
# CERN’s journey with OpenShift Origin and OKD

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OpenShift Commons Gathering @ KubeCon EU 2023

# Web services at CERN

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# The Origins in 2014

Goal: enable **wider adoption of CI by facilitating deployment of Jenkins instances**

Historical context: Jenkins setup on dedicated VMs, provisioned with OpenStack and Puppet, requested via ticket

→ Looking for ways to **consolidate resources** and **simplify management** (especially for small software projects)

# Hosting Jenkins on OpenShift

- OpenShift's **Jenkins template** proved to be an **ideal place for getting started**
- Jenkins admins have/need a lot of control
  → **offer not only a *service*, but a *platform***

# Hosting Jenkins on OpenShift

OPENSHIFT origin

- OpenShift's **Jenkins template** proved to be an **ideal place for getting started**
- Jenkins admins have/need a lot of control
  → **offer not only a *service*, but a *platform***

**OpenShift is capable of much more** – why not also use it as a **PaaS**?

- Lots of **small web apps** (Python, PHP, Tomcat) that occupy **dedicated VMs**
- **Manual setup**: OpenStack VM, Puppet, Database, DNS, SSO, version control …
- **Requirements**: low setup overhead, resource efficiency, minimal ongoing maintenance cost (OS and security management)

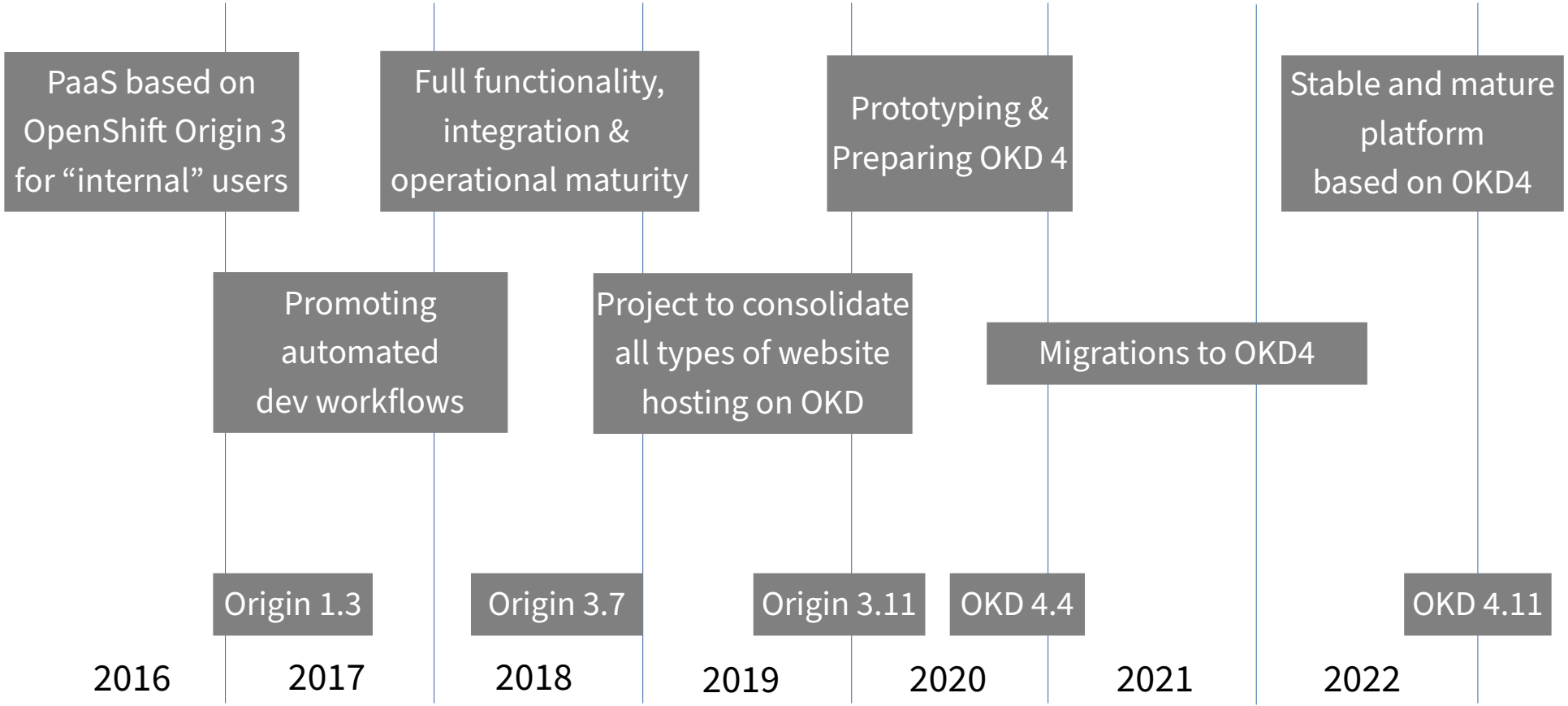
# Moving towards a general-purpose PaaS

- **Continuous Deployment** with **S2I workflow** (*BuildConfig* + *DeploymentConfig*)
  **→ automated deployments became easy!**

- **Knowledge sharing** / **teaching** was necessary:
  Containers, Images, Docker, Kubernetes …

- **Integrations** needed to be developed:
  CERN's website management, DNS, Firewall, SSO, various storage systems

# Timeline


PaaS based on OpenShift Origin 3 for “internal” users
Full functionality, integration & operational maturity
Prototyping & Preparing OKD 4
Stable and mature platform based on OKD4
Promoting automated dev workflows
Project to consolidate all types of website hosting on OKD
Migrations to OKD4
Origin 1.3
Origin 3.7
Origin 3.11
OKD 4.4
OKD 4.11
2016
2017
2018
2019
2020
2021
2022

# Fast-forward to 2023

**OKD4** is the **foundation of Webservices Infrastructure** at **CERN**

Provides a **multi-tenant**, **highly-available** and **secure base**

**Enhanced** by us with additional features and integrations for:

- Hostname registration, DNS setup, certificates, backups
- Authentication and resource management
- Storage: CephFS, EOS, CVMFS
- Ingress router sharding

→ Using **operators**, **controllers** and **webhooks**

# OKD4 @ CERN

“Our” OKD provides **shared base** for different **cluster flavors**:

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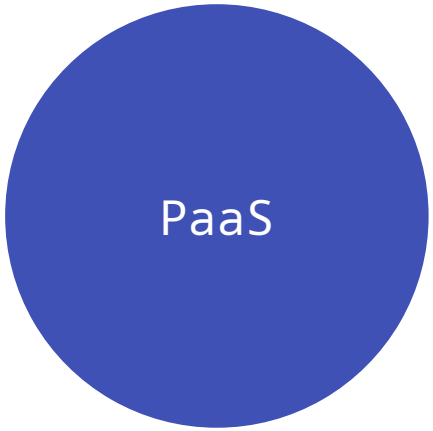


1400 projects, 96 nodes,
1500 cores, 2.7 TiB memory

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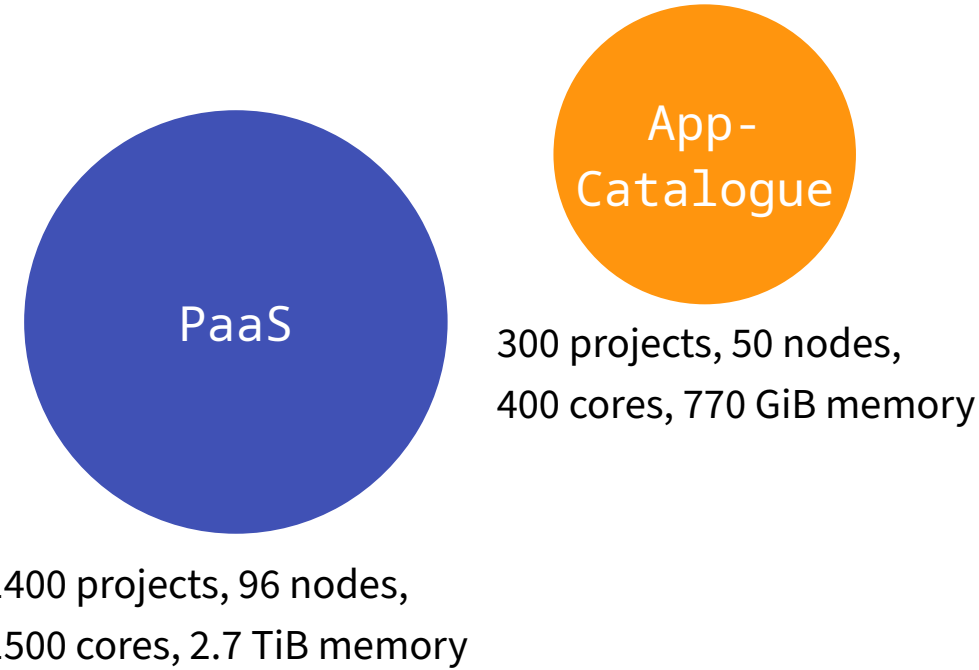

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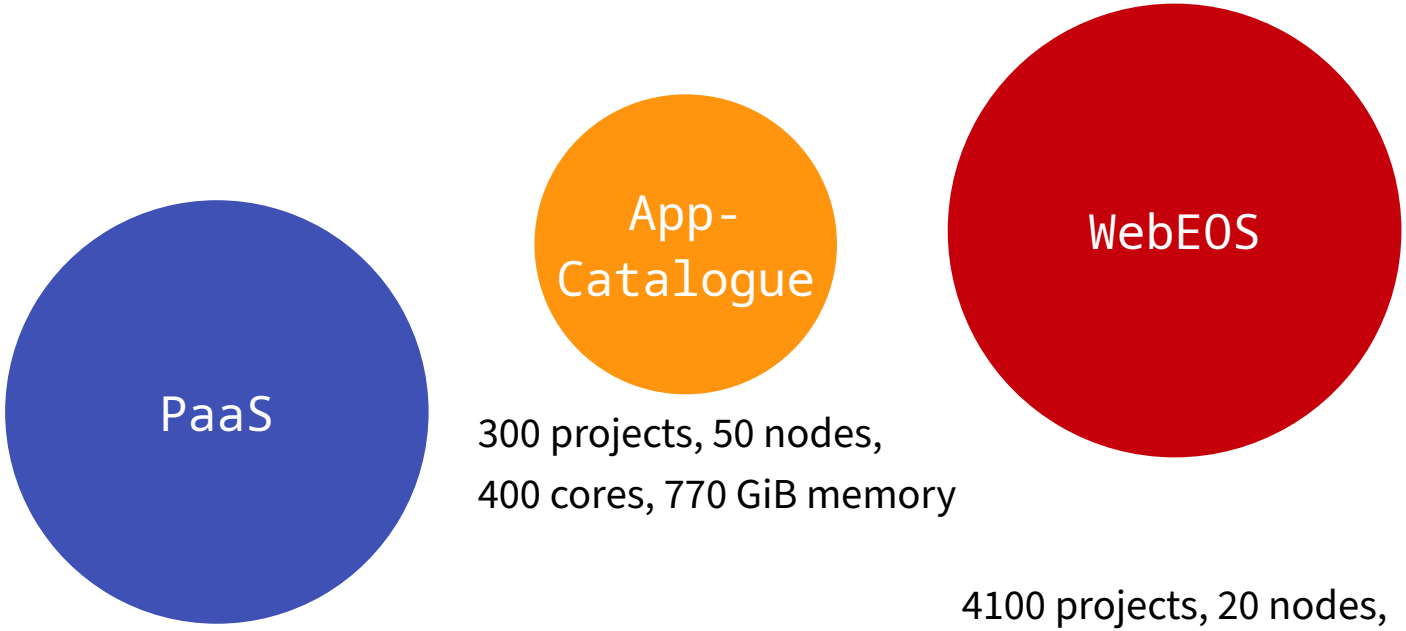


1400 projects, 96 nodes,
1500 cores, 2.7 TiB memory

300 projects, 50 nodes,
400 cores, 770 GiB memory

4100 projects, 20 nodes,
270 cores, 600 GiB memory

# OKD4 @ CERN

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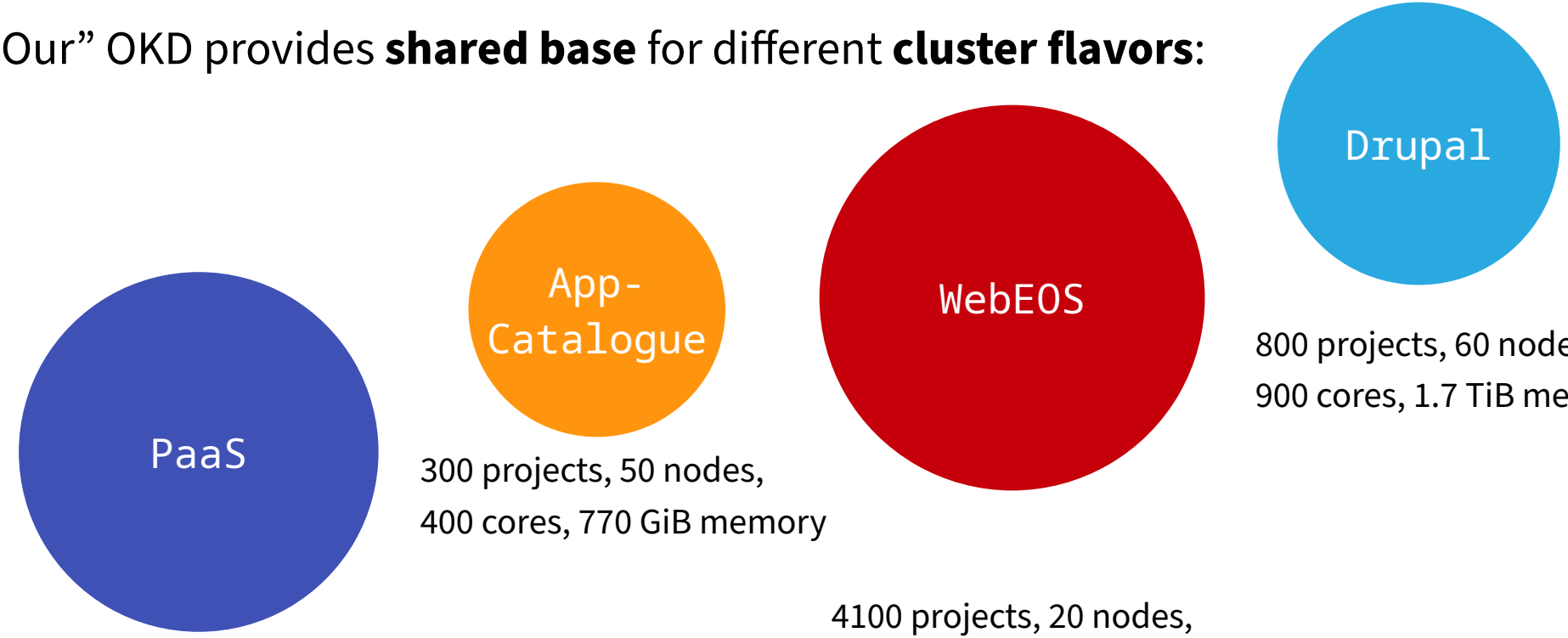

# Web Services Portal

**Stateless** web UI **federates** OKD clusters and offers entrypoint for **non-technical users**

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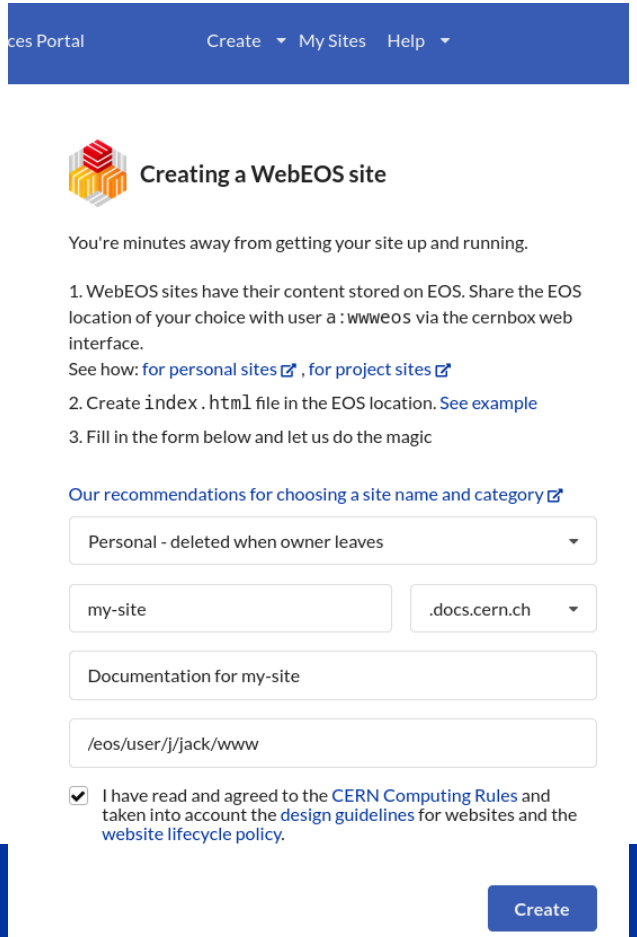

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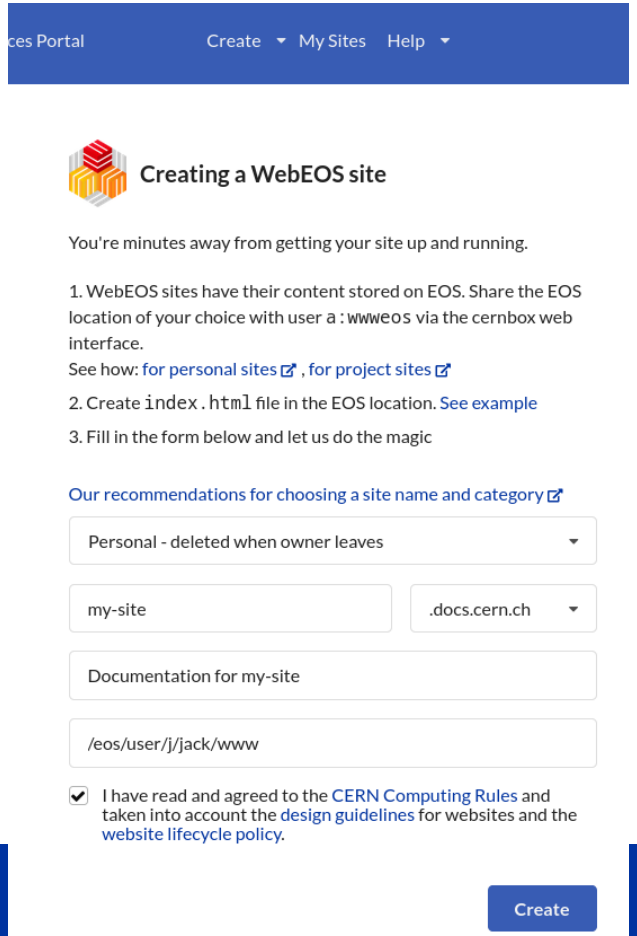


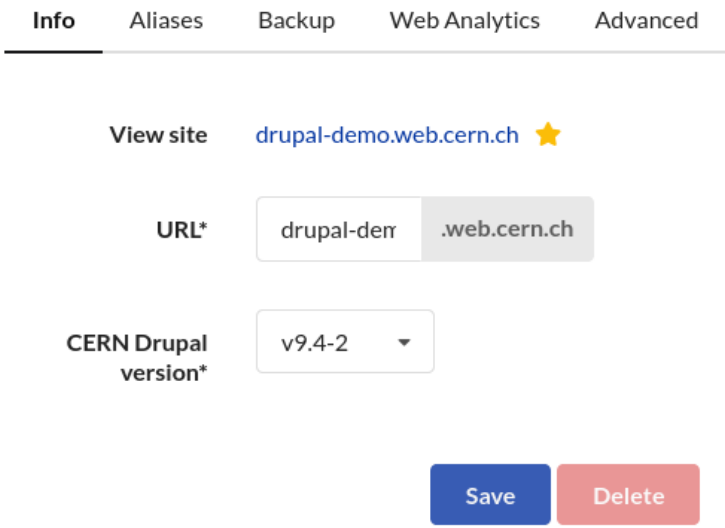

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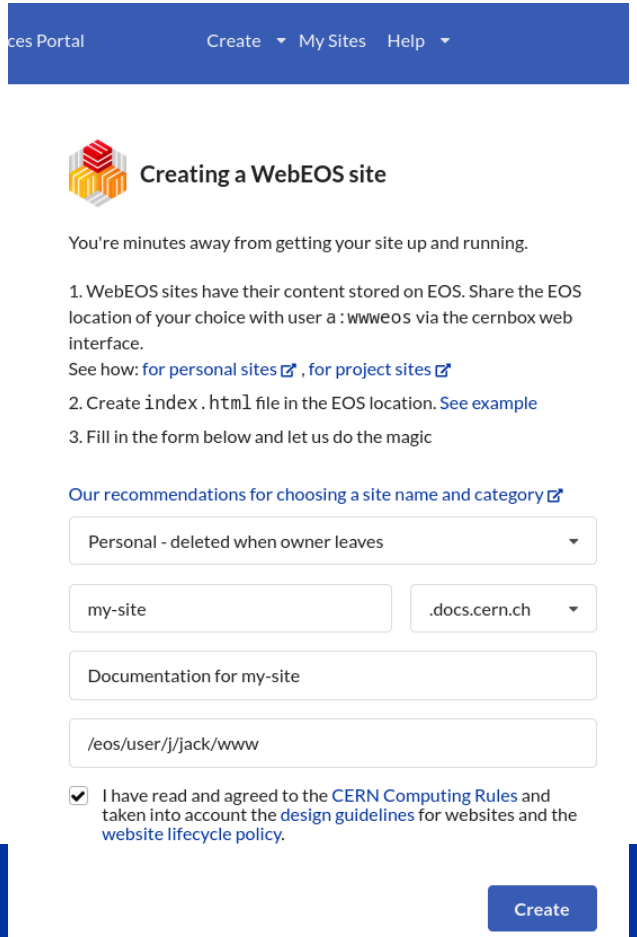


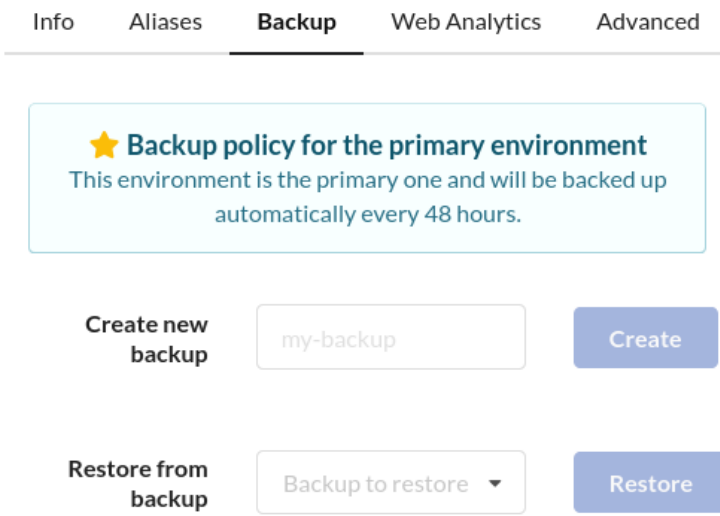

# Behind the scenes

```yaml
apiVersion: drupal.webservices.cern.ch/v1alpha1
kind: DrupalSite
metadata:
  name: drupal-tools
spec:
  configuration:
    databaseClass: standard
    diskSize: 1G
    qosClass: standard
    scheduledBackups: enabled
  siteUrl:
    - drupal-tools.web.cern.ch
  version:
    name: v9.4-2
    releaseSpec: RELEASE-2023.02.13T13-47-51Z
status:
  availableBackups: [...]
  dBUpdatesLastCheckTimestamp: 'Feb 14, 2023 at 7:38am (UTC)'
  expectedDeploymentReplicas: 1
```

# OKD cluster management

- Clusters are **pets**: production clusters are **stateful** since they run and store **user workload**
- Each cluster is completely **self-sufficient** and **isolated**
- Developed internal ***okdctl* tool** to faciliate common operations (creating/deleting clusters, replacing nodes)
- OKD4 **in-place cluster upgrades** are completely **automated** and **seamless**
- All **infra workloads** are **managed by ArgoCD**


argo

# GitOps with ArgoCD

- **Natural extension** of Kubernetes' **continuous reconciliation** model
- Ensures all resources converge to the desired state (incl. orchestration)
  - despite manual actions in the cluster (troubleshooting, debugging etc.)
  → automatic alerts if this is not the case
- Fits the **operator-driven cluster management** of OKD
- **CLI & Web UI** are useful **for understanding** which resources are deployed and **what their state is**

# Automated provisioning & Integration tests

**Fully automated provisioning** (with custom tool) of **isolated clusters**

```
$ okdctl/okdctl provision-cluster --yes --cluster-name "${CLUSTER_NAME}"
# Checking provided SSH key
# Obtaining openshift-installer binary [11:18:31]
# Generating ignition configs [11:18:41]
# Uploading ignition data for bootstrap VM [11:18:48]
# Creating the bootstrap VM [11:18:49]
+ openstack server create --wait ci-28717890-boot-5wujq --format json --
```

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Paired with **integration tests that verify almost every feature** works as expected from a **user & admin perspective**

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```
$ bats -rpT tests/1-common/
1-authz-operator.bats
[ 1/22]   SSO registration with application lifecyle and bootstrap application role ✓
[ 2/22]   Namespace is not deleted if ProjectLifecyclePolicy says not to delete it ✓
[ 3/22]   Namespace is blocked if ProjectLifecyclePolicy says 'BlockAndDeleteAfterGrac
[ 4/22]   Namespace is not deleted if AppReg is deleted ✓ [14s]
2-cephfs-persistent-volumes.bats
[ 5/22]   Test provisioning, backup and deletion of cephfs PVs ✓ [332s]
3-opa-cephfs.bats
[ 6/22]   Test OPA pv.opa.openshift.cern.ch/set-default-annotations ✓ [13s]
[ 7/22]   Test OPA pv.opa.openshift.cern.ch/set-default-labels ✓ [13s]
4-opa-custom-ingress-default-hostname.bats
[ 8/22]   Generate default route hostname using domain in namespace annotation ✓ [8s]
[ 9/22]   Do not modify default route hostname generated by OKD if no domain specified
```

# Automated provisioning & Integration tests

**Fully automated provisioning** (with custom tool) of **isolated clusters**

Paired with **integration tests that verify almost every feature** works as expected from a **user & admin perspective**

Allows **deploying changes frequently** and **predictably**

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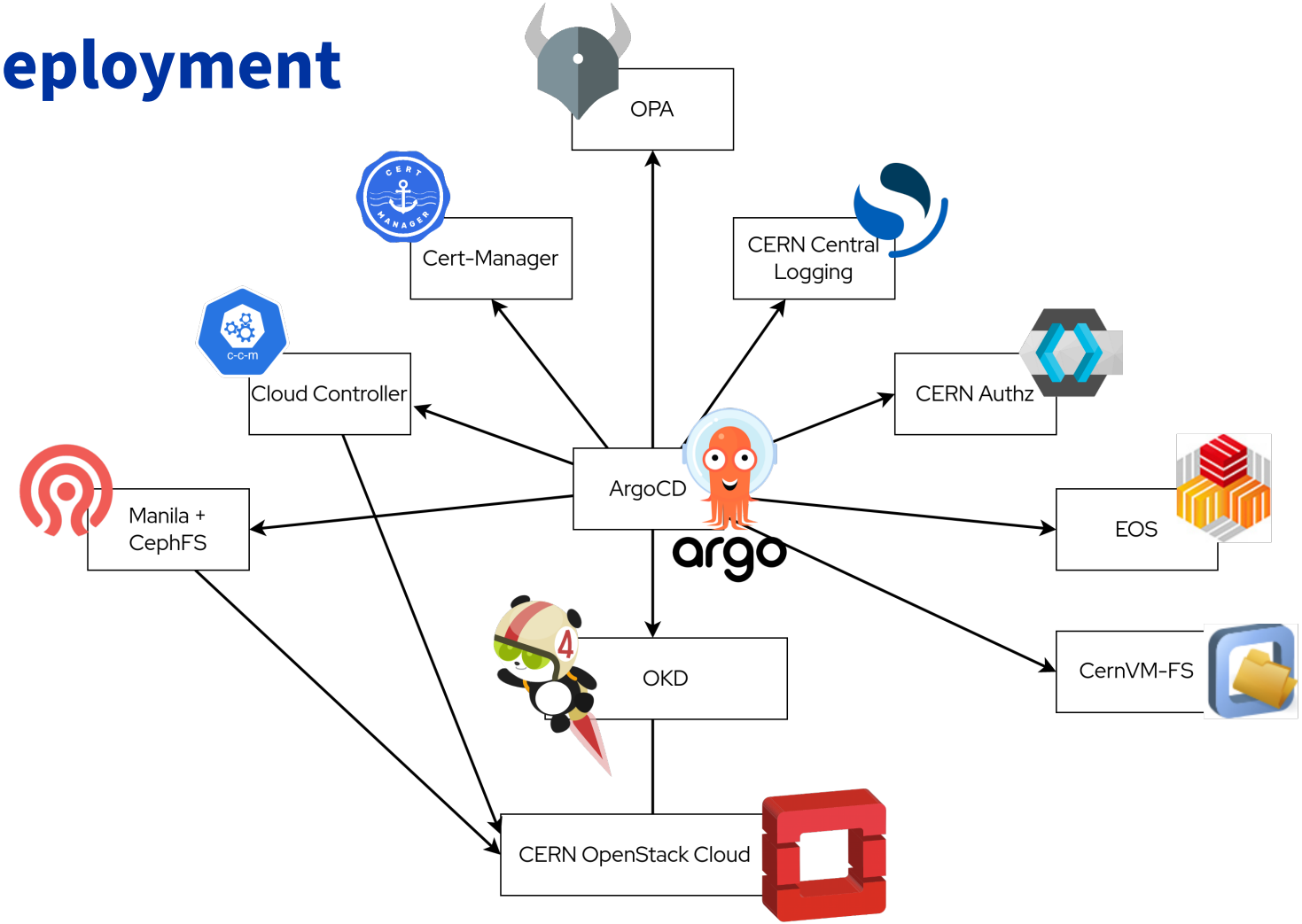
# OKD deployment



# Spotlight: OpenPolicyAgent

**OPA** is used for a wide range of use cases (to **help admins & users**):

- **Unique hostnames** across all clusters
- **Ingress** sharding
- **Volume** labels & annotations (used for backups and mount permissions)
- **Network** visibility (Internet/Intranet/Private Networks)
- **Automation** of EOS mounts (initContainer + sidecar injection for authentication)

# What we like about OpenShift Origin & OKD

- **Strong multi-tenancy, security** and **high availability** out-of-the-box
- It's **stable**
- Simple yet **powerful web UI**
- It's fully **open source**
  - We can troubleshoot and fix issues ourselves!
  - We can contribute back!

openshift / router Public

Code | Issues 9 | Pull requests 14 | Security | Insights

## Respect route targetPort in dynamic config #7

Merged openshift-merg... merged 1 commit into `openshift:master` from `alexcern:fix/dynamic_config_targetport`

Conversation 16 | Commits 1 | Checks 0 | Files changed 1

alexcern commented on Jan 16, 2019 Contributo

Fix #6

openshift / oc Public

Code | Issues 26 | Pull requests 32 | Projects | Security | Insights

## Allow triggers on batch/v1 CronJobs #1077

Merged openshift-merg... merged 1 commit into `openshift:master` from `mic4ael:set-trig`

Conversation 42 | Commits 1 | Checks 0 | Files changed 1

mic4ael commented on Feb 21, 2022 • edited

openshift / router Public

Edit Pins

Code | Issues 9 | Pull requests 14 | Security | Insights

## Bug 2093454: HAProxy: enable PROXY protocol for all list

Merged openshift-merg... merged 1 commit into `openshift:master` from `jacksgt:fix-ipv4v6-proxy` on Jun 10, 2022

Conversation 51 | Commits 1 | Checks 0 | Files changed 1

jacksgt commented on Jan 19, 2022 Contributor

Previously, the `accept-proxy` directive (which enables HAProxy to listen for PROXY protocol instead of regular HTTP traffic) was only appended to the last entry in the section.
This worked fine for the IPv4 or IPv6 single-stack use-case, but not

openshift / openshift-ansible Public

Code | Issues 4 | Pull requests 4 | Projects | Security | Insights

## Set nameservers on DHCPv6 event #2853

Merged sdodson merged 1 commit into `openshift:master` from `alexcern:dhcpv6`

Conversation 11 | Commits 1 | Checks 0 | Files changed 1

alexcern commented on Nov 23, 2016

openshift / cluster-logging-operator Public

Code | Issues 2 | Pull requests 9 | Projects | Security | Insights

## Fix namespace metadata in gen-olm-artifacts

Merged openshift-merg... merged 1 commit into `openshift:master` from `jacksgt:patch-1`

openshift / router Public

Code | Issues 9 | Pull requests 14 | Security | Insights

## Use ServiceAliasConfigKeys for dynamic config #

Merged openshift-merg... merged 1 commit into `openshift:master` from `alexcern:fix/dynamic_route`

# Takeaways

Users are very **happy about internal documentation**

**Operators** are a great way to provide automation **for users and admins**
- but they are also **very sharp tools → use soft deletion where possible!**

**Worthwhile effort** to fully automate **cluster provisioning** and **integration tests**

**For admins: not every manual operation needs to be automated**

# Thank you!

**Slides: https://cern.ch/openshift-commons-2023**

home.cern