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QUALITATIVE EVALUATION OF ROUTING PROTOCOLS OF MANET IN WIRELESS SENSOR NETWORK

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Abstract: A mobile ad-hoc network (MANET) is composed of mobile nodes without any infrastructure. Mobile nodes self-organize to form a network over radio links. The goal of MANETs is to extend mobility into the realm of autonomous, mobile and wireless domains, where a set of nodes form the network routing infrastructure in an ad-hoc fashion. The majority of applications of MANETs are in areas where rapid deployment and dynamic reconfiguration are necessary and wired network is not available. Due to their time varying nature of the topology of these networks traditional routing methods cannot be directly used .In this paper a number of routing protocols which are used in MANETS are studied and compared on a range of parameters.

Keywords : *MANET, routing protocols, DSDV, WRP, ZRP, ZHLS, AODV, DSR.*

I. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using centralized access points, infrastructure, or centralized administration. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. The network topology is unstructured and nodes may enter or leave at their will. A node can communicate to other nodes which are within its transmission range. This kind of network promises many advantages in terms of cost and flexibility compared to network with infrastructures. MANETs are very suitable for a great variety of applications such as data collection, seismic activities, and medical applications. Unfortunately nodes in MANETs are limited in energy, bandwidth. These resources constraints pose a set of non trivial problems; in particular, routing and flow control.

II. ROUTING IN MANET

Routing in MANET is a Dynamic Optimization Problem as the search space changes over time. The routing policy is defined as the rule that specifies what node to take next at each decision node to reach the destination node. Due to the time varying nature of the topology of the networks, traditional routing techniques such as distance-vector and link-state algorithms that are used in fixed networks, cannot be directly applied to mobile ad hoc networks.

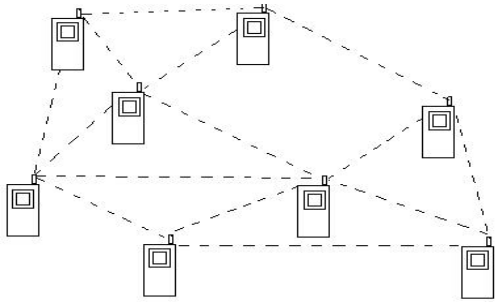

Figure 1: Example of a Mobile Ad Hoc Network

The constraints of MANETs demand the need of specialized routing algorithms that can work in a decentralized and self-organizing way. The routing protocol of a MANET must dynamically adapt to the variations in the network topology.

The routing scheme in a MANET can be classified into two major categories – Proactive and Reactive. The proactive or table driven routing protocols maintain routes between all node pairs all the time. It uses periodic broadcast advertisements to keep routing table up-to-date.

A. Proactive (Table- Driven) Protocols

Table-driven routing protocol attempt to maintain consistent, up -to-date routing information from each node to every other node in the network[5]. These protocols require each node to maintain one or more tables to store routing information, and they respond to changes in network topology by propagating updates routes throughout them network in order to maintain a consistent network view.

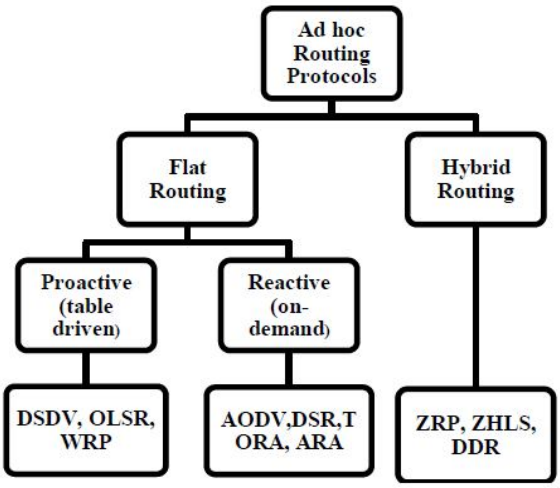

Figure 2: Classification of Ad hoc Routing Protocols

DSDV

Destination-Sequenced Distance Vector routing (DSDV) is a proactive hop -by- hop routing protocol that uses the classical distance vector method. Nodes periodically broadcast a packet to all of their immediate neighbours containing a list of all nodes they can reach and the costs of reaching those nodes. Sequence numbers are used to help prevent the formation of routing loops and to encourage the use of newer routing information. To further reduce the protocol's overhead, nodes can decide to broadcast "incremental" updates at more frequent intervals and complete updates at less frequent intervals.

WRP

Its prime goal is to maintain routing information among all the nodes in the network. Each node in network is responsible for maintaining 4 tables and these are the Distance Table, Routing Table, Link Cost Table, and Message Retransmission List (MRL) Table[6]. The MRL table contains the sequence number of the update message, a retransmission counter (how often a message is retransmitted before the connection is rebuild) and a list of updates sent in the update message.

Table 1: comparison Between DSDV AND WRP

Parameters	**DSDV**	**WRP**
Number of Routing Table	2	4
Rate of Updations	Periodic and as required	Highly Periodic (HELLO messages)
Features	Exhibit no loop	No loop formation
Caching Overhead	Medium	High

B. On Demand-Driven Routing Protocols

A different approach from table-driven routing is on-demand routing. This type of routing creates routes only when desired by source node[2]. When a node requires a route to a destination, it initiates a route discovery process within the network.

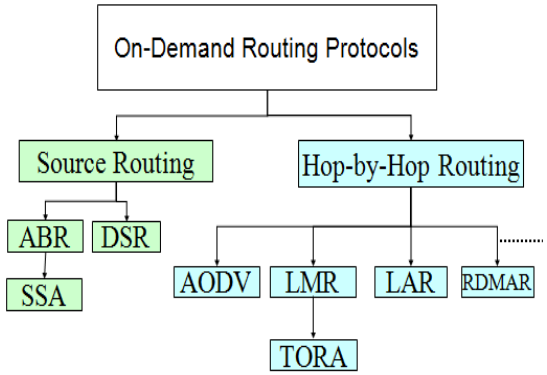

Figure 3: Classification of Reactive Routing Protocols

This process is completed once a route is found or all possible routes permutations have been examined [14].Once a route has been established, it is maintained by a route maintenance procedure until either the destination becomes inaccessible along every path from the source or until the route is no longer desired.

AODV

Ad-Hoc Distance Vector routing (AODV) is a reactive hop-by-hop routing protocol. When a packet needs a route to a destination, it is placed in a queue and a Route Request (RREQ) packet is sent[8]. Individual nodes keep track of what node they received the RREQ from, and use this to build a short-lived reverse route back to the originator of the RREQ[7]. When the destination receives the RREQ, it sends a Route Reply (RREP) back to the originator along this reverse route.

Table 2: comparison Between Source and Hop By Hop Routing

Source Routing	**Hop-By-Hop Routing**
Data packets carry the complete addresses from source to destination	Data packets carry the address of the destination and the next hop
No routing table in intermediate nodes	All nodes maintain localized routing tables
Not Scalable	Scalable

This RREP is used by each node along the route to build proper entries in their routing tables. Sequence numbers are used to prioritize new information and avoid routing loops.

DSR

Dynamic Source Routing (DSR) is a reactive source routing protocol. Each DSR keeps a "route cache", which holds a complete route for each destination. When a packet is to be transmitted, the node looks up the packet's destination in its route cache and writes the route into the packet's headers[1]. Each node along the route then examines this route to decide where to forward the packet next. When no route to a packet's destination is found in its cache, the node initiates route discovery using a cascading broadcast. Each packet in the broadcast keeps track of the nodes it has visited.

Table 3: Comparison Between AODV and DSR

Parameters	**AODV**	**DSR**
Source Routing	No	Yes
Time Relay	Does relay	Doesn't relay
Path Discovered	Single route	Multiple routes
Periodic Broadcast	Yes	No
Routing Overhead	Less	More
Route Storage Structure	Routing Table	Route Cache
Benefit	Adaptable to highly dynamic network topologies	Multiple Routes
Caching Overhead	Low	High

When the desired destination receives the broadcast, it sends back a response packet with this route information to the source node. The protocol also takes steps to attempt to repair routes that have been disrupted by mobility, rather than requiring them to be rebuilt completely.

C. Hybrid Routing Protocols

Based on combination of both table and demand driven routing protocols, some hybrid routing protocols are proposed to combine advantage of both proactive and reactive protocols. The most typical hybrid one is zone routing protocol[9]. As to the major division of routing protocols,Table gives a comparison of table-driven, demand-driven and hybrid Routing Protocol.

ZRP

The Zone Routing Protocol (ZRP) is a hybrid proactive/reactive routing protocol. It divides the network into zones, and uses different routing protocols for routing traffic within zones and routing traffic between zones[4]. Within zones, ZRP uses a proactive approach, providing a quick response to local topology changes and ensuring that nodes have a reliable picture of their immediate surroundings. Between zones, ZRP uses a reactive approach, which minimizes overhead.

Table 4: Comparison Between ZRP and ZHLS

Parameters	**ZRP**	**ZHLS**
Routes Available	Single route	Multiple route
Route Reconstruction	At failure point	Sent the location request
Beacons	Yes	No
Routing	Flat Routing	Hierarchical Routing
Benefit	Retransmissions are reduced	Single power failure is reduced, low control overhead
Zones Information	Zones are overlapped	Static zone map required

ZHLS

Zone-Based Hierarchical Link State (ZHLS) Protocol designed by Joa-Ng and Lu. It simplify the routing by dividing the topologies on two levels namely node level and zone level topology with no cluster heads. Each node has a node ID and zone ID calculated with the help of location tool GPS (Global Positioning System). Source node on transmission of data packets will first checks its intra-zone routing table and if the destination recites in its zone then the routing information are already present, no need for broadcasting. When the destination is in other zone then source node broadcast zone-level location request with node ID, Zone ID pair to all other zones and as destination got this request, it replies with the path. Hence ZHLS generates low overhead as compared to flooding approach in reactive protocols. Also because of the node ID, zone ID pair which is required for routing to destination node, routing path is adaptable to the changing topology.

III. CONCLUSION

In Table 5 we have differentiated MANETs protocols namely proactive, reactive and hybrid on the various parameters. Proactive is best in the situation where nodes communicating with each other on regular basis, require updated information periodically and thus routes are always available. On-demand routing comes into account where we want to reduce traffic overhead that is when routes are required they are initiated. While hybrid is best suitable for large networks and attempted to reduce rebroadcasting nodes, as they define a structure for taking routing decision. Hybrid protocols take advantage of best of

reactive and proactive protocols. Its goal is to initiate route-discovery on-demand but at limited search cost.

Table 5: Comparison Between Proactive, Reactive and Hybrid

Parameters	**Proactive**	**Reactive(on-demand)**	**Hybrid**
Routing	Flat and Hierarchical	Flat	Hierarchical
Route Availability	Always route is available	Determine on-demand	It depends on location of destination.
Network Mobility	Low	High	Very high
Control Traffic	High	Low	Lower than other two types
Periodic Message	Required	Not required	Sometimes used inside each zone.
Routing Information	Stored in routing tables	Doesn't stored	If requirement is there then provided.
Delay	Low	High	Low (in Intrazone) and High (in Interzone)
Benefit	Rapid establishment of routes & routing information is updated periodically.	Obtain required route when needed & don't exchange routing table periodically & loop free.	Updated routing information, limited search cost & more scalable.
Drawback	Convergence time is low, resource amount is used heavily, routing information flooded in whole network.	Routes are not up-to-date, large delay, more packet dropping.	Required more resources for larger size zones.

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