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Star link: Internet via Satellite

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A B S T R A C T

SpaceX is working on a satellite constellation to construct a low-cost, high-performance satellite bus as well as the necessary client ground transceivers to implement a new space-based Internet communication system. To bring high-speed internet to end-users, SpaceX aims to deploy two NGSO constellations called Starlink. The system will provide continuous global coverage by launching 4425 satellites into circular low orbits. The prospect of using these satellite missions as an illumination source for bistatic real and synthetic aperture radars is studied, assuming a receiver on or near the earth's surface. For conceivable applications, the practicality of these systems is examined. Starlink will be a wireless broadband alternative to wired broadband. It will make wired internet connectivity more difficult to use.

Keywords: star link, space, satellite, Network

1. Introduction

The concept of low latency high band width communication via a network of medium and low earth orbit (MEO) satellites gained traction in the late 1980s. In the late 1990s, systems like ICO, Iridium, and Globalstar were installed. However, the essentials of such satellite networks have been condensed thanks to rapid upgrades in terrestrial optical fibre and cellular wireless communication systems. As a result, those MEO/LEO systems failed to make a profit. With the rapid advancement of ICT and growing demands for communication capacity in the second decade of the twentieth century, the importance of LEO satellite constellations, with their short latency and high yield, re-emerged. The inability of optical fibre and wireless communication technologies to reach remote portions of the world owing to a variety of factors acts as a motivator.

Several LEO constellation designs were merged as a result of this backdrop, including Kuiper, Starlink, Telesat, and One Web. These systems are in various phases of development and employ cutting-edge technology for spectrum utilisation, satellite and constellation production, ground equipment development, and system management. Starlink is the most widespread of these constellations and the one that has contributed the most to deployment. The United States' Federal Communication Commission (FCC) awarded SpaceX Starlink authority to launch a constellation of LEO satellites in five orbital shells in 2018.

So far, SpaceX Starlink has deployed over 1500 1st shell satellites in orbits of 560 km with 53.00 inclinations. The Starlink satellite map as of May 21, 2021. They are spread out in 72 orbital plains, each with about 20 satellites. The satellites operate in the Ku-band and weigh around 240 kg each. In the inter-satellite link, phase array antennas are used for up and downlinks, and laser communication is used (ISL). Because laser communication takes place in a vacuum, light travels 47 percent quicker than it does on a terrestrial fibre network. This network should have a latency of less than 30 milliseconds.

2. STARLINK

SpaceX, an aircraft manufacturing and space transportation firm, has a division called Starlink. It has spent three years sending over 1,000 satellites into orbit, and the US Federal Communications Commission just awarded it $885.5 million in grant monies. Currently it's taking preorders/sign-ups, and Elon Musk said in February 2021 that Starlink now has over 10,000 clients. Starlink's satellites are supposed to be able to connect you to the internet. "High-speed broadband internet to regions where access has been spotty or altogether absent," Starlink says. It currently only works in homes and isn't mobile, but that will change soon.

ARCHITECTURE –

Ground stations, also known as Starlink Gateways, maintain constant communication with satellites. They provide user terminals with control information and internet connectivity. Ku band is used for user-to-satellite communication, while Ka band is used for ground station-to-satellite communication. Because SpaceX spacecraft are far closer to the planet than geostationary satellites, they can create ultra-small spot-size beams. Higher speed and lesser latency are provided by being close to the earth.

At the commencement of commercial deployment, the expected total bandwidth throughput is 23.7 Tbps. A satellite dish, a Wi-Fi router, and a power supply unit make up Starlink customer premises equipment (CPE). This system is ready to use. The dish is 23" in diameter and may simply be set up on the ground or under a canopy where there is clear sky visibility. The dish is made out of a stacked honeycomb construction with a phased antenna array. The dish can always align with a Starlink satellite that is available.

The router comes with Wi-Fi and a Gigabit Ethernet connection for connectivity. The satellite dish is connected to the router through Power over Ethernet, and both are powered (PoE). A single router may support up to 128 devices at once. It is powered by a 56 V DC source provided via PoE. The router is compliant with the IEEE 802.11 standard.

3. Working of Star link

The basic communication structure is that the signal is connected to the LEO satellite in earth's orbit by the ground base station (web server). The LEO satellite is explicitly linked to the user's satellite, allowing the user to obtain network communication data as long as the user is a recipient at a position where the communication host may directly face the sky, acknowledge satellite signals, and then establish network connections. The biggest disadvantage at the moment is that if the LEO satellite cannot receive an effective ground base station (web server) signal initially, it will be unable to hook up with the host on the user side, requiring the entire communication architecture to switch lines until it is functional.

The goal for the future is to improve internal signal conversion between satellites. In this situation, one LEO satellite above the earth can get the signal source for network communication as long as it can link up with the ground base station (web server). As long as the client can connect to the LEO satellite, it can theoretically join to the network instantly without having to search for a legitimate signal source. Starlink architecture of this calibre is actually accomplished and commercially viable. The first prototype satellites of Star Link were deployed into orbit in 2018. Since then, more than 20 satellites have been successfully launched, bringing the total number of satellites launched to approximately 1,300 by February 2021.

The Falcon 9 orbital rocket was used by SpaceX to send some of the satellites into orbit. Starlink intends to eventually cover the entire world with satellites capable of beaming a useable, high-speed Wi-Fi connection. To reach that goal, Starlink will most likely need at least 10,000 satellites in orbit. SpaceX has stated that it wants as many as 30,000 satellites in the constellation, and Musk has stated that the service will be available worldwide in 2022 if several more satellite launches are successful.

When you sign up for Starlink, you will receive a package that includes a router and a satellite dish. To complete the connection, simply install a satellite dish at your residence. It picks up the signal and sends the data to your router. A Starlink app for Android and iOS that uses augmented reality to help users choose the ideal location for their receivers at home is available.

Although the speed of Starlink varies depending on your location, Ookla's testing reveals that it is consistently faster than competing satellite internet services. Starlink doubles the median download speed of fixed internet providers in the UK, which is fairly astounding. More information on Starlink's real-world speeds can be found here. On Twitter, Musk announced that the service is ready to launch "completely mobile" in April 2021. Keep in mind that Starlink customers cannot currently migrate their existing gear from one location to another. You must provide your location information at checkout and then stay put with the equipment as a beta member. Musk acknowledges that Starlink's terminals are too large for Tesla automobiles, but claims that they may be used in planes, RVs, trucks, and ships. Starlink has begun to accept orders.

Customers can place preorders on a first-come, first-served basis, according to Starlink. It could take up to six months to complete some preorders. In October 2020, a public beta trial programme for subscribers was launched in the northern United States and Canada between the latitudes of 45o and 52o. Starlink plans to give full equatorial coverage beginning in 2022. Sri Lankan Starlink services will be available in 2022. According to the Starlink website, regulatory authorisation is required. In June 2021, the ROADMAP-5G research group of the Carintia University of Applied Sciences in Austria conducted an independent performance investigation of the Starlink user terminal. Key findings of the experiment are shown in the Table 1. According to the experiment YouTube streaming provided satisfactory performance with a rare exception of having 4-6 second interruptions. Automatic switching between the satellites follows a pre-defined timing of 15 seconds according to the observations. Latencies fluctuated nearly always during this period.

Parameter	Performance
Average upload throughput	~17 Mbps
Maximum upload throughput	~60 Mbps
Latency	30ms – 2s
Percentage of time latency is below 90ms	98%
Average power consumption	105 W
Peak power consumption	190 W
Average download throughput	~170 Mbps
Maximum download throughput	~330 Mbps
Percentage of time latency is below 50ms	77%
Down time	2.4%

Table 1: Key performance parameters of Starlink

4. Conclusion

The Starlink project currently expects SpaceX to build 11,943 satellite constellations in the next 6 to 7 years (that is, by 2026 or 2027). 1,500 are on the 550 kilometre orbit, 2800 on the 1150 kilometre orbit, and 7,500 on the 340 kilometre orbit. Following this stage, another 30,000 satellites will be deployed, finally totaling 42,000 satellites to build a global satellite network. The goal is to deliver high-speed, low-latency broadband connections to people all around the world. The current network traffic can reach the anticipated speed of 300 Mbps, and the latency will be kept to around 20 milliseconds. After 40,000 satellites are in orbit, the target speed will increase from 1 mph to 2 mph.

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