



PRESENT

WORKSHOP ADVANCED DOCKER



สอนการ deploy Dockers ด้วย Kubernetes
จากประสบการณ์ใช้งานจริงบน Production ของ
application ระดับประเทศ



วิทยากร : คุณ PRAPARN LUNGPOONLARP
INFRASTRUCTURE ENGINEER, NETWORK ENGINEER,
SYSTEM ENGINEER



kubernetes



Outline Day 1

- Container concept (Recap)
- Introduction to Kubernetes
- System Architecture
- Fundamental of Kubernetes
 - Pods, Container and Services
 - Daemon Sets and Replication Controller (RC)
 - Deployment/Replica-Set (RS) and Rolling update
 - Volume
 - Resource Management and Horizontal Pods Autoscaling (HPA)
 - ConfigMap Secret



Outline Day 2

- Fundamental of Kubernetes
 - Job and CronJob
 - Log and Monitoring
- Ingress Networking
- Security on Kubernetes
 - Network Policy
 - Volume Policy
 - Resource Usage Policy
 - Resource Consumption Policy
 - Access Control Policy
 - Security Policy
- Kubernetes in real world
 - Cluster Setup for Bare Metal
 - Orchestrator Assignment
 - nodeSelector
 - Interlude
 - Affinity
 - Taints/Tolerations
- Stateful application deployment
 - Consideration and Awareness
 - Persistent Volumes
 - StatefulSets
- Helm basic operation
- Monitoring with prometheus operator



Pre-require

- Windows 10 (64 bit) / Mac OSX (64 Bit) with memory 8 GB
- Intermediate understand for docker/compose and container concept
- Cloud / Bare Material /Play with K8S
- LINE Account
- Basic understand for network/load balance concept
- Tool for editor (atom etc)
- Tool for shell (putty / terminal etc)
- Tool for transfer file (winscp / scp)
- Internet for download / upload image



LabSheet

- <https://tinyurl.com/y8yazrxy>

LabSheet

ไฟล์ แก้ไข ดู แทรก รูปแบบ ข้อมูล เครื่องมือ ស่วนเสริม ความช่วยเหลือ แก้ไขล่าสุด 1 นาทีที่ผ่านมา

Group No

	A	B	C	D	E	F	G	H	I	J
1	Group No	No	Machine Name	Private IP Address	Public IP Address	Role	Username	ssh connect string		Remark
2		1	Training_AdvanceDockerwithK8S_StudentG1_1	10.0.1.109	13.229.92.115	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.92.115		
3		2	Training_AdvanceDockerwithK8S_StudentG1_2	10.0.1.139	13.250.11.169	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 13.250.11.169		
4	1	3	Training_AdvanceDockerwithK8S_StudentG1_3	10.0.1.47	52.221.249.56	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 52.221.249.56		
5		4	Training_AdvanceDockerwithK8S_StudentG2_1	10.0.1.50	13.229.215.190	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.215.190		
6		5	Training_AdvanceDockerwithK8S_StudentG2_2	10.0.1.196	13.229.72.95	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.72.95		
7	2	6	Training_AdvanceDockerwithK8S_StudentG2_3	10.0.1.77	13.229.251.109	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.251.109		
8		7	Training_AdvanceDockerwithK8S_StudentG3_1	10.0.1.174	54.169.75.239	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 54.169.75.239		
9		8	Training_AdvanceDockerwithK8S_StudentG3_2	10.0.1.252	13.229.247.143	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.247.143		
10	3	9	Training_AdvanceDockerwithK8S_StudentG3_3	10.0.1.75	13.229.65.47	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.65.47		
11		10	Training_AdvanceDockerwithK8S_StudentG4_1	10.0.1.85	13.229.206.76	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.206.76		
12		11	Training_AdvanceDockerwithK8S_StudentG4_2	10.0.1.208	13.229.70.154	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 13.229.70.154		
13	4	12	Training_AdvanceDockerwithK8S_StudentG4_3	10.0.1.86	3.0.147.248	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.147.248		
14		13	Training_AdvanceDockerwithK8S_StudentG5_1	10.0.1.234	3.0.146.98	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.146.98		
15		14	Training_AdvanceDockerwithK8S_StudentG5_2	10.0.1.209	54.255.172.4	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 54.255.172.4		
16	5	15	Training_AdvanceDockerwithK8S_StudentG5_3	10.0.1.207	54.255.136.224	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 54.255.136.224		
17		16	Training_AdvanceDockerwithK8S_StudentG6_1	10.0.1.134	54.169.204.141	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 54.169.204.141		
18		17	Training_AdvanceDockerwithK8S_StudentG6_2	10.0.1.62	3.0.183.181	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.183.181		
19	6	18	Training_AdvanceDockerwithK8S_StudentG6_3	10.0.1.95	18.136.199.90	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 18.136.199.90		
20		19	Training_AdvanceDockerwithK8S_StudentG7_1	10.0.1.202	3.0.176.230	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.176.230		
21		20	Training_AdvanceDockerwithK8S_StudentG7_2	10.0.1.41	3.0.94.126	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.94.126		
22	7	21	Training_AdvanceDockerwithK8S_StudentG7_3	10.0.1.81	3.0.54.130	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.54.130		
23		22	Training_AdvanceDockerwithK8S_StudentG8_1	10.0.1.65	3.0.98.215	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.98.215		
24		23	Training_AdvanceDockerwithK8S_StudentG8_2	10.0.1.93	18.136.210.250	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 18.136.210.250		
25	8	24	Training_AdvanceDockerwithK8S_StudentG8_3	10.0.1.146	54.254.214.135	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 54.254.214.135		
26		25	Training_AdvanceDockerwithK8S_StudentG9_1	10.0.1.154	54.255.138.111	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 54.255.138.111		
27		26	Training_AdvanceDockerwithK8S_StudentG9_2	10.0.1.223	3.0.92.216	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.92.216		
28	9	27	Training_AdvanceDockerwithK8S_StudentG9_3	10.0.1.224	3.0.17.138	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.17.138		
29		28	Training_AdvanceDockerwithK8S_StudentG10_1	10.0.1.55	13.250.38.8	Master	ubuntu	ssh -i "docker_lab" ubuntu@ 13.250.38.8		
30		29	Training_AdvanceDockerwithK8S_StudentG10_2	10.0.1.149	52.221.184.17	Worker1	ubuntu	ssh -i "docker_lab" ubuntu@ 52.221.184.17		
31	10	30	Training_AdvanceDockerwithK8S_StudentG10_3	10.0.1.17	3.0.50.103	Worker2	ubuntu	ssh -i "docker_lab" ubuntu@ 3.0.50.103		

Present by: Praparn L. (eva10409@gmail.com)



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Lab Resource

- Repository for lab

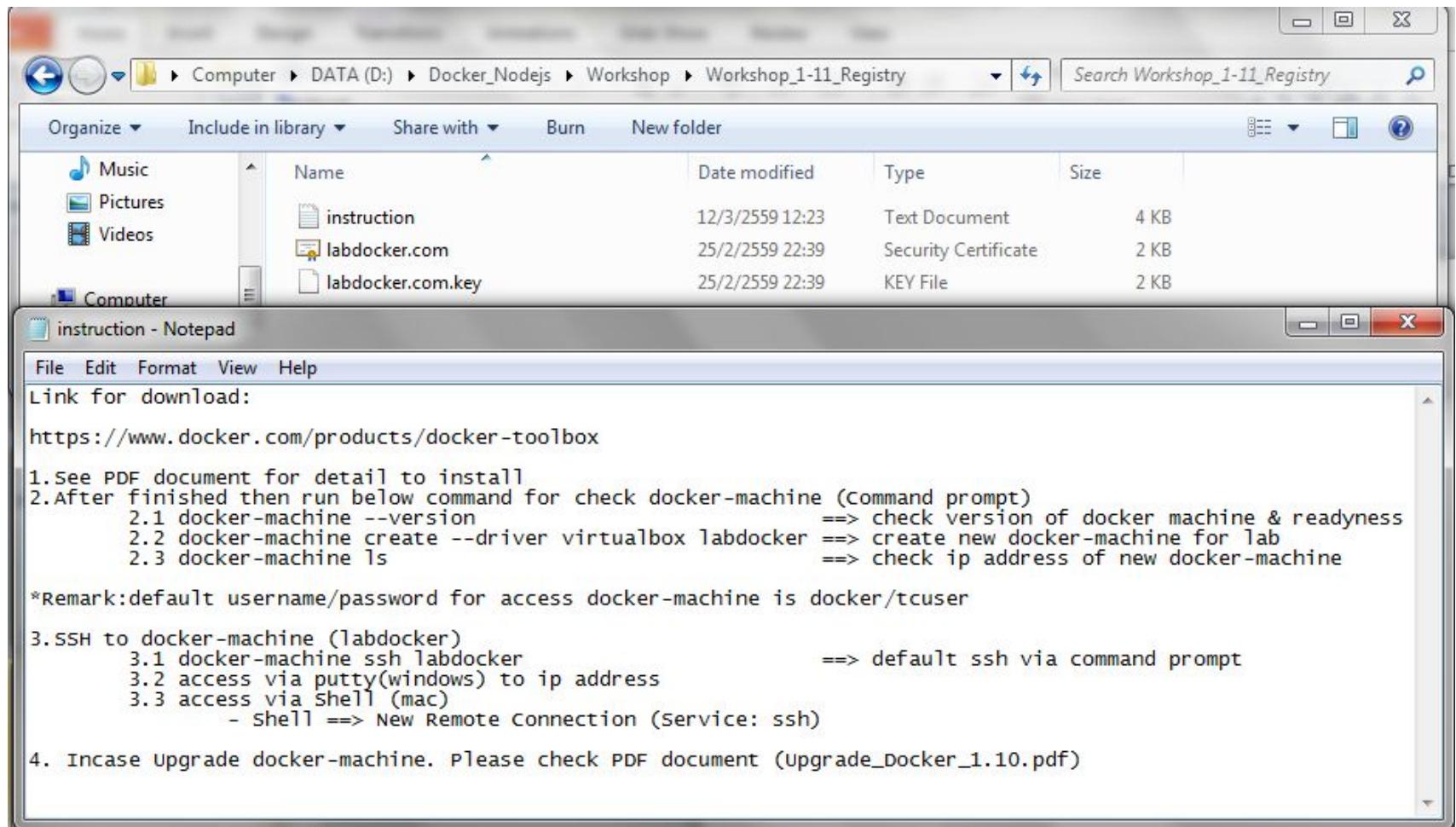
The screenshot shows a search results page for 'labdocker' on a platform that uses a Docker icon in its logo. The interface includes a search bar with the query 'labdocker', a 'Sign up' button, and a 'Log In' button. Below the search bar, the text 'Repositories (7)' is displayed. A dropdown menu labeled 'All' is visible. The main content area lists seven repositories:

Repository	Type	Stars	Pulls	Details
labdocker/alpineweb	public	0	31	DETAILS
labdocker/nginx	public	0	16	DETAILS
labdocker/alpine	public	0	7	DETAILS
labdocker/centos	public	0	5	DETAILS
labdocker/debian	public	0	4	DETAILS
labdocker/fedora	public	0	3	DETAILS
labdocker/ubuntu	public	0	2	DETAILS



Lab Resource

- Software in lab



Lab Resource

- Download on Google Drive
 - <https://tinyurl.com/k8slabth>
- Download on GitHub
 - Git clone https://github.com/praparn/kubernetes_202205

No description, website, or topics provided.

Branch: master ▾ New pull request

Clone with SSH Use HTTPS
git@github.com:praparn/kuberneteslab.git

File	Created	Last Commit
WorkShop_1.1_Install_Kubernetes	2017/11/02 14:05:55	an hour ago
WorkShop_1.2_Pods_Service_Deployment	2017/11/02 14:05:55	an hour ago
WorkShop_1.3_Replication_Controller	2017/11/02 14:05:55	an hour ago
WorkShop_1.4_Deployment	2017/11/02 14:05:55	an hour ago
WorkShop_1.5_Volume	2017/11/02 14:05:55	an hour ago
WorkShop_1.6_Liveness_Readiness_Probe	2017/11/02 14:05:55	an hour ago
WorkShop_1.7_Resource_Management_and_HPA	2017/11/02 14:05:55	an hour ago
WorkShop_2.1_ConfigMap_Secret	2017/11/02 14:05:55	an hour ago
WorkShop_2.3_Log_and_Monitoring	2017/11/02 14:05:55	an hour ago
WorkShop_2.4_Ingress_Network	2017/11/02 14:05:55	an hour ago
WorkShop_2.5_Kubernetes_RealWorld	2017/11/02 14:05:55	an hour ago
WorkShop_2.6_Orchestrator_Assignment	2017/11/08 23:56:28	2 days ago
WorkShop_2.7_Persistent_Storage	2017/11/10	23 hours ago
Workshop_2.2_Job_CronJob	2017/11/02 14:05:55	an hour ago
.DS_Store	2017/11/00 03:43	22 hours ago
Kubernetes_Training_master.pdf	2017/11/00 03:43	22 hours ago
Untitled-1	2017/11/02 14:05:55	an hour ago



Workshop: Install Kubernetes



Kubernetes: Production Workload Orchestration



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Workshop: Install Kubernetes

- LAB Sheet
- <https://tinyurl.com/y8yazrxy>

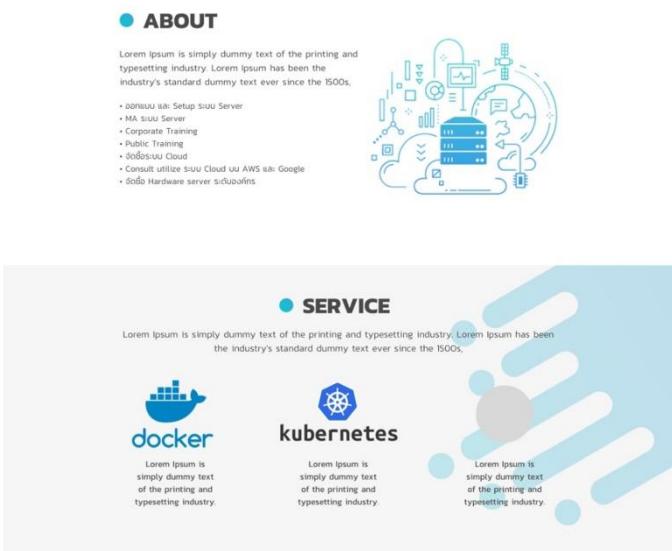
Table No	Group No	No	Public IP Address	Private IP Address	Role
1	1	1	54.169.12.33	10.0.1.25	Master
		2	54.255.243.139	10.0.1.102	Worker
		3	52.221.203.26	10.0.1.254	Worker
	2	1	13.250.121.106	10.0.1.100	Master
		2	54.255.243.173	10.0.1.202	Worker
		3	52.221.232.245	10.0.1.12	Worker
	3	1	54.169.39.94	10.0.1.169	Master
		2	13.229.72.232	10.0.1.107	Worker
		3	13.250.109.203	10.0.1.135	Worker
2	4	1	13.250.103.188	10.0.1.110	Master
		2	13.229.128.105	10.0.1.199	Worker
		3	54.169.134.39	10.0.1.162	Worker
	5	1	54.255.145.5	10.0.1.32	Master
		2	54.254.218.192	10.0.1.59	Worker
		3	52.221.216.253	10.0.1.166	Worker
3	6	1	13.250.112.82	10.0.1.45	Master
		2	54.254.166.86	10.0.1.50	Worker
		3	52.221.181.188	10.0.1.218	Worker
	7	1	52.221.208.50	10.0.1.182	Master
		2	52.77.249.187	10.0.1.4	Worker
		3	13.250.104.158	10.0.1.173	Worker
4	8	1	54.169.32.99	10.0.1.222	Master
		2	52.221.191.74	10.0.1.147	Worker
		3	13.229.80.170	10.0.1.167	Worker



Who are we ? (Opcellent)



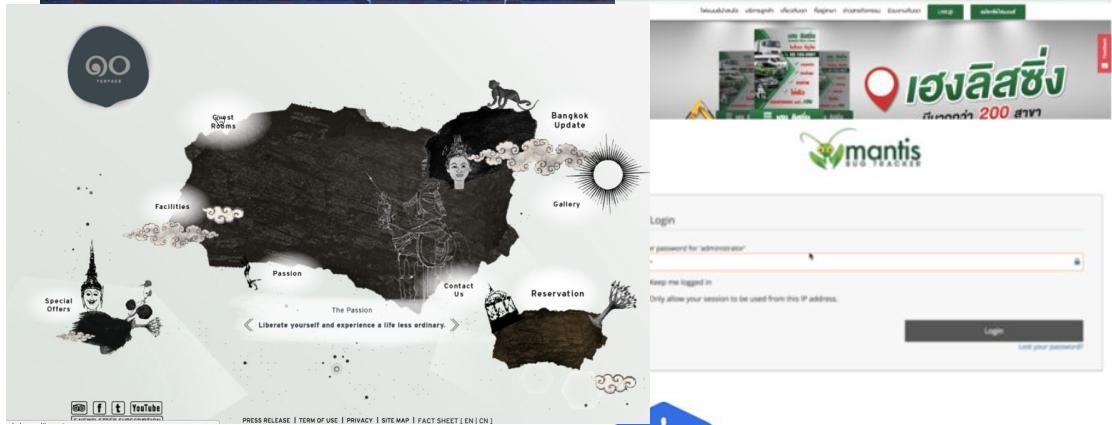
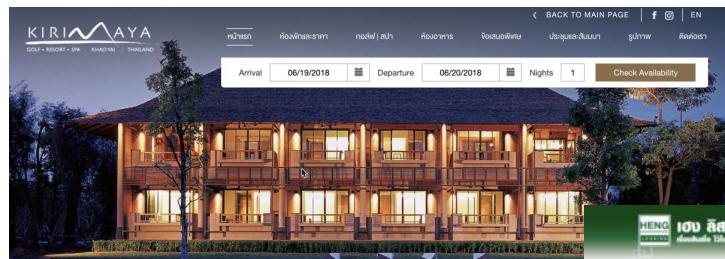
The Opcellent website features a light blue header with the company logo and navigation links for About, Service, Training, and Contact. Below the header is a large white section with a blue abstract graphic and the text "Modern Server Technology Implementer". A "GET DETAILS" button is located in the bottom left corner of this section.



The "SERVICE" page on the Opcellent website includes sections for Docker and Kubernetes. Each section contains a brief description of the service, a small icon, and a "Lorem Ipsum" placeholder text block. The background features a large blue abstract graphic.



A screenshot of an event listing for "Advanced Docker and Kubernetes 101" presented by GDG Chiang Mai and Artisan Digital. The event is on Saturday, 12 May 2018, at Punspace Tha Pae Gate. It includes details about registration, networking, and networking/games. There are also sections for food and beer, and a note about bringing one's own laptop. Buttons for "Interested" and "Going" are shown.



A composite image showing the Kirinaya website's main page with a map of Thailand and various resort facilities, and a separate screenshot of the website's login page. The login page has fields for "Email" and "Password", a "Remember me" checkbox, and a "Login" button.

Kubernetes: Production Workload Orchestration



Kubernetes 1.24

Kubernetes 1.24: Stargazer

Tuesday, May 03, 2022

Authors: Kubernetes 1.24 Release Team

We are excited to announce the release of Kubernetes 1.24, the first release of 2022!

This release consists of 46 enhancements: fourteen enhancements have graduated to stable, fifteen enhancements are moving to beta, and thirteen enhancements are entering alpha. Also, two features have been deprecated, and two features have been removed.

Major Themes

Dockershim Removed from kubelet

After its deprecation in v1.20, the dockershim component has been removed from the kubelet in Kubernetes v1.24. From v1.24 onwards, you will need to either use one of the other [supported runtimes](#) (such as containerd or CRI-O) or use cri-dockerd if you are relying on Docker Engine as your container runtime. For more information about ensuring your cluster is ready for this removal, please see [this guide](#).

Beta APIs Off by Default

New beta APIs will not be enabled in clusters by default. Existing beta APIs and new versions of existing beta APIs will continue to be enabled by default.

Siging Release Artifacts

Release artifacts are [signed](#) using [cosign](#) signatures, and there is experimental support for [verifying image signatures](#). Signing and verification of release artifacts is part of [increasing software supply chain security for the Kubernetes release process](#).

OpenAPI v3

Kubernetes 1.24 offers beta support for publishing its APIs in the [OpenAPI v3 format](#).

Storage Capacity and Volume Expansion Are Generally Available

[Storage capacity tracking](#) supports exposing currently available storage capacity via [CSIStorageCapacity objects](#) and enhances scheduling of pods that use CSI volumes with late binding.

[Volume expansion](#) adds support for resizing existing persistent volumes.

Ref: <https://kubernetes.io/blog/2022/05/03/kubernetes-1-24-release-announcement/>

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Kubernetes 1.24

NonPreemptingPriority to Stable

This feature adds a new option to [PriorityClasses](#), which can enable or disable pod preemption.

Storage Plugin Migration

Work is underway to [migrate the internals of in-tree storage plugins](#) to call out to CSI Plugins while maintaining the original API. The [Azure Disk](#) and [OpenStack Cinder](#) plugins have both been migrated.

gRPC Probes Graduate to Beta

With Kubernetes 1.24, the [gRPC probes functionality](#) has entered beta and is available by default. You can now [configure startup, liveness, and readiness probes](#) for your gRPC app natively within Kubernetes without exposing an HTTP endpoint or using an extra executable.

Kubelet Credential Provider Graduates to Beta

Originally released as Alpha in Kubernetes 1.20, the kubelet's support for [image credential providers](#) has now graduated to Beta. This allows the kubelet to dynamically retrieve credentials for a container image registry using exec plugins rather than storing credentials on the node's filesystem.

Contextual Logging in Alpha

Kubernetes 1.24 has introduced [contextual logging](#) that enables the caller of a function to control all aspects of logging (output formatting, verbosity, additional values, and names).

Avoiding Collisions in IP allocation to Services

Kubernetes 1.24 introduces a new opt-in feature that allows you to [soft-reserve a range for static IP address assignments](#) to Services. With the manual enablement of this feature, the cluster will prefer automatic assignment from the pool of Service IP addresses, thereby reducing the risk of collision.

A Service `ClusterIP` can be assigned:

- dynamically, which means the cluster will automatically pick a free IP within the configured Service IP range.
- statically, which means the user will set one IP within the configured Service IP range.

Service `ClusterIP` are unique; hence, trying to create a Service with a `ClusterIP` that has already been allocated will return an error.

Dynamic Kubelet Configuration is Removed from the Kubelet

After being deprecated in Kubernetes 1.22, Dynamic Kubelet Configuration has been removed from the kubelet. The feature will be removed from the API server in Kubernetes 1.26.

Ref: <https://kubernetes.io/blog/2022/05/03/kubernetes-1-24-release-announcement/>

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CNI Version-Related Breaking Change

Before you upgrade to Kubernetes 1.24, please verify that you are using/upgrading to a container runtime that has been tested to work correctly with this release.

For example, the following container runtimes are being prepared, or have already been prepared, for Kubernetes:

- containerd v1.6.4 and later, v1.5.11 and later
- CRI-O 1.24 and later

Service issues exist for pod CNI network setup and tear down in containerd v1.6.0–v1.6.3 when the CNI plugins have not been upgraded and/or the CNI config version is not declared in the CNI config files. The containerd team reports, "these issues are resolved in containerd v1.6.4."

With containerd v1.6.0–v1.6.3, if you do not upgrade the CNI plugins and/or declare the CNI config version, you might encounter the following "Incompatible CNI versions" or "Failed to destroy network for sandbox" error conditions.

CSI Snapshot

This information was added after initial publication.

[VolumeSnapshot v1beta1 CRD has been removed](#). Volume snapshot and restore functionality for Kubernetes and the Container Storage Interface (CSI), which provides standardized APIs design (CRDs) and adds PV snapshot/restore support for CSI volume drivers, moved to GA in v1.20. VolumeSnapshot v1beta1 was deprecated in v1.20 and is now unsupported. Refer to [KEP-177: CSI Snapshot](#) and [Volume Snapshot GA blog](#) for more information.

Other Updates

Graduations to Stable

This release saw fourteen enhancements promoted to stable:

- [Container Storage Interface \(CSI\) Volume Expansion](#)
- [Pod Overhead](#): Account for resources tied to the pod sandbox but not specific containers.
- [Add non-preempting option to PriorityClasses](#)
- [Storage Capacity Tracking](#)
- [OpenStack Cinder In-Tree to CSI Driver Migration](#)
- [Azure Disk In-Tree to CSI Driver Migration](#)
- [Efficient Watch Resumption](#): Watch can be efficiently resumed after kube-apiserver reboot.
- [Service Type=LoadBalancer Class Field](#): Introduce a new Service annotation `service.kubernetes.io/load-balancer-class` that allows multiple implementations of `type: LoadBalancer` Services in the same cluster.
- [Indexed Job](#): Add a completion index to Pods of Jobs with a fixed completion count.
- [Add Suspend Field to Jobs API](#): Add a suspend field to the Jobs API to allow orchestrators to create jobs with more control over when pods

Ref: <https://kubernetes.io/blog/2022/05/03/kubernetes-1-24-release-announcement/>

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Dockershim and his story



Products Use Cases Delivery Approach

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Mirantis to take over support of Kubernetes dockershim

Adam Parco - December 4, 2020 - [kubernetes](#)



For many people this has sparked a moment of panic, but take a deep breath, everything is going to be OK.

Even better news, however, is that Mirantis and Docker have agreed to partner to maintain the shim code standalone outside Kubernetes, as a conformant CRI interface for the Docker Engine API. For Mirantis customers, that means that Docker Engine's commercially supported version, Mirantis Container Runtime (MCR), will be CRI compliant. We will start with the great initial prototype from [Dims](#) at <https://github.com/dims/cri-dockerd> and continue to make it available as an open source project, <https://github.com/Mirantis/cri-dockerd>. This means that you can continue to build Kubernetes based on the Docker Engine as before, just switching from the built in dockershim to the external one. We will work together on making sure it continues to work as well as before and that it passes all the conformance tests and continues to work just like the built in version did. Mirantis will be using this in Mirantis Kubernetes Engine, and Docker will continue to ship this shim in Docker Desktop.

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Creating K8s objects with YAML

Ref: <https://www.mirantis.com/blog/mirantis-to-take-over-support-of-kubernetes-dockershim-2/>

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 kubernetes

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Search

Kubernetes Documentation / Getting started / Production environment / Container runtimes

Container runtimes

You need to install a container runtime into each node in the cluster so that Pods can run there. This page outlines what is involved and describes related tasks for setting up nodes.

This page lists details for using several common container runtimes with Kubernetes, on Linux:

- containerd
- CRI-O
- Docker

Note: For other operating systems, look for documentation specific to your platform.

Cgroup drivers
Container runtimes
containerd
CRI-O
Docker

containerd

This section contains the necessary steps to use containerd as CRI runtime.

Use the following commands to install Containerd on your system:

Install and configure prerequisites:

```
cat <<EOF | sudo tee /etc/modules-load.d/containerd.conf
overlay
br_netfilter
EOF

sudo modprobe overlay
sudo modprobe br_netfilter

# Setup required sysctl params, these persist across reboots.
cat <<EOF | sudo tee /etc/sysctl.d/99-kubernetes-cri.conf
net.bridge.bridge-nf-call-iptables = 1
net.ipv4.ip_forward = 1
net.bridge.bridge-nf-call-ip6tables = 1
EOF

# Apply sysctl params without reboot
sudo sysctl --system
```

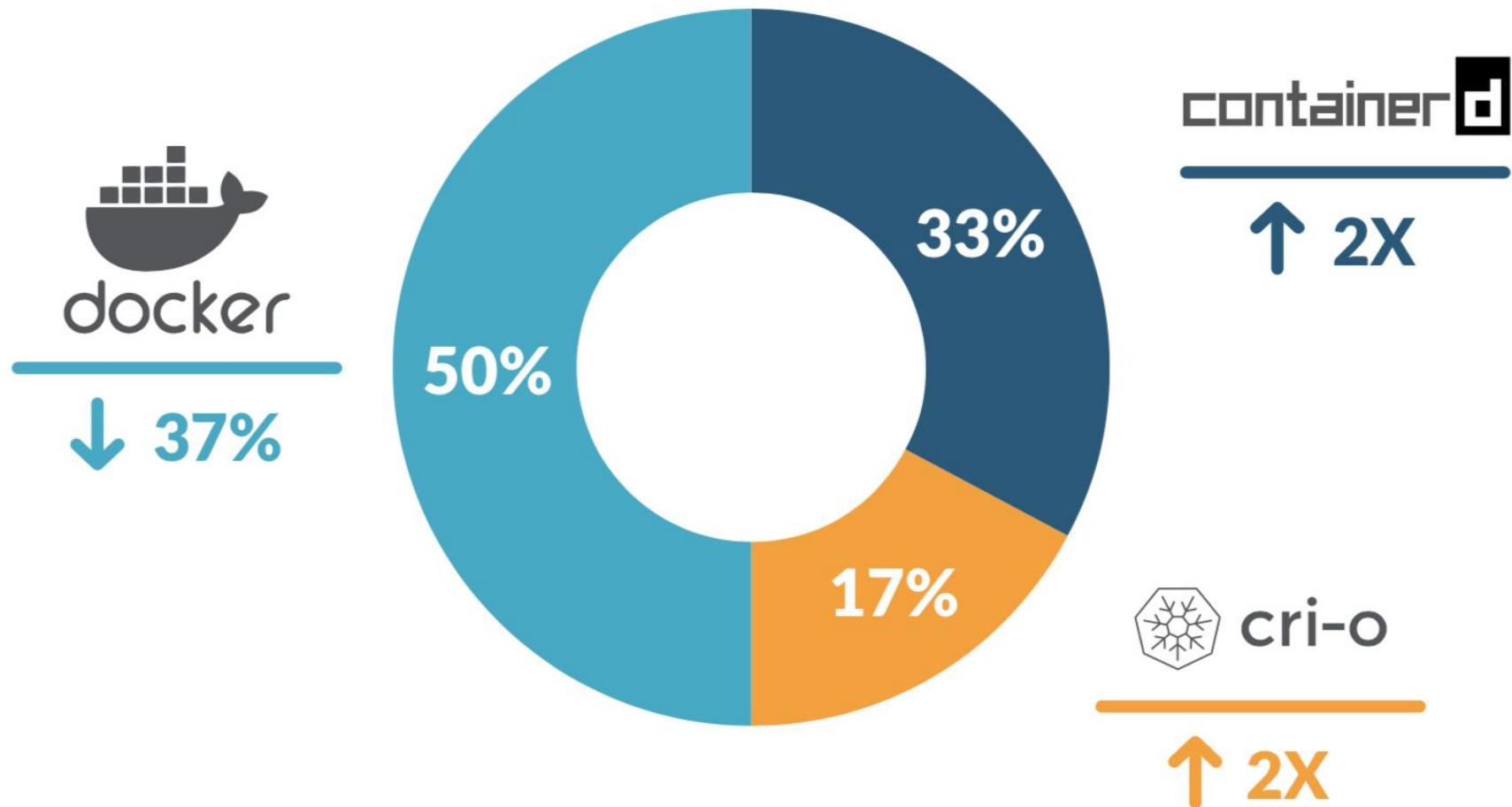
Ref: <https://kubernetes.io/docs/setup/production-environment/container-runtimes/#containerd>

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Ref: <https://kubernetes.io/docs/setup/production-environment/container-runtimes/#containerd>

Kubernetes: Production Workload Orchestration



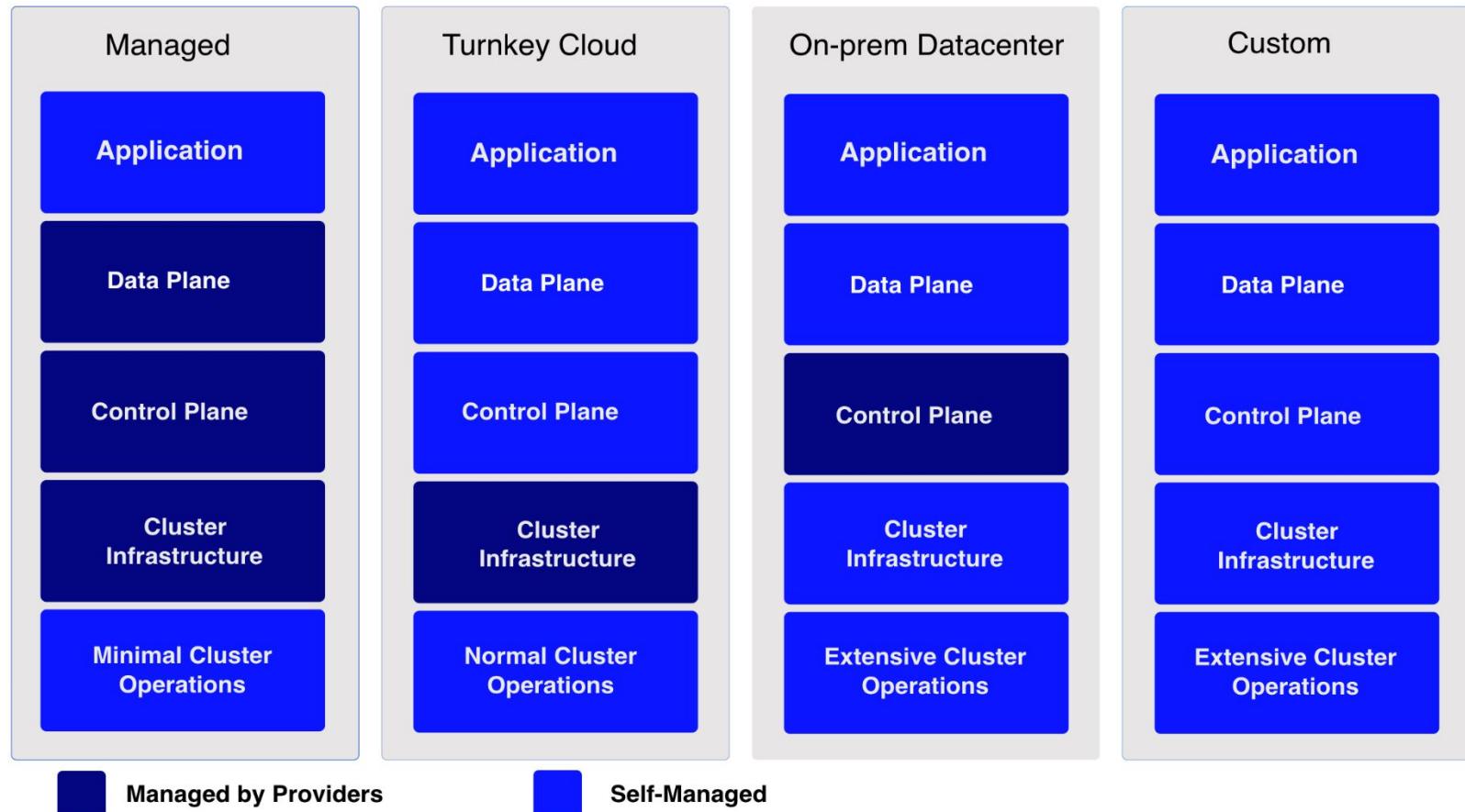
Kubernetes Environment

Production environment

When evaluating a solution for a production environment, consider which aspects of operating a Kubernetes cluster (or *abstractions*) you want to manage yourself or offload to a provider.

Some possible abstractions of a Kubernetes cluster are applications, data plane, control plane, cluster infrastructure, and cluster operations.

The following diagram lists the possible abstractions of a Kubernetes cluster and whether an abstraction is self-managed or managed by a provider.



Production environment solutions

Ref:<https://kubernetes.io/docs/setup/release/notes/>

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Kubernetes Environment

Providers	Managed	Turnkey cloud	On-prem datacenter	Custom (cloud)	Custom (On-premises VMs)	Custom (Bare Metal)
Agile Stacks		✓	✓			
Alibaba Cloud		✓				
Amazon	Amazon EKS	Amazon EC2				
AppsCode	✓					
APPUiO	✓	✓	✓			
Banzai Cloud Pipeline Kubernetes Engine (PKE)		✓		✓	✓	✓
CenturyLink Cloud		✓				
Cisco Container Platform			✓			
Cloud Foundry Container Runtime (CFCR)				✓	✓	
CloudStack					✓	
Canonical	✓	✓	✓	✓	✓	✓
Containership	✓	✓				
Digital Rebar						✓
DigitalOcean	✓					
Docker Enterprise		✓	✓			✓
Fedora (Multi Node)					✓	✓
Fedora (Single Node)						✓
Gardener	✓	✓	✓ (via OpenStack)	✓		
Giant Swarm	✓	✓	✓			
Google	Google Kubernetes Engine (GKE)	Google Compute Engine (GCE)	GKE On-Prem			
IBM	IBM Cloud Kubernetes Service		IBM Cloud Private			
Ionos	Ionos Managed Kubernetes	Ionos Enterprise Cloud				
Kontena Pharos		✓	✓			
Kubermatic	✓	✓	✓			
KubeSail	✓					
Kubespray				✓	✓	✓
Kulbr	✓	✓	✓	✓	✓	✓
Microsoft Azure	Azure Kubernetes Service (AKS)					
Mirantis Cloud Platform			✓			
Nirmata		✓	✓			
Nutanix	Nutanix Karbon	Nutanix Karbon			Nutanix AHV	
OpenShift	OpenShift Dedicated and OpenShift Online		OpenShift Container Platform		OpenShift Container Platform	OpenShift Container Platform



Kubernetes Environment

Oracle Cloud Infrastructure Container Engine for Kubernetes (OKE)	✓	✓				
oVirt					✓	
Pivotal		Enterprise Pivotal Container Service (PKS)	Enterprise Pivotal Container Service (PKS)			
Platform9	✓	✓	✓		✓	✓
Rancher		Rancher 2.x		Rancher Kubernetes Engine (RKE)		k3s
StackPoint	✓	✓				
Supergiant		✓				
SUSE		✓				
SysEleven	✓					
Tencent Cloud	Tencent Kubernetes Engine	✓	✓			✓
VEXXHOST	✓	✓				
VMware	VMware Cloud PKS	VMware Enterprise PKS	VMware Enterprise PKS	VMware Essential PKS		VMware Essential PKS
Z.A.R.V.I.S.	✓					



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Introduction to Kubernetes



Kubernetes: Production Workload Orchestration



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Workshop: Install Kubernetes



Kubernetes: Production Workload Orchestration



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Workshop : Install Kubernetes

- Alternate Solution:



Play with Kubernetes

A simple, interactive and fun playground to learn Kubernetes

Login ▾

github
docker

The screenshot shows a terminal session within the Play with Kubernetes interface. The session title is "c8deucc1_c8deuds1r0f000b0dvrg". The terminal displays the output of several Kubernetes commands:

```
[node1 ~]$ kubectl get nodes
NAME      STATUS   ROLES      AGE   VERSION
node1     Ready    control-plane,master   57s   v1.20.1
[node1 ~]$ kubectl get pods -n=kube-system
NAME          READY   STATUS    RESTARTS   AGE
coredns-74ff55c5b-7zpc   1/1    Running   0          43s
coredns-74ff55c5b-cgk2   1/1    Running   0          43s
kube-dns-74kms           1/1    Running   0          44s
kube-root-f74rc          1/1    Running   0          44s
[node1 ~]$
```

Play with Kubernetes is a labs site provided by [Docker](#) and created by Tutorius. Play with Kubernetes is a playground which allows users to run K8s clusters in a matter of seconds. It gives the experience of having a free Alpine Linux Virtual Machine in browser. Under the hood Docker-in-Docker (DinD) is used to give the effect of multiple VMs/PCs.

If you want to learn more about Kubernetes, consider the [Play with Kubernetes Classroom](#) which provides more directed learning using an integrated Play with Kubernetes commandline.

Your use of Play With Docker is subject to the Docker Terms of Service which can be accessed [here](#)

Site provided by [Docker, Inc.](#), created by Tutorius

Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes

- Check kubernetes version

```
kubectl get nodes -o yaml
```

```
[praparn-MacBook-Pro:~ praparn$ kubectl get nodes -o yaml
apiVersion: v1
items:
- apiVersion: v1
  kind: Node
  metadata:
    annotations:
      node.alpha.kubernetes.io/ttl: "0"
      volumes.kubernetes.io/controller-managed-attach-detach: "true"
    creationTimestamp: 2017-06-24T09:03:07Z
    labels:
      beta.kubernetes.io/arch: amd64
      beta.kubernetes.io/os: linux
      kubernetes.io/hostname: minikube
    name: minikube
    namespace: ""
    resourceVersion: "15676"
    selfLink: /api/v1/nodes/minikube
    uid: f03de16d-58bb-11e7-aae1-080027559511
  spec:
    externalID: minikube
          nodeInfo:
            architecture: amd64
            bootID: cdf78a28-072d-4707-8c1d-dbaa0b95fff7
            containerRuntimeVersion: docker://1.11.1
            kernelVersion: 4.9.13
            kubeProxyVersion: v1.6.0
            kubeletVersion: v1.6.0
            machineID: ef85c4ce9a23440e83266debd5cc9856
            operatingSystem: linux
            osImage: Buildroot 2017.02
            systemUUID: 801D91BA-D487-47D2-9C5D-C12F278B49C5
            kind: List
            metadata: {}
            resourceVersion: ""
            selfLink: "
```



Introduction to Kubernetes



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What is CNCF?

CNCF is an open source software foundation dedicated to making cloud native computing universal and sustainable. Cloud native computing uses an open source software stack to deploy applications as microservices, packaging each part into its own container, and dynamically orchestrating those containers to optimize resource utilization. Cloud native technologies enable software developers to build great products faster.

JOIN



Projects

We host and nurture components of cloud native software stacks, including Kubernetes, Prometheus and Envoy. Kubernetes and other CNCF projects are some of the **highest velocity projects** in the history of open source. We are regularly adding new projects to better support a full stack cloud native environment.



Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes

- What is Orchestration (Computing)?
 - Align business request with Application/Data/Infrastructure
 - Centralized management for:
 - Resource Pool
 - Automated Workflow
 - Provisioning
 - Scale Up/Down
 - Monitoring
 - Billing
 - etc



Ref: [https://en.wikipedia.org/wiki/Orchestration_\(computing\)](https://en.wikipedia.org/wiki/Orchestration_(computing))

Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes

- But why we need Container Orchestration ?
 - Production environment is cluster system
 - Microservice maintain connect was required
 - Application state-full will run on stateless architecture
 - Application scale up/Down was required
 - Many native command/shell for maintain container in production environment
 - etc



Introduction to Kubernetes



Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes



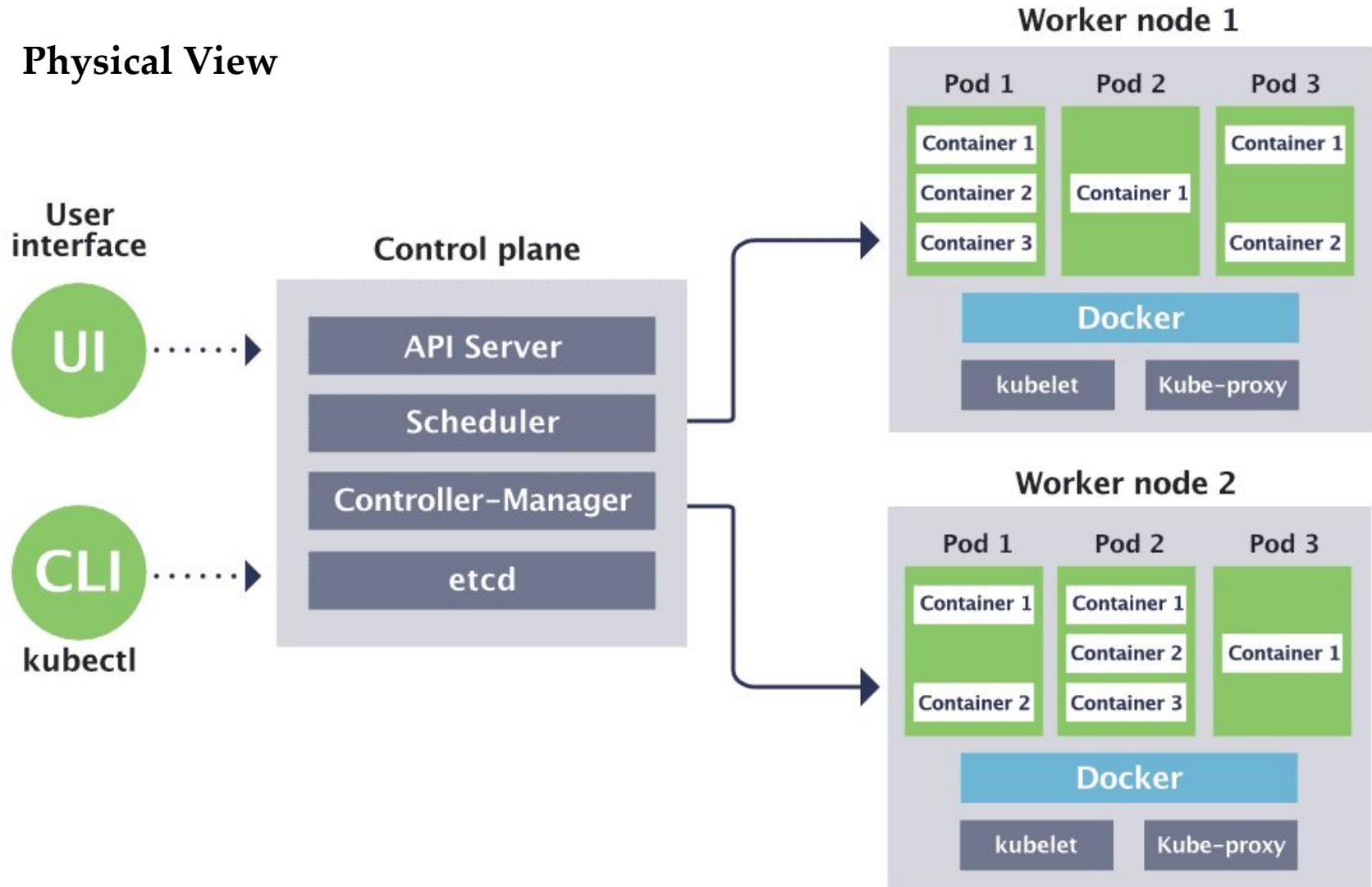
Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes

Physical View



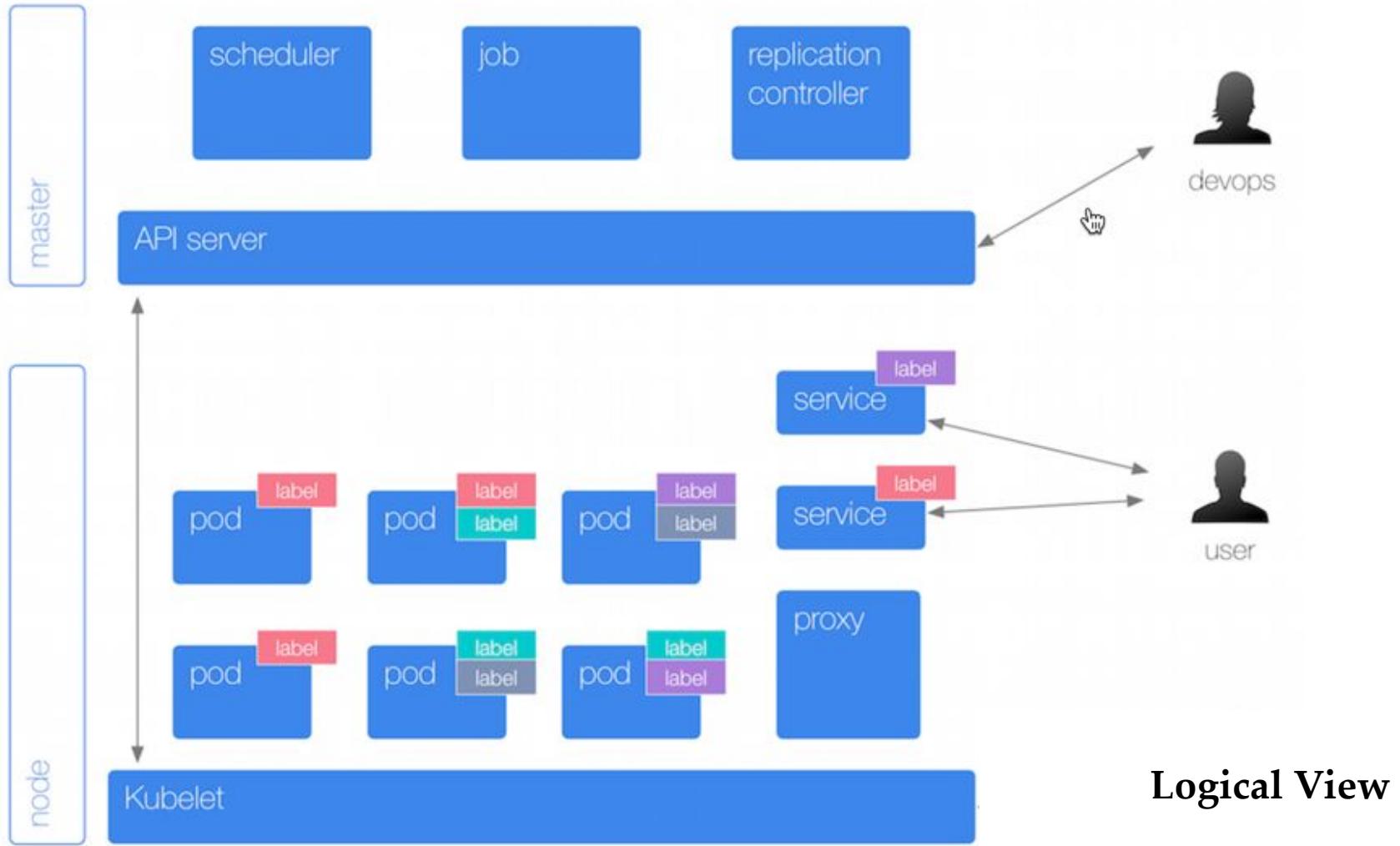
Ref: <https://www.cncf.io/blog/2019/08/19/how-kubernetes-works/>

Kubernetes: Production Workload Orchestration



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Introduction to Kubernetes



Introduction to Kubernetes

- Key Feature
 - Automatic binpacking
 - Horizontal Pod Autoscaling (HPA)
 - Automated rollouts and rollbacks
 - Storage orchestration
 - Self-healing
 - Service discovery and load balancing
 - Secret and configuration management
 - Batch execution



Introduction to Kubernetes

- Automatic binpacking
 - CPU/Memory's utilization can define on Pods (Smallest Unit of Kubernetes)
 - Schedule will select the node by ensure all resource is enough for running Pods as required
 - If reach memory limit
 - Current Pods will be terminate (Kill)
 - If restart flag was set. Kubenetes will try to restart Pods on other node
 - If reach cpu limit
 - Schedule will not kill Pods and waiting for it back to normal state
 - Check available node resource by command: kubectl describe node

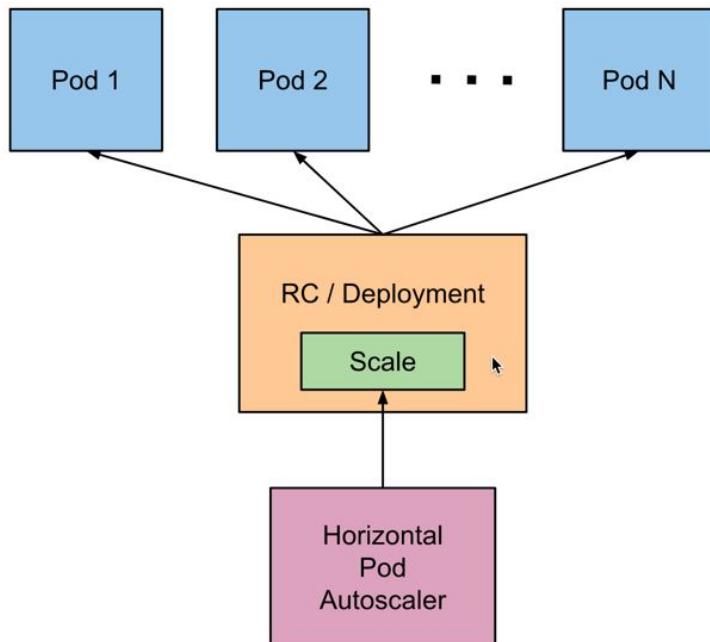
Non-terminated Pods:		(3 in total)			
Namespace	Name	CPU Requests	CPU Limits	Memory Requests	Memory Limits
kube-system	kube-addon-manager-minikube	5m (0%)	0 (0%)	50Mi (2%)	0 (0%)
kube-system	kube-dns-268032401-mx7s3	260m (13%)	0 (0%)	110Mi (5%)	170Mi (8%)
kube-system	kubernetes-dashboard-hdhrz	0 (0%)	0 (0%)	0 (0%)	0 (0%)

Allocated resources:					
(Total limits may be over 100 percent, i.e., overcommitted.)					
CPU Requests	CPU Limits	Memory Requests	Memory Limits		
265m (13%)	0 (0%)	160Mi (8%)	170Mi (8%)		

Events:	<none>
---------	--------

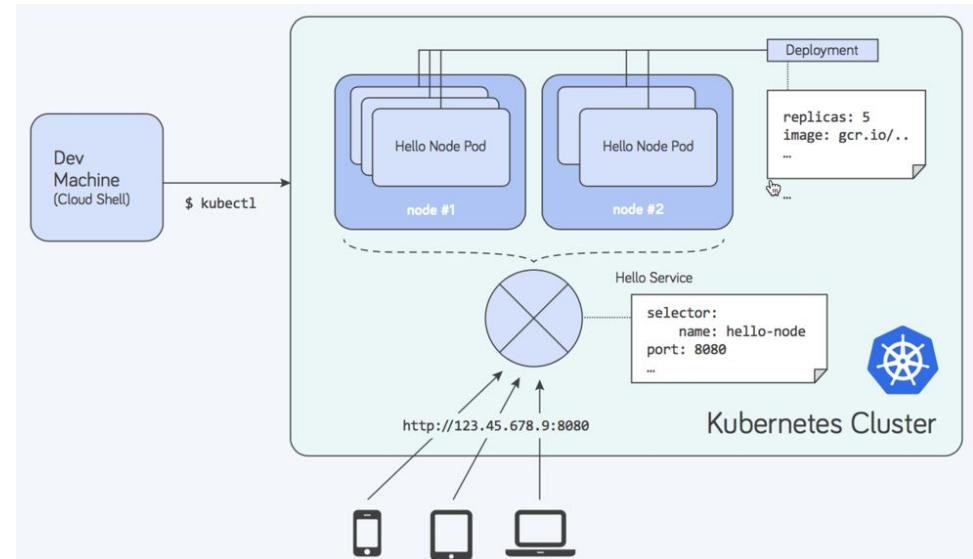
Introduction to Kubernetes

- Horizon Pods Autoscaling (hpa)
 - Talk with RC (Replication Controller) for complete task
 - Automatic scaling Pods's number base cpu's / memory utilization
 - Support multiple criteria (metric) for scale (Alpha feature)
 - Support customize criteria (metric) for scale (Alpha feature)
 - Looping check resource's utilization every 30 seconds (default)



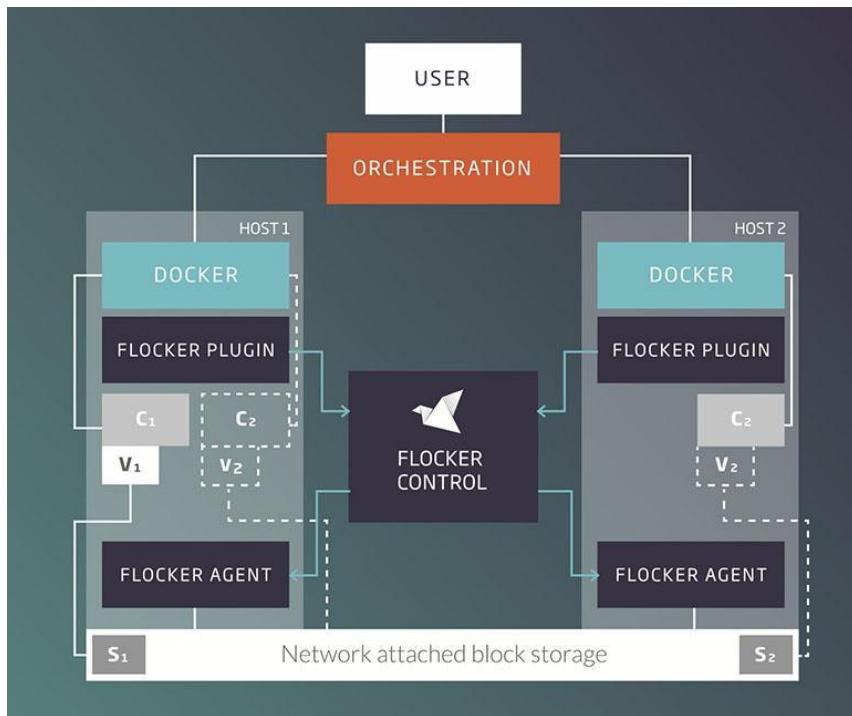
Introduction to Kubernetes

- Automated Rollout and Rollbacks
 - Update will base on Pod's template
 - Rollout existing deployment with all remain replicas number as desired
 - If rollout is success. New version will be provision until success
 - Rollback will possible with single command
 - Rollout process can pause/resume as need



Introduction to Kubernetes

- Storage Orchestrator
 - Support several storage type:
 - Local Storage
 - Network Storage (NFS, iScsi, Gluster, Ceph, Cinder, Flocker)
 - Cloud Storage (AWS, GCE, Azure Disk etc)



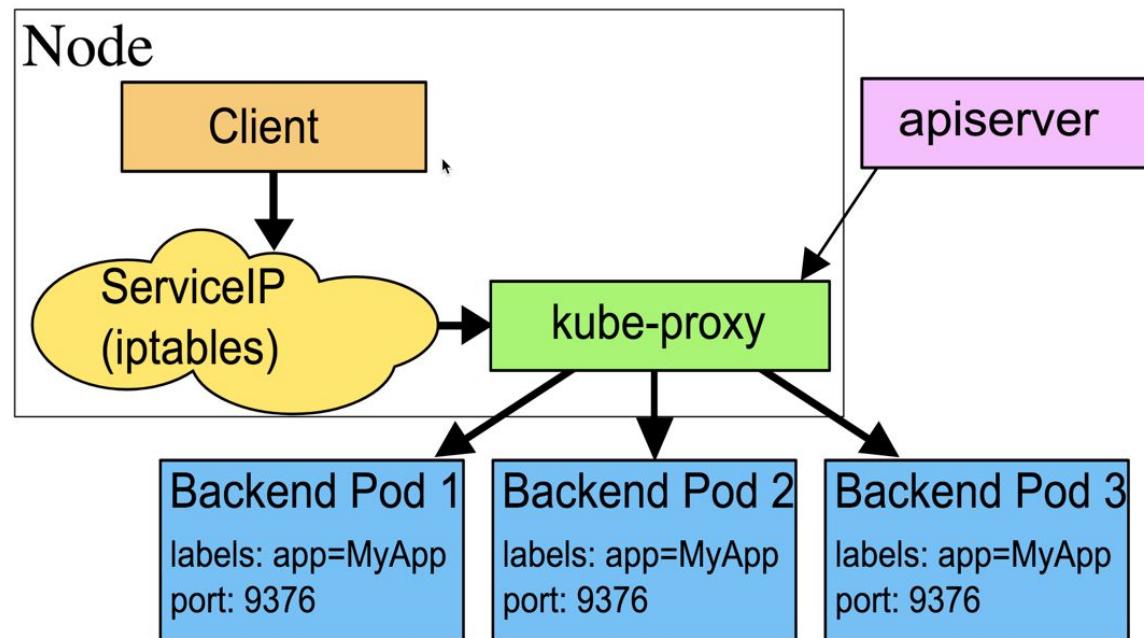
Introduction to Kubernetes

- Self-healing
 - Replication Controller (RC) will maintain unit of Pods as design (not to much (kill) and not to few (create))
 - Full-fail Pods on every failure case with automatic by system



Introduction to Kubernetes

- Service Discovery and Load Balancing
 - Service will act like “connector” for client need to connect with Pods
 - Discovery will use for service to look “Pods” by environment variable or dns service
 - Support load balancing between multiple Pods (replica)



Introduction to Kubernetes

- Secret and Configuration Management
 - Kubernetes can keep confidential data (such as username/password) for running application on encrypt format.
 - Can reference on Pods instead plain text configuration.

```
$ kubectl get secrets
NAME          TYPE        DATA  AGE
db-user-pass  Opaque      2     51s

$ kubectl describe secrets/db-user-pass
Name:         db-user-pass
Namespace:    default
Labels:       <none>
Annotations: <none>

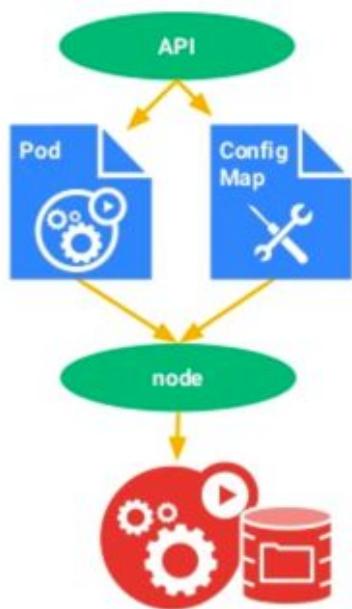
Type:         Opaque

Data
====
password.txt: 12 bytes
username.txt: 5 bytes
```



Introduction to Kubernetes

- Secret and Configuration Management
 - Sometimes we have many configuration that need to specify on each application, But it should be change every time need.
 - Idea is creating configuration file (ConfigMap) for define all configuration that reference on Pods instead



ConfigMap

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: dragon-config
  labels:
    environment: non-prod
data:
  dragon.how.much: very
  dragon.type: fast
```

```
apiVersion: v1
kind: Pod
metadata:
  name: dragon-pod
spec:
  containers:
    - name: dragon-container
      image: dragon-image
      env:
        - name: DRAGON_LEVEL
          valueFrom:
            configMapKeyRef:
              name: dragon-config
              key: dragon.how.much
        - name: DRAGON_TYPE
          valueFrom:
            configMapKeyRef:
              name: dragon-config
              key: dragon.type
```



Introduction to Kubernetes

- Batch Execution
 - A job will response some kind of batch execute by create special Pods (Terminate when batch complete)
 - Normally kubernetes will use job for maintain many background process for cluster system such as Replication Controller (RC) will submit job for start new Pods when existing is fail or delete.
 - Type of Job
 - Non-parallel jobs
 - Parallel jobs with fix-completion
 - Parallel jobs with work queue



System Architecture

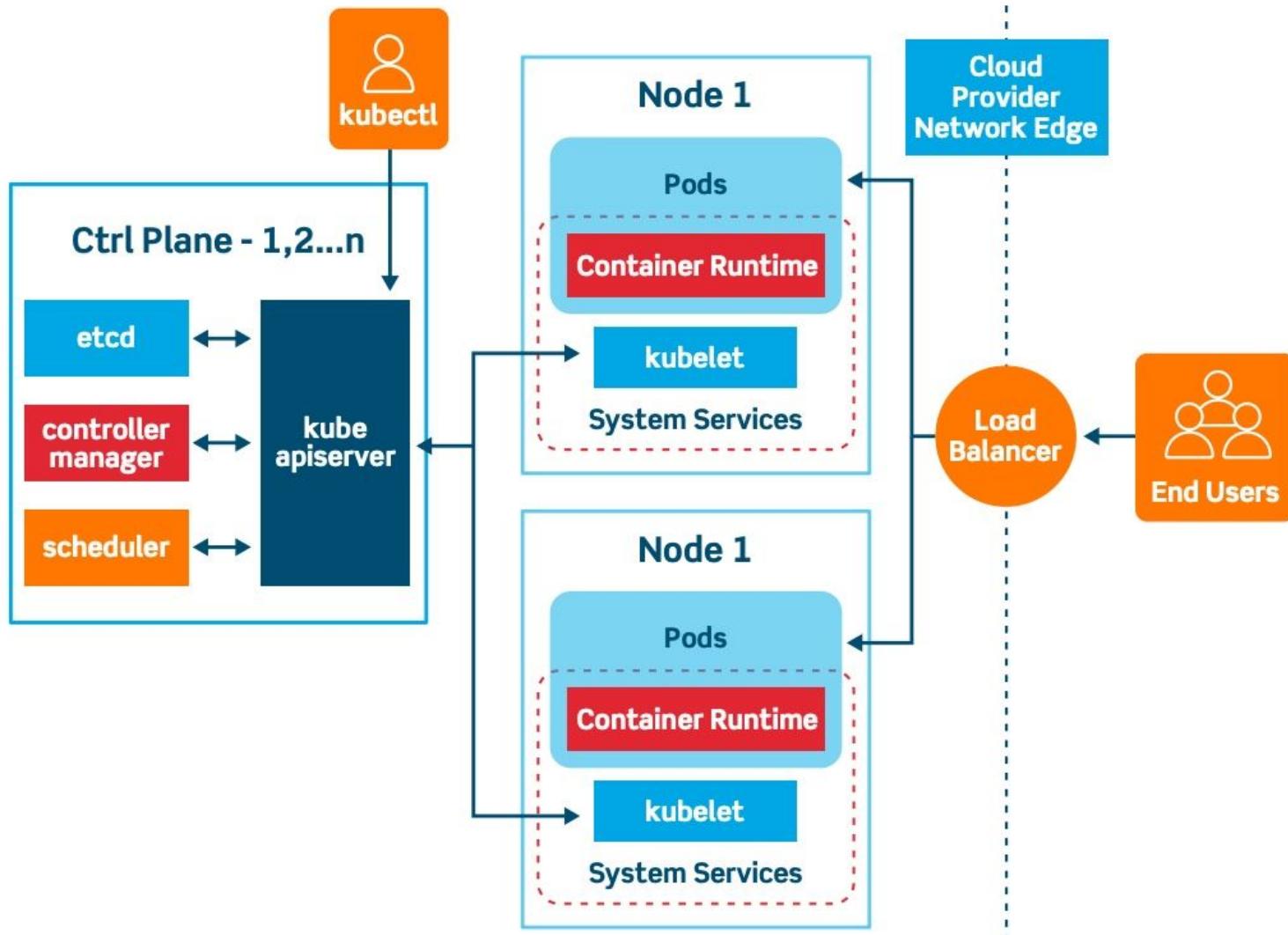


Kubernetes: Production Workload Orchestration



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System Architecture



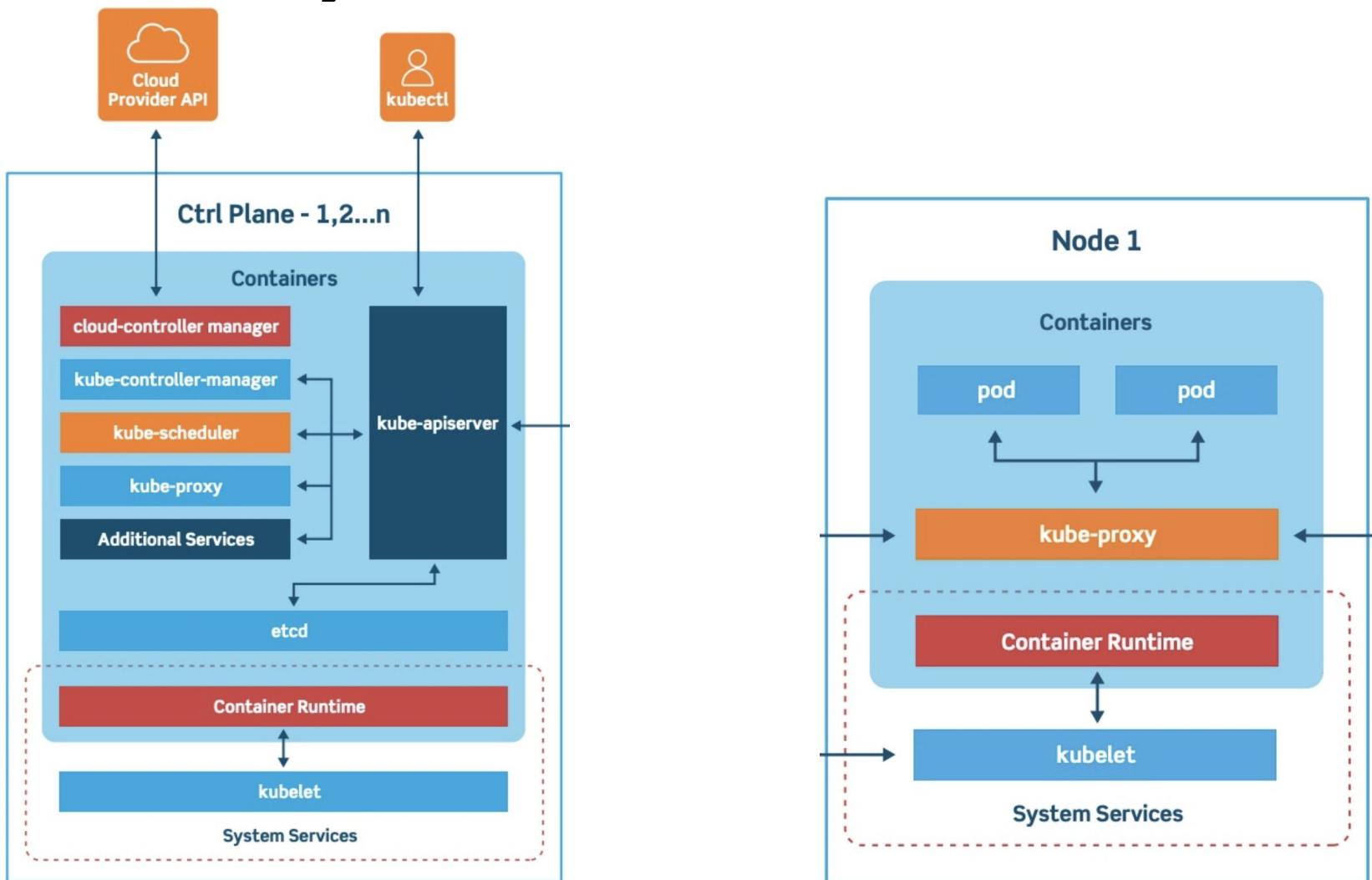
Ref: <https://platform9.com/blog/kubernetes-enterprise-chapter-2-kubernetes-architecture-concepts/>

Kubernetes: Production Workload Orchestration



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System Architecture



Ref: <https://platform9.com/blog/kubernetes-enterprise-chapter-2-kubernetes-architecture-concepts/>

Kubernetes: Production Workload Orchestration



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System Architecture

- Kubernetes Master
 - API Server: Interface for all UI to command that interact with kubernetes cluster
 - Scheduler (Job Dispatcher): Schedule all nodes resource and dispatching Pods to nodes with match criteria
 - CPU ?
 - Memory ?
 - Affinity / Constraint ?
 - Controller and Replication Controller (RC) : Control/Coordinate all nodes for maintain server as configure on cluster system
 - Etcd (Open-source): Key-value database for keep state of nodes/Pods/Container
 - Secret: Encrypt confidential data
 - HPA (Horizon Pods Auto scaling): Scale pods with CPU criteria (major)
 - Event: Keep log and event on cluster
 - NameSpace: Limit resource quota via define namespace (cpu, memory, pods etc)

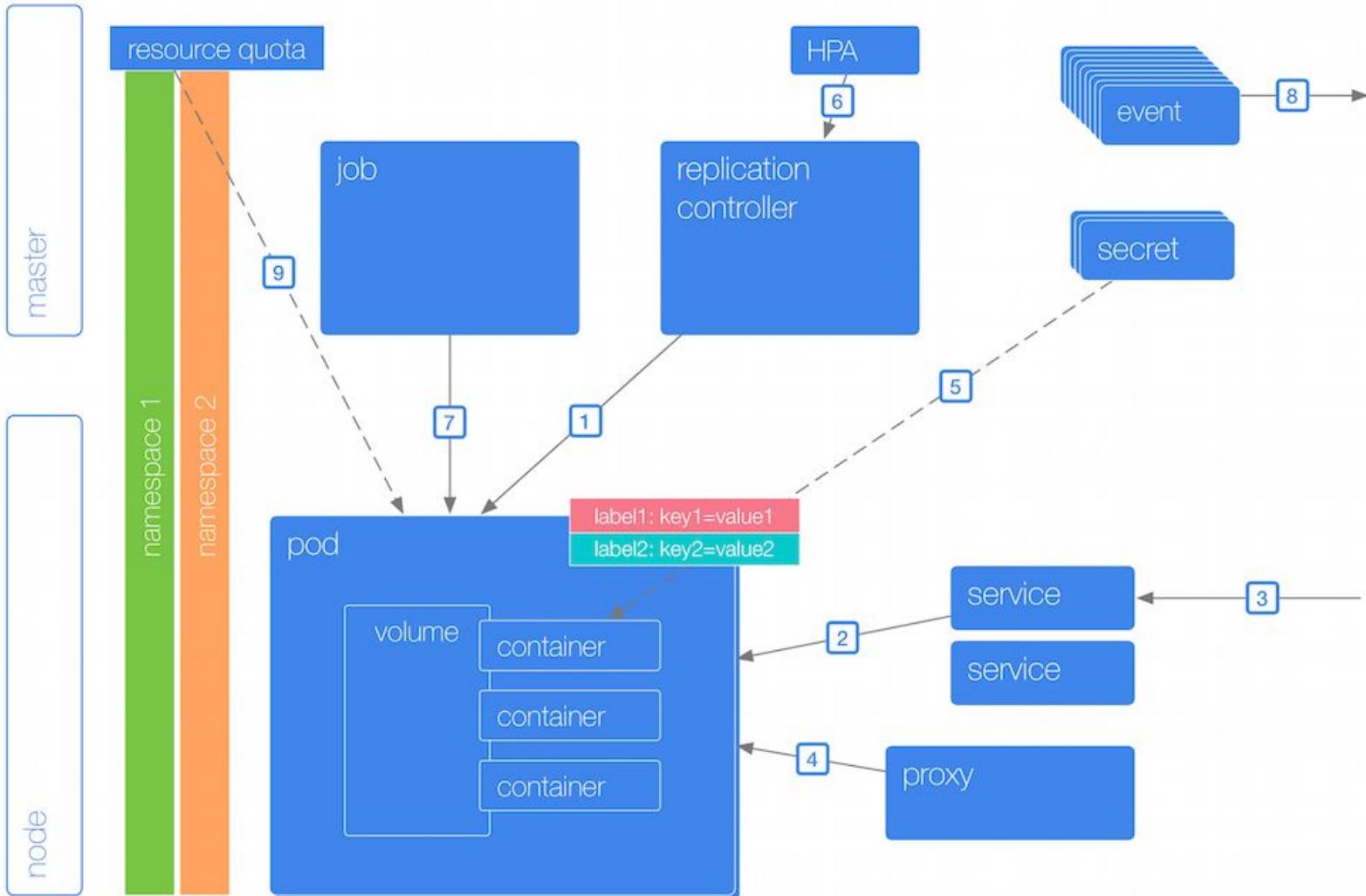


System Architecture

- Kubernetes Node
 - Pods: Pods is smallest deployable units of computing that can be created and manage in kubernetes (Pods != Container).
 - Container runtime: Container engine for run container. Kubernetes support the runtime with standard CRI. such as cri-o, containerd
 - Kubelet: Agent on node to talk with kubernetes master and send status/health of node
 - Kube-Proxy: Manage all network interface on node (Core network component)



System Architecture



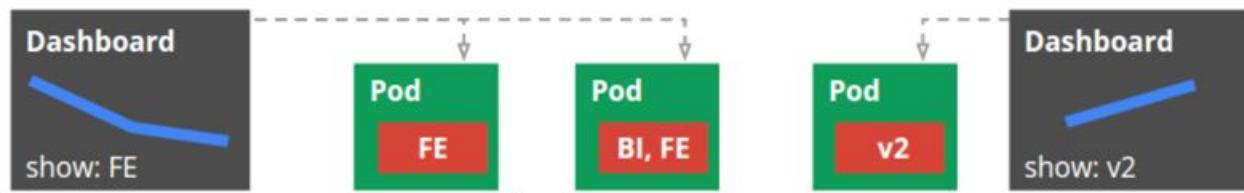
Ref: <http://k8s.info/cs.html>

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System Architecture



```
"labels": {  
  "key1" : "value1",  
  "key2" : "value2"  
}
```

```
"release" : "stable", "release" : "canary"
```

```
"environment" : "dev", "environment" : "qa", "environment" : "production"
```

```
"tier" : "frontend", "tier" : "backend", "tier" : "cache"
```

```
"partition" : "customerA", "partition" : "customerB"
```

```
"track" : "daily", "track" : "weekly"
```

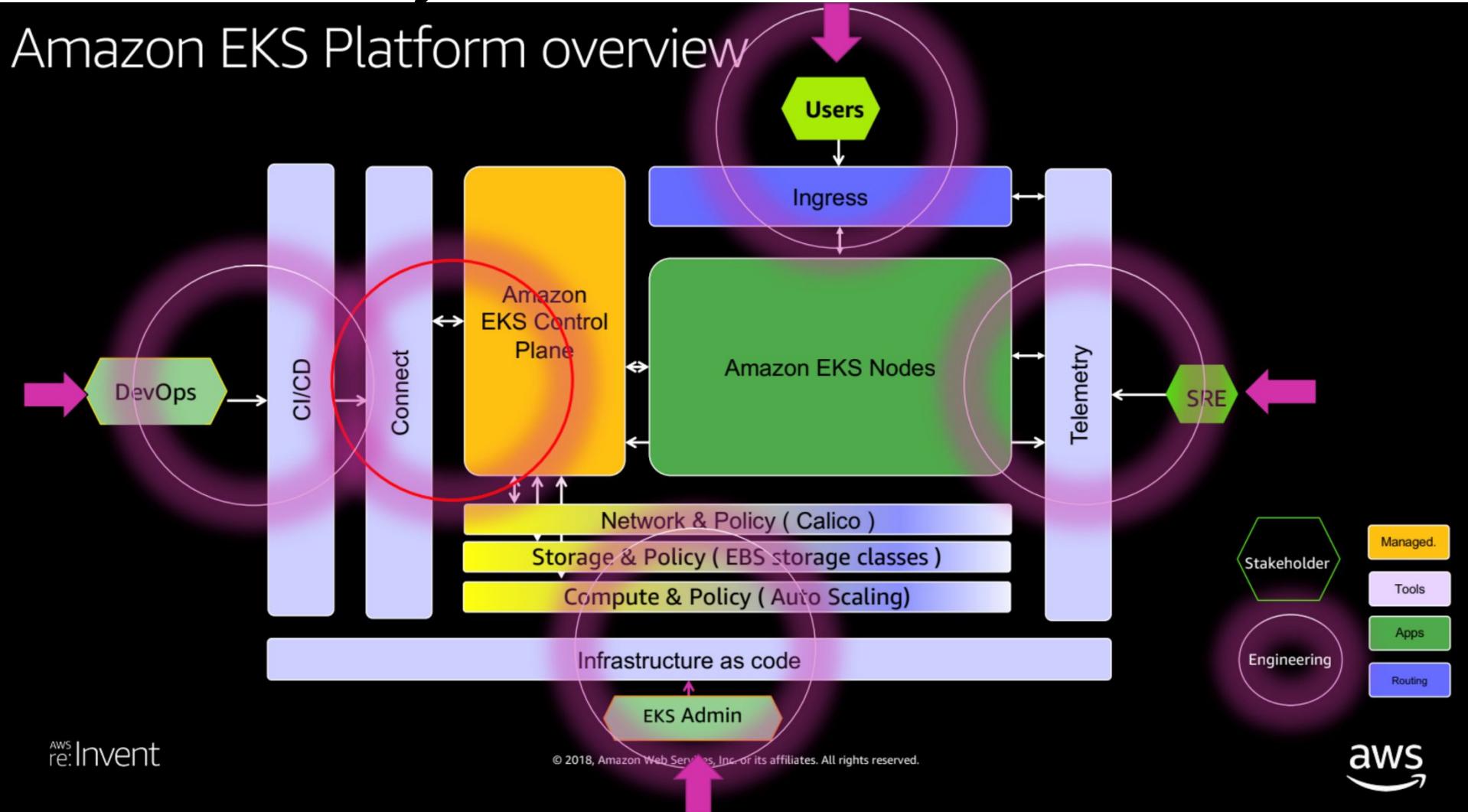
System Architecture

Topic	K8S	Docker/Swarm
Architecture	Open-system (Base on cluster manager "Borg" for support complex workload)	Swarm: Proprietary of Docker product, "Easy to use", "Extend capability of Docker in cluster"
Operation command	Almost operate by "YAML" file (Declarative Command)	Almost operate by "command" (Imperative Command)
Unit of Work	Pods (Pods >= Container)	Container
How to Identify Work	"Label operation"	Docker: By container name Swarm: By service/stack name
Level of workload management	Service Level: (Simple) Replication Level: (Auto healing) Deployment Level: (Auto healing + Roll Update)	Docker: N/A Swarm: Service Level (Snag with service/stack)
Auto scaling	HPA (Horizontal Pods Scaling) base on CPU,Memory	No
Health check	Liveness & Readiness (Multi option to check application health)	Service health only



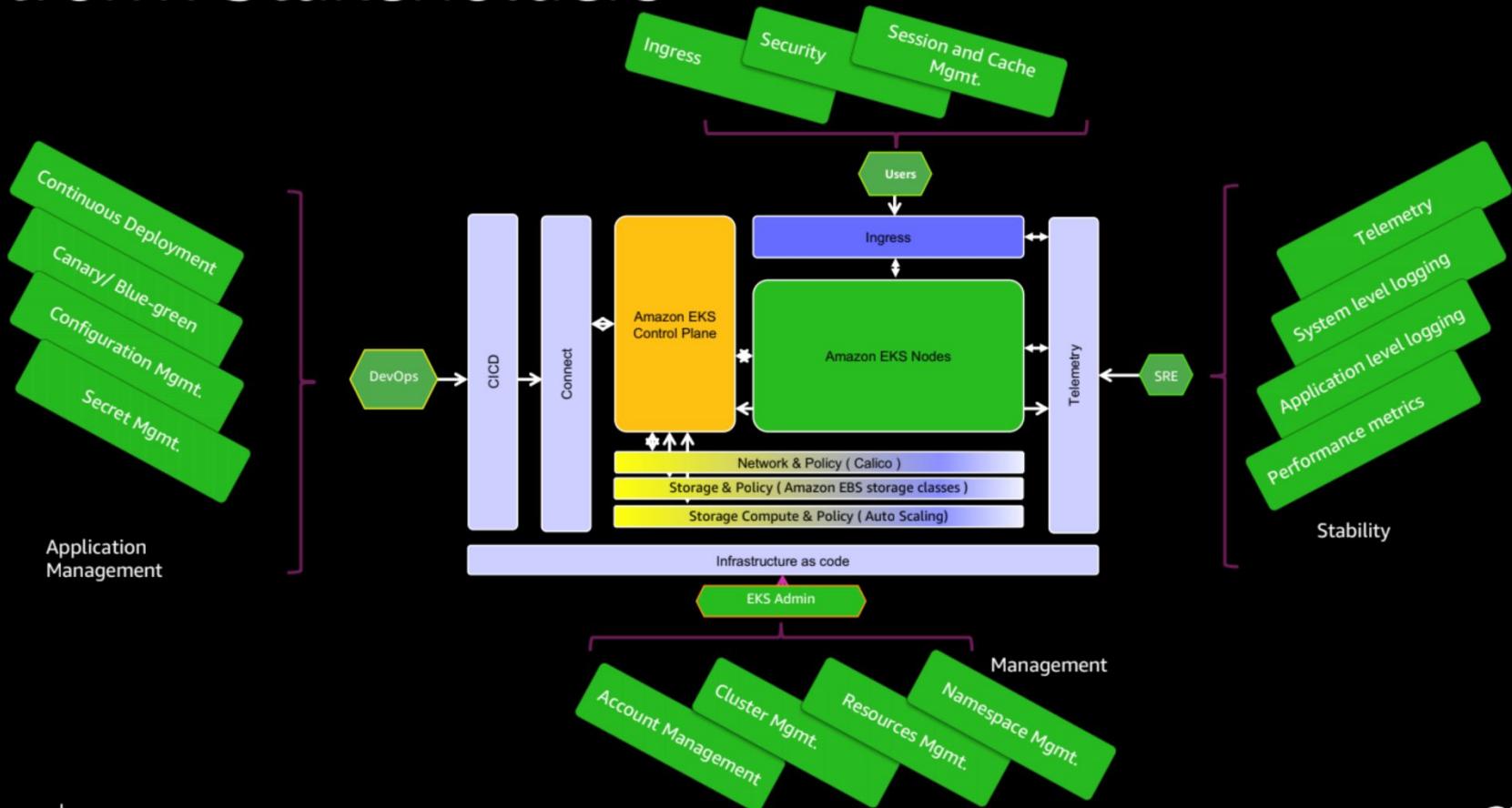
System Architecture

Amazon EKS Platform overview



System Architecture

Platform Stakeholders



aws re:Invent

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Kubernetes: Production Workload Orchestration



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Fundamental of Kubernetes



Kubernetes: Production Workload Orchestration



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Pods, Container and Services



Kubernetes: Production Workload Orchestration



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Pods, Container and Services

- Pods vs Container
 - Docker's view point:
 - 1 Container: 1 Application, 1 Component of Microservice
 - So for micro service we need multi container
 - Cache component
 - Web component
 - Database component
 - Etc
 - Kubernetes view point:
 - 1 Pods = 1 Container
 - 1 Pods = N Container (Container on the same context, Work closely)
 - So we can have 1 Pods for container more than 1 container

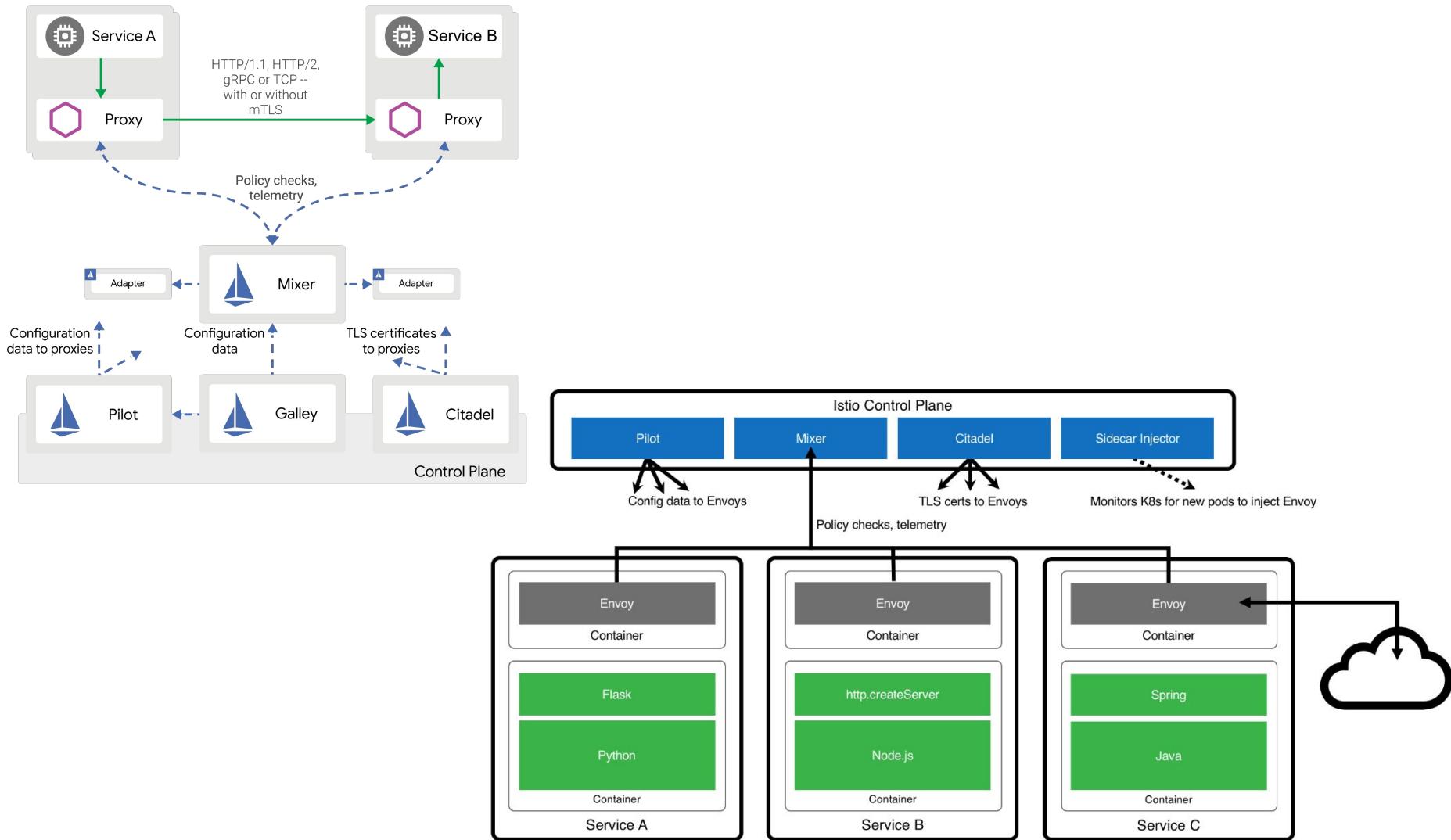


Pods, Container and Services

- Pods vs Container
 - All container on same Pods will share:
 - Process ID (PID)
 - Network access (Communicate to each other via “localhost”)
 - Internal Process Command (IPC)
 - Unix Time-Sharing (UTS)
 - Hostname
 - IP Address/Ports
 - Use Case for Multiple Pods:
 - Apache (1 Container) +Tomcat (1 Container)
 - Apache(1 Container) + PHP (1 Container)
 - Nginx (Cache: 1 Container) + Apache/PHP (1 Container)
 - Web Server (1 Container) + Data Volume(Cache: 1 Container)
 - Service Mesh (Istio / Kong etc)
 - Pods will can create replicas of 1000+ set on cluster system

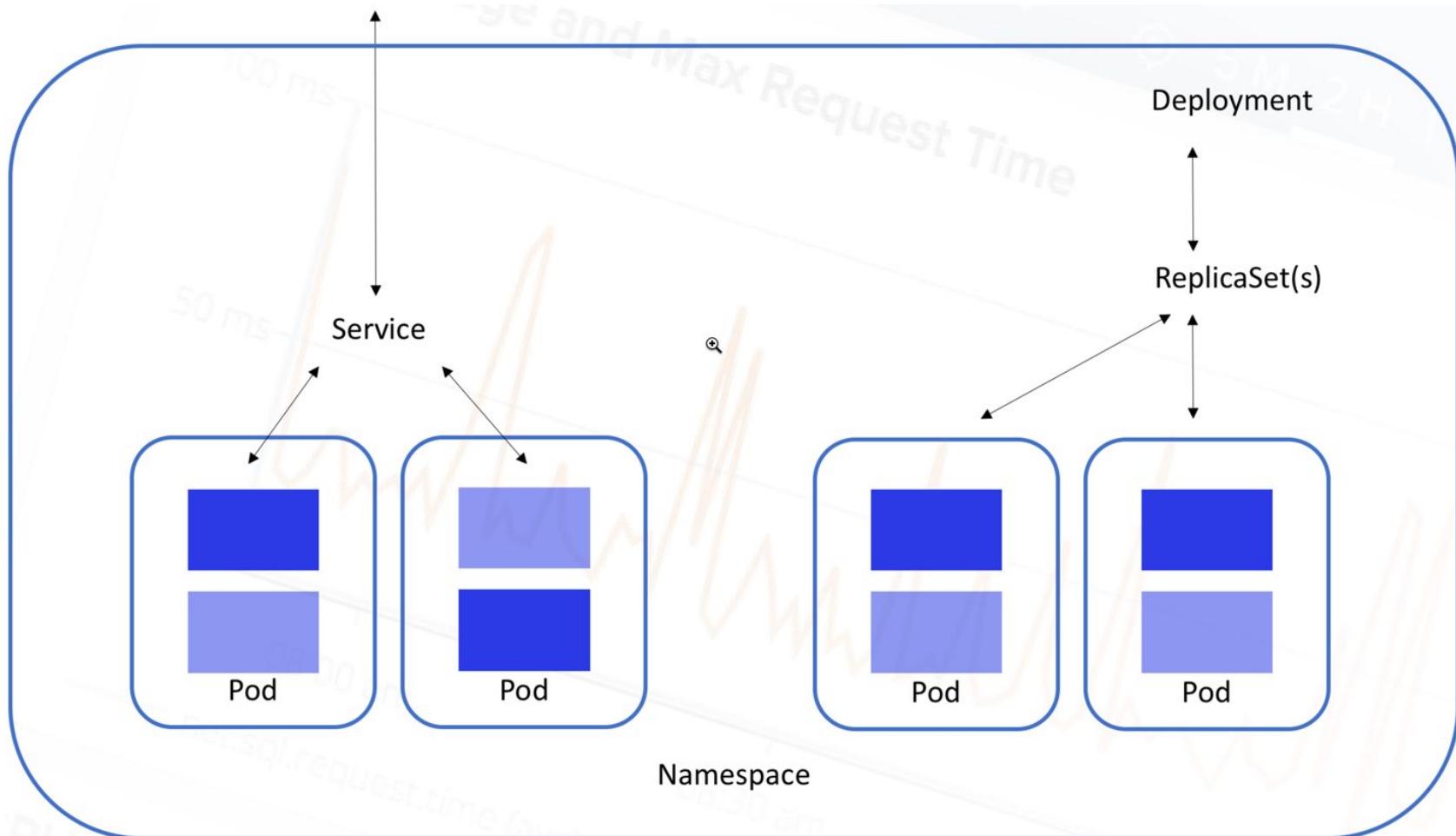


Pods, Container and Services



Pods, Container and Services

- Container/ Pods / Service / Deployment/ RS



Pods, Container and Services

- Way to deploy object in kubernetes by kubectl

Management technique	Operates on	Recommended environment	Supported writers	Learning curve
Imperative commands	Live objects	Development projects	1+	Lowest
Imperative object configuration	Individual files	Production projects	1	Moderate
Declarative object configuration	Directories of files	Production projects	1+	Highest

- Imperative commands:
 - Ex: kubectl <action> <type/name> <option>
 - Ex: kubectl run webtest --image labdocker/nginx:latest
- Imperative object configuration
 - Ex: kubectl <action> -f <YAML file>
 - Ex: kubectl create -f nginx.yml
 - Ex: kubectl replace -f nginx_update.yml
- Declarative object configuration
 - Ex: kubectl apply -f <directory>

```
apiVersion: "v1"
kind: Pod
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  containers:
    - name: webtest
      image: labdocker/cluster:webservicelite
      ports:
        - containerPort: 5000
          protocol: TCP
```



Pods, Container and Services

- Imperative commands:
 - “kubectl run” (Pods + Deployment+ RC (Replicas))

```
kubectl run --image=<image name> <option>
```

- Option:
 - --env="key=value"
 - --port=port
 - --replicas=<number of Pods replicas>
 - --overrides=<json>
 - --labels=<label>
 - Etc

- Example:

```
[praparns-MacBook-Pro:~ praparn$ kubectl run webtest --image=labdocker/cluster:webservicelite --port=5000  
deployment "webtest" created
```

- **DEPRECATED !!!**



Pods, Container and Services

- Imperative commands:

- kubectl expose (Service)

```
kubectl expose deployment <name> <option>
```

- Option:

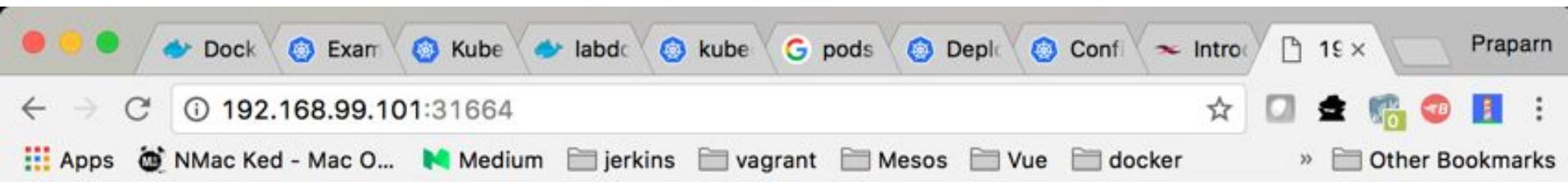
- --name=name
- --port=port for service
- --target-port=port of deployment set
- --type=<NodePort/ClusterIP/LoadBalance>
- --protocol=<TCP/UAT etc>
- Etc

```
[praparns-MacBook-Pro:~ praparn$ kubectl expose deployment webtest --target-port=5000 --type=NodePort
service "webtest" exposed
[praparns-MacBook-Pro:~ praparn$ kubectl get svc webtest
NAME      CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
webtest   10.0.0.96    <nodes>        5000:31664/TCP  8s
```



Pods, Container and Services

- Imperative commands:



Welcome Page from Container Python Lab

Checkpoint Date/Time: Sun Jul 2 04:20:03 2017

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Pods, Container and Services

- Imperative object configuration

```
kubectl create -f <Filename>
```

- Create Pods (YAML)

```
apiVersion: "v1"
kind: Pod
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  containers:
    - name: webtest
      image: labdocker/cluster:webservicelite
      ports:
        - containerPort: 5000
          protocol: TCP
```

- Create Service (YAML)

```
apiVersion: v1
kind: Service
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  selector:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
  type: NodePort
  ports:
    - port: 5000
      name: http
      targetPort: 5000
      protocol: TCP
```



Pods, Container and Services



JSON Formatter | My Ip | Search | Recent Links | Sample | More ▾ | Sign in | (?)

YAML Converter

Save & Share

YAML Input

```
apiVersion: "v1"
kind: Pod
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  containers:
    - name: webtest
      image: labdocker/cluster:webservicelite
      ports:
        - containerPort: 5000
          protocol: TCP
  nodeSelector:
    kubernetes.io/hostname: kubernetes-1
```

sample

Load Url

Browse

YAML TO JSON

YAML TO XML

YAML TO CSV

Validate

Seen this ad multiple times Not interested in this ad

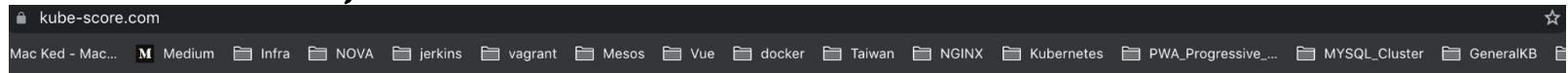
Download

Result : YAML TO JSON

```
{ "apiVersion": "v1", "kind": "Pod", "metadata": { "name": "webtest", "labels": { "name": "web", "owner": "Praparn_L", "version": "1.0", "module": "WebServer", "environment": "development" } }, "spec": { "containers": [ { "name": "webtest", "image": "labdocker/cluster:webservicelite", "ports": [ { "containerPort": 5000, "protocol": "TCP" } ] }, "nodeSelector": { "kubernetes.io/hostname": "kubernetes-1" } ] }
```



Pods, Container and Services



kube-score

Kubernetes object analysis with recommendations for improved reliability and security.

kube-score is a tool that does static code analysis of your Kubernetes object definitions. The output is a list of recommendations of what you can improve to make your application more secure and resilient.

kube-score is [open-source and available under the MIT-license](#). For more information about how to use kube-score, see [zegl/kube-score](#) on GitHub. Use this website to easily test kube-score, just paste your object definition YAML or JSON in the box below.

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: statefulset-test-1
spec:
  template:
    metadata:
      labels:
        app: foo
    spec:
      containers:
        - name: foobar
          image: foo:bar
---
apiVersion: policy/v1beta1
kind: PodDisruptionBudget
```

```
apps/v1/Deployment statefulset-test-1
[CRITICAL] Container Image Pull Policy
  • foobar -> ImagePullPolicy is not set to Always
    It's recommended to always set the ImagePullPolicy to Always, to make sure that the
    imagePullSecrets are always correct, and to always get the image you want.
[CRITICAL] Pod NetworkPolicy
  • The pod does not have a matching NetworkPolicy
    Create a NetworkPolicy that targets this pod to control who/what can communicate with this pod.
    Note, this feature needs to be supported by the CNI implementation used in the Kubernetes cluster
    to have an effect.
[CRITICAL] Container Security Context
  • foobar -> Container has no configured security context
    Set securityContext to run the container in a more secure context.
```

Ref: <https://github.com/zegl/kube-score#installation>

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Pods, Container and Services

README.md

Conftest

go report A+ netlify Success

Conftest helps you write tests against structured configuration data. Using Conftest you can write tests for your Kubernetes configuration, Tekton pipeline definitions, Terraform code, Serverless configs or any other config files.

Conftest uses the [Rego language from Open Policy Agent](#) for writing the assertions. You can read more about Rego in [How do I write policies](#) in the Open Policy Agent documentation.

Here's a quick example. Save the following as `policy/deployment.rego`:

```
package main

deny[msg] {
    input.kind == "Deployment"
    not input.spec.template.spec.securityContext.runAsNonRoot

    msg := "Containers must not run as root"
}

deny[msg] {
    input.kind == "Deployment"
    not input.spec.selector.matchLabels.app

    msg := "Containers must provide app label for pod selectors"
}
```

Assuming you have a Kubernetes deployment in `deployment.yaml` you can run Conftest like so:

```
$ conftest test deployment.yaml
FAIL - deployment.yaml - Containers must not run as root
FAIL - deployment.yaml - Containers must provide app label for pod selectors

2 tests, 0 passed, 0 warnings, 2 failures, 0 exceptions
```

Conftest isn't specific to Kubernetes. It will happily let you write tests for any configuration files in a variety of different formats. See the [documentation for installation instructions](#) and more details about the features.

Want to contribute to Conftest?

- See [DEVELOPMENT.md](#) to build and test Conftest itself.
- See [CONTRIBUTING.md](#) to get started.

For discussions and questions join us on the [Open Policy Agent Slack](#) in the `#conftest` channel.

check_image_registry.rego

```
package main

deny[msg] {

    input.kind == "Deployment"
    image := input.spec.template.spec.containers[_].image
    not startswith(image, "my-company.com/")
    msg := sprintf("image '%v' doesn't come from my-company.com repository",
}
```

bash

```
$ conftest test --policy ./conftest-checks base-valid.yaml
FAIL - base-valid.yaml - image 'hashicorp/http-echo' doesn't come from my-c
1 tests, 1 passed, 0 warnings, 1 failure

$
```

Ref: <https://github.com/open-policy-agent/conftest>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Pods, Container and Services

☰ README.md

KubeLibrary

circleci | passing | pypi | v0.4.0 | downloads | 2.7k/month | license | MIT | slack | robotframework/#kubernetes

RobotFramework library for testing Kubernetes cluster

Quick start

```
# install library itself
pip install robotframework-kubelibrary

# export KUBECONFIG
export KUBECONFIG=~/.kube/config

# run example tests
pip install robotframework-requests
git clone https://github.com/devopsspiral/KubeLibrary.git
cd KubeLibrary
robot -e prerelease testcases
```

Example testcase

```
Pods in kube-system are ok
[Documentation] Test if all pods in kube-system initiated correctly and are running or succeeded
[Tags]    cluster    smoke
Given kubernetes API responds
When getting all pods in "kube-system"
Then all pods in "kube-system" are running or succeeded

Grafana has correct version
[Documentation] Test if Grafana container image is in correct version
[Tags]    grafana
Given kubernetes API responds
When accessing "grafana-" excluding "svclb" container images version in "default"
Then "grafana/grafana:6.5.0" version is used
```

More examples in testcases/ directory



KubeLibrary

RobotFramework library for
testing Kubernetes cluster

Ref: <https://github.com/zegl/kube-score#installation>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Pods, Container and Services

- Imperative object configuration

```
kubectl create -f <Filename>
```

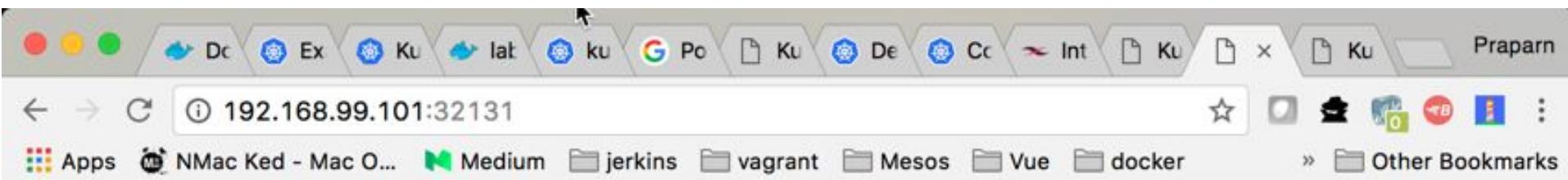
```
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ ls -lh
total 24
-rw-r--r--@ 1 praparn  staff  550B Jul  2 09:29 instruction.txt
-rw-r--r--@ 1 praparn  staff  321B Jul  2 12:52 webtest_pod.yml
-rw-r--r--@ 1 praparn  staff  393B Jul  2 12:52 webtest_svc.yml
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl create -f webtest_pod.yml
pod "webtest" created
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl get pods
NAME      READY     STATUS    RESTARTS   AGE
webtest   1/1      Running   0          4m
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl create -f webtest_svc.yml
service "webtest" created
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl get svc
NAME      CLUSTER-IP    EXTERNAL-IP   PORT(S)        AGE
kubernetes  10.0.0.1    <none>       443/TCP       4d
webtest    10.0.0.87    <nodes>      5000:32131/TCP  4m
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ curl http://192.168.99.101:32131
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Jul  2 06:04:08 2017
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$
```



Pods, Container and Services

- Imperative object configuration

```
kubectl create -f <Filename>
```



Pods, Container and Services

- Check log on container:

```
kubectl logs <Pods name> -c <container name>
```

```
praparns-MacBook-Pro:singlecontainer praparn$ kubectl logs webtest -c webtest
* Running on http://0.0.0.0:5000/ (Press CTRL+C to quit)
* Restarting with stat
* Debugger is active!
* Debugger PIN: 985-709-866
```

- Shell inside container:

```
kubectl exec -it <Pods name> -c <container name> sh
```

```
praparns-MacBook-Pro:singlecontainer praparn$ kubectl exec -it webtest -c webtest sh
/usr/src/app # ls -lh
total 36
-rw-r--r--  1 root    root        482 Jul  1 03:42 docker-compose.yml
-rw-r--r--  1 root    root       345 Jul  1 02:10 dockerfile_nginx
-rw-r--r--  1 root    root        80 Jun 30 17:32 dockerfile_python
-rw-r--r--  1 root    root        88 Jul  2 03:29 dockerfile_python_lite
-rw-r--r--  1 root    root      2.7K Jul  2 03:01 main.py
-rw-r--r--  1 root    root      291 Jul  2 03:46 mainlite.py
-rw-r--r--  1 root    root     1.2K Jul  1 03:51 nginx.conf
-rw-r--r--  1 root    root      24 Jun 18 04:33 requirements.txt
-rw-r--r--  1 root    root       6 Jul  2 03:32 requirementslite.txt
/usr/src/app # hostname
webtest
/usr/src/app #
```



Pods, Container and Services

- Check detail property of Pods/Service

```
kubectl describe <Pods/SVC/etc> <Name>
```

```
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl describe pods webtest
Name:           webtest
Namespace:      default
Node:          minikube/192.168.99.101
Start Time:    Sun, 02 Jul 2017 12:56:50 +0700
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
Annotations:   <none>
Status:        Running
IP:            172.17.0.4
Controllers:   <none>
Containers:
  webtest:
    Container ID:    docker://04b9cdfdd6451a4e78c873f704fb4d35de7bba082343d0773c7ea0ebbb3f03a
    Image:          labdockerc/cluster:webservicelite
    Image ID:       docker://sha256:837c8f41c918ede06705f9b554b6120fdb654cc2a8eb7eec74bc383b09865f2b
    Port:          5000/TCP
    State:         Running
    Started:      Sun, 02 Jul 2017 12:56:51 +0700
    Ready:         True
    Restart Count: 0
    Environment:   <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-vxm58 (ro)
Conditions:
  Type      Status
  Initialized  True
  Ready      True
  PodScheduled  True
Volumes:
  default-token-vxm58:
    Type:  Secret (a volume populated by a Secret)
    SecretName: default-token-vxm58
    Optional:  false
QoS Class:  BestEffort
Node-Selectors: <none>
Tolerations: <none>
Events:
FirstSeen  LastSeen  Count  From             SubObjectPath          Type   Reason   Message
-----  -----  -----  -----  -----  -----
14m        14m       1  default-scheduler   spec.containers{webtest}  Normal  Scheduled  Successfully assigned webtest to minikube
14m        14m       1  kubelet, minikube   spec.containers{webtest}  Normal  Pulled    Container image "labdockerc/cluster:webservicelite" already
y present on machine
14m        14m       1  kubelet, minikube   spec.containers{webtest}  Normal  Created   Created container with id 04b9cdfdd6451a4e78c873f704fb4d3
5de7bba082343d0773c7ea0ebbb3f03a
14m        14m       1  kubelet, minikube   spec.containers{webtest}  Normal  Started   Started container with id 04b9cdfdd6451a4e78c873f704fb4d3
5de7bba082343d0773c7ea0ebbb3f03a
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$
```



Pods, Container and Services

- Check detail property of Pods/Service

```
kubectl describe <Pods/SVC/etc> <Name>
```

```
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ kubectl describe svc webtest
Name:           webtest
Namespace:      default
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
Annotations:   <none>
Selector:      environment=development,module=WebServer,name=web,owner=Praparn_L,version=1.0
Type:          NodePort
IP:            10.0.0.87
Port:          http    5000/TCP
NodePort:      http    32131/TCP
Endpoints:    172.17.0.4:5000
Session Affinity: None
Events:        <none>
praparns-MacBook-Pro:WorkShop_1.2_Pods_Service_Deployment praparn$ █
```

Pods, Container and Services

- Check overall of Pods/Service

```
kubectl get <Pods/SVC/etc>
```

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME      READY    STATUS    RESTARTS   AGE
maindb    1/1      Running   0          18m
web       3/3      Running   0          16m
praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
kubernetes  10.0.0.1    <none>        443/TCP       4d
maindb     10.0.0.134   <none>        3306/TCP      17m
web        10.0.0.69    <nodes>       5000:30661/TCP,80:30500/TCP  16m
praparns-MacBook-Pro:multicontainer praparn$ █
```

- Remove Pod/Service

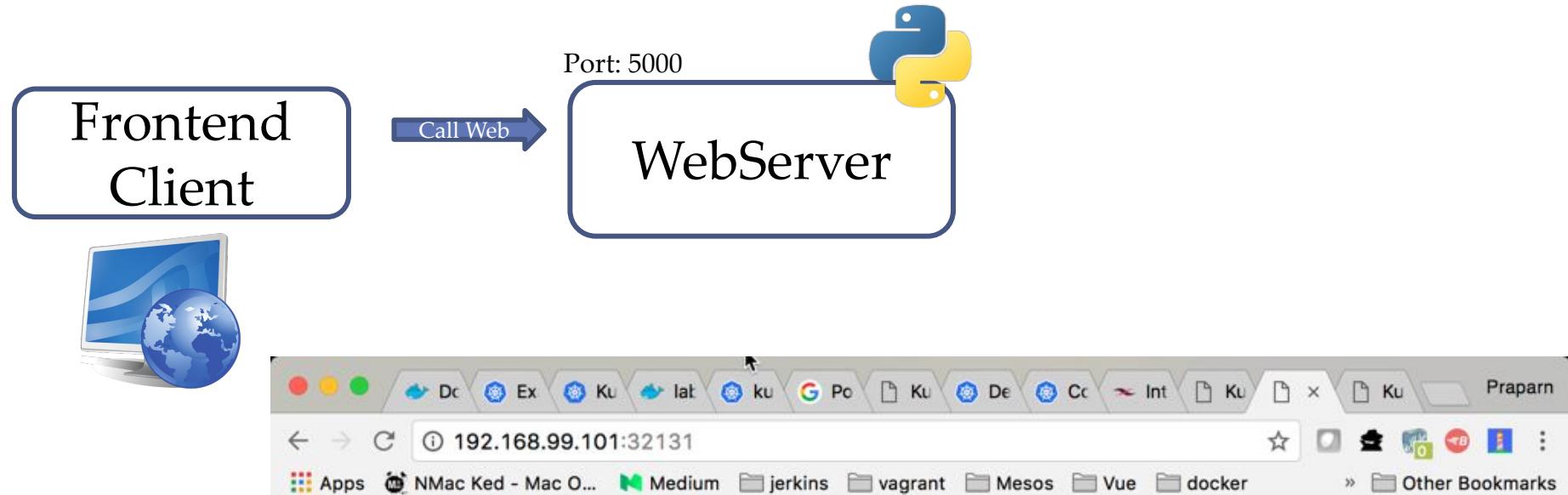
```
kubectl delete -f <Filename>
```

```
praparns-MacBook-Pro:singlecontainer praparn$ kubectl delete -f webtest_svc.yml
service "webtest" deleted █
praparns-MacBook-Pro:singlecontainer praparn$ kubectl delete -f webtest_pod.yml
pod "webtest" deleted
```



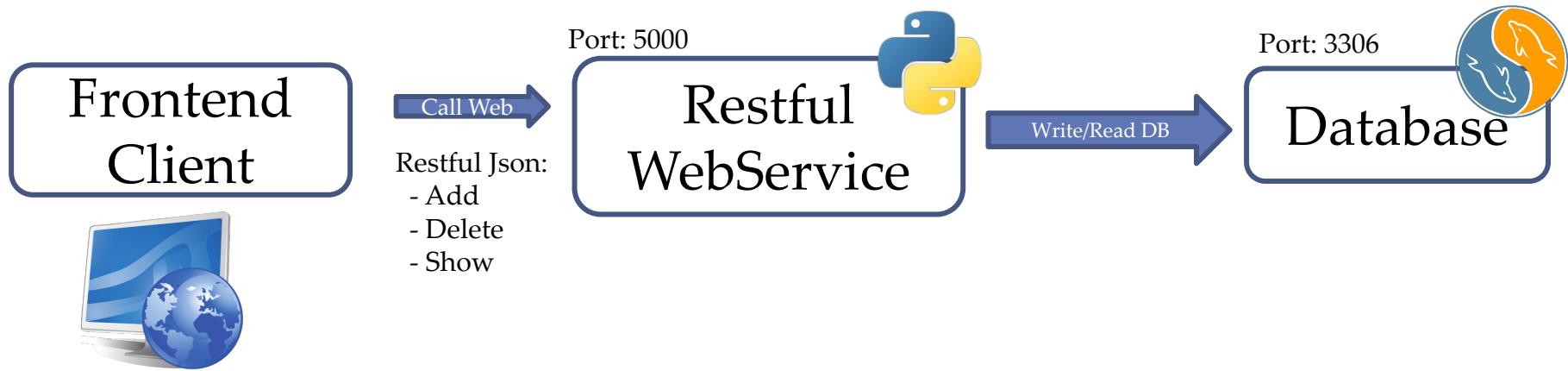
Workshop: Pods & Service

- Part 1: Deploy simple web pods with single container



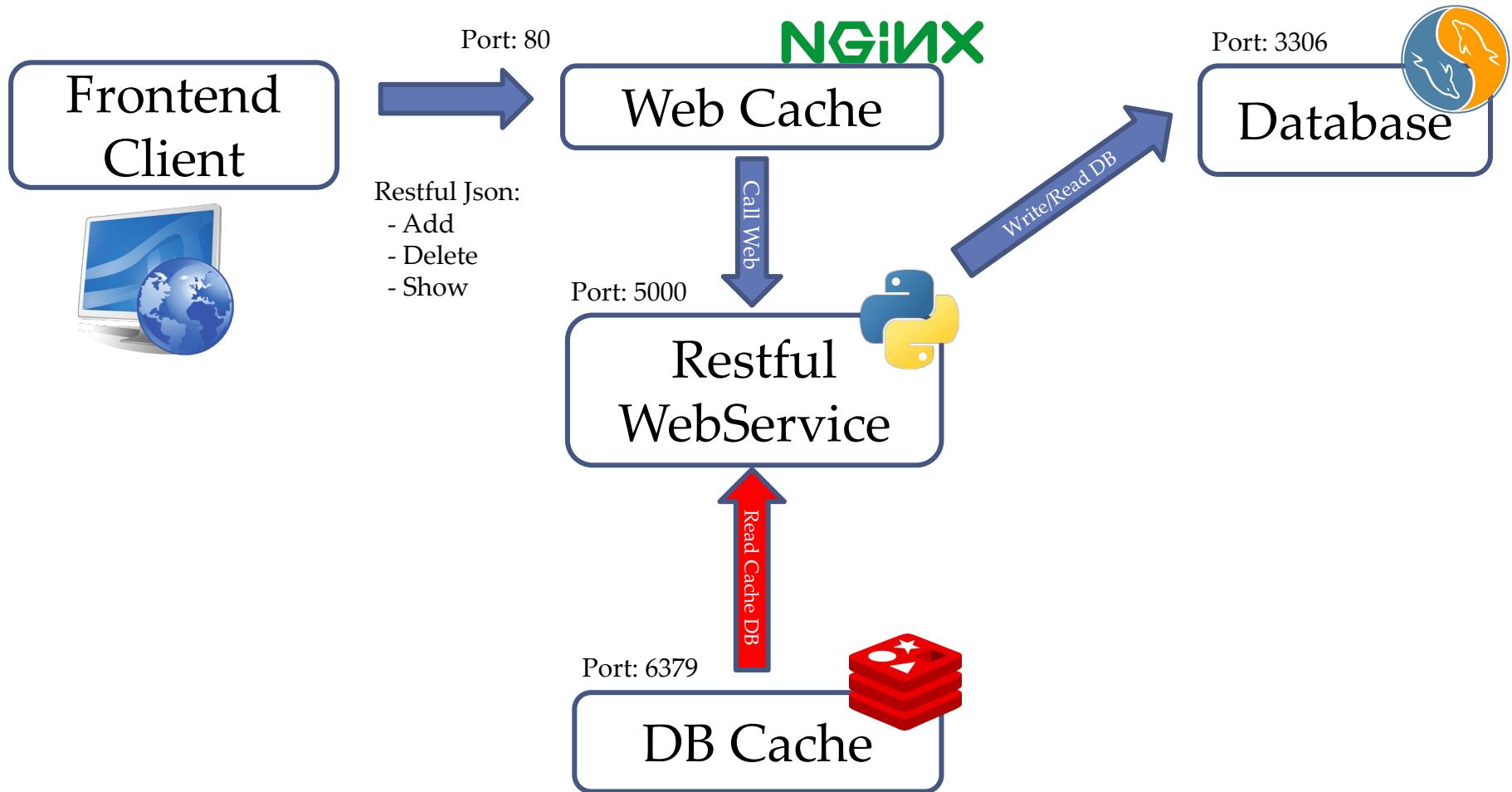
Pods, Container and Service

- Example Case: Basic Restful API



Pods, Container and Service

- Example Case: High I/O Restful API



Pods, Container and Service

- Restful WebService
 - /init

```
@app.route('/init')
def init():
    MAIN_DB.execute("DROP DATABASE IF EXISTS ACCTABLE")
    MAIN_DB.execute("CREATE DATABASE ACCTABLE")
    MAIN_DB.execute("USE ACCTABLE")
    sql = """CREATE TABLE users (
        ID int,
        USER char(30),
        DESRIPE char(250)
    )"""
    MAIN_DB.execute(sql)
    db.commit()
    return "##### Database Create New Account Table Done #####"
```

- /insertuser

```
@app.route("/users/insertuser", methods=['POST'])
def add_users():
    req_json = request.get_json()
    MAIN_DB.execute("INSERT INTO ACCTABLE.users (ID, USER, DESRIPE) VALUES (%s,%s,%s)", (req_json['uid'], req_json['user'], req_json['desripe']))
    #curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "1", "user":"Praparn Luangphoonlap", "desripe":"System Engineer"}' http://<IP>
    db.commit()
    return Response("##### Record was added #####", status=200, mimetype='application/json')
```



Pods, Container and Service

- Restful WebService
 - /removeuser/<uid>

```
@app.route('/users/removeuser/<uid>')
def remove_users(uid):
    hash = hashlib.sha224(str(uid)).hexdigest()
    key = "sql_cache:" + hash
    MAIN_DB.execute("DELETE FROM ACCTABLE.users WHERE ID =" + str(uid))
    db.commit()
    #curl http://<IP Host>:<Port>/users/removeuser/<uid>
    if (CACHE_DB.get(key)):
        CACHE_DB.delete(key)
        return Response("##### Record was deleted (Both Database Cache) #####", status=200, mimetype='application/json')
    else:
        return Response("##### Record was deleted #####", status=200, mimetype='application/json')
```

Pods, Container and Service

- Restful WebService
 - /users/<uid>

```
@app.route('/users/<uid>')
def get_users(uid):
    hash = hashlib.sha224(str(uid)).hexdigest()
    key = "sql_cache:" + hash
    #curl http://<IP Host>:<Port>/users/<uid>
    if (CACHE_DB.get(key)):
        return CACHE_DB.get(key) + "(Database Cache)"
    else:
        MAIN_DB.execute("select USER from ACCTABLE.users where ID=" + str(uid))
        data = MAIN_DB.fetchone()
        if data:
            CACHE_DB.set(key,data[0])
            CACHE_DB.expire(key, 36);
            return CACHE_DB.get(key)
        else:
            return "##### Record not found #####"
```

Pods, Container and Service

- Web Cache

```
http {
    client_max_body_size 500M;
    client_body_timeout 3000s;
    include /etc/nginx/mime.types;
    default_type application/octet-stream;
    log_format main '$remote_addr - $remote_user [$time_local] "$request" '
    '$status $body_bytes_sent "'.$http_referer"
    '"$http_user_agent" "$http_x_forwarded_for"';

    access_log /var/log/nginx/access.log main;
    tcp_nopush on;

    keepalive_timeout 65;
    [REDACTED]
    gzip on;

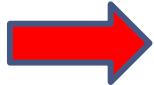
    include /etc/nginx/conf.d/*.conf;
server {
    listen 80;
    client_body_buffer_size 50M;
    index index.html      index.htm;
    location / {
        proxy_pass http://webservice:5000;
        proxy_next_upstream error timeout invalid_header http_500 http_502 http_503 http_504;
        proxy_redirect off;
        proxy_buffering off;
        proxy_set_header      Host          $host;
        proxy_set_header      X-Real-IP     $remote_addr;
        proxy_set_header      X-Forwarded-For $proxy_add_x_forwarded_for;
    }
}
```



Pods, Container and Service

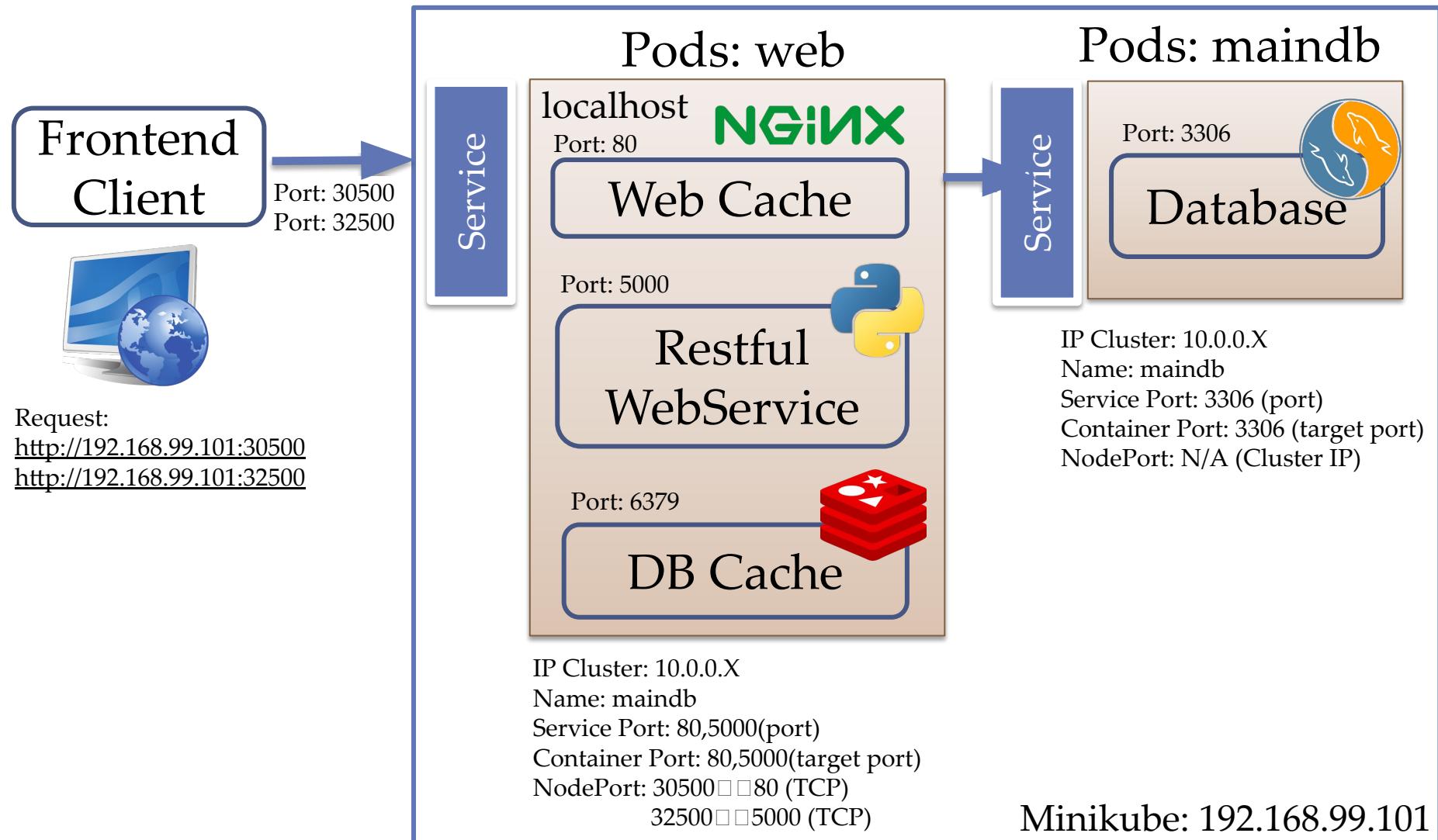
- Database and Database Cache

```
maindb:  
  image: labdocker/mysql:latest  
  container_name: maindb  
  environment:  
    MYSQL_ROOT_PASSWORD: password  
  
cachedb:  
  image: labdocker/redis:latest  
  container_name: cachedb  
  
webservice:  
  build: .  
  dockerfile: dockerfile_python  
  container_name: webservice  
  ports:  
    - "5000:5000"  
  links:  
    - cachedb:cachedb  
    - maindb:maindb  
  
webcache:  
  build: .  
  dockerfile: dockerfile_nginx  
  container_name: webcache  
  ports:  
    - "80:80"  
  links:  
    - webservice:webservice
```

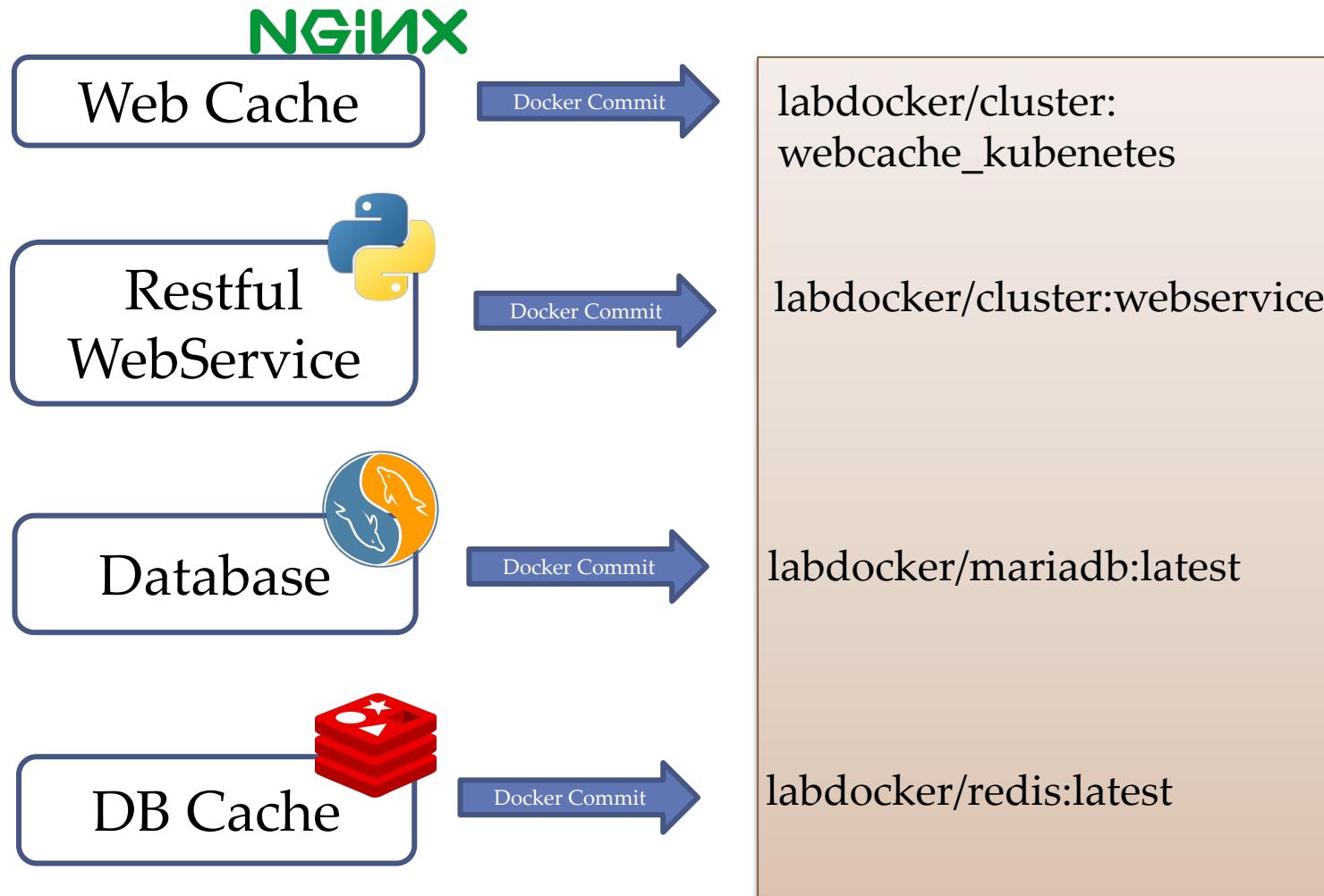
 Mysql Database

 Redis Key-Value Database

Pods, Container and Service



Pods, Container and Service



Pods, Container and Service

- Pods: maindb(YML)

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: maindb
5    labels:
6      name: "maindb"
7      owner: "Praparn_L"
8      version: "1.0"
9      module: "maindb"
10     environment: "development"
11   spec:
12     containers:
13       - name: maindb
14         image: labdocker/mariadb:latest
15         ports:
16           - containerPort: 3306
17             protocol: TCP
18         env:
19           -
20             name: "MYSQL_ROOT_PASSWORD"
21             value: "password"
22
```

- Service: maindb(YML)

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: maindb
5    labels:
6      name: "maindb"
7      owner: "Praparn_L"
8      version: "1.0"
9      module: "maindb"
10     environment: "development"
11   spec:
12     ports:
13       - port: 3306
14         targetPort: 3306
15     selector:
16       name: "maindb"
17       owner: "Praparn_L"
18       version: "1.0"
19       module: "maindb"
20     environment: "development"
21
```



Pods, Container and Service

- Pods: web(YML)

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: web
5    labels:
6      name: "web"
7      owner: "Praparn_L"
8      version: "1.0"
9      module: "web"
10     environment: "development"
11
12   spec:
13     containers:
14       - name: cachedb
15         image: labdocker/redis:latest
16         ports:
17           - containerPort: 6379
18             protocol: TCP
19       - name: webservice
20         image: labdocker/cluster:webservicev2
21         env:
22           - name: "REDIS_HOST"
23             value: "localhost"
24         ports:
25           - containerPort: 5000
26             protocol: TCP
27       - name: webcache
28         image: labdocker/cluster:webcache_kubernetes
29         ports:
30           - containerPort: 80
31             protocol: TCP
```

- Service: web (YML)

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: web
5    labels:
6      name: "web"
7      owner: "Praparn_L"
8      version: "1.0"
9      module: "Web"
10     environment: "development"
11
12   spec:
13     selector:
14       name: "web"
15       owner: "Praparn_L"
16       version: "1.0"
17       module: "web"
18       environment: "development"
19     type: NodePort
20     ports:
21       - port: 5000
22         name: webservice
23         targetPort: 5000
24         protocol: TCP
25         nodePort: 32500
26       - port: 80
27         name: webcache
28         targetPort: 80
29         protocol: TCP
30         nodePort: 30500
```



Pods, Container and Service

- Create "maindb" Pods and service

```
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
No resources found.
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP  EXTERNAL-IP  PORT(S)  AGE
kubernetes  10.0.0.1    <none>        443/TCP  4d
[praparns-MacBook-Pro:multicontainer praparn$ kubectl create -f databasemodule_pod.yml
pod "maindb" created
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME      READY      STATUS      RESTARTS      AGE
maindb   1/1       Running     0            9s
[praparns-MacBook-Pro:multicontainer praparn$ kubectl create -f databasemodule_svc.yml
service "maindb" created
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP  EXTERNAL-IP  PORT(S)  AGE
kubernetes  10.0.0.1    <none>        443/TCP  4d
maindb     10.0.0.134  <none>        3306/TCP  7s
praparns-MacBook-Pro:multicontainer praparn$ ]
```



Pods, Container and Service

- Create “web” Pods and service

```
[praparns-MacBook-Pro:multicontainer praparn$ kubectl create -f webmodule_pod.yml
pod "web" created
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME      READY     STATUS    RESTARTS   AGE
maindb    1/1      Running   0          2m
web       3/3      Running   0          29s
[praparns-MacBook-Pro:multicontainer praparn$ kubectl create -f webmodule_svc.yml
service "web" created
[praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME            CLUSTER-IP      EXTERNAL-IP      PORT(S)           AGE
kubernetes      10.0.0.1        <none>          443/TCP          4d
maindb          10.0.0.134      <none>          3306/TCP         1m
web             10.0.0.69       <nodes>         5000:30661/TCP,80:30500/TCP   4s
praparns-MacBook-Pro:multicontainer praparn$ ]
```



Welcome Page from Container Python Lab

Checkpoint Date/Time: Sun Jul 2 13:08:00 2017



Pods, Container and Service

- Initial database and insert data

```
praparns-MacBook-Pro:multicontainer praparn$ export Server_IP=192.168.99.100
praparns-MacBook-Pro:multicontainer praparn$ export Server_Port=30500
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port
curl: (7) Failed to connect to 192.168.99.100 port 30500: Connection refused
praparns-MacBook-Pro:multicontainer praparn$ clear
```

```
praparns-MacBook-Pro:multicontainer praparn$ export Server_IP=192.168.99.101
praparns-MacBook-Pro:multicontainer praparn$ export Server_Port=30500
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Jul  2 13:18:09 2017
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/init
##### Database Create New Account Table Done #####
```

```
praparns-MacBook-Pro:multicontainer praparn$ curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "1", "user":"Praparn Luangphoonlap", "desribe":"Slave"}' http://$Server_IP:$Server_Port/users/insertuser
HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 02 Jul 2017 13:18:45 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive
#####
Record was added #####
praparns-MacBook-Pro:multicontainer praparn$
```



Pods, Container and Service

- Initial database, insert and get data (Direct/Cache)

```
praparns-MacBook-Pro:multicontainer praparn$ export Server_IP=192.168.99.100
praparns-MacBook-Pro:multicontainer praparn$ export Server_Port=30500
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port
curl: (7) Failed to connect to 192.168.99.100 port 30500: Connection refused
praparns-MacBook-Pro:multicontainer praparn$ clear
```

```
praparns-MacBook-Pro:multicontainer praparn$ export Server_IP=192.168.99.101
praparns-MacBook-Pro:multicontainer praparn$ export Server_Port=30500
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Jul  2 13:18:09 2017
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/init
##### Database Create New Account Table Done #####
```

```
praparns-MacBook-Pro:multicontainer praparn$ curl -i -H "Content-Type: application/json" -X POST -d '{"uid": "1", "user":"Praparn Luangphoonlap", "desribe":"Slave"}' http://$Server_IP:$Server_Port/users/insertuser
HTTP/1.1 200 OK
Server: nginx/1.8.1
Date: Sun, 02 Jul 2017 13:18:45 GMT
Content-Type: application/json
Content-Length: 41
Connection: keep-alive
##### Record was added #####
praparns-MacBook-Pro:multicontainer praparn$
```

```
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/1
Praparn Luangphoonlap(Database Direct)
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/1
Praparn Luangphoonlap(Database Cache)
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/4
Sakkan Yanyicharoen(Database Direct)
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/4
Sakkan Yanyicharoen(Database Cache)
```



Pods, Container and Service

- Delete data (Both cache and database)

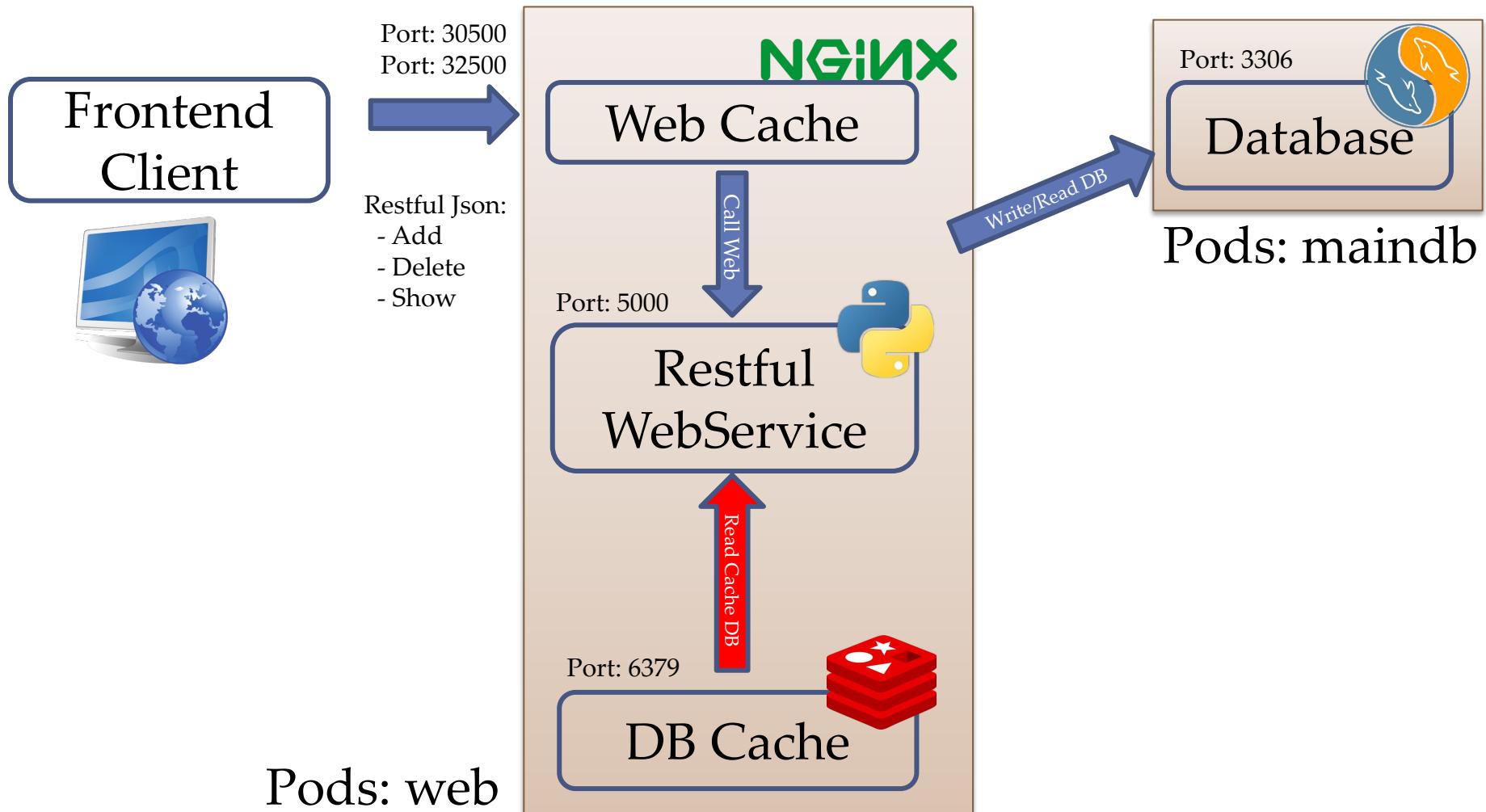
```
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/removeuser/1
#####
Record was deleted (Both Database Cache) #####
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/removeuser/2
#####
Record was deleted #####
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/removeuser/3
#####
Record was deleted #####
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port/users/removeuser/4
#####
Record was deleted (Both Database Cache) #####
praparns-MacBook-Pro:multicontainer praparn$ █
```

- Remove

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl delete svc maindb web
service "maindb" deleted
service "web" deleted
praparns-MacBook-Pro:multicontainer praparn$ kubectl delete pods maindb web
pod "maindb" deleted
pod "web" deleted
praparns-MacBook-Pro:multicontainer praparn$ █
```

Workshop: Pods & Service

- Part 2: Deploy web pods with multi container



Pods, Container and Services

- Check how to operate with component on Kubernetes via “Kubectl explain xxx”

```
kubectl explain <Pods/SVC/etc>
```

```
kubectl api-versions
```

```
ubuntu@ip-10-0-1-239:~$ kubectl explain pods
KIND:     Pod
VERSION:  v1

DESCRIPTION:
  Pod is a collection of containers that can run on a host. This resource is
  created by clients and scheduled onto hosts.

FIELDS:
  apiVersion  <string>
    APIVersion defines the versioned schema of this representation of an
    object. Servers should convert recognized schemas to the latest internal
    value, and may reject unrecognized values. More info:
    https://git.k8s.io/community/contributors/devel/api-conventions.md#resources

  kind <string>
    Kind is a string value representing the REST resource this object
    represents. Servers may infer this from the endpoint the client submits
    requests to. Cannot be updated. In CamelCase. More info:
    https://git.k8s.io/community/contributors/devel/api-conventions.md#types-kinds

  metadata    <Object>
    Standard object's metadata. More info:
    https://git.k8s.io/community/contributors/devel/api-conventions.md#metadata

  spec <Object>
    Specification of the desired behavior of the pod. More info:
    https://git.k8s.io/community/contributors/devel/api-conventions.md#spec-and-status

  status      <Object>
    Most recently observed status of the pod. This data may not be up to date.
    Populated by the system. Read-only. More info:
    https://git.k8s.io/community/contributors/devel/api-conventions.md#spec-and-status

ubuntu@ip-10-0-1-239:~$
```

```
ubuntu@ip-10-0-1-239:~$ kubectl api-versions
admissionregistration.k8s.io/v1beta1
apiextensions.k8s.io/v1beta1
apiregistration.k8s.io/v1
apiregistration.k8s.io/v1beta1
apps/v1
apps/v1beta1
apps/v1beta2
authentication.k8s.io/v1
authentication.k8s.io/v1beta1
authorization.k8s.io/v1
authorization.k8s.io/v1beta1
autoscaling/v1
autoscaling/v2beta1
autoscaling/v2beta2
batch/v1
batch/v1beta1
certificates.k8s.io/v1beta1
coordination.k8s.io/v1
coordination.k8s.io/v1beta1
crd.projectcalico.org/v1
events.k8s.io/v1beta1
extensions/v1beta1
networking.k8s.io/v1
networking.k8s.io/v1beta1
node.k8s.io/v1beta1
policy/v1beta1
rbac.authorization.k8s.io/v1
rbac.authorization.k8s.io/v1beta1
scheduling.k8s.io/v1
scheduling.k8s.io/v1beta1
storage.k8s.io/v1
storage.k8s.io/v1beta1
v1
ubuntu@ip-10-0-1-239:~$
```



Pods, Container and Services

- For check all component on K8S version

```
kubectl api-resources --o wide
```

NAME	SHORTNAMES	APIGROUP	NAMESPACED	KIND	VERBS
bindings			true	Binding	[create] [get list]
componentstatuses	cs		false	ComponentStatus	[create delete deletecollection get list patch update watch]
configmaps	cm		true	ConfigMap	[create delete deletecollection get list patch update watch]
endpoints	ep		true	Endpoints	[create delete deletecollection get list patch update watch]
events	ev		true	Event	[create delete deletecollection get list patch update watch]
limitranges	limits		true	LimitRange	[create delete deletecollection get list patch update watch]
namespaces	ns		false	Namespace	[create delete get list patch update watch]
nodes	no		false	Node	[create delete deletecollection get list patch update watch]
persistentvolumeclaims	pvc		true	PersistentVolumeClaim	[create delete deletecollection get list patch update watch]
persistentvolumes	pv		false	PersistentVolume	[create delete deletecollection get list patch update watch]
pods	po		true	Pod	[create delete deletecollection get list patch update watch]
podtemplates			true	PodTemplate	[create delete deletecollection get list patch update watch]
replicationcontrollers	rc		true	ReplicationController	[create delete deletecollection get list patch update watch]
resourcequotas	quota		true	ResourceQuota	[create delete deletecollection get list patch update watch]
secrets			true	Secret	[create delete deletecollection get list patch update watch]
serviceaccounts	sa		true	ServiceAccount	[create delete deletecollection get list patch update watch]
services	svc		true	Service	[create delete get list patch update watch]
mutatingwebhookconfigurations		admissionregistration.k8s.io	false	MutatingWebhookConfiguration	[create delete deletecollection get list patch update watch]
validatingwebhookconfigurations		admissionregistration.k8s.io	false	ValidatingWebhookConfiguration	[create delete deletecollection get list patch update watch]
customresourcedefinitions	crd, crds	apiextensions.k8s.io	false	CustomResourceDefinition	[create delete deletecollection get list patch update watch]
apiservices		apiregistration.k8s.io	false	APIService	[create delete deletecollection get list patch update watch]
controllerrevisions		apps	true	ControllerRevision	[create delete deletecollection get list patch update watch]
daemonsets	ds	apps	true	DaemonSet	[create delete deletecollection get list patch update watch]
deployments	deploy	apps	true	Deployment	[create delete deletecollection get list patch update watch]
replicasets	rs	apps	true	ReplicaSet	[create delete deletecollection get list patch update watch]
statefulsets	sts	apps	true	StatefulSet	[create delete deletecollection get list patch update watch]
tokenreviews		authentication.k8s.io	false	TokenReview	[create]
localsubjectaccessreviews		authorization.k8s.io	true	LocalSubjectAccessReview	[create]
selfsubjectaccesreviews		authorization.k8s.io	false	SelfSubjectAccessReview	[create]
selfsubjectrulesreviews		authorization.k8s.io	false	SelfSubjectRulesReview	[create]
subjectaccesreviews		authorization.k8s.io	false	SubjectAccessReview	[create]
horizontalpodautoscalers	hpa	autoscaling	true	HorizontalPodAutoscaler	[create delete deletecollection get list patch update watch]
cronjobs	cj	batch	true	CronJob	[create delete deletecollection get list patch update watch]
jobs		batch	true	Job	[create delete deletecollection get list patch update watch]
certificatingsigningrequests	csr	certificates.k8s.io	false	CertificateSigningRequest	[create delete deletecollection get list patch update watch]
leases		coordination.k8s.io	true	Lease	[create delete deletecollection get list patch update watch]
bgpconfigurations		crd.projectcalico.org	false	BGPConfiguration	[delete deletecollection get list patch create update watch]
bgppeers		crd.projectcalico.org	false	BGPPeer	[delete deletecollection get list patch create update watch]
blockaffinities		crd.projectcalico.org	false	BlockAffinity	[delete deletecollection get list patch create update watch]
clusterinformations		crd.projectcalico.org	false	ClusterInformation	[delete deletecollection get list patch create update watch]
felixconfigurations		crd.projectcalico.org	false	FelixConfiguration	[delete deletecollection get list patch create update watch]
globalnetworkpolicies		crd.projectcalico.org	false	GlobalNetworkPolicy	[delete deletecollection get list patch create update watch]
globalnetworksets		crd.projectcalico.org	false	GlobalNetworkSet	[delete deletecollection get list patch create update watch]
hostendpoints		crd.projectcalico.org	false	HostEndpoint	[delete deletecollection get list patch create update watch]
ipamblocks		crd.projectcalico.org	false	IPAMBlock	[delete deletecollection get list patch create update watch]
ipamconfigs		crd.projectcalico.org	false	IPAMConfig	[delete deletecollection get list patch create update watch]
ipamhandles		crd.projectcalico.org	false	IPAMHandle	[delete deletecollection get list patch create update watch]
ippools		crd.projectcalico.org	false	IPPool	[delete deletecollection get list patch create update watch]
networkpolicies		crd.projectcalico.org	true	NetworkPolicy	[delete deletecollection get list patch create update watch]
networksets		crd.projectcalico.org	true	NetworkSet	[delete deletecollection get list patch create update watch]
events	ev	events.k8s.io	true	Event	[create delete deletecollection get list patch update watch]
daemonsets	ds	extensions	true	DaemonSet	[create delete deletecollection get list patch update watch]
deployments	deploy	extensions	true	Deployment	[create delete deletecollection get list patch update watch]
ingresses	ing	extensions	true	Ingress	[create delete deletecollection get list patch update watch]
networkpolicies	netpol	extensions	true	NetworkPolicy	[create delete deletecollection get list patch update watch]
podsecuritypolicies	psp	extensions	false	PodSecurityPolicy	[create delete deletecollection get list patch update watch]
replicasets	rs	extensions	true	ReplicaSet	[create delete deletecollection get list patch update watch]
ingresses	ing	networking.k8s.io	true	Ingress	[create delete deletecollection get list patch update watch]



Pods, Container and Services

Overview

WORKLOADS APIs

Container v1 core

CronJob v1beta1 batch

DaemonSet v1 apps

Deployment v1 apps

Job v1 batch

Pod v1 core

ReplicaSet v1 apps

ReplicationController v1 core

StatefulSet v1 apps

SERVICE APIs

Endpoints v1 core

Ingress v1beta1 networking.k8s.io

Service v1 core

CONFIG AND STORAGE APIs

ConfigMap v1 core

CSI Driver v1beta1 storage.k8s.io

CSINode v1beta1 storage.k8s.io

Secret v1 core

PersistentVolumeClaim v1 core

StorageClass v1 storage.k8s.io

Volume v1 core

VolumeAttachment v1 storage.k8s.io

METADATA APIs

ControllerRevision v1 apps

CustomResourceDefinition v1beta1 apiextensions.k8s.io

Event v1 core

LimitRange v1 core

HorizontalPodAutoscaler v1 autoscaling

API OVERVIEW

Welcome to the Kubernetes API. You can use the Kubernetes API to read and write Kubernetes resource objects via a Kubernetes API endpoint.

Resource Categories

This is a high-level overview of the basic types of resources provided by the Kubernetes API and their primary functions.

Workloads are objects you use to manage and run your containers on the cluster.

Discovery & LB resources are objects you use to "stitch" your workloads together into an externally accessible, load-balanced Service.

Config & Storage resources are objects you use to inject initialization data into your applications, and to persist data that is external to your container.

Cluster resources define how the cluster itself is configured; these are typically used only by cluster operators.

Metadata resources are objects you use to configure the behavior of other resources within the cluster, such as `HorizontalPodAutoscaler` for scaling workloads.

Resource Objects

Resource objects typically have 3 components:

- **Resource ObjectMeta:** This is metadata about the resource, such as its name, type, API version, annotations, and labels. This contains fields that may be updated both by the end user and the system (e.g. annotations).
- **ResourceSpec:** This is defined by the user and describes the desired state of the system. Fill this in when creating or updating an object.
- **ResourceStatus:** This is filled in by the server and reports the current state of the system. In most cases, users don't need to change this.

Ref: <https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.15/#-strong-api-overview-strong->

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Pods, Container and Services

- Services

- Service is independent from Pods
 - Pods can create / destroy / restart every time (manual/automatic)
 - Mean “Pods” always change their nodes/ip/location everytime
 - Service don't care how Pods are being, But they still can map the Pods
- Service is abstract of Pods (1 – N Pods)
 - Usually defined port by “Label”
 - Expose access Pods/Load Balance with service (kube-proxy: iptables)
 - “port” that service open for access
 - “target port” that map with Pods for access
 - “type” TCP/UDP
 - Discovery service option:
 - ENVIRONMENT:
 - {SVC_NAME_SERVICE_HOST}
 - {SVC_NAME_SERVICE_PORT}
 - DNS (cluster-addon): Name same service name



Pods, Container and Services

- Services
 - Pods “web”

```
1 apiVersion: "v1"
2 kind: Pod
3 metadata:
4   name: web
5   labels:
6     name: "web"
7     owner: "Praparn_L"
8     version: "1.0"
9     module: "web"
10    environment: "development"
11  spec:
12    containers:
13      - name: cachedb
14        image: labdocker/redis:latest
15        ports:
16          - containerPort: 6379
17            protocol: TCP
18        - name: webservice
19          image: labdocker/cluster:webservicev2
20          env:
21            - name: "REDIS_HOST"
22              value: "localhost"
23          ports:
24            - containerPort: 5000
25              protocol: TCP
26        - name: webcache
27          image: labdocker/cluster:webcache_kubernetes
28          ports:
29            - containerPort: 80
30              protocol: TCP
```

Pods “web2”

```
1 apiVersion: "v1"
2 kind: Pod
3 metadata:
4   name: web2
5   labels:
6     name: "web"
7     owner: "Praparn_L"
8     version: "1.0"
9     module: "web"
10    environment: "development"
11  spec:
12    containers:
13      - name: cachedb
14        image: labdocker/redis:latest
15        ports:
16          - containerPort: 6379
17            protocol: TCP
18      - name: webservice
19        image: labdocker/cluster:webservicev2set2
20        env:
21          - name: "REDIS_HOST"
22            value: "localhost"
23        ports:
24          - containerPort: 5000
25            protocol: TCP
26      - name: webcache
27        image: labdocker/cluster:webcache_kubernetes
28        ports:
29          - containerPort: 80
30            protocol: TCP
```

Service “web”

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: web
5   labels:
6     name: "web"
7     owner: "Praparn_L"
8     version: "1.0"
9     module: "Web"
10    environment: "development"
11  spec:
12    selector:
13      name: "web"
14      owner: "Praparn_L"
15      version: "1.0"
16      module: "web"
17      environment: "development"
18    type: NodePort
19    ports:
20      - port: 5000
21        name: webservice
22        targetPort: 5000
23        protocol: TCP
24        nodePort: 32500
25      - port: 80
26        name: webcache
27        targetPort: 80
28        protocol: TCP
29        nodePort: 30500
```



Pods, Container and Services

- Services
 - Existing Pods “web”

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME          READY   STATUS      RESTARTS   AGE
curl-1580724602-gjjhq   0/1     CrashLoopBackOff   27        1h
maindb         1/1     Running    0          56m
web            3/3     Running    0          7m
praparns-MacBook-Pro:multicontainer praparn$ curl http://$Server_IP:$Server_Port
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Sun Jul  2 15:28:13 2017
praparns-MacBook-Pro:multicontainer praparn$ 
```



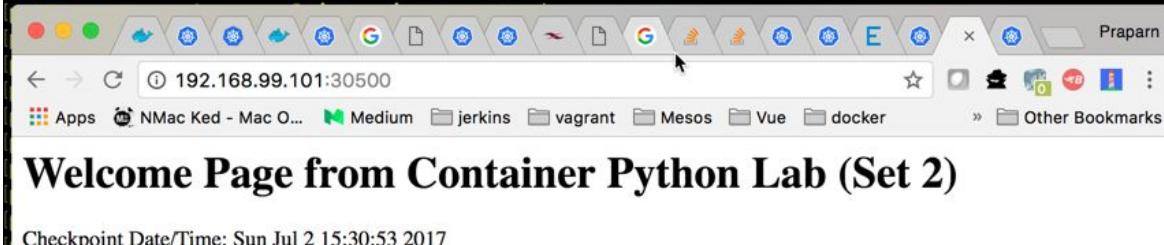
The screenshot shows a Mac OS X desktop environment. A web browser window is open, displaying a "Welcome Page from Container Python Lab". The URL in the address bar is "192.168.99.101:30500". Below the address bar, the status bar shows "Checkpoint Date/Time: Sun Jul 2 15:28:20 2017". The browser's toolbar includes icons for back, forward, search, and other common functions. The title bar of the browser says "Praparn". The background of the desktop shows a dark theme with some icons.

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP   EXTERNAL-IP   PORT(S)           AGE
kubernetes  10.0.0.1    <none>        443/TCP          5d
maindb     10.0.0.236   <none>        3306/TCP         1m
web        10.0.0.212   <nodes>       5000:32500/TCP,80:30500/TCP   1m
praparns-MacBook-Pro:multicontainer praparn$ 
```



Pods, Container and Services

- Services
 - Replace new Pods “web2”

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl create -f webmodule_pod2.yml
pod "web2" created
praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME        READY   STATUS    RESTARTS   AGE
curl-1580724602-gjjhq  0/1     CrashLoopBackOff  27          1h
maindb      1/1     Running   0           58m
web         3/3     Running   0           10m
web2        3/3     Running   0           1m
praparns-MacBook-Pro:multicontainer praparn$ kubectl delete pods web
pod "web" deleted
praparns-MacBook-Pro:multicontainer praparn$ kubectl get pods
NAME        READY   STATUS    RESTARTS   AGE
curl-1580724602-gjjhq  0/1     CrashLoopBackOff  27          1h
maindb      1/1     Running   0           59m
web2        3/3     Running   0           2m


Welcome Page from Container Python Lab (Set 2)



Checkpoint Date/Time: Sun Jul 2 15:30:53 2017



```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME CLUSTER-IP EXTERNAL-IP PORT(S) AGE
kubernetes 10.0.0.1 <none> 443/TCP 5d
maindb 10.0.0.236 <none> 3306/TCP 1m
web 10.0.0.212 <nodes> 5000:32500/TCP,80:30500/TCP 1m
praparns-MacBook-Pro:multicontainer praparn$
```


```



Pods, Container and Services

- Services:
 - Publish Service Type:
 - CLUSTER-IP (Default): blind port with ip address of cluster (Accessible from internal cluster system)
 - NodePort: blind port with ip address of node. By default kubernetes will random port (30000-32757). If we need to specify set the option: “nodePort: XXXXX”

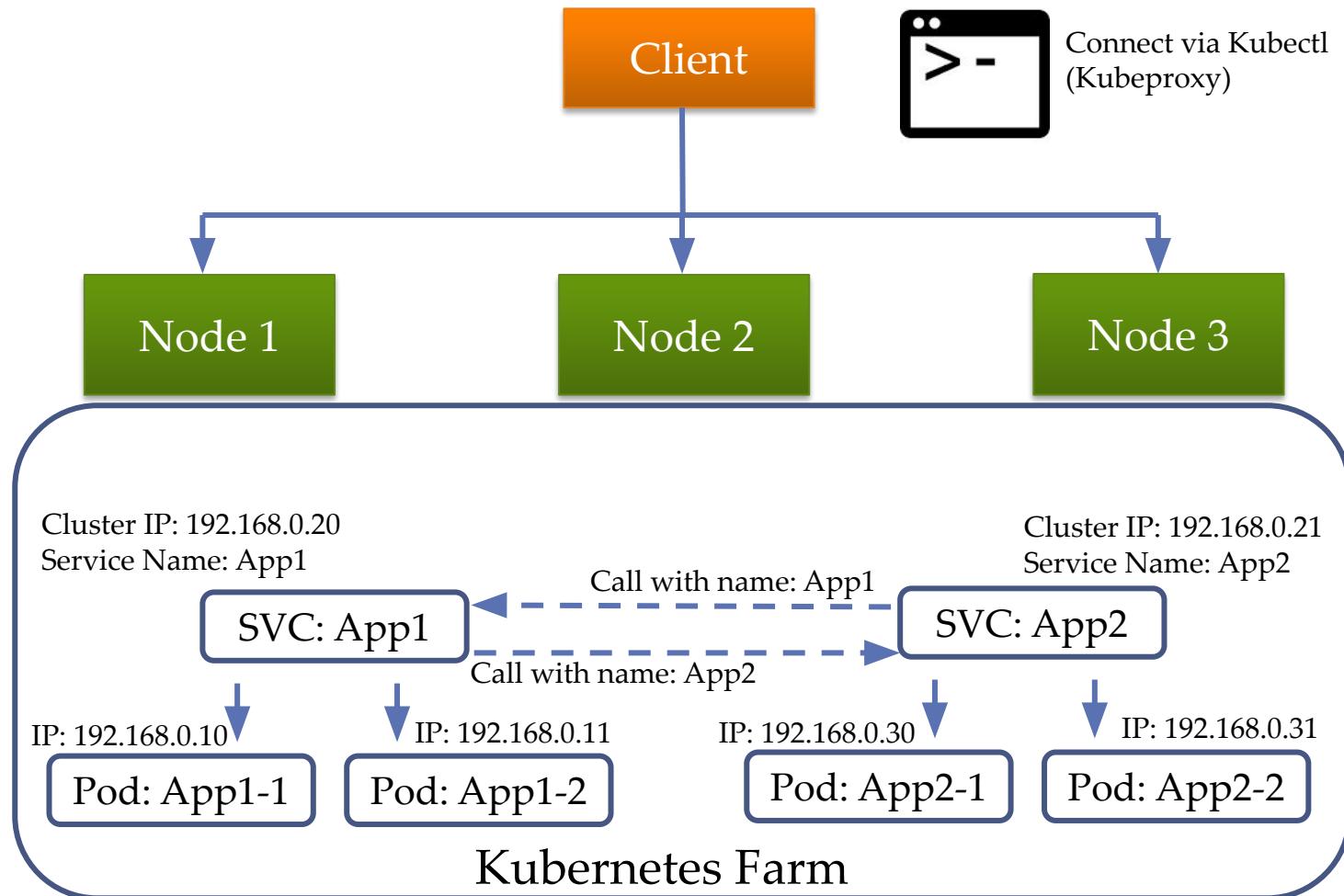
```
18 type: NodePort
19 ports:
20   - port: 5000
21     name: webservice
22     targetPort: 5000
23     protocol: TCP
24     nodePort: 32500
25   - port: 80
26     name: webcache
27     targetPort: 80
28     protocol: TCP
29     nodePort: 30500
```

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP  EXTERNAL-IP  PORT(S)          AGE
kubernetes  10.0.0.1    <none>       443/TCP        5d
maindb     10.0.0.236   <none>       3306/TCP       1m
web        10.0.0.212   <nodes>      5000:32500/TCP,80:30500/TCP  1m
praparns-MacBook-Pro:multicontainer praparn$ █
```



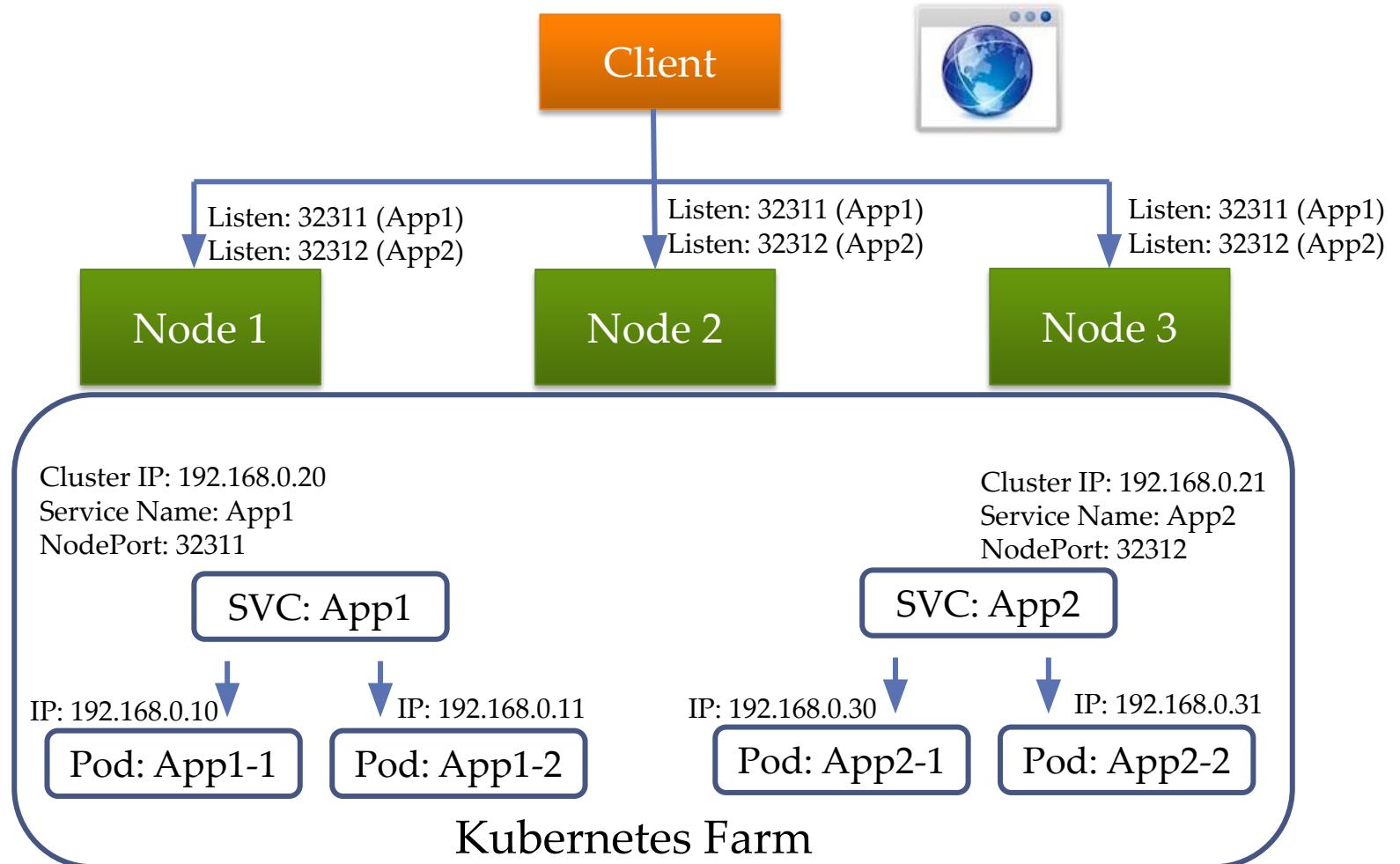
Pods, Container and Services

- Services: ClusterIP



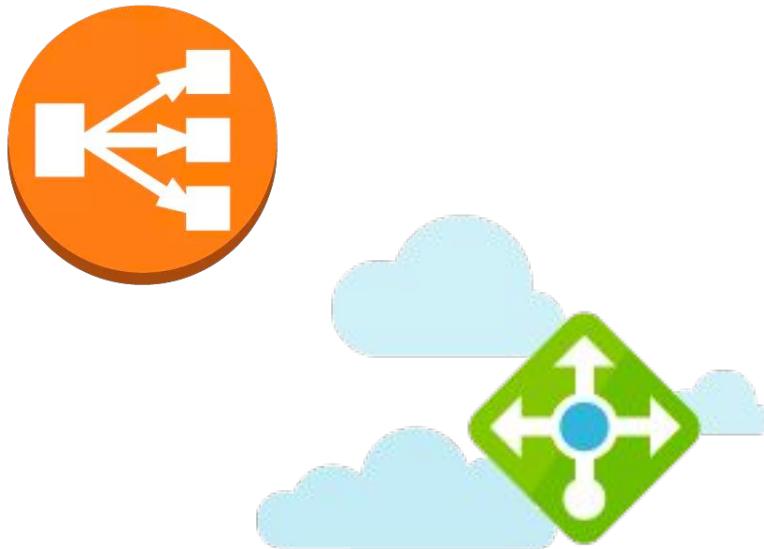
Pods, Container and Services

- Services: NodePort



Pods, Container and Services

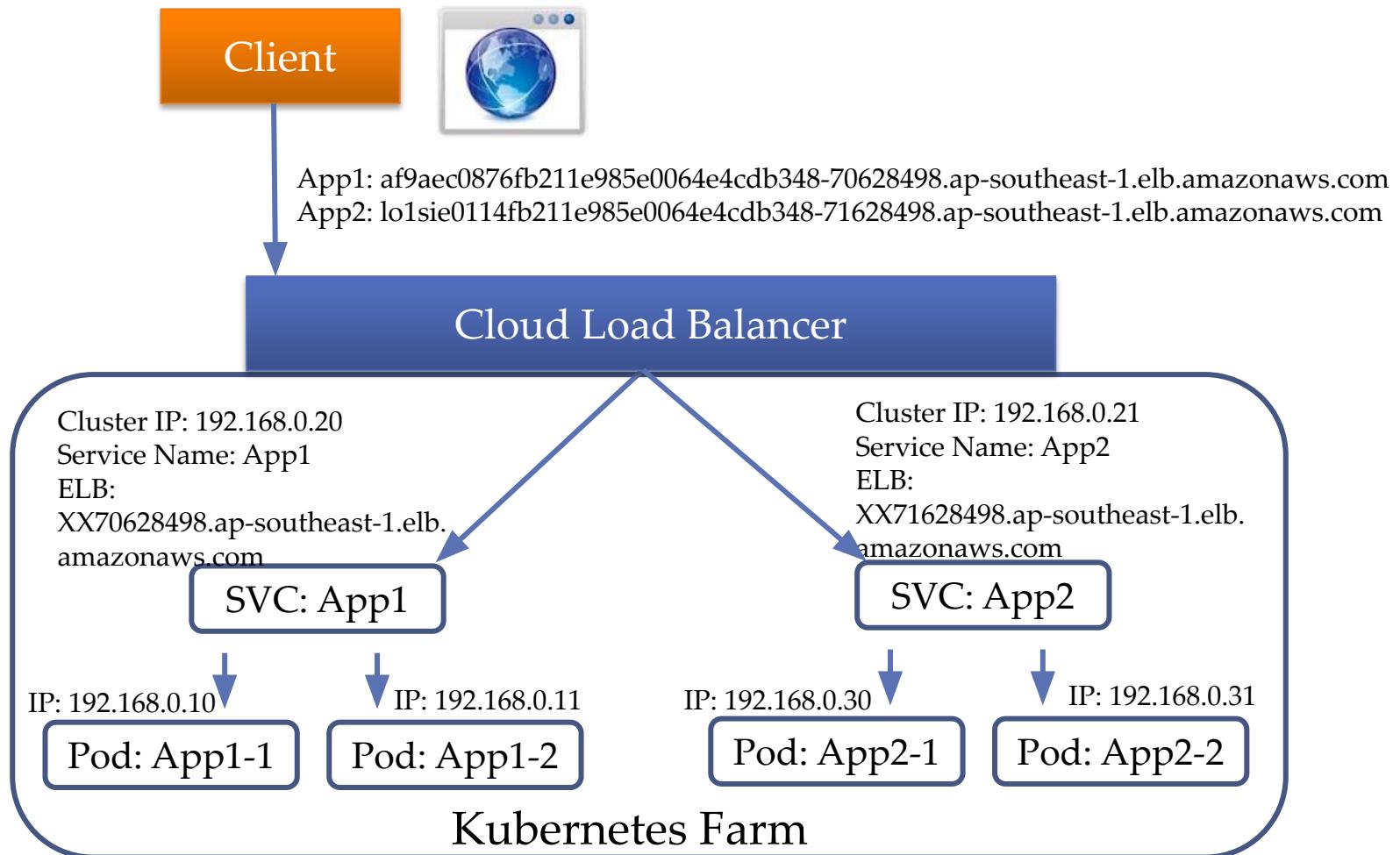
- Services
 - Publish Service Type:
 - LoadBalance:
 - Use load balancer from external cloud provider for intercept traffic
 - Manage by Kubernetes Itself
 - Flexible for use facilities on cloud



```
1 kind: Service
2 apiVersion: v1
3 metadata:
4   name: my-service
5 spec:
6   selector:
7     app: MyApp
8   ports:
9     - protocol: TCP
10    port: 80
11    targetPort: 9376
12    nodePort: 30061
13   clusterIP: 10.0.171.239
14   loadBalancerIP: 78.11.24.19
15   type: LoadBalancer
16 status:
17   loadBalancer:
18     ingress:
19       - ip: 146.148.47.155
20 |
```

Pods, Container and Services

- Services: Load Balancer



Pods, Container and Services

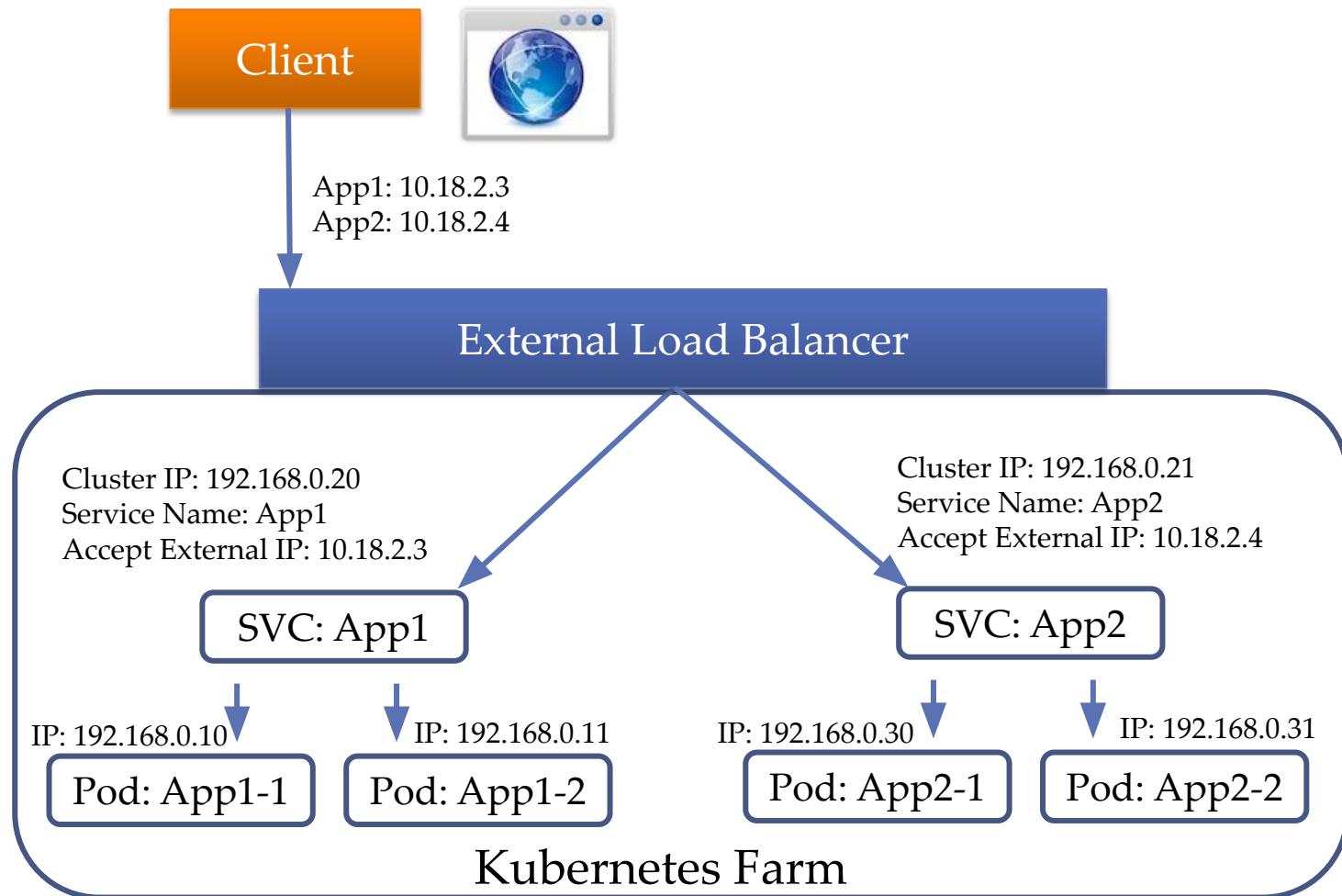
- Services:
 - Publish Service Type:
 - ExternalIP:
 - Similar with Load Balancer
 - Reference to external load balance by IP Address
 - Not manage by kubernetes itself

```
1 kind: Service
2 apiVersion: v1
3 metadata:
4   name: my-service
5 spec:
6   selector:
7     app: MyApp
8   ports:
9     - name: http
10    protocol: TCP
11    port: 80
12    targetPort: 9376
13   externalIPs:
14     - 80.11.12.10
```



Pods, Container and Services

- Services: External IP



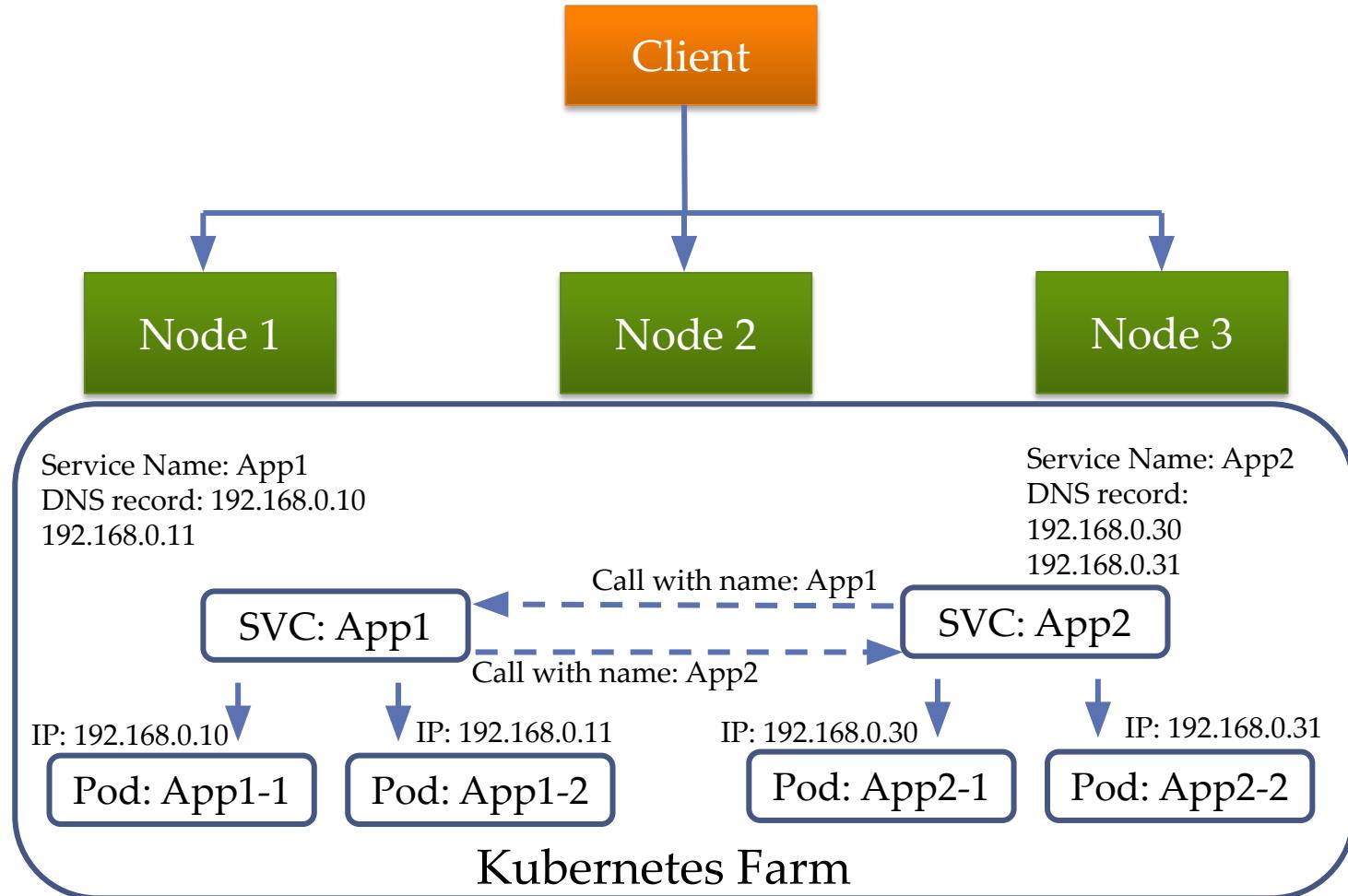
Pods, Container and Services

- Services
 - Publish Service Type:
 - Headless Service (StatefulSet): service will just dns round-robin for all statefulset pods's ip address

```
! 20dns.yml ✘
1 # A headless service to create DNS records
2 ---
3 apiVersion: v1
4 kind: Service
5 metadata:
6   name: kafka
7   namespace: sansiri-unityapi
8 spec:
9   ports:
10    - port: 9092
11      # [podname].broker.kafka.svc.cluster.local
12      clusterIP: None
13   selector:
14     app: kafka
15
```

Pods, Container and Services

- Services: Headless



Pods, Container and Services

- Services
 - Publish Service Type:
 - ExternalName:
 - No selector / No define pods / No endpoints
 - Use for return CNAME record for DNS-Load Balance
 - Work with kube-dns (Kubernetes V1.7 or higher)

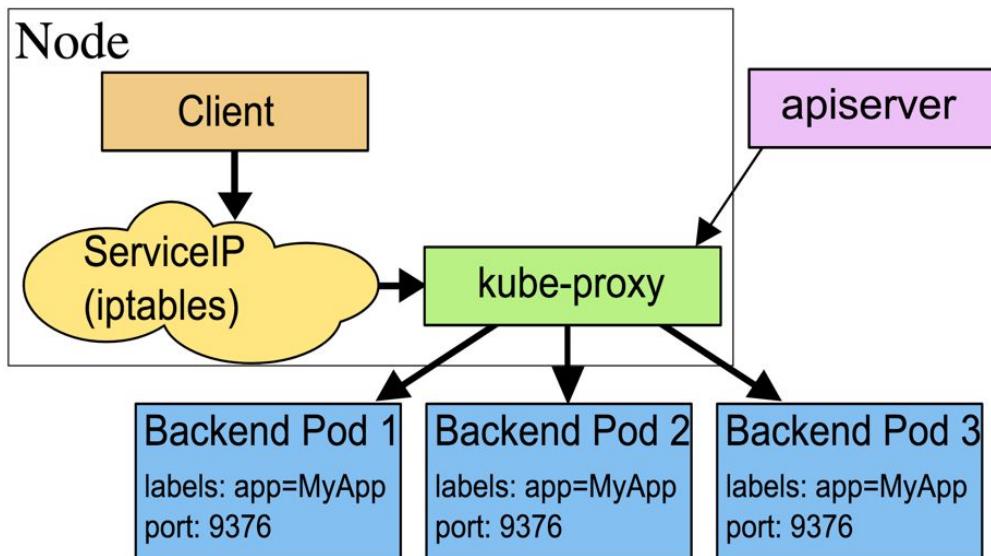
```
1 kind: Service
2 apiVersion: v1
3 metadata:
4   name: my-service
5   namespace: prod
6 spec:
7   type: ExternalName
8   externalName: my.database.example.com
```

- nslookup “my-service.prod.svc.CLUSTER” > return CNAME: “my.database.example.com”



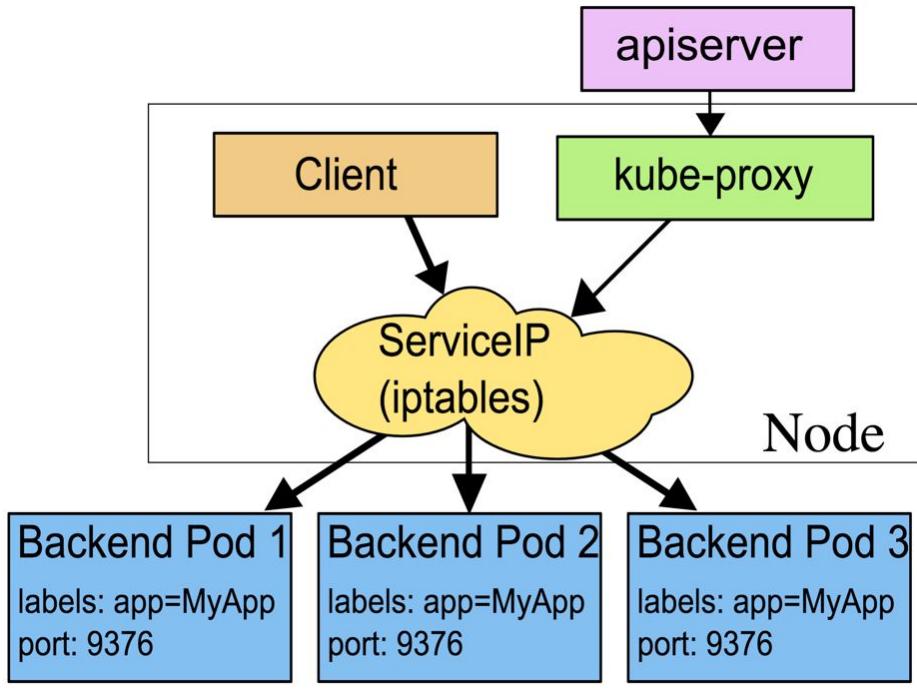
Pods, Container and Services

- kube-proxy (proxy-mode)
 - Every node on K8S will use kube-proxy for response to service
 - Initial Virtual IP for service (except External Name)
 - Vary “proxy-mode” for support in kube-proxy
 - Proxy-mode: userspace (default on kubernetes v1.0 – 1.7)
 - Open port on local node (random) and proxy to backend pods
 - Userspace (binary) will terminate and establish new connect to pods
 - Round robin traffic / retry on case pods fail



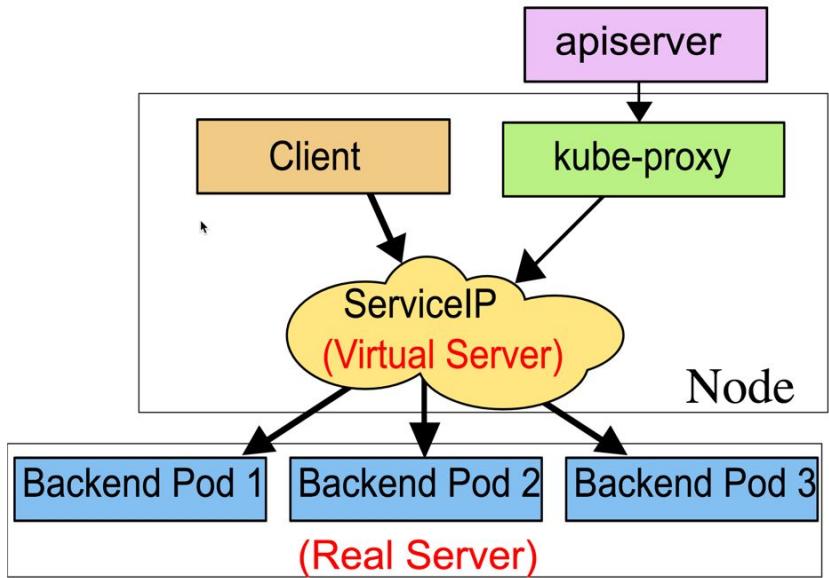
Pods, Container and Services

- kube-proxy (proxy-mode)
 - Proxy-mode: iptables (default on kubernetes v1.8 - 1.22)
 - Install iptable rule on ServiceIP (VIP) for capture traffic and port
 - Redirect traffic to local node for load balance traffic to pods
 - User kernel space that faster than user space (No switch between kernel space and user space)
 - Not support in case pods fail



Pods, Container and Services

- kube-proxy (proxy-mode)
 - Proxy-mode: ipvs (GA on kubernetes v1.11)
 - L4 LB for TCP/UDP with Support Health Check and Retries
 - Create “netlink” interface for establish connection via IPVS
 - Establish IPVS (IP Virtual Server) rule and sync (periodic for consistency before establish)
 - Pure 100% kernel space and better performance
 - Multiple option for load balance
 - rr: round-robin
 - wrr: weight round-robin
 - sh: source hash



Pods, Container and Services

- Configure kube-proxy (proxy-mode)

Run kube-proxy in IPVS mode

Currently, local-up scripts, GCE scripts and kubeadm support switching IPVS proxy mode via exporting environment variables or specifying flags.

Prerequisite

Ensure IPVS required kernel modules (**Notes:** use `nf_conntrack` instead of `nf_conntrack_ipv4` for Linux kernel 4.19 and later)

```
ip_vs
ip_vs_rr
ip_vs_wrr
ip_vs_sh
nf_conntrack_ipv4
```

```
---
apiVersion: kubeproxy.config.k8s.io/v1alpha1
kind: KubeProxyConfiguration
mode: ipvs
```

<https://github.com/kubernetes/kubernetes/tree/master/pkg/proxy/ipvs>

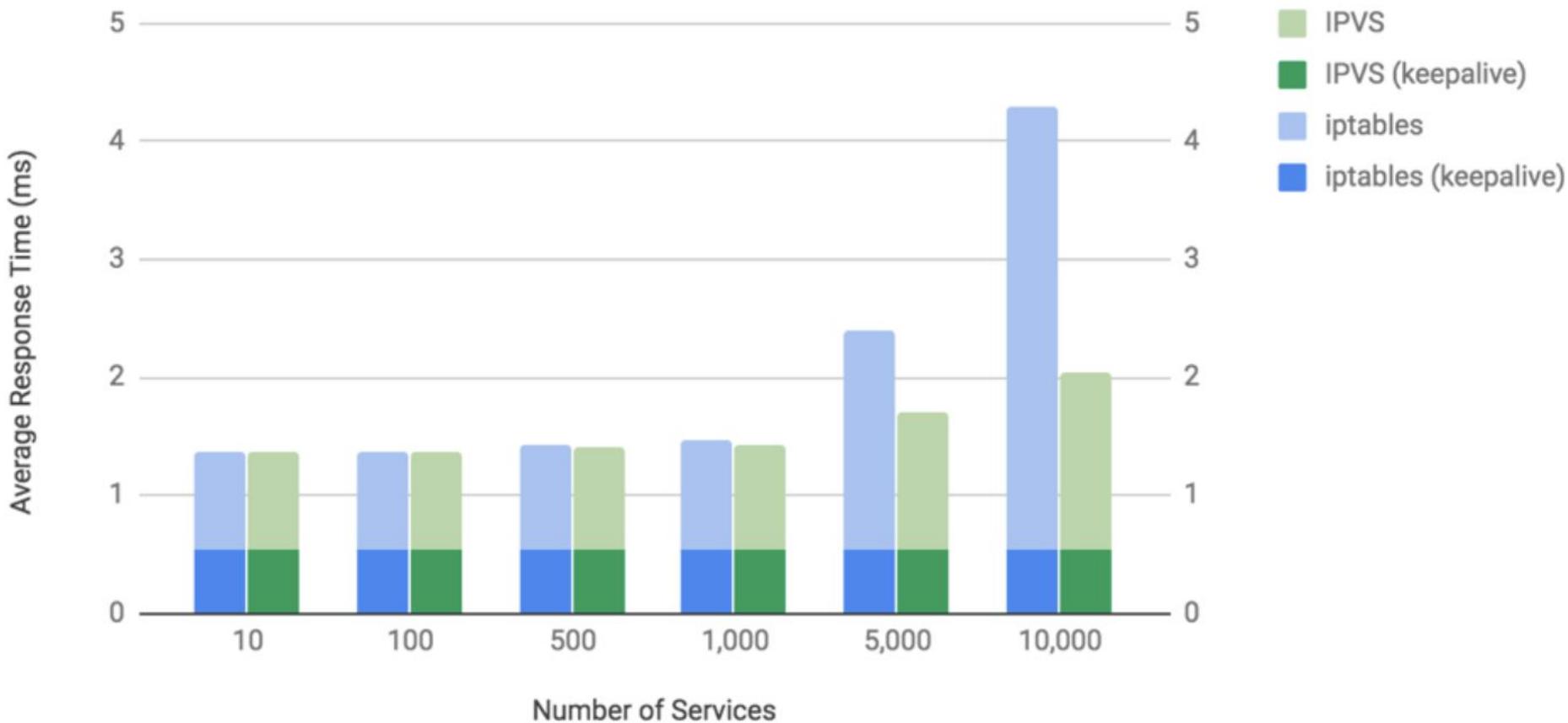
Kubernetes: Production Workload Orchestration



kubernetes
by Google

Pods, Container and Services

- Compare between IPVS and iptables



Ref: <https://www.tigera.io/blog/comparing-kube-proxy-modes-iptables-or-ipvs/>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Pods, Container and Services

- Pods Priority and Preemption
 - Give the priority create for pods. When resource is insufficient kubernetes will consider to run higher priority pods first and evict the lower priority pods.
 - Priority will effective only when pods was “created”
 - Disable feature of “Preemption” is not recommend

```
1 apiVersion: componentconfig/v1alpha1
2 kind: KubeSchedulerConfiguration
3 algorithmSource:
4   provider: DefaultProvider
5
6 ...
7
8 disablePreemption: true
```



Pods, Container and Services

- Pods Priority and Preemption
 - Kubernetes will use value on object “PriorityClass” for consideration. Pods will reference this for define

```
1 apiVersion: scheduling.k8s.io/v1
2 kind: PriorityClass
3 metadata:
4   name: high-priority
5 value: 1000000
6 globalDefault: false
7 description: "This priority class for highest pods."
8
9 ---
10
11 apiVersion: scheduling.k8s.io/v1
12 kind: PriorityClass
13 metadata:
14   name: medium-priority
15 value: 1000
16 globalDefault: true
17 description: "This priority class for default pods."
18
19 ---
20
21 apiVersion: scheduling.k8s.io/v1
22 kind: PriorityClass
23 metadata:
24   name: low-priority
25 value: 100
26 globalDefault: false
27 description: "This priority class for lowest pods."
28
```

```
1 apiVersion: "v1"
2 kind: Pod
3 metadata:
4   name: webtest
5 labels:
6   name: web
7   owner: Praparn_L
8   version: "1.0"
9   module: WebServer
10  environment: development
11 spec:
12   containers:
13     - name: webtest
14       image: labdocker/cluster:webservicelite
15       ports:
16         - containerPort: 5000
17           protocol: TCP
18   priorityClassName: high-priority
```



Daemon Set and RC

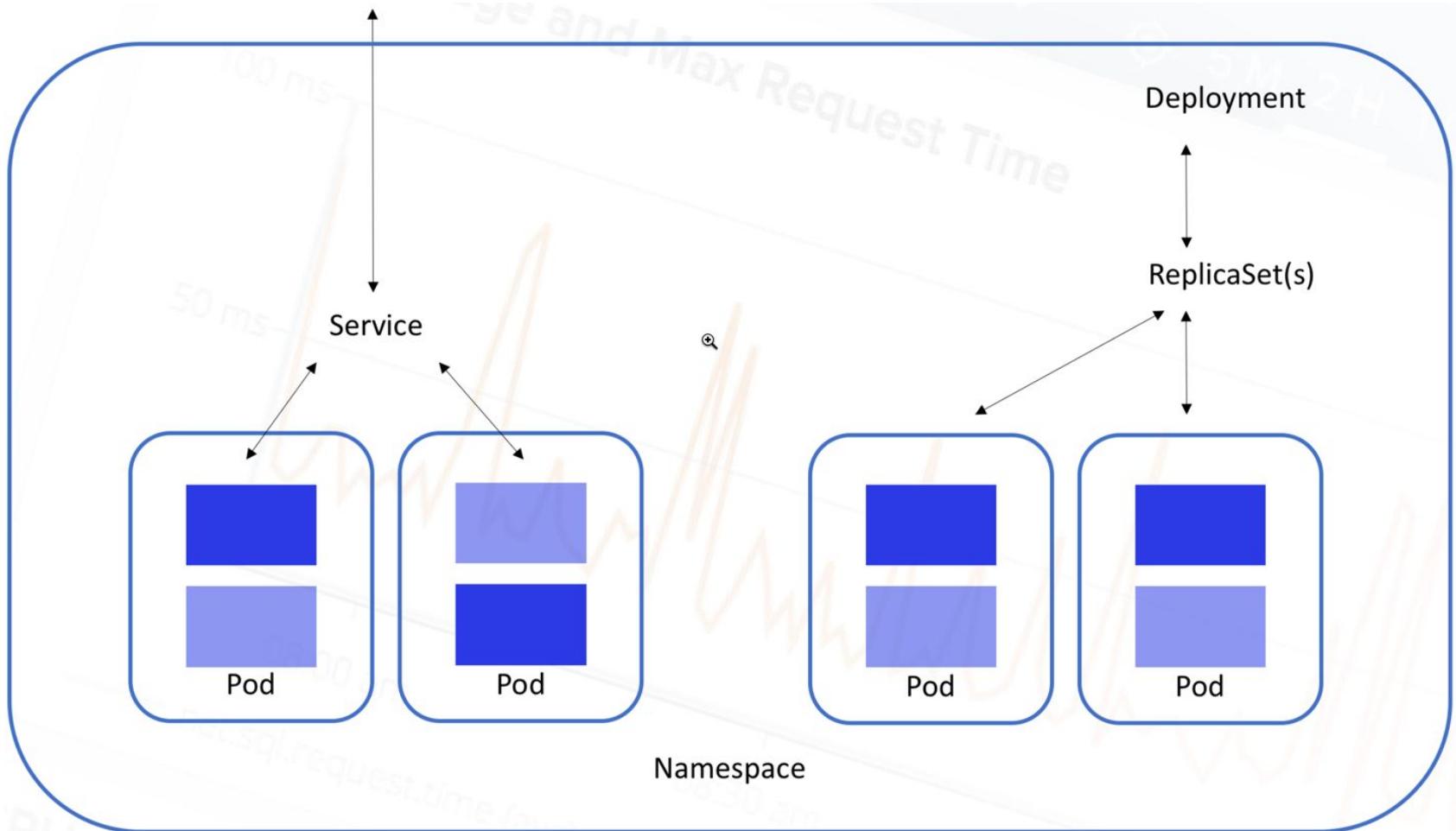


Kubernetes: Production Workload Orchestration



kubernetes
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Daemon Set and RC



Daemon Set and RC

- What is Daemon Set
 - On basic pods and service can make microservice up and run!
 - But...
 - No maintain about available of Pods
 - Not response Pods scaling
 - Etc
 - Daemon Set will response:
 - Make sure that Pods run on all (or some) node in cluster
 - When node add to cluster. Pods will deploy automatic
 - When node remove, GC will automatic remove Pod
 - When remove Daemon Set, Pods will automatic remove
 - General Use Case
 - Storage Daemon (Ceph etc)
 - Node Monitor Daemon (Prometheus Agent etc)



Replication Controller (RC)

- What is RC
 - Daemon Set and Replication Controller work similarly.
 - RC (Replication Controller) will respond:
 - Create/Maintain Pods as "Replication Controller" (Pods Farm)
 - Keep copy of Pods (Replicas) as designed
 - Ensure that Pods are up and running with amount like design
 - If too much, it will kill some Pods
 - If too few, it will create another replicas of Pods
 - Auto healing if some Pods crash for any reason
 - Maintenance on cluster-level not node level



Replication Controller (RC)

- Replication Controller (RC)
 - RC is first version of module to maintain Pods available in cluster
 - Use Case...
 - Rescheduling
 - Scaling
 - Rolling updates (Complicate)
 - Map with service for manage release
 - RC is running base on label type: “Equality-based requirement”
 - Ex:

```
selector:  
  name: web  
  owner: Praparn_L      |  
  version: "1.0"  
  module: WebServer  
  environment: development
```

Replication Controller (RC)

- Example

- Pods “webtest”

```
1 apiVersion: "v1"
2 kind: Pod
3 metadata:
4   name: webtest
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11  spec:
12    containers:
13      - name: webtest
14        image: labdocker/cluster:webservicelite
15        ports:
16          - containerPort: 5000
17            protocol: TCP
```

- RC “webtest”

```
1 apiVersion: v1
2 kind: ReplicationController
3 metadata:
4   name: webtest
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11  spec:
12    replicas: 3
13    template:
14      metadata:
15        labels:
16          name: web
17          owner: Praparn_L
18          version: "1.0"
19          module: WebServer
20          environment: development
21    spec:
22      containers:
23        - name: webtest
24          image: labdocker/cluster:webservicelite
25          ports:
26            - containerPort: 5000
27              protocol: TCP
```

- SVC “webtest”

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: webtest
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11  spec:
12    selector:
13      name: web
14      owner: Praparn_L
15      version: "1.0"
16      module: WebServer
17      environment: development
18
19    type: NodePort
20    ports:
21      - port: 5000
22        name: http
23        targetPort: 5000
24        protocol: TCP
25        nodePort: 32500
```



Replication Controller (RC)

- Create rc “webtest”

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl create -f webtest_rc.yml
replicationcontroller "webtest" created
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get rc
NAME      DESIRED   CURRENT   READY    AGE
webtest   3          3          3        2m
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME        READY   STATUS    RESTARTS   AGE
webtest-9m8tx  1/1    Running   0          3m
webtest-9xgt3  1/1    Running   0          3m
webtest-cns49  1/1    Running   0          3m
```

- Create svc “webtest”

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl create -f webtest_svc.yml
service "webtest" created
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get svc
NAME      CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
kubernetes  10.0.0.1    <none>        443/TCP       8d
webtest     10.0.0.6    <nodes>       5000:32500/TCP  6s
praparns-MacBook-Pro:ReplicationController praparn$
```



Welcome Page from Container Python Lab

Checkpoint Date/Time: Wed Jul 5 15:55:31 2017



Replication Controller (RC)

- Test delete some Pods from command line

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME      READY   STATUS    RESTARTS   AGE
webtest-9m8tx  1/1     Running   0          11m
webtest-9xgt3  1/1     Running   0          11m
webtest-cns49  1/1     Running   0          11m
praparns-MacBook-Pro:ReplicationController praparn$ kubectl delete pods webtest-9m8tx
pod "webtest-9m8tx" deleted
```

- Recheck Pods unit and available

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME      READY   STATUS    RESTARTS   AGE
webtest-9xgt3  1/1     Running   0          21m
webtest-cns49  1/1     Running   0          21m
webtest-lmn54  1/1     Running   0          8m
praparns-MacBook-Pro:ReplicationController praparn$ curl http://192.168.99.100:32500
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Wed Jul  5 15:51:59 2017
praparns-MacBook-Pro:ReplicationController praparn$
```



Welcome Page from Container Python Lab

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Replication Controller (RC)

- Check detail of create process on RC

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl describe rc webtest
Name:           webtest
Namespace:      default
Selector:       environment=development,module=WebServer,name=web,owner=Praparn_L,version=1.0
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
Annotations:    <none>
Replicas:       3 current / 3 desired
Pods Status:   3 Running / 0 Waiting / 0 Succeeded / 0 Failed
Pod Template:
  Labels:        environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
  Containers:
    webtest:
      Image:        labdocker/cluster:webserviceelite
      Port:         5000/TCP
      Environment:  <none>
      Mounts:       <none>
      Volumes:      <none>
Events:
FirstSeen  LastSeen  Count  From            SubObjectPath  Type  Reason          Message
-----  -----  -----  -----  -----  -----  -----  -----
26m        26m       1      replication-controller  Normal  SuccessfulCreate  Created pod: webtest-9m8tx
26m        26m       1      replication-controller  Normal  SuccessfulCreate  Created pod: webtest-cns49
26m        26m       1      replication-controller  Normal  SuccessfulCreate  Created pod: webtest-9xgt3
13m        13m       1      replication-controller  Normal  SuccessfulCreate  Created pod: webtest-lmn54
praparns-MacBook-Pro:ReplicationController praparn$
```



Replication Controller (RC)

- Scale up replicas on RC

```
kubectl scale <option> --replicas <Type/Name>
```

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl scale --replicas=10 rc/webtest
replicationcontroller "webtest" scaled
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get rc
NAME      DESIRED   CURRENT   READY    AGE
webtest   10        10        5       32m
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME        READY   STATUS    RESTARTS   AGE
webtest-2hgdq 1/1     Running   0          18s
webtest-9xgt3 1/1     Running   0          32m
webtest-cns49 1/1     Running   0          32m
webtest-jbqdq 1/1     Running   0          18s
webtest-lgprd 1/1     Running   0          18s
webtest-lmn54 1/1     Running   0          19m
webtest-sqsjk 1/1     Running   0          18s
webtest-thhxsf 1/1    Running   0          18s
webtest-tx0px  1/1    Running   0          18s
webtest-v0n6s  1/1    Running   0          18s
```

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl scale --replicas=5 -f webtest_rc.yml
replicationcontroller "webtest" scaled
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get rc webtest
NAME      DESIRED   CURRENT   READY    AGE
webtest   5         5         5       40m
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME        READY   STATUS    RESTARTS   AGE
webtest-9xgt3 1/1     Running   0          40m
webtest-cns49 1/1     Running   0          40m
webtest-lmn54 1/1     Running   0          27m
webtest-tx0px  1/1    Running   0          7m
webtest-v0n6s  1/1    Running   0          7m
praparns-MacBook-Pro:ReplicationController praparn$
```



Replication Controller

- Check detail of create process on RC

```
Containers:
  webtest:
    Image:          labdocker/cluster:webservicelite
    Port:           5000/TCP
    Environment:   <none>
    Mounts:        <none>
    Volumes:       <none>

Events:
  FirstSeen  LastSeen  Count  From            SubObjectPath  Type    Reason               Message
  -----  -----  -----  -----  -----  -----  -----  -----
  42m     42m      1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-cns49
  42m     42m      1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-9xgt3
  42m     42m      1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-9m8tx
  29m     29m      1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-lmn54
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-lgprd
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-v0n6s
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-thhx
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-sqsjk
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-tx0px
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-2hgdq
  9m      9m       1   replication-controller  Normal  SuccessfulCreate  Created pod: webtest-jbqdd
  2m      2m       1   replication-controller  Normal  SuccessfulDelete  Deleted pod: webtest-lgprd
  2m      2m       1   replication-controller  Normal  SuccessfulDelete  Deleted pod: webtest-thhx
  2m      2m       1   replication-controller  Normal  SuccessfulDelete  Deleted pod: webtest-2hgdq
  2m      2m       1   replication-controller  Normal  SuccessfulDelete  Deleted pod: webtest-sqsjk
  2m      2m       1   replication-controller  Normal  SuccessfulDelete  Deleted pod: webtest-jbqdd
praparns-MacBook-Pro:ReplicationController praparn$ █
```



Replication Controller

- Test delete some Pods from command line

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME      READY   STATUS    RESTARTS   AGE
webtest-9m8tx  1/1     Running   0          11m
webtest-9xgt3  1/1     Running   0          11m
webtest-cns49  1/1     Running   0          11m
praparns-MacBook-Pro:ReplicationController praparn$ kubectl delete pods webtest-9m8tx
pod "webtest-9m8tx" deleted
```

- Recheck Pods unit and available

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
NAME      READY   STATUS    RESTARTS   AGE
webtest-9xgt3  1/1     Running   0          21m
webtest-cns49  1/1     Running   0          21m
webtest-lmn54  1/1     Running   0          8m
praparns-MacBook-Pro:ReplicationController praparn$ curl http://192.168.99.100:32500
<H1> Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: Wed Jul  5 15:51:59 2017
praparns-MacBook-Pro:ReplicationController praparn$
```



Welcome Page from Container Python Lab

Checkpoint Date/Time: Wed Jul 5 15:55:31 2017



Replication Controller

- Cleanup Lab

```
praparns-MacBook-Pro:ReplicationController praparn$ kubectl delete -f webtest_svc.yml
service "webtest" deleted
praparns-MacBook-Pro:ReplicationController praparn$ kubectl delete -f webtest_rc.yml
replicationcontroller "webtest" deleted
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get rc
No resources found.
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get pods
No resources found.
praparns-MacBook-Pro:ReplicationController praparn$ kubectl get svc
NAME      CLUSTER-IP    EXTERNAL-IP    PORT(S)    AGE
kubernetes  10.0.0.1    <none>        443/TCP   8d
praparns-MacBook-Pro:ReplicationController praparn$ █
```



Workshop: RC

- Deploy replication controller

```
Containers:
  webtest:
    Image:          labdocker/cluster:webservicelite
    Port:           5000/TCP
    Environment:   <none>
    Mounts:        <none>
    Volumes:       <none>

Events:
  FirstSeen     LastSeen   Count  From            SubObjectPath  Type    Reason          Message
  ----          ----      ---   ---            ---          ---    ---            ---
  42m          42m       1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-cns49
  42m          42m       1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-9xgt3
  42m          42m       1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-9m8tx
  29m          29m       1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-lmn54
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-lgprd
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-v0n6s
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-thhx
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-sqsjk
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-tx0px
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-2hgdq
  9m           9m        1      replication-controller   Normal   SuccessfulCreate  Created pod: webtest-jbqdd
  2m            2m        1      replication-controller   Normal   SuccessfulDelete  Deleted pod: webtest-lgprd
  2m            2m        1      replication-controller   Normal   SuccessfulDelete  Deleted pod: webtest-thhx
  2m            2m        1      replication-controller   Normal   SuccessfulDelete  Deleted pod: webtest-2hgdq
  2m            2m        1      replication-          Normal   SuccessfulDelete  Deleted pod: webtest-sqsjk
  2m            2m        1      replication-          Normal   SuccessfulDelete  Deleted pod: webtest-jbqdd
praparns-MacBook-Pro:ReplicationController praparn$
```

192.168.99.100:32500

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Welcome Page from Container Python Lab

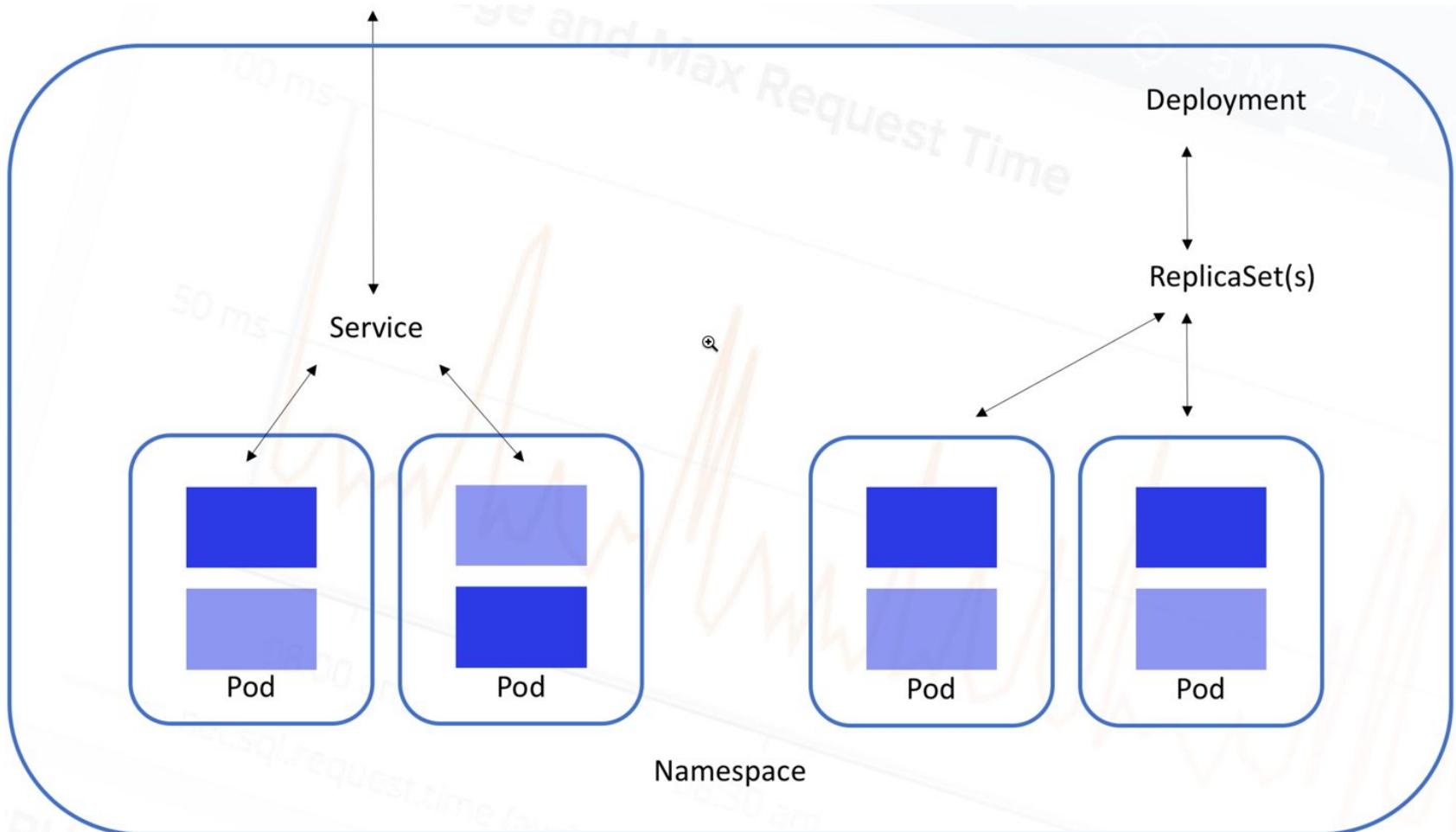
Checkpoint Date/Time: Wed Jul 5 15:55:31 2017



Deployment/RS and Update



Deployment/RS and Update



Deployment/RS and Update

- What is deployment/RS?
 - Deployment and RS (ReplicaSet) is set “next-generation of RC” by provide full function to maintain versioning of Pods in production (No downtime: On-the-fly)
 - Update new version (Rollout)
 - Revert old version (Rollback)
 - Pause/Resume process
 - Check status
 - By design deployment will order job to ReplicaSet(RS) for create Pods as design for up and run
 - When new version was rollout from deployment (Automatic)
 - Create new RS and start to scale as desired
 - Scale down existing RS to 0
 - Delete existing RS

Deployment/RS and Update

- ReplicaSet(RS) vs Replication Controller (RC)
 - RS is generation that evolution from RC with capability more dynamic
 - RC support label with method “Equality-based requirement”

```
selector:  
  name: web  
  owner: Praparn_L      I  
  version: "1.0"  
  module: WebServer  
  environment: development
```

- RS support label with method “Equality-based requirement” and

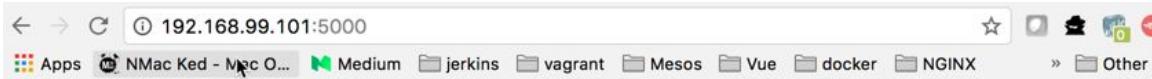
```
selector:  
  matchLabels:  
    environment: development  
  matchExpressions:  
    - {key: environment, operator: In, values: [development]}
```



Deployment/RS and Update

- Example

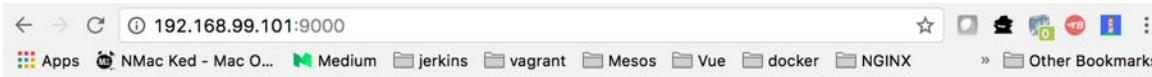
- labdocker/cluster:webservicelite_v1



Welcome Page from Container Python Lab Web Version 1.00

Checkpoint Date/Time: Thu Jul 6 15:19:27 2017

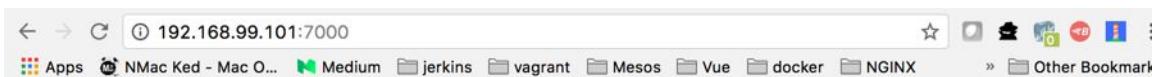
- labdocker/cluster:webservicelite_v1.51rc



Welcome Page from Container Python Lab Web Version 1.51 RC

Checkpoint Date/Time: Thu Jul 6 15:39:05 2017

- labdocker/cluster:webservicelite_v1.8ga



Welcome Page from Container Python Lab Web Version 1.80 GA

Checkpoint Date/Time: Thu Jul 6 15:36:54 2017



Deployment/RS and Update

- Example
 - Deployment “webtest”

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  replicas: 3
  revisionHistoryLimit: 3
  selector:
    matchLabels:
      name: web
      owner: Praparn_L
      version: "1.0"
      module: WebServer
      environment: development
  template:
    metadata:
      labels:
        name: web
        owner: Praparn_L
        version: "1.0"
        module: WebServer
        environment: development
    spec:
      containers:
        - name: webtest
          image: labdocker/cluster:webservicelite_v1
          ports:
            - containerPort: 5000
              protocol: TCP
```

SVC “webtest”

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4  name: webtest
5  labels:
6  name: web
7  owner: Praparn_L
8  version: "1.0"
9  module: WebServer
10 environment: development
11 spec:
12   selector:
13     name: web
14     owner: Praparn_L
15     version: "1.0"
16     module: WebServer
17     environment: development
18
19   type: NodePort
20   ports:
21     - port: 5000
22       name: http
23       targetPort: 5000
24       protocol: TCP
25       nodePort: 32500
```



Deployment/RS and Update

- Create deployment “webtest” and ReplicaSet (RS)

```
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl create -f webtest_deploy.yml --record
deployment "webtest" created
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl get deployment webtest
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
webtest   3          3          3           3           10s
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl get rs
NAME      DESIRED   CURRENT   READY      AGE
webtest-4261491039  3          3          3           16s
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl get pods
NAME            READY   STATUS    RESTARTS   AGE
webtest-4261491039-b7gkv  1/1     Running   0          20s
webtest-4261491039-p231t  1/1     Running   0          20s
webtest-4261491039-rjzk4  1/1     Running   0          20s
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$
```

- Create svc “webtest”

```
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl create -f webtest_svc.yml --record
service "webtest" created
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl get svc
NAME      CLUSTER-IP   EXTERNAL-IP   PORT(S)      AGE
kubernetes  10.0.0.1    <none>        443/TCP     9d
webtest    10.0.0.97   <nodes>        5000:32500/TCP 4s
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$
```



Deployment/RS and Update

- Procedure for deployment operate
 - Check existing RS (0 when create new)
 - Create new RS
 - Scale RS to designed replicas

```
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$ kubectl describe deployment/webtest
Name:           webtest
Namespace:      default
CreationTimestamp:  Thu, 06 Jul 2017 23:17:25 +0700
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
Annotations:    deployment.kubernetes.io/revision=1
Selector:       environment=development,module=WebServer,name=web,owner=Praparn_L,version=1.0
Replicas:       3 desired | 3 updated | 3 total | 3 available | 0 unavailable
StrategyType:   RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 1 max unavailable, 1 max surge
Pod Template:
  Labels:      environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
```

```
Conditions:
  Type     Status  Reason
  ----
  Available  True    MinimumReplicasAvailable
OldReplicaSets: <none>
NewReplicaSet:  webtest-4261491039 (3/3 replicas created)
Events:
  FirstSeen  LastSeen  Count  From            SubObjectPath  Type        Reason          Message
  -----  -----  -----  -----  -----  -----  -----  -----
  10m       10m       1      deployment-controller      Normal      ScalingReplicaSet  Scaled up replica set webtest-4
261491039 to 3
praparns-MacBook-Pro:WorkShop_1.4_Deployment praparn$
```



Deployment/RS and Update

- Deployment update strategy (Rolling Update)
 - Update will start trigger when some of “spec:template” is changed

```
 1  apiVersion: apps/v1
 2  kind: Deployment
 3  metadata:
 4    name: webtest
 5    labels:
 6      name: web
 7      owner: Praparn_L
 8      version: "1.0"
 9      module: WebServer
10      environment: development
11
12  spec:
13    replicas: 3
14    selector:
15      matchLabels:
16        name: web
17        owner: Praparn_L
18        version: "1.0"
19        module: WebServer
20        environment: development
21
22  template:
23    metadata:
24      labels:
25        name: web
26        owner: Praparn_L
27        version: "1.0"
28        module: WebServer
29        environment: development
30
31  spec:
```

- Step for produce update (rollout) with Each Change (Default)
 - Create new RS for template change
 - Scale down existing RS to 1 (1 max unavailable)
 - Scale new RS as designed (No more than design +1: 1 max surge)
 - Delete existing RS
 - Default deployment will allow 25% for lack (max Unavailable) and 25% for over design (maxSurge)

Deployment/RS and Update

- Let's Talk about deployment strategies !!!
 - On deployment we have many procedure for apply rollout strategy with deployment
 - Recreate (For Development): Destroy all pods and recreate it again.
 - RollingUpdate (Default): Create new version of pods and wait for it ready before terminate existing version
 - Blue/Green: Create new deployment for "green" version and reconfigure service for point to new deployment
 - Canary: Create new deployment with same "Label" but less replicas in begin and increase as need
 - A/B: Create new deployment and let's use service mesh for select some traffic to new deployment

Ref:

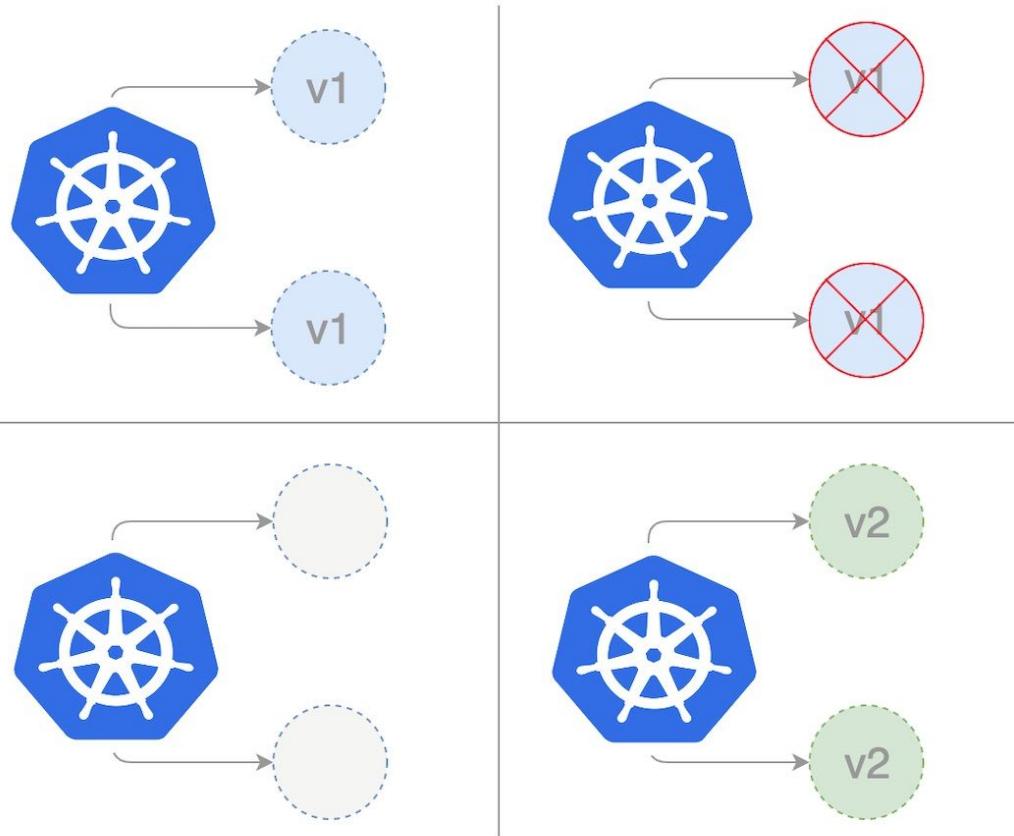
<https://container-solutions.com/kubernetes-deployment-strategies/?fbclid=IwAR1T3mdkK46HmJ7ckla6iEjtAuKKnijLWRcsrK3Jetzb5BOB21akiYBgm5Y>

<https://auth0.com/blog/deployment-strategies-in-kubernetes/>



Deployment/RS and Update

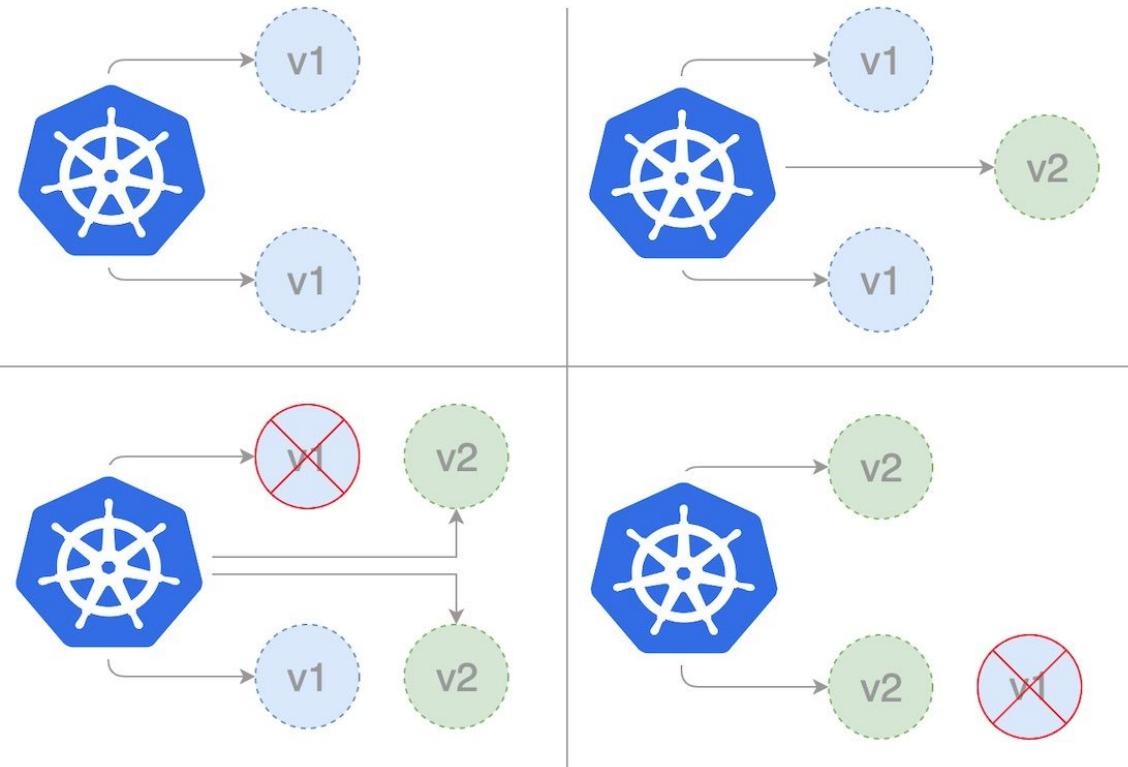
- Recreate



```
! webtest_deploy.yml ●  
1  apiVersion: apps/v1  
2  kind: Deployment  
3  metadata:  
4    name: webtest  
5    labels:  
6      name: web  
7      owner: Praparn_L  
8    version: "1.0"  
9    module: WebServer  
10   environment: development  
11  
12  spec:  
13    replicas: 1  
14    strategy:  
15      type: Recreate  
16    selector:  
17      matchLabels:  
18        name: web  
          owner: Praparn_L
```

Deployment/RS and Update

- RollingUpdate (Default)



```
! webtest_deploy.yml ●  
1 apiVersion: apps/v1  
2 kind: Deployment  
3 metadata:  
4   name: webtest  
5   labels:  
6     name: web  
7     owner: Praparn_L  
8     version: "1.0"  
9   module: WebServer  
10  environment: development  
11 spec:  
12   replicas: 4  
13   strategy:  
14     type: RollingUpdate  
15     rollingUpdate:  
16       maxUnavailable: 1  
17       maxSurge: 1  
18   selector:  
19     matchLabels:  
20       name: web  
21       owner: Praparn_L
```

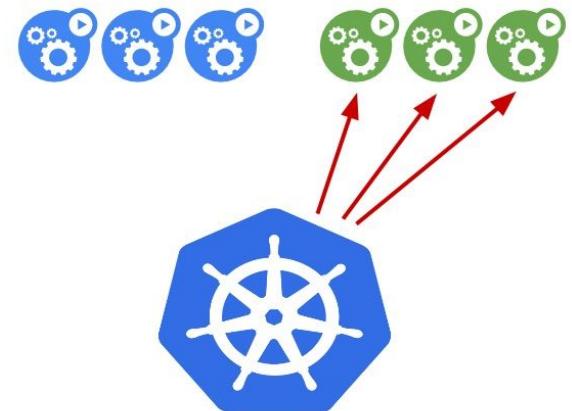
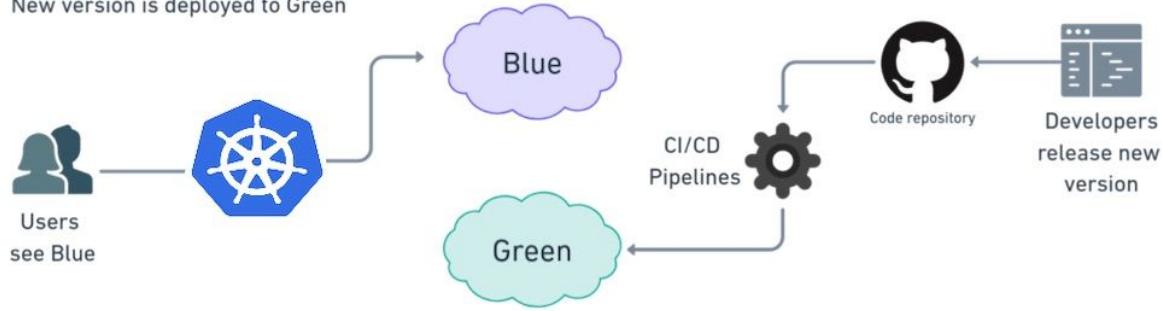


kubernetes
by Google

Deployment/RS and Update

- Blue/Green

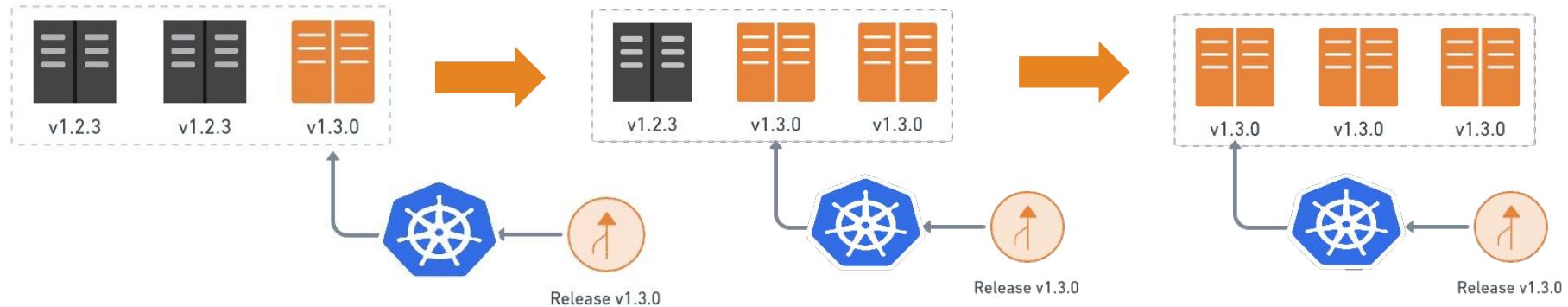
Blue is production/stable
New version is deployed to Green



```
! webtest_deploy.yml • ! webtest_svc.yml x
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12   spec:
13     selector:
14       name: web
15       owner: Praparn_L
16       version: "1.0"
17       module: WebServer
18       environment: development
```

Deployment/RS and Update

- Canary: (2 Deployment same label)



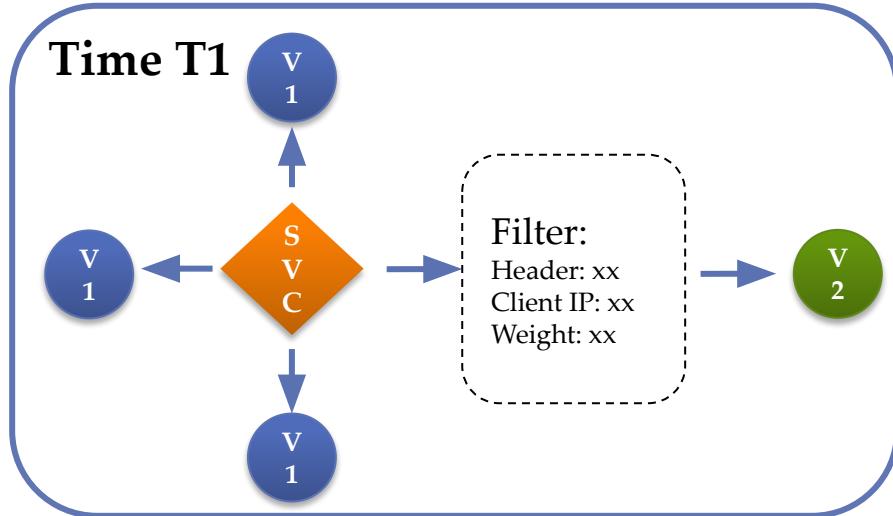
```
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   name: webtest_V1
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11 spec:
12   replicas: 3
```

```
1  apiVersion: apps/v1
2  kind: Deployment
3  metadata:
4    name: webtest_V2
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11    spec:
12      replicas: 1
```

```
! webtest_deploy.yml • ! webtest_svc.yml x
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11 spec:
12   selector:
13     name: web
14     owner: Praparn_L
15     version: "1.0"
16     module: WebServer
17     environment: development
```

Deployment/RS and Update

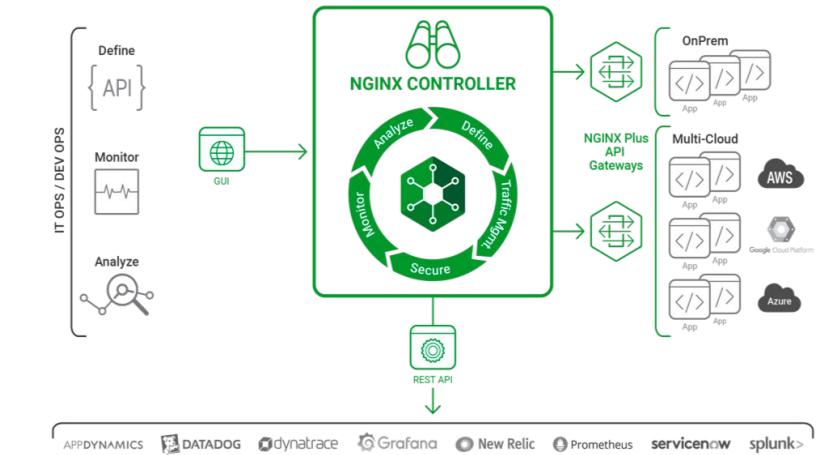
- A/B: (2 Deployment with Service Mesh)



Istio

Connect, secure, control, and observe services.

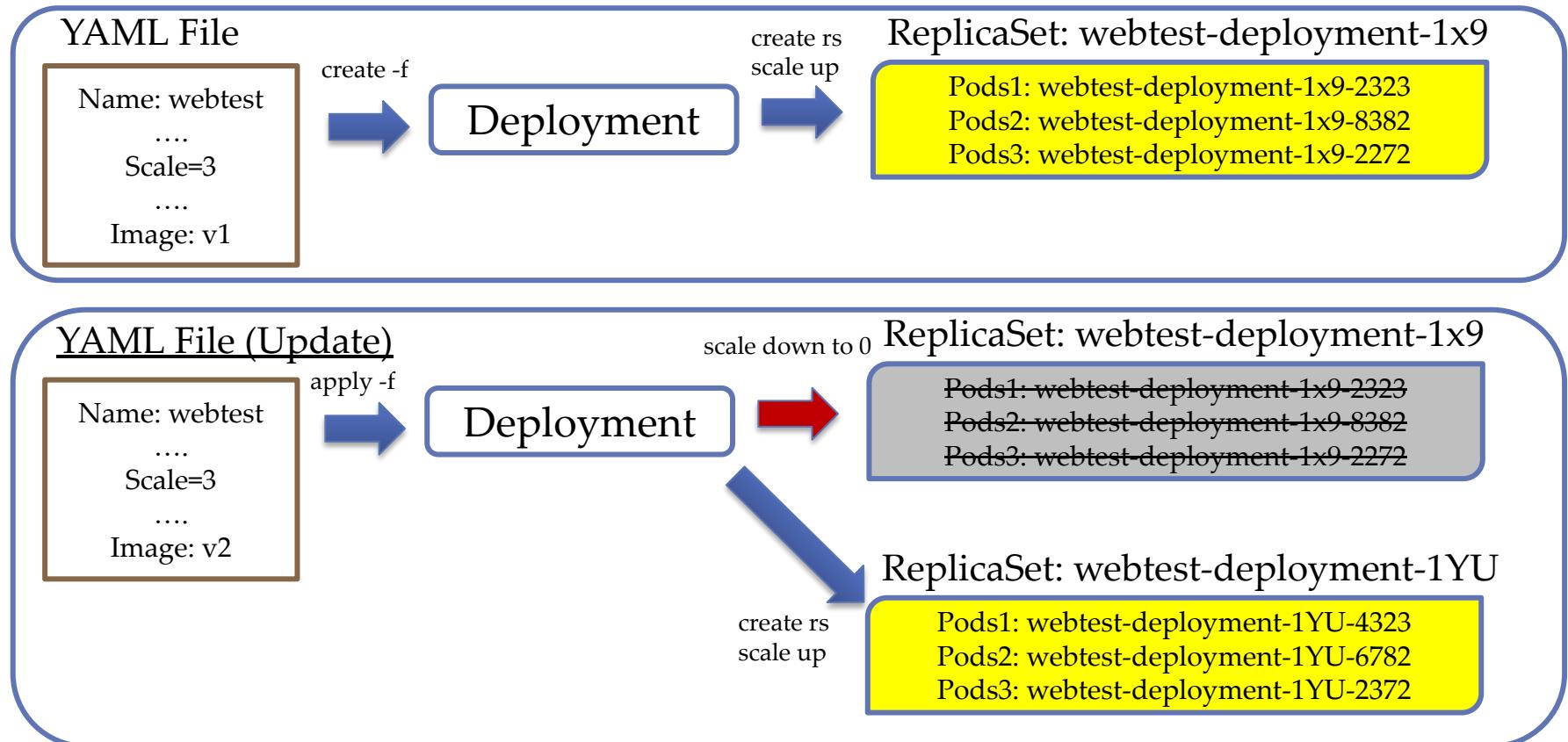
Kubernetes: Production Workload Orchestration



kubernetes
by Google

Deployment/RS and Update

- Deployment update strategy (RollingUpdate)



Deployment/RS and Update

- How to be grateful rollout/rollback
 - Set the rollingupdate's strategy

replicas: 3

strategy:

 type: RollingUpdate

 rollingUpdate:

 maxUnavailable: 50%

 maxSurge: 100%

- Setup “terminationGracePeriodSeconds” (After SIGTERM)

spec:

 terminationGracePeriodSeconds: 30

- Setup “readiness” for indicate application is ready (Next chapter) and coding for set readiness fail when get “SIGTERM”
- Setup “readinessGates” for additional healthcheck for external hookback before start open pods

Deployment/RS and Update

- Define “revisionHistoryLimit” as design (Default: 10)

```
replicas: 3
revisionHistoryLimit: 3
strategy:
  type: RollingUpdate
  rollingUpdate:
    maxUnavailable: 50%
    maxSurge: 100%
```

Deployment/RS and Update

- Deployment update strategy (Rollout)
 - Trigger Change on Deployment
 - **Method1: Set online**

```
kubectl set <Property> <Type/Name> Variable=Value
```

- Ex: kubectl set image deployment/webtest webtest:betaversion

- **Method2: Edit online**

```
kubectl edit <Type/Name>
```

- Ex: kubectl edit deployment/webtest

- **Method3: Edit YAML File and Apply**

```
Edit file <FileName>.YML
```

```
kubectl apply -f <FileName>
```

Deployment/RS and Update

- Check status of deployment's update (rollout)
 - Use “rollout” utility (status/history/pause/resume/undo)

```
kubectl rollout <Option> <Type/Name>
```

- Ex:
 - Check status of rollout process:
 - kubectl rollout status deployment/webtest
 - Check history of rollout process:
 - Kubectl rollout history deployment/webtest
 - Rollback rollout process:
 - kubectl rollout undo deployment/webtest --to-revision=2
 - Pause/Resume process:
 - kubectl rollout pause/resume deployment/webtest



Deployment/RS and Update

- Deployment update strategy
 - Set new image on deployment

```
ubuntu@ip-10-0-1-211:~$ kubectl set image deployment/webtest webtest=labdocker/cluster:webservicelite_v1.51rc --record=true
deployment.extensions/webtest image updated
ubuntu@ip-10-0-1-211:~$ kubectl rollout status deployment/webtest
Waiting for deployment "webtest" rollout to finish: 1 old replicas are pending termination...
Waiting for deployment "webtest" rollout to finish: 1 old replicas are pending termination...
deployment "webtest" successfully rolled out
ubuntu@ip-10-0-1-211:~$ kubectl get deployment
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
webtest   3          3          3           3           98s
ubuntu@ip-10-0-1-211:~$ kubectl get rs
NAME      DESIRED   CURRENT   READY     AGE
webtest-594bdc7f5d   3          3          3           17s
webtest-7dc5bdccdd7 0          0          0           102s
ubuntu@ip-10-0-1-211:~$ kubectl get pods
NAME            READY   STATUS    RESTARTS   AGE
webtest-594bdc7f5d-2pqwf  1/1     Running   0          22s
webtest-594bdc7f5d-fngzv  1/1     Running   0          19s
webtest-594bdc7f5d-wwkqj  1/1     Running   0          20s
ubuntu@ip-10-0-1-211:~$ kubectl set image deployment/webtest webtest=labdocker/cluster:webservicelite_v1.8ga --record=true
deployment.extensions/webtest image updated
ubuntu@ip-10-0-1-211:~$ kubectl rollout status deployment/webtest
deployment "webtest" successfully rolled out
ubuntu@ip-10-0-1-211:~$
```



Deployment/RS and Update

- Deployment update strategy
 - Rollout History

```
ubuntu@ip-10-0-1-211:~$ kubectl rollout history deployment/webtest
deployment.extensions/webtest
REVISION  CHANGE-CAUSE
1          kubectl create --filename=https://raw.githubusercontent.com/praparn/kubernetes_20180701/master/WorkShop_1.4_Deployment/webtest_deploy.yml --record=true
2          kubectl set image deployment/webtest webtest=labdocker/cluster:webservicelite_v1.51rc --record=true
3          kubectl set image deployment/webtest webtest=labdocker/cluster:webservicelite_v1.8ga --record=true

ubuntu@ip-10-0-1-211:~$ █
```



Deployment/RS and Update

- Deployment update strategy
 - Rollback process

```
[ubuntu@ip-10-0-1-211:~$ kubectl rollout undo deployment/webtest --to-revision=2
deployment.extensions/webtest
[ubuntu@ip-10-0-1-211:~$ kubectl rollout status deployment/webtest
deployment "webtest" successfully rolled out
[ubuntu@ip-10-0-1-211:~$ curl http://10.0.1.211:32500
<H1> Welcome Page from Container Python Lab Web Version 1.51 RC </H1>Checkpoint Date/Time: Mon Oct 29 08:10:17 2018
ubuntu@ip-10-0-1-211:~$ ]
```

- Rollout History

```
[ubuntu@ip-10-0-1-211:~$ kubectl rollout history deployment/webtest
deployment.extensions/webtest
REVISION  CHANGE-CAUSE
1          kubectl create --filename=https://raw.githubusercontent.com/praparn/kubernetes_20180701/master/WorkShop_1.4_Deployment/webtest_deploy.yml --record=true
3          kubectl set image deployment/webtest webtest=labdocker/cluster:webserviceelite_v1.8ga --record=true
4          kubectl set image deployment/webtest webtest=labdocker/cluster:webserviceelite_v1.51rc --record=true
ubuntu@ip-10-0-1-211:~$ ]
```



Volume



Volume

- By default all container in same Pods will share storage (emptyDir)
 - This storage will keep all read/write for all container in Pods
 - Persistent storage for container as long as Pods still available
 - Container crash not effect to this storage type
 - When Pods was delete from node. emptyDir was deleted forever
- Data in container/Pods is “ephemeral” that may loss when Pods was restart/distribute
- Kubernetes support many type of volume on system



Volume

- List of support storage
 - EmptyDir
 - **hostPath**
 - gcePersistent
 - awsElasticBlockStore
 - Nfs
 - Iscsi
 - fc(fibrechannel)
 - Flocker
 - Glusterfs
 - Rbd
 - Cephfs
 - gitRepo (deprecated)
 - Secret
 - **persistentVolumeClaim (PVC) (Talk Day2)**
 - downwardAPI
 - Projected
 - azureDisk
 - azureFile
 - vsphereVolume
 - Quobyte
 - PortworxVolume
 - ScaleIO
 - StorageOS
 - Local
 - ConfigMap
 - Secret
 - csi

Volume

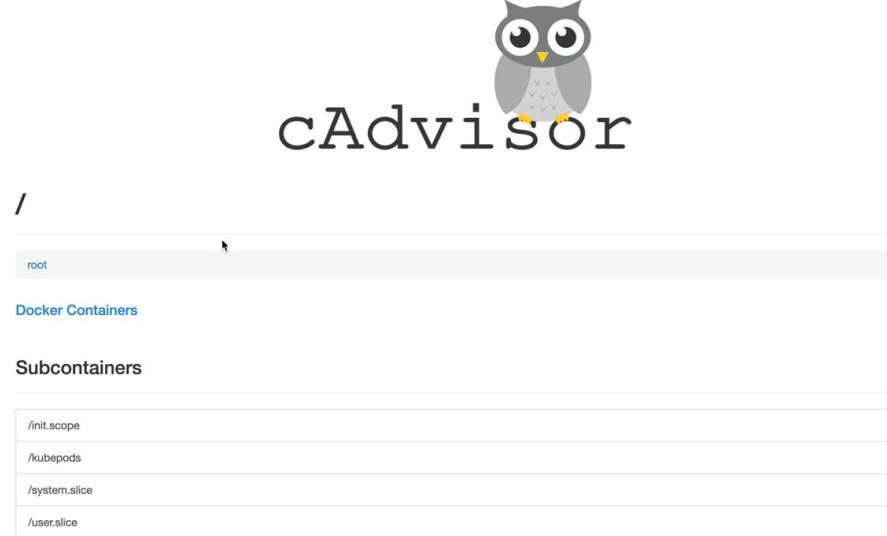
- hostPath:
 - Mount file/directory on host to Pods
 - Recommend for Pods that need read some data on host path (Such as cAdvisor etc)
 - Consideration
 - hostPath may effect to some of path/file not equal on different host
 - Kubernetes resource scheduling cannot check readiness of hostPath
 - Some hostPath may need privilege for access. This need to consideration.



Volume

- hostPath:

```
Users > paparnlueangphoonlap > Work > Kubernetes > Train
31   labels:
32     name: cAdvisor
33     owner: Praparn_L
34     version: "1.0"
35     module: Monitor
36     environment: development
37 spec:
38   replicas: 1
39   selector:
40     matchLabels:
41       name: cAdvisor
42       owner: Praparn_L
43       version: "1.0"
44       module: Monitor
45       environment: development
46 template:
47   metadata:
48     labels:
49       name: cAdvisor
50       owner: Praparn_L
51       version: "1.0"
52       module: Monitor
53       environment: development
54 spec:
55   containers:
56     - name: cAdvisor
57       volumeMounts:
58         - mountPath: /var/run
59           name: volrun
60         - mountPath: /sys
61           name: volsys
62         - mountPath: /var/lib/containerd/
63           name: voldocker
64           image: labdockerc/cadvisor:latest
65       ports:
66         - containerPort: 8080
67           protocol: TCP
68       volumes:
69         - name: volrun
70           hostPath:
71             path: /var/run
72         - name: volsys
73           hostPath:
74             path: /sys
75         - name: voldocker
76           hostPath:
77             path: /var/lib/containerd/
```



Volume

- hostPath:
- Container create file

Host check file

```
praparnlueangphoonlap — Terminal MAC Pro — kubectl exec -it cadvisor
~ — Terminal MAC Pro — ssh + minikube ssh
praparn-MacBook-Pro% kubectl get pods
NAME          READY   STATUS    RESTARTS   AGE
cAdvisor-1335144146-jgm3h   1/1     Running   0          15m
praparn-MacBook-Pro% kubectl exec -it cAdvisor-1335144146-jgm3h sh
[/ # touch /var/lib/docker/test_cAdvisor.txt
[/ # ls -lh /var/lib/docker
total 52
drwx----- 28 root      root      4.0K Sep 24 15:57 containers
drwx-----  3 root      root      4.0K Sep 24 04:02 image
drwxr-x---  3 root      root      4.0K Sep 24 04:02 network
drwx----- 155 root      root     20.0K Sep 24 15:57 overlay
drwx-----  2 root      root      4.0K Sep 24 04:02 swarm
-rw-r--r--  1 root      root      0 Sep 24 16:12 test_cAdvisor.txt
-rw-r--r--  1 root      root      0 Sep 24 16:00 testfile.txt
drwx-----  2 root      root      4.0K Sep 24 15:13 tmp
drwx-----  2 root      root      4.0K Sep 24 04:02 trust
drwx-----  2 root      root      4.0K Sep 24 09:27 volumes
/ #
```

```
praparn-MacBook-Pro% minikube ssh
$ sudo su -
# ls /var/lib/docker
containers image network overlay swarm test_cAdvisor.txt testfile.txt tmp trust volumes
#
```



Volume

```
Users > paparnlueangphoonlap > Work > Kubernetes > Training > k  
1  apiVersion: "v1"  
2  kind: Pod  
3  metadata:  
4    name: webtest  
5    labels:  
6      name: web  
7      owner: Paparn_L  
8      version: "1.0"  
9      module: WebServer  
10     environment: development  
11 spec:  
12   containers:  
13     - name: webtest  
14       image: labdocker/cluster:webservicelite_v1  
15       ports:  
16         - containerPort: 5000  
17         | protocol: TCP  
18       volumeMounts:  
19         - mountPath: /temp  
20         | name: voldocker  
21       volumes:  
22         - name: voldocker  
23           hostPath:  
24             path: /var/lib/containerd/
```

```
paparns-MacBook-Pro% kubectl create -f webtest_pod.yml  
pod "webtest" created  
paparns-MacBook-Pro% kubectl get pods  
NAME          READY   STATUS    RESTARTS   AGE  
cadvisor-1335144146-jgm3h   1/1    Running   0          21m  
webtest        1/1    Running   0          3s  
paparns-MacBook-Pro% kubectl exec -it webtest sh  
/usr/src/app # ls -lh /temp  
total 56  
drwx----- 32 root    root    4.0K Sep 24 16:18 containers  
drwx-----  3 root    root    4.0K Sep 24 04:02 image  
drwxr-x---  3 root    root    4.0K Sep 24 04:02 network  
drwx----- 163 root    root   24.0K Sep 24 16:18 overlay  
drwx-----  2 root    root    4.0K Sep 24 04:02 swarm  
-rw-r--r--  1 root    root     0 Sep 24 16:12 test_cAdvisor.txt  
-rw-r--r--  1 root    root     0 Sep 24 16:00 testfile.txt  
drwx-----  2 root    root    4.0K Sep 24 15:13 tmp  
drwx-----  2 root    root    4.0K Sep 24 04:02 trust  
drwx-----  2 root    root    4.0K Sep 24 09:27 volumes  
/usr/src/app # █
```



Workshop: Volume

```
Users > praparnlueangphoona > Work > Kubernetes > Train
31   labels:
32     name: cadvisor
33     owner: Praparn_L
34     version: "1.0"
35     module: Monitor
36     environment: development
37 spec:
38 replicas: 1
39 selector:
40   matchLabels:
41     name: cadvisor
42     owner: Praparn_L
43     version: "1.0"
44     module: Monitor
45     environment: development
46 template:
47 metadata:
48   labels:
49     name: cadvisor
50     owner: Praparn_L
51     version: "1.0"
52     module: Monitor
53     environment: development
54 spec:
55   containers:
56     - name: cadvisor
57       volumeMounts:
58         - mountPath: /var/run
59           name: volrun
60         - mountPath: /sys
61           name: volsys
62         - mountPath: /var/lib/containerd/
63           name: voldocker
64           image: labdocker/cadvisor:latest
65           ports:
66             - containerPort: 8080
67               protocol: TCP
68       volumes:
69         - name: volrun
70           hostPath:
71             path: /var/run
72         - name: volsys
73           hostPath:
74             path: /sys
75         - name: voldocker
76           hostPath:
77             path: /var/lib/containerd/
```



/

root

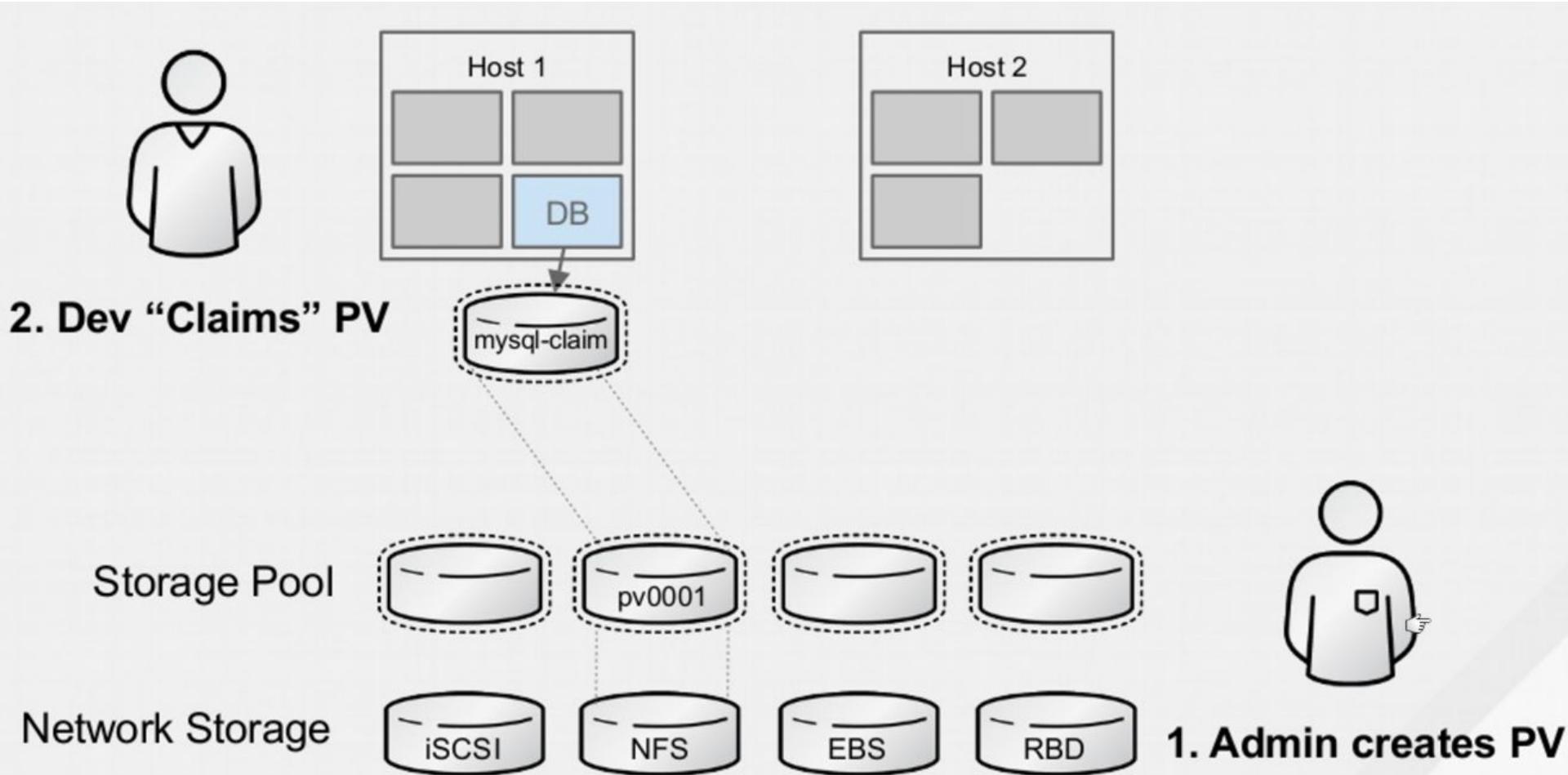
Docker Containers

Subcontainers

- /init.scope
- /kubepods
- /system.slice
- /user.slice



Volume



Liveness and Readiness Probe



Liveness and Readiness Probe

- Pods are you still alright ?
 - Normally kubernetes will check Pods status and process criteria for orchestrator following “restartPolicy”
 - Always (Default)
 - On-Failure
 - None
 - Pods status is depend on “ContainerState” in that Pods (1-M)
 - Waiting (ContainerStateWaiting)
 - Running (ContainerStateRunning)
 - Terminated (ContainerStateTerminated)



Liveness and Readiness Probe

- Pods are you still alright ?
 - When Pods receive status from container. It will set Pods's status to inform kubelet for operate with Pods (Remain / Terminated / Restart)
 - Pods Phase (Phase Value)
 - Pending: When initial Pods and loading images for container
 - Running: Some container running but not all
 - Successed: All container fullfill running
 - Failed: All container exit fail
 - Unknow: Can not monitor state
- Do we need more specific health-check?
 - Depend on container (application) fail condition.
 - If container fail condition will make process “crash” or effect to container down/unhealthy. This no need to operate more check.
 - If container fail condition may occur inside application that possible process still online. This need more health check

Liveness and Readiness Probe

- Container probe process
 - Kubernetes have function for make properly make sure that container (inside Pods) still healthy by three options
 - ExecAction: Execute some command inside container (expect result: return 0)
 - TCPSocketAction: Start TCP communication on specific port of container (expect result: port open)
 - HTTPGetAction: Send http/https request to specific port and path (expect result: return 200 for OK)
 - Probe's result
 - Success
 - Failed
 - Unknown
 - livenessProbe and readinessProbe Difference
 - livenessProbe: check status of container is running properly or not ?
 - readinessProbe: check readiness for process service or not ?

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Liveness and Readiness Probe

- Container Lifecycle Hooks
 - On kubernetes we can provide some process (Exec, HTTP) to hook on container Life cycle that kubernetes support in 2 event
 - PostStart:
 - Run some activity immediate when container is created (No guarantee to execute before “ENTRYPOINT” of container)
 - PreStop:
 - Run some activity immediate before container terminate (Delete, Liveness Fail) This is will blocking to do this task before terminate

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



kubernetes
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Liveness and Readiness Probe

```
41      - name: ES_JAVA_OPTS
42        value: -Xms5g -Xmx5g
43      - name: bootstrap.memory_lock
44        value: "false"
45      - name: cluster.name
46        value: pam-es-docker-cluster
47      - name: xpack.security.enabled
48        value: "false"
49    image: "3dsinteractive/elasticsearch-std:6.6"
50    lifecycle:
51      postStart:
52        exec:
53          command: ["/bin/sh", "-c", "chown -R 1000:1000 /usr/share/elasticsearch/data && chmod -R 777 /usr/share/elasticsearch/data"]
54
55  #       imagePullPolicy: Always
56  ports:
57    - name: "elastic9200"
58      containerPort: 9200
59    - name: "elastic9300"
60      containerPort: 9300
61
62  resources:
```

```
1  apiVersion: app/v1
2  kind: Deployment
3  metadata:
4    name: nginx
5  spec:
6    template:
7      metadata:
8        labels:
9          app: nginx
10     spec:
11       containers:
12         - name: nginx
13           image: nginx
14           ports:
15             - containerPort: 80
16           lifecycle:
17             preStop:
18               exec:
19                 command: ["nginx","-s","quit"]
```

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



kubernetes
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Liveness and Readiness Probe

- ExecAction:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  replicas: 1
  revisionHistoryLimit: 3
  selector:
    matchLabels:
      name: web
      owner: Praparn_L
      version: "1.0"
      module: WebServer
      environment: development
  template:
    metadata:
      labels:
        name: web
        owner: Praparn_L
        version: "1.0"
        module: WebServer
        environment: development
```

```
28
29   spec:
30     containers:
31       - name: webtest
32         image: labdocker/cluster:webservicelite_v1
33         ports:
34           - containerPort: 5000
35             protocol: TCP
36         readinessProbe:
37           exec:
38             command:
39               - cat
40               - /usr/src/app/main.py
41             initialDelaySeconds: 15
42             periodSeconds: 5
43         livenessProbe:
44           exec:
45             command:
46               - cat
47               - /usr/src/app/main.py
48             initialDelaySeconds: 15
             periodSeconds: 15
```

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration

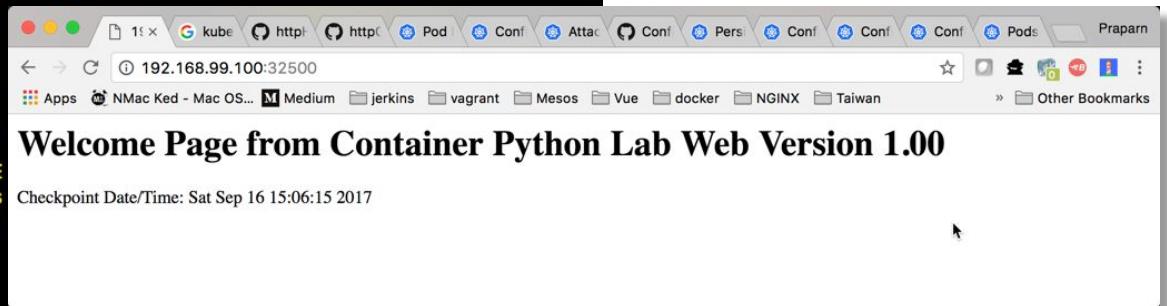


kubernetes
by Google

Liveness and Readiness Probe

- ExecAction:

```
praparns-MacBook-Pro% kubectl create -f webtest_deploy_liveness_readiness_exec.yml
    kubectl create -f webtest_svc.yml
deployment "webtest" created
service "webtest" created
praparns-MacBook-Pro% kubectl get svc/webtest
NAME      CLUSTER-IP   EXTERNAL-IP   PORT(S)        AGE
webtest   10.0.0.127   <nodes>       5000:32500/TCP  20s
praparns-MacBook-Pro% kubectl get deployment/webtest
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
webtest   1         1         1           1           33s
praparns-MacBook-Pro% kubectl describe deployment/webtest
Name:           webtest
Namespace:      default
CreationTimestamp: Sat, 16 Sep 2017 22:04:07 +0700
Labels:          environment=development
                 module=WebServer
                 name=web
                 owner=Praparn_L
                 version=1.0
Annotations:    deployment.kubernetes.io/revision=1
Selector:        environment=development,module=WebServer,name=web,owner=Praparn_L,version=1.0
Replicas:        1 desired | 1 updated | 1 total | 1 available | 0 unavailable
StrategyType:   RollingUpdate
MinReadySeconds: 0
RollingUpdateStrategy: 1 max unavailable, 1 max surge
Pod Template:
  Labels:      environment=development
               module=WebServer
               name=web
               owner=Praparn_L
               version=1.0
  Containers:
    webtest:
      Image:      labdocker/cluster:webservicelite_v1
      Port:       5000/TCP
      Liveness:   exec [cat /usr/src/app/main.py] delay=15s timeout=1s period=15s #success=1 #failure=3
      Readiness:  exec [cat /usr/src/app/main.py] delay=15s timeout=1s period=5s #success=1 #failure=3
      Environment: <none>
```



Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



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Liveness and Readiness Probe

- ExecAction:

```
praparns-MacBook-Pro% kubectl get pods
NAME           READY   STATUS    RESTARTS   AGE
webtest-336910061-26pdb  1/1     Running   0          4m
praparns-MacBook-Pro% kubectl exec -it webtest-336910061-26pdb sh
/usr/src/app # ls
docker-compose.yml      dockerfile_python_lite  nginx.conf
dockerfile_nginx         main.py                  requirements.txt
dockerfile_python        mainlite.py             requirementslite.txt
/usr/src/app # rm main.py
/usr/src/app # exit
praparns-MacBook-Pro%
```

```
praparns-MacBook-Pro% kubectl get pods
NAME           READY   STATUS    RESTARTS   AGE
webtest-336910061-26pdb  1/1     Running   1          7m
praparns-MacBook-Pro% kubectl describe pods/webtest-336910061-26pdb
Name:           webtest-336910061-26pdb
Namespace:      default
Node:           minikube/192.168.99.100
Start Time:    Sat, 16 Sep 2017 22:04:07 +0700
Labels:         environment=development
               module=WebServer
               name=web
               owner=Praparn_L
               pod-template-hash=336910061
               version=1.0
Annotations:   kubernetes.io/created-by={"kind":"SerializedReference","apiVersion":"v1","reference":{"kind":"ReplicaSet","namespace":"default","name":"webtest-336910061","uid":"4992f987-9af0-11e7-bc1a-080027fb95be",...}
Status:        Running
```

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



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Liveness and Readiness Probe

- ExecAction:

```
Events:
FirstSeen    LastSeen    Count  From          SubObjectPath             Type   Reason        Message
-----    -----    ----  -----          -----             -----   -----   -----
7m          7m           1      default-scheduler
y assigned webtest-336910061-26pdb to minikube
7m          7m           1      kubelet, minikube
 SetUp succeeded for volume "default-token-pcw4h"
2m          2m           8      kubelet, minikube   spec.containers{webtest}   Warning  Unhealthy
probe failed: cat: can't open '/usr/src/app/main.py': No such file or directory
2m          2m           3      kubelet, minikube   spec.containers{webtest}   Warning  Unhealthy
Liveness probe failed: cat: can't open '/us
r/src/app/main.py': No such file or directory
7m          2m           2      kubelet, minikube   spec.containers{webtest}   Normal   Pulled  Container image "labdocker/cluster:webservicelite_v
1" already present on machine
7m          2m           2      kubelet, minikube   spec.containers{webtest}   Normal   Created  Created container
7m          2m           2      kubelet, minikube   spec.containers{webtest}   Normal   Started  Started container
2m          2m           1      kubelet, minikube   spec.containers{webtest}   Normal   Killing  Killing container with id docker://webtest:pod "web
test-336910061-26pdb_default(499cef14-9af0-11e7-bc1a-080027fb95be)" container "webtest" is unhealthy, it will be killed and re-created.
praparns-MacBook-Pro% █
```

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



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Liveness and Readiness Probe

- TCP Socket Action:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  replicas: 1
  revisionHistoryLimit: 3
  selector:
    matchLabels:
      name: web
      owner: Praparn_L
      version: "1.0"
      module: WebServer
      environment: development
  template:
    metadata:
      labels:
        name: web
        owner: Praparn_L
        version: "1.0"
        module: WebServer
        environment: development
```

```
28   spec:
29     containers:
30       - name: webtest
31         image: labdocker/cluster:webservicelite_v1
32         ports:
33           - name: webservice
34             containerPort: 5000
35             protocol: TCP
36             readinessProbe:
37               tcpSocket:
38                 port: 5000
39             initialDelaySeconds: 15
40             periodSeconds: 5
41             livenessProbe:
42               tcpSocket:
43                 port: 5000
44             initialDelaySeconds: 15
45             periodSeconds: 15
```

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

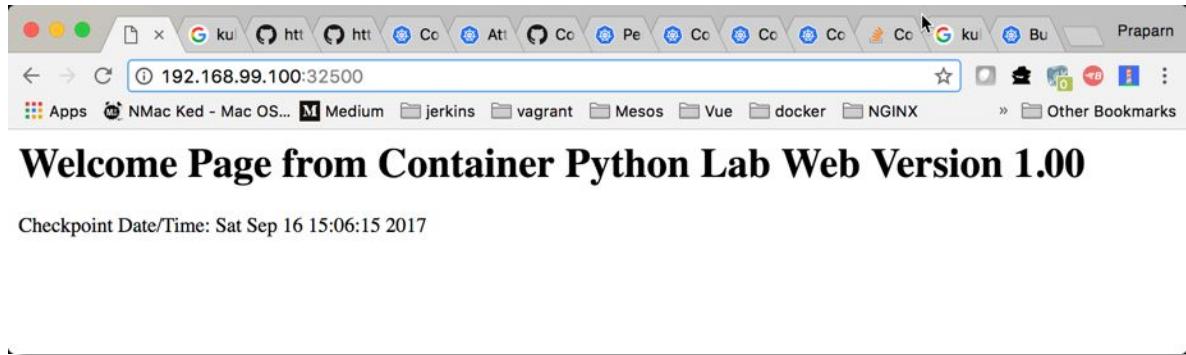
Kubernetes: Production Workload Orchestration



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Liveness and Readiness Probe

- TCPSocketAction:



```
[praparns-MacBook-Pro% kubectl create -f webtest_deploy_liveness_readiness_port.yml
deployment "webtest" created
[praparns-MacBook-Pro% kubectl get deployment/webtest
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
webtest   1          1          1           0           14s
[praparns-MacBook-Pro% kubectl get pods --show-labels
NAME            READY   STATUS    RESTARTS   AGE   LABELS
webtest-3579274848-1w2mn   0/1     Running   0          18s   environment=development,modu
hash=3579274848,version=1.0
```

Events:							
FirstSeen	LastSeen	Count	From	SubObjectPath	Type	Reason	Message
2m	2m	1	default-scheduler		Normal	Scheduled	Successful
y	assigned webtest-3579274848-1w2mn to minikube				Normal	SuccessfulMountVolume	MountVolume
.	SetUp succeeded for volume "default-token-pcw4h"				Normal	Pulled	Container i
mage	"labdocke/cluster:webservicelite_v1" already present on machine			spec.containers{webtest}	Normal	Created	Created con
tainer			kubelet, minikube	spec.containers{webtest}	Normal	Started	Started con
tainer		1	kubelet, minikube	spec.containers{webtest}	Normal		

Ref: <https://kubernetes.io/docs/concepts/workloads/pods/pod-lifecycle/>

Kubernetes: Production Workload Orchestration



Liveness and Readiness Probe

- TCPSocketAction:

```
instruction.txt ! webtest_deploy_liveness_readiness_port.yml •  
21     spec:  
22       containers:  
23         - name: webtest  
24           image: labdocker/cluster:webserviceelite_v1  
25           ports:  
26             - name: webservice  
27               containerPort: 5000  
28               protocol: TCP  
29             readinessProbe:  
30               tcpSocket:  
31                 port: 3000  
32               initialDelaySeconds: 15  
33               periodSeconds: 5  
34             livenessProbe:  
35               tcpSocket:  
36                 port: 3000  
37               initialDelaySeconds: 15  
38               periodSeconds: 15
```

```
praparns-MacBook-Pro% kubectl apply -f webtest_deploy_liveness_readiness_port.yml  
deployment "webtest" configured  
praparns-MacBook-Pro% kubectl get pods  
NAME          READY     STATUS    RESTARTS   AGE  
webtest-1810247028-x5xdf   0/1      Running   0          13s  
praparns-MacBook-Pro% kubectl describe pods/webtest-1810247028-x5xdf  
Name:           webtest-1810247028-x5xdf  
Namespace:      default  
Node:           minikube/192.168.99.100  
Start Time:     Sat, 16 Sep 2017 22:32:18 +0700  
Labels:          environment=development  
                  module=WebServer  
                  name=web  
                  owner=Praparn_L  
                  pod-template-hash=1810247028  
                  version=1.0  
Annotations:    kubernetes.io/created-by={"kind":"SerializedReference","apiVersion":"v1","reference":{"kind":"ReplicaSet","namespace":"default","name":"webtest-1810247028","uid":"38ea7253-9af4-11e7-bc1a-080027fb95be"}...
```



Liveness and Readiness Probe

- TCPSocketAction:

Events:								
FirstSeen	LastSeen	Count	From	SubObjectPath	Type	Reason	Message	
4m	4m	1	default-scheduler		Normal	Scheduled	Successful	
y assigned webtest-1810247028-x5xdf to minikube								
4m	4m	1	kubelet, minikube		Normal	SuccessfulMountVolume	MountVolume	
.SetUp succeeded for volume "default-token-pcw4h"								
4m	38s	6	kubelet, minikube	spec.containers{webtest}	Normal	Pulled	Container i	
mage "labdocker/cluster:webservicelite_v1" already present on machine								
4m	38s	6	kubelet, minikube	spec.containers{webtest}	Normal	Created	Created con	
tainer								
4m	38s	6	kubelet, minikube	spec.containers{webtest}	Normal	Started	Started con	
tainer								
3m	38s	5	kubelet, minikube	spec.containers{webtest}	Normal	Killing	Killing con	
tainer with id docker://webtest:pod "webtest-1810247028-x5xdf_default(38f840f4-9af4-11e7-bc1a-080027fb95be)" container "webtest" is unhealthy, it w								
ill be killed and re-created.								
4m	9s	12	kubelet, minikube	spec.containers{webtest}	Warning	Unhealthy	Liveness pr	
obe failed: dial tcp 172.17.0.6:3000: getsockopt: connection refused								
4m	4s	37	kubelet, minikube	spec.containers{webtest}	Warning	Unhealthy	Readiness p	
robe failed: dial tcp 172.17.0.6:3000: getsockopt: connection refused								
www www MacBook Pro% █								

Liveness and Readiness Probe

- HTTPGetAction:



Liveness and Readiness Probe

- HTTPGetAction:

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webtest
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  replicas: 1
  revisionHistoryLimit: 3
  selector:
    matchLabels:
      name: web
      owner: Praparn_L
      version: "1.0"
      module: WebServer
      environment: development
  template:
    metadata:
      labels:
        name: web
        owner: Praparn_L
        version: "1.0"
        module: WebServer
        environment: development
```

```
28   spec:
29     containers:
30       - name: webtest
31         image: labdocker/cluster:webservicelite_v1
32         ports:
33           - name: webservice
34             containerPort: 5000
35             protocol: TCP
36         readinessProbe:
37           httpGet:
38             # Optional "host: my-host" for set specific ip of Pods
39             # Optional "scheme: HTTPS"
40             #schema: HTTPS
41             path: /
42             port: webservice
43           initialDelaySeconds: 15
44           periodSeconds: 5
45           timeoutSeconds: 10
46           successThreshold: 1
47           failureThreshold: 3
48         livenessProbe:
49           httpGet:
50             # Optional "host: my-host" for set specific ip of Pods
51             # Optional "scheme: HTTPS"
52             #schema: HTTPS
53             path: /
54             port: webservice
55           initialDelaySeconds: 15
56           periodSeconds: 10
57           timeoutSeconds: 15
58           successThreshold: 1
59           failureThreshold: 3
```



Liveness and Readiness Probe

- HTTPGetAction:

```
praparns-MacBook-Pro% kubectl create -f webtest_deploy_liveness_readiness_http.yml
  kubectl get deployment/webtest
  kubectl get pods --show-labels
deployment "webtest" created
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE
webtest   1          0          0           0           0s
NAME              READY   STATUS        RESTARTS   AGE   LABELS
webtest-1098172621-zvd22  0/1   ContainerCreating   0          0s   environment=development,module=WebServer,name=web,owner=Praparn_L,pod
-ttemplate-hash=1098172621,version=1.0

```

Events:								
FirstSeen	LastSeen	Count	From	SubObjectPath	Type	Reason	Message	
9m	9m	1	default-scheduler		Normal	Scheduled	Successful	
y	assigned webtest-1098172621-zvd22 to minikube							
9m	9m	1	kubelet, minikube		Normal	SuccessfulMountVolume	MountVolume	
.SetUp succeeded for volume "default-token-pcw4h"								
9m	9m	1	kubelet, minikube	spec.containers{webtest}	Normal	Pulled	Container i	
mage	labdocker/cluster:webserviceelite_v1" already present on machine							
9m	9m	1	kubelet, minikube	spec.containers{webtest}	Normal	Created	Created con	
9m	9m	1	kubelet, minikube	spec.containers{webtest}	Normal	Started	Started con	
tainer								
tainer								

Liveness and Readiness Probe

- HTTPGetAction:

```
29      livenessProbe:  
30        httpGet:  
31          # Optional "host: my-host" for set specific ip of Pods  
32          # Optional "scheme: HTTPS"  
33          #schema: HTTPS  
34          path: /init  
35          port: webservice  
36          httpHeaders:  
37            - name: server  
38            value: "Werkzeug/0.12.2 Python/2.7.13"  
39          initialDelaySeconds: 15  
40          periodSeconds: 5  
41          timeoutSeconds: 5  
42          successThreshold: 1  
43          failureThreshold: 3  
44      livenessProbe:  
45        httpGet:  
46          # Optional "host: my-host" for set specific ip of Pods  
47          # Optional "scheme: HTTPS"  
48          #schema: HTTPS  
49          path: /init  
50          port: webservice  
51          httpHeaders:  
52            - name: server  
53            value: "Werkzeug/0.12.2 Python/2.7.13"  
54          initialDelaySeconds: 15  
55          periodSeconds: 5  
56          timeoutSeconds: 5  
57          successThreshold: 1  
58          failureThreshold: 3
```

```
praparns-MacBook-Pro% kubectl apply -f webtest_deploy_liveness_readiness_http.yml  
deployment "webtest" configured  
praparns-MacBook-Pro% kubectl get deployment/webtest  
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE  
webtest   1          1          1           0           14m  
praparns-MacBook-Pro% kubectl get deployment/webtest  
NAME      DESIRED   CURRENT   UP-TO-DATE   AVAILABLE   AGE  
webtest   1          1          1           0           15m  
praparns-MacBook-Pro% kubectl get pods  
NAME                  READY   STATUS    RESTARTS   AGE  
webtest-692878837-fxpw4   0/1     Running   3          1m
```



Liveness and Readiness Probe

- HTTPGetAction:

Events:								
FirstSeen	LastSeen	Count	From	SubObjectPath	Type	Reason	Message	
1m	1m	1	default-scheduler		Normal	Scheduled	Successful	
y assigned webtest-692878837-fxpw4 to minikube								
1m	1m	1	kubelet, minikube		Normal	SuccessfulMountVolume	MountVolume	
.SetUp succeeded for volume "default-token-pcw4h"								
1m	13s	5	kubelet, minikube	spec.containers{webtest}	Normal	Pulled	Container i	
mage "labdocker/cluster:webservicelite_v1" already present on machine								
1m	13s	9	kubelet, minikube	spec.containers{webtest}	Warning	Unhealthy	Readiness p	
robe failed: HTTP probe failed with statuscode: 404								
1m	13s	9	kubelet, minikube	spec.containers{webtest}	Warning	Unhealthy	Liveness pr	
obe failed: HTTP probe failed with statuscode: 404								
1m	13s	4	kubelet, minikube	spec.containers{webtest}	Normal	Killing	Killing con	
tainer with id docker://webtest:pod "webtest-692878837-fxpw4_default(4f6f205f-9b00-11e7-bc1a-080027fb95be)" container "webtest" is unhealthy, it wi								
ll be killed and re-created.								
1m	12s	5	kubelet, minikube	spec.containers{webtest}	Normal	Created	Created con	
tainer								
1m	12s	5	kubelet, minikube	spec.containers{webtest}	Normal	Started	Started con	
tainer								
praparns-MacBook-Pro%								

Liveness and Readiness Probe

- ReadinessGate:

```
Users > praparnlueangphoonlap > Desktop > ! 1.yaml
1   kind: Pod
2   ...
3   spec:
4     readinessGates:
5       - conditionType: "www.example.com/feature-1"
6   status:
7     conditions:
8       - type: Ready                      # a built in PodCondition
9         status: "False"
10        lastProbeTime: null
11        lastTransitionTime: 2018-01-01T00:00:00Z
12       - type: "www.example.com/feature-1"      # an extra PodCondition
13         status: "False"
14         lastProbeTime: null
15         lastTransitionTime: 2018-01-01T00:00:00Z
16     containerStatuses:
17       - containerID: docker://abcd...
18         ready: true
19   ...
```

Workshop: Liveness and Readiness

The screenshot shows a web browser window with the URL `http://192.168.99.100:32500`. The page title is "Welcome Page from Container Python Lab Web Version 1.00". Below the title, it says "Checkpoint Date/Time: Sat Sep 16 15:54:10 2017". To the right of the browser, a Postman application window is open, showing a list of API requests and their details.

Postman Application Details:

- Builder Tab:** Shows a collection named "http://192.168.99.100" with one GET request to `http://192.168.99.100:32500`.
- Authorization Tab:** Set to "No Auth".
- Headers Tab:** Contains four headers:
 - `content-length` → 113
 - `content-type` → `text/html; charset=utf-8`
 - `date` → `Sat, 16 Sep 2017 15:56:21 GMT`
 - `server` → `Werkzeug/0.12.2 Python/2.7.13`
- Code Tab:** Shows status `200 OK` and time `46 ms`.

Postman History:

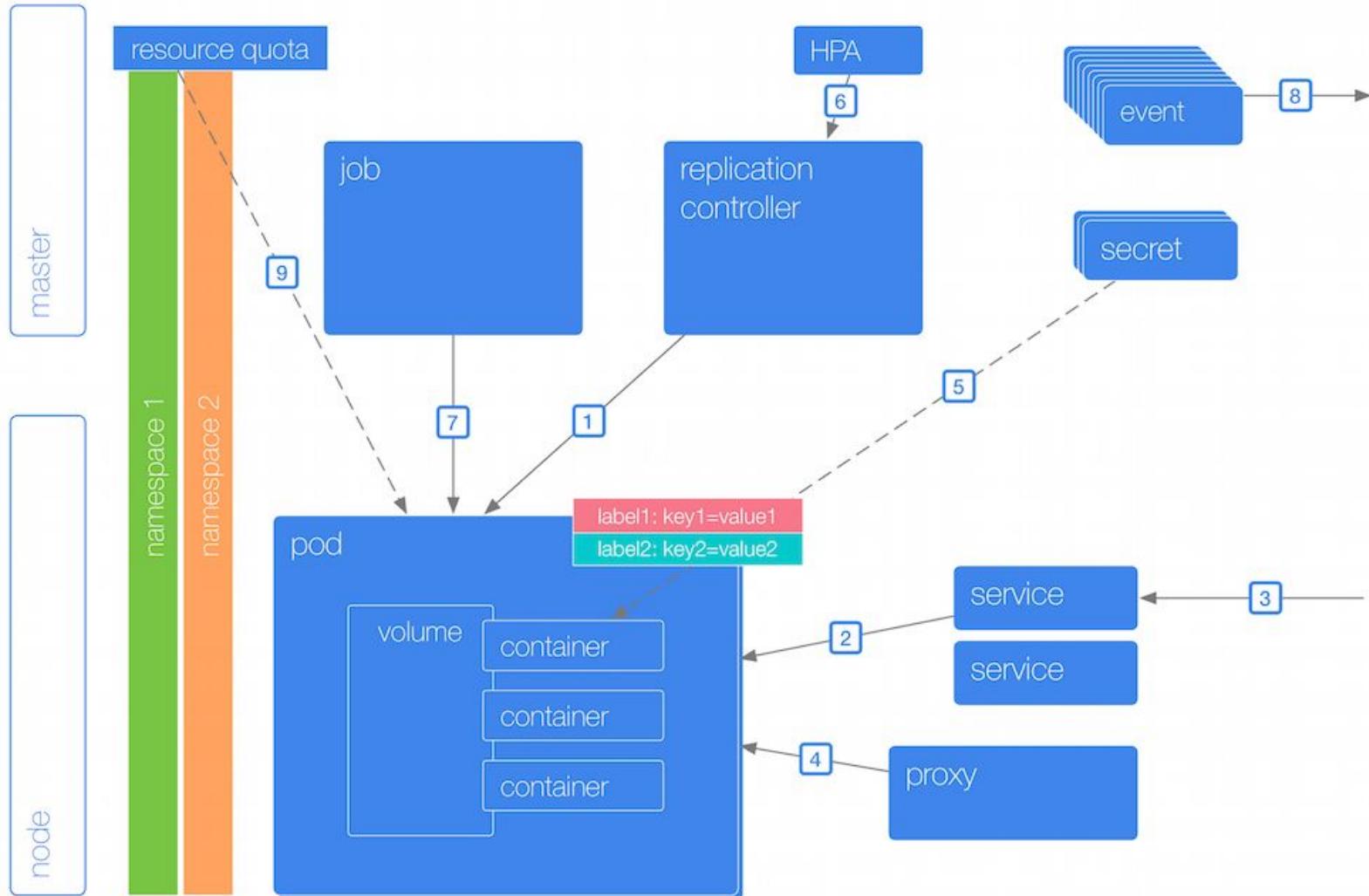
- Today:** One GET request to `http://192.168.99.100:32500`.
- September 8:** Four requests:
 - GET to `http://192.168.99.100/users/removeUser/99`
 - GET to `http://192.168.99.100/users/1`
 - POST to `http://192.168.99.100/users/insertUser`
 - GET to `http://192.168.99.100/init`
- August 27:** One GET request to `http://192.168.99.100/`.



Resource Management and HPA



Resource Management and HPA



Ref: <http://k8s.info/cs.html>

Kubernetes: Production Workload Orchestration



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Resource Management and HPA

- Kubernetes can manage resource in 2 ways
 - Container level configuration
 - Scope on Container unit independence
 - etc
 - Namespace level configuration
 - Scope on Pods and Container level
 - Create global limit and assign to namespace
 - Apply namespace to any Pods (Template Resource Limit)
- What happen when Container resource exceed ?
 - CPU
 - Container will not get CPU as it need and the free-slot of CPU was distributed to all container's request with ratio
 - Memory
 - Container was killed and restart it again



Resource Management and HPA

- Container level configuration
 - CPU
 - Request:
 - XXXm (Unit: millicores) (Ratio: 1024)
 - 0.1 = 100m
 - 1 CPU =
 - 1 vCPU (AWS)
 - 1 GCP (Google Cloud)
 - 1 Azure v Core
 - 1 Hyper thread (Bare Metal)
 - Consider as “--cpu-share”
 - Limit:
 - XXXm (Unit: millicores) (Ratio: 100000/1000: ~1000)
 - Consider as “--cpu-quota”
 - Memory
 - Request:
 - XXX (Unit: Ki, Mi, Gi, Pi, Ei)
 - Limit
 - XXX (Unit: Ki, Mi, Gi, Pi, Ei)

Ref: <https://github.com/kubernetes/community/blob/master/contributors/design-proposals/resource-qos.md>

Kubernetes: Production Workload Orchestration



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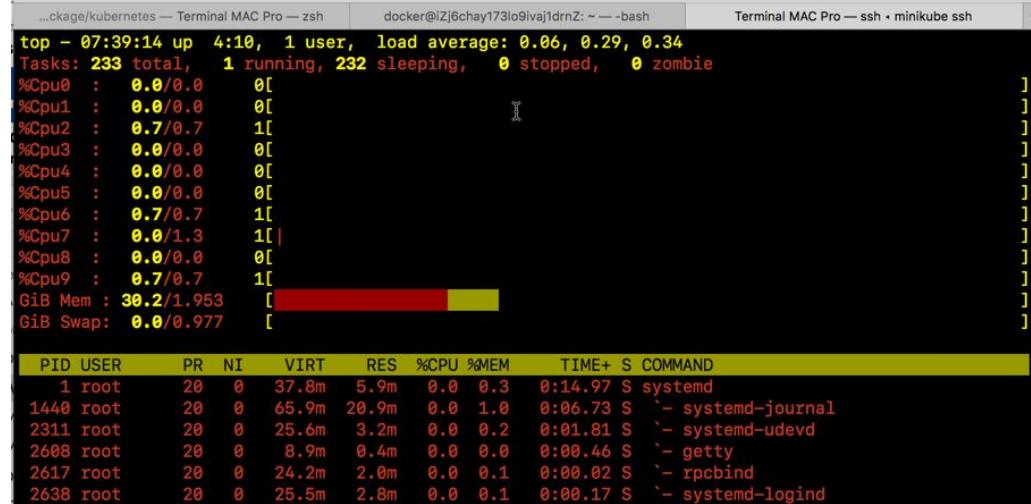
Resource Management and HPA

- Container level configuration

- Pods “webtest”

```
1 apiVersion: "v1"
2 kind: Pod
3 metadata:
4   name: webtest
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9   module: WebServer
10  environment: development
11 spec:
12   containers:
13     - name: webtest
14       image: labdocker/cluster:webservicelite_v1
15     resources:
16       requests:
17         memory: "16Mi"
18         cpu: "100m"
19       limits:
20         memory: "32Mi"
21         cpu: "1"
22     ports:
23       - containerPort: 5000
24         protocol: TCP
```

System status



The screenshot shows a terminal window with three panes. The left pane displays a YAML configuration file for a Kubernetes pod named 'webtest'. The middle pane shows the output of the 'top' command, which provides a real-time view of system tasks and resource usage across eight CPU cores. The right pane shows the output of the 'ps' command, listing processes by PID, user, and command.

PID	USER	PR	NI	VIRT	RES	%CPU	%MEM	TIME+	S	COMMAND
1	root	20	0	37.8m	5.9m	0.0	0.3	0:14.97	S	systemd
1440	root	20	0	65.9m	20.9m	0.0	1.0	0:06.73	S	- systemd-journal
2311	root	20	0	25.6m	3.2m	0.0	0.2	0:01.81	S	- systemd-udevd
2608	root	20	0	8.9m	0.4m	0.0	0.0	0:00.46	S	- getty
2617	root	20	0	24.2m	2.0m	0.0	0.1	0:00.02	S	- rpcbind
2638	root	20	0	25.5m	2.8m	0.0	0.1	0:00.17	S	- systemd-logind



Resource Management and HPA

- Container level configuration
 - Allocate status on node

Namespace	Name	CPU Requests	CPU Limits	Memory Requests	Memory Limits
default	cadvisor-76c9899d7f-pbz29	0 (0%)	0 (0%)	0 (0%)	0 (0%)
default	webtest	100m (1%)	1 (10%)	16Mi (0%)	32Mi (1%)
kube-system	default-http-backend-xq22v	10m (0%)	10m (0%)	20Mi (1%)	20Mi (1%)
kube-system	heapster-4nfdm	0 (0%)	0 (0%)	0 (0%)	0 (0%)
kube-system	influxdb-grafana-kzmsf	0 (0%)	0 (0%)	0 (0%)	0 (0%)
kube-system	kube-addon-manager-minikube	5m (0%)	0 (0%)	50Mi (2%)	0 (0%)
kube-system	kube-dns-54cccfbd8-tqh51	260m (2%)	0 (0%)	110Mi (5%)	170Mi (8%)
kube-system	kubernetes-dashboard-77d8b98585-z4lxz	0 (0%)	0 (0%)	0 (0%)	0 (0%)
kube-system	nginx-ingress-controller-hjwt6	0 (0%)	0 (0%)	0 (0%)	0 (0%)
kube-system	storage-provisioner	0 (0%)	0 (0%)	0 (0%)	0 (0%)



Resource Management and HPA

- Container level configuration
 - Create Load on CPU (T1)

```
[praparns-MacBook-Pro% kubectl create -f webtest_pod.yml
pod "webtest" created
[praparns-MacBook-Pro% kubectl get pods
  NAME      READY     STATUS    RESTARTS   AGE
  webtest   1/1      Running   0          13m
[praparns-MacBook-Pro% kubectl exec webtest -c webtest md5sum /dev/urandom
^C
praparns-MacBook-Pro%
```

- System status

```
top - 07:45:00 up 4:16, 1 user, load average: 0.69, 0.35, 0.33
Tasks: 234 total, 2 running, 232 sleeping, 0 stopped, 0 zombie
%Cpu0 : 0.0/0.0  0[                ]
%Cpu1 : 0.0/1.3  1[|               ]
%Cpu2 : 0.0/0.0  0[                ]
%Cpu3 : 26.2/73.8 100[███████████]
%Cpu4 : 0.7/0.0  1[                ]
%Cpu5 : 0.7/0.0  1[                ]
%Cpu6 : 0.7/0.0  1[                ]
%Cpu7 : 0.7/0.7  1[                ]
%Cpu8 : 0.7/0.0  1[                ]
%Cpu9 : 0.7/0.7  1[                ]
GiB Mem : 31.2/1.953 [███████████]
GiB Swap: 0.0/0.977 [                ]
```

Resource Management and HPA

- Container level configuration
 - Create Load on CPU (T2)

```
praparns-MacBook-Pro% kubectl create -f webtest_pod.yml
pod "webtest" created
praparns-MacBook-Pro% kubectl get pods
NAME      READY     STATUS    RESTARTS   AGE
webtest   1/1      Running   0          13m
praparns-MacBook-Pro% kubectl exec webtest -c webtest md5sum /dev/urandom
^C
praparns-MacBook-Pro% kubectl exec webtest -c webtest md5sum /dev/urandom
^C
praparns-MacBook-Pro%
```

- ### ○ System status

Workshop: Resource MNG/HPA

- Part 1: Container level configuration

```
top - 07:45:00 up 4:16, 1 user, load average: 0.69, 0.35, 0.33
Tasks: 234 total, 2 running, 232 sleeping, 0 stopped, 0 zombie
%CPU0 : 0.0/0.0   0[ ]
%CPU1 : 0.0/1.3   1[ ]
%CPU2 : 0.0/0.0   0[ ]
%CPU3 : 26.2/73.8 100[███████████] 26.2%
%CPU4 : 0.7/0.0   1[ ]
%CPU5 : 0.7/0.0   1[ ]
%CPU6 : 0.7/0.0   1[ ]
%CPU7 : 0.7/0.7   1[ ]
%CPU8 : 0.7/0.0   1[ ]
%CPU9 : 0.7/0.7   1[ ]
GiB Mem : 31.2/1.953 [███████████] 1.6%
GiB Swap: 0.0/0.977 [ ] 0%
```



Resource Management and HPA

- Namespace level configuration
 - Name space provide collection of resource of cluster system that easy to defined and apply to object in cluster system
 - Name space can apply with
 - Pods
 - Services
 - Replication Controller
 - Deployment and ReplicaSets
 - Quota
 - LimitRange
 - Etc
 - For resource management resource in name space level. We will use Quota and LimitRange
 - Quota: Summary of resource control on name space
 - LimitRange: Resource admission control/Default resource define



Resource Management and HPA

- Quota
 - Compute resource
 - CPU
 - Limits
 - Request
 - Memory
 - Limits
 - Request
 - Disk I/O
 - PersistentVolumeClaims
 - Request.Storage
 - Counting Object
 - Pods
 - Service
 - Replication Controller
 - ConfigMap
 - Secrets

```
1  apiVersion: v1
2  kind: ResourceQuota
3  metadata:
4    name: webtest-quota
5    labels:
6      name: webtest_quota
7      owner: Praparn_L
8      version: "1.0"
9      module: Quota
10     environment: development
11   spec:
12     hard:
13       pods: "4"
14       requests.cpu: "1"
15       requests.memory: 1Gi
16       limits.cpu: "4"
17       limits.memory: 4Gi
```

Ref: <https://kubernetes.io/docs/concepts/policy/resource-quotas>

Kubernetes: Production Workload Orchestration



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Resource Management and HPA

- LimitRange
 - Type: (Pods/Container)
 - Max
 - CPU:
 - Memory:
 - Min
 - CPU
 - Memory
 - Default (Limit Default for Container)
 - CPU
 - Memory
 - DefaultRequest (Default for Container)
 - CPU
 - Memory

```
1  apiVersion: v1
2  kind: LimitRange
3  metadata:
4    name: webtest_limit
5    labels:
6      name: webtest_limit
7      owner: Praparn_L
8      version: "1.0"
9    module: LimitRange
10   environment: development
11  spec:
12    limits:
13      - max:
14        cpu: "1"
15        memory: 1Gi
16      min:
17        cpu: 200m
18        memory: 6Mi
19      type: Pod
20    - default:
21      cpu: 300m
22      memory: 200Mi
23    defaultRequest:
24      cpu: 200m
25      memory: 100Mi
26    max:
27      cpu: "1"
28      memory: 1Gi
29    min:
30      cpu: 100m
31      memory: 3Mi
32    type: Container
```

Ref: <https://kubernetes.io/docs/tasks/administer-cluster/apply-resource-quota-limit/>

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Resource Management and HPA

- Create Namespace, assign quota with name space

```
kubectl create namespace <name>
```

```
kubectl create -f <Quota File> -- namespace <name>
```

```
praparns-MacBook-Pro% kubectl create namespace webtest-namespace
namespace "webtest-namespace" created
praparns-MacBook-Pro% kubectl create -f webtest_quota.yml --namespace=webtest-namespace
resourcequota "webtest-quota" created
praparns-MacBook-Pro% kubectl describe namespace webtest-namespace
Name:           webtest-namespace
Labels:         <none>
Annotations:    <none>
Status:         Active
                □

Resource Quotas
  Name:          webtest-quota
  Resource      Used   Hard
  ----          ---   ---
  limits.cpu    0      4
  limits.memory 0      4Gi
  pods          0      4
  requests.cpu  0      1
  requests.memory 0     1Gi

  No resource limits.
praparns-MacBook-Pro%
```

Ref: <https://kubernetes.io/docs/concepts/policy/resource-quotas>

Kubernetes: Production Workload Orchestration



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Resource Management and HPA

- Deployment

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12   spec:
13     selector:
14       name: web
15       owner: Praparn_L
16       version: "1.0"
17       module: WebServer
18       environment: development
19
20     type: NodePort
21     ports:
22       - port: 5000
23         name: http
24         targetPort: 5000
25         protocol: TCP
26         nodePort: 32500
27
28   apiVersion: apps/v1
29   kind: Deployment
30   metadata:
31     name: webtest
32     labels:
33       name: web
34       owner: Praparn_L
35       version: "1.0"
```

```
35     module: WebServer
36     environment: development
37
38   spec:
39     replicas: 1
40     template:
41       metadata:
42         labels:
43           name: web
44           owner: Praparn_L
45           version: "1.0"
46           module: WebServer
47           environment: development
48
49   spec:
50     containers:
51       - name: webtest
52         image: labdocker/cluster:webservicelite_v1
53         ports:
54           - containerPort: 5000
55             protocol: TCP
```



Resource Management and HPA

- Create Deployment and check result

```
kubectl create -f <Deployment File> --namespace <name>
```

```
praparns-MacBook-Pro% kubectl create -f webtest_deploy.yml --namespace=webtest-namespace
service "webtest" created
deployment "webtest" created
[praparns-MacBook-Pro% kubectl get deployment/webtest --namespace=webtest-namespace
NAME      DESIRED  CURRENT  UP-TO-DATE  AVAILABLE   AGE
webtest    1         0         0          0           5m
[praparns-MacBook-Pro% kubectl get rs --namespace=webtest-namespace
NAME      DESIRED  CURRENT  READY     AGE
webtest-4261491039  1         0         0           5m
[praparns-MacBook-Pro% kubectl get svc/webtest --namespace=webtest-namespace
NAME      CLUSTER-IP  EXTERNAL-IP  PORT(S)        AGE
webtest  10.0.0.48  <nodes>      5000:32500/TCP  5m
[praparns-MacBook-Pro% kubectl get pods --namespace=webtest-namespace
No resources found.
praparns-MacBook-Pro%
```



Resource Management and HPA

- Why it fail ?

```
kubectl describe rs --namespace <name>
```

```
Events:
FirstSeen      LastSeen      Count   From            SubObjectPath      Type    Reason          Message
-----      -----      ----   ----            -----      ----    ----          -----
6m           5m           15   replicaset-controller      Warning   FailedCreate  Error creating: pods "webtest-4261491039-" is
forbidden: failed quota: webtest-quota: must specify limits.cpu,limits.memory,requests.cpu,requests.memory
```

```
spec:
  replicas: 1
  template:
    metadata:
      labels:
        name: web
        owner: Praparn_L
        version: "1.0"
        module: WebServer
        environment: development
    spec:
      containers:
        - name: webtest
          image: labdocker/cluster:webservicelite_v1
          ports:
            - containerPort: 5000
              protocol: TCP
```



Resource Management and HPA

- Create LimitRange and check result

```
kubectl create -f <LimitRange File> --namespace <name>
```

```
praparns-MacBook-Pro% kubectl create -f webtest_limit.yml --namespace=webtest-namespace
limitrange "webtest-limit" created
praparns-MacBook-Pro% kubectl describe namespace/webtest-namespace
Name:           webtest-namespace
Labels:         <none>
Annotations:    <none>
Status:         Active

Resource Quotas
  Name:          webtest-quota
  Resource      Used   Hard
  ----          ---    ---
  limits.cpu    0       4
  limits.memory 0       4Gi
  pods          0       4
  requests.cpu  0       1
  requests.memory 0       1Gi

Resource Limits
  Type        Resource  Min   Max   Default Request Default Limit  Max Limit/Request Ratio
  ----        -----  ---   ---   -----      -----      -----      -----
  Pod         cpu      200m  1     -          -          -
  Pod         memory  6Mi   1Gi   -          -          -
  Container   cpu      100m  1     200m      300m      -
  Container   memory  3Mi   1Gi   100Mi    200Mi     -
```



Resource Management and HPA

- Recreate Deployment and check result

```
praparns-MacBook-Pro% kubectl delete -f webtest_deploy.yml --namespace=webtest-namespace
service "webtest" deleted
deployment "webtest" deleted
praparns-MacBook-Pro% kubectl create -f webtest_deploy.yml --namespace=webtest-namespace
service "webtest" created
deployment "webtest" created
praparns-MacBook-Pro% kubectl get deployment/webtest --namespace=webtest-namespace
NAME      DESIRED  CURRENT  UP-TO-DATE  AVAILABLE   AGE
webtest   1         1         1           1           5m
praparns-MacBook-Pro% kubectl get rs --namespace=webtest-namespace
NAME      DESIRED  CURRENT  READY     AGE
webtest-4261491039  1         1         1           5m
praparns-MacBook-Pro% kubectl get svc/webtest --namespace=webtest-namespace
NAME      CLUSTER-IP    EXTERNAL-IP    PORT(S)        AGE
webtest  10.0.0.125  <nodes>        5000:32500/TCP  5m
praparns-MacBook-Pro% kubectl get pods --namespace=webtest-namespace
NAME          READY  STATUS    RESTARTS  AGE
webtest-4261491039-pft5m  1/1    Running   0          5m
praparns-MacBook-Pro% curl http://192.168.99.100:32500
<H1> Welcome Page from Container Python Lab Web Version 1.00 </H1>Checkpoint Date/Time: Sat Jul  8 13:44:12 2017
praparns-MacBook-Pro%
```

Resource Management and HPA

- Check describe of Pods

```
kubectl describe pods --namespace <name>
```

```
Status:          Running
IP:             172.17.0.2
Controllers:    ReplicaSet/webtest-4261491039
Containers:
  webtest:
    Container ID:      docker://0acf26d00b7b9f28b200fdfc
    Image:            labdocker/cluster:webservicelite_
    Image ID:         docker-pullable://labdocker/clust
    Port:             5000/TCP
    State:            Running
    Started:          Sat, 08 Jul 2017 20:43:27 +0700
    Ready:            True
    Restart Count:   0
    Limits:
      cpu:        300m
      memory:     200Mi
    Requests:
      cpu:        200m
      memory:     100Mi
    Environment:    <none>
    Mounts:
```



Resource Management and HPA

- Test burn cpu utilize and monitor

```
[praparns-MacBook-Pro: ~] kubectl exec -it webtest-4261491039-pft5m -c webtest md5sum /dev/urandom --namespace=webtest-namespace
```

```
top - 13:57:03 up 7:33, 1 user,  load average: 0.22, 0.35, 0.20
Tasks: 228 total,  2 running, 226 sleeping,  0 stopped,  0 zombie
%Cpu0 : 0.0/0.0   0[ ]
%Cpu1 : 0.7/0.7   1[|||]
%Cpu2 : 0.0/0.0   0[ ]
%Cpu3 : 0.0/0.0   0[ ]
%Cpu4 : 0.0/0.0   0[ ]
%Cpu5 : 0.0/0.7   1[|]
%Cpu6 : 0.0/0.0   0[ ]
%Cpu7 : 0.7/0.7   1[||]
%Cpu8 : 7.9/21.9  30[||||||||||||||||||||||||||||||||]
%Cpu9 : 0.0/0.0   0[ ]
GiB Mem : 32.4/1.953 [███████████] 100%
GiB Swap: 0.0/0.977 [ ]
```

Resource Management and HPA

- Edit deployment for update cpu/memory Limits,request

```
[praparn-MacBook-Pro% kubectl set resources deployment/webtest --limits=cpu="1",memory=1Gi --requests=cpu="0.8",memory=800Mi --record
--namespace=webtest-namespace
deployment "webtest" resource requirements updated

[praparn-MacBook-Pro% kubectl describe pods webtest-d6986bb64-bm5q9 --namespace=webtest-namespace
Name:           webtest-d6986bb64-bm5q9
Namespace:      webtest-namespace
Node:          minikube/192.168.99.100
Start Time:    Wed, 21 Mar 2018 00:46:27 +0700
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                pod-template-hash=825426620
                version=1.0
Annotations:   <none>
Status:        Running
IP:            172.17.0.11
Controlled By: ReplicaSet/webtest-d6986bb64
Containers:
  webtest:
    Container ID:  docker://7e1ae95ed7db8fb9c91b9bcf89b97aedef9e8592d129852930835e744a12b6b6
    Image:         labdocker/cluster:webserviceelite_v1
    Image ID:     docker-pullable://labdocker/cluster@sha256:f0f261307a9a0ce8acf317f533e22c3aa438b3a7c5d4c0b5705ce67504326940
    Port:          5000/TCP
    State:        Running
      Started:    Wed, 21 Mar 2018 00:46:28 +0700
    Ready:        True
    Restart Count: 0
    Limits:
      cpu: 1
      memory: 1Gi
    Requests:
      cpu: 800m
      memory: 800Mi
    Environment:  <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-n8h4m (ro)
```



Workshop: Resource MNG/HPA

- Part 2: Namespace level configuration



192.168.99.100:32500

Apps NMac Ked - Mac O... Medium jenkins vagrant Mesos Vue docker NGINX Taiwan Kuberr

Welcome Page from Container Python Lab Web Version 1.00

Checkpoint Date/Time: Sat Jul 8 14:10:26 2017

System Info:	Value				
Machine ID:	88a2186a47ff442aa72465d9e09fc21f				
System UUID:	F631F911-A47C-493D-BFCB-872F1F5C2D30				
Boot ID:	99b9bb5a-67ba-43d0-bed1-e64fe04c367d				
Kernel Version:	4.9.13				
OS Image:	Buildroot 2017.02				
Operating System:	linux				
Architecture:	amd64				
Container Runtime Version:	docker://1.12.6				
Kubelet Version:	v1.7.0-alpha.2				
Kube-Proxy Version:	v1.7.0-alpha.2				
ExternalID:	minikube				
Non-terminated Pods:	(4 in total)				
Namespace	Name	CPU Requests	CPU Limits	Memory Requests	Memory Limits
kube-system	kube-addon-manager-minikube	5m (0%)	0 (0%)	50Mi (2%)	0 (0%)
kube-system	kube-dns-268032401-9h5s6	260m (2%)	0 (0%)	110Mi (5%)	170Mi (8%)
kube-system	kubernetes-dashboard-2vk98	0 (0%)	0 (0%)	0 (0%)	0 (0%)
webtest-namespace	webtest-4261491039-pft5m	200m (2%)	300m (3%)	100Mi (5%)	200Mi (10%)
Allocated resources:	(Total limits may be over 100 percent, i.e., overcommitted.)				
CPU Requests	CPU Limits	Memory Requests	Memory Limits		
465m (4%)	300m (3%)	260Mi (13%)	370Mi (19%)		



Resource Management and HPA

- Qos for resource management
 - Kubernetes provide 3 type of Qos for defined resource
 - Guaranteed
 - Burstable
 - BestEffort
- Guaranteed: Reserve all resource for support as design,
Apply to all init/container equality
 - All Container in the Pod must have a memory limit/request.
 - All Container in the Pod, the memory limit = request.
 - All Container in the Pod must have a CPU limit/request.
 - All Container in the Pod, the CPU limit = request.
- Burstable: Extendable if resource is available
 - Does not meet the criteria for QoS class Guaranteed.
 - At least one Container in the Pod has a memory or CPU request.
- Best Effort:
 - Containers in the Pod must not have any memory or CPU limits or requests.



Workshop: Resource MNG/HPA

- Part 3: Qos POC

```
apiVersion: "v1"
kind: Pod
metadata:
  name: webtest
  namespace: qos-namespace
  labels:
    name: web
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  containers:
    - name: webtest
      image: labdocker/cluster:webserviceelite_v1
      resources:
        requests:
          memory: "16Mi"
          cpu: "150m"
        limits:
          memory: "16Mi"
          cpu: "150m"
      ports:
        - containerPort: 5000
          protocol: TCP
```



Resource Management and HPA

- Horizontal Pod Autoscaling (HPA)
 - The scale is easy to operate with "kubectl scale --replicas=XXX deployment/<name>" with single command
 - But..
 - How can you scale meet up/down actual required ?
 - HPA will response for monitor workload on Pods (Now base on CPU) and automatic trigger deployment to scale-up application

```
kubectl autoscale <type/name> <option:>
```

- Ex: kubectl autoscale deployment/webtest --min=1--max=10
--cpu-percent=80



Resource Management and HPA

```
27 apiVersion: apps/v1
28 kind: Deployment
29 metadata:
30   name: webtest
31   labels:
32     name: web
33     owner: Paparn_L
34     version: "1.0"
35     module: WebServer
36     environment: development
37 spec:
38   replicas: 1
39   revisionHistoryLimit: 3
40   selector:
41     matchLabels:
42       name: web
43       owner: Paparn_L
44       version: "1.0"
45       module: WebServer
46       environment: development
47 template:
48   metadata:
49     labels:
50       name: web
51       owner: Paparn_L
52       version: "1.0"
53       module: WebServer
54       environment: development
55 spec:
56   containers:
57     - name: webtest
58       image: labdocker/cluster:webservicelite_v1
59       resources:
60         requests:
61           cpu: "200m"
62       ports:
63         - containerPort: 5000
64           protocol: TCP
```

```
1  apiVersion: autoscaling/v2
2  kind: HorizontalPodAutoscaler
3  metadata:
4    annotations:
5      name: webtest
6      namespace: default
7  spec:
8    scaleTargetRef:
9      apiVersion: apps/v1
10     kind: Deployment
11     name: webtest
12   minReplicas: 1
13   maxReplicas: 10
14   metrics:
15     - type: Resource
16       resource:
17         name: cpu
18         target:
19           type: Utilization
20           averageUtilization: 10
21     #   - type: Resource
22     #     resource:
23     #       name: memory
24     #       target:
25     #         type: Utilization
26     #         averageUtilization: 20
```

```
1  apiVersion: v1
2  kind: Service
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Paparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11 spec:
12   selector:
13     name: web
14     owner: Paparn_L
15     version: "1.0"
16     module: WebServer
17     environment: development
18
19   type: NodePort
20   ports:
21     - port: 5000
22       name: http
23       targetPort: 5000
24       protocol: TCP
25       nodePort: 32500
```

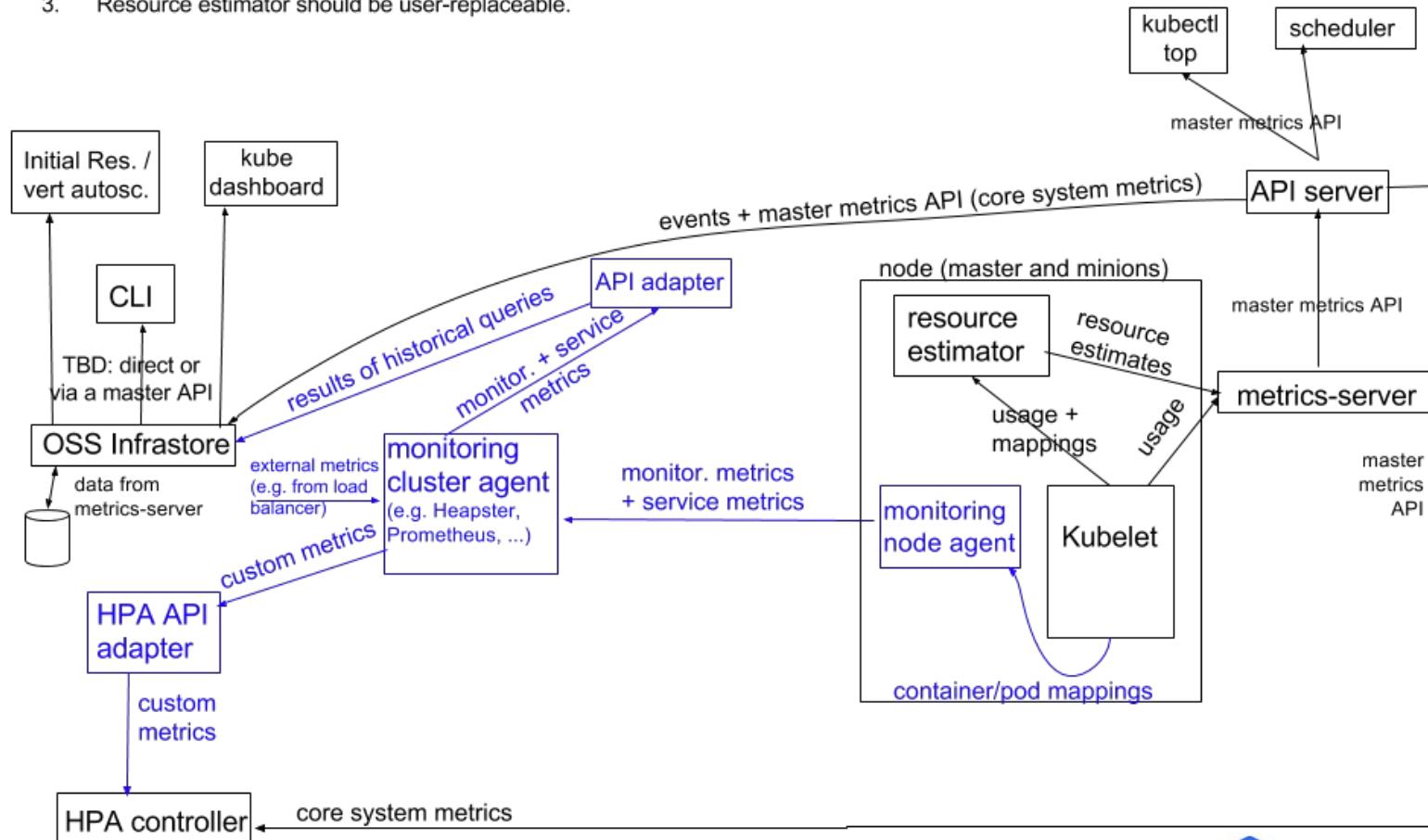


Resource Management and HPA

Monitoring architecture proposal: OSS
(arrows show direction of metrics flow)

Notes

1. Arrows show direction of metrics flow.
2. **Monitoring pipeline is in blue**. It is user-supplied and optional.
3. Resource estimator should be user-replaceable.



Resource Management and HPA

Algorithm Details

From the most basic perspective, the Horizontal Pod Autoscaler controller operates on the ratio between desired metric value and current metric value:

```
desiredReplicas = ceil[currentReplicas * ( currentMetricValue / desiredMetricValue )]
```

For example, if the current metric value is `200m`, and the desired value is `100m`, the number of replicas will be doubled, since `200.0 / 100.0 == 2.0`. If the current value is instead `50m`, we'll halve the number of replicas, since `50.0 / 100.0 == 0.5`. We'll skip scaling if the ratio is sufficiently close to 1.0 (within a globally-configurable tolerance, from the `--horizontal-pod-autoscaler-tolerance` flag, which defaults to 0.1).

--horizontal-pod-autoscaler-initial-readiness-delay

- Default 30 seconds

--horizontal-pod-autoscaler-cpu-initialization-period

- Default 300 seconds

--horizontal-pod-autoscaler-downscale-stabilization

- Default 300 seconds

Resource Management and HPA

- Apply HPA for monitor and scale (TARGET CPU 10%)

```
docker@kubernetes-ms:~$ kubectl autoscale deployment/webtest --min=1 --max=10 --cpu-percent=10
deployment "webtest" autoscaled
docker@kubernetes-ms:~$ kubectl get hpa/webtest
NAME      REFERENCE      TARGETS      MINPODS      MAXPODS      REPLICAS      AGE
webtest   Deployment/webtest   <unknown> / 10%    1            10           0            10s
docker@kubernetes-ms:~$ kubectl get hpa/webtest
NAME      REFERENCE      TARGETS      MINPODS      MAXPODS      REPLICAS      AGE
webtest   Deployment/webtest   2% / 10%    1            10           1            59s
docker@kubernetes-ms:~$ kubectl describe hpa/webtest
Name:          webtest
Namespace:     default
Labels:        <none>
Annotations:   <none>
CreationTimestamp: Fri, 02 Feb 2018 10:29:38 -0600
Reference:     Deployment/webtest
Metrics:       resource cpu on pods  (as a percentage of request): 2% (5m) / 10%
Min replicas: 1
Max replicas: 10
Conditions:
  Type    Status  Reason                         Message
  ----  -----  ----
  AbleToScale  True    ReadyForNewScale          the last scale time was sufficiently old as to warrant a new scale
  ScalingActive  True    ValidMetricFound        the HPA was able to successfully calculate a replica count from cpu resource utilization (percentage of request)
  ScalingLimited False   DesiredWithinRange      the desired count is within the acceptable range
Events:        <none>
docker@kubernetes-ms:~$
```



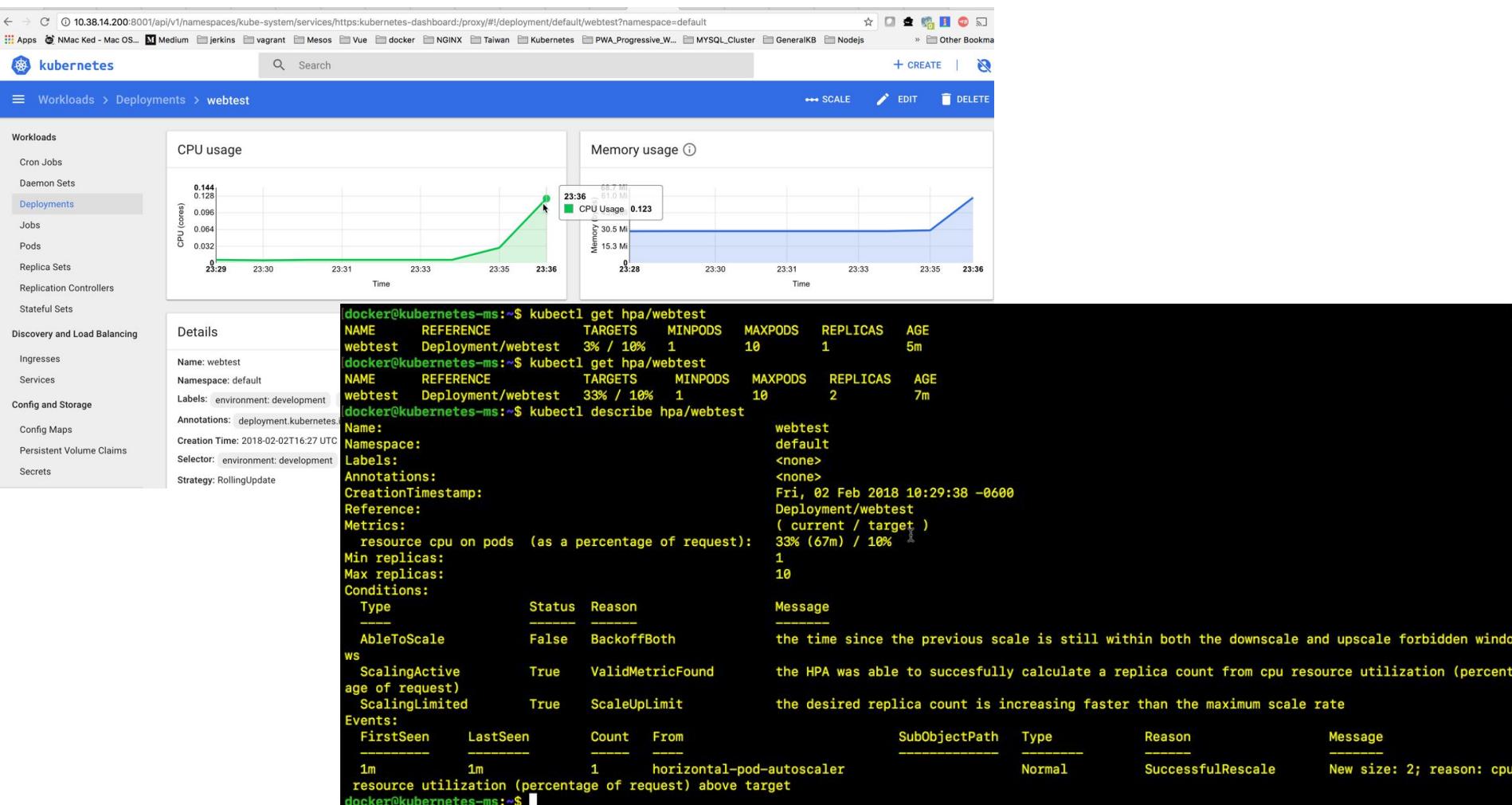
Resource Management and HPA

- Generate load by busybox (wget every 10 ms)

```
[docker@kubernetes-ms:~$ kubectl top nodes
NAME          CPU(cores)   CPU%      MEMORY(bytes)  MEMORY%
kubernetes-ms  283m        14%      1868Mi        48%
kubernetes-1   83m         4%       1434Mi        37%
kubernetes-2   114m        5%       1410Mi        36%
[docker@kubernetes-ms:~$ kubectl top pods
NAME          CPU(cores)  MEMORY(bytes)
webtest-7d89786977-6zktl  29m        29Mi
[docker@kubernetes-ms:~$ kubectl get hpa/webtest
```

Resource Management and HPA

- Load increase and HPA scale-out



Resource Management and HPA

- HPA Scale-Out until meet target (Interval every 5 min)

```
docker@kubernetes-ms:~$ kubectl top pods
NAME                               CPU(cores)   MEMORY(bytes)
webtest-7d89786977-6zktl          69m         29Mi
load-generator-5c4d59d5dd-psqm9   120m        7Mi
webtest-7d89786977-xsp6t          65m         29Mi
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  33% / 10%   1          10          4          10m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  18% / 10%   1          10          4          11m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  18% / 10%   1          10          8          14m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  13% / 10%   1          10          8          15m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  11% / 10%   1          10          8          16m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  11% / 10%   1          10          8          17m
docker@kubernetes-ms:~$ kubectl get hpa
NAME      REFERENCE      TARGETS      MINPODS   MAXPODS   REPLICAS   AGE
webtest   Deployment/webtest  10% / 10%   1          10          9          19m
```

Resource Management and HPA

- Stop load and HPA Scale-down

Resource Management and HPA

- Stop load and HPA Scale-down

```
docker@kubernetes-ms:~$ kubectl top nodes
NAME          CPU(cores)   CPU%      MEMORY(bytes)  MEMORY%
kubernetes-2  374m        18%       1526Mi        39%
kubernetes-ms  390m        19%       1956Mi        50%
kubernetes-1  184m        9%        1537Mi        39%
docker@kubernetes-ms:~$ kubectl get hpa
NAME          REFERENCE      TARGETS      MINPODS    MAXPODS   REPLICAS   AGE
webtest      Deployment/webtest  5% / 10%   1          10         9          22m
docker@kubernetes-ms:~$ kubectl get hpa
NAME          REFERENCE      TARGETS      MINPODS    MAXPODS   REPLICAS   AGE
webtest      Deployment/webtest  3% / 10%   1          10         3          25m
docker@kubernetes-ms:~$ kubectl get hpa
NAME          REFERENCE      TARGETS      MINPODS    MAXPODS   REPLICAS   AGE
webtest      Deployment/webtest  3% / 10%   1          10         1          30m
docker@kubernetes-ms:~$ kubectl describe hpa/webtest
Name:                  webtest
Namespace:             default
Labels:                <none>
Annotations:           <none>
CreationTimestamp:     Fri, 02 Feb 2018 10:29:38 -0600
Reference:             Deployment/webtest
Metrics:               resource cpu on pods  (as a percentage of request): 3% (6m) / 10%
Min replicas:          1
Max replicas:          10
Conditions:
  Type        Status  Reason
  ----        ----  -----
  AbleToScale  False   BackoffBoth
  ScalingActive True    ValidMetricFound
  ScalingLimited False   DesiredWithinRange
Events:
  FirstSeen  LastSeen  Count  From                    SubObjectPath  Type  Reason
  -----  -----  -----  -----                    -----  -----  -----
  24m        24m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  (percentage of request) above target
  21m        21m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  (percentage of request) above target
  17m        17m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  (percentage of request) above target
  13m        13m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  (percentage of request) above target
  7m          7m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  1m          1m       1      horizontal-pod-autoscaler  Normal  SuccessfulRescale
  New size: 2; reason: cpu resource utilization
  New size: 4; reason: cpu resource utilization
  New size: 8; reason: cpu resource utilization
  New size: 9; reason: cpu resource utilization
  New size: 3; reason: All metrics below target
  New size: 1; reason: All metrics below target
docker@kubernetes-ms:~$
```

ConfigMap and Secret



ConfigMap and Secret

- Make secret data and configuration great again !
- Many container need some configuration/potential data for make it work. But is it should store in image/configuration (Container, Pods, Deployment, RC etc)?
 - Root password of database
 - Environment variable
 - Custom variable
 - Path of mount volume data
 - Etc
- ConfigMap will provide central configuration for Pods operate
- Secret will encode sensitive data for keep secret



ConfigMap and Secret

- ConfigMap
 - ConfigMap belong to namespace scope
 - Option to create:
 - literal values
 - From file or folder
 - YAML file

```
kubectl create configmap <name> <option>
```

- Ex: “kubectl create configmap webmodule_configmap
--from-literal=REDIS_HOST=localhost”
- Ex: “kubectl create -f webmodule_configmap.yml”

```
1  apiVersion: v1
2  kind: ConfigMap
3  metadata:
4    name: webmodule_configmap
5    namespace: webmicroservice
6    labels:
7      name: "webmodule_configmap"
8      owner: "Praparn_L"
9      version: "1.0"
10     module: "ConfigMap"
11     environment: "development"
12   data:
13     REDIS_HOST: localhost
```



ConfigMap and Secret

- Secret
 - ConfigMap will encode64 algorithm
 - Option to create:
 - From file <store confidential value>
 - YAML file

```
kubectl create secret generic <name> <option>
```

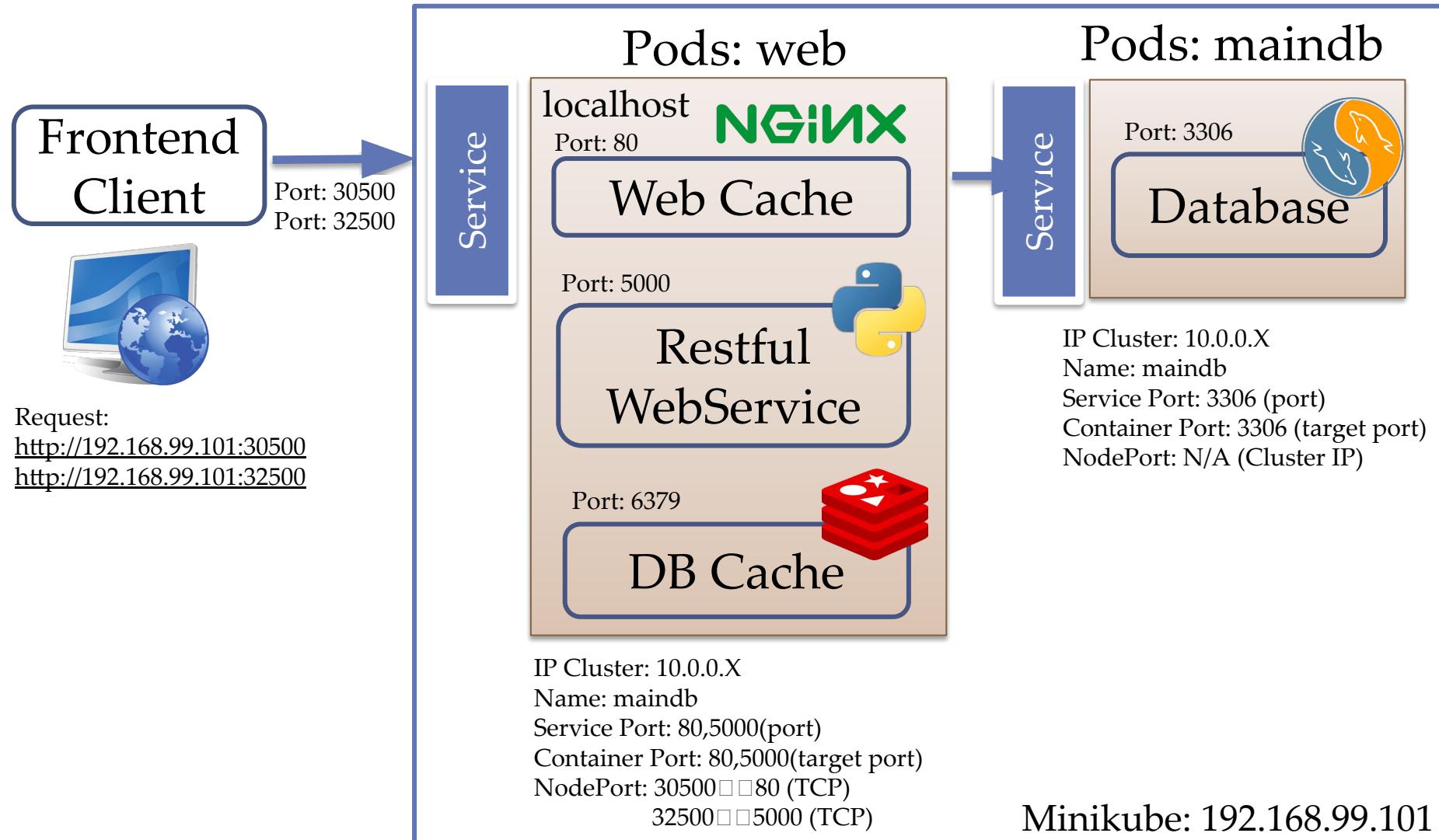
- Ex: “kubectl create secret generic databasemodule_secret --from-file=./username.txt --from-file=./password.txt”
- Ex: “kubectl create -f databasemodule_secret.yml”

```
|praparns-MBP:~ praparn$ echo -n "root"|base64  
cm9vdA==  
|praparns-MBP:~ praparn$ echo -n "password"|base64  
cGFzc3dvcmQ=  
praparns-MBP:~ praparn$ █
```

```
1  apiVersion: v1  
2  kind: Secret  
3  metadata:  
4    name: databasemodule_secret  
5    namespace: webmicroservice  
6    labels:  
7      name: "databasemodule_secret"  
8      owner: "Praparn_L"  
9      version: "1.0"  
10     module: "Secret"  
11     environment: "development"  
12   type: Opaque  
13   data:  
14     username: cm9vdA==  
15     password: cGFzc3dvcmQ=
```



ConfigMap and Secret



ConfigMap and Secret

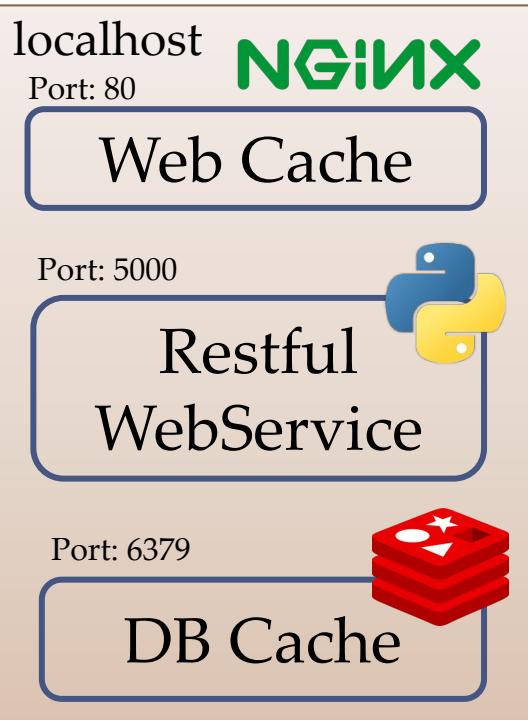
Service



Pods.yml: databasemodule_pod.yml

```
containers:
  - name: maindb
    image: labdocker/mysql:latest
    ports:
      - containerPort: 3306
        protocol: TCP
    env:
      - name: "MYSQL_ROOT_PASSWORD"
        value: "password"
```

Service



Sourcecode: main.py

```
6 CACHE_DB = redis.Redis(host=os.environ.get('REDIS_HOST', 'cachedb'), port=6379)
7 db = MySQLdb.connect("maindb","root","password")
8 MAIN_DB = db.cursor()
```

Pods.yml: webmodule_pod.yml

```
18 - name: webservice
19   image: labdocker/cluster:webservice
20   env:
21     - name: "REDIS_HOST"
22       value: "localhost"
```

Kubernetes: Production Workload Orchestration



kubernetes
by Google

ConfigMap and Secret

Service

Port: 3306

Database



Secret.yml: databasemodule_secret.yml

```
1 apiVersion: v1
2 kind: Secret
3 metadata:
4   name: databasemodule-secret
5   namespace: webmicroservice
6   labels:
7     name: "databasemodule-secret"
8     owner: "Praparn_L"
9     version: "1.0"
10    module: "Secret"
11    environment: "development"
12 type: Opaque
13 data:
14   username: cm9vdA==
15   password: cGFzc3dvcmQ=
```



Deploy.yml: databasemodule_deploy_config.yml

```
22 apiVersion: "v1"
23 kind: Deployment
24 metadata:
25   name: maindb
26   labels:
27     name: "maindb"
28     owner: "Praparn_L"
29     version: "1.0"
30   module: "maindb"
31   environment: "development"
32 spec:
33   replicas: 1
34   template:
35     metadata:
36       labels:
37     spec:
38       containers:
39         - name: maindb
40           image: labdocker/mysql:latest
41           ports:
42             - containerPort: 3306
43               protocol: TCP
44           env:
45             - name: username
46               valueFrom:
47                 secretKeyRef:
48                   name: databasemodule-secret
49                   key: username
50             - name: password
51               valueFrom:
52                 secretKeyRef:
53                   name: databasemodule-secret
54                   key: password
```

ConfigMap and Secret

Secret.yaml:

databasemodule_secret.yaml

```
1 apiVersion: v1
2 kind: Secret
3 metadata:
4   name: databasemodule-secret
5   namespace: webmicroservice
6   labels:
7     name: "databasemodule-secret"
8     owner: "Praparn_L"
9     version: "1.0"
10    module: "Secret"
11    environment: "development"
12   type: Opaque
13  data:
14    username: cm9vdA==
15    password: cGFzc3dvcmQ=
```

Deploy.yaml:

webmodule_deploy_config.yaml

```
46
47
48
49
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53
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55
56
57
58
59
60
61
62
63
64
65
66
67
68
69
70
71
72
73
```

```
spec:
  containers:
    - name: cachedb
      image: labdocker/redis:latest
      ports:
        - containerPort: 6379
          protocol: TCP
    - name: webservice
      image: labdocker/cluster:webservice
      env:
        - name: REDIS_HOST
          valueFrom:
            configMapKeyRef:
              name: webmodule_configmap
              key: REDIS_HOST
        - name: username
          valueFrom:
            secretKeyRef:
              name: databasemodule-secret
              key: username
        - name: password
          valueFrom:
            secretKeyRef:
              name: databasemodule-secret
              key: password
      ports:
        - containerPort: 5000
          protocol: TCP
```

ConfigMap.yaml:

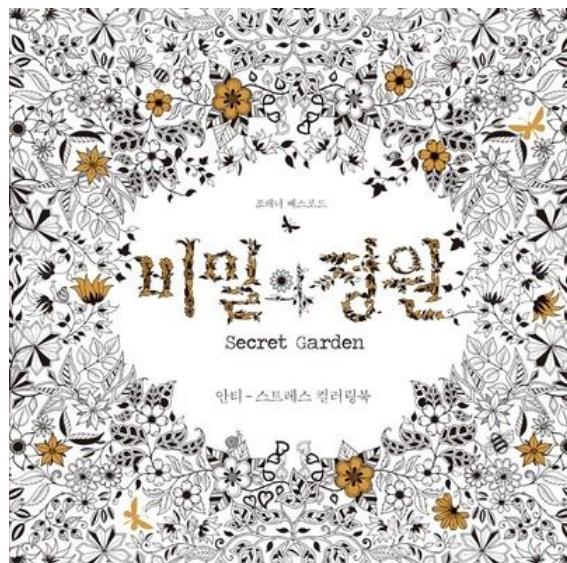
webmodule_configmap.yaml

```
1 apiVersion: v1
2 kind: ConfigMap
3 metadata:
4   name: webmodule-configmap
5   namespace: webmicroservice
6   labels:
7     name: "webmodule-configmap"
8     owner: "Praparn_L"
9     version: "1.0"
10    module: "ConfigMap"
11    environment: "development"
12   data:
13     REDIS_HOST: localhost
```



Workshop: ConfigMap and Secret

```
~ — Terminal MAC Pro — zsh          ~ — Terminal MAC Pro — WinSCP.exe TERM...          ~ — Terminal MAC Pro — ssh + docker-mach...          ~ — Terminal MAC Pro — -bash
Environment:
  username:           <set to the key 'username' in secret 'databasemodule-secret'>  Optional: false
  MYSQL_ROOT_PASSWORD: <set to the key 'password' in secret 'databasemodule-secret'>  Optional: false
Mounts:
  /var/run/secrets/kubernetes.io/serviceaccount from default-token-ts1ql (ro)
Conditions:
  Type      Status
  Initialized  True
  Ready        True
  PodScheduled  True
Volumes:
  default-token-ts1ql:
    Type:     Secret (a volume populated by a Secret)
    SecretName: default-token-ts1ql
    Optional:  false
  QoS Class:  BestEffort
  Node-Selectors: <none>
  Tolerations:  <none>
```



```
[praparn-MacBook-Pro% kubectl describe configmap/webmodule-configmap --namespace webmicroservice
Name:            webmodule-configmap
Namespace:       webmicroservice
Labels:          environment=development
                  module=ConfigMap
                  name=webmodule-configmap
                  owner=Praparn_L
                  version=1.0
Annotations:     <none>

Data
=====
REDIS_HOST:
-----
localhost

[praparn-MacBook-Pro% kubectl describe secret/databasemodule-secret --namespace webmicroservice
Name:            databasemodule-secret
Namespace:       webmicroservice
Labels:          environment=development
                  module=Secret
                  name=databasemodule-secret
                  owner=Praparn_L
                  version=1.0
Annotations:     <none>

Type:  Opaque

Data
=====
password:        8 bytes
username:        4 bytes
```



Recap Day 1

- Container concept (Recap)
- Introduction to Kubernetes
- System Architecture
- Fundamental of Kubernetes
 - Pods, Container and Services
 - Replication Controller (RC)
 - Deployment/Replica-Set (RS) and Rolling update
 - Volume
 - Liveness and Readyness Probe
 - Resource Management and Horizontal Pods Autoscaling (HPA)
 - ConfigMap Secret



Outline Day 2

- Fundamental of Kubernetes
 - Job and CronJob
 - Log and Monitoring
- Ingress Networking
- Security on Kubernetes
 - Network Policy
 - Volume Policy
 - Resource Usage Policy
 - Resource Consumption Policy
 - Access Control Policy
 - Security Policy
- Kubernetes in real world
 - Cluster Setup for Bare Metal
 - Orchestrator Assignment
 - nodeSelector
 - Interlude
 - Affinity
 - Taints/Tolerations
- Stateful application deployment
 - Consideration and Awareness
 - Persistent Volumes
 - StatefulSets



Question & Answer Section



By: Praparn L (eva10409@gmail.com)



kubernetes
by Google

WORKSHOP ADVANCED DOCKER



สอนการ deploy Dockers ด้วย Kubernetes
จากประสบการณ์ใช้งานจริงบน Production ของ
application ระดับประเทศ



วิทยากร : คุณ PRAPARN LUNGPOONLARP
INFRASTRUCTURE ENGINEER, NETWORK ENGINEER,
SYSTEM ENGINEER



kubernetes



Day 2



Outline Day 2

- Fundamental of Kubernetes
 - Job and CronJob
 - Log and Monitoring
- Ingress Networking
- Security on Kubernetes
 - Network Policy
 - Volume Policy
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 - Persistent Volumes
 - StatefulSets



Job and Cron Jobs



Job and Cron Job

- Some task on kubernetes will batch process or non-interactive job
 - Update EOD Process
 - Monitor System Health
 - Calculate Balance
 - Run reindexing file/database
 - etc
- “Job” on kubernetes was design to operate special purpose
 - Job will track status of complete job
 - Job will autostart new Pods when it failed or deleted
 - Job will delete Pods when job was deleted

```
kubectl create -f <YAML File>
```

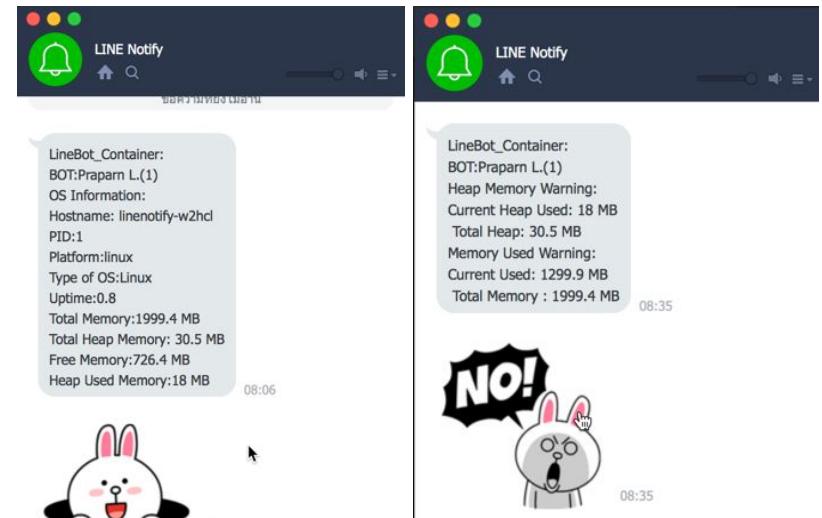


Job and Cron Job

Job.yml:

```
WorkShop_2.2_Job_CronJob › ! job.yml
 1  apiVersion: batch/v1
 2  kind: Job
 3  metadata:
 4    name: linenotify
 5    labels:
 6      name: linenotify
 7      owner: Paparn_L
 8      version: "1.0"
 9      module: Job
10      environment: development
11 spec:
12   ttlSecondsAfterFinished: 30
13   activeDeadlineSeconds: 60
14   template:
15     metadata:
16       name: linenotify
17     spec:
18       containers:
19         - name: linenotify
20           image: labdocker/linenotify:onetime
21           env:
22             - name: TITLE
23               value: "BOT:Paparn_L."
24             - name: INTERVAL
25               value: "10000"
26             - name: HEAP_HIGH
27               value: "20"
28             - name: MEM_HIGH
29               value: "20"
30             - name: SH_OS
31               value: "Y"
32             - name: TOKEN
33               value: "E1eqyillzkzpaCo1R0rebZTcGbIyzDZHp0jcdd0t6CX"
34   restartPolicy: Never
```

```
praparns-MacBook-Pro% kubectl create -f job.yml
job "linenotify" created
praparns-MacBook-Pro% kubectl get jobs
NAME      DESIRED  SUCCESSFUL  AGE
linenotify  1        0          1m
praparns-MacBook-Pro% kubectl get pods
NAME        READY  STATUS  RESTARTS  AGE
linenotify-w2hcl  1/1   Running  0   2m
praparns-MacBook-Pro% kubectl describe jobs/linenotify
Name:            linenotify
Namespace:       default
Selector:        controller-uid=e816fc3f-6e79-11e7-9aa8-08002763e747
Labels:          environment=development
                 module=Job
                 name=linenotify
                 owner=Paparn_L
                 version=1.0
Annotations:    <none>
```



Job and Cron Job



Reference

HOME GETTING STARTED CONCEPTS TASKS TUTORIALS REFERENCE CONTRIBUTE

Reference

Standardized Glossary

- ▶ Kubernetes Issues and Security
- ▶ Using the Kubernetes API
- ▶ Accessing the API
- ▶ API Reference
- ▼ Setup tools reference

Kubeadm

Overview of kubeadm

kubeadm init

kubeadm join

Options

```
--apiserver-advertise-address string      The IP address the API Server will advertise it's listening on. If not set the default netw
--apiserver-bind-port int32                Port for the API Server to bind to. (default 6443)
--apiserver-cert-extra-sans strings       Optional extra Subject Alternative Names (SANs) to use for the API Server serving certifica
--cert-dir string                         The path where to save and store the certificates. (default "/etc/kubernetes/pki")
--certificate-key string                  Key used to encrypt the control-plane certificates in the kubeadm-certs Secret.
--config string                           Path to a kubeadm configuration file.
--cri-socket string                      Path to the CRI socket to connect. If empty kubeadm will try to auto-detect this value; use
--dry-run                                Don't apply any changes; just output what would be done.
--feature-gates string                   A set of key-value pairs that describe feature gates for various features. No feature gates
--help                                     help for init
--ignore-preflight-errors strings        A list of checks whose errors will be shown as warnings. Example: 'IsPrivilegedUser,Swap'.
--image-repository string                Choose a container registry to pull control plane images from (default "k8s.gcr.io")
--kubernetes-version string             Choose a specific Kubernetes version for the control plane. (default "stable-1")
--node-name string                       Specify the node name.
--pod-network-cidr string               Specify range of IP addresses for the pod network. If set, the control plane will automatic
--service-cidr string                   Use alternative range of IP address for service VIPs. (default "10.96.0.0/12")
--service-dns-domain string            Use alternative domain for services, e.g. "myorg.internal". (default "cluster.local")
--skip-certificate-key-prime           Don't print the key used to encrypt the control-plane certificates.
--skip-phases strings                  List of phases to be skipped
--skip-token-print                     Skip printing of the default bootstrap token generated by 'kubeadm init'.
--token string                          The token to use for establishing bidirectional trust between nodes and control-plane nodes
--token-ttl duration                  The duration before the token is automatically deleted (e.g. 1s, 2m, 3h). If set to '0', th
--upload-certs                         Upload control-plane certificates to the kubeadm-certs Secret.
```

kubeadm init



savitaashture commented on Dec 13, 2018

Author + ⚡ ...

Thanks a lot.

Its working now.

Earlier i haven't set --feature-gates=TTLAfterFinished=true in controller yaml thats the reason it was not working.

3

TTL Mechanism for Finished Jobs

FEATURE STATE: Kubernetes v1.12 alpha

Another way to clean up finished Jobs (either `Complete` or `Failed`) automatically is to use a TTL mechanism provided by a `TTL` controller for finished resources, by specifying the `.spec.ttlSecondsAfterFinished` field of the Job.

When the TTL controller cleans up the Job, it will delete the Job cascadingly, i.e. delete its dependent objects, such as Pods, together with the Job. Note that when the Job is deleted, its lifecycle guarantees, such as finalizers, will be honored.

For example:

```
apiVersion: batch/v1
kind: Job
metadata:
  name: pi-with-ttl
spec:
  ttlSecondsAfterFinished: 100
  template:
    spec:
      containers:
        - name: pi
          image: perl
          command: ["perl", "-Mbignum=bpi", "-wle", "print bpi(2000)"]
          restartPolicy: Never
```

The Job `pi-with-ttl` will be eligible to be automatically deleted, `100` seconds after it finishes.

<https://kubernetes.io/docs/reference/setup-tools/kubeadm/kubeadm-init/>

<https://github.com/kubernetes/kubernetes/issues/71993>

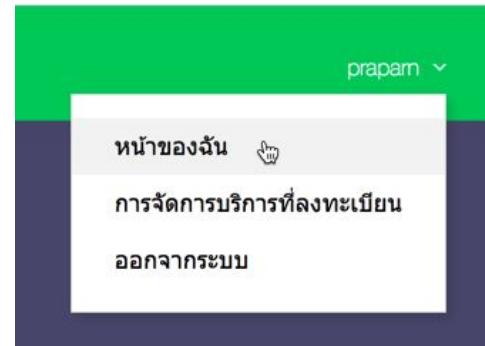
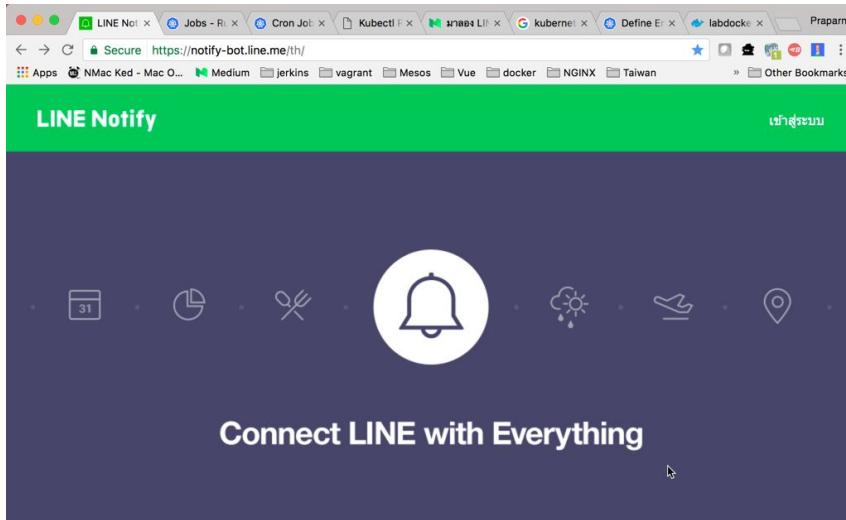
Kubernetes: Production Workload Orchestration



kubernetes
by Google

Workshop: Job and CronJob

- Task0: Generate LINE token
 - <https://notify-bot.line.me>



ออก Access Token (สำหรับผู้พัฒนา)

เมื่อใช้ Access Token แบบบุคคล จะสามารถตั้งค่าการแจ้งเตือนได้โดยไม่ต้องลงทะเบียนกับเว็บเซอร์วิส



Workshop: Job and CronJob

ออก Token

โปรดใส่ชื่อ Token (จะแสดงเมื่อมีการแจ้งเตือน)

LINEBOT

โปรดเลือกห้องแขวงที่ต้องการส่งข้อความแจ้งเตือน

Search by group name

 รับการแจ้งเตือนแบบตัวต่อตัวจาก LINE Notify

Token ที่ออก

`zHOlcJCcpIIS8mEedn`

ถ้าออกจากหน้านี้ ระบบจะไม่แสดง Token ที่ออกใหม่ถ้าต่อไป โปรดลอก Token ก่อนออกจากหน้านี้

คัดลอก **ปิด**



2017.07.19 23:42
From: LineBot_Container
To: praparn

ยกเลิก

Workshop: Job and CronJob

- Task1: Create Jobs for Monitor System via LINE

```
1  apiVersion: batch/v1
2  kind: Job
3  metadata:
4    name: linenotify
5    labels:
6      name: linenotify
7      owner: Praparn_L
8      version: "1.0"
9      module: Job
10     environment: development
11
12    spec:
13      template:
14        metadata:
15          name: linenotify
16        spec:
17          containers:
18            - name: linenotify
19              image: labdocker/linenotify
20              env:
21                - name: TITLE
22                  value: "BOT:Praparn L."
23                - name: INTERVAL
24                  value: "10000"
25                - name: HEAP_HIGH
26                  value: "20"
27                - name: MEM_HIGH
28                  value: "20"
29                - name: SH_OS
30                  value: "N"
31                - name: TOKEN
32                  value: "EIEeqyillzkzpaCo1R0rebZTcGbIyzDZHp0jcd0t6CX"
33
34      restartPolicy: Never
```



TITLE: Input Name
INTERVAL : Input Check Interval (ms)
HEAP_HIGH: % of Heap Memory Warn
MEM_HIGH: % of Memory Used Warn
SH_OS: Mode
(Show information:Y, Show only Warning
Reach:N)
TOKEN: Input LINE TOKEN

Workshop: Job and CronJob

- Task2: Create Cronjob for Monitor System via LINE

```
WorkShop_1.9_Job_CronJob > ! job_notify_cron.yaml
```

```
1  apiVersion: batch/v1beta1
2  kind: CronJob
3  metadata:
4    name: linenotify
5    labels:
6      name: linenotify
7      owner: Praparn_L
8      version: "1.0"
9      module: Job
10     environment: development
11
12    spec:
13      schedule: "*/1 * * * *"
14      successfulJobsHistoryLimit: 5
15      failedJobsHistoryLimit: 1
16      jobTemplate:
17        spec:
18          template:
19            spec:
20              containers:
21                - name: linenotify
22                  image: labdocker/linenotify:onetime
23                  env:
24                    - name: TITLE
25                      value: "BOT NOTIFY:Praparn L."
26                    - name: INTERVAL
27                      value: "10000"
28                    - name: HEAP_HIGH
29                      value: "20"
30                    - name: MEM_HIGH
31                      value: "20"
32                    - name: SH_OS
33                      value: "N"
34                    - name: TOKEN
35                      value: "EIEeqyillzkzpaCo1R0rebZTcGbIyzDZHpojcdd0t6CX"
36
37      restartPolicy: Never
```



```
Every 2.0s: kubectl get jobs
```

NAME	COMPLETIONS	DURATION	AGE
linenotify-1570292460	1/1	14s	3m15s
linenotify-1570292520	1/1	14s	2m15s
linenotify-1570292580	1/1	15s	75s
linenotify-1570292640	1/1	15s	15s

Job and Cron Job

- “CronJob” is time base “Jobs” with
 - Run on specific point-in-time
 - Repeat point in time
 - etc

```
* * * * * command to be executed
- - - -
| | | |
| | | ----- Day of week (0 - 7) (Sunday=0 or 7)
| | | ----- Month (1 - 12)
| | ----- Day of month (1 - 31)
| ----- Hour (0 - 23)
----- Minute (0 - 59)
```

Cron Job Limitations

A cron job creates a job object *about* once per execution time of its schedule. We say “about” because there are certain circumstances where two jobs might be created, or no job might be created. We attempt to make these rare, but do not completely prevent them. Therefore, jobs should be *idempotent*.

If `startingDeadlineSeconds` is set to a large value or left unset (the default) and if `concurrencyPolicy` is set to `Allow`, the jobs will always run at least once.

For every CronJob, the CronJob Controller checks how many schedules it missed in the duration from its last scheduled time until now. If there are more than 100 missed schedules, then it does not start the job and logs the error

```
Cannot determine if job needs to be started. Too many missed start time (> 100). Set or decrease .spec.startingDeadlineSeconds or check clock skew.
```

It is important to note that if the `startingDeadlineSeconds` field is set (not `null`), the controller counts how many missed jobs occurred from the value of `startingDeadlineSeconds` until now rather than from the last scheduled time until now. For example, if `startingDeadlineSeconds` is `200`, the controller counts how many missed jobs occurred in the last 200 seconds.

A CronJob is counted as missed if it has failed to be created at its scheduled time. For example, If `concurrencyPolicy` is set to `Forbid` and a CronJob was attempted to be scheduled when there was a previous schedule still running, then it would count as missed.

For example, suppose a CronJob is set to schedule a new Job every one minute beginning at `08:30:00`, and its `startingDeadlineSeconds` field is not set. If the CronJob controller happens to be down from `08:29:00` to `10:21:00`, the job will not start as the number of missed jobs which missed their schedule is greater than 100.

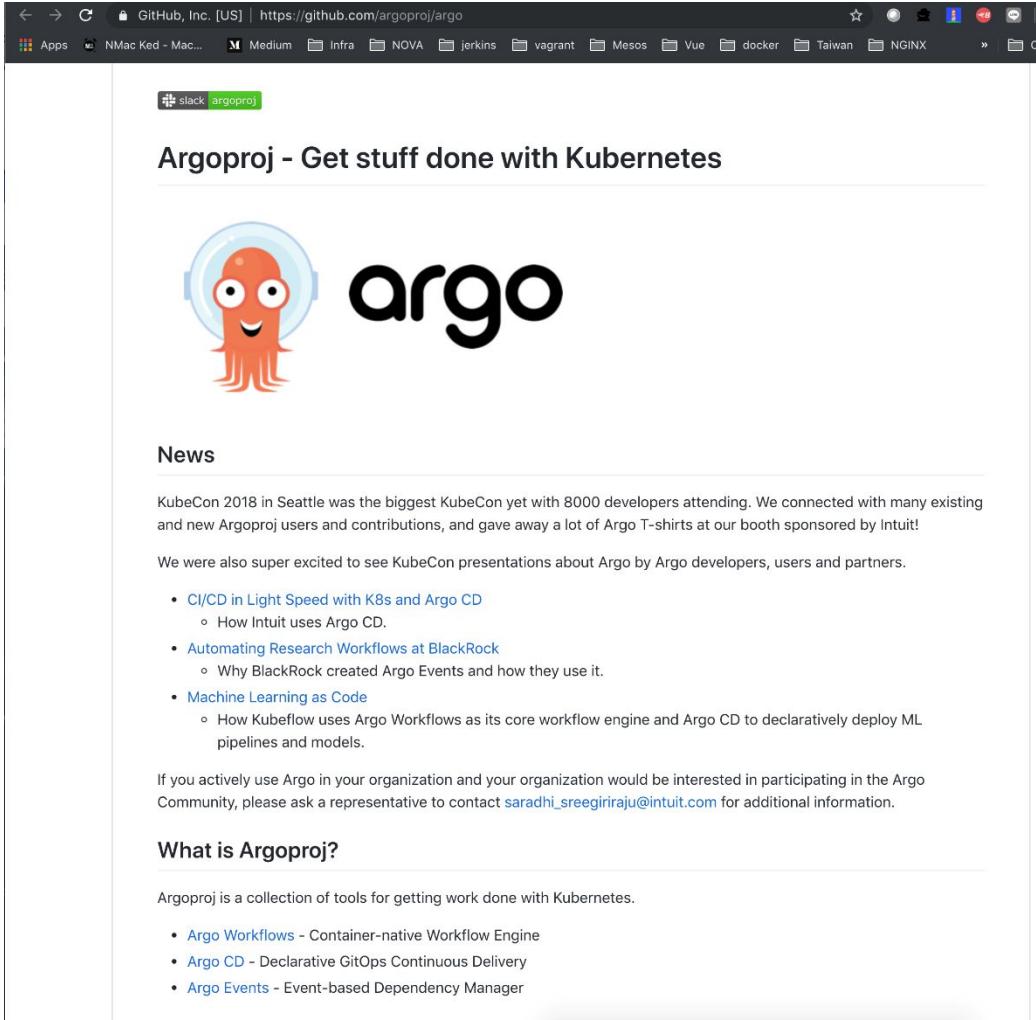
To illustrate this concept further, suppose a CronJob is set to schedule a new Job every one minute beginning at `08:30:00`, and its `startingDeadlineSeconds` is set to 200 seconds. If the CronJob controller happens to be down for the same period as the previous example (`08:29:00` to `10:21:00`), the Job will still start at 10:22:00. This happens as the controller now checks how many missed schedules happened in the last 200 seconds (ie, 3 missed schedules), rather than from the last scheduled time until now.

The CronJob is only responsible for creating Jobs that match its schedule, and the Job in turn is responsible for the management of the Pods it represents.



Job and Cron Job

- WorkFlow Job



The screenshot shows the GitHub repository page for <https://github.com/argoproj/argo>. The page features the Argoproj logo, which includes a cartoon octopus character inside a circular frame next to the word "argo". Below the logo is a "News" section. The news summary states: "KubeCon 2018 in Seattle was the biggest KubeCon yet with 8000 developers attending. We connected with many existing and new Argoproj users and contributions, and gave away a lot of Argo T-shirts at our booth sponsored by Intuit!" It also mentions presentations about Argo at KubeCon. A bulleted list of topics covered includes CI/CD, Research Workflows, Machine Learning as Code, and Kubeflow integration. At the bottom, there's a note about the Argo Community and a contact email. The "What is Argoproj?" section defines it as a collection of tools for Kubernetes, listing Argo Workflows, Argo CD, and Argo Events.

Argoproj - Get stuff done with Kubernetes

 argo

News

KubeCon 2018 in Seattle was the biggest KubeCon yet with 8000 developers attending. We connected with many existing and new Argoproj users and contributions, and gave away a lot of Argo T-shirts at our booth sponsored by Intuit!

We were also super excited to see KubeCon presentations about Argo by Argo developers, users and partners.

- [CI/CD in Light Speed with K8s and Argo CD](#)
 - How Intuit uses Argo CD.
- [Automating Research Workflows at BlackRock](#)
 - Why BlackRock created Argo Events and how they use it.
- [Machine Learning as Code](#)
 - How Kubeflow uses Argo Workflows as its core workflow engine and Argo CD to declaratively deploy ML pipelines and models.

If you actively use Argo in your organization and your organization would be interested in participating in the Argo Community, please ask a representative to contact saradhi_sreegiriraju@intuit.com for additional information.

What is Argoproj?

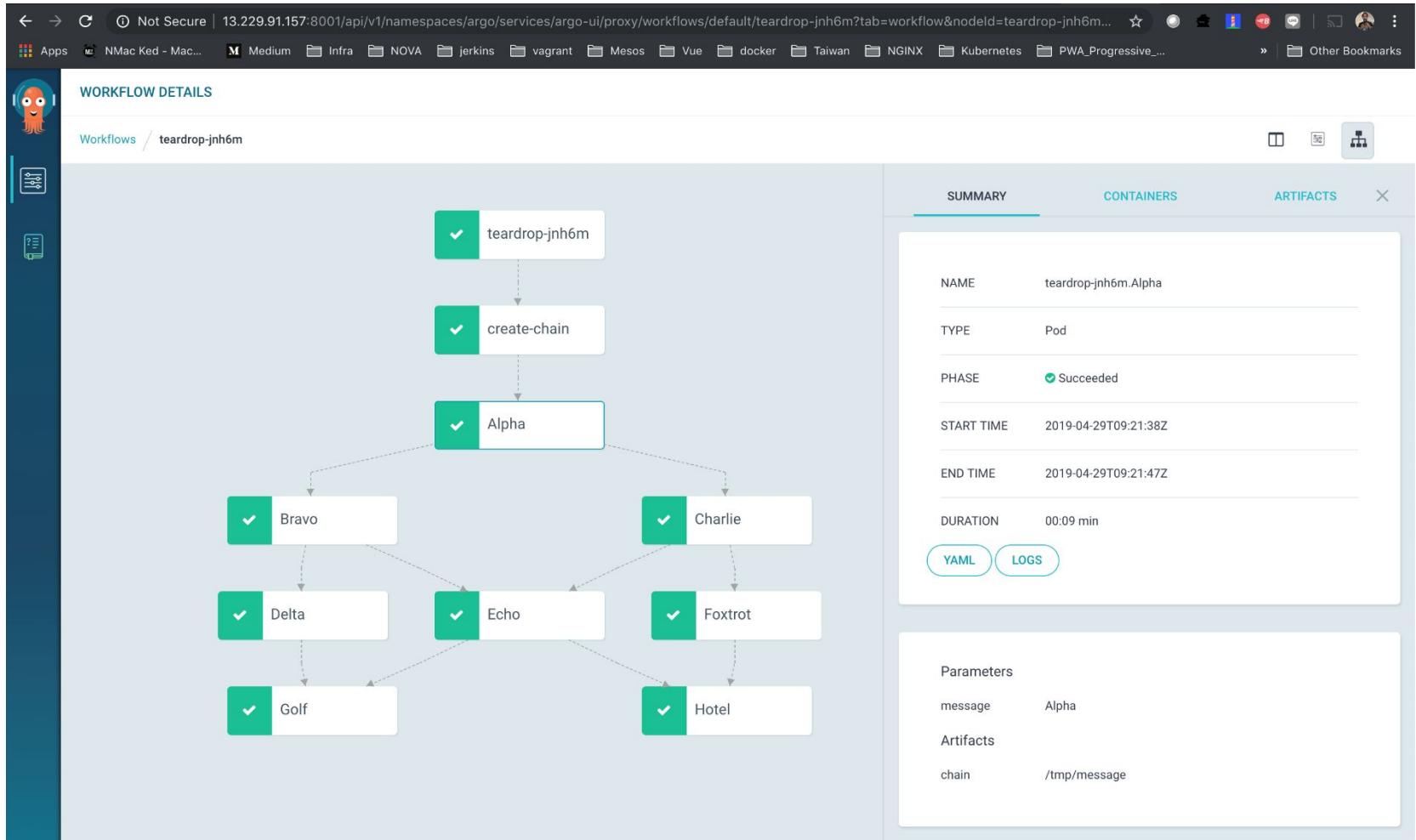
Argoproj is a collection of tools for getting work done with Kubernetes.

- [Argo Workflows](#) - Container-native Workflow Engine
- [Argo CD](#) - Declarative GitOps Continuous Delivery
- [Argo Events](#) - Event-based Dependency Manager

<https://github.com/argoproj/argo>

Job and Cron Job

- WorkFlow Job



<https://github.com/argoproj/argo>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Debug Log and Monitoring



Debug Log and Monitoring

- Normally kubernetes provide tool for check log on Pods and container level with several option

```
kubectl logs pods/<pods name> -c <container name> <option>
```

- Option:
 - -p, --previous=false ==> Printout last container fail in Pods
 - -f, --follow=false ==> Follow stream log
 - -c, --container ==> Specific container for check log
 - -l, --selector ==> Select filter some label for check log
- Ex:
 - kubectl logs -f pods/maindb -c maindb

Debug Log and Monitoring

- Monitoring kubernetes system via dashboard

kubernetes dashboard

The screenshot shows the Kubernetes dashboard interface under the 'Workloads' tab. On the left is a sidebar with navigation links for Admin, Namespaces, Nodes, Persistent Volumes, Storage Classes, Namespace (default), Workloads (selected), Deployments, Replica Sets, Replication Controllers, Daemon Sets, Stateful Sets, Jobs, Pods, Services and discovery (Services, Ingresses, Storage), and Persistent Volume Claims.

Deployments

Name	Labels	Pods	Age	Images
maindb	environment: development module: maindb	2 / 1	48 seconds	labdocker/mysql:latest
web	environment: development module: web	2 / 1	41 seconds	labdocker/redis:latest labdocker/cluster/webservi... labdocker/cluster/webcach...

Replica Sets

Name	Labels	Pods	Age	Images
maindb-1334333237	environment: development module: maindb	1 / 1	48 seconds	labdocker/mysql:latest
	environment: development module: maindb

The screenshot shows the 'Edit a Service' dialog box. At the top is a search bar and a toolbar with icons for creating, deleting, and saving changes. Below is a tree-view configuration editor showing the service's structure:

```
Service {5}
  kind : Service
  apiVersion : v1
  metadata {7}
    name : kubernetes
    namespace : default
    selfLink : /api/v1/namespaces/default/services/kubernetes
    uid : a0367a8c-640c-11e7-92a2-08002763e747
    resourceVersion : 8
    creationTimestamp : 2017-07-08T18:38:24Z
  labels {2}
    component : apiserver
    provider : kubernetes
  spec {4}
    ports [1]
```

At the bottom are 'CANCEL' and 'UPDATE' buttons.



Debug Log and Monitoring

- Ephemeral Container (Obsolete):
 - Getting debug application inside "Pods"
 - Ideally is run container inside pods for operate as "debugger"
 - Not necessary for external component

API changes and improvements for ephemeral containers

The API used to create [Ephemeral Containers](#) changes in 1.22. The Ephemeral Containers feature is alpha and disabled by default, and the new API does not work with clients that attempt to use the old API.

For stable features, the kubectl tool follows the Kubernetes [version skew policy](#); however, kubectl v1.21 and older do not support the new API for ephemeral containers. If you plan to use `kubectl debug` to create ephemeral containers, and your cluster is running Kubernetes v1.22, you cannot do so with kubectl v1.21 or earlier. Please update kubectl to 1.22 if you wish to use `kubectl debug` with a mix of cluster versions.



Workshop: Log and Monitoring



Ingress Network



Ingress Network

- Remember Service ?
 - Service will expose for other Pods / External to connect and access service on Pods inside

```
praparns-MacBook-Pro:multicontainer praparn$ kubectl get svc
NAME      CLUSTER-IP   EXTERNAL-IP   PORT(S)           AGE
kubernetes  10.0.0.1    <none>        443/TCP          4d
maindb     10.0.0.134   <none>        3306/TCP         17m
web        10.0.0.69    <nodes>       5000:30661/TCP,80:30500/TCP  16m
praparns-MacBook-Pro:multicontainer praparn$
```

- Service quite limit and non flexible for operate
 - How to handle for multiple service on same port ?
 - How to limit protocol for access ? (HTTP/HTTPS/FTP etc)
 - How to binding with hostname ? (www.xxxx.yyy)
 - How to TLS connection ?
 - etc
- Ingress is tool will operate for that
 - Give some customize label for classify host and define some selector criteria for specific node run Pods
 - Ingress can be implemented by different controller and specify with ingress class (categories)



Ingress Network

Kubernetes as a project supports and maintains [AWS](#), [GCE](#), and [nginx](#) ingress controllers.

Additional controllers

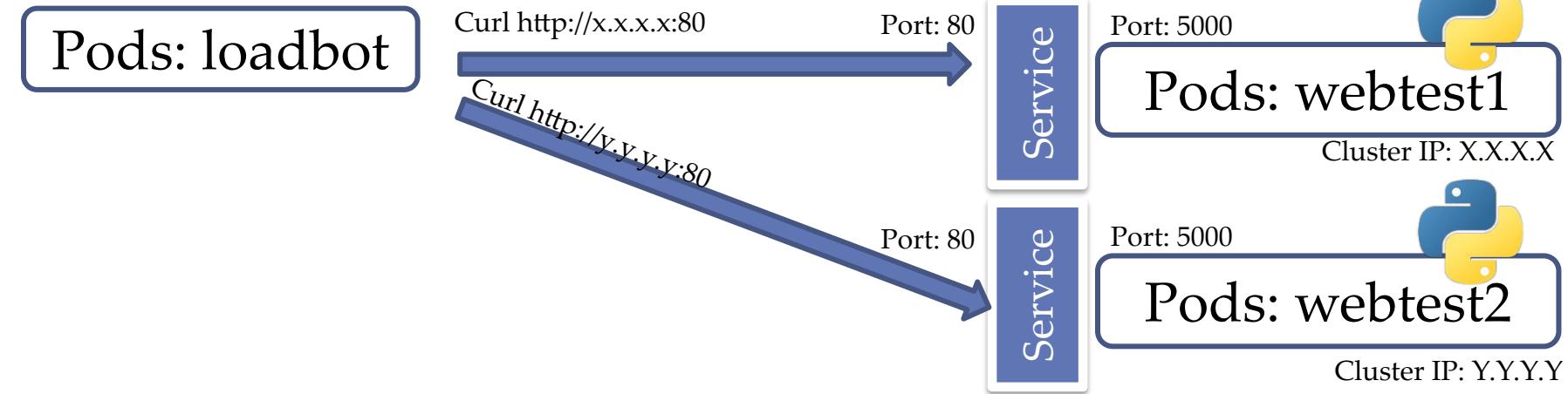
Caution: This section links to third party projects that provide functionality required by Kubernetes. The Kubernetes project authors aren't responsible for these projects. This page follows [CNCF website guidelines](#) by listing projects alphabetically. To add a project to this list, read the [content guide](#) before submitting a change.

- [AKS Application Gateway Ingress Controller](#) is an ingress controller that configures the [Azure Application Gateway](#).
- [Ambassador API Gateway](#) is an [Envoy](#)-based ingress controller.
- [Apache APISIX ingress controller](#) is an [Apache APISIX](#)-based ingress controller.
- [Avi Kubernetes Operator](#) provides L4-L7 load-balancing using [VMware NSX Advanced Load Balancer](#).
- The [Citrix ingress controller](#) works with Citrix Application Delivery Controller.
- [Contour](#) is an [Envoy](#) based ingress controller.
- [EnRoute](#) is an [Envoy](#) based API gateway that can run as an ingress controller.
- [Easegress IngressController](#) is an [Easegress](#) based API gateway that can run as an ingress controller.
- [F5 BIG-IP Container Ingress Services for Kubernetes](#) lets you use an Ingress to configure F5 BIG-IP virtual servers.
- [Gloo](#) is an open-source ingress controller based on [Envoy](#), which offers API gateway functionality.
- [HAProxy Ingress](#) is an ingress controller for [HAProxy](#).
- The [HAProxy Ingress Controller for Kubernetes](#) is also an ingress controller for [HAProxy](#).
- [Istio Ingress](#) is an [Istio](#) based ingress controller.
- The [Kong Ingress Controller for Kubernetes](#) is an ingress controller driving [Kong Gateway](#).
- The [NGINX Ingress Controller for Kubernetes](#) works with the [NGINX](#) webserver (as a proxy).
- [Skipper](#) HTTP router and reverse proxy for service composition, including use cases like Kubernetes Ingress, designed as a library to build your custom proxy.
- The [Traefik Kubernetes Ingress provider](#) is an ingress controller for the [Traefik](#) proxy.
- [Tyk Operator](#) extends Ingress with Custom Resources to bring API Management capabilities to Ingress. Tyk Operator works with the Open Source Tyk Gateway & Tyk Cloud control plane.
- [Voyager](#) is an ingress controller for [HAProxy](#).



Ingress Network

- Service:



Request:
<http://192.168.99.101:30500>
<http://192.168.99.101:32500>

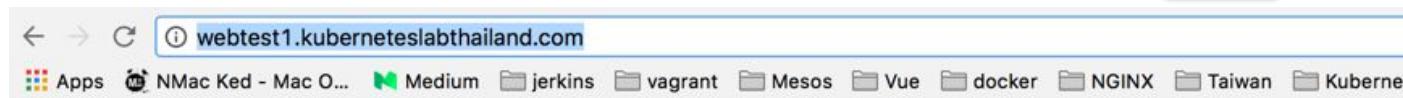
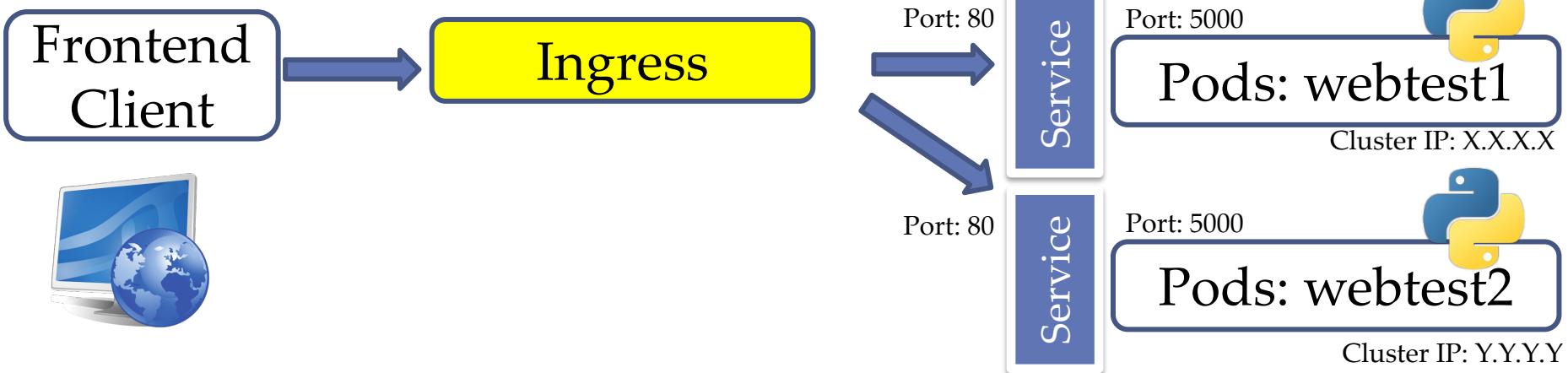
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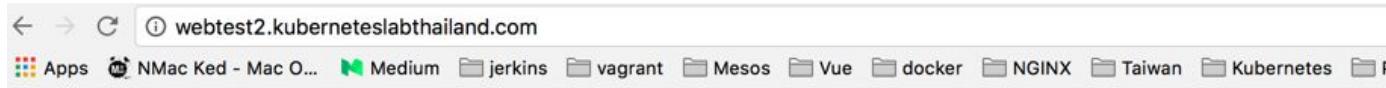
Ingress Network

- Ingress:



Welcome Page from Container Python Lab Web Version 1.00

Checkpoint Date/Time: Wed Jul 26 15:44:27 2017



Welcome Page from Container Python Lab Web Version 1.51 RC

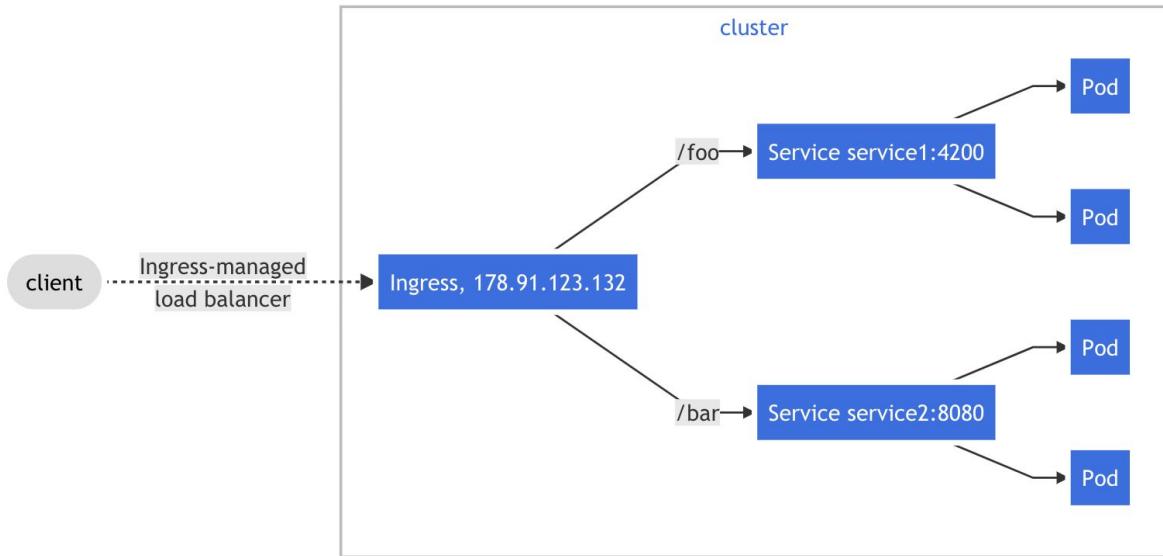
Checkpoint Date/Time: Wed Jul 26 15:49:23 2017



Ingress Network

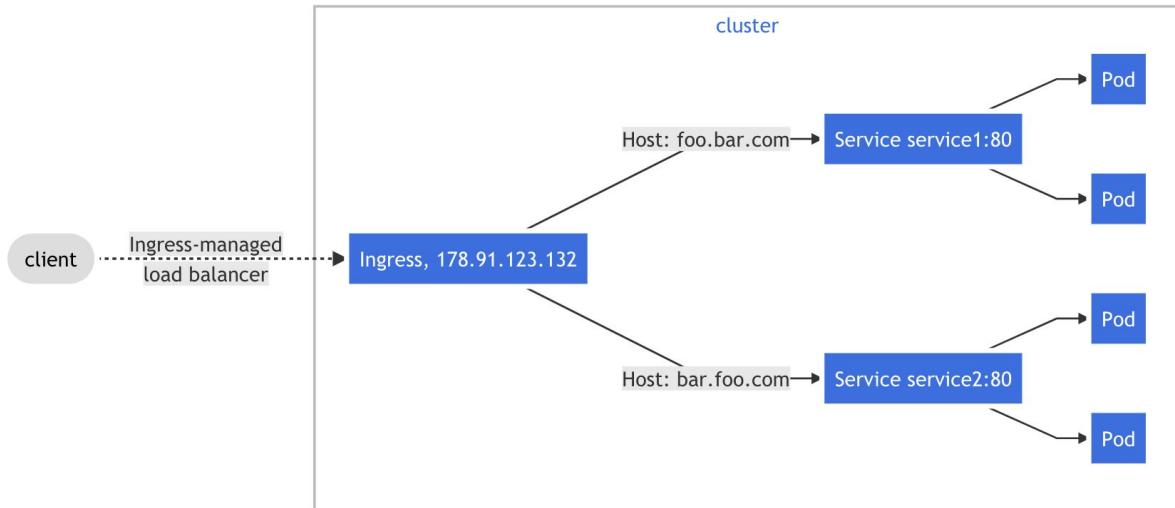
Users > praparnlueangphoonlap > Desktop > !

```
1  apiVersion: networking.k8s.io/v1
2  kind: Ingress
3  metadata:
4    name: simple-fanout-example
5  spec:
6    rules:
7      - host: foo.bar.com
8        http:
9          paths:
10            - path: /foo
11              pathType: Prefix
12              backend:
13                service:
14                  name: service1
15                  port:
16                      number: 4200
17            - path: /bar
18              pathType: Prefix
19              backend:
20                service:
21                  name: service2
22                  port:
23                      number: 8080
```



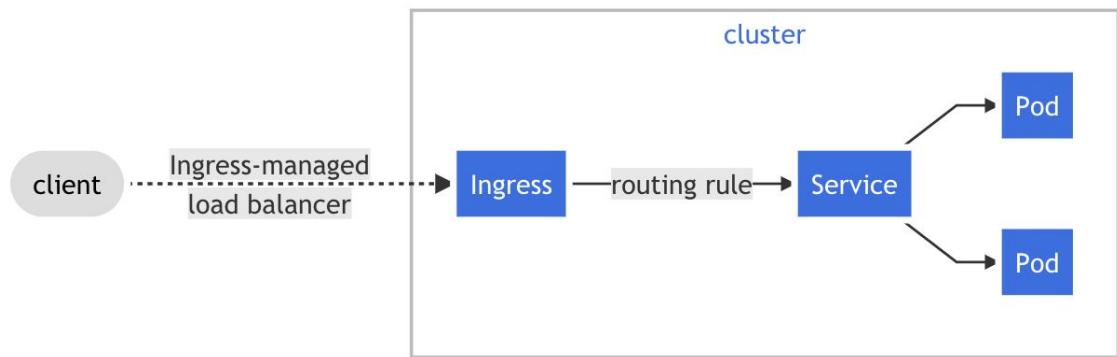
Ingress Network

```
Users > paparnlueangphoonlap > Desktop > !  
1  apiVersion: networking.k8s.io/v1  
2  kind: Ingress  
3  metadata:  
4    name: name-virtual-host-ingress  
5  spec:  
6    rules:  
7      - host: foo.bar.com  
8        http:  
9          paths:  
10            - pathType: Prefix  
11              path: "/"  
12              backend:  
13                service:  
14                  name: service1  
15                  port:  
16                      number: 80  
17      - host: bar.foo.com  
18        http:  
19          paths:  
20            - pathType: Prefix  
21              path: "/"  
22              backend:  
23                service:  
24                  name: service2  
25                  port:  
26                      number: 80
```



Ingress Network

```
Users > praparnlueangphoonlap > Desktop > ! 1.yaml
1  apiVersion: networking.k8s.io/v1
2  kind: Ingress
3  metadata:
4    name: name-virtual-host-ingress-no-third-host
5  spec:
6    rules:
7      - host: first.bar.com
8        http:
9          paths:
10         - pathType: Prefix
11           path: "/"
12           backend:
13             service:
14               name: service1
15               port:
16                 number: 80
17      - host: second.bar.com
18        http:
19          paths:
20         - pathType: Prefix
21           path: "/"
22           backend:
23             service:
24               name: service2
25               port:
26                 number: 80
27      - http:
28        paths:
29         - pathType: Prefix
30           path: "/"
31           backend:
32             service:
33               name: service3
34               port:
35                 number: 80
```



Ingress Network

SVC: webtest1

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: webtest1
5   labels:
6     name: webtest1
7     owner: Praparn_L
8     version: "1.0"
9   module: WebServer
10  environment: development
11 spec:
12   selector:
13     name: webtest1
14     owner: Praparn_L
15     version: "1.0"
16     module: WebServer
17     environment: development
18 ports:
19   - port: 80
20     name: http
21     targetPort: 5000
22     protocol: TCP
23
24
```

Ingress: ingresswebtest

```
1 apiVersion: networking.k8s.io/v1
2 kind: Ingress
3 metadata:
4   name: ingresswebtest
5 spec:
6   ingressClassName: nginx
7   rules:
8     - host: webtest1.kuberneteslabthailand.com
9       http:
10         paths:
11           - pathType: Prefix
12             path: "/"
13             backend:
14               service:
15                 name: webtest1
16                 port:
17                   number: 80
18     - host: webtest2.kuberneteslabthailand.com
19       http:
20         paths:
21           - pathType: Prefix
22             path: "/"
23             backend:
24               service:
25                 name: webtest2
26                 port:
27                   number: 80
```



SVC: webtest2

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: webtest2
5   labels:
6     name: webtest2
7     owner: Praparn_L
8     version: "1.0"
9   module: WebServer
10  environment: development
11 spec:
12   selector:
13     name: webtest2
14     owner: Praparn_L
15     version: "1.0"
16     module: WebServer
17     environment: development
18 ports:
19   - port: 80
20     name: http
21     targetPort: 5000
22     protocol: TCP
23
```

Kubernetes: Production Workload Orchestration



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Ingress Network

- Path Type:
 - Prefix: Match based on URL path (Case sensitive)
 - Exact: Match path exactly and with case sensitivity
 - ImplementationSpecific: Use for ingress class
- Multiple match:
 - Longest match path (1)
 - Exact match path (2) (Exact > Prefix)

Ingress Network

Kind	Path(s)	Request path(s)	Matches?
Prefix	/	(all paths)	Yes
Exact	/foo	/foo	Yes
Exact	/foo	/bar	No
Exact	/foo	/foo/	No
Exact	/foo/	/foo	No
Prefix	/foo	/foo , /foo/	Yes
Prefix	/foo/	/foo , /foo/	Yes
Prefix	/aaa/bb	/aaa/bbb	No
Prefix	/aaa/bbb	/aaa/bbb	Yes
Prefix	/aaa/bbb/	/aaa/bbb	Yes, ignores trailing slash
Prefix	/aaa/bbb	/aaa/bbb/	Yes, matches trailing slash
Prefix	/aaa/bbb	/aaa/bbb/ccc	Yes, matches subpath
Prefix	/aaa/bbb	/aaa/bbbxyz	No, does not match string prefix
Prefix	/ , /aaa	/aaa/ccc	Yes, matches /aaa prefix
Prefix	/ , /aaa , /aaa/bbb	/aaa/bbb	Yes, matches /aaa/bbb prefix
Prefix	/ , /aaa , /aaa/bbb	/ccc	Yes, matches / prefix
Prefix	/aaa	/ccc	No, uses default backend
Mixed	/foo (Prefix), /foo (Exact)	/foo	Yes, prefers Exact

Ingress Network

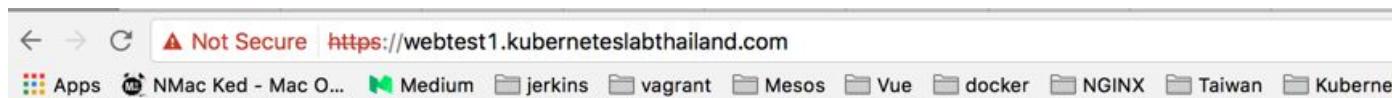
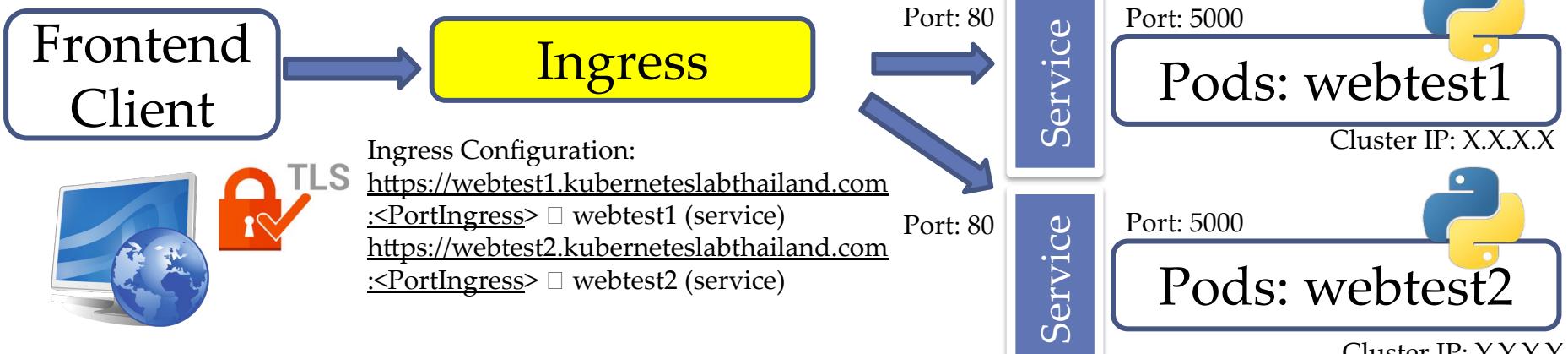
- Multiple-controller of ingress
 - Kubernetes have capability for housing multiple ingress controller on same cluster
 - Each ingress controller
- Ingress Class: Categories of ingress controller

```
---  
# Source: ingress-nginx/templates/controller-ingressclass.yaml  
# We don't support namespaced ingressClass yet  
# So a ClusterRole and a ClusterRoleBinding is required  
apiVersion: networking.k8s.io/v1  
kind: IngressClass  
metadata:  
  labels:  
    helm.sh/chart: ingress-nginx-4.0.1  
    app.kubernetes.io/name: ingress-nginx  
    app.kubernetes.io/instance: ingress-nginx  
    app.kubernetes.io/version: 1.0.0  
    app.kubernetes.io/managed-by: Helm  
    app.kubernetes.io/component: controller  
  name: nginx  
  namespace: ingress-nginx  
  #annotation:  
  #  ingressclass.kubernetes.io/is-default-class: true  #This for set default ingress controller on cluster  
spec:  
  controller: k8s.io/ingress-nginx  
---
```



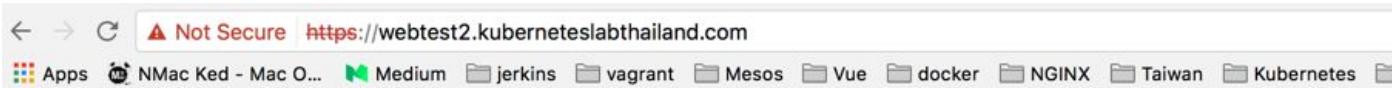
Ingress Network

- Ingress (TLS):



Welcome Page from Container Python Lab Web Version 1.00

Checkpoint Date/Time: Wed Jul 26 16:36:39 2017



Welcome Page from Container Python Lab Web Version 1.51 RC

Checkpoint Date/Time: Wed Jul 26 16:39:09 2017



Ingress Network

① www.selfsignedcertificate.com

NMac Ked - Mac O... Medium jenkins vagrant Mesos Vue docker NGINX Taiwan Kubernetes PWA_Progressive_... MYSQL_Cluster GeneralKB Nodejs

Self-Signed Certificate Generator

Development Tips

About

Self-Signed Certificate Generator

Self-signed ssl certificates can be used to set up temporary ssl servers. You can use it for test and development servers where security is not a big concern. Use the form below to generate a self-signed ssl certificate and key.

Server name:

Generate »

About SSL Certificates

SSL certificates are required in order to run web sites using the HTTPS protocol. For professional web sites, you usually buy such a certificate from Verisign, Thawte or any other ssl certificate vendor. SSL certificates use a chain of trust, where each certificate is signed (trusted) by a higher, more credible certificate. At the top of the chain of trust are the root certificates, owned by Verisign and others. These certificates are typically shipped with your operating system or web browser.



sslstore



AFFORDABLE
SSL CERTIFICATES

ISSUED IN
MINUTES*

FROM
\$10.99

SAVE 80%



Ingress Network

SVC: webtest1

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: webtest1
5   labels:
6     name: webtest1
7     owner: Paparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11
12  spec:
13    selector:
14      name: webtest1
15      owner: Paparn_L
16      version: "1.0"
17      module: WebServer
18      environment: development
19
20  ports:
21    - port: 80
22      name: http
23      targetPort: 5000
24      protocol: TCP
```

SVC: webtest2

```
1 apiVersion: v1
2 kind: Service
3 metadata:
4   name: webtest2
5   labels:
6     name: webtest2
7     owner: Paparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11
12  spec:
13    selector:
14      name: webtest2
15      owner: Paparn_L
16      version: "1.0"
17      module: WebServer
18      environment: development
19
20  ports:
21    - port: 80
22      name: http
23      targetPort: 5000
24      protocol: TCP
```

Ingress: ingresswebtest

```
1 apiVersion: networking.k8s.io/v1
2 kind: Ingress
3 metadata:
4   name: ingresswebtest
5   spec:
6     ingressClassName: nginx
7     tls:
8       - hosts:
9         - webtest1.kuberneteslabthailand.com
10        secretName: webtest1secret
11       - hosts:
12         - webtest2.kuberneteslabthailand.com
13        secretName: webtest2secret
14     rules:
15       - host: webtest1.kuberneteslabthailand.com
16         http:
17           paths:
18             - pathType: Prefix
19               path: "/"
20               backend:
21                 service:
22                   name: webtest1
23                   port:
24                     number: 80
25       - host: webtest2.kuberneteslabthailand.com
26         http:
27           paths:
28             - pathType: Prefix
29               path: "/"
30               backend:
31                 service:
32                   name: webtest2
33                   port:
34                     number: 80
```

Secret: webtest1

```
1 apiVersion: v1
2 data:
3   tls.crt: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSURMVENDQWhXZ0F3SUJBZ01K0
4   tls.key: LS0tLS1CRUdJTiBSU0EgUFJJVkJURSBLRVktLS0tLQpNSUlFb3dJQkFB50NBUVB5
5 kind: Secret
6 metadata:
7   name: webtest1secret
8   namespace: default
9 type: Opaque
```

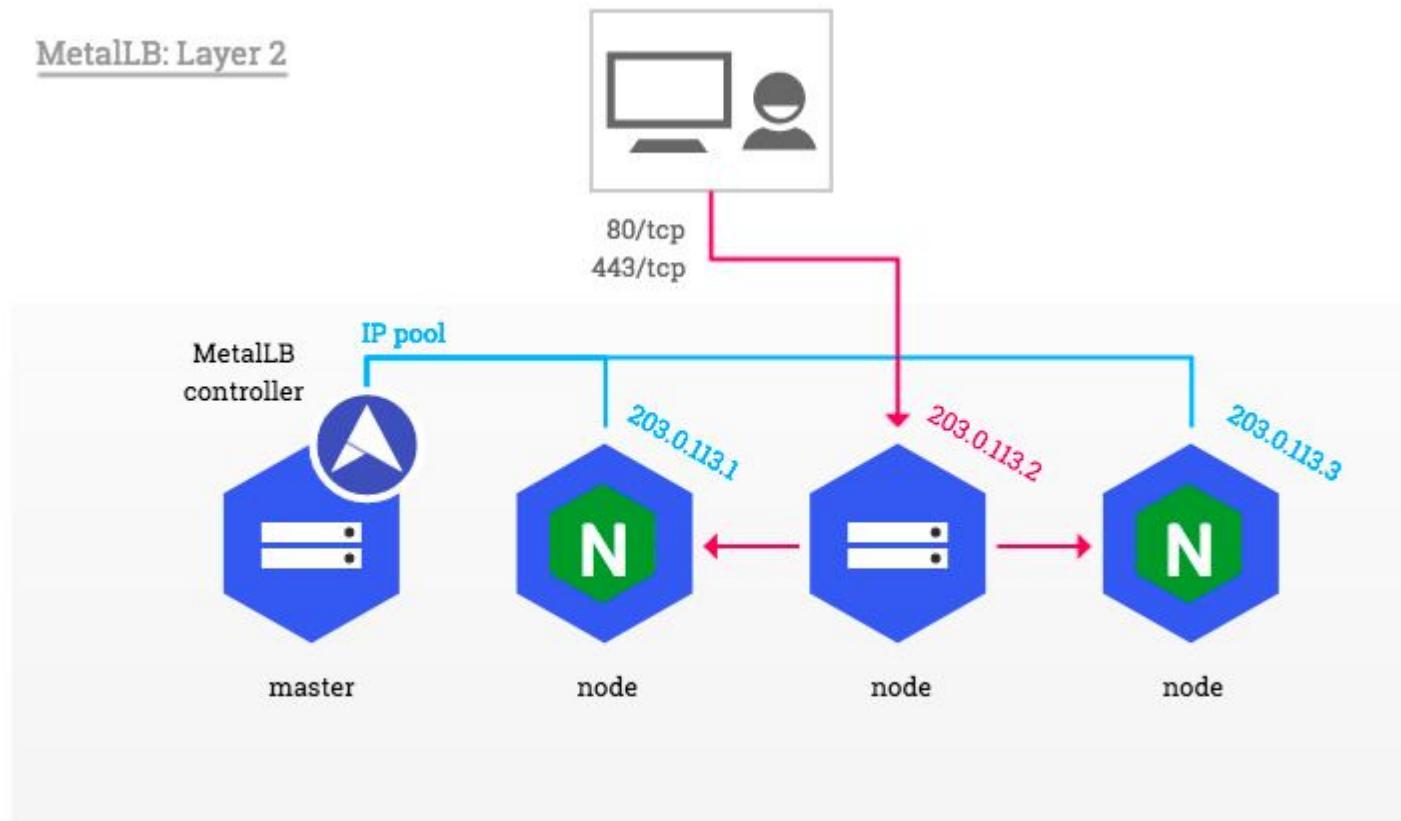
Secret: webtest2

```
1 apiVersion: v1
2 data:
3   tls.crt: LS0tLS1CRUdJTiBDRVJUSUZJQ0FURS0tLS0tCk1JSURMVENDQWhXZ0F3SUJBZ01K0
4   tls.key: LS0tLS1CRUdJTiBSU0EgUFJJVkJURSBLRVktLS0tLQpNSUlFb3dJQkFB50NBUVB5
5 kind: Secret
6 metadata:
7   name: webtest2secret
8   namespace: default
9 type: Opaque
```



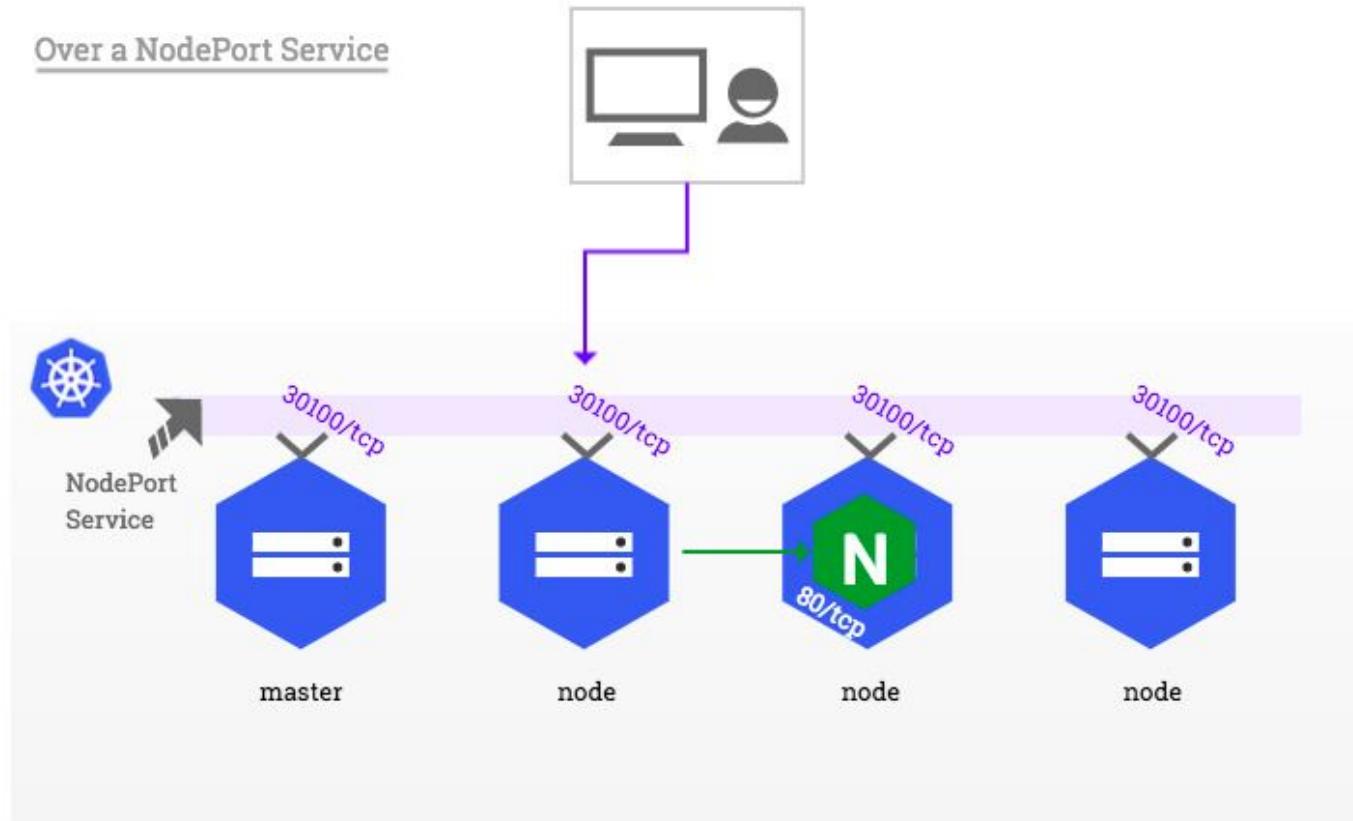
Ingress Network

- Ingress for On-prem strategy
 - MetalLB (L2 Load Balance)



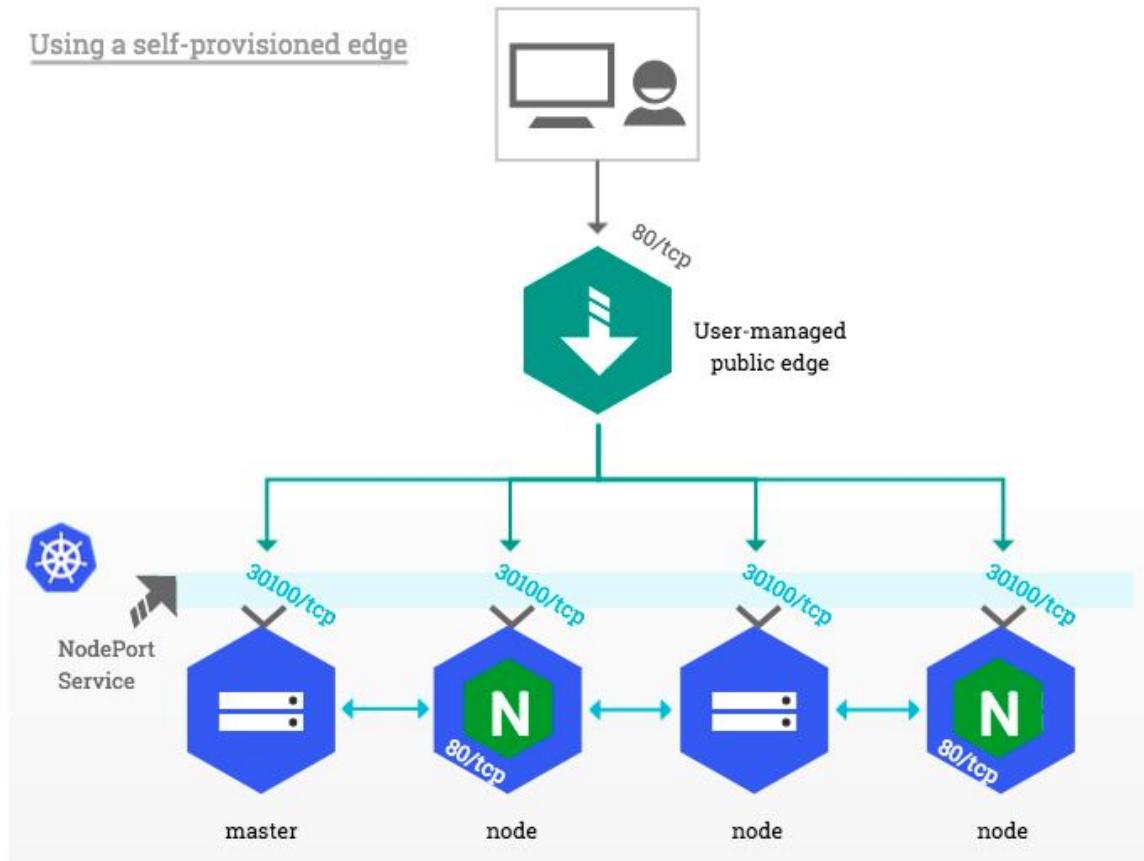
Ingress Network

- Ingress for On-prem strategy
 - NodePort (External Load Balance)



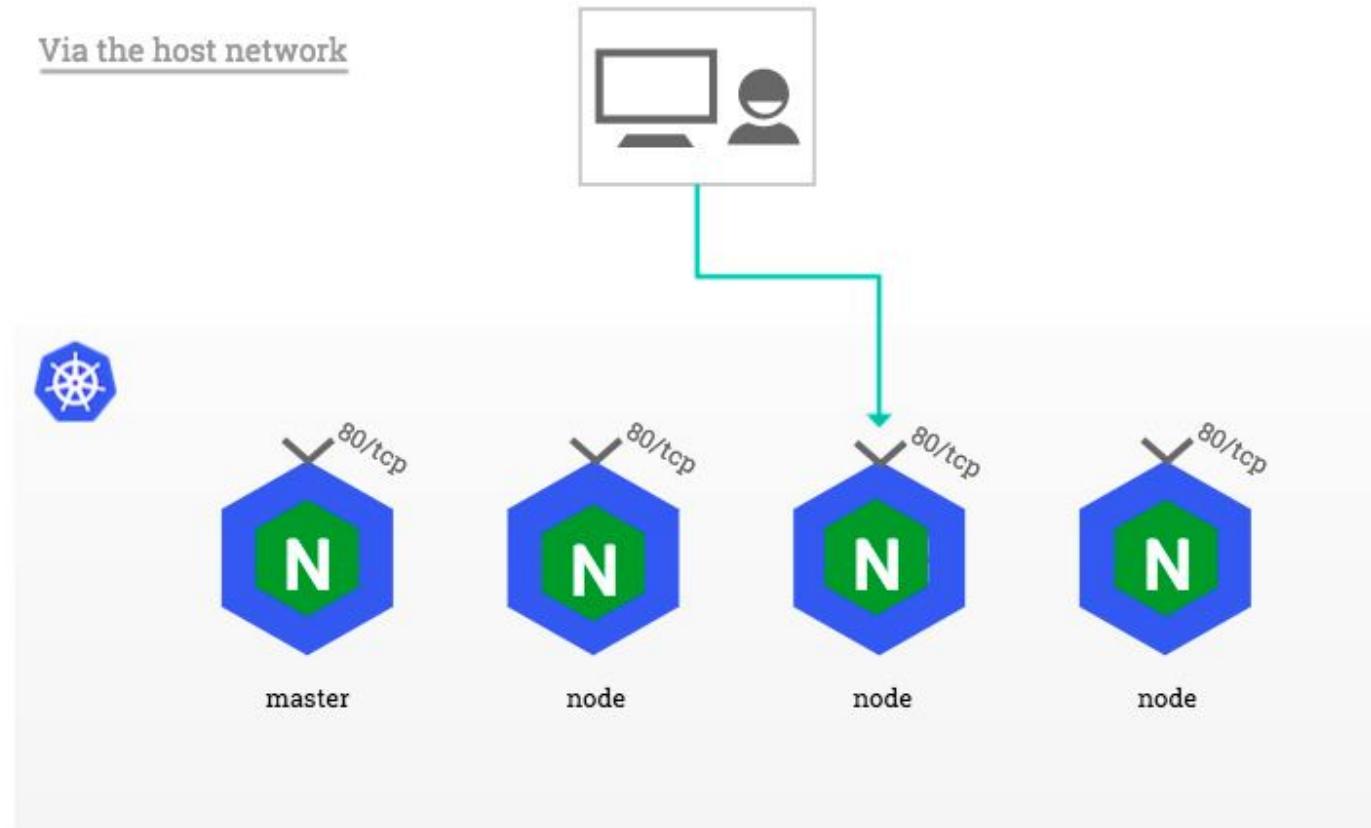
Ingress Network

- Ingress for On-prem strategy
 - NodePort (External Load Balance)



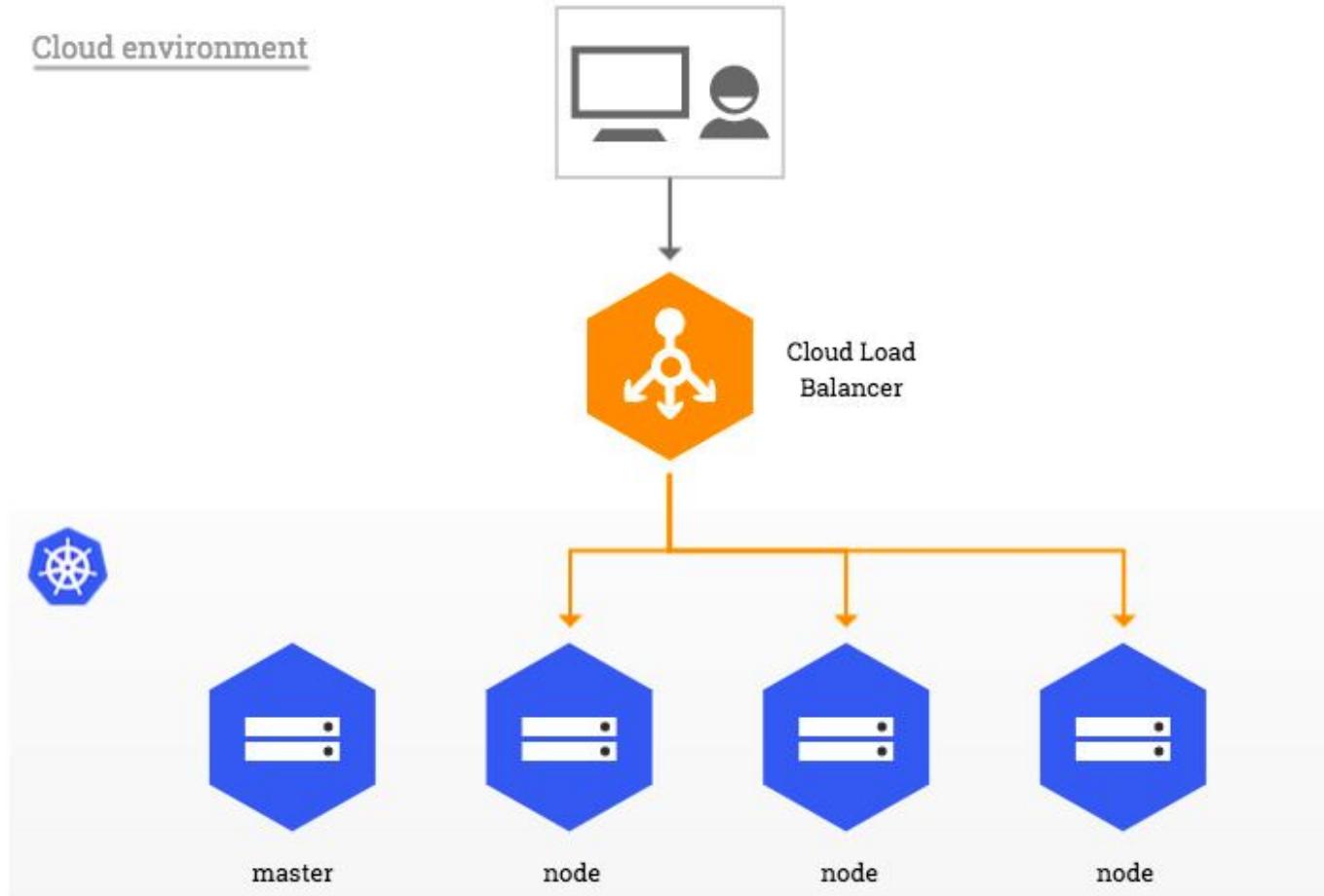
Ingress Network

- Ingress for On-prem strategy
 - Host network (Security concern, Not recommend)



Ingress Network

- Ingress for Cloud strategy



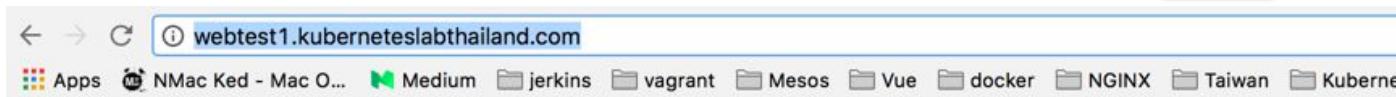
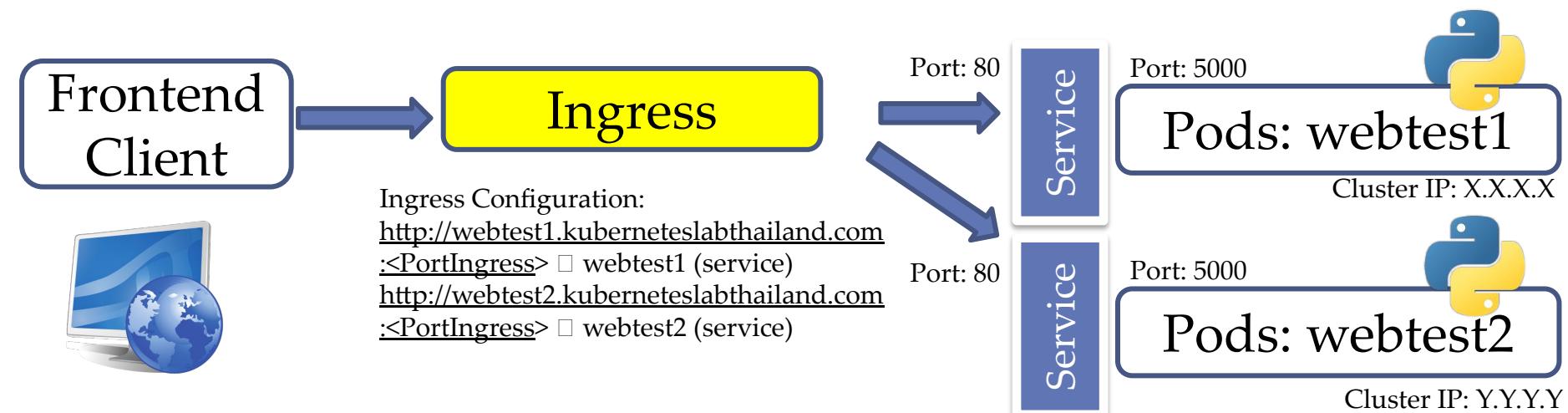
Ingress Network

- Ingress for Cloud strategy (Example: AWS)
 - Create Tag: kubernetes.io/cluster/<Cluster Name> for all resource
 - EC2 (VMWare Machine)
 - VPC
 - Subnet
 - Routing Table

Key	Value	
AZ	ap-southeast-1a	Show Column
Categories	traning	Show Column
Environment	uat	Show Column
Module	kubernetes farm	Show Column
Name	Training_DockerZerotoHero_StudentG5_1	Hide Column
Region	ap-southeast-1	Show Column
Zone	private	Show Column
kubernetes.io/cluster/TrainingAdvanceDockerwithK8SStudentG5	me	Show Column

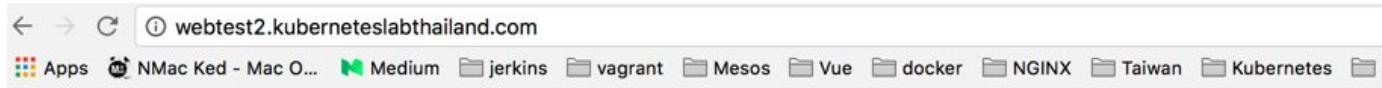


Workshop: Ingress Network



Welcome Page from Container Python Lab Web Version 1.00

Checkpoint Date/Time: Wed Jul 26 15:44:27 2017



Welcome Page from Container Python Lab Web Version 1.51 RC

Checkpoint Date/Time: Wed Jul 26 15:49:23 2017



Security



Kubernetes: Production Workload Orchestration



kubernetes
by Google

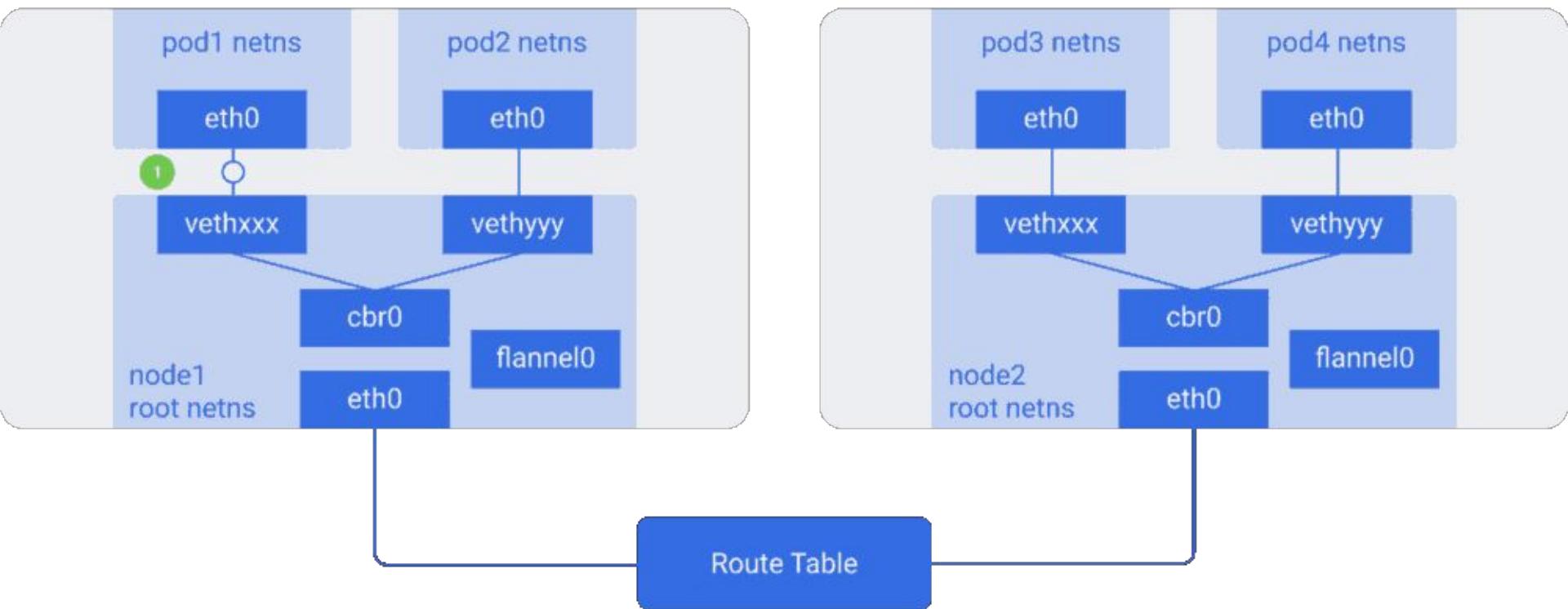
Security

- Kubernetes have several security enhancement for manage in farm
 - **Network Policy:** Control policy for allow/deny connection between endpoint
 - **Volume Policy:** Control/Limit total volume attached to node
 - **Resource Usage Policy:** Control lower/upper acceptable range in namespace (LimitRange)
 - **Resource Consumption Policy:** Limit maximum consumption policy in namespace (Quota)
 - **Access Control Policy:** Deny/Allow fine-grained permission by RBAC, Rule etc
 - **Pod Security Admission (Alpha):** Control security enforcement context (New on 1.22)



Security

- Network Policy:
 - Within same namespace
 - Each service will call by <service> or <service>.<namespace>
 - Across service across namespaces will call <service>.<namespace>



Security

- Network Policy:

- By default, pods are non-isolated; they accept traffic from any source.
- Network policy will apply target by “podSelector”, “
- We can configure network policy base on label
 - Ingress: Control traffic incoming to pods
 - Template:
 - ingress
 - from: <podSelector>/<namespaceSelector>
 - Egress
 - to: <podSelector>/<namespaceSelector>
 - Network Policy type
 - podSelector: Control policy of pods's in/out same namespace (Base on label)
 - namespaceSelector: Control policy of pods's in/out between namespace (Base on label)
 - ipBlock: Control policy by block ip address (Block ip range)

Security



[Documentation](#) [Kubernetes Blog](#)

Search

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Advertise Extended Resources for a Node

Autoscale the DNS Service in a Cluster

Change the default StorageClass

Change the Reclaim Policy of a PersistentVolume

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Declare Network Policy

This document helps you get started using the Kubernetes [NetworkPolicy API](#) to declare network policies that govern how pods communicate with each other.

Caution: This section links to third party projects that provide functionality required by Kubernetes. The Kubernetes project authors aren't responsible for these projects. This page follows [CNCF website guidelines](#) by listing projects alphabetically. To add a project to this list, read the [content guide](#) before submitting a change.

Before you begin

You need to have a Kubernetes cluster, and the `kubectl` command-line tool must be configured to communicate with your cluster. If you do not already have a cluster, you can create one by using [minikube](#) or you can use one of these Kubernetes playgrounds:

- [Katacoda](#)
- [Play with Kubernetes](#)

Your Kubernetes server must be at or later than version v1.8. To check the version, enter `kubectl version`.

Make sure you've configured a network provider with network policy support. There are a number of network providers that support [NetworkPolicy](#), including:

- [Calico](#)
- [Cilium](#)
- [Kube-router](#)
- [Romana](#)
- [Weave Net](#)



Security

- Network Policy:

```
WorkShop_2.2_Security > ! policy-default-allow-egress.yml
1  apiVersion: networking.k8s.io/v1
2  kind: NetworkPolicy
3  metadata:
4    name: allow-all
5  spec:
6    podSelector: {}
7    egress:
8      - {}
9    policyTypes:
10   - Egress
```

```
WorkShop_2.2_Security > ! policy-default-allow-ingress.yml
1  apiVersion: networking.k8s.io/v1
2  kind: NetworkPolicy
3  metadata:
4    name: allow-all
5  spec:
6    podSelector: {}
7    ingress:
8      - {}
9    policyTypes:
10   - Ingress
```

```
WorkShop_2.2_Security > ! policy-backend-policy.yml
1  kind: NetworkPolicy
2  apiVersion: networking.k8s.io/v1
3  metadata:
4    namespace: stars
5    name: backend-policy
6  spec:
7    podSelector:
8      matchLabels:
9        role: backend
10   ingress:
11     - from:
12       - podSelector:
13         matchLabels:
14           role: frontend
15       ports:
16         - protocol: TCP
17           port: 6379
```

```
WorkShop_2.2_Security > ! policy-template.yml
2  kind: NetworkPolicy
3  metadata:
4    name: policy-template
5    namespace: stars
6  spec:
7    podSelector:
8      matchLabels:
9        role: backend
10   policyTypes:
11     - Ingress
12     - Egress
13   ingress:
14     - from:
15       - ipBlock:
16         cidr: 172.17.0.0/16
17         except:
18           - 172.17.1.0/24
19       - namespaceSelector:
20         matchLabels:
21           role: management-ui
22     - podSelector:
23       matchLabels:
24           role: frontend
25     ports:
26       - protocol: TCP
27         port: 6379
28   egress:
29     - to:
30       - ipBlock:
31         cidr: 10.0.0.0/24
32       ports:
33         - protocol: TCP
34           port: 5978
```

Security

- Network Policy:

Namespace: management-ui

<- Label: role=management-ui>

RC: management-ui

Pods: <label: role=management-ui>

manage-ui-xx

Service

Type: NodePort
Name: management-ui
Service Port: 80
Container Port: 9001
NodePort: 32500



Namespace: stars

<- Label: role=stars>

RC: frontend

Pods: <label: role=frontend>

frontend-xx

Type: Cluster-IP
Name: frontend
Service Port: 80
Container Port: 80
Url: http://frontend.stars

Service

RC: backend

Pods: <label: role=backend>

backend-xx

Type: Cluster-IP
Name: backend
Service Port: 6379
Container Port: 6379
Url: http://backend.stars:6379

Namespace: client

<- Label: role=client>

RC: client

Pods: <label: role=client>

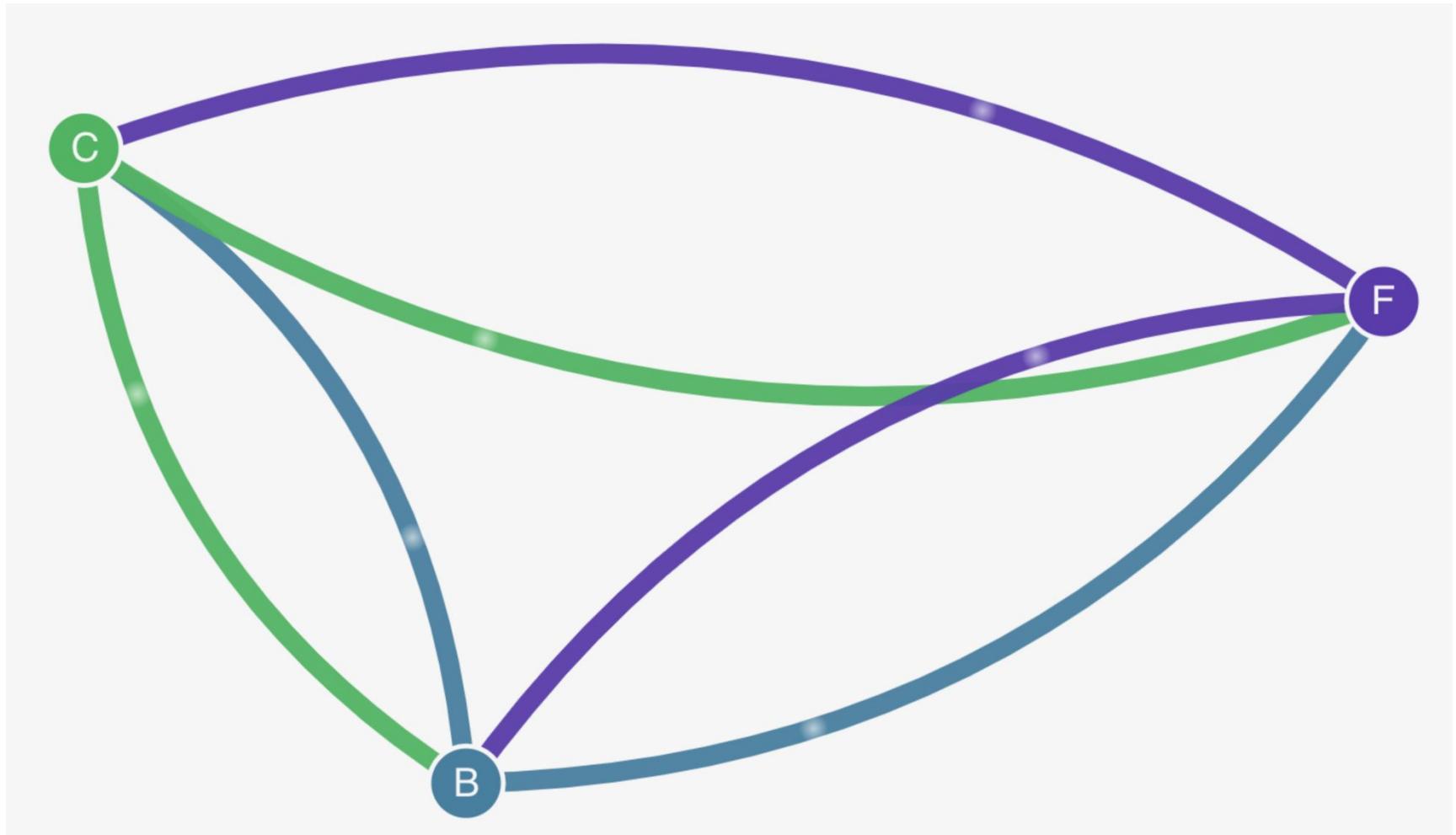
client-xx

Type: Cluster-IP
Name: client
Service Port: 9000
Container Port: 9000
Url: http://client.client:9000



Security

- Network Policy:



Security

- Network Policy:

Namespace: management-ui

<- Label: role=management-ui>

RC: management-ui

Pods: <label: role=management-ui>

manage-ui-xx

Service

Type: NodePort
Name: management-ui
Service Port: 80
Container Port: 9001
NodePort: 32500



```
1 kind: NetworkPolicy
2 apiVersion: networking.k8s.io/v1
3 metadata:
4   name: default-deny
5   namespace: stars
6 spec:
7   podSelector:
8     matchLabels: {}
```

Namespace: stars

<- Label: role=stars>

RC: frontend

Pods: <label: role=frontend>

frontend-xx

Type: Cluster-IP
Name: frontend
Service Port: 80
Container Port: 80
Url: http://frontend.stars

X

Service

RC: backend

Pods: <label: role=backend>

backend-xx

Type: Cluster-IP
Name: backend
Service Port: 6379
Container Port: 6379
Url: http://backend.stars:6379

X

Namespace: client

<- Label: role=client>

RC: client

Pods: <label: role=client>

client-xx

Type: Cluster-IP
Name: client
Service Port: 9000
Container Port: 9000
Url: http://client.client:9000

X

```
1 kind: NetworkPolicy
2 apiVersion: networking.k8s.io/v1
3 metadata:
4   name: default-deny
5   namespace: client
6 spec:
7   podSelector:
8     matchLabels: {}
```



Security

- Network Policy:

[Toggle Unreachable](#)

[Toggle Markers](#)



Security

- Network Policy:

Namespace: management-ui

<- Label: role=management-ui>

RC: management-ui

Pods: <label: role=management-ui>

manage-ui-xx

Service

Type: NodePort

Name: management-ui

Service Port: 80

Container Port: 9001

NodePort: 32500



Kubernetes: I

Namespace: stars

<- Label: role=stars>

RC: frontend

Pods: <label: role=frontend>

frontend-xx

X

Type: Cluster-IP

Name: frontend

Service Port: 80

Container Port: 80

Url: http://frontend.stars

Y

RC: backend

Pods: <label: role=backend>

backend-xx

Type: Cluster-IP

Name: backend

Service Port: 6379

Container Port: 6379

Url: http://backend.stars:6379

d Orchestration

Namespace: client

<- Label: role=client>

RC: client

Pods: <label: role=client>

client-xx

Service

X

Y

Type: Cluster-IP

Name: client

Service Port: 9000

Container Port: 9000

Url: http://client.client:9000

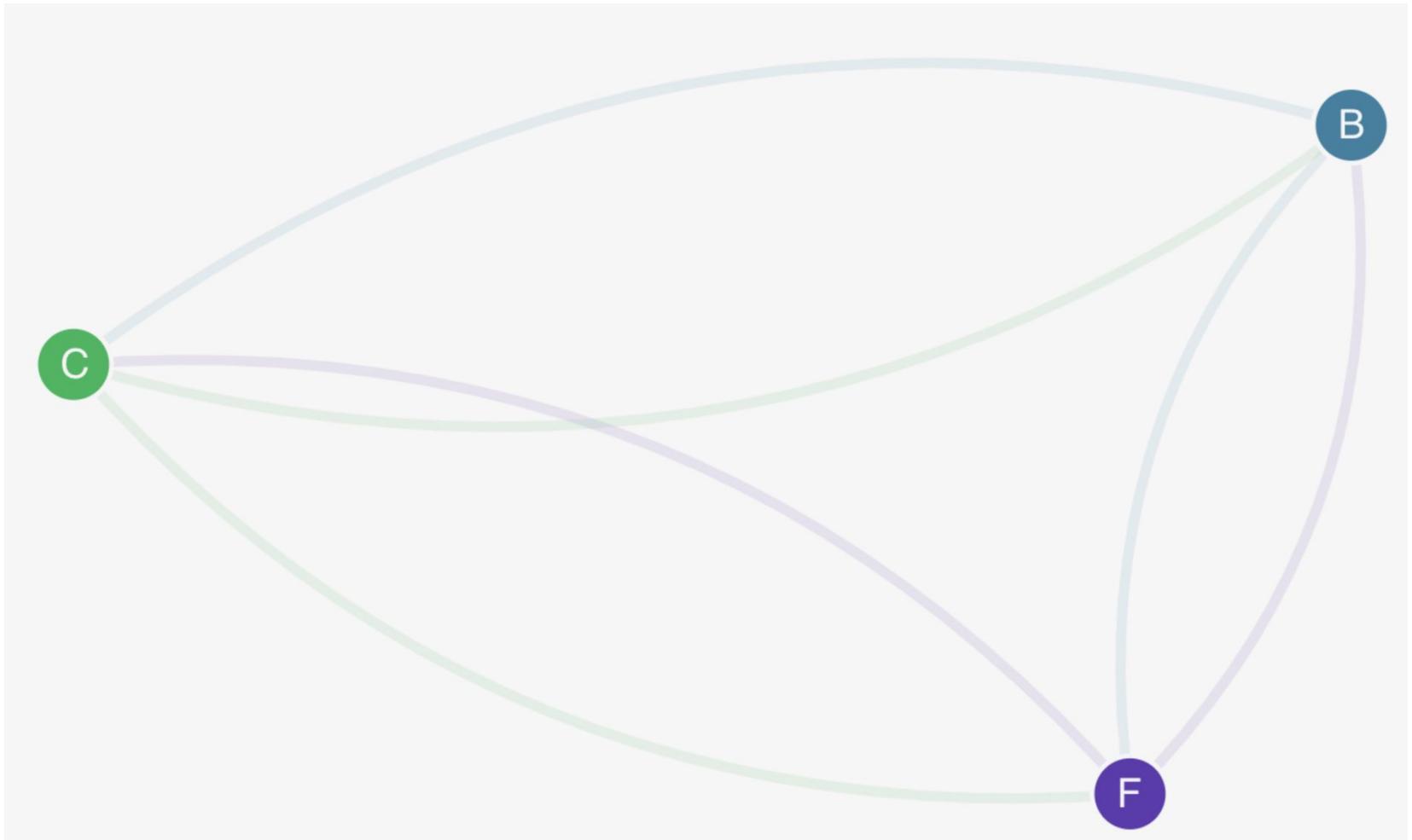
```
1 kind: NetworkPolicy
2 apiVersion: extensions/v1beta1
3 metadata:
4   namespace: stars
5   name: allow-ui
6 spec:
7   podSelector:
8     matchLabels: {}
9   ingress:
10    - from:
11      - namespaceSelector:
12        matchLabels:
13          role: management-ui
```



kubernetes
by Google

Security

- Network Policy:



Security

- Network Policy:

Namespace: management-ui

<- Label: role=management-ui>

RC: management-ui

Pods: <label: role=management-ui>

manage-ui-xx

Service

Type: NodePort

Name: management-ui

Service Port: 80

Container Port: 9001

NodePort: 32500



Kubernetes: Pro

```
1 kind: NetworkPolicy
2 apiVersion: networking.k8s.io/v1
3 metadata:
4   namespace: stars
5   name: frontend-policy
6 spec:
7   podSelector:
8     matchLabels:
9       role: frontend
10    ingress:
11      - from:
12        - podSelector:
13          matchLabels:
14            role: backend
15          ports:
16            - protocol: TCP
17              port: 6379
```

Namespace: stars

<- Label: role=stars>

RC: frontend

Pods: <label: role=frontend>

frontend-xx

X

Y

Y

Type: Cluster-IP

Name: frontend

Service Port: 80

Container Port: 80

Url: http://frontend.stars

RC: backend

Pods: <label: role=backend>

backend-xx

Type: Cluster-IP

Name: backend

Service Port: 6379

Container Port: 6379

Url: http://backend.stars:6379

Servi

Y

Namespace: client

<- Label: role=client>

RC: client

Pods: <label: role=client>

client-xx

X

Y

Type: Cluster-IP

Name: client

Service Port: 9000

Container Port: 9000

Url: http://client.client:9000

```
1 kind: NetworkPolicy
2 apiVersion: networking.k8s.io/v1
3 metadata:
4   namespace: stars
5   name: frontend-policy
6 spec:
7   podSelector:
8     matchLabels:
9       role: frontend
10    ingress:
11      - from:
12        - namespaceSelector:
13          matchLabels:
14            role: client
15          ports:
16            - protocol: TCP
17              port: 80
```

Orchestration



kubernetes
by Google

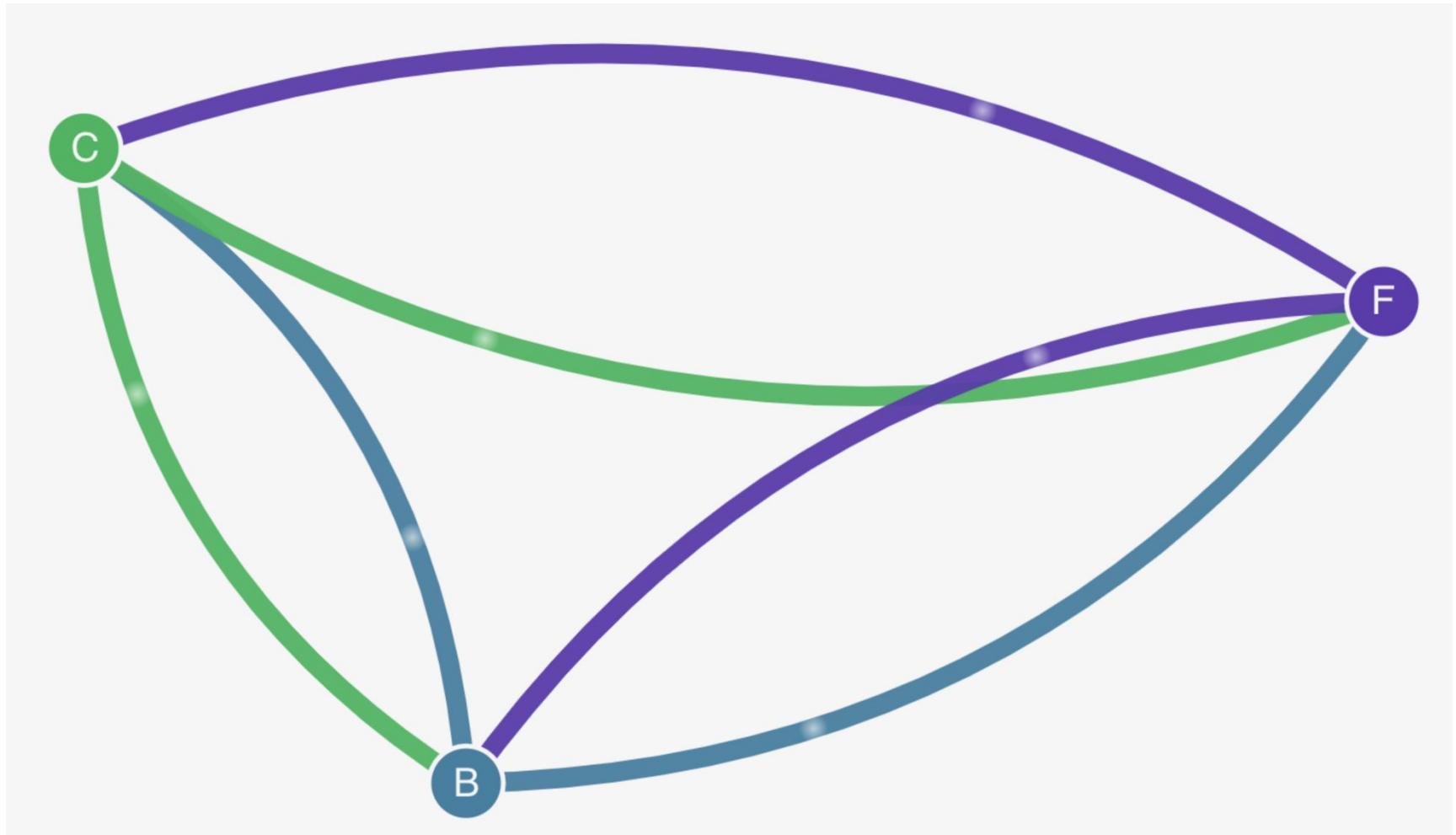
Security

- Network Policy:



Workshop: Security

- Part: Network Policy



Security

- Volume Policy:
 - Kubernetes have default limit volume attached per host
 - Custom this value by environment variable: KUBE_MAX_PD_VOLS



Node-specific Volume Limits

This page describes the maximum number of volumes that can be attached to a Node for various cloud providers.

Cloud providers like Google, Amazon, and Microsoft typically have a limit on how many volumes can be attached to a Node. It is important for Kubernetes to respect those limits. Otherwise, Pods scheduled on a Node could get stuck waiting for volumes to attach.

- [Kubernetes default limits](#)
- [Custom limits](#)
- [Dynamic volume limits](#)

Kubernetes default limits

The Kubernetes scheduler has default limits on the number of volumes that can be attached to a Node:

Cloud service	Maximum volumes per Node
Amazon Elastic Block Store (EBS)	39
Google Persistent Disk	16
Microsoft Azure Disk Storage	16

Ref: <https://kubernetes.io/docs/concepts/storage/storage-limits/>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Security

- Resource Usage Policy:
 - Control by “ResourceQuota”

```
1 apiVersion: v1
2 kind: ResourceQuota
3 metadata:
4   name: webtest-quota
5   labels:
6     name: webtest_quota
7     owner: Praparn_L
8     version: "1.0"
9     module: Quota
10    environment: development
11 spec:
12   hard:
13     pods: "4"
14     requests.cpu: "1"
15     requests.memory: 1Gi
16     limits.cpu: "4"
17     limits.memory: 4Gi
```

- Resource Consume Policy:
 - Control by “LimitRange”

```
1 apiVersion: v1
2 kind: LimitRange
3 metadata:
4   name: webtest_limit
5   labels:
6     name: webtest_limit
7     owner: Praparn_L
8     version: "1.0"
9     module: LimitRange
10    environment: development
11 spec:
12   limits:
13     - max:
14       cpu: "1"
15       memory: 1Gi
16     min:
17       cpu: 200m
18       memory: 6Mi
19     type: Pod
20   default:
21     cpu: 300m
22     memory: 200Mi
23   defaultRequest:
24     cpu: 200m
25     memory: 100Mi
26   max:
27     cpu: "1"
28     memory: 1Gi
29   min:
30     cpu: 100m
31     memory: 3Mi
32   type: Container
```



Security

- Access Control Policy
 - Normally Kubernetes manage privilege via RBAC (Role-base access control) for flexibility to change and assign privilege in role
 - Account for access with cluster will define to “User Account/Service Account”
 - RBAC normally describe in 4 categories
 - Role and ClusterRole:
 - RoleBinding and ClusterRoleBinding:
 - Referring to Resources:
 - Aggregated ClusterRoles:

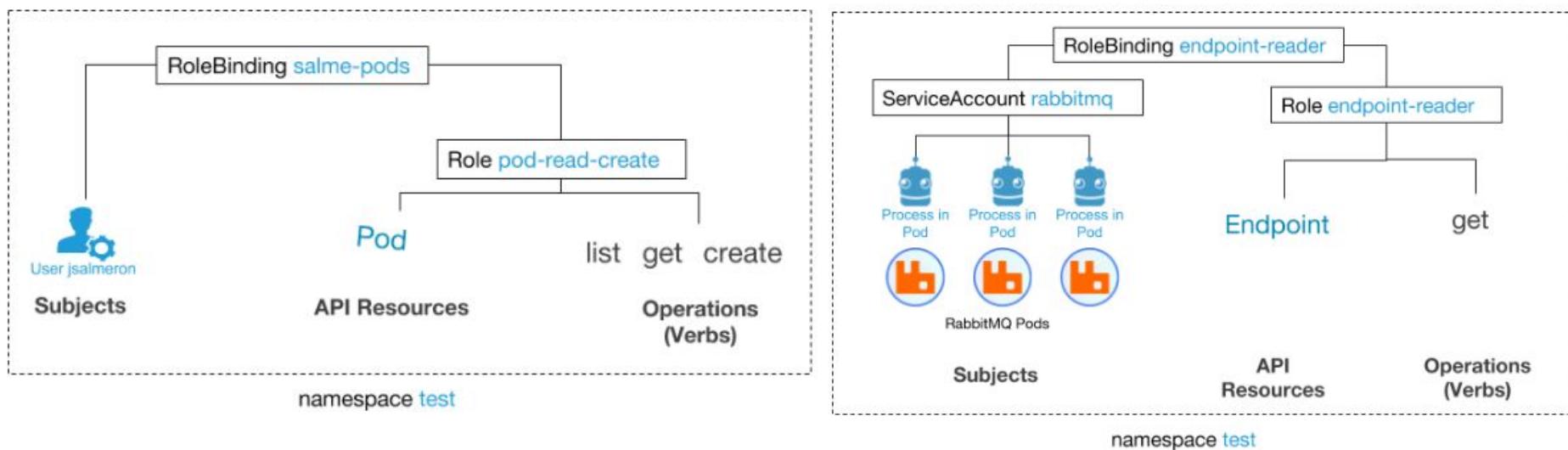


Security

- Access Control Policy

- Account Management

- User accounts are for humans. Service accounts are for processes, which run in pods.
 - User accounts are global scope. Names must be unique across all namespaces of a cluster.
 - Auditing considerations for humans and service accounts may differ.



Ref: <https://www.cncf.io/blog/2018/08/01/demystifying-rbac-in-kubernetes/>
Kubernetes: Production Workload Orchestration

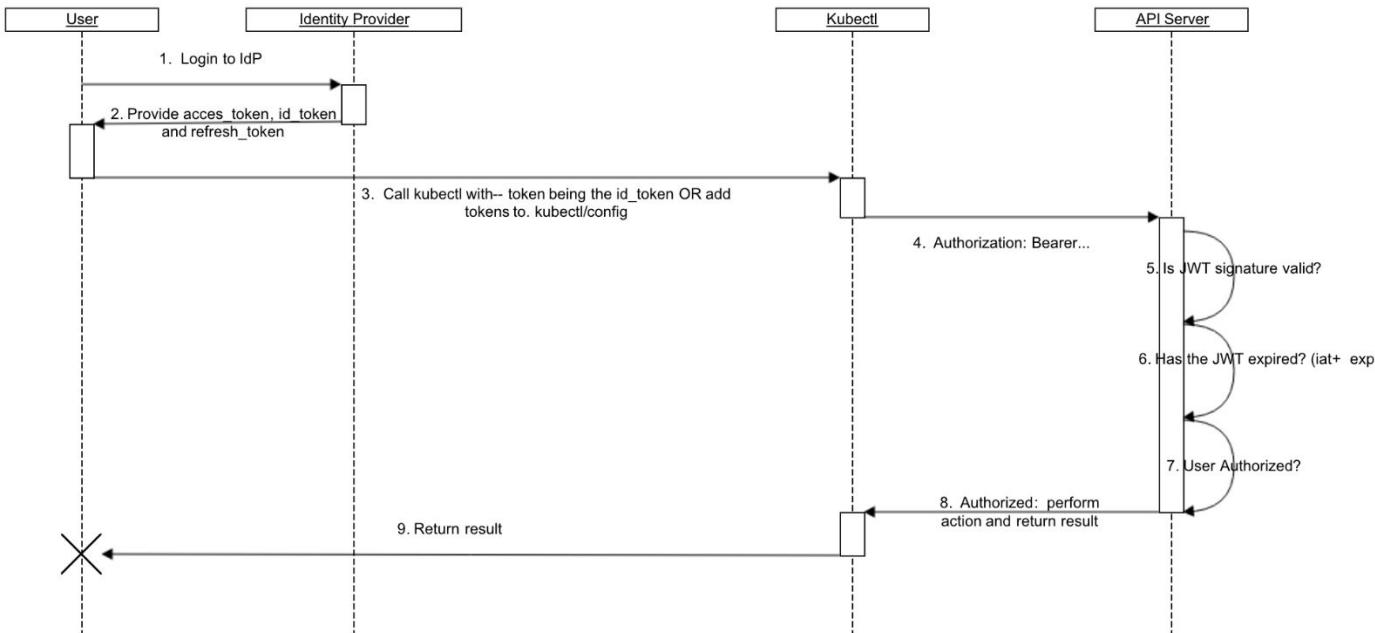
Security

- Access Control Policy
 - Account Management
 - Support OpenID.

OpenID Connect Tokens

OpenID Connect is a flavor of OAuth2 supported by some OAuth2 providers, notably Azure Active Directory, Salesforce, and Google. The protocol's main extension of OAuth2 is an additional field returned with the access token called an ID Token. This token is a JSON Web Token (JWT) with well known fields, such as a user's email, signed by the server.

To identify the user, the authenticator uses the `id_token` (not the `access_token`) from the OAuth2 [token response](#) as a bearer token. See [above](#) for how the token is included in a request.



Ref: <https://kubernetes.io/docs/reference/access-authn-authz/authentication/>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Security

- Access Control Policy

- **Account Management**

- Service Accounts

```
1  apiVersion: v1
2  kind: ServiceAccount
3  metadata:
4    name: serviceaccount-readonly
```

- User Accounts

- No yaml file for create user account
 - Create via “openssl/kubectl” operate
 - private key for user and create csr (certificate sign request)(openssl)
 - generate final certificate from CA of Kubernetes CA (openssl)
 - create context for user via kubectl

Security

- Access Control Policy
 - **RBAC Operate**
 - Role and ClusterRole
 - Role: Describe rule for allow action on namespace level
 - ClusterRole: Describe rule for allow action on cluster level
 - Structure of syntax
 - rules
 - apiGroup[""] □ Core API Group
 - resource[""] □ King of resource to manage
 - verbs[""] □ Action to allow
 - Default ClusterRole can check on this
<https://github.com/kubernetes/kubernetes/blob/master/plugin/pkg/auth/authorizer/rbac/bootstrappolicy/testdata/cluster-roles.yaml>

Security

```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: Role
3 metadata:
4   namespace: security
5   name: templaterole
6 rules:
7 - apiGroups: [""]
8   resources: ["pods"]
9   verbs: ["get", "watch", "list"]
10 - apiGroups: ["apps"]
11   resources: ["deployments"]
12   verbs: ["get", "list", "watch", "create", "update", "patch", "delete"]
13 - apiGroups: ["batch"]
14   resources: ["jobs"]
15   verbs: ["get", "list", "watch", "create", "update", "patch", "delete"]
16 - apiGroups: [""]
17   resources: ["configmaps"]
18   resourceNames: ["testconfigmap"]
19   verbs: ["get"]
20 - apiGroups: [""]
21   resources: ["nodes"]
22   verbs: ["get", "list", "watch"]
```

```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: Role
3 metadata:
4   namespace: security
5   name: rolereadonly
6 rules:
7 - apiGroups: [ "", "apps" ]
8   resources: ["deployments", "replicasets", "pods"]
9   verbs: ["get", "list", "watch"]
```

```
1 apiVersion: v1
2 kind: ConfigMap
3 metadata:
4   name: webmodule-configmap
5   namespace: webmicroservice
6   labels:
7     name: webmodule-configmap
8     owner: "Praparn_L"
9     version: "1.0"
10    module: "ConfigMap"
11    environment: "development"
12 data:
13   REDIS_HOST: localhost
14
```

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: webtest1
  labels:
    name: webtest1
    owner: Praparn_L
    version: "1.0"
    module: WebServer
    environment: development
spec:
  replicas: 1
  selector:
    matchLabels:
      name: webtest1
```

WorkShop_1.9_Job_CronJob > ! job.yml

```
1 apiVersion: batch/v1
2 kind: Job
3 metadata:
4   name: linenotify
5   labels:
6     name: linenotify
7     owner: Praparn_L
8     version: "1.0"
9     module: Job
10    environment: development
11 spec:
12   ttlSecondsAfterFinished: 30
13   activeDeadlineSeconds: 60
14   template:
15     metadata:
16       name: linenotify
17     spec:
18       containers:
19         - name: linenotify
20           image: labdocker/linenotify:onetime
21
```



Security

```
1 kind: ClusterRole
2 metadata:
3   annotations:
4     | rbac.authorization.kubernetes.io/autoupdate: "true"
5   labels:
6     name: clusterrolereadonly
7   rules:
8     - apiGroups: [ "", "apps", "extensions" ]
9     resources: ["*"]
10    verbs: ["get", "list", "watch"]
```

```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: ClusterRole
3 metadata:
4   name: templateclusterrole
5   labels:
6     | rbac.kubernetestthailand.com/security: "true"
7   rules:
8     - apiGroups: [""]
9       resources: ["pods"]
10      verbs: ["get", "watch", "list"]
11     - apiGroups: ["apps"]
12       resources: ["deployments"]
13       verbs: ["get", "list"]
14     - apiGroups: ["batch"]
15       resources: ["jobs"]
16       verbs: ["get", "list"]
17     - apiGroups: [""]
18       resources: ["nodes"]
19       verbs: ["get", "list", "watch"]
```



Security

NAME	SHORTNAMES	APIGROUP	NAMESPACED	KIND	VERBS
bindings			true	Binding	[create] [get list]
componentstatuses	cs		false	ComponentStatus	[create delete deletecollection get list patch update watch]
configmaps	cm		true	ConfigMap	[create delete deletecollection get list patch update watch]
endpoints	ep		true	Endpoints	[create delete deletecollection get list patch update watch]
events	ev		true	Event	[create delete deletecollection get list patch update watch]
limitranges	limits		true	LimitRange	[create delete deletecollection get list patch update watch]
namespaces	ns		false	Namespace	[create delete get list patch update watch]
nodes	no		false	Node	[create delete deletecollection get list patch update watch]
persistentvolumeclaims	pvc		true	PersistentVolumeClaim	[create delete deletecollection get list patch update watch]
persistentvolumes	pv		false	PersistentVolume	[create delete deletecollection get list patch update watch]
pods	po		true	Pod	[create delete deletecollection get list patch update watch]
podtemplates			true	PodTemplate	[create delete deletecollection get list patch update watch]
replicationcontrollers	rc		true	ReplicationController	[create delete deletecollection get list patch update watch]
resourcequotas	quota		true	ResourceQuota	[create delete deletecollection get list patch update watch]
secrets			true	Secret	[create delete deletecollection get list patch update watch]
serviceaccounts	sa		true	ServiceAccount	[create delete deletecollection get list patch update watch]
services	svc		true	Service	[create delete get list patch update watch]
mutatingwebhookconfigurations		admissionregistration.k8s.io	false	MutatingWebhookConfiguration	[create delete deletecollection get list patch update watch]
validatingwebhookconfigurations		admissionregistration.k8s.io	false	ValidatingWebhookConfiguration	[create delete deletecollection get list patch update watch]
customresourcedefinitions	crd,crds	apiextensions.k8s.io	false	CustomResourceDefinition	[create delete deletecollection get list patch update watch]
apiservices		apiregistration.k8s.io	false	APIService	[create delete deletecollection get list patch update watch]
controllerrevisions		apps	true	ControllerRevision	[create delete deletecollection get list patch update watch]
daemonsets	ds	apps	true	DaemonSet	[create delete deletecollection get list patch update watch]
deployments	deploy	apps	true	Deployment	[create delete deletecollection get list patch update watch]
replicasesets	rs	apps	true	ReplicaSet	[create delete deletecollection get list patch update watch]
statefulsets	sts	apps	true	StatefulSet	[create delete deletecollection get list patch update watch]
tokenreviews		authentication.k8s.io	false	TokenReview	[create delete deletecollection get list patch update watch]
localsubjectaccessreviews		authorization.k8s.io	true	LocalSubjectAccessReview	[create]
selfsubjectaccesreviews		authorization.k8s.io	false	SelfSubjectAccessReview	[create]
selfsubjectrulesreviews		authorization.k8s.io	false	SelfSubjectRulesReview	[create]
subjectaccesreviews		authorization.k8s.io	false	SubjectAccessReview	[create]
horizontalpodautoscalers	hpa	autoscaling	true	HorizontalPodAutoscaler	[create delete deletecollection get list patch update watch]
cronjobs	cj	batch	true	CronJob	[create delete deletecollection get list patch update watch]
jobs		batch	true	Job	[create delete deletecollection get list patch update watch]
certificatesigningrequests	csr	certificates.k8s.io	false	CertificateSigningRequest	[create delete deletecollection get list patch update watch]
leases		coordination.k8s.io	true	Lease	[create delete deletecollection get list patch update watch]
bgpconfigurations		crd.projectcalico.org	false	BGPConfiguration	[delete deletecollection get list patch create update watch]
bgppeers		crd.projectcalico.org	false	BGPPeer	[delete deletecollection get list patch create update watch]
blockaffinities		crd.projectcalico.org	false	BlockAffinity	[delete deletecollection get list patch create update watch]
clusterinformations		crd.projectcalico.org	false	ClusterInformation	[delete deletecollection get list patch create update watch]
felixconfigurations		crd.projectcalico.org	false	FelixConfiguration	[delete deletecollection get list patch create update watch]
globalnetworkpolicies		crd.projectcalico.org	false	GlobalNetworkPolicy	[delete deletecollection get list patch create update watch]
globalnetworksets		crd.projectcalico.org	false	GlobalNetworkSet	[delete deletecollection get list patch create update watch]
hostendpoints		crd.projectcalico.org	false	HostEndpoint	[delete deletecollection get list patch create update watch]
ipamblocks		crd.projectcalico.org	false	IPAMBlock	[delete deletecollection get list patch create update watch]
ipamconfigs		crd.projectcalico.org	false	IPAMConfig	[delete deletecollection get list patch create update watch]
ipamhandles		crd.projectcalico.org	false	IPAMHandle	[delete deletecollection get list patch create update watch]
ippools		crd.projectcalico.org	false	IPPool	[delete deletecollection get list patch create update watch]
networkpolicies		crd.projectcalico.org	true	NetworkPolicy	[delete deletecollection get list patch create update watch]
networksets		crd.projectcalico.org	true	NetworkSet	[delete deletecollection get list patch create update watch]
events	ev	events.k8s.io	true	Event	[create delete deletecollection get list patch create update watch]
ingresses	ing	extensions	true	Ingress	[create delete deletecollection get list patch update watch]
ingresses	ing	networking.k8s.io	true	Ingress	[create delete deletecollection get list patch update watch]
networkpolicies	netpol	networking.k8s.io	true	NetworkPolicy	[create delete deletecollection get list patch update watch]
runtimeclasses		node.k8s.io	false	RuntimeClass	[create delete deletecollection get list patch update watch]
poddisruptionbudgets	pdb	policy	true	PodDisruptionBudget	[create delete deletecollection get list patch update watch]
podsecuritypolicies	psp	policy	false	PodSecurityPolicy	[create delete deletecollection get list patch update watch]
clusterrolebindings		rbac.authorization.k8s.io	false	ClusterRoleBinding	[create delete deletecollection get list patch update watch]
clusterroles		rbac.authorization.k8s.io	false	ClusterRole	[create delete deletecollection get list patch update watch]
rolebindings		rbac.authorization.k8s.io	true	RoleBinding	[create delete deletecollection get list patch update watch]
roles		rbac.authorization.k8s.io	true	Role	[create delete deletecollection get list patch update watch]
priorityclasses	pc	scheduling.k8s.io	false	PriorityClass	[create delete deletecollection get list patch update watch]
csidrivers		storage.k8s.io	false	CSI Driver	[create delete deletecollection get list patch update watch]
csinodes		storage.k8s.io	false	CSI Node	[create delete deletecollection get list patch update watch]
storageclasses	sc	storage.k8s.io	false	StorageClass	[create delete deletecollection get list patch update watch]
volumeattachments		storage.k8s.io	false	VolumeAttachment	[create delete deletecollection get list patch update watch]

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Security



API OVERVIEW

Overview

WORKLOADS APIs

Container v1 core

CronJob v1beta1 batch

DaemonSet v1 apps

Deployment v1 apps

Job v1 batch

Pod v1 core

ReplicaSet v1 apps

ReplicationController v1 core

StatefulSet v1 apps

SERVICE APIs

Endpoints v1 core

EndpointSlice v1alpha1 discovery.k8s.io

Ingress v1beta1 networking.k8s.io

Service v1 core

CONFIG AND STORAGE APIs

ConfigMap v1 core

CSIDriver v1beta1 storage.k8s.io

CSINode v1beta1 storage.k8s.io

Secret v1 core

PersistentVolumeClaim v1 core

StorageClass v1 storage.k8s.io

Volume v1 core

VolumeAttachment v1 storage.k8s.io

Welcome to the Kubernetes API. You can use the Kubernetes API to read and write Kubernetes resource objects via a Kubernetes API endpoint.

Resource Categories

This is a high-level overview of the basic types of resources provided by the Kubernetes API and their primary functions.

Workloads are objects you use to manage and run your containers on the cluster.

Discovery & LB resources are objects you use to "stitch" your workloads together into an externally accessible, load-balanced Service.

Config & Storage resources are objects you use to inject initialization data into your applications, and to persist data that is external to your container.

Cluster resources define how the cluster itself is configured; these are typically used only by cluster operators.

Metadata resources are objects you use to configure the behavior of other resources within the cluster, such as `HorizontalPodAutoscaler` for scaling workloads.

Resource Objects

Resource objects typically have 3 components:

- **Resource ObjectMeta:** This is metadata about the resource, such as its name, type, API version, annotations, and labels. This contains fields that may be updated both by the end user and the system (e.g. annotations).
- **ResourceSpec:** This is defined by the user and describes the desired state of the system. Fill this in when creating or updating an object.
- **ResourceStatus:** This is filled in by the server and reports the current state of the system. In most cases, users don't need to change this.

Ref: <https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.16/>

Kubernetes: Production Workload Orchestration



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Security

- Access Control Policy
 - **RBAC Operate**
 - RoleBinding and ClusterRoleBinding:
 - Binding user accounts/system accounts to role or clusterrole

```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: RoleBinding
3 metadata:
4   name: rolebindinglabsecurity
5   namespace: security
6 subjects:
7 - kind: User
8   name: labreadonly
9   apiGroup: rbac.authorization.k8s.io
10 roleRef:
11   kind: Role
12   name: rolereadonly
13   apiGroup: rbac.authorization.k8s.io
```

```
1  apiVersion: v1
2  kind: ServiceAccount
3  metadata:
4    name: admin-user
5    namespace: kubernetes-dashboard
6
7  ---
8
9  apiVersion: rbac.authorization.k8s.io/v1
10 kind: ClusterRoleBinding
11 metadata:
12   name: admin-user
13 roleRef:
14   apiGroup: rbac.authorization.k8s.io
15   kind: ClusterRole
16   name: cluster-admin
17 subjects:
18 - kind: ServiceAccount
19   name: admin-user
20   namespace: kubernetes-dashboard
```



Security

- Access Control Policy
 - **RBAC Operate**
 - Referring to Resource
 - Identification "subresource" under main resource
 - Identification "specific resource" under main resource

```
WorkShop_2.2_Security > ! security-role-subresource.yaml
1  apiVersion: rbac.authorization.k8s.io/v1
2  kind: Role
3  metadata:
4    namespace: security
5    name: templaterolesubresource
6  rules:
7    - apiGroups: []
8      resources: ["pods/log"]
9      verbs: ["get"]
10     - apiGroups: []
11       resources: ["configmaps"]
12       resourceName: ["testconfigmap"]
13       verbs: ["update", "get"]
```

Security

- Access Control Policy:
 - **RBAC Operate**
 - Aggregated ClusterRoles
 - Combine of multiple cluster roles
 - Match by label and rule will automatic filled

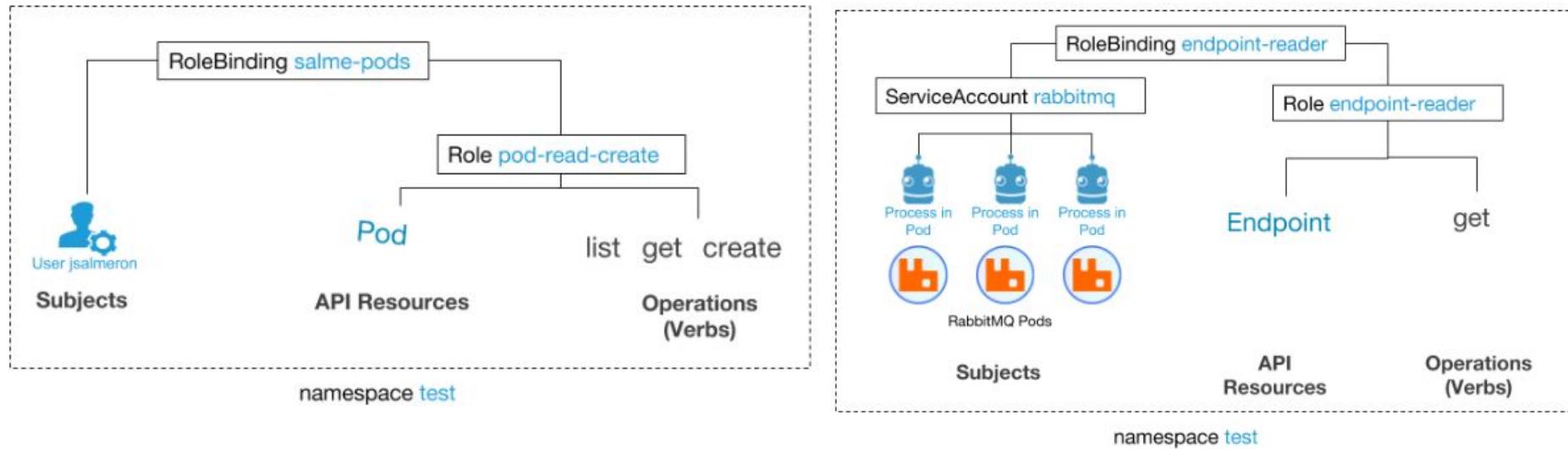
```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: ClusterRole
3 metadata:
4   name: templateaggregateclusterrole
5   namespace: security
6 aggregationRule:
7   clusterRoleSelectors:
8     - matchLabels:
9       rbac.kubernetestthailand.com/security: "true"
10  rules: [] # Rules are automatically filled in by the controller
```

```
1 apiVersion: rbac.authorization.k8s.io/v1
2 kind: ClusterRole
3 metadata:
4   name: templateclusterrole
5   labels:
6     |   rbac.kubernetestthailand.com/security: "true"
7   rules:
8     - apiGroups: [""] # "" indicates the core API group
9       resources: ["pods"]
10      verbs: ["get", "watch", "list"]
11     - apiGroups: ["apps"]
12       resources: ["deployments"]
13      verbs: ["get", "list"]
14     - apiGroups: ["batch"]
15       resources: ["jobs"]
16      verbs: ["get", "list"]
17     - apiGroups: [""]
18       resources: ["nodes"]
19       verbs: ["get", "list", "watch"]
```



Workshop: Security

- Part: Access Control Policy



```
[ubuntu@ip-10-0-1-78:~$ kubectl --context=labreadonly-context get pods
NAME      READY  STATUS    RESTARTS   AGE
webtest   1/1    Running   0          56m
[ubuntu@ip-10-0-1-78:~$ kubectl --context=labreadonly-context delete pods/webtest
Error from server (Forbidden): pods "webtest" is forbidden: User "labreadonly" cannot delete resource "pods" in API group "" in the namespace "security"
[ubuntu@ip-10-0-1-78:~$ kubectl --context=labreadonly-context run webtest --image=labdocker/nginx:http2 --port=443
kubectl run --generator=deployment/apps.v1 is DEPRECATED and will be removed in a future version. Use kubectl run --generator=run-pod/v1 or kubectl create instead.
Error from server (Forbidden): deployments.apps is forbidden: User "labreadonly" cannot create resource "deployments" in API group "apps" in the namespace "security"
[ubuntu@ip-10-0-1-78:~$ kubectl --context=labreadonly-context run webtest --image=labdocker/nginx:http2 --port=443 -n=security
kubectl run --generator=deployment/apps.v1 is DEPRECATED and will be removed in a future version. Use kubectl run --generator=run-pod/v1 or kubectl create instead.
Error from server (Forbidden): deployments.apps is forbidden: User "labreadonly" cannot create resource "deployments" in API group "apps" in the namespace "security"
[ubuntu@ip-10-0-1-78:~$ kubectl --context=labreadonly-context ls svc
```



Security

- Pod Security Admission (Beta: 1.23):

PodSecurity graduates to Beta

`PodSecurity` moves to Beta. `PodSecurity` replaces the deprecated `PodSecurityPolicy` admission controller. `PodSecurity` is an admission controller that enforces Pod Security Standards on Pods in a Namespace based on specific namespace labels that set the enforcement level. In 1.23, the `PodSecurity` feature gate is enabled by default.

Security

- Pod Security Admission:
 - Next generation of Pod Security Policy (Obsolete PSP on 1.25)
 - Enforcement security policy both in level of “cluster/namespace/pods” with 3 mode for operate
 - **Enforcing:** Policy violations will cause the pod to be rejected.
 - **Audit:** Policy violations will trigger the addition of an audit annotation to the event recorded in the audit log, but are otherwise allowed
 - **Warn:** Policy violations will trigger a user-facing warning, but are otherwise allowed.
 - For each mode for operate. We can define rule with 3 profiles for apply
 - **Privilege:** Unrestricted policy (Privilege escalate)
 - **Baseline:** Minimally restrictive policy which prevents known privilege escalations
 - **Restrict:** Heavily restricted policy, following current Pod hardening best practices.



Security

- Privilege Profile:
 - Unrestrict at all !!!
 - Aim for infrastructure/system namespace
 - Manage by trust users



Security

- Baseline Profile:
 - Adoption for common containerized workload
 - Prevent known privilege escalate
 - Target for general application deployment
 - “Non-critical” system
 - (New Feature) Allow windows privilege for windows pods
 - NT AUTHORITY\SYSTEM
 - NT AUTHORITY\Local service
 - NT AUTHORITY\NetworkService

Ref: <https://kubernetes.io/docs/concepts/security/pod-security-standards/>



Security

- Baseline Profile:

Control	Policy
HostProcess	<p>Windows pods offer the ability to run HostProcess containers which enables privileged access to the Windows node. Privileged access to the host is disallowed in the baseline policy. HostProcess pods are an alpha feature as of Kubernetes v1.22.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• spec.securityContext.windowsOptions.hostProcess• spec.containers[*].securityContext.windowsOptions.hostProcess• spec.initContainers[*].securityContext.windowsOptions.hostProcess• spec.ephemeralContainers[*].securityContext.windowsOptions.hostProcess <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• false
Host Namespaces	<p>Sharing the host namespaces must be disallowed.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• spec.hostNetwork• spec.hostPID• spec.hostIPC <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• false
Privileged Containers	<p>Privileged Pods disable most security mechanisms and must be disallowed.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• spec.containers[*].securityContext.privileged• spec.initContainers[*].securityContext.privileged• spec.ephemeralContainers[*].securityContext.privileged <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• false



Security

- Baseline Profile:

Capabilities	Adding additional capabilities beyond those listed below must be disallowed.
	<p>Restricted Fields</p> <ul style="list-style-type: none">• spec.containers[*].securityContext.capabilities.add• spec.initContainers[*].securityContext.capabilities.add• spec.ephemeralContainers[*].securityContext.capabilities.add <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• AUDIT_WRITE• CHOWN• DAC_OVERRIDE• FOWNER• FSETID• KILL• MKNOD• NET_BIND_SERVICE• SETFCAP• SETGID• SETPCAP• SETUID• SYS_CHROOT

HostPath Volumes	HostPath volumes must be forbidden.
	<p>Restricted Fields</p> <ul style="list-style-type: none">• spec.volumes[*].hostPath <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil



Security

- Baseline Profile:

Host Ports	<p>HostPorts should be disallowed, or at minimum restricted to a known list.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• <code>spec.containers[*].ports[*].hostPort</code>• <code>spec.initContainers[*].ports[*].hostPort</code>• <code>spec.ephemeralContainers[*].ports[*].hostPort</code> <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• Known list• 0
AppArmor	<p>On supported hosts, the <code>runtime/default</code> AppArmor profile is applied by default. The baseline policy should prevent overriding or disabling the default AppArmor profile, or restrict overrides to an allowed set of profiles.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• <code>metadata.annotations["container.apparmor.security.beta.kubernetes.io/*"]</code> <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil• <code>runtime/default</code>• <code>localhost/*</code>

Security

- Baseline Profile:

SELinux	Setting the SELinux type is restricted, and setting a custom SELinux user or role option is forbidden.
	Restricted Fields <ul style="list-style-type: none">• spec.securityContext.seLinuxOptions.type• spec.containers[*].securityContext.seLinuxOptions.type• spec.initContainers[*].securityContext.seLinuxOptions.type• spec.ephemeralContainers[*].securityContext.seLinuxOptions.type Allowed Values <ul style="list-style-type: none">• Undefined/""• container_t• container_init_t• container_kvm_t
	Restricted Fields <ul style="list-style-type: none">• spec.securityContext.seLinuxOptions.user• spec.containers[*].securityContext.seLinuxOptions.user• spec.initContainers[*].securityContext.seLinuxOptions.user• spec.ephemeralContainers[*].securityContext.seLinuxOptions.user• spec.securityContext.seLinuxOptions.role• spec.containers[*].securityContext.seLinuxOptions.role• spec.initContainers[*].securityContext.seLinuxOptions.role• spec.ephemeralContainers[*].securityContext.seLinuxOptions.role Allowed Values <ul style="list-style-type: none">• Undefined/""

/proc Mount Type The default /proc masks are set up to reduce attack surface, and should be required.

	Restricted Fields <ul style="list-style-type: none">• spec.containers[*].securityContext.procMount• spec.initContainers[*].securityContext.procMount• spec.ephemeralContainers[*].securityContext.procMount Allowed Values <ul style="list-style-type: none">• Undefined/nil• Default
--	--

Security

- Baseline Profile:

Seccomp

Seccomp profile must not be explicitly set to `Unconfined`.

Restricted Fields

- `spec.securityContext.seccompProfile.type`
- `spec.containers[*].securityContext.seccompProfile.type`
- `spec.initContainers[*].securityContext.seccompProfile.type`
- `spec.ephemeralContainers[*].securityContext.seccompProfile.type`

Allowed Values

- `Undefined/nil`
- `RuntimeDefault`
- `Localhost`

Sysctls

Sysctls can disable security mechanisms or affect all containers on a host, and should be disallowed except for an allowed "safe" subset. A sysctl is considered safe if it is namespaced in the container or the Pod, and it is isolated from other Pods or processes on the same Node.

Restricted Fields

- `spec.securityContext.sysctls[*].name`

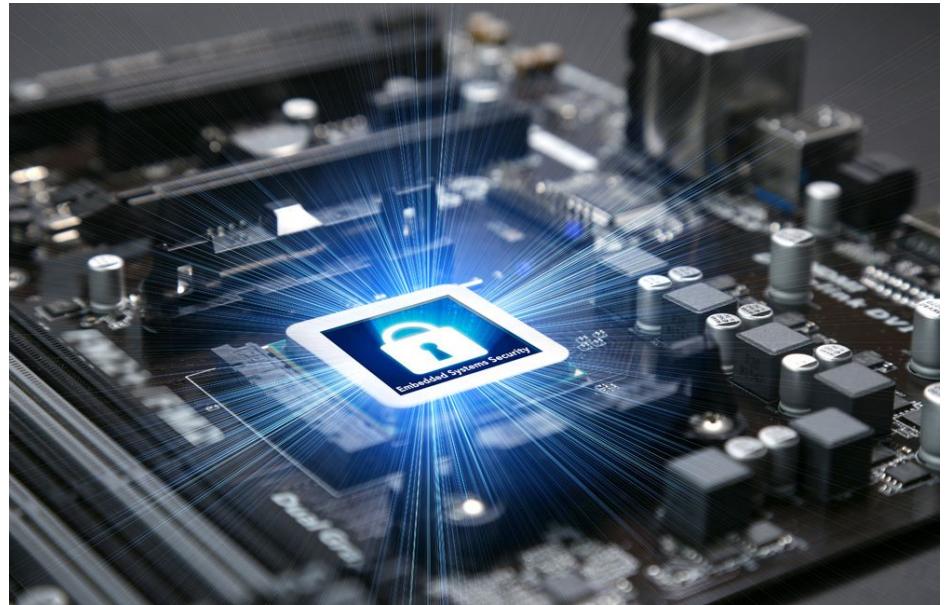
Allowed Values

- `Undefined/nil`
- `kernel.shm_rmid_forced`
- `net.ipv4.ip_local_port_range`
- `net.ipv4.ip_unprivileged_port_start`
- `net.ipv4.tcp_syncookies`
- `net.ipv4.ping_group_range`



Security

- Restricted Profile:
 - Hardest practice for security profile
 - Low trust user environment
 - “Critical” system
 - Base on “baseline” profile with enhancement more



Ref: <https://kubernetes.io/docs/concepts/security/pod-security-standards/>

Security

- Restricted Profile:

Volume Types	In addition to restricting HostPath volumes, the restricted policy limits usage of non-core volume types to those defined through PersistentVolumes.
Restricted Fields	<ul style="list-style-type: none">• spec.volumes[*].hostPath• spec.volumes[*].gcePersistentDisk• spec.volumes[*].awsElasticBlockStore• spec.volumes[*].gitRepo• spec.volumes[*].nfs• spec.volumes[*].iscsi• spec.volumes[*].glusterfs• spec.volumes[*].rbd• spec.volumes[*].flexVolume• spec.volumes[*].cinder• spec.volumes[*].cephfs• spec.volumes[*].flocker• spec.volumes[*].fc• spec.volumes[*].azureFile• spec.volumes[*].vsphereVolume• spec.volumes[*].quobyte• spec.volumes[*].azureDisk• spec.volumes[*].portworxVolume• spec.volumes[*].scaleIO• spec.volumes[*].storageos• spec.volumes[*].photonPersistentDisk
Allowed Values	<ul style="list-style-type: none">• Undefined/nil

Privilege Escalation (v1.8+) Privilege escalation (such as via set-user-ID or set-group-ID file mode) should not be allowed.

Restricted Fields
<ul style="list-style-type: none">• spec.containers[*].securityContext.allowPrivilegeEscalation• spec.initContainers[*].securityContext.allowPrivilegeEscalation• spec.ephemeralContainers[*].securityContext.allowPrivilegeEscalation

Allowed Values

- false



Security

- Restricted Profile:

Running as Non-root	<p>Containers must be required to run as non-root users.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• <code>spec.securityContext.runAsNonRoot</code>• <code>spec.containers[*].securityContext.runAsNonRoot</code>• <code>spec.initContainers[*].securityContext.runAsNonRoot</code>• <code>spec.ephemeralContainers[*].securityContext.runAsNonRoot</code> <p>Allowed Values</p> <ul style="list-style-type: none">• <code>true</code> <p>The container fields may be undefined/ <code>nil</code> if the pod-level <code>spec.securityContext.runAsNonRoot</code> is set to <code>true</code>.</p>
Non-root groups (<i>optional</i>)	<p>Containers should be forbidden from running with a root primary or supplementary GID.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• <code>spec.securityContext.runAsGroup</code>• <code>spec.securityContext.supplementalGroups[*]</code>• <code>spec.securityContext.fsGroup</code>• <code>spec.containers[*].securityContext.runAsGroup</code>• <code>spec.initContainers[*].securityContext.runAsGroup</code>• <code>spec.ephemeralContainers[*].securityContext.runAsGroup</code> <p>Allowed Values</p> <ul style="list-style-type: none">• Undefined/nil (except for <code>*.runAsGroup</code>)• Non-zero
Seccomp (v1.19+)	<p>Seccomp profile must be explicitly set to one of the allowed values. Both the <code>Unconfined</code> profile and the <i>absence</i> of a profile are prohibited.</p> <p>Restricted Fields</p> <ul style="list-style-type: none">• <code>spec.securityContext.seccompProfile.type</code>• <code>spec.containers[*].securityContext.seccompProfile.type</code>• <code>spec.initContainers[*].securityContext.seccompProfile.type</code>• <code>spec.ephemeralContainers[*].securityContext.seccompProfile.type</code> <p>Allowed Values</p> <ul style="list-style-type: none">• <code>RuntimeDefault</code>• <code>Localhost</code> <p>The container fields may be undefined/ <code>nil</code> if the pod-level <code>spec.securityContext.seccompProfile.type</code> field is set appropriately. Conversely, the pod-level field may be undefined/ <code>nil</code> if <code>_all_</code> container-level fields are set.</p>

Security

- Restricted Profile:

Capabilities (v1.22+)

Containers must drop ALL capabilities, and are only permitted to add back the NET_BIND_SERVICE capability.

Restricted Fields

- spec.containers[*].securityContext.capabilities.drop
- spec.initContainers[*].securityContext.capabilities.drop
- spec.ephemeralContainers[*].securityContext.capabilities.drop

Allowed Values

- Any list of capabilities that includes ALL
-

Restricted Fields

- spec.containers[*].securityContext.capabilities.add
- spec.initContainers[*].securityContext.capabilities.add
- spec.ephemeralContainers[*].securityContext.capabilities.add

Allowed Values

- Undefined/nil
- NET_BIND_SERVICE



Security

- Pods security standard for cluster/namespace
 - Customize for security profile on each mode
 - enforce: (baseline/restricted/privileged)
 - audit: (baseline/restricted/privileged)
 - warning: (baseline/restricted/privileged)
 - Enforce PSA for new namespace

```
1  apiVersion: v1
2  kind: Namespace
3  metadata:
4    name: namespace-psa
5    labels:
6      name: namespace-psa
7      owner: Praparn_L
8      version: "1.0"
9      module: NameSpace
10     environment: development
11     pod-security.kubernetes.io/enforce: baseline
12     pod-security.kubernetes.io/enforce-version: v1.23
13
14     # We are setting these to our _desired_ `enforce` level.
15     pod-security.kubernetes.io/audit: restricted
16     pod-security.kubernetes.io/audit-version: v1.23
17     pod-security.kubernetes.io/warn: restricted
18     pod-security.kubernetes.io/warn-version: v1.23
```

Security

- Namespace Level: Enforce PSA existing namespace

```
[ubuntu@ip-10-21-2-23:~$ kubectl get nodes
NAME        STATUS   ROLES          AGE   VERSION
10.21.2.116 Ready    controlplane,etcd,worker  41d   v1.20.9
10.21.2.188 Ready    controlplane,etcd,worker  41d   v1.20.9
10.21.2.203 Ready    controlplane,etcd,worker  41d   v1.20.9
ubuntu@ip-10-21-2-23:~$ kubectl label --overwrite ns namespace-psa \
>   pod-security.kubernetes.io/enforce=restricted \
>   pod-security.kubernetes.io/enforce-version=v1.22 \
>   pod-security.kubernetes.io/audit: restricted \
>   pod-security.kubernetes.io/audit-version: v1.22 \
>   pod-security.kubernetes.io/warn: restricted \
>   pod-security.kubernetes.io/warn-version: v1.22]
```

Security

- Cluster Level: Enforce PSA all namespace

```
[ubuntu@ip-10-21-2-23:~$ kubectl get nodes
NAME        STATUS   ROLES          AGE   VERSION
10.21.2.116 Ready    controlplane,etcd,worker  41d   v1.20.9
10.21.2.188 Ready    controlplane,etcd,worker  41d   v1.20.9
10.21.2.203 Ready    controlplane,etcd,worker  41d   v1.20.9
ubuntu@ip-10-21-2-23:~$   kubectl label --overwrite ns --all \
>   pod-security.kubernetes.io/enforce=restricted \
>   pod-security.kubernetes.io/enforce-version=v1.22 \
>   pod-security.kubernetes.io/audit: restricted \
>   pod-security.kubernetes.io/audit-version: v1.22 \
>   pod-security.kubernetes.io/warn: restricted \
>   pod-security.kubernetes.io/warn-version: v1.22 ]
```

Security

- Pods security standard for pods/container
 - Permission to access object (Base on user/group id)
 - Security-Enhanced Linux (SELinux)
 - Privilege/Non-Privileged running
 - Limit some capability of root on pods/container (Linux capability)
 - Apparmor/Seccomp
 - AllowPrivilegeEscalation
 - readOnlyRootFilesystem

Security

- Example: Pods security context

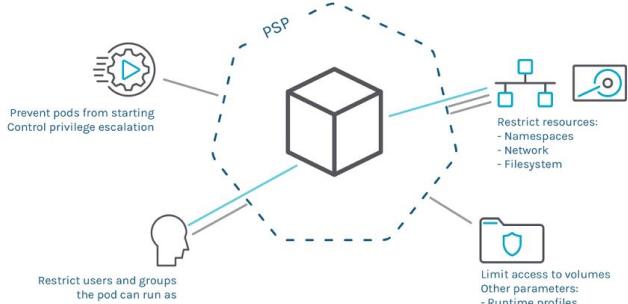
```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: alpineweb
5    namespace: namespace-psa
6    labels:
7      name: alpineweb
8      owner: Praparn_L
9      version: "1.0"
10     module: WebServer
11     environment: development
12 spec:
13   securityContext:
14     runAsUser: 1000
15     runAsGroup: 3000
16     fsGroup: 2000
17   containers:
18     - name: alpine
19       image: labdocker/alpineweb:restrict
20       resources:
21         requests:
22           memory: "16Mi"
23           cpu: "100m"
24         limits:
25           memory: "32Mi"
26           cpu: "200m"
27       ports:
28         - containerPort: 22
29           protocol: TCP
```

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: alpineweb
5    namespace: namespace-psa
6    labels:
7      name: alpineweb
8      owner: Praparn_L
9      version: "1.0"
10     module: WebServer
11     environment: development
12 spec:
13   securityContext:
14     runAsUser: 1000
15     runAsGroup: 3000
16     fsGroup: 2000
17   containers:
18     - name: alpineweb
19       image: labdocker/alpineweb:restrict
20       resources:
21         requests:
22           memory: "16Mi"
23           cpu: "100m"
24         limits:
25           memory: "32Mi"
26           cpu: "200m"
27       ports:
28         - containerPort: 22
29           protocol: TCP
30       volumeMounts:
31         - mountPath: /temp
32           name: voldocker
33       volumes:
34         - name: voldocker
35           hostPath:
36             path: /var/lib/containerd/
```



Workshop: Security

- Part: Pod Security Association (PSA)



PodSecurity admission (PodSecurityPolicy replacement) #2579

[Open](#) 4 of 8 tasks tallclair opened this issue on Mar 20 · 14 comments

tallclair commented on Mar 20 · edited by liggett · Member ...

Enhancement Description

- One-line enhancement description (can be used as a release note): Introduce a new admission controller for enforcing the [Pod Security Standards](#) on pods in a namespace.
- Kubernetes Enhancement Proposal: <https://github.com/kubernetes/enhancements/blob/master/keps/sig-auth/2579-psp-replacement/>
- Discussion Link: <https://docs.google.com/document/d/1woLGRoONE3EBVx-wTb4ppv4C17tmLZ6IS26VTbosLKM/view#bookmark=id.km06bp3uzuco>
- Primary contact (assignee): @tallclair
- Responsible SIGs: sig-auth, sig-security
- Enhancement target (which target equals to which milestone):
 - Alpha release target (x,y): 1.22
 - Beta release target (x,y): 1.23
 - Stable release target (x,y):

Alpha

- KEP ([k/enhancements](#)) update PR(s): [↳ PSP Replacement KEP #2582](#)
- Code ([k/k](#)) update PR(s):
 - [↳ \[PodSecurity\] Add ValidatePodSecurityConfiguration](#) kubernetes#103560
 - [↳ PodSecurity message/check/fixture cleanups](#) kubernetes#103558
 - [↳ PodSecurity: use code/reason/details from admission library](#) kubernetes#103552
 - [↳ Implement check drop capabilities.go](#) kubernetes#103543
 - [↳ Podsecurity fixture cleanup](#) kubernetes#103517
 - [↳ Podsecurity webhook](#) kubernetes#103465
 - [↳ Move pod-security-admission to an external Attributes interface](#) kubernetes#103445
 - [↳ \[PodSecurity\] hostProcess baseline check](#) kubernetes#103382
 - [↳ \[PodSecurity\] baseline - apparmor](#) kubernetes#103378
 - [↳ PodSecurity: make failure integration tests feature-aware](#) kubernetes#103365
 - [↳ \[PodSecurity\] Add privileged containers baseline check](#) kubernetes#103364



Kubernetes in real world



Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

- Kubernetes have a lot of component need to install / configuration on real world
- Normally kubernetes need some 3rd tool for deployment
 - Ubuntu(MAAS, JUiu)
 - CoreOS
 - Fedora (Ansible)
- provide new solution for create cluster system with kubernetes orchestrator

kubeadm <init>

- Option:
 - --apiserver-advertise-address= x.x.x.x (Default: First Interface)
 - --apiserver-bind-port = xxx (Default: 6443)
 - --kubernetes-version = xxx (Default: latest)
 - --pod-network-cidr = x.x.x.x (CNI), Need for Flennel
 - --token = xxxx (Default: auto gen)
 - --skip-preflight-checks
 - etc



Kubernetes in real world

- Kubernetes have a lot of component need to install / configuration on real world
- Normally kubernetes need some 3rd tool for deployment
 - Ubuntu(MAAS, JUiu)
 - CoreOS
 - Fedora (Ansible)
- Since kubernetes 1.6 and later. Cluster system can make with command “kubeadm”
- Prerequisite
 - Docker Engine
 - Kubernetes Engine (Kubelet, Kubectl, Kubeadm)
- Role of the cluster system
 - Master:
 - Control all activity on cluster system (Pods, Services, Job, CronJob, RS, RC etc)
 - Node:
 - Worker for running as Master's order



Kubernetes in real world

- Create cluster from bare metal
- Step for setup
 - Phase 1: Install prerequisite component
 - Docker Engine
 - Kubelet Engine
 - Kubeadm Engine
 - Phase 2: Initialize Master node
 - `kubeadm init <option>`
 - Phase 3: Install Pods Network (3rd party) with CNI support
 - Flannel (Support Cross-Platform)
 - Weave Net (Support Cross-Platform)
 - Calico
 - Canal (Flannel + Calico)
 - Contiv
 - Romana
 - Kube-Router
 - Etc
 - Phase 4: Join node to cluster system
 - `kubeadm join <option>`



Kubernetes in real world

Kubeadm

Kubeadm is a tool built to provide `kubeadm init` and `kubeadm join` as best-practice "fast paths" for creating Kubernetes clusters.

`kubeadm` performs the actions necessary to get a minimum viable cluster up and running. By design, it cares only about bootstrapping, not about provisioning machines. Likewise, installing various nice-to-have addons, like the Kubernetes Dashboard, monitoring solutions, and cloud-specific addons, is not in scope.

Instead, we expect higher-level and more tailored tooling to be built on top of `kubeadm`, and ideally, using `kubeadm` as the basis of all deployments will make it easier to create conformant clusters.



How to install

To install `kubeadm`, see the [installation guide](#).

What's next

- `kubeadm init` to bootstrap a Kubernetes control-plane node
- `kubeadm join` to bootstrap a Kubernetes worker node and join it to the cluster
- `kubeadm upgrade` to upgrade a Kubernetes cluster to a newer version
- `kubeadm config` if you initialized your cluster using `kubeadm v1.7.x` or lower, to configure your cluster for `kubeadm upgrade`
- `kubeadm token` to manage tokens for `kubeadm join`
- `kubeadm reset` to revert any changes made to this host by `kubeadm init` or `kubeadm join`
- `kubeadm certs` to manage Kubernetes certificates
- `kubeadm kubeconfig` to manage kubeconfig files
- `kubeadm version` to print the `kubeadm` version
- `kubeadm alpha` to preview a set of features made available for gathering feedback from the community

Ref: <https://kubernetes.io/docs/setup/independent/create-cluster-kubeadm/>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

The image shows a web browser interface with two main pages. On the left, the Kubernetes landing page features a large blue hexagonal logo with a white steering wheel icon. The page has a "Welcome!" header, a "Before starting we need to verify you are a human" message, and a "Create session" button. The main title is "kubernetes by Google™". On the right, a session details page for a node named "d7498ce6_node1" is displayed. It includes a clock showing "03:52:40", an orange "CLOSE SESSION" button, and a "Instances" section with a "DELETE" button. The session details table shows IP: 10.0.12.3, Memory: 27.21% (1.087GiB / 3.996GiB), and CPU: 27.32%. Below this, a terminal window shows command-line output for Kubernetes commands like `kubectl get svc` and `kubectl get pods`.

host2.labs.play-with-k8s.com/p/d7498ce6-f563-4e73-b7e7-62503f1db77b#d7498ce6_node1

NAME	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
kubernetes	10.96.0.1	<none>	443/TCP	4m

```
[node1 /]$ kubectl get pods
No resources found.
[node1 /]$ 
```

Kubernetes: Production Workload Orchestration

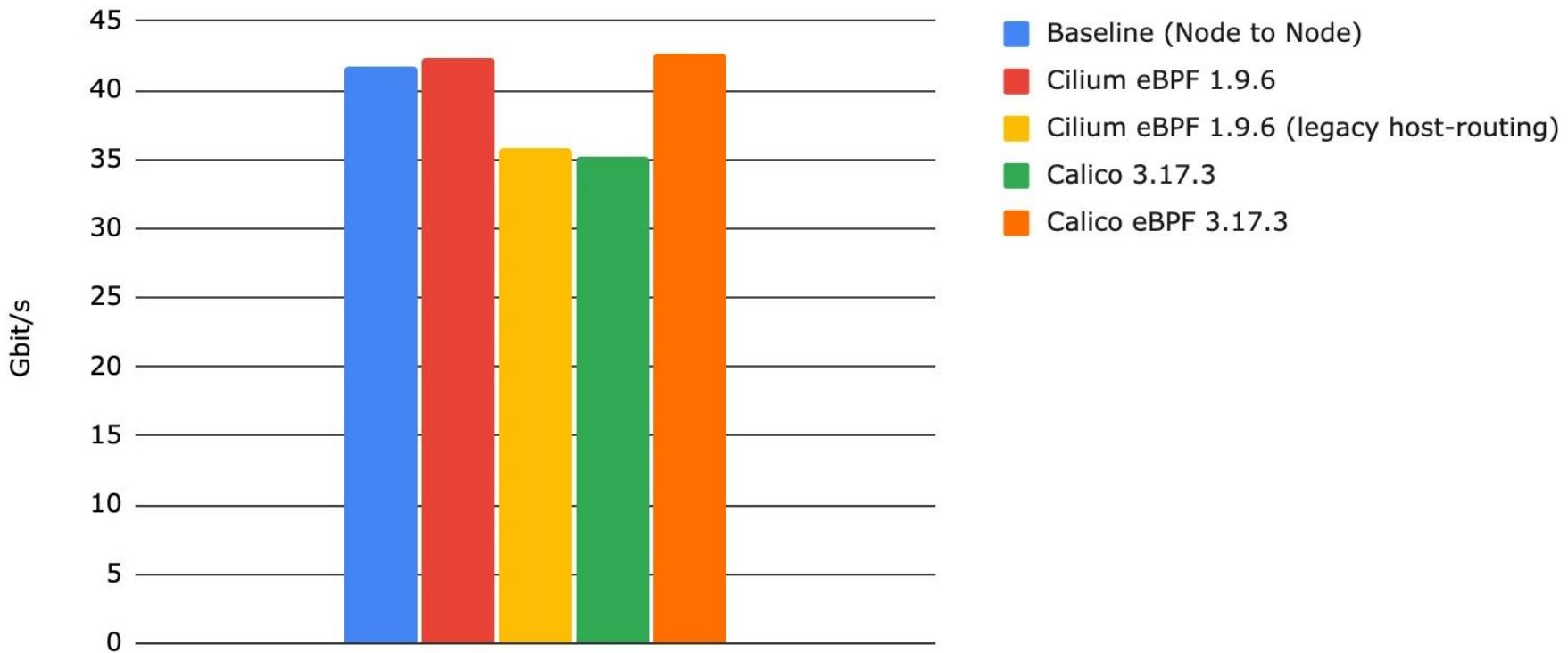


kubernetes
by Google

Kubernetes in real world

- Network Optional

TCP Throughput (1 Stream) - Higher is better



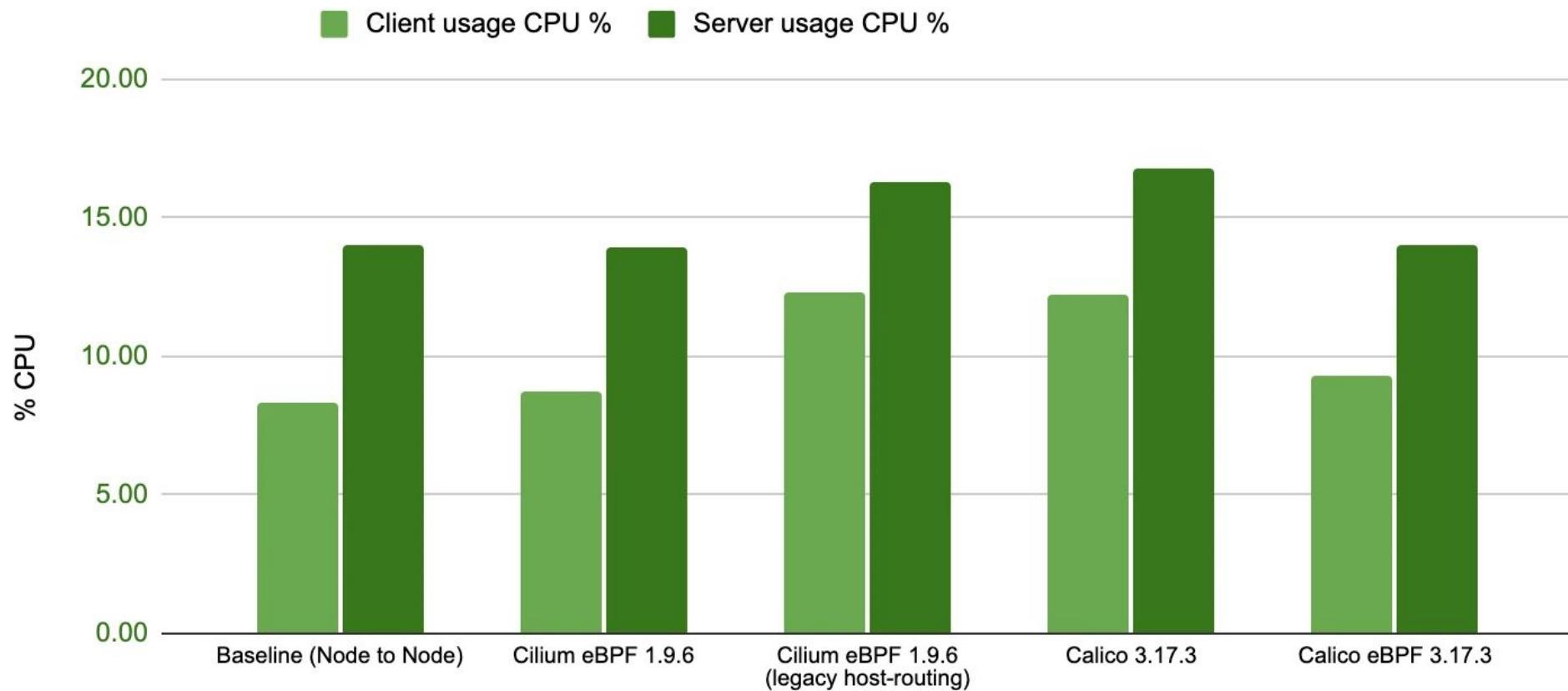
Ref: <https://cilium.io/blog/2021/05/11/cni-benchmark>



Kubernetes in real world

- Network Optional

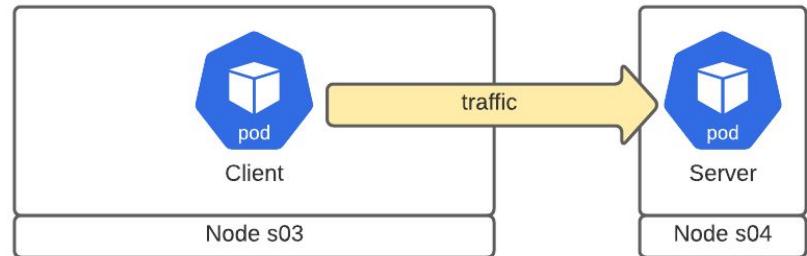
TCP Throughput (1 Stream): %CPU for 100Gbit/s - Lower is better



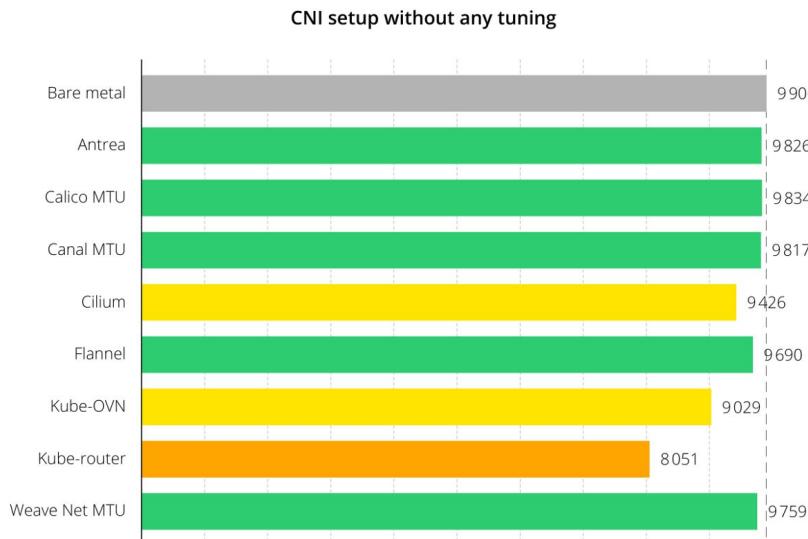
Ref: <https://cilium.io/blog/2021/05/11/cni-benchmark>

Kubernetes in real world

- Network Optional

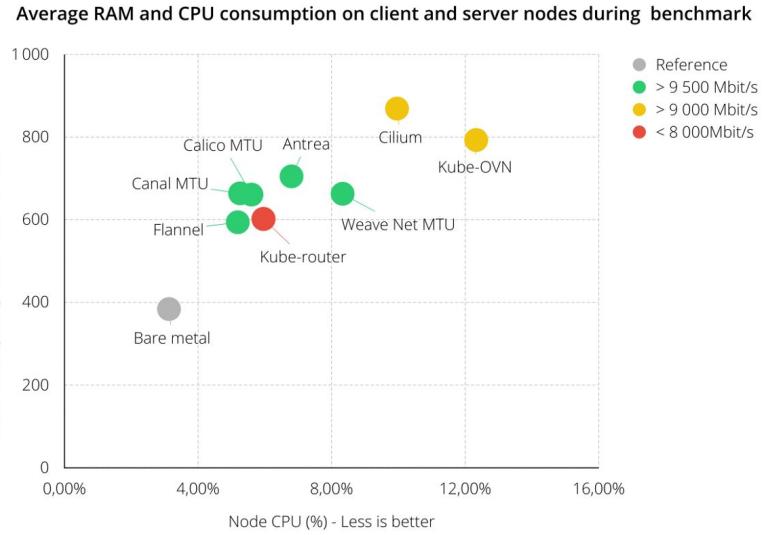


K8S CNI Benchmark - Pod to Pod - TCP - Bandwidth



2020-08-27 - Alexis Ducastel - infrabuilder - Source : <https://github.com/InfraBuilder/benchmark-k8s-cni-2020-08>

K8S CNI Benchmark - Pod to Pod - TCP - Resources



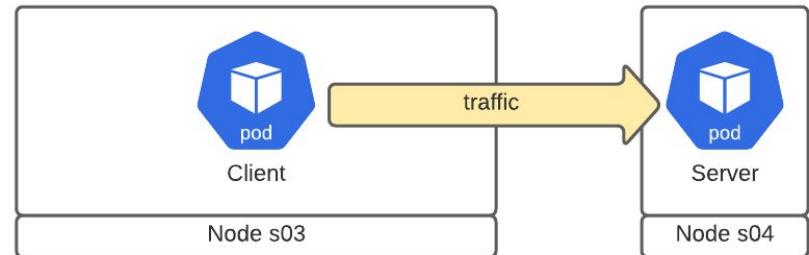
2020-08-27 - Alexis Ducastel - infrabuilder - Benchmark tool : knb (<https://github.com/InfraBuilder/k8s-bench-suite>)

<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>

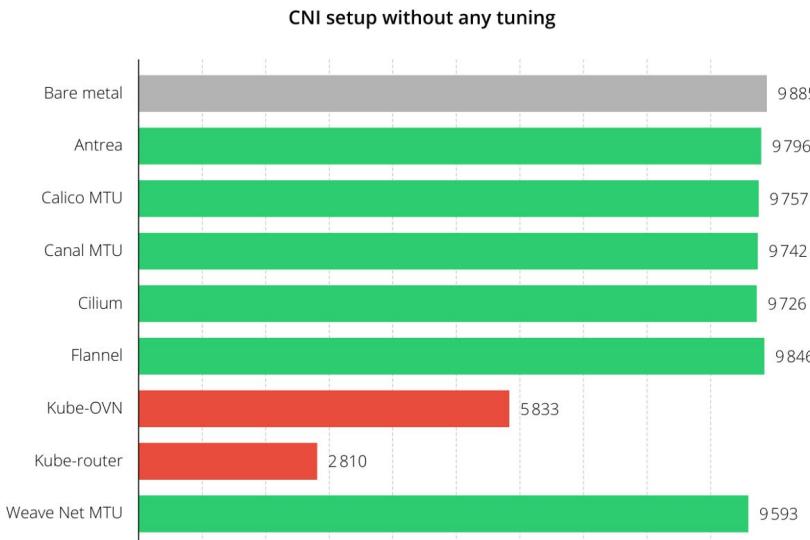


Kubernetes in real world

- Network Optional

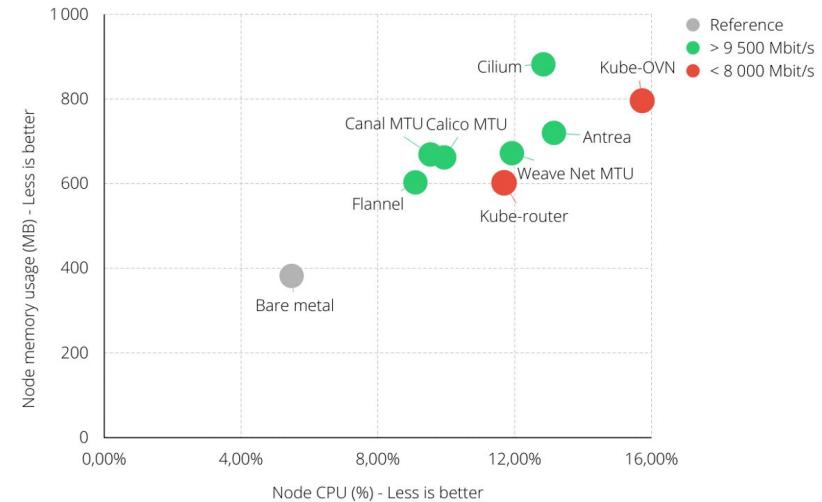


K8S CNI Benchmark - Pod to Pod - UDP - Bandwidth



K8S CNI Benchmark - Pod to Pod - UDP - Resources

Average RAM and CPU consumption on client and server nodes during benchmark



2020-08-27 - Alexis Ducastel - infrabuilder - Source : <https://github.com/InfraBuilder/benchmark-k8s-cni-2020-08>

2020-08-27 - Alexis Ducastel - infrabuilder - Benchmark tool : knb (<https://github.com/InfraBuilder/k8s-bench-suite>)

<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>

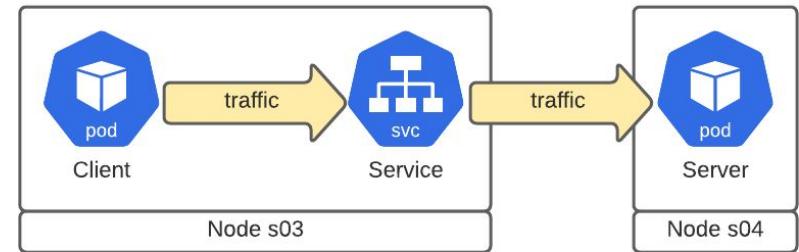
Kubernetes: Production Workload Orchestration



kubernetes
by Google

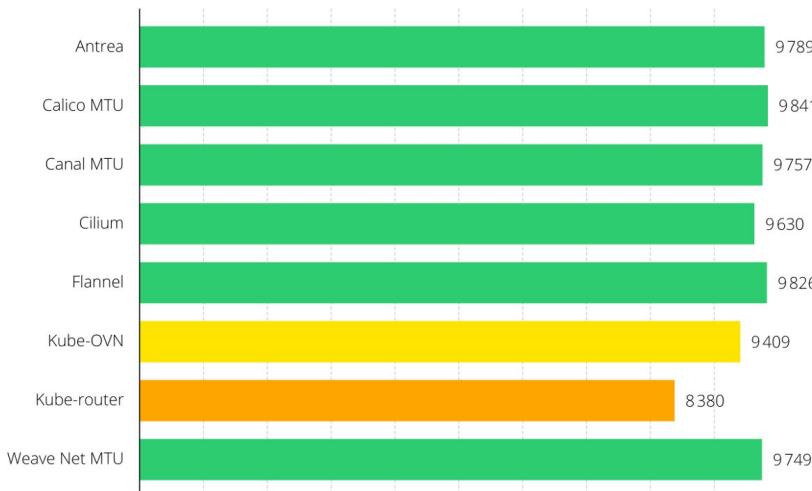
Kubernetes in real world

- Network Optional



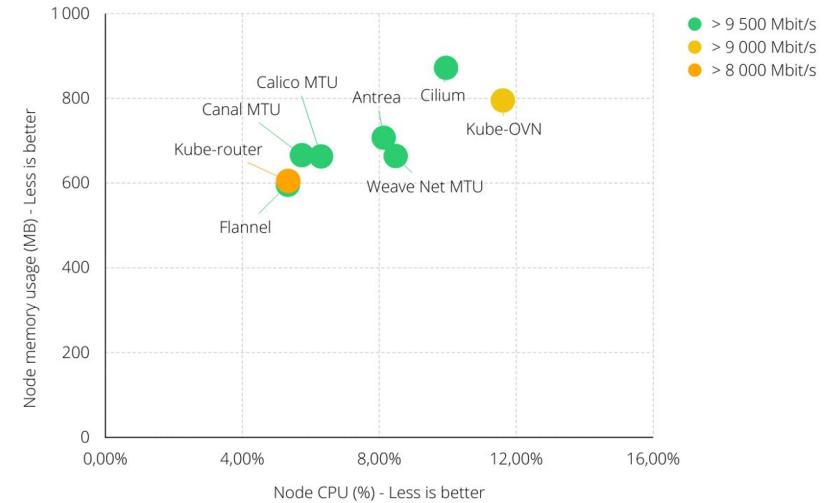
K8S CNI Benchmark - Pod to Service - TCP - Bandwidth

CNI setup without any tuning



K8S CNI Benchmark - Pod to Service - TCP - Resources

Average RAM and CPU consumption on client and server nodes during benchmark



2020-08-27 - Alexis Ducastel - infrabuilder - Source : <https://github.com/InfraBuilder/benchmark-k8s-cni-2020-08>

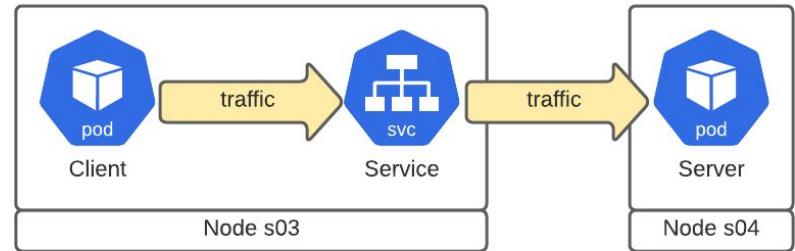
2020-08-27 - Alexis Ducastel - infrabuilder - Benchmark tool : knb (<https://github.com/InfraBuilder/k8s-bench-suite>)

<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>

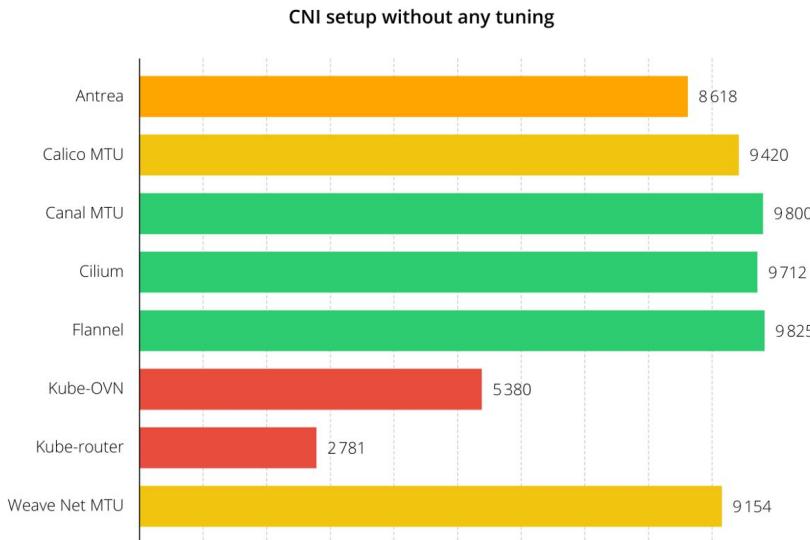


Kubernetes in real world

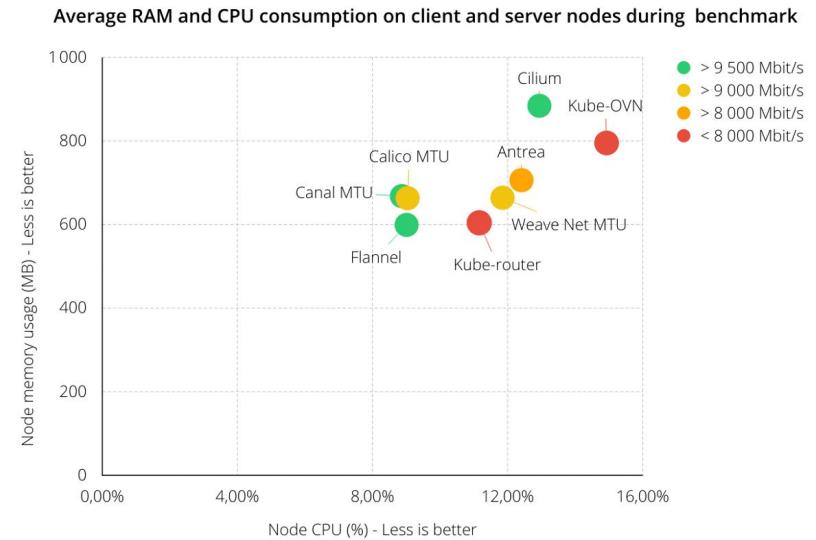
- Network Optional



K8S CNI Benchmark - Pod to Service - UDP - Bandwidth



K8S CNI Benchmark - Pod to Service - UDP - Resources



2020-08-27 - Alexis Du castel - infrabuilder - Source : <https://github.com/InfraBuilder/benchmark-k8s-cni-2020-08>

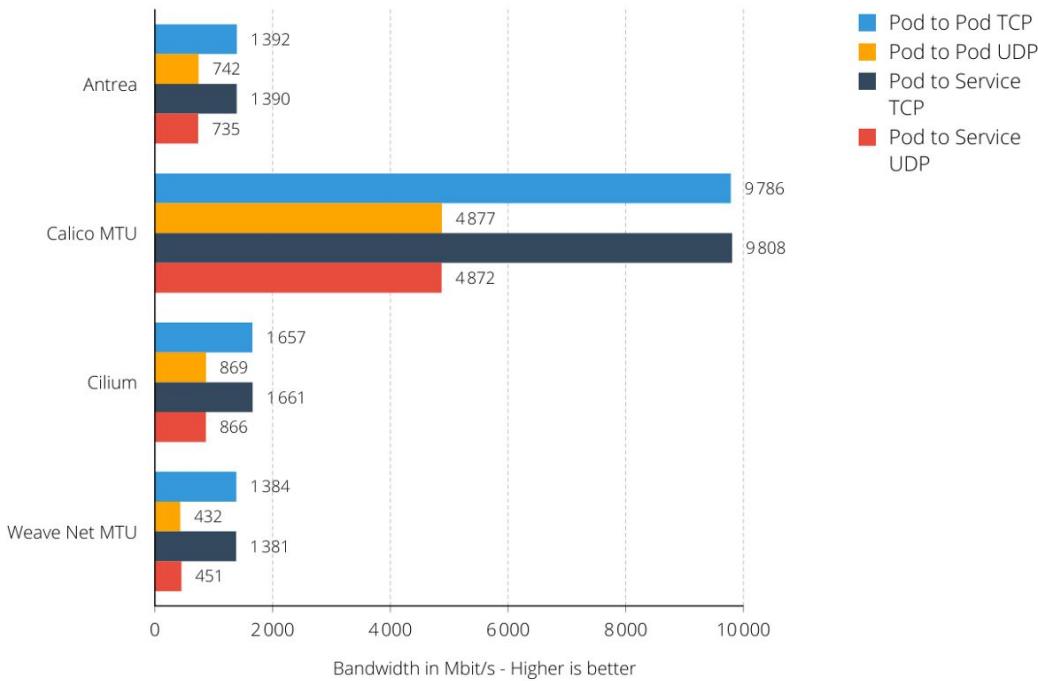
<https://1tnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-1ugbit-s-network-updated-august-2020-6e1b757b9e49>



Kubernetes in real world

- Network Optional

K8S CNI Benchmark - Encrypted CNIs



2020-08-27 - Alexis Ducastel - infrabuilder - Source : <https://github.com/InfraBuilder/benchmark-k8s-cni-2020-08>

<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>

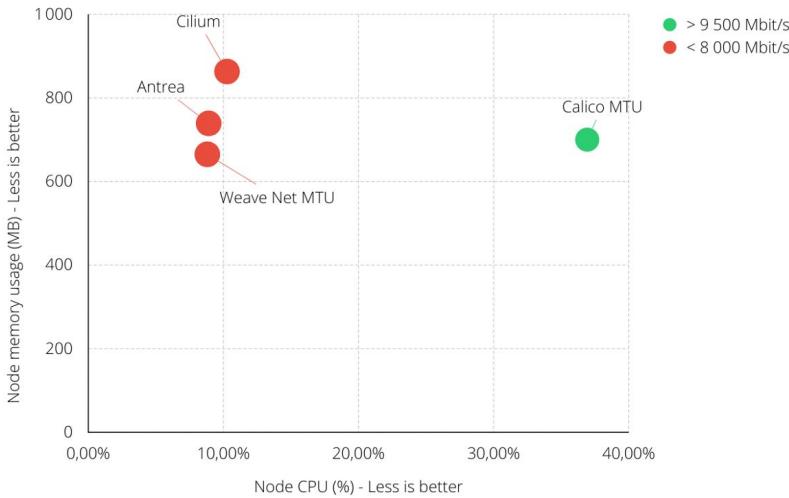


Kubernetes in real world

- Network Optional

K8S CNI Benchmark - Encrypted - P2P - TCP - Resources

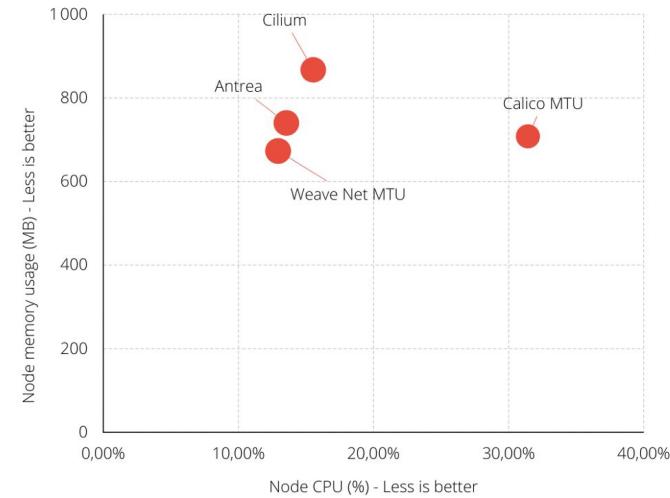
Average RAM and CPU consumption on client and server nodes during benchmark



2020-08-27 - Alexis Ducastel - infrabuilder - Benchmark tool : knb (<https://github.com/InfraBuilder/k8s-bench-suite>)

K8S CNI Benchmark - Encrypted - P2P - UDP - Resources

Average RAM and CPU consumption on client and server nodes during benchmark



2020-08-27 - Alexis Ducastel - infrabuilder - Benchmark tool : knb (<https://github.com/InfraBuilder/k8s-bench-suite>)

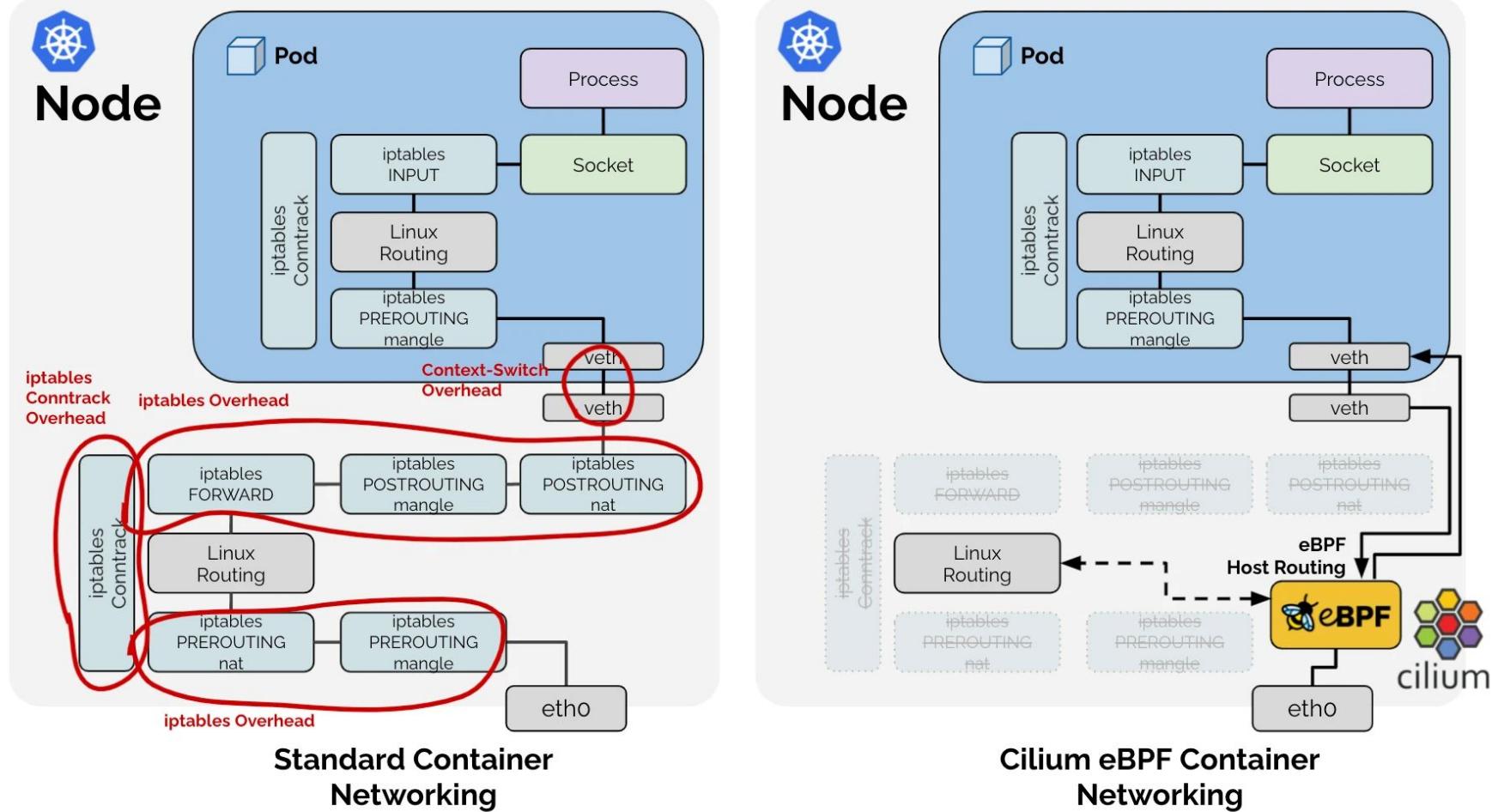
<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>

Kubernetes: Production Workload Orchestration



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Kubernetes in real world



<https://itnext.io/benchmark-results-of-kubernetes-network-plugins-cni-over-10gbit-s-network-updated-august-2020-6e1b757b9e49>



Kubernetes in real world

- Initial Master role

```
kubeadm <init>
```

- Option:
 - --apiserver-advertise-address= x.x.x.x (Default: First Interface)
 - --apiserver-bind-port = xxx (Default: 6443)
 - --kubernetes-version = xxx (Default: latest)
 - --pod-network-cidr = x.x.x.x (CNI), Need for Flennel
 - --token = xxxx (Default: auto gen)
 - --skip-preflight-checks
 - Etc

- Join Node in Cluster

```
kubeadm <init>
```

- Option:
 - --apiserver-advertise-address= x.x.x.x (Default: First Interface)
 - --apiserver-bind-port = xxx (Default: 6443)
 - --kubernetes-version

Kubernetes in real world

- Initial Master role by config file

```
kubeadm init --config <configuration file>
```

```
Untitled-2 • instruction.txt ! kubeadm-init.yaml x
1 apiVersion: kubeadm.k8s.io/v1beta1
2 bootstrapTokens:
3   - groups:
4     - system:bootstrappers:kubeadm:default-node-token
5       ttl: 24h0m0s
6     usages:
7       - signing
8       - authentication
9   kind: InitConfiguration
10  localAPIEndpoint:
11    bindPort: 6443
12  nodeRegistration:
13    criSocket: /var/run/docker.sock
14    name: hostnamemaster
15    kubeletExtraArgs:
16      cloud-provider: aws
17    taints:
18      - effect: NoSchedule
19        key: node-role.kubernetes.io/master
20 ---
```

```
20 ---
21   apiServer:
22     certSANs:
23       - 1.1.1.1
24     extraArgs:
25       | authorization-mode: Node,RBAC
26       | timeoutForControlPlane: 4m0s
27
28   apiVersion: kubeadm.k8s.io/v1beta1
29   certificatesDir: /etc/kubernetes/pki
30   clusterName: Kubernetes
31   controlPlaneEndpoint: ""
32   controllerManager:
33     extraArgs:
34       | cloud-provider: aws
35       | configure-cloud-routes: "false"
36       | address: 0.0.0.0
37   dns:
38     type: CoreDNS
39   etcd:
40     local:
41       | dataDir: /var/lib/etcd
42   imageRepository: k8s.gcr.io
43   kind: ClusterConfiguration
44   kubernetesVersion: v1.13.0
45   networking:
46     dnsDomain: cluster.local
47     podSubnet: 192.168.0.0/16
48     serviceSubnet: 10.96.0.0/12
49   scheduler:
50     extraArgs:
51       | address: 0.0.0.0
```

Ref: <https://godoc.org/k8s.io/kubernetes/cmd/kubeadm/app/apis/kubeadm/v1beta1>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

- Join Worker role by config file

```
kubeadm join --config <configuration file>
```

```
Untitled-2 ● instruction.txt kubeadm-join.yaml x
1  apiVersion: kubeadm.k8s.io/v1beta1
2  caCertPath: /etc/kubernetes/pki/ca.crt
3  discovery:
4    bootstrapToken:
5      token: tokenid
6      apiServerEndpoint: hostnamemaster:6443
7      caCertHashes:
8        - "sha256:cahash"
9      timeout: 5m0s
10 kind: JoinConfiguration
11 nodeRegistration:
12   name: hostnameworker
13   kubeletExtraArgs:
14     cloud-provider: aws
```

Ref: <https://godoc.org/k8s.io/kubernetes/cmd/kubeadm/app/apis/kubeadm/v1beta1>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

```
apiVersion: kubeadm.k8s.io/v1beta3
kind: InitConfiguration
bootstrapTokens:
- token: "9a08jv.c0izixklcxtmnze7"
  description: "kubeadm bootstrap token"
  ttl: "24h"
- token: "783bde.3f89s0fje9f38fhf"
  description: "another bootstrap token"
  usages:
  - authentication
  - signing
groups:
- system:bootstrappers:kubeadm:default-node-token
nodeRegistration:
  name: "ec2-10-100-0-1"
  criSocket: "/var/run/dockershim.sock"
  taints:
  - key: "kubeadmNode"
    value: "master"
    effect: "NoSchedule"
kubletExtraArgs:
  v: 4
  ignorePreflightErrors:
  - IsPrivilegedUser
imagePullPolicy: "IfNotPresent"
localAPIEndpoint:
  advertiseAddress: "10.100.0.1"
  bindPort: 6443
  certificateKey: "e6a2eb8581237ab72a4f494f30285ec12a9694d750b9785706a83bfcbbbd2204"
skipPhases:
- addon/kube-proxy
---
apiVersion: kubeadm.k8s.io/v1beta3
kind: ClusterConfiguration
etcd:
  # one of local or external
  local:
    imageRepository: "k8s.gcr.io"
    imageTag: "3.2.24"
    dataDir: "/var/lib/etcd"
    extraArgs:
      listen-client-urls: "http://10.100.0.1:2379"
    serverCertSANs:
    - "ec2-10-100-0-1.compute-1.amazonaws.com"
```

```
peerCertSANs:
- "10.100.0.1"
# external:
#   endpoints:
#   - "10.100.0.1:2379"
#   - "10.100.0.2:2379"
#   caFile: "/etc/kubernetes/pki/etcd/etcd-ca.crt"
#   certFile: "/etc/kubernetes/pki/etcd/etcd.crt"
#   keyFile: "/etc/kubernetes/pki/etcd/etcd.key"
networking:
  serviceSubnet: "10.96.0.0/16"
  podSubnet: "10.244.0.0/24"
  dnsDomain: "cluster.local"
  kubernetesVersion: "v1.21.0"
  controlPlaneEndpoint: "10.100.0.1:6443"
apiServer:
  extraArgs:
    authorization-mode: "Node,RBAC"
extraVolumes:
- name: "some-volume"
  hostPath: "/etc/some-path"
  mountPath: "/etc/some-pod-path"
  readOnly: false
  pathType: File
certSANs:
- "10.100.1.1"
- "ec2-10-100-0-1.compute-1.amazonaws.com"
timeoutForControlPlane: 4m0s
controllerManager:
  extraArgs:
    "node-cidr-mask-size": "20"
extraVolumes:
- name: "some-volume"
  hostPath: "/etc/some-path"
  mountPath: "/etc/some-pod-path"
  readOnly: false
  pathType: File
scheduler:
  extraArgs:
    address: "10.100.0.1"
extraVolumes:
- name: "some-volume"
  hostPath: "/etc/some-path"
  mountPath: "/etc/some-pod-path"
  readOnly: false
  pathType: File
  certificatesDir: "/etc/kubernetes/pki"
```

```
certificatesDir: "/etc/kubernetes/pki"
imageRepository: "k8s.gcr.io"
clusterName: "example-cluster"
---
apiVersion: kubelet.config.k8s.io/v1beta1
kind: KubeletConfiguration
# kubelet specific options here
---
apiVersion: kubeProxy.config.k8s.io/v1alpha1
kind: KubeProxyConfiguration
# kube-proxy specific options here
```

Ref: <https://godoc.org/k8s.io/kubernetes/cmd/kubeadm/app/apis/kubeadm/v1beta3>

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

- Kubeadm support multiple cloud provider
 - AWS
 - Azure
 - CloudStack
 - GCE
 - OpenStack
 - OVirt
 - Proton
 - Vsphere
 - IBM Cloud Kubernetes Service
 - Baidu Cloud Container Engine
 - etc
- Get fully benefit for utilize capability from cloud provider. Ex: Storage dynamic provision, Network load balancer etc



Kubernetes in real world

- Phase 1: Install prerequisite component

```
1 #Install Base docker-engine
2 sudo apt-get remove docker docker-engine
3 sudo apt-get -y install \
4     apt-transport-https \
5     ca-certificates \
6     curl \
7     software-properties-common
8 curl -fsSL https://download.docker.com/linux/ubuntu/gpg | sudo apt-key add -
9 sudo apt-key fingerprint 0EBFCD88
10 sudo add-apt-repository \
11     "deb [arch=amd64] https://download.docker.com/linux/ubuntu \
12     $(lsb_release -cs) \
13     stable"
14 sudo apt-get update
15 sudo apt-get -y install docker-ce
16 sudo groupadd docker
17 sudo usermod -aG docker $USER
18 sudo systemctl enable docker
19
20 #Install Kubernetes Base
21 curl -LO https://storage.googleapis.com/kubernetes-release/release/v1.7.0/bin/linux/amd64/kubectl
22 chmod +x ./kubectl
23 sudo mv ./kubectl /usr/local/bin/kubectl
24 sudo apt-get update && apt-get install -y apt-transport-https
25 curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -
26 sudo touch /etc/apt/sources.list.d/kubernetes.list
27 #sudo bash -c 'echo "deb http://apt.kubernetes.io/ kubernetes-xenial-1.7 main" >
28 /etc/apt/sources.list.d/kubernetes.list'
29 sudo bash -c 'echo "deb http://apt.kubernetes.io/ kubernetes-xenial main" >
30 /etc/apt/sources.list.d/kubernetes.list'
31 sudo apt-get update
32 sudo apt-get install -y kubelet=1.7.0-00 kubeadm=1.7.0-00
```



Kubernetes in real world

- Phase 2: Initialize Master node

```
praparn@kubernetes-ms:~$ sudo su -
root@kubernetes-ms:~# kubeadm init --kubernetes-version=v1.7.0 --pod-network-cidr=10.244.0.0/16 --token 8c2350.f55343444a6ffc46
[kubeadm] WARNING: kubeadm is in beta, please do not use it for production clusters.
[init] Using Kubernetes version: v1.7.0
[init] Using Authorization modes: [Node RBAC]
[preflight] Running pre-flight checks
[preflight] WARNING: docker version is greater than the most recently validated version. Docker version: 17.06.0-ce. Max validated version: 1.12
[certificates] Generated CA certificate and key.
[certificates] Generated API server certificate and key.
[certificates] API Server serving cert is signed for DNS names [kubernetes-ms kubernetes kubernetes.default kubernetes.default.svc kubernetes.default.svc.cluster.local] and IPs [10.96.0.1 192.168.99.200]
[certificates] Generated API server kubelet client certificate and key.
[certificates] Generated service account token signing key and public key.
[certificates] Generated front-proxy CA certificate and key.
[certificates] Generated front-proxy client certificate and key.
[certificates] Valid certificates and keys now exist in "/etc/kubernetes/pki"
[kubeconfig] Wrote KubeConfig file to disk: "/etc/kubernetes/admin.conf"
[kubeconfig] Wrote KubeConfig file to disk: "/etc/kubernetes/kubelet.conf"
[kubeconfig] Wrote KubeConfig file to disk: "/etc/kubernetes/controller-manager.conf"
[kubeconfig] Wrote KubeConfig file to disk: "/etc/kubernetes/scheduler.conf"
[apiclient] Created API client, waiting for the control plane to become ready
```

```
Your Kubernetes master has initialized successfully!

To start using your cluster, you'll need to run (as a regular user):

mkdir -p $HOME/.kube
sudo cp -i /etc/kubernetes/admin.conf $HOME/.kube/config
sudo chown $(id -u):$(id -g) $HOME/.kube/config

You should now deploy a pod network to the cluster.
Run "kubectl apply -f [podnetwork].yaml" with one of the options listed at:
  http://kubernetes.io/docs/admin/addons/

You can now join any number of machines by running the following on each node
as root:

  kubeadm join --token 8c2350.f55343444a6ffc46 192.168.99.200:6443

root@kubernetes-ms:~#
```



Kubernetes in real world

- Phase 3: Install Pods Network (3rd party) with CNI support

```
[praparn@kubernetes-ms:~]$ kubectl apply -n kube-system -f "https://cloud.weave.works/k8s/net?k8s-version=$(kubectl version | base64 | tr -d '\n')"
serviceaccount "weave-net" created
clusterrole "weave-net" created
clusterrolebinding "weave-net" created
daemonset "weave-net" created
[praparn@kubernetes-ms:~]$ kubectl get pods --all-namespaces
NAMESPACE     NAME           READY   STATUS    RESTARTS   AGE
kube-system   etcd-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-apiserver-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-controller-manager-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-dns-2425271678-32cjf   0/3     Pending   0          2m
kube-system   kube-proxy-9jtxj   1/1     Running   0          2m
kube-system   kube-scheduler-kubernetes-ms   1/1     Running   0          2m
kube-system   weave-net-bg346   0/2     ContainerCreating   0          15s
[praparn@kubernetes-ms:~]$
```

```
[praparn@kubernetes-ms:~]$ kubectl get pods --all-namespaces
NAMESPACE     NAME           READY   STATUS    RESTARTS   AGE
kube-system   etcd-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-apiserver-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-controller-manager-kubernetes-ms   1/1     Running   0          2m
kube-system   kube-dns-2425271678-32cjf   3/3     Running   0          2m
kube-system   kube-proxy-9jtxj   1/1     Running   0          2m
kube-system   kube-scheduler-kubernetes-ms   1/1     Running   0          2m
kube-system   weave-net-bg346   2/2     Running   0          51s
[praparn@kubernetes-ms:~]$
```



Kubernetes in real world

- Phase 3: Install Pods Network (3rd party) with CNI support

```
[ubuntu@ip-10-21-1-92:~]$ cilium install
[+] using Cilium version "v1.11.2"
[+] Auto-detected cluster name: kuberneteslab
[+] Auto-detected IPAM mode: cluster-pool
[+] Created CA in secret cilium-ca
[+] Generating certificates for Hubble...
[+] Creating Service accounts...
[+] Creating Cluster roles...
[+] Creating ConfigMap for Cilium version 1.11.2...
[+] Creating Agent DaemonSet...
[+] Creating Operator Deployment...
[+] Waiting for Cilium to be installed and ready...
[✓] Cilium was successfully installed! Run 'cilium status' to view installation health
[ubuntu@ip-10-21-1-92:~]$ cilium hubble enable --ui
[+] Found CA in secret cilium-ca
[+] Patching ConfigMap cilium-config to enable Hubble...
[+] Restarted Cilium pods
[+] Waiting for Cilium to become ready before deploying other Hubble component(s)...
[+] Generating certificates for Relay...
[+] Deploying Relay from quay.io/cilium/hubble-relay:v1.11.2...
[+] Deploying Hubble UI from quay.io/cilium/hubble-ui:v0.8.5 and Hubble UI Backend from quay.io/cilium/hubble-ui-backend:v0.8.5...
[+] Waiting for Hubble to be installed...
[✓] Hubble was successfully enabled!
[ubuntu@ip-10-21-1-92:~]$ cilium status
   _/` \
  /_ \_` \
 /_ \_` \
/_ \_` \
  Cilium:      OK
  Operator:    OK
  Hubble:      OK
ClusterMesh:  disabled

DaemonSet     cilium       Desired: 1, Ready: 1/1, Available: 1/1
Deployment    cilium-operator Desired: 1, Ready: 1/1, Available: 1/1
Deployment    hubble-relay   Desired: 1, Ready: 1/1, Available: 1/1
Deployment    hubble-ui     Desired: 1, Ready: 1/1, Available: 1/1
Containers:
  cilium       Running: 1
  cilium-operator Running: 1
  hubble-relay  Running: 1
  hubble-ui    Running: 1

Cluster Pods: 4/4 managed by Cilium
Image versions  cilium       quay.io/cilium/cilium:v1.11.2@sha256:4332428fbb528bda32fffe124454458c9b716c86211266d1a03c4ddf695d7f60: 1
                cilium-operator quay.io/operator-generic:v1.11.0@sha256:4c8bea6818ee3e4932f99e9c1d7efa88b8c0f3cd516160caec878406531e45e7: 1
                hubble-relay   quay.io/cilium/hubble-relay:v1.11.2@sha256:f031f95f3c9ba8962094649c0cc913f90723d553203444c8fb9a591e38873c9d: 1
                hubble-ui     quay.io/cilium/hubble-ui-backend:v0.8.5@sha256:2bce50ctfc32719d072706f7ceccad654bfa907b2745a496da9961077fe31ed: 1
                hubble-ui     docker.io/envoyproxy/envoy:v1.18.2@sha256:e8b37c1d75787dd1e712ff389b0d37337dc8a174a63bed9c34ba73359dc67da7: 1
                hubble-ui     quay.io/cilium/hubble-ui:v0.8.5@sha256:4eacalec1741043cfba6066a165b3bf251590cf4ac66371c4f63fbed2224ebbf4: 1

[ubuntu@ip-10-21-1-92:~]$
```

Kubernetes in real world

- Phase 4: Join node to cluster system

```
praparn@kubernetes-1:~$ sudo su -
root@kubernetes-1:~# kubeadm --token 8c2350.f55343444a6ffc46 join 192.168.99.200:6443
[kubeadm] WARNING: kubeadm is in beta, please do not use it for production clusters.
[preflight] Running pre-flight checks
[preflight] WARNING: docker version is greater than the most recently validated version. Docker version: 17.06.0-ce. Max validated version: 1.12
[discovery] Trying to connect to API Server "192.168.99.200:6443"
[discovery] Created cluster-info discovery client, requesting info from "https://192.168.99.200:6443"
[discovery] Cluster info signature and contents are valid, will use API Server "https://192.168.99.200:6443"
[discovery] Successfully established connection with API Server "192.168.99.200:6443"
[bootstrap] Detected server version: v1.7.0
[bootstrap] The server supports the Certificates API (certificates.k8s.io/v1beta1)
[csr] Created API client to obtain unique certificate for this node, generating keys and certificate signing request
[csr] Received signed certificate from the API server, generating KubeConfig...
[kubeconfig] Wrote KubeConfig file to disk: "/etc/kubernetes/kubelet.conf"

Node join complete:
* Certificate signing request sent to master and response received.
* Kubelet informed of new secure connection details.

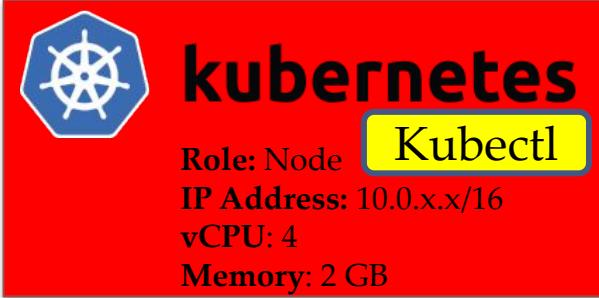
Run 'kubectl get nodes' on the master to see this machine join.
root@kubernetes-1:~#
```

```
praparn@kubernetes-ms:~$ kubectl get node
NAME      STATUS    AGE     VERSION
kubernetes-1  Ready    5m      v1.7.0
kubernetes-2  Ready    4m      v1.7.0
kubernetes-ms  Ready   11m      v1.7.0
praparn@kubernetes-ms:~$
```

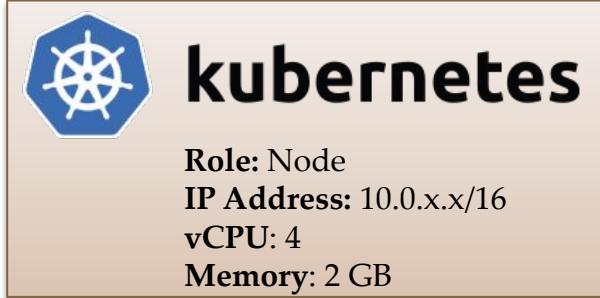


Workshop: Kubernetes Real World

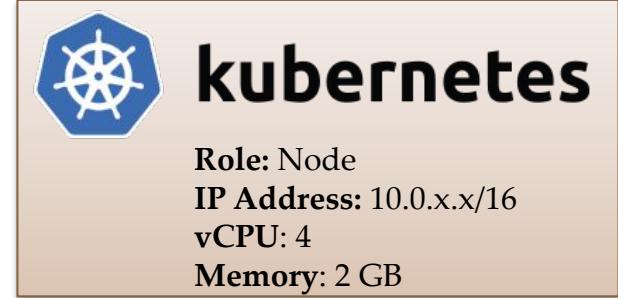
Machine: Kubernetes_MS



Machine: Kubernetes_1



Machine: Kubernetes_2



AWS CLI
Command/Monitor



Role: Client



Kubernetes: Production Workload Orchestration



kubernetes
by Google

Kubernetes in real world

- Multiple Master

The screenshot shows the official Kubernetes documentation website. The top navigation bar includes links for Documentation, Blog, Partners, Community, Case Studies, English, and v1.16. The main content area is titled "Creating Highly Available clusters with kubeadm". It explains two approaches: stacked control plane nodes and an external etcd cluster. A "Caution" box notes that neither approach works with Service objects of type LoadBalancer or dynamic PersistentVolumes in a cloud environment. Below the main content, a sidebar lists other "Getting started" topics like Release notes and version skew, Learning environment, Production environment (Container runtimes, Installing Kubernetes with deployment tools, Bootstrapping clusters with kubeadm), and more.

Creating Highly Available clusters with kubeadm

This page explains two different approaches to setting up a highly available Kubernetes cluster using kubeadm:

- With stacked control plane nodes. This approach requires less infrastructure. The etcd members and control plane nodes are co-located.
- With an external etcd cluster. This approach requires more infrastructure. The control plane nodes and etcd members are separated.

Before proceeding, you should carefully consider which approach best meets the needs of your applications and environment. [This comparison topic](#) outlines the advantages and disadvantages of each.

If you encounter issues with setting up the HA cluster, please provide us with feedback in the kubeadm [issue tracker](#).

See also [The upgrade documentation](#).

Caution: This page does not address running your cluster on a cloud provider. In a cloud environment, neither approach documented here works with Service objects of type LoadBalancer, or with dynamic PersistentVolumes.

[Before you begin](#)
[First steps for both methods](#)
[Stacked control plane and etcd nodes](#)
[External etcd nodes](#)
[Common tasks after bootstrapping control plane](#)
[Manual certificate distribution](#)

Ref: <https://kubernetes.io/docs/setup/independent/high-availability/>

Kubernetes: Production Workload Orchestration



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Orchestrator Assignment



Kubernetes: Production Workload Orchestration



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Orchestrator Assignment

- Kubernetes have several way for control/restrict pod to run on nodes
- nodeSelector
 - Give some customize label for classify host and define some selector criteria for specific node run Pods
- Interlude
 - Build-in labels with nodes
 - kubernetes.io/hostname
 - failure-domain.beta.kubernetes.io/zone
 - failure-domain.beta.kubernetes.io/region
 - beta.kubernetes.io/instance-type
 - beta.kubernetes.io/arch
- Affinity
 - Node Affinity
 - Inter-Pods Affinity and Anti-Affinity
- Taints and tolerations



nodeSelector

Nodes: kubernetes-ms, kubernetes-1, kubernetes-2

```
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-ms storage=M2
node "kubernetes-ms" labeled
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-1 storage=SSD
node "kubernetes-1" labeled
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-2 storage=SAS
node "kubernetes-2" labeled
praparn@kubernetes-ms:~$ kubectl describe nodes
Name:           kubernetes-1
Role:           kubernetes-1
Labels:          beta.kubernetes.io/arch=amd64
                  beta.kubernetes.io/os=linux
                  kubernetes.io/hostname=kubernetes-1
                  storage=SSD
Name:           kubernetes-2
Role:           kubernetes-2
Labels:          beta.kubernetes.io/arch=amd64
                  beta.kubernetes.io/os=linux
                  kubernetes.io/hostname=kubernetes-2
                  storage=SAS
Name:           kubernetes-ms
Role:           kubernetes-ms
Labels:          beta.kubernetes.io/arch=amd64
                  beta.kubernetes.io/os=linux
                  kubernetes.io/hostname=kubernetes-ms
                  node-role.kubernetes.io/master=
                  storage=M2
```

Pods YAML File:

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12   spec:
13     containers:
14       - name: webtest
15         image: labdocker/cluster:webserviceelite
16         ports:
17           - containerPort: 5000
18             protocol: TCP
19     nodeSelector:
20       storage: M2
```



nodeSelector

```
[praparn@kubernetes-ms:~$ kubectl create -f webtest_pod_nodeselector.yml
pod "webtest" created
[praparn@kubernetes-ms:~$ kubectl describe pods/webtest
Name:           webtest
Namespace:      default
Node:          kubernetes-ms/192.168.99.200
Start Time:    Sun, 23 Jul 2017 13:20:34 +0000
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                version=1.0
Annotations:   <none>
Status:        Pending
```

```
Node-Selectors: storage=M2
Tolerations:  node.alpha.kubernetes.io/notReady:NoExecute for 300s
              node.alpha.kubernetes.io/unreachable:NoExecute for 300s
Events:
FirstSeen     LastSeen      Count  From           SubObjectPath      Type  Reason
---          ---          ---   ---           ---           ---           ---  ---
--          --          --   --           --           --           --  --
12m          12m          1    default-scheduler
cheduled      Successfully assigned webtest to kubernetes-ms
12m          12m          1    kubelet, kubernetes-ms
uccesfulMountVolume  MountVolume.SetUp succeeded for volume "default-token-1ltqv"
12m          12m          1    kubelet, kubernetes-ms spec.containers{webtest}
ulling       pulling image "labdocker/cluster:webservicelite"
11m          11m          1    kubelet, kubernetes-ms spec.containers{webtest}
ulled       Successfully pulled image "labdocker/cluster:webservicelite"
11m          11m          1    kubelet, kubernetes-ms spec.containers{webtest}
reated      Created container
11m          11m          1    kubelet, kubernetes-ms spec.containers{webtest}
arted       Started container
[praparn@kubernetes-ms:~$ kubectl get pods -o wide
NAME    READY  STATUS    RESTARTS   AGE     IP          NODE
webtest  1/1    Running   0          12m    10.32.0.3  kubernetes-ms
[praparn@kubernetes-ms:~$ ]
```



Interlude

Nodes: kubernetes-ms, kubernetes-1, kubernetes-2

```
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-ms storage=M2
node "kubernetes-ms" labeled
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-1 storage=SSD
node "kubernetes-1" labeled
praparn@kubernetes-ms:~$ kubectl label nodes kubernetes-2 storage=SAS
node "kubernetes-2" labeled
praparn@kubernetes-ms:~$ kubectl describe nodes
Name:           kubernetes-1
Role:           kubernetes-1
Labels:         beta.kubernetes.io/arch=amd64
                beta.kubernetes.io/os=linux
                kubernetes.io/hostname=kubernetes-1
                storage=SSD
```

```
Name:           kubernetes-2
Role:           kubernetes-2
Labels:         beta.kubernetes.io/arch=amd64
                beta.kubernetes.io/os=linux
                kubernetes.io/hostname=kubernetes-2
                storage=SAS
```

```
Name:           kubernetes-ms
Role:           kubernetes-ms
Labels:         beta.kubernetes.io/arch=amd64
                beta.kubernetes.io/os=linux
                kubernetes.io/hostname=kubernetes-ms
                node-role.kubernetes.io/master=
                storage=M2
```

Pods YAML File:

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12   spec:
13     containers:
14       - name: webtest
15         image: labdocker/cluster:webserviceelite
16         ports:
17           - containerPort: 5000
18             protocol: TCP
19             nodeSelector:
20               kubernetes.io/hostname: kubernetes-1
```



Interlude

```
praparn@kubernetes-ms:~$ kubectl create -f webtest_pod_interlude.yml
pod "webtest" created
praparn@kubernetes-ms:~$ kubectl get pods -o wide
NAME      READY   STATUS            RESTARTS   AGE       IP           NODE
webtest   0/1    ContainerCreating   0          6s      <none>     kubernetes-1
praparn@kubernetes-ms:~$ kubectl describe pods/webtest
Name:         webtest
Namespace:    default
Node:         kubernetes-1/192.168.99.201
Start Time:   Sun, 23 Jul 2017 14:11:36 +0000
Labels:       environment=development
              module=WebServer
              name=web
              owner=Praparn_L
              version=1.0
Annotations:  <none>
Status:       Pending
IP:
Containers:
  webtest:
    Container ID:        labdocker/cluster:webserviceelite
    Image:               labdocker/cluster:webserviceelite
    Image ID:             ...
    Port:                5000/TCP
    State:               Waiting
      Reason:             ContainerCreating
    Ready:               False
    Restart Count:       0
    Environment:        <none>
    Mounts:
      /var/run/secrets/kubernetes.io/serviceaccount from default-token-1ltqv (ro)
Conditions:
  Type      Status
  Initialized  True
  Ready      False
  PodScheduled  True
Volumes:
  default-token-1ltqv:
    Type:      Secret (a volume populated by a Secret)
    SecretName: default-token-1ltqv
    Optional:   false
  QoS Class:  BestEffort
  Node-Selectors: kubernetes.io/hostname=kubernetes-1
```



Affinity

- Node Affinity
 - Similar to “nodeSelector” but more flexible for selection
 - requiredDuringSchedulingIgnoredDuringExecution (Hard)
 - preferredDuringSchedulingIgnoredDuringExecution (Soft)
 - If Pods was define both “nodeSelector” and “Affinity”. It need to satisfy both for operate
- Inter-pod Affinity and Anti-affinity
 - “based on labels on pods (X) that are already running on the node with criteria (Y)”
 - Add constrain/dependence from Pods
 - podAffinity (Run with existing pods)
 - podAntiAffinity (Not run with existing pods)
 - Criteria(Y) will consider as “topologyKey”
 - Ex:
 - Run pods (podAffinity) on any node with same hostname (topologyKey (Y)=hostname) with existing pods that label “environment=development” (X)

Node Affinity

Pods YAML File:

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12    spec:
13      affinity:
14        nodeAffinity:
15          requiredDuringSchedulingIgnoredDuringExecution:
16            nodeSelectorTerms:
17              - matchExpressions:
18                - key: beta.kubernetes.io/os
19                  operator: In #In, NotIn, Exists, DoesNotExist, Gt, Lt
20                  values:
21                    - linux
22          preferredDuringSchedulingIgnoredDuringExecution:
23            - weight: 1
24              preference:
25                matchExpressions:
26                  - key: storage
27                      operator: In
28                      values:
29                        - SSD
30
31        containers:
32          - name: webtest
33            image: labdocker/cluster:webservicelite
34            ports:
35              - containerPort: 5000
36                protocol: TCP
```



Inter-pod Affinity and Anti-affinity

Pods YAML File:

```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: webtest2
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11
12   spec:
13     affinity:
14       podAffinity:
15         requiredDuringSchedulingIgnoredDuringExecution:
16           - labelSelector:
17             matchExpressions:
18               - key: environment
19                 operator: In
20                 values:
21                   - development
22             topologyKey: kubernetes.io/hostname
23
24     podAntiAffinity:
25       preferredDuringSchedulingIgnoredDuringExecution:
26         - weight: 1
27           podAffinityTerm:
28             labelSelector:
29               matchExpressions:
30                 - key: module
31                   operator: In
32                   values:
33                     - DBServer
34             topologyKey: storage
35
36   containers:
37     - name: webtest2
38       image: labdocker/cluster:webservicelite
39       ports:
40         - containerPort: 5000
```

“Run Pods on any node that have existing pods with key (environment=development) on node same hostname”

“Don’t run Pods on any node that have existing pods with key (module=DBServer) on node same storage type”



Taint and Tolerations

- Node side consideration
- Force/Repel Pods from Node
- Taint will apply to Node for protect “node” to run any pods without “tolerate” match taint
- Tolerations apply to Pods for suggest (Not required) Pods to schedule
- Use Case:
 - Dedicated Node / Maintenance Node
 - Special Hardware Node
- Value for Taint
 - PreferNoSchedule
 - NoSchedule
 - NoExecute



Taint and Tolerations

Taint on Node:

```
praparn@kubernetes-ms:~$ kubectl taint nodes kubernetes-1 dedicated=admin:NoSchedule
node "kubernetes-1" tainted
```

Pods YAML File:

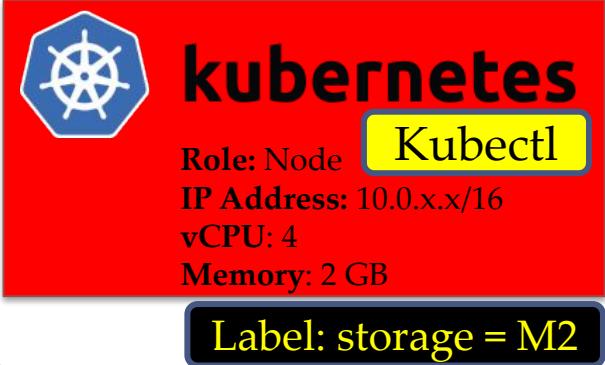
```
1  apiVersion: "v1"
2  kind: Pod
3  metadata:
4    name: webtest
5    labels:
6      name: web
7      owner: Praparn_L
8      version: "1.0"
9      module: WebServer
10     environment: development
11 spec:
12   containers:
13     - name: webtest
14       image: labdocker/cluster:webservicelite
15       ports:
16         - containerPort: 5000
17           protocol: TCP
18   tolerations:
19     - key: "dedicated"
20       operator: "Equal"
21       value: "admin"
22       effect: "NoSchedule"
23   nodeSelector:
24     kubernetes.io/hostname: kubernetes-1
```

Tolerations:
Key="dedicated"
Operator="Equal"
Value="Admin"
Effect="NoSchedule"

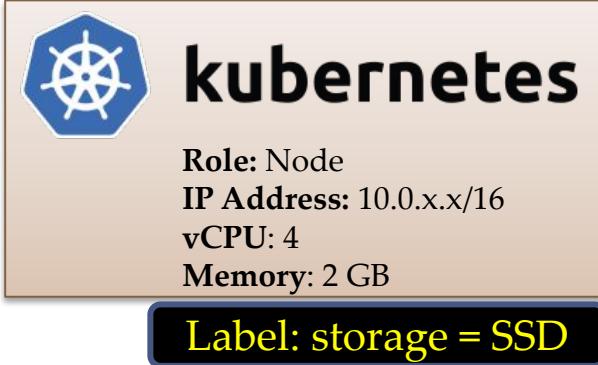


Workshop: Orchestrator Assignment

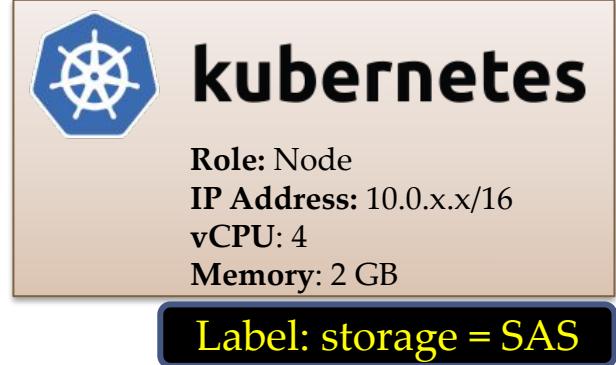
Machine: Kubernetes_MS



Machine: Kubernetes_1



Machine: Kubernetes_2



Role: Client

Lab Section:

- Part 1: nodeSelector
- Part 2: Interlude
- Part 3: Affinity (Node)
- Part 4: Inter-Pod Affinity and Anti-affinity
- Part 5: Taint and Tolerations

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Stateful Application Deployment



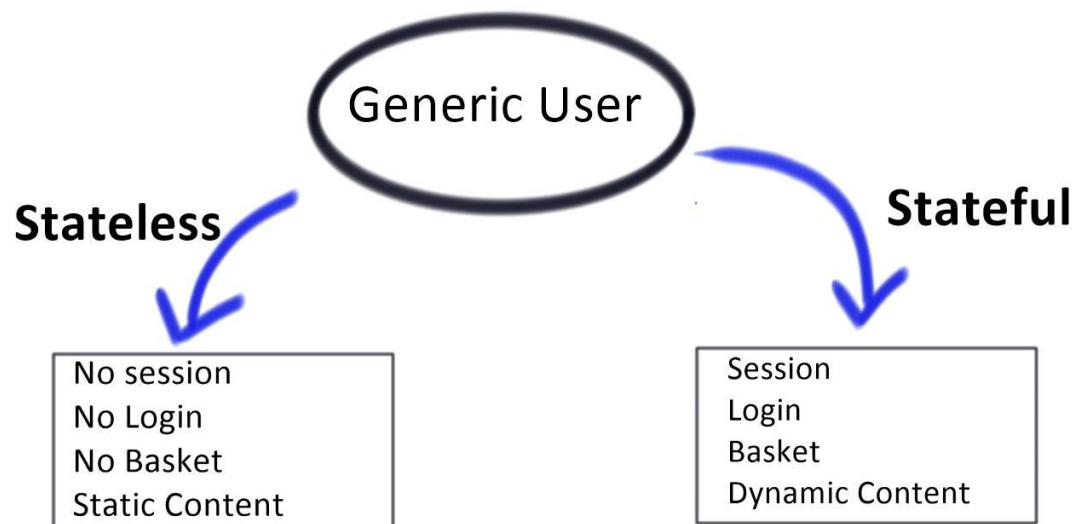
Kubernetes: Production Workload Orchestration



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Stateful Application Deployment

- Some application need “state” for keep application flow and store some information on “session” (Such as login’s session id) that store on web server or middle tier server module
- Ex: Joomla, Wordpress, Mantis (Bug Tracking), Normal etc

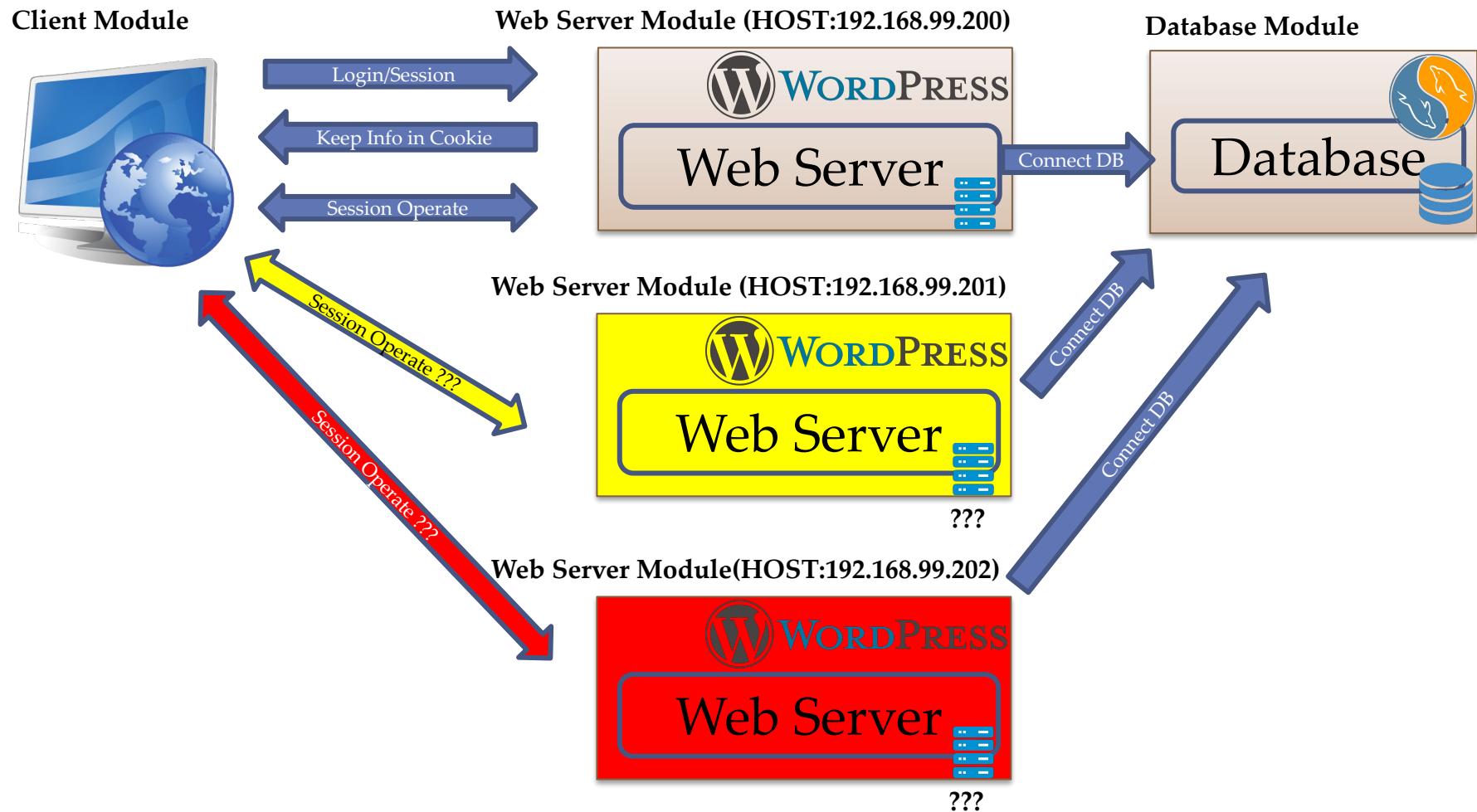


Stateful Application Deployment

- Considering
 - Original “HTTP” protocol is “stateless”
 - Stateful application need to keep session by web/app server and keep “cookies” on client for pass authentication
 - Work on memory for keep session (Fast/Easy but consume resource)
 - Many problem with native mobile app/Centralize Problem
 - Scale will effect for consideration traffic redirect to correct server (Keep state)
- Awareness
 - Container is naturally design for “stateless” application
 - All load-balance/dispatch job is not aware about “state” of application inside



Stateful Application Deployment

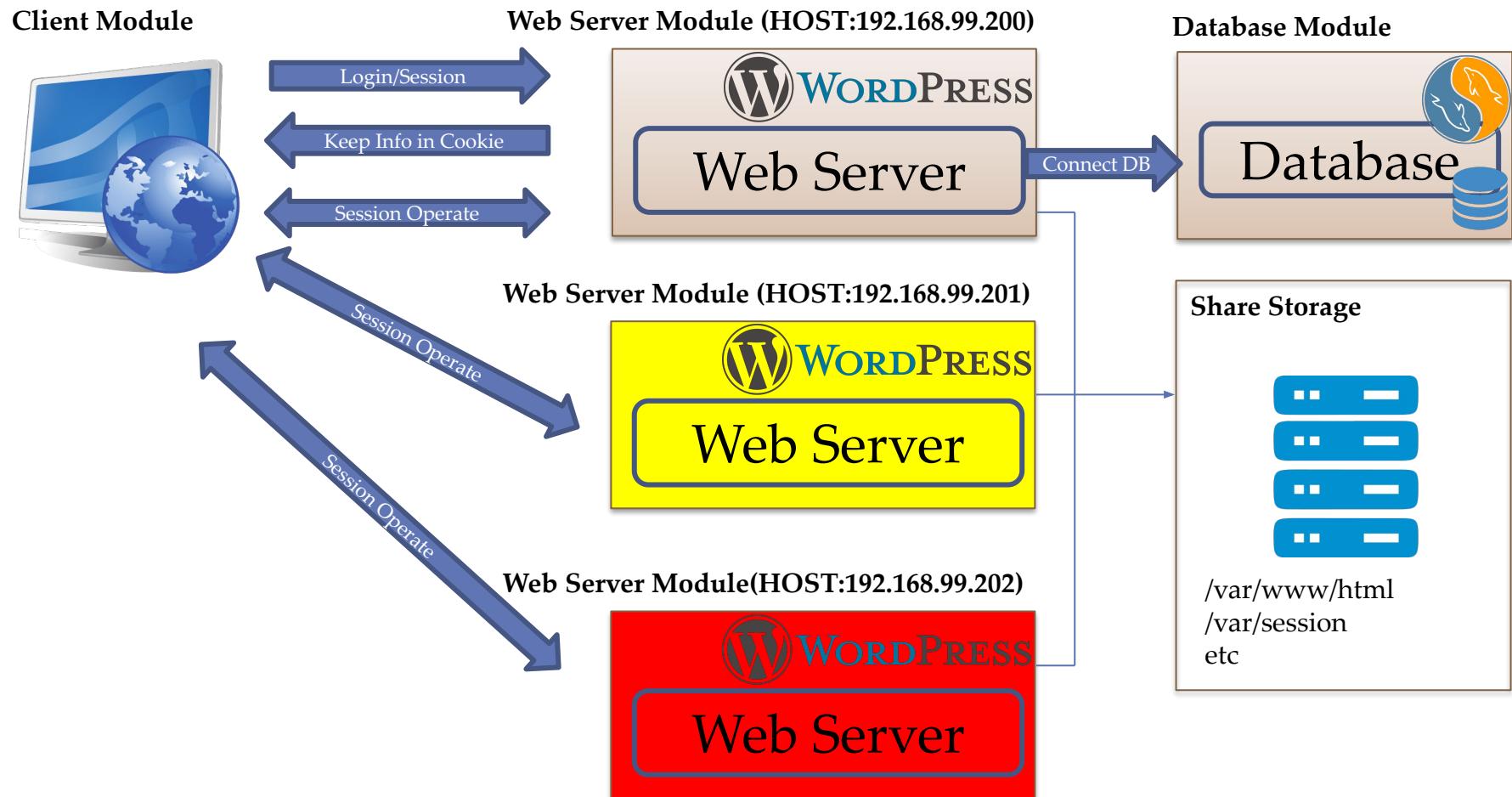


Stateful Application Deployment

- Solution ?

- SDS (Software-Defined Storage) for make centralize storage pool
- Share centralize storage pool for all node
- For Web/App Server
 - Keep application path / Session path on storage pool
 - Every server will read/write on same place
- For Database Server
 - Many option for operate (depend on type of database)
 - Active/Active
 - Active/Hot-Passive
 - Active/Cold-Passive
 - Postgres Kubedb Tool (Beta)
 - Idea also keep data on storage pool

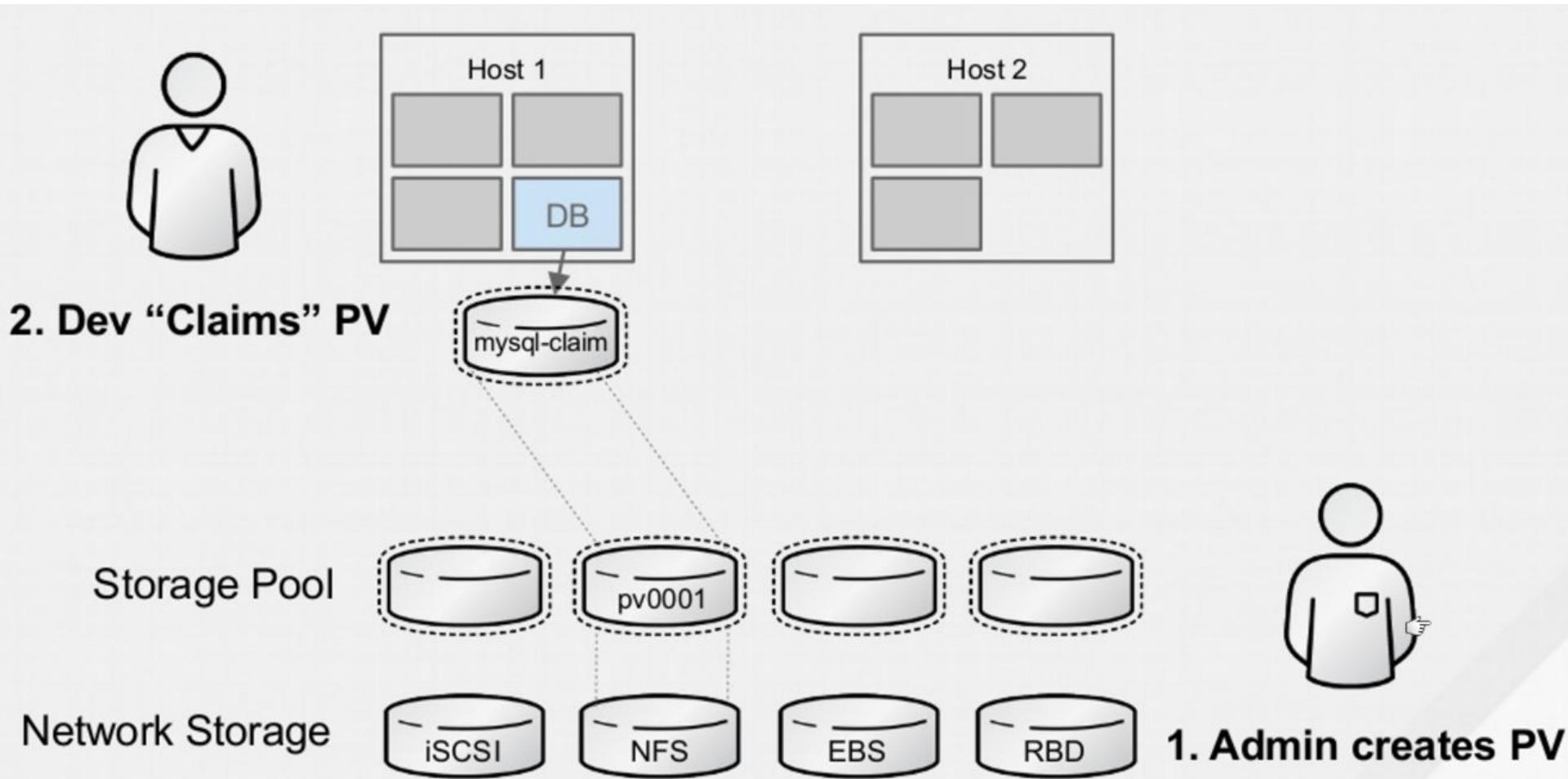
Stateful Application Deployment



Persistent Volume



Persistent Volume



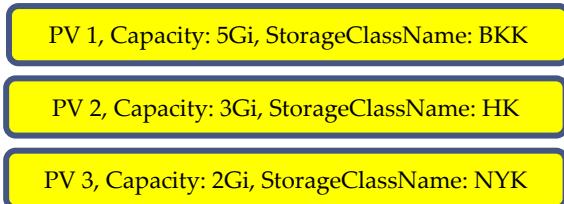
Persistent Volume

- Persistent Volume (PV)
 - Resource in cluster system
 - Act like pieces of storage (Independence from Pods)
 - Lifecycle was depended on Pods who used PV via PVC(Persistent Volume Claim)
 - Multiple type of PV as plugin support
- Persistent Volume Claim (PVC)
 - Similar Pod, That create for request storage from PV
 - PVC can specific
 - Size: Datasize for claim storage
 - Access Method:
 - ReadWriteOnce (RWO)
 - ReadOnlyMany (ROX)
 - ReadWriteMany (RWX)
- StorageClass
 - “Profiling” storage concept
 - Easy to classify storage (IOPS, Region etc)

Persistent Volume

- Volume Life Cycle

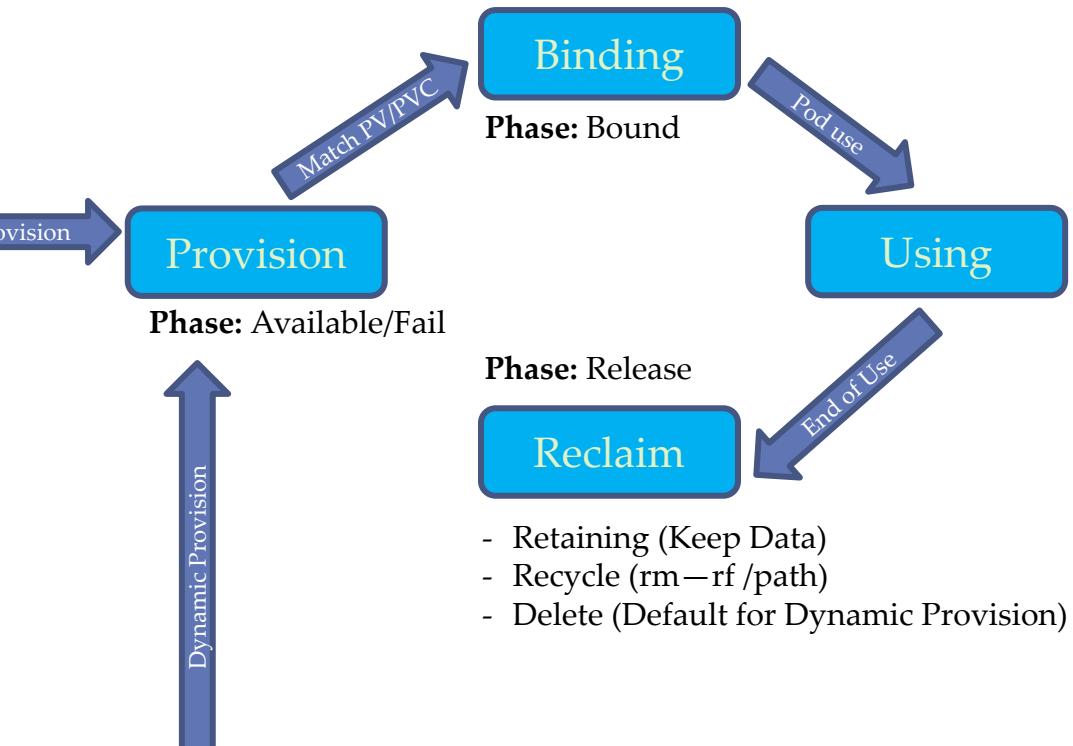
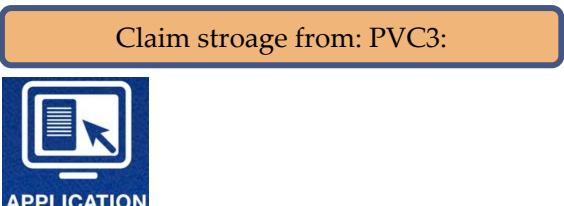
PV Pool



PVC Request

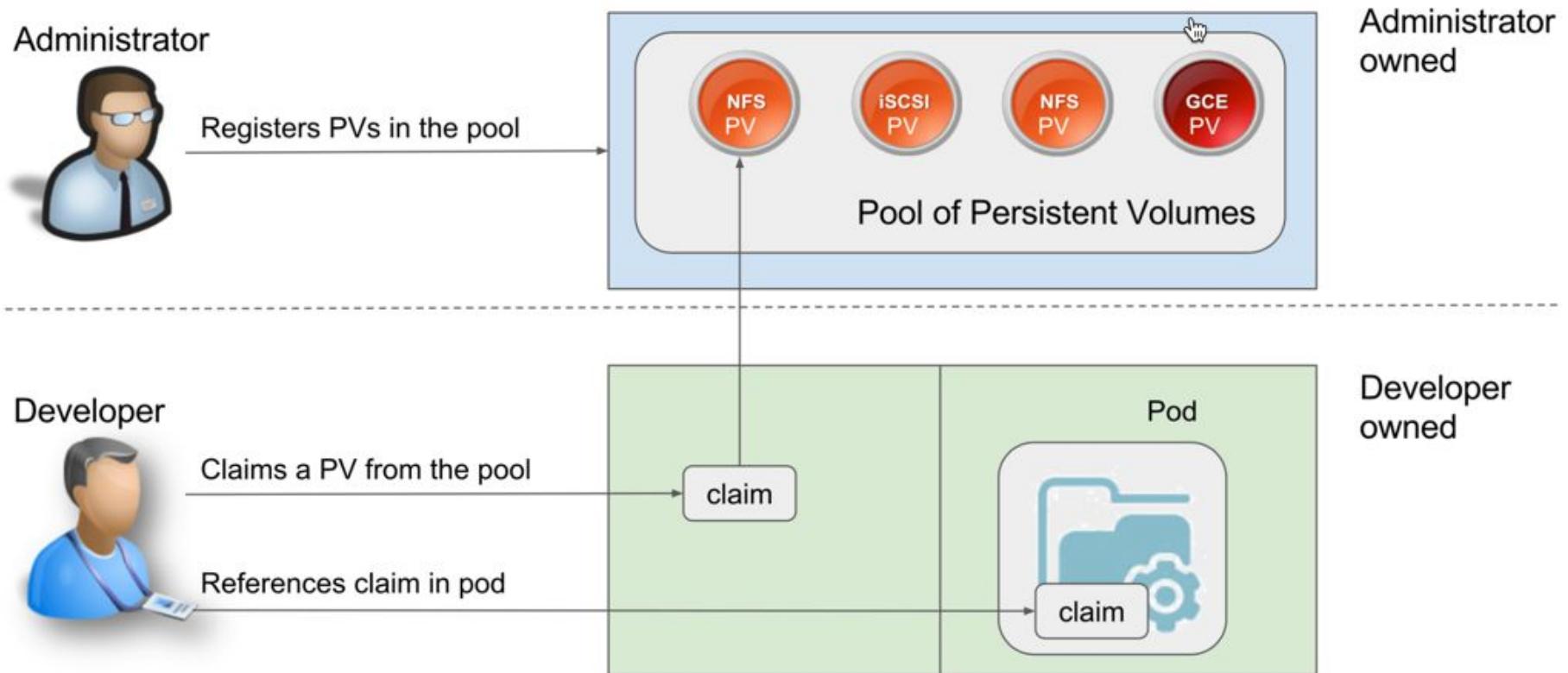


Pods for Application



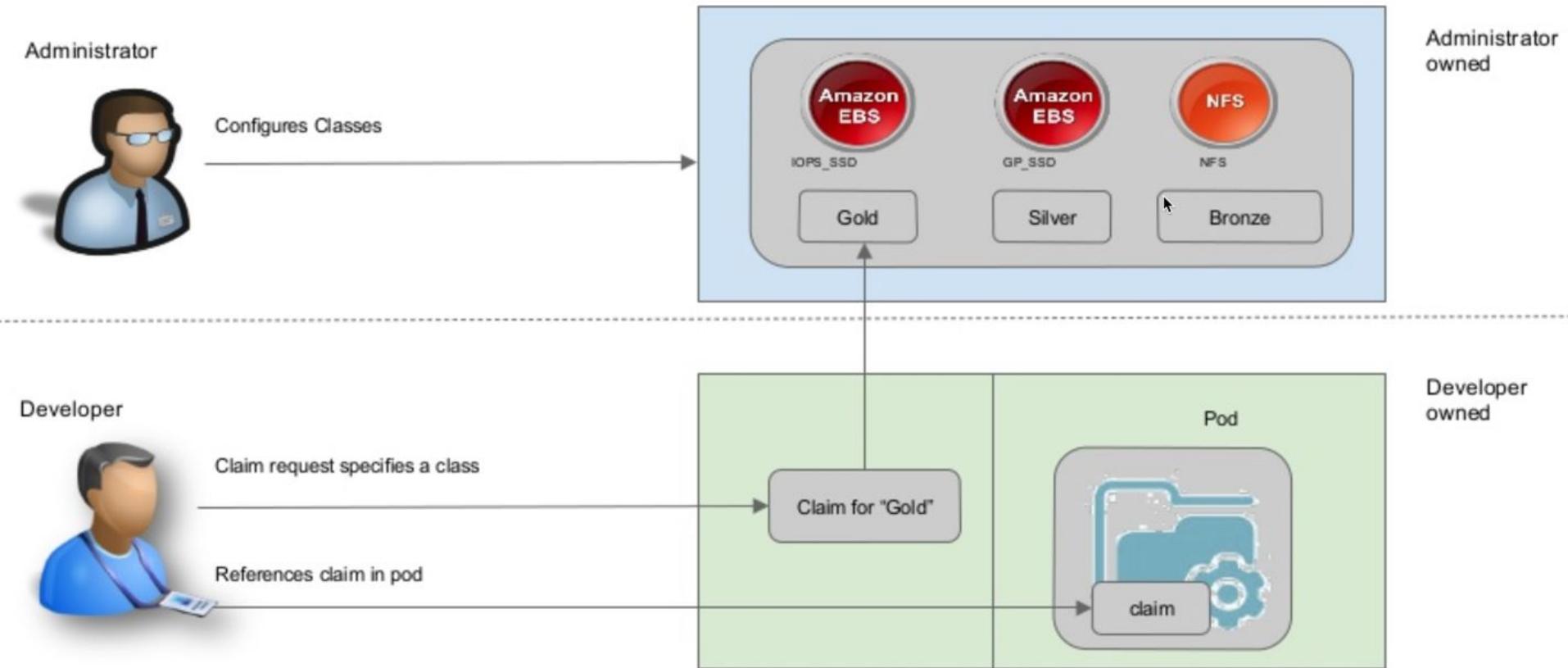
Persistent Volume

- Static Provision



Persistent Volume

- Dynamic Provision



Persistent Volume

- Type of Persistent Volume/Access Method

Volume Plugin	ReadWriteOnce	ReadOnlyMany	ReadWriteMany
AWSElasticBlockStore	✓	-	-
AzureFile	✓	✓	✓
AzureDisk	✓	-	-
CephFS	✓	✓	✓
Cinder	✓	-	-
FC	✓	✓	-
FlexVolume	✓	✓	-
Flocker	✓	-	-
GCEPersistentDisk	✓	✓	-
Glusterfs	✓	✓	✓
HostPath	✓	-	-
iSCSI	✓	✓	-
PhotonPersistentDisk	✓	-	-
Quobyte	✓	✓	✓
NFS	✓	✓	✓
RBD	✓	✓	-
VsphereVolume	✓	-	-
PortworxVolume	✓	-	✓
ScaleIO	✓	✓	-
StorageOS	✓	-	-



Persistent Volume

Volume health monitoring

Kubernetes *volume health monitoring* is part of how Kubernetes implements the Container Storage Interface (CSI). Volume health monitoring feature is implemented in two components: an External Health Monitor controller, and the [kubelet](#).

If a CSI Driver supports Volume Health Monitoring feature from the controller side, an event will be reported on the related [PersistentVolumeClaim](#) (PVC) when an abnormal volume condition is detected on a CSI volume.

The External Health Monitor [controller](#) also watches for node failure events. You can enable node failure monitoring by setting the `enable-node-watcher` flag to true. When the external health monitor detects a node failure event, the controller reports an Event will be reported on the PVC to indicate that pods using this PVC are on a failed node.

If a CSI Driver supports Volume Health Monitoring feature from the node side, an Event will be reported on every Pod using the PVC when an abnormal volume condition is detected on a CSI volume. In addition, Volume Health information is exposed as Kubelet VolumeStats metrics. A new metric `kubelet_volume_stats_health_status_abnormal` is added. This metric includes two labels: `namespace` and `persistentvolumeclaim`. The count is either 1 or 0. 1 indicates the volume is unhealthy, 0 indicates volume is healthy. For more information, please check [KEP](#).

Note: You need to enable the [CSIVolumeHealth feature gate](#) to use this feature from the node side.



Persistent Volume

Production Drivers

Name	CSI Driver Name	Compatible with CSI Version(s)	Description	Persistence (Beyond Pod Lifetime)	Supported Access Modes	Dynamic Provisioning	Other Features
Alicloud Disk	diskplugin.csi.alibabacloud.com	v1.0	A Container Storage Interface (CSI) Driver for Alicloud Disk	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot
Alicloud NAS	nasplugin.csi.alibabacloud.com	v1.0	A Container Storage Interface (CSI) Driver for Alicloud Network Attached Storage (NAS)	Persistent	Read/Write Multiple Pods	No	
Alicloud OSS	ossplugin.csi.alibabacloud.com	v1.0	A Container Storage Interface (CSI) Driver for Alicloud Object Storage Service (OSS)	Persistent	Read/Write Multiple Pods	No	
Alluxio	csi.alluxio.com	v1.0	A Container Storage Interface (CSI) Driver for Alluxio File System	Persistent	Read/Write Multiple Pods	Yes	
ArStor CSI	arstor.csi.huayun.io	v1.0	A Container Storage Interface (CSI) Driver for Huayun Storage Service (ArStor)	Persistent and Ephemeral	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion, Cloning

Ref:<https://kubernetes-csi.github.io/docs/drivers.html>

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Persistent Volume

AWS Elastic Block Storage	ebs.csi.aws.com	v0.3, v1.0	A Container Storage Interface (CSI) Driver for AWS Elastic Block Storage (EBS)	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion
AWS Elastic File System	efs.csi.aws.com	v0.3, v1.0	A Container Storage Interface (CSI) Driver for AWS Elastic File System (EFS)	Persistent	Read/Write Multiple Pods	No	
AWS FSx for Lustre	fsx.csi.aws.com	v0.3, v1.0	A Container Storage Interface (CSI) Driver for AWS FSx for Lustre (EBS)	Persistent	Read/Write Multiple Pods	Yes	
Azure Blob	blob.csi.azure.com	v1.0	A Container Storage Interface (CSI) Driver for Azure Blob storage	Persistent	Read/Write Multiple Pods	Yes	Expansion >
Azure Disk	disk.csi.azure.com	v1.0	A Container Storage Interface (CSI) Driver for Azure Disk	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion, Cloning, Topology
Azure File	file.csi.azure.com	v1.0	A Container Storage Interface (CSI) Driver for Azure File	Persistent	Read/Write Multiple Pods	Yes	Expansion
BeeGFS	beegfs.csi.netapp.com	v1.3	A Container Storage Interface (CSI) Driver for the BeeGFS Parallel File System	Persistent	Read/Write Multiple Pods	Yes	
			A Container Storage				

Ref:<https://kubernetes-csi.github.io/docs/drivers.html>

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Persistent Volume

Bigtera VirtualStor (block)	csi.block.bigtera.com	v0.3, v1.0.0, v1.1.0	A Container Storage Interface (CSI) Driver for Bigtera VirtualStor block storage	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion
Bigtera VirtualStor (filesystem)	csi.fs.bigtera.com	v0.3, v1.0.0, v1.1.0	A Container Storage Interface (CSI) Driver for Bigtera VirtualStor filesystem	Persistent	Read/Write Multiple Pods	Yes	Expansion
BizFlyCloud Block Storage	volume.csi.bizflycloud.vn	v1.2	A Container Storage Interface (CSI) Driver for BizFly Cloud block storage	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion
CephFS	cephfs.csi.ceph.com	v0.3, >=v1.0.0	A Container Storage Interface (CSI) Driver for CephFS	Persistent	Read/Write Multiple Pods	Yes	Expansion, Snapshot, Cloning
Ceph RBD	rbd.csi.ceph.com	v0.3, >=v1.0.0	A Container Storage Interface (CSI) Driver for Ceph RBD	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion, Topology, Cloning, In-tree plugin migration
Cisco HyperFlex CSI	HX-CS1	v1.2	A Container Storage Interface (CSI) Driver for Cisco HyperFlex	Persistent	Read/Write Multiple Pods	Yes	Raw Block, Expansion, Cloning
ChubaoFS	csi.chubaofs.com	v1.0.0	A Container Storage Interface (CSI) Driver for ChubaoFS Storage	Persistent	Read/Write Multiple Pods	Yes	

Ref:<https://kubernetes-csi.github.io/docs/drivers.html>

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Persistent Volume

Cinder	cinder.csi.openstack.org	v0.3, v1.0, v1.1.0, v1.2.0, v1.3.0	A Container Storage Interface (CSI) Driver for OpenStack Cinder	Persistent and Ephemeral	Depends on the storage backend used	Yes, if storage backend supports it	Raw Block, Snapshot, Expansion, Cloning, Topology
cloudscale.ch	csi.cloudscale.ch	v1.0	A Container Storage Interface (CSI) Driver for the cloudscale.ch IaaS platform	Persistent	Read/Write Single Pod	Yes	Snapshot
Datom-InfinityCSI	csi-infiblock-plugin	v0.3, v1.0.0, v1.1.0	A Container Storage Interface (CSI) Driver for DATATOM Infinity storage	Persistent	Read/Write Single Pod	Yes	Raw Block, Snapshot, Expansion, Topology
Datom-InfinityCSI (filesystem)	csi-infifps-plugin	v0.3, v1.0.0, v1.1.0	A Container Storage Interface (CSI) Driver for DATATOM Infinity filesystem storage	Persistent	Read/Write Multiple Pods	Yes	Expansion
Datera	dsp.csi.daterainc.io	v1.0	A Container Storage Interface (CSI) Driver for Datera Data Services Platform (DSP)	Persistent	Read/Write Single Pod	Yes	Snapshot
DDN EXAScaler	exa.csi.ddn.com	v1.0, v1.1	A Container Storage Interface (CSI) Driver for DDN EXAScaler filesystems	Persistent	Read/Write Multiple Pods	Yes	Expansion

Ref:<https://kubernetes-csi.github.io/docs/drivers.html>

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Persistent Volume



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You can verify the creation of a new EBS Snapshot by navigating to the EC2 and then Volumes tab in the AWS Management console. You should see something like the following:

Create Snapshot		Actions	
Owned By Me	Filter by tags and attributes or search by keyword		
Name	Snapshot ID	Size	Description
snap-0ffbd0d77d59ef993	4 GiB	Created by AWS EBS CSI driver for volume vol-05fd72d6946bca299	Status: Started Completed: October 16, 2020 at 5:28:03

You can also verify the Volume Snapshot creation by executing the following command:

```
kubectl get volumesnapshot
```

You should see something similar to the below:

NAME	READYTOUSE	SOURCEPVC	SOURCESNAPSHOTCONTENT	RESTORESIZE	SNAPSHOTCLASS	SNAPSHOTCONTENT	CREATIONTIME	AGE
test-snapshot	true	ebs-claim		4Gi	test-snapshot-class	snapshotcontent-650e4531-89d0-407e-8fa9-25f81cc94885	2d3h	2d3h

Step 5: Create a persistent volume by restoring the Volume Snapshot

First, you need to create a Persistent Volume Claim (PVC) using the Volume Snapshot. Note that the claim this time is 20 GB in size.

Create a YAML file and Copy the YAML definition below in the `volume-from-snap.yaml` file.

```
YAML
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: pvc-restore
  namespace: default
spec:
  storageClassName: ebs-sc
  dataSource:
    name: test-snapshot
    kind: VolumeSnapshot
    apiGroup: snapshot.storage.k8s.io
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 20Gi
```

Ref:<https://aws.amazon.com/blogs/containers/using-ebs-snapshots-for-persistent-storage-with-your-eks-cluster/>

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Persistent Volume

- Type of Persistent Volume/Access Method

The screenshot shows the GitHub README page for the AWS EBS CSI driver. It includes sections for Overview, CSI Specification Compatibility Matrix, and Deploy driver. The Deploy driver section provides instructions for deployment via Kubernetes and Helm.

Amazon Elastic Block Store (EBS) CSI driver

Overview

The Amazon Elastic Block Store Container Storage Interface (CSI) Driver provides a CSI interface used by Container Orchestrators to manage the lifecycle of Amazon EBS volumes.

CSI Specification Compatibility Matrix

AWS EBS CSI Driver \ CSI Version	v0.3.0	v1.0.0	v1.1.0
master branch	no	no	yes
v0.4.0-v1.5.x	no	no	yes
v0.2.0-v0.3.0	no	yes	no
v0.1.0	yes	no	no

Deploy driver

Please see the compatibility matrix above before you deploy the driver

To deploy the CSI driver:

```
kubectl apply -k "github.com/kubernetes-sigs/aws-ebs-csi-driver/deploy/kubernetes/overlays/stable/?"
```

Verify driver is running:

```
kubectl get pods -n kube-system
```

Alternatively, you could also install the driver using helm:

Add the aws-ebs-csi-driver Helm repository:

```
helm repo add aws-ebs-csi-driver https://kubernetes-sigs.github.io/aws-ebs-csi-driver
helm repo update
```

Then install a release of the driver using the chart

```
helm upgrade --install aws-ebs-csi-driver \
--namespace kube-system \
aws-ebs-csi-driver/aws-ebs-csi-driver
```

Ref: <https://github.com/kubernetes-sigs/aws-ebs-csi-driver>



Persistent Volume

- Static Provision
- Persistent Volume

```
1  apiVersion: v1
2  kind: PersistentVolume
3  metadata:
4    name: nfs-share-pv
5    labels:
6      name: nfs-share-pv
7      owner: Praparn_L
8      version: "1.0"
9    module: PV
10   environment: development
11
12  spec:
13    capacity:
14      storage: 1Gi
15    storageClassName: ""
16    accessModes:
17      - ReadWriteMany
18    nfs:
19      server: 192.168.99.200
20      path: "/var/nfsshare"
```

Persistent Volume Claims

```
1  apiVersion: v1
2  kind: PersistentVolumeClaim
3  metadata:
4    name: nfs-share-pvc
5    labels:
6      name: nfs-share-pvc
7      owner: Praparn_L
8      version: "1.0"
9    module: PVC
10   environment: development
11
12  spec:
13    accessModes:
14      - ReadWriteMany
15    storageClassName: ""
16    resources:
17      requests:
18        storage: 500Mi
19    selector:
20      matchLabels:
21        name: nfs-share-pv
22        owner: Praparn_L
23        version: "1.0"
24        module: PV
25        environment: development
```

Persistent Volume

- Dynamic Provision
- Storage Class

```
1 kind: StorageClass
2 apiVersion: storage.k8s.io/v1
3 metadata:
4   name: ebs-sc
5 provisioner: ebs.csi.aws.com
6 parameters:
7   type: gp3
8   fsType: ext4
```

Persistent Volume Claims

```
1  apiVersion: v1
2  kind: PersistentVolumeClaim
3  metadata:
4    name: aws-ebs-pvc
5  spec:
6    accessModes:
7      - ReadWriteOnce
8    resources:
9      requests:
10        storage: 5Gi
11    storageClassName: ebs-sc
```



Persistent Volume

- Dynamic Provision
 - Test create SC/PVC

```
[ubuntu@ip-10-0-1-229:~$ kubectl apply -f ~/kubernetes_201904/WorkShop_2.7_Persistent_Storage/aws_sc.yml
storageclass.storage.k8s.io/aws-ebs created
[ubuntu@ip-10-0-1-229:~$ kubectl describe -f ~/kubernetes_201904/WorkShop_2.7_Persistent_Storage/aws_sc.yml
Name:           aws-ebs
IsDefaultClass: No
Annotations:    kubectl.kubernetes.io/last-applied-configuration={"apiVersion":"storage.k8s.io/v1","kind":"StorageClass","metadata":{"annotations":{},"name":"aws-ebs"},"parameters":{"fsType":"ext4","type":"gp2"},"provisioner":"kubernetes.io/aws-ebs"}
Provisioner:     kubernetes.io/aws-ebs
Parameters:     fsType=ext4,type=gp2
AllowVolumeExpansion: <unset>
MountOptions:   <none>
ReclaimPolicy: Delete
VolumeBindingMode: Immediate
Events:         <none>
[ubuntu@ip-10-0-1-229:~$ kubectl describe sc/aws-ebs
Name:           aws-ebs
IsDefaultClass: No
Annotations:    kubectl.kubernetes.io/last-applied-configuration={"apiVersion":"storage.k8s.io/v1","kind":"StorageClass","metadata":{"annotations":{},"name":"aws-ebs"},"parameters":{"fsType":"ext4","type":"gp2"},"provisioner":"kubernetes.io/aws-ebs"}
Provisioner:     kubernetes.io/aws-ebs
Parameters:     fsType=ext4,type=gp2
AllowVolumeExpansion: <unset>
MountOptions:   <none>
ReclaimPolicy: Delete
VolumeBindingMode: Immediate
Events:         <none>
[ubuntu@ip-10-0-1-229:~$ kubectl apply -f ~/kubernetes_201904/WorkShop_2.7_Persistent_Storage/aws_pvc.yml
persistentvolumeclaim/aws-ebs-pvc created
[ubuntu@ip-10-0-1-229:~$ kubectl get pvc
NAME      STATUS      VOLUME      CAPACITY   ACCESS MODES   STORAGECLASS   AGE
aws-ebs-pvc  Pending          aws-ebs      4s
[ubuntu@ip-10-0-1-229:~$ kubectl get pvc
NAME      STATUS      VOLUME      CAPACITY   ACCESS MODES   STORAGECLASS   AGE
aws-ebs-pvc  Bound      pvc-0a14702e-4268-11e9-9e8e-02d2fffaea91a  5Gi        RWO          aws-ebs      18s
[ubuntu@ip-10-0-1-229:~$ kubectl describe pvc
NAME: aws-ebs-pvc
Status: Pending
```



Persistent Volume

- Dynamic Provision
 - Test create SC/PVC

```
[ubuntu@ip-10-0-1-229:~$ kubectl get pv
NAME           CAPACITY   ACCESS MODES  RECLAIM POLICY  STATUS    CLAIM          STORAGECLASS  REASON  AGE
pvc-0a14702e-4268-11e9-9e8e-02d2ffaea91a  5Gi        RWO          Delete        Bound    default/aws-ebs-pvc  aws-ebs      26m
[ubuntu@ip-10-0-1-229:~$ kubectl get pvc
NAME      STATUS    VOLUME
aws-ebs-pvc  Bound    pvc-0a14702e-4268-11e9-9e8e-02d2ffaea91a
[ubuntu@ip-10-0-1-229:~$ ]
```

Name	Volume ID	Size	Type	IOPS	Snapshot	Created	Avg.
kubernetes-dynamic-pvc-0a14702e-4268-11e9-9e8e-02d2ffaea91a	vol-0be1ef23e8b209c0d	5 GiB	gp2	100		March 9, 2019 at 7:37:09 PM UTC+7	ap-southeast-1a
	vol-038c386...	30 GiB	gp2	100	snap-0f7083a4...	March 8, 2019 at 10:45:20 PM UTC+7	ap-southeast-1a



Persistent Volume

- Dynamic Provision

The screenshot shows the Kubernetes web interface with the following details:

Cluster sidebar: Namespaces, Nodes, Persistent Volumes, Roles, **Storage Classes** (selected), Namespace, default.

Storage Classes page header: Search bar, + CREATE, EDIT, DELETE.

aws-ebs Storage Class Details:

- Name: aws-ebs
- Annotations: `kubectl.kubernetes.io/last-applied-configuration`
- Creation Time: 2019-03-09T12:34 UTC
- Labels: -
- Provisioner: kubernetes.io/aws-ebs
- Parameters: `fsType: ext4`, `type: gp2`

Persistent Volumes table:

Name	Capacity	Access Modes	Reclaim Policy	Status	Claim	Storage Class	Reason	Age	⋮
<input checked="" type="checkbox"/> pvc-0a14702e-4...	5Gi	ReadWriteOnce	Delete	Bound	default/aws-ebs-...	aws-ebs	-	29 minutes	⋮



Persistent Volume

- Dynamic Provision

The screenshot shows two views in the Kubernetes dashboard:

Persistent Volumes View:

Name	Capacity	Access Modes	Reclaim Policy	Status	Claim	Storage Class	Reason	Age
pvc-0a14702e-4...	5Gi	ReadWriteOnce	Delete	Bound	default/aws-ebs-...	aws-ebs	-	30 minutes

Persistent Volume Claims View:

Name	Status	Volume	Capacity	Access Modes	Storage Class	Age
aws-ebs-pvc	Bound	pvc-0a14702e-4268-11e9-9e8e-02d2ffaea91a	5Gi	ReadWriteOnce	-	30 minutes



Persistent Volume

- Dynamic Provision

```
[ubuntu@ip-10-0-1-229:~$ kubectl get pv
NAME           CAPACITY   ACCESS MODES  RECLAIM POLICY  STATUS    CLAIM          STORAGECLASS  REASON  AGE
pvc-0a14702e-4268-11e9-9e8e-02d2ffa91a  5Gi        RWO         Delete        Bound     default/aws-ebs-pvc  aws-ebs      37m
[ubuntu@ip-10-0-1-229:~$ kubectl get pvc
NAME      STATUS    VOLUME                                     CAPACITY   ACCESS MODES  STORAGECLASS  AGE
aws-ebs-pvc  Bound    pvc-0a14702e-4268-11e9-9e8e-02d2ffa91a  5Gi        RWO         aws-ebs      37m
[ubuntu@ip-10-0-1-229:~$ kubectl delete -f ~/kubernetes_201904/WorkShop_2.7_Persistent_Storage/aws_pvc.yml
persistentvolumeclaim "aws-ebs-pvc" deleted
[ubuntu@ip-10-0-1-229:~$ kubectl get pv
No resources found.
[ubuntu@ip-10-0-1-229:~$ kubectl get pvc
No resources found.
[ubuntu@ip-10-0-1-229:~$ ]
```

EC2 Dashboard

Events

Tags

Reports

Limits

INSTANCES

Instances

Launch Templates

Spot Requests

Create Volume

Actions

Name : kubernetes-dynamic-pvc-0a14702e-4268-11... Add filter

Name	Volume ID	Size	Volume Type	IOPS
No Volumes found				

Select a volume above



Persistent Volume

- Deployment reference

```
1 apiVersion: apps/v1
2 kind: Deployment
3 metadata:
4   name: webtest
5   labels:
6     name: web
7     owner: Praparn_L
8     version: "1.0"
9     module: WebServer
10    environment: development
11
12  spec:
13    replicas: 1
14    selector:
15      matchLabels:
16        name: web
17        owner: "Praparn_L"
18        version: "1.0"
19        module: WebServer
20        environment: development
21
22    template:
23      metadata:
24        labels:
25          name: web
26          owner: Praparn_L
27          version: "1.0"
28          module: WebServer
29          environment: development
30
31      spec:
32        containers:
33          - name: webtest
34            image: labdocker/cluster:webservicelite_v1
35            ports:
36              - containerPort: 5000
37                protocol: TCP
38            volumeMounts:
39              - name: aws-share-pvc
40                mountPath: /usr/src/app
41            initContainers:
42              - name: download
43                image: labdocker/alpineweb:latest
44                volumeMounts:
45                  - name: aws-share-pvc
46                    mountPath: /source
47                command:
48                  - wget
49                  - "-O"
50                  - "/source/mainlite.py"
51                  - "https://raw.githubusercontent.com/praparn/kubernetes\_201904/master/WorkShop\_2.7\_Persistent\_Storage/mainlite.py"
52
53      volumes:
54        - name: aws-share-pvc
55          persistentVolumeClaim:
56            claimName: aws-ebs-pvc
```



Run iniContainers Process



Reference for mount disk volume from "PVC"



Persistent Volume

- Dynamic Provision on Deployment

```
[ubuntu@ip-10-0-1-229:~$ kubectl create -f https://raw.githubusercontent.com/praparn/kubernetes_201904/master/WorkShop_2.7_Persistent_Storage/aws_webtest_deployall.yaml
deployment.apps/webtest created
[ubuntu@ip-10-0-1-229:~$ kubectl create -f https://raw.githubusercontent.com/praparn/kubernetes_201904/master/WorkShop_2.7_Persistent_Storage/aws_webtest_svc.yaml
service/webtest created
[ubuntu@ip-10-0-1-229:~$ kubectl get deployment
NAME      READY   UP-TO-DATE   AVAILABLE   AGE
webtest   1/1     1           1           13s
[ubuntu@ip-10-0-1-229:~$ kubectl get pods
NAME                  READY   STATUS    RESTARTS   AGE
webtest-6f4bdd5f6b-kj4jn   1/1     Running   0          18s
[ubuntu@ip-10-0-1-229:~$ kubectl describe pods/webtest-6f4bdd5f6b-kj4jn
Name:           webtest-6f4bdd5f6b-kj4jn
Namespace:      default
Priority:       0
PriorityClassName: <none>
Node:          ip-10-0-1-165.ap-southeast-1.compute.internal/10.0.1.165
Start Time:    Sat, 09 Mar 2019 16:05:40 +0000
Labels:         environment=development
                module=WebServer
                name=web
                owner=Praparn_L
                pod-template-hash=6f4bdd5f6b
                version=1.0
Annotations:   cni.projectcalico.org/podIP: 192.168.1.40/32
Status:        Running
IP:           192.168.1.40
Controlled By: ReplicaSet/webtest-6f4bdd5f6b
```

Events:				
Type	Reason	Age	From	Message
Normal	Scheduled	28s	default-scheduler	Successfully assigned default/webtest-6f4bdd5f6b-kj4jn to ip-10-0-1-165.ap-southeast-1.compute.internal
Normal	SuccessfulAttachVolume	27s	attachdetach-controller	AttachVolume.Attach succeeded for volume "pvc-e7988ede-4284-11e9-9e8e-02d2ffaea91a"
Normal	Pulling	23s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	pulling image "labdocker/alpineweb:latest"
Normal	Pulled	19s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Successfully pulled image "labdocker/alpineweb:latest"
Normal	Created	19s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Created container
Normal	Started	19s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Started container
Normal	Pulled	18s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Container image "labdocker/cluster:webservicelite_v1" already present on machine
Normal	Created	18s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Created container
Normal	Started	18s	kubelet, ip-10-0-1-165.ap-southeast-1.compute.internal	Started container

Persistent Volume

A screenshot of a web browser window. The title bar shows various icons and links: kube, Create, Linu, doc, EC2, prep, Sett, QUI, High, and M. The address bar displays a URL: Not Secure | 18.136.102.184:32500. Below the address bar, a message says "Click to go back, hold to see history". The main content area features a large, bold heading: "Welcome Page from Container Python Lab". Below the heading, a timestamp is shown: "Checkpoint Date/Time: Sat Mar 9 16:08:09 2019".

Kubernetes: Production Workload Orchestration



kubernetes
by Google

Persistent Volume

```
...-0-1-77: ~ -- bash | ...orker-1: ~ -- bash | ...-219-46: ~ -- bash
[ubuntu@ip-10-0-1-229:~]$ kubectl get pods
NAME           READY   STATUS    RESTARTS   AGE
webtest-6f4bdd5f6b-kj4jn   1/1     Running   0          2m51s
[ubuntu@ip-10-0-1-229:~]$ kubectl exec -it webtest-6f4bdd5f6b-kj4jn sh
[/usr/src/app # vi mainlite.py
/usr/src/app #
```

```
from flask import Flask
import os
import time
app = Flask(__name__)

@app.route('/')
def hello():
    return '<H1>TEST EDIT Welcome Page from Container Python Lab </H1>Checkpoint Date/Time: ' + time.strftime("%c") +'\n'

if __name__ == "__main__":
    app.run(host="0.0.0.0", port=5000, debug=True)
~
```

← → ⌂ ⓘ Not Secure | 18.136.102.184:32500

apps NMac Ked - Mac ... M Medium _Infra_ NOVA _jenkins_ vagrant Mesos Vue do

TEST EDIT Welcome Page from Container Python Lab

Checkpoint Date/Time: Sat Mar 9 16:10:42 2019



Persistent Volume

- Create Deployment

Cluster

- Namespaces
- Nodes
- Persistent Volumes
- Roles
- Storage Classes

Namespaces

- default

Overview

Workloads

- Cron Jobs
- Daemon Sets
- Deployments
- Jobs
- Pods**
- Replica Sets
- Replication Controllers
- Stateful Sets

Discovery and Load Balancing

- Ingresses
- Services

Config and Storage

- Config Maps

Details

Name:	webtest-6f4bdd5f6b-kj4jn	Network
Namespace:	default	Node:
Labels:	environment: development module: WebServer name: web owner: Paparn_L pod-template-hash: 6f4bdd5f6b	IP:
Annotations:	cni.projectcalico.org/podIP: 192.168.1.40/32	192.168.1.40
Creation Time:	2019-03-09T16:05 UTC	
Status:	Running	
QoS Class:	BestEffort	

Containers

Container	Image	Environment variables	Commands	Args
webtest	labdocker/cluster:webservicelite_v1	-	-	-
download	labdocker/alpineweb:latest	-	wget -O /source/mainlite.py https://raw.githubusercontent.com/praparn/kubernetes_201904/master/WorkShop_2.7_Persistent_Storage/mainlite.py	-

Init Containers

Container	Image	Environment variables	Commands	Args
		-	-	-



Persistent Volume

- Create Deployment

Kubernetes dashboard interface showing the details of a Pod named `webtest-6f4bdd5f6b-kj4jn`.

Pod Details:

Field	Value
name	web
owner	Paparn_L
pod-template-hash	6f4bdd5f6b

Events:

Message	Source	Sub-object	Count	First seen	Last seen
Successfully assigned default/webtest-6f4bdd5f6b-kj4jn to ip-10-0-1-165.ap-southeast-1.compute.internal	default-scheduler	-	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
AttachVolume.Attach succeeded for volume "pvc-e7988ede-4284-11e9-9e8e-02d2ffaea91a"	attachdetach-controller	-	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
pulling image "labdocker/alpineweb:latest"	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers(download)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Successfully pulled image "labdocker/alpineweb:latest"	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers(download)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Created container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers(download)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Started container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers(download)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Container image "labdocker/cluster:webserviceelite_v1" already present on machine	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers(webtest)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Created container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers(webtest)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Started container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers(webtest)	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC

Persistent Volume Claims:

Name	Status	Volume	Capacity	Access Modes	Storage Class	Age
aws-ebs-pvc	Bound	pvc-e7988ede-4284-11e9-9e8e-02d2ffaea91a	5Gi	ReadWriteOnce	-	9 minutes



Workshop: Persistence Storage

 kubernetes

Search

+ CREATE | 

☰ Workloads > Pods > webtest-6f4bdd5f6b-kj4jn

Cluster Namespaces Nodes Persistent Volumes Roles Storage Classes

Namespace default

Overview Workloads Cron Jobs Daemon Sets Deployments Jobs Pods Replica Sets Replication Controllers Stateful Sets Discovery and Load Balancing Ingresses Services

Config and Storage Config Maps Persistent Volume Claims Secrets

replicaset name: web owner: Paparn_L 1 / 1 7 minutes labdocker/cluster:webserviceclit... :

Events

Message	Source	Sub-object	Count	First seen	Last seen
Successfully assigned default/webtest-6f4bdd5f6b-kj4jn to ip-10-0-1-165.ap-southeast-1.compute.internal	default-scheduler	-	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
AttachVolume.Attach succeeded for volume "pvc-e7988ede-4284-11e9-9e8e-02d2ffaea91a"	attachdetach-controller	-	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
pulling image "labdocker/alpineweb.latest"	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers{download}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Successfully pulled image "labdocker/alpineweb.latest"	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers{download}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Created container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers{download}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Started container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.initContainers{download}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Container image "labdocker/cluster:webserviceclite_v1" already present on machine	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers{webtest}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Created container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers{webtest}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC
Started container	kubelet ip-10-0-1-165.ap-southeast-1.compute.internal	spec.containers{webtest}	1	2019-03-09T16:05 UTC	2019-03-09T16:05 UTC

Persistent Volume Claims

Name	Status	Volume	Capacity	Access Modes	Storage Class	Age
aws-ebs-pvc	Bound	pvc-e7988ede-4284-11e9-9e8e-02d2ffaea91a	5Gi	ReadWriteOnce	-	9 minutes



StatefulSet



Kubernetes: Production Workload Orchestration

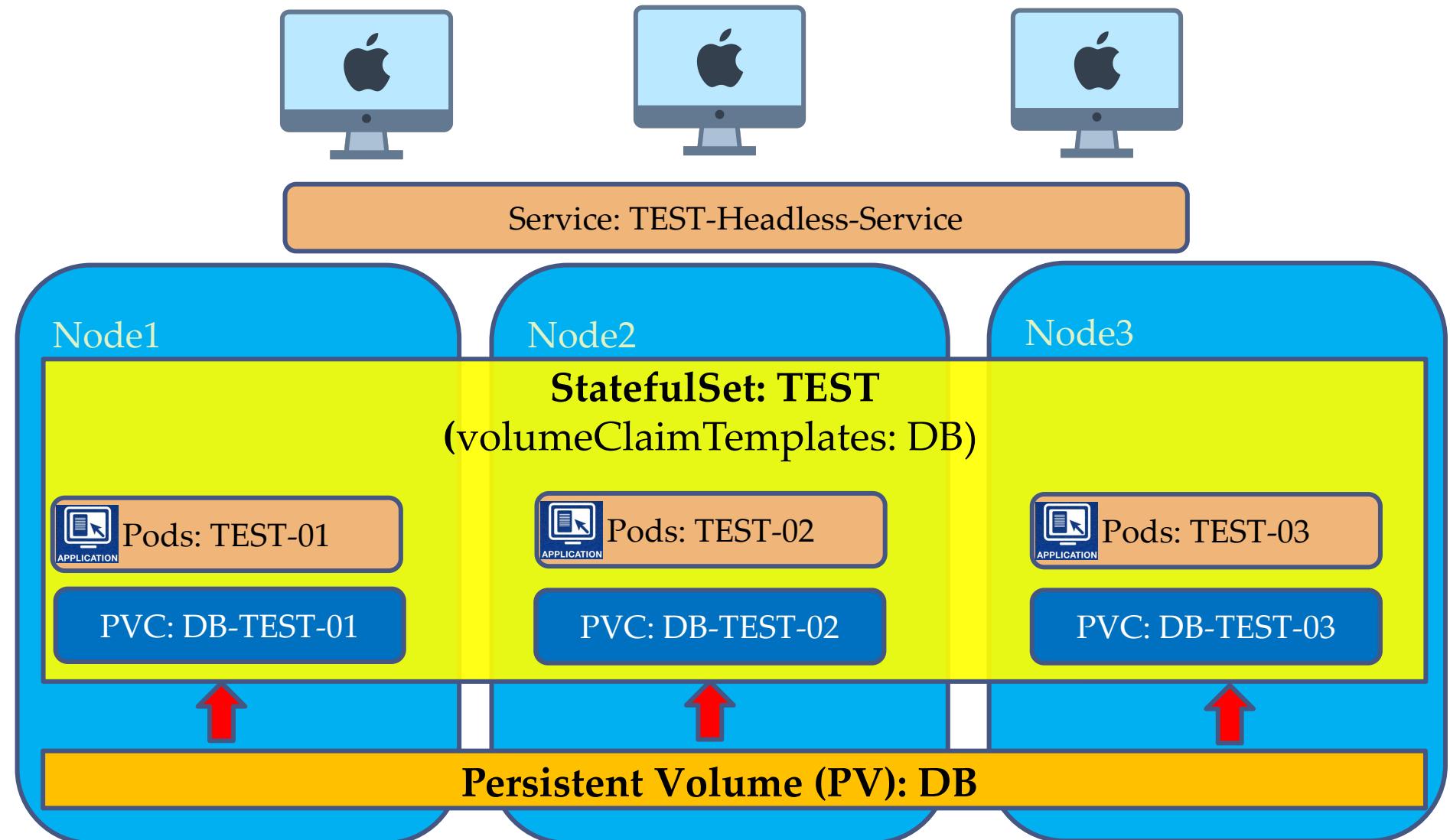


kubernetes
by Google

StatefulSet

- What is StatefulSet?
 - Do you remember Deployment ?
 - StatefulSet similar with Deployment
 - But StatefulSet is design for applicate that need
 - Persistent Storage
 - Stable Storage/Stable Network
 - Ordered for
 - Deployment (Create)
 - Scale
 - Roll Update
- Benefit from StatefulSet
 - Sequential create/scale/update Pods
 - Each Pods got unique resource
 - Name of Pods
 - Storage on Pods (Dedicate PVC)
 - Exist on Hosts/Network

StatefulSet



StatefulSet

- StatefulSet

```
16 apiVersion: apps/v1beta2
17 kind: StatefulSet
18 metadata:
19   name: TEST
20 spec:
21   serviceName: "TEST"
22   replicas: 3
23   selector:
24     matchLabels:
25       app: nginx
26   template:
27     metadata:
28       labels:
29         app: nginx
30     spec:
31       containers:
32         - name: nginx
33           image: labdocker/nginx:latest
34           ports:
35             - containerPort: 80
36               name: web
37               volumeMounts:
38                 - name: DB
39                   mountPath: /usr/share/nginx/html
40   volumeClaimTemplates:
41     - metadata:
42       name: DB
43       spec:
44         accessModes: [ "ReadWriteOnce" ]
45         resources:
46           requests:
47             storage: 1Gi
```

Service

```
2  apiVersion: v1
3  kind: Service
4  metadata:
5   name: TEST
6   labels:
7     app: TEST
8   spec:
9     ports:
10      - port: 80
11        name: TEST
12        clusterIP: None
13        selector:
14          app: nginx
```



Recapture Day 2

- Fundamental of Kubernetes
 - Job and CronJob
 - Log and Monitoring
- Ingress Networking
- Security on Kubernetes
 - Network Policy
 - Volume Policy
 - Resource Usage Policy
 - Resource Consumption Policy
 - Access Control Policy
 - Security Policy
- Kubernetes in real world
 - Cluster Setup for Bare Metal
 - Orchestrator Assignment
 - nodeSelector
 - Interlude
 - Affinity
 - Taints/Tolerations
- Stateful application deployment
 - Consideration and Awareness
 - Persistent Volumes
 - StatefulSets



WORKSHOP ADVANCED DOCKER



สอนการ deploy Dockers ด้วย Kubernetes
จากประสบการณ์ใช้งานจริงบน Production ของ
application ระดับประเทศ



วิทยากร : คุณ PRAPARN LUNGPOONLARP
INFRASTRUCTURE ENGINEER, NETWORK ENGINEER,
SYSTEM ENGINEER



kubernetes

