Future Generation Computer Systems 87 (2018) 416–419

Contents lists available at ScienceDirect

Future Generation Computer Systems

journal homepage: www.elsevier.com/locate/fgcs

Editorial

Emerging trends, issues and challenges in Internet of Things, Big Data and cloud computing

Anna Kobusińska [a,*], Carson Leung [b], Ching-Hsien Hsu [c], Raghavendra S. [d], Victor Chang [e,f]

[a] Institute of Computing Science, Poznań University of Technology, Poznań, Poland
[b] University of Manitoba, Winnipeg, MB, Canada
[c] Chung Hua University, Hsinchu, Taiwan
[d] University Visvesvaraya College of Engineering, Bangalore, Karnataka, India
[e] International Business School Suzhou, Xi'an Jiaotong-Liverpool University, Suzhou, China
[f] Research Institute of Big Data Analytics, Xi'an Jiaotong-Liverpool University, Suzhou, China

ARTICLE INFO

Keywords:
Big Data
Cloud computing
Internet of Things
Data analysis
Cloud computing platforms
Applications and management

ABSTRACT

Although Big Data, IoT and cloud computing are three distinct approaches that have evolved independently, they are becoming more and more interconnected over time. The convergence of IoT, Big Data and clouds provides new opportunities and results in development of new applications in many fields, including business, healthcare, sciences and engineering. At the same time, various challenges are faced during processing and management of massive amounts of data, as well as during their storage in cloud environments. This special issue presents novel research approaches related to Big Data, IOT and cloud computing. It also discusses the encountered problems and open issues.

1. Introduction

Cloud computing has emerged as an important computing paradigm, enabling ubiquitous convenient on-demand access through Internet to a shared pool of configurable computing resources [1,2]. In this paradigm, software (applications, databases, or other data), infrastructure and computing platforms are widely used as services for data storage, management and processing. They provide a number of benefits, including reduced IT costs, flexibility, as well as space and time complexity. To benefit, however, from numerous promises that cloud computing offers, many issues have to be resolved, including architectural solutions, performance optimization, resource virtualization, providing reliability and security, ensuring privacy, etc [3–5].

Another significant technology trend that nowadays is gaining increasing attention is Internet of Things (IoT) [6,7]. In IoT, intelligent and self conguring embedded devices and sensors are interconnected in a dynamic and global network infrastructure, enabling scalability, flexibility, agility and ubiquity in fields of massive scale multimedia data processing, storage, access and communications. IoT is driving new interest in Big Data [8–10], by generation of enormous amount of new types of data being generated by sensors and other input devices, which have to be stored, processed and accessed. The need to monitor, analyze and act upon these data brings many issues like data confidentiality, data verification, authorization, data mining, secure communication and computation.

The future development of cloud computing systems is more and more influenced by Big Data and IoT [11,12]. There are research and industrial works showing applications, services, experiments and simulations in Clouds that support the cases related to IoT and Big Data [13–15]. Provision of above issues presents a new set of emerging problems and challenges that are expected to be identified and addressed. Therefore, the aim of this special issue is to present and discuss novel ideas and research outcomes on all aspects of Big Data, Internet of Things and cloud computing, as well as to identify new research topics. In particular, this special issue aims to examine the prospects and challenges that arise during the conjunction of the modern cloud applications with the field of Internet of Things and Big Data. Promoting the submission of the ongoing work with the existing important theoretical and practical results, along with position papers and case studies of already present verification projects, this special issue will highlight the art in this domain. As one of the goals, this special issue intends also to convene researchers and practitioners to review the diverse range of features of security, privacy, trust and reliability in IoT and Cloud. It also examines significant theories, scrutinies technology enablers, formulates significant application and devise new methods to overcome the major problems that this research area poses.

2. Brief review of special issue content

The special issue consists of invited top conference papers from SC2-2016 and IoTDBS 2017 conferences, as well as papers from the

* Corresponding editor.
E-mail address: Anna.Kobusinska@cs.put.poznan.pl (A. Kobusińska).

https://doi.org/10.1016/j.future.2018.05.021
0167-739X/

open call. In the response to the call for papers, 128 high-quality manuscripts submitted by various authors, and encompassing the most varied topics within the scope of the special issue were received. All manuscripts underwent a rigorous peer review process to ensure they meet the standards and quality of the FGCS journal. A throughout analysis of the research contributions of submitted papers, and the compliance with the scope and relevance to the special issue was conducted. Also, the innovations of manuscripts have been considered carefully to finalize the selection process. Eventually, we were pleased to select 15 high-quality manuscripts, which focus on advancing the latest research on the topic of Internet of Things, Big Data and cloud computing. The acceptance rate of the papers was 11.7%.

In the first paper, the real-time monitoring and profiling of big data applications and frameworks was considered. Many big data applications and frameworks involve heavy use of system resources. To improve performance of these applications and frameworks, Enes et al. in [16] presented a new framework, called BDWatchdog, to monitor system resources and profile big data applications in real time. BDWatchdog provides a process-based accurate analysis to visually characterize the performance of both big data workloads and frameworks by combining time series for resource monitoring and Java Virtual Machine (JVM) flame graphs for source code profiling. The proposed framework is architected in such a way that it allows scalable analysis of big data-scale applications across clusters, spotting of resource and code bottlenecks, as well as characterization of big data applications.

The second paper [17], considers resource allocation and task scheduling in cloudlet systems. The paper is motivated by the observation that the ability to provide cloud service is critical for the emerging mobile cloud computing (MCC) systems. Although the cloudlet possesses adequate resources to simultaneously process multiple mobile requests, it is not as sufficient as a remote cloud data center. Zhang et al. introduced a load-aware resource allocation and task scheduling (LA-RATS) strategy for cloudlet-based MCC systems. The proposed solution enhances the quality of mobile cloud service by adaptively allocating resource in a MCC system for delay-tolerant and delay-sensitive mobile applications based on the dynamic behavior and load profile of cloudlets. Specifically, it applies heuristic and meta-heuristic technology for scheduling tasks and allocating resources in cloudlet under normal load. It migrates tasks of delay-tolerant applications under cloudlet overload. To raise the utilization of the cloudlet, Zhang et al. also proposed a tree generation-based task backfilling mechanism to enable full use of the idle resource via a backward shifting strategy and to avoid unnecessary queue growth for virtual machines.

The following two papers of this special issue are devoted to virtualization problem. Network virtualization enables to group multiple physical networks into one virtual network, or separate a single physical network into multiple logical networks. Among different virtual network approaches, the Hybrid Virtual Networks (HVN) gain a lot of attention. G. Sun et al. in [18], investigated how to provide Hybrid Virtual Networks support both multicast and unicast traffic. It is a meaningful topic since network virtualization solves the problem of current network structure and multicast coexist with unicast traffic in the network. The authors proposed both ILP and heuristic solutions, a relatively complete simulation results are given.

Also, the interconnected cloud approach attracts a lot attention. Interconnected clouds enable to host computing resources, and share the load in private clouds, providing a high-performance, and cost-efficiency at the same time. But, they also have to deal with the problem that different cloud providers have different kinds of Virtual Machine (VM) instance types, pricing models, and management interfaces. Chih-Tien Fan et al. proposed a job management system for federated clouds that exploits agent technology to interconnect different cloud environments [19]. In the paper [19], the proposed solution VM instances are selected based on the job's deadline constraint. The authors proposed to use the rough set theory to predict job length based on historical data, such that the scheduler has the knowledge to see whether the system can meet the deadline constraint of a submitted job. Since this paper does not assume the job execution time is known, the proposed approach is thus novel and practical for job management on federated clouds. The experimental result show that the proposed approach works well for various types of jobs.

Further, this special issue tackles the problem of security and reliability of cloud environments. The chosen papers introduce different approaches and methods to provide those features. First, in [20], the secure policy execution is examined. The policy-based management is an important issue in the collaborative clouds that allow multiple users from different domains to access and share files. To carry out or enforce the policy decisions, a Cloud Policy Decision Point (CPDP) service is currently often used. But, this process reveals information about the policies to the third-party clouds. M. Alam et al. in [20], proposed using reusable garbled circuits (RGC) to protect the policy information from being revealed. The proposed protocol, privacy aware cross tenant access control (PaCTAC), contains three phases, the policy generation phase, and an attribute generation phase, and then a policy evaluation phase. The protocol makes use of the ABE RGC scheme. By using PaCTAC, it is possible to prevent a CPDP from learning about the policy in transactions, which take place in the CPDP.

In turn, increasing the reliability of cloud environments is discussed in [21]. The paper focuses on the cloud resources and cloud management capabilities, which are exposed via RESTful services. The reliability of such solutions plays an important role. The paper describes a new idea for increasing reliability of RESTful web services in clouds environment. Since the simple restart of a failed processing (as a new instance) from the very beginning, is usually insufficient and often leads to unacceptable inconsistency of processing state, the authors of [21] proposed the system mechanism that copes with this problem. The paper contributes with three main issues: RESTful recovery consistency model, application of the model in ReServE service and formal and empirical evaluation of the proposed recovery protocol. The introduced formal definition of RESTful recovery consistent model may be a formal basis for any forthcoming research.

The succeeding paper [22], discusses the source location privacy issue. There are many security-critical wireless sensor network applications in the current era of big data. Hence, source location privacy (SLP) has become important. Gu et al., in the considered paper proposed a viable 2-step framework for SLP-aware routing protocol selection. It uses the existing library of performance profiles of various routing algorithms and decision theoretic heuristics to access trade-offs. With this framework, the protocols are first profiled and filtered by capturing their performance under various protocol configurations and metric sets. Then, decision theoretic heuristics are applied to characterize and select the most appropriate SLP routing protocols for different applications in wireless sensor networks by removing dominated protocols and formalizing the notion of relevance with suitable weights and utility functions of attributes.

Finally, among proposed solutions that increase security and reliability, the erasure coding is considered in [23]. Erasure coding is one of the techniques offering data protection of large scale distributed cloud storage systems. This technique is used to store and retrieve data in the cloud storage. Existing solutions, such as striping encoding and replicating encoding, either provide a poor read/write performance or generate high network and I/O overhead. The model proposed by F. Xu et al., called incremental encoding, is a solution that provides a good performance similar to the replicating encoding, while achieves a low overhead as in the

striping encoding. It gains these two by encoding data incrementally without initially replicating it.

The special issue pays also attention to the new big data storage facilities. Current storage technologies encounter difficulties while handling the large amounts of data generated by the Internet of Things, cloud environments and services computing. Big data storage requirements are complex and thus new storage facilities have to be investigated to mitigate storage challenges. In [24], W.Bhat presented a comparative analysis of three storage facilities, namely Optical data storage, DNA data storage and Holographic data storage, which could be adopted for the cloud in order to bridge the data-capacity gap in big data storage. In the manuscript also the implications of their adoption are discussed, their evaluation results are presented, and challenges they face were highlighted.

Since data is being generated in very huge volumes with great velocity in all multi-structured formats from all different sources, there is a huge demand not only to efficiently store it, but also process and analyze the large amounts of data in an agile way in order to make it usable. In [25], B. Zhang et al. explored the problem of the optimization for recurring queries that process growing data sets at scheduled intervals. in Big Data analysis system with MapReduce. They provide algorithms that can improve the recurring queries by using consistent window slice, late scheduling strategy and reuse strategy. The authors also design MapReduce late scheduling strategy that improves data processing and optimize computation resource scheduling.

Edge intelligence pushes processing for data intensive applications away from the core of the cloud to the edge of the network, and promises low latency as well as agile computation augmenting services for device users. Huang et al. in [26] proposed the edge intelligence, hierarchical framework for IoT applications based on a service-oriented IoT infrastructure. The proposed framework clarifies the relationship of edge, devices and IoT applications. It also provides a top-down paradigm for IoT architects and programmers to better understand and design their IoT systems. The built-in analytics support on streaming data provides edge nodes the learning capability, which previously has not been extensively studied. The paper enhances the WuKong IoT middleware.

The special issue could not evade the papers related to the analysis of large amounts of data. The paper [27] is related to the up to date research in cloud computing, which puts forward interesting capabilities for knowledge fusion, having similar requirements of big data computations. In their work, Chih-Hua Tai et al. addressed an interesting idea of the fusion and inference problem for hybrid knowledge that can be represented in association rules. They specified six issues related to the problem, and presented a cloud computing based system, referred to as HyKFICE (Hybrid Knowledge Fusion and Inference on Cloud Environment) system as a comprehensive solution to the mentioned problems. HyKFICE is capable to deduce on the possibilities of the presence of items at a given condition through knowledge fusion and inference based on the probability theory.

To enable the early detection and tracking of important topics, Wang et al. provided in [28] a multi-layered performance analysis for big data topic detection and tracking (TDT) applications deployed in a cloud environment. This novel vertical analysis on three cloud layers (infrastructure, platform and software layers) combines both cloud resources and TDT. A case study on MapReduce-based big data TDT applications shows that the presented performance analysis effectively helps identify key parameters and metrics in the aforementioned three cloud layers and helps establish dependencies among these metrics across multi-layers.

The paper [29] is focused on the analysis of the scholarly big data. The work is motivated by the fact that scientific collaboration across multiple fields or disciplines facilitates advanced research. In the result, cross-disciplinary information embedded in scholarly big data and collaborative relationships among researchers in different fields can be complex, complicated and subtle. Hence, Liang et al. proposed an effective cross-disciplinary collaboration recommendation (CDCR) model to discover and recommend research fields for collaboration. Specifically, for research field discovery, the CDCR model identifies implicit research fields and detects cross-disciplinary collaboration patterns from research publications based on topic modeling. These collaboration patterns reveal correlations among different fields. Based on the revealed correlations and researchers' profiles, the CDCR model makes valuable recommendation for potential cross-disciplinary collaboration.

Finally, the last paper from this special issue, discusses the convergence between different IoT domains. IoT is an important source of contextual data, which makes it an interesting and challenging domain for Big Data research. But, the disparity between IoT domains has isolated the evolution of Big Data approaches in each domain. Thus, the mutual understanding across IoT domains allows to indicate the similarities and differences in Big Data research in different IoT domains. M. Ge at al. presented a survey of Big Data technologies used in the various IoT domains [30]. Based on a vast literature review, the authors considered different aspects of Big Data analysis process. In the result, they gathered the information which Big Data techniques are predominant for a given IoT domain, and how they are used. On the basis of the obtained results, the authors suggested which Big Data technologies could be used for a given IoT domain.

References

[1] M. Armbrust, A. Fox, R. Griffith, A.D. Joseph, R. Katz, A. Konwinski, G. Lee, D. Patterson, A. Rabkin, I. Stoica, et al., A view of cloud computing, Commun. ACM 53 (4) (2010) 50–58.

[2] B. Chang, Y. Lee, Y. Liang, Reward-based Markov chain analysis adaptive global resource management for inter-cloud computing, Future Gener. Comput. Syst. 79 (2018) 588–603.

[3] A.S. Sohal, R. Sandhu, S.K. Sood, V. Chang, A cybersecurity framework to identify malicious edge device in fog computing and cloud-of-things environments, Comput. Secur. 74 (2018) 340–354.

[4] Y. Al-Dhuraibi, F. Paraiso, N. Djarallah, P. Merle, Elasticity in cloud computing: State of the art and research challenges, IEEE Trans. Serv. Comput. 11 (2) (2018) 430–447.

[5] X. Liu, R.H. Deng, Y. Yang, N.H. Tran, S. Zhong, Hybrid privacy-preserving clinical decision support system in fog-cloud computing, Future Gener. Comput. Syst. 78 (2018) 825–837.

[6] W. Yu, F. Liang, X. He, W.G. Hatcher, C. Lu, J. Lin, X. Yang, A survey on the edge computing for the internet of things, IEEE Access 6 (2018) 6900–6919.

[7] B.R. Ray, J.H. Abawajy, M.U. Chowdhury, A. Alelaiwi, Universal and secure object ownership transfer protocol for the internet of things, Future Gener. Comput. Syst. 78 (2018) 838–849.

[8] A. Ahmad, M. Khan, A. Paul, S. Din, M.M. Rathore, G. Jeon, G.S. Choi, Toward modeling and optimization of features selection in big data based social internet of things, Future Gener. Comput. Syst. 82 (2018) 715–726.

[9] T.K. Goyal, R. Rathi, V.K. Jain, E.S. Pilli, A.P. Mazumdar, Big data handling over cloud for internet of things, IJITWE 13 (2) (2018) 37–47.

[10] A. Ahmad, M. Khan, A. Paul, S. Din, M.M. Rathore, G. Jeon, G.S. Choi, Toward modeling and optimization of features selection in big data based social internet of things, Future Gener. Comput. Syst. 82 (2018) 715–726.

[11] Q. Xia, W. Liang, Z. Xu, Data locality-aware big data query evaluation in distributed clouds, Comput. J. 60 (6) (2017) 791–809.

[12] L. Belcastro, F. Marozzo, D. Talia, P. Trunfio, Big data analysis on clouds, in: Handbook of Big Data Technologies, 2017, pp. 101–142.

[13] V. Chang, Towards data analysis for weather cloud computing, Knowl.-Based Syst. 127 (2017) 29–45.

[14] K. Kaur, S. Garg, G.S. Aujla, N. Kumar, J.J.P.C. Rodrigues, M. Guizani, Edge computing in the industrial internet of things environment: Software-defined-networks-based edge-cloud interplay, IEEE Commun. Mag. 56 (2) (2018) 44–51.

[15] J. Ni, K. Zhang, X. Lin, X.S. Shen, Securing fog computing for internet of things applications: Challenges and solutions, IEEE Commun. Surv. Tutor. 20 (1) (2018) 601–628.

[16] J. Enes, R.R. Exposito, J. Tourino, BDwatchdog: Real-time monitoring and profiling of big data applications and frameworks, Future Gener. Comput. Syst. 87 (2018) 420–437.

[17] F. Zhang, J. Ge, Z. Li, C. Li, C. Wong, L. Kong, B. Luo, V. Chang, A load-aware resource allocation and task scheduling for the emerging cloudlet system, Future Gener. Comput. Syst. 87 (2018) 438–456.
[18] G. Sun, D. Liao, D. Zhao, Z. Sun, V. Chang, Towards provisioning hybrid virtual networks in federated cloud data centers, Future Gener. Comput. Syst. 87 (2018) 457–469.
[19] C.-T. Fan, Y.-S. Chang, S.-M. Yuana, VM instance selection for deadline constraint job on agent-based interconnected cloud, Future Gener. Comput. Syst. 87 (2018) 470–487.
[20] M. Alam, N. Emmanuel, T. Khan, A. Khan, N. Javaid, K.-K.R. Choo, R. Buyya, Secure policy execution using reusable garbled circuit in the cloud, Future Gener. Comput. Syst. 87 (2018) 488–501.
[21] A. Kobusiska, C.-H. Hsu, Towards increasing reliability of clouds environments with restful web services, Future Gener. Comput. Syst. 87 (2018) 502–513.
[22] C. Gu, M. Bradbury, J. Kirton, A. Jhumka, A decision theoretic framework for selecting source location privacy aware routing protocols in wireless sensor networks, Future Gener. Comput. Syst. 87 (2018) 514–526.
[23] F. Xu, Y. Wang, X. Ma, Incremental encoding for erasure-coded cross-datacenters cloud storage, Future Gener. Comput. Syst. 87 (2018) 527–537.
[24] W.A. Bhat, Bridging data-capacity gap in big data storage, Future Gener. Comput. Syst. 87 (2018) 538–548.
[25] B. Zhang, X. Wang, Z. Zheng, The optimization for recurring queries in big data analysis system with MapReduce, Future Gener. Comput. Syst. 87 (2018) 549–556.
[26] Z. Huang, K.-J. Lin, B.-L. Tsai, S. Yan, C.-S. Shih, Building edge intelligence for online activity recognition in service-oriented IoT systems, Future Gener. Comput. Syst. 87 (2018) 557–567.
[27] C.-H. Tai, C.-T. Chang, Y.-S. Chang, Hybrid knowledge fusion and inference on cloud environment, Future Gener. Comput. Syst. 87 (2018) 568–579.
[28] M. Wang, P.P. Jayaraman, E. Solaiman, L.Y. Chen, Z. Lie, S. Jun, D. Georgakopoulos, R. Ranjan, A multi-layered performance analysis for cloud-based topic detection and tracking in big data applications, Future Gener. Comput. Syst. 87 (2018) 580–590.
[29] W. Liang, X. Zhou, S. Huang, C. Hu, X. Xu, Q. Jin, Modeling of cross-disciplinary collaboration for potential field discovery and recommendation based on scholarly big data, Future Gener. Comput. Syst. 87 (2018) 591–600.
[30] M. Ge, H. Bangui, B. Buhnova, Big data for internet of things: A survey, Future Gener. Comput. Syst. 87 (2018) 601–614.

Anna Kobusinska received her M.Sc. and Ph.D. degrees in computer science from Poznań University of Technology, in 1999 and 2006, respectively. She currently works at the Laboratory of Computing Systems, Faculty of Computing Science, Poznań University of Technology, Poland. Her research interests include large-scale distributed systems, service-oriented systems and cloud computing. She focuses on distributed algorithms, Big Data analysis, replication and consistency models, as well as fault-tolerance, specifically checkpointing and rollback recovery techniques.

She has served and is currently serving as a PC member of several international conferences and workshops. She is also author and co-author of many publications in high quality peer reviewed international conferences and journals. She participated to various research projects supported by national organizations and by EC in collaboration with academic institutions and industrial partners.

Carson Leung received his B.Sc. (Hons.), M.Sc., and Ph.D. degrees all from the University of British Columbia, Vancouver, Canada. He is currently a Professor at the University of Manitoba, Canada. He has contributed more than 200 refereed publications on the topics of big data, data analytics, databases, data mining, Internet of Things (IoT), cloud computing, social network analysis, and visual analytics. These include papers in ACM Transactions on Database Systems (TODS), Future Generation Computer Systems (FGCS), Journal of Organizational Computing and Electronic Commerce, Social Network Analysis and Mining, World Wide Web Journal (WWW J), IEEE International Conference on Data Engineering (ICDE), IEEE International Conference on Data Mining (ICDM), the SCA 2012 Best Paper on social computing and its applications, as well as the IEEE/ACM ASONAM-FAB 2016 Best Paper on foundations and applications of big data analytics. In recent years, he has taken different roles in the Organizing Committee of various refereed international conferences such as ACM CIKM, ACM SIGMOD, IEEE ICDM, and IEEE SC2. For instance, he has served as a General Chair for IEEE CBDCom 2016 & IEEE SmartData 2018, a Program Chair for IEEE BigDataSE 2016 & IEEE HPCC 2016, as well as the Finance Chair for IEEE DSAA 2016. He is a Senior Member of the ACM and the IEEE.

Ching-Hsien Hsu is a Distinguished Professor in the department of computer science and information engineering at Chung Hua University, Taiwan; his research includes high performance computing, cloud computing, parallel and distributed systems, big data analytics, ubiquitous/pervasive computing and intelligence. Dr. Hsu is serving as editorial board for a number of prestigious journals, including IEEE Transactions on Service Computing, IEEE Transactions on Cloud Computing. Dr. Hsu was awarded six times talent awards from Ministry of Science and Technology, Ministry of Education, and nine times distinguished award for excellence in research from Chung Hua University, Taiwan. Dr. Hsu is Vice Chair of the IEEE Technical Committee on Cloud Computing (TCCLD), and IET Fellow.

Raghavendra S. is a research scholar in the department of Computer Science and Engineering, University Visvesvaraya College of Engineering, Bangalore University, Bangalore. He received his Bachelor degree in Computer Science and Engineering from BMS Institute of Technology, Visvesvaraya Technological University, Bangalore and Master degree from R V College of Engineering, Visvesvaraya Technological University, Bangalore. Dr. Raghavendra S. has authored over 20 publications and his research interests include Cloud Computing, applied cryptography and Internet of Things. He is serving as Reviewer, editorial board member and Guest editor for a number of prestigious journals, like Elsevier, Springer, KJIP, Wily. He is a member of the IEEE.

Victor Chang is an Associate Professor (Reader), Director of Ph.D. (June 2016 – May 2018) and Director of MRes at International Business School Suzhou (IBSS), Xi'an Jiaotong-Liverpool University (XJTLU), Suzhou, China, since June 2016. He is also a very active and contributive key member at Research Institute of Big Data Analytics (RIBDA), XJTLU. Previously he worked as a Senior Lecturer at Leeds Beckett University, UK, for 3.5 years. Within 4 years, he completed Ph.D. (CS, Southampton) and PGCert (Higher Education, Fellow, Greenwich) while working for several projects at the same time. Before becoming an academic, he has achieved 97% on average in 27 IT certifications. He won a European Award on Cloud Migration in 2011, IEEE Outstanding Service Award in 2015, best papers in 2012 and 2015, the 2016 European award: Best Project in Research, 2016 SEID Excellent Scholar, Suzhou, China, Outstanding Young Scientist award in 2017, 2017 special award on Data Science, 2017 and 2018 INSTICC Service Awards and numerous awards since 2012. He is a visiting scholar/Ph.D. examiner at several universities, an Editor-in-Chief of IJOCI & OJBD journals, Editor of FGCS, Associate Editor of TII, founding chair of two international workshops and founding Conference Chair of IoTBDS http://www.iotbd.org and COMPLEXIS http://www.complexis.org since Year 2016. He was involved in different projects worth more than £12.5 million in Europe and Asia. He has published 3 books as sole authors and the editor of 2 books on Cloud Computing and related technologies. He gave 16 keynotes at international conferences. He is widely regarded as one of the most active and influential young scientist and expert in IoT/Data Science/Cloud/security/AI/IS.