Multi-Criteria Dynamic Service Migration for Ultra-Large-Scale Edge Computing Networks

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Multi-access edge computing (MEC) service migration is a technology whose key objective is to support ultra-low-latency access to services. However, the complex ultra-large-scale edge service migration problem requires extensive research efforts, regarding the foreseen ultra-densified edge nodes in 5G and beyond. Therefore, we proposed a novel dynamic service migration optimization architecture for ultra-large-scale multi-access edge computing networks, with edge exposure function, monitoring and global/local optimization modules, which could achieve global optimal dynamic service migration and releasing the centralized traffic burden of cloud server, simultaneously. We developed a new multi-criteria decision-making algorithm: Technique for Order of Preference by Similarity to Ideal Solution with Attribute-based Niche count, named TOPANSIS, which showcased its strength to provide an optimal solution for service migration in large-scale deployments towards optimal data rate, latency, and load balancing. We further decentralized the operation of TOPANSIS to release the traffic burden from central datacenters by leveraging local decision making by edge nodes, while relying on central cloud coordination to account for the overall network information. The feasibility of the proposed solution was validated by means of a proof-of-concept implementation and experimental assessments. Experimental and simulation results showcased that the proposed architecture outperformed the selected benchmarks with an average improvement of 39.41% for latency, 2.92% for data rate, as well as 10.53% and 6.26% for RAM and CPU load balancing, respectively. Therefore, the developed MEC-based service migration architecture can achieve optimized latency, data rate, and load balancing, comprehensively, which provides referable architectural guidance to the future dynamic ultra-large-scale MEC service migration networks.

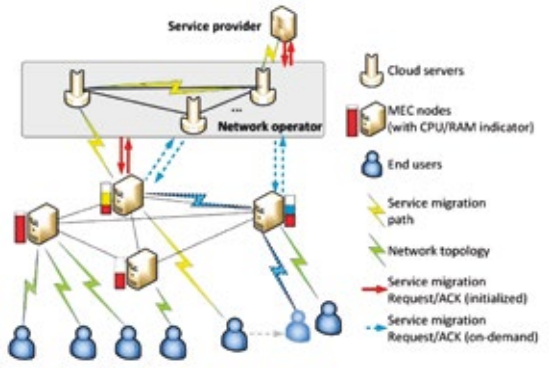

FIGURE 1
The proposed multi-criteria service migration optimization architecture for ultra-large-scale MEC networks, which achieves on-demand service migration/instantiation with low latency and high QoS.

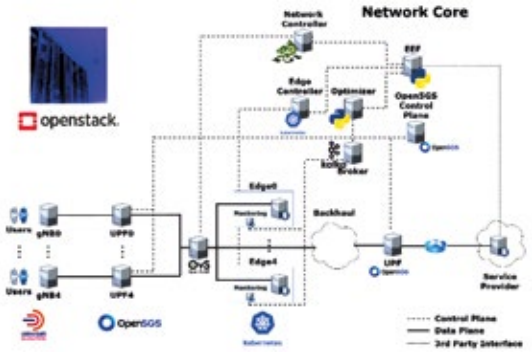

FIGURE 2
Prototype and Scenario Evaluation: proof-of-concept implementation implemented in an OpenStack-based virtual environment from the 5GAIner infrastructure.