Abstract of Ph.D. Thesis
"Efficient Techniques for Broadcast of In-band System Information in Massive MIMO Systems"
Mr. Kamal Biswas (2015EEZ8416)

Non-orthogonal broadcast of system information (SI) in massive MIMO systems is a method where beamforming of information to scheduled terminals (STs) and broadcast of SI to idle terminals (ITs) is carried out on the same time-frequency resource by signalling SI on the null-space of the space spanned by the channel vectors of the STs. In this thesis, we consider joint beamforming of data to STs and broadcast of SI to ITs on the same time-frequency resource for two different type of systems: a) multi-cell multi-user massive MIMO systems and b) single cell mmWave massive MIMO systems.

For multi-cell multi-user massive MIMO systems, we consider two different types of SI broadcast, i) synchronous broadcast of common (i.e., same) SI symbols from all cells, and ii) synchronous broadcast of cell-specific SI symbols from each cell. Through analysis we derive expressions for the achievable sum rate to STs in each cell and the rate of SI transmission to an IT for both these types of SI broadcast. We also derive expressions for the sum rate to STs and the rate to an IT for traditional orthogonal broadcast strategy (OBS) where a fraction of physical resource is reserved for broadcast of SI. Simulations reveal that, just as in the single-cell scenario, for the multi-cell scenario also, non-orthogonal broadcast of system information (NoBS) is more energy efficient than OBS.

Prior work has shown that for i.i.d. Rayleigh fading, the transmit power required to achieve a desired sum-rate to STs and a desired rate of SI broadcast to the ITs, is smaller for NoBS when compared to that for the traditional OBS where a fraction of the resource is dedicated for broadcast of SI. However, to the best of our knowledge there is no work which has studied the power advantage of NoBS over OBS for the mmWave scenarios. Therefore, in this thesis we study the performance of NoBS for mmWave massive MIMO systems in two different scenarios: i) single cell mmWave massive MIMO system with single LoS path between base station (BS) and a user terminal (UT) with the BS having perfect knowledge of channel state information (CSI) to the STs, ii) single cell mmWave massive MIMO system with multiple channel path components between BS and a UT and the BS having imperfect CSI of STs. For the case of single LoS path between the BS and a UT, we consider Millimeter wave (mmWave) Massive MIMO systems where a large antenna array at the base station (BS) serves a few scheduled terminals. Our analysis re-

veals the interesting result that with a sufficiently large antenna array this non-orthogonal broadcast strategy requires significantly less total transmit power when compared to the traditional orthogonal strategy where a fraction of the total resource is reserved for broadcast of system information. Also we show that even with imperfect CSI of STs at the BS and multi-path mmWave channel, the power advantage of NoBS over OBS in mmWave massive MIMO systems can be large (around 9 dB) which makes NoBS a desirable strategy for such systems.