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Performance Analysis of AOMDV over TCP and UDP Traffic Pattern under Several Scenarios in Mobile Adhoc NETworks (MANETs)

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ABSTRACT

Mobile Adhoc NETwork (MANET) is an infrastructure less network which is setup on temporary basis for the regions where infrastructure network is of no mean. Mobile nodes are the building blocks of MANETs which moves in arbitrary directions and create random topology. In MANETs the nodes communicate with each other in peer to peer fashion without the involvement of any base station. Routing is one of the major challenges in MANETs. This paper presents the performance analysis of Adhoc On-Demand Multipath Distance Vector (AOMDV) routing protocol over Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) Traffic Pattern under several scenarios. The performance metrics used are throughput, average end to end delay (E2E delay), Packet Loss and Normalized Routing Load (NRL). The varied scenarios used in our simulation environment include number of nodes, pause time and node speed. The results show that AOMDV over TCP perform better than UDP in all cases and it is also concluded that AOMDV over both traffic pattern performs well both in low and high mobility.
KEYWORDS: NS-2.34, MANETs, AOMDV, Traffic Pattern, TCP and UDP.

I. INTRODUCTION

Mobile Adhoc NETworks (MANETs) consist of mobile nodes that exchange data with each other without central controller or Access Point [1, 2]. Nodes are independent of each other. Each mobile node in the communication can acts as a peer as well as a client at the same time [3]. MANETs are implemented in the areas where the deployment of infrastructure network is meaningless or not very cost-effective. It is developed for the situations like battle field and earthquake effected areas or any emergency events [4]. In MANETs, The source communicates with destination either directly if nodes are within the range or using multi-hops if out of wireless range [5]. Directly connected nodes communicate in peer to peer fashion while indirectly nodes follow multihop using intermediate nodes [6, 7]. MANETs posses dynamic topology due to the nodes which are free to moves in any direction and hence the topology changes instantly and unpredictably [8]. Due to high dynamic topology, the chances for link breakage are more [9]. The sophisticated and well known characteristics of MANETs include unpredictably changing topology, limited bandwidth, energy constrained operations and less physical security [10, 11]. MANETs are not fully secured-susceptible to security attacks [12] because the communication channel is open, to which any malicious device can be connected and similarly there is no centralize management [13] for controlling the mobile nodes from a single point.

Routing in MANETs is important and complicated issue [14, 15]. Routing in MANETs is used for path discovery and maintenance between source and destination via intermediate nodes [14]. In routing, the best path between source and destination is discovered that is used for exchanging data packets in proper time frame [4]. Three types of routing protocols used in MANETs are Proactive, Reactive and Hybrid [16].

Proactive routing protocols maintain routing tables which have the information of the entire topology. The routing table updated either periodically or due to certain changes occurred in the network. Proactive protocols discover routes at the beginning and maintain them until they are valid so when a route is needed, the proactive protocols provide it immediately. The side effect of these protocols is the excessive routing overhead due to regular sending of hello messages for maintaining a route up to date [17].

Reactive routing protocols do not maintain route unless needed. When a route is demanded, reactive protocols start route discovery for it. These protocols maintain the routes for active destination nodes [7].

Hybrid routing protocols have the properties of both proactive and reactive protocols thus sometime they work like proactive and sometime reactive hence they give the advantages of both [17-19].

Our work is limited to reactive Adhoc On-Demand Multipath Distance Vector (AOMDV) routing protocol.

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The rest of paper is organized in such a way that section II shows overview of the selected protocol AOMDV. Section III contains literature overview and section IV presents simulation setup. Performance metrics are included in section V, section VI is about simulation results and finally the conclusion is described in section VII.

II. OVERVIEW OF SELECTED PROTOCOL 'AOMDV'

AOMDV is reactive routing protocol [4] basically designed for high dynamic topology where there are high chances of link failure [20]. AOMDV is the enhanced form of AODV used to locate multiple routes from source towards destination. The multiple routes computed by AOMDV are loop-free and link-disjoint. The details of next hops along with their corresponding hop counts are kept by each routing entries in the routing table for each destination. Link disjoint and path disjoint are two types of path used in AOMDV. Link disjoint path as show in Figure 1 (a) don't have any common link whereas node disjoint path as shown in Figure 1 (b) don't have common node except the source and destination [20]. In AOMDV route discovery, Route Request (RREQ) is broadcasted in the network and all nodes acknowledges with Route Reply by providing additional route towards destination. These alternate paths can lead toward routing loops. In order to terminate the chance for loop creation, 'advertised hop count' is used which defines the maximum hop count for all paths. The advertised hop count is maintained in the routing table of each node. In route advertisement this advertised hop count is sent. While selecting the path from alternate ones, the protocol select the path with less number of hop counts. If the alternate paths have either smaller sequence number or same hop counts they are immediately discarded and if route advertisement received for a destination have higher sequence number, the next hop list and advertised hop counts are refreshed i.e. path with higher sequence is selected [21].

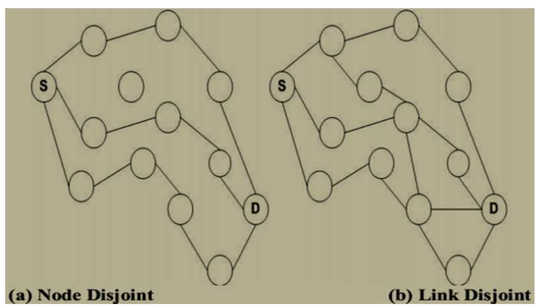

Figure: 1 Representation of Node and Link disjointness [14]

III. LITERATURE REVIEW

In [2], the authors have evaluated the performance of AODV, AOMDV, DSDV and DSR using 1 and 2 hop scenarios. The authors have used NS-2.34 using Two Ray ground propagation model. Throughput, delay and fairness are the QoS parameters used by authors. The authors have used number of sources and intervals for finding performance metrics. The authors concluded that in 2 hops the AODV protocol gives good throughput but poor delay similarly it is also shown that throughput and delay in case of DSDV protocol is poor. The authors also concluded that DSR gives balanced throughput and delay. In single hop fairness of AODV and AOMDV protocol is good, it is balanced in DSR and it is worst in DSDV.

The performance evaluation of AOMDV is shown in [4]. The authors have used several mobility models which are RWM, RPGM, MGM, GMM using simulator NS-2.34. The metrics they used are PDF, Average throughput, Routing Overhead, Normalized Routing Overhead, Average End to End Delay and Packet Loss. The authors have shown the performance of AOMDV under TCP and CBR traffic pattern with varied nodes 25, 50, 75, and 100. The authors have concluded the model in which AOMDV has worked best. They concluded that AOMDV gives significant performance both in CBR and TCP traffic in RPGM model. The authors also shown that RWM is the most widely used mobility model in MANETs.

In [7], the authors have shown the comparative analysis of DSDV and AOMDV. They carried out experiments in NS-2 using metrics such as End-to-End delay, PDR and Routing load. The authors simulated and recorded the performance of their selected protocols under TCP traffic pattern. They recommended DSDV protocol for compact while AOMDV protocol for dense network.

Analysis of Quality of Service for AOMDV protocol is done with TCP and UDP traffic in Grid topology area 1000*1000 using NS-2.34. The authors have presented the performance by using different packet transmission rate, no's of sources and destination. With data packet size 512 bytes and simulation time 50 s the authors have analyzed the performance of AOMDV in terms of throughput, Drop Packet Ratio, Average Delay (Avg Delay), route discovery frequency and routing overhead. The authors concluded that by increasing packet rate, degradation occur in the performance of AOMDV over CBR traffic while the performance consistent for UDP [9].

A comparative study of AODV and its variation AOMDV under TCP and UDP protocol using NS-2 is done by the authors in [26]. The authors concluded that AOMDV perform better than AODV in terms of throughput and energy consumption.

IV. SIMULATION SETUP

All the simulations are carried out in NS-2.34. The mobile nodes are created for Random Waypoint Mobility model using *setdest* utility of NS-2. Three different scenarios with varied number of nodes, pause time and node speed are used for the evaluation of AOMDV performance. The constant parameters for each scenario are Pause Time, Speed and Area which are 2 sec, 10 m/sec and 700*700 meter square respectively. The rest of important parameters are shown in Table 1.

V. PERFORMANCE METRICS

Throughput:
The actual data passing through the network in unit time [22].

Average end to end delay (average E2E delay):
The time taken by the data packets to the time it is received by the receiver.

E2E delay = received time – sent time

Average E2E delay is equal to the summation of time taken by all received packets divided by their total numbers [23].

Packet Loss:
It is the ratio of the packets generated by the source to the ratio of Packets not received by the destination [23].

Packet Loss = sent packets – received packets

Normalized Routing Load (NRL):
The number of routing packets delivered per data packets [24].

Parameters	**Values**
Simulator	NS-2.34
MAC	802.11
Interface Queue Type	Queue/DropTail/PriQueue
Propagation Model	Two Ray Ground
Antenna	Omni Antenna
Protocol	AOMDV
Mobility Model	Random WayPoint
Number of nodes	10,20,30,40,50,60
Pause time	0,30,60,120 sec
Node speed	5,10,20 m/sec
Simulation Area	700*700 m^2
Data Rate	0.01 Mbps
Traffic Pattern	TCP,UDP
Maximum connections	8 Connections

Table: 1 Parameters used in simulations

VI. SIMULATION RESULTS:

In our simulations results, each scenario exists two times redundantly in graphs with different performance metrics. In scenario 1 there are two Figures, evaluating the performance of AOMDV under node density. Figure 2 show throughput and packet loss over TCP and UDP whereas Figure 3 show End to End Delay and NRL over TCP and UDP under Node density. Same procedure is used for all scenarios.

Scenario 1 Node Density:

It has been shown in Figure 2 that the throughput of AOMDV over both TCP and UDP connection work well for our proposed network however beyond 50 nodes the throughput becomes degraded as the connections become weaker to allow more nodes to pass through them. Individually, TCP outperform UDP in every case and this fact is same for all the scenarios in our simulations.

For the given number of nodes, the performance of AOMDV over TCP traffic pattern in terms of packet loss is not effected at all. UDP gives a slight degradation on 60 nodes in terms of packet loss.

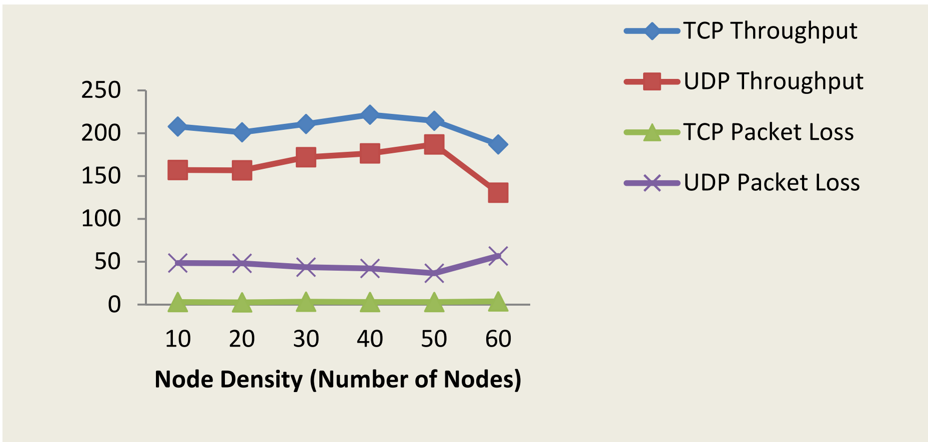

Figure: 2 Throughput and Packet Loss analysis of AOMDV over TCP and UDP under Node Density

Figure 3 shows that by increasing number of nodes, AOMDV performance become weaker in terms of Delay in UDP traffic pattern while in TCP, the delay is almost same and near to zero for all number of nodes. Higher delay of UDP is due to the fact that sender send the data without acknowledgement of the receiver, hence the data often stay in waiting queue of the receiver whereas in case of TCP the sender consult the receiver for amount of data. Traffic flow is controlled in TCP by windowing that is why delay is minor in TCP.

NRL increases continuously by increasing number of nodes both for TCP and UDP traffic pattern. This is because AOMDV due to its nature, send routing packets on multiple routes and hence creates more routing overhead. Individually, TCP perform better than UDP for AOMDV in all cases.

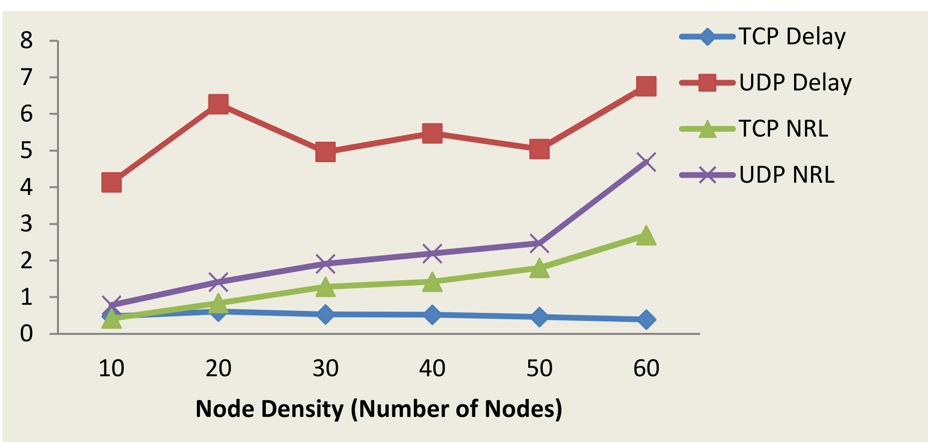

Figure: 3 Delay and NRL analysis of AOMDV over TCP and UDP under Node Density

Scenario 2 Pause Time:

The throughput of AOMDV over both TCP and UDP become low in high pause time as compared to low pause time. From Figure 4 we also see that on high given pause time the throughput of AOMDV for TCP become degraded which becomes nearly equal to UDP.

Packet drop ratio of AOMDV over UDP is much higher than AOMDV over TCP on all given pause time. Increasing pause time creates minor increments in the drop rate of UDP.

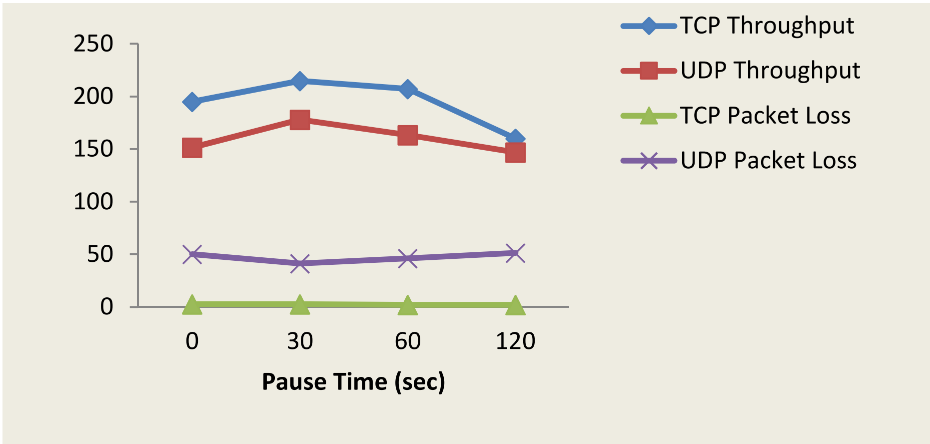

Figure: 4 Throughput and Packet Loss analysis of AOMDV over TCP and UDP under Pause Time

It is cleared from Figure 5 that high pause time badly effects the performance of AOMDV in terms of delay for UDP whereas TCP traffic pattern gives negligible and same delay in all cases.

Routing overhead for AOMDV over UDP traffic pattern, is higher as compared to TCP and both shows unchanging behavior in pause time.

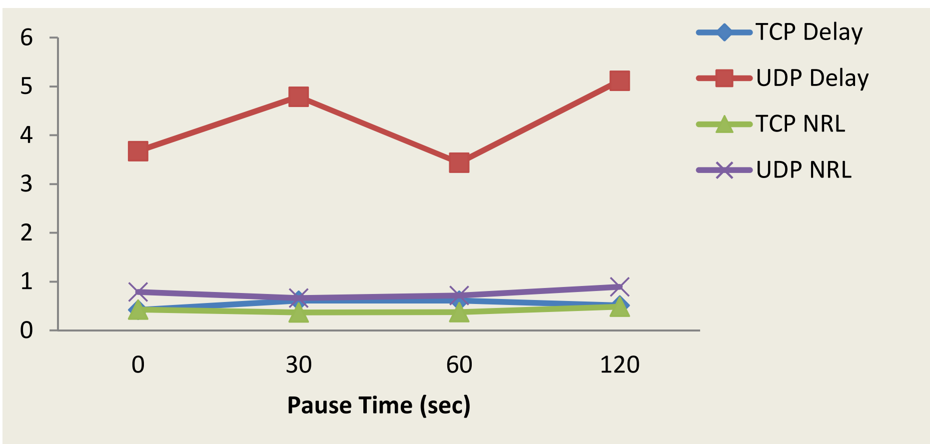

Figure: 5 Delay and NRL analysis of AOMDV over TCP and UDP under Pause Time

Scenario 3 Node Speed/Mobility:

According to our simulation result, AOMDV perform well in high mobility for TCP. It is declared from Figure 6. TCP performance has far better than UDP for AOMDV. Performance degradation is observed beyond 10 m/sec for UDP.

AOMDV packet loss rate for both traffic patterns almost remains same by changing mobility. Individually, UDP over AOMDV drop more packets as compared to TCP. AOMDV maintains multiple paths from source to destination so in case of link breakage the data is immediately send out via alternate paths that is why in high dynamic topologies AOMDV works well. Figure 7 declares that except a slight degradation of AOMDV performance in term of delay over UDP, AOMDV works well for the rest of the parameters.

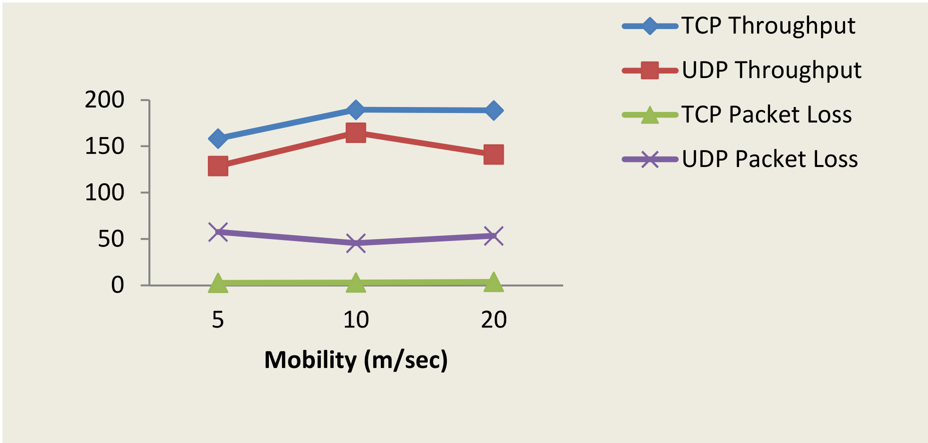

Figure: 6 Throughput and Packet Loss analysis of AOMDV over TCP and UDP under Mobility

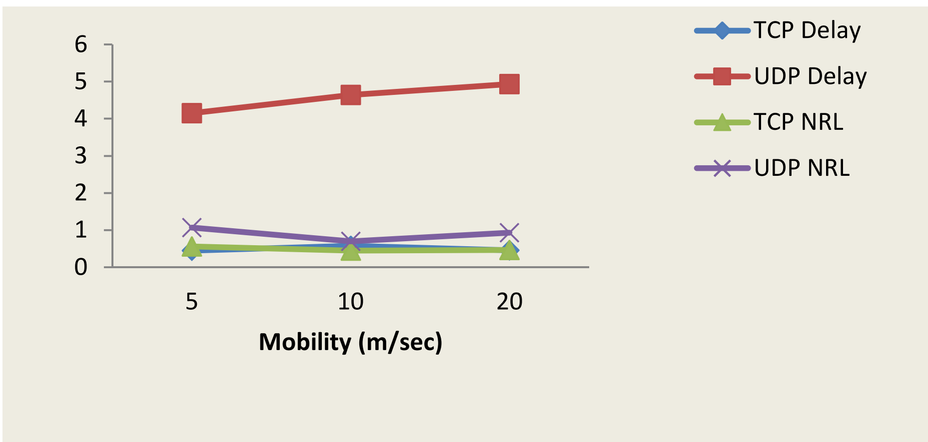

Figure: 7 Delay and NRL analysis of AOMDV over TCP and UDP under Mobility

VII. CONCLUSION

This paper presents the performance analysis of AOMDV over TCP and UDP traffic pattern using NS-2.34. The analysis was based on throughput, end-to-end delay, packet loss and normalized routing load by changing number of nodes, node speed and pause time. According to our simulation results, AOMDV over both TCP and UDP gives good and almost static throughput by varying node density however more number of nodes slightly degraded the performance of AOMDV in terms of Delay for UDP traffic pattern. Node Density has no certain effect on drop ratio. In high density network, more Normalized Routing Load is observed for AOMDV over both traffic patterns. Pause time and mobility has negligible effect on the performance of AOMDV in terms of NRL. By increasing pause time, the delay for UDP connection increases which degraded the performance. According to our simulation environment, AOMDV works well in high mobility almost in every case due to its multipath nature.

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