International Journal of Advanced Research in Computer Science and Software Engineering

Research Paper
Available online at: www.ijarcsse.com

Performance Analysis of Proactive and Reactive Routing Protocols in MANET

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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 main classes of MANET routing protocols are Proactive, Reactive and Hybrid. In this paper we compare performance of Proactive routing protocol by focusing on Optimized Link State Routing (OLSR) and Reactive Routing Protocol by focusing on Ad Hoc On Demand Distance Vector (AODV). In this paper our simulation tool will be OPNET modeler. The performance of these routing protocols is analysed by three metrics: delay, network load and throughput. This paper presents a performance analysis of two Mobile Ad Hoc Network (MANET) routing protocols - AODV and OLSR. For the behaviour simulation and evaluation of these protocols we used the OPNET Modeler simulation tool. Each routing protocol was configured into two network scenarios with the default and modified parameters in order to achieve better transmission characteristics. The final evaluation is presented at the end of this paper.

Keywords— MANET, AODV, OLSR, OPNET Simulator, Routing Protocols

I. INTRODUCTION

MANET stands for Mobile Ad hoc Network. It is a decentralized autonomous wireless system which consists of free nodes. Nodes communicate with each other without the use of predefined infrastructure. In this network nodes will generate both user and application traffic and carry out network control and routing duties. Mobile Ad hoc Networks have the attributes like wireless connection, different types of topology, distributed operation and some communication protocol. The primary challenge in building a MANET [4][5] is equipping each device to continuously maintain the information required to route traffic. MANET routing protocols are traditionally divided into three categories which are Proactive Routing Protocols, Reactive Routing Protocols, Hybrid. Proactive Routing Protocols [6][7] are also called table driven routing protocols and it constantly maintain the updated topology of the network. Each node in this protocol maintains individual routing table which contains routing information of every node in the network. Reactive Routing Protocol is also called on-demand routing protocol. Reactive protocols do not initiate route discovery by themselves, until they are requested. Hybrid Routing Protocols can be derived from the two previous ones, containing the advantages of both the protocols. The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding.

II. AD-HOC ROUTING PROTOCOLS

This section describes the main features of two protocols AODV (Ad hoc On-demand Distance Vector) [1] and OLSR (Optimized Link State Routing)[2] deeply studied using OPNET 14.5 .

An ad-hoc routing protocol is a convention, or standard, that it improves the scalability of wireless networks compared to infrastructure based wireless networks because of its decentralized nature. Ad-hoc networks are best suited due to minimal configuration and quick operation.
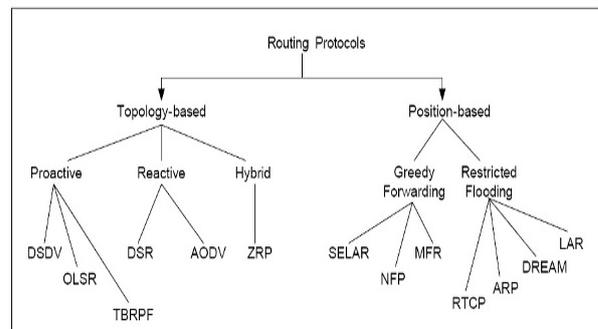

Figure 1: Classification of Routing Protocols

A. AODV ((Ad hoc On-demand Distance Vector)

AODV is an on-demand routing protocol. The AODV [9] algorithm gives an easy way to get change in the link

situation. For example if a link fails notifications are sent only to the affected nodes in the network. This notification cancels all the routes through this affected node. It builds unicast routes from source to destination and that's why the network usage is least. Since the routes are build on demand so the network traffic is minimum. AODV does not allow keeping extra routing which is not in use [10]. If two nodes wish to establish a connection in an ad hoc network then AODV is responsible to enable them to build a multihop route. AODV uses Destination Sequence Numbers (DSN) to avoid counting to infinity that is why it is loop free. This is the characteristic of this algorithm. When a node send request to a destination, it sends its DSNs together with all routing information. It also selects the most favorable route based on the sequence number [10]. There are three AODV messages i.e. Route Request (RREQs), Route Replies (RREPs), and Route Errors (RERRs) when the source node wants to create a new route to the destination, the requesting node broadcast an RREQ message in the network [9]. The RREQ message is broadcasted from source node A to the destination node B. The RREQ message is shown by the black line from source node A to many directions. The source node A broadcasts the RREQ message in the neighbour nodes. When the neighbour nodes receive the RREQ message it creates a reverse route to the source node A. This neighbour node is the next hop to the source node A. The hop count of the RREQ is incremented by one. The neighbour node will check if it has an active route to the destination or not. If it has a route so it will forward a RREP to the source node A. If it does not have an active route to the destination it will broadcast the RREQ message in the network again with an incremented hop count value. The procedure for finding the destination node B. The RREQ message is flooded in the network in searching for finding the destination node B. The intermediate nodes can reply to the RREQ message only if they have the destination sequence number (DSN) equal to or greater than the number contained in the packet header of RREQ.

The intermediate nodes forward the RREQ message to the neighbour nodes and record the address of these nodes in their routing cache. This information will be used to make a reverse path for RREP message from the destination node. The destination node B replies with RREP message denoted by the dotted orange line, the shortest path from destination B to source A. The RREP reached to the originator of the request. This route is only available by unicasting a RREP back to the source. The nodes receiving these messages are cached from originator of the RREQ to all the nodes.

When a link is failed an RERR message is generated. RERR message contains information about nodes that are not reachable. The IP addresses of all the nodes which are as their next hop to the destination.

B. OLSR (Optimized Link State Routing)

It is a proactive routing protocol and is also called as table driven protocol because it permanently stores and updates its routing table. OLSR [2][8] keeps track of routing table in order to provide a route if needed. OLSR

can be implemented in any ad hoc network. Due to its nature OLSR is called as proactive routing protocol. Multipoint relay (MPR) nodes in the network do not broadcast the route packets. Just Multipoint Relay (MPR) nodes broadcast route packets. These MPR nodes can be selected in the neighbor of source node. Each node in the network keeps a list of MPR nodes. This MPR selector is obtained from HELLO packets sending between in neighbor nodes. These routes are built before any source node intends to send a message to a specified destination. Each and every node in the network keeps a routing table. This is the reason the routing overhead for OLSR [8] is minimum than other reactive routing protocols and it provide a shortest route to the destination in the network. There is no need to build the new routes, as the existing in use route does not increase enough routing overhead. It reduces the route discovery delay.

III.   EXPERIMENTAL SET UP

We carried out simulations on Opnet [3] simulator. The simulation parameters are summarized in table 1.

Statistic	Value
Simulator	OPNET 14.5
Routing Protocol	AODV and OLSR
Trajectory Model	wlan_interference_scenario
Scenario Size	3.5×3.5 km
Simulation Time	8 min
Node	25,50
802.11 data rate	11Mbps

Table 1. Simulation parameters

Figure 2. Shows a sample network created with 25 Nodes, one static FTP server, application configuration and profile configuration for the network in which FTP has been chosen as an application. Figure 2 depicts a network with 25 fixed nodes whose behaviour has to be analysed nodes in the network with respect to time to determine the effecting features of each protocol

Figure 2. Network created with 25 nodes

IV. PERFORMANCE PARAMETERS

OPNET modeler 14.5[6][7] is used to investigate the performance of routing protocols AODV and OLSR with varying network sizes, data rates, and network load. We evaluate three parameters in our study on overall network performance. These different types of parameter show the different nature of these Protocols, the parameters are throughput, delay and network load.

A. 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 [9]. Throughput is expressed as bytes or bits per sec (byte/sec or bit/sec).

B. Delay

The packet end-to-end delay is the time of generation of a packet by the source up to the destination reception. So this is the time that a packet takes to go across the network. This time is expressed in sec. Hence all the delays in the network are called packet end-to-end delay [10], like buffer queues and transmission time. Sometimes this delay can be called as latency; it has the same meaning as delay.

C. Network Load

Network load represents the total load in bit/sec submitted to wireless LAN layers by all higher layers in all WLAN nodes of the network [10]. When there is more traffic coming on the network, and it is difficult for the network to handle all this traffic so it is called the network load.

V. RESULTS

We carried out simulations on Opnet simulator14.5. The results show differences in performance between considered routing protocols, which are the consequence of various mechanisms on which protocols are based. We carried out our simulations with 25 and 50 nodes.

Figures 3,4,5,6,7 and 8 depicts the throughput, delay and network load of this network with respect to total simulation time which is taken as 8 minutes for which the simulation was run.

In this simulation, the networks is set to 25 and 50 nodes, the traffic is FPT mode, the data transmission rate is 11 Mbps and the simulation time is 8 minutes.

A. Throughput

In this fig .show that throughput in AODV is the higher than OLSR we have the minimum throughput Fig.3 it is shows that the network throughput of AODV and OLSR becomes low with the increase of the node number. The reason is that the increase of the node number will lead to the reducing of data packets' receiving in the network due to collision and delay in the network, hence that the network throughput is low.
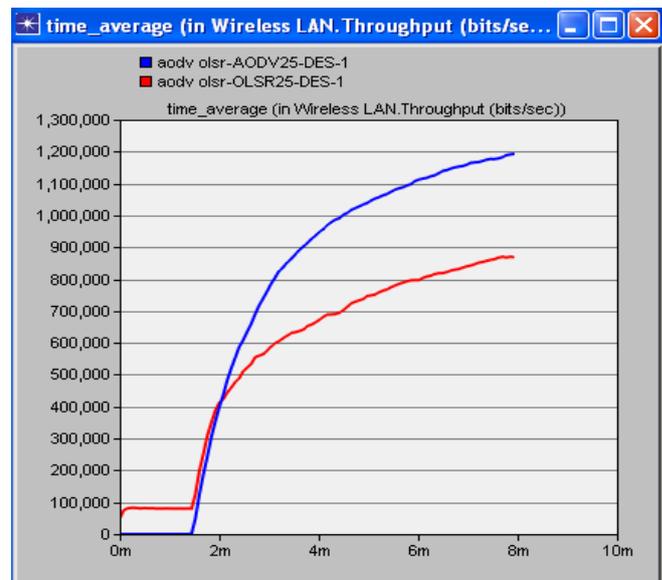

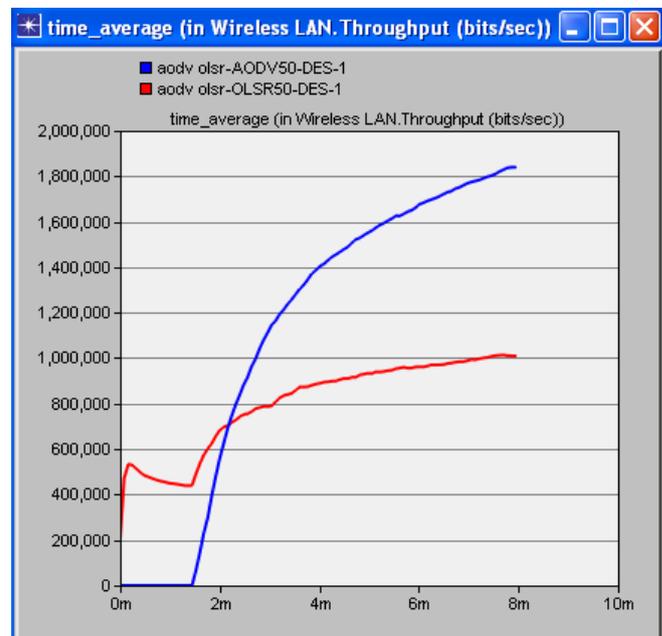Figure 3. Throughput comparison in routing protocols with 25 nodes

Figure 4. Throughput comparison in routing protocols with 50 nodes

We can see that the network throughput of AODV is higher than OLSR. The reason is that the routing mechanisms of the two protocols are different in which AODV is based on purpose-driven and OLSR is based on Table driven routing protocol.

B. Delay

In Fig. 5, we see that OLSR has initial delay at first of simulation. We can conclude that delay in OLSR is the higher than AODV, we have the minimum Delay.
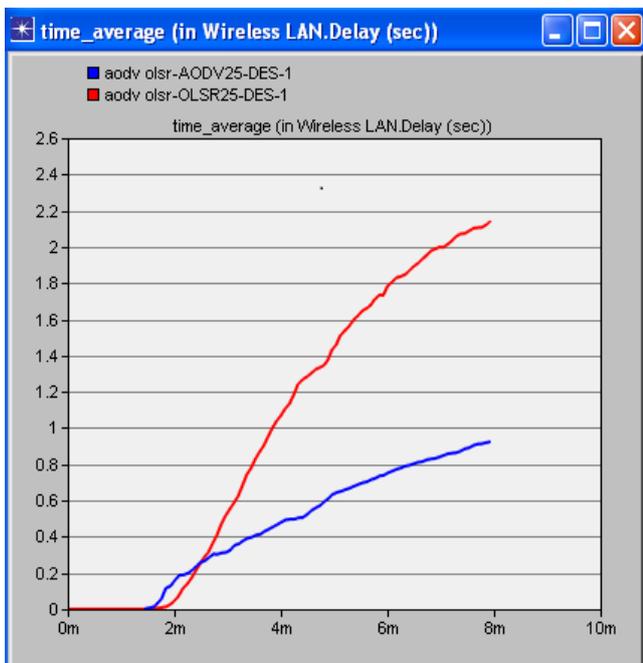
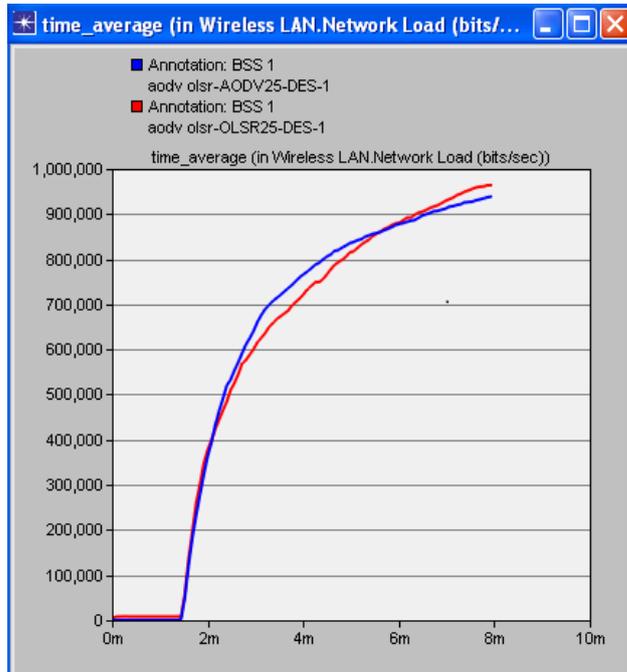Figure 5.Delay comparison in two routing protocols with 25 nodes

Figure 7.Load (bits/sec) comparison in two routing protocols with 25 nodes
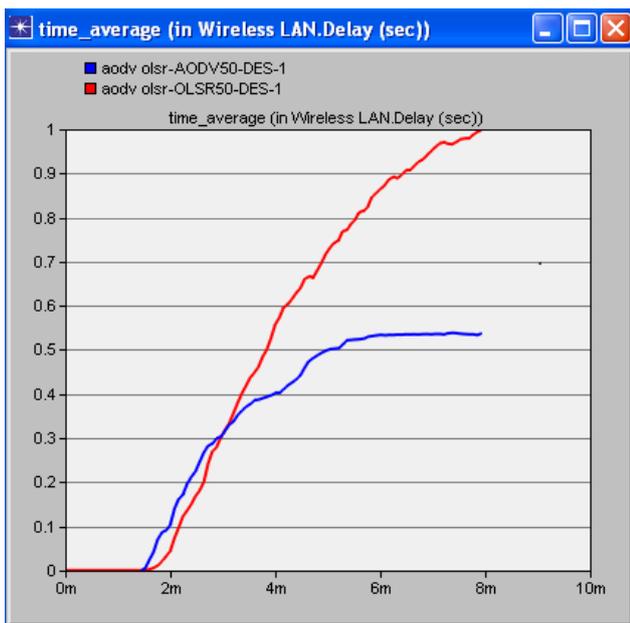

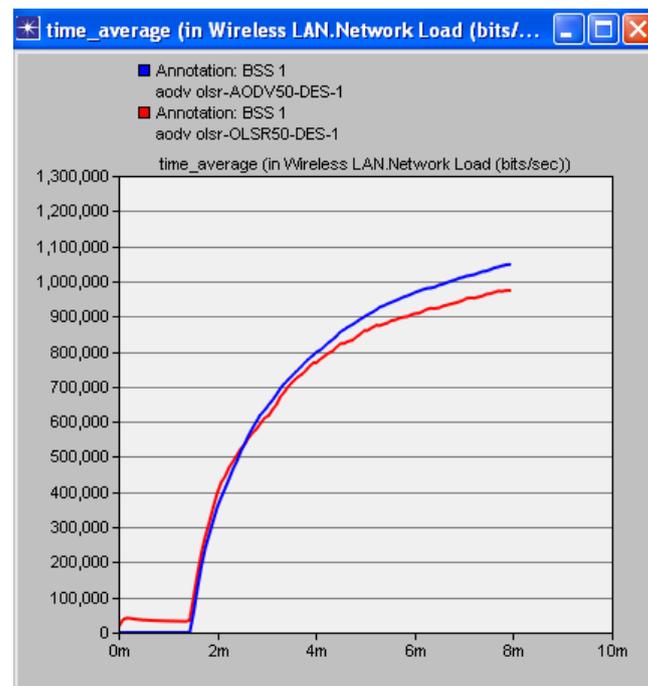Figure 6.Delay comparison in two routing protocols with 50 nodes

Figure 8.Load (bits/sec) comparison in two routing protocols with 50 nodes

C. Network Load

According to simulation, as we can see in Fig. 7, load in OLSR is higher than AODV and finally the minimum value of load belongs to AODV.

In Fig. 8, we can see that under the OLSR, the value of network load start with peak value equal to 25,000 bit/sec and start to decrease for some duration of simulation period and after that start to increase along the simulation period to reach the peak value 1,000,000 bit/ sec.

Under the AODV, the load begins with its smallest value 0 bit/ sec until the 8 minutes of simulation period than start to increase to reach its peak value which is equal to 10,50,000 bit/sec.

VI.   CONCLUSION

The aim of our work was to compare the performance of reactive AODV and proactive OLSR ad hoc routing protocols. For evaluation of these protocols we used the OPNET Modeler simulation environment where we created the model of wireless ad hoc network composed of four scenarios; two scenarios with AODV and OLSR routing protocols each with 25 nodes and the other with AODV and OLSR routing protocols each with 50 nodes. At the end we came to the point from our simulation and analytical study that the performance of routing protocols vary with network and selection of accurate routing protocols according to the network, ultimately influence the efficiency of that network in magnificent way.

VII.   REFERENCES

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