

# Summary of the Dagstuhl-Seminar “Scalable Data Management in Evolving Networks”

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## **Abstract:**

Network technologies like mobile ad-hoc networks, peer-to-peer systems, and sensor networks are getting increasingly popular, but come up with new challenges to scalable data management because data management techniques developed for fixed-wired networks that usually depend on reliable and stable networks can not directly be used. The goal of this Dagstuhl Seminar was to identify common challenges in these popular network technologies problems, and to get a better understanding of the generality and applicability of solutions to the major problems in scalable data management in these areas.

## **Key words:**

peer-to-peer, mobile ad-hoc, and sensor networks, atomic transactions, P2P databases.

Data management technologies have been widely used in fixed-wired networks within the last two decades. Scalable technologies for query evaluation, transaction management and data storage have been developed for client-server systems and are widely used in industry. Nevertheless, key data management technologies are limited in their support of evolving networks including mobile ad-hoc networks (MANETs), peer-to-peer (P2P) systems, and sensor networks. More specifically, current database system technologies lack sufficient features for handling the mobility and ad-hoc aspects of many networking infrastructures. This includes cross-layer optimization involving network and data management aspects, location based data management and optimization, and mechanisms for handling error situations, such as node failures, link failures, and network partitioning. Therefore, an adaptation of current data management technologies and their applications to mobility and ad-hoc requirements is essential for them to be useful to mobile users.

During this one week seminar, the 25 participants that came to Dagstuhl were actively involved in discussions about these topics and discussed the requirements and protocols for atomic transactions in mobile environments, the role and definition of P2P

databases, and the differences in characteristics of environments like MANETs, P2P, and sensor networks.

One focused working group discussed the application scenarios, the technical requirements, and the open research questions for atomic transaction commitment in mobile ad-hoc environments. After collecting the requirements in different application fields ranging from emergency scenarios to mobile business and mobile gaming, the group investigated how the requirements are met by current atomic commit protocol implementations. One of the conclusions drawn was that although much research has been contributed to this field, the atomic commit problem is still open and unsolved for server-less applications and a demand for further research in this area exists.

Another focused working group discussed key requirements for P2P databases. Since P2P systems allow new forms of data and resource sharing among fast-changing communities having thousands of users, new ways of modelling, indexing, storing and querying data are required and must be adapted to P2P overlay structures.

The third working group discussed and compared a huge variety of extensions of conventional data management technologies that have been proposed for meeting the particular requirements of MANETs, P2P, and sensor networks. The discussion focused on the aspects of “typical application requirements” and “core technologies required for meeting the application requirements”. One of the conclusions was that MANETs, P2P, and sensor networks have a lot of common additional requirements beyond standard database technology, but they are used in very different scenarios, which have different requirements.

Additionally, there were four inspiring overview talks on data management in sensor networks, middleware approaches for sensor networks, personalization for the wireless user, and location-based services, which were followed by interesting discussions on further research directions in the whole group.

Finally, a couple of spontaneous ad-hoc organized discussions deepened some aspects of the workshop, for example, a discussion on a comparison of specific atomic commit protocols for MANETs, a discussion on data compression techniques, as well as more general discussions like how to teach the major results in the field.

Altogether, the seminar offered an excellent opportunity to share experiences and compare different contributions to data management in evolving networks from all the above areas, i.e. MANETs, P2P and sensor networks. We are convinced that a better understanding of problems that are common to different areas of data management in evolving networks has been achieved, and that this will result in synergetic effects in further research. All in all, the seminar was very successful and offered researchers of various disciplines from different countries an opportunity to share their experiences and expertise in a setting that is, as always, both inspiring for deep thoughts and pleasurable for idea exchanges.