Guest Editorial Introduction to the Special Section on Cognitive Software Defined Networks and Applications

NEXT generation networks (NGNs) are expected to utilize internal and external sources of data through information and wireless communication techniques. Particularly, the demand for autonomic network management, orchestrations and optimization is as intense as ever, even though significant research has been needed.

Software Defined Networks (SDNs) have been proposed to address QoS requirements for NGNs including high throughput, high mobility, low latency, heterogeneity and scalability. SDN has improved the user experience by providing high-performance communications between the network nodes, reconstructing the network structure, and optimizing the networking coverage, system security, communication latency, etc. The control intelligence is moved out of devices in a logically centralized controller, which interacts with data plane devices through standard interfaces.

However, the existing applications in the SDN attract more attention to develop new learning algorithms, enhanced protocols and is even used in sensor power line communication for data transmission. The Cognitive Learning algorithms are the best solution to some particular applications. The cognitive software defined network (CSDN) presents to combine the efficiencies of SDN with new cognitive learning algorithms and enhanced protocols to automatize SDN. Its research and implementation are based on autonomic network management and control concepts. Such a combination of SDNs with autonomic frameworks and cognitive algorithms is better to solve the issues of traditional SDNs. This architecture of CSDN enables up-to-date control schemes to be developed and deployed to enable new smart networking services. This special issue brings together academic and industrial researchers to identify and discuss technical challenges and recent results related to cognitive software defined networks.

We appreciate contributions to this special section and the valuable and extensive efforts of the reviewers.

The topics of this special section range from modeling, analysis, spreading evolution, and control of various networks with cognitive software defined networks. A brief review follows.

In "Many-Objective Deployment Optimization of Edge Devices for 5G Networks," Cao *et al*. propose an improved optimization algorithm named Grouping-based Many-objective Evolutionary Algorithm (GMEA) to optimize the deployment of edge devices to maximize service quality and reliability, while minimizing cost and energy consumption. To address the efficient and cognitive sharing of AI services, Liao *et al*. in "Cognitive Popularity Based AI Service Sharing for Software-Ddefined Information-Centric Networks" propose a cognitive popularity-based AI service distribution architecture based on Software-Defined Information-Centric Networking (SDICN). In "Machine Learning for RF Slicing Using CSI Prediction in Software Defined Large-Scale MIMO Wireless Networks," Sapavath *et al*. investigate the machine learning approaches (sparse Bayesian linear regression (SBLR) and support vector machine (SVM)) for channel state information (CSI) prediction and dynamic radio frequency (RF) slicing for software defined virtual wireless networks in large-scale multi-input multi-output (MIMO) wireless networks. In "PSAC: Proactive Sequence-Aware Content Caching via Deep Learning at the Network Edge," Zhang *et al*. propose a proactive sequence-aware content caching strategy (PSAC). Specifically, for general content at the network edge and content with sequential features, PSAC gen (based on a convolutional neural network) and PSAC seq (based on an attention mechanism that can automatically capture sequential features), respectively, are proposed to implement proactive caching. In "A Software Defined Network Based Fuzzy Normalized Neural Adaptive Multipath Congestion Control for the Internet of Things," Naeem *et al*. propose a novel model-free SDN-based adaptive actor-critic deep reinforcement learning framework based on a fuzzy normalized neural network to address the issue of congestion control for multi-path TCP (MPTCP) in the IoT networks.

We believe this special section explores the recent advances and disseminates state-of-the-art research related to CSDN on designing, building, and deploying novel cognitive computing, services and technologies, to enable smart SDN services and applications.

HUIMIN LU, *Guest Editor*
Kyushu Institute of Technology
Fukuoka 804-8550, Japan

PIN-HAN HO, *Guest Editor*
University of Waterloo
Waterloo, ON N2L 3G1, Canada

HAIDER ABBAS, *Guest Editor*
National University of Sciences and Technology
Islamabad 24090, Pakistan

TRUNG Q. DUONG, *Guest Editor*
Queen's University Belfast
Belfast BT7 1NN, U.K.

AMMAR RAYES, *Guest Editor*
Cisco Systems,
San Jose, CA 95134 USA

KEMAL AKKAYA, *Guest Editor*
Florida International University
Miami, FL 33199 USA

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Huimin Lu (Senior Member, IEEE) is currently an Associate Professor with the Kyushu Institute of Technology, Fukuoka, Japan and an Excellent Young Researcher of Ministry of Education, Culture, Sports, Science and Technology, Japan. His research interests include artificial intelligence, machine vision, deep-sea observing, Internet of Things, and robotics.

Pin-Han Ho (Fellow, IEEE) is currently a Professor with the Department of Electrical and Computer Engineering, University of Waterloo, Waterloo, ON, Canada. His current research interests cover a wide range of topics in broadband wired and wireless communication networks, including survivable network design, and wireless metropolitan area networks.

Haider Abbas (Senior Member, IEEE) is currently Heading the R&D Department, College of Signals, and the Director and Founder of National Cyber Security Auditing and Evaluation Lab (NCSAEL), National University of Sciences and Technology, Islamabad, Pakistan.

Trung Q. Duong (Senior Member, IEEE) is currently a Professor with Queen's University Belfast, Belfast, U.K. and the Royal Academy of Engineering Research Chair. His current research interests include IoT, wireless networks (small-cell networks, ultra-dense networks, HetNets, and physical layer security, URLLC).

Ammar Rayes (Senior Member, IEEE) is currently a Distinguished Engineer/vCTO at Cisco's Customer Experience Technology Office focusing on network analytics, automation, machine learning, and NMS/OSS.

Kemal Akkaya (Senior Member, IEEE) is currently a Full Professor with the Department of Electrical and Computer Engineering, Florida International University, Miami, FL, USA. His current research interests include security and privacy, Internet of Things, and cyber-physical systems.