The Cluster Based Approach in Mobile Ad-hoc Network

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Abstract: Mobile Ad-hoc network is a wide area network that can establish anywhere. This network forms a large network without any complexity. To improve the speed of network and to decrease the overload of network cluster techniques can implements in this network. This paper defines the different clustering technique with the ad-hoc network. The paper discussed about various methods of clustering and usefulness of the clustering mechanism and characterizes the solution of network burden. The paper illustrates the formulas of network node selection in clustering implemented in physical network. This paper talks about the selection of cluster head member and other related member of cluster. The last section of paper involves replication technique in the cluster oriented network. Where, data must be available for every node.

Keywords: Mobile Ad-hoc Network, Clustering Techniques, Cluster Head Replication.

I. INTRODUCTION

Mobile Ad-hoc Network (MANET) is a form of network which has a collection various mobile devices with self-systematize and self-configuring feature. These devices work as router in the network. And it has also contains the information of nodes, in the network that moves dynamically. When Source node sends a message to their destination node, the nearest nodes work as router. These routers carry the self information and message information for securing network and to provide better communication. Mobile Ad-hoc network uses various key features and components. Ad-hoc network is not fixed so that it is dividing self into several groups. This is the way to reduce the overhead of the network in various groups. These groups are called cluster. By clustering network can manage the work easily by assigning to each node. [1]
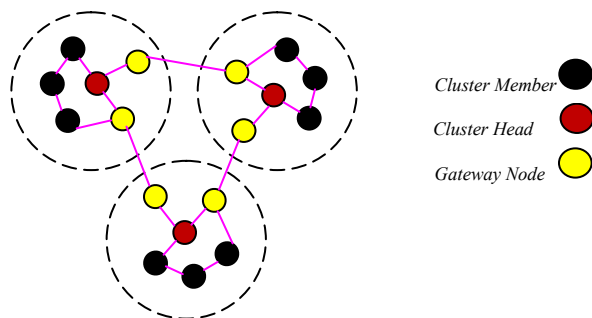

Fig 1. Cluster Network In MANET

The above figure 1, Illustrating the i.e. of cluster network. In this figure network divided into sub categories. Each sub categories hold some kind of node like cluster member, cluster head, Gateway node. Cluster member is the node that

is work as mobile node. If any request have generates by these nodes, then its related nodes doing that work. Cluster Head is the node that processes the information of its related nodes. Cluster head allocate the resource to all nodes belonging to its cluster. It receives the request from their mobile nodes and transferred it to gateway node if required. Gateway node is used to connect the sub network with each other. [1]

In the cluster, nodes are not fixed. It is optimized by the network through various heuristic approaches. By these approaches cluster election problem can be solved easily. Genetic algorithms are used to solve the selection of nodes such as reproduction, crossover mutation, and probability of nodes. These algorithms provided more optimized result. The goal of these algorithms is to achieve the more probability of network nodes. [2]

II. CLUSTERING IN AD-HOC NETWORK

When an ad-hoc network divides into sub network, then it is necessary to select the best node of every cluster to provide services to its related nodes. In clustering genetic algorithms decides the node probability and according to them it decides the cluster head, gateway and other mobile nodes. The allocation of cluster head is used to reduce the overhead of the cluster. Each cluster has its own cluster head that control the services of own area. Gateway connects this cluster with another part of cluster to show a single network area. The result of this cluster is that increase throughput but the data have to go from various cluster head so that it's resulted high latency. Maximum cluster head result is that increase the number of hops to get the route from source to destination. [2]

A. Cluster Head selection Process

In the network number of nodes is represented by 'V' and links among the nodes represents by 'E'. The link

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among nodes is an undirected graph that is G= (V, E). Here G is a collection of whole network links and Vertices. To represent the sub part of the network uses S that is a part of V (G). Now to represent the neighbor node of the network N (V) is used. [2]

To represent the neighbor node of V: N (V) =V (G)

The formula to calculate the cluster head:

$$d_v = |N(v)| = \sum_{v \in V, v \neq v}^{n} \{ dist(v,v) < tx_{range} \}$$

Here tx_{range}, is the transmission range of vertex v. To calculate the cluster head following key features considered mobility distance, power of signals, degree of node to compute the compute the signals.

III. CLUSTERING APPROACH FOR NETWORK

In data mining various clustering techniques are available. These techniques classify the data according to its rules. The clustering goal is that to minimize the inter cluster similarity and to maximize the intra cluster similarity. Cluster technique first of computes all the local model and aggregate them into single model to produce the head of cluster and last is use this aggregate model to produce localize optimize network model. The following clustering techniques are discussed here: k-means, model based, density and hierarchical grid. [3]

A. K-Mean Clustering:

K-Mean clustering technique classifies the similar types of node; group these nodes into a single node. K-mean clustering gathers the information from each local cluster and transmits this information to its aggregate model. It transmits the statistics of the information to cluster head rather than transmitting the information. This is the way to reduce the overhead of the network and it also maintains the privacy of data. [4]
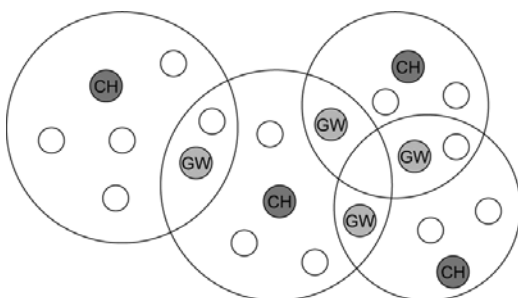

Fig 2. K-Mean Clustering with differ classes

In the given figure 2, two different nodes are showing: 'CH' and 'GW'. K-mean clustering selects the similar types of node for grouping and creates new classes. The node that is not belongs to these classes working as their supporting nodes.

B. Model based Clustering:

In this model each local system processes its work individually. In this network a piece of work assigns to each node and for final clustering it uses Gaussian formula. Gaussian formula aggregates the work of all nodes and

transmits it to central node of the network. The central node combines the received information into global information by the aggregate Gaussian method. This technique divide the work into several parts and process individually after processing it will merged into a single global data. [4]
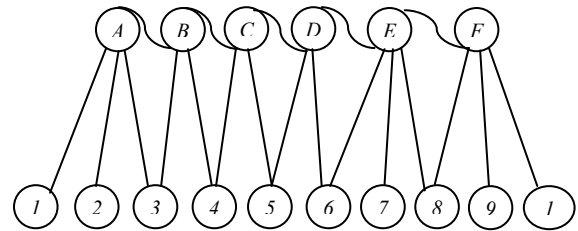

Fig 3. Data partition into sub categories

In the above figure 3 Model shows the different nodes. Here {1,2,3,4………9,10} are the cluster nodes and {A,B….E,F} is head of nodes. These nodes assign the work to their cluster nodes and aggregate this work by the Gaussian method.

Gaussian Formula:

$$f(x) = ae - \frac{(x-b)^2}{2c^2}$$

Here, a,b,c and e are euler's number and $x \to \infty$ is 0. In this formula nodes value can be put and it will combined the information into global form.

C. Density Grid:

The Density grid checks the density of nodes in an area and finds the optimum number of neighbor nodes. This approach used in complex network area in which the nodes are not properly arranged and moves dynamically. This approach work together with wireless network easily. Density grid calculates the nearest nodes and cluster head in each minute according to number of nodes in the area. The formula for calculating the density is that:

$$Density = n * (\pi * R^2)/(X * Y)$$

Where, R is the radio signals transmission range, X and Y are dimension of topography area and 'n' is the number of nodes in the simulation area. Density calculates the cluster head for the simulation area and allocate to each sub network. By putting them simulation area and number of nodes, we can easily calculate the central node of the network. [5]
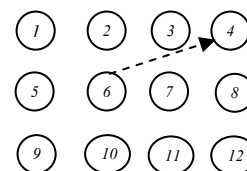

Fig 4. Density of Nodes Measurement

D. Hierarchical Grid:

Hierarchical grid is a same approach as density grid. But some differences are here. Hierarchical grid starts with some distinct points. Each point forms its own cluster and it continuously merge all nearest cluster into single

cluster until a single cluster not made. The merging of cluster is depends on closer cluster of the network. This technique creates the hierarchical form of network. This technique design a complex grid but with fast communication. The request or response is travelled from cluster head central node and after it will goes to the other cluster of network. [6]
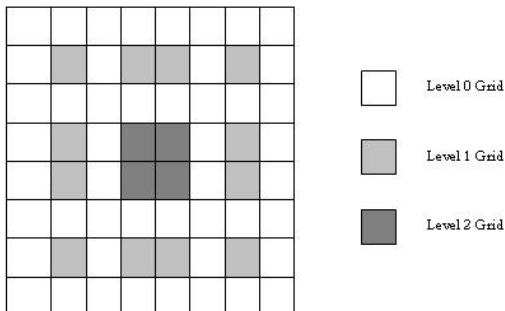

Fig 5. Hierarchical Grid's 3 Level

In the above figure5, 3 levels of cluster are shows. In each cluster it has a head and after merging cluster into a single cluster, it will decide the max powerful cluster in overall network in a central area of grid. When transmission is having in the network first signal sends to central cluster and this cluster sends the signal to its sub clusters. K-mean clustering observe the each node as nearest mean for every cluster.

IV. CLUSTER BASED VIRTUAL BACKBONE

The cluster based approach enthused from data mining approach. It gives the various methods to implements in the wireless network. Some methods of clustering are very popular for implementing in the network like K-mean clustering and hierarchical clustering. The ad-hoc clustering aim is to group all nodes of the network into a cluster. Each cluster denoted by a cluster head node. This node controls all the nodes of cluster which are working under it. [7]
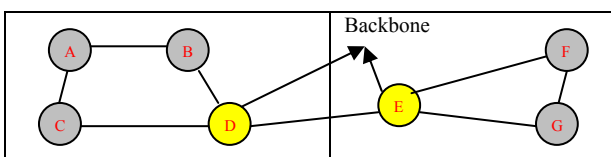

Fig 6. Clustering Solution with cluster Head

The above figure 6. Shows the cluster head solution for clustering technique. Where D, E are cluster Head and other nodes are survive nodes of the network. A cluster network finds its related neighbor of another cluster and connects with them. This process reduces the weight of network on individual node of network.

V. REPLICATION IN AD-HOC NETWORK

Replication of Data in network is very effective Technique. It increases the accessibility of data from mobile nodes. The clustering divides the whole network in sub parts that is inherited by its parent node. If a node demanding data from other node but it is busy then the node will waits for unknown type until the requested node release. It is very difficult to store all data on mobile nodes because the

storage capacity of mobile devices is not more. To remove this problem replica problem periodic data update mechanism are used. Three replica allocation methods are discussed here.

A. Extended Static Access Frequency method:
This method checks the replicas of data at periodic time period. If the replica is not updated then it will update them, but if data already exist on the node then it will skip the updating.

B. Extended Dynamic Access Frequency And Neighborhood:
This method checks the availability of data same as E-SAF method. If the node has data then it will replaces the old data with current data. If node has not any data then it will create new replica at the node.

C. Extended Dynamic Connectivity Based Grouping:
This method share whole data in the network in the layered group. Each cluster has a group in which a replica has by a node. The cluster belonging nodes share the data from its own replica node.

VI. ACKNOWLEDGEMENT

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