ISSN: 2321-7782 (Online)
Volume 4, Issue 1, January 2016
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

A Comprehensive Analysis of AODV, OLSR and Cosmopolitan Structure of Routing Protocol for MANET

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Abstract: ***In this paper, attempt has been made to evaluate the performance of hybrid routing protocol and has been compared with reactive routing protocol and proactive routing protocol. Simulations are carried over Proactive routing protocol i.e. Optimized Link State Routing (OLSR), Reactive routing protocol i.e. Ad hoc On Demand Distance Vector (AODV) and hybrid routing protocol which is designed by combining the features of both AODV and OLSR. Performance evaluation of following parameters such as Throughput, Packet Delivery Ratio (PDR), MAC collision, Average Routing Overheads and Error Rate by using MATLAB is discussed. The evaluation results show that our designed hybrid protocol outperforms then AODV and OLSR for all the observed parameters except MAC collision.***

Key words: OLSR, AODV, HYBRID protocol, Reactive protocol, Proactive protocols, MANET's.

I. INTRODUCTION

A communication is said as direct (single-hop), if the source and destination nodes are directly within the range of each other so that they can communicate directly with each other, otherwise data packets are routed through the intermediate nodes to reach the destination (multi-hop) [1]. A MANET is infrastructure less, multi-hop wireless network having mobile hosts communicating with each other without the support of a fixed network infrastructure. All the nodes of MANET are capable to generate, receive and to transmit the data. Within the communication area nodes are allowed to move anywhere anytime and nodes participating in communication routing can join and leave the network any time so make the topology ever changing [2,3]. That's why the routing paths are affected by the addition and deletion of mobile nodes. Furthermore as all the mobile nodes depends upon the batteries for their operation, so battery can die any time during communication. All these make the MANET highly unpredictable. According to these characteristics, routing is a critical issue and we should choose an efficient routing protocol to makes the MANET reliable [4].

The available routing protocols are categorized as Reactive routing protocols, Proactive routing protocols and Hybrid routing protocols. Reactive routing protocol obtains necessary path information only when needed [5, 6], whereas proactive protocols periodically exchange their routing information in the form of routing tables [6]. Hybrid routing protocol combines the best of above two. We have reviewed and discussed various reactive protocols [7] in our work and analyzed the performance of these protocols on the basis of performance parameters and find that AODV is performing well and can be utilized for hybrid protocol along with OLSR [8].

In this work we worked on two well-known routing protocols in MANET and merge the properties of these two to form a new hybrid protocol. We choose the AODV [9] and OLSR [10] routing protocols and combine them to develop a new hybrid protocol which can enjoy the properties of these two protocols when they are applied individually. Exhaustive simulation results

show that our newly proposed combined protocol outperforms the other two protocols in terms of throughput, packet delivery ratio, MAC collision, routing overheads and error rate.

Remainder of this Paper is organized as follows: Section II give the details of related work on hybrid protocol, Section III presents the detailed description of our proposed hybrid protocol. Section IV provides the simulation environment and performance metrics are described in Section V and then the results are presented in Section VI. Finally Section VII concludes the paper.

II. Related Work

In [11], AOHR, the combination of AODV and OLSR, is designed and implemented. In this work total area is divided into zones and the route for communication within zone is searched by OLSR, and beyond the zone routes are searched by AODV. In [12] divide the network in upper and lower layer where upper layer formed up by stationary mesh router and lower layer consist of movable mesh clients and to decrease the delay and to extend the life time, author propose proactive protocols for upper layer and reactive protocols for lower layer. In [13], author use the hierarchical routing concept and use k-hop algorithm, to find best route, ensure packet delivery and to reduce the number of retransmission, by forming separate cluster at both static (mesh router) and dynamic (mesh client) levels to achieve fast routing and multipath routing for fault tolerance. A. Ramakrishana et.al. uses hybrid protocol i.e. Optimized Fisheye Link State Routing (OFLSR) at static mesh level and Ad-hoc On Demand Distance Vector (AODV) protocol at dynamic client level. Proactive concept is used to collect the topology information and reactive concept is used to route the packet. To achieve better scalability, robustness, and adaptability in large scale mobile ad-hoc networks Niu X. et.al [14] organize the nodes into hierarchical structure of multi hop cluster and based upon that suggest Hybrid Cluster Routing protocol, in which each cluster contains cluster head, gateway nodes and other ordinary nodes. The cluster heads are responsible for maintaining the local membership and global topology information.

III. Proposed Hybrid Protocol

In this work we propose new hybrid algorithm to enhance the capability of routing protocol by adding the features of proactive and reactive routing protocols. For this work, we use AODV as reactive routing protocol and OLSR as pro-active routing protocol. The working is as per the given algorithm in which the source to destination path is initially searched by AODV within the network area and data packets are transmitted on the route. In case of link failure or any type of link breakage the link repair is done by the OLSR protocol.

Proposed Algorithm

1. Start
2. h = Height of network; w = width of network; n = number of nodes;
3. Calculate CovRange = (w * 25)/100;
4. Place nodes with gps(x,y) co-ordinates;
5. Find the source node and destination node;
6. Find d = distance from each node to other node, cov_list = [];
7. For each n in nodes

   d = sqrt($(x_{n+1} - x_n))^2 + (y_{n+1} - y_n)^2$);

   if(d < CovRange)

   cov_list(n,1) = n;

cov_list(n, length+1) = n+1;

8. end for
9. path=[]; path[1]=Source;
10. Find nearest node to source

While destination! found == 1

Find closest node to previous node;

Add to path[];

End while

Start hybridization;

11. Find sink.x=width*0.5; sink.y=height*0.5;
12. Initiate all parameters to observe and packets to transfer ;
13. Implement radio energy model
14. For every x in path

If x.E.pattern<= energy model pattern

then

Accept;

Else

Drop;

15. End

IV. SIMULATION ENVIRONMENT

Our proposed algorithm is implemented using MATLAB with following parameters given in table 1; are considered for simulation results. The traffic sources are CBR (continuous bit rate). The source-destination pairs are stretch randomly over the network. The mobility model uses 'random waypoint model' in a rectangular filed of 2500m x 2500m with 150 nodes. During the simulation, one randomly selected node starts the data transmission to randomly selected node. By implementing the algorithm of concerned routing protocols, route has been discovered and data transmission took place. Speed of the nodes and transmission range of any particular node is fixed for simulation. Due to the random movement of nodes, the topology is ever changing. That's why different protocols perform differently in the same environment.

TABLE 1: Simulation Parameters

Simulation Parameter	Values
Simulator	MATLAB R2010a
Channel Type	Wireless Channel
Area	2500*2500 m^2
Transmission Range	400 m
Packet size	100
Number of Nodes	150
Speed	5 m/s
Pause time	0 sec
MAC type	Mac 802_11
Antenna model	Omni Antenna
Routing Protocol	OLSR/AODV/WRP

V. Performance Analysis

In this section we examine the performance of various parameters that are taken into account for comparison.

a. **MAC Collision Rate:** MAC collision rate is the number of data packet collisions occurring at MAC layer in a network over a specified period of time. It indicates the rate at which data packets collide or are lost in collisions. It is measured as a percentage of the data packets successfully sent out.

b. **Normalized routing overhead:** It is the ratio of total packet size of control packets (including the RREQ, RREP, RERR and Hello) to the total packet size of data packets delivered to the destination.

c. **Packet delivery ratio:** It is the ratio of number of data packet successfully received by the CBR (constant bit rate) destination to the number of data packet generated by the CBR source. It measures the loss rate by transport protocols. Mathematically, it can be expressed as:

$$PDR = \frac{\sum(\text{all the packets received by destination})}{\sum(\text{all the packets sent by source})} \ldots \text{(i)}$$

d. **Error rate:** It is the rate at which error may occur in the transmitted data packets. More error rate means the higher losses in data packets and more retransmissions are required which increase the overheads and reduce the throughput.

e. **Average Throughput:** Throughput is defined as the total number of packets delivered over the total simulation time. Mathematically, it can be defined by equation (ii) as:

$$\text{Throughput} = \frac{N}{1000} \ldots\ldots\ldots\ldots \text{(ii)}$$

Where N is the number of bits received successfully by all destinations. And average of the total throughput is called as average throughput.

VI. Results and Discussions

Figure 1 shows the MAC collision rate for AODV, OLSR and hybrid protocol under same simulation environment. For AODV, average MAC collisions are 7.90; whereas for OLSR, the collisions are 20.19; but for hybrid protocol the average collisions are 19.91.

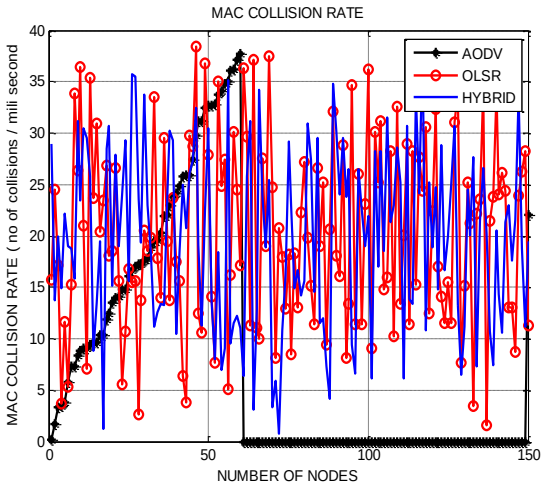

Figure 1 MAC collision rate Vs Number of Nodes

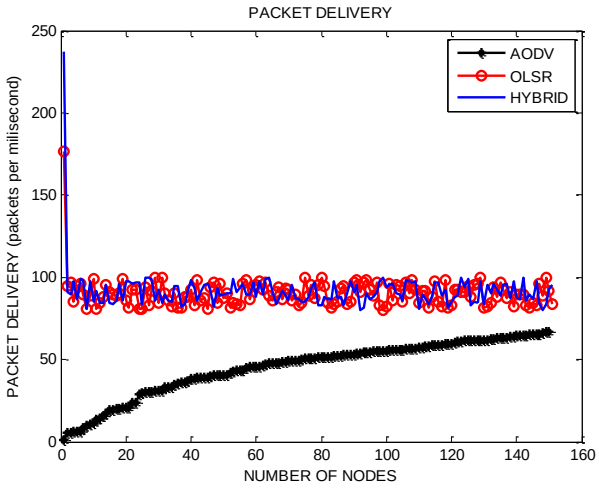

Figure 2 Packet deliveries Vs Number of Nodes

Figure 2 shows the comparison graph for packet delivery ratio of three protocols. Result shows that our proposed algorithm has performed better than AODV and OLSR. It remains 91.75% on an average for hybrid protocol in comparison to OLSR which is delivering the packets almost near to the hybrid protocols as 89.9% but for AODV, PDR is 49.58%.

Comparison of Average routing overheads is shown in figure 3. OLSR had maximum routing overheads as compared with AODV and hybrid protocol. In OLSR, average routing overheads are 177.35 whereas for AODV and hybrid protocol average routing overheads are 73.76 and 51.86 respectively.

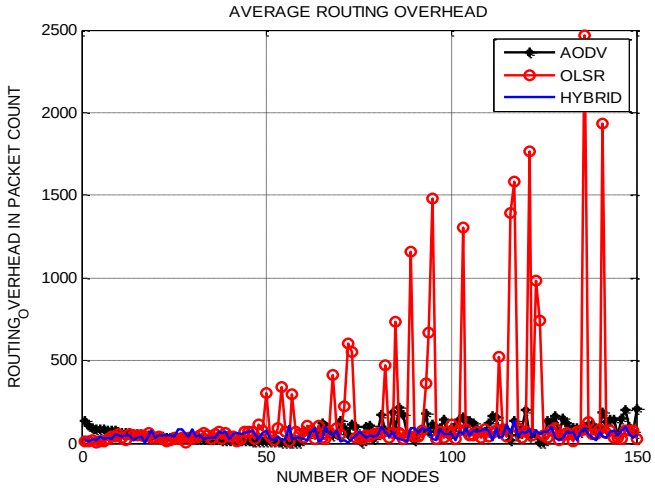

Figure 3 Average routing overheads Vs Number of nodes

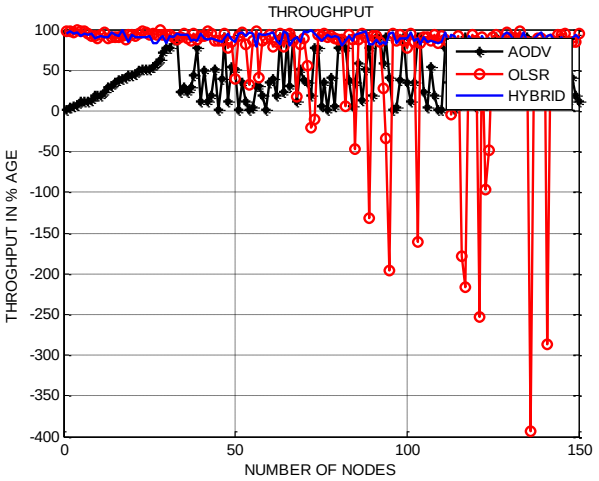

Figure 4 Throughput Vs Number of nodes

Figure 4 shows the comparison results of throughput of three protocols. The Average throughput of hybrid protocol is 89.62% that is higher than the AODV and OLSR. The average throughput of AODV and OLSR is 38.18% and 64.52% respectively.

In figure 5, performance analysis of error rate for AODV, OLSR and hybrid protocol are shown. The average error rate for OLSR is 0.536 that is lower than AODV but higher than hybrid protocol. Error rate for AODV is 1.141 and for hybrid protocol it is 0.37 only.

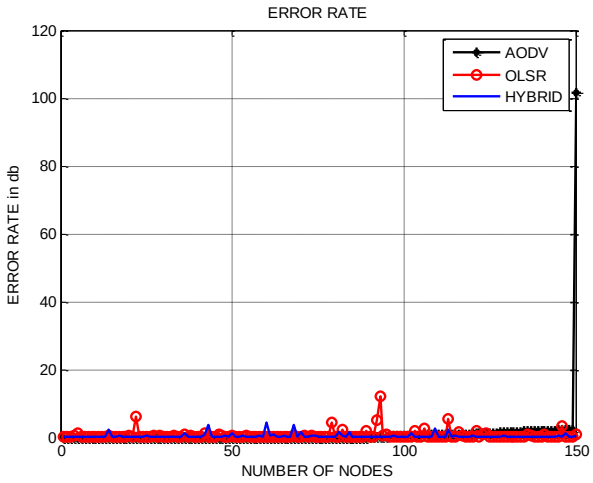

Figure 5 Error rate Vs Number of nodes

VII. CONCLUSION

Our focus in this paper is to evaluate the performance of our designed hybrid protocol with AODV that is popular among reactive routing protocol and OLSR which is proactive in nature on the basis of packet delivery ratio, normalized routing overheads, throughput, error rate and MAC collision rate by using MATLAB. From the simulation results it had been cleared that for the same simulation environment protocols behave differently. This is because of their way of working. The overall performance of our designed hybrid protocols is better than AODV and OLSR when compared on the basis of packet delivery ratio, normalized routing overheads, error rate and throughput but MAC collision rate of AODV is less than both.

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