하이브리드 3G 네트워크를 위한 SCI 기술

SCI Scheme for Hybrid 3G Networks

김귀정, 김석훈*, 한정수**
건양대학교 의공학과, 경희대학교 컴퓨터공학과*,
백석대학교 정보통신학부**

Kim Gui-Jung, Kim Seok-Hoon*, Han Jung-Soo**
Biomedical Engineering, Konyang University.,
Dept. of Computer, KyungHee University*,
Division of Information & Communication,
Baeseok Univ..**

요약

본 연구에서는 밀 결합 연동과 소 결합 연동을 갖는 Smoothly Coupled Integration(SCI)를 제안하였다. 게다가, SCI로 결합되는 3G 네트워크와 WiBro 네트워크는 빠른 핸드오프에 의하여 이동성과 seamless 서비스를 지원하는 독립적인 기술을 지닌다. OPNET의 사용한 시뮬레이션은 SCI의 우수성을 입증하였다.

Abstract

The Smoothly Coupled Integration (SCI) proposed in this paper takes only the strength of loosely coupled integration and tightly coupled integration. Furthermore, 3G network and WiBro network, which are coupled with SCI, have independent architecture which supports mobility and seamless services by fast handoff. Computer simulation with the use of OPNET marked excellence in performance of smoothly coupled integration.

1. Introduction

There are solutions for the wired-wireless network integration, such as fiber optic technology based on FTTH, optical fiber technology based on DWDM and QoS, next generation technology for wired network, and 4G or B3G technology based on ALL-IP. However, no concrete solution for the wireless networks interworking has been developed yet.

Drawing a roadmap for the wireless networks interworking is difficult procedure because architecture, protocol stack, mobility, quality of service, authentication, security, and billing system must be taken into account. However, incompatibleness of specifications, standards, service area, and data rates makes the wireless network interworking difficult to provide a general solution.

Although, many studies have been done in interworking of popular 3G network and WLAN, WiBro is getting into the spotlight these days because of its several advantages over WLAN. Wide range of service, cost reduction, and fast data transmission rate are all delivered by the interworking of 3G and WiBro network. Moreover, 3G-WiBro will provide seamless service over frequent handoffs to Mobile Station.

The proposed SCI (Smoothly Coupled Integration) scheme allows independent network architecture and has the advantages of LCI (Loosely Coupled Integration) and TCI (Tightly Coupled Integration)

schemes. Mobility and seamless service are also provided by fast handoff.

2. Smoothly Coupled Integration Scheme

2.1 SCI Concept

WiBro is so called the evolution of WLAN. The limitation of immovable environment brought by WLAN is overcome by WiBro technology, which provides seamless service with mobility of Mobile Station. Therefore, mobility must be considered prior to any other features in 3G-WiBro interworking

The fundamental ideas of LCI and TCI schemes in 3G-WLAN could be applied in 3G-WiBro interworking. However, the problems of LCI mobility and the heavy loads of complex standardizations of TCI still remain. SCI scheme is suggested in this paper because it allows the usage of LCI and TCI schemes as well as independent operation of each network.

2.2 Operation Procedure of SCI Scheme

There are six cases of consideration in 3G-WiBro interworking scheme.

- Case 1: When MS starts in WiBro network.
- Case 2: When MS starts in cdma2000
- Case 3: When MS moves from WiBro to cdma2000 network
- Case 4: When MS moves from cdma2000 to WiBro network
- Case 5: When MS returns back to WiBro network after moving to cdma2000
- Case 6: When MS returns back to cdma2000 network after moving to WiBro

The following functions should be added in the standard in order to support SCI scheme.

- Function to distinguish a cdma2000 call from a WiBro call at PDSN
- Function to obtain cdma2000 ANID (Access

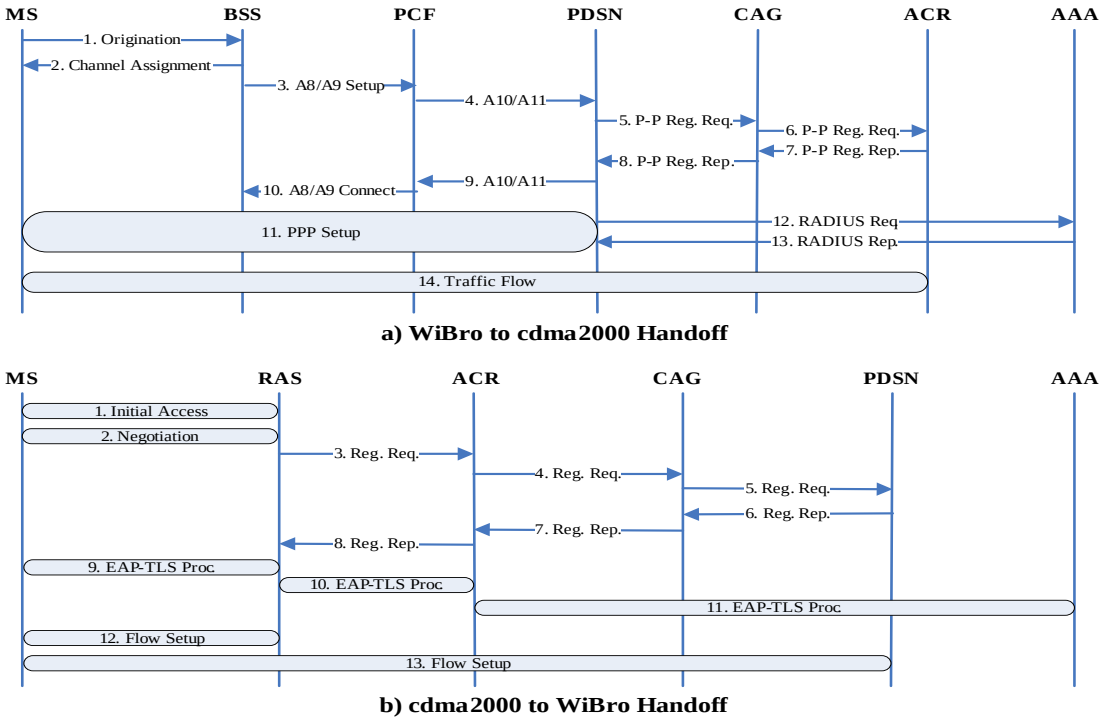

Figure 1. Handoff Call Flows of SCI

Network ID) at WiBro network

- Function to forward PANID from WiBro to cdma2000 network

As shown in Fig. 1, only cdma2000 network requires PPP configuration for data transmission, whereas WiBro network does not. PDSN should be able to distinguish and to handle calls accordingly to the network type by looking at the service option field of Accounting Record in A11 registration request message.

In WiBro network, ANID is not defined in the registration message where it is defined in cdma2000 network. In order to acquire ANID field from the message, mapping ANID field of cdma2000 to Base Station field of WiBro is suggested in this paper.

Base Station ID field, which is defined in DL-MAP (Downlink Channel Description) field of WiBro MAC management message, is 48-bit long in size, whereas ANID is only 40-bit long. The deliverance of PANID in WiBro network can be done by adding PANID field in Registration Request message. The problem of many changes of standards in order to support the functions above can be only solved by introducing SCI scheme.

3. Performance Evaluation

3.1 Simulation Model

The OPNET simulation is conducted to examine the performance of SIC scheme. A total of 135 MSs used in this simulation supports Dual Mode Stack (cdma2000 & WiBro). WiBro network celss and cdma2000 network cells are attached one by another in the simulation. Picocells and Microcells are only used to generate frequent handoffs of MS. Since Markov mobility model used in this simulation, as shown in Figure 2, is designed for MS at low-speed, the following probability density function is added to give more speed. m represents the average speed of MS in a cell. A speed of 60km/h is used since it is the fastest speed of MS in this experiment.

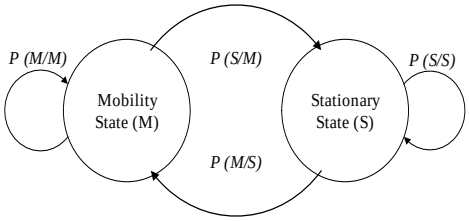

Figure 2. Mobility Model

$$f_{init}(v) = \begin{cases} k \dfrac{1}{\sqrt{2\pi\sigma}} e^{-\frac{(v-m)^2}{2\sigma^2}}, & v \geq 0 \\ 0, & v < 0 \end{cases} \quad (1)$$

3.2 Simulation Result and its Analysis

Both LCI and SCI schemes are simulated to prove the superiority of SCI over LCI on most popular services in mobile environment, such as streaming, web browsing, and E-mail service. These services are categorized into Streaming, Interactive, and Background traffic class, respectively. In addition, Conversational class is also added for video conferencing service simulation.

Figure 3 to Figure 5 show that all services simulated with SCI scheme marked better than LCI scheme. Conceptually, performance data resulted in each scheme cannot be different except when handoff occurs. Therefore, performance differences shown in Figure 3 to Figure 5 are all by handoff processes. Figures also show that handoff occurrence is very frequent at interval times of 6 to 23, 32 to 35, and 55 to 57.

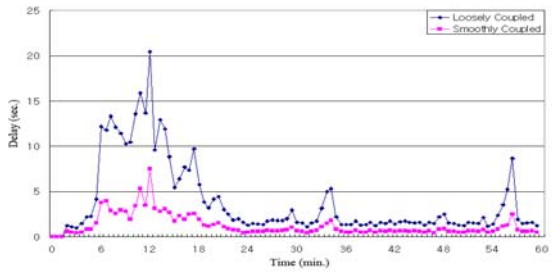

Figure 3. Delay Comparison SCI and LCI for Interactive Traffic Class

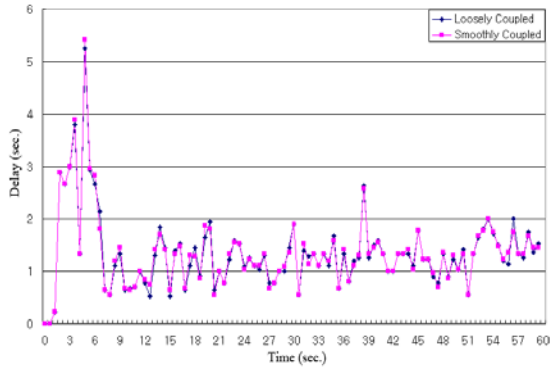

Figure 4. Delay Comparison SCI and LCI for Background Traffic Class

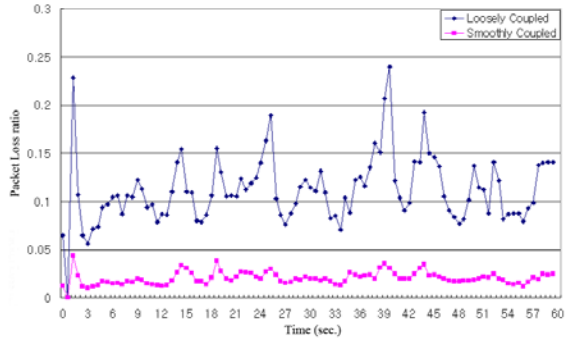

Figure 5. Packet Loss Ratio Comparison SCI and LCI

Figure 3 shows delays of the Interactive traffic data using HTTP. Difference in delays between LCI and SCI is high due to the burstness of the web traffic when frequent handoffs occur. The graph of Background traffic class like Email, as shown in Figure 4, shows almost no difference in delays. It is so because services like email, for example, have the characteristics of background traffic.

Figure 5 describes the packet loss ratio in SCI and LCI scheme. The reason that packet loss ratio in LCI is higher than in SCI is because LCI supports handoff based on Mobile IP whereas SCI supports handoff based on Simple IP. Simple IP is designed to run faster in handoff process. Therefore, SCI scheme is right solution for real-time service, such as Conversational traffic class or Streaming traffic class.

4. Conclusion

In this paper, we proposed a scheme, which supports interworking of cdma2000 and WiBro networks, and fast handoff in 3G-WiBro network. The functions of each network NE are redefined and described in detail.

The proposed SCI scheme as mentioned so far takes only the advantages of each LCI and TCI schemes. It will be a solution for high reliability and fast handoff. However, users will not satisfy with the results shown in the analysis. Researches in interworking must be continued in terms of the quality of service and international standardization.

▌Reference ▐

[1] M.M. Buddhikot, G. Chandranmenon, S. Han, Y.W. Lee, S. Miller, and L. Salgarelli, "Design and implementation of a WLAN/CDMA2000 interworking architecture," IEEE Communications, Vol. 41, No. 11, Nov., 2003, pp. 90~100.

[2] 3GPP2, "3GPP2-WLAN Interworking - Stage 1 Requirements," 3GPP2 S.R0087-0 v1.0, Jul., 2004.

[3] F. M. Chiussi, D. A. Khotimsky, and S. Krishnan, "Mobility management in third-generation all-IP

networks," IEEE Communications, Vol. 40, No. 9, Sep., 2002., pp. 124~135

[4] N. Musikka and L. Rinnback, "Ericsson's IP-based BSS and radio network server," Ericsson Review, No. 4, 2000, pp. 224~233.

[5] H. Luo, Z. Jiang, B.J. Kim, and P. Henry, "Integrating wireless LAN and cellular data for the enterprise," IEEE Internet Computing, Vol. 7, No. 2, Apr., 2003, pp. 25~33.

[7] K. Ahmavaara, H. Haverinen, and R. Pichna, "Interworking architecture between 3GPP and WLAN systems," IEEE Communications, Vol. 41, No. 11, Nov., 2003, pp. 74~81.