Performance Analysis of Efficient Path Maintenance Scheme Routing Protocol in MANET

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Abstract--- Mobile Ad-Hoc Network (MANET) is a self-configuring network. The portable hubs are powerfully self-compose in the self-assertive temporary network topology. There is no predefined foundation in light of this it doesn't contains the reasonable limit. The vast majority of the energy-efficient model addresses the insufficient assets in view of the OLSR protocol and Differential Equation (DE)-OLSR protocol along with many parameters. Because of this, the outcomes in higher power utilization because of expanded crash amid packet transmission. In this work, we provide an effective energy model like Route path Maintenance Scheme based Energy Efficient-Optimized Link State Routing (EE-OLSR) Protocol. The proposed EE-OLSR Protocol expends lesser energy and diminishes the routing overhead and route path setup delay. It also increases the network lifetime based on an effective search for the viable energy-efficient route path. The performance is evaluated based on metrics such as nodal speed, packet size, and average connection arrival rate.

Keywords--- Energy, Routing Protocol, EE-OLSR, Mobile Ad hoc Network (MANET).

I. Introduction

The primary aim of this study is to introduce a route path maintenance scheme based Energy Efficient-Optimized Link State Routing (EE-OLSR) in Mobile Ad hoc Networking (MANET).

Mobile AD-HOC Network (MANET)

The Mobile Ad-Hoc Network (MANET) is various self configuring system cell phones that are associated with each other through numerous remote connections. It is generally taking a shot at a compelled transmission capacity. The network topologies are powerfully completed every now and then.

A portion of the center issues considers routing incorporate variable remote connection quality, spread way misfortune, blurring, impedance; influence devoured and organizes topological changes. Propelled elements of remote portable frameworks contain information rate perfect with interactive media applications, worldwide meandering capacity and coordination with other system structures, are empowering new applications. Some outstanding Adhoc arrange applications are communitarian work, crisis-management applications, personal area networking and Bluetooth.

Every mobile host available in the MANET acts as a router. [1]It supports both peer-to-peer and peer-to-remote communications to reduce the administrative cost. Figure 1 shows the block diagram of the MANET. Here, the MANET does not require any type of infrastructure, i.e., access points or base stations**.** Because of this the MANET is well-suited for temporary communication links.

Figure 1: Mobile Ad-Hoc Network Architecture

Distinctive qualities required in the MANET are disseminated operations, multi hop routing, self-governing host, dynamic changing topology, light-weight hosts and mutual physical medium. MANET utilized as a part of various applications, for example, military front line, community oriented work, neighborhood level, individual zone system, Bluetooth and business segment.

The most challenging task in the MANET is to provide the Quality-of-Service (QoS) routing with various constraints such as unpredictable topology and limitation. It occurs due to a nature of devices i.e., limited memory size and computing capacity and limitation in communication medium such as limited bandwidth, interference, etc.

Routing Protocol

A routing protocol is needed at no matter purpose a packet ought to be transmitted to a receiver through range of hubs and various routing protocols.

Classifications of Routing Protocol

MANET routing protocols [3] could be approximately categorized into three major categories, namely, table-driven, on-demand and hybrid.

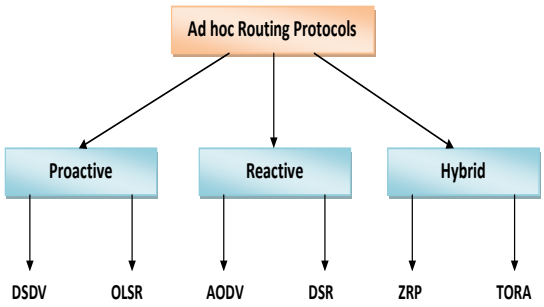


Figure 2: Classifications of Routing Protocol in Mobile Ad-Hoc Network

Proactive Routing Protocols

Table-driven protocols absorb the topology of the network by exchanging topological information between the network hubs. The cost of keeping up the network may be high, if the network topology changes too regularly. The data about real topology may not be utilized, if the network movement is low. Table-driven protocols compute the routes in the network, which required sending the packet route and it is promptly prepared for utilize, in this way, there is no time delay. Subsequently, a shortest route path can be found immediately. Regardless, these methods are not efficient for MANET, since situation issue of heavy traffic may develop. Different changes of table-driven methods are designed for ousting its deficiencies and use in ad hoc networks. It continues with the unicast courses among each center point without considering all courses, which are used or not.

Reactive Routing Protocols

It depends on a particular kind of query-reply discussion and this protocol is named as demand routing. The on-demand routing protocol is more powerful than table-driven routing protocol. At that point, the modifications have been done on this kind of routing for improving it to an ever increasing extent in the present work. Also, this sort of routing is to discover a route between a sender and receiver at whatever point the route is required. The table-driven protocols were keeping up all routes without concerning its condition of utilization. Along these lines, on-demand protocols are convenience about the routes, which are not utilized without further ado. On demand routing method is based on the route of network topology it evade the cost of continuing paths and it controls the traffic. Since, it does not send outrageous messages, which generate an extensive difference amongst table-driven and on-demand protocols. Likewise, the network latency time in on-demand protocols is more prominent contrasted with table-driven types, which are ascertained when it is required. For example, Dynamic Source Routing Protocol (DSR), Ad-hoc On Demand Distance Vector Protocol (AODV) and so forth,

Hybrid Routing Protocol

This procedure joins the benefits of proactive and on-demand. The table-driven and on-demand routing procedures have a couple of upsides and drawbacks. Hybrid routing protocol is a blend of table-driven and on-

demand routing procedures are used. The on-demand routing protocol is AODV with some table-driven segments by strengthening courses of dynamic goals. This procedure would lessen the postponement and interim can build up the execution of the hub and system. Thu-sly, these sorts of conventions can join the office of different conventions, without coordinating with its individual points of interest. Examples of hybrid protocols are, Zone Routing Protocol (ZRP).

Proactive Energy Efficient Routing Protocol

The protocol can be used based on the network parameters. Some protocols are given with respect to energy efficient routing and alterations are projected for use in MANET.

Destination-Sequenced Distance Vector (DSDV)

The table driven routing structure in adhoc mobile networks is a Destination Sequenced Distance Vector Routing (DSDV). It can evacuate the inefficiencies separate vector convention. In this method, each hub keeps up a directing table. DSDV contains each and every open goal, then the accompanying center reach to the goal and the quantity of jumps between it. Once every center point changes its territory it convey the directing moves up to the extra centers. The succession number is used to dodge circle issues. Thu-sly, the course for goal is open in the steering table of all centers. Therefore, there is no inactivity impacted by course disclosure. Regardless, the communication of routing method updates may achieve high activity stack between the center points, if the thickness of the centers is high.

Optimized Link State Routing (OLSR)

OLSR is a link state, table-driven protocol that routes to every single open hub in the network with minimal delay. In this protocol, the idea of selective flooding decreases the power utilization and network traffic for highly dense network [2]. Along these lines, it allows just to the arrangement of hubs to transmit the control messages when the topology changes. The benefit of OLSR protocol was useful for crowded network, which was not maintained by AODV protocol. The issue with this protocol is to choose a least set of MPR every time changes in the structure. The serious issue in MANET is OLSR protocol was not proper for the perspective of energy efficiency. Accordingly, this exploration work proposed a energy efficient unicast routing protocol EE-OLSR. EE-OLSR extends the network lifetime by picking the route pathway having least cost. Moreover, the cost is considered on the lasting energy of each traversed hub and the energy potted on this route path.

II. Materials and Methods

Path Maintenance Scheme

Normally, in the route path maintenance scheme, the routing protocols are for the most part used to confirm that how to accomplish the neighbor for transmission of data packets. [3] design the uniroutepath routing protocols to give the single route path between the sender and the receiver by setting up the multi-hop remote connection between hubs, where the hubs are in the communication range of the hub. In the uniroute path routing protocols, every hub is going about as a switch for finding the routes furthermore maintain the route. The uniroute path routing protocol is grouped into two types, for example, a table driven, on-demand routing protocol and hybrid. The table driven protocol is otherwise called a table-driven protocol, here the table-driven protocol is for the most part used to assess the routes intermittently. It likewise used to keep up the route in the network for every hub. The cases of the table-driven protocols are Destination-Sequenced Distance Vector (DSDV), Open Shortest Path First (OSPF), Optimized Link State Routing (OLSR), and so forth. What's more, the on demand protocol is otherwise called on-demand protocol; these protocol start the route discovery when the sender requires a route towards a receiver. Two types of the on-demand routing protocol are Adhoc On-demand Distance Vector (AODV) [5] and Dynamic Source Routing (DSR).

A hybrid routing protocol is the combination of table-driven and on-demand protocols. A hierarchical or layered network framework is used to design the hybrid routing protocols, where Zone Routing Protocol (ZRP) and Temporally Ordered Routing Algorithm (TORA) are the two important hybrid routing protocols. A multiroute path routing protocol is mainly used instead of a single route path approach to provide multiple route paths between the sender and the receiver. The performance of the unicast protocols is improved by using this multiroute path routing protocol by providing multiple route paths using alternate routes at the time of route failure. The sender transmits the packet to the receiver by using the alternate route when the primary route fails.

In the MANET, the transmission of data is immediately getting started after establishing the primary route. [4] handles a route maintenance to remove the broken link and to provide the interruption free transmission between the sender and the receiver. A route recovery is one of the parts of the route maintenance. The Multiple route paths are

used as backup route concurrently for parallel communication such as round robin scheduling. The multiple route paths are categories into three such as disjoint, inter-twisted and hybrid route paths.

1. Disjoint: It is categories into node-disjoint and link-disjoint. Here, no shared nodes between the calculated route paths are contained in a node-disjoint multiroute path type. This links sender and receiver. The link-disjoint multiroute path type shares common nodes in different links.
2. Inter-twisted: One or more route links are shared in the inter-twisted multiroute path type.
3. Hybrid route paths: It describes the combination of both disjoint and inter-twisted.

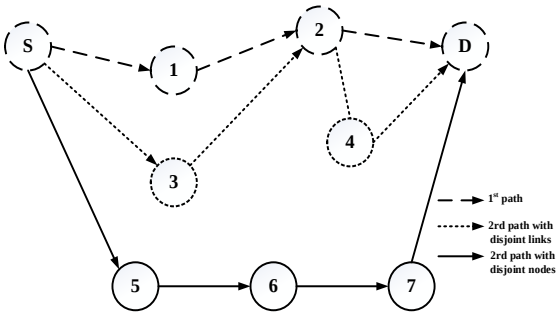


Figure 3: Multiroute Path Routing

Figure 2 describes the multiroute path routing. Here, the sender of the flow evaluates a starting route path for minimizing the cost using a Dijkstra's algorithm. After that it removes all the links used to evaluate the second route path for minimizing the cost. A re-routing process is performed in an on-going session in case of a route path break due to host mobility. The reservation is rapidly and effectively reestablished in the flow restoration process. In the route path maintenance scheme, a probabilistic counter-based method results in significant performance improvement in terms of routing overhead, Media Access control collisions and end-to-end delay while still achieving a good throughput. Various types of protocols are described based on aon-demand routing protocol namely Ad-Hoc On-demand Distance Vector (AODV) routing or Dynamic Source Routing (DSR). Due to these variations, the on-demand multiroute path routing protocols improves network performances such as load balancing, delay and energy efficiency. Some of the disadvantages involved in the protocol are described below:

Route request storm: The multiroute path on-demand routing protocol generates a large amount of route request messages. The redundant overhead packets are proposed in the networks to process duplicate request messages in intermediate nodes.

Inefficient route discovery: Some multiroute path routing protocols keep the middle hub from sending an answer from its route cache to discover hub disjoint or connect disjoint route paths. The sender hub is in the holding up state until a receiver answers. Thus, the route discovery process of the multiroute path routing protocol get longer when contrasted with that of the DSR or the AODV protocols. Amid this route path maintenance scheme, a data packet transmission is performed to assess the shortest route path based on the hop count.

Aon-demand approach is utilized by this protocol that takes out the need to intermittently flood the network. This network is coordinated with table overhaul messages. This table upgrade messages are required in a table-driven approach. In aon-demand i.e., on-demand approach, the route is set up when it is required and consequently the need to discover route to every single other hub in the network as required by the table-driven approach is dispensed with. The halfway hubs likewise uses the route cache information effectively lessens the control overhead.

Hop Count

The *hop count* is generally defined as the number of nodes between the sender and the receiver nodes for successful nodes. *Throughput rate* defines the total number of packets received by the receiver to the total number of packet transmits by the sender. In general, the hop count is a rough measure of the distance between the two hosts. If n number of hop count is present in the hosts means, the n number of gateways are separate the sender host from the receiver host without determining the optimal network route path. Some of the routing protocol such as Routing Information Protocol (RIP) [6] may use as their sole metric.

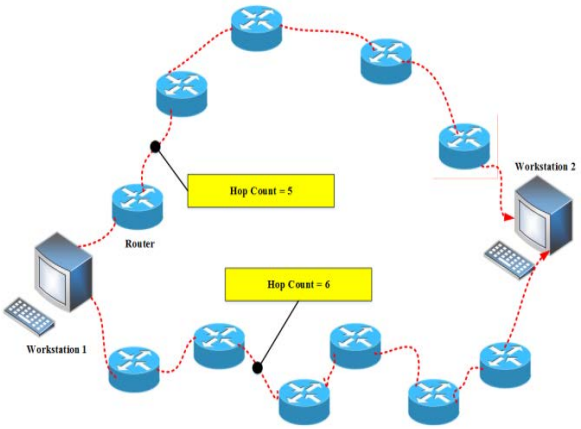


Figure 4: Hop Count Analysis Scheme

In the hop count, the point-to-point link is termed as a network device such as router or gateway, the processing performed in the device is utilized to decide the condition to forward the packet which adds overhead to the transmission. The figure 3 demonstrates the examination plan of the hop count. Here, two workstations are associated through the point-to-point link. This point-to-point link is actually named as the hop, the hop count is the number of network devices, i.e., routers between the sender hub and the receiver hub. In this proposed work, the route path maintenance scheme is performed based on quad-oriented forwarding algorithm [9]. It is mainly used to reduce routing message overhead by enhancing data packet delivery ratio. The various routing route paths are estimated by using this scheme. This routing route path is updated in a routing table for selecting the valid route route path.

Routing Table

The up-to-date view of the network for whole known receivers is present in a routing table. It contains the shortest distance, the predecessor node, the successor node and the flag indicating the status of the route path. The status of the route path is a simple route path or a loop. The previous and successive nodes are stored which assists in detecting loops to avoid the counting-to-infinity problem of the distance vector routing [7]. A flexible infrastructure is provided by a multiple routing table system on top to implement the policy routing. The routing table contains the necessary information for packet forwarding along with the best route path towards to its receiver. Each packet in the routing table contains information about the sender and the receiver nodes. A network device examines the received packet, and is matched with the routing table entry to offer the better match for its receiver. A basic routing table contains below in order:

- Destination: The final destination of the packet is addressed through the Internet Protocol (IP).
- Next hop: The Internet Protocol address of packet is forwarded from side to side by the router.
- Interface: The outgoing network interface acts as a midway for forwarding the packet to the next hop or last receiver.
- Metric: In this metric, the cost is assigned to each available route, so that the most competent cost route path is selected.
- Routes: It contains directly-attached subnets and indirect subnets for routing through multiple hops.

This routing table can be maintained physically or dynamically. When a network administrator will change manually, then the tables for static network devices may change dynamically. In a dynamic routing, the static network devices automatically construct and maintain their routing tables by using the routing protocols to replace the information about the nearby network topology. The valid routing route path selection is used for data packet transmission with shortest routing route path. By using the routing table, four possibilities to save power from devices are:

Minimal power consumption per packet.

Maximize the network connectivity.

Minimum variance in node energy levels.

Minimize the maximum power levels.

Data Packet Transmission

In data packet transmission, the Internet Protocol (IP) recognized the sender and the receiver amid routing process. The packet forwarding procedure is the actual delivery of the packet. By using the various algorithms, the routing can be performed automatically or physically by the overseer. The last consequence of the routing process is put away in the routing table. The packet is conveyed to the receiver. In the data packet transmission, a router gets an IP packet after that forwards the packet out of another of its interfaces relies on upon the substance of the IP header. On the off chance that the packet is sent hop by hop, the packets network layer header remains moderately unaltered. The router confirms the substance of the IP header by checking the protocol version, header length, packet length and header checksum fields. A secured data transmission is a noteworthy issue required in the MANET that is upgraded by utilizing the on-demand and table-driven protocols [8]. Amid the data packet transmission, the routing overhead is happened.

Routing Overhead

In MANET, every node available in the network is required to participate as a router and maintaining individually routes to other nodes. The mobility of the node increases the overhead due to the maintenance of the routes, consuming the scarce bandwidth in the MANET to reduce the throughput. The routing overhead formulates the problem of overhead in the MANET as a rate distortion problem and provide overhead as function of the mobility parameters. The network topology is continuously changed in the MANET [10]. It causes link breakage and invalidation of end-to-end route. The link failure prediction and the route discovery are resolved by using the routing protocols to adapt the dynamic change of network topology. Routes maintained only between nodes who need to communicate to reduce overhead of route maintenance. The route caching can reduce route discovery overhead. A single route discovery that yields the routes to the receiver, due to intermediate nodes replying from local caches.

The routing overhead plays a vital role to determine the scalability of the routing protocol. It denotes the number of additional messages to achieve the acceptance rate of the message. The EE-OLSR energy model is used to reduce the routing overhead while transferring the data packet.

III. Design Parameter

Nodal Speed

It denotes the transmission speed of the mobile node. Here, the mobile node is generally defined in the range of minimum speed and maximum speed. By controlling the speed of node, the performance of the routing is increased.

Energy Consumption

The energy consumption is the consumption of energy or power. The total energy is evaluated during the packet transmission between the sender and the receiver nodes.

Average Connection Arrival Rate

The arrival rate is generally defined as the load in the packet per time unit. Here, the arrival rate of various packet is evaluated from this the average value of this arrival rate is evaluated.

Packet Inter-arrival Time

The packet inter-arrival time is the amount of time between the arrival of one packet and the arrival of the next packet. This packet inert-arrival time is evaluated for each packet after the first and is often averaged to get the mean inter-arrival time that is represented by lambda.

Average Network Lifetime

A network lifetime is characterized as the time until the first hub in the network lost. For maximizing the network lifetime, packet should be routed in the appropriate route path to improve the lifetime of the network.

IV. Results and Discussion

The route path maintenance based EE-OLSR energy model is modeled in a network of 150 nodes arranged with a density of 94 nodes per square kilometer. The existing energy models considered for the survey analysis are Differential Evolution Optimized Link State Routing (DE-OLSR), Energy-efficient table-driven routing, Energy-efficient distributed clustering method, Random Walk with Distribution Selection algorithm (RW-DS), Device-Energy-Load Aware Relay (DELAR) [11] framework, Multicasting through Time Reservation using Adaptive

Control for Energy efficiency MC-TRACE, hierarchical identity based key management method, and Progressive Energy Efficient Routing (PEER). The nodal speed is varied from 1 m/s to 25 m/s. The route path maintenance based EE-OLSR energy model is analyzed in terms of energy consumption for a set of nodal speeds, packet sizes, and connection arrival rates. The energy dissipation analysis for a set of nodal speeds is performed per packet, per node and on an average basis. The energy consumption of the system is analyzed for the specified number of nodes and grid size.

V. Stages of Simulation

Simulation Environment

The simulation environment consists of 50 nodes representing the sink and the sender with grid based topography. Figure 5 depicts the simulation environment model.

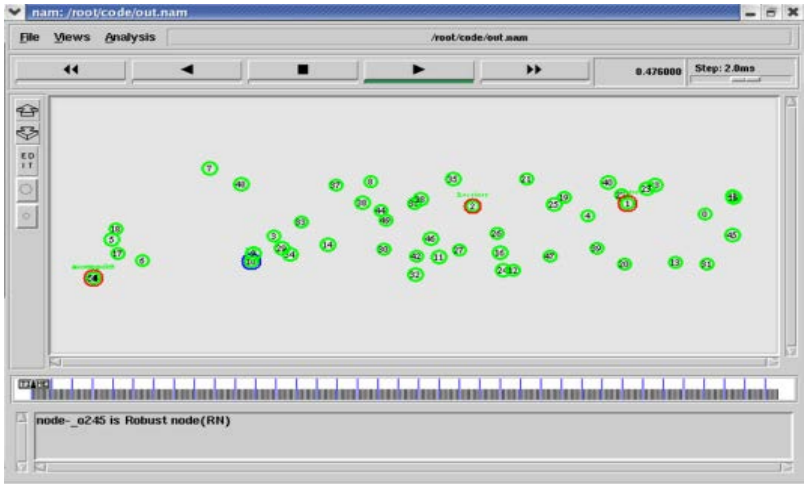


Figure 5: Simulation Environment

Packet Transmission

The figure 6 demonstrates the packet delivery ratio. Packet delivery is characterized as the proportion between numbers of packets transmitted by the sender to the number of packets got by the receiver. This ought to be bigger for capable network. Along these lines, throughput can be evaluated from the packet delivery ratio.

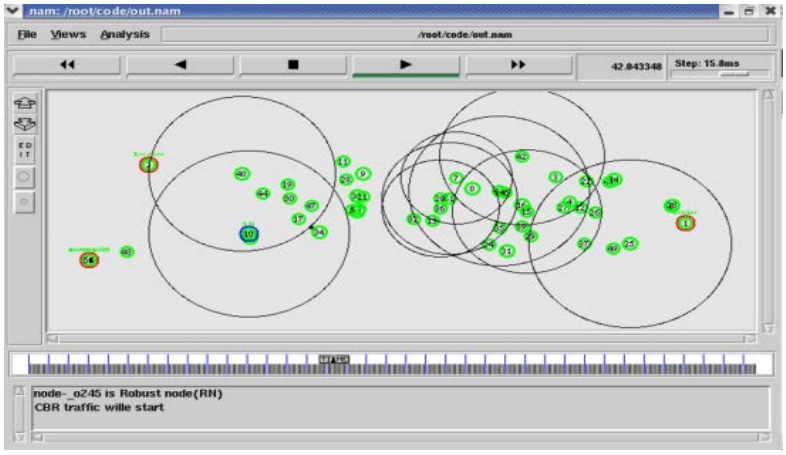


Figure 6: Packet Transmission

Energy Idle State

The figure 7 shows the energy at idle state during the simulation result. Energy consumption can be significantly reduced by switching the nodes to a sleep state when it is idle. After the transmission of all the packets, the nodes are turned into idle state to improve the lifetime of the sensor nodes and the network.

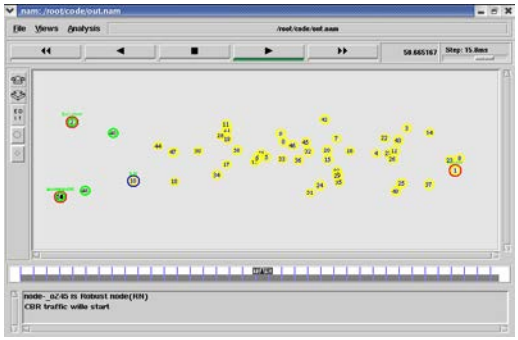


Figure 7: Energy Idle State

Node State after Drained Energy

The figure 8 portrays the packet transmission amid the simulation. Toward the end of the execution time, the energy of the hubs is depleted. In our framework, the hubs are adapting up the energy upto 800ms.

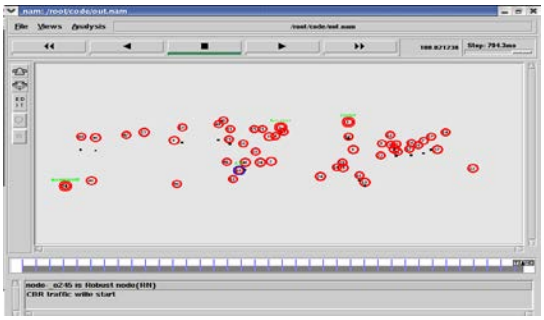


Figure 8: Node State after Drained Energy

VI. Performance Analysis

The performance analysis evaluates the performance metrics for existing and proposed method. The metrics are traffic rate, throughput, and energy consumption simulation.

Traffic Rate for OLSR and Route path Maintenance based EE-OLSR

The figure 9 shows that the comparative graph between traffic rate of both OLSR and route path maintenance based EE-OLSR for no. of packets. If the no. of packets transmitted to the receiver will get increased then the traffic rate is also get increased. When compared with the OLSR, the route path maintenance based EE-OLSR has high traffic rate.

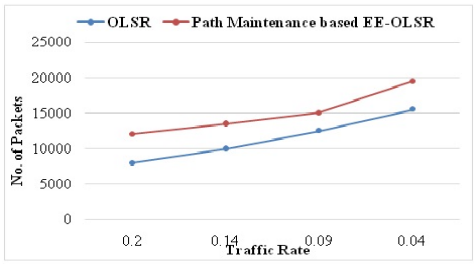


Figure 9: Traffic Rate vs Number of Packets

Average Throughput Analysis

The figure 10 shows the average throughput of OLSR and route path maintenance based EE-OLSR. The comparative result of the average throughput of OLSR and route path maintenance based EE-OLSR is obtained according to their speed. The average throughput of the EE-OLSR is gradually reduced when compared to the OLSR while improving the transmission speed of the data.

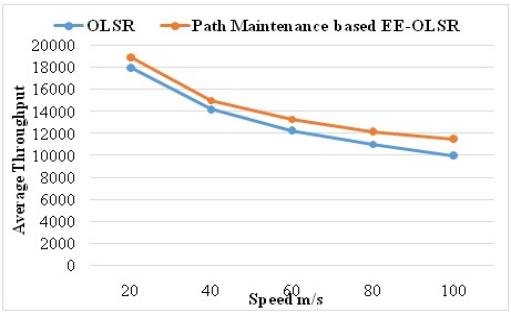


Figure 10: Speed Vs Average Throughput

Path Maintenance Based EE-OLSR Model

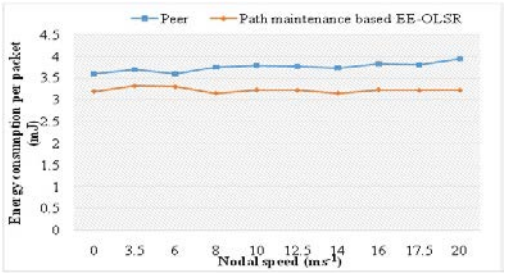
The route path maintenance based EE-OLSR energy model is also analyzed in terms of nodal energy consumption for a given set of packet inter-arrival time, and network lifetime for a given set of nodes. The total energy consumed during the system modeling by DE-OLSR scheme, is 6684.708 J, and by that of the route path maintenance based EE-OLSR scheme is 6023.342 J. The amount of energy consumed by the radio to operate the transmitter or receiver (Eelec) is 50 nJ/bit by Energy-efficient distributed clustering method, and 43.23 nJ/bit by the route path maintenance based EE-OLSR scheme. The amount of energy required to operate the transmitter amplifier (Eamp) is 100 pJ/bit per m2 by Energy-efficient distributed clustering method, and 95.23 pJ/bit per m2 by the route path maintenance based EE-OLSR scheme.

Energy Consumption with Respect to Various Parameters

The energy consumption is broke down in the different energy models concerning parameters like nodal rate, no. of nodes, grid extent and packet inter-arrival time, packet size, average link arrival rate.

Nodal Speed

The energy consumption per packet is analyzed in terms of various nodal speeds for the route path maintenance based EE-OLSR scheme and PEER scheme. The average energy consumption per node is analyzed in terms of nodal speed for the proposed EE-OLSR scheme, DELAR scheme [11] and MC-TRACE scheme. The comparative analysis is given in figure 11.



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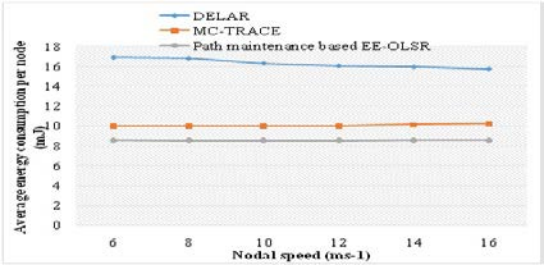
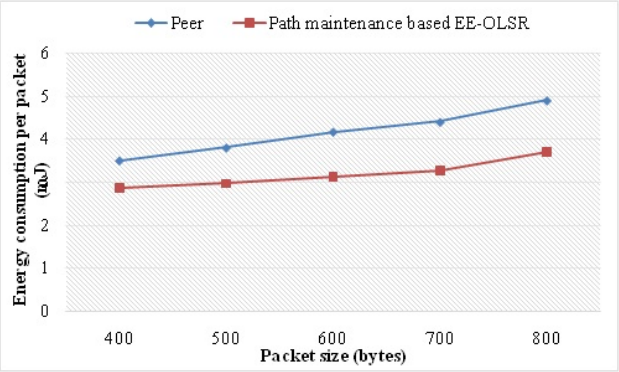


(b)

Figure 11 (a): Per Packet Analysis in the Route Path Maintenance based EE-OLSR Scheme and PEER Scheme and (b) Average Energy Consumption Per Node in the Route Path Maintenance based EE-OLSR Scheme, DELAR Scheme, and MC-TRACE Scheme

Packet Size and Connection Arrival Time

The energy consumption is analyzed per packet in the route path maintenance based EE-OLSR scheme and PEER scheme, for a set of packet sizes (bytes) and average connection arrival rates (per hour), and compared in and figure 12.



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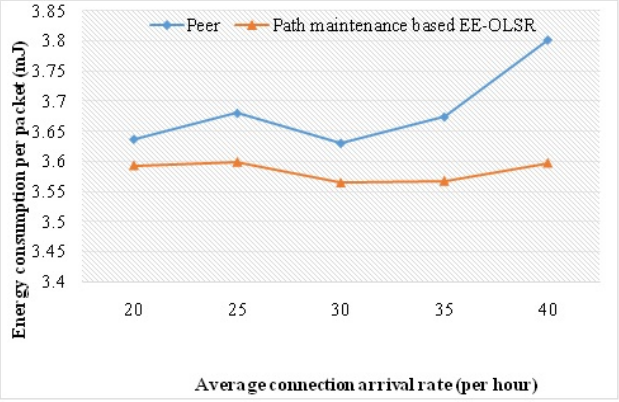

(b)

Figure 12 (a): Set of Packet Sizes and (b) for a Set of Average Connection Arrival Rates

VII. Conclusion

This study exhibits a route path maintenance scheme based Energy Efficient-Optimized Link State Routing (EE-OLSR) protocol. Because of a periodic search for most energy-efficient route path, the proficiency of this energy model is upgraded. By utilizing this energy model, the routing overhead and route path construction delay is diminished and the network lifetime is improved. The route path maintenance scheme is performed in view of quad-oriented forwarding algorithm with single hop beaconing from the primary route hubs. This proposed route path maintenance scheme based EE-OLSR expends lesser energy.

Exploratory results demonstrate that the proposed work delivers better and compelling results. The proposed energy model is actualized on the Networking stage and it creates better node speed, packet size, and average connection arrival rate, when compared with existing energy model. At long last, the outcomes show that the proposed approach devours lesser energy.

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