Guest editorial: special issue on transparent computing

Jiannong Cao¹ · Jingde Cheng² · Jianhua Ma³ · Ju Ren⁴

Published online: 2 November 2017
© Springer Science+Business Media, LLC 2017

Moving data storage, computing and control into cloud has been a significant trend in the past decade. However, as the explosion of connected lightweight devices drives us to the era of Internet-of-Things (IoT), cloud computing is facing increasing limitations to meet the delay-sensitive, power-constrained and cross-platform service demands of IoT devices and applications. By changing the computing paradigm from server-centric to user-centric, transparent computing provides a promising solution to achieve prompt, energy-efficient, secure and platform-independent service provisioning for lightweight and heterogeneous IoT devices.

Different from cloud computing that handles all the service computation and storage at the server side, transparent computing seeks to jointly leverage local and server computation as well as the computing capability of nearby devices to improve the service performance. By taking advantage of virtualization and streaming service execution, transparent computing can provide on-demand and cross-platform services for heterogeneous terminals and make the whole service provisioning process transparent to users. Benefited from these advantages, transparent computing has attracted significant attention from both academia and industry and brought many successful applications and products over the past decade. However, as we

are heading to the IoT era, lightweight and mobile devices become dominating terminals in the Internet and our daily life. Meanwhile, network computing environment gradually evolves into mobile Internet, where mobile devices can request different services via heterogeneous and unstable wireless networks, such as WiFi and cellular. The ever-increasing user demands on lightweight and mobile devices provide great opportunities to exploit transparent computing to build more efficient, powerful and secure terminals, but also bring new challenges for applying transparent computing into new terminals and network environments.

The purpose of this special issue is to investigate the current research trends on addressing the arisen challenges, and help industry and academia better understand recent advances and potential research directions in the developing field of transparent computing. Through an open call for papers and rigorous peer-review, we selected 5 articles from 14 submissions as representatives of ongoing research and development activities. These 5 articles encompass a wide range of research topics covering cache management, resource allocation, code scheduling, data integration and fusion, as well as secure authentication, forming a comprehensive report of the latest research advances in transparent computing.

In the first article, “A Case for Software-Defined Code Scheduling based on Transparent Computing”, Zhou et al. propose a software-defined stream-based code scheduling framework to adaptively assign code computation and storage to appropriate nearby devices/servers with the assistance of performance and capacity monitoring facilities. They also developed a pilot transparent computing system that can support the decoupling of computation and storage of software codes by delivering the codes in a stream-based manner.

In the second article, “A Resource Allocation Model Based on Double-sided Combinational Auctions for Transparent

This article is part of the Topical Collection: *Special Issue on Transparent Computing*

Guest Editors: Jiannong Cao, Jingde Cheng, Jianhua Ma, and Ju Ren

✉ Ju Ren
renju@csu.edu.cn

¹ The Hong Kong Polytechnic University, Hong Kong, China

² Saitama University, Saitama, Japan

³ Hosei University, Tokyo, Japan

⁴ Central South University, Changsha, China

Computing”, Wang et al. focus on investigating an efficient resource allocation model for transparent computing systems in an economic view. By analyzing the quality-of-experience and limited communication bandwidth, they propose a resource allocation scheme based on double-sided combination auctions to allocate resources between the server side and client side for maximizing the welfare of the whole system.

In the third article, “An Evolvable and Transparent Data as a Service Framework for Multisource Data Integration and Fusion”, Xie et al. design a Transparent Data as a Service framework that combines transparent computing and representational state transfer web services based on linked data, to integrate data from different sources and provision data services in a transparent way. In the proposed framework, consumers can enjoy data services without knowing any details of where and how the data is stored.

In the fourth article, “A Block-Level Caching Optimization Method for Mobile Transparent Computing”, Tang et al. propose a block-level caching optimization method for servers and clients through analyzing the system bottleneck of I/O operations in mobile transparent computing. By designing a bitmap-based data structure for data caching, the proposed method can effectively reduce the number of I/O operations on server disks and improve the concurrency of mobile transparent computing systems.

In the last article, “Secure Ultra-lightweight RFID Mutual Authentication Protocol Based on Transparent Computing for IoV”, Fan et al. construct a secure and efficient data sharing scheme based on transparent computing for Internet-of-Vehicle systems. A secure RFID mutual authentication protocol is also proposed for resisting synchronization attacks by leveraging transparent computing to fully utilize the computation capability of local devices.

We believe that this special issue is delivering the state-of-the-art research on current transparent computing topics, and can attract the attention of the community to devote continuous efforts in addressing remaining open challenges. Finally, we would like to express our appreciation to the authors of all submitted articles and the reviewers for their contributions to this special issue. We also sincerely thank Prof. Sherman Shen, the Editor-in-Chief of Peer-to-Peer Networking and Applications, for his support of the special issue, and Fearon Melissa, senior editor of Springer, for her guidance and great help in the whole production process.

Jiannong Cao

(csjcao@comp.polyu.edu.hk) is a Chair Professor and Head of Department of Computing at The Hong Kong Polytechnic University. He received the B.Sc. degree (1982) in computer science from Nanjing University, China, and the M.Sc. (1986) and Ph.D. (1990) degrees in computer science from Washington State University, USA. His research interests include parallel and distributed computing, wireless networks and mobile computing, big data and cloud computing, pervasive computing, and fault tolerant computing. He has co-authored 4 books, co-edited 9 books, and published over 500 papers in major international journals and conference proceedings. He was the Chair of the Technical Committee on Distributed Computing of IEEE Computer Society in 2012–2014. He has served as an associate editor and a member of the editorial boards of many international journals, including ACM Transactions on Sensor Networks, IEEE Transactions on Computers, IEEE Transactions on Parallel and Distributed Systems, IEEE Networks, Pervasive and Mobile Computing Journal, and Peer-to-Peer Networking and Applications. He has also served as a chair and member of organizing/program committees for many international conferences, including PERCOM, INFOCOM, ICDCS, IPDPS, ICPP, RTSS, SRDS, MASS, and GLOBECOM. He is a fellow of IEEE, a senior member of China Computer Federation, and a member of ACM.

Jingde Cheng

(cheng@ics.saitama-u.ac.jp) is a professor of computer science at Graduate School of Science and Engineering, Saitama University, Japan. He received the B.Eng. (1982) degree in computer science from Tsinghua University, China, and the M.Eng. (1986) and D.Eng. (1989) degrees in computer science from Kyushu University, Japan. Before he joined Saitama University in 1999, he was a research associate (1989–1991), an associate professor (1991–1996), and a professor (1996–1999) at Kyushu University. He is working on software engineering, knowledge engineering, and information security engineering. His current research interests include relevant reasoning, relevant logic and its applications, epistemic programming paradigm for scientific discovery, autonomous evolution of knowledge-based systems, anticipatory reasoning-reacting systems, persistent computing, and information security engineering environment. He is a senior member of ACM, and a member of IEEE-CS, IEEE-SMC, and IPSJ.

Jianhua Ma

(jianhua@hosei.ac.jp) is a Professor at the Faculty of Computer and Information Sciences, Hosei University, Japan. He received the B.Sc. (1982) and M.Sc. (1985) degrees from National University of Defense Technology, China, both in communication systems and the Ph.D. (1990) degree from Xidian University, China, in Information Engineering. His current research interests include ubiquitous computing, social

computing, context-aware service, Internet of Things, wearable computing, personality computing, digital clone and cybermatics. Dr. Ma has published over 200 papers, and edited over 15 books. He has served JUCI, JMM, JoATC, JPCC, IJUNESST, and IJDTA, as a Co-EiC, and on the editorial boards of many journals, and has edited over 20 journal special issues as a Guest Editor. He organized the 6th Int'l Conf. on Distributed Multimedia Systems (DMS'99) as a PC Co-Chair, the 1st Int'l Conf. on Cyber Worlds (CW'02) as one of founders and PC Co-Chairs, the 18th Int'l Conf. on Advanced Information Networks & Applications (AINA'04) as a General Co-Chair, and the 1st IEEE Int'l Conf. on Social Computing (SocialCom'09) as an Advisory Chair. He is a founder of IEEE Conferences on Ubiquitous Intelligence and Computing (UIC), on Autonomic and Trusted Computing (ATC), on Cyber, Physical and Social Computing (CPSCoM), and on Internet of Things (iThings), Smart World Congress, and Cyber Science and Technology Congress (CyberSciTech). He is a founding chair of IEEE CIS Task Force on Smart World, and IEEE SMCS Technical Committee on Cybermatics for Cyber-enabled Worlds.

Ju Ren

(renju@csu.edu.cn) is a tenure-tracking professor with the School of Information Science and Engineering, Central South University, China. He received the B.Sc., M.Sc., Ph.D. degrees all in computer science, from Central South University, China, in 2009, 2012 and 2016, respectively. From Aug. 2013 to Sept. 2015, he was a visiting Ph.D. student in the Department of Electrical and Computer Engineering, University of Waterloo, Ontario, Canada. His

research interests include Internet-of-Things, wireless communication, transparent computing and cloud computing. In these related research areas, he has published over 30 papers on prestigious international journals and conferences, including IEEE TIFS, TWC, TVT, TII, TETC, etc. Dr. Ren serves/has served as an associate editor for Peer-to-Peer Networking and Applications, a guest editor for IEEE Network, and a Technical Program Committee member of many international conferences including IEEE INFOCOM 2018, Globecom 2017, WCNC 2017, WCSP 2016, etc. Dr. Ren is also serving as a co-chair for the “Vehicular Communications, Networks, and Telematics” track of the IEEE VTC 2017 Fall, a co-chair of the “Transparent Media Computing” special session of IEEE VCIP 2017, and as an active reviewer of more than 10 international journals. He is a member of IEEE and ACM.