Performance Analysis of AODV and OLSR Routing Protocol with Different Topologies

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Abstract: ***In this review paper I represent a survey of performance analysis of AODV and OLSR routing protocol on the basis of some performance parameters. How they work with different topologies and condition. Also, compare the both protocols by using different parameters and conclude which one is better. This Survey paper describes the comparison between AODV and OLSR routing protocol using simulation process using many network simulation tools just like OPNET, NS-2 etc. on the basis of different network parameters and conclude the efficiency of both the protocols. For the survey process I took one of them is proactive and second one is Reactive protocol and then illustrates the difference between them.***

Keywords: Wireless ad hoc network, MANETS, performance parameters, AODV, OLSR

1. Introduction

1.1 Ad Hoc On demand Distance Vector

The Ad Hoc On demand Distance Vector (AODV) protocol is a distance vector routing for mobile ad-hoc networks [1] [2]. AODV is an on-demand routing approach, i.e. there are no periodical exchanges of routing information. The protocol consists of two phases [2]:

a. Route Discovery
b. Route Maintenance.

A node wishing to communicate with another node first looks for a route in its routing table. If it finds path, the communication starts immediately, otherwise the node start a route discovery process. The route discovery process consists of a route-request message (RREQ) which is broadcasted. If a node has a valid route to the destination, it replies to the route request with a route-reply (RREP) message. Additionally, the replying node creates a so called reverse route entry in its routing table, which contains the address of the source node, the number of hops to the source, and the next hop's address, i.e. the address of the node from which the message was received. A lifetime is associated with each reverse route entry, i.e. if the route entry is not used within the lifetime it will be removed [2].

The second phase of the protocol is called route maintenance. It is performed by the source node and can be subdivided into:

Source node moves: Source node initiates a new route discovery process.

Destination or an intermediate node moves: A route error message (RERR) is sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages, which are small RREP packets containing a node's address and additional information [2].

2. Performance Parameters

Parameter	Value
MY_ROUTE_TIMEOUT	10 seconds
ACTIVE_ROUTE_TIMEOUT	10 seconds
REV_ROUTE_LIFE	6 seconds
BCAST_ID_SAVE	6 seconds
NODE_TRAVERSAL_TIME	30 hops
NODE_TRAVERSAL_TIME	30 ms
RREQ_RETRIES	2
MAX_RREQ_TIMEOUT	10 seconds
TTL_START	1
TTL_INCREMENT	2
TTL_THRESHOLD	7

Table 1: Default values of AODV Protocol [1]

Parameter	Value
Topology Area	1000 meter x 1000 meter
Number of mobile stations	36
Transmission range	250 ms
Number of gateways	2
Data rate	2 Mbps
Packet size	512 Bytes
Simulation Time	500 seconds

Table 2: Simulation Parameters of MANET [1]

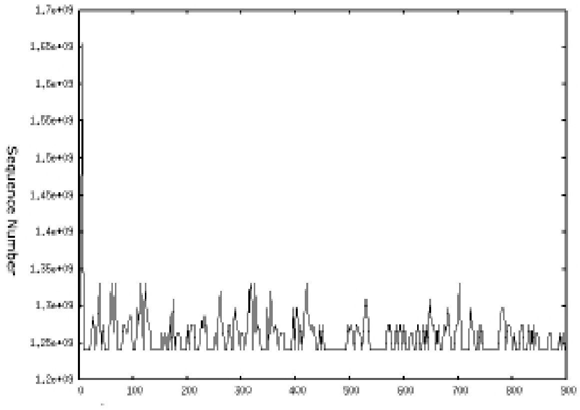

Figure 1: Packet sequence traces [1]

The figure 1 represents the packet sequence traces [1]. The wireless part has shown in horizontal, it represents the sequence number and the bottom one the time in seconds that continuously fluctuated due to wireless medium. This graph represented by using Gnu-plot.

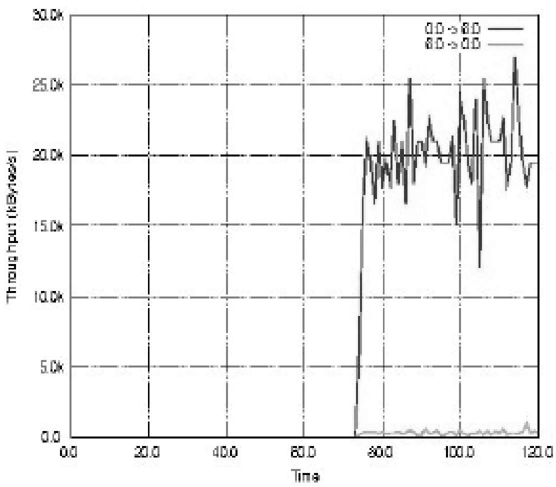

Figure 2: Throughput of MANET [1]

The Figure 2 represents the throughput of MANET [1] that represents with using Perl script. The Y-axis shows throughput in kilobytes and X-axis shows time. The red line of the graph shows the best effort and green represents the voice transmission. We start a best effort approximately started at 70 s and going on until 120 s. The following figure shows the throughput over time. The throughput is calculated as total bytes received by the destination node per second. The delay is more when the communication between the nodes is no more and the throughput is nil. When the different nodes have been communicating with each other then it start over 70 s. The data is more stable when AODV protocol is run. It also shows when the network topologies have been changed then AODV protocol is mostly used because the data remains stable.

Packet delivery ratio[2][3]: packet delivery ratio is as the ratio between the number of packets sent by Constant Bit Rate (CBR) at application layer and the number of received packets by the CBR sink at destination.

$$\frac{\sum NumberOfReceivedDataPackets}{\sum NumberOfSentDataPackets}$$

End-to-End delay [3]: It is defined as the time between the points in time the source want to send a packet and the time the packet reach its destination.

$$\frac{\sum (TimePacketArrive@Dest - TimePacketSent@Source)}{TotalNumberOfConnectionPairs}$$

Routing Overhead [3]: It is the sum of all transmissions of routing packets during the simulation. For packets transmitted over multiple hops, each transmission over one hop is counted as one transmission.

$$\frac{TotalBytesOfControlMessagesTransmittedByAODV}{TotalBytesTransmitted}$$

Normalized Routing Load [2]: The number of routing packets transmitted per data packet delivered at the destination. Each hop wise transmission of a routing packet is counted as one transmission. We have evaluated the above parameters on the basis of varying mobility and varying node density.

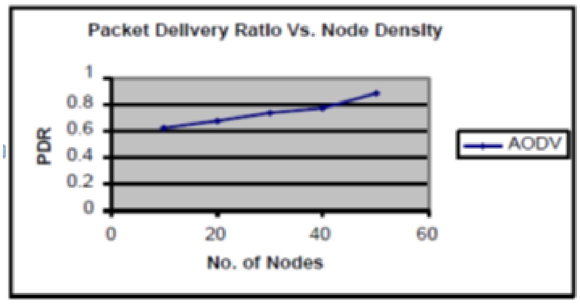

Figure 3: Packet Delivery Ratios vs. Node Density [2]

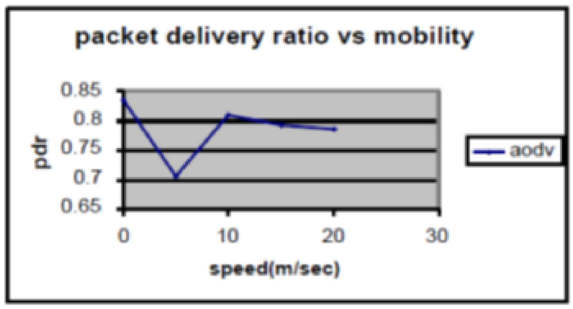

Figure 4: Packet Delivery Ratios vs. Mobility [2]

Effect of Varying Node Density [2]: In the proposed algorithm the simulation is carried out by varying the number of nodes from 10 to 50 and evaluated the results by comparing those with the standard result for that variation. In case of packet delivery ratio as the number of nodes increases the packet delivery ratio increases (figure 3). The presence of only 10 nodes present in the taken simulation area is not sufficient to provide enough connectivity. This reflects in terms of poor packet delivery ratio with both protocol variants. But, as the number of nodes increased to 20 and above, the performance of AODV slightly improves packet delivery ratio.

Effect of Varying Mobility [2]: In our simulation we have varied the speed of nodes from 0 to 20(m/sec) with keeping number of nodes constant.

Figure 5: Packet Delivery Ratio vs. Time [2]

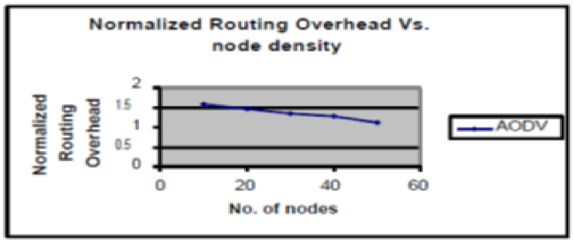

Figure 6: Normalized Routing Overhead vs. Node Density [2]

Variation of node density [2]: As the number of nodes increases the nodes behaving as intermediate nodes also increase and so the neighbour discovering time minimizes. This results in quicker path finding. So we obtain the better packet delivery ratio from source to destination (Figure 3). As node density increases the normalized routing load also decreases (Figure 6). With time packet delivery stabilizes as mostly routes are discovered and less route discoveries are required (Figure 5).

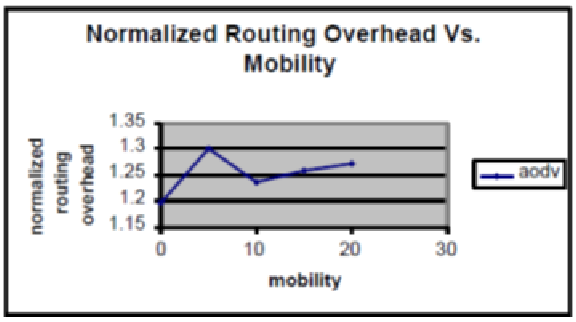

Figure 7: Normalized Routing Overhead vs. Mobility [2]

Variation of node mobility [2]: As the speed of nodes increases, the link failure between the source and destination occurs frequently. This will result in low packet delivery ratio (figure 4), high normalized routing load (Figure 7).

In the presence of high mobility, link failure can happen very frequently. Link failures trigger new route discoveries in AODV since it has almost one route per destination in its routing table. Thus the frequently occurrences of route discoveries in AODV is directly proportional to the number of route breaks. So on varying the speed of nodes increases the packet delivery ratio will decreases (Figure 4) because on increasing the speed the link between source and destination will break frequently. The normalized routing overhead also increases as the mobility becomes more than 10 (Figure 7). AODV perform better under low mobility and high node density. As we have seen in the graphs, the effects of different parameters with the variation of node density and mobility [2].

2.1 Optimized Link State Routing Protocol

The Optimized Link State Routing Protocol (OLSR) [4] is a proactive routing protocol. Every node sends periodically broadcast "Hello"-messages with information to specific nodes in the network to exchange neighborhood information. The information includes the nodes IP, sequence number and a list of the distance information of the nodes neighbors. After receiving this information a node builds itself a routing table. Now the node can calculate with the shortest path algorithm the route to every node it wants to communicate.

When a node receives an information packet with the same sequence number twice it is going to discard it. In these routing tables it stores the information of the route to each node in the network. The information is only updated [4]:

1. A change in the neighbourhood is detected
2. A route to any destination is expired
3. A better (shorter) route is detected for a destination

The Optimized Link State Routing Protocol (OLSR) [4] is developed for mobile ad hoc networks. It operates as a table driven, proactive protocol, i.e., exchanges topology information with other nodes of the network regularly. Each node selects a set of its neighbor nodes as 'multi−point relays' (MPR). In OLSR, only nodes, selected as such MPRs are responsible for forwarding control traffic, intended for diffusion into the entire network. MPRs provide an efficient mechanism for flooding control traffic by reducing the number of transmissions required.

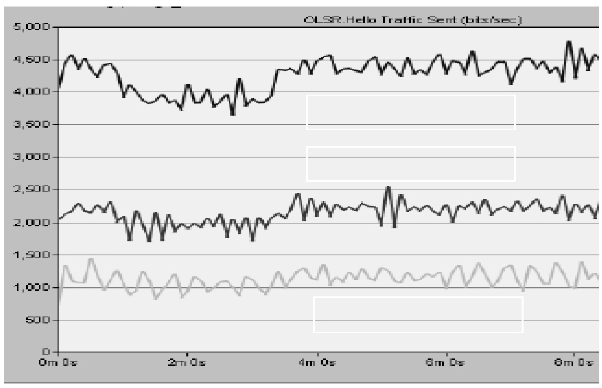

Figure 8: The graphs show the 'Hello' traffic sent when t = 2, 4 and 8 seconds respectively [5]

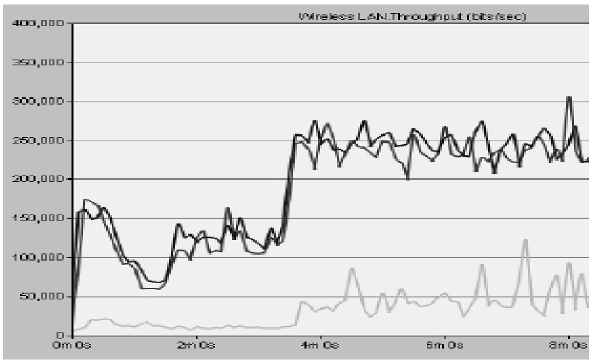

Figure 9: The throughput of simulated network for different 'Hello' intervals.[5]

Using the OPNET simulator to evaluate [5], Twenty five mobile nodes are created with data rate of 11 Mbps and transmit power of 0.005 watts. Each node is capable of creating raw unformatted data and is programmed to transmit data at t=100s. The destination for data transmission is selected randomly. TC interval is fixed at 5 second with IPV4 as the addressing mode. Each node moves randomly within the network range of 500 meter by 500 meter. The simulation is run with 'Hello' intervals of 2 seconds, 4 seconds and 8 seconds. Simulations were carried for a period of 10 minutes in each case [5]. The simulated output is shown in figure 8 and 9.

As the time between 'Hello' message is increased among all the nodes, the total number of network control traffic sent decreases overall in the network. However the throughput plays a crucial role for establishing the quality of service [5]. The throughput for different 'Hello' interval is given in figure 9. From figure 9 we see that the throughput is not greatly affected when the 'Hello' message interval is increased from 2 to 4. However the throughput decreases drastically when the interval is increased to 8.

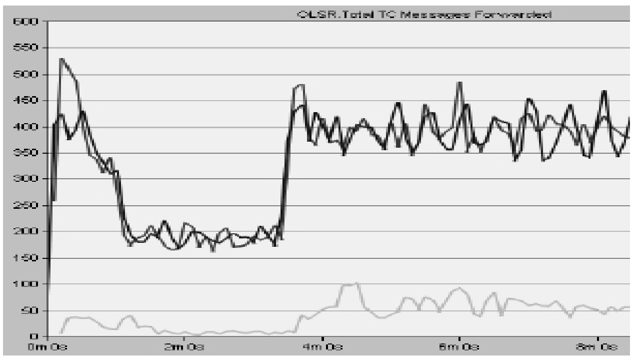

Figure 10: Total TC messages forwarded in all three cases [5]

An ad hoc network was simulated with 25 nodes moving randomly in an area of 500 m by 500 m with OLSR routing protocol. 'Hello' message time was varied from t=2,4 and seconds and the throughput studied. From the above simulation it is seen that for a moderately random movement of nodes in a network the throughput of the network is not affected drastically when the time interval is changed from t=2 second to t=4 second. There is considerable saving in bandwidth which could be useful in bandwidth constrained networks. However when the 'Hello' interval is changed to 8 seconds, the throughput is affected which can decrease the quality of service provided. The entire goal is to improve the performance of OLSR which can be achieved by tuning the 'Hello' interval based on the type of network.

3. Conclusion: AODV Vs OLSR

3.1 Packet Delivery Ratio Comparison [6]

The On-Demand protocol AODV performed particularly well, delivering over 85% of the data packets regardless of mobility rate. But AODV fails when the node density increases. OLSR shows consistent performance.

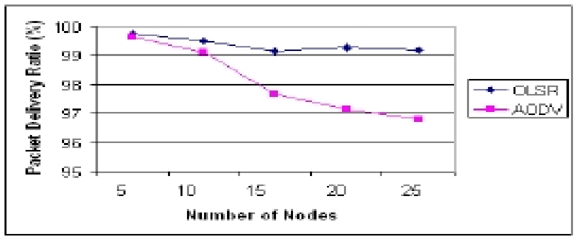

Figure 11: Packet Delivery Ratio v/s Number of Nodes [6]

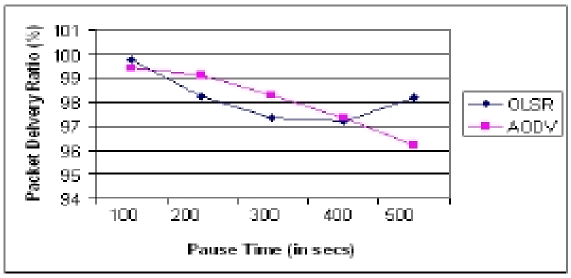

Figure 12: Packet Delivery Ratio v/s Pause Time [6]

Both the protocols deliver a greater percentage of the originated data packets when there is little node mobility (i.e. at large pause time), converging to 100% delivery when there is no node motion.

3.2 Average End to End Packet Delivery [3]

The average end to end delay of packet delivery was higher in OLSR as compared to AODV as shown in Figure 3 and Figure 4. This observation is made while varying the nodes:

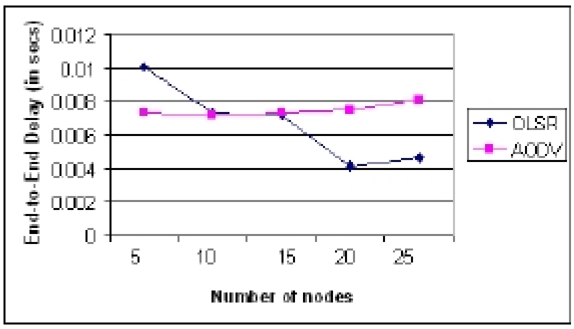

Figure 13: End to End Delay v/s Number of Nodes [6]

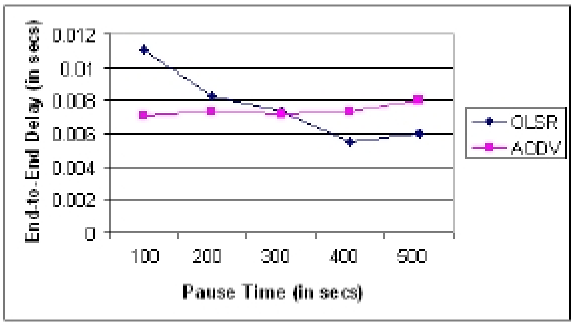

Figure 14: End to End delay v/s Pause Time [6]

3.3 Normalized Routing Load Comparison [6]

In all cases, AODV demonstrates significantly lower routing load than OLSR (Figure15 and Figure 16), with the factor increasing with a growing number of nodes

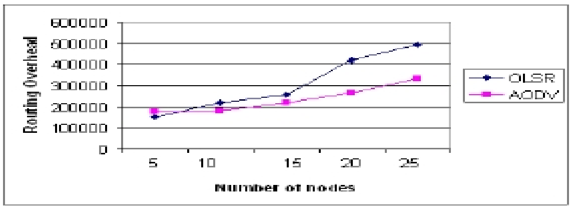

Figure 15: Routing Overhead v/s Number of Nodes [6]

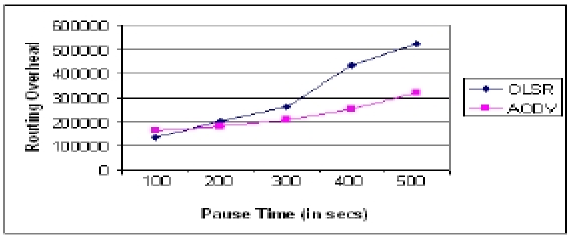

Figure 16: Routing Overhead v/s Pause time [6]

OLSR fails to converge below lower pause times. At higher rates of mobility (lower pause times), OLSR does poorly, dropping to a 70% packet de-livery ratio. Nearly all of the dropped packets are lost because a stale routing table entry directed them to be forwarded over a broken link. As described in the earlier section, OLSR maintains only one route per destination and consequently, each packet that the MAC layer is unable to deliver is dropped since there are no alternate routes. For OLSR and AODV, packet delivery ratio is independent of offered traffic load, with both protocols delivering between 85% and 100% of the packets in all cases.

The AODV protocol will perform better in the networks with static traffic, with the number of source and destination pairs is relatively small for each host. It uses fewer resources than OLSR, because the control messages size is kept small requiring less bandwidth for maintaining the routes and the route table is kept small reducing the computational power. The AODV protocol can be used in resource critical environments. The OLSR protocol is more efficient in networks with high density and highly sporadic traffic. But the best situation is when there is a large number of hosts. OLSR requires that it continuously has some bandwidth in order to receive the topology update messages. Both protocols scalability is restricted due to their proactive or reactive characteristic. In the AODV protocol it is the flooding overhead in the high mobility networks. In the OLSR protocol it is the size of the routing table and topological updates messages and their performance depends a lot on the network environment.

References

[1] Rajan Bansal M.Tech (CSE) BMSCE Muktsar, 152026, India Himani Goyal Principal BMSCE Muktsar, 152026, India Parminder Singh Senior Lecturer CEC Landran, 140307 “Analytical Study the Performance Evaluation of Mobile Ad Hoc Networks using AODV Protocol”, International Journal of Computer Applications (0975 – 8887) Volume 14– No.4, January 2011.

[2] Parma Nand- Doctoral Candidate, Wireless Computing Research Lab., DPT, Indian Institute of Technology, Roorkee, India “Simulation Based Parametric Analysis of AODV Protocol for Adhoc Network”, Published in International Journal of Advanced Engineering & Applications, Jan. 2010

[3] Abdusy Syarif Electrical Engineering Department Universitas Indonesia Kampus Baru Depok, Indonesia Abdusy.syarif@ui.ac.id. Riri Fitri Sari Electrical Engineering Department Universitas Indonesia Kampus Baru Depok, Indonesia riri@ui.ac.id Abdusy Syarif et al. “Performance Analysis of AODV-UI Routing Protocol With Energy Consumption Improvement Under Mobility Models in Hybrid Ad hoc Network”, International Journal on Computer Science and Engineering (IJCSE) ISSN : 0975-3397 Vol. 3 No. 7 July 2011

[4] RFC 3626 Network Working Group T. Clausen, Ed.P. Jacquet, Ed. Project Hipercom, INRIA October 2003

[5] P.SuganthiResearch ScholarMother Teresa Women’s UniversityKodaikanal, TamilNadu, India. Dr.A.Tamilarasi Professor & HOD Kongu Engineering College Perundurai, TamilNadu, India. P.Suganthi “Performance Of OLSR Routing Protocol Under Different Route Refresh Intervals In Ad Hoc Networks”, International Journal on Computer Science and Engineering (IJCSE) ISSN : 0975-3397 Vol. 3 No. 1 Jan 2011

[6] ” S. Gowrishankar, T.G. Basavaraju, M. Singh, Subir Kumar Sarkar Jadavpur University, Acharya Institute of Technology India E-mail: gowru_tiptur@yahoo.com, tgbasava@hotmail.com, sksarkar@ecte.jdvu.ac.in “Scenario based Performance Analysis of AODV and OLSR in Mobile Ad hoc Networks

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