COMAPARATIVE ANALYSIS OF QOS PARAMETERS IN WIRELESS SENSOR NETWORKS USING ANT COLONY OPTIMIZATION

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Abstract— This paper presents a novel approach to approve the best QoS parameters like Packet Delivery Ratio (PDR), Packet Loss Ratio (PLR) and End -to-End Delay (EED) with the help of Swarm Intelligence (SI) which serves an ideal model for formulating routing protocols for WSNs. In this paper, the proposed work is a designed strategy. Firstly, to deploy the wireless sensor network. Secondly, to communicate among the sensor nodes with the help of Ant Colony Optimization (ACO) so that it acquires the shortest path. Thirdly, Low–Loss Energy Aware Routing Protocol (LLEAP) along with ACO improves the performance metrics. Thus, proposed work is compared with the LLEAP.

Keywords*-LLEAP; ACO; QoS; WSN*

I. INTRODUCTION

A wireless sensor network (WSN) is an adhoc-network with an affordable embedded randomly distributed sensor nodes. These nodes collectively process data of the objects in the geographical area of the network. The nodes can be stationary or moving. They can be aware of their location and homogeneous. A more general scenario includes multiple sinks in the network. According to the node density, a larger number of sinks will decrease the probability of isolated clusters of nodes that cannot deliver their data. A multiple-sink WSN can be scalable, while this is clearly not true for a single-sink network. In many cases nodes send the data collected to one of the sinks, selected among many, which forward the data to the gateway, toward the final user. From the protocol viewpoint, this means that a selection can be done, based on a parameters such as minimum delay, maximum delivery ratio etc. Therefore, the presence of multiple sinks ensures better network performance with respect to the single-sink case but the communication protocols must be more complex and should be designed according to suitable criteria.

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The author in [1] describes the deployment of WSN, packet sending criteria, delay. Layout of sensor nodes may vary depending on the area under observation and it has effects on routing performance. Sensor nodes can be deployed in predetermined places. And in, self organizing networks, the sensor nodes are placed randomly in the form of an adhoc infrastructure. Delay is another important factor influencing routing protocol design. Delay in a WSN is the time taken by data to get from one specified sensor point to the base station or sink node, whereas delay in a sensor network is measured either one-way i.e. the time it takes for the source to send a packet to the destination receiving it. Secondly it is measured round-trip i.e. the one-way delay from source to destination, including the one-way delay from the destination back to the source. [2] In the real world ants search aimlessly until they find food, once they do then they return to the colony leaving a chemical behind called *pheromone* in the form of trail. After some-time this pheromone trail will begin to evaporate if it is not followed by other ants which keep it strong by relaying the pheromone. As ants begin to follow the trail to the food source, if they discover shorter paths by following another route, they will lay pheromone trail. The remaining ants will take these paths and make that pheromone stronger, and the previous pheromone trails will evaporate. In this way pheromone evaporation allows ants to enhance their paths and helps in finding the most optimal route. This trail is updated by probabilities which are increased whenever a successful path is achieved. Whenever a packet comes to a specific point where it can proceed down multiple paths it picks the next step. In other way this type of communication among different ants is called *stigmergy*. This trail is developed and maintained by two different types of ants, the regular ants and the uniform ants. In ACO [3] it is the regular ants which transport packets from their origin to destination in the most efficient manner. When a route is taken more often and is proved to be the most efficient route, its probability of being taken again will be increased. This will make all the regular ants to follow that route which is then taken by almost all of the packets. When this state is achieved the ants are said to be stable. This is how the technique finds the shortest path through the topology. The regular ants do not use as much intelligence as the uniform ants, which are used to discover the shortest paths through the network.

II. LITERATURE SURVEY

Lindsey et.al [4] proposed PEGASIS, a greedy chain protocol which resolves the data-gathering problem of the wireless sensor networks. The main thing is for each node to receive from and transmit to close neighbors and take turns being the leader for transmission to the base station. This approach will distribute the energy load evenly among the sensor nodes in the network. It shows better results as compared to LEACH [5] by removing the overhead of dynamic cluster formation, reducing the number of transmissions, and using only one transmission to the base station per round. and shows better improvement if the network size increases. Manjeshwar et. al [6] proposed TEEN which is the first protocol developed for reactive networks. In this, at every cluster change time, the cluster-head broadcasts to its members. It is well suited for time critical applications and is also quite efficient in terms of energy consumption and response time. The main drawback of this scheme is if the thresholds are not achieved, the nodes will never communicate, the user will not get any data packet from the network and will not come to know about the nodes if they die. Thus, this scheme is not well suitable for applications where the user wants to get data regular. Misra et.al [7] proposed EAAR protocol in which a set of paths with similar energy is obtained, but only some nodes will be of distinct type of nodes. Authors used the concept of naturally occurring behavior of real ants [8] and on this basis an energy aware routing protocol is designed. This help in obtaining the better paths because parameter used in this approach is not limited to hop count only. This protocol has very less number of dead nodes as compared to other algorithms. This is multi-path energy-aware routing protocol which demonstrates the better results because once a route has been established it is reliable as far as the energy of that route is concerned. [9] Bajaber et.al described an adaptive clustering protocol for wireless sensor networks called ADRP in which cluster-heads and next heads are elected based on residual energy of each node and the average energy of each cluster having nodes. Cluster-heads rotate to balance the energy released from the sensor nodes. This protocol is used for collecting data from distributed sensor nodes and transmits data to the base station. This protocol is helpful in supporting periodic remote monitoring sensor networks This protocol has least amount of energy and reduces communication overheads. Khalil et.al [10] proposed EAERP in which authors reformulate the design of important feature of EA (Evolutionary Algorithms) so that the routing protocol provides more robust results as compared to the existing heuristics. The authors have presented a new evolutionary dynamic cluster formation in WSN. This protocol proves to be an important for deriving clustered routes with better trade-off between network stability and network lifetime with well-distributed energy consumption. Nayebi et.al [11] proposed an analytical model for investigating the effect of mobility on a cluster-based protocol called LEACH. This evaluates data loss which can be used to estimate the balanced energy and data loss ratio. As LEACH is type of random clustering scheme so this is used for the applications of random clustering. This approach leads to the geometric model which is presented to evaluate the reliability of links between cluster-heads and cluster-members.

Basioni et.al [12] proposed EAP which includes the QoS of an energy efficient cluster based routing protocol in terms of lifetime, loss percentage, delay and throughput. EAP works like LEACH and each round consists of two important phases, set-up phase and data phase. The set-up phase is subdivided into two phases, cluster formation phase and cluster heads tree construction phase. The main disadvantage is that the protocol slightly degrades lifetime of the network without affecting the other parameters.

III. PROBLEM FORMULATION

This section describes the reliable delivery of packets having minimum loss ration as well as minimum delay so as to improve these aforesaid parameters. To achieve this, many bio-inspired algorithms have been implemented. Here, ACO is implemented so as to obtain the better results in terms of PDR, EED. Thus there is essential requirement of increasing existing LLEAP with ACO.

IV. IMPLEMENTATION

This section describes the way in which simulations are carried out. The objectives of this section are:

- Deploying a Wireless Sensor Network.
- Implementing LLEAP & measure performance parameters which includes PDR, EED.
- Optimizing LLEAP along with ACO.
- Comparison of LLEAP with proposed algorithm

The simulation is carried out using Custom Built Iterative based simulator in MATLAB 7.12.0.635 (R2011a) which simulates the transmitting, receiving of data in terms of packet delivery and packet loss ratio. The simulation parameters [12] are :

- *Packet delivery ratio*: The ratio of number of packets sent from the source to the number of packets received at the destination. The greater the value of PDR means better performance of the protocol.
- *Packet loss percentage*: The ratio of number of raw packets lost due to death of the node to the total number of raw packets transmitted in the network until the last node dies.
- *End-to-End Delay*: The average time taken by raw packets to transverse from the simple

nodes to the sink inspite of observing the form in which they are received.

V. SIMULATIONS RESULTS

The results of proposed algorithm and LLEAP is shown graphically.

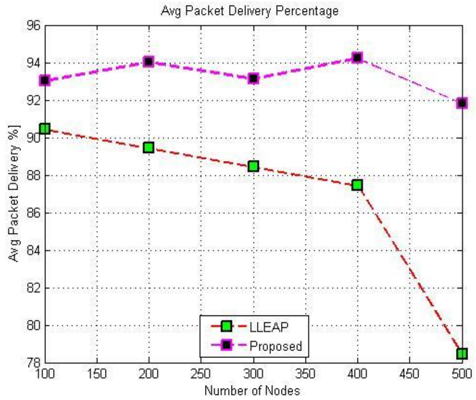

Figure.1 Packet Delivery Ratio

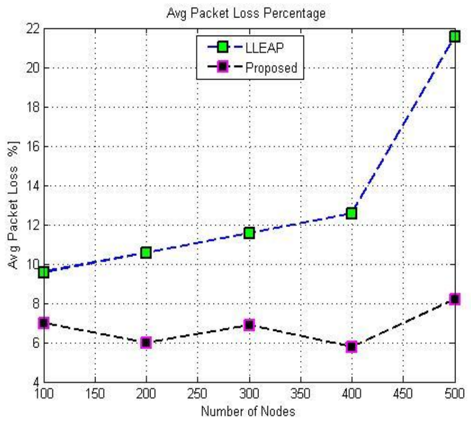

Figure. 2 Packet Loss Ratio

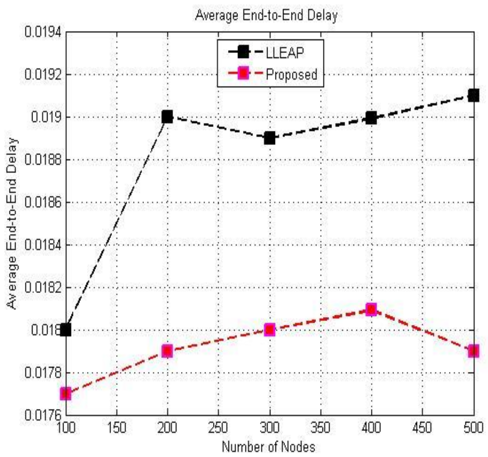

Figure. 3 End-to-End Delay

The graphical interpretation shows the better results as compared to LLEAP. Thus the average Packet Delivery Percentage graph shows how many packets are successfully reaching the destination i.e sink node. It can be seen from the graph that initially the numbers of nodes are 100; the PDR of proposed algorithm is about 3% more as compared to the previous algorithm. The routing path becomes more clear due to the formation of Directed Acyclic Graph [13] (DAG) in terms of nodes and its edges. It is formed by a collection of various vertices and directed edges, each edge connecting one vertex to another Thus the weights based on Eq.1 [12] further help to reduce the overall time in sending the data from source node to the destination node, thereby reducing the EED in reaching the destination or sink.

$$\text{LLEAP CH selection} = \frac{D(RSS_i) \times E_{residual}}{D(RSS_{\max}) \times E_a} \quad (1)$$

E_a [12] has no meaning and no effect, rather, it may have a negative impact on the selection of inappropriate CH as a root. E_a is the average residual energy of all the neighbors in the cluster range. $E_{residual}$ is the remaining energy left. RSS_i denotes node i's received signal strength of the signal broadcasted by the base station. RSS_{max} is a constant which is determined by the location of the base station. D is the distance between node i and the base station.

VI. CONCLUSION AND FUTURE SCOPE

The results of proposed algorithm are better as compared to the previous algorithm. For the future directions, the QoS parameters can be improved by using various algorithms or optimization techniques.

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