International Journal of Computer Science and Business Informatics

IJCSBI.ORG

A Multi-parametric based W-PAC Mechanism in Ad Hoc Network using IPv6 and IPv4 Address

S. Thirumurugan
Department of Computer Applications
J. J. College of Engineering and Technology
Trichy,Tamilnadu, India.

Dr. E. George Dharma Prakash Raj
Department of Computer Science and Engineering
Bharathidasan University
Trichy,Tamilnadu, India.

ABSTRACT
The wireless network plays an indispensable role in the present communication scenario. This network functionality has been improved with the advent of clustering mechanism. The type of nodes which are used in forming these clusters will decide the nature of the applications the network could be utilized. These nodes can be either IPv4 or IPv6 nodes. There are various queries need to be resolved while IPv4 or IPv6 nodes have been considered to devise the clusters. This paper work brings out the discussion on cluster formation using IPv4 nodes and IPv6 nodes. This study proposes IPv4 cluster creation, IPv6 cluster creation and also a novel duplicate address detection strategy for stateless address autoconfiguration. The cluster formation work has been simulated with the help of OMNET++.

Keywords
W-PAC, IPV4, IPV6.

1. INTRODUCTION
The ad hoc wireless network formation has been based on IPv4 or IPv6 nodes. The IPv4 nodes are configured with the 32bit IP address and IPv6 nodes are configured with 128bit address. The configuration of node with IPv4 address has almost got saturated in this present scenario. Due to this non availability of unique IPv4 address the situation drives us to move towards IPv6 address. The configuration of IPv4 node could be done manually or dynamically using DHCP server. The IPv6 node can be configured dynamically using DHCPv6 or stateless auto configuration without DHCPv6. Generally the IPv6 node can self configure automatically. The DHCPv6 has been similar to DHCPv4 used in IPv4 nodes configuration. This study considers the clustering mechanism on ad hoc scenario network to support scalability and improves the performance of

network in terms of bandwidth utilization. The IPv4 or IPv6 nodes are considered to form the clusters. This work discusses the cluster formation and issues need to be faced when IPv4 nodes or IPv6 nodes are used to make clusters.

This paper has been organized as follows. Section 1 deals with introduction. Section 2 says about the related works. Section 3 speaks about the existing W-PAC algorithm to form clusters. Section 4 tells about the cluster creation with the help IPv4 nodes. Section 5 gives out the cluster formation using IPv6 nodes. Section 6 puts down the experimental results and analysis. Section.7 signifies the future works on this study. Section.8 ends up with the conclusion.

2. RELATED WORKS

The existing single parameter cluster formation algorithm k-means has faced problem in obtaining an efficient cluster in terms of time. The PAC [1] algorithm has solved that problem. But this algorithm forms clusters at the initial level and leaves many nodes as non clustered node. It also doesn't able to form maximum clusters that is possible for the given sample set of nodes.

The Ex-PAC [2] algorithm, comes under single parametric algorithm, has been an extension of the PAC mainly to overcome the drawbacks faced by the PAC. In this algorithm the sample size also high for experimental results. This also could be able to form the maximum number of clusters possible for the given sample set of nodes.

The multi-parametric cluster formation algorithm W-PAC [3] forms the cluster based on weight computation involves multiple parameters. This method also suggests cluster maintenance strategy which deals with the load distribution and mobility.

The cluster formation includes essential parameters on creating clusters dynamically. The PSO-PAC [4] applies the swarm intelligence to device clusters by considering the essential parameters. This ultimately reduces the computation time towards optimizing the cluster creation process.

The cluster formation approach could be integrated with the existing well performing protocols [5] has been realized. The applications [6] show significance performance hike while the clustering has been incorporated with the existing protocols at the network layer.

The IPv4 address no longer will serve the world has been realized. The IPv6 address has got the focus in the present scenario. The configuration of address can be done in two ways. The configuration uses DHCPv6 server and stateless autoconfiguration [7]. This address can be local link address or global address. This will be decided based on the application requirement. But there must be awareness on the restrictions of using the address range has been essential.

The stateless autoconfiguration of IPv6 nodes should have duplicate address detection mechanism. Since when the nodes move across the clusters there is a possibility of address duplication. To eliminate this passive duplicate address detection mechanism [8] has been introduced. This method shows improved results than passive autoconfiguration for mobile ad hoc networks.

The purpose of autoconfigured address has been realized while the ad hoc network has come to existence. The limitations of IPv4 and the need of IPv6 [9][10] have been understood clearly. Having understood the difference between IPv4 and IPv6 the scenarios will demand the specific way of addressing the nodes. These works are dealing the autoconfiguration or manual configuration of IPv4 and IPv6 nodes. The clustering as a mechanism comes for this IPv4 or IPv6 autoconfigured node to make the routing simple and also confirms the efficient utilization of bandwidth and other resources.

3. W-PAC

The clustering mechanism W-PAC (weighted Partitioning Around Cluster head) forms the cluster based on the weight value of the node. This has three phases in clustering process. They are cluster creation, cluster head election and maintenance phase. The cluster creation phase devises the clusters and cluster head election phase selects the cluster head.

Cluster Creation

(1) Initialize set of nodes as M.

(2) Compute the degree of node Ni.

(3) Deg (Ni) = 0.

(5) If (i not equal to j)

(4) j = 1.

begin

MD (Ni, Nj) = $\text{MOD}\{(X_2 - X_1) + (Y_2 - Y_1)\}$

If (Manhattan Dist(Ni , Nj) < Radius)

begin

Add (Ni, Cm) // add to cluster

Deg(Ni) = Deg(Ni) + 1

j = j + 1

end

else

Add (Ni , NCn) // add to Non cluster

end

(6) Repeat the step 5 until j = M.

Cluster Head Election

(1) Create Clusters using W-PAC cluster creation.

(2) Cluster = Ci, P = Number of nodes in Ci.

(3) j = 1; Ni = (U_t, V_t); Nj = (U_{t-1}, V_{t-1});

(4) If (i not equal to j)

begin

If (Manhattan Dist(Ni,Nj) < Radious)

begin

Compute the Mobility speed of Node Ni belongs to Ci.

$$M(Ni) = \frac{1}{T}\sum_{t=1}^{T} MOD\{(U_t - U_{t-1}) + (V_t - V_{t-1})\}$$

Compute the Distance between Ni and Nj.

$$D(Ni) = \sum_{t=1}^{T} MOD\{(U_t - U_{t-1}) + (V_t - V_{t-1})\}$$

j = j + 1

end

end

(5) Repeat the step 4 until j = P.

(6) Assume the energy consumption of nodes E(Ni).

(7) The weight of node Ni computed as follows,

W(Ni) = q1*Deg(Ni) + q2*M(Ni) + q3*D(Ni) + q4*E(Ni)

(8) Repeat the step 7 for all nodes belong to Ci.

(9) CHk = Min { $W(N_1), W(N_2), W(N_3) \ldots W(N_M)$ }.

(10) Repeat the step 2 through 9 for i = 1…..no of clusters.

4. IPV4

The clusters with cluster head created using W-PAC procedure have been considered for implementing the clusters using IPv4 nodes. By default all the nodes are configured with IPv4 address.

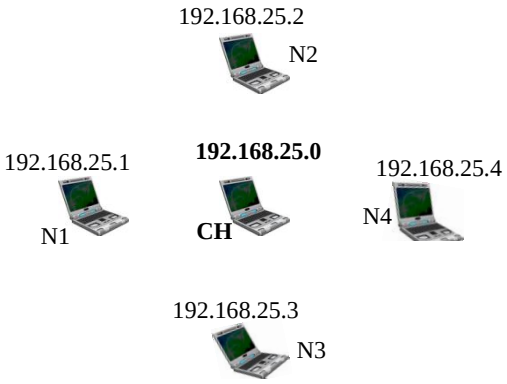

Figure 1. IPv4 Network Model

Algorithm: IPv4 nodes Configuration.

1) Input the Clusters Created using W-PAC procedure.
2) Assume CH(Cluster head) node as DHCPv4 server.
3) for each cluster Ci
   Begin
   Consider each node within Ci as DHCPv4 Client.
   The Client sends Request message to DHCPv4 server.
   The DHCP Server Configures the DHCPv4 Client
   Node.
   End
4) Repeat the step 3 for i = 1..... Number of clusters.

The Fig.1 shows the network model comprised of IPv4 nodes. The DHCPv4 server runs at Cluster head node. This will have the IPv4 address to be assigned dynamically upon the client's request. This server periodically sends the probing message to all the member nodes to know the status of them. This clustering technique reduces the burden of handling the number of clients by the cluster head and also eases the monitoring process of the cluster head. One of the major benefit of the clustering mechanism would be the frequencies which are used by the cluster can be reused by some other cluster. The network model shows that the nodes are configured with IPv4 address by DHCPv4 server dynamically.

Figure 2 shows the communication happens between client and server as a process of member node affiliation with the cluster head. The W-PAC

algorithm forms the clusters with cluster head. The cluster head node which runs server process broadcasts the probe message to all the member nodes belong to the same cluster. The member nodes put the request to cluster head to configure themselves if the nodes have received the message first time. The server periodically probes the client node to have the member nodes under its affiliation.

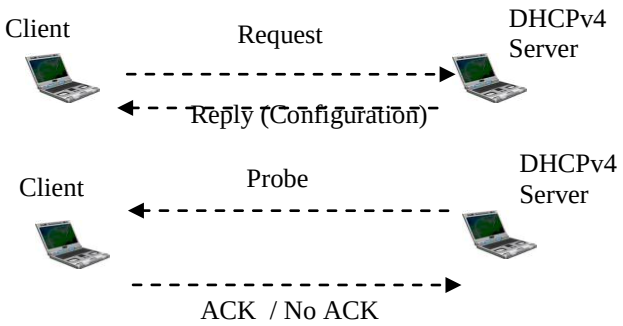

Figure 2. Communication between Client and Server

The member node which runs the client process sends the acknowledgement to the server process runs under cluster head node while the message received count is more than once. This will update the members' list table in cluster head. The absence of the acknowledgement indicates the movement of node beyond the cluster boundary. In this way the cluster head will be aware of the member nodes under its control.

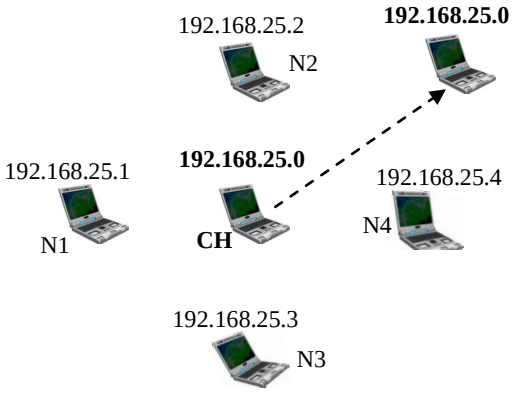

Figure 3. Mobility of IPv4 Cluster

Figure 3 shows the mobility scenario of cluster head. In this cluster head mobility scenario the re-election of cluster head through broadcasting the request message would be an overhead in the process of ad hoc network maintenance. Thus, the result of W-PAC has already listed out the order of the cluster heads. If the node at the second top position has adequate energy

to hold the position of cluster head, then this would be considered for the cluster head position otherwise this will be continued till the node with the sufficient energy level has been identified within the cluster.

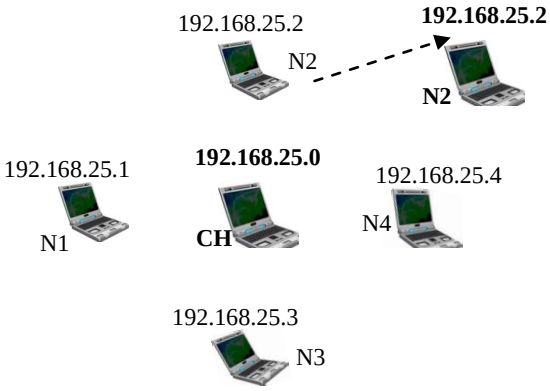

Figure 4. Mobility of IPv4

The Figure 4 shows the mobility scenario of the member node. The node movement across the cluster boundary will be known by the DHCPv4 server. Since the server monitors the nodes status by periodically sending the probing packet. The server will reuse the IPv4 address of the node which has moved out of the cluster. If the node enters to new cluster the probe message will reach the member node from the cluster head of that cluster. The node may send a request to the cluster head while the probe message reaches first time to the member node.

5. IPV6

The clusters created using W-PAC procedure has been considered as input for implementing the clusters using IPv6 nodes. The Figure 5 shows the network model comprised of IPv6 nodes. These IPv6 nodes may be configured in two ways. They can be either assigned with IPv6 address using DHCPv6 server in a stateful or IPv6 stateless address autoconfiguration way. These IPv6 address starts with fe80 for the local network address. The DHCPv6 server will have the addresses in the database which can be assigned for every client on their entry or presence to the cluster. In the case of stateless method every IPv6 node need to identify the unique address in the network where the node has been associated.

The functionality of this network has been similar to IPv4 network. The cluster head runs DHCPv6 server. This server configures the member node which runs client process. The clients are assigned with IPv6 address as part of configuration.

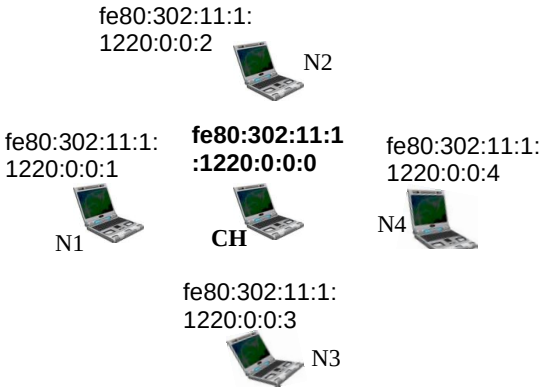

Figure 5. IPv6 Network Model with Stateful address configuration

1) IPv6 nodes stateful address Configuration

Algorithm:

1) Input the Clusters Created using W-PAC procedure.
2) Assume CH(Cluster head) node as DHCPv6 server.
3) for each cluster Ci
   Begin
   Consider each node within Ci as DHCPv6 Client.
   The Client sends hello message to DHCPv6 server.
   The DHCP Server Configures the DHCPv6 Client Node.
   End
4) Repeat the step 3 for i = 1..... Number of clusters.

The DHCPv6 server assigns address dynamically to the IPv6 nodes. These addresses can be reused while the node moves out of the cluster.

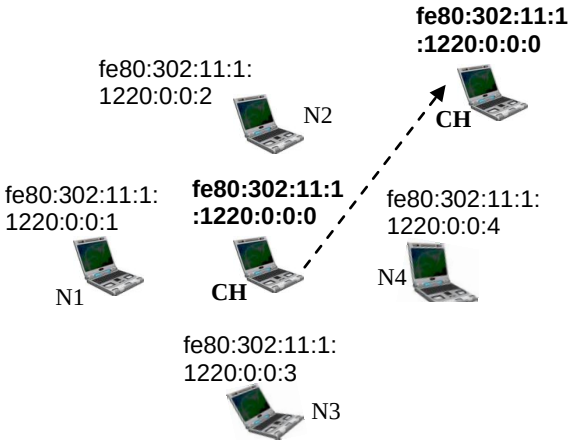

Figure 6. Mobility of IPv6 Cluster

The Figure 6 shows the mobility of the IPv6 node acts as cluster head. The movement of cluster head will elect the member node as next cluster head. This will be decided based on the weight values computed for all nodes. The next node which has least weight will be elected as cluster head. This process will be limited by the clusters boundary.

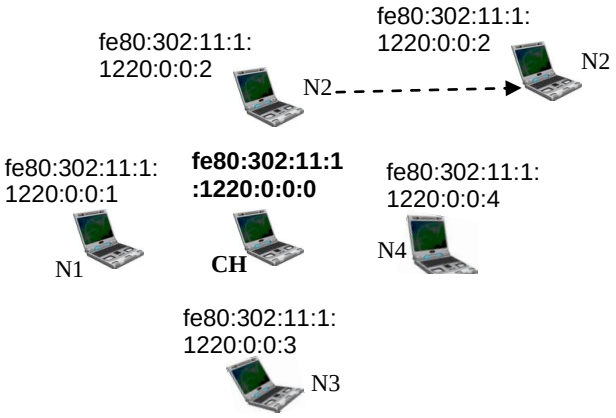

Figure 7. Mobility of IPv6 node

The Figure 7 shows the mobility scenario of the member node. The node movement out of the cluster boundary will be known by the DHCPv6 server. Since the server monitors the nodes status by periodically sending the probing packet. The server will reuse the IPv6 address of the node which has moved out of the cluster. If the node enters to new cluster the probe message will reach the member node from the cluster head of that cluster. The node may send a request to the cluster head while the probe message reaches first time to the member node.

2) IPv6 nodes stateless address Autoconfiguration

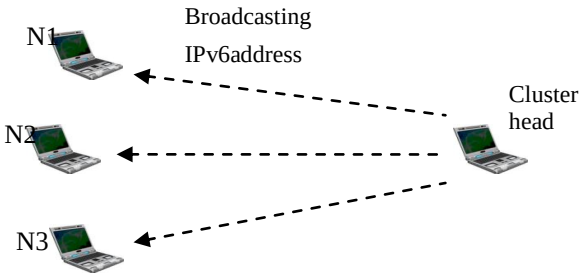

Figure 8. Cluster head broadcasting IPv6

The Figure 8 shows the cluster head broadcasting of IPv6 address to all the member nodes of the same cluster. This cluster head is elected with the help of W-PAC algorithm.

Algorithm: Autoconfiguration of IPv6 nodes

(1) Input the clusters formed through W-PAC.
Clusters : C1, C2.....Cn
(2) Cluster head is elected based on weight.
(3) i = 0.
// Cluster head broadcasts IPv6 address
(4) For each cluster Ci
Begin
Repeat
Begin
j = j + 1
CH broadcast IPv6 address to Nj
End
Until (j < number of Nodes under Ci)
End
(5) Repeat the step 4 for i = 1.....number of clusters.
// Node Affiliation
(6) For each node Nj of Ci
Begin
Nj sends IPv6 address to cluster head
Cluster head adds to member list
Cluster head verifies the IPv6 address of Node Nj
Cluster head replies Unique/Duplicate to member node.
End
(7) Repeat the step 6 for j = 1....number of nodes of Ci
(8) Repeat the step 7 for i = 1..... number of clusters.

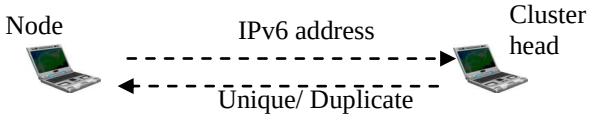

Figure 9. Node confirms unique IPv6 address with the cluster head

Figure 9 shows the node communication with the cluster head to detect the duplication in the selected address under stateless autoconfiguration method. The cluster head reply conveys the uniqueness of the address which is obtained by the member node.

Algorithm: CHDAD

(1) ADD_LIST ={ Empty }
(2) Duplicate = false.
(3) Member node N sends IPv6 address to CHi of the cluster Ci.
(4) For each cluster Ci

Begin

The Cluster head CHi validates the address

Begin

If (IPv6 of N ∈ ADD_LIST) then

Reply to member node N about the duplication of

IPv6 address.

Duplicate = true

End

i = i + 1

End

(5) If (Duplicate = false) then

Add the IPv6 address of node N to ADD_LIST.

(6) Repeat the steps 2 through 5 for all the node of the cluster Ci.

(7) Repeat the steps 1 through 6 for all the clusters of the network.

The CHDAD (Cluster head's duplicate address detection) mechanism takes the IPv6 address decided by the member nodes . This will be probed against the duplication by the respective CH head by checking the existence of the address in their list ADD_LIST or neighbors list. If the address is not found in this list then the address gets added to the list of the respective cluster head. The cluster head node should have the information stored in the form of table as shown in Table.1. This will be exchanged among the cluster heads on demand.

Table 1. Data structure of CH's Info Packet Fields

List of Affiliated Nodes IPv6 address (ADD_LIST)	List of Neighbor CHs' IPv6 address

The Figure 10 shows the IPv6 address autoconfiguration in the network model.

In this model the cluster head is elected based on the weight value as similar to IPv4 network model. The cluster head role has been changed in this network. The nodes need to configure themselves since there is no DHCP server as for as this network model has been concerned. The cluster head is useful on detecting duplicate address. Initially the cluster head will configure itself automatically then it will broadcast the address to all the nodes belong to the cluster. After that, each node chooses the IPv6 address

and immediately informs the cluster head node. The cluster head maintains a list of IPv6 addresses which are allotted.

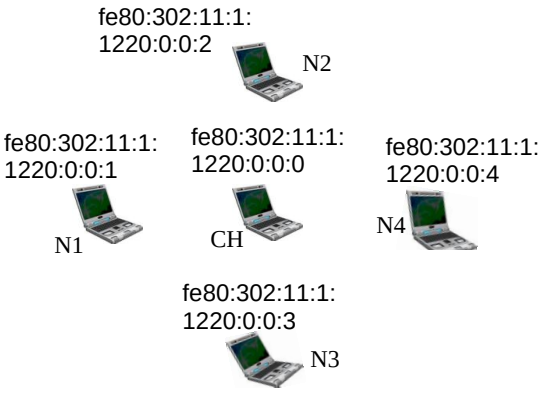

Figure 10. Stateless address autoconfiguration of IPv6

Thus, the cluster head will be aware of the addresses already in use. The member node communicates with cluster head to detect the duplicate address. In this way the bandwidth consumption has been reduced significantly. Since the broadcasting of the node address to detect the duplicate address has been eliminated. As a result this the performance using the clustering mechanism has shown an improvement in terms of efficiently utilizing the service parameters.

6. EXPERIMENTAL RESULTS

The simulation has been done with the help of OMNET++. The following Table.2 shows the simulation parameters that are considered for the simulation.

Table 2. Simulation Parameters

Parameter	**Values**
N (Number of IPv6 Nodes)	10
Space (area)	30 × 30
Tr (Transmission range)	6m
Ideal nodes percentage	90%
Simulation Time	5 sec
Weighing Factors (w1,w2,w3,w4)	0.7,0.2, 0.05,0.05
Threshold(Energy) in Units	500

Table 3. Nodes Weight

Cluster	Node	Weight (WNi)
-	N0	73.45
C2	N1	107.90
C1	N2	158.70
-	N3	208.40
C1	N4	258.70
C1	N5	308.75
C1	N6	58.70
-	N7	133.40
C1	N8	352.95
C2	N9	127.90

The Table.3 shows the computed weight value of the nodes. The results show that the cluster1 and cluster2 will have cluster heads as node6 and node1 respectively. These are decided based on the weight value of the nodes belong to each cluster. The Figure 11 shows the clusters formed using set of nodes. The W-PAC cluster formation algorithm forms two clusters for the given sample set. These nodes later on configured with IPv6 address either by stateless or stateful way.

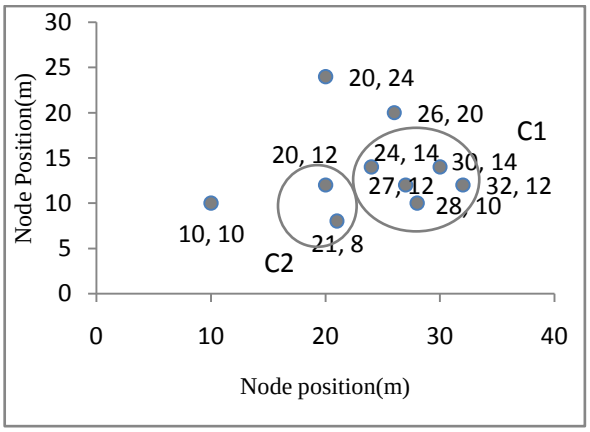

Figure 11. Result of W-PAC

The Figure 12 shows the cluster C1 comprised of member nodes and cluster head as node6. The CH6 node runs DHCPv6 to configure the nodes under

stateful method using IPv6 address. The node6 will broadcast the IPv6 address to the member nodes in order to communicate with the server node. The member node sends the request and gets the IPv6 address from the server as their unique address.

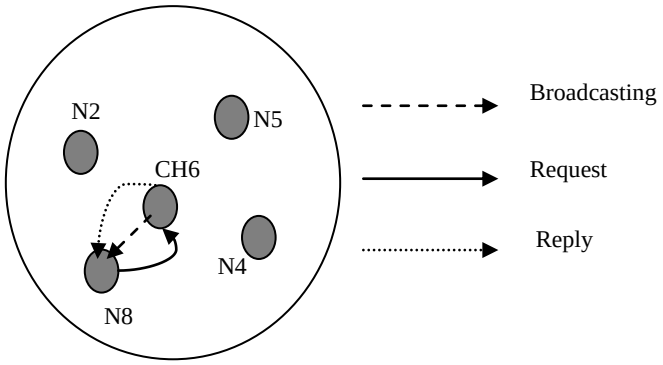

Figure 12. Configuration of Cluster1 nodes

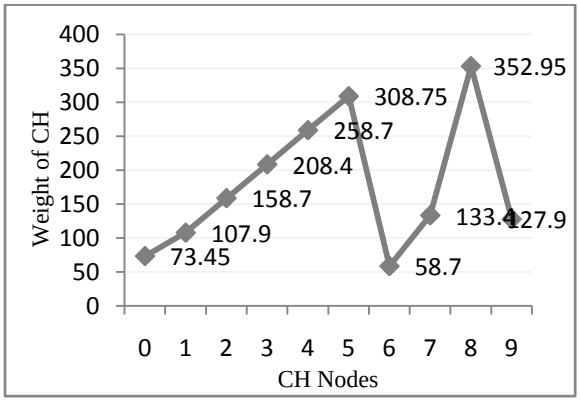

Figure 13. CH Nodes based on Weight

The Figure 13 shows the cluster heads order based on weight to change the cluster heads when the existing cluster head moved away.

7. CONCLUSIONS

This study describes the cluster formation of IPv4 and IPv6 nodes. It has pointed out the methods of forming clusters while using IPv6 nodes. The cluster maintenance strategy after the cluster formation using W-PAC has also been discussed. The simulation with the help of OMNET++ shows the study to be applied in a realistic manner. In future this work has to be extended for huge sample set and also consider forming the clusters dynamically.

REFERENCES

[1] S. Thirumurugan and E. George Dharma Prakash Raj, "PAC - A Novel approach For Clustering Mechanism in Adhoc Network", ICSCCN 2011, pp.593-598.

[2] S. Thirumurugan and E. George Dharma Prakash Raj, "Ex-PAC: An Improved Clustering Technique in Ad Hoc network", RACSS'12, 2012, pp.195-199.

[3] S. Thirumurugan and E. George Dharma Prakash Raj, "W-PAC: An Efficient Weighted Partinioning Around Cluster head Mechanism for Adhoc Network", CCSEIT'12, pp.182-188.

[4] S. Thirumurugan and E. George Dharma Prakash Raj, "PSO-PAC: An Intelligent Clustering Mechanism in Ad hoc Network", NETCOM' 12.

[5] S. Thirumurugan, "Direct sequenced C-IAODV Routing Protocol", International Journal of Computer Science and Technology, Vol.1, Issue.2, Dec 2010, pp. 108-113.

[6] S. Thirumurugan, "C-AODV: Routing Protocol for Tunnel's Network", International Journal of computer science and technology, Vol.2, Issue.1, Mar2011, pp.113-116.

[7] Li Qing, "An IP address auto-configuration scheme for MANET with global connectivity", ICIME'10, 2010, pp.244-247.

[8] M. Sivakumar, C J Jickson and R M S Parvathi , "Passive Duplicate Address Detection in DYMO Routing Protocol for MANETS", ICVCI'11, 2011, pp.9-14.

[9] He Zhonglin and He Yuhua , "Study on Key Technologies of MANET", ISME'10, 2010, pp.112-115.

[10] Ulrich Herberg and Thomas Clausen, "Yet Another Autoconf Proposal (YAAP) for Mobile Ad hoc NETworks", MASN'10, 2010, pp.20-26.