Comparative Study of Reactive Routing Protocols for MANETs

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----------ABSTRACT----------

MANET – Mobile Ad- hoc Network is a dynamic network which works with the characteristic of wireless Communication Network. It does not have a centralized server or an arbitrator. It is a system that works individually connecting with wireless links using mobile routers. Due to the infrastructure less network every mobile node moves freely with the arbitrary direction with no guaranteed path. Routing in MANET is a challenge due to the mobility of Nodes and lack of server. Therefore a routing protocol is necessary to have an efficient communication between nodes in different network situations which are heavily loaded at some point. A comparative study is made as to how the reactive protocols (on-demand) which have the potentiality to deliver the packets in a large ad hoc network perform best in these varied situations.

KEYWORDS: Mobile Ad hoc Network (MANET), Routing protocols, AODV, DSR, TORA, LMR

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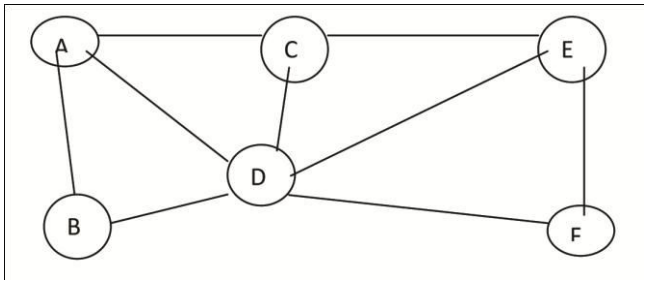
1. INTRODUCTION

The mobile ad hoc networks (MANET) are group of mobile nodes that form a network independently and are connected through wireless links. A number of routing protocols are developed to help in the maintenance of route mechanism for the mobile nodes so that they can communicate with other nodes in MANET. The main aim of the protocols is to find the best feasible and reliable path. Each node behaves like a router.

MANET



Some of the features of MANET are:-

a. MANET can be formed without any existence of infrastructure.
b. It is dynamic topology
c. Every node helps in routing packets.
d. Less power and physical security.

Attacks on MANET:-

There are two types of attacks namely passive and active. The common are Passive attacks which are eavesdropping and disclosure of information. Active attacks are those which deny the service, modification of data by viruses, Trojans and worms. The other security issues include attacks that create erroneous routing information and diverting network traffic thus making routing inefficient. There are many ways to prevent these attacks by using the conventional authentication and encryption technique and also an intrusion detection system.

Due to mobility and openness, mobile ad hoc networks are prone to security threats.

2. ROUTING PROTOCOLS

This has been the constant attention of researcher that helped them to develop many routing protocols which may be classified into three types (fig1) pro-active, reactive and hybrid (combination of pro-active and reactive).

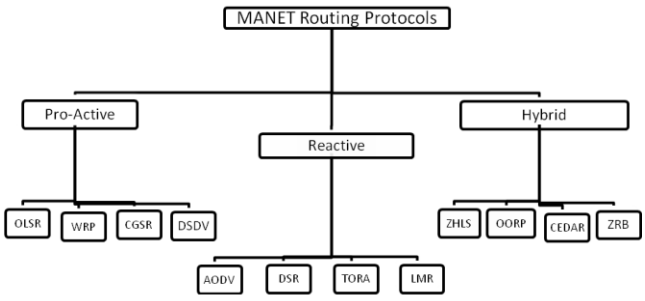


Figure 1 MANET routing protocols

If a node is classified to be slow then the pro-active protocol will be used else the reactive protocol is applied. Routing protocols for MANET has been evaluated based on their performance metrics, throughput and delivery ratio.

2.1 PRO-ACTIVE ROUTING PROTOCOLS (TABLE FORM)

Every node continuously acquires the routing information which is stored in the routing tables. These tables differ according to the information propagated through all the nodes in the network. Flooding mechanism is used often to

discover and update routes. The table is updated by two kinds namely, periodic update and triggered update. They generate more traffic because of the constant updating routing tables and the increase in nodes.

The routing protocol like Link State Routing (LSR) protocol (open shortest path first) and the Distance Vector Routing Protocol (Bellman-Ford algorithm) are not suitable to be used in mobile environment.

Destination Sequenced Distance Vector routing protocol (DSDV) and Wireless routing protocols were proposed to eliminate counting to infinity and looping problems of the distributed Bellman-Ford Algorithm.

2.2 REACTIVE ROUTING PROTOCOLS (ON-DEMAND)

They discover and maintain the route table by the latest topology as and when needed. Route search is needed for every new destination therefore the communication overhead is reduced at the expense of delay to search the route. They are classified as source routing (data packet headers, carry the path) and hop by hop routing (intermediate nodes increases which causes route failure). Flooding strategy is used to discover the route to its destination. This discovery packet is called the Route Request (RREQ) packet and the mechanism is called Route Discovery. The destination replies with a Route Reply (RREP) packet.

The protocols are:

- Ad hoc On-demand Distance Vector Routing (AODV).
- Dynamic Source Routing (DSR).
- Location Aided Routing (LAR).
- Temporally Ordered Routing Algorithm (TORA)

2.3 HYBRID ROUTING PROTOCOLS

This has both the proactive and reactive features. It is used when there is increase of nodes. This minimizes the delay and over head caused by pro-active and reactive. They are best known for their scalability of using few nodes in the routing and topology discovery. Zone Routing Protocol (ZRP), Zone-based hierarchical link state protocol (ZHLS) is an example of the hybrid routing protocols. The main concept of hybrid is reactive can be used in global network and pr-active may be used at the Node's local point.

3. REACTIVE ROUTING PROTOCOLS(ON-DEMAND)

This has a great potential to give good information about the delivery in large ad hoc network. The best part is these protocols are used in route discover only when the route is determined and initiates a route discovery. They are the most known routing algorithm for mobile computation for its low bandwidth. They are well designed to remove the overload on pro-active protocols. On-demand protocols have the potentials to reach the high levels of scalability in ad hoc networks. To achieve the scalability the route discovery is made at the actual time needed, thus reducing the routing overhead. The on demand protocols takes place in two steps:

a. Route discovery
b. Route maintenance

When a node needs to send a data but the existing route is not available then the route discovery is initiated were the RREQ is sent from the source node through the network till it reaches the destination till the active route is found and a reply(RREP) is sent back using blind flooding.

3.1 AODV (AD HOC ON-DEMAND VECTOR)

ADOV builds request through route request and route request Query. The different types of control messages for route maintenance in ADOV are as follows:

3.1.1 RREQ

Route request message is transmitted by a node which initiates a route to a node. This protocol uses the ring technique when flooding the messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions.

3.1.2 RREP

A route reply message is sent back to the source from where the RREQ is sent, if the receiver is the node using the requested address, or it is the correct route to the requested address. The reason one can send the message back, is that every route forwarding a RREQ caches a route back to the originator D.

3.1.3 RERR

The link status of next hops in active routes is monitored by the node. When there is a link break in an active route, a RERR message is sent to notify other nodes of the loss. In order to enable this reporting mechanically, each node keeps a ``previous list'', containing the IP address of each of its neighbors that are likely to use it for its next hop towards each destination.

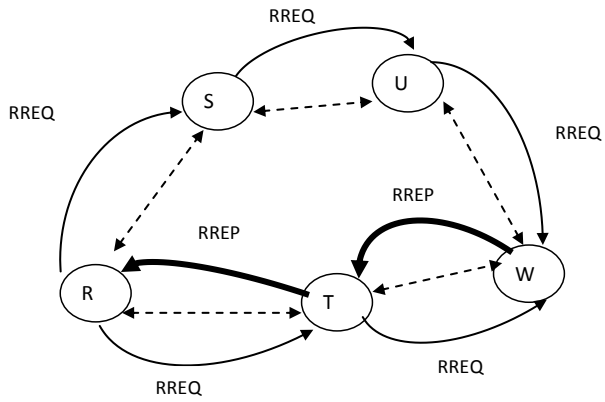


FIG 2 AODV route

From the above Fig2, if Node R wishes to initiate traffic to node W for which there are no direct route. The broadcast

is flooded to all the nodes. When W receives the request it sends the reply to R by the cached entries in T and U.

The Nodes that receive the packet updates the information from the source node and sets backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply RREP, if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the REQ.

3.2 DSR (DYNAMIC SOURCE ROUTING)

It uses the source routing instead of relying on the routing table at each intermediate device. It accumulates every address from the source to the destination during route discovery. To avoid long paths or large addresses the Dynamic source routing allows the packet to be passed through hop-by-hop basis.

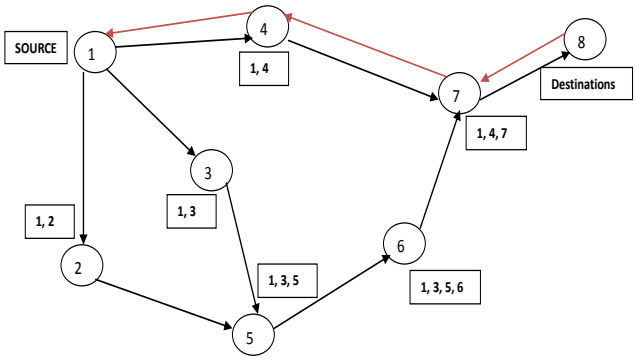


Fig 3 DSR protocol

From the above fig3 we see the DSR functioning, the source broadcasts the packet with the information of source address, destination address, request id and the path. If the packet is seen before by the host it is discarded, else the route finds for the route caches and searches for the destination, if not found it adds its information into the packet and rebroadcasts. If the route is found in the route cache it send a reply to the source with the help of the route cache or route discovery.

Advantages:

- There is no need to flood the route table periodically as it uses a reactive approach.
- It establishes a route only when needed.
- The intermediate node uses the route cache to reduce overhead.

Disadvantages

- The Route mechanism does not give a solution when a link is broken in between.
- The delay in connection setup is much when compared to a table driven protocol.
- The performance decreases as the mobility increases.

3.3 TORA (TEMPORALLY ORDERED ROUTING PROTOCOL)

It is invented Vincent Park and M. Scott Corson, mainly to function in a multihop network. It uses an arbitrary parameter to determine the direction of the link between the two nodes. It builds a directed acyclic graph (DAG). There are many routes but it is not necessary that it should be the shortest. TORA has a unique feature of maintaining the multiple routes till the destination, so that the nature of topology does not need a reaction for it.

The three functions of TORA are

- route creation,
- route maintenance,
- route erasure

To initiate a route a QUERY packet is sent till it reaches the destination or till it reaches the node that routes to the destination and then receives an UPDATE which gives the height of the destination node. During the course of journey if it is found that the route is not correct it automatically changes its height.

3.4 LMR (LOW BASED MULTIPATH ROUTING)

The sensors that are wireless consists of a very large number of nodes that work at a very low data rate and require a global unique id, which are expensive. These networks are data centered; routing to and fro to the node is not needed. LMR can work with different data centric routing protocols. It is designed to use the local information to make disjoint paths to protect the path that is working. In this flooding overhead is reduced by schemes used by the routers. This uses the reversal algorithm. It addresses the issue through the partitioning the network thro erase mechanism. This algorithm is good for dense network.

Advantages

- Flooding overhead is reduced.
- With just one flooding it can find many segments or disjoint path to protect the working path.

Disadvantages

- In a Trap topology, the path that is working may block all the possible disjoint paths.

The three routing principles in LMR are :-

- Label
- Back-off algorithm
- Label enforcement

4. PROTOCOL COMPARISON

The Below table summarizes the theoretical analyses and the properties they have or do not have.

Protocols/properties	AODV	DSR	TORA
Multiple routes	**Yes**	No	No
Broadcasting	Full	Full	Local
Route metric method	Shortest Path	Shortest path or next route cache available	Shortest path or next available.
Route maintained	Route table	Route cache	Route table
Update information	Route error	Route Error	Node's Height
Storage capacity	O(E)	O(E)	O(Dd*A)
Topology	Full	Full	Reduced
Complexity	O2D	O2D	O2D

Every routing protocol has their own merits and demerits. No is better than the other. Each of them works in a special way.

5. Conclusion

Many researchers are developing new MANET protocols by comparing and improving the existing ones. MANET routing protocols after simulations are standardized. In this paper we discussed the various reactive routing protocols comparing their performance and properties. The most commonly use mobile ad hoc routing protocols are AODV, DSR and TORA. On demand routing the protocols are determined when they are needed. With the increasing use of wireless devices AODV keeps are solid state in its routing table as it needs to track and do changes according to the route. It keeps a local route discovery. According to the analysis made AODV has throughput with lowest delay. Thus it is better than the other routing protocols.

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