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A Survey on an Efficient Delay based Load Balancing using AOMDV in MANET

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ABSTRACT

Mobile Ad hoc Network (MANET) are infrastructure less networks, dynamically formed by an autonomous system of mobile nodes that are connected via wireless links. The nodes are free to move randomly and organize themselves arbitrarily; thus the network's wireless topology may change rapidly and unpredictably MANET has no centralized control for distribution of load properly so load balancing become one of the most important issues in MANET. Load Balancing is the process of improving the performance of a network through a distribution of load among different nodes. If a network is heavily loaded without any load balancing capability, it degrades the performance by causing congestion, delay and resource loss in network. In recent years, multi-path routing protocols have attained more attention in mobile ad hoc networks as compared to single path routing due to their abilities and efficiency in improving bandwidth of communication, increasing delivery reliability, responding to congestion and heavy traffic. This paper provides the complete survey on load balancing using multipath routing in MANET.

1. Introduction

A mobile ad hoc network (MANET) is a set of wireless mobile nodes that can communicate without any centralized administration. Due to its self-configuration, flexibility and distributed nature, it is used in many applications such as disaster recovery, search and rescue operations, military service, and vehicular networks. MANETs have many features, including multihop communication, dynamics topology, limited security and resources. These features create special challenges in routing protocol design. The main objectives of the MANET routing protocol are—maximize network lifetime, energy efficiency, network throughput and delay minimization. To achieve these objectives, many routing protocols have been proposed for MANETs. The routing protocols in MANETs are classified into three categories: proactive routing protocols, reactive routing protocols and hybrid routing protocols. In proactive routing protocols, each node maintains routing information to reach other nodes in the network and updates its routing table periodically. The reactive routing protocol creates routes only when it is needed. Hybrid routing protocols are a combination of the best features from proactive and reactive routing protocols.

Among the many issues to be addressed in MANET, but routing it is a challenging issue due to its dynamic nature of network topology and limitations of resource constraints. The routing depends on many factors that include topology of a network, selection of routes and selection of routing algorithms and techniques. There is a huge need to design an efficient routing protocol that should be fully distributed, adaptive to dynamic topology and mobility, fast and easy route computation and maintenance process. The single-path routing protocols use shortest-path routing approach, so centre of the network gets more congestion comparing to the perimeter of the network. Also, it causes more overheads and consumes more bandwidth. Route discovery frequency is also high due to dynamic node's mobility and link failures.

To overcome the limitations of the single path routing protocol and achieve high performance, multipath routing protocols are introduced. The objectives of multipath routing are to ensure load-balancing, reliable communication, efficient Quality of service (QoS), maximize node and network life time, improve throughput etc. Numerous on-demand multipath routing protocols have been proposed for MANET. These multipath routing protocols attempt to discover multipath between source and destination pairs in the network and it discovers multipath in a single route discovery process. The selected multipath should be loop-free paths, disjointness of paths and consume optimal bandwidth. Multipath routing protocols relatively have a greater ability to reduce route discovery frequency than single-path routing protocols. Multipath routing protocols discover new routes when all paths become failing at the same time and also the possibility of such failure is very small.

Hence, routing is challenging issue in MANET, to distribute load among nodes become difficult in MANET because the nodes are free to move in network. The Improper distribution of load may lead to congestion in the network and also the heavily loaded nodes will be dead due to its limited bandwidth and resources. So in such situation, the proper distribute of load among node is needed with the multipath routing protocols.

The rest of this paper is organized as follows. In section II we discuss what is load balancing and what the need of it is. In III is described the related work that has been done in this field and section at the last V section V concludes this paper.

2. Load Balancing in MANET

Load balancing can be defined as a methodology to distribute or divide the traffic load evenly across two or more network nodes in order to mediate the communication and also to achieve redundancy in case that one of the links fails. Load balancing can be optimal resource utilization, increased throughput, and lesser overhead. The load can also be unequally distributed over multiple links by manipulating the path cost involved. In mobile ad hoc networks, balancing the load can evenly distribute the traffic over the network and prevent early expiration of overloaded nodes due to excessive power consumption in forwarding packets. It can also allow an appropriate usage of the available network resources. The existing ad hoc routing protocols do not have a mechanism to convey the load information to the neighbors and cannot evenly distribute the load in the network. On-demand routing protocols such as AODV initiate the route discovery only if the current topology changes and the current routes are not available. In high mobility situations where the topology is highly dynamic, existing links may break quickly [7]. It may be safe to assume that in such scenarios the on-demand routing protocol like AODV and DSR can achieve load balancing effect automatically by searching for new routes and using different intermediate nodes to forward traffic. Whereas, in the scenarios where the same intermediate nodes are used for longer period of time, the on-demand behavior may create bottlenecks and cause network degradation due to the congestion and lead to long delays, in addition, the caching mechanism in most on-demand routing protocols for intermediate nodes to reply from cache can cause concentration of load on certain nodes. It had been shown that the increase in traffic load degrades the network performance in MANETs. In other words, if the topology changes are minimal then this behavior results in the same routes being used for a longer period of time which in turn increases the traffic concentration on specific intermediate nodes. The early expiration of nodes can cause an increase in the control packets and the transmission power of other nodes to compensate the loss. Furthermore, it can result in network degradation and even an early expiration of the entire ad hoc network. Besides, using the same node for routing traffic for a longer duration may result in an uneven usage of the available network resources, like bandwidth. A network is less reliable if the load among network nodes is not well balanced [7].

3. Need for Load Balancing in MANET

A crucial part of the best possible network is the load balancing. For instance, job completion becomes complex, if enormous load is given to the nodes with less processing capabilities and which do not have any means to share the load. There is a possibility of load imbalance due to that the computing/processing power of the systems are non-uniform (i.e.,) few nodes maybe idle and few will be overloaded. A node which has high processing power finishes its own work quickly and is estimated to have less or no load at all most of the time. So, in the presence of under-loaded nodes, the need for over-loaded nodes is undesirable. Multi-path routing can balance the load better than the single path routing in ad hoc networks, where the first selective shortest paths are used for routing. This is possible only for the networks having a huge number of nodes (i.e., a large fraction of the total number of nodes in the network) between any source-destination pair of nodes. It is infeasible to build such a system it is economical for discovering and maintaining a large number of paths. Load balance is not improved by using multiple shortest path routes instead of a single path. So, for a better load balanced network distributed multi-path load splitting strategies need to be carefully designed [2].

4. Related work

This section briefs the existing work done in this field.

The authors proposed path-efficient ad hoc on demand multipath distance vector routing protocol [4] which compute the load on the node using the number of links passed through that node. They introduce two variable Active path(AP) threshold which defines the maximum number of paths passing over a node and AP counter is used to keep current active number of paths on a node. The AP counter variable is incremented by one for every new communication path establishment. AP counter variable and the AP threshold is added to the routing table and route request packet of the PE-AOMDV. If the nodes AP counter value is below the RREQ packets' AP threshold value, then the node is qualified and able to broadcast RREQ packet. Now AP counter is updated by one, the selected node will rebroadcast RREQ packet, only if the number of hops is less than or equal to the last hop count recorded in the routing table. By doing so, the overloaded nodes are excluded from the paths and an on-demand routing protocol using these scheme will distribute the traffic load evenly on multiple nodes in the network.

This paper [5] proposed an efficient routing technique called the multipath load balancing technique for congestion control (MLBCC) in MANETs to efficiently balance a load among the multiple paths. The proposed technique performs the two major functions during the data transmission phase of multipath routing protocols. Firstly, congestion is detected by using an arrival rate and an outgoing rate at a particular time interval time T. Secondly; gateway nodes are selected by using the link cost and the path cost to efficiently distribute the load by selecting the most desirable paths. Whenever the load is beyond a maximum threshold value (i.e., overloaded), the traffic is distributed via the gateway nodes. The gateway nodes are the relay nodes of the established reliable paths. The packets are fragmented, evenly distributed and sent through different randomly chosen paths in a round robin fashion. The availability of nodes on the current path and the average availability of paths are calculated for transmission. The flow distribution on each path is according to the node availability degree standard deviation value.

The authors eventual Fibonacci sequence based load balancing (FMLB) routing protocol in [6]. FMLB is based on distance vector routing and split the data via hop-by-hop transfer of packets. The FMLB protocol distributes transmitted packets around multiple paths through the mobile nodes using Fibonacci sequence. Such distribution can increase the delivery ratio. The FMLB protocol's function is balancing the packets transmission around the engaged paths and ordering them by hops count. A weight based on number of hops is assigned to each route. The weight is expected according to Fibonacci sequence numbers. Fibonacci number is calculated as follows:

$$fib(0) = 0$$
$$fib(1) = 1 \quad (1)$$
$$fib(n) = fib(n-2) + fib(n-1); \quad n >= 2$$

If the number of routes in FMLB is n and they are arranged according to number of hops in non-decreasing order, then FMLB assigns *fib(n), fib(n-1), fib(n-2).....fib(2),fib(1)* weight, respectively. If the numbers of hops for any two paths are same, then the recent path is preferred to the older one.

The drawback of the protocol FMLB in [6] is modified by the authors in [7] that Fibonacci sequence based load balancing routing protocol which is called as Congestion-Aware FMLB. They depict this protocol in three phases: route discovery phase, load balancing phase and route maintenance phase. In route discovery phase, when the source node broadcast RREQ towards the destination the source node saved its sending time in the routing table and when the RREP packet arrives at the source node, its receiving time is saved in the routing table. Using the RREQ packet sending time and RREP packet receiving time, round-trip is calculated. In the Load balancing phase, the round-trip time is suited because congestion in the network is convinced based on this field. As we understand, the most of the routing protocols decide the best route according to the number of hops. If a route requires a fewer number of hops than other routes, then this route is recommended to other routes. It is supposed that the route with a few numbers of hops requires less time. But it is not true in all the cases. If the communication is already taking place among intermediate nodes in the shortest paths then scenario will be different. If RREQ packet is going through the shortest route, there is a possibility that the packet will arrive to destination node very late. Instead of that we can use round trip time for selection the route. Using round-trip time, it can be easily determine whether there is traffic jam in any route. Using this function, routes are sorted out and consequently load is assigned according to the Fibonacci sequence numbers.

The authors find the solution for avoiding heavy traffic in the network by adapting to the moment changes in the congestion state a new algorithm has been proposed in [8]. The approaching congestion adaptive algorithm skilled of countering congestion in the network and is specified as load balanced congestion adaptive routing (LBCAR)algorithm. In this protocol each node maintains a record of the latest traffic load estimations at each of its neighbours in a table called the neighbourhood table. This table is used to retrieve the load information of local neighbours at each node. Neighbours that receive this packet update the corresponding neighbour's load information in their neighbourhood tables. LBCAR is a new load balanced congestion adaptive technique expected to minimize congestion and to maximize the network operational lifetime. The metric traffic load density is used to explain the congestion status of the route and link cost is used to show the lifetime of the route. The route with low traffic load intensity and maximum lifetime is occupied for packet transmission and this algorithm infrequently limits the idealized maximum number of packets transmittable over the route having weakest node with minimum lifetime and high traffic load intensity. In this behaviour, traffic is distributed according to the traffic load intensity and link cost. The overloaded nodes are secure by using the nodes of lighter traffic load to assist the route, so as to balance the network load, minimize the congestion of the network, improve the data transmission efficiency, and maximize the network lifetime.

The queue length based approach for load balancing is design by author in [9]. AOMDV routing protocol establish multiple disjoint paths between sender and receiver after a route discovery process. The sender uses these multiple paths for sending data to receiver thus tends to balance the load of the network. Now whenever a sender wants to send data it uses multiple paths and every time it measures end-to-end delay as well as normal time (without congestion) acknowledgment delay difference and store it. Now we create the second scenario in which a number of TCP senders and receivers share common mobile node resulting congestion in the network which is unavoidable so each sender compares new acknowledgment delay difference with previous acknowledgment delay difference. If sender finds that delay are increasing from previous recorded time so it changes the data rate (minimum from previous). This bandwidth estimation technique through acknowledgment delay difference is applied to each TCP sender node and according to it each sender node changes its basic data sending rate and minimizes congestion in the network. Second approach for congestion control is dynamic queue management technique in this technique dynamic queue is implemented at each node of a network so that congestion due to queue overflow will be minimized. Both technique base we minimize congestion and increase the percentage of receiving data in the network as well as de-crease average end-to-end delay of the network.

The authors design AOMDV based load balancing and rate based congestion control in MANET environment in [10] that source node forwards the data packet to the destination through the intermediate nodes. On reception of the data packet at the intermediate node, percentage of channel utilization and queue length are estimated and node is verified for congestion status. This process is repeated at every intermediate node, and finally the packet reaches the destination node. After the reception of the data packet, the destination node checks for the rate information in the packets IP header fields. Along with other essential fields, estimated rate is copied to an acknowledgement packet and sent as a feedback to the sender. The sender performs rate control according to the estimated rate obtained from the destination.

Problem with the existing AOMDV has been described [11] and based on that they improved the AOMDV multipath protocol. For the load distribution the protocol selects the route with the lower hopcount to forward the data. However, the less congestion routes can provide short end to end delay than routes providing lower hopcount. To choose the less congestion routes, author introduce a new matric which allow source node to select the less congestion routes for that reason buffer size is used to check the congestion level of the route. The maximum buffer size is defined as the maximum occupation size of the link i buffer in each intermediate node. Exceeding this matric value indicates congestion at the route traversing this node. To build the Load balancing AOMDV

protocol, the structure of RREP packet by adding a new field called buffer_size which take into account the traffic load on the route. This traffic load is expressed as the sum of buffer_size of intermediate nodes for each route between source and destination. When an intermediate node receives RREP packet, it increments the new field with the size of its buffer. On the other hand, when the source node receives RREP packet, it divides the value of buffer size field by the hopcount of each route between source and destination in order to have congestion level.

The improved AOMDV multipath routing in [11], has been extended in [12] by using additional parameter delay and throughput. QoS routing requires not only to find a route from a source to a destination, but a route that satisfies the end to-end QoS requirement, often given in terms of bandwidth, delay or loss probability. Quality of service is more difficult to achieve in ad hoc networks than in their wired counterparts, because the wireless bandwidth is shared among adjacent nodes and the network topology changes unpredictably as the nodes move. The objective of QoS routing in MANET is to optimize the network resource utilization while satisfying specific application requirements. The difficulties for supporting QoS in MANET environments are node mobility, routing overhead and limited battery life. Author adds QoS to our proposal LB-AOMDV protocol which includes delay and throughput parameters. It takes advantage of the RREQ messages to exchange the essential information to achieve the QoS requirements. Enabling a QoS constrained from source to destination is the objective of our new protocol called QLB-AOMDV. Each node in the network estimates its quality of links with its one-hope neighbors. Node can estimate the link delay by using the information in the RREQ message. For that reason, were define the structure of RREQ message by adding two new fields which indicates the received time of the packet(Tr) and the transmission delay of the packet (Delay).

5. Comparison

The following Table 1. shows the comparison of existing load balancing techniques in the different parameters like packet delivery ratio(PDR), delay, throughput and routing overhead.

Table 1. Comparison of the Existing Load Balancing Techniques.

	Delay	PDR	Throughput	Routing overhead
PE-AOMDV [4]	Low	High	High	Low
MLBCC [5]	Low	Moderate	-	Moderate
FMLB [6]	Moderate	High	-	-
Congestion Aware FMLB [7]	Low	High	-	-
LBCAR[8]	Moderate	Moderate	-	Moderate
Queue Length based AOMDV [9]	Moderate	High	High	Low
MLBRCC [10]	Low	Moderate	-	-
LB-AOMDV [11]	Low	Moderate	-	-

6. Conclusion

There is no centralized control in MANET and the nodes can freely move and self-configured into the network topology. Hence, balancing the load in MANET is important because nodes in the network have limited communication resources such as bandwidth, buffer space and battery power. So it is important to distribute the traffic among the mobile node properly. Load balancing is used to improve performance of the network. Also, it is possible to maximize nodes lifetime, packet delivery ratio and minimize traffic congestion also we can decrease the end-to-end packet delay. This paper discussed various load metric and various load balancing routing techniques by that we aware about the different work that has been done in this field with their limitations.

References

1. R. Sharma, "Survey of Load Balancing and Load Sharing through AOMDV Protocol in MANET", International Journal of Scientific & Engineering Research, vol. 4, no. 5, pp. 2269-2275, 2013.
2. B. Sharma, S. Chugh and V. Jain, "Investigation of Adaptive Multipath Routing For Load Balancing In MANET", International Journal of Engineering and Advanced Technology (IJEAT), vol. 2, no. 5, pp. 65-71, 2013.
3. M. Marina and S. Das, "Ad hoc on-demand multipath distance vector routing", Wireless Communications and Mobile Computing, vol. 6, no. 7, pp. 969-988, 2006.
4. K. Mounagurusamy and K. Eswaramurthy, "A Novel Load Balancing Scheme for Multipath Routing Protocol in MANET", Journal of Computing and Information Technology, vol. 24, no. 3, pp. 209-220, 2016.
5. S. Mallapur, S. Patil and J. Agarkhed, "Load Balancing Technique for Congestion Control Multipath Routing Protocol in MANETs", Wireless Personal Communications, vol. 92, no. 2, pp. 749-770, 2016.
6. Y. Tashtoush, O. Darwish and M. Hayajneh, "Fibonacci sequence based multipath load balancing approach for mobile ad hoc networks", Ad Hoc Networks, vol. 16, pp. 237-246, 2014.
7. M. Naseem and C. Kumar, "Congestion-Aware Fibonacci Sequence Based Multipath Load Balancing Routing Protocol for MANETs", Wireless Personal Communications, vol. 84, no. 4, pp. 2955-2974, 2015.
8. J. Kim, G. Tomar, L. Shrivastava, S. Bhadauria and W. Lee, "Load Balanced Congestion Adaptive Routing for Mobile Ad

Hoc Networks", International Journal of Distributed Sensor Networks, vol. 10, no. 7, p. 532043, 2014.

9. [9] A. Shukla and S. Sharma, "Queue Length based Load Balancing Technique using with AOMDV Protocol in MANET", International Journal of Scientific & Engineering Research, vol. 4, no. 10, pp. 506-511, 2013
10. S. Soundararajan and R. S. Bhuvaneswaran, "Multipath load balancing & rate based congestion control for mobile ad hoc networks (MANET)," *Digital Information and Communication Technology and its Applications (DICTAP), 2012 Second International Conference on*, Bangkok, 2012, pp. 30-35.
11. M. Tekaya, N. Tabbane and S. Tabbane, "Multipath routing mechanism with load balancing in ad hoc network," The 2010 International Conference on Computer Engineering & Systems, Cairo, 2010, pp. 67-72.
12. M. Tekaya, N. Tabbane and S. Tabbane, "Multipath Routing with Load Balancing and QoS in Ad hoc Network", International Journal of Computer Science and Network Security, vol. 10, no. 8, pp. 280-286, 2010.

