Intelligent Edge Caching and Computing for Scalable Information Systems

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Abstract

INTRODUCTION: In scalable information systems, edge computing can help to overcome the challenges of latency, bandwidth, and connectivity in large-scale networks by reducing the amount of data that needs to be transmitted over the network.
OBJECTIVES: The edge devices, such as sensors, cameras, gateways, routers, switches, multiplexers, integrated access devices, etc., can perform initial data processing and filtering, reducing the data volume sent to the central system.
METHODS: This special issue aims to provide the recent progress of intelligent edge caching and computing for scalable information systems.
RESULTS: The guest editors received more than 30 submissions, and finally, ten papers were accepted.
CONCLUSION: This special issue has contributed to advancing academic research and practice in intelligent edge caching and computing for scalable information systems.

In scalable information systems, edge computing (EC) [1] can help to overcome the challenges of latency, bandwidth, and connectivity in large-scale networks by reducing the amount of data that needs to be transmitted over the network. The edge devices [2], such as sensors, cameras, gateways, routers, switches, multiplexers [3], integrated access devices (IADs), etc., can perform initial data processing and filtering, reducing the data volume sent to the central system.

This special issue aims to provide the recent progress of intelligent edge caching and computing for scalable information systems. The guest editors received more than 30 submissions, and finally, ten papers were accepted.

Tang, Y. et al. (2022) [4] first overview the data rate of wireless-active transmission. The authors then overview the latency of wireless-active transmission, which is particularly important for the applications of monitoring services. The authors further overview the spectral efficiency of the active transmission, which is particularly important for the battery-limited Internet of Things (IoT) networks. After these overviews, The authors give several critical challenges on active transmission and present feasible solutions to meet these challenges.

Zhou, Y. et al. (2022) [5] first examine the power system transformer with one KG node and one eavesdropper E, where the eavesdropper E can overhear the network from the source, which may cause physical-layer secure issue and an outage probability event. To deal with the issue, the authors analyze and design the system-secure performance under the eavesdropper and define the outage probability for system security by providing an analytical expression of outage probability. The authors further

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investigate the power system transformer with multiple KG nodes, which can help strengthen the system's security and reliability.

Zhou, Y. et al. (2022) [6] first introduce the typical deep learning networks of convolutional neural network (CNN) for the knowledge service system and then employ the CNN to implement the knowledge classification based on deep learning. Finally, some simulation results on the knowledge service system are presented to validate the proposed studies.

He, S. et al. (2023) [7] study the relaying and cache-aided digital grid data transmission, where the relaying may be equipped by caching, depending on specific applications. For both cases, the authors evaluate the impact of relaying and caching on the system performance of digital grid data transmission through theoretical derivation.

Lu, J. et al. (2022) [8] adopt an intelligent wireless monitoring technology where a monitoring node is employed to monitor the network transmission status through wireless links. The authors evaluate the system monitoring performance by using the metric of outage probability, depending on the wireless data rate over wireless channels. For the considered system, the authors derive analytical outage probability to measure the system performance in the whole range of signal-to-noise ratio (SNR).

Zhou, Y. et al. (2023) [9] investigate the online document transmission and recognition of digital power grids with knowledge graphs. In particular, the authors jointly consider the impact of online transmission and recognition based on computing, where the wireless transmission channels and computing capability are randomly varying. The authors investigate the system performance for the considered system by deriving the analytical expression of outage probability, defined by the transmission and recognition latency.

Li, B. et al. (2023) [10] investigate the communication technology of optical fiber composite overhead ground wire (OPGW) line in a distribution network under an interference environment, where there is one primary link, one secondary link, and one legitimate monitor listening to the secondary link. The secondary user must transmit its message to the secondary receiver under the interference power constrained by the primary node.

Lin, Z. et al. (2022) [11] study the knowledge management-based power system by employing the deep learning technique. Specifically, the authors first introduce data augmentation in the knowledge management-based power system and the associated activated functions. The authors then develop the deep network architecture to extract the local spatial features among the data of the knowledge management-based power system. The authors further provide several training strategies for data classification in the knowledge management-based power system, where the cross entropy-based loss function is used.

Zeng, Y. et al. (2023) [12] examine a physical-layer secure distribution network OPGW with edge computing in this article, where there exists one transmitter S, one receiver D, one authorized legitimate monitor LM, and an interfering node I. The authors first define the system outage probability based on the secure data rate to analyze the system performance better. Then, the authors evaluate the system performance for the distribution network OPGW by deriving the analytical outage probability of secure data processing to facilitate the system performance evaluation of secure data processing in the entire SNR regime.

Liu, X. et al. (2022) [13] study the two-way data processing technology for OPGW line of distribution power communication networks, where a single relay node assists the two-way data processing in time-division multiplexing mode. The authors evaluate the influence of the model parameters on the system data processing performance by investigating the outage probability. In contrast, the analytical and simulation results show the effectiveness of two-way data processing for OPGW communication.

In all, this special issue has contributed to advancing academic research and practice in intelligent edge caching and computing for scalable information systems.

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