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Experimental Assessment of the Impact of Velocity on UDP End-to-End Delay of Mobile Unicast Data Network (MUDNET)

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Abstract - Mobile Unicast network is one hop network where the source node transmits traffic to one destination node characterized by movement in one direction at a time. This study evaluated the effect of nodal velocity on the UDP end-to-end delay in two different mobile unicast data networks (MUDNET) setups. Our setup for the two networks is the same using the network functionalities in our configurations as shown in table 1. We adopted Iperf as our management tool because it allows the tuning of various parameters, and reports UDP characteristics such as bandwidth, delay, and datagram loss. We observed a significant decrease in the delay of network 1 as nodal speed increases while keeping the server stationary and the client in motion in a given direction at a given time. However, in network 2 where the client is stationary and the server in motion, the result was similar but the effect was not pronounced as in network 1. Our result showed that the effect of nodal velocity on the delay of MUDNET can be minimized by keeping only the client stationary while the server can move at any velocity applicable.

***Keywords** - UDP, MUDNET, Velocity, End-to-end delay, unicast*

1. Introduction

UDP is a model protocol for network applications in which the expected quality at the receiving end cannot be adversely affected by certain data loss. UDP unlike TCP is a connectionless Datagram oriented protocol. It initiates, maintains and terminates connection without the use of handshaking dialogues [1]; as a result, the delivery of data to the destination cannot be guaranteed. According to [1] and [2], its suitability for real-time applications such as Voice over IP, online games, and many protocols built on top of the Real-Time Streaming Protocol is a function of its lack of retransmission delays.

2. The Performance Metrics

This section presents the performance metrics used to assess ad-hoc data network protocols. The throughput, average end-to-end delay and routing message overhead are among the most widely used metrics to assess MADNET.

2.1 Throughput

Throughput is the size of the effective network transmission rate. It's defined as the number of data packets successfully conveyed from source to sink in a unit of time. To properly define this metric in relation to other networks, two variables must be determined which include the number of active nodes in the network and the network's packet size. Therefore, (A.A. Radwan, T.M. Mahmoud and E.H. Houssein, 2011) [12] defines a network's end-to-end throughput as the ratio of the number of data bytes successfully delivered to their final destination per unit of time, to the number of nodes in the network

2.2 Routing Message Overhead

According to the review in [17], the routing overhead defines how many routing packets for route discovery and route maintenance need to be sent to propagate the data packets. Routing overhead is the total number of control

packets transmitted within the time of transmitting a given data from the source to the sink. The increase in the routing overhead degrades the performance of MUDNETs as it uses some portions from the bandwidth available for transmission of data between the nodes. The observation in [16] show that there are two important sources of the routing overhead:
(1) Number of neighbors of any node (2) Number of hops from source to destination

2.3 Average End to End Delay

A network's end-to-end delay is the measure of the average time interval taken to generate and effectively deliver data packets from the source to every node in a network, for a selected period. The dropping of packets or lost ones is a frequent occurrence in wireless networks, so time lost in such occurrence is not considered in the calculation of this metric [12]. All the likely delays experienced such as in buffering during route-finding latency, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times as detailed in [15] are all considered. According to F.T. AL-Dhief et al (2018), it is the meantime of the successfully transmitted data packet over the network from the source to the destination. It is computed as follow:

$$End - to - end\ delay = \frac{\sum \text{arrival time} - \text{send time}}{\sum \text{number of connections}}$$

3. Related Works

UDP and TCP are the two transport layer protocols that establish a connection between communicating nodes. The data packets are conveyed from the source to the sink by the primary IP.

Bikash Chandra Singh et al [5], through simulation results in the NS-2 environment evaluated throughput and end-to-end packet delay over the UDP connections in ad-hoc networks. They observed from the results of simulations for four network scenarios of 4, 8, 16 and 32 nodes that UDP throughput increases as the number of nodes increases. It’s observed from the result that UDP throughput performance is best over the DSR routing protocol followed by AODV. DSDV degrades the performance for the largest routing overload but shows the lowest end-to-end packet delay than AODV and DSR for UDP transmission because of its table-driven characteristics.

Providing suitable connectivity for mobile computers in the ad-hoc network is a serious challenge. In [6] an innovative approach, DSDV that models the mobile computers as routers, and cooperates in forwarding packets conveniently as needed to each other. [7] is a relative performance analysis of TCP and UDP over DSDV in a Mobile Ad hoc Network. The network evaluation is based on three parameters: throughput, end-to-end delay and packet loss. The results from the NS-2 environment show that UDP traffic over DSDV protocol performs high in terms of offered throughput within a MANET system. but UDP performance degrades in highly mobile environments. they conclude that TCP traffic over DSDV gives better results in terms of delay and packet loss in multiple scenarios. They observe that pause time has an insignificant effect on TCP traffic as compared to UDP. UDP performance is lower in the static or less mobile environment than TCP. Conclusively their study shows that DSDV works well for TCP traffic as compared to UDP traffic type.

The effects of multipath routing on TCP goodput in wireless ad hoc networks are explored in [8]. They consider different multipath routing strategies: (a) finding multiple edge-disjoint paths and using the shortest one until it breaks, then switching to the next shortest path and so on, (b) simultaneously using multiple edge-disjoint paths. The study resulted in the following observations: (i) Multipath routing affects long TCP connections positively while short TCP connections suffer a slight degradation in goodput as compared with TCP using the single shortest path. (ii) The spatial diversity benefits of using multiple paths simultaneously are very limited. (iii) The different multipath routing strategies behave identically in terms of TCP goodput. (iv) Multipath routing improves the efficiency of the route discovery process for long TCP connections in on-demand routing protocols. Conclusively, multipath routing can ease the unfairness between short TCP connections and long TCP connections [8].

The effect of increasing or decreasing buffer size has been examined in [9], using packet loss, packet delay and TCP congestion window size as performance metrics. The dynamics of UDP and TCP interaction at a bottleneck link router equipped with very small buffers is part of the work. Also, The study took into account Random Early Detection (RED) and LALRED, for different TCP (RENO) and UDP Poisson streams. Observing the impact of buffer size on TCP they found that with increasing buffer size the throughput increased as well as the performance of the TCP which includes low-delay and less retransmission of packets increased also. Conclusively, the following two results were arrived at in [9]: firstly, the number of packets lost at the gateway using LALRED is lower as compared to that using RED and secondly, the average queue size maintained when using LALRED is lower than the average queue size when using RED.

There are many possible measures of performance for queuing systems [10]. Bushnag, Anas and Bach, Christian [11], Proposed a model for performance evaluation of the most famous queuing protocols which are FIFO, FQ, SFQ, DRR and RED using packet loss ratio, end-to-end delay, delay jitter and drop fairness as performance metrics. The study uses CBR over UDP traffic because it represents multimedia data in the NS-2 environment. The scenario consists of making two nodes send traffic to a destination and then collecting results under different metrics. The result shows that FQ was providing the best results in the case of the packet loss ratio and dropping fairness, whereas SFQ and DRR were better in the case of end-to-end delay. Finally, SFQ had the best performance in the case of delay jitter.

4. Methodology

In this section, we focus on experimentally implementing a mobile ad-hoc data unicast network and observe the impact of varying velocity rate on the end-to-end delay of the network using the laptops with capacity and network functionalities as shown in table 1. In evaluating the performance of wireless networks such as mobile ad-hoc data networks, end-to-end delay takes a foremost position among other performance metrics [4]. Among other performance tools, we adopted Iperf as our management tool because it allows the tuning of various parameters, and reports UDP characteristics such as bandwidth, delay, and datagram loss. We installed it in our laptops designating one as the client (Iperf –c) and the other as the server (Iperf -s) through Iperf configurations and commands in each of the networks used for the study. We set up two networks 1 and 2 and carried out an ad-hoc UDP measurement between two computer nodes. In network 1 we kept the server stationary while the client was put into motion at varying velocity by a car which maintains a specified velocity for a given time and in a given direction as shown in fig. 1. Secondly, in network 2, we maintained the same conditions and configurations; the only variation was keeping the client stationary while the server is put into motion at varying velocity, unlike in network 1. The client sends data to the server for 10 seconds while moving at a given nodal velocity. We took a record of the delay encountered during transmission. The measurement is taken twice for each connection and the average recorded. Based on the measurements we got, we observed the impact of the node velocity on the performance of the networks and then drew our conclusions

.Table 1. Experimental setup functionalities

Specifications	Value
laptop	Hp 2710p
Wireless Standard	IEEE 802.11g
Data Rate	54mbps
Frequency	1.2GHz
Radio Channel	6
Modulation	OFDM
RF Power	20dbm (maximum)
Operating System	Win 7
RAM	2GB
Subnet mask	255.255.255.0
Gateway	disabled

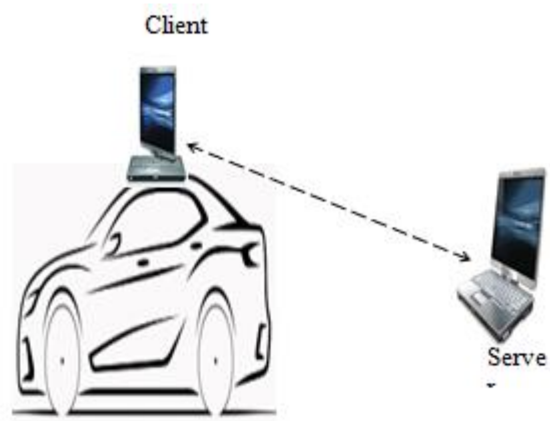

Fig. 1 Experimental set up

Table 2. End-to-end Delay of MUDNET setups

Velocity (m/s)	Delay in Network 1 (ms)	Delay in Network 2 (ms)
2.8	1.424	0.330
5.6	1.166	0.331
8.3	0.604	0.332
11.1	0.327	0.331
13.9	0.284	0.328
16.7	0.365	0.324

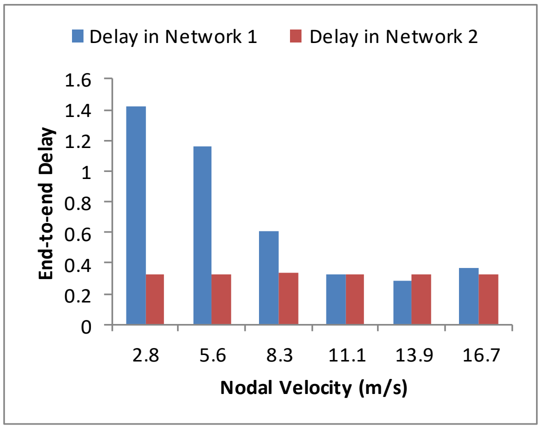

Fig.2. Bar chart of End-to-end Delay with Nodal Velocity

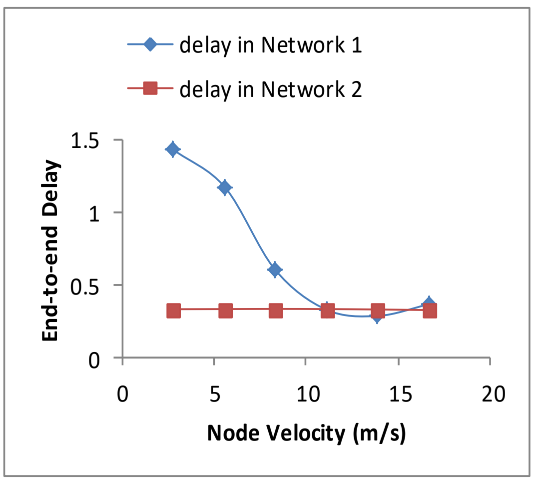

Fig.3. End-to-end Delay as a function of Nodal Velocity

5. Results

The average measurements taken from the UDP connections of networks 1 and 2 are tabulated in table 2. In network 1, the client is stationary while the server moves at specified velocity; however, the reverse is the case in network 2. We observed from fig. 2 and 3 that while the nodal speed increased in network 1, the delay also decreased, showing a direct relationship between the two variables. On the other hand the same relationship existed in network 2 but the decrease was so much minimized when the server was in motion. The effect of the movement was more pronounced in network 1 where the client is in motion compared to network 2 where the server was in motion.

6. Conclusion

This study experimented on the effect of nodal velocity on the UDP end-to-end delay in two different MADNET unicast network setups. Our observation did not only show the descendent effect of delay as the nodal velocity increases but also showed that which of the node that moves is a dominant factor that determines the rate at which the delay decreases as the speed increases. The effect of movement could be masked in network 2 by putting only the server in motion. We recommend that similar to the nodal velocity effect on the throughput in [4] where the effect of velocity was masked when the server was in motion; that to maintain the minimum effect on delay with an increased rate of movement, the client should be stationary while the server can move at any speed practicable.

References

[1] Dr. M. Kumar and R. Yadav “TCP & UDP Packets Analysis Using Wireshark” International Journal of Science, Engineering and Technology Research (IJSETR), Volume 4, Issue 7, July 2015
[2] P.R. Verma, and N. Singh “TCP & UDP Packets Analysis Communication on Personal Computer with Wireshark” Intl J Engg Sci Adv Research; 3(1):1-9 ISSN NO: 2395-0730, March 2017
[3] https://www.geeksforgeeks.org/differences-between-Tcp-and-udp/
[4] S.E. Eleje, R.I. Hart and M.T. Pepple "Impact of Node Velocity on the TCP Throughput of Mobile Ad-Hoc Data Network (MADNET)” European Journal of Engineering and Technology Vol. 8 No. 1, pg 48-55, 2056-5860. 2020
[5] B.C. Singh, T. K Godder, Md. S. Miah, H. M. Abdul Awal “Experimental Analysis of UDP Performance in Mobile Ad Hoc Networks with Different Routing Protocols and varying payload” International Journal of Distributed and Parallel Systems (IJDPS) Vol.2, No.6, DOI : 10.5121/ijdps.2011.2610 107. November 2011
[6] Charles E. Perkins and Parvin Bhagwat, “Highly dynamic destination-sequenced-distance-vector routing (DSDV) for mobile computers”, Technical report, IBM Research and University of Maryland, USA
[7] H.F Zahid, M. Ahmad, M. Najam-Ul-Islam and H. Javed “Performance Evaluation of TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) over Destination Sequence Distance Vector (DSDV) for Random Waypoint Mobility Model” World Applied Sciences Journal 20 (7): 910-916, ISSN 1818-4952 ©IDOSI Publications, 2012 DOI:10.5829/idosi.wasj.2012.20 07.2650. 2012
[8] Z. Ye, S.V. Krishnamurthy, S.K. Tripathi “Effects of

Multipath Routing on TCP Performance in Ad Hoc Networks"
[9] P.G Ambhore, S.G Mahajan "Effect of Router Buffer on TCP/UDP Performance" IOSR Journal of Computer Engineering (IOSR-JCE) e-ISSN : 2278-0661, p-ISSN : 2278-8727 PP 12-17. 2015
[10] Giddaluru Madhavia and M.K. Kaushikb "Queuing Methodology Based Power Efficient Routing Protocol for Reliable Data Communications in Manets" 2013
[11] A. Bushnag, and C. Bach "Performance Evaluation of Unicast Networks Using Different Queuing Protocols" ASEE 2014 Zone I Conference, April 3-5, University of Bridgeport, Bridgeport, CT, USA. 2014.
[12] A.A. Radwan, T.M. Mahmoud and E.H. Houssein "Performance Measurement of Some Mobile Ad Hoc Network Routing Protocols" IJCSI International Journal of Computer Science Issues, Vol. 8, Issue 1, ISSN (Online): 1694-0814 www.IJCSI.org. January 2011
[13] F.T. AL-Dhief et al "Performance Comparison between TCP and UDP Protocols in Different Simulation Scenarios" International Journal of Engineering & Technology, 7 (4.36) (2018) 172-176. 2018
[14] M. Naserian, K.E. Tepe, and M. Tarique "Routing Overhead Analysis for Reactive Routing Protocols in Wireless Ad Hoc Networks" 18 January 2017.
[15] A. Al-Maashri, and M. Ould-Khaoua, "Performance analysis of MANET routing protocols in the presence of self-similar traffic" In, Proceedings of the 31st IEEE Conference on Local Computer Networks, 2006, 14-16, pages pp. 801-807, Tampa, Florida, USA, November 2006.
[16] K S R Murthy, Dr S.V. Raju "Based on Packet Delivery Performance Review for Route Discovery in Reactive Routing Protocols (AODV, AOMDV, DSDV)" (IJCSIT) International Journal of Computer Science and Information Technologies, Vol. 6 (3), 3210-3218. 2015

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