International Journal on Recent and Innovation Trends in Computing and Communication ISSN: 2321-8169
Volume: 5 Issue: 6 815 – 822

A Systematic Packet Forwarding Approach for Overlapped Hetero Cooperative Sensor Network

Ranjitha N
Dept. of computer science
Siddaganga institute of technology
Tumkur,India
Ranju.ramya143@gmail.com

Gururaj S P
Dept. of computer science
Siddaganga institute of technology
Tumkur,India
gururajsp@gmail.com

***Abstract*—** Due to the limitation of energy and network lifetime, the routing protocols of wireless sensor network (WSN) must minimize energy consumption and thus extend the network lifetime. Systematic packet forwarding approach is the genuine classical routing protocol in WSN. A heterogeneous characteristics is introduced whileforwarding packet to the next node. During data transmission, we are using cooperative category routing to communicate with the sink node, so that it can utilize energy more effectively and evenly. By analysing the disadvantage of previous routing approach, this paper proposes an improved Systematic packet forwarding approach. The improved routing system can reduce energy consumption and thus prolong the network lifetime. In order to provide energy reduction concept to the improved routing system , this paper introduces energy pool it acts as a mediator for to control overall energy required for communication.

Keywords-*Heterogeneous; Cooperative network; Network lifetime; Wireless sensor network;*

*****

1. INTRODUCTION

In the present century Wireless Sensor Networks (WSNs) are being widely considered one of the most major technologies for many real time applications [1]. Wireless Sensor Networks

Consists of many tiny sensor nodes and these sensor nodes are consists of sensors (temperature, light, humidity, radiation, and more), microprocessor, memory, transceiver, and power supply [2]. These sensor nodes are commonly deployed in a targeted area and communicated through internet and wireless links, which provide opportunities for a variety of civilian and military applications, for example, environmental monitoring, battle field surveillance, and industry process control [1].

Sensors are deployed in a cooperative manner in the area of interest to monitor events and gather data about the environment. They have the ability of sensing, data processing and communicating with each other in the network environment. Multi-hopping in the WSNs can cause a sensor node to communicate with a node with is far away from it. This allows the sensor nodes in the network to expand the monitored area and hence proves its scalability and flexibility property [3]. If the node is not able to communicate with other through direct link, i.e. they are out of coverage area of each other, than the data can be sent to the other node by using the nodes in between them. This property in WSNs is referred as multi-hoping.

Though almost all sensor nodes generate a equal amount of data packets. The nodes nearer to sink transact a more data packets than other nodes presented in the network. That's why nodes which is nearer to the sink completely looses its energy(maximum energy consumption) for data transaction than data generation. Hence, overall network lifetime can be increased by managing the communication load at around sink nodes. This can be called as a energy hole issue and it is the most major issue in sensor networks. So many studies are there for WSNs such as clustering.

WSNs are diffused widely, constructing multiple overlapping networks is more common. Hence, cooperation among sensor networks for to enhance the lifetime of the network. Let each sink of WSNs has been located in different areas, so that loaded nodes also located differently. In this situation, cooperation between multiple WSNs will able to advancement the lifetime of the network of each WSN by load managing the overall sensor network.

In a case, multiple WSNs are constructed at the same area, they performs their applications own or of course independently and they also have their hetero characteristic features. However, now presented studies do not consider this characteristics. For example, if capacity of the battery is different for different networks, in order to cooperate in a beneficial way , need to consider some criteria's, like energy consumption rate, not only remaining battery power. Alternatively, also possible that some WSNs enhance their lifetime but remains shorten their lifetime. So that their applications are also different, data sending time and/or packet size also be different. Hence, for systematic packet routing with cooperation, it is requires to consider the total number of times nodes have to forward the data packet, in spite of attention on each and every packet forwards only. Further, operation start, total number of nodes and/or sensing area of each network are also be different.

In this paper, consider the heterogeneity of sensor networks and proposes a systematic packet forwarding approach with cooperation method, for to avoid ugly improvements in the certain networks. Here introducing one or few shared nodes, so that it can use multiple path channels for to forward data packets. Let, the sink and shared nodes can communicate easily through any WSNs , different WSNs can make use of cooperation routing with each other since shared nodes allow each sensor nodes to communicate data from one to another network. When a node receives a packet, a shared node chooses the path for to send a packet, according to the proposed route selection approach. This cooperation increases the lifetime of each network equally as possible.

2. EXISTING SYSTEM

2.1 Classical approach for longer lifetime

Clustering is most familiarmethod because of its good scalability and the support for data aggregation. Data aggregation merges data packets from multiple sensor nodes into one data packet by eliminating unwanted information. This can eliminates transaction load and the total amount of data. In clustering, the energy load is well managed by dynamic election of cluster heads(CHs). By turning the CH role among all nodes, each node tends to expend the equal amount energy all time. Moreover , with common multihop forwarding, a CH nearer to the sink leads to have higher traffic than other cluster heads. Result implies, nodes around sinks vanishes earlier than other nodes, even in clustered sensor network.

Generally, single WSN has a single sink. The density of traffic increases nearer to the sink, that's why nodes around the sink tends to vanishes earlier. This issue is called energy hole problem. Similarly, in large scale WSN have a large number of sensor nodes, the energy hole problem is more dangerous. So many researchers proposed construction methods of multiple sink networks. In multiple sink WSN, sensor nodes are grouped into a few clusters. Sensor nodes belongs to a cluster are linked to one sink, that belongs to a same cluster. In a single sink WSN, nodes nearer to the sink collects data from almost all the nodes, nodes around each sink transmits smaller amount of data only from nodes belongs to a same cluster. That's why , the communication traffic around sink nodes can be eliminated. However, some problems will be remains as it is , such as optical location of the sink and optical number of sinks.

2.2 Cooperation between multiple WSNs

According to the existing system, most researches thought a single network is deployed by a single department in the sensing area. However, WSN can be utilized more widely, multiple WSNs can lead to deployed in the same area. Let us consider the example, in UK few various networks of cameras by various departments such as police, highway patrol, and local information departments are deployed on the same roads. So that, some researchers proposed the cooperation method of multiple WSNs in this type of situations.

However, multiple WSNs are constructed in close approximately, so that they can help each other by sending data ,all networks involved profitably from merging effort. In potential benefits of cooperation in multiple WSNs are analysed. The researchers organized the system model with objective function and a group of problem constraints. For to solve the optimization problem, linear programming framework can be used. Due to their aim is to investigate the maximum provable sensor network lifetime with various multi domain cooperation criteria, network lifetime is the only objective of the optimization, it can be defined as the time when first node in network looses its battery power and vanishes. The researchers investigated multiple networks with cooperation manner, that are deployed in various locations.

Researchers addressed the cooperation problem using game theoretic framework. WSN has a special character like rational and selfish, it will cooperate one another network, provides services to justify the cooperation concept.

Game theoretic approaches uses virtual cooperation bond(VCB) protocol. Basically VCB is distributed protocol, for to make different networks to cooperate. If and only if all the networks got some profit through cooperation. The researchers solved cooperation problem among different WSNs using cooperative game in game theory. In VCB Protocol, data communication can be used as costs in the rate of energy consumption. If costs tends higher then network payoff becomes lower. A sensor node and another node that belongs to another network sends a data coming from the other side, only if all networks will obtain higher payoffs than null cooperation scenario. The transmission energy can be saved between 20% and 30% using VCB protocol, this will be showed in simulation window.

2.3 Problematic issues

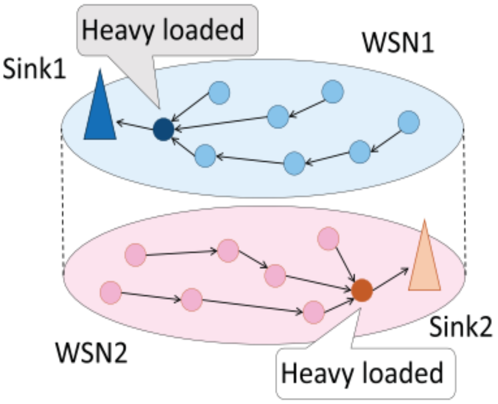
Let multiple WSNs are planted by different departments in the same area. Those WSNs performs various applications independently, so they have heterogeneous characters, such as battery power, operation start time, number of nodes, nodes locations, energy consumption, packet size and/or data transmission timing. Thus, most available cooperation routing does not consider this hetero characters. For example, when capability of batteries on nodes are little unique by a WSN, using cooperative routing based on residual energy is not suitable due to a WSN has the maximum battery power always sends data from other networks. Finally, some networks enhance their network lifetime and some looses their network lifetime.

In such cases, a systematic packet forwarding approach with cooperation manner is highly a important issue.

3.PROPOSED METHOD

3.1 Assumed environment

In this paper, let consider the following environment. In a sensing area, *m*different networks constructed, various applications are performing in each networks independently.



Above figure shows a WSN s are created . if heavy traffic sensor nodes are in various location belongs to WSN s as mentioned in the example ,it is also possible that data can be sent via heavy traffic notes through other nodes in another WSN.

Thus every network adopts various channel ,so nodes are unfortunately unable to communicate with a sensor node belongs to another WSN.

To recover this disadvantage ,qshared nodes , which are big end sensor nodes with multiple channel communication unit ,are planted in the sensor area. Sinks and shared nodes are capable to communicate with any sensor nodes belongs to all WSNs .

Nodes requires their energy by only communication , it is a reasonable assumption in networks through simple sensors . shared nodes and sinks have sufficiently big batteries or power supply . it can also defined as, the WSNs lifetime as the time when a first node depletes its all energy .

Due to heterogeneity , the battery capacity of a node , number of nodes , nodes location , energy consumption by communication , packet size , data transmission timing and operation start time are various by each WSN. Also sensing area is common in all WSNs so need to achieve cooperation in overlapped multiple networks

3.2 System model

In this section , we calculate the overlapped WSNs model for systematic packet forwarding approach with cooperation

In a sensing area , *m*various WSNs N1,…….N*m* are created , and every network N*i* , 1≤ *i*≤*m*, ha a set of unique sensor nodes

$$Ni = \{ ni1\ ni2,\ldots.ni|\ Ni|\ \}$$

Let the sink base station BS*i* . q shared nodes s1,……sq also available in the sensing area .

Every WSNs are capable to utilize these shared nodes as relay node for data rooting .

For guaranteeing , the enhancement of life time by the cooperation , consider network lifetime be L*i*, the estimated lifetime of N*i* , is obtained by below equation

$$Li = \min_{nij \in Ni} Lij\ (1\leq j \leq |\ Ni|\ ) \qquad (1)$$

Lij is the estimated lifetime of node n*ij* here .it can be called as node lifetime . in other side , the calculated lifetime of WSN is a minimum (smaller) a calculated lifetime of its all nodes . every node measures its own details of energy consumption while definite time τ and formulates L*IJ* by make use of it .

Let e*ijt* be the remaining energy of the sensor node *nij*, at time *t* , then , per unit energy consumption can be calculated as

$$\frac{eijt - eij(t+\tau)}{\tau}, \qquad \text{……….(2)}$$

And L*ij* is identified by make use of the equation(3).

$$Lij = eij\ (t+r).\ \frac{\tau}{eijt - eij\ (t+r)} \text{……..(3)}$$

By interchanging L*ij* periodically from neighbour nodes , every node updates L*i*. In addition to this , minimum lifetime L_i^0 , the calculated lifetime here of no cooperation , is estimated by every node . specifically , every WSN performs with no cooperation from time *t*=0 to *t*=0 +τ =τ, and after the duration L_i^0 is formulated equation (4).

$$L_i^0 = eij\tau.\frac{\tau}{eij\,0 - eij\tau} \text{……(4)}$$

L_i^0 is also interchanged and updated from sensor nodes . a shared node sk $(1\leq k \leq q)$, has m routes R_{kl}^i to the base station BS*i* through the network N*l*$(1\leq l \leq m)$. that's why sk selects one of the *m* paths when sk receives a data from the sensor network N*i* .if $i \neq l$, *Ni* gains the energy source from N*l*

Thus , it can also define root lifetime LR_{kl}^l has the calculated lifetime of the route R_{kl}^l. The perfect definition is as follows

$$L\,R_{kl}^l = \min_{nij \in R_{kl}^l}\ Lij \qquad \text{…….(5)}$$

Equation (5) means that LR_{kl}^l is the smaller lifetime among the sensor nodes being contained in route R_{kl}^l.

 ISSN: 2321-8169
815 – 822

3.3 Route discovery

Every sensor node constructs its own routing table based on its routing protocol . in this paper , ad hoc on demand distance vector (AODV)is used as a routing protocol , due to AODV was invented for wireless networks and was adopted for some certain WSN protocol like zigbee and ANT .in route finding , every node finds its route not only for its own sinks in WSN but also different sinks belongs to different WSNs for opportunities to send data from sensor nodes in various WSNs to their own sink ..that s why ,the routing table of every node has m routes corresponding to all sink in all WSNs .

A shared node finds its own route with a little different mechanism . a shared node constructs m routes through m different WSNs to sink .There are m sinks ,in total ,corresponding to m WSNs. .that's why , a shared node has $m \times m$ routes .

In AODV protocol selects a route that has less number of hops to the sink . thus , the proposed method does not mind about the number of hops but in terms of cost in calculated by simple accumulation , so that large number of routes are established through shared nodes . this is because various WSNs used only shared nodes as alter routes . specifically , set 1 as the general cost from all over the sensor node and we set x (0<x<1) as the cost follows through a shared node . if every node finds a route , its selects a route in such a way that minimum cost estimated as the total traversing sensor nodes. in addition to that, it has a merit like Proposed route discovery uses shared nodes , which have perfectly large batteries or power supply ,is expected to eliminates maximally power consumption of other sensor nodes .

3.4 Gaining Lifetime Information

For cooperation routing , it considers systematic approach among different WSNs , shared node sk maintains calculated lifetime information , network lifetime Li , minimum lifetime L_i^0 and route lifetime L R_{kl}^{l}. Gaining these information is as follows .

At the period of sending a data packet , sensor node nij adds the values of its network lifetime Li and route lifetimeL R_{kl}^{l} to the MAC frame header of the packet .if the sensor node does not have any related information on network lifetime or route lifetime yet , for example at the time immediately after constructing or updating the path , its own node lifetime Lij is summed alternatively . every sensor node updates these information by waiting for packets from other sensor nodes . specifically , if node nij waits for a data packet , it compares cost of the network lifetime in the data packet and Li in its own information and update its own Li to the minimum value between them .however , if the data packet from node which have R_{ji}^{i} , the path from nij to base station , it verifies the value of route lifetime at the place of packet header , and updates its value by as small as possible in the case of updating Li. After that , the over hearing sensornode quit the packet immediately if it is not a destination node . network lifetime for the time 0 to τ is identified as a minimum lifetime L_i^0 . to calculate this value , every sensor node update its minimum lifetime with the value of network lifetime on an over heard data packet , from the period τ to 2τ figure 2 shows the mechanism for to gain lifetime information .

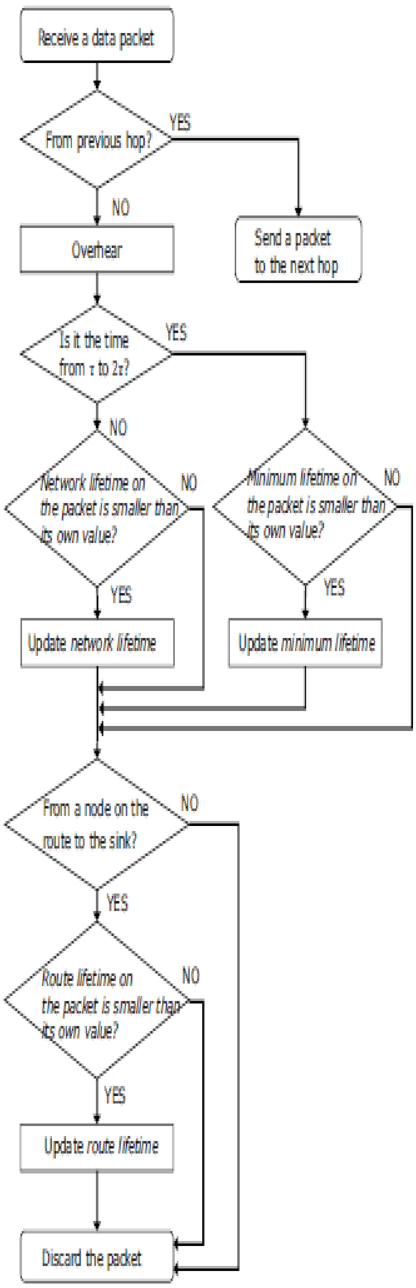


Fig 2. Gaining lifetime info

ISSN: 2321-8169
815 – 822

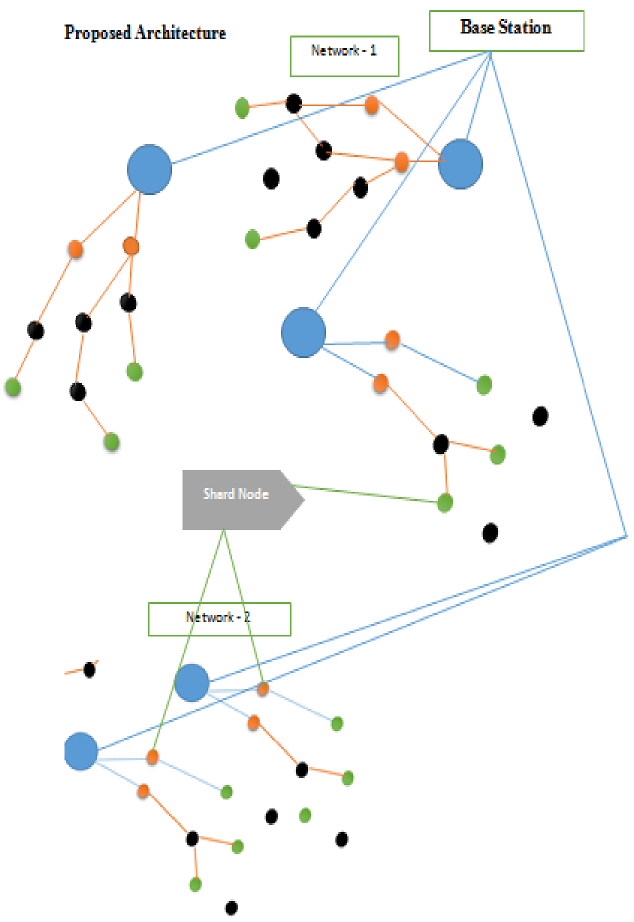


Fig 3. Cooperative routing with a shared node concept

3.5 Cooperative data forwarding

Hence , a node has a single route for to forward data to a sink in its WSN ,it sends a packet immediately to the next node on the route .on the other side , a shared node sk has *m* routes for the sink through *m* network , that's why it can selects appropriate path for data sending .

Thus, the lifetime of network depends on the lifetime of the nodes which have energy bottleneck in the WSN , using cooperative data forwarding through alternate nodes belongs to another WSN instead of nodes which have energy bottleneck is expected to advanced the lifetime of the WSN .let us consider the example described in the below figure3. here the nodes of WSN 2 between the shared node and the sink belongs to WSN 1can send data to same sink using alternative routes through another WSN . however , if the alter sensor nodes are also suffering from bottleneck from their WSN ,then lifetime should be a shortened .to overcome this result , a shared node is capable is select the alternate route if and only if alternate are not suffering from bottleneck . this meant that ,condition for to forward the packet from shared node sk to the sink base station in WSN through route lifetime of WSN available in the network can be calculated as follows.

$L\,R_{kl}^{l} > L_l^0$ .... (6)

Using above condition , lifetime discretion of every WSN by sending data from other WSNs can be minimized , and it guarantees the improvement in lifetime .

A shared nodes has various routes to the sink ,but an algorithm to chooses an approximate route is required . proposing a systematic packet forwarding approach with cooperation manner have 2 route selection algorithms . the first one is pool based route selection . here using cooperative forwarding , shared nodes maintains the energy pool ,the summation of overall energy consumption used by cooperative routing continuously. When a sensor node n*lj*belongs to the network N*l* sends a data packet from another network N*u*, this implies that energy pool at N*l* increases and at N*u* decreases. Choosing a route is totally based on the energy pool value, using cooperation manner energy consumption can be noticeably decreases in heterogeneous environment. Also, this method is capable to manage the energy consumption by cooperation manner even though if every WSN starts to perform from various time.

If a shared node sk retrieves a data packet , if and only if it has multiple available paths to the sink, also it initially compares the energy pool value P*l* in every network, after that it chooses the path in such a way that it has minimum pool value P. Let consider R_{kv}^{i} indicates selected path from shared node sk to the sink base station through the network N*v*. P*v* is the value of energy pool belongs to the network N*v*. If R_{kv}^{i}belongs to the network is increased and also P*i*, the energy pool of the network N*i*(source node) is decreased. The density of increase and decrease ΔP is the energy consumption by data sending from shared node sk to the base station.

It is calculated by equation 7

i.e.. $\Delta P = hR_{kv}^{i}(Erv + Etv)$ ....(7)

Above equation contains the parameters like Hop count on R_{kv}^{i},Reception energy, and Transmission energy.

Below figure (4) shows a flowchart of pool based route selection at time when sk receives data from network Na.

ISSN: 2321-8169
815 – 822

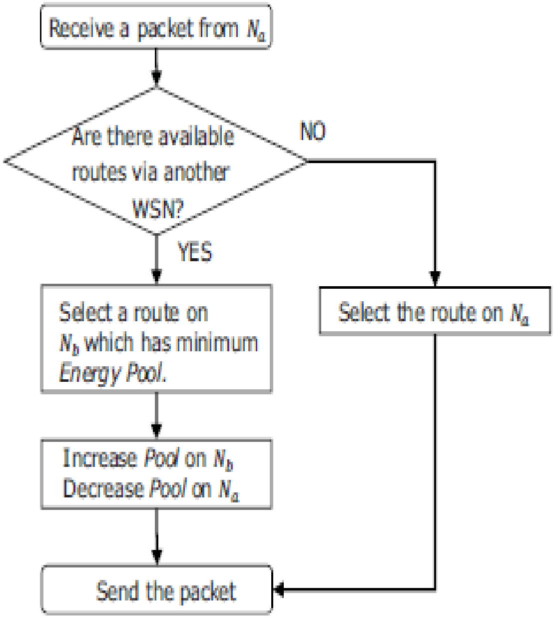


Fig 4. Pool based route selection

Similarly other one is named as the *life based* route selection, this chooses route in such a way that route which has maximum network lifetime. If consider a energy pool based route selection procedure, it gives attention towards the nodes remaining energy. But here, life based is focusing on traffic loads by calculating the route lifetime. That's why, the heavily loaded nodes manages their loads to other network nodes and it emerges to a longer lifetime. Below figure(5) shows the flowchart of life based route selection at time when sk receives data from network Na.

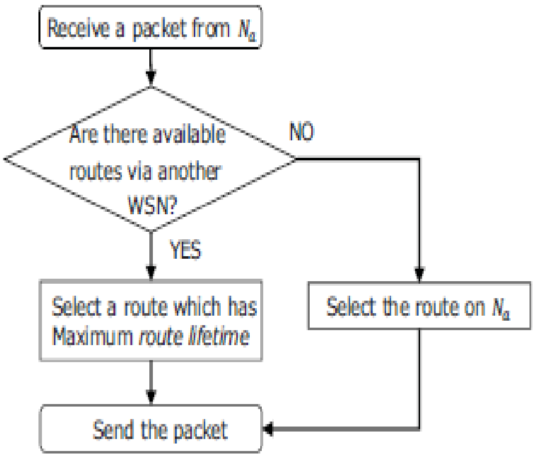


Fig 5 Life based route selection

4 Simulation Resultsand Analysis

The proposed project is implemented in ns-2 simulator.

In our scenario, we are comparing the existing routing algorithm with the proposed systematic packet forwarding approach in cooperation overlapped network in heterogeneous environment.

Here receiving rate means the rate of sensor nodes that send data packets to their base station successfully. So that a single node can not communicate with its base station as a dead node, instead of remaining battery power. 1 is the maximum receiving value.

In this simulation model,

- Simulated 4 WSNs, such as WSN1,WSN2,WSN3,and WSN4.
- Every WSN has 49 sensor nodes based on randomness.
- Dimension of sensing field is 490m ×490m square.
- PHY mode = IEEE802.11b, data rate is 2mbps.
- Radio transmission range is 150m.
- Each sink located @ each corner of the network.
- Shared node will be @ centre.
- Each node sends 512 bytes data asynchronously every 10 seconds.
- Assumed that sink and shared nodes had large battery with unlimited capacities

In this scenario, we are comparing the proposed algorithm with AODV protocol and DSR via some performance metrics.

a. Throughput:
   It can be defined as the total number of delivered data packets to the total time required for simulation.

The comparison throughput results of the proposed algorithm with AODV protocol and DSR reveals that the throughput of proposed systematic routing protocol is more than existed one.

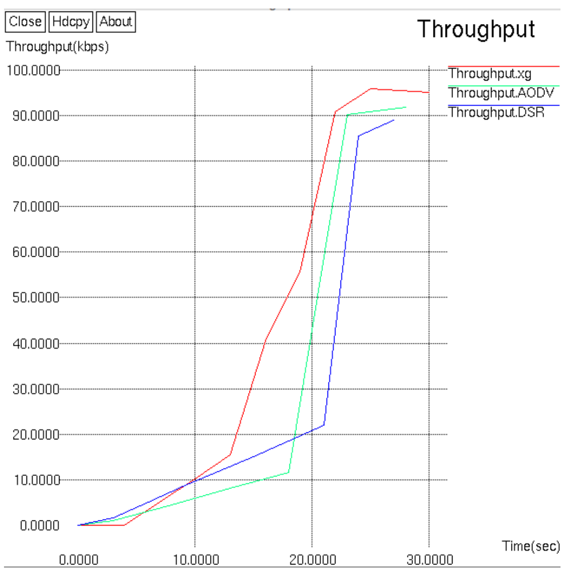


Fig 6 Throughput

ISSN: 2321-8169
815 – 822

b. Packet Delivery Ratio (PDR):

It's a ratio between total number of packets received at destination to the total number of packets sent by the source.

The comparison PDR results of the proposed algorithm with AODV protocol and DSR reveals that proposed systematic routing protocol is better than existing one.

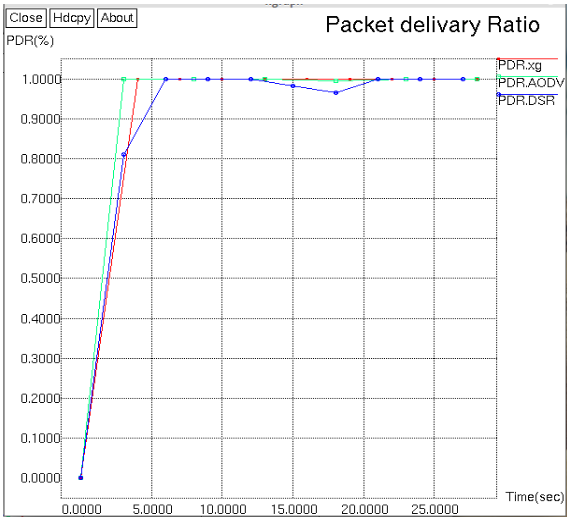


Fig 7 packet delivery ratio

Packet Retrieval:

It is a success rate of receiving a data packet at the destination node. That is number of successfully received data packets among total number of packets sent.

The comparison throughput results of the proposed algorithm with AODV protocol and DSR reveals that the success rate is more for proposed routing protocol compared to existed one.

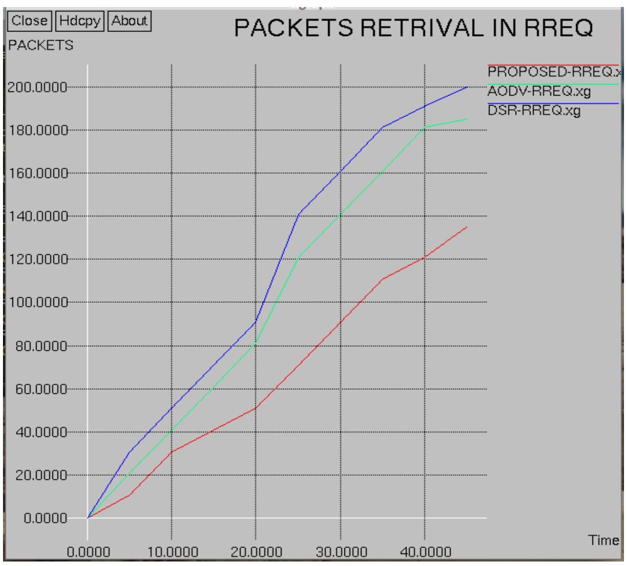


Fig 8 Packets retrieval

c. Packet Drops:

Source sends data packets to the destination node via communication channel, in between many problems may arises like energy hole, bottleneck etc. Due to this, data packets may be wasted like drops. So that required information can retrieved at the destination because of packet drops.

The comparison packet drops results of the proposed algorithm with AODV protocol and DSR reveals that the proposed routing protocol has less packet drops compared to others.

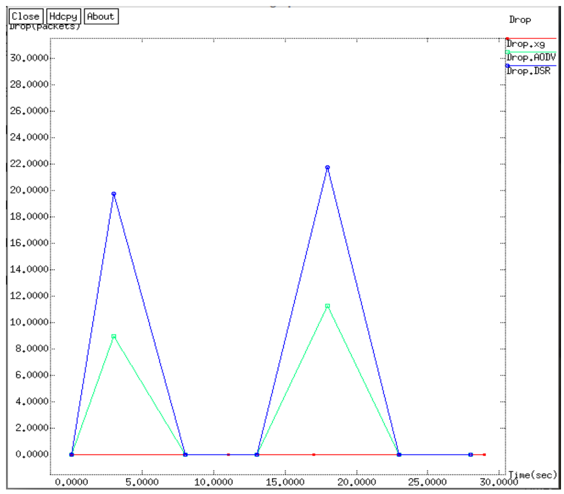


Fig 9 Packet drops

d. Average Energy Consumption:

The comparison average energy consumption results of the proposed algorithm with AODV protocol and DSR reveals that the proposed routing protocol is less compared to others.

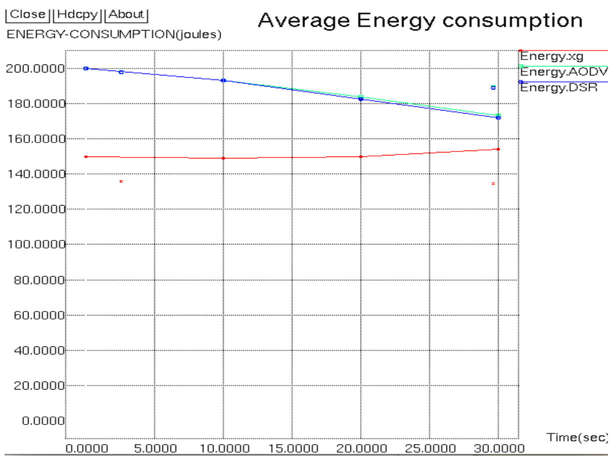


Fig 10 Average Energy Consumption

ISSN: 2321-8169
815 – 822

5. CONCLUSION

In this proposed routing system, here mainly gives attention towards heterogeneous characteristics for overlapped networks, built at common area. At this stage, expecting their lifetime has to be improved through cooperation manner in multiple sensor networks. Till up to existing system, they never consider heterogeneity in every network, systematic approach in terms of improvement in lifetime is needed. Proposed systematic packet forwarding approach for cooperative routing method via shared nodes, with aim is to achieve a noticeable improvement in lifetime in hetero overlapped sensor networks.

References

[1] J.Yick,B.Mukherjee and D.Goshal, ”WSN survey and Computer Networks” in international journal of WSN, 52, pp, 2292-2230, April 2008.

[2] L.Akyildiz, W.Su, Y.Sankarasubramaniam and E.Cayirci,” A survey on sensor networks” published in IEEE communication magazine, Vol.40, No.8, pp. 102-114,Aug 2002.

[3] I.Dietrich and F.Dressler,”On the lifetime on WSN”, in ACM Transactions on sensor networks, Vol.5, No.1, Article 5,Feb 2009.

[4] M.Perillo, Z.Cheng and W.Heinzelman, “On the problem of unbalanced load distribution in WSN”, in IEEE workshop on Ad Hoc sensor networks,pp.74-79, Dec 2004.

[5] J.Li and P.Mohapatra, “ Analytical modelling and mitigation techniques for the energy hole problem in sensor networks”, published in pervasive and mobile computing, Vol.3, issue 3, pp.233-254,June 2007.

[6] X.Wu,G.Chen and S.Das, “Avoiding energy holes in WSN with nonuniform node distribution”, in IEEE transactions,Vol.19, No.5, pp.710-720, May 2008.

[7] A.A.Abbasi and M.Younis,”A survey on clustering algorithms for WSN”, published in computer communications,Vol.30, No.14, 14-15, pp.2826-2841,Jul 2007.

[8] L.Buttyan, T.Holczer, P.Schaffer, ”Spontaneous cooperation in multi domain sensor networks”, proceeded at European workshop on security and privacy in Ad Hoc networks, July 2005.

[9] E.Poorter, B.Latre, I.Moerman and P.Demeester,”Symbolic networks: towards a new level of cooperation between wireless networks”, in Int. J. of wireless personal communications, pp.479-495,June 2008.

[10] J.Steffan, L.Fiege, M.Cilia and A.Buchmann,”Towards multi purpose WSN”, in Int. J. on sensor networks, June 2005.

[11] K.Bicaki and B.Tavli,”Prolonging network lifetime with multi domain cooperation strategies in WSN”, in Ad Hoc networks, Vol.8, issue 6, pp.582-596,August 2010.

[12] K.Bicakci, I.Ethem Bagcib, B.Tavli,Z.Palac,”Neighbour sensor networks: increasing lifetime and eliminating partitioning through cooperation”, in computer standards and interfaces, Vol.35, issue 4, pp.396-402, June 2013.