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: GUEST EDITORIAL

IEEE ACCESS SPECIAL SECTION EDITORIAL: RECENT ADVANCES IN SOCIALLY-AWARE MOBILE NETWORKING

Mobile data traffic has been growing exponentially over the past few years. A report from Cisco shows that the mobile data traffic in 2014 grew 69 percent and was nearly 30 times the size of the entire global Internet in 2000 [item 1] in the Appendix]. One of the primary contributors to the explosive mobile traffic growth is the rapid proliferation of mobile social applications running on multimedia mobile devices (particularly smartphones). These sharp increases in mobile traffic (particularly from mobile social applications) are projected to continue in the foreseeable future. As mobile networks by and large are designed and deployed to meet people's social needs, people's behaviors and interactions in the social domain will shape their ways to access mobile services. Therefore, there is an urgent need to integrate social effects into the design of mobile networks.

Socially-aware mobile networks have emerged as a promising direction for future mobile networks. Socially-aware mobile network designs can improve shared spectrum access, cooperative spectrum sensing and device-to-device (D2D) communications. Proper exploitations of social ties among the network nodes may enhance all network functionalities and lead to significant increases in network capacity. In spite of the potential benefits of socially-aware mobile networking, many technical challenges have yet to be addressed. For example, mobile users need to trust others to carry out effective cooperation, and a natural question to ask is "how to leverage human social trust to enhance distributed spectrum access?" Moreover, since mobile users need to communicate potentially sensitive information (such as location) to neighbors and third parties (like in D2D sharing), privacy and security protection are also important components in the design of socially-aware mobile networks.

Inspired by the aforementioned attractive features and potential advantages of socially-aware mobile networks, socially-aware mobile networking has recently garnered much attention, but remains not well understood, and therefore deserves further investigation from both the academia and industry. This Special Section in IEEE ACCESS aims to bring together academic and industrial researchers to identify and discuss technical challenges and recent results related to socially-aware mobile networking, so as to enrich the evolution of future mobile networks. After peer review of each submission, this Special Section has 11 accepted articles,

covering a wide spread of topics in socially-aware mobile networking.

To investigate how to improve the information diffusion performance in socially aware mobile networks, the paper entitled "The Value Strength Aided Information Diffusion in Socially-Aware Mobile Networks" by J. Wang *et al.* proposes a time-varying graph based mobility model for information diffusion, as well as the value strength, the social influence of a node, finally resulting in the social strength, exploited to probabilistically select the most appropriate forwarding node among neighbors thus improving the information coverage. Another paper entitled "Social-Aware Resource Allocation for Content Dissemination Networks: An Evolutionary Game Approach" by Z. Huang *et al.* proposes an evolutionary-game-based distributed resource allocation scheme, in order to reduce the delay of content dissemination process with D2D communication. In this scheme, all D2D links will select resource adaptively, based on the predicted contact duration, whose prediction accuracy is improved using the proposed social trajectory similarity by mining user behavior patterns. Further, in the paper entitled "Social Network-Based Content Delivery in Device-to-Device Underlay Cellular Networks Using Matching Theory" by C. Xu *et al.*, the content delivery problem related to optimization of peer discovery and resource allocation is studied by combining both the social and physical layer information in D2D underlay networks. In particular, the social relationship is modeled as the probability of selecting similar contents and estimated by using the Bayesian nonparametric models, which is used as a weight to characterize the impact of social features on D2D pair formation and content sharing. A three-dimensional iterative matching algorithm is proposed to maximize the sum rate of D2D pairs weighted by the intensity of social relationships while guaranteeing the quality of service requirements of both cellular and D2D links simultaneously.

As mobile social device caching (MSDC) has become an active area of research, the paper entitled "Challenges of Mobile Social Device Caching" by Y. Wu *et al.* introduces the structure and key concepts of MSDC, which include the above social and physical layers, elaborates its connections and differences to traditional caching, and brings to evidence several design and research challenges for MSDC. Moreover, a concrete illustrative example is presented to illustrate the

modeling of the MSDC, and performance improvements of four proposed content placement strategies are compared. In spite of the potential benefits of caching, caching data for other nodes may result in additional cost to the node serving as cache in D2D networks. The paper entitled “Social-Aware Incentivized Caching for D2D Communications” by K. Zhu *et al.* proposes a social-aware caching game to incentivize nodes to cache data for others, where the social ties and physical distance are combined to formulate the caching cost. A social-aware caching algorithm, minimizing the total cost incurred by all mobile nodes of getting object data in the network and reaching the Nash equilibrium of this social-aware caching game, is proposed.

Fixed and mobile intelligent devices embedded in the urban environment enable the concept of Smart City (SC) and aim at improving the overall social welfare. The paper entitled “Social-Aware Data Collection Scheme Through Opportunistic Communication in Vehicular Mobile Networks” by Z. Tang *et al.* proposes the Social Welfare Data Collection Paradigm (SWDCP) SCmules data collection framework to detect and collect the status of infrastructures by therein embedded intelligent devices, the “SCmules” picking up data from nearby intelligent devices and then store-carry-forwarding them to nearby data centers on the move via short-range wireless connections. In a similar scenario, the paper entitled “CRATER: A Crowd Sensing Application To Estimate Road Conditions” by F. Kalim *et al.* develops a crowd sensing application to estimate road conditions (CRATER), which is a smartphone application that opportunistically measures acceleration when it finds itself on the road in order to map and measure the locations of potholes and speedbumps. This map allows both citizens and municipal authorities to localize road segments in need of repair and imbalances in infrastructure maintenance efforts across cities.

Moreover, this Special Section also covers recent advances of many other important topics. The paper entitled “When Social Network Meets Mobile Cloud: A Social Group Utility Approach for Optimizing Computation Offloading in Cloudlet” by L. Tang *et al.* optimizes computation offloading in cloudlet, a small-scale data center directly available by wireless connection for nearby devices, by leveraging the social tie structure among mobile user. Mutually beneficial computation offloading decision making for cases with both strong and weak information are proposed to maximize the system-wide social welfare. The paper entitled “Dynamic Trust Associations Over Socially-Aware D2D Technology: A Practical Implementation Perspective” by A. Ometov *et al.* studies the crucial aspects of trusted social associations over proximity-based direct communications technology, including security, implementation issues in resource-constrained devices, and coalition dynamics. By developing a comprehensive proof-of-concept implementation, the paper proposes an information security protocol suite for secure and trusted social-aware D2D communications. To tackle the dynamic topology of mobile social networks and inspired by the theory of information potentials, the paper entitled “You

Can Act Locally With Efficiency: Influential User Identification in Mobile Social Networks” by M. Zhang *et al.* proposes a scheme for influential user identification and selection that exploits the mobility and activeness of users to construct the most effective route reaching the global maxima without depending on specific routing protocols. As a promising paradigm for the fifth generation mobile communication (5G) system, the fog radio access network (F-RAN) has been proposed as an advanced socially aware mobile networking architecture to provide high spectral efficiency while maintaining high energy efficiency and low latency. The paper entitled “Recent Advances in Fog Radio Access Networks: Performance Analysis and Radio Resource Allocation” by M. Peng *et al.* comprehensively summarizes the recent advances of the performance analysis and radio resource allocation in F-RANs.

Finally, we would like to thank all reviewers for their great efforts in reviewing the submitted manuscripts, without which this Special Section would not have been published as scheduled. We would also like to thank the Managing Editor B. M. Onat, the Publications Editor K. Shumard, and the Editor-in-Chief and Staff Members for their supportive guidance during the whole process in the organization of this Special Section.

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APPENDIX

RELATED WORKS

- 1) Cisco, “Cisco visual networking index: Global mobile data traffic forecast update, 2013–2018,” Cisco, San Jose, CA, USA, White Paper, Feb. 2014. [Online]. Available: <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/whitepaperc11-520862.html>



MUGEN PENG (M'05–SM'11) received the B.E. degree in electronics engineering from the Nanjing University of Posts and Telecommunications, Nanjing, China, in 2000, and the Ph.D. degree in communication and information systems from the Beijing University of Posts and Telecommunications (BUPT), Beijing, China, in 2005. After the Ph.D. graduation, he joined BUPT, where he has been a Full Professor with the School of Information and Communication Engineering, since 2012. In 2014, he was an Academic Visiting Fellow with Princeton University, Princeton, NJ, USA. He leads the Research Group, focusing on wireless transmission and networking technologies with the Key Laboratory of Universal Wireless Communications (Ministry of Education), BUPT. He has authored or co-authored over 40 refereed IEEE journal papers and over 200 conference proceeding papers. His main research interests include wireless communication theory, radio signal processing, and convex optimizations, with a particular interests in cooperative communication, radio network coding, self-organization networking, heterogeneous networking, and cloud communication. He was a recipient of the 2014 IEEE

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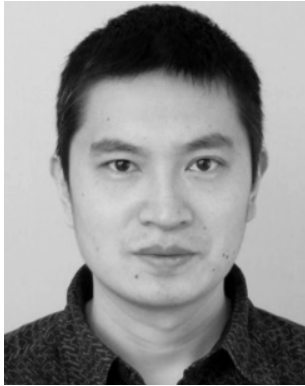


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Student Paper Award at the ACM SIGMETRICS/IFIP Performance 2016, the Best Paper Runner-up Award at the IEEE INFOCOM 2009 and the IEEE INFOCOM 2014, and the Best Paper Award at the IEEE ICC 2008. He was an Associate Editor of the *IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS*, an Editor of the *Computer Network Journal*, and an Editor of the *IEEE Wireless Communication Magazine*. He was a Distinguished Lecturer of the IEEE Communications Society. He is currently serving as an Editor-at-Large of the *IEEE/ACM TRANSACTIONS ON NETWORKING* and an Editor of the *IEEE Network Magazine*.



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