

# Editorial

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Ad hoc networks, due to their intended support of “no-limit” infrastructure-less communication, pose many significant new challenges with respect to traditional wireless networks. Main peculiarities of ad hoc networks, which typically require new solutions for distributed signal processing and control, can be summarized as follows: autonomous and spontaneous nature of nodes which leads to dynamic unpredictable topology; mobility of nodes which may cause link failures and network partitions; battery limitations which imply constraints on transmission power and network connectivity; need of cooperative and/or opportunistic behaviour in spite of the natural energy-conservative selfish attitude of nodes.

The traditional layered protocol architectures are not well suited to deal with the above-multifaceted issues, because they do not exploit the potential improvement in performance that can be obtained through cross-layer design.

Typical examples of transversal objectives which deserve joint interaction of algorithms and techniques that span multiple layers are energy efficiency, quality-of-service support, reliability, network scalability.

This special issue has been conceptualized within the framework of the IST-FP6 Network of Excellence in Wireless Communications (NEWCOM), and, more specifically, within the context of the NEWCOM Project A on “Ad Hoc and Sensor Networks.”

It contains thirteen papers, which are all communed by their focus on the potential benefits gained by applying a cross-layer design perspective to ad hoc networks. More in

detail, five papers address cross-layer approaches to routing, five deal with cross-layer design of clustering and topology management strategies, two with support of multimedia applications, and finally one paper focuses on middleware architectures and embedded operating systems in wireless sensor networks.

The first paper “Position-based relaying with hybrid-ARQ for efficient ad hoc networking,” by B. Zhao and M. C. Valenti, presents an integrated cross-layer protocol which, using position location, jointly performs operations of cooperative diversity, hybrid-ARQ retransmission, and relaying/routing in an energy-efficient way.

The second paper “Traffic-dependent and energy-based time delay routing algorithms for improving energy efficiency in mobile ad hoc networks,” by K. Murugan and S. Shanmugavel, introduces an extension to the basic DSR protocol that utilizes energy-efficiency metrics to optimize routing.

The third paper “Energy-aware routing protocol for ad hoc wireless sensor networks,” by R. P. Mann et al., proposes a new routing protocol where energy consumption considerations are exploited to estimate the route expiry time and minimize the route request processing.

The fourth paper “A cross-layer route discovery framework for mobile ad hoc networks,” by B. Zhou et al., introduces a cross-layer route discovery framework which is aimed at reducing the problems that are known in literature as next-hop racing and rebroadcast redundancy.

In the fifth paper “Adaptive QoS routing by cross-layer cooperation in ad hoc networks,” H. Sun and H. D. Hughes

propose an adaptive multipath routing scheme which exploits local QoS information provided by cross-layer mechanisms.

The sixth paper “Cross-layer design of an energy-efficient cluster formation algorithm with carrier-sensing multiple access for wireless sensor networks,” by C. Buratti et al., introduces a new protocol, called LEACH B+, which enables self-organization of nodes in clusters and allows nodes to route information according to energy-related considerations.

In the seventh paper “Automatic decentralized clustering for wireless sensor networks,” C.-Y. Wen and W. A. Sethares propose and analyze a clustering scheme where sensors in an ad hoc network use local criteria to determine their own operations.

The eighth paper “Optimizing transmission and shut-down for energy-efficient real-time packet scheduling in clustered ad hoc networks,” by S. Pollin et al., introduces a cross-layer transmission strategy which considers the transceiver power characteristics, the system load, and the channel constraints, as well as the relevant tradeoff.

The ninth paper “Dynamic resource reservation and connectivity tracking to support real-time communication among mobile units,” by T. Facchinetti et al., proposes a new MAC protocol to schedule real-time communication in a network of robotic mobile units and introduces a distributed topology tracking mechanism which is used to support resource reservation and packet routing.

Security in clustered ad hoc networks is the subject of the tenth paper “Authentication based on multilayer clustering in ad hoc networks,” by K.-H. Lee et al., where an end-to-end message authentication scheme that relies on mutual trust between nodes in different clusters is introduced.

In the eleventh paper “Cross-layer QoS control for video communications over wireless ad hoc networks,” Q. Qu et al. propose a cross-layer rate-control scheme and a joint source-channel coding which are based on an analytical study of how the effective video transmission rate is affected by such parameters as the interference environment, the number of transmission hops to the destination, and the packet loss rate.

The twelfth paper “An evaluation of media-oriented rate selection algorithm for multimedia transmission in MANETs,” by M. H. Manshaei et al., proposes a cross-layer mechanism for dynamically selecting the transmission mode of real-time audio/video information over 802.11 ad hoc networks which consider both the channel conditions and characteristics of the media.

In the thirteenth paper “A survey of application distribution in wireless sensor networks,” by M. Kuorilehto et al., a taxonomy of middleware architectures and embedded operating systems in wireless sensor networks is presented and the new framework SensorOS, aimed at minimizing the control signalling overhead and maximizing the network lifetime, is introduced.

Finally, we would like to thank the Editor-in-Chief, Phillip Regalia, for giving us the opportunity and the support to achieve this special issue within the frame of the IST FP6 Network of Excellence NEWCOM, all the authors of the papers submitted (either accepted or not) for considering this

issue as a target of their own work, and—last but not least—the many reviewers who allowed us to take our editorial decisions on which papers to select. Our indebted appreciation to all of them!

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**Sergio Palazzo** received his degree in electrical engineering from the University of Catania in 1977. Since 1987, he has been at the University of Catania, where he is now a Full Professor of telecommunications networks. In 1994, he spent the summer at the International Computer Science Institute (ICSI), Berkeley, as a Senior Visitor. He is a recipient of the 2003 Visiting Erskine Fellowship by the University of Canterbury, Christchurch, New Zealand. He will be the General Chair of the ACM MobiHoc 2006 Conference. In the recent past, he has been the General Vice Chair of the ACM MobiCom 2001 Conference. He currently serves on the Editorial Boards of the IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, Computer Networks, Ad Hoc Networks, and Wireless Communications and Mobile Computing. In the recent past, he also was an Editor of the IEEE Wireless Communications Magazine. He was a Guest Editor of special issues in the IEEE Journal of Selected Areas in Communications, in the IEEE Personal Communications Magazine, and in the Computer Networks Journal. He is the recipient of the 2002 Best Editor Award for the Computer Networks Journal. His current research interests include mobile systems, wireless and satellite IP networks, multimedia traffic modelling, and protocols for the next generation of the Internet.



**Leandros Tassioulas** is a Professor in the Department of Computer Engineering and Telecommunications at the University of Thessaly, Greece, since 2002 and a Research Professor at the University of Maryland, College Park. His research activity over the last fifteen years has been towards the development of communication and information-processing networks that facilitate access and exchange of information among multiple entities. Current research and teaching topics include wireless mobile communications, ad hoc networks, smart antennas, sensor networks, high-speed networked environments. He was an Assistant Professor at the Polytechnic University, NY, in 1991–1995, an Associate Professor at the University of Maryland, College Park, until 2002 (on leave from 2000 to 2002), and a Professor of computer science at the University of Ioannina, Greece, in 1999–2002. He obtained the Diploma in electrical engineering from the University of Thessaloniki, Greece, in 1987, and the M.S. and Ph.D. degrees in electrical engineering from the University of Maryland, College Park, in 1989 and 1991, respectively. He has been an Associate Editor for Communication Networks for the IEEE Transactions on Information Theory and an Editor for IEEE/ACM Transactions on Networking. His research activity received several recognitions including 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, a Bodossaki Foundation Award in 1999, and the INFOCOM '94 Best Paper Award.

**Lang Tong** joined Cornell University in 1998 where he is now a Professor. Prior to joining Cornell University, he was on faculty at the West Virginia University and the University of Connecticut. He was also the 2001 Cor Wit Visiting Professor at the Delft University of Technology. He received the B.E. degree from Tsinghua University, Beijing, China, in 1985, and Ph.D. degree in electronic engineering from the University of Notre Dame, Notre Dame, Indiana, in 1991. He was a Post-doctoral Research Affiliate at the Information Systems Laboratory, Stanford University, in 1991. He is a Fellow of the IEEE. He received the Outstanding Young Author Award from the IEEE Circuits and Systems Society, the 2004 Best Paper Award (with Min Dong) from the IEEE Signal Processing Society, and the 2004 Leonard G. Abraham Prize Paper Award from the IEEE Communications Society (with Parvathinathan Venkitasubramaniam and Srihari Adireddy). He also received the Young Investigator Award from the Office of Naval Research. His research is in the general area of statistical signal processing, communication systems and networks, and information theory. Specific topics include multiaccess communications, parameter estimation and detection, random access protocols, and performance analysis. His research group is currently investigating roles of signal processing in wireless systems and networks with specific applications in cellular and ad hoc networks, detection and estimation in sensor networks, broadcast HDTV, wireless LAN, and cable and DSL systems.

