340 mi) in planes inclined 53.0°,[305] with no change to the first shell of the constellation launched largely in 2020.[319] SpaceX also applied in the United States for use of the E-band in their constellation[320] The FCC approved the application in April 2021.[321][322][323]

On 24 January 2021 SpaceX released a new group of 10 Starlink satellites, the first Starlink satellites in polar orbits. The launch surpassed ISRO's record of launching the most satellites in one mission (143), taking to 1,025 the cumulative number of satellites deployed for Starlink to that date.[324][325]

On 3 February 2022, 49 satellites were launched as Starlink Group 4-7. A G2-rated geomagnetic storm occurred on 4 February, caused the atmosphere to warm and density at the low deployment altitudes to increase. Predictions were that up to 40 of the 49 satellites might be lost due to drag.[326] After the event, 38 satellites reentered the atmosphere by 12 February while the remaining 11 were able to raise their orbits and avoid loss due to the storm.[327][328]

In March 2023 SpaceX submitted an application to add V-band payload to the second generation satellites rather than fly phase 2 V-band satellites as originally planned and authorized.[329] The request is subject to FCC approval.

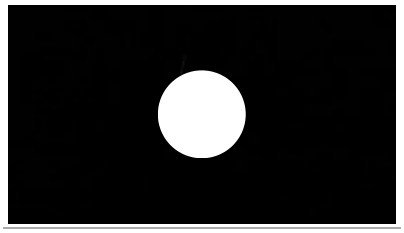
Second Generation (2A)

Phase	Group designation	Orbital shells		Orbital planes[330][a]			Committed completion date		Deployed satellites 16 August 2023[310]	
		Altitude (km)	Planned satellites	Incli-nation	Count	Satellites per	Half	Full	Active	Decaying/ deorbited
1[b]	Group 5[310]	530 km (330 mi)	3360[b]	43°[310]	28	120	1 December 2028[332]	1 December 2031[332]	696	3
	Group 6[310]	559 km (347 mi)[333]							214	12
		525 km (326 mi)	3360[b]	53°	28	120				
		535 km (332 mi)	3360[b]	33°	28	120				

a. SpaceX abandoned configuration 2 proposed in the amendment[331]

b. The FCC limited phase 1 to 7,500 satellites across 3 shells.[332]

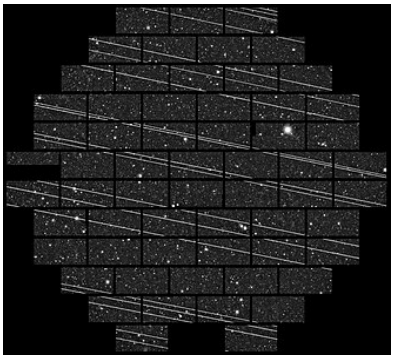
With the unknown of when Starship will be able to launch the second generation satellites, SpaceX modified the original V2 blueprint into a smaller, more compact one named "V2 Mini". This adjustment, allowed Falcon 9 to transport these satellites, though not as many, into orbit.[334] The first set of 21 of these satellites was launched on February 27, 2023. SpaceX committed to reducing debris by keeping the Starlink tension rods, which hold the V2 mini-satellites together, attached to the Falcon 9 second stage. These tension rods were discarded into orbit while launching an earlier versions of Starlink satellites.[335] Observations confirm these V2 mini-satellites host two solar panels like the Starship V2 satellites.[336]



Starlink 12 Feb 2023 launch plus 19 hours

Impact on astronomy

The planned large number of satellites has been met with criticism from the astronomical community because of concerns over light pollution.[339][340][341] Astronomers claim that the number of visible satellites will outnumber visible stars and that their brightness in both optical and radio wavelengths will severely impact scientific observations. While astronomers can schedule observations to avoid pointing where satellites currently orbit, it is "getting more difficult" as more satellites come online.[342] The International Astronomical Union (IAU), National Radio Astronomy Observatory (NRAO), and Square Kilometre Array Organization (SKAO) have released official statements expressing concern on the matter.[343][344][345]



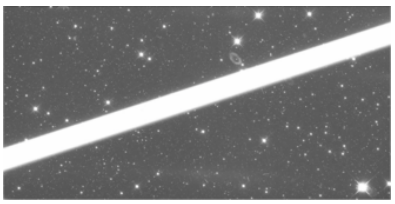
Signal pollution in a 333-second exposure image taken from the Blanco four-meter (13') telescope at the Cerro Tololo Inter-American Observatory in November 2019.

On 20 November 2019, the four-meter (13') Blanco telescope of the Cerro Tololo Inter-American Observatory (CTIO) recorded strong signal loss and the appearance of 19 white lines on a DECam shot (right image). This image noise was correlated to the transit of a Starlink satellite train, launched a week earlier.[346]

SpaceX representatives and Musk have claimed that the satellites will have minimal impact, being easily mitigated by pixel masking and image stacking.[347] However, professional astronomers have disputed these claims based on initial observation of the Starlink v0.9 satellites on the first launch, shortly after their deployment from the launch vehicle.[348][349][350][351] In later statements on Twitter, Musk stated that SpaceX will work on reducing the albedo of the satellites and will provide on-demand orientation adjustments for astronomical experiments, if necessary.[352][353] One Starlink satellite (Starlink 1130 / DarkSat) launched with an experimental coating to reduce its albedo. The reduction in g-band magnitude is 0.8 magnitude (55%).[354][355] Despite these measures, astronomers found that the satellites were still too bright, thus making DarkSat essentially a "dead end".[356]


Starlink in Tübingen, Germany

On 17 April 2020, SpaceX wrote in an FCC filing that it would test new methods of mitigating light pollution, and also provide access to satellite tracking data for astronomers to "better coordinate their observations with our satellites".[357][358] On 27 April 2020, Musk announced that the company would introduce a new sunshade designed to reduce the brightness of Starlink satellites.[357] As of 15 October 2020, over 200 Starlink satellites had a sunshade. An October 2020 analysis found them to be only marginally fainter than DarkSat.[359] A January 2021 study pinned the brightness at 31% of the original design.[360]


Starlink 1619 seen by the Hubble Space Telescope

According to a May 2021 study, "A large number of fast-moving transmitting stations (i.e. satellites) will cause further interference. New analysis methods could mitigate some of these effects, but data loss is inevitable, increasing the time needed for each study and limiting the overall amount of science done".[361]


Timelapse of recently deployed satellites[337][338]

In February 2022, the International Astronomical Union (IAU) established a center to help astronomers deal with the adverse effects of satellite constellations such as Starlink. Work will include the development of software tools for astronomers, advancement of national and international policies, community outreach and work with industry on relevant technologies.[362]

In June 2022, the IAU released a website for astronomers to deal with some adverse effects via satellite tracking. This will enable astronomers to be able to track satellites to be able to avoid and time them for minimal impact on current work.[363]

The first batch of Generation 2 spacecraft was launched in February 2023. These satellites are referred to as "Mini" because they are smaller than the full-sized Gen 2 spacecraft that will come later. SpaceX uses brightness mitigation for Gen 2 that includes a mirror-like surface which reflects sunlight back into space and they orient the solar panels so that observers on the ground only see the dark sides. [364] The Minis are fainter than Gen 1 spacecraft despite being four times as large according to an observational study published in June 2023, being 19% as bright as Gen 1 when placed in the final "brightness-mitigated" orbit. Minis appear 12 times brighter before they reach the target orbit.[365]

Increased risk of satellite collision

The large number of satellites employed by Starlink may create the long-term danger of space debris resulting from placing thousands of satellites in orbit and the risk of causing a satellite collision, potentially triggering a phenomenon known as Kessler syndrome.[366][367] SpaceX has said that most of the satellites are launched at a lower altitude, and failed satellites are expected to deorbit within five years without propulsion.[368][369]

Early in the program, a near-miss occurred when SpaceX did not move a satellite that had a 1 in 1,000 chance of colliding with a European one, ten times higher than ESA's threshold for avoidance maneuvers. SpaceX subsequently fixed an issue with its paging system that had disrupted emails between ESA and SpaceX. ESA said it plans to invest in technologies to automate satellite collision avoidance maneuvers.[370][371] In 2021, Chinese authorities lodged a complaint with the United Nations, saying their space station had performed evasive maneuvers that year to avoid

Starlink satellites.[372] In the document, Chinese delegates said that the continuously maneuvering Starlink satellites posed a risk of collision, and two close encounters with the satellites in July and October constituted dangers to the life or health of astronauts aboard the Chinese Tiangong space station.[373][369]

All these reported issues, plus current plans for the extension of the constellation, motivated a formal letter from the National Telecommunications and Information Administration (NTIA) on behalf of NASA and the NSF, submitted to the FCC on 8 February 2022, warning about the potential impact on low Earth orbit, increased collision risk, impact on science missions, rocket launches, International Space Station and Radio frequencies.[374]

SpaceX satellites will maneuver if the probability of collision is greater than 10^{-5} (1 in 100,000 chance of collision), as opposed to the industry standard of 10^{-4} (1 in 10,000 chance of collision).[375] SpaceX has budgeted sufficient propellant to accommodate approximately 5,000 propulsive maneuvers over the life of a Gen2 satellite, including a budget of approximately 350 collision avoidance maneuvers per satellite over that time period.[301]

As of May 2022, the average Starlink satellite had conducted fewer than three collision-avoidance maneuvers over the 6 preceding months.[301] Over 1,700 out of 6,873 maneuvers were performed to avoid Kosmos 1408 debris.[375]

Competition and market effects

In addition to the OneWeb constellation, announced nearly concurrently with the SpaceX constellation, a 2015 proposal from Samsung outlined a 4,600-satellite constellation orbiting at 1,400 km (870 mi) that could provide a zettabyte per month capacity worldwide, an equivalent of 200 gigabytes per month for 5 billion users of Internet data,[376][377] but by 2020, no more public information had been released about the Samsung constellation. Telesat announced a smaller 117 satellite constellation in 2015 with plans to deliver initial service in 2021.[378] Amazon announced a large broadband internet satellite constellation in April 2019, planning to launch 3,236 satellites in the next decade in what the company calls "Project Kuiper", a satellite constellation that will work in concert[379] with Amazon's previously announced large network of twelve satellite ground station facilities (the "AWS ground station unit") announced in November 2018.[380]

In February 2015, financial analysts questioned established geosynchronous orbit communications satellite fleet operators as to how they intended to respond to the competitive threat of SpaceX and OneWeb LEO communication satellites.[381] In October 2015, SpaceX President Gwynne Shotwell indicated that while development continues, the business case for the long-term rollout of an operational satellite network was still in an early phase.[382]

By October 2017, the expectation for large increases in satellite network capacity from emerging lower-altitude broadband constellations caused market players to cancel some planned investments in new geosynchronous orbit broadband communications satellites.[383]

SpaceX was challenged regarding Starlink in February 2021 when the National Rural Electric Cooperative Association (NRECA), a political interest group representing traditional rural internet service providers, urged the U.S. Federal Communications Commission (FCC) to "actively, and aggressively, and thoughtfully vet" the subsidy applications of SpaceX and other broadband providers. At the time, SpaceX had provisionally won $886 million for a commitment to provide service to approximately 643,000 locations in 35 states as part of the Rural Digital Opportunity Fund (RDOF).[384] The NRECA criticisms included that the funding allocation to Starlink would include service to locations—such as Harlem and terminals at Newark Liberty International Airport and Miami International Airport—that are not rural, and because SpaceX was planning to build the infrastructure and serve any customers who request service with or without the FCC subsidy.[384] Additionally, Jim Matheson, chief executive officer of the NRECA voiced concern about technologies that had not yet been proven to meet the high speeds required for the award category. Starlink was specifically criticized for being still in beta testing and for unproven technology.[385]

While Starlink is deployed worldwide, it has encountered trademark conflicts in some countries such as Mexico.[386]

Similar or competitive systems

- OneWeb satellite constellation – a satellite constellation project that began operational deployment of satellites in 2020.[387]

- China national satellite internet project – a planned satellite internet offering for the Chinese market.[388]
- Kuiper Systems – a planned 3,276 LEO satellite Internet constellation by an Amazon subsidiary.
- Hughes Network Systems – a current broadband satellite provider providing fixed, cellular backhaul, and airborne antennas.
- Viasat, Inc. – a current broadband satellite provider providing fixed, ground mobile, and airborne antennas.
- O3b – Medium Earth orbit constellation that provides access to mobile phone operators and internet service providers. It covers only the equatorial region.

See also

- AST SpaceMobile – a satellite-to-mobile-phone satellite constellation working with large mobile network operators such as Vodafone, AT&T, Orange, Rakuten, Telestra, Telefónica, etc. with the objective to provide broadband internet coverage to existing unmodified mobile phones
- Orbcomm – an operational constellation used to provide global asset monitoring and messaging services from its constellation of 29 LEO communications satellites orbiting at 775 km
- Globalstar – an operational low Earth orbit (LEO) satellite constellation for satellite phone and low-speed data communications, covering most of the world's landmass
- Iridium – an operational constellation of 66 cross-linked satellites in a polar orbit, used to provide satellite phone and low-speed data services over the entire surface of Earth
- Lynk Global – a satellite-to-mobile-phone satellite constellation with the objective to coverage to traditional low-cost mobile devices
- Teledesic – a former (1990s) venture to accomplish broadband satellite internet services
- Project Loon – former concept to provide internet access via balloons in the stratosphere

References

1. "Starlink Group 4-5 | Falcon 9 Block 5" (https://everydayastronaut.com/starlink-group-4-5-falcon-9-block-5-2/). Everyday Astronaut. 8 January 2022. Retrieved 2 January 2023.
2. Ralph, Eric (30 May 2022). "SpaceX CEO Elon Musk reveals next-generation Starlink satellite details" (https://www.teslarati.com/spacex-elon-musk-next-gen-starlink-satellite-details/). *Teslarati*. Retrieved 5 June 2022.
3. Grush, Loren (15 February 2018). "SpaceX is about to launch two of its space Internet satellites – the first of nearly 12,000" (https://www.theverge.com/2018/2/15/17016208/spacex-falcon-9-launch-starlink-microsat-2a-2b-paz-watch-live). The Verge. Archived (https://web.archive.org/web/20190616184857/https://www.theverge.com/2018/2/15/17016208/spacex-falcon-9-launch-starlink-microsat-2a-2b-paz-watch-live) from the original on 16 June 2019. Retrieved 16 February 2018.
4. Kolodny, Lora (25 August 2022). "SpaceX and T-Mobile team up to use Starlink satellites to 'end mobile dead zones' " (https://www.cnbc.com/2022/08/25/spacex-and-t-mobile-team-up-to-use-starlink-satellites.html). *CNBC*. Retrieved 26 August 2022.
5. McDowell, Jonathan (4 May 2023). "Starlink Launch Statistics" (https://planet4589.org/space/con/star/stats.html). planet4589. Retrieved 5 May 2023.
6. SpaceX [@SpaceX] (19 December 2022). "Starlink now has more than 1,000,000 active subscribers" (https://twitter.com/SpaceX/status/1604872936976154624) (Tweet). Retrieved 13 March 2023 – via Twitter.
7. Starlink. "Thank you to our 1.5M+ customers around the world!" (https://twitter.com/Starlink/status/1654673695007457280?s=20). *Twitter*. Retrieved 14 May 2023.
8. Baylor, Michael (17 May 2018). "With Block 5, SpaceX to increase launch cadence and lower prices" (https://www.nasaspaceflight.com/2018/05/block-5-spacex-increase-launch-cadence-lower-prices/). NASASpaceFlight.com. Archived (https://web.archive.org/web/20180518060725/https://www.nasaspaceflight.com/2018/05/block-5-spacex-increase-launch-cadence-lower-prices/) from the original on 18 May 2018. Retrieved 22 May 2018. "The system is designed to improve global Internet access by utilizing thousands of satellites in Low Earth orbit. SpaceX President Gwynne Shotwell stated in a TED Talk last month that she expects the constellation to cost at least US$10 billion. Therefore, reducing launch costs will be vital."
9. Winkler, Rolfe; Pasztor, Andy (13 January 2017). "Exclusive Peek at SpaceX Data Shows Loss in 2015, Heavy Expectations for Nascent Internet Service" (https://www.wsj.com/articles/exclusive-peek-at-spacex-data-shows-loss-in-2015-heavy-expectations-for-nascent-internet-service-1484316455). *The Wall Street Journal*. Retrieved 9 February 2018.

10. Etherington, Darrell. "SpaceX hopes satellite Internet business will pad thin rocket launch margins" (https://techcrunch.com/2017/01/13/spacex-hopes-satellite-internet-business-will-pad-thin-rocket-launch-margins/). TechCrunch. Archived (https://web.archive.org/web/20201117160313/https://techcrunch.com/2017/01/13/spacex-hopes-satellite-internet-business-will-pad-thin-rocket-launch-margins/) from the original on 17 November 2020. Retrieved 9 February 2018.
11. "Will Elon Musk's Starlink satellites harm astronomy? Here's what we know" (https://www.nationalgeographic.com/science/article/elon-musk-starlink-internet-satellites-trouble-for-astronomy-light-pollution). *National Geographic*. 29 May 2019. Archived (https://web.archive.org/web/20210309192056/https://www.nationalgeographic.com/science/article/elon-musk-starlink-internet-satellites-trouble-for-astronomy-light-pollution) from the original on 9 March 2021. Retrieved 12 March 2021.
12. "JASON Report on the Impacts of Large Satellite Constellations" (https://www.nsf.gov/news/special_reports/jasonreportconstellations/). National Science Foundation. Retrieved 20 October 2021.
13. SpaceX (28 April 2020). "Astronomy Discussion with National Academy of Sciences" (https://www.spacex.com/updates/starlink-update-04-28-2020/index.html). Archived (https://web.archive.org/web/20210516183544/https://www.spacex.com/updates/starlink-update-04-28-2020/index.html) from the original on 16 May 2021. Retrieved 4 April 2021.
14. "Starlink Block v1.0" (https://space.skyrocket.de/doc_sdat/starlink-v1-0.htm). space.skyrocket.de. Archived (https://web.archive.org/web/20201117160214/https://space.skyrocket.de/doc_sdat/starlink-v1-0.htm) from the original on 17 November 2020. Retrieved 1 July 2021.
15. " Teledesic Plays Its Last Card, Leaves the Game." (http://www.space.com/spacenews/archive03/teledesicarch_071403.html)Archived (https://web.archive.org/web/20031018172953/http://www.space.com/spacenews/archive03/teledesicarch_071403.html) 18 October 2003 at the Wayback Machine Space News, 14 July 2003
16. Gilder, George (6 October 1997). "Light Speed Trap Ahead" (https://www.forbes.com/asap/1997/1006/118_3.html). *Forbes*.
17. "SpaceX Wash Ops Executive Launching Consulting Firm" (https://spacenews.com/spacex-wash-ops-executive-launching-consulting-firm/). *Spacenews*. 12 March 2012. Retrieved 10 December 2021.
18. de Selding, Peter B (29 June 2004). "Space X Takes 10 Percent Stake in Surrey Satellite Technology" (https://spacenews.com/space-x-takes-10-percent-stake-surrey-satellite-technology/). Space News.
19. UK-DMC satellite first to transfer sensor data from space using 'bundle' protocol (http://www.sstl.co.uk/News_and_Events/Latest_News/?story=1254) Archived (https://web.archive.org/web/20120426220355/http://www.sstl.co.uk/News_and_Events/Latest_News/?story=1254) 26 April 2012 at the Wayback Machine, press release, Surrey Satellite Technology Ltd, 11 September 2008.
20. "EADS Astrium signs an agreement to acquire Surrey Satellite Technology Limited from the University of Surrey." (http://portal.surrey.ac.uk/press/0408/070408)Archived (https://web.archive.org/web/20080416155340/http://portal.surrey.ac.uk/portal/page?_pageid=799,1960672&_dad=portal&_schema=PORTAL) 16 April 2008 at the Wayback Machine *University of Surrey*, 7 April 2008.
21. Winkler, Rolfe (7 November 2014). "Elon Musk's Next Mission: Internet Satellites" (https://www.wsj.com/articles/elon-musks-next-mission-internet-satellites-1415390062). *The Wall Street Journal*. Retrieved 10 September 2021.
22. Fernholz, Tim (24 June 2015). "Inside the race to create the next generation of satellite internet" (https://qz.com/434997/inside-the-race-to-create-the-next-generation-of-satellite-internet/). Archived (https://web.archive.org/web/20210911055525/https://qz.com/434997/inside-the-race-to-create-the-next-generation-of-satellite-internet/) from the original on 11 September 2021. Retrieved 10 September 2021.
23. "Application for Fixed Satellite Service by Space Exploration Holdings, LLC; Technical attachment" (https://fcc.report/IBFS/SAT-LOA-20161115-00118/1158350.pdf) (PDF). 15 November 2016. p. 49. Archived (https://web.archive.org/web/20210508131757/https://fcc.report/IBFS/SAT-LOA-20161115-00118/1158350.pdf) (PDF) from the original on 8 May 2021. Retrieved 11 September 2021. This article incorporates text from this source, which is in the public domain.
24. Boyle, Alan (19 September 2017). "SpaceX seeks to trademark the name "Starlink" for satellite broadband network" (https://www.geekwire.com/2017/spacex-seeks-trademark-name-starlink-satellite-broadband-network/). GeekWire. Archived (https://web.archive.org/web/20201117160054/https://www.geekwire.com/2017/spacex-seeks-trademark-name-starlink-satellite-broadband-network/) from the original on 17 November 2020. Retrieved 13 May 2019.

25. "How Indianapolis author John Green inspired one of Elon Musk's most grand ideas" (https://www.indystar.com/story/news/2018/02/22/how-indianapolis-author-john-green-inspired-one-elon-musks-most-grand-ideas/3608890022/). *The Indianapolis Star*. Archived (https://web.archive.org/web/20201117160058/https://www.indystar.com/story/news/2018/02/22/how-indianapolis-author-john-green-inspired-one-elon-musks-most-grand-ideas/360889002/) from the original on 17 November 2020. Retrieved 15 May 2019.
26. Foust, Jeff (10 October 2016). "Shotwell says SpaceX "homing in" on cause of Falcon 9 pad explosion" (http://spacenews.com/shotwell-says-spacex-homing-in-on-cause-of-falcon-9-pad-explosion/). SpaceNews. Archived (https://wayback.archive-it.org/all/20170818133616/http://spacenews.com/shotwell-says-spacex-homing-in-on-cause-of-falcon-9-pad-explosion/) from the original on 18 August 2017. Retrieved 16 October 2016.
27. "Types of Broadband Connections" (https://www.fcc.gov/general/types-broadband-connections). *fcc.gov*. Federal Communications Commission (FCC). 23 June 2014. Archived (https://web.archive.org/web/20201117160108/https://www.fcc.gov/general/types-broadband-connections) from the original on 17 November 2020. Retrieved 3 September 2020. This article incorporates text from this source, which is in the public domain.
28. Gates, Dominic (16 January 2015). "Elon Musk touts launch of "SpaceX Seattle" " (http://seattletimes.com/html/businesstechnology/2025480750_spacexmuskxml.html). *The Seattle Times*. Archived (https://web.archive.org/web/20150213044054/http://seattletimes.com/html/businesstechnology/2025480750_spacexmuskxml.html) from the original on 13 February 2015. Retrieved 19 January 2015.
29. *SpaceX Seattle 2015* (https://www.youtube.com/watch?v=AHeZHyOnsm4). Cliff O. 17 January 2015. Archived (https://web.archive.org/web/20211231102517/https://www.youtube.com/watch?v=AHeZHyOnsm4) from the original on 31 December 2021. Retrieved 5 February 2022 – via YouTube.
30. Foust, Jeff (12 March 2018). "Musk reiterates plans for testing BFR" (http://spacenews.com/musk-reiterates-plans-for-testing-bfr/). SpaceNews. Archived (https://archive.today/20200402064406/https://spacenews.com/musk-reiterates-plans-for-testing-bfr/) from the original on 2 April 2020. Retrieved 15 March 2018. "Construction of the first prototype spaceship is in progress. "We're actually building that ship right now", he said. "I think we'll probably be able to do short flights, short sort of up-and-down flights, probably sometime in the first half of next year"."
31. "SpaceX will build Starlink-like constellation around Mars, its president says" (https://futurism.com/the-byte/spacex-starlink-like-constellation-mars). *Futurism*. Archived (https://web.archive.org/web/20210203224012/https://futurism.com/the-byte/spacex-starlink-like-constellation-mars) from the original on 3 February 2021. Retrieved 28 April 2021.
32. Boyle, Alan (27 January 2017). "SpaceX adds a big new lab to its satellite development operation in Seattle area" (http://www.geekwire.com/2017/spacex-lab-satellite-development-redmond/). GeekWire. Archived (https://web.archive.org/web/20191127080411/https://www.geekwire.com/2017/spacex-lab-satellite-development-redmond/) from the original on 27 November 2019. Retrieved 13 May 2019.
33. Boyle, Alan (31 October 2018). "SpaceX reorganizes Starlink satellite operation, reportedly with high-level firings" (https://www.geekwire.com/2018/spacex-reorganizes-seattle-starlink-satellite/). GeekWire. Archived (https://web.archive.org/web/20200502122956/https://www.geekwire.com/2018/spacex-reorganizes-seattle-starlink-satellite/) from the original on 2 May 2020. Retrieved 2 November 2018.
34. "SpaceX expands to new 8000 sqft office space in Orange County, California" (http://www.teslarati.com/spacex-expands-office-space-in-orange-county/). *teslarati.com*. 8 July 2016. Archived (https://web.archive.org/web/20190513175400/https://www.teslarati.com/spacex-expands-office-space-in-orange-county/) from the original on 13 May 2019. Retrieved 23 May 2019.
35. "Open Positions" (http://www.spacex.com/careers/list). SpaceX. Archived (https://web.archive.org/web/20190819080642/https://www.spacex.com/careers/list) from the original on 19 August 2019. Retrieved 2 February 2017.
36. de Selding, Peter B. (5 October 2016). "SpaceX's Shotwell on Falcon 9 inquiry, discounts for reused rockets and Silicon Valley's test-and-fail ethos" (http://spacenews.com/spacexs-shotwell-on-falcon-9-inquiry-discounts-for-reused-rockets-and-silicon-valleys-test-and-fail-ethos/). SpaceNews. Archived (http://webarchive.loc.gov/all/20170331044056/http://spacenews.com/spacexs%2Dshotwell%2Don%2Dfalcon%2D9%2Dinquiry%2Ddiscounts%2Dfor%2Dreused%2Drockets%2Dand%2Dsilicon%2Dvalleys%2Dtest%2Dand%2Dfail%2Dethos/) from the original on 31 March 2017. Retrieved 8 October 2016.

37. "FCC Selected Application Listing File Number=SATLOA2016111500118" (https://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File%20Number/=/SATLOA2016111500118&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/). *International Bureau Application Filing and Reporting System*. FCC. 15 November 2016. Archived (https://web.archive.org/web/20200420083344/https://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC%2FFile%20Number%2F%3D%2FSATLOA2016111500118&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC%2F) from the original on 20 April 2020. Retrieved 22 November 2016. This article incorporates text from this source, which is in the public domain.
38. Henry, Caleb (2 March 2017). "FCC gets five new applications for non-geostationary satellite constellations" (http://spacenews.com/fcc-gets-five-new-applications-for-non-geostationary-satellite-constellations/). SpaceNews. Retrieved 1 January 2023.
39. Henry, Caleb (19 September 2017). "SpaceX asks FCC to make exception for LEO constellations in Connect America Fund decisions" (http://spacenews.com/spacex-asks-fcc-to-make-exception-for-leo-constellations-in-connect-america-fund-decisions/). SpaceNews. Archived (https://archive.today/20200923212553/https://spacenews.com/spacex-asks-fcc-to-make-exception-for-leo-constellations-in-connect-america-fund-decisions/) from the original on 23 September 2020. Retrieved 23 May 2019.
40. Foust, Jeff (2 December 2022). "FCC grants partial approval for Starlink second-generation constellation" (https://spacenews.com/fcc-grants-partial-approval-for-starlink-second-generation-constellation/). *SpaceNews*. Retrieved 4 December 2022.
41. "Updating Rules for Non-Geostationary-Satellite Orbit Fixed-Satellite Service Constellations" (https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0907/DOC-346584A1.pdf) (PDF). *FCC*. 7 September 2017. p. 44. Archived (https://web.archive.org/web/20210512212502/https://transition.fcc.gov/Daily_Releases/Daily_Business/2017/db0907/DOC-346584A1.pdf) (PDF) from the original on 12 May 2021.
42. Brodkin, Jon (4 October 2017). "SpaceX and OneWeb broadband satellites raise fears about space debris" (https://arstechnica.com/information-technology/2017/10/spacex-and-oneweb-broadband-satellites-raise-fears-about-space-debris/). Ars Technica. Archived (https://web.archive.org/web/20171006232900/https://arstechnica.com/information-technology/2017/10/spacex-and-oneweb-broadband-satellites-raise-fears-about-space-debris/) from the original on 6 October 2017. Retrieved 7 October 2017.
43. "FCC Authorizes SpaceX to Provide Broadband Satellite Services" (https://www.fcc.gov/document/fcc-authorizes-spacex-provide-broadband-satellite-services). Federal Communications Commission. 29 March 2018. Archived (https://web.archive.org/web/20201117160055/https://www.fcc.gov/document/fcc-authorizes-spacex-provide-broadband-satellite-services) from the original on 17 November 2020. Retrieved 31 March 2018. This article incorporates text from this source, which is in the public domain.
44. Brodkin, Jon (30 March 2018). "FCC approves SpaceX plan to launch 4,425 broadband satellites" (https://arstechnica.com/information-technology/2018/03/spacex-gets-fcc-approval-to-build-worldwide-satellite-broadband-network/). Ars Technica. Archived (https://web.archive.org/web/20201117160139/https://arstechnica.com/information-technology/2018/03/spacex-gets-fcc-approval-to-build-worldwide-satellite-broadband-network/) from the original on 17 November 2020. Retrieved 30 March 2018.
45. Henry, Caleb (29 March 2018). "FCC approves SpaceX constellation, denies waiver for easier deployment deadline" (https://spacenews.com/us-regulators-approve-spacex-constellation-but-deny-waiver-for-easier-deployment-deadline/). SpaceNews. Archived (https://archive.today/20180331174720/http://spacenews.com/us-regulators-approve-spacex-constellation-but-deny-waiver-for-easier-deployment-deadline/) from the original on 31 March 2018. Retrieved 23 May 2019.
46. "Authorizing SpaceX V-Band Constellation Deployment & Operation" (https://www.fcc.gov/document/authorizing-spacex-v-band-constellation-deployment-operation). *FCC*. 25 October 2018. Archived (https://web.archive.org/web/20210509084117/https://www.fcc.gov/document/authorizing-spacex-v-band-constellation-deployment-operation) from the original on 9 May 2021.
47. Brodkin, Jon (30 March 2018). "FCC tells SpaceX it can deploy up to 11,943 broadband satellites" (https://arstechnica.com/information-technology/2018/11/spacex-gets-fcc-approval-for-7500-more-broadband-satellites/). Ars Technica. Archived (https://web.archive.org/web/20201117160132/https://arstechnica.com/information-technology/2018/11/spacex-gets-fcc-approval-for-7500-more-broadband-satellites/) from the original on 17 November 2020. Retrieved 25 March 2019.
48. Roulette, Joey (9 April 2021). "OneWeb, SpaceX satellites dodged a potential collision in orbit" (https://www.theverge.com/2021/4/9/22374262/oneweb-spacex-satellites-dodged-potential-collision-orbit-space-force). *The Verge*. Archived (https://web.archive.org/web/20210414094901/https://www.theverge.com/2021/4/9/22374262/oneweb-spacex-satellites-dodged-potential-collision-orbit-space-force) from the original on 14 April 2021. Retrieved 14 April 2021.

49. Wiltshire, William M., ed. (18 November 2018), "Application for Fixed Satellite Service by Space Exploration Holdings, LLC" (https://fcc.report/IBFS/SAT-MOD-20181108-00083), *SAT-MOD-20181108-00083/SATMOD2018110800083* (https://fcc.report), FCC, archived (https://web.archive.org/web/20201117160126/https://fcc.report/) from the original on 17 November 2020, retrieved 24 March 2019, "Space Exploration Holdings, LLC seeks to modify its Ku/Ka-band NGSO license to relocate satellites previously authorized to operate at an altitude of 1,150 km (710 mi) to an altitude of 550 km (340 mi), and to make related changes to the operations of the satellites in this new lower shell of the constellation" This article incorporates text from this source, which is in the public domain.
50. "SpaceX non-geostationary satellite system, Attachment A, Technical Information to Supplement Schedule S, U.S. Federal Communications Commission" (https://fcc.report/IBFS/SAT-MOD-20181108-00083/1569860). 8 November 2018. Archived (https://web.archive.org/web/20201117160058/https://fcc.report/IBFS/SAT-MOD-20181108-00083/1569860) from the original on 17 November 2020. Retrieved 23 November 2018. This article incorporates text from this source, which is in the public domain.
51. Henry, Caleb (26 April 2019). "FCC OKs lower orbit for some Starlink satellites" (https://spacenews.com/fcc-oks-lower-orbit-for-some-starlink-satellites/). SpaceNews. Archived (https://web.archive.org/web/20201117160100/https://spacenews.com/fcc-oks-lower-orbit-for-some-starlink-satellites/) from the original on 17 November 2020. Retrieved 28 April 2019. "lower the orbit of nearly 1,600 of its proposed broadband satellites. The Federal Communications Commission said 26 April 2019 it was correct with SpaceX changing its plans to orbit those satellites at 550 km (340 mi) instead of 1,150 km (710 mi). SpaceX says the adjustment, requested six months ago, will make a safer space environment, since any defunct satellites at the lower altitude would reenter the Earth's atmosphere in five years even without propulsion. The lower orbit also means more distance between Starlink and competing Internet constellations proposed by OneWeb and Telesat. FCC approval allows satellite companies to provide communications services in the United States. The agency granted SpaceX market access in March 2018 for 4,425 satellites using Ku-band and Ka-band spectrum, and authorized 7,518 V-band satellites in November 2018. SpaceX's modified plans apply to the smaller of the two constellations."
52. "SpaceX submits paperwork for 30,000 more Starlink satellites" (https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/). 15 October 2019. Archived (http://wayback.archive-it.org/all/20191016032000/https://spacenews.com/spacex%2Dsubmits%2Dpaperwork%2Dfor%2D30000%2Dmore%2Dstarlink%2Dsatellites/) from the original on 16 October 2019. Retrieved 16 October 2019.
53. "SpaceX Services Application for Blanket-licensed Earth stations" (https://fcc.report/IBFS/SES-LIC-INTR2019-00217/1616678). *fcc.report*. FCC. 1 February 2019. Archived (https://web.archive.org/web/20190529075424/https://fcc.report/IBFS/SES-LIC-INTR2019-00217/1616678) from the original on 29 May 2019. Retrieved 9 February 2019. This article incorporates text from this source, which is in the public domain.
54. "Starlink Press Kit" (https://www.spacex.com/sites/spacex/files/starlink_press_kit.pdf) (PDF). *spacex.com*. 15 May 2019. Archived (https://web.archive.org/web/20190515091900/https://www.spacex.com/sites/spacex/files/starlink_press_kit.pdf) (PDF) from the original on 15 May 2019. Retrieved 23 May 2019.
55. "FCC Form 442 – Application for new or modified radio station under Part 5 of FCC rules – Experimental radio service: 0517-EX-CN-2019" (https://apps.fcc.gov/oetcf/els/reports/442_Print.cfm?mode=current&application_seq=93257&license_seq=94236). Federal Communications Commission. Archived (https://web.archive.org/web/20201117160150/https://apps.fcc.gov/oetcf/els/reports/442_Print.cfm?mode=current&application_seq=93257&license_seq=94236) from the original on 17 November 2020. Retrieved 4 July 2019. This article incorporates text from this source, which is in the public domain.
56. "0517-EX-CN-2019 – Application Question 7: Purpose of Experiment" (https://fcc.report/ELS/Space-Exploration-Holdings-LLC/0517-EX-CN-2019/232942.pdf) (PDF). FCC. June 2019. Retrieved 4 July 2019. "SpaceX seeks experimental authority for two types of testing: (1) a total of 70 user terminals (mixed between the two types of antennas) so that it can test multiple devices at a number of geographically dispersed locations throughout the United States; and (2) up to 200 phased array user terminals to be deployed within the state of Washington at the homes of SpaceX employees for ongoing testing. Such authority would enable SpaceX to obtain critical data regarding the operational performance of these user terminals and the SpaceX NGSO system." This article incorporates text from this source, which is in the public domain.
57. "FCC FORM 442 – APPLICATION FOR NEW OR MODIFIED RADIO STATION UNDER PART 5 OF FCC RULES – EXPERIMENTAL RADIO SERVICE: 0515-EX-CN-2019" (https://apps.fcc.gov/oetcf/els/reports/442_Print.cfm?mode=current&application_seq=93244&license_seq=94223). Federal Communications Commission. Archived (https://web.archive.org/web/20201117160146/https://apps.fcc.gov/oetcf/els/reports/442_Print.cfm?mode=current&application_seq=93244&license_seq=94223) from the original on 17 November 2020. Retrieved 4 July 2019. This article incorporates text from this source, which is in the public domain.

58. "Application question 7: Purpose of Experiment" (https://apps.fcc.gov/els/GetAtt.html?id=233157&x). FCC. June 2019. Archived (https://web.archive.org/web/20201117160127/https://apps.fcc.gov/els/GetAtt.html?id=233157&x=) from the original on 17 November 2020. Retrieved 4 July 2019. "SpaceX seeks an experimental authorization to test activities ... tests are designed to demonstrate the ability to transmit and receive information (1) between five ground sites ("Ground-to-Ground") and (2) between four ground sites and an airborne aircraft ("Ground-to-Air") ... This application seeks only to use an Earth station to transmit signals to the SpaceX satellites first from the ground and later from a moving aircraft." This article incorporates text from this source, which is in the public domain.
59. Ralph, Eric (8 April 2019). "SpaceX's first dedicated Starlink launch announced as mass production begins" (https://www.teslarati.com/spacex-starlink-first-launch-date/). Teslarati. Archived (https://web.archive.org/web/20201117160124/https://www.teslarati.com/spacex-starlink-first-launch-date/) from the original on 17 November 2020. Retrieved 9 April 2019.
60. "SpaceX submits paperwork for 30,000 more Starlink satellites" (https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/). 15 October 2019. Archived (https://archive.today/20191015180034/https://spacenews.com/spacex-submits-paperwork-for-30000-more-starlink-satellites/) from the original on 15 October 2019. Retrieved 16 October 2019.
61. Musk, Elon [@elonmusk] (22 October 2019). "Sending this tweet through space via Starlink satellite " (https://twitter.com/elonmusk/status/1186523464712146944) (Tweet). Archived (https://web.archive.org/web/20220121222826/https://twitter.com/elonmusk/status/1186523464712146944) from the original on 21 January 2022. Retrieved 5 February 2022 – via Twitter.
62. Mathewson, Samantha (5 November 2020). "SpaceX opens Starlink satellite internet to public beta testers" (https://www.space.com/spacex-invites-starlink-internet-beta-testing). Space.com. Archived (https://web.archive.org/web/20201105194623/https://www.space.com/spacex-invites-starlink-internet-beta-testing) from the original on 5 November 2020. Retrieved 11 March 2021.
63. "SpaceX's Starlink Internet speeds are consistently topping 150 Mbps — now Elon Musk says the biggest challenge is slashing the US$600 up-front cost for users" (https://www.businessinsider.com/starlink-public-beta-speed-cost-subscription-elon-musk-2020-11). *Business Insider*. Archived (https://web.archive.org/web/20201117160211/https://www.businessinsider.com/starlink-public-beta-speed-cost-subscription-elon-musk-2020-11) from the original on 17 November 2020. Retrieved 6 November 2020.
64. "SpaceX opens Starlink satellite Internet pre-orders to the public" (https://www.engadget.com/spacex-starlink-internet-preorders-121427490.html). Engadget. Archived (https://web.archive.org/web/20210210134847/https://www.engadget.com/spacex-starlink-internet-preorders-121427490.html) from the original on 10 February 2021. Retrieved 10 February 2021.
65. Foust, Jeff (15 April 2021). "SpaceX adds to latest funding round" (https://spacenews.com/spacex-adds-to-latest-funding-round/). SpaceNews. Archived (https://archive.today/20210620013106/https://spacenews.com/spacex-adds-to-latest-funding-round/) from the original on 20 June 2021. Retrieved 15 April 2021.
66. "Elon Musk's SpaceX raises $1.9 billion in funding" (https://www.reuters.com/article/us-spacex-funding-idUSKCN25E26E). *Reuters*. Archived (https://web.archive.org/web/20200820203147/https://www.reuters.com/article/us-spacex-funding-idUSKCN25E26E) from the original on 20 August 2020. Retrieved 15 April 2021.
67. ISED [@ISED_CA] (6 November 2020). ".@SpaceX is joining the effort to help get Canadians connected to high-speed Internet! Regulatory approval for the @SpaceXStarlink low Earth orbit satellite constellation has been granted!" (https://twitter.com/ISED_CA/status/1324790429947174913) (Tweet). Archived (https://web.archive.org/web/20220104021502/https://twitter.com/ised_ca/status/1324790429947174913) from the original on 4 January 2022. Retrieved 5 February 2022 – via Twitter.
68. "SpaceX's Starlink wins nearly US$900 million in FCC subsidies to bring Internet to rural areas" (https://www.cnbc.com/2020/12/07/spacex-starlink-wins-nearly-900-million-in-fcc-subsidies-auction.html). *cnbc.com*. CNBC. 9 December 2020. Archived (https://web.archive.org/web/20201216185501/https://www.cnbc.com/2020/12/07/spacex-starlink-wins-nearly-900-million-in-fcc-subsidies-auction.html) from the original on 16 December 2020. Retrieved 10 December 2020.
69. Fingas, J. (10 August 2022). "FCC rejects Starlink request for nearly $900 million in broadband subsidies" (https://www.engadget.com/fcc-rejects-spacex-starlink-rural-broad-band-funds-194352343.html). *Engadget*. Retrieved 11 August 2022.
70. "Starlink appeals FCC rejection of $886M grant, calls reversal "grossly unfair" " (https://arstechnica.com/tech-policy/2022/09/starlink-appeals-fcc-rejection-of-886m-grant-calls-reversal-grossly-unfair/). Ars Technica. 12 September 2022. Retrieved 15 September 2022.

71. "APPLICATION FOR BLANKET-LICENSED EARTH STATIONS IN MOTION" (https://fcc.report/IBFS/SES-LIC-INTR2021-00934/3877177.pdf) (PDF). Federal Communications Commission (FCC). Archived (https://web.archive.org/web/20210309064421/https://fcc.report/IBFS/SES-LIC-INTR2021-00934/3877177.pdf) (PDF) from the original on 9 March 2021. Retrieved 7 March 2021. This article incorporates text from this source, which is in the public domain.
72. Alvarez, Simon (6 March 2021). "Starlink FCC application reveal plans for satellite internet in moving vehicles" (https://www.teslarati.com/starlink-moving-vehicles-tesla-fcc-application/). *teslarati.com*. Archived (https://web.archive.org/web/20210306223117/https://www.teslarati.com/starlink-moving-vehicles-tesla-fcc-application/) from the original on 6 March 2021. Retrieved 7 March 2021.
73. Novet, Jordan (13 May 2021). "Google wins cloud deal from Elon Musk's SpaceX for Starlink internet connectivity" (https://archive.today/20210513202004/https://www.cnbc.com/2021/05/13/google-cloud-wins-spacex-deal-for-starlink-internet-connectivity.html). CNBC. Archived from the original (https://www.cnbc.com/2021/05/13/google-cloud-wins-spacex-deal-for-starlink-internet-connectivity.html) on 13 May 2021.
74. "Viasat asks FCC to halt Starlink launches while it seeks court ruling" (https://spacenews.com/viasat-asks-fcc-to-halt-starlink-launches-while-it-seeks-court-ruling/). SpaceNews. 25 May 2021. Archived (https://web.archive.org/web/20211001025041/https://spacenews.com/viasat-asks-fcc-to-halt-starlink-launches-while-it-seeks-court-ruling/) from the original on 1 October 2021. Retrieved 26 May 2021.
75. Ralph, Eric (1 July 2021). "SpaceX says Starship can beat "plasma blackout" with Starlink antennas" (https://www.teslarati.com/spacex-starship-plasma-blackout-starlink-test/). Archived (https://web.archive.org/web/20210701203411/https://www.teslarati.com/spacex-starship-plasma-blackout-starlink-test) from the original on 1 July 2021. Retrieved 5 July 2021.
76. Rainbow, Jason (4 January 2022). "Starlink's head of India resigns as SpaceX refunds preorders" (https://spacenews.com/starlinks-head-of-india-resigns-as-spacex-refunds-preorders/). *SpaceNews*. Retrieved 9 February 2022.
77. "Sanjay Bhargava to head Elon Musk's Starlink satellite broadband venture in India" (https://economictimes.indiatimes.com/industry/telecom/telecom-news/sanjay-bhargava-to-head-elon-musks-starlink-satellite-broadband-venture-in-india/articleshow/86612212.cms). The Economic Times. Retrieved 1 October 2021.
78. Porter, Jon (2 February 2022). "SpaceX's new Starlink Business tier promises up to 500Mbps for $500 a month – The new antenna carries an upfront cost of $2500" (https://www.theverge.com/2022/2/2/22913921/spacex-starlink-premium-satellite-internet-faster-speed-expensive). *The Verge*. Retrieved 3 February 2022.
79. SpaceX (2 February 2022). "Starlink Business" (https://www.starlink.com/business). *Starlink*. Retrieved 29 March 2022.
80. Rainbow, Jason (31 August 2022). "Starlink secures first cruise line customer with Royal Caribbean" (https://spacenews.com/starlink-secures-first-cruise-line-customer-with-royal-caribbean/). *SpaceNews*. Retrieved 31 August 2022.
81. "Starlink Deliveries Slow Amid Chip Shortage, FedEx Delays" (https://www.pcmag.com/news/starlink-deliveries-slow-amid-chip-shortage-fedex-delays). PC Magazine. 7 January 2022. Retrieved 1 January 2023.
82. "SpaceX says its Starlink satellite Internet service now has over 10,000 users" (https://www.cnbc.com/2021/02/04/spacex-starlink-satellite-internet-service-has-over-10000-users.html). CNBC. 4 February 2021. Archived (https://web.archive.org/web/20210205002532/https://www.cnbc.com/2021/02/04/spacex-starlink-satellite-internet-service-has-over-10000-users.html) from the original on 5 February 2021. Retrieved 5 February 2021.
83. "SpaceX president says Starlink global satellite broadband service to be live by September" (https://www.zdnet.com/article/spacex-president-says-starlink-global-satellite-broadband-service-to-be-live-by-september/). 23 June 2021. Archived (https://web.archive.org/web/20210623062230/https://www.zdnet.com/article/spacex-president-says-starlink-global-satellite-broadband-service-to-be-live-by-september/) from the original on 23 June 2021. Retrieved 23 June 2021.
84. *Starlink Mission* (https://www.youtube.com/watch?v=xpl_JnG7rcg). SpaceX. 4 May 2021. Archived (https://web.archive.org/web/20220104081257/https://www.youtube.com/watch?v=xpl_JnG7rcg) from the original on 4 January 2022. Retrieved 5 February 2022 – via YouTube.
85. "Starlink has 700,000 subs" (https://advanced-television.com/2022/09/19/starlink-has-700000-subs/). 19 September 2022. Archived (https://web.archive.org/web/20220923182546/https://advanced-television.com/2022/09/19/starlink-has-700000-subs/) from the original on 23 September 2022. Retrieved 23 September 2022.
86. Starlink [@starlink] (6 May 2023). "Thank you to our 1.5M+ customers around the world! 🛰️🌎❤️ " (https://twitter.com/starlink/status/1654673695007457280) (Tweet) – via Twitter.
87. "Starlink set to deliver breakthrough internet services to PH soon" (https://newsinfo.inquirer.net/1604932/starlink-set-to-deliver-breakthrough-internet-services-to-ph-soon). 31 May 2022.

88. Stephen Chen (25 May 2022). "China military must be able to destroy Elon Musk's Starlink satellites if they threaten national security: scientists" (https://www.scmp.com/news/china/science/article/3178939/china-military-needs-defence-against-potential-starlink-threat).
89. REN, Yuan-zhen; JIN, Sheng; LU, Yao-bing; GAO, Hong-wei; SUN, Shu-yan (2022). "The Development Status of Starlink and Its Countermeasures" (https://web.archive.org/web/20220526210244/https://www.xdfyjs.cn/EN/10.3969/j.issn.1009-086x.2022.02.002). *Modern Defense Technology*. **50** (2): 11–17. doi:10.3969/j.issn.1009-086x.2022.02.002 (https://doi.org/10.3969%2Fj.issn.1009-086x.2022.02.002). Archived from the original (https://www.xdfyjs.cn/EN/10.3969/j.issn.1009-086x.2022.02.002) on 26 May 2022.
90. Passant Rabie (27 May 2022). "Chinese Researchers Publish Strategy to Destroy Elon Musk's Starlink" (https://gizmodo.com/spacex-starlink-china-military-1848982845).
91. Elon Musk [@elonmusk] (17 September 2022). "Starlink is meant for peaceful use only... to help mend the fault in our stars" (https://twitter.com/elonmusk/status/1571154307759603718) (Tweet) – via Twitter.
92. Ed Browne (16 September 2022). "Fact Check: Did Kremlin Threaten to Destroy Starlink Satellites?" (https://www.newsweek.com/russia-starlink-war-ukraine-satellite-1743675). *Newsweek*.
93. "Starlink's RV service lets users jump the line — for a price" (https://spacenews.com/starlinks-rv-service-enables-lets-users-jump-the-line-for-a-price). *SpaceNews*. 24 May 2022. Retrieved 24 May 2022.
94. Dunphy, Chris (7 July 2022). "Starlink For Boats! - SpaceX Announces Starlink Maritime, with Eye-Popping Price" (https://www.rvmobileinternet.com/starlink-for-boats-spacex-announces-starlink-maritime-with-eye-popping-price/). *Mobile Internet Resource Center*. Retrieved 27 September 2022.
95. "Starlink" (https://www.starlink.com/). *Starlink*. Retrieved 27 September 2022.
96. Heming, Dan (24 August 2022). "Starlink Introduces Best Effort Service" (https://www.rvmobileinternet.com/starlink-introduces-best-effort-service/). *Mobile Internet Resource Center*. Retrieved 27 September 2022.
97. "Help Center" (https://support.starlink.com/). *support.starlink.com*. Retrieved 27 September 2022.
98. "Starlink announces 1TB monthly cap, users who go over will get slower speeds" (https://arstechnica.com/tech-policy/2022/11/starlink-to-cap-users-at-1tb-of-high-speed-data-unless-they-pay-extra/amp/). ARSTechnica. 8 November 2022. Retrieved 1 January 2023.
99. Brodkin, Jon (23 September 2022). "Starlink is getting a lot slower as more people use it, speed tests show" (https://arstechnica.com/tech-policy/2022/09/ookla-starlinks-median-us-download-speed-fell-nearly-30mbps-in-q2-2022/). *Ars Technica*. Retrieved 26 September 2022.
100. SpaceX says it will test Starlink's satellite-to-cell service with T-Mobile this year (https://www.cnbc.com/2023/03/13/spacex-t-mobile-cell-service-tests-this-year.html), CNBC, 13 March 2023.
101. "Starlink connectivity effective in 9 provinces – Mutati" (https://www.lusakatimes.com/2023/04/06/starlink-connectivity-effective-in-9-provinces-mutati/). *lusakatimes.com*. 6 April 2023. Retrieved 10 June 2023.
102. "Starlink secures licence to operate in Zambia" (https://www.commsupdate.com/articles/2023/06/09/starlink-secures-licence-to-operate-in-zambia/). *commsupdate.com*. 9 June 2023. Retrieved 10 June 2023.
103. "Elon Musk's Starlink given license to operate in Zambia" (https://zambianobserver.com/elon-musks-starlink-given-license-to-operate-in-zambia/). *zambianobserver.com*. 7 June 2023. Retrieved 10 June 2023.
104. "Elon Musk's SpaceX to launch satellite internet service in Mongolia" (https://www.reuters.com/technology/elon-musks-spacex-launch-satellite-internet-service-mongolia-2023-07-07/). *Reuters*. 7 July 2023.
105. "What is Starlink?" (https://www.techtarget.com/whatis/definition/Starlink). *Tech Target*. August 2022. Retrieved 10 January 2023.
106. Catherine McNally (28 March 2023). "SpaceX Starlink Satellite Internet Review 2023" (https://www.reviews.org/internet-service/spacex-starlink-satellite-internet-review/). *reviews.org*. Retrieved 1 April 2023.
107. Musk, Elon [@elonmusk] (15 April 2021). "@Erdayastronaut @thesheetztweetz Yeah, should be fully mobile later this year, so you can move it anywhere or use it on an RV or truck in motion. We need a few more satellite launches to achieve compete coverage & some key software upgrades" (https://twitter.com/elonmusk/status/1382842277719003136) (Tweet). Archived (https://web.archive.org/web/20211018231510/https://twitter.com/elonmusk/status/1382842277719003136) from the original on 18 October 2021. Retrieved 5 February 2022 – via Twitter.
108. O'Callaghan, Jonathan (27 October 2020). "SpaceX Reveals Monthly Cost Of Starlink Internet In Its 'Better Than Nothing Beta'" (https://www.forbes.com/sites/jonathanocallaghan/2020/10/27/spacex-reveals-monthly-cost-of-starlink-internet-in-its-better-than-nothing-betabut-is-it-too-expensive/). *Forbes*. Archived (https://web.archive.org/web/20201117160314/https://www.forbes.com/sites/jonathanocallaghan/2020/10/27/spacex-reveals-monthly-cost-of-starlink-internet-in-its-better-than-nothing-betabut-is-it-too-expensive/) from the original on 17 November 2020. Retrieved 30 October 2020.

109. "Broadband Genie 2023 Awards: The Best Internet Providers" (https://www.broadbandgenie.co.uk/broadband-awards). *www.broadbandgenie.co.uk*. Retrieved 14 July 2023.
110. Harper, Zachary (9 October 2022). "Why is Starlink so Expensive - Will the Price Drop" (https://turbospeedwifi.com/why-is-starlink-so-expensive-will-the-price-drop/). *Turbo Speed Wifi*. Retrieved 26 October 2022.
111. Ricker, Thomas (25 August 2022). "Starlink lowers monthly internet prices by 50 percent for some" (https://www.theverge.com/2022/8/25/23321262/starlink-discount-price-drop). *The Verge*. Retrieved 26 October 2022.
112. Samios, Zoe (26 February 2023). "Elon Musk's Starlink nears 100,000 Australian customers" (https://www.smh.com.au/business/companies/elon-musk-s-starlink-nears-100-000-australian-customers-20230223-p5cn23.html). *The Sydney Morning Herald*. Retrieved 8 March 2023.
113. Berger, Eric (25 August 2022). "Forget 5G wireless, SpaceX and T-Mobile want to offer Zero-G coverage" (https://arstechnica.com/science/2022/08/forget-5g-wireless-spacex-and-t-mobile-want-to-offer-zero-g-coverage/). *Ars Technica*. Retrieved 26 August 2022.
114. "T-Mobile is winning the race to 100MHz for midband 5G" (https://www.lightreading.com/5g/t-mobile-is-winning-race-to-100mhz-for-midband-5g/a/d-id/773516). *Light Reading*. 15 November 2021. Retrieved 25 August 2022.
115. "SpaceX" (https://one.nz/why-choose-us/spacex/). *One NZ*. Retrieved 27 July 2023.
116. Pullar-Strecker, Tom (2 April 2023). "One NZ inks deal with SpaceX to provide 100% mobile coverage of NZ" (https://www.stuff.co.nz/business/131664617/one-nz-inks-deal-with-spacex-to-provide-100-mobile-coverage-of-nz). *Stuff*. Retrieved 27 July 2023.
117. "Together Optus and SpaceX Plan to Cover 100% of Australia" (https://www.optus.com.au/about/media-centre/media-releases/2023/07/together-optus-and-spacex-plan-to-cover-100-percent-of-australia).
118. Popkin, Gabriel (22 January 2019). "Decades after Reagan's 'Star Wars,' Trump calls for missile defenses that would blast warheads from the sky" (https://www.science.org/content/article/decades-after-reagan-s-star-wars-trump-calls-missile-defenses-would-blast-warheads-sky).
119. Pompeo, Mike (18 January 2022). "Nuclear Weapons, China, and a Strategic Defense Initiative for this Century" (https://nationalinterest.org/feature/nuclear-weapons-china-and-strategic-defense-initiative-century-199549).
120. Erwin, Sandra (21 April 2019). "Space Development Agency a huge win for Griffin in his war against the status quo" (https://spacenews.com/space-development-agency-a-huge-win-for-griffin-in-his-war-against-the-status-quo/). Retrieved 1 January 2020.
121. Kenneth Chang (30 May 2020). "Entrepreneur Tries His Midas Touch in Space, New York Times" (https://www.nytimes.com/2020/05/30/science/spacex-nasa-astronauts.html). *The New York Times*.
122. Trevithick, Joseph (21 September 2018). "SpaceX Exec Says Company Would Launch A Weapon Into Space In 'Defense Of This Country' " (https://www.thedrive.com/the-war-zone/23733/spacex-exec-says-company-would-launch-a-weapon-into-space-in-defense-of-this-country). Retrieved 1 January 2023.
123. Erwin, Sandra (5 October 2020). "L3Harris, SpaceX win Space Development Agency contracts to build missile-warning satellites" (https://spacenews.com/spacex-l3harris-win-space-development-agency-contracts-to-build-missile-warning-satellites/). SpaceNews. Retrieved 1 December 2021.
124. Machi, Vivienne (1 June 2021). "US Military Places a Bet on LEO for Space Security" (https://www.sda.mil/us-military-places-a-bet-on-leo-for-space-security/). Space Development Agency. Retrieved 1 December 2021. This article incorporates text from this source, which is in the public domain.
125. Erwin, Sandra (2 April 2022). "SpaceX launches 10 satellites for U.S. Space Development Agency" (https://spacenews.com/spacex-launches-10-satellites-for-u-s-space-development-agency/).
126. Sandra Erwin (9 Dec 2022) Space Development Agency's first launch slips to March due to satellite glitch (https://spacenews.com/space-development-agencys-first-launch-slips-to-march-due-to-satellite-glitch/)
127. "Hypersonic Missile Defense: Issues for Congress" (https://crsreports.congress.gov/product/pdf/IF/IF11623). Congressional Research Service. 22 January 2022. Retrieved 21 June 2022.
128. " 'Warfighter Council' Guides Capability Development for Space Development Agency" (https://www.defense.gov/News/News-Stories/Article/Article/2525434/warfighter-council-guides-capability-development-for-space-development-agency/). U.S. Department of Defense. 4 March 2021. Retrieved 21 June 2022.
129. "Costs of Implementing Recommendations of the 2019 Missile Defense Review" (https://www.cbo.gov/publication/56960/). Congressional Budget Office. 1 January 2021. Retrieved 1 December 2021.
130. Machi, Vivienne (1 June 2021). "US Military Places a Bet on LEO for Space Security" (https://www.sda.mil/us-military-places-a-bet-on-leo-for-space-security/). Space Development Agency. Retrieved 1 December 2021.

131. "2019 Missile Defense Review" (https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/The%202019%20MDR_Executive%20Summary.pdf) (PDF). Office of the Secretary of Defense. 1 November 2019. Retrieved 21 June 2022.
132. "Space-based Missile Defense" (https://www.ucsusa.org/resources/space-based-missile-defense-0). Union of Concerned Scientists. 30 August 2018. Retrieved 1 December 2021.
133. "Approaching the Third Rail? A Trilateral Treaty to Prohibit Space-Based Missile Defenses" (https://carnegieendowment.org/2021/12/16/approaching-third-rail-trilateral-treaty-to-prohibit-space-based-missile-defenses-pub-85965). Carnegie Endowment for International Peace. 16 December 2021. Retrieved 1 November 2022.
134. "Elon Musk's SpaceX, Once a Washington Outsider, Courts Military Business" (https://www.wsj.com/articles/elon-musk-once-a-washington-outsider-courts-military-business-11604517046). *The Wall Street Journal*. 4 November 2020. Retrieved 1 December 2021.
135. "NDIA Appoints 16 Members to Board" (https://www.govconwire.com/2021/10/ndia-appoints-16-members-to-board/). GovCon Wire. 5 October 2021. Retrieved 1 December 2021.
136. "Statement of General Terrence J. O'Shaugnessy before the Senate Armed Services Committee" (https://www.armed-services.senate.gov/imo/media/doc/OShaughnessy_02-13-20.pdf) (PDF). U.S. Senate. 13 February 2020. Retrieved 1 November 2022.
137. "Space Development Agency Makes Awards for 126 Satellites to Build Tranche 1 Transport Laye" (https://www.defense.gov/News/Releases/Release/Article/2948229/space-development-agency-makes-awards-for-126-satellites-to-build-tranche-1-tra/https%3A%2F%2Fwww.defense.gov%2FNews%2FReleases%2FRelease%2FArticle%2F2948229%2Fspace-development-agency-makes-awards-for-126-satellites-to-build-tranche-1-tra%2F). *U.S. Department of Defense*. Retrieved 23 August 2023.
138. "USA 320, ..., 323, 328, ..., 331" (https://space.skyrocket.de/doc_sdat/usa-320.htm).
139. "Starshield: Supporting National Security" (https://www.spacex.com/starshield/). SpaceX. 2 December 2022. Retrieved 2 December 2022.
140. "SpaceX Releases 'Starshield' Satellite Services Designed for Government Use to Support National Security" (https://www.tesmanian.com/blogs/tesmanian-blog/starshield).
141. "Musk's SpaceX wins Pentagon award for missile tracking satellites" (https://www.reuters.com/article/uk-space-exploration-spacex-satellites-idUKKBN26Q3A5). *Reuters*. 5 October 2020.
142. Jonathan McDowell [@planet4589] (20 June 2022). "Space-Track confirms the presence of four secret payloads on the Globalstar Falcon 9 launch - USA 328 to USA 331, catalog 52889 to 52892, orbital data not available. One piece of debris, probably a Starlink-style tension rod?" (https://twitter.com/planet4589/status/1538960051414646796) (Tweet) – via Twitter.
143. @cgbassa (21 June 2022). "The four classified satellites launched together with Globalstar FM15 on a Falcon 9 rocket yesterday have been detected in a ~535 km orbit at 53 deg inclination" (https://twitter.com/cgbassa/status/1539044005564100609) (Tweet) – via Twitter.
144. "SpaceX launches Globalstar satellite on mysterious Falcon 9 mission" (https://www.nasaspaceflight.com/2022/06/spacex-globalstar-falcon-9/). NASASpaceFlight.com. 18 June 2022.
145. "Tranche 0 flight 1's 2 tracking layer sats' matches the on-orbit images released on starshield page for Starshield sats" (https://twitter.com/GewoonLukas_/status/1669067458190123009?s=20). *Twitter*. Retrieved 15 June 2023.
146. "Tracking Layer Tranche-0 WFOV 1, ..., 4" (https://space.skyrocket.de/doc_sdat/tracking-layer-tranche-0-wfov-spx.htm).
147. Erwin, Sandra (22 October 2019). "SpaceX plans to start offering Starlink broadband services in 2020" (https://spacenews.com/spacex-plans-to-start-offering-starlink-broadband-services-in-2020/). SpaceNews. Archived (https://archive.today/20191023131758/https://spacenews.com/spacex-plans-to-start-offering-starlink-broadband-services-in-2020/) from the original on 23 October 2019. Retrieved 17 February 2020.
148. Insinna, Valerie (22 January 2020). "The Air Force tested its Advanced Battle Management System. Here's what worked, and what didn't" (https://www.defensenews.com/air/2020/01/22/the-us-air-force-tested-its-advanced-battle-management-system-heres-what-worked-and-what-didnt/). DefenseNews. Archived (https://archive.today/20200128115330/https://www.defensenews.com/air/2020/01/22/the-us-air-force-tested-its-advanced-battle-management-system-heres-what-worked-and-what-didnt/) from the original on 28 January 2020. Retrieved 29 September 2020.

149. Rich, Gillian (23 September 2020). "SpaceX Starlink Impresses Air Force Weapons Buyer In Big Live-Fire Exercise" (https://www.investors.com/news/spacex-starlink-impressed-air-force-in-big-live-fire-exercise/). Investors. Archived (https://web.archive.org/web/20201117160317/https://www.investors.com/news/spacex-starlink-impressed-air-force-in-big-live-fire-exercise/) from the original on 17 November 2020. Retrieved 29 September 2020.
150. "How Elon Musk's satellites have saved Ukraine and changed warfare" (https://www.economist.com/briefing/2023/01/05/how-elon-musks-satellites-have-saved-ukraine-and-changed-warfare?utm_campaign=a.the-economist-today&utm_medium=email.internal-newsletter.np&utm_source=salesforce-marketing-cloud&utm_term=5/18/2023&utm_id=1602653). *The Economist*. ISSN 0013-0613 (https://www.worldcat.org/issn/0013-0613). Retrieved 6 June 2023.
151. Reese, Isaac (5 March 2022). "Can Elon Musk's Starlink Keep Ukraine Online?" (https://reason.com/video/2022/03/05/can-elon-musks-starlink-keep-ukraine-online/). *reason.com*. Reason. Retrieved 14 March 2022.
152. Elon Musk says SpaceX's Starlink satellites active over Ukraine after request from embattled country's leaders (https://www.independent.co.uk/news/world/europe/starlink-service-ukraine-elon-musk-b2024184.html), The Independent (26 February 2022)
153. "@elonmusk while you try to colonize Mars — Russia try to occupy Ukraine! While your rockets successfully land from space — Russian rockets attack Ukrainian civil people! We ask you to provide Ukraine with Starlink stations and to address sane Russians to stand" (https://twitter.com/fedorovmykhailo/status/1497543633293266944). *Twitter*. 26 February 2022.
154. Sabbagh, Dan (9 February 2023). "Fury in Ukraine as Elon Musk's SpaceX limits Starlink use for drones" (https://www.theguardian.com/world/2023/feb/09/zelenskiy-aide-takes-aim-at-curbs-on-ukraine-use-of-starlink-to-pilot-drones-elon-musk). *The Guardian*. ISSN 0261-3077 (https://www.worldcat.org/issn/0261-3077). Retrieved 20 May 2023.
155. "How Elon Musk's satellites have saved Ukraine and changed warfare" (https://www.economist.com/briefing/2023/01/05/how-elon-musks-satellites-have-saved-ukraine-and-changed-warfare?utm_campaign=a.the-economist-today&utm_medium=email.internal-newsletter.np&utm_source=salesforce-marketing-cloud&utm_term=5/18/2023&utm_id=1602653). *The Economist*. ISSN 0013-0613 (https://www.worldcat.org/issn/0013-0613). Retrieved 6 June 2023.
156. "How Elon Musk's Starlink satellite internet keeps Ukraine online" (https://kyivindependent.com/how-elon-musks-starlink-satellite-internet-keeps-ukraine-online/). *The Kyiv Independent*. 3 September 2022. Retrieved 6 June 2023.
157. Bajak, Frank (9 February 2023). "Musk deputy's words on Starlink 'weaponization' vex Ukraine" (https://apnews.com/article/russia-ukraine-elon-musk-spacex-technology-business-c79c81ff4e6a09f4a185e627dad858fa). *The Associated Press*. Retrieved 28 April 2023.
158. "Krieg in der Ukraine: Die Erfolgsgeschichte der ukrainischen Artillerie" (https://www.youtube.com/watch?v=pzAl29Gl9MA). *YouTube*.
159. "How Elon Musk's satellites have saved Ukraine and changed warfare" (https://www.economist.com/briefing/2023/01/05/how-elon-musks-satellites-have-saved-ukraine-and-changed-warfare?utm_campaign=a.the-economist-today&utm_medium=email.internal-newsletter.np&utm_source=salesforce-marketing-cloud&utm_term=5/18/2023&utm_id=1602653). *The Economist*. ISSN 0013-0613 (https://www.worldcat.org/issn/0013-0613). Retrieved 6 June 2023.
160. Sutton, HI (15 February 2023). "Starlink Limits Ukraine's Maritime Drones At Time Of New Russian Threat" (https://www.navalnews.com/naval-news/2023/02/starlink-limits-ukraines-maritime-drones-at-time-of-new-russian-threat/). *Naval News*. Retrieved 15 February 2023.
161. Hern, Alex (16 October 2022). "Elon Musk says SpaceX will keep funding Starlink internet in Ukraine" (https://www.theguardian.com/world/2022/oct/15/the-hell-with-it-elon-musk-says-spacex-will-fund-starlink-internet-in-ukraine). *The Guardian*. ISSN 0261-3077 (https://www.worldcat.org/issn/0261-3077). Retrieved 6 June 2023.
162. Capaccio, Anthony. "Elon Musk's SpaceX Wins Pentagon Deal for Starlink in Ukraine" (https://www.bloomberg.com/news/articles/2023-06-01/musk-s-spacex-wins-pentagon-deal-for-its-starlink-in-ukraine). Bloomberg.
163. " "Steven Seagal is calling" - circus on Russian television (Break the Fake)" (https://www.youtube.com/watch?v=3pJQT4V91i8). TVP World. YouTube. 3 February 2023.
164. Bajak, Frank (9 February 2023). "Musk deputy's words on Starlink 'weaponization' vex Ukraine" (https://apnews.com/article/russia-ukraine-elon-musk-spacex-technology-business-c79c81ff4e6a09f4a185e627dad858fa). *The Associated Press*. Retrieved 28 April 2023.

165. Stone, Mike; Roulette, Joey (1 June 2023). "SpaceX's Starlink wins Pentagon contract for satellite services to Ukraine" (https://www.reuters.com/business/aerospace-defense/pentagon-buys-starlink-ukraine-statement-2023-06-01/). *Reuters*. Retrieved 1 June 2023.
166. SpaceX [@SpaceX] (10 September 2022). "Starlink is available in Malta – now serving 40 countries around the world! → starlink.com/map" (https://twitter.com/SpaceX/status/1568675521168347137) (Tweet). Retrieved 10 September 2022 – via Twitter.
167. "Elon Musk's company SpaceX applies to offer high-speed Internet service to Canadians" (https://www.cbc.ca/news/business/spacex-high-speed-internet-1.5618918). CBC News. 19 June 2020. Archived (https://web.archive.org/web/20201117160154/https://www.cbc.ca/news/business/spacex-high-speed-internet-1.5618918) from the original on 17 November 2020. Retrieved 27 July 2021.
168. "Canadians Can Now Sign Up for Starlink Internet beta Without an Invite, If Eligible" (https://www.iphoneincanada.ca/tesla/canadians-can-now-sign-up-for-starlink-internet-beta-without-an-invite-if-eligible/). iPhone in Canada. 21 January 2021. Archived (https://web.archive.org/web/20210121053314/https://www.iphoneincanada.ca/tesla/canadians-can-now-sign-up-for-starlink-internet-beta-without-an-invite-if-eligible/) from the original on 21 January 2021. Retrieved 11 March 2021.
169. Musk, Elon [@elonmusk] (23 August 2021). "Our license applications are pending in many more countries. Hoping to serve Earth soon!" (https://twitter.com/elonmusk/status/1429924523822829571) (Tweet). Archived (https://web.archive.org/web/20220204034307/https://twitter.com/elonmusk/status/1429924523822829571) from the original on 4 February 2022. Retrieved 5 February 2022 – via Twitter.
170. "SpaceX's Starlink broadband to be available in Japan's remote areas next year" (https://spacenews.com/spacexs-starlink-broadband-to-be-available-in-japans-remote-areas-next-year/). SpaceNews. 13 September 2021. Archived (https://web.archive.org/web/20211001025041/https://spacenews.com/spacexs-starlink-broadband-to-be-available-in-japans-remote-areas-next-year/) from the original on 1 October 2021. Retrieved 14 September 2021.
171. "Hawaiian Airlines to Offer Free, High-Speed Starlink Internet Connectivity on Transpacific Fleet" (https://newsroom.hawaiianairlines.com/releases/hawaiian-airlines-to-offer-free-high-speed-starlink-internet-connectivity-on-transpacific-fleet). Hawaiian Airlines. 25 April 2022.
172. SpaceX [@SpaceX] (22 July 2022). "Starlink is available for service in 36 countries (or 41 markets) around the world, now including Luxembourg, Saint Martin, and St. Barthelemy → starlink.com/map" (https://twitter.com/SpaceX/status/1550555439779049473) (Tweet). Retrieved 22 July 2022 – via Twitter.
173. "Starlink approved in Nigeria and Mozambique, says Elon Musk" (https://spacenews.com/starlink-approved-in-nigeria-and-mozambique-says-elon-musk/). *SpaceNews*. 27 May 2022. Retrieved 27 May 2022.
174. "The Philippines gives green light to Starlink" (https://spacenews.com/the-philippines-gives-green-light-to-starlink/). *SpaceNews*. 27 May 2022. Retrieved 28 May 2022.
175. "Elon Musk's Starlink gets nod to provide internet in Philippines" (https://www.bangkokpost.com/business/2317086/elon-musks-starlink-gets-nod-to-provide-internet-in-philippines). *Bangkok Post*. 27 May 2022.
176. "Starlink is now live in the Philippines" (https://web.archive.org/web/20230327220635/https://www.philstar.com/business/2023/02/22/2246811/starlink-now-live-philippines). *Philstar.com*. Archived from the original (https://www.philstar.com/business/2023/02/22/2246811/starlink-now-live-philippines) on 27 March 2023. Retrieved 27 March 2023.
177. Sheetz, Michael (29 September 2020). "Washington emergency responders first to use SpaceX's Starlink internet in the field: "It's amazing" " (https://www.cnbc.com/2020/09/29/washington-emergency-responders-use-spacex-starlink-satellite-internet.html). CNBC. Archived (https://web.archive.org/web/20210703151216/https://www.cnbc.com/2020/09/29/washington-emergency-responders-use-spacex-starlink-satellite-internet.html) from the original on 3 July 2021. Retrieved 4 September 2021.
178. "FCC approves SpaceX change to its Starlink network, a win despite objections from Amazon and others" (https://www.cnbc.com/2021/04/27/fcc-approves-spacex-starlink-modification-despite-objections.html). *CNBC*. 27 April 2021.
179. Sheetz, Michael (20 January 2021). "SpaceX expands public beta test of Starlink satellite internet to Canada and the UK" (https://www.cnbc.com/2021/01/20/spacex-expands-starlink-public-beta-test-to-canada-united-kingdom.html). CNBC. Archived (https://web.archive.org/web/20210120165607/https://www.cnbc.com/2021/01/20/spacex-expands-starlink-public-beta-test-to-canada-united-kingdom.html) from the original on 20 January 2021. Retrieved 11 March 2021.
180. SpaceX [@SpaceX] (22 November 2022). "Starlink is now operating in two of the most remote areas in the world: Pitcairn Island and Easter Island, both of which are thousands of miles away from the nearest continent" (https://twitter.com/SpaceX/status/1595110752092028933) (Tweet). Retrieved 1 February 2023 – via Twitter.

181. Ralph, Eric (11 March 2021). "SpaceX aces Starlink launch, kicks off service in Germany, New Zealand" (https://www.teslarati.com/spacex-starlink-20-launch-germany-new-zealand-service/). *teslarati.com*. Archived (https://web.archive.org/web/20210311093111/https://www.teslarati.com/spacex-starlink-20-launch-germany-new-zealand-service/) from the original on 11 March 2021. Retrieved 11 March 2021.
182. "SpaceX Starlink Service Arrives To New Zealand, Residents Test Network & Find Ground Station" (https://www.tesmanian.com/blogs/tesmanian-blog/star-2). *tesmanian.com*. 26 March 2021. Archived (https://web.archive.org/web/20210411224246/https://www.tesmanian.com/blogs/tesmanian-blog/star-2) from the original on 11 April 2021. Retrieved 11 April 2021.
183.
    - Long, Christan. "New Zealand's Remotest Family Gets Starlink" (https://www.youtube.com/watch?v=4J27Rm1l37o). Gorge River, between Haast and Milford Sound, West Coast, South Island, New Zealand. Retrieved 27 August 2023. "Yesterday I flew home in a helicopter and my visit has one main purpose this time. It's actually to install our new Starlink internet."
    - " 'No electricity until I was 6': The Kiwi boy who grew up two days hike from the nearest town" (https://www.nzherald.co.nz/lifestyle/chris-long-the-kiwi-boy-who-grew-up-two-days-hike-from-the-nearest-town/TXJW2KYCYT426XEIFFOAXNDDJE/). *NZ Herald*. 30 December 2022. Retrieved 27 August 2023.
184. "Starlink now available in Australia!" (https://www.reddit.com/r/Starlink/comments/mnb8dp/starlink_going_live_in_australia/). 9 April 2021. Archived (https://web.archive.org/web/20220329112419/https://www.reddit.com/r/Starlink/comments/mnb8dp/starlink_going_live_in_australia/) from the original on 29 March 2022. Retrieved 29 March 2022.
185. "Starlink now available in Austria!" (https://www.reddit.com/r/Starlink/comments/n7500x/starlink_now_available_in_austria/). 7 May 2021. Archived (https://web.archive.org/web/20220329111932/https://www.reddit.com/r/Starlink/comments/n72bq2/starlink_available_in_france/) from the original on 29 March 2022. Retrieved 29 March 2022.
186. Augusto, Hadrien (8 May 2021). "Starlink disponible en France: "premier arrivé, premier servi" (https://www.presse-citron.net/starlink-disponible-en-france-premier-arrive-premier-servi/amp/). *presse-citron.net* (in French). PresseCitron. Archived (https://web.archive.org/web/20210513055035/https://www.presse-citron.net/starlink-disponible-en-france-premier-arrive-premier-servi/amp/) from the original on 13 May 2021. Retrieved 8 May 2021.
187. "ARCEP Launches public consultation for starlink frequencies" (https://en.arcep.fr/news/press-releases/view/n/frequencies-starlink-080422.html). 8 April 2022.
188. "ARCEP awards Starlink a new authorisation to use frequencies" (https://en.arcep.fr/news/press-releases/view/n/frequencies-020622.html). 2 June 2022.
189. SpaceX [@SpaceX] (29 September 2022). "Starlink est désormais disponible en Martinique et en Guadeloupe → starlink.com/map" (https://twitter.com/SpaceX/status/1575638241335603200) (Tweet). Retrieved 30 September 2022 – via Twitter.
190. "Starlink in the Netherlands!" (https://www.reddit.com/r/Starlink/comments/nbkmg7/starlink_in_the_netherlands_just_got/). 13 May 2021. Archived (https://web.archive.org/web/20220329114658/https://www.reddit.com/r/Starlink/comments/nbkmg7/starlink_in_the_netherlands_just_got/) from the original on 29 March 2022. Retrieved 29 March 2022.
191. "Starlink Now Serving Belgium" (https://www.reddit.com/r/Starlink/comments/nh7zqk/starlink_now_serving_belgium/). 20 May 2021. Archived (https://web.archive.org/web/20220329115325/https://www.reddit.com/r/Starlink/comments/nh7zqk/starlink_now_serving_belgium/) from the original on 29 March 2022. Retrieved 29 March 2022.
192. Lucey, Anne (30 March 2021). "Elon Musk's Starlink kit arrives in Kerry ahead of broadband plan" (https://www.irishexaminer.com/news/munster/arid-40253768.html). *Irish Examiner*. Archived (https://web.archive.org/web/20210905051804/https://www.irishexaminer.com/news/munster/arid-40253768.html) from the original on 5 September 2021. Retrieved 4 September 2021.
193. "SpaceX Starlink Broadband Service Is Now Available In Ireland" (https://www.tesmanian.com/blogs/tesmanian-blog/ireland). *Tesmanian*. 15 July 2021. Archived (https://web.archive.org/web/20210905051800/https://www.tesmanian.com/blogs/tesmanian-blog/ireland) from the original on 5 September 2021. Retrieved 4 September 2021.
194. Grove, Morten [@mortenlund89] (1 July 2021). "#Starlink email just ticked in: now with availability in Denmark 🇩🇰 t.co/6VzsaeFRpz" (https://twitter.com/mortenlund89/status/1410672979114184710) (Tweet). Archived (https://web.archive.org/web/20210728132031/https://twitter.com/mortenlund89/status/1410672979114184710) from the original on 28 July 2021. Retrieved 5 February 2022 – via Twitter.

195. "Vai aproveitar? Acesso à Internet da Starlink já está disponível em Portugal" (https://pplware.sapo.pt/internet/vai-aproveitar-acesso-a-internet-da-starlink-ja-esta-disponivel-em-portugal/) [Would you like it? Starlink internet access is now available in Portugal]. *Pplware.com* (in Portuguese). 11 August 2021. Archived (https://web.archive.org/web/20210810233816/https://pplware.sapo.pt/internet/vai-aproveitar-acesso-a-internet-da-starlink-ja-esta-disponivel-em-portugal/) from the original on 10 August 2021. Retrieved 11 August 2021.
196. Musk, Elon [@elonmusk] (23 August 2021). "Now serving 🇺🇸 🇨🇦 🇬🇧 🇩🇪 🇫🇷 🇦🇹 🇳🇱 🇮🇪 🇧🇪 🇨🇭 🇩🇰 🇵🇹 🇳🇿 🇦🇺 " (https://twitter.com/elonmusk/status/1429923342044176385) (Tweet). Archived (https://web.archive.org/web/20220204034302/https://twitter.com/elonmusk/status/1429923342044176385) from the original on 4 February 2022. Retrieved 5 February 2022 – via Twitter.
197. "SpaceX Selects Chile As The First Latin American Country To Test Starlink Internet Service In Rural Communities" (https://www.tesmanian.com/blogs/tesmanian-blog/starlink-chile). *Tesmanian*. 5 July 2021. Archived (https://web.archive.org/web/20210705223304/https://www.tesmanian.com/blogs/tesmanian-blog/starlink-chile) from the original on 5 July 2021. Retrieved 5 July 2021.
198. "Chile Is The First Latin American Country To Have Access To SpaceX's Starlink Internet–Service Is Now Available To Order!" (https://www.tesmanian.com/blogs/tesmanian-blog/starlink-chile-1). *Tesmanian*. 4 September 2021. Archived (https://web.archive.org/web/20210904194633/https://www.tesmanian.com/blogs/tesmanian-blog/starlink-chile-1) from the original on 4 September 2021. Retrieved 4 September 2021.
199. "Starlink Now Serving Poland!" (https://www.reddit.com/r/Starlink/comments/plpn25/starlink_now_serving_poland_got_the_email_minutes/). 10 September 2021. Retrieved 29 March 2022.
200. "Starlink arriva in Italia in quantità limitate" (https://www.hdblog.it/mobile/articoli/n544033/starlink-italia-disponibile/) [Starlink arrives in Italy in limited quantities]. *hdblog.it* (in Italian). 14 September 2021. Archived (https://web.archive.org/web/20210915100906/https://www.hdblog.it/mobile/articoli/n544033/starlink-italia-disponibile/) from the original on 15 September 2021. Retrieved 14 September 2021.
201. Vaculík, Přemysl [@PremyslVaculik] (30 September 2021). "Starlink Now Serving the Czech Republic @SpaceXStarlink t.co/Znb9fuAt9P" (https://twitter.com/PremyslVaculik/status/1443622486843793421) (Tweet). Archived (https://web.archive.org/web/20211018220202/https://twitter.com/premyslvaculik/status/1443622486843793421) from the original on 18 October 2021. Retrieved 5 February 2022 – via Twitter.
202. "Starlink is now approved for operations in Sweden" (https://www.reddit.com/r/Starlink/comments/qit44r/starlink_is_now_approved_for_operations_in_sweden/). *Reddit*. 30 October 2021. Retrieved 30 March 2022.
203. "SpaceX Starlink Internet Is Now Available In Mexico" (https://www.tesmanian.com/de/blogs/tesmanian-blog/starlink-mexico). *tesmanian.com*. 5 November 2021. Retrieved 6 November 2021.
204. "Starlink starts offering satellite internet services in Croatia" (https://www.telecompaper.com/news/starlink-starts-offering-satellite-internet-services-in-croatia--1403962). *telecompaper.com*. 12 November 2021. Retrieved 16 November 2021.
205. "Ministras pasidalijo džiugia žinia – Musko bendrovės padalinys "Starlink" Lietuvoje įjungė savo paslaugas" (https://www.lrt.lt/naujienos/mokslas-ir-it/11/1555867/ministras-pasidalijo-dziugia-zinia-musko-bendroves-padalinys-starlink-lietuvoje-ijunge-savo-paslaugas). *lrt.lt* (in Lithuanian). 2 December 2021. Retrieved 2 December 2021.
206. Skuodis, Marius [@Skuodis] (2 December 2021). "Excited to hear that @SpaceX #Starlink has just turned on service in #Lithuania! Thanks for bringing Starlink to us so fast! 🍾 🇱🇹 @SpaceXStarlink" (https://twitter.com/Skuodis/status/1466486546929000448) (Tweet). Archived (https://web.archive.org/web/20211228215436/https://twitter.com/Skuodis/status/1466486546929000448) from the original on 28 December 2021. Retrieved 5 February 2022 – via Twitter.
207. "SpaceX Starlink Internet Service Is Now Available In Spain" (https://www.tesmanian.com/blogs/tesmanian-blog/starlink-spain). *tesmanian.com*. 5 January 2022.
208. "Starlink is officially available in Slovakia!" (https://web.archive.org/web/20220107020307/https://www.gearcoupon.com/starlink-is-officially-available-in-slovakia/). *gearcoupon.com*. 7 January 2022. Archived from the original (https://www.gearcoupon.com/starlink-is-officially-available-in-slovakia/) on 7 January 2022. Retrieved 7 January 2022.
209. *Starlink Mission* (https://www.youtube.com/watch?v=Yov854ZT1lg). SpaceX. 18 January 2022. Archived (https://web.archive.org/web/20220129131259/https://www.youtube.com/watch?v=Yov854ZT1lg) from the original on 29 January 2022. Retrieved 5 February 2022 – via YouTube.
210. "Musk's SpaceX working to restore Tonga's internet – Fiji official" (https://www.reuters.com/technology/musks-spacex-working-restore-tongas-internet-fiji-official-2022-02-07/). *reuters.com*. 7 February 2022.
211. "Starlink no Brasil: quando a internet por satélite vai chegar no seu endereço?" (https://canaltech.com.br/internet/starlink-no-brasil-quando-a-internet-por-satelite-vai-chegar-no-seu-endereco-213029/). *Canaltech* (in Brazilian Portuguese). 1 April 2022. Retrieved 26 April 2022.

212. "Starlink, de Elon Musk, recebe autorização para oferecer internet no Brasil" (https://www.uol.com.br/tilt/noticias/redacao/2022/01/28/starlink-de-elon-musk-recebe-autorizacao-para-oferecer-internet-no-brasil.htm). *www.uol.com.br* (in Brazilian Portuguese). Retrieved 26 April 2022.
213. Keremedchiev, Simeon (26 February 2022). "Starlink и как интернетът на Илон Мъск вече може да бъде достъпен и от България" (https://news.bg/mobile/starlink-i-kak-internetat-na-ilon-mask-veche-mozhe-da-bade-dostapen-i-ot-balgariya.html). *news.bg* (in Bulgarian). Archived (https://web.archive.org/web/20220405220912/https://news.bg/web/20220405220912/https://news.bg/web/20220405220912/https://news.bg/mobile/starlink-i-kak-internetat-na-ilon-mask-veche-mozhe-da-bade-dostapen-i-ot-balgariya.html) from the original on 5 April 2022. Retrieved 6 April 2022.
214. Elon Musk [@elonmusk] (26 February 2022). "Starlink service is now active in Ukraine. More terminals en route" (https://twitter.com/elonmusk/status/1497701484003213317) (Tweet) – via Twitter.
215. "Starlink a debutat în România; Iată tarifele şi viteza promisă" (https://www.mobilissimo.ro/stiri-diverse/starlink-a-debutat-in-romania-iata-tarifele-si-viteza-promisa). 7 April 2022. Archived (https://web.archive.org/web/20220408085828/https://www.mobilissimo.ro/stiri-diverse/starlink-a-debutat-in-romania-iata-tarifele-si-viteza-promisa) from the original on 8 April 2022. Retrieved 8 April 2022.
216. *Starlink Map* (https://starlink.com/map), retrieved 23 April 2022
217. *Starlink Map* (https://starlink.com/map), retrieved 29 April 2022
218. *Starlink Map* (https://starlink.com/map), retrieved 11 May 2022
219. *Starlink Map* (https://starlink.com/map), retrieved 16 June 2022
220. "Starlink is Now Available in the Caribbean After Dominican Republic President's Visit to SpaceX Headquarters" (https://www.tesmanian.com/blogs/tesmanian-blog/dr).
221. SpaceX [@SpaceX] (3 August 2022). "Starlink is now live in Moldova → starlink.com/map" (https://twitter.com/SpaceX/status/1554975109907066880) (Tweet). Retrieved 3 August 2022 – via Twitter.
222. SpaceX [@SpaceX] (11 August 2022). "Starlink is now available in Estonia → starlink.com/map" (https://twitter.com/SpaceX/status/1557533515540881408) (Tweet). Retrieved 11 August 2022 – via Twitter.
223. SpaceX [@SpaceX] (27 August 2022). "Starlink is now available in Norway!" (https://twitter.com/SpaceX/status/1563594331465797639) (Tweet). Retrieved 30 August 2022 – via Twitter.
224. "Musk says he will activate Starlink amid Iran protests" (https://www.reuters.com/world/middle-east/musk-says-activating-starlink-response-blinken-internet-freedom-iran-2022-09-23/). *Reuters*. 23 September 2022.
225. Musk, Elon [@elonmusk] (23 September 2022). "Activating Starlink..." (https://twitter.com/elonmusk/status/1573379244268437504) (Tweet). Retrieved 10 October 2022 – via Twitter.
226. SpaceX [@SpaceX] (10 October 2022). "Starlink が日本でのサービスを開始しました – アジアでは初めてのサービス国です → starlink.com/map" (https://twitter.com/SpaceX/status/1579587196033462272) (Tweet) (in Japanese). Retrieved 11 October 2022 – via Twitter.
227. SpaceX [@SpaceX] (24 October 2022). "Starlink is now available in Jamaica" (https://twitter.com/SpaceX/status/1584605119466725376) (Tweet). Retrieved 24 October 2022 – via Twitter.
228. "SpaceX Says Starlink Now Reaches All of Alaska, Canada, Finland, Sweden, Norway" (https://teslanorth.com/2022/11/21/spacex-says-starlink-now-reaches-all-of-alaska-canada-finland-sweden-norway/). 21 November 2022. Retrieved 3 December 2022.
229. SpaceX [@SpaceX] (27 January 2023). "Starlink ahora está disponible en Perú!" (https://twitter.com/SpaceX/status/1619091771581153296) (Tweet). Retrieved 28 January 2023 – via Twitter.
230. SpaceX [@SpaceX] (30 January 2023). "Starlink is now available in Nigeria – the first African country to receive service!" (https://twitter.com/SpaceX/status/1620166806722981890) (Tweet). Retrieved 31 January 2023 – via Twitter.
231. Arevalo, Evelyn Janeidy (3 February 2023). "SpaceX Starlink Internet service is now available across all of Colombia" (https://www.tesmanian.com/blogs/tesmanian-blog/colombia). *tesmanian.com*. Retrieved 7 February 2023.
232. SpaceX [@SpaceX] (9 February 2023). "Starlink is now available in Iceland" (https://twitter.com/SpaceX/status/1623671522819989504) (Tweet). Retrieved 13 March 2023 – via Twitter.
233. SpaceX [@SpaceX] (22 February 2023). "Starlink is now live in Rwanda" (https://twitter.com/SpaceX/status/1628396847076106240) (Tweet). Retrieved 13 March 2023 – via Twitter.
234. "Heads up! Starlink now available in Philippines, says Elon Musk's SpaceX" (https://news.abs-cbn.com/business/02/22/23/starlink-goes-live-in-philippines-spacex). *ABS-CBN News*. Retrieved 22 February 2023.

235. SpaceX [@SpaceX] (21 February 2023). "Available na ngayon ang Starlink sa Pilipinas" (https://twitter.com/SpaceX/status/1628192967935799297) (Tweet). Retrieved 22 February 2023 – via Twitter.
236. SpaceX [@SpaceX] (23 March 2023). "Starlink is now available in Haiti" (https://twitter.com/SpaceX/status/1638692986014900225) (Tweet). Retrieved 23 March 2023 – via Twitter.
237. SpaceX [@SpaceX] (29 March 2023). "Starlink ahora disponible en Ecuador" (https://twitter.com/SpaceX/status/1641207206518616066) (Tweet) (in Spanish). Retrieved 30 March 2023 – via Twitter.
238. SpaceX [@SpaceX] (12 April 2023). "Starlink ahora disponible en El Salvador" (https://twitter.com/SpaceX/status/1646260782940975104) (Tweet) (in Spanish). Retrieved 12 April 2023 – via Twitter.
239. SpaceX [@SpaceX] (18 May 2023). "¡Starlink ya está disponible en Panamá!" (https://twitter.com/SpaceX/status/1658961362746503168) (Tweet) (in Spanish). Retrieved 18 May 2023 – via Twitter.
240. Starlink [@Starlink] (2 June 2023). "Starlink está agora disponível em Moçambique!" (https://twitter.com/Starlink/status/1664425134323810304) (Tweet) (in Portuguese). Retrieved 2 June 2023 – via Twitter.
241. Starlink [@Starlink] (14 June 2023). "Starlink is now available in Trinidad and Tobago" (https://twitter.com/Starlink/status/1669055777443815425) (Tweet). Retrieved 15 June 2023 – via Twitter.
242. Starlink [@Starlink] (13 July 2023). "Starlink is now available in Cyprus" (https://twitter.com/Starlink/status/1679553136661532673) (Tweet). Retrieved 13 July 2023 – via Twitter.
243. Starlink [@Starlink] (14 July 2023). "¡Starlink ya está disponible en Guatemala!" (https://twitter.com/Starlink/status/1679912808283262976) (Tweet) (in Spanish). Retrieved 14 July 2023 – via Twitter.
244. Starlink [@Starlink] (18 July 2023). "Starlink is now available in Kenya" (https://twitter.com/Starlink/status/1681287681341542400) (Tweet). Retrieved 18 July 2023 – via Twitter.
245. Starlink [@Starlink] (24 July 2023). "Starlink is now available in Malaysia" (https://twitter.com/Starlink/status/1683673673105018881) (Tweet). Retrieved 24 July 2023 – via Twitter.
246. Starlink [@Starlink] (24 July 2023). "Starlink is now available in Malawi!" (https://twitter.com/Starlink/status/1683897037639790592) (Tweet). Retrieved 24 July 2023 – via Twitter.
247. Starlink [@Starlink] (11 August 2023). "Starlink is now available in the Bahamas" (https://twitter.com/Starlink/status/1689747288233857028) (Tweet). Retrieved 11 August 2023 – via Twitter.
248. Grush, Loren (9 November 2018). "SpaceX wants to fly some internet satellites closer to Earth to cut down on space trash" (https://www.theverge.com/2018/11/9/18016962/spacex-internet-satellites-space-debris-trash-orbit-closer-earth-distance-atmosphere). The Verge. Archived (https://web.archive.org/web/20201117160255/https://www.theverge.com/2018/11/9/18016962/spacex-internet-satellites-space-debris-trash-orbit-closer-earth-distance-atmosphere) from the original on 17 November 2020. Retrieved 9 November 2018.
249. *ISSRDC 2015 – A Conversation with Elon Musk* (https://www.youtube.com/watch?v=ZmEg95wPiVU). ISS National Lab. 8 July 2015. Archived (https://web.archive.org/web/20211202091228/https://www.youtube.com/watch?v=ZmEg95wPiVU) from the original on 2 December 2021. Retrieved 5 February 2022 – via YouTube.
250. Space Exploration Holdings, LLC (15 November 2016). "SPACEX NON-GEOSTATIONARY SATELLITE SYSTEM – ATTACHMENT A" (http://licensing.fcc.gov/myibfs/download.do?attachment_key=1158350). FCC Space Station Applications. Archived (https://web.archive.org/web/20201117160252/http://licensing.fcc.gov/myibfs/download.do?attachment_key=1158350) from the original on 17 November 2020. Retrieved 15 February 2018. This article incorporates text from this source, which is in the public domain.
251. Space Exploration Holdings, LLC (15 November 2016). "SAT-LOA-20161115-00118" (http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SATLOA2016111500118&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number). FCC Space Station Applications. Archived (https://web.archive.org/web/20201117160348/http://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC%2FFile+Number%2F%3D%2FSATLOA2016111500118&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC%2FFile+Number) from the original on 17 November 2020. Retrieved 15 February 2018. This article incorporates text from this source, which is in the public domain.
252. Wiltshire, William M. (20 April 2017). "Re: Space Exploration Holdings, LLC, IBFS File No. SAT-LOA-20161115-00118" (http://licensing.fcc.gov/myibfs/download.do?attachment_key=1210294). FCC Space Station Application. Archived (https://web.archive.org/web/20201117160308/http://licensing.fcc.gov/myibfs/download.do?attachment_key=1210294) from the original on 17 November 2020. Retrieved 15 February 2018. This article incorporates text from this source, which is in the public domain.

253. Zafar, Ramish (3 September 2020). "SpaceX Successfully Tests Inter-Satellite Starlink Connectivity Via Lasers" (https://wccftech.com/spacex-starlink-satellite-laser-test/). *wccftech.com*. Archived (https://web.archive.org/web/20201117160313/https://wccftech.com/spacex-starlink-satellite-laser-test/) from the original on 17 November 2020. Retrieved 6 September 2020.
254. Sheetz, Michael (3 September 2020). "SpaceX's Starlink internet shows fast speeds during early tests, capable of gaming and streaming" (https://www.cnbc.com/2020/09/03/spacex-starlink-satellite-internet-network-early-tests-show-fast-speeds.html). *cnbc.com*. CNBC. Archived (https://web.archive.org/web/20201117160306/https://www.cnbc.com/2020/09/03/spacex-starlink-satellite-internet-network-early-tests-show-fast-speeds.html) from the original on 17 November 2020. Retrieved 6 September 2020.
255. Hull, Dana; Johnsson, Julie (14 January 2015). "SpaceX chief Elon Musk has high hopes for Seattle office" (http://old.seattletimes.com/html/businesstechnology/2025451224_muskseattlexml.html). Seattle Times. Archived (https://web.archive.org/web/20201117160329/https://www.seattletimes.com/) from the original on 17 November 2020. Retrieved 25 May 2019.
256. Petersen, Melody (16 January 2015). "Elon Musk and Richard Branson invest in satellite-Internet ventures" (https://www.latimes.com/business/la-fi-satellite-entrepreneurs-20150117-story.html). *Los Angeles Times*. Archived (https://web.archive.org/web/20200730230957/https://www.latimes.com/business/la-fi-satellite-entrepreneurs-20150117-story.html) from the original on 30 July 2020. Retrieved 19 January 2015.
257. Alleven, Monica (22 February 2015). "In 5G proceeding, SpaceX urges FCC to protect future satellite ventures" (http://www.fiercewireless.com/tech/story/5g-proceeding-spacex-urges-fcc-protect-future-satellite-ventures/2015-02-22). FierceWirelessTech. Archived (https://web.archive.org/web/20150226084948/http://www.fiercewireless.com/tech/story/5g-proceeding-spacex-urges-fcc-protect-future-satellite-ventures/2015-02-22) from the original on 26 February 2015. Retrieved 3 March 2015. "SpaceX pointed out that it recently announced plans to build a network of 4,000 non-geostationary orbit (NGSO) communications satellites, which it will manufacture, launch and operate."
258. Brodkin, Jon (14 February 2018). "SpaceX hits two milestones in plan for low-latency satellite broadband" (https://arstechnica.com/information-technology/2018/02/spacexs-satellite-broadband-nears-fcc-approval-and-first-test-launch/). Ars Technica. Archived (https://web.archive.org/web/20201117160316/https://arstechnica.com/information-technology/2018/02/spacexs-satellite-broadband-nears-fcc-approval-and-first-test-launch/) from the original on 17 November 2020. Retrieved 13 May 2019.
259. Musk, Elon [@elonmusk] (25 February 2018). "@andrestaltz Will be simpler than IPv6 and have tiny packet overhead. Definitely peer-to-peer" (https://twitter.com/elonmusk/status/967712110661615616) (Tweet). Archived (https://web.archive.org/web/20211229202546/https://twitter.com/elonmusk/status/967712110661615616) from the original on 29 December 2021. Retrieved 5 February 2022 – via Twitter.
260. "High winds scrub SpaceX launch of 60 Starlink internet relay satellites" (https://www.cbsnews.com/news/spacex-falcon-9-launch-kick-starts-space-based-internet-starlink-satellites/). *CBS News*. 15 May 2019. Archived (https://web.archive.org/web/20201117160317/https://www.cbsnews.com/news/spacex-falcon-9-launch-kick-starts-space-based-internet-starlink-satellites/) from the original on 17 November 2020. Retrieved 24 May 2019.
261. Ralph, Eric (22 March 2019). "SpaceX's Starlink satellite lawyers refute latest "flawed" OneWeb critique" (https://www.teslarati.com/spacex-starlink-lawyers-oneweb-critique/). Teslarati. Archived (https://web.archive.org/web/20201117160310/https://www.teslarati.com/spacex-starlink-lawyers-oneweb-critique/) from the original on 17 November 2020. Retrieved 2 May 2019.
262. *KHT – KRYPTON HALL THRUSTERS – IDENTIFICATION, EVALUATION AND TESTING OF ALTERNATIVE PROPELLANTS FOR ELECTRIC PROPULSION SYSTEMS* (https://artes.esa.int/projects/kht-krypton-hall-thrusters). Project KHT. European Space Agency. 6 September 2017. Archived (https://web.archive.org/web/20201117160336/https://artes.esa.int/projects/kht-krypton-hall-thrusters) from the original on 17 November 2020. Retrieved 17 May 2019. "The overall outcome is that propellant different from xenon can provide significant economic benefits in the long term for commercial telecom applications. In particular, krypton would allow for a major reduction of qualification and operation costs with minor performance drawbacks."
263. "SpaceX on Instagram: "Among other enhancements, V2 minis are equipped with new argon Hall thrusters for on orbit maneuvering. Developed by SpaceX engineers, they have 2.4x the thrust and 1.5x the specific impulse of our first gen thrusters. This will also be the first time ever that argon Hall thrusters are operated in space" " (https://www.instagram.com/p/CpImiuwOgsM/). *Instagram*. Retrieved 26 February 2023.
264. Musk, Elon [@elonmusk] (14 October 2020). "@antonkanerva Yes. Everything is slow to a phased array antenna" (https://twitter.com/elonmusk/status/1316255322835759105) (Tweet). Archived (https://web.archive.org/web/20211202091213/https://twitter.com/elonmusk/status/1316255322835759105) from the original on 2 December 2021. Retrieved 5 February 2022 – via Twitter.

265. [1] (https://www.tesmanian.com/blogs/tesmanian-blog/ufo-starlink-terminal) Archived (https://web.archive.org/web/20200622154317/https://www.tesmanian.com/blogs/tesmanian-blog/ufo-starlink-terminal) 22 June 2020 at the Wayback Machine, 19 June 2020
266. Jon Brodkin (19 April 2021). "Dishy McFlatface to become "fully mobile", allowing Starlink use away from home" (https://arstechnica.com/information-technology/2021/04/dishy-mcflatface-to-become-fully-mobile-allowing-starlink-use-away-from-home/). Ars Technica. Archived (https://web.archive.org/web/20210423041140/https://arstechnica.com/information-technology/2021/04/dishy-mcflatface-to-become-fully-mobile-allowing-starlink-use-away-from-home/) from the original on 23 April 2021. Retrieved 23 April 2021.
267. Jon Brodkin (2 December 2020). "Teardown of "Dishy McFlatface", the SpaceX Starlink user terminal" (https://arstechnica.com/information-technology/2020/12/teardown-of-dishy-mcflatface-the-spacex-starlink-user-terminal/). Ars Technica. Archived (https://web.archive.org/web/20210423041141/https://arstechnica.com/information-technology/2020/12/teardown-of-dishy-mcflatface-the-spacex-starlink-user-terminal/) from the original on 23 April 2021. Retrieved 23 April 2021.
268. Ralph, Eric (4 January 2021). "SpaceX Starlink beta arrives in the UK, sets sights on rest of Europe and Australia" (https://www.teslarati.com/spacex-starlink-beta-uk-arrival-europe-australia/). *Teslarati*. Archived (https://web.archive.org/web/20210104100044/https://www.teslarati.com/spacex-starlink-beta-uk-arrival-europe-australia/) from the original on 4 January 2021. Retrieved 4 January 2021.
269. "SpaceX to test Starlink terminals on ships" (https://advanced-television.com/2020/09/21/spacex-to-test-starlink-terminals-on-its-ships/). *advanced-television.com*. 21 September 2020. Archived (https://web.archive.org/web/20201117160344/https://advanced-television.com/2020/09/21/spacex-to-test-starlink-terminals-on-its-ships/) from the original on 17 November 2020. Retrieved 15 October 2020.
270. Wouters, Lennert (10 August 2022). *Glitched on Earth by Humans: A Black-Box Security Evaluation of the SpaceX Starlink User Terminal* (https://i.blackhat.com/USA-22/Wednesday/US-22-Wouters-Glitched-On-Earth.pdf) (PDF). Black Hat USA 2022.
271. "*SpaceX Requests FCC Approval For Starlink Earth Stations As Company's Applications Continue To Pile With The Commission*" (https://web.archive.org/web/20200818103454/https://wccftech.com/spacex-fcc-starlink-lull/). 6 July 2020. Archived from the original (https://wccftech.com/spacex-fcc-starlink-lull/) on 18 August 2020. This article incorporates text from this source, which is in the public domain.
272. "SpaceX launches Starlink V2 satellites to increase internet capacity" (https://www.newscientist.com/article/2361798-spacex-launches-starlink-v2-satellites-to-increase-internet-capacity/). *New Scientist*. Retrieved 6 March 2023.
273. "SpaceX's Starlink drops proposals for two of three planned ground stations in France" (https://www.datacenterdynamics.com/en/news/spacexs-starlink-drops-proposals-for-two-of-three-planned-ground-stations-in-france/).
274. "SpaceX presentation at NOAA" (http://www.nesdis.noaa.gov/CRSRA/files/space_x.pdf) (PDF). Archived (https://web.archive.org/web/20201117160243/https://www.nesdis.noaa.gov/CRSRA/files/space_x.pdf) (PDF) from the original on 17 November 2020. Retrieved 21 October 2016. This article incorporates text from this source, which is in the public domain.
275. "MicroSat 1a, 1b" (http://space.skyrocket.de/doc_sdat/microsat-1.htm). *space.skyrocket.de*. Archived (https://web.archive.org/web/20201117160301/https://space.skyrocket.de/doc_sdat/microsat-1.htm) from the original on 17 November 2020. Retrieved 9 June 2018.
276. Boyle, Alan (4 June 2015). "How SpaceX Plans to Test Its Satellite Internet Service in 2016" (https://www.nbcnews.com/science/space/how-spacex-plans-test-its-satellite-internet-service-2016-n370196). NBC News. Archived (https://web.archive.org/web/20191208025050/https://www.nbcnews.com/science/space/how-spacex-plans-test-its-satellite-internet-service-2016-n370196) from the original on 8 December 2019. Retrieved 5 June 2015.
277. Henry, Caleb [@CHenry_QA] (25 October 2017). "SpaceX's Patricia Cooper: 2 demo sats launching in next few months, then constellation deployment in 2019. Can start service w/ ~800 sats" (https://twitter.com/CHenry_QA/status/923205405643329536) (Tweet). Archived (https://web.archive.org/web/20220101010107/https://twitter.com/CHenry_QA/status/923205405643329536) from the original on 1 January 2022. Retrieved 5 February 2022 – via Twitter.
278. "MicroSat 2a, 2b (Tintin A, B)" (http://space.skyrocket.de/doc_sdat/microsat-2.htm). *space.skyrocket.de*. Archived (https://web.archive.org/web/20210307233108/https://space.skyrocket.de/doc_sdat/microsat-2.htm) from the original on 7 March 2021. Retrieved 9 June 2018.
279. "Starlink Microsat Experiment Purposes" (https://apps.fcc.gov/els/GetAtt.html?id=185534). FCC. Archived (https://web.archive.org/web/20201117160317/https://apps.fcc.gov/els/GetAtt.html?id=185534) from the original on 17 November 2020. Retrieved 29 September 2018. This article incorporates text from this source, which is in the public domain.

280. Tintin A (http://www.n2yo.com/satellite/?s=43216) Archived (https://web.archive.org/web/20201117160321/https://www.n2yo.com/satellite/?s=43216) 17 November 2020 at the Wayback Machine and Tintin B (http://www.n2yo.com/satellite/?s=43217) Archived (https://web.archive.org/web/20201117160354/https://www.n2yo.com/satellite/?s=43217) 17 November 2020 at the Wayback Machine at n2yo.com
281. Kang, Cecilia; Davenport, Christian (9 June 2015). "SpaceX founder files with government to provide Internet service from space" (https://www.washingtonpost.com/business/economy/spacex-founder-files-with-government-to-provide-internet-service-from-space/2015/06/09/db8d8d02-0eb7-11e5-a0dc-2b6f404ff5cf_story.html). *Washington Post*. Archived (https://web.archive.org/web/20170223183501/https://www.washingtonpost.com/business/economy/spacex-founder-files-with-government-to-provide-internet-service-from-space/2015/06/09/db8d8d02-0eb7-11e5-a0dc-2b6f404ff5cf_story.html) from the original on 23 February 2017. Retrieved 14 September 2017.
282. Musk, Elon. "Starlink" (http://www.starlink.com/). *starlink.com*. Archived (https://web.archive.org/web/20201117160327/https://www.starlink.com/) from the original on 17 November 2020. Retrieved 20 August 2019.
283. Garrity, John; Husar, Arndt (April 2021). "Digital Connectivity and Low Earth Orbit Satellite Constellations: Opportunities for Asia and the Pacific" (https://think-asia.org/handle/11540/13626). *think-asia.org*.
284. Krebs, Gunter. "Starlink Block v1.0" (https://space.skyrocket.de/doc_sdat/starlink-v1-0.htm). *space.skyrocket.de*. Archived (https://web.archive.org/web/20201117160326/https://space.skyrocket.de/doc_sdat/starlink-v1-0.htm) from the original on 17 November 2020. Retrieved 15 July 2020.
285. "SpaceX working on fix for Starlink satellites so they don't disrupt astronomy" (https://spacenews.com/spacex-working-on-fix-for-starlink-satellites-so-they-dont-disrupt-astronomy/). 7 December 2019. Archived (https://archive.today/20200102000114/https://spacenews.com/spacex-working-on-fix-for-starlink-satellites-so-they-dont-disrupt-astronomy/) from the original on 2 January 2020. Retrieved 10 December 2019.
286. "Starlink Discussion National Academy Of Sciences" (https://www.spacex.com/updates/starlink-update-04-28-2020/). SpaceX. 28 April 2020. Archived (https://web.archive.org/web/20201117160400/https://www.spacex.com/updates/starlink-update-04-28-2020/) from the original on 17 November 2020. Retrieved 15 July 2020.
287. "SpaceX to add sunshades to all future Starlink satellites" (https://spacenews.com/spacex-to-add-sunshades-to-all-future-starlink-satellites/). *SpaceNews*. 27 May 2020. Retrieved 28 February 2022.
288. Mack, Eric. "SpaceX launches first batch of Starlink satellites wearing sun visors" (https://www.cnet.com/news/spacex-launches-first-batch-of-starlink-satellites-wearing-sun-visors/). *CNET*. Retrieved 28 February 2022.
289. "Starlink Satellites Are Fainter Now — But Still Visible" (https://skyandtelescope.org/astronomy-news/starlink-satellites-fainter-but-still-visible/). *Sky & Telescope*. 22 January 2021. Retrieved 28 February 2022.
290. Mallama, Anthony (15 June 2020). "Starlink Satellite Brightness Before VisorSat". arXiv:2006.08422 (https://arxiv.org/abs/2006.08422) [astro-ph.EP (https://arxiv.org/archive/astro-ph.EP)].
291. Clark, Stephen (6 April 2021). "SpaceX to ramp up Vandenberg launch cadence with Starlink missions" (https://spaceflightnow.com/2021/04/06/spacex-to-ramp-up-vandenberg-launch-cadence-with-starlink-missions/). Spaceflight Now. Archived (https://web.archive.org/web/20210407201524/https://spaceflightnow.com/2021/04/06/spacex-to-ramp-up-vandenberg-launch-cadence-with-starlink-missions/) from the original on 7 April 2021. Retrieved 8 April 2021.
292. Witze, Alexandra (26 May 2022). " 'Unsustainable': how satellite swarms pose a rising threat to astronomy" (https://www.nature.com/articles/d41586-022-01420-9). *Nature*. **606** (7913): 236–237. Bibcode:2022Natur.606..236W (https://ui.adsabs.harvard.edu/abs/2022Natur.606..236W). doi:10.1038/d41586-022-01420-9 (https://doi.org/10.1038%2Fd41586-022-01420-9). PMID 35618807 (https://pubmed.ncbi.nlm.nih.gov/35618807). S2CID 249096524 (https://api.semanticscholar.org/CorpusID:249096524).
293. "SpaceX - Starshield" (https://www.spacex.com/starshield/). *www.spacex.com*. Retrieved 28 December 2022.
294. Sheetz, Michael (29 January 2021). "SpaceX looks to build next-generation Starlink internet satellites after launching 1,000 so far" (https://www.cnbc.com/2021/01/28/spacex-plans-next-generation-starlink-satellites-with-1000-launched.html). *CNBC*. Archived (https://web.archive.org/web/20210129184731/https://www.cnbc.com/2021/01/28/spacex-plans-next-generation-starlink-satellites-with-1000-launched.html) from the original on 29 January 2021. Retrieved 29 January 2021.
295. Everyday Astronaut (26 May 2022). *Go up SpaceX's Starship-catching robotic launch tower with Elon Musk!* (https://www.youtube.com/watch?v=XP5k3ZzPf_0&t=695s) (video). Event occurs at 11:35–11:43. Retrieved 1 June 2022 – via YouTube.
296. SpaceX supplemental filing on IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105 (https://licensing.fcc.gov/myibfs/download.do?attachment_key=16832647), FCC documents website, PDF, 19 August 2022.

297. Ralph, Eric (30 May 2022). "SpaceX CEO Elon Musk reveals next-generation Starlink satellite details" (https://www.teslarati.com/spacex-elon-musk-next-gen-starlink-satellite-details/). *Teslarati*. Retrieved 5 June 2022.
298. Rainbow, Jason (26 August 2021). "All future Starlink satellites will have laser crosslinks" (https://spacenews.com/all-future-starlink-satellites-will-have-laser-crosslinks/). *SpaceNews*. Retrieved 6 June 2022.
299. "Brightness Mitigation Best Practices for Satellite Operators" (https://api.starlink.com/public-files/BrightnessMitigationBestPracticesSatelliteOperators.pdf) (PDF). *SpaceX*. 29 July 2022. Retrieved 30 July 2022.
300. Michael Sheetz [@thesheetztweetz] (7 December 2022). "After the FCC last week authorized SpaceX to deploy 7,500 Gen2 Starlink satellites, the company yesterday filed a request to put payloads on 2,016 of those satellites for its direct-to-cell system with T-Mobile to enable coverage "by mid-2024." " (https://twitter.com/thesheetztweetz/status/1600595289995345920) (Tweet). Retrieved 27 December 2022 – via Twitter.
301. "Re: IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105. EXHIBIT B. SATELLITE DIMENSIONS AND DAS OUTPUTS" (https://licensing.fcc.gov/myibfs/download.do?attachment_key=17429628). 4 October 2022. Retrieved 21 January 2023.
302. "SpaceX might launch first Starlink Gen2 satellites next week" (https://www.teslarati.com/spacex-first-starlink-gen2-satellite-launch-2022/). 22 December 2022.
303. McDowell, Jonathan (1 March 2023). "Starlink Statistics" (https://web.archive.org/web/20230301184654/https://planet4589.org/space/con/star/stats.html). *Jonathan's Space Pages*. Jonathan's Space Report. Archived from the original (https://planet4589.org/space/con/star/stats.html) on 1 March 2023. Retrieved 1 March 2023.
304. "SpaceX raising over US$500 million, double what Elon Musk's company planned to bring in" (https://www.cnbc.com/2020/03/09/spacex-raising-500-million-in-new-funding-for-elon-musks-company.html). 9 March 2020. Archived (https://web.archive.org/web/20201117160144/https://www.cnbc.com/2020/03/09/spacex-raising-500-million-in-new-funding-for-elon-musks-company.html) from the original on 17 November 2020. Retrieved 9 March 2020.
305. "SpaceX launches more Starlink satellites, beta testing well underway" (https://spaceflightnow.com/2020/09/03/spacex-launches-more-starlink-satellites-beta-testing-well-underway/). Spaceflight Now. 3 September 2020. Archived (https://web.archive.org/web/20201117160244/https://spaceflightnow.com/2020/09/03/spacex-launches-more-starlink-satellites-beta-testing-well-underway/) from the original on 17 November 2020. Retrieved 4 September 2020.
306. SpaceX [@SpaceX] (24 May 2019). "Falcon 9 launches 60 Starlink satellites to orbit – targeting up to 6 Starlink launches this year and will accelerate our cadence next year to put ~720 satellites in orbit for continuous coverage of most populated areas on Earth t.co/HF8bCI4JQD" (https://twitter.com/SpaceX/status/1131946588597829634) (Tweet). Archived (https://web.archive.org/web/20211229133542/https://twitter.com/spacex/status/1131946588597829634) from the original on 29 December 2021. Retrieved 5 February 2022 – via Twitter.
307. "Technical details for satellite Starlink Group" (https://www.n2yo.com//satellite/?s=74001). N2YO.com. Archived (https://web.archive.org/web/20201117160134/https://www.n2yo.com//satellite/?s=74001) from the original on 17 November 2020. Retrieved 1 June 2019.
308. "SpaceX wants to land Starship on the moon within three years, president says, with people soon after" (https://www.cnbc.com/2019/10/27/spacex-president-we-will-land-starship-on-moon-before-2022.html). 27 October 2019. Archived (https://web.archive.org/web/20201117160144/https://www.cnbc.com/2019/10/27/spacex-president-we-will-land-starship-on-moon-before-2022.html) from the original on 17 November 2020. Retrieved 28 October 2019.
309. "ORDER AND AUTHORIZATION AND ORDER ON RECONSIDERATION" (https://docs.fcc.gov/public/attachments/FCC-21-48A1.pdf) (PDF). Archived (https://web.archive.org/web/20210502025640/https://docs.fcc.gov/public/attachments/FCC-21-48A1.pdf) (PDF) from the original on 2 May 2021. Retrieved 1 May 2021. This article incorporates text from this source, which is in the public domain.
310. McDowell, Jonathan (3 March 2023). "Starlink Statistics" (https://planet4589.org/space/con/star/stats.html). *Jonathan's Space Pages*. Jonathan's Space Report. Retrieved 4 March 2023.
311. "Spacex V-Band Non-Geostationary Satellite System" (https://fcc.report/IBFS/SAT-MOD-20200417-00037/2274316.pdf) (PDF). *FCC*. 17 April 2020. p. 3. Archived (https://web.archive.org/web/20211019221725/https://fcc.report/IBFS/SAT-MOD-20200417-00037/2274316.pdf) (PDF) from the original on 19 October 2021.
312. Alcantarilla Romera, Alejandro (7 July 2022). "SpaceX opens busy second half of 2022 with Starlink launch" (https://www.nasaspaceflight.com/2022/07/starlink-4-21-launch/). *NASASpaceFlight*. Retrieved 7 July 2022.
313. "In April 2020 SpaceX submitted an application asking for approval to relocate shells 2-5 down to altitudes ranging from 540 km to 570 km. Proposed orbital configuration" (https://fcc.report/IBFS/SAT-MOD-20200417-00037/2274315). Archived (https://web.archive.org/web/20210104231321/https://fcc.report/IBFS/SAT-MOD-20200417-00037/2274315) from the original on 4 January 2021. Retrieved 11 January 2021.

314. McDowell, Jonathan (2 August 2022). "Starlink Statistics" (https://web.archive.org/web/20220802055129/https://planet4589.org/space/stats/star/starstats.html). *Jonathan's Space Pages*. Jonathan's Space Report. Archived from the original (https://planet4589.org/space/stats/star/starstats.html) on 2 August 2022. Retrieved 17 September 2022.
315. Alcantarilla Romera, Alejandro [@Alexphysics13] (20 May 2022). "SpaceX is on tap to begin Starlink launches to the third shell of their constellation this coming July with two launches from Vandenberg: Starlink Group 3-1 and Starlink Group 3-2" (https://twitter.com/Alexphysics13/status/1527575550784577536) (Tweet). Retrieved 10 October 2022 – via Twitter.
316. "Spacex V-Band Non-Geostationary Satellite System" (https://fcc.report/IBFS/SAT-LOA-20170301-00027/1190019.pdf) (PDF). *FCC*. 1 March 2017. p. 2. Archived (https://web.archive.org/web/20211022090848/https://fcc.report/IBFS/SAT-LOA-20170301-00027/1190019.pdf) (PDF) from the original on 22 October 2021.
317. "SpaceX Seeks FCC Permission for Operating All First-Gen Starlink in Lower Orbit" (https://spacenews.com/spacex-seeks-fcc-permission-for-operating-all-first-gen-starlink-in-lower-orbit/). SpaceNews. 21 April 2020. Archived (http://webarchive.loc.gov/all/20200422161329/https://spacenews.com/spacex%2Dseeks%2Dfcc%2Dpermission%2Dfor%2Doperating%2Dall%2Dfirst%2Dgen%2Dstarlink%2Din%2Dlower%2Dorbit/) from the original on 22 April 2020. Retrieved 14 June 2020.
318. "Application for Fixed Satellite Service by Space Exploration Holdings, LLC [SAT-MOD-20200417-00037]" (https://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SATMOD2020041700037&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number). *fcc.report*. FCC. 17 April 2020. Archived (https://web.archive.org/web/20201117160336/https://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC%2FFile+Number%2F%3D%2FSATMOD2020041700037&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC%2FFile+Number) from the original on 17 November 2020. Retrieved 26 January 2021. "Space Exploration Holdings, LLC seeks to modify its Ku/Ka–band NGSO license to relocate satellites previously authorized to operate at altitudes from 1110 km to 1325 km down to altitudes ranging from 540 km to 570 km, and to make related changes." This article incorporates text from this source, which is in the public domain.
319. "SpaceX modifies Starlink network design" (https://spaceflightnow.com/2020/04/21/spacex-modifies-starlink-network-design-as-another-60-satellites-gear-up-for-launch/). Spaceflight Now. 21 April 2020. Archived (https://web.archive.org/web/20201117160117/https://spaceflightnow.com/2020/04/21/spacex-modifies-starlink-network-design-as-another-60-satellites-gear-up-for-launch/) from the original on 17 November 2020. Retrieved 22 April 2020.
320. "Starlink Gen2 FCC Application Narrative Attachment" (https://fcc.report/IBFS/SAT-LOA-20200526-00055/2378669). FCC. 26 May 2020. Archived (https://web.archive.org/web/20201117160150/https://fcc.report/IBFS/SAT-LOA-20200526-00055/2378669) from the original on 17 November 2020. Retrieved 18 June 2020. This article incorporates text from this source, which is in the public domain.
321. Sheetz, Michael (27 April 2021). "FCC approves SpaceX change to its Starlink network, a win despite objections from Amazon and others" (https://www.cnbc.com/2021/04/27/fcc-approves-spacex-starlink-modification-despite-objections.html). CNBC. Archived (https://web.archive.org/web/20210427184844/https://www.cnbc.com/2021/04/27/fcc-approves-spacex-starlink-modification-despite-objections.html) from the original on 27 April 2021. Retrieved 27 April 2021.
322. "FCC approves SpaceX change to its Starlink network, a win despite objections from Amazon and others" (https://www.cnbc.com/2021/04/27/fcc-approves-spacex-starlink-modification-despite-objections.html). CNBC. 27 April 2021. Archived (https://web.archive.org/web/20210427151302/https://www.cnbc.com/2021/04/27/fcc-approves-spacex-starlink-modification-despite-objections.html) from the original on 27 April 2021. Retrieved 27 April 2021.
323. "U.S. FCC approves SpaceX satellite deployment plan" (https://finance.yahoo.com/news/fcc-votes-approve-spacex-satellite-135545524.html). Yahoo Finance. 27 April 2021. Archived (https://web.archive.org/web/20210427140512/https://finance.yahoo.com/news/fcc-votes-approve-spacex-satellite-135545524.html) from the original on 27 April 2021. Retrieved 27 April 2021.
324. "SpaceX surpasses 1,000-satellite mark in latest Starlink launch" (https://spacenews.com/spacex-surpasses-1000-satellite-mark-in-latest-starlink-launch/). *SpaceNews*. 20 January 2021. Archived (https://web.archive.org/web/20211001025115/https://spacenews.com/spacex-surpasses-1000-satellite-mark-in-latest-starlink-launch/) from the original on 1 October 2021. Retrieved 27 January 2021.
325. "SpaceX smashes record with launch of 143 small satellites" (https://spaceflightnow.com/2021/01/24/spacex-launches-record-setting-rideshare-mission-with-143-small-satellites/). Spaceflight Now. 24 January 2021. Archived (https://web.archive.org/web/20210125030820/https://spaceflightnow.com/2021/01/24/spacex-launches-record-setting-rideshare-mission-with-143-small-satellites/) from the original on 25 January 2021. Retrieved 25 January 2021.

326. Foust, Jeff (9 February 2022). "Dozens of Starlink satellites from latest launch to reenter after geomagnetic storm" (https://spacenews.com/dozens-of-starlink-satellites-from-latest-launch-to-reenter-after-geomagnetic-storm/). *SpaceNews*. Retrieved 9 February 2022.
327. McDowell, Jonathan [@planet4589] (13 February 2022). "Object 51470, one of the failed Starlink satellites from the recent launch, reentered at 1708 UTC Feb 12 off the coast of California. I believe this to be the last of the failed satellites to reenter; the remaining 11 satellites still being tracked are slowly raising their orbits" (https://twitter.com/planet4589/status/1492964347794325506) (Tweet). Retrieved 19 February 2022 – via Twitter.
328. "Geomagnetic storm and recently deployed Starlink satellites" (https://www.spacex.com/updates/). *SpaceX*. 3 February 2022. Retrieved 8 February 2022.
329. "SpaceX seeks to modify its V-band license so that it may deploy and operate up to 7,500 V-band payloads on satellites launched into its Gen2 system" (https://licensing.fcc.gov/cgi-bin/ws.exe/prod/ib/forms/reports/swr031b.hts?q_set=V_SITE_ANTENNA_FREQ.file_numberC/File+Number/%3D/SATMOD2023032200062&prepare=&column=V_SITE_ANTENNA_FREQ.file_numberC/File+Number). 22 March 2023. Retrieved 23 August 2023.
330. "REVISED SPACEX GEN2 NON-GEOSTATIONARY SATELLITE SYSTEM" (https://web.archive.org/web/20211020214125/https://licensing.fcc.gov/myibfs/download.do?attachment_key=12943362). Archived from the original (https://licensing.fcc.gov/myibfs/download.do?attachment_key=12943362) on 20 October 2021. Retrieved 26 December 2022.
331. "Re: IBFS File Nos. SAT-LOA-20200526-00055 and SAT-AMD-20210818-00105" (https://licensing.fcc.gov/myibfs/download.do?attachment_key=14456966). 7 January 2022. Retrieved 15 January 2023.
332. "Request for Orbital Deployment and Operating Authority for the SpaceX Gen2 NGSO Satellite System, Order and Authorization" (https://docs.fcc.gov/public/attachments/FCC-22-91A1.pdf) (PDF). FCC. 1 December 2022. Retrieved 1 January 2023.
333. "SpaceX F9 : Starlink group 6-1 : CCSFS SLC-40 : 27 February 2023 (23:13 UTC)" (https://forum.nasaspaceflight.com/index.php?topic=57918.msg2462181#msg2462181).
334. SpaceX [@SpaceX] (26 February 2023). "We call them "V2 Mini". They represent a step forward in Starlink capability" (https://twitter.com/SpaceX/status/1629898468373192707) (Tweet). Retrieved 4 March 2023 – via Twitter.
335. "SpaceX" (http://www.spacex.com/). *SpaceX*. Retrieved 28 February 2023.
336. GewoonLukas_ [@GewoonLukas_] (7 March 2023). "Image of a Starlink V2 Mini satellite in orbit. This also confirms that V2 Mini satellites gave 2 solar arrays xompared to the V1.5 satellites which have 1 solar array" (https://twitter.com/GewoonLukas_/status/1633003628221833216) (Tweet). Retrieved 7 March 2023 – via Twitter.
337. "Media Advisory: IAU Centre for the Protection of the Dark and Quiet Sky from Satellite Constellation Interference" (https://noirlab.edu/public/announcements/ann22005/). Retrieved 30 January 2023.
338. "NSF's NOIRLab and the SKA Observatory to Co-host New IAU Center for Satellite Constellation Interference" (https://noirlab.edu/public/news/noirlab2206/). Retrieved 30 January 2023.
339. Hall, Shannon (June 2019). "After SpaceX Starlink Launch, a Fear of Satellites That Outnumber All Visible Stars" (https://www.nytimes.com/2019/06/01/science/starlink-spacex-astronomers.html). *The New York Times*. Archived (https://web.archive.org/web/20200821011421/https://www.nytimes.com/2019/06/01/science/starlink-spacex-astronomers.html) from the original on 21 August 2020. Retrieved 3 June 2019.
340. "The unexpected brightness of new satellites could ruin the night sky" (https://www.economist.com/science-and-technology/2019/05/30/the-unexpected-brightness-of-new-satellites-could-ruin-the-night-sky). *The Economist*. 30 May 2019. Archived (https://web.archive.org/web/20201117160416/https://www.economist.com/science-and-technology/2019/05/30/the-unexpected-brightness-of-new-satellites-could-ruin-the-night-sky) from the original on 17 November 2020. Retrieved 3 June 2019.
341. "SpaceX's Starlink Could Change The Night Sky Forever, And Astronomers Are Not Happy" (https://www.forbes.com/sites/jonathanocallaghan/2019/05/27/spacexs-starlink-could-change-the-night-sky-forever-and-astronomers-are-not-happy/). *Forbes*. Archived (https://web.archive.org/web/20201117160330/https://www.forbes.com/sites/jonathanocallaghan/2019/05/27/spacexs-starlink-could-change-the-night-sky-forever-and-astronomers-are-not-happy/) from the original on 17 November 2020. Retrieved 3 June 2019.
342. "Megaconstellations like SpaceX's Starlink may interfere with search for life by world's largest radio telescope" (https://www.space.com/spacex-starlink-affects-search-for-life-radio-observatory). *Space.com*. 3 February 2022. Retrieved 8 February 2022.
343. "IAU's statement on satellite constellations" (https://www.iau.org/news/announcements/detail/ann19035/). International Astronomical Union. Archived (https://web.archive.org/web/20200527073625/https://www.iau.org/news/announcements/detail/ann19035/) from the original on 27 May 2020. Retrieved 3 June 2019.

344. "Statement on Starlink and "Constellations" of Communication Satellites" (https://public.nrao.edu/news/nrao-statement-commsats/). National Radio Astronomy Observatory. Archived (https://web.archive.org/web/20201117160310/https://public.nrao.edu/news/nrao-statement-commsats/) from the original on 17 November 2020. Retrieved 3 June 2019.
345. "SKAO needs corrective measures from satellite "mega-constellation" operators to minimise impact on its telescopes" (https://www.skatelescope.org/news/skao-satellite-impact-analysis/). Square Kilometre Array Organization. 7 October 2020. Archived (https://web.archive.org/web/20201117160310/https://www.skatelescope.org/news/skao-satellite-impact-analysis/) from the original on 17 November 2020. Retrieved 15 October 2020.
346. "Starlink Satellites Imaged from CTIO — IOTW1946" (https://nationalastro.org/news/starlink-satellites-imaged-from-ctio/). 20 November 2019. Archived (https://web.archive.org/web/20201117160314/https://noirlab.edu/public/images/iotw1946a/) from the original on 17 November 2020. Retrieved 3 May 2020.
347. "Sightings of SpaceX's Starlink satellites spark awe — and astronomical angst" (https://www.geekwire.com/2019/sightings-spacexs-starlink-satellites-spark-awe-astronomical-angst/). Geek Wire. 25 May 2019. Archived (https://web.archive.org/web/20201117160333/https://www.geekwire.com/2019/sightings-spacexs-starlink-satellites-spark-awe-astronomical-angst/) from the original on 17 November 2020. Retrieved 3 June 2019.
348. McCaughrean, Mark [@markmccaughrean] (25 May 2019). "If predictions are correct that 400–500 Starlink satellites about that bright will also be visible *all the time*" (https://twitter.com/markmccaughrean/status/1132394346945421317) (Tweet) – via Twitter.
349. Mack, Katie [@AstroKatie] (25 May 2019). "SpaceX just launched 60 new satellites, which have been spotted as a chain of bright lights across the sky. As more are launched and orbits change, this could be a very big problem for ground-based astronomy. Musk's offhand "they can't be seen at night" is not true or reassuring. t.co/OwbsPJOw9H" (https://twitter.com/AstroKatie/status/1132377572170452992) (Tweet). Archived (https://web.archive.org/web/20211229190706/https://twitter.com/AstroKatie/status/1132377572170452992) from the original on 29 December 2021. Retrieved 5 February 2022 – via Twitter.
350. Jamie R Lomax [@jrlomax] (25 May 2019). "@AstroKatie Even if they were only visible at dusk and dawn as claimed, they would still affect our data because we take calibrations then. Dusk/dawn flats are hard enough to take as is. Having a subset of 12,000 bright things running through those exposures would be infuriating" (https://twitter.com/jrlomax/status/1132408926811643905) (Tweet). Archived (https://web.archive.org/web/20210207195715/https://twitter.com/jrlomax/status/1132408926811643905) from the original on 7 February 2021. Retrieved 5 February 2022 – via Twitter.
351. Parker, Alex [@Alex_Parker] (25 May 2019). "I know people are excited about those images of the train of SpaceX Starlink satellites, but it gives me pause. They're bright, and there are going to be a lot of them. If SpaceX launches all 12,000, they will outnumber stars visible to the naked eye" (https://twitter.com/Alex_Parker/status/1132163931378610178) (Tweet). Archived (https://web.archive.org/web/20211222150705/https://twitter.com/Alex_Parker/status/1132163931378610178) from the original on 22 December 2021. Retrieved 5 February 2022 – via Twitter.
352. Musk, Elon [@elonmusk] (27 May 2019). "@13ericralph31 @varunversion1 @Erdayastronaut @SpaceX If we need to tweak sat orientation to minimize solar reflection during critical astronomical experiments, that's easily done. Most orbital objects are close to Earth btw, as shown by this NASA density map. t.co/83MwIZAEP6 t.co/NllMXregRg" (https://twitter.com/elonmusk/status/1132902372458418176) (Tweet). Archived (https://web.archive.org/web/20211108101158/https://twitter.com/elonmusk/status/1132902372458418176) from the original on 8 November 2021. Retrieved 5 February 2022 – via Twitter.
353. Musk, Elon [@elonmusk] (27 May 2019). "@Cosmic_Penguin Agreed, sent a note to Starlink team last week specifically regarding albedo reduction. We'll get a better sense of value of this when satellites have raised orbits & arrays are tracking to the sun" (https://twitter.com/elonmusk/status/1132908689860415488) (Tweet). Archived (https://web.archive.org/web/20220107005704/https://twitter.com/elonmusk/status/1132908689860415488) from the original on 7 January 2022. Retrieved 5 February 2022 – via Twitter.
354. Mallama, Anthony (2020). "A Flat-Panel Brightness Model for the Starlink Satellites and Measurement of their Absolute Visual Magnitude". arXiv:2003.07805 (https://arxiv.org/abs/2003.07805) [astro-ph.IM (https://arxiv.org/archive/astro-ph.IM)].
355. Tregloan-Reed, J.; Otarola, A.; Ortiz, E.; Molina, V.; Anais, J.; González, R.; Colque, J. P.; Unda-Sanzana, E. (2020). "First observations and magnitude measurement of Starlink's Darksat". *Astronomy & Astrophysics*. **637**: L1. arXiv:2003.07251 (https://arxiv.org/abs/2003.07251). Bibcode:2020A&A...637L...1T (https://ui.adsabs.harvard.edu/abs/2020A&A...637L...1T). doi:10.1051/0004-6361/202037958 (https://doi.org/10.1051%2F0004-6361%2F202037958). S2CID 212725531 (https://api.semanticscholar.org/CorpusID:212725531).

356. Zhang, Emily. "SpaceX's Dark Satellites Are Still Too Bright for Astronomers" (https://www.scientificamerican.com/article/spacexs-dark-satellites-are-still-too-bright-for-astronomers/). Scientific American. Archived (https://web.archive.org/web/20210102065559/https://www.scientificamerican.com/article/spacexs-dark-satellites-are-still-too-bright-for-astronomers/) from the original on 2 January 2021. Retrieved 24 December 2020.
357. "SpaceX to debut satellite-dimming sunshade on Starlink launch next month" (https://spaceflightnow.com/2020/04/28/spacex-to-debut-satellite-dimming-sunshade-on-starlink-launch-next-month/). Spaceflight Now. 28 April 2020. Archived (https://web.archive.org/web/20201117160219/https://spaceflightnow.com/2020/04/28/spacex-to-debut-satellite-dimming-sunshade-on-starlink-launch-next-month/) from the original on 17 November 2020. Retrieved 29 April 2020.
358. Clark, Stephen (22 April 2020). "SpaceX's Starlink network surpasses 400-satellite mark after successful launch" (https://spaceflightnow.com/2020/04/22/spacexs-starlink-network-surpasses-400-satellite-mark-after-successful-launch/). Spaceflight Now. Archived (https://web.archive.org/web/20200430031030/https://spaceflightnow.com/2020/04/22/spacexs-starlink-network-surpasses-400-satellite-mark-after-successful-launch/) from the original on 30 April 2020. Retrieved 28 April 2020.
359. Cole, Richard E. (2020). "A Sky Brightness Model for the Starlink "Visorsat" Spacecraft" (https://iopscience.iop.org/article/10.3847/2515-5172/abc0e9). *Research Notes of the AAS*. **4** (10): 182. arXiv:2107.06026 (https://arxiv.org/abs/2107.06026). Bibcode:2020RNAAS...4..182C (https://ui.adsabs.harvard.edu/abs/2020RNAAS...4..182C). doi:10.3847/2515-5172/abc0e9 (https://doi.org/10.3847%2F2515-5172%2Fabc0e9). S2CID 228996341 (https://api.semanticscholar.org/CorpusID:228996341). Archived (https://web.archive.org/web/20201101005226/https://iopscience.iop.org/article/10.3847/2515-5172/abc0e9) from the original on 1 November 2020. Retrieved 24 December 2020.
360. Anthony Mallama (2 January 2021). "The Brightness of VisorSat-Design Starlink Satellites". arXiv:2101.00374 (https://arxiv.org/abs/2101.00374) [astro-ph.IM (https://arxiv.org/archive/astro-ph.IM)].
361. Boley, Aaron C.; Byers, Michael (20 May 2021). "Satellite mega-constellations create risks in Low Earth Orbit, the atmosphere and on Earth" (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8137964). *Scientific Reports*. **11** (1): 10642. Bibcode:2021NatSR..1110642B (https://ui.adsabs.harvard.edu/abs/2021NatSR..1110642B). doi:10.1038/s41598-021-89909-7 (https://doi.org/10.1038%2Fs41598-021-89909-7). ISSN 2045-2322 (https://www.worldcat.org/issn/2045-2322). PMC 8137964 (https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8137964). PMID 34017017 (https://pubmed.ncbi.nlm.nih.gov/34017017).
362. "New center to coordinate work to mitigate the effect of satellite constellations on astronomy" (https://spacenews.com/new-center-to-coordinate-work-to-mitigate-effect-of-satellite-constellations-on-astronomy/). *SpaceNews*. 5 February 2022. Retrieved 7 February 2022.
363. Witze, Alexandra (26 May 2022). " 'Unsustainable': how satellite swarms pose a rising threat to astronomy" (https://www.nature.com/articles/d41586-022-01420-9). *Nature*. **606** (7913): 236–237. Bibcode:2022Natur.606..236W (https://ui.adsabs.harvard.edu/abs/2022Natur.606..236W). doi:10.1038/d41586-022-01420-9 (https://doi.org/10.1038%2Fd41586-022-01420-9). PMID 35618807 (https://pubmed.ncbi.nlm.nih.gov/35618807). S2CID 249096524 (https://api.semanticscholar.org/CorpusID:249096524). Retrieved 21 June 2022.
364. "Brightness mitigation best practices for satellite operators" (https://api.starlink.com/public-files/BrightnessMitigationBestPracticesSatelliteOperators.pdf) (PDF).
365. Mallama, A.; Cole, R. E.; Harrington, S.; Hornig, A.; Respler, J.; Worley, A.; Lee, R. (11 June 2023). Starlink Generation 2 Mini satellites: photometric characterization (Report). arXiv:2306.06657 (https://arxiv.org/abs/2306.06657).
366. O'Callaghan, Jonathan (13 May 2019). "SpaceX's Starlink Could Cause Cascades of Space Junk" (https://www.scientificamerican.com/article/spacexs-starlink-could-cause-cascades-of-space-junk/). Scientific American. Archived (https://web.archive.org/web/20201117160329/https://www.scientificamerican.com/article/spacexs-starlink-could-cause-cascades-of-space-junk/) from the original on 17 November 2020. Retrieved 2 August 2020.
367. Does Starlink Pose a Space Debris Threat? An Expert Answers. (https://www.skyandtelescope.com/astronomy-news/starlink-space-debris/) Archived (https://web.archive.org/web/20201117160315/https://skyandtelescope.org/astronomy-news/starlink-space-debris/) 17 November 2020 at the Wayback Machine Jan Hattenbach, *Sky & Telescope*, 3 June 2019
368. Foust, Jeff (2 July 2019). "Starlink failures highlight space sustainability concerns" (https://spacenews.com/starlink-failures-highlight-space-sustainability-concerns/). SpaceNews. Archived (http://webarchive.loc.gov/all/20200707123031/https://spacenews.com/starlink%2Dfailures%2Dhighlight%2Dspace%2Dsustainability%2Dconcerns/) from the original on 7 July 2020. Retrieved 18 September 2019.

369. Stephen Chen, SCMP (24 Feb 2023) China aims to launch nearly 13,000 satellites to 'suppress' Elon Musk's Starlink, researchers say (https://www.scmp.com/news/china/article/3211438/china-aims-launch-nearly-13000-satellites-suppress-elon-musks-starlink-researchers-say) in near-Earth orbit
370. "ESA spacecraft dodges large constellation" (https://www.esa.int/Safety_Security/ESA_spacecraft_dodges_large_constellation). *esa.int*. Archived (https://web.archive.org/web/20201117160315/https://www.esa.int/Safety_Security/ESA_spacecraft_dodges_large_constellation) from the original on 17 November 2020. Retrieved 8 April 2020.
371. "SpaceX satellite was on "collision course" until ESA satellite was re-routed" (https://arstechnica.com/information-technology/2019/09/spacex-satellite-was-on-collision-course-until-esa-satellite-was-re-routed). *arstechnica.com*. Ars Technica. 3 September 2019. Archived (https://web.archive.org/web/20201117160331/https://arstechnica.com/information-technology/2019/09/spacex-satellite-was-on-collision-course-until-esa-satellite-was-re-routed/) from the original on 17 November 2020. Retrieved 29 April 2020.
372. "China anger after space station forced to move to avoid Elon Musk Starlink satellites" (https://www.theguardian.com/science/2021/dec/28/china-complains-to-un-after-space-station-is-forced-to-move-to-avoid-starlink-satellites). *The Guardian*. 27 December 2021. Retrieved 28 December 2021.
373. "Elon Musk Faces Backlash In China After "Close Encounters" Between His Starlink Satellites And Chinese Space Station" (https://www.forbes.com/sites/sergeiklebnikov/2021/12/27/elon-musk-faces-backlash-in-china-after-close-encounters-between-his-starlink-satellites-and-chinese-space-station/?sh=d6843031a614). *Forbes*. 27 December 2021. Retrieved 28 December 2021.
374. "NASA Letter to FCC Regarding SpaceX Starlink Gen 2 System" (https://spaceref.com/status-report/nasa-letter-to-fcc-regarding-spacex-starlink-gen-2-system/). 14 February 2022.
375. "SPACEX CONSTELLATION STATUS REPORT. December 1, 2021 – May 31, 2022" (https://licensing.fcc.gov/myibfs/download.do?attachment_key=16644318). 1 July 2022. Retrieved 4 February 2023.
376. Gershgorn, Dave (17 August 2015). "Samsung Wants To Blanket The Earth In Satellite Internet" (http://www.popsci.com/samsung-wants-launch-thousands-satellites-bring-everyone-earth-internet). Popular Science. Archived (https://web.archive.org/web/20150820193642/http://www.popsci.com/samsung-wants-launch-thousands-satellites-bring-everyone-earth-internet) from the original on 20 August 2015. Retrieved 21 August 2015.
377. Khan, Farooq (2015). "Mobile Internet from the Heavens". arXiv:1508.02383 (https://arxiv.org/abs/1508.02383) [cs.NI (https://arxiv.org/archive/cs.NI)].
378. Foust, Jeff (18 February 2018). "Telesat to announce manufacturing plans for LEO constellation in coming months" (http://spacenews.com/telesat-to-announce-manufacturing-plans-for-leo-constellation-in-coming-months/). SpaceNews. Retrieved 1 January 2023.
379. Sheetz, Michael (4 April 2019). "Amazon wants to launch thousands of satellites so it can offer broadband internet from space" (https://www.cnbc.com/2019/04/04/amazon-project-kuiper-broadband-internet-small-satellite-network.html). CNBC. Archived (https://web.archive.org/web/20190404151556/https://www.cnbc.com/2019/04/04/amazon-project-kuiper-broadband-internet-small-satellite-network.html) from the original on 4 April 2019. Retrieved 4 April 2019.
380. Sheetz, Michael (27 November 2018). "Amazon cloud business reaches into space with satellite connection service" (https://www.cnbc.com/2018/11/27/amazon-launches-aws-ground-station-satellite-data-collection-service.html). CNBC. Archived (https://web.archive.org/web/20190407001146/https://www.cnbc.com/2018/11/27/amazon-launches-aws-ground-station-satellite-data-collection-service.html) from the original on 7 April 2019. Retrieved 4 April 2019.
381. de Selding, Peter B. (23 February 2015). "Wall Street Grills Fleet Operators Over Mega-Constellation Threat" (http://spacenews.com/wall-st-grills-fleet-operators-over-mega-constellation-threat/). SpaceNews. Archived (https://archive.today/20150224023647/http://spacenews.com/wall-st-grills-fleet-operators-over-mega-constellation-threat/) from the original on 24 February 2015. Retrieved 24 February 2015.
382. Boyle, Alan (27 October 2015). "SpaceX's Gwynne Shotwell signals go-slow approach for Seattle satellite plan" (https://www.geekwire.com/2015/spacexs-gwynne-shotwell-signals-go-slow-approach-for-seattle-satellite-operation/). Archived (https://web.archive.org/web/20201117160244/https://www.geekwire.com/2015/spacexs-gwynne-shotwell-signals-go-slow-approach-for-seattle-satellite-operation/) from the original on 17 November 2020. Retrieved 28 October 2015.
383. de Selding, Peter B. (5 October 2017). "Panasonic Avionics' surprising conversion into a satellite mega-constellation believer" (https://www.spaceintelreport.com/panasonic-avionics-surprising-conversion-satellite-mega-constellation-believer/). Space Intel Report. Archived (https://web.archive.org/web/20171013120725/https://www.spaceintelreport.com/panasonic-avionics-surprising-conversion-satellite-mega-constellation-believer/) from the original on 13 October 2017. Retrieved 13 October 2017.

384. Shields, Todd (4 February 2021). "Musk's Internet-From-Space Subsidy at Risk as Rivals Protest" (https://finance.yahoo.com/news/musk-broadband-space-subsidy-irks-070000411.html). *Yahoo!Finance*. Archived (https://web.archive.org/web/20210215060017/https://finance.yahoo.com/news/musk-broadband-space-subsidy-irks-070000411.html) from the original on 15 February 2021. Retrieved 5 February 2021.
385. Khaled, Fatma (4 February 2021). "Small internet service providers say SpaceX's Starlink shouldn't get federal funds to expand internet access" (https://www.businessinsider.com/starlink-spacex-fcc-rural-america-2021-2). Business Insider. Archived (https://web.archive.org/web/20210205125109/https://www.businessinsider.com/starlink-spacex-fcc-rural-america-2021-2) from the original on 5 February 2021. Retrieved 5 February 2021.
386. americanpost (1 September 2021). "Elon Musk fights with Mexican businessman over StarLink trademark registration" (https://www.americanpost.news/elon-musk-fights-with-mexican-businessman-over-starlink-trademark-registration/). *American Post*. Retrieved 7 December 2022.
387. Wattles, Jackie. "The race for space-based broadband: OneWeb launches 34 more internet satellites" (https://www.cnn.com/2020/02/06/tech/oneweb-satellite-internet-launch-scn/index.html). *CNN*. Archived (https://web.archive.org/web/20210815055818/https://www.cnn.com/2020/02/06/tech/oneweb-satellite-internet-launch-scn/index.html) from the original on 15 August 2021. Retrieved 7 February 2020.
388. Jones, Andrew (27 July 2021). "Chinese rocket company Space Pioneer secures major funding ahead of first launch" (https://spacenews.com/chinese-rocket-company-space-pioneer-secures-major-funding-ahead-of-first-launch/). SpaceNews. Archived (https://web.archive.org/web/20210727183506/https://spacenews.com/chinese-rocket-company-space-pioneer-secures-major-funding-ahead-of-first-launch/) from the original on 27 July 2021. Retrieved 27 July 2021.

External links

- Official website (https://www.starlink.com/)
- Official Starlink Availability Map (https://www.starlink.com/map)
- Starlink Satellite and Groundstation Locations, Data Links, path projection, environmental Information etc. (starlink.sx) (https://starlink.sx/)
- Starlink Coverage Area, Satellite and Groundstation Locations for Starlink, OneWeb and GPS constellations (satellitemap.space) (https://satellitemap.space/?constellation=starlink)
- Complete Starlink Satellite Catalog allowing tracking location details from user location. (https://www.karhukoti.com/Satellites/?search=STARLINK)
- Starlink Satellite Locations and Information on individual coverage area, connections, etc. (https://www.satflare.com/track.asp?q=starlink)
- See A Satellite Tonight (https://james.darpinian.com/satellites/?special=starlink) shows when Starlink satellites can be seen.
- Shows real-time Starlink satellites position (https://www.heavens-above.com/StarLink.aspx?lat=32.0141&lng=34.9334&loc=%d7%98%d7%99%d7%a8%d7%aa+%d7%99%d7%94%d7%95%d7%93%d7%94&alt=0&tz=)
- Starlink Professional Installers Directory (https://starlink.internet-exchange.site)
- List of Starlink dish firmware updates (https://www.starlinkhardware.com/firmware-updates/)
- *A User Friendly Real-Time SpaceX Satellite Locator* (https://satellitemap.space/?constellation=starlink)