

Performance Analysis of Mobile Packet Radio Networks by Means of Transient Fluid Approximation

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This paper deals with two major issues in the performance analysis of mobile packet radio networks — the influence of the time dependency of the channel state and the problems related to zone structured networks. We also develop a new analytic method called TFA (Transient Fluid Approximation) to evaluate performance of those systems.

The TFA can be applied to the analysis of various random access systems. In the analysis, the expected system states at imbedded points are obtained asymptotically from the one-step state transition matrix for an individual terminal.

Studies of the system with time varying channel are divided into two stages. In the first stage, we examine the basic influence of mobile terminals in slotted ALOHA systems. We assume that the channel between a terminal and the station is in one of the three extreme states and the state changes with the terminal's location. A Markov model is used to express such a channel with memory. In the second stage, for the channel to be more realistic, we take into account both long and short term fluctuations of received signal power. The existence of noise is also assumed. Based on this channel model, the performance of slotted ALOHA systems with capture effect is evaluated.

As for the study of multi-zone networks, we investigate slotted ALOHA systems with two stations as an elemental example. Both static and dynamic performances are evaluated to examine the effect of mobile speed, zone overlapping, etc.