Best Paper Award at IEEE PIMRC 2016

Tatsunori Obara, Yuki Inoue, Satoshi Suyama and Yukihiko Okumura of 5G Laboratory, NTT DOCOMO Research Laboratories, and Yuichi Aoki and Jaekon Lee of Samsung Electronics Co., Ltd. received the "Best Paper Award" at the Institute of Electrical and Electronics Engineers International Symposium on Personal, Indoor and Mobile Radio Communications 2016 (IEEE PIMRC 2016), an international conference held in Valencia, Spain from September 5 to 7, 2016.

Held regularly since 1991, this conference is one of the flagship conferences of the IEEE Communications Society. This year 903 papers from approximately 60 countries were submitted, and approximately 49% were accepted. From among these, the Best Paper Award was conferred for three papers assessed for their superior accomplishments.

The award-winning paper is titled "Experiment of 28 GHz Band 5G Super Wideband Transmission Using Beamforming and Beam Tracking in High Mobility Environment." The "5G" 5th generation mobile communications system is to go into commercial service by 2020, and compared to 2010 services, will offer communications capacities 1,000 times greater and achieve user data rates 100 times faster. Hence, studies into these technologies are being actively pursued around the world. To contribute to the early creation of 5G, NTT DOCOMO has been conducting transmission experiments with cooperation of 13 of the world's major vendors to test elemental technologies key to 5G efficiency and effectiveness. Because high frequency bands will be used to secure wide frequency bandwidth, we are conducting experiments into multi-antenna transmission technologies such as beam forming*1 to verify their effectiveness.

Through experiments on beam forming and beam tracking technologies done in cooperation with Samsung Electronics, the paper presented results of throughput evaluations made in high-speed moving environments and clarified the effectiveness of the 28 GHz band.

28 GHz is one of leading candidates of frequency band for 5G. Because radio waves in high frequency bands such as 28 GHz have high straightness and high propagation loss with distance, applying them to cellular mobile communications is problematic. In recent years, it has been shown that it is possible to achieve high-speed communications and significantly reduce these losses due to distance in the 28 GHz band by applying beam forming technologies with Massive Multiple-Input Multiple-Output (Massive MIMO) *2 and super multi-element antenna arrays. The equipment used in this experiment is capable of maximum 3.77 Gbps throughput by using a combination of spacial multiplexing technology with a 96-element Massive MIMO antenna base station and an eight-element terminal using analog beamforming technology. This equipment also uses beam tracking functions to switch beams adaptively to follow the movement of the terminal. The terminal equipment also uses a compact antenna simulating the smartphone shape, so that the experimental environment reflects actual assumed usage scenes. The experiment verified beam forming and beam tracking technologies in high-speed moving environments and successfully reached a maximum throughput of 3.77 Gbps even at mobile speeds of 60 km/h, and also achieved more than 1 Gbps throughput at a distance of 500 m from the base station.

The paper received the award for presenting the effectiveness of the 28 GHz band in 5G by clarifying that high throughput is possible with beam forming and beam tracking technologies in real-world usage scenes.

*1 **Beam forming:** A technique for increasing or decreasing the gain of antennas in specific directions by controlling the amplitude and phase of multiple antennas to form radiation patterns.

*2 **Massive MIMO:** Technology that adopts super multi-antenna arrays consisting of greater numbers of antennas in MIMO systems, which transmit radio signals multiplexed in the space domain by using the multiple antenna elements for transmission and reception. This technology can secure a desired service area by using sharply formed radio beams to compensate for the radio propagation losses that accompany high-frequency band usage, and achieves high-speed data communications by multiple stream transmission.


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BEST PAPER AWARD

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Narcis Cardona, General Chair, PIMRC'16