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Performance Analysis of Proactive and Reactive Protocols in Mobile Adhoc Network

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Abstract-A mobile ad hoc network (MANET) consists of mobile wireless nodes. The communication between these mobile nodes is carried out without any centralized control. MANET is a self organized and self configurable network where the mobile nodes move arbitrarily. The mobile nodes can receive and forward packets as a router. Routing is a critical issue in MANET and hence the focus of the paper along with the performance analysis of routing protocols. Here the comparison of three routing protocols i.e. AODV, DSDV and OLSR. The simulation tool will be NS-3. The performance of these routing protocols is analyzed by four metrics: Average end to end delay, Normalized Routing Load, Packet Delivery Ratio and Throughput.

Keywords: AODV, DSDV, OLSR and NS-3

I. Introduction

A wireless ad hoc network is a decentralized type of wireless network. The network is ad hoc because it does not rely on a pre-existing infrastructure, such as routers in wired networks or access points in managed (infrastructure) wireless networks [2]. Instead, each node participates in routing by forwarding data for other nodes, and so the determination of which nodes forward data is made dynamically based on the network connectivity. An ad hoc routing protocol is a convention or standard that controls how nodes decide which way to route packets between computing devices in a mobile ad hoc network. In ad hoc networks, nodes do not start out familiar with the topology of their network instead, they have to discover it. The basic idea is that a new node may announce its presence and should listen for announcements broadcast by its neighbors. Each node learns about nearby nodes and how to reach them and may announce that it can reach them too. [15]

II. Adhoc Routing Protocols

Routing protocols in MANETs are classified into two different categories according to their functionality
A. Reactive protocols
B. Proactive protocols

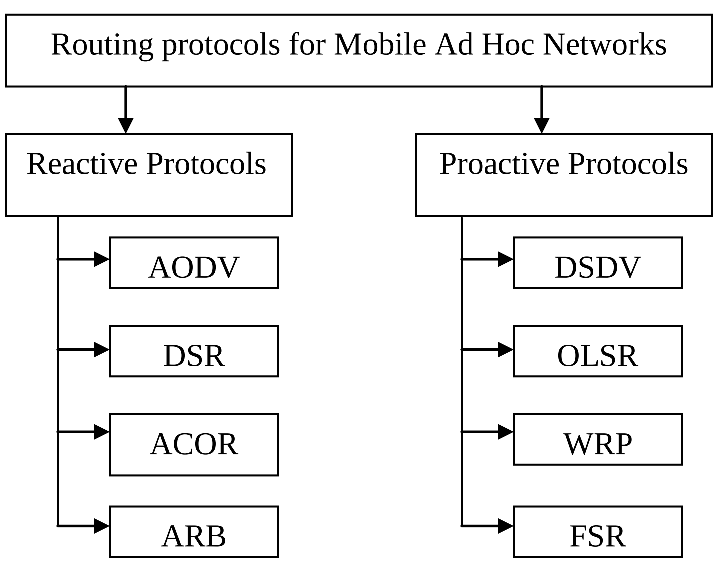


Fig. 1 Classification of routing protocols

A. Reactive Protocols

Reactive protocols are also known as On-demand driven reactive protocols. These Protocols do not initiate route discovery by themselves, until or unless a source node request to find a route. That‘s why these protocols are called reactive protocols. These protocols setup routes when demanded [4], [3]. When a node wants to communicate with another node in the network, and the source node does not have a route to the node it wants to communicate with, reactive routing protocols will establish a route for the source to destination node. Normally reactive protocols

- Don‘t find route until demanded
- Uses flooding technique to propagate the query, to find the destination ―On-Demand.
- Do not consume bandwidth for sending information.
- They consume bandwidth only, when the node start transmitting the data to the destination node.

Some of the most used on demand routing protocols are DSR [5], [6], AODV [4], [12] and Admission Control enabled On demand Routing Protocol (ACOR).

AODV- AODV offers low network utilization and uses destination sequence number to ensure loop freedom. It is a reactive protocol implying that it requests a route when needed and it does not maintain routes for those nodes that do not actively participate in a communication. An important feature of AODV is that it uses a destination sequence number, which corresponds to a destination node that was requested by a routing sender node. The destination itself provides the number along with the route it has to take to reach from the request sender node up to the destination. If there are multiple routes from a request sender to a destination, the sender takes the route with a higher sequence number. This ensures that the ad hoc network protocol remains loop-free [1].

B. Proactive Protocols

Proactive routing protocols work as the other way around as compared to Reactive routing protocols. These protocols constantly maintain update-to-date topology of the network. Every node in the network knows about the other node in advance, in other words the whole network is known to all the nodes making that network. All the routing information is usually kept in tables. Whenever there is a change in the network topology, these tables are updated according to the change. The nodes exchange topology information with each other; they can have route information any time when they needed. Some of the existing proactive routing protocols are DSDV [7], OLSR [8] and Wireless Routing Protocol (WRP).

DSDV- Destination Sequenced Distance Vector (DSDV) is a Proactive routing protocol that solves the major problem associated with the Distance Vector routing of wired. The DSDV protocol requires each mobile station to advertise, to each of its current neighbours, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile computer can almost always locate every other mobile computer. In addition, each mobile computer agrees to relay data packets to other computers upon request. At all instants, the DSDV protocol guarantees loop-free paths to each destination [1].

OLSR- Optimized Link State Routing (OLSR) is a link state routing protocol. OLSR is an adoption of conventional routing protocols to work in an ad hoc network on top of IMEP.

The novel attribute of OLSR is its ability to track and use multipoint relays. The idea of multipoint relays is to minimize the flooding of broadcast messages in the network by reducing/optimizing duplicate retransmissions in the same region. Each node in the network selects a set of nodes in its neighbor-hood that will retransmit its broadcast packets. This set of selected neighbor nodes is called the multipoint relays of that node. Each node selects its multipoint relay set in a manner to cover all the nodes that are two hops away from it. The neighbors that are not in the multipoint relay set still receive and process broadcast packets, but do not retransmit them [13].

III. Performance Metrics

We evaluated key performance metrics for three different applications using AODV, DSDV, OLSR protocols. There are different kinds of parameters for the performance evaluation of the routing protocols. These have different behaviors of the overall network performance. We will evaluate four parameters for the comparison of our study on the overall network performance. These parameters are Average end to end delay, normalized routing load, Packet delivery ratio and throughput for protocols evaluation.

- **Packet Delivery Ratio**: The ratio of the data packets delivered to the destinations to those generated by the sources.[14]
- **Average end-to-end delay**: This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, and propagation and transfer times[14].
- **Normalized routing load**: The number of routing packets “transmitted” per data packet “delivered” at the destination [14].

- **Throughput**: Throughput is defined as; the ratio of the total data reaches a receiver from the sender. The time it takes by the receiver to receive the last message is called as throughput. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec). Some factors affect the throughput as; if there are many topology changes in the network, unreliable communication between nodes, limited bandwidth available and limited energy. A high throughput is absolute choice in every network.

IV. Simulation

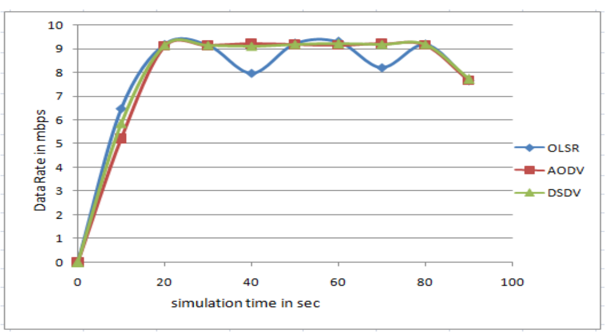
The simulation is carried out in the Network Simulator 3.13 (ns-3.13). The key parameters are provided here i.e. Average end to end delay, normalized routing load, Packet Delivery Ratio and throughput. We run three scenarios. In every scenario there are different numbers of mobile nodes. In first scenario we have 2 mobile nodes. In sec we have 3 and in third scenario we have 4 mobile nodes. We simulate three scenarios. Each scenario was run for 90 sec (simulation time). All the simulations show the required results. Under each simulation we check the behavior of AODV, DSDV and OLSR. We get multiple graphs from simulations. Main goal of our simulation was to model the behavior of the routing protocols. A network was modeled within an area of 50m x 50m. Constant Position Mobility Model was used in this simulation. Data Rate is 10 mbp.

Table. 1 Simulation parameters

simulator	NS-3
Protocols studied	AODV,DSDV,OLSR
Simulation time	90 seconds
Simulation area	50m*50m
Wi-Fi Scenario	802.11g
Node movement model	Constant Position Mobility Model
Packet Size	1 kb
Data Rate	10 mbps

PERFORMANCE COMPARISON OF THE PROTOCOLS

We will analyze and discuss the results of simulations we done. We begin the analysis of AODV, DSDV and OLSR. We check these protocols by four parameters such as Average end to end delay, normalized routing load, Packet delivery ratio and throughput. The results obtained in the form of graphs. We used three scenarios i.e. 2 nodes, 3 nodes and the last one is 4 nodes.



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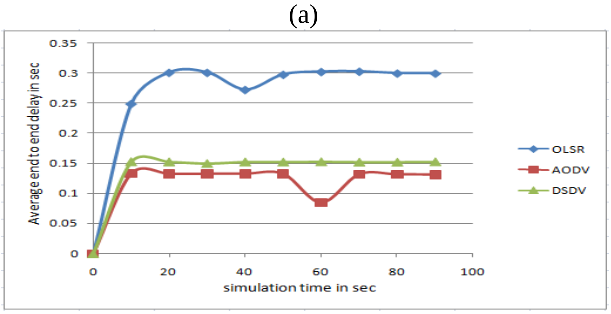

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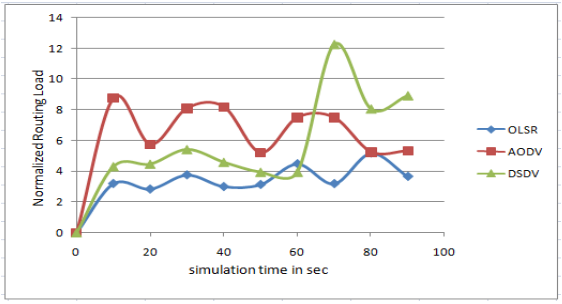

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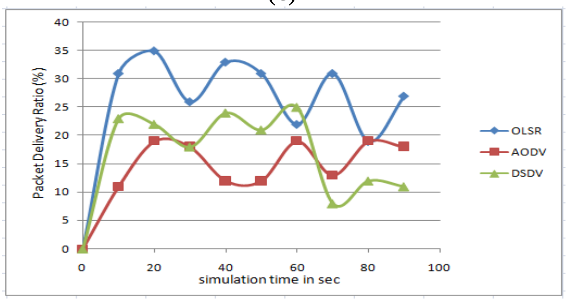

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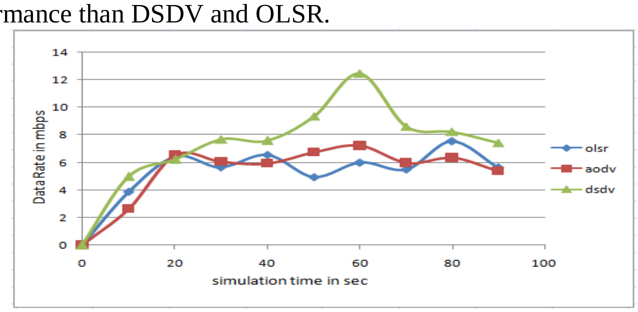
Fig 2 Performance of AODV, DSDV, OLSR in 2 nodes (a) Throughput (b) Average end to end delay (c) Normalized Routing Load (d) Packet Delivery Ratio

In first scenario, 2 mobile nodes were simulated. The graph represents performance of AODV, DSDV, OLSR based on throughput, average end to end delay, Normalized Routing Load, Packet delivery Ratio. OLSR shows better performance in throughput, Normalized Routing Load, Packet delivery Ratio than AODV and DSDV. But in case of Average end to end delay AODV shows better performance than DSDV and OLSR.



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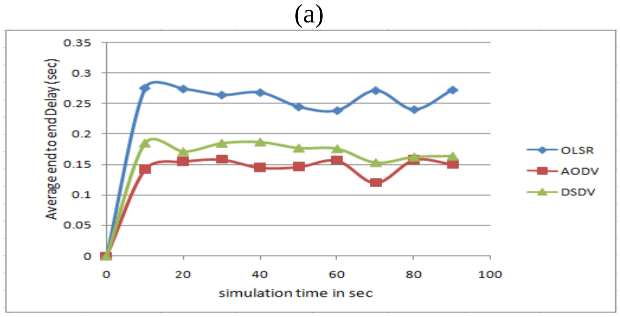

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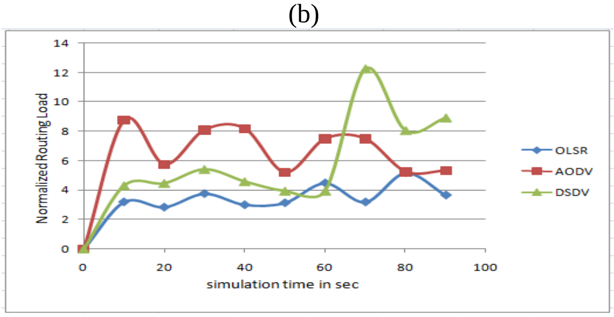

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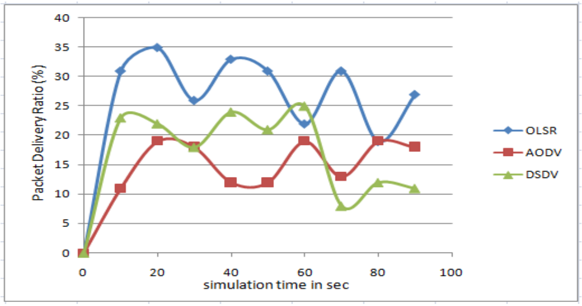

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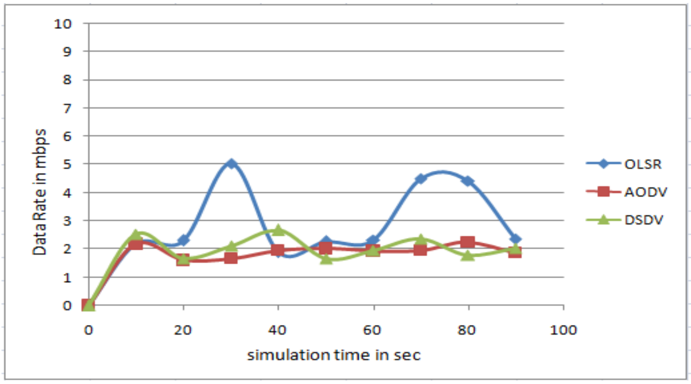
Fig 3 Performance of AODV, DSDV, OLSR in 3 nodes (a) Throughput (b) Average end to end delay (c) Normalized Routing Load (d) Packet Delivery Ratio

In second scenario, 3 mobile nodes were simulated. The graph represents performance of AODV, DSDV, OLSR based on throughput, average end to end delay, Normalized Routing Load, Packet delivery Ratio. But in case of Average end to end delay OLSR shows worst performance than DSDV and AODV. OLSR shows better performance in throughput, Normalized Routing Load, Packet delivery Ratio than AODV and DSDV. But in case of Average end to end delay AODV shows better performance than DSDV and OLSR.



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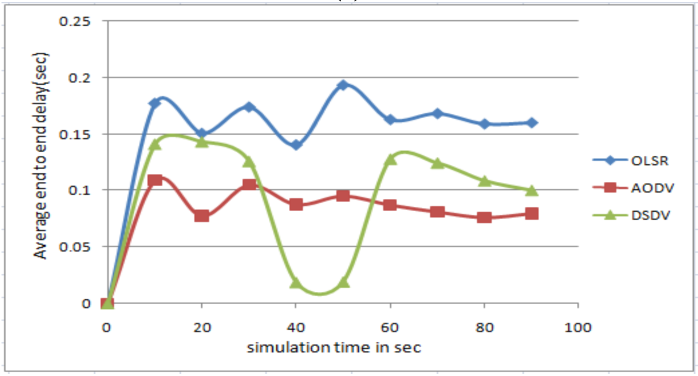

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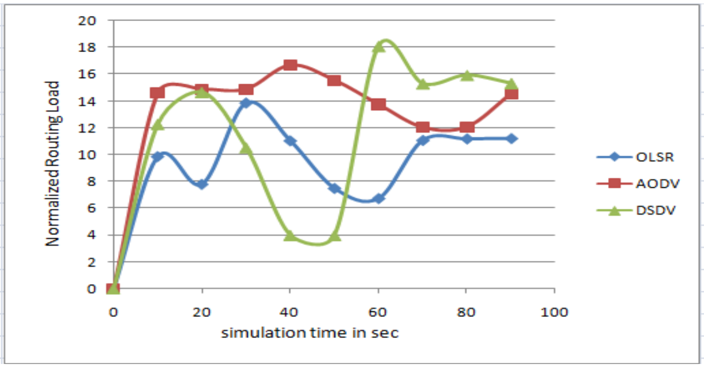

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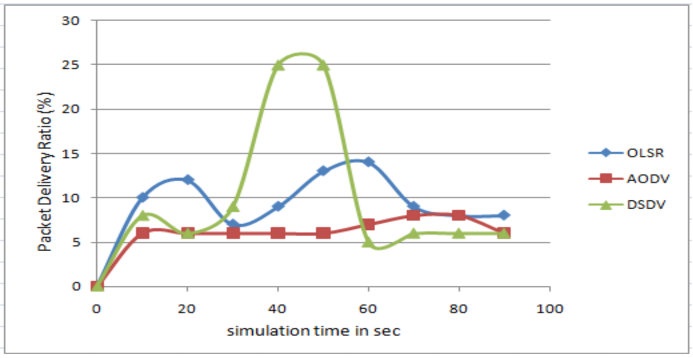

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Fig 5 Performance of AODV, DSDV, OLSR in 4 nodes (a) Throughput (b) Average end to end delay (c) Normalized Routing Load (d) Packet Delivery Ratio

In third scenario, 4 mobile nodes were simulated. The graph represents performance of AODV, DSDV, OLSR based on throughput, average end to end delay, Normalized Routing Load, Packet delivery Ratio OLSR is again showing good results in normalized routing load, Packet delivery ratio and throughput than AODV and DSDV respectively. AODV offer good results in average end to end delay than OLSR and DSDV.

V. Conclusion

In this paper, NS-3 simulator has been used, we evaluated the performance of widely used ad hoc network routing protocols. The simulation characteristics used in this research that is Average end to end delay, normalized routing load, Packet delivery ratio and throughput. It is very important for performance evaluation of any networking protocol. In this paper we compare three protocols AODV, DSDV, OLSR. . Our motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters. The selection of efficient and reliable protocol is a critical issue. In this simulation work we get results in the simulation graphs. From the entire above figures the behaviors of all the routing protocols in different numbers of mobile nodes, it can be seen that which routing protocol perform well. From the above analysis of routing protocols, the OLSR outperforms the two AODV and DSDV protocols in terms of throughput, normalized routing load, Packet delivery ratio in 2, 3, 4 mobile nodes. AODV offer good results in average end to end delay than OLSR and DSDV in 2, 3, 4 mobile nodes respectively. The study of these routing protocols shows that the OLSR is better in MANET according to our simulation results but it is not necessary that OLSR perform always better in all the networks, its performance may vary by varying the network.

VI. Future Work

The future work suggested is the development of modified version of the selected routing protocols which should consider different aspects of routing protocols such as rate of higher route establishment with lesser route breakage and the weakness of the protocols mentioned should be improvised and also on Average end to end delay for better performance of OLSR.The research will not work only optimizing the different parameters also produce new protocols which will be better than the present protocol in one and other environment. The research work will be fruitful and beneficial for the society and researchers.

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