Realistic Propagation Models for Indoor Distributed Antenna Systems

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For distributed antenna systems (DAS), realistic RF propagation models have a direct influence on the optimum antenna placement and, consequently, on the performance of the underlying communications system. Several researchers have studied the capacity of such systems and proposed various deployment strategies for optimum performance. However, relatively little work has addressed the impact of realistic propagation channel models on the system performance and deployment strategies. The vast majority of previous works assume some conventional models of path loss and shadow fading, as well as the fast fading associated with multipath scattering. In particular, shadow fading between the different antenna elements and the mobile unit is conventionally assumed to follow a certain i.i.d. log-normal distribution, or equivalently a Gaussian distribution on the log-scale with zero-mean and certain standard deviation. However, as discussed in some previous work, the assumption of i.i.d. shadow fading is not always fair, especially for indoor environments where the obstacles causing the shadow fading are usually close to the mobile terminal, and there is spatial cross-correlation that has strong impact on the system performance. Simply ignoring such correlation overestimates the diversity gain and, consequently, the receiver performance.

Here, we present our progress in developing propagation models that capture the spatial cross-correlation effect between the different paths from the antenna elements and mobile terminal. We begin by presenting: 1) our measurement strategy, including our method for reducing the amount of data required to the minimum but which extracts the maximum information, 2) the configuration of our measurement system, and 3) preliminary results obtained within various campus buildings including office, teaching and public spaces. By quantifying such effects, we are able to formulate a new optimization problem for the antenna elements locations with a key constraint defined by a minimum separation distance that should be on orders of magnitude with the coherence distance derived from the cross-correlation statistics. This work leads to an improved prediction of the DAS performance within indoor environments as well as optimum realistic deployment strategies.