

Improvement in The Handoff Performance for High Speed Mobile Services



Engineering

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ABSTRACT

In this paper, we focus on the improvement in the handoff performance and the capacity of the system. We introduce soft handoff IP Scheme and an enhanced inter-access point protocol to increase the capacity of the system and to eliminate the frame loss during handoff. We proposed advanced hierarchical handoff algorithm uses velocity estimated method scheme to optimize the handoff performance of high speed mobile services. The proposed schemes minimize the probability of the handoff failure and enhancing the capacity and performance of system for the mobile services.

I. INTRODUCTION

With the current advances in the mobile communication technologies and the rapid growth of the internet, providing wireless internet access to the mobile users without any interruptions in their connections is of crucial importance. And with the growth of mobile services it has become important to maintain continuous connectivity when a mobile host moves from one place to another. But there is main problem arising of failure of handoff. Handoff is a process, when mobile moves into a different cell or sector while a call in progress; the mobile switching center (MSC) will automatically transfers the call to a new channel belonging to the new base station (BS). The velocity difference between the each mobile service becomes more notable in cellular mobile communication system. To overcome these problems, this paper introduced advanced hierarchical handoff algorithm uses velocity estimated method scheme to optimize the handoff performance of high speed mobile services. We will introduce a hierarchical structure of cellular system in section II and advanced hierarchical handoff algorithm in section III and Soft Handoff IP Scheme in section IV and An Enhanced IAPP in section V and section VI is conclusion.

II. HIERARCHICAL STRUCTURE OF CELLULAR SYSTEM

Hierarchical structure, it is a splitting of cells. For each cell, there are seven smaller cells underneath, thus forming a hierarchy [4]. Fig.1 shows a two-tier cellular system. It combines macrocells and microcells together into one mobile communication system. In a two-tier system, high mobility users should be assigned to macrocells and low mobility users should be assigned to micro cells.

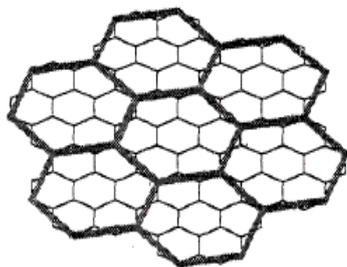


Fig.1 Two tier cellular system.

It is characterized by overlapping of macro cells and microcells in service area. This overlapping property delivers an advantage that traffic load can be shared by two tiers to increase the performance of the system.

III. ADVANCED HIERARCHICAL HANDOFF ALGORITHM

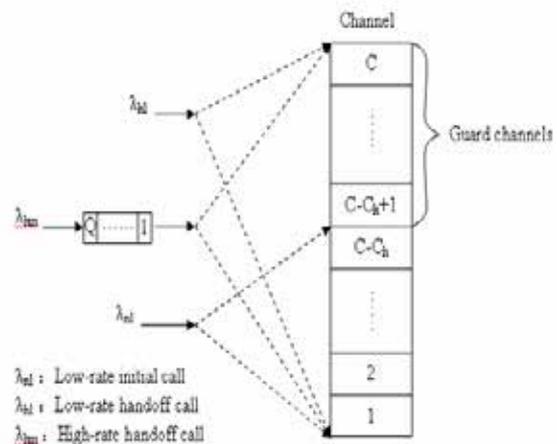
When the mobility changes fast in cellular system then the problem of traffic occurs. Therefore, we are introducing an advanced hierarchical structure of two-tier cellular system handoff algorithm; this is based on velocity estimation method. In order to balance the traffic load, we have to use the two-tier hierarchical structure showing in fig.1. This system uses velocity property as inter-tier's handoff rule while uses the pilot signal strength as

intra-tier's handoff rule. According to velocity estimation method, mobile services are divided into the high-speed services which assigned to macrocells and the low-speed services which assigned to microcells. When microcell and macrocell uses the same frequency, interference from inter-tier can be endured due to the gain, thus frequency reused factor is 1. The intra-tier interference will be deteriorated by power control, while inter-tier interference will be controlled by space isolation. When microcell and macro cell uses the different frequency, interference mainly arises from neighbor channel's overflow. Hence it is required that more frequency bandwidth, with hard handoff presented in the situation of inter-tier handoff. So we are assuming that the mobile users are suffering from more initial blockings than blockings while communication. The 'C_h' guard channels are assigned for handoff calls of both the low-rate and the high-rate traffics. Moreover, queue sized Q can be used dedicated for high-rate handoff calls because it is prior to low-rate handoff calls. Here we consider that number of channels in both microcells and macrocells are 'C' as shown in fig.2 and fig.3. Low-rate traffic needs a basic rate channel, while high-rate traffic needs 'm' basic rate channels to reflect the quantity difference of MS velocity [2], [3] and [4].

For low rate call mobile users.

When low-rate initial calls arrive, firstly the type of call is determined as initial call or handoff call and the management depends on idle common channels. Low-rate initial calls will occupy one of (C-Ch) channels if the idle common channels occur. Otherwise, new calls are blocked if number of channel equal to or less than Ch. This situation is shown in fig.2.

Fig.2 Low-rate traffic handoff management.

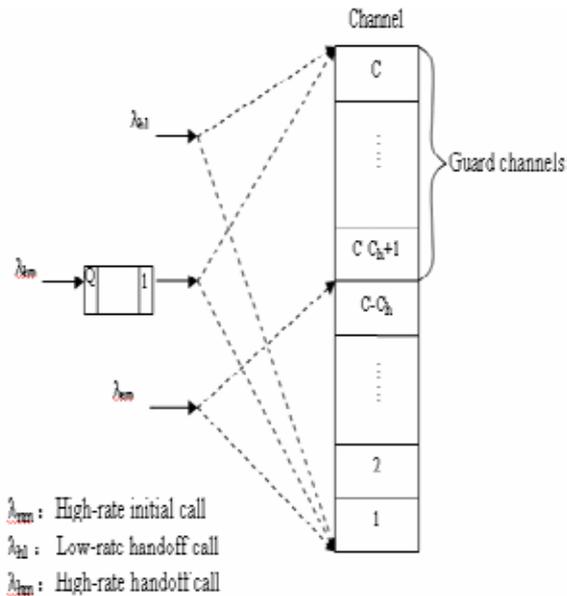


When MS (Mobile Station) moves to the boundary of microcell, handoff is requested along with the weak pilot signal strength of current base station. Because transmitting power from macrocell base station is always stronger than power from microcell base station (BS), the inter-tier handoff is requested as well. New call will occupy one of (C-C_h) channels if one idle common

channel exists. Otherwise, new call will occupy one of C_h channels if one guard channels exist. Intra-tier handoff succeeds. On the opposite, low-rate handoff call is blocked. This situation is shown in fig.2.

For high rate call mobile users

If high-rate initial calls arrive, firstly the type of call is determined as initial call or handoff call and the management depends on the idle common channels. So the high-rate initial calls will occupy 'm' channels of $(C-C_h)$ channels if idle common channels occur. Otherwise, new calls are blocked if the number of channels more than or equal to (C_h+m) . Fig.3 shows this situation.



New call will occupy one of $(C-C_h)$ channels if the one idle common channel exists. Else, new call will occupy one of C_h channels if one guard channel occurs. Macrocell to microcell inter-tier handoff succeeds. On the opposite, low-rate handoff call is blocked. Fig.3 shows this situation as well.

IV. SOFT HANDOFF IP SCHEME (SHIP)

The capacity often decreases due to the increase of the number of channels used by MNs (mobile node) during soft handoff. We proposed a soft handoff IP scheme for forward-link that 1) overcomes the need for synchronization and 2) it will increase the capacity of the network. The idea is to combine the information received from different ANs at the network-layer instead of the physical-layer because the network-layer allows more flexible delay than that allowed at the physical-layer [1] and [5].

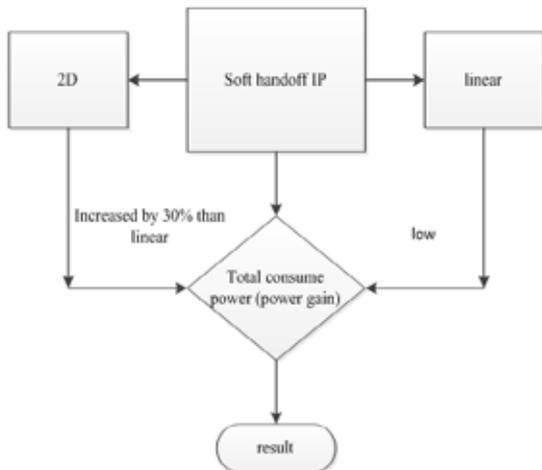


Fig.4 Total consuming power in system.

SHIP shows in fig.5, combines both copies of each packet at the MN's (mobile node) network-layer, and constructs one packet for further processing at the higher layer [11] and [12].

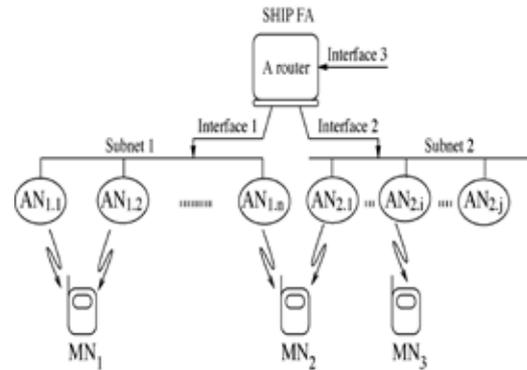


Fig.5 Soft Handoff IP functional units.

For the forward-link traffic, two copies of each packet are simultaneously transmitted to MN_i through $AN_{i,1}$ and $AN_{i,2}$. MN_i combines the two received signals at the physical-layer on a bit-by-bit basis. Hence, this approach requires the both ANs to be tightly synchronized. Instead of sending two identical copies, soft handoff IP generates two descriptions of the packet and delivers them through the ANs (access node); i.e., $AN_{i,1}$ relays one description, while the other description is relayed through $AN_{i,2}$.

Power control solution for both linear and 2D cell model

For the duration of the forward-link soft handoff process, multiple identical copies of each packet are simultaneously transmitted to the MN through different ANs. The MN then combines the received signals on a bit-by-bit basis resulting in a stronger signal-to-interference and noise ratio (SINR), which in turn reduces the bit-error rate (BER) [10] and [13]. In a forward-link communication, SINR for a particular MN_i communicating through AN_k depends mainly on the power level P_{ik} at which AN_k is transmitting to MN_i , the interference level caused by other neighboring transmitters, and the noise of the channel. The interference level depends on the power level at which the neighboring ANs are transmitting, and the path losses between the MN_i and these interfering ANs. Let H_{im} represent the path loss between MN_i and AN_m . The path loss depends on the distance (l) between the MN_i and the AN_m , i.e.

$$H_{im} = l^{-\alpha}$$

Where $\alpha \in \{1,2,3,4,\dots\}$. If α is larger, then the channel is worse.

The SINR for a particular MN_i receiving from AN_k depends on three features. First, the power level received at MN_i . Second, the interference level I_i seen by MN_i 's signal and it is caused by all other neighboring transmitters; i.e. all cells belonging to A_k . Third, the noise condition of the wireless medium over which MN is communicating. We will consider a white Gaussian noisy medium with variance σ^2 .

Let $MN_i \in AN_k$. The SINR of MN_i , also denoted as γ_i can be written as

$$\gamma_i = \frac{G H_{ik} P_{ik}}{I_i + G \sigma^2}$$

G is processing gain. The interference level I_i seen by a $MN_i \in AN_k$ is a function of the power levels at which all $AN_m, m \in A_k$, are transmitting and the path losses H_{im} between the MN_i and all $AN_m, m \in A_k$. The interference I_i can be written as

$$I_i = \sum_{m \in A_k} I_{im} - H_{ik} P_{ik}$$

Therefore, equation (1) can be written as

$$\gamma_i = \frac{G H_{ik} P_{ik}}{\sum_{m \in A_k} I_{im} - H_{ik} P_{ik} + G \sigma^2}$$

For every $m \in A_k$, I_{im} is the interference caused by AN_m and seen by MN_i . The amount of interference experienced by a MN_i situated in AN_k can be evaluated as

$$\sum_{m \in A_k} I_{im} = \sum_{m \in A_k} H_{im} \sum_{j \in AN_m} P_{jm} \quad (3)$$

Since the MNs are uniformly distributed and the MN density is the same for all cells, the amount is the same for all AN_m , $m \in A_k$. Let P_T be that amount which defines the total amount of power consumed by any AN_m , $m \in A_k$. Thus, (3) can be rewritten as

$$\sum_{m \in A_k} I_{im} = P_T \sum_{m \in A_k} H_{im}$$

Therefore, the total consuming power is

$$P_T = \sum_{j \in AN_m} P_{jm}$$

Thus we can measure the total amount of consuming power.

The proposed scheme eliminates the need for synchronizing the ANs simultaneously transmitting to the MNs during forward-link soft handoff communications. The soft handoff scheme increases the capacity, and saves the consumed power of the network in the forward-link traffic by exploiting the repetition of the descriptions.

As a result, Fig.3 shows that the forward link network capacity and power gain is increased by about 30% and 20% in 2-D SHIP as compared to linear SHIP.

V. AN ENHANCED INTER-ACCESS POINT PROTOCOL

An enhanced Inter-Access Point Protocol (IAPP) is proposed to provide an integrated solution for both intra and inter subnet handoff processes. This enhancement not only eliminates frame losses during an intra-subnet handoff but it also realizes loss-free, fast inter subnet handoffs without modifying the IP-mobility protocols such as Mobile IP [6], [7], [8] and [9]. Fig.6 shows that there is a problem arising due to handoff latency. This problem is overcome by decoupling of mobile IP operations from the underlying handoff process in Enhanced IAPP. The enhanced IAPP reduces the inter subnet handoff latency significantly without requiring any modification to Mobile IP. Such decoupling makes the enhanced IAPP appropriate to other IP-mobility solutions.

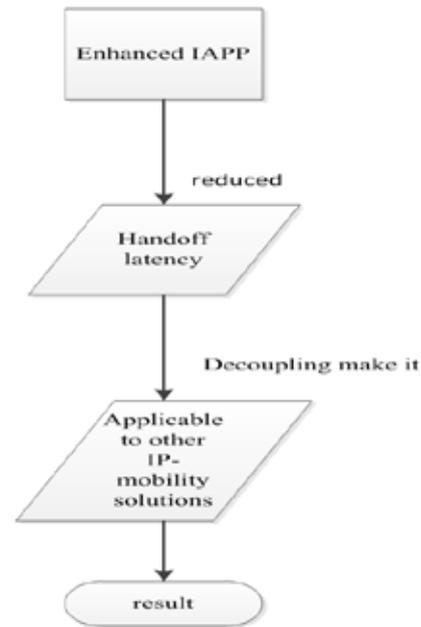


Fig.6 Enhanced IAPP to reduce handoff latency.

As a result, the enhanced IAPP supports high user mobility. It performs fast handoff automatically by means of the enhanced IAPP frame buffering and forwarding. It allows the mobile IP to use less destructive movement detection, therefore reducing the associated control above.

VI. CONCLUSION

We introduced an advanced hierarchical handoff algorithm for high speed of mobile services but by using number of channels there is a loss in the capacity and the power consumption of the system. Therefore, we introduced Soft handoff IP to increase the capacity of the system. It also overcomes the need of synchronization. Then we introduce enhanced IAPP to reduce the handoff latency. These proposed schemes, improve the handoff performance for the high speed of mobile services.

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