Emergent Semantics Systems

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Abstract

Until recently, most data interoperability techniques involved central components, e.g., global schemas or ontologies, to overcome semantic heterogeneity for enabling transparent access to heterogeneous data sources. Today, however, with the democratization of tools facilitating knowledge elicitation in machine-processable formats, one cannot rely on global, centralized schemas anymore as knowledge creation and consumption are getting more and more dynamic and decentralized. Peer Data Management Systems (PDMS) implementing semantic overlay networks are a good example of this new breed of systems eliminating the central semantic component and replacing it through decentralized processes of local schema alignment and query processing. As a result semantic interoperability becomes an emergent property of the system.

In this talk we provide examples of both structural and dynamic aspects of such emergent semantics systems based on semantic overlay networks. ¿From the structural perspective we can show that the typical properties of self-organizing networks also appear in semantic overlay networks. They form directed, scale-free graphs. We present both analytical models for characterizing those graphs and empirical results providing insight on their quantitative properties. Then we present semantic gossiping, a model for the dynamic reorganization of semantic overlay networks resulting from information propagation through the network and local realignment of semantic relationships. The techniques we apply in that context are based on belief propagation, a distributed probabilistic reasoning technique frequently encountered in self-organizing systems. Finally we will give a quick glance on how this techniques can be implemented at the systems level, based on a peer-to-peer systems approach.

Biographical Sketch

Karl Aberer is a Professor for Distributed Information Systems at EPFL Lausanne, Switzerland, and director of the Swiss National Centre for Mobile Information and Communication Systems (NCCR-MICS). His research interests are on decentralization and self-organization in information systems with applications in peer-to-peer search, overlay networks, trust management and mobile and sensor networks. Before joining EPFL in 2000 he was leading the research division of open adaptive information systems at the Integrated Publication and Information Systems Institute (IPSI) of GMD in Germany, which

he joined in 1992. There his work concentrated on XML data management and cross-organizational workflows. He studied mathematics at ETH Zrich where he also completed his Ph.D. in theoretical computer science in 1991. From 1991 to 1992 he was postdoctoral fellow at the International Computer Science Institute (ICSI) at the University of California, Berkeley. He is member of several journal editorial boards, including VLDB Journal, and conference steering committees. Recently he served as PC co-chair of ICDE 2005, MDM 2006 and ISWC 2007.