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PERFORMANCE ANALYSIS OF MANET ROUTING PROTOCOLS BASIS ON DELAY AND THROUGHPUT

Asha Kumari Jakhar[1], Rakesh Kumar[2]

[1]Research Scholar, [2]Assistant Professor, Department of Electronics & Communication Engineering, Sobhasaria Engineering College, Sikar, RTU Kota (India)

ABSTRACT

Infrastructure-less mobile networks are known as mobile ad hoc networks (MANET). Mobile Ad hoc network (MANET) is a collection of mobile nodes that are arbitrarily located so that the interconnections between nodes are dynamically changing. A node communicates directly with the nodes within radio range and indirectly with all others using a dynamically-determined multi-hop route. Routing protocols are used to find routes between mobile nodes to facilitate communication within the network. Routing protocols for MANETs could be differing depending on the application and network architecture. The main goal of such an ad hoc network routing protocols are to establish correct and efficient route between a pair of mobile nodes so that messages delivered within the active route timeout interval. In this paper different routing protocols AODV, DSR, OLSR, GRP and TORA are compared for different mobile nodes 20, 40 and 60 in terms of delay and throughput under application ftp and http with IEEE802.11g standard using OPNET14.5.

***Keywords*: AODV, DSR, FTP, GRP, HTTP, MANET, OLSR, TORA and OPNET.**

I. INTRODUCTION

A mobile ad hoc network is a collection of wireless mobile nodes that dynamically establishes the network in the absence of fixed infrastructure. One of the distinctive features of MANET is each node must be able to act as a router to find out the optimal path to forward a packet. As nodes may be mobile, entering and leaving the network, the topology of the network will change continuously. MANETs provide an emerging technology for civilian and military applications. One of the important research areas in MANET is establishing and maintaining the ad hoc network through the use of routing protocols [1].

Objectives of MANET Routing Protocols:

- To maximize network throughput.
- To maximize network lifetime.
- To minimize delay.

The network throughput is usually measured by packet delivery ratio and delay between transmission and reception. To achieve efficiency in network delay should be less and throughput must high, but what algorithms are good in this manner to identify this analysis of different routing algorithms in different situation required [2].

II. MANET ROUTING PROTOCOLS

MANET routing protocols could be broadly classified into two major categories- table driven (proactive), on demand (reactive).

2.1 Table Driven (Proactive) Routing Protocols

This type of protocols maintains fresh lists of destinations and their routes by periodically distributing routing tables throughout the network Proactive protocols continuously learn the topology of the network by exchanging topological information among the network nodes. Examples are OLSR and GRP.

2.2 On Demand (Reactive) Routing Protocols

The reactive routing protocols are based on some sort of query-reply dialog. This type of protocols finds a route on demand by flooding the network with Route Request packets. Discovering the route on demand avoids the cost of maintaining routes that are not being used and also controls the traffic of the network because it doesn't send excessive control messages which significantly create a large difference between proactive and reactive protocols. Examples are AODV, DSR and TORA.

2.3 AODV

Ad hoc On Demand Distance Vector AODV is collectively based on DSDV and DSR. It aims to minimize the requirement of system-wide broadcasts to the greater extent. Routes are discovered as and when needed and are maintained only as long as they are required. The key steps used by AODV for establishment of unicast routes are Route discovery and Route maintenance.

2.3.1 Route Discovery

AODV initiates a route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node will create a RREQ packet containing its IP address, its current sequence number, the destination's IP address, the destination's last sequence number and broadcast ID. The broadcast ID is incremented each time the source node initiates RREQ. Basically, the sequence numbers are used to determine the timeliness of each data packet and the broadcast ID & the IP address together form a unique identifier for RREQ so as to uniquely identify each request. The requests are sent using RREQ message and the information in connection with creation of a route is sent back in RREP message. The source node broadcasts the RREQ packet to its neighbors and then sets a timer to wait for a reply. To process the RREQ, the node sets up a reverse route entry for the source node in its route table. This helps to know how to forward a RREP to the source. Basically a lifetime is associated with the reverse route entry and if this entry is not used within this lifetime, the route information is deleted. If the RREQ is lost during transmission, the source node is allowed to broadcast again using route discovery mechanism.

2.3.2 Route maintenance

As long as the route remains active, it will continue to be maintained. A route is considered active as long as there are data packets periodically travelling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error

(RERR) message to the source node to inform it of the now unreachable destination(s). After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery [3].

2.4 DSR

DSR is a loop-free, source based, on demand routing protocol. This protocol is source-initiated rather than hop-by-hop, completely self-organizing and self-configuring. This protocol is composed of two essential parts of route discovery and route maintenance. Every node maintains a cache to store recently discovered paths. When a node desires to send a packet to some node, it first checks its entry in the cache. If it is there, then it uses that path to transmit the packet and also attach its source address on the packet. If it is not there in the cache or the entry in cache is expired, the sender broadcasts a route request packet to all of its neighbors asking for a path to the destination. The sender will be waiting till the route is discovered. During waiting time, the sender can perform other tasks such as sending/forwarding other packets. As the route request packet arrives to any of the nodes, they check from their neighbor or from their caches whether the destination asked is known or unknown. If route information is known, they send back a route reply packet to the destination otherwise they broadcast the same route request packet. When the route is discovered, the required packets will be transmitted by the sender on the discovered route. Also an entry in the cache will be inserted for the future use. The node will also maintain the age information of the entry so as to know whether the cache is fresh or not. When a data packet is received by any intermediate node, it first checks whether the packet is meant for itself or not. If it is meant for itself, the packet is received otherwise the same will be forwarded using the path attached on the data packet. Since in Ad hoc network, any link might fail anytime. Therefore, route maintenance process will constantly monitors and will also notify the nodes if there is any failure in the path. Consequently, the nodes will change the entries of their route cache [4].

2.5 Olsr

Optimized Link State Routing OLSR incorporates two optimizations over the conventional link state routing in ad hoc networks. Each node selects a set of neighbor nodes called multi-point relays (MPRs). Furthermore, when exchanging link-state routing information, a node lists only the connections to those neighbors that have selected it as MPR, i.e., its Multipoint Relay Selector set. Further, the link state updates are diffused throughout the network only using these MPRs thus significantly reducing the number of retransmissions. The MPRs of a node are basically the smallest set of neighbors who can effectively reach all the two hop neighbors of that node. The MPRs of a node changes with node mobility and are updated using periodic HELLO messaging. A source-destination route is basically a sequence of hops through the multipoint relay nodes. Routes selected are shortest hop as in the conventional link state algorithm. The protocol selects bi-directional links for routing [5].

2.6 GRP

The Geographic Routing Protocol (GRP) is a position-based protocol classified as Proactive Routing Protocol. In GRP protocol the location of a node is marked by GPS and flooding will be optimized by quadrants. Flooding location is updated on distance when the node moves and crosses neighborhood. A ‘Hello’ protocol will be exchanged between nodes to identify their neighbors and their positions. At the same time, by means of route locking a node can return its packet to the last node when it cannot keep on sending the packet to the next node. GRP divides a network into many quadrants to reduce route flooding. The entire world is divided into quadrants from Lat, Long (-90, -180) to Lat, Long (+90, +180). Every node knows the initial position of every other accessible node once initial 'flooding' is completed in the network. When the node moves a distance longer than a user has specified or when the node crosses a quadrant the routing flooding will be occurred [6].

2.7 Tora

The Temporally Ordered Routing Algorithm (TORA) is an adaptive routing protocol for multi hop networks. TORA is a distributed algorithm, maintains states on a pre-destination basis like other distance vector algorithms. It uses a mechanism that combines reactive and proactive routing. Sources initiate route requests in a reactive mode. At the same time, selected destinations may start proactive operations to build traditional routing tables. Usually, routes to these destinations may be consistently or frequently required such as routes to gateways or servers. TORA supports multiple path routing and it minimizes the communication overhead associated with network topology changes. The reason is that TORA maintains multiple paths and it does not need to discover a new route when the network topology changes unless all routes in the local route cache fail. Hence, the route used in this protocol may not always be the shortest one since a set of paths is used. TORA assigns directions to all links according to the heights of their neighboring routers in terms of upstream or downstream. A link is considered an upstream link for the "lower" neighboring router. At the same time, it is also considered a downstream link for the "higher" neighboring router. An upstream link for a router implies that data flows to the corresponding destination can only come into this router via that link. A downstream link for a router means that data flows can only leave this router to the neighboring router. TORA is a complex algorithm compared to DSR. It has four operations: creating routes, maintaining routes, erasing routes and optimizing the routes. The creating routes operation is responsible for selecting the proper heights for routers and forming a directed sequence of links leading to the destination in a previously undirected network. The maintaining routes operation is the process that responds to network topology changes. The operation of erasing routes is used to set routers 'heights' to NULL and set the links to undirected. TORA uses the optimizing routes function to adjust the heights of routers to improve routing. Four packets are used to perform these operations: query (QRY), update (UPD), clear (CLR), and optimization (OPT) [7].

III. RELATED WORK

Nirendra Kumar and Pratap Singh Patwal, "Performance Evaluation of MANET Routing Protocols of with FTP Application Using an Optimized Scalable Simulation Model", International Journal of Advanced Research in Computer Science and Software Engineering, Volume 3, Issue 6, June 2013 [8]. Researcher presented a comparative study of OLSR, AODV and GRP using three parameters i.e throughput, delay and network load under FTP traffic and result present that the OLSR outperforms the two AODV and GRP protocols in terms of delay, network load and delay in 75 and 150 mobile nodes. OLSR performs better in handling FTP traffic in smaller networks and when the node density is increased OLSR performance falls less slowly. Muhammad Shaffatul Islam, Md. Adnan Riaz and Mohammed Tarique "Performance Analysis of The Routing Protocols for Video Streaming over Mobile Ad Hoc Networks" International Journal of Computer Networks & Communications (IJCNC) Vol.4, No.3, May 2012 [9]. In their paper DSR, AODV, TORA), OLSR and GRP) compared for supporting video streaming applications and overall performance of TORA was the best as all

QOS parameters have favorable results, TORA uses the optimizing routes function to adjust improve routing. The performance of AODV is poor compared to OLSR and GRP but better than DSR.

IV. SIMULATION SETUP

This paper will analyze routing protocols for 20, 40 and 60 nodes in terms of delay and throughput and follow other simulation parameters given in table 1 and design the configuration as shown in Fig.1 below.

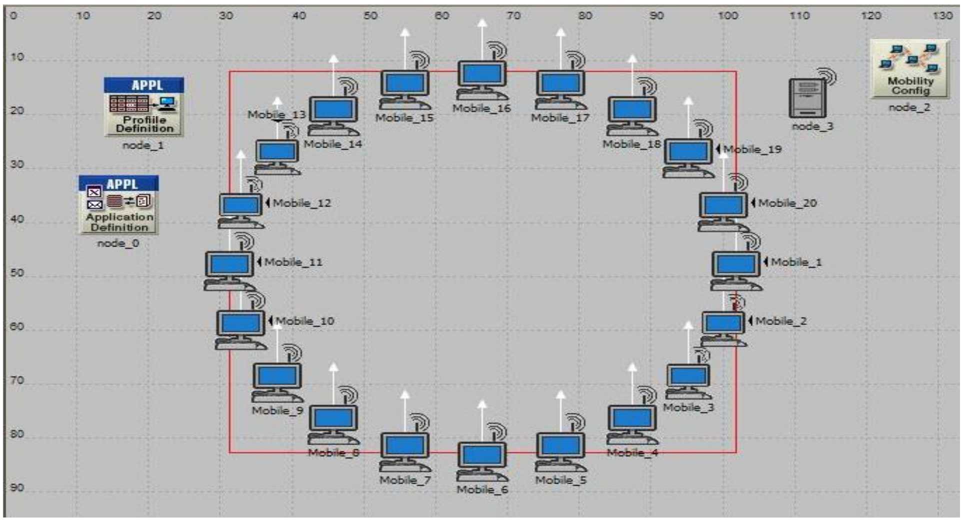


Figure.1. Design of Network Consisting of Different Nodes (20 Nodes), Ethernet Server and Different Configuration.

Table 1 Simulation Parameters

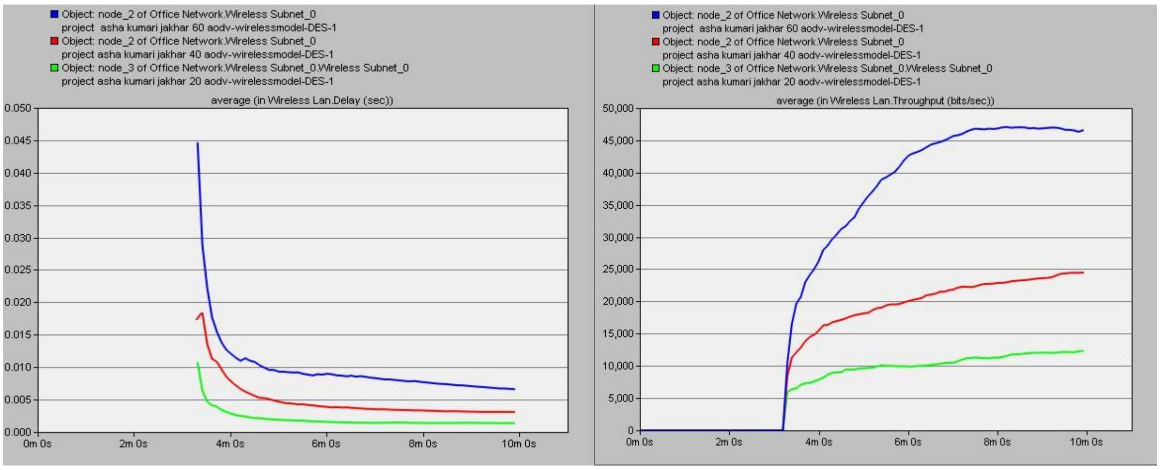
Simulation Parameters	Value
Routing protocols	AODV, DSR, OLSR, GRP and TORA
Data rate	36Mpps
Transmit power	0.005W
Topology , IEEE standard	Circular, 802.11g
Mobility profile	Random waypoint
Parameters for analysis	Delay, throughput
Area, No. of nodes	$5000m^2$, 20, 40, 60
Applications	FTP and HTTP

V. RESULTS AND DISCUSSION

After simulation results are analyzed as follows-

5.1 AODV

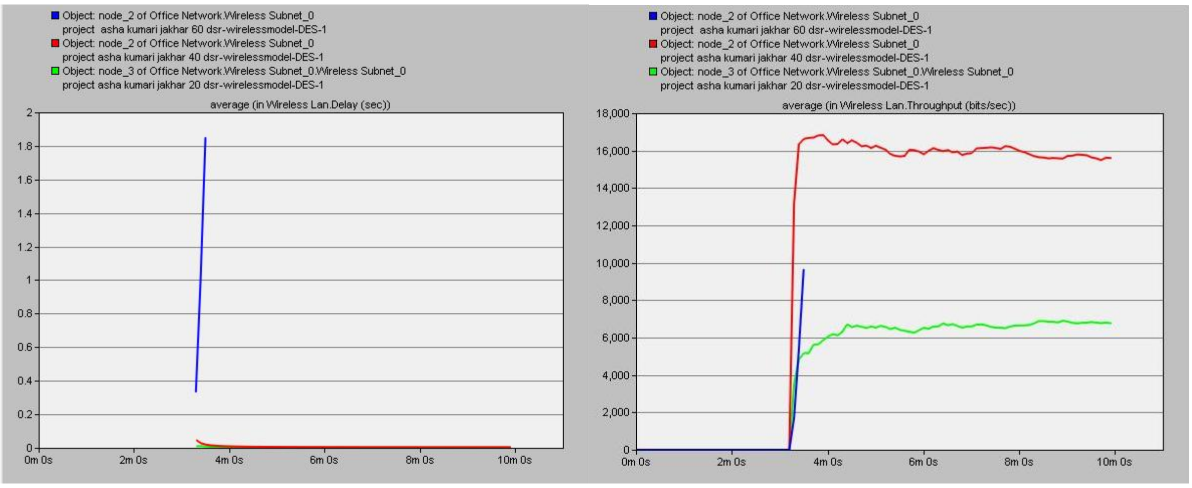
For AODV simulation shows that as the no. of mobile node increases delay also increases as shown in graph. For individual 20, 40 and 60 nodes the delay is high in first then decreases continuously. As the no. of mobile node increases throughput also increases as shown in graph. For individual 20, 40 and 60 nodes the load parameter increases in first fast then become constant.



(a) **(b)**

Figure.2. (a) Delay and (b) Throughput Analysis of AODV for Mobile Nodes (20, 40, 60)

5.2 DSR



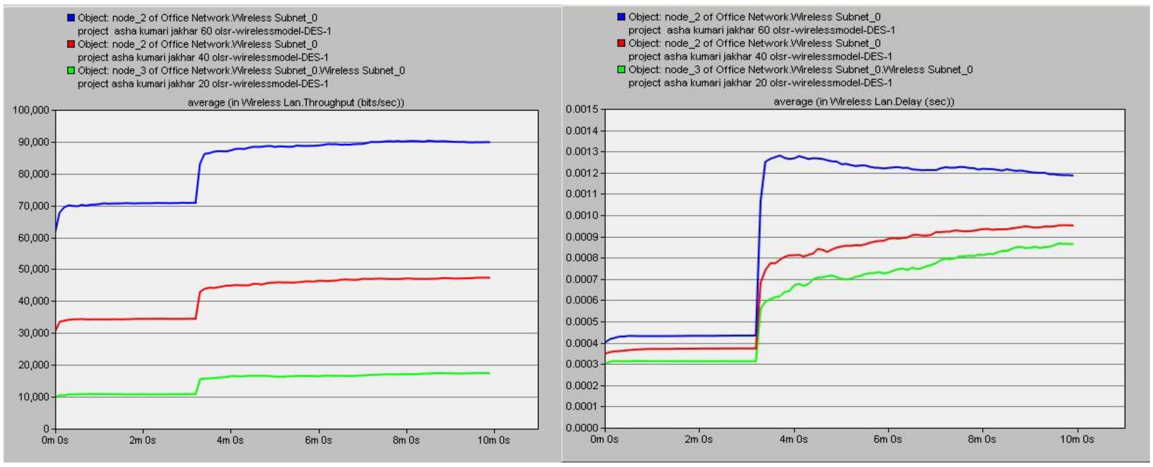
(a) **(b)**

Figure.3. (a) Delay and (b) Throughput Analysis of DSR for Mobile Nodes (20, 40, 60)

For DSR simulation shows that as the no. of mobile node increases delay also increases but at very high traffic DSR response start break down mechanism as shown in graph. Delay became very high at high traffic and for low traffic it is negligible. As the no. of mobile node increases throughput also increases but at very high traffic DSR response start to disappear as shown in above graph.

5.3 OLSR

For OLSR simulation shows that as the no. of mobile node increases delay also increases but in contrast to DSR and AODV delay initially low than start to increase in OLSR as shown in graph. As the no. of mobile node increases throughput also increases as shown in graph.

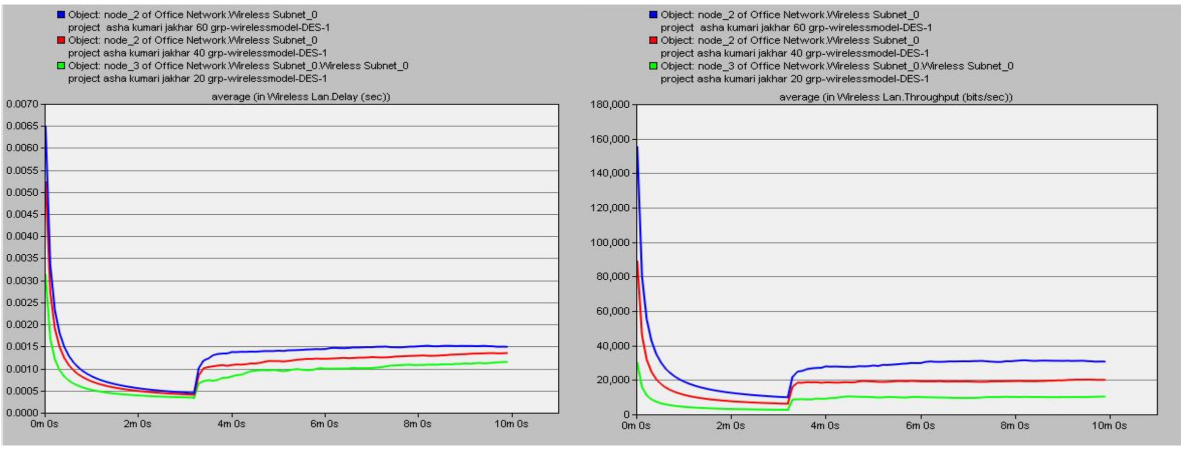


(a) **(b)**

Figure.4. (a) Delay and (b) Throughput Analysis of OLSR for Mobile Nodes (20, 40, 60)

5.4 GRP

For GRP simulation shows that as the no. of mobile node increases delay also increases but for each node delay start negatively then became constant at last increase positively as shown in graph.



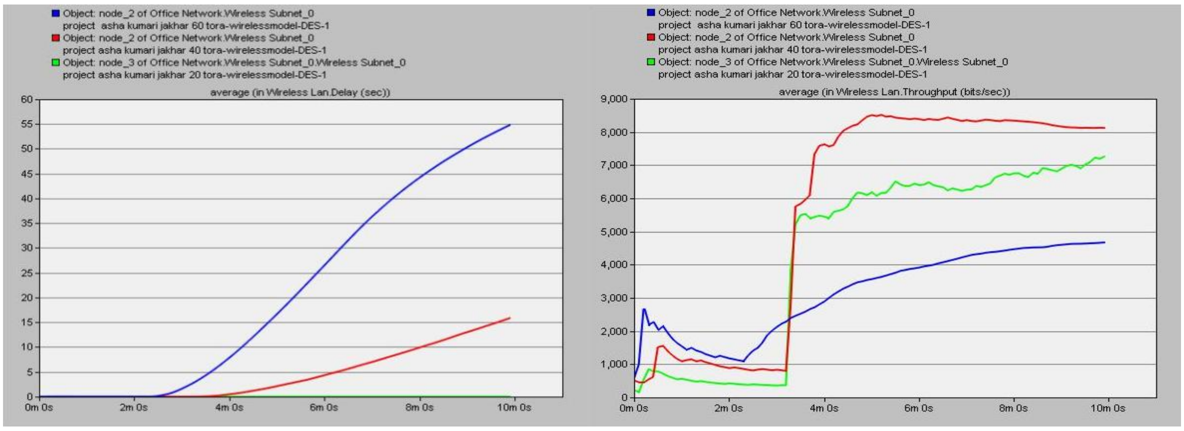
(a) **(b)**

Figure.5. (a) Delay and (b) Throughput Analysis of GRP for Mobile Nodes (20, 40, 60)

As the no. of mobile node increases throughput also increases but for each node bit transmission start negatively then became constant at last increase positively as shown in graph.

5.5 TORA

For TORA simulation shows that as the no. of mobile node increases delay also increases as shown in graph. As the no. of mobile node increases throughput decrease in contrast to all other routing algorithms as shown in graph.



(a) **(b)**

Figure.6. (a) Delay and (b) Throughput Analysis of TORA for Mobile Nodes (20, 40, 60)

Thus AODV, GRP and OLSR are best in delay and throughput results at high traffic.

VI. CONCLUSION

The simulation study of this paper consisted of five routing protocols AODV, DSR, OLSR, GRP and TORA deployed over MANET using FTP and HTTP traffic analyzing their behavior with respect to two parameters i.e. delay and throughput. The selection of efficient and reliable protocol is a critical issue. From the above analysis of routing protocols, the OLSR, GRP and AODV outperforms the two DSR and TORA protocols in terms of delay and throughput in 20, 40 and 60 mobile nodes. But it is not necessary that OLSR, GRP and AODV perform always better in all the networks, its performance may vary by varying the network. At the end we came to the point from our simulation and analytical study that the performance of routing protocols vary with network and selection of accurate routing protocols according to the network, ultimately influence the efficiency of that network in magnificent way.

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