An Enhanced Weight Based Clustering Algorithm for Mobile Adhoc Networks

Danish Shehzad, Waqar Ishaq, Zakir Khan, and Junaid Iqbal

***Abstract*—**Mobile adhoc network is a versatile and dynamic network formed temporarily for communication between mobile nodes.MANETS are difficult to manage as compared to wired networks because of lack of infrastructure and continuous change in topology. Cluster formation is the mechanism for grouping wireless nodes in the form of clusters under cluster head for the purpose of easy management of network. Proper cluster head selectionfor the management of cluster is the critical and challenging problem in cluster formation for researchers. In this paper we propose an enhanced weight based clustering algorithm in which node with highest calculatedpercentile weight-age based on battery life time, processing speed, connectivity and mobility of nodeis selected as cluster head for the efficient and effective management of cluster. We also propose solution of hash function when there is tie between nodes based on calculated weight for the selection of cluster head. Thus our proposed algorithmfor cluster head selection enhances the existing algorithms and minimizes the chance of any weak node to become cluster head.

***Keywords*—**Mobile Adhoc Network MANET, Clustering, Hash.

I. INTRODUCTION

MOBILE Adhoc Networks are networks that provide communication through wireless links between nodes in the absence of fixed infrastructure. Wireless nodes transmit and receive data directly without any infrastructure enabling multi hop wireless communication in the network. It is the combination of few mobile nodes that reside in transmission range of each other. MANETs have diverse challenges because nodes can join or leave network at any time. Clustering is an attempt to providewireless networks a logical infrastructure. Unlike wired networks these networks are difficult to handle but clustering organize nodes and make network feasible for proper functionality.

Clustering enables network resources to be used efficiently, it increase the reliability of network by load leveling and make large networks to appearsmaller. It has many benefits over un clustered networks [1]. It reduces network routing table at network layer and thus improves routing within network. Clustering saves energy and communication bandwidth it also allows network to adapt change in topology efficiently.

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The paper has following organization: Section 2 states some background knowledge an existing work. Section 3defines the proposed mechanism and objective of the research. Section 4 concludes the research work and directs for future enhancements in the area.

II. RELATED WORK.

Many cluster formation algorithms have been proposed according to conditions and requirements of mobile ad hoc networks. These algorithms endeavor their best to select the appropriate node as cluster head for the proper management of network. Few of the concerned techniques are as:

Highest Degree clustering algorithm [2] selects the node with highest degree as cluster head and all other nodes as cluster members.The problem with this technique is that along with increase in number of nodes in cluster its performance and throughput decreases.Least Movement Clustering Algorithm[3] selects the nodewith highest battery level and lowest movement as cluster head. Greater the battery and lesser the movement greater the chances of becoming cluster head, but node with least number of neighbors may become cluster head, resulting in overhead for information exchange with cluster members.The Distributed Clustering Algorithm (DCA) [4] defines algorithm in which each node has weight based on few parameters, the node with highest weight is selected as cluster head. However it does not consider battery level and node elected as cluster head may be close to battery drainage.

MOBIC[5] proposes a solution to elect cluster head based on the relative power of received messages by neighbors after consistent time intervals and thus calculatingrelative speed of mobile node and depends only on one factor.

The Weighted Clustering Algorithm (WCA) [6] [7] form clusters based on calculated weights. Earlier proposed weighted algorithms consisted of single parameter to decide cluster head selection. These parameters included node degree, distance from neighbors, speed of node and maximum or minimum IDs. Although WCA are considered as appropriate for selecting cluster head but in the case of equivalency of nodes weight causes complex problem for decision of cluster head.

For these reasons we proposed enhanced algorithm by calculating weight by combining favorable parameters of the existing proposed algorithms and combined few existing and proposed new parameters to elect the cluster head. Also we proposed a solution to solve the problem in case of weight equivalency by applying Hash function for the selection of cluster head.

III. PROPOSED SOLUTION

Cluster formation is considered as best mechanism for handling the mobile nature of MANETs, a new clustering algorithm is proposed for the efficient handling of MANET nodes, which enhances the existing algorithms minimizing the chances of any weak node to become cluster head.

Cluster head will be selected as the best node with the maximum knack of four key parameters which are remaining Power/Battery level, processor speed, mobility of node andConnectivity. The above parameters are critical for calculating the exact and appropriate cluster head and are assigned percentile weightage so that overall weight of node is best representation of mobile node capabilities in the cluster.

Cluster Head Selection Algorithm:

1. *Start*
2. *Send receive beacon messages*
3. *Weight Calculation*
   - A. *Remaining Battery*
   - B. *Connectivity*
   - C. *Processing Speed*
   - D. *Mobility*
4. *Weight sharing upto first hop neighbors*
5. *Weight Comparison*
6. *if(my weight > neighbors weight)*
   - A. *Elect me as Cluster Head*
7. *Else if(my weight < neighbors weight)*
   - A. *Quit me from candidate list*
   - B. *Weight to receive broadcasted message from clusterhead*
8. *Else*
   - A. *Generate Hash of MAC address*
   - B. *Apply defined principle on Hash of MAC address(H2)*
   - C. *Elect the Cluster Head has Max Value got by H2*
9. *End if*
10. *Broadcast the Cluster head*

The process of cluster head selection starts with sending and receiving beacon messages to and from neighbors. Nodes becoming aware by beacon messages now forcluster head selection calculates their own weights and share with neighbors. Nodes after receiving weight of neighbors compare its own weight with weights of neighbors and one with highest weight becomes cluster head.

Though process seems to be simple conversely there are two decision making steps which decides whether node is eligible to contend for becoming cluster head or not. One that is not legible for becoming cluster head refrain from selection process and weights for receiving message by the selected cluster head these two decisional steps are as follows.

A. Weight Calculation:

It is the first key decision making step in this algorithm. Depending upon the weightsof four different factors nodes fate to contend or exit cluster head selection process is decided. If weights are above threshold values, nodes are selected for further process otherwise refrain fromselection process. These four key factors are.

1) Remaining Battery level.(0.25)

As node contending for becoming cluster head must not be near to battery drainage so thresh hold value for battery level is defined, under which node cannot contend for clusterhead and exits clusters head selection process.

2) Connectivity.(0.20)

Connectivity means number of direct neighbors, it ensures that node which contends for the cluster head might not be the node with minimal number of neighbors reducing the overhead of indirect communication and control.

3) Processing Speed.(0.25)

There may be nodes that are much slower than others in the network and in the presence of high-speed calculating device it is not appropriate to select a node with slow processing speed as cluster head. So the processing speed of node is given 25% weightage in calculating overall weight of a node.

4) Mobility.(0.30)

Mobility is the relative speed of mobile node with respect to its neighbors. It ensure that node that is going to leave network because of its rapid movement might not be selected as cluster head.

These four parameters after calculation are given the assigned weights and aggregate weight of node is calculated. This weight is true representation of nodes capabilities and level in the network.

B. Weight Comparison:

The second decision making step in the process is weight comparison. Three scenarios are generated in weight comparison which are.

1) When weight of node is less than its neighbors weight, the node quits the selection process, although it fulfills the minimum requirement for becoming cluster head but in the case when its neighbor has more weight it exits contention process allowing most suitable candidate to become cluster head.

2) When weight of node is greater than all of its neighbors and first neighbors. It becomes cluster head and broadcast message to all nodes to become part of its cluster as leaf nodes.

3) When weight of two or more nodes become equal, than it is an out of the ordinary situation, in this case Hash function is applied on the Mac address of competitors, after calculating hash H2 policy of calculating of comparing last two digits of calculated Mac address are compared, the one with highest values is calculated as Cluster head in the network.

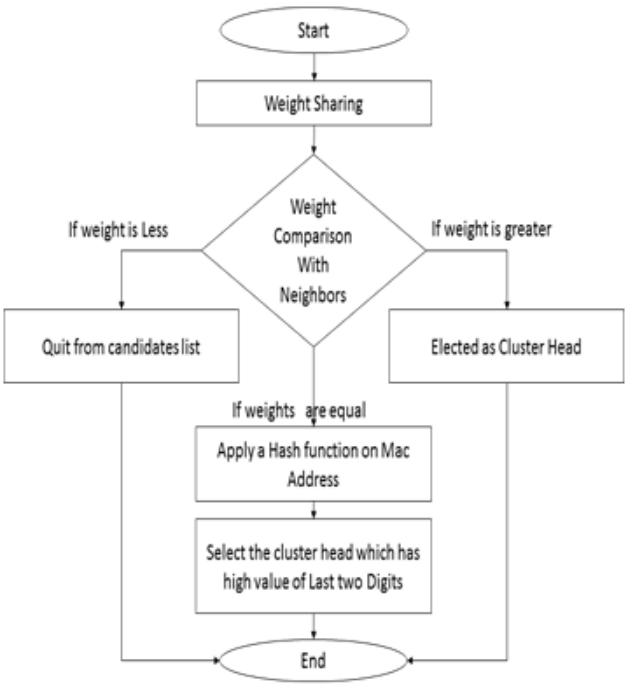

Fig.2 Weight comparison mechanism

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Diagrammatically the overall process of cluster head selection can be illustrated as.

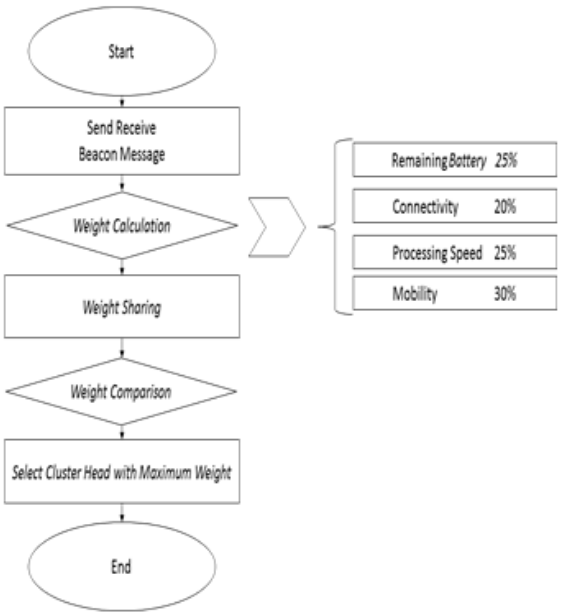

Fig.1 Cluster head selection process

Thus, electing node with maximum weight which is most efficient, stable, having suitable processing speed and limited mobility that retains cluster for specific time and mininimal battery level of cluster head retains cluster head till reelection of clusterhead is started.

IV. CONCLUSION

In this paper, we have proposed a novel cluster formation technique which enables MANET nodes to select most suitable cluster head for efficient management of resources. Cluster head is selected based on four key parameters as remaining battery level, processing speed, relative mobility of node and connectivity of node in the network. The node with highest calculated weight is selected as cluster head with most efficient resources for network management. We have also proposed technique based on hash function for selecting cluster headwhen two or more nodes have same calculated weights. Thus our proposed algorithm is capable and efficient solution for cluster formation in MANETS. In future we aim to simulate proposed algorithm to check and compare performance, delay and throughput of MANET in different scenarios.

REFERENCES

[1] M. Anupama, B. Sathyanarayana, (2011). Survey of Cluster Baser Routing Protocols in Mobile Ad Hoc Networks, International Journal of Computer Theory and Engineering.

[2] Sucec.J.,&Marsic.I. (2002). Clustering overhead for hierarchical routing in mobile ad hoc networks, IEEE proceeding.

[3] Toh.c.k, & Chai K Toh(2002). Ad Hoc Mobile Wireless Networks protocols and Systems, New Jersey:Prentice Hall PTR.

[4] Dhurandher.S.K.,&Singh.G.V. (2006). Power Aware Clustering Technique in Wireless Ad Hoc Networks,International Symposium onAd Hoc and Ubiquitous Computing, ISAUHC .

[5] Jing Wu ,Guo-changGu, &Guo-zhaoHou (2009). A Clustering Algorithm Considering on a Hierarchical Topology's Stability for Ad Hoc Networks. First International Workshop on Education Technology and Computer Science. http://dx.doi.org/10.1109/ETCS.2009.199

[6] Vieu .V.B., Nasser .N.,&Mikou .N. (2006). A Weighted Clustering Algorithm Using Local Cluster-heads Election for QoS in MANETs. IEEE GLOBECOM.

[7] Yu .J.P. & Chong P.H.J. (2005).A Survey of Clustering Schemes for Mobile Ad Hoc Networks. IEEE Communications Surveys and Tutorials.

[8] Dhurandher S.K., & Singh .G.V. (2005). Weight Based Adaptive Clustering in Wireless Ad Hoc Networks. IEEE International Conference on Personal Wireless Communications.

[9] Vieu .V.B., Nasser .N.,&Mikou .N. (2006). A Weighted Clustering Algorithm Using Local Cluster-heads Election for QoS in MANETs. IEEE GLOBECOM.