**Power Consumption of A/D Converters in Millimeter-Wave Systems**

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**Introduction of Team:** Oner Orhan is Elza Erkip’s PhD student. He is completing his fourth year in the PhD program. He has a strong foundation in communication theory and optimization. He has been working on energy efficient communication systems and has several publications on this; in particular he has studied the impact of processing energy and delay in both point-to-point and multihop energy harvesting systems. He is currently a summer intern at Huawei working on efficient simulation techniques for cellular systems. Oner’s past research and summer internship will put him in a unique position to carry out the proposed research.

**Affiliate Sponsors with Direct Interest:** Ericsson, Intel, Huawei, National Instruments, Qualcomm and NSN.

**Overview Research Statement:** The wide bandwidth and large number of antennas used in mmWave systems put a heavy burden on the power consumption of the A/D conversion. A/D power consumption typically scales linearly in the sampling rate and exponentially in the number of bits per samples. As a result, mmWave devices generally are limited to using low-resolution quantization and analog beamforming. This project will study in detail the power consumption for A/D converters and its impact on the link and system capacity, and also devise signal processing techniques to reduce the power consumption.

**Research Thrusts and Improvements for NYU WIRELESS**: The research will build upon and extend our work in [1], [2]. In particular, following [2], we will study the effect of low-resolution quantization and combined analog/digital beamforming on the system capacity. This work will complement our existing analysis of mmWave system capacity and will answer some of the important questions pertaining to the power consumption of mmWave terminals. We expect significant interest not only from our industrial partners, but also from the wireless industry and academia in general.

**Justification for this Project:** Apart from the reasons stated above, this project will reinforce the leadership of NYU WIRELESS in the mmWave domain. We expect to have multiple conference papers, and at least one journal paper in IEEE Communications or Signal Processing publications. The project will also help Oner pursue industrial positions upon graduation (expected August 2015) by complementing his current work and establishing him as one of the leaders in mmWave power consumption.

**Existing support and additional justification for the Project**: The project will leverage joint NSF funding of Elza Erkip, Sundeep Rangan and Ted Rappaport.

**References:**

[1] S. Rangan, T.S. Rapapport, and E. Erkip, “Millimeter wave cellular wireless networks: Potentials and challenges,” *Proceedings of the IEEE*, vol. 102, pp. 366 – 385, March 2014.

[2] M.R. Akdeniz, Y. Liu, M. Samimi, S. Sun, S. Rangan, T.S. Rappaport, and E. Erkip, “Millimeter wave channel modeling and cellular capacity evaluation,” *IEEE Journal on Selected Areas in Communications, Special Issue on 5G Wireless Communication Systems*, to appear.