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Editorial

Ad hoc networking for pervasive systems

The hardware and software progresses of the last ten years provided the basic elements (wearable computers, several wireless-network technologies, devices for sensing and remote control, etc.) for the realization of pervasive computing and communication systems. In these systems the environment is saturated with computing and communication capabilities, completely integrated with the surrounding environment, aimed at helping the users in the everyday life.

In a pervasive computing environment, the infrastructure-based wireless communication model is often not adequate: it takes time to set up the infrastructure network, while the costs associated with installing infrastructure can be quite high. These costs and delays may not be acceptable for dynamic environments where people and/or vehicles need to be temporarily interconnected in areas without a pre-existing communication infrastructure (e.g., inter-vehicular and disaster networks), or where the infrastructure cost is not justified (e.g., in-building networks, specific residential communities networks, etc.). In these cases, infrastructure-less or ad hoc networks provide a more efficient solution.

The simplest ad hoc network is a peer-to-peer network formed by a set of stations within the range of each other that dynamically configure themselves to set up a temporary single-hop ad hoc network. The widespread adoption of the Bluetooth technology in computing and consumer electronic devices makes the Bluetooth piconet the most relevant solution for single-hop ad hoc networks.

A single-hop ad hoc network only interconnects devices that are within the same transmission range. This limitation can be overcome by exploiting the multi-hop ad hoc (MANET) technology. In a MANET, the users' mobile devices cooperatively provide the functionalities usually provided by the network infrastructure (e.g. routers, switches, servers). Devices that are not directly connected, communicate by forwarding their traffic via a sequence of intermediate devices.

Sensor nodes are an important component of pervasive systems, and wireless ad hoc networking techniques also constitute the basis for sensor networks. However, the special constraints imposed by the unique characteristics of sensing devices, and by the application requirements, make many of the solutions designed for multi-hop wireless networks (generally) not suitable for sensor networks. For this reason, the ad hoc networking research community recently has generated an extensive literature dedicated to sensor networks.

The seven papers selected for this special issue address several hot research issues in this new exciting networking field.

The first paper in the special issue is by Carlos de M. Cordeiro, Sachin Abhyankar, and Dharma P. Agrawal. In "An Enhanced and Energy Efficient Communication Architecture for Bluetooth Wireless PANs" the authors propose a novel dynamic slot assignment scheme for a Bluetooth wireless PAN. This scheme allows the slaves to communicate directly with each other without any master intervention. Significant performance

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improvements are shown via extensive simulative analyses.

Following this, the paper by Werner Priess, José Ferreira de Rezende, and Luci Pirmez "Adaptive Interpiconet Scheduling for Multipurpose Scatternet Scenarios" proposes an interpiconet scheduling algorithm, adaptive to traffic conditions, which can optimize performance indices such as: traffic aggregated throughput, delay, and power consumption. Simulative experiments are used to validate the proposed algorithm.

Next, Romit Roy Choudhury and Nitin H. Vaidya, in their paper "Performance of Ad Hoc Routing using Directional Antennas", analyze the impact of directional antennas on the dynamic source routing (DSR) performance. The authors show results that are counter-intuitive in many instances, and provide insights about performance. In addition they suggest two modifications to the original DSR algorithm for efficient use of directional antennas.

In the next paper on "Improving TCP Performance in Ad Hoc Networks using Signal Strength based Link Management", Fabius Klemm, Zhenqiang Ye, Srikanth V. Krishnamurthy, and Satish K. Tripathi propose mechanisms to reduce the number of lost TCP packets in a MANET by differentiating, using the signal strength, between losses due to congestion and to link failure.

The analysis of cooperation in MANET is the topic of the next paper by Pietro Michiardi and Refik Molva "Analysis of Coalition Formation and Cooperation Strategies in Mobile Ad Hoc Networks". This paper analyzes the problem of cooperation in wireless mobile networks with game theoretical techniques. By using non-cooperative game theory, they show the superiority of their mechanism for cooperation enforcing (CORE) over the history based schemes.

MANET is also the topic of "Lessons from Experimental MANET Research" by Christian Tschudin, Per Gunningberg, Henrik Lundgren and Erik Nordström. The paper provides a critical review of the current status of MANET research. The authors point out limitations of studies based only on simulations. Furthermore, the paper discusses and identifies the "ad hoc horizon", i.e., a boundary within which decent network service can be provided with the MANET paradigm.

The final paper of the special issue, by Raquel A.F. Mini, Max do Val Machado, Antonio A.F. Loureiro, and Badri Nath, focuses on sensor networks. In their paper "Prediction-based Energy Map for Wireless Sensor Networks" the authors address the problem of constructing a sensor-network energy map, i.e., the amount of available energy in each part of the network. They propose a prediction-based approach to forecast the future energy consumption of a sensor node by using its own past history.

As guest editors it has been a great pleasure to put together this issue. We would like to thank the authors for their contributions and the reviewers for their time, energy, and comments that helped shape this special issue.

Marco Conti received the Laurea degree in Computer Science from the University of Pisa, Italy, in 1987. In 1987 he joined the Italian National Research Council (CNR). He is currently a senior researcher at IIT-CNR. His research interests include Internet architecture and protocols, wireless networks, ad hoc networking, mobile computing, and QoS in packet switching networks. He co-authored the book "Metropolitan Area Networks" (Springer, London, 1997) and is co-editor of the book "Mobile Ad Hoc Networking" (IEEE—Wiley, 2004). He published in journals and conference proceedings more than 120 research papers related to design, modeling, and performance evaluation of computer-network architectures and protocols. He served as TPC chair of the IFIP-TC6 Conferences "Networking2002", and "PWC2003", and as TPC co-chair of ACM WoWMoM 2002, the IFIP-TC6 Conference on Wireless On-demand Network Systems (WONS 2004), and the 2nd Workshop on Modeling and Optimization in Mobile, Ad Hoc and Wireless Networks (WiOpt'04). He is on the editorial board of Ad Hoc Networks journal and ACM Mobile Computing and Communications Review. He served as guest editor for the Cluster Computing Journal (special issue on "Mobile Ad Hoc Networking"), IEEE Transactions on Computers (special issue on "Quality of Service Issues in Internet Web Services"), ACM/Kluwer Mobile Networks & Applications Journal (special issue on "Mobile Ad Hoc Networks"), and the "Networking2002" journal special issues of Performance Evaluation, Cluster Computing and ACM/Kluwer Wireless Networks journals. He has been member of the Program Committee of several Int'l ACM, IFIP and IEEE conferences. He is member of IFIP WGs 6.2, 6.3 and 6.8.

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