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Bandwidth as a Determinant Factor for Effective Internet Connectivity in Educational Research Purpose in Higher Institutions of Learning

Amaku Amaku[1], Raphael E.Watti[2], Igbinosa O. G.[3]
[1]Department of Computer Science, College of ICT, Salem University, P.M.B. 1060 Lokoja, Kogi State, Nigeria.
[2] Information Technology Division of Ajaokuta Steel Company Ltd, Ajaokuta,Kogi State, Nigeria.
[3]Department of Computer Science, College of ICT, Salem University, P.M.B. 1060 Lokoja, Kogi State, Nigeria.

ABSTRACT

Internet connection is a primary requirement in promoting research work in an academic community. Efficiency of Speed, cost factor, reliability and usability are considerably required in determining the installation of internet connection in such academic environment. A connection is accepted by consumers if the service is speedily fast, reliable and affordable. This research paper will explore some bandwidth spectrum and it's relevance in terms of efficiency and effectiveness for educational research purposes.

Key Words: *Internet Connection, Bandwidth, Reliability, Affordability and VSAT Connectivity, Bandwidth*

1. INTRODUCTION

The history of the Internet begins with the development of electronic computers in the 1950s. Initial concepts of packet networking originated in several computer science laboratories in the United States, Great Britain, and France. The US Department of Defense awarded contracts as early as the 1960s for packet network systems, including the development of the ARPANET (which would become the first network to use the Internet Protocol.) The first message was sent over the ARPANET from computer science Professor Leonard Kleinrock's laboratory at University of California, Los Angeles (UCLA) to the second network node at Stanford Research Institute (SRI).[19]

Packet switching networks such as ARPANET, Mark I at NPL in the UK, CYCLADES, Merit Network, Tymnet, and Telenet, were developed in the late 1960s and early 1970s using a variety of communications protocols. The ARPANET in particular led to the development of protocols for internetworking, in which multiple separate networks could be joined into a network of networks.

Access to the ARPANET was expanded in 1981 when the National Science Foundation (NSF) funded the Computer Science Network (CSNET). In 1982, the Internet protocol suite (TCP/IP) was introduced as the standard networking protocol on the ARPANET. In the early 1980s the NSF funded the establishment for national supercomputing centers at several universities, and provided interconnectivity in 1986 with the NSFNET project, which also created network access to the supercomputer sites in the United States from research and education organizations. Commercial Internet service providers (ISPs) began to emerge in the late 1980s. The ARPANET was decommissioned in 1990. Private connections to the Internet by commercial entities became widespread quickly, and the NSFNET was decommissioned in 1995, removing the last restrictions on the use of the Internet to carry commercial traffic.[19][20]

Since the mid-1990s, the Internet has had a revolutionary impact on culture and commerce, including the rise of near-instant communication by electronic mail, instant messaging, voice over Internet Protocol (VoIP) telephone calls, two-way interactive video calls, and the World Wide Web with its discussion forums, blogs, social networking, and online shopping sites. The research and education community continues to develop and use advanced networks such as NSF's very high speed Backbone Network Service (vBNS), Internet2, and National LambdaRail. Increasing amounts of data are transmitted at higher and higher speeds over fiber optic networks operating at 1-Gbit/s, 10-Gbit/s, or more. The Internet's takeover of the global communication landscape was almost instant in historical terms: it only communicated 1% of the information flowing through two-way telecommunications networks in the year 1993, already 51% by 2000, and more than 97% of the telecommunicated information by 2007.[16] Today the Internet continues to grow, driven by ever greater amounts of online information, commerce, entertainment, and social networking and the services are expected to be running 24x7x365. Given the scale and rate of change of these services, this is no easy task. Understanding how any given client request is being fulfilled within a service is difficult enough; understanding why a particular client request is *not* working—determining the root cause of a failure—is an even greater challenge [15].

The advent of high-throughput satellites (HTS) enables network service providers to offer a new generation of communications solutions. HTS systems combine the exceptional spectrum efficiency and performance of spot-beam antennas with ultra-wideband transponders to enable unprecedented levels of bandwidth and throughput.

Thousands of remote sites worldwide utilizes above 4GHz of capacity across over 60 different satellites in C, Ku, Ka, L, X and UHF bands [1].

Why Internet Connection

AutoTutor Lite (ATL) is an Intelligent Tutoring System that lets people interact with it over the Web using an ordinary browser. ATL is cross-platform enabled and specifically designed to handle large numbers of users across different platforms [2].

ATL uses Artificial Intelligence Markup Language to handle questions, and uses learner's characteristic curves to handle dialog moves [3,10, 11].

ATL has a talking animated agent interface. It converses with users based on expectations using hints and elaboration. To the best of our knowledge, ATL is the first Web-based Intelligent Tutoring System that allows learners to interact with it through the use of natural language, in this case English. ATL uses Latent Semantic Analysis to "understand" natural language, present users with images, sounds, text, and video [12].

ATL elicits verbal responses from the learner and encourages them to further elaborate their understanding. ATL can thus be used to encourage self-explanation Through a natural language dialogue with the learner, ATL guides the learner toward a set of expectations. With ATL, tutorials are built from units called SKOs (Sharable Knowledge Objects) [13].

Massively Multiplayer Online Role-Playing Games (MMORPGs) and social networking games (e.g., Farmville), for example, encourage players to engage socially both in and through games. Cupitt et al said This is consistent with evidence that gamers prefer to play with others rather than alone [5].

Social interaction has been identified as both a motivational and experiential factor in gaming, particularly in multi-user environments [4].

Motivational nature of social gaming is reflected in a number of player typologies [7,8,9].

Other research has argued that the Internet provides a platform through which networked individuals can form a "Fifth Estate" [14].

Necessary attribute of the Fourth Estate is its independence of other institutions, especially government, business and industry. He further said, users can source their own information, independent of any single institution, using the capabilities provided by search and social media. Also users can create content in many forms – like blogs, email, tweets, comments on websites – that provide even greater independence from other institutions and offer a mechanism whereby public opinion can be directly expressed [6].

2. BANDWIDTH

Bandwidth describes the maximum data transfer rate of a network or Internet connection. It measures how much data can be sent over a specific connection in a given amount of time. For example, a gigabit Ethernet connection has a bandwidth of 1,000 Mbps, (125 megabytes per second). An Internet connection via cable modem may provide 25 Mbps of bandwidth.

While bandwidth is used to describe network speeds, it does not measure how fast bits of data move from one location to another. Since data packets travel over electronic or fiber-optic cables, the speed of each bit transferred is negligible. Instead, bandwidth measures how much data can flow through a specific connection at one time.

When visualizing bandwidth, it may help to think of a network connection as a tube and each bit of data as a grain of sand. If you pour a large amount of sand into a skinny tube, it will take a long time for the sand to flow through it. If you pour the same amount of sand through a wide tube, the sand will finish flowing through the tube much faster. Similarly, a download will finish much faster when you have a high-bandwidth connection rather than a low-bandwidth connection.

Data often flows over multiple network connections, which means the connection with the smallest bandwidth acts as a bottleneck. Generally, the Internet backbone and connections between servers have the most bandwidth, so they rarely serve as bottlenecks. Instead, the most common Internet bottleneck is your connection to your ISP.

NOTE: Bandwidth also refers to a range of frequencies used to transmit a signal. This type of bandwidth is measured in hertz and is often referenced in signal processing applications.

What is Obtainable?

Ka band frequency is almost twice the frequency used by Ku and that of Ku twice that of C. The low state of Frequency in any band enables it to overcome propagation impairment, experience low attenuation, resistant to rain fade but susceptible to terrestrial microwaves [1]. Figure 1 depicts the various frequency of some VSAT bands. Thousands of remote sites worldwide utilizes above 4GHz of capacity across over 60 different satellites in C, Ku, Ka, L, X and UHF bands.

L band	1 to 2 GHz
S band	2 to 4 GHz
C band	4 to 8 GHz
X band	8 to 12 GHz
Ku band	12 to 18 GHz
K band	18 to 26.5 GHz
Ka band	26.5 to 40 GHz

Figure 1 Frequency of VSAT bands

From Wikipedia, table 1 shows the various ranges of Frequency and Wavelengths in various bands

Table 1: Frequency and Wavelength Ranges of Various Bands

Letter Designation	Frequency range	Wavelength range	Typical uses
L band	1 to 2 GHz	15 cm to 30 cm	military telemetry, GPS, mobile phones (GSM), amateur radio
S band	2 to 4 GHz	7.5 cm to 15 cm	weather radar, surface ship radar, and some communications satellites (microwave ovens, microwave devices/communications, radio astronomy, mobile phones, wireless LAN, Bluetooth, ZigBee, GPS, amateur radio)
C band	4 to 8 GHz	3.75 cm to 7.5 cm	long-distance radio telecommunications
X band	8 to 12 GHz	25 mm to 37.5 mm	satellite communications, radar, terrestrial broadband, space communications, amateur radio
K_u band	12 to 18 GHz	16.7 mm to 25 mm	satellite communications
K band	18 to 26.5 GHz	11.3 mm to 16.7 mm	radar, satellite communications, astronomical observations
K_a band	26.5 to 40 GHz	5.0 mm to 11.3 mm	satellite communications
Q band	33 to 50 GHz	6.0 mm to 9.0 mm	satellite communications, terrestrial microwave communications, radio astronomy, automotive radar
U band	40 to 60 GHz	5.0 mm to 7.5 mm	
V band	50 to 75 GHz	4.0 mm to 6.0 mm	millimeter wave radar research and other kinds of scientific research
E band	60 to 90 GHz	3.3 mm to 5 mm	UHF transmissions
W band	75 to 110 GHz	2.7 mm to 4.0 mm	satellite communications, millimeter-wave radar research, military radar targeting and tracking applications, and some non-military applications
F band	90 to 140 GHz	2.1 mm to 3.3 mm	SHF transmissions: Radio astronomy, microwave devices/communications, wireless LAN, most modern radars, communications satellites, satellite television broadcasting, DBS, amateur radio

D band	110 to 170 GHz	1.8 mm to 2.7 mm	EHF transmissions: Radio astronomy, high-frequency microwave radio relay, microwave remote sensing, amateur radio, directed-energy weapon, millimeter wave scanner

From Scatmag.com, The atmosphere provides a low loss signal path for certain microwave frequencies. Satellite broadcasters therefore use this fact and provide satellite broadcasts at these frequencies.

A satellite broadcasts a few watts of microwave signals from the geostationary orbit 36,000 kilometres above the earth. The transmissions are also broadcast over a wide “footprint” area. The satellite signals suffer an attenuation of approximately 200 dB, while making this 36,000 kilometer journey from the satellite to reception points on the ground. The satellite signals which finally arrive are extremely weak. A dish antenna is used to collect these weak satellite signals over a large area - the surface of the dish.

Frequency and Wavelengths of C, Ku and Ka

Table 2 below describes the frequencies and the wavelengths of C, Ku and Ka bands, which will be used to deduce some preference later.

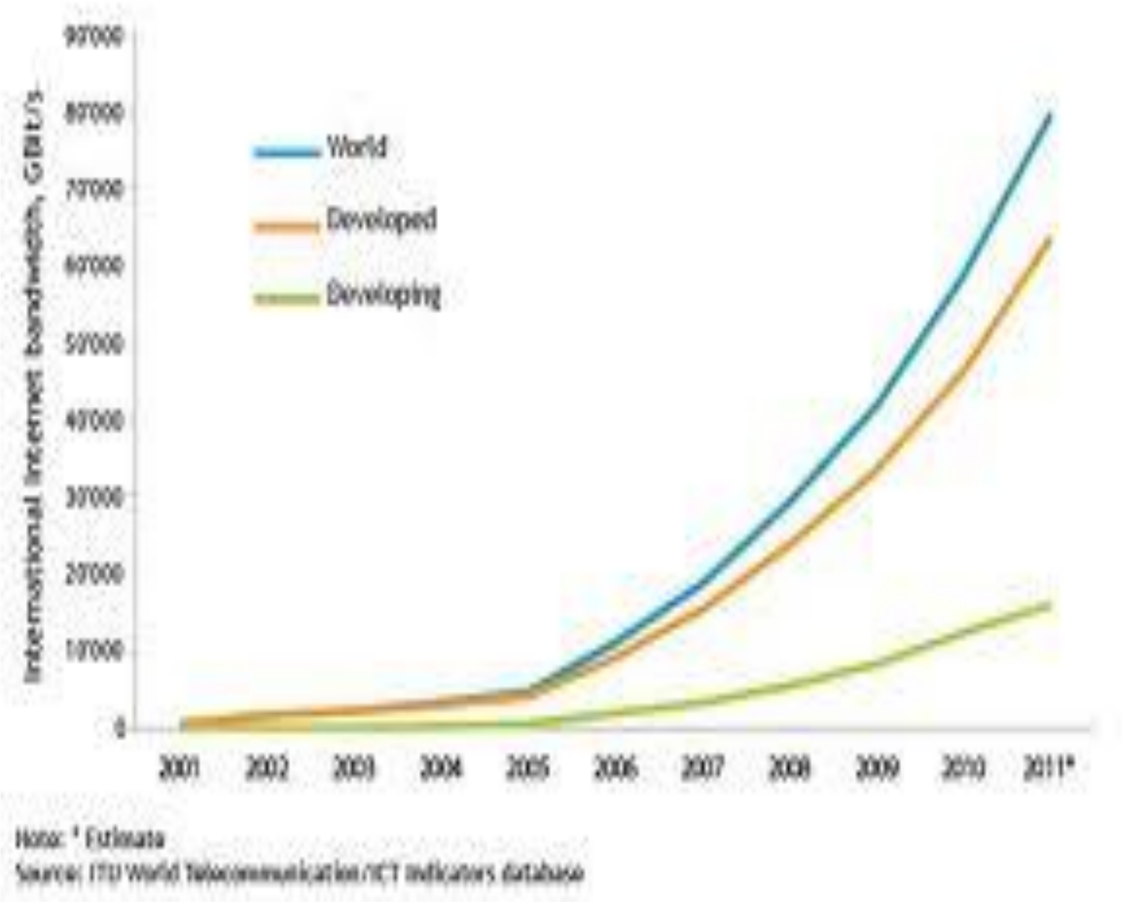
Table 2: Frequency and Wavelengths of some VSAT Bands

Bands	Frequencies (GHZ)	Wavelengths
C	4-8	3.75cm-7.5cm
Ku	12-18	16.7mm-25mm
Ka	26.5-40	5-11.3mm

Table 2 above shows that Ka has more frequency than Ku and C but C having highest wavelength.

Implications of Table 2

Table 2 entails that Wavelength is inversely proportional to the frequency ($\lambda \alpha 1/F$). Which means that the higher the frequency of the transmission, the smaller the wavelength.



Data from https://www.broabandtrafficmanagement.blogspot.com Figure 2: International Internet Bandwidth Trend

Table 2: Comparism of Freequencies and Wavelengths

	Frequencies	Wavelengths
High/Long	More susceptible to weather disruption and atmospheric disturbances, particularly in regions of high rainfall like Nigeria, transmits signal more quickly but easily attenuated, used by organizations that does not need a highly reliable service	Overcome propagation impairment, provides available and reliable service, affected by terrestrial microwaves, transmits signal more slowly but hardly attenuated, used by organizations that needs highly reliable service
Low/Short	Overcome propagation impairment, provides available and reliable service, affected by terrestrial microwaves, transmits signal more slowly but hardly attenuated, used by organizations that needs highly reliable service	More susceptible to weather disruption and atmospheric disturbances particularly in regions of high rainfall like Nigeria, transmits signal more quickly but easily attenuated, used by organizations that does not need a highly reliable service

General Analysis

Table 1 indicates that dedicated C- band service appears to be more fast and reliable than shared, Ku and Ka, whereas Ku band better than Ka. However, Ka is more cost-effective

Table 2 indicates that C-band has lower frequency and longer wavelength compare to Ku and Ka and Ku-band with lower frequency and longer wavelength to Ka.

This implies that C-band's low rate of frequency with long wavelength makes it more reliable, less disturbance from rain fade, but with a disadvantage of interference from terrestrial microwaves over Ku and Ka

Recommendations:

Dedicated C-band is highly recommended for any Nigerian Tertiary Education because of its resistance to weather disruption, atmospheric disturbance and its reliability.

CONCLUSIONS

Most times our tertiary institutions are been situated in a high rainfall region, C-band connectivity medium remains a better option for overcoming the weather disruption and atmospheric disturbance in such region Compare to Ku and Ka bands.

REFERENCES

[1] Harris CapRock (2012). White Paper. Communications, Inc.

[2] Christopher (2012).Improving Internal Consistency in Conditional Probability Estimation With an Intelligent Tutoring System and Web-Based Tutorials. Internaional Journal of Internet Science. 7(1), 37-54

[3] Hu et al (2008). Enhance learning with ITS style interactions between learner and content. Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC

[4] Colwell, J. (2007). Needs met through computer game play among adolescents. Personality and Individual Differences, 43, 2072–2082.

[5] Kaye (2012). Putting The "Fun Factor" Into Gaming:The Influence of Social Contexts on Experiences of Playing Videogames. International Journal of Internet Science. 2012, 7 (1), 23–36

[6] Nic (2012). Social Media in the Changing Ecology of News: The Fourth and Fifth Estates in Britain. International Journal of Internet Science 2012, 7 (1), 6–22

[7] Bartle, R. A. (1996). Hearts, clubs, diamonds and spades: Players who suit MUDs. Journal of MUD Research 1(1).

[8] Bartle, R. A. (2004). Designing virtual worlds. Berkeley, CA: New Riders.

[9] Yee, N. (2006). The demographics, motivations and derived experiences of users of Massively Multi-User Online Graphical Environments. Presence: Teleoperators and Virtual Environments, 15, 309–329.

[10] Hu, X., & Martindale, T. (2008). Enhance learning with ITS style interactions between learner and content. Interservice/Industry Training, Simulation, and Education Conference (I/ITSEC).

[11] Hu, X., Han, L., & Cai, Z. (2008, November). Semantic decomposition of student's contributions: An implementation

of LCC in AutoTutor Lite. Paper presented at the conference of the Society for Computers in Psychology, Chicago, Illinois.

[12] Graesser, A., & McNamara, D. (2010). Self-regulated learning in learning environments with pedagogical agents that interact in natural language. Educational Psychologist, 45, 234–244.

[13] Chi, et al (1994). Eliciting self-explanations improves understanding.

[14] Dutton, W. H. (2009). The Fifth Estate emerging through the network of networks. Prometheus, 27(1), 1–15.

[15] Mike et al (). Pinpoint: Problem Determination in Large, Dynamic Internet Services

[16] "The World's Technological Capacity to Store, Communicate, and Compute Information", Martin Hilbert and Priscila López (2011), Science (journal), 332(6025), 60–65; free access to the article through here: martinhilbert.net/WorldInfoCapacity.html

[17] "J.C.R. Licklider and the Universal Network". *The Internet*. 2000.

[18] "Internet Architecture". *IAB Architectural Principles of the Internet*. Retrieved April 10, 2012.

[19] "Lawrence Roberts Manages The ARPANET Program". *Living Internet.com*. Retrieved 6 November 2008..

[20] "Packet Switching History", Living Internet, retrieved 26 August 2012

[21]"J.C.R. Licklider And The Universal Network", Living Internet