Report on the 2020 NS English Session Awards and Award Ceremony

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1. Introduction

In the 2020 IEICE General Conference that was held on March 17-20 2020, the IEICE Technical Committee on Network Systems (NS) provided the complete English Symposium Session entitled "In-Network Intelligence for Design, Management, and Control of Future Networks and Services". Due to concerns about COVID-19, the English session this year was held online via Zoom [1] on March 17. In this year, 23 papers were submitted to the English session, among which 6 papers were presented at the online conference. The submitted papers include a variety of interesting research topics related to "in-network intelligence", such as security/privacy, network virtualization technologies, Internet of Things (IoT) networks, wired/wireless networking, and machine learning [2].

The NS committee selected recipients of NS English Session Award among the 23 papers. The recipients won the award at an award ceremony and presented the progress of their awarded papers as an invited lecture at the NS technical meeting in October 2020.

2. Award Ceremony

The award ceremony was held in the NS technical meeting on October 9, 2020 online. Many participants attended the ceremony. Three distinguished papers won the NS English Session Award, and all the recipients received an award certificate and a plaque from NS technical committee chair (Fig. 1). (For the past recipients, please see our English home page. URL: http://www.ieice.org/cs/ns/eng/index.html)

Fig. 1 English session award recipients
(Prof. Kimura: Top left [2],
Ms. Dinh: Top right [3],
Mr. Le: Bottom left [4]),
and secretary (Yoshida): Bottom right.

3. English Session Awards 2020

The abstracts of the three papers that won the 2020 NS English Session Award are as follows.

"Distributed Deployment of Unmanned Aerial Vehicle Base Stations for Maximizing Ground User QoS" [2]

Flying aerial base stations (ABSs) equipped with unmanned aerial vehicles (UAVs) are an emerging technology having the potential of significantly increasing the capacity of existing fixed networks in a more flexible and on-demand manner during temporary events, such as disaster and sports events. However, the dynamic optimization of 3D-deployment of ABSs is a significantly challenging problem due to the high degree of freedom in 3D space, the complicated air-to-ground channel characteristics, and an interference problem among multiple ABSs.

In this paper, we propose a novel distributed 3D-deployment method of ABSs that maximizes the quality of service (QoS) of ground users. In our method, each ABS dynamically updates its 3D-position by collaborating with neighboring ABSs so that the total QoS of ground users is maximized in an on-demand manner. Owing to this distributed nature and incremental updates, our method is applicable to dynamic network environments.

Since obtaining all the specific positions of ground users is computationally intensive and unrealistic in a dynamic network environment, we model the locations of users using a spatial point process. Under this model, we consider the maximization of the total expected data rate of ground users and formulate it as a distributed optimization problem. Furthermore, to solve the problem in a distributed manner, we utilize a distributed push-sum algorithm framework, in which each ABS dynamically optimizes its 3D-position considering interference among ABSs. By employing this framework, we also prove the convergence of our distributed algorithm. Simulation results demonstrate that our method can improve the overall QoS of ground users in an efficient manner, and it can be applied to a dynamic network in which the density of ground users varies temporally.

"Deep Reinforcement Learning-based User-to-Multiple Access Points Association Method for Heterogeneous Quality of Service Provision" [3]

Future wireless networks are predicted to become denser and denser owing to an increased amount of Access Points (AP) and mobile users. Moreover, Beyond 5G networks are expected to provide various applications to each user simultaneously. This raises inevitable challenges for enabling efficient wireless resource sharing while satisfying the diverse and stringent Quality of Service (QoS) constraints. In such a context, this work investigates the issue of user-to-multiple Access Points (AP) association, where a user requiring several applications may be served by several APs simultaneously. This problem is formulated as a network sum-rate maximization subject to the required QoS constraints for each user and application, and AP load constraints. To handle this problem in large-scale and dense future wireless systems, we propose a distributed association method based on deep reinforcement learning techniques, which allows each user to decide its association to multiple APs simultaneously using its locally available network information. Simulation results show that, compared to reference schemes, the proposed method enables large throughput enhancements while satisfying the QoS constraints and AP load limitations, thereby reducing user outage probabilities.

"**Performance Evaluation on MAC Layer Protocol in Crash Warning Application using PC5-based Cellular-V2X mode4**" **[4]**

Knowledge on the future traffic load in network links plays an important role in various networking problems such as traffic engineering, quality of service provisioning, etc. For estimating future traffic, Deep Learning techniques have been currently exploited and achieved much better performance compared with traditional regression-based approaches (e.g., ARIMA). However, predicting network traffic is still a challenging problem due to the complicated network behavior and the problem of missing data. Although the prediction accuracy largely depends on the amount of historical data, obtaining all the measured data at high monitoring frequency is impractical due to the monitoring resources constraints as well as the un-avoidable data loss. Thus, the existing approaches reveal poor performance regarding traffic inference when lacking historical data. In this paper, we address the prediction problem of traffic load in network links with partial monitoring information. We design a new prediction model by modifying the Diffusion Convolutional Recurrent Neural Network (DCRNN) to overcome the missing data problem. We also introduce a new graph-based structure to represent the dynamic relation among the links. Based on the proposed graph we present a novel DCRNN model that can capture the dynamic spatial relation among links to improve prediction accuracy. The experiment results show that our proposed approach achieve significantly high prediction accuracy compared to original DCRNN model.

4. Future Plans

In the 2021 IEICE General Conference, the English Session entitled "AI technologies and their applications for future network systems and services" will be held on March 9-12, 2021. Many interesting studies on "network" and "service" including "wireless" and "optical" will be presented. Please attend the IEICE General Conference and enjoy the NS English session during the four days.

5. Acknowledgement

We would like to give special thanks to Prof. Yoshiaki Tanaka for his great contributions.

6. References

[1] Zoom, http://zoom.us/.
[2] T. Kimura, Y. Tanigawa, S. Kawano, S. Mizuno, A. Nakao, and Y. Okazaki, "Report on NS English Session at 2020 IEICE General Conference -BS-4 Compositive Information Communication Technologies and Applications for Future Network Systems-," *IEICE GLOBAL NEWSLETTER*, vol. 44, no. 2, p. 25, June 2020.
[3] T. Kimura, and M. Ogura, "Distributed Deployment of Unmanned Aerial Vehicle Base Stations for Maximizing Ground User QoS ," *IEICE General Conference*, BS-1-7, Mar. 2020.
[4] T. H. L. Dinh, and M. Kaneko, "Deep Reinforcement Learning-based User-to-Multiple Access Points Association Method for Heterogeneous Quality of Service Provision," *IEICE General Conference*, BS-1-18, Mar. 2020.
[5] V. A. Le and Y. Ji, "Dynamic Diffusion Convolutional Recurrent Neural Network-based Traffic Prediction," *IEICE General Conference*, BS-1-20, Mar. 2020.

