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Survey of load balancing routing protocols in MANET

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ABSTRACT

A mobile ad hoc network is a group of wireless mobile hosts forming a temporary network without the aid of any stand-alone infrastructure administration. Mobile Ad-hoc networks are self organizing and self-configuring multihop wireless networks where the network structure changed dynamically. This is mainly due to the mobility of the nodes. Nodes in these networks cooperating in a gracious manner to engaging themselves in multihop forwarding. The nodes in the network not only act as hosts but also act as routers that route data to/from other nodes in network. MANETs requires an efficient routing protocol that provides the quality of service (QoS) mechanism. Routing protocol should be fully distributed; Easy computation and maintenance, Adaptive to frequent topology change, Optimal and loop free route optimal use of resources, Collision should be minimum. MANET detect the shortest path with minimum hop count as optimal route without any consideration traffic and the performance degrading of the network Therefore it is very essential to consider load balancing issue in routing mechanism. We mainly focuses on survey of various load balanced Routing protocols for efficient data transmission in MANETs.

Keywords: **Delay, Load balancing, Network Traffic, QoS, Throughput.**

1. INTRODUCTION

In Ad hoc networks, it is necessary to use efficient routing protocols that provide high quality communication. To maintain size, portability and weight of the device has takes lot of resource constrain. The nodes in MANET have limited bandwidth, battery power, buffer space, etc. So it is essential to distribute the traffic among the mobile host.

A routing protocol in MANET should comparatively distribute the routing tasks among the mobile host. An unbalanced traffic/load distribution leads to degradation the performance of the network. Due to this unbalancing nature, few nodes in the network are highly loaded which causes the high packet delay, large queue size, high packet loss ratio and high power consumption. This problem solved by using of load balancing routing algorithm in MANET.

1.1MANET APPLICATIONS

Day to day life MANETs applications are as follows

(a) *Military functions*- MANETs are useful in automation of battlefields through networks

(b) *Emergency operations*- the services such as search and rescue operations, hospital services and disaster Recoveries etc are the emergency services served by MANETs.

(c) *Educational areas*- virtual classroom setting, ad-hoc communication through meetings and lectures, online distance education and college campus etc are the educational services in MANETs

(d) *Home and entertainment services*- multiuser gaming facility, robotic parks, theme park setups etc are applications of MANETs

(e) *E-Services- E-banking and E-commerce*-that is business anytime and anywhere makes use of the MANET networks.

2. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET

The routing protocols in MANET are classified based on routing scheme and network configuration. According to the routing scheme the routing protocols can be categorized as Proactive and Reactive, while depending on the network configuration these are classified as hierarchical routing, flat routing and geographic position assisted routing.

2.1 Proactive (table driven) Routing protocol:-

Each and every node in the network maintains its routing information about every other node in the network. Routes information is generally kept in the routing tables and is regularly updated as the network topology changes.

Examples: DSDV and WRP.

2.2 Reactive (on-demand) Routing protocol:-

This protocols, does not maintain routing information at the network nodes if there is no communication. If a node wants to send a packet to another node in the network then this protocol searches for the route based on- demand behaviour and establishes the connection in order to receive and transmit the packet.
Examples: DSR, AODV.

2.3 Hybrid Routing Protocol:-

These protocols, combination of best features of above two protocols. Node within a particular geographical region, are said to be in routing zone. Proactive approach is used within the network and reactive approach is used outside the network.

3. CLASSIFICATION OF LOAD BALANCED ROUTING PROTOCOLS IN MANET

Chai Keong Toh et al. Says Various Load balanced ad hoc routing protocols are on-demand-based protocols; load

balancing strategies is combined with route discovery phase. The load balancing protocols are classified into three bases.

3.1 Delay-based:

In this load balancing is achieved by avoid nodes with high link delay.
Example: Dynamic Load-Aware On-Demand Adhoc Routing (DLOA), Weighted Load Aware Routing (WLAR).

3.2 Traffic-based:

In this load balancing is achieved by uniformly distributing traffic load among network nodes.
*Example***:** Load Balanced Ad Hoc Routing (LBAR).

3.3 Hybrid-based:

In this load balancing is achieved by combining the characteristics of traffic-based and delay-based techniques.
Example: Load Aware Routing in Ad Hoc (LARA).

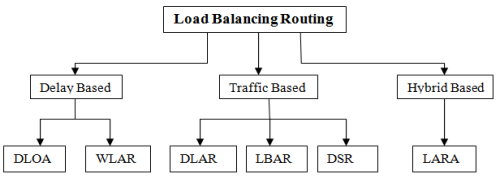

Fig 1.*Classification of Load Balancing Routing Protocols*

4. LOAD BALANCED ROUTING PROTOCOLS IN MANET

4.1 Delay-based Load-Aware On-demand Ad-hoc Routing (DLOA)

J-H. Song et al. Says DLOA uses the best path based on the approximate total path delay and the hop count as the route selection standard. The delay of each node is calculated based on packet transmission time and packet arrival time. The standard delay at node includes the queuing disputation and transmission delays.

In route discovery procedure, the RREQ packet carries hop count and the total path delay Dp of a path P. On reception the RREQ packet and the destination node send RREP packet back. If the duplicate RREQ packet has a minimum hop count and total path delay than the previous one, the destination sends a RREP packet again to the source node to change the route instantly. Delay based Load Aware On-demand Ad-hoc Routing (D-LOA) protocol is an extension of the AODV.

1) D-LOAR allows the in-between nodes to relay duplicate RREQ packets if the new path (P') to the
Source of RREQ is shorter than the previous path (P) in hop count, and DP'is lesser than DP (i.e., DP' < DP).

2) Each node updates the route entry only when the newly acquired path (P') is lesserr than the previous path (P) in hop count, and DP' is lesser than DP (i.e., DP' < DP).

Advantage:

Increases packet delivery fraction and Decreases end-to-end delay in a moderate Network scenario.

Limitation:

It collects the information about the other nodes in network. So routing overhead is comparatively high.

4.2 Weighted Load Aware Routing (WLAR)

Dae Choi et al. Says WLAR is an extension of AODV, it distribute the traffics among ad hoc nodes through load balancing mechanism. They consider total traffic load, as a route selection metric. Queue size and sharing nodes are used to find the total traffic. The total traffic is the product of average queue size and number of sharing nodes. Total traffic load in node is defined as its own traffic load plus the product of its own traffic load and the number of chipping nodes.

Path load is defined as sum of total traffic loads of the nodes which include source node and all central nodes on the route, except the destination node. In route discovery phase, when RREQ messages come at central node, it rebroadcast it based on its own total traffic load so that the flooded RREQ's which traverse the heavily loaded routes are at the

destination node or dropped on the way. Destination node will select the best route and replies RREP.

Advantage:

It's mainly focus on the delay based routing. So its avoid the influence of burst traffic.

Limitation:

It collects all the information about the routing. So overhead of route request packets is increased.

4.3 Dynamic Load Aware Routing (DLAR):-

S. J. Lee et al. says DLAR uses the number of packets buffered in the interface as the primary route selection criteria. These algorithms in selecting the least loaded route.

This protocol takes the central nodes load as a metric for choice the route and then it define the status of the routes that are active to construct the paths when the nodes of the route have overloaded the interface queue. The RRQ (route request) packet is flooded to the discovery of the route from source. DLAR automatically builds the route when in case there is no information about the destination node. It follows the backward learning

<Source, destination> node and searches for the previous hop.

The load information is attached to the RRQ packet. The destination now waits for some time to learn about all possible routes. This protocol does not facilitate REQUEST REPLY to be sent from those routes. In case the REQUEST REPLY is also send then the congestion will occur. DLAR does not allow congestion and so does not allow sending of REPLY via that route. When the active sessions occur the nodes piggyback their load information on the data packets. These data packets now have the information which the destination receives and so the destination comes to know whether the path is congested or not. In case the path is congested, a new and light path is constructed so that the data packet can be send safely over that route to the destination without congestion.

Advantage:

DLAR periodically monitors the congestion status of
Active data sessions and automatically reconfigures the routes that are being congested. Using the least loaded
routes helps balance the load of the network nodes

Limitation:

It only focus on traffic in route selection so
Interface queue length doesn't give a true
Picture of actual load.

4.4 Load-Balanced Ad hoc Routing (LBAR)

H. Hassanein et al. Says LBAR is on-demand routing protocol intended for delay-sensitive applications. It finds out route with least traffic and load so that data packets can be routed with least delay.

This algorithm proposes four stages:

1) Route Discovery
2) Path Maintenance
3) Local Connectivity Management
4) Cost Function Computation

The route discovery function contain two stages as follows

Forward stage- it is started at the source node where a setup message is broadcasted to its neighbours.

Setup message carries the cost from node 1 to the current node. The node which receives the setup

Message will send it to all its neighbours the same way and also update its cost which will be based on

Nodal activity. All setup messages have route records to prevent looping. Destination collects the

Setup messages within a predefined time for selecting the best cost path called route select waiting

Period.

Backward stage- it starts from the last node when acknowledgement is send backwards to the source

node on the best selected path which we call as the active path. The cost function is used to select the

Path from the node to destination which fulfils the goal.

Advantage:

Intended for delay-sensitive applications. In addition, in order to keep up with frequent topology change,

LBAR provides quick response to link failure by

Patching up the broken routes in use, thus

Guaranteeing reliability of data transmission.

Limitation:

It's mainly suitable for connectionless application. So

Connection orientated application not fit into it.

4.5 Dynamic Source Routing (DSR)-

It is the simplest and the most effectively used protocol for balancing load in mobile ad-hoc networks. It enables a network to be completely self organising and self configuring.

It follows two processes-

Route Discovery: When a source node n wants to send the data to destination node d only then the route is to be discovered between source node n and destination node d.

ROUTE REQUEST- node a wants to send the data to node e but does not know the path.It has a unique identification number (id=4)

It also contains address of each node through which the nodes are passed or forwarded.

ROUTE REPLY- when the target (node e) receives the packet then it sends the signal back with the route information. It caches the

route in the route cache and then the packets are send to destination.

Route Maintenance: In some cases it is possible that node n which is the source node while sending packets to the destination node d, the route does not work any longer on that context either some other route is followed or the route discovery is called again to select a route from source node n to destination node d. Maintenance is only used on this route when node n is actually sending data to destination node d.

Advantage:

It mainly suitable for mobility based networks so its better suited for the heady load networks with low mobility.

Limitation:

Its mainly focus on mobility so specific pattern is required to predict the Network traffic.

4.6 Load Aware Routing (LARA):-

Traffic density is a parameter in LARA which is used for mobile ad-hoc networks load balancing. Traffic density is a degree of contention at the MAC layer. When the route is being set then at that time this metric is used to select the path which has minimum traffic density. Each node in LARA maintains the traffic queue latest estimation as a neighbourhood table.

LARA BROADCASTS are of 2 types:-

ROUTE REQUEST- In this node attempts to discover the route to destination.

HELLO PACKET BROADCASTING- it is explained below

Important points about hello packet broadcasting as follows:-

When a new packet comes from a new node the neighbourhood node updates the neighbourhood table.

In case a message is not received in some particular time then it is assumed that the node has lost its radio

Signal and updating are made in the neighbourhood table.

Important terms used in LARA:-

TRAFFIC QUEUE- in a period of time when the average of the interface queue length value is calculated then it is called traffic queue.

TRAFFIC DENSITY- the node t has the traffic density as the sum of traffic queue (Qt) plus the traffic queue of all neighbours.

Advantages:

Uniformly distributes the load among all the nodes in the network, leading to better overall performance. This protocol makes enhanced route selection attempt based on traffic density and traffic cost which leads to better performance than DLAR and DSR.

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Limitations:

It does not consider the route conditions once it is Route Selected. So the connection link fails occur we need the route maintains.

5. CONCLUSION

In this we have discussed some important issues related to the load-balanced routing protocols for mobile ad hoc networks (MANET). Nodes in MANET have limited bandwidth, buffer space, battery power etc. So it is essential to distribute the traffic among the mobile host. There are different metrics used for the route selection. Load balancing algorithms are delay based, traffic based or hybrid based.

In MANET, to improve the performance, it is very essential to balance the load. Load balancing is used to increase throughput of the network. Also it is possible to maximize nodes lifetime, packet delivery ratio, and minimize traffic congestion and load unbalance, as a result, end-to-end packet delay can be minimized, and energy consumption can be balanced.

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