COMPARISON OF STARLINK ISP WITH MIKROTIK TECHNOLOGY

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ABSTRACT

Considering the unique context of Nigeria, this paper explores the operational intricacies of the Low Earth Orbit (LEO) satellite system Starlink and does a comparison analysis with classic Geostationary Earth Orbit (GEO) satellite systems. This study used a qualitative technique to examine many performance characteristics, such as Jitter, Packet Loss, Throughput, Routing Strategy, Latency, Generic Data Transfer, and Environmental Influential Factors.

Our goal is to provide significant insights into the real-world uses and consequences of Starlink's technology in Nigeria through this research. It is anticipated that the results would provide insight into the performance dynamics of satellite systems to academics, stakeholders, enabling them to make well-informed decisions in the constantly changing telecommunications industry.

DEDICATION

Chapter 1

INTRODUCTION

1.1 Context Of Study

History has it that in August 1962, J.C.R. Licklider of MIT wrote a series of memoranda outlining his "Galactic Network" concept, which was the first documented account of the social connections that networking could facilitate. [**?**]. In the course of the Cold War, the internet was used as a government project to establish communication in the military that could not be damaged by a nuclear bomb [**?**]. After the war, modern day internet was born. On April 30, 1995, the American government halted operations of the old NSFNET backbone and handed over the infrastructure to private companies [**?**].

According to [**?**] the mode of connection to this early internet was through modems connected over telephone line charging in per use basis at a speed of 33.6kbps and 56 kbps. This means that it would take 1 day, 18 hours and 36 minutes to download a 1 gigabyte file. As the need for faster internet became more glaring, broadband became available to the public with better speed and constant connection unlike modems which require dial-up before connection

. [**?**] explains that there are roughly five types of broadband connection technologies currently in use. Among them are Digital Subscriber Line (DSL), cable modem, fibre, wireless, satellite, and broadband over power lines.

Satellite broadband, which is our focus, was first considered for internet usage in 1986 by

Via-Sat, a company started by Mark Dankberg, Steve Hart, and Mark Miller ("Satellite Communications: A Brief History From Sputnik to ViaSat-3"). With the technology developing rapidly, companies ventured into satellite broadband using Geographical Earth Orbit (GEO) satellites, but it came with some disadvantages, yielding to the exploration of satellite broadband using Low Earth Orbit (LEO) satellites.

SpaceX Starlink, a satellite internet service provider licenced for operation in May 2022 in Nigeria (NCC 2023), has raised questions concerning her reliability to deliver better internet performance for Nigerians, where the need for fast internet is rampant as technology develops rapidly. The regular internet service providers in Nigeria, employs GEO technology where ground stations communicates with the satellite orbiting 35,786km from the earth's surface. This approach of internet connection is said to be characterized by slow speed and it has high latency and longer routing strategy. In a bid to providing a solution, a more recent approach to internet connectivity, that is been employed by SpaceX Starlink has been developed - LEO (Low Earth Orbit) Satellite. Starlink satellites are LEO, meaning they are launched to an orbit about 550km away from the earth, which is a distance much closer to the Earth compared to GEO satellites. With this, Starlink is excepted to have better performance in terms of Latency, Routing Strategy and Throughput as the distance is shorter and direct communication with the satellite dish (Dishy) is made possible.

For Starlink broadband to function, it requires the communication between a Starlink internet antenna or Starlink dish antenna called Dishy Mcflatface (Dishy for short) which is placed in an obstruction-free location and a Starlink satellite orbiting at a speed of 27000km/hr in the LEO. The Dishy is made of sturdy, temperature- and weather-resistant material that can tolerate harsh weather. It consists of various layers but most importantly, 1280 antennas which are arranged in a hexagonal honeycomb pattern. Communication with the fast moving satellite is made possible by including phased array technology which helps steer the beams from the antennas without physically moving it. Various versions of Dishy have been launched with a visible difference in flatness and size thereby making Starlink suitable for mobility

The first lunched Starlink requires the user to be about 50km from ground stations also known as gateways. This is necessary because Dishy needs to communicate with the ground station with its required data which is then related to the Starlink satellite before the later transmits to the Dishy; It is termed bentpipe architecture. Version 2 Satellites launched in April 2023 are equipped with LASER communication to enable the satellite communicate between themselves in orbit, thereby limiting the need for ground stations.

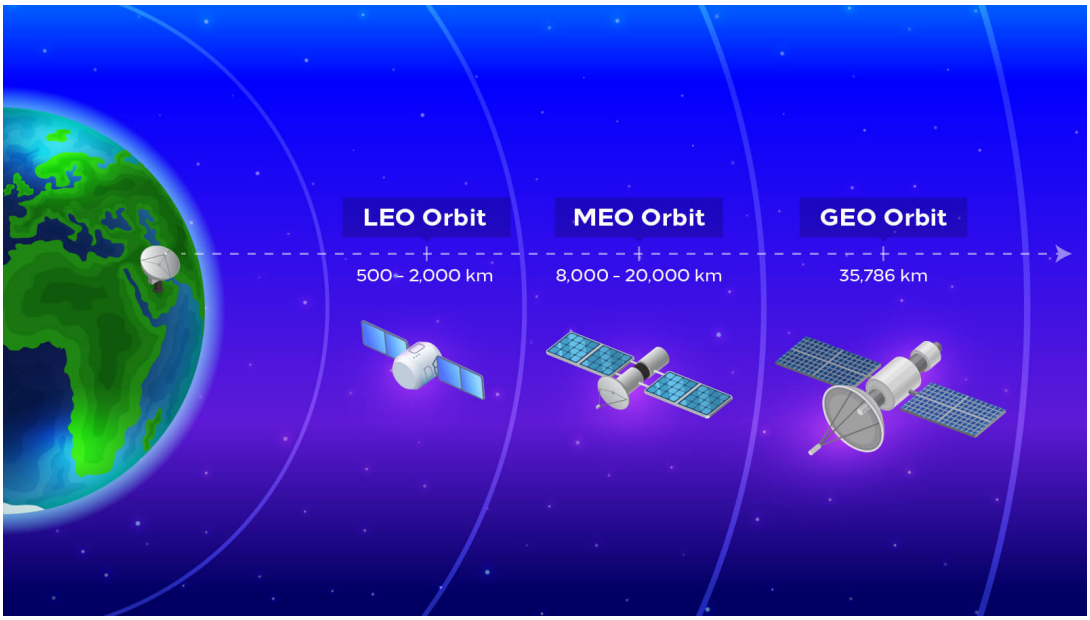

Figure 1.1: Types of Satellite Constellations

1.2 Motivation for Study

The dynamic nature of satellite technology and its potential to alleviate Nigeria's connection issues are the driving forces behind this research. It is necessary to comprehend how Low Earth Orbit (LEO) satellite constellations, such as Starlink, work in relation to more established Geostationary Earth Orbit (GEO) systems in the particular context of Nigeria.

First and foremost, the need to overcome connectivity gaps in Nigeria's underprivileged and isolated areas is what spurred the study. Despite being revolutionary, Starlink's increased cost creates a special hurdle. Starlink is currently operating in Nigeria, with the cost for purchase going for about ₦290,000 to ₦350,000. For an average Nigerian, this

price is relatively high, considering the product has little to no empirical analysis done to compare it's performance with already established broadband providers that cost less. Hence the question should one spend that much?

Secondly, the absence of thorough evaluations of Starlink's effectiveness in Nigeria is the second driving force. By carefully examining important performance variables, this study seeks to bridge this gap by conducting an in-depth examination of Starlink's performance, taking into account factors such as latency, throughput, and browsing performance. This helps to clarify the practicality of Starlink and provides a baseline for further research in the area.

Quite a number of people have tried measuring Starlink's performance in high internet speed demanding platforms such as gaming and streaming. It is important to state that their review from such tests cannot be free from major errors as the performance is not in it's totality dependent on the broadband, as there could be external influences too. Hence this research to empirically do testing that follows proper scientific procedures.

1.3 Aim of study

Specifically in the context of Nigeria, this study aims to accomplish multiple overarching goals, all of which contribute to a comprehensive understanding of the performance dynamics between traditional Geostationary Earth Orbit (GEO) satellite systems and Starlink's Low Earth Orbit (LEO) satellite constellation. The objectives of this comparative study are listed as follows:

1. Evaluate the Performance of Starlink in Nigerian Conditions:

   This study aims to do a thorough analysis of Starlink's performance indicators, encompassing browsing speed, latency, reliability, and coverage, in the context of Nigeria's unique environmental and infrastructural constraints. This assessment is expected to yield significant information regarding Starlink's flexibility and reliability in tackling the various connectivity obstacles encountered around the nation.

2. Compare Starlink's Performance with Traditional GEO Satellite Systems:

The principal objective of this study is to make relevant comparisons between the well-known GEO satellite systems and Starlink, which are both utilised for internet connectivity. Through a methodical evaluation of the two technologies side by side, the research aims to pinpoint the advantages and disadvantages of each, providing a nuanced viewpoint on their respective efficacy and suitability in the Nigerian telecommunications domain.

In conclusion, the goal of this research is to add significant knowledge that not only discusses the particular performance of Starlink in Nigeria but also lays the groundwork for strategic planning and well-informed decision-making within the rapidly changing satellite communication market in that nation.

1.4 Scope

The geographic scope of this exploration is intricately tied to Nigeria, offering a detailed examination of how Starlink operates in this environment. This research is centered on examining how Starlink operates, evaluating its performance and comparing its performance with those of traditional GEO satellite systems and existing Internet Service Providers (ISPs) in Nigeria.

The analysis delves into key technical performance metrics such as speed, latency, reliability, and coverage, considering the environmental and infrastructural conditions unique to Nigeria.

Unlike an exhaustive exploration of the underlying technological complexities, this study refrains from delving into the minute details already covered in dedicated articles. Instead, it emphasizes understanding the practical applications and implications of Starlink's technology.

Lastly, this research is singularly focused on one specific Starlink dish model – the rectangular (square) Starlink Dishy. Findings and conclusions drawn will be confined to this particular model, ensuring a targeted and in-depth investigation.

1.5 Methodology

In order to examine the practical performance of Starlink and do a comparison study with conventional Geostationary Earth Orbit (GEO) satellite systems, this research especially examines the Nigerian telecommunications environment using a qualitative method. The technique is intended to provide insights into a range of performance metrics, such as:

1. Latency
2. Throughput
3. Packet Loss
4. Routing Strategy
5. Jitter
6. Generic Data Transfer
7. Environmental Influential Factors