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Survey Paper on Energy Efficient Routing Protocol in MANET

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Abstract: In mobile ad hoc network hierarchical approach and distributed approach are more practical as compared to the flat architecture. Energy efficiency in mobile ad hoc network is very important. Similar the looping free path is also very important. There are the numbers of protocol for ad hoc network but one confusing problem is the vast number of separate protocol. All the protocols are designed to do its task as well as possible. We will propose energy-efficient routing protocol which gives efficient energy to the MANET. Ad hoc On Demand Distance Vector Multipoint Relay Routing Protocol (AODVMPR). AODVMPR is used to overcome the issue of energy and the looping problem in a single routing protocol. This protocol helps to improve the traffic on the network. We use AODV and in AODV we use MPR which reduce the flooding of control message. In multi-point relay each node has computed a multipoint relay set. If any node which is not in the multipoint relay set than this node cannot broadcast the packet.

Keywords: Distance routing protocol, Multipoint Relay, and Ad hoc network.

I. Introduction

Ad hoc network are the temporary network. Ad hoc network short-range network and they are created when device uses the same protocol. Ad-hoc network does not need any subscription service. With the help of ad-hoc network it reduces the cost and improves the security. An ad hoc network is a local area network where messages flow from one node to another node instead of relying on a base station. Ad hoc networks give the ability to wireless devices to communicate with each other in local area network. Ad hoc networks decreased the dependence in infrastructure and increase the speed of deployment. Since nodes are not bound to any centralized control they are free to move about arbitrarily and hence the topology changes. Due to the noise, capacity of each link can vary. Ad hoc network nodes rely on batteries or some other exhaustive mean energy. For lean power consumption we tend to design these protocols. MANET [1], [8] stands for Mobile Ad hoc network. Mobile ad hoc network is a self-organized network of mobile nodes, without base station support. In this the mobile nodes communicate with each other with the help of a shared wireless channel. The most significant characters of MANET are mobility. This means that nodes can join or leave the network in MANET dynamically. This leads to rapid change in topology. In order to keep the routing information available, all the nodes need to know the topological changes occurring anywhere in the network. When regular updates occur related to topology then the traffic of the network is rises. MANET is a peer-to-peer network, which allows live communication between any two nodes, only if both nodes are within their radio range. Unfortunately, in large cases not all the nodes of network are in the radio range of each other to communicate directly i.e. not within one hop. So we can use multi-hop topology. These nodes are called Intermediate nodes through which the message is being sent by source relayed node to the destination node. A MANET is a decentralized system. A decentralized wireless system consists of free nodes. It is sometimes called mobile mesh network and is a self-configurable wireless network. MANET consists of mobile nodes and a router. A router connects to multiple hosts and wireless communication devices. These wireless communication devices are transmitter or receivers. Receiver and transmitters will have smart antennas of various kinds and nodes (transmitter/receiver) can be fixed or mobile. In real life these node referred to those devices which are free to move in any direction such as a mobile phone, laptop, personal computer etc.

All the nodes are also located in cars, airplanes or with people having small electronic devices etc. These nodes can connect each other randomly and forms topologies. These nodes communicate to each other and send packets to neighbour nodes as a router. Ability of self-configuration of these nodes makes them more suitable for instant network connections. The Ad Hoc on Demand Distance Vector Protocol (AODV) protocol was provided by the RFC and is a reactive protocol. In this the route is created and maintained only when they are needed. When a route is created routing table stores all the information of the next hop sequence number of the destination which is received from the destination and indicates the freshness of the received information. The information about the active neighbors is received throughout the discovery of the destination host and when the corresponding route breaks, the neighbors can be notified. Route discovery is used by broadcasting the RREQ (route request) message to the neighbors with the requested destination sequence number. This prevents the old information to be sent back to the request and also prevents looping

problems. This looping problem occurs in traditional distance vector protocols. In this the route request does not add any new information about the past hosts; it only increases its hop metric. Each request that passes the host makes update in their own routing table about the requested host. In this way this information helps the destination reply to be easily routed back to the requested host. Route reply use RREP (route reply) message that can be only generated by the destination host or the hosts who have the information that the destination host is alive and the connection is fresh. One feature of energy-efficient ad hoc routing protocol is its use of power for each route entry. It chooses between two routes to a destination and to achieve this, a requesting node is required to select one with better power status, which is more active, efficient transmission power management and system power management. They are the major means of increasing the life of a node. These all schemes deal in the management of energy resources by controlling the early depletion of the battery. And they adjust the transmission power to decide the proper power level of a node and incorporate low power consumption strategies into the protocols. The energy efficiency of a node is defined by the number of packets delivered by a node in a certain amount of energy. Few reasons for need of energy management in MANETs are:

- The ad hoc networks have been developed to provide communication for an environment. In ad hoc network, fixed infrastructure cannot be deployed. Moreover the nodes in ad hoc networks have very limited energy resources as they are battery powered.
- It is almost impossible to replace the battery or recharge it.

In the ad hoc network there is no central coordinator as a base station in cellular networks. An ad hoc networks work on the concept of multi-hop routing in which intermediate nodes play the role of the relay nodes. If the relay traffic is high, it leads to rapid depletion of a node and if the traffic is negligible it leads to the partitioning of a network. If the battery size is small, it decreases the lifetime of a node and if node is large then it increases the weight of the mobile node. So it's important to keep the standard small size of a battery. Energy management techniques are required to utilize battery efficiently. To design smart battery packs that can select appropriate battery discharge policies under different load conditions is a challenging problem. Chen et al. have proposed energy-efficient AODV for Low mobility Ad hoc Networks, in which the node energy consumption of the overall network is reduced by dynamically controlling the transmission power by utilizing a novel route cost metric.

II. Review Of Literature

In this we will discuss about the different type of the protocol and their works. In this we will study about the research work of different authors, how they use the protocol to solve the problems and what are their future works. Till now there are many contributions which strive to develop energy efficient network planning and routing in MANET.

Classification of Protocols

MANET broadly can be classified into three categories such as reactive protocol, proactive protocol and hybrid protocol.

Reactive protocol

Reactive protocol also called as on demand routing protocol. Reactive protocol is based upon some sort of query –reply dialog. Reactive protocol is better than the proactive protocol. Most of time everyone can use the reactive protocol because it is an on-demand routing protocol. For example reactive protocols are AODV, PAAMODV etc...

Proactive protocol

In the proactive protocol all the nodes maintains the information about the next node. All the nodes of any protocol have to relay it's entire to its adjacent nodes. The nodes send the packet data from one node to the other node after mutual agreement therefore the entire node constantly update their position.

Hybrid protocol

Hybrid protocol is based upon distance vector protocol but contain many features and advantage of link state protocol. Hybrid protocol enhances interior gateway routing protocol.

Benjie Chen, Kyle Jamison, hari Balakarishnan and Robert Morris [2] provide a span technique. It is a distributed coordination technique for multi-hop ad hoc wireless networks that reduces energy consumption without significantly diminishing the capacity or connectivity of the network. The span adaptively elects coordinators from all nodes in the network, and rotates them in time. The span coordinators stay awake and perform multi-hop packet routing within the ad hoc network. When all the other node perform multi hop packet than rest nodes remain in power-saving mode and periodically check if they should awaken and become a coordinator. In Span, each node uses a random back off delay to decide the coordinator. Delay is the number of other nodes in the neighborhood that can be bridged using this node and the amount of energy it has remaining. There results shows that Span not only save network connectivity. It also preserves capacity and provides energy savings. For a practical range of node densities and a practical energy model, system lifetime with Span is more than a factor of two better than without Span. The amount of energy that Span saves increases only and density increases. Their current implementation of Span uses the power saving features of 802.11. When node want to send the packet only then nodes periodically wake up and listen for traffic advertisements shows that this approach can be extremely expensive. It gives warrants investigation into a more robust and efficient power saving MAC layer, one that minimizes the amount of time each node in power saving mode must stay up.

Wassim El-Hajj, Ala Al-Fuqaha[3] proposed OLSR protocol. They provide the information regarding cluster and node maintenance. They used the FDDS (fast distribution connected dominating set) techniques to maintain connectivity in the network and also to take care of the routing part. It uses the FDDS-M to maintain the connectivity of the network and FDDS-R to take care the routing part. FDDS is used to handle the initial hierarchical architecture in a distributed way. Their job is to elect CHs and connect nodes to CHs. Initially normal node network composed of CHs which is disconnected. It assumes that node knows Stock its ID, residual energy (RE), and traffic load (T). A node can calculate its mobility (M) by measuring its displacement with respect to his own position and its neighbours at different time periods. Scalability of FDDS-R comes from OLSR. OLSR uses MPR, which minimizes the Flooding of control messages in the network. Also OLSR is known to perform well in wide Scale and dense networks. In their design, they only need to flood information in the backbone Network. Since, the backbone network size is very small compared to the total size of the network, FDDS-R Achieves scalability. Even though the controller tries to balance entry of the energy path and its length, it is more biased to high energy paths. This is directly Contributes in the energy-efficiency of FDDS-R. The best (highest) outputs produced by the controller are for routing paths that are powerful with short nodes.

Andy An-Kai Jeng and Rong-Hong Jan [5] propose an adaptive topology control protocol for mobile nodes. This protocol allows each node to decide whether to support energy-efficient routing to conserve its own energy. It can drastically shrink the broadcasting power of beacon messages for mobile nodes. The r-neighbourhood graph provide a more realistic power consumption model with independent parameter r^u to node u. They also proposed an energy-efficient maintenance protocol to reduce the beacon power. They have been proven that any reconstruction and power change can coverage in four and five beacon intervals. An adaptive configuration rule is given to configure the parameter for each node based on the node's mobility and energy levels. Based on the equivalence they design an energy-efficient maintenance protocol for the general enclosed graph. The ANGTC Protocol is to utilize the information partially received from nearby nodes to confine the broadcasting radiuses of subsequent beacons. Every time interval each node broadcasts a beacon at a certain radius to nearby nodes. This protocol can significantly decrease the total energy consumption for successfully transmitted data, and the lifetimes of nodes, especially in high mobility environments.

Yuguang Fang yuguang, Yao guoliang, Zhang chi, Liu Wei [6] proposed new scheme device-energy-load aware Relaying framework, namely DELAR, it achieve energy conservation in heterogeneous mobile ad hoc networks. A DELAR utilizes the device heterogeneity inherent in ad hoc networks and features the cross-layer protocol design methodology. It take better advantage of powerful nodes (P-nodes) while mitigating their interference to the ongoing communications, a hybrid transmission scheduling mechanism is used to schedule and coordinate the transmission activities among P-nodes and B-nodes (normal nodes). In order to support reliable transmissions in the presence of unidirectional links between P-nodes and B-nodes, we introduce the mini routing technique and the novel Asymmetric MAC (A-MAC) protocol. It demonstrates that A-MAC can effectively enable the MAC layer acknowledgements over unidirectional links. They show that DELAR can significantly reduce the energy consumption and thus prolong the network lifetime even with just a few P-nodes placed in the network. There various energy conservation techniques such as power saving modes. Transmission power control and power aware routing can be integrated to jointly achieve better energy conservation. More importantly, in this the framework provides a platform to address other challenging issues such as quality of service provisioning and security support as well.

Rajaram and sugesh J[7] provide a Power aware ad hoc on demand multipath distance vector scheme for energy efficient routing protocol. In PAAOMDV (power aware ad hoc on demand multipath distance vector) each node should maintain an Energy Reservation Table (ERT) instead of the route cache in the common on-demand protocols. ERT is mapped to a route passing this node, and records the corresponding energy reserved. ERT contain the following entries of an item request id, source id destination id, amount of energy reserved, last operation time, and route. The basic operations of PAAOMDV include discovery of route, forwarding of packets and maintenance of route. Packet Forwarding-Once the route has been established, the source starts sending the data packets to the destination. After the node on the route forwards a data packet, it will update the corresponding item in the routing table by firstly subtracting the amount of energy just consumed from the amount of energy reserved. When a node finds a fault in forwarding a data packet; it will initiate a route error packet (RERR) and send it back to the source. Each node that receives the RERR packet would remove the corresponding item from routing table and switch to alternate path. For the nodes that could not receive the RERR packet on the route, expiration time out is used to switch from that path to other.

Xiaonan Luo et Al [9] provide information regarding energy-efficient packet routing in a multi-hop wireless network, where mobility is taken into account by adopting a deterministic model. They considered the objective of minimizing the energy consumption or packet delivery and subject to the packet delay constraint and SINR requirement among concurrent transmissions. This can be formulated and solved by a dynamic programming algorithm. They also presented a heuristic approaches. In this approached packets in a greedy manner. Heuristic approach involves only the shortest path computation, and can thus better scale to the network size and the online traffic demand. There simulation results indicate that, with mobility globally taken into account, the performance can be greatly improved over a wide range of network settings. The multiple hops relay may be involved and a sender might better hold the packet first and transmit when the relay link is in a sound channel condition. Where interference among concurrent transmissions can be ignored, to take advantage of node mobility and multiple packets might use nearby concurrent transmissions or even share exactly the same transmission link at the same instant for packet relay. They specifically to ensure high throughput and low energy usage, preferably we should choose transmission links with relatively low energy requirement. The system's performance would be greatly improved if the packets of delivery can be arranged in few relays with relatively low energy consumption and small impact to the system.

Table II.1Comparison between different types of protocol

Name	Nature	Topology	Uses
OLSR	Proactive	It is Static in nature	OLSR will perform best when the traffic is sporadic.
PAAOMDV	Reactive	It is dynamic in nature	It *use when we want to on demand routing protocol*
AODV	Reactive	It is dynamic in nature	For long duration traffic, AODV perform better.
SPAN	Reactive	It is dynamic in nature	It is useful for saving the energy.
ANGTC	Proactive	It is dynamic in nature	It is used when we want to increase the node lifetime in high mobility environment.

Problem Formulation

Problem in the AODV is energy efficiency. We can reduce the energy by using MPR in AODV. We are using MPR because MPR reduces the number of nodes to which the message in the network is to be broadcasted. When we calculate the MPR set then each node must have information about one or two hop neighbour. When a nodes want to know the information about their neighbour than they can broadcast the hello packet. By the help of hello message two neighbours are found. The goal of the MPR selection algorithm is to find shortest path between the source and destination. Initially source will broadcast hello packet to other nodes and these nodes reply to the source through route-reply. If this contains our destination node then process ends else a node is selected which is kept as an MPR set and later this will broadcast the message until destination is found or a new node will be added to MPR set.

III. Discussion And Result

Literature review provides us with the information about the current work done in this particular field. In our case literature review highlighted the main problem and drawbacks. Some of the problems are energy efficiency, looping problem, scalability, quality of services. This comprised our primary research. Our next aim is to implement and solve the problems that were highlighted and for this purpose we will be using AODV protocol and implementation will be carried out with the help of different type of simulator.

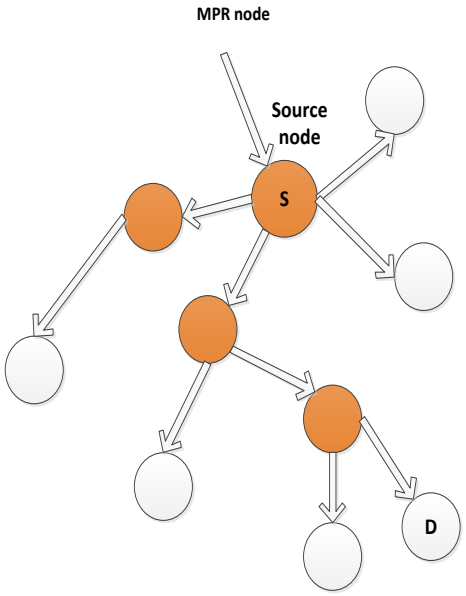

Fig. 1 MPR flooding mechanism

We have to implement MPR (multipoint relay) in AODV. Multipoint relay is used in the ad-hoc network because it is a broadcast mechanism. According to the multipoint relay, each node first computes a multipoint relay set. To compute the Multipoint relay set, firstly we need to find 1hop neighbour and then find the 2-hop neighbour. The intermediated node is called as the MPR set node. The following diagram shows the MPR flooding.

MPR flooding

- Assume that S is a source and D is a destination node.
- S firstly finds their 1-hop neighbour and two hop neighbours.
- Then S can broadcast the message to their 1-hop neighbours.
- Then node can broadcast the message to their two hop neighbours.
- If source node S broadcast message M, each node N that receives the message forwards M unless it has been previously forwarded.

So from the above discussion we came to know that our proposed protocol is better than the other schemes as it will reduce the congestion and improve the quality of service and we can also improve the efficiency. MPR can improve the congestion because when one node sends the message to their neighbours it checks for the destination. If destination found then it stops else it sends packets to the intermediate node which further sends packets to the nodes who have not received packets till now and this continues until we reach the destination.

IV. Conclusion

MANET's we have design a hierarchical energy efficiency scheme. This scheme can be easily set up and maintained. In this scheme we can include the AODV protocol and MPR scheme. In AODV protocol we will use the MPR scheme to improve the efficiency and the quality of the services. By using this scheme we can also improve the congestion.

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