Hindawi Publishing Corporation
EURASIP Journal on Wireless Communications and Networking
Volume 2007, Article ID 52861, 2 pages
doi:10.1155/2007/52861

# *Editorial*
# Algorithmic Aspects of Wireless Networks

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Received 2 May 2007; Accepted 2 May 2007



Recent advances in electronic and computer technologies have paved the way for the proliferation of ubiquitous wireless networks. Fast deployment of these communication networks for the users is preferred under many situations. Topics that are related to ad hoc and sensor networking, mobile computing, and wireless and mobile security have been extensively studied recently. Potential applications of these networks include search and rescue, smart homes, battlefield surveillance, environment monitoring and control, and so forth.

In response to the above demand for wireless networks, this special issue aims at providing a timely and concise reference of the current activities and findings in the relevant technical fields, as well focuses on the state-of-the-art and up-to-date efforts in the algorithmic aspects of wireless networks include location management, topology control and coverage, security and privacy, scalable design, cross-layer design, resource optimization, QoS, to just name a few. We believe that almost all papers included in this special issue not only provide novel ideas, new analytical models, simulation and experimental results, and handful experience in this field, but also simulate the future research activities in the area of the quality of service for mobile ad hoc networks. A brief summary of each paper is listed as follows.

The first paper, by M. Shabany et al., proposes a novel framework to model downlink resource allocation problem in multiservice direct sequence code division multiple access (DS-CDMA) cellular networks. This framework is based on a defined utility function, which leads to utilizing the network resources in a more efficient way. This utility function quantifies the degree of utilization of resources. As a matter of fact, using the defined utility function, users' channel fluctuations and their delay constraints along with the load conditions of all BSs are all taken into consideration. Unlike previous works, the authors solve the problem with the general objective of maximizing the total network utility instead of maximizing the achieved utility of each base-station (BS). It is shown that this problem is equivalent to finding the optimum BS assignment throughout the network, which is mapped to a multidimensional multiple-choice Knapsack problem (MMKP). Since MMKP is NP-hard, a polynomial-time suboptimal algorithm is then proposed to develop an efficient base-station assignment. Simulation results indicate a significant performance improvement in terms of achieved utility and packet-drop ratio.

The second paper, by M. Ding et al., introduces the authors' exploratory work toward identifying the targets in sensor networks with faulty sensors. They explore both spatial and temporal dimensions for data aggregation to decrease the false alarm rate and improve the target position accuracy. To filter out extreme measurements, the median of all readings in a close neighborhood of a sensor is used to approximate its local observation to the targets. The sensor whose observation is a local maximal computes a position estimate at each epoch. Results from multiple epochs are combined together to further decrease the false alarm rate and improve the target localization accuracy. Their algorithms have low computation and communication overheads. Simulation study demonstrates the validity and efficiency of their design.

The third paper, by T. Li et al., analyzes security weakness of the operational and proposed CDMA systems and presents an encryption-based secure scrambling process. First, instead of using the long code sequences generated by the LFSR directly, the scrambling sequences are generated through AES operations. As a result, the physical layer built-in security of the CDMA system is significantly increased with very limited complexity load. Second, it is shown that by scrambling, the training sequence and the message sequence separately with two independent scrambling sequences, both information privacy and system performance, can be further

improved. Finally, error-tolerant decryption can be achieved through secure scrambling. The proposed scheme is very feasible and can be readily implemented for security enhancement in wireless networks.

The fourth paper, by S. Guo et al., considers the problem of maximizing the network lifetime for both single and multiple multicast connections in a wireless ad hoc network (WANET) that use omnidirectional/directional antennas and have limited energy resources. Unlike most centralized multicast algorithms, the authors provide a globally optimal solution to this problem in a distributed manner for the special case of single multicast session in a WANET with omnidirectional antennas. This graph-theoretic approach provides us with insights into more general case of using directional antennas, and inspires us to produce a group of distributed algorithms. Experimental results show that our distributed algorithms outperform other centralized multicast algorithms significantly in terms of network lifetime for both single session and multiple session scenarios.

The fifth paper, by J. Wang and M. Song, analyzes existing AQM schemes and proposes a rate-based exponential AQM (REAQM) scheme. The proposed REAQM scheme uses input rate as the primary metric and queue length as the secondary metric. The objectives are to stabilize the system with low packet delay, low packet loss, and high link utilization regardless the dynamic of network conditions. The authors prove the global asymptotic stability of the equilibrium based on Lyapunov theory. Simulation results indicate that REAQM is capable of performing well for TCP flows over both wired and wireless links, and has comparable implementation complexity as other AQM schemes.

The sixth paper, by Q. Liang, firstly performs some theoretical studies on radar sensor network (RSN) design based on linear frequency modulation (LFM) waveform: (1) the conditions for waveform coexistence, (2) interferences among waveforms in RSN, (3) waveform diversity in RSN. Then the author applies RSN to ATR with delay-doppler uncertainty and proposes maximum-likelihood (ML) ATR algorithms for fluctuating target and nonfluctuating target. Simulation results show that the author's RSN vastly reduces the ATR error comparing to a single radar system in ATR with delay-doppler uncertainty. The proposed waveform design and diversity algorithms can also be applied to active RFID sensor networks and underwater acoustic sensor networks.

The seventh paper, by Y. Kubo and K. Sekiyama, deals with a novel communication timing control for wireless networks and radio interference problem. Communication timing control is based on the mutual synchronization of coupled phase oscillatory dynamics with a stochastic adaptation, according to the history of collision frequency in communication nodes. Through local and fully distributed interactions in the communication network, the coupled phase dynamics self-organizes collision-free communication. In wireless communication, the influence of the interference wave causes unexpected collisions. Therefore, they propose a more effective timing control by selecting the interaction nodes according to received signal strength.

The last paper, by R. J. Haines et al., reviews and compares different mechanisms, to achieve this end, and a number of different means of obtaining the configurations themselves. They describe an analytical model of the system under consideration and present two mathematical approaches to derive solutions for any system configuration and deployment, along with an adaptive feedback-based solution. They also describe a comprehensive simulation-based model for the problem, and a prototype that allows comparison of these approaches. Their investigations demonstrate that a self-adaptive dynamic approach far out-performs any static scheme, and that using a mathematical model to produce the configurations themselves confers several advantages.

In closing, we would like to thank the support from the Editor-in-Chief, Phillip Regalia, and the contributions from authors and reviewers, to make this special issue possible.

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