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# Review of Energy Efficient Routing Schemes in Mobile Ad hoc Network

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***Abstract— Devices in Mobile Ad hoc Networks (MANET) i.e. called nodes are typically battery-powered or energy dependent. The sources of power are providing the capability of working and measures in joules unit that's why it also called energy. The growing need for energy efficiency in cable less networks, in general, and in mobile ad hoc networks in particular, calls for energy enhancement features. Energy aware scheme can be applied in MANET routing protocols. Average change in energy over time in the unmodified protocols show a steady increase with time, while the energy aware protocols show an increase in the starting, then it levels for sometime before it starts to decrease. The energy aware scheme shows improvements in static and in coordinated mobility scenarios. In random mobility the energy aware protocols show no advantage over the unmodified protocols. In this paper provides as well as analyzes different energy efficient routing protocols designed for ad hoc wireless networks which are only based on the mechanism of routing protocol. The goal of the researches that has done in this field is to extend network lifetime by improving energy utilization in MANET routing.***

***Keywords: - Conservation, Energy, MANET, Routing and Mobility.***

## I. INTRODUCTION

The infrastructure-based wireless networks mainly consist of two portions: fixed configuration and mobile node portions. The fixed configuration portion, including base station, mobile switching center, etc., is linked by a wired backbone infrastructure. A mobile node can communicate with the nearest base station within its radio coverage area. The network supplies mobile users with only one-single-hop of radio communications. Only if the users reside in the radio coverage area of a base station or an access point, can they communicate with the other users. The users are also confined to the Barrier of the radio coverage area of the base stations or access points. Ad hoc mobile wireless networks are designed to overcome the natural limitation of these wired backbone networks and infrastructure-based wireless networks [1, 15]. Ad hoc mobile wireless networks are a collection of mobile nodes sharing a wireless channel and dynamically existence of network infrastructure or centralized administration. Restricted by transmission range, each mobile node can only communicate with neighboring nodes within its radio coverage area; Topology Control in Ad Hoc Network Lacking of Centralized framework cause on Ad Hoc network to have not a clear and special topology. In addition, an important activity in Ad Hoc networks determines a topology using high level routing protocols. Topology control in Ad Hoc network determines a topology in a network at each moment and also establishes an arrangement among the existing host in ad hoc network. So, many algorithms developed in order to control the topology witch assess their qualities based on some characteristics such as connection, energy efficiency and mobility. Some of the reasons for wasteful energy include,

1) Exchange of non-data related information frequently.
2) Computation at the nodes.
3) Improper integration between the layers of the protocol stack.

These can be reduced to a great extent by properly integrating the various layers of the protocol stack and exchanging information between them. This in-turn reduces the information exchanged between the nodes.

The remaining parts of this paper follow the pattern highlighted as discussed here: Section 2 has presents the features of MANET and Section 3 are describes the energy constraint in MANET. Section 4 has describes the routing and routing protocols in MANET and Section 5 presents a survey of energy efficient routing protocols for MANET. Section 6 has concluded this paper and Section 7 discusses Expected outcome that proposed a new energy efficient scheme after survey of previous schemes.

## II. ROUTING IN MANET

Traditional routing protocols applied to wired networks are not suitable for ad hoc mobile wireless networks. For example, distance vector (Bellman-Ford) [5] and link state routing schemes suffer from slow convergence to topology changes and bandwidth waste in periodical routing table exchanges. Especially, the routing loop in distance vector routing is another serious problem. Therefore, various routing protocols are proposed for ad hoc mobile wireless networks to solve the problems of routing loop and provide fast convergence to topology change. Broadly speaking, they are table-driven routing protocols [6]. Table-driven routing protocols demand that each mobile node should have up-to-date routing information of all nodes in the network. To achieve this goal, a routing table is maintained within each node and broadcast network-wide when network topology changes. Moreover, the routing table has to be exchanged periodically by broadcasting to all nodes in the network to keep track of the newest messages even though the network topology is not

 

changed. Each node has routing information about all nodes of the whole network though most of it is undesired. However, on-demand routing protocols have a totally different approach; they create routes only when needed. Having data for transmission, a source node initiates a route discovery procedure to find the destination node. Route maintenance procedure is triggered when ever a route has been discovered and is in progress until the route is no longer required. The control messages used in on-demand routing protocols record only the nodes on the route, not all nodes in the network. Without maintaining the whole network topology, only if the route is changed, do the protocols proceed to maintain the route.

### *A. Routing Protocols*

Existing routing protocols [7, 8] for MANET can be categorized into Proactive(Table-driven),Reactive(On Demand) and Hybrid routing protocol.

*1) Proactive Protocol:*

A proactive protocol like DSDV and OLSR maintains topology information by exchanging information with the other nodes of the network on a regular basis. This type of protocol can find a path immediately between any pair of nodes whenever there is a need. Advantages are low route latency and state information although it has some disadvantages like the following.

- High overhead of updating routing table periodically.
- Bandwidth consumption due to maintenance of links.
- Maintain links that may never be used.

*2) Reactive Protocol:*

Unlike proactive protocols reactive protocols like AODV and DSR do not maintain route information in advance, finds a path only when there is a need. They are best suited for low band width consumption as exchange of periodic routing table update messages is not required Main disadvantage is very high route latency.

*3) Hybrid Routing Protocols*

Proactive and reactive protocols each work best in oppositely different scenarios. Hybrid routing protocol like ZRP uses the combination of both the routing techniques. It is used to find a balance between both protocols. Proactive operations are used in small domain, whereas, reactive protocols are able to locating nodes outside those domains.

## III. RELATED WORK

In this paper [9] propose an Energy Efficient Integrated Routing Protocol (E2IRP) for Mobile Ad Hoc networks used in remote surveillance systems. It is the use of cameras to monitor properties and assets from a remote location. It is used as protection device for areas where it is not possible or practical to install a wired network. The integration of MAC and routing layers can effectively reduce the amount of control information being exchanged for discovery and maintenance of the route in the network. This is reduces the energy and time consumed for the processing of these packets. When the number of packets and processing is small, the protocol provides a better reliability and throughput.

A new scheme [10] has been proposed that works on a reactive approach and utilizes alternate paths by satisfying a set of energy and distance based threshold criteria. The scheme can be incorporated into any ad hoc on-demand routing protocol to reduce frequent route discoveries. Alternate routes are utilized only when data cannot be delivered through the primary route. As a study, the proposed scheme has been applied to AODV and a significant improvement in performance was observed as compare to DSR. Simulation results indicated that the proposed scheme provides robustness to mobility and AODV protocol performance. Average increment in packet delivery occurs for different network scenarios. The scheme performs better in denser medium as mode nodes are available for better selection.

An Energy and Delay Constrained Routing in MANETs have been proposed by Laura et al. [11], in which energy saving and timely delivery of data packets is incorporated into the route discovery phase to select paths with lower cost. This algorithm utilizes two metrics, queue length and residual energy at each node. Buffer information is like a traffic load characteristic and its use is to limit the battery power consumption and end to end delay.

Chen et al. [12] have proposed an 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.

In [13] EPSAR is an approach to the selection of farthest and efficient node within the clusters that can act as a gateway and finally we have an adaptable and energy conserved path too. From the above simulations and results it is clear that EPSAR is more suitable and highly feasible as the network grows in size and how mobility can change the network performance. It gives elegant results while dealing with on demand routing and have large network. This paper gives more emphasis on the same phenomenon by simulating the protocol EPSAR over ADOV (reactive) and DSDV (proactive) existing protocol and also elaborates the mobility issue. The performance and the feasibility of EPSAR are considered by different network parameters.

This paper [14] had discussed about the power consumption aspect of the MANET routing protocols. A comparison of Dynamic Source Routing (DSR) and Ad hoc On-Demand Distance Vector (AODV) routing protocols with respect to average energy consumption and routing energy consumption are explained thoroughly. After then evaluation of how the varying metrics in diverse scenarios affect the power consumption in these two protocols is discussed. The overall results show a better performance of DSR rather than AODV except in static networks while AODV uses hop-by-hop routing and DSR uses source routing with longer header. The reason is that DSR uses caching mechanisms to reduce the discovery routes overhead.

 

In this paper [1, 15] had take number of test simulation and conclude that E-DSDV routing is efficient if node motion is very slow and energy utilization is also efficient but E-DSR gives better result in any situation as compare to E-DSDV protocol This paper addresses energy conservation which is a very important factor in Energy Constraint Mobile ad-hoc Networks (MANETs) and also try to reduce routing overhead for efficient functioning of the network. All protocol gives different results depending upon the application. Here we are checking two different protocols in context of energy conservation and routing overhead. All the below result conclude that E-DSR protocol is efficient in mobile ad-hoc network and also provide energy saving and energy aware mechanism of the nodes and destination location information so that the overhead is minimize.

In this work [16] proposed algorithm reduces the congestions in the network and recovers the packet loss very efficiently. The algorithm alter the energy consumption, secondly, a flawless path is selected for packet transfer. This is done by determining the nodes with maximum residual energy and a route is established such that it has maximum energy remaining in all the nodes. The possibility of packet loss will be less in such routes than compared to other routes, because if nodes have less surplus energy the probability of slow transmission or system breakdown increases. Thus energy valuable route discovery is optimum and reduces packet loss and end-to-end packet delay and thereby reducing the overall network performance. Finally, resting hop count ratio is used to prioritize the packet flow in the network. This is completed in the MAC layer but the hop count information is obtained from the network layer. This decreased the packet delay, because packets have been delivered priority based and this reduced the congestions and traffic load. These schemes have been simulated and the results were obtained and compared.

The EPCMAC protocol [17] is to improve the throughput and to save energy by sending all the packets with optimal transmit power. This communication method promises improved throughput and delay performance .This protocol transmits all the packets with optimum transmission power and periodically increases the power of the DATA packets to a suitable level to eliminate the collisions. The periodic pulse power is found based on maximizing the channel capacity, reducing the carrier sensing range and considering the Signal to Interference Ratio. Simulation result shows that the EPCMAC scheme achieved more total data delivered per joule. This means that the EPCMAC scheme can achieves a high reduction in the energy consumption. It also illustrated that the EPCMAC pattern highly improves the network throughput compared to all other schemes.

This paper [18] proposes a novel method based on energy estimation to restore broken links and reconstruct the paths of them. So review of broken links on topology control and routing process in Ad Hoc network. It was designated that these effects were harmful in the mentioned couple of network portions. These effects may cause to some serious problems in data transferring and efficiency of different parts of network. For this purpose a strategy was made in order to prevent link break and disordering. This strategy could give some suggestions to route the network through prediction and time estimation of link break.

Energy-efficient broadcast routing algorithms called Minimum Longest Edge (MLE) and Minimum Weight Incremental Arborescence (MWIA) are introduced in [19]. MLE is able to achieve a longer network lifetime by reducing the maximum transmission power of nodes. With MLE, the likelihood that a node is overused is reduced significantly. This process was expanded by considering a scenario where we introduce edge weights on the basis of the remaining energy of the sending nodes and receiving nodes. MWIA was generated from this idea, which is the best possible solution for broadcast routing with the minimum largest edge-weight.

This paper [20] had proposed the Minimum Incremental Power (MIP) algorithm and it is known as the most energy-efficient heuristic in terms of the total energy consumption among all the topologies. MIP is based on the Broadcast Incremental Power (BIP) algorithm. The MIP algorithm is used as a observation for the solution to the Energy-balanced topology control problem, which rather minimizing the total energy, minimizes the maximal energy consumption at each node.

Routing protocol (MTPR) Minimum Total Transmission Power Routing [21] is an aimed at minimizing overall power consumption in MANETs. Given a source s and a destination d, we denote with Pr the total transmission power for a generic route r from s to d. Pr is the sum of the power consumed for the transmission between each pair of adjacent nodes belonging to r. MTPR selects the route $r*$ such that $r* = \min_{r \in R} Pr$, where R is the set containing all possible routes from s to d. A simple shortest path algorithm can be used to find this route. A drawback of this schema is that a route with a great number of hops can be selected, with a consequent increase in both delay and path instability (the latter, due to the dynamic nature of the MANETs). A more significant drawback is that, while the total transmission power is reduced, residual energy of every node is not considered and the nodes can fail quickly.

Minimum Battery Cost Routing (MBCR) [22] associates each node ni in the network with a weight $fi(ci(t)) = 1/ci(t)$, where ci(t) is the battery capacity level of ni at time t. Given a source s and a destination d, if we say Er the sum of the nodes weights of a generic route r from s to d, MBCR selects the route $r*$ such that $r* = \min_{r \in R} Er$, where R is the set containing all possible routes from s to d. Such a scheme will always choose routes with maximum total residual energy. Nevertheless, this metric does not consider the residual energy of a single node. For instance, if a route includes a node characterized by a very low energy together with others with high energy, such route might be chosen. Indeed, in this case it would be better to choose a path in which all the nodes have comparable energy levels, even though not so high.

Min-Max Battery Cost Routing (MMBCR) [23] starting from the above definition of fi(ci(t)), for each route r from a source s to a destination d, a cost is defined as $Cr(t) = \max_{i \in r} fi(ci(t))$. The chosen route $r*$ verifies the relation $Cr*(t) = \min_{r \in R} Cr(t)$. MMBCR safeguards nodes with low energy level because it selects the route in which the node with minimum energy has more energy, compared to the nodes with minimum energies of the other routes. Nevertheless, it

 

does not take into account explicitly the transmission power consumption, hence resulting in a possible reduction of the overall network lifetime.

Conditional Max-Min Battery Capacity Routing (CMMBCR) [24] proposes an approach based on both MTPR and MMBCR. Let us consider the node of a generic route r from a source s to a destination d, with lowest energy. Let also mr(t) be its energy, and R the set of all the routes from s to d. If some paths with mr(t) over a specific threshold exist in R, one of these will be chosen using the MTPR scheme. Otherwise, the route $r*$ satisfying the relation $mr*(t) = max_{r \in R} mr(t)$ will be selected. This scheme suffers from an unfair increment of the forwarding traffic towards nodes with more energy.

Minimum Drain Rate (MDR) [25] proposes a mechanism which takes into account node energy dissipation rate, thus avoiding the above problem. MDR defines for each node ni a weight Ci = RBPi/DRi, where RBPi is the residual battery power and DRi the drain rate of ni. Intuitively, DRi represents the consumed energy per second in a specified time interval. To confer more precision to this energy dissipation rate estimation, this parameter is computed by each node every T seconds as: $DRi = DRiold + (1 - \alpha)DRisample$ . DRiold is the previous computed value of DRi and DR is ample the new one. The parameter $\alpha$ reflects the relative importance to be given to the past with respect to the current values of DRi. Obviously, T has to be tuned appropriately in order to avoid frequent updates. Now, let Cr be the minimum weight of a generic route r from a source s to a destination d. MDR selects the route $r*$ such that $Cr* = max_{r \in R} Cr$. In this way, residual energy levels, as well as the energy consumption rate due to the incoming traffic to be forwarded.

## IV. ENERGY CONSTRAINT IN MANET

Mobile nodes are faced with energy constraints [3, 4] and as such, energy saving is a major factor to consider in implementation of MANET. Additionally, radio power limitations, channel application and network size are considered. These points limit the ability of nodes in a MANET to communicate directly between the source and destination. When number of nodes increases in the network, transmission between the source and destination increasingly relies on intermediate nodes. Most routing protocols rely on their neighbors to route traffic and the increase in the number of neighbors causes even more traffic in the network due to multiplication of broadcast traffic. Following are the types of energy consumption that have been identified:-

1) Energy consumed while nodes sending a packet.
2) Energy consumed while nodes receiving a packet.
3) Energy consumed while nodes are in idle mode.
4) Energy consumed while nodes are sensing mode.

Energy consumed while in sleep mode which occurs when the wireless interface of the Mobile node is turned off. It should be noted that the energy consumed during sending a packet is the largest source of energy consumption of all modes. This is postdated by the energy consumption during receiving a packet. Against the fact that while in idle mode the node does not actually handle data communication operations.

The aim of this paper is to contribute research trend in energy efficiency management in mobile network and to assist researchers in identifying base protocols to achieve power reduction design objectives.

## V. LIMITATION OF AD HOC NETWORK

The mobile ad hoc network has the successive typical features [2] –

(i) Unreliability of radio links between nodes. Because of the finite energy supply for the cable less nodes and the mobility of the nodes, the cable less links between mobile nodes in the ad hoc network are not consistent for the communication participants.

(ii) Constantly dynamic topology. Due to the regular gesture of nodes, the topology of the mobile ad hoc network changes constantly. The nodes can regularly move into and out of the radio range of the other nodes in the ad hoc network, and the routing data will be changing all the time because of the movement of the nodes.

(iii) Lack of incorporation of security features in statically configured wireless routing protocol not meant for ad hoc environments. Due the topology of the ad hoc networks is changing continually, it is necessary for each pair of adjacent nodes to incorporate in the routing issue so as to prevent some kind of potential attacks that try to make use of vulnerabilities in the statically configured routing protocol.

## VI. PROPOSED WORK

The nodes in network are energy dependent by that the life of Ad hoc network are limited and the energy regaining recourses are negligible in ad hoc network by that the efficient utilization of energy are prolong the life time of battery and network. Now in this scheme we proposed the new energy efficient technique that is based on the minimum transmission and receiving energy of nodes. We know that very well every node in the network has variant energy consumption that is depend on the hardware also. The proposed scheme is efficient because of:-

- Always select the nodes that have minimum transmission and receiving power consume by node.
- If more than one path energy is same than we select minimum delay base path (shortest difference between receiving and transmission power).
- The nodes are identified the range of other nodes at the time of sensing them in network.
- If we know the exact range of node from sender or next neighbor then not need to transmit data from full power means variation in power are saving the energy of nodes.
- Now try to select the node in routing procedure has maximum energy but have minimum transmission and receiving power.

 

- The nodes that has on boundary of radio range has establish unreliable connection by that intermediate nodes in between sender to receiver are try to not established connection or reply to that nodes for request by that energy consumption are minimized.

## VII. EXPECTED OUTCOME

This survey has provides the idea about how is it possible to reduce the energy consumption and proposed a new scheme in future that utilizes the battery energy efficiently. The main aim of proposed routing is to increase the life time of network with low overhead while achieving many desired features of routing protocol of MANET. It selects the optimal paths using energy aware metric and optimizes the energy consumption, overhead and bandwidth. It supports reliability by providing node-disjoint paths and it provides the stability (increasing mean life time of the nodes) by distributing the burden of routing and congestion control. It consists of the following four main mechanisms

- Route selection
- Route Discovery
- Maximization of Network lifetime and control energy wastage in retransmission.
- Route Maintenance.

## VIII. CONCLUSION

Energy aware routing technique that takes advantage of the battery power of nodes is continuously participating in communication in network. A survey of the literature reveals that most of the techniques used in energy aware or energy efficient routing protocols rely mainly on either dynamically changing the transmission power as a means to reduce energy expended in the network or route according to battery energy reserve of the nodes and, thus, prolong network life. In multiple-hop networks, exploiting battery energy reserve as the sole means to save energy of nodes that forward packets between a sender and a receiver. it is important to minimize the variation in energy expended to be fair to intermediate nodes in terms of distributing utilization of network energy resources, reduce network failure by not shrinking the network due to node failure, e.g. when an intermediate node serves two different destination nodes, and extend the life of the network by distributing the energy load among different intermediate nodes over time.

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