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MEC Network Resource Allocation Strategy Based on Improved PSO in 5G Communication Network

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ABSTRACT

Relying on features such as high-speed, low latency, support for cutting-edge technology, internet of things, and multimodality, 5G networks will greatly contribute to the transformation of Web 3.0. In order to realize low-latency and high-speed information exchange in 5G communication networks, a method based on the allocation of network computing resource in view of edge computing model is proposed. The method first considers three computing modes: local device computing, local mobile edge computing (MEC) server computing, and adjacent MEC server computing. Then, a multi-scenario edge computing model is further constructed for optimizing energy consumption and delay. At the same time, the encoding-decoding mode is used to optimize PSO algorithm and combined with the improvement of fitness function, which can effectively support the communication network to achieve reasonable allocation of resources, ensuring efficiency of information exchange in the network. In the end, the results show that when the number of users is 500, the method can complete the task assignment within 44s.

KEYWORDS

5G Communication Network, Edge Computing, Fitness Function, Particle Swarm Optimization, Resource Allocation, Web 3.0

1. INTRODUCTION

Growth in mobile and Web traffic in new application requirements have attached requirements with higher levels in the service capability of 5th Generation (5G) mobile communication network (Sami, et al., 2021; Islambouli, et al., 2020, June; Mansour, et al., 2022). With the rise and development of the Metaverse, the emergence of computing- intensive and delay- sensitive applications with big amount makes users' requirements for service quality increase exponentially (Sami., & Mourad.., 2020; Inan., & Dikenelli., 2021). The final form of the Metaverse must be decentralized, and the current network ecology cannot fully meet the needs of Metaverse decentralization. Some people believe that the coming Web3.0 era is highly coincident with the network ecology required by the

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Metaverse. Web3.0 is expanding the data center to the edge (Chen, et al., 2022; Zhang, T. 2022). Compared with the current amount of Internet data, the amount of data generated and consumed in the Metaverse will be hundreds of times higher than the current amount. Relying on high-speed, low latency, and multimodal characteristics, 5G networks have greatly changed the possibilities of Web 3.0 applications. 5G networks can provide faster and more stable network services, support more new technologies, achieve the interconnection of everything, and greatly contribute to the transformation of Web 3.0. In the era of Web 3.0, the increase in the amount of task calculation results in local devices being unable to handle the corresponding computing tasks, while the cloud computing acts as solution of insufficiency in computing power (Tiwari, A., & Garg, R., 2022; Hussain., & Sayed., 2021). However, cloud computing also generates problems like costs of data transmission, cloud storage cost, Internet access management and security (Al-Qerem, et al., 2020; Stergiou, et al., 2021). Therefore, finding a reasonable network resource allocation method is crucial to support 5G networks to provide high-quality user services.

As Mobile Edge Computing (MEC) emerges, the device-cloud architecture is transformed with device-edge-cloud, thus reducing latency accordingly. Additionally, computing task throughput is improved by the strategy of allocating 3 computing reasonably, thus better meeting to the users' experience quality requirements can be better met and maximize economic benefits (Mychael, et al., 2022). In MEC environments, if the number of concurrent users is large, edge base stations may be overloaded. MEC reduces server load through swarm intelligence collaboration technology. Group intelligence collaboration technology uses a large number of base stations to complete tasks that cannot be completed by a single base station. Edge servers can also collaborate to perform tasks to balance network load. However, swarm intelligence collaboration technology requires the use of a large number of devices, which is suitable for the case of a large number of user devices and a small storage capacity of a single device. In PSO, each bird is considered a particle, and the bird swarm is considered a particle swarm, and each particle is encoded as a task resource scheduler. The main goal of PSO is to find the optimal particle from the population after multiple iterations of updates, that is, the optimal task resource scheduling program.

Relying on the model of edge computing, a method of communication network based on network resource allocation is proposed with major innovations as below:

1) Consider three network scenarios: local computing, offloading to MEC server in local area, and offloading within regional MEC server to build a multi-scenario task analysis mode. Aiming at optimizing delay in system computing and energy consumption, a mathematical model of strategic resource allocation for network computing is established to optimize the network operation state.
2) Using the encoding-decoding mode to optimize and design particle swarm algorithm, which improves the computing efficiency of PSO algorithm's computing efficiency, thus further optimizing the adaptation function of resource allocation model, realize the analysis on collaborative optimization of delay and energy consumption, which effectively support the efficient and stable operation of communication network.

2. RELATED WORK

According to 2020 Cisco White Paper, it is expected that from 2018 to 2023, global Internet users will show a rising trend, with 6% annual growth rate. By 2023, there will be nearly 300 million apps downloaded on mobile devices worldwide, producing trillions of gigabytes of data every day.

In the future, 5G communication networks will have to face new requirements, such as more applications that require complex computing, lower the latency of task execution, lower device energy consumption and higher service quality. The above service applications all need the support of a reasonable and reliable computing resource allocation strategy (Daniel, et al., 2022).

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