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Performance Investigation and Analysis of Routing Protocols in MANET

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Abstract: Mobile Ad-hoc Network (MANET) is a significant and confirms research area. The routing protocol should distinguish and keep an exceptional route among source and target. There are several assailants that able to create problems in the network, for example, a flooding assailant that causes a sag in several packages. In this study, it creates an investigation and analysis of lateness, normalized routing loads and packet delivery fractions of MANET, 2 routing protocols using Transmission Control Protocol (TCP) and User Datagram Protocol (UDP), under normal conditions and under dropping packet cases. This comparison is important when choosing the better transfer package from the source to the target and the traffic kind in the network by routing protocol. The results show that AOMDV is better than AODV using TCP and UDP. In a normal condition, the delay of packets in AOMDV reaches its maximum at 0.1967, 0.3116 and 0.2832 with TCP and at 0.045, 0.0386 and 0.094 with UDP in the first, second and third scenarios, respectively. In dropping packets condition, the delay of packets in AOMDV reaches its maximum at 0.0162, 0.0587 and 0.0224 with TCP and at 0.0151, 0.0201 and 0.014 with UDP in the 1st-3rd scenarios, respectively.

Key words: MANET, AODV, AOMDV, NS-2, research, exceptional

INTRODUCTION

A Mobile Ad-hoc Network (MANET) is an accumulation of wireless mobile nodes which dynamically creates the network in the lack of static framework. One of the unique characteristics of MANET is every node must be able to work as a router to discover the best track to send a package. As nodes, may be mobile, entering and departure the network, the topology of the network will alteration continuously. MANETs supply a developing mechanism for civilian and military applications. One of the significant research areas in MANETs is creating and keeping the ad hoc network over the utilize of routing protocols (Kiess and Mauve, 2007; Ramanathan and Redi, 2002).

Ad hoc routing protocols can be separated into 2 classifications; proactive routing protocols and reactive routing protocols. Proactive (table-driven) routing protocol is a method where every router able to build its own routing schedule depend on the data which every router or node able to absorb through replacing data between the network's routers. This is accomplished via., replacing update messages among routers on a uniform basis to save the routing schedule in every router modern. Furthermore, every router refers its own routing schedule to route a package from its source to its target.

When the node of source or an intermediate node refers the routing schedule, the track data that is update is directly obtainable and able to be utilize through the node. The reason behind this issue that every router or node in the network occasionally up-to-date routes to each nearby nodes by distribution messages which the node received from the other nodes in the network (Boukerche *et al*., 2011). In a proactive routing protocol, despite the fact that getting the way data is quick, the upkeep of update network needs high overhead traffic and require a few important amount of bandwidth. In addition in a reactive routing protocol, the route detection procedure occurs extra often. However, this procedure demand low control overhead traffic analysis to the proactive routing protocol. Then, the reactive is deemed to be extra climbable from the proactive routing protocol. Furthermore, utilizing a reactive, the node has to wait for the detection procedure every time the node tries to forward a message; this raise the general lateness (Abolhasan *et al*., 2004; Alotaibi and Mukherjee, 2012).

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In this study, the implementation of different scenarios has covered the performance of the routing protocols AODV and AOMDV. In addition, it used different protocol UDP and TCP to performance evaluation routing protocols. Also, answered the question of which is the best routing protocol the performance metrics which are the average End-To-End (E2E) delay, normalized routing load and packet delivery fraction using the Software NS-2.

General review of ad-hoc routing protocols: In MANETS, the primary motivation behind the tradition or standard protocols is to control the path in that the versatile hubs choose how to exchange the course parcels to each other. These protocols are approximately categorized into 3 main classified namely proactive, reactive and hybrid protocols. Proactive protocols keeping routes to all nodes, containing nodes to that no packages are forwarded. Proactive protocols contain DSDV, OLSR and WRP. In reactive protocols, routes among hosts are strongminded only when they are clearly required to send package. Reactive protocols contain AOMDV and AODV. Hybrid mechanisms join proactive and reactive approaches to discovery effective routes without abundant control overhead. The routing protocols that used in this study over MANET are:

Ad-hoc On-Demand distance Vector routing (AODV): AODV is a reactive and a single track routing protocol. It let users to discovery and keep routes to other users in the network and every routes are requirement. The ad-hoc on request distance vector routing protocol gives unicast and multicast communications in ad-hoc networks. AODV starts route find whenever a route is required via., the source node or whenever a node demands to join a group of multicast. Routes are kept therefore they are required over the source node or the group of multicast occur and routes are continuously circle free over the utilize of sequence numbers. AODV keeps a route schedule in that the next hop routing data for target nodes is kept (Royer and Perkins, 2000). Route detection in AODV keep track a route demand/response period. A source node in requirement of Route Broadcasts a Route Demand (RREQ) package via., the network. Each node with a present route to the target itself able to return to the RREQ via., unicasting a Route Response (RREP) to the source node. When the source node needs to transfer note to some target nodes and unable to have a good route to which target it starts a track find method to determine the other node. It broadcasts a Route demand (RREQ) package to its neighbors that then send the demand to their neighbors and until either the target or an Intermediate

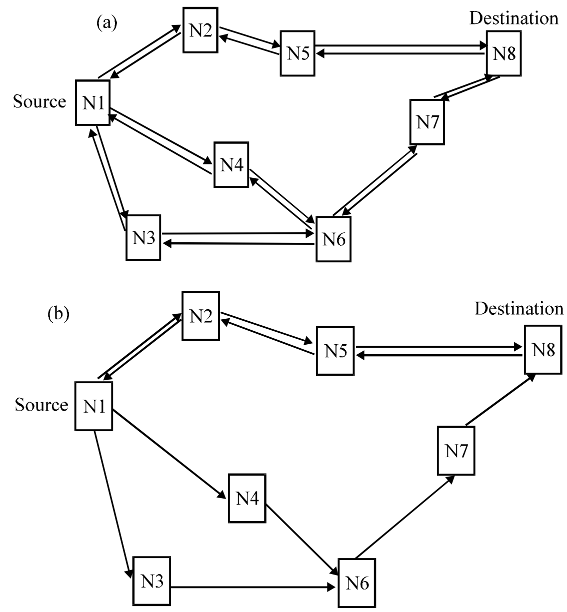

Fig. 1: AODV procedure of route discovery; a) Propagation of the RREQ and b) Path of the RREP to the source

node with a "fresh enough" route to the target is existing. Figure 1 clarify the broadcast RREQs spread over the network. AODV use target sequence numbers to guarantee all routes are circle-free and include the modern route data. in every node keeps its own sequence number and in addition a broadcast ID. The broadcast ID is increased for each RREQ the node starts and together with the node's IP address inimitably recognize an RREQ. The source node contains in the RREQ the newest sequence number it has to the target. Intermediate nodes able to response to the RREQ only if they have a route to the target whose consistent target sequence number is bigger than or similar to which involved in the RREQ. Pending the procedure of sending register of intermediate nodes in their route schedule the neighbor address from that the primary copy of the broadcast package is collected, thus, creating an opposite path. If extra copies of the similar RREQ are later received, these packages are waste (Royer and Toh, 1999). Once the RREQ achieves the designation or an intermediate node with a new sufficient route the target intermediate node reply via., unicasting a Route Response (RREP) package back to the neighbor from that it primary received the Route demand (RREQ) (Royer and Toh, 1999). Once the source node receives the RREP it able to start forwarding information packages along this route to the target (Royer and Perkins, 2000).

Figure 1 is the explain of RREP notes send to the source node and next route chosen through the source node to the target. As the RREP is routed back together the turnaround track, nodes through path set up send route entrance in their route schedule that point to the node from that the RREP arrived. These send route passes tick the active send route. Connected with every route entry is route timer that will work on discovery of the access if it is not utilize into the determine life time. The reason behind this issue that RREP is sent along the track decided via., the RREQ, AODV only provides the utilize of symmetric connections (Royer and Toh, 1999). The interface disruptions are probably going to happen. When a connection disruption in an active route happens, the node upstream of the pause broadcasts a route error note restrain a schedule of all targets that are now unable to access because of the loss of the connection. The RERR is spread back to the source node. Once the source node obtains the note it can return the route find if it is still indispensable a route (Royer and Perkins *et al*., 2000).

In any case, AODV embraces an altogether different system to keep up routing data. It utilizes conventional routing schedule, one access per target. AODV utilize sequence numbers keep at every target to locate routing freshness data and to restring routing loops. These sequence numbers are load through all routing package. A signifying advantage of AODV is the conservation of timer-based cases in every node, related use of separate routing schedule entries. A routing schedule entry is expired if not utilize newly. A group of precursor nodes is keep to every routing schedule entry, referring the group of neighboring nodes that utilize that entry to route information packages. These nodes are report with RERR package when the next-hop connection disruptions. Every precursor node sends the RERR to its own group of precursors, therefore, efficiently erasing whole routes utilizing the wrecked connection.

Ad-hoc On-demand Multi path Distance Vector routing (AOMDV): Ad-hoc On-demand Multipath Distance Vector Routing (AOMDV) protocol is an expansion to the AODV protocol to calculate multiple circle-free and connection separate tracks. Multipath routing is a mechanism supply multiple substitute paths among every source and target in a network. The interest of every mechanism is a mistake tolerance, bandwidth raising and security refinement. Correspondingly, circling (infinity circle) and best separate tracks or node-separate are the maj or issue in such systems (Ibrahim *et al*., 2009).

When some route declarations are received for a target with a larger number of sequence, the next-hop schedule and the declared hop count are reinitialized. AOMDV able to be utilized to discovery node-separate or

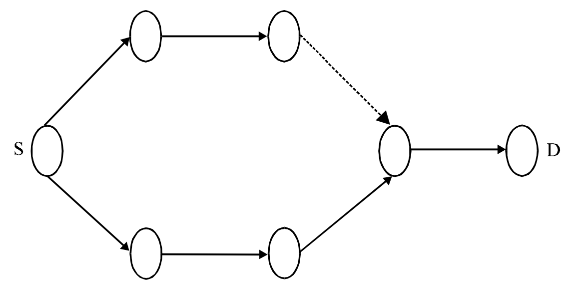

Fig. 2: RREQ is transferred by the dotted connection

connection-separate routes. To discovery node-separate routes, every node does not immediately reject repeat RREQs. Every RREQs coming by a between neighbor of the source understand a node-separate track. The reason behinds this issue, nodes not able to be broadcast repeat RREQs, so, every 2 RREQs coming at an intermediate node by a various neighbor of the source could not have disconnect the similar node.

Many vicissitudes are indispensable in the fundamental AODV route find technique to allow calculation of multiple connect unite routes among source target pairs. Note which every intermediate node on the route among a source S and a destination D able to likewise form such multiple routes to D, therefore, creating obtainable a huge number of routes among S and D. In the route find process, a reverse track is set up backwards to the source by the similar track the route demand RREQ has crossed. If repeats of the RREQ impending by various tracks are deleted as before only one reverse track able to be formed. To form multiple routes all repeats of the RREQ reaching at a node are tested as every repeat describes a substitute route. Figure 2 shows every of these substitute routes cannot be separate. The first hop data requests to be involved in the RREQ package as an extra field. Every node recalls the first hop of every it has seen with the similar source id and broadcast id. A reverse track is created when the primary hop is wonderful. Nevertheless, as in regular AODV only the primary copy of the RREQ is progressed. So, there is no extra routing overhead. All these reverse tracks able to be using to increase multiple RREPs towards the source, so which multiple sent tracks able to be designed. Message which all each tracks are node separate.

Literature review: This study presents an overview of the use of routing protocols AODV and AOMDV in MANET.

Survey on MANET routing protocol and suggested multipath extension in AODV development AOMDV with the route detection and route maintenance phase similar to AODV. The main difference lies in the route discovery procedure which has been modified to allow multiple paths (Javaid *et al*., 2013; Jain *et al*., 2012). An overview of AODV routing protocol stated the AODV is a reactive protocol routes are created whenever required for transmission of the data. If the wireless nodes are within the range of other then intermediate nodes do not require. However, we need intermediate nodes for source to destination transfer of data. Different routing algorithms define a scheme to transfer the information ways. Adhoc network various from the traditional ways as they need to discover path every time as path varies with changes in the topology (Maurya *et al*., 2012).

Performance comparison of AODV and AOMDV routing protocols in mobile Ad-Hoc networks. In this work it examines these routing protocols via., wide simulations in NS-2 simulator and indication which how number of nodes, stop time and traffic rate impact their performance of AODV and AOMDV is evaluated depend on packet delivery ratio, network life time, scheme life time and lateness. AOMDV was design primarily for highly dynamic Ad-Hoc network where link failures and route breaks occurs frequently. It analyzes these routing protocols via extensive simulations in NS-2 simulator and show that how pause time affect their performance. Performance of AODV and AOMDV is evaluated based on packet delivery ratio, throughput, packets dropped, normalized routing overhead, end-to-end delay and optimal path length.

Simulation and analysis of AODV and AOMDV protocol during link breakage in MANET using NS-2 it describes the simulation results in order to select wich routing protocol has better performance and respond faster when implemented under link breakage condition in MANET. The simulations and comparisons of two Ad-hoc routing protocols that are Ad-hoc On-demand Distance Vector (AODV) and Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol. By using the performance metric such as average end-to-end delay, Throughput and Jitter. It can predict the best routing protocol and fast responding protocol among AODV and AOMDV when implemented under link breakage condition in MANET using Network Simulator (NS) 2 tool. Performance analysis of AODV and AOMDV and comparative to the MAODV routing protocol for MANET considered a systematic comparative analysis of a multipath routing protocol and on request routing protocol for MANETS.

The protocol, called Ad-hoc on demand Multipath Distance Vector (AOMIDV) and Ad-hoc On-demand Distance Vector (AODV). This effort evaluation metrics are Packet Delivery Ratio Residual Energy.

Our research evaluates and analyzes AODV and AOMDV routing protocols based on 2 protocols with different scenarios in MANET. In addition, we analyzed and studied problems and solutions for each QoS case.

QoS metrics: QoS is typically realized as a group of service requests which desires to be encountered via., the network while transferring a package flow from a source to its target. The network is predictable to assurance a group of able to be gauged identified service characteristics to the user such as mean lateness, packet delivery fraction and normalize routing load are QoS attributes which are determine to wireless ad hoc networks because of the limited battery source. Three type of the performance metrics is utilizing in this study, average end-to-end delay, packet delivery fraction and normalize routing load as followed.

Average end-to-end delay: It is defined as average time taken through an information packet to reached in the target:

$$\text{Delay} = \frac{\text{Sum of period time of all arrived packets}}{\text{Number of received information packets}}$$

Normalize routing load: Normalize routing load is a mean among package of routing control and information package number is reached to the destination:

$$\text{NRL} = \frac{\text{Number of routing packets}}{\text{Number of received packet}}$$

Packet delivery fraction: This is the fraction of the information packages created through the TCP or UDP sources to those sent to the target.

$$\text{PDF} = \frac{\text{Number of received packets}}{\text{Number of sent packet}} \times 100$$

MATERIALS AND METHODS

Simulation scenario: We used 3 different scenarios to evaluate and gauge different types from quality of service (QoS). The scenarios have been clarified in the Table 1.

Simulation parameters: The simulation is performed using the Network Simulator NS-2. These are

Table 1: Scenarios of the system

Number of the scenarios	Values of the parameters
First scenario	Nodes speed t =10, 20, 30, 40 and 50 (m/sec) time of pause = 0 (sec) nodes number = 50
Second scenario	Time of pause = 0, 10, 20,30 and 40 (sec) nodes speed = 10 (sec) nodes number = 50
Third scenario	Nodes number = 10, 30, ..., 0, time of pause = 0 (sec) nodes speed = 10 (sec)

Table 2: Simulation parameters

Components	Types
Simulation time	900 (sec)
Map size	1500×300 (m)
Channel type	Channel/Wireless channel
Radio propagation delay	Propagation/Two ray ground
Network interface type	Phy/WirelessPhy
MAC type	Mac/802-11
Interface queue type	Queue/DropTail/Priqueue
Link layer type	LL
Antenna model	Antenna/Omniaantenna
Max packet	50
Routing protocol	AODV and AOMDV
Traffic type	CBR and TCP
Connection rate	4 (packets/sec)
Number of connection	5
Bandwidth	2 (Mbit)
Packet size	512 (Byte)
Maximum number of nodes	50 (nodes)
Maximum pause time	40 (sec)
Maximum speed	50 (m/sec)

simulation parameters used in different scenarios to develop the network as illustrated in Table 2. Performance metrics are determined earlier in order to identify which protocols give better output when compare to each other.

RESULTS AND DISCUSSION

In this study, the simulation results are shown as below in the form of graphs. The performance of AODV and AMODV routing protocols based on 3 various scenarios to create our parameter aims. The quality of service is measured and analyzed of AODV and AOMDV routing protocols.

Analysis of the results by TCP protocol based on first scenario: Figure 3 the end-to-end delay reduces by time and node speed is improved in both routing protocols. The aim for this reduce indicates to the improve received packages number and the reducing time lateness of transferring packages to the destination. The transmission time reduced, due to the nodes become nearer for each other occasionally through the simulation.

As shown Fig. 4, the value of the normalized routing load progressively raises at the same time nodes speed will increase. The nodes altered their location rapidly because of this speed of increasing that lead to a raise in the routing packets number at the same time.

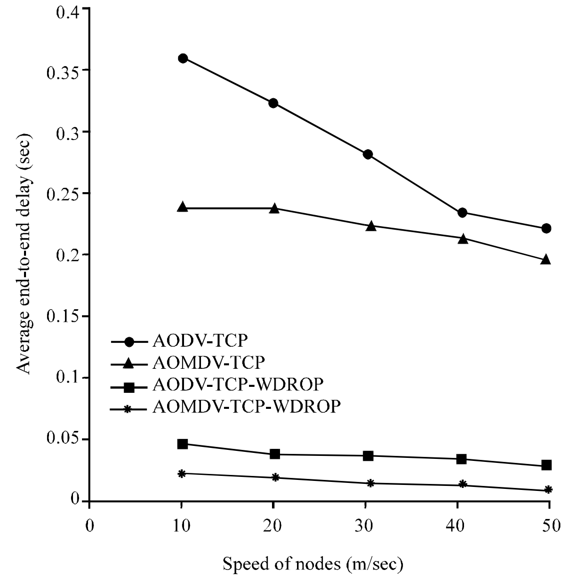

Fig. 3: Average end-to-end packet delay

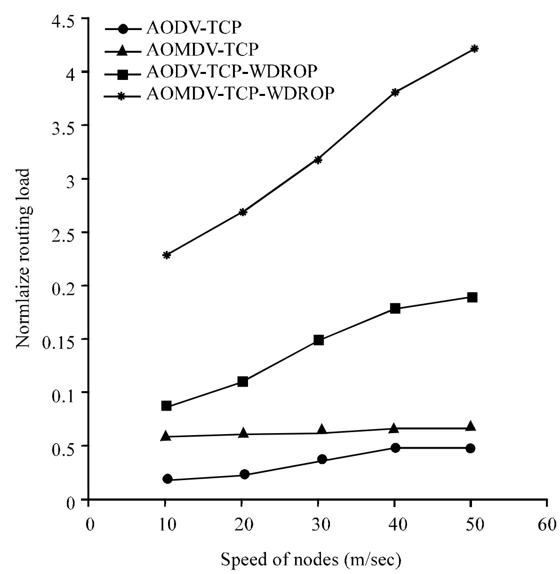

Fig. 4: Normalize routing load

Figure 5 shows the packet delivery fraction of package failures with this raising speed because of a reducing packages received number during the destination caused through the alteration in the nodes speed. This alteration in speed and location leads to a rise in routing overhead and a raising dropped packets number.

Analysis of the results by TCP protocol based on second scenario: Figure 6 shows the end-to-end lateness rises if the time of pause of the nodes is likewise raised. When

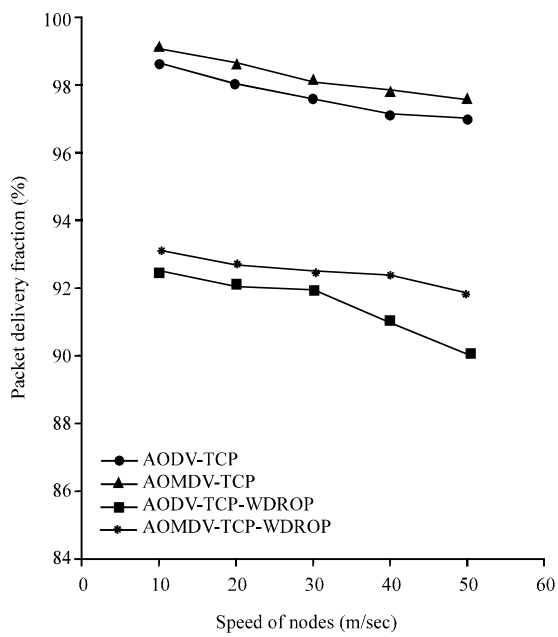

Fig. 5: Packet delivery fraction

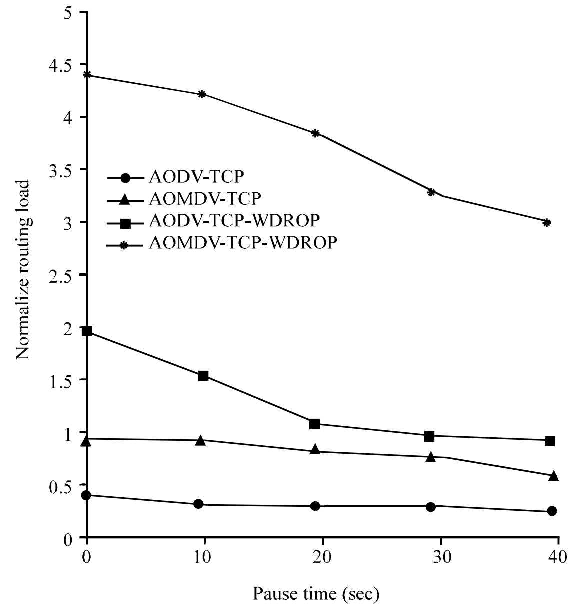

Fig. 7: Normalize routing load

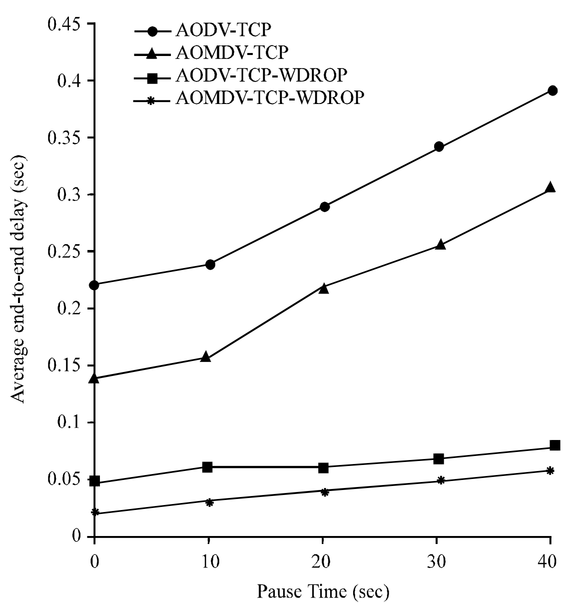

Fig. 6: Average end-to-end delay

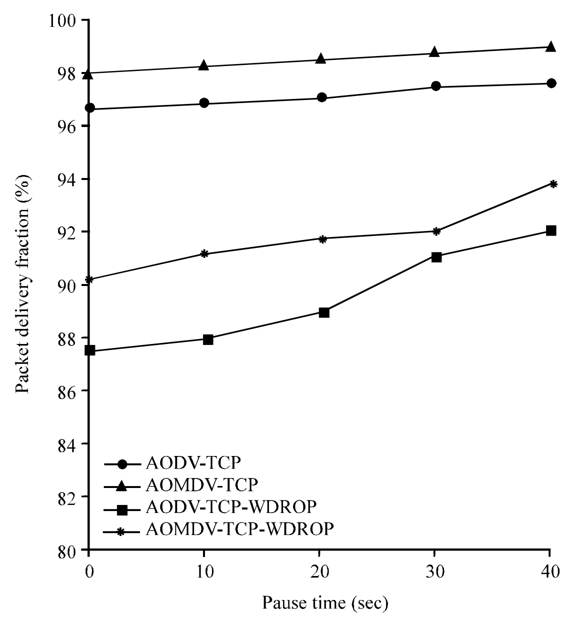

Fig. 8: Packet delivery fraction

the nodes movement stops to sometimes, the mileage among the source and the destination can become far. This refers to a need for extra time to forward the packages from the transmitter to the target.

In Fig. 7 normalized routing load reduces by time, a raised stop time for the nodes. The aim for this reduces indicates to the reducing routing packages number when the node's pause time rises. For example, when the nodes stopping needs extra time, the number of dropped packages reduces. Then, the routing packages likewise reduces.

Figure 8 shows the packet delivery fraction rises when the node stop time rises. When the stop time for every node rises, the packets number which reach at the distention likewise rises. This gets due to the number of dropped packages reduces.

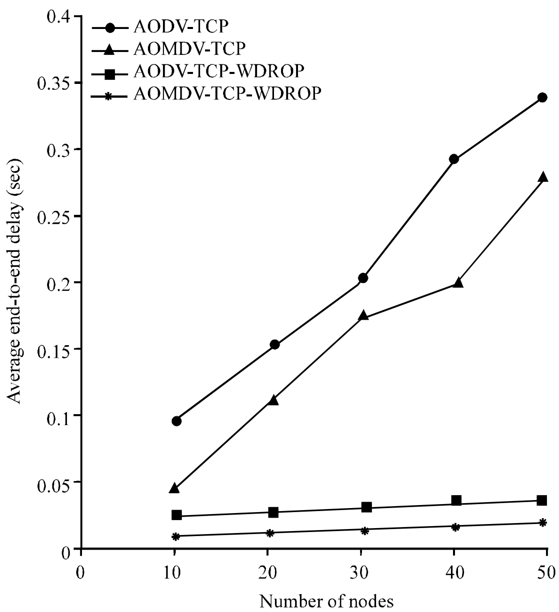

Fig. 9: Average end-to-end packet delay

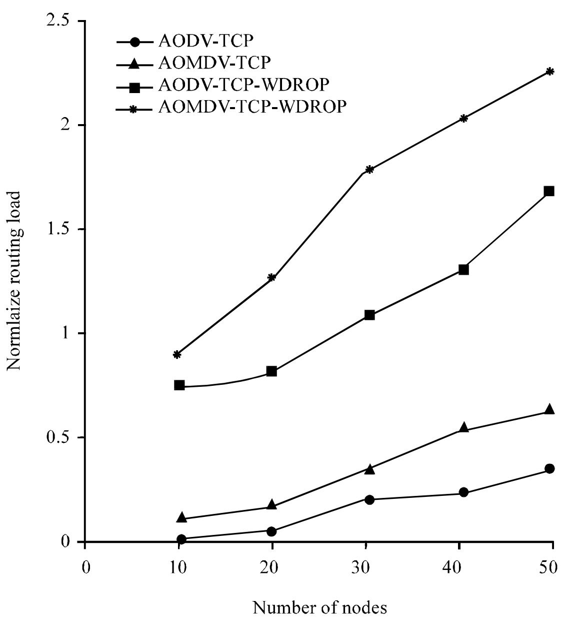

Fig. 10: Normalize routing load

Analysis of the results by tcp protocol based on third scenario: Figure 9 shows the end to end delay rises progressively by time, along with a raising nodes number. When the nodes number rises, the total amount of the delayed packages and the total number of received packages likewise rises.

Figure 10 shows the normalized routing load rises sharply with the improved nodes number. This is because of a request to extra routing packages in this simulation.

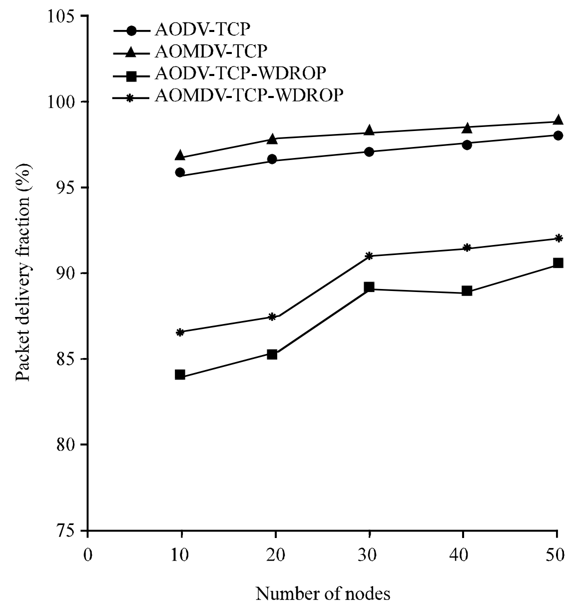

Fig. 11: Packet delivery fraction

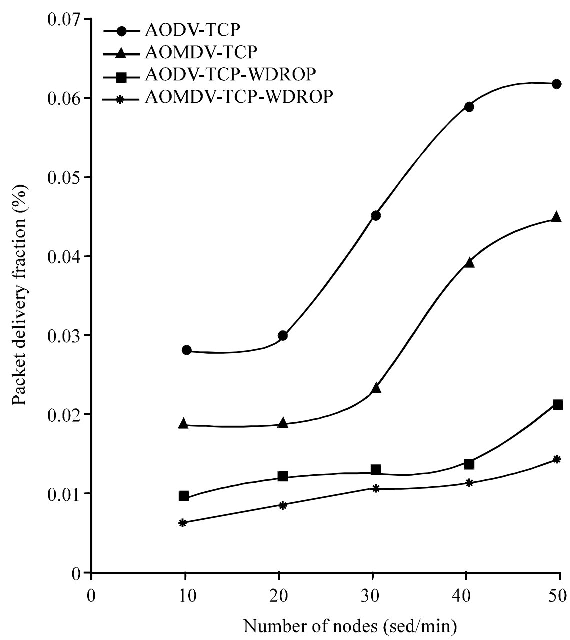

Fig. 12: Average end-to-end packet delay

Figure 11 shows the packet delivery fraction rises due to the improved packets received number during the distention. If the nodes number rises, the packets transport among the nodes likewise rises.

Analysis of the results by UDP protocol based on first scenario: Figure 12 shows the lateness rises with an

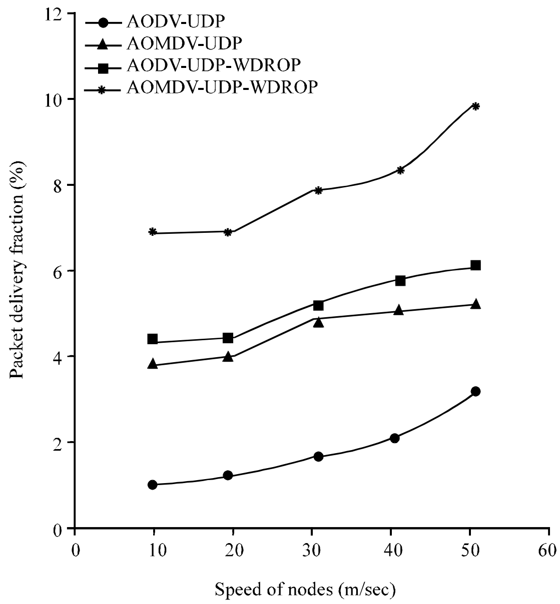

Fig. 13: Normalize routing load

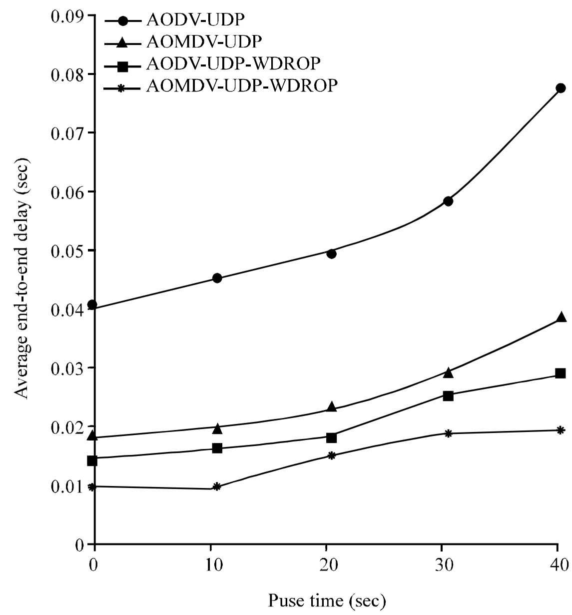

Fig. 15: Average end-to-end packet delay

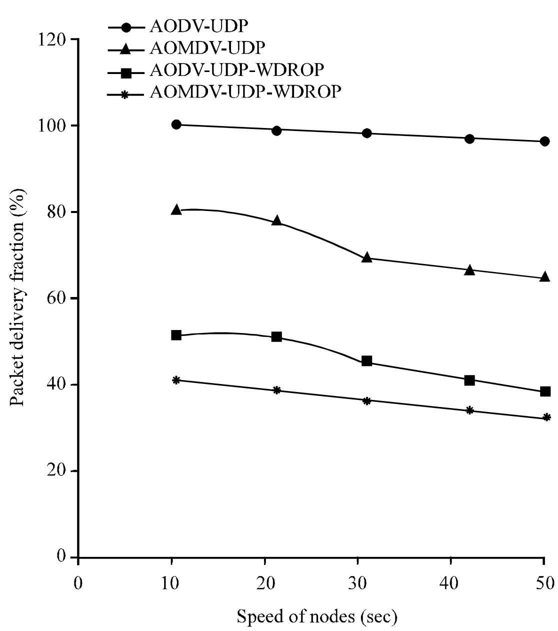

Fig. 14: Packet delivery fraction

improved speed of nodes. In addition it contains for two major aims to these improve lateness. The primary aim is alteration in the nodes location. This is because of the incremented speed and incremented distance among the source and destination. Furthermore, the reach time of packet likewise rises. The second aim is the improved routing overhead because of high traffic congestion.

Analysis of the results by UDP protocol based on second scenario: Figure 13 shows a sharply raising by routing load with the improve nodes speed. The nodes alter their mobility progressively that refers to an incrementing the dropped packages number. Furthermore, when the dropped packets number increments, the received packages number at the target likewise reduces.

Figure 14 shows the packet delivery fraction falls when the nodes speed rises by time because of an incremented dropped packages number and a reduced received packages number.

Figure 15 shows the packages delay time rises progressively through an increased the nodes stop time. The reason for this rise includes to a rise in the pause duration time of the nodes from any package sent.

Figure 16 shows the results tumbles during time with an increasing nodes stop time in the simulation. This is because of the node movement constancy and because less extra routing packets are desired when their route breaks. Figure 17 shows the results rises with an increasing stop time, due to the dropped packets number reduces.

Analysis of the results by UDP protocol based on third scenario: Figure 18 shows the results packet reduces with an increasing the nodes number due to reduced traffic congestion. For this reason, the time required to the packages for arrive their target likewise reduces.

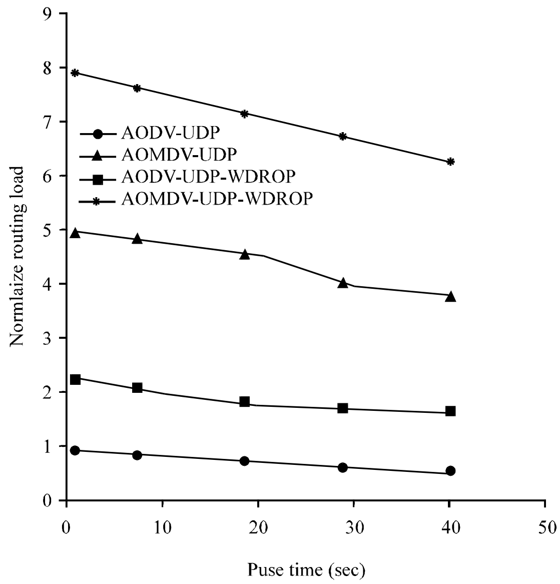

Fig. 16: Normalize routing load

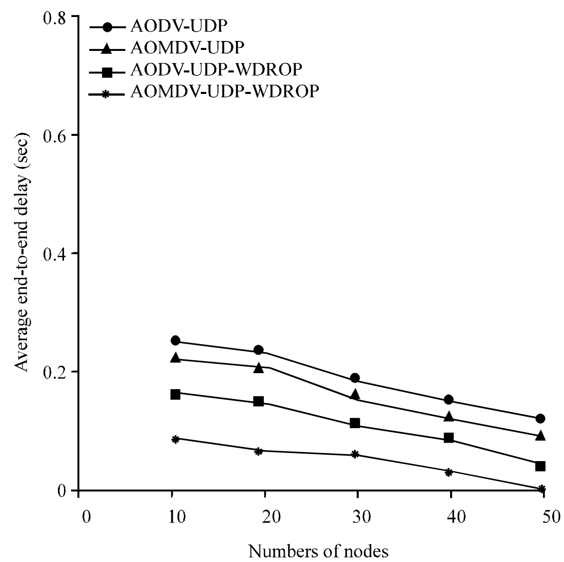

Fig. 18: Average end-to-end packet delay

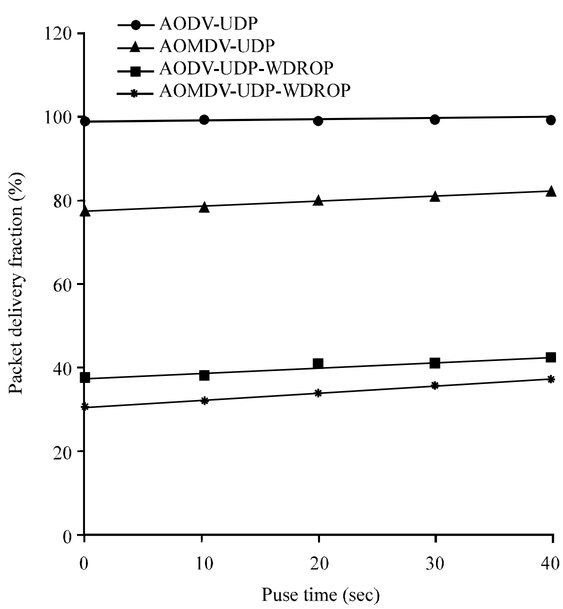

Fig. 17: Packet delivery fraction

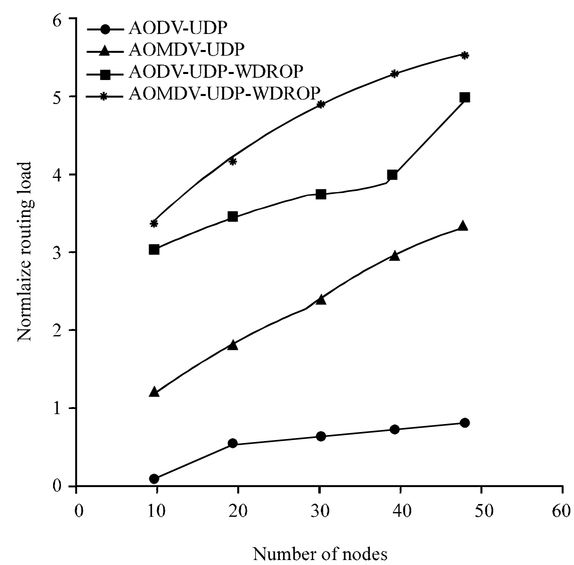

Fig. 19: Normalize routing load

In Fig. 19, the normalized routing load progressively rises with an increased nodes number. This rise happens because the routing packet rises because of a requirement for extra route detections to the target.

Figure 20 shows the packet delivery value rises with an increasing the nodes number. When the nodes number rises, packets become extra track options to arrive their target. Then, the received packets number rises.

Comparison of analysis among aodv and aomdv based on two protocols

End-to-end delay: When the lateness in AODV and AOMDV is compared it is shown which the lateness is larger in AODV than it is in AOMDV. The reason for this issue AOMDV is a multiple track protocol.

Normalize routing load: From the graphs it is shown which it is in AOMDV is larger than which of AODV. The reason behands this issue of the usual structure of

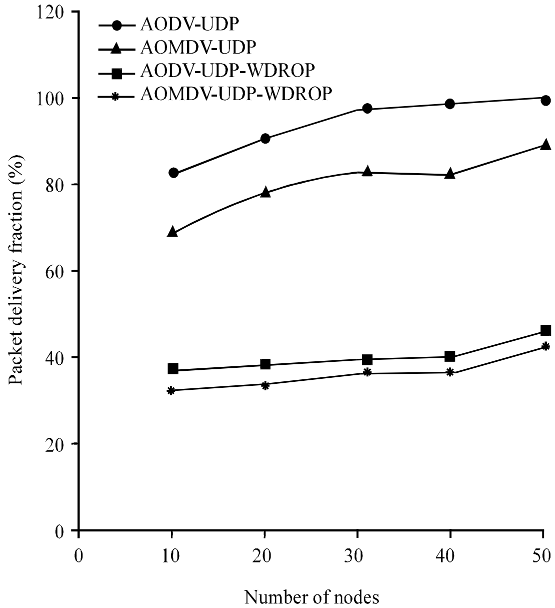

Fig. 20: Packet delivery fraction

AOMDV that is a multiple track type of AODV and requests extra routing package because of multiple track detections.

Packet delivery fraction: From the graphs it is indicated the packet delivery of AODV is lesser than AOMDV when the traffic kind is connection-oriented protocol while it is lesser when the traffic kind is connectionless protocol. This is because AOMDV provides extra chance to collect the packages to the destination than AODV and so, the received package number is greater in AOMDV.

Comparison of analysis in the performance metrics based on two protocols

Ends-to-end delay: The figures present that the lateness is fewer in the UDP than TCP protocol. Furthermore, connection-oriented requests extra time than connectionless to create the manual select method among the source and the destination.

Normalize routing load: From the figures results it is shown which it is extra when the traffic kind is connectionless protocol than the kind of traffic is connection-oriented protocol. The reason for this issue the nodes utilizing UDP transfer extra packages than TCP protocol. Furthermore, UDP requests extra routing packages.

Analysis comparison of the performance metrics in normal condition and dropping packets condition: The figures show that, the normalize routing load is higher in dropping packets case than in normal condition. On the other hand, the average end-to-end packet delay and packet delivery fraction are lower in dropping packets case than in normal condition. This is because the number of received packets is lower than normal condition.

CONCLUSION

The main aim of this study is to compare the performance metrics of AODV and AOMDV under usual conditions and under dropping packet cases based on 2 protocols in the MANET. The simulation was implemented by 3 various scenarios using constant parameters. First, the nodes number and the pause time value in the simulation were fixed, whilst the speed of the nodes was changed. In the second scenario, the speed and number of nodes were unchanged but the pause time during the simulation was changed. Finally, in the third scenario, the nodes number was altered, whilst the speed and nodes pause time remained fixed.

From the results, it able to be concluded that the end-to-end delay decreased by time through the increasing speed of the nodes. This is because of quick changes in its location. Furthermore, increasing the distance among the source and the destination. Meanwhile, the packets delay increased when the nodes number increased because of congestion in the queues and improved when the stop time increased because of the new location for the nodes. The normalized routing load increased when the speed and the nodes number was increased because of an increase in the packets routing. However, it decreased when the stop time increased, because in this situation, the routing packets number decreased. Finally, the packet delivery fraction decreased when the nodes speed was increased because of an increase in routing overhead and dropping packets. while it falls when the pause time and number of nodes are increased.

Furthermore, AODV and AOMDV are compared, the lateness is higher in AODV. The reason for this issue, packages arrive at the destination quicker. Meanwhile, the normalized routing load in AOMDV is better. The reason behands this issue, extra routing packages are required in every transition. Packet delivery fraction in AOMDV is greater than AODV because the number of received packets is greater.

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