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Research Article

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A Typical Carrying Capacity of Ka-Band Internet Services

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Abstract A Ka-band satellite internet connectivity provides a high speed broadband Internet service from Yahsat, covering 28 countries across Africa, Middle East and South West Asia. The Ka-band internet service is a fluctuating one. It has limited access depending on the subscription bandwidth. This paper assesses the carrying capacity of a subscribed service in a typical Nigeria Private University. This private University has subscribed for C and Ku bands services before that of Ka band at different time. How many internet users were able to access the Ka-band services were assessed by simple survey over a period of time. The method of survey used was a "one question interview", office to office on a daily basis over the subscription period. Accumulated responses were retrieved and analysed from which conclusion and recommendations were made. From all indications, it was concluded that Ka-band Satellite services' carrying capacity is small, given the research findings.

Keywords Ka-band, Internet Services, Carrying Capacity

1. Introduction

The potential of the Internet as an instrument of social and academic research remains largely unknown [4]. The current issues of internet service reflect recent changes in technology while at the same time provide room for longer-lasting academic controversies in the field that should not be neglected [2]. The advent of Ka-band technology can be viewed as a new generation of cost-effective skyscrapers. This technology adopted within a social system can have profound consequences on whether the innovation is ultimately adopted and how its use is "re-invented" by the users of said technology [3]. Ka -band is the latest satellite technology in the satellite broadband industry. It has speeds way beyond current ku and c band technologies. Its costs are as low as terrestrial broadband service. It is the logical successor of ku band with an increasing demand for more capacity.

2. Literature Review

Satellite Systems provides seamless covering and have become an important systemin the next generation global personal communication system [5]. The advent of High Throughput Satellites (HTS) enables network service providers to offer a new generation of communications solutions [1]. In the context of Very Small Aperture Terminal (VSAT) network services, ka band provides up to 24 times more bandwidth than C-band and 8 times more bandwidth than Ku-band. Therefore, opening the door for dramatic increase in a population (capacity) of a city. The slogan "faster and cheaper" is often used by Ka-band Marketers to describe its preference over Ku and C bands. It is viewed as a new generation of cost-effective skyscrapers which can be built within the existing city and with minimal planning restrictions.

Ka-band as a satellite system has a large available disadvantages. These include disadvantages at downlinks such as rain dissipating three to ten times more energy at Ka-band than at Ku-band (11 GHz vs 20GHz). At uplink, rain dissipates 63 to 400 times more energy at Ka-band than at Ku-band (14GHz vs. 30GHz). However,

many existing and proposed Ka, C and Ku-band HTS systems has been evaluated. From perspectives, conclusions about their potential use for customers in remote or harsh operating environments, who generally place a higher priority on network accessibility, reliability and user throughput was reached. Some of these conclusions indicates that Ka-band has dishes with small diameter, yet seems faster compare to Ku and C bands. C-band seemed to be more reliable in service in hash weather (cold, hot etc) over others. Ku-band seemed to be good only in a warm and or hot weather from experience of users in question [1]. Particularly, the evaluation involved in this research covers primarily Ka-band carrying capacity in terms of Internet service accessibility of users within the concerned environment within a subscription.

Ka-band systems are also proprietary or closed networks that require specific satellite modern technology or configurations that are not available with other providers [1, 2, 3, 4]. The smaller wavelength and higher frequency of Ka band makes its links far more susceptible to disruption from weather and other atmospheric disturbances than Ku and C bands links [1, 2, 3, 4]. Obtaining the same level of link availability (say 99 %) in a Ka spot beam, requires exponentially more transponder power than a comparable link and antenna size in Ku and C bands. It is therefore more difficult and expensive to provide high availability and reliable services in Ka-band than in C or Ku-band, particularly in regions (like African countries) where heavy rain fall is common [1, 2, 3, 4, 5].

Networks expand the list of accessible resources far beyond those provided in most Organizations [6]. Broadband internet service allows the propagation of multiple signals at the same time through different Channels [7, 8]. This is more useful in a university system.

A network may not be accessible due to several problems (caused by say 20 possible sources) [9]. Isolating such a problem may take more time than solving it. The Ka-band VSAT platform, which could only serve 10% of the Internet users on a campus in Nigeria was a challenge [10]. There could be questions over the implication of the Internet being centrally increasing to everyday life and work, particularly in institutions of learning [11, 12].

Also, the internet provides a platform through which networked individuals can form a "Fifth Estate" [13]. A virtual classroom which is one of the key benefits of internet service in a University System requires a better accessibility of users (Staff and Students) which enhances Students-Teacher interaction without being in contact physically [14]. Poor accessibility does not provide such virtual environment for e-learning. Hence, providing a low carrying capacity by implication. With the increasing levels of deployment of various forms of high-speed (or broadband) services within today's Internet, there is new impetus to find some usable answers that allow both providers and users to place some objective benchmarks against the service offerings [15].

A topology (hybrid) would provide a desired improvement of network performance for the Campus [16]. The rudiments of these performance would include good puts which may need to be 73 % or above, packets loss below 28% and delay below 24 ms for a reasonable performance [17]. Hence, Hence, bandwidth subscription joins efforts with topology settings for an improved network.

3. Methodology

A research was carried out on the quality of Ka-band internet service by user experience. It was concluded that the quality is limited, compared to C and Ku [18]. A "one question" interview was conducted on potential customers over a subscription period to assess how many people could access the internet service per-time, per-day. The question was asked to most users across the campus at different locations. A person or few people per location were asked and noted for each day. The nature of response will be discussed in the survey results' section of this study. Observations have been made over the performance of various VSAT internet services, which will be compared later in the result analysis of this research.

4. Survey Results

A person or few people were asked "Are you connected to the internet?" in different office(s) at different location daily. In an average, 100 people were asked daily, if they are connected or not. Table 1explains how many staff and students participated in the survey based on the average participation.

Table 1: Survey's Participants

Number of Staff	Number of Students	Total

40	60	100

Table 2 shows that 30 Staff and Students acknowledged that they were connected to the Internet Service on the Campus. This means that there is actually Internet service on the campus, for the fact that there is acknowledgment of Internet connection. But, in-connectivity by some people where indicated which happened to be the majority responses, 70 people in particular. This by implication connotes that the services could not carry the campus to a point where some people could not connect to the Internet service in the campus at a time.

Table 2: Internet Service Acknowledgment

Are you connected to the internet?	Number of Staff	Number of Students	Total Responses
Yes	10	20	30
No	30	40	70
Total Participants	40	60	100

Table 3 indicates additional information given by students and staff about the situation of internet connectivity. Comments were made by staff and students in addition to their responses to the actual interview question. These were captured and recorded as part of exploring the research tendency.

Table 3: Internet Service Accessibility

Comments	Number of Staff	Number of Students	Total Responses
I access when I come early	20	25	45
I only access in the evening	10	15	25
I sometimes access at break time	10	20	30
Total Participants	40	60	100

In essence, table 1 presents the categories of respondents; students or staff. Table 2 indicates the connectivity of users to the Ka-band internet service. These explored the fact that the carrying capacity of the ka-band services by user-connectivity was low. Table 3 further specifies additional comments made by respondents in the course of their interview. Particularly, those that accesses the services in the morning were seemingly more, followed by the evening. Based on other interactions with users, many of them said once they don't access in the morning, they don't access again for the whole of that day. Averagely, only 30 users connect to the internet daily. This is out of about 200 internet users; students and staff, who seeks to get connected daily.

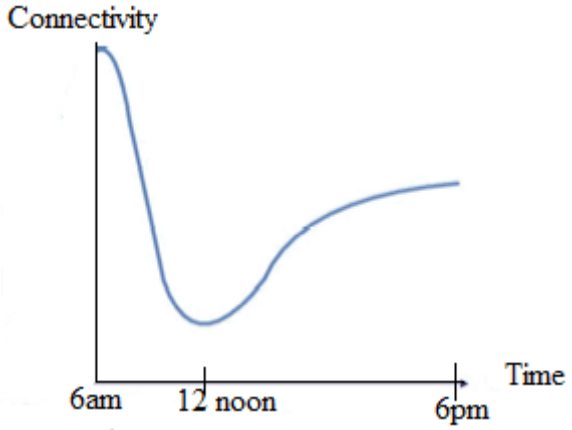

Figure 1: Internet-connectivity curve

Figure 1 depicts a curve that describes a situation where participants mentioned when they connect to the internet. Most of the respondents indicates that they connect to the internet mostly in the morning from 6am. By 12 noon, many of these respondents indicated that they do not connect in the afternoon but connects better in the evening time much better.

Beside advantage(s), Ka-band services have Drawback(s) and Limitation(s). Ka-band Satellite services have gained general customer acceptance and is widely viewed as "The wave of the future" for SATCOM. Her equipment and subscriptions are cost-effective; they are cheaper compare to C and Ku bands in terms of cost-of-equipment, cost-of-Installation and subscription charges.

The much smaller wavelength and higher frequency of Ka-band makes its links more susceptible to disruption from weather and other atmospheric disturbances like high rain fall, humidity etc. Unlike C and Ku-band, which is more sustainable and reliable in such weather. These were confirmed by observation. The small spot of Ka-band HTS suffer a severe cost disadvantage in harsh climate regions like Africa. In the University where this research held, ka-band service was breaking when there was heavy rain fall or hash sun shine. C band services was more stable in hash climatic condition over Ku and Ka bands.

5. Limitation of the Ka-band Services

By limitation, ka-band service is more reliable in regions of less rain fall. Such regions, unlike Africa experience more of the "faster …" slogan used to describe the betterness of its service speed compare to C and Ku bands. The Ka band Internet service could not carry much people at a time compare to that of C and Ku, based on the survey.

6. Conclusion and Recommendations

Conclusion and Recommendation(s) over the research are necessary to shed more light on the research relevance. It can therefore be concluded that Ka-band based services would not serve a large population environment like the University system. This shows that its quality is not of university campus network requirement.

Based on the conclusion in this research, Ka-band will be good for small population population areas like a department in a university, Cafes, business centres. Because of the cost-effectiveness of the installation and subscriptions, these specified areas would coup with the limited services.

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