International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-10, Issue-2, February 2020

Energy Efficient Single Path with Multi Hop Routing Protocol for Mobile Coordinated Wireless Sensor Networks

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***Abstract*—The mobile access coordinated wireless sensor network (MC-WSN) is an energy efficient scheme for time-sensitive applications. In conventional sensor networks with mobile access points (SENMA), the mobile access points (MAs) traverse the network to collect information directly from individual sensors. While simplifying the routing process, a major limitation with SENMA is that data transmission is limited by the physical speed of the MAs and their trajectory length, resulting in low throughput and large delay [2]. This problem is resolved by the MCWSN architecture, for which a major feature is that: through active network deployment and topology design, the number of hops from any sensor to the MA can be limited to a pre-specified number. The optimal topology design for MCWSN that minimizes the average number of hops in multi-hop using single path is implemented and throughput analysis is done using energy as the criteria. Putting MC-WSN in the bigger picture of network design and development, the topology is provided network modeling and characterization. flexibility. Under this general framework it can be seen that MCWSN reflects the integration of structure to ensure reliability/efficiency and ad-hoc enabled flexibility.**

***Index Terms*— MCWSN, CCH, CH, SN, MA, UAV, throughput, energy efficiency.**

I. Introduction

A wireless sensor network (WSN) consists of sensor nodes capable of collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to one or more sinks, generally via multi-hop communication. Wireless sensor network has been identified as a key technology in green communications, due to its indispensable role in both civilian and military applications, such as reconnaissance, surveillance, environmental monitoring, emergency response, smart transportation, and target tracking. . The sensor nodes are typically expected to operate with batteries and are often deployed to not-easily-accessible or hostile environment, sometimes in large impossible to replace the batteries of the sensor nodes. On the other hand, the sink is typically rich in energy. Since quantities. It can be difficult or The sensor energy is the most precious resource in the WSN, efficient utilization of the energy to prolong the network lifetime has been the focus of much of the research the WSN. The communications in the WSN has the many-to-one property in that data from a large number of sensor nodes tend to be concentrated into a few sinks. Since multi-hop routing generally needed for distant sensor nodes from the sinks to save on energy, the nodes near a sink can be burdened with relaying a large amount of traffic from other nodes. Sensor nodes are resource constrained in term of energy, processor and memory and low range communication and bandwidth. Limited battery power is used to operate the sensor nodes and is very difficult to replace or recharge it, when the nodes die. This will affect the network performance. Energy conservation increases the lifetime of the network. Optimize the communication range and minimize the energy usage, we need to conserve the energy of sensor nodes .Sensor nodes are deployed to gather information and desired that all the nodes works continuously and transmit information as long as possible. This addresses the lifetime problem in wireless sensor networks. Sensor nodes spend their energy during transmitting the data, receiving and relaying packets.

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II. RelatedWork

[1]Mobile coordination wireless sensor networks an energy efficient schema for real time transmission is a active network deployment with decreasing delay time and by not using much energy.

[2]In SENMA there are randomly deployed “low power sensors are architecture by a few powerful mobile access point. UAV’s has been utilized in WSN Energy efficient over multi hop and ad hoc networks not scalable, power inefficient.

[3]The Performance analysis of wireless sensor networks with mobile sinks does, sensors each route its information to nearest collection point through multi hop then data is delivered to the sink when it visits the corner location. Data collection rate Performance to be increased, data collection to be increased network life time.

Wireless sensor network (WSN) is a promising technology that can revolutionize the way we observe and interact with the physical world. A typical WSN consists of a static sink and many static sensors, which are powered by a battery. Moreover, a sensor usually sends its data to the sink by a multi-hop wireless route that comprises many sensors.

[4]Distributed architecture for a robotic platform with aerial sensor transportation and self-deployment capabilities has the advantage of self deployment with the real time UAV’s. But it is not robust and it is cost effective.

[5] Autonomous deployment and repair of a sensor network using an unmanned aerial vehicle states that it can observe the network deployment through UAV's has also been explored. It is not robust.

[6]The Collaborative compressive spectrum sensing in a UAV environment, consumes energy at MA. SENMA improves energy efficiency of each sensor. Where the small altitude UAV serves as MA that collects information for survalliance reconnaisance collaboration spectrum sensing, it combine distributed and compressive spectrum sensing, and enhance it by introducing collaboration. Specifically, we examine how we can improve the decoding of compressive measurements from one sensor by utilizing the decoded results from another. As we will see, the benefit of collaborative decoding can be substantial. It will refer to the resulting scheme as collaborative compressive spectrum sensing (CCSS).The UAV receives compressed measurements from ground sensors, and performs decoding for all of them. By leveraging its center role of knowing the decoded results for all ground sensors, the UAV implements collaborative decoding.

[7]Here the data transmission scheme is done using mobile sink in static wireless sensor networks

[8]An energy-efficient routing protocol for wireless sensor networks with a mobile sink is a new network setup with mobile sink. Certain nodes along a ring in the network are informed about the sink. Data transmission done by process acquires sink location and then to the anchor node which is nearest sink location and then it reach to the destination sink . Here overhead associated with sink location acquisition.

[9]One throughput capacity of sensor networks with mobile relays Mobile relays are utilized to facilitate data collection. And would be inefficient in terms of energy consumption as well as delay. Here the advantage is data collection rate. Based on the proposed MRADC model, we investigate the throughput capacity of large-scale WSNs using a constructive approach, which can achieve a certain throughput by choosing appropriate mobility parameters, such as the travelling speed, travelling distance, and other timing parameters. Our analysis then the throughput illustrates that, if k is less than threshold k, capacity can be linearly increased with the increase in k. On the then the throughput capacity is a constant ,other h
and, if k > k, and the capacity gain over a static WSN depends on two factors:1) the transmission range and 2) the impact of interference. To verify our analysis, we conduct extensive simulation experiments, which validate the selection of mobility parameters in the constructive approach and demonstrate the same throughput behaviours obtained by analysis
[10]Architecture design of mobile access coordinated wireless sensor networks.

[11]Mobile access coordinated wireless sensor networks –topology design and throughput analysis.

III. METHODOLOGY

A. *Existing system:*

In SENMA, the mobile access points (MAs) traverse the network to collect the sensing information directly from the sensor nodes. Each sensor routes its information to the nearest collection point through multi hop routing, then data is delivered to the sink when it visits the corresponding location. A major limitation with SENMA is that a transmission is made only if an MA visits the corresponding source node; lead to low throughput and large delay. SENMA it notifies the "Beacon Signals" which are coming from MA. That means no node here will not be in "sleep state". It should be in "alert state every time. By this the energy of the nodes gradually drops downs and leads to the network failure of the system.

B. Problem Statement:

MCWSN(Mobile coordinated wireless sensor networks) the hop number from the source to destination is considered to pre-specified one count and so delay can be managed ,and is Independent of physical speed of MA. So that MCWSN can provide the optimal shortest path and reflects the integration of structure ensured reliability/efficiency and ad-hoc enabled flexibility.

C. Proposed System:

The MA point coordinates the sensors and resolves the node deployment issue as well as the energy consumption problem of wireless sensor networks. More specifically, the mobile access point are responsible for:

(i) Deploying and sensing nodes,

(ii) Replacing and recharging nodes by control channel in MAC,

(iii) Collecting the information from sensors and delivering it to a MA.

IV. MCWSN IMPLEMENTATION

The network firstly, it is divided into cells of radius *d*. Each cell contains a single powerful mobile access point (MA) and *n* uniformly deployed sensor nodes (SNs) that are arranged into Network of clusters heads. Each cluster is managed by a cluster head (CH), to which all the cluster members report their data. CHs then route the data to the MA [10][11]. A powerful center cluster head (CCH) is employed in the middle of each cell, The CCH can establish direct communication with the MA .All nodes within a distance *Ro* from the CCH route their data to the MA through the CCH. All other nodes route their data to the MA. If a sensor is within the MA's coverage range, then direct communications can take place when permitted or needed. After receiving the data of the sensors, the MA delivers it to a Base Station (BS). The overall network architecture is illustrated below, the number of hops from any sensor to the MA can be limited to a pre-specified number through the deployment number of CCH [1].

MCWSN-50 NODE/180 NODE

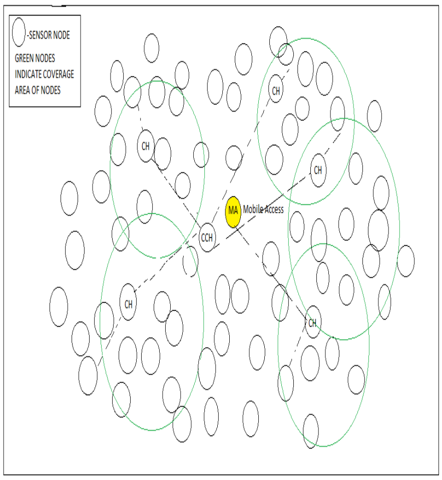
The following figure is 50 node MCWSN topology frame work which has been introduced now. Yellow circles indicates the MA (Mobile Access) oval shape indicates the nodes. That green circles indicate the coverage ranges of that particular CH (cluster heads).The passing of messages is indicated by that dotted line, that is done by ADHOC process i.e., by temporary dynamically forming of networks (Technically by AODV) in NS2. Here the message passing is done in this following manner.

SN→CH→CCH→MA→BS

In MCWSN every node has a packet to transmit. All the node here including SN, CH AND CCH severs as relay (ON/ OFF) nodes. That means when the work is assigned it has should move on to alert state from the sleep state. The routing protocol (AODV- Ad-hoc on demand distance vector) | determines the hop number from source to destination. The network performance is generally defined as amount of information that can be successfully transmitted over the network i.e., throughput independent of physical speed of MA determined by network protocol. Sensor nodes does not involve in inter cluster process and saves energy.

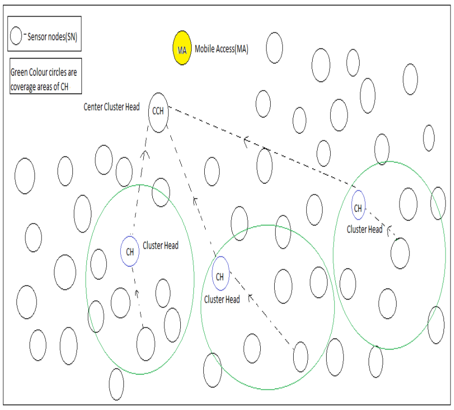
MCWSN 50 NODES

MCWSN 180 NODE
DIAGRAM



Cluster Head Selection Process

- All member of the cluster are asked to generate a energy value of it.
- And if the energy level is less than a pre determined assumed threshold value that particular node becomes a cluster head for the current round.
- Thus energy levels of the sensors are compared then the node with highest energy can act as a CH.
- In this process if more than one node have same energy (highest value), then they have to generate a random number in both the numbers.
- Once a node is acted as a cluster head, it cannot become the cluster head next time onwards.



Proposed MCWSN Architecture

Sensing and Data Collection

During the initial network setup phase basic nodes (sensor nodes) within each cluster are informed about their schedules to transmit to corresponding CH, and informed about their schedule to transmit to CCH. For Ad-hoc routing among CH's before packet reach's its CCH "CSMA (carrier sense multiple access)" is used. For each relay CH the nearby CH would first verify absence of traffic in channel before transmission. CH detects the channel is busy it waits for random period and try again. The waiting time of each CH is exponentially distributed and its mean is proportional to the inverse of the number of CHs it relays. CHs that relay the same number of packets will have equal opportunity of transmission. In such cases the node which is near to CCH can directly go to CCH, so that the waiting delay time does not come into existence. This phenomenon has overcome from LEACH. By this it proves MCWSN is better than LEACH (low energy adaptive clustering hierarchy).

Energy efficiency

When the energy of the node (CH) has low remaining energy (over heads) it sends a "Control messages" to MA notifying it with energy levels. This whole process done in MAC(medium access control) layer. In case of "retransmission of packets", exist a schedule such that from source CH to all its intermediate relays are assigned, time slots to "transmit/ forward" the source data. If transmission in all slot get stopped then, it will drop the slot index from throughput expression and "amplify and forward" protocol is adopted. In case of complexity and delay at all hops "decode and forward" is employed at intermediate CH's**.**

$$E_{SN,M} = E_{tx} + \epsilon_{pa} \; \gamma_c^{\beta} \; \text{(J/bit)}$$

Maximum energy dissipation in a node to transmit a bit to its CH is above, when the control message is received by MA , at that time calculates with this formulae here p is consumed amplifier; gamma is the per hop distance; beta is the path loss exponent; J is joules per bit.

3.4Network topology design

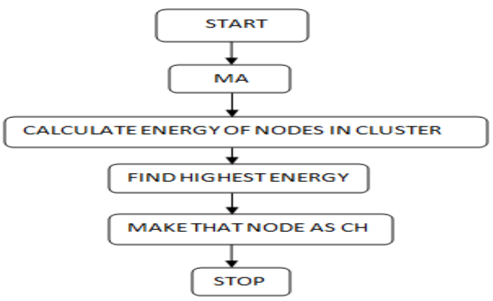
Here X is the distance from the CH to the center of the cell, Θ is the angle of the CH in the polar system with CCH as the origin. f(θ) denote the probability density function (PDF) of X and Θ, respectively. Here, we approximate the hexagonal cell with a circularly-shaped cell. CHs are uniformly distributed in a circle of radius d , then fX(x) can be approximated by fX(x) = 2x d2 , and the PDF of Θ is modeled as f(θ) = 1 2 , ∀θ ∈ [0, 2π]

$$d^2 = 2k\left[\int_{\theta=0}^{\pi/k}\int_{x=0}^{R} x^2\ fx(x)\, f\Theta\, dx\, d\theta\right]$$

The algorithm given below explains about the transmission to find the high energy node in cluster.

- **Step 1**: Generate all the possible nodes.
- **Step 2**: Calculate the TEnode (total energy of the node) for each node of each route .
- **Step 3**: Check the below condition for each route till no route is available to transmit the packet. If (RBE < = TEnode) Make the node into sleep mode. (route bandwidth energy) else
  Select all the routes which have
  active nodes end
- **Step 4**: Calculate the total transmission energy for all the selected routes.
- **Step 5**: Select the energy efficient route on the basis of minimum total transmission energy of the route.
- **Step 6**: Calculate the RBE for each node of the selected route.
- **Step 7**: go to step 3.
- **Step 8**: End.

Protocol Description: Operations at Source:



V. RESULTS AND DISCUSSION

Tested the simulation output with NS2 simulator and got a two type of results, one is NAM, and X graph. The results are compared between SENMA and MCWSN.

A. Probability density rate: The number packets delivered at constant delivery rate.
B. Energy Consumption: The total energy consumption is the summation of the transmitting and receiving energy cost at the source, destination and relay.
C. Delay: The delay of a network specifies how long it takes for a bit of data to travel across the network from one node or endpoint to another. It is typically measured in multiples or fractions of seconds.
D. Throughput: The throughput metric measures how well the network can constantly provide data to the sink. The throughput is the number of packet arriving at the destination per seconds.

Table: 5.1: PDR (Probobility density rate)

TIME	SENMA(Ex)	MCWSN(Pr)
0	0	0
1	15850	15669
2	18400	16489
3	18415	19466
4	18891	19421
5	18458	19400
6	18485	19465
7	18889	19654

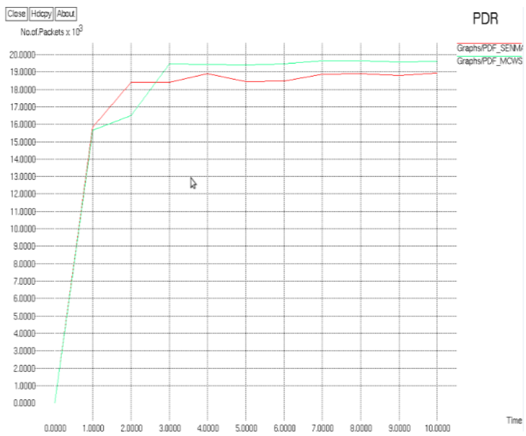


Fig: 5.1PDR (Probobility density rate)

PDR: The number of packets delivered at constant rate.The graph represents the time on X-axis and number of packets on Y-axis. Red line indicates the existing system (SENMA) and the green line indicates the proposed system (MCWSN).

Table 5.2: ENERGY

TIME	SENMA(Ex)	MCWSN(Pr)
0	100	100
1	976	97.6
2	94.23	95.14
3	90.25	93.14
4	87.1	90.25
5	84.1	88.36
6	80.245	85.145
7	76.89	81.145
8	71.69	79.145
9	67.852	79.14

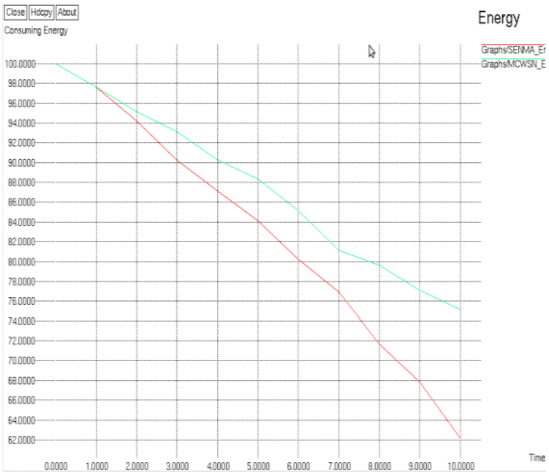


Fig: 5.2 Graph represents the Energy graph

The proposed system energy point is more than the existing ones. On X-axis it indicates time and on Y-axis consuming energy. Red line indicates the existing system and green line indicates the proposed system. Energy of green line is more that means the energy is not consumed more in this system.

Table 5.3: DELAY

TIME	SENMA(Ex)	MCWSN(Pr)
0	0	0
2	2.166	0
4	2.197	1.163

Fig:5.3Graph represents Delay.

The X-axis shows the technology and the Y-axis show time. Red bar indicates the existing SENMA, Green bar indicates the existing WCWSN. Here in new system delay has decreased from past system.

Table : 5.4: THROUGHPUT

TIME	SENMA(Ex)	MCWSN(Pr)
0	0	0
2	16543	17365
4	23966	19356
6	24017	20564

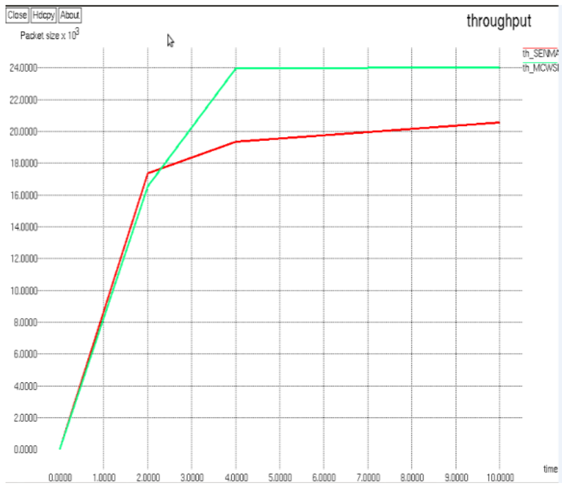


Fig: 5.4 Graph explains about the Throughput (bps)-bits per second.

It indicates that number of packets delivery at constant deliver rate.

The above graph represents the throughput by taking the time on X-axis and packet sec*10^3 on the Y-axis. Red line indicates the existing system and green line indicates the proposed system.

VI CONCLUSION

Mobile access coordinated wireless sensor networks (MC-WSN) architecture was proposed for reliable, efficient, and time-sensitive information exchange. MC-WSN exploits the MAs to coordinate the network through deploying, replacing, and recharging nodes. The hierarchical and heterogeneous structure makes the MC-WSN a highly resilient, reliable, and scalable architecture. It provides the optimal topology design for MC-WSN such that "the average number of hops from any sensor to the MA is minimized". The performance of MC-WSN is analysed in terms of throughput. It shows that with active network deployment and hop number control, MC-WSN achieves much higher throughput and energy efficiency over the conventional SENMA. The analysis also indicated that with hop number control, network analysis does become more tractable. Moreover, putting MC-WSN in the bigger picture of network design and development, it provides a unified framework for wireless network modelling and characterization. Under this general framework, it can be seen that MC-WSN reflects the integration of structure-ensured reliability/efficiency.

The idea of hybrid networks, which actually reflects the “convergence of centralized and ad-hoc networks”. The evolution of the centralized and ad-hoc networks to hybrid networks indicates that: for wireless communications, we would need both network centric management as well as ad-hoc flexibility In the same time, the network should provide sufficient flexibility by following authorized ad-hoc communications among the nodes or devices.

VII. REFERENCES

[1] G. Mergen, Z. Qing, and L. Tong, “Sensor networks with mobile access: Energy and capacity considerations,” IEEE Transactions on Communications, vol. 54, no. 11, pp. 2033–2044, Nov. 2006.

[2] W. Liu, K. Lu, J. Wang, G. Xing, and L. Huang, “Performance analysis of wireless sensor networks with mobile sinks,” IEEE Transactions on Vehicular Technology, vol. 61, no. 6, pp. 2777–2788, Jul. 2012.

[3] I. Maza, F. Caballero, J. Capitan, J. Martinez-de Dios, and A. Ollero, “A distributed architecture for a robotic platform with aerial sensor transportation and self-deployment capabilities,” Journal of Field Robotics, vol. 28, no. 3, pp. 303–328, 2011. [Online]. Available: http://dx.doi.org/10.1002/rob.20383

[4] P. Corke, S. Hrabar, R. Peterson, D. Rus, S. Saripalli, and G. Sukhatme, “Autonomous deployment and repair of a sensor network using an unmanned aerial vehicle,” IEEE International Conference on Robotics and Automation, ICRA’04, vol. 4, pp. 3602–3608, May 2004.

[5] H.-C. Chen, D. Kung, D. Hague, M. Muccio, and B. Poland, “Collaborative compressive spectrum sensing in a U AV environment,” IEEE Military Communications Conference, MIL-COM’11, Nov. 2011.

[6] A. Ahmad, M. M. Rathore, A. Paul, and B.-W. Chen, “Data transmission scheme using mobile sink in static wireless sensor network,” Journal of Sensors, vol. 2015, 2015.

[7] C. Tunca, S. Isik, M. Donmez, and C. Ersoy, “Ring routing: An energy-efficient routing protocol for wireless sensor networks with a mobile sink,” IEEE Transactions on Mobile Computing, vol. 14, no. 9, pp. 1947–1960, Sept 2015.

[8] W. Liu, K. Lu, J. Wang, L. Huang, and D. Wu, “On the throughput capacity of wireless sensor networks with mobile relays,” IEEE Transactions on Vehicular Technology, vol. 61, no. 4, pp. 1801–1809, May 2012.

[9] M. Abdelhakim, L. Lightfoot, J. Ren, and T. Li, “Architecture design of mobile access coordinated wireless sensor networks,” IEEE International Conference on Communications, ICC’13, pp. 1720–1724, Jun. 2013.

[10] M. Abdelhakim, J. Ren, and T. Li, “Mobile access coordinated wireless sensor networks –topology design and throughput analysis,” IEEE Global Communications Conference, GLOBE-COM’13, pp. 4627–4632, Dec. 2013.

[11] J. Luo and A. Ephremides, “On the throughput, capacity, and stability regions of random multiple access,” IEEE Transactions on Information Theory, vol. 52, no. 6, pp.

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