Bandwidth Monitoring and Network Usage in a Wireless Network

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***Abstract*: This study was undertaken to investigate the usage of the wireless network and monitoring of its bandwidth in Federal Polytechnic Ede, the study became paramount because of the need to ascertain the adequacy of the bandwidth for the Polytechnic community and to also confirm the purpose of usage by the users. Questionnaire and onsite observation are the major instruments used for data acquisition. The results show the uplink and downlink speed of the bandwidth in three different locations in the Polytechnic for three days. It also gives a comparative picture of the network usage among the academic and non-academic staff. The result will however assist the decision makers about the need to upgrade the bandwidth to meet the need of the Polytechnic and create more awareness of the availability of the benefits in the information superhighway.**

***Keywords*: Bandwidth, Monitoring, Usage, Network, Polytechnic.**

I. INTRODUCTION

Bandwidth management is a generic term that describes the various techniques, technologies, tools, and policies employed by an organization to enable the most efficient use of its bandwidth resources [1]. According to [2] bandwidth management is a process of allocating bandwidth resources to critical applications on a network. Bad management aims to improve the performance of an Internet connection by removing unnecessary traffic [3]. As the Polytechnic is faced with problems with its wireless network, it is evident that the number of users on the network will grow per time, this, to an extreme, which may result in traffic congestion and bottleneck on the network. To this end, the bandwidth of the Polytechnic Wireless Network has to be monitored so as to:

a. Ascertain the peak time (a particular period in the day) That the bandwidth is most utilized.
b. Control the network usage by the users on the network.
c. Deliver better quality of service to the users by being Proactive
d. Prevent the users from visiting some sites that do Consume the bandwidth, as a result of the huge size of their files.
e. Avert users on the network from doing malicious things on the network.
f. To forestall any illegal attempt to break into the network.
g. Ensure a secure network.

The objective of this study is to investigate the monitoring of the bandwidth and its usage in the institution's wireless network. The timeframe for the conduct of the study was two academic semesters of the 2018/2019 academic year.

II. REVIEW OF LITERATURE

A unique dataset from a rural sub-Saharan village that captured usage before and after an Internet access speed the upgrade was analyzed in [4]. They studied the effects of this upgrade on-network performance and user behavior. They also found that performance improved immediately after the upgrade, whereby automatic services that were previously failing due to slow access speed were finally able to complete. With improved network performance, subscribers attempted more bandwidth-demanding services such as YouTube video streaming. There also was a substantial increase in attempts to share online content, whereby the uplink byte volume doubled in the Long-term. Unfortunately, with the increase of upload attempts, the failure rate of uploads grew as well, resulting in a drastic decrease in the number of uploaded bytes. Broadband Internet access was presents in [5], however, is still largely unavailable in developing countries, with only 6% of the population having broadband connectivity [6], the majority of whom reside in urban areas. Recent efforts to bring connectivity to rural areas of the developing world employ asymmetric satellite or other low-bandwidth wireless links [7]; [8]. Bandwidth Monitor is compatible with most of the network connections including modem, ISDN, DSL, ADSL, cable modem, Ethernet cards, wireless, VPN, etc and can be used over a wide range of platforms including Windows 98, Windows Me, Windows NT 4.0, Windows 2000, Windows XP, Windows 2003, Windows Vista, and Windows 7. [4] Nowadays, there are many ways to get an Internet connection such as ADSL, Mobile, Wifi, WiMax, FTTx. Furthermore, the Internet connection can get anywhere and at any time. The PBX systems would be low interested because the PBX (Private Branch Exchange) is used circuit switching system and is also used to expend the phone bills [9]. The VoIP system uses packet switching which it can use everywhere in the place of getting an Internet connection.

In [10] the phenomenon of social networking access as it occurred in a higher education environment was presented. Despites of debate about the negative assumptions of social networking impact on productivities, some campus elements such as students or lecturers using these sites to disseminate

information and support the communication among them. Based on this phenomenon, we researched to explore the usage of social networking in a higher education environment, especially among lecturers and students, and analyse the impact of teaching-learning activity. The research was conducted in three private universities which have familiar with social networking activities. The research focused on the usage of four kinds of activities such as connecting through Facebook, microblogging, instant messaging, and blogging, 300 respondents use the access not only for entertainment but also for information distribution and communication to support teaching activity. The usages ranges from class rescheduling negotiation, examination task assignment, announcement, and many more, they however uses some applications such as Telegraph, Whatsapp, Facebook, Twitter, instant messenger, and blog site.

The Network Bandwidth Utilization Forecast Model on High bandwidth Networks was presented in [11]. With the increasing number of geographically distributed scientific collaborations and the growing sizes of scientific data, it has become challenging for users to achieve the best possible network performance on a shared network. They developed a model to forecast expected bandwidth utilization on high-bandwidth wide-area networks. The foremost model can improve the efficiency of resource utilization and scheduling of data movements on high-bandwidth networks to accommodate ever-increasing data volume for large scientific applications.

The four primary benefits WLANs were identified in [12] as:

a. User Mobility—users can have access to network resources, files and the Internet without having to physically connect to the network with wires. Users can be mobile yet retain high-speed, real-time access to the enterprise LAN.

b. Rapid Installation—the time required for installation is reduced because network connections can be made without moving or adding wires, or pulling them through walls or ceilings, or making modifications to the infrastructure cable plant. For example, WLANs are often cited as making LAN installations possible in buildings that are subject to historic preservation rules.

c. Flexibility—Enterprises can also enjoy the flexibility of installing and taking down WLANs in locations as necessary. Users can install a WLAN for temporary needs such as a conference, meetings, and trade show.

d. Scalability—WLAN network topologies can easily be configured to meet specific application and installation needs and to scale from small peer-to-peer networks to very large enterprise networks that enable roaming over a broad area.

The explosive growth in Internet and intranet deployment for a constantly growing variety of applications have created a massive increase in demand for bandwidth, performance, predictable Quality of Service (QoS), and differentiated network services. Simultaneously, the need has emerged for measurement and monitoring of network utilization and performance. Different factors can influence the performance of a network were identified in [10] and the two values concerning the performance of a network are Bandwidth and Latency. They explained that if small packets are used, then latency will become the most important factor. However if many data are to be transferred, the the bandwidth of the network will be the bottleneck for the job. Knowledge of the up-to-date bandwidth utilizations and path latencies are critical for numerous important network management tasks, including application and user profiling, proactive and reactive resource management and traffic engineering, as well as providing and verifying QoS guarantees for end-user applications.

The challenges of effective measuring and monitoring bandwidth and network usage have led to developing novel tools and infrastructures for measuring network bandwidth and latency parameters. Examples of these tools include SNMP and RMON measurement probes, Cisco's NetFlow tools, etc. SNMP would be the tool of our choice for monitoring the bandwidth of the wireless network because of the features it has and also its capability to work with Multi Router Traffic Grapher (MRTG).

III. MONITORING THE BANDWIDTH AND THE NETWORK USAGE OF THE POLYTECHNIC WIRELESS NETWORK

The Wireless Network of the Federal Polytechnic, Ede was installed by the institution in the year 2008. The institution provided this facility for her staff to foster teaching and research development, especially among the academic staff.

The wireless network has its base radio at the e-Learning Center and a repeater at the Engineering Complex, both within the Institution's premises. The monitoring of the bandwidth of the Polytechnic Wireless Network was done for three days from three geographical distances from the base station at some different time intervals using the internet speed. The questionnaire was the technique adopted for the study, which was designed and administered by the staff of the Polytechnic. The questionnaire has 27 test questions. The total number of the respondent was 147. The Monitoring of the bandwidth of the Wireless Network was achieved by the usage of the internet bandwidth test software – WIMI [13] on the internet as presented in Figure 1.

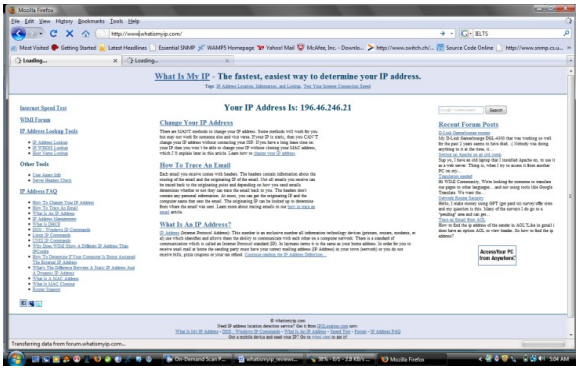

Figure 1 The home page of internet bandwidth test software - WIMI

From the result of the bandwidth measurement gotten from the three different locations within the Polytechnic, it is discovered that the uplink speed was so high than the downlink speed. This is because people using the internet rarely perform uploading either of files or other things. For illustration, let us compare the uplink-downlink speed of the three days at different geographical locations within the Polytechnic.

IV. RESULTS AND DISCUSSION

A. Day 1

As presented in Table 1 and Figure 2, the uplink at the location 100m away from the base station was high with a speed of 45.3KB/sec, whereas the downlink speed was 10KB/sec. The uplink at 200m was 11.3KB/sec while the downlink speed was 1.9KB/sec. when the distance was 300m, the uplink speed was 10.6 KB/sec and the downlink speed was 1 KB/sec. At the 200m and 300m away from the base radio, both the uplink-downlink dropped as a result of degrading in TCP/IP over a network.

Table 1: Uplink Downlink Speed at locations 100m, 200m, and 300m from the base station for Day1

Day	Transfer Rate	100m	200m	300m
Day1	Uplink KB/sec	45.3	11.3	10.6
	Downlink KB/sec	10	1.9	1

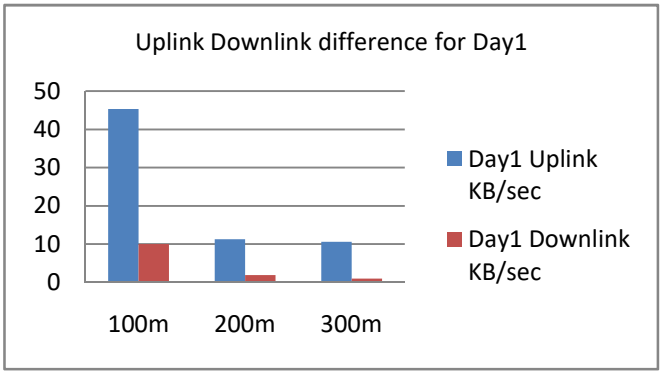

Figure 2: Bar Chart showing the Uplink Downlink Speed at locations100m, 200m, and 300m from the base station for Day1.

B. Day 2

Unlike the result of the result for day1, the uplink-downlink speed for day2 was a bit low, (Table 2 and figure 3) because the test was carried at the peak time of the day (between 12:30 pm and 2:00 pm) when the network usage is high. Moreover, the speed of the uplink is higher than that of the downlink for the three locations within the Polytechnic.

Table 2 The Bar Chart showing the Uplink Downlink Speed at locations100m, 200m, and 300m from the base station for Day2

Day	Transfer Rate	100m	200m	300m
Day2	Uplink KB/sec	18.4	10	9
	Downlink KB/sec	3.5	1	1.5

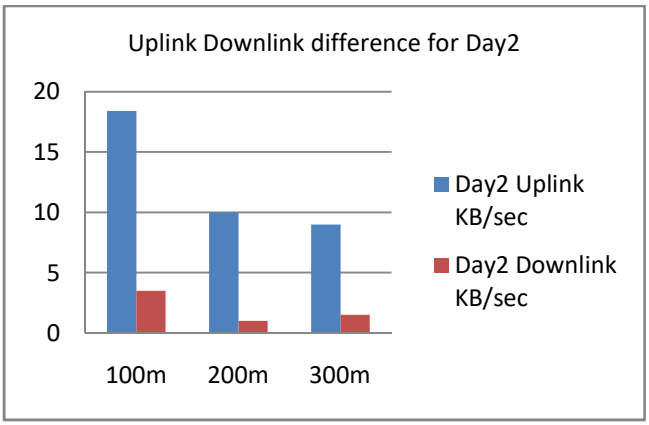

Figure 3 Bar Chart showing the Uplink Downlink Speed at locations100m, 200m, and 300m from the base station for Day2.

C. Day 3

The uplink at the location 100m away from the base station was high with a speed of 13.3KB/sec, whereas the downlink speed was 1.6KB/sec. The uplink at 200m was 29.6KB/sec while the downlink speed was 8B/sec. when the distance was 300m, the uplink speed was 1.6 KB/sec and the downlink speed was 1 KB/sec. It is noted that both the uplink-downlink at the location 300m away from the base station was the lowest of all the measurement because of the distance which is the Entrepreneurship building within the school compound as shown in Table3 and Figure 4.

Table 3 Uplink Downlink Speed at locations 100m, 200m, and 300m from the base station for Day 3

Day	Transfer Rate	100m	200m	300m
Day 3	Uplink KB/sec	13.3	29.6	1.6
	Downlink KB/sec	1.6	8	1

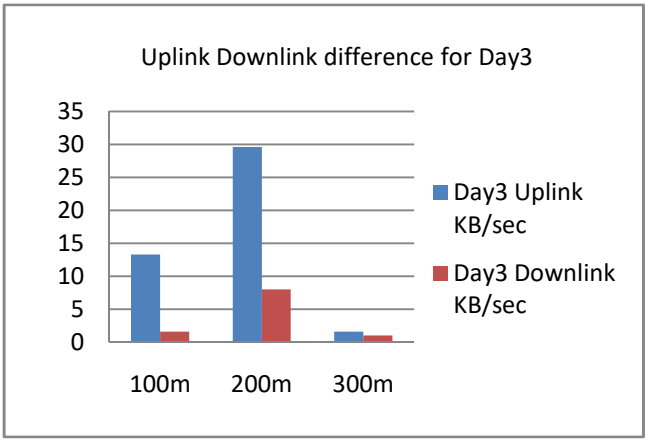

Figure 4 The Bar Chart shows the Uplink Downlink Speed at locations100m, 200m, and 300m from the base station For Day3

V. THE USAGE OF THE POLYTECHNIC WIRELESS NETWORK

The analysis of the results gathered from the respondents is as follows.

A. Awareness of the Wireless Network among the Staff

The survey that was carried out among the staff, through the questionnaire, made it clear that 9% percent of the male staff and 14% percent of the female staff were not aware that the wireless network existed. The staffs that were aware of the wireless network but not subscribed to it, has 27% percent of the male staff and 17% percent of the female staff. The percentage of the male staff and female staff that are aware of the wireless network and were subscribed to it is 23% and 10% respectively. This information is summarized in Table 4 and Figure 5.

Table 4 Awareness of Wireless Network among the Staff

STAFF	AWARENESS	%
Academic	Not Aware	0%
	Aware not Subscribed	12%
	Aware & Subscribed	22%
Non-Academic	Not Aware	23%
	Aware not Subscribed	31%
	Aware & Subscribed	12%

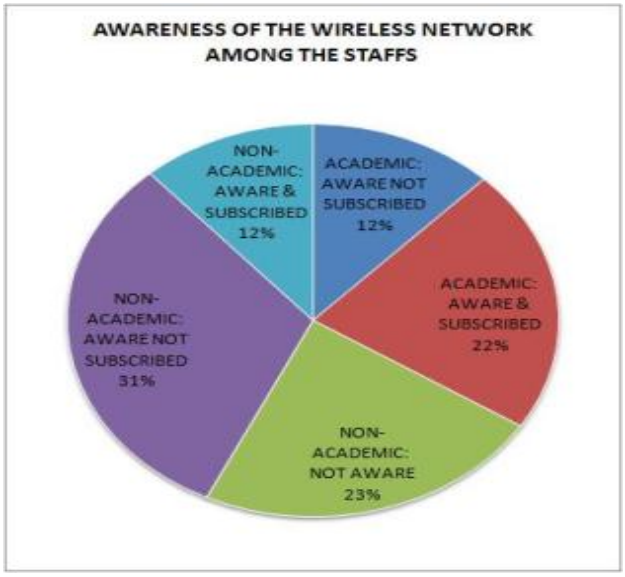

Figure 5: The table shows awareness of the Wireless Network among the Academic and Non-Academic Staff

Table 5: Wireless Network among the Academic and Non-Academic Staff by Sex

Sex	Awareness	%
Male	Not aware	9%
	Aware not subscribed	27%
	Aware & subscribed	23%
Female	Not aware	14%
	Aware not subscribed	17%
	Aware & subscribed	10%

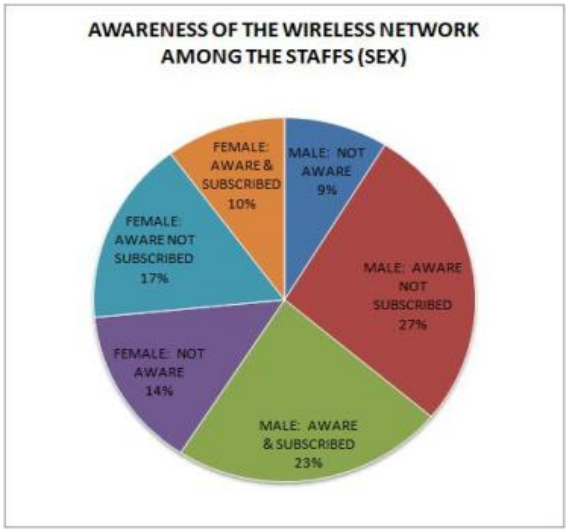

Figure 6 The Pie Chart shows awareness of the Wireless Network among the male and female Staff

The percentage of Non-academic staff that is not aware of the wireless network is about 23%. The percentage of Academic staff and Non-academic staff, that are aware of the wireless network but not subscribed to it, is 12% and 31% respectively. The statistics of the staffs that are aware of the wireless network and are subscribed to it has 22% percent of the Academic staff and 12% Non-academic staff. This information has summarized in the table and pie-chart below.

B. Subscription to the Wireless Network

Each of the staff is to pay a monthly subscription so as to have access to the Wireless Network, and access to the network is withdrawn as soon the subscription expires.

It was discovered through the survey carried out among the staff that out of 70% of the male staff that are subscribed to the wireless network, 49% are Academic staff while 21% are Non-academics staff. The percentage of the female staff paying subscription to the wireless network is 30%, and out of this, 16% are Academic staff while The non-academic staff took 14%. The total percentage of Academic staff subscribed to the wireless network is about 65%, whereas 45% of the Non-academic staff were subscribed to the wireless network. The table and pie chart below shows the summary of this information.

Table 6 Percentage of the wireless network subscribers

SEX	STAFF	SUBSCRIBERS
Male	Academic	49%
	Non-Academic	21%
Female	Academic	16%
	Non-Academic	14%

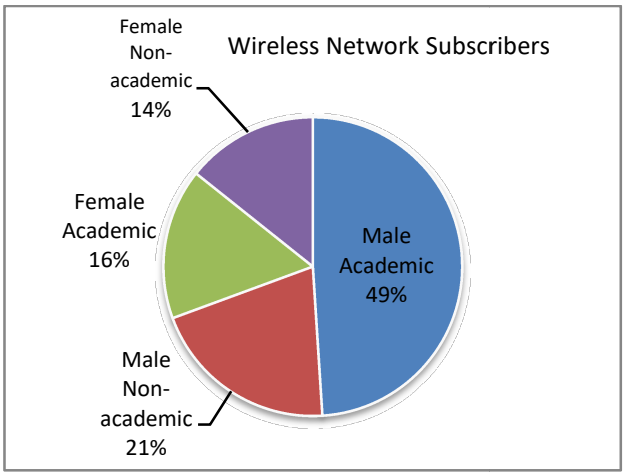

Figure 7 The Pie Chart shows percentage of the wireless network subscribers

C. *The Network Usage by the Subscribers*

The survey carried out revealed that the facility of the wireless network is always used by about 55% of the staff in which 43% are Academic staff whereas 12% are Non-academic staff. Besides, the wireless network is rarely used by 23% of the Academic staff and 22% of the Non-academic staff and the total percentage of the staff that rarely use the wireless network is an amount to 45%. All this information is summed up in the table and the pie-chart below.

Table 7 Network usage by subscribers

Staff	Usage	Percentage
Academic	Always	43%
	Rarely	23%
Non-Academic	Always	12%
	Rarely	22%

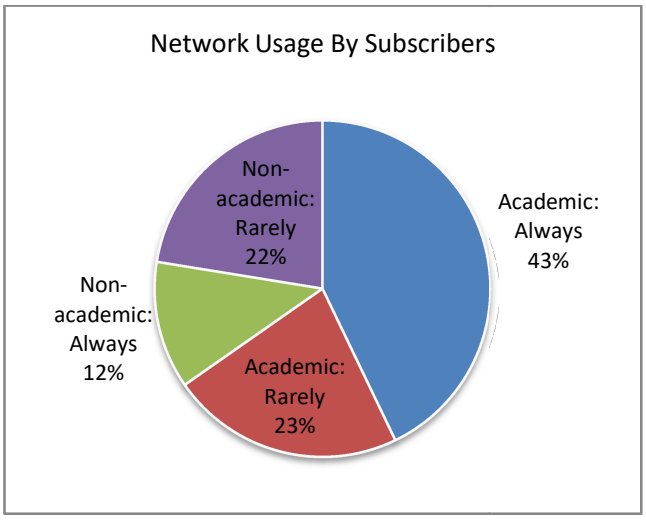

Figure 8 shows the usage of the Network by the Subscribers

VI. CONCLUSION

The Polytechnic wireless network was monitored for three days at three different locations within the Polytechnic, and it is discovered that the coverage is limited to some part of the Polytechnic. However, many of the Non-academic staffs were not aware of the existence of the facility.

More awareness should be made to the staff, especially the Non-academic staff, so that the potential of the graceful resource could be highly utilized and the reason for the installation could be achieved. Some of the staff declared "they rarely use the network because of the performance of the facility that is below their expectation". So, the performance of the network should be upgraded so that the staff could exploit the potential of the network.

Also, the number of subscribers could increase if more awareness is made among the staffers and the performance of the wireless network should be upgraded so that more staff could be motivated to subscribe to the polytechnic wireless network and enjoy the unlimited resources of the global information superhighway.

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