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A Comparative Analysis Review of Various MANET Routing Protocols

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ABSTRACT
Mobile Ad-hoc Networks (MANET) are the congress of mobile nodes that inter-communicate on common wireless channels without any stable infrastructure or any central control. It's an auto-configuring network where each node must role as a router. These mobile nodes traffic arbitrarily and form asymmetrical topologies. Routing is consequently a key challenge in ad-hoc networks. Various routing protocols have been proposed to date where each one has its own advantages and pitfalls and thus used in various scenarios. These protocols mainly classified into three categories specifically reactive, proactive and hybrid. This paper offers an outline and comparison analysis of some of the protocols by presenting their functionality, characteristics, benefits and limitations.

Keywords:- MANET, CBRP, TORA, DSR, AODV, DSDV.

I. INTRODUCTION

Ad-hoc means "formed for a particular tenacity". Thus MANET's are the tenacity specific networks which are configured on the fly when there exists limited or no communication arrangement. They do not need a pre-existing architecture for communication purpose and do not rely on any type of wired infrastructure; thus in an ad hoc network all communication occurs through a wireless median. MANETs can be installed to allow the communication devices to form a dynamic and temporary network among them. It is used in zones of Sensor networks for environmental observing, Rescue operations in remote zones, Remote building sites, and Personal area Networking, Emergency tasks, Military environments, Civilian environments etc. [2]. Due to the dynamic nature of these networks and rapidly changing topologies routing is very crucial issue to deal with. An Ad-hoc routing protocol is a contract or standard that controls, how nodes arise to agree which way to route packets between computing devices in a MANET [1]. There are many routing protocols that are being used currently in MANET. These protocols are divided in three categories.

A. Proactive Routing Protocol (Table-Driven)

This type of protocols maintains a list of destinations and their routes at each node. The proactive routing protocols use link-state routing algorithms which frequently flood the link information about its neighbours [4]. The main disadvantage of such algorithms is that overhead involved in maintaining the routing table is high.

Reactive Routing Protocol (On Demand)

The reactive routing protocols are based on some sort of query-reply dialog [3]. Routes are discovered on demand and are not known beforehand as in proactive protocols. Thus the overhead of maintaining routing table is reduced.

B. Hybrid routing protocol

The routing is initially established with some proactively prospected routes and then serves the demand from additionally activated nodes through reactive flooding [4]. Scalability is the important feature provided by these protocols.

The remainder of the paper is structured as follows. Section II delivers the outline of some renowned routing protocols of MANET specifically CBRP, TORA DSR, AODV and DSDV. This section concisely describes the working mechanism of these protocols, their advantages and limitations. Comparison of the above mentioned protocols is done on various grounds in section III followed by the conclusion in section IV.

II. OVERVIEW OF ROUTING PROTOCOLS

In this section an outline of five MANET routing protocols is done.

A. Cluster-based routing protocol (CBRP)

Unlike the routing protocols described so far in CBRP the nodes are organized in a hierarchy. The protocol divides the nodes of the ad-hoc network into a number of overlapping or disjoint clusters. Each cluster has a cluster-head and member node. These Clusterhead coordinate the complete routing process and are also connected to Clusterhead of other clusters through gateway nodes. By clustering nodes into sets, the protocol competently minimizes the flooding traffic during route discovery and speeds up this procedure as well. Also, the protocol takes into consideration the existence of unidirectional links and uses these links for both intra-cluster and inter-cluster routing [1]. This protocol has an attribute of scalability however, in hierarchical routing protocols, the outlays related with cluster formation and cluster maintenance is a drawback.

B. Temporally ordered routing algorithm (TORA)

TORA is a reactive routing protocol with some proactive enhancements where a link between nodes is established creating a Directed Acyclic Graph (DAG) of the route from the source node to the destination [3]. This protocol uses a "link reversal" model in route discovery. TORA does not continuously implement shortest-path estimation and thus the metric used to set up the routing structure does not denote a distance. TORA describes a new metric named as height where no two nodes may have alike height. Links between nodes are allocated directions ("upstream" or "downstream") based on the relative values of a metric associated with each router. This forms a routing structure that is used to forward packets to the destination. Data flows from nodes with higher heights to nodes with lower heights which forms a loop free and multipath routing structure. A route discovery request is broadcasted and propagated throughout the network until it reaches the destination or a node that has address to destination. As the query response packet termed as update packet (UPD) propagates back, every intermediate node informs its TORA table with the route and height to the destination node. The source node then practices the height to select the best route towards the destination. TORA is designed to minimize the communication overhead associated with adapting to network topological changes [10].

C. Dynamic source routing protocol (DSR)

Dynamic source routing protocol (DSR) [7] is an on-demand routing protocol that uses "source routing". It is together of the two key mechanisms of "Route Maintenance" and "Route Discovery". DSR does not essential broadcasting of periodic packets of any kind at any layer intimate the network. For example, any periodic routing table advertisement, link status sensing does not used by DSR. This reduces the amount of overhead in transmitting broadcasts significantly when the network is established. As nodes arise to move more or as topology pattern changes that are not affecting routes currently in use are ignored and do not trigger reaction from the protocol. An advantage of DSR is that the nodes can store multiple routes in their route cache, which shows that the source node can check its route cache for the existence of a valid route before initiating route discovery, in instance a valid route is found there is no need for route discovery. Multiple routes are also advantageous for load balancing purposes. It is also very beneficial with less mobility in network. Since the routes retained in the route cache will be valid longer.

D. Ad-Hoc on demand distance vector routing protocol (AODV)

The Ad-hoc On-Demand Distance Vector (AODV) algorithm supports dynamic, multihop routing, self-starting between participating mobile nodes wishing to establish and maintain an ad- hoc network. Mobile nodes permits by AODV to obtain routes quickly for new destinations, and does not need nodes to maintain routes to destinations that are not in active communication [8]. When any source node wants to send a packet to a destination, it broadcasts a route request (RREQ) packet. Every

node in turn forwards RREQ packet until the destination node itself is reached or the node which has a fresh route to destination is reached. A route reply (RREP) packet is then unicasted back to source node through established reverse route. Nodes monitor the link status of next hops in active routes. Once a link breakdown in an active route is found, a route error (RERR) message is used to notify other nodes that the link is missing. The AODV routing protocol is a blend of DSDV and DSR algorithm. It uses the periodic broadcasting and sequence numbering procedure of DSDV and a route discovery procedure of DSR. However, there are two important differences between DSR and AODV. The most unique feature is that the routing packet carries full routing information in DSR, while the packets transmit the destination address only in AODV. This causes AODV to have potentially less routing overheads than DSR. The further difference is that the route reply packets in AODV carry the destination IP address and the sequence number whereas in DSR it contains the address of every node beside the route. The benefit of AODV is that it is flexible to high mobility networks. However AODV is not suitable for large size networks due to route discovery latency.

E. Destination sequence distance vector routing protocol (DSDV)

DSDV [6] is developed on the basis of Bellman–Ford routing algorithm with some amendments [3]. It is proactive protocol where all network nodes maintains a routing table which contains the next-hop for, and numeral of hops to, all reachable destinations. Routing tables are updated by periodical broadcasts in case of any changes in the topology. To make the protocol loop free DSDV uses sequence number stored in routing tables. Every node maintains a monotonically increasing sequence number for itself. It also preserves the highest known sequence number for each destination in the routing table (called “destination sequence numbers”). The routing updates can be “Event Driven” or “Time Driven". These routing table updates can be sent via “full dump” or “incremental updates”. In incremental updates, only that information is sent which have changed since last updates. Full Dump means sending whole routing table [5]. In a relatively stable network, incremental updates are used while in fast changing network full dumps are preferable. DSDV needs a regular update of its routing tables, which uses up battery power as well as bandwidth even when the network is idle. On every occasion the topology of the network variations, a new sequence number is essential before the network re-converges; thus DSDV is not suitable for highly dynamic networks [2].

III. COMPARISON OF ROUTING PROTOCOL

Various routing protocols are given in Table I with their features and characteristics. The first column indicates the grounds on which the comparison is done followed by the features of CBRP, TORA DSR, AODV and DSDV. Study reveals that each protocol performs proficiently in some particular scenarios. In CBRP TORA and DSDV, broadcasting is done periodically to maintain routing informs but in AODV, only hello messages are directed to its neighbours to sustain local connectivity. DSDV essentials to broadcast periodic informs in the routing table anytime the topology changes occur on the other hand in DSR updates are sent only if the routes currently in use are affected by topology change. Hence routing outlays will be minimum in DSR and highest in DSDV. For stationary networks routing table informs and routing table size will be minimizing so DSDV will be best suited for such networks. In CBRP only Clusterhead are flooded with the routing updates which reduces network traffic. Thus network is well scalable if it uses CBRP. TORA and DSR deliver multiple routes to destination. Thus before initiating the route discovery process source node will look into its routing table for any existing route to destination which minimizes bandwidth usage. DSR affixes entire route address in its data packets and so the packet size increases in DSR as the network size increases while in AODV packets does not contain full route address. Hence DSR is well appropriate for smaller networks as compared to AODV.

TABLE I
COMPARATIVE ANALYSIS OF VARIOUS CLUSTERING TECHNIQUES

Factors	CBRP	TORA	DSR	AODV	DSDV
Category	Hybrid/ Hierarchical	Hybrid	On-demand or reactive	On-demand Or reactive	Table driven or Proactive
Periodical Broadcast	Yes	Yes	No	Yes / Hello messages	Yes
Protocol algorithm	Clustering	Link reversal	Source routing	Distance vector	Distance vector
Routing Overhead	Moderate	Moderate	Minimum	Moderate	High
Loop free	Yes	Yes	Yes	Yes	Yes
Multiple routes	Yes	Yes	Yes	No	No
Suitable for	For large size networks with moderate mobility	For large size networks with low mobility	For small size networks with moderate mobility	For moderate size and highly dynamic networks like VANET	For smaller and relatively static networks

IV. CONCLUSIONS

There are numerous clustering techniques existing with varying attributes which is suitable for the requirement of the data being analyzed. Each clustering technique has pros and cons over and is suitable in appropriate domain. The best method is used for achieving best results. There is no clustering algorithm which gives the solution for every domain. Appearance.

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