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A Network Coded Mobile Agent Based Energy Efficient Data Gathering Scheme for Heterogeneous WSNS

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Abstract*: Latest centuries have observed a rising attention in organizing huge amounts of micro-sensors which cooperate in a distributed method on information gathering as well as handling. Sensors remain estimated towards being economical and might remain positioned in a huge measure in strict atmospheres which concludes that sensors remain normally operative unattended. Through inadequate battery control, Energy-efficient information distribution remains critical as sensor nodes activate. Presently, maximum energy-efficient applications in Heterogeneous wireless sensor network (WSN) remain based on the customer or server calculating model, where every sensor node sends its information towards a sink node. A sensor network's information traffic might exceed the network capability as the link bandwidth of a WSN remains normally far lower compared to that of a connected network. For reducing the energy consumption in the network, it remains verified several times that clustering is one of the favorable approaches. In this effort, for collecting the combined information openly from the CHs, here we suggest and study a new energy-effective information assembly method NCMA (Novel Energy-Efficient Data Gathering Scheme) which hires mobile representatives and cluster head (CH) consumes the charge of collaborating by the mobile representative as well as the participant nodes. For limiting the information communication in the network, Network coding and TDMA programing is utilized.

***Index Terms*:Heterogeneous WSNs, cluster head selection, TDMA, Network coding, multi-hop routing, energy efficiency, Mobile agent, Network lifetime.**

I. INTRODUCTION

WSNs are developing equally fundamental and widespread methods of delivering certain calculating atmospheres for numerous submissions owing to characteristics such as minor extent, less-price, less-power, as well as multi-purposes by improvements in wireless transmissions, micro electromechanical networks (MEMS) expertise as well as low-power electronics [1].

In these type of presentations, hundreds otherwise even thousands of less-price sensor node remain distributed greater than the controlling region, using nodes wisely established in a wireless network, wherein every sensor node occasionally informs its sensed information towards base station. While they run in unfriendly atmospheres, it remains problematic for replacing or recharging batteries of the sensor nodes.

Energy saving remains a significant subject for WSN. Several methods aimed at energy savings remain advanced, containing sleep arranging as well as media access control (MAC) procedures, routing procedures, information accumulation, topological control, etc. [2]. Amongst them, routing procedure remains a significant subject for planning WSN and may remain categorized into twofold collections: planar routing as well as hierarchical routing. Hierarchical routing typically achieves a network through separating the network to dissimilar clusters that ensure a cluster head liable in place of fusing information from cluster members thenit is transferred towards base station (BS). The gain of little energy consumption, modest routing tabletops as well as upright scalability, has prepared hierarchical routing remaina hot investigation region of WSN [3].

Entire sensor nodes remain indistinguishable in relations of battery capability and hardware difficulty in homogeneous networks. Using clustering in a homogeneous network, nodes in a cluster track information and transfers towards cluster head (CH) that sequentially collects the information which remains terminated as well as extremely connected from entire cluster members and transfers towards the base station through single-hop otherwise multi-hop. Clustering saves energy thus improving the lifespan of the network. Similarly it may remain practiced for huge sensor networks. Since it remains informal to achieve the cluster heads compared to the complete network. Clustering may remain very operative in one-to-many, many-to-one, otherwise one-to-all (broadcast) transmissions [4]. Built on hierarchical clustering in addition to a traditional hierarchical routing procedure in Heterogeneous WSNs, Low energy adaptive clustering hierarchy (LEACH) [5] remains a leading routing procedure. An excessive agreement of resolution suggestions occurs aimed at energy-efficient clustering afterward LEACH [6–12]. In Ref. [6], Mahmood et al. suggested a routing procedure named MODLEACH and cluster wouldn't alter in following stagewhenever residual energy of the head node remains above a threshold, thus the energy spent for cluster establishment might remain protected. In Refs [7–8], Zhao et al. proposed a comparable approach of choosing the cluster heads as well as their preservation, however all of Refs. [6–8] do not deliberate the transmission amongst the CH as well as BS. Indeed, in conservative heterogeneous networks, the foremost energy consumption originates after the communicating processes amid CH and the BS.

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Consequently, while scheming routing algorithms, we ought to integrate a trade-off amid distance between CH and SINK are more, we performing three objectives.

In this broadsheet, we discourse the following complications:

1) Frequent re-clustering happens due to the energy imbalance among the nodes
2) Overhead is increases particularly in inter-cluster communication
3) Large number of nodes participate in clustering
4) Re-clustering happens after certain rounds of communication due to the depletion of energy on previously elected CH's.

We solve the above problems using our proposed method it's involving with following criteria's:

- Mobile agents between CHs and SINK node
- Network coding technique
- TDMA Scheduling technique

II. EXISTING WORK

Numerous heuristics have likewise remained offered for routing in Heterogeneous WSNs. LEACH [13] remains a prevalent cluster-grounded routing procedure, which actively replaces the load of the CHs among the sensor node that remains suitable aimed at load balancing. Nevertheless, the chief drawback of this method is that a node using very small energy might remain chosen by means of a CH that might expire rapidly. Furthermore, the CHs interact with base station through single-hop that remains difficult for Heterogeneous WSNs by huge coverage region. Hence, a huge amount of procedures have been established towards improving LEACH that can remain originated in [14], [15]. In [16], author has offered a price-focused distributed energy composed clustering as well as routing procedure for CH choice and cluster establishment. Nevertheless, the procedure undergoes connectivity issue of the chosen CHs.

A sum of metaheuristic built clustering procedures has been described for Heterogeneous WSNs. Nevertheless, extreme of them have allocated using CH choice only. In recent times, a GA grounded weight composed clustering procedure for Heterogeneous WSNs [17] was suggested. The procedure customs group in such an approach that the extreme weight of every entry remains reduced and the aforementioned workings aimed at both the identical and inadequate capacity of the sensor node. The procedure consumes quicker convergence as well as improved load balancing compared to customary GA [18]. Nevertheless, it consumes the disadvantage that the CHs responsively communicate by the BS that might not remain accurate aimed at wide region networks. Furthermore, the procedure does not assume residual energy of the sensor node and gateways in cluster establishment that might direct towards varying energy consumption of the sensor node. In [19], author has offered a GA-grounded procedure for information routing amid gateways in a two-tire wireless sensor network. Selection of gateways is supported by the Roulette-wheel selection process as well as the suitability role remains well-defined using network lifespan in terms of series. A GA-grounded routing procedure named GAR was proposed where the complete transmission distance from the gateways towards the BS remains reduced [20]. Nevertheless, both of the procedures [19] [20] assume only routing of combined information from the gateways towards the BS without assuming information transmission from the sensor node towards the gateways in every cluster.

In [21],focusing on lessening the communication distance amongst the nodes in addition to lessening the amount of network overhead necessaryaimed at setting up a cluster, author presents the Energy-aware and layering-based clustering and routing algorithm (EA-CRA). It remains more problematical to scheme a network as the sum of power constrained nodes rises. This is caused by the massive overhead that arriveswhenever the network expandsenormously. Its limitations include Overhead increases particularly in inter-cluster communication when applied in highly dense networks and Re-clustering is also one of the major issue in this method as no mechanism to monitor and control the load and energy of the nodes.

In [22], author presents the Cluster-head Restricted Energy-efficient protocol (CREEP) and critically analyzed the numerousstatic heterogeneous clustering procedures and estimated their lifespan and throughput performance in mobile node setscorrespondingly.In a two-level heterogeneous WSNbytransforming the CH selection thresholds, it enhances network lifespan. Itincludes the limitation that the system complexity may increase if hugenumber of nodes partakes in the clustering method.

For extending network timeby a combining of a clustering methodin addition tooptimum relay selection procedure,author anticipated a novel routing procedure for WSNs named Novel energy aware hierarchical cluster-based routing protocol (NEAHC)in [23]. The suggestion is for determining optimal routing path commencing the source towards the destination inapprovingmaximumresidual battery power, minimal energy consumption in multi-hop path, as well asoptimal fairness between sensor nodes. Its limitation increase the work load among the cluster head nodes and energy is depleted more quickly in the CH nodes, which leads to frequent re-clustering and CH rotation. Also this method would increase the traffic at the nodes surrounding near to the sink node.

III. PROPOSED FRAMEWORK

So, to improve the clustering efficiency and to reduce the frequent re-clustering in the network, we proposed a method called NCMA. The introduction of MA's reduces the load among the CHs and the surrounding nodes. Also energy is not a primary parameter for CH selection. So CH rotation is limited and prolong for a long time. The network coded methods is used for data aggregation. The working process of proposed method shows in figure 1.

3.1 Clustering phase

At this time, we propose a LEACH-alike clustering method, where the network is subdivided into a group of clusters by single cluster head in every cluster. Communication amongst cluster head as well as Base Station remains straight. The Base Station transmits a "hello" message to entire nodes at an assured power point in the network deployment level. Using this method, every node may calculate the estimated distance for the nodes based on the expected signal power.

It supports nodes for selecting the appropriate power point for communicating through the Base Station. In cluster head selection level, finely distributed cluster heads remain selected using a slight control overhead. A new task is presented towards forming clusters in cluster development stage.

3.2 Cluster head (CH) selection phase

Many cluster heads are selected in this point. Towards advertising their determinations, Nodes turn out to be CANDIDATE nodes through a possibility T and then transmit the COMPETE_HEAD_MSGs inside radio extent R. Every CANDIDATE node verifies whether here exists a CANDIDATE node by small distance in the range R. When the CANDIDATE node discovers an extra significant CANDIDATE node, it will hand over the competition without getting sub-consecutive COMPETE_HEAD_MSGs. It will remain selected as HEAD in the conclusion otherwise.

3.3 Cluster formation

In this stage, every HEAD node transmits the HEADAD-MSG across the network while the PLAIN nodes accept all the HEAD_AD_MSGs and select which cluster to link. The metric for PLAIN nodes for making choices remains the distance metric. For instance, the PLAIN nodes select the cluster head that demand least communication towards the established signal strength. Nevertheless, tracking effective energy consumption of the PLAIN nodes merely direct HEAD nodes drained fast throughout the information communication level.

3.4 Network coding technique

The package dealing out process of a node in the network coding layer is presented. Every single node in the network coding layer preserves a received queue (RecvQueue ()) as well as a sensed queue (SensQueue ()). By getting a package Pi, a node places the package in RecvQueue (Pi). Suppose the package remains previously administered using the node than it is rejected, or else the node practices the package additionally. The node verify its role from EncoderNodeSet (), whether it is an encoder or else a modest transmit nodule. Suppose the package is a natural (non-coded) package and the node remains an encoder, the nodule appeals the technique XorEncode (). The node conveys the coded packet towards the sink on effectively producing an encrypting packet. The processed package remains implanted in the forwarding set ForwardSet () that stocks forward packets and support in confining additional terminated broadcasts. Nevertheless, the arrived package Pi is formerly an encoded package and it remains rejected by the node. Additionally, if the node is a decoder, it performances by means of an unsure relay and transmits the estimated packet Pi towards the Drop.

3.5 Decoding of packets

The sink node or else the delivery node obtain natural packages from the modest relay nodes as well as coded packets from the network coder node. In COPE the internal node encrypts and decrypts packets. The sink preserves a group of packets, in which it stores every customary native packet. The sink recovers the equivalent native packets in sequence from the group of packets when the sink accepts an encrypted packet containing of ˆ k native packets. The Drop XORs the ˆ k − 1 native packets using the received coded packet recover the misplaced packet that remains completely misplaced or else delivered by fault at the sink.

3.6 TDMA scheduling

The bandwidth of frequency is shared among several stations on the basis of interval in TDMA. Every single location is assigned by a period opening through which it may deliver its information i.e. every location could convey its statistics in its assigned time slot. Every single location need to recognize the starting of its slot as well as the position of its slot. TDMA involves synchronization amid dissimilar locations. Synchronization remains attained by means of consuming certain synchronization bits (preamble bits) on the opening of every slot. Though they remain theoretically same, TDMA remains altered from TDM. TDM remains a physical layer method which groups the information from relaxed networks and communicates then by means of consuming a quicker network. This procedure implements the physical multiplexer. TDMA, on other hand, remains an admission technique in the data link layer. The data link layer in every station expresses its physical layer to practice the assigned time slot. There is no physical multiplexer at the physical level.

3.7 Flow Chart

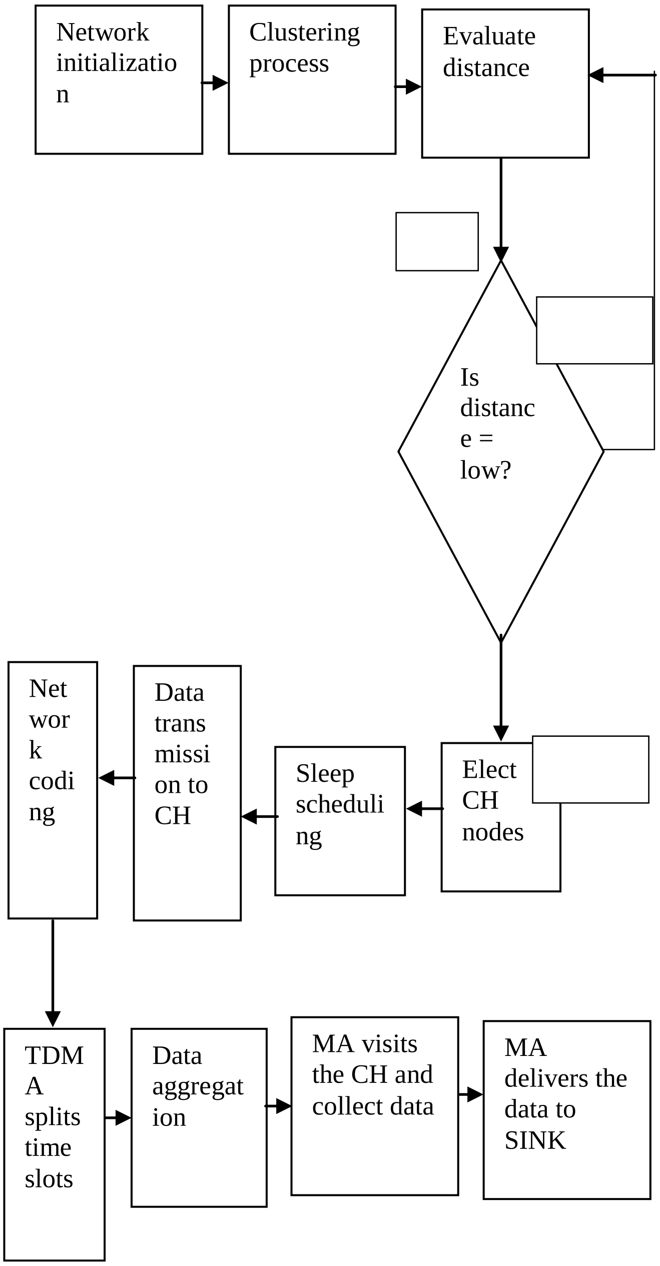

Fig. 1: Flowchart of Proposed method

IV. RESULTS AND DISCUSSION

Byachievingrelative simulations,wecalculate the realization of NCMA. Byconsuming Network simulator-2,the anticipatedprocedure, NEAHC, EA-CRA, and CREEP protocols are simulated.Aimed at NEAHC, EA-CRA, CREEP protocols and NCMA, the energy model appliedremainsequal. 76 sensor nodes remainaccidentally deployed in a geographical area A of dimension 1000 m x 500 minthe presenting simulation. Significantlimitations for our simulation are presented in table 1.

Table 1 expresses the network parameters employed in our simulations. In this paper, with the intention of simplifying scheduling for the mobile sink, we accept that the information gathered using sensor nodes remains the deferral tolerant information i.e. they can wait for the mobile sink to come and boost them up.

Weassume the resulting metricsaimed atstudying and comparing the presentation of our protocol by existing protocols.

1) Network performance: The number of transmitted packets evaluated by Megabits per sec.
2) Propagation Delay: The propagation of a packet from source node to destination node in an average time.
3) Energy consumption: The overall energyutilized by the nodes in the network.

Table1: Simulation Specifications

Parameter	Value
Application traffic	CBR
Transmission rate	512 bytes / 0.05ms
Communication range	250m
Data Packet size	4096 bits
Number of sensor nodes	76
Number of simulation iterations	220
Initial energy	100j
Network area	1000x500
Number of clusters	8
Routing methods	NCMA, EA-CRA, CREEP, NEAHC.
Routing protocol	AODV

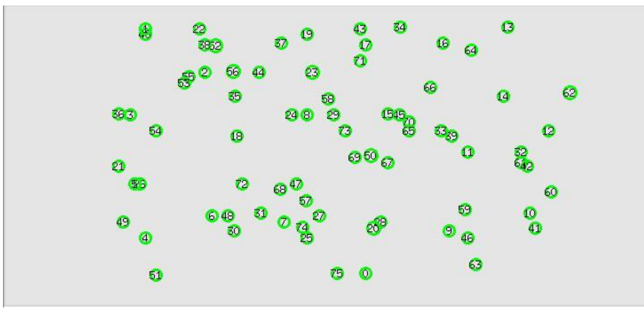

Fig. 2: Network deployment

Figure2 represents the network deployment. All the nodes are physically located in anindiscriminate way.

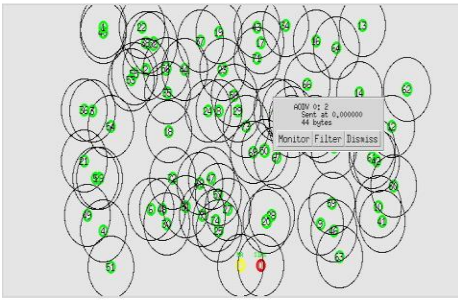

Fig.3: Broadcasting in network

Figure3 represents the broadcasting process in network. Here all the nodes request their neighbor nodes for route reply. In this network, routing protocol decides the RREQ and RREP processes.

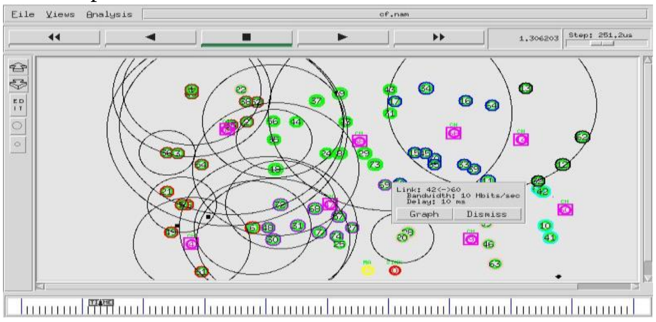

Fig.4: Cluster member to Cluster head transmission

Figure4 represents the cluster member to cluster head data transmission. After cluster formation, cluster heads are selected based on their distance from node to node in each cluster. Here link must be represented between the cluster member and cluster head process.

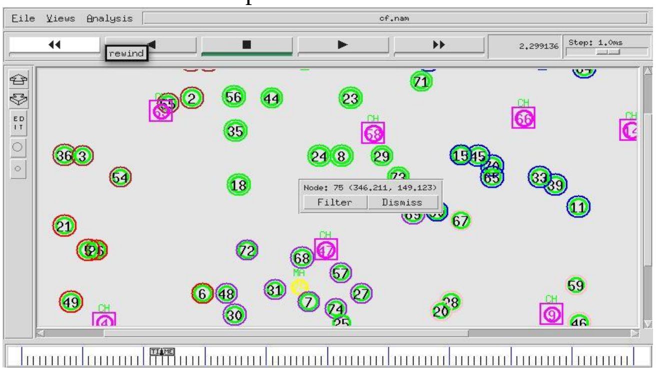

Fig. 5: Mobile node moving to nearby CH

Figure5 represents the mobile node movement in network. Here mobile node starts travelling towards CH nodes from SINK node.

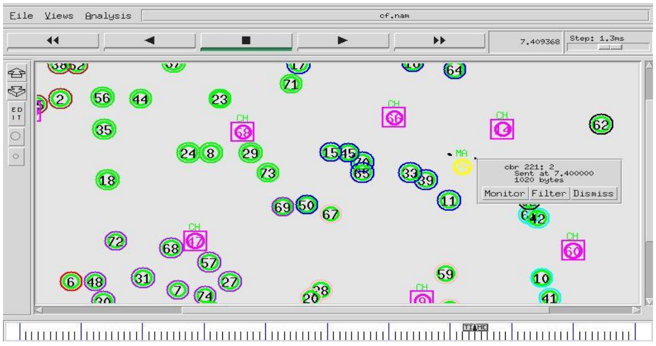

Fig. 6: CH to MA Data transmission

Figure6 represents the cluster head (CH) to mobile agent (MA) data transmission. Here MA collects the data from all the cluster heads while travelling in network.

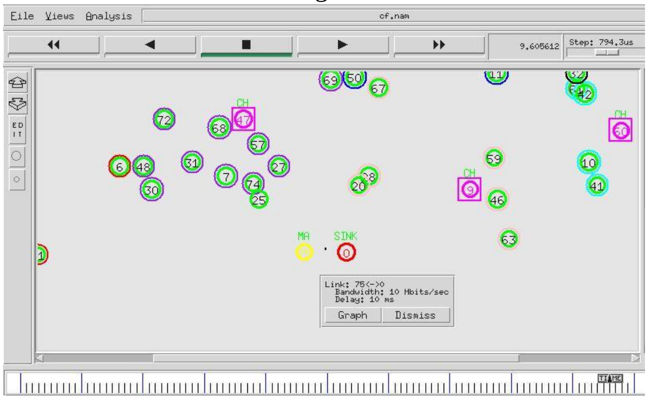

Fig. 7: MA to SINK data transmission

Figure7 represents mobile sink as SINK node data transmission. Here SINK node collects all the data present in the MA. In this figure, SINK node act as data storage point.

We analyze network performance of EA-CRA, CREEP, NEAHC, and our protocols.Asthe network progresses,westudy the technique of simulation time variation.Itremainsfair that the anticipated protocol consumesenhanced throughput compared to existing protocols in figure 8.

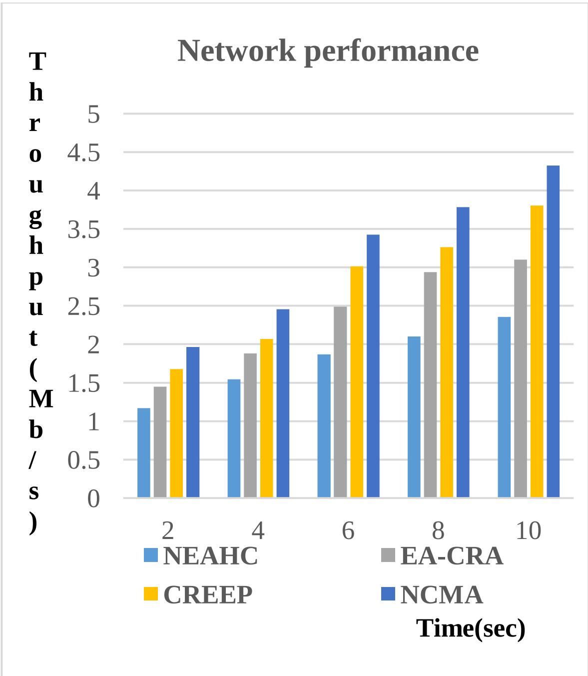

Fig8: Throughput

Figure 9 shows delay of network. For large networks, some data packets remain delayed sincespecific cluster heads doesn't existin the range of others. Delay of network is suitable for proposed protocol than EA-CRA, CREEP, and NEAHC.

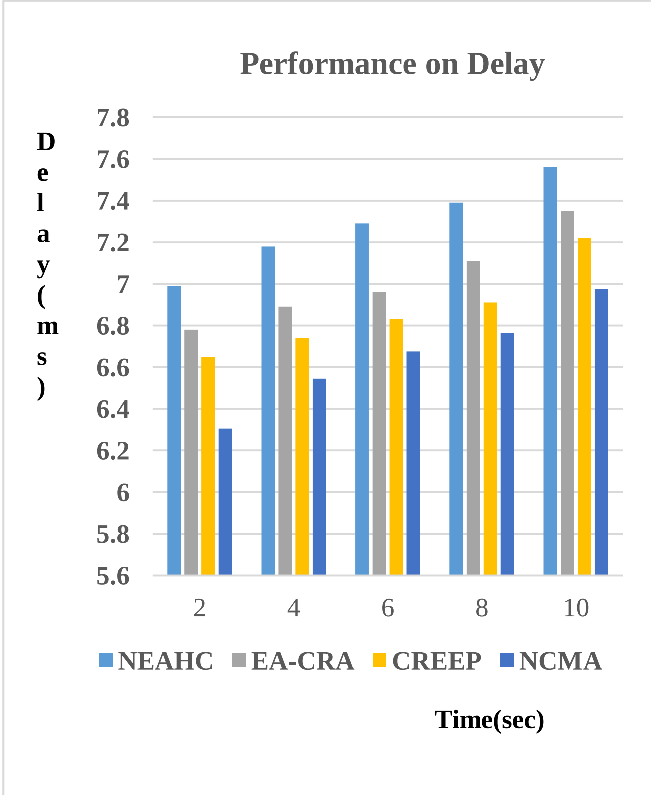

Fig9: End to End Delay

In figure 10, the proposed protocol has less energy consumption than EA-CRA, NEAHC, and CREEP because of choosing a multi-hop path with minimum communication cost.

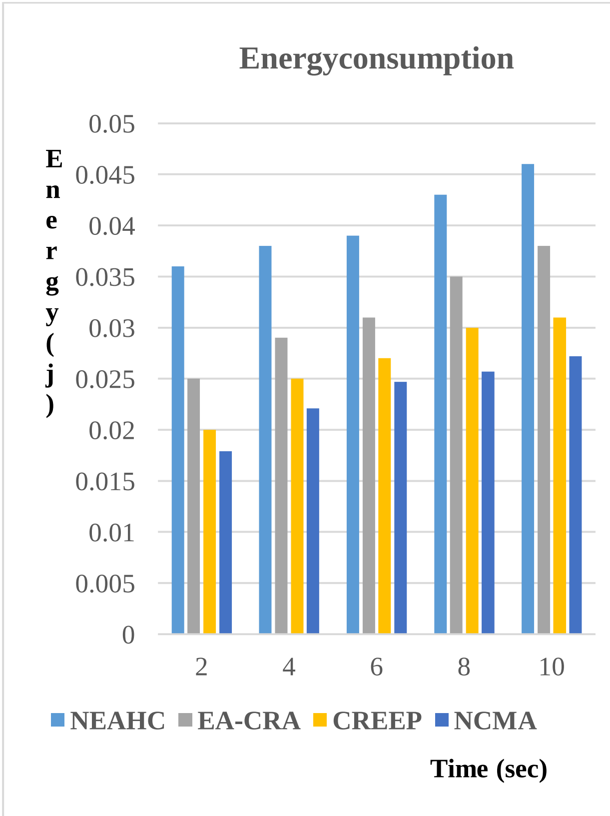

Fig10: Energy consumption

V. CONCLUSION

Achieving Energy efficiency is the major task for WSNs, since these networks are energy constrained. Most of the previously proposed clustering algorithms achieves energy efficiency in intra clustering but failed to maintain the tradeoff between inter and intra cluster routing. In this paper, we proposed a novel energy-efficient data gathering scheme (NCMA). This method employs moving sinks between the BS and CHs to collect the data that are aggregated using network coding technique. This would reduce the communication overhead between BS and CHs. Time division based scheduling is used for reducing the redundant data transmission. The simulation outcomes show that the proposed NCMA completely outperforms the protocols like EA-CRA, NEAHC, and CREEP and improves the network lifetime. In this paper, 30% improvement of the anticipatedscheme over the existentschemesconsidered stands observed with respect to the performance parameters given.

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