SCALING METHODS FOR COMMUNICATION NETWORKS

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It is in general quite difficult to have a satisfactory description of the behavior of a Markov processes $(X(t))$ describing a stochastic network, especially when the dimension of the state space is greater than 1. It is nevertheless possible to get some insight on the behavior of these processes through limit procedures which can be roughly described as follows: for some parameter δ of the system, there is some critical value δ_0 of δ where, with an appropriate scaling, as δ is close to δ_0 the Markov process is converging to a much simpler process, like the solution of some ordinary differential equation. Examples of such scalings are

— *Heavy Traffic for Loss Networks (Kelly's scaling).*
These networks are subject to streams of call requests and their nodes have a finite capacity. The scaling considers the case where the arrival rates of requests and the capacities converge to infinity at proportional speed.

— *Thermodynamic Limits.*
This is the case when the network has N nodes and N is supposed to be very large.

— *Fluid Limits.*
The parameter δ is the norm of the initial state of $(X(t))$, the scaling consists in speeding up the time scale by a factor δ and the Markov process itself by $1/\delta$ and let δ converge to $+\infty$

— *Central Limit Scalings.*
It consists in speeding up the time scale by a factor δ^2 and the Markov process itself by $1/\delta$.

This talk presents several *simple* examples including TCP protocol or various examples of loss networks where these scalings can be used. The purpose of this talk is to show how powerful this approach can be, especially for networks with several nodes (more than 2 !).

References

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