

# A COMPARATIVE ANALYSIS OF VARIOUS ROUTING PROTOCOL IN MANETS

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**Abstract-** A MANET is an infrastructure-less type network, which consists of number of mobile nodes with wireless network interfaces . MANET is a wireless network that consists of nodes which are mobile in nature. In order to make communication among nodes, the nodes dynamically establish paths among one another. Each node in the network acts as a router which provides the flexibility to the topology of the network. There are many routing protocols in the MANET such as DSR, AODV, TORA etc and these are classified in different routing protocols .In this paper we will discuss and compare the routing protocols such as AODV, DSR, TORA, OSLR, ABR on the basis of Throughput, End-to-End delay and packet delivery ratio. These performance are measured through NS-2 network simulator.

**Index Terms-** AODV (Ad-hoc On-demand Distance Vector), DSR (Dynamic Source Routing), ABR(Associativity Based Routing Protocols)

## I. INTRODUCTION

A mobile ad-hoc network (MANET) is a self-configuring network which are wirelessly connected by radio links the union of which form an arbitrary topology. The routers are free to move in any direction in a network and arrange themselves arbitrarily. Thus, the network's topology changes rapidly and unpredictably. A collection of wireless mobile nodes which can be dynamically establish the network in the absence of fixed based infrastructure Because of these characteristics, routing is a critical issue and an efficient routing protocol needs to be chosen to make the MANET reliable . The most popular routing protocols in MANET are AODV (reactive), DSR (reactive), OLSR (proactive) and TORA(reactive), ABR(on demand). Reactive protocols find the routes whenever it is required. On-demand protocols find a path whenever it is demanded by flooding the network with route request packets. Proactive protocols are table driven protocols and find routes before they need it. The organization of the paper is as follows. We explain routing protocols in section II, related work are discussed in section III, section IV explains the simulation and performance metrics ,section V explains the results of simulations and finally section VI concludes the paper.

## II. ROUTING PROTOCOLS

Mobile Ad-Hoc Network (MANET) is a autonomous collection of nodes in network. They does not relies on any assess point for the communication in a network.. MANETs is a self-configuring network and form an uniform topology. Each node in a network behaves like routers in network for routing the packet. Due to rapid change of topology in MANETs, routing protocols are required in MANETS. The routing protocol is required whenever the source needs to communicates with destination. Routing protocols are classified as Proactive (Table Driven Routing Protocol), Reactive (On Demand Routing Protocol) and Hybrid (having the advantages of both proactive and Reactive routing protocols) routing protocols. MANETs routing protocols are classified as:-

- A. Reactive protocols
- B. Proactive protocols
- C. Hybrid protocols

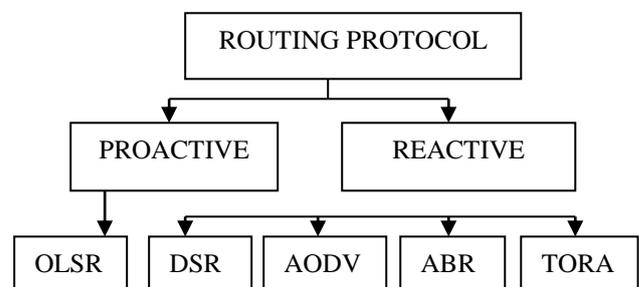


Figure 1: Routing protocols of MANET

Reactive Protocols:

Reactive protocols are also known as on demand driven reactive protocols. They are mainly used to find the path between source node and destination node whenever it is needed. As required by the source node this routing protocol initiate route discovery process, to find the route to the destination. Then this route is used for further communication e.g. AODV.

### Proactive Protocols:

Proactive protocols also known as Table driven routing protocols. Every node maintains routing tables which are consistent and contains up-to-date routing information for every node in the network. Whenever any new node is entered into network or removed from the network, control messages are sent to all neighboring nodes then they update their routing tables. This routing protocol uses link-state routing algorithms which frequently flood the link information about its neighbors. Proactive routing protocols are OSPF and OLSR

### Hybrid Routing Protocol:

Hybrid routing protocol contains the advantage of both proactive and reactive routing protocols. First of all it behaves like a proactive routing protocol, because it uses table at the starting. Then whenever nodes find that they do not have route to destination, they start route discovery and behave like reactive routing protocols. Hybrid protocols are TORA and ZRP

### DSR PROTOCOL

Dynamic Source Routing (DSR) is an Ad Hoc routing protocol which is source-based routing other than table-based. This is generally designed for use in multi hop wireless networks of mobile nodes. Basically, DSR protocol does not require any network infrastructure or central administration and this is completely self-organizing and self-configuring. This Protocol is composed of phase i.e route discovery and route maintenance. Each recently discovered paths are maintained in a cache. Whenever any node desires to send a packet to some other node, it first checks its entry in the cache. If it is there, then it use that path to transmit the packet and also attach its source address on that data packet. If it is not there in the cache or the entry in cache is expired then sender broadcasts a route request packet to all of its neighbors asking for a route to the destination. The sender waits till the route is discovered. During waiting time, the other tasks can be performed by the sender 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 is already available or not. If route information is available, then they send back a route reply packet to the destination otherwise they broadcast the same route request packet. Whenever the route is discovered, the required packets will be transmitted by the sender on the discovered route. The node will also maintain the 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.

### AODV PROTOCOL

AODV is a mixture of Destination-Sequenced Distance-Vector (DSDV) routing protocol and DSR routing protocol. It minimize the requirement of system-wide broadcasts to its extreme strength. It does not maintain routes from every node to every other node in the network rather they are discovered as and when needed & are maintained only as long as they are required. AODV is heavily based on two process.

#### Route Discovery

When a node wants to send a data packet to a destination node, the entries in route table are checked in order to find that whether there is any current route to that destination node or not. If there is any route, the data packet is forwarded to the appropriate next hop toward the destination. If it is not then, the route discovery process is initiated. Initiation of route in AODV is done by route discovery process using Route Request (RREQ) and Route Reply (RREP). The source node send 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 automatically incremented whenever the source node initiates RREQ. Generally, 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 each RREQ so that it can uniquely identify each request. The requests are sent using RREQ message and the information about the connection created is sent back in RREP message. The source node broadcasts the RREQ packet to its neighbours 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.

#### Route Maintenance

A route discovered between a source node and destination node is maintained as long as needed by the source node. Since there is continuous movement of nodes in a network and if the source node moves during an active session, it can reinitiate route discovery mechanism to establish a new route to destination. Conversely, if the destination node or some intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream neighbors/nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still required. and their sending rates may differ widely and can change dynamically from node to node. In addition, as the size of network grows, various performance metrics begin decreasing. AODV is vulnerable to various kinds of attacks as it based on the assumption that all nodes must cooperate and without their cooperation no route can be established

#### TORA PROTOCOL

TORA is a distributed highly adaptable routing protocol which operate in a dynamic multihop network. An arbitrary height parameter is used by TORA to determine the direction of link between any two nodes for a particular destination. Generally, multiple routes often exist for a destination but none of them are mainly the shortest route. To initialize a route, the node broadcasts a QUERY packet to its neighbors. This QUERY is rebroadcasted through the network until it reaches the destination or an intermediate node that has a route to the destination. The recipient of the QUERY packet then broadcasts the UPDATE packet which lists its height with respect to the destination. When this packet propagates in the network, each node that receives the UPDATE packet sets its height to a value greater than the height of the neighbour from which the UPDATE was received. This has the effect of creating a series of directed links from the original sender of the QUERY packet to the node that initially generated the UPDATE packet. When it was discovered by a node that the route to a destination is no longer valid, it will adjust its height so that it will be a local maximum with respect to its neighbours and then transmits an UPDATE packet. If the node has no neighbors of finite height with respect to the destination, then the node will attempt to discover a new route as described above. When a node detects a network partition, it will generate a CLEAR packet that results in reset of routing over the ad hoc network.:

#### OLSR PROTOCOL

OLSR is proactive routing protocol or table driven protocol. It is based on the link-state algorithm. It usually stores and updates its routes so when a route is needed, it present the route immediately without any initial delay.. Each node maintains the topology information of network and sending this information from time to time to neighbors. In OLSR, some candidate nodes called multipoint relays (MPRs) are selected and responsible to forward broadcast packets during the flooding process. The basic concept of MPR is to reduce the loops of retransmissions of the packets. Only MPR nodes broadcast route packets. A node senses and selects its MPR's with control messages called HELLO messages. Hello messages are used to ensure a bidirectional link with the neighbor.

#### ABR PROTOCOL

*Associativity Based Routing Protocols(ABR):* The Associativity Based Routing (ABR) protocol is new protocol which is efficient for routing .ABR defines a new metric for routing known as the degree of stability association. It is completely free from loops, deadlock, and packet duplicates. In ABR, selection of the route is based on associativity states of nodes. The routes thus selected is liked as a long-lived route. All node generate continuous beacons to signify there existence. When a neighbor node receives a beacon, associativity tables is updated. For each and every beacon received, the node increments its associativity parameter with respect to the node from which it received the beacon. Association stability means connection stability of one node with respect to another node over time and space. A high associative value tick with respect to a node indicates a low state of node mobility, while a associative value tick may indicate a high state of node mobility. Associativity ticks are reset when the neighbors of a node or the node itself move out of proximity. The fundamental objective of ABR is to find longer-lived routes for ad hoc mobile networks. ABR has three phases i.e Route discovery, Route reconstruction (RRC) and Route deletion.

#### III. RELATED WORKS

AODV, OLSR and TORA have lot of attention in recent times. B.M Sobral et. al. [1] compared the performance of AODV and OLSR using a self-configuration mechanism for Heterogeneous Wireless Mesh Networks. As relevant results they got some improvements related to the original OLSR and AODV protocols, by applying the self-configuration capacity, such as, the increased throughput of the overall network, improvement of the delay of discovery local neighboring routes by reducing the HELLO traffic messages and the MPR Count metric and finally the improvement of the delivery of packets due to smaller dropped packets.

The performance investigation of reactive and proactive MANET routing protocols, namely AODV, DSR, TORA and OLSR is done by Ashish Shrestha and Firat Tekiner [2]. They have concluded that with regards to overall performance, AODV and OLSR performed pretty well. However, AODV showed better efficiency to deal with high congestion and it scaled better by successfully delivering packets over heavily trafficked network compared to OLSR and TORA. Comparison of OLSR and TORA has been done by Pankaj Palta and Sonia Goyal in [2]. They have concluded that OLSR is better in those scenario where bandwidth is large as OLSR always updated their nodes so large bandwidth is used than TORA on same conditions.

The performance comparison of various routing protocols over MANET namely-AODV, DSR, TORA, OLSR and GRP by varying the number of nodes with FTP and HTTP applications is done by Gagangeet singh aujla and Sandeep singh kang [3] on the basis of throughput, delay, load and data dropped performance metrics. They concluded that results for ftp give the clear picture about the OLSR protocol's best performance in all scenarios whereas the results for http application give the mixed picture. OLSR has highest throughput, least data dropped. TORA has high delay, load, data drop in all scenarios for ftp. DSR shows least throughput.

IV. SIMULATION

Simulation Parameters

Parameter	Value
Topology	900 x 900
Simulation Time	70 sec
Pause Time	10 ms
No of nodes	10,20,25,30
Packet Size	256 bytes
Traffic Size	CBR(Constant Bit Rate)
Routing Protocol	AODV,DSR,OSLR,TORA,ABR

PERFORMANCE METRICSES

- **Packet Delivery Ratio:** It is the ratio of data packets delivered to the destinations to those

generated by the CBR sources is known as packet delivery ratio.

- **Average End To End Delay:** Average end-to-end delay is delay of data packets. Lower the end to end delay better is the performance of the protocol.

Average End to End Delay= Total end to end delay/number of packets received

- **Average Throughput:** The average number of packets received per amount of time (from the first packet sent to the last packet received).

Average Throughput= Total received packets / simulation time

V. RESULT & DISCUSSION



Figure 2: Packet delivery ratio vs Time Arrival

The above figure shows the Packet Delivery Ratio of five protocols AODV, DSR, TORA, ABR and OSLR. The packet delivery ratio of AODV is greater than all the other protocols. With the high mobility all the protocol behave almost same but at the low mobility AODV performs better. The performance of ABR is least among these all protocols. Therefore the protocol which have highest Packet Delivery Ratio is good because maximum packets are received by destination node.

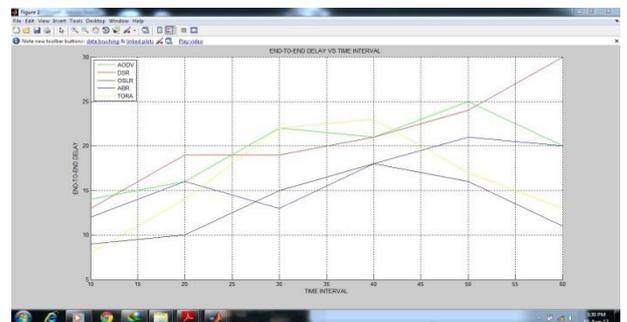


Figure 3: End-to-End delay vs Time Arrival

The above figure compares the average End-To-End packet delay between AODV, DSR, ABR, TORA and OLSR. In this figure, while DSR exhibit highest delay while TORA exhibited the lowest average end-to-end delay. The end-to-end delay of other protocols are between DSR and TORA. TORA has the lowest average end-to-end delay because its routing table does not rediscover the route for the same destination.

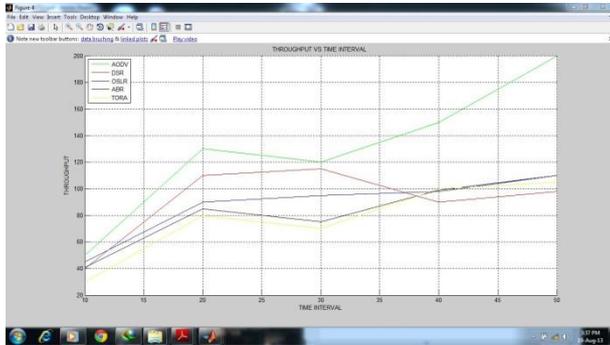


Figure 4: Throughput vs Time Arrival

The above figure shows the total throughput of AODV, DSR, TORA, ABR and OLSR. Total throughput is the amount of packet transferred through the network per unit time. At a higher mobility, DSR exhibit the lowest total throughput, while TORA had the highest throughput at a higher mobility. The average throughput of AODV is higher than DSR, ABR, OLSR, TORA. Higher the throughput, better performance of the routing protocol.

## VI. CONCLUSION

Mobile Ad-Hoc Networks is best for deploying in those place where we don't have any fixed infrastructure environment. With the importance of MANET comparative to its vast potential it has still many challenges left in order to overcome. Comparison of various performance in routing protocols within MANET is one of the important aspects. In this paper performance of five routing protocols was analyzed and their performance were compared i.e End to end delay, Packet delivery Fraction and Throughput. Out of all the protocols AODV is more efficient for Packet Delivery Ratio and Throughput. ABR's performance was consistently good in terms of Throughput. TORA performs best for End-To-End packet delay.

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