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ROUTING PROTOCOLS IN MOBILE AD HOC NETWORK

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Abstract: Mobile ad hoc networks (MANETs) are autonomously self-organized networks without infrastructure support. In a mobile ad hoc network, nodes move arbitrarily; therefore the network may experience rapid and unpredictable topology changes. Because nodes in a MANET normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad hoc networks potentially contain multiple hops, and every node in mobile ad hoc networks has the responsibility to act as a router. In this paper, we survey of routing protocols for MANET.

Keywords: MANETs, Proactive, Reactive and Hybrid Routing Protocols.

I.INTRODUCTION

A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires in fig. 1. Ad hoc is Latin and means "for this purpose". Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently. Each device must forward traffic unrelated to its own use, and therefore be a router. Mobile ad hoc networks (MANETs) consist of a collection of wireless mobile nodes which dynamically exchange data among themselves without the reliance on a fixed base station or a wired backbone network. In such networks, nodes are typically distinguished by their limited power, processing, and memory resources as well as high degree of mobility. Due to the limited transmission range of wireless network nodes, multiple hops are usually needed for a node to exchange information with any other node in the network. Thus, routing protocols play an important role in ad hoc network communications. Since all nodes in an ad hoc network can be connected dynamically in an arbitrary manner it is usually possible to establish more than one path between a source and a destination. This property of ad-hoc network routing is called multipath routing. A

Typical Structure of MANET diagram as shown in figure 1.

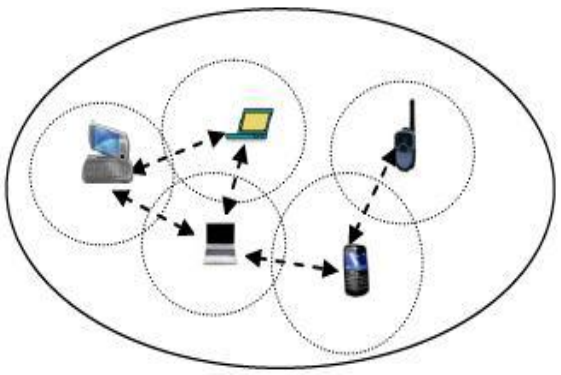

Figure 1: A Typical Structure of MANET

In most cases, the ability of creating multiple routes from a source to a destination is used to provide a backup route. When the primary route fails to deliver the packets in some way, the backup is used. This provides a better fault tolerance in the sense of faster and efficient recovery from route failures. Multiple paths can also provide load balancing and route failure protection by distributing traffic among a set of disjoint paths.

The main design criteria for the routing protocols in MANETs are as follows:

- Scalability and Reliability
- Simplicity and ease of implementation
- Fault Tolerance.
- Dynamic topology maintenance
- Distributed and lightweight

II. ROUTING PROTOCOLS IN MANET

MANET routing protocols could be broadly classified into three major categories:

A. Proactive Routing Protocols
B. Reactive Routing Protocols
C. Hybrid Routing Protocols

A. Proactive Routing Protocols

Proactive protocols rely upon maintaining routing tables of known destinations, this reduces the amount of control traffic overhead that proactive routing generates because packets are forwarded immediately using known routes, however routing tables must be kept up-to-date; this uses memory and nodes periodically send update messages to neighbours, even when no traffic is present, wasting bandwidth [1]. Proactive routing is unsuitable for highly dynamic networks because routing tables must be updated with each topology change, this leads to increased control message overheads which can degrade network performance at high loads [2].

B. Reactive Routing Protocols

Reactive Protocols use a route discovery process to flood the network with route query requests when a packet needs to be routed using source routing or distance vector routing

Source routing uses data packet headers containing routing information meaning nodes don't need routing tables; however this has high network overhead. Distance vector routing uses next hop and destination addresses to route packets, this requires nodes to store active routes information until no longer required or an active route timeout occurs, this prevents stale routes [1]. Flooding is a reliable method of disseminating information over the network, however it uses bandwidth and creates network overhead, reactive routing broadcasts routing requests whenever a packet needs routing, this can cause delays in packet transmission as routes are calculated, but features very little control traffic overhead and has typically lower memory usage than proactive alternatives, this increases the scalability of the protocol [3].

C. Hybrid Routing Protocols

Hybrid protocols combine features from both reactive and proactive routing protocols, typically attempting to exploit the reduced control traffic overhead from proactive systems whilst reducing the route discovery delays of reactive systems by maintaining some form of routing table [1]. The two survey papers [3], [4] successfully collect information from a wide range of literature and provide detailed and extensive reference material for attempting to deploy a MANET, both papers reach the conclusion that no single MANET routing protocol is best for every situation meaning analysis of the network and environmental requirements is essential for selecting an effective protocol. Whilst these papers contain functionality details for many of the protocols available, performance information for the different protocols is very limited and no details of any testing methodologies is provided, because of this the validity of some claims made cannot be verified. There are number of routing protocols in MANET, which are classified into three major categories: proactive, reactive and hybrid as shown in Table 1.

Proactive	Reactive	Hybrid
DSDV GSR OLSR WRP TBRPF	DSR AODV TORA ABR CBRP	ZRP HSLS

Table 1. Classification of Routing Protocols in MANET

III. SURVEY ON ROUTING PROTOCOLS IN MANET

Proactive Routing Protocols: Proactive routing protocol is also known as table driven routing protocol in which each node maintains one or more tables containing routing information to every other node in the network. Some of the proactive routing protocols are: destination sequenced distance vector (DSDV), global state routing (GSR), wireless routing protocol (WRP), optimized link state routing (OLSR) and topology broadcast based on reverse-path forwarding (TBRPF).

a. Destination-Sequenced Distance-Vector Routing (DSDV)

The proactive DSDV protocol was proposed by [5] and is based upon the Bellman-Ford algorithm to calculate the shortest number of hops to the destination [2]. Each DSDV node maintains a routing table which stores; destinations, next hop addresses and number of hops as well as sequence numbers; routing table updates are sent periodically as incremental dumps limited to a size of 1 packet containing only new information [6]. DSDV compensates for mobility using sequence numbers and routing table updates, if a route update with a higher sequence number is received it will replace the existing route thereby reducing the chance of routing loops, when a major topology change is detected a full routing table dump will be performed, this can add significant overhead to the network in dynamic scenarios [5].

b. Global State Routing (GSR)

In GSR protocol [21], nodes exchange vectors of link states among their neighbors during routing information exchange. Based on the link state vectors, nodes maintain a global knowledge of the network topology and optimize their routing decisions locally. Functionally, this protocol is similar to DSDV, but it improves DSDV in the sense that it avoids flooding of routing messages.

c. Optimized Link State Routing Protocol (OLSR)

The OLSR is an IP routing protocol optimized for mobile ad hoc networks, which can also be used on other wireless ad hoc networks. OLSR is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information throughout the mobile ad hoc network. Individual nodes use this topology information to compute next hop destinations for all nodes in the network using shortest hop forwarding paths. OLSR data flow diagram as shown in figure 2.

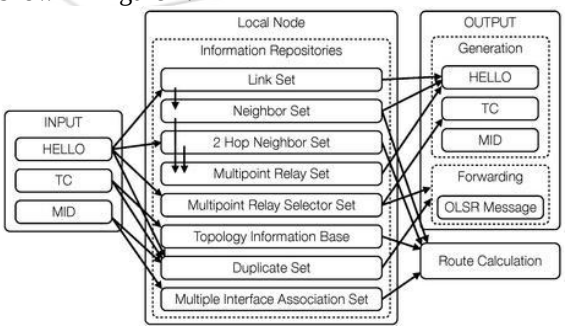

Figure 2: OLSR Data Flow Diagram

d. Wireless Routing Protocol (WRP)

WRP [17] belongs to the general class of path-finding algorithms[18][19][20],defined as the set of distributed shortest path algorithms that calculate the paths using information regarding the length and second-to-last hop of the shortest path to each destination. WRP reduces the number of cases in which a temporary routing loop can occur. For the purpose of routing, each node maintains four things:

1. A distance table

2. A routing table
3.A link-cost table
4. A message retransmission list (MRL).

WRP uses periodic update message transmissions to the neighbors of a node. The nodes in the response list of update message (which is formed using MRL) should send acknowledgments. If there is no change from the last update, the nodes in the response list should send an idle Hello message to ensure connectivity. A node can decide whether to update its routing table after receiving an update message from a neighbor and always it looks for a better path using the new information.

e. Topology broadcast based on reverse-path forwarding (TBRPF)

TBRPF[7][8] is a link-state routing protocol for wireless mesh networks.The obvious design for a wireless link-state protocol (such as the optimized link-state routing protocol) transmits large amounts of routing data, and this limits the utility of a link-state protocol when the network is made of moving nodes. The number and size of the routing transmissions make the network unusable for any but the smallest networks.The conventional solution is to use a distance-vector routing protocol such as AODV, which usually transmits no data about routing. However, distance-vector routing requires more time to establish a connection,and the routes are less optimized than a link-state router.

Advantages:

- Improved efficiency
- Alternate paths immediately available. Helps the quality of service

Disadvantages:

- Better suited for larger applications

Reactive Routing Protocols : Reactive routing protocol is also known as on-demand routing protocol in which routes are created as when required. Some of the reactive routing protocols are: dynamic state routing (DSR), adhoc on-demand distance vector (AODV), temporally ordered routing algorithm (TORA), associability-based routing (ABR) and cluster based routing protocol (CBRP). And hybrid routing protocol is a combination of proactive and reactive routing methods which are better than the both used in isolation.

a. Dynamic Source Routing (DSR)

DSR [9] allows nodes in the MANET to dynamically discover a source route across multiple network hops to any destination. In this protocol, the mobile nodes are required to maintain route caches or the known routes. The route cache is updated when any new route is known for a particular entry in the route cache. Routing in DSR is done using two phases: route discovery and route maintenance. When a source node wants to send apacket to a destination, it first consults its route cache to determine whether it already knows about any route to the destination or not. If already there is an entry for that destination, the source uses that to send the packet. If not, it initiates a route request broadcast.

b. Ad hoc On-Demand Distance Vector (AODV) Routing

AODV [10] is basically an improvement of DSDV. But, AODV is a reactive routing protocol instead of proactive. It minimizes the number of broadcasts by creating routes based on demand, which is not the case for DSDV. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. The neighboring nodes in turn broadcast the packet to their neighbors and the process continues until the packet reaches the destination. During the process of forwarding the route request, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received. This record is stored in their route tables, which helps for establishing a reverse path.

c. Temporary Ordered Routing Algorithm (TORA)

TORA is a highly adaptive, efficient and scalable distributed routing algorithm based on the concept of link reversal [11]. TORA is proposed for highly dynamic mobile, multi-hop wireless networks. It is a source-initiated on-demand routing protocol. It finds multiple routes from a source node to a destination node. The main feature of TORA is that the control messages are localized to a very small set of nodes near the occurrence of a topological change. To achieve this, the nodes maintain routing information about adjacent nodes. The protocol has three basic functions:

1.Route creation,
2.Route maintenance
3.Route erasure

TORA can suffer from unbounded worst-case convergence time for very stressful scenarios [12][13]. TORA has a unique feature of maintaining multiple routes to the destination so that topological changes do not require any reaction at all. The protocol reacts only when all routes to the destination are lost. In the event of network partitions the protocol is able to detect the partition and erase all invalid routes.

d. Associativity-based routing (ABR)

ABR [14] protocol defines a new type of routing metric, degree of association stability' for mobile ad hoc networks. In this routing protocol, a route is selected based on the degree of association stability of mobile nodes. Each node periodically generates beacon to announce its existence. Upon receiving the beacon message, a neighbor node updates its own associativity table. For each beacon received, the associativity tick of the receiving node with the beaconing node is increased. A high value of associativity tick for any particular beaconing node means that the node is relatively static. Associativity tick is reset when any neighboring node moves out of the neighborhood of any other node.

e. Cluster Based Routing Protocol (CBRP)

CBRP is an on-demand routing protocol, where the nodes are divided into clusters. It uses clustering's structure for routing protocol. Clustering is a process that divides the network into interconnected substructures, called clusters. Each cluster has a cluster head as coordinator within the substructure. Each cluster head acts as a temporary base

station within its zone or cluster and communicates with other cluster heads. CBRP is a routing protocol designed to be used in mobile ad hoc networks. The protocol divides the nodes of the ad hoc network into a number of overlapping or disjoint 2-hopdiameter clusters in a distributed manner. Each cluster chooses a head to retain cluster membership information. There are four possible states for the node: NORMAL, ISOLATED, CLUSTERHEAD and GATEWAY. Initially all nodes are in the state of ISOLATED. Each node maintains the NEIGHBOR table wherein the information about the other neighbor nodes is stored cluster heads have another table (cluster heads NEIGHBOR) wherein the information about the other neighbor cluster heads is stored[15]. CBRP diagram as shown in figure 3.

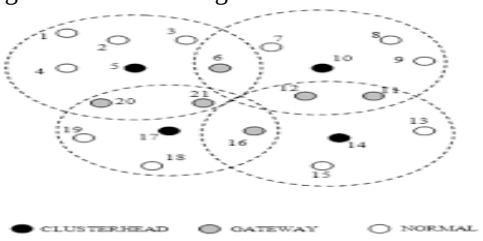

Figure 3: CBRP

Hybrid Routing Protocols: Hybrid protocols are: zone routing protocol (ZRP) and hazy-sighted link state routing protocol (HSLS).

a. Zone Routing Protocol (ZRP)

ZRP limits the proactive overhead to only the size of the zone. It also limits reactive search overhead to only select border nodes. Potential inefficiency may occur when flooding of the RREQ packets goes through the entire network. To some extent this protocol can provide a better solution in terms of reducing communication overhead and delay. But this benefit is subjected to the size of a zone and the dynamics of a zone. ZRP does not provide an overall optimized shortest path if the destination has to be found through IERP [16]. Moreover with the increase of network size ZRP could create unpredictable large overhead. In ZRP each path to a destination may be suboptimal. This also means that each node will have higher level topological information. Thus poses a higher memory requirement and an extra burden on the network resources.

IV. CONCLUSION

This paper concludes that there is not only a single protocol which can give the best performance in mobile ad hoc network; in fact there are many routing protocols in MANET. Performance of the protocol varies according to the variation in the network parameters. Mobility of the node and the energy of the node are the main concern. So, we have surveyed many types of routing protocols and their comparison among them. In this paper we have done the absolute survey and discussed some of the routing protocols such as DSDV,GSR,OLSR,WRP,TBRPF,DSR,AODV, TORA, ABR,CBRP and ZRP .

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