Analysis of Energy Efficient Techniques of WSN

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ABSTRACT:—In this work, further enhancement will be proposed in RFID protocol for clock synchronization. In the proposed improvement the clocks of the sensor nodes will be synchronized on the basis of time lay technique. When the time of the cluster head gets mismatched then the cluster head will adjust its clock according to the sink node timing and sensor nodes. The proposed technique has been implemented in simulated environmental conditions. The graphical results show that proposed technique performs better than previous protocol in terms of throughput, delay, overhead, energy consumption and packet loss in the network.

KEYWORDS: RFID,CLOCK,SINK NODE,SENSOR NODE,ENERGY

1. INTRODUCTION

The monitoring of sensor is done for examining the environmental conditions surrounding the nodes of the network. The information gathered is helpful for applications of various fields such as industries, commercials, and public as well as consumer applications. There are various factors to be ensured such as the expansion of security, convenience etc. This helps in arranging the sensors for the utilization of clients. The degrees of profits within the WSNS can be determined by the organizations through various factors such as:

- Reduction of energy utilization
- Security enhancement
- Providing convenience
- Minimizing the cost expenses of labour

Within the useful or wasted resources, a sensor node within these networks can consume the energy.
The reasons due to which useful energy is consumed are:

- Send and receiving the data
- The processing of requests generated
- The data is forwarded to the neighbouring nodes

The reasons due to which the energy consumption is not useful or is wasteful are:

- Continuously hearing the media
- Sending the packets numerous times due to packet collision
- Overhearing

1.1 STRUCTURE OF A WIRELESS SENSOR NODE

The figure below shows the architecture of a sensor node which comprises of:

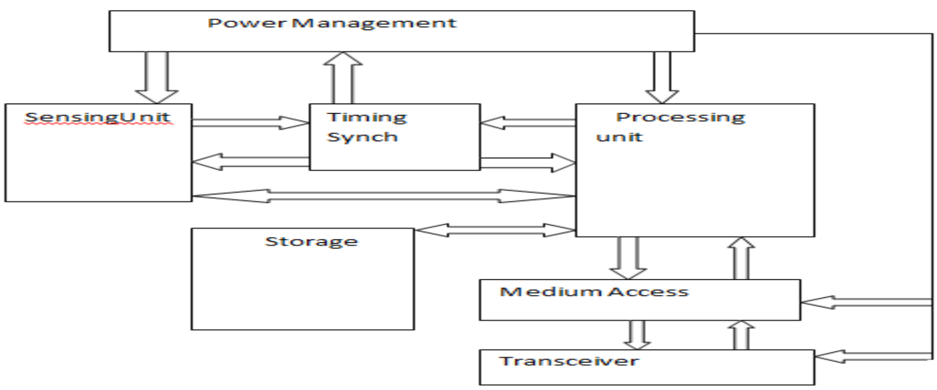

Figure 1.1: Schematic diagram of a sensornode

Power Unit: The power consumption within the sensor nodes is to be managed through this unit. To the maximum limit it can be reduced, it should be done.
Transceiver: Another name for this block is the communication unit as it provides communication channel in which the various ways are utilized for communication. It uses radio, laser, optical or infrared rays for communication .
Processing unit: Along with the storage unit the processing unit works. The sensed data is computed with the help of sensing unit. There is an internal RAM present within the processing unit. The processing unit together manages the communication with the sensor nodes and the working of sensor nodes all. There are other components such as RAM and microcontroller present within it. Various components such as operating system and timer are responsible for storing, processing and executing the events.
Sensing unit: The environmental conditions such as temperature, pressure and many other are sensed with the help of sensing unit. There are collections of signals that produce electrical signals, which help in forming a block. They are further utilized for sensing the surrounding environments. The transformation of various signals is done through the Analog to Digital converter (ADC). It completely depends on the application regarding which type of sensor is to be involved here.
Storage and time synchronization: There are various components such as storage and time synchronization components. A flash memory is present within the sensor devices for storage purposes. For accessing the shared interfaces, a medium access control unit works with the transceiver. There are also many potential external sensing units present along with the battery which helps is providing power to the sensor device. Other components such as antenna help in localizing the sensor within the network.

2. PROBLEM FORMULATION

The wireless sensor node is the part of the microelectronic device in which there is limited energy. It is not possible to replace energy resources all the time as its recharge and replacement procedure is not easy in some application area. Hence, the lifetime of the sensor node is solely dependent on the lifetime of battery. There is chance of network damage increases if the sensor node expires due to limited battery due to which it becomes impossible to collect the data of the particular area such as temperature, humidity etc. Each node in the multi-hop ad hoc sensor network has played the dual role of data creator and data router. There are significant topological changes due to the malfunctioning of a few nodes and it also requires packets rerouting and the network reorganization.

3. RESEARCH METHODOLOGY

In the infinite sensor nodes, the sensor network is deployed initially. In the clusters all the sensor nodes are grouped together. These clusters are formed on the basis of the sensor nodes. A cluster head is present within each cluster and for the selection of these cluster heads an election algorithm is used. The node with more resources and energy is selected within the cluster for cluster head. All these nodes transfer their data to cluster heads after which the data is further forwarded to their destinations by the cluster head. AODV routing protocol discovered the route for transmission and also establish the path between source and destination. The virtual paths mean dynamic paths have been discovered by the AODV routing protocol.
The synchronization of sensor nodes is necessary with cluster head so that packet collision remains minimum in the network. There is a sink available at the network. After that, there are clusters having cluster head and node in it. First of all, the message is send by the one cluster head to the sink. After receiving message sink will minus transmission delay from the message and calculate its current time. At the end, to the same cluster head message is send by the sink. Now again this cluster head will minus transmission delay from the message and calculate its time. Now we have final delay that is transmission delay of sink– transmission delay of cluster head.

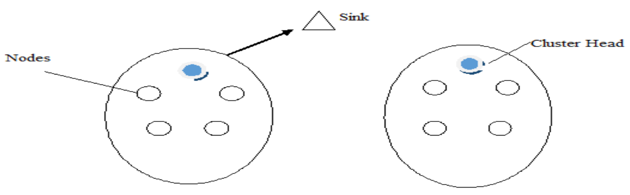

Fig. 3.1 : Cluster head sends message to the sink

Finally, cluster head will set its clock according to the current timing after deductioning delay. This process will continue until all the cluster head gets the similar clock. Same process will be applicable to the clock synchronization between cluster head and node in a cluster. In fig. 3.1, cluster head sends clock message to the sink for synchronization. In fig. 3.2, sink sends message to cluster head. After receiving message from sink cluster head will minus its delay from the message. For the final clock timing cluster head will calculate final delay and deduct it from the timing. The remaining time will the final time for clock setting. All the other nodes also set their clock by sending message to the cluster head first. Cluster head will calculate time by deducting transmission delay and send message back to node. Now node will calculate time by deducting transmission delay from the message. Again calculate final delay and minus it from the current time. The remaining time will be final time and node sets its clock according to it. As illustrated in the figure 4.6, two steps have been taken to synchronize entire network.

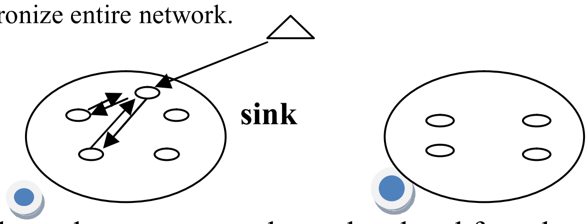

Fig.3.2 Sink sends message to cluster head and for other nodes

The synchronization of cluster head is done in the first step and the sensor nodes will be synchronized within the cluster in the second step. The RTS packets are transferred by the cluster head within the network to all cluster heads in the initial stage. The clocks are represented by the cluster heads when it receives the RTS packets. After which CTS packets to sink is transferred by the cluster head. The clocks are adjusted by the cluster head after sending CTS packets to sink node. On the basis of time it receive the RTS packet from SINK, the clocks are adjusted. The cluster heads when gets synchronized, then cluster head will send PING messages to all the sensor nodes which are in their cluster. After receiving, PING messages sensor nodes will adjust its clocks according to time when it receive PING messages from the cluster heads. The whole network is synchronized in this manner, no packet loss happens, and energy will be less consumed by this.

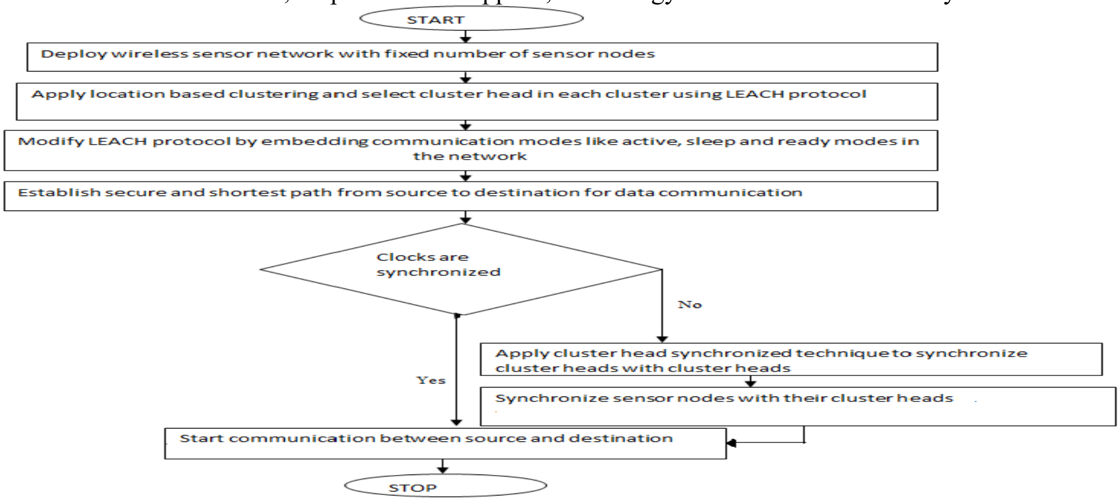

Figure 3.3 : Proposed Work Flowchart

4. SIMULATION RESULTS AND ANALYSIS

The NS2 is the simulator, which provided both type of text based, and animation based simulation. The animation based simulation is shown in the network animator and text based simulation is shown in .tr files. In the NS2 on the backend, C++ is used and on the front end, tcl (tool command language) is used for simulation. The NS2 is the Linux based tool and Ubuntu 12.04 is used as the plate form.

Table 4.1. Simulation Parameters used for the solution implementation

Parameter	**Description**
Channel	Wireless
Number of nodes	100
Area	200*200(m)
Initial Energy	100(joules)
Network Interface Type	Phy/WirelessPhy
Interface Queue type	Droptail/PriQueue
Routing Protocol	AODV
Antenna Type	Omni
Topology	Random

4.1 PROBLEM IMPLEMENTATION:

4.1.1NodeDeployment: The nodesare randomly deployed in the system. Sensor nodes are in finite number. 100 nodes are taken in this system for the simulation. Sensor nodes are capable of sensing the various things.Nodes communicate with each otherandthesinknode and then sink communicates with end users through internet.

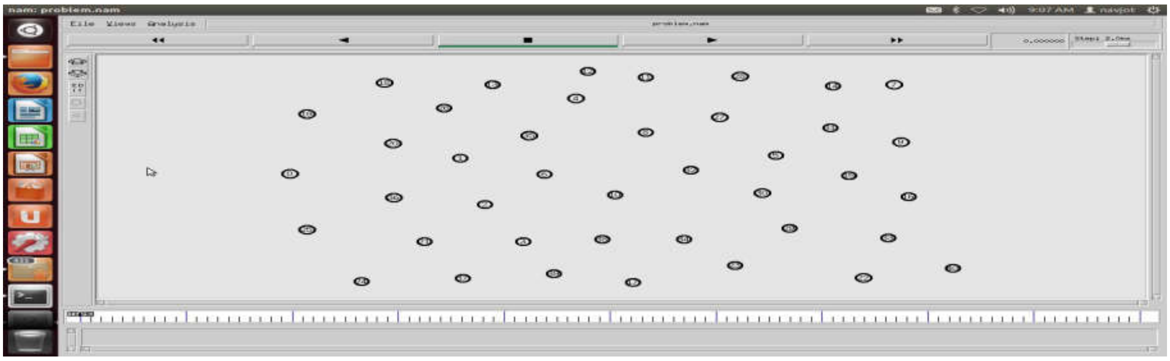

Figure4.1.1:NodeDeployment

4.1.2 Cluster formation: For the cluster formation, nodes exchange their resources with each other or with the neighbors' nodes. For efficient communication, multi – hop communication is preferred in the system. During this process, nodes are elected to become a single cluster.

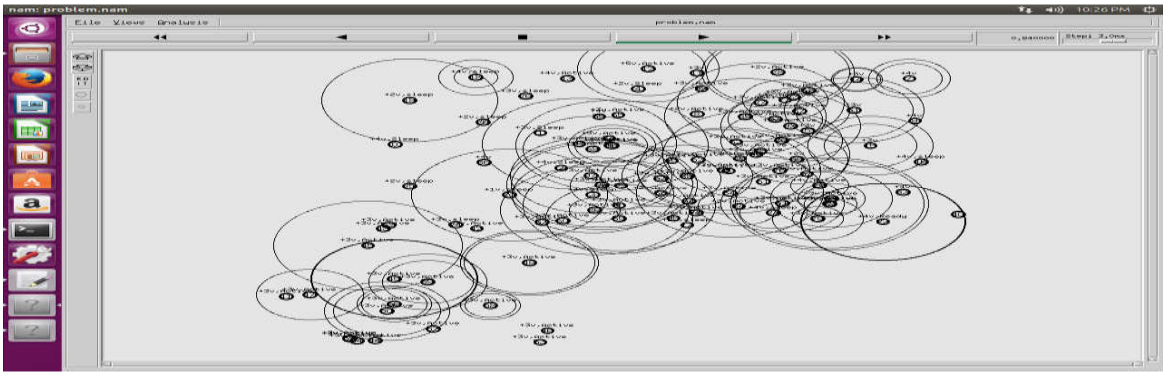

Figure 4.1.2:Clusterformation

4.1.3 SinkDeployment and cluster formation: Cluster formation is done on the sensor nodes. From 100 sensor nodes, 11 clusters are formed which communicate with each other to transmit the information to the base station. Cluster size is fixed in the process. Multi- hop communication is preferred here to minimize the use of energy.

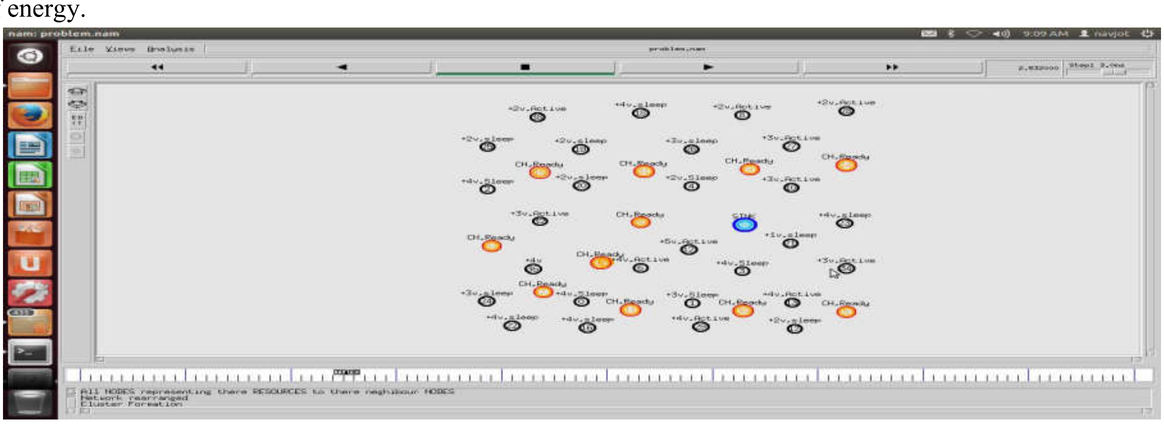

Figure4.1.3:SinkDeployment and cluster formation

4.1.4 Cluster Headselection: Fixed size clusters are formed then in each cluster one cluster head is chose, cluster are head chosen by the LEACH protocol based on the remaining energy on nodes. Nodes represent their resources to the neighboring nodes. Cluster head communicate with each other to transmit the data to the sink node. One sink node is selected based on the highest energy.

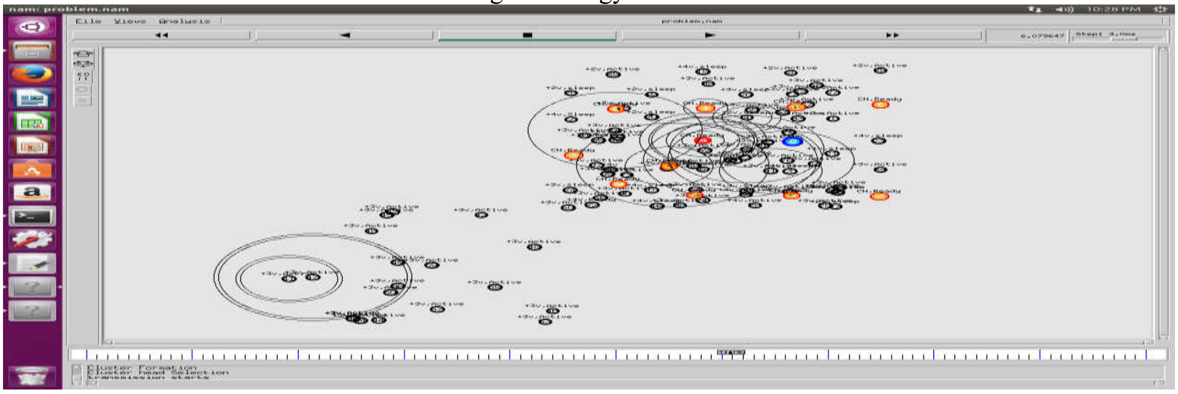

Figure4.1.4:clusterheadselection

4.1.5Intra-clustercommunication startsfrom source: When any node want to sense the channel, then it sense the channel, collect the data and send that data to its cluster head than that cluster head transmit the data to the base station. Source sends the data to cluster head. Further communication is from one cluster head to another cluster head.

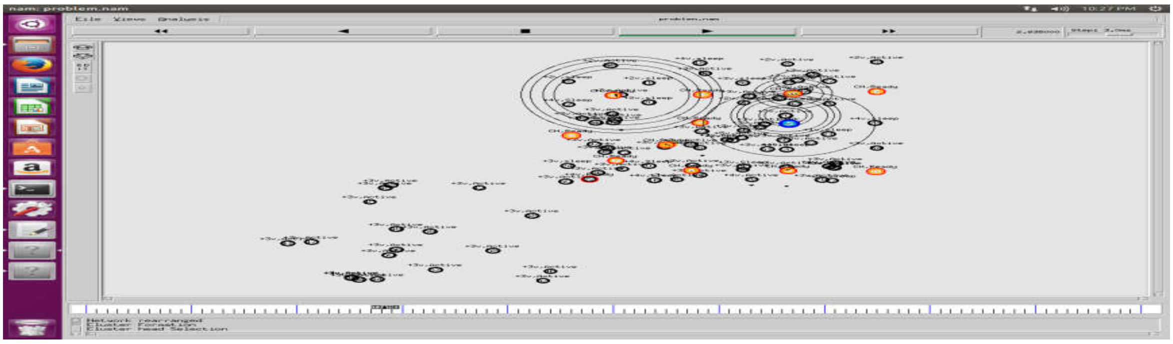

Figure 4.1.5:Intra-clustercommunicationfromsource

4.1.6 Collisionofpackets: As there is a fixed path between the cluster heads for the routing packets that path is find out by the AODV protocol. So this fixed path can create the problem and results in packet loss. Also during transmission if clock of nodes are not matched or synchronized than there will be packet loss in the system. Channel sensing is done here by RFID. It will increase the energy consumption and reduce network lifetime.

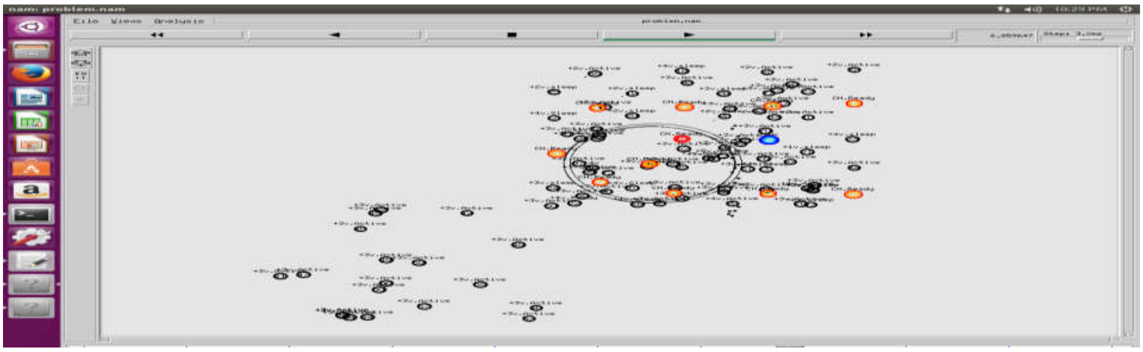

Figure 4.1.6:PacketCollision

4.2 Solution Implementation:

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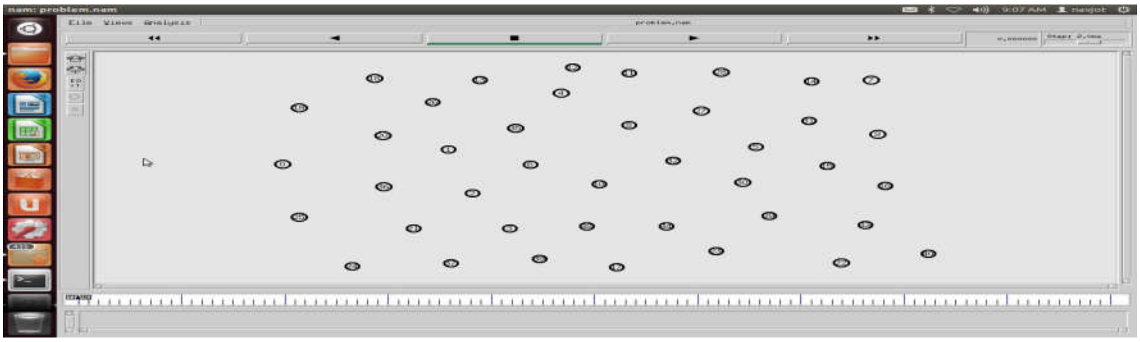


Figure 4.2.1:Networkdeployed

4.2.2 Cluster formation: For the cluster formation, nodes exchange their resources with each other or with the neighbors' nodes. For efficient communication, multi – hop communication is preferred in the system. During this process, nodes are elected to become a single cluster.

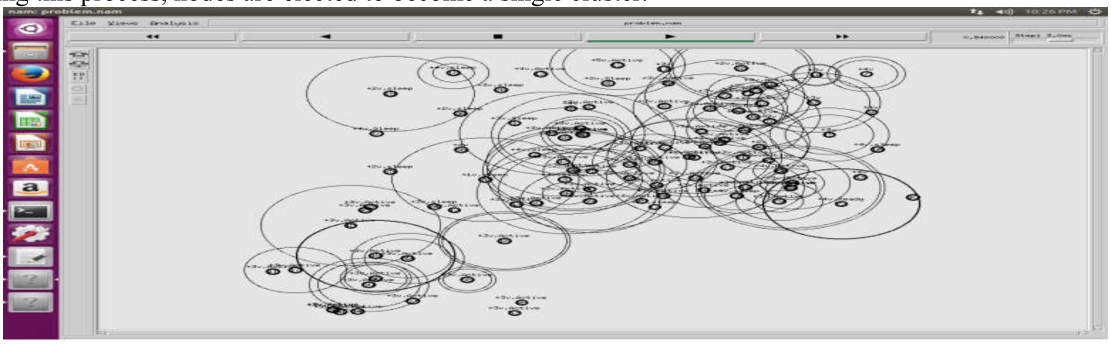
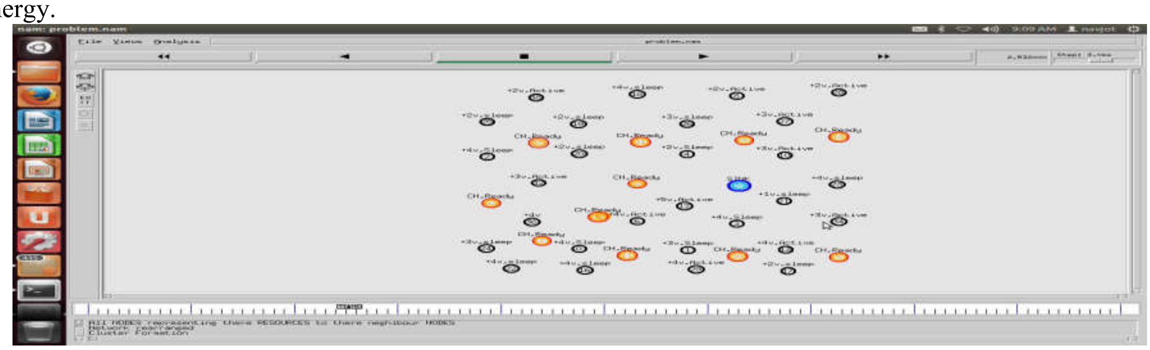


Figure 4.2.2 Electionforcluster

4.2.3 Sinknode and cluster formation: Cluster formation is done on the sensor nodes. From 100 sensor nodes, 11 clusters are formed which communicate with each other to transmit the information to the base station. Cluster size is fixed in the process. Multi- hop communication is preferred here to minimize the use of energy.



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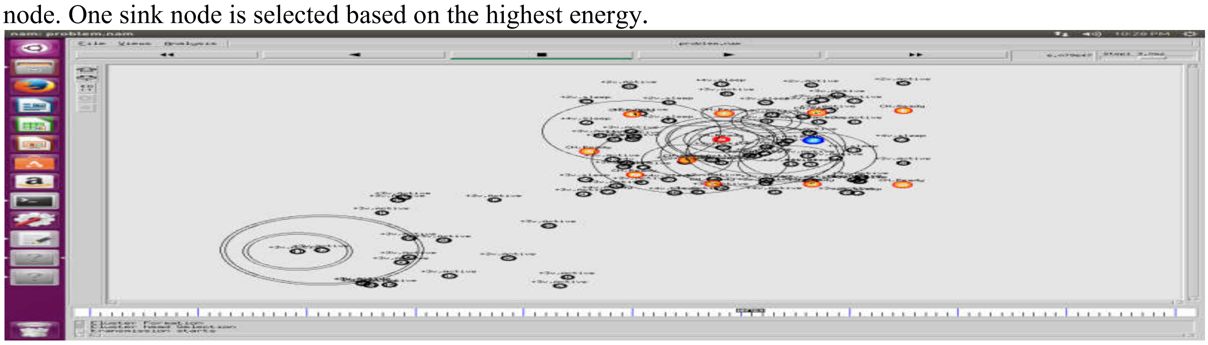

Figure 4.2.4:clusterheadselection

4.2.5Clock Synchronization: All the clocks are synchronized by using a time lay technique in the system so that there will be no mismatch of timings. Firstly cluster heads are synchronized than nodes in the cluster are synchronized.

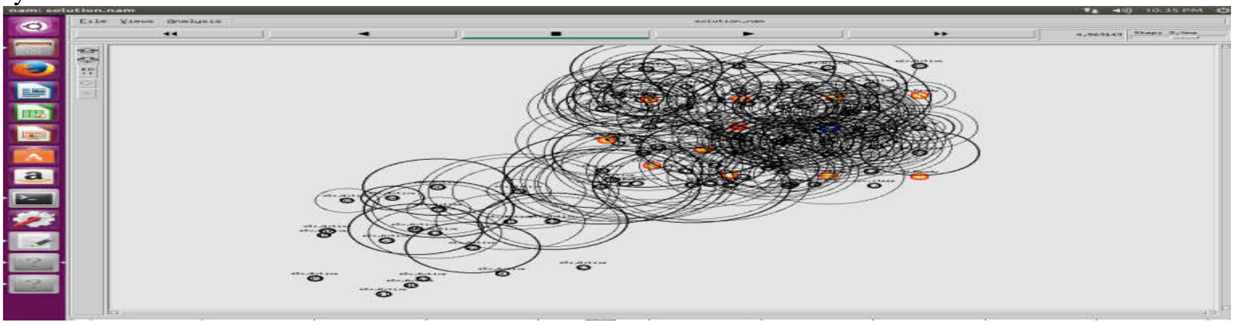

Figure 4.2.5:Clock synchronization

4.2.6PathEstablishment: Thepathisfind out betweensourceandbase station throughclusterheads.AODV routing protocol isusedfor pathestablishment.Source transmitsrouterequestpacketstothe cluster heads. Cluster heads having path to the destination send reply packets to the source.

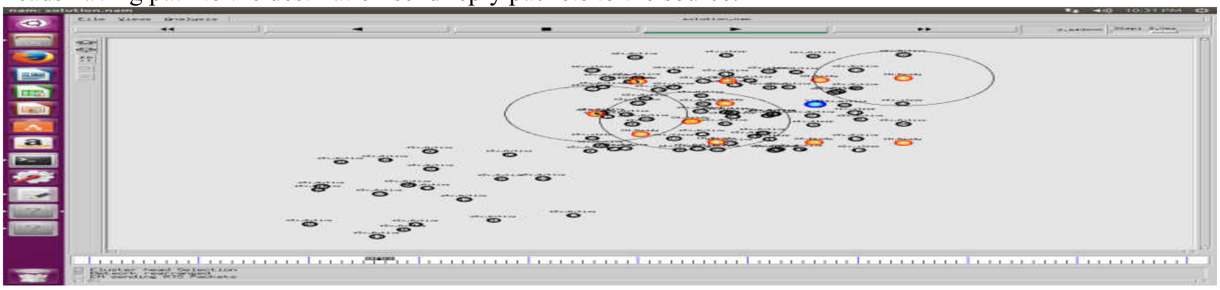

Figure 4.2.6:VirtualPathEstablishment

5. RESULTS

5.1Throughput Graph: Figure 5.1 shows the throughput graph. Comparison between new and previous technique is shown in the figure. Proposed work throughput is shown here by the red line and previous work is shown with the green line. Throughput in the modified work is more as there is synchronization between nodes and no packet loss. Throughput is measured in terms of packet sent per second.

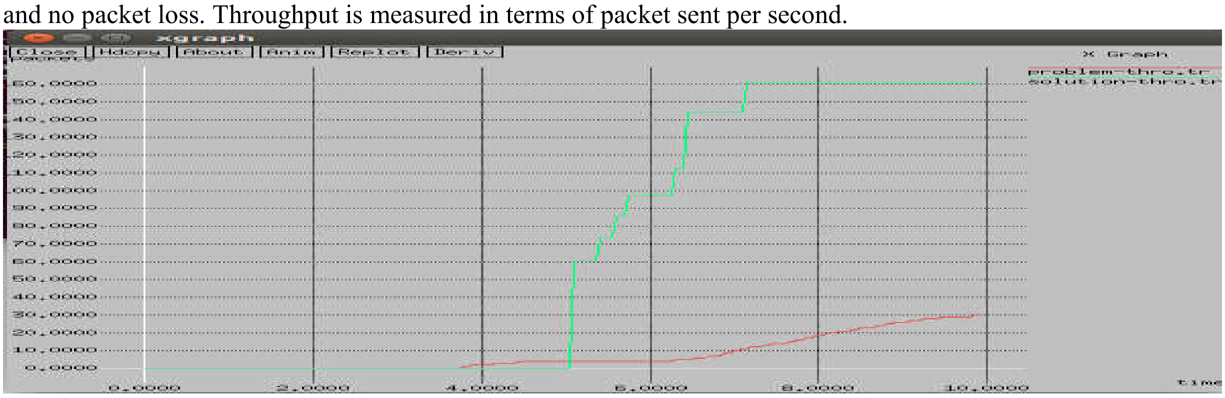

Figure5.1: Comparison based on throughput

5.2 Packet Loss Graph: Figure 5.2 is for the packet loss in the system. Green line is for the packet loss in the proposed work and red line shows the packet loss in the existing technique. Packet loss decreases because in the modified technique, clock synchronization technique is implied which reduces the collision and hence packet loss. Packet loss decrease from 19000 to 4000.

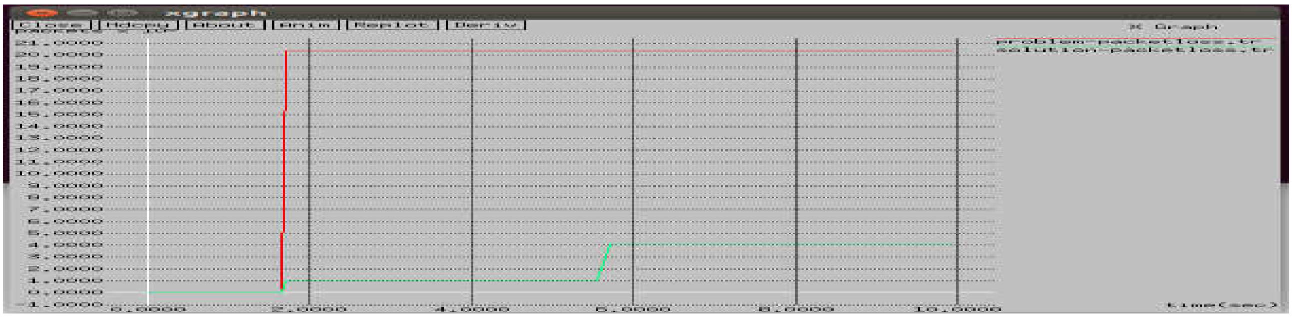

Figure5.2: Comparison based on packet loss

5.3 DelayGraph: Figure 5.5 shows the results in the delay. Green line shows the delay in the proposed work and red line shows the delay in existing method. Delay in proposed work decreases from 525 to 125(approx.). It is because of synchronization.

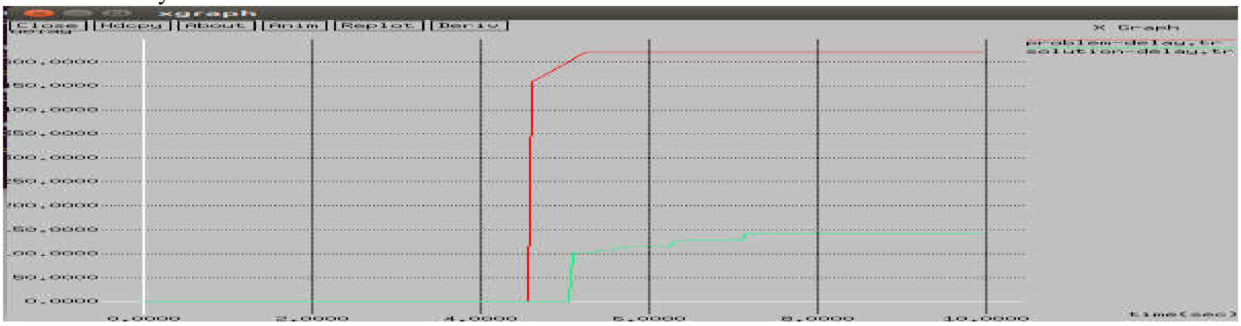

Figure5.3: Delay Graph

5.4 Energy Consumption: Figure 5.4 shows the energy consumption in the system. Red line shows the energy consumption in the existing work and green line shows the energy consumption in the modified or proposed work. The energy consumptioninthe modified method isreduced,because synchronization is donewith time lay technique.

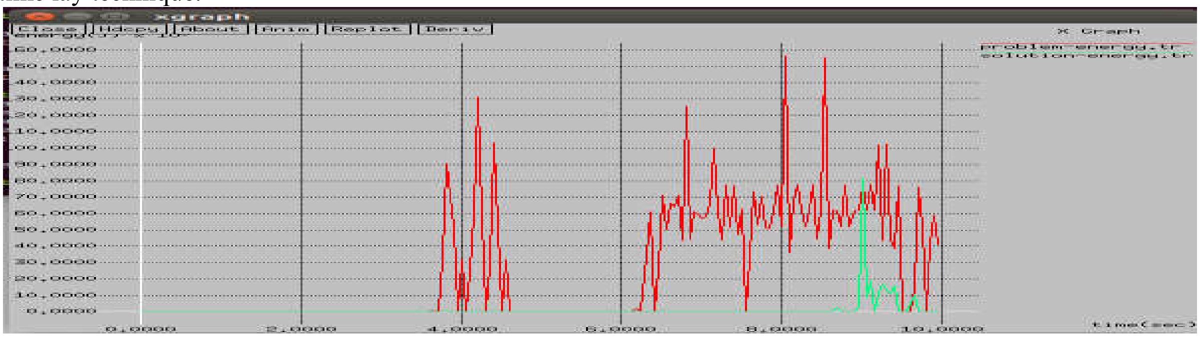

Figure5.4: EnergyConsumption Graph

5.5Overhead: Figure 5. 5shows the overhead results. Green line denotes the overhead in the proposed work which is less as compared to the existing methodology which is due to synchronization between the nodes. Packet loss decreases and hence message overhead.

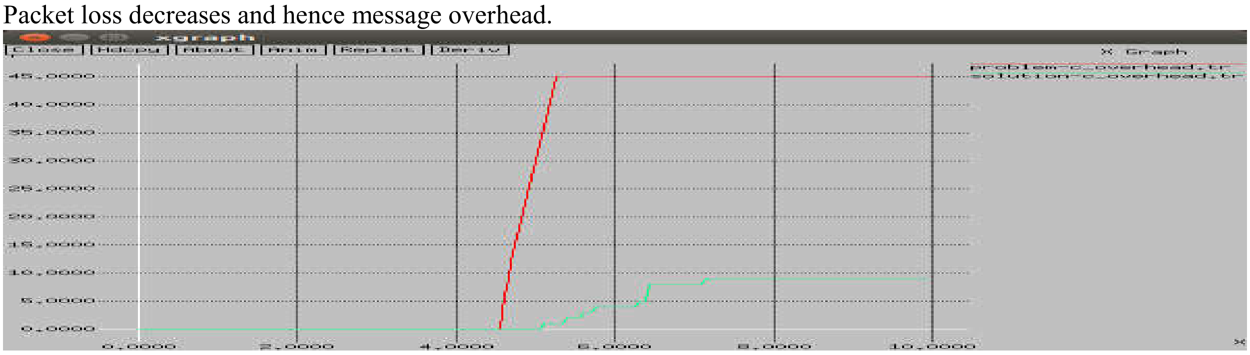

Figure5.5: Overhead Graph

Table 5.5: Table of Comparison

Parameters	Existing Algorithm	Proposed Algorithm
Throughput	30 packets	60 packet
Packetloss	20 packets	4 packets
Delay	150 packets	350 packets
Energy	150 joules	80 joules
Overhead	40 packets	8 packets

As shown in table 5.5, the proposed and existing algorithms are compared in terms of various parameters. In all the parameters, proposed algorithm performs well as compared to existing algorithm

6.Conclusion

Wireless sensor network is collection of many small power devices named as sensor nodes that are randomly deployed in the sensor network at various locations or sometimes at remote locations. Sensor nodes mainly comprises of four main components : sensors, processor , power management unit and transceiver which have the communication ability with the other nodes.These small devices have very low power and sometimes it is not possible to replace the battery of these devices and this will take more energy in processing or sensing the data. It will take more energy in sensing data in the network and then transferring this data to the base station leads to decrease the lifetime of the network. Main issue in the wireless sensor network is of energy consumption and limited battery power.Various methods have been developed till now to save the energy. One is clustering. In clustering, various clusters are formed with the nodes. In each cluster there is a cluster head. Cluster head are chosen based on the distance and residual energy of nodes. LEACH protocol is used for the clustering of nodes.

Then three different modes are applied on the LEACH. These are sleep, active and ready. When a node is sending the request and communicating with sink node or cluster head than it will be in ready mode. If it is only sending the requesting, than waiting for its turn than it is in active mode otherwise, node is in sleep mode

Then there comes a problem in this method. There is weak synchronization between the nodes in the network. Due to which , nodes timing mismatch and packet loss occurs in the system.So, in proposed work, a clock synchronization technique is applied which match the timing of every node with each other. Cluster head match their timings with each other and to the base station. In this way, synchronization achieved.Then, process is implemented in NS2 and results are compared based on the factors such as throughput, packet loss, delay, energy consumption, overhead.Results showed that proposed techniques is better than the existing technique in terms of above given factors. Hence, energy consumption is reduced and network lifetime is increased.

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