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Comparative Analysis of MANET Reactive Protocols

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***Abstract*— an Ad-hoc network is a group of mobile nodes. In an ad-hoc network a mobile node can directly communicate with the other node that lies in its transmission range or it can forward its information to the other node that will act as an intermediate node and forwards the information to the desired node using multi-hop links. In such a network there is no need of any infrastructure. Ad-hoc networks routing protocols are classified into two categories: Proactive/table-driven and reactive/on-demand. Reactive routing protocol is used whenever a communication is requested. There are two types of reactive protocols: AODV (Ad hoc on-demand distance vector protocol) and DSR (Dynamic source routing protocol). In one type of scenario one protocol may perform best while another may perform worst, so there is a need to determine an optimal one out of these in a more dynamic environment. The differences in the working of these protocols lead to significant performance differentials for both of these protocols.**

***Keywords*- MANET, AODV, DSR, RREQ, RREP**

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I. INTRODUCTION

With the development in technologies there is a rapid increase in the use of devices like mobile phones and computers. These devices provide access to network through wireless interfaces. Ad-hoc networks are the wireless networks without any fixed infrastructure. An Ad-hoc network is a collection of nodes that are mobile in nature therefore they are also known as MANETS (mobile ad hoc networks).

A MANET (mobile ad hoc network) is an independent collection of mobile users that communicate with each other via wireless links that is through radio waves. In an ad-hoc network a mobile node can directly communicate with the other node that lies in its transmission range or it can forward its information to the other node that will act as an intermediate node. The network is decentralized as all the network activities for example discovering the topologies and delivering messages must be executed by the nodes themselves. Therefore routing is necessary for the mobile nodes. Such type of networks can be used in the environments where there is no infrastructure or setting of an infrastructure is very expensive or the existing wired infrastructure has been destroyed by the natural calamity ,for example earthquakes, floods.

A. Characteristics of MANETS are:

- Nodes can act like both hosts and routers (intermediate nodes).
- Communication via radio waves.
- Limited Bandwidth.
- Less Security.
- Dynamic network topology.

B. Applications of MANET are:

- Emergency situations or disaster areas, where a hurricane or earthquake has destroyed the communication infrastructure.
- Coverage area expansion of cellular networks.
- Commercial and Industrial areas where associates can share information during a meeting and participants in a conference can exchange documents or presentations.
- Inter-vehicle communication.
- Sensor Networks represent a special kind of ad hoc networks that consist of nodes having sensing communication and processing abilities.

C. Properties of MANET Routing protocols are:

- The routing protocols should be capable of using not only the bi-directional links but

also the unidirectional links that will improve the performance of routing protocols.

- The nodes in the ad-hoc network can be laptops or cell phones that are limited in battery power so it is very important that the routing protocol has support for sleep modes.
- The protocol should be reactive in nature that the protocol should react only when needed and should not periodically broadcast information This minimize the control overhead in the network and prevent misuse of the network resources.
- The protocol should be distributed that is it should not be dependent on any centralized controlling system. The nodes in an ad-hoc network are mobile in nature so they can enter or leave the network any time causing partitions.
- The radio environment is especially vulnerable to attacks so some sort of security measures should be followed like Authentication and encryption.
- The routes used for communication should be loop free. This avoids any misuse of bandwidth and improves the overall performance.
- Multiple routes can be used to reduce the number of reactions to topological changes and congestion. If one route becomes invalid, it is possible that another route can be used.
- The routing protocols should incorporate Quality of service that helps to find where these networks can be used for example for real time traffic support.

II. Routing Protocols

Ad-hoc networks have routing protocols that can be classified into two categories:

- Proactive/table-driven
- Reactive/on-demand.

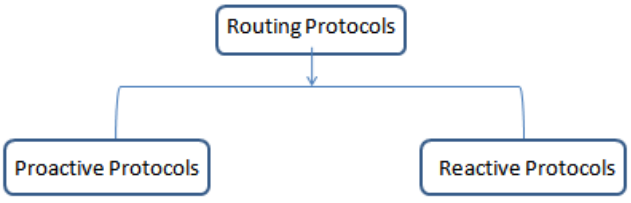

Fig 2: Type of Routing Protocols

A. *Proactive Protocol*

Proactive protocols are also known as table-driven protocols. These protocols always maintain routes between every host that means there is a regular exchange of network topology packets between the nodes of the network. So there is a minimal delay in determining which route should to be taken. These protocols consume bandwidth to keep routes up-to-date and also maintain routes which may never be used. The increased mobility in the network causes traffic overhead. If the nodes transmit packets infrequently then the routing information is considered redundant.
Proactive protocols are most suitable in the networks that have low node mobility and where the nodes transmit data frequently. Examples of Proactive Protocols are: Optimized Link State Routing (OLSR), Fish-eye State Routing (FSR), Destination-Sequenced Distance Vector (DSDV), and Cluster-head Gateway Switch Routing Protocol (CGSR).

B. *Reactive Protocol*

Reactive routing protocols are also known as on-demand routing protocols as they are used whenever a communication is requested. Firstly, Source node checks its route cache if there is a route available from source to destination and if the route is not available then it initiates route discovery process.
The reactive routing protocols perform two functions:
Route discovery: In this the source node initiates a route discovery process on demand basis. A source node then sees its route cache for the available route and if the route from source to destination is not present then it initiates a route discovery process. 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 ad hoc networks, route failures between the nodes are more frequent that arises due to link breakage between the nodes. Route maintenance is done to avoid this problem by using an acknowledgement mechanism. Examples of Reactive protocols are Dynamic Source Routing (DSR) and Ad-hoc on- demand distance vector (AODV).

III. Ad hoc On-Demand Distance Vector (AODV)

Ad hoc On-Demand Distance Vector (AODV) routing is a reactive routing protocol for mobile ad hoc networks. It is an on-demand and distance-vector routing protocol that is a route is established by AODV from a destination only on demand. AODV routing protocol is capable of both unicast and multicast routing. It keeps the routes in the routing table as long as they are needed by the source nodes. AODV generates a tree or trees are composed of the group members and the nodes that are needed to connect their members. AODV uses destination sequence numbers to ensure the

freshness of routes. Its operations are loop-free. AODV can also scales to large numbers of mobile nodes.
Each mobile node in the network maintains a route table entry for each destination in its route table.

- Number of hops (Hop count)
- Destination sequence number
- Destination IP address
- Active neighbors for this route
- Lifetime (Expiration time of the route)
- Next hop

When a node suppose S wants to communicate with another node suppose D, then it initiates route discovery process by broadcasting a Route Request packet (RREQ) to its neighbors. If the neighbor node has a route to the destination then it replies with a route reply packet, otherwise it broadcast the route request packet to all its neighbors and some packets reach to the destination D.

When the Route Reply (RREP) is generated, it reaches back to the source node, based on the reverse path. Each node along this path sets a forward pointer to the node and records the latest destination sequence number.
The RREQ has the following fields:

- Source address
- Source sequence number used to maintain freshness info about the route to the source.
- Destination address
- Destination sequence number
- Hop-count

Route Request (RREQ) Message Format

Type	J	R	G	D	U	Reserved	Hop Count
RREQ ID							
Destination IP Address							
Destination Sequence Number							
Source IP Address							
Source Sequence Number							

The Route Request message includes the following fields:
Type 1
J Join flag, reserved for multicast.
R Repair flag, reserved for multicast.
G Gratuitous RREP flag.
D Destination only flag, indicates that destination can respond to this RREQ.
U Unknown sequence number indicates that destination sequence number is unknown.
Reserved Sent as 0.
Hop Count Number of hops from Source to the node handling the request.

A. *Advantages and Disadvantages*

The main advantage of AODV protocol is that AODV established routes on demand basis and uses destination sequence numbers to find the latest route to the destination. The connection setup delay is also less in AODV. The HELLO messages used in AODV that supports the routes maintenance are range-limited so they do not cause unnecessary overhead in the network. AODV are well suited for large networks.

A disadvantage of this protocol is that intermediate nodes can lead to inconsistent routes if the sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number. Multiple Route Reply messages in response to a single Route Request packet can lead to heavy control overhead. The periodic HELLO message leads to gratuitous bandwidth consumption.

IV. Dynamic Source Routing (DSR)

Dynamic Source Routing (DSR) is also a reactive routing protocol for ad hoc networks. It is similar to AODV as it establishes a route on-demand. It uses source routing instead of relying on the routing table at each intermediate node. Dynamic source routing protocol is an on-demand, source routing protocol, where all the routing information is maintained at mobile nodes. Every node contains a route cache. Each entry in route cache specifies the intermediate nodes to a destination. The route cache is used to respond to RREQs even if it is not the destination. The route cache is always updated when it learns a new route. The entries from the route cache are removed only when a node receives an RERR.

DSR allows the network to be self-organizing and self-configuring without the need for any existing infrastructure. The protocol is based on two main mechanisms: Route Discovery and Route Maintenance.

In Route discovery the source node floods the network with RREQ packets. The RREQ contain the source and destination address and also the unique identity of the request. When a node receives an RREQ and if it is the destination then it responds back with an RREP containing the route from the source to the destination required, if not the node appends its own address to the RREQ header and rebroadcasts the RREQ to all its neighbour nodes. But a node that is not the destination receives the RREQ and contains a route to the destination may send an RREP. Upon receiving the RREP packet the source node records the route indicated in RREP in its route cache.

A shortest path for the communication between a source node and destination node is determined by Route Discovery process. Route Maintenance mechanism ensures that the communication path remains loop-free according the change in network conditions. Route Reply is generated

only in the case if the message has reached the destination node.

A. *Advantages and Disadvantages*

DSR uses a reactive approach which eliminates the need to periodically flooding the network with update messages which are required in a table-driven approach. The intermediate node utilizes the route cache information efficiently to reduce the control overhead. DSR has information of multiple routes.

The disadvantage of DSR is that it is not suitable for large networks and the route maintenance mechanism does not repair a broken link. The performance of DSR degrades rapidly with increasing mobility. Routing overhead is involved due to the source-routing mechanism used in DSR.

V. Comparison Between AODV and DSR

TABLE I

Sr. No.	AODV	DSR
1.	It uses table-driven routing.	It uses source routing.
2.	It delivers virtually all packets at low mobility.	It is very good at all mobility rates.
3.		It has low end to end delay.
4.	AODV uses one route per destination.	DSR uses routing cache aggressively, and maintains multiple routes per destination.
5.	For real time traffic AODV is preferred.	
6.	It is more conservative as the fresher route is always chosen.	DSR does not have any explicit mechanism to expire stale routes in the cache.
7.	It outperforms DSR in more stress situations (more load, higher mobility.	It outperforms AODV in less stressful situations (smaller # of nodes and lower load and/or mobility).

VI. CONCLUSION

In this paper an effort has been made on the theoretical study of mobile ad hoc network routing protocols. There are mainly two types of routing protocols: Proactive and Reactive routing protocols. Various advantages and disadvantages of these protocols are also included in this. There are various shortcomings in different routing protocols and it is very difficult to choose a right routing protocol for a particular situation as there are tradeoffs between various protocols.

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