Study of MANET Routing Protocols

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----------ABSTRACT----------
Abstract – MANETS perform a difficult task of multi hop communication without any devoted infrastructure. Communication in manets face many challenges such as the nodes have limited battery life, low bandwidth, multiple paths between source and destination, variable population of nodes and depriving links. Migrant nodes and rapidly changing topology makes the routing even more challenging. Hundreds of packet routing algorithms have been explored by different researchers in the past. The focus of this paper is to showcase a few of traditional algorithms along with their comparison and new packet routing techniques based on them.

Keywords – MANET, Routing Protocol.

I. INTRODUCTION

Mobile Ad hoc networks (MANETs) are collection of mobile nodes connected by wireless links. They also come in the broad category of wireless sensor networks. All nodes can move freely and dynamically self-organize into arbitrary and temporary topology. They are infrastructure less in nature so, every node performs as a host as well as a router and each node participates in routing. The lack of infrastructure makes it difficult to ensure the reliability of packet delivery over multi-hop routes. That is why routing is much more complex in adhoc networks than in traditional wireless systems, due to the lack of centralized control and dynamically changing topology. In some real time application areas like defense communication etc, ad hoc networking is really the only feasible solution, while in other ad hoc networking competes with other technologies. The routing of packets has faced many challenges in the past and the traditional routing protocols have always been the area of research for the scholars. Many research activities have been conducted to improve the efficiency of protocols of different classes. Because of the nature of MANETs and problem of mobility of nodes in manets the stable communication and assurance of packet delivery is challenging. That is why this area has always been the interest of different researchers. Routing in MANETs has to confront the problem of mobility, variable path length, rapidly changing topology, delay, short duration links etc. So, the traditional routing protocols are combined with new methods to improve packet delivery rate. The focus of this paper is to have a basic insight into the taxonomy of routing protocols.

II. ROUTING PROTOCOLS

Depending on the application, different architectures and design goals/constraints have been considered for adhoc networks. Performance of a routing protocol is closely related to the architectural model. So, routing protocols have been categorized under different sections shown in fig 1. Although aim of these protocols is the same: maximize throughput while minimizing packet loss, control overhead and energy usage still they give different results in different scenarios. Routing protocols are categorized under following headings but they are interrelated or dependent on each other.

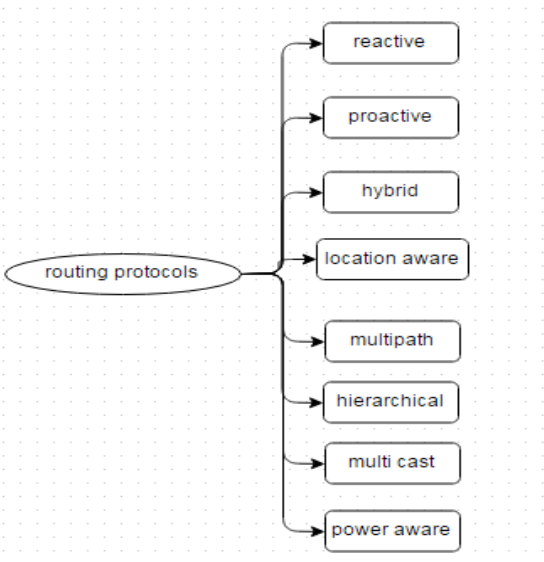

Fig 1: taxonomy of routing protocol

*A **Source-initiated routing protocols (reactive protocols)***
Source-initiated routing represents a class of routing protocols where the route is created only when the source requests a route to a destination. Routing process is subdivided into route discovery and route maintenance. The routing process starts with route discovery in which network is flooded with route request packets. Once a route or multiple routes are obtained to the destination, the route

discovery process comes to an end. A route maintenance procedure maintains the continuity of the route while transfer of packet. Route discovery process contains route request packet, that a source broadcasts on the network. In route maintenance phase route error and acknowledgement packets are used. Few of the reactive protocols are under listed:

- Dynamic Source Routing(DSR)
- Adhoc on demand distance vector (AODV)
- Temporally ordered routing algorithm(TORA)
- Signal stability based adaptive routing (SSBR)
- Ant colony based routing algorithm(ARA)

There are many other protocols that come under this category which are variations of one or the other protocol such as Space content adaptive time routing (SCATR), Forwarding Dilemma Game(FDG) which are based on AODV. Distributed Ant Routing (DAR) algorithm based on ant behavior in colonies.

B. Proactive Routing protocols(Table driven)

The class of proactive protocols maintains updated information of routes at every node about the source and destination of a packet. Also, route updates are propagated throughout the network to keep the routing state information up to date. Few of the proactive protocols are as follows.

- Destination-Sequenced Distance vector(DSDV)
- Optimized link state routing(OLSR)
- Cluster head gateway switch routing(CGSR)
- Wireless routing protocol(WRP)

Hierarchical proactive routing mechanism for mobile ad hoc networks (HOLSR) algorithm which builds upon the OLSR protocol by introducing a hierarchical architecture with multiple ad hoc networks [10]

C. Hybrid Protocols:

The hybrid routing schemes combine elements of reactive and proactive protocols. It has been observed that the areas where the links change relatively slowly are more compliant to proactive protocols whereas the areas of high mobility are more appropriate for reactive protocols.[1] after combining the concepts of both we get hybrid protocols which increases the overall performance of packet routing. Hybrid protocols are as follows:

- Zone routing protocol(ZRP)
- Fish eye state routing(FSR)
- Landmark adhoc routing(LANMAR)
- Distributed dynamic routing(DDR)
- Hybrid ant colony optimization(HACO)
- Adhoc networking with swarm intelligence(ANSI)

A hybrid routing algorithm based on Ant Colony Optimization (ACO) and zone routing has been proposed in [11]. It considers the scenario of ants travelling from one zone to the other with local proactive route discovery within a zone and reactive communication between zones.

D. Location Aware:

Location Aware protocols represent the collection of protocols in which the co ordinates of the respective nodes are determined by Global positioning system and the location of every node is known to every other node. This class of protocols participates in predictive routing. As the position of a node changes due to mobility, routes from source to destination needs to be updated. In [8] authors have used the concept of location aware routing to predict the nodes mobility to find optimized route from source to destination. Few representatives of this class are

- Location Aided Routing(LAR)
- Distance Routing Effect Algorithm for Mobility (DREAM)
- Greedy perimeter state routing (GPSR)
- Dynamic route maintenance (DRM) for geographic forwarding

E. Multi-path:

Adhoc networks are a collection of nodes scattered over a large area and connected through wireless links. Fig 2 .There may be set of hops between source and destination and multiple paths or routes through which the data packets can travel. So the shortest or optimal path for packet delivery should be chosen.The main advantage of this scheme is the path with less number of hops or less congested may be chosen in order to deliver the packet in time securely. Protocols under this section are:

- Caching and multipath routing protocol(CHAMP)
- Split multipath routing (SMR)
- Secure multipath routing(SecMR)

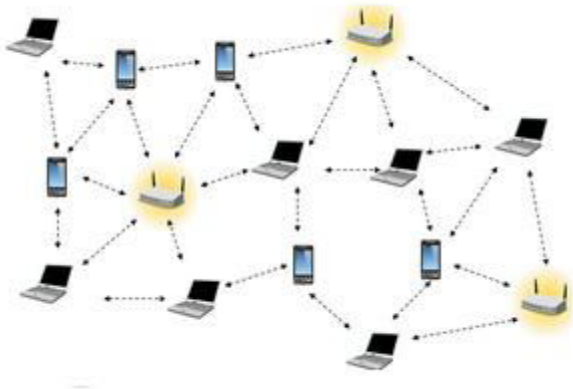

Fig 2: multiple paths

F. Hierarchical Protocols:

As the size of network increases, routing table sizes and control packet overhead also increase. The main idea behind hierarchical protocols is to reduce this overhead. Hierarchical ad hoc routing clustering techniques to form tree like structure of nodes. Nodes at the higher levels of the hierarchy provide special services, improving the scalability and the efficiency of routing. [1] Hierarchical state routing (HSR), Core extraction distributed adhoc routing and hierarchical landmark routing are few protocols under this class.

Clustering is one of the most popular techniques preferred in routing operations. In paper[7], clustering mechanism, based on artificial bee colony algorithm, is proposed to increase the duration of links in network. The performance of the proposed approach in this paper is compared with protocols based on particle swarm optimization, which are studied in several routing applications.

G. *Multicast Protocols:*

Real time applications like video streaming, teleconferencing require the concept of multicasting, where one sender transmits the data to many receivers simultaneously [1]. Althougth the protocols under this class are source initiated

- Dynamic core based multicast routing(DCMP)
- Energy efficient multicast routing
- Genetic algorithms for group multicast
- Content based multicasting(CBM)
- Geographical Multicast:

This type of protocols is the variations of multicast protocols in the way that the location of nodes is assumed to be in a particular geographical region. The position is obtained by GPS systems. Protocols of this class are generally based on set of location aware protocols. They also have to face the challenge of defining the geographical area from which the nodes are taken. The protocols of this class are directional guided routing (DGR), GeoTORA etc.

H. *Power Aware*:

In this group of protocols the routing decision is based on available power of the nodes other than number of hops. It is observed that generally the shortest path has usually minimum consumption of energy. The protocols under this group are device and energy aware routing(DEAR), interface aware cooperative routing etc.

III. COMPARISON

In contrast to source initiated routing (reactive), table driven routing (proactive) has extensive precedents in the research done for routing in the wired network. Reactive protocols have the overhead of route maintenance so the main goal of proactive protocols is to reduce this overhead. Also proactive protocols are not suitable for highly dynamic routes due to extra control overhead generated to keep the table updated. Proactive protocols such as OLSR only evaluate hop counts to search for the shortest path. As for reactive protocols, AODV only checks hop counts to determine if the routing table entry should be updated; DSR relies on hop counts for automatic route shorting and preventing route reply storms. But the fact that shortest route may not prove to be the optimal one as, it may face high overall congestion and inefficient packet delivery rate, cannot be neglected. [6] In MANETs variable length links is threat for timely delivery of packet so a greedy routing algorithm has been proposed, which selects the next hop node having the highest link lifetime. Greedy and Contention-based forwarding schemes perform hop-by-hop transmission of data, without discovering the end-to-end route to the destination [2]. Greedy algorithms select the nearest hop from source to destination and contention based methods broadcasts the packets to its immediate neighbors which forward the packet after competing with each other. GPSR protocol (representative of location aware protocols) is greedy in nature as it selects nearest neighbor to forward its packet. Multipath protocols like CHAMP, SMR are reactive in nature. The route metric of CHAMP is shortest path and for SMR its delay.

Also, some nodes in MANET are selfish in nature i.e. they may accept the node forwarded to them but may not transfer it in order to save their battery life. Routing in such an environment is based upon hiding the identity of destination node from each participant hop. [3] Node behavior is affected by social selfishness too. The authors in [4] have explained the concept of social selfishness as the nodes will not forward the packet received by them to whom they were not connected in the past. They will not participate in new route discovery due to limited resources available to them. They priorities the nodes among the neighbors and have developed social selfishness aware routing algorithm using multiple knapsack problem with assignment restrictions as the base of their algorithm. Most of the traditional protocols consider hop count as best metric to identify best packet route in [5] Nenad S. Kojie etal have proposed a routing protocol based on Hopfield neural network.

IV. CONCLUSION AND FUTURE SCOPE

Routing protocols has to consider the problems that take place due to node mobility. Most of the current protocols assume that nodes are stationary. However, the nodes change their positions frequently. In such cases, the frequent update of the position of nodes and the propagation of that information through the network consumes the energy of nodes. New routing algorithms are needed in order to handle the overhead of mobility and topology changes in such energy constrained environment. The limitations of this paper are it lacks to cover each category of routing protocol in detail. Routing using bee colony or ant colony may prove to be much more reliable so these techniques with other routing methods should be exploited in order to achieve maximum throughput and minimum overhead for packet delivery. Also prediction of routes based on different predicting techniques is open area of research for more assured packet delivery.

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