COMPARATIVE PERFORMANCE ANALYSIS OF MANET ROUTING PROTOCOLS

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Abstract: **MANET consists of wireless nodes that are required to communicate with each other. The network topology may change rapidly. MANET nodes are work as a router as well as router. The main objective of this paper is to compare the performance of different MANET protocols like reactive protocol (AODV), proactive protocol (OLSR) and hybrid protocol (ZRP) using different performance metrics like energy consumption, average transmission delay, end-to-end delay, throughput. Simulation is carried out using widely used simulator Qualnet.**

Keywords: MANET, Reactive protocols, Proactive protocols, Hybrid protocols, Performance metrics.

A. INTRODUCTION

A MANET is wireless mobile Adhoc network in which the wireless nodes are connected with each other. It is a collection of mobile devices, self-organized and self-configured [1]. It is an infrastructure-less networks i.e. there is no central access point in network. Nodes are highly mobile and network topology change very frequently. In MANET, node can easily enter or relieve the network without any permission from network or device [2].The nodes in MANET itself act as a sender, receiver and router and communicate with each other without any centralized infrastructure [3]. The source nodes are forward the packets with the destination using the intermediate nodes if the destination node resides out of the coverage area. The different routing protocols are used for the communication in MANET.

B. Routing protocols

MANET's routing protocol may be classified into three types:

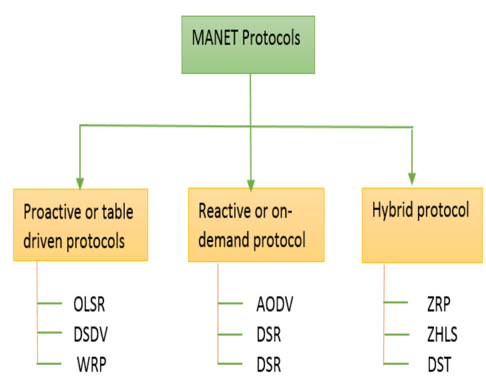

Fig.1 Routing Protocols

1. **Proactive or Table Driven Protocols**:

In proactive protocols, there are number of tables and information of every node contains in routing tables. When there is change in topology, the routing tables are updated. All nodes maintain an accurate and consistent update of network topology. The proactive protocols based on link state algorithms [4]. The proactive protocols do not have initial route discovery delay but it consume lot of bandwidth for periodic update of topology [5]. Proactive protocols are OLSR, DSDV.

OLSR: Optimized link state routing is based on link state algorithm. It is optimization version of pure link state protocol. In pure link state protocol, all the neighbour links are declared and flooded in the entire network. But in OLSR, it reduce the size of control packets rather than all links, it declares only a subset of link with its neighbour those are multipoint relay selector[6].OLSR is table driven protocol in which according to the requirement, routes are immediately available. OLSR protocol uses the MPR to reduce overhead. MPR is multipoint relay, is set of nodes used to relay message between nodes. During the flooding process, MPR is used to forward the broadcast message and also used to find the shortest path between source and destination.

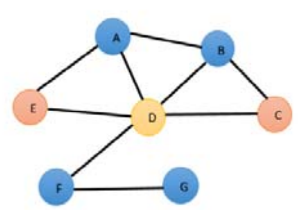

Fig.2 Example of OLSR

As shown in fig.2, F is MPR and communication is done through the node D. G is unidirectional link and D is bidirectional link. OLSR protocol has following different protocol functioning for transmission of data:

1. Neighbour sensing
2. MPR selection
3. MPR declaration

Neighbour Sensing: neighbour sensing is link sensing which is used to detect the direct and bidirectional links. "HELLO" message is broadcast by all the nodes and each node contains the information about all their neighbour nodes & its link states. Each node has the information of the 1-hop neighbours and 2-hop neighbours. Hello message contains the neighbour addresses which have valid bidirectional link as well as list of received hello message but link is not yet validated as bidirectional. On this information basis, each node performs the selection of its multipoint relay. Each node constructs its MPR selector table on the reception of hello message. Neighbour table contains the information about the 1-hop neighbours and 2-hop neighbour. In 1-hop neighbour table contains the neighbour ID and state of link and 2-hop neighbour contains the neighbour ID and links access through.

Table 1:1-hop neighbour table:

Neighbour 's ID	State of link
G	Unidirectional
D	Bidirectional
F	MPR
..	...

Table 2:2-hop neighbour table:

Neighbour's ID	Access through
A	D
B	D
..	..

Multipoint relay selection: Each node select own set of multipoint relay which declares in transmitted hello message. If any type of make changes in neighbour node like addition or deletion of node then the MPR is recalculated. Each node construct MPR selector table with information received from Hello message. MPR selector table contains the address of its 1-hop neighbour nodes and sequence number i.e. is associated to MPR. Sequence number increments if some updates occurred in MPR selector table.

Multipoint relay declaration: MPR define the topology control (TC) message.

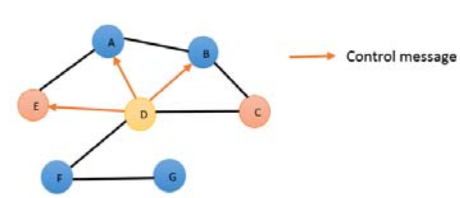

Fig.3 Topology control message forwarding

Fig.3 shows that D transmit the control message to E,D and B. MPR nodes forward message regularly to declare its MPR selector. TC message consist of the MPR selector and sequence number. Routing tables are calculated based on the topology table.

Table 3: Route table

Destination address	Destination MPR	MPR selector sequence number	Holding time

Destination address depicts the MPR selector on received TC message and Destination MPR is last hop node to the destination of TC message.

2. **Reactive or on demand protocols**:

Routing tables updates the information when required. When the information is to be exchanged, it calls the route. There is less bandwidth consume because of routing tables update on demand rather than proactive protocols [3]. There is no big overhead for maintenance of routing tables as in proactive protocols. But the disadvantage is high latency time. Reactive protocols are AODV, DSR.

AODV: Adhoc on demand distance vector routing algorithm. AODV is used for unicast and multicast routing. It is used in large network i.e. providing loop free routing. AODV inherit the feature of DSDV and DSR. The two operations performed in AODV is route discovery and route maintenance [7]. AODV is reactive protocol that discover the route when require for the transformation of packet. AODV includes the destination sequence number, Request ID, hop count. The packet has following information to for the transmission.

Table 4: Packet Information

Source address	Destination address	Destination sequence number	Hop count	Life time

Sender sends the RREQ to all neighbour nodes with destination sequence number. AODV avoid the count to infinity problem by using of sequence number.

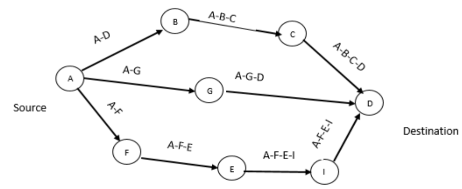

Fig.4 Route Discovery

Request ID and Hop count avoid the problem of duplication of RREQ. And then the RREP is unicast back to sender.

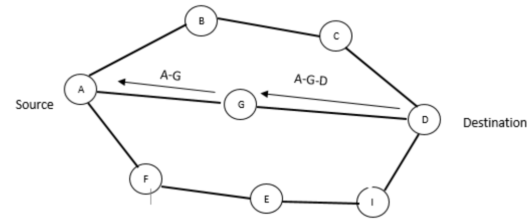

Fig.5 Path Selected

Whenever route lost then generate a (RERR) route error message to notify the other nodes. Whenever there is link breakage in route then the route error packet is initiated. The route error packet is transmitted back to the source node and then the source initiate the again ROUTE_REQUEST message and transmit to the nodes.

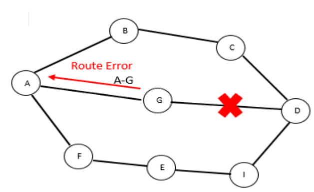

Fig.6 Route Error

The route is active whenever the packets are transmitted, but if the route is not use for the some period of time then the route is deleted [8]. AODV needs less number of overhead packets as compared to DSDV. When mobility increases then overhead packets also increased and this rises the frequent line breaks and route discovery. Latency is also less in AODV than DSR and DSDV. If the node concentration is similar then the route latency remains same even with increasing of mobility.

3. **Hybrid routing protocols**:

Hybrid routing protocols is mixture of proactive and reactive routing protocols. It overcomes the problem of reactive and proactive routing protocols [9]. Hybrid overcomes the problem of overhead in proactive and latency time problem in reactive routing protocol. Hybrid routing protocols are ZRP, TORA.

ZRP: Zone Routing Protocol is used to overcome the control overhead of proactive routing protocol and decrease the latency time caused by route discovery in reactive routing.ZRP defines the different zones around each node having its k-neighbourhood.ZRP has three parts, IARP proactive part ,IERP reactive part and BRP used with IERP to reduce query traffic[10].

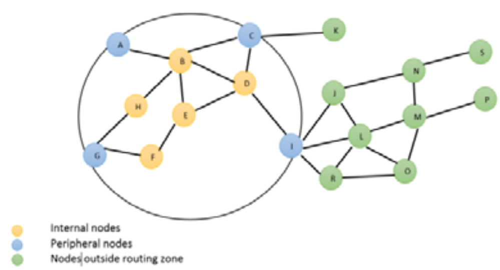

Fig.7 Example of ZRP

In the routing zone, the nodes are divided into interior nodes, peripheral nodes. Radius of zone is equal to the minimum distance of peripheral node to the central node. In example, E routing zone consist the node B-I, not J. In this, radius is equal to 2 as shown in fig.7. Node G can be reached by two different length i.e. 2 and 3.

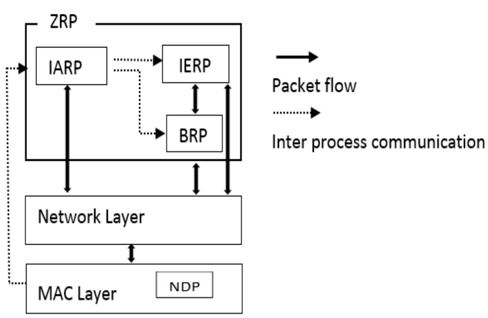

Fig.8 ZRP Layers

The relationship between components is shown in above diagram. NDP triggers the route update at MAC layer and when the neighbour table is updated, it notifies to the IARP. At MAC layer, NDP transmit the “HELLO” beacons at the regular interval. Neighbour table is updated when beacon is received. If beacon is not received within specific time then neighbours deleted from the neighbour table. IERP uses the IARP routing table for the route queries. IERP forward the queries with BRP.

IARP: IARP is intra zone proactive routing protocol. It is local routing protocol [11]. In this protocol, each node contains the information about all other nodes like DSDV protocol. Its radius shows the scope of proactive part, the proactive tracking of local network connectivity provide support of route acquiring & route maintenance.

IERP: IERP is global inter routing protocol. The existing reactive routing protocol implementation is adopts in this protocol [12]. When route discovery is required ,the routing zone based border cast rather than queries from neighbour to neighbour.IN this, if the destination is within routing zone of source, the routing is completed in intrazone routing phase otherwise source node send the packet to the peripheral nodes of its zone through border casting[13].

BRP: BRP stands for border cast resolution protocol. BRP uses query mechanism to transmit RREQ away from the network area that has already covered by query [14]. The combination of multicasting and zone based query mechanism makes border casting an efficient &tuneable services.

Example:

In fig.9, E is source node, the radius is equal to 2 and P is destination node. IARP routing table is used by the node to check that the destination node is within zone. If there is no destination route is find then the IERP initiate the route request and that route request border cast to the peripheral nodes.

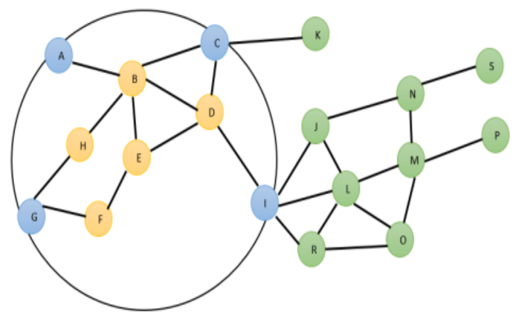

Fig.9 Route Discovery when center node is E

Node I does not find the destination node in their routing table and then again broadcast the route request to their peripheral nodes.

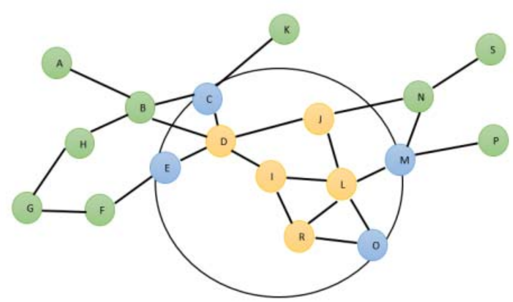

Fig.10 Route Discovery when center node is I

In fig.10, node I is centre node and route request broadcast to the peripheral nodes but the destination is not received in routing table of peripheral nodes. And then again check another zone.

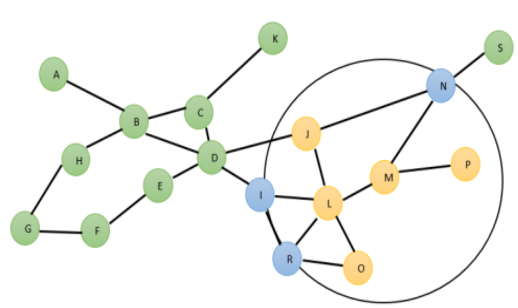

Fig.11 Route Discovery when center node is M

Finally, the destination node is received by node M. Destination node is received within the routing zone and then the centre node M send back the route reply to source through the peripheral node. If there is multiple paths from the source to destination then source received the multiple replies [15].

C. Simulation Environment

The objective of this simulation study is to evaluate and analyze the performance of three existing routing protocols. The simulation has been done using Qualnet version 6.1, software that provides scalable simulations of Networks. The simulation is done over different networks in which network varies from 10 to 40 nodes over a terrain of 500m*1500m area. The sender and receiver are same in each model among network members are placed at same place initially but as the simulation start, and then the nodes start moving towards the destination.

Table 5: SUMMARY OF SIMULATION ENVIRONMENT

Parameters	Values
Routing Protocols	AODV,OLSR,ZRP
Terrain size	1500*1500
Mobility Model	Random waypoint model
No. of Sources	10,20,30,40
Simulation Duration	30sec
Data Traffic Rate	CBR

D. Performances Metrics:

End-to-end delay: The delay in the average time, response of packet at latency, delay in retransmission. End-to-end delay is delay between the sender to receiver. It consists of all possible delays route discovery.

Throughput: The total number of bits forwarded from source to destination. Throughput is the average rate of all the successful received packet from sender to receiver .This is measured in bits/sec.

Average transmission delay: It is amount of time required to transmit all the packets into the link. It is ratio of packet length and link bandwidth.

E. **Results and Discussions**:

In this ,we is to evaluate three routing protocols one based on table driven protocol named as Optimized Link State Routing Protocol (OLSR) and one based, on-demand behaviour, namely, Ad hoc Demand Distance vector (AODV) and one from Hybrid Routing i.e. Zone Routing Protocol(ZRP) , for wireless ad hoc networks based on performance. We were simulating all three routing Protocols with variations in nodes. And analyzing the performance of AODV, OLSR and ZRP in the light of Energy consumption, Throughput, Average transmission delay and end to end delay in MANET.

Average Transmission delay: Fig 12. Shows that AODV have more delay than OLSR and ZRP. Delay increases with large variation of source nodes.

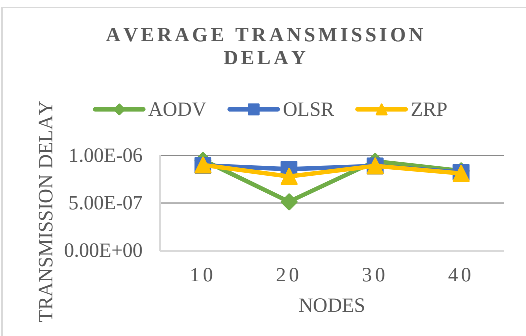

Fig 12: Average transmission delay

End-to-end delay: Fig 13. Shows that OLSR and ZRP have more delay than AODV. But OLSR and ZRP have more end-to-end delay.

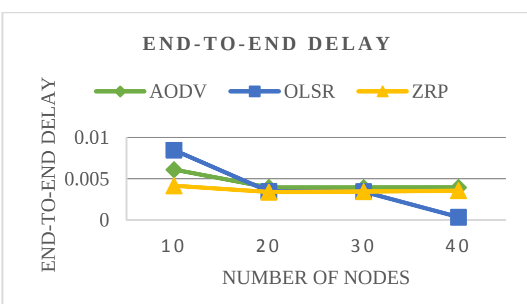

Fig 13:End-to-end delay

Throughput: Fig 14. Shows that the throughput of AODV is greater than another routing protocol. OLSR and ZRP have similar throughput with small variations. AODV perform better than other protocols

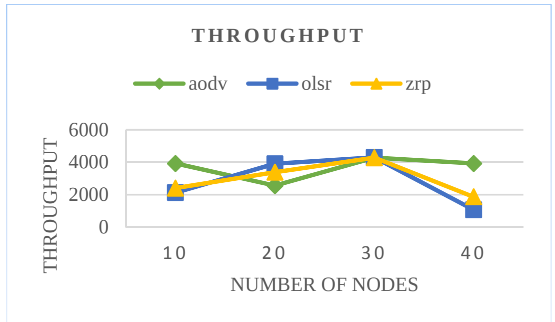

Fig 14.Throughput

Energy consumption in transmit mode: Fig 15. shows that OLSR and ZRP consume more energy in transmission mode but AODV consume less energy as compared to another protocols.

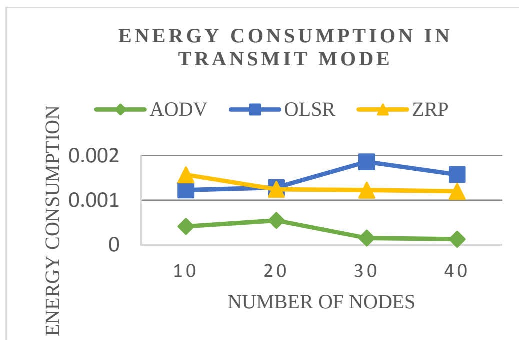

Fig 15. Energy consumption in transmit mode

Energy consumption in receive mode: Fig 16. Shows that OLSR consume more energy .OLSR and ZRP have similar energy consumption n receive mode with small variation. AODV consume less energy than OLSR and ZRP.

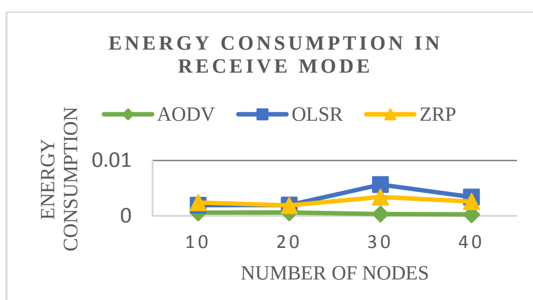

Fig 16. Energy consumption in receive mode

F.CONCLUSION AND FUTURE WORK:

In this study, compare the performances analysis of Proactive protocol(OLSR),Reactive protocol(AODV) and Hybrid protocol(ZRP) using performance metrics energy consumption, average transmission delay, end-to-end delay, throughput. The performance of AODV is best than OLSR and ZRP. In future we plan for implementation attacks in same network and performance analysis of same network

References:

[1]. *P.R.Jasmine jeni, A.Vimala Juliet, R.Parthasarathy, A.Messiah Bose* "Performance Analysis of DOA and AODV Routing Protocols with Black Hole Attack in MANET" International Conference on Smart Structures & Systems, ISBN: 978-1-4673-6240-5/32©2013 IEEE.

[2]. *Avni Khatkar, Yudhvir Singh* "Performance Evaluation of Hybrid Routing Protocols in Mobile Adhoc Networks " International Conference on Advanced Computing & Communication Technologies,ISBN:978-0-7695-4640-7/12©2012 IEEE.

[3]. *Mona N.Alslaim, Haifaa A.Alaqel, Soba S.Zaghloul* "A Comparative Study of MANET Routing Protocols" ISBN:978-1-4799-3166-8©2014 IEEE.

[4]. *Harjeet Kaur, Varsha Sahni, Dr. Manju Bala* " A Survey of Reactive,Proactive and Hybrid Routing Protocols in MANET:A Review" IJCSIT,ISSN:0975-9646,2013.

[5]. *Latif Ullah Khan, Faheem Khan, Naeem Khan* "Effect of Network Density on the Performance of MANET Routing Protocols" International Conference on Circuits, Power and Computing Technologies,ISBN:978-1-4673-4922-2/13©2013 IEEE.

[6].*Pragya Gupta ,Sudha Gupta* "Performance Evaluation of Mobility Models on MANET Routing Protocols " International Conference on Advanced Computing & Communication Technologies" ISBN:9780-0-7695-4941-5/13©2013 IEEE.

[7]. *Ajinkya. D.Kadam, Prof. Sharad.S.Wagh* "Evaluating MANET Routing Protocols Under Multimedia Traffic " ICCCNT-2013,IEEE-31661.

[8]. *Mazhar H malik*,Qasim Always#, Mohsin Jamil** and Dhyani#* "Performance Analysis of Proactive and Reactive Protocols in Mobile Ad-Hoc Networking:A Simulation based Analysis" ICREATE ,ISBN:978-1-4799-5132-1/14©2014 IEEE.

[9]. *Changling Liu.Jorg Kaiser* " A Survey of Mobile Ad Hoc Routing Protocols.

[10]. *Nicklas Beijar*,"Zone Routing Protocol".

[11]. *Shabana Habib, Somaila Saleem, Khawaja Muhammad Saqib* " Review on MANET Routing Protocols and Challenges " Student Conference on Research and Development,ISBN:978-1-4799-2656-5/13 ©2013 IEEE.

[12]. *Anil Manohar Dogra, Rajvir Singh* "Zone Based Analysis of ZRP Under Varying Mobility and Transmission range in MANETs" IJECS,ISSN:2319-7242,2014.

[13]. *Swati Bhasin, Ankur Gupta, Puneet Mehta* " Comparison of AODV,OLSR and ZRP Protocols in Mobile Ad-hoc Network on the basis of Jitter" International Journal of Applied Engineering Research,ISSN-0973-4562,2012

[14]. *Harjeet Kaur, Manju Bala, Varsha Sahul* " Performance Evaluation of AODV,OLSR and ZRP Routing Protocols under the Black hole Attacks in MANET" IJAREEIE,ISSN:2278-8875,2013.

[15].Neeraj Arora and Dr. N.C. Barwar,"Evaluation of AODV,OLSR and ZRP under Black hole attack",IKAIEM,ISSN 2319-4847.