Virtual Antenna Mapping MIMO Techniques in a Massive MIMO Test-bed for Backward Compatible LTE Mobile Systems

Seok Ho Won, Saeyoung Cho, and Jaewook Shin

Mobile Communication Division,

ETRI (Electronics and Telecommunications Research Institute), Korea

shwon@etri.re.kr, csy1009@etri.re.kr, jwshin@etri.re.kr

Abstract— **This paper proposes a virtual antenna mapping method for backward compatible massive or large-scale antenna multiple input multiple output (MIMO) base stations that provide communication services for legacy user equipment (UE) that can recognize only two or four base station antennas. The proposed method adopts and improves the omnidirectional beamforming that has been pioneered in previous works with proposing new method of determining antenna array coefficients through shifting the discrete Fourier transform (DFT) basis vectors for Zadoff-Chu (ZC) sequences. In the proposed method, the number of the parameters to be optimized is only two although the number of transmit antennas is hundreds or more (e.g., 500 antennas was proved in the paper as an example). Moreover, with the independent properties of the shifted versions of ZC sequences, this paper proves the fact that the coefficient vectors consisting virtual transmit antennas are independent when the channel gains work as the coefficients of them. This characteristic gives diversity with the pre-codes because two pre-code vectors must independent which means their linear combination with the non-zero channel gains or coefficients cannot be zero. The computer simulation results provide four important findings; the most important is that the actual number of virtually mapped physical antennas is inversely proportional to the transmit power per antenna.**

Keywords — massive MIMO, virtual antenna techniques, omnidirectional beamforming, large array antennas, precoding t echniques

Seok Ho Won received his B.S. degree in clinical pathology and electrical engineering from Kwangwoon University, Seoul, Rep. of Korea, in 1985 and 1990, respectively, and his Ph.D. degree in electrical engineering from Chungnam National University, Daejeon, Rep. of Korea, in 2002. Since 1985, he has been a clinical pathologist at Sin-Chon General Hospital, Gyeonggi-do, Rep. of Korea. Since 1990, he has been a principal engineer at ETRI, Daejeon, Rep. of Korea. He was a research faculty member at Virginia Tech, USA, in 2005. His research interests include information theory, error correction coding, MIMO, and beamforming with an emphasis on mobile communications.

Saeyoung Cho Received the B.E. and M.E. degrees in department of Electronic and Information Engineering for Chonbuk National University, Jeonju, Chonbuk, Korea in 2008 and 2010, respectively. Since 2011, he has been with Electronics and Telecommunications Research Institude, Daejon, Korea, where he is the Research Staff of Wireless transmission research department. His research interests include digital communication and MIMO OFDM system.

Jaewook Shin received the M.S. degree from the Kyungpook National University, South Korea in 1994 and Ph.D. degree in computer science from the Chungnam National University, South Korea in 2005. He has been working for Electronics and Telecommunications Research Institute (ETRI) as a researcher since 1994. He was a visiting researcher at the University of California, Irvine in 2012. He is currently a director of radio transmission technology section in ETRI. His current research interests include 5G mobile telecommunication, D2D and M2M.