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## A Novel Review on Routing Protocols in MANETs

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# A Novel Review on Routing Protocols in MANETs

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**Abstract** - Mobile means moving and ad hoc means temporary without any fixed infrastructure so mobile ad hoc networks are a kind of temporary networks in which nodes are moving without any fixed infrastructure or centralized administration. MANETs are generating lots of interest due to their dynamic topology and decentralized administration. Due to the diverse applications which use MANETs for wireless roaming it is a current research issue. There are different aspects which are taken for research like routing, synchronization, power consumption, bandwidth considerations etc. This paper concentrates on routing techniques which is the most challenging issue due to the dynamic topology of ad hoc networks. There are different strategies proposed for efficient routing which claimed to provide improved performance. There are different routing protocols proposed for MANETs which makes it quite difficult to determine which protocol is suitable for different network conditions as proposed by their Quality of service offerings. This paper provides an overview of different routing protocols proposed in literature and also provides a comparison between them.

**Keywords** - MANETs, routing protocol, reactive, proactive, hybrid, performance, dynamic topology.

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## I. INTRODUCTION

In recent years MANET has gained popularity and lots of research is being done on different aspects of MANET. It is an infrastructure less network having no fixed base stations MANET is characterized by dynamic topology low bandwidth and low power consumption. All the nodes in the network are moving i.e. topology of the network is dynamic so the nodes can act both as host as well as router to route information unnecessary for its use. This kind of infrastructure-less network is very useful in situation in which ordinary wired networks is not feasible like battlefields, natural disasters etc. The nodes which are in the transmission range of each other communicate directly otherwise communication is done through intermediate nodes which are willing to forward packet hence these networks are also called as multi-hop networks

## II. CHARACTERISTICS OF MANETs

**Dynamic topology:** Nodes are free to move arbitrarily in any direction thus the topology of the network change unpredictably.

**Limited Bandwidth:** the bandwidth available for wireless networks is generally low than that of wired networks. The throughput of these networks is generally low due various noises, fading effects.

**Energy constrained operation:** the nodes are portable devices and are dependent on batteries. This is the most important design consideration of the MANET

**Security:** wireless networks are more prone to threats than wired networks. The increased possibility of various security attacks like eavesdropping, denial of service should be handled carefully.

Performance of MANET depends on the routing protocol, battery consumption by the nodes. There are various Quality of service parameters which affect the performance like bandwidth delay, jitter, throughput etc. Due to dynamic topology routing is the major challenge in these networks because the bandwidth provided to the nodes at one point of time becomes unavailable if the nodes move from a particular position and go to other position. Moreover routing affects the performance of these networks. Therefore efficient routing protocol needs to be developed to meet all these challenges. routing protocol in MANET is classified into three categories on the basis of route discovery reactive also called as on demand routing protocol ,proactive also known as table driven protocol and Hybrid protocol. Further classification of routing protocols is done on the basis of network organisation as flat based, hierarchical based and location based. In flat based protocol all the nodes are equal i.e. they play the same role in the network. In hierarchical protocol different nodes play different roles i.e. in this different cluster heads are chosen among cluster members. In location based protocol nodes rely on the location information and use this information for communication.

### III. ROUTING PROTOCOLS

Routing protocols define a set of rules which governs the journey of message packets from source to destination in a network. In MANET, there are different types of routing protocols each of them is applied according to the network circumstances. Figure 1 shows the basic classification of the routing protocols in MANETs.

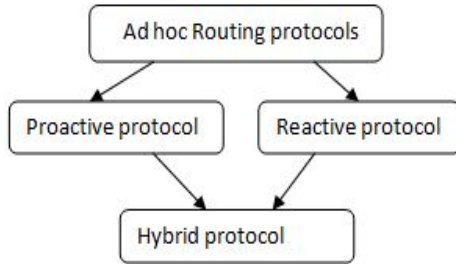


Fig. 1 : Classification of Routing protocols

#### i. Reactive Routing Protocols

Reactive routing protocol is also known as on demand routing protocol. In this protocol route is discovered whenever it is needed. Nodes initiate route discovery on demand basis. Source node sees its route cache for the available route from source to destination. If the route is not available then it initiates route discovery process. The on-demand routing protocols have two major components [1]:

**Route discovery:** In this phase source node initiates route discovery on demand basis. Source nodes consults its route cache for the available route from source to destination otherwise if the route is not present it initiates route discovery. The source node, in the packet, includes the destination address of the node as well as address of the intermediate nodes to the destination.

**Route maintenance:** Due to dynamic topology of the network cases of the route failure between the nodes arises due to link breakage etc, so route maintenance is done. Reactive protocols have acknowledgement mechanism due to which route maintenance is possible.

Reactive protocols add latency to the network due to the route discovery mechanism. Each intermediate node involved in the route discovery process adds latency. These protocols decrease the routing overhead but at the cost of increased latency in the network. Hence these protocols are suitable in the situations where low routing overhead is required.

There are various well known reactive routing protocols present in MANET for example DSR, AODV, TORA and LMR.

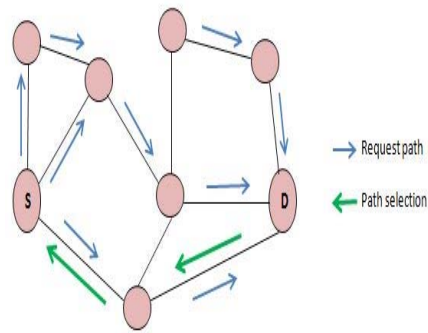


Fig. 2 : DSR protocol

In *Dynamic Source Routing (DSR)*, shown in Figure.2, the protocol is based on the link state algorithm in which source initiates route discovery on demand basis. The sender determines the route from source to destination and it includes the address of intermediate nodes to the route record in the packet. DSR was designed for multi hop networks for small Diameters.

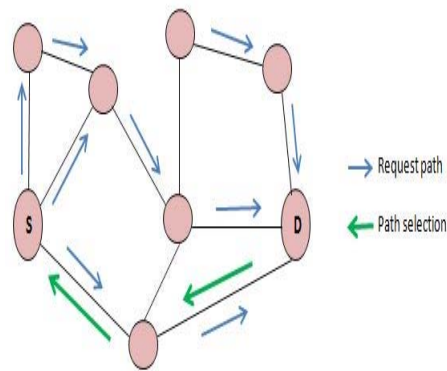


Fig. 3 : AODV protocol

It is a beaconless protocol in which no HELLO messages are exchanged between nodes to notify them of their neighbours in the network. *Ad hoc On Demand distance Vector (AODV)* is also a reactive routing protocol. In this protocol, instead of containing information about the complete network topology sender only includes the address of its neighbour in the packet. In this way overhead in this protocol is comparatively less than DSR. A basic AODV protocol is shown in Figure.3. *Temporally ordered routing algorithm (TORA)*, *Light weight Mobile routing (LMR)* is also reactive protocol based on the link reversal algorithm. It also consists of two phases like DSR route establishment and route maintenance. In route establishment route is discovered by the use of query packets in the network, the route maintenance is done by sending failure query messages to detect route

failures in the network. There are various advantages as well as disadvantages of reactive protocols. As these are based on route discovery on demand bases so these include less overhead of control messages hence saving bandwidth but the price paid for this is increased network latency due to route discovery process.

### ii. Proactive Routing Protocols

Proactive routing protocols are also called as table driven routing protocols. In this every node maintain routing table which contains information about the network topology even without requiring it. This feature although useful for datagram traffic, incurs substantial signalling traffic and power consumption [2]. The routing tables are updated periodically whenever the network topology changes. Proactive protocols are not suitable for large networks as they need to maintain node entries for each and every node in the routing table of every node [3]. These protocols maintain different number of routing tables varying from protocol to protocol.

There are various well known proactive routing protocols. Example: DSDV, OLSR, WRP etc. *Destination sequenced distance vector (DSDV) routing protocol* is table driven protocol based on the Distributed Bellman Ford Algorithm. The improvements made to the Bellman Ford algorithm include the freedom from loops in routing tables [2]. In this each node maintain routing table which contains next hop, number of hops to reach the destination, sequence number. Each node appends its. DSDV has large overhead due to routing tables. *WRP (wireless routing protocol)* is enhanced version of DSDV. Being proactive protocol it maintains routing information in the routing table. There are four types of tables maintained in this protocol namely distance table, routing table, link cost table, message retransmission list.

*Optimised link state routing (OLSR)* is based on the link state algorithm. OLSR protocol performs hop by hop routing i.e. each node uses its most recent information to route a packet [5]. In this, MPR (Multipoint Relay nodes) are selected based on the greedy algorithm. The source node select nodes as MPR which are at one hop away from it and are able to cover the whole network. MPR are used to diffuse control message in the network which helps to reduce overhead. Whole network is covered through these MPR shown in Figure.4. Basic idea behind the MPR in the network is to reduce flooding in the network. The source node communicates with its two-hop neighbours through these MPR. The source node pass the control message to its MPR and the nodes which are not the MPR but are only one-hop neighbours just process the messages without forwarding them.

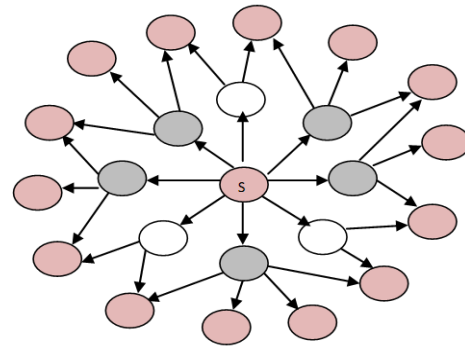


Fig. 4 : MPR structure

The source node S selects MPR from its one hop neighbours. The grey nodes represent MPR and white nodes are one hop neighbours but not the MPR nodes. The other nodes are two hop neighbours. The source node communicates with the two hop neighbours through its MPR.

Proactive protocols also has various advantages and disadvantages, being table driven protocols they increase the control messages in the network due which message overhead in the network increases .But at the same time due to routing information already present latency is reduced in the network. Proactive approaches also suffer from either out of date states or flooding of periodic updates [4].

### iii. Hybrid Routing Protocol

While most of the protocols presented for MANET are either proactive or reactive protocols. There is a trade-off between proactive and reactive protocols. Proactive protocols have large overhead and less latency while reactive protocols have less overhead and more latency. So a Hybrid protocol is presented to overcome the shortcomings of both proactive and reactive routing protocols. Hybrid routing protocol is combination of both proactive and reactive routing protocol. It uses the route discovery mechanism of reactive protocol and the table maintenance mechanism of proactive protocol so as to avoid latency and overhead problems in the network. Hybrid protocol is suitable for large networks where large numbers of nodes are present. In this large network is divided into set of zones where routing inside the zone is performed by using reactive approach and outside the zone routing is done using reactive approach. There are various popular hybrid routing protocols for MANET like ZRP, SHRP,

*ZRP (Zone Routing Protocol)*[6] shown in Figure.5 uses the hybrid approach to routing. It is based on the merits of both proactive and reactive routing protocol. The nodes of a zone are divided into peripheral nodes and

interior nodes [7]. Every node in the network has a zone associated to it. The zone of a node is defined as the collection of nodes whose minimum distance from the node is not greater than the radius of the node. The minimum distance is defined in terms of number of hops from that node. The routing inside the zone i.e. intra-zone is done by using proactive approach. For intra-zone routing a node must know about its neighbours. The neighbours of nodes are defined as the nodes which are one hop away from particular node. The neighbour discovery is done by neighbour discovery protocol (NDP) so as to proactively monitor the network for intra-zone routing. The central node selects its zone by considering set of nodes whose distance

from the central node is not greater than the radius of the zone. These set of nodes are known as peripheral nodes.

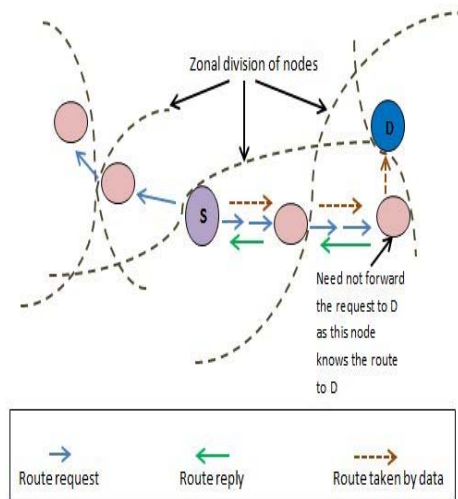


Fig. 5 : ZRP protocol

The intra-zone routing is done by intra-zone routing protocol (IARP). The IARP proactively monitors the network and maintains routes inside the zone. Outside the zone route discovering based on reactive approach is done to maintain routes. The Inter zone routing protocol (IERP) is responsible for maintaining the routes. Route discovery is done through a process called border casting. It is a packet delivery process through which nodes deliver packets to their peripheral nodes. In the route discovery mechanism source nodes initiate the route discovery it first checks whether destination is inside the zone or outside it, if it is inside the zone then the route is already available in the source node otherwise it send the query packet to its peripheral nodes, these nodes then verify whether the destination is inside their zone or not. In this way route discovery is been done.

#### IV. COMPARISON OF PROTOCOLS

The comparison among the different types of routing protocols is shown in Table.1.

Table.1 Parametric Comparison

Parameters	Reactive protocol	Proactive protocol	Hybrid protocol
Routing philosophy	Flat	Flat/Hierarchical	Hierarchical
Routing scheme	On demand	Table driven	Combination of both
Routing overhead	Low	High	Medium
Latency	High due to flooding	Low due to routing tables	Inside zone low outside similar to Reactive protocols
Scalability level	Not suitable for large networks	Low	Designed for large networks
Availability of routing information	Available when required	Always available stored in tables	Combination of both
Periodic updates	Not needed as route available on demand	Yes. Whenever the topology of the network changes	Yes needed inside the zone
Storage capacity	Low generally Depends upon the number of routes	High ,due to the routing tables	Depends on the size of Zone, inside the zone sometimes high as proactive protocol
Mobility support	Route maintenance	Periodical updates	Combination of both

Summary of protocols on the basis of advantages and disadvantages is shown in Table.2.

Table.2 Pros and Cons Comparison

Protocol	Advantages	Disadvantages
Proactive	Information is always available. Latency is reduced in the network	Overhead is high, Routing information is flooded in the whole network

Reactive	Path available when needed overhead is low and free from loops.	Latency is increased in the network
Hybrid	Suitable for large networks and up to date information available	Complexity increases

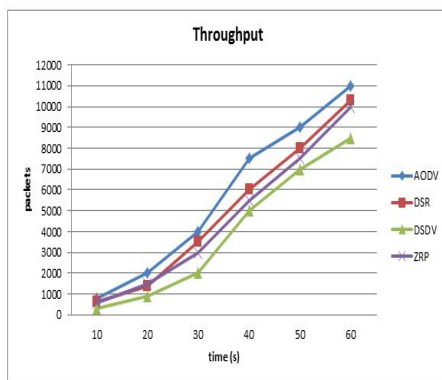
**V. RESULT**

Due to dynamic topology of ad hoc networks routing is one of the challenging issues in these networks. There are various types of routing protocols and these are suitable for different situations. It is seen that due to route discovery mechanism by reactive routing protocols overhead is very low in these protocols in contrast to proactive routing protocol in which overhead increases due to routing information stored in routing tables. But due to route discovery process the latency in the Reactive protocols increases whereas latency is very low in proactive protocols due to the fact that the routing information is already being stored in routing table and is available whenever needed. The Hybrid protocols have combined the advantages of both Reactive and Proactive protocols. The latency is decreased by using proactive protocol inside the zone and overhead is decreased by using reactive protocol outside the zone. Hence a protocol is presented which improves the performance of network by using the advantages of both reactive and proactive protocols.

**A. Performance Metrics**

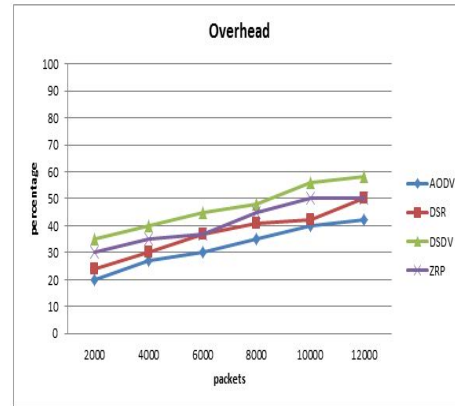
*Throughput:* This is the parameter related to the channel capacity. It is defined as the maximum possible delivery of the messages over the channel. It is usually measured in bits per second. The result is shown in Figure.6.

Fig. 6 : Result 1(Throughput)



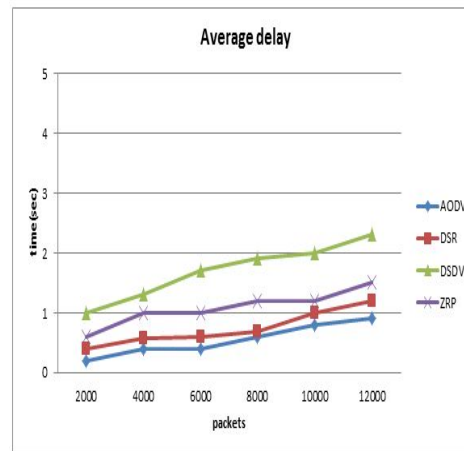
*Routing Overhead:* It is defined in terms of number of control packets need to be sent for the route discovery as well as route maintenance so as to send data packets. The result is shown in Figure.7.

Fig. 7 : Result 2 (overhead)



*Average delay:* it is defined as the time taken by the packet to reach from source to destination. It is measured in seconds. It is also known as end to end delay. The result is shown in Figure.8.

Fig. 8 : Result 3 (Average delay)



*Packet delivery ratio:* It is defined as the ratio of incoming data packets to the received data packets. We can understand that AODV has the better packet delivery ratio from the result of throughput shown in Figure.6.

*Scalability:* It is defined as the performance of routing protocols in presence of large number of nodes. Generally the performances of routing protocols degrade in presence of large number of nodes. We can compare this metric among the routing protocols and can say that AODV is the most scalable of all the

routing protocol, all other metrics regarding this protocol is better than the others.

## VI. CONCLUSION

In this paper an effort has been made on the comparative study of Reactive, Proactive and Hybrid routing protocols. A comparison of three protocols has been presented in the form of table. Various advantages and disadvantages of these protocols are also presented in the form of table. There are various shortcomings in different routing protocols and it is difficult to choose routing protocol for different situations as there is trade-off between various protocols. The field of mobile ad-hoc networks is very vast and there are various challenges that need to be met, so these networks are going to have widespread use in the future.

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