

Mathematics of peer-to-peer networking

Ilkka Norros (VTT Technical Research Centre of Finland Ltd)

Abstract: Internet is a medium that provides a potential connection between any pair of terminals, and peer-to-peer networks are virtual networks built on Internet connections between terminal nodes. We consider two examples, where an efficient system design can rely on randomness: distances in a random network, and file-sharing based on random contacts. The "messages" of the discussed results are:

(i) Distances in a random network with N nodes scale like $\log\log N$, if the node degrees follow a power law corresponding to finite mean and infinite variance.

(ii) Selfish random file-sharing suffers from a "rare piece syndrome", manifested as instability in a Markov model. However, the rare piece syndrome can be overcome by a simple distributed rule leading to a provably stable system.