Volume 6, Issue 7, July 2016 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Cluster Head Selection Techniques and Algorithm for Mobile Adhoc Networks (MANETs)

Dr. K.Prabu
Assistant Professor,
PG & Research Department of Computer Science,
Sudharsan College of Arts & Science,
Pudukkottai, India

Prof. K.Thamizhmaran
Assistant Professor in ECE,
Department of Electrical Engg,
Annamalai University,
Chidambaram, India

Abstract - MANETs is considered as a group all the mobile terminals, and system performance is a challenging the entire task. The packet delivery ratio, throughput and delay factors at the time of mobility and availability of MANETs are considered a most important feature for efficient Processing. The clustering in MANET helps to ensure the efficient performance of MANET to some extent. In the network clustered topology, cluster based routing protocols are used for well self-organized routing in MANET. In a network structure, cluster head and border nodes form backbone for routing among neighboring cluster nodes. But the head node selection is an important criterion to be considered because the head node will be the co-coordinator in network architecture. In this paper we describe the head node selection and its algorithm for the MANETs routing topology.

Keywords— MANET, Cluster head, Cluster head selection Algorithm, Mobility, Power-aware clustering.

I. INTRODUCTION

MANETs (Mobile Ad-hoc Networks) [1] consist of wireless hosts that communicate with each other in the absence of a fixed infrastructure. The hosts in the MANET have a limited battery power. In the case of large MANETs, a flat structure may not be the most efficient organization for routing between nodes. Instead, many clustering schemes have been proposed that organize the MANET into a hierarchy, with a view to improve the efficiency of Routing. It is important that cluster formation and maintenance should not be costly, in terms of resources used such as bandwidth, battery power etc [2] [3]. Otherwise, the purpose of clustering is defeated. To present a scheme that leads to cluster formation this efficiently uses the resources of the MANETs. We first of all (a) create the nodes in specified region (ii) secondly; form the clusters of created nodes (iii) finally, applying the SEP protocol for the election of the cluster head node and this created cluster head node will be of larger lifespan.

1.1 Cluster Head:

A cluster head, as defined in the literature, serves as a local coordinator for its cluster, performing inter-cluster routing, data forwarding and so on. In our self-organized clustering scheme the cluster head only serves the purpose of providing a unique ID for the cluster, limiting the cluster boundaries show in figure 1.

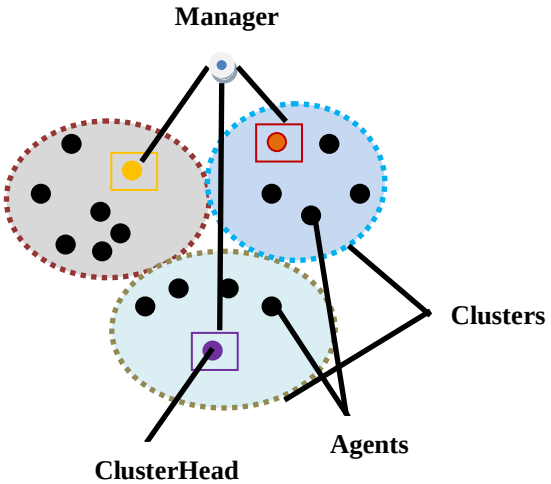

Figure1. Cluster Head

1.2 Cluster Gateway:

A cluster gateway is anon-cluster-head node with inter-cluster links, so it can access neighboring clusters and forward information between clusters.

1.3 Cluster Member:

A cluster member is anode that is neither a cluster head nor a cluster gateway. In MANET, clustering as two phases: first is the cluster creation and second is the cluster maintenance.

1.4 CH Selection:

Cluster head selection is needed in cluster based Network, Must research has been done on election of cluster head in a clustering environment. In MANET, there is no centrality to control the election process and mobility is also an issue. Another Cluster Head Election technique was proposed based on remaining energy and relative position of the node in the cluster, the cluster head is selected on the basis of threshold value T, Threshold is calculated by the three factors Energy, Distance and Location and probability of the node, Every node generates a Random number, if it is smaller than a predefined value the node elects itself as a Cluster-head [7] [8].

Another Cluster Head Election technique was proposed based on remaining energy and relative position of the node in the cluster, the cluster head is selected on the basis of threshold value T, Threshold is calculated by the three factors Energy, Distance and Location and probability of the node, Every node generates a Random number, if it is smaller than a predefined value the node elects itself as a Cluster-head [4] [5].

II. CLUSTER HEAD

Network selection parameters like in-network data processing, node deployment and capabilities are best described in Clustering objectives like load balancing and fault-tolerance, increased connectivity, reduced delay, minimum cluster count, maximal network longevity are also described with reference to the presented a classification of clustering attributes as clustering properties, cluster head capabilities and clustering process, our survey is based on selecting best optimized cluster head selection based on Fuzzy AHP with Multiple criteria decision making [6].

2.1. Cluster-head Capabilities:

The following attributes of the CH node are differentiating factors among clustering schemes:

a) *Mobility:* CH may be stationary or mobile. In most cases, they are stationary. But sometimes, CHs can move within a limited region to reposition themselves for better network performance.
b) *Node Types:* Generally sensor nodes among the deployed sensors are designated as CHs, but sometimes sensor nodes equipped with significantly more computation and communication resources are selected as CHs.
c) *Role:* Some of the main roles of the CHs are simply relaying the traffic, aggregation or fusion of the sensed data.

2.2. CH Selection Criteria

a) *Initial Energy:* This is an important parameter to select the CH. When any algorithm starts it generally considers the initial energy.
b) *Residual Energy:* After some of the rounds are completed, the cluster head selection should be based on the energy remaining in the sensors.
c) *Energy Consumption Rate:* This is another important parameter that considers the energy.
d) *Average Energy of the Network:* The average energy is used as the reference energy for each node. It is the ideal energy that each node should own in current round to keep the network alive [9] [10].

III. HEAD NODE SELECTION ALGORITHMS

Clustering schemes can also be divided into 1-hop clustering and multi-hop clustering. CH selection techniques comparison is made in terms of parameters used and the objective of the selection procedure. The cluster head selection procedure is taken as the main criteria and depending on the different parameters and objectives, the algorithm is classified under five categories. The algorithm is classified as Identifier-based, Connectivity based, Mobility based, Cost based, Power based algorithms as below [11] [12]:

3.1 Identifier based:

The algorithms are further classified into Lowest ID cluster algorithm (LIC) and Max-Min d-cluster formation algorithm. The cluster head selection procedure is based on the ID of the node.

3.2 Connectivity based:

The algorithms are further classified into highest connectivity clustering algorithm (HCC), K-hop connectivity ID clustering algorithm (KCONID). Adaptive cluster load balance method and Adaptive multihop clustering (With load balancing capabilities).The connectivity based method focuses mainly on the selection of a particular node as a head node based on the neighbourhood connectivity. The based method with its load balancing efficiency calculates the efficient cluster head with the help of the number of mobile nodes connected [14].

3.3 Mobility:

The aware clustering is further classified into Mobility-based d-hop clustering algorithm, Mobility Based Metric for Clustering and Mobility Based framework for Adaptive Clustering. This approach focuses on the stability of a mobile node based on its speed, variance and selects the head which is more stable than the other nodes [13].

3.4 Low cost:

The of maintenance clustering algorithm is classified into Least cluster change algorithm (LCC), Adaptive clustering for mobile wireless network and 3-hop between adjacent cluster heads (3-hBAC).This algorithm mainly focuses on the reduction of communication overhead caused by cluster maintenance. The method of selecting the cluster head is based on the ID. Depending on the cluster maintenance the cluster head selection is paid attention on the cluster formation phase and cluster maintenance phase.

3.5 Power Based:

The power aware clustering is classified into Power-aware connected dominant set, clustering for energy conservation, weighted clustering algorithm and Entropy-based weighted clustering algorithm. Energy level is considered as the main criteria in this classification.

Cluster head selection Algorithm:

If broadcasting Time then
Send (ID, Er, RSn, RTn, X, Y) *(RSn represents restart number)*
While
RTn indicates retransmission number *(X, Y is the coordinate of the node)*
Else
Receive (ID, Er, RSn, and RTn, X, Y)
end if
Fuzzy and judgement matrix construction based on questionnaire investigation
The consistency test
Calculate the composite value f of the following criteria
Ti ← (1-(0.9 x f +0.1 x rand (0, 1))) x Ti
If no CH advertisement was received && Ti time out then
Broadcast (CH)
Head Flag ← 1
End if
If total advertisement Time timeout then
My CH ← select Best (CH)
Join (my CH)
End if
If head Flag = = 1 then
Create TDMA ()
Broadcast (TDMA)
Else
Receive (TDMA)
End if

IV. METHODOLOGY

Algorithm Classified for the Cluster Head Selection Procedure as abbreviated below:

4.1 Identifier Based Clustering:

- Lowest ID cluster algorithm (LIC)
- Max-Min d-cluster formation algorithm

Nodes with minimum Id is the cluster head. If a node *A* is the largest in the d-neighbourhood of another node *B*, *A* will be elected a cluster head.

4.2 Connectivity-based clustering:

- Highest connectivity clustering algorithm (HCC)
- K-hop connectivity ID clustering algorithm (KCONID)
- Adaptive cluster load balance method
- Adaptive multihop clustering (with load balancing capabilities)

The node with maximum number of neighbours (i.e., maximum degree) is chosen as a cluster head. Each node in the network is assigned a pair id = (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 the HCC Clustering scheme's hello message format, there is an "Option" item. If a sender node is a cluster head, it will set the number of its dominated member nodes as "Option" value. When a sender node is not a cluster head or it is undecided (CH or non-CH), "Option" item will be reset to 0. When a CH's Hello message shows its dominated nodes' number exceeds a threshold (the maximum number one CH can manage), no new node will participate in this cluster. Each mobile node periodically broadcasts information about its ID, Cluster head ID, and its status (cluster head / member / gateway) to others within the same cluster. Thus, a cluster head can know the

number of mobile nodes of each neighbouring cluster. Adaptive multihop clustering sets upper and lower bounds (U and L) on the number of cluster members within a cluster that a cluster head can handle

4.3 Mobility-aware clustering:

- Mobility-based d-hop clustering algorithm
- Mobility Based Metric for Clustering
- Mobility-based Frame Work for Adaptive Clustering

Local stability is computed in order to select some nodes as cluster heads. A node may become a cluster head if it is found to be the most stable node among its neighbourhood. Thus, the cluster head will be the node with the lowest value of local stability among its neighbours. This scheme proposes a local mobility metric for the cluster formation process such that mobile nodes with low speed relative to their neighbours have the chance to become cluster heads .Mobile nodes with low variance values in their neighbourhoods are chosen as Cluster head. For cluster maintenance, timer is used to reduce the cluster head change rate by avoiding reclustering for incidental contacts of two passing cluster heads.

4.4 Low cost of maintenance clustering:

- Least cluster change algorithm (LCC)
- Adaptive clustering for mobile wireless network
- 3-hop between adjacent cluster heads (3-hBAC)

The cluster formation simply follows LIC, i.e. initially mobile nodes with the lowest ID in their neighbourhoods are chosen as Cluster heads. In this adaptive clustering scheme, every mobile node i keep its own ID and the ID of its direct neighbours in a set Gi. Each mobile node with the lowest ID in their local area declares to be a cluster head and set its own ID as its cluster ID (CID). The CID information includes a mobile node's ID and CID. When a mobile node i receives CID information from a neighbour j, it deletes j from its set Gi. If the CID information from j is a cluster head claim, the mobile node checks its own CID aspect. If its CID is unspecified (it is not involved in any cluster yet) or larger than the ID (CID) of j, it sets j as its cluster head The cluster formation always begins from the neighbourhood of the mobile node with the lowest ID (assuming it is mobile node mo) in a MANET. The mobile node with the highest node degree in mo's closed neighbour set is chosen to be the first cluster head. A mobile node, which is not denied cluster head capability, declares as a new cluster head when it is with the highest node degree in its neighbourhood.

4.5 Power-aware clustering:

- Power-aware connected dominant set Clustering for energy conservation
- Weighted clustering algorithm
- Entropy-based Weighted clustering algorithm

In this scheme Energy level (el) instead of ID or node degree is used to determine whether anode should serve as a cluster head. Clustering for energy conservation assumes two node types: master and slave. A slave node must be connected to only one master node, and a direct connection between slave nodes is not allowed. Each master node can establish a cluster based on connections to slave nodes. The area of a cluster is determined by the farthest distance between the master node and a slave node in the cluster. Weighted clustering algorithm (WCA) selects a cluster head according to the number of nodes it can handle, mobility, transmission power and battery power. It uses an entropy based model for evaluating the route stability in ad hoc networks and electing Cluster head.

V. CONCLUSION AND FUTURE WORK

In mobile ad-hoc networks have been attracted more attention in recent years, much research has been addressing all the kinds of issues related. Since a large-scale MANETs not guarantee performance with a flat structure, many cluster hierarchy algorithms has been implemented to solve the availability issue. In this article, we first provided basic concepts about MANET, importance of structure; cluster selection based routing protocols, Clustering in MANET including the definition of the cluster and clustering, importance of Cluster Head selection for a large dynamic MANET Clustering. Then we classified new proposed clustering schemes into different categories based on their main objectives in select the head node selection procedure. With this survey we see that a cluster Head selection in MANET has many of important of issues to examine in the fairness of cluster heads for a all the mobile node. Also, different types of clustering nodes schemes may have a different focus and objectives such as Identifier–based, connectivity –based, Mobility based, cost-based, and Power-aware based. Although each scheme is well suited for certain scenarios, based on efficient cluster head node it is not guaranteed that any one of them is the best for every situations. The future research will be focused on the more effective clustering schemes and a combination of the different parameters in choosing the effective cluster head in topology for MANETs.

REFERENCE

[1] E. M. Belding-Royer, "Hierarchical Routing in Ad Hoc Mobile Networks," Wireless Communication and Mobile Computing, vol. 2, No.5, pp. 515–32, 2002.

[2] C. E. Perkins, "Ad Hoc Networking", Addison-Wesley, 2001.

[3] M. Jiang, J. Li, and Y. C. Tay: "Cluster Based Routing Protocol (CBRP) Functional Specification", Internet Draft, work in progress, 1999

[4] Ratish Agarwal, and Dr. Mahesh Motwani, "Survey of clustering algorithms For MANET", IJCSE, Vol. 1, Issue No. 2, pp. 98-104, 2009

[5] Jane Y.Yu, and Peter H.J. Chong, "A Survey of clustering schemes for Mobile ad hoc networks ",IEEE communications and surveys, Vol.7, No.1,pp.32-47, 2005

[6] Blanca Alicia Correa, Laura ospina, and Roberto carloshincapie "Survey of Clustering techniques for mobile ad hoc networks", International conference on networks, pp.145-161, 2007

[7] Mihir Mehta, and IndrJeet Rajput, "A survey of clustering approaches for Mobile adhoc network", Computer software, Vol. 3, No.2, pp. 507- 512, 2014.

[8] M. Anupama and B. Sathyanarayana "Survey of Cluster Based Routing Protocols in Mobile Ad hoc Networks," International Journal of Computer Theory and Engineering, Vol.3, No.6, 2011.

[9] N. Gupta, and M. Shrivastava, A. Singh, "Cluster Based on Demand Routing Protocol for Mobile Ad Hoc Network", IJERT, Vol. 1, No. 3, 2012.

[10] A.Ephremides, J. E. Wieselthier and D.J. Baker. "A Design Concept for Reliable Mobile Radio Networks with Frequency Hopping Signalling", IEEE Proc. IRE, pp. 56-73, 1987.

[11] M.Gerla, et.al, "Multicluster Mobile Multimedia Radio Network", Wireless Networks, Vol 1, pp.255-265, 1995.

[12] Prabu, K. and Subramani, A. "Performance comparison of routing protocol in MANET", Int. J. of Adv. Research in Com. Sci. and Soft Engg., Vol. 2, No. 9, pp.388–392, 2012.

[13] Prabu, K. and Subramani, A. "Energy efficient routing in MANET through edge node selection using ESPR algorithm", Int. J. Mobile Network Design and Innovation, Vol. 5, No. 3, pp.166–175, 2014.

[14] M. Chatterjee, et.al, "WCA: A Weighted Clustering Algorithm for Mobile Ad Hoc Networks", Cluster Computing Journal, Vol. 5, No. 2, pp. 193-204, 2002.

AUTHOR BIOGRAPHY

Dr. K.Prabu received his Ph.D Degree in Computer Applications from Manonmaniam Sundaranar University, Tirunelveli. He is now working as an Assistant Professor in PG & Research Department of Computer Science, Sudharsan College of Arts & Science, Pudukkottai, and Tamilnadu, India. His research interested includes Adhoc Networks, Wireless Networks and Mobile Computing. He has published more than30 technical papers at various National / International Conferences and Journals. He is a life member of ISTE, IAENG, and IACSIT.

Prof. K. Thamizhmaran has received his B.E and M.E degree from Annamalai University, Chidambaram, Tamilnadu, India in the year of 2008 and 2012 respectively. He is currently working as an Assistant Professor in ECE / Department of Electrical Engg, FEAT, Annamalai University, Annamalai Nagar, Chidambaram, Tamilnadu., India. His research interested includes area includes Networks security, Ad Hoc Networks, Mobile Communications, Digital Signal Processing. He has published more than 20technical papers at various National / International Conference and Journals. He is a member of IAENG, IACSIT

