Journal of Advanced Research in Microelectronics and VLSI
Volume 4, Issue 2 - 2021, Pg. No. 7-10
Peer Reviewed Journal

Article

Performance Analysis of Multi-Head Clustering Network using BCD Algorithm in Wireless Sensor Network

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How to cite this article:
Patil R, Kohir VV. Performance Analysis of Multi-Head Clustering Network using BCD Algorithm in Wireless Sensor Network. *J Adv Res Microelec VLSI* 2021; 4(2): 7-10.

Date of Submission: 2021-12-10
Date of Acceptance: 2022-01-05

A B S T R A C T

In this work, we propose a Multi-Head Clustering Network (MHCN) with Balanced Cluster Distribution (BCD) algorithm. This algorithm defines a new scenario for wireless sensor networks instead of doing round rotation for cluster head selection as compared to classical leach algorithm.

Keywords: Balanced Cluster Distribution, Multi-Head Clustering Network, Algorithm, Wireless Sensor

Introduction

Wireless Sensor Networks (WSNs) have emerged as one of the popular wireless technologies all over the world. In contrast with different wireless communication techniques such as ad-hoc network or mesh network etc., sensor network has its own advantages and limitations in exchanging data information continuously in real time environment. In WSN, sensor units are deployed at various locations in the network and they continuously sense the physical parameters such as temperature, humidity, pressure etc. Sensors are deployed at any corner and easily monitored. Wireless Sensor Network (WSN) consists of a group of sensor nodes working together to sense the environment and nodes communicate over a short distance using wireless link. The nodes can perform simple data processing work and are deployed randomly. These sensor nodes are typically small size, low cost and battery powered. WSN has various important applications in military, environmental monitoring and target tracking. The design of a WSN depends significantly on the objectives of the applications and it must consider factors such as environment, cost, hardware and system constraints. The number of nodes in WSN varies from few to several hundreds or even thousands, where each node is connected to one sensor.

Proposed Method

Multi-Head Clustering Network (MHCN) with BCD Algorithm

Figure 1, shows our newly developed multi-head clustering network, with a new trafficking model, so as to achieve higher refreshment in monitoring data. This new network scenario introduces scheduling technique which includes interference, where nodes switches between gateways and cluster heads for optimal power conservation in constraint to interference for forwarding data. In earlier proposed clustering network every node used to be initialized as CH, but their drawbacks were already discussed above. In order to overcome those limitations we propose Multi-Head Clustering Network algorithm as shown in below Figure 3.

Figure 1.Multi-Head Clustering Network (MHCN) Scenario

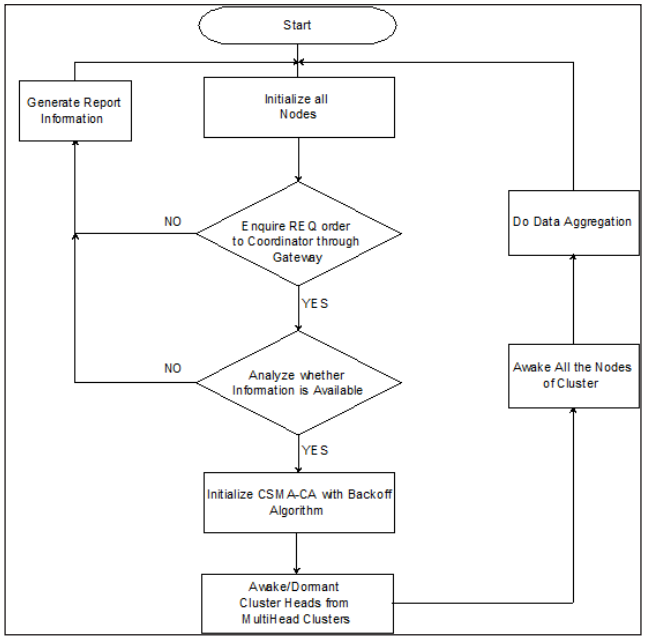

Figure 2.Multi-Head Clustering Network (MHCN) Algorithm

There are many different clustering algorithms classified and discussed by various researchers and scholars depending upon cluster head selection strategies. But our proposed MHCN algorithm defines new scenario for wireless sensor networks, instead of doing round rotation for cluster head selection we use Balanced Cluster Distribution (BCD) method for selection of CH.

Balanced Cluster Distribution (BCD)

Here we divide our cluster elements into three parts.

- End Device or Sensing Node
- Multi-Head Node or Multiple Cluster Heads
- Gateway Node

In our MHCN, End Device node operates as sensing node which collects continuous data from environment where network is established and it also computes the gathered data information needed to monitor and further forwards this information to Multi-Head node. Depending upon the coverage area and number of end device nodes we select number of multiple cluster heads needed within any cluster network.

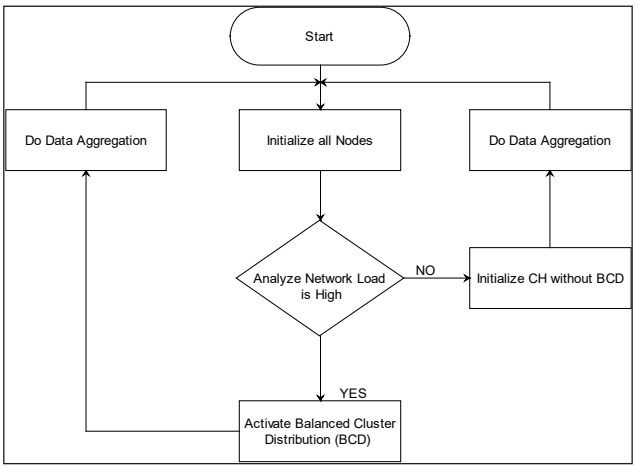

Figure 3.BCD Method to Activate CH in MHCN

Our proposed MHCN uses BCD method to activate CH among available multi-heads such that these multi-head nodes remain active only when data is to be aggregated and data is to be exchanged in between inter-clusters through gateway or else all multi-head will act as normal sensing node sometimes become dormant or enter into sleep mode. BCD method analyses the network load, and enables the multiple cluster heads if the traffic is very high within network, if less network load exists then it simply uses minimum cluster heads to perform data aggregation. Each aggregated data is forwarded to gateway node for monitoring and analyzing the data, gateway node also acts as link between all sensing nodes and end user. Some of the major advantages of implementing MHCN are:

- Eliminates earlier round rotation cluster formation role for cluster heads
- Enables proper distribution of cluster heads within network
- Creates balanced clusters
- Uses minimum network parameters
- Minimizes cluster head selection strategy hence improves performance
- Since it ignores Node power level or residual energy then introduces minimum interference and improves network lifetime and efficiency

Result and Discussion

The proposed Multi-Head Clustering Network MHCN scenario shown in Figure 4, is simulated under Opnet tool. In this scenario we have created a wireless sensor network with 4 different clusters. Each cluster consists of 2 end device nodes, 2 multi-head clusters nodes and

1 gate way node, the overall simulation time chosen was 1200 sec (20 mins). Parameters used in the simulation are tabulated in Table 1.

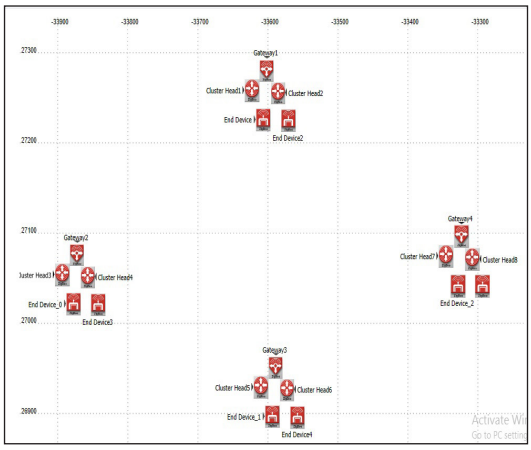

Figure 4.Multi-Head Clustering Network (MHCN) Scenario

Table 1.Simulation Parameters of MHCN

Number Clusters in Network	4
PAN ID's of Gateway Nodes	1, 2, 3, 4
Multi Head Cluster Nodes	8
End Device Nodes	8
Number of Retransmission Attempts	5
Minimum Back Off Exponent	3
Maximum Number of Back Offs	4
Transmission Bands	2450MHz

Figure 5, shows throughput within cluster 1, it can clearly be seen that whenever a less network load is detected then no BCD method is enabled, the only one cluster head (Cluster head 2) becomes Active Mode and other cluster head (Cluster head 1) enters into Sleep Mode or becomes dormant.

Similarly in Figure 6, shows throughput within cluster 2, here also it can clearly be seen that whenever a high network load is detected then BCD method is initialized, both cluster heads (Cluster head 3 and 4) enters into Active Mode enabling sharing of channel resources in efficient manner. This suggests implementing MHCN in wireless sensor network will improve the overall efficiency of network lifetime thereby enhances the performance of overall Quality of Service.

Now analyze the Figure 7 and 8, the delay introduced within both cluster 1 and 2 are same, this means whenever a cluster head within MHCN remains active/ dormant the BCD method enables required number of cluster head such that less loss of information takes place, thereby minimizing interference and collision issues. Figure 9, is the overall network throughput and Figure 10, is overall network delay.

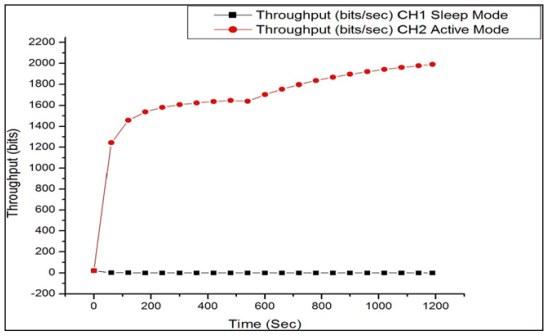

Figure 5.Throughput of Cluster 1 using MHCN Scenario

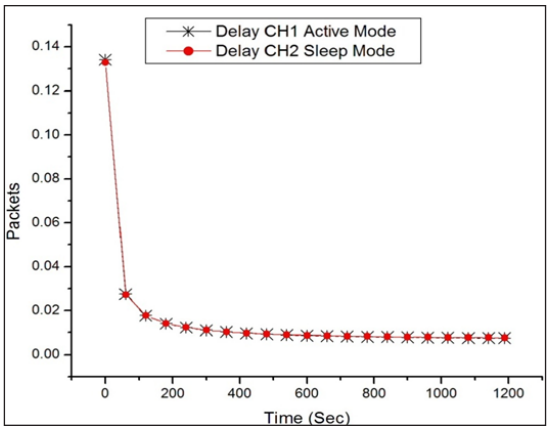

Figure 6.Delay of Cluster 1 using MHCN Scenario

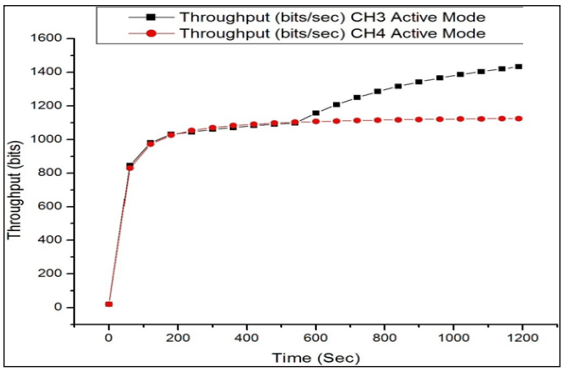

Figure 7.Throughput of Cluster 2 using MHCN Scenario

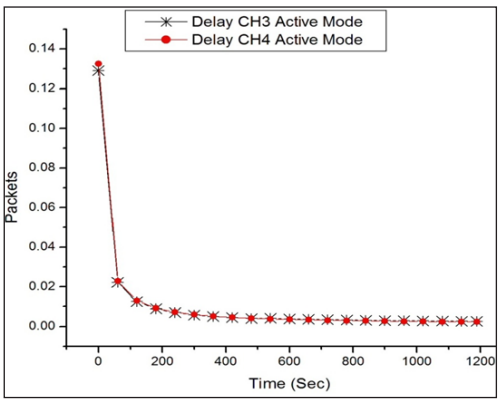

Figure 8.Delay of Cluster 2 using MHCN Scenario

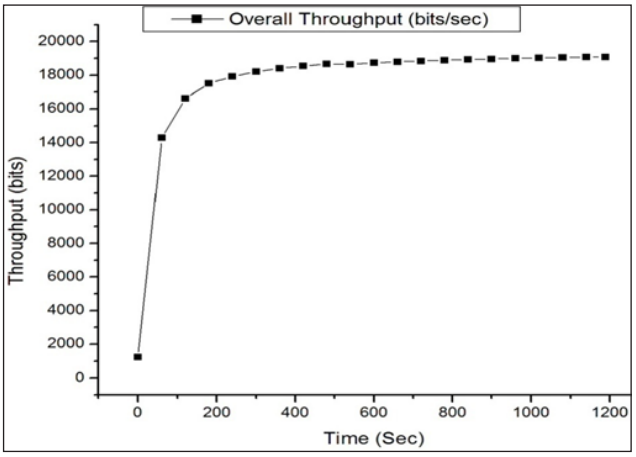

Figure 9.Throughput of Overall Network using MHCN Scenario

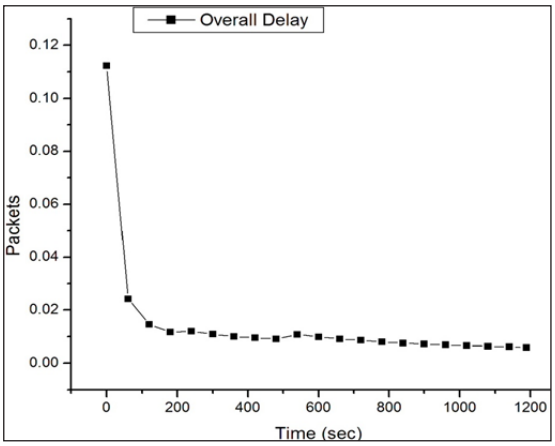

Figure 10.Delay of Overall Network using MHCN Scenario

Conclusion

In this paper we propose a new Multi-Head Clustering Network MHCN algorithm in wireless sensor networks boosted the overall network life time thrice compared to traditional Cluster Head method. Our MHCN algorithm is best clustering technique that can be integrated with any standard motes (sensor nodes) used in wireless sensor networks.

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