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Effective Handover Technique in Cluster Based MANET Using Cooperative Communication

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***Abstract*— *Mobile ad hoc networks (MANETs) are becoming increasingly common now a days and typical network loads considered for MANETs are increasing as applications evolve. This increases the importance of bandwidth efficiency and requirements on energy consumption delay and jitter. Coordinated channel access protocols have been shown to be well suited for MANETs under uniform load distributions. However, these protocols are not well suited for non-uniform load distributions as uncoordinated channel access protocols due to the lack of on-demand dynamic channel allocation mechanisms that exist in infrastructure based coordinated protocols. We have considered a lightweight dynamic channel allocation algorithm and a cooperative load balancing strategy that are helpful for the cluster based MANETs and an effective handover technique to improve the increased packet transmission mechanism. This helps in reduce jitter, packet delay and packet transfer speed, we use a novel handover algorithm to address this problem We present protocols that utilize these mechanisms to improve performance in terms of throughput, energy consumption and inter-packet delay variation (IPDV).*

Keywords*— *MANET, handover, dynamic channel allocation, cooperative communication.

I. INTRODUCTION

An ad hoc network is a decentralized form of wireless network. The network is ad hoc because it does not depend on a preexisting infrastructure, such as routers in wired networks or access points in managed wireless networks.

A mobile ad-hoc network [1],[3],[5] is a self-configuration, infrastructure less network connected wirelessly. Each system in a MANET is free to move independently in Omni direction and will change its link to various other devices frequently. MANET's are a kind of ad-hoc network that has a routable networking environment above a linked layer ad-hoc network. MANET's consist of peer to peer , self-forming and aself-healing network.

Cooperative wireless network [1] are the model allowing coordinated operation among two or more wireless network out fitted with two or more communication device. It helps in network utilization Cooperative load balancing [1] is used to increase the capacity combined with the reliability of application. It is used to balance traffic nodes across various WAN [8],[11] without any complex protocol. Cooperative Load balancing aims to optimize resource usage and maximize throughput with minimum response time and to avoid overload of any resource. If a wireless user travels from one area of coverage to another area within the call duration then that call has to be switched to new base station. This mobility is obtained by a handover mechanism [17].

Process of data transfer in wireless communication to maintain the continuity with its own signal strength direction and decision making. Below given are some of the handover techniques [17] that belong in wireless ad-hoc networks. Handover between one or more base stations of the similar network is called Horizontal Handover.

In handover the mobile node changes after one cell to extra of the same area to maintain the signal strength and quality. There are two types in horizontal handover, the horizontal handoff between two base stations under the equal base station is recognized as Intra system Handoff. In Intersystem, handover works with the different base station (BS). It takes within the intra system when a mobile terminal gets access to the single admittance router and makes path into the planned colony of further admission router within the present network.

Vertical Handover occurs in diverse of network technologies such that between various access points. A base place of a network handover is then again classified into ascendant, downhill, upright level transportable trick meticulous system assisted and web measured mobile assisted handover.

The existing system provided with the packet transfer from one cluster to another within a system that are dynamically allocated. We proposed a dynamic channel allocation algorithm for the dynamically arranged channel and a novel MAC protocol for a non-uniform cooperative

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channels in MANET. This helps in increasing throughput, reduce packet delay and jitter in the system.

- Thus the proposed system works on Cooperative load balancing algorithm is used for non-uniform load distribution system.
- A novel MAC [1]protocolis proposed with MH TRACE algorithm[1],[9].
- Applying DCA(Dynamic channel allocation) and Cooperative load balancing to TRACE [1],[6],[18].
- CDCA-TRACE(Coordinated Dynamic Channel Allocation) algorithm is proposed by combining DCA and CLB algorithm[1] .

The performance parameters are based on the throughput, energy efficiency, network connectivity and packet transfer functions. These parameters are responsible for the effective packet transfer.

The network throughput is the amount of data moved successfully from one place to another in a given time period. They are typically measured in bits per second (bps) and given by the equation

$$\text{Throughput} = \text{Amount of data moved} \;/\; \text{Time period}$$

With the fastest development in the wireless networks the energy efficiency of wireless networking protocols becomes a concern to many wireless networking stakeholders. Different wireless networking protocols have different energy efficiency measures to reduce the power consumption according to their payload, cover area Network is a group of two or more devices that can communicate.

Network connectivity describes the extensive process of connecting various network parts to one and other, for example, through the use of routers, switches and gateways, and how that process works.

The packet transfer is the process by which the number of packet received per the number of packets sent to the destination, this ratio is called packet delivery ratio given by the equation.

The existing system provided with the process of packet transfer from one cluster to another within a system that are dynamically allocated. Proposed a dynamic channel allocation algorithm for the dynamically arranged channel and a novel MAC protocol for a non uniform cooperative channels in MANET. This helps in increasing throughput, reduce packet delay and jitter in the system.

II. EFFICIENT DATA TRANSFER INCOOPERATIVE NETWORK

The existing system is explained using the flow diagram as shown below in figure 1 shows the flow chart explaining the complete process in existing system

- . *Selection of nodes.* The nodes that are to be included in a cluster are selected dynamically based on the energy level and based on the dynamic search distance vector routing protocol as shown in the figure 2.

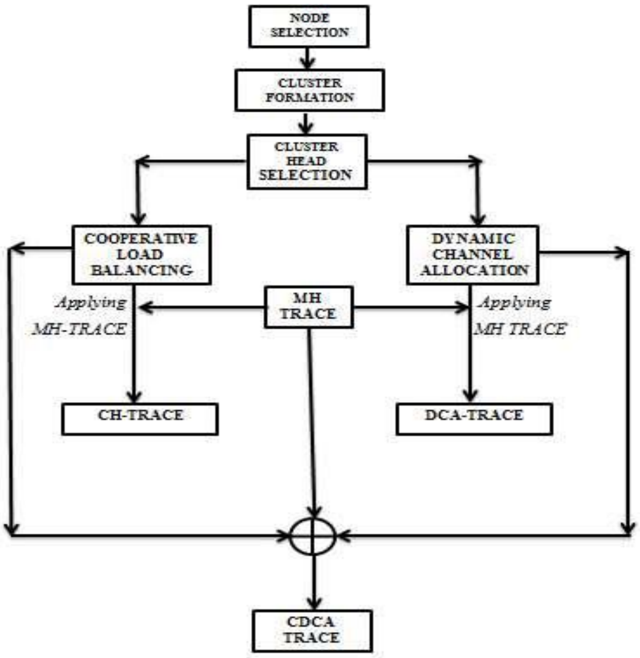

Fig.1: Flow Diagram of Exiting Method

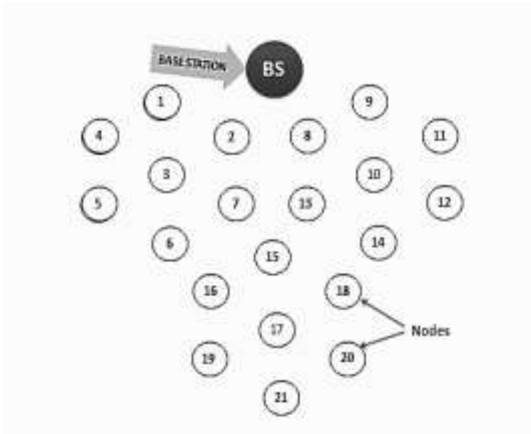

Fig.2: Selection Of Nodes

- *Formation of clusters and CH.* thus by the DSDV algorithm the clusters are formed and based on the energy level of the nodes choosing the best among them becomes the cluster head as shown in the figure 3. There are 3 different clusters that are shown below with different colors .the cluster heads are represented in hexagon shaped, figure 3 shows the formation of clusters and the CH's node 3,10,17.

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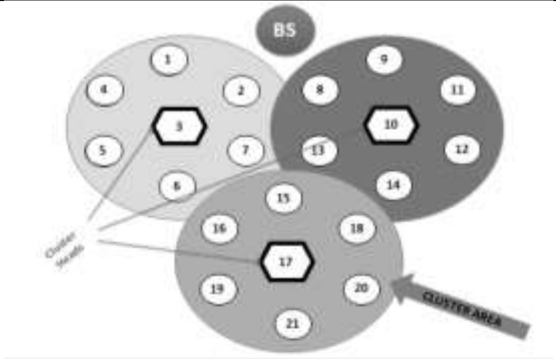

Fig.3: formation of clusters and cluster head

- *Function of cluster head.* The cluster head does the function of collecting the data of the cluster members and maintains the regular update of the cluster members, since it is a cooperative cluster communication the CH even collects the information from the neighboring nodes. This helps the cluster to automatically help or it can borrow the nodes if any of the path is dropped, below given figures show the function of cluster head.

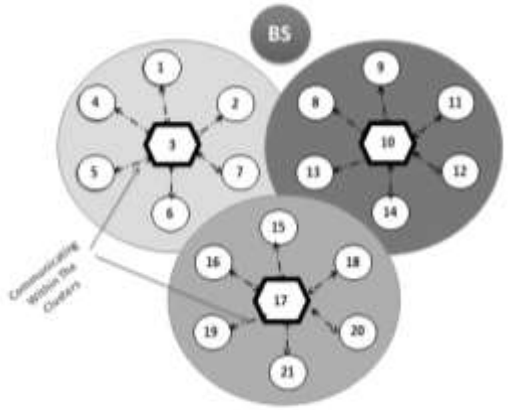

Fig.a.

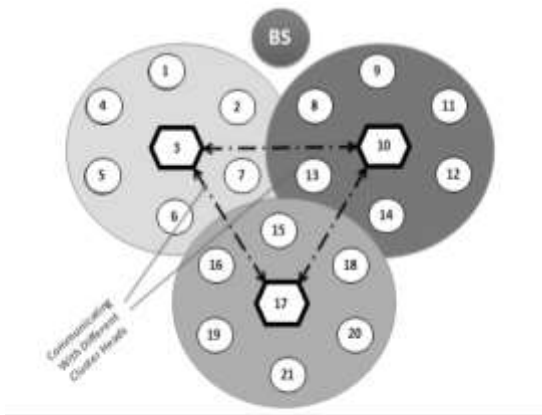

Fig.b.

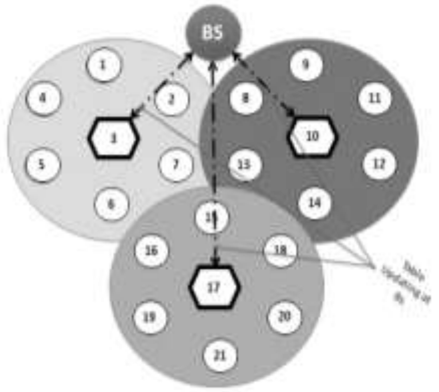

Figure c.

Fig.4: A) CH Collecting Cluster Members Details, B) CH Sharing The Cluster Details With Neighboring Clusters, C) Base Station Collecting And Updating The MAC Table

Thus the above function is processed by using the following algorithms that are explained in the following chapters.

A. Dynamic Channel Allocation Algorithm

The dynamic channel allocation algorithm is mainly functions in places of non-uniform loads. This algorithm helps the channel coordinator with the increasing local network load by increasing the sharing of bandwidth. By using DCA algorithm the channel controller continuously monitors the power level in all available channels in the network and will access the availability of the channels by comparing them by measuring the power level by threshold status.

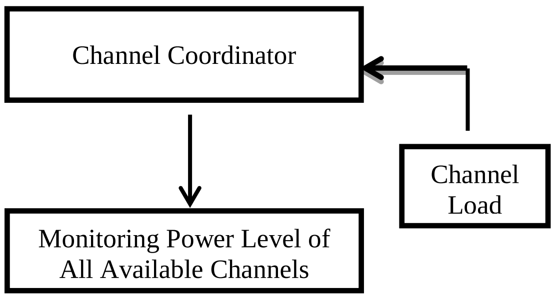

Fig.5: Flow diagram explaining the dynamic channel allocation algorithm

Considering if the load in channel controller is beyond capacity and measured power is minimum,the channel coordinator seeks and uses the additional channel with lowest power level measured. Once the channel coordinator starts to use another channels, the transmission level increases the power level measurement of that channel for nearby channel controllers this intern prevents them from accessing same channel that is been

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used currently. Also the local network load decreases the controller which do not need some channel, will stop channel transmission in that particular channel and making it available for other channel controllers.

B. Cooprative Load Balancing Algorithm

The cooperative load balancing algorithm is also used to consider the issues of non-uniform load distribution but by the use of other nodes in the network. The aim of this algorithm is that , each active nodes in cooperative network continuously monitor the load of the channel coordinator and then switches from heavily loaded coordinator to the coordinators with available resources.

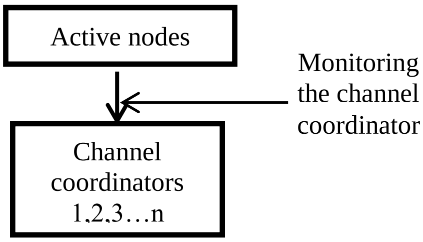

Fig.6: Flow Diagram Explaining Cooperative Load Balancing Algorithm

These active nodes detect the rise and fall of the channel by the coordinators and transfers load to other channel coordinators which has considerable resources. These resources vacated by the nodes are now available for other nodes which do not have any other channel coordinators. Thus increasing the total number of nodes that access the same channel hence increases the throughput.

C. MH Trace Algorithm

In MH-TRACE, some nodes take the role of channel coordinators called as cluster-heads. Each nodes are made up of super frames and these super frames are subdivided into different sub frames.

- *Control sub frame.* This control sub frame sends signal between the nodes and the cluster heads. This sub frame sends beacon packets by using the beacon slot this allows CH announcing its existence. The other part is the CA slot or cannel access slot that helps in interference elimination. The contention slot takes care of the transmission scheduling. The IS slot sends short packets to notify the neighboring nodes to cluster head.

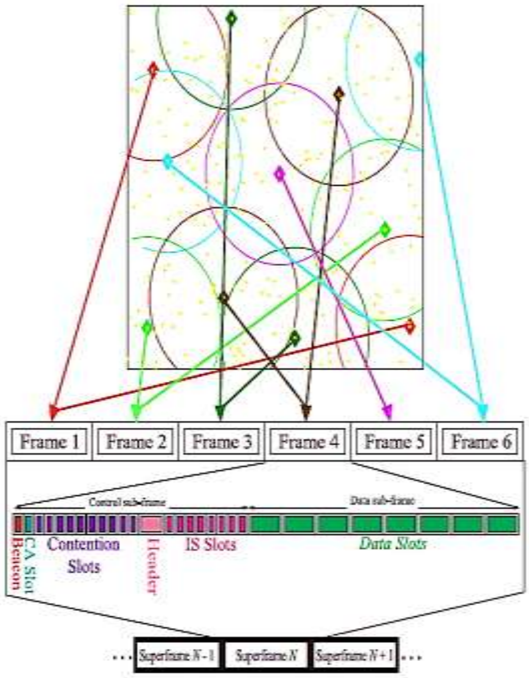

Fig.7: Snapshot of MH-TRACE Clustering and Medium Access , the Diamond Shaped are CHs.

- *Data sub frame.* this sub frame transmit data payload. In the data slot the CH receives as it has a reservation in super frame and the CH drops the reservation if the IS packets are lost.

In the beginning of the frame each CH calculates the available data slots and information of beacon. Thus this allows the data transfer from one cluster to another in a more streamline way in dynamic nodes mainly in cooperative networks. From the above figure 4 the data is to be transferred from a source node say node 2 to the destination node18, this data transfer takes place in different paths

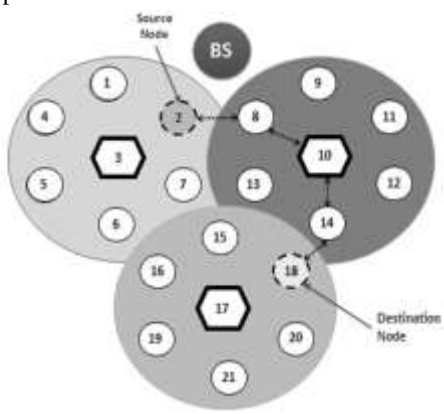

Fig.8: Data Packet Transfer From Node 2 To Node 18 but by choosing the best path with the help of the cluster head the routing path is found easily. Thus increases speed of the data transfer in the system.

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D. DCA TRACE, CH TRACE And CDCA TRACE

DCA-TRACE helps CHs to operate in more than one frame per super frame, if it is overloaded. Instead of selecting and operating in the less noisy frame as that in MH-TRACE, the DCA-TRACE is based on the level of the load, CHs decides the number of frames they can require and resourcefully chooses as many frames from the least noisy ones. DCA-TRACE includes additional mechanisms on top of MH-TRACE:

a. a mechanism to keep track of the interference level in each frame from other CH;
b. a mechanism to sense the interference level in each data slot in each frame from the transmitting nodes.

In MH-TRACE, cluster heads use this mechanism to choose the less interference frame for themselves. DCATRACE makes use of the such structure. However, in order to maintain temporary changes in the interference levels that may occur due to CH resignation or unexpected packet drops, an exponential moving average update mechanism is considered to determine the present interference levels in each frame. At the end of each frame, the interference level of the Beacon slots and CA slots are continuously updated with the measured values in that frame using.

$$I_{k,t} = \begin{cases} M_{k,t} & if\ I_{k,t-1} < M_{k,t}; \\ (1-\alpha)I_{k,t-1} + \alpha M_{k,t} & o.w., \end{cases}$$

Where $I_{k;t}$ and $I_{k;t-1}$ are the interference levels of the k^{th} number slot in the current and the previous superframe, respectively. $M_{k;t}$ is the calculated interference level of the k^{th} slot in the current super frame, and as a smoothing factor, which is set to 0:2 in this simulations. The interference equal of the frame is taken as the maximum interference level among the interference levels of the Beacon and CA slots.

Another mechanism that DCA-TRACE computes with the MH-TRACE is the dynamically assigning the data slots. In MH-TRACE the data slots are assigned in a serialized order. On the other hand, since DCA-TRACE introduces channel borrowing the CH had to cease from reallocating a data slot instead must allocate another data slot that has a lower interference value from that had borrowed by another CH.In the TRACE protocols, nodes resist for channel access from one of the CHs that have available data slots around them.

After successfully obtaining the contention, CH do not monitor the available data slots of the CHs around them. Since the network load is dynamic in nature, a cluster having lots of free spaced or available data slots may become heavily loaded at the time of data stream. In order to overcome this issue, each nodes should consider the load of the CH not only when in the first contention for channel access but also after obtaining a reserved data slot during the entire time of their data stream.

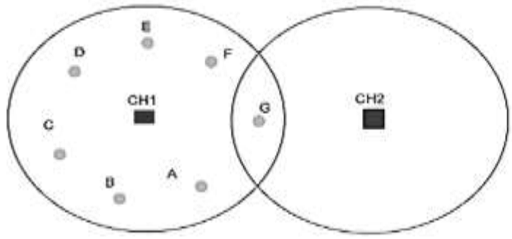

Fig.9: Demonstrating Scenario of Collaborative Load Balancing

In DCA-TRACE, once one of the CH allocates all of its available slots, it activates the algorithm to select an extra frame. However, accessing one additional frame might not always be possible, if the interference levels on all the other frames are comparatively very high. In case if accessing additional frames it increases the interference in the Beacon slots and Header slots of these frames and may cause Cluster Head to reassign and reselect in the rest of the network that provisionally affects the ongoing data streams on the resigned cluster heads. By using additional frames ,the increases in interference in the IS slots and data slots of the new frame and decreases the potential extent of these packets that are able to reach finally.

In order to overcome such difficulties, we propose CMH-TRACE and CDCA-TRACE, which adds cooperative CH monitoring and reselection of MH-TRACE and DCA-TRACE, respectively. In CMH-TRACE and CDCATRACE, nodes continuously monitor the available data slots at the CHs around themselves broadcast by the Beacon messages. When all the available data slots for a CH are allocated, with a probability p, the active nodes attempt to trigger the cooperative load balancing algorithm. When the cooperative load balancing is activated, the node that is currently using a particular data slot from a heavily loaded cluster head contends for data slots from the nearby cluster heads while keeping and using its reserved data slot until it secures a new data slot from another CH.

III. HANDOVER TECHNIQUE WITH CLUSTERS

This existing system has to concentrate on handover function too , in order to prevent data loss within or outer networks. This makes the system more active, in any of the node drops from transmission the other takes in charge to pass the data to the next cluster.

In order to perform the effective way of handover mechanism two important algorithm has been proposed in

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this system they are distance vector routing protocol and the tour planning algorithm

A. Distance Vector Routing Algorithm

A DSDV algorithm requires the routing information of the neighbor topology changes periodically. It manipulates with the distance of the nodes in a network.

Calculates the direction and distance of any link in a network Updates are done periodically where the routing table are sent to all neighbor nodes

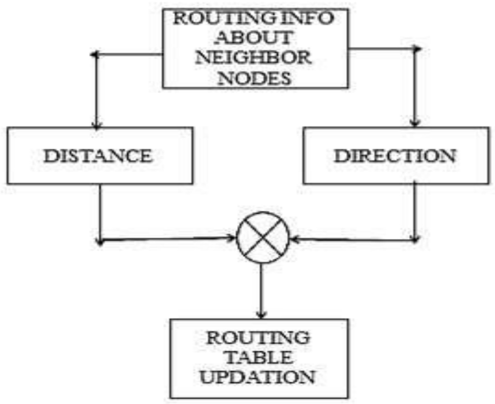

Fig.10: flow diagram explaining distance vector routing

B. Tour Planning Algorithm

By knowing the available number of the nodes in the network,route trace is been done. Bythis technique when a node is dropped or lost or less energy efficient then choosing of more effective node to transfer the packets to the network.Once the path is known the data is transferred automatically.

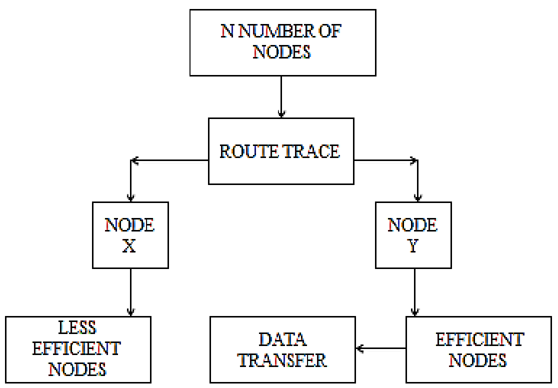

Fig.11: Flow Chart Explaining the Tour Planning Algorithm

The hand over technique is been introduced with the help of tour selection protocol is used so as to find the suitable path for the cluster node transfer. We have mainly concentrated in packet loss and delay less connectivity in cooperative communication. Below given is the process of performing the hand over in the system in a cooperative cluster communication.

- *Cluster Monitoring.* Since the function of CH is to monitor the cluster and its member activities it also looks for the neighbor in case of any emergency.

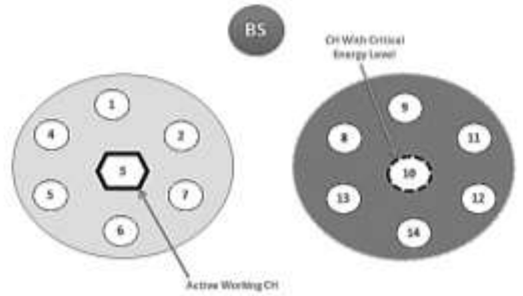

Fig.A

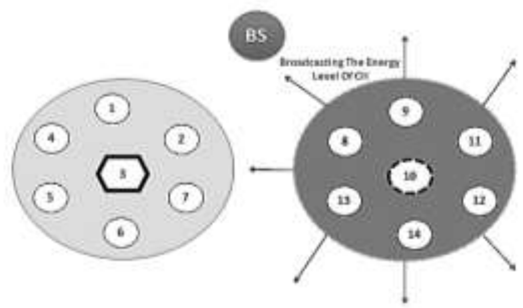

Fig.B

Fig.12: A-Ch 3 is Continuously Monitoring the Cluster and Member Nodes, B- the CH 10 Sends the Message to its Neighboring Nodes.

This makes an up to date information of the clusters. This is the function of the cooperative networks that includes the channel borrowing etc.

- *Energy Transfer.* Since the CH 10 has the critical energy the neighbor cluster tries to help the node thus the hand over function is done within the cluster networks. Below shown is the energy transfer from one system to another.

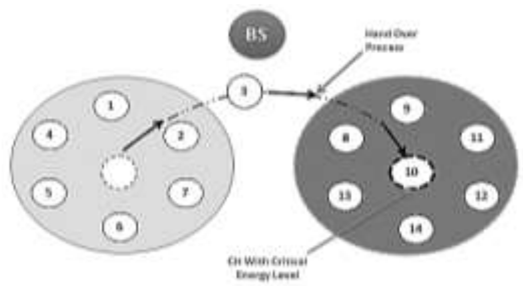

Fig.13: Energy Transfer Attempt From CH 3 to CH 10.

Above shown is one of the cluster head has the critical energy that is been indicated to the entire network, thus the nearest and the best node helps the cluster to gain control or share its energy in order to avoid the data loss.

- *Cluster Heads After Handover*. By effective handover technique the CH has been to the active stage and the node that delivered has its position within the cluster or any suitable clusters. This clusters formed are with new cluster heads and are been updated in the base station, this process continues from one cluster to another.

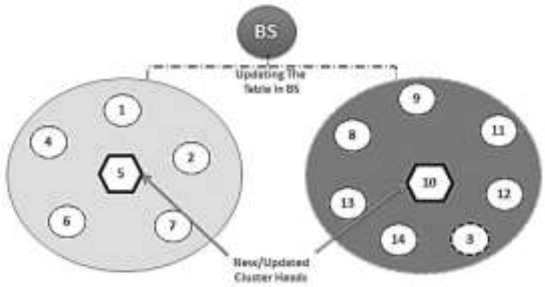

Fig.14: New and Updated Cluster Heads

IV. PERFORMANCE COMPARISON

The performance measure is done base on these important parameters such that comparing the performance with three different networks, the non-cooperative networks , cooperative networks and the cooperative network with hand over.

The parameters include the throughput, network connectivity, packet received, packet transfer and the energy efficiency of the proposed system .

A. *Packet Received*

The below given graph represents packet received during the transmission of packets from one cluster to other. The comparison shown between the two network is clear that the packet received in given time is gradually increasing in cooperative network compared with the non-cooperative network. Packets received are measured 0.2x 10^3 per second. Packet delivery ratio $=\frac{received\ packets}{sent\ packts}$

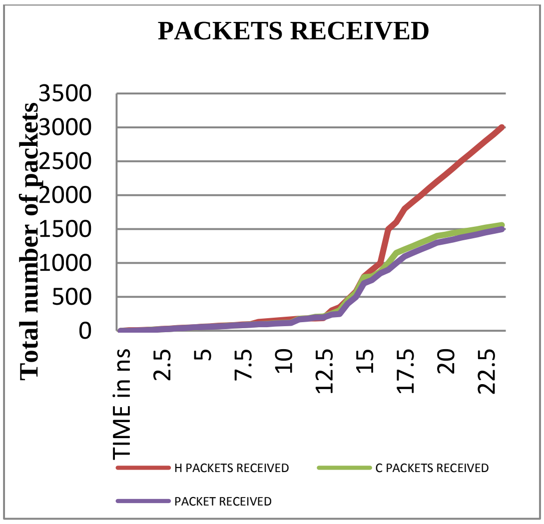

Fig.15: Graph Describing Packet Received.

B. *Network Connectivity Delay*

Below given graph shows the network connectivity delay

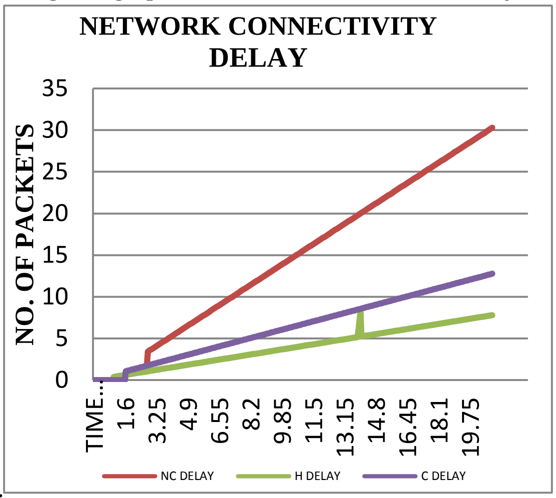

Fig.16: Graph Describing Network Delay comparing the cooperative network and non-cooperative network. Below shown Figure 4.10 is that the cooperative network has delay time less compared with the other network.

C. *Energy Efficiency*

Below given graph shown figure 4.11 the energy dissipation between cooperative network and non-cooperative network.

The graph given is gradual energy loss on both the networks comparatively cooperative networks has minimum dissipation of energy. The energy used during the transmission are given in joules.Energy (J) = coulomb(C) x voltage (V)

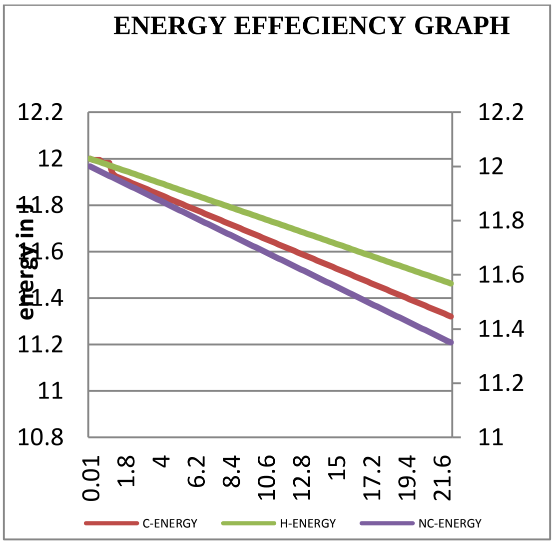

Fig.17: Graph Describing Energy Efficiency

V. DISCUSSION AND CONCLUSION

By the above simulation and execution of the proposed system it is clear that the performance level in case of delay, trough put, and packet loss is reduced in cooperative network using MANET compared with the

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other ad-hoc networks. The above give simulated output shows the function of the cooperative network in packet data transferring using cluster based MANET.

The performance measure for packet delay, time delay, throughput and energy decepation are represented graphically comparing cooperative network verses non-cooperative network. According to the result it is clear that the cooperative network has much more efficient way of data packets transfer compared to any other non-cooperative network

For the delay less packet transfer through the high traffic network, the future work will focus on the effective handover technique to improve the packet transfer. This helps in the improvement in throughput, reduced jitter and traffic management .a novel cluster management algorithm can be used and decision making algorithm for channel heads in order to make out in coordinated network.

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