

StarLink Update

Updates on the progress of Elon Musk's Satellite Based Internet Services Initiative

By Bob Primak

For the Lexington Technology Users Group

Lexington MA

Sept. 16, 2020

StarLink update

- **Three Parts:**
 - 1) Project Description, Scope and Benchmarks
 - 2) Videos and Pictures of the Sept. 3, 2020 Launch and Recovery Operations
 - 3) Starlink Internet Services Details
- ***(All images used have credits embedded in the image copies themselves.)***
- (The recording of this presentation will be paused to avoid including copies of any copyrighted videos.)
- (Please use Chat for questions and comments until the end.)

StarLink Update

- Article #1: [Article One](#) – See References for full URLs.

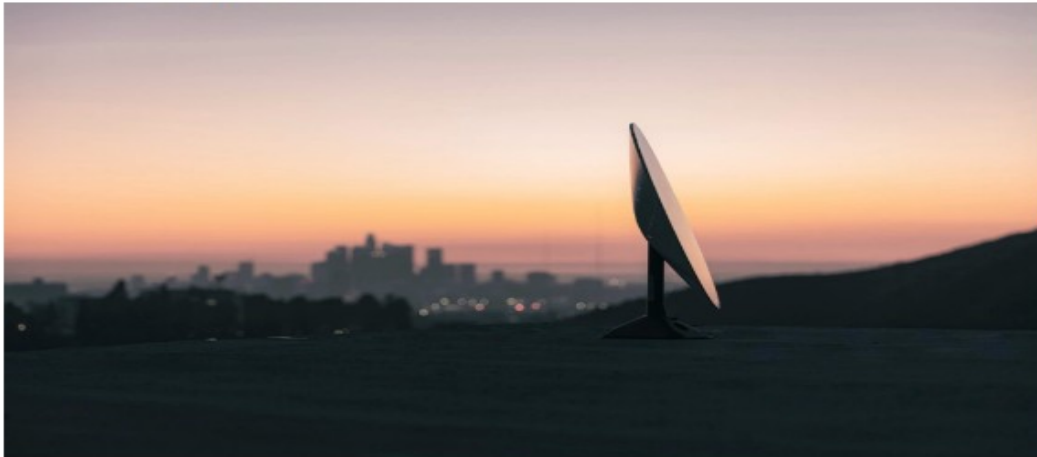
SpaceX confirms Starlink internet private beta underway, showing low latency and speeds over 100Mbps



Darrell Etherington @etherington / 9:10 am EDT • September 3, 2020

 Comment

Image Credits: SpaceX



StarLink Update

- SpaceX's service has demonstrated latency low enough to allow it to play the "fastest multiplayer" networked online games, and that it has also shown download speeds in excess of 100Mbps, which she added is fast enough to stream multiple HD video streams at once, with additional bandwidth to spare.

StarLink Update

- Starlink's goal is to leapfrog what's out there already with its low Earth orbit constellation, which has the advantage of transmitting its signal much closer in to Earth than the far-out geostationary satellites that provide legacy networking capabilities.

StarLink Update

- SpaceX recently completed its first inter-satellite link between Starlink spacecraft — which can transfer hundreds of gigabytes of data between satellites via optical laser, at speeds that will be the fastest available anywhere for inter-satellite communications.

StarLink Update

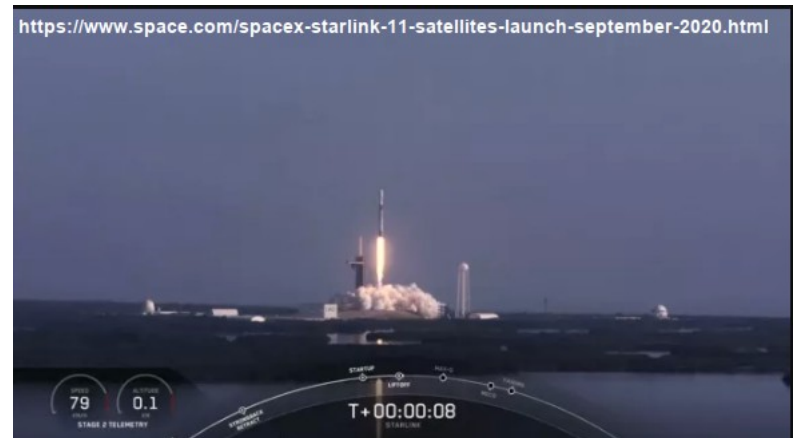
- This last feature is necessary to allow handoffs which allow content to be shared with users around the world.
- So how good is the performance? And why does this matter?

StarLink Update

- SpaceX launches 60 Starlink internet satellites, sticks rocket landing

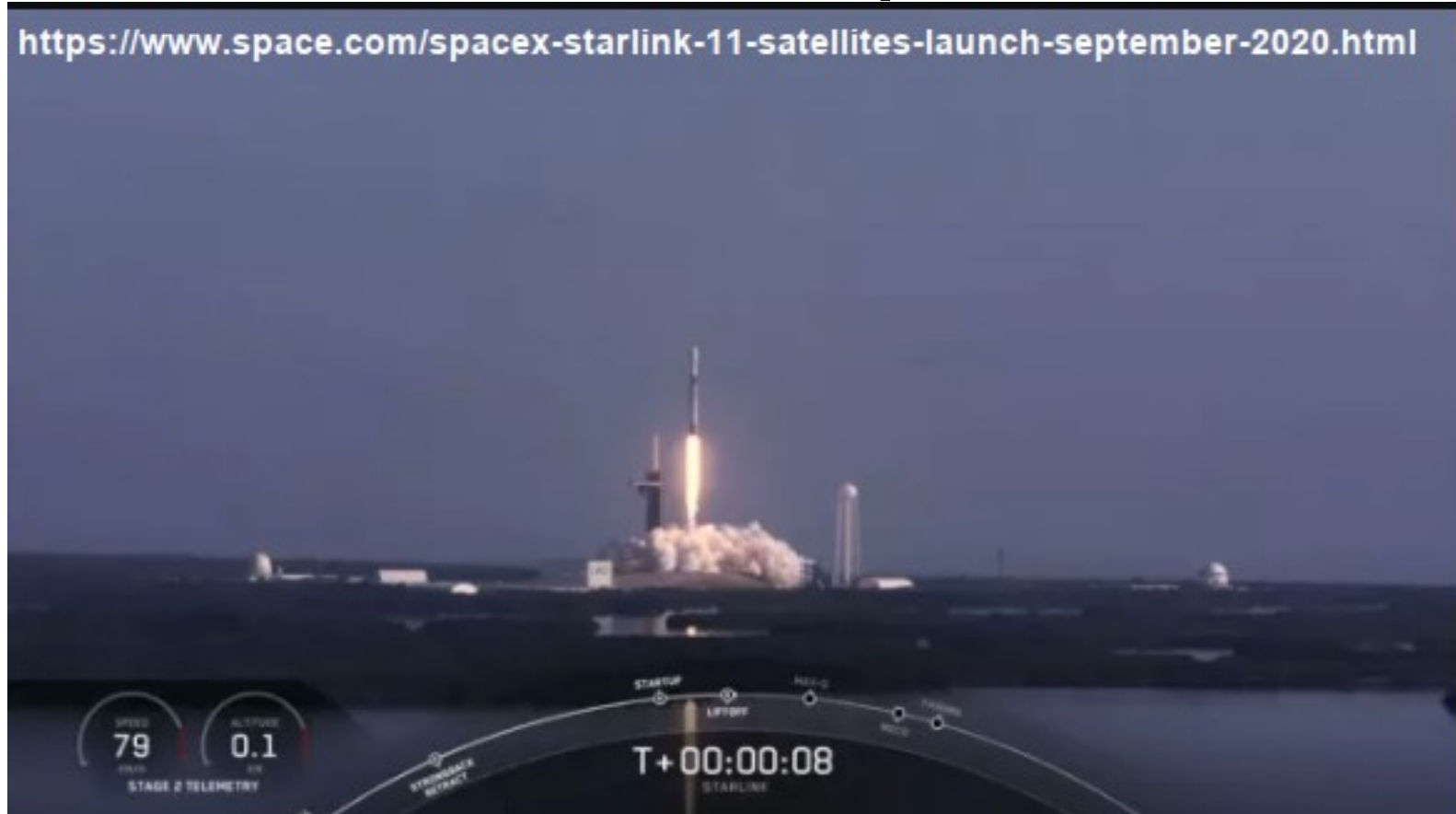
By Amy Thompson [Second Article](#)

– Full URL in References



StarLink Update

<https://www.space.com/spacex-starlink-11-satellites-launch-september-2020.html>



StarLink Update

- A two-stage Falcon 9 rocket carrying a full load of 60 Starlink satellites lifted off at 8:46 a.m. EDT (1246 GMT) from Pad 39A at NASA's Kennedy Space Center in Florida. The booster's first stage came back to Earth about 9 minutes after launch, landing on one of SpaceX's drone ships in the Atlantic Ocean.

StarLink Update

- This was the third attempt to get this particular mission off the ground, following weather and data-review delays.
- SpaceX had initially planned to conduct a launch doubleheader on Sunday (Aug. 30), with two different Falcon 9s launching from the company's Florida-based launch pads on the same day — a first for the private spaceflight company.

StarLink Update

- Photographers have a small window of time to set up cameras, so as not to interfere with prelaunch activities. Unfortunately, for both the Starlink setup and the SAOCOM-1B mission, weather officers detected lightning around the pad and could not permit anyone to be outside, so no cameras were set up.

StarLink Update

- This is the second reuse of the B1060 booster.
- Approximately nine minutes after liftoff, the first stage made another landing, touching down on the deck of the SpaceX drone ship "Of Course I Still Love You."
- The landing today marked the 60th recovery of a Falcon first stage.

StarLink Update

- Earlier this year, SpaceX upgraded its second drone ship, "Just Read the Instructions," and started using it to help catch boosters out in the Atlantic Ocean. (I like that ship's name!)



StarLink Update

<https://www.space.com/spacex-starlink-11-satellites-launch-september-2020.html>
<https://cdn.mos.cms.futurecdn.net/72MZZ6pa4YkX9a4smbFkjn-970-80.png.webp>



StarLink Update

- Including the 60 satellites SpaceX launched on this mission, which marks the 12th Starlink flight since May 2019, SpaceX has delivered more than 700 of the internet-beaming satellites into space. Company founder and CEO Elon Musk has said that there need to be between 500 and 800 satellites in orbit before service can begin to roll out.

StarLink Update

- The U.S. Federal Communications Commission granted SpaceX approval to launch as many as 12,000 Starlink satellites to low Earth orbit, providing customers with high-speed, low-latency internet.
- Some astronomers are not pleased with these numbers. (Interferes with their work.)

StarLink Update

- In advance of rolling out its internet service, SpaceX has started offering prospective users the chance to test out its Starlink network before commencing commercial service. Select users have already started beta-testing the service now, but many more satellites could end up launching before Musk and SpaceX connect the world.

StarLink Update

- Fairing recovery efforts
- SpaceX wants to limit fairings' exposure to seawater, to ease reuse of this critical piece of hardware.
- Two ships are deployed normally per launch.

StarLink Update

- But this time due to dual launches, the ships had to be split up.
- GO Ms. Chief was able to scoop both pieces of the SAOCOM-1B fairing out of the ocean and safely deliver them back to SpaceX's facilities at Port Canaveral.

StarLink Update

- The vessel then headed back out to sea, joining its partner, already stationed out in the Atlantic and awaiting today's Starlink mission. All recovery efforts (either a catch or a scoop) are expected to occur approximately 40 minutes after liftoff.
- (The nets can directly catch the fairings, limiting their exposure to seawater.)

StarLink Update

- So:
- How well does StarLink's service perform?
- What financial incentives does StarLink expect to receive?
- What will be the cost and benefits to users?

StarLink Update

- We saw in my previous 5G Update that there are two very different markets for high-speed Internet services in the US now.
- Urban markets require high-density, low-latency antennas with low power per antenna.
- Rural areas require broad area, low-density antennas with much more power per antenna.

StarLink Update

- A company called Starry is now providing urban areas with fixed wireless 5G Internet services, using rooftop antennas to send and receive signals. (They are in Cambridge and Somerville today.)
- But in rural areas there are no existing rooftops. So, big towers have to be built.
- This is expensive.

StarLink Update

- And in underserved countries in Asia and Africa, remote locations present terrestrial tower builders with very difficult challenges.
- StarLink is designed to bridge these gaps and to allow everyone on Earth high-speed Internet access at affordable prices.
- (What we call affordable is subject to questions.)

StarLink Update

- To help with costs, our own FCC has a
- Rural Digital Opportunity Fund (RDOF).
- To qualify for inclusion, StarLink must meet specific performance goals:
- Download Speeds and
- Latency Standards

StarLink Update

- I think we all have run speed tests on our Internet, so we have an idea of what Speed means.
- Latency is what happens when there is a lag between when the signal is sent and when it is received.
- This differs from lag, which is the difference between when the audio part of the signal is decoded and when the video part comes through.

StarLink Update

- The importance of latency is familiar to gamers and people who stream videos. You don't want too much delay between your action (a mouse click, e.g.) and the response (a game move, e.g.).
- Acceptable broadband Internet has the following specs: (FCC minimum)

StarLink Update

- The FCC wants to be able to promise 1 gig (1 Gbps) speeds under RDOF.
- SpaceX must demonstrate that signals sent through its Starlink satellites have less than 100 milliseconds of latency.
- StarLink is currently nowhere near these numbers.

StarLink Update

- So far, results show that Starlink users can expect internet download speeds of anywhere from 11 megabits per second (Mbps) to 60 Mbps, and upload speeds of 5 Mbps to 18 Mbps.
- Latency is about 31ms to 94ms.
- (Everyone's service varies on latency measures.)

StarLink Update

- That's still far better performance than most rural US customers can get today from ground-based or satellite Internet services.

StarLink Update

- **What comes next**
- As far as qualifying to compete for RDOF and the FCC's \$16 billion, this looks very much like "mission accomplished" for SpaceX.
- Going forward, the company will be aiming to drive its lag rate down below 20 ms, while boosting its internet download speed toward 1 Gbps.

StarLink Update

- And over time, SpaceX hopes that these levels of performance will win it as many as 5 million broadband satellite internet customers in the U.S.
- At a rumored monthly service cost of \$80, times 12 months in a year, Starlink therefore looks to be building toward a \$4.8 billion annual revenue stream for SpaceX.

StarLink Update

- SpaceX President Gwynne Shotwell in 2018 said that “it will cost the company about \$10 billion or more” to build the Starlink network.
- Since the beginning of 2019, SpaceX has raised nearly \$1.7 billion in capital.
- So they have a way to go.

StarLink Update

- <https://www.reviews.org/internet-service/spacex-starlink-satellite-internet-review/#Recap>
- – URL also in References --
- (This article's Recap follows.)
- SpaceX Starlink Satellite Internet Update 2020
- SpaceX's Starlink internet seeks to solve the rural vs. urban internet divide, and it looks promising.
- Aug 10, 2020

StarLink Update

- Estimated launch: Mid-2020 (delayed)
- Estimated cost: \$80/mo. (ongoing)
- Estimated equipment fees: \$100–\$300 (one-time setup)

- (Note: This system does use a satellite dish, which needs a permit in some communities.)
- (Services like Starry for Fixed 5G Internet to the Home or Business, do not need dish or other large exterior antennas, though a whole-building mast antenna may be used.)

StarLink Update

- (Recording of the presentation will be paused while these copyrighted videos are shown.)
- (URLS are on these slides and in my references.)
- **Stop Recording Meeting for the videos.**
- videos of launch, fairing recovery and booster return and landing on a ship:
- [Launch and Fairing Recovery](#)
- Missed it by That Much! (Fairing Recovery Tests)
- <https://www.youtube.com/watch?v=xPeFbEbxPKQ>
- https://www.youtube.com/watch?v=GT_7420ltlw

StarLink Update

- (URLs are in my References.)
- deployment of satellites:
- [Deployment Video](#)
- fairing recovery (previous launch in July)
- [Fairing Recovery Video](#)
- **Resume recording of meeting for Discussion Period.**

StarLink Update

- Questions? Comments?
- Thank you!
- Bob Primak
- Sept. 16, 2020

StarLink Update

- Additional Notes (if needed):