

## Efficient seamless handoff over heterogeneous wireless networks

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### abstract

Users using mobile terminal want to receive seamless service anywhere, anytime. In order to satisfy user's needs a communication between heterogeneous networks has to provide seamless service. Now a commercialized IMT-2000 is used with both WCDMA and CDMA together. Because asynchronous WCDMA and synchronous CDMA use different technology in their interface and traffic management, communication between the two networks can become disconnected. If a mobile terminal swerves from the handoff area before handoff completion, packet loss and service disconnection will happened. In this paper, we propose a handoff scheme to provide seamless service, when mobile terminal moves from the WCDMA to the CDMA. And we prove that the proposed handoff scheme provide seamless service.

### 1. Introduction

The mobile communication services confront difficulties to deliver services because of many constraints. An existing mobile communication service uses different technologies for implementing each service it offers. Although the technology is the same, frequency band is different in various countries and regions. So mobility can not be completely realized.

As commercial IMT-2000 is using WCDMA and CDMA together, traffic management and mobility are very important issues, because asynchronous WCDMA and synchronous CDMA use different technology in their interface and traffic management. That is, when an active mobile terminal using WCDMA moves towards the CDMA area, a resource used in WCDMA can not be used in the CDMA area. Therefore handoff technology is necessary to assign the resource and to protect against service loss.

In this paper, we propose a handoff scheme to provide seamless service, when mobile terminal moves between different networks. And we prove that the proposed handoff scheme does not incur service disconnection and/or packet loss.

### 2. Related Work

#### 2.1 Handoff

Handoff in wireless networks can be classified into two types: horizontal handoff and vertical handoff. Horizontal handoff occurs when the mobile terminal (MT) is handed-over from the old base station (BS) to the new BS within the same network. As one of the method for horizontal handoff, a fast and efficient handoff scheme is presented to handle the movements of mobile nodes among small wireless cells.[1]

A vertical handoff occurs when the MT is handed-over from the old BS to the new BS in a different network. As one of the methods for vertical handoff, a new handoff method for an IMT-2000 wireless system was proposed in which the handoff connection setup process was divided into the network connection setup and the radio connection setup parts [2]. Reducing handoff time in heterogeneous wireless networks is also studied [3].

#### 2.2 Active network

Active network allows an intermediate router to perform computations up to an application layer. Its programs travel inside network packets and are executed in the intermediate nodes resulting in the modification of their state and behavior. That is called Store-COMPUTE-Forward. By this function, an active network can provide a dynamic network structure [4].

3. Handoff between WCDMA and CDMA

Because resources of the WCDMA network has different interface and structure, they can not use in CDMA network. So, if users move to a new CDMA network out of the WCDMA area, service is disconnected. Therefore we propose an efficient handoff algorithm for heterogeneous networks.

3.1 Efficient handoff model

People are moving at fast speed and use multimedia services. So if a mobile terminal is out of old BS before handoff execution is completed, it can lose some amount of data packets. To solve this problem, when the mobile terminal location is in an area where both WCDMA and CDMA coexist, handoff initiation is started. And when the mobile terminal moves to handoff area, handoff is carried out immediately.

Figure 1 shows handoff model as stated above. The model assumes that the direction is not changed and the mobile terminal moves from WCDMA network towards CDMA network.

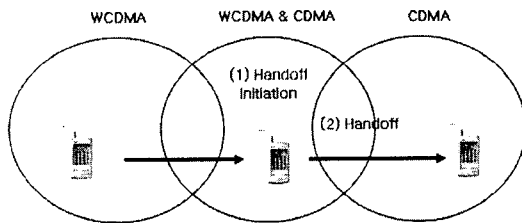


Figure 1 Handoff Model

- ◆ area (1) : WCDMA & CDMA coexistence area  
Handoff Initiation
- ◆ area (2) : Handoff area  
Handoff is finished completely.

The handoff initiation is the preparation phase that assigns resources and sets up the path. After handoff is started, handoff towards the new CDMA network is completed using reserved resources. An active router between the source and the destination conducts buffering during the handoff. A mobile terminal located in the new area registers location using binding update and receives buffered packets.

3.2 Handoff process

Figure 2 shows the handoff process for seamless service between heterogeneous networks

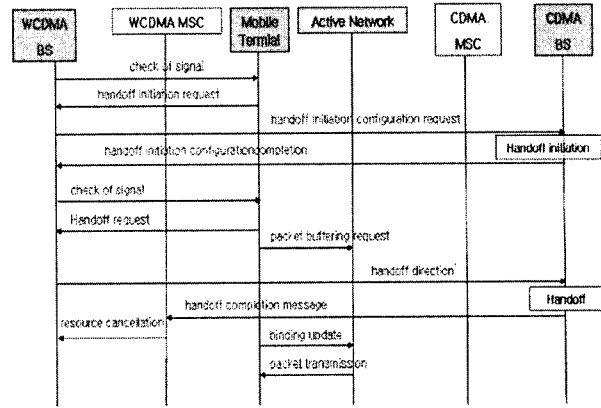


Figure 2 Handoff Process

- ① Mobile terminal recognizes the signal that shows that the area where WCDMA and CDMA coexist.
- ② A mobile terminal in the coexistence area requests handoff initiation from the WCDMA BS.
- ③ The WCDMA BS instructs Handoff Initiation to the CDMA BS.
- ④ The BS of CDMA sends ACK message to BS of WCDMA.
- ⑤ If a mobile terminal enters the handoff area, the mobile terminal requests the start of the handoff to the BS of the WCDMA network and for the packet buffering to the active router.
- ⑥ The BS of the WCDMA network completes the handoff towards the BS of CDMA.
- ⑦ After conducting handoff completely, BS of CDMA sends handoff-completion-message to the BS of the WCDMA network.
- ⑧ The mobile terminal registers a new location using the binding update.
- ⑨ Active router upon receiving the binding update forwards buffered data packets to the mobile terminal buffered packets.

4. Evaluation

4.1 Simulation Model

Figure 3 is the simulation model that verifies the handoff process. This model assumes that the direction is not changing and the mobile terminal

moves from the WCDMA towards the CDMA network.

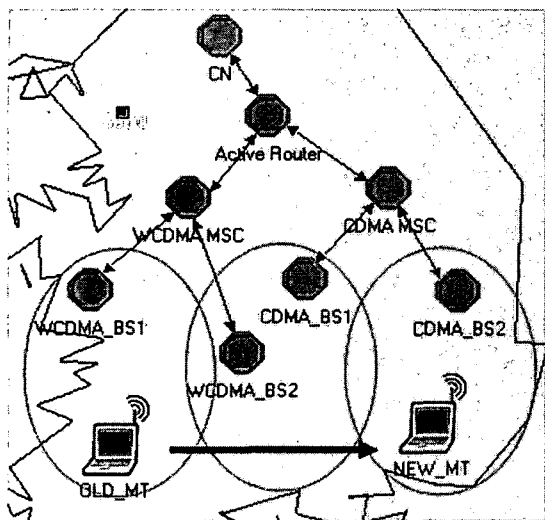


Figure 3 Simulation Model

The OLD\_MT communicates CN and then moves towards the NEW\_MT. At this time mobile switching center(MSC) of WCDMA requests BS of CDMA to proceed with the handoff and waits for the ACK message. During the handoff, active router buffers packets. After finishing the handoff, active router sends to the NEW\_MT buffered packets.

#### 4.2 Result of simulation

Figure 4 is result of simulation using OPNET.[5]

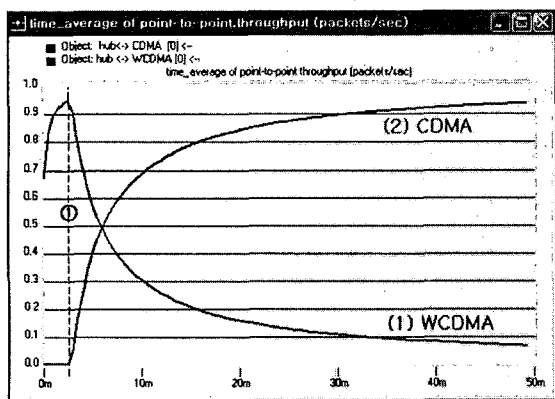


Figure 4 movement of packets

① is starting point of handoff. left of ① is occurrence of the handoff initiation and send packets to the mobile terminal of the WCDMA network. Handoff Initiation phase previously reserved

some resource and path. Therefore this part does not send packets to CDMA area. Right of ① is assigned a reserved resource and handoff is being conducted. At this time sent packets to WCDMA are transmitted toward the mobile terminal of the CDMA network. During handoff, packets are not lost and service is not disconnected because the active router buffered the packets.

#### 5. Conclusion

In this paper, we propose an efficient handoff model and its process between heterogeneous networks. It provides seamless service and removes packet losses.

The handoff initiation can fast convert interface and path toward new network area. During the handoff, seamlessness is provided, because the active router buffers the packets. In evaluation, we obtained reliable results because proposed objects have a real function and role.

In this paper, we assume that the direction is not changing and the mobile terminal moves from the WCDMA towards the CDMA network. But the mobile terminal can change toward various area in the handoff region. So, we need further research when the mobile terminal moves to various area in handoff region.

#### 6. Reference

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