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MERGING OF CLUSTERING GSTEB WITH GRID BASED MULTIPATH CONGESTION AVOIDANCE ROUTING PROTOCOL FOR WIRELESS SENSOR NETWORK.

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Wireless sensor network is one of the prominent communication network in recent technology.one of the main challenges in wireless sensor network is energy efficient. When the sensor node is deployed it cannot be recharged. A new clustered GSTEB energy efficient routing protocol handles a real and non-real-time application in wireless sensor network. In large network load balancing among the cluster causes delay, redundancy and congestion. Intention of achieving better overall amenities among sensor in the cluster, so we employ the idea of merging cluster GSTEB with Grid. In grid, dividing the sensor network field into grid structure, in that one node is selected as a master node which is responsible for data delivery generated by any node in that grid. For each master node, multiple paths which is connected the master node to the sink are stored as routing entries in the routing table of that node. These paths are the diagonal paths between the sink and the master node. In case of congestion occurrence, a novel congestion control mechanism is also proposed in order to relieve the congested areas. Simulation results have shown that our proposed protocol has the capability to extend the lifetime of the sensor network and to utilize the available storage.
Keyword: Wireless sensor network, Cluster GSTEB, Congestion Control.

Introduction

In the past few years, there is a rapidly increasing the growth of wireless sensor network in various field like Engineering, Military surveillance fire monitoring needs a real-time report progression for further needs. But wireless sensor network which containing of a large number of low cost, low power sensor nodes randomly deployed in order to obtain data from real time application[1]. Hence the battery power of sensor node is limited, when it is deployed it cannot be replaced so energy efficient routing is needed. For long range of transmission one hop is not suitable because of energy cost. Thus, multi-hop is needed to transmit the data packet from source to destination. when the data packet is send from source to destination delay is occurred so it will affect the network performance. This will encourage a new delay aware routing protocol that are designed to deliver the delay sensitive data to the destination before missing the deadlines[].

In sensor network, there are two main reason for delay: packet queuing and congestion. Congestion detection is a technique is occurred in which the abnormalities in the usual traffic is been made out. i.e., while transferring a data packet from one node to other node. when the data is transfer in the node, congestion is caused by buffer overflow. Due to node level congestion more number of packets is lost. Increase in packet loss leads to more energy consumptions and the decrease in link utilization. The link level congestion occurs when more than one sensor node tries to acquire the channel at same time. In case of link-level congestion, all the nodes attempt to send traffic on the link simultaneously[10]. It results in packet collisions. Furthermore, due to link-level congestion, the link utilization is reduced. To avoid all the above mentioned effects of congestion, congestion must be controlled or avoided in an effective way. It also reassured by using CGSTEB energy efficient routing protocol [7][8][9]which also evenly leads load balancing was proposed which was based on virtual heads, which will control the congestion for the large network, which have hierarchical clustering and multi-hop structures.

The main aim is to find the congested virtual head and this algorithm results in lower transmission delay and high throughput. To detect congestion in the clusters of the network, a new multipath protocol GMCAR (Grid based multipath with Congestion

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Avoidance Routing protocol)was proposed and intended to route packet fast, utilize and extend sensor network congestion[14]. Threshold is maintained according to the different applications.

In this paper, To achieve this goal of clustering GSTEB and grid with GMCAR we propose of Merging Grid into CGSTEB for Wireless Sensor Networks. And We employ the idea is to divide the sensor network field into squared-shaped grids. Then for each grid, a master node is selected to take the routing role for all data generated by the nodes in the same grid, or the role of routing the data received from neighbor grids. Our proposed protocol is suitable for real-time and non-real time traffic[14][15].

The reset of this paper is organized as follows. Section 2 Related work on multi-path routing and congestion control techniques. Section 3 presents our proposed protocol grid based multi diagonal grid . In Section 4 Merging of grid into CGSTEB . Finally, section 5 concludes the paper.

2. RELATED WORK

Several routing protocol have been proposed. In cluster-based routing nodes are divided into clusters and the cluster head will send the data collected from normal nodes to sink.Low Energy Adaptive Clustering Hierarchy (LEACH) is proposed by Heinzelman. This routing protocol divides nodes into several clusters by their location, and the nodes can only communicate with in the same cluster.

Energy-Balanced Chain-cluster Routing Protocol (EBCRP) is proposed by Xi-Rong Bao. It is a cluster-based distributed algorithm that builds a path of chains through the use of a ladder algorithm.

There are numerious protocol have been proposed in the literature to focuses the problem of routing delay sensitive data in wireless sensor networks. The main aim is to route the packets before missing their deadlines with minimum energy consumption. congestion is the main reasons for hot spots in which any packet routed through these hot spots are if not dropped jeopardized to a large routing delay.

DEAP [Delay-Energy Aware Routing Protocol for sensor and actor networks is a routing protocol that uses the packet delay in routing decision . DEAP creates a Forwarding Candidate Set (FCS) which is a set composed of the nodes that are closer to the destination than the sender node by a certain threshold. Upon forwarding a packet, an active node is chosen from the FCS as the next hop thus more than one forwarding choice exists.

MQOSR is another QoS-enabled multipath routing protocol which is based on the assumption that the base stations are typically many orders of magnitude more power than common sensor nodes. MQOSR is an improved version of the Secure and Energy-Efficient Multipath protocol(SEEM) . While SEEM did not avoid the collision problem that may occur when there are multiple source nodes are sending at the same time, the problem is resolved by MQOSR protocol.

A multi-path routing protocol that is resilient to node failure is proposed . This protocol aims to find multiple paths between the source and the sink, so that when the shortest path goes down an alternative path is selected quickly. The alternative paths could be disjoint or braided. This protocol does not focus on achieving high delivery ratio and balancing the load among the available alternative paths. Load balancing can extend network lifetime by utilizing nodes energy evenly whereas high delivery ratio is very desirable in real-time sensor applications.

3.PROPOSED WORK

The proposed methodology contains various steps required to accomplish the objective of the paper.
Step 1: Initialize the Network.
Step 2: Deploy network randomly in predefined sensor field.
Step3: Apply Grid in the network
Step 4: Apply Grid with CGSTEB energy efficient protocol
Step 5: Merging of Grid with CGSTEB protocol.
Step 6: Apply GMCAR Congestion Avoidance in grid
Step 6: Evaluate Energy Level consumption.
Step 7: Check for energy and else continue to step 3

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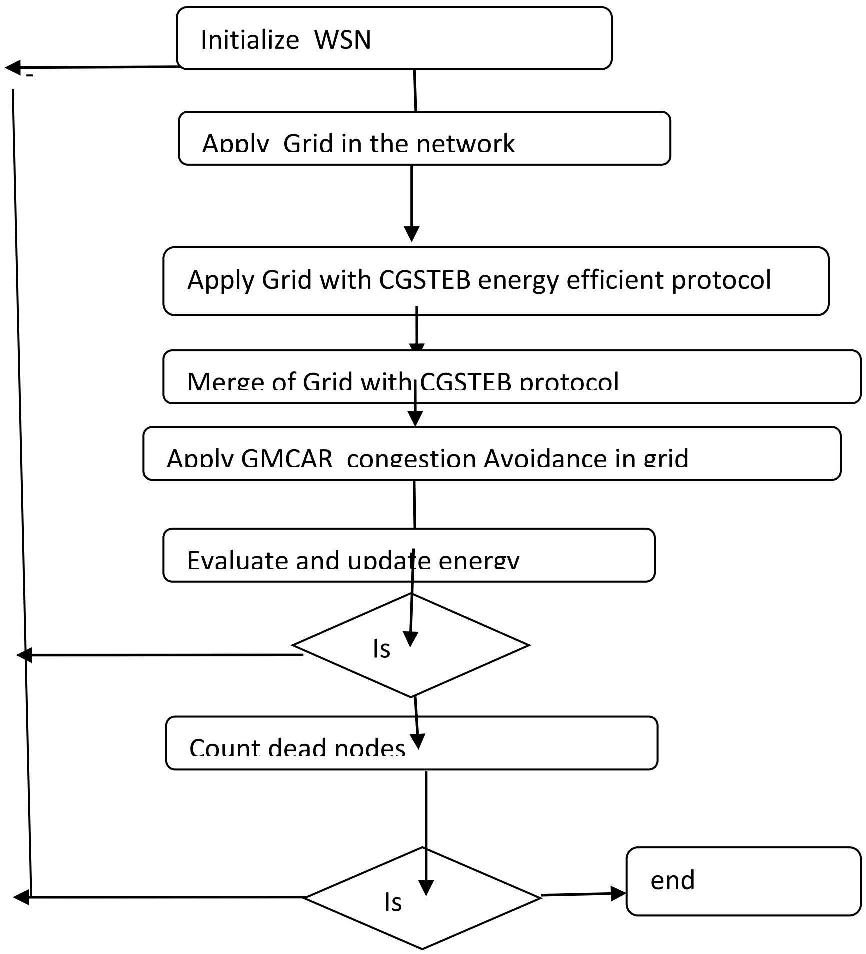

Fig 1: Proposed Methodology

Grid in network

In our approach, we aim at building multiple paths that connect the master node in each grid with sink. In our proposed protocol we divide into three phases

- Grid Formation
- Establish Routing Information
- Data Transmission

Phase I:Grid Formation

In these phase, the nodes are randomly deployed in square shape grids with predominate size. The maximum size of the grid is calculated using the formula $R=2\sqrt{2}G$(where R is the Radius and G is the grid size). This ensures that any node in one grid can reach any other node in the neighbor grids. For each grid, a master node is elected randomly and the remaining non-master nodes inform the master node that they belong to this grid before they enter the sleep state

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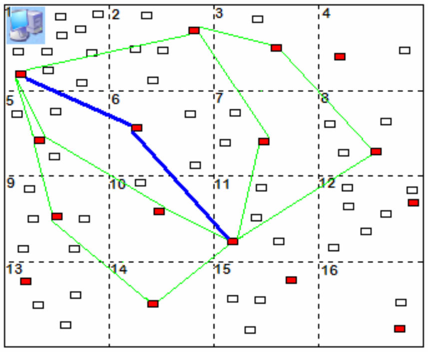

Fig 2 Multi path Routing in grid based network.

Phase 2: Establish Routing Information

After grid formation, the sink commences a choking message to discover the available paths from each grid to the sink. After receiving the message, each master node broadcasts routing information to its neighbors, The routing information being exchanged. It carries information regarding two metrics: *hop count* (H) and *grid density (Gd).* Hop count determines the number of hops the sink is far away from the grid and Grid density determines the total number of nodes in that grid.

To achieve the goal of minimum delay and fast transmission the proposed protocol creates multiple paths towards the destination. We assume that the base station is located always in one of the topology corners, we can differentiate between two types of grids: boundary and non-boundary grids. Boundary girds are those grids that lie on the topology boundaries horizontally or vertically along the base station where the non-boundary grids are surrounded by boundary grids as shown in Figure3(a). Master nodes for the non-boundary grids have one primary diagonal path (if the diagonal neighbor grid is not empty) and alternative diagonal paths through grid neighbors. Figure 3. (a) shows the possible paths for the master node in grid 11 (primary path shown in bold blue line while the alternatives are shown in green sink is reachable and the network does not have a major cut that separate it into two isolated regions.

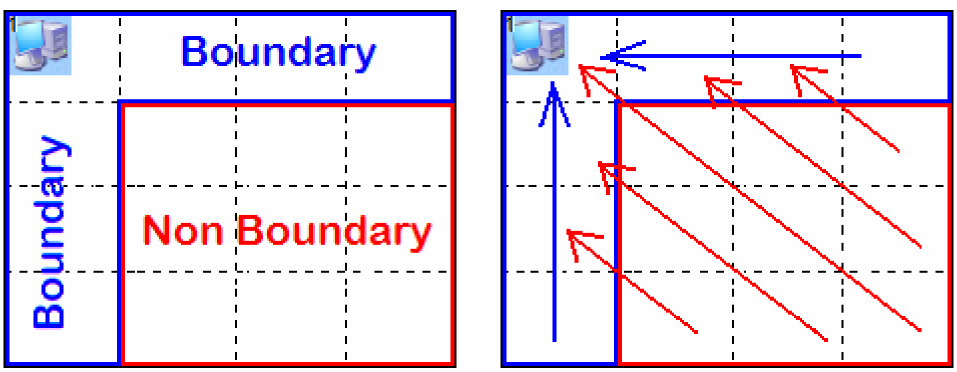

Figure 3: (a) Boundary and non-boundary grids (b) The traffic direction.in 4X4 grid network.

Since we aim to extend network lifetime while providing efficient forwarding paths, each one of the available paths is assigned a weight. Path weight depends on the weight of each link over that path. The weight of a link is a function of number of hops and the density of the first grid along this path. We choose this criteria because including path length will guarantee selecting the appropriate path based on the packet deadline while grid density factor help utilizing the network energy evenly by favoring the paths with higher density over other low density paths to let the low density paths last longer. In case that there are two links with the same weight, our protocol balances the load among these links. The weight of the link is calculated as:

$Wl = a\ .Gd - b\ .H$ (1)

Where *Wl* is the weight of link *l*, *Gd* is the grid density, *H* is the hop count, and a , b Î [0,1] such that a+b=1. Grid density is given positive weight while hop count is given negative weight. This indicates that grids with higher densities and lower hop counts are preferred.

Phase 3: Data transmission. After establishing the routing tables, nodes can start transmitting their data. Each non-master node transmits any information to the grid master node, and the grid master node in turn is responsible for selecting the suitable path to forward the data to. Non-master nodes can go back to sleep state if it has no more data to send while master nodes cannot go to sleep state in order to receive any routing updates. This situation is continued until the master node energy is about to drain out where the master node starts an election process to select the master node that will be in charge. The node with the highest residual energy will be chosen. If the master node is the only remaining node in the grid, the master node broadcasts a routing update message to the neighbor grids to invalidate any path going through this grid.

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Congestion Avoidance

GMCAR protocols have common functionalities. Both are state-based protocols which mean that they have to maintain some kind of routing information as tables in their memory. We avoid congestion occurrence by creating multiple diagonal paths to the sink where the master nodes can distribute the traffic along these paths. Load balancing is used when two of the alternative paths have the same weight.

4.Merging Grid into Clustering-Based Routing Protocol

Clustering GSTEB(CGSTEB)

First, we must define the CGSTEB routing protocol parameters and variables.
Rectangle Unit Block (Block): This is a rectangular block. The user defined value of N divides the network into several blocks with same size without overlapping.
Center of Block (BC): After dividing the network into several grids, we will calculate the center coordinates of the grids. We assume Block_Center i (BCi) is the i-th center coordinates of the block.
Cluster: Cluster can be regarded as a set C which is includes several sensor nodes We can represent a set C as C = {Sj},Sj S,j=1,2,…,n. Where j is the number of sensor nodes. We assume the Cluster_ID is i which represent the cluster number of the grid. In any cluster, if any member of the sensor nodes are not in a cluster, it is an invalid cluster, otherwise, it is valid cluster.
Distribution: We define a new parameter in a valid cluster Distribution it is used to evaluate the distribution of nodes in a valid cluster. The number of nodes within a valid cluster closer to BC are the best. The formula (1) is used to calculate the distribution of the cluster. Where is the distance between the member of the sensor nodes in cluster and the BC of the cluster and where is the number of sensor nodes in the cluster. After defining these parameters and variables, the following details the description of each step.

Step 1: Network Gridding
After the deployment of the sensor nodes, we will make a grid of the network. In this paper, we assume that the sensor nodes in the network can be arranged to an M*M area, and assume every length of block is N. The network will be divided into same size blocks. Where the user defined the N value and M value is the length of the sensor network.

Step 2: Calculate Center of Grid
Formula (2) calculates the center of the grid. is the two-dimensional coordinate vector, where i=1,2,…, , this is used to indicate the number of the grid,and also is also the Cluster_ID. The numbering starts from the (0,0) position along the X axis towards the right, Sequenced 1, 2, …, until numbered to the right- border of the sensor network, then back to left-border of the sensor network. In this moment, shift the Y-axis direction one unit block down, then repeat the sequencing step until the grid is complete. Then use the number of grids and formula (6) to get each center of grid.

Step 3: Deploy the Cluster GSTEB into Grid
After the calculation of the grid we have to deploy the cluster GSTEB into the grid. Here the CGSTEB is used to select the Cluster Head Selection. Assume the variable K is the user set up number of clusters Head in the network. The value of K will affect the efficiency of network, so we must decide the variable K according to the network size and number of nodes. The operation of clustering will be repeated until N(VC)=K. After clustering Head finishes, the sink will send related information to the sensor node for an update.

Step 4: Calculate Distribution ( ) of Valid Cluster
In this step, we will calculate the Distribution of the valid cluster. First, we give a set VC that includes all valid clusters in the network. N(VC) expresses the number of valid clusters. We will only calculate the Distribution of clusters in the VC set. After each Distribution in each cluster has been calculated, we will start the cluster merging process

Distribution= $\frac{\sum sm\epsilon sd(sm,Bci)}{N(ci)}$-------------------------------(1)

Bci=([(i-1)%($\frac{M}{N}$)+$\frac{1}{2}$]*$\frac{M}{N}$,[[i-1]/ ($\frac{M}{N}$)+$\frac{1}{2}$]*$\frac{M}{N}$------------------(2)

Step 4 : Merge sValid Cluster
First, we choose the fewest number of nodes and the cluster with the largest Distribution value from the VC set. Assume a cluster from the VC set that meets the above conditions is , where , A=1,2,…, , then we will start the merge. Let the distance between and be minimal, where ,B=1,2,…, , and . Then we add all the sensor nodes to
from . In other words, let all the Cluster_IDs of the sensor nodes from change to , and remove from the VC , resulting in one less N(VC) .

Clustering GSTEB Head Selection:

The main task of the cluster head is to fuse data that sensor nodes sensed within a cluster, receive other cluster heads' sensed data, and, send to sink, after clustering finishes and, cluster head must be selected from each cluster. To do so, the sink will broadcast a Head_Elect Message packet to every sensor node in each cluster in the network. When a sensor node gets this packet, it will

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generate a random variable P between 0 and 1, The residual energy is then calculated. The member nodes of the same cluster compare each of their residual energies according to the transmission power to obtain cost between them. Sensor nodes with the most residual energy will be selected as the cluster head. If more than one sensor nodes have the same residual energy in the same cluster then the sensor node with the larger *P* value will be selected as cluster head. After each of the cluster heads of cluster has been selected, each cluster head will send a Head_Confirm packet to the sink. The packet format is shown in TABLE 4 The Header records the name of packet, Node_ID expresses the Node_ID of the sensor node that is the cluster head, Cluster_ID expresses the Cluster_ID of the cluster to where the cluster head belongs. After the sink received all the Head_Confirm packets, it will consolidate the information and forward it to each cluster head allowing them to, update their Head_List table.

TABLE 4 .

Header	**Node_ID**	**Cluster_ID**

5. Energy

The energy exhausted for transmission of a bit packet over distance is calculated by using

$$Etx(k,d) = Eelect * k + \mathcal{E}fs * k * d * d \quad if\ (d < d0)$$
$$Eelect * k + \mathcal{E}amp * k * d * d * d * d \quad if\ (d > d0)$$

Where $\mathcal{E}_{fs}$ is free space energy loss, Ɛamp is a multipath energy loss, d is a distance between source node and destination node, and d_0 is crossover the distance:

$$d0 = square\ root(\mathcal{E}fs / \mathcal{E}amp)$$

The energy spent for the radio to receive this message is

$$ERX(k) = k * Eelect$$

keeping the load evenly distributed.

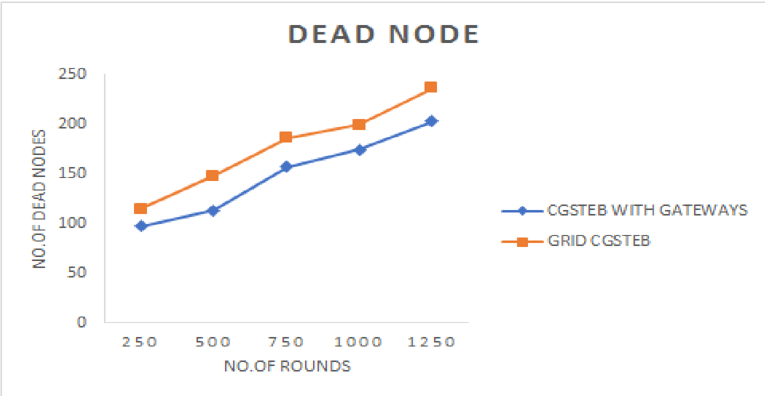
6. RESULTS AND DISCUSSIONS:

NS-2 simulator is used to investigate the performance as shown in the given figures below, here we are comparing the result of parameters.

Table 5. has shown a variety of constants and variables required to simulate this work.

Parameter	Value
Area(x,y))	100,100
Nodes	200
Initial energy	0.01
Etx,Erx	50nJ/bit
Transmit amplifier	100nJ/bit
Number of grids	49
Maximum lifetime	100
Message size	512 bytes

6.1 Dead Node



NO.OF ROUNDS VS Dead Nodes

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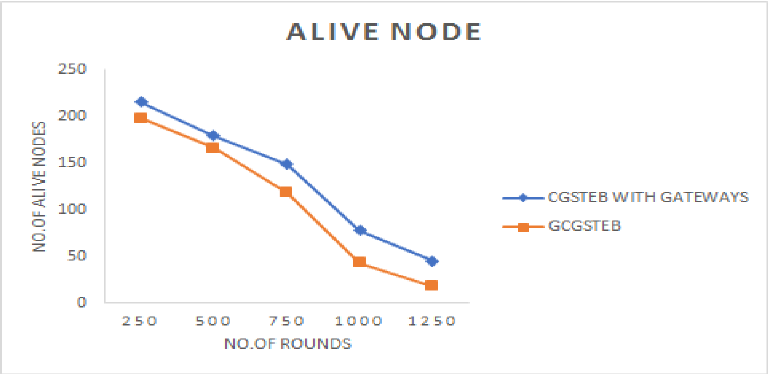
Figure 6.1 is showing dead nodes. Here the graph X-axis signifies No.of. Rounds and Y axis signifies No.of Dead nodes. The illustration of Dead nodes CGSTEB with Gateways and grid based CGSTEB approach for different round consequences. It is concluded that the Dead node of the proposed grid based CGSTEB approach has 92 %of higher than CGSTEB with gateways.

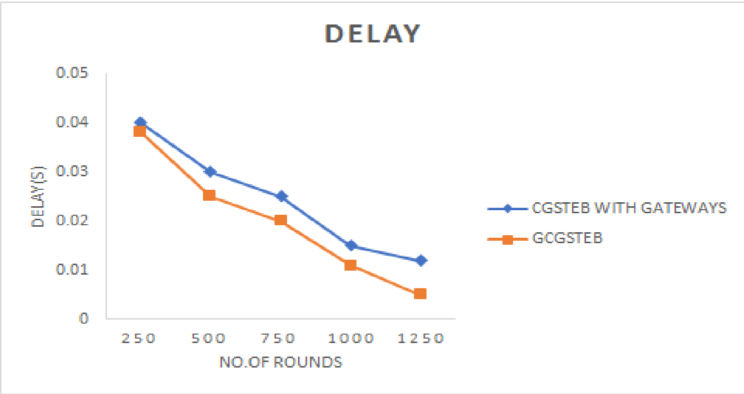
6.2 ALIVE NODES



NO. OF ROUNDS VS ALIVE NODES

Figure 6.2 is showing dead nodes. Here the graph X-axis represents No.of. Rounds and Y axis represents No.of Alive nodes. The illustration of Alive nodes CGSTEB With Gateways and grid based CGSTEB approach for different round consequences. It is concluded that the Alive of the proposed grid based CGSTEB approach has 8% of lesser than CGSTEB With gateways.

Delay



NO.OF.ROUNDS VS DELAY

Figure 6.3 showing Delay. Here the graph X-axis represents No.of. Rounds and Y-axis represents Delay. The illustration of Delay for data packet of CGSTEB With Gateways and grid based CGSTEB approach for different round consequences. It is concluded that the Delay of the proposed grid based CGSTEB approach has 8% of lesser.

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6.4 Packet Delivery Ratio

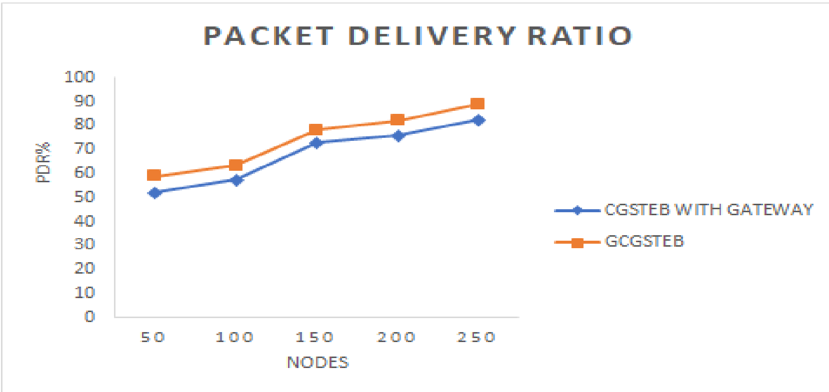

Figure 6.4 is showing PDR value of CGSTEB with gateways and grid based CGSTEB. Here the graph X-axis represents No.of. Nodes and Y- axis represents PDR.The illustration of PDR With Gateways approach with different Node consequences. It is concluded that the PDR for proposed grid based CGSTEB approaches has 16% higher than others.

6.5 Energy

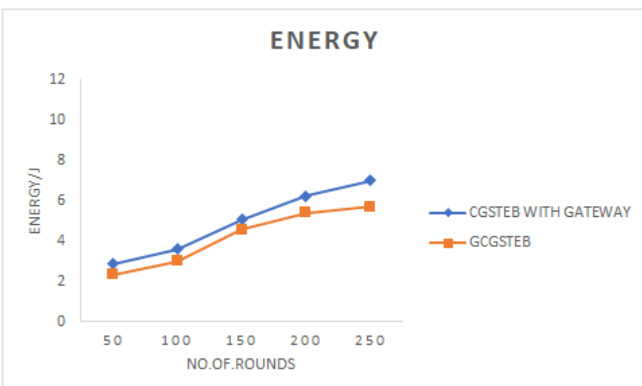

Figure 6.5 is showing Energy Consumption Here the graph X-axis signifies Nodes and Y- axis signifies Energy measured by Joules. The illustration of Energy for CGSTEB With Gateways and grid based CGSTEB approach with different round consequences. It is concluded that the Energy consumption for proposed grid based CGSTEB approach has 18% higher than CGSTEB with gateways.

6.6 Alternative paths

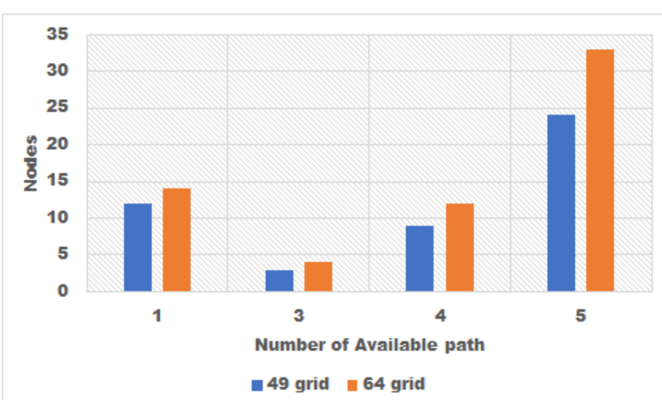

Fig 6.6: shows the number of alternative paths for 49 and 64 grid topology.

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Conclusion

In these routing protocol ,the proposed grid the network and then we combine the clustered GSTEB with Grid to achieve long lifetime and better energy efficiency. Here GMCAR protocol is designed to overcome issues of real-time traffic. A novel congestion control are proposed to overcome the delay ,congestion and redundancy . we incorporated load balancing in our protocol to distribute routing load over all the nodes.so that when we merging CGSTEB routing protocol with grid our proposed protocol achieve 75% better than existing . Then the simulation results shows our proposed protocol have shown better performance.

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