



OpenShift Installation & Administration

Tobias Derksen



Über mich ...



Tobias Derksen

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- 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

Einführung in OpenShift

Was ein Chaos ...

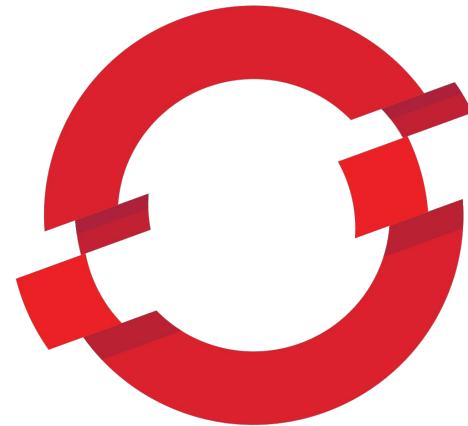


redhat. okd



kubernetes

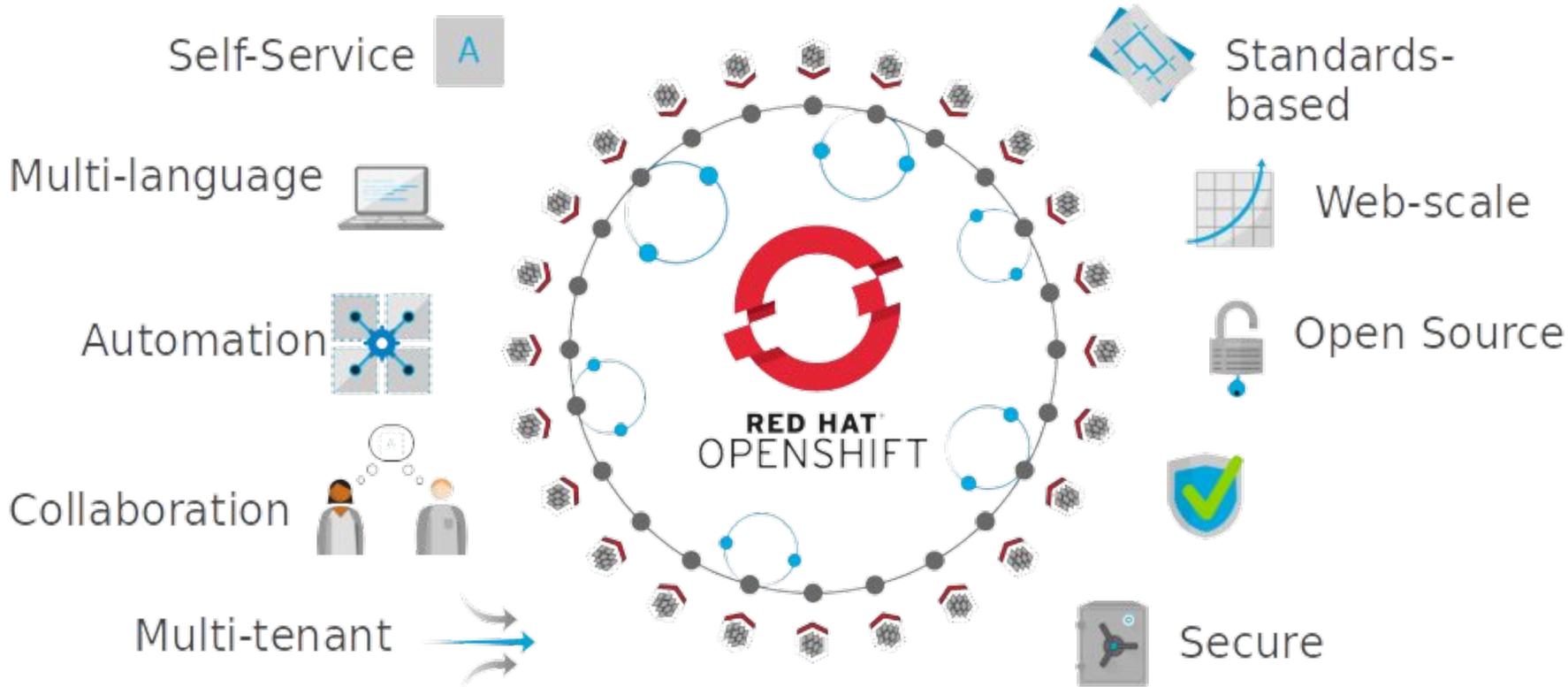
OPENSIFT
origin



cri-o



OPENSIFT



OpenShift ist ... kubernetes plus

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

Mit Red Hat 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

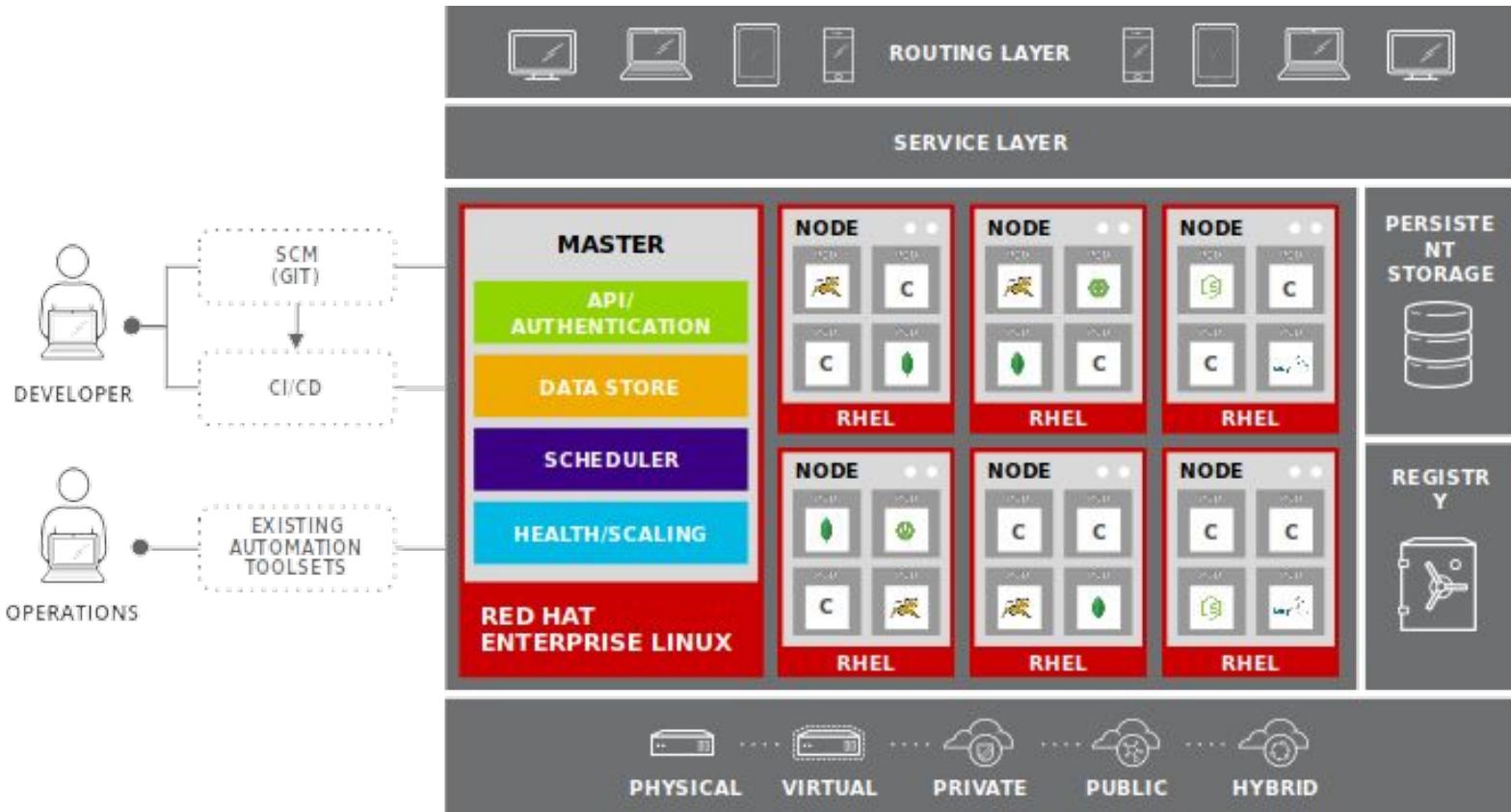
Builds

Andere Workloads

Storage Nodes

Nur beim Einsatz von
Gluster

Nodes mit physischem
Speicher



Minimum Cluster Sizing

Master Nodes	Infrastructure Nodes	Compute Nodes
<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• 4 (v)CPU• 16GB RAM• 50GB disk	<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• 2 (v)CPU• 8 GB RAM• 50GB disk	<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• 1 (v)CPU• 8 GB RAM• 35GB disk

Recommended Cluster Sizing

Master Nodes	Infrastructure Nodes	Compute Nodes
<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• 4 (v)CPU• 16GB RAM• 100GB disk	<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• 4 (v)CPU• 16GB RAM• 100GB root disk• \geq 250GB registry storage	<ul style="list-style-type: none">• Fedora, CentOS oder RHEL• \geq 2 (v)CPU• \geq 8GB RAM• \geq 50GB disk

Mehr RAM \Rightarrow 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$1KSuj66CggeWSv.D.BX0A1', 'user': '$apr1$.gw8w9i1$ln9bfTRiD60wuNTG5LvW50'}

[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
- Metrics
- Logging

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

Web Console Basics

OpenShift CLI Basics

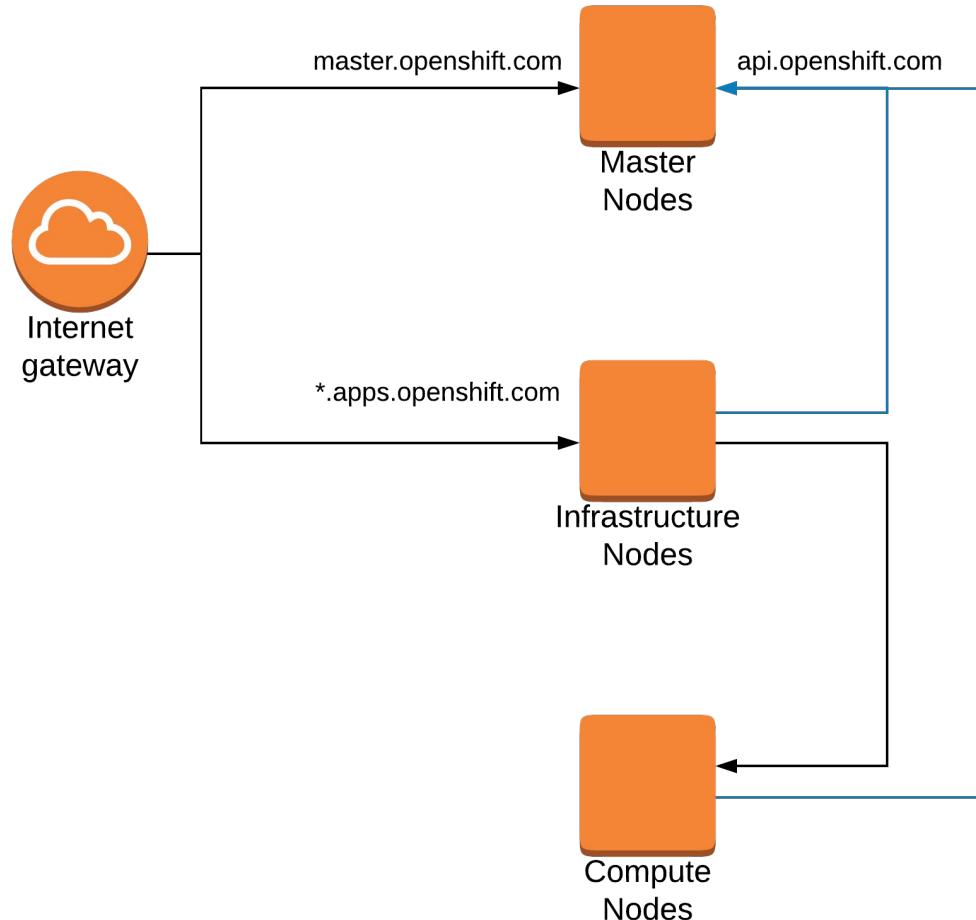
Skalierung & HA

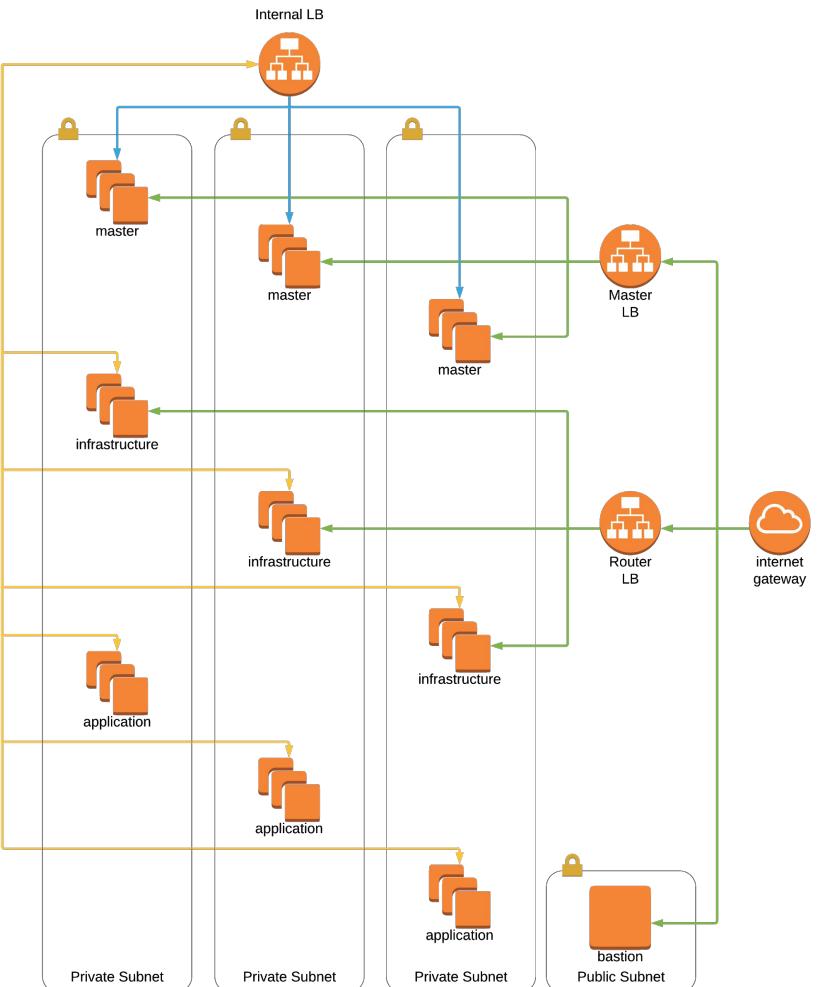
Skalierung

- 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
- HA im Netzwerk / Rechenzentrum





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

```
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

```
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

```
➜ etcdctl3 snapshot save /backup/db
```

```
➜ etcdctl3 member list
```

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

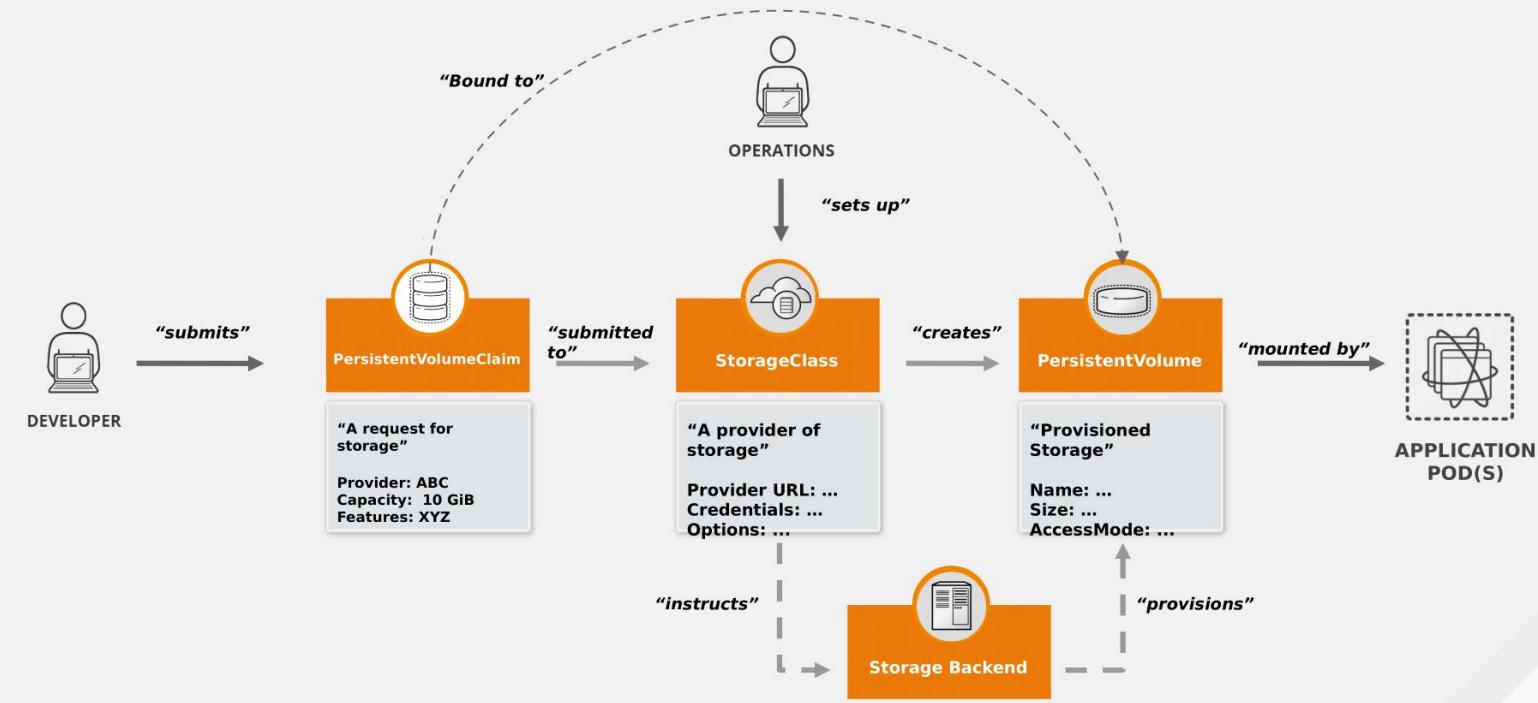
Persistent Storage Provider

- 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)

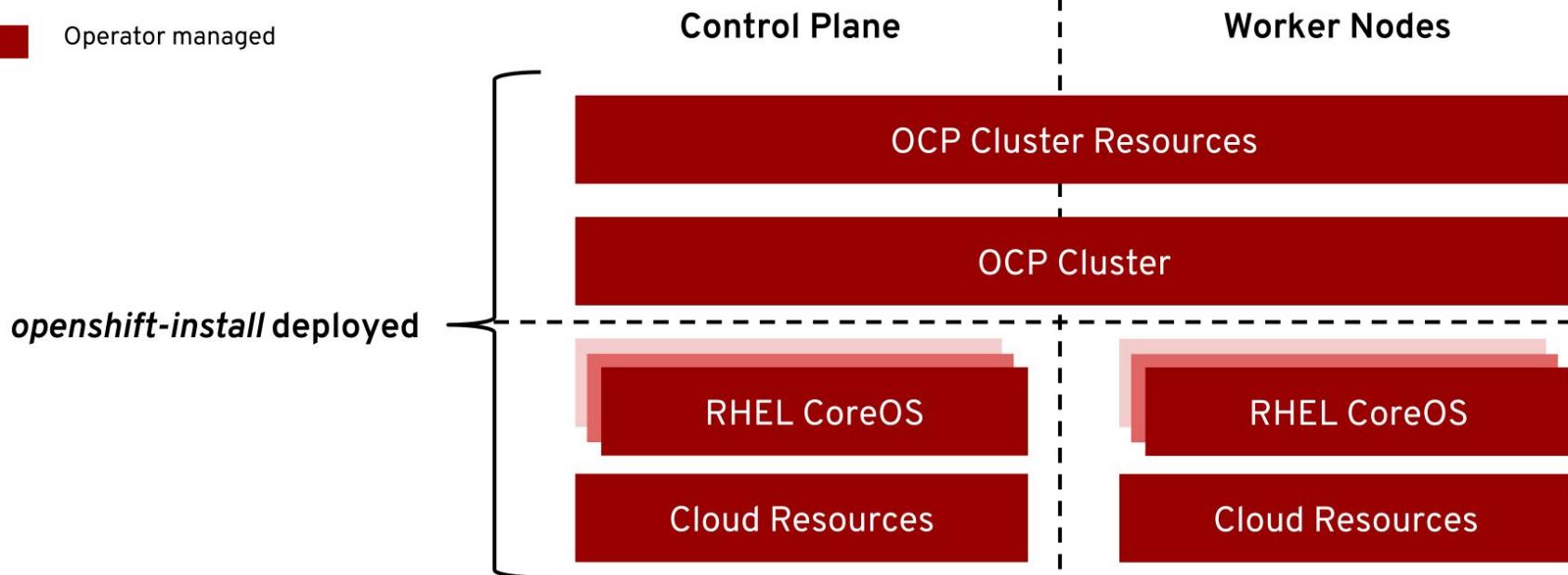
- AWS
- Azure
- VMware
- Bare Metal

Full Stack Automated Deployments

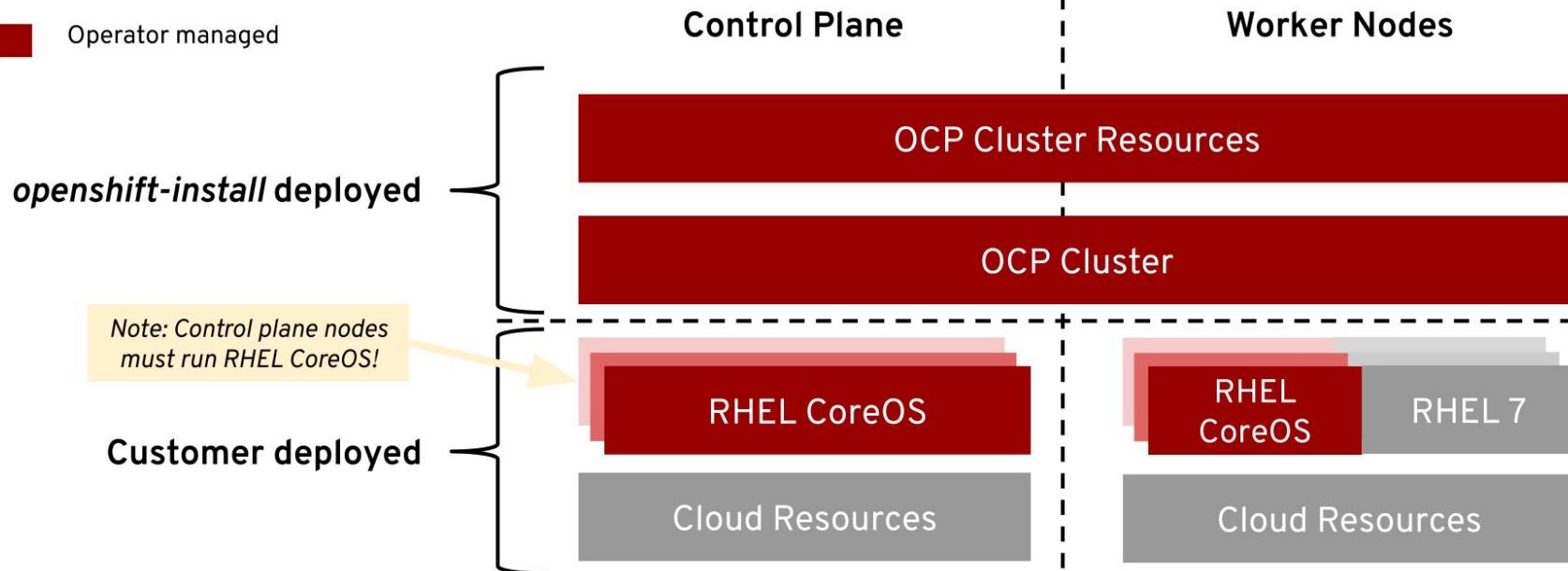
Day 1: openshift-install - Day 2: Operators

User managed

Operator managed



- User managed
- Operator managed



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

- | | |
|----------|---|
| HOSTED | <ul style="list-style-type: none">• OpenShift Serverless (Knative) - DP• OpenShift Pipelines (Tekton) - DP• CodeReady Workspaces - GA• CodeReady Containers - Alpha• Developer CLI (odo) - Beta |
| PLATFORM | <ul style="list-style-type: none">• 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 |
| APP | <ul style="list-style-type: none">• OperatorHub• Operator Lifecycle Manager• Service Mesh (~2 month after) |
| DEV | |

Q3 CY2019 OpenShift 4.2

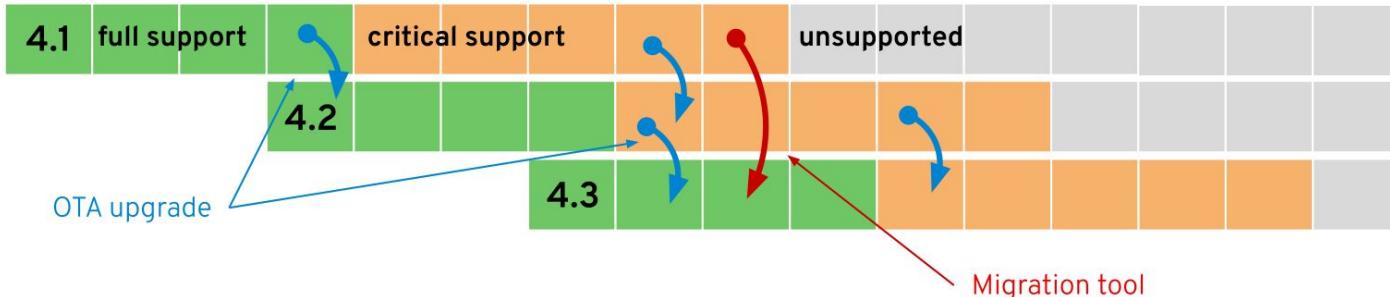
- | | |
|----------|--|
| HOSTED | <ul style="list-style-type: none">• cloud.redhat.com - Multi-Cluster Deployment• Proactive Support Operator |
| PLATFORM | <ul style="list-style-type: none">• Kubernetes 1.14 w/ CRI-O runtime• Disconnected Install and Update• Automated Installer for Azure, OSP, GCP• OVN Tech Preview• FIPS• Federation Workload API• Automated App cert rotation• OpenShift Container Storage 4.2 |
| APP | <ul style="list-style-type: none">• GPU metering• OperatorHub Enhancements• Operator Deployment Field Forms• Application Binding with Operators• Application Migration Console |
| DEV | <ul style="list-style-type: none">• Developer Console - GA• OpenShift Serverless (Knative) - TP• OpenShift Pipelines (Tekton) - TP• CodeReady Containers - GA• Developer CLI (odo) - GA |

Q4 CY19/Q1 CY20 OpenShift 4.3

- | | |
|----------|---|
| HOSTED | <ul style="list-style-type: none">• cloud.redhat.com - Subscription Mgmt Consumption Improvements |
| PLATFORM | <ul style="list-style-type: none">• 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 |
| APP | <ul style="list-style-type: none">• Metering for Services• Windows Containers |
| DEV | <ul style="list-style-type: none">• OpenShift Serverless (Knative) - GA• OpenShift Pipelines (Tekton) - GA |

OpenShift 4 Upgrades

* Hypothetical timeline for discussion purposes



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

DEVOPS



APM



DATA SERVICES



DATABASE



SECURITY



STORAGE



Ende

Upcoming Events

- 19.11. - OpenShift Anwendertreffen Berlin
- 19. - 21.11. - kubecon San Diego (USA)
- 30.3. - 02.04. - kubecon Europe Amsterdam (NL)

Stay connected

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Hello, World!

CodeReady Workspaces

Hochverfügbarkeit done right

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

Container-native Anwendungen

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

HA for Applications

cc_primary template colours (included in master template)



#FFFFFF



#15584C



#000000



#1FB18A



#F0F6F4



#2CE6AF



#004452



Link colour



#007891



#D6B32C



#00AED2



#9C954E



#03BDEC

cc_secondary template colours (you need to build by yourself)



#EF5E1B



#D6B32C



#E61B77

cc_icons

