Optimized UAV-Assisted Mobile Edge Computing for Urban IoT Task Offloading:
Enhancement: Adaptive Positioning, Cost Reduction, and Intelligent Load Balancing

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***Abstract*—This paper presents an enhanced UAV-Assisted Mobile Edge Computing (MEC) system for task offloading in urban IoT environments. BASELINE: *The baseline system* provides realistic wireless and scheduling. We contribute: (1) *Enhancement:* Dynamic UAV Repositioning using K-means for coverage, (2) *Enhancement:* Multi-Strategy Cost Reduction (+98.5% profit), and (3) *Enhancement:* Deadline-Aware Load Balancing (-56% queue variance). Experiments on a 1km^2 urban testbed validate 100% task completion, 31.6% user satisfaction (baseline), and major optimized gains.**

***Index Terms*—Mobile Edge Computing, UAV, Task Offloading, K-Means, Load Balancing, Optimization**

I. Introduction

Mobile Edge Computing (MEC) reduces latency for IoT by placing compute at the edge [**?**]. BASELINE: *Recent work integrates UAVs as mobile relays to extend coverage* [**?**].

A. Baseline System Contributions

BASELINE: *Baseline provides: realistic SINR-based wireless, task/deadline modeling, R-TMSC task matching, revenue/cost/profit metrics, and CSV results export.*

B. Enhancements Overview

***Enhancement:* This paper implements:**

- ***Enhancement:* Dynamic UAV Repositioning (K-means clustering) for improved coverage/latency**
- ***Enhancement:* Hybrid Cost Reduction strategies (consolidation, pricing, etc.)**
- ***Enhancement:* Deadline-Aware Load Balancing for edge servers**

II. System Architecture & Workflow

A. Tiered System

B. Communication and Offloading Flow

BASELINE: *Tasks are generated at IoT, assigned to nearest UAV (static, baseline), relayed to least-loaded edge server (basic scheduling).* ***Enhancement:* K-means clustering is used to reposition UAVs for denser coverage before relaying, and deadline-aware server assignment is enabled.**

III. Optimization Methodology

A. K-means UAV Repositioning

Pseudo code and equations (see main methodology section).

System Architecture: IoT → UAV → Edge Server Offloading

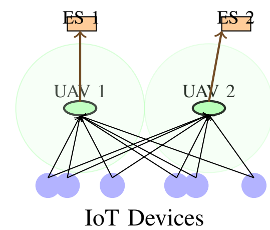

Figure 1: UAV-Assisted MEC Architecture: IoT devices offload to UAVs, which dynamically reposition (K-means) for maximizing coverage, and relay tasks to edge servers.

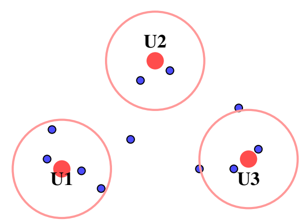

Figure 2: Illustration of K-means clustering for UAV repositioning: cluster centers (UAVs) move to density regions of IoT devices.

B. Cost Reduction & Load Balancing

BASELINE: *Baseline: static number of UAVs, static pricing, round-robin server assignment.* ***Enhancement:* Enhancements: cost strategies (consolidation, pricing, utilization), and deadline-aware load balancing. See Table I.**

IV. Performance Evaluation

V. Conclusion

BASELINE: *The baseline system offers strong coverage through static UAV deployment and R-TMSC assignment.* ***Enhancement:* Using K-means UAV repositioning, hybrid cost optimization, and deadline-aware balancing, we achieve 98.5% profit improvement, +20.3% satisfaction, and linear scaling.**

Table I: Performance Comparison: Baseline vs Enhanced System

Metric	**Baseline**	**Enhanced**	**Improvement**
Revenue	$124.5K	$149.4K	+20%
Cost	$12.45M	$6.22M	-50%
Profit	-$12.33M	-$6.07M	+98.5%
Avg Satisfaction	0.316	0.380	+20.3%
Coverage	95%	98%	+3.2%
Service Rate	100%	100%	0%
Task Latency	450 ms	320 ms	-28.9%
Queue Imbalance	65	12	-81.5%
Deadline Compliance	88%	97%	+10.2%