A Topology Based Routing Protocols Comparative Analysis for MANETs

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Abstract— *MANET is a dynamic topology wireless network in which each mobile works as a sender and receiver wireless router. MANET have very low deployment cost, a low cost option to extend network coverage and ease of maintenance due to their self healing properties. MANETs are powered by batteries that have very limited capacity and it is a very important issue. The primary goal of MANET routing protocols is to find out an efficient route between any two mobile nodes with minimum time and less resource consumption. The MANET routing protocol designing is a very challenging due to various challenges such as the nodes have short battery life, small bandwidth, number of paths between source and destination, variable population of nodes and lose links. The central focus of this paper is to comparative study of different kinds of routing protocols and comparing on the basis of some common properties. Therefore, it is quite difficult to determine which protocols may perform best under a number of different network scenarios, such as increasing node density and traffic mobility. In this paper, we try to provide an overview of a topology based routing protocols proposed in the literature.*

Keywords— Mobile Ad Hoc Network MANET, Vehicular Ad Hoc Network VANET.

I. INTRODUCTION

In the past few years, most of the devices are smart and based on the wireless communication system working online applications[1].Mobile Ad hoc networks (MANETs) are the collection of different kind of wireless devices these devices are known as node. In MANET each node can freely move within the network area and outside of the network area that's why MANET topology is very dynamic in nature. MANET is popular because it is no need of any base station and not required any fixed infrastructure. MANET topologies are self motivated, self maintaining, self healing and self organized resources. The ability of this type of communication networks are to work anywhere and anytime easily[2]. These features make MANETs one of the most favorite areas of research scholars. The routing between sender and receiver packets is in MANTEs facing many challenges. Too many research works have been done to improve the routing protocol efficiency. The mobility of nodes are the nature of MANETs and topology is frequently changed. MANETs having variable path length, short duration establish link, limited power of battery etc. so, the traditional routing protocols are not feasible with MANET and these are combined with new technology to improve the routing protocols efficiency[3]. For, MANET large number of different kind of algorithms and routing protocols have been developed for efficient solving of routing issues[4]. The high dynamic network with high speed and mobility makes the routing more difficult in VANETs and variation from MANETs [5]. Some of the main challenges MANETs facing to develop a strong routing protocol these are followings:

1. Dynamic nature of Networking Topology
2. Open network architecture
3. Frequently routing link breakages
4. Shared medium
5. High speed of mobile nodes
6. Limited Energy source
7. Identifying misbehaving node routing

Mobile ad hoc network has the lot of potential to establish a communication network in emergency situations like search and rescue operations, military and police operations etc[6] Figure 1 show the Mobile ad hoc network architecture.

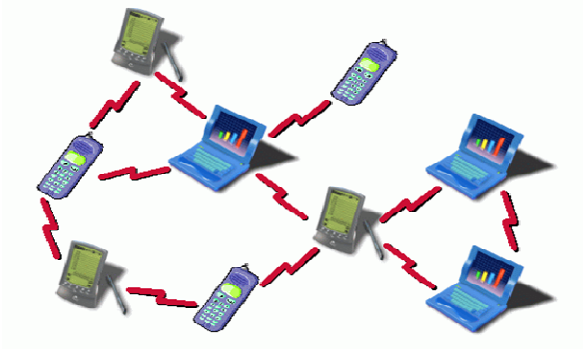


Fig.1: Mobile Ad Hoc Network Scenario

The rest of the paper organization is as following. Section II types of topology based routing protocols, Section III study of the routing protocols,

Section IV comparative study of routing protocols, Section V conclusion of comparative study of MANETs routing protocols.

II. ROUTING PROTOCOLS

To establishing the network communication route between the sender and receiver routing protocols are responsible. The routing protocols are also responsible to maintaining the communication link until the communication not completed. The network communication link must be optimum. The optimality may be in terms of no of nodes or the distance between source and destination. The routing protocol is completely responsible for the optimum route selection and establishing the path between two nodes. The optimum in term of distance means the path to the destination is shortest and optimum in term of nodes means the minimum numbers of hops are occurred foe a message to reach at destination node[6]. The main aim of the routing protocol is provide optimal paths between two sender and receiver networks nodes with minimum overhead. Many routing protocols already developed for MANETs wireless environment and these can be classified in different ways in different aspects as like protocols techniques used, its characteristics, routing information, quality of services, network topology structure, routing algorithm used, transmission type etc. some research papers classified MANETs routing protocols into three classes on the basis of protocol characteristic and techniques as well other paper classified MANETs routing protocol five classes on the basis of topology moreover others are classified into two classes on the basis of routing strategies and other are basis on the transmission strategies classification. However all previous classifications are right concern to all routing protocols.

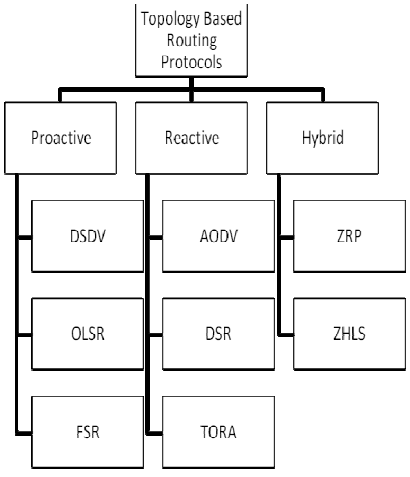


Fig.1: Topology Based Routing Protocol in MANET

Here i would represent routing protocols comparative study of the MANET environment are classified into topology based these are depicted in figure 2 [7].

In the above figure classification of MANETs routing protocols, MANET routing technology to ensure communication routes are updated quickly and accurately. MANET is a self healing network and its routers are connected by wireless links. It is a form of a random topology and nodes are free to move from one location to another, they organize themselves at random that's why MANET topology may change rapidly and unpredictably. In mobile ad hoc networking, a mobile node has two responsibilities as a host and a router. Therefore each and every node is co-operative and coordinating to each others. MANET not having any background network controls operations. It is formed in two layouts single hop and multi hop, MANET network formation is a nonstop making formation[1].

III. REVIEW OF ROUTING PROTOCOLS

A) Topology Based Routing Protocols

Topology based MANETs routing protocols are divided into three classes: Proactive (periodic), Reactive (On-demand) and Hybrid. This kind of protocols are usually called traditional MANET routing protocols, it stored the link's information in the routing table on the basis of packet forward from source to destination node.

1. Proactive Routing Protocols

In this type of routing protocol, each node in a network maintains use the routing table to store the routes information for all other nodes, each table entry contains the next hop node regardless of whether the route is actually needed or not. The table must be updated regularly to reflect the changes of the network topology and for this each node should be broadcast message regularly to the entire network. However, it incurs additional overhead cost due to maintaining up-to-date information and as a result; throughput of the network may be affected but it provides the actual information to the availability of the network. The proactive routing protocols depends on shortest path algorithm to find out which path will be optimum, they use two kind of strategies for chosen the best route: First one is Link state strategy and second one distance vector strategy.

1.1 DSDV

DSDV is an oldest MANET routing protocol. DSDV stands for destination sequence distance vector routing protocol. It is base on distance vector strategy and applies the shortest path algorithm to implement. In this only one route stored in the routing table for destination and each routing table having the information to all approachable networks nodes with the total number of hops occurred to reach the nodes. In the routing table each entry having

the label with sequence number, destination node. DSDV maintain the route reliability by periodically broadcasting the message to its neighbor. DSDV protocol does not having loop in the path and always keeps the optimal path for each node so that it always helps to reduce the size of routing table. When increasing the nodes in the MANET network the overhead increased to maintaining the routing table due to unwanted broadcasting even if there is no change in the existing topology. The main limitations of DSDV routing protocol is that it is not provide the network congestion control, multiple paths for destination due to these limitations decreases the DSDV routing protocol efficiency. These limitations are resolved by the R-DSDV randomized DSDV protocol that support network congestion control but it having more overhead rather than the DSDV protocol[7].

1.2 OLSR

Optimized link state routing protocol (OLSR) is based on the routing link state strategy. In this, routing table has the information of all possible paths to the network nodes. Once the network topology is changed than each node sending the updated information to the some nodes and these nodes send to its selective nodes and so on. The nodes those not in selected list only read and process the packet. Researchers thought that OLSR is efficiently work with dynamic topology also it is very suitable for warning applications. However, OLSR generating traffic to handle topology changes due to this may cause network congestion. Some researchers proposed the Hierarchical Optimized Link State Routing HOLSR, in which they decreased routing control overhead and maximized the performance of protocol.

1.3 FSR

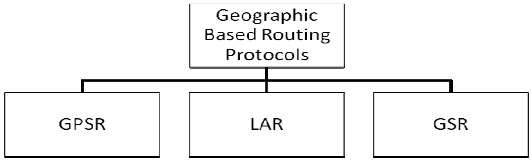
The fisheye state routing (FSR) protocol is updating nodes routing table periodically on the basis of received information from their neighbor nodes. The routing table entries are updating through broadcasting different frequencies for neighbor nodes. If the nodes are further in the distance broadcast with lower frequency than the nearer. The FSR could be more accurate when the packet comes closer to the destination. The FSR has problem that if the network size is growing the routing table will also increased. If the topology change occurred then the route become inaccurate for destination node.

The main advantages of proactive routing protocols are that no needs to route discovery process because the route to the destination nodes kept in the background and its update periodically. These protocols are more suitable for low mobility and low density networks.

Recently studies of researchers show that the proactive routing protocols are efficiently work rather than reactive routing protocols in terms of network throughput.

2. Reactive Routing Protocols

Reactive routing protocols are reduced the network overhead. Reactive protocols maintaining the route only when the required. In it's the source node start a route discovery process when needed and not existing path to



destination node. The network path searching process flooding the route request message and when it reached to destination node, it is replying the received message to the source node through unicast communication. These kind of routing protocols are more suitable for dense mobile ad hoc network, high mobility and frequently change topology. The following section illustrates the characteristics of some listed reactive routing protocols.

2.1 AODV

In mobile ad hoc network routing protocol AODV is a reactive protocol. AODV stands for ad hoc on-demand distance vector routing protocol. Several researchers are evaluated this protocol to test this efficiency. The AODV protocol having low network overhead and it reduced network message flooding. It is more suitable for more flexible dynamic network topology because it keeps only recent active route entries. However, it causes delay for route searching, if failure occurs than required again discovery new route. The ad hoc on demand distance vector routing protocol has drawback, if network size grow than increase network overhead, collisions lead to packet lost problem and if it is not control AODV consume extra band width. Many researchers have been proposed several enhanced protocols to reducing AODV problems like AOMDV

2.2 DSR

Dynamic source routing (DSR) protocol main objective is providing a very low network overhead and a highly dynamic reactive routing protocol. The DSR provides successful data packet delivery despite of network changes. Dynamic source routing protocol has two steps for route one is discovery and second is maintenance. It is a multi hop routing protocol[7]. In the DSR protocol each data packet have all middle node list if any one node delete from the path its replace by another neighbor node to reach the destination node. The DSR protocol having some benefits over other MANET routing protocols this is identifies by many researchers using different simulation tools.

2.3 TORA

TORA stands for temporally ordered routing algorithm. TORA is a multi hop routing protocol that also reduced the network communication overhead irrespective of frequent network topology changes. It has multi path loop free routing that indicate the source could communicate to destination node using the graph of nodes those are loop free. TORA broadcast a packet to the destination node through its neighbor, if it is in route than it again broadcast to downward neighbor link. If it is not in route than it just drop the packet. TORA follow the top down approach, forward packet downwards not to upward back. TORA have advantages that are it has multiple paths to every node and reduced the control message broadcast.

3. HYBRID ROUTING PROTOCOLS

Hybrid routing protocol as name suggested that it is developed on the basis of reactive and proactive routing concept. The aim of the hybrid routing protocol is to reduce the limitation of proactive protocol, routing network control overhead and reactive protocol, delay in the route discovery process. In this, the whole network nodes divide into zones according to many criteria. It's provided easier handling to maintenance, more reliability for route discovery. In this each node labeled as region inside node or outside nodes.

3.1 ZRP

According to name zone routing protocol (ZRP) it divide the whole network into zones on the basis of some criteria as like transmission power required, transmission signal strength, mobility of nodes, etc. ZPR is the first hybrid category routing protocol that based on the proactive and reactive routing approaches. ZPR using the proactive routing approach for inside region nodes of zone and reactive routing approach for outside region nodes of zone. ZPR is fully independent to use any reactive and proactive existing routing protocols. The main problem in ZPR is that it is similar to reactive routing protocol if zone size is large. It is suitable for small size zones.

3.2 ZHLS

The zone based hierarchical link state (ZHLS) routing protocol divides the network into non overlapping zones. Each node in the network has its own ID and a zone ID. In ZHLS protocol not have cluster manager or position administrator for communication. ZHLS message flooding scheme is pure reactive that reduce the network overhead. ZHLS used the zone ID and node ID to discover the destination node routing.

IV. COMPARATIVE ANALYSIS

An analysis on the basis of review the above specified MANETs routing protocols. The analysis is on the basis of the different parameters. In this section try to provide detail analysis of the MANET routing protocols.

The Comparison between proactive routing protocols is OLSR, DSDV and FSR as following table.

Table 1 Comparative Analysis of proactive protocols

Routing Protocol Class	OLSR	DSDV	FSR
Topology Structure	Flat/Hierarchical	Flat/Hierarchical	Flat/Hierarchical
Multicast	No	Yes	No
Frequency of Table Updates	Periodic	As needed	Periodic
Approach	Shortest Link Path	Distance vector	Frequency based
Storage Requirements	High	High	High
Mobility Support	Supported	Supported	Supported
Network Congestion Control	Yes	No	Yes
Drawback	Throughput	Throughput	Throughput
Advantage	Efficient	Efficient	Efficient
Extension of existing protocol	Yes	Yes	Yes
Suitable for large network	No	No	No
No of Tables	5	2	4
Strength	Reduce control overhead	Loop free	Faster route coverage

The Comparison between reactive routing protocols is AODV, DSR and TORA as following table.

Table 2 Comparative Analysis of reactive protocols

Routing Protocol Class	AODV	DSR	TORA
Topology Structure	Mostly Flat	Mostly Flat	Mostly Flat
Multipath	No	No	Yes
Frequency of Updates	Not needed	Not needed	Not needed
Approach	Shortest path	Shortest path	Shortest and strong

			path
Storage Requirements	Low	Low	Low
Mobility Support	Yes	Yes	Yes
Network Congestion Control	Required high bandwidth	Required high bandwidth	Required high bandwidth
Drawback	Large Delay	Overhead	Temporary Routing
Advantage	Low overhead	Route stability	Multiple routes
Extension of existing protocol	Yes	Yes	Yes
Suitable for large network	Overhead increased	Overhead increased	Overhead increased
Strength	Highly adaptive	Rapidly build route	Longer lived route

The Comparison between hybrid routing protocols is ZRP and ZHLS as following table.

Table 3 Comparative Analysis of hybrid protocols

Routing Protocol Class	ZRP	ZHLS
Topology Structure	Cluster/ Hierarchical	Cluster/ Hierarchical
Multipath	Yes	Yes
Frequency of Updates	Periodic	Periodic
Approach	Hybrid	Hybrid ID based
Storage Requirements	Medium	Medium
Mobility Support	Yes	Yes
Network Congestion Control	Yes	Yes
Drawback	Not support large size	Not support dynamic topology
Advantage	Independent protocol in zone	No traffic congestion
Extension of existing protocol	Yes	Yes
Suitable for large network	No	No
Strength	Lower Overhead	Lower Overhead

V. CONCLUSION

This Paper provides the comparative study of topology based routing protocols for mobile ad hoc networks. MANETs routing protocols are classified in many ways but I choose only topology based because the most wildly used only these protocols and most of researches are study on topology based protocols. These are mostly used to establish the connection between multiple network hops. Each of the MANETs routing protocols have some unique features. These features are used to comparative study. The main features to distinguish these routing protocols as their strength, drawback, advantages and their approach. In this paper each of the class proactive, reactive and hybrid routing protocols deeply analysis and find the conclusion that we used routing protocols as per their circumstances so it is very difficult to say that only one protocol can handle all types of circumstances. The future work required to develop that only one light weighted protocols for all kind of circumstances.

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