505/E1

Adapting particle movement models to mobile device connectivity patterns

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This study attempts to model the stochastic behavior of movements of mobile in an adhoc network environment. For this purpose pair-wise contact duration as well as the inter-contact time of mobile ad-hoc devices are obtained from a practical scenario. The objective is to find the probability distributions and the characteristic behavior of contact times and inter-contact times of these mobile devices that were observed. This leads to an insight into how probabilistic data dissemination occurs in such an environment.

The study uses the mobility traces, which are available in CRAWDAD [1]. Among the characteristics of these mobile ad-hoc devices are the non-infrastructure property, the peer-to-peer connectivity manner, and the content distribution while in close proximity to each other. Statistical packages such as SPSS, SAS and Minitab were used to analyze the traces. Descriptive statistics, graphical methods and diagnostic checks had been used based on the plausibility of the statistical model assumptions. The Gauss-Markov model [4] is currently being used as a synthetic model and the model to be developed would be tuned for these mobile traces. A mathematical model will be derived for the mobile connectivity once the tuning is complete.

The study revealed that the mobility traces defer from the established distributions and their characteristics. The contact durations depict a near exponential decay, but not exactly as the statistical test reveals. When observed using the other intervals the contact durations exposed a certain degree of log normality, especially when the durations were increased. This could be due to the Gauss Markov property. So the simulation process was tested to fine-tune the parameters of the Gauss-Markov model to fit the distribution of mobility traces. Inter-contact times were also seen to deviate from the defined distributions. For the given practical scenario, the mean inter-contact time is around 2 hours and 19 minutes with a recurring pair-wise contact probability of 0.8.

Simulated traces set showed very much identical pattern to the Cambridge traces set. It confirms that the lognormal property holds for separate intervals for connection duration distribution at expanded intervals. Also, the simulation produced close results for the CCDF for inter-contact times indicating that the real life mobility scenario nearly follows a Gauss-Markov model.

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