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An Energy Efficient DSR Routing Protocol for Energy Consumption in MANET

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ABSTRACT: In this paper considers energy constrained routing protocols and Energy Consumption techniques for improving MANET routing protocols and energy efficiency. Given a new routing protocol that EEDSR(Energy Efficient Dynamic Source Routing) technique to the MANET routing protocols with node caching enhancement. Also, show new application of energy efficiency metrics to MANET routing protocols for energy efficiency evaluation of the protocols with limited power supply. Main protocol of existing system is EPAR and it many network metrics (EPAR, DSR) used for different purpose. But still this system not yet enough improvement in performance. Because of these drawbacks may propose system aims to implement the Energy Efficient Dynamic Source Routing (EEDSR) protocol. Main contribution of this system is an EEDSR this protocol, satisfying less energy consumption from the viewpoints of nodes and networks. Its protocol must be able to handle high mobility of the nodes that often cause changes in the network topology. In this scheme reduces the total energy consumption and decreases the mean delay, especially for high load networks, while achieving a good packet delivery ratio.

KEYWORDS: Routing Protocol, Mobile Adhoc Networking, EPAR, EEDSR, DSR Energy Consumption.

I. INTRODUCTION

In mobile ad hoc network (MANET) each node creates a network link in a self-organizing manner, forwarding data packets for other nodes in the network. Mobile ad hoc networks (MANETs) are instantly deployable without any wired base station or fixed infrastructure. Due to these features, MANETs suffers from limitations like lower capacity, limited security, higher loss rates, more delays and jitter as compared to fixed networks. A critical issue for MANETs is that the activity of node is energy-constrained. In MANET, operations of nodes rely on batteries or other exhaustible power supplies for their energy. Hence depletion of batteries will have greater effect on overall network. As a consequence, energy saving is an important system design criterion. Mobile Ad hoc wireless networks are energy constrained since nodes operate with limited battery energy. If some nodes die early due to lack of energy, they cannot communicate with each other. Therefore, inordinate consumption of nodes energy should be prevented. In fact, node energy consumption should be balanced in order to increase the energy awareness of networks and find out the scheme has been proposed that utilizes energy status of each mobile node and alternate paths. This scheme can be incorporated into any ad hoc on-demand routing protocol to improve reliable packet delivery in the face of node movements and route breaks.

MANET have many applications, they are applied in Military Scenarios, RescueOperations, Data Networks, Free Internet Connection Sharing, Sensor Network etc.all mobile nodes are battery operated. They are suffering from limited energy level problems and the battery lifetime extension is very important aim. Some nodes get down due to power exhaustion and thus often reduce the lifetime of Manet. Nowadays researchers are trying to develop efficient energy routing protocols. Although there are other types of protocols like DSR ,DSDV, AODV etc. these protocols makes routing based on the smallest distance routing algorithm and never consider the factor power. But in energy efficient routing protocol the main considering factor is power.

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II. RELATED WORK

Most of the previous work on routing in wireless ad-hoc networks deals with the problem of finding and maintaining correct routes to the destination during mobility and changing topology. In, the authors presented a simple implementable algorithm which guarantees strong connectivity and assumes limited node range. Shortest path algorithm is used in this strongly connected backbone network. However, the route may not be the minimum energy solution due to the possible omission of the optimal links at the time of the backbone connection network calculation. In, the authors developed a dynamic routing algorithm for establishing and maintaining connection-oriented sessions which uses the idea of proactive to cope with the unpredictable topology changes.

A. Proactive Energy Aware Routing

With table-driven routing protocols, each node attempts to maintain consistent up to date routing information to every other node in the network. This is done in response to changes in the network by having each node update its routing table and propagate the updates to its neighboring nodes. Thus, it is proactive in the sense that when a packet needs to be forwarded the route is already known and can be immediately used. As is the case for wired networks, the routing table is constructed using either link-state or distance vector algorithms containing a list of all the destinations, the next hop, and the number of hops to each destination.

B. Reactive Energy Aware Routing

With on-demand driven routing, routes are discovered only when a source node desires them. Route discovery and route maintenance are two main procedures: The route discovery process involves sending route-request packets from a source to its neighbor nodes, which then forward the request to their neighbors, and so on. Once the route-request reaches the destination node, it responds by unicasting a route-reply packet back to the source node via the neighbor from which reaches an intermediate node that has a sufficiently up-to-date route, it stops forwarding and sends a route-reply message back to the source. Once the route is established, some form of route maintenance process maintains it in each node's internal data structure called a route-cache until the destination becomes inaccessible along the route. Note that each node learns the routing paths as time passes not only as a source or an intermediate node but also as an overhearing neighbor node. In contrast to table-driven routing protocols, not all up-to-date routes are maintained at every node. Dynamic Source Routing (DSR) and *Ad-Hoc On-Demand Distance Vector* (AODV) are examples of on-demand driven protocols.

C. DSR Protocol

Through the dynamic source protocol has many advantages; it does have some drawback, which limits its performance in certain scenarios. The various drawbacks of DSR are as follows: - DSR does not support multicasting. The dataPacket header in DSR consists of all the intermediate route address along with source and destination, thereby decreasing the throughput. DSR sends route reply packets through all routes from where the route request packets came. This increases the available multiple paths for source but at the same time increases the routing packet load of the network. Current specification of DSR does not contain any mechanism for route entry invalidation or route prioritization when faced with a choice of multiple routes. This leads to stale cache entries particularly in high mobility.

D. Energy Aware Metrics

The majority of energy efficient routing protocols for MANET try to reduce energy consumption by means of an energy efficient routing metric, used in routing table computation instead of the minimum-hop metric. This way, a routing protocol can easily introduce energy efficiency in its packet forwarding. These protocols try either to route data through the path with maximum energy bottleneck, or to minimize the end-to-end transmission energy for packets, or a weighted combination of both. A first approach for energy-efficient routing is known as Minimum Transmission Power Routing (MTPR). That mechanism uses a simple energy metric, represented by the total energy consumed to forward the information along the route. This way, MTPR reduces the overall transmission power consumed per packet, but it does not directly affect the lifetime of each node. However, minimizing the transmission energy only differs from shortest hop routing if nodes can adjust transmission power levels, so that multiple short hops are more advantageous, from an energy point of view, than a single long hop. In the route discovery phase, the bandwidth and energy

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constraints are built in into the DSR route discovery mechanism. In the event of an impending link failure, a repair mechanism is invoked to search for an energy stable alternate path locally.

E. Energy Efficient Manet Routing Protocol

Different routing protocols have been used to establish a correct and efficient route between a pair of nodes. But because of the limited available power of each node, the selected route cannot remain for a long time so that the source-destination pair can use it for its successful communication. To achieve the goal of getting longer lifetime for a network, we should minimize nodes energy not only during active communication but also when they are in inactive state. Two approaches to minimize the active communication energy are:

- Transmission power control approach.
- Load distribution approach.
- sleep/power-down mode

a. Transmission Power Control Approach

A routing algorithm essentially involves finding an optimal route on a given network graph where a vertex represents a mobile node and an edge represents a wireless link between two end nodes that are within each other's radio transmission range. When a node's radio transmission power is controllable their direct communication ranges as well as the number of its immediate neighbors are also adjustable. While stronger transmission power increases the transmission range and reduces the hop count to the destination, weaker transmission power makes the topology sparse which may result in network partitioning and high end-to-end delay due to a larger hop count. There has been active research on topology control of a MANET via transmission power adjustment and the primary objective is to maintain a connected topology using the minimal power. Energy efficient routing protocols based on transmission power control find the best route that minimizes the total transmission power between a source-destination pair.

b. Load Distribution Approach

The specific goal of the load distribution approach is to balance the energy usage of all mobile nodes by selecting a route with underutilized nodes rather than the shortest route. This may result in longer routes but packets are routed only through energy rich intermediate nodes. Protocols based on this approach do not necessarily provide the lowest energy route but prevent certain nodes from being overloaded and thus ensures longer network lifetime. This subsection discusses two such protocols: Localized Energy-Aware Routing (LEAR) and Conditional Max-Min Battery Capacity Routing (CMMBCR) protocols.

c. Sleep/Power-Down Mode Approach

The sleep/power-down mode approach focuses on inactive time of communication. Since most radio hardware supports a number of low power states, it is desirable to put the radio subsystem into the sleep state or simply turn it off to save energy.

f. Energy Consumption Modes

The mobile nodes in wireless mobile ad hoc network are connected to other mobile nodes. These nodes are free to transmit and receive the data packet to or from other nodes and require energy to such activity. The sources of power consumption are communication and computation with communication often being the chief power consumer. An ad hoc (or "spontaneous") network is a local area network or other small network, especially one with wireless or temporary plug-in connections in which some of the network devices are part of the network only for the duration of a communications session or in the case of mobile or portable devices, while in some close proximity to the rest of the network. Although significant in terms of reducing the power consumption in the wireless transmitter of a sender, it does little to conserve power among the other nodes receivers, forwarders and nodes not involved in this communication. The total energy of nodes is spent in following modes: Transmission Mode, Reception Mode, Idle Mode and Overhearing Mode

a. Transmission Mode

A node is said in transmission mode when it sends data packet to other nodes in network. These nodes require energy to transmit data packet, such energy is called Transmission Energy (Tx) of that nodes. Transmission energy is

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depended on size of data packet (in Bits), means when the size of a data packet is increased the required transmission energy is also increased. The transmission energy can be formulated as:

$$T_x = (330 * \text{Plength}) / 2 * 10^6 \text{--- (1)}$$

And

$$P_T = T_x / T_t \text{--- (2)}$$

Where T_x is Transmission Energy, P_T is Transmission Power, T_t is time taken to transmit data packet and Plength is length of data packet in Bits.

b. Reception Mode: When a node receives a data packet from other nodes then it said to be in Reception Mode and the energy taken to receive packet is called Reception Energy (R_x). Then Reception Energy can be given as:

$$R_x = (230 * \text{Plength}) / 2 * 10^6 \text{--- (3)}$$

And

$$P_R = R_x / T_r \text{--- (4)}$$

Where R_x is a Reception Energy, P_R is a Reception Power, T_r is a time taken to receive data packet and Plength is length of data packet in Bits.

c. Idle Mode

In this mode generally the node is neither transmitting nor receiving any data packets. But this mode consumes power because the nodes have to listen to the wireless medium continuously in order to detect a packet that it should receive so that the node can then switch into receive mode from idle mode. Despite the fact that while in idle mode the node does not actually handle data communication operations it was found that the wireless interface consumes a considerable amount of energy nevertheless. This amount approaches the amount that is consumed in the receive operation. Idle energy is a wasted energy that should be eliminated or reduced. Then power consumed in Idle Mode is:

$$P_I = P_R \text{--- (5)}$$

Where P_I is power consumed in Idle Mode and P_R is power consumed in Reception Mode.

d. Overhearing Mode

When a node receives data packets that are not destined for it, then it said to be in overhearing mode and it may consume the energy used in receiving mode. Unnecessarily receiving such packets will cause energy consumption. Then power consumed in overhearing mode is:

$$P_{\text{over}} = P_R \text{--- (6)}$$

Where P_{over} is power consumed in Overhearing Mode and P_R is power consumed in Reception Mode.

g. Protocol Selection

Energy Efficiency does not mean only the less power consumption, here energy efficiency means increasing the time duration in which any network maintains certain performance levels. A single routing protocol of MANET is not qualified to all metrics of energy efficiency routing. The route discovery and maintenance of each routing protocol is better than other for different energy efficient metrics. DSR outperforms other by consuming less energy per packet. DSR has very quick adaptation to routing changes and frequent host movement. DSDV has longer network lifetime but consumes larger amount of energy per packet and less packet delivery ratio for high speed and less throughput for high mobility. DSR performs better at low and medium mobility scenarios than AODV. It is possible because at low and medium mobility scenarios, there is delay in Route discovery as the route caches of the nodes are up-to date in DSR. AODV shows almost same performance as DSR when there is increase in mobility. AODV is preferred only when the nodes are highly mobile. AODV is for real time traffic over DSR. DSR has a slight edge over AODV because of multipath and alternative routes are available in its cache if it finds any broken links.

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Table 1: Comparison between AODV, DSR and DSDV

Sr.no	AODV	DSR	DSDV
1	It is Reactive Protocol	It is Reactive Protocol	It's Proactive Protocol
2	It delivers virtually all packets at low mobility	It is very good at all Mobility rates.	It performs almost as DSR, but requires transmission overheads of many packets.
3	It has low end to end delay	It has low end to end delay	It has high for pause time 0 but it starts decreasing as time increases.
4	It performs better for larger number of nodes	It performs better for larger number of nodes	It performs better for few number of nodes
5	For real time traffic AODV is preferred	For real time traffic DSR is not preferred	For real time traffic DSDV is not preferred

III PROPOSED TECHNIQUE

A. Algorithm for Energy Efficient Dynamic Source Routing

Step 1 If the Source node S wants to send data to the destination node D, it will first send REQ message to all its neighbour nodes.

Step 2 When neighbour nodes receive REQ message they will check their Route Cache, if this packet's ID is already in their Route Cache then packet will be discarded.

Step 3 Otherwise, node will calculate its power by using: $E_{new} = E_{tx} - E_r + E_{th} + E_m + P$ over and send this value as a reply to source node.

Step 4 Source node will calculate the mean value of all the values of P_{new} of all the nodes and send a RREQ message to the node whose P_{new} value is nearest to the mean value.

Step 5 When the node receives a RREQ message it will send REQ message to its own neighbours and this process will be continued till the destination node reaches.

Step 6 When destination node will receive the RREQ message it will send the RREP message back with the same route.

Step 7 RREP process is same as in traditional DSR.

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IV SIMULATION RESULTS AND DISCUSSION

The simulation work for the proposed Technique EEDSR is done in NS-2 [26]. The simulation result shows that the proposed method is more efficient than the existing method. The table 2 shows the parameters used in simulation

Table 2: Parameter Used

Simulator used	NS-2
Protocol under test	EEDSR
Protocol under test	50
Dimensions of simulation area	2000*2000
Simulation time	200
Traffic type	Tcp
Packet size	512 bytes

A. Scenario 1: Simulation of EPAR protocol with 50 Nodes

The network animator shows the simulation of 50 nodes of DSR protocol. In this scenario simulation of DSR is performed with 50 nodes. Nodes in the simulation scenario are at same position initially. We can see the network animator of twenty-five nodes at a particular instant. As the position of the nodes changes, some nodes are out of range for each other.

B. Scenario 2: Simulation of EEDSR protocol with 50 Nodes

The network animator shows the simulation of 50 nodes of EEDSR protocol. Nodes in the simulation scenario are at same position initially. With the passage of time they started moving to different positions (i.e. mobile).

The nodes transmit their routing table information to nodes that are covered under their range of communication. Now, when a particular node goes out of range of a particular node then the packets received by the other node are less than the packets sent by the source (sender) node. The figure 1 shows the NAM for EEDSR for 50 nodes.

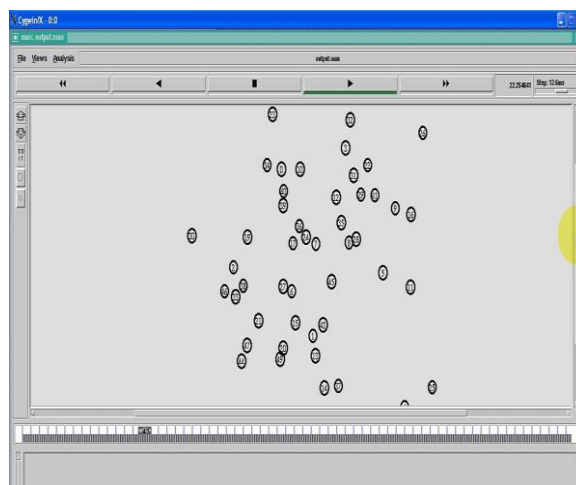


Figure 1: A Screenshot of 50 Nodes of EEDSR

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C. Scenario 3: Throughput

Network throughput is the average rate of successful message delivery over a communication channel. The throughput is usually measured in bits per second (bit/s or bps) and sometimes in data packets per second. Throughput refers to how much data can be transferred from one location to another in a given amount of time.

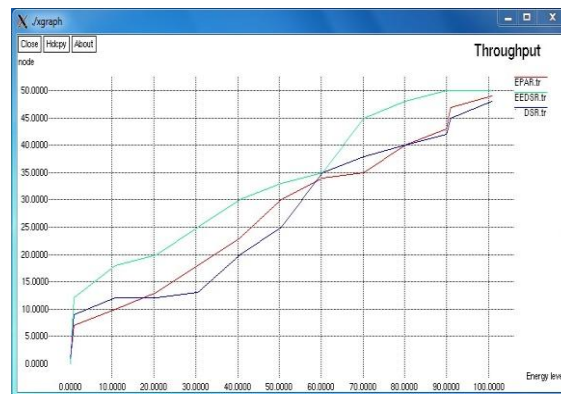


Figure 2: Throughput vs. Number of Nodes.

The figure 2 shows the better performance of EEDSR as compare to DSR and graph show the values of throughput on different number of nodes like after 5, 10, 15, 20 and 50 nodes. The green line represents the variations in the values of throughput of EEDSR and red line represents DSR.

D. Scenario 4: Packet Delivery Fraction

Packet Delivery Fraction is the ratio of number of data packets successfully delivered to the destination. The figure 8 shows the better performance of EEDSR as compare to DSR. EEDSR provides considerable improvement of PDF. This indicates that EEDSR is more resistive in stressful situation than DSR because it uses transmit power control. The transmit power control reduces the collision rate of the packets. Even the stress (number of connections and traffics) is high; every data packet must be transmitted with appropriate power level.

E. Scenario 5: Average Energy consumption

Average energy consumption is the ratio of total energy consumed by all the nodes in the network by the number of nodes. The figure 3 shows the graph of average energy consumption vs. number of nodes and the nodes in EEDSR will consume less energy as compare to the nodes in DSR. The green line shows the average energy consumption of EEDSR and red line shows the average energy consumption of DSR on different number of nodes. We compare the values of average energy consumption on different number of nodes.

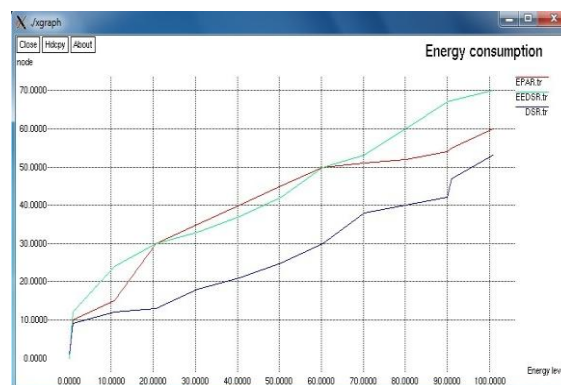


Figure 3: Average Energy consumption vs. Number of Nodes

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F. Scenario 6: End to End Delay

The average time from is the beginning of a packet transmission at a source node until packet delivery to destination. This includes delays caused by buffering of data packets during route discovery, queuing at the interface queue, retransmission delays at the MAC and propagation and transfer time.

V CONCLUSION

This method mainly deals with the problem of maximizing the network lifetime of a MANET, i.e. the time period during which the network is fully working. The presented an original solution called EEDSR which is basically an improvement on DSR. In this system has evaluated power-aware ad hoc routing protocols in different network environment taking into consideration network lifetime and packet delivery ratio. Overall, the findings show that the energy consumption and throughput in small size networks did not reveal any significant differences. However, for medium and large ad-hoc networks the DSR performance proved to be inefficient in this study. In particular, in small size networks EPAR, DSR and MTPR are comparable. But in medium and large size networks, the EEDSR and EPAR produced good results and the performance of EEDSR in terms of throughput is good in all the scenarios that have been investigated. It mainly used for energy consumption in this system. Compare to EPAR, DSR protocols EEDSR is very efficient and it reduces 10% of total energy consumption and decreases mean delay.

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