

Downlink macro-diversity with limited backhaul capacity

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Abstract

Multicell processing in the form of joint encoding for the downlink of a cellular system is studied under the realistic assumption that the base stations (BSs) are connected to a central unit via finite-capacity links (finite-capacity backhaul). Three scenarios are considered that present different trade-offs between global processing at the central unit and local processing at the base stations and different requirements in terms of codebook information (CI) at the BSs: 1) local encoding with CI limited to a subset of nearby BSs; 2) mixed local and central encoding with only local CI; and 3) central encoding with oblivious cells (no CI). Three transmission strategies are proposed that provide achievable rates for the considered scenarios. Performance is evaluated in asymptotic regimes of interest (high backhaul capacity and extreme signal-to-noise ratio, SNR) and further corroborated by numerical results. The major finding of this work is that central encoding with oblivious cells is a very attractive option for both ease of implementation and performance, unless the application of interest requires high data rate (i.e., high SNR) and the backhaul capacity is not allowed to increase with the SNR, in which case some form of CI at the BSs becomes necessary.