

Special Issue on Seamless Mobility in Wireless Networks

Guest Editorial

With the emerging wireless technologies, mobility has more generic meaning than just node movement as in the traditional sense. It also means that when the operational environment changes (such as frequency and power), a node or the network adapts to the environmental changes, which requires the cognitive capability. On one hand, it is of critical importance that seamless, low latency, and transparent services are provided to the users, via potentially multiple heterogeneous wireless technologies during the course of node movement or environmental changes. This is particularly challenging if infrastructure networks are absent. *Environment cognizance*, *mobility management*, and *vertical handoff* become critical components in the solution space of seamless mobility support. On the other hand, host and network mobility also affects the performance of network protocols significantly, which in turn makes *mobility adaptability* an important design issue. This asks the design of wireless architectures, protocols, spectrum management, and mobility management mechanisms to be revisited. Traditional infrastructure-based approach is not sufficient to tackle all the challenges manifested today.

In view of the advances in wireless technologies and the growing demand of mobile services, this special issue is dedicated to the recent advances in architecture, system, protocol, modeling, and testbed design, as well as emerging applications and standards to enable seamless mobility and transparency in wireless networks. The aim of this special issue is to enhance the understanding of the holistic picture for providing seamless mobility in wireless networks.

After a peer-reviewing process, for this special issue, we selected nine high-quality papers. The selected papers cover general areas of wireless mobility, including mobility in mobile Internet, mobility in heterogeneous wireless networks, mobility in multihop wireless networks, and security during mobility. In the following, we briefly summarize the papers included in this special issue.

Mobility in Mobile Internet: The first paper “Distributed and Dynamic Mobility Management in Mobile Internet: Current Approaches and Issues” by H. A. Chan, H. Yokota, J. Xie, P. Seite, and D. Liu, surveys existing mobility management solutions in mobile Internet, explains the limitations of a centralized mobility management approach, and discusses potential approaches of distributing mobility management functions. The issues and challenges in the design of distributed and dynamic mobility management are also described in the paper.

Mobility in Heterogeneous Wireless Networks: There are three papers in this issue addressing the seamless handoff issue in heterogeneous wireless networks with multi-interface mobile devices. The second paper “An Integrated Multi-layer Approach for Seamless Soft Handoff in Mobile Ad Hoc Networks” by H. Zeng, J. H. Li, S. Das, A. McAuley, J. Lee, T. Stuhmann, and M. Gerla, presents an integrated framework and a cross-layer approach to realize seamless soft handoffs in heterogeneous wireless networks with multiple interfaces. Both simulation and emulation with real wireless hardware are conducted to demonstrate that transparent user application can be achieved using the proposed integrated multi-layer handoff approach. The third paper “Minimum-Risk Layer 2 Trigger Levels for Proactive Media-Independent Handovers” by D. Griffith, A. Delye, and N. Golmie, proposes a weighted risk function that can be used to determine the optimal link going down (LGD) trigger threshold under IEEE 802.21 Media Independent Handover (MIH). The proposed risk function characterizes the signaling overhead of triggering an anticipated handoff and the mean time required for a handoff completion. Simulation results show that network operators can use the proposed risk function to devise event trigger thresholds that optimize the handoff performance. The fourth paper “A Software Architecture for Network-Assisted Handover in IEEE 802.21” by C. Cicconetti, F. Galeassi, and R. Mambrini, proposes a Media Independent Information Service (MIIS) architecture and procedures that enable network-assisted handoffs. The proposed network-assisted handoff can reduce the energy consumption of mobile nodes due to scanning. The authors implemented a prototype to prove the feasibility of the proposed solution.

Mobility in Multihop Wireless Networks: There are four papers in this issue addressing the routing and data dissemination issues in multihop wireless networks. The fifth paper “A Discussion on Developing Multihop Routing Metrics Sensitive to Node Mobility” by N. Chama and R. Sofia, discusses several parameters and heuristics that can assist multihop routing more sensitive to node mobility. The sixth paper “Adaptive Localized Active Route Maintenance Mechanism to Improve Performance of VoIP over Ad Hoc Networks” by A. S. Otero and M. Atiquzzaman, develops a route maintenance mechanism that enables real-time communications in mobile ad hoc networks. The proposed mechanism can recognize, respond, and recover quickly from link breaks due to node mobility and maintain on-going communications. Experimental results from a testbed show the improvement of the proposed mechanism in the response time to link failures and overall network performance. The seventh paper “Mobility-adaptive Routing for Stable Transmission in Mobile Ad Hoc Networks” by X. Hu, J. Wang, and C. Wang, focuses on the adaptability of the constructed route to node mobility. A routing algorithm is proposed to select the most stable route. Simulation results show that the proposed mobility-adaptive routing algorithm can provide good network performance in mobile network environments. The eighth paper “I2V Highway and Urban Vehicular Networks: A Comparative Analysis of the Impact of Mobility on Broadcast Data Dissemination” by S. Busanelli, G. Ferrari, and V. A. Giorgio, analyzes the impact of vehicular mobility on the data dissemination performance in infrastructure-to-

vehicular (I2V) IEEE 802.11 networks. Both highway and urban scenarios are considered in the analysis. Both per-packet and per-flow performance is analyzed using numerical simulations.

Security during Mobility: The last paper “Securing Host-Based Mobility and Multi-Homing Protocols against On-Path Attackers” by G. K. Hampel and V. Kolesnikov, presents a balanced security solution that protects host-based mobility and multi-homing protocols against on-path attackers. The proposed solution is based on proof of session ownership using secret/answer chains as well as temporal separation and routability tests.

We hope this special issue can give readers an overview of the state-of-the art technologies, challenges, and trends in supporting seamless mobility in wireless networks. We also hope that the research papers in this special issue can sparkle further research in one of the most prevailing and ever important issues in current and future wireless networks: seamless wireless mobility.

We would like to sincerely thank all the reviewers who provided timely and constructive feedback to the authors. We also thank all the authors for their high-quality contributions to this special issue. We thank the staff at JCM Academy Publisher for their efficient job in handling the manuscripts. Finally, we would like to thank the Editor-in-Chief of JCM, Dr. Haohong Wang, for his guidance and assistance with this special issue.

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Subir Das is a Senior Scientist in Mobile Networking research department, Telcordia Technologies. Dr. Das received his PhD in Computer Engineering from Electrical and Electronics Communication Engineering Department, Indian Institute Technology, Kharagpur, India. From 1997-99, Dr. Das was a faculty member in the same Department. Dr. Das was a Principal Investigator of an Army Research Laboratory sponsored project on Secure, Dynamic Ad Hoc Networking and is currently leading several research programs on wireless IP and ad hoc networking in Telcordia Technologies. He has published more than sixty papers and several book chapters in the area of wireless networking. Dr. Das has four US patent to his credit and more than a dozen applications are pending. He is a member of the TPC of several IEEE international conferences and a reviewer of IEEE JSAC, TMC, TON, Wireless Communication, Communication magazine and Wiley and Elsevier Network Journals. He is a lead contributor to IEEE and IETF Standards. Dr. Das is currently the Vice Chair of IEEE 802.21 WG and earlier served as co-chair of IETF PANA WG. He served as organizing committee member in several conferences and workshops such as IEEE Sarnoff, ACM Mobicom Workshop, IEEE PerCom, IEEE CollaborateCom, and so on. He has delivered tutorials in several international conferences including ICC and VTC and chaired several workshop and symposium panels.



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Mario Gerla obtained his Engineering degree from Politecnico di Milano, Italy and Ph.D. degree from UCLA. He became IEEE Fellow in 2002. He is currently a Professor in the Computer Science at UCLA. He joined the UCLA Faculty in 1976. At UCLA, he was part of the team that developed the early ARPANET protocols under the guidance of Prof. Leonard Kleinrock. He has designed network protocols including ad hoc wireless clustering, multicast (ODMRP and CODECast) and Internet transport (TCP Westwood). He has lead the ONR MINUTEMAN project, designing the next generation scalable airborne Internet for tactical and homeland defense scenarios. He is now leading two advanced wireless network projects under ARMY and IBM funding. His team is developing a Vehicular Testbed for safe navigation, urban sensing and intelligent transport. A parallel research activity explores personal communications for cooperative, networked medical monitoring (see www.cs.ucla.edu/NRL for recent publications).

Nada Golmie received her Ph.D. in computer science from the University of Maryland at College Park. Since 1993, she has been a research engineer in the advanced networking technologies division at the National Institute of Standards and Technology (NIST). She is currently the manager of the emerging and mobile network technologies group. Her research in media access control and protocols for wireless networks led to over 100 papers presented at professional conferences, journals, and contributed to international standard organizations and industry led consortia. She currently serves as an area editor for Elsevier Ad Hoc Networks and a technical program committee for several IEEE and ACM conferences including INFOCOM, ICC and GLOBECOM. She is the author of *Coexistence in Wireless Networks: Challenges and System-Level Solutions in the Unlicensed Bands* (Cambridge University Press, 2006).



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