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A Fuzzy Clustering with Optimized Cluster Head Selection Method in MANET

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Abstract: ***MANET'S are a kind of Wireless ad hoc networks. The nodes in the networks are randomly move to different directions, self configurable and the network topology is various continuously and its act as a point-to-point, self-organisable, self-healing network.The network that assembled as an integral will be easily motile along with the nodes available in the network be capable of diagnosing the existence of remnant nodes and implement the establishment of decisive network to facilitate communications. Large networks are divided into various sub-networks and this segregation is called clustering which plays a compelling role in ad hoc networks. Clustering technique was primarily implemented to decrease the consumption of energy, efficient realization of MAC is enhanced, for security mechanisms and gathering of data. A mob of nodes that are interconnected together are called cluster. A committed node consisting of nodes that are interconnected is defined as CH (Cluster Head). Cluster head is crucially helpful for operating network in a desired way.This sweeping survey cynosures principally on the different clustering, Cluster head selection methodologies and compare with the proposed Fuzzy clustering with optimized cluster head selection method in terms of delay, energy, and throughput parameters.***

Keywords: ***MANET, Clustering, Cluster Head, Fuzzy Clustering, Trust***

I. INTRODUCTION

A Dynamic, multi-hop, wireless, infrastructure less networks produced by a set of nodes, establishing fecund peculiarity useful for the services and technologies of modern communication are defined as ad hoc networks. Ad hoc networks implemented in mobile devices are certainly called as a MANET [1][2][3]. Without the deliverance of centralized management or pre-defined configuration which dwells with a congregation of mobile nodes which composes itself producing an alternate network is called MANET (Mobile Ad hoc Network). Latin name for ad hoc is "for this only". Three generations of Mobile ad hoc networks are introduced till date, they are first, second and third. In the year 1973first generation of mobile ad hoc networks are refined by DARPA (Defence Advanced Research Projects Agency) in the form of packet radio networks which are significantly helpful for various military synopsis. From 1980's to mid 1990's second generation were introduced with the main goal of supplementary amelioration of first generation ad hoc networks resulting in the development of NTDR (Near Term Digital Radio) and Global mobile information systems (GloMo). Then in 1990's third generation networks were proposed which are widely known as commercial ad hoc network systems. These include Bluetooth and ad hoc sensors. These third generation ad hoc networks can also be represented as mobile ad hoc networks giving birth to several mobile devices such as notebooks, palmtops and PDA's. Portable devices such as laptops, sensors, smart phones etc.That conveys via wireless links with each other. Group of these forms a mobile ad hoc network. Particular planning and fixing base stations is not required for MANET [4][5][6]. Easy installation can be done with minimum user friendly interference. These networks can be added to internet or WWW which integrates with various devices, thereby achieving other users to use all the existing services. MANET networks are also adapted for 4G construction that helps users in fulfilling their tasks anytime and also from any device. As a coin has two sides MANET networks has some real time challenges like wireless transmission range is shortened, Battery continence and Security constraint. Some unique applications of MANET comprises of various sensor networks, PAN, Bluetooth and also useful for military field. Large networks are divided into various sub-networks and this segregation is called clustering which plays a imperative role in ad hoc networks. Clustering technique was primarily implemented to decrease the consumption of energy, efficient realization of MAC is enhanced, for security mechanisms and gathering of data. A mob of nodes that are interconnected together are called cluster. A committed node consisting of nodes that are interconnected is defined as CH (Cluster Head). Cluster head is crucially helpful for operating network in a desired way. This paper Papooses the A fuzzy Clustering & optimized CH selection method in MANET with comparison of various clustering and CH selection methods. A modern clustering method depending upon on the Fuzzy clustering and CH selection method is based on the trust factors. Incipiently, the Fuzzy clustering is accredited producing optimal clusters based on membership degree. The optimal CH is detected based on the factors of trust and the node that having superlative value of the trust becomes the CH of that particular cluster.

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II. LITERATURE SURVEY ON CLUSTERING:

Clustering is primarily used for balancing of load data, endurance of fault and parallel processing. The various techniques [5] for cluster are event to sink directed clustering, load balanced clustering scheme, K-means algorithm, low-energy adaptive clustering, hybrid energy-efficient distributed clustering [5]. These are

2.1 Event to Sink Directed Clustering

Whenever an event occurs and whenever there is a requirement only that particular clusters are produced by the ESDC (Event to Sink Directed Clustering) [5] method. In the place wherever an event occurs cluster is formed only in that particular region and never takes place in other region where event does not occur. The significance of ESDC (Event-to-Sink Directed Clustering) is that it has three advancements these are: No necessity to do the unwanted clustering rounds as it is done only when the event occurs, Unidirectional flow of data is done almost every time as from up-streams only cluster heads are chosen and from down-streams non-cluster heads are preferred, Clusters are produced only when the event occurs in the direction from event to sink, hence the migration of data in the cluster is minute. Hence consumption of energy, processing delay time in forwarding of data is minimized with this event to sink directed clustering approach. And also the overall lifetime of network will be enhanced with this approach as unnecessary clusters are removed. The drawback is Extra clusters are produced.

2.2 Load Balancing Clustering Scheme

It is a type of clustering technique [5] which was introduced by Shujuan Jin Keqiu Li. Heavy load can cause loss of excessive energy and can damage the network and these excessive tasks are done by cluster head. In this approach a node called assistant node is preferred to execute data aggregation and data processing task which are done by the cluster head. The process in this approach is that data is transmitted to base station by assistant node which is received by the cluster head which then cluster head process the data and then dispatches it back to assistant node. The received information from cluster head to assistant node is again sent back to the base station by assistant node. As assistant node is used excessively, to avoid the early damage of assistant node transmission is done in the form of multi-hop data transmission. Like of advantages, there are some disadvantages that this approach completely depends on nodes and the base station. There are closer nodes and far nodes that are closer and far away from the base station. Closer nodes receive excessive data from base station compared to the nodes that are far away. Hence, to receive more data more chunk of energy is obsessed by the closer nodes than far away nodes and gets destroyed soon and also uniformity of data flow among the nodes is not achieved accurately.

2.3 K-means Algorithm

It is another clustering algorithm technique mainly performs under the CH. In this algorithm CH is uniquely chosen hinge on two factors, they are**:** Euclidian Distances**,** Residual energies of nodes. It is the modified extension for first generation networks called packet radio networks. In packet radio networks clustering are performed centrally, in which a central node is placed and it receives the complete data and if this central node is damaged then the entire data is lost. Hence this system is modified by the K-means algorithm [5] by the distributed method. In this distributed method even if a node damages if finds another way to send or receive the data by using the neighbor's packets or nodes. K-means algorithm is performed after collecting all the data from all its consecutive nodes. To increase the efficiency of clustering technique, distributed method has nodes of energy harvesting capability to retrieve energy from natural resources like sun, air and water etc.., which automatically gains energy and maintains it evenly. The advantage of this method is Efficiency of network is increased .The disadvantage is lifetime is very less.

2.4 Single Cluster Algorithm

Hwee-pink Tan, Pengfei Zhang and Gaoxi Xiao [5] presented a study on these nodes with energy harvesting technique and implemented with the clustered wireless ad hoc networks. In this technique mainly the clutter head position is maintained accordingly to enhance the lifetime of the battery. Then between the cluster heads and base station nodes with energy harvesting technique are fixed and observed that the network lifetime has enhanced to 8.59% approximately. The drawback of this approach is that this algorithm is applicable for only single cluster.

2.5 Low Energy Adaptive Clustering

A type of clustering technique [5] where nodes become CH's. The preeminent goal of this technique is, more energy is consumed by cluster heads compared to non-cluster heads. So each and every node can become cluster head and hence the load is evenly shared between the nodes which results the nodes without the shortage of energy. Drawback of this technique is that single-hop inter-cluster technique is implemented in this approach and hence it cannot perform networks of large size.

2.6 Hybrid Energy-Efficient Distributed Clustering

This is another clustering technique [5] which makes a decision if the node can become cluster head or not. This approach is scalable and also consumes excessive energy. The disadvantage of this technique is that it conserves large bandwidth as it produces extra clusters thereby consuming excess energy and producing several iterations. This approach has a drawback of selecting unwanted cluster heads which are excessive resulting in the decrease of network efficiency.

III. LITERATURE SURVEY ON CLUSTER HEAD TECHNIQUES

Cluster head performance generally revolves between cluster and the nodes. Present information about the target position with the cluster is accessed by the CH. The CH techniques are five types, they are identifier based, connectivity based, mobility based, cost based and power based cluster head [4].

3.1 Identifier Based Technique for Clustering

It is a member of cluster head technique that provides nodes with a particular ID. Each node ID is known to every other neighbour nodes and these are followed by some techniques as follows [4]: Lowest ID Cluster Algorithm, Max-Min d-Cluster formation Algorithm.

3.2 Connectivity Based Clustering Technique

This is a Cluster head technique which is primarily based on connecting the nodes, cluster heads and the base stations. This technique has 4 sub-parts and they are stated below [4]: Highest connectivity clustering algorithm, K- hop connectivity ID clustering algorithm, Adaptive cluster load balance method, Adaptive multi-hop clustering.

3.4 Cost based clustering algorithm

For any technique or product less cost is preferable with high efficiency. Hence this algorithm is primarily based on the cost reduction and to increase efficiency [4]. This algorithm contains four sub parts and they are: Least cluster change algorithm, Adaptive clustering for mobile wireless network, 3-hop between adjacent CH's, Passive clustering.

3.5 Power based clustering scheme

This technique primarily deals with the balancing of load with minimal consumption of power and energy. This technique contains three sub-techniques and they are as follows [4]: Load balancing clustering, Power-aware connected dominant set, clustering for energy conservation.

IV. PROPOSED SYSTEM

4.1Fuzzy Clustering

Fuzzy clustering is also called soft clustering or soft k-means is one of the clustering technique in which each node can belong to multi cluster. In fuzzy clustering [1] the clustered nodes belongs to a cluster based on the membership degree. The advantages the Fuzzy clustering technique isi suitable for imprecated data and the individual point of data chimes to either unique or multi cluster center because of the enrolment functions. It was described by Kaufman (1990) which reduces Objective function, *C*, made up of cluster memberships and distances.

$$C = \sum_{\substack{k=1 \\ j=1}}^{K} \frac{\sum_{i=1}^{N}\sum_{j=1}^{N} m_{ik}^{2}\, m_{jk}^{2}\, d_{ij}}{2\sum_{}^{N} m_{jk}^{2}} \qquad (1)$$

Where m_{ik} represents the unidentified membership of the object i in cluster k and d_{ij} is the mismatch of objects i and j .

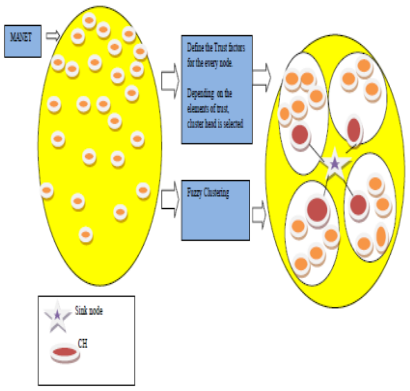


Figure 1: Pictorial Representation the proposed method

4.2 Trust factors for CH selection

The CH election is the biggest paramount criteria to the MANET. Generally we are considering the nodes initial energy, residual energy, energy consumption rate and average energy of the network for CH selection. Along these parameters we are proposed trust [1] factors defines the accurate selection of the CH's.

a) CH selection depending upon on the data bytes forwarded from one node to another node: The cluster head selection based on datum send by Transceivers' node. The element of trust [1] is given as,

$$T_{p,q}^{B} = \frac{1}{2} \times \left[\frac{B_{p,q}^{p}}{L} + \frac{B_{p,q}^{q}}{L} \right] \qquad (2)$$

where, $B_{p,q}^{s}$ stipulates the bytes send by one node and denotes the bytes send by another node. The bourne of the packets of data to one and another is denoted as L .

b) CH selection hinge on the Error in connection of network: The cluster head selection stands on the error in the connection of network. The formulae for the error [1] in network connection is given as,

$$T_{p,q}^{e} = \frac{1}{e} \times \sum_{i=1}^{e} e_{i}^{p,q} \qquad (3)$$

Where

$$e_{i}^{p,q} = \begin{cases} 0 & ; \text{if } i^{th} \text{ connection specifies the error} \\ 1 & ; \text{else} \end{cases}$$

e Specifies the consummate number of transactions. The initial value of error is '0', if there any error in Connection of network it will become one.

c) CH selection stands on the no of data Packet delivery amidst the nodes:

The CH selection is based on the packet delivery [1] of data which is the sum of packets of data remitted in between the nodes that hinges on the scale of the quantity of data packets retrieved from the nodes to the number of the data packets forwarded between the nodes. The element of trust is represented as,

$$T_{p,q}^{D} = \frac{1}{e} \times \sum_{i=1}^{e} P_{i}^{p,q} \quad (4)$$

$$P_{i}^{p,q} = \frac{N_{R,i}^{p,q}}{N_{v}^{p,q}}$$

Where

N_R enumerates the total amount of packets endured and N_v determines total number of packets that are disseminated.

5.1 Experimental Setup with data set description:

The simulation is done in windows 8, Intel i3, and 8GB RAM and the software is Network Simulator-2 KDD cup 99 dataset

Table 1: facsimile Parameters

Parameters	Type
Radio-propagation	Propagation
MAC	Mac 802_11
Network interface	WirelessPhy
Antenna	OmniAntenna
Routing protocol	AODV
Packet Size	512
Rate	250kb
Initial Energy	15.1 J
X axis	1000
Y axis	1000
Number of Nodes	100
Simulation Time	50

5.2 Simulation parameters

The simulation results analysis includes energy, throughput and delay. Energy adduces the energy circus at the each node that should be less for the better node selection. The throughput should be high, delay must be very low for the potent method.

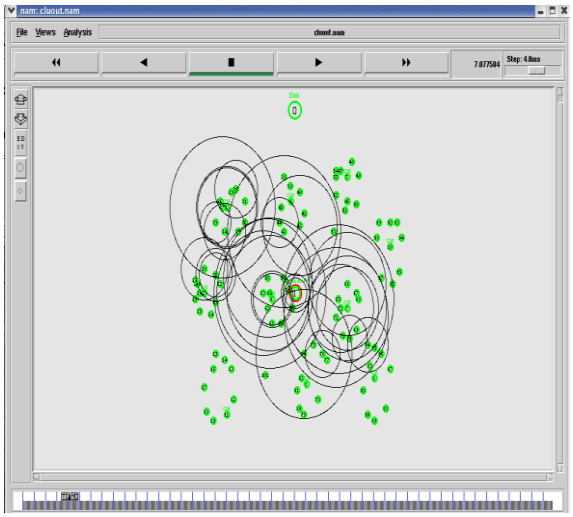


Figure 2: Clustering& Cluster head selection

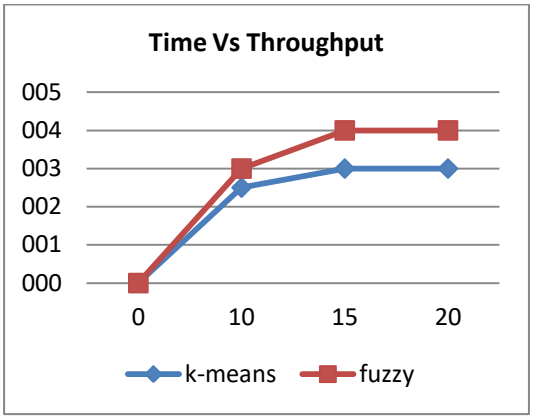
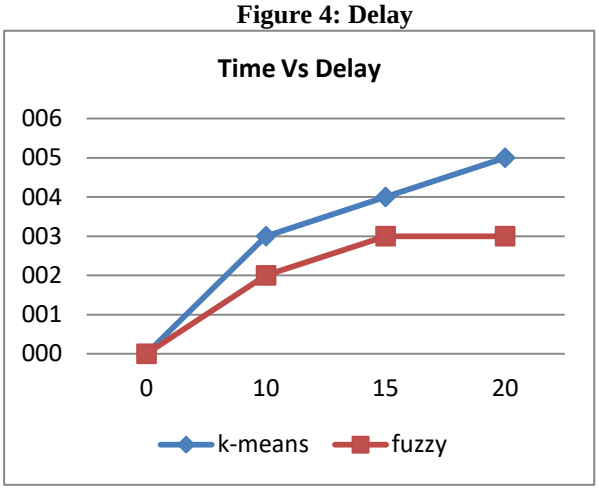


Figure 3: Throughput

Figure 4: Delay



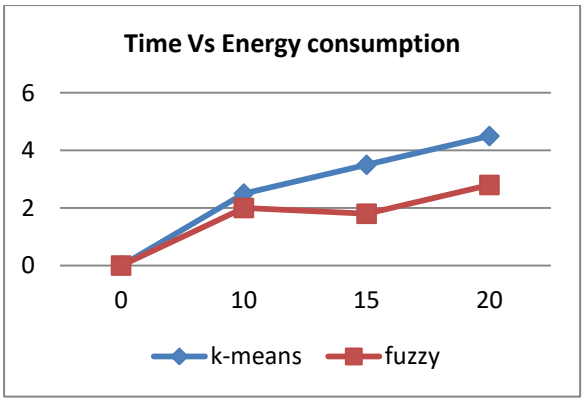


Figure 5: Energy consumption

V. CONCLUSION:

In this disposable, we have made a detailed review of ad hoc networks, about cluster and origin of ad hoc networks having extension with MANET, summarized several clustering and clustering head selection techniques and compare with the proposed Fuzzy clustering with optimized CH selection method with K-means Algorithm in respective with the parameters of delay, energy, and throughput. From the simulation results contemplated technique give the better results i.e. less in delay, less energy consumption and max throughput.

Future research will be executed based on the clustering head techniques when combined with several other techniques and to produce the cluster heads with more efficiency than the previous networks.

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