Volume 4, Issue 12, December 2014 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Mobility Based Clustering Algorithm for Ad Hoc Network: MBCA

Ira Nath, Soumitra Das
JIS College of Engineering
Kalyani, Nadia, India

Abstract- A Mobile Ad-hoc network (MANET) is formed when group of mobile wireless nodes collaborate between them to communicate through wireless links in the absence of the fixed infrastructure and any centralized control. These characteristics make it able to adapt and operate in difficult conditions. It is vital to keep the topology stable as long as possible. In this project a new approach to cluster formation based on mobility of every node that is the selection of cluster head using through minimum mobility for better stability of cluster and also overcome the weakness of weighted clustering algorithm (WCA).WCA does not re clustering that is when a low weight node may enter into a cluster or detach any node from the cluster, this situation, the project presented a new algorithm to generate re-clustering. Therefore, this algorithm can result in a more stable configuration, and thus yield better performance.

Keywords: ad hoc network; cluster; MANET; mobility.

I. INTRODUCTION

With the advent in wireless communication the internet service have reached every corner of the world. So the demand of instant networking service has increased everywhere. Wireless networks consist of mobile host or nodes which can communicate with each other over the wireless links without any static network interaction. Each node has the capability to communicate directly with another mobile host in its area. Most of the wireless communication depend infrastructure means a certain geographical boundary. Infrastructure network consist of a network with fixed and wired gateways. That type of network requires time & cost though may not possible to provide emergency service. An ad-hoc wireless network is self-organizing and adaptive. This means that a formed network can be de-formed on-the-fly without the need for any system administration. The ad hoc network can be heterogeneous, that is the nodes can be of different types (palmtop, laptop, mobile phone...) with different computation, storage and communication capabilities. In ad-hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. Ad-hoc networks are comprised of collection of wireless mobile nodes without a wired network infrastructure. That move freely and communicate with each other using wireless links. A mobile ad-hoc network (MANET) consists of a set of nodes that move their positions over time and communicate with each other via wireless links. Due to lack of fixed control infrastructure, nodes in the network not only send/receive messages like normal end hosts, but also forward messages like routers. The use of the traditional link state algorithm faces the scalability problem in ad hoc networks because of costs from frequent topology updates. But in mobile ad-hoc network (MANET) needs no time and cost for its deployment because every node plays the role of a router. MANETs are useful in places that have no communications or when that infrastructure is severely damaged. Like emergency search and rescue operations, military operations. Clustering algorithm in MANETs should be able to maintain its cluster structure as stable as possible while the topology changes. in this paper, the proposed mobility based clustering algorithm which takes into considerations the number of nodes a cluster head can handle ideally transmission power, mobility, and battery power of the nodes for cluster formation in ad hoc network. In this paper Background and Related Work is done in section II. In section III, Re-clustering in Weighted clustering algorithm (WCA) & MBCA is depicted. Simulation result is in section IV. Conclusion and Future work is in section V.

II. BACKGROUND AND RELATED WORK [1-10]

(A) Clustering in mobile ad-hoc network

One of the most common ways to improve the organization of ad-hoc network is partitioning the network into clusters. That is virtual partitioning of the dynamic nodes into various groups. Clustering algorithms are used to partition networks into multi-level hierarchies. Many clustering algorithms uses some special nodes, called cluster head(CH), to create clusters and other nodes cooperate with the closest CHs to form clusters. Two nodes are said to be neighbor of each other when both of them lie within their transmission range & set up a bidirectional link between them. In each cluster, a cluster head is elected to assist with the resource allocation & data transmission among its members as well as communication with neighboring cluster head. Clustering provides a method to build and maintain hierarchical addresses in ad hoc networks.

Depending on the diameter of the cluster there exist two kinds of cluster control architecture.

© 2014, IJARCSSE All Rights Reserved

1. One hop clustering architecture.(directly connected with cluster head)
2. Multi hop clustering or d-hop architecture. (Connected with cluster head via two or more node)

Till now researchers have raised a lot of clustering algorithm to choose cluster heads in ad hoc network and some of them have been practically used. They include:

1. Lowest id clustering algorithm (LID)
2. Highest degree clustering algorithm (HDC)
3. Distributed mobility adaptive clustering algorithm (DMAC)
4. Weighted clustering algorithm (WCA).

Those algorithms each have different benefits and working environments.

(a)Lowest ID clustering algorithm (LID)

Lowest ID clustering algorithm also known as Identifier based clustering algorithm. It provides three different roles for the nodes: original, gateway, and cluster head. In this algorithm, every node is assigned with a unique non negative identification number ID which is the deciding factor for the status of a node. Here every single node broadcast its ID to its neighbors & receives the same from its neighbors.

Advantage

1. These algorithms are so simple to use and system performance is better compared to other algorithm in terms of the throughput.
2. Cluster setup process is faster.
3. The main advantage of distributed gateway is maintaining connectivity in situations where any clustering algorithm fails to provide connectivity.

Disadvantage

The drawback of this heuristic is its bias towards nodes with smaller id which leads to the battery drainage of certain nodes. Moreover, it does not attempt to balance the load uniformly across all the nodes.

(b)Highest-Degree clustering algorithm (HDC)

It also known as connectivity based clustering algorithm. In this algorithm each node is assigned a unique ID in the network. A node having highest degree of connectivity is selected as cluster head and the adjacent node whose status is not yet decides becomes the member of the selected cluster head. The node with the most number of neighbors is elected as the cluster head. If there is a tie, the node with the lower node ID is chosen. The cluster heads cannot be direct neighbors.

Advantage

1. These algorithms are also simple to use.
2. A higher degree of connectivity ensures efficient service to the member nodes by minimizing the number of cluster head at high transmission range.

Disadvantage

1. A cluster head cannot handle a large number of nodes due to resource limitations.
2. As the number of nodes in a cluster is increased, the throughput of each user drops and hence, a gradual degradation in the system performance is observed.
3. Highly unstable.
4. A single change in connectivity may lead to re election.

(c)Distributed mobility adaptive clustering algorithm (DMAC)

Distributed Mobility-Adaptive Clustering (DMAC) is the enhanced version of Distributed Clustering Algorithm (DCA) which works the best in quasi-static networks. (When the nodes in the network either move or move very slowly.) DMAC is more suitable for dynamically changing environments. There are at least three conditions that must hold for these algorithms:

1) Each partition must have a cluster head of its own.
2) Each ordinary node will affiliate with one neighboring cluster head.
   The weight of the cluster head is larger than the weight of the nodes in the cluster.
3) Cluster heads cannot be direct neighbors.

Advantage

DMAC removes the non-mobility assumption of the hosts during clustering setup and maintenance. Thus DMAC is the most suitable algorithm for the cluster formation and maintenance.
DMAC are passive algorithms that save energy improving lifetime of the network.
Works well for quasi-static networks.

© 2014, IJARCSSE All Rights Reserved

Disadvantage

The major weakness of this algorithm lays with the lower weighted nodes .No criteria of assigning the node-weights, No two cluster head can be neighbors of each other so increase the re-affiliation and reelection.

(d)Weighted clustering algorithm (WCA)

These algorithms are mostly heuristic nature and aim at generating the minimum number of clusters such that any node in any cluster is at most d hops away from the cluster head. Weight is the function of degree of connectivity, transmission power, mobility and available battery power of the individual nodes. That's considered for selection of a cluster head and is given different weights depending on the network scenario.

Advantage

WCA has improved performance and better Cluster stability compared with other previous clustering algorithms. Re-affiliation is very low reducing the network overhead.

Disadvantage

1. The high mobility of nodes will lead to high frequency of re-affiliation which will increase the network overhead.
2. Many parameters are considered for setup. This is increase setup delay.
3. Higher complexity.
4. Whenever reelection take place the combined weight of every node is needs to be calculated this increase the computation cost.
5. A large number of information are stored and exchanged among the nodes to find the smallest weights. This becomes increase the network size.
6. WCA does not re-cluster when a member node changes its attaching cluster head that is there may be a situation when a low weight node may enter into a cluster whose head is of higher value than this newly entered node.

III. RE-CLUSTERING IN WEIGHTED CLUSTERING ALGORITHM (WCA) & MBCA

The main disadvantage of weighted clustering algorithm (WCA) is that it does not re clustering that is when a low weight node may enter into a cluster or detach any node from the cluster. In this project we are done the re-clustering part through this proposed algorithm.

(A)Proposed algorithm

(a)If new node entered then check the distance of the node among the nearest cluster

```
Start
If
{
  Distance (CH, x) <tx_range (CH) /* Here CH denote Cluster Head*/
  Add(x) as a neighbor              /* Here x denote new node*/
}
End if
End
```

(b)Compare the weight between newly entered node and cluster head

```
Start
If
{
 Weight (x) >weight (CH)
   Join (x) as an ordinary node
}
Else if
{
   Weight(x) < weight (CH)
   CH.receved message(x)
   masterClusterhead(CH) = x        /*  masterClusterHead denotes the
                                        Current cluster head */
}
Else if (weight(x) == weight (CH))
{
batterypower (CH_BA)>batterypower(new_BA):? masterclusterhead(CH)=CH : masterclusterhead(new)=CH
}                          /* CH_BA is a variable which denotes the battery
                              Power of the cluster head*/
End if                 /* new_BA is a variable which denotes the battery
                                 Power of the new node*/
```

© 2014, IJARCSSE All Rights Reserved

```
©If the existing node move from the cluster
Start
  If
       {
         Distance (v, CH)>tx_range (CH)
         Move from the cluster
       }                                  /* CH denote Cluster Head */
                                           /* v denote existing node */
End if
End
```

(B)Advantages of re-clustering

The proposed re-clustering based weighted clustering algorithm overcomes the re-clustering part of existing clustering algorithm i.e. a lower weight node may enter into a cluster, where previous cluster head is having the higher weight than the newly entered node. So, WCA does not re-cluster when member node changes its attaching cluster head. The proposed algorithm modified the situation in where if lower weight node enters the cluster then first it will be compared the weight of existing cluster head with the newly entered node weight, if the weight of existing cluster head is higher than the newly entered node, then the newly entered node became the cluster head. This proposed algorithm chooses cluster head when the newly entered node weight and the existing cluster head weight is same then this algorithm compared the cluster head by comparing battery power of the two nodes.

(C)Depend on mobility power

Based on the preceding discussion the propose algorithm called mobility based clustering algorithm (MBCA) that count the node id, mobility and the battery power of every node. The battery power can be efficiently used within certain transmission range that is, it will take less power for a node to communicate with other nodes if they are within close distance to each other. A cluster head consumes more battery power than an ordinary node. Here mobility is an important factor in deciding the clusters heads. In order to avoid frequent cluster head changes, it is desirable to elect a cluster head that does not move very quickly .This algorithm elect those cluster head that does not move very quickly or does not move. Here we choose random value for mobility of every node. The cluster formation phase deals with the logical partition of the mobile nodes in to several groups and selection of a set of suitable nodes to act as heads in every group in mobile ad-hoc network where the topology changes frequently, selection of optimum number of cluster heads is difficult. Hence there exists some representative algorithm that used the parameters like node identify number, mobility, transmission power, battery power, degree of connectivity etc to decided how well suited a node is for being a cluster heads. Now we describe that how to select cluster head through this algorithm below. The values of mobility are chosen randomly.

(D)To elect cluster head based on mobility

In this section we describe mobility based clustering algorithm and discuss how it can be used in formation of clusters .The WCA (Weighted Clustering Algorithm) does not couple the clustering process with the mobility of the nodes. If a node with a low Weight happens to be highly mobile, it will cause severe re clustering when it moves into the transmission range of other cluster heads. In such occasions the low weight node will prevail and re clustering will happen. The basic idea in this project is that the clustering process should be aware of the mobility of the individual nodes with respect to its neighboring nodes. A node should not be elected a cluster head if it is highly mobile relative to its neighbors, since, in that situation, the probability that a cluster will break and that re clustering will happen is high. Instead, here we should attempt to select a node that is less mobile relative to its neighbors for the role of a cluster head.

(E)MBCA-Mobility Based Clustering Algorithm

In order to use the mobility for clustering, we propose a distributed, lowest mobility clustering algorithm, MBCA, which is similar in execution to the Weighted Clustering algorithm as described in previous. This algorithm describes in the following steps:

• All nodes send and receive “Hello” messages to/from their neighbors. Each node measures the received power levels of two successive “Hello” message transmissions from every neighbor, and then calculates the pair wise relative mobility value. Before sending the next broadcast packet to its neighbors, a node computes the aggregate relative mobility value.

• All nodes start in Cluster Undecided state. Every node broadcasts its own mobility value, initialized to 0 at the beginning of operations in a “Hello” or “I’m Alive” message to its 1-hop neighbors every Broadcast Interval (BI) period. It is then stored in the neighbor table of each neighbor along with a timeout period (TP) set. This algorithm is executed in a distributed manner. Thus, a node receives the aggregate mobility values from its neighboring nodes, and then compares its own mobility value with those of its neighbors.

• If a node has the lowest mobility value amongst all its neighbors, it assumes the status of a Cluster Head; otherwise it declares itself to be a Cluster Member. This algorithm leads to the formation of clusters. If a node is a neighbor of two cluster heads, then it becomes a “gateway” node. If two neighboring nodes in a Cluster Undecided state have the same mobility value, then selecting the cluster head by comparison of mobility value with battery power.

© 2014, IJARCSSE All Rights Reserved

IV. SIMULATION RESULT

(A) Difference between existing WCA & Mobility based clustering algorithm (MBCA)

The main advantage of this algorithm is that when the algorithm selects the cluster head through mobility then stability of cluster due to low mobility will also be increased. If the cluster head cannot move or move slowly (as if not affecting the stability) then the cluster head will be working for long time. Then the cluster formation algorithm needs not to repeat. This increases the network speed because due to low movement of nodes repetition of the algorithm is not necessary. Ultimately, we can draw the conclusion that MBCA has better performance than WCA in transmission range shown in Fig1.

(B) Used parameters

Parameter	Meaning	Value
N	Number of Nodes	10
Tx	Transmission Range	10 − 250 m

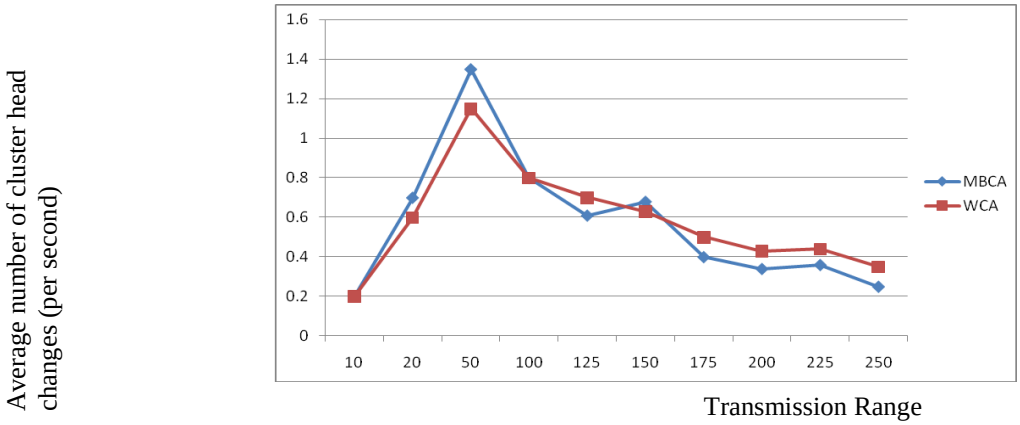

Fig1:- Number of CH Changes: WCA vs. MBCA.

V. COMPARISONS OF THE DIFFERENT CLUSTERING ALGORITHMS

Names	**Characteristics**	**Strengths**	**Weaknesses**
LID	Lowest identity based node among the neighbors.	Simple, faster cluster setup. System performance is better than HDC in terms of throughput.	It is bias towards nodes with those CHs with smaller IDs suffer from the battery drainage, resulting short lifetime of the system.
HDC	Highest connectivity based node among the neighbors.	Simple, minimum cluster heads at high transmission range	Due to low throughput degradation in the system performance is observed. A single change in connectivity may lead to reelection.
DMAC	Lowest weighted node within its local topology. Weight may be the node mobility/transmission power.	Distributive and mobility during setup. Works well for quasi-static networks	No criteria of assigning the node-weights, Increase the re-affiliation and reelection.
WCA	Lowest weighted node in the entire network. Weight is the function of degree of connectivity, mobility, available battery power of individual nodes.	Better performance. Reelection is done on demand. So better cluster stability.re-affiliation is very low reducing the overhead.	Increase setup delay. Increase the computation cost. Also increase the network size. Does not re-cluster.

© 2014, IJARCSSE All Rights Reserved

Re-clustering WCA	Lowest weighted node in the entire network. Weight is the function of degree of connectivity, mobility, available battery power of individual nodes.	Better performance. Re-cluster done	
MBCA	Lowest mobility among the node elect as cluster head.	Highly stable, faster cluster setup. Less no. of parameters is considered & requested time is less.	If the maximum number of node move very frequently during low frame of time then in a particular time the cluster head may be defined but in long duration there is no particular cluster head to be defined for the algorithm.

VI. CONCLUSION &FUTURE WORK

In order to get more accurate result of existing clustering algorithms we want to implement our algorithm in the ns-2 simulator for better cluster stability and enhance the network lifetime. As well as we want to maintains the proposed mobility based clustering algorithm for better cluster stability. The simulations will be run for different topologies, sizes of network, and various limitations of the cluster structure properties. We plan to use one or several group mobility models to get more realistic picture of algorithms performance. Mobile ad hoc networks (MANETs) are self-organized wireless networks that are formed by mobile nodes through distributed protocols. Clustering is a well known technique for grouping nodes that are close to each another in the network. Clustering problem is one of the biggest challenges that MANETs are facing with and it is also one of the hottest spots in the research areas. For a fixed Cluster head election scheme, a cluster head with constrained energy may drain its battery quickly due to heavy utilization. In order to spread the energy usage over the network and achieve a better load balancing among cluster heads, reelection of the cluster heads may be a useful strategy. This paper presents an algorithm that overcome the demerits of WCA that is re-clustering.and also presents a mobility based clustering algorithm for cluster formation in ad hoc network.

REFERENCES

[1] C. R. Lin and M. Gerla. Adaptive clustering for mobile wireless networks. *IEEE Journal on Selected Areas in Communications*.

[2] A. B. McDonald and T. F. Znati. A mobility-based framework for adaptive clustering in wireless ad hoc networks. *IEEE Journal on Selected Areas in Communications*.

[3] C. E. Perkins, editor. Ad Hoc Networking. Addison-Wesley.

[4] D. J. Baker and A. Ephremides. The architectural organization of a mobile radio network via a distributed algorithm. *IEEE Transactions on Communications*.

[5] A. Ephremides, J. Wieselthier, and D. Baker. A design concept for reliable mobile radio network with frequency hopping signaling.

[6] A. K. Parekh. Selecting routers in ad hoc wireless networks.

[7] C.-C. Chiang, H.-K. Wu, W. Liu, and M. Gerla. Routing in clustered multihop, mobile wireless networks with fading channel. *IEEE Singapore International Conference on Networks (SICON)*.

[8] P. Basu, N. Khan, and T. D. C. Little. Mobility based metric for clustering in mobile ad hoc networks. *Workshop on Distributed Computing Systems*.

[9] A. D. Amis, R. Prakash, T. H. P. Vuong, and D. T. Huynh. Max-min d-cluster formation in wireless ad hoc networks.

[10] X. Hong, M. Gerla, G. Pei, and C. Chiang. A group mobility model for ad hoc wireless networks. In *Proceedings of ACM/IEEE MSWiM*, Seattle, WA, Aug.1999.

[11] F. G. Nocetti, J. S. Gonzalez, I. Stojmenovic, "Connectivity based k-hop clustering in wireless networks," *Telecommunication Systems*.

[12] K. Fall, and K. Varadhan, "The ns Manual," http://www.isi.edu/ nsnam/ns/, 2002.

[13] Chatterjee, M., Das, S.K., Turgut, D.: WCA: a weighted clustering algorithm for mobile Ad Hoc networks

[14] Turgut.D.,Yeung.C.S.,Aydin.N.:A performance comparison of clustering algorithm in ad-hoc network.

© 2014, IJARCSSE All Rights Reserved