Orchestration and Distribution of Services in Hybrid Cloud/Edge Environments

Dissertation supervised by:

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“The golden rule: can you make a change to a service and deploy it by itself without changing anything else?”

—Sam Newman

Problem

67%

of enterprise infrastructure and software will be for cloud-based (2020)

Problem

Technical

Robustness and Resilience of Heterogeneous Infrastructures

Socioeconomic

Temporal and Geographical Estimations of Service Demand

Problem

Management

Architecture complexity, low-level verbose configuration files

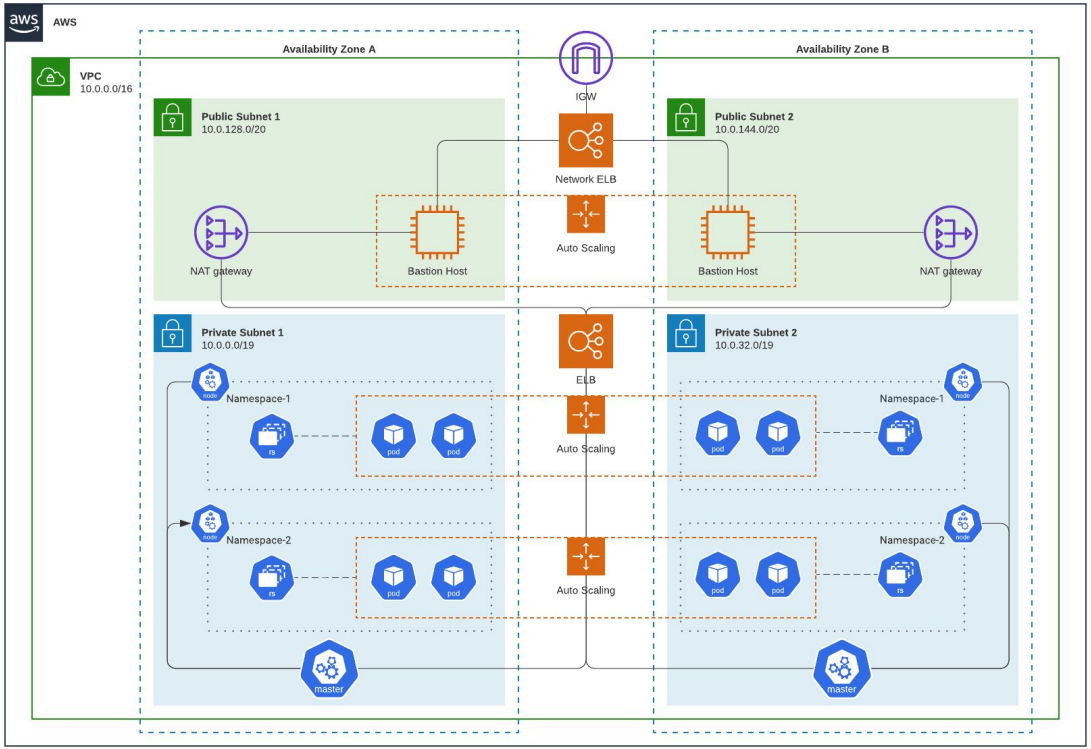
Technical

Robustness and Resilience of Heterogeneous Infrastructures

Socioeconomic

Temporal and Geographical Estimations of Service Demand

Kubernetes Implementation Diagram



Time Series Analysis

Scale Necessary Resources

Dynamic autonomous Infrastructure

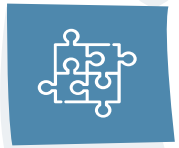
Anticipate Service Usage

Optimal Distribution Solution

02

Objectives

- **Cluster and Application Management**
- **Orchestration and Distribution Protocols**



Heterogenous

Resource Optimized

Ease of Use

Scalable

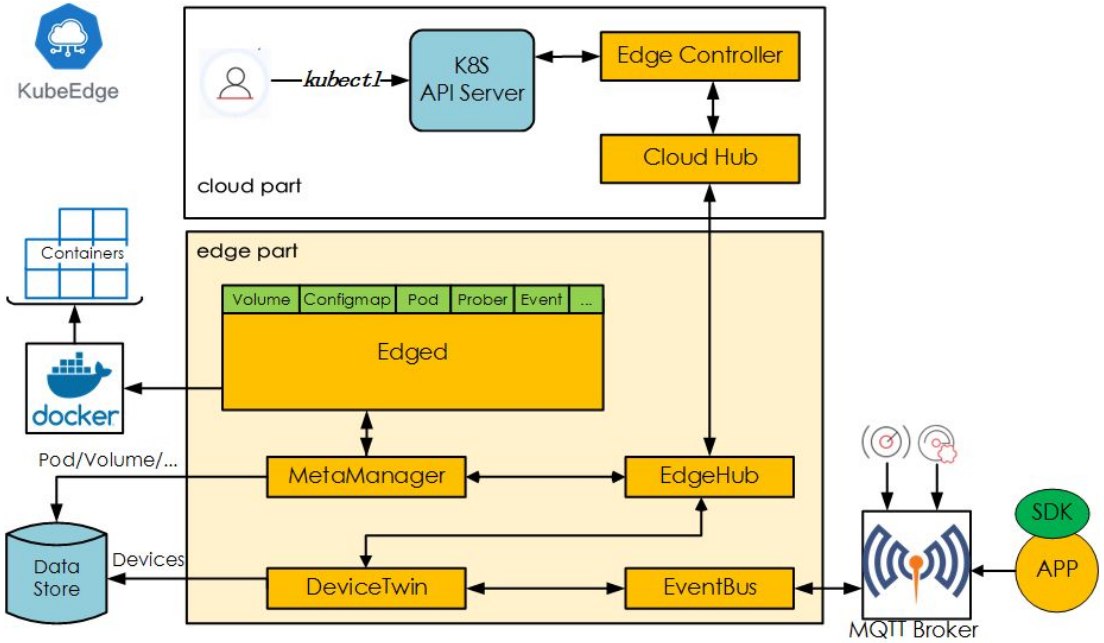
Related Work

Resource Allocation and Scheduling

Solutions to the resource allocation and scheduling problem in Cloud/Edge environments

- **Partial solution** to this problem solely focused on **fog computing models**
- Resource optimization and profit-maximizing decisions, but **difficulties in handling heterogeneous infrastructures**
- **Complex solution** with **contracts establishment** between the edge and cloud node

Cloud/Edge Orchestration System



KubeEdge architecture, https://kubernetes.io

Resource Scheduling Algorithms

Minimizing General Convex Objectives

Client assignments to capacity constrained facility locations

Distributed Optimization Protocol

Based on consensus algorithm, solves resource allocation, and management in IoT heterogeneous networks

04

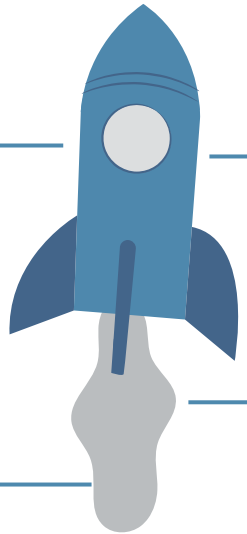
Proposed Approach

High-Level Config

Abstract Kubernetes/KubeEdge configuration

Cloud/Edge

Seamless handling of heterogeneous software and hardware



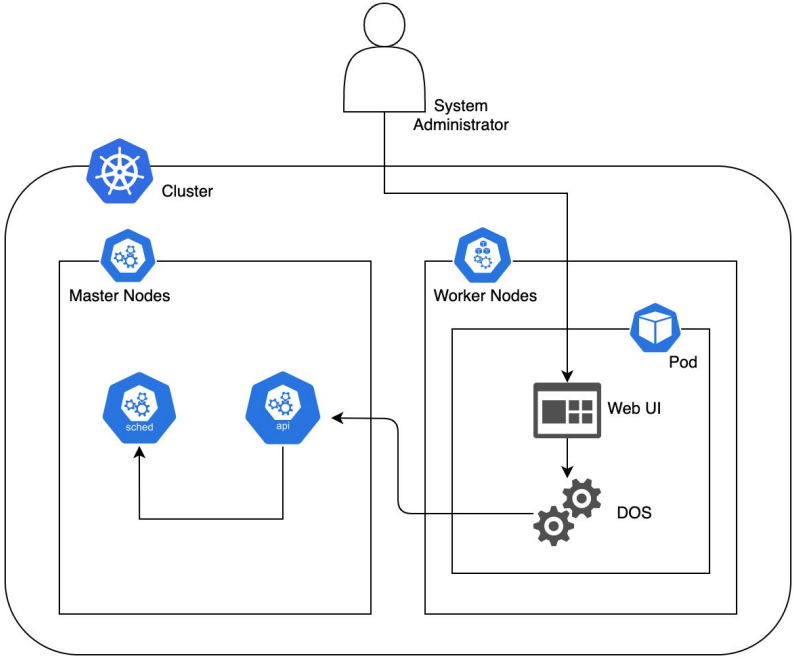
Geo-Location

Define nodes geographic location and application placement

Node Setup

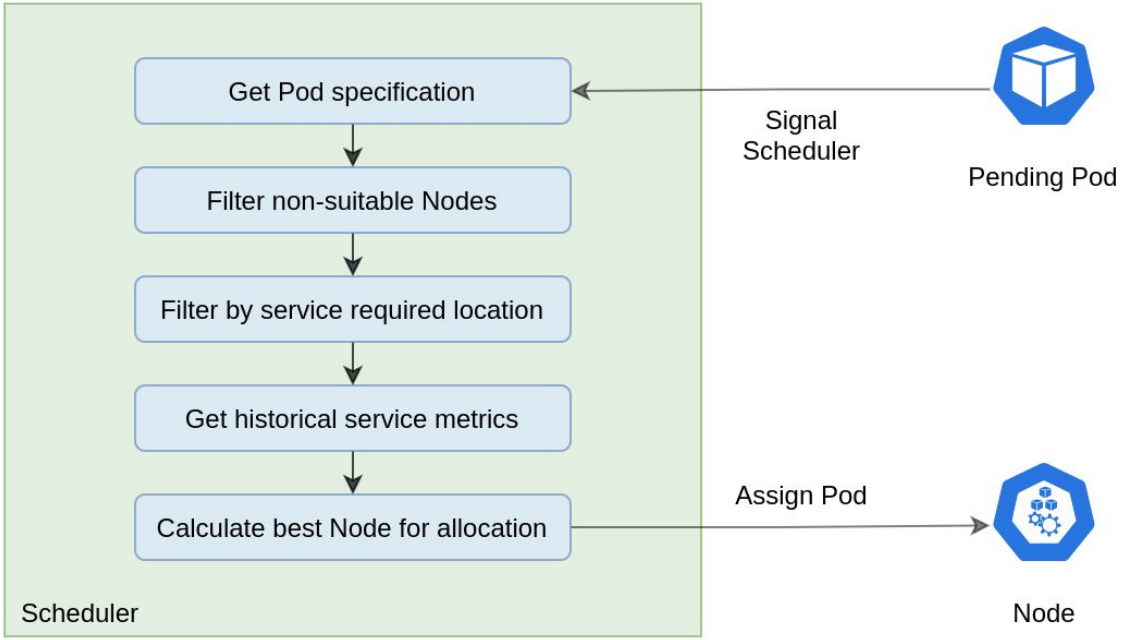
Automatic node configuration and cluster addition

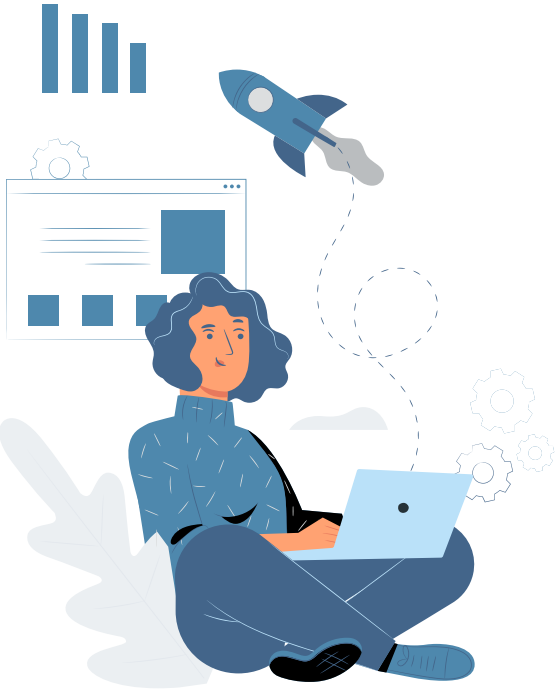
Cluster Administration Service



Scheduler

Scheduler

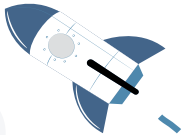

Get Pod specification
Filter non-suitable Nodes
Filter by service required location
Get historical service metrics
Calculate best Node for allocation
Scheduler
Signal Scheduler
Pending Pod
Assign Pod
Node



05

Work Done and Schedule

Work Done



System Architecture Modeling

Structure and
Behaviour definition

KubeEdge

Cluster Setup and
Tests

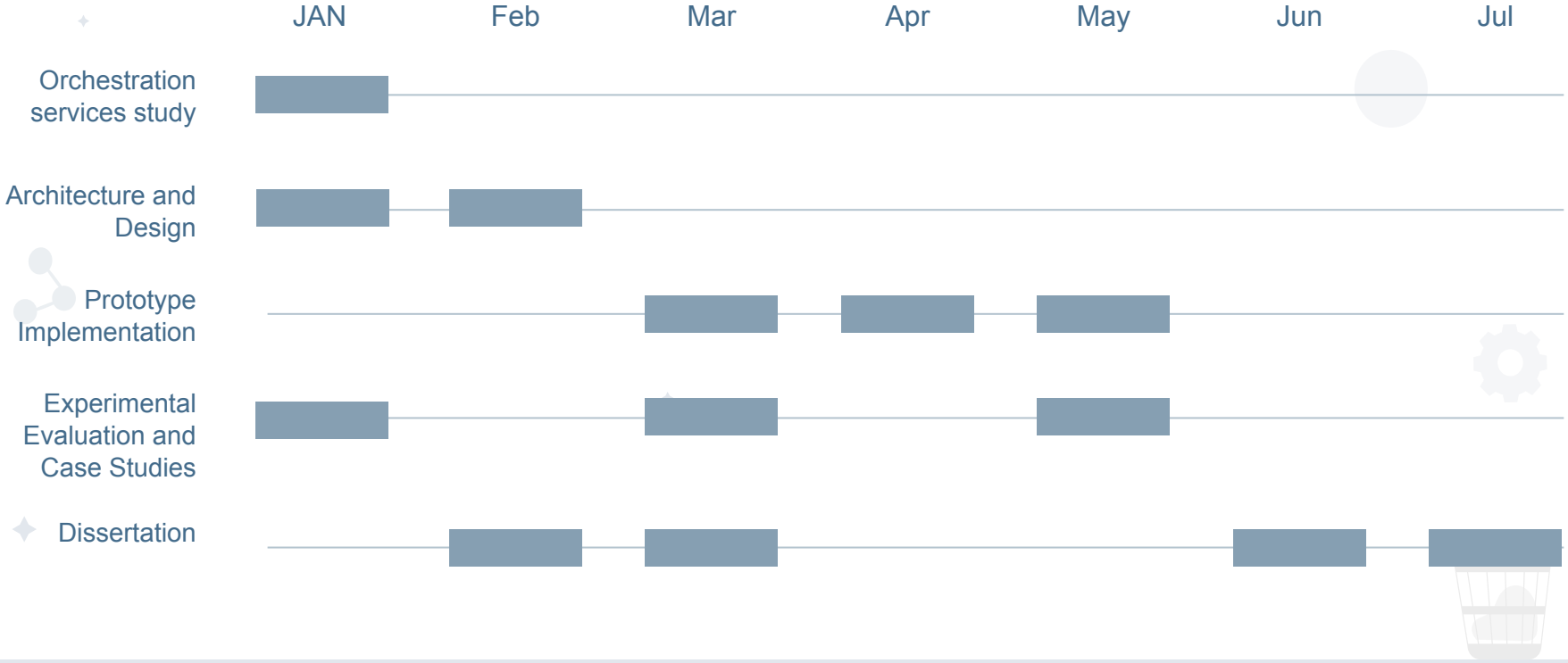
Nodes Setup

Automated Ansible node
provisioning

DOS Analysis

Tools and Architectures

Schedule


JAN
Feb
Mar
Apr
May
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Jul
Orchestration services study
Architecture and Design
Prototype Implementation
Experimental Evaluation and Case Studies
Dissertation

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