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Challenges Toward Spectrum-Energy Efficient Wireless Networks

Abstract: Due to recent rapid penetration of smart phones into our society, broadband wireless services have been getting more and more popular. It is said that the wireless traffic volume has been increasing rapidly by about 2 times per year. Because of limited available bandwidth, the spectrum-efficiency has been the most important concern for the last few decades. The available energy, in particular for battery operated user terminals, is also limited. Therefore, the energy-efficiency has become an important issue. However, the spectrum-efficiency and the energy-efficiency are in a tradeoff relationship. To improve the spectrum-efficiency and energy-efficiency simultaneously, the wireless access network may need a significant restructuring.

One promising solution is an introduction of small-cell structured network. Both spectrum-efficiency and energy-efficiency can simultaneously be improved by adopting the small-cell structure. However, a wide range of user mobility is problematic; frequent handover will happen. Furthermore, traffic density is not necessarily high everywhere. It is wise to keep the cell size the same as macro-cell network while exploiting more the spatial distribution of users. We are recently investigating two-layer virtual macro-cell network (e.g., a combination of small-cells and macro-cells). There are two approaches to implement the small-cell layer: distributed small base stations and distributed antennas.

In this talk, we will overview the wireless evolution, discuss the spectrum-energy efficiency tradeoff. Then, we will introduce the two-layer virtual macro-cell network. Finally, we will discuss about the power on/off management, distributed dynamic channel allocation, and multi-access problems.

Biography: Fumiyuki Adachi received the B.S. and Dr. Eng. degrees in electrical engineering from Tohoku University, Sendai, Japan, in 1973 and 1984, respectively. In April 1973, he joined the Electrical Communications Laboratories of Nippon Telegraph & Telephone Corporation (now NTT) and conducted various researches on digital cellular mobile communications. From July 1992 to December 1999, he was with NTT Mobile Communications Network, Inc. (now NTT DoCoMo, Inc.), where he led a research group on Wideband CDMA for 3G systems. Since January 2000, he has been with Tohoku University, Sendai, Japan, where he is a Professor at the Dept. of Communications Engineering, Graduate School of Engineering. His research interest is in the area of wireless signal processing (multi-access, equalization, antenna diversity, adaptive transmission, channel coding, etc.) and networking.

He is an IEICE Fellow and an IEEE Fellow. He was a recipient of the IEEE Vehicular Technology Society Avant Garde Award 2000, IEICE Achievement Award 2002, Thomson Scientific Research Front Award 2004, Ericsson Telecommunications Award 2008, Telecom System Technology Award 2009, Prime Minister Invention Award 2010, British Royal Academy of Engineering Distinguished Visiting Fellowship 2011, KDDI Foundation Excellent Research Award 2012, VTS Conference Chair Award 2014, and C&C Prize 2014.

He is listed in Highly Cited Researchers (http://highlycited.com/isihighlycited.htm#table).