

ACM/Springer Mobile Networks and Applications (MONET) Special Issue on “Recent Advances in IEEE 802.11 WLANs: Protocols, Solutions and Future Directions”

Editorial

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With the rapid growth in popularity of wireless data services and the increasing demand for wireless connectivity, Wireless Local Area Networks (WLANs) have become more widespread and are making their way into commercial and public areas being almost everywhere including business, office and home deployments. WLANs based on the IEEE 802.11 standards enjoy an exceptionally high popularity owing to their simplicity of setup, configuration, and management, increased deployment flexibility, operability in

unlicensed frequency bands, low cost, and connectivity with minimal infrastructure changes.

Lately, the need for real-time multimedia services over WLANs to support applications such as Voice over IP (VoIP), audio/video (AV) streaming, Internet videoconferencing, IPTV, distance learning systems, entertainment and gaming programs has dramatically increased. The impressive proliferation of networking scenarios (e.g. multi-hop and mesh networks) and applications (e.g. real-time multimedia services) not natively supported by the original standard has boosted the design of several protocol extensions, which have been proposed and evaluated by the research community, the industry and the standardization groups.

However, despite recent advances in wireless technology, many research issues such as bandwidth management, power conservation, compatibility with legacy networks and error resilient design still need to be addressed. Furthermore, the dynamically-varying and error-prone nature of the wireless medium pose further challenges in providing efficient channel access mechanisms and Quality of Service (QoS) support over WLANs.

This special issue presents a collection of selected papers that represent advances towards the performance enhancement of IEEE 802.11 WLANs. A total of 37 high-quality papers were received from the open call and finally eight were selected to be published in this issue.

The first paper, “*A Control Theoretic Approach for Throughput Optimization in IEEE 802.11e EDCA WLANs*”, by Patras, Banchs and Serrano, proposes a control theoretic approach to adapt the congestion window (CW) to the conditions of the WLAN, based on an analytical model of its operation that is fully compliant with the IEEE 802.11e standard. The controller is a Proportional Integrator, able to

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perform a theoretic analysis to determine its configuration and to drive the WLAN to its optimal point of operation.

In the paper “*Cross-Layer Scheduling with QoS Support over a Distributed Queuing MAC for Wireless LANs*” Kartsakli, Alonso-Zárate, Alonso and Verikoukis propose four scheduling algorithms that are based on an efficient distributed MAC protocol named Distributed Queuing Collision Avoidance (DQCA). The proposed schemes combine the efficiency of opportunistic scheduling with the Quality of Service (QoS) provisioning through service differentiation in order to provide QoS guarantees. The authors study the throughput, delay and jitter performance of the proposed schemes through simulations for a scenario with heterogeneous traffic of voice, video, best-effort and background data traffic flows.

The paper “*A Multi-Scale Statistical Control Process for Mobility and Interference Identification in IEEE 802.11*” by Oliveira, Loureiro and Frery deals with the problem of estimating the wireless channel conditions in indoor environment. In fact, different optimization strategies can be pursued according to the physical origin (e.g. collisions or fading) of channel impairments. Thus, the availability of reliable estimation techniques for distinguishing different failure events has several practical implications. The authors present a new method for user centric management on IEEE 802.11b/g focused in improving the user experience.

The paper “*DPS: An Architecture for VBR Scheduling in IEEE 802.11e HCCA Networks with Multiple Access Points*”, by Vergados, Vergados and Douligeris, is focused on the problem of interference management among overlapping polling-based networks. Since nowadays the unlicensed spectrum is overloaded, it is very likely that multiple overlapping networks work on the same channel, thus creating potential conflicts among polling commands and node transmissions, which are not managed via the carrier-sense function. The paper describes these problems and proposes an interesting multi-cell coordination scheme for coping with conflicting polling.

The paper “*IEEE 802.11n MAC Enhancement and Performance Evaluation*”, by Wang and Wei, examines the network performance enhancement by the proposed IEEE 802.11n MAC layer features like aggregation, block acknowledgement and reverse direction mechanism. The authors implement a new 802.11n module in the NS-2 simulation platform and through simulations they demonstrate that IEEE 802.11n indeed improves the channel efficiency and provides high quality for VoIP services.

The paper “*Packet Delay Metrics for IEEE 802.11 Distributed Coordination Function*”, by Raptis, Vitsas and Paparrizos, introduces a comprehensive packet delay analysis for wireless networks based on IEEE 802.11 Distributed Coordination Function (DCF). The approach is based on proper mathematical models that calculate a set of packet delay metrics, including average delay, delay distribution and jitter. The developed models are based on calculating station’s delay time at the transmission slot(s) plus the average time that station defers at backoff slots before successful transmission, leading to simple and computationally efficient models.

In the paper “*Performance Study of A Mobile Multi-Hop 802.11a/b Railway Network using Passive Measurement*”, Zhou, Sharif, Hempel, Mahasukhon, Wang and Chen build an outdoor multi-hop multi-interface railroad testbed and study the performance of IEEE 802.11a/b protocols in a large-scale mobile railway network. They introduce a large-scale passive measurement approach that enables a global performance view for the entire monitored network. Furthermore, the paper discusses the implications on guaranteeing the quality of mobile services in IEEE 802.11-family railway networks.

In the paper “*Green WLANs: On-demand WLAN Infrastructure*”, Jardosh, Papagiannaki, Belding, Almeroth, Iannaccone and Vinnakota consider achieving energy conservation in dense WLAN deployments where a potentially large number of access points with overlapping coverage areas can be managed centrally. The paper presents resource on-demand (RoD) strategies for switching power to the access points to reduce the total energy consumption while maintaining coverage to all users. The authors also discuss several future research directions towards the wide-spread deployment of RoD WLANs.

We would like to thank all authors for submitting their work to this Special Issue and the external reviewers for their tireless work and efforts during the reviewing process. We also wish to thank MONET Editorial Staff for their continuous support and professionalism. Finally, we want to express our gratitude to the Editor-in-Chief, Professor Imrich Chlamtac, for giving us this great opportunity of organizing this special issue and for his invaluable support and suggestions.

We are most pleased to present this issue and we hope that it will provide a good source for up-to-date information on this exciting topic.

Enjoy the issue!



Periklis Chatzimisios received his BSc degree in Informatics from Technological Educational Institution of Thessaloniki, Greece, in 2000 and his PhD degree in wireless communications from Bournemouth University, U.K., in 2005. He is currently working as a Postdoctoral Researcher and adjunct Assistant Professor with the Department of Informatics at the Technological Educational Institution of Thessaloniki. He has been also employed as an adjunct Lecturer by University of Macedonia,

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Dr. Yang Xiao worked in industry as a MAC (Medium Access Control) architect involving the IEEE 802.11 standard enhancement work before he joined Department of Computer Science at The University of Memphis in 2002. He is currently with Department of Computer Science at The University of Alabama. He was a voting member of IEEE 802.11 Working Group from 2001 to 2004. He is an IEEE Senior Member. He is a member of American Telemedicine Association. He currently serves as Editor-

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major journals (more than 60 in various IEEE journals/magazines), refereed conference proceedings, book chapters related to these research areas. Dr. Xiao's research has been supported by the US National Science Foundation (NSF), U.S. Army Research, Fleet & Industrial Supply Center San Diego (FISCSD), and The University of Alabama's Research Grants Committee.



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multiple access algorithms with quality of service provisioning; cross-layer interactions between access solutions and physical layer; mobility management and load balancing in wireless packet networks.



Fabrizio Granelli received the "Laurea" (M.Sc.) degree in Electronic Engineering from the University of Genoa, Italy, in 1997, with a thesis on video coding, awarded with the TELECOM Italy prize, and the Ph.D. in Telecommunications, in 2001. Since 2000 he is teaching as Assistant Professor in Telecommunications and Coordinator of the Networking Research Laboratory at the Dept. of Information Engineering and Computer Science-University of Trento (Italy). In August 2004, he was visiting

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