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A Review on Routing Protocol in MANETs

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Abstract*— *A mobile ad hoc network can be defined as infrastructure less, dynamically configured self organized set of nodes, these set of nodes act as routers. Routing protocols are used to transfer the data packets between these mobile nodes. These routing protocols done the work of finding the route and sends the packets and done the maintenance work. Routing between these mobile nodes is very complex and critical task due to highly dynamic nature of the links between these nodes thus they might change topology frequently. Many researchers have been proposed several routing protocol for mobile ad hoc networks. These routing protocols have been categorised into proactive, reactive and hybrid routing protocols. This review paper provides an overview of these routing protocols with their functionality, characteristics and their limitations and tabulates the comparison between these routing protocols to analyse their mechanism of providing routes, their advantages and disadvantages.

Keywords *— **Mobile Ad Hoc Network, Routing protocol, Proactive, Reactive, Hybrid, Comparison.***

I. INTRODUCTION

Wireless ad hoc network have gained a lot of importance in wireless communication .Wireless communication is established by node acting as routers and transferring packet from one to another in ad hoc networks. Routing in these networks is highly complex due to mobility nature of these networks. This paper concentrate mainly on routing protocols and their functionality in ad hoc network with a discussion being made on these routing protocols.. Routing is an act of moving information from a source to destination on a network. During this process at least one intermediate node within the internetwork is encountered. The routing concept basically involves two activities firstly determine optimal routing paths and secondly, transferring groups called packets) through the internetwork. Routing protocol uses several metrics to calculate the best path to route the packet. To its destination these metrics are standard measurement that could be number of hops which is used by routing algorithm to determine the optimal path for the packet to its destination.

II. MOBILE AD HOC NETWORK

Mobile ad hoc network [1] is a collection of wireless mobile host forming a temporary network without the aid of any standalone infrastructure or centralized administration. MANET is an infrastructure less, standalone network and autonomous in nature. These are the problems occur in MANNETs

- Asymmetric links
- Routing overhead
- Dynamic topology
- Interface Problem (major problem)

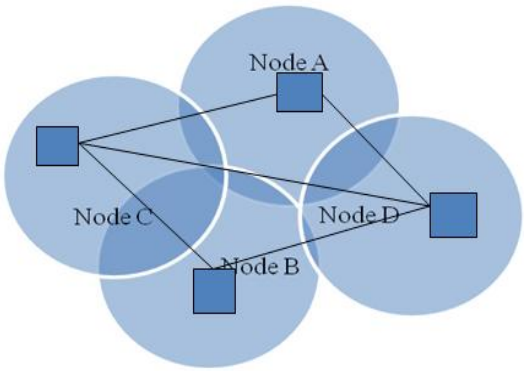

Fig.1 Mobile Ad Hoc Network

Characteristics of Mobile Ad hoc network:

In MANET at given point of time the position of the mobile nodes changed, the sender, receiver coverage patterns and the wireless connectivity in the form of multi hop graphs exists between the nodes. In MANET as the topology change frequently, it is difficult to adjust the transmission of the packets on the network link. There are some characteristics [2] of the MANET which are important to consider because they can cause packet loss during transmission.

- Mobility: In MANET the mobile node change the position very frequently as they are free to move .The connection between the nodes keep on changing which may lead: Route failure and Network partition.
- Wireless Connection: Mobile nodes use wireless channel as a way to send and receive data. However, it is known that wireless channel is not strong, unreliable and unsafe from outside signals. In other words, wireless channel prone the following complexities: Contention: The use of common wireless channel restrictions the ability of a node to send packets. Two types of contention- (i) Interflow contention which refers to the contention practiced by a node due to transmission by in close proximity flow. (ii) Interflow contention which points to the argument within same node due to the frontward data sending's and reverses ACK transmission. Commonly, contention may provide packet loss and delay.

III. MANET ROUTING PROTOCOL

MANET has no structure as its topology change very frequently so we have various different routing protocols to route the packet from one end to another end. Routing protocol mainly classified in three types: Proactive (table-driven) approach, Reactive (On-Demand) Routing Protocol and Hybrid Routing Protocol. Figure 3 is showing the main popular routing protocols in all these three approaches.

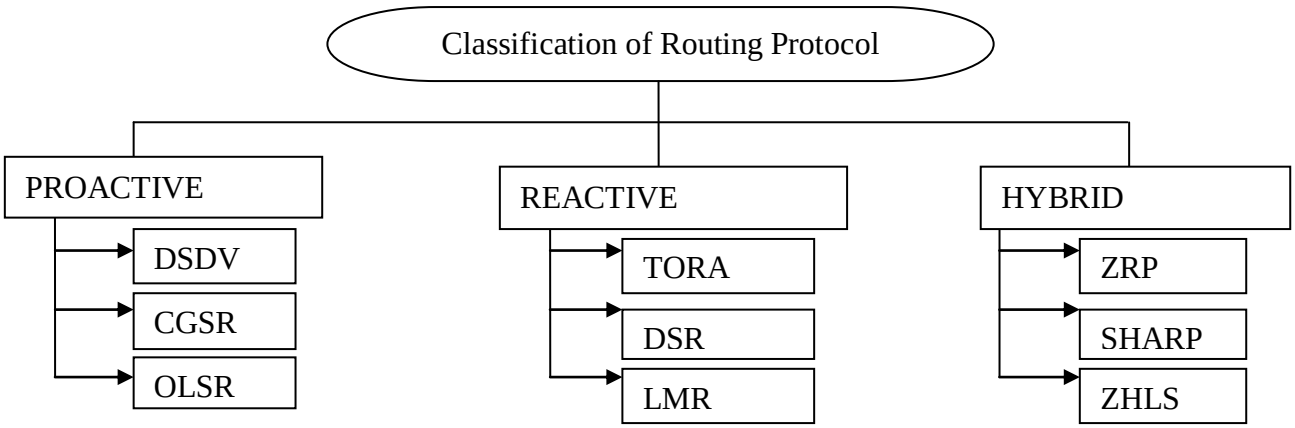

Fig.2 Classification of Routing Protocols

A. Proactive (Table-driven) routing protocol:

This approach maintains two or more routing table in every node in order to store routing information about other node in the MANET. These routing protocol attempts to update the routing table information either periodically or in response to change in the network topology in order to maintain consistent and up-to -date routing information. Proactive approach (table- driven) maintains the routing information even before it is needed. Each and every node in the network maintains the routing information to every other in the network. Not suitable for layer networks, as they need to maintain node entries for every node in the routing table, which causes more overhead in the table leading to consumption of more bandwidth. The following sections discuss some of the existing table-driven Mobile ad hoc routing protocol. These routing uses a different method for routing broadcast and updating routing table and they use different number of tables. The advantage of this approach is that the source node does not need a route discovery procedure to find out a route to destination node. The following sections discuss some of the existing table-driven Mobile ad hoc routing protocol.

***1.1) Destination sequenced distance vector*:** This approach [3] is a table driven algorithm based on the classical Bellman Ford routing [15] mechanism. The improvements made to the Bellman Ford algorithm include freedom from loops in the routing table. Every mobile node in the network maintains a routing table in which all of the possible destination within the network and number of hops to each destination is recorded. Each entry marked as a sequence number assigned by the destination node. The packet may be transmitted containing the layer 2 or layer 3 address the data broadcast by each node will contain its new information for each new route. The destination address ,the number of hops required to reach the destination .the new sequence number, originally stamped by the destination .the routing table also contain the hardware information like the hardware address, network address of the mobile host transmitting them, time between broadcasting the routing information packet is the other important factor to be considered. The broadcast in DSDV is two type namely: full dump and incremental dump. Full dump broadcasting will carry all the routing information while the incremental dump will carry only information that has changed since last full dump. Irrespective of the two type of broadcasting is done in the network protocol data units (NPDU) .Full dump require multiple NPDUs while incremental require only one NPDU to fit in all the information.

1.2) Optimized Link State Routing: This approach is based on the link state algorithm and its nature is proactive. OLSR is an optimization over a pure link state protocols it compact the size of the message and further reduces the number of re-transmission to flood these message in entire network. For this purpose the protocol used multipoint relay in technique to efficiently and economically flood its control messages. It provides optimal route in terms of number of hops, which are immediately available when needed. OLSR is best suitable for large and dense ad hoc network. Apart from periodic control messages, the protocol does not generate extra control traffic in response to link failure and additions. The protocol is designed to completely distribute manner and thus does not depend upon any control entity. OLSR protocol perform hop by hop routing i.e. each node uses it's most recent information to route a packet.

Multi point relays: Each node in the network select a set of nodes in its neighbourhood, which retransmits packets. This set of selected neighbour node is called the multi point relays (MPRs) of that node. The neighbours of any node N which are not in its MPR set, read and process the packet but do not transmit the broadcast packet received from node N.OLSR protocol relies on the selection of multi point relays, and calculates its route to all known destination through these nodes i.e. MPR node are selected as intermediate nodes in the path. The overall behaviour of a protocol specifies its working domain for which it could be suitable OLSR protocol is proactive or table driven in nature, hence it favours the networking context where this all time kept information used more and more, and where route request for new destination are very frequent. The protocol also goes in favour of the application which does not allow long delays in transmitting data packets OLSR .protocol is adapted to the network which is dense and where the communication is assumed to occur frequently between a large numbers of nodes.

1.3) Cluster gateway Switch Routing: This approach is totally different from previous two protocols in the type of addressing and network organization scheme employed. It's a cluster multi hop mobile wireless with several heuristic routing schemes. A selection algorithm is utilized to elect a node as the cluster head using a distributed algorithm. There are some disadvantage of selecting this cluster head scheme is that frequent cluster head changes can affect the performance of the routing protocol because node were busy in selecting cluster head instead of delivering data packets. It uses DSDV as the underlying routing scheme hence it also has the same overhead as DSDV.

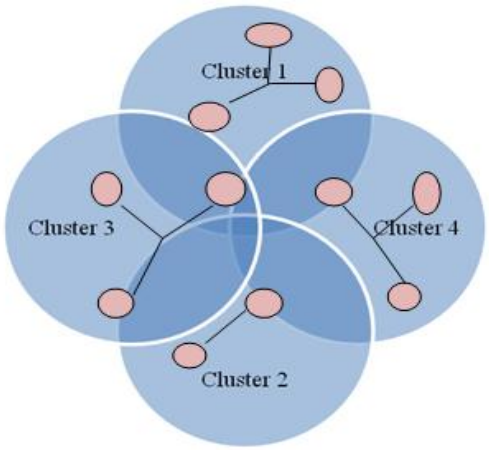

Fig.3 CSGR Routing Protocol

In this approach every node has cluster member table where its store the destination cluster head for each mobile node in the network. Every node also maintain a routing table which is storing the information of next hop in order to reach the destination whenever a node receive a packet the node check its cluster member table to determine the nearest cluster head and the route to the destination .Then the node will check its routing table to determine the next hop used to reach the selected cluster head and node will transmit the receiver packet to that node.

Table 1: Characteristics of Table –Driven Routing Protocols [4].

Parameters	***DSDV***	***CGSR***	***WRP***
Time Complexity	O(d)	O(d)	O(d)
Communication Complexity	O(x=N)	O(x=N)	O(x=N)
Routing Approach	Flat	Hierarchical	Flat
Loop free	Yes	Yes	Yes but not instantaneous
Multicast Capability	No	No	No
No. of req. table	2	2	4
Freq. of update transmission	Periodic as needed	Periodic	Periodic as needed
Critical nodes	Yes	Yes	Yes
Routing metric	Shortest path	Shortest path	Shortest path

N= Number of nodes in the network, d= Network in diameter, h= Height of routing, x = Number of nodes affected by a topological change

B. Reactive (On-Demand) Routing Protocol:

Reactive routing protocol is also known as on demand routing protocol. In this protocol route discovery is done whenever it is needed. Nodes initiate route discovery on demand basis. Whenever a node want to send a packet source node sees its route table 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 [5] ***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 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 suffer by 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 [6].

1.1) Ad Hoc On Demand Distance Vector Routing: AODV[7] approach is an on demand routing protocol it provides uni cast and multicast connectivity in MANET .AODV uses sequences numbers as we used in routing in DSDV which helps in loop prevention. It is one of the very popular proactive routing protocol and an improved version of DSR (Dynamic Source Routing) as DSR used distance vector routing in which we gain every single bit of information by maintaining the short term routing table. AODV route the packet between source nodes to destination node using these three mechanisms: Route Requests (RREQs), Route Replies (RREPs) and Route Errors (RERRs). AODV used ring search mechanism based upon incrementing (TTL) to avoid unnecessary RREQ messages flooding .For the detection and removal process of outdated route nodes AODV use the sequence number of node. Some important parameter as round trip time, transmission and throughput, dropped packets, delay are the some important metrics for QOS consideration and performance evaluation.

***1.2) Dynamic Source Routing*:** The dynamic source routing protocol is a reactive (on-demand) routing protocol which is presented in [8].DSR routes the in two parts: Route discovery and route maintenance. In the route Discovery phase where we establish the route between sources to destination by flooding the Route Request packet in the network. Then destination node sends Route Reply packet to the source node. In this process all the neighbour node of the source node broadcast the Route Request message. When destination nodes receive this packet it sends Route Reply packet to source node. Each routing node has unique sequence number which helps the packet to prevent from loops. The RREQ packet is broadcast whenever a node wants to send any packet thus it reduce the overhead on the network. The disadvantage of DSR is that it does not have any route maintenance mechanism to repair the broken links by itself, and due to the connection establishment phase the latency is become higher than in table driven protocols and performance degrades if mobility in network is high.

1.3) Temporally Ordered Routing Algorithm (TORA): TORA [8] is a reactive routing protocol with some proactive enhancements where a link between nodes is established creating a Directed Acyclic Graph (DAG) of the route from the source node to the destination.TORA maintain the DAG for routing packet to destination. This protocol uses link traversal model for route discovery. TORA define a parameter height in the DAG with condition that no two nodes have same height. The parameter height can be defined as distance between the respond nodes to the requesting node. In the mechanism of route discovery this requesting node works as querying node. In the response acknowledged by query node all the intermediate node updates its table with height to the destination node and with other information. Source node uses this table to select the best way to route the packet. Thus TORA frequently update the shortest route by the parameter height which results in minimized overhead. TORA flows from higher node to lower node to complete the packet routing .TORA works in three phases: Route Creation phase it start whenever a source node requires a link to send the packet to desired destination the source node, sends a QRY packet containing the destination id. The answer to this query packet destination sends an update message which contains all the desired information. Second phase is Route Maintenance which works when link breakage happen, and in third phase of Route Erasure whenever a node detects partition it sets NULL in the field of height and clear its neighbour height too. For all these attempts, TORA tries to minimize the routing management traffic overhead [9].

Table 2: Characteristics of On –Demand Ad hoc Routing Protocols [10]

Parameter	***AODV***	***DSR***	***TORA***
Time Complexity (initialization)	O(2d)	O(2d)	O(2d)
Time Complexity (post failure)	O(2d)	O(2d) or 0	O(2d)
Communication Complexity(initialization)	O(2N)	O(2N)	O(2N)
Communication Complexity(post failure)	O(2N)	O(2N)	O(2x)
Routing approach	Flat	Flat	Flat
Loop free	Yes	Yes	Yes
Multicast Capability	Yes	No	No
Route maintain in	Route table	Route table	Route table
Routing Metric	Fastest & Shortest path	Shortest path	Shortest path

C) Hybrid Routing Protocol:

Hybrid Routing Protocol combines the advantages of both proactive and reactive routing protocol. Proactive routing protocol stored large number of information in the form of table which causes the large overhead but provides less latency while reactive routing protocol has less overhead but more latency. Thus the hybrid routing protocol combines the both proactive and reactive. It uses reactive for route discovery mechanism and proactive for maintaining the table to reduce the problem of latency and overhead. Hybrid routing protocol is suitable for large network area where number of nodes are very large. There are various popular hybrids routing protocol in MANET for example ZRP, ZHLS and SHARP.

1.1) Zone Routing Protocol (ZRP): Zone Routing protocol[11] is one of the hybrid routing protocol that used in mobile ad hoc network.ZRP uses both proactive and reactive routing protocol for routing packets between source to destination. The work process of ZRP is whenever a mobile node wants to send a packet to another mobile node, protocol checks whether the packet destination node is in same zone or outside the zone. If the destination is in the same zone ,proactive routing protocol use an already stored routing table to route the packet otherwise reactive protocol take the responsibility and check each successive route in the zone and then reactive routing protocol will be used to deliver the packet to the destination.ZRP reduces the processing overhead as it uses proactive routing protocol which stored the route listing table which is to deliver the packet when needed.ZRP works very well for large network area. IARP (Intra-Zone Routing Protocol) routing algorithm which is described in detail in [12] works for ZRP.IARP is a proactive routing protocol which works inside the zone. IERP (Inter-Zone Routing Protocol) works between routing zones which uses reactive routing protocol.

Table.3 Comparison of routing protocols

Protocol	***RS***	***Multiple Routes***	***Routes Metric Method***	***Route Maintenance***	***Advantages***	***Disadvantages***
DSDV	F	No	Shortest path	HM	Loop free	High overhead
WRP	F	No	Shortest path	HM	Loop free	Memory overhead
AODV	F	No	Freshest &SP	RT	Adaptable to highly dynamic topologies	Scalability problems, large delays
DSR	F	No	SP or next available in RC	RC	Promiscuous overhearing	Scalability problems due to source routing
LMR	F	Yes	SP or next available	RT	Multiple routes	Temporary routing loops
TORA	F	Yes	SP or next available	RT	Multiple routes	Temporary routing loops
ABR	F	No	Strongest associability	RT	Route stability	Scalability problems
SSA	F	No	Strongest signal	RT	Route stability	Scalability problems, large delays
ZRP	F	Yes	SP	Intra zone & Inter zone	Reduce retransmission	Overlapping zones
ZHLS	H	Yes ,if more than one virtual link	SP or next available virtual link	Intra zone & Inter zone	Reduction of SP	Static zone map required

RS= routing structure, F=flat, H=hierarchical, RT= route table, SP= shortest path, RC=route cache.

IV. CONCLUSION

In this paper we have describe some of the routing protocol for MANET.MANET architecture is not centralized and does not have any fixed structure so for packet routing a single approach will not work properly. This is the reason why we have so many routing protocols with different- different approaches and characteristics. Here we broadly classified the routing protocols as proactive (table- driven) routing protocol, reactive (on- demand) routing protocol and hybrid routing protocol. Here we highlighted the main approaches how the protocols works, what are their features and characteristics, where we used these routing protocol and comparison between the characteristics, complexity difference, advantage and disadvantages well. For example DSR, AODV and OLSR are preferable for small network. This paper will help the new researchers to identify the best suitable routing protocol which can be used in their domain of network.

REFERENCES

[1] Heena Gupta, Deepak Goyal, "*A Review on congestion control in Ad hoc Network*", International Journal of Computer Science and Mobile Computing, Vol.3 Issue.7, July- 2014.

[2] Prakash B. Khelage Dr. Uttam Kolekar, *"Survey and Simulation based Performance Analysis of TCP-Variants in terms of Throughput, Delay and drop Packets over MANETs*", International Journal of Scientific & Engineering Research, Volume 5, Issue 1, January-2014.

[3] Perkins CE, Bhagwat P,"*Highly Dynamic Destination-Sequenced Distance-Vector Routing (DSDV) for Mobile Computers"*. Proceedings of ACM SIGCOMM 1994:234–244 ,1994

[4] Elizabeth M. Royer," *A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks*" University of California, Santa Barbara Chai-Keong Toh, Georgia Institute of Technology, IEEE Personal Communications, pp. 46-55, April 1999

[5] Tarek Sheltami and Hussein Mouftah, "*Comparative study of on demand and Cluster Based Routing protocols in MANETs*", IEEE conference, pp. 291-295, 2003.

[6] C K Toh, "*Ad Hoc Mobile Wireless Networks"*, Prentice Hall Publishers, 2002

[7] Perkins CE, Royer EM, Chakeres I ,"*Ad hoc On-Demand Distance Vector (AODV) Routing*". IETF Draft October, 2003.

[8] Park VD, Corson MS, "*A highly adaptive distributed routing algorithm for mobile wireless networks".* Proceedings of IEEE INFOCOM, Volume 3:1405–1413, 1997.

[9] G.Vijaya Kumar , Y.Vasudeva Reddyr , Dr.M.Nagendra , "*Current Research Work on Routing Protocols for MANET: A Literature Survey"*, International Journal on Computer Science and Engineering Vol. 02, No. 03, 2010, 706-713

[10] Elizabeth M. Royer,"*A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks*" University of California, Santa Barbara Chai-Keong Toh, Georgia Institute of Technology, IEEE Personal Communications, pp. 46-55, April 1999.

[11] Pearlman MR, Samar P, "*The Zone Routing Protocol (ZRP) for Ad Hoc Networks"*. IETF draft, July 2002, available at http://tools.ietf.org/id/draft-ietf-manetzone-zrp-04.txt. Accessed [22] February 2008, S.K. Pathan and C.S. Hong Haas ZJ, Pearlman MR, Samar P, *"Intra zone Routing Protocol (IARP*)". IETF Internet Draft, July 2002.

