OpenShift
Installation & Administration

Tobias Derksen

codecentric

Über mich …

Tobias Derksen

- IT Consultant @codecentric
- DevOps Specialist
- OpenShift Trainer
- RedHat Certified Engineer

Vorstellung

Agenda

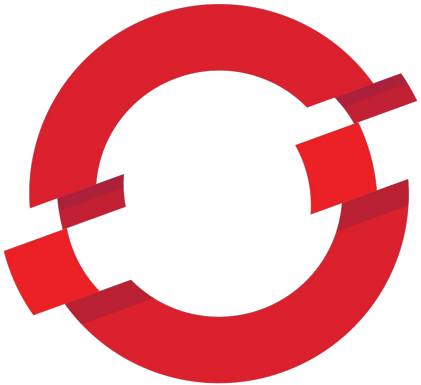
- Einführung in OpenShift
- Cluster Konzeption
- Installation
- Web Interface & CLI Basics
- Hochverfügbarkeit
- Networking / SDN
- Persistent Storage
- Best Practices
- OpenShift 4
- Hochverfügbarkeit für Applikationen

Einführung in OpenShift

Was ein Chaos ...

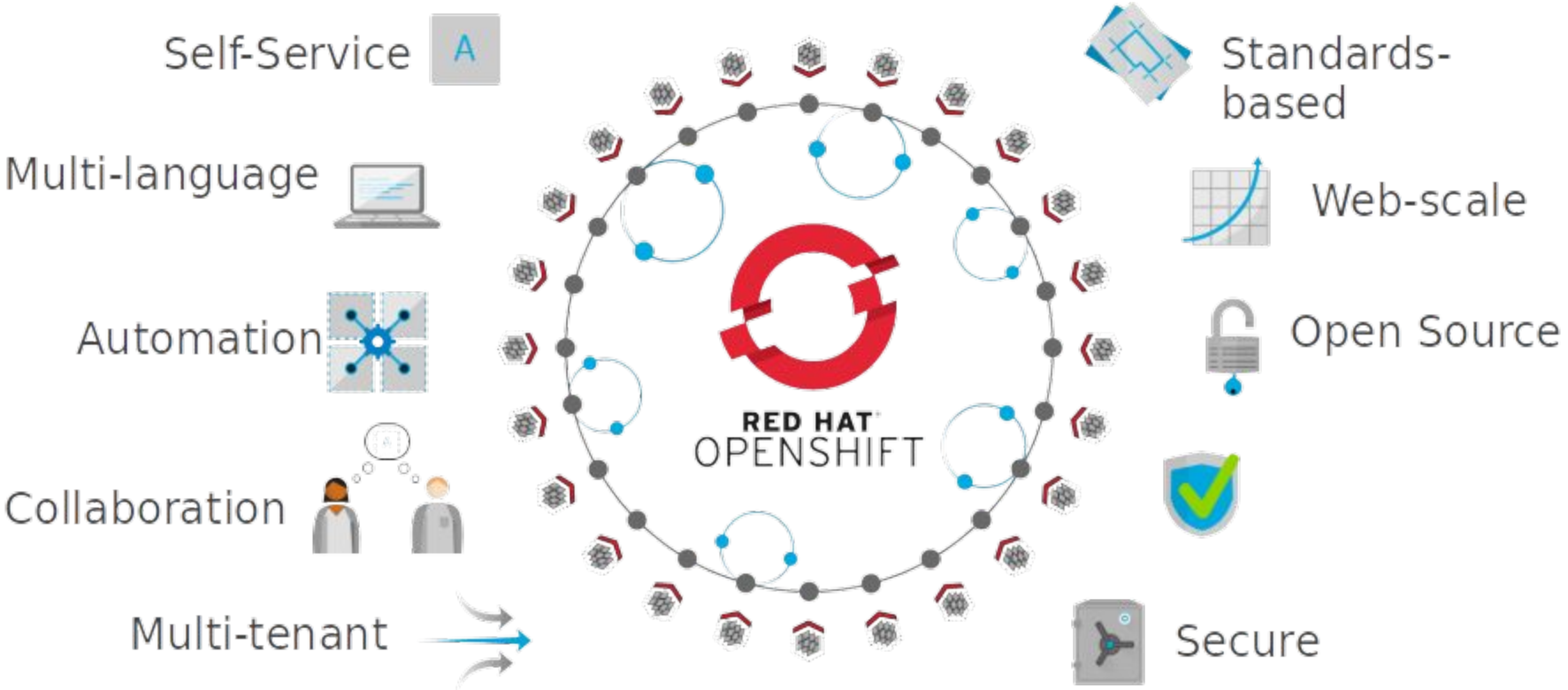
redhat

OPENSHIFT origin



OPENSHIFT

kubernetes


Self-Service
Multi-language
Automation
Collaboration
Multi-tenant
RED HAT
OPENSHIFT
Standards-based
Web-scale
Open Source
Secure

OpenShift ist … kubernetes plus

- Routing
- Metriken
- Logging
- Web Oberfläche
- Builds
- Image Registry
- Sicherheitsmaßnahmen
- SDN
- Templates

Mit Redhat Subscription:

- Trusted Registry
- Security Newsletter
- **Support**

Begriffe

- Container
- Pod
- Node
- Projekt
- Namespace
- etcd
- Gluster

- Ansible
- Inventory
- Playbook

Cluster Konzeption

Verschiedene Node Typen

Master Nodes

API - Server

ETCD

Web Console

Infrastructure Nodes

Router

Image Registry

Logging Stack

Metriken

Storage Controller

Compute Nodes

Applikationen

Services

Datenbanken

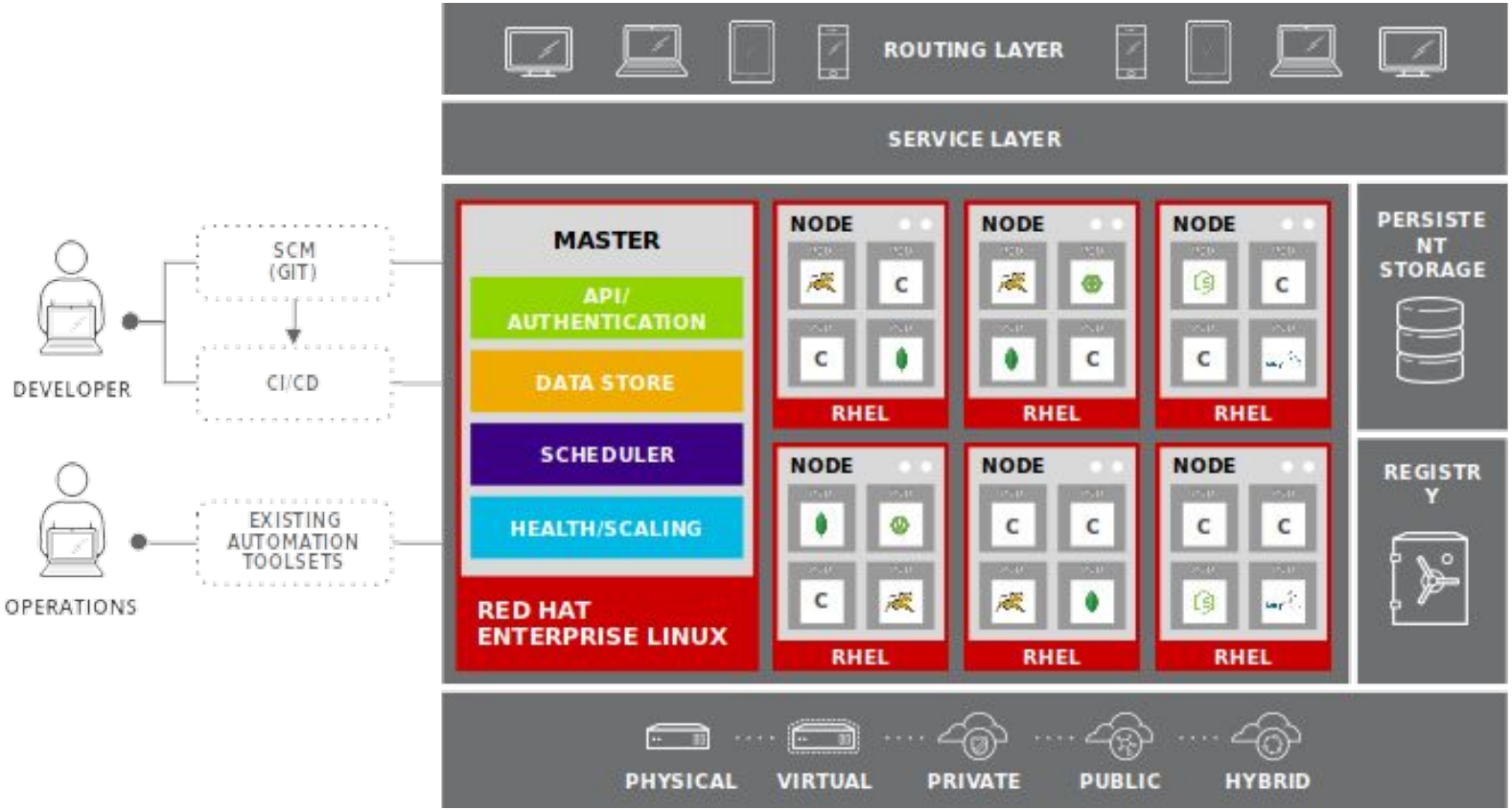
Builds

Andere Workloads

Storage Nodes

Nur beim EInsatz von Gluster

Nodes mit physischem Speicher


ROUTING LAYER
SERVICE LAYER
MASTER
API/ AUTHENTICATION
DATA STORE
SCHEDULER
HEALTH/SCALING
RED HAT ENTERPRISE LINUX
NODE
RHEL
PERSISTENT STORAGE
REGISTRY
SCM (GIT)
CI/CD
DEVELOPER
EXISTING AUTOMATION TOOLSETS
OPERATIONS
PHYSICAL
VIRTUAL
PRIVATE
PUBLIC
HYBRID

Minimum Cluster Sizing

Master Nodes	Infrastructure Nodes	Compute Nodes
• Fedora, CentOS oder RHEL • 4 (v)CPU • 16GB RAM • 50GB disk	• Fedora, CentOS oder RHEL • 2 (v)CPU • 8 GB RAM • 50GB disk	• Fedora, CentOS oder RHEL • 1 (v)CPU • 8 GB RAM • 35GB disk

Recommended Cluster Sizing

Master Nodes	Infrastructure Nodes	Compute Nodes
• Fedora, CentOS oder RHEL • 4 (v)CPU • 16GB RAM • 100GB disk	• Fedora, CentOS oder RHEL • 4 (v)CPU • 16GB RAM • 100GB root disk • >= 250GB registry storage	• Fedora, CentOS oder RHEL • >= 2 (v)CPU • >= 8GB RAM • >= 50GB disk

Mehr RAM => mehr disk (+25GB disk / 8GB RAM)

Anzahl der Nodes

	Minimal	Development	Production	Production (HA)
Master	1	1	1	3
Infrastructure			1+	2+
Compute		2+	3+	6+

Und wie viele Nodes brauche ich jetzt genau?

Einzelfall abhängig!

Kriterien:

- Erwarteter Workload der Applikationen
- Fest allokierte Ressourcen der Applikationen
- Gewünschte Pods per Node
- Hochverfügbarkeit (HA)
- Cluster Reserven
- Automatische Skalierung
- Mehr Ressourcen sind besser als mehr Nodes

Cluster Limits (OKD 3.11)

Anzahl der Nodes	2.000
Anzahl der Pods	150.000
Pods per Node	250
Namespaces / Projekte	10.000
Pods per Namespace	3.000
Pods per CPU	entfallen

Installation vorbereiten

Bastion Host

- Sprung-Host für SSH
- Zentrale Verwaltung der Konfiguration
- Zentrale Verwaltung der OpenShift-Version
- Keine Ansible / Python Versionsprobleme
- Installer benötigt Abhängigkeiten

Schritt für Schritt zur Installation

1. Infrastruktur provisionieren
2. System Updates und Abhängigkeiten installieren
3. DNS Einträge erstellen und prüfen
4. Inventory erstellen
5. Playbook: prerequisites.yml
6. Playbook: deploy_cluster.yml
7. Zusätzliche Aufgaben nach der Installation

Besonderheiten & Abhängigkeiten

- x86_64 Architecture
- Kein Support für IPv6 cluster-intern
- SELinux benötigt (enforcing)
- NetworkManager
- firewalld (recommended)
- rngd (rng-tools)

DNS Einträge

Eintrag	Master (extern)	Master (intern)	Routes
Beispiel	master.openshift.com	internal.openshift.com	*.apps.openshift.com
Ziel	Master Nodes (8443)	Master Nodes (8443)	Infra Nodes (80, 443)
Benutzung	Externer Zugriff auf Master für CLI und Web Oberfläche.	Interne Kommunikation der Nodes mit dem Master	Eintrittspunkt für externen Traffic. Konkrete Routen werden von OpenShift generiert.

```
[OSEv3:children]
masters
nodes
etcd

[OSEv3:vars]
ansible_user=centos
ansible_become=true
ansible_ssh_common_args='-o StrictHostKeyChecking=no'

deployment_type=origin
openshift_deployment_type=origin

openshift_disable_check=docker_storage,memory_availability
openshift_clock_enable=true
openshift_use_dnsmasq=true
os_firewall_use_firewalld=true

osm_use_cockpit=true
openshift_release='v3.11'

openshift_master_default_subdomain='apps.training0.cc-openshift.de'
openshift_master_cluster_hostname='master0.training0.cc-openshift.de'
openshift_master_cluster_public_hostname='master0.training0.cc-openshift.de'

openshift_master_identity_providers=[{'name': 'htpasswd_auth', 'login': 'true', 'challenge': 'true', 'kind': 'HTPasswdPasswordIdentityProvider'}]
openshift_master_htpasswd_users={'admin': '$apr1$zgSjCrLt$1KSuj66CggeWSv.D.BXOA1', 'user': '$apr1$.gw8w9i1$ln9bfTRiD6OwuNTG5LvW50'}

[masters]
master0.training0.cc-openshift.de openshift_node_group_name='node-config-master-infra' openshift_schedulable=true

[etcd]
master0.training0.cc-openshift.de

[nodes]
master0.training0.cc-openshift.de openshift_node_group_name='node-config-master-infra' openshift_schedulable=true
app0.training0.cc-openshift.de openshift_node_group_name='node-config-compute' openshift_schedulable=true
app1.training0.cc-openshift.de openshift_node_group_name='node-config-compute' openshift_schedulable=true
app2.training0.cc-openshift.de openshift_node_group_name='node-config-compute' openshift_schedulable=true
```

Node Group Config

- `node-config-master`
- `node-config-infra`
- `node-config-compute`

- `node-config-master-infra`
- `node-config-all-in-one`

Nach der Installation

- Cluster Administrator ernennen

```
~ oc adm policy add-cluster-role-to-user cluster-admin <username>
```

Wichtige Cluster Komponenten

- Master API
- etcd
- Web Console
- Router
- Registry

Zertifikate

- OpenShift Root CA wird bei Installation generiert
- Zertifikate werden erstellt für:
  - Nodes
  - etcd
  - Router
  - Services (Metriken, Logging, etc)

Achtet auf das Ablaufdatum!!!!!!

Erneuerung der Zertifikate mit Playbook

Nachinstallation von Komponenten

- Einige Komponenten lassen sich einfach nachinstallieren
- Man kann das “deploy_cluster” Playbook nochmal laufen lassen
- Man kann das entsprechende Komponentenplaybook starten

```
openshift_logging_install_logging=true
openshift_metrics_install_metrics=true
openshift_logging_es_nodeselector={"node-role.kubernetes.io/infra":"true"}
```

Objekte & Ressourcen

Alles nur Objekte

- Der Zustand des Clusters wird mit den verschiedenen Objekten abgebildet.

- Cluster Objekte (z.B. Namespaces, Persistent Volumes)
- Projekt Objekte (z.B. Deployments, Builds)

- Die Objekte werden im etcd gespeichert

Wichtige Objekt Typen

- Clusterroles
- Rolebindings
- Persistent Volumes
- Persistent Volume Claims
- Template
- Pod

- ConfigMap
- Secret
- Deployment
- DeploymentConfig
- Build
- Route
- Service

OpenShift CLI Basics

Skalierung & HA

Skalierung

- Master hinzufügen
- Node hinzufügen
- Node entfernen

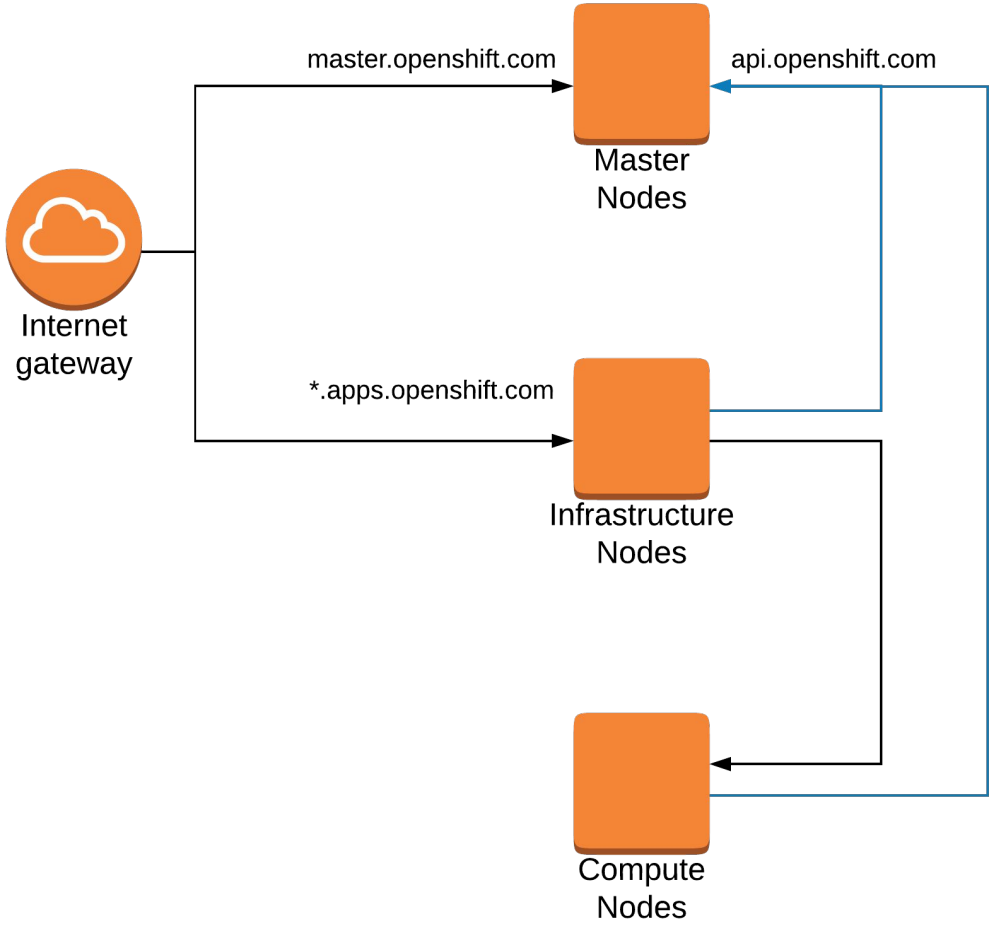
- Node updaten (System updates)
- Cluster updaten

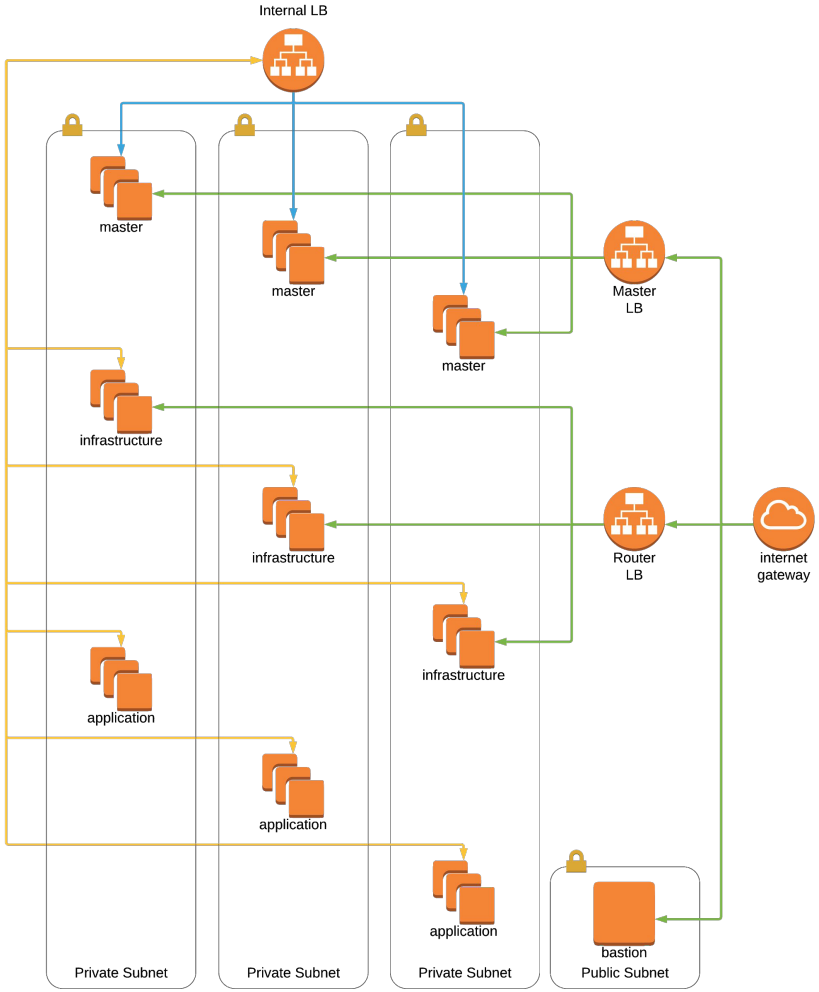
Hochverfügbarkeit

- min. 3 Master Nodes
- min. 2 Infrastructure Nodes
- Genug Compute Nodes um die Workload zu übernehmen

- Loadbalancer für Infrastructure Nodes
- Loadbalancer für Master API
- Vorsicht vor DNS Problemen

- HA im DNS
- HA im Storage System


master.openshift.com
api.openshift.com
Master
Nodes
Internet
gateway
*.apps.openshift.com
Infrastructure
Nodes
Compute
Nodes


Internal LB
master
master
master
Master
LB
infrastructure
infrastructure
infrastructure
Router
LB
internet
gateway
application
application
application
bastion
Private Subnet
Private Subnet
Private Subnet
Public Subnet

Zones & Region

- /etc/origin/master/scheduler.json
- Zone: Anti-Affinität
- Region: Affinität
- Custom Configuration:
  - Racks
  - Build Nodes
  - Enforce Labeling

```
[root@ip-10-1-5-240 master]# oc label node master-1 zone="zone-1" region="frankfurt"
```


```
[ ⊟
  { ⊟
    "argument":{ ⊟
      "serviceAntiAffinity":{ ⊟
        "label":"zone"
      },
      "name":"Zone",
      "weight":2
    }
  },
  { ⊟
    "argument":{ ⊟
      "serviceAffinity":{ ⊟
        "label":"region"
      },
      "name":"Region",
      "weight":2
    }
  }
]
```

User Management

OpenShift Identity Provider

Möglichkeiten zur User Verwaltung

HTPASSWD

Hard-coded Passwörter im htpasswd Format welche lokal auf den Mastern liegen.

LDAP

Generischer LDAP Authenticator. Kann mit jedem handelsüblichen LDAP Server verbunden werden.

Social Logins

Github

Gitlab

Google

OpenID Connect

Generischer OpenID Connect Authenticator. Kann jeden OAuth2 oder OIDC Provider anbinden.

LDAP Anbindung im Inventory

```
openshift_master_identity_providers=[
{
      'name': 'ldap_auth',
      'challenge': 'true',
      'login': 'true',
      'kind': 'LDAPPasswordIdentityProvider',
      'attributes': {'id': ['uid'], 'email': ['mail'], 'name': ['cn'], 'preferredUsername': ['cn']},
      'bindDN': 'cn=openshift,dc=cc-openshift,dc=de',
      'bindPassword': 'OpenShiftLdap',
      'insecure': 'true',
      'url': 'ldap://ldap.cc-openshift.de:389/dc=cc-openshift,dc=de?cn'
}
]
```

LDAP Gruppen synchronisieren

- Mapping von LDAP Gruppen auf OpenShift Rollen
- Manuelle Konfiguration
- Manuelles Synchronisieren
- https://docs.okd.io/3.11/install_config/syncing_groups_with_ldap.html

```
groupUIDNameMapping:
  "cn=group1,ou=groups,dc=example,dc=com": cluster-admin
  "cn=group2,ou=groups,dc=example,dc=com": cluster-reader
  "cn=group3,ou=groups,dc=example,dc=com": project-admin
```

```
~ oc adm groups sync --sync-config=config.yaml --confirm
```

Rollen & Rechte

- Cluster Rollen
- Projekt Rollen
- Rechte bestehen aus Verb + Objekttype (Beispiel: get projects)
- Rechte eines Accounts = Summe aller erlaubten Aktionen
- Serviceaccounts

Cluster Rollen:

- cluster-admin
- cluster-reader
- self-provisioner

Projekt Rollen:

- admin
- edit
- view

OpenShift SDN

Network Plugins

- ovs-subnet
- ovs-networkpolicy
- ovs-multitenant

- Unterschiede in Isolationsgrade

```
os_sdn_network_plugin_name='redhat/openshift-ovs-networkpolicy'
```

Ingress Network Policy

- Objekttyp: NetworkPolicy
- Kontrolliert eingehenden Traffic per Pod
- Kann einzelne Pods im **selben** Namespace freischalten
- Kann **ganze** externe Namespaces freischalten

```yaml
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
  name: allow-http-and-https
spec:
  podSelector:
    matchLabels:
      role: frontend
  ingress:
  - ports:
    - protocol: TCP
      port: 80
    - protocol: TCP
      port: 443
```

Egress Network Policy

- Objekttyp: EgressNetworkPolicy
- Kontrolliert **cluster-externen** Traffic
- Ein Policy Objekt pro Namespace
- Kann mit einigen Techniken umgangen werden

```yaml
kind: EgressNetworkPolicy
apiVersion: v1
metadata:
  name: default
spec:
  egress:
  - type: Allow
    to:
      cidrSelector: 1.2.3.0/24
  - type: Allow
    to:
      dnsName: www.foo.com
  - type: Deny
    to:
      cidrSelector: 0.0.0.0/0
```

Third-Party-Plugins

- https://docs.okd.io/3.11/architecture/networking/network_plugins.html

Backup & Restore

Backup Möglichkeiten

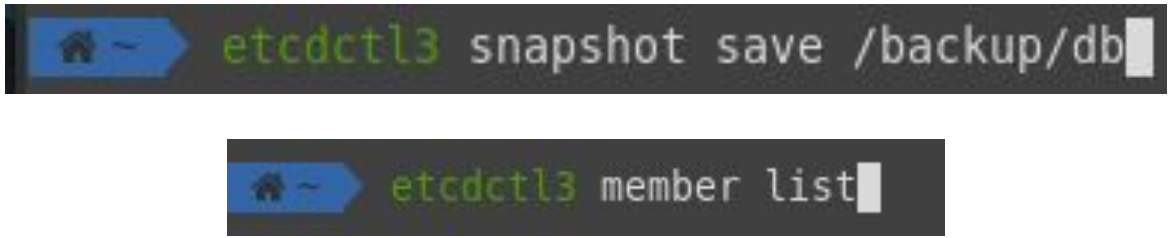
1. Snapshot der Maschinen
2. Backup der Konfigurationen und wichtigen Daten
3. etcd Backup
4. Objekt-Export als YAML oder JSON
5. Infrastructure-as-Code

https://github.com/lukeelten/openshift-backup

https://velero.io

etcd Backup

- Backup der etcd Datenbank
- Bringt den Cluster in den **exakt** selben Zustand wie zur Zeit des Backups



DR Szenarien

1. Node(s) fällt aus
2. Master fällt aus
3. Projekt(e) wird gelöscht / verschwindet
4. Rechenzentrum fällt aus (mit HA)
5. Cluster fällt aus
6. etcd fehlerhaft

Persistent Storage

Persistent Storage Provider

- HostPath
- EmptyDir (Ephemeral Storage)

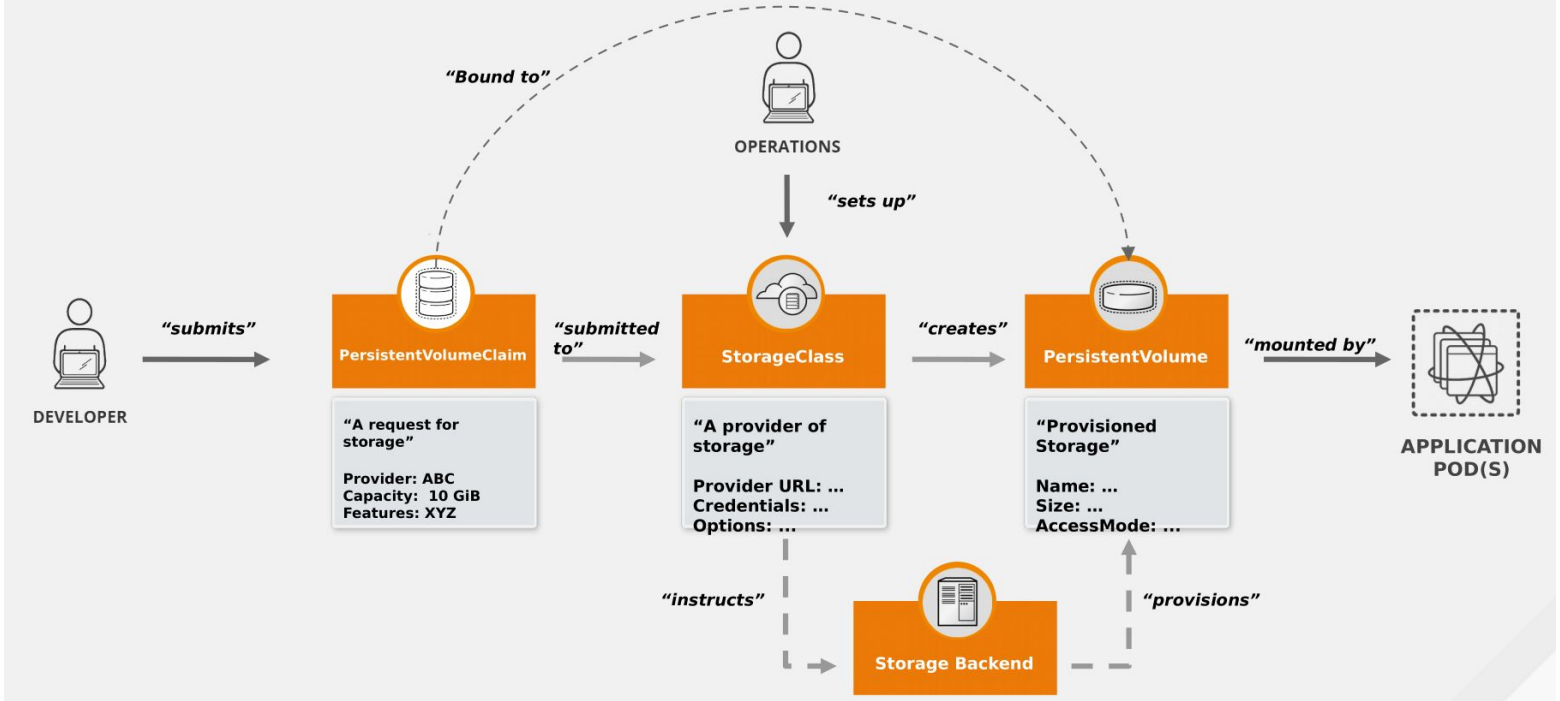
- GlusterFS / OpenShift Container Storage
- NFS (unsupported)
- iSCSI
- Ceph
- Diverse Cloud Mechanismen (AWS, GCE, Azure, etc)

- Dynamic Provisioning

Access Modes

- Read Only (ROX)
- Read Write Once (RWO)
- Read Write Many (RWX)

OPENSHIFT PERSISTENT STORAGE FRAMEWORK



Best Practices

Externe Image Registry

Vorteile:

- Keine Abhängigkeiten an die interne Registry
- Hochverfügbarkeit wird ausgelagert

Nachteile:

- Wartung
- evt. Lizenzkosten
- Hardware

Best Practices - Cluster betreiben

- Nicht alle Applikationen eignen sich dafür
  - Monolithen -> schlechte Skalierung
  - Datenbanken -> von schneller Storage abhängig
  - Nicht HTTP basierter Traffic
- Infrastructure-as-Code
- “/var/log” läuft schnell voll
- Monitoring der Ressourcen und Kapazitäten
- RedHat Subscription
- Trennen von Development und Production

Best Practices - Security

- SELinux nicht deaktivieren
- Cluster Nodes nur intern (über Bastion) erreichbar
- non-root Container
- Container Scanning nach Sicherheitslücken
- Blocken von offenen Registries (Docker Hub, Quay.io)
- EgressIP für Firewalls / Network Policies
- Traffic Encryption (Service Mesh)
- Regelmäßige Updates im Cluster
- **Regelmäßige Updates der Base Images**

OpenShift 4

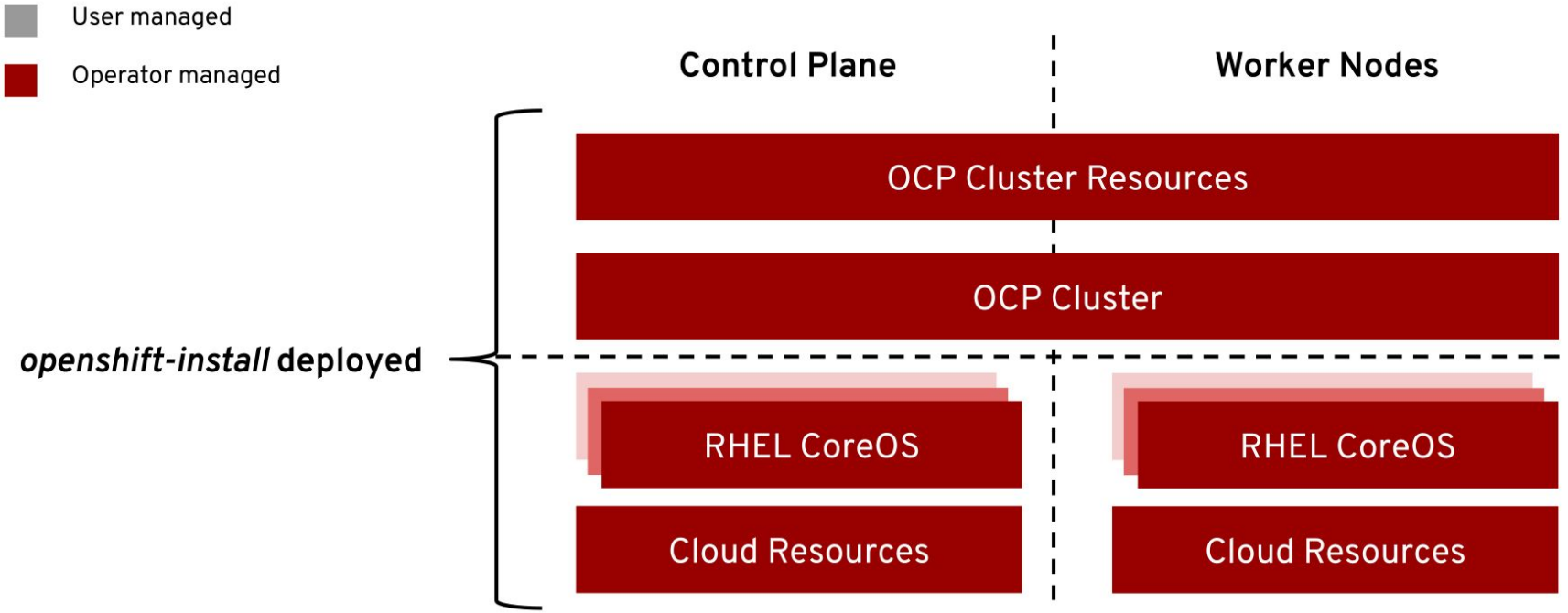
Installation

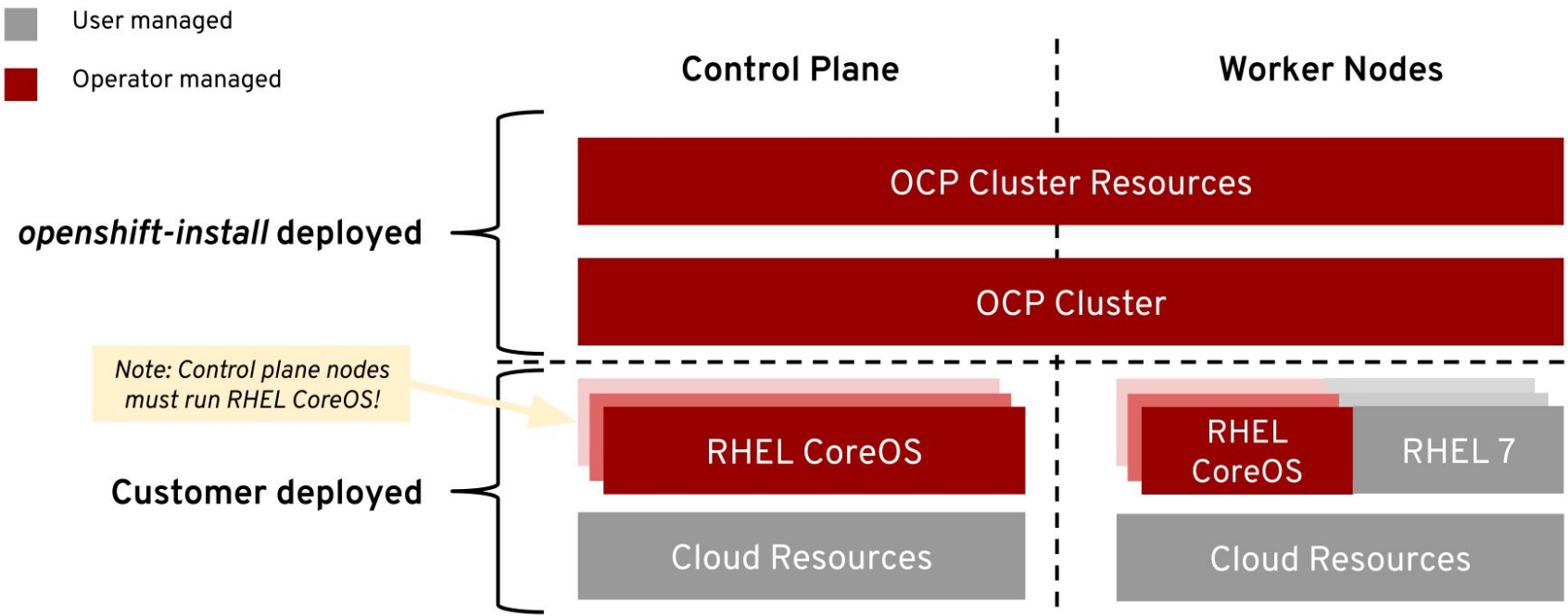
- Installer provisioned Infrastructure (IPI)
- User provisioned Infrastructure (UPI)

- AWS
- Azure
- VMware
- Bare Metal

Full Stack Automated Deployments

Day 1: openshift-install - Day 2: Operators




User managed
Operator managed
Control Plane
Worker Nodes
openshift-install deployed
OCP Cluster Resources
OCP Cluster
Note: Control plane nodes must run RHEL CoreOS!
Customer deployed
RHEL CoreOS
RHEL CoreOS
RHEL 7
Cloud Resources
Cloud Resources

Deployment Comparison

	Full Stack Automation	Pre-existing Infrastructure
Build Network	Installer	User
Setup Load Balancers	Installer	User
Configure DNS	Installer	User
Hardware/VM Provisioning	Installer	User
OS Installation	Installer	User
Generate Ignition Configs	Installer	Installer
OS Support	RHEL CoreOS	RHEL CoreOS + RHEL 7
Node Provisioning / Autoscaling	Yes	Only for providers with OpenShift Machine API support
Customization & Provider Support	AWS	AWS, Bare Metal, VMware

Installation Experiences

OPENSHIFT CONTAINER PLATFORM

Full Stack Automated

Simplified opinionated "Best Practices" for cluster provisioning

Fully automated installation and updates including host container OS.

Red Hat Enterprise Linux CoreOS

Pre-existing Infrastructure

Customer managed resources & infrastructure provisioning

Plug into existing DNS and security boundaries

Red Hat Enterprise Linux CoreOS

Red Hat Enterprise Linux

HOSTED OPENSHIFT

Azure Red Hat OpenShift

Deploy directly from the Azure console. Jointly managed by Red Hat and Microsoft Azure engineers.

OpenShift Dedicated

Get a powerful cluster, fully Managed by Red Hat engineers and support.

What’s new ...

- Neuer Installer
- Over-the-air Updates
- Cluster Autoscaling
- Neues User Interface
- Developer CLI Tools (ODO)
- Service Mesh (Istio)
- Quay
- Operators & Operator Hub

Q2 CY2019
OpenShift 4.1

DEV
- OpenShift Serverless (Knative) - DP
- OpenShift Pipelines (Tekton) - DP
- CodeReady Workspaces - GA
- CodeReady Containers - Alpha
- Developer CLI (odo) - Beta

APP
- OperatorHub
- Operator Lifecycle Manager
- Service Mesh (~2 month after)

PLATFORM
- Kubernetes 1.13 with CRI-O runtime
- RHEL CoreOS, RHEL7
- Automated Installer for AWS
- Pre-existing Infra Installer for Bare Metal, VMware, AWS
- Automated, one-click updates
- Multus (Kubernetes multi-network)
- Quay v3

HOSTED
- cloud.redhat.com - Multi-Cluster Mgmt
- OCP Cluster Subscription Management
- Azure Red Hat OpenShift
- OpenShift Dedicated consumption pricing

Q3 CY2019
OpenShift 4.2

DEV
- Developer Console - GA
- OpenShift Serverless (Knative) - TP
- OpenShift Pipelines (Tekton) - TP
- CodeReady Containers - GA
- Developer CLI (odo) - GA

APP
- GPU metering
- OperatorHub Enhancements
- Operator Deployment Field Forms
- Application Binding with Operators
- Application Migration Console

PLATFORM
- Kubernetes 1.14 w/ CRI-O runtime
- Disconnected Install and Update
- Automated Installer for Azure, OSP, GCP
- OVN Tech Preview
- FIPS
- Federation Workload API
- Automated App cert rotation
- OpenShift Container Storage 4.2

HOSTED
- cloud.redhat.com - Multi-Cluster Deployment
- Proactive Support Operator

Q4 CY19/Q1 CY20
OpenShift 4.3

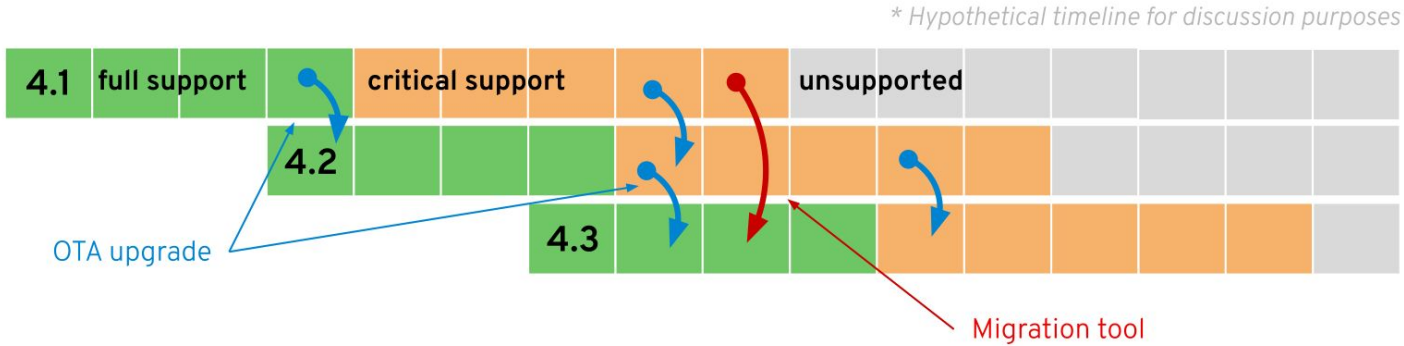
DEV
- OpenShift Serverless (Knative) - GA
- OpenShift Pipelines (Tekton) - GA

APP
- Metering for Services
- Windows Containers

PLATFORM
- Kubernetes 1.15 w/ CRI-O runtime
- Automated Installer for IBM Cloud, Alibaba, RHV, Bare Metal Hardware Appliance
- Pre-existing Infra Installer for Azure, OSP, GCP
- OVN GA w/ Windows Networking Integration

HOSTED
- cloud.redhat.com - Subscription Mgmt Consumption Improvements

OpenShift 4 Upgrades



OTA Upgrades
Works between two minor releases in a serial manner.

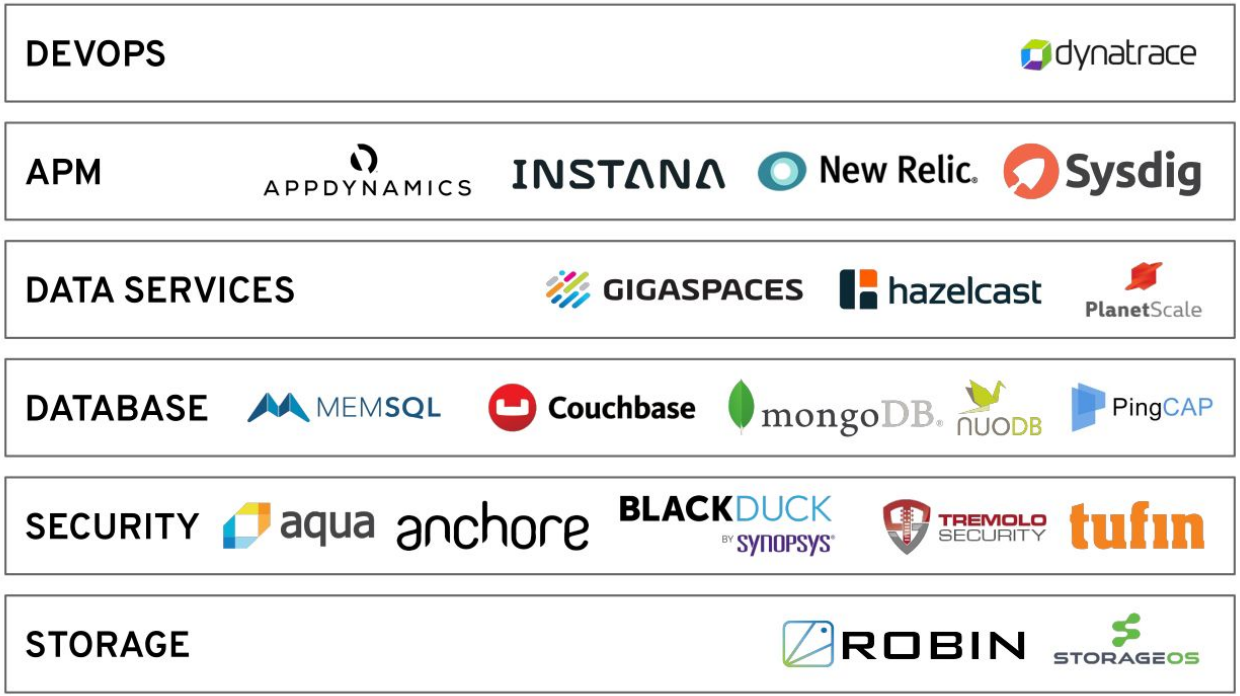
Happy path = migrate through each version
On a regular cadence, migrate to the next supported version.

Optional path = migration tooling
If you fall more than two releases behind, you must use the application migration tooling to move to a new cluster.

Current minor release
Full support for all bugs and security issues
1 month full support overlap with next release to aid migrations

Previous minor release
Fixes for critical bugs and security issues for 5 months

Red Hat Certified Operators



HA for Applications

Container-native Anwendungen

- Konfiguration
  - Environment
  - ConfigMaps
  - Secrets
- Service Discovery
- Statelessness
- Microservices
- Sidecars
- CI/CD
- 12-Factor https://12factor.net/de/

Hochverfügbarkeit done right

- Replicas
- Storage
- externe Abhängigkeiten
- Resource Allocation / Quality of Service
- PodDisruptionBudget
- Deployment Strategy

CodeReady Workspaces

Ende

Upcoming Events

- 30.9. - OpenShift Anwendertreffen Frankfurt
- 19. - 21.11. - kubecon San Diego (USA)

Stay connected

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cc_primary template colours
(included in master template)

#FFFFFF

#000000

#F0F6F4

#004452

#007891

#00AED2

#03BDEC

#15584C

#1FB18A

#2CE6AF

Link colour

#D6B32C

#9C954E

cc_secondary template colours
(you need to build by yourself)

#EF5E1B

#D6B32C

#E61B77

cc_icons