

STARLINK TECHNOLOGY

Sangeeta M Upadhye

(Department of Master of Computer Applications, VTU/KLS Gogte Institute of Technology, Belagavi, Karnataka)

Abstract: Starlink, a revolutionary satellite internet constellation project developed by SpaceX, has significant attention for its potential to provide high-speed, low-latency internet connectivity to users around the world, even in remote and underserved regions. This research paper dig into the technological aspects of Starlink, examining its working, speed and coverage. Through a comprehensive analysis of the challenges and security. This paper explores the potential impacts of Starlink on global internet accessibility.

Keywords: Starlink, Satellite, Network

I. INTRODUCTION

Starlink is a satellite internet constellation project run by Elon Musk's SpaceX aerospace company that provides internet connection via satellites all around the world, which could improve the availability of network services for the power system equipment that can communicate in places where network connection is expensive, unstable, or altogether unavailable and also in remote and rural areas around the world. The Starlink public beta services are currently available in 19 countries as of 2021

The first things that come to mind when we consider internet service are mobile towers, broadband, and fiberoptic, but there is a potential that a satellite will also come to mind. Similar to how satellite tends to be connected to television content and the international space station rather than supplying power for your internet connection, it doesn't immediately come to mind. The internet has become a regular aspect of our lives these days. While it may appear difficult and very technical, satellite internet is a straightforward and completely acceptable broadband option for people who may live slightly off the grid. Since some regions of the world do not even have electricity, it is difficult to imagine having access to the internet there. Fortunately, this satellite-based[5]. Starlink has given an inaugural offer to customers worldwide, including India, to move their everyday activities online in the current context, where many enterprises and institutions of higher learning are doing so.

II. LITERATURE REVIEW

The objective of this literature review is to explore and examine the Starlink technology.

Analysis of Research Paper:

In this paper the author[1] had concluded the impact of the Starlink Satellite project on internet service in emerging economies. The paper includes a quantitative approach, and an online questionnaire that includes a data from Thailand with the convenience sample of 617 participants. The methods in this paper included convenience sampling technique using demographic, behaviour and social media variables. A study found that the impact of the Starlink satellite project on internet provider services in emerging economies could be influenced by factors such as gender, education, device usage, internet time and duration, and social media use. So the paper states that in order to promote sustainable and equitable access to broadband connectivity in emerging economies, it is crucial to understand the impact of these factors and develop effective strategies accordingly.

In the referenced research paper, the author[2] concludes that the focus of their study is on future application of the Starlink space network in Cyber Physical Power Systems (CPPS). This paper examines the communication infrastructure and transmission parameters, also the IEEE 39-bus test power system was emulated on the heterogeneous co-emulation platform. This proposed that the Starlink space network layer can enhance the connection quality of the existing CPPS architecture.

In this paper the author[3] had concluded of the convergence between satellite and Terrestrial networks as a significant advancement in the development of 5G Technology it highlights various scenarios such as fixed broadband wireless access via satellite, which enables satellite Communications on smartphone. Additionally it emphasizes that the convergence of satellite and Terrestrial networks will be a measure Trend as the world transitions from the 5G era to the communication era of 6G.

In this paper, the author[4] has concluded that there are several areas where Starlink needs to focus, such as marketing strategy during the beta period, similar to Reliance Jio, where it is preferable to grab the market at an early stage. Furthermore, even though most people are aware of the information and services provided by Starlink, there is a scarcity of understanding in terms of services and facts regarding the Internet service provided by Starlink. In addition, the "right education" aspect of the programs must be vigorously pursued. People are price sensitive and require some sort of incentive to continue forward with the purchase of a product or service.

In this paper, the author[5] has addressed issues related to the internet technologies that exist in recent times during COVID -19 and the technology that can fix these issues. The paper highlights the Starlink as a prominent provider of LEO technology along with the advancements in FTTH technology and have the potential to revolutionize the Indian market by offering high speed 5G internet with low latency.

III. STARLINK TECHNOLOGY

3.1 Starlink and how does it work?

The Starlink constellation is made up of interconnected LEO (Low-Earth-Orbit) satellites that communicate with a specified base transceiver. The business has currently launched over 1700 satellites into orbit and plans to rapidly increase the number. The Starlink public beta services are currently available in 19 countries as of 2021. Radiofrequency transmissions are used by these satellites to communicate both internally and with Earth-based ground stations. In order to transfer internet data between user terminals (dish receivers) and base stations, satellites in orbit serve as relays.

Users must install a user terminal, also referred to as a "dish" or "phased-array antenna," at their location in order to use Starlink's internet service. Due to the precise tracking capabilities of this dish, a stable link may be made by having it automatically align with passing satellites. Data can be sent to and received from the user terminal via the satellite network after the dish connects with a satellite overhead. In order to reach the larger internet infrastructure, the data must first travel from the user's position to the satellite, then to a base station on Earth.

3.2 Starlink Speed and Coverage

Speed: It is the world's most cutting-edge broadband internet system. While the majority of satellite internet services available today use a single geostationary satellite that orbits the earth at a distance of about 35000 kilometres, Starlink uses a constellation of multiple satellites that orbit much closer to the earth at a distance of about 550 kilometres and covers the entire planet. Starlink internet broadband works by sending information through the vacuum of spaces, through which it travels much faster than in fibre optic cables and can reach far more people.

The round-trip data time between the user and the satellites, also known as latency, is significantly lower with Starlink satellites than with those geostationary satellites because they are located in the low orbit zone. Starlink quoted speeds ranging from 50 Mbps to 150 Mbps when it was still in the beta testing stage. On occasion, some users experienced significantly faster speeds. Starlink strives to provide competitive internet speeds, especially in rural and distant places where traditional broadband options are few. These speeds are high for satellite internet[3].

Coverage: To increase its global coverage, Starlink has been continuously putting groups of satellites into orbit. Starlink seeks to bring internet connection to regions with few or no connectivity alternatives by putting its satellites in low Earth orbit (LEO). In order to attain worldwide coverage, both inhabited areas and isolated locations that are now underserved by terrestrial internet providers must be included.

Remember that depending on your geographic location, the amount of satellites in your area, and network congestion, the actual speed and coverage you receive with Starlink may differ. The goal of SpaceX is to increase both the speed and coverage of the Starlink service by continuing to launch additional satellites and fine-tune the network.

3.3 Starlink Internet Services Cost

In India, Starlink's subscription plans come in a variety of rates and speeds. The most basic package costs Rs 499 per month and includes download and upload speeds of up to 50 Mbps and 25 Mbps, respectively. The most expensive plan costs Rs 2,499 per month and includes download and upload speeds of up to 150 Mbps and 30 Mbps, respectively.

In addition to these options, Starlink charges a Rs 6,000 installation fee, which covers the cost of the Starlink equipment. The Starlink terminal, a mounting tripod, and two Wi-Fi routers are all included in the box[5].



3.4 Security of Starlink

Transport Layer Security (TLS) is a secure connection technology used by Starlink. TLS is a cryptographic technology that ensures data integrity and communication privacy between two computer applications. This means that data sent between Starlink satellites and a user's device is encrypted, making it harder for hackers to intercept or access.

To protect user data, Starlink employs "Zero-Trust Networking" technology. This system tries to keep hostile actors out of Starlink's network by monitoring every activity and granting access only to the most trustworthy users and devices.

IV. IMPACT OF STARLINK TECHNOLOGY

Industrial and Industrial Applications: Industries such as mining, agriculture, and forestry can benefit from enhanced connectivity via Starlink. This technology can provide real-time data monitoring, improve operational efficiency, and improve safety measures in isolated work locations. Interplanetary communication and space exploration: Starlink's satellite technology and ground infrastructure experience may have applications beyond Earth. Lessons learnt from running and managing a large satellite constellation could be applied to future space exploration missions such as interplanetary communication and data relay.

V. CHALLENGES OF STARLINK TECHNOLOGY

1. Mitigation of Space Debris: With hundreds or even thousands of satellites in orbit, potential space debris and its effects on other satellites and spacecraft are a concern. To reduce space debris and ensure a sustainable use of space, the appropriate procedures must be adopted.
2. Users could use the internet without being subject to the control of the governments of their respective countries. Governments might view this as a danger to their independence. In order to resolve this issue to the satisfaction of all parties involved, Starlink must reach a workable deal with governments.
3. As more businesses create their own satellite constellations, the satellite internet market is getting more and more competitive. OneWeb, Amazon's Project Kuiper, and other companies compete with SpaceX's Starlink.
4. Customers must be able to connect to the Starlink network via user terminals or satellite dishes that are affordable, simple to install, and able to withstand adverse environmental conditions.
5. Any country that Starlink wishes to operate in requires that it obtain regulatory approval in order to offer communications services there. There is currently no proof that any of the global south's nations gave the Starlink their blessing. They're anticipated to begin that process soon.

VI. BENEFITS OF STARLINK

1. Reduced Latency: Because the satellites in Low Earth Orbit (LEO) are so close together, Starlink can achieve lower latency than typical geostationary satellite internet systems. This lower latency is advantageous for real-time applications like video conferencing and online gaming.[3]
2. Starlink's satellite constellation can be rapidly expanded by launching additional satellites as needed. This scalability allows for quick deployment in new regions and can accommodate a growing number of users without significant infrastructure investments.
3. With developments in user terminal technology, Starlink hopes to provide mobile connection options, such as internet access while on the move, in vehicles, ships, and aircraft.
4. Revenue generated from Starlink services can help fund future space exploration missions and advancements in space technology.

VII. CONCLUSION

This paper puts forward a conceptual idea of how the Starlink technology focuses on delivering high-speed, low-latency broadband internet in remote and rural locations worldwide, has the potential to have a substantial impact on internet provider service in emerging economies. This can aid in closing the digital divide and improving internet access in



locations where traditional terrestrial infrastructure is missing or inadequate. It also safeguards the transferred information, which incorporates privacy. By all counts and analyses, we decided that Starlink is a new satellite internet provider that will conquer all barriers and companies during the next decade. It is appropriate for places of the world where connectivity has traditionally been difficult.

REFERENCES

- [1] Yarnaphat Shaengchart , Tanpat Kraiwanit(2023): Factors influencing the effects of the Starlink Satellite Project on the internet service provider market in Thailand.
- [2] Tong Duan , Graduate Student Member, IEEE, and Venkata Dinavahi(2021):Starlink space network-enhanced cyber-physical power system.
- [3] Prof. Shreehari HS1, Makam Supreeth(2022):Optically steerable phased array enabling technology based on mesogenic azobenzene liquid crystals for starlink towards 6G.
- [4] Shreehari HS, Makam Supreeth : Starlink Satellite Internet Service
- [5] Anjali Yadav, Manthan Agarwal, Somya Agarwal, Sachin Verma(2022): Internet From Space Anywhere and Anytime – Starlink
- [6] H.M.V.R.Herath, Starlink : A Solution to the Digital Connectivity Divide in Education in the Global South
- [7] Pawan Kalyani, “Internet From Sky: Starlink” An Empirical Study on The Introductory Offer from Starlink In Pandemic Situation - Its Competition, Opportunity and Future in one of the world’s biggest consumer Market.
- [8] Avery Walker, Starlink: Societal Factors Affecting SpaceX’s Satellite Internet Constellation.
- [9] I-Kang Fu, Gilles Charbit, Satellite and Terrestrial Network Convergence on the Way toward 6G.