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Simulation Based Comparative Study of AODV, DSR and ZRP Routing Protocol at 20, 50 Nodes in Mobile Ad hoc Networks (MANETs) Using Qualnet Simulation tools 5.0.2

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Abstract: A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration of the mobile networks .Data transmission between two nodes requires multiple hops as nodes transmission range is limited in Mobile Ad hoc networks (MANET's). Mobility of the networks nodes to makes the situation even more complicated in wireless networks. Multiple routing protocols find optimized routes from a source to some destination. This articles presents performance analysis of three different routing protocols Ad hoc on demand routing protocol (AODV), Dynamic Source Routing (DSR) and Zone Routing Protocol (ZRP). This article mainly focuses on comparing the performance analysis of three routing protocols taken different 20, 50 nodes in Mobile Ad-Hoc networks (MANET's). We have used QualNet Simulator 5.0.2 from Scalable Networks to perform the simulations. Comparative Performance analysis of AODV, DSR and ZRP is evaluated based on performance metrics like Average end to end delay(s), TTL based hop count, Average Jitters(s) and throughput (bits/s) in Mobile ad hoc networks (MANET).

Keywords: AODV, DSR, ZRP, MANET, QualNet 5.0.2 etc.

I. INTRODUCTION

A mobile ad hoc network (MANET) [2, 7] group has been formed within IETF. The goal is to support mobile ad hoc networks with hundreds of routers and solve challenges. A mobile ad hoc network (MANET) [2, 7] is a self-configuring infrastructure less network of mobile devices connected by wireless links. Each device in a MANET [2, 7] is free to move independently in any Direction, and will therefore change its links to other devices frequently. An ad Hoc network is a collection of mobile computers or mobile nodes that cooperate to forward packets for each other to extend the limited transmission range of each node's wireless network interface. Each must forward traffic unrelated to its own use, and therefore be a router. Wireless networks are an emerging new technology that will allow users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two type's infrastructure network and infrastructure less ad hoc networks. Infrastructures network consists of a network with fixed and wired gateways.

A mobile host communicates with a bridge in the Network or called base station within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. The primary challenge in building a MANET [2, 7] is equipping each device to continuously maintain the information required to properly route traffic. Such networks may operate by themselves or may be connected to the larger Internet. Active research work for mobile ad hoc networks is carrying on mainly in the fields of Medium Access Control (MAC) [8], routing, resource management, power control, and security. Because of the importance of routing protocols in dynamic multi hop networks, a lot of mobile ad hoc network routing protocols have been proposed in the last few years. Mobile ad hoc networks originated from the DARPA [14] and SURAN [14] project. Mobile ad hoc networks have a several advantages such as fast and easy of deployment, improved flexibility and reduced costs. Mobile ad hoc networks are appropriate for mobile Applications are non-military public organizations and in commercial and industrial areas. The typical application scenarios include the rescue missions, law enforcement operations, cooperating industrial robots, traffic management, and educational operations in campus with wireless network. In this article mainly discuss various routing protocol of mobile ad hoc network like ad hoc on demand routing protocol (AODV) [4,5], Dynamic source routing protocol (DSR) [2,7,10], Zone routing protocol (ZRP) [3,11,12], and mobile ad hoc network (MANET) [2,7].

II. MOBILE AD HOC NETWORK (MANET)

A "mobile ad hoc network" (MANET) [2,7] is an autonomous system of mobile routers and associated hosts connected by wireless links .The routers are free to move randomly and organize themselves arbitrarily; thus, the network's Wireless topology may change rapidly and unpredictably. Such a network may be connected to the larger Internet. Basic Routing functionality for mobile ad hoc networks: A routing protocol is the mechanism by which user Traffic is directed and transported through the network from the source nodes to the destination node**.**

- ***a. Path Generation:*** generates paths according to the assembled and distributed state information of the network and of the application, assembling and distributing network and user traffic state information.
- ***b. Path Selection:*** selects appropriate paths based on network and application state information
- ***c. Data Forwarding:*** forwards user traffic along the selected route, forwarding user traffic along the selected route

d. ***Path Maintenance:*** maintaining of the selected route.

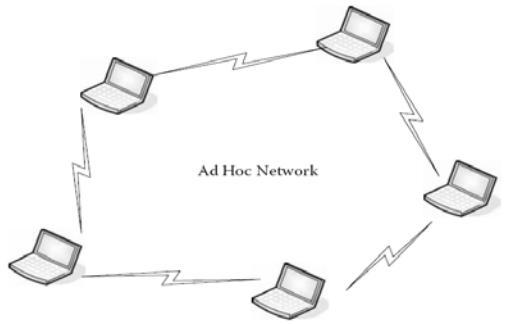

Figure 1 Mobile Ad hoc Networks (MANET)

III. OVERVIEW OF ROUTING PROTOCOLS IN MOBILE AD HOC NETWORKS (MANET)

A. ***Ad hoc on Demand Routing Protocol (AODV):*** Ad hoc on demand routing protocol (AODV) [4, 5] is a Reactive routing or on demand routing protocol that means to maintain the routing information only when needs about the active paths. Routing information is maintained in routing tables at nodes and every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. In case AODV when a source S node wants to send packets to the destination D but no route is available, it initiates a route discovery operation. In the route discovery operation, the source broadcasts route request (RREQ) packets. A RREQ includes addresses of the source S and the destination D, the broadcast ID, which is used as its identifier, the last seen sequence number (Seq. no) of the destination as well as the source node's sequence number (Seq. no) . Sequence numbers (Seq. no) are used for remove the duplicate rout and provides loop-free, up-to-date routes. Discovery operation reduce the flooding overhead, a node discards RREQ.

B. ***Distance Source Routing (DSR):*** The dynamic source routing protocol (DSR) [2,7,10] is an on demand or reactive routing protocol to maintain routing information efficient manner as compared to table driven routing protocol because this maintain route information only needed. Dynamic source routing network is completely self-organizing and self-configuring requiring no existing network infrastructure or administration. DSR protocol has two main mechanisms

a. ***Route Discovery:*** Route discovery is the mechanism by which source node S wishing to send a packet to a destination node D obtains a source route to destination D. Route discovery is used only when S attempts to send a packet to D and does not already know a route to destination D.

b. ***Route Maintenance:*** Route maintenance is the mechanism by which source node S is able to detect .while using a source route to destination D. When route maintenance indicates a source route is broken. Source node S can attempts to use any other route it happens to know to destination node D. route maintenance for this route is used only when source node S is actually sending packets to destination node D.

C. ***Zone Routing Protocol (ZRP):*** The Zone Routing Protocol (ZRP) [3, 11, 12] combines both reactive routing and pro-active routing protocols into a hybrid routing protocol. ZRP routing protocol divided into zones.

a. ***Intrazone Routing Protocol (IARP):*** Interazone routing protocol (IARP) [3, 11] to communicate with the interior nodes of within zone with limited radius of the zone. It works fast when topology change, local neighborhood of a node may change rapidly because controlling all information of within zone. Thus node periodically updates the routing information or you can say that this also called table driven routing protocol.

b. ***Interzone Routing Protocol (IERP):*** The global reactive routing or on demand routing component of the ZRP, the Interzone Routing Protocol (IERP) [11, 12]. It better works outside the zone. IERP handled route discovery when change the way. When you need to broadcast a route request to the entire node to used Bordercast Resolution Protocol (BRP).

IV. PARAMETERS FOR SIMULATION SETUP

Tables1. Parameters for simulation setup scenarios

Parameters	**Values**
No of Nodes	20,50 Nodes
Area	700m*700m
Routing Protocols	AODV, DSR and ZRP
Fading Model	Rayleigh
Shadowing Model	Constant
Energy Model	Mica Motes
Battery Model	Simple linear model
Terrain File	DEM
Node Placement	Random node placement
Simulation time	600 sec
Channel frequency	2.4Ghz
Traffic Source	CBR
Weather-Mobility Interval	100 ms
Propagation-Pathloss-Model	Two Ray Model
PHY-Model	PHY802.11b
Data Rate	2 Mbps
Antenna-Model	Omnidirectional
Mobility-WP -max speed	10
Mobility-WP-Pause time	150Sec
Battery-Charge-Monitoring-Interval	60Sec

V. NODES PLACEMENT SCENARIOS

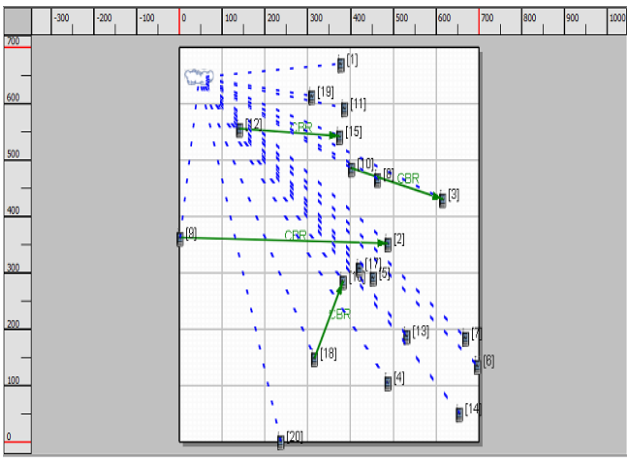

Figure 2 showing the nodes placement scenarios in this scenarios constant bit rate CBR apply from source nodes (9,10,12,18) to destination (2,3,15,16) in nodes placement scenarios.

VI. ANIMATION VIEW OF SCENARIOS

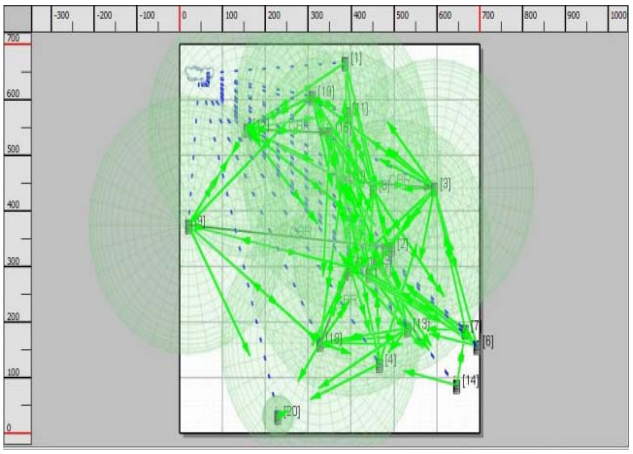

Figure 3 showing the animation view of scenarios for AODV, DSR and ZRP Routing Protocol.

VII. PERFORMANCE METRICS:

A. Average Jitter (s): Jitter is defined as the difference between the expected time of arrival of a packet and the actual time of arrival. Jitter is caused primarily by delays and congestion in the packet network. Jitter causes discontinuity in the real-time voice stream. To minimize the delay variations, a jitter buffer are implemented which temporarily stores arriving packets.

Average jitter = (total packet jitter for all received packets) / (number of packets received - 1) where, packet jitter = transmission delay of the current packet - transmission delay of the previous packet. Jitter can be calculated only if at least two packets have been received Average jitter for request packets received (in seconds).

B. Average End to End delay (s): The average end-to-end delay of a data packet is the time interval when a data packet generated from Constant Bit Rate source completely received to the application layer of the destination**.**

Average delay for packet transmission between client and server (seconds):

Average end-to-end delay = (total of transmission delays of all received packets) / (number of packets received), where, transmission delay of a packet = time packet received at server - time packet transmitted at client, where the times are in seconds.

C. Throughput (bits/s): The throughput is defined as the total amount of data a receiver receives from the sender divided by the time it takes from the receiver to get the last packet. The throughput is measured in bits per second (bit/s or bps).Throughput at the server (bits/second):

If the session is complete, throughput = (total bytes received * 8) / (time last packet received - time first packet received), where the times are in seconds. • If the session is incomplete, throughput = (total bytes received * 8) / (simulation time - time first packet received), where the times are in seconds.

D. TTL (Time to Live): Hop count is the number of hops a packet takes to reach its destination. An expanding ring search starts by sending an RREQ with a smaller TTL and resends it with increasing TTL if a response is not received. The full TTL search sends the initial and subsequent RREQs using the net diameter value as TTL. An expanding ring search starts by sending an RREQ with a smaller TTL and resends it with increasing TTL if a response is not received. The full TTL search sends the initial and subsequent RREQs using the net diameter value as TTL.

Simulation results of comparative Performance Routing AODV, DSR and ZRP Protocols on 20 Nodes Vs 50 Nodes in Scenarios:

For 50 Nodes routing protocol:

a) QualNet.Feb.08.12_16.49.26 (AODV)
b) QualNet.Feb.08.12_16.50.28 (DSR)
c) QualNet.Feb.08.12_17.00.44 (ZRP)
d) RP: Routing Protocol

Average Jitter(s) Vs 20, 50 Nodes of RP

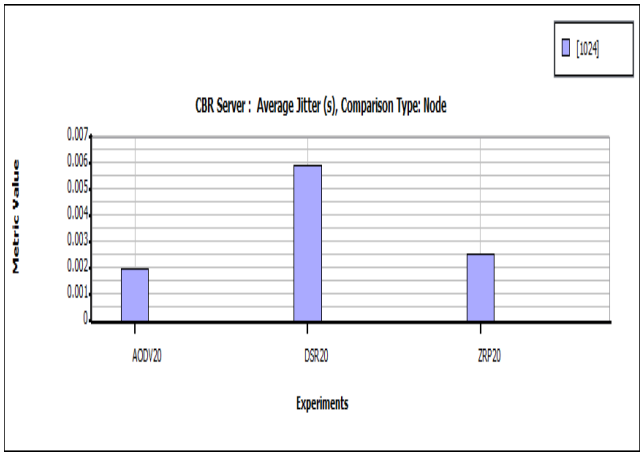

Figure 4 Average Jitter(s) Vs 20 Nodes of RP

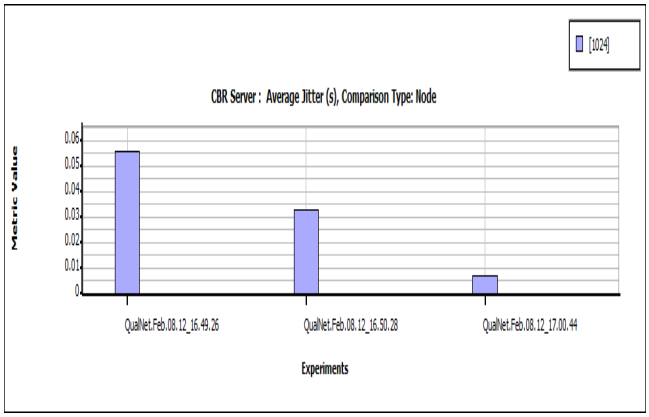

Figure 5 Average Jitter(s) Vs 50 Nodes of RP

Figure 4,5 showing the performance average Jitter (s) Vs routing protocol at 20,50 nodes taken in this scenarios .average jitter is larger of 50 nodes as comared to 20 nodes of routing protocols (AODV) at 20 nodes average jitter (s) is .002 and 50 nodes average jitter is .05,average jitter (s) of DSR .006 at 20 nodes and .035 at 50 nodes of routing protocols and in case of ZRP routing protocol average jitter (s) is .0025 at 20 nodes and .005 at 50 nodes of ZRP routing protocols.comparing these three routing protocol small average jitter AODV is .002 at 20 nodes and ZRP is .005 at 50 nodes of routing protocols . in case of largest average jitter (s) DSR is .006 at 20 nodes of routing protocol and AODV is .05 at 50 nodes of routing protocol

Average End to End delay(s) Vs 20, 50 Nodes of RP

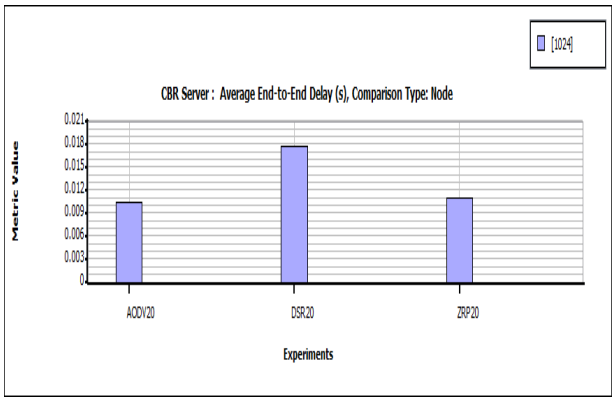

Figure 6 Average End to End delay(s) Vs 20 Nodes of RP

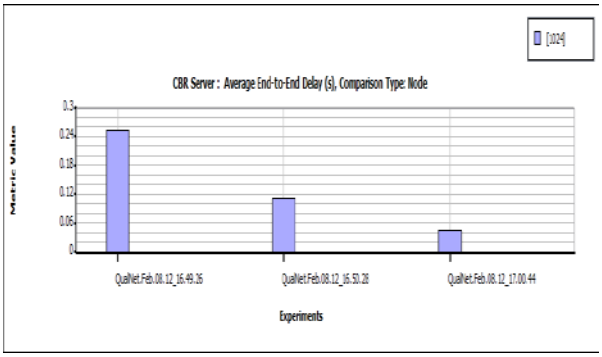

Figure 7 Average End to End delay(s) Vs 50 Nodes Of RP

Figure 6, 7 showing the performance of Average End to End delay (s) Vs 20, 50 nodes of routing protocol. End to End delay (s) of AODV routing protocol is .01 at 20 nodes and .25 at 50 nodes .End to End delay (s) of DSR routing protocol is .18 at 20 nodes and .11 at 50 nodes of routing protocol and in case of ZRP End to End delay (s) is .012 at 20 nodes and .07 at 50 nodes of routing protocol. Finally compare the performance of three routing protocol small and largest End to End delay (s) are taken AODV is .01 a small End to End delay (s) at 20 nodes and ZRP is .07 small End to End delay (s) at 50 nodes of routing protocol and in case of largest End to End delay (s) is DSR .18 at 20 nodes and AODV is .25 have largest End to End delay (s) at 50 nodes of routing protocols.

Throughput (bits/s) Vs 20, 50 Nodes of RP

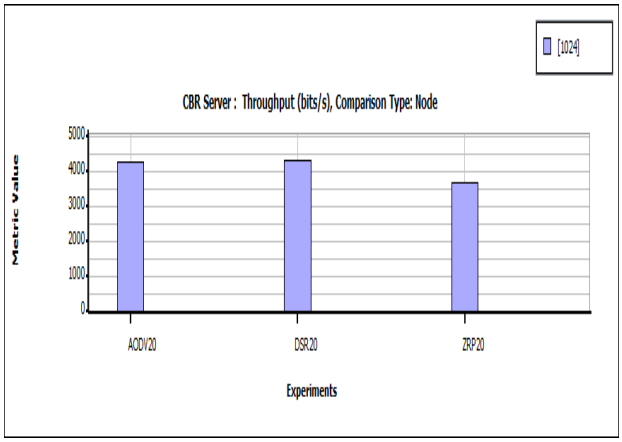

Figure 8 Throughput (bits/s) Vs 20 Nodes of RP

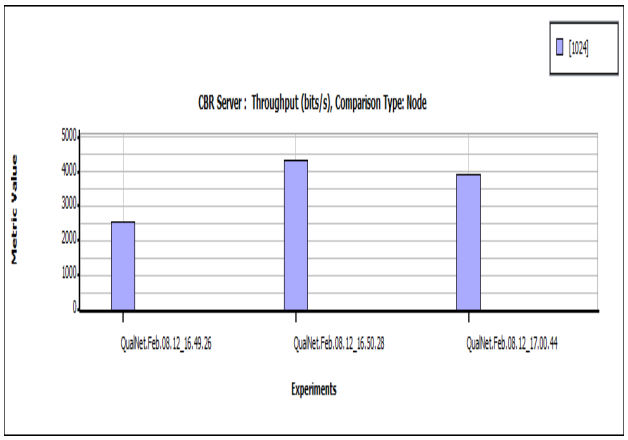

Figure 9 Throughput (bits/s) Vs 50 Nodes of RP

Figure 8, 9 showing the comparative performance of AODV, DSR and ZRP Routing Protocol at 20, 50 nodes performance metrics is throughput (bits/s). In case of 20 nodes AODV and DSR have same throughput 4200 and ZRP have smallest throughput is 3600.when taken 50 nodes the performance metric throughput AODV is 2500 smallest throughput ,DSR have largest throughput 4300 and ZRP have throughput 4000 less than DSR but greater than AODV routing protocols.

IP:ipDelivers TTL-based average hop count Vs 20, 50 Nodes of RP

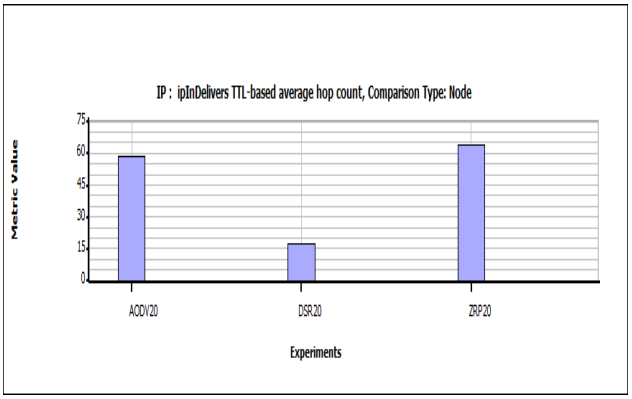

Figure 10 TTL-based average hop count Vs 20, 50 Nodes of RP

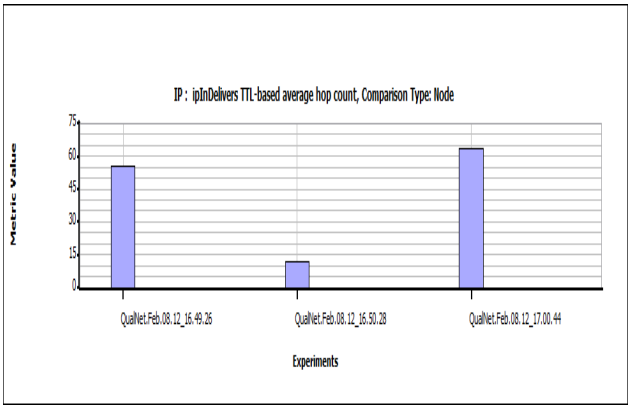

Figure 11 TTL-based average hop count Vs 20, 50 Nodes of RP

Figure 10,11 showing the three routing protocol AODV,DSR and ZRP on the basis of TTL base average hop count and nodes of routing protocol at 20,50 nodes.in case of 20 nodes DSR is 16 a small TTL hop count as copared to 50 nodes DSR is 11,AODV is a 59 at 20 nodes and 55 have

at 50 nodes of routing protocol and in case of ZRP is 65 at 20 nodes and ZRP is 64 at 50 nodes of routing protocols.if we are taken over all performance DSR have small TTL hop count ,largest AODV as compared to DSR but less than ZRP at 20 nodes of routing protocol and at 50 nodes small TTL hop count DSR,largest AODV but AODV is less than ZRP .

VIII. ACKNOWLEDGEMENT

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IX. CONCLUSION

In this article we have provided descriptions of three routing protocols for mobile ad hoc networks. In this article mainly focus on proactive, reactive, and hybrids routing protocols like AODV, DSR, and ZRP and comparative performance study of AODV, DSR and ZRP Routing protocol at 20, 50 nodes simulate the performance metrics Average End to End delay(s), throughput (bits/s), Average Jitters(s) and TTL based Hop count in Qualnet simulation tools 5.0.2. These performances taken according to apply constant bit rate (CBR) of nodes from source to destination. All Constant Bit Rate starting time 1sec from source and 25 sec end from the destination nodes of CBR All simulation time of the scenario's 600sec to complete of the process and provides the efficient simulation result of comparative performance AODV, DSR and ZRP routing protocol in mobile ad hoc network (MANET).

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