Uniport Journal of Engineering and Scientific Research (UJESR)

Vol. 7, Issue 1, 2023, Page 100-104
ISSN: 2616-1192

(www.ujesr.org)

User Datagram Protocol Downstream Throughput Probability Prediction in WLAN System

Ayidu, J.N[a]* and Akhideno, I.O[b]
[a,b]Benson Idahosa University, Department of Electrical/Electronic Engineering, Benin City, Nigeria
*Corresponding author's email: jayidu@biu.edu.ng

Abstract
The proliferation of wireless local area networks (WLAN) in offices, homes and schools have spiraled in recent years. This could be attributable to increased Internet activities and the ubiquity of mobile phones. Transport of data, and the reliability is mostly handled at the transport layer of the Open System Interconnection (OSI) model. This can be implemented by either the transmission control protocol (TCP) or the user datagram protocol (UDP). This work focusses on the determination of the reliability of UDP downstream link as regard throughput in IEEE802.11b/g WLAN system. The throughput was analyzed as a function of signal-to-noise ratio for a UDP implementation of WLAN. Then a probability model that would enable the prediction of UDP Throughput in a WLAN environment was developed. The probability model was based on the cumulative distribution function (CDF) on different predefined downstream throughput thresholds. With the aid of experimental data conducted, a CDF model of UDP downstream throughput (UDPdownT) was developed. The result shows that despite the erratic characteristic behaviour of UDP, a normal cumulative distribution function (CDF) can be obtained for estimating UDP downstream throughput availability over a typical 802.11 b/g network.

Keywords: *IEEE802.11b/g, Downstream, WLAN, User datagram protocol, Throughput, Signal to noise ratio*

Received: 9th May, 2022 *Accepted: 18th April, 2023*

1. Introduction

There is an abundance of literature on the throughput analysis of IEEE 802.11 media access control (MAC) protocols. This is probably because it is the most popular wireless local area network (WLAN) standard. Its commercial success grows per year as more versions become increasingly available, for example 802.11e and 802.11n, with increasing throughputs (Bruno, et al., 2008). Driving this would seem to be necessary because of the prevalence of high bandwidth applications such as virtual reality and high-resolution video streaming. The prediction of throughput would seem to be important as it is a determinant of the quality of real time video and audio streaming services on low–latency network protocols (Agatha, 2009). The physical layer of the IEEE802.11 standard used by WLAN systems specifies multiple communication data rates that vary depending on the quality of the link. This variation is typically measured by looking at the signal-to-noise-ratio (SNR). The SNR is an important metric for consideration when changing the data link rate (DLR) in WLANs (Metreaud, 2006). The amount of data bits conveyed from a data source or group of data sources to a destination or group of destinations within a stated time is called the throughput. Throughput can be measured in packet per second, bit per second or bytes per second. Throughput can also be defined in real time as the rate of data delivery over a specific period of time. Throughput yield a better measure of network performance because it is the actual speed of a network. Network monitoring relies heavily on its value. It can be measured with the aid of several network monitoring analysis tools (Akintola et al., 2006). In some cases, it becomes necessary to be able to predict the throughput of a network at any given time provided there are some other conditions stated as live measurements and analysis are not always possible. Predicting a transmission throughput through a network using a limited set of information available to network Engineer can present a serious challenge. UDP are often used as the transport layered protocol by which data can be transported from the server and client connection to estimate the throughput prediction for both empirical and probability model. To accurately predict the throughput at specified throughput ranges for downlink transmission of data is a challenge. This paper seeks to address this, offering a probability model as an alternative method to predict a specific throughput value for pre-specified classes of signal to noise ratio (SNR) for UDP for the downstream scenario. This is applied to real time and non-real time scenarios, where real time scenarios refer to live data services such as voice and video streaming and non-real time refers to activities such as file transfers and so on.

2. Materials and methods

The study was carried out within the University of Benin main campus, Benin City, Nigeria. A typical WLAN networking environment was set up consisting of a single user under different traffic scenarios (see Table 1). Three (3) environments within the main campus were considered: open space, hallway, and administrative office building. These environments were labelled for the purpose of this work as environment 1, 2, and 3 respectively.

Downstream data of UDP was collected in these various environments using both hardware and software tools to achieve the field work involving data collection. The two software tools used are: Tamosoft Throughput Test and inSSIDer version 2.1 and the hardware tools used are: Access point (AP), Laptop Computers with a Wireless LAN Card corresponding to the vendor of the AP in real-time measurements. The AP was setup as a bridge network to connect with the laptops. When connecting the device to the network, Power over Ethernet (POE), a direct Ethernet cable (RJ45) cable and a Power Adaptor was used. One cable was connected to the POE entering, another connected to the device, the other connected between the LAN entering, and the Ethernet computer access, then the power adaptor was connected to a Direct current (DC) source**.** Received Signal Strength Level (RSSL) at the client terminal was taken into consideration as a parameter to measure. The throughput is measured in Mbps while the RSSL measured in dBm. In this study, both hardware and software tools were used to achieve the field work involving data collection. Real time traffic transmitted using UDP has various ranges of activities listed under the following Quality of Service.

Table 1: Quality of service (QoS) traffic

S/N	Traffic Types
1	Audio video
2	Background
3	Best effort
4	Control
5	Excellent effort
6	Voice

Table 2: Specifications of device used

Computer Name / Use	Processor	Operating System	Installed Measurement Software	Network Card	RAM size
Laptop1/running Single user Server	AMD Turion Dual-core RM-75 2.20GH	32 bit operating system	Tamosoft throughput test and insider	Atheros AR5007 802.11b/gWiFi Adapter	3GB
Laptop 2/ Running single user client	Intel (R) Pentium (R) CPU B960 @ 2.20GHz 2.20GHz	64-bit operating system	Tamosoft throughput test and insider	Dell wireless 1702 802.11b/g/n	4.00GB

3. Results and discussion

3.1 Average UDPdownT computed data

The mean value of UDPdownT, RSSI and noise floor measurement and their computed standard deviations (STDs) are presented in Table 3 for single user taken in their different sub positions under their various sample points for Front and Back (F and B) for UDP downstream throughput (UDPdownT) respectively. Describe, Interpret and compare result with related previous findings.

Table 3: UDP downstream throughput for a single user client in environment 1

Average of $UDP_{down}T$ at sample point 1 in Environment 1					
QoS Traffic Type	**sample size F and B**	**Ave. UDPdownT F (Mbps)**	**Ave. UDPdownT B (Mbps)**	**UDPdownT Ave. per QoS traffic (Mbps)**	**STD for all Inst. UDPdownT (Mbps)**
Best effort	18	12.7877	13.0655	12.9266	1.7210
Background	18	69.8288	12.7866	41.3077	72.723
Excellent effort	18	13.4844	10.5144	11.9994	2.6316
Audio video	18	12.5033	12.2233	12.3633	0.6586
Voice	18	11.8355	11.0888	11.4622	2.3798
Control	18	11.2866	12.5388	11.9127	2.7735
Total UDPupT Ave. (Mbps)		21.9544	12.0362	16.9953	13.8146
Total sample sizes	108				
Average of $UDP_{down}T$ at sample point 2 in Environment 1					
QoS Traffic Type	**sample size F and B**	**Ave. UDPdownT F (Mbps)**	**Ave. UDPdownT B (Mbps)**	**UDPdownT Ave. per QoS traffic (Mbps)**	**STD for all Inst. UDPdownT (Mbps)**
Best effort	18	24.4277	21.3588	22.8933	2.5208
Background	18	25.9000	21.2333	23.5666	3.3161
Excellent effort	18	22.1244	23.9194	11.0765	2.6629
Audio video	18	22.1200	19.6700	20.8950	7.7514
Voice	18	23.9666	22.8000	23.3833	5.0644
Control	18	20.7788	24.2455	22.5122	5.0850
Total UDPupT Ave. (Mbps)		23.2196	22.2045	20.7211	4.4001
Total sample sizes	108				
Average of $UDP_{down}T$ at sample point 3 in Environment 1					
QoS Traffic Type	**sample size F and B**	**Ave. UDPdownT F (Mbps)**	**Ave. UDPdownT B (Mbps)**	**UDPdownT Ave. per QoS traffic (Mbps)**	**STD for all Inst. UDPdownT (Mbps)**
Best effort	18	25.2233	194.1488	109.6861	216.7417
Background	18	23.7766	16.3700	20.0733	6.6544
Excellent effort	18	16.2676	10.3181	9.8382	0.4895
Audio video	18	20.8766	19.0944	19.9855	16.2676
Voice	18	20.9644	19.4388	20.2016	6.44366
Control	18	22.5900	22.5900	20.2122	4.81689
Total UDPupT Ave. (Mbps)		21.6164	46.9933	33.3328	41.9023
Total sample sizes	108				

3.2 Probability representation

Substituting the values from the experiment and applying normal standard distribution table, a plot of the Cumulative Distribut5ion Function (CDF) was obtained, which shows that at a probability of 0.9 there was an increase in UDPupT performance with about 26Mbps as shown in Fig. 1. The CDF plot for throughput prediction shows the probability that a throughput will be less than or equal to a certain range of value. Based on the probability description, the computed SNR used for the experiment is categorized into their various signal ranges of excellent, fair and poor signals shown in Table 4. for UDPdownT.

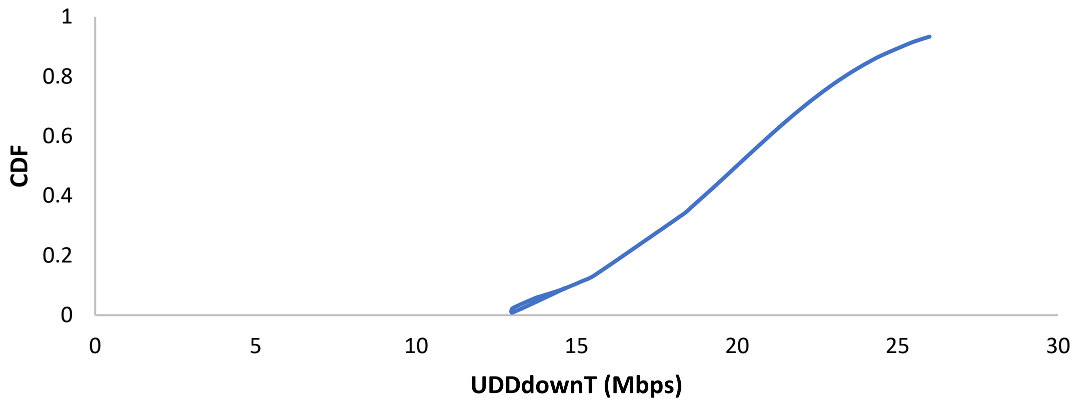

Fig. 1: CDF probability plot UDP downstream throughput (single user)

Table 4: CDF probability look up table for UDP downstream throughput

UDPdownT (Mbps)	Statistical Parameter	CDF Probability model value
>28	Probability	1
26-27.99	Probability	>0.9337
24-25.99	Probability	0.9337
22-23.9	Probability	0.8337
20-21.99	Probability	0.7000
18-19.99	Probability	0.4947
16-17.99	Probability	0.3380
14-15.99	Probability	0.1337
12 - 13.99	Probability	0.0087
10 -11.99	Probability	0

Table.5: Probability representation of UDPdownT SNR ranges

SNR Ranges	SNR	Throughput probability
A	35-68	0.9337
Excellent - Outstanding		0.7000
B	29-34	0.650
Fair -Good		0.4500
C	18-28	0.025
Poor		

4. Conclusion

This paper presented a proposed User Datagram Protocol (UDP) downstream Throughput probability description for a user on a network under different conditions of SNR. A CDF was given and the probability of picking a specific throughput range was determined. The result was used to classify empirical SNR into three main categories, namely A-Excellent/outstanding, B-Fair/Good and C- Poor. The work would enable Network Engineers predict throughput QoS for Single user upload operations on IEEE802.11b/g WLAN networks. It is concluded that UDP which does not guarantee a delivery of data can obtain good throughput in the downlink for a single user provided that it is in the SNR ranges of 35dB and above.

References

Agatha, K. (2009) Analysis of different approaches in separation of elastic and inelastic traffic. Institute of electrical Electronic EngineeringI EEE 11th international conference on computer modelling and simulation - Cambridge, UK (Poland), Pp 508-513.

Akintola, A., Aderounmu, G. and Owojori O, A. M. (2006) Performance Modeling of UDP over IP-Based Wireline and Wireless Networks. Issues in Informing Science and Information Technology, 3: 13-21.

Bikash, C.S., Tapan, K.G., Sipon, M.M. and Abdul, H.M. (2011) Experimental Analysis of UDP Performance in Mobile Ad Hoc Networks with Different Routing Protocols and varying payload. International Journal of Distributed and Parallel Systems, 2(6): 107-113.

Bruno, R., Conti, M. and Gregori, E. (2008) Throughput Analysis and Measurements in Instistute of electrical Electronic Engineering (IEEE) 802.11 WLANs with TCP and UDP Traffic Flows., 7(2), pp. 171-186.

Metreaud, T. (2006) An RF-Isolated Real-Time Multipath Testbed for Performance Analysis of WLANs. Masters of Science in Electrical and Computer Engineering Dissertation. Worcester Polytechnic Institute, USA, pp. 1-123.