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# Target Coverage and Data Collection for lifetime maximization in Wireless Sensor Network

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**ABSTRACT**

To cover target points and collect data are the elementary problems of WSNs. Target covering is required to monitoring the specific events to be happen through select sensors in a given area, that collected data need to send to sink. In many fields the sensors are battery powered and so it is expected for a WSN to work uncared for a long period. Energy consumption is the main parameter which will be used for data collection in WSNs with the objective of maximizing network lifetime. Node based scheduling algorithm has been adopted from classical multihop scheduling algorithm which is developed for general ad hoc network with the idea of scheduling. Further, the practical efficiency of our algorithms is analyzed through simulation.

***Index Terms:*** WSN, Scheduling, Sensors, Node, Energy

## 1. INTRODUCTION

Wireless sensor networks (WSNs) devices that can sense and monitor [2] different physical phenomena such as, humidity, temperature, pressure, ultrasonic, displacement for various applications, like target tracking, infrastructure security, battlefield surveillance, health monitoring, and traffic control.

The deficient in device placement is rewarded by an over sized device population deployed within the zone, which might improve the likelihood of target coverage. The data collected from the sensors is sent to a central node (e.g. cluster head) for processing.

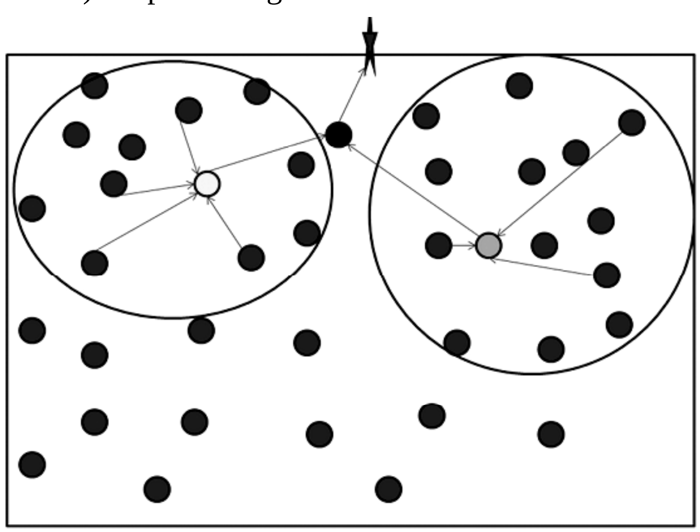

**Figure 1: Network Architecture**

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## 2. RELATED WORK

For the lifetime maximization of the WSN various algorithms are implemented by different authors. Some of them are shown below in Table 1.

**Table 1**
**WSN various Algorithm**

| *Sr. no* | *Author* | *Achievement* | *Remark* |
|---|---|---|---|
| 1 | Zden'dtHanzalek & PetrJur'cik[1] | minimize the energy utilization of the node by setting TDCS period | Scheduling complexity |
| 2 | Chunsheng Zhu , Lei Shu[2] | CLSS schemes(i.e. CLSS1 & CLSS2) for WSN integrated with MCC | Save energy utilization, focuses scalability and robustness of the integrated WSN |
| 3 | Ju-Jang Lee[3] | Proposed rsolution to the ECC difficulty under real number space, which used real facts as location values for the sensors | Express that the ACB-SA can resolve the EEC problem with more practical approach |
| 4 | Yaxiong Zhao, Jie Wu, Feng Li[4] | Present a combined backbone scheduling and duty cycling method called VBS.Used two centralized Imationmation algorithms | Use only local informations so poor quality, transition between backbone is restricted to be local, so sensor node may not be replaced evenly |
| 5 | Begonya Otal, Luis Alonso, Christos Verikoukis[5] | The new distributed Queing body area network (DQBAN) MAC protocol cross – layer fuzzy-rule scheduling algorithm | Guaranteed packet transmissions to particular application dependent QoS |
| 6 | Xi Zhang, Huadong Ma,[6] | Tackled node selection problem by balancing the trade off between the accuracy of target localization and the energy consumption in camera sensor networks | Useful only in camera sensitive area so that much efficient |
| 7 | Pratap Kumar Sahu, Eric Hsiao Kuang Wu[7] | Explore RSSI based localization techniques for sensor networks where the sensor are not equipped with the ranging hardware. | Achives higher location accuracy and higher resilience to environmental factors |

## 3. PRELIMINARIES

### 3.1. Assumption

We developed anatomy of accordant attributes and categorized the altered schemes according to the objectives, the desired group of sensor properties and clustering form process. We highlighted the effect of the network model on the pursued approaches and summarized a number of schemes, stating their strength and limitations.. We highlighted the effect of the network model on the pursued approaches and summarized a number of schemes, stating their strength and limitations. These technologies have produced very effective results, once we deploy these wireless sensor networks for mission critical applications.

In this paper we are using mainly 6 tuples,{P, S, N, F, E, T}

Where

P is, P = {P1, P2, P3, ………… Pn} Set of Target points where sensors are deployed, data collections takes place.

S is the set of state i.e. active,sleep, sniff state,

N is the set of neighbourhood,

F denotes the transition function, which is deterministic function that gives state Si(t + 1) of the i^th cell at the time step(t + 1)as a function of state of the neighborhood Ni at a time t i.e.

Si(t + 1) = f(Sj,Ct):j€Ni).

E = Energy consumption model in that sensing. receiving, computation (compression), transmission (Et),

T is the transmission link from 1 node to another.

By using this 6 tuples processing can be done by Event Monitoring i.e upper and lower bound limits are set, whenever values are lower than lower bound and higher than upper bound then data will be correctly send to the base station without any delay, so it works on the basis of Continuous Time Slot in which data will reported continuously to base station repeatedly.

## 3.2. Terminologies

Energy Setting

### *3.2.1. Energy Calculation*

No. of sensors (n) = 60

Energy required for one sensor.(Si) = P = V * I————1

Controller Board Requires Power = Ci

Ethernet shield = Et

Total Energy = E =.(Et. + Ci. + Si.).*nH

Threshold Value Setting

Activated Sensor nodes(As)

Unactivated Sensor nodes.(Uas)

Ea = nh[Et+Ci+Si(As)]

Euas = nh *Si(uas) ……………..Saved Energy

Battery in general mode

Total power consumption of battery Per day = Bgc.

How many days the battery will work =

Total power of battery /Bgc

Threshold battery calculation

Total Energy Consumption in threshold mode = Bt

Total no.of days the battery will be come = Total power of battery /Bt.

ATLS

Activated sensor in ATLS mode = Ats

Unactivated sensor in ATLS mode = Uats

No. of hours activated the sensor = n.*Ats

$$\text{Total energy required for sensor} = Ats.*n.(Ats) .*Eats \quad (1)$$

ATLS battery calculation

Total energy calculation of ATLS =

$$Eats = .(Et.+ Ci .+ Ats.*Eats.)nh \quad (2)$$

If .(S.>St)

$$Eats = Eats\ 1 + Eats\ 2 + \ldots\ldots.. + Eatsn \quad (3)$$

Eats dx 0 to n

### 3.3. Queing Theory

M/D/1

where

M = arrival rate ($\lambda$)

D = Deterministic Service Time

1 = No.of server

An M/D/1 queue is process whose state is the set {0, 1, 2, 3, ...} where the value corresponds to the number of data packets in the system, including any currently in service in WSN.

$\lambda$ is arrival rate and process move from one sensoer node to another sensor node i.e state i to i + 1.i.e ,

$\lambda 1$ is the data sensed by first node and

$\lambda 2$ is the data send from 1st node to 2nd node like that $\lambda 1+ \lambda 2+ \lambda 3+ \ldots + \lambda n$ upto total no.of nodes in the network.

So the arrival rate in the WSN is

$$\lambda t = \lambda 1 + \lambda 2 + \lambda 3 + \ldots\ldots + \lambda n \tag{4}$$

n = Tota l no.of sensor nodes inthe network.

$$\lambda t = \left(\sum_{i=1}^{n} \lambda i\right) \tag{5}$$

Service times are specific time that are used for that instance D. (serving at rate $\mu$ = 1/D).

In single sever services it operates on only one incoming data packet one at a time , from arrival points of the queue, according to a dynamic multilevel priority served discipline. When the service is complete for any data packets, it removed from the queue and the number of packets in the system reduces by one.Size of buffer is infinite, so there is unlimlited packet it can take.

#### *3.3.1. Delay*

As data packets are transmitted from one node to another node to base station,so that data is coming towords base station by various nodes in the WSN network so that base station will be busy to provide service to currently avialble packets so other incoming packets need to wait until base station finishes current service if incoming packets have same or lowest priority than servicing packet which is decided by DMP algorithm for that particular time slot term $\rho = \lambda/\mu$ as the use;then the mean delay in the system in an M/D/1 queue is

$$\frac{1}{2\mu}.\frac{2-\rho}{1-\rho}. \tag{6}$$

and in the queue:

$$\frac{1}{2\mu}.\frac{\rho}{1-\rho}. \tag{7}$$

## 4. PROPSED NODE BASED SCHEDULING

### 4.1. Working Principle

The proposed scheduling algorithm must provide following requirement.

1. Complete coverage of the network area.
2. The set of the selected active nodes should consume as little power as possible so as to prolong the network lifetime. We consider the following assumptions:

- The set of sensor nodes residing throughout the network area covers the area completely.
- Sensor nodes are aware of their physical locations (using some localization techniques ).
- *N* which is the number of sensor nodes within the area of the network is known by all nodes.

For each node si corresponding with cell i in CA do in parallel .

The probability of selecting each of these actions is initially computed according to

$$P0 = Ni/N$$
$$P1 = 1 - p0 \tag{8}$$

In this equation, *Ni* is a constant which is greater than the minimum number of active nodes required to cover the entire area of the network.

*P0* is selected this way in order to have a suitable initial distribution (in terms of area coverage) of active nodes throughout the network area.

## 4.2. Pseudocode

*Initialize*

*1 Wake up After (Random(0,μ"0))*

*2 Select an action according (4)*

*3 If (the action is á0) then*

*ChangeOperation_Mode/State To(Active)*

*Else /* the action is á1 */*

*ChangeOperation_Mode/State To(ideal)*

*End if*

*4 While(not sensor reaches threshold value)do*

*Send data packets from one one node to another*

*End while*

*5 While(the node isin ideal state)do*

*If(NOT AssuranceToNeighbors)then*

*If(monitored area of the node is covered by neighbors)then*

*ChangeOperation_Mode/State To(sleep)*

*End if*

*End if*

*EndWhile*

*6 If the node is in "sleep"State)then*

*Wakeup after (sleeping time)*

*ChangeOperation_Mode/State To(ideal)*

*End if*

*End while*

*7End for*

## 5. PERFORMANCE ANALAYSIS

$$F(e1, e2, e3, e4......en) = \left(\sum_{i=1}^{n} ei\right)2 / n.\sum_{i=1}^{n} ei2 \quad (9)$$

Active Node Ratio = Number of Active Node/Total Number of Nodes (10)

Transmission range is 40 m each packet is 100B

Channel Capacity = 200kb/s

## 6. PERFORMANCE EVALUTION

Network Size = 100*100

No. Of Nodes = 50 to 100

*Data Transfer Rate*: Amount of data transfer per unit of time is called data transfer rate.

*Battery Lifetime*: Threshold value is set to 30% Battery life should decrease according to kb of file transfereed and time required for transmission ,When battery life come to certain KB it should pop up message that please recharge.

*Energ consumption*: sensing.receiving,computation (compression),transmission(Et), T is the transmission link from 1 node to another.

*Energy Settings*: Every node must show their battery life Battery life should decrease according to kb of file transferred and time required for transmission ,When battery life come to certain KB it should pop up message that please recharge.

## 7. RESULT ANALYSIS AND DISCUSSION

### 7.1. Hetrogeneous Heirachical

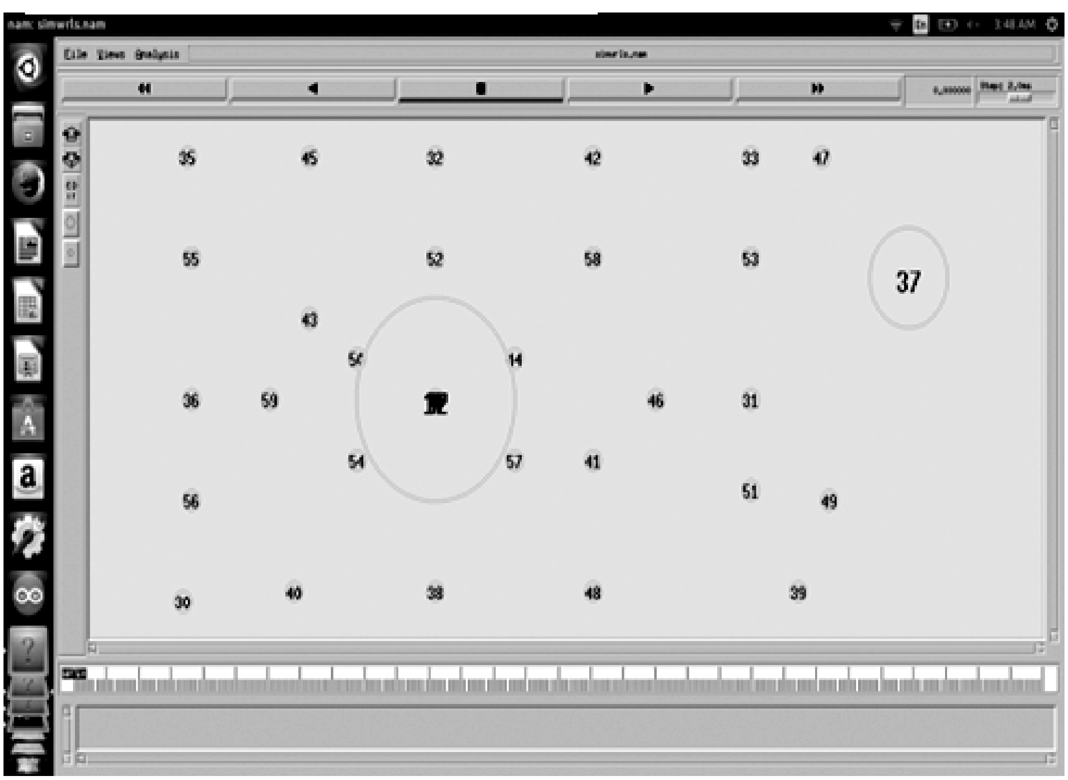


**Figure 2: Hetrogeneous Heirachical**

## 7.2. Sensor deployment

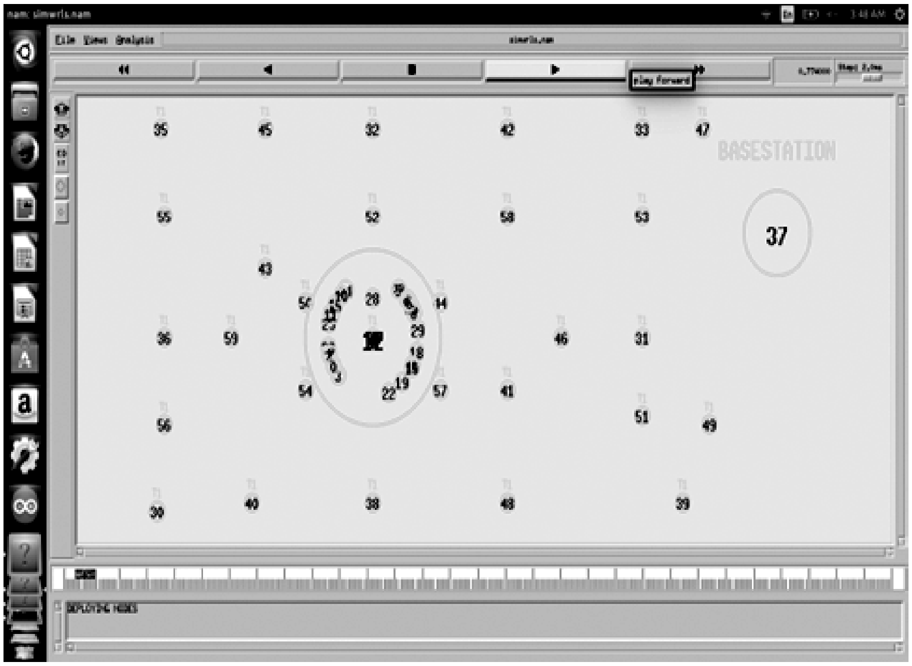


**Figure 3(a): Sensor deployment**

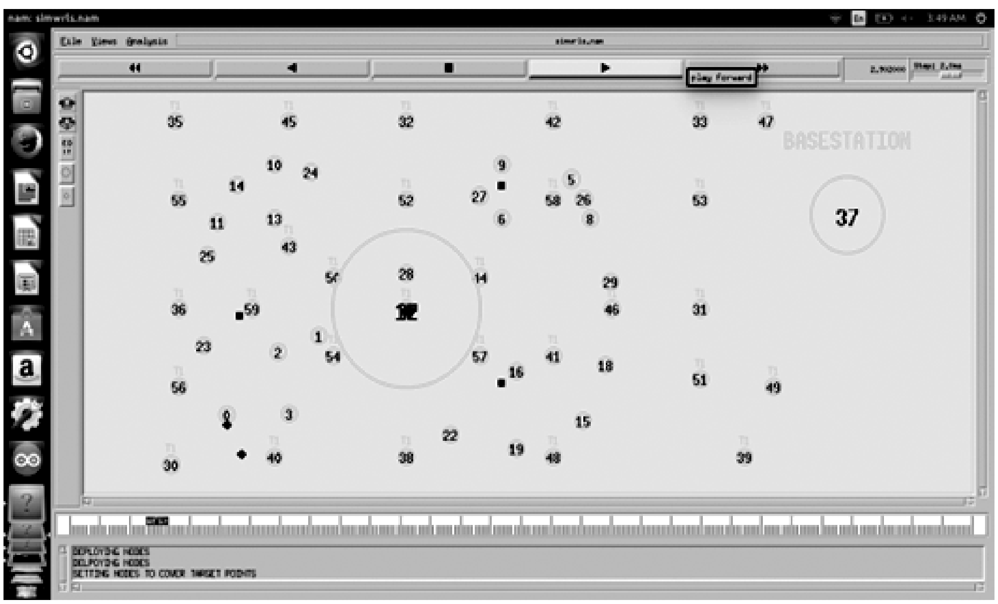


**Figure 3(b): Sensor deployment**

For exact result of each algorithm -to cover target points particular sensors are arranged so two algorithms are used as follows

### *7.2.1. Primal and Dual method*

-by eucledian distance formula calculate the distance between node n target points

1) take no.of target points and sensors
2) divide the total heterogeneous area of network and set target points and calculate the distance between sensor and target points

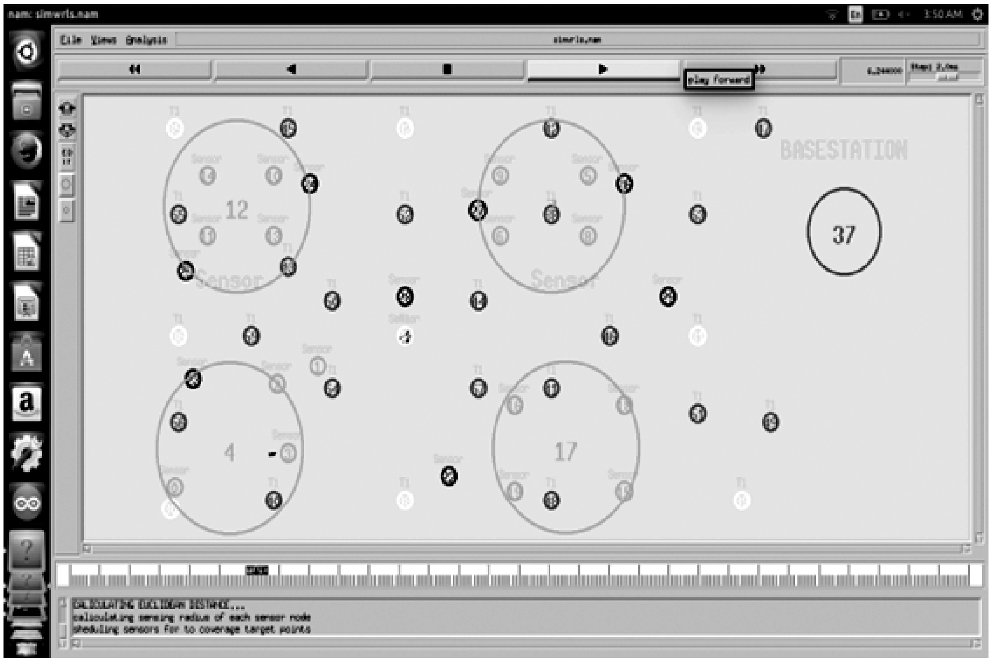


**Figure 4: Primal and Dual method**

3) calculate eucledian distance and monitor how many sensor will require to cover target area
4) So to cover target points sensors will be monitor and compare the distances and sensor which having very less distance that will be covered the target point .

But this method have some limitations

1) sensor cover only one target points
2) so for this large energy consumption as one to one relationship one sensor will used continuously so high node failure.

### *7.2.2. Constant factor approximation*

To overcome the limitation of primal and dual method, constant factor approximation method is used. In this multiple target points cover by single sensor or single target points covered by multiple sensor so it will

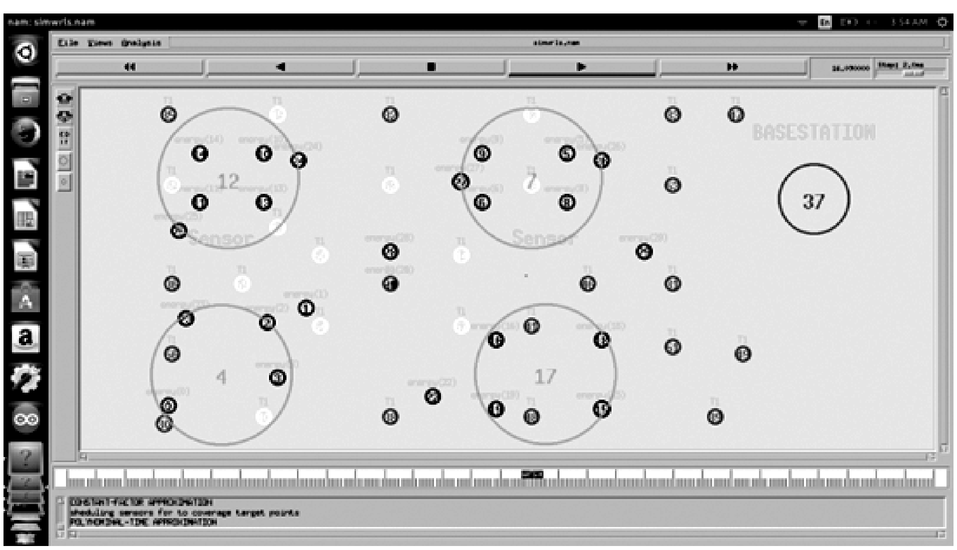


**Figure 5: Constant factor approximation**

cover all heterogeneous network, But this will consume more energy even though multiple sensor can cover multiple target points so network lifetime will be reduced.

### *7.2.3.* Polynomial time approximation

So above two methods will be used for target coverage but high energy consumption raise to network failure so to overcome the limitation, scheduling policy used to reduce energy consumption.

In scheduling rather than using single sensor or multiple sensor only required sensors will be on and others will be off so less energy consumption takes place.

But even though scheduling technique node may gets failure.

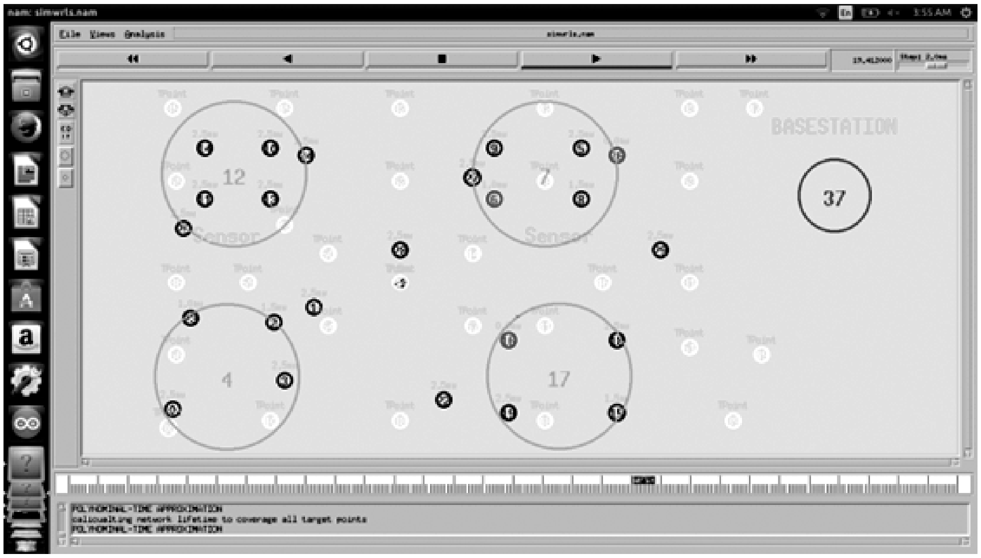


**Figure 6: Polynomial time approximation**

### *7.2.4. CA based node scheduling*

So to overcome the limitation of all the above methods; CA based node scheduling is useful to set energy threshold value of the nodes, so in scheduling when node reaches threshold value of energy level of then node will not be used. So network lifetime increases and node failure will reduced.

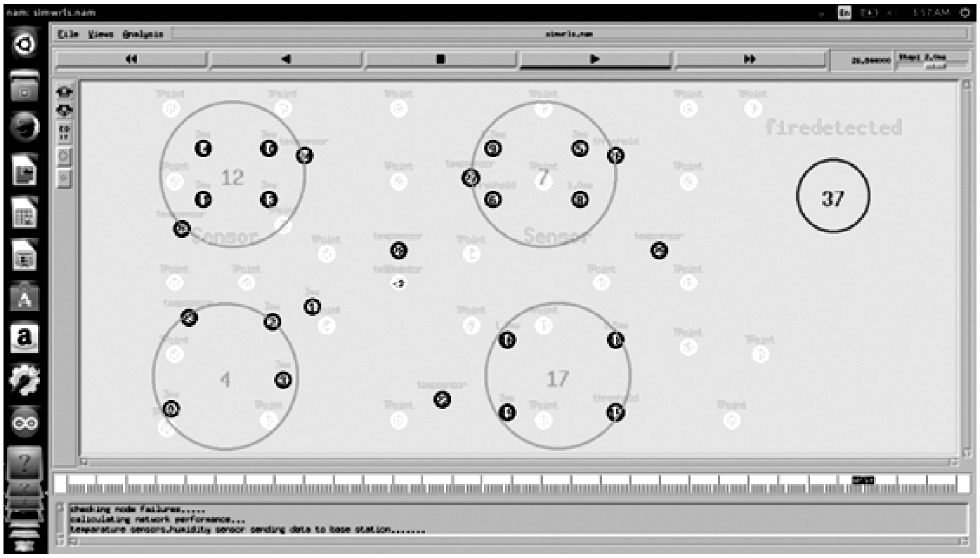


**Figure 7: CA based node scheduling**

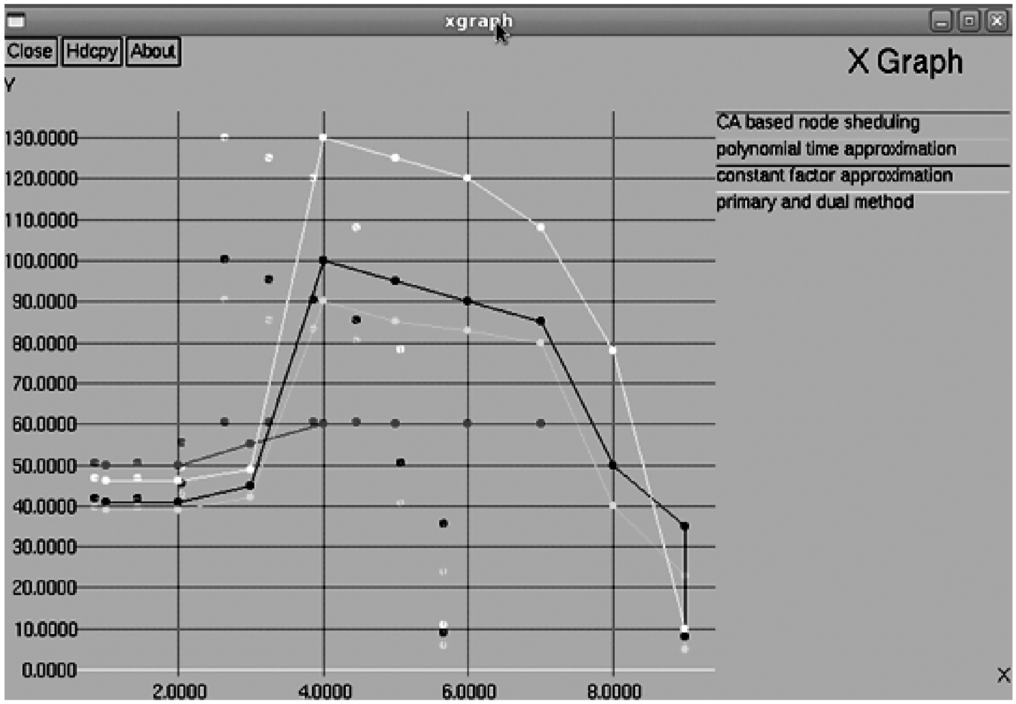


**Figure 8: Comparitive Result**

Fig. 8 shows comparative result of Primal and Dual method, Constant factor approximation, Polynomial time approximation and CA based node scheduling. In CA based node scheduling engery consumption is less and consistent as compare to other methods.

## 8. CONCLUSION AND FUTURE SCHEME

In this paper, we have proposed a WSN for disaster management and for that node scheduling control algorithm is usedfor achieving a balanceamong energysavings while maintaining good coverage qualityfor WSNs.The proposed algorithm is purely distributed; all decisionsby the nodes are performed locally byobserving their environments.Each sensor node interacts directly with its neighbors and reacts to changing dynamics in theirenergy levels and coverage. Result analysis shows less enery consumption and consistentcy in CA based node scheduling and other methods shows unusal energy consumption.

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