A Review on Load Balancing Approach in MANET

Neena Yadav, Renu Yadav

***Abstract*— Mobile ad hoc networks are defined as the category of wireless networks that utilize multi-hop radio relaying and are capable of operating without the support of any fixed infrastructure. A MANET is a dynamic multi-hop wireless network which is established by a group of mobile and independent nodes on a shared wireless channel by moral goodness of their proximity to each other. Generally low configured nodes are used in mobile ad-hoc networks to support mobility to user, so limited resources, dynamic network topology and link variations are the major issues with MANET. The number of link breakages observed by a node in an ad-hoc network can be used as a mobility metric so that each individual node can adjust its routing behavior based on the environment around it which improves the overall routing protocol performance. The classification of routing protocols and their brief description, based on their operating principles and underlying features is explained in this paper.**

***Index Terms*— Node mobility, Mobility factor, Routing, QoS, Time delay**

I. INTRODUCTION:

A MANET is a collection of wireless nodes that can dynamically form a network to exchange information without using any pre-existing fixed network infrastructure. In MANETs every node may function as a router and forward packets through routing paths. Co-operation among nodes during path discovery and packet relaying is of primary concern and should be supported for correct functioning of the network. Communication in a MANET occurs in a discrete and disperse environment with no centralized management which arises a main issue in MANET that is the breakage of link at certain moment and re-generation of link at certain state as it consists of routers which are mobile in nature i. e. are independent to roam in an arbitrary motion. Unlike cellular networks, MANETs establishes multi-hop wireless links among mobile nodes. The routing, path maintenance and resource management are done in distributed manner in which all the mobile nodes coordinate to enable communication among them. The mobile nodes in mobile ad hoc environment are far more complex than their cellular networks counterparts because to enable a node to function both as a network host for transmitting and receiving data and as a router for routing packets among nodes, this requires each node to be more intelligent. [2].

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II. ROUTING IN MOBILE AD-HOC NETWORKS(MANETS

Ad-hoc wireless network routing protocols can be classified in three major categories. These are:-

Proactive: Proactive routing protocols are also called the table driven routing protocols. In table driven routing protocols every node in the network maintains routing information and periodically exchange it with other nodes, Sequence numbers are used to distinguish recent information from the staleness data. The nodes exchange the routing information either through incremental updates or in full dumps.

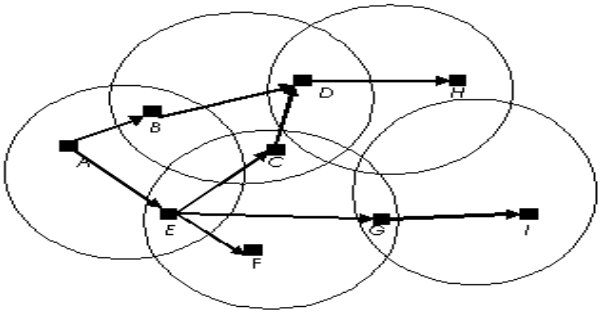
Reactive: Reactive routing protocols are also called the On-demand routing protocols. Reactive protocols out performs proactive ones but high mobility in the network leads to degradation of performance. These protocols eliminate the need to periodically flood the network with table update packets and thus control the bandwidth requirement. Ad-hoc on Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) are the quintessence of reactive routing. [8].

Hybrid Routing: Hybrid routing supports dynamic switching between the reactive and proactive parts of the protocol and thus make use of the best features of the above two categories. By combining the best features of proactive and on demand routing scheme, hybrid routing reduces the control overhead compared to the routing request flooding mechanism employed in reactive approach and periodic flooding of routing information packets in proactive approaches. Hybrid routing sometime fails to form an optimal path to the destination node. Core Extraction Distributed Ad-hoc routing protocol (CEDAR) and Zone routing protocol (ZRP) falls under the category of hybrid routing based protocols.

Preemptive Routing: Age of the path and the signal strength are the two parameters which are adopted to compute the reliability of the links a prior. If a same set of nodes participate in the data transmission, then there are chances of these nodes failing because of their resource drain.

III. MULTI-HOPPING BEHAVIOR OF MANETS

The Multi-hopping behavior of MANETs is as shown in below Figure. The routing information and data packets travels from one hop to another in the network, if a node A wants to send a data packet to node D, it can do so via B which is in the common range of both the nodes. However if B moves away and is beyond the range of A, the link is broken and a different route has to be established. [4].



Multi-hopping behavior of nodes in Mobile Ad Hoc Networks

IV. A CRITICAL ISSUE IN LOAD BLANCING:

Load imbalance is one of the most critical issues in these networks and network performance can be reached by fairly distributing load among nodes within the network. Generally, mobile ad hoc networks (MANETs) can be deployed in various scenarios but the depends on varying degree of resources, mobility of nodes and the lack of load-balancing capabilities in MANETs poses a big challenge for such networks to scale and perform efficiently when subjected to varying network conditions. Special attention has been given to the load balancing and congestion control in network. Here it is intended to deliver data packets circumventing congested routes, so as to realize a short end to end delay and load balancing of the overall network. The various load-balancing schemes discussed offer an ability to alleviate congestion by traffic distribution of excessive load and to support better performance, taking different parameters into consideration. [7].

V. TYPES OF LOAD BALANCING :

Based on Traffic*:* The most effective type of load balancing is to balance the load by attempting to distribute the network traffic evenly among network nodes or paths. The term, load in a network is defined as the number of bytes of packets transmitted by the node and the number of nodes from which it is currently receiving the packets. As the node gets overloaded, excluding it out of the routes and resetting all the paths is a cumbersome task. For SD pair w, let r_w be the total packet flow rate from source to destination and split x amount of it on path p of P such that,

$$\sum_{p \in P} x = r_w ,$$

This distribution of traffic among the mobile hosts fairly is useful to take full advantage of limited resources in MANET.

Based on the path: *:* Load balancing schemes based on the path in which the load is balanced works by selecting nodes with less number of active routes to forward data. Thus, the nodes which participate in the data forwarding and act as forwarding nodes are those having less overhead. This form of load balancing is not a most effective type as the energy consumption and available resources cannot be correctly determined solely on the basis of the number of routes through a node. [5].

Based on the Computed Weights of the Multiple Paths: The weighted approaches computes the weights of the paths in terms of certain predefined parameters by computing the values at each node. The source or destination estimates the path weight to send or receive data respectively. Thus, the path having the best metrics is selected over the others. The selection of best path must ensure congestion free, optimal and minimum overhead routing and thus minimum end to end delay. To improve the energy efficiency, paths with nodes having the sufficient energy levels are preferred. The information traverses the nodes through request/ reply packets.

Based on Delay: The delay in transferring data over the path is a measure of the difference in times when the packet was transferred by the sender and the time when the receiving node receives it. Time delay measurement across a path carries valuable information with it. Firstly, it determines the length of the path, shortest paths causes lesser delays than the larger ones. The length of a path is a measure of its hops. Secondly, if an intermediate node is congested and not having enough bandwidth, it queues up the packets for processing for longer intervals and thus causes huge gaps between the packets being received at the receiver. Time delay determines the available resources i.e. the bandwidth and the processing power of the intermediate nodes. The schemes under this category balance the load by attempting to avoid nodes with high time delays. [6].

VI. FACTORS EFFECTING LOAD BALANCING FOR MOBILE AD HOC NETWORKS (MANETS):

The proposed algorithm selects first nodes that have a higher energy, less mobility, higher degree and less distance from its neighbor nodes as cluster-heads, then periodically monitors the cluster-heads' energy and other parameters as the topology changes and locally circulates the responsibility of cluster-head among other nodes based on their weights to enhance the network lifetime by reducing the energy consumption of the suffering cluster-heads. When a collection of mobile nodes are cooperatively engaged without the required intervention of any centralized access point or existing infrastructure, resulting network is called an ad-hoc network. Minimal configuration, cheap equipment, quick deployment and absence of a central governing authority make ad hoc networks suitable for emergency situations like natural disasters, military conflicts, emergency medical situations etc. The performance of routing protocol in mobile ad hoc network (MANET) could be enhanced if in addition to number of hops, QoS based routing metrics like bandwidth, delay, energy and most important changing load conditions of the network are considered. The primary objective of the MANET routing protocols are to maximize energy efficiency, maximize network throughput, maximum network lifetime and minimum overhead. [10].

VII. PURPOSE OF LOAD-BALANCING PROTOCOLS:

The overall purpose of various load-balancing schemes is to:

- To intensify the utilization of resource
- Reduce number of packet lost by queue overflow

- Balance energy decay of the network
- To secure efficiency and robustness [3].

VIII. FORMATION OF CLUSTER AND DESIGN PARADIGMS IN MANETS

Certain nodes are elected to form the wireless backbone. These nodes are called Cluster heads and Gateways while other nodes work as member nodes. A Cluster head serves as a local co-coordinator for its cluster and vested with the responsibility of routing, data forwarding and so on, for all the nodes within its cluster. Gateways nodes are the nodes at the fringe of a cluster within inter-cluster links and access the neighboring cluster to forward information between clusters. A neighboring cluster is accessed through the gateway nodes. A cluster member is a node other than a cluster head. It might behave as a cluster gateway if present at the boundaries of the cluster. These member nodes form the communication links within a cluster and may access Cluster head for its services. The Clusters are either deployed with proactive routing scheme or a reactive routing scheme and thus operates accordingly. Nodes are powered by limited batteries because of their mobile nature. Cluster head is involved in every communication within its cluster, so the amount of communication should be kept to a minimum to avoid a node to be dropped out of the network prematurely. [9].

IX. IMPROVE THE EFFICIENCY AND NODE LIFETIME IN MANETS

MANET has a dynamic network topology, and constraint resources, such as bandwidth, buffer space, battery and transmission power and so on. Distributing traffic fairly among the mobile hosts, based on measurement of path statistics, is beneficial in order to take full advantage of the limited resources and to use network resources better so that the congestion and end-to-end delay are minimized. Load balancing schemes distribute the network loads, which can prevent network from getting into the state of congestion, and avoid the resources of congested node to be exhausted. The routing algorithms in MANET that choose the shortest route to build up the communication path may incur traffic imbalanced problems in the network. Those routing algorithm cannot fully exploit system capabilities and thus aren't worth. Multi-path routing can offer higher bandwidth and improved packet delivery ratio for multimedia applications than traditional shortest path routing protocols as multi-path routing protocols try to use multiple concurrent paths to transfer data. The effect of the route coupling in this environment can severely limit the gain offered by multipath routing strategies. During data communication the interference between two or more multiple paths located physically close enough to interfere with each other, refers to route coupling.

1. A Load-Balancing Scheme for QoS in MANETs:

The messages used are: QUEUE_INFO, REPLY and INFORM. When a node receives data packet, it broadcasts a QUEUE_INFO message to its neighbors if this node is congested, node 6 here (in fig.1). All its neighbor nodes, after receiving the message send a REPLY message only if they have the available buffer space. The congested node chooses the one within the transmission range of the sender node, and having least load among all, node 7 (in fig. 2) and preserve the rest of the information for further assistance for a particular time period and send INFORM message to the sender node, 4 to inform the address of the selected node, node 7. The new route will be constructed, excluding the congested node as shown in fig.2. [5].

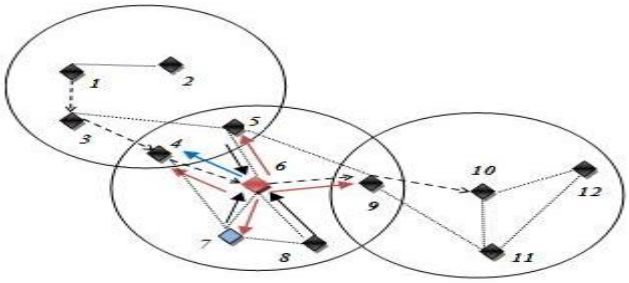


Fig 2.3 Exchange of messages when congestion occurs.

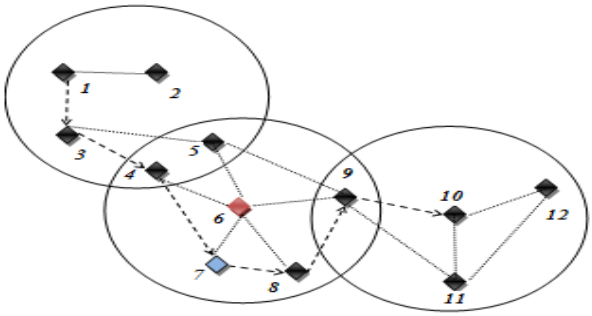
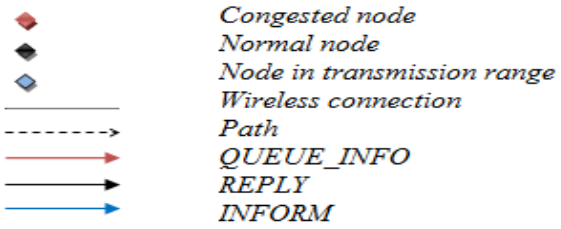


Fig 2.4 Route through less congested node.



X. CONCLUSION & FUTURE SCOPE

The selection of multi-paths avoid the repetitive selection of alternate routes and avoid minimum less efficient paths (i.e. congested, low energy paths) to participate in routing. **Clustering** scheme, the radio links in MANETs are opportunistic because of the restricted bandwidth between the nodes thus **Load balancing** is of vital importance in such networks. The formation of clusters and the organization of nodes in such a manner, with a view to improve the efficiency of routing, incurs low cost in terms of the resources used such as bandwidth, battery power, computation power etc. the purpose of clustering may be defeated otherwise. One of the way support efficient communication and improved system performance is to develop wireless backbone architecture. Such networks may be logically represented as a set of clusters by grouping together nodes that are in close

proximity. A mobile router will also allow mobility of an ad-hoc network, where mobile users may use an Internet access within an ad-hoc network domain.

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