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PERFORMANCE EVALUATION OF UDP BASED ON TRAFFIC SIZE AND TRAFFIC LOAD USING NS2

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ABSTRACT

This study concerned on examining network matrices over user datagram protocol (UDP). The current challenges associated with network performance and streaming of packets was the main motivation for the researchers. A review of UDP was given with the relation to its network performance. We found UDP offer a minimal, unreliable, best-effort and message-passing transport to applications. Hence, a further examination of its performance was performed using NS2 on aspects related to traffic size and traffic load. The simulation result revealed that when establishing communication over UDP, it was noticed that changing packet size and traffic load has a small effect on UDP performance in which it was found a minimal associated end system state.

Keywords: UDP, NS2, Packet size, traffic load, throughput, end-to-end delay.

1. INTRODUCTION

The quality of services (QoS) over networks having wireless access can be a common exploration topic and it is often studied regarding end-to-end QoS or even cross-layer architectures (Al-Hubaishi *et al*., 2013). Most authors in previous studies concentrated on particular circle elements or even domains (such as terminals, airwaves interfaces, or even core networks) associated with particular protocol tiers (Garg and Kappes, 2003, Huang and Liao, 2007). Having this in mind, current utilization of network protocols has also addressed the congestion handle schemes with regard to wireless multimedia with the transport stratum or even QoS-scheduling techniques with the radio software (He and Chan, 2004, Baghaei and Hunt, 2004). As such, the QoS recognized by prospects is an end-to-end issue and it is therefore afflicted with every area of the network, the particular protocol tiers, and the way they all work together (Bruno *et al*., 2008).

Moreover, ensuring effective transfer of packets on-line requires instant control for networks to coordinate the manner so that it can support package data companies with unique QoS prerequisites. In like scenarios, data support performance assessment is often addressed via active critical monitoring over real networks (Lee *et al*., 2001). This includes the effective cost that can be due to the network performance from the reasonable volume of terminals, purposes, and spots (Nácher *et al*., 2007). It might also prove to be an extremely time-consuming process as a result of variety regarding potential scenarios (Giannoulis *et al*., 2009), both when it comes to the kind of service recommended and the spatial spot.

By utilizing UDP for network connection based on the header format shown in Figure1, the retransmission difficulties double retransmit as compared to transmission control protocol (TCP)(Mohamed *et al*., 2005). A connection transferred within the network is not TCP within TCP, but rather TCP within UDP. UDP does not support any retransmission components, so it is going to only function as the forwarded TCP connection which will do retransmissions. An additional gain from using UDP would be the smaller header dimensions (Soni and Chockalingam, 2002). UDP features a header dimension of 8 bytes when TCP employ a header dimension of 20 bytes. This may leave space for bandwidth improvement within the network channel (Eckart *et al*., 2008).

UDP Datagram Header Format

Bit #	0 – 7	8 – 15	16 – 23	24 – 31
0	Source Port		Destination Port	
32	Length		Header and Data Checksum	

Figure 1. UDP header format.

The huge benefit from employing UDP was recognized by many network providers in which providing quality network connection with UDP do not come simply(Petrovic and Aboelaze, 2003). UDP does not support dependable transport as compared to TCP. This indicates, that UDP packets might be lost or arrive out-of-order at the receiver (Kay and Pasquale, 1992). By utilizing UDP, there exists thus an excellent loss involving reliability in the base relationship.

The main objective of this paper is to study the performance of UDP protocol in terms of throughput and end-to-end delay varying the packet size and traffic load.

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2. LITERATURE REVIEW

2.1 UDP

UDP is probably the network protocols which can be commonly found in the world-wide-web for helping better info buffer. The services given by UDP are usually a unordered supply of packets, connectionless support, full duplex connection and meaning boundaries keeping, no traffic jam control along with packet supply (Issariyakul and Hossain, 2012).

This kind of protocol is regarded as being the most effected standard for media data transfer over several transport layers, it supplies reliable along with a fast mechanism to handle voice, image, audio along with video data traffic (Wang *et al*., 2010, Jasin *et al*., 2012). Thus, various network experts always ponder over it to be a vital mechanism for enhancing system performance below various system conditions. Identifying the performance involving UDP over wireless networks which can help provide stable conditions for understanding the adaptability involving wireless networks to process data related to speech, video along with data traffic as compared with TCP. Additionally, wireless system performance is actually affected not merely by the congestion, but also by various other factors like environment, long distance and method implementation (Zahid *et al*., 2012). A comparison between the two protocols can be found in Table-1.

Table-1. TCP versus UDP.

Characteristics/ Description	UDP	TCP
General Description	Simple High speed low functionality "wrapper" that interface applications to the network layer and does little else	Full-featured protocol that allows applications to send data reliably without worrying about network layer issues.
Protocol connection Setup	Connection less data is sent without setup	Connection-oriented; Connection must be Established prior to transmission.
Data interface to application	Message base-based is sent in discrete packages by the application.	Stream-based; data is sent by the application with no particular structure
Reliability and Acknowledgements	Unreliable best-effort delivery without acknowledgements	Reliable delivery of message all data is acknowledged.
Retransmissions	Not performed. Application must detect lost data and retransmit if needed.	Delivery of all data is managed, and lost data is retransmitted automatically.
Features Provided to Manage flow of Data	None	Flow control using sliding windows; window size adjustment heuristics; congestion avoidance algorithms
Overhead	Very Low	Low, but higher than UDP
Transmission speed	Very High	High but not as high as UDP
Data Quantity Suitability	Small to moderate amounts of data.	Small to very large amounts of data.

The working settings of UDP does not yield retransmission delay as compared to TCP in which it results in a decrease of the delay ration in network applications (Nam *et al*., 2010). Some sort of UDP packet consists of a header and also payload. UDP utilizes a cyclic redundancy check (CRC) to help verify this integrity of packets; for that reason, it can easily detect any kind of error within the packet header as well as payload. If a mistake is recognized, the packet is declared lost and also discarded(Melodia and Akyildiz, 2011).

2.2 Related work

Networking and performance improvement are the main aspects that most researchers recently investigating. In order to transmit and receive data, the effective network protocol is needed based on the type and nature of service (Ekici and Yongacoglu, 2008). When data is sent from one network address to another, important characteristic regarding any multilevel speed needs to be considered for the aim of determining the performance of a network. While multilevel performance is often a crucial activity in multilevel administration, network effectiveness evaluation is now one of the major threads in network research. In (Wylie-Green and Svensson, 2010), authors range attachment to traffic modelling in addition to network effectiveness evaluation is needed. Also, those different factors of multilevel performance are different and many generic variables exist which affect the performance of a LAN.

Research scientific studies of multilevel performance can be done based on the different computer hardware, software, standards, services, systems, traffic

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integrated to the multilevel. Some researchers like in (Izui et al., 2014) categorized network effectiveness research ways into a couple of categories in order to deal largely with network visitors in addition to modelling issues. In addition, other researchers were mostly concern about the performance evaluation. For instance, authors in (Ono et al., 2014) analysed the result of information on network effectiveness and propose a broad information theoretical framework which may be applied in order to any multilevel. They have inked a literature review about generic variables that affect the effectiveness of local area network (LAN), mainly centring on the effectiveness and metrics of common operating systems that have been implemented to make IT facilities. Their literature findings display that effectiveness analysis, internet standards and wireless are classified as the major designs in literature.

From these, we can conclude that different network protocols in addition to network mass media play a significant role within a network to ascertain network verbal exchanges channels and gaze after the performance. Authors in (Hernandez and Helal, 2001) claim that IP may be the basic foundation used permit information technologies communication channels and to improve the actual performance on the overall and the actual network, which proves that this performance on the IP stack needs to be improved. Moreover, authors in (Wu *et al*., 2008) reported their finding on unified multilevel performance methods and stated that just to be able to evaluate the vulnerability along with the reliability of a network, a measure that can quantifiably seize the effectiveness or performance of a network need to be developed.

Giannoulis in (Giannoulis *et al*., 2009) introduced the potentiality of examining and categorizing QoS and power management for the purposes of indicating layer transport of any protocol stack. The author addressed the simulation settings for stimulating TCP and UDP as a transport layer alternatives in which the approximate packet transmission was evaluated based on the means of QoS such as throughput, maximum and mean delay. Such configuration led the author to conclude that power behaviour under multimedia-like streaming conditions can be regulated based on the packet related settings and transport layer protocol.

On the other hand, Gopinath in (Gopinath *et al*., 2013) addressed the current lack of congestion control schemes especially in the network applications executed over UDP which can result in overwhelming the host network and to consume more energy as a result. The author firstly investigated the possible impact of transport layer protocols such as TCP and UDP on the performance of wireless ad-hoc networks. The author also considered fixing the nodes of the designed network model into a static and placed in a grid topology. Then, the author analysed the performance of TCP and UDP protocols based on increasing traffic load and congestion in the network. The result showed that value associated with TCP running was better as compared to UDP latency while UDP provides better Throughput when compared to TCP.

From these, it can be noted that network performance continues to be tested by different multilevel parameters. These guidelines are known as performance metrics that may be measured to evaluate the performance of a network.

3. DEVELOP CONCEPTUAL MODEL

We now have considered the most common scenario where network nodes organized uniformly in the environment associated with two foundation stations of BS0 and BS1. As for most streaming data, handover can be used to provide more potential for processing video or voice data where the session cannot be interrupted.

4. DEVELOP SPECIFICATION MODEL

Indicating the best simulation scenario relied on the network structure which is usually a matter involving personal selection, but may very well be related for the layer where the adviser will operate and its particular assumptions with lower stratum functionality. The simplest type involving Agent, connectionless datagram-oriented transfer, is the actual Agent/UDP basic class. Traffic generators can simply be linked with UDP real estate agents. For standards wishing to employ a connection-oriented steady stream transport (like TCP), the many TCP Agents could be used. Finally, if a whole new transport or maybe “sub-transport” protocol might be developed, using Agent because the base class would likely be your best option. Figure-2 shows the packet specification for the designed network in which the header info is predetermined within the Object-oriented Tool Command Language (OTcl) settings included in the Make file.

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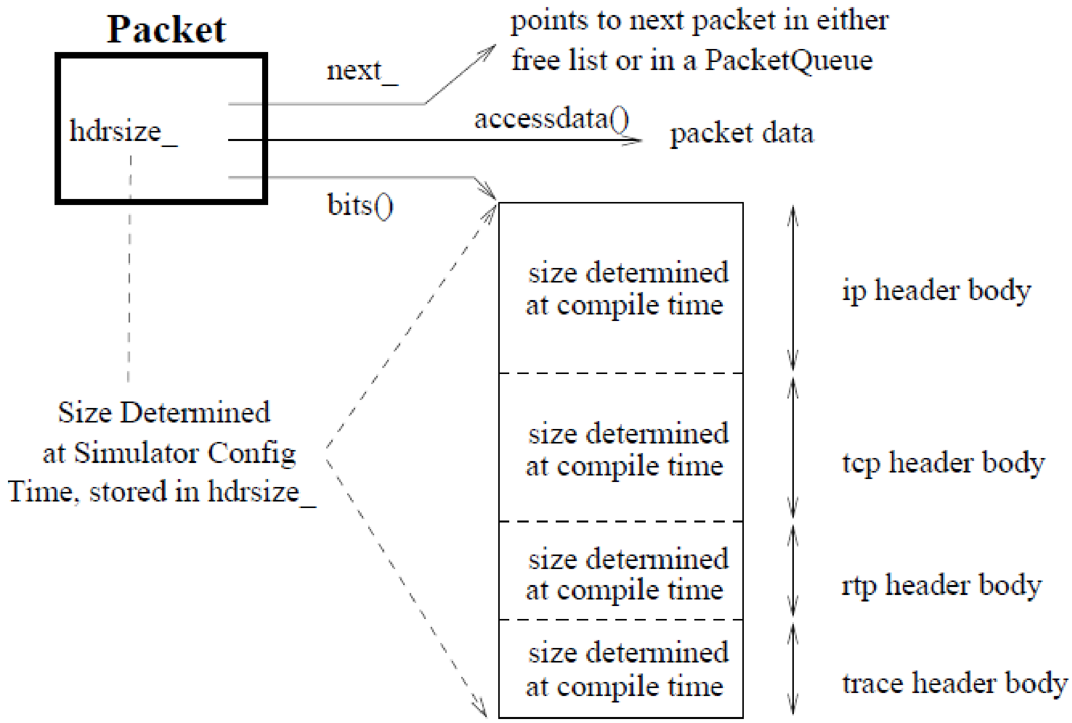

Figure-2. Packet specification.

The model setting consists of a number of agents for facilitating packet transmission which were also provided to be instantiated and attached to a node. We used 154 nodes which assumed to be enough for deploying QoS related studies. The following OTcl code performs these functions.

set echoagent [new Agent/ECHO]
$simulator attach-agent $node $echoagent
$simulator attach-apps $ node transfer
$simulator UDP-attach

However, the set the interval and packet size was also identified for evaluating UDP performance in different transmission settings whereas OTcl code is executed.

$echoagent set dst_ $dest
$echoagent set fid_ 0
$echoagent set prio_ 0
$echoagent set flags_ 0
$echoagent set interval_ 1.66
$echoagent set packetSize_ 1024
$echoagent set packetsent_ 50
$echoagent deploy
$echoagent start

On the other hand, the commands were executed to setup UDP agents in simulation scripts.

set udp0 [new Agent/UDP]
$ns_ attach-agent <node><agent>
$traffic-gen attach-agent <agent>
set cbr1 [new Application/Traffic/CBR]
$cbr1 attach-agent $udp1
$ns_ connect <src-agent><dst-agent>
$udp set packetSize_ <pktsize>
$udp set dst_addr_ <address>
$udp set dst_port_ <portnum>
$udp set class_ <class-type>
$udp set ttl_ <time-to-live>
…

5. DEVELOP SIMULATION MODEL

NS2 which is a part with the VINT project was used. We also used IU OTcl interpreter. By means of this language, we were able to determine the conditional parameters with the simulation like network topology, chosen from different physical backlinks and readily used protocols. We customized traffic settings throughout C++ and rely on them in NS2 through instantiations with OTcl.

Figure-3 shows the simulation data flow for UDP which was used to determine the number of packets needs to be sent to the destination. A total of 50 packets were sent and means value was generated to be used in model validation and verification. Due to the fact UDP is not going to include just about any congestion manage or retransmission things, UDP throughput may be simply computed in the IP throughput by for the header overhead. Performance signals and parameters at the UDP coating.

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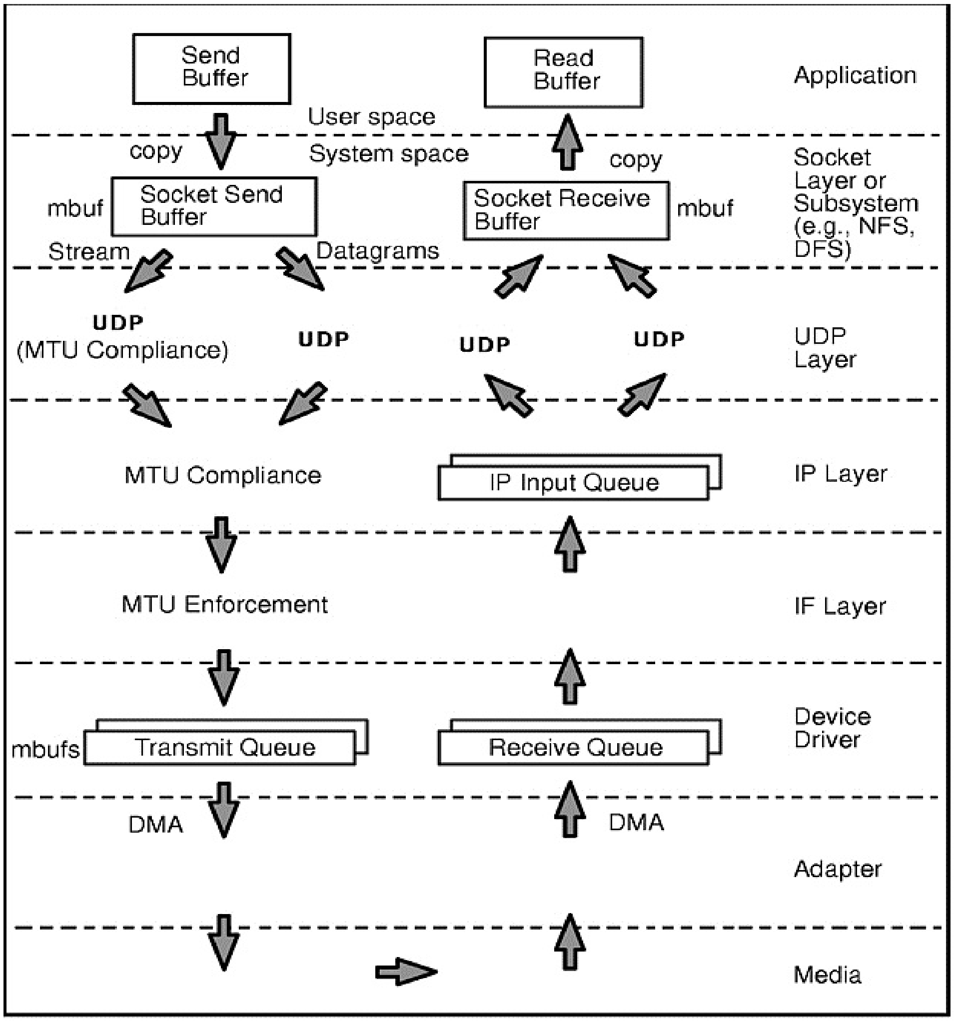


Figure-3. UDP simulation data flow.

6. PERFORMANCE METRICS

6.1 Average Throughput (TP)

The normal rate from which the information packet is usually delivered successfully from node to a different over any communication network is referred to as throughput. The throughput is frequently measured inside kilobits per second (kbps) (Edgar, 2004). A throughput that has a higher importance is more frequently an overall choice for the network. Mathematically, throughput is usually defined with the following.

$$Average\ \ TP\,(\text{kbps}) = \frac{\text{Number of bytes received}}{\text{Simulation time}} \; * 8 \; * 1000 \qquad (1)$$

6.2 Average End to End Delay (E2E delay)

Average End-to-End Delays the average time to broadcast the packet of the data successfully from source to destination through the network. It contains all possible delays such as the propagation, buffering during discovery latency of the route, queuing at the interface queue, retransmission delay at the MAC and time of the transmission delay. The average e2e delay is computed as below.

$$\text{Average } e2e \text{ delay (ms)} = \frac{\sum_{i=1}^{n}(R_i - S_i)}{n} \qquad (2)$$

where i is the data packet index, Ri is the time of received data packet, Si is the time of sent data packet and n is the total number of data packets.

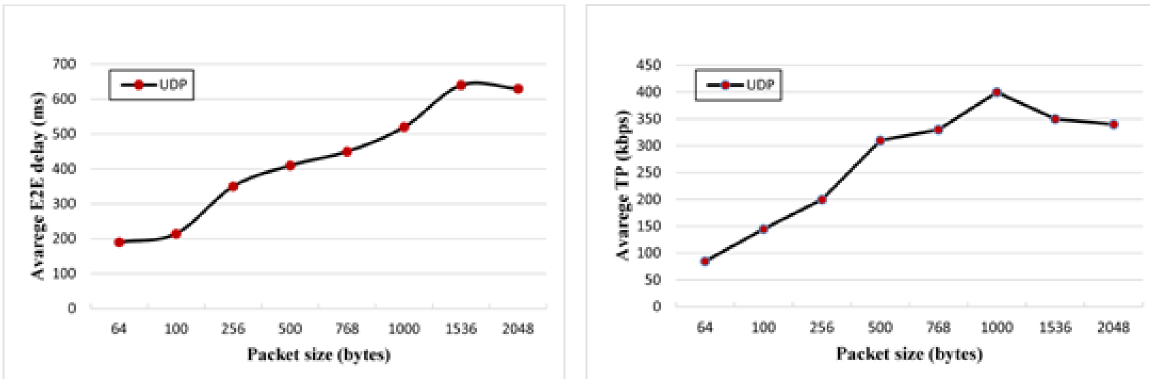
7. RESULTS AND EVALUATION

7.1 UDP based on packet size

In this study, the number of stations was mapped based on the state of active links between the stations and load. In addition, we examined the possible changes in UDP performance in the event of any jumbo frames. Packet size of 1550 bytes and 2048 bytes.

From Figure-4 (a), it can be summated that UDP based on the packet size value experience a behaviour of constant increase as found in E2E delay. This led us to conclude that UDP relies heavily on the amount of packet size transferred. On the other hand, we also found that queuing delay is the main factor in rising graph values E2E delays and it keeps on increasing if packet size increases.

In the case of UDP throughput always depends on the packet size. The values for throughput in UDP scenario showed a tendency in the upper side (Figure-4(b). This can be reasoned to the effect of environmental aspects resulted to reliability and congestion avoidance mechanisms.



(a) (b)

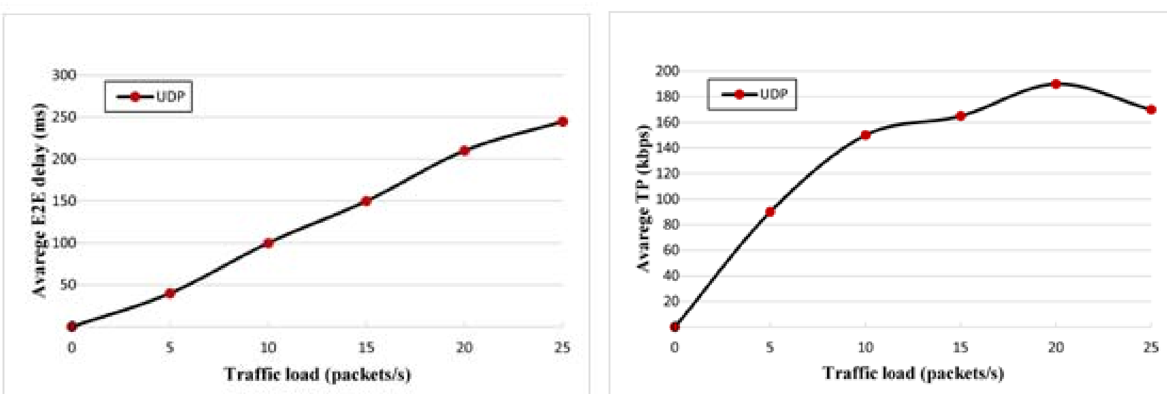
Figure-4. UDP-based packet size. (a) Average E2E delay, (b) Average TP.

7.2 UDP based on traffic load

Figure-5(a) shows that UDP flows a constant increase in E2E delay has been monitored due to occupied links, resulting in congestion as the load increases eventually leads to incrementing E2E delay.

The throughput analysis with constant packet size resulted in performance that initially an abrupt increase in throughput is observed because of low E2E delays and free links but after a constant smooth behaviour it becomes decrementing as the congestion on links increases (Figure-5(b).

The results show that UDP can always achieve sufficient fairness. Furthermore, UDP does not have any back-off mechanism in response to out-of-order packet delivery for the purpose of throughput improvement, and the improvement can be even more prominent than TCP.



(a) (b)

Figure-5. UDP-basedtraffic load. (a) Average E2E delay, (b) Average TP.

8. CONCLUSIONS

This paper introduced the common practice for evaluating UDP in certain network matrices. The researcher provided insights necessary for observing UDP performance based on examining E2E Delay and throughput using NS2. The result showed that UDP throughput always depends on the packet size in which the throughput analysis with constant packet size resulted in performance that initially an abrupt increase in throughput. Such result can be due to the tunnel endpoint encapsulates the packets of another protocol inside UDP datagrams and transmits them to another tunnel endpoint.

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