

In the following paper ([cond-mat/0308399](#)), which has been accepted for publication in Physical Review Letters, we explore global organization of networks from local optimization based on local information exchange. Me, Martin Rosvall, would happily contribute with a talk on this project at the workshop.

## Modeling Dynamics of Information Networks

Martin Rosvall and Kim Sneppen

*Nordita, Blegdamsvej 17, 2100 Copenhagen Ø*

*rosvall@acc.umu.se*

(Dated: October 16, 2003)

We propose an information-based model for network dynamics in which imperfect information leads to networks where the different vertices have widely different numbers of edges to other vertices, and where the topology has hierarchical features. The possibility to observe scale-free networks is linked to a minimally connected system where hubs remain dynamic.

In a society the information horizon is set by each individual's social contacts, which in turn is a part of the global network of human communication. One simple goal for individuals is to be central. Thus we model a society where players try to be as close as possible to everybody else by moving their social connections. Local communication gives rise to global organization. Communication and not correctness appears as a success-strategy for individuals.

In other words we explore the local dynamic origin of global network organization by modeling response to information transfer in a simplified social system. The scenario is a set of players, that each tries to be as close

as possible to everybody else. The players adjust their social connections to achieve this goal, guided by a limited knowledge about the individual players' positions in the network. The finite information is in turn obtained by local communication. When local communication is weak, the system disorganizes into a highly dynamic and chaotic network where no single player is dominating the system. In network language, the degree distribution is narrow, or in technical words exponential. On the other hand, when local communication is strong, the system organizes into a coherent structure dominated by a central hub that remains indefinitely frozen. In between, there is a critical transition in the dynamics where no hubs take over for ever, and where at the same

time the network has players with all types of connectivities. The network is scale-free and furthermore hierarchical, in a way that resembles the Internet and often social and biological networks.

The modeled society opens for investigation of the interplay between individual behavior and global organization, as well as for exploring possible success-strategies for individuals. For example, we find that scale free-networks may be associated to a dynamics on the edge

of chaos. In fact, the system can self-organize to this transition between the frozen and the disordered state by a simple feedback mechanism associated to just the two most connected players in the system. Another interesting feature is that the success of individuals appears to not so much depend on their correctness, but rather on their ability to communicate actively. A talkative player's boasting is a self prophecy in the sense that it will lead him to become a major player in the system. Name-dropping pays off, also in a simulated society.