

System Model and Task Features

Task Features

- Data size: uniformly distributed in $[16, 80]$ Mbit
- Required CPU cycles: uniformly distributed in $[1.5, 3.5]$ GHz
- Deadline: uniformly distributed in $[2, 4]$ s

User Equipment (UE) Features

- Distance: uniformly distributed in $[10, 50]$ m
- CPU frequency: uniformly distributed in $[0.5, 1.5]$ GHz

Server Features

- CPU frequency: 6 GHz
- Power: 5 W
- Spectrum bandwidth: 20 MHz

Server Scheduling using SP-MARL (MAPPO)

Objective: Assign priority to each task offloaded to the server. **Note:** The scheduling considers both Quality of Service (QoS) and energy consumption simultaneously.

Offloading Decision and Resource Allocation using SP-MARL (MAPPO)

Objective: For each UE, decide whether to offload the task or execute locally and determine the spectrum ratio allocation. **Note:** Both QoS and energy efficiency are taken into account simultaneously.

Quality of Service (QoS) Model

QoS is defined as:

- QoS = 1 before the deadline.
- QoS decreases linearly from 1 at the deadline to 0 at $2 \times$ deadline.
- After $2 \times$ deadline, QoS remains 0.

Mathematically, it can be expressed as:

$$\text{QoS}(t) = \begin{cases} 1, & t \leq D, \\ 1 - \frac{t-D}{D}, & D < t < 2D, \\ 0, & t \geq 2D, \end{cases}$$

where D denotes the task deadline.

System Model Reference

The communication and energy consumption formulations follow the system model proposed in:

“Deep Reinforcement Learning for Energy-Efficient Computation Offloading in Mobile-Edge Computing.”