A Unified Framework for Cluster Manager Election and Clustering Mechanism in Mobile Ad Hoc Networks

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Abstract

In Mobile Ad hoc NETwork (MANET), every node could active dynamically. Therefore, those nodes will affect the stability of network topology because of clustering and de-clustering, and continuously make reconfiguration for the groups of network, all that will influence the overall function of network. It is an important issue that how to choose a cluster manager to keep the stability of network topology. In this paper, a mechanism for the designation of clustering and cluster manager is given by MANET. The mechanism is named as Unified Framework Clustering Mechanism (UFCM for short), which is a kind of processing mechanism under considering in multi-network service, such as processing mode of initial state in the network system, processing mode of access of nodes in the group, and the processing mode concerned on failing to manage the group because the cluster manager is error. Beyond that, we also propose a backup manager to take works of cluster manager when the cluster manager is fault.

Keywords: Mobile ad-hoc network, clustering, manager election, backup manager.

1. Introduction

With the explosion of wireless network, the activity of mankind has been impacted, in the infrastructure network structure; the medium for fixing center will be regarded as the relay station to bringing about the connection of two mobile equipments, so that the data is transmitted. The relay station, such as access point, was given an excellent feature to control the position of mobile equipments, which is just the same as the router. But these equipments are usually damaged by the extrinsic factors such as the war, natural disasters, etc., which will cause the failure connection between the Mobile Nodes (MNs), therefore, the traditional wireless network has failed to meet the needs of mankind. In recent years, many experts and scholars have started paying attention to the non- infrastructure network structure, in which, Mobile Ad hoc NETwork (MANET) is purposed to be free to gain information in anytime and anyplace under a non-infrastructure network structure for meeting the needs of mankind. Therefore, MANET should be paid more attention to all fields of application. There are typically four kinds of application such as the private local area network, military environment, civil and emergency, etc. in MANET [7].

The strong points of MANET is given that is easy and fast to deploy, which need not replying on the fixed
relay station for quickly logging on in anytime and anyplace. Therefore, there is a research of topic under MANET in this paper, the researched MANET consists of many mobile nodes such as the mobile phone, portable computer, PDA, etc.

At present, almost wireless network structure must depend on the base station of connecting with the bone via the wired system, which means this network structure is still fixed and limed to the signal of base station, while it must cost a lot of money to build this wireless network environment, with the difficulty to finish the building at once when the emergency happens. Therefore, MANET is the peer-to-peer network, under the situation of failing to connect with the bone network in the battlefield and natural disaster; MANET will be played an important role. This network structure can make every mobile node move; the signal will be transmitted via the delivery between the mobile nodes.

MANET consists of many Cluster Managers (CMs) and mobile nodes. The given node of cluster manager centers on forming the clustering and keeping the network topology. CM will make the resource allocation and control supervision for all nodes in the relevant clustering. The other nodes except for the manager all that are named as the mobile nodes. Under this structure, the nodes need not the base station to dynamically form the network with each other. MN can be free to move and connect with each other via multi-hop wireless links; every MN can play the role of router to help the other nodes of network transmitting the data package. Due to the features of MANET, its structure is very usable in the specific environments such as the rescue of the battlefield and rescue of disaster, the rebuilding after the earthquake, the discovery to some unknown area, etc. However, just because MN can be free to move everywhere, the network topology appears the dynamic change.

With the instant development of network, the connecting type of network model is various, the research on the clustering and election of manager in [2,3,6,10,15,16] did not consider the operating mode and building of backup manager under the initial stage of network and finished group. Every mobile node has the characteristic of dynamic action, therefore, the nodes will continue to be clustered and decomposed, which will affect the stability of network topology, and cause constantly the reconfiguration of the network groups, all that will influence the overall function of network. Therefore, it is an important issue that how to choose a CM to keep the stability of network topology. The election of suitable CM is NP hard [3], the existing method for solving this kind of problems almost is based on serving as heuristic, without the relevant research trying to keep the stability of network topology [3,6]. However, a good clustering network structure should keep the stability of structure as possible when the node is moving or the network topology is changed, otherwise, the redistribution of groups and the transfer of the numerous information will cause the network burden and the cost raising. Because all things are particular about the reliability and usability today, the building of a mechanism should consider the various situations. The passing research was failure to consider the initial stage of network and finished clustering, so when the manager is fault, the needed redistribution of groups would influence the efficiency and stability. Therefore, this technology will research the method of clustering and election of managers according to the different network nodes in MANET, and add the mechanism of backup manager to reduce the disadvantages and improve the efficiency when the original manager does not work.

This research serves as MANET to design Unified Framework Clustering Mechanism (UFCM for short) for the backup manager, which centers on how does MANET bring the clustering and election of manager under the limited conditions (transmission speed and the quantity of mobile nodes), with the least times of data exchange and network transmission.

The second part of this paper will treat of the issue concerned; the third part introduced the method and
2. Literature Review

As MANET need not any infrastructure to provide the multi-hop wireless links for the mobile user, the network will offer the mechanism for the simultaneous uses of many users in order to widely apply for the field of actual practice. However, the method of search-address and ringing is more difficult than the common the network, for this reason, the hierarchical search-address of MANET is able to efficiently solve the problems of complex search-address, while the clustering is used for setting up and keeping the hierarchical search-address. In this part, it is first to introduce the features of MANET and the existing common clustering.

2.1 Characteristics of MANET

With the people’s desire to get rid of the limit of wired network for the free communication in anytime and anywhere, in recent years, the wireless network communication had been developing quickly. The people can bring about the mobile communication via the portable computer or PDA with the wireless devices. The existing mobile communication almost needs the wired infrastructure (i.e. base station) to be realized, therefore, a kind of new network technology --- MANET is emerging because of demand for realizing communication in the locality without the base station. MANET need not supporting by the wired infrastructure, which can arrive in the communication via freely forming the network with the aid of mobile devices. MANET improves the free communication under the any environment for the people, which also provides the efficient proposal for the military radio, rescue of disaster and temporary communication at the same time.

MANET is a kind of mobile network without the fixed wire infrastructure; the nodes of network are formed by the mobile devices. MANET was first to be used for the military, which came of the project on the dada communication of packet radio network under the battlefield, this project was supported by DARPA, at later, the research of SURAN (Survivable Adaptive Network) and GloMo (Global Information System) was made in 1983 and 1994 [4,12]. MANET has been growing under the common environment because of the continuous development of wireless communication and terminal technology, if the temporary communication needs going to the area with wired infrastructure, MANET is able to be very easy to arrive in the communication.

In MANET, when two mobile devices are in their own range of communication, the direct communication can be arrived. However, the range of communication of mobile device is limited, so the transmission via the mobile device is necessary to bringing about the communication between two long-distance devices with each other. Therefore, the device is the same as the router in MANET, with the responsibility for searching the route and transmitting the packet. In MANET, the range of communication of every device is limited, so the route generally consists of multi-hop, the data must be transmitted by many devices for reaching the destination. Therefore, MANET is also named as multi-hop wireless network.

MANET can be seen as the integration of mobile communication and computer network, while the communication device is generally the mobile terminal devices such as the portable computer, personal data assistant, etc. What is more, MANET is different from IP (Mobile IP) in the existing Internet, the mobile
device is ported with the network through the fixed wired network, wireless network, dialing, etc. in IP, but there is only one connecting type of wireless network in MANET. The communication of mobile device is arrived through the support of the wired devices such as the close base station, etc. in IP, the wired network is existed in the base stations (or agencies), the traditional route protocol of Internet is still used, while MANET needn’t supporting by these devices as above. In addition, the mobile device has not the function of router in IP, only a common communication terminal device, when the mobile device is moved from one side to another side, the network topology is not changed, but the mobile devices of MANET will change the network topology.

The control to MANET is more complex than the wired network because of the characteristics of MANET. The network topology can be dynamically changed, so it is nature to need the dynamically automatic configuration for the control of network, meanwhile, some limits in the mobile devices itself such as the limited energy, the change of connecting type, the limited memory, etc. all that must be considered. Therefore, the considerations consist of the applicability of the network control in the various environments, etc. besides the load of entire network. The problems that need to be solved in MANET are as follows [14,17]:

- To know the network topology in NMP (Network Management Protocol) is an important task, in the wired network, it is very easy to gain the network topology because the change of network is not frequent. However, in the mobile network, the movement of nodes will bring a frequent change of topology structure, therefore, the manager must collect the connecting data of nodes regularly, and it will cause the burden to the network.

- Almost nodes are charged by the battery, so the burden from the network management should be ensured to be close the minimum for saving the energy, and reducing the quantity of nodes in the receiving and processing as possible, but which is contradictive with the regular update when to keep the topology structure.

- The finiteness of energy and mobility of nodes results in the separation between the nodes and network, so it is necessary that NMP can find the access of nodes in time to real-time update the topology structure.

- Because the signal quality is unstable largely under the wireless environment, the decline and choke-out of signal will give the manager a wrong idea that the nodes have been come off, therefore, the manager must be able to identify the movement of nodes caused the linkage interrupt or the connection unstable.

- MANET is usually applied to the military, so the prevention from the wiretap, destroy and invasion is very important, thus, the manager is usually asked to encrypt and authenticate.

As stated above, network manager of MANET is different from the traditional network, the problems such as the collection of network topology data, processing of dynamic network configuration and encryption, etc. all that need solving. Therefore, there is a treatment concerned on the management method of clustering for keeping the stable development of MANET topology in the next section, at the same time, the improvement of this research will be deepened with this treatment.

### 2.2 Clustering algorithm

The control to the MANET topology can define the appropriateness of topology, while the substance,
position of node and setting surrounding will produce the potential topology type. However, the network can use easier substructure with the aid of the other limits in the network.

One of methods on producing small number of groups in a graph is Independent Dominating Set, Baker and Ephremides developed the earliest cluster algorithm [1] --- Linked Cluster Algorithm in MANET. This algorithm is working in a synchronous MANET, in which, every node of network connects with the same TDMA (Time Division Multiple Access) and time slot for avoiding the collision. Therefore, every node needs the specific-number time slot to record the structure of its neighboring node.

Gerla and Tsai pointed out two cluster algorithms as per the peak ID and degree in [10]. In the Lowest-ID Cluster Algorithm (LICA), the node with the lowest ID will be chosen as the head of clustering in a group of nodes. While in the Highest Connective Cluster Algorithm (HCCA), the node with the highest connection will be chosen as the head of clustering in a group of nodes. However, Chen proposed these two algorithms were difficult to be suitable for all network topology in [5]. Therefore, Lin and Gerla developed the reversed Lowest-ID Algorithm for building the independent dominating set in [13]. What is more, Chen raised a dominating set algorithm in the form of a distance --- k for deepening this research in [13] in this algorithm, the distance between the members of dominating set is at least k+1.

Das and Bharghavan put forward the distributed actual operation to the algorithm of Guha and Khuller in [8] for building the linked dominating set in MANET. This distributed algorithm will produce the same linked dominating set as the centralized algorithm, and the whole operation can be supervised via the centralized coordinator, this algorithm has the same closing rate as the original algorithm.

For positioning the issue [8] on the non-regional calculation in the distributed algorithm raised by Das and Bharghavan, Wu and Li put forth the regional distributed algorithm to find the dominating set with the smallest linkage of the neighboring nodes through the distance between two hops in [19,20]. Moreover, in the past researches, some experts such as Dubhashi, etc. raised the distributed algorithm for building the small linked dominating set and O(log?) weak linked dominating set in [9]. Such linked dominating set algorithm is first to build a dominating set, second to add the additional nodes through the economical way, therefore, the built dominating sets are interconnected with each other with the provable efficiency ratio. Especially, thus algorithm utilizes the stochastic algorithm raised by Jia, Rajaraman and Sue in [11] to build the smallest dominating set with the factor of O(log?).

Meanwhile, in [18], some experts such as Weber, etc. put forth WCA (Weighted Clustering Algorithm), which collocate its own weight calculation through four factors such as the collection of nodes, the total distance from the closing point, the rate of movement on average and node electricity as the basis of election manager. It can be closer to the characteristic of node through selecting the factor, and the selected manager will offer better service to be stabilizing the topology of the whole network; what is more, the result is more flexible through the establishment of weight.

According to the research in this part, it is known that every clustering sub-network can solve the needs of the mobile nodes through one CM merely in MANET, thus CM will become a Critical Component, if this Critical Component failed, and the relevant network would fail to work until to reselect the new CM for recovery. Besides, such CM would unstable through that one CM manages one clustering sub-network because of adding the quantity of mobile nodes or the network flow increasing suddenly. Therefore, we will select one backup CM for every CM to solve the problems as above. Thus, when CM of MANET is fault, the backup CM can take over the works. Furthermore, how to efficiently and quickly take over the work are also treated in this
paper, so that the mobile nodes of the clustering network can get right immediately when CM does not work. While the past research on the clustering and election of manager failed to think through the operation method and establishment of backup manager under different situations. However, all things are particular about the reliability and usability today, the building of a mechanism should consider the various situations. The past research result is not entirely applicable through the considerations as above; therefore, this technology will research the method of clustering and election of managers according to the different network nodes in MANET.

3. The proposed method

Generally, under the real environment, all mobile nodes are possible to be distributed in the different place, so they need to communicate and coordinate with each other; such environment is named as the environment of MANET. Under such circumstance, it is very important about how to efficiently cluster and select manager.

There are many small networks in MANET, and every small network is given a lot of mobile nodes, this research is purposed to make every mobile node finish the election of manager and clustering through the information exchange. In the past, many scholars brought the treatment of the different methods of election of manager and clustering [2,3,6,10,15,16], with the difference from the methods, the applicability of clustering and election of manager will produce the various results. It is very important to set up a good mechanism with the comprehensive consideration for arriving in the election of manager and clustering under the environment of MANET. Therefore, a general mechanism will be built in this research for solving the problems of election of manager and clustering under the environment of MANET.

Then the clustering network topology with the appropriate management range will be built, which can reduce the transmission of signal for adding the function of network band. In order to make the research be more practical, the environment used for the research will be located in more plausible environment of MANET; the network environment consists of various processing capability, nodes of electricity and communication range. In this research, the rate of movement of node is not considered because the mobile device of actual network environment is difficult to know the rate of movement at that time by itself. In the past, some relevant researches considered the rate of movement, but they all were indirect to get the rate of movement via the devices such as the assumed data or assumed GPS and so on. While this research considers the characteristics of which the node can be free to move rather than the relevant influences because of the rate of movement of nodes for being close to the fact.

The node is divided into three roles such as the common node, manager and backup manager, the common node is the mobile node that is controlled by the manager in the clustering of MANET.

The manager node is the node that the most superior one become the clustering manager after the comparison at the beginning of network clustering. The manager is mainly in charge of the node management of clustering network, which must keep the list on the current all management nodes, therefore, when the manager starts working, it can inform its common node to change the work of manager. The manager is also responsible for the information exchange between the nodes in the clustering or the clustering and clustering.

After the manager appears, it will select the secondary node as the backup manager in the common nodes. The backup manager is only a mark of its identity rather than in charge of any matters when it is primarily built. If the manager node does not work because of the troubles, the backup manager will become the manager to
take over the work through the action of changing the manager, and then the new manager will continue to select the new backup manager.

3.1 Election of cluster manager

The communication of MANET is divided into three states such as the initial, normal, and manager failed. The method of election of manager of each state will be introduced respectively in this part.

At the initial stage, no manager has been elected. Therefore, every node is the common node under this stage. Every node of network will produce a value by itself randomly, this value will minus one after every unit time interval. When the value of some node is to be zero, its own relevant information such as the percentage of the surplus power \((e)\), degree of busy \((b)\) and communication capacity \((c)\) will be transformed into a capacity value \((p)\) according to the formula (1) in this research, which will be delivered to the nodes surrounded as the basis of manager election, while the weight values \(w_1, w_2, w_3\) will be defined in accordance with the important of each item of factors for meeting the various needs.

\[
p = (e)w_1 + (1/b)w_2 + (c)w_3 \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots (1)
\]

\[w_1+w_2+w_3=1\]

The advantages of this method are easily for reducing the time of election of manager besides reducing the transmission of information. The reason of random value to be down counted is as follows: Because all nodes must compare capacity value with the surrounding nodes to produce the manager at the beginning, if all nodes execute this operation simultaneously, a large number of transmission will be suddenly produced to result in the paralysis of network operation, therefore, the random count value can disperse the action of delivery and comparison to reduce the load of network at the beginning of comparison. What is more, this research set up the comparison that the transmission distance (delay time) between two nodes has to be lower than some value for getting the optimum result of information transmission in every group.

When one node receives the capacity value from the neighboring node, its own capacity value and the received value will be compared. The owner of the higher capacity value will be the manager, and record the serial and capacity value of the compared node to form a network clustering with another node, while the controlled node will record the serial of this manager. The election of manager at the beginning of network is illustrated as Fig. 1. In Fig. 1 (a), it is assumed there are three nodes in the present network, the upper-left of node is their reciprocal value. In Fig. 1 (b), the node B is first to be reciprocal to the zero, therefore, it will be earlier to send signal to compare with the node C. While in Fig. 1 (c), the node B will be the manager and form a group with the node C after the comparison. Fig. 1 illustrates the election of manager at the initial stage of network.
After all groups are built and managers are elected, it will enter the normal stage, every node is either the manager or the controlled sub-node. Therefore, all nodes are not made the active comparison of capacity, such advantage is to reduce the waste of frequency band and choke-out of network because of the unnecessary comparison, and which is designed as the passive mode to avoid the change because of the unnecessary comparison. Therefore, this stage will be called the stable state in this research, which will not change until the manager is failed.

When one new manager appears, the manager will record the relevant information of all sub-nodes in this group, such as the serial of node, capacity value after the conversion, etc., at this time, manager will automatically select the node with the highest capacity value as the backup manager in these sub-nodes. Meanwhile, after finishing the election of backup manager, the present manager will tell the information of all sub-nodes to the backup manager, and then the manager will send message to tell the controlled sub-node who is the backup manager, so that the sub-nodes can know who is the backup manager when the manager is failed in the future.

After the backup manager is confirmed, the manager will make a regular check whether it is in the clustering network or not, if the backup manager is not in the clustering network, the manager will reselect the sub-node with the highest capacity value as the backup manager from the sub-nodes.

### 3.2 Clustering mechanism

After every exchange and comparison of data, the superior mobile node will become the manager at that time, while the clustering of network will be also formed one by one, at last, every mobile node will be assigned to every group, and this mechanism is called the clustering mechanism. There are three steps in the clustering mechanism of this research, such as: (i) the establishment of the clustering in MANET; (ii) the establishment of the clustering after the access of mobile node; (iii) the processing when the manager is failed.

In the course of producing the manager at the primary stage, after the comparison between every two nodes, one superior node (if the capacity is the same after the comparison, it will have either) will be appeared, which will be the manager at that time, and form a small group with another node. These two nodes will enter the common stage by now, and wait for the neighboring node to compare with it, after these steps are repeated to operate, all nodes of MANET will be automatically vested in their own group.

As Fig. 2 showed, in the original group, when the new node D enters MANET (Fig. 2a), it will be
positively close to the neighboring node to compare in the capacity because it is not yet accept the control of any manager (Fig. 2b). Because the node C is controlled by the node B, when the node C receives this signal, it will direct to tell the node D that the node B is the manager for reducing the unnecessary comparison. After the node D receives this signal, it will direct to join in the group in which the manager B is located (Fig. 2c).

When the transmission distance (delay time) between the node D and the manager B is overlong, the node D will cancel this comparison, and continue to repeat the above steps with the neighboring nodes, if the result is failed after the comparison with the neighboring nodes, the node D will be formed a group by itself and become the manager. Fig. 2 illustrates the adjustment of the clustering after the nodes enter.

![Fig. 2: The adjustment of the clustering after the nodes enter](image)

As Fig. 3(a) shown, when the sub-nodes under the manager D fails to connect with D because D is short of electricity, beyond the range or the other reasons, the relevant sub-nodes will connect with the recorded backup manager (Fig. 3 b). If this procedure is right, the sub-nodes will define the backup manager as the new manager, and update the record of the manager, thus, this backup manager will become the new manager in this group (Fig. 3 c).

![Fig. 3: The adjustment of clustering when the manager is failed](image)

As the above steps shown, when the sub-nodes appear the fault in the course of trying to connect with the backup manager, this clustering will be automatically decomposed after some times of fault, all nodes will be backed to the primary stage, and re-compare with the neighboring node to select the new manager, thus, the new network group will be reformed.
With the instant development of network, the connecting type of network model is various, the past research on the clustering and election of manager did not think through the operating mode and building of backup manager under the various situations. However, all things are particular about the reliability and usability today, the building of a mechanism should consider the various situations. Therefore, this research bases on MANET to develop how to make MANET possible for the clustering and election of manager under the limited conditions (transmission speed and the quantity of the mobile nodes in the group). According to the states of the network nodes under the different modes and the fault that the manager is possible to appear, at the same time, a mechanism of the backup manager clustering and election of manager will be designed on the premise of the least data exchange and transmission of network.

4. Simulation Experiment

There is a compilation on the actual procedures as the method of clustering of this research according to the method in the third part. In the experiment, the environment of topology is designated as an area of 1000*1000, the nature of every node consists of Node_ID, Pos_X, Pos_Y, Direction, Speed, Range, Energy, Busy, and Bandwidth, of which the parameters will produce 1000 nodes and the relevant nature value under NS-2 [21] through the random value producer except the Node_ID, while it is assumed to be able to transmit the nodes within the range in the experiment. Therefore, the transmission of nodes is not limited to the effective parameter. There are the sample data of this experiment under NS-2 in Table 1.

<table>
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<th>Node_ID</th>
<th>Pos_X</th>
<th>Pos_Y</th>
<th>Direction</th>
<th>Speed</th>
<th>Range</th>
<th>Energy(%)</th>
<th>Busy(%)</th>
<th>Bandwidth(%)</th>
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Use Borland C++ Builder to develop all emulator in the experiment of this research. Some values such as the nodes quantity used for the experiment, clustering range, weighted range, etc. all that will be defined by the users, Fig. 4 illustrates the interface of the emulator.
Regarding the comparison of the clustering, the clustering theory is selected which is famous and integrated with this research, this theory consists of three parts such as Lowest-ID Cluster Algorithm (LICA) [10], Highest Connective Cluster Algorithm (HCCA) [10] and Weighted Cluster Algorithm (WCA) [18], the result of this research will be proved by the above three methods.

The experiment is divided two stages in this research, the first stage is to treat the stability of the clustering based on the different nodes (30, 50, 100) and clustering range (50, 150, 200, 300, 500) via the experiment in this research; the second stage is to compare the method of clustering (LICA, HCCA, and WCA) raised by the past scholars with UFCM. In the second stage, it will bring the comparison of experiment based on the different nodes (30, 50, 100) and clustering range (50, 150, 200, 300, 500). Therefore, the experiments in this research are divided four parts as follows, with 30 times of repeated experiments for getting result that is more practical.

**Scenario 1**: Under the environment of the nodes of 30, 50, 100, the group is ranged to 150, covering 30 times of repeated experiments for UFCM, and record the comparison of packet and the groups in the course of clustering.

**Scenario 2**: The group is ranged to the environment of 50, 150, 200, 300, 500, the nodes are fixed with 50, covering 30 times of repeated experiments for UFCM, and record the comparison of packet and the groups in the course of clustering.

**Scenario 3**: Under the environment of the nodes of 30, 50, 100, the group is ranged to 150, covering 30 times of repeated experiments for UFCM, LICA, HCCA and WCA, and record the comparison of packet and the groups in the course of clustering.

**Scenario 4**: The group is ranged to the environment of 50, 150, 200, 300, 500, the nodes are fixed with 50, covering 30 times of repeated experiments for UFCM, LICA, HCCA and WCA, and record the comparison of packet and the groups in the course of clustering.

![Fig. 4: The interface of the emulator.](image)
4.1 Result of scenario 1

Under the environment of the nodes of 30, 50, 100, the group is ranged to 150, covering 30 times of repeated experiments, and record the comparison of packet and the groups in the course of clustering. Fig. 5 illustrates the comparison of the packets, Fig. 6 illustrates the comparison of the groups.

Fig. 5: Experiment 1: Result of comparison of packets

According to Fig. 5 and Fig. 6, the random value of every node is counted backward under the beginning mechanism of this research. Therefore, it is uncertain to brought the capacity comparison by which nodes and form the groups, but the result tells us that the comparison of packets and the formed groups will be kept stability. There is no difference between every comparison of packets or clusters with the design of the reciprocal mechanism of the random value, therefore, the stability of clustering will not be influenced with the design of reciprocal mechanism of the random value.

4.2 Result of scenario 2

The group is ranged to the environment of 50, 150, 200, 300, 500, the nodes are fixed with 50, covering 30 times of repeated experiments, and record the comparison of packet and the groups in the course of clustering, Fig. 7 illustrates the comparison of packets, Fig. 8 illustrates the formed groups.
According to Fig. 7 and Fig. 8, based on the comparison of packets or the formed groups, even if the clustering range is different, the method in this research will be able to be kept stability under the various situations. The different mobile device has the different capacity and range of communication in the actual network environment. Therefore, the design of this research will be regarded as the emulated UFCM to arrive in the result under the different mobile device, this result tells us that UFCM can bring the stable clustering for the mobile device under the different range of communication.

4.3 Result of scenario 3

Under the environment of the nodes of 30, 50, 100, the group is ranged to 150, covering 30 times of repeated experiments for UFCM, LICA, HCCA and WCA, and record the comparison of packet and the groups in the course of clustering, Fig. 9 illustrates the comparison of packets, Fig. 10 illustrates the formed groups.
According to Fig. 9 and Fig. 10, after the comparison of the average value of the packets, that UFCM method can bring a good result to the control of the packets with the nodes increase in the environment. Thus, it will make the network more stable even if a large of packets appear for keeping down the generation of broadcast storm.

4.4 Result of scenario 4

The group is ranged to the environment of 50, 150, 200, 300, 500, the nodes are fixed with 50, covering 30 times of repeated experiments for UFCM, LICA, HCCA and WCA, and record the comparison of packet and the groups in the course of clustering.
According to Fig. 11 and Fig. 12, the clustering mechanism of this research is the reciprocal value of random value at the beginning, the value is first to be zero for comparing with the other nodes to form the group, and it will stop the comparison after forming the group. Therefore, UFCM method here can reduce the packets as compared with the other three parts in accordance with the packets needed.

5. Conclusion and Future Works

There is an applicable treatment of relevant issue on MANET in this research. According to the researches in this field from the past scholars, their many methods on the election of manager and clustering in MANET did not consider the different stage of network, not develop the suitable method on the election of manager and clustering either, even failed to consider the reason why the manager is failed.

For these reasons, this research brings a treatment of the issue on the mechanism of election of manager and clustering, and tries to raise more comprehensive method to simplify this mechanism with the feasibility and efficiency with the aid of the research results in this field and overcoming the possible problems. What is more, this research will also treat of the building of clustering and election of manager under multiple stages of network, of which covers the processing method of primary stage, common stage and failure of manager in MANET. Referring to the comparison of capacity, this research uses the percentage of the surplus power,
degree of busy and communication capacity, etc. as the basis of comparison, moreover, the distance between every sub-node in group and the manager will be limited to make every group good in the capacity of communication.

According to the result of experiment, it is known that UFCM in this research is not only stable, but also reduce the quantity of data at the beginning of network environment as compared with the clustering raised by the past scholars, thus can be further to reduce the primary cost besides avoiding the broadcast storm.

In addition, the safety is very important especially in MANET, so the safe defense mechanism will be tried to be entered in the communication between the nodes and manager for improving the safety of information exchange in every group, avoiding the malignant nodes controlling the transmission route of nodes via the aggressive and forged information.

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