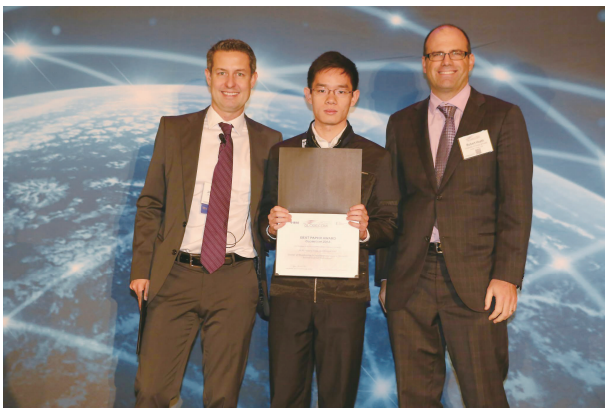
Received "Best Paper Award" in IEEE Globecom 2014

Hiroyuki Ishii† of DOCOMO Innovations, Inc., and Bo Yu and Liuqing Yang of Colorado State University received the Best Paper Award at the Institute of Electrical and Electronics Engineers Global Communications Conference 2014 (IEEE Globecom 2014) held in Austin, Texas (U.S.) from December 8-12, 2014.

IEEE GLOBECOM is one of two flagship conferences of the IEEE Communications Society (ComSoc), together with IEEE ICC. Each year the conference attracts about 3,000 submitted scientific papers [1], of which approximately 35% are accepted for publication. Among the published papers, 14 papers received the Best Paper Award for their outstanding performance.

The title of the award-winning paper was "3D Beamforming for Capacity Improvement in Macrocell-Assisted Small Cell Architecture." 5G, which is the next phase of mobile telecommunication standards beyond the current LTE/LTE-Advanced, is being studied all over the world for commercialization in the 2020's. 5G aims to achieve a 1,000-fold system capacity per km^2 and a 100-fold increase in user-experienced throughput compared to 2010. It is expected to significantly improve the above system capacity and user-experienced throughput by means of three approaches; namely, "spectrum efficiency enhancement by utilizing 3D Beam-forming/ Massive MIMO," "spectrum extension by utilizing frequency bands higher than 3 GHz," and "network densification by utilizing small cells."

This paper proposes the capacity enhancement for small cells under "*Phantom Cell*® *1 architecture" utilizing the flexible 3-dimensional (3D) Beam-forming*2 facilitated by the adoption of the Active Antenna System (AAS) at Base Stations (BSs). Phantom Cell is a macrocell-assisted small cell architecture proposed by DOCOMO. The aim of Phantom Cell architecture is to provide high system capacity and robust mobility while reducing the cell planning efforts. One of the key features for Phantom Cell architecture is the C-plane/U-plane Split configuration. C-plane is supported by macro cell layer to maintain good connectivity and mobility using lower existing frequency bands while the U-plane is supported by small cells to provide higher throughput and more flexible and energy efficient operations using higher frequency bands (e.g., 3.5 GHz band). With such configurations in Phantom Cells and the assistance from macrocells, conventional cellular network problems, such as coverage holes or handover failure, need not be considered. This enables more dynamic and flexible 3D Beam-forming using an extremely narrow beam, and thereby the received signal quality can be improved and the interference can also be controlled more effectively. The system level simulations demonstrate the significant gain of capacity enhancement with 3D Beamforming over the conventional sectorization with fixed



down-tilt in terms of both the cell average capacity (up to 124.8% gain) and the cell edge user throughput (up to 454.3% gain).

The simple configuration of "combining 3D Beam-forming and small cells on the basis of the Phantom Cell concept" has verified that a large capacity/user throughput gain can be obtained and has demonstrated the potential performance of 5G, which was evaluated and resulted in receiving the award.

Reference

[1] IEEE GLOBECOM 2014: "Welcome to IEEE 2014."
http://globecom2014.ieee-globecom.org/about.html

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*1 **Phantom Cell™:** A trademark of NTT DOCOMO, INC.

*2 **3D Beam-forming:** Beam-forming is a signal processing technique used to control the directionality of the transmission and reception of radio signals. The improvement compared with omnidirectional reception/transmission is known as receive/transmit gain (or loss). 3D Beam-forming is a technology that dynamically performs beam-forming in both horizontal and vertical domains.