Merging independent mobile adhoc networks-A new methodology for autoconfiguration of IP addresses

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Abstract

Autoconfiguration of mobile nodes is an important issue on self-organizing mobile adhoc network. Autoconfiguration is needed to identify mobile nodes in the network uniquely. This is a critical problem to assign unique IP addresses to the mobile nodes when two or more than two independent adhoc networks merges to form a single network. Because when two independent mobile adhoc networks are merged then it may be possible that these independent networks have the nodes with a common IP address which results in IP address conflict. Most of the approaches available in the literature for autoconfiguration of IP addresses are based on single mobile adhoc network. In this paper we have proposed a new methodology for autoconfiguration of mobile nodes in the case of merging.

Keywords: IP address, autoconfiguration, mobile adhoc networks

Introduction

Mobile adhoc networks are infrastructreless self-organizing wireless networks. Each node can be mobile and has routing capabilities [3] to be able to forward packets on behalf of other nodes .Adhoc networks are typically composed of homogeneous nodes that communicate over wireless links without any central control. Adhoc wireless networks inherit the traditional problem of wireless and mobile communication, such as bandwidth optimization, power control and transmission quality enhancement .In addition topology is highly dynamic & random & very hard to predict. Physical security is limited. Mobile Ad-hoc Network serves as a temporary wireless network [5] in which node changes its IP address with the help of an intelligent auto-configuration protocol [1]. The main role of IP address autoconfiguration protocol is to manage the address space and also the protocol must be able to allocate a unique network address to un-configured node [2].

Related Work:

Ad hoc network is a special kind of wireless network which does not require any backbone infrastructure. These kinds of networks are very flexible and can easy to deploy. The most challenging issues for these kinds of networks are to maintain routes and links between nodes as they do not have any prior knowledge about the topology of the network. The routing protocols for Mobile Ad hoc Network (MANET) undertake to setup and maintain routes between nodes [7]. The behaviour of the MANET depends on the topology of the network. As in the case of MANET the topology of the network is not fixed and it varies according to the mobility factor and the number of nodes participating in the network. Hence, we simulated the network using the density of nodes as a parameter in which the throughput has increased effectiveness. Previous works [1], [2], [3] , [4] and [5] have done extensive work on the qualitative and quantitative analysis of Ad hoc routing protocols by means of different performance metrics with VBR traffic, and packets of small sizes with the mobility of nodes as a metric. There are several scenarios in which a mobile node will change its IP address:

i) Partitions of a network in MANET

If some mobile nodes in the MANET move out of the transmission range of the other nodes, the network becomes partitioned. Because these nodes may not be aware of the partition, they may still use the previous allocated addresses. If the IP address of a node in one partition is allocated to the new node in the other partition, address conflict occurs when these two partitions become connected.

ii) Merger of two independent Mobile Networks

The second scenario is that two independent configured MANETs are merged as in Figure 1. And the MANET before merging is shown in Fig. 1. Because these two networks are auto configured separately, there may be some duplicate addresses in both networks, such as node A in MANET1 and node B in MANET2. Thus one needs to change its addresses due to the merger.

Problem Formulation

To overcome IP address configuration problems such as when independent networks are merging then this leads the high degree of probability that some nodes are using same IPs and during merging of two networks it will create the problem of known as IP address conflict [16], which must be resolved before merging of the network. To resolve configuration problem a Proposed algorithm is applied to the MANETs (this may also be applied when number of MANETs are increases)[10].

Proposed Algorithm

In the proposed algorithm scenario of mobile nodes have been taken. In the scenario three independent configured MANETs are merged as shown in Figure 2. Because these networks are individual network [11], there may be a chance of the duplicity of addresses in both networks. Thus one needs to change its addresses due to the merger. The proposed algorithm is used for the purpose of assigning conflict free addresses to the duplicate nodes. This algorithm leads to a tree structure in the way the addresses are generated. As From the Figure 2 three independent MANETs are coming to each other which results in a merged network. There is the duplicity of IP addresses in the merged network as from the Figure 2. Node C has the same IP address 192.168.1.3 in each MANET. When such nodes participate in different network merged then collision of IP addresses may occur [14].

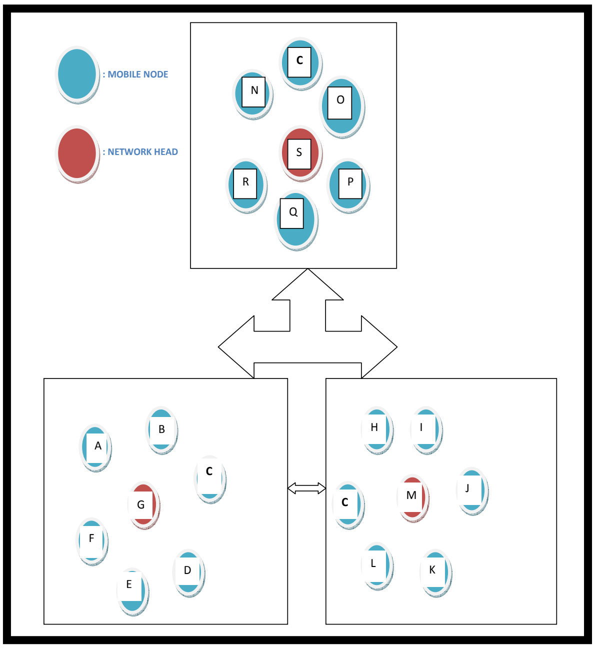

Figure 1: Three independent MANET

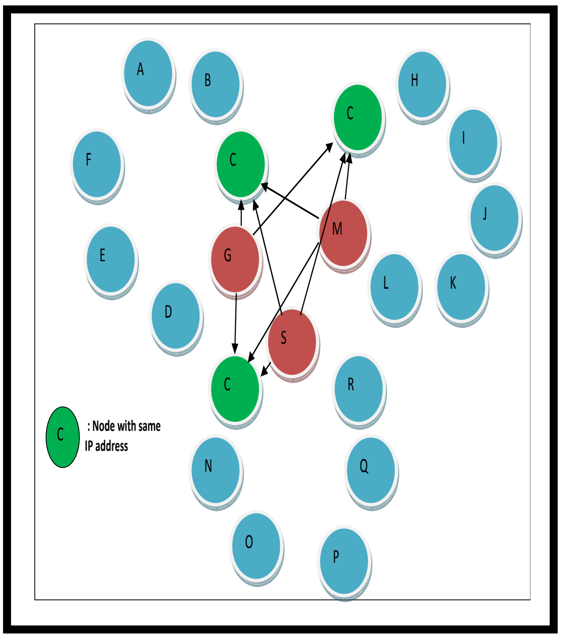

Figure 2: Merged Network of MANET1, MANET2 and

The algorithm is divided into three sub categories which is as follows:

a) Algorithm1(A1): Conflict in Normal nodes:

When two nodes except the Network head node, are conflicting then at the time of merging two Network head will share the routing table of their internal domain, cluster head of both networks will create a temporary routing table before merging the network.

b) Algorithm2 (A2): Conflict of Network Head Node with Normal node

If there is a conflict between a Network Head node and a normal node then algorithm A2 should be used to remove the conflict.

c) Algorithm3 (A3): Conflict of Network head to Network head

If there is a conflict between Network head of two different networks then in case of merging two independent networks, algorithm A3 should be used.

Algorithm 1:

1. When the network detects another network:
2. Cluster Head of one network sends the HELLO message to the Cluster Head of another Network. Ex. G, S and M are the cluster heads of MANET-1, MANET-2 and MANET-3
3. Exchange the Routing table by the cluster head / network.
4. Make a M_ IP_ table in the buffer for each MANET.

   Set

   Conflict=false;

   Array C1=null;

   //Array of conflicted IP address in MANET_1

   Array C2=null;

   MANET_1.node[i].NH_IP_hostnumber=MANET_1.node [i].IP_hostnumber;

   //ex. The node G

   MANET_2.node[i].NH_IP_hostnumber=MANET_1.node [i].IP_hostnumber;

   //ex. The node M

5. If no node has IP conflicts then go to step7.

   If (MANET_1.node [i].IP_hostnumber ==MANET_2.node [j].IP_hostnumber)

   Then

   Set

   Conflict=true;

   Add M(C1, MANET_1.node [i].IP_hostnumber); //Procedure to add conflicted IP address in C1

   Add N (C2, MANET_2.node [j].IP_hostnumber); //Procedure to add conflicted IP address in C2

   Else

   goto step _7;

   *the same procedure will be applied for all participating MANETs.

6. If two nodes have conflict then the steps are shown below :

   - Leave entry blank on the MS IP Table.

     If (conflict)

     Then

     If(i<s1) //s1 is the Size of MANET one

     Set

     MANET_1.C1 [i].IP=null;

     If (j<s2) //s2 is the Size of MANET two

     Set

     MANET_2.C2 [j].IP=null;

     Update M_IP_table; //update M_IP_table from entries in array C1 and C2 EX.

     S1=7; S2-=7

   - If (S1>= S2)

     Then

Set

MANET_1.node [i].IP_hostnumber =previous IP_hostnumber

// Enter the previous IP of MANET_1's M_IP_Table.

MANET_2.node [i].IP_hostnumber =Random number //unique IP, Assign a Random number which is not in M_ IP_ Table entry.

Else

Set

MANET_1.node [i].IP_hostnumber =Random number

MANET_2.node [i].IP_hostnumber =previous IP_hostnumber

7. If (S1 >= S2)

Then

Set

MANET_merged.node[i].NH_IP_hostnumber=MANET_1.node [i].NH_IP_hostnumber;

// the network head of MANET_1 will be new cluster/Network head for merged network.Ex.

8. Assign the M_ IP _Table as shown in Table 3.7 to the Network head of MANET_1 and drop the IP Table from the network

Head of MANET_2 is M.

Merged_MANET $_G$=MANET_1 $_G$+MANET_2 $_M$; // if S1>=S2

Merged_MANET $_{M=}$ MANET_1 $_G$+MANET_2 $_M$; //if S1< S2

9. The node M broadcasts the updated information to other nodes in the network as shown in Figure 3.7.

Algorithm2: "Confliction of Network Head Node with Normal node"

In this case two situations arise which are as follows:

a) Conflict between Network head and a node of the same MANET.

b) Conflict between Network head of one MANET and a node of the different MANET.

Case a: Each node in the network is capable to configure itself .Whenever a message comes from other nodes in the network.

1. The entry is checked to see if it's coming from the duplicate address.

2. The cluster head in this case checks for the entries in the table and assign a Unique IP address if found duplicate entry.

Case b:

1. A joining node sends a hello message to the Network Head of the MANET

2. Network Head matches the particular entry of the joining node and when it finds the node's address is same as it has .It assigns the Unique IP Address to the joining node from the pool of already existing IP Addresses and updates the table.

Algorithm 3: Conflict of Network head to Network head

1. Cluster Head or Network head of a MANET_1 sends a HELLO message to the Network head of MANET_2.

2. After exchanging the IP table Network head of MANET_1 finds the duplicate address in MANET_2.

3. It sends a request to Network head of MANET_2 to change the IP address of that particular node before joining.

Or

It assigns the random IP from the IP address pool to that particular node.

4. Updates the table after merging.

4.1 Simulation Setup

Simulation scenario is shown in Figure 4.1. In this scenario different MANETs (3) are merged to form a complete network. All nodes have unique IP address in its corresponding MANET. In this part we are taking a geographical Location of 10*10 Sq. Km for the simulation .Each node in these MANET [12] is mobile and in the range of associated MANET. Three mobile subnets (MANET-1, MANET-2, and MANET-3) have been taken. We have used seven mobile nodes in each subnet. Initially individual MANETs are fixed but nodes inside these MANETs are changing their position. After some time (10ms) MANET-1 and MANET-2 starts moving to MANET-3. Both the sub MANETs are moving with different speed. In this scenario we have taken node

$C_{MANET-1}$, $C1_{MANET-2}$, $C2_{MANET-3}$ with the same IP address 192.0.1.27 for conflict (Table 4.1) and 192.0.1.3, 192.0.1.8, 192.0.1.20 for Unique IPs (Table 4.2). We are not using the profile definition and application definition node as there is a node need to define these in case of MANET (mobile node).

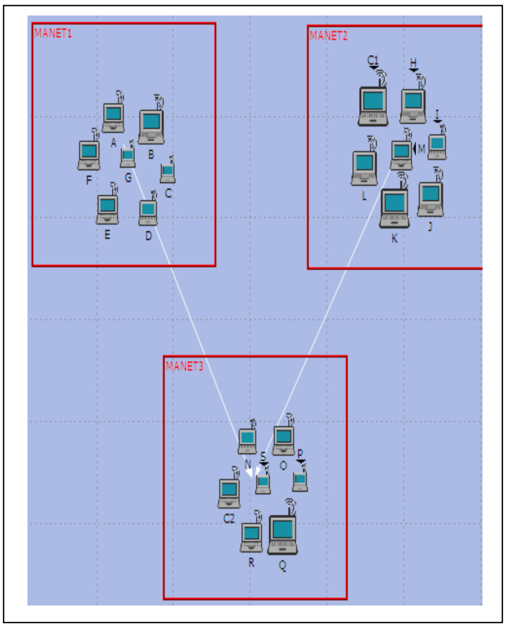

Figure 3**: Scenario for 21 nodes**

Result Analysis

In this part the complete analysis of the simulation is done .We have taken a scenario as shown in Figure 4.1. The Parent subnet is composed of three different MANETs (MANET1, MANET2 and MANET3) [13] Arrow in white shows the path to be followed by MANET1 and MANET2.We are simulating the result for a route discovery time, total route error sent by using AODV protocol [9]. Algorithm is protocol independent and the performance may be checked in the case of the DSR protocol [8].

Total Route Errors sent

When MANET1 and MANET2 starts moving [11] and finally merge to MANET3 then IP conflicts occur. Packets are falsely routed to node C, C1 and node C2.Total route errors increases at a very high rate. With the help of proposed algorithm the above problem does not occur. In the result analysis for the total Route Errors sent of the scenario, Value of route Errors sent on IP-conflict is near about 160 and value of route Errors sent on after reconfiguration it is 5 (as in Figure 4.1) on start of the simulation but after some time where constant value of route Errors sent for the IP-conflict is 40 and after reconfiguration it is 10. On analyzing them we concluded that route Errors sent on IP-conflict is larger than after reconfiguration.

As from proposed algorithm by removing duplicate IPs and assigning unique IPs total route errors decreases from 89% to 2% (see appendix B).In The Figure arcs in blue shows the total route error sent after reconfiguration and the arcs in red shows when the conflicts occurred .Figure 4.2 indicates that Route errors are high when conflict occurs.

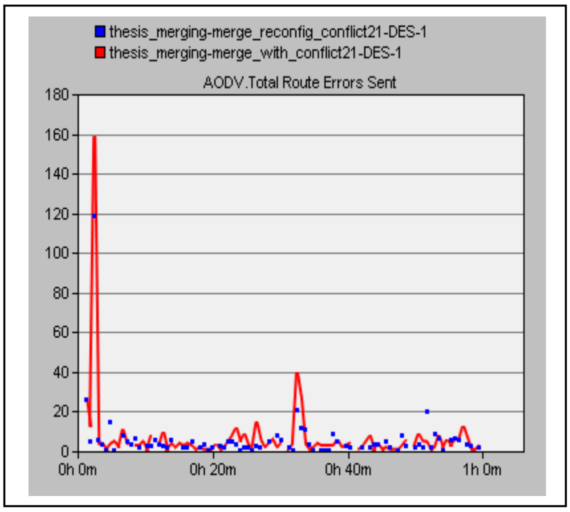

Figure 5: Total Route Errors sent

Route discovery time (sec):

Those routed packets go to the IP address 192.0.1.27 falsely routed to all the nodes having this IP address. Bulk of acknowledgement received from these conflicted nodes .In our case node C, Node C1 and node C2 are the nodes having duplicate address. So route discovery time increases (75%). In the result analysis for the route discovery time of the scenario, Value of route discovery time on IP-conflict is near about 0.07 seconds and value of route discovery time on reconfig is 0.04 seconds (as in Figure 4.5) on the start of the simulation but after some time value of route discovery time for the IP-conflict is 0.01 seconds and for reconfig it is 0.30 seconds. On analyzing them we concluded that route discovery time of reconfig is better than the IP-conflict (see appendix B). In the Figure 4.5 lines in blue shows that when the node is reconfigured with unique address and lines in red shows when the conflict occurs .Figure 4.5 shows that when a conflict is removed by assigning a unique IP address the background delay reduces to a smaller value.

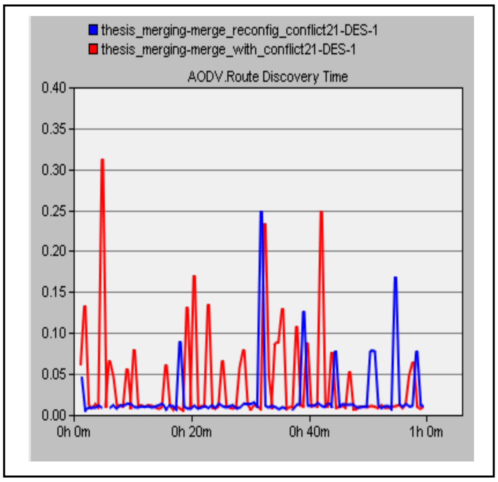

Figure 6: Route discovery time (sec)

Conclusion

In this paper a new methodology for autoconfiguration of IP addresses is proposed. The proposed algorithm is categorized with three possibilities where conflict may occur when different independent network merge to form a single network. The performance when duplicate addresses are presents is evaluated in the case of merging with duplicate address and merging by applying the proposed algorithm. From the result analysis it is shown that there is sufficient improvement of the performance of the network by applying the proposed algorithm for merging. Further work is in progress to test the algorithm in the case of mobility.

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