ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

PERFORMANCE COMPARISON OF DRAGONFLY AND FIREFLY ALGORITHM IN THE RFID NETWORK TO IMPROVE THE DATA TRANSMISSION

[1]C.HEMA, [2]Dr.SHARMILA SANKAR, [3]Dr.SANDHYA

[1]Assistant Professor (Sr.Gr), Department of Computer Science and Engineering, B.S.Abdur Rahman University, INDIA

[2,3]Professor, Department of Computer Science and Engineering, B.S.Abdur Rahman University, INDIA

E-mail: [1]hemac@bsauniv.ac.in, [2]sharmilasankar@bsauniv.ac.in, [3]sandhya@bsauniv.ac.in

ABSTRACT

RFID (Radio Frequency Identification) network is used for sensing and tracking the objects. The main flaw in this network is reader collision which leads to redundant data. Consequently, due to dissimilar mobility between a head and its member nodes causes unstable clustering. Hence, the protocol known as Dragonfly based Clustering Protocol (DCP) is proposed to minimize the frequent cluster breakage and to improve the data transmission in the network. The readers with high residual energy level are picked as an eligible cluster head. After picking the eligible head, the distance, speed and neighbor count values are calculated between the head nodes and its neighbors. The values are added and optimum cluster heads are opted if the calculated value is high. Then the other nodes join the cluster based on the movement of the head. The conclusion shows that optimal cluster heads are opted using DCP than LEACH and firefly algorithm in which mobility and neighbor count are not taken into account while picking the cluster head. The simulated result in NS2 shows that DCP protocol selects optimal cluster head and the cluster breakage is low when compared with LEACH protocol and firefly algorithm. The reading efficiency in RFID network is also improved using Dragonfly based clustering.

Keywords: *RFID, DCP, Firefly, Optimal cluster head, Cluster breakage.*

1. INTRODUCTION

Radio frequency identification (RFID) is a technique that is used to identify and track the unique items using radio frequency transmission. It is a technology that has the potential to make great economic impacts on many industries. RFID technology is used in many applications such as advertising, promotion tracking, transportation and logistics, commerce and access control. It is a technology that suitable for gathering multiple pieces of information on items for tracking and counting purposes in supportive surroundings

It consists of the transmission technology called RF part and the unique identifiers called ID part. Short range wireless communication networks like Wi-Fi and Bluetooth are increasingly used in RFID applications. Optical tagging solutions compete with certain RFID applications, particularly aimed at consumers. RFID is not as cheap as traditional labeling technologies, but it also offers added value. It could facilitate its big scale acceptance for managing customer retail commodities at a significant price point.

RFID does not require any line of sight. It allows detection from a greater distance and not like earlier bar-code technology. Various applications of RFID includes Library Systems, Tool Tracking, IT Asset Tracking, Access control, Attendee Tracking, Race timing, logistics, kiosks and Interactive marketing.

The RFID system can be classified into two key aspects such as technical infrastructure and logical infrastructure. The technical infrastructure consists of the actual information capture technology included of tags, interrogators and transmission medium. The logical infrastructures refer to the automatic identification (ID) scheme used in identifying objects. The ID scheme includes the actual coding or naming system for objects and the database or registry contains the information relating to the codes or IDs. An ID resolution mechanism is used for matching the ID data with object information.

In the logical infrastructure, transponder data acts as an indication for more specified information

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

about the tagged object. Unique identifiers or codes resolve the information stored in databases. This logical infrastructure model is based on the principle of moving intelligence. It stores all required data about the object on the tag itself. It is very expensive and therefore limited to applications. Some RFID applications utilize codes especially produced for a novel service which are simply encoded and stored on RFID tags in place of barcodes whereas others systems use existing numbering systems like an ISBN or UPC.

The technical infrastructure of RFID systems comprises of three components in two combinations. One is a transceiver (transmitter/receiver) and antenna combined as an RFID reader and another is a transponder (transmitter/responder) and antenna combined to make an RFID tag. Tags store information about the object. Readers sense the information from the tags.

A basic RFID system be made of three modules:

- An antenna or coil used to convert electric power to radio signals
- A Interrogator used to read the information accumulated in the tags.
- A RFID tag electronically programmed to accumulated the distinctive information about the object.

In a typical Mobile RFID environment, there are generally two collision problems that reduces read throughput (number of tags read per unit time)

1)Tag collision: It occurs when more than one tag responds to a reader and the reader fails to identify the signals from the corresponding tags.

2)Reader Collision: In M-RFID, Certain applications need multiple readers to function in close proximity of each other. Because of this basis the signals from one RFID reader might overlaps with the signals from the other RFID readers in the network.Such interference is called reader collision.

There are two classification type of reader collision

1)Multiple reader to tag collision: Multiple reader to tag collision occurs when one tag is attempted to be read by multiple readers simultaneously.

2)Reader to reader collision: Reader to reader collision occurs when a tough signal from a reader interferes with a feebly transmitted signal from a tag.

Reader Collision directs to lack of communication among the readers and some tags, incompetent and wrong operation of a RFID system.

When RFID readers are movable and they are thickly distributed, reader collision becomes predictable. Therefore, developing ways to manage the increasing number of readers without intrusion from neighboring readers is very important.

In a wireless sensor networks, a leaving node is defined as a node that moves away from its parent cluster head before the process of a new cluster head selection. The leaving rate increases when the difference of the mobility between the head node and the members is large. The mobility on the leaving rate should be reduced.

In RFID networks, the number of leaving readers leads to reader tag collision which is the major problem. In the reader tag collision, same tag information can be read by multiple readers due to the mobility. It leads to redundant data in the network. It is evaded by selecting the cluster head depends on the mobility, the power and the speed. The readers with high residual energy are selected as an eligible cluster heads. From the eligible cluster heads, mobility factor is considered to select the optimal cluster heads which reduces the leaving rate. After cluster head selection, the remaining nodes joined the cluster based on the mobility of the cluster head.

In existing approach two clustering protocols are used namely LEACH and efficient clustering approach called Efficient Cluster Head Selection for cluster formation. LEACH is TDMA-based MAC protocol used for cluster head selection. In this, nodes become cluster heads without considering the mobility. The nodes inside the cluster move away from it before data transmission. Due to this, the network topology is affected by such node joins and failures. LEACH protocol have high leaving rate. Thus, the fixed frame time of MAC protocols [1] causes performance deprivation in the LEACH protocol.

In the efficient clustering approach, the clusters are formed by considering the mobility and energy. The nodes inside the cluster will not move away before data transmission. But the reader tag collision is not avoided in this method. Same information is collected by the cluster head. This leads to redundant information in the cluster head. By sending the redundant information, cluster head energy is consumed more and reclustering must be done after data transmission.

2. PROPOSED SYSTEM

Energy Efficient cluster head selection scheme for data aggregation is used for minimizing the node mobility in RFID networks. In the cluster

Journal of Theoretical and Applied Information Technology
15th January 2017. Vol.95. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

head selection process, all the readers in the network sent the energy level information to the Base station. Base station average the energy and selected the eligible cluster heads. Optimal cluster heads are selected by applying the dragonfly algorithm to the eligible cluster heads. Remaining nodes that are not selected as a cluster head, joined the cluster join based on the mobility of the cluster head

2.1. Mobility Based Cluster Protocol

In a mobile environment, readers which has a similar mobility as its members and has high energy should be selected as a cluster head to decrease the number of leaving nodes and lengthen the network lifetime. An energy efficient clustering scheme is used for minimizing mobility between the readers in the RFID network. This scheme consists of two phases. In the first phase, cluster heads are selected based on the mobility and energy level of the readers. After finishing the process of selecting the candidates of cluster head, the cluster head advertise the information to all nodes. In the second phase, the rest of the readers that are not elected as cluster heads joined the best effective cluster head based on the mobility.

2.1.1 Firefly algorithm

The firefly algorithm [8] is a metaheuristic proposed by Xin-She Yang and motivated by the flickering behaviour of fireflies. The goal of Firefly Algorithm is to discover the particle position that outcomes in the best estimation of a given fitness function. In the firefly algorithm, disparity of light intensity and the formulation of the difficulty in terms of attractiveness are critical as the objective function. The light intensity facilitates a firefly cloud go to brighter and gorgeous locations which can be used to find the best solution in the search space.
In this algorithm, there are three major rules:

- The first one is a firefly will be attracted by other fireflies not considering of their sex. All fireflies are unisex
- The second one is a firefly attractiveness is directly relative to its brightness and it reduces as the distance increases.
- The third one is the objective function provides the brightness of a firefly.

Light Intensity and Attractiveness:

The light intensity is used to express the rate at which light spreads over a surface of a known area some distance from a source. The light intensity can be determined as shown in the equation (1)

$$I(r) = I0 \exp(-\Upsilon r^2) \quad (1)$$

Where I(r) is the light intensity at a distance r and is the intensity in the source, Io is the coefficient of absorption in the medium. The attractiveness of a firefly is relative to the light intensity seen by the neighboring fireflies. So the attractiveness β of a firefly is given by the equation (2)

$$\beta = \beta 0 \exp(-\Upsilon r^m) \quad (2)$$

Where β is the attractiveness at r=0. ri,j is the distance among any two fireflies and , which are situated at xi and xj correspondingly

2.1.1. 1. Cluster head selection using firefly

In the selection of cluster head, each reader sends the energy level and its mobility to the base station. The base station computes average energy level of all RFID readers, and picks the eligible RFID readers based on energy level. Base station applies the firefly algorithm for selecting the optimized cluster heads among the eligible readers.

- Begin sensing and transmitting data to the cluster-heads.
- Then, the cluster-head reader collects the data from all RFID readers in the cluster, cumulate it before transmitting it to the base station.
- After some period, which is determined a priori, the network goes back into the setup phase.

The residual energy of the readers is not considered for the selecting the cluster head reader. But there are other metrics like node reliability are taken into account for cluster head selection in order to reduce the mobility. The architecture diagram of cluster head selection and formation is shown in figure1.

The protocol is a centralized algorithm in which the Base Station runs Firefly Algorithm to determine the best K CHs that can minimize the cost function, which is defined as in equation (3)

$$Cost = \beta * f1 + (1 - \beta) * f2 \quad (3)$$

Journal of Theoretical and Applied Information Technology
15th January 2017. Vol.95. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

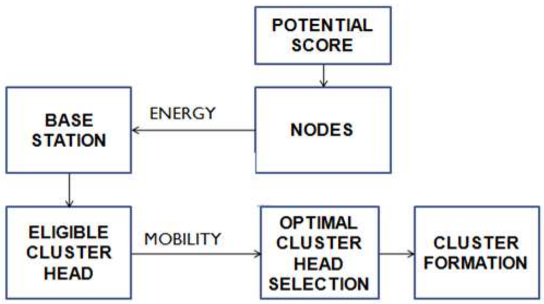

Figure1.Cluster Formation in RFID networks using Firefly algorithm

Where f1 is the maximum average Euclidean distance of nodes to their associated cluster heads, f2 is the function which is the proportion of total opening energy of all the RFID readers in the network to the total current energy of the cluster head RFID readers in the current round. The constant value β is a user defined constant to weigh the contribution of each of the sub-objectives.

For a network with N readers and K predetermined number of clusters, the RFID network can be clustered as follows:

1. Begin S particles to contain K erratically selected cluster head readers among all the qualified cluster head readers.
2. Compute the cost function of every particle:
   - For every reader (ni i = 1, 2…. N) compute the distance d between reader ni and all cluster head readers CHp,k.
   - Allocate reader to cluster head reader CHp,k where d(ni, CHp,k,)= min {(ni, CHp,k)}for k=1,2,…K.
3. Rank the flies and find the current best.
4. Revise the particle's location and limit the modification in the location value of the particle.
5. Plot the new rationalized location with the nearby (x, y) coordinates.
6. Replicate the steps 2 to 5 until the highest number of iterations is reached.

The base station has identified the optimal set of cluster heads and their associated cluster members.

Cluster-head probability of a reader determines the probability of a reader for being a cluster-head inside the cluster. Figure 2 shows the cluster head selection process. Cluster head is selected based on energy and mobility of the readers. If a newly arrived reader has higher probability than the existing cluster head of a cluster to which it likes to join, then the newly arrived reader becomes the cluster-head reader for that cluster without disturbing the entire topology which raises the constancy of the network. If the newly arrived reader has lower probability than the existing cluster-head of the cluster to which it likes to join then it becomes the member of that cluster-head.

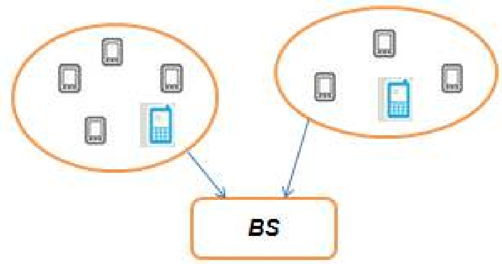

Figure 2.Cluster Setup.

2.1.1.2 Cluster formation algorithm

The readers have selected themselves to be Cluster Heads (CHs), the cluster head reader notify all other readers that they have selected this cluster head reader role for the current round.CH reader transmits an advertisement message (ADV) to all readers in the cluster using CSMA protocol. Every non-Cluster Head reader decides its Cluster Head reader for this round depends on the received signal strength of ADV message, Every non-Cluster Head reader transmits a connect-call message to its selected Cluster Head reader using a CSMA protocol.

Algorithm for cluster formation and CH selection using Firefly algorithm

Step 1: Generate opening population of fireflies xi (i=1, 2... m) and intention
function f(x), x= (x1... xd)

Step 2: Intensity of light Ii at xi is decided by f (xi)

Step 3: Describe coefficient of light absorption γ while (t<MAxGeneration)

Step 4: All m fireflies for i=1: m

Step 5: All m fireflies for j=1: m

Step 6: if (Ij >Ii) go firefly i in the direction of j in dimension; end if

Step 7: Attractiveness varies with distance r via exp [-γr]

Step 8: Calculate novel results and revise light intensity

Step 9: Finish for j

Step 10: Finish for i

Step 11: Grade the fireflies and find the current best

Step 12: Finish while

2.2 Dragonfly Clustering Protocol

For collect the data, cluster head selection scheme [10] using dragonfly Clustering Protocol should reduce the node mobility in RFID networks.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Optimal cluster heads are selected and redundant data is eliminated by data aggregation at the cluster head. In this section, a new clustering approach called "Dragonfly clustering approach" is introduced. The first part in this describes the cluster head selection and cluster formation. The second part explains how data aggregation is performed in the RFID network.

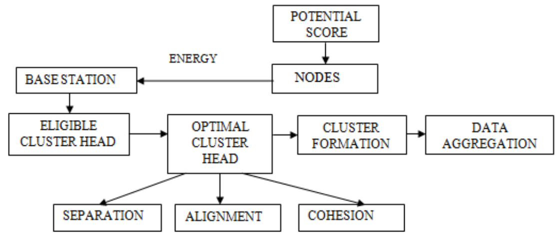

Figure 3. Cluster head selection and formation using Dragonfly algorithm.

2.2.1 Dragonfly

Dragonflies are the fancy insects. There are almost 3000 different species of this kind are found in the globe. Dragonflies are small predators, in nature it hunt many small insects in the world. Nymph dragonflies hunt other marine insects. This type of species also hunts small fishes. This is the unique and rare swarming behaviour about dragonflies when compared with other insects. Dragonflies swarm do two process such as hunting the prey and migration from one swarm to another. Dragonflies can be static or dynamic in nature. Static swarm is known as feeding swarm and dynamic is known as migratory swarm. Dragonflies form small cluster over a small area and fly front and back to hunt other flying preys such as mosquitoes and butterflies. It create sub-group at multiple areas to hunt the prey. The main aim of any swarm is survival in the world, so all of the dragonflies move towards food sources and separated from enemies.

2.2.1.1 Cluster head selection

The cluster heads are selected inside the clusters in order to avoid the energy consumption from all nodes. Each reader broadcast hello message to its neighbours. All the readers lie within the communication range, receive the hello message and acknowledge the sending reader as its neighbour. By this, each reader can know its neighbours in the network. The cluster heads are selected based on the potential score such as energy and mobility. In every cluster, energy level of each RFID reader is compared with the threshold value. Threshold value can be defined as the residual energy required for receiving data from all readers, aggregating the data sent by readers and sending it to the BS. The reader with high residual energy compared to its threshold value is selected as eligible cluster head. Among the eligible cluster head, optimal cluster heads are elected in the network using Dragonfly Clustering. After the eligible cluster head selection the dragonfly algorithm is applied.The architecture diagram of cluster head selection and formation is shown in figure 3.

Dragonfly algorithm follows three primitive principles:

- Separation refers to the collision avoidance of one reader from other in the neighbourhood. For separation, the distance between the eligible cluster head and neighbours are taken into consideration.
- Alignment indicates mobility matching of eligible cluster head to that of other readers in neighbourhood of the network. In this direction and speed of the readers are taken into account for the selection of heads.
- Cohesion means neighbour count of each eligible cluster head in the network. Separation, Alignment and Cohesion are used in dragonfly algorithm as shown in figure 4.

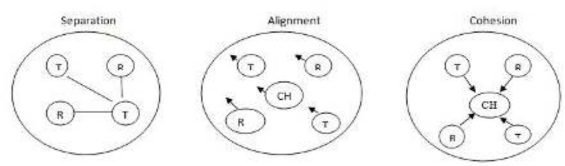

Figure 4. Techniques used in dragonfly algorithm.

The readers and tags are mobile in the network. By considering the dynamic behaviours of the readers in the network, there are three main factors used in position updating of nodes in the network such as separation, alignment, cohesion. Each of the factors is used for optimal cluster head selection. The behaviours are mathematically modelled as follows:
Separation: After the eligible selection of cluster head, the distance between the cluster head and its neighbours are calculated. The distance is calculated by the equation (4) in order to determine whether the nodes are near in order to improve data transmission in the RFID network.
The separation is calculated by the equation given below:

$$S_i=(\sqrt{(X2-X1)^2+(Y2-Y1)^2}) \quad (4)$$

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Where (x1,y1)is the location of the current node either reader or tag,(x2,y2) shows the position of N number of neighbouring readers among the current reader.

Alignment: After the separation, the reader and tag nodes that are neighbours to cluster head join the cluster based on the mobility of the cluster head. The movement of cluster head must be similar to neighbour readers to form the cluster to avoid cluster breakage in RFID network. The mobility for each node is calculated by the equation (5).

The alignment is calculated by the equation given below:

$$A_i = (\sum_{j=1}^{N} Vj)/N \quad (5)$$

Where Vj shows the mobility of j-th neighbouring node in the network. N is the number of neighbour readers among the readers. After the alignment is calculated, the direction and speed of the cluster head is selected.

Cohesion: Once the alignment process is completed, the neighbour count is calculated by the equation (6) for the eligible cluster heads. Neighbour count refers to number of nodes around the cluster head. If the count is less than the effective clustering is affected. So the count must be high for improving the efficiency in the network. The cohesion is calculated by the equation given below:

$$C_i = (\sum_{j=1}^{N} Xj)/N-X \quad (6)$$

Where X is the position of the current individual, N is the number of neighbourhoods and Xj shows the position j-th neighbouring node in RFID network.

The separation, alignment and cohesion values are added for each cluster head. The highest value eligible head is selected as cluster head. The cluster head is optimally selected based on less mobility, highest neighbour count and distance.

2.2.1.2 Cluster formation

Once the optimal cluster head is selected, the remaining readers and tags form the cluster based on the cluster head mobility. The movement of cluster head and members must be similar to avoid the frequent cluster breakage in the network.

Algorithm for cluster head selection and cluster formation:

Step 1: Initialize the readers and tags in the network R_i (i=1,2,3,...n)
Step 2: Set the potential score to each reader and tag nodes.
Step 3: Sending the energy level of the Reader and find threshold value.
Step 4: if (Residual Energy (R_i)> Threshold value)
Step 5: Update the node as Eligible Cluster Head
Step 6: Update the node as Remaining node in the network.
Step 7: Separation is calculated for eligible head using Eq. (4)
Step 8: Alignment is calculated for head in the network using Eq. (5)
Step 9: Cohesion is calculated for eligible head in the network using Eq. (6)
Step 10: Add the values of separation, alignment and cohesion
Step 11: If the value is high select as "Optimal head"
Step 12: else "Become ordinary readers" in the network.
Step 13: Cluster formation is done.

Cluster head selection and cluster formation using Dragonfly clustering protocol is presented in Algorithm. The algorithm finds the optimal cluster head by considering the potential score of the readers in the RFID network. The Separation, alignment and cohesion techniques are used in the algorithm for effective cluster formation.

3. SIMULATION RESULTS OF FIREFLY ALGORITHM

3.1 Construction of Nodes

Total number of nodes is 60. In this network, there are 20 readers and 40 tags as shown in figure 5. Each node has speed and mobility. Energy is set to all readers.

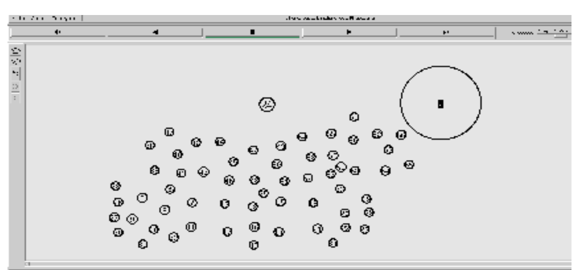

Figure 5. Nodes creation in the network

3.2 Potential Score

Each reader will contain information like mobility and energy level. The energy level of all the readers is sent to the base station as shown in figure 6.

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

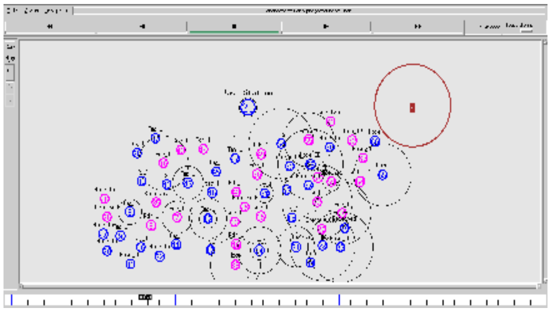

Figure 6. Potential Score of the Nodes.

3.3 Cluster Head Selection

The cluster heads are selected based on the potential score such as energy and mobility as shown in figure 7. The reader which has high energy will be selected as a cluster head.

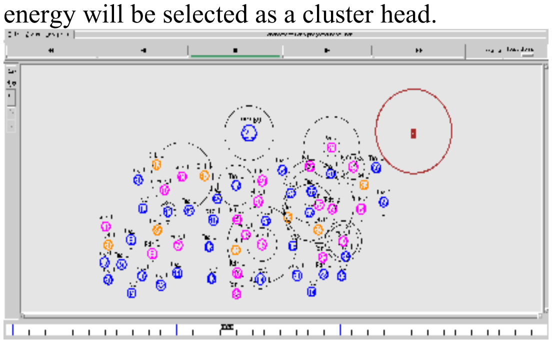

Figure 7. Cluster Head setup

3.4 Cluster Formation

Once the cluster heads are selected, the remaining readers and tags will join the cluster based on the mobility as shown in figure 8.

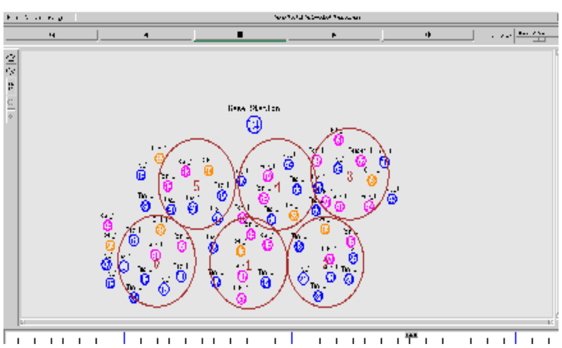

Figure 8. Cluster Grouping

4. SIMULATION RESULTS OF DRAGONFLY CLUSTERING PROTOCOL

4.1 Cluster Head Selection

The cluster heads are selected based on the potential score such as energy and the mobility as shown in figure 9. The readers which have high energy and similar mobility are selected as a cluster heads in the network.

Figure 9: Cluster Head Selection.

Once the cluster heads are selected, the remaining readers and tags will join the cluster based on the mobility as shown in figure 10. The distance between the members of nodes is maintained to avoid collision.

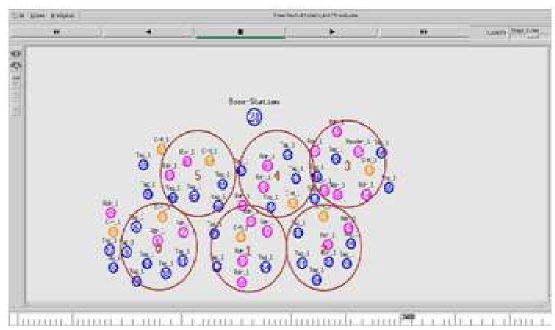

Figure 10: Cluster Formation.

The members of nodes move towards cluster head for improving the data transmission inside the cluster in the RFID network.

5. RESULTS AND ANALYSIS COMPARATIVE GRAPH

The performance improvement is studied in terms of Residual Energy and Packet Delivery Ratio after data aggregation at the cluster head. Table1. shows the performance improvement in terms of Residual Energy.

Journal of Theoretical and Applied Information Technology
15th January 2017. Vol.95. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 1. Residual Energy Comparison.

NUMBER OF NODES	DRAGON FLY (Joules)	FIREFLY (Joules)	LEACH (Joules)
10	32.31	32.31	32.31
20	24.08	20.858	16.32
30	21.01	16.717	8.05
40	10.15	11.9	5.16
50	10.15	7.119	2.3
60	7.5	3.14	0.19

Figure 11 shows the graph based on the residual energy corresponding to the values listed in the above table. In the graph, x axis denotes number of nodes and the y axis denotes residual energy in joules.

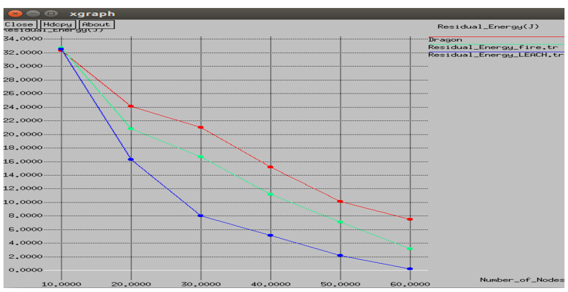

Figure 11 Comparative graph based on Residual Energy.

The results indicate that the residual energy of the nodes using the LEACH algorithm and firefly algorithm decreases when compare to the Dragonfly algorithm. It shows considerable performance improvement.

The performance improvement in terms of Packet Delivery Ratio (PDR) in % is shown in Table 2. Packet Delivery Ratio Comparison

.

Table 2. Packet Delivery Ratio Comparison

NUMBER OF NODES	DRAGONFL Y (PDR %)	FIREFLY (PDR %)	LEACH (PDR %)
10	86.21	70.58	56.58
20	84.23	65.8	55.8
30	92.20	64.78	58.78
40	82.24	68.14	56.16
50	85.14	63.14	58.14

Figure 12 shows the graph based on the Packet Delivery Ratio corresponding to the values listed in the above table.

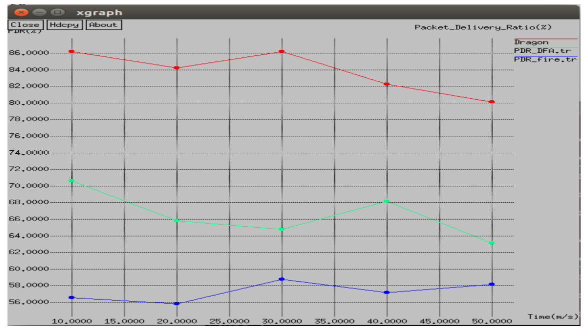

Figure 12 Packet Delivery Ratio Comparative graph

The results indicate that the packet delivery ratio of the nodes using the Dragonfly algorithm is highs when compare to the Firefly and LEACH algorithm. Dragonfly algorithm shows considerable performance improvement.

6. CONCLUSION AND FUTURE WORK

In RFID network, readers send the signals to tags for sensing the information. Energy based clustering techniques are proposed to improve the performance of the RFID network. Dragonfly clustering protocol is applied for optimally choosing the cluster head. The proposed DCP protocol reduces the cluster breakage by selecting the cluster head with high residual energy level and similar mobility. The energy consumption is reduced by avoiding cluster breakage. In this clustering strategy, redundant data are eliminated by aggregating the data at the head. It improves the reading efficiency as compared to certain existing techniques such as Firefly and LEACH in RFID network. The simulation results states that DCP provides better performance in terms of lifetime, residual energy and average number of packets communicated to the base station as compared to Firefly and LEACH algorithm.

Future work will be focused in the direction towards enhancing the proposed approach to reduce reader collision in heterogeneous networks and include various other performance parameters into consideration and also towards scaling the approach to more number of clusters. Also, the study can be carried out by extending the network configuration changes and exploring possibilities of enhancing the performance furtherInput: All the tags in the RFID system.

REFERENCES:

[1] Shailesh M. Birari and Sridhar Iyer ," PULSE: A MAC Protocol for RFID Networks"Springer,2005

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

[2] Jianwei Wang, Dong Wang, Yuping Zhao and Timo Korhonen," A Novel Anti-Collision Protocol with Collision based Dynamic Clustering in Multiple-Reader RFID Systems", International Conference on Applied Informatics And Communications, 2008, 417-422.

[3] M.V. Bueno Delgado, J. Vales Alonso, F.J. Gonzalez Castaño,"Analysis of DFSA Anticollision Protocols in passive RFID environment"IEEE, 2009

[4] Waleed Alsalih, Kashif Ali, and Hossam Hassanein,"Optimal distance-based clustering for tag anti-collision in RFID systems",IEEE 2008

[5] Oh Seung Hyun, Lee Sang Hyuk," An Energy-Efficient Cluster-Head Selection Algorithm for Wireless Sensor Networks", International Journal of Digital Content Technology and its applications, Jan 2013.

[6] Kiran Maraiya, Kamal Kant and Nitin Gupta ," Efficient Cluster Head Selection Scheme for Data Aggregation in Wireless Sensor Network", International Journal of Computer Applications,June 2011

[7] Hiren Thakkar, Sushruta Mishra, Alok Chakrabarty" A Power Efficient Cluster-based Data Aggregation Protocol for WSN (MHML)", International Journal of Engineering and Innovative Technology (IJEIT) Volume 1, Issue 4, April 2012.

[8] Prof. N.V.S.N Sarma, Mahesh Gopi," Energy Efficient Clustering using Jumper Firefly Algorithm in Wireless Sensor Networks" International Journal of Engineering Trends and Technology ,Apr 2014

[9] Amin Rostami and Mohammad Hossin Mottar,"Wireless Sensor Networkclustering Usingparticlesswarpmization For Reducing Energy Onsumption" International Journal of Managing Information, November 2014

[10] Seyedali Mirjalili,"Dragonfly algorithm: a new meta-heuristic optimization technique for solving single-objective, discrete, and multi-objective problems",Springer,May 2015

[11] Rajiv Misra, and Chittaranjan Mandal Ant-aggregation: Ant Colony Algorithm for optimal data aggregation in Wireless Sensor Networks,IEEE 2008.

[12] Bai Chen , Yaxiao Zhang a, Yuxian Li b, Xiaochen Hao a, Yan Fang a," A Clustering Algorithm of Cluster-head Optimization for Wireless Sensor Networks Based on Energy", Journal of Information & Computational Science, November 2011.

[13] Xiong Luo *, Yuechao Ni, Xue Bai," Cluster Head Optimization Strategy For Wireless Sensor Network Based On Univariate Marginal Distribution Algorithm", Journal Of Networks, Vol. 7, No. 12, December 2012.

[14] Joongheon Kim, Wonjun Lee, Jieun Yu, Eunkyo Kim, "Effect of Localized Optimal Clustering for Reader Anti-Collision in RFID Networks:Fairness Aspects to the Readers",IEEE 2005.