"SECURE AND ROBUST ENERGY-EFFICIENT AND RELIABLE ROUTING FOR MULTI HOP NETWORKS USING WIRELESS SENSOR NETWORKS"

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Abstract - *The sensor nodes are inexpensive, disposable, and expected to last until their energy drains out. Therefore, energy is a very limited resource for a WSN system. Reliable and successful data delivery at the BS is desired. Energy efficiency is an important aspect of any application of WSN. Routing of data in WSN is a critical task, and significant amount of energy can be saved if routing can be carried out tactfully. We present a novel energy-efficient and reliable routing protocol for Wireless sensor networks in terms of data delivery at the base station (BS). The proposed protocol is Hierarchical and Cluster based. Each cluster consists of one cluster head (CH) node, two deputy cluster head nodes, and some ordinary sensor nodes. The reclustering time and energy requirements have been minimized by introducing the concept of cluster head panel. Depending on the topology of the network, the data transmission from the cluster head node to the base station is carried out either directly or in multihop fashion. Develop a model for attacks show detection and prevention mechanism at the first stage of the protocol, the base station selects a set of probable cluster head nodes and forms the cluster head panel. Using security data aggregation algorithm secured the data by faulty nodes in a transmission process. Reliability aspect of the protocol, it puts best effort to ensure a specified throughput level at the base station by avoiding attacks in the network. Simulation results the energy efficiency, throughput, and prolonged lifetime of the nodes under the influence of the proposed protocol.*

***Key Words*: Energy efficiency, mobile base station (BS), mobile nodes, reliability, routing protocol, wireless sensor networks (WSNs).**

1. INTRODUCTION

Energy is one of the most important resources in networks. Wireless Sensor Networks are resource constrained. Superlative use of energy is necessary. Hence Energy-Efficient Routing protocol for Wireless Sensor Networks is developed. The protocol is reliable in terms of data delivery at the Base Station (BS). The scheduled protocol is Hierarchical and Cluster based. Each cluster made up of one Cluster Head (CH) node, two Deputy Cluster Head (DCH) nodes, and some ordinary sensor nodes called as cluster members. The concept of cluster head panel is introduced to minimize the reclustering time and energy usage. Depending on the topology of the network, the data transmission from the cluster head node to the base station is carried out either directly or in multihop fashion.

At the first stage of the protocol, the base station selects a set of possible cluster head nodes and forms the cluster head panel based on their energy, range and certain parameters. Reliability characteristics of the protocol, places a best effort to confirm a specified throughput level at the base station. Simulation results the energy efficiency, throughput, and prolonged lifetime of the nodes under the impact of the proposed system.

2. RELATED WORK

Proposed a Low-Energy Adaptive Clustering Hierarchy (LEACH) [1], that uses a randomized rotation of local cluster based station (cluster-heads) to allocate the energy load among the sensors network and also proposed one is cluster-base protocol. LEACH uses robustness for dynamic networks, limited coordination to enable scalability and, incorporates data fusion into the routing protocol to reduce the amount of information that must be transmitted to the base station. Disadvantages: Energy and Communication cost, Overhead of dynamic cluster formation, Performance has to be improved.

In a Literature, PEGASIS(Power-efficient gathering in sensor information systems) [2] a near optimal chain-based protocol that is an improvement over LEACH. In PEGASIS, each node communicates only with a close neighbor nodes and takes turns transmitting to the base station, thus reducing the amount of energy spent per round. Also PEGASIS shows better performance than LEACH by about 100 to 300% when 1%, 20%, 50%, and 100% of nodes die for different network sizes and topologies. Disadvantages: System lifetime, Quality of the network. Energy load balance.

Threshold sensitive Energy Efficient sensor Network protocol (TEEN) [3] is a new energy efficient protocol, for reactive networks. For a simple temperature sensing applications, Evaluate the performance of protocol. This protocol has been observed to outperform existing conventional sensor network protocols. TEEN perform much better than LEACH. Disadvantages: Energy Consumption, Response time is low, Accuracy.

Introduced a Hybrid protocol APTEEN [4] which combines the best features of both proactive and reactive networks. About critical events it provides periodic data collection as well as near real-time warnings. This system is suitable for a network with evenly distributed nodes. It can be extended further to sensor networks with uneven node distributions. Disadvantages: Energy Consumption, Response time is low, Average delay.

Different routing protocols using distance vector or link state algorithms, protocol uses dynamic source routing [5] which adapts quickly to routing changes when host movement is frequent, yet requires little or no overhead during periods in which hosts move less frequently. The protocol performs well over a variety of environmental conditions such as host density and movement rates, based on results from a packet-level simulation of mobile hosts operating in an ad hoc network,. Disadvantages: Overhead, Not Robust, Performance

The new routing algorithm is suitable for a dynamic self-starting network, as required by users wishing to utilize Adhoc networks. Even while repairing broken links AODV [6] provides loop free routes. Because the protocol does not require global periodic routing advertisements, the demand on the overall bandwidth available to the mobile nodes is substantially less than in those protocols that do necessitate such advertisements. Disadvantages: Not scalable, Performance.

In literature [7], authors have introduced a new packet delivery technique named MMSPEED for wireless sensor networks to give service discrimination and probabilistic QoS assures in the timeliness and reliability field. For the timeliness field, multiple network-wide speed options are provided so that different traffic types can demoniacally select the appropriate speed options for their data packets on the basis of their end-to-end deadlines. For the reliability field, probabilistic multipath forwarding technique is used to manage the number of packet delivery routes on the basis of necessary end-to-end reaching probability. These methods are constructed in a confined way with changing allowance to compensate for the inaccuracies of local decisions as packets progress towards their destinations. Since the proposed mechanisms work locally at each node without global network state information and end-to-end route arrangement, it can conserve seductive properties like scalability for big sensor networks, self adaptability to network dynamics, and appropriateness for urgent a periodic and periodic packets. As an outcome, MMSPEED can considerably increase the adequate capability of a sensor network in terms of number of flows meeting both reliability and timeliness requirements. Disadvantages: Overhead, Response time is low.

In this literature, proposed a hierarchical and clustering based energy efficient routing protocol [8]. In this, each group contains one cluster head (CH) node, two Deputy CH nodes, and some normal sensor nodes. The reclustering time and energy requirements have been reduced by introducing the concept of CH panel. At the early stage of the protocol, the BS selects a set of possible CH nodes and creates the CH panel. Taking into account the reliability issue of the protocol, it gives best effort to assure a stated throughput level at the base station. Based on the structure of the network, the data transportation from the CH node to the BS is done either directly or in multihop manner. Furthermore, replacement paths are used for data transportation among a CH node and the base station. Proposed protocol assures the energy effectiveness, throughput, and enhanced lifespan of the nodes and thus the network.

2.2. Problem statement

We proposed an energy-efficient and reliable routing protocol for mobile WSNs. The proposed protocol E2R2 is hierarchical and cluster based. The proposed protocol, which is called Energy efficient and Reliable routing, achieves fault tolerance by offering some alternate routes to forward data in presence of any fault in the existing route. The CH nodes do the data aggregation to remove redundancy and then forward the aggregated data toward the BS. Each cluster contains one cluster head node, and the cluster head node is assisted by two deputy cluster head nodes, which are also called cluster management nodes and Phishing attacks detection and prevention mechanism.

The performance of the proposed protocol through simulations and compare with M-LEACH the proposed protocol outperforms M-LEACH in terms of lifetime and throughput. In the proposed protocol, the throughput improvement is 15% *on* average over M-LEACH. Such a routing protocol is useful when the sensor nodes and the base station are mobile. Advantages

- Deputy cluster head which increases the lifetime of the network.
- Cluster head panel which also increases the lifetime of the network.
- The notion of feedback by the BS efficient data delivery.
- The protocol ensures reliability in terms of data delivery at the BS.
- Data forwarding.
- Throughput in the high-data-rate situation.

3. PROPOSSED SYSTEM

To avoid the collision, usage of energy and bandwidth in an WSN technology, form the clusters based on their Received signal strength (RSS) and distance or degree of density. Once cluster forms then go to cluster head selection. Cluster head

(CH) selection is based on the cumulative credit points namely, residual energy level of the node, degree of the node (i.e., the number of neighbors), and mobility level of the node (high, medium, low) and also based threshold energy.

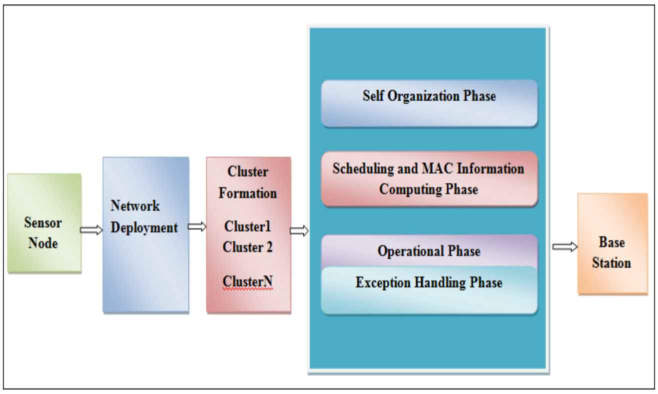
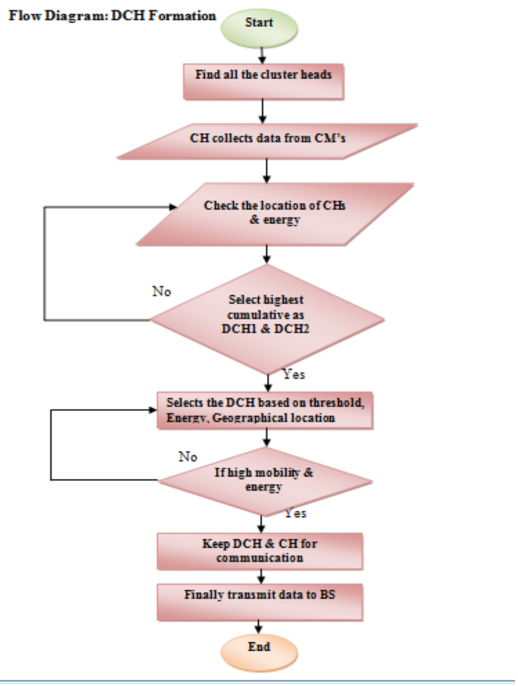


Fig -1: System Architecture

In transmission process CH is busy in Data gathering process, so need another node as Deputy Cluster head (DCH) to forward the data to the sink by collecting it from CH node. Selection of DCH is also based on cumulative credit points which have next to CH. Secure the networks using secured data aggregation algorithm by determining the faulty nodes which has lowest energy level.



Flow Diagram: DCH Formation

3.1 Enhancement

We propose an improvement for Enhanced iterative filtering technique check the data which will come from sensor nodes at each and time intervals. we provide a robust initial estimation of the trustworthiness of sensor nodes to be used in the enhanced iteration of the IF algorithm using SHA.

Iterative filtering algorithms hold great promise for such a purpose. Such algorithms simultaneously aggregate data from multiple sources and provide trust assessment of these sources, usually in a form of corresponding weight factors assigned to data provided by each source. In this paper we demonstrate that several existing iterative filtering algorithms while significantly more secure and robust against collusion attacks than the simple averaging methods, are nevertheless susceptive to a novel sophisticated collusion attack we introduce. To address this security issue, we propose an improvement for iterative filtering techniques by providing an initial approximation for such algorithms which makes them not only collusion robust, but also more accurate and faster converging.

3.2 Analytical Model

Algorithm: to compute cumulative credit point of a node

Input: d→ degree of the node or number of one-hop neighbor,
e →residual energy level of the node,
m→ mobility level (high/medium/low).

Output: Cp → cumulative credit point of the node

Variables: N→ the total number of candidate sensor nodes shortlisted by the BS

3.3 Equations

CH is selected based on the cumulative credit points. Then also based on threshold values of a sensor nodes. To calculate threshold (Th) values,

$$Th = \frac{Energy * RSS}{Distance} \quad (1)$$

Node which has highest threshold value i.e Th1 is selected as CH, which has highest values but less than Th1 i.e Th2 and Th3 selected as DCH1 and DCH2 in an clusters. The protocol is reliable in terms of data delivery at the base station (BS) by constructing network in tree manner and also it avoid the collision during transmission.

4. SIMULATION ANALYSIS

The influence of the proposed routing approach is validated through simulation experiments. Here, discuss various performance metrics used, simulator architecture, simulation environments, and the experimental results. The results of proposed system are also compared with another routing approach, i.e., M-LEACH [40]. We get better throughputs and results compared to M-LEACH.

4.1Performance Metrics

The following metrics are used to understand the performance of our routing approach and to compare it with M-LEACH.

Average Communication Energy*:* It is the average of the total energy consumed due to communication in the network over a particular time period and with respect to a specific data rate. A protocol with lower average communication energy is necessary.

Throughput*:* It is the ratio between the definite numbers of packets transmitted by the nodes in the system to the numbers of successfully delivered packets at the BS. It reproduces the percentage of packets lost during transmission. A protocol with higher throughput is necessary.

Lifetime: It is the time taken since the start of the network (during the simulation) for the first node to die. A protocol with larger lifetime is desirable.

Node Death Rate*:* It is a measure with regard to the number of nodes that died over a time period since the start of the simulation.

4.2 Simulation Parameters:

In the simulation, 82 mobile nodes move in a 1000 meter x 1000 meter region for 20 seconds of simulation time. Transmission range of all nodes is 40 meters. The simulation parameters and settings are shown in Table 1

No. of Nodes	50
Area Size	1000 X 1000
Mac	IEEE 802.11
Transmission Range	40 m
Traffic Source	CBR
Packet Size	500
Initial Energy	100 J
Transmission Power	1.0
Receiving Power	0.5

Table1: Simulation Parameter

5. SIMULATION RESULTS

Results are obtained through simulations by Compare the performance of the proposed protocol with that of M-LEACH figure shows Average communication energy against time, In terms of throughput and lifetime against different data rate. Designed LEACH by keeping sensor nodes as static. Therefore, in our simulation, we consider M-LEACH, which is applicable for mobile sensor networks. We also analyze the performance of the proposed protocol with respect to different data rates. Based on the parameters like geographic location information, residual energy level, and mobility level or velocity CH and DCH nodes were selected.

Based on Algorithm (to compute cumulative credit point), CH and two DCHs selected by BS. The proposed protocol in terms of average communication energy expenditure with respect to data rates of Proposed and M-LEACH, respectively, throughout the simulation time. The average communication energy expenditure is higher when data rates in M- LEACH than when it is proposed. It is observed that, due to death of nodes which actually leads to lesser traffic, while data rate is M-LEACH, the average energy expenditure gradually reduces shown in chart-1.

Chart-1: Average communication energy against time

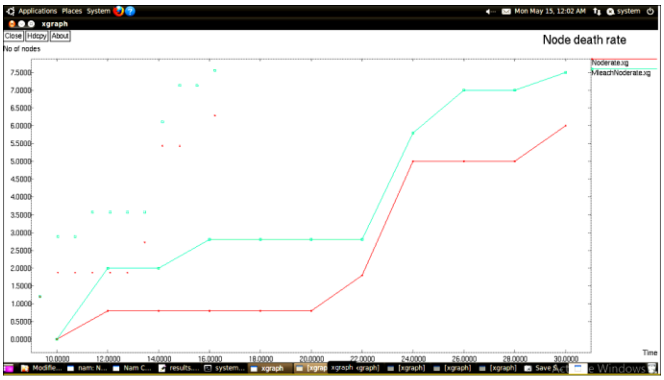


Chart-3: Node death rate (over simulation time)

Chart-3 depicts the number of nodes that died after different time intervals over the entire simulation time.

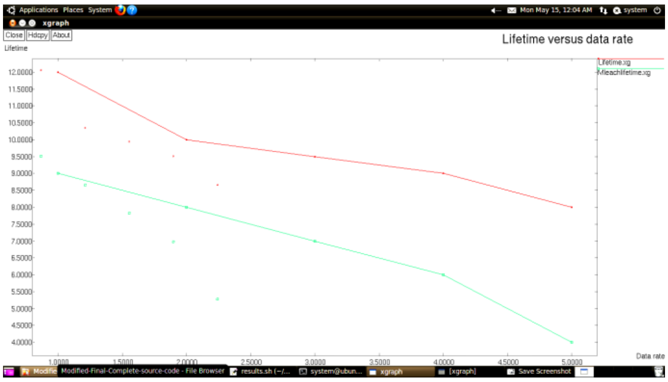


Chart-4: Comparison of the proposed protocol with M-LEACH (lifetime versus data rate).

In chrat-4, the proposed protocol outperforms M-LEACH in terms of lifetime. It is also observed that lifetime decreases along with the increase in the data rate in the case of both the proposed and M-LEACH protocols.

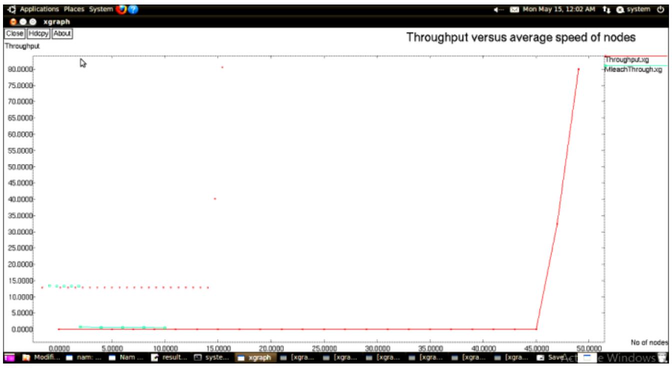


Chart-5: Comparison of the proposed protocol with M-LEACH (throughput versus data rate)

It has been observed in chart-5 that the throughput decreases along with the increase in the data rate for both the proposed and M-LEACH protocols. However, the proposed protocol outperforms the M-LEACH protocol in terms of throughput also.

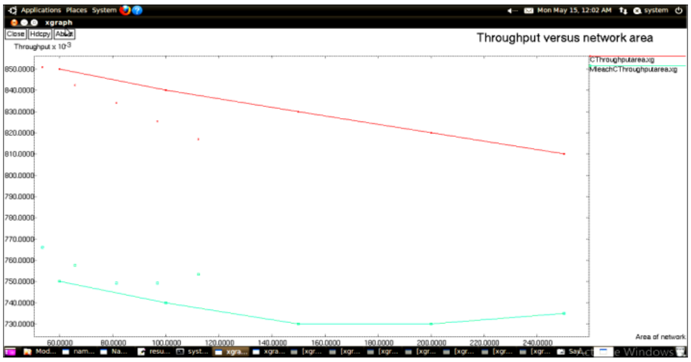


Chart-6: Throughput analysis with respect to network size.

Chart-6 depict throughput analysis under the influence of the proposed protocol while the network size in terms of the number of nodes deployed in the field is varied In both analyses, the proposed protocol Energy efficient and reliable routing improves the throughput level at the BS in comparison with that of M-LEACH.

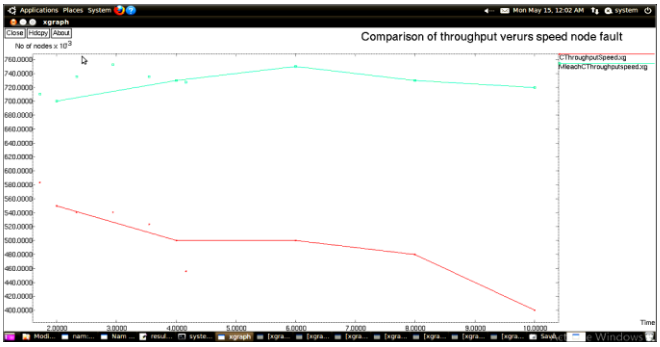


Chart-7: Throughput versus average speed of nodes

The performance of the proposed protocol in terms of throughput against different mobility levels or speeds of the nodes is compared with that of M-LEACH, as shown in chart-7.

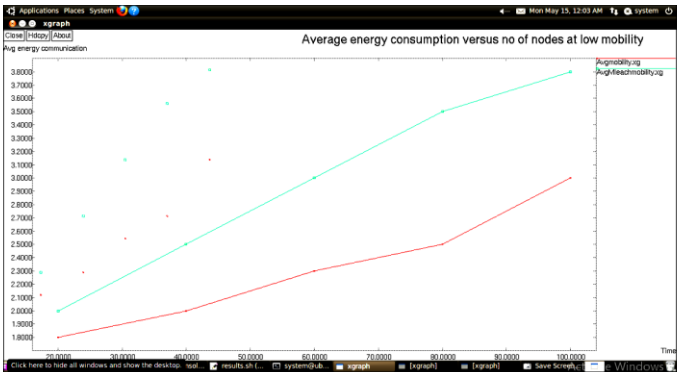


Chart-8: Average energy consumption versus number of nodes at low mobility.

The average energy consumption of the proposed protocol is compared with that of M-LEAH, as shown in chart-8.

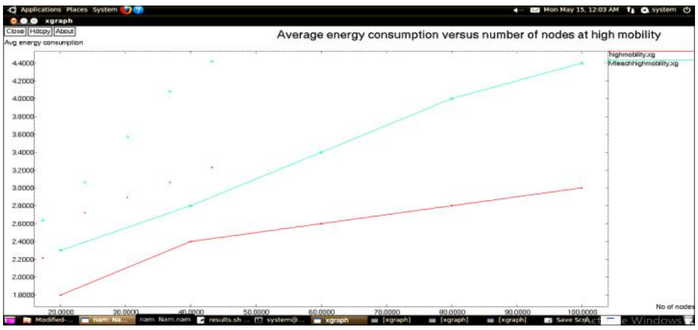


Chart-9: Average energy consumption versus number of nodes at high mobility level.

The average energy expenditure of the nodes under the influence of the proposed protocol and M-LEACH, in a high mobility environment, is analyzed in chart-9.The high-mobility environment indicates that the nodes move with a higher speed.

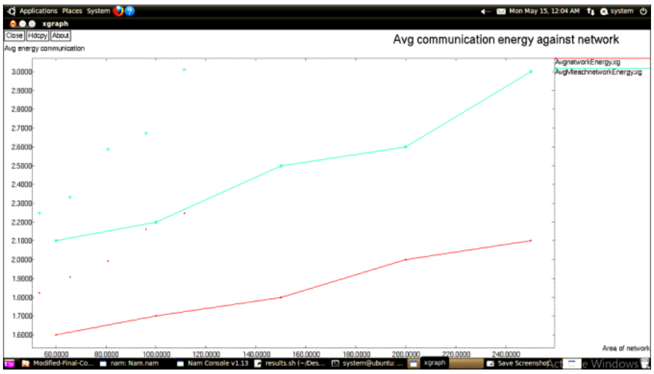


Chart-10: Average communication energy versus network area.

Average communication energy expenditures of the proposed protocol and M-LEACH, for networks of different sizes in terms of geographical area, are compared in chart-10.

Again, average communication energy increases along with the growth in the area of network. This is because of the fact that long-distance communication incurs more energy expenditure. Throughput levels of both protocols are compared with respect to varying network sizes in terms of geographic area. Here, considered a network of 50 nodes. The proposed protocol performs better than M-LEACH and produces higher throughput. The throughput levels of both protocols degrade insignificantly along with the growth in the network size. This degradation is due to the fact that the number of intermediate hops increases along with the increase in network area. Thus, packets need to traverse through more number of links toward the sink. This leads to a higher probability of packet loss and that is why the throughput is low for a large network area.

6. CONCLUSION

In this paper, we have proposed an secure and robust energy-efficient and reliable routing protocol for mobile WSNs. The proposed protocol Energy efficient and reliable routing is hierarchical and cluster based. Each cluster contains one CH node, and the CH node is assisted by two DCH nodes, which are also called cluster management nodes. Also using iterative filtering algorithm enhances the proposed system by securing the data transmission. We analyze the performance of the proposed protocol through simulations and compare with M-LEACH.

The proposed protocol outperforms M-LEACH in terms of lifetime and throughput. In the proposed protocol, the throughput improvement is 15% on average over M-LEACH. Such a routing protocol is useful when the sensor nodes and the BS are mobile. This work can be extended to improve the throughput even in the high-data-rate situation, where the sensor nodes generate data at a very high constant rate. The proposed protocol can be also tested under the influence of highly mobile sensor nodes.

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