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Evaluation of Quality of Service of Different Routing Protocols using QualNet 6.1 Simulator

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Abstract: Ad-hoc network is a network that comprised of mobilized devices communicating with each other through a centralized access network. Since nodes operate over a limited battery power and it is impractical to refill or replace the battery, hence it is important to design/modified an energy-efficient routing protocols for ad-hoc networks. Improving routing protocols to improve the lifetime of ad hoc networks have been an interested research area in the past few years. In this paper, number of simulations have been done in order to evaluate the quality of service for five routing protocols OLSR,AODV, LANMAR, DSR, ZRP under CBR traffic in terms of their throughput, mean end-to-end delay and jitter at the application layer in network scenarios. Various network scenarios are considered by varying number of nodes with mobility and non-mobility. The simulations are carried out in QualNet 6.1 simulator .

Keywords: Routing Protocols, Throughput, Mean end to end delay, Jitter, Mobility etc.

1. INTRODUCTION

One of the major utilization of wireless networks is in Mobile Ad-Hoc networks (MANET). In a network, every node will act as a routing station to forward data to the designated node. In the network, nodes are constantly changing their position from one location to another. The application of these types network is in emergency situation, battle fields, crowd control, disaster etc. Hence, the routing protocols for the mobile ad hoc network can be classified as On Demand ,Table Driven and Hybrid Routing protocol.
The paper is organized as follows: Section 2 provides a brief introduction of a wide range of routing protocols and techniques. In sections 3, different type of routing protocols is discussed. Section 4 deals with the development of MANET simulation model in QUALNET 6.1 used to evaluate the various parameters such as throughput, mean end to end delay and jitter at the application layer which helps in determining the quality of services provided by the routing protocols. In section 5, presents conclusion and analysis of result of various parameters of routing protocols.

2. ROUTING PROCESS

Routing process is the method of transferring the data from one node to another node. The nodes may be located anywhere in cars, ships airplanes, bus, perhaps even on tiny devices, and there may be multiple hosts connected to one router. Each router has information of its immediate neighbor's nodes. Routers will share this information to each node so that routers have knowledge of its neighbor's nodes and network
Routing tables is prepared to determine the destination nodes. Each routing protocols has its own characteristics and features. Therefore, it is quite difficult to determine which routing algorithm may perform best under the different network scenarios, such as increasing node density [1], mobility and traffic. There are various Qualities of Service parameters which affect the performance like bandwidth delay, jitter, throughput etc.
Other challenging task is supporting mobility in MANETs. The mobility of nodes in MANETs increases the complexity of routing protocols. The MANET routing protocols is divided into three major categories [2]:

- Table Driven Protocols - maintain an up-to-date list of immediate nodes and their routing path by regular updating of routing tables via network.
- On Demand Protocols - find a routing path/table when the demand arises i.e. the route is planned before the transfer of data between the source and destination nodes.
- Hybrid Routing Protocols - combine the properties of both On-Demand and Table Driven routing protocols.

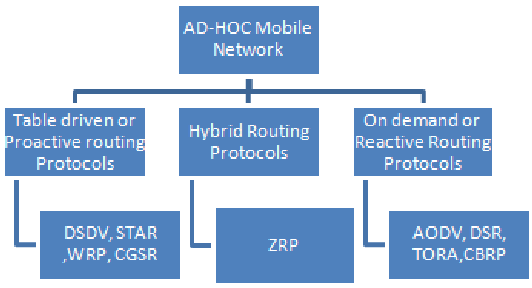

Figure 1. Classification of Routing Protocols

3. ROUTING PROTOCOLS

A. Optimized link state routing protocols (OLSR*):*

The Optimized Link State Routing (OLSR) is a table-driven or proactive routing protocol developed [3] for Ad-hoc networks. It is based on optimized pure link state in which it reduces the control packet size and the number of control packets transmission required for maintaining routing tables. OLSR reduces the control traffic overhead with the help of Multipoint Relays (MPR), which is the key component in OLSR. A MPR is a one-hop neighbor node which has been selected for packets forwarding, instead of flooding to the network, packets are just forwarded by a MPRs node. This delimits the network overhead, hence becomes more efficient than pure link state routing protocols. The routing information is maintained by periodically exchange link state information. By using MPRs, OLSR is well suited for a large and a dense mobile network. The larger the network is, the more optimized link state routing path is selected. MPR helps in finding the shortest path to the destination nodes.

B. AD-hoc on demand distance vector (AODV):

AODV is an On-Demand OR reactive routing algorithm [4] in which it determines a routing path only when a node has a packet to send. AODV is capable of both multicast and unicast routing and routing paths are maintained as long as they are needed by the source packets. In AODV, every node maintains a table, containing information about its neighbor to send the packets to the destination. AODV has route discovery cycle for route finding and repairing .The loop freedom can be achieved through sequence numbers. Number sequencing, is the unique features of AODV, ensures the freshness of routes number.

C. Landmark Ad-hoc Routing Protocols(LANMAR):

LANMAR combines the properties of distance vector and link state algorithm and builds groups of nodes which are likely to move together [5].The LANMAR is elected in each subnet. Each node keeps local routes to the neighbors up to hop distance. Every node maintains routes to all landmarks. This information is used by LANMAR to determine the destination address. The LANMAR routing table is different from the fisheye state routing (FSR) protocol. In LANMAR consist of routing table only for the nodes within the scope and landmark nodes whereas FSR contains the routing tables for the entire nodes. While forwarding the packets, the destination is checked to see whether the forwarding node's is within the neighbor scope or not. If yes, then the packet is directly forwarded to the destination address obtained from the routing table. Otherwise, the packet is send first to its nearest landmark node. When it acquires more accurate routing information to bypass the landmark node and routed directly to the destination nodes. The benefits of LANMAR routing protocols is dramatic reduction of both routing overhead and table size, which is helpful in scalable it to large networks.

D. Dynamic Source Routing(DSR):

Dynamic Source Routing (DSR) is an on-demand or reactive routing protocol comprised of two parts: Route Discovery and Maintenance [6] [7]. When a node want to send packet to destination but it does not have a routing path to that destination in its Route Cache memory, the source node will transmits a route request (RREQ) packet by specifying a unique identifier and a destination address. If it was recently received request, node discards the router request. Otherwise, it attaches its own node address and rebroadcasts the request. When the route request (RREQ) reaches the destination node, the node sends a route reply (RREP) back to the initiator, consist a copy of the accumulated list of addresses from the router request (RREQ). When the request reply (RREP) reaches the initiator, it caches the new route in its Route Cache memory. When a node detects that specific path to the destination is broken, and then the Route Maintenance mechanism is used.

E. Zone Routing Protocol (ZRP):

Zone Routing Protocol (ZRP) [8] is a type of hybrid routing protocol which combines the features of both table Driven and On Demand routing protocols. For route discovery ,Table Driven protocols uses large bandwidth to maintain the routing table while On Demand protocols has long route request(RREQ) delays and inefficient flooding mechanism. ZRP [9] eliminate these problems. It takes features of Table Driven discovery method within a local neighborhood node and outside the local loop an On Demand routing protocol features are used. ZRP reduces the Table Driven scope to a limited zone so that the routing information can be maintained or updated easily. Zone Routing Protocol [8]consist of inter-zone routing protocols(IERP), intra-zone routing protocols(IARP), and Border routing protocols (BRP), which provide the full routing benefits to hybrid routing protocols.

a) Intra-zone Routing Protocols (IARP):

Intra-zone Routing Protocol (IARP) is the locally Table Driven routing method of finding the destination node within the zone region. Hence it first checks whether the destination node is within its local zone region or outside the zone region [9]. The packet can be routed reactively if the destination node is outside the zone region or proactively if its destination is within local zone region. However, due to the mobility of nodes, local neighborhood node may rapidly change from one region to another region. To avoid conflicts, IARP continuously update the routing information of all nodes.

b) Inter-zone Routing Protocols (IERP):

Inter-zone routing protocols (IERP) [9], consist of two phases. In the route request (RREQ) phase, a router sends the packets from source node to its outermost nodes. If the receiver knows the destination node, it responds by sending a route reply (RREP) back to the initiator. Otherwise, it forwards the packets to its neighbor's node However if it receives the multiple copies of the same route request, node discards the route request. In route reply (RREP) phase, any node can send route reply if it has a routing path to the destination. It also handles route discovery if route request (RREQ) is initiated by outermost nodes with the help of Border cast Resolution Protocol (BRP).

c) Border Routing Protocols (BRP):

BRP helps in to direct route request initiated by globally reactive IERP [9] to the outermost nodes and utilizes the topology information provided by IARP to direct query request to the border of the zone. It also helps in maximizing the efficiency and removing redundant of hybrid routing .protocols.

4. SIMULATION MODELS PARAMETERS:

In this paper, QualNet 6.1 network simulator [10] is used to examine the characteristics of different routing protocols. The physical 802.11 layer with a data rate of 2 Mbps is used. The MAC 802.11 protocol is used configured for MANET networks

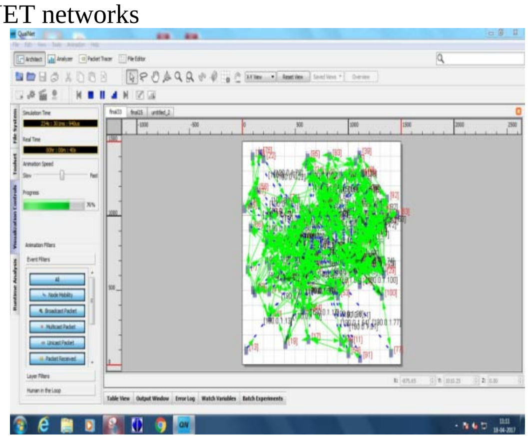

Figure 2. Qualnet 6.1 Simulation tool.

In this work, radio types module of IEEE 802.11b is used to enable mobility of the wireless nodes under the different constant bit rate(CBR).The simulations are carried out for network densities of 10, 40 , 80 , 100 nodes respectively.

Table 1: Simulation parameter:

Simulation Parameters	**Values**	
No. of nodes	10,40,80,100	
Dimension of space	1500*1500	
Radio types	802.11b	
Simulation time	300sec	
Constant Bit rate(CBR)	For 10 node-{(1-2),(6-10),(4-8)} For 40 node –{(6-12),(16-32),(13-26),(11-22)} For 80 node –{(4-12),(16-42),(21-53),(29-78),(71-80)} For 100 node – {(9-19),(23-30),(80-100),(50-87),(89-97)}	
Mobility	None(Scenario 2)	Random way Point(Scenario 1)
Energy Model	Mica-Motes	
Battery Model	Linear Model	
Simulator	Qualnet 6.1	
Total Simulation	15	

The performance of routing protocols (AODV, OLSR, LANMAR, DSR, and ZRP) is evaluated by comparing the throughput, mean end to end delay and jitter at the application layer.

a) Mean End to End Delay:

It indicates how much time it takes to send packets from the constant bit rate (CBR) source to the destination node in the application layer. The mean delay from source to the destination node in the application layer with mobility and with-out mobility is shown in figure3 and figure 4. With the increase in the number of nodes mean end to end delay increases in ZRP protocol in both the scenario whereas in all other protocols variation is small. In AODV without mobility, with increase in nodes, mean end to end delay increase first then decreases.

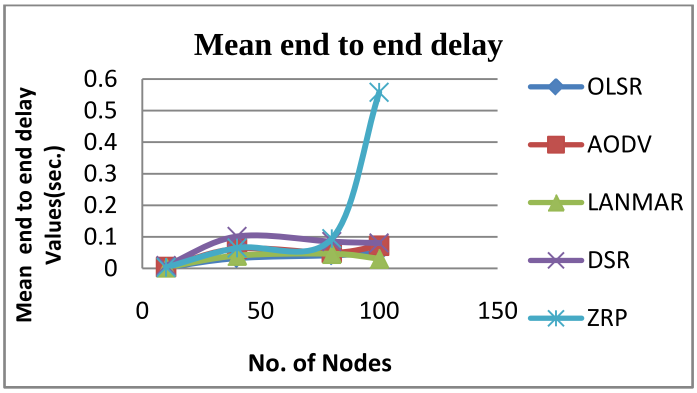

Figure 3 Simulation results of mean end to end delay with mobility.

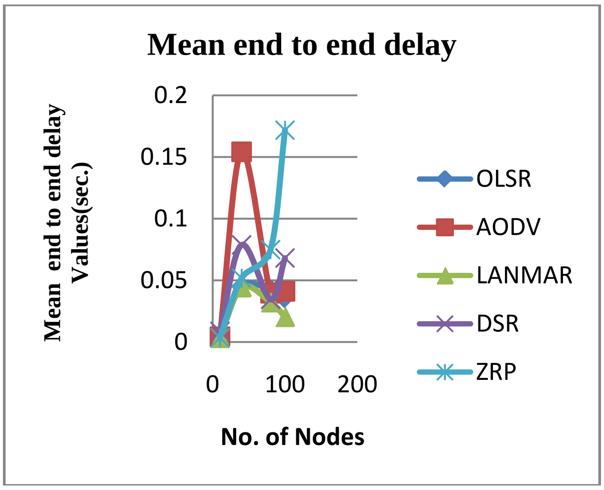

Figure 4 Simulation results of mean end to end delay without mobility.

b) Throughput :

Throughput is defined as the total data received at the receiver node from the initiator divided by the time taken to receive the last packets. It is measured in bits per second (bit/second or bps). The throughput of different routing protocols with or without mobility is shown in figure 5 and figure 6 for scenario 1 and scenario 2 respectively. Simulation results shows, in both scenarios, throughput of ZRP fluctuates largely with the increase in number of nodes whereas in all other routing protocols the variation is not large.

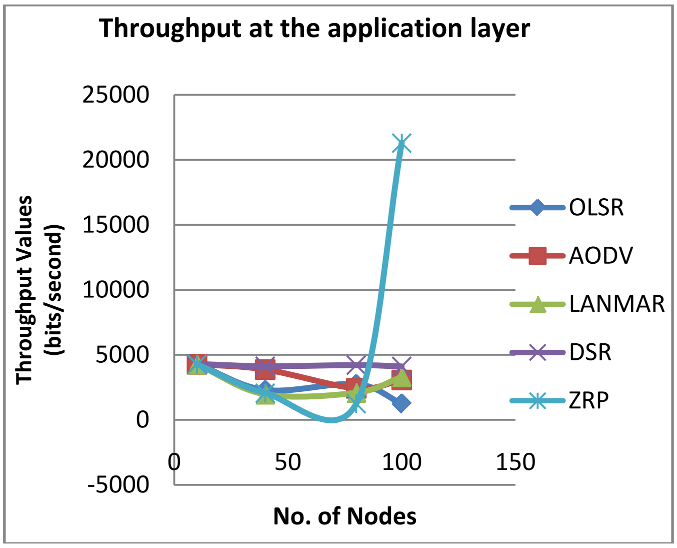

Figure 5 Simulation results of Throughput at the application layer with mobility.

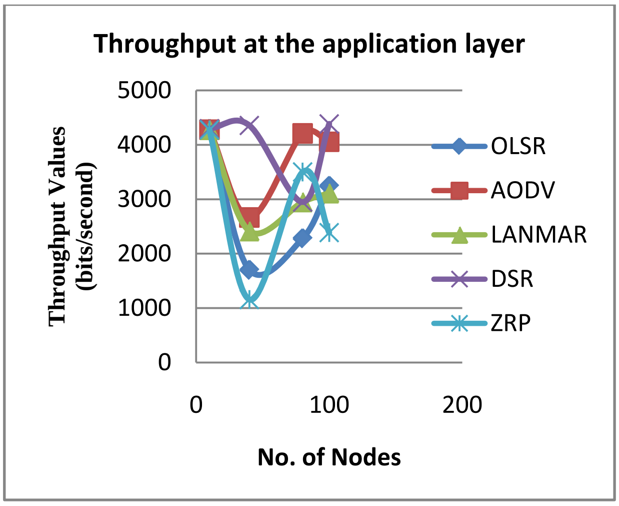

Figure 6 Simulation results of Throughput at the application layer without mobility.

a) Average Jitter

Jitter is defined as the variation in the time interval between packets receiving at the destination nodes, caused by network congestion, route changes or timing drifting. Jitter should be as small as possible for better performing of the routing protocol. The average jitter for the different routing protocols with or without mobility is shown in figure 7 and figure 8.

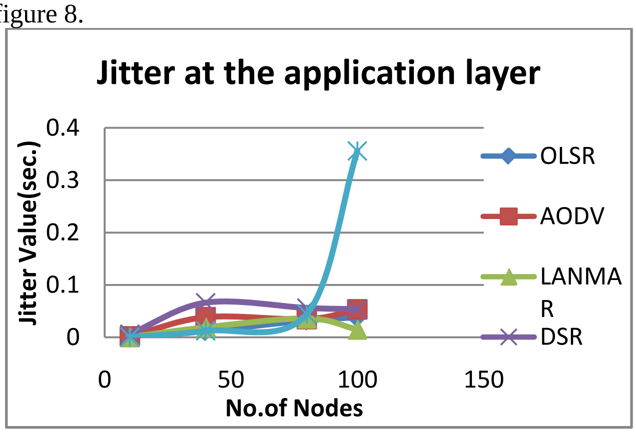

Figure 7 Simulation results of Jitter at the application layer with mobility.

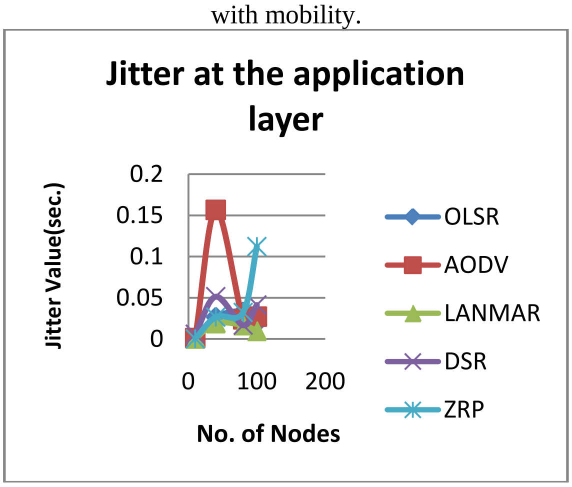

Figure 8 Simulation results of Jitter at the application layer without mobility.

5. CONCLUSION

In this paper, the performance of different routing protocols such as OLSR, DSR, AODV, LANMAR and ZRP for mobile ad-hoc networks with mobility and without mobility along with the variation in the number of nodes have been evaluated. Average jitter, mean end-to-end delay and throughput have been measured as performance parameter metrics. The simulation results shows that LANMAR is the best scheme in terms of mean end-to-end delay and average jitter while DSR shows best performance in terms of throughput. ZRP shows large variation in mean end to end delay, throughput and average jitter with the variation in the number of nodes with mobility and without mobility. This work can be further extended, by taking the different node placement strategy, more sources, additional metrics such as residual energy, mean packet size of routing packets and normalized routing overhead may be used to examine the quality of service provide by the different routing protocols.

6. REFERENCES

[1] Performance comparison of MANET routing Protocols in different network sizes by David Oliver Jorg, institute of computer Science and applied mathematics computer Networks and distributed systems University of Berne, Switzerland IAM RVS February 2004 computer science projects.

[2] Seema pahal and Kusum Dalal "A Review Paper on Routing Protocols in Wireless Sensor Networks''International Journal of Recent Trends in Engineering and research (IJRTER),Volume 02,Issue 03, pp:417-422, March-2016,ISSN:2455-1457.

[3] S.Agrawal, M.B.Daigavane and K.D. Kulat, "Performance Evaluation of Routing Protocols for Wireless Adhoc Network", International Journal of Advanced Engineering Technology, III(I), (2012) 13-17.

[4] Kadyamatimba, M. Mbougni, Z.P. Ncube, A. Helberg and E. Dube, "Performance Evaluation of Routing Protocols in Mobile Ad Hoc Networks Using Http Traffic", DOI:10.7763/IPEDR, 54, (2012) 69-74.

[5] Guangyu, P.; Geria, M.; Xiaoyan Hong; , "LANMAR: landmark routing for large scale wireless ad hoc networks with group mobility," *First Annual Workshop on Mobile and Ad Hoc Networking and Computing 2000 (MobiHOC. 2000)*, pp. 11-18, 2000.

[6] S. Ali and A. Ali, "Performance Analysis of AODV, DSR and OLSR in MANET", Department of Electrical Engineering with emphasis on Telecommunication Blekinge Institute of Technology, Sweden, (2009) 1-59

[7] B. Ballav et. al., "Performance Analysis of Routing Protocols in Mobile Adhoc Network", International Conference on industrial Technology (ICIT), Bhubaneswar, India, 2015.

[8] T.Ravi Nayak, Sake Pothalaih and K Ashok Babu," Implementation of Adaptive Zone Routing Protocols For Wireless Network",IJEST,vol. 2(12),2012.

[9] Z.J Haaz ,M.R Pearlamn, and P.Samar,"Intrazone Routing Protocol (IARP), "Internet Draft,2001, available at:http://tools.ietf.org/iddraft-ieft-MANETs-iarp-01.txt.

[10] The Qualnet simulator www.scalable networks.com..