Comparative Study of AODV, OLSR and GRP using OPNET

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Abstract- A mobile ad-hoc network (MANET) is an infrastructure less open network of moveable devices which are connected by wireless links. Every node in a MANET is free to move in any direction and will therefore change its links to other devices continuously and unpredictably. Mobile devices can communicate with each other without the use of a predefined infrastructure or centralized administration. In this paper routing protocols AODV, OLSR and GRP for mobile ad hoc network are compared on the basis of Delay, Network load, Media Access Delay and Throughput. This comparative study shows that OLSR outperforms the rest of three protocols in terms of network load and throughput.

*Keywords- MANET, AODV, OLSR, GRP, OPNET, routing*

I. INTRODUCTION

A mobile ad-hoc network (MANET) is an infrastructure less open network of mobile routers (and associated hosts) connected by wireless links—the union of which form an arbitrary topology. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. A collection of wireless mobile nodes can dynamically establish the network in the absence of fixed infrastructure [1]. Because of these characteristics, routing is a critical issue and an efficient routing protocol needs to be chosen to make the MANET reliable [2]. The most popular routing protocols in MANET are AODV (reactive), OLSR (proactive) and GRP (Hybrid). Reactive protocols find the routes when they are needed. On-demand protocols find a route on demand by flooding the network with route request packets. Proactive protocols are table driven protocols and find routes before they need it. Hybrid Protocols covers the advantages of both Proactive and Reactive routing protocols. In this paper, three MANET routing protocols AODV, OLSR and GRP are evaluated on the basis of four parameters: Delay, Network Load, Media Access Delay and Throughput**.** The organization of the paper is as follows. We explain routing protocols in section II, related works are discussed in section III, section IV explains the simulation and performance metrics, section V explains the results of simulations and finally section VI concludes the paper.

II. ROUTING PROTOCOLS IN MANETS

In order to facilitate communication within the network, a routing protocol is used to discover routes between nodes. The primary goal of such an ad-hoc network routing protocol is correct and efficient route establishment between a pair of nodes so that messages may be delivered in a timely manner. Route construction should be done with a minimum of overhead and bandwidth consumption.

Types of Routing Protocols: Numerous protocols have been developed for ad-hoc mobile networks. Such protocols must deal with the typical limitations of these networks, which include high power consumption, low bandwidth, and high error rates. As shown in Figure 1 below, these routing protocols may generally be categorized as: (a) Proactive (b) Reactive and (c) Hybrid. Solid lines in this figure represent direct descendants while dotted lines depict logical descendants. Despite being designed for the same type of underlying network, the characteristics of each of these protocols are quite distinct.
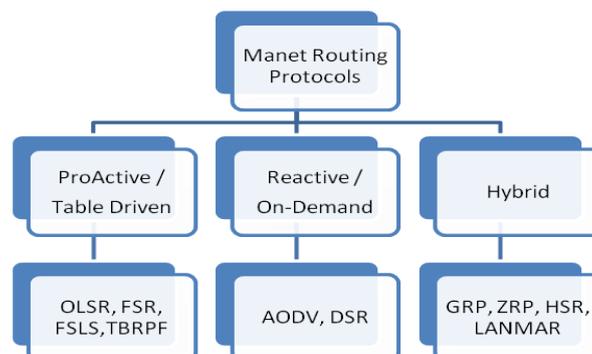
The routing protocols considered in this paper are namely: AODV, OLSR and GRP. Below is a brief description of each protocol:

A. Ad-hoc On-demand Distance Vector Routing Protocol (AODV):
AODV [3] is reactive protocol, when a source wants to initiate transmission with another node as destination in the network, AODV use control messages to find a route to the destination node in the network. AODV will provide topology information (like route) for the node. In AODV protocol if one Node wants to send messages to another node. It will generate a Route Request message (RREQ) and forwarded to the neighbours, and those node forward the control message to their neighbour's nodes. Whenever the route to destination node is located or an intermediate node have route to destination. They generate route reply message (RREP) and send to source node. When the route is established between nodes then they communicate with each other.

B. Optimized Link State Routing Protocol (OLSR):
 OLSR is a table driven protocol. It usually stores and updates its routes so when a route is needed, it present the route immediately without any initial delay. In OLSR, some candidate nodes called multipoint relays (MPRs) are selected and responsible to forward broadcast packets during the flooding process. This technique reduces the overhead of packet transmission compared to flooding mechanism [2]. OLSR performs hop-by-hop routing, where each node uses its most recent routing information to route packets. MPR"s is made in a way that it covers all nodes that are two hops away (i.e. neighbours of the neighbours). A node senses and selects its MPR's with control messages called HELLO messages. Hello messages are used to ensure a bidirectional link with the neighbour. HELLO messages are sent at a certain interval. Nodes broadcast "TC" or Topology control messages to determine it's MPRs [2].

C. Gathering Based Routing (GRP)
This schema collects network information at a source node with a small amount of control overheads. According to the collected information, source node can finds routes and continuously transmit data even if the current route is disconnected. The result of this approach is achieving fast transfer with less overhead of control massages. This approach is widely known as hybrid routing protocol, because it can simultaneously use the strengths of reactive routing and proactive routing protocols. A packet that named DQ is used continuously to forward to each nodes neighbours until the destination is reached. When it reaches the destination, the destination node broadcasts a network information gathering (NIG) packet to its neighbours. The source node computes the best route according to collected information and then immediately starts to transmit data packets

III. RELATED WORKS

The performance comparison of various routing protocols over MANET namely-AODV, DSR, TORA, OLSR and GRP by varying the number of nodes with FTP and HTTP applications is done by Gagangeet singh aujla and Sandeep singh kang [4] on the basis of throughput, delay, load and data dropped performance metrics. They concluded that results for ftp give the clear picture about the OLSR protocol's best performance in all scenarios whereas the results for http application give the mixed picture. OLSR has highest throughput, least data dropped. TORA has high delay, load, data drop in all scenarios for ftp. DSR shows least throughput. GRP shows least delay. AODV gives highest throughput for http. The performance comparison of MANET routing protocols, namely AODV, DSR, TORA and OLSR is done by Ashish Shrestha and Firat Tekiner [5] which shows the overall performance of AODV and OLSR. However, AODV showed better efficiency to deal with high congestion and it proves better by successfully delivering packets over heavily trafficked network compared to OLSR and TORA. Performance comparison of three routing protocol -AODV, DSDV and TORA under different network size is done by N Vetrivelan, A V Reddy [6] shows that AODV performs well in terms of Average Delay, Packet Delivery Fraction and for Routing Load TORA performs well. In less stressful situation, the Packet Delivery Fraction, the TORA outperforms DSDV and AODV. Comparison of OLSR and TORA is done by Pankaj Palta and Sonia Goyal in [2] which shows that OLSR is better in those scenario where bandwidth is large as OLSR always updated their nodes so large bandwidth is used than TORA on same conditions. Performance comparison of OLSR, GRP and TORA using OPNET are compared on the basis of packets delay, load, media access and throughput by Harmanpreet Kaur and Jaswinder Singh [7]. Comparison of AODV, TORA and DSR is also done by N.Adam, M.Y Ismail and J. Abdullah [8] in terms of PDR, delay, throughput, dropped and routing load. AODV is best with minimum delay, packet delivery ratio and maximum throughput whereas TORA is worst. The simulation study for MANET network under five routing protocols AODV, DSR, OLSR, TORA and GRP were deployed using FTP traffic in [9].These protocols were tested with three QOS parameters. From their analysis, the OLSR outperforms others in both delay and throughput. Mr. L Raja, Capt. Dr. S Santhosh Baboo has done the comparative study of reactive routing protocol AODV, DSR, ABR and TORA [10].

IV. SIMULATION PARAMETERS AND PERFORMANCE METRICS

In this paper, network simulator, Optimized Network Engineering Tools 14.5 has been used as a simulation environment. OPNET is a simulator built on top of discrete event system (DES) and it simulates the system behaviour by modelling each event in the system and processes it through user defined processes. OPNET is very powerful software to simulate heterogeneous network with various protocols. OPNET is a high level user interface that is built as of C and C + + source code with huge library of OPNET function.

In this Paper, three scenarios are created where MANET networks are configured by using AODV, OLSR and GRP routing protocols. Two network scenarios are dedicated to AODV and OLSR routing protocols are compared and evaluated based on some quantitative metrics such as Network Load, Delay and Throughput.

Network load: It is the amount of traffic being carried by the network. It is the total data traffic (in bits/sec) received by the entire wlan from higher layers that is accepted and queued for transmission.

Delay: It is the time taken by a packet from the movement it is transmitted on the network by source node to reach the destination node.

Throughput: It is the number of packets received by all the destinations over the duration of simulation.

Media Access Delay: Represents the global statistic for the total of queuing and contention delays of the data, management, delayed Block-ACK and Block-ACK Request frames transmitted by all WLAN MACs in the network. It also includes multiple numbers of back-off periods.
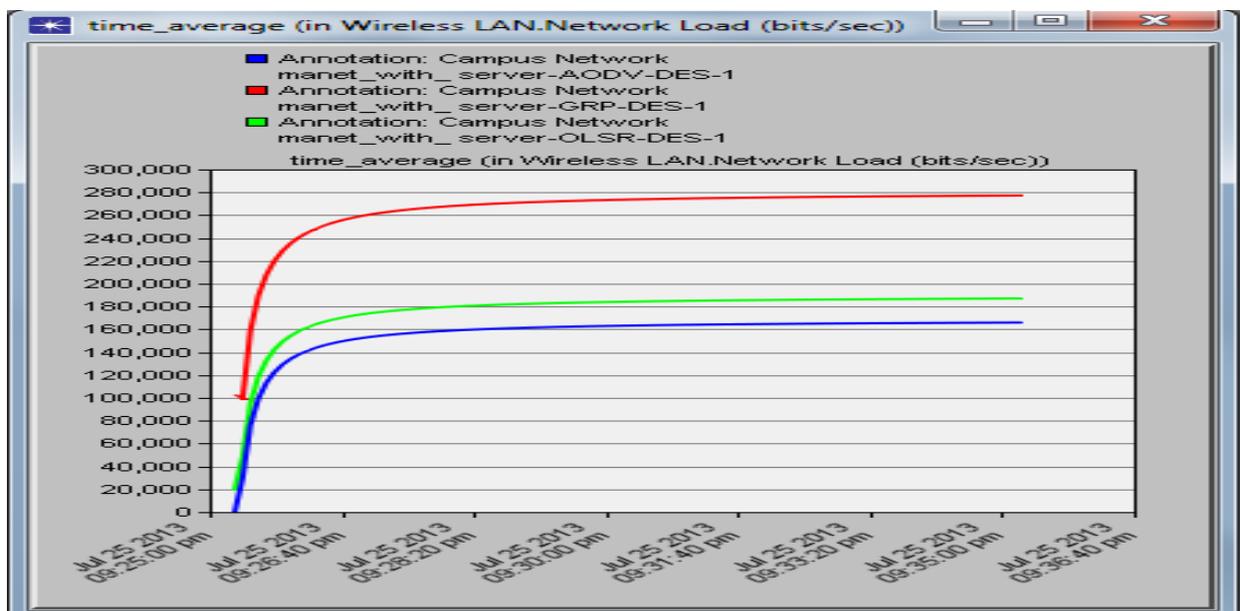
V. RESULTS

A. Delay:
Here Blue line in the graph shows Delay for AODV routing protocol. Similarly, Green line represents OLSR and Red line shows GRP. AODV has more delay then OLSR although AODV and OLSR are very close to each other. GRP come last in the list with respect to delay.
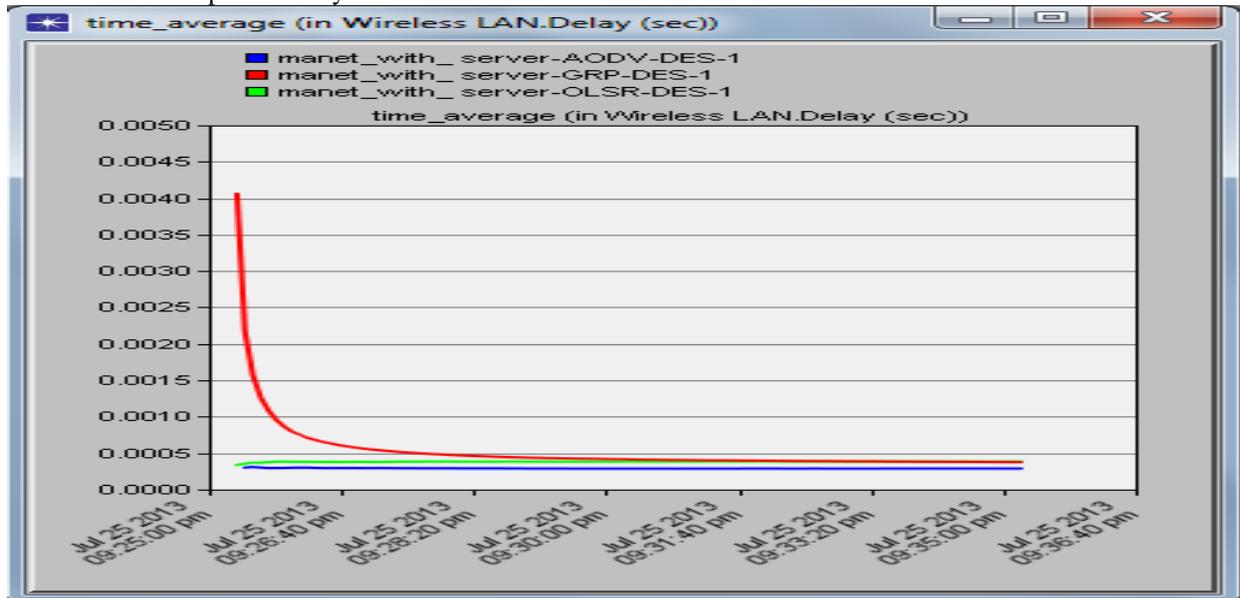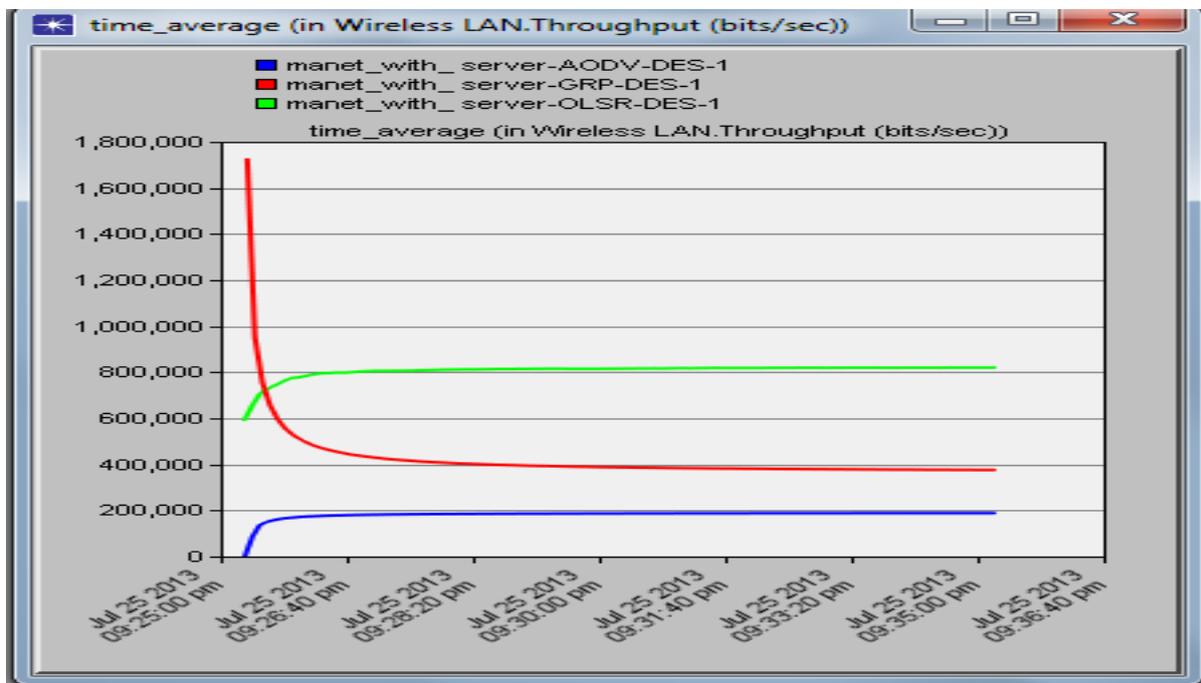

B Network load:
Here Blue line in the graph shows network load for AODV routing protocol. Similarly, Green line represents OLSR and Red line shows network load GRP. GRP have shown better results than other two scenarios with respect to network load. Network load of GRP is very high as compare to other routing protocols, which is followed by OLSR then by AODV.

C. Throughput:

In the present graph, the x-axis shows the time (in seconds) and the y-axis shows the number of bits. So in this graph the throughput is compared as bits/sec for all the routing protocols and network scenarios. Here Blue line in the graph shows throughput for AODV routing protocol. Similarly, Green line represents OLSR and Red line shows throughput for GRP. The difference in the graph can be seen clearly as the performance of OLSR is very good followed by GRP then AODV.

D. Media Access delay:

Here Blue line in the graph shows Media access delay for AODV routing protocol. Similarly, Green line represents OLSR and Red line shows media access delay GRP. Initially GRP shows huge delay in media access. But as the time passes delay in all scenarios become almost negligible and ends up at same value.
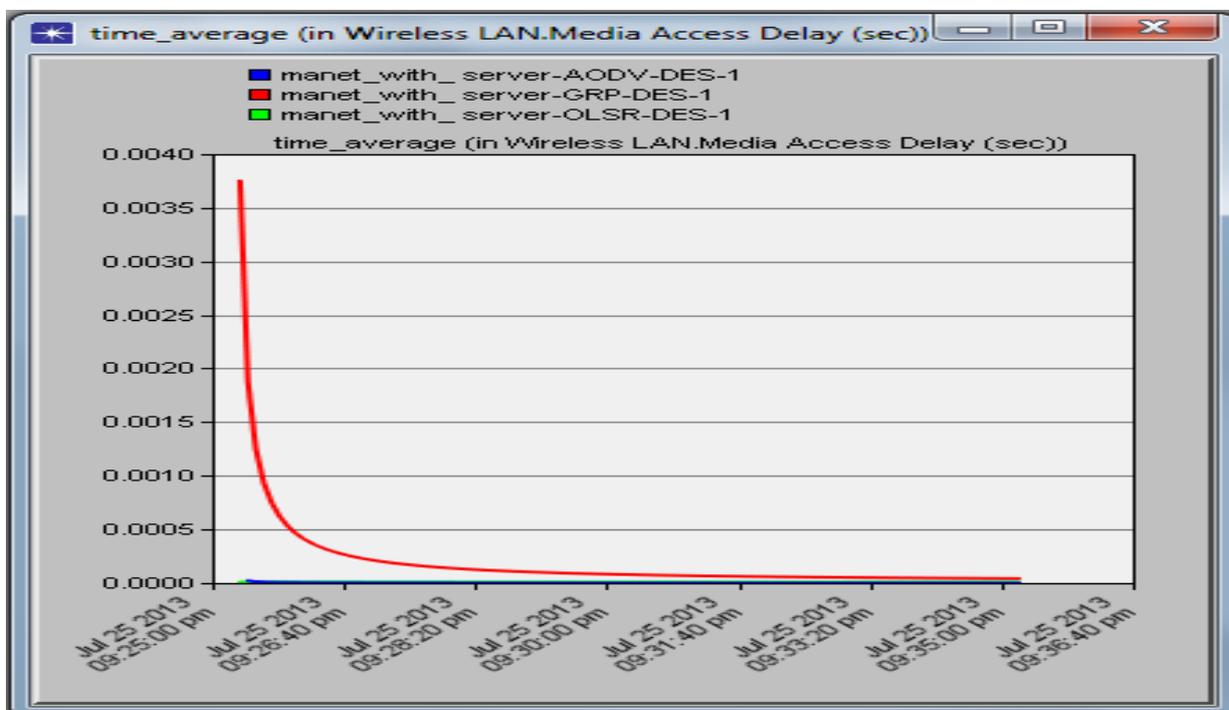
VI. Conclusion

In this paper performance of three MANET routing protocols was analyzed. Here a table is formulated to show the performance of these protocols based upon the performance parameters. From number 1 to number 3 are used to rate the performance where number 1 refers to best protocol and number 3 refers to worst protocol choice with concern to performance parameters.

Network Model based on Routing Protocol	Throughput	Network Load	Delay	Media Access Delay
OLSR	1	2	2	2
AODV	3	3	1	1
GRP	2	1	3	3

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