Improving Performance of Wireless Sensor Networks using Priority based Load Balanced Clustering Dual Data Uploading

V.ChandrashekharRao[1], Mr.Y.V.S. Durga Prasad[2], Mr.S.Karunakar Reddy[3], Mrs. P. Kavitha[4]

[1]PG Scholar, Department of ECE (DECS), ACE Engineering College, Ankushapur
[2]Assoc. Professor, Department of ECE, ACE Engineering College, Ankushapur
[3]Assoc. Professor, Department of ECE, ACE Engineering College, Ankushapur
[4]Assoc. Professor, Department of ECE, CVR College of Engineering, Vastunagar

***Abstract* -** In this paper, a three-layer framework is planned for mobile knowledge assortment in wireless detector networks, which has the sensor detector layer, cluster headlayer, and mobile collector (called SenCar) layer. The framework employs distributed load balanced clustering and twin knowledge uploading, that is stated as LBC-DDU. The target is to realize sensible measurability, long network lifetime and low knowledge assortment latency. At the sensor detector layer, a distributed load balanced cluster (LBC) formula is planned for sensors to self-organize themselves into clusters. In distinction to existing cluster strategies, our theme generates multiple cluster heads in every cluster to balance the work load and facilitate twin knowledge uploading. At the cluster head layer, the inter-cluster transmission vary is rigorously chosen to ensure the property among the clusters. Multiple cluster heads inside a cluster cooperate with one another to perform energy-saving inter-cluster communications. Through inter-cluster transmissions, cluster head information is forwarded to SenCar for its moving mechanical phenomenon designing. At the mobile collector layer, SenCar is provided with 2 antennas that permits 2 cluster heads to at the same time transfer knowledge to SenCar in whenever by utilizing multi-user multiple-input and multiple-output (MU-MIMO) technique. The mechanical phenomenon designing for SenCar is optimized to completely utilize twin knowledge uploading capability by Properly choosing polling points in every cluster. By visiting every selected polling purpose, SenCar will with efficiency gather knowledge from cluster heads and transport the knowledge the info the information to the static data sink. In depth simulations area unit conducted to gauge the effectiveness of the planned LBC-DDU theme. The results show that once every cluster has at the most 2 cluster heads, LBC-DDU achieves over 50 % energy saving per node and 60 % energy saving on cluster heads comparison with knowledge assortment through multi-hop relay to the static knowledge sink, and 20 % shorter knowledge assortment time compared to ancient mobile knowledge gathering.

Keywords - *Wireless sensor networks (WSNs), data collection, load balanced clustering, dual data uploading, multi-user multiple-input and multiple-output (MU-MIMO), mobility control, polling point.*

I. INTRODUCTION

The proliferation of the implementation for low-priced, low-power, multifunctional sensors has created wireless sensor networks (WSNs) a distinguished knowledge assortment paradigm for extracting native measures of interests [1], [2]. In such applications, sensors are usually densely deployed and at random scattered over a sensing field and left unattended after being deployed, that makes it troublesome to recharge or replace their batteries. When sensors type into autonomous organizations, those sensors close to the information sink typically consume their batteries energy quicker than others due to a lot of relaying traffic. Once sensors round the knowledge sink deplete their energy, network property and coverage may not be secure. Thanks to these constraints, it's crucial to design Associate in Nursing energy-efficient knowledge assortment theme that consumes energy uniformly across the sensing field to achieve long network life [3]. What is more, as sensing data in some applications are time-sensitive, knowledge assortment may be needed to be performed inside a mere time frame. Therefore,long network lifespan and low knowledge latency. Several approaches are projected for economical data assortment within the literature, see, for instance, [4], [5], [6], supported the main target of those works, we are able to roughly divide them into 3 classes. The first class is that the increased relay routing , within which knowledge are relayed among sensors. Besides relaying, another factors, like load balance, schedule pattern and knowledge redundancy, also are thought of. The second class organizes sensors into clusters and permits cluster heads to require the responsibility for forwarding data to the knowledge the info the information sink.Cluster is especially useful for applications with quantifiability demand and is extremely effective in native knowledge aggregation since it will reduce the collisions and balance load among sensors. The third class is to form use of mobile collectors to require the burden of knowledge routing from sensors , although these works give effective solutions to knowledge collection in WSNs, their inefficiencies are detected. Specifically, in relay routing schemes, minimizing energy consumption on the forwarding path doesn't essentially prolong network lifespan, since some vital sensors on the path could run out of energy quicker than others. In cluster-Based schemes, cluster heads can inevitably consume. Much more energy than different sensors owing to handling intra-cluster aggregation and inter-cluster information forwarding.

Though mistreatment mobile collectors could alleviate non-uniform energy consumption, it's going to end in disappointing information collection latency. Supported these observations, in thispaper, we have a tendency to propose a three-layer mobile information assortment framework, named Load Balanced agglomeration and twin information

Uploading (LBC-DDU). The most motivation is to utilize distributed clustering for measurability, to use quality for energy saving and uniform energy consumption, and to exploit Multi-User Multiple-Input and Multiple-Output (MU-MIMO) technique for coinciding information uploading to shorten latency.

The main contributions of this work is summarized

As follows. First, we have a tendency to propose a distributed rule to organize sensors into clusters, wherever every cluster has multiple cluster heads. In distinction to agglomeration techniques plannedin previous works, our rule balances the load of intra-cluster aggregation and allows dual information uploading between multiple cluster heads and the mobile collector. Second, multiple cluster heads among a cluster will collaborate with one another to perform energy efficient inter-cluster transmissions. Totally different from different hierarchical schemes , in our rule, cluster heads don't relay information packets from different a cluster, which effectively alleviates the burden of every cluster head. Instead, forwarding methods among clusters area unit solely won't to route small-sized identification (ID) info of cluster heads to the mobile collector for optimizing the information assortment tour. Third, we have a tendency to deploy a mobile collector with 2 antennas (called SenCar during this paper) to permit coinciding uploading from 2 cluster heads by mistreatment MU-MIMO communication. The SenCar collects information from the cluster heads by visiting every cluster. It chooses the stop locations inside every cluster and determines the sequence to go to them, such information assortment is drained minimum time. Our work chiefly distinguishes from different mobile collection schemes within the utilization of MU-MIMO technique, which allows twin information uploading to shorten information transmission latency. We have a tendency to coordinate the mobility of SenCar to completely get pleasure from the advantages of twin information Uploading, that ultimately results in an information assortment tour with each short moving mechanical phenomenon and short information uploading time. The rest of the paper is organized as follows. Section 2 performs a literature review of previous works. Section 3 presents the system overview of the proposed framework. Section 4 describes the distributed load balanced clustering algorithm on sensor nodes and Section 5 considers the cluster head layer. Section 6 focuses on data collection tour planning of SenCar. Finally, Section 7 provides performance evaluation results and Section 8 concludes the paper.

II. RELATED WORKS

2.1 Relay Routing and Clustering Schemes

Relay routing could be a easy and effective approach to routing messages to the information sink during a multi-hop fashion. Chenget al. [4] devised acoordinated transfer schedule by selecting alternate routes to avoid congestions.

the construction of a maximum-lifetime knowledge gathering tree by planning associate rule that starts from associate whimsical tree and iteratively reduces the load on bottleneck nodes. Xu et al. [5] studied deployments of relay nodes to elongate network period of time. Evaluated assortment tree protocol (CTP) via test beds in [6]. CTP computes wireless

Routes accommodative to wireless link standing and satisfy dependableness, robustness, potency and hardware independence requirements.

However, once some nodes on the crucialpaths are subject to energy depletion, knowledge assortment performance will be deteriorated. Another approach is to permit nodes to make into clustersto reduce the quantity of relays , planned a cluster formation theme, named LEACH, which ends within the smallest expected number of clusters.

However, it doesn't guarantee smart cluster head distribution and assumes uniform energy consumption for cluster heads. More proposed “HEED,” within which a mix of residual energy and value is taken into account because the metric in cluster head selection. HEED will manufacture well-distributed cluster heads and compact clusters.thought-about energyefficient clustering in loss wireless detector networks based mostly on link quality. self-addressed d-hop agglomeration with every node being at the most d hops off from a cluster head. In these cluster-based schemes, besides serving because the aggregation purpose for native knowledge assortment, a cluster head also acts as a hardware or controller for in-network process. thought-about economical programming of cluster heads to alleviate the collisions among totally different transmissions. explored the correlation of sensing knowledge and dynamically divided. the sensor nodes into clusters. The cluster heads utilize the Spatio-temporal correlation to minimize the readings for

Energy saving. Nevertheless, traditional single-head clustering schemes may not be compatible with MU-MIMO. Thus, for generality, we propose a load-balanced multi-head clustering algorithm in this paper

2.2 Mobile Data Collections

Compared with information assortment via a static sink, introducing mobility for information assortment enjoys the advantages of reconciliation energy consumptions within the network and connecting disconnected regions. investigated quality under stochastic process wherever the mobile collector picks up data from close sensors, buffers and eventually offloads information to the wired access purpose. However, random flight cannot guarantee a latency bound that is needed in several applications. In. more planned to regulate data mules to traverse the sensing field on parallel straight lines and collect information from close sensors with multi-hop transmissions this themeWorks well during a uniformly distributed detector network. To achieve a lot of versatile information gathering tour for mobile collectors, Ma And principle planned an economical moving path planning algorithmic rule by determinant some turning points on the straight lines, that is adjective to the detector distribution and can effectively avoid obstacles on the trail. In, they as an alternative planned a single-hop information gathering scheme to pursue the right uniformity of energy consumption among sensors (see Fig. 1c), wherever a mobile collector called SenCar is optimized to prevent at some locations to gather information from sensors within the proximity via single-hop transmission. The work was more extended in to optimize the data gathering tour by exploring the trade-off between the shortest moving tour of SenCar and therefore the full utilization of co-occurring information uploading among sensors. Moreover, planned AN algorithmic rule tostudy the programming of mobile components specified there's no information loss owing to buffer overflow. Though these works consider utilizing mobile collectors, latency could also be increased owing to information transmission and mobile collector’s traveling time. Thus, during this paper, we tend to exploit MU-MIMO to reduce information UTC for mobile information assortment.

2.3 MU-MIMO in WSNs

The feasibleness of using MIMO techniques in wirelesssensor networks is visualized in . Attributable to difficulties to mount multiple antennas on one detector node, MIMO is adopted in WSNs to hunt cooperation’s from multiple nodes to realize diversity and cut back bit error rate. An overview of MIMO-based planning algorithms to coordinate transmissions was mentioned . Another challenge in MIMO is that the energy consumption in circuits might be beyond a standard Single-Input-Single-Output (SISO) approach , it absolutely was incontestable that MIMO can trounce SISO once the transmission distance is larger than bound thresholds (e.g., 25 m), it was shown that with correct styles of system parameters, vital energy saving is achieved with MIMO techniques. To compensate energy consumptions within the circuit, optimization of coordinated universal time and modulation.

III. SYSTEM OVERVIEW

An overview of LBC-DDU framework is delineated in,which consists of 3 layers: sensing element layer, cluster head layer and SenCar layer. The sensing element layer is that the bottom and basic layer. For generality, we have a tendency to don't build any assumptions on sensing element distribution or node capability, like location-awareness. Each sensor is assumed to be ready to communicate solely with its Neighbors, i.e., the nodes inside its transmission vary. During low-level formatting, sensors are self-organized into clusters. Each sensing element decides to be either a Cluster head or a cluster member in a distributed manner. In the end, sensors with higher residual energy would become cluster heads and each cluster has at the most cluster heads, where M is a system parameter. For convenience, the multiple cluster heads within a cluster are known as a cluster head cluster (CHG), with each cluster head being the peer of others. The algorithmic program constructs clusters specified every sensing element during a cluster is one- hop aloof from a minimum of one cluster head. The advantage of such organization is that the intra-cluster aggregation is restricted to one hop. within the case that a sensing element is also lined by multiple cluster heads during a CHG, it will be optionally affiliated with one cluster head for load reconciliation. To avoid collisions throughout knowledge aggregation, the CHG adopts time-division-multiple-access (TDMA) primarily based technique to coordinate communications between sensing element nodes. Right once the cluster heads areno appointive, the nodes synchronize their native clocks via beacon messages. for instance, all the nodes during a CHG may modify their native clocks supportedthat of the node with the best residual energy. once native synchronization is finished, Associate in Nursing existing programming theme will be adopted to collect knowledge from cluster members. Note that solely intra-cluster synchronization is required here because knowledge ar collected via SenCar. within the case of imperfect synchronization, some hybrid techniques to mix TDMA with contention-based access protocols (Carrier Sense Multiple Access (CSMA)) that hear the medium before sending are youneeded. for instance, hybrid protocols like Z-MAC may be utilized to reinforce the strengths and offset the weaknesses of TDMA and CSMA.Upon the arrival of SenCar, every CHG uploads buffered knowledge via MU-MIMO communications and synchronizes its native clocks with the world enter SenCar via acknowledgement messages. Finally, periodical re-clustering is performed to rotate cluster heads among sensors with higher residual energy to avoid debilitating energy from cluster heads. The cluster head layer consists of all the cluster heads. As aforementioned, inter-cluster forwarding is just wont to send the CHG data of every cluster to SenCar, which contains associate identification list of multiple cluster heads in an exceedingly CHG. Such data should be sent before SenCar departs for its knowledge assortment tour. Upon receiving this data, SenCar utilizes it to work out wherever to prevent among every cluster to gather knowledge from its CHG. to ensure the connectivity for inter-cluster communication, the cluster heads In a CHG will hand in glove channelize duplicated information to attain special diversity that provides reliable transmissions and energy saving. Moreover, cluster heads may also alter their output power for a fascinating transmission varies to make sure a precise degree of connectivity among clusters.The top layer is that the SenCar layer, that chiefly manages mobility of SenCar. There area unit 2 problems to be addressed at this layer. First, we want to work out the positions wherever SenCar would stop to speak with cluster heads when it arrives at a cluster. In LBC-DDU, SenCar communicates with cluster heads via single-hop transmissions. It is equipped with 2 antennas whereas every sensing element incorporates a single antenna and is unbroken as straightforward as potential. The itinerary of data uploading in an exceedingly cluster is many-to-one, where data from multiple cluster heads converge to SenCar. Equipped with 2 receiving antennas, every time SenCar makes twin data uploading whenever potential, during which 2 cluster heads will transfer knowledge at the same time. By process the received signals with filters supported channel state information SenCar will with success separate and rewrite the information from distinct cluster heads. To collect knowledge as quick as potential, SenCar ought to stop at positions within a cluster which will deliver the goods most capacity. In theory, since SenCar is mobile, it's the liberty to choose any most popular position. However, this can be unworkable in practice, as a result of it's terribly arduous to estimate channel conditions for all potential positions. Thus, we have a tendency to solely take into account a finite set of locations. To mitigate the impact from dynamic channel conditions, SenCar measures channel state information before every knowledge assortment tour to pick candidate locations for knowledge assortment. We have a tendency to decision these potential locations SenCar will stop to perform coincident knowledge collections polling points. In fact, SenCar doesn't have to visit all the polling points. Instead, it calculates some polling points that are accessible and that we decision those selected polling points In addition; we want to work out the sequence for SenCar to visit these elite polling points specified knowledge assortment latency is decreased. Since SenCar has pre-knowledge about the locations of polling points, it will notice an honest trajectory by seeking the shortest route that visits every elite polling purpose precisely once and so returns to the info sink. The projected framework aims to attain nice energy saving and shortened knowledge assortment latency, that has the potential for various varieties of knowledge services. Though ancient designs of WSNs will support low-rate knowledge services, more and a lot of sensing applications these days need high-definition footage and audio/video recording, which has become an awesome trend for next generation device designs. as an example, within the situation of military defense, sensors deployed in reconnaissance mission missions got to transmit back high-definition pictures to spot hostile units. Delays in gathering detected knowledge might not solely expose sensors or mobile collector to enemy police investigation however additionally depreciate the duration of gathered intelligence. Using MU-MIMO will greatly speed up knowledge assortment time and reduce the general latency. Another application situation emerges in disaster rescue. as an example, to combat forest fire, device nodes square measure typically deployed densely to observe the state of affairs. These applications typically involve tons of readings in an exceedingly short amount (a great deal of data) and are risky for creature to manually collect detected knowledge. A mobile collector equipped with multiple antennas overcomes these difficulties by reducing knowledge assortment latency and reaching hazard regions not accessible by creature. Although using quality could elongate the moving time, knowledge assortment time would become dominant or at least appreciate moving time for several high-rate ordensely deployed sensing applications. Additionally, using the mobile knowledge collector will with success acquire knowledge even from disconnected regions and guarantee that each one of the generated Data square measure collected.

IV. SENSOR LAYER: LOAD BALANCED CLUSTERING

In this section, we have a tendency to gift the distributed load balanced clustering algorithmic program at the sensing element layer. The essential operation of agglomeration is that the choice of cluster heads. To prolong network lifespan, we have a tendency to naturally expect the chosen cluster heads square measure those with higher residual energy. Hence, we have a tendency to use the proportion of residual energy of every sensor because the initial agglomeration priority. Assume that a group of sensors, denoted by S ¼ fs1; s2; . . . ; sng, square measure same and each of them severally makes the choice on its standing supported native info. when running the LBC algorithmic program, every cluster can have at the most M (1) cluster heads, which suggests that the dimensions of CHG of every cluster is no quite M. every sensing element is roofed by a minimum of one cluster head within a cluster. The LBC algorithmic program is

Comprised of 4 phases: (1) Initialization; (2) standing claim; (3) Cluster forming and (4) Cluster head synchronization. Next, we have a tendency to describe the operation through wherever a complete often sensors (plotted as numbered circles in Fig. 3a) square measure tagged with their initial priorities and the property among them is shown by the links between neighboring nodes.

4.1 Cluster Forming

The third part is cluster forming that decides thatcluster head a sensing element ought to be related to. the factors can be delineated as follows: for a sensing element with tentative status or being a cluster member, it might arbitrarily affiliate itself with a cluster head among its candidate peers for load balance purpose. Within the rare case that there's no cluster head among the candidate peers of a sensing element with tentative standing, the sensing element would claim itself and its

```
1: if My.status¼ cluster_headthen
My.cluster_head_My.id;
2: else
3: recv_pkt ();
4: My _Fnl_NðMy:BÞ;
5: if My 6¼ F then
6: My. Status _ clustermember;
7: My.cluster_head_Rand_oneðMy:BÞ.id;
8: send_pkt (3, My.id, My.cluster_head,
Clustermember, My.init_prio);
9: else
10: My. Status _ clusterhead;
11: My.cluster_head_ My.id;
12: send_pkt (2, My.id, ID_ListðMy: AÞ,
```

Clusterhead, My.priocurrent candidate peers because the cluster heads. the main points are given in rule three. Fig. three d shows the ultimate results of each sensing element. Whether or not a sensing element will finally become a clusterhead primarily depends on its priority. Specifically, we tend to partition the priority into 3 zones by 2 thresholds, the and tm (th> metallic element), that change a sensing element to declare itself to be acluster head or member, severally, before reaching itsmaximum variety of iterations. Throughout the iterations, in some cases, if the priority of a sensing element is bigger than th or less than metallic element compared with its neighbors, it will right away decide its final standing and quit from the iteration. We denote the potential cluster heads within the neighborhoodof a sensing element by a collection B. In every iteration, a sensor, say, si, first tries to probabilistically embrace itself into si:B as a tentative cluster head if it's not in already . Once thriving, a packet includes its node ID and prioritywill be sent out and also the sensors within the proximity can add si as their potential cluster heads upon receiving the packet. Then, si checks its current potential cluster heads. If they do exist, there are 2 cases for is to create the ultimate standing call, otherwise, si would keep within the tentative standing for the next spherical of iteration.

4.2 Inter-Cluster Communications

Next, we tend to discuss however cluster heads in an exceedingly CHG collaboratefor energy-efficient inter-cluster communication. We treat cluster heads in an exceedingly CHG as multiple antennas each within the transmitting and receiving sides specified identical MIMO system is created . The self-driven cluster head in an exceedingly CHG will either coordinate the native info sharing at the sending facet or act because the destination

for the cooperative reception at the receiving facet. Every cooperative cluster head because the transmitter encodes the transmission sequence consistent with a nominal reference system block code (STBC) to realize spatial diversity. Compared to the single-input single-output system, it's been shown that a MIMO system with spatial diversity results in higher reliableness given a similar power budget. an alternate view is that for a similar receive sensitivity, MIMO systems require less transmission energy than SISO systems for the same transmission distance. Therefore, given 2 connected clusters, compared with the single-head structure, in which the inter-cluster transmission is like a SISO system, the multi-head structure in LBC-DDU will save energy for inter-cluster communication.

V. CONCLUSIONS AND FUTURE WORKS

In this paper, we've projected the LBC-DDU framework for mobile knowledge assortment in an exceedingly WSN. It consists of device layer, cluster head layer and SenCar layer. It employs distributed load balanced cluster for device organization, adopts cooperative inter-cluster communication for energy-efficient transmissions among CHGs, uses dual data uploading for quick knowledge assortment, and optimizes SenCar's quality to totally fancy the advantages of MU-MIMO. Our performance study demonstrates the effectiveness of the projected framework. The results show that LBC-DDU can greatly cut back energy consumptions by assuaging routing burdens on nodes and equalization work among Cluster heads, that achieves twenty p.c less knowledge assortment time compared to SISO mobile knowledge gathering and Over sixty p.c energy saving on cluster heads. We have also even the energy overhead and explored the results with completely different numbers of cluster heads within the framework. Finally, we'd wish to denote that there square measure some interesting issues which will be studied in our future work. The first downside is a way to realize polling points and compatible pairs for every cluster. A discretization theme ought to be developed to partition the continual house to find the Optimal polling purpose for every cluster. Then finding the compatible pairs becomes an identical downside to attain best overall special diversity. The second downside is a way to schedule MIMO uploading from multiple clusters. Associate algorithmic rule that adapts to this

MIMO-based transmission scheduling algorithms ought to be studied in future.

VI. RESULTS

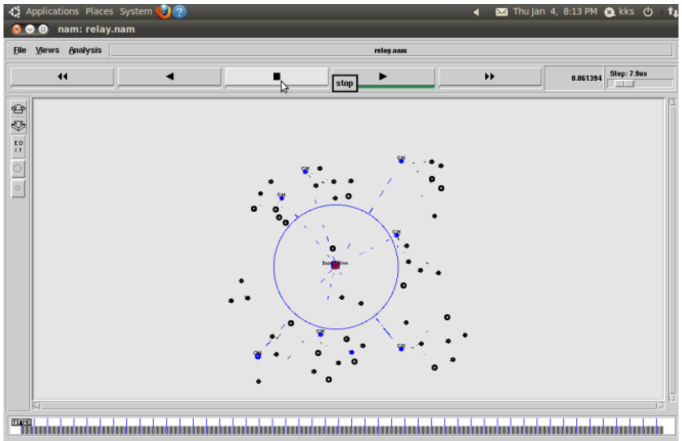

Fig1: elect to the cluster head

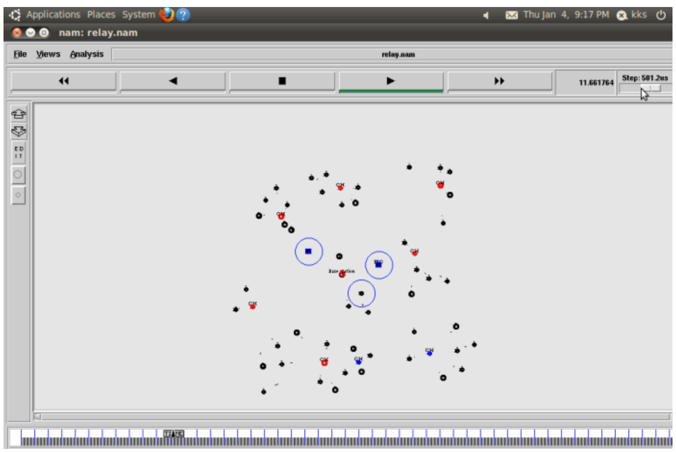

Fig.2: sencar in MIMO uploading from multiple cluster.

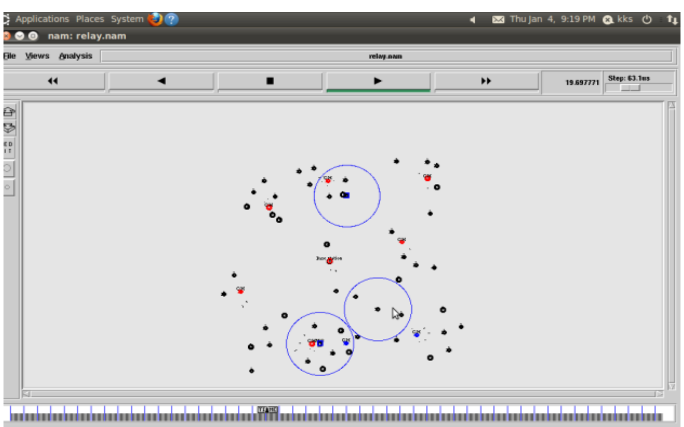

Fig3: duel data uploading xGraphs:

Delay Graph

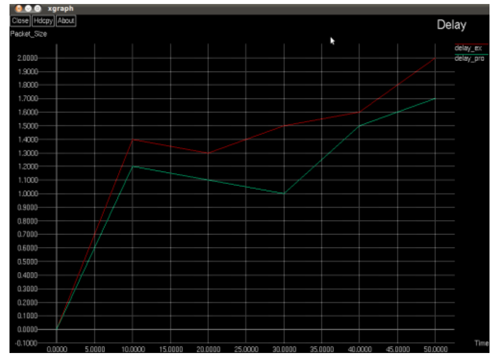

Fig.4: delay graph

Energy Graph

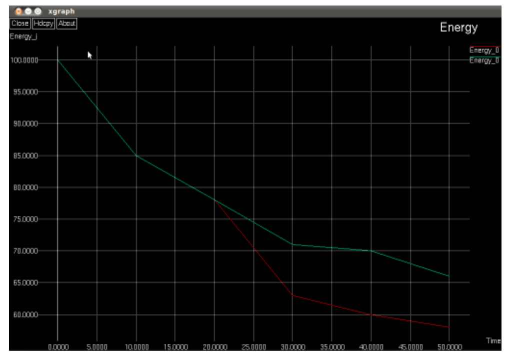

Fig.5: Energy graph

Throughput Graph

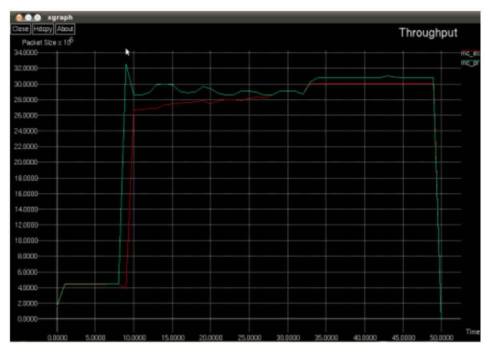

Fig.6: Throughput graph

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