Network Period growth Using Layer Based Topology Control Design With Mobile Node Circulation

Dr. B. SENTHILKUMAR

Abstract: A computer network is a collection of computers and network devices grouped together which allows or transfer their data with one another. A wireless network is a computer network of any type that uses wireless signals to connect the nodes in the network to transfer/share the data for its applications. A wireless sensor network is a network having autonomous sensors distributed evenly to monitor and send the data of the physical, environmental and real time conditions periodically. The mobile node rotation model is exploited using Adaptive Energy Threshold Algorithm and Distributed Swap Level Algorithm. It mainly focus on rearranging the sensors to appropriate place without changing the network topology. The Adaptive Energy Threshold Algorithm is used to find out the energy level threshold value of each node in the network. The Distributed Swap Level Algorithm exchanges the node according to their energy level and location by taking the node energy level value below the threshold energy level value. The periodical node rotation or swapping lead to rotation overhead and the layer based topology organize the nodes in layers according to value of their energy levels. The rotation is carried out between and within the layers that decreases energy consumption level and improves the lifetime of the network. The node rotation is implemented by using OMNeT++ software and the simulation is written in C++ to compute and evaluate the performance.

1. INTRODUCTION

A network is a collection or group of nodes interconnected each other in the communication paths. The networks can be interconnected with other networks and sub networks. The most commonly used topologies or general configurations of networks include the bus, star, token ring, hybrid and mesh topologies. Networks can be characterized and categorized in terms of spatial distance, data transmission, network users, connections and physical links is described by Nader et al [1]. Large telecommunication networks have sharing and exchanging arrangements with other companies/institutions so that the larger networks are created. A wireless network is a type of network that uses wireless media connections to connect the network nodes for data communication. Wireless networks avoid the expensive process of installing cables into a big building and connection between various network equipment in different locations. Wireless networks are generally implemented and administered using radio communication signals. The implementation takes place at the physical layer of the OSI reference model network structure is described by James et al [2]. The wireless links used in wireless data communications are Terrestrial microwave, satellites, radio frequency signals, spread spectrum technologies and free space optical communication.

A Wireless Sensor Network (WSN) is a collection of nodes and sensors with low cost, low power and energy constrained to monitor a physical occurrence and back send to the node as data. It consists of base stations which receive the data from number of wireless sensors. Each sensor or network device is considered as a unit with wireless data communication capability that can collect and process data independently and send to the base station. Most of the sensors are used to monitor the actions of the objects in a specific field and transmit the data to the base station during predefined time interval. The end users can access the data from the base station. A node in a sensor network is typically equipped with a radio transceiver, a small microcontroller and an energy source known as battery is described by Kazem et al [3]. A sensor node might vary in size from a shoebox down to the size of a grain of dust. The cost of sensor nodes is likewise variable, ranging from hundreds of dollars to few nodes depending on the size of the sensor network and the complexity required of individual sensor nodes. The node size and rate constraints on sensor nodes result in equivalent constraints on resources like energy, memory, computational speed and bandwidth. A sensor network normally constitutes a wireless network meaning that each sensor supports a multi hop routing algorithm. The main characteristics of WSN include:

1. They can harvest or store limited power.
2. Ability to withstand harsh environmental conditions.
3. Ability to cope with node failures.
4. Mobility of nodes.
5. Dynamic network topology.

1.1 NETWORK LIFETIME

Network lifetime is the time span from the deployment to instant of the network considered nonfunctional. A network should be considered nonfunctional during the first sensor dies, a percentage of sensors die, the network partitions or the loss of coverage occurs. Network duration is the majority of important metric for the estimation of wireless sensor networks. The consumption of energy must be considered in a resource constrained environment. Energy consumption in a mobile sensor node can be attributed to either helpful or inefficient sources. Energy consumption is considered useful during transmitting or receiving data, processing query requests and forwarding queries or data to neighboring nodes. Wasteful energy utilization can be due to idle listening to the media, retransmitting due to packet collisions, overhearing and producing or coping with manipulate packets. The network community lifetime as a measure for power consumption occupies the outstanding role that it forms an upper certain for the utility of the sensor network. The network can only fulfill its purpose until it is considered alive and after
that it is considered dead. It is consequently an indicator for the most utility a wireless sensor network can provide. Lifetime is considered a fundamental parameter in the context of availability and security in networks. Network lifetime strongly depends on the lifetime of single nodes that constitute the network. The network lifetime metric deviates in an uncontrollable manner if the lifetime of single node is not predicted accurately. The lifetime of a sensor node depends basically on two factors based on energy consumption over time and energy availability. The predominant amount of energy is consumed by a wireless sensor mobile node for the duration of sensing, communication and data processing activities. The network lifetime is improved by reducing the energy consumption using Energy Consumption Model. It is classified into continuous energy consumption and the reporting energy consumption. The continuous energy utilization is the smallest energy needed to sustain the network during its lifetime without data collection. The reporting energy consumption is the minimum energy consumed in data collection. It depends on the rate of data collection, channel model, network architecture and protocols. The network lifetime can also enhanced by minimizing the number of hops and network interruption. The number of hops can be controlled by improving the topology of the network.

2. REVIEW OF LITRATURE
The wireless sensor network has several methods or schemes to increase the network lifetime such as duty cycling, data reduction, mobility management and topology control. The duty cycling mechanism alternately turns their power on and off in order to save their energy during the node idle state. The data reduction method reduces the amount of data the nodes generate and transmit it subsequently to decrease the radio component energy consumption. Mobility management is the ability of a network to move nodes without any human intervention. The different controlled mobility methodologies are data mules, mobile relays and mobile base station. In data mule, each node termed as mules that visit all the sources in the network to collect the data and then physically transmit the data to the sink. The mobile relays relocate the nodes to different places to reduce the distance between sensors in the network. In mobile base station method, a powerful moveable sink travels around the wireless sensor network through single or multiple hops and collect data from the sensors. The topology control is used to reduce the energy consumption by reducing the initial topology of the network. Luo et al [4] proposed a scheme called an adaptive sampling and diversity reception in multi hop wireless audio sensor networks. An adaptive sampling method based on diversity reception is used as an alternate to the commonly used sampling technique. Diversity reception is appropriate for data fusion of audio stream from the neighboring sensors. The adaptive sampling algorithm keeps resources and also assuring the quality of received audio with additional computation and communication overhead. El Moukaddem et al [5] proposed a method which increases the capacity of data gathering in wireless sensor networks using mobile relays. A Max-Data Mobile Relay Configuration is introduced to maximize the data collection capacity of hybrid wireless sensor networks having both mobile and static nodes. The energy consumption while the transmission process is mainly considered and the simulations results disclose that the protocols quickly converge on a final solution with little messaging overhead. Liu et al [6] proposed a method called a reliable clustering algorithm which based on leach protocol in wireless mobile sensor networks. The energy load is reduced in all the nodes and an enhanced algorithm named Distributed Low Energy Adaptive Clustering Hierarchy based on LEACH was proposed. The algorithm fuse the ideas of revising the threshold function and a multi-hop communication mechanism among the cluster heads to attain more lifetime. The simulation result shows that the new strategy of cluster heads election can get better network's lifetime efficiently. Yoon et al [7] proposed a method called Multi-layer Topology control for Long term wireless sensor networks. The inadequacy of a flat topology for most wireless sensor networks (WSNs) have a cluster or tree structure and this causes an imbalance of energy between the nodes. It gets worse over time as nodes become non-operational and alternate nodes are inserted. Multiple layers are better than the typical two layer cluster based topology because it can hold nodes with different levels of residual energy. The simulation result shows that this scheme can balance node energy levels and lengthen the lifetime of the network. El Moukaddem et al [8] proposed a scheme called Mobile Node Rotation which maximize the lifetime of a network effectively. Mobile node rotation is a new method to deal the discrepancy in energy consumption of the low cost sensor nodes and lengthen the wireless sensor network lifetime. The nodes are made to rotate through the high power consumption locations. The efficient algorithms for single and multiple rounds of rotations was proposed. The simulation shows that mobile node rotation can extend the network lifetime eight times than average and is much better than existing alternatives. The various techniques such as controlled mobility, data mules and mobile relay are experiencing the random mobility that cause change in topology. The change in topology of the network leads to disconnection of that specific network. The lifetime of network can be enhanced by reducing the energy consumption using layer based topology control scheme with mobile node rotation.

3. MAXIMIZING NETWORK TOPOLOGY LIFETIME USING MOBILE NODE ROTATION
3.1 Mobile Node Rotation
Mobile node rotation utilizes the node mobility to mitigate differential power consumption by swapping the nodes in high power consumption positions without altering the existing topology. Mobile node rotation concept was coined from huddling and rotating nature of penguins. The penguins swap their positions from outside to inside huddle and vice versa to preserve the energy for the significant wind protection. The rotation is performed by the planned time intervals because almost all the wireless sensor applications, sensor nodes are idle most of the time during their lifetime. The duty cycling method is introduced to reduce energy consumption. The energy conserving capacity reduces the need of mobile node rotation that leads to maximizing the lifetime of network topology. The wireless sensor networks have many portable sensor nodes and a single fixed sink node. The sink is always...
to be active all the time and good energy backup. Sensors collect the data from their location and send it to the sink node through single or multi-hop forming a directed routing tree is explained by Luo et al [9]. An adaptive energy threshold algorithm is used for calculating required threshold and the nodes are swapped with the high energy nodes during the energy level of sensor nodes below the threshold level is described by Kansal et al [10].

3.2 Network, Energy and Duty Cycle Models
The network model comprises of time divided into intervals. The sensor nodes collects a fixed amount of data and transmit along the data received in multiple hops from its child node to its parent node with routing tree in each time interval is described by Somasundara et al [11]. The data collected from different sensor nodes cannot be combined to reduce the transmission load of nodes in the routing tree. The main objective is to maximize the lifetime of the wireless sensor network by maximizing the capacity of data collection is described by El Moukaddem et al [12]. The term lifetime is due to the immutable position requirement. The wireless sensor networks have a low duty cycle because of restricted available energy. The power efficient MAC protocols have been proposed to keep reasonable communication performance despite of low duty cycle is described by Sha et al [13]. The sensor nodes sleep and idle for 87 percent of the time and still it increases the network throughput. The nodes sleep between 60 and 70 percent of the time without conceding the throughput. Node rotation is executed during sleep mode, so the network operation is not troubled. The node rotation needs a very short time to perform and can be finished without any disturbance to the system for duty cycles as high as 90 percent.

3.3 Formal Definition
Sensor nodes may swap their positions in single round or multiple times. The swapping is classified according to the number of swaps as single and multiple round swaps. In single round swapping, all the sensors nodes rearrange their position at the same time in single round. The multiple round swapping swaps the sensor nodes multiple times in multiple rounds. The mathematical model of wireless sensor nodes is shown below,

\[
W = \{I, O, Pr\} \text{ is a system}
\]

\[
I = \{S, U, P, E, V\} \text{ be an input instance}
\]

\[
S = \{s_1, ..., s_n\}, \text{ a list of sensor nodes}
\]

\[
U = \text{network sink and } p_s, \text{ is its location}
\]

\[
P = \{p_1, ..., p_n\} \text{ a list of positions}
\]

\[
E = \{e_1, ..., e_n\} \text{ a list of initial energy of nodes}
\]

\[
V = \{v_1, ..., v_n\} \text{ a amount of data gathered at each location per time interval}
\]

\[
f_1 = \text{original position of node}
\]

\[
f_2 = \text{new position of node}
\]

\[
P_r = \text{Exchange of nodes using swap level algorithm}
\]

3.4 One Round Max Lifetime Node Rotation Algorithm
This algorithm start with calculating the load \(l_i\) at each position \(p_i\) in \(P\). The load \(l_i\) is the total energy used in transmitting all the collected data at one time interval from the sub-tree rooted position \(p_i\) to its parent. The Rotate Once algorithm change the input request or order into an instance of the assignment problem. It is a combinatorial optimization problem in that \(n\) tasks are assigned to \(n\) people and each person's task execution performance is evaluated. The primary objective is to assign each task to a person to optimize the main functional measures like maximizing the bottleneck efficiency and reducing the total cost of all tasks completion is described by Handy et al [14]. The nodes stay at their starting positions for optimal length of the first time interval \(r_1\). The mobile node \(s_i\) communicate to a person and location \(p_j\) corresponds to a task. The efficiency \(c_j\) of a person \(s_i\) on performing the task \(p_j\) corresponds to the total life time of that person, after transmitting the collected data for a time interval period \(r_1\) from its original position \(p_f\) and then moving to \(p_f\) where it transmits the data until its energy is exhausted. The best possible solution for the maximum assignment instance \(l\) is optimal matching \(M\) with the given time interval \(r_1\). The increase of \(r_1\) affects \(r_2\) because there is less energy for the second round so \(r_2\) decrease naturally. The \(r_2\) is expressed as a function \(L_2\) \((r_1)\) that decreases as \(r_1\) increases. The total lifetime of the network is derived as shown in the below Equation (3.1).

\[
L(r_i) = r_1 + L_2(r_1)
\]  

(3.1)

The algorithm Rotate Once executes in \(O(\log L(l)n^{2.5})\) time because the search ratio has \(O(\log L(l))\) time complexity and each task assignment problem has \(O(n^{2.5})\) time complexity. It computes the rotation configuration by using only the utilization rates. It ignores the routing topology except during the estimation of load for each node. The regularities in topologies like grids can make simple and ease the node rotation computation because the most significant factor is the traffic loads forced on each node by the routing topology.

3.5 Multiple Rounds Max Lifetime Problem
The centralized algorithms for the m-MaxLife problem present the baseline to the extended version of Rotate Once algorithm which runs in multiple rounds. It explains the Swap Rate algorithm is more capable to maximize the network lifetime by reducing the number of rounds. This algorithm performs continuous operation for a longer lifetime. The Swap Level Merge algorithm blends Swap Rate and Swap Level to provide a balance between the number of rounds and the lifetime enhancement ratio. It works according to the consumption position and node energy level.

3.6 Repeated Optimal Matchings Baseline
The Repeated Optimal matching is an extension of Rotate Once algorithm that solves them-MaxLife problem efficiently. It runs in multiple rounds and the nodes are matched to positions using an best matching for that round. A node is chosen and acts as a controller. The controller fetch the complete knowledge of the network by collecting energy and location information from all the other node. This approach carry out with multiple rounds and the duration of each round is preset to a given duration \(r\). The controller computes the matching of nodes to positions for second round and on using a fixed duration \(r\) as round length, the matching process are executed until the initial node expires. The controller has adequate information to estimate each node’s energy availability for the future round and then broadcasts the number of rounds for all matching to the other nodes.

3.7 Observations for Improved Algorithms
The major disadvantage of the baseline are creating too many unnecessary node movements. In each round, many high energy nodes unnecessarily swap positions. The enhanced
algorithms use different approach to eliminate the unnecessary movements. The techniques used in improved algorithms is to carry out swaps of two nodes only. This allows to develop distributed implementations of algorithms.

3.8 Consumption Rate Algorithm
The Swap Rate swaps the nodes which are located at high consumption rate positions. The other nodes take part in swapping only and can facilitate critical nodes located in high consumption positions. A node is selected to be a controller in the baseline and it collects information about energy, location details from all the other nodes and computes an initial list of critical nodes \( L_c \), such that \( Z > L_c \). The \( L_c \) is a given critical threshold consumption rate, it proceeds in rounds of fixed length interval \( r \). In each round, the controller computes a swap associate for each node in critical list. The nodes in \( L_c \) are arranged in the descending order with their present consumption rate. The controller considers all available non critical nodes ‘s’ and swapping ‘c’ with ‘s’ is suitable for the current critical node ‘c’. Among the suitable swap partners, the controller picks the one that maximizes the resulting minimum lifetime of nodes ‘s’ and ‘c’. The node ‘s’ is then marked as unavailable for later critical nodes. After all the swaps are completed, a new round starts and the process is repeated until the first node expires.

3.9 Energy Level Algorithm
The Swap Level need less computation from the controller and less synchronization among the nodes as nodes relocate independently. This algorithm differs from swap rate in swapping where the key measure is the node energy level and node mobility is described by Xing et al [15]. A swap is started by a node during its energy level goes below a certain threshold. The controller initiate the process by gathering the node energy level and location information from all nodes. The controller computes s’s swap time t for each node s. The controller finds an suitable partners, to swap with s, during the swap time maximizes L2 \( s \) 2. If there is no suitable swap partner \( s \), then \( s \) reset its critical energy threshold and continue to function from its current position. The two nodes swap their positions and other nodes will transmit until the swap process completed. Almost all the nodes in the network will sooner or later lose energy to start a swap and nodes will try to start a swap during the network lifetime. The few nodes will do this more regularly and few nodes may try to swap but not able to find the suitable swap partners. The Swap Rate algorithm execute swaps exclusively based on the node location consumption rate. It generates swaps at more positions and create more systematic rotation of nodes during the network lifetime.

3.10 Merged Swaps Algorithm
The Merged Swaps algorithm contains a series of node rotations within a short period of time cause forced sleep modes particularly if the network duty cycle is high. It provides a balanced solution between the Swap Rate and Swap Level algorithms. The controller calculates the swap time of the nodes in the network. The node \( s_i \) have the first swap time \( t_1 \). The nodes having swap time within a period \( u \) of \( t_1 \) have their swap times moved to \( t_2 \). The controller try to find suitable swap partners for each of the nodes in the network. When \( t_1 \) is reached the nodes with suitable swap partners execute their swaps and all the other nodes go idle. The nodes try to swap but couldn’t find an suitable swap partner will reset their critical energy thresholds and remain until the swapping nodes complete their swap process. This continues until the first node’s expiry or the energy level of the node go down below the critical point.

4. NETWORK PERIOD GROWTH USING LAYER BASED TOPOLOGY CONTROL DESIGN WITH MOBILE NODE CIRCULATION

4.1 Problem Definition
The nodes in a wireless sensor network are often grouped together to get better efficiency of data transmission that causes an energy imbalance at every node. It generally weakens the transmission capability of some nodes and cut the network connectivity. when the imbalance worsens, the nodes become non-operational. A layer based topology control method with mobile node rotation was proposed and have the nodes in the network are battery-powered. The nodes periodically select its own layer depending on the energy availability to balance the energy and keep network connectivity. The simulation result shows that this design improves the delivery of data across a wireless sensor network. The mobile node rotation swaps the nodes in high consumption to the low consumption position during the reduction of energy level below the threshold level. This method will improve the network lifetime and reduce the energy consumption.

4.2 Layer Based Topology Control Method
The layer based topology control method give details about the allocation of nodes to layers and explain the operation of the nodes within layers. In hierarchical topology, the data moves hierarchically as the nodes are arranged in hierarchical fashion is described. The nodes in higher layer periodically collect the data from nodes which is in lower layer and forward it to sink node in the network. This is used to reduce energy imbalance and the nodes in higher layer need more energy to send data packets to the sink node. The energy rich nodes are positioned near to the sink. The nodes are placed in layers based on energy availability and the topology control information. The global topology control information gives the details of whole network and the local topology control information gives the details about two hop neighbours. The mobile node relocation scheme relocate the high energy consumption position with low consumption position in layers. The node near to sink is the high energy consumption position that consumes more energy than any other nodes in other position. The node relocation between the layers takes place when the node in high energy consumption position in upper layer falls below the threshold energy level and non availability of nodes within layer for swapping. The threshold energy value is calculated based on adaptive energy threshold algorithm. It calculates based on the energy used to transmit number of packets with energy required for each individual packet. The node relocation method commonly use the distributed consumption rate algorithm to perform relocation.
The Figure 4.1 shows the routing tree having single stationary sink node and number of portable sensor nodes namely $n_1$ to $n_{10}$ arranged in different layers. Initially, the newly positioned node selects its layer based on energy level. The sensor nodes $n_3$, $n_7$ and $n_9$ are relocated within layers according to threshold energy value based on distributed consumption rate algorithm. During the node relocation, if it doesn’t find suitable node for relocation within same layer, then it search nodes from next layer for relocation by using layer based topology control method. The energy required for a node at a high consumption location is shared by low consumption location sensor nodes which increases the network lifetime.

![Figure 4.1 Layer Determination Scheme](image)

The Layer Determination Algorithm

The enhanced layer based topology control method tells the layer determination by each and its node. The node deployed in a network for the first time fix the lowest layer and choose a target node in response to local topology control information (TCI) messages among its neighboring nodes. Nodes begin to collect information from the environment location and sends it to the sink node through its target node during gathering interval. The sink node broadcast a global topology control information (TCI) message to the whole network using a flooding process during the start of each round. This engages a setup period. Each node starts it layer determination process at the beginning of the subsequent period if it has received the global TCI message from the sink node. This process establish new layer for nodes. During the movement of node to another layer, it sends a layer notification message to the neighbor nodes and sometimes they may have to choose new target nodes as a result. The layer determination of each node requires information about its 1 and 2-hop neighbor nodes in the network. This information can be provided to nodes by topology control information (TCI) messages which may be local or global depending on the content to be sent. At the beginning of each setup period, a global topology control information message containing details about topology control and the routing are transmitted by the sink node to the entire network using a flooding process. After receiving the message, it starts the synchronous layer determination process to change its layer. The sink node selects setup time period. A longer setup period makes topology control more precise but the acceptable topology control overhead is limited. A local topology control information message contains details about a node’s 2-hop neighbors, the shortest hop count from the sending node to a higher layer node and the expected lifetime of nodes together with neighborhood information normally exchange by nodes within the network. A node regularly broadcasts within interval to its 1-hop neighbors, following a generic wireless sensor network protocol at the beginning of its layer determination period is explained the Layer determination algorithm steps are discussed below,

**STEP 1:** Initially the deployed node joins the lowest layer.
- Number of nodes: 75
- Layer1: Blue
- Layer2: Green
- Layer3: Red

**STEP 2:** The sink node sends the global topology control information to the entire network.
- Sink node: 0

**STEP 3:** According to global topology control information and energy availability, the node decides whether to move one layer up or one layer down.
- Number of packets: 25
- Layer1 Energy: 60
- Layer2 Energy: 75
- Layer3 Energy: 10

**STEP 4:** If Expected Lifetime (E’) is greater than average local expected lifetime (E), then it moves one layer up.
- Energy of node 23: 80
- It moves from layer 1 to layer 2

**STEP 5:** If Expected Lifetime (E’) is less than average local expected lifetime (E), then it moves one layer down.
- Energy of node 59: 50
- It moves from layer 2 to layer 1

**STEP 6:** If the node changes its layer, the notification message will be sent.

### Table 4.1 Network Parameters

<table>
<thead>
<tr>
<th>Number of Nodes</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Packet Size</td>
<td>1024 bytes</td>
</tr>
<tr>
<td>Energy</td>
<td>100J</td>
</tr>
<tr>
<td>Threshold Energy</td>
<td>50J</td>
</tr>
<tr>
<td>Transmission Range</td>
<td>100m</td>
</tr>
<tr>
<td>Simulation Time</td>
<td>350s</td>
</tr>
</tbody>
</table>

### 4.4 Adaptive Energy Threshold Algorithm

In network lifetime expansion using mobile sensor node swapping with duty cycling mechanism, initial energy of every node in the network is known. The threshold energy value is determined using adaptive threshold energy algorithm. The threshold energy value is calculated according to number of packets transmitted and energy required for each packet. The adaptive energy threshold algorithm is used to determine the threshold value for energy level of every node in the network to find out which nodes that moves next. It is used as an input to the distributed swap level algorithm for performing node rotation according to energy level. The steps involved in adaptive energy threshold algorithm are as follows,

**STEP 1:** Get the data of source node in bytes (D).
- Data = 1024 bytes

**STEP 2:** Calculate the number of packets (p) required for sending data (D).
STEP 1: The controller collects only local information and energy value from the sensor nodes.

STEP 2: Each node calculates the Energy drop level
- Energy of Node 1: 55
- Energy of Node 2: 49
- Energy of Node 3: 49

STEP 3: Then compare energy drop level with threshold value (p) calculated from adaptive energy threshold algorithm.
- Energy of Node 1: 55 > 50
- Energy of Node 2: 49 < 50
- Energy of Node 3: 49 < 50

STEP 4: If energy drop level falls below the threshold value, then node swapping occurs by finding appropriate swap node.

STEP 5: If energy drop level is greater than or equal to threshold value, then it remains in its own position.

The layer based topology control with node rotation performs node rotation within the layer or between the layers based on node energy value. This decreases rotation overhead and reduce energy consumption to get better network lifetime.

5. RESULT AND DISCUSSION

The layer based topology control method with mobile node rotation model is simulated by using the theOMNeT++ tool. It is not a simulator by itself but offer infrastructure, environment and tools to write and conduct simulations. It have Network Description (NED) file to create simple and complex structured modules. It supports graphical user interface. The .ini file is a configuration file used to define and initialize the configuration parameters. The extension .cc files are used for writing C++ coding to carry out the simulation. The OMNeT++ simulator first compiles network description file and then .ini file. Finally, .cc is compiled to perform the simulation. The key features of OMNeT++ are as follows,
- It is widely used in modeling wired and wireless communication networks.
- It is used for hardware architecture validation.
- It is used to evaluate the performance of complex software’s.
- It is used in modeling queuing networks.

5.1 RESULT

The node creation using network description file is shown in below figure 5.1

The tree topology formation using network description file is shown in the below figure 5.2

The packet generation and transmission is shown in below figure 5.3 as.
energy is shown in the below figure 5.4,

The energy file after node relocation without duty cycling is shown in below figure 5.5,

The energy file after node relocation with duty cycling is shown in below figure 5.6,

The layer formation with node rotation is shown in below figure 5.7,

The layer formation with node rotation is shown in below figure 5.8,

The energy file after layer formation is shown in below figure 5.9,

The energy comparison of existing and proposed system is shown in below figure 5.9.

<table>
<thead>
<tr>
<th>No of Nodes</th>
<th>Energy of Existing system</th>
<th>Energy of Proposed system</th>
</tr>
</thead>
<tbody>
<tr>
<td>Node 1</td>
<td>90</td>
<td>95</td>
</tr>
<tr>
<td>Node 2</td>
<td>80</td>
<td>85</td>
</tr>
<tr>
<td>Node 3</td>
<td>74</td>
<td>80</td>
</tr>
</tbody>
</table>
The Energy comparison approach and the simulation shows that the energy of each node is enhanced. The advancement of energy of each node increases the network lifetime by 10%. The results and discussion implements the layer based topology method with mobile node rotation mechanism. It explains in detail the fact that nodes are arranged in layers according to its energy level and relocation takes place when energy value fall under the threshold energy value. The duty cycling mechanism reduces the energy consumption to get better lifetime of the entire network.

5. CONCLUSION AND FUTURE ENHANCEMENT

The network lifetime enrichment based on layer based topology control method using mobile sensor rotation mechanism utilize the rotation of nodes to appropriate position in layers based on threshold energy value. The threshold energy value of node is calculated based on number of packets and size of packets. Each node in the network calculates the energy drop level. When node energy level falls below the threshold energy, the node swaps the position with suitable node with higher energy. The periodic node rotation leads to rotation overhead and the layer based topology control method is established to overcome the same. It use the arrangement of nodes in layers based on remaining energy and depicts the operation of nodes within the layers. The nodes in higher layer merge the data collected from lower layer and send to the sink node. This maintain the network connectivity and rotation overhead. In future, the work is to take advantage of the layer based topology control method with mobile rotation mechanism using multi-sink model. The multi-sink model have more than one sink to collect the data which reduces the huge network traffic and increase the lifetime of the network.

REFERENCES


