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Identified the Cluster Based Stretch and Shrink Method Based On Load Balancing Algorithm for Ad Hoc Network Topology Stability

Ramalingam. M
Assistant Professor in Computer Science
Gobi Arts & Science College (Autonomous)
Gobichettipalayam, T.N India
ramsgobi@gmail.com

Dr.Thiagarasu.V
Associate Professor in Computer Science
Gobi Arts & Science College (Autonomous)
Gobichettipalayam, T.N India
gascavt@gmail.com

***Abstract*—**A Mobile ad hoc Network (MANET) is a collection of autonomous wireless nodes forming temporary network to exchange information (packets) without using any fixed topology or centralized administration. In this dynamic network, each node changes its geographical position and act as a router for forwarding packets to the other node. Broadcast method is used to routing the information from one source point to all the nodes in the network. Clustering is an effective technique used to divide the large ad hoc network into non overlapped or overlapped interconnected substructure. Each cluster and sub cluster has Cluster Head (CH) and Sub Cluster Head (SCH) respectively to handle the cluster based ad hoc environment. In this research paper, propose a sub-cluster method for high mobility nodes and to minimize the cluster head work load, so identified the sub-cluster stretch and shrink method for ad hoc network to providing more stable cluster based topology.

Keywords- *Sub clustering, Stretch and Shrink ad hoc Cluster, load balance cluster*

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I. INTRODUCTION

MANET is a collection of self-organized mobile nodes that establishes the wireless network, in which each node changes its geographical position repeatedly and the node acts both as a host and a router. Ad hoc network can be created and used at anytime, anywhere without using any fixed topology or centralized administration. The self-configuration of MANET can be finding its applications in the following areas: conferences, meetings, natural disasters, crowd controls, battle fields, intelligent transportation in vehicle-to-vehicle communication, search and rescue and emergency situations. Flat routing protocols are required for small network but the large network requires hierarchical or geographic protocols [1].The characteristics of ad hoc network are: Autonomous terminal, Distributed operation, Multi-hop Routing, Dynamic network topology, Fluctuating link capacity, and Low-power device [2].

A. Proactive Routing Protocol

Proactive protocols continuously broadcast complete picture of topology on every node and learn the global topology updated information among the network node in order to discover the path from source to endpoint. It is also called table-driven protocol, it maintain routing table to store the routing information and getting the information whenever needed. It is not fit for large network. Some of the proactive Routing Protocols are AWDS, CGSR, OLSR, DFR, DBF, FSR, HSR, IARP, and TBRPF [1]**.**

B. Reactive Routing Protocol

Reactive protocols are using query-reply dialog mechanism. Frequently storing the topology broadcast information is waste of bandwidth. Instead of storing the updated data in routing table, this reactive protocol discovers the route only on the demand basis. The routing has two phases, (i) Route discovery: It means, construction of route between the source and destination node. When the route is not obtainable to the endpoint, the source node broadcast a route discovery packet to all nodes in the network.

ii) Rout maintenance: [4] Once the route is established, it introduced to check the validity of the route. The link may be break because of shutdown or the node may move. The source node reinitiates the route discovery task immediately when the route disconnect form source to destination. Some of the Reactive Routing Protocols are ACOR, ABR, AODV, SSA, DSR, CHAMP, CBRP, and LAR1 [1].

C. Hybrid routing protocols

The hybrid protocol inherits assets of proactive as well as reactive routing protocols to making control of delay and packages. The mixed approach is used to establish the route and activate the nodes. Some of the hybrid protocols are ZRP, HRPLS, ADV, HSLS, HWMP, and OORP [1].

II. RELATED WORK

Clustering is used as a data processing technique in many different areas, including artificial intelligence, bioinformatics, biology, computer vision, city planning, data mining, data compression, earth quake studies, image analysis, image segmentation, information retrieval, machine learning, marketing, medicine, object recognition, pattern recognition, spatial database analysis, statistics and web mining [10][11].

Clustering is a process that divides the network into interconnected substructures, called clusters. Each cluster has a cluster head (CH) as coordinator within the substructure. Each CH acts as a temporary base station within its zone or cluster and communicates with other CHs [12] [13] [14]. Cluster heads may frequently change their relative position on highways, and then, the size and stability of clusters change unpredictably if lowest ID and node-weight heuristics are used. On the other hand, vehicles on (one way) highways have almost the same direction within a certain area. Therefore, their geographical location and velocity information are helpful when they are evenly divided into non-overlapping clusters along highways. [15] Better performance could be achieved if the geographic position of the network nodes is known [16]. A MANET can be divided into several overlapped clusters. A cluster comprises of

a subset of nodes that communicate via their assigned CH. The network is modeled as an undirected graph *G* (*V*, *E*) where V denotes the set of all MHs (*vertices*) in the MANET and *E* denotes the set of links or *edges* [17]. Routing is depended on the address of cluster heads. By failing any node in the route, its cluster head may use another node to forward packets (if available). This causes the error tolerance to enhance. Because of the nodes mobility, the network topology will change over time. A node may join or leave an existing cluster at a time. Two CHs may come within one hop, which may trigger a cluster head change event [12].

A. Highest-Degree Algorithm

The Highest-Degree Algorithm, also known as connectivity-based clustering algorithm, was originally proposed by Gerla and Parekh [18,19], in which the degree of a node is calculated based on its distance from others. Any two nodes in a cluster are at most two-hops away since the cluster head is straightway linked to every one of its neighbors in the cluster. Fundamentally, every node either becomes a cluster head or common node (neighbor of a cluster head). Main negative aspect of this algorithm is the number of nodes in a cluster is enlarged, the throughput falls down and hence a gradual degradation in the system performance is observed, and another restriction is the re-affiliation calculation of nodes are high due to node travels and as a result, the highest degree node (the current cluster head) may not be re-elected to be a cluster head even if it loses one neighbor. All these drawbacks occur because this approach does not have any restriction on the upper bound on the number of nodes in a cluster [20].

B. Load-Balance Clustering

[21] Proposed the load balanced clustering for nodes in ad hoc networks charged by batteries because of their moving character. Communications cause the batteries to be run down. Therefore, the amount of transmissions should be reserved to a least to avoid a node falling out of the network prematurely. Cluster head batteries are run down faster because they are normally appears in every transaction within their cluster. Therefore, it is a required to share out the responsibility of being a cluster head to all nodes (load-balancing). The planned heuristic offers load balancing among cluster heads to insure a fair sharing of load among cluster heads.

[21] Author specifies some of the goals of the heuristic are:

1. Decrease the number and size of the data structures is essential to implement the heuristic,
2. Make longer the cluster head period based on an input parameter,
3. Allow every node to get equal change to become a cluster head with in a time,
4. Increased the stability in the network.

Two cluster head load-balancing heuristics has proposed for ad hoc networks. The first heuristic is for cluster election heuristics that support the election of cluster heads, it is based on node id. Here the heuristic seats a budget on the contiguous amount of time that a node stays a cluster head. The second heuristic is for cluster election heuristics that favors the voting of cluster heads depends on the degree of connectivity. A cluster head stays a cluster head as long as its degree of connectivity is within a specific range. The Degree based heuristic was simulated with this load-balancing heuristic. The simulation results show a much needed increase in cluster head duration while still maintaining a low variance. However, the drawback is that the cluster head serving time alone may not be a good indicator of energy consumption of a mobile node [23] [21].

The Load Balance Cluster is compared with AMC [24] (Adaptive Multi-hop Clustering) and [22] the LBC algorithm runs the clustering scheme periodically to maintain the number of mobile nodes in each cluster around a system parameter, *ED*, which indicates the optimum number of mobile nodes that a cluster head can handle. A cluster head de-promote to a normal node if the difference between *ED* and the number of mobile nodes that it currently serves exceeds some value, *Max_Delta*. This system tries to make all cluster heads almost serve the same and optimal number of member nodes. Compared with [22], Degree Load Balance Clustering (DLBC) can minimize the rate of cluster head alteration because a cluster head does not need to resign its cluster head status whenever it has a member node with a higher node degree. However, since the cluster head change is still based on node degree, DLBC likely will cause frequent re-clustering because the movement of mobile nodes and consequent link setup/break results in dynamic variation of mobile node degree. In addition, how to select a cluster head is not addressed in DLBC if in a local area no mobile nodes can satisfy the degree difference requirement between *ED* and its current node degree (2-hop). Similar to AMC [24] (Adaptive Multi-hop Clustering), how to decide the important system parameters, *ED* and *Max_Delta*, is not discussed in DLBC [21, 31].

III. TYPES OF CAST PROPERTY

To sending the data from source to destination in four ways: Unicast, Multicast, Geocast, Broadcast [3].

A. Unicast Routing

In this type of routing, the source node delivers individual copy to all receiver nodes. So, packets are duplicated in the source node and sends to each destination in the MANET. Most proposals in the MANET are based upon unicast communication. Thus, the most basic operation in the MANET IP layer is to effectively convey data packets from one source node to another destination node. The forwarding method is very humble in itself: with the routing table, the transmit node just uses the endpoint address in the data packet to look it up in the routing table. If the longest matching destination address is found in the table, the packet is sent to the corresponding next hop. The problem that arises is how the routing table is built in the nodes in the MANET [17][2]**.**

B. Multicast Routing

The source delivers a same packet to multiple receivers in the network at the same time; this method is called packets broadcast [2] [1].

Multicasting is the transmission of data grams to a group of hosts identified by a single destination address. Multicasting is intended for group-oriented computing. There are more and more applications where one-to-many dissemination is necessary. The use of multicasting within a network has many benefits. Multicasting reduces the communication costs for applications that send the same data to multiple recipients. Instead of sending via multiple unicasts, multicasting minimizes the link bandwidth consumption, sender and router processing, and delivery delay [5].

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C. *Tree-based multicast routing*

There is single pathway among a source node and receiver node in tree-based multicast protocols. But in the high mobility position, the tree based protocol is not enough to handle the tough environment. Two routing methods in multicast routing (i) Source-tree-based multicast routing, (ii) Shared-tree-based multicast routings. Single tree is maintained in source tree based, a single tree is shared by all source node is called shared tree method and it's scalable. [6] [1].

D. *Mesh-based multicast routing*

In multicast routing, multiple paths between the source and destination nodes and using multiple hops. The link between the nodes breaks because of nodes are geographically moving (mobility) and using multiple hops.

E. *Geo-cast*

Geographic position information assisted routing protocols improve routing by using Global Position System (GPS) receivers built into the nodes to get their location information [18]. Those protocols route the data using Geographic Addressing and Routing (GeoCast) where messages are sent to all nodes in specific geographical area. GeoCast uses the geographical information rather than logical addresses. Geographical information about nodes eliminates propagation of routing information. Hence, geographical protocols have more efficiency in adapting to changes in node density compared to other protocols. Examples of geographic routing are DREAM and SLURP. However, mapping address to location produces more overheads. In addition, using GPS consumes the power of a mobile node. Geocast is used to deliver data to groups of node in a specific geographical area [6].

F. *Broadcast Routing*

In the ad-hoc network, broadcast mechanism is also used for transmission of large amount of same data from one source node to all nodes in the network. This is referred to as one-to-all model. So this model needs to find the efficient route before transmission of data. The broadcasting technique is differing from flooding scheme mechanism [7] [8] [9]. Broadcasting provides several basic advantages. First, it does not require the creation of any delivery structure. Second, there is a natural redundancy in broadcasting due to multiple rebroadcast nodes. This redundancy provides extra robustness in conditions of mobility. Therefore, broadcasting is preferable for use in the scenarios with large group members or in case of high mobility [5].

IV. CLUSTER ANALYSIS

Clusters are potential classes and cluster analysis is the study of technique for automatically finding classes. Some of the examples: Biology, Information retrieval, climate, psychology and medicine, business [27]. Clustering can be implemented at different levels of the system, including hardware, operating systems, middleware, systems management and applications [26].

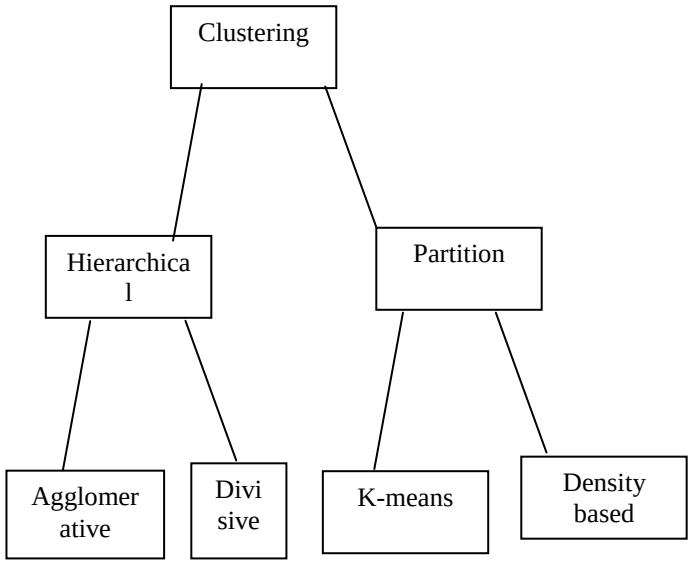

Figure 1. Categories of Clustering

A. *Categories of clustering*

Hierarchical and partitioned clustering

Partition clustering simply splits the large network into group of non-overlapping sub clusters as shown in Fig 2. whereas hierarchical clustering produces nested clusters. The partition cluster uses various types of algorithms such as minimum spanning tree, K-means, nearest neighbor and Density based. The cluster classification is shown in Fig.1. [28] [29].Initially set of clusters are selected at random in k-means, and then the nodes in the cluster is moved between clusters till preferred set is shaped. High degree of similarity among nodes in a cluster is obtained [25].

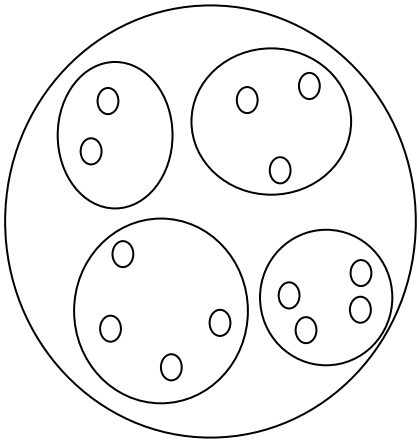

Figure 2. Non-Overlapped sub clusters

In nearest neighbor algorithm, objects are iteratively combined into the present clusters that are close to each other. Inconsistent edges are identified and detached in Minimum Spanning Tree (MST) algorithm. Then, a set of ordered pairs are formed as clusters. Density based method produces a partition clustering, in which the dense regions of probability

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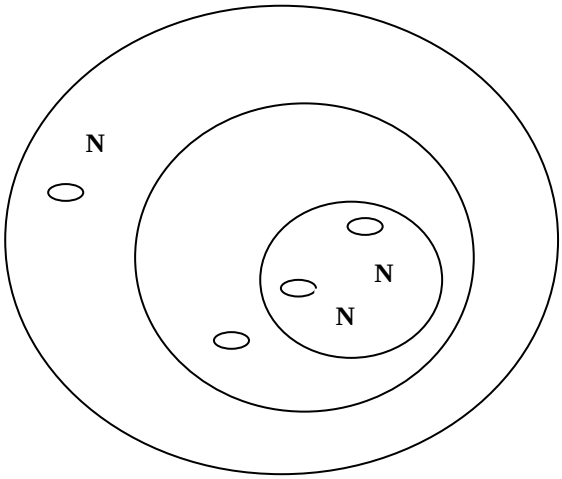
density in the data sets, data that is in low-density regions are treated as noise or outliers [28].

Divisive Hierarchical Method

In this method, the entire data set has recursively split into sub cluster until to reach some stopping criteria. There are two types of divisive methods: Monothetic, and Polythetic [30].

Agglomerative Hierarchical Method

It is opposite of divisive method, starts with single cluster and merging nearest clusters to build the consecutively larger cluster [25].



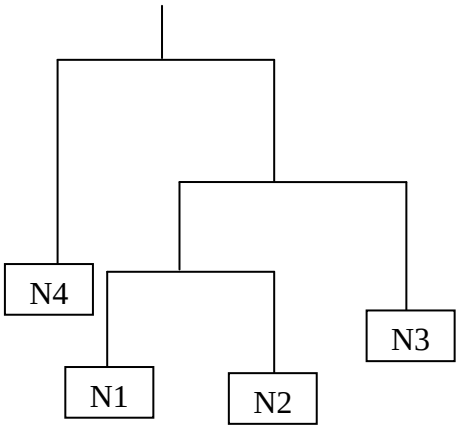


Figure 3. Nested Hierarchical Clustering

V. IDENTIFIED THE CLUSTER METHOD FOR AD HOC NETWORK

To increase the stability of cluster, it will be divided into a sub-cluster when the number of nodes become more than the expected rate in a cluster. Each sub-cluster has Sub Cluster head (SCH), and the SCH act as a leader within the cluster and the collection of sub cluster is called main cluster and it has one main Cluster Head (CH), the CH act as a leader for whole cluster shown in Fig.4.

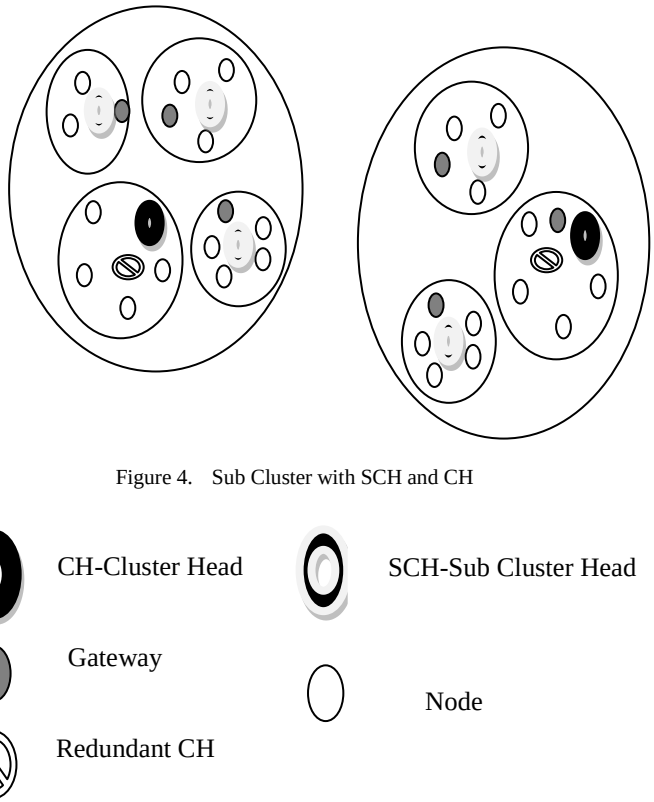


Figure 4. Sub Cluster with SCH and CH

Source Node -> CH-> SCH->Destination Node(s)

C1→sc1, sc2, sc3
C2→ sc1, sc2, sc3, sc4

C1, C2 are two clusters, the C1 is divided into three sub clusters and C2 also divided into four sub clusters. Each C1 and C2 has one CH and sub-clusters have SCH for each one.

A. Cluster Based Stretch and Shrink Method for ad hoc

The new Stretch and shrink ad hoc method is proposed to handle the mobility nodes in the network. The clustering technique in large ad hoc network used to divide the network into clusters (small group) and when the number of nodes increased in the cluster, then the clustered network again split into two sub-clusters and recursively calling cluster algorithm until reach the predefined condition (load balanced). When the number of node is getting decreased in a specific sub-cluster, the Agglomerative Hierarchical approach is used to merge the decreased sub-cluster into nearest another one sub-cluster. Redundant cluster head (RCH): This Stretch and Shrink ad hoc method also have the redundant cluster head to handle the nodes in the cluster when the CH is log off or absent.

VI. CONCLUSION AND FUTURE WORK

The proposed Stretch and Shrink sub-cluster method can be used to enhance the cluster stability and to minimize the cluster head load. So the proposed method improves the network scalability, in order to achieve high throughput and good reliability in ad hoc network even the high number of nodes. Further, analysis the existing load balance and weighted cluster algorithm to improve the topology stability, network scalability and the traffic load distribution over the network.

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