International Journal of Engineering Technology and Management Sciences
Website: ijetms.in Issue: 1 Volume No.8 January - February – 2024
DOI:10.46647/ijetms.2024.v08i01.040 ISSN: 2581-4621

# Design of an efficient energy based dual level co-operative route protocols in multiple hop WSNs

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**Abstract**

The design and implementation of an energy efficient dual stage cooperative routing protocol (DSCR) in multiple hop wireless nets is discussed in this paper in brief, with the goal of improving network life-time, boosting dependability, and reducing energy consumption. This contribution's major goal is to propose an enhanced version of the double stage data transfer system that computes the routing path utilizing cooperative mechanisms and the notion of reduced node energy. The work presented here also includes talks, discussion and graphical representations of the various outcomes achieved for all of the test scenarios, as well as the relevant observations and explanations. The research paper comes to a close with the multiple hop networks' overall conclusions remarks.

**Keywords :** WSN, CBR, Simulation, Result, Node.

## Introduction

Helpful directing is one of the most broadly utilized advancements for improving the vitality effectiveness and vitality equalization (*energy efficiency and balancing*) of remote multi-hopping systems. Be that as it may, the start to finish vitality costs and system life time are significantly confined if the cooperation model's transmission properties isn't structured appropriately. The fundamental point of the work undertaken in this chapter is to investigate a double stage agreeable directing plan to additionally improve the vitality proficiency and draw out the system lifetime. A double-arrange agreeable (DSC) transmission model is right off the bat structured in which the canter aide is acquainted with decide the partner set for collaboration. At that point, the two-arrange connect's cost is planned where *p*, the heaviness of leftover vitality, is acquainted with be balanced for various structure objectives. By choosing the ideal partner set, the two-arrange connection cost of each connection can be advanced or lessened (*becomes cost-effective*). At long last, in light of the structured DSC transmission model and the advanced dual-organize interface cost, a dispersed two-arrange helpful directing concept is additionally proposed to limit the start to finish agreeable steering cost. In the work, a parameter $p$ is designed to be evaluated on distinctive execution measurement. When the parametric value $p = 0$, the fastest start to finish transmission delays and highest energy efficiencies can be achieved. When the parametric value $p > 0$, a longer time is needed for the data to be transferred. Optimal cooperative transmission from $s$ to $d$ via multi-hop dual stage mechanisms are being used. Due to the use of this dual hopping WSN, the network energy was reduced, became highly reliable, network life time and reliability increased due to the end-to-end time delay's reductions.

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**Two Stage Hop-WSNs**

A two stage WSN is one in which if a 1st node is unable to process the data transfer, then one to go for the 2nd node and because of this, one can stabilize the energy of the nodes and this being the primary objective of the proposed research areana undertaken in this chapter. If anyone looks at the data transmission as shown in the Fig. 1, say one cluster of nodes exist, say $A_1$, $A_2$, …… , $A_{n-1}$, $A_n$, where all the $A_i$'s are cluster of nodes. In the 1st cluster, say node 1 of cluster 1 ($A_1$) and node 1 of cluster 2 ($A_2$) are existing side by side. Node 1 of $A_1$ is collecting the data and it is transmitting to node 1 of cluster 2 ($A_2$)

Then the node 1 of the cluster 2 ($A_2$) will do the wireless data's transmission of the information packets to the other nodal points. Thus, the 2 nodes of $A_1$ and $A_2$ cluster will make the group as a more efficient one. The main aim of this research work taken up in this chapter is the development of a dual level co-operative (DSC) transmission's framework, which the main nodal point and the helpers will be taken into consideration for determining the helper-set's characteristics for the cooperative process. A core-node helper is nothing but a node which is going to transferring of the information from any node to any node, so that one can be able to reduce the communication gap and there is no need to wait for a long time

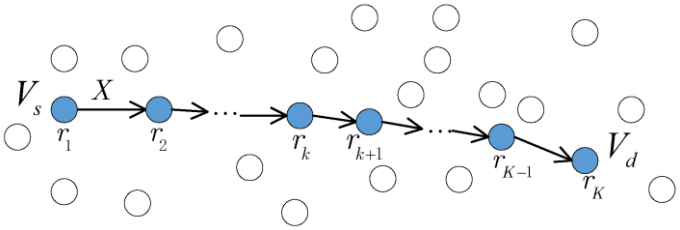


Fig. 1 : Graphical model of a two-stage multi-hop WSN [100]

A network has to be formed in a group, say a group of 49 nodes, i.e., the quantity of sensor node will be fixed to be 49. In this process, 2 steps are involved, first one to find the 1st node, 2nd one to find the 2nd cooperative node. So, the 2nd stage cooperative node will help us to transfer the data. Once the node deployment is over, they will form groups or clusters (in the work 8 groups are formed). In that group, the main aim is to find the one main cooperative node and then the 2nd cooperative node which will help in data transfer.

The 1st cooperative node job is to collect the data from all the neighbours and it will give it to the 2nd cooperative node, which will help to transfer the data from one group to another group. This is done in order to reduce the burden on the main cooperative node. Same thing is going to happen in the 2nd stage, where in the 1st node of the 2nd group is going to procure the information and hand it over to the 2nd nodal point of the 2nd group and the 2nd node of the 2nd group will help in transferring of the data to the next group so that the sender node will be balanced between the nodes and can claim that it is more energy efficient.

Next step is to apply the multi-path routing in the 2-stage data transfer process. All the cooperative nodes will be communicated together between each other, data collected by one node (main) and forwarding to the other node (cooperative). The 2nd node of each groups' will be participating in the multiple transmissions so that most of the data can be transmitted from one group to another group. To start with, all the nodes will start communicating together. In each group, there will be one head and one sub head like captain and a vice-captain indicating 2-stages.

In the 1st stage, the main node communicates with the neighbour nodes and in the 2nd stage, the main node after collecting all the data will forward to the 2nd node which transmits the received data for the transmission purposes. To achieve this, the main node energy has to be extracted as it will be in the operational mode (active state) for a longer amount of time. The algorithm is going to check which is the node having the highest energy and this is taken care of by the energy.awk file. In a group, a node which will be having more energy will be selected as the main node (head node). In that particular group itself, the algorithm is going to select the second head (co-operative node.

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It has to be noted in this context that all the groups will be simultaneously in operation in collecting the data by the main nodes and handing it over to the 2nd head and there is no need to wait for the transmission, duty of main head node in the group is only collection. Once, the process of data collection is over, the nodes are going to send the acknowledgment and the second node transfer the data to the sink, so that the data transfer rate is speeded up, say : Leader node – 4 sending acknowledgment message to its neighbour 5.

In the group considered, say 8 groups data are simultaneously collected by the main nodes, hand over to the 8 sub-head node, which parallel transmits the 8 group data to the sink thus increasing the transmission of the data at a faster rate. Data is being sent in multiple paths in all the directions using the 2-way stage mechanisms. It has to be noted that why the data is transferred in multiple paths, because the 2-stage network has to operate in multi-hop fashion. In this process, the end to end delay can be reduced so that there is no need for wait for the long time, data can be sent in a quick manner as the multiple hopping concept can be applied.

The main advantage is data transfer occurs at a faster rate, paralleling processing done, load sharing is adopted, energy is reduced, more efficient, power consumption is less because of multiple node participation in data transfer, fast operation, and computational time required is less. In this process, if any node is not behaving properly, that node is not considered for the data transmission purpose. A general structure of a multiple hopping sensor net is displayed here in Fig. 2.

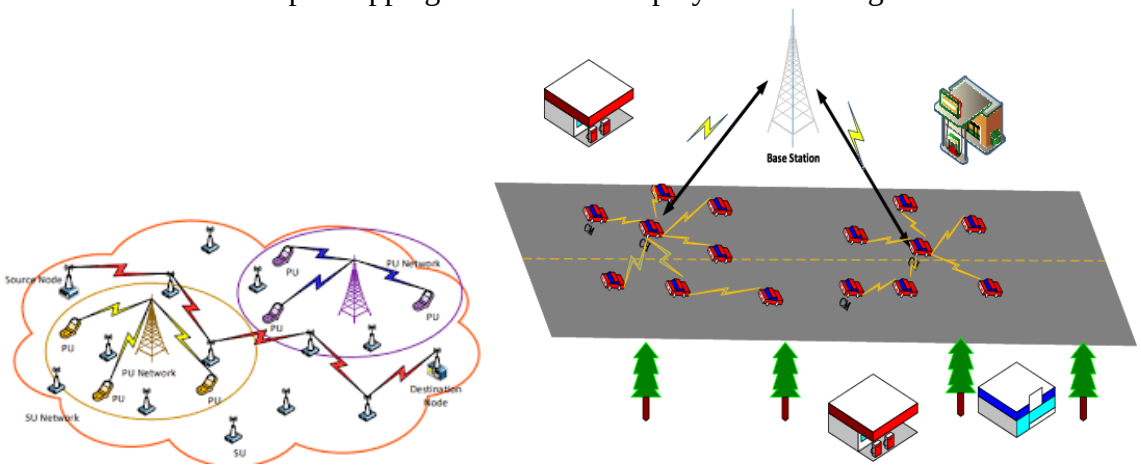


Fig. 2 :Multi-hop network with multi-stage data transfer transmission model.

**NS-2 Simulation results and discussions with the execution steps**

In this study, an energy-efficient dual-stage co-operative route protocols for multiple hopping wireless nets is being created, with improved life durations due to parallel processing principles and lower node energies. The coding (script writing) w.r.t. the wireless sensor network is developed in the NS2 tool by writing ***.tcl*** scripts and when it will be completed, it is tested for its effectiveness as per the algorithmatic rules which are given below from s1 to s14. Simulation results are observed both for the individual parameters as well as for the comparison ones.

1. Codings are developed using the *.tcl* scripts incorporating the developed hybrid protocol and the developed codes are saved in a particular folder in the software environment (Ubuntu).
2. Ubuntu is started from the terminal mode, commands like command 'sudo' '–s' is used for entering the kernel.
3. Then the password will be entered and the source codes where the directory / folder is present is made change using the change directory cd command and entered.
4. Developed code is executed using ns filename**.**tcl and the command window of the NS-2 simulator appears with the simulator start button along with the network animator once the simulation is started, the sensor node deployment within the '*n* = 49' is done and displayed.
5. Groups of 8 are formed with each group having 8 nodes, groups 1 (1 - 8), groups 2 (9 - 16), groups 3 (17 - 24), groups 4 (25 - 32), groups 5 (33 - 40), groups 6 (41 - 48) and sensor node 49 is

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designated as the sink node (Fig. 5.7).

6. Each group 2 prominent members are selected (main head and sub head) and appears on the NS-2 animator screen.
7. Each group head collects data, give to sub head, ……, continue till 8th group and finally transfer the data packets from the sub heads to the sink parallel at a time.
8. Few minutes are utilized to perform the simulation and it will pass through different stages of data packets send data, verification, encrypt data, decryption from the sub-heads to ending point (Fig. 5.10) and compute the time of data transfer.
9. Results are observed at the command prompt (terminal) by using the results visualizations chmod 777 results.sh and./results.sh or sometimes the result observation command can be directly embedded into the code at program end.
10. Output graphs showing all the parameters such as graph of load which is varying in nature v/s the PDR and comparison of the proposed work with others, Plot of drop in packets showing that no packets are dropped from the sending end (cluster sub-head in group) to the receiving end (sink), Plot of throughput vs. time, Plot of comparision of PDR with existing systems and the plot of power of the proposed system.

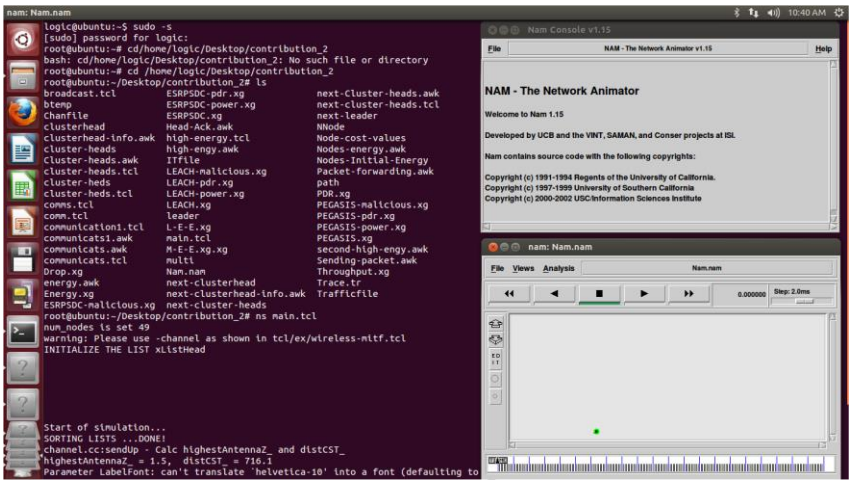


Fig. 2 : The NAM window and instructions are used to run the simulation of the 2-stage multiple hopping networks, displaying the file list in the simulations and also indicate the start of the simulation study in the terminal's command prompt.

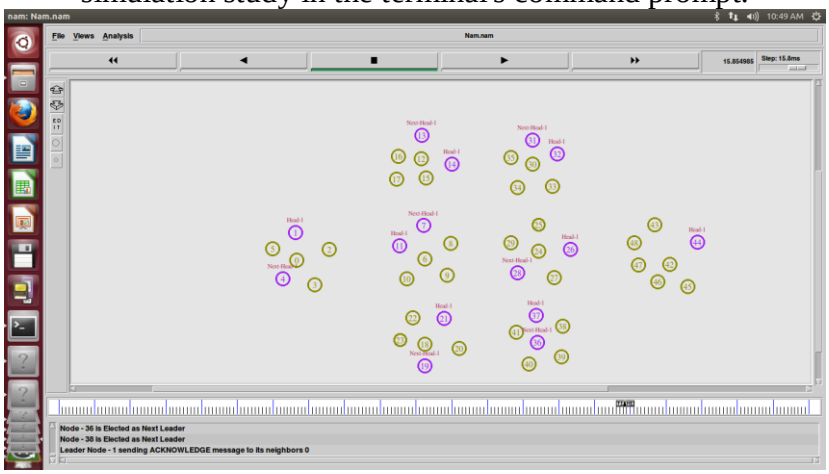

Fig. 3 : Simulation results showing the election of the leader as 'Deputy Head-1 or the Next-Head' having the maximum energy minus 1 of the head in one particular group, totally 6 sub-heads are selected (2nd stage in dual-stage wireless transmission)

| No. | Name of parameter | Specifications value |
|---|---|---|
| 1. | Simulation Software | Network Simulator tool 2 or 3 |
| 2. | Channels | Wireless |

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| | | |
|---|---|---|
| 3. | Run times of the simulation | 50 ms |
| 4. | Area in which nodes to move | 900 × 600 |
| 5. | Packet size | 1024 bytes (1 KB) |
| 6. | Speed | 1 m/s to 10 m/s |
| 7. | Routing Protocol | Distributed, Multi-Hop, Dual-Stage |
| 8. | Propagation model | TwoRayGround |
| 9. | Type of networking interfaces | Wireless (Physical) |
| 10. | Type of Queues | Tail drops |
| 11. | IFQ-Length | 50 packets |
| 12. | MAC Layer Type | Mac - 802.11 |
| 13. | Type of antennas | Omni type Antennas |
| 14. | No. of Sensor Nodes | 49 |
| 15. | No. of cluster groups | 6 |

Table 1 : Specification table of the research problem considered

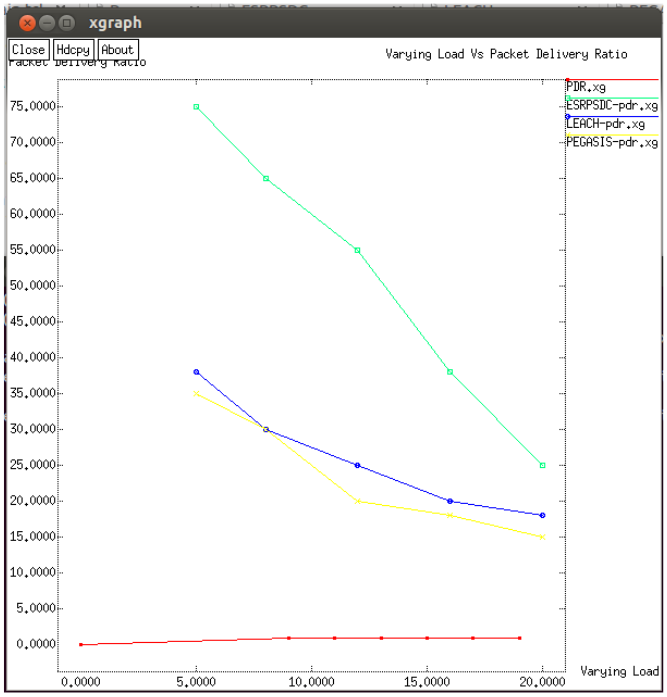


Fig. 4 : Plotting altering loads vs. the PDR, as well as comparing the suggested work to everybody else

The graph of variable loads vs. PDR, as well as a comparative analysis of the suggested work with others, is schematically represented in Fig. 4, which demonstrates that the suggested methodology (red colour) is more powerful than the others (blue and green colour), demonstrating the efficacy of the methodology devised. When compared to existing approaches such as LEACH, ESRPSDC, and PEGASIS, the graph indicates that the PDR is zero as the load varies. In the sense that other systems suffer from loss during datas.

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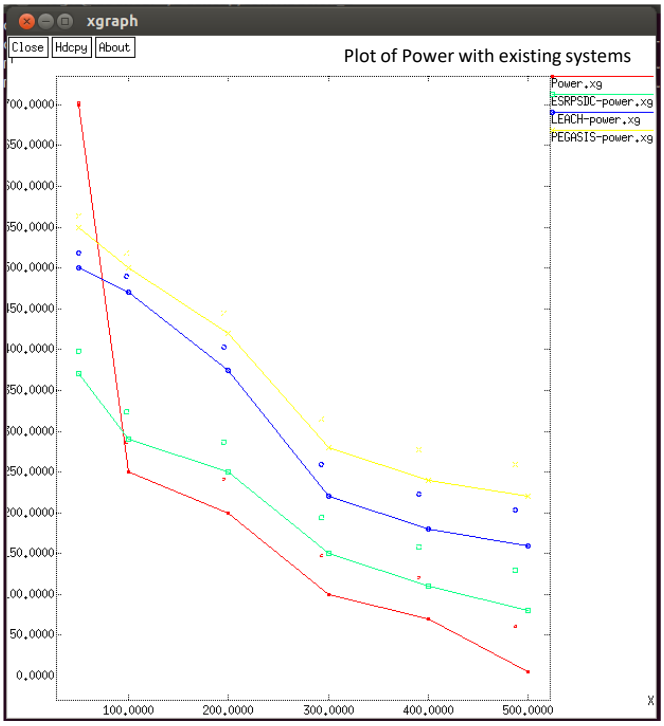


Fig. 5 : A plot illustrating the planned system's power and a comparison to current system to other system

The graph of power-energy consumption and comparisons of the presented design to others is artistically represented in Fig. 5, which indicates that the suggested technique (red color) is more efficient than the other researchers (blue and green color), demonstrating the efficacy of the approach developed. The plots illustrates that as time is used, i.e., as *t*, the suggested technique consumes significantly less energy and power than existing methods, indicating that the proposed method is more efficient than others and is effective when the power and energy of the net is considered.

## Conclusions

In this conclusions section, the overall conclusive remarks are presented. In multiple hopping wireless nets, an energy based efficient double level co-operative route protocols with improved life durations due to parallel processing principles and lower node energies is being devised. The major goal of this work is to propose an improvised version of double stage data transfer system that computes the routing paths using co-operative mechanisms and the concept of reduced nodal energies, as evidenced by simulation results. Algorithms are created under the Ubuntu environment with the NS2 tool. After running the generated code, simulations are seen, demonstrating the varied results acquired for all test cases, as well as the necessary observations and explanations in the form of discussions, indicating the affectivity of the suggested technique in contrast to other work. The main advantages highlighted in this third and penultimate contributory work are data transmission speed, the concept of two-way or two-stage processing, parallel processing, less time consumed, computing time is very short, reduced energy or power consumption by the nodes since the dual-stage concept is introduced, and so on.

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