

# Trade-Off between Spectral Efficiency and Energy Efficiency in Multi-Cell Uplink Networks

Hyunwoo Nam and Bang Chul Jung

Dept. of Electronics Engineering, Chungnam National University, Republic of Korea

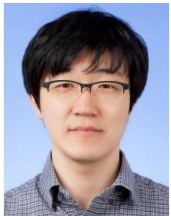
hwnam@cnu.ac.kr, bcjung@cnu.ac.kr

**Abstract**—In this paper, we investigate the effect of user scheduling and transmit power control on trade-off between spectral efficiency and energy efficiency in multi-cell uplink networks. We assume that each user adaptively controls the transmit power according to its generating interference to other cell base stations (BSs) and each BS schedules the user having the largest effective channel gain among users in a cell. The users transmit data with the peak power,  $P_{MAX}$ , if the generating interference to other cell BSs is smaller than a particular threshold,  $\eta_I$ . With the joint interference-aware power control (IAPC) and user scheduling, the trade-off between spectral efficiency and energy efficiency becomes significantly improved as the number of users in each cell increased, compared with the conventional maximum signal-to-noise ratio (maxSNR) user scheduling and minimum interference-to-noise ratio (minINR) user scheduling. In addition, the power consumption becomes significantly reduced with the IAPC and user scheduling for a given spectral efficiency.

**Keyword**— Spectral efficiency, energy efficiency, trade-off, multi-user diversity, interference-aware power control



**Hyunwoo Nam** received the B.S degree in electrical engineering from Chungnam National University, Daejeon, Republic of Korea in 2016. He is currently working toward the M.S degree in the electrical engineering, Chungnam National University, Daejeon, Republic of Korea. His research interests include Statistical Signal Processing, and interference management.



**Bang Chul Jung** (S'02-M'08-SM'14) received the B.S. degree in Electronics Engineering from Ajou University, Suwon, Korea, in 2002 and the M.S. and Ph.D. degrees in Electrical & Computer Engineering from KAIST, Daejeon, Korea, in 2004 and 2008, respectively. He was a senior researcher/research professor with KAIST Institute for Information Technology Convergence, Daejeon, Korea, from January 2009 to February 2010. From March 2010 to August 2015, he was a Faculty of Gyeongsang National University. He is currently an Associate Professor of the Department of Electronics Engineering, Chungnam National University, Daejeon, Korea. His research interests include 5G mobile communication systems, statistical signal processing, opportunistic communications, compressed sensing, interference management, interference alignment, random access, relaying techniques, device-to-device networks, in-network computation, and network coding. Dr. Jung was the recipient of the Fifth IEEE Communication Society Asia-Pacific Outstanding Young Researcher Award in 2011. He was also the recipient of the Bronze Prize of Intel Student Paper Contest in 2005, the First Prize of KAIST's Invention Idea Contest in 2008, the Bronze Prize of Samsung Humantech Paper Contest in 2009, and the Outstanding Paper Award in Spring Conference

of Korea Institute of Information and Communication Engineering in 2015. Dr. Jung has been selected as a winner of Haedong Young Scholar Award in 2015, which is sponsored by the Haedong foundation and given by Korea Institute of Communications and Information Science (KICS)