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Empirical Study of UDPuploss in IEEE802.11b/G WLAN System

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Abstract

A data link performance in terms of throughput based on the signal *noise ratio (SNR) observed were measured and recorded for a rad environment in a Wireless Local Area Network (WLAN)***.** *Th environment was taken into consideration due to the fact that WLA are likely going to be used in real-life.* ***User Datagram Protoc (UDP)*** *upstream loss (uploss) and Received Signal Strength Lev (RSSL) were measured from a WLANs in IEEE802.11b/g support network using Tamosoft Throughput Test and inSSIDer softwa tools. Signal to noise ratio (SNR) was computed from the measur RSSL. A wide variety of quality of service (QoS) traffic havi different levels of network priority and all corresponding to differe Wi-fi Multimedia (WMM) access categories were used in th research. Empirical data was statistically generated and tested f performance.*

1. Introduction

The application of Wireless Local Area Network (WLAN) is more useful in the public environment, enabling mobility support for new smart and mobile devices such as smartphones, tablets, smart television and portable laptops [1,2]. This WLAN network which has made methods of communication possible have various IEEE (Institute of Electrical Electronics Engineering) standards that enable communication wirelessly without being limited by physical wires [3]. The IEEE standard board formed a standard (WLAN standard) called IEEE 802.11 on June 26, 1997, published by the IEEE on November 18, 1997. The standards define both the Physical layer (PHY layer) and the Medium Access Control Layer (MAC layer). IEEE 802.11 was the original standard, developed in 1999. It operates on 2.4GHz license-free Industrial Scientific and Medical (ISM) band, at 1Mbps and 2Mbps data rates. Over the years, ratified amendment on 802.11 standard have yielded remarkable improvement in performance, data rate, security, and so on, in WLAN deployment. The amendment resulted in standards like; IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, IEEE 802.11n, IEEE 802.11s, IEEE 802.11w, and others with higher data rates [1,4].

Other standards were designed to enhance security and Quality of Service (QoS) issues. An additional mechanism was later presented to eradicate different QoS support and security challenges in IEEE 802.11i and IEEE 802.11c. The IEEE 802.11n standard presented MAC improvement that can overrule MAC layer boundaries in recent principles [5]. IEEE 802.11s was designed to standardize mesh networking in 2011. It uses mesh routing protocol called Hybrid Wireless Mesh Protocol (HWMP), which has improved internet connectivity and security in a larger network. IEEE 802.11u enhances internetworking through outer non-802.11 networks. IEEE 802.11w was a combined effort to 802.11i concealing management frame security. The IEEE 802.11ad standard combines a "fast session transfer" attribute allowing a seamless wireless device connection among 2.4GHz and 5GHz at a frequency of 60GHz The IEEE 802.11ac standard, still under development is expected to provide a multi-station WLAN throughput of about 1Gbps and a single link throughput up to 500Mbps [6]. Currently, several other standards have been introduced to the IEEE 802.11 family.

In the modeling of UDP upstream loss (UDPuploss), the IEEE802.11b/g standard was introduced to examine the loss in the end-to-end communication, to enable network engineers to design the network based on user's experience.

2. Methodology

This work investigates the performance of the transport layer of the Transmission Control Protocol/ Internet Protocol (TCP/IP) for UDPuploss connection in a WLAN single user environment of free space. The research was carried out within the University of Benin main campus. The location lies within the coordinates 6°23'51"N and longitude of 5º 37' 28" E. The pictorial and plan view of the environment is shown in Figure 1, which indicates the measurement sample point.

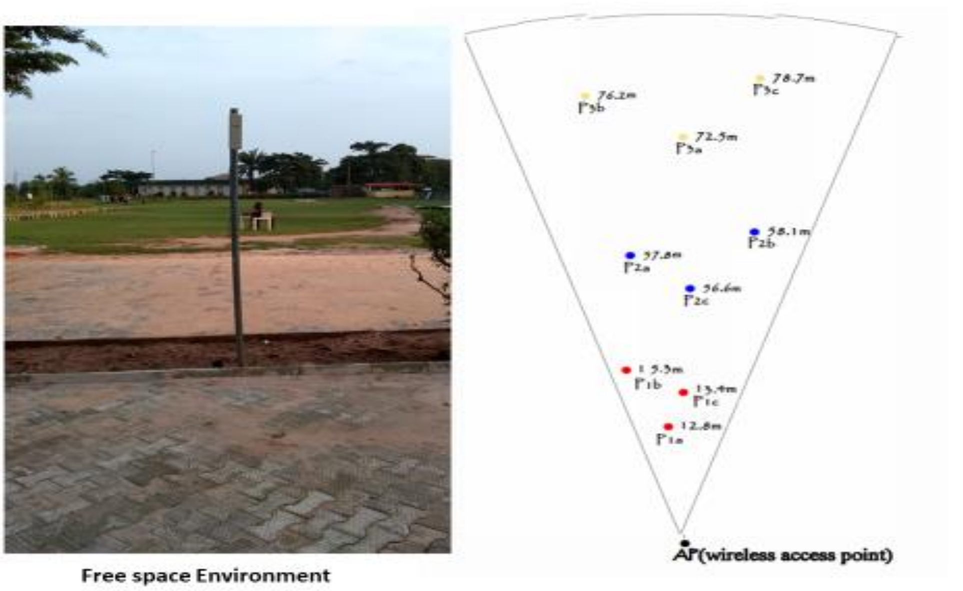

Figure 1: Pictorial and plan view of free space Environment

In order to determine the performance of WLAN in terms of the UDP upstream loss, assessment of the TCP/IP layer behavior was monitored in this work through real-time measurement. The work also considered Received Signal Strength Level (RSSL) at the client's terminal as an important parameter to measure. The throughput is measured in Mbps while the RSSL is measured in dBm.

2.1 Experimental Setup

To carry out the measurement campaign, a measurement test-bed was set up as shown in Figure 2.

Figure 2: Experimental setup with a connected ethernet user

Both hardware and software tools were used to achieve field work involving data collection. The soft tools used are Tamosoft Throughput Test and inSSIDer version 2.1 for signal. The experimental test-bed/setup comprised of an Access Point (AP), which was mounted on a pole. This AP has the capability to support data speed up to 100MHz, operating at 2.4GHz band. It also supports both IEEE 802.11b and g standard, with the capability of extended data rate. The Ethernet cable used was CAT 5. The transmitted power from the system setup is ideally -26dBm, with a sensitivity of about -97dBm. The AP has an integrated adaptive antenna that enables the network users within its coverage area to receive radio waves. The AP was powered from the 12Vdc output from the power adapter, and connected with a Power over Ethernet (PoE) cable terminated at the RJ45 connector. The AP was configured with a private IP address 192.168.1.30. Laptops representing server and client were also connected to the network.

3. Result and Discussion

The empirical study which is based on experimental data was statistically generated for a combined single user free space scenario using Microsoft excel package. This tool is of great importance among students and professional researchers due to its capability of analyzing a wide scope as well as a large amount of data. The performance of the given parameter (UDPuploss) based on the SNR was observed for the environment considered The Signal-to-Noise ratio (SNR) was determined from the average values of the received signal strength level (RSSL) measured at every sampling point. The primary field data of the environment were analysed which gave the parameter as shown in Table 1.

Table 1: Combined field Data for free space environment

SNR (dB)	Average UDPupLoss (%)
61	1
60	1
59	1
58	1
57	0
56	1
55	0
54	2
53	53
51	2
50	2
49	2
48	2
47	2
46	1
45	2
44	2
43	2
42	2
41	1
40	3
39	1
38	1
37	1
36	2
35	1
33	1
32	1
31	3
30	1
29	1

In order to clearly visualize the behaviour/relationship of UDP loss with respect to SNR, the average of the combined single user data was plotted against SNR. SNR was computed from the primary field data as a function of signal and noise, which is given as;

SNR (dB) = RSSI (dBm) – Noise floor level (dBm) (1)

The graphical representation of the observed data generated for a single user free space environment considered for this research as shown in Figure 3.

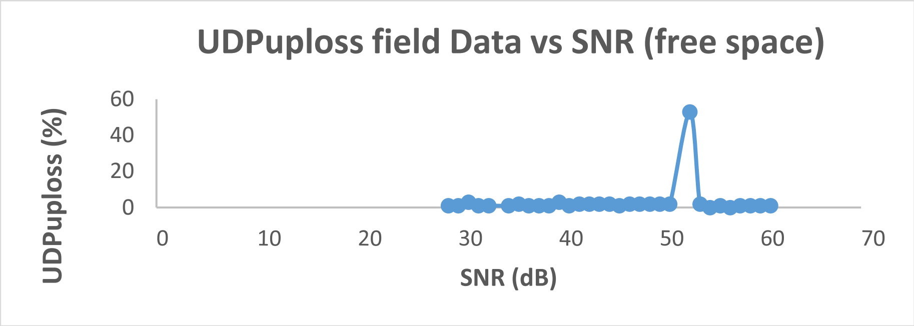

Figure 3: Average UDPuploss field Data vs SNR (free space)

The graphical representation of UDPuploss free space environment shows how the loss remains constant at a point as the SNR increases but at a certain point between 50dB to 54dB there was a spike in loss due to the nature of UDP being unreliable protocol. From the investigation carried out within one year we found out that UDP being unreliable, is still a good protocol that is fast and efficient for applications that do not need acknowledgment, like in real-time computer communication such as Audio conferencing, Video conferencing, online gaming and so on.

4. Conclusion

Understanding the end-to-end communication in a network environment is essential for the successful deployment and improvement of WLAN. Oftentimes, different approaches have been introduced to investigate loss in UDP protocol. This paper tries to examine the loss in UDP protocol with respect to SNR observed from the measured RSSL represented in the WLAN actual user environment. Though UDP being unreliable protocol, but not completely unreliable as it seems because this protocol is still much useful to some applications that do not require acknowledgement and flow control.

Nomenclature

AP	Access point
Gbps	Gigabits per second
GHz	Gigahertz
HWMP	Hybrid Wireless Mesh Protocol
IEEE	Institute of Electrical Electronic Engineering
ISM band	Industrial Scientific and Medical Band
IP	Internet Protocol
MAC	Medium Access Control
Mbps	*Megabits per second*
PHY layer	Physical layer
PoE	Power over Ethernet
QoS	Quality of Service
RJ45	Registered jack-45
RSSI	Received Signal Strength Indicator
RSSL	Received Signal Strength Level
SNR	Signal to noise ratio
SPSS	Statistical Package for Social Sciences.
SU	*Single User*
TCP	Transmission Control Protocol

UDP	User Datagram Protocol
$UDPP_{up}loss$	User Datagram Protocol Uploss
WLANs	Wireless local area networks
WMM	Wi-Fi Multimedia

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