Kubernetes basics

Discussed topics

- Containers orchestration
- Kubernetes
- Kubernetes architecture components
- Pods
- Pod basic commands
- Deployments
- Namespaces
- Labels & filtering
- Daemonsets, Jobs & CronJobs
- Services

Containers orchestration

Containers

In order to follow this presentation, **basic** understanding of **containers** and docker usage is required.

If this kind of knowledge is missing, the reader is invited to **first**, check the containers presentation **before** proceeding any further.

Containers limits

When working with containers multiple limits can be observed:

- What happens if the host machine is **unstable** ?
- What happens if the containers use **all** of the available **cpu** or **memory** ?
- Which machine is **best suited** to run the containers ?
- What if one container is no longer enough to handle the **load** ?
- What is responsible for restarting an **unhealthy** container ?
- What is an **unhealthy** container ?
- How to **access** a given service in a container ?
- How to define **communication rules** between containers ?

Containers orchestration

Containers **orchestration** is the **automated** management of the **operational** loads related to running **containers**.

Examples of what this operational load includes:

- Scheduling
- Scaling
- Health monitoring
- Network access

Kubernetes

Kubernetes

Kubernetes is the most popular container orchestration system.

Kubernetes is open-source & each public cloud providers offers his own managed service:

- GCP: Google Kubernetes Engine (GKE & GKE autopilot)
- AWS: Elastic Kubernetes Service (EKS)
- Microsoft Azure: Azure Kubernetes Service (AKS)

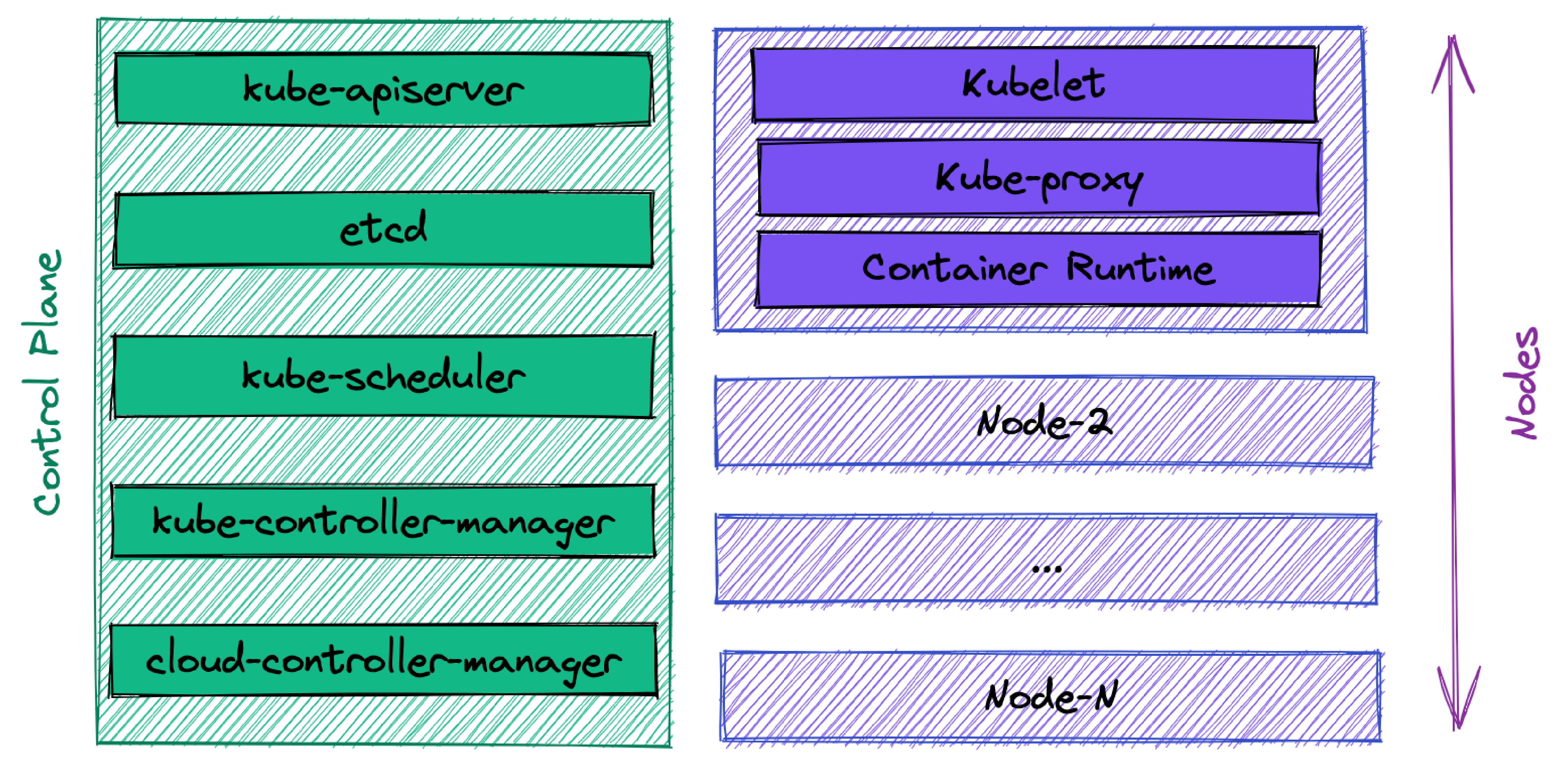
Kubernetes features

Some of kubernetes basic features are:

- Running containers on a cluster (multiple machines connected by network)
- Containers health monitoring & auto recovery
- Node health monitoring & container re-scheduling
- Service discovery

Kubernetes architecture

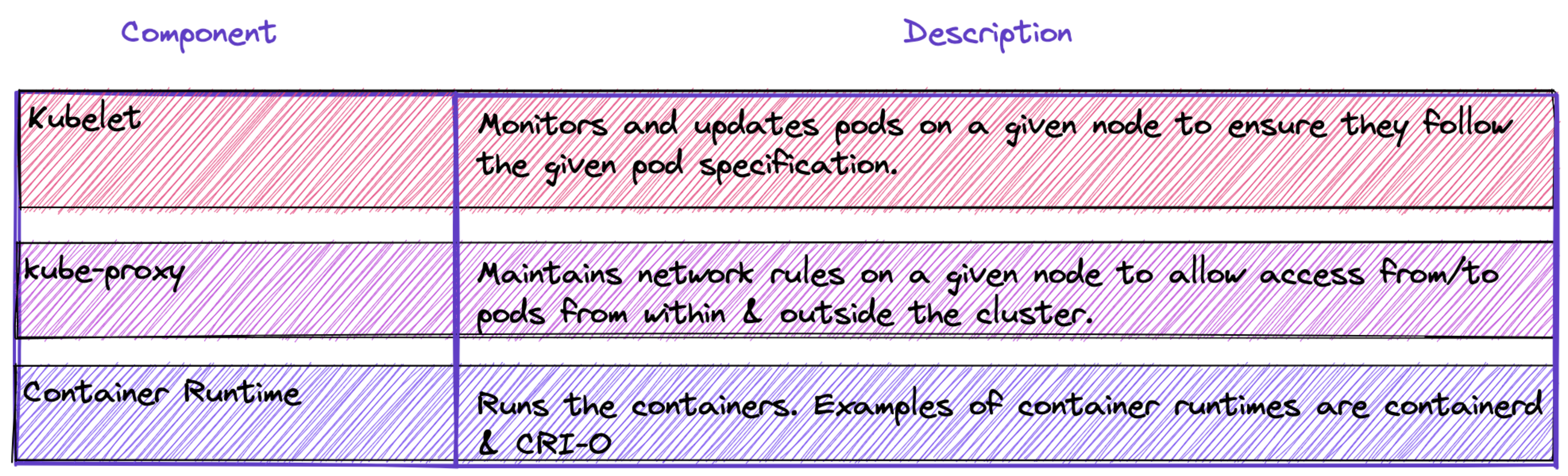
Kubernetes components (1/3)



Kubernetes components (2/3)

Component	Description
kube-apiserver	API: CRUD operations on kubernetes objects
etcd	Database: Key/value store to hold cluster data
kube-scheduler	Scheduler: responsible for scheduling pods & assigning them to nodes
kube-controller-manager	Controller aggregation: -> Nodes: supervise nodes for availability -> Endpoints: handles endpoints -> ...
cloud-controller-manager	Controller: responsible for interactions with cloud APIs -> Request an additional disk -> Reduce the number of machines -> ...

Kubernetes components (3/3)



Component	Description
Kubelet	Monitors and updates pods on a given node to ensure they follow the given pod specification.
kube-proxy	Maintains network rules on a given node to allow access from/to pods from within & outside the cluster.
Container Runtime	Runs the containers. Examples of container runtimes are containerd & CRI-O

Pods

Pods

Pods are units containing one or multiple **containers**.

Pods are **kubernetes objects** that are created by calling the kubernetes API.

Pods follow the structure below:

```yaml
apiVersion: v1
kind: Pod
metadata:
  # ... ignored for now
  name: nginx # Pod name
spec:
  containers:
  - image: nginx:stable # Container image
    name: nginx # Container name
  # ... ignored for now
```

Running a simple Pod

In order to run a simple **pod** we can do the following:

```
$ cat hands-on/yaml-samples/pod.yaml
apiVersion: v1
kind: Pod
metadata:
  name: nginx-from-yaml
spec:
  containers:
  - image: nginx:stable
    name: nginx-from-yaml
$ kubectl apply -f hands-on/yaml-samples/pod.yaml
pod/nginx-from-yaml created
```

In docker, this would have been equivalent to:

```
$ docker run -d -it nginx:stable
```

Pod basic commands

Please proceed to **hands-on** pod-basic-commands.md.

Deployments

Deployments can be viewed as **managed pods**.

In order to better understand deployments, please proceed to **hands-on** pods-vs-deployments.md.

Namespaces

```
$ k explain namespaces
#...
Namespace provides a scope for Names. Use of multiple namespaces is optional
```

- Namespaces provide a **context** in a kubernetes environment.
- Namespaces help **isolate** objects.

Use cases

- Namespaces can split a **single** physical kubernetes cluster into **multiple** logical clusters.
    - a namespace for dev and another one for staging on the same cluster.
    - a namespace for each team on a shared cluster.
- Each namespace can be **accessed** by a **different** group of **individuals** (IAM)
- Each namespace can be **assigned** a **different** set of **resources** (CPU/RAM)
- **Communication** between pods in different namespaces can be **blocked** or **enabled**.

In order to better understand namespaces, please proceed to **hands-on** namespaces.md.

Labels & filtering

Labels

```
$ k explain pod.metadata.labels
#...
Map of string keys and values that can be used to organize and categorize (scope and select) objects
```

- Labels can be assigned to all **kubernetes objects**
- Labels enable **filtering** kubernetes objects based on a **key** and a **value**

In order to better understand labels, please proceed to **hands-on** labels.md.