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Starlink - The future of connectivity

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Abstract

Starlink is a network of satellites that SpaceX - Elon Musk's private American space flight company is developing to provide affordable internet to remote and physically inaccessible locations. While SpaceX initially hopes to have as much as 42,000 satellites in this network, the gigantic scale of the Starlink project has stunned astronomy enthusiasts and skywatchers. The mega constellation of satellites will consist of thousands of industrially made mini satellites in low Earth orbit (LEO), which communicate with designated ground receivers. The Starlink research, development, manufacturing, and orbit control teams are located in Washington. 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. The scale of the project has intrigued and worried scientists, environmental activists and officials who are concerned with issues like space debris, safety concerns of crashes and interference with future scientific exploration of the cosmos. The research indicates that starlink stands to be an ambitious project with the potential to connect remote, inaccessible areas of the globe without physical infrastructure with minimal risks and damage to our ecosystem.

Keywords : Starlink, Connectivity, Internet, Satellites internet constellation, High speed broadband

Period of study:

The study was made between June and July 2021

Introduction :

Satellite communication plays a vital role in the global connectivity ecosystem, allowing us to connect remote populations, providing high-speed connectivity to networks, and quickly establishing and maintaining communication in emergency and disaster response situations. In this research paper, I focus on low Earth orbit (LEO) satellites, which have been in use for tens of years and are once again a reason for expert interest and speculation as new large constellations are in early stages of deployment. These new LEO constellations (Starlink by SpaceX, Project Kuiper by Amazon, OneWeb, Lightspeed by Telesat etc) have the potential to transform the connectivity scenario thanks to their ability for global outreach without the requirement of physical fiber optic infrastructure.

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SpaceX, Elon Musk's American Space exploration company launched Starlink in 2015. He announced "the organization had filed documents with international regulators to place about 4,000 satellites in low Earth orbit. The U.S Federal Communications Commission (FCC) has granted SpaceX permission to fly 12,000 Starlink satellites, and the company has filed paperwork with an international regulator to launch up to 30,000 additional spacecraft." In comparison to that, out of the 11500 satellites launched globally, only 4300 remain currently functioning in Earth's orbit, which makes the project magnanimous in scale. First two satellite tests, named TinTinA and B, were launched in Feb '18 successfully. Initial testing indicates that Starlink asked policy makers for its network of satellites to be given permission to operate at lower atmosphere than originally intended, and the FCC committee gave the go ahead. The first 60 Starlink satellites were launched on 23 May, 2019, onboard a SpaceX Falcon 9 rocket. The satellites successfully reached their desired altitude of 545 kilometers — just low enough to get dragged down to Earth by gravity in some years so that they don't become space garbage after they die.

Current limitations

The world is changing rapidly and despite the fact that internet connectivity has encompassed vast swathes of population centers, there are many rural and remote areas on the planet where a lack of internet and physical infrastructure hinders progress and restricts essential and emergency facilities. This gap can be potentially bridged by satellite communication to rapidly bring connectivity to these excluded areas and boost local infrastructure with minimal physical development. Recent data from the ITU International Telecommunication Union suggests that a staggering 3.7 billion people do not have access to the internet. This huge chunk of population comprises 49% of the global population. Out of these, more than 65% of households are rural and lack the amenities required to participate online

To see the big picture, we must take into consideration the fact that almost 1.4 billion people reside in regions without access to efficient mobile data coverage - like 4G LTE, while 608 million people live in places with 0 mobile data coverage (4G or 3G network). The organization also indicates that it would cost nearly USD 430 billion to provide worldwide internet connectivity which is an exorbitant amount by all standards. A large group of the global population, almost 4.9 billion people, reside more than 12 kms from the nearest internet connectivity infrastructure. Considering other issues such as hesitancy to change lifestyle, economic feasibility, language barriers and illiteracy has barred almost 2.5 billion lives from participating on the internet.

Currently, this technology is used for research stations in remote and inaccessible areas and for private and industrial users but starlink is rapidly changing that scenario to open it's services to the general populace. "Figure 2 provides an overview of the internet infrastructure network components, from international connectivity to the last mile" Since the cost of data transmission is higher via starlink vs land infrastructure, this technology is currently used to provide internet capabilities in areas with weak economies and low population. This is rapidly changing as more and more countries are adapting to this technology and embracing satellite communications as their primary network infrastructure. In case of nations who lack access to underwater fiber networks, this is an innovative solution to bring them into the greater picture and open up a world of connectivity.

Financial viability

Starlink's existent public test value is USD 99 per month and it indicates a good source of cash flow from an initial base of closed users. In the pre-launch phase of the commercial project, the company won USD 880 million extension by the FCC to enhance connectivity in more than 600,000 homes. FInancial analysts predict that Starlink technology can rake in upto $25 billion within a decade. At this rate, Starlink would have to step up their game and acquire new users to the tune of 20 million registered users.

The market and demand for satellite technology has seen a huge growth in the past few years. The data suggest further growth and higher demand from the internet and connectivity perspective. Data suggests a rapid growth of more than 4.2% annually and the revenue pumped into this industry is more than $37 billion in the last 4 years. The space exploration industry is estimated to touch 1 - 3 Trillion USD in the coming decades and technology like Starlink and it's competitors could account for more than 52% of the sector. The following figure shows the sector wise breakdown of demand for satellite technology.

Challenges and obstacles

1. One of the major issues raised by astronomers and public societies is the concern that a constellation of satellites might hinder space observation and celestial viewing efforts. This was first noticed in June 2019, when the early versions of Starlink satellites were visible without any telescopes or equipment. This prompted Starlink to update the design of the satellites in the second version and called it "DarkSats" with a dark layer to make it tough to spot for observers and high-powered telescopes. The issue still remains as around 35% of exposures made from observatories was affected when conducting cosmic surveys at dawn or dusk due to reflection of sunlight from the satellites. Further research and improvements are ongoing at Starlink.

2. Another concern raised was regarding space junk or debris as the constellation of satellites were at a risk of colliding with each other and leaving a string of metal and other substances strewn across space. These satellites have a life of around 15 years. Starlink solved this problem by designing them in such a way that they would deorbit and burn upon reentry into the Earth's atmosphere once they're no longer useful. Starlink has also updated each satellite with a collision detection and avoidance system to lower the frequency of such accidents.

Conclusion and recommendation

As private companies like Starlink gear up to offer commercial internet connectivity services in 2021, the potential for improving existing broadband speeds and consistency is not missed. However, companies should price and position themselves in such a way that underdeveloped and developing nations can afford these groundbreaking services and reap their benefits. Some more recommended points to keep in mind are:

Flexibility and seamless registration

Ensuring that the registration process is universal and simple in terms of experience will go a long way to gain people's acceptance. Appropriate licensing and getting the required permissions from the

legal and government bodies across the globe will take a huge step in ensuring the process of registration and maintenance can be hassle free.

Reduced taxation and import costs

Reducing these costs to import and export required hardware and equipment to establish base stations can reduce the overall cost of the product and ensure greater outreach to all classes of society.

Active investment in global connectivity infrastructure

Private companies and government bodies can get together to incentivize setting up infrastructure and fuel financial institutions to fund and invest space programs and projects to ensure financial support.

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