IJCSE International Journal of Computer Sciences and Engineering Open Access
Review Paper Vol.-6, Issue-12, Dec 2018 E-ISSN: 2347-2693

Review of Clustering Algorithm for Cluster Head Selection of MANET Using Weighted Metrics

Sandeep Monga[1*], J.L Rana[2], Jitendra Agarwal[3]

[1]School of Information Technology, RGPV, Bhopal, Madhya Pradesh, India
[2] Department of Computer Science & Engineering, RGPV, Bhopal, Madhya Pradesh, India
[3]School of Information Technology RGPV, Bhopal, Madhya Pradesh, India

[*]*Corresponding Author: smongaphd6@gmail.com , Tel.: +919425302578*

Available online at: www.ijcseonline.org

Accepted: 18/Dec/2018, Published: 31/Dec/2018

Abstract— A Mobile Ad hoc Network (MANET) is an accumulation of wireless portable nodes shaping a system without utilizing any current infrastructure. The mobility characteristic of MANETs is an extremely critical one. The mobile nodes may follow different mobility patterns that may affect connectivity and performance. In MANET due to decentralize of resources every nodes have to perform the routing functionalities themselves. Communication in such type of network is challenge and complex. To overcome these problems Clustering is the best solution for wide, flexible and high portability Ad-Hoc System. It increases the potential of network and reduces the routing overhead for efficient routing in MANET. Different types of phases involve in Cluster are Designing of Cluster and Maintenance of Cluster. In Cluster designing, selecting proper cluster head is one of the primary issues of research. For Maintenance of cluster an efficient system is required so that cluster head can keep update all the data of cluster, due to change in cluster structure because of nodes mobility. This paper basically focused on the Weighted Metric algorithms in MANET.

***Keywords*—**MANET,Cluster Head, Clustering

I. INTRODUCTION

A MANET is an autonomous system of mobile nodes. The nodes may be located in or on cars, trucks, ships and anywhere on earth. The MANET nodes are equipped with wireless transmitters and receivers using an antenna that is used to communicate with each node. This Ad-hoc topology may change with time as the nodes move or adjust their transmission and reception parameters. MANET has several characteristics such as dynamic topology (free to move in multi-hop), bandwidth constrains, energy constrained, limited physical security, etc.

MANET does not require the Access Point or Base Stations for communication between the nodes. The only possibility of communication is through the neighbouring nodes. One of the most interesting features is the possibility of multi-hop communication [1]. Thus, it is essential to construct virtual network with the subset of nodes that is responsible for forwarding packets. The nodes can be grouped into distinctive clusters.

In general topologies include large numbers of nodes, routing packets will demand a large percentage of the limited wireless bandwidth. To successfully overcome such barriers and to address the issues of scalability and maintenance of MANETs, it is essential to build hierarchies among the nodes, such that the network topology can be abstracted with minimal research. This process is commonly referred to as Clustering [2].Clustering provides a hierarchical MANET system that helps to maintain the routing information. For instance, when a group of people come together and use wireless communication for some computer based on collaborative activities; which is also referred to as spontaneous networking [3].

Many academic papers evaluate protocols and their abilities, assuming varying degrees of mobility within a bounded space, usually with all nodes within a few hops of each other. Different protocols are then evaluated based on measure such as the packet drop rate, the overhead introduced by the routing protocol, end-to-end packet delays, network throughput etc. Since the bandwidth is limited in the ad-hoc network, it is essential to construct virtual network with the subset of nodes that is responsible for forwarding packets. The nodes are grouped into distinctive clusters. Clustering of nodes is one of the biggest challenges that MANETs are facing with and it is a hot topic in the research areas nowadays. Proper clustering solutions can greatly enhance the practicability and performance of MANETs [4].

The mobile nodes can directly communicate to those nodes that are in radio range of each other, whereas others nodes need the help of intermediate nodes to route their packets.

These networks are fully distributed and can work at any place without the aid of any infrastructure. This distinctive advantage makes these networks highly robust.

Clustering can improve the network management and energy saving. Normally, cluster formation and cluster maintenance are the two phases that exists in clustering. Since the mobile nodes may not be aware of changes in their neighbourhood, cluster maintenance is initiated to have frequent updating of clusters and cluster heads to maintain the accurate network topology.

Due to the unpredictable mobility of the nodes, it leads to the arbitrary changes of network topology over a time. Therefore, some of the nodes are elected to be most significant for the MANET system [5]. These nodes are called Cluster Heads (CH). The Cluster Heads within each cluster acts as the local coordinator for its cluster member. The cluster heads manage and stores recent routing information. Clustering solutions consider different node characteristics and perceives different weight parameters as a priority criterion in electing cluster heads [6].

II. NETWORK MODEL

MANET is based on undirected Graph G={V,E} where V is set of Nodes and E is a set of Links. Due to node mobility, Graph is changing in respect to time.

In MANET it is assumed that every node has unique ID and Weight. Any two nodes V_i and V_j are considered to be connected by the link E, if they received signals from each other. If any two nodes are connected through direct link are considered to be neighbor nodes.

Cluster is a subset of network nodes. In Cluster the node with minimum or maximum weight among all its neighbor nodes is selected to be Cluster Head. Every node of Cluster is either Cluster Head or Normal Node.

The set of all Cluster Head is called as Dominant Set. It is well known result, that finding maximum/minimum dominating set is NP-complete problem [7].

III. CLUSTERING ALGORITHM WITH WEIGHTED METRIC FOR CLUSTER HEAD SELECTION IN MANET

In this section few algorithms are listed to solve the Dominant Set problem for MANET, using nodes characteristics.

A) **Weighted Clustering Algorithm (WCA)** [8]: In this algorithm, combined metric is used for cluster head selection i.e. Node Degree (Δv), Sum of the distance with neighbor nodes (D_v), mobility of the node till current time (M_v) and Battery Power (P_v).

The node weight is calculated using following expression:

$W_v=W_1\Delta v+W_2D_v+W_3M_v+W_4P_v$

Here $W_1+W_2+W_3+W_4=1$

The node with the smallest W_v amongst neighbor is chosen as Cluster Head.

B) **An Adaptive Weighted Clustering Based Routing Protocol (AWCBRP)** [9]: In this algorithm, weight metric consider for Cluster Head Selection are Power Level, Connectivity Level and Stability of Node.

The power level (P_v) for each node is estimated by applying a centralized Protocol and distributed to the Cluster Members.

The connectivity level ($D_{v)}$ of the node is measured based on exchange of signals.

The stability ($S_{v)}$ is calculated using Reference Nodes, Total Time, Interval Time and Distance between nodes.

Following expression is used to calculated the weight of each node

$W_v=W_1P_v+W_2D_v+W_3S_v$

Here $W_1+W_2+W_3=1$

The node which has least W_v value will be elected as Cluster Head.

C) **Vote Based Clustering** [10]**:** In this algorithm, weight of the node is calculate as sum of number of valid neighbors and remaining battery time

$W_v=W_1(n/N)+W_2(m/M)$

Here $W_1+W_2=1$

n/N is a fraction of number of neighbors the Network Size

m/M is a ratio of remaining battery time to the maximum of remaining battery time.

This algorithm has the ability to load balance between Clusters, by using OPTION field to store the number of nodes in a cluster.

D) **Virtual Links Weight-Based Clustering (VLWBC)** [11]:In this algorithm, the weight of the node is calculate using node parameters and through consequence of neighbor

nodes parameters, this can be done by determining weights of virtual links through which all nodes are connected. The weight of virtual links between the two nodes is calculated by using the following expression

$W_v=W_1P_v+W_2N_L+W_3E_L+W_4I_L$

Here $W_1+W_2+W_3+W_4=1$

(i)P_v is links neighborhood contribution percentage and it indicated how many neighbors are available in each node transmission range.
(ii) N_L is a stability degree and incorporates the estimated link duration, smaller the value of this factor shows more stable.
(iii) E_L is nodes Energy which indicates residual and consumed energy.
(iv) I_L is the distance factor which is measured by GPS or Packet round time.

After calculating the weight of every node, this final weight of nodes will exchange with neighbors nodes. A node with the highest weight among its all the neighbor node declare itself as cluster head.

This protocol improves the stability of network and increase the cluster lifetime and decreases the consumed energy.

E) **Robust Clustering Algorithm** [12]: In this algorithm, the weight of each node is evaluated by using its mobility, power and workload, which can be computed locally and consider the factors which cause re-clustering. This algorithm increase the lifetime of MANETs and has a decrease the cluster head change rate.

F) **An Innovative based on Cluster Stability for Clustering Algorithm of MANET** [13]: this clustering algorithm in MANET based on nodes weight. The weight of the node is calculate using the following parameters i.e relative speed, number of nodes moving towards a node, stability, and battery remaining. In this algorithm the number of cluster formation is decrease and maximize lifespan of mobile nodes in the network.

G) **An Efficient Weight Based clustering algorithm for MANET** [14]: In this algorithm, each node has a quality factor that indicates its suitability as a cluster head. This quality is calculated according to following four parameters: Number of Neighbors, Residual Power of Battery, Stability and Variance of distance with all neighbors. This algorithm minimizes routing overhead, and increase end-to-end throughput.

H) **Cluster Formation based Comparison of Genetic Algorithm and Particle swarm Optimization Algorithm in Wireless Sensor Network** [15]: In this paper, Particle Swarm Optimization and Genetic algorithm is compared on the basis of their fitness function which is calculated by using Euclidean distances. GA is better than PSO in maximizing fitness value and reduction in energy consumption of the nodes.

IV CONCLUSIONS

Clustering is very useful in organizing and maintaining logical based hierarchical topology of MANET. Weighted metric based clustering algorithms are better because it provides high stability in cluster and creates less number of clusters.

REFERENCES

[1] Ilyas M, "The Hand book of Wireless Networks", CRC Press, 2003

[2] Angione G, Bellavista P., Corradi, A., & Magistretti E, "A k-hop Clustering Protocol for Dense Mobile Ad-Hoc Networks", 26th IEEE International Conference on Distributed Computing Systems Workshops (ICDCSW'06), Lisboa, Portugal, 2007

[3] Perkins C, "Ad hoc Networks", Addison-Wesley, 2001.

[4] Varadharajan, V., Shankaran, R., Hitchens, M, "Security for Cluster Based Ad hoc Networks", Computer Communications 27(5), pp. 488–501, 2004.

[5] Amis A.D., R. Prakash, T.H.PVuong, D.T. Huynh, "Max-Min DCluster Formation in Wireless Ad Hoc Networks". In proceedings of IEEE Conference on Computer Communications (INFOCOM) Vol. 1. pp. 32-41, 2000.

[6] Basagni S, "Finding a Maximal Weighted Independent Set in Wireless Networks", Telecomm. Systems. 18(1/3):155-168, September 2001.

[7] S.T. Hedetniemi and R.C. Laskar, "Bibliography on domination in graphs and some basic definitions of domination parameters," Discrete Mathematics, vol. 86 (1–3), pp. 257-277, 1990.

[8] M. Chatterjee, "WCA: A weighted clustering algorithm for mobile ad hoc networks," in Cluster computing Journal, vol. 5 (2), 2002, pp. 193-204.

[9] S. Karunakaran and P. Thangaraj, "An Adaptive Weighted Cluster Based Routing (AWCBRP) Protocol for Mobile Ad-hoc Networks," in WSEAS Transactions on Communications, vol. 7 (4), Stevens Point: WSEAS, 2008, pp. 248-257.

[10] F. Li, S. Zhang, X. Wang, X. Xue, H. Shen, "Vote-Based Clustering Algorithm in Mobile Ad Hoc Networks," in Information Networking, vol. 3090, Springer Berlin Heidelberg, 2004, pp.13-23

[11] A. Karimi, F.Zarafshan, A. Afsharfarnia and S.A.R Al Haddad, "A Novel Clustering Algorithm for Mobile AdHoc Newtorks Based on Determination of Virutal Links' Weight to Increase Network Stability" in The Scientific World Journal, vol. 2014, Iran: Hindawi, 2014.

[12] Zhaowen Xing, Le Gruenwald and K.K. Phang, "A Robust Clustering Algorithm for Mobile Ad Hoc Networks", Handbook of Research on Next Generation Networks and Ubiquitous Computing, December 2008.

[13] Mohammad Shayesteh and Nima Karimi, " An Innovative Clustering Algorithm for MANETs Based on Cluster Stability", International Journal of Modeling and Optimization, Vol. 2, No. 3, June 2012.

[14] Mohammad Reza Monsed, Sam Jabbehdari and Farshad Safaei, "An Efficient Weight based Clustering Algorithm for MANET ", JOURNAL OF COMPUTING VOLUME 3, ISSUE 1, JANUARY 2011 ISSN 2151-9617.

[15] Garg, A., Batra, N., Taneja, I., Bhatnagar, A., Yadav, A., & Kumar, S. (2017). "Cluster Formation based Comparison of Genetic Algorithm and Particle swarm Optimization Algorithm in Wireless Sensor Network", International Journal of Scientific Research in Computer Science and Engineering Vol.5, Issue.2, pp.14-20, April (2017).

