Advances in Mathematics: Scientific Journal **9** (2020), no.6, 3331–3339
ISSN: 1857-8365 (printed); 1857-8438 (electronic)
https://doi.org/10.37418/amsj.9.6.13 Spec. Issue on RDESTM-2020

COMPARATIVE ANALYSIS OF OPTIMAL TRANSMISSION RANGE FOR MESADC AND MESAEED CLUSTERING PROTOCOLS

BHUPESH GUPTA[1] AND SANJEEV RANA

ABSTRACT. In distributed clustering, Cluster heads were selected by sensor nodes themselves which was suitable for large WSN and requires less overhead. This paper firstly discuss previously proposed clustering protocols MESADC (Mutual Exclusive Sleep Awake Distributive Clustering) and MESAEED (Mutual Exclusive Sleep Awake Energy Efficient Distributive) which works in sleep awake mode. After that this paper presents optimal range for transmission for both these clustering protocols with respect to HEED protocol. For finding optimal transmission range simulation was done on NS2-(Allinone-2.34).

1. INTRODUCTION

The infrastructure less, decentralized nature and quick formation of wireless technology have made it better suitable means of communication where any other way of communication is not possible. Any type of computer network that uses wireless data communication for connecting the network nodes is called Wireless Network. It includes WPAN (Wireless Personal Area Network), WLAN (Wireless Local Area Network), WMAN (Wireless Metropolitan Area Network), and WWAN (Wireless Wide Area Network), Cellular Network, Wireless Sensor Network etc. A Wireless Sensor Network is one that has gain significant popularity and attention in the last few years [1]. In WSN sensors plays key role

[1]*corresponding author*

2010 *Mathematics Subject Classification.* 68M12.
Key words and phrases. Clustering Protocol, MESADC, MESAEED.

of sensing when deployed in planned area. According to theory of communication endurance consumption in WSN was proportional to packet size and also square power or fourth power of distance [1, 5]. For optimizing communication usage clustering concept came into existence [1, 2, 7]. Clustering results in optimizing power requirement during communication. In clustering grouping of sensors can take place in which one cluster head is there and other sensor nodes act as cluster members [3, 4, 6].

2. PRELIMINARIES

This section composed of some of the existing wireless sensor network sleep scheduling techniques and clustering protocols. The various wireless sensor network sleep scheduling includes dynamic sleep scheduling, balanced energy sleep scheduling, optimal sleep scheduling, energy efficient TDMA sleep scheduling and delay efficient sleep scheduling. Dynamic Sleep Scheduling [8, 9] is used to abstain packet scheduling and if it is used with MAC layer results in high throughput. Two types of period are important in dynamic sleep scheduling one when there will be no activity and other when event occurs. While dynamic sleep scheduling it is important to control traffic and also data looses if network is large. Balanced Energy Sleep Scheduling [10] is used for extending network lifetime by reiterating sensor nodes and using leftover sensors to sleep. It is also helpful in balancing load in sensor network which results in improvement in efficiency of sensor network. But one must take care of distance while balancing load in a network. Optimal Sleep Scheduling [11] is used to deprecate the discontinuation in communication and helpful in prolonging network lifetime. While using this technique one must take care of connectivity. Energy Efficient TDMA sleep scheduling [12] is used for prolonging network lifetime. With the help of this technique packet loss can be reduced at great extent. Time slots must be taken into consideration while using this sleep scheduling so that delay can be minimizes and channel utilization will improve. Delay Efficient Sleep Scheduling [12, 13] is used for abstaining collision and to reduce energy consumption to great extent. This technique is also helpful in reducing communication delays. Although it faces some difficulty during broadcasting the message. Maintaining latency pattern is challenging issue in this technique. Likewise some of the existing clustering protocols include TEEN [14], SHORT [15], HEED [16], PEACH

[17], EEUC [18], LEACH [19], LEACH-C [20]. Protocols LEACH-C and SHORT uses centralized structure, LEACH, HEED, PEACH, EEUC, DHAC uses distributive structure, HEED, EEUC uses Multi hop inter cluster communication, HEED also comes under the category of Power based protocol. So HEED is distributive, multi hop and power based protocol. HEED also follows multilevel clustering. So in this paper HEED protocol is using for comparison. MESADC (Mutual Exclusive Sleep Awake Distributed Clustering) was our proposed work in [21]. This protocol works in homogeneous environment. By homogeneous we mean that initially all the deployed sensors had same battery life. Formation of good quality cluster head which helps in prolonging lifetime of Wireless Sensor Network was the main goal of MESADC protocol. In this protocol cluster headâĂŹs were chosen on the basis of Sleep-Awake mode in mutual exclusive way under communication range. Figure.1 shows model for MESADC protocol. For enhancing the lifetime of wireless sensor network we proposed a clustering protocol MESAEED (Mutual Exclusive Sleep Awake Energy Efficient Distributive) in [22]. Proposed clustering protocol was an extension work to our previously proposed MESADC (Mutual Exclusive Sleep Awake Distributive Clustering) protocol. MESAEED protocol includes parameters of MESADC and HEED protocols, A* algorithm of heuristic search. MESADC protocol was working on the parameters of coeval endurance, communication range, and sleep awake mode. HEED protocol working parameters includes Chprob, Snbr, and communication range. The working parameters of the proposed MESAEED protocol includes cluster head probability, coeval endurance, range of communication and A* algorithm. In the proposed work we exclude the second parameter Snbr of HEED protocol and include coeval endurance and benefits of A* algorithm of heuristic search and remaining parameters were same as HEED i.e. cluster head probability and communication range. The purpose of the heuristic function was to guide the search process in the most profitable direction by suggesting which path to be following first when there were more than one available. A* algorithm of heuristic search uses cost function. The cost function was one that tells how much resources were required to reach the final goal. Resources can be in any form like time, money, endurance, etc. In our work, we are using coeval endurance as a resource. For calculating estimating function i.e. estimated node value two parameters required first one is cost function which was in the form of coeval endurance and the second parameter was a distance which is in the

form of communication range in our work. And reason for not including Snbr parameter of HEED protocol in our proposed work was that we were not getting recently updated values. Snbr parameter totally depends upon starting level remaining energy. Due to which we were not getting recently updated values. So to get recent update values we use the coeval endurance parameter. Because coeval endurance was calculated at each track and not dependent upon the starting level. Also, it reflects the endurance determinant of previous cluster heads. With the help of coeval endurance, decision making will be more effective. Figure.2 shows the model for MESAEED protocol.

3. Experimental Results

For simulating MESADC, MESAEED and HEED on NS2-(Allinone-2.34) the terrain size considered was 1500*300 and the antenna used was Omni directional. Rest parameters were shown in Table 4.2. Figure 3 shows the energy consumption of different routing schemes (HEED, MESADC and proposed MESAEED.) under the constraints of transmission range that varies from 20-60. In graph X axis represents transmission range and Y axis represents energy consumption. It can be observed that it remains approximately constant for HEED and it varies for MESADC and MESAEED w.r.t. transmission range. With minimum transmission range (20), it was lowest for MESADC and it was increasing for the transmission range (40-60). MESAEED consumed the highest energy with the minimum transmission range and it was slightly reduced for the higher transmission ranges. From the graph it was also clear that it performs well under transmission range of 40 as compared with other transmission range. Figure 4 represents graphical representation of Alive sensor nodes in all three cases w.r.t. transmission range. It can be observed that if transmission range is low, only MESADC has the highest number of Alive sensor nodes as compared to others. For transmission range 40, MESAEED and HEED offer more alive nodes whereas these are reduced for MESADC. In case of highest transmission range of 60, number of Alive nodes were reduced for all protocols. The graphical representation shows number of alive sensor nodes in case of MESAEED was more as compared with HEED and MESADC protocol when transmission range was 40. As transmission range increases from 20 to 40 and from 40 to 60 the number of Alive sensor nodes decreases. Figure.5 shows the End-to-End Delay comparison

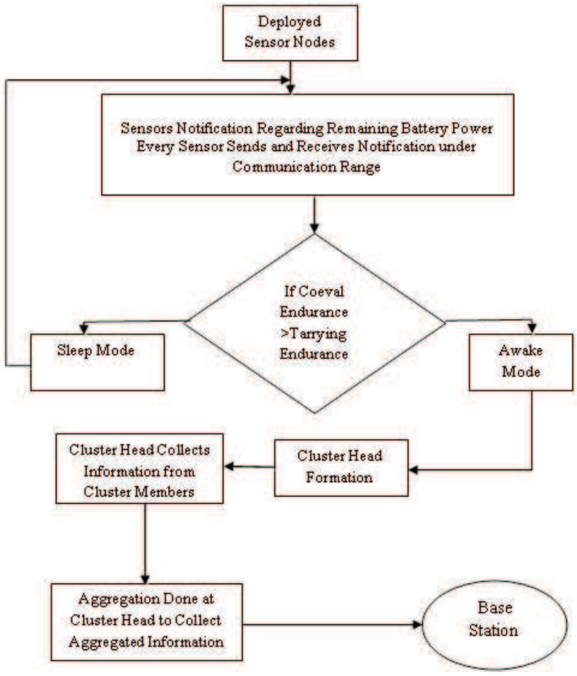

FIGURE 1. MESADC model

of different routing schemes under the constraints of transmission range that varies from 20-60. It can be observed that it varies for HEED and MESAEED and sharply increases for MESADC w.r.t. transmission range. In case of transmission range 20, it was minimum for MESADC and highest for other protocols. For higher transmission ranges, it was reduced for HEED and MESAEED.

4. CONCLUSION

The previously proposed MESADC and MESAEED protocol was capable of performing clustering. It outperforms generic clustering protocol on various factors. It also helps in solving network objectives. With the help of proposed protocols network can survive for a longer time. Along with this optimal transmission range was also found. All the three protocols perform well when transmission range was 40. Energy consumption was less during communication. Balanced clusters will be there in proposed protocols.

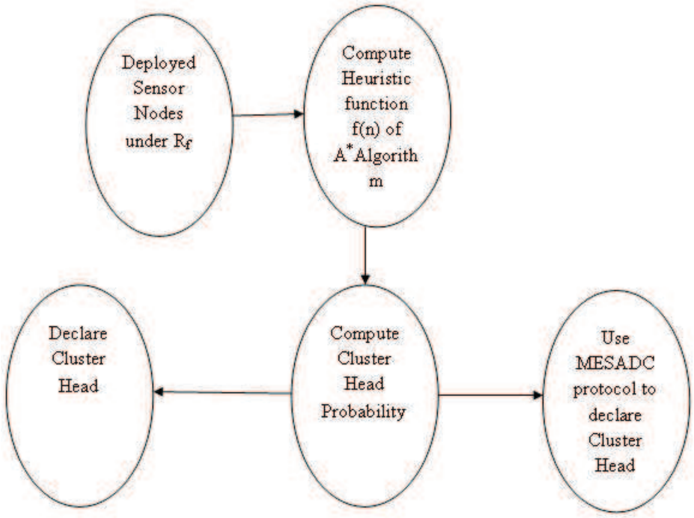

FIGURE 2. MESAEED model

TABLE 1. Simulation Parameters - II for MESAEED

Simulation Parameters	
Sensor Nodes	100
Link-layer	RCA Link Layer
Sensor Mac protocol	Mac/Sensor
Queue	Drop Tail Queue
Max packets in if q	100
Wireless channel	Phy/Wireless Phy
Antenna type Antenna height	Omni Antenna Omni directional antena 1.5
Energy	10 joules
Terrain size	1500*300
Transmission Thresh over Range #20 Transmission Thresh over Range#40 Transmission Thresh over Range#60	0.000170557 0.000341115 0.000511672

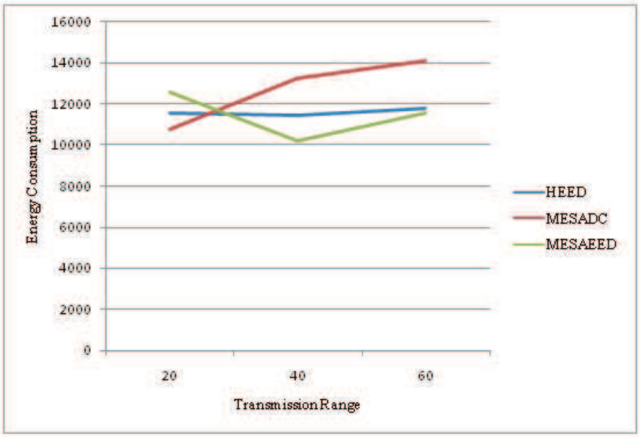

FIGURE 3. Comparative Graph of Energy Consumption

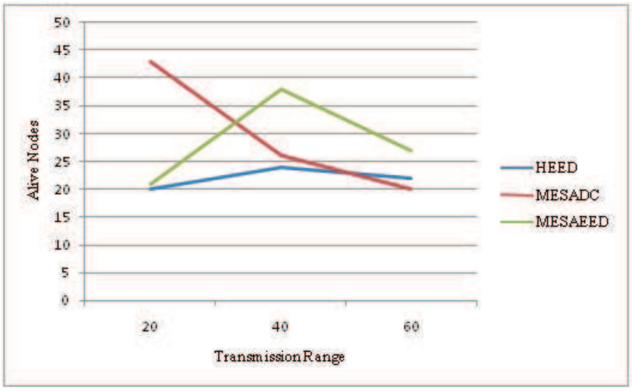

FIGURE 4. Comparative graph of Alive Sensor Nodes

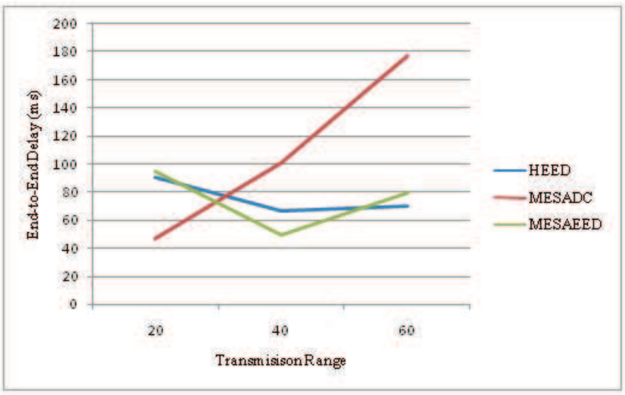

FIGURE 5. Comparative graph End-to-End Delay

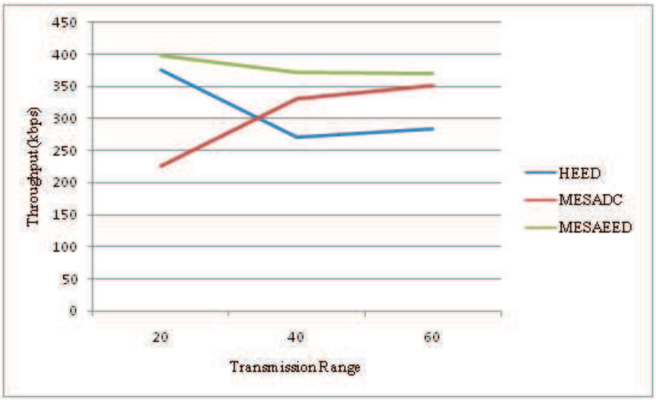

FIGURE 6. Comparative Graph of Throughput

REFERENCES

[1] N. SHIGEI, H. MIYAJIMA, H. MORISHITA, M. MAEDA: *Centralized and Distributed clustering methods for energy efficient wireless sensor Networks*, Proceedings of the International Multi Conference of Engineers and Computer Scientists IMECS, **1** 2009.

[2] A. A. ABBASI, M. YOUNIS: *A survey on clustering algorithms for wireless sensor networks*, International journal computer communication, **30**(14–15) (2007), 2826–2841.

[3] O. YOUNIS, M. KRUNZ, S. RAMASUBRAMANIAN: *Node Clustering in Wireless Sensor Networks: Recent Developments and Deployment Challenges*, IEEE international journal of Network, **20**(3) (2006), 20–25.

[4] V. MHATRE, C. ROSENBERG: *Design guidelines for wireless sensor networks communication, clustering and aggregation*, Elsevier Ad Hoc Networks, **2**(1) (2004), 45–63.

[5] B. GUPTA, S. RANA: *Energy Conservation Protocols in Wireless Sensor Networks: A Review*, IJFRCSCE International Journal on Future Revolution in Computer Science and Communication Engineering, **4**(3) (2018), 16–20.

[6] B. GUPTA, S. RANA, A. SHARMA: *An Efficient Data Aggregation Approach for Prolonging Lifetime of Wireless Sensor Network*, International Conference on Innovative Computing and Communications. Advances in Intelligent Systems and Computing, **1059** Springer Singapore 2020.

[7] B. GUPTA, S. K. GOYAL, A. OBEROI: *A Review On Query Clustering Algorithms for Search Engine Optimization*, IJARCSSE, **2**(2) (2012), 33–44.

[8] C. Y. CHONG, S. P. KUMAR: *Sensor networks: evolution, opportunities and challenges*, Proc IEEE, **91**(8) (2003), 1247–1256.

[9] I. F. AKYILDIZ, W. SU, Y. SANKARASUBRAMANIAM, E. CAYIRCI: *A survey on wireless sensor networks*, IEEE Common. Mag., **41**(8) (2003), 102–114.

[10] U. CETINTEMEL, A. FLINDERS, Y. SUN: *Power-efficient data dissemination in wireless sensor networks*, Proceedings of the ACMMobiDE'03, 2003.

[11] A. MANJESHWAR, D. AGRAWAL: *TEEN: a routing protocol for enhanced efficiency in wireless sensor networks*, Proceedings of the IEEE IPDPS 2001, 2009–2012.

[12] C. F. HEIN, M. LIU: *Network coverage using low duty-cycled sensors: random and coordinated sleep algorithms*, Proceedings of the IPSN'04, 2004.

[13] J. SEN: *A survey on wireless sensor network security*, CoRR, 1011.1529, 2010.

[14] A. MANJESHWAR, D. P. AGRAWAL: *TEEN: A Routing Protocol for Enhanced Efficiency in Wireless Sensor Networks*, IEEE 15th international conference on parallel, 2001.

[15] Y. YANG , H. H. WU, H. H. CHEN: *Short: Shortest hop routing tree for wireless sensor networks*, International Journals of sensor networks, **2** (2007), 368–374.

[16] O. YOUNIS, S. FAHMY: *HEED: A Hybrid, Energy Efficient, Distributed Clustering Approach for Ad-hoc Sensor Networks*, IEEE transaction on Mobile Computing, **3**(4) (2004), 366–379.

[17] S. YI , J. HEO , Y. CHO, J. HONG: *PEACH: Power efficient and adaptive clustering hierarchy protocol for wireless sensor networks*, Elsevier International Journal of Computer Communication Network Coverage and Routing Schemes for Wireless Sensor Networks, **30** (2007), 2842–2852.

[18] C. LI, M. YE, G. CHEN, J. WU: *An energy-efficient unequal clustering mechanism for wireless sensor networks*, Proceedings of the 2nd IEEE International conference on performance,computing,and communication IPCCC, 2005, 535–540.

[19] W. B. HEINZELMAN, A. CHANDRAKASAN, H. BALAKRISHNAN: *Energy-efficient communication protocol for wireless microsensor networks*, System sciences, Proceedings of the 33rd annual Hawaii international conference, 2000.

[20] W. B. HEINZELMAN, A. P. CHANDRAKASAN, H. BALAKRISHNAN: *An application-specific protocol architecture for wireless microsensor networks*, Wireless Communications, IEEE Transactions, **1**(4) (2002), 660–670.

[21] B. GUPTA, S. RANA: *Mutual Exclusive Sleep Awake Distributive Clustering (MESADC): An Energy Efficient Protocol for Prolonging Lifetime of Wireless Sensor Network*, IJCSE International Journal of Computer Sciences and Engineering, **6**(4) (2018), 1–7.

[22] B. GUPTA, S. RANA: *Mutual Exclusive Sleep Awake Energy Efficient Distributive (MESAEED) Clustering: An Approach for Enhancing lifetime of Wireless Sensor Network*, JCTN Journal of Computational and Theoretical Nanoscience, **16**(9) (2019), 3925–3931.

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MAHARISHI MARKANDESHWAR (DEEMED TO BE UNIVERSITY)
MULLANA, AMBALA, HARYANA, INDIA
E-mail address: bhupeshgupta81@gmail.com

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING
MAHARISHI MARKANDESHWAR (DEEMED TO BE UNIVERSITY)
MULLANA, AMBALA, HARYANA, INDIA
E-mail address: dr.sanjeevrana@yahoo.com