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Editorial

Wireless Machine-to-Machine Networks

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Machine-to-Machine (M2M) technology allows events captured by sensors in machine devices to be communicated directly with each other through wireless and/or wired systems and processed by the machine devices without human intervention. With worldwide expansion of wireless networks information can be exchanged between machine devices much easier and faster at lower cost. M2M technology opens unique opportunities to businesses as well as consumers on cost reduction and services improvement. It holds huge potential for applications in a wide range of industries.

Over the next few years there will be a huge increase in the number of machines enabled by M2M technology. The development of wireless M2M networks supporting machine devices in that scale is pivotal to the success of M2M. Sensor nodes in wireless M2M networks could be connected by a wide range of wireless network technologies including cellular networks, WPAN, RFID, Wi-Fi, Wimax, and satellite networks. However, these heterogeneous network technologies combined with the low-power machine devices and diverse QoS requirements of M2M applications present big challenges to the wireless M2M networks, including support of possibly huge number (up to billions) of M2M devices, supporting a wide range of M2M applications with significantly different traffic patterns and QoS requirements, supporting different types of sensors with low power and low mobility.

These challenges are not so often faced by general wireless sensor networks and can cause problems on almost all layers of wireless M2M networks. To ensure success of M2M applications under these challenges, many issues remain to be solved for wireless M2M networks. For example, wireless M2M networks need to consistently provide reliable communication services (in terms of effective QoS and security) for the M2M applications. Scalable, smart, and adaptive protocols and algorithms should also be designed and implemented for M2M networks as the networks are more likely to malfunction without human intervention. These protocols and algorithms should intelligently adapt to dynamic network environments characterized by a large amount of low-power M2M devices, heterogeneous networks with limited bandwidth, and many coexisting applications with diverse QoS requirements.

This special issue aims to gather researchers and engineers from different relevant areas, such as wireless sensor networks, RFID, WPAN, cellular networks, and smart grid, to present the latest research on wireless M2M networks. Thirteen papers have been accepted in this special issue. They are mainly focused on four different research areas: (1) tackling the challenge of supporting a large number of M2M devices by developing advanced wireless communication technologies to improve network capacity; (2) design and analysis of wireless channel access and resource management for M2M applications which have specific QoS requirements; (3) energy efficiency issue and scalability issue of networking/topology control; (4) scalable network architecture and flexible resource description that can be used for M2M networks.

The paper "*On the achievable user number of the downlinks in cellular-based machine-to-machine communications*" by Y. Li et al. is concentrated on analyzing the number of M2M users that can be admitted into cellular networks with certain preconfigured QoS.

In the paper "*Distributed energy-efficient topology control algorithm in home M2M networks*" by C.-Y. Lee et al. a distributed energy-efficient topology control algorithm was proposed to enhance energy efficiency and prolong network lifetime.

The paper "*Energy-efficient chain formation algorithm for data gathering in wireless sensor networks*" by S.-J. Lim et al. investigated chain-based routing protocols for improving energy efficiency of wireless sensor networks.

The paper "*An energy-efficient and fault-tolerant convergecast protocol in wireless sensor networks*" by T. Yang et al. explored the hyper-graph theory to compute energy efficient data delivery for convergecast applications over large scale WSNs.

The paper "*Collaborative relay beamforming strategies for multiple destinations with guaranteed QoS in wireless machine-to-machine networks*" by D. Wang et al. studied the amplify-and-forward (AF) relay beamforming to guarantee the QoS requirements of M2M devices. Two iterative strategies were proposed to jointly optimize the source antenna selection and the collaborative relay beamforming weights.

In the paper "*Resource description language: a unified description language for network embedded resources*" A. C. Santos et al. proposed a resource description language that represents a uniform way of describing embedded resources, which can contribute to overcome performance issues in dense or highly dynamic M2M networks.

In the paper "*Service-oriented radio architecture: a novel M2M network architecture for cognitive radio systems*" X. Dong et al. proposed a flexible M2M network architecture, which can be used for the development of cognitive radio networks.

The paper "*A dynamic pricing scheme for congestion game in wireless machine-to-machine networks*" by Z. Mao et al. developed a distributed dynamic pricing scheme for wireless M2M networks with objective of minimizing the maximum latency over all source nodes, in which routing congestion was formulated as a dynamic game.

The paper "*Optimal routing control in disconnected machine-to-machine networks*" by Y. Wu et al. investigated incentive policies for optimal routing in M2M networks which may not be always connected.

The paper "*Adaptive message rate control of infrastructured DSRC vehicle networks for coexisting road safety and non-safety applications*" by W. Guan et al. is concentrated on the QoS provisioning in vehicle network for both road safety and non-safety applications. Adaptive rate control schemes were proposed to improve the system performances.

In the paper "*Distributed beamforming for relay assisted multiuser machine-to-machine networks*" C. Chen et al. developed distributed algorithms for relay assisted beamforming, by which each relay node individually learns its own beamforming weights with local channel state information (CSI). Two suboptimal relay beamforming schemes were proposed that only require local CSI to minimize mean square error (MSE) for all the users with non-orthogonal channels.

The paper "*Multilayer orthogonal beamforming for priority-guaranteed wireless communications*" by J. Xie et al. studied efficient spectrum sharing between M2M devices and normal mobile users over cellular networks. A multilayer orthogonal beamforming (MOBF) scheme is proposed by which frequency resource could be efficiently reused by both normal mobile users and M2M devices, and QoS of normal users is not affected by the admission of M2M devices.

The paper "*Investigation of uncoordinated coexisting IEEE 802.15.4 networks with sleep mode for machine-to-machine communications*" by C. Ma et al. investigated the impact of uncoordinated operations on the QoS performances of coexisting IEEE 802.15.4 based M2M networks.

The thirteen papers included in this special issue presented the latest research on both protocol design and theoretic analysis for wireless M2M networks, which are based on various wireless communication technologies (e.g., cellular networks, wireless sensor networks, DSRC, and IEEE 802.15.4). We hope that this special issue can help readers to get a better understanding about the breadth and depth of the current research on wireless M2M networks and boost further research and practical developments in the field of wireless M2M networks.

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