Frontiers of Information Technology & Electronic Engineering
www.zju.edu.cn/jzus; engineering.cae.cn; www.springerlink.com
ISSN 2095-9184 (print); ISSN 2095-9230 (online)
E-mail: jzus@zju.edu.cn

Editorial:

Special issue on future network: software-defined networking

Tao HUANG[†1], F. Richard YU[†2], Yun-jie LIU[3]
([1]*Beijing University of Posts and Telecommunications, China*)
([2]*Carleton University, Canada*)
([3]*Chinese Academy of Engineering, China*)
[†]E-mail: htao@bupt.edu.cn; richardyu@cunet.carleton.ca

http://dx.doi.org/10.1631/FITEE.SDN2016

Computer networks have to support an ever-increasing array of applications, ranging from cloud computing in datacenters to Internet access for users. In order to meet the various demands, a large number of network devices running different protocols are designed and deployed in networks. As a result, network management and the deployment of new protocols and applications are quite challenging. On one hand, network operators have to manage so many different network devices and manually configure these devices using different tools. On the other hand, vendors use different physical infrastructures as well as software interfaces to manufacture devices, which makes it difficult for researchers to implement new functions in devices. Therefore, network infrastructure and architecture design face great challenges.

Software-defined networking (SDN) has been proposed as a new way to facilitate network evolution. SDN decouples the data and control planes, and removes the control plane from network hardware. In SDN, all the devices are controlled by a centralized controller through open protocols, such as OpenFlow, BGP, and NETCONF. Then, control functions are implemented in the centralized controller to realize operational efficiency and reduce costs. Thus, it dramatically simplifies the network, and brings many potential benefits in terms of network management, network virtualization, trouble shooting, and other new network function deployments. In fact, the advantages of SDN technology are attracting great attention from both academia and industry.

However, the current technologies of SDN have some limitations. In the perspective of architecture, the centralized controller needs to control all the resources of the network, and therefore the scalability of centralized control becomes an important problem in SDN. Additionally, compared to the distributed design that makes forwarding decisions locally, centralized control inevitably increases the delay of packet forwarding and thus affects the performance of applications. Therefore, using the distributed control plane and choosing the optimal placement of the controller are important for the performance of the network. In the perspective of network functions, SDN brings agile and programmable controllability, but leveraging this powerful controllability to design new network functions for cloud datacenters, wireless networks, or enterprise networks remains a challenge.

Motivated by the above considerations, we bring together researchers, developers, practitioners, and educators to identify and discuss the technical challenges and recent advances related to SDN. This special issue aims to attract the attention of both academia and industry in developing advanced and innovative SDN technologies. This special issue comprises eight best papers selected from the submissions. The topics in this special issue cover both theoretical analyses and practical systems.

To survey software-defined wireless networks (SDWNs) and their technologies, Feng *et al.* (2016) presented the architecture and the possible research directions of SDWN, and then investigated several important technical aspects of SDWN and analyzed how the SDN approach can be incorporated to enhance network performance with these aspects.

ORCID: Tao HUANG, http://orcid.org/0000-0002-3545-1122

To improve the scalability and increase the performance of the control plane, Xiao *et al*. (2016) proposed spectral clustering based partition and placement algorithms. They partitioned large networks into small domains and thus reduced the control overheads and increased scalability. Simulation results showed the effectiveness of this algorithm for SDN domain partition and controller placement problems. A new multi-controller architecture based on distributed rule store (DRS) was presented to reduce the overhead of one controller (Wang *et al*., 2016). The results showed that DRS can effectively maintain a consistent distributed rule store and, at the same time, achieve a shorter flow setup time and a higher processing throughput, compared with the traditional controller.

To improve performance and reduce network delays, LESSOR (Liu *et al.*, 2016) leverages multiple paths in datacenters, and computes optimal forwarding paths by using the centralized controller. Experimental results showed that LESSOR is scalable and that both the network scale and network load models have little impact on its performance. In the work by Xiong *et al.* (2016), to reduce the average traffic delay, an improved quantum genetic algorithm was used to choose the optimal service placement. Yang *et al.* (2016) presented a video conferencing system based on SDN-enabled SVC (scalable video coding) multicast to reduce the delay and achieve flexible management.

Failures in an ongoing session can cause packet losses and delay, which can significantly affect the quality of service (QoS). In the work by Renganathan Raja *et al*. (2016), a subtree-based technique was designed to detect failures and then recover from the failure for multicast applications, such as live video streaming and video conferencing. The method can detect link or node failures from a multicast tree and then determine which part of the multicast tree requires changes in the flow table to recover from the failure.

Virtual network embedding is a key problem in the SDN environment. However, most of the existing embedding algorithms cannot be directly applied to SDN virtualization. Gong *et al*. (2016) presented a novel online virtual SDN embedding algorithm, called CO-vSDNE, to minimize the embedding cost as well as the controller-to-switch delay for each virtual SDN.

We would like to thank the anonymous reviewers for their great efforts in reviewing the submitted manuscripts. We would like to thank the editors of this special issue.

References

Feng, M.J., Mao, S.W., Jiang, T., 2016. Enhancing the performance of future wireless networks with software-defined networking. *Front. Inform. Technol. Electron. Eng.*, **17**(7):606-619. http://dx.doi.org/10.1631/FITEE.1500336

Gong, S.Q., Chen, J., Kang, Q.Y., *et al.*, 2016. An efficient and coordinated mapping algorithm in virtualized SDN networks. *Front. Inform. Technol. Electron. Eng.*, **17**(7): 701-716. http://dx.doi.org/10.1631/FITEE.1500387

Liu, B., Chen, M., Xu, B., *et al.*, 2016. An OpenFlow-based performance-oriented multipath forwarding scheme in datacenters. *Front. Inform. Technol. Electron. Eng.*, **17**(7): 647-660. http://dx.doi.org/10.1631/FITEE.1601059

Renganathan Raja, V., Lung, C.H., Pandey, A., *et al.*, 2016. A subtree-based approach to failure detection and protection for multicast in SDN. *Front. Inform. Technol. Electron. Eng.*, **17**(7):682-700. http://dx.doi.org/10.1631/FITEE.1601135

Wang, H.Z., Zhang, P., Xiong, L., *et al.*, 2016. A secure and high-performance multi-controller architecture for software-defined networking. *Front. Inform. Technol. Electron. Eng.*, **17**(7):634-646. http://dx.doi.org/10.1631/FITEE.1500321

Xiao, P., Li, Z.Y., Guo, S., *et al.*, 2016. A *K* self-adaptive SDN controller placement for wide area networks. *Front. Inform. Technol. Electron. Eng.*, **17**(7):620-633. http://dx.doi.org/10.1631/FITEE.1500350

Xiong, G., Hu, Y.X., Tian, L., *et al.*, 2016. A virtual service placement approach based on improved quantum genetic algorithm. *Front. Inform. Technol. Electron. Eng.*, **17**(7): 661-671. http://dx.doi.org/10.1631/FITEE.1500494

Yang, E.Z., Zhang, L.K., Yao, Z., *et al.*, 2016. A video conferencing system based on SDN-enabled SVC multicast. *Front. Inform. Technol. Electron. Eng.*, **17**(7): 672-681. http://dx.doi.org/10.1631/FITEE.1601087

Tao HUANG is an Associate Professor with the Beijing University of Posts and Telecommunications (BUPT), China. He has carried out basic research in areas such as network architecture and software-defined networking (SDN), put forward the definition of service-oriented SDN architecture, and led the research and development of a future network innovation experiment platform at BUPT, which has achieved network interconnection in the universities at Beijing, Nanjing, Xi'an, and Chongqing. In addition, he has developed the platform and related systems of SDN and a new generation of content distribution, which have been widely used at CCTV and China Unicom. He has published more than 100 academic papers, has 32 national technology invention patents, submitted 25 international standards proposals, and has published four individual monographs.

F. Richard YU received the PhD degree in electrical engineering from the University of British Columbia (UBC), Canada, in 2003. From 2002 to 2006, he worked with Ericsson (Lund, Sweden) and a start-up in California, USA. He joined Carleton University in 2007, where he is currently a Professor. He received the IEEE Outstanding Service Award in 2016, the IEEE Outstanding Leadership Award in 2013, the Carleton Research Achievement Award in 2012, the Ontario Early Researcher Award in 2011, the Excellent Contribution Award at IEEE/IFIP TrustCom 2010, the Leadership Opportunity Fund Award from the Canada Foundation of Innovation in 2009, and the Best Paper awards at IEEE ICC 2014, Globecom 2012, IEEE/IFIP TrustCom 2009, and International Conference on Networking 2005. His current research interests include cross-layer/cross-system design, security, green IT, and QoS provisioning in wireless-based systems. He serves on the editorial boards of several journals, including Co-Editor-in-Chief for *Ad Hoc & Sensor Wireless Networks*, Lead Series Editor for *IEEE Transactions on Vehicular Technology* and *IEEE Communications Surveys & Tutorials*. He has served as the Technical Program Committee (TPC) Co-Chair of numerous conferences.

Yun-jie LIU is a member of the Chinese Academy of Engineering, and Director of the Science and Technology Committee of China Unicom. He took a leading role in the design, construction, and operation of the national public data network, computer Internet, and high-speed broadband, which have been instrumental for the construction of an information society in China. He also played the leading role in the design, construction, and operation of the China UniNet (a unified network platform for multiple services), which provides a feasible solution for network convergence. It has been a successful project implemented on a large scale in the evolution to the next-generation network (NGN). He has been a recipient of a first-grade National Prize for Progress in Science and Technology and also the first-grade Ministerial Prize for Progress in Science and Technology. He has obtained two national invention patents and published 59 papers and 7 academic books.