PRACTICAL ASPECTS OF MOBILITY IN WIRELESS SELF-ORGANIZING NETWORKS

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Wireless and mobile computing have advanced significantly in the last decade. In particular, we now face the challenge to spontaneously establish wireless self-organizing networks, such as ad hoc, disruption-tolerant, sensor, and wireless mesh networks. These spontaneous self-organizing networks have been the focus of intensive research activity in recent years. Spontaneous networks arise from the cooperation of mobile devices in an ad hoc fashion requiring no previous infrastructure in place. A key point to couple research and real-life applications in this context is to understand how mobility (of devices, users, and applications) impacts practical networking aspects.

The knowledge accumulated so far in the area of wireless self-organizing networks is in general supported by either simulation or theoretical analysis relying on strong assumptions. The research community needs to consider real aspects of mobility in their protocols and algorithms. Such a situation may be compared with that of infrastructure-based networks (e.g., cellular networks), in which mobility has been thoroughly investigated (both theoretically and through measurements) and properly incorporated in their management architecture. In wireless self-organizing networks, contrary to common belief, much is still to be done in this domain, and definitive solutions are still to emerge.

Mobility can no longer be seen as an issue to be hidden from higher layers of the protocol stack, but as an expected characteristic of today's communication systems. In this context it is of utmost importance to address issues related to the impact of mobility as seen in practice, covering characterization, modeling, and applications of mobility in modern wireless networks. The research community working on wireless self-organizing networks has recently started paying more attention to the practical mobility issues in this area. This may be attested by the increasing number of initiatives worldwide like the many measurement campaigns and the considerable body of developed theoretical background work supported by practical arguments (e.g., mobility models, mobility increasing network capacity, relationships between node mobility and wireless channel conditions).

The goal of this special issue is to help fill this gap by presenting contributions ranging from the impact of mobility on self-organizing networks to mobility-aware architectures for self-organizing networks. We received 35 paper submissions from all over the world. Each paper was reviewed by three qualified reviewers. At the end of the review process, due to space limitations, we have accepted only eight articles. This special issue has thus an acceptance rate of about 23 percent. We hope the following articles are a great source of information to researchers and engineers working in the area of self-organizing wireless networks.

The articles composing this special issue are organized as follows. The first article is entitled "Mobility in an RF Isolated Test Platform" and is authored by Scully, Skehill, and McGrath. It presents a test platform equipped with IEEE 802.11 devices intended to ensure repeatability and reliability in wireless experiments. The authors consider a diverse set of mobility models to drive the device mobility patterns adopted in experiments using this test platform, and analyze the impact of these different mobility models on the performance of voice and data applications.

The second article is "An Empirical Study of the Impact of Mobility on Link Failures in an 802.11 Ad Hoc Network" by Lenders, Wagner, Heimlicher, May, and Plattner. It provides an experimental investigation of how link failures are affected by mobility. The authors develop a model to distinguish the causes of link failures, classifying them into two classes:

- Link failures due to node mobility
- Link failures incurred by collisions or interference that are independent of node mobility

Such information may be used, for instance, by routing protocols to optimize route repair decisions. The authors also provide a comparison between real user mobility and the mobility patterns determined by widely adopted mobility models.

The third article, "Mobility-Aware Middleware for Self-Organizing Heterogeneous Networks with Multihop Multipath Connectivity," is authored by Bellavista, Corradi, and Giannelli. This article proposes a middleware solution for self-organizing networks with multhop multipath heterogeneous

connectivity (MMHC). The management decisions on the proposed mobility-aware application-layer middleware are based on a local procedure that preselects a subset of the available single-hop connections and a global procedure that determines the most suitable MMHC paths. The authors have designed and implemented MMHC middleware with such features for lightweight management decisions and present some experimental results.

The fourth article is entitled "Strategies for Data Dissemination to Mobile Sinks in Wireless Sensor Networks" and is authored by Ben Hamida and Chelius. The authors consider wireless sensor networks with mobile sinks for an extended network lifetime compared to scenarios with static sinks. In this context the article surveys data dissemination approaches that rely on virtual infrastructures to support mobile sinks in wireless sensor networks. The authors also analyze how different virtual infrastructures impact network performance in terms of network lifetime and energy consumption.

In the fifth article, "Enabling Mobility in Heterogeneous Wireless Sensor Networks Cooperating with UAVs for Mission-Critical Management," Erman, van Hoesel, and Havinga rely on the hybrid nature of a wireless sensor network in terms of mobility to perform fundamental tasks such as in-network aggregation of sensor data, routing, and activity monitoring of responders. The work led to a two-layer architecture that is part of a European project. The authors show through real deployment the merit of their approach.

Efficient management of network reconfiguration in case of node mobility is the focus of the sixth article, "On Reconfiguration in Case of Node Mobility in Clustered Wireless Sensor Networks," by Radeke, Marandin, Claudios, Todorova, and Tomic. The authors tackle the case of clustering techniques in wireless sensor networks composed of nodes equipped with IEEE 802.15.4/ZigBee communication capabilities. The authors propose a combination of proactive and reactive reconfiguration strategies to reorganize clustered structures in case of node mobility. They show that the combination of both schemes performs only slightly better than the proactive reconfiguration, but at the cost of more overhead, and conclude that the best choice is to use only the proactive reconfiguration.

The seventh article is entitled "On the Impact of User Mobility on Peer-to-Peer Video Streaming," and is authored by Moraes, Campista, Duarte, Passos, Costa, Rubinstein, Albuquerque, and Duarte. The authors investigate the behavior of P2P video streaming applications in a scenario where users of a wireless mesh network are mobile. The authors investigate the issues of using TCP and UDP depending on the conditions and on the type of mobility. The authors also discuss a number of open issues that should be addressed by the research community.

Finally, in the eighth article, entitled "Data Harvesting in Sensor Networks using Mobile Sinks," Rao and Biswas address the trade-off between data delivery delay and energy consumption around the sink. The authors then propose to benefit from the possibility of making sinks move in order to achieve better energy usage while respecting delay constraints. They propose a distributed cooperative control mechanism in which nodes determine the best trajectory to be followed by the sink.

The guest editors would like to thank all authors that contributed to this special issue and are grateful to the many reviewers that did a wonderful job helping us select the articles. We would also like to thank Abbas Jamalipour for his invaluable help and for hosting this special issue. We hope the readers will be happy with the contents of this special issue on practical aspects of mobility in wireless self-organizing networks.

BIOGRAPHIES

MARCELO DIAS DE AMORIM [S'00, M'01] is a full time research scientist at the French National Center for Scientific Research (CNRS) and a member of the LIP6 laboratory of the Université Pierre et Marie Curie — Paris 6. He holds a B.Sc. in electronic engineering and an M.Sc. in electrical engineering, both from Universidade Federal do Rio de Janeiro (UFRJ), Brazil, and a Ph.D. from the University of Versailles, France. His research interests focus on self-organizing networks. He is involved in various national and European projects, and is the technical coordinator of the IST WIP project. He has served on the technical program committees of numerous international conferences and is currently on the editorial board of *IEEE Communications Surveys and Tutorials*.

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LEANDROS TASSIULAS [S'89, M'91, SM'05, F'07] obtained a Diploma in electrical engineering from the Aristotelian University of Thessaloniki, Greece, in 1987, and M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park in 1989 and 1991, respectively. He is a professor in the Department of Computer and Telecommunications Engineering, University of Thessaly, since 2002. He has held positions as assistant professor at Polytechnic University New York (1991–1995), assistant and associate professor, University of Maryland College Park (1995–2001) and Professor, University of Ioannina Greece (1999–2001). His research interests are in the field of computer and communication networks with emphasis on fundamental mathematical models, architectures and protocols of wireless systems, sensor networks, high-speed Internet, and satellite communications. He received a National Science Foundation (NSF) Research Initiation Award in 1992, an NSF CAREER Award in 1995, an Office of Naval Research Young Investigator Award in 1997, and a Bodosaki Foundation award in 1999. He also received the INFOCOM 1994 best paper award and the INFOCOM 2007 achievement award.