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ENERGY SAVING ROUTING PROTOCOL WITH POWER CONSUMPTION OPTIMIZATION IN MANET

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ABSTRACT

As technology rapidly increases , diverse sensing and mobility capabilities have become readily available to devices and consequently mobile adhoc networks (MANETs) are being deployed to perform a number of important tasks. The energy efficiency at individual nodes is the key concern in MANET. We propose a hybrid protocol comarising of LEACH and EPAR (efficient Power Aware Routing) i.e. LEPAR (Leach efficient Power Aware Routing). In contrast to conventional power aware algorithms , LEPAR identify the capacity of node not just by its residual battery power , but also by the expected energy spent in reliably forwording data packets over a specific link . This protocol must be able to handle high mobility of nodes which often cause change in the network topology. Our proposed scheme reduces for more than 10% of the total energy consumption.

KEYWORDS

Manet, energy saving, power consumption optimization.

I. INTRODUCTION

MOBILE ADHOC NETWORK

Communication nows day has become very important for exchanging information between people from one place to anywhere at any time.[1] A mobile ad hoc network (MANET) is a collection of randomly moving wireless nodes within a particular area. In cellular networks, there are fixed base stations but in MANET.There is not any fixed base-stations to support routing and mobility management. These mobile devices are equipped with wireless transmitter and receivers that allow them to communicate with each other without the help of wired base stations. Therefore effective range of each transmitter is limited and distant nodes communicate through multihop paths with other nodes in the middle as routers.[2]

Therefore those mobile devices are battery driven and increasing the battery lifetime has become an important aim. Recently Most of the researchers have started to consider power-aware development of effcient algorithms for MANETs. As the routing function is performed by each mobile node in a MANET for establishing communication among different mobile nodes, the vanishing of even a few of the nodes due to power exhaustion might cause disconnect of services in the entire MANETs ,because Mobile nodes in MANETs are battery driven. Thus they suffer from limited energy level problems.[4] In such a network, each node acts as a host and may act as a router. Multiple hops may be needed to exchange data between nodes in the network due to the limited transmission range of wireless network interfaces.Because of the frequent changes in the network topology and limited network resources, link failure can occure during routing in MANET more oftenly.[3] There are two major reasons of link breakage in such an network :

- Node dying with energy exhaustion
- Node moves out of the radio range of other node [1]

II. ROUTING SCHEMES

In an ad hoc network , Mobile nodes use multi hop wireless link to communicate with each other. There is no stationary infrastructure and no base station .Each node in the network also act as a router , forwording data packets for other nodes. Deployment of dynamic routing protocols is a research issue in the design of ad hoc network. High degree of node mobility often change the network topology so that routing protocol must be able to keep up with that. In large networks , flat routing schemes produce an plenthora of information that can saturate the network . Nodes with large computational and communication power and powerful batteries are more suitable for supporting the ad hoc network routing than other nodes.[5]

PERFORMANCE PARAMETERS

The following terms are used to evaluate the performance of routing protocols:

- **Stability Period:** Stability period or stable region is the time interval between the start of the network operation and the death of the first sensor node.
- **Instability Period or Unstable Region:** The time interval between the death of first node and the death of the last sensor node is called instability Period or Unstable Region.
- **Network Lifetime:** Network lifetime is the time interval between the start of the network operation and the death of the last sensor node.
- **Number of Cluster Heads per round:** cluster heads selected from the total number of nodes from the whole network in each round. These cluster heads collects the data from member nodes and then sends these data, after aggregation, to the sink.
- **Number of Alive Nodes:** The total number of sensor nodes that have not yet depleted all of their energy.
- **Number of Dead Nodes:** The total number of sensor nodes that are not able to do any kind of functionality and have consumed all of their energy.
- **Throughput:** The throughput is defined as the rate of data sent from the cluster heads to the sink. It may also be defined as the rate of data sent from member nodes to their respective cluster heads.
- **Reliability:** The term reliability depends upon the measurement of the stable region and the unstable region. The meaning of better reliability means larger stable region and smaller unstable region.
- There is a trade-off between network lifetime and reliability. Network lifetime includes both unstable and stable regions. For the same stable region, a smaller unstable region means more reliability but a shorter network lifetime.

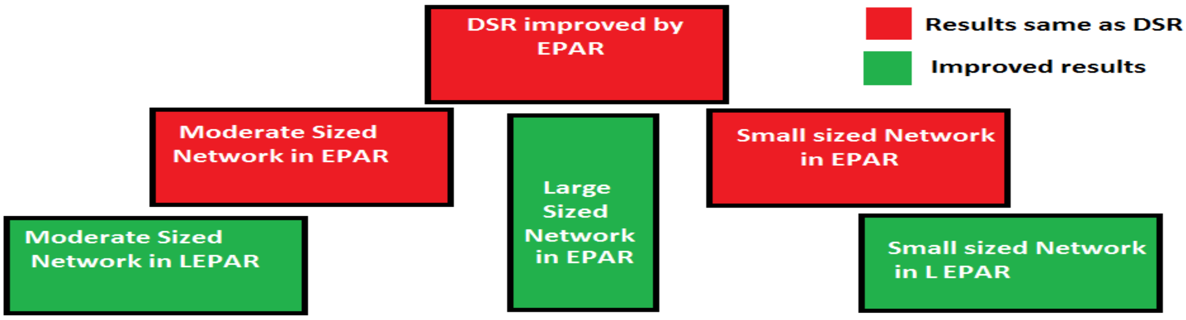
III. RELATED RESEARCH WORK

Dynamic Source Routing (DSR) is a routing protocol for wireless mesh networks. It is similar to AODV in that it forms a route on-demand when a transmitting node requests one. However, it uses source routing instead of relying on the routing table at each intermediate device.

Determining source routes requires accumulating the address of each device between the source and destination during route discovery. The accumulated path information is cached by nodes processing the route discovery packets. The learned paths are used to route packets. To accomplish source routing, the routed packets contain the address of each device the packet will traverse. This may result in high overhead for long paths or large addresses, like IPv6. To avoid using source routing, DSR optionally defines a flow id option that allows packets to be forwarded on a hop-by-hop basis.

Energy Profile Aware Routing (EPAR), which consists in the minimization of the overall energy consumption based on the EP of network devices and the actual traffic load.

FIG. 1



In the above mentioned block diagram there the process of DSR is first improved using EPAR algorithm to enhance the energy efficient output. With this merging of processes we are able to enhance the output of the system in Large sized networks only but we were required the improvement in all sizes of the networks i.e. in small as well as moderate sized networks. So firstly we implemented LEACH algorithm in EPAR which is a cluster based algorithm.LEACH stands for Low-Energy Adaptive Clustering Hierarchy. LEACH is the network protocol that uses hierarchical routing for wireless sensor networks to increase the life time of network. All the nodes in a network organize themselves into local clusters, with one node acting as the cluster-head. LEACH incorporates randomized rotation of the high-energy cluster-head position such that it rotates among the sensors in order to avoid draining the battery of any one sensor in the network. In this way, the energy load associated with being a cluster-head is evenly distributed among the nodes. When we merged the two processes EPAR and LEACH a new algorithm formed and named as LEPAR. This LEPAR is now re-merged to DSR process and now we achieved a new improved algorithm which is highly efficient and is very useful and energy efficient not only in the large networks but also in the moderate and small networks effectively

A. LEACH (LOW ENERGY ADAPTIVE CLUSTERING HIERARCHY)

LEACH is one of the first cluster-based routing protocols.[9] It is most popular hierarchical routing protocol for [10] MANET. LEACH is based on a hierarchical clustering structure model and energy efficient cluster-based routing protocols for sensor networks. In this routing protocol, nodes self-organize themselves into several local clusters, each of which has one node serving as the cluster-head. In order to prolong the overall lifetime of the sensor networks, LEACH changes cluster heads periodically. Clustering in mobile adhoc netwoks as virtual partitioning of the dynamic nodes into various groups. [6] Cluster based routing is a good solution to address nodes heterogeneity and to limit the amount of routing information that propagates inside the network. The idea behind clustering is to group the network nodes into a number of overlapping clusters. Clustering makes possible a hierarchical routing in which paths are recorded between clusters instead of between nodes.[11] This increases the routes lifetime therefore decreasing the amount of routing control overhead. Inside the cluster one node that coordinates the cluster activities is clusterhead (CH). Inside the cluster, there are ordinary nodes also that have direct access only to this one clusterhead and gateways. Gateways are nodes that can hear two or more clusterheads.[7]

Ordinary nodes send the packets to their cluster head that either distributes the packets inside the cluster or (if the destination is outside the cluster) forwards them to a gateway node to be delivered to the other clusters. By replacing the nodes with clusters, existing routing protocols can be directly applied to the network. Only gateways and cluster heads participate in the propagation of routing control/update messages. In dense networks this significantly reduces the routing overhead thus solving scalability problems for routing algorithms in large ad hoc networks.[8]

B. EPAR (EFFICIENT POWER AWARE ROUTING) PROTOCOL

This is one of the more obvious metrics . To conserve energy, there should minimize the amount of energy consumed by all packets traversing from source node to destination node. i.e. we want to know the total amount of energy the packets consumed when it travels from each and every node on the route to the next hop. The energy consumed for one packet is calculated by the equation

$$E_c = \sum^{k} T\, n_i , n_{i+1}$$

I = 1

E_c = Energy consumed by one packet

T = Energy consumed in Transmitting and receiving a packet over one hop.

n_i and n_k = nodes in route

The main objective of EPAR is to minimize the variation in the remaining energies of all the nodes and therby increase the network lifetime.

ROUTE DISCOVERY AND MAINTENANCE IN EPAR ALGORITHM

For EPAR, however, the path is chosen based on energy. Firstly, they calculate the battery power for each path, that is, the lowest hop energy of the path. The path is then selected by choosing the path with the maximum lowest hop energy. For example, consider the following scenario. There are two paths to choose from. The first path contains three hops with energy values 22, 18, and 100, and the second path contains four hops with energy values 40, 25, 45, and 90. The battery power for the first path is 18, while the battery power for the second path is 25. Because 25 is greater than 8, the second path would be chosen. EPAR alghorithm is an on demand source routing protocol that uses battery lifetime prediction. In Fig. , DSR selects the shortest path AEFD or AECD and MTPR selects minimum power route path AEFD. But proposed EPAR selects ABCD only, because that selected path has the maximum lifetime of the network (1000s). It increases the network lifetime of the MANET shown in equation . The objective of this routing protocol is to extend the service lifetime of MANET with dynamic topology. This protocol favors the path whose lifetime is maximum .

$Max_k\, T_k\, t = Min_{i\epsilon k}\, T_i\, t$

Where $T_k(t)$ = lifetime of path k

$T_i(t)$ = predicted lifetime of node I in path k

Proof :

1. $T_k 0 = Min\ T_i 0 = Min\ (T_A 0 , T_B 0 , T_C 0\ T_D 0)$

$T_k(0)=Min\ (T_i(0)) = Min\ (800 , 1000,400 ,200) = 200$

2. $T_k 0 = Min\ T_i 0 = Min\ (T_A 0 , T_B 0 , T_C 0\ T_D 0)$

$T_k(0)=Min\ (T_i(0)) = Min\ (800 , 700,400 ,200) = 200$

3. $T_k 0 = Min\ T_i 0 = Min\ (T_A 0 , T_B 0 , T_C 0\ T_D 0)$

$T_k(0)=Min\ (T_i(0)) = Min\ (800 , 700,100 ,200) = 100$

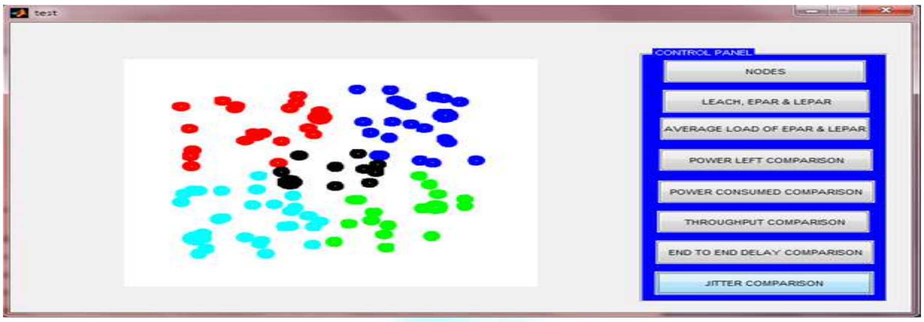
Hence $Max_k T_k$ = 200,200,100 = 200

This approach is a dynamic distributed load balancing approach that avoids power congested nodes and choose lightly loaded paths.

IV. SIMULATION SETUP AND RESULTS DISCUSSION

Simulations were conducted using MATLAB.The Simulated network consist of 120 nodes randomaly deployed . Nodes are moving at six different uniform speeds ranging between 0 to 10 m/s and uniform pause time of 10s.

FIG. 2: RANDOM DEPLOYMENT OF NODES



V. SIMULATION RESULTS

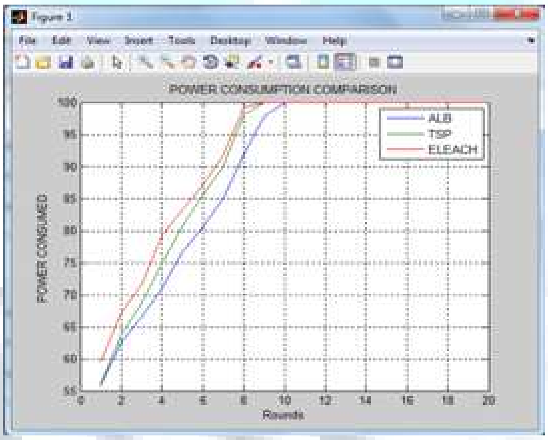
POWER LEFT COMPARISON

Figure 3 shows the total number of power left after each round of LEACH, EPAR & LEPAR. The LEPAR protocol has the overall network life of 10 rounds, while EPAR and LEACH has network life of 7 and 9 rounds respectively. This shows that our proposed protocol is about 30% and 10% better network lifetime than LEACH and EPAR respectively.

FIG. 3: TOTAL NUMBER OF POWER LEFT IN EACH ROUND IN LEPAR, EPAR AND LEACH

POWER CONSUMPTION COMPARISON

FIG. 4: TOTAL NUMBER OF POWER CONSUMED



This comparison is just like the power left it is just that it measures otherwise.

VI. CONCLUSION

Sensors are required to routing packets as well as transmit the data to the base station. If more of these operations are performed the sensor battery life decays drastically. By using the proper communication protocol, the control of congestion and unnecessary data transmission or reception can help in better management of battery life. By considering the influencing factors such as congestion, energy awareness, scalability and latency, the purpose of this research is to find a congestion free energy efficient routing protocol for Wireless Sensor Networks. In this paper , we proposed an optimized routing scheme for MANETs. The main focus was to provide the congestion free and Energy efficient protocol. In our proposed scheme, LEPAR is used in MANETs. In LEPAR, we have removed the issues that we had found out in problem formulation. LEPAR as an improvement to DSR in MANETs improves upon the energy and QoS in Moderatee and small sized Networks.

VII. FUTURE WORK

In Future the issue which is to be resolved is that it is mandatory for us to think of solutions which are of different magnitude and which applicable for all kind of scenarios. After this work we would also like to work upon an Idea of a protocol which generated great power efficiency in all forms of a network. Thus creating a protocol which is as efficient as EPAR in large networks will be the Future objective.

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