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Policy Based Fast Handoff Mechanism for MANET

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Abstract— Mobile ad hoc Network (MANET) has a challenging task because of the dynamic and infrastructure less nature of the network. This dynamic nature leads to the difficulty in handoff, addressing, routing and data delivering process. For getting good QoS, better flexibility, effective and efficient handoff process in this dynamic network need better handoff mechanism for avoiding any discontinuity, packet loss, delay and jitter during handoff process. Therefore, it is necessary to make fast handoff based on group mobility and policy driven approach for this network. Thus, In this paper, We propose a policy based handoff mechanism with group mobility over hierarchical cluster based architecture involving proactive and reactive handoff approaches based on policy for nodes of MANET.

Key words: MANET (Mobile ad hoc Network); Fast Handoff; Proactive and Reactive handoff; Policy based approach; Group mobility; Cluster head.

I. INTRODUCTION:

A Wireless ad hoc network is a collection of mobile nodes like Laptop computers and personal digital assistants with no pre-defined infrastructure and has wireless interface and communicate independently with each other via radio or infrared. With the recent advances in infrastructure less network MANET came into existence [19] .MANETs have several salient characteristics such as Dynamic topologies, Bandwidth-constrained, Energy-constrained operation, Limited physical security etc. Several useful and disparate applications in emergency situations need handoff mechanism in MANET.

The handover process stresses these performance bounds by introducing delays due to discovery, configuration, authentication and binding update procedures associated with a mobility event [27] .When a mobile user travels from one cell to another cell within a call's duration the call should be transferred to the new cell's base station. Otherwise, the call will be dropped. This is called as handoff. Two basic types of handoff are hard handoff and soft handoff. With hard handoff, the link to the prior base station is terminated before or as the user is transferred to the new cell's base station. With soft handoff, the link to the prior base station is not terminated before or as the user is transferred to the new cell's base station [26].

Mobility of nodes is an important issue in mobile ad-hoc networks (MANET). Nodes in MANET move from one network to another individually and in the form of group. In group mobility scheme only one node in a group i.e. group representative (GR) performs registration on behalf of all other nodes in the group and is assigned Care of Address (COA). Internet protocol (IP) of all other nodes in the group remains. This scheme reduces number of messages, network load and consumes less time for registration of nodes [2].As we know MANET is a collection of various heterogeneous networks so to make compatibility among them we need some policy driven based common criteria's for them.

Policy makes the internetworking possible. In order for multiple heterogeneous networks to interoperate together they must agree on a common policy mechanism and allow network administrators to specify policies for handoff, routing, data forwarding and other services. It employs concepts such as policy-enabled [12 - 17] management. Handoff in mobile packet networks commonly produces packet loss, delay and jitter, thereby significantly degrading network performance [20]. For supporting delay sensitive services various faster handoff schemes based on policy-driven approach has been defined.

For getting good QOS, better flexibility, effective and efficient handoff process in this dynamic network need better handoff mechanism for avoiding any discontinuity, packet loss, delay and jitter during handoff process. Therefore, it is necessary to make fast handoff based on group mobility and policy driven approach for MANET.

The rest of the paper is organized as follows. Section-II describes the background. The architecture for policy based Fast Handoff with group based mobility mechanism is described in section-III under heads of proposed architecture and mechanism. Section-IV concludes the contribution of this paper and section-V defines the future scope of this paper. At the end of this paper references are given in section-VI.

II. BACKGROUND:

Paper [10, 20, 22, 25, 27, 28, 29, 30] describe mobility management techniques that support fast handover by enhancing currently available mobility management protocols

In, [10] The Internet draft "Global Connectivity for IPv6 Mobile Ad Hoc Networks" [31] describes how to provide Internet connectivity to mobile ad hoc networks. It explains how a mobile node and an Internet gateway should operate. Further, it proposes and illustrates how to apply a method for discovering Internet gateways. Two methods for Internet gateway discovery are described in the draft: proactive gateway discovery periodically disseminates Internet gateway advertisements to all nodes in the MANET; reactive gateway discovery utilizes solicitation and advertisement signaling between a MANET node and the Internet gateway. The proposed methods target all MANET protocols regardless of whether they are reactive and proactive. [27] gives the proactive based fast handover mechanism which helps in mobility optimization that takes advantage of IEEE 802.21 as well as a media independent pre-authentication (MPA) framework to provide secured and seamless convergence and support heterogeneous handover but lacks behind in providing the QOS. [18, 22] defines the characteristics of Mobile ad hoc networks (MANET) and various schemes of cluster formation in MANET including cluster head selection based on computing the trust value of each node in a cluster. These are having some disadvantages like computing trust value of each node in a cluster so many times and compare this value with its neighbor brings a lot of overhead in exchanging the message between the two mobile nodes.

[2] Organized with mobility schemes in MANET. Mobile IP routers are used to support mobility [7]. A scheme is proposed by Zhao [8] for ad hoc network connection to the internet. In this scheme dynamic gateways with mobile IP functionality used to connect mobile nodes in ad hoc network to the internet. Mobile IP functionality is used in mobile ad hoc network [5]. All the nodes in the network are mobile except one node that is fixed. This fixed node acts as a gateway. This concept allows single node mobility. When a node moves, it asks for registration request and it is assigned a Care of Address (CoA). All the nodes are assigned an individual CoA in the new network. A scheme explained internet based mobile ad hoc networking [9]. Each node in a mobile ad hoc network (MANET) logically consists of a router with possibly multiple IP addressable hosts. End devices in MANET are mobile. [7] defines network model including the combination of agent and policy based architecture. Such a system is composed of one or more operating environments (e.g. computers) hosting management agents and managed objects. A policy directed system operates under a set of guidelines (policies) that constrain its behavior relative to its current state and perceived operating environment. This work does not guarantee for QOS required for fast handoff mechanism in MANET.[6] defines the complementary approach provides handover delay hiding and is introduced in the Fast Handover for MIPv6 scheme (FMIPv6) by Koodli [26]and [21]. FMIPv6 attempts to anticipate layer 3 handovers and to redirect traffic to the new location, the MN is about to move to. A severe functional risk arises from a conceptual uncertainty: As the exact moment of layer 2 handover generally cannot be foreseen, and even flickering may occur, a traffic redirect due to anticipation may lead to data damage largely exceeding regular MIPv6 handover bare any optimization [20].

The proposed system overcomes the problem of high latency handoff by considering group mobility as well as the system is fault tolerant in many situations. In addition with these this is incorporated with policy driven mechanism for Fast handover without affecting the performance.

III. PROPOSED ARCHITECTURE AND MECHANISM:

Proposed architecture includes modules like cluster based hierarchical architecture, Handoff mechanism, Policy based architecture.

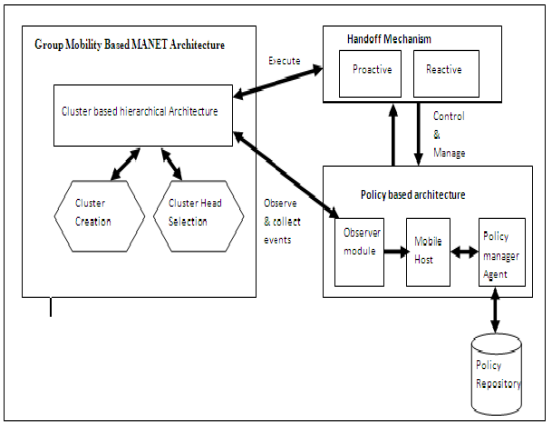

Figure-1: Policy based Fast handoff for MANET

A. Group Mobility Based MANET Architecture:

In group mobility scheme only one node in a group i.e. group representative (GR) performs registration on behalf of all other nodes in the group. Thus, network load is reduced in group mobility scheme [2]. It uses clustering's hierarchical structure diverse to decrease handoff control overhead and improve the networks scalability [5].

Cluster based hierarchical structure with group Mobility: The goal of clustering is to form groups of objects with similar characteristics [4]

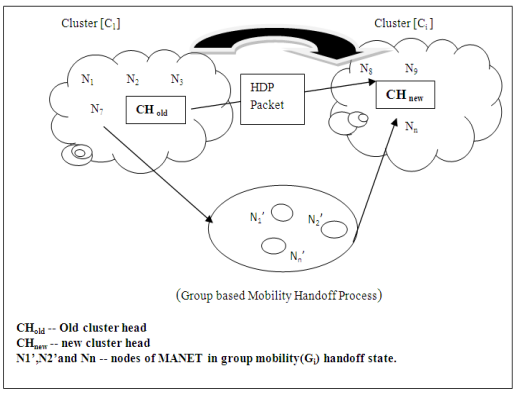

Figure - 2: Cluster based hierarchical structure with group mobility

Above architecture consists of multiple clusters with multiple numbers of nodes. Handoff will be carried out with group mobility scheme from one cluster to another by having either proactive or reactive handoff.

Figure -2 consists of two modules for maintaining architecture:

Cluster creation: the MANET area has been break up into a number of sizes of clusters each one is having a cluster head according to distance, cluster range, received signal strength indication (RSSI) value and service list provided as per the cluster formation algorithm given [8].

Cluster head selection: A cluster head serves as a local coordinator for its cluster, performing intra-cluster communication, data forwarding and so on [3]. It is elected based on maximum number of contacts, minimum distance with centroid of the cluster, minimum probability to leave the cluster in future.

B. Policy Based Architecture

A policy driven architecture is incorporated with group mobility based MANET architecture in order to make FAST handoff and that can provides efficient usage criteria's among various emergency situations in disaster Area.

Figure – 3 operates with these steps:

- Observing and collecting updates from environmental conditions .
- Consulting or specifying policies,
- Executing the resultant behavioral constraints,
- Adapting or confirming the behavioral constraints

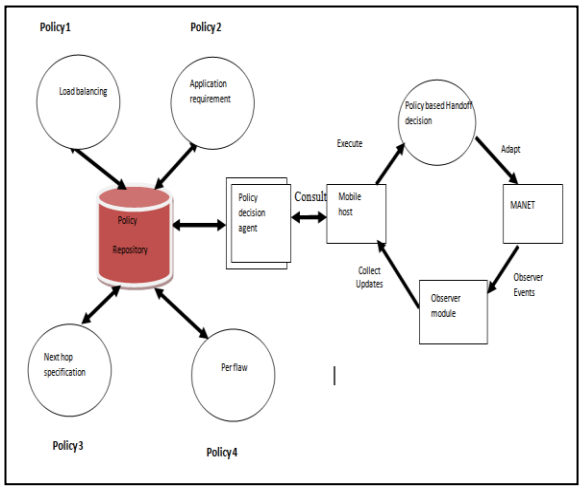

Figure-3: Policy based Architecture for fast handoff.

Handoff decisions and operations are all done at the mobile host. Periodically, the mobile host collects current dynamic conditions, and consults with a policy module on which is the best reachable network [9]. The Policy based architecture includes following components:

1) Policy Repository: It includes all the correspondent policies for making handoff decision and corresponding to each policy define in this there are dynamic parameters for Handoff Request Packet (HRP) describes later in this section.

The various related polices are:

Load Balancing: This policy ensures number of available nodes in an cluster is always less than the original capacity of nodes that can be serviced by the cluster head in a corresponding cluster otherwise handoff occurs.

Application requirement : The mobile host should exist in the cluster if the service required by them are the same as provided by the cluster head otherwise they have to search for another network according to application requirement

Next-hop Specification: In case when the mobile host obtain equal received signal strength indication (RSSI) value from two different cluster heads then it has to check its next near hop and conclude to which cluster it will have to be associated.

Per-flow policy: Since MANETs needs better QoS , it is highly desirable to support different forwarding policies per traffic type. E.g. reliable but expensive satellite communications should be reserved for critical messages.

2) Observer module: It acts as a detection module that observer the various events from the network and gives collection update to mobile host and ultimately responsible for policy based handoff decision

3) Policy based decision agent: It is responsible for communicating with mobile host and check

various parameters based decision for choosing the corresponding policy and gives suggestions to mobile host for getting handoff.

4) Mobile hosts: These are the real entities of the mobile ad-hoc network that are in the position of making the handoff based upon certain updates taken from observer module and consultation with policy decision agent about the corresponding policies.

5) Creation of dynamic packets :

a) Handoff Request Packet (HRP)

Primit_Var1	Primit_Var2	Primit_Var3

CALL POLICY1 :LOAD BALANCING

//When the number of nodes in a cluster is more than the capacity
//Assume number of nodes in cluster and capacity of handling nodes in cluster.

if (No. of nodes(N) > Cluster Capacity)
{
Set parameter Value as:
Primit_Var1: No. of nodes to make handoff
Primit_Var2: M' , where M' is distance in terms of hop count to new cluster head
Primit_Var3: Handoff latency ($H_{latency}$)

CALL POLICY2: APPLICATION REQUIREMENT

//When the mobile hosts are searching for specified services
Set parameter Value as:
Primit_Var1: Offered Service list
Primit_Var2: Offered service plans
Primit_Var3: Security features provided

CALL POLICY 3: NEXT HOP SPECIFICATION

//When the mobile hosts are getting equal Received signal strength indication (RSSI)
//From more than two cluster heads
Set parameter Value as:
Primit_Var1: Min Pwr (K)
Primit_Var2: RSSI value
Primit_Var3: Weight variable value

CALL POLICY 4: PER FLAW POLICY

//reliable but expensive satellite communications should be reserved for critical messages
Set parameter Value as:
Default Value: emergency services.

Handoff label Packet (HLP)

Primit_Var1 Reply	Primit_Var1 Reply	Primit_Var1 Reply

Default Handoff label Packet (HLP)

RSSI value	H_{laten} value	Min Pwr (K)	Service Plans

Handoff Directional Packet (HDP)

Data Information	Control information

This Handoff Directional Packet contains the data and control information about the group mobile nodes that crates handoff from old cluster to new cluster

Handoff Mechanism

When some group mobile nodes from old cluster wants to move in new cluster based upon some policy driven mechanism then handoff mechanism begins.

Here we consider two handoff mechanism, they are: Reactive or Proactive handoff mechanism [10].

Reactive Handoff Algorithm:

Figure - 4 shows the mechanism of Reactive Handoff mechanism which is obtained as follows:

Step-1: Mobile host (group nodes) detects the need of handoff based on policy based schemes.
Step-2&3: If required, send handoff request packet to all the nearby cluster heads [$H_{i—Z}$] within a range of mobile host.
Step-4&5: In response of handoff request packet a handoff label packet that contains the (ack + reply message) will be obtained by all target cluster nodes [$H_{i—Z}$].
Step-6: Call handoff algorithm, Check for Handoff (true)
Step-7: If true then continue to find the best cluster head [H_i] to be associated with; otherwise Exit.
Step-8: After that a link request packet will be send by old cluster head [H_1] to the selected cluster head [H_i] which is basically registration request.
Step-9: In reply a link reply message is obtained by cluster head [H_i] which is basically a registration acceptance message.
Step-10: Mobile host (group nodes) send new cluster information to old cluster head [H_1].
Step-11: cluster head [H_1] sends handoff directional packet (contains data and control information of mobile host) to new cluster head [H_i].
Step-12: At last mobile host send binding update message to new cluster head [H_i].

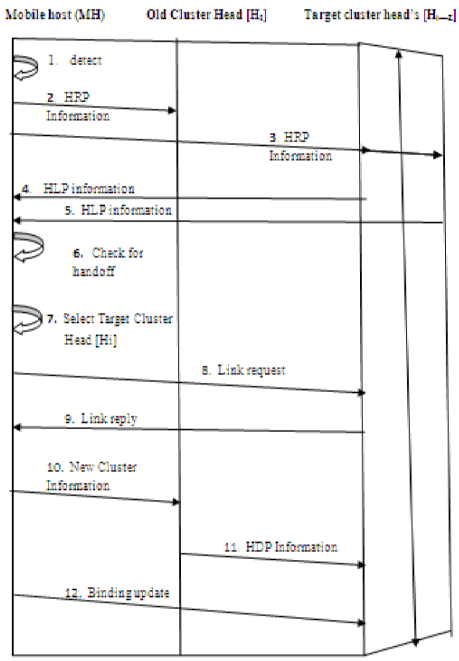

Figure-4: Reactive Handoff

Proactive Handoff Algorithm:

Figure - 5 shows the mechanism of Proactive Handoff mechanism which is obtained as follows:

Step-1: Mobile host (group nodes) detects the need of handoff based on policy based schemes.

Step-2&3: Default handoff label packet (HLP) is send by all nearby cluster heads [$H_{i—Z}$] within a range of mobile host.

Step-4: Call handoff algorithm, Check for Handoff (true)

Step-5: If true then continue to select the best cluster head [H_i] to be associated with; otherwise Exit.

Step-6: After that a link request packet will be send by old cluster head [H_1] to the selected cluster head [H_i] which is basically registration request.

Step-7: In reply a link reply message is obtained by cluster head [H_i] which is basically a registration acceptance message.

Step-8: Mobile host (group nodes) send new cluster information to old cluster head [H_1].

Step-9: cluster head [H_1] sends handoff directional packet (contains data and control information of mobile host) to new cluster head [H_i].

Step-10: At last mobile host send binding update message to new cluster head [H_i].

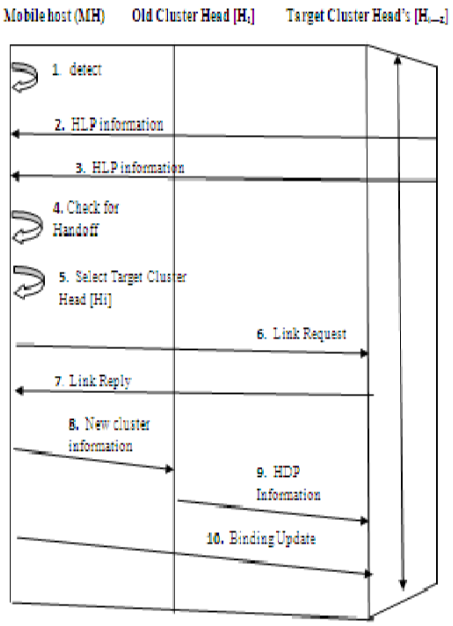

Figure -5: Proactive Handoff

Mechanism for Proposed Architecture

Step1: Cluster formation method:

```
Cluster formation ( )
{
While (Ni= =Device Type  && Bw (Ni ) >= BWth)
{
        For all nodes N1 to Nn
        {
        While (true)                //Assume distance and cluster power range
        {
        If ((distance between Ni & Nn <= distanceth) && (Cluster_ range (Ni) <= rangeth))
                                                //        Where Ni is already in MANET
                Cluster [Ci] = Node [Ni];  //        accepted in cluster
        }

        While( true)
        //        Assume Received signal strength indication(RSSI) and service required by mobile
host
        {
        If ((RSSI store- ≥ RSSIth) && ((Services required € Service offered by cluster head))
        //        accepted In Cluster
                Cluster [Ci] = Node [Ni];
        }
                else
                        Exit;                // do not Accepted in cluster
        }
    }
}
```

Step2: Cluster head selection Mechanism:

```
Cluster_ head_selection ()
{
For all nodes N1 to Nn
// assume maximum no of neighbors node, distance to centroid of cluster and node mobility
{
        If ((Maximum number of neighbor nodes ≈ n) &&
        (Ni € centroid of cluster && Speed<=threshold (t)))
        // where n denotes the maximum number of available nodes in a cluster
}

cluster head i = Node i;
Return cluster head i;        // node Ni Accepted as Cluster Head of Cluster Ci
        }
```

```
STEP-3  Fast Handoff Mechanism:
        Handoff ( )
            {
              Find new cluster head;
              If (Cluster Head is already in the list)
              Continue
                    else
                          {
                          Cluster head selection ( );
                          Add Cluster head to list;
                          }
                    While (group nodes handoff not complete)        // Check for group nodes ready
                                                                          For handoff
                          {
                    if (group nodes are in handoff state)
                      {
              If (Find closest Cluster head to group nodes || (RSSI (new cluster head)> RSSI (old cluster
              head)) && (Handoff_latency (new cluster head) <= Handoff_th) && (M' M≤ η) && (Services
              required € Service offered by new cluster head))
                                    //where M' is the distance of group nodes to the new cluster head &
                                    M is the distance of group nodes to the old cluster head & η is the
                                    threshold distance value
                          {
                          Perform handoff;
                          Receive handoff response message from new cluster head
                          }
                    Remove group nodes from the list of old cluster head
                    //Handoff successfully done.
                    else
                          Lets group nodes go for searching another cluster head;
                          }
                    }
            }
```

```
STEP-4 Conditions of handoff in transition        //When group nodes or cluster head make handoff.
    While (not handoff successfully done)
    {
      If (group nodes are in handoff state)
      {
      Old cluster head [H_old] removes group nodes information from its member list;
      Group nodes (n) registered with new cluster head [H_new];
      Send reply message to old cluster head [H_old];
      Old cluster head [H_old] send Handoff directional packet (HRP) packet to new cluster head [H_new];
      }

      else

      If (Cluster head [H_old] is in handoff state)
      {
      Sends LEFT message to all its member nodes;
      Call cluster_head_selection ( );
      NewAppointedClusterHead = Node_i;  // Accepted as new appointed Cluster Head of C_i
      Old cluster head [H_old] sends information of its members to newAppointedClusterHead;
      NewAppointedClusterHead broadcast update message to all its members;
      }
    }
```

IV. CONCLUSION:

In this work we have presented a solution to improve the handoff process in mobile ad-hoc networks. The proposal is based upon a group mobility scheme that reduces number of messages and consumes less time for registration of nodes as compared to single node mobility scheme. Thus network load is reduced in group mobility scheme

To further improve the performance of handoff scheme we consider a policy based handoff mechanism that provides efficient usage criteria's among various emergency situations in the disaster area. The main idea is at adapt the Fast handover approach by having reactive and proactive handoff mechanism incorporated with the policy based architecture that greatly improves the efficiency and network extendibility and could be assured better QoS values for the user .

V. FUTURE SCOPE:

The proposed architecture work defines Policy based fast handoff mechanism for MANET. This architecture works very effectively and efficiently but as the nodes scalability may scalable up so the more overhead information could be transmitted over the network, therefore sometimes leads towards the congestion. Moreover the architecture defines the scope of portability in which the MANET nodes should able to work with same efficiency in heterogeneous clusters. In addition with these, this system works with heterogeneity in case when handoff occurs with different networks.

This system only works with limited policy-driven handoff approaches. For better functionality and performance of the system we will look after the certain conditions and try to make more policies for improving the QOS and reducing the handoff latency for the mobile nodes. In future, facilitates faster handoff mechanism across heterogeneous access networks and helps mobile users experience better performance during mobility events by the way of improving the service quality.

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