

A New Method to Reduce Energy Consumption in Manet Network Routing based on OLSR Protocol and Genetic Algorithm

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Abstract

Mobile Ad Hoc Networks (MANET) can be considered as a class of unstructured networks created by a number of autonomous wireless and sensor nodes. The inherent characteristics of such networks have made specific applications, such as multimedia transfer and challenging. Basically, the functionality of a node and very few resources directly affect the delivery of packets which depends on the quality of the selected route. Since the nodes in MANET get their energy and power from batteries or other end-to-end resources, the most important criterion to design an optimal system is energy conservation. The purpose of this paper was to increase the efficiency of the OLSR routing protocol by generating new parameters and considering the amount of nodes energy. In this method, the optimal route was selected based on the remained energy in the middle nodes, the distance between the nodes and the number of steps. Therefore, the present paper used a genetic algorithm-based approach for optimal routing in the OLSR protocol based on the remained energy of each node. It used the weight factor which has been determined based on energy consumption combined with shortest routes. It considered the energy factor of each node in routing and selected the optimal route.

Keywords: Mobile Ad Hoc Network (MANET), Routing Protocol, Energy-Based Routing, Genetic Algorithm

1. Introduction

Wireless sensor networks are one of the key technologies for the future and they can be considered as the most important technology in the 21st century. Mobile Ad Hoc Network (MANET) can be considered as a class of unstructured networks created by a number of autonomous mobile and sensor nodes [1]. The inherent characteristics of such networks have made specific applications, such as multimedia transfer and challenging. Basically, the functionality of a node and very few resources directly affect the delivery of packets which depends on the quality of the selected route. Since the nodes in MANET get their energy and power from batteries or other end-to-end resources, the most important criterion to design an optimal system is energy conservation. However, two components of improving energy consumption and reliability in MANET networks have been investigated separately and by using different methods and other routing algorithms [1].

The OLSR¹ protocol is one of the routing protocols in mobile ad hoc networks that use the Dijkstra algorithm to select the shortest route as the best route. This algorithm is one of the graph search algorithms that solve the problem of the shortest route from the single source for weight graphs with no negative weights. Finally, it makes the shortest route from the source to all the vertices of the graph by creating the shortest route tree. In this protocol, the distance between the nodes is considered as the weight of each edge and the criterion of route selection [2]. But this route selection criterion in the OLSR protocol does not allow finding the optimal route as it does not take into account the energy factor of each node. The purpose of this paper was to increase the efficiency of the OLSR routing protocol by generating new parameters and considering the amount of nodes' energy. In this method, the optimal route was selected based on the remained energy in the middle nodes and the distance between the nodes as well as the number of steps.

Another challenge to this protocol is choosing an optimal MPR² set which is an NP³ issue due to the mobility of the nodes and the displacement of nodes and network conditions. Therefore, the researchers have been trying to change OLSR to a practical protocol in the real world in order to improve the performance of the OLSR protocol and to reduce the overhead of this protocol, especially at high speeds and dense networks [3].

MANETs are very flexible and suitable for several types of applications. Some important applications of MANETs are military applications, disaster recovery, exploration, law enforcement, sensor networks and multimedia applications. In design of ad hoc networks a critical issue is the effective routing of packets to destinations [4].

In this paper, a genetic algorithm-based approach was used for optimal routing based on each node's energy in which weight factor was used in combination with the shortest routes. It integrated the energy factor of each node into routing and selected the most optimal route.

The remainder of this paper is structured as follows: In Section II we provide a short discussion of related work. In Section III, The proposed method approach is expressed. Section IV, explores the performance evaluation of the proposed schemes followed by simulation scenario demonstration. At last the study is concluded in section v.

2. Literature Review

So far, many studies have been done to improve data flow and increase network efficiency to send multimedia data which indicates the importance and value of this issue in mobile contingency networks. The proposed solutions to improve the flow of data can be divided into two categories: providing methods based on interlayer criteria and providing methods to streamline data through routing criteria.

2.1 Interlinear methods

The importance of mobile contingency networks for wireless communications and increase in popularity of mobile devices have been mentioned in many studies [8]. The proposed method prioritizes data packets using MAC layer information to improve the

¹Optimized link state routing

²Multi-point relay

³non deterministic polynomial

efficiency of TFRC¹. The advantage of this method is interlayer designing proposed to measure SNR² along the route in order to rebuild a more efficient route. Traffic classification and the use of SNR category lead to improved end-to-end service quality.

The proposed method in this study did not consider the efficient routing criteria (such as overhead, latency and packet loss rates along the route from origin to destination) which ultimately lower efficiency and effectiveness.

In an article written by [9], an interlayer design framework has been developed to support latency traffic on contingency wireless networks and its benefits have been investigated for real-time data transmission. In the proposed framework, the optimal allocation of capacity on the edge of the capacity region has been determined by means of time division among different transmission designs. In this work, network congestion was used as a cost function. Network congestion reflects the latency of data packets. Also, some other important benefits of layers including the link layer and the end-to-end exchange of the transmission layer have been neglected. One limitation of the proposed method is the routing criterion which has not been taken into account sufficiently. However, the most important parameters of video sending (latency changes, end-to-end delay) depend on the routing protocol's performance.

2.2 Methods to streamline data by using routing criteria

In an article written by [10], the benefits of 4 multimode routing optimization in 5 real-time transmissions of data of limited bandwidth contingency wireless networks have been taken into account. In such environments, the performance of each node can potentially affect the overall network location. Therefore, optimal routing solutions that seek to reduce congestion is attractive as these solutions optimize the use of resources. The proposed method in this paper for real time data transmission with low delay suggests limiting the number of routes to overcome the limitations of such solutions. Using multi-directional routing reduces the frequency of upgrades and increases the strength. Routing algorithms minimize the steps between source and destination and minimize network congestion. The limitations of the proposed method in this paper are the need for high-memory proposed method for multimode mechanisms over each source and destination. Besides, high overhead of multimode methods can be considered as the disadvantages of the proposed method. On the other hand, the efficient measures of other layers in this method have not been taken into account.

Mobile ad hoc networks [11], also called MANET (Mobile Ad-hoc Network) are formed dynamically by a great number of mobile terminals (nodes) that connect without using an existing loyal substructure and by using wireless seams (radio waves). The nodes can interact and collaborate to exchange services. These nodes are free to move and organize themselves arbitrarily, involving a wide variability in the network topology. Each node is able to communicate directly with its neighbors (located in its coverage area), and through which they pass to communicate with more remote nodes which may serve as a relay for other nodes in the network.

In an article written by [12], the routing and control of the input rate have been discussed concurrently. In this method, a descending cost function = - P0; the constraint of the specified value of the transaction; and the value of the incremental value of the transaction were determined predictably; and, as a whole, the cost of downloading the

¹TCP Friendly Rate Control

²Singal to Noise ratio

software should be reduced to zero. The limitations of this method are no guarantee for the quality of exchanges and no attention to advantages of other layers.

In [13] stated that the main challenge in Mobile Ad hoc Networks (MANETs) is their multi-step nature, especially in the flow of multimedia data on MANETs, which have been increasingly used in different areas.

In [14] found that when data are sent immediately on MANETs, network efficiency, multimedia file size, response time, delay, scalability and loss of packets are considered. Scalability has been analyzed from different aspects such as self-configuration, security, routing flexibility, data distribution, service quality, and response time. In this paper, several routing methods available for sending data on MANETs have been investigated and the used methods have been classified into five classes according to their scalability.

In [15] a new dynamic clustering model in WSNs to improve the efficiency of leach protocol which tries to cluster heads election from different distributed parts of ground and then the number of clusters in each round is fixed. so adjusted a threshold function that makes the necessary controls to ensure two goals. This is an efficient model for improving the performance of the saturation protocol. This model was superior to leach protocol with respect to all aspects of the time of death for first node, network's lifetime and also energy consumption of networks.

Qin et al. in [16] discussed the routing and control of the input rate. In this method, a convex descending charge function is defined for the input allocation rate of each conversation and a convex cluster charge function for the intensity of each line. Then, sum of these functions was minimized across the network in order to measure the network's transmission and reduce congestion.

Wang et al. in [17] examined the timing and routing problems simultaneously. It has been shown that the proposed algorithm is optimal in term of passing. Thus, at the beginning of each time interval, in each line of difference, the lengths of the queues of the various destinations are calculated by the end of the line, and the largest of them are considered as line weights, and finally a set of lines is selected but they should not interact.

In [18], a new design for transfer and transport in sensor networks was presented using the imperialist competitive algorithm, which was used for mobile robots to improve coverage and connections in different areas. In this method, by inactivating unnecessary nodes in the network and using robots to discover the topology, collecting additional sensors, and eventually replacing the sensors in the revolutionary stage of imperialist competitive algorithms, network's energy consumption have been greatly saved and longevity of the network have increased, and the robots heal their cavities by replacing the disabled sensor with their sensors and thus improved coverage and connectivity. The proposed method focuses on how to use the approaches through initial and random use to complete coverage and connectivity points.

Recently, genetic algorithm has found a special place among optimization methods to solve hard problems and it is considered as an efficient and effective way to solve such problems in commercial, scientific and engineering fields [19]. Genetic algorithm is based on a series of problem-solving solutions aims at gaining the best answers to the best survival law. In each generation, better approximations of the final result can be obtained by using a selection process proportional to the value of the answers and the reproduction of the selected solutions imitated from natural genetics with the help of

operators and better approximations are obtained based on the final result. This process makes the new generations more consistent with the conditions of the problem [19]

The most important operator has been integrated in the genetic algorithm. Integration is a process in which the old generation of chromosomes integrates or combines to create a new generation of chromosomes. The couples that were considered as the parent in the selection section will exchange their genes together and create new members. Integration in the genetic algorithm results in the loss of genetic diversity or dispersion, since it allows good genes find each other [20].

3. The Proposed Method

In Mobile Ad Hoc Network (MANET), the main purpose of the routing protocol is to route the data to any point in the network. The obvious solution is routing to the destination by using the minimum possible number of steps. This approach is significant as it greatly minimizes the routing time. Recently, one of the main concerns of MANET has been energy efficiency in order to achieve better performance. Accordingly, it is very important to consider this issue in the proposed routing protocols.

In this paper, a significant process in designing the least costly energy solutions for MANET was examined based on previous study [7]. The proposed approach provides energy efficiency for a MANET by upgrading the OLSR routing algorithm and it aims at better energy conservation in MANET. This study was described in detail in the previous section. The main approach of this paper is to use the genetic optimization algorithm to select the multi-point relay for the OLSR promotion, which is provided to select multi-point relays based on the quality of service parameters such as the latency of each node and the degree of interest. The packet delay was measured based on the average time required to send packets from one node to another in one step. The degree of interest also indicates the interest of the node in order to prioritize other nodes to send data to the network.

Minimizing energy consumption is a very important issue in MANET. In this paper, a significant process to design the least costly energy solutions for the MANET was provided regarding the previous study [7] which provides energy efficiency for a MANET by upgrading the OLSR routing algorithm in order to achieve better energy conservation in MANET. This new approach is basically based on the communication environment parameters, especially the communication distance of mobile nodes and their mobility. The innovation of this research is that a method for selecting the point-to-point relay (MPR) was added in this study, which is based on an evolutionary genetic algorithm to find the appropriate problem space and to choose the optimal solution. Our solution modeling is presented in the next section. Thus, proposed method is presented in follow. The simulation results also indicate the effectiveness of these approaches in increasing and improving the efficiency of the OLSR routing algorithm.

3.1 Proposed approach: Using Genetic Optimization Algorithm to Select Multi-Point Relays

The aim of using the genetic optimization algorithm is the complexity of the network which in contrast to other AI algorithms has also been considered as an advantage and it reduces energy consumption. The genetic algorithm was presented and simulated due to its simplicity in the selection of multipoint relays in several programs and networks with different densities. The genetic algorithm has been modified to meet the requirement for

multi-point relays with better service quality. Simplicity and rapid convergence towards an optimal solution was a solution proposed by the genetic algorithm in this paper. Accordingly, the proposed method of this paper was used in the algorithm to select multi-point relays with less repetition in order to find multi-point relays in mobile wireless networks.

3.2 Details of the proposed method to select multipoint relays

OLSR has done a distributive selection of a pointed distribution relays set that plays the role of assigned routes. In OLSR, only nodes such as multi-point relays are responsible to forward traffic control with the intention of spreading across the network. Multipoint relays provide an efficient mechanism to control traffic flow by reducing the number of required transmissions. In this experiment, the OLSR used hi-res message to help neighbors find their own single-step and double-step through their answers. However, when there is more than one single-step neighbor which cover a number of similar uncovered double-step neighbors. Thus, the neighbor who has a minimal delay and a high degree of interest in this node was chosen as a node of multiple relays.

OLSR used the exchange of hi-res message to obtain information and to calculate latency. In OLSR, a node periodically releases hi-res messages. Neighborhood changes have been discovered through the information in these messages. A hi-res message contains the publisher's node address and a list of neighbors known to that node, including the link state for each neighbor (for example, symmetric or non-symmetric). Accordingly, a node informs its neighbors to communicate with which neighbor and in which direction communications have been approved.

By receiving a hi-res message a node can collect information that describes its neighbors and double-step neighbors. Besides, it determined the quality of the links in its neighborhood: the link from the node m to the neighbor n is symmetric if the node m in the hi-res message from n serves its own address (with any link state), otherwise the link is asymmetric. The multi-gap relay selection process in the proposed method was shown in Fig1.

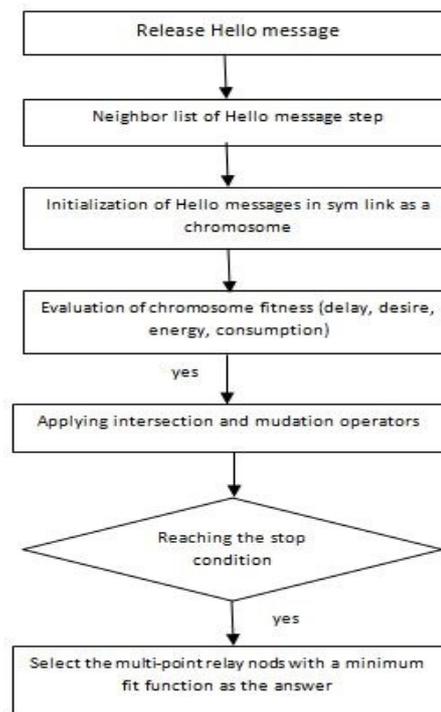


figure1: The flow diagram of a genetic algorithm based method in the selection of multi-point relay algorithms

Each node has an information set that describes the neighbors and the double-step neighbors. Such information is valid for a limited period of time. The hi-res message is exchanged between neighbors and provides topological information for a node that describes the neighbors and the double-step neighbors.

The information received from the hi-res message along with the time it was sent and received was used to calculate the delay between the nodes and it is considered as one criterion in the proposed routing method in this paper. Another metric is another route of interest, a degree of interest.

Degree of interest	The amount of
Interested-never	0
Interested-down	1
Default-interested	3
Interested-up	6
Interested-always	7

The degree of interest in the node's interest in wireless mesh networks is intended to provide a contribution or commitment to other nodes in the transmission of data on the network. In OLSR, the interest is based on the node energy state which has been calculated in the second section of this paper. The nodal interest is placed in integers

between 0 and 7, indicating how much the node is interested in forwarding traffic from the other nodes. A list of interest values has been shown in Table (1). The values of this table and the range of each have been determined based on different experiments and selection of the best mode. Various quantities have been determined based on the amount of energy consumed in the method presented in [7] which is the basis of this paper.

Regarding the default state, nodes have a default interest status. An interest always implies that a node is always selected to carry traffic from the other nodes. If a node does not carry other node traffic due to loss of traffic power, its interest in interest will never change.

After calculating the latency of the hi-res message exchange and creating a degree of interest, the routing criterion becomes the proportion function for the proposed method. In the proposed method, a number of chromosomes have been placed in the search function of the fit function. Accordingly, the proposed method evaluated the proportionality of the target of each chromosome in its current position. Each chromosome was presented as a hi-res message in each node and its proportionality was determined by applying the operators of the combination of the best members of the search space and then the operation of the mutation operator. The next repetition of the process of the proposed method of this paper ends when the desired criterion (i.e., minimalistic fit function) is obtained or that when a predetermined number of duplicates is achieved. A node with a minimal value of the fit function was selected as the node of the multi-point relay.

$$fitness_{mn}(k) = delay_{mn}(k) + weight_{mn}(k)$$

Fitness $mn(k)$: Fit function for the transfer of packet k from node m to node n

Delay $mn(k)$: The time delay required by the transfer of the packet k from the node m to the node n and

Weight $mn(k)$: The inverse of the degree of interest is the packet transfer k from node m to node n (here the value is an integer). The greater the amount of interest is, the weight $mn(k)$ is reduced and we go towards minimizing the fit function.

4. Evaluation of the Proposed Method

4.1 Characteristics of the model of implementation and simulation model

MATLAB R2010a software has been used to simulate the proposed method. This simulation has been run on a system computer with corei7 processor with original 4GB of memory on Windows 7 operating system.

Simulations have been performed for 1000 seconds; each data point is an average provider of three runs that are identical with traffic patterns, but different randomly generated scenarios. To fit, the same mobility scenarios and traffic have been used when comparisons were made between protocol changes.

The main purpose of our experiments is to examine the performance of the proposed method and to demonstrate its effects on reliability and energy consumption in a mobile ad hoc network. The proposed approach was evaluated in terms of packet loss, energy consumption, and network lifetime and some parameters were used in accordance with the method presented in [7]. MATLAB software was used to simulate the network. This attachment consists of a set of routing protocols for mobile ad hoc network. To do

simulation, the effective transmission range is 250 meters. A 550-meter interference domain was also taken into account and all nodes in a given nodal transit distance interact with the intermediary. Each node has a 50-bit packet buffer link layer which has been managed with a closed end state of the packet. The method of scheduling closed packets is FIFO.

Three key performance measures: reliability of the protocol, energy consumption and network lifetime were investigated in this paper. Thus, OLSR base protocol as well as the method presented in [7] called the EM-OLSR were used. The reason for this is that the proposed method of this paper introduced the efficiency upgrading method as a basic method and then developed it by selecting the multiplicity of relays with genetic algorithms.

4.2 Reliability of protocols

• Speed change

For this simulation, the stop time was equal to 50 seconds and the load of a network was equal to 20 sources which is in accordance with the method presented in [7] to be a fair comparison. For weak mobility of the nodes, the network provided a stability which was relatively high and the failure of the links was lower compared to high mobility. As a result, the amount of data loss grew when the nodes moved at low speed and the smaller ones grew when mobility increased. It should be noted that the packet loss rates for the two protocols of OLSR and the method [7] are relatively similar, but the proposed method of this paper managed to look for an appropriate and fast area of the problem in comparison with the appropriate choice of relays. Therefore, a more appropriate route can be selected for data transfer and thereby it improves the package loss rate. Based on these results, it is concluded that the reliability of the proposed method is similar to that of the OLSR and method in paper [7] while both have been affected by the speed of nodes' mobility. So while simulation seeks to boost energy consumption in the network, it does not reduce the reliability of the OLSR protocol.

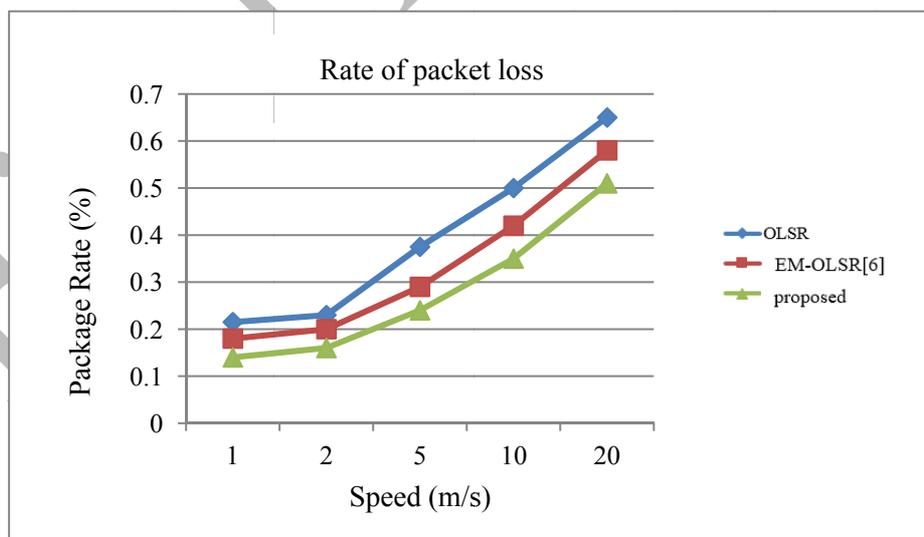


Figure 2: Rate of data loss compared to speed

• Stop time change

Figure 3 shows the rate of data loss at a time when the stop time was changed by using nodes with a speed equal to 2 m / s and a network load equaled to 20 sets of resources

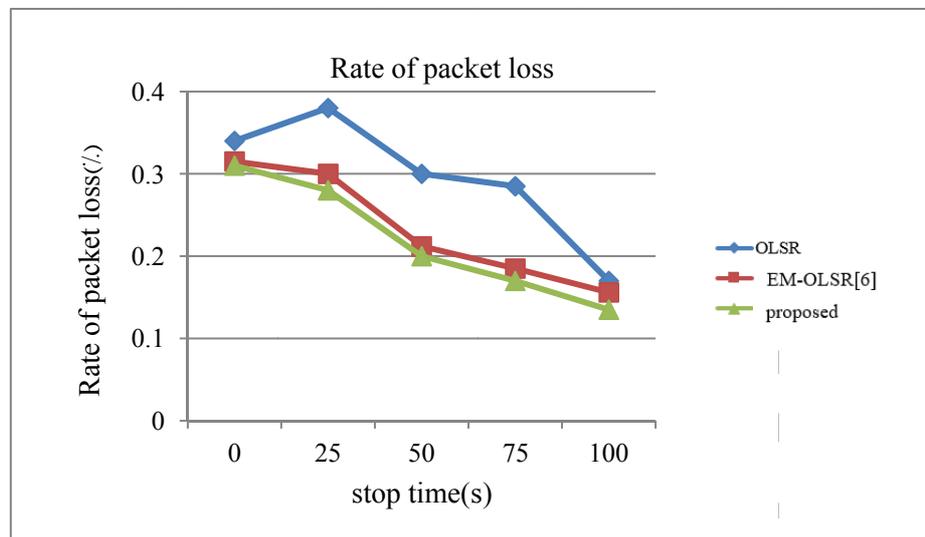


Figure 3: Loss of data based on stop time

An increase in stop time led to network stability that is appropriate for entering the data packet to their destination, and, accordingly, the amount of data loss decreased. The packet loss rate for both OLSR protocols and the proposed method, such as speed change, is almost identical. It can be stated that the reliability of the proposed method in this paper is more efficient when it is compared to the OLSR base protocol as well as the EM-OLSR method. This solution does not reduce the reliability of OLSR in the network by changing the stop time and it improves performance in this regard. Based on these two results, it should be said that our solution based on the proposed method of this paper is influenced by the speed of the nodes and their stop time. It should be noted that the main goal of this solution is to consume energy in the network.

4.3 Energy consumption

Based on the results of our previous studies the following scenario has been developed in energy consumption issue.

Nodes number = 10 knots; continuous bit number of sources = 3 sources; maximum speed = 2 m / s; stop time = 50 seconds; simulation time = 1000 seconds; initial energy = 20 J.

• Total network energy

In this comparison, the total network energy decreases faster before upgrade rather than the period after the upgrade over a time period of (0.600 s). The difference in consumption during this period was due to intelligent management of this energy by choosing the right point-to-point relay through a genetic algorithm that reduces energy consumption. During this period (600 s, 1000 s), it is determined that the grid energy level before the upgrade is fixed due to the loss of its connection.

Loss of connection is due to the fact that the nodes' energy was used inappropriately which results in the depletion of the total energy of nodes that are most often read by the OLSR protocol. This explains the failure of the network connection that stops network activity.

In addition, when $t = 600$ s, the number of active nodes in the network before the upgrade is 4, and these nodes probably do not make relationship with each other because of their distance. During the same time period, energy in the network began to decrease with the upgrade of the proposed model of the paper, which proves that the nodes are communicating. Different values are also determined based on the amount of energy consumed in the method presented in [7], which is the basis of this paper. For each mobile node I the most important parameters in the communication environment that can really affect the energy consumption are the mobility rate of the node I which is represented by $M I$ and it is measured by unit meters per unit time, as well as the communication distance indicated by D_i and its unit is m . The proposed method in [7] created an appropriate balance between these two factors and calculated the energy consumption.

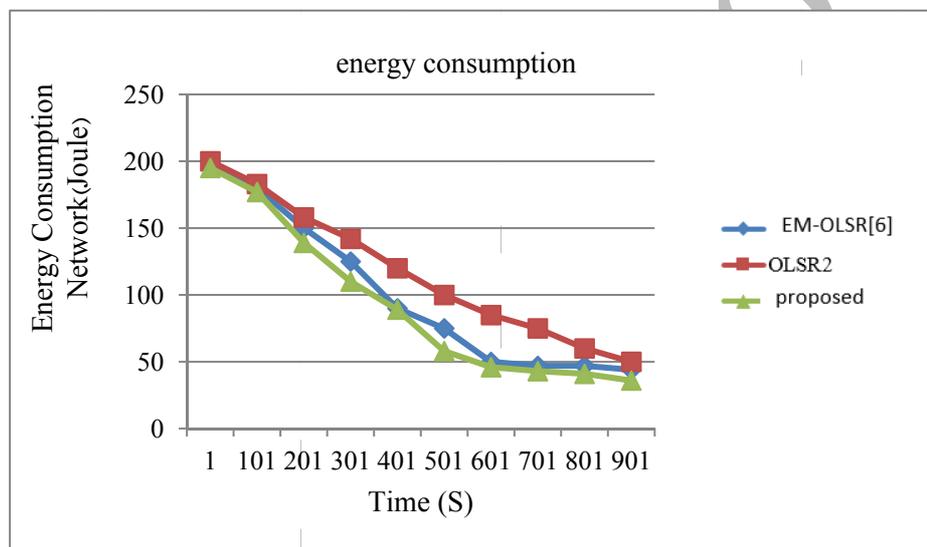


Figure 4: Total energy vs. time estimation

After calculating the energy value of this period (0.600) it was concluded that the approach to the proposed method of this paper saves about 17% of the total energy in the network. The results show that the previous EM-OLSR method has been improved when it is compared with the base-energy algorithm. The simulation results show that the efficiency of the proposed method is better than the OLSR base protocol and it is also better than the previous proposed method which is EM-OLSR.

• Network lifetime

Figure 5 shows the network lifetime. This figure shows that the number of active nodes in the network before the upgrade has been reduced and it started at $t = 350$ s, and it got stable at $t = 700$ s to only three nodes due to loss of connectivity. This number of nodes started to decrease again at about $t = 900$ s. But in the proposed protocol, the number of active nodes kept stable in the network remained at about $t = 750$ s, but then it started to slow down rapidly.

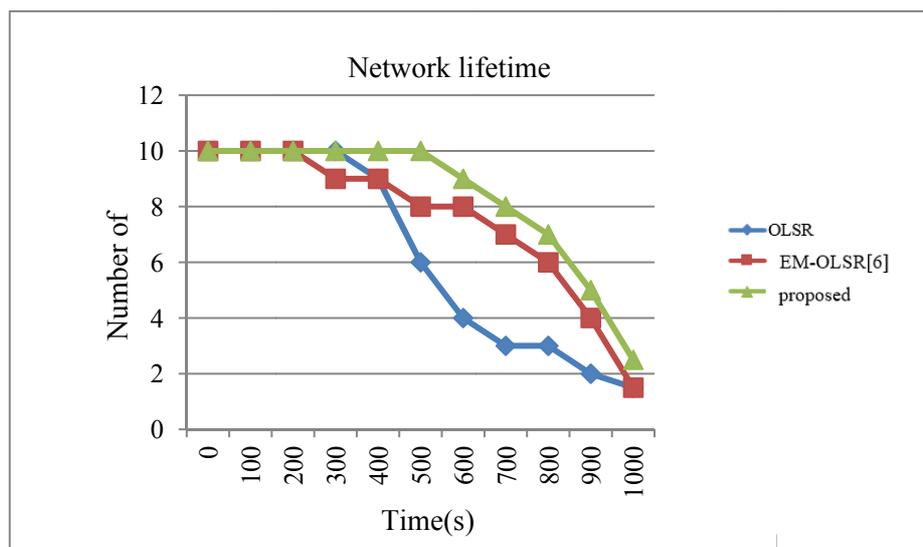


Figure 5: Network lifetime

The proposed approach of this paper was higher due to the use of multi-point relays with the genetic algorithm in favor of the remaining energy nodes and it made use of them appropriately. Simulation results showed that this approach improved the average lifetime of a node appropriately compared to the OLSR protocol and the EM-OLSR protocol and it can increase the total lifetime of the network.

4.4 Comparison with other studies

Each routing protocol investigates optimization and guarantee of the quality of communications in the network. Choosing the best MPR set will significantly reduce the control message in the network. The problem of choosing the optimal MPR set is an NP issue, so the researchers have been trying to turn OLSR into a real-world application with a proper solution. In order to evaluate the proposed method, this study was compared with other studies. To do this purpose, two studies in [2] and [6] have been used. In study [5] an appropriate method was presented to improve the performance of the OLSR protocol and reduce the overhead of this protocol, especially at high speeds and dense networks. The applied method showed the change in selection process of the MPR set and choosing a stable set with higher efficiency. The stability of the nodes is the result of predicting the pattern of nodes movement in the future and the higher efficiency of combining different parameters in the selection of this set.

For this purpose, the current position of the nodes was used to predict their position in the future which can be used to determine the stability time of a neighbor. The obtained time showed the degree of each node, and accessibility was used as inputs of a simple fuzzy system for final decision making.

In [6], a set of OLSR protocol characteristics was introduced to cover all aspects of its behavior, and it used machine learning approach to present an anomaly detection system based on the conceptual collection of data which predicts the next in order to reduce energy consumption. The system considered characteristics based on the data source in four groups, and then it learned a pattern for normal data in each group which resulted in reducing energy consumption.

In the following, a comparison has been made to evaluate the proposed method.

- **Total network energy**

The total network energy decreased before the upgrade faster than the period after the upgrade over a period of time (0.600 s). The difference in consumption during this period was due to the intelligent management of this energy by adding the equalization parameter to the multi-point relay method which sometimes increases energy consumption. During this period (600 s, 1000 s), it is determined that the energy level of the network before the upgrade is fixed due to the loss of its connection.

The diagram below shows the energy consumption of the proposed method in comparison with the two studies in [5] and [6]. This amount of energy is shown based on the time elapsed from the network activity at 100 second intervals.

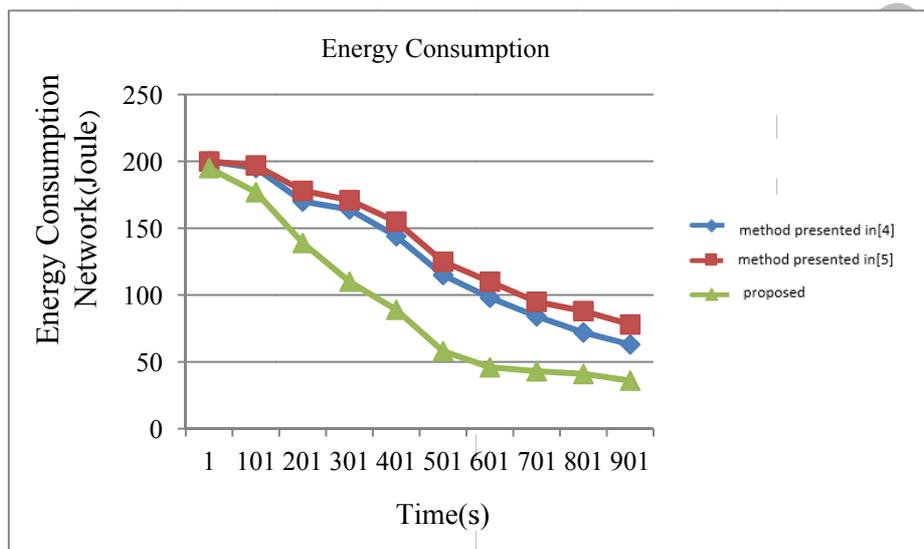


Figure 6: Total Energy versus Time Estimation Compared to Other Studies

As the results show this method significantly reduces energy consumption compared to other methods. This is because the proposed method of this paper uses the power of OLSR routing protocol. The proposed method along with the multi-point relay method used by this protocol decided to use a different parameter that consumes the right energy (fair) in a matched set of a multi-point relay. Another comparison has also been made based on the network lifetime compared to the two previous methods which shows the results presented in the diagram below improve the results of the convenience of time forward.

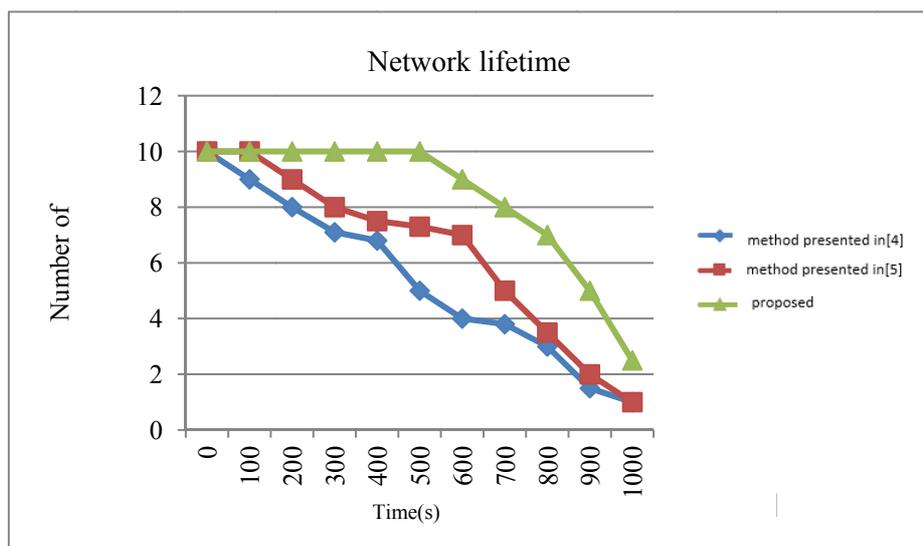


figure7: Compare network lifetime with other studies

These results also indicate the proper quality of the proposed method at all times of the network lifetime and shows that the number of live nodes at any given moment in the network time is greater than the number of nodes in other studies. The reason for this is that the method of choosing the next step in the proposed method is different from other studies. Other energy efficient methods based on OLSR protocol upgrade utilize the network layer through OLSR protocol adaption. In link status protocols, each node announces direct links to its neighbors for the entire network. In terms of OLSR routing, nodes only annotate a sub-segment of their neighbors by using a multi-point relay method. They are initially composed so that each node must ignore a set of direct links and neighbors that are used to calculate additional shorter routes. More precisely, in a set of neighboring nodes, only one subset has been considered. This subset was selected to reach all double-step neighbors (all neighboring neighbors). This subset was named multi-point relay set. However, in the proposed method with multiple selective relay approach, the genetic algorithm has reduced energy consumption which improves the quality of the proposed method when it is compared to other studies.

5. Conclusion

In this paper, a new approach in Mobile Ad Hoc Networks (MANET) was presented by upgrading the OLSR based on the energy efficiency which can be a progression in the OLSR protocol for better energy conservation in MANET. This new approach is fundamentally based on the energy quality of mobile nodes and their mobility. Then, another parameter was added to the multi-point relay method by this protocol. The present paper introduced the process of upgrading the selection of multi-point relays in the OLSR protocol by using the genetic algorithm optimization where the delay and degree of interest have been proposed as the fit function. The results showed that the proposed method has a better performance rather than standard OLSR in terms of operating power and energy consumption as well as network lifetime.

References

- [1] M. Kserawi, S. Jung, D. Lee, J. Sung, and J. Rhee, "Multipath Video Real-Time Streaming by Field-Based Anycast Routing," *IEEE TRANSACTIONS ON MULTIMEDIA*, Vol. 16, pp. 533-540, 2014.
- [2] S. Prajapati, N. Pate, R. Patel, "Optimizing Performance of OLSR Protocol Using Energy Based MPR Selection in MANET," 2015 Fifth International Conference on Communication Systems and Network Technologies, 2015.
- [3] Z. Guo, S. Malakooti, S. Sheikh, C. Al-Najjar, M. Lehman, B. Malakooti, "Energy aware proactive optimized link state routing in mobile ad-hoc networks," *Applied Mathematical Modelling* 35 (2011) 4715–4729, 2011.
- [4] Sajjad Jahanbakhsh Gudakahriz, Shahram Jamali, Mina Vajed Khiavi. "Energy Efficient Routing in Mobile Ad Hoc Networks by Using Honey Bee Mating Optimization". Sari Branch, Islamic Azad University, Sari, I.R.Iran, Vol. 3, No. 4, November 2012.
- [5] S. Hamrioui, "A new approach for energy efficiency in MANET based on the OLSR protocol," *International Journal of Wireless and Mobile Computing*, Vol. 5, No. 3, 2012.
- [6] T. Gupta, A. Dureja, and K. Khanna, "Comparative Survey on Reliable Video Transmission in MANET Using Node Stabilization," *International Journal of Innovations & Advancement in Computer Science*, Vol.4, pp. 676-682, 2015.
- [7] P. Goudarzi, and M. Mohammadzadeh, "An Optimal Rate Allocation Method for Video Transmission Over Wireless Ad Hoc Networks", *IEEE Multimedia*, Vol. 17, p.44 -55, 2010.
- [8] G. Adam, C. Bouras, A. Gkamas, V. Kapoulas, and G. Kioumourtzis, "Cross Layer Design for Video Streaming in MANETs," *JOURNAL OF NETWORKS*, Vol. 9, pp. 328-338, 2014.
- [9] T. Yoo, E. Setton, X. Zhu, A. Goldsmith, and B. Girod, "Cross Layer Design for Video Streaming over Wireless Adhoc Networks," *IEEE Journal on Selected Areas on Communications*, Vol. 11, pp. 89-93, 2006.
- [10] E. Setton, T. Yoo, X. Zhu, A. Goldsmith, and B. Girod, "Cross Layer Design of Adhoc Networks for Real-Time Video Streaming," *IEEE Transactions on Wireless Communications*, Vol. 18, pp. 34-41, 2010.
- [11] F Semchedine, A Moussaoui, Kh Zouaoui, S Mehamel. "Crypto Optimized Link State Routing for MANET". *IEEE* 24 April 2017 .
- [12] Y. Qin, C. Westphal, and J. J. Garcia-Luna-Aceves, "Using geographical coordinates to attain efficient route signaling in ad hoc networks," in *Proceedings of the Fourteenth International Symposium on a World of Wireless, Mobile and Multimedia Networks*. IEEE Press, 2013.
- [13] G. Adam, C. Bouras, A. Gkamas, V. Kapoulas, and G. Kioumourtzis, "Cross Layer Design for Video Streaming in MANETs," *JOURNAL OF NETWORKS*, Vol. 9, pp. 328-338, 2014.
- [14] Nan. Jiang, Larry. Dennison, Santa. Clara, "Network routing for fine-grained communication," SC '15 Proceedings of the International Conference for High Performance Computing, Networking, Storage and Analysis, 2015.
- [15] Rohollah Omidvar, Hamid Parvin, Farhad Rad, Amin Eskandari, Ali Chamkoori. "A New Dynamic Clustering Control Method in Wireless Sensor Networks". Sari Branch, Islamic Azad University, Sari, I.R.Iran, Vol. 8, No. 3, August 2017.
- [16] H. Cui, D. Qian, X. Zhang, C. Jing, "Joint Source-Network Coding Optimization for Video Streaming over Wireless Multi-hop Networks," *IEEE Vehicular Technology*, pp. 1-5, 2012.
- [17] Y. Wang, C. Westphal, and J. J. Garcia-Luna-Aceves, "Using geographical coordinates to attain efficient route signaling in ad hoc networks," in *Proceedings of the Fourteenth International Symposium on a World of Wireless, Mobile and Multimedia Networks*. IEEE Press, 2013.

- [18] Nasrin Elyasi , Omid Pourgalehdari . " Representing a Model for Improving Connectivity and Power Dissipation in Wireless Networks Using Mobile Sensors ". Sari Branch, Islamic Azad University, Sari, I.R.Iran Vol. 9, No. 3, August 2018.
- [19] H. N. Saha, "A Review On Manet Routing Protocols and Its Vulnerabilities", International Journal of Emerging Trends & Technology in Computer Science, vol. 2, no. 6, pp. 252-262, 2013.
- [20] K.N Muralidhara, New Generation Routing Protocol over Mobile Ad Hoc Wireless Networks based on Neuro-Fuzzy-Genetic Paradigm, 2011.

Final Approval