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Cost-effective resource segmentation in hierarchical mobile edge clouds

Key words: Edge clouds; Edge computing; Edge caching; Resource segmentation; Virtual machine (VM) allocation

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Motivation

1. 5G network cloudification has been an inevitable trend in the network realm, enabling the edge deployment of multiple services.

2. The efficiency of VM allocation is a key challenge for mobile network operators (MNOs) when deploying services for third parties.

3. Different services have different deploy requirements, which should be satisfied simultaneously when conducting resource allocation.

Main idea

1. A VM allocation problem is formulated based on the hierarchical edge cloud model of a 5G MNO and the detailed application deployment requirements of multiple third parties.

2. To solve the NP-hard and non-convex problem, an elitist genetic algorithm (eGA) is designed.

3. Extensive simulations are conducted to evaluate the feasibility and effectiveness of the proposed algorithm.

Method

1. Two types of applications, computation-intensive applications and storage-intensive applications, are defined in detail to capture the deploy requirements of the services.

2. An elitist genetic algorithm is designed, which separately executes the elitist selection operator, crossover operator, and mutation operator in every generation to obtain the optimal solution.

Major results

1. Feasibility and convergence of eGA

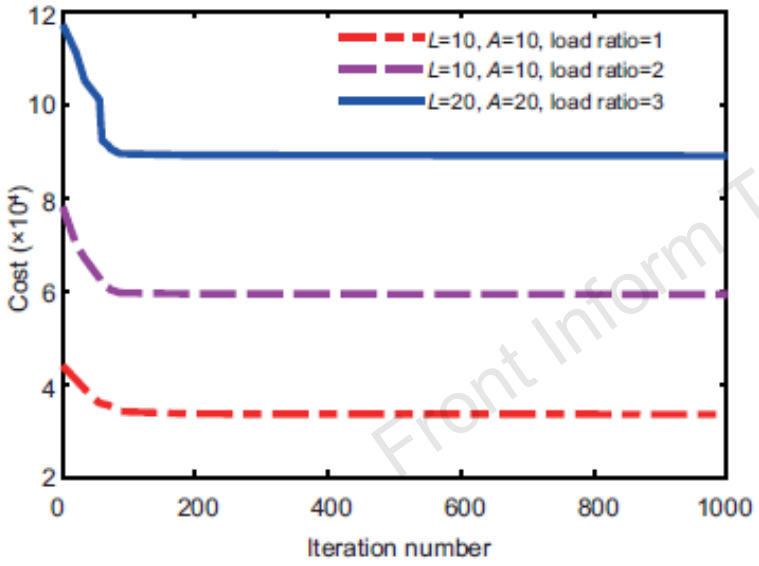

Fig. 3 Convergence of the elitist genetic algorithm (eGA)

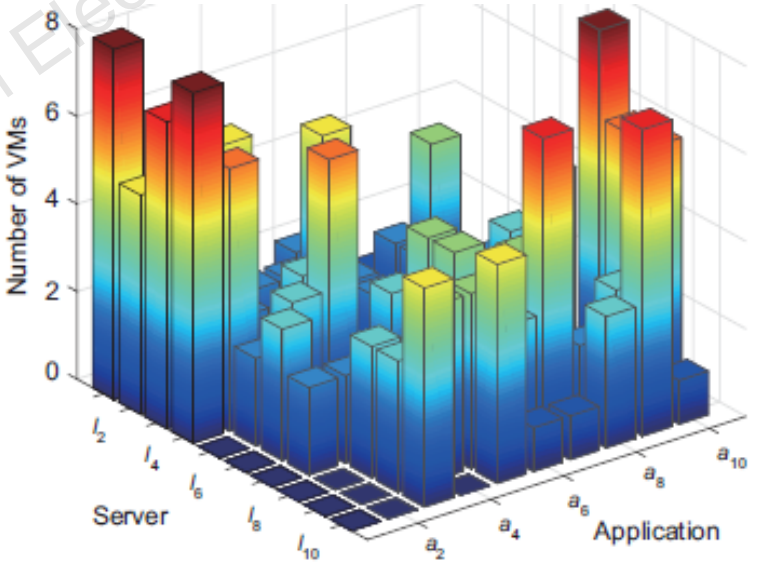

Fig. 4 Optimal solution when the load ratio is three and latency is one

Major results (Cont'd)

2. Number of VMs in every data center

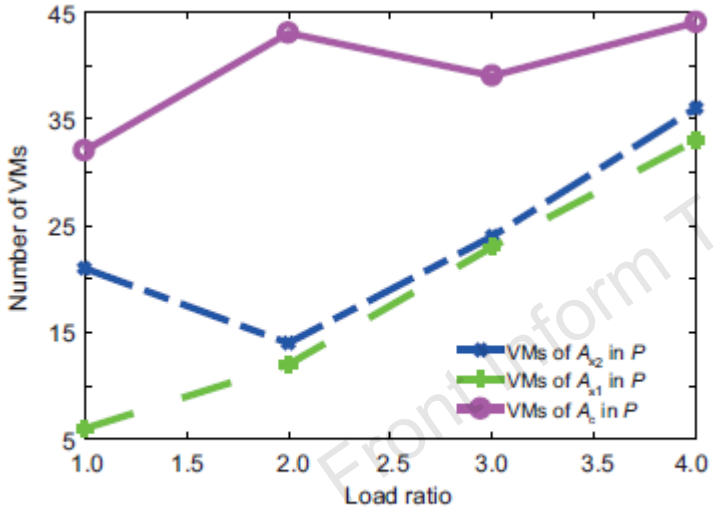

Fig. 7 Number of VMs for each type of application in P when the load ratio increases

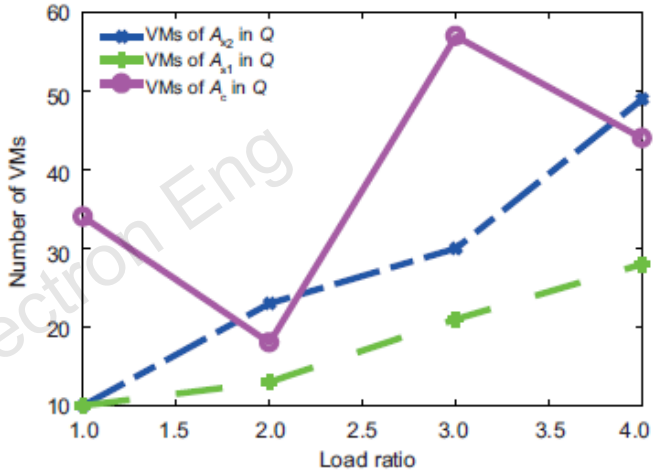

Fig. 8 Number of VMs for each type of application in Q when the load ratio increases

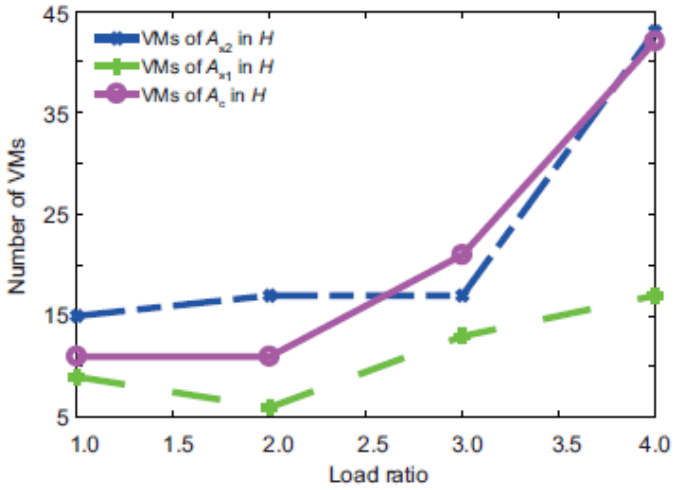

Fig. 9 Number of VMs for each type of application in H when the load ratio increases

Major results (Cont'd)

3. Total number of VMs

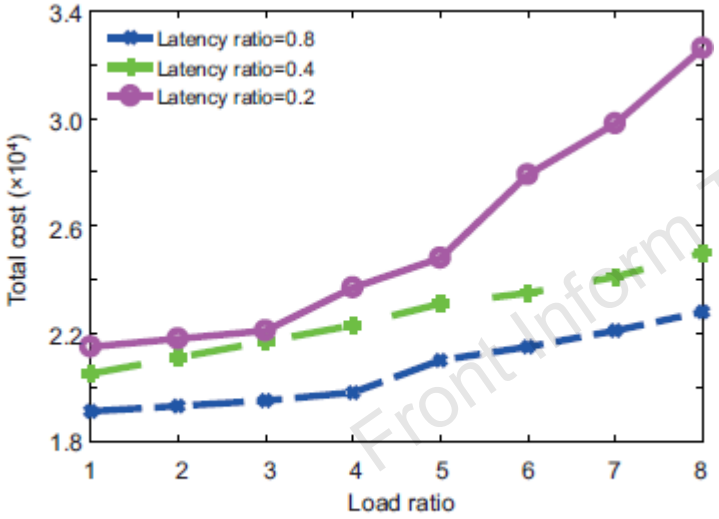

Fig. 5 Total cost when the load ratio increases

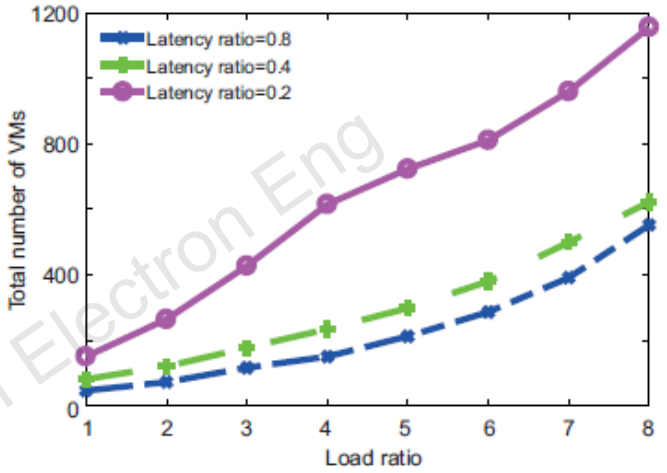

Fig. 6 Total number of VMs when the load ratio increases

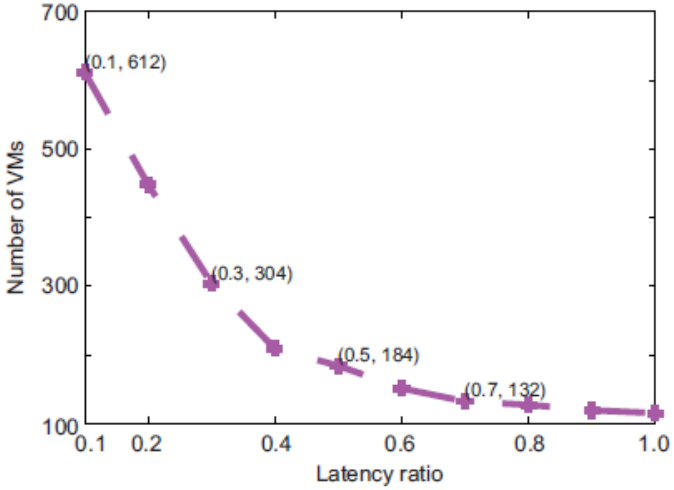

Fig. 10 Number of VMs when the latency ratio decreases

Major results (Cont'd)

4. Resource utilization

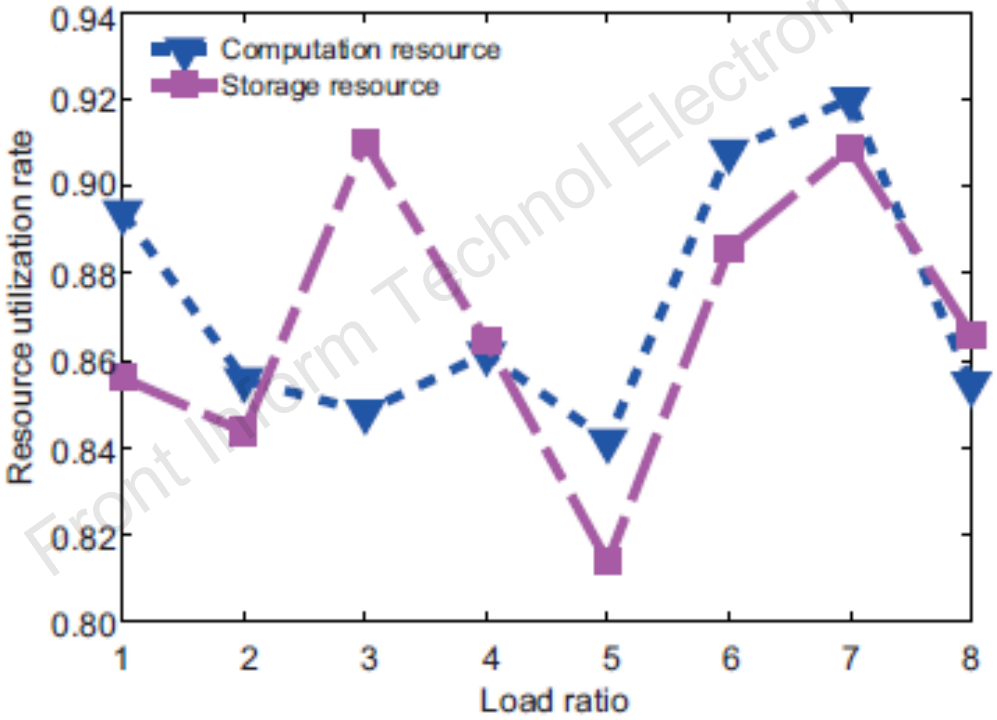

Fig. 11 Resource utilization rate when the load ratio increases

Conclusions

1. A VM allocation problem has been formulated to minimize the total cost of MNOs when deploying services for third parties.

2. An elitist genetic algorithm has been designed to find the optimal solution of the problem in polynomial time.

3. Simulations have been conducted to evaluate the feasibility and effectiveness of the proposed algorithm.