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Average Energy Drop in MANET's using FCM

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***Abstract*: MANET stands for Mobile ad hoc network which consists of devices that are autonomously self-organizing, self-configuring in networks. MANETs are very important in situation like disaster, search & rescue operations, in battle field for communication, military environment etc. Since Each & every nodes are battery driven & hence have limited battery power it is mandatory to use this power in a very limited manner. For this Average energy consumption must be very low so that every node can be participated in network for transferring data for long time. Here Fuzzy C- Mean clustering(FCM) is used for reduction in average energy which will increase the energy efficiency.**

***Keywords*: — MANET, FCM, Cluster Member, Cluster Head, Mobile nodes etc.**

1. Introduction

MANET is a special type of network which is infrastructure less or footing its establishment in all fields due to high efficiency of their autonomous and self-governing mobile nodes. Mobile ad hoc networks are also called de-centralized networks because there is no central device which controls the network, such as router or switch. All devices have same status and free to create link with other ad hoc networks where link is available. The devices in this type of network are free in moving and also provide the services of host and router forwards the packet to destination. During data communication from sender to receiver, there are many constraints in the path finding, node selecting, and detection of link failures, route maintenance, route repair, retaining routing tables and to take correct decision of packet forwarding towards the direction of exact destination. MANET consists of number of mobile nodes which operates on battery. A mobile node has a finite energy which is degrading soon when use in continuous communication. Therefore, these nodes must to be conserved energy to maximize the life time of the network.

A Cluster is a group of linked nodes working together for same purpose & belongs to same topological structure. Each cluster comprises a cluster head to manage the cluster & co-ordinate with other clusters through inter or intra communications [1]

Basic terminology is as follows:

- *Cluster:* It refers to a collection of nodes, grouped for the functioning for same purpose.
- *Cluster Head (CH):* Cluster head is a special node which has certain extra responsibilities. All the information is passed through this node only.
- *Cluster Gateway (CG):* A node which is common member of more than one cluster is called as Cluster Gateway.
- *Cluster Member Node (CMN):* The nodes which are the member of a cluster.

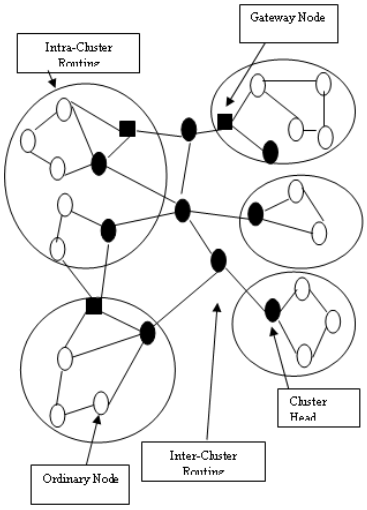

Fig. 1. Cluster formation

As mobile nodes move around in the network, the structure of cluster changes according to the specified criterion in the algorithm and in large network, complete information is maintained within cluster using proactive routing algorithms that is intra-cluster routing while the inter-clustering routing is achieved by using reactive routing algorithms. The performance of a cluster also depends upon the number of cluster member nodes in the cluster.[2]. Clustering is an important approach to solving capacity and Scalability problems in mobile ad hoc networks where no physical infrastructure is available & connected dominating set (CDS) is a special cluster structure where the cluster heads form a connected network without using gateways [3].

2. Literature review

Sudipta Sahana et. al. [1] proposed a new routing algorithm named as Weighted Hierarchal cluster based routing which is based on load balancing approach among cluster heads for MANET's. In this cluster head selection is depends on highest degree, large transmission range & lowest mobility factor.

Depending upon the parameter, weight factor is calculated for each mobile node & the highest weighted node is selected as cluster head.

K. G. Santhiya et.al [2] proposed a novel adaptive Artificial Bee Colony optimization framework with cluster based environment to provide scalability and guarantees QoS by minimize the cluster maintenance overhead by using employee and Onlooker bees with nodes in the cluster.

Mohamed Aissa et. al. [3] considered the problem of constructing a framework for dynamic organizing mobile nodes in wireless ad-hoc networks into clusters where it is necessary to provide robustness in the face of topological changes caused by node motion, node failure and node insertion/removal. Author introduced new mechanisms to overcome some inefficiencies detected in WCA (weighted clustering Algorithms) with the help of node quality based clustering algorithm and other similar clustering algorithms in [4]. It was shown that the proposed clustering algorithm performs similarly to the best well known algorithms.[5]

Jaskaran Preet Singh et.al [6] proposed a hybrid backbone based clustering algorithm. The proposed algorithm use a backbone known as cluster leadership to decide upon the cluster-head. As observed in simulation results the proposed algorithm reduces the overhead of CH election and re-election, leads to fewer status changes by a node within the cluster and shows cluster lifetime comparable to Aggregate Local Mobility(ALM) algorithm with slight improvement.

V. V. Neethu et. al. [7] presented a mobility aware clustering algorithm for heterogeneous MANET. The cluster head selected by the algorithm has higher transmission range and lower mobility and thus the cluster would be more stable. The algorithm produces less number of clusters and incurs lower maintenance overhead. It forms a loose cluster by selecting only hosts connected through bidirectional links. As the algorithm forms a 2-hop cluster, the coverage area of each cluster has been increased. The results confirm that the algorithm forms less number of clusters with comparatively longer lifetime. The cluster stability can be enhanced further by constructing load balanced clusters.

Piyalikar et.al [8] proposed a Forecast weighted clustering algorithm which selects proper and most eligible node as cluster head, reduce per node calculation overhead by introducing server node. It can be observed that the proposed FW gives better result than weight values.

3. Proposed work

In various researches, different type of energy efficient algorithm has been presented for minimizing the energy consumption. Still realizing a true energy efficient MANET is a big challenge. In Proposed work two algorithms are taken into consideration for achieving the proposed results such as Fuzzy C-Mean Clustering Algorithm(FCM) & Differential Evolution (DE). FCM is used for clustering purpose and & DE is used for cluster head selection.

4. Proposed algorithm

FCM is a method of clustering which allows one piece of data to belong to two or more clusters. This method is developed by Dunn in 1973 and improved by Bezdek in 1981. It is frequently used in pattern recognition. It is based on minimization of the following as in Eqn. (1).

$$j_m = \sum_{i-1}^{N}\sum_{j-1}^{C} u_{ij}^{m}\left\|x_i - c_j\right\|^2, \qquad 1 \le m < \infty \qquad (1)$$

Where m is any real number greater than 1,uij is the degree of membership of xi in the cluster j as in Eqn. (2), xi is the ith of d-dimensional measured data, cj is the d-dimension center of the cluster by Eqn. (3), and ||*|| is any norm expressing the similarity between any measured data and the center. Fuzzy partitioning is carried out through an iterative optimization of the objective function shown above, with the update of membership uij and the cluster centers cj.

$$u_{ij} = \frac{1}{\sum_{k-1}^{c}\left(\frac{\left\|x_i - c_j\right\|}{\left\|x_i - c_k\right\|}\right)^{\frac{2}{m-1}}}, \qquad (2)$$

$$c_j = \frac{\sum_{i-1}^{N} u_{ij}^{m}.x_i}{\sum_{i-1}^{N} u_{ij}^{m}} \qquad (3)$$

This iteration will stop when$\max_{ij}\left\{\left\|u^{(k+1)}{}_{ij} - u^{(k)}{}_{ij}\right\|\right\} < €$, where €is a termination criterion between 0 and 1, whereas *k* are the iteration steps. This procedure converges to a local minimum or a saddle point of J_m.

A. *Proposed steps*

In Algorithm, first defining parameter to set value of x-axis & y axis that is 1000m x1000m.

Set Dimension of network Area.
Set co-ordinate for Base station.
Set Number of Nodes.
Set Pcr = 9 J.
Set Data Packet Size.

Calculate transmitting & receiving Energy, Bit rate required for Data Packet.

Counter for dead Nodes.

Cluster Formation in which cluster centres formed from fuzzy logic clustering. Calculate distance of the node from their centroid& base station, select cluster head which is near to member nodes as well as base station.

Calculate remaining energy to transmit a packet.

In proposed work, main aim is to minimize the average energy consumption for data packet size 5 MB & bit rate 3 Mbps-20 Mbps which is basically for 4G connection so that network work for long duration without any loss in data

5. Simulations & result

Creation of Simulation environment is using MATLAB (R

2015 a) MATLAB (matrix laboratory) is a multi-paradigm numerical computing environment and proprietary programming language developed by Math Works. MATLAB allows matrix manipulations, plotting of functions and data, implementation of algorithms, creation of user interfaces, and interfacing with programs written in other languages, including C, C++, C#, Java, Fortran and Python.

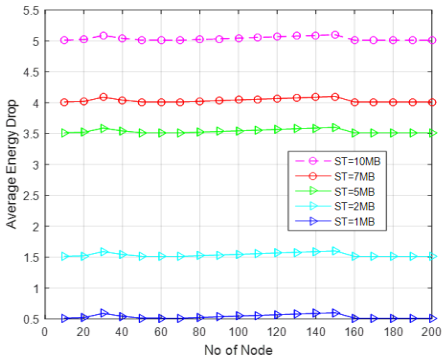

Fig. 2. Variation in average energy drop

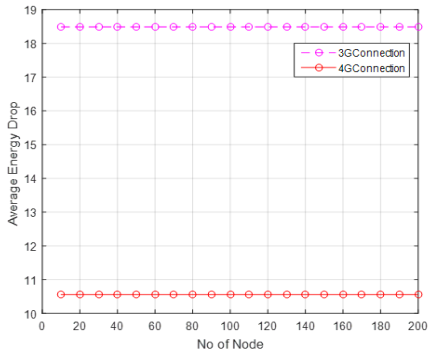

Fig. 3. Average Energy drop with Varying bit rate(3Mbps-20Mbps)

From Fig. 3, it can be observed that 4G & 3G connections lead to significant reduction in energy drop that make the algorithm energy efficient. So this energy can be utilized for communication between mobile nodes.

Table 1
Simulation Results

S. No.	Parameters Evaluated	Existing Value [9]	Proposed Outcomes	Result Achieved
1	Average Energy drop with data packet size(5MB)	5J	5J-3J	3.5J
2	Average Energy drop with bit rate(3Mbps-20Mbps)	12 J	12J-10J	10.5370 J

6. Conclusion and future scope

Both the life span of a mobile node as well as the consumption of energy are both equally significant. It results in better network lifetime such that network performance does not deteriorate too early. The goal of the present work was to minimize energy consumption to prevent the link failure between two nodes while maximizing the network lifetime. Average energy drop among nodes is an indicator of energy efficiency of the entire routing process. Using this algorithm average energy drop can be achieved as shown in Results. Future work includes comparison of this proposed algorithm with various existing algorithm & simulation of Network lifetime.

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