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Performance Analysis of Hybrid Routing Protocol in Mobile Adhoc Networks

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Abstract: An ad hoc network is a wireless and infrastructure less network. Various routing protocols have been discussed so far to improve the routing performance and reliability. A detail study shows that performance of on demand Routing protocols AODV and DSR are better than table driven protocols .AODV and DSR still suffer some short coming problems due to longer set up time in case of link failure and scalability problem due to more routing overhead .In our work Hybrid protocol by combining DSR and AODV is implemented to overcome these problems .Simulation is carried out to check the performance of protocol in terms of packet delivery ratio, Packet miss ratio, throughput, end to end delay , routing overhead and energy consumption under the stressed conditions of node mobility and node density. The simulations are carried out by using MATLAB.

Keywords: AODV, DSR, HYBRID, MANET, Performance Evaluation, Protocol, MATLAB.

I. INTRODUCTION

The mobile ad hoc network is a dynamic and temporary network. This network is composed of a set of mobile nodes, which are capable of searching and orientating dynamically and resuming automatically. They can fulfill the routing, the transmitting of packets, and the discovering of service without fixed communication establishment [1], [3]. A MANET is much more vulnerable to attacks as compared to a wired network due to nodes have limited energy. Even if the channel is reliable, the communication may still be unreliable due to the broadcast nature of MANETs. There is no central management point, which makes it difficult to ensure that all nodes participating in the network are benign. Mobility of nodes plays a very important role in the network, which makes routing even more challenging as the topology keeps changing regularly. Sinkhole and Black hole attacks drastically degrade packet efficiency and throughput, and also increase the routing overhead [2]. Manets can be exploited in a wide area of applications, from military, emergency rescue, law Enforcement and commercial. Wireless information systems face new kinds of problems, such as narrow band-widths, lack of coverage, devices with Small memory and screens which cannot display large amount of data and diversity of users and devices. Quality attributes which are affected by mobile-wireless information systems are Functionality, Reliability, Usability, Maintainability, Portability, Quality in Use and Efficiency. Goal is to carry out a systematic performance study of on demand routing protocols using QOS parameters.
The two fields will be merged to achieve a suitable routing protocol. AODV and DSR have been used as base protocols to incorporate the changes [4]. Many Routing protocols have been developed for accomplishing this task. These routing protocols

can be divided into the following basic categories: Proactive routing protocols (DSDV, WRP, OLSR, WRP, CGSR, FSR, GSR) Reactive routing protocols (DSR, AODV, TORA .Traditional routing protocols used in hardwired networks, such as distance vector protocols (e.g. RIP) and link state protocols (e.g., OSPF) cannot be applied in the MANET directly due to Considerable consumption of bandwidth and power due to periodic routing information updates [5].

MANTES typically encompass of battery operated mobile devices that interconnects and exchange signals and information wirelessly which are logically resource intensive. The energy saving feature supports the life prolongation of all nodes concurrently. This objective can be achieved by minimizing the energy consumption at each communication call resulting from the even distribution of the energy consumption rate at each node. To prolong lifetime of ad-hoc network, it is essential to lengthen each individual node life through minimizing the energy consumption for each communication request [6]. The main problem is to choose the reliable, efficient and correct routing protocol for different MANET scenarios. The main questions arise for the evaluations of these problems are: Which routing protocol provides a better performance in Mobile Ad hoc Networks in different traffic environments and what will be the effect of node density in Mobile Ad hoc Networks [8]. One of the distinctive features of MANET is that each node must be able to act as a router to find out the optimal path to forward a packet. As nodes may be mobile, entering and leaving the network, the topology of the network will change continuously. A fundamental problem in ad hoc networking is routing i.e. how to deliver data packets among mobile nodes efficiently without predetermined topology or centralized control, which is the main objective of ad hoc routing protocols. Since mobile ad hoc networks change their topology frequently, routing in such networks is a challenging task. Moreover, bandwidth, energy and physical security are limited [9]. As a network grows, routes between sources and destinations become longer. When a route breaks due to node mobility or node failure, flat routing protocols like DSR and AODV typically discard the whole original route and initiate another round of route discovery to establish a new route from the source to the destination. When a route breaks, usually only a few hops are broken, but other hops are still intact. Thus, this approach wastes the knowledge of the original route and may cause significant overhead in global route discoveries. An optimization to AODV is local repair. However, the local repair is suitable for situations where link failures occur near the Destination, this is because in AODV, intermediate nodes only know the destination and the next hop for a route and the target of the local repair has to be the destination. If a link failure occurs far from the destination, it would be better for the source to discover a new route directly. Consequently, the new routing protocol incurs less routing overhead and exhibits better scalability and performance. In this paper, we present a scalable routing model for MANETs, Way Point Routing (WPR), which maintains a Hierarchy only for active routes. In WPR, a number of intermediate nodes on a route are selected as waypoints and the route is divided into segments by the waypoints [11].

Reactive Routing Protocols

A. Dynamic Source routing (DSR)

DSR uses source routing and caching, where the sender node includes the complete hop-by-hop route to the destination node in the packet header and routes are stored in a route cache [10]. When a node wants to communicate with another node to which it does not know the route, it initiates a route discovery process with a flooding request of route request (RREQ) packets. Each node receiving the RREQ packets retransmits it unless it is the target node or it knows the route to the destination from its cache. Such a node replies to the RREQ message with a route reply (RREP) packet. The RREP packet takes the traverse path back to the source node established by the RREQ packet. This route is stored in the source node cache for future communication. If any link of this route is broken, the source node is informed by a route error (RERR) packet and this route is discarded from cache. Intermediate nodes store the source route in their cache for possible future use [13], [14].

B. Ad-hoc On-Demand Distance Vector Routing (AODV)

AODV is a destination based reactive protocol. This protocol inherits the feature of route discovery from DSR. However, AODV resolves the problem of large headers found in DSR. This problem can cause significant performance degradation especially when the actual data contents are small. AODV maintains routing tables on the nodes instead of including a header in the data packet. The source node initiates the route discovery process in the same way as in DSR. An intermediate node may reply with a route reply (RREP) only if it knows a more recent path than the one known by the sender node to the destination. A destination sequence number is used to indicate how recent the path is as follows. [7], [10]. A new route request generated by the sender node is tagged with a higher sequence number and an intermediate node that knows the route to the destination with a smaller sequence number cannot send the RREP message. Forward links are setup when a RREP travels back along the path taken by RREQ. So the routing table entries are used to forward the data packet and the route is not included in the packet header. If an intermediate node is unable to forward the packet to the next hop or destination due to link failures, it generates the route error (RERR) message by tagging it with a higher destination sequence number. When the sender node receives the RERR message, it initiates a new route discovery for the destination node.

II. RELATED WORK

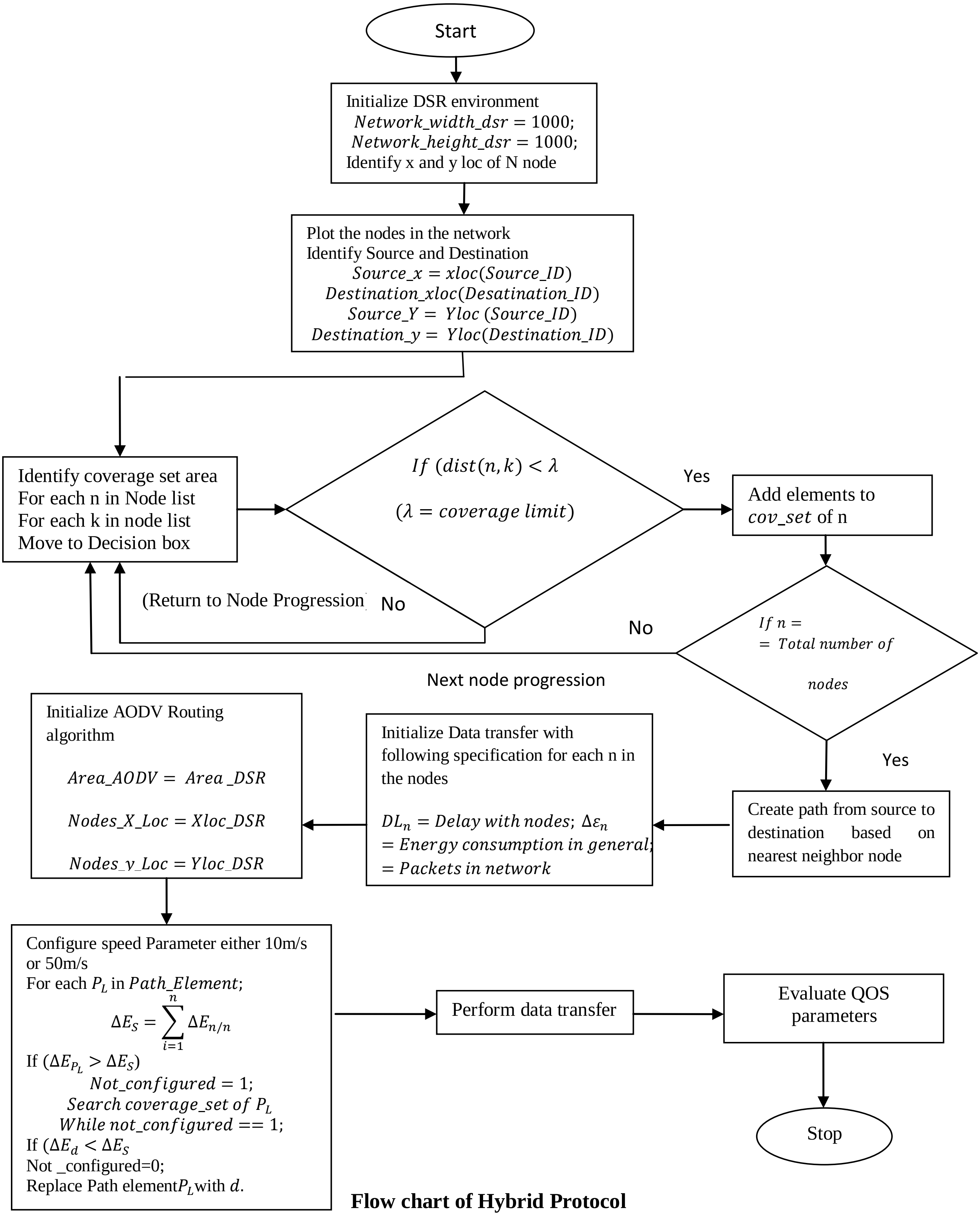
Rendong Bai and Mukesh Singhal et. al [11] present an instantiation of WPR, where they use DSR as the intersegment routing protocol and AODV as the intrasegment routing protocol. This instantiation is termed DSR over AODV (DOA) routing protocol. Thus, DSR and AODV—two well-known on-demand routing protocols for MANETs—are combined into hierarchical routing protocol. Furthermore, author present two novel techniques for DOA are efficient loop detection method and the other is a multitarget route discovery. Simulation results show that DOA scales well for large networks, incurring about 60 percent-80 percent less overhead than AODV, while other metrics are better than or comparable to AODV and DSR. Compared to hierarchical routing protocols such as CGSR and Zone Routing Protocol (ZRP), WPR is a lightweight scheme for two reasons. First, the hierarchy in WPR only involves nodes on active routes, while the hierarchy in CGSR and ZRP involves all nodes in the network. Second, the hierarchy in WPR is easier to maintain. Nodes in WPR work uniformly because the assignment of waypoint nodes and non waypoint nodes is specifically for each route. A node may act as a waypoint node for one route and may act as a no waypoint node for another route. As an instantiation of WPR, author chooses DSR and AODV as the intersegment and the intrasegment protocols, respectively and term this instantiation as DSR over AODV (DOA) routing protocol. When the segment length is set to 1, DOA works in DSR mode because each hop is a segment and the intersegment routing protocol (DSR) dominates; when the segment length is set to a large number, DOA works in AODV mode because the whole route is one segment and the intrasegment routing protocol (AODV) dominates. In this paper, we also present two novel techniques for DOA; one is an efficient loop detection method and the other is a multitarget route discovery.

M.Vanith al [12] a combination of the two routing protocols called DOA (DSR over AODV) is used to overcome these issues. DOA is usually implemented using a model called Way Point Routing model in which the problem of position estimation errors occurs. This work enhances DOA with a new algorithm called Exponential Weighted Moving Average (EWMA) for on-line updating of nodal contact probability to minimize the possibilities of position estimation errors. In this work, new packet called Delay to Send (DTS) packets instead of NACK packets has been used in addition to RTS and CTS packets. Here DTS packets are to recover the delayed data within a certain time period instead of dropping the packet after final retransmission in case of delay due to unexpected traffic in packet delivery. A Simulation analysis is carried out to analyze the performance of DOA with EWMA compared to AODV and DSR. It proves that DOA with EWMA reduces the routing overhead by 80% and scalability problem that occurred in AODV and DSR. Exponential Weighted Moving Average (EWMA) Algorithm Wireless sensor networks are relatively denser ad- hoc networks, in which nodes will have multiple pairs of neighbors from which position estimations can be formed. Each of these estimations is then combined into a single estimate such that only one position estimation is retained by each of the nodes. The ability to average the position estimates using filtering techniques allow high frequency fluctuations in the position estimates to be minimized and thus improves the accuracy in position estimations. An exponentially weighted moving average (EWMA) algorithm is well-suited for situations where the older information is to be weighted lower than newer information. This is useful in iterative localization, where the newest position estimates are likely to be more accurate than the previous estimates. Therefore, EWMA type algorithms provide a good starting point for iterative localization systems for ad hoc networks.

III. PROPOSED WORK

The environment is created for transferring the data from one place to another with 1000* 1000 dimensions. 100 nodes have been given as an input. Xlocs and ylocs are being found out with- in a network. Randomly, source and destination nodes have been chosen from the nodes. Initiate the coverage area i.e., 20 % of the width of the network to find to coverage set for each node. On the basis of DSR, the path is being found based on the nearest neighbor node. In DSR Routing approach, source node send packet to destination node to get the route from source to destination. It contains request_id which is unique and record listing of the address for each intermediate node. This message has forwarded. Destination node of the route discovery returns the RREP message to the source node. When the source node received RREP it records this route in the route cache. Before sending packets, node saves the copy of original packet in a local buffer. In route maintenance, source node detects another route towards the destination if the network topology change or existing link breaks as a network grows. When a route breaks due to node mobility or node failure, flat routing protocols like DSR and AODV typically discard the whole original route and initiate another round of route discovery to establish a new route from the source to the destination. When a route breaks, usually only a few hops are broken, but other hops are still intact. Thus, traditional approach wastes the knowledge of the original route and may cause significant overhead in global route discoveries. An optimization of Protocol is based on shortest and reliable path to destination and local repair of path during link break due to mobility of nodes. For this initialize data transfer with further specifications: $DL_n = Delay\ with\ nodes$; $\Delta\varepsilon_n = Energy\ consumption\ in\ general$; $P_n = Packets\ in\ network.$

After that, initialize AODV routing algorithm. The area of DSR is given to area of AODV and the xlocs and ylocs of DSR is transferred to xlocs and ylocs of AODV. The speed parameters are configured further 10m/s or 50 m/s. AODV is combined with DSR routing protocol i.e. named as Hybrid Routing Protocol which can be created by modifying the path of DSR routing protocol on the basis of energy consumption parameter. Except source and destination nodes, all the energy parameters of nodes would be selected of the path. A node is finding out which has the less energy consumption as compare to path node within the coverage area of its previous and next node of path. Now, this node would be replaced by the path node and this process will be applied to rest of the nodes of path. With this, a path is generated with less energy consumption. With the new path, data transferred is performed and the QOS parameters evaluated.



Flow chart of Hybrid Protocol

IV. SIMULATION ENVIRONMENT AND PERFORMANCE METRICS

For the performance analysis of HYBRID Protocol, we have used MATLAB as the network software. The mobility model we have chosen is Random Way Point model. The other parameters that we have chosen for the network are as listed in the table:-

TABLE 1: Simulation Parameters

PARAMETERS	USED IN SIMULATION
Simulator software	MATLAB(2010)
Channel type	wireless channel
Antenna type	Omni Antenna
Radio-propagation model	two ray ground
Mac type	Mac/802.11
Protocols studied	HYBRID PROTOCOL
Simulation area	1000m×1000m
Transmission range	250m
Node movement model	Random waypoint
Traffic type	CBR(UDP)
Packet size	512 Bytes
Number of nodes	10,20,30,40,50,60,70,80,90,100
Node Speed	10m/s and 50m/sec

Performance Parameters

Packet Delivery Ratio (PDR): PDR also known as the ratio of the data packets delivered to the destinations to those generated by the CBR sources. This metric characterizes both the completeness and correctness of the routing protocol.

Average End to End Delay: Average End to End delay is the average time taken by a data packet to reach from source node to destination node. It is ratio of total delay to the number of packets received.

Number of Dropped Data Packets: Packet loss occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet loss is distinguished errors types encountered in digital communications; the other two being bit error and spurious packets caused due to noise.

Throughput: Throughput is the ratio of total number of delivered or received data packets to the total duration of simulation time

.***Normalized Routing Load (NRL)****: It* is the ratio of control packets to data packets in the network. It gives a measure of the protocol routing overhead; i.e. how many control packets were required (for route discovery/maintenance) to successfully transport data packets to their destinations. It characterizes the protocol routing performance under Congestion.

V. SIMULATION RESULTS AND ANALYSIS

Simulation study shows that performance of routing protocol in terms of throughput, packet delivery ratio, and routing overhead strongly depends upon network conditions such as mobility and node density .The set of experiments uses varying no. of nodes and varying speed.

Performance analysis with varying node density and varying speed

1) Packet delivery ratio vs. nodes

Figure 1 indicates the plot between packet delivery ratio and number of nodes. Packet Delivery Ratio decreases as the number of nodes increases. At high node density, more collision occurs due to traffic and more link break. Hybrid routing protocol finds the best route, maintains routes hierarchically and repairs a broken route locally. Thus, an active route in Hybrid routing protocol lasts longer and more data packets delivered. . At high mobility, nodes moves out of network and packet does not reach the desired destination node. Due to this, at high mobility packet delivery is less and dropped to 50% as compared to low node mobility.

2) ***Packets miss ratio vs. nodes***

Figure 2 indicates the plot between packet miss ratio and number of nodes. Packet Miss Ratio increases as the number of nodes increases. This occurs due to more collision occurs due to more traffic. At high mobility of nodes, link break is more. Hybrid routing protocol maintains routes hierarchically and repairs a broken route locally .Even though at more speed and more number of nodes, packet miss ratio is more in comparison to low speed.

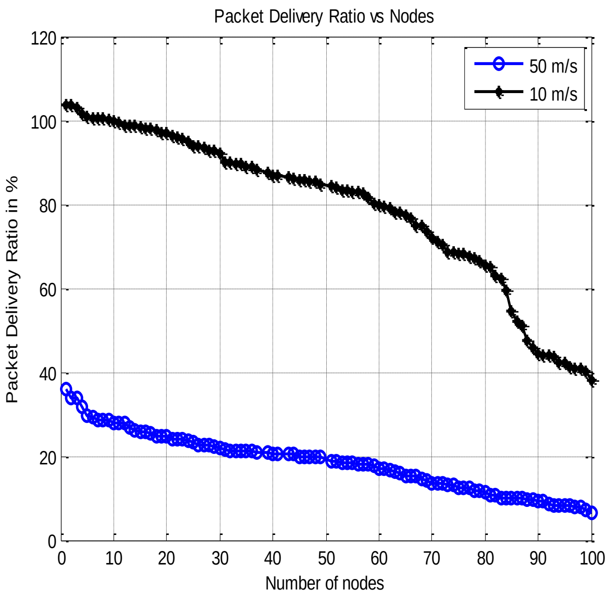


Fig.1 Packet delivery ratio vs. no. of nodes for speed 10m/sec and50m/s

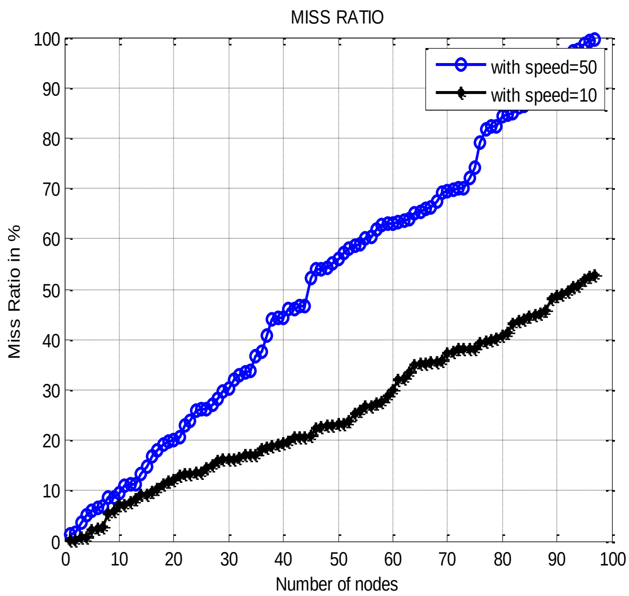


Fig.2 Packet miss ratio vs. no. of nodes for speed for10m/sec and50m/s

3) ***Throughput vs. no. of nodes***

Figure 3indicates the graph between throughputs vs. no. of nodes. As the no. of nodes increase, the throughput decreases. This is due to the fact that packet delivered to the destination are lost during transmission. Routing takes more time to deliver packets to destination due to retransmission attempts

4) End to end delay vs. no. of nodes

Figure 4indicates the graph between Ends to end delay vs. no. of nodes. As the no. of nodes increase, end to end delay increases. It is also observed that for lower speed delay is very less as compared to high node speed.

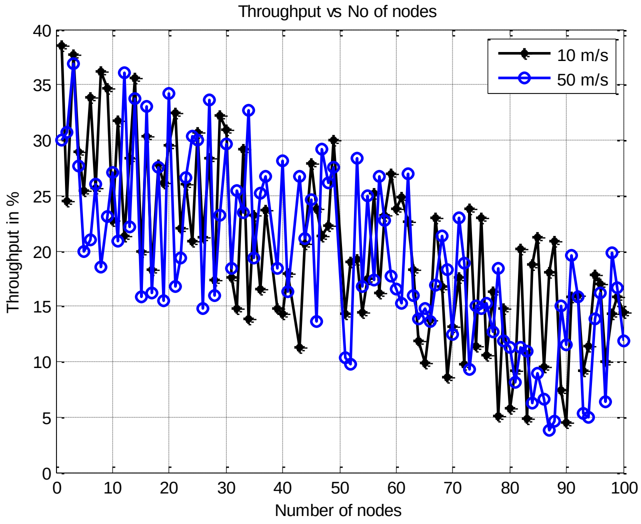


Fig.3Throughput vs. no. of nodes for speed 10m/sec and 50m/sec

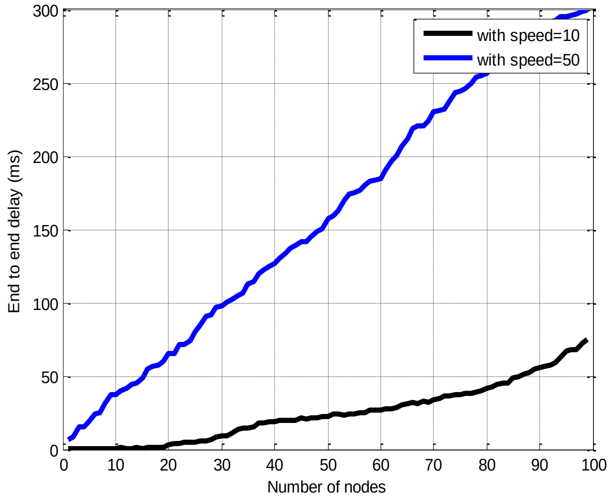


Fig.4end to end delay vs. no. of nodes for speed 10m/sec and 50m/sec

5*) Routing Over head vs. no. of nodes*

Figure 5 indicates the graph between routing Over head vs. no. of nodes. The most distinct advantage of Hybrid is that when a node on the route moves or fails, instead of discarding the whole route and discovering a new route only the particular broken segment can be can be replaced with a new one. This is done to save time in discovering a new route .Routing overhead is more at more speed but remain constant over the entire node density. The number of control packets for establishing a new route not increases, due to which routing overhead not increased.

***6) Energy consumption* vs. no. of nodes**

Figure 6 indicates that when the number of nodes increases, the energy consumption increases .To maintains the routing information of all nodes, the number of the packets needed increased rapidly at high node density. So the consumption increases sharply. There is not much difference between energy consumption for low and high speed of nodes.

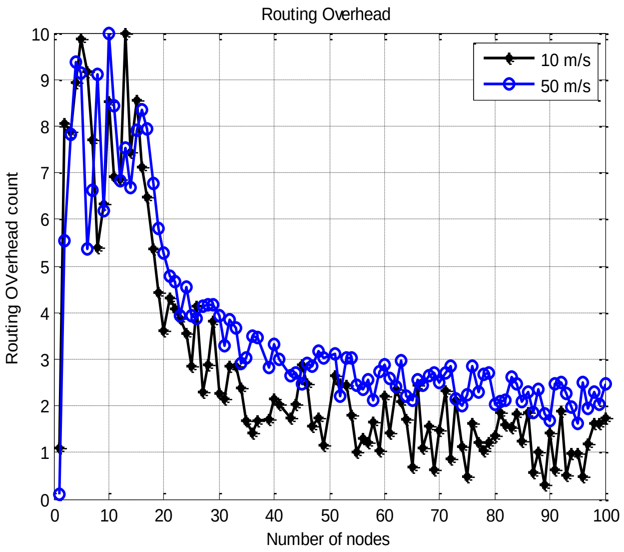


Fig.5Routing Overhead vs. no. of nodes for speed 10m/sec

and 50m/sec.

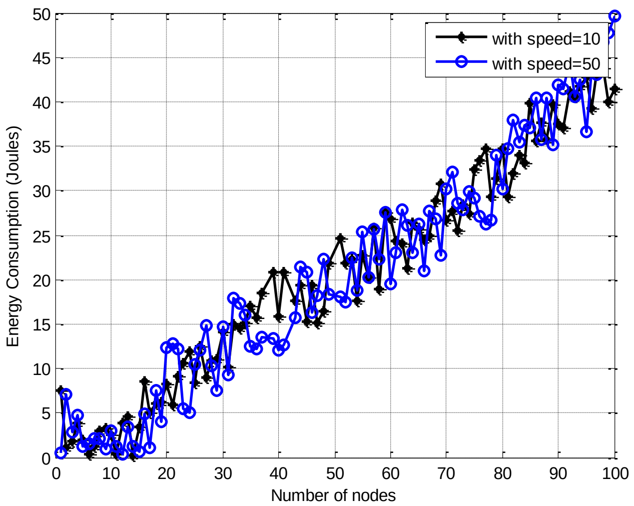


Fig.6 Energy Consumption vs. no. of nodes for speed 10m/sec

and 50m/sec

VI. CONCLUSION

In this work, performance of Hybrid routing protocol in mobile ad hoc networks has been studied and evaluated by using MATLAB. Hybrid protocol is implemented using DSR and AODV Routing Protocols. Performance carried out in terms of packet delivery ratio, packet miss ratio, Throughput, end to end delay, routing overhead and energy consumption. From the analysis, it is observed that packet delivery ratio, throughput decreases as node density and node speed increases. Also it is observed that packet miss ratio, end to end delay and energy consumption increases as node density and node speed increases. End to end delay is very less as comparative to more node speed in network. Routing overhead is almost constant for node density and node speed in network. Our future work is to analyze and compare the performance of three protocols in the case of different networks topology and environment condition.

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