

EEDACS- A Novel Routing Algorithm for Energy-Efficient Distributed Averaging with Consistent Node Selection

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ABSTRACT

Wireless Networks (WN) can be deployed on a battlefield and organize themselves in a large-scale ad-hoc network. Conventional routing protocols do not take into account that a node contains only a limited energy supply. Optimal routing attempts to maximize the period over which the sensing task can be performed, but involves future knowledge. However, using typical algorithms can lead to a significant waste of energy by repeatedly recirculating unneeded information. Therefore in this work the proposed system EEDACS (Energy Efficient Distributed Averaging with Consistent Node Selection) the problem of distributed averaging while routing is focused. The problem of averaging is resolved with the new way of routing with the proposed protocol. The nodes in regions communicates by selecting random neighbor nodes instead of communicates using hop node. Also to resolve the distributed averaging issue the nodes are required with the following processes: distributed nodes identification, consistent node selection and optimization of the consistent node. The work presents the theoretical representation with the experimental results for the proposed system and the performance analysis depicted.

Keywords: EEDACS, Routing Algorithm, Wireless Network, Adhoc Network, Energy Efficient, Consistent Node Selection, Optimal Routing.

1. Introduction

An ad hoc network is a multi-hop wireless network with dynamic infrastructure. Rooftop networks and sensor networks are two existing kinds of networks that might be executed using the ad hoc networking technology. Ad hoc networks can be conveniently deployed in applications such as disaster relief, tether less classrooms, and battlefield situations. In ad hoc networks, the power supply of individual nodes is limited, wireless bandwidth is limited, and the channel condition can vary significantly. Furthermore the nodes can be mobile, routes may continuously modify. Consequently, to facilitate efficient communication, robust routing protocols must be developed.

The procedure of path selection and directing packets from a network source node to the destination node is called Routing and is an active area of research in ad hoc networks. In a network source node sends data packet to its neighboring node(s). This data packet is further passed on to the node(s) closer to the destination node(s) [1]. This system is called forwarding and continues until the packet achieves to the destination. There may exist one-to-many or many to-one or many-to-many relationship between source and destination nodes. Due to which routing may follow static or dynamic path as well as it may be Unipath or Multipath based on the designed algorithm and needed scenario.

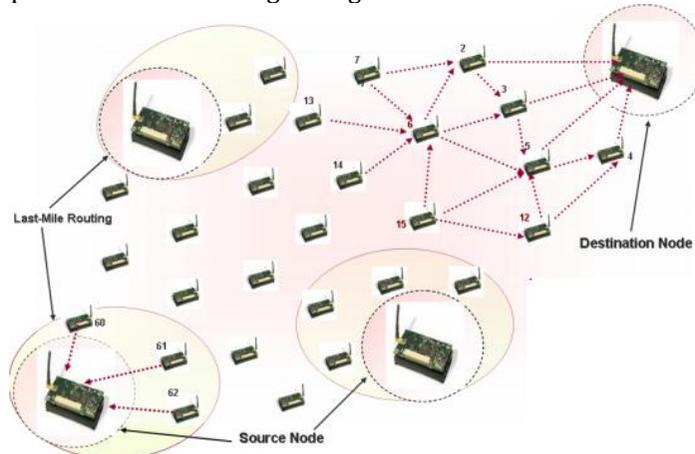


Figure 1: A Typical Wireless Ad Hoc Network

2. Review of Literature

In Wireless Networks routing is extremely challenging due to innate characteristic of that network which vary it from other networks like mobile ad hoc networks and mobile networks. The major task of wireless networks has to detain the data available in environment and sent it for auxiliary processing. So algorithms have been proposed for that principle [4,3]. Many previous methods to in-network processing assume that the network can provide specialized routing services.

For example, some schemes require the existence of a cyclic route through the network that passes through every node precisely one time [5,6]. Others are based on forming a spanning tree rooted at the fusion center or information sink, and then aggregating data up the tree [7,8]. Although utilizing a static routing scheme is instinctive, there are many limitations to this procedure in wireless networking scenarios. Aggregating data towards a fusion center at the root of a tree can cause a bottleneck in communications next to the root and makes a single point of breakdown. Moreover, wireless links are unreliable, and in dynamic environments, a significant amount of undesirable overhead traffic may be produced just to begin and maintain routes.

In the work [9] discussed about the adjusted probabilistic flooding. In dense networks, multiple nodes distribute analogous transmission range. Therefore, these probabilities control the frequency of rebroadcasts and thus might save network resources without disturbing delivery ratios. Note that in sparse networks there is much less shared coverage; thus some nodes will not obtain all the broadcast packets unless the probability parameter is high. In the work [10] proposed (EPDEMR) a novel routing protocol for WN communication which decreases the route failure during transmission. So the proposed routing protocol considers these two parameters to choose the best deliverer node in the path. The reliable data communication is accomplished by transmitting information via the path selected by the proposed routing scheme. In the work [11] proposed (DCBLE) to response for the unbalanced energy allocation while transmission is overcome by the cluster-head selection to balance the energy consumption and that increases the network lifetime during routing.

3. Proposed Scheme

In general, while energy sources are scarce and constrained and batteries are low-powered, energy efficient data forwarding is supposed to be a significant challenge in wireless network applications. Hence, it can be disputed that energy consumption should be maintained so that network lifetime of wireless networks is significantly prolonged. On the other hand, the majority of routing algorithms in wireless networks want reliable and real time data forwarding to the sink node in many to one scheme. Thus, energy efficiency and QoS based data routing are considered as a complex challenge in wireless networks and there is a trade-off between energy-efficiency and QoS parameters. On the other hand, non-uniform energy consumption and load unbalancing are vital issues in many routing protocols of wireless networks which result in network partitioning.

This communication happens via multi-hop routes through other nodes. Since the nodes need to be unobtrusive, they carry only small size of battery and its structured as small size. As a outcome, they have a limited energy supply and low-power operation is required must. Multi-hop routing protocols for these networks essentially have to be designed with a focus on energy efficiency. Due to the large number of nodes, network-scale interaction is indeed too energy expensive. Moreover, a centralized algorithm would result in a single point of failure, which is unacceptable in the battlefield.

This work proposed a novel routing algorithm *Energy-Efficient Distributed Averaging with Consistent Node Selection (EEDACS)*. In this work, the proposed system is to find the optimal path with energy efficient routing for the source node to destination node. The nodes of the network gather the assessment of the each node in some modality of interest. In such gathering, it is focused to solve the issue of *distributed averaging*. Thus to solve the problem of distributed averaging, this work focuses on distributed computation in WNs by performing distributed identifying, classifying and optimizing the nodes. The overall architectural design of proposed system is depicted in Figure 3:

The proposed system is mainly categorized into three phases are as follows:

- Distributed Random Nodes Filtering and Identification
- Reliable Routing with Consistent Node Selection
- Dynamic-N Clustering for Transmission with Consistent Nodes Optimization

In first phase of the proposed system includes identifying the distributed averaging among the nodes of the various regions. The various region nodes are gathered with the initiation of the network structure. In the process of identifying the nodes from the regions the routing nodes are identified with

some criteria of the distributed averaging. In the second phase, the consistent node classification is included for the reliable routing nodes classification. The consistent nodes are elected from the identified distributed nodes. In this process, the reliable nodes are selected by evaluating the link and path quality. Finally the consistent nodes are optimized for the dynamic routing for energy-efficiency and high life-time of the network. The consistent nodes are clustered with the dynamic selection of cluster-head which is nearest to the base station (BS).

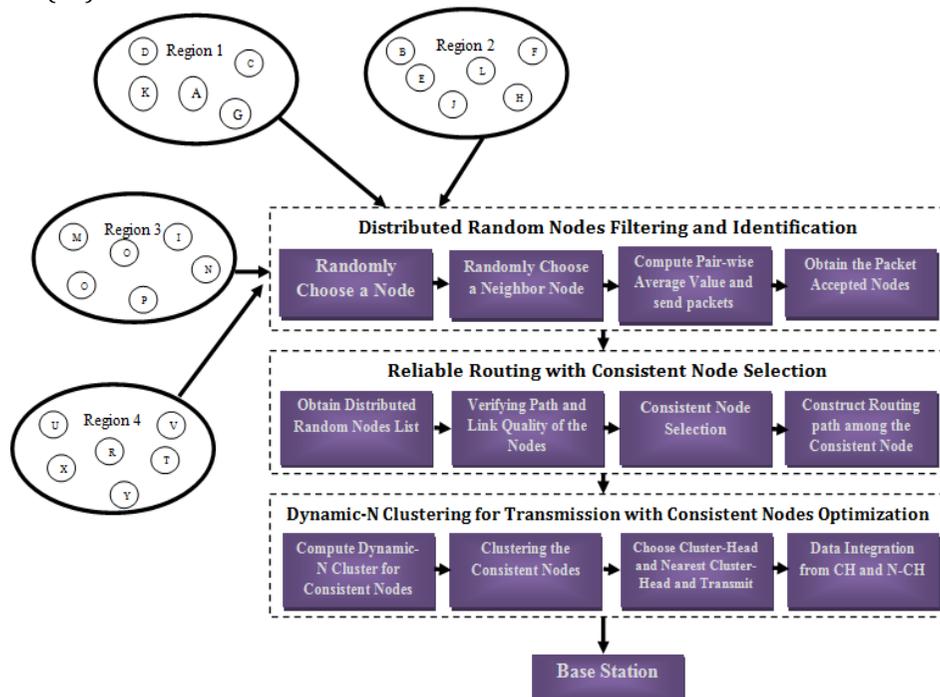


Figure 2: Overall Architectural Design of the Proposed Model

(a) Distributed Random Nodes Filtering and Identification

In this phase of the proposed system includes the process of distributed routing nodes identification to solve the distributed averaging problem. The multi-hop routing has some problems in distributed communication. Accordingly, the goal of this work is to develop and analyze alternative and ultimately more efficient methods for solving distributed averaging problems in wireless networks. The system leverages the fact that nodes typically know their locations, and can exploit this knowledge to perform routing.

The key concept of this method is that transmitting the information with the geographic routing instead of one-hop or multi-hop exchanging of information. In this kind of routing, the nodes are exchanging the information with random nodes which are far away from the network. The issue of the averaging problem and significant misuse of energy is solved by utilizing random nodes filtering and identification.

In this process, the each node are communicates with its neighborhood nodes in every round from the regions. To solve the averaging problem, the pairwise averaging is computing in every round for a particular region. In each round of the transmission, a particular node is selected randomly and that node randomly chooses its neighborhood node. Then the randomly chosen node transmits packets to its neighborly selected nodes. Routing terminates when a node receives the packet and has no one-hop neighbors with distance smaller to the random target than its own. Then the nodes compute its pairwise averaging values and the original value of the node is replaced with the computed pairwise value. If the packets are rejected by the neighborhood nodes then the original nodes chooses new neighborhood nodes and the process is iterated. Finally, the packet accepted nodes are identified as the distributed random nodes for reliable and energy-efficient routing and the packets rejected nodes are filtered.

(b) Reliable Routing with Consistent Node Selection

In the second phase of this system includes the reliable routing based on the identified distributed random nodes. The identified random nodes are gathered to verify the quality of the path and link for reliable routing among the regions of the nodes to transmit the information. The node-to-node channel quality changes powerfully which may influence the multi-hop data flows. The link quality also severely influences the multi-hop data streams.

This process chooses a random node from the distributed random node list to verify the path and link quality. In a communications path, an analysis that (a) incorporates the general assessment of the component quality measures, the individual link quality measures, and the aggregate path quality measures, and (b) is performed by assessing communications parameters, such as bit error ratio and packet delivery ratio.

Link quality is assessed from the quality of the received signal. In this work, another new link quality metric is presented. The time during which the link exists between the nodes is taken to gauge the link quality. In the proposed scheme, the link quality measurement is used to diminish the route failure in the highly dynamic environment. As the exact depiction of wireless links in WNs is a monotonous task, a new metric link residual life can easily be estimated based on the communication range and the relative velocity between the nodes.

In the node link fading causes impedance in WNs. So the level of QoS will be decreased. The link failure in the WNs tends to reproduce the route. The continuous route reconstruction causes end-to-end delay and high routing overhead. The node turns out to be dead when the energy in the node is depleted. At the point when the node in the path is dead, the path ought to be remade. Subsequently, the proposed method diminishes route failure by considering path quality and link quality as the parameters to choose the *consistent node* in the path.

The *consistent nodes* Selection are performed for the reliable routing to avoid the energy wastage of the nodes. Then the consistent nodes are collected with the list of trusted nodes for the transmission to the target destination node. The particular selection of the consistent node assists in energy efficiency of every node in the regions. These consistent nodes are gathered and classified for the data transmission.

(c) Dynamic-N Clustering for Transmission with Consistent Nodes Optimization

After the consistent nodes selection, the consistent nodes are optimizing the routing using Dynamic-N Clustering (D-N-C). The optimization of the consistent nodes for the data transmission with the clustering of nodes is performed in this phase. The D-N-C is a novel enhanced protocol is proposed to balance the energy loads of the nodes while transmission. The proposed protocol performs based on the dynamic selection of the number of clusters that would be required for the transmission. The dynamic-n cluster selection is achieved with the number of nodes in the network. If the network becomes large, it would consume energy and the evaluation choosing single or double cluster is a tedious process. Thus to solve the issue by dynamic-n cluster selection is proposed in this work.

In Proposed Protocol, all consistent nodes are evaluated to compute number of 'n' clusters dynamically, the value of n is computed to construct each cluster-heads and the cluster-head nearer to the base station this will balance the network lifetime; this also results in some unnecessary overhead because clusters need to send broadcast messages to all consistent nodes. The nodes transmit the data through the clusters-head, and then each cluster-head transfers the data to the cluster-head nearer to the base station.

This structures dynamic-n cluster with the optimal number is assessed. In a cluster which has cluster heads are in charge of receiving and combining information gathered from the other consistent nodes and sending them to its cluster head. In a cluster, cluster head is in charge of gathering information from the member node and sending them to the closest cluster-head to the base station after the information was integrated. It represents the data exchange stage that the energy utilization of information accepting and information combination are not as much as that for information transferring, particularly for long distance data exchanging, so the life of clusters with closest cluster heads will be extended out a considerable measure in order to bring new energy parity of energy utilization of whole network.

When clusters have formed and the schedule is determined, the nodes start to transfer the monitoring data. The nearer cluster heads receive data from the other nodes and fuse these data, these fused data was sent to the cluster heads, then cluster head send these data to base station by single-hop method. In those clusters without secondary cluster head, the cluster heads receive the information from other nodes, fuse them and send them to base station.

4. Result and Discussion

4.1 Simulation Environment

Simulation Environment	Matlab
Network Size	100 * 100 (m)
Number Of Nodes	100
Initial Energy	0.1 j

k (Control packet)	50 bit
k (Data packet)	400 bit
Network's Radius	40m

Table 1: Simulation Environment Details

4.2 Procedure of Simulation:

1. Connect the node with the appropriate sink.
2. Initialize the nodes with some energy.
3. Algorithm will be implemented on network.
4. Graphs will be the result of algorithm which will
5. Depict the difference between proposed system and Existing Systems.

4.3 Packet Delivery Ratio

The key characteristic of evaluate the performance is packet delivery ratio. In a round, a number of packets can be passing on. PDR is the number of packets successfully received by the destination. The graph depicts the performance of Existing algorithms. By the graph it is apparent that more packets will be received in case of EEDACS. In percentage, approximate 20% more packets will be received with EEDACS as compared to EPDEMR and DCBLE.

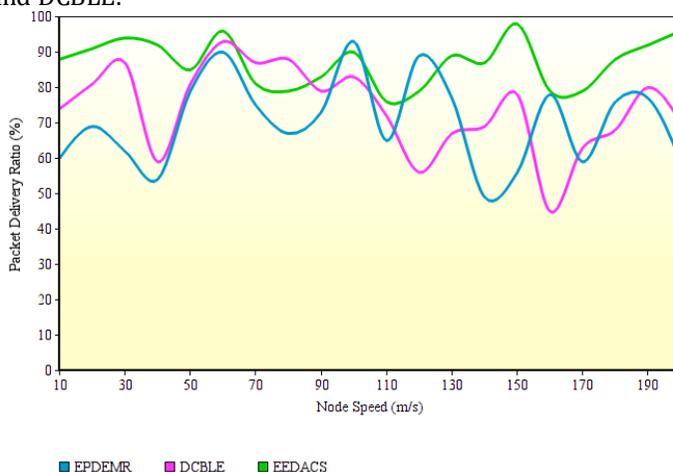


Figure 3: Packet Delivery Ratio

4.4 Total Energy Consumed

Total energy consumed is measured to be the sum of energy obsessive in sending and energy exhausted in receiving the packets. The graph below portrays the energy consumed of Existing Algorithms.

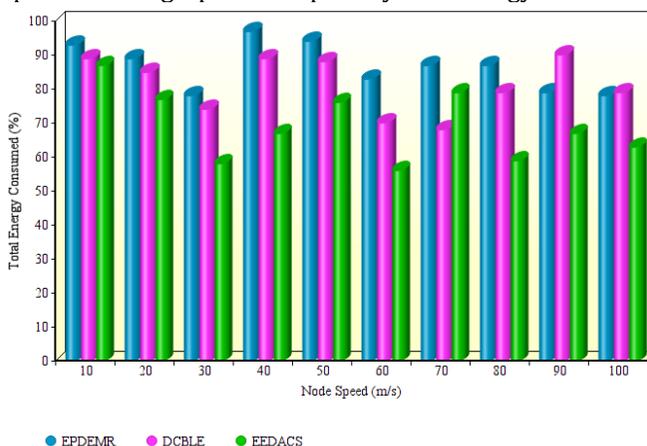


Figure 4: Total Energy Consumption

4.5 Alive Nodes

The count of alive nodes is directly related with the total energy consumed. As the graphs of total energy consumed states that EEDACS consumes lesser energy than EPDEMR and DCBLE. From the graph below this work can conclude that as the number of rounds is increasing alive sensor nodes are reducing in existing ones. Initially it is same, but with the increase in rounds it is falling as an average of existing ones. As the rounds proceeds, it became almost same because in EEDACS nodes consumed in data transmission.

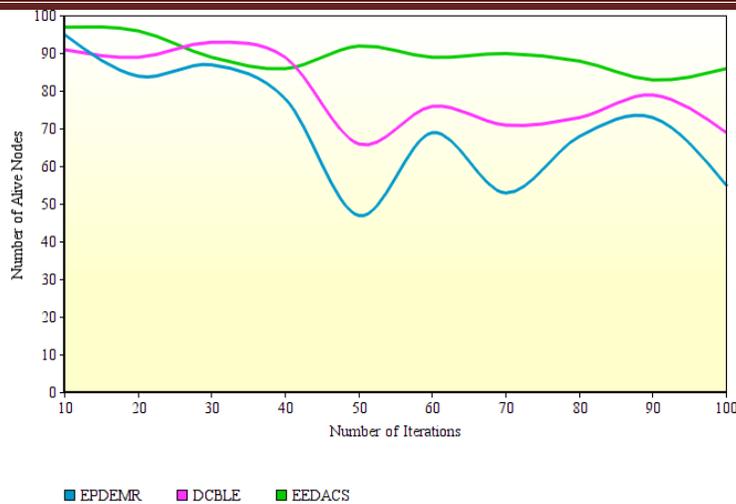


Figure 5: Number of Alive Nodes Vs Number of Iterations

5. Conclusion

The energy efficient routing for the wireless networks is the main challenge in the large-scale ad hoc networks. Thus to resolve the problem of distributed averaging during the routing for various regions of nodes, the work proposed a novel routing technique. The proposed routing technique is based on the various processes such as distributed nodes identification, consistent node selection and filtering and the optimization of the consistent node for the energy efficient routing. The proposed protocol communicates with the large-scale ad-hoc network by communicates with its neighboring nodes instead of communicates with every node, because it consumes more energy for the communication. Thus to reduce the energy consumption and increase the network lifetime of the network the proposed protocol performs with more alive nodes than the other techniques. The performance result provides better outcomes for the proposed protocol.

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