Bio-Inspired Information Networking - Why and How We Can Build Self-Organizing Networks

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The development of computer networks has seen a paradigm shift from static, hierarchical network structures to highly distributed, autonomous systems without any form of centralized control. For networking nodes, the ability to self-adapt and self-organize in a changing environment has become a key issue. For those types of new dynamic networks, the following three requirements for network control are considered mandatory: expandability (or scalability), mobility, and diversity. The only solution to meet these characteristics seems to be that end hosts must be equipped with mechanisms permitting them to adapt to the current network status. For this reason, biologically inspired approaches seem promising since they are highly capable of self-adaptation, although they can be rather slow to adapt to environmental changes. Of course, the application of biologically inspired approaches in information technologies is not a new issue, but most of the previous attempts have been concentrated on optimization problems in network control. We can learn further important lessons from nature and the focus should lie on the scalability, adaptability, robustness and self-organization properties of biological systems. The purpose of this talk is to introduce general concepts from biological systems and to show their possible application in the field of computer networking. Then, we will present some case studies of methods from swarm intelligence, and will summarize some approaches which are based on evolutionary and adaptive systems.