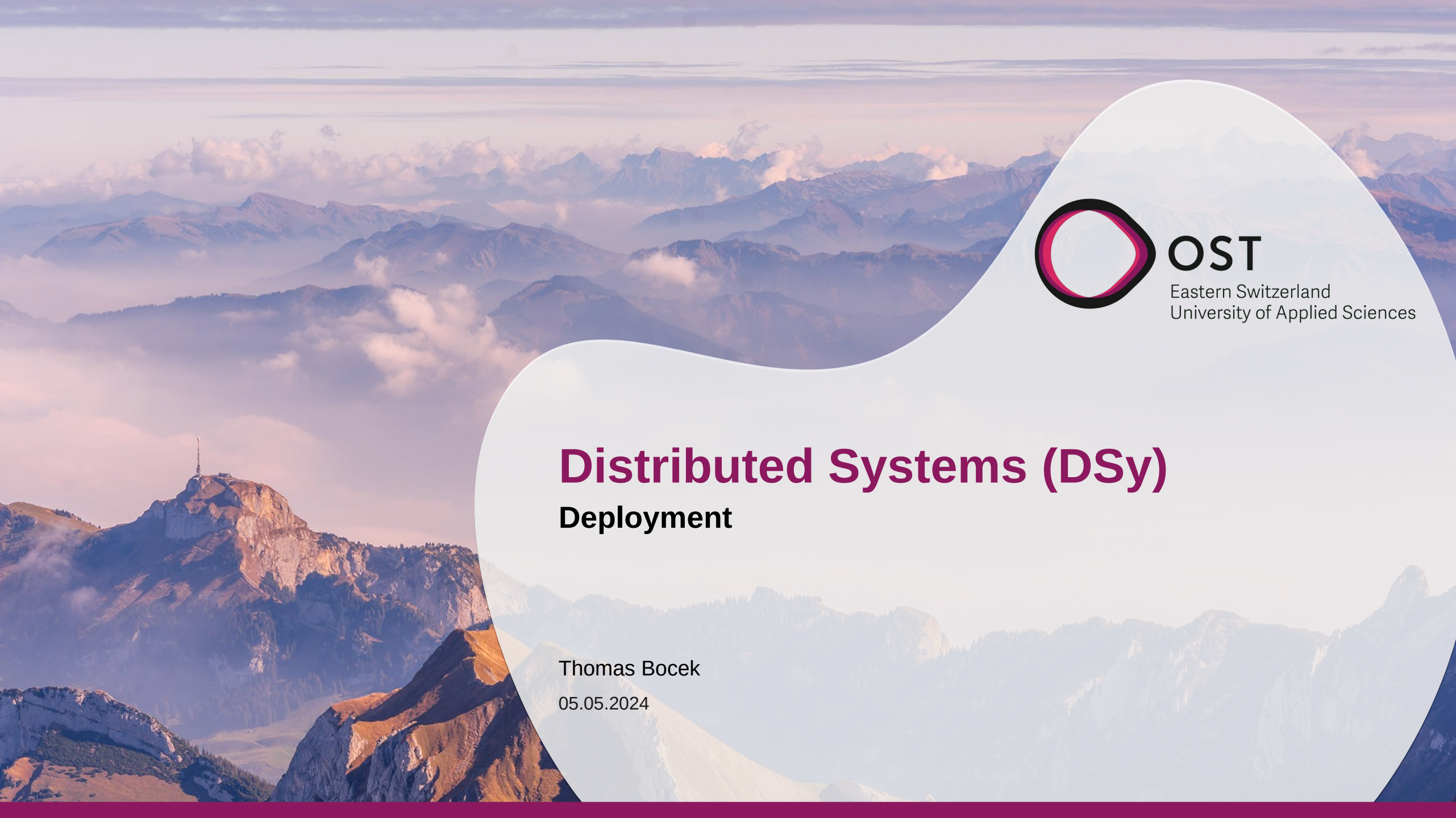

OST
Eastern Switzerland
University of Applied Sciences

Distributed Systems (DSy)

Deployment

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Learning Goals

- Lecture 10 (Deployment)
  - Different ways to deploy your service
    - High-level overview
  - Cloud Infrastructure [link], Cloud Operations [link] - Caracas Alexandru / Schnyder Norwin
  - Cloud Solutions [link] - Mirko Stocker

Back in the old days…

- OTS: apt-get / yum / pacman install package, e.g., Apache – configure – run
- Custom SW in the old days: Java: war, provide custom /etc/init.d script with binary or script
- Problem:
  - It runs on my machine, who installs Java in the right version?
  - What happens on crashes?
  - Scaling?
  - HW defect?
  - Misconfiguration - access to complete PC?
- VMs / Containers help a lot
  - No access to complete PC, can scale, move to another machine, pre-install the right Java version
- The new way: based on containers
- How to deploy?
  - Just copy container to prod, done?
  - Many, many strategies...

Deployment Strategies

- Many strategies and variations [link, link, link]
- Rolling Deployment
  - New version is gradually deployed to replace the old version - without taking the entire system down at once
    + Minimal downtime, low risk
    - Complexity, longer deployment times
- Blue-Green Deployment
  - 2 environments, current prod (blue), current prod with new release (green). Test, then switch
    + Instant rollback, 0 downtime
    - 2 prod environments, keep data in sync
- Canary Releases
  - Canary in a coal mine - new version to a small group of users or servers first, if all goes well, more users
    + Risk reduction, user feedback
    - Complexity, inconsistencies
- Feature Toggle
  - Fine grained canary, set feature for specific users
    + More risk reduction, specific user feedback
    - Increase complexity of codebase, config management
- Big Bang
  - Deploy everything at once
    + Simple
    - High risk, limited rollback

Practical Deployment

- Containerization as basis
  - Ansible (Progress Chef, Puppet) - and more
    - Playbooks with ssh host list – your host should run the same OS (apt/yum)
  - Docker Swarm
    - Works with docker-compose.yml – with docker you package your application the same way on any platform - simple
    - Which to use? [link]
  - Kubernetes
    - Widespread
  - Plain docker / podman
    - Simple

- Ansible (intro)
  - No agents running (unlike Progress Chef, Puppet)
  - Push-based system
  - ssh host list
  - Playbook
  - Run it: `ansible-playbook playbook.yml`

```
[webservers]
mwivmweb01
mwivmweb02
```

- More basic:
  - pssh

```
---
- name: Playbook
  hosts: webservers
  become: yes
  become_user: root
  tasks:
    - name: ensure apache is at the latest version
      yum:
        name: httpd
        state: latest
    - name: ensure apache is running
      service:
        name: httpd
        state: started
```

Docker / Podman

- Use docker --context to run/maintain containers on other machines
  - One of my super simple deployment scripts

```
#!/usr/bin/env bash

export DOCKER_HOST="ssh://xyz@192.168.1.2"

docker compose build
docker-compose up -d
```

  - Copy files into image works as docker sends this file from local machine to the remote. Mount files does not do this
  - No scaling, no logging, no resource monitoring, but simple

- Podman is daemonless
  - Simpler, but deployment needs more work [link]
  - Quadlet
    - Run container under systemd in a declarative way
    - Use another container config file to create a systemd config file
    - Use another project to create a container config from a podman command [link]
    - But, running upgrading images works seamless [link]
- Many variations, tools, helpers: podman-compose [link]
- Opinion: I'm still using docker / docker-compose: daemon is awesome for deployments, docker-compose for local development works quite well

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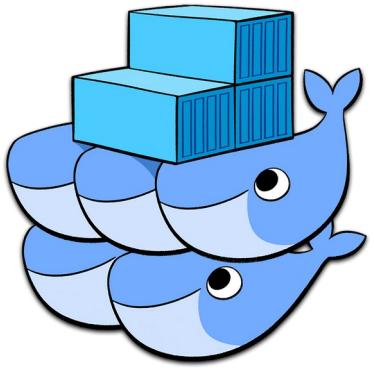
Docker Swarm

- Docker Swarm
  - Deploy with docker-compose.yml (deploy)
  - Built into docker
    - docker swarm – manage swarm
    - docker node – manage nodes
  - Scheduler is responsible for placement of containers to nodes
  - Can use the same files, easy to setup?
    - Azure, Google cloud, Amazon
    - Deprecated...



- Kubernetes vs. Docker Swarm
- “Docker Swarm has already lost the battle against Kubernetes for supremacy in the container orchestration space” [link]
- “Kubernetes supports higher demands with more complexity while Docker Swarm offers a simple solution that is quick to get started with.” [link]

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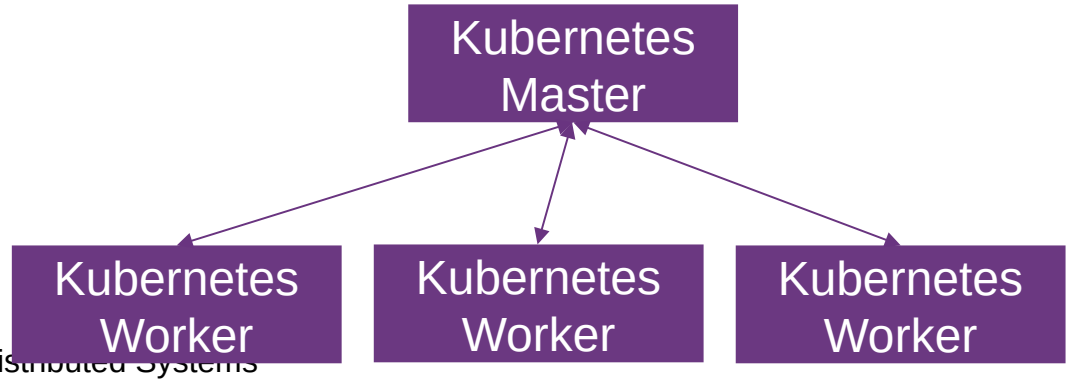
Kubernetes

- What is Kubernetes (K8s)
  - Container orchestration
    - Automates deployment, scaling, and management of containerized applications
  - Started by Google in 2014, now with CNCF
    - Widely adopted in the industry for managing complex applications
- Kubernetes-based PaaS
  - Google, Amazon, Azure (book), Digital Ocean, …
    - Difficult pricing schemes
- Why Kubernetes?
  - Simplifies application deployment and management
    - Development: run on one machine, deployment how and where to distribute?
  - Ensures high availability and fault tolerance
    - Containers can crash, machine that runs container can crash (e.g., out of memory)
  - Supports auto-scaling based on demand
  - Facilitates rolling updates and rollbacks
    - Rollbacks are hard, especially with state, stateless rollback is easier
  - Provides a powerful ecosystem of tools and services
    - Package manager Helm released in 2016 (convert docker-compose)

Kubernetes

- Design principles
  - Configuration is declarative – declare state with YAML/JSON
  - Immutable containers
    - Don’t store state in a container. If a health check fails, Kubernetes removes the container and starts a new one
    - Rollback applications, use older version of container – may need to change schema



- Architecture
  - Master Node: Controls the overall state of the cluster
    - API Server: Manages communication within the cluster
    - etcd: Stores configuration data for the cluster
    - Controller Manager: Ensures the desired state of the cluster
    - Scheduler: Assigns workloads to worker nodes
  - Worker Node: Runs application containers
    - kubelet: Communicates with the master node and manages containers
    - kube-proxy: Handles network routing and load balancing
    - Container runtime: Executes containers (Docker, containerd, etc.)

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Kubernetes

- Key Concepts [link]
  - Pod: Smallest deployable unit, contains one or more containers
  - Service: Stable network endpoint to expose a set of Pods
  - Deployment: Manages the desired state of an application, define scale, HW limits
  - ConfigMap: Stores non-sensitive configuration data for an application
  - Secret: Stores sensitive configuration data, like passwords and API keys
  - Volume: Persistent storage for data generated by a container
  - Namespaces – run multiple projects on one cluster, separate with namespaces

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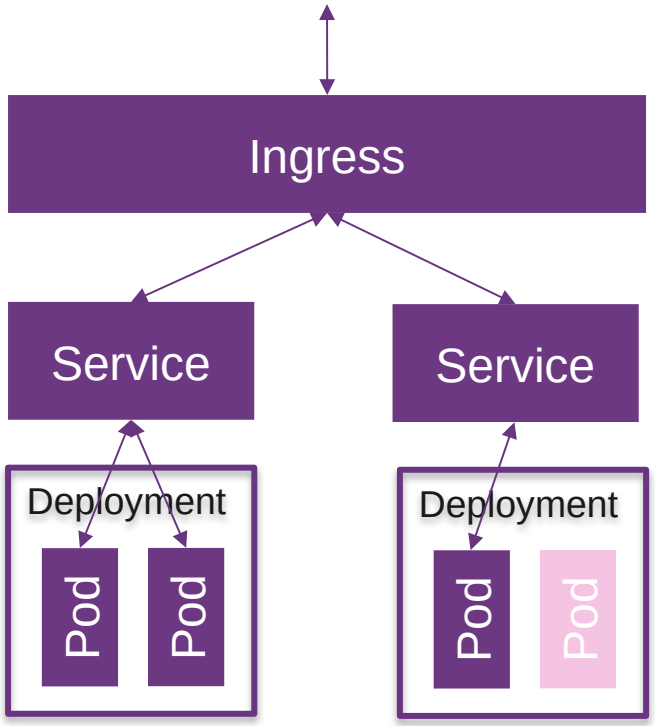
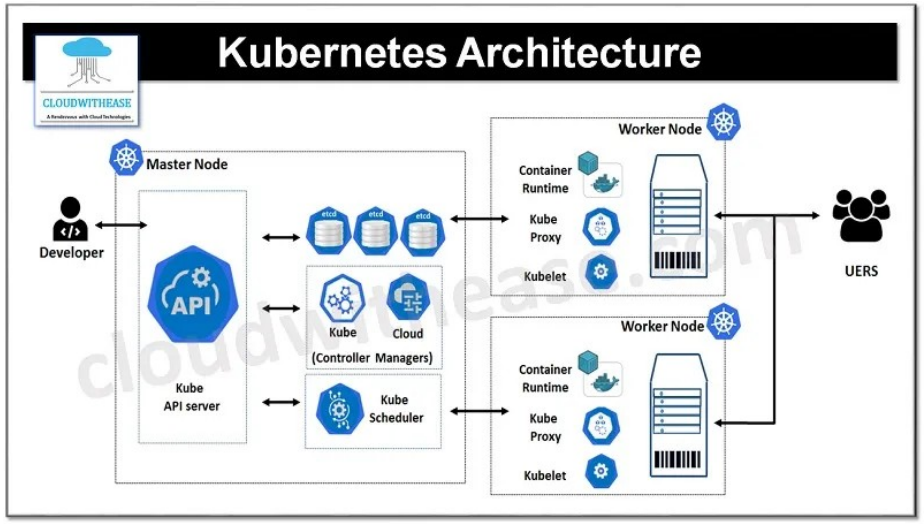
Kubernetes

- Getting Started with Kubernetes: Minikube, k3s
  - Minikube: Run a single-node Kubernetes cluster locally
  - kubectl: Command-line tool for managing a Kubernetes cluster
  - Kubernetes Dashboard: Web-based user interface for managing a cluster
- Deploy any containerized application
  - Use health endpoints
    - Liveness/Readiness
- Official documentation: https://kubernetes.io/docs
- Kubernetes tutorials: https://kubernetes.io/training
- Youtube course





Source: https://cloudwithease.com/what-is-kubernetes/

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