A Novel Energy Efficient Routing for Data Intensive MANETs

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***Abstract*—**Mobile ad hoc networks (MANETs) consist of a collection of wireless mobile nodes which dynamically exchange data among themselves without the need of fixed infrastructure or a wired backbone network. Routing protocol scheme for wireless networks are support by two essential requirements, minimize energy metrics or maximize network throughput. In this paper we propose a proactive source routing protocol with multipath routing facility. This multipath routing is established reactively. Owing to the inconsistency of the wireless infrastructure and nodes mobility, single path routing protocols causes performance degradation in mobile networks. Multi path routing protocol enhances the end-to-end throughput and offers load balancing in MANETs.Energy consumption in MANET is one of the important issues in this research. Reliable data delivery in MANET consumes lot of energy. Here we use a data aggregation technique along with multipath routing. As data communication involves heavy energy consumption, reducing the number of data transmissions helps in energy conservation. The performance analysis and simulation are carried out using Network Simulator-2.

Keywords:- *MANET, Multi path routing, Energy, Data aggregation, Throughput*

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I. INTRODUCTION

A mobile ad hoc network is a group of wireless mobile nodes which are capable and agree to establish relations, using without any centralize supervision and infrastructure. The self-organized characteristic of such networks makes them particularly suited for the scenarios where quick deployment of communication network is desired without depending on an existing infrastructure, such as defence operations and emergency search-and-rescue operations. Thus each node of a mobile ad-hoc network acts not only as a host but also as a router – forwarding data packets for the other participating nodes. The nodes also need to actively participate in discovering new routes for their own requirements as well as for the benefit of other nodes. Mobile nodes forming the ad hoc networks are generally autonomous and can move at their own free will, resulting in dynamic topologies of such networks. In the absence of a fixed infrastructure, discovering and maintaining routes under such dynamic conditions is a nontrivial task.

In order to facilitate communication within the network a routing protocol is used to discover routes between nodes. The primary goal of such ad hoc network routing protocol is correct and efficient route establishment between a pair of nodes so that packets can be delivered in a timely manner. Along with that energy efficiency is a critical issue in ad hoc network for longer network connectivity.

Energy consumption in MANET is one of the important issues in ad hoc networks. Reliable data delivery in MANET consumes lot of energy. There will be many retransmissions and the data need to be propagated to the destination node. The nodes will have limited energy resources and this retransmissions etc., will consume lot of energy compared to energy available to the MANET node. Routing protocol scheme for wireless networks are support by two essential requirements, minimize energy metrics or maximize network throughput. The objective of this paper is to facilitate multipath routing in MANET along with data aggregation technique. Multipath routing protocol enhances the end-to-end throughput and offers load balancing in MANETs. As data communication involves heavy energy consumption, reducing the number of data transmissions by data aggregation helps in energy conservation.

II. RELATED WORKS

In traditional routing approaches a single path is selected for active communication between source and destination. Multipath routing discovers multiple routes between a source and destination at the time of single route discovery. It helps to maintain alternative routes even if one route failure occurs during fault tolerance. Energy consumption in MANET is one of the important issues in ad hoc networks. Reliable data delivery in MANET consumes lot of energy. There are several energy efficient multipath routing protocols for choosing energy efficient path. This will minimize the energy consumption in ad hoc networks. The bandwidth limitation is a major drawback of single path routing, where it may not offer adequate bandwidth for a connection. The routes can be established either by reactively or proactively. Hybrid routing methods increase efficiency of the network. PSR is a light weight proactive source routing protocol [1]. PSR can maintain more network topology information than distance vector (DV) routing to facilitate source routing, although it has much smaller overhead than traditional routing protocols. Fujian Qin et al. [2] have proposed a new Multipath source routing protocol with bandwidth and reliability constraints for MANET. In order to get the multipath routing, they expand DSR's routing discovery and maintenance technique. To attain a better cooperation among load balancing and network overhead, an ultimate count of multipath route is examined. Also, per packet granularity is utilized to allocate the packets from multiple links between the paths in MSR.

III. PROACTIVE SOURCE ROUTING PROTOCOL

To support opportunistic data forwarding in MANET, here we use a light weight proactive source routing protocol. It can maintain more network topology information than traditional routing protocols. Network topology information in proactive source routing is efficiently maintained and exchanged by using the tree structure, hence the overhead get greatly reduced. Here each node maintains a breadth-first search spanning tree of the network rooted at itself. The update operation is iterative and distributed among all nodes in the network due to the proactive nature. Each node updates its own BFST based on the recent information received from its neighbors. Communication overhead is not increased as one routing message is sent per update interval. Thus, proactive source routing allows a node to have full-path information to all other nodes in the network, although the communication cost is only linear to the number of the nodes.

In route update operation, each node maintains a neighbor table about entire network topology information. For this purpose nodes periodically exchange their table information with neighbors. The beacon message used to advertise the availability of node to other nodes. By using the information collected from neighbours during the most recent iteration, every node refreshes its knowledge about the network topology by adding such recent information. In the next round of operation this knowledge will be distributed to its neighbours. It does not increase the communication overhead as one routing message is sent per update interval.

In proactive source routing when a neighbour is disconnected from the network, then each node removes all the data about the lost node. By using the source routing, the node can update the intermediate node details. Based on the time interval of packet arrival, new packet generation will be cancelled. Such process is triggered when no routing update or data packet has been received from this neighbour for a given time and when data transmission to such node has failed. This process can be initiated more number of times. Also in proactive source routing full update messages are sent less frequently than shorter messages containing the difference between the current and previous knowledge of a node's routing module.

IV. ENERGY EFFICIENT MULTIPATH ROUTING

Here we introduce multipath routing in our proposed scheme. In proactive routing, the nodes need to get the periodic update from their neighbors. Due to time dependency, the proactive routing will be get fails to build instant route when the link fails. Multipath routing discovers multiple routes between a source and destination at the time of single route discovery.It helps to maintain alternative routes even if one route failure occurs during fault tolerance. The bandwidth limitation is a major drawback of single path routing, where it may not offer adequate bandwidth for a connection. Since, data is routed simultaneously among multiple paths in multipath routing, the cumulative bandwidth may suit bandwidth requirement of an application [12]. This protocol enhances the end-to-end throughput and offers load balancing in MANETs.

In route discovery procedure, routes are determined periodically and the routes are available from routing table. Whenever a node wants to send data it will select one of the routes from routing table. When the transmission uses the same path for entire communication, the energy level of that path is decreased. To avoid this we will choose the alternate path based on the time. The entire data is transmitted in many paths, so the energy of the single path is shared with multiple paths. This helps to improve energy efficiency of the network. In proactive routing usually the error packets are broadcasted only when broken links are discovered in the route discovery procedure. So the probability of links breaking increases as the mobility increases. In our proposed work whenever a link fails it will establish the route reactively by selecting another path from the available routes and avoiding the failed link or nodes. Nodes mobility will cause the communication links between nodes to frequently be broken. A local repair will, in general, also cost less power consumption relative to reestablishing a new source-to-destination route. Intermediate nodes that participate in exchanging data traffic are allowed to locally repair broken routes through a route repair packet instead of just reporting a broken route to its source nodes. Once an intermediate node recognizes a broken link to a certain destination nodes, it buffers the received data packets for that destination node. Then, the intermediate nodes look up its own neighbor table to find if it has any neighbor nodes closer to the intended destination nodes. If a closer neighbor nodes is available, data packets are forwarded to that nodes after the intermediate nodes has updated its own neighbor table.

The multipath routing is established using AOMDV protocol. So here we combine both the advantage of proactive and reactive routing. Multiple paths are established by considering energy of the nodes. Energy of all nodes in the network is periodically monitored. While monitoring energy of the nodes in the network, if it finds energy of a node is decreasing it will immediately switch the data to the other node so that we can avoid node failure due to lack of energy. In this routing scheme nodes always store their energy level in allocated array. So node can check previous energy level before current value update. According to this energy level nodes switch their data to other node. This will increase life time of the network. Even if we are switching the nodes based on energy there can be failures in the path, at that time the paths are established reactively. Periodic energy monitoring and route updating will improve energy efficiency of the network.

V. DATA AGGREGATION

As data communication involves heavy energy consumption, reducing the number of data transmissions by data aggregation helps in energy conservation. When many packets are intended for the same destination the network will be more congested. A node has to wait when any data is sending or receiving, by this waiting time delay for the transmission is increased. To avoid this data are combined into a single packet and forwarded instead of sending data in various packets. This reduces redundancy and saving energy by minimizing number of transmissions. In the data aggregation method all the data from the nodes and its own data are combined in to a single packet. Here we are

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physically combining the data from different sources into a single packet. The destination regenerates all the original packets when it receives an aggregated packet.

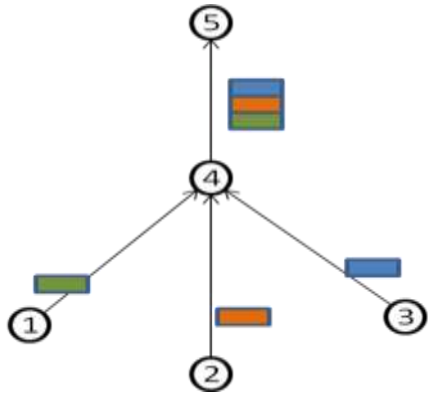

Fig. 1 Packet Combining

When data from different sources are forwarded to the base station, some of the intermediate nodes will participate in data aggregation. The energy of these intermediate nodes will decrease after a period of time. These intermediate nodes combine packets from different sources into one bigger packet. The packet combining continues until a timeout occurs. The overhead of the packet in this case reduces and granularity of the data is preserved. Packet combining can also prevent unauthorized information disclosure. The packet combining reduces number of packets in the network.

VI. SIMULATION RESULTS

Fig. 2 shows the network topology and data transmission. Table updating and energy monitoring occurs periodically. Here the topology information's are updated proactively and the routes are established reactively.

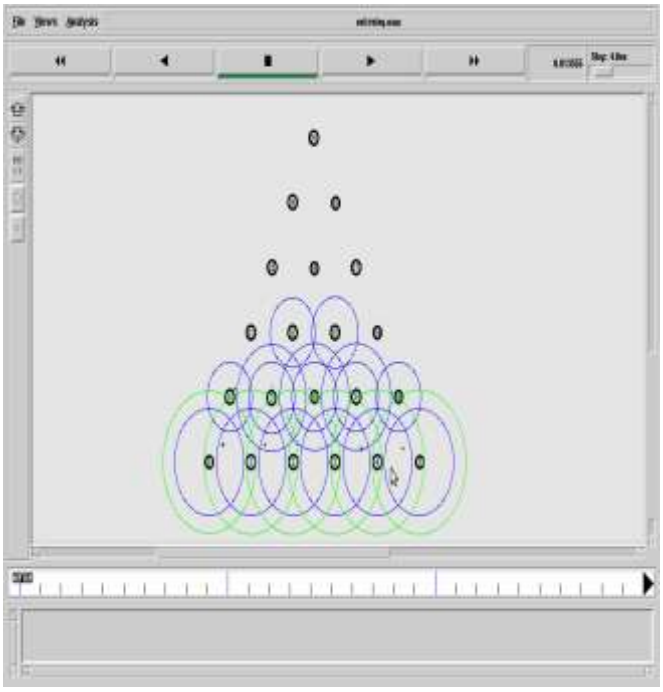

Fig. 2 Network Topology

Fig. 3 shows the energy consumption graph plotted between number of nodes and energy utilization. Normally in proactive source routing when number of node increases the energy consumption also increases to a great extend. But in the proposed scheme we can see that the energy consumption is less compared to proactive source routing because of the balanced energy utilization.

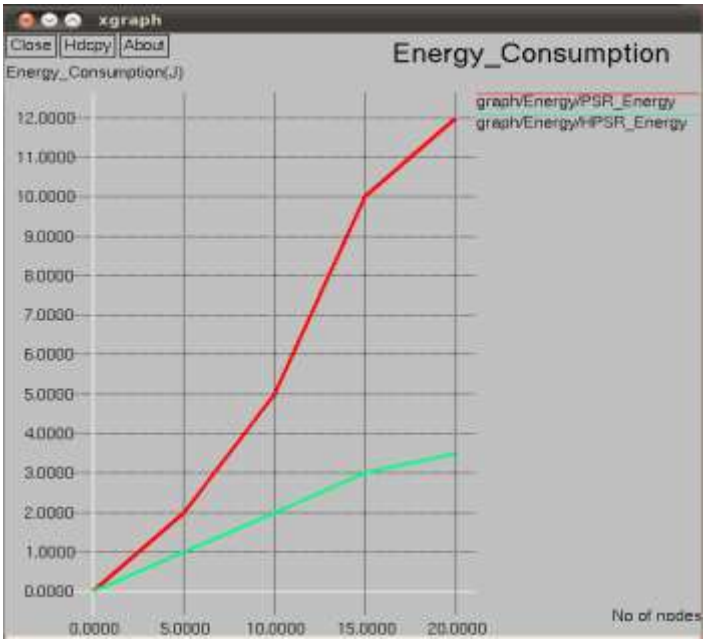

Fig. 3 Energy vs. Number of Nodes

Fig. 4 shows the graph plotted between throughput and number of nodes. Throughput is the data transferred or handled per unit time.

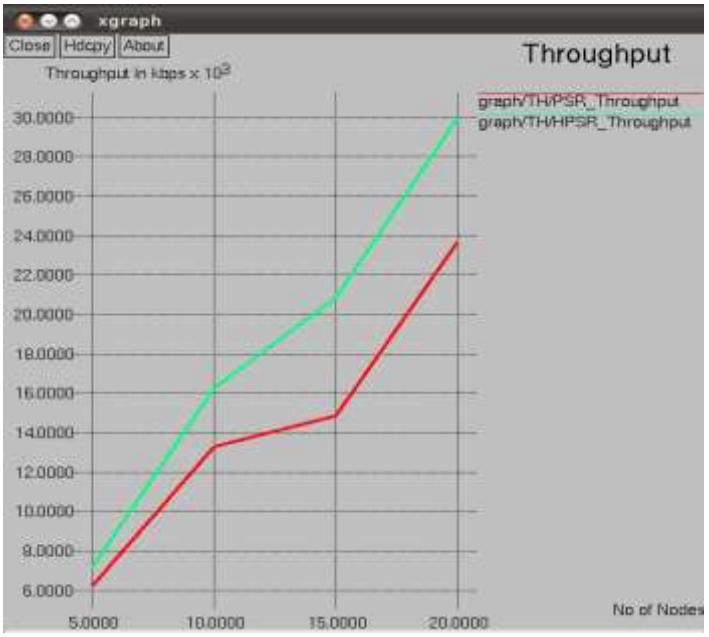

Fig. 4 Data rate vs. Number of nodes

Fig. 5 shows overhead graph. Simulation result shows that the overhead in our proposed scheme is decreased by a large amount than proactive source routing.

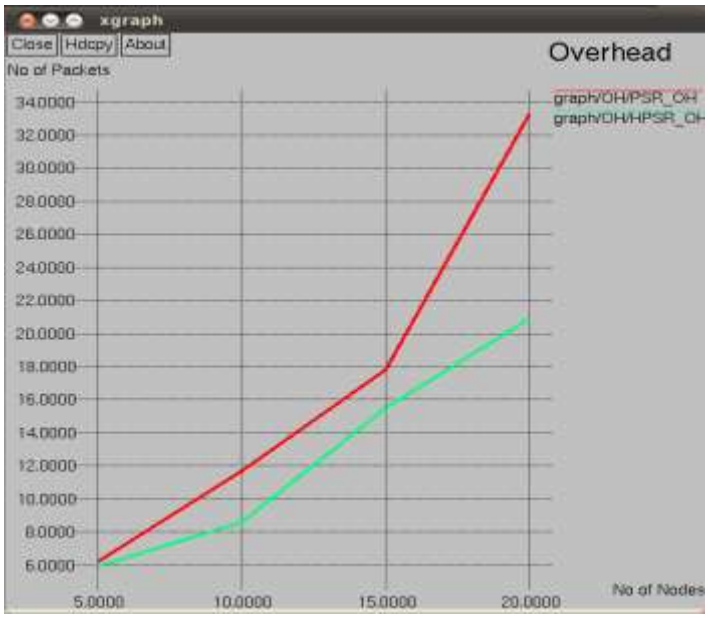

Fig. 5 Number of packets vs. Number of nodes

VII. CONCLUSION

Energy conservation is an important issue in ad hoc networks as nodes are usually battery powered. Routing protocol scheme for wireless networks are support by two essential requirements, minimize energy metrics or maximize network throughput. In order to satisfy these requirements here we are using an energy efficient routing scheme. Here the topology of the network is discovered in a proactive manner and routes are established in a reactive manner. The packet combining scheme reduces overhead in the network. Simulation result shows that the throughput is increased and also the energy utilization is minimized.

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