Recent Advances on Future Networks and Their Management

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The rapid growth in mobile traffic and broadband wireless connections, together with the advent of the Internet-of-Things call for novel mobile and wireless network management techniques, able to cope with an increasing number of challenges. Individual techniques can no longer be considered in isolation, but there must be a clear cooperation and cross fertilization amongst them. Since 2009, the International Conference on Mobile Networks and Management (MONAMI) provides researchers with the opportunity to describe and discuss their latest research results. The Call-for-Papers of this Special Issue was a result of the 5th edition of the MONAMI conference, which was held in Cork, in September 2013.

The six papers that were finally selected for publication, after a thorough review process in which each paper was reviewed by at least three experts, provide a good picture of the currently most relevant topics within the field of mobile and wireless networking. They give an interesting perspective on some of the most challenging problems and discuss interesting techniques and solutions to address them.

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From the point of view of the wireless substratum, one of the topics that has received much attention recently is the cognitive radio paradigm. In order to be able to support the increasing resource demand, a more efficient usage of the available spectrum is necessary. In the first paper of this special issue, Sunita S. Barve proposes an opportunistic routing and channel assignment scheme for mobile ad-hoc networks. The proposed holistic approach is based on multi-agent reinforcement learning (MARL) techniques and aims at exploiting unused chunks of licensed spectrum bands. The author combines a number of different metrics to take decisions and by means of simulations, he shows that the MARL-based routing scheme outperforms other state-of-the-art solutions. He also analyses different techniques to carry out relay selection.

Another key aspect of the management of future wireless networks is their mobility. Traditional schemes might not be sufficient to cope with stringent new requirements and therefore, novel solutions must be fostered. The next two papers of this special issue specifically deal with advanced mobility solutions. First, Wen-Kang Jia, after providing an interesting survey of existing MobileIP based mobility protocols, proposes a universal IP mobility framework that is able to select the most suitable mobility protocol, for scenarios in which Mobile IPv6 and Proxy Mobile IPv6 coexist. The author also proposes Traffic Driven Pseudo Binding Update (TDPBU), a novel route optimization scheme, and assesses its performance by means of extensive simulation studies. Afterwards, Li Jun Zhang et al. propose Seamless Mobile IPv6 (SMIPv6), a novel mobility protocol that exploits the multi-homing capabilities of most of current wireless devices to establish bidirectional secure tunnels that are established before handoffs. The authors use the OPNET simulator to compare the performance of this protocol with traditional MIPv6. The results show that SMIPv6 outperforms the state of the art both in terms of handoff latency and packet losses.

Another angle that is also covered in this special issue is a new set of services and applications that have emerged from the possibilities of new wireless technologies. In particular, Michael Charitos and Grigorios Kalivas present, in the fourth paper of this special issue, a surveillance system by means of a vehicular WiMAX - WiFi Network. They present a highly modular architecture, able to cover a wide range of scenarios. One clear contribution of this paper is that the authors use a real hybrid-network prototype to assess the performance of their architecture over an in-tunnel scenario. The results demonstrate that, in terms of the downlink throughput, the system is feasible and can effectively cope with its requirements.

An important aspect that needs to be addressed in forthcoming wireless network scenarios is the convergence with fixed networks. Although the capacity of wireless technologies is continuously increasing, they will never reach the capacity of their wired counterparts. In fact, mobile operators are currently fostering offloading techniques and, in many cases, the smaller access alternatives rely on a fixed broadband connection. In addition, the trend is to offer each home with a fiber connection. In order to appropriately manage this broadband connectivity, Giacomo Bernardi et al. propose in the fifth paper of this special issue BSense, a flexible broadband mapping system to assess the coverage and the quality of the available connections in a given geographic region. The proposed management scheme obtains data from both ISPs as well as from a dedicated software client that runs on users' computers. The authors assess the operation of the proposed framework by means of extensive measurements that in addition characterize the behavior of different broadband connections: ADSL, cable, Wireless and Satellite. The paper also describes how the BSense framework could be used to analyze the broadband coverage for a large geographical area, by inspecting the available data for the whole of Scotland.

We would like to highlight the last paper in this special issue, since it is the revised version of the work which was awarded the best paper during the MONAMI'13 conference. Minji Kim et al. present a thorough analysis of the benefits in terms of throughput and energy that the use of network coding (NC) techniques can bring if combined with the TCP protocol. By building on the Padhye model, they characterize the throughput as a function of the characteristics of lossy links. They propose a mathematical model, which demonstrates the clear gain brought about by the combination of TCP and NC. The authors also study the tradeoff between the goodput of a wireless network and the corresponding energy additional cost (due to the increased number of base stations); and they propose a mathematical model, which is corroborated with a system-level simulation carried out with Matlab.

Ramón Agüero received a degree in Telecommunications Engineering from the University of Cantabria in 2001 and the PhD in 2008. He is currently an Associate Professor at the Communications Engineering Department at that university. He has participated in several collaborative research projects and his research focuses on future network architectures, especially regarding the (wireless) access part of the network. He is also interested on multi-hop (mesh) networks and device-to-device communications. He has published more than 100 technical papers in such areas and he is a regular TPC member and reviewer on various related conferences and journals.

Bernd-Ludwig Wenning received Dipl.-Ing. and Dr.-Ing. degrees in Electrical Engineering and Information Technology from University of Bremen, Germany, in 2002 and 2009. From 2002 to 2012, he was a researcher at University of Bremen, participating in several projects in the area of communication networks. In 2012, he joined Nimbus Centre at Cork Institute of Technology, Ireland, as a Research Fellow. Since then, he has been involved in a number of national and European projects around wireless sensor networks. Throughout his research career, Bernd-Ludwig Wenning has published more than 30 papers in conferences and journals.

Andreas Timm-Giel was, between 1994 and 1999, group leader at the University of Bremen in the area of mobile and satellite communications and involved in several EU funded projects. After receiving his PhD in 1999 he moved to MediaMobil GmbH and M2SAT Ltd. as Technical Project Leader and Manager Network Operations. In December 2002 he joined the Communication Networks group at the University of Bremen as senior researcher and lecturer. He was leading several industrial, national and EC funded research projects and from 2006 he was additionally directing the interdisciplinary activity "Adaptive Communications" of TZI (Center of Computing and Communication Technologies). In November 2009 he was appointed full professor at Hamburg University of Technology (TUHH) and is heading the Institute of Communication Networks. Since 2012 he is coordinator of the research cluster SOMSED "Self-organizing mobile sensor and data networks" at TUHH and since 2013 deputy head of the TUHH's school of electrical engineering, computer science and mathematics. His research interests are mobile and wireless communications, sensor networks and the Future Internet.

Dirk Pesch is Head of the Nimbus Centre for Embedded Systems Research at Cork Institute of Technology. Prior to joining CIT in 1999, he was a research fellow at the University of Strathclyde in Glasgow, UK, and was a design engineer with Nokia in Germany and England. He holds a Dipl .Ing. degree from RWTH Aachen University in Germany (1993), and a PhD from the University of Strathclyde in Glasgow (1999), both in Electrical and Electronic Engineering. His expertise centres around development and analysis of wireless/mobile ad-hoc and wireless sensor network architectures and protocols and cloud based service and management platforms with applications in energy management, transportation, and smart cities. He is very active in national and EU research projects in the area of wireless networks and applications in the building management space. Dirk has co-authored 7 book chapters and made over 170 publications in his area of expertise. He is on the editorial board of the IEEE Vehicular Technology Magazine, Elsevier Pervasive and Mobile Computing, International Journal of Distributed Sensor Networks and Springer Wireless Networks. He also contributes to conference organisation as chair/member of technical programme committees of a large number of leading international conferences and workshops.