EDITORIAL



Future of Network and Service Operations and Management: Trends, Developments, and Directions

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In recent years, the operation and management of networks and systems have gone through significant advances, driven by substantial developments regarding methods and techniques (e.g., network programmability, big data analytics, and artificial intelligence-enabled systems) and increasingly complex network and service environments. Given such profound changes, it is essential to step back from time to time, revisit the area, and ponder about the future. What are the new management requirements to be met? What are the novel challenges that the research community should focus on in the short and mid-term future? How can the latest enabling technologies help in shaping innovative management solutions?

To address these questions, we have invited recognized researchers on the field to share their visions. This Special Issue on the "Future of Network and Service Operations and Management: Trends, Developments, and Directions" includes nine papers covering different application contexts, as well as various management paradigms, methods, and technologies. Starting with "Network Management 2030: Operations and Control of Network 2030 Services", Clemm et al. describe emerging ultra-high-precision services (e.g., tactile Internet, holographic-type communications, and tele-driving) and discuss management challenges, solution approaches and research opportunities for the next 10 years towards the assurance of these applications.

In "FlexNGIA: A Flexible Internet Architecture for the Next-Generation Tactile Internet", Zhani et al. advocate that the traditional network architecture and protocols cannot cater to the stringent requirements imposed by next-generation applications. The authors then propose a novel network architecture adapted to the tactile Internet called FlexNGIA, which stands for a Flexible Next-Generation Internet Architecture. Along the same lines, in "Immersive Interconnected Virtual and Augmented Reality: A 5G and IoT Perspective", Vega et al. discuss the challenges to enable a future AR/VR end-to-end architecture that combines 5G Ultra-Reliable Low Latency Communications (URLLC) and tactile IoT technology.



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Aware of the essential role that artificial intelligence can play for the correct and efficient operation of modern Information Technology infrastructures, in "A Frontier: Dependable, Reliable and Secure Machine Learning for Network/System Management", Le et al. present opportunities and challenges of exploring machine learning in network and systems management. In "Adaptive ML-Based Frame Length Optimization in Enterprise SD-WLANs", Coronado et al. discuss the application of machine learning techniques in Software-Defined Wireless Local Area Networks (SD-WLANs), focusing on the frame length optimization problem.

Considering that trustworthiness is a critical property for existing and future networks, the Special Issue includes three exciting papers addressing different facets of this immense challenge. In "A Responsible Internet to Increase Trust in the Digital World", Hesselman et al. propose the notion (and building blocks) of a responsible Internet. The authors' design aims to improve the transparency, accountability, and controllability of the Internet at the network level. Abhishek et al. present, in "Network Virtualization and Survivability of 5G Networks", an optimization formulation and a heuristic for network survivability of 5G networks. In "Blockchain Signaling System (BloSS): Cooperative Signaling of Distributed Denial-of-Service Attacks", Rodrigues et al. introduce a signaling system based on blockchain technology that enables DDoS mitigation across multiple domains.

Finally, in "Big Spatial Data Management for the Internet of Things: A Survey", Al Jawarneh et al. address the very challenging problem of managing big geospatial data in the Internet of Things context. In addition to surveying this relevant research area, the authors define a conceptual framework and identify future research frontiers in the field.

We believe that these nine articles shed light on the broad spectrum of challenges and opportunities in network and service management for the years ahead. We hope that you will enjoy this Special Issue and find these articles inspiring.

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Luciano Paschoal Gaspary holds a Ph.D. in Computer Science (UFRGS, 2002). He is currently Deputy Dean and Associate Professor at the Institute of Informatics, UFRGS. He is also the current Editor-in-Chief for the Springer's Journal of Network and Systems Management. From 2008 to 2014, he worked as Director of the National Laboratory on Computer Networks (LARC) and, from 2009 to 2013, was Managing Director of the Brazilian Computer Society (SBC). He has been involved in various research areas, mainly computer networks, network management, and computer system security. He is author of more than 200 full papers published in leading peer-reviewed publications and has a history of dedication to research activities such as the organization of scientific events, participation in the TPC of relevant symposia, and participation as an editorial board member of various journals. More information about Prof. Gaspary can be found at https://www.inf.ufrgs.br/~paschoal/.

