

Abstract

The rapid growth of the Internet of Things (IoT) has led to an increased demand for efficient data processing closer to the data source, making edge computing a critical component of modern IoT ecosystems. To ensure improved overall performance, task execution in an IoT-edge-cloud environment poses significant resource optimisation challenges. With an emphasis on methods to increase the performance efficiency of IoT-Edge environments, this thesis investigates several resource optimization approaches for IoT edge environments. The study begins by analyzing traditional resource optimization methods and their limitations in IoT-Edge environments. It identifies three critical components of job execution in such environment: (i) placement of edge servers, (ii) job offloading, and (iii) task scheduling strategies. The investigation of state-of-the-art techniques has revealed significant metrics still needing attention. The primary challenges to resource optimization in IoT-Edge environments include: (i) Need of strategies capable of determining the optimal number of edge servers while extending network lifespan and maximizing coverage. (ii) In resource optimization, many existing task-offloading techniques fail to account for minimizing task cancellation for time-sensitive jobs. (iii) Most job scheduling methods tend to focus on factors like QoS, migration costs, and resource utilization, overlooking critical elements such as job priority, conflicts, and dependencies that are vital for efficient job execution at edge nodes. This thesis addresses these challenges. The first challenge is tackled by introducing a method for selecting cluster heads using Glowworm Swarm Optimization, which effectively divides the network into an optimal number of clusters while balancing the needs of edge servers and associated base stations. The second challenge is met with a proposed Cuckoo Search-based offloading algorithm for IoT networks within an edge computing framework, designed to enhance service time and resource utilization for data-sensitive, deadline-driven tasks. The third challenge is resolved by offering a job scheduling algorithm that employs Cuckoo Search for IoT systems, concentrating on job priority, dependencies, and conflicts to create an effective job schedule.

All algorithms presented in this thesis have been validated through simulations and demonstrate superior performance compared to state-of-the-art techniques. The proposed edge server placement algorithm significantly surpasses existing IoT clustering protocols, even when more than 20% of nodes experience power loss. A benchmark dataset has been utilized for simulation purposes, along with effective simulation software including Matlab, I-Net, and Cisco Packet Tracer. Additionally, the proposed task-offloading method results in 12.8% fewer task cancellations compared to a state-of-the-art approach. Simulations indicate that the proposed task scheduling strategy outperforms existing edge-computing task scheduling methods, especially in scenarios involving conflicting or dependent jobs.