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Cost-Minimized Partial Computation Offloading in Cloud-Assisted Mobile Edge Computing Systems

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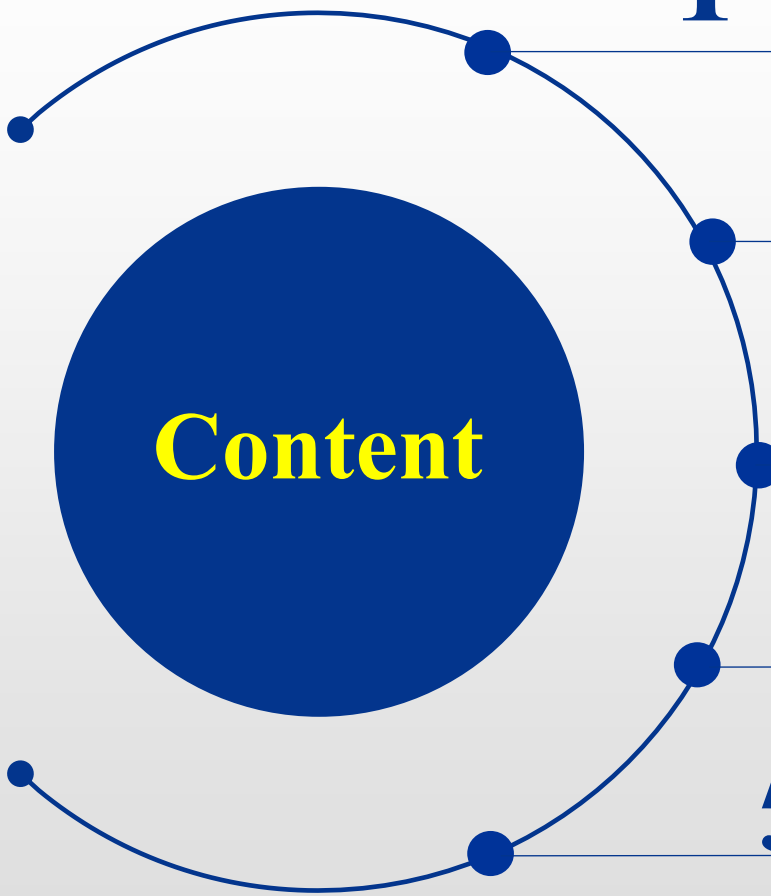
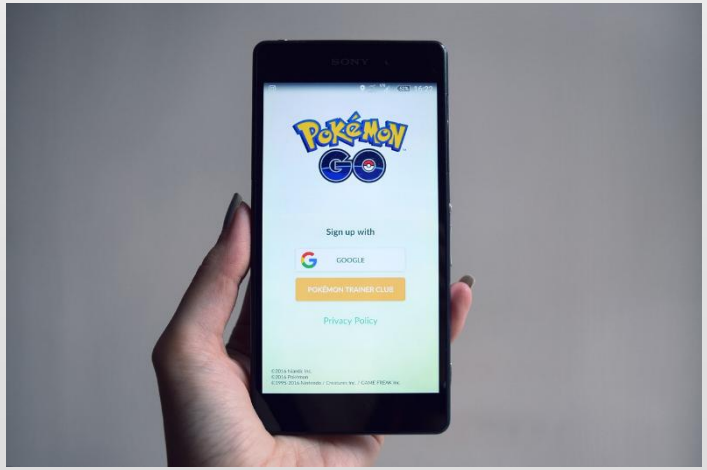
Content



1 Introduction

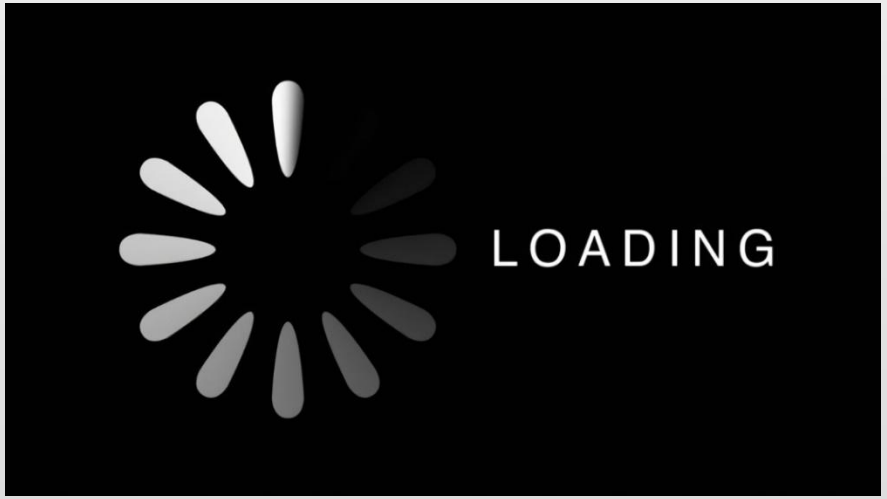
Introduction

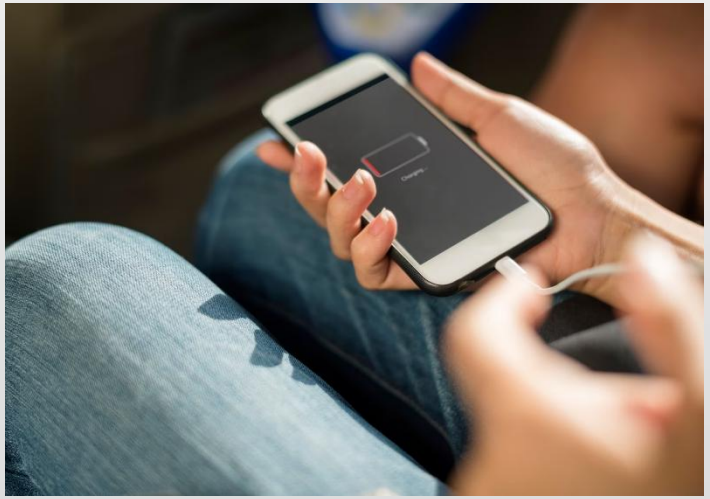
- Smart Mobile Devices (SMDs)
  - Mobile games
  - Online meeting
  - Customized applications

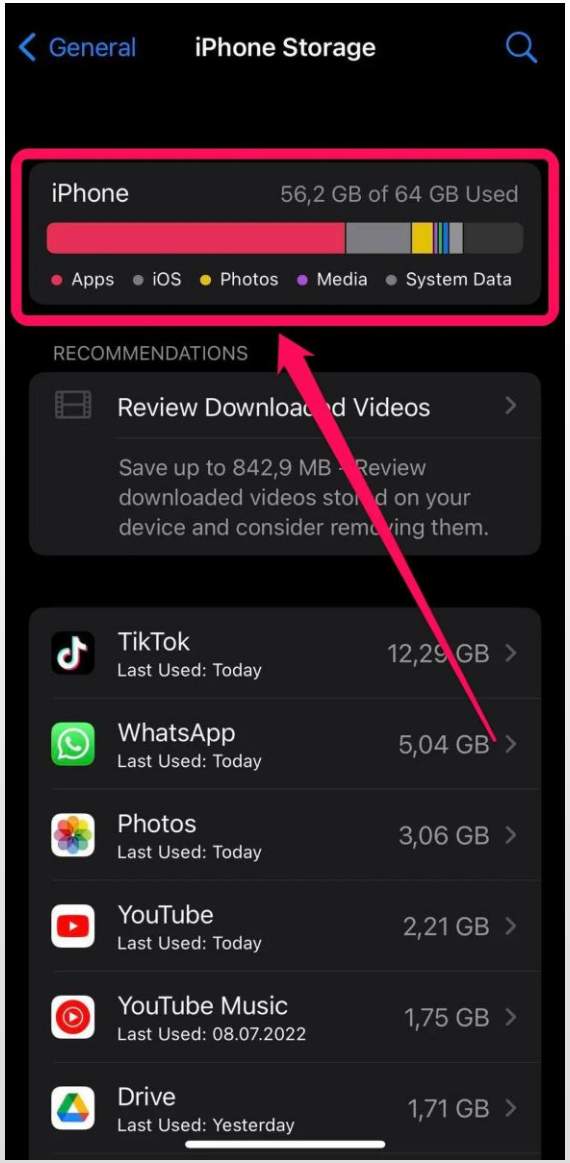


Introduction

- Limited resources in SMDs
  - CPU
  - Memory
  - Battery power







Introduction

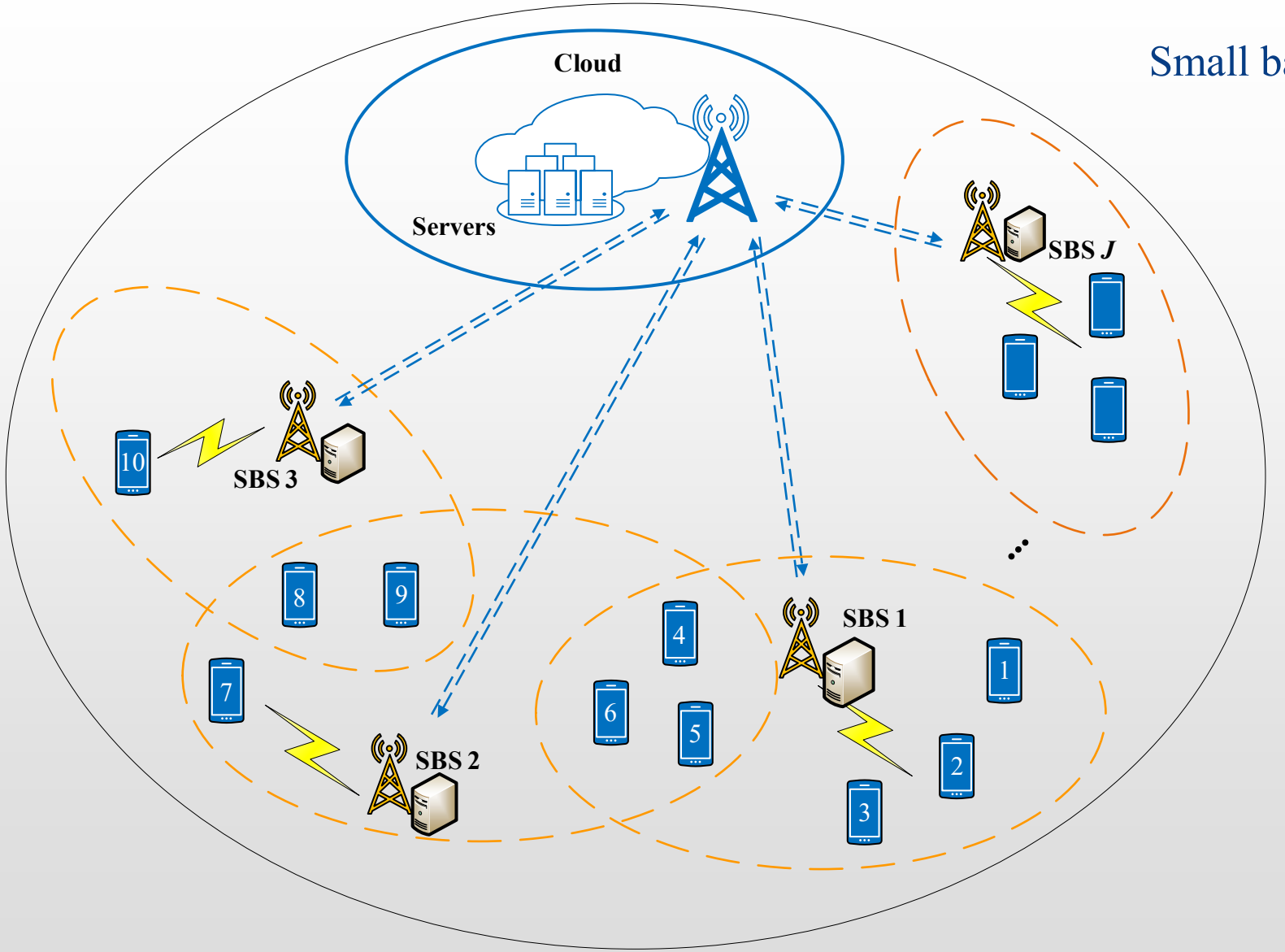
- Mobile edge computing (MEC)
  - Network capabilities near data sources
  - Low transmission latency
  - Limited computing resources

- Cloud-assisted MEC
  - Adequate computing resources
  - Flexible deployment
  - Additional overhead of communication
  - Increased energy consumption of the system

2 Problem Definition

Problem Definition

Small base station (SBS)



Architecture of the cloud-assisted MEC system

Problem Definition

- Cost optimization

Contributions

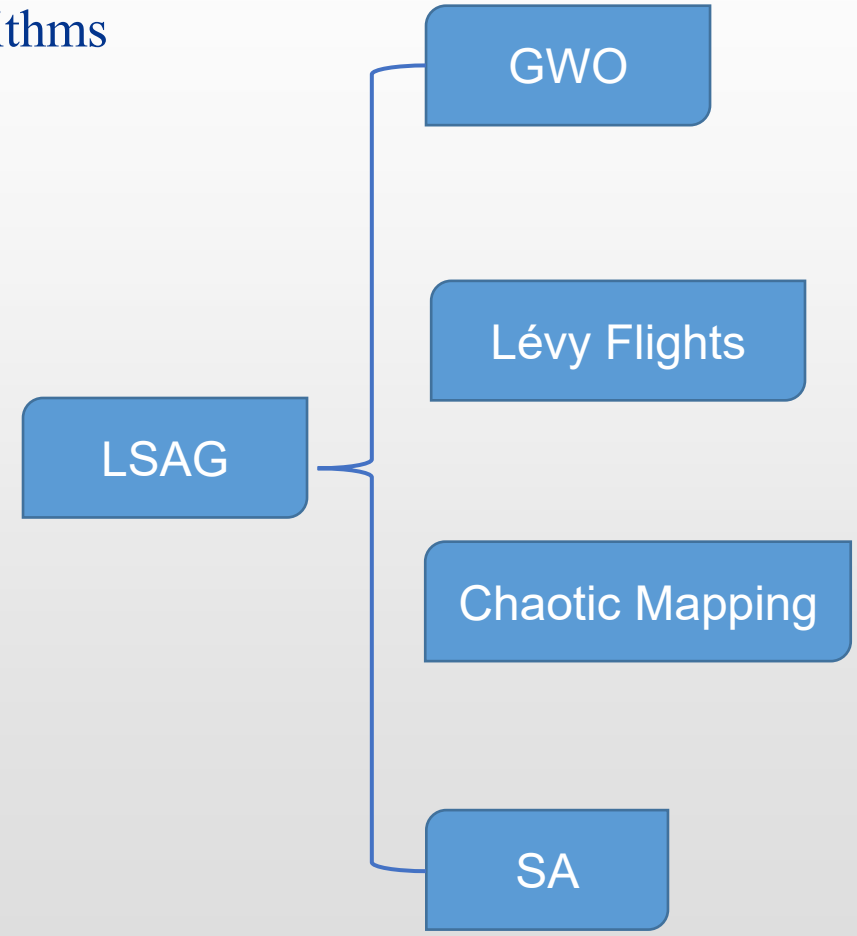
Goal: Minimize cost of SMDs and edges under latency constraints

1. More realistic partial computation offloading model
   - Modeling of SMDs
     - Latency and energy consumption in SMDs' computing
   - Modeling of SBS and the cloud
     - Latency and energy consumption in edges
   - Modeling of the communication channels
     - Latency and energy consumption in communication between SMDs and edges
2. Propose a novel optimization algorithm-Lévy Flights and Simulated Annealing-based Grey Wolf Optimizer (LSAG)

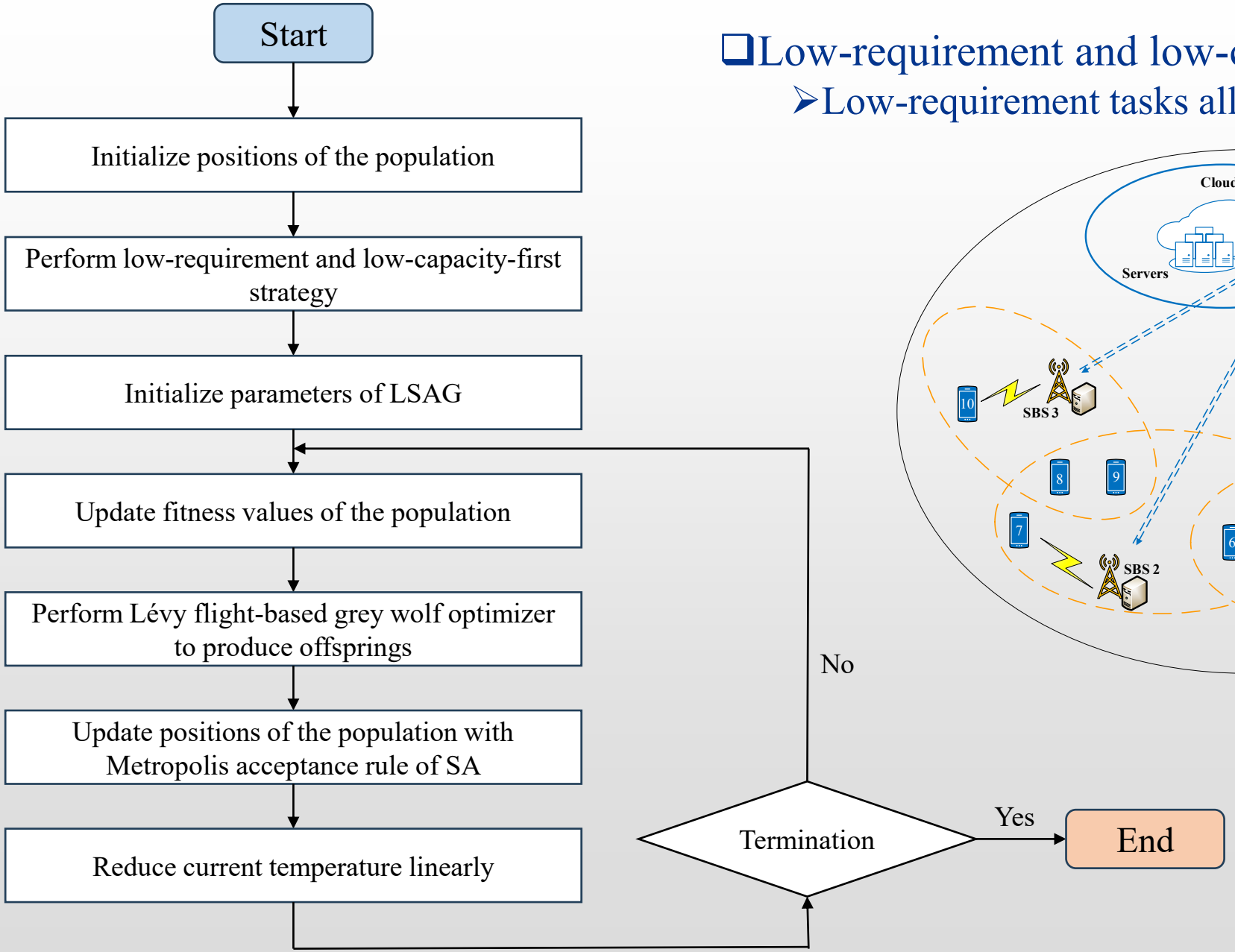
3 LSAG

LSAG

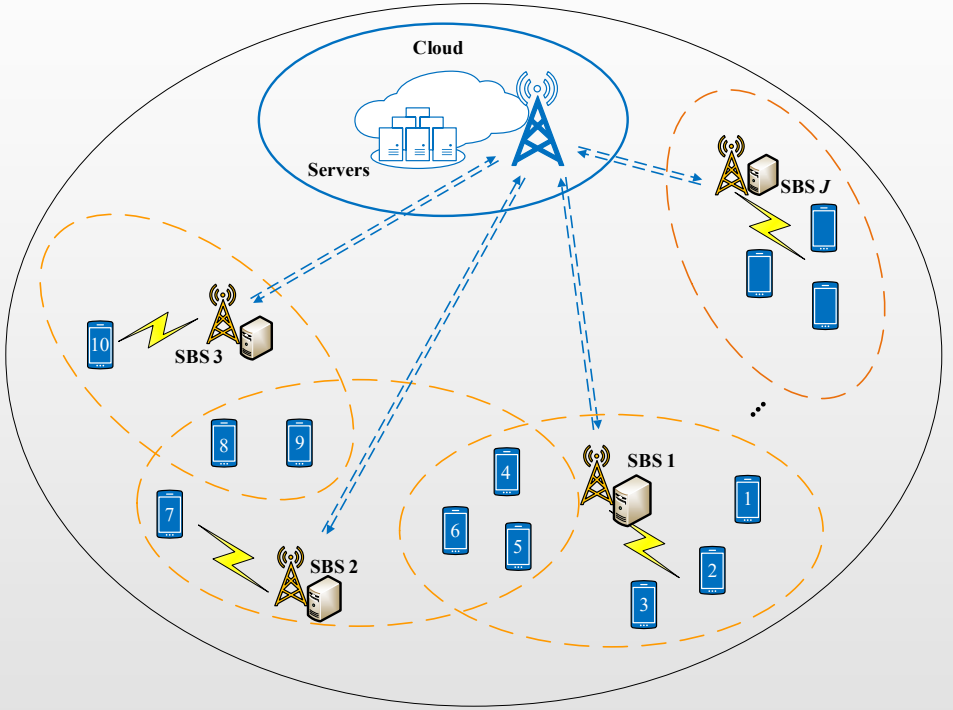
- Non-Linear Program
  - NP-hard & difficult to solve with deterministic algorithms
- Grey Wolf Optimizer (GWO)
  - Advantage: Fast convergence speed
  - Disadvantage:
    a) Easy to be trapped into local optima
    b) Insufficient exploration ability
- Lévy Flights
  - Advantage: Excellent global search capability
- Chaotic Mapping
  - Advantage: Well cover the search space
- Simulated Annealing (SA)
  - Advantage: Efficient global optimization ability



LSAG



- Low-requirement and low-capacity-first (LLF)
  - Low-requirement tasks allocate to low-capacity SBS first



4 Experimental Results and Discussion

Experimental Results and Discussion

❑Optimization results of several algorithms with 10 SMDs

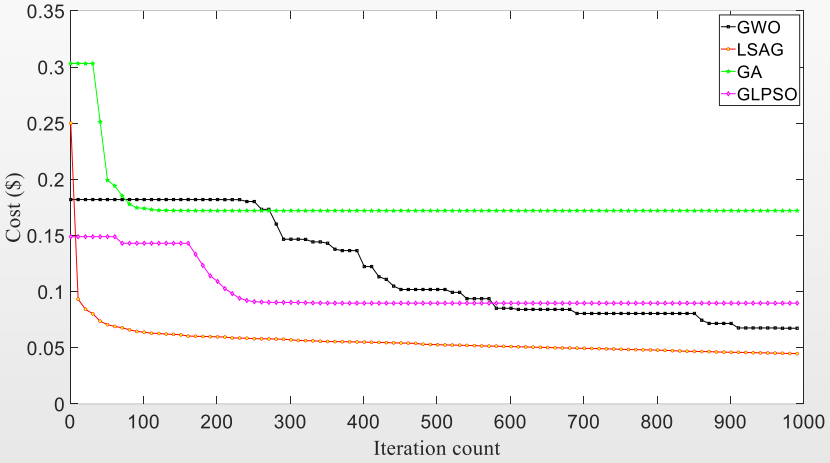


Fig. 1. Cost in each iteration for each algorithm

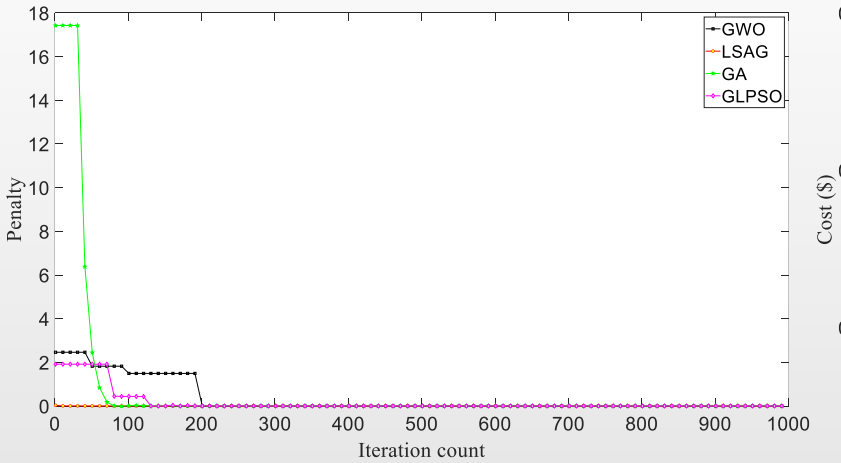


Fig. 2. Penalty for each algorithm

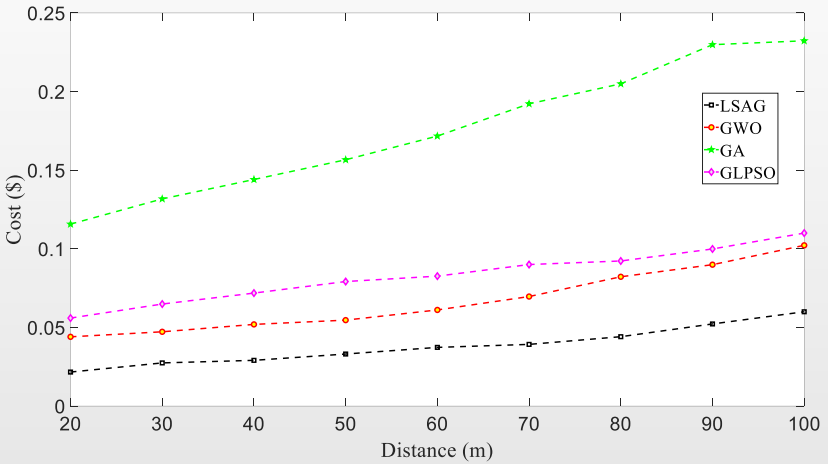


Fig. 3. Cost v.s. distance for each algorithm

LSAG achieves the best result with zero penalty

Experimental Results and Discussion

❑Optimization results of several algorithms with different number of SMDs

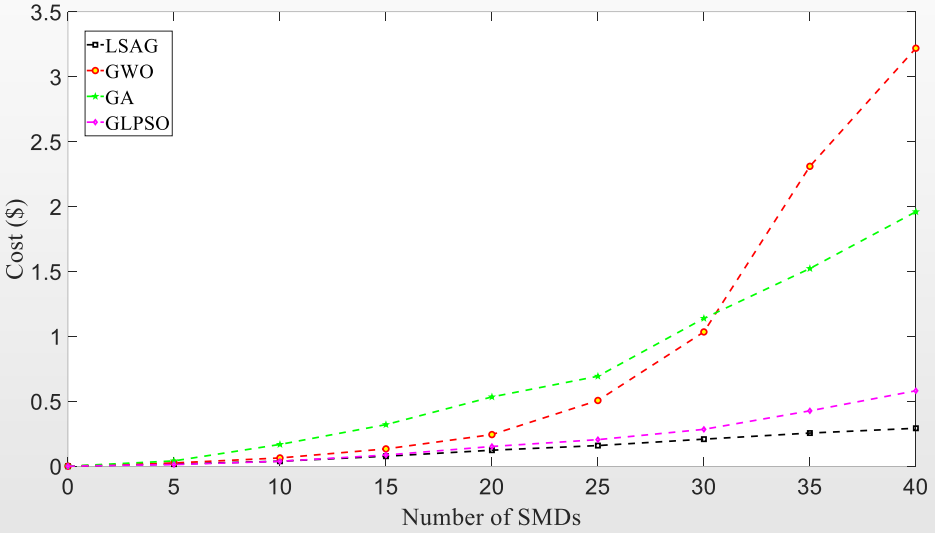


Fig. 4. Cost v.s. SMDs' number for each algorithm

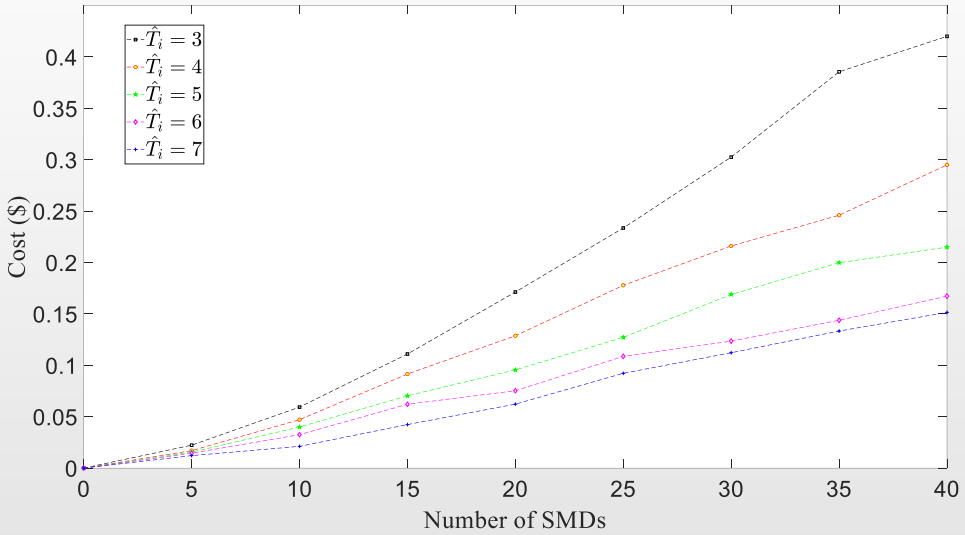


Fig. 5. Cost with $\hat{T}_i$ and SMDs' number for LSAG

LSAG achieves the best result with zero penalty

Experimental Results and Discussion

❑Optimization results of different strategies

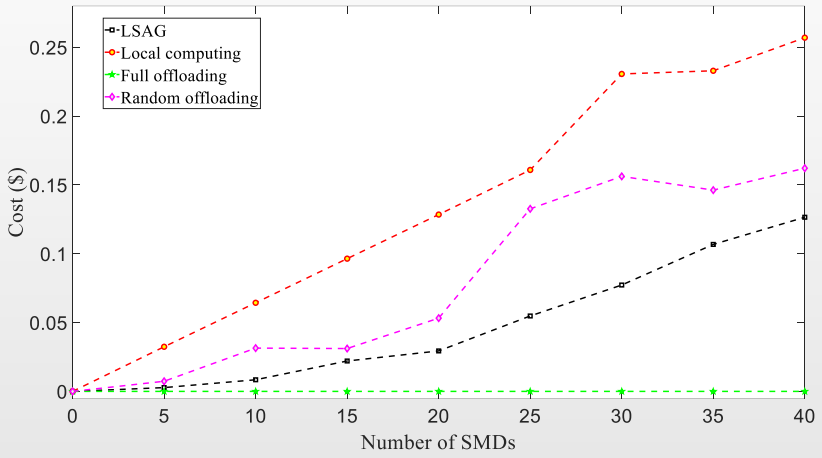


Fig. 6. Cost of SMDs for different number of SMDs

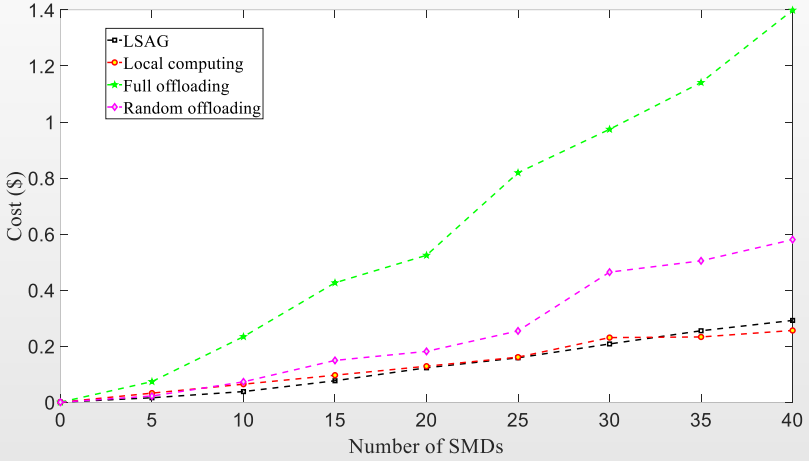


Fig. 7. Cost of system for different number of SMDs

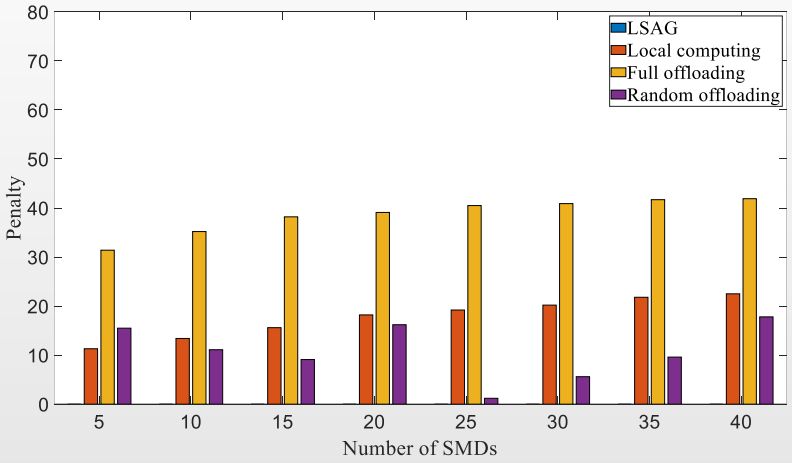


Fig. 8. Penalty of each strategy

5 Conclusion

Conclusion

- A cost-minimized computation offloading problem with latency limits
- Lévy Flights and Simulated Annealing-based Grey Wolf Optimizer (LSAG)
- Implemented the lowest cost compared with three widely-used peers and three offloading strategies

Q & A

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