Simulation of Energy Efficient Clustering Technique in a Gaussian Network

D. Angeline Ranjithamani, J. Abalin Luther, S. Jasmine Mary

Abstract: ***In Wireless sensor network (WSN) the sensor nodes are randomly distributed in the network. As the sensor nodes are adhoc in nature the geographical location must be assessed earlier and for data transmission. Maintenance of the energy level in each sensor node is very challengeable. In this paper a Gaussian network is deployed with four virtual grids and cluster head is obtained using the Gaussian integer. The traditional DSDV protocol is modified and simulated in Network Simulator. The energy efficiency of modified DSDV with regard to increase in number of nodes in compared with traditional AODV protocol and found a better performance of the modified DSDV protocol.***

Keywords:Wireless Sensor Networks(WSN), Cluster Head(CH).Adhoc On Demand Vector(AODV), D Destination-Sequenced Distance Vector (DSDV)

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I. INTRODUCTION

Wireless sensor network consists of huge amount of sensor nodes and sink nodes to gather the information from the nodes and process the information. Each self-executable node has its own processor, battery, transceiver and sensor. These sensor nodes deployed in a network either organized manner or randomly scattered. Energy maintenance in each sensor nodes relies on network topology. Selection of the network topology was done with the perspective view of energy level of the sensor nodes. The network topology is an important factor that influence the lifetime of the sensor node. The lifetime is limited by one-hop away from the Sink node. The reason is that these sensors have to relay all the traffic from other sensors, resulting in a faster consumption of energy for traffic reception and retransmission. When such first hop sensors have exhausted their energy, the network becomes useless even if other sensors may have tremendous residual energy [2]. Topology optimization paves a way for the above said issue. Takahiro Sato et. al proposed that one can determine optimal shapes of machines which are composed of various materials such as iron, magnet and nonmagnetic material using the normalized Gaussian network (NGnet). A modeling for the interconnection network is proposed, which is called as the Gaussian network. The Gaussian network is represented by the set of Gaussian integers. One of the advantages of the Gaussian network over the torus network is that for a given number of nodes, N, the diameter of the Gaussian network can be much less than that of the torus network. This is a good metric for forwarding a message from the source node to the destination node. The shortest routing path may be as long as the network diameter k. We call a routing algorithm optimal if its worst-case time complexity is asymptotically O(k). In addition, based on the node symmetry and four adjacent nodes, there are two edge disjoint Hamiltonian cycles in the Gaussian network, so all the nodes can be connected through these Hamiltonian cycles. The effectiveness of the Gaussian networks in applications is indicated in the literature [3].

Dung Nguyen Quoc et. al. recommends a new wireless sensor network connection model, on which the network area will be divided into some virtual square grids. In the new wireless sensor network connection model, they describe each virtual square grid as a node in the Gaussian network, therefrom, they propose a routing method, which is a combination of the shortest path routing protocol in the Gaussian network and clustering protocol to improve the routing efficiency of the wireless sensor network.

The remainder of the paper is organized in follows: Section 2 presents overview of literature review on Gaussian network importance in Clustering techniques in WSNs. Section 3 presents the working of Gaussian network in WSNs. Section 4 presents comparison between AODV protocols with GAODV. Section 5 presents the conclusion of the paper and future research articles globally. All accepted papers should be formatted as per Journal Template.

II. LITERATURE SURVEY

Distance-Vector algorithm, in this approaches every node selects the path to the destination by using shortest distance. Distance vector algorithm is a classical Distributed Bellman-Ford(DBF) algorithm. It is more efficient compared to link state method. Link state cause a looping problem, DBF eliminates looping problem by forcing all nodes to participate in the network form of intermodal coordination protocol. Intermodal coordination mechanism might be effective when network topology changes. Disadvantage of Distance-vector algorithm is in mobile environment enforcing intermodal coordination mechanism will be difficult due to rapid change in topology.[10]

LEACH outperforms traditional clustering algorithms by using adaptive clusters and rotating cluster header, which can distribute energy consumption among all the sensor nodes. In addition, LEACH can perform local computation so that the amount of transmitted data can be reduced. However, LEACH assumes direct communication between a node and a base station.

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This is a high-power operation and shortens the lifetime of the network. Moreover, the random selection of headers does not guarantee optimal cluster construction and may cause rounds of communication when cluster headers are not available.[11]

A loadbalancing heuristic to extend the life of a clusterhead to the maximum budget before allowing the clusterhead to retire and give way to another node is proposed by [12].

[5] Constructed two edge disjoint Hamiltonian cycles when the gcd (a; b) = d > 1. The main idea of the methods is as follows. First it is shown that we can generate two sets of d cycles, with each cycle of length (a2 +b2)=d, the edges in the first set of d cycles along the real dimension and the edges in the second set of d cycles along the imaginary dimension.

[6] Characterized the main distance-related properties of Gaussian networks, providing closed expressions for their diameter and average distance.

III. THEORY

A. Clustering based on Gaussian network

A 1. Problem Definition

Dung Nguyen Quoc et al. use the Gaussian network connection model and cluster to describe the connections of nodes in the WSN. Sensor nodes are deployed in rectangular area S = X × Y, so to suit the distribution of the sensors in the WSN, Gaussian network is generated by a Gaussian integer α = a + bi with 0 < a ≤ b and gcd(a, b) = d > 1 to apply for representation of the WSN's nodes in the rectangle. Initially, every node starts with the discovery state, they set a timer for Td seconds. When predefined time Td finish, the discovery node broadcasts a message and it enters state active if the energy level is greater than a threshold and it does not receive any other discovery message. In each virtual square grid at a time, there will be only one active node. The active node is selected as a cluster head (CH) node, it collects and transmits packets to all of the nodes in four adjacent virtual grids {Gi1,Gi2,Gi3,Gi4}. Each virtual grid will have only one Gaussian integer, so we can connect the CH nodes in adjacent virtual grids as adjacent nodes in the Gaussian network. In this model, there are two types of links between the adjacent grids. The internal links are links between the adjacent grid in the communication range of CH nodes and the external links are the links between the adjacent grids out of communication of CH nodes.

A 2. Algorithm

The algorithm is given as follows

- Initially the Gaussian network has been deployed
- Initialize the discovery state for each virtual grid.
- Send and receive packets and assume the state of the node
- Get the CH node of each cluster deployed
- Get the Gaussian node
- Transmit packets
- Update Xmin and Ymin of each packet

IV. EXPERIMENTS AND RESULTS

A. Simulation Environment

The algorithm is simulated in the network simulator with 80 nodes for Gaussian network deployment. A phenom is initialized (Electron microscope) is defined to gather the AoA and RSSI of the nodes and the phenom is designed in such a way it moves all around the work space. The Traditional DSDV protocol is modified and compared with traditional AODV

Table 1. Parameters used

Descriptions	Input Parameters
Mac /phy	Mac / 802_11
Channel	Wireless Channel
Propogation	TwoRayGround
Area	450 * 450
Number of Nodes	27
Traffic	CBR
Routing Protocol	DSDV, AODV
Initial Energy	5 j
Transmit Power	0.175
Receiving Power	0.175
Speed	10

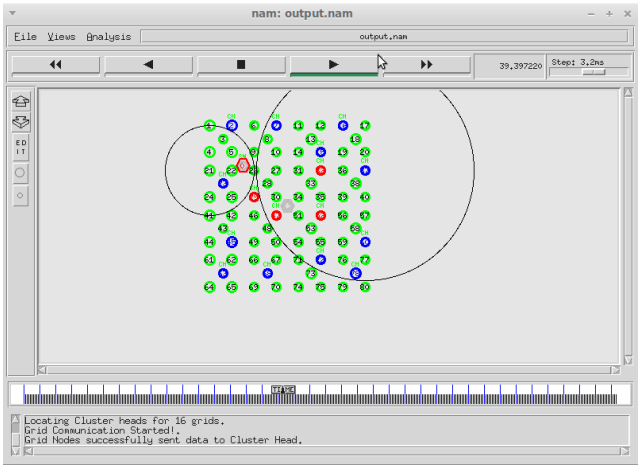

Fig.1 Simulation of 80 nodes

B. Performance metric

The performance metrics are analyzed by comparing the three methods with the traditional protocol AODV.

B 1. Average Energy Consumption

The average energy consumed as electric energy by the nodes in receiving and sending the packets in a given period of time. It can be calculated as follows

Power consumed = W·h (Watt x Hour)

Where Watt - total energy consumed

Hour – given period of time

B 2. Energy Efficiency

Energy efficiency is the goal of efforts to reduce the amount of energy consumed when radio transmission takes place between nodes.

It is calculated as follows

Energy Efficiency = Total energy consumed / Standard rating (EER)

EER – Changes according to no. of nodes

C. Experimental Results

C 1. Average Energy Consumption

Table II give the energy consumed by the protocol. The energy consumption is very high in AODV and low in DSDV and thus makes the protocol DSDV better.

Table.2.Energy consumption

Rate (Pkts/ Sec)	AODV Energy Consumption	DSDV Energy Consumption
0.5	380	245
1	400	296
1.5	412	356
2	464	423
2.5	513	496
3	580	520

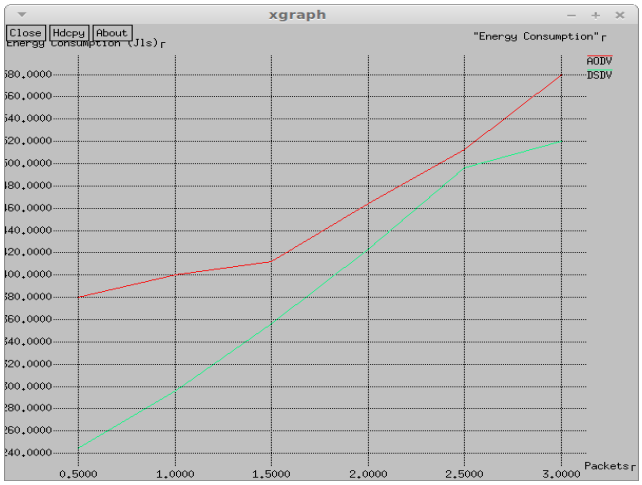

Fig. 1. Energy Consumption graph

C 2. Energy Efficiency

The energy efficiency is improved for MPAODV as the nodes get increased and it is shown in Table III. The energy efficiency is very low for IMAODV. The graph is shown in Figure 2.

Table.2.Energy efficiency

Nodes	AODV Energy Efficiency	DSDV Energy Efficiency
10	57.5	82.25
20	70	83.95
30	76.5	87.75
40	85	89.5

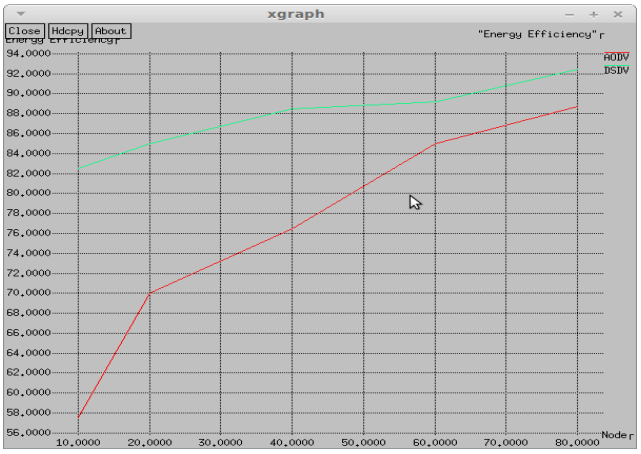

Fig. 2. Energy Efficiency graph

V. DISCUSSION AND CONCLUSION

In this paper a Gaussian network is deployed to describe the connections of nodes using the Gaussian integer and with the help of four virtual grids the packets are transmitted and this protocol was implemented by modifying DSDV protocol. The work is simulated in the network simulator. The performance of the protocols DSDV and AODV is analyzed. The protocol DSDV has given a better performance than the traditional AODV protocol regarding the energy efficiency and energy consumption.

VI. FUTURE SCOPE

The target velocity is the unknown variable in the cluster head so the packet loss is observed and the repetition of the transmission packet is observed. In future this will be eliminated for better performance.

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