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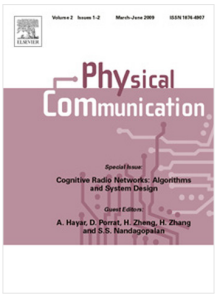

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Carrier to Interference Ratio, Rate and coverage Analysis in Shotgun Cellular Systems over Composite Fading Channels

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Abstract: Wireless communication performance in shotgun cellular system (SCS: wireless communication system with randomly placed base stations) is analysed. Aiming at this analysis, (i) the carrier to interference ratio (CIR), as an important measure in a cellular network, is considered in the downlink (path-loss, shadowing and multi-path) fading channel. Since direct calculating of the distribution of CIR is complicated, a related mathematical equation is determined through which the probability density function (PDF) of CIR can be calculated. And then, as a special case, the tail probability of CIR is obtained. (ii) A normal approximation for inverse of CIR is proposed which is applicable for calculating a tractable PDF for the downlink CIR. The analytically calculated and the approximate PDFs of CIR are compared with numerical PDFs. (iii) The distribution of the downlink rate and a lower bound for the average rate; the analytical expression for coverage of a user in an SCS based on its received CIR, and an average value for coverage are calculated. (iv) Simulation results show that the closed form and approximate PDFs over different models are close to numerical ones.

Keywords- Carrier to interference ratio (CIR), Coverage, Multi-path fading effect, Rate and average rate, Shadowing effect, Shotgun cellular system, Tail probability of CIR.

1. Introduction

Cellular communication consists of a set of radio base stations (BSs) distributed over a region that communicate with mobile stations (MSs). In contrast to hexagonal cellular systems (i.e. ideal systems) with regular BS placement in many wireless systems such as Local Area Networks (LANs) and femtocells [1], due to site acquisition difficulties, BSs are placed irregularly over the deployment region. These random systems called shotgun cellular systems (SCSs) can be described by BS density function $\lambda(r)$ as a function of the distances between BSs and the MS. In an SCS the signal propagation is affected by three phenomena. First is path-loss effect (here is random), the second is Log-normal shadowing, and third is multi-path fading effect. Hence many cellular deployments have significant randomness. So that, an SCS is a system affected by random phenomena.

The SCS and its performance metrics have been studied under different channel models [2-10]. Introducing a new random substitute for hexagonal systems was started by [2]. In [3] the downlink communication in an SCS was compared with hexagonal system and it was shown that in Log-normal shadowing, SCS with fixed channel assignment has the signal level of about *4db* lower than that of hexagonal cellular systems. So, in an SCS with random channel assignment the system performance needs