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Editorial: Intelligent Mobility and Edge Computing for a Smarter World

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1 Editorial

The recent development of wireless networking and mobile cloud computing initiates an emerging cyber system called mobile/multi-access edge computing (MEC). MEC moves computing and data processing capability from distant cloud datacenters to edge servers that are closer to the mobile devices to offer users the lowest possible latency, the highest possible bandwidth, and direct access to real-time network services.

Although MEC is expected to largely improve the QoE for mobile users, it is challenging to realize and utilize the MEC systems effectively and efficiently due to its inherent heterogeneities. First, since a typical MEC datacenter is composed of heterogenous resources such as CPU/GPU clusters, FPGAs, programable network routers, etc., this heterogeneity is big challenge to the traditional orchestration systems. In addition, due to the differences in scales, architectures, and Internet access technologies, it is challenging to realize the coordination of multiple MEC datacenters for conducting complicated tasks. Finally, the applications using MEC are also heterogenous. Different applications have different objectives and metrics, and correspondingly different flavors to specific MEC servers. Therefore, joint optimization of multiple applications and the MEC orchestration has to be considered. Addressing these issues efficiently will have significant importance to the future mobile computing and communications technologies.

This special issue features six selected papers with high quality. The first article, "Intelligent Predicting Method for Optimizing Remote Loading Efficiency in Edge Service Migration", authored by Xianyu Meng, proposes an intelligent trace-driven predicting approach (ITPA) that improves the efficiency of I/O scheduling and the hit ratio of caching when migrating services between resource-constrained edge nodes to speed up network application loading during service migration in highly dynamic and heterogeneous edge computing environments.

The second article titled "Unlicensed Assisted Ultra-Reliable and Low-Latency Communications" adopts the duty-cycle muting (DCM) mechanism to share unlicensed spectrums with the WiFi network, which guarantees the fair coexistence. Meanwhile, the authors use the mini-slot, user grouping, and finite block length regime to satisfy the low latency and high reliability requirements. This paper establishes a non-convex optimization model with respect to power and spectrum, and solves it to minimize the power consumption at the devices, where the closed-form expressions are given by several mathematical derivations and the Lagrangian multiplier method.

In the next article with the title "EDSF: Efficient Distributed Scheduling Function for IETF 6TiSCH-based Industrial Wireless Networks", the authors propose an efficient distributed scheduling function (EDSF) for 6TiSCH wireless networks; it fully considers the use probability and distance of cells rather than random selection. Additionally, a schedule collision detection algorithm is proposed to detect two pairs of neighbor nodes that use the same cell. It fully utilizes the historical statistical data from the cell packet delivery ratio. Finally, the authors implement the EDSF scheme and verify its performance through experiments on a 6TiSCH simulator. The experimental results show that the proposed scheme can achieve a low end-to-end latency without additional costs.

Secure Multipath TCP Communications is widely regarded as one of the most promising technologies for post

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5G data communication networks. The fourth article titled "Empirical Mode Decomposition-empowered Network Traffic Anomaly Detection for Secure Multipath TCP Communications" proposes a network traffic anomaly detection model based on MPTCP networks, called MPTCP-EMD. The model combines multi-scale detection and digital signal processing theory to implement anomaly detection based on the self-similarity of MPTCP network traffic. It uses the empirical modal decomposition (EMD) method to decompose MPTCP traffic data and reconstruct the valid signal by removing high-frequency noise and residual trend term. Using the idea of sliding windows, the model then compares the changes in the Hurst exponent of the MPTCP network under different attack conditions to determine whether anomalies have occurred. The simulation results show that the EMD method can be used for anomaly detection of MPTCP network traffic.

Active distribution networks (ADNs) can solve the problem of grid compatibility and large-scale, intermittent, renewable energy applications. In this paper, the authors model the data transmission in 5G, designing a rolling solution framework from predicting interference to improving data repetition, and then allocate wireless resources. To adapt resource allocation to time-varying interference, the authors propose an interference prediction algorithm to accurately estimate the interference distribution in the whole scheduling cycle. Moreover, to meet the second-level, resource scheduling requirement, the authors model resource allocation as a dynamic programming problem with the goal of maximizing energy efficiency and solve it by a DDQN-based reinforcement learning algorithm.

The last article titled "WiPD: A Robust Framework for Phase Difference-based Activity Recognition" presents a robust framework named WiPD for accurate activity recognition based on Wi-Fi phase difference data. Firstly, a novel feature representation mechanism named visualized spectrum matrix (VSM) for Wi-Fi activity recognition is proposed. VSM is generated by performing a Short Time Fourier Transform operation on Wi-Fi phase difference data. Then, the authors design a neural network with the input type of VSM, namely, WiPD-Net, in which the activity features are extracted by both four convolutional neural network submodules and two WiPD-Block submodules. Experiment results show that the proposed WiPD-Net outperforms the existing baselines on our dataset and one public dataset.

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