

BIG DATA INTELLIGENT NETWORKING



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Internet of Things (IoT) is likely to have a significant impact on human lives as new services and applications are developed through integration of the physical and digital worlds. IoT is an umbrella term referring to a large number of sensing and actuation devices connected to the Internet. The vast amounts of data will be generated from those devices and form big data to provide smarter living and/or improve production efficiency.

The huge amount of data opens new challenges in the era of new data-driven solutions, which also have significant influence on communication networks. Current networks are often designed based on static end-to-end design principles hindering the efficient and intelligent provisioning of big data. This special issue features recent and emerging advances in the areas of big data analytics in networking applications and networking for big data. Of the 76 submitted papers, 13 were selected for this issue. For big data analytics for intelligent networking, the selected articles cover topics including but not limited to edge intelligence, traffic and transport intelligence, service intelligence, and intelligent network deployment and management. Regarding networking for big data, the topics, such as blockchain and network security and reliability for big data, are covered in this special issue.

An important research trend is to employ big data analytics to provide edge intelligence. The first article, “Edge QoE: Intelligent Big Data Caching via Deep Reinforcement Learning” by Xiaoming He, Kun Wang, Haodong Lu, Athanasios V. Vasilakos, and Song Guo, introduces a novel big data architecture. This consists of data management units for content extraction and caching decisions, to improve the QoS and ensuring QoE, where deep reinforcement learning (DRL) is utilized to gain a lower cost for intelligent caching. The second article, “Edge Intelligence Assisted Gateway Defense in Cyber Security” by Shengjie Xu, Yi Qian, and Rose Qingyang Hu, presents an edge intelligence assisted gateway defense in cyber security. The authors conduct an experimental study on applying a semi-supervised learning approach to perform network anomaly detections.

Traffic and transport intelligence is another important area to enable intelligent networking. The third article, “Optimizing Feature Selection for Efficient Encrypted Traffic Classification: A Systematic Approach” by Meng Shen, Yiting Liu, Liehuang Zhu, Ke Xu, Xiaojiang Du, and Nadra

Guizani, presents a systematic approach to optimizing feature selection for encrypted traffic classification. The fourth article, “Congestion Control in SDN-based Network via Multi-task Deep Reinforcement Learning” by Kai Lei, Yuzhi Liang, and Wei Li, proposes a congestion control model based on multi-task deep reinforcement learning taking congestion control as the main task and load balancing as the auxiliary task. The fifth article, “MPTCP Meets Big Data: Customizing Transmission Strategy for Various Data Flows” by Yitao Xing, Jiangping Han, Kaiping Xue, Jianqing Liu, Miao Pan, and Peilin Hong, gives optimal strategies for different data flows, and proposes a cross-layer solution for multipath TCP to automatically provide flexible and optimal transmission strategies.

Big data also provides intelligence to the services, network deployment and management. The sixth article, “Community Detection Method Based on Local Optimization in Social Networks” by Guangxia Xu, Xinkai Wu, Jun Liu, and Yanbing Liu, proposes community detection for social networks based on local fitness maximal and local community stability, which can effectively find smaller and more meaningful clusters. The seventh article, “Intelligent Post-Disaster Networking by Exploiting Crowd Big Data” by Xiaoyan Wang, Fangzhou Jiang, Lei Zhong, Yusheng Ji, Shigeki Yamada, Kiyoshi Takano, and Guoliang Xue, exploits crowd dynamics to estimate the population distribution after a disaster and place the limited number of relay nodes to maximize the population coverage ratio. The eighth article, “Big Data for 5G Intelligent Network Slicing Management” by Hatim Chergui, and Christos Verikoukis, proposes a complete framework for implementing big data-driven dynamic slicing resource provisioning while respecting service level agreements (SLAs).

Blockchain is an emerging approach to enable trustworthy big data sharing. The ninth article, “Blockchain-based Sharing and Tamper-proof Framework of Big Data Networking” by Jiachen Yang, Jiabao Wen, Bin Jiang, and Huihui Wang, presents a big data sharing and transaction framework based on blockchain and a data tamper-proof mechanism to prevent transaction data from being tampered. The tenth article, “Shadow-Chain: A Decentralized Storage System for Log Data” by Feng Lu, Wei Li, Hai Jin, Lu Gan, and Albert Y. Zomaya, identifies the problem of preserving personal privacy when sharing health data. In particular, they propose

a decentralized storage system for log data based on blockchain, shadow-chain, to realize data sharing between untrustworthy parties.

Network security and reliability is an indispensable area enabling intelligent networking for big data. The eleventh article, "ID-Based SDN for Internet of Things" by Xiaoliang Wang, Ke Xu, Wenlong Chen, Qi Li, Meng Shen, and Bo Wu, leverages unforgeable terminal identities in the data stream to propose an ID-based SDN secure network architecture for IoT big data security. The twelfth article, "Protecting Machine Learning Integrity in Distributed Big Data Networking" by Yunkai Wei, Yijin Chen, Mingyue Xiao, Sabita Maharjan, and Yan Zhang, presents a secure architecture consisting of a HaSi scheme and two data tampering detection schemes for protecting machine learning integrity in distributed big data networking. The last article, "Reliability for Smart Healthcare: A Network Slicing Perspective" by Andressa Vergutz, Guevara Noubir and Michele Nogueira, investigates reliability in healthcare systems and presents an architecture relying on fingerprinting healthcare applications to quickly customize resources and meet the level of reliability for smart health applications.

This special issue has successfully addressed important topics in the cross area between big data analytics and intelligent networking. Besides these studies, there are still many open challenges in this area, such as: How to use big data analytics to realize efficient network function deployment? How to use big data to enhance the performance of wireless networks? How to preserve privacy? How to enable the network to intelligently steer traffic to transverse a specific set of network functions?

We would like to take this opportunity to thank all the reviewers for their great support in reviewing these manuscripts. We also thank the Editor-in-Chief, Prof. Mohsen Guizani, for his supportive guidance during the entire process.

BIOGRAPHIES

Ruidong Li is a senior researcher at the National Institute of Information and Communications Technology (NICT). He received his Ph.D. degree in computer science from the University of Tsukuba in 2008. He is the secretary of the Internet TC, chair of the IEEE SIG on big data intelligent networking, and IEEE SIG on intelligent Internet edge. He has served as an associate editor for *IEEE IoT Journal* (2020-present). His current research interests include future networks, big data networking, blockchain, network security, and Internet of Things.

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Jiannong Cao is the chair professor of distributed and mobile computing with the Department of Computing and the director of the university research facility in big data analytics, Hong Kong Polytechnic University, Hong Kong. He has served as the Chair and a member of the Organizing and Technical Committees of many international conferences, including PERCOM, INFOCOM, ICPADS, IWQoS, ICDCS, DSN, and ICNP. He also has also served as an associate editor and an Editorial Board member of many international journals, such as IEEE TPDS, TCC.

Payam Barnaghi is currently a professor of machine intelligence at the University of Surrey. His is Deputy Director of the Care Research and Technology Centre at the UK Dementia Research Institute (UK DRI). He will start his role as professor of machine intelligence applied to medicine at Imperial College London in September 2020. His research interests include machine learning, semantic computing and Internet of Things, and their applications in healthcare.

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Constandinos X. Mavromoustakis (SM 2016) is currently a professor with the Department of Computer Science at the University of Nicosia, Cyprus, leading the Mobile Systems Lab. in the Department of Computer Science at the University of Nicosia. He has served as a Chair of the IEEE/R8 Cyprus section since January 2020, and since May 2009 he has served as the Chair of the C16 Computer Society Chapter of the Cyprus IEEE section. He has authored/edited several books and he has an extensive publication record.