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Performance evaluation of IEEE802.11 based MANETs using different routing protocols

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ABSTRACT

Mobile Ad hoc network is a self configurable network which has no central access point and it has extended its connectivity beyond the traditional infrastructure networks. MANETs have dynamic topology which means that every node in the network is movable and because of this topology changes. It has different routing challenges for which Quality of Service (QoS) can be considered as the key factor for the implementation of MANETs. In this paper we have used performance metrics such as throughput, jitter, end to end delay to evaluate QoS for IEEE 802.11 based MANETs using different routing protocols. Routing protocols such as AODV, DSR, ZRP, OLSR are used which affects the QoS when the size of network is varied.

Keywords- MANETs, Routing Protocols, QoS, Performance, Throughput, Jitter, QualNet

1 INTRODUCTION

Mobile Ad hoc networks are the wireless networks in which all the nodes are connected to each other and the packets are transferred from one node to other by using different routing protocols. Nodes in MANETs are mobile and there is no fixed infrastructure because of dynamic topology followed by MANETs [1].Here every node can behave as host as well as routers. As there is no central controller and no fixed topology, MANETs face a challenging task which is routing. Routing is a mechanism which is used to forward data packets from a source to a destination. There are number of routing protocols developed for the transmission and reception of packets between nodes. In MANETs routing protocols are categorized into three parts which are reactive protocols, proactive protocols and hybrid routing protocols.

1.1 Proactive Protocols: These protocols are also named as Table driven protocols. The route is already present between source and destination before nodes need it [2].Routing information is kept in the routing tables maintained by each node. Whenever there is a change in the network's topology, these routing tables require updation [3].For the large network they are not much opted because of the maintenance of the entries for each node in the routing table. STAR, FSR, GSR, OLSR etc are some examples.

1.2 Reactive Routing Protocols: These protocols are also named as On demand routing protocols. Whenever there is a requirement of route they find it [2].Route discovery mechanism is used by which a route discovery packet is sent on the whole network. When the route between the source and destination is found then

the transmission of data can be done. As the nature of the MANETs is dynamic, chances of link failure is there.Therefore route maintenance mechanism is used to maintain the routes and avoid the failure of the routes or links. DSR, AODV, LAR, TORA etc are some examples [5].

1.3 Hybrid routing protocols: Hybrid routing protocol combines the perks of both reactive routing protocols and proactive routing protocols. According to the need, this protocol switches between proactive and reactive parts of the protocol.

II. BRIEF DESCRIPTION OF PROTOCOLS USED

2.1 AODV (Ad hoc On Demand Distance Vector Routing protocol): AODV routing protocol is an On demand routing protocol in which route establishment is done when a source node needs to transmit the data packets. The sequence number is used to spot the recently used path [3].Comparing AODV and DSR results that source routing is used by DSR in which the address of each device contained by the routed packets from where the packet travels through. But in AODV there is an accumulation of next-hop information by the source node and intermediary node for the transmission of data. For a particular destination when the route is not present, then the network is flooded by the route request packets sent by the source node in an On Demand routing protocol. Unicasting, multicasting and broadcasting is supported by AODV.

2.1 DSR (Dynamic Source Routing): DSR in the wireless networks is used where number of hops can occur. As AODV uses two mechanisms which are route discovery and route maintenance, DSR seems to be same like AODV. There are two ways by which DSR works. One way of working is that when a route is already found then this routing information is used by the source node to destination. Other way is, by using route discovery packet when node finds the routing information to the destination [6].DSR has an advantage that multiple routes can be stored in route cache by the nodes, means before initiating the route discovery, source node checks the route cache for the route and if the particular route is present then route discovery is no longer needed. Network which has low mobility, DSR acts as an asset because the routes which are present in the route cache will be valid for longer time. The periodic exchange of HELLO message is not required in DSR, so nodes can switch themselves to sleep mode to save their power.

2.3 OLSR (Optical Link State Routing Protocol): It is a table driven protocol in which routes are usually stored and updated. When there is a need of route, OLSR presents the route instantly without any delay. Some candidate nodes known to be Multipoint relays (MPR) are present in OLSR which are liable to flood the control messages. The size of control packet is reduced by OLSR by creating a MPR subset of links with its neighboring nodes. The broadcast message is retransmitted by only MPR of a node. So, whenever there are link failures and join/leave instances, OLSR does not produce extra control traffic. OLSR is opted for large and huge networks. Some neighbors which are not the part of MPR set cannot retransmit broadcast packet received by a node but they can study and process the packet.

In this routing protocol, a HELLO message which has the data about neighbors and their links is broadcasted to its neighboring nodes and received by other nodes which are only one hop away.MPR selector table is created by each node when they receive HELLO messages.

2.4 ZRP-Zone routing protocol is said to be hybrid protocol which has reactive as well as proactive nature. In proactive routing protocol excess bandwidth is used for the maintenance of routing information, while in reactive protocols there are delays in route request and inept flooding of the network for the determination of route. These problems are reduced by hybrid protocols i.e. ZRP. It solves these problems by using both the protocols. Intra-zone routing protocol (IARP) which is a proactive routing protocol used within a local neighborhood called as routing zones and Inter zone routing protocol (IERP) which is a reactive protocol used beyond the routing zones. Within the routing zone, a route to destination can be determined by the IARP by using cached routing table. So if both source and destination is present within the same routing zone, delivery of packets can be done instantly. IERP is used when destination is not available within the routing zone [4].

III. LITERATURE REVIEW

Ashish shrestha et al. [8] studied the reactive and proactive MANET routing protocols, namely: AODV, DSR, TORA and OLSR. They have come to a conclusion that AODV and DSR performed great with respect to the performance metrics where the efficiency shown by AODV is better when deals with high congestion and it delivered packets successfully over a network with heavy traffic compared to OLSR and TORA.

Gagangeet Singh Aujla et al. [9] studied and analysis is performed on AODV, DSR, OLSR, TORA and GRP routing protocol .AODV is an appropriate protocol for video conferencing for low number of nodes and OLSR can be used as an alternate as its performance deteriorate for high number of nodes. The OLSR protocol performs better for email traffic but GRP is also equally good. GRP performs better for low number of nodes but its performance degrades with increase in number of nodes but OLSR improves its performance. TORA shows poor results in both scenarios followed by DSR.

Chandra Shekar Reddy Putta et al. [10] studied AODV, DSR and OLSR routing protocol with qualitative and quantitative criteria. Parameters used are routing load, end-to-end data delay, packet delivery ratio. They showed that OLSR performs better for CBR sources and it offers lowest delay.

Bhabani Sankar Gouda et al. [11]studied the proactive, reactive and hybrid routing protocol AODV, OLSR, ZRP, AODV, DYMO, AOMDV and DSR Routing Protocols over Random Waypoint Mobility Model. Their simulation results shows DSR is the best scheme in terms of total bytes receive. ZRP is the best in terms of total packet receive, last packet receives and first packet receives but ZRP shows worst performance in terms of end to end delay ZRP is the highest normalized routing load.

IV. SIMULATION AND PERFORMANCE ANALYSIS

In this research paper QualNet is used for simulation. However QualNet is chosen one of the best simulation tools to evaluate the QoS of MANETs. The designing of wireless network includes number of mobile nodes, profile configuration and application configuration which are connected in ad hoc wireless network. Nodes are

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deployed randomly in the ad hoc mode. Attributes are set as default for all the nodes. Routing protocols used in this scenario are OLSR, AODV, ZRP, and DSR. The simulation is performed by using 25, 50, 75, 100 mobile nodes. On the nodes, CBR application is applied .The mobility for the nodes is taken as random waypoint. The motive of this simulation is to evaluate the QoS of IEEE802.11 based MANETs. It is done by using various parameters which are average jitter, Average throughput, Packet Delivery Ratio (PDR) and end to end delay. The simulation parameters are described in Table 1 which is given below.

Parameters	**Values**
Physical Layer protocol	802.11
Routing Protocol	OLSR,AODV,ZRP,DSR
Node speed	10 m/s
Mobility	Random Way Point
Packet Size	1024 bytes
Number of nodes	25,50,75,100
Area	1000X1000 sq. metre
Application	CBR
Simulation Time	300sec

Table 1 Parameters used in the simulation

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View of nodes

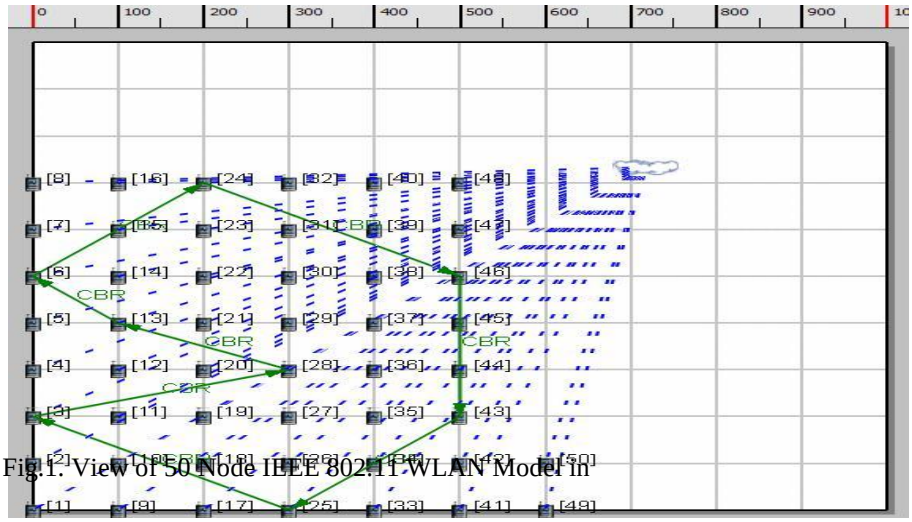

Fig.1. View of 50 Node IEEE 802.11 WLAN Model in

4.1 End to End Delay (ms)

As the number of nodes increases in the network, the end to end to end delay also increases. It is clear from the graph that the maximum delay is achieved by ZRP protocol where as the minimum delay is for AODV amongst the four routing protocol used. The average end to end delay for AODV is 744.582 ms, for DSR is 7549.61 ms, for OLSR is 4096.86 ms and for ZRP is 2976.481 ms. Initially for smaller node network delay was less, but as the number of nodes are increased delay also increases. Hence AODV performance is the best with minimum end to end delay. Fig.2. represents the CBR servers End to End Delay for all the four routing protocols.

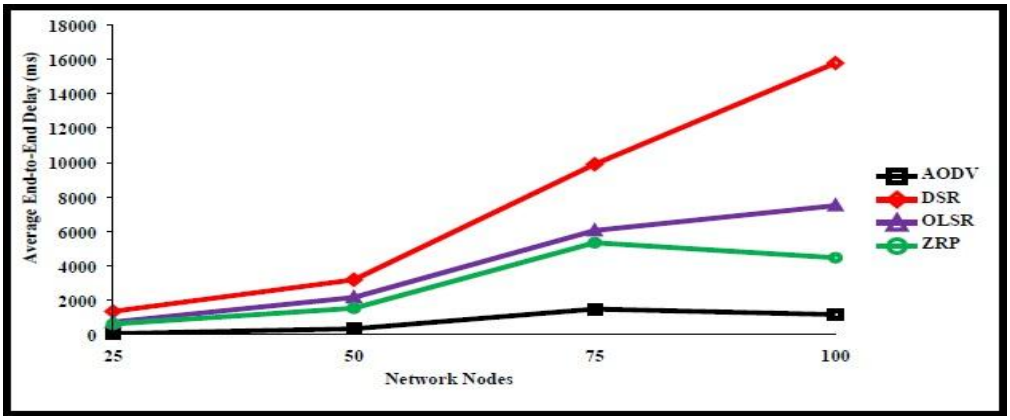

Fig.**2. Effect on Delay with various Routing Protocol and varying number of network node**

4.2 Average Throughput (bps)

As the numbers of nodes in the network are increased, throughput decreases. The CBR server average throughput value for AODV, DSR, OLSR, ZRP are 54153.76, 32693.1, 49827.63 and 47849.35 bps. It is clear from the graph, that with maximum average throughput amongst all routing protocols AODV performance is

better and hence it can be considered for routing for ad-hoc network for larger number of nodes. Fig.3. represents the CBR servers Average Throughput (bps) for all the four routing protocols.

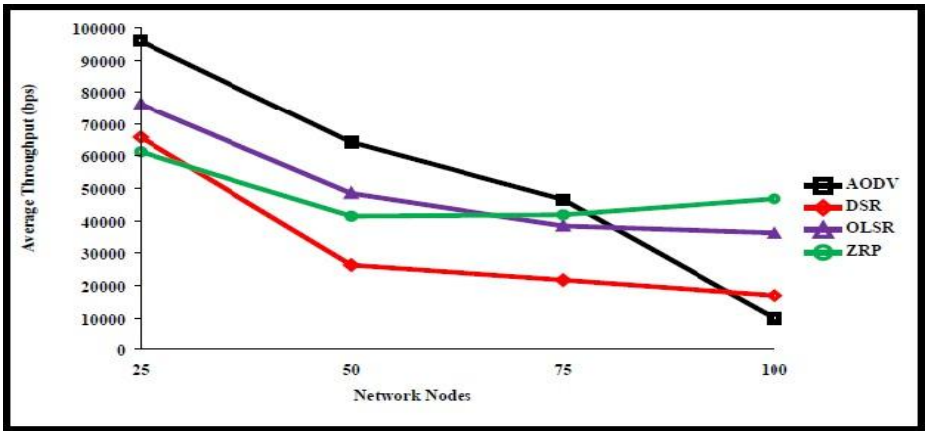

Fig.3. Average Throughput (bps) in MANETs with various Routing Protocols

4.3 Packet Delivery Ratio (PDR)

The CBR server packet delivery ratio (%) for AODV, DSR, OLSR and ZRP are 52.82, 31.87, 48.86 and 45.74. With increasing number of nodes, packet delivery ratio decreases. Hence it is clear from the graph that AODV has the best Packet Delivery Ratio of 52.82% amongst all the routing protocols. Fig.4. represents the PDR (%) for all the four routing protocols.

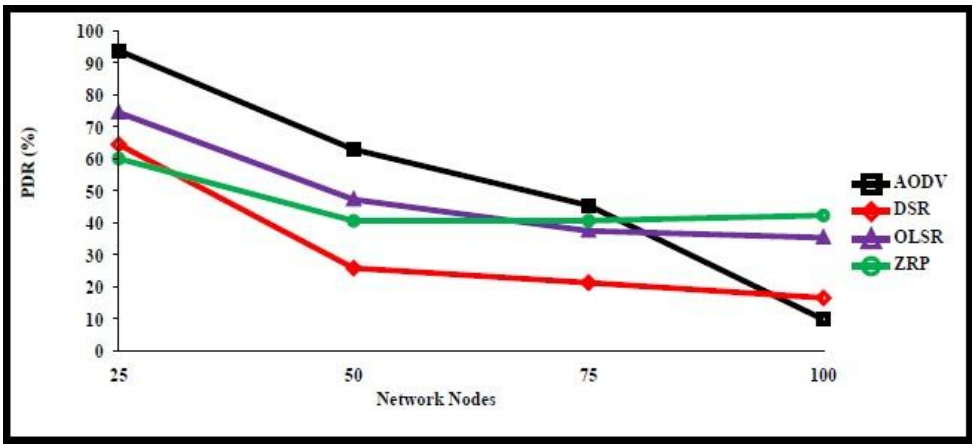

Fig.4. Packet Delivery Ratio (%)in MANETs with various Routing Protocols

4.4 Average Jitter (ms)

The CBR server average jitter for AODV, DSR, OLSR and ZRP are 75.572, 273.06, 147.011 and 86.552 ms. With the increasing number of nodes, the average jitter also increases. Amongst all the routing protocols, average jitter is minimum for AODV i.e. 75.57 ms. Hence AODV performance is better amongst all routing protocols. Fig.5. represents the CBR server Average Jitter (ms) for all the four routing protocols.

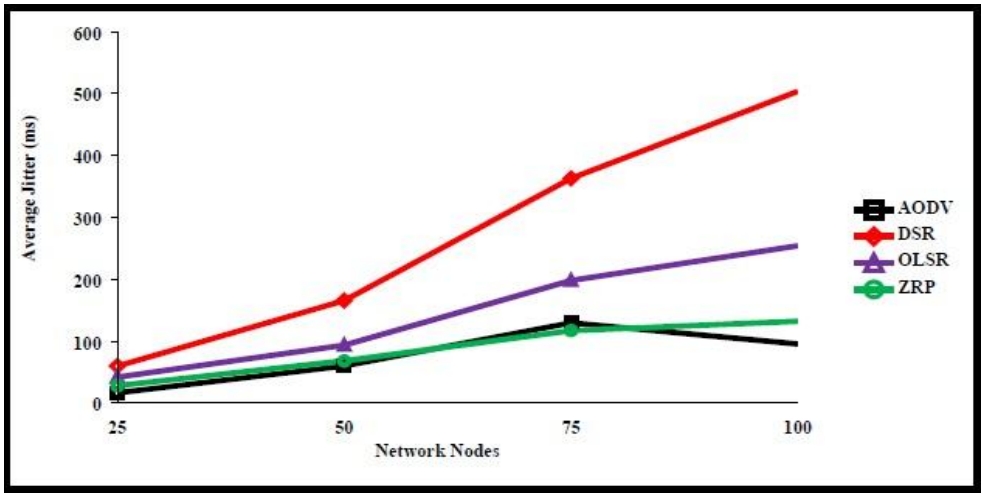

Fig.5. Average Jitter (ms) in IEEE 802.11 based MANETs with various Routing Protocols

V. CONCLUSIONS

This paper evaluates the performance of IEEE 802.11 based MANETs by using various routing protocols on the basis of performance metrics to ensure proper QoS. It is seen from the results that when number of nodes in the network are increased, the delay increases, average jitter increases, average throughput decreases and PDR decreases. Among all the four routing protocols, AODV has minimum end to end delay, maximum average throughput, minimum average jitter and maximum PDR. Therefore AODV outperforms rest of the routing protocols in terms of all the performance metrics.

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