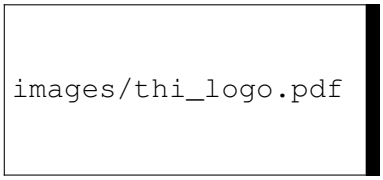

Technische Hochschule Ingolstadt

Specialist area Computer Science
Bachelor's course Computer Science

Bachelor's thesis

Subject:	Conception, Implementation, and Evaluation of a Highly Scalable and Highly Available Kubernetes-Based SaaS Platform on Kubernetes Control Plane (KCP)
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Issued on:	TODO: Insert Issue Date
Submitted on:	TODO: Insert Submit Date
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Abstract

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1.2 Objectives and Scope

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2.1 Kubernetes and Multi-Tenancy

Kubernetes as the Foundation for Cloud-Native Applications As the de facto standard for deploying and managing *cloud-native applications*, Kubernetes plays a pivotal role in modern cloud architecture . Kubernetes works as an application orchestrator for *containerized, cloud-native microservice* apps, meaning it can deploy applications and dynamically respond to changes . It offers a platform for declarative configuration and automation for containerized workloads, enabling organizations to run distributed applications and services at scale .

The Importance of Multi-Tenancy in Modern SaaS Platforms Multi-tenancy plays a fundamental role in modern cloud computing. By allowing multiple tenants to share the same infrastructure through virtualization, it significantly increases resource utilization, reduces operational costs, and enables essential features such as VM mobility and dynamic resource allocation . These benefits are critical for cloud providers, as they make the cloud business model economically viable and scalable. In the context of modern SaaS platforms, multi-tenancy goes even further by enabling unified management, frictionless onboarding, and simplified operational processes that allow providers to add new tenants without introducing incremental complexity or cost .

However, while multi-tenancy is indispensable for achieving efficiency, scalability, and cost-effectiveness, it simultaneously introduces complex security challenges, especially in shared environments where resource isolation is limited. In particular, the potential for cross-tenant access and side-channel attacks makes security in multi-tenant environments a primary concern . As such, understanding and addressing multi-tenancy from both operational and security perspectives is essential when designing and securing modern cloud-native platforms .

The Challenges of Multi-Tenancy and the Need for Solutions

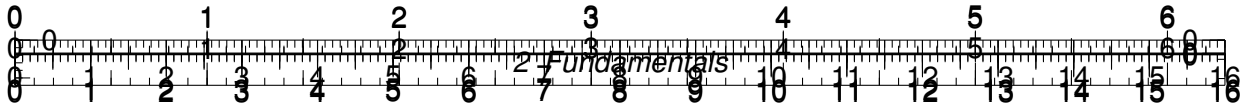
Kubernetes Control Plane (KCP) as a Promising Approach

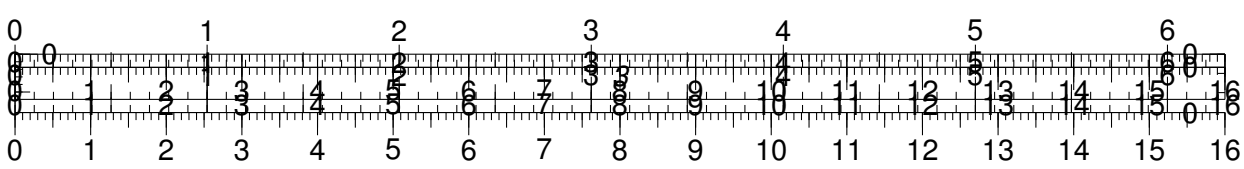
Background: The Evolution of Kubernetes Kubernetes was originally developed at Google and released as open source in 2014 .

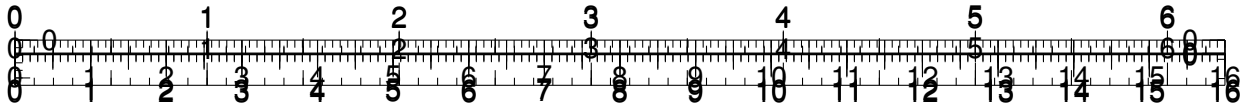
Background: Containerization as an Enabler of Kubernetes *Containerization* is a way to bundle an application's code with all its dependencies to run on any infrastructure thus enhancing portability . This comes with additional advantages that can be leveraged by Kubernetes, including vertical and horizontal autoscaling facilitated by quick container boot times, along with self-healing mechanisms and support for distributed, resilient infrastructures .

Background: Kubernetes Resource Isolation Mechanisms

Relevance to SaaS and this Thesis







Appendix