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Analysis and comparison of various routing methods for Mobile adhoc Networks (MANETs)

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Abstract

It is necessary to develop a new routing approach because MANET have restricted recourses. Also the algorithms designed for traditional infrastructure based network such as link-state or distance vector, does not fit well in wireless surroundings. To overcome this problem a number of routing protocols have been developed. It is very difficult to decide appropriate protocols for different network scenarios such as network size and topology etc. This paper provides an overview of the existing routing protocols with their distinctiveness and functionality. The comparison is provided based on the routing strategies and information used to make routing decisions. The performance of all the routing protocols is also discussed.

Keywords: Mobile ad hoc networks, Routing strategy, mobile node.

1. INTRODUCTION

A Mobile ad hoc network is a group of wireless mobile nodes (computer); in which nodes cooperate with each other by forwarding packets for each other to allow them

to communicate outside range of direct wireless transmission. An ad hoc network not needs a centralized coordinator or fixed infrastructure such as BSS or access points. A MANET is a self-governing group of mobile users that communicate over practically slow wireless links. The network topology may fluctuate quickly and randomly over time, because the nodes are mobile. Such a network may operate in a unconnected fashion, or may be connected to the larger Internet. MANETs possess certain characteristics like limited band width, variable links, limited energy, Limited Security, unstable network topology, repeated routing updates. Figure 1 shows a typical mobile ad hoc network.

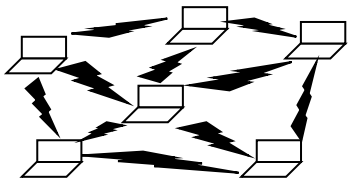

Fig .1 Adhoc Network

PAPER OUTLINE

The paper is arranged as follows : Section II presents routing in MANETs. Section III presents categorization of various routing strategy. In Sections IV summary of various protocol class is given. Then comparative study is given in the form of table followed by Section V with conclusion and end up with

references.

2. MOBILE ADHOC NETWORK ROUTING

A Mobile Ad Hoc Network is an infrastructure less, self-governing and multi-hop network with quickly changing topology causing the wireless links to be broken and re-established spontaneously [1]. Major consideration is that the Routing Protocol must be able to respond quickly to frequent changes in network topology. In MANET, each node must be able of perform as a router. As a result of restricted bandwidth of mobile nodes, the source and destination may have to communicate through intermediate nodes [2]. Main issue in routing are in consistent links, Routing Overhead, Interference, and frequent change in topology. In recent years numerous protocols have been introduced for addressing the problems of routing. These protocols are divided into two broad classes – Reactive and Proactive [3]. In Reactive or on demand routing protocol the routes are formed only when they are needed. The application of this protocol can be seen in the Dynamic Source Routing Protocol (DSR) and the Ad-hoc On-demand Distance Vector Routing Protocol (AODV). Wherein Proactive or Table-driven routing protocols the nodes keep updating their routing tables by periodical communication. This can be seen in Destination

Sequenced Distance Vector Protocol (DSDV). in next Section paper will present classification routing protocols , their class and review their characteristics.

3. CATEGORIZATION OF SOME EXISTING ROUTING PROTOCOLS

We will discuss the categorization of existing wireless ad hoc routing strategies . The Routing Protocols for ad hoc wireless networks can be separated into three categories based on the routing information update system. There are two major category namely flat routing and hybrid routing[6-15].

Flat routing is further divided in to two classes which are following

1. Proactive OR Table-driven
2. Reactive OR On-demand,

Figure 2 shows the three categories of Ad hoc routing protocols and Protocols under each category [7, 8, 9]. proactive ad hoc routing approach is comparable to the packet switched approach of forwarding packets, with no concern that all that rout are needed or not. While in reactive routing protocols a node using an on-demand protocol requests a route to a new destination, and node have to wait until route is constructed . On the other hand, because routing information is constantly propagated and maintained in table-driven routing protocols, a route to every other node in the ad hoc network is always available.

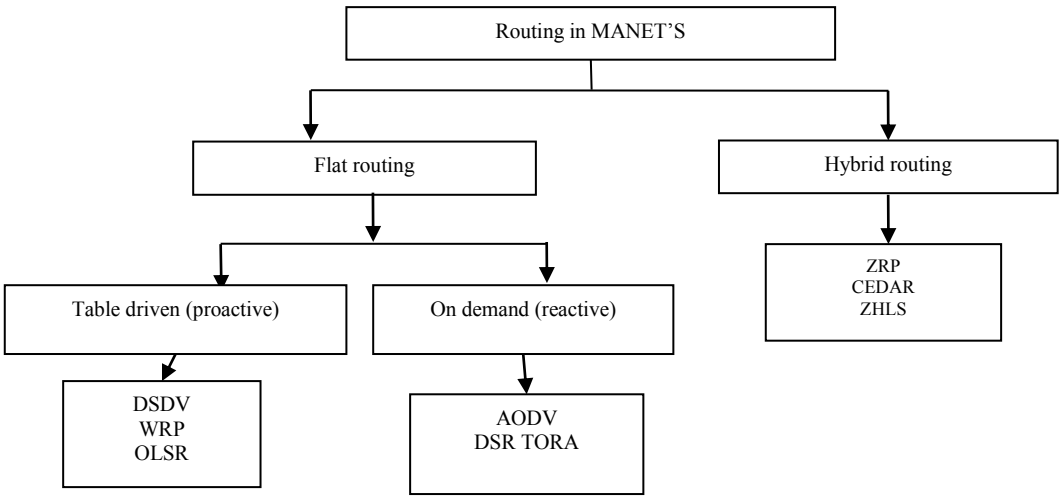

Fig 2: categorization of routing protocol

3.1. *FLAT ROUTING PROTOCOLS*

Flat routing protocols exchange information as required to any router that can be reached or receive information. No effort is made to systematize the network or its

traffic, only to discover the best route hop by hop to a destination by any path. all routers sitting on a flat geometric plane. Following are the sub category

3.1.1 PROACTIVE PROTOCOLS

These protocols always maintain latest information of routes from every node to every other node in the network. These protocols constantly hear the topology of the network by communicating topological information among the peers in the network . Thus, whenever there is a requirement for a route to a destination, such route information is obtainable straight away. Nodes in such routing protocol require maintain one or more data-tables to store latest routing information and to propagate that information throughout the network .Such protocols are also known as table-driven. These protocols attempt and maintain suitable routes to all possible destination node all the time, that means before a route is actually required. Periodic latest topological information is exchanged in order to coordinate the tables. Some examples of proactive ad hoc routing protocols are DSDV[12], and Wireless Routing Protocol (WRP) [14] optimized Link State Routing Protocol (OLSR) [13].

DSDV

The Destination-Sequenced Distance-Vector (DSDV) [14] Routing strategy is based on the idea of the classical Bellman-Ford Routing Algorithm with some changes and optimization such as making free from loop. In this, each mobile node maintains a routing table containing entries for all other mobile node in the network. In order to keep the routing table entirely up-to-dated at all the time each mobile node at regular intervals broadcasts routing information to its neighbour mobile node. When a neighbour mobile node receives the broadcasted routing information and knows the latest rout cost to the node, it compares this value with the value stored in its routing table. If update were found, it changes the value and computes again the cost (hop count) of the route and updates it in the table.

WRP

The Wireless Routing Protocol is a table-driven protocol [18] just like Destination-Sequenced Distance-Vector it also imitate the Bellman- Ford Algorithm. Main consideration is to maintaining topological and routing information among all devices in the network ,that is minimum hop count to every other mobile device.WRP overcome the loop problem in routing. WRP is a path discovering strategy but faces count-to-infinity problem so that forcing each node to perform stability test to information sent by all neighbours . Each node in the network have set

of four tables to maintain the up to date topological scenario namely: DT,RT,LCT ,MRL which stands for Distance table,Routing table, Link-cost table , Message retransmission list table respectively. Whenever there is a link break between any two device ,device send link break information to all its neighbours (node with distance of one hop). WRP overcome loop problem but have count to infinity.

OLSR

Optimized Link State Protocol, is a table driven routing protocol that uses a link state packet forwarding strategy known as multipoint relaying [16, 17]. It optimized the routing by use of as minimum as possible control packet with shortest path to propagate link state information ,it also minimize the size for control packet. Every node exchange the up to date network state information(topology) by sending the link state information to every other node at regular interval. Optimized Link State Protocol performs following task that are neighbour listening , optimized flooding , and discovering the optimal path(with minimum hop count). Neighbour listening is the identification of update in neighbourhood of node. The shortest path algorithm is then applied for computing the optimal path. Routes to every destination node are right away obtainable when data communication starts and remain available till a certain period of time until information is up dated with new shortest path.

3.1.2 REACTIVE PROTOCOLS

The on demand routing strategy mobile device does not maintain current network state (topology) all the time and its base on request-reply mechanism to discover path. Whenever a mobile node wants to establish a path to destination a path finding routine is executed. The main consideration of reactive protocol is keep routing control packet as minimum as possible throughout the network. The main function in on demand routing protocol is route discovery. Node that need to establish a path to destination node send a route request packet to is neighbouring node which further forwarded by these node to their neighbouring node until the destination node is located this phenomenon is called. The rout followed by the route request packet is recorded and destination node use this recorded path to send route reply packet back to the source node. There may be a situation that sender can receive more than one route reply message from multiple path in which optimal path is chosen. There are some class od on demand routing strategy such as AODV[23] and DSR[22].

AODV

Ad hoc On-demand Distance Vector is a classic reactive routing strategy. It obtain path and maintain it using procedure used in DSR and apply packet relaying just like

DSDV.AODV have the provision of sequence number to overcome the problem of looping and it broadcast self-presences after regular interval to its neighbour through a message called beacons and also overcome the count to infinity whenever topology changes. AODV does not ensure any security. The problem with this protocol is illusory increase in sequence number and illusory reduction in hop count. This protocol unable to reconstruct broken link by its local topology when there is path break it comes in knowledge of source and destination node by bacons and they notifies the link break then source reinitiate the path obtaining routine to repair the broken path.

DSR

Dynamic Source Routing is reactive routing strategy and it overcome the problem associated with proactive routing protocol i.e. bandwidth consumption. In DSR a node need not to update its routing table at regular interval that leads to minimize the control packet flow over bandwidth restricted network. The advantage of DSR is that it uses source initiate rout discovery in which source nod itself guide the packet for succession of node by which the packet has to travel until the destination is reached .Source node listed the intermediate nodes address in packet itself explicitly. Route discovery and maintenance is done when needed it makes DSR as reactive in nature. In DSR Every node maintains a temporary memory which is used to store recent discovered route. Whenever a mobile node need to establish a connection it checks its temporary memory if there is a entry for required route it uses that path for communication otherwise it broadcast a route request packet to its local topology and wait until the rout is obtained. On receiving the route request packet intermediate node check their temporary memory for destination requested if there is entry for destination then they send a route reply message to the destination otherwise they further forward the route request message in their local topology. As the route is obtained source node uses that route for communication and makes entry in its temporary memory (cache) for future. Node also keep track of lifetime of this route entry for freshness. Communication goes in check and relay fashion by intermediate node.

TORA

Temporarily ordered routing algorithm **(**TORA) is another reactive protocol with many quality i.e. scalable that it works well in large network ,and overcome the problem of loop .TORA uses graph theory in which it apply directed acyclic graph to determine the path in the terms of upstream and downstream. with the help of directed graph TORA works well in relatively dense network [28].unlike other protocol where source reinitiate the path obtaining routine TORA is able to

reconstruct broken link locally in which control packet floated around the place of breakage this quality makes this protocol different from other. Due to local maintenance this protocol is able to work well in large network. Temporarily ordered routing algorithm has following function namely construction, maintenance, deleting, and optimization. In this protocol every node has a height attribute if a node do not have this attribute considered as a deleted node. Algorithm to optimize height also employed known as optimization of path.

3.2 *HYBRID ROUTING PROTOCOLS*

Hybrid routing protocols exploit the features of table driven as well as on demand routing protocols. Tis class of protocol partitioned the network in to hierarchies or group node into a unit called cluster. Hybrid protocol faces the problem of power consumption and need large memory because node have to maintain lot of routing information. ZRP, CEDAR,ZHLS are well known example included in this category.

ZRP

ZRP is a hybrid routing strategy which combine the mobile nodes in to sub group called zone . it utilize the advantage of reactive routing protocol and proactive routing protocol .Inside the zone node communicate through table driven mechanism and transmission among the zone utilize reactive approach leads to reduction in control messages. zone of a node N is determined by the hop count *d* all neighbour with distance *d* from N comes into Ns zone. Important consideration to choose the value of *d*. Node inside a particular zone need to updated their routing table at regular interval.

CEDAR

Core Extraction Distributed Ad hoc Routing is a distributive protocol which divide the network into groups of node. Every group have a core node called dominator node. CEDAR also ensures the QOS in routing. It include the concept of dominator set, a dominator set of a graph defined as group of node such that every mobile node is either Member or should be neighbour of a node which is member of DS. Dominator node apply on demand routing for route discovery among the different set from source to destination. Protocol include three major phase:

1. Creation and maintenance of core for routing.
2. Propagation of link state information in the core.
3. A QoS route construction mechanism is invoked at the dominator node.

CEDAR uses slow moving increase-waves and fast moving decreased waves to achieve QoS which propagates the bandwidth availability information of a stable link.

ZHLS

ZHLS protocol partitioned the network in to zones every node in network assigned to a node_id and zone_id provided by geographical location. Protocol uses two level of topology one is at node level and other on zone level. It has two link state packets namely node LSP: list of connected neighbour and Zone LSP : list of connected zone. In this protocol every node share its node LSP to its neighbour node at regular interval thus every node in same zone share common link state information. Whenever a node wants to communicate with node first it check the inra zone routing information in if destination node present in same zone it communicate directly through its routing table. Otherwise node send a request packet to other zone through gateway node(boundary node) which reply with packet having zone id of destination node. In communication data packet contains node ID and zone ID of destination node. Algorithm is adaptable frequent changing topology as zone id and node id is needed for communication.

4. SUMMARY

In table driven routing protocol the routing information is communicated and exchanged among all the mobile devices in a adhoc network. Also infrastructure based routing mechanism have encouraged their own classes of protocols in proactive ad hoc routing. For example in DSDV mobile device only have concern to their local topology ,and maintain their routing information applying standard BF algorithm , one other example is OLSR where mobile node exchange entire network state then apply classic graph theory to find path with minimal hop count . Table driven or proactive protocols have their own pros and cons one benefit of table driven routing protocol is that any mobile node can easily obtain path to any destination node straight away whenever it needed and the problem with proactive protocols is that they have to maintain a lot of routing information in terms of table and many data structure which leads to increase processing time and power consumption more over link break restructuring takes time considerably.

On-demand routing is improvement over proactive protocol in regard of network traffic overhead. the reference protocol in this class are AODV and DSR and used extensively in many platform. Path discovery and maintenance are two common routine in this class of protocol. The starting node initiate a route request message which further propagated in entire network in check and relay fashion by intermediate node until destination node is located. The rout travelled by request message is recorded and used to back track the source node from the destination(reply message).there may be a situation where source receives multiple reply massage that

means having multiple path from source to destination ,optimal path is selected. Regular interval update of table is not required path is obtained when needed. Beside their advantage this class of protocol have excessive flooding problem that leads to paralyse the network and also time taken in path discovery is considerable.

Hybrid routing protocol are next generation routing strategy where merit of table driven and on demand routing protocol are incorporated. this class of protocol are adaptable to large network more than its counterpart .these routing protocol are distributive in nature thus mitigate the single point failure. This because of decentralization of routing and data forwarding means any node can involve itself in routing. They arrange network into hierarchy. The critical aspect is how to decide the network parameter to organize network into partition. Update of routing information at regular interval has been minimized. The main problem with these protocol that node should have large memory to handle the lot of routing information which further leads to power consumption.

Comparison has been made of different class of routing protocol in Table 1,Table 2 and Table3

Table1: Comparison of table driven routing Protocol

consideration	**WRP**	**DSDV**	**OLSR**
Control overhead	Higher	Higher	Lower
Refresh of table	At regular interval	At regular interval	At regular interval
Free form looping	yes	yes	yes
Performance	Lower	Lower	Moderate
Number of table	4	2	4

Table 2: Comparison of on demand routing protocols

Consideration	**AODV**	**DSR**	**TORA**
Performance	Higher	Lower	Lower
Path construction	By source node	By source node	By source node
Refresh of table	No	No	No
Control overhead	Higher	Higher	Higher
Path updation	When needed	When needed	High control over head
Metric of performance	Time	Shortness of path	Time

Table 3: Comparison of hybrid routing protocols

Consideration	**ZHLS**	**ZRP**	**CEDAR**
Beaconing	No	Yes	No
Alternate path	Yes	No	No
Routing system	Hierarchical	Flat	Hierarchical
Path metric	Shortest Path	Shortest Path	Path with QoS

Now comparison of all three philosophy of MANET routing has been given in Table 4.

Table 4: Comparison between the three class of routing Protocols

Consideration	Proactive	Reactive	Hybrid
Path Availability	Available all the time	When needed	Depends upon the location of source
Time taken in transmission	Lower	Higher	Depends on the destinations location
Memory needed	High	Dependent on need	Dependent on partition seize
Updation at regular interval	Yes	No	Yes in zone
Network size	Lower	Moderate	Higher
Control overhead	Higher	Lower	Relatively lower
Routing system	Almost flat	Flat	Hierarchical

5. CONCLUSION

This paper has shown a comparative study of different classes of mobile adhoc network routing protocols. In mobile adhoc network routing protocol are broadly classified in two category namely Flat and Hierarchical (hybrid). Flat routing further subdivided into two category namely Proactive (table driven) and reactive (On demand).paper gives the brief idea of classic protocol for each of these classes. Every routing philosophy has its merits and demerits. Which routing strategy suitable for network is depends upon the network scenario (size, geography) .the nature of adhoc network in dynamic inherently, topology changes frequently which add the challenges to routing protocol. Presented protocols apply different mechanism to find the path and maintenance. In this paper comparative study of protocol class has been given in tabular form with their advantage and disadvantage. Researcher can take help to understand the basic idea of various routing classes. MANETS placed the various challenges to research due to dynamic topology and security.

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