

Self-Organization in Ad Hoc Networks – the Past, the Present, and the Future

Dr. Falko Dressler

Autonomic Networking Group, Dept. of Computer Sciences, University of Erlangen

dressler@informatik.uni-erlangen.de

Self-organization in technical systems has become a major research issue in the last couple of years. Especially in the areas of autonomous systems and communication networks, there was some remarkable progress in building small and simple components that are collectively used in a much larger context to solve complex tasks. The search for unconventional methodologies in interdisciplinary fields, particularly in various fields of biology has brought us many unforeseen great concepts. This encouraging course seems to hold on for many aspects in technology.

In this talk, the capabilities of self-organization mechanisms in communication networks are discussed with the focus on ad hoc wireless networks and most popular sensor networks.

The Past – Classically, layered network architectures and communication protocols were used to provide a high level of abstraction. This allowed for particular self-organization mechanisms at each layer individually. Unfortunately, there were no cross cutting concerns for self-organization on a larger context.

The Present – The classical, layered architecture of communication networks is being changing today. Cross-layer concerns moved into the focus of autonomous systems research. By using new methodologies for protocol and system design, such as aspect-oriented programming, resource optimization and self-organization features can be achieved.

The Future – The awareness that nature has solved the problems of self-organization and the study of biological systems offer unconventional alternatives. The adaptation of such solutions as a model for technology, as demonstrated in several bio-inspired networking approaches provides high potentials for self-organized autonomous sensor/actuator networks.

The issues of self-organization as mentioned before are detailed and discussed by several examples in the area of ad hoc wireless networks that are primarily focusing on the following issues: scalability, energy efficiency, security, and quality of service support. In particular, a feedback oriented methodology for data dissemination in sensor networks is introduced as well as a corresponding congestion control mechanism. Both methods are meant to allow a completely self-organized behavior of the network nodes by relying on locally available information only.