Comparative Study of Clustering Based Algorithm in Mobile Ad-Hoc Network

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Abstract— Today Energy efficiency is a critical issue in mobile ad hoc networks (MANETs) for increasing the lifetime of the individual nodes as well as the overall network. Mobile ad-hoc network has become a very important field of study for students and researchers owing to its wide application. In mobile ad-hoc network all nodes are responsible for routing and forwarding of packets, hence all nodes are required to act selflessly for proper functioning of mobile ad-hoc network. In the we present the study of low power clustering algorithm. In this paper present the survey of clustering algorithms in MANET. In particular, the algorithms under consideration are single hop representatives of the energy constrained ad hoc network. The emphasis is given mostly on the cluster formation principles and the cluster maintenance parameters of the algorithms. Simulation results are discussed to describe the effect of transmission range and the size of the network on the parameters like cluster density, frequency of reelection, frequency of cluster changes in the dynamic network. Partitioning the mobile nodes is a NP-hard problem. The lowest id, highest connectivity and weighted cluster algorithm to make it more intrusting.

Index Terms—MANET, Lowest id theorem, highest connective algorithm, Weight cluster algorithm.

I. INTRODUCTION

The present day communication system demands a high speed and reliable network where a wired backbone can be connected to several wireless networks The category of wireless networks could be cellular networks wireless personal area network (WPAN), wireless local area network (WLAN) or mobile ad hoc network (MANET). Most wireless technologies operate in the Unlicensed Industrial Scientific and Medical (ISM) 2.4 GHz band. The increasing application of wireless mobile devices like phones and laptops is tending to the possibility for spontaneous or ad hoc wireless communication known as Mobile Ad Hoc Networks (MANET). Mobile Ad-hoc Network (MANET) [1] which is the most intrusting research topic from past over 10 years. With high advancement in wireless technologies and development of mobile devices, ad hoc networks are playing a very interesting roll in field of communication for today and tomorrow. A rapid growth can be achieved for video and data communication, mobile radio technologies. A MANET is a dynamic wireless network formed by a set of mobile hosts which communicate among themselves by means of the air without any fixed infrastructure . Each node in the MANET can act as router as well as host. In order to maintain connectivity in a mobile ad-hoc network all participating nodes have to perform routing of network traffic. The success of communication highly depends on other nodes cooperation.

Mobile Ad-Hoc Networks is a type of infrastructure less networks in which nodes are portable devices such as mobile phones and Therefore, MANET has the property of rapid infrastructure-less deployment and no centralized controller which makes it convenient to People and vehicles can thus be internet-worked in areas without a pre-existing communication infrastructure or when the use of such infrastructure requires wireless extension. By extending range of mobile nodes ad hoc networks supports multi-hop routing by which they can extend the range of wireless networks. Range depends upon the concentration of wireless users. Fig 1.3 shows MANET.

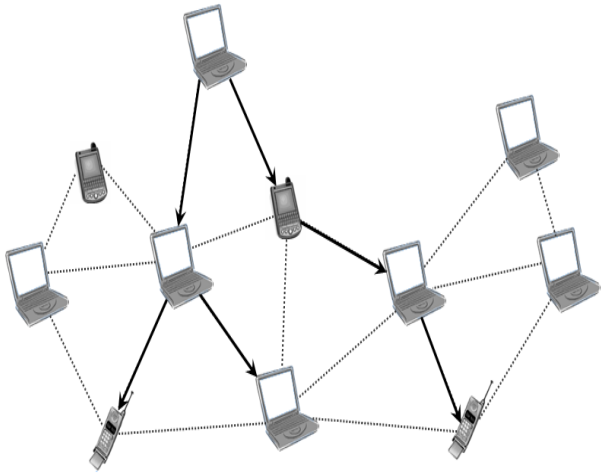

Figure 1 : Example of MANET[2]

II. LINKED CLUSTER ALGORITHM

Basically a server which is formed for to achieve a goal for proper communication it should be formed isolated set of various parts that should work with both the operating systems. Such device is avoids introducing complexity of processing system which is schedule for the dependencies between the operating system and clusters. For enabling the cluster features there is need to change in base operating system which includes as given below:

- Support for dynamic formation and detecting of network names and addresses.
- Updating of the file system to enable the function closing open files during disk drive dismounts.
- Creating (I/O) subsystem to achieve sharing disks and volume sets between multiple nodes.

Else than the above separation and minor updating cluster capabilities are made on the highest of the existing base of the server 2003 and 2000 operating system.

The linked cluster algorithm (LCA) performs the job of initial three tasks

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such as topology fetching, cluster creation and cluster linkage. On other hand, Where as the link activation algorithm (LAA) performs the job of link activation between the nodes in the network. The routing protocol which provides the details of the routing operations for packet communication of the divide. Main aim of the current work is to focus on the basis of neighbourhood detection in changing topology and cluster formation.Topology sensing is the initial step in implementing the linked cluster architecture where the nodes discover their neighbours by the method of probing as described in [5].

$$W_C = W_1 D_V + W_2 M_V + W_3 T_V + W_4 P_V$$

Where *Dv* is the gap of the cardinality of the neighbours of a node *v* represented as $|Nv|$
and a scenario based threshold δ which limits the upper bound for the number of members in a cluster, i.e. $Dv = ||Nv|-\delta|$. *Mv* is the average speed of a node
since the last re election reaches it place and
$Tv = \_dist(v, \bar{} v)$, where *v* is the set
of neighbour nodes of *v* . *Pv* is the cumulative time for which the node remains as the cluster head. All these parameters are normalised to a predetermined value and the weighing factors are chosen so that Initially, the node having the smallest weight is selected as the initial cluster head and its 1 hop neighbours become the members of the cluster. Such layered set of nodes are exempted from taking part in the further selection [4]. This process is repeated till all the nodes are allocated a status of either a head or an ordinary member. Fair distribution of load among the cluster heads are tried to make by restricting the upper limit for number of member nodes within a cluster. Such restriction of member nodes also improves the MAC layer efficiency. The cluster heads work in a dual power mode, i.e. it works in a low power mode for intra cluster communication and in a high power mode for inter cluster communication.

III. LOWEST ID ALGORITHM

Lowest ID algorithm is the easiest clustering processed protocol which basically selects cluster head on the basis of unique ID assigned to a particular set node. This algorithm follows functions as given below:

Each node delivers its own ID to all other neighbouring node in a proper time separation and in form of any "Hi" message. The Lowest ID algorithm is applicable to determine cluster nodes and the heads which constitute the cluster. The LID Algorithm is stand Lowest ID Algorithm. The LID algorithm is also applicable to fetch the cluster heads and the nodes that constitute the cluster. Every node is assigned a unique id and a node with the lowest ID is chosen as the cluster head, every nodes within radius R around that node are its members. The operation repeats until every node belongs to a cluster. The ANDA algorithm was improved to implement the LID algorithm along with it. The basic approach is to select the cluster-heads using the LID algorithm and then implement ANDA to cover the nodes, and calculate the network lifetime Nodes that receive messages from its neighbouring node compare their Ids and the node with lowest ID has been selected as a cluster head. If a node transmits message from two of its neighbouring nodes has become a Gateway node.

A. Disadvantage:-

- It may cause over heading as no number of nodes in a cluster is fixed.
- The drawback of Lowest ID is its bias towards nodes with same ids which leads to battery drainage of certain nodes.
- The performance of such a system is unpredictable and random as no network related paramenters are in consideration

IV. HIGHEST CONNECTIVITY ALGORITHM

The degree of a node is computed based on its distance from others. Each node broadcasts its id to the nodes that are within its transmission range. The node with maximum number of neighbors (i.e., maximum degree) is chosen as a cluster head. The neighbors of a cluster head become members of that cluster and can no longer participate in the election process. Since no cluster heads are directly linked, only one cluster head is allowed per cluster. Any two formation of the nodes in the model at most two hops away since the cluster head is directly linked to each of its neighbors in the cluster. Basically, each node either becomes a cluster head or remains an ordinary node This system has a low rate of cluster head change but the throughput is low. Typically, each cluster is assigned some resources which is shared among the members of that cluster. As the number of nodes in a cluster is increased, the throughput drops. The re affiliation count of nodes is high due to node movements 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 looses 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. In comparison with comparison with Lowest-ID scheme, it is basically the power of nodes is calculating based on its gap formed from each other's [6]. Each of the nodes flood its connectivity value under its transmission operational range. So, within their operational transmission range. So a node declarers to be a CH or remain constant as CN by comparing the connectivity value of its closest cell with its previous value. The operating node with such a highest connectivity value in its vicinity will become CH. Connectivity-based clustering follows the same circumstances of ID-based regarding to cluster size and performance degradation.

V. K-HOPE CONNECTIVITY ID CLUSTERING ALGORITHM

(KCONID)[3] Combines two clustering algorithms: the Lowest and the Highest-degree heuristics. In order to select cluster heads connectivity is considered as a first criterion and lower ID is not as a primary choice. For the connectivity purpose using a single node as a criterion causes numerous ties between nodes on other side, using only a lower ID criterion generates more clusters than necessary. Main aim is to minimize the number of cells in each cluster by which number is reduced of formed in the network and in this way obtain dominating sets of smaller sizes. Clusters in the KCONID approach are formed by a cluster head and all nodes that are at distance at most k-hops from the cluster head. In the starting

of the algorithm, a node initiates a flooding process in which a clustering request is transmits to all other nodes. In case of the Highest-degree heuristic, by which degree of the node is only measures connectivity for 1-hop clusters. K-CONID forms a link which is generalized for a k-hop neighborhood. Thus, when k = 1 connectivity is the same as node degree. Every node in the network is assigned a pair did = (d, ID). d is a node's connectivity and ID is the node's identifier. A node is selected as a cluster head if it has the highest connectivity. In case of uniform connection, a node has cluster head which contains priority if it has lowest ID. The fundamental theme is that every node broadcasts its clustering decision once all its k-hop neighbors with larger cluster head priority have done so.

VI. WEIGHT CLUSTER ALGORITHM

It is also a weight based distributed clustering algorithm like DMAC but here weight is specifically defined . WCA (weighted Clustering Algorithm) selects cluster heads on the basis of number of nodes which is to handle, mobility, transmission power and battery power. The main steps in the algorithm is as :

Measuring of all the parameters such as battery power, mobility, transmission power and degree difference for each node.

Mv is the mobility of node. A node with less mobility is always better.

T.ΔV is the degree difference which is actually variegation of actual degree of node to ideal degree.

Dv is sum of distance from a node to all its neighbours .it is used as energy consumption parameter.

Pv is total time the node has served as cluster head.

Weight factors are chosen as W1+W2+W3+W4 = 1

The node with minimum weight is selected as cluster head.

A well explain threshold is formed in order to specify the number of nodes each cluster head can ideally support, in order to avoid overload. The cluster heads work in a dual power mode, i.e. it works in a low power mode for intra cluster communication and in a high power mode for inter cluster communication. However, the limitation of the algorithm lies in yielding the global minima of weight values in the network. For the distributed solution of the algorithm, a large number of information are stored and exchanged among the nodes to find the smallest weight. The performance of the system becomes worse with the enhancing in network size. When a part of node transmits out of the system which is called as MH also, transmission range of all the cluster heads Whenever a current head goes out of the range of its member nodes leaving them as orphan nodes. This reduces the frequency of re-elections to great extent. The cluster heads in this protocol remain as neighbours to increase the backbone connectivity which in turn reduces the number of re-elections and re-affiliations as shown in figure It can be observed that WCA out performs any of the algorithms in terms of the re-affiliation and re-election rate of the mobile nodes in the dynamic network. WCA uses an top level for the clusters under the system.

VII. BRTCM

In Ad Hoc network using Ad Hoc On-Demand Distance Vector (AODV) routing algorithm every node update the routing table, which stores the following information about the route to a particular destination.

- Destination node
- Next hop
- number of hops
- Destination sequence number
- Active neighbors for the route
- For route table provided expiration time

Whenever a data packet is to be sent by a node, on primary work checks with its routing table to determine whether it is possible a route to the node is already available. Which uses that route to send the packets to the destination node. If a route is not inactivated or the previously entered route is unavailable, then the node initiates a route discovery process. A RREQ (Route REQuest) packet is broadcasted by the node. Every node that receives the RREQ packet first checks if it is the destination for that packet and if so, it sends back an RREP (Route Reply) packet. On other hand if it is not the target node, then it checks with its routing table to determine if it has got a route to the destination. If not, it relays the RREQ packet by transmitting it to its closest node. If its routing table does contain an entry to the destination, then the next process is the comparison of the 'Destination Sequence' number in its routing table to that present in the RREQ packet. This Destination Sequence number is the sequence number of the last sent packet from the destination to the source. If the node sequence number(table) present in the routing table is lesser than or equal to the one contained in the RREQ packet, then the node relays the request further to its neighbors. If the number in the routing table is higher than the number in the packet, it denotes that the route is a 'fresh route' and packets can be sent through this route. This intermediate node then sends a RREP packet to the node through which it received the RREQ packet. The RREP data gets relayed back to the source through the reverse route can be perform. The source node then updates its routing table and sends its packet through this route. During the operation, if any node identifies a link failure it sends a RERR (Route ERRor) packet to all other nodes that uses this link for their communication to other nodes.

VIII. COMPARISON OF ALGORITHMS

we have presented the basics of cluster formation for different one-hop clustering algorithms along with their simulation result in the direction of cluster maintenance. The graphs comparing the results of all the above algorithms are presented in this section. It can be observed from the comparison of the graphs that, the pattern of the results are almost similar for most of the algorithms. Even for some algorithms the differences are marginal. But some algorithms like HC provide worse performance in some cases where as MOBIC has the worst result for some other maintenance parameters. So this can be concluded that each of these algorithms has its own strengths and weaknesses. Depending on the network condition and requirement, out of all the protocol anyone can be selected for the operation for implementation prior to the actual routing job. For example, LID results in an overall good performance among other algorithms in achieving the cluster population, re-affiliation overhead and

number of reelections as shown in the figures. But the identification based weight calculation criteria biases the lower ID nodes to become the heads all the time. This may cause faster resource drainage or even node failure to such lower ID nodes.

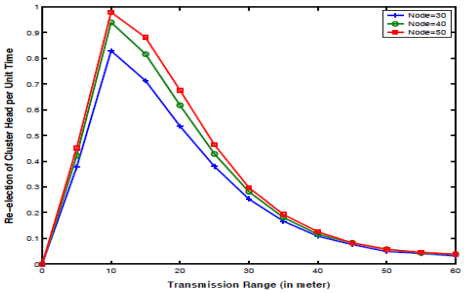

Figure 2- Comparison of algorithms for avg. no. of cluster heads[7]

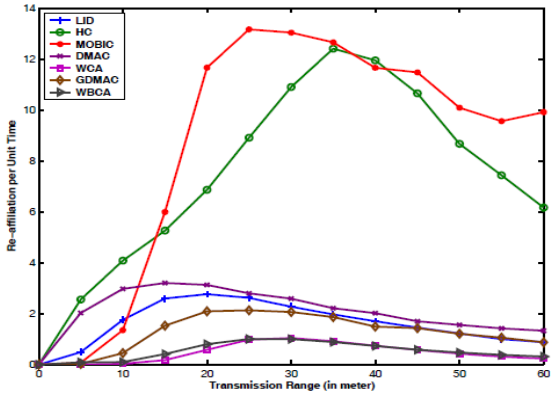

Figure 3- Comparison of algorithms for frequency of re-affiliation by the nodes[7]

so that the routing delay is minimized due to reduced number of routing heads. But at the same time the re-elections and the number of re affiliations are compromised as shown in figures 2 which does not encourage a designer to choose this algorithm for implementation. MOBIC and GDMAC have a higher cluster population as shown in figure because they allow more than one cluster heads to exist as neighbours for a Cluster Contention Interval (CCI) period or till their weight difference exceeds a threshold value *H*. Higher cluster population of these two algorithms may increase the routing delay and affect the QoS of the network layer. But, when the stability of clusters is concerned, MOBIC and GDMAC provide the best result due to their lower re-election rate as shown in figure. So, for these two algorithms it may be concluded that they provide better cluster stability or the route stability (as the cluster heads are the routers of the dynamic network) at the cost of increasing routing hops or the delay in packet forwarding. MOBIC has a very high re-affiliation rate than GDMAC as shown in figure. So more control messages are exchanged for member up dating.

IX. CONCLUSION

The focused aim has been achieved as to survey the MANET protocol has been done. The protocol consists linked cluster algorithm, Lowest ID theorem, Highest connective algorithm, weight cluster algorithm and comparison of each algorithm is provided. There is a lot comparative algorithms is been presented by which the proper statement of better algorithm can be use in case of mobile ad-hoc networking. The transmission range and re-afflation range settlement represents the result of comparative study where the node 50 shows the better noise immunity and performance. The basic operation has been illustrated with the research work into starting of the paper. By keeping time target each kind of algorithm which is useful for MANET and having better noise immunity and energy efficient system is been presented to keep this paper more interesting.

REFERENCES

1. Luc Hogie. Mobile Ad Hoc Networks: Modelling, Simulation and Broadcast-based Applications. PhD thesis, University of Luxembourg, April 2007.
2. Q. Gao, K. J. Blow, D. J. Holding, I. W. Marshall, and X. H. Peng. Radio range adjustment for energy efficient wireless sensor networks. Ad Hoc Networks, 4(3):75–82, 2006.
3. G. Noubir G. Lin and R. Rajaraman. Mobility models for ad hoc network simulation. In proceedings of IEEE INFOCOM 04, 2004
4. M. R. Garey and D. S. Johnson. Computers and Intractability: A guide to the theory of NP-completeness. Freeman, San Francisco, CA, 1979.
5. D. J. Baker, A. Ephremides, and J. A. Flynn. The design and simulation of a mobile radio network with distributed control. IEEE Journal on selected areas in communication, SAC-2(1):226–237, January 1984.
6. A. Ephremides, J. E. Wieselthier, and D. J. Baker, "A design concept for reliable mobile radio networks with frequency hopping signaling," presented at the Proceedings of the IEEE , Jan. 1987.
7. Suchismita Chinara “Analysis and Design of Protocols for Clustering in Mobile Ad Hoc Networks” Doctor of Philosophy thesis at National Institute of Technology Rourkela 2011.

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Prof. Harjeet Singh Chauhan is Working as a Professor at BM Group of Institution, Gurgaon . he have around 13+ years of teaching experience. He had obtained his PhD in reliability engineering in year 0f 2003. He have presented 15 national and international journal and conferences.