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Impact of Considering the ITU-R Two Slope Propagation Model in the System Capacity Trade-off for LTE-A HetNets with Small cells

This work aims at understanding and evaluating the impact of using different path loss models in the optimization trade-off of small cell (SC) networks, understanding the network coverage areas, the co-channel interference and the underlying system capacity. The choice of a given path loss model enables to calculate the minimum transmitter power needed to transmit from an eNB at a given frequency, in a given environment (outdoor, urban, suburban, rural, indoor), and therefore to provide an acceptable quality of coverage, as well as to implement different frequency reuse schemes in a cellular system. In a congested frequency spectrum, as in LTE-A, the more realistic propagation models are, the more efficient the radio and network planning becomes. In this work we compare four urban path loss models: the urban/vehicular and pedestrian test environment from the ITU-R M. 1255 Report as well as the two slope Micro Urban Line- of-Sight (LoS) and Non-Line-of-Sight (NLoS) from the ITU-R 2135 Report. In these SC scenario, we consider the first three rings of interferers, assuming the exact distance of each interferer to the SC eNodeB, to calculate the carrier-to-interference and carrier-to- interference-plus-noise ratios. We have learned from the analysis that by considering the ITU-R two slope model that considers the existence of a breakpoint in the behaviour of the path loss, for coverage distances, R, up to breakpoint distance divided by reuse pattern, supported cell throughput, Rb-sup, is much lower than expected when traditional single-slope models are assumed. For Rs longer than dBP/K the results for Rb-sup are increasing with R, whereas they are steady or decreasing with R while considering the traditional single-slope propagation models. This increase is due to the existence of a low propagation exponent (slope) in term of coverage and a high slope in terms of interference for dBP/K ≤R≤ dBP. We conclude that the two-slope propagation model yields a significantly lower throughput per square km than a traditional one-slope model if and only if cell radius is small.

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