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SURVEY ON LOAD BALANCING PROTOCOLS USED IN MANET'S (MOBILE AD-HOC NETWORK)

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Abstract—*In this paper we describe about mobile ad hoc networks (MANET'S) and the load balancing protocol used in MANET.A mobile Ad-hoc network (MANET) is a self-configuring, infrastructure less network of mobile nodes connected by wireless links, to form an node arbitrary topology. MANET are free to move in any direction, so they change their links to other devices frequently. As MANET has no centralized control for the distribution of load properly, so load balancing is the process of improving the performance of parallel and distributed network through a redistribution of load among different nodes. If a network is heavily loaded without any load balancing capability, it degrades the performance by causing congestion delay, power loss and packet loss in network. Load balancing protocol is used to increase the performance and efficient packet transmission and communication and minimize the congestion and over load.*

Keywords: *MANET (mobile ad-hoc network), Routing, Node balancing protocol.*

1. INTRODUCTION

A Mobile Ad-hoc[1][2] Network is a collection of independent mobile nodes that can communicate to each other via radio waves. The mobile nodes that are in radio range of each other can directly communicate, whereas others needs the aid of intermediate nodes to route their packets.Each of the nodehas a wireless interface to communicate with each other. These networks are fully distributed, and can work at any place without the help of any fixed infrastructure as access points or base stations. This network can be created and used at anytime, anywhere without any pre-existing base station infrastructure and central administration.

1.1 Characteristics of MANET

a) **Dynamic topology:** In dynamic topology nodes are free to move arbitrarily with different speeds thus, the network topology may change randomly and at unpredictable time. The nodes in the MANET dynamically establish routing among themselves as they travel around, establishing their own network.

b) **Distributed operation:** There is no background network for the central control of the network operation, the control of the network is distributed among the nodes. The nodes involved in a MANET should cooperate with each other and communicate among themselves and each node acts as a relay as needed, to implement specific functions such as routing and security.

c) **Light weight terminal:** In maximum cases, the nodes at MANET are mobile with less CPU capability, low power storage and small memory size.

d) **Shared physical medium:** The wireless communication medium is accessible to any entity with the appropriate equipment and adequate resources. Accordingly, access to the channel cannot be restricted.

e) **Autonomous timing:** In MANET, each mobile node is an independent node, which could function as both a host and a router.

f) **Multi hop routing:** When a node tries to send information to other nodes which is out of its communication range, the packet should be forwarded via one or more intermediate nodes.

1.2 Advantages of MANET

- Network can be setup at any place any time.
- Scalable-accommodates addition of more nodes.
- Improved flexibility.
- Robust due to decentralized administration.
- Provide access to information and services regardless of geographical position.
- Self-configuring network, nodes are act as a routers.
- Less expensive as compared to wired network.

1.3 Challenges in MANET

a) Limited Bandwidth: Wireless link continue to have significantly lower capacity than infrastructure networks. In addition, the realized throughput of wireless communication after accounting for the effect of

multiple access, fading, noise, and interference conditions, etc., is often much less than a radio's maximum transmission rate.

b) **Dynamic topology:** Dynamic topology membership may disturb the trust relationship among nodes. The trust may also be disturbed if some nodes are detected as compromised.

c) **Routing overhead:** In wireless ad-hoc networks, nodes often change their location within network. So, some stale routes are generated in the routing table which leads to unnecessary routing overhead.

d) **Hidden terminal problem: :** The hidden terminal problem refers to the collision of packets at a receiving node due to the simultaneous transmission of those nodes that are not within the direct transmission range of the sender, but are within the transmission range of the receiver.

e) **Packet loss due to transmission: :** Ad hoc wireless networks experiences a much higher packet loss due to factors such as increased collisions due to the presence of hidden terminals, presence of interference, unidirectional links, frequent path breaks due to mobility of nodes.

f) **Battery constraints:** Devices used in these networks have restrictions on the power source in order to maintain portability, size and weight of the device.

g) **Security threats:** The wireless mobile ad hoc nature of MANETs brings new security challenges to the network design. As the wireless medium is vulnerable to eavesdropping and ad hoc network functionality is established through node cooperation, mobile ad hoc networks are intrinsically exposed to numerous security attacks**.**

1.4 Application of MANET

a) **Military battlefield:**Ad-Hoc networking would allow the military to take advantage of commonplace network technology to maintain an information network between the soldiers, vehicles, and military information head quarter.

b) **Collaborative work:**For some business environments, the need for collaborative computing might be more important outside office environments than inside and where people do need to have outside meetings to cooperate and exchange information on a given project.

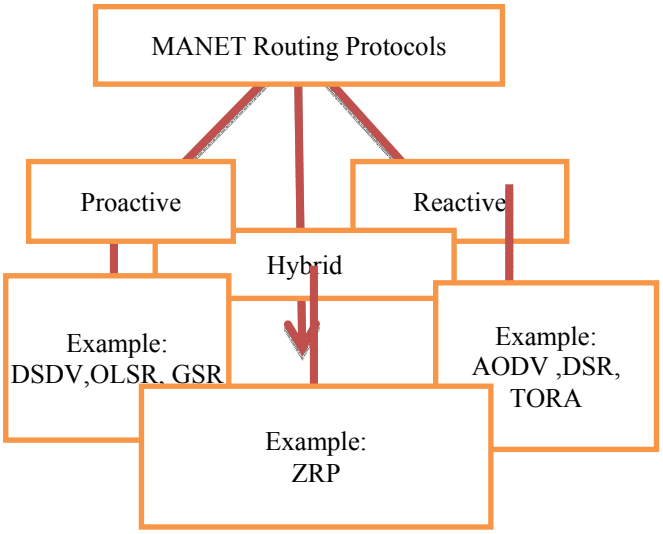
c) **Local level:**Ad-Hoc networks can autonomously link an instant and temporary multimedia network using notebook computers to spread and share information among participants at a e.g. conference or classroom. Another appropriate local level application might be in home networks where devices can communicate directly to exchange information.

d) **Personal area network and Bluetooth:**A personal area network is a short range, localized network where nodes are usually associated with a given person. Short-range MANET such as Bluetooth can simplify the inter communication between various mobile devices such as a laptop, and a mobile phone.

e) **Commercial Sector:** Ad hoc can be used in emergency/rescue operations for disaster relief efforts, e.g. in fire, flood, or earthquake. Emergency rescue operations must take place where non-existing or damaged communications infrastructure and rapid deployment of a communication network is needed.

2. ROUTING IN MANET

"Routing is the process of information exchange[3][4] from one host to the other host in a network." Routing is the mechanism of forwarding packet towards its destination using most efficient path. Efficiency of the path is measured in various metrics like, Number of hops, traffic, security, etc. In Ad-hoc network each host node acts as specialized router itself. The protocols may be categorized into two types, Proactive and Reactive. Other category of MANET routing protocols which is a combination of both proactive and reactive is referred as Hybrid.



Classification of MANET routing protocols

Proactive routing (Table- Driven) protocols: In this protocol, all the nodes continuously search for routing information with in a network, Every node maintains one or more tables representing the entire topology of the network. These tables are updated regularly so that when a route is needed, the route is already known. If any node wants to send any information to another node, path is known, therefore, latency is low. However, when there is a lot of node movement then the cost of maintaining all topology information is very high. Example of proactive routing protocols are-

- DSDV(Destination sequence distance vector Routing)
- OLSR(Optimized link state Routing)
- GSR(Global state Routing)

Reactive Routing (On-Demand) protocols: Routing informationis collected only when it is needed, and route determination depends on sending route queries throughout the network. That is whenever there is a need of a path from any source to destination then a type of query reply dialog does the work. Therefore, the latency is high; however, no unnecessary control messages are required. Example of reactive routing protocols are-

- AODV(Ad hoc on demand distance vector Routing)
- DSR(Dynamic source Routing)
- TORA(Temporally ordered Routing algorithm)

Hybrid routing protocols: These protocols incorporates the merits of proactive as well as reactive routing protocols. Nodes are grouped into zones based on their geographical locations or distances from each other. Inside a single zone, routing is done using table-driven mechanisms while an on-demand routing is applied for routing beyond the zone boundaries. The routing table size and update packet size are reduced by including in them only art of the network (instead of the whole); thus, control overhead is reduced. Example of hybrid routing protocols are –

- ZRP(Zone Routing Protocol)

3. LOAD BALANCING

The nodes [5] that are more powerful in a mobile ad hoc network finish their assigned tasks as soon as possible and become idle much earlier than those which are less powerful and do their tasks slowly. If we split the efficiency of the nodes on multiple paths then the source – to – destination flow could be speed up. This process is called as load balancing and is used for improving the efficiency of the network. The difference between an overloaded and an under loaded node is effectively improved by the load balancing technique. It helps to improve the lifeof the nodes which is called as the network lifetime. The load balancing technique also helps to improve the end-to-end delay and also minimizes the congestion. Load balancing routing aims to move from the areas that are above the optimal load to less loaded areas so, that the whole network achieves the better performance.

3.1 Load Balancing Protocols

1) LBAR(Load–Balanced Ad hoc Routing)

The load balancing ad-hoc routing[6] protocol focuses on how to find an optimal path, which would reflect the least traffic load So data packet can be routed with least delay. LBAR defines a metric for routing known as Degree of nodal activity to represent load on a metric node. The route discovery process is initiated whenever a source node needs to communicate with another node needs to communicate with another node for which it does not have a known route. The route discovery processis initiated whenever a source node needs to communicate with another node for which it does not have a known route. The process is divided into two stages: forward and backward. The forward stage starts at the source node by broadcasting setup messages to its neighbors. A setup message carries the cost seen from the source to the current node. A node that receives a setup message will forward it, in the same manner, to its neighbors after updating the cost based on its nodal activity value. In order to prevent looping when setup messages are routed, all setup messages are assumed to contain a route record, including a list of all node Ids used in establishing the path fragment from the source node to the current intermediate node. The destination node Collectarriving setup messages within a route-select waiting period, which is a predefined timer for selecting the best-cost path. The backward stage begins with an ACK message forwarded backward towards the source node along the selected path, which we call the active path. The cost function is used to find a path with the least traffic so that data packets can be transmitted to the destination as fast as possible which achieves the goal of balancing loads over the network. In this protocol, Active path is a path from a source to a destination, which is followed by packets along this selected route. Active node is considered active if it originates or relays data packets or is a destination. Inactive node is considered inactive if it is note along an active path. Activity is the number of active paths through a node is defined as a metric measuring the activity of the node. Cost is the minimum traffic load plus interference is proposed as the metric for best cost.

2) Alternate Path Routing

Alternate path provides load balancing[7] by distributing the data traffic along set of alternative paths. By using set of alternate paths, APR also provide failure protection, i.e. if one path fails to transfer the data, it can use another alternative paths. Due to Route coupling resulted from geographic proximity of different candidate paths between common endpoints (nodes) APR are not fully utilized. Coupling occurs because candidate paths have to share common intermediate nodes. This protocol anyhow works well for multi-channel networks, but this may cause much serious problem in single channel networks.

3) DLAR PROTOCOL(dynamic load aware routing)

In DLAR[8] protocol the intermediate nodes load as a metric for selection of the route and detect the status of the routes that are active to construct the path when the nodes of the route have overloaded interface queue.Source node sends the RREQ packet to its immediate neighboring nodes to find a new route. When intermediate node receives RREQ then they make the entry of <source and destination> pair and also record the previous entry to proceeds backward learning. DLAR does not allow sending REPLY via that route for avoiding the congestion.in the active state nodes piggybacks their load information on the data packets. These data packets have the information which the destination receives and so the destination comes to know whether the path is congested or

not. In the case of congested path a new path is constructed, so that the data packets can be send safely over that route to the destination without congestion.

4) LARA PROTOCOL(load aware routing)

Traffic density is a parameter used in LARA[9] which is used for mobile ad hoc networks for load balancing. Traffic density is a degree of contention at MAC layer. The traffic density of a node is the sum of traffic queue qi of node i plus the traffic queues of all its neighbors, formally

$Q(i)= \sum q(j)$

For all $j \in N(i)$

Where N(i) is neighborhood of node i.

q(j) is the size of traffic queue at node j.

Q(i) is the sum of traffic queue of all neighbors of node i itself. LARA protocol requires that each node maintain a record of the latest traffic queue estimations at each of its neighbors in a table called the neighborhood table. This table is used to keep the load information of local neighbors at each node. LARA broad cast the messages in two ways-

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

HELLO PACKET BROADCASTING-A hello packet contains the sender node's identity and its traffic queue status. Neighbors that receive this packet update the corresponding neighbor's load information in their neighborhood tables. If a node does not receive a data or a hello message from some of its neighbors for a predefined time, it assumes that these nodes have moved out of the radio range of this node and it changes its neighborhood table accordingly.

5) SLAR PROTOCOL(simple load balancing ad hoc routing)

SLAR [10] is not a new routing protocol but as an enhancement of any existing ad hoc routing protocols like AODV,DSR etc. SLAR may not provide optimized solution but it may reduce the overhead introduced by load balancing and prevent from severe battery power consumption caused by forwarding packets. Advantages of SLAR protocols are-

- Reduces overhead
- Reduces the severe battery power consumption caused by forward packets.

6) Congestion Avoidance Based Load Balanced Routing(CALBR)

CLBAR [11] is a routing scheme for mobile ad hoc network.Each node keeps track of the number of data packets transmitted by him as well as the data packets transmitted by its one hop neighboring nodes along with their flag bit status for the current time interval. The proposed approach is attempts to avoid the congestion of a node by selecting the disjoint paths. This is achieved by setting a flag bit with the time limit TTL, at the node. On exceeding of this value, the flag bit is reset. By this approach we have attempted to limit the flooding and congestion of the node along with effective balancing of the traffic load.

7) Traffic Size Aware Routing (TSAR)

The "Traffic-Size" based load balancing

Routing protocols like DLAR, LARA, LSR etc. in TSAR [12] traffic size is measured by the number of packets and size (in bytes) of every packet that it routes using a particular entry. Every node maintains an entry for active virtual path it services. The creation time of entry is recorded in the entry itself by the node. In this scheme, the network nodes keep track of the size of traffic (in bytes) being routed.The nodes are also aware of the size of the traffic that is routed through their neighbors. For any path that consists of multiple hops, the load metric of the path is the sum of all the traffic that is routed through all the hops that make up that path.

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