Handover / Handoff Mechanism for Mobility Improvement in Wireless Communication

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***Abstract*— Mobility is the most important feature of a wireless communication system. Due to rapid change in technology,With the increasing demands for new data and real-time services, wireless networks should support calls with different traffic characteristics and different Quality of Service (QoS) guarantees. the demand for better and faster cellular communication also increases. The First Generation were referred to as cellular, which was later shortened to "cell", Cell phone signals were based on analog system transmissions, and First Generation devices were comparatively less heavy and expensive. Second Generation phones deploy GSM technology. Global System for Mobile communications or GSM uses digital modulation to improve voice quality but the network offers limited data service. The Third Generation revolution allowed mobile telephone customers to use audio, graphics and video applications. Fourth Generation is short for fourth-generation cell phones or/and hand held devices. Instead of developing a new uniform standard for all wireless communications systems, 4G communication networks strive to seamlessly integrate various existing wireless communication technologies when compareing to 2G, 3G networks. One of the major challenges in this migration is to realize seamless handoffs among various communications systems with small handoff latency and packet loss. IP has been recognized to be the de facto protocol for next-generation integrated wireless. In this paper we discuss Challenges and Solutions for Handoff Issues in 2G and 3Gnetwork to 4G network. Mobile IPv6, HMIPv6 and their comparative study and analysis.**

***Index Terms*— 2G, 3 Gand 4G networks, Handoff management, Handoff latency, HMIPV6, MIPV6 , fast hand off,dynamic decision model.**

I. INTRODUCTION

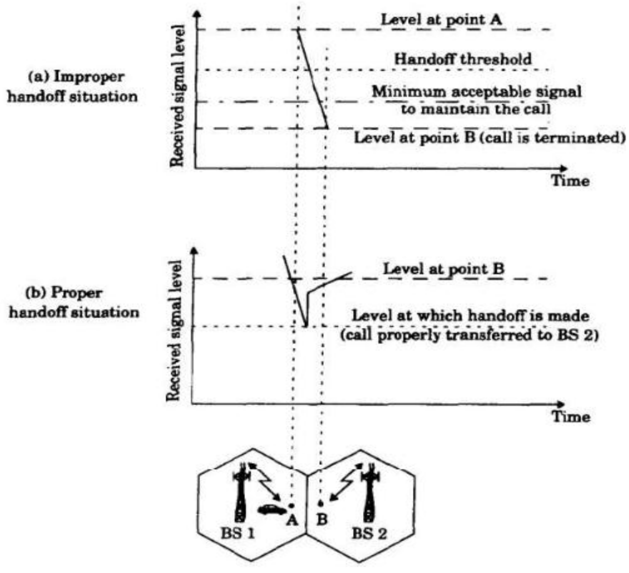
In wireless communication system**,**with the increasing demands for new data and real-time services, wireless networks should support calls,video with different traffic characteristics and different Quality of Service (QoS), Mobile and wireless networks have made tremendous growth in the last fifteen years ,but the handoff problem remains constant,which is responsible to degrade the quality of service,due to call blocking and droping, all problems are occurred due to improper handoff, The process of handover takes place that transfer an ongoing call from one cell to another cell as the user moves through the coverage area of a cellular network. In handover process cellular network automatically transfer a call from one radio channel to another radio channel while maintaining quality of services (QoS) of a call . Handover mechanism is extremely important in mobile network because of the cellular architecture employed to maximize spectrum utilization.

Handoff Management: In Handoff management a mobile device keeps its connection active when it moves from one cell to anothercell.. Depending on the broad category, handoffs may be of two types: (i) horizontal handoff (intra-system handoff) (ii) vertical handoff (inter-system handoff).

Horizontal handoff - Handoffs in homogeneous networks are referred to as horizontal handoff . This type of handoff occurs when the signal strength of the serving BS goes below a certain threshold value. The reason for such handoff could be poor signal strength, local interference, load balancing .

Vertical handoff

Inter-System Handoff or vertical handoff between two BSs, belong to two different systems.The reason for such handoff could be poor signal strength, local interference. There are three steps in a handoff process. (I) The initiation of handoff is triggered by the mobile device, other changing network conditions.(II) The second stage is for a new connection generation, where the network must find new resources for the handoff connection and perform any additional routing operations. Finally, data-flow control needs to maintain the delivery of the data from the old connection to the new connection according to the agreed upon QoS guarantees Once a call is in progress the MSC adjusts the transmitted power of the mobile and changes the channel of the mobile unit and base station in order to maintain call quality as the subscriber moves in and out of range of each base station called handoff process.



Handoff strategies at cell boundry

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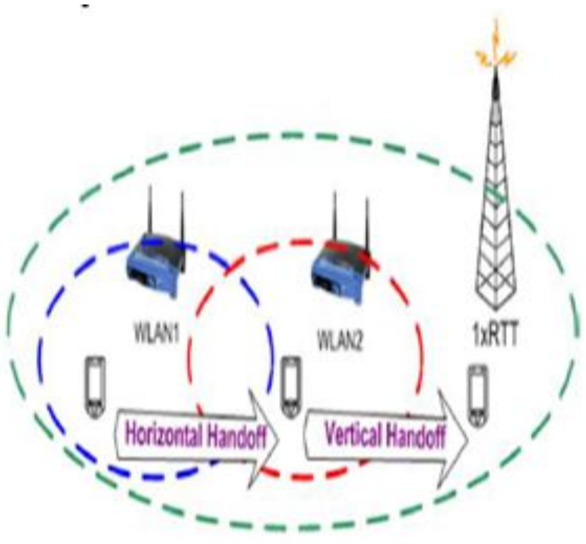


Horizontal and vertical Handoff

Currently, most of research work on handoff issues in 4G systems focuses on keeping unbroken communications with timely location update or reducing handoff latency and packet loss in IP-based wireless networks. Mobile IPv6 [Johnson and Perkins, 2001, Montavont and Noel, 2002, Beloeil, 2002] is proposed as one of mobility management protocols in 4G IP-based wireless network. Mobile IPv6 tries to keep unbroken communications between a MU(mobile user) and its correspondent by creating

a binding scheme between MU's home address and its care-of address during handoff process. However, Mobile IP can not control handoff latency, which results from creating new care-of address, exchanging information between mobile terminal and its home agent whenever status of MU's location information changes. Inheriting binding scheme from Mobile IPv6, Hierarchical Mobile IPv6 [H. Soliman et al., 2001, Pack and Choi, 2003] is proposed to minimize handoff latency and the amount of signaling traffic to correspondent(s) and the home agent by allowing an MU to locally register in a domain without informing the MU's home agent. In addition, Fast Handover [Dommety et al., 2001] is another new handoff proposal, which reduces the handoff latency through predicting the coming movement to initiate a handoff earlier.

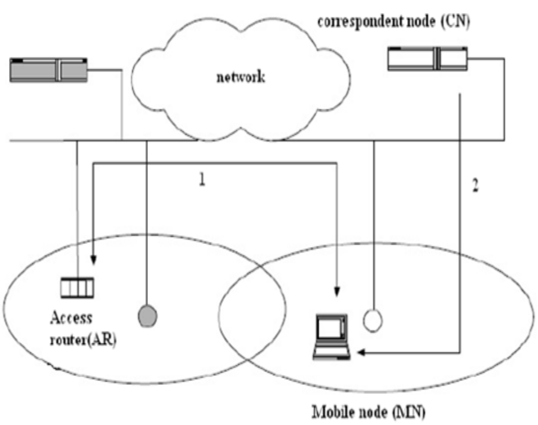
II. Objectives

In this paper, we present and discuss the handover management schemes mainly for 4g technology, including Mobile IPv6, Hierarchical Mobile IPv6, Fast Handover,and decision dynamic model, the main problem is to maintain the ongoing calls without interrupted,upto 3rd generation handover problem is solved easily, but in next generation(4G),(Higher data transmission with speed up to 100Mbps) due to high speed data transfer, to maintain the audio, video other features are very difficult.The rest of the paper is organized as follows: we first introduce the normal handoff, Mobile IPv6 and give a discussion of its attributes. Then the Hierarchical Mobile IPv6 , Fast handover, and dynamic decision model are presented as improved schemes for Mobile IPv6, respectively. Finally, we give a brief discussion for these handoff schemes before we conclude this paper.

III. Handoff Protocols Schemes

A. *Mobile IPv6*

Mobile IPv6 [Johnson and Perkins, 2001, Beloeil, 2002] is proposed to keep any communication between a mobile user and a correspondent user (CU) while the mobile user moves from one IPv6-based sub-network to another one. In this model, each MU has a home address identifying its home network.In home network, each MU uses the traditional routing functions to exchange IP datagram with its correspondent node . Whenever an MU moves from its local network to a new network, its home address becomes invalid. And then the MU can create a new address called care-of address (CoA) from a router advertisement message sent by the new visited network. A binding between MU's CoA and its home address is updated to the MU's home agent to keep continuous communications between the MU and its correspondent(s). In this way, MU's home agent can always detect coming communication packets to MU with MU's home address, and locate the current position of MU with MU's CoA. At the beginning of the handover procedure, an MU can use "Neighbor Discovery" scheme, which is based on reception of Router Advertisement (RA) sent by current access router (AR), to detect its movement to a new subnet, as shown in Figure . After verifying the uniqueness of its linklocal address on the new link, the MU will create an IPv6 address called CoA from the corresponding prefix in RA. After that, MU will exchange binding update information which include MU's CoA with its HA and its CU to allow all of them to maintain their connections, . Mobile IPv6 can reasonably keep track of MU's new address by timely binding update between the MU and its home agent. However, before finishing binding update, data packet communications are interrupted. The MU needs to spend time discovering new subnet, establishing new care-of address, and exchanging information between MU and its home agent. For 4G high-speed data multimedia communications, all of them will create a lot of signaling traffic and latency, resulting in packet loss. It is even worse when an MN roams between two ARs several times. This frequent roaming will cause pingpong effects, which refer to the situation in which too frequent and unnecessary location updates and handoffs occur in a short time. In this case, MU cannot keep normal continuous communications with its CU(s). In the meantime, all packets destined for the old care-of address are dropped. Therefore, we need to improve binding update procedure of Mobile IPv6 handover schemes to reduce handoff latency and signaling traffic.



B. Mobile IPv6 wireless network

C handoff,. For Hierarchical Mobile IPv6, binding updates between MU and its home agent can be successfully reduced with Mobility Anchor Point (MAP) in charge of MU's local movements in a region. However, the burden of MAP will increase if MAP handles too many MUs in one region. It is easy for an MAP to appear "bottleneck" phenomena, which affects the speed of data packets to MUs. Even worse situation, if an MAP "die" or work randomly, it is disastrous to all MUs in same region. One new scheme [Montavont and Noel, 2002] is proposed to relieve the load of MAP by adding a few more MAPs per region. However, this method will cause other problems such as dynamic load distribution among MAPs. While Hierarchical Mobile IPv6 deals with both intradomain and interdomain handoffs, IDMP-based Fast Handoff protocol is proposed mainly for reducing packet loss during intradomain handoff in next generation network or 4G networks. Each SA in a region buffers inbound information when the MA in the same region multicasts all incoming packets to the entire set of neighboring subnet agents (SAs). In this way, MU can keep communication maintain without any break by receiving buffered packets from the new SA, without waiting for the MA to receive the corresponding intraregion location update. Nevertheless, the set of neighboring BSs covered by each MA is constant, which means each BS permanently belongs to one multicast set and the size of the set is not dynamically changed according to traffic load. Due to this method, some MA will become very busy in multicasting data packets frequently because the corresponding set of SAs cover too many MUs and related movement activities, while other MA will become "idle".This time will easily cause communication overload,which in turn increases the probability of packet loss during handoff , and decreases the efficiency of the network.

C. IDMP-based Fast Handover protocol

Intra-Domain Mobility Management Protocol (IDMP) is a multi-CoA intradomain mobility solution. Based on modification of Mobile IP architecture. Similar to HMIPv6, an MU can get two CoAs under IDMP: one is Local care-of address (LCoA) which identifies the MU's present subnet, the other is Global care-of address (GCoA) which represents the MU's domain location. The concept of fast handover [Dommety et al., 2001] is that an AR can predict an incoming Layer 3 (L3: IP layer) handover, which means handover between different APs in different subnets, by receiving certain messages from MN or system. The main purpose of IDMP-based Fast Handoff [Misra et al., 2002] system is to eliminate intraregion update delay by anticipating incoming handover in connectivity between the network and MUs. The anticipation of MU's movement is based on Layer 2 (L2: link-layer) trigger [Dommety et al., 2001] which initiates L3 handover before ending the L2 handover which represents MU's movement between APs belonging to a same subnet. An L2 trigger contains information on the MU L2 connection and on the link layer identification of the different entities. To minimize the interruption in the procedure, the scheme uses triggers from either MU or BS to notify the MA of an incoming handoff. Then MA multicasts all incoming packets to the entire set of neighboring subnet agents (SAs). Each of SAs buffers the packets in order to reduce the loss of inflight packets during the handoff procedure. After the MU finishes registration on the new subnet agent, the SA can directly transfer all buffered packets to the MU. So in this way, MN can keep communications continuous without waiting for MA to finish all location update procedures. Unlike other handoff proposals mentioned before, IDMP-based fast handoff [Dommety et al., 2001, Misra et al., 2000, Misra, et al., 2002] only focuses on intradomain location update procedures. And multicasting scheme in IDMP can save wireless bandwidth because all other BSs or SAs do not need to transfer packets to an MU except only one certain SA or BS which is chosen by the MU can forward packets to corresponding MU. Furthermore, IDMP is a network-controlled handoff technique, in which MA decides the set of target SAs or BSs. But this technique is not fully satisfied in case of next generation system due to high data transfer rate and others feature.

D. Dynamic decision model

Goyal et al. proposed dynamic decision model that responsible the right vertical handoff decisions by selecting the "best" network at "best" time among available networks based on, dynamic factors such as "Received Signal Strength(RSS)" of network and "velocity" of mobile station with static factors like offered bandwidth and power consumption. A Handoff Management Center (HMC) monitors the various inputs collected from the network interfaces and their base stations (BS)analyse this information, took handoff decisions and provides the connection between the network interface and the upper layer applications. The Priority Phase of The algorithm for dynamic decision is used to remove all the unwanted and ineligible networks from the prospective candidate networks. Normal Phase is used to furnish user-specific preferences regarding the usage of network interfaces. User preferences are expressed in terms of weight factors. The Decision Phase is finally used to select the "Best" network and executing the handoff to the selected network.The algorithm for dynamic decision is described.

E. Dynamic decision process algorithm

a) INITIAL PHASE (network discovery)

1. Select all the available network in to the user list
2. First scan all the network and record their received signal strength
3. Mark the network velocity of mobile station
4. Eliminate the poor signal which do not satisfy the required RSS and velocity criteria
5. Calculate and assign the preferences to all the candidate network based on the difference between RSS and its threshold value.
6. Complete all priorities process.
7. Continue with normal phase.

b) NORMAL PHASE (network analysis)

8. From SM component collect current system status and determine the weight factors.

9.from the candidate list collect information on every wireless interface

10.Using cost function for every user.

11. Calculate static scoe ''SC'' by cost function

12.continue with decision phase

c) DECISION PHASE(network selection and execution)

13. Calculate the dynamic score ''DC-SCORE'' by multiply the priority of each candidate score with their static score "SC".

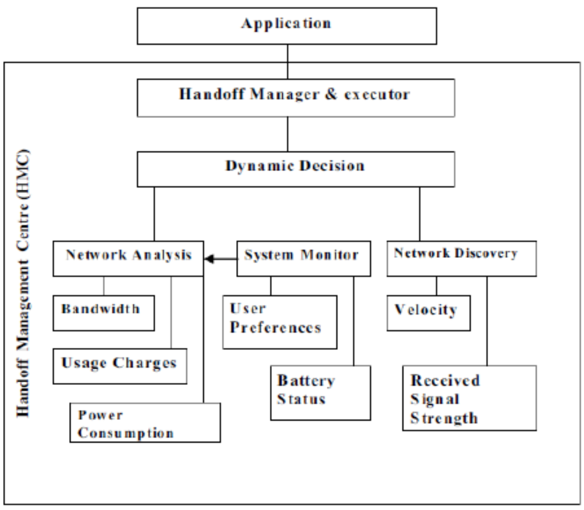
14.Select the network with high value of static score or which network have maximum static score, selected first.

15.Handoff all current information to the ''selected network'' if different from current network.

Mrs. Chandralekha et al. proposed a theory for selection of the best available wireless network during handoffs based on a set of predefined user preferences on a mobile device. Neural network model has been presented to process multi-criteria vertical handoff decision metrics.

F. Dynamic decision mode

The features used from generated data has been carefully selected and used as inputs for the neural network in order to have high performance rate. Adaptive resonance theory (ART)" has been designed as a modified type of competitive learning to overcome the problem of learning stability.The proposed method is capable of selecting the best available wireless network with a reasonable performance rate.



IV. HANDOFF METRICS REQUIREMENT IN HETEROGENEOUS NETWORKS

Handoff metrics are used to show whether a handoff is needed or not. In this paper the requirements for vertical handoff decision model for heterogeneous 4G networks are listed on the basis of previous works.

A. BANDWIDTH

When bandwidth is higher, lower call dropping and call blocking probabilities, hence higher throughput . During movement of user , bandwidth requirement of mobile node should be managed to provide seamless or uninterrupted handover with good Quality of service in wireless environment.

B. RECEIVED SIGNAL STRENGTH (RSS)

Traditional handover algorithms depend on comparing the differential signal power level between the serving BS and target BSs to a fixed handoff hysteresis value which is designed to reduce the Ping-Pongeffect in the handoff procedure. Selection of the hysteresis value becomes important for optimizing handover performance. Many unnecessary handoffs may be processed and increasing the network load if "h" is too small. If the long handoff delay may result in a call-dropped and reduced QoS if h is too large.

C. VELOCITY

In vertical handoff, the velocity factor has a important role in handoff decision than in traditional horizontal handoffs. Because of the overlaid architecture of heterogeneous networks, when a high speeds processing handover to an embedded network with small cell area is discouraged since a handoff returned to the source network would occur very shortly after that when the mobile terminal leaves the smaller embedded network. Mobile users are connected to the upper layers and benefit from a greater coverage area .This requirement is satisfied by Towards Autonomic Handover Decision Management in 4G Networks
and A Dynamic Decision Model for Vertical Handoffs across Heterogeneous Wireless Networks.

D. USER PREFERENCES

User preferences ,such as network operator, preferred technology type, user application requirements,real time, non-real time,Voice, data, video, Quality of service should be used to cater special requests for one type of network over another.

E. HANDOFF LATENCY

Handover latency which can cause many packets to be dropped while a mobile user is moving from one access network to another network. efficient handoff decision model should conceder Handoff latency and minimize it to increase user experience. To minimize the handoff latency (Policy-Enabled Handoffs across Heterogeneous Wireless Networks) and (Use of ART or Vertical Handoff Decision in Heterogeneous Wireless Environment) incorporate this factor in their handoff decision models.

V. CONCLUSION

In this paper we give an overview of handoff management , and comparison current handoff techniques for IP-based 4G mobile networks. Specifically, we have described and analyses handoff protocol schemes in details, Mobile IPv6, Hierarchical Mobile IPv6. Mobile IPv6 protocols define a care-of address for MU(mobile user) in a new visited network.. Among we analyze handoff latency of MIPv6 and HMIPV6 protocol schemes and also discuss fast handoff and dynamic process model ,A succesor of 2G and 3G, 4G promises download speed upto 100Mbps. Due to high speed of data the 4G wireless networks create new handoff challenges due to multiple requirements for vertical handoff. Future work should be carried out in determining other new obstacles in handoff schemes and protocols need to be improved.

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