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EFFECT OF A COMPREHENSIVE PERFORMANCE METRICS COMPARISON BETWEEN MDART, DSDV AND DSR IN MANETs

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ABSTRACT

Mobile Ad Hoc Networks (MANETs) represent a group of multi-hop remote nodes that connect with each other without central control or recognized organization. The topology-changeable of these networks demands a new set of the strategy network routing protocols to be performingto supply efficient end-to-end communication. There are numerous of MANETs routing protocols offering different levels of performance metrics at various scenarios. In this paper, we compare three routing protocols in MANETs "Destination-Sequenced Distance-Vector Routing (DSDV), Dynamic Source Routing (DSR) and Multi-Path Dynamic Addressing Routing (MDART)" to determine the perfect conditional protocol. This paper has been simulated and analysis of these routing protocols by Network Simulator version 2.35 (NS2) and show how several of parameters that effect on the performance of network subsequently effected on packets transmitted led to lost packets between a source node and destination. The performance study of several performance metrics such as a Packet loss ratio, Avg Routing Overhead, Packet Delivery Ratio, Avg E2E Delay presents a DSR routing protocol gives better performance in some scenarios than DSDV and MDART.

Keywords: DSDV, DSR, MDART, routing protocol, MANETs, ad hoc networks.

1. INTRODUCTION

MANETs is a type of ad-hoc network that can change locations and configure itself on the fly. Also, can be a model Wi-Fi connection, or another standard, like a cellular or satellite transmission. MANETs have many applications like military, communication, conference, meeting, automated battlefield, creating virtual classrooms and in a sensor network. The main feature of MANETs restoring and self-organizing and transmission through multiple hops [1]. A network topology involves two aspects: network nodes and the connecting links among them. In general, a link is composed of two nodes, which are in the transmission range of each other in classical MANETs, and the topology is parameterized by some controllable parameters, which determine the existence of wireless links directly. Usually, these parameters can be transmitted power and antenna directions [2].

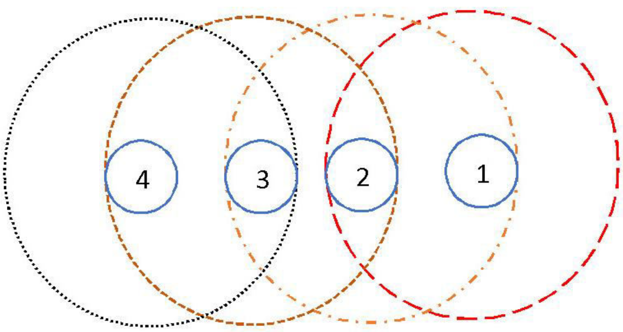

Figure-1. Ad hoc networks.

2. AD HOC ROUTING PROTOCOLS

The packets have to be transmitted to a destination via somenodes and many routing protocols have been proposed for such sort of ad hoc networks. These protocols discovery a road for packet delivery and transport the packet to the right last stop. The studies on diverse aspects of routing protocols have been an active area of research for many years. Many protocols have been suggested keeping applications and type of network in view.Routing protocols can be broadly classified into two categoriesas (a) Table Driven Protocols or Proactive Protocols and (b) On-Demand Protocols or Reactive Protocols [3].

2.1 Proactive routing protocols

Proactive routing protocols are also known as a table driven routing protocols. Nodes using proactive routing protocols maintain routing table, which contains information about each and every node residing in that particular network [4]. The information in the routing table is upgraded over time so that each node in the network has the clearest view of the original structure of the network. The proactive protocols are appropriate for less number of nodes in networks because they need to update node entries for each and every node in the routing table of every node, which creates additional routing overhead [5]. Proactive protocols have the advantage that routes are available the moment they are needed. However, the disadvantages of these protocols are that the control overhead can be significant in large networks or networks with rapidly moving nodes and additional control traffic. Some examples of Proactive Routing Protocols are [6]:

DSDV Was originally used in wired network table-driven routing protocol has two main algorithms: Distance Vector Routing (DVR) and Link State Routing

(LSR). However, due to the wireless network of nodes may be able to move, so the original calculations of the mechanism would need to be amendedto apply to the wireless network. DVR for an amendment shall be derived from the routing protocol DSDV. The DVR itself may arise from loop effects, and then in DSDV has been resolved.DSDVis based on the traditional Bellman-Ford routing algorithm, the improvement which developed a routing table for the protocol [7].

In DSDV, each wireless node must be stored and continuously update a routing table. The routing table will record the destination, next hop, metric, sequence number, as well as installing, while the routing table within the each record contains sequential numbers, can be used to determine whether some relatively old path to avoid routing loop generation.Each node will periodically send their routing tables to the nearest neighbors, to maintain all nodes have the characteristics of the full path. When the network topology changes in a larger path of the table so there is a substantial change in, the node will take the initiative to send a new path to the table to the nearest node, so the path table updates have both triggered by time (time-driven) and from the event trigger (event-driven) features [8].

M-DART extends the DART protocol to discover multiple routes between the source and the destination. In such a way, M-DART canimprove the tolerance of a tree-based address space against mobility as well as channel impairments. Moreover, the multi-path feature also improves the performances in case of static topologies thanks to the route diversity. M-DART has two novel aspects compared to other multi-path routing protocols [9]. First, the redundant routes discovered by M-DART are guaranteed to be communication-free and coordination-free, "their discovering and announcing though the network does not require any additional communication or coordination overhead." Second, M-DART discovers all the available redundant paths between source and destination, not just a limited number.

In particular, it does not employ any special control Packet or extra field in the routing update entry and, moreover, the number of entries in the routing update packet is the same as DART.

Nodes need no special coordinated action, and the memory node requirements constitute the only additional overhead in M-DART about DART [10].

2.2 Reactive routing protocols

The reactive protocol is also known as on-demand protocols. This protocol finds route only when needed.

DSR protocol is a Reactive routing protocol and was used for the wireless ad-hoc networks. It is an on-demand routing protocol. Therefore, it reacts on demand and finds routes when they are needed. DSR allows the network to be completely self-configuring and self-organizing without any need of existing infrastructure. DSR was based on the link-state routing algorithm means it does not create much traffic; it supports loop-free routing and responds rapidly to topology changes or node failures. However, it requires higher memory than others, the memory stored on each node can be quite large. DSR utilizing source routing represent that the node of origin must know the complete hop sequence to the destination. Each node stores the information about all routes it knows in the route cache [11]. If the desired route cannot be found, then the route discovery process is initiated.

As mentioned above, DSR uses source routing; the source contains the complete sequence of hop on which each packet should traverse. Therefore, each packet header includes the sequence of hops. The advantage of source routing is that it does not need up-to-date routing information in the intermediate nodes because a packet includes all the routing information which is necessary. DSR supports loop-free routing means it avoids loops in the routing because the single node determines the whole route, instead of hop-by-hop decision making. DSR supports two main mechanisms: "route discovery" and "route maintenance," and both works together for allowing nodes to discover and maintain routes from source to destination in ad-hoc networks. The DSR protocol allows multiple routes to any destination and allows senders to choose and control the routes in routing [12].

In the discovery procedure, the initiator transmits a Route Request packet, identifying the target to which the route is needed. Each node upon receiving the Route Request, in general, retransmits the request if it has not already forwarded a copy of the Route Request; when the target node receives the request, it returns a Route Reply to the initiator, listing the route taken by the Request, rather than forwarding the request. The target node returns a route reply for each copy of the route request that it receives. So, the source will then select a path with the lowest latency. Each Route Request packet carries a sequence number generated by the node of origin and the path it has traversed. A node upon receiving the Route Request packet checks the sequence number of the packet before forwarding it. The sequence number of the packet is used to prevent loop formations and to avoid multiple transmissions of the same Route Request packet by an intermediate node that receives it through multiple paths.

During the Maintenance procedure when an intermediate node in the path moves away, causing the wireless link to break, a Route Error message is generated from the node adjacent to the broken link to inform the source node. The source node initiates the route establishment procedure. The cached entries at the intermediate nodes and the node of originare removed when a Route Error packet is received [13].

3. RELATED WORK

Several research works have addressed the performance ofrouting protocols for different applications and scenarios:

Aggarwal*et al.* 2011 [14] mention that in the Table-driven protocols, each node maintains routing information about every other node, which participates in the network. In this context, every node retains a view of the network topology, by propagating update messages in regular periods of time

Stephen*et al.* 2004 [15] presented multipath routing in ad hoc networks mostly regarding the network layer. Multi-path routing permits the establishment of multiple paths between a single source and single destination node,to raise the dependability of data transmission or to provide load balancing. Load balancing is of especial importance in MANETs because of the limited bandwidth between the nodes.

Sharma*et al.* 2014 [16] present different uni-path and Multipath routing protocols “AODV, AOMDV, and MDART.”Multipath routing is the routing method of by multiple alternative paths through a network, which can yield a variety of benefits such as fault tolerance, increased bandwidth.

4. PERFORMANCE METRICS EVALUATION

Several of performance metrics was evaluated as shown below:

A- **End-to-End delay:** This metric represents the average End-to-End delays experienced by each data packet at each hop on its way from the source node to the destination node [17].

B- **Avg routing overhead:** The control overhead metric represents the total number of packets exchanged by all the nodes in the network [18].

C- **Packet delivery ratio:** The ratio between some incoming data packets and received data packets.

D- **Packet loss ratio:** The ratio of the data lost at destinations to those generated by the CBR sources. The packets are lost when it is not able to find the proper route to deliver the packets.

5. SIMULATION RESULT AND ANALYSIS

Using NS2 to perform the simulation and result mainly popular in the ad hoc networking community. The mobility nodes used random waypoint model, the source traffic connection is TCP, also data packet size 512 bytes. The connections pair between a source node and sink is prevalent randomly over the network in a rectangular field of 670 m × 670 m. using two scenarios every node inoutset its journey from a random spot to specifically chosen destination stop point. When a node reaches the destination node getsa waitingperiod in second, so another random destination is selected after pause time. This process repeats throughout the simulation, causing different changes in the topology of the implicit network. 300 seconds is the time of simulation and maximum velocity 10 m/s, and interface queue is 50 packet drop tail priority queue as shown in Table-1. Speed and the nodes represent two scenarios generated.

Table-1. Simulation parameters.

Parameters	Values	Unites
Simulation Time	300	Second
Traffic Type	TCP	-
Routing Protocols	DSR, DSDV, and M-DART	-
Maximum-Connection	3	Number
Pause Time	5	Second
Number of Nodes	5,10,15,20	Node
Node Speed	3,5,7,10	m/s
Packet Size	512	Byte
Network Area Size	670 × 670	M^2
Mobility model	Random waypoint	-

In the first scenario present, the simulation parameters throughout three routing protocols can be shown in Figure-2. It is clearly shown that when the movement of the nodes has been taken into account, the network achieves better performance in a packet loss ratio for DSR routing protocols reduced over network size increased. Also, MDART protocol behaves slightly better performance than DSDV and exactly when the network starts to increase the network size number more than 15 nodes. However, DSDV still lost most of the packets throughout the large network size. Also, simulation result proved that DSR better than DSDV and MDART protocols in packet loss ratio performance metrics.

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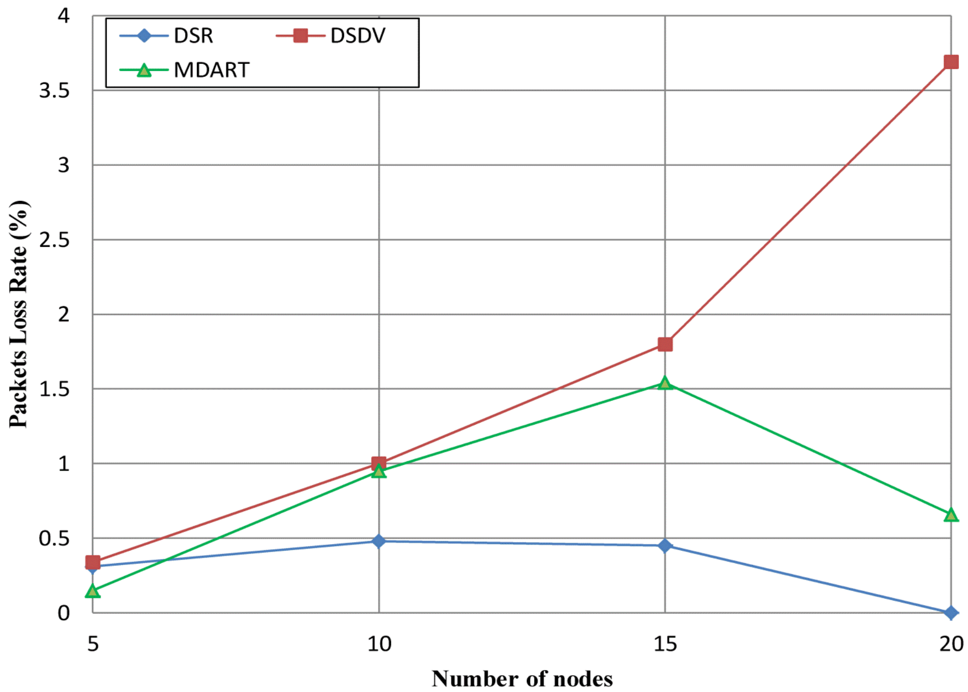

Figure-2. Number of nodes versus drop packet rate.

From Figure-3 shows that Avg E2E delay for DSDV protocol starts with better performance and after that slightly increased through expanding the network size over simulation time. While AvgE2E delay for DSR starts with slightly higher than DSDV and still keeps on his performance then reduced cross grow up nodes. On the other hand, MDART seems in a worse, percentage in the Avg E2E delay through the protocol journey. However, although the Avg E2E delay can note in the DSR routing protocol better than DSDV and MDART.

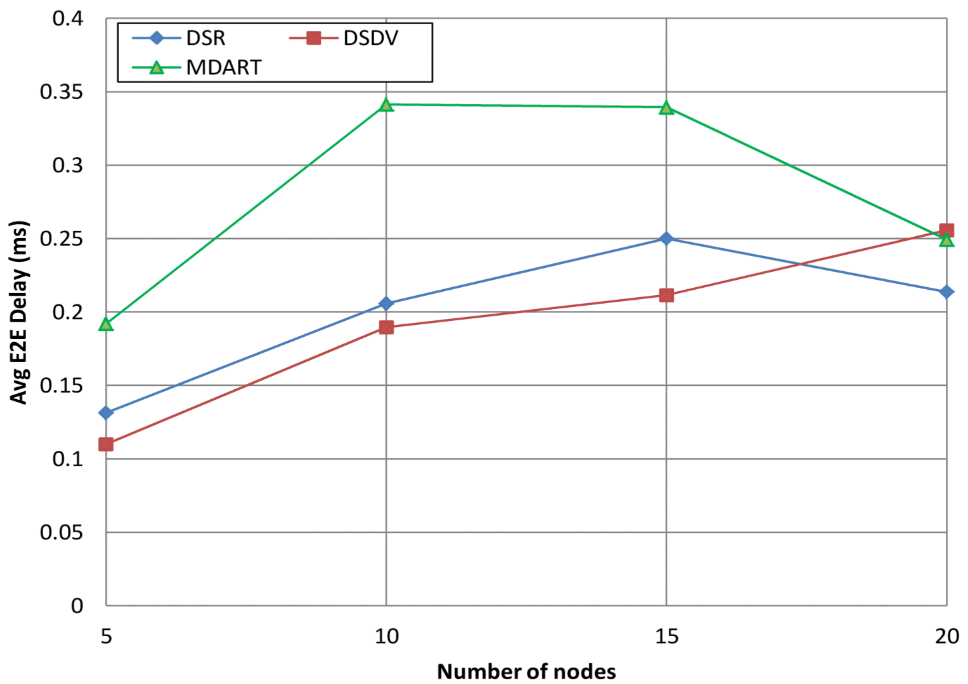

Figure-3. Number of nodes versus Avg e2e delay.

As shown in Figure-4, the packet delivery ratio in DSR protocol is better performance than DSDV and MDART protocol throughout the increased in network size. On the other hand, most of transferring packets fromsource node to a destination node in DSDV failed to reach because the percentage of the packet delivery ratio is the lowest through increasing the network size over simulation time.

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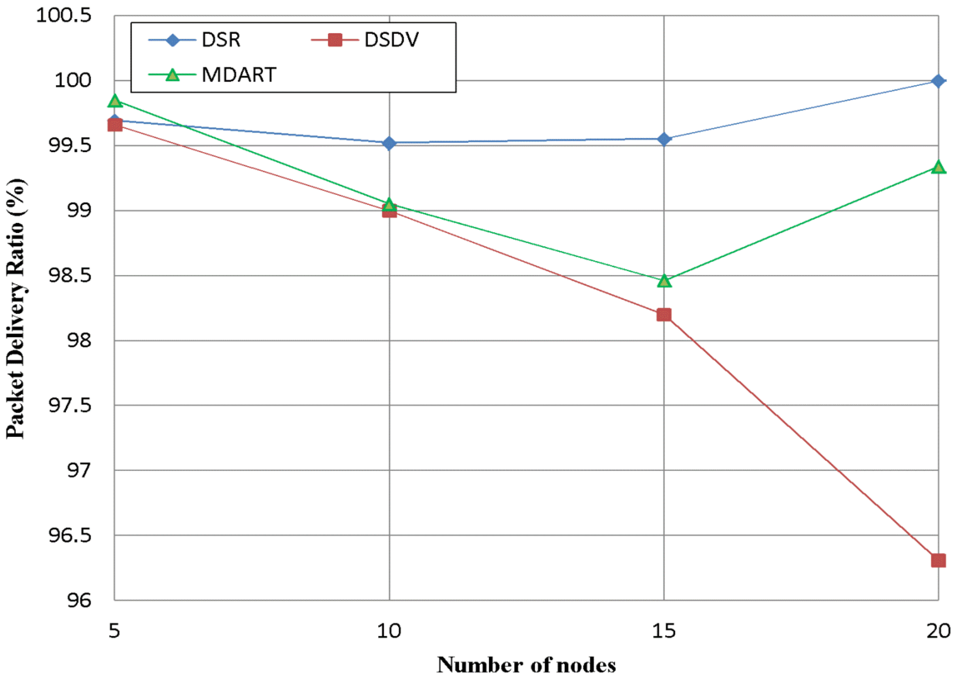

Figure-4. Number of nodes versus packet delivery ratio.

In Figure-5 shows the performance metrics of Avg routing overhead for DSR protocol through change the network size still low, however, the DSDV routing protocol is the worst performance crosses same simulation time. Whereas MDART starts with a lower percentage of the packet delivery ratio then gradually raised respectively with increasing number of nodes. The DSR routing protocol is better performance in Avg routing overhead than DSDV and MDART through protocols journey.

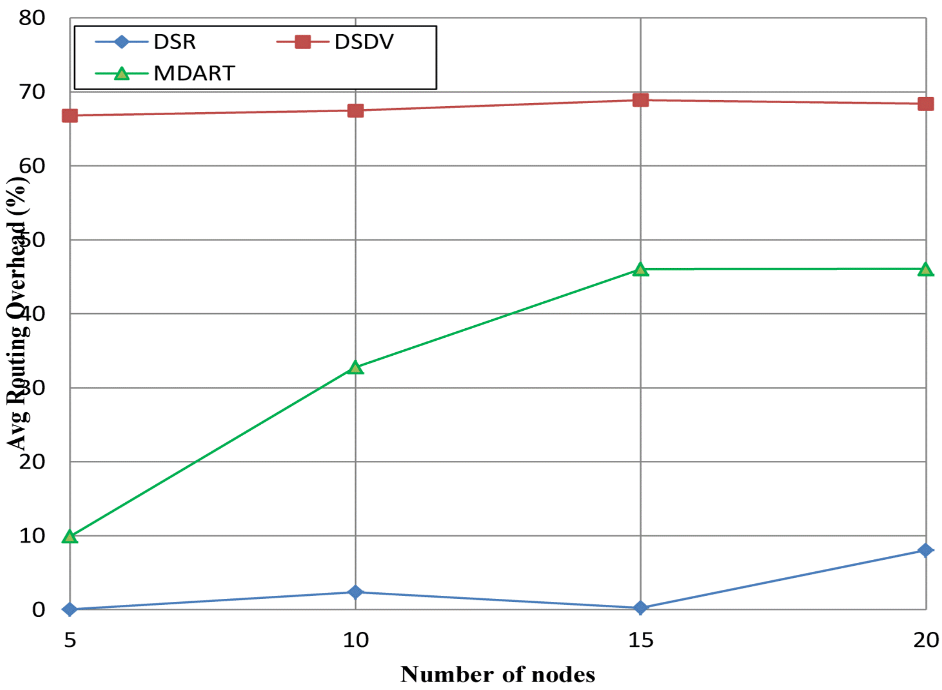

Figure-5. Number of nodes versus Avg routing overhead.

A second scenario presents that in Figure-6. The DSR routing protocol starts with the lowest percentage of Avg E2E delay the slightly decreased through simulation time. On the other hand, DSDV starts with a higher proportion than DSR and gradual rose till to 7 m/s then reduced until the time finish Whereas MDART is the

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worst protocol in Avg E2E delay performance metric through increasing the node speed. The performance metrics of the DSR routing protocol are better than DSDV and MDART in AvgE2E delay through protocols journey.

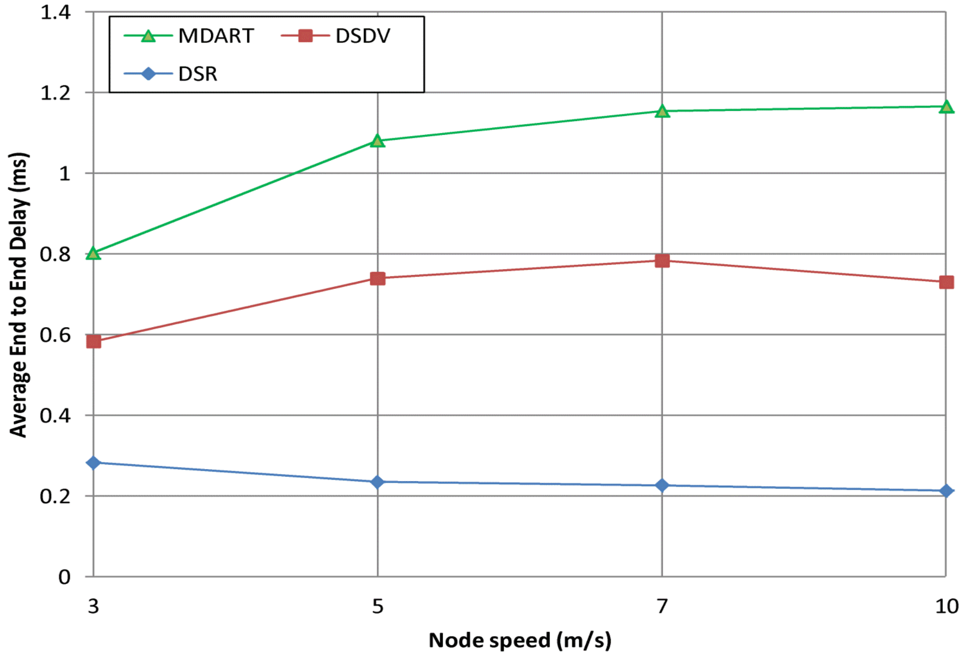

Figure-6. Nodes speed versus AvgE2E delay.

Through Figure-7 shows the performance metrics of the packet delivery ratio of MDART routing protocol starts with high percentage then gradually reduced through increasing of node speed. On the other hand, the DSR routing protocol lost most of transferring packets because not all packets reached to the destination node. Whereas DSDV behaves like MDART with the lowest percentage through increasing of node speed.

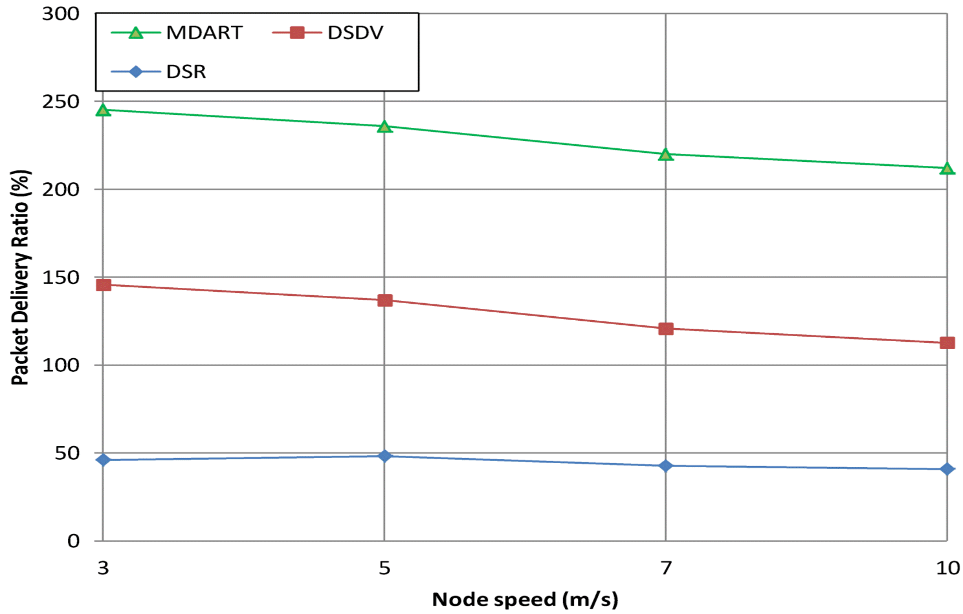

Figure-7. Nodes speed versus packet delivery ratio.

In Figure-8 shows the difference between DSR, DSDV, and MDART in the performance metrics of packet loss ratio. The graph presents the number of lost packets reduced through continuously node speed in the DSR protocol till 5 m/s. While DSDV and MDART gradually decrease till to 7 m/s then continuously raised through journey packets over the simulation time finish. This lead that the DSR routing protocol has better performance in packet loss ratio than DSDV and MDART.

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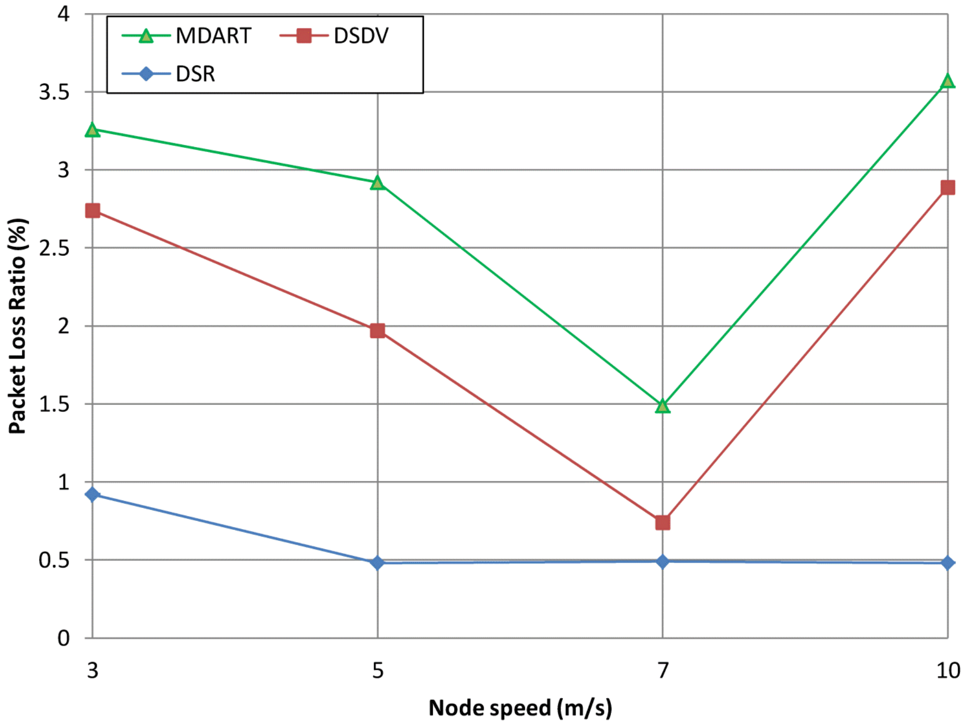

Figure-8. Nodes speed versus packet loss ratio.

Finally, in Figure-9 presents the DSR routing protocol better performance metrics than DSDV and MDART in Avg routing overhead through increasing of node speed over time simulation. Whereas MDART has a high percentage through the changing of node speed. However, the DSDV routing protocol has slightly changed through time simulation.

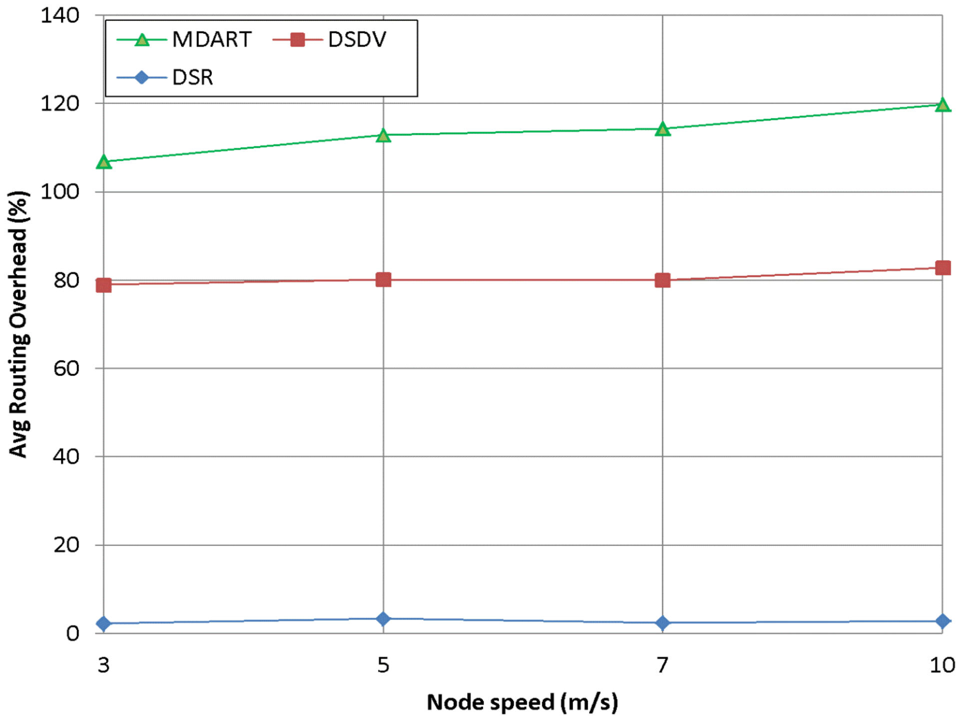

Figure-9. Nodes speed versus Avg routing overhead.

6. CONCLUSIONS

This paper is an endeavor to evaluate the performance of three routing protocols MDART, DSDV, and DSR, which are commonly used in mobile networks. The evaluations of performance metrics are simulated in NS2, and the comparison was based on "Avg routing overhead, packet loss ratio, Avg E2E delay, packet delivery ratio" and simulation result are shown by many figures. By using a final consequence of the NS2, we can indicate that the DSR routing protocol gives better performance metric with changing of network size represent by nodes, on the other hand, DSDV and MDART give a little better result in node speed when has been modified.

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