# Improved Energy Efficiency Link Prediction Protocol with QoS in MANET

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**Abstract -** The nodes that are wireless in MANET would present severe constraints of resource like restricted power of battery as well as the capacity of storing, as the aware of energy cross-layer design is important for enhancing the life of battery. The conservation of energy is a significant problem in protocol design of routing in ad-hoc wireless networks for increased network operational duration. The routing of convention protocols utilizes the smallest hop count as the primary metric for computing the best path to route the packets of data to its destination irrespective of the energy saving challenges. The cost of primary energy source in a routing protocol is the energy that has been utilized for transmitting the data packets irrespective of the energy saving issues. Frequent modifications in network topology because of the mobility and battery power which is limited of the mobile devices are the primary issues in the Ad hoc networks. The power source depletion might cause early unavailability of nodes &hence the links are not available in the network. We would initiate a new protocol which would incorporate the prediction of link failure at network layer & Power Control Protocol at MAC layer to enhance the performance of network in this document. Simulation outcomes would show our suggested cross-layer routing protocol would offer the performance development as compared to AODV in terms of entire transmission power, efficient energy, energy utilization per node, & throughput.

**Keywords:** MANET, Cross layer, Energy efficiency, Link prediction, MAC layer, QoS, Network lifetime, EE-LP-QoS, AODV.

## I. INTRODUCTION

In order to provide the service quality for real-time multimedia applications' new requirements, the MANETs (Mobile Ad hoc Networks) should have the ability that would be required to the high throughput and reduced delay. For facilitating the QoS (quality of service) in terms of reliability, throughput, jitter, and delay, etc., the networks could be able to imperative. Based on particular networks such as medium topology and shared dynamic, the limitations are imposed by taking into the account. By including the traffic transportation from source to destination in the network, QoS series would be characterized by RFC 2386[1]. For transmission of data by giving the security level, the ability of a network (router, node, etc…) is discussed in [2]. As the performance is developed and data flow is enabled [3], it's very important to consider in Ad hoc networks. By relying on the least number of hops among the source node and destination node, the route selection will be made since the routing protocols are considered as multi-hops when describing its characteristic. It's not enough to establish a route in addition to the high reliability [4], [5] and minimum end-to-end delay might result by this metric (hop count).

A high quality and a high reliability should have for a route in the links. In general, the link quality in wireless channel among the nodes based on the varied duration and relying on the Doppler effect, atmospheric phenomena, path loss, and fading. A signal strength with low level is reached by the links which having weak quality. A high rate of frame error [6], lower packet delivery fraction [7], and low throughput [8] are resulted. At the selection of route time, the original reactive routing protocols (e.g. AODV & DSR) weak point is considered. Among the nodes, the factors are not considered that have the link quality including passive effect and the route reliability is achieved [9], [10]. To aware of the different quality links between the nodes, the routing protocols would be operated better for the route selection [11], [12].

By relying on the received signal strength, the link quality is decided among the two successive nodes and the exchanging of packets is done among them [13], [14]. Between nodes, the reception of signal strength of packets are exchanged along with path to create a route in addition to the high quality of a link (i.e. route that is reliable) and is being used as a metric for selecting the route [15], [16]. In a dynamic environment, the routing protocol will have the capability of making changes in the topology of network, giving the coherent attitude no matter what are the mobility variations of network nodes, and latent mobility.

In this context, the route layer parameters awareness is considered for getting the underlying layers. Let's say, the value of signal strength at the physical layer is received. In addition to the routing protocols [19], [20], and [21], the

method of cross-layer need to be incorporated and developed. In this study, a novel version of the distance vector routing protocol of ad hoc network is to be improved which is called as EE-LP-QoS (Energy Efficiency Link Prediction Protocol with Quality of Service) to achieve the improvement in the design of cross layer of original AODV.

## II. LITERATURE SURVEY

An algorithm of anticipated route maintenance is proposed by Park and Voorst [22], [23]. The link failure between any two successive nodes is predicted by the algorithm in addition to the route is determined based on the predefined time. By using GPS, velocities and locations of nodes are computed. Two phases are included in the proposed algorithm such as Shrinking phase and Expanding phase. In prior to the link failure, the route is prevented in the expanding phase from failure which operating as a gap into the weak link by inserting a node. To decrease the hops count, the unnecessary nodes from the route are eliminated in the Shrinking phase on another hand.

By including the modifications of two consecutive data packets' signal strength which received based on intermediate node, an algorithm of a link failure prediction is proposed by Qin et al. [24]. A "Broken route message" is sent to source node based on an intermediate node if a data packet's received current signal strength is less than the data packet which is received by a certain threshold previously. Based on the route discovery process, the source node is tried to determine the alternative node after receiving this message. If route failure is forthcoming to occur, the requirement of route discovery process doesn't mitigated by this mechanism.

For detecting link failure, an anticipated warning mechanism is developed that is known as AODV – Reliable Delivery (AODV-RD) [25]. To detect the good or bad link, Signal Stability-Based Adaptive Routing (SSA) method [26] is improved according to the analyzation of greatness or weakness of signals. Before breaking the primary route, a repair action is processed. PDR is improved and end-to-end delay is reduced by using this protocol.

According to the link or route stability estimation, the routing protocol of Modified Reverse Modified Reverse Ad Hoc on-demand Vector (MRAODV) which is mentioned in [27] and it helps to decrease the discovery and maintenance process's route overhead and to improve the packet delivery ratio. The best path is chosen by the source node in a set of all available routes based on the awareness of route stabilities if in case of failure of an active route.

In MANETs, a protocol of Route Stability based QoS Routing (RSQR) is developed by Sarma and Nandi [28] in order to support the requirements of QoS Routing such as delay and throughput. With the use of received signal strengths, the protocol is computed the route stability and link stability as well. For choosing a route with higher stability amid of all available feasible routes, the information of route stability is utilized. The performance improvements have been done by RSQR that are in terms of control overhead, packet delivery ratio, and average end-to-end delay.

Based on route reliability and stability, works are combined to AODV protocol and multipaths in [29-32]. For supporting the multi-path detection, the routing protocol of AODV is extended by Helberg and Boshoff [29] for MANETs. Instead of hop count, end-to-end delay is utilized as metric for selecting the route. An alternate route is used when there is an occurrence of the route failure. The improvements in packet delivery fraction, delay, and routing overhead are shown by the protocol significantly when compared to the other existing protocols.

AODV protocol is improved by most of these proposals in [33-37] and mechanism of failure prediction is used for developing the lifetime of a network and reduces the energy consumption. With the determination of routing solutions, Lifetime Prediction Routing (LPR) is proposed by Maleki, Mortez et al [33] for developing the lifetime of a network that lead to the reduction of remaining energies of nodes' variance in the MANET. Based on the past activity, battery lifetime prediction is utilized and the path with maximum lifetime is chosen by them. An additional traffic is introduced by LPR but the network's lifetime is improved.

## III. PROPOSED FRAMEWORK

Numerous changes in topology of network because of the mobility as well as the restricted battery power of the mobile devices are the primary issues in the Ad hoc networks. Early unavailability of nodes might lead due to the source of power depletion. Hence, the links are not available in the network. Primarily, the availability of a route would depend on the links availability among the nodes forming the route. The mobility of nodes would also cause the frequent breaks of routes & adversely affects the essential performance for the applications. Hence, it is important for predicting the future link availability which is currently available. Figure 1 represents the flowchart of proposed system.

Ad hoc Network has a primary resource of energy limitation at every node. The data packets couldn't be forwarded to other nodes whenever a node dies that results in the hampering the network's connectivity. Thus, there has been a study completed in improving protocols of power aware for the Adhoc networks. The protocols of power aware have been also been separated relying on which factor the protocol has been utilizing for minimizing the consumption of energy e.g. optimization of transmission power level. These particular protocols types

which would be altering the level of transmission power are called as Power Aware protocols.

Owing to the lack of alternate paths or routes, the data loss of considerable packets is caused by a frequent disconnection and an additional volume packets (routing) protocol is generated in the dynamic environment. By using the signal strength between neighboring nodes, it's a vital process for forecasting any probable disconnection or failure on active route. The link quality is informed by the value of a signal strength which is relied on the mobility of nodes. If the quality of a link is improved (more stable) or decreased (probability of failure), the signal strength can compute. This results in the making of more robust in the link management and failure of a link is predicted. Thus, the contribution of QoS is improved.

The prediction of an exact probability of link failure is very tough to note. Based on the recent values of signal strength which is received on the link, it's possible to determine the connection's relative stability.

A cross layer design is proposed for prediction of link failures and power control in the networks of mobile Ad hoc to address the problems like availability of a link. This can be occurred due to the increment of battery life and mobility of the nodes. This procedure would be using non-adjacent layers' interaction e.g. physical and network layers for links forecasting break and optimization of power at MAC layer. Figure1 represent the flowchart of proposed system.

The primary contribution of this work is for introducing the new system which might increase the network capacity along with maximizing the network lifetime for ensuring the successful transmission of data packets with decreased contention and less power. Here we would be introducing a design of cross layer for Power control & the availability of link to develop the Mobile Ad hoc Network performance. The link failure prediction at network layer would be incorporated and Power Control Protocol at MAC layer to improve network performance for that.

**3.1 Discovery phase:**

The routing table is verified by a node every time for determined any valid path to the desired destination if in case a node wants to transmit the data. The discovery paths are launched by nodes if it is not the case. Based on the specified parameters like TTL (Time To Live), pair of ID packet and IP source address, and sequence number, the operation of transmission or discovery paths are initiated by the control packet of RREQ. Here, TTL is used to assigning of an initial value of TTL_START, pair is to check whether the request is ready to treat the node or note, and sequence number for indicating the fresh paths. The source node is rebroadcasted the same RREQ when no response is made after the period of RREP_WAIT_TIMEOUT. There is no longer time for making the response for waiting period than the previous one with an incremented TTL by TTL_INCREMENT (more hops and more chance to determine a path).

To be avail of path to the destination, the routing table is checked out if a request RREQ is received by an intermediate node. The returning of a reply packet (RREP) is reached to the source and knowing to reach the destination further. Or else, the hop count is incremented and RREQ packet is rebroadcasted. IPs is stored by the node before sending and received the first copy of applications by a node. RREP packet is to be traversed by using a reverse path in uncast.

A RREP packet is constructed and forwarded it later based on the prior saved IPs if the RREP packet is reached to the destination node. However, increments the field "hop count" of the packet (RREP) based on the transmission of each passage in reverse path and distance in number of hops.

**3.2 Maintenance phase:**

The HELLO message is transmitted where HELLO is nothing but a RREP with TTL equal to one for maintaining the consistent paths. The failure of a link is considered as question when not receiving the three HELLO messages consequently from neighboring node. According to the nodes mobility, the link failures are generally accomplished in Ad hoc networks. To determine another path, the source node is tried and the number of attempts (RREQ_RETRIES) is decremented by one if it is unsuccessful.

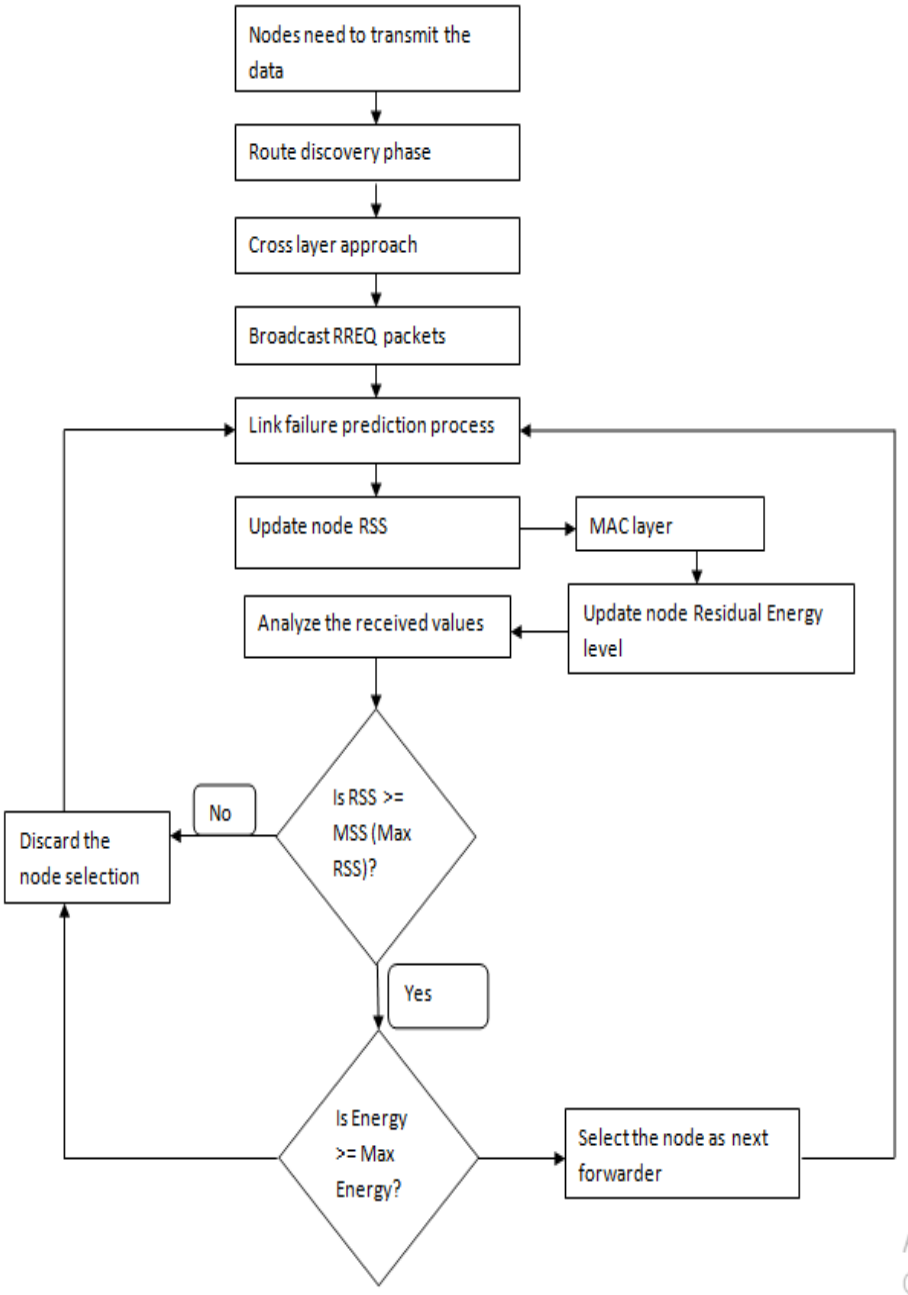


Fig1: flowchart of proposed system

## IV. RESULTS AND DISCUSSION

The assessment of performance & comparison of suggested scheme, EE-LP-QoS, against original RDSR & LBP-AOMSV have been completed by utilizing network simulator NS2. To assess the performance, the metrics have been used and compare the performance with EC (Energy Consumption), Throughput, and Average E-to-E delay (End to End Delay). The parameters of simulation are demonstrated in Table 1.

| Simulation Parameters | Values |
|---|---|
| Simulation Tool | NS-2.35 |
| No.of nodes | 23 |
| Simulation time | 20 second |
| Simulation area | 1000*1000 m |

| | |
|---|---|
| Pause time | 2-20 S |
| Mobility model | Random waypoint model |
| Routing protocol | AODV, EE-LP-QoS |
| Packet rate | 2 packet/millisecond |
| Mobility speed | 2m/ms |
| Channel type | Wireless |
| Mac layer | 802.11 |
| Traffic type | CBR |
| Antenna type | Antenna/Omni antenna |
| Initial energy | 100 j |

NS2 (Network Simulator) version 2.35has been utilized for investigating and analyzing the suggested idea. The context of simulation would consist of 23 nodes in a region 1000 x 1000 m2. The mobility of RWP (Random Way Point) has been utilized & the range of transmission has been set to 250m for ideal unstructured. The moves of nodes at average speed of 2m/ms. 2 scripts have been utilized, the first (code.tcl) to generate random traffic for CBR (Constant Bit Rate) of 1024 bytes in accordance with protocol of UDP & the second(Setdest) for producing the scenarios of mobility. The simulation duration is sets to 20 s for all the examinations.

At any node, the received data or reply packet is included a strong effect on the signal strength is measured and has been affected with the pause node time by the node movement level. As a pause time function, the presentation of all above-mentioned metrics of performance is done. In the simulation environment, the pause duration has been changed among 2 and 20 seconds. High node mobility is represented at the time duration 20 sec. and node of static means 20 sec.

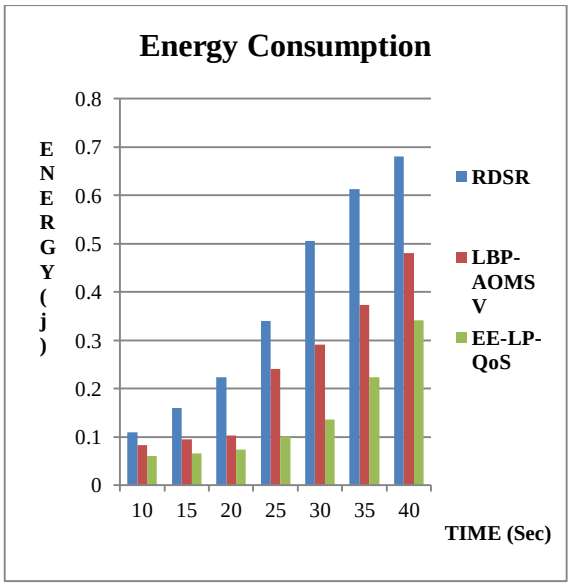


**Figure2: Energy Vs Simulation time**

Energy vs. Simulation time for RDSR, LBP-AOMSV and EE-LP-QoS has been presented in Figure 2. This is due to route selection of EE-LP-QoS is depending on the maximum - minimum signal strength criteria & the recommended failure to link mechanism which would predict of the failure of a link earlier before the energy loss for individual nodes. We would note that the EE-LP-QoS has low consumption of energy than that one of RDSR& LBP-AOMSV. All of this would be resulting in efficient energy consumption of the suggested EE-LP-QoS.

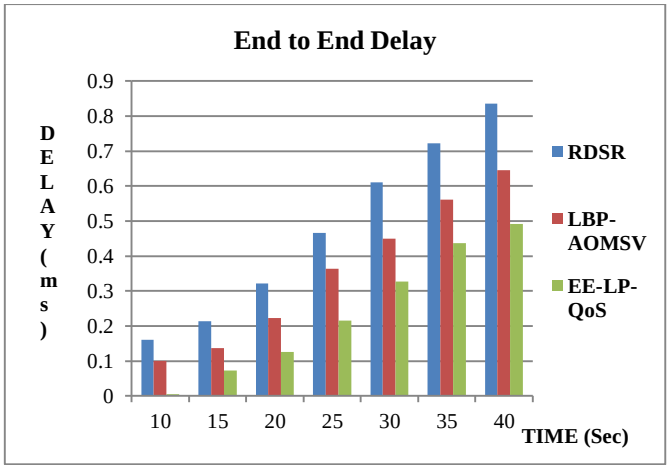


**Figure3: End to End Delay vs simulation time**

The simulation time against end-to-end delay (E2E delay) is illustrated in Figure 3. A lower value of E2E delay is included the EE-LP-QoS which is less than that one of the LBP-AOMSV and RDSR. Due to the earlier link failure mechanism and prolonging the route stability lifetime, the repetition probability of route discovery process is reduced which lead to the E2E minimization of delay.

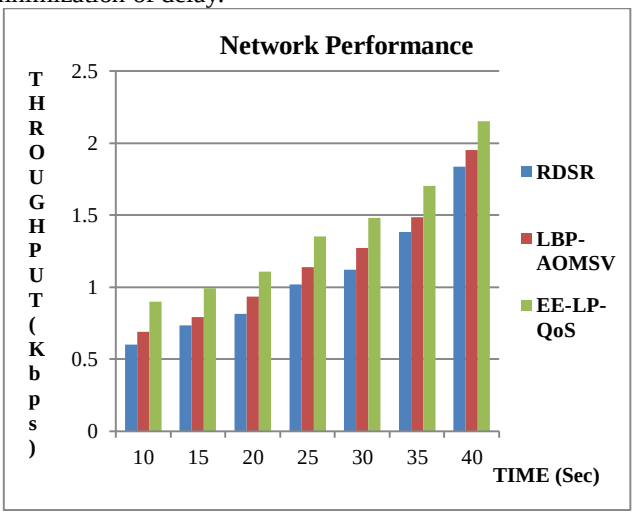


**Figure 4: Throughput vs Simulation time**

Time of simulation vs. throughput would be described in figure 4. Owing to the route selection of EE-LP-QoS is, this would be resulted and is depending on the maximum-minimum criteria of signal strength which would be resulting in prolonging route lifetime, & the suggested mechanism of link failure which would expect the failure of link in an earlier time before data packets dropping. The throughput is value of average 30 Kb/s in EE-LP-QoS which is higher than other of the RDSR & LBP-AOMSV with the average value of 19.6 kb/s which is nearly constant. With the suggested EE-LP-QoS, a high throughput would be resulted.

## V. CONCLUSION

We have suggested a refined original version of AODV in this document, known as EE-LP-QoS, using the plan to obtain a route with stability by improving the lifetime of a route. Also, for avoiding the frequent failures of link because of mobility of nodes, a maintenance policy of new route has been suggested by utilizing the mechanism of cross layer which would be predicting the failure of link in prior to the dropping of data packets. Hence, at the time of phase of route discovery, selection of route is depending on the signal strength of RREP packet's measured value. We would incorporate prediction of link failure at layer of network and Power Control Protocol at MAC layer for improving the network performance for that. The simulation results proved that suggested EE-LP-QoS has a superior performance than RDSR and LBP-AOMSV from point of view of energy consumption, end-to-end delay,& throughput correspondingly. The evaluation of performance and EE-LP-QoS comparison against original RDSR as well as LBP-AOMSV has been finished by using network simulator NS2.

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