Kubernetes at war on Azure

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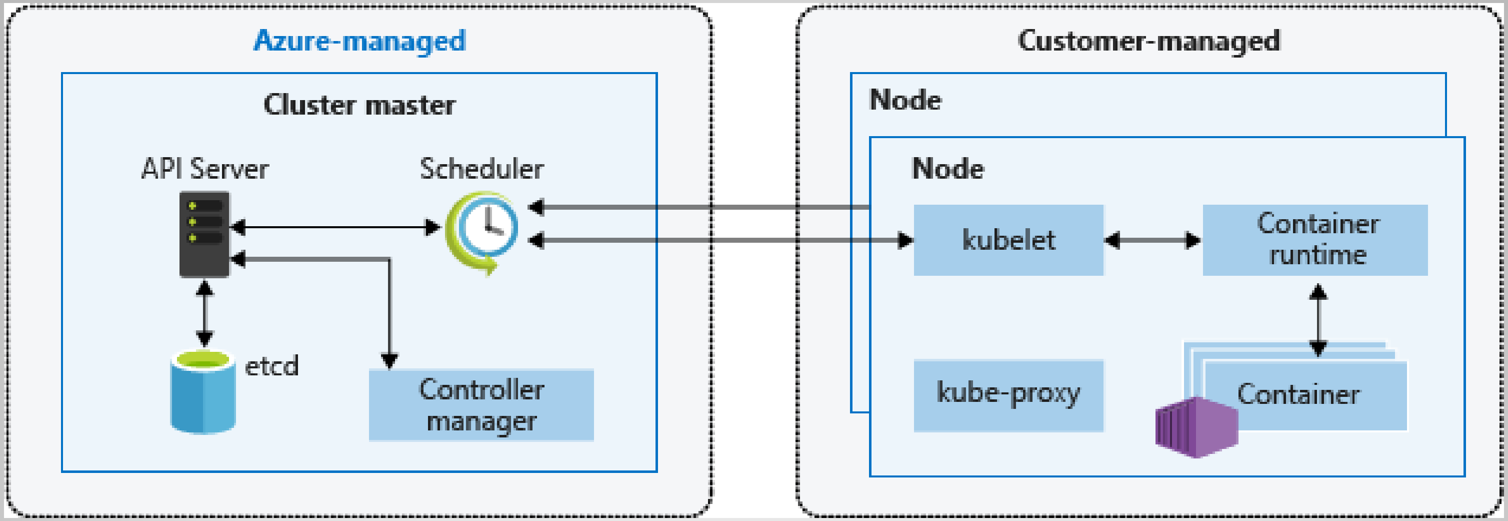
About me…

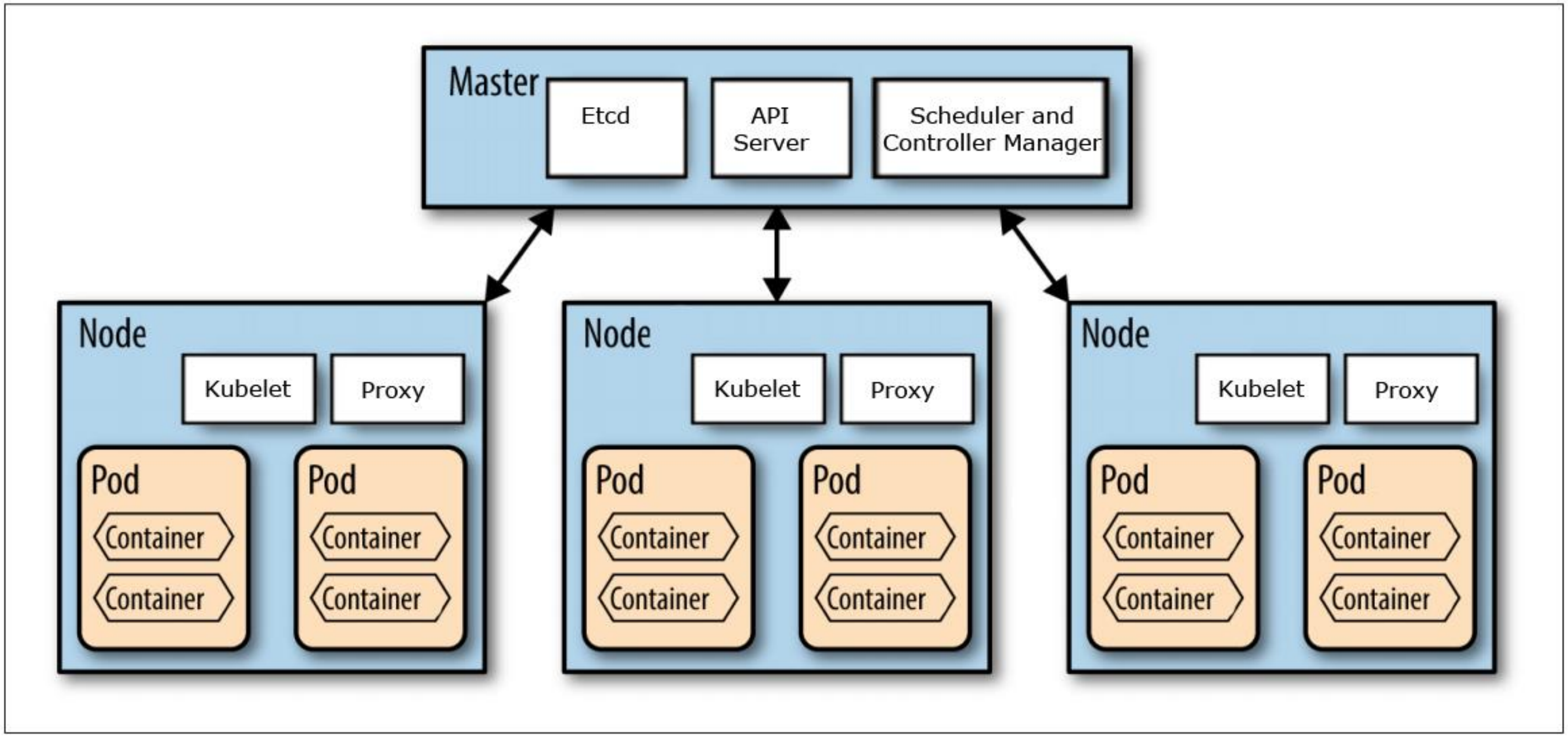
- https://www.youtube.com/watch?v=PH-2FfFD2PU

Cluster master nodes provide the core Kubernetes services and orchestration of application workloads.

Nodes run your application workloads.



Kubernetes in 5 minutes



Kubernetes in 5 minutes

Kubernetes limits

At v1.16, Kubernetes supports clusters with up to 5000 nodes. More specifically, we support configurations that meet *all* of the following criteria:

No more than 5000 nodes

No more than 150000 total pods

No more than 300000 total containers

No more than 100 pods per node

https://kubernetes.io/docs/setup/best-practices/cluster-large/

Limits, requests

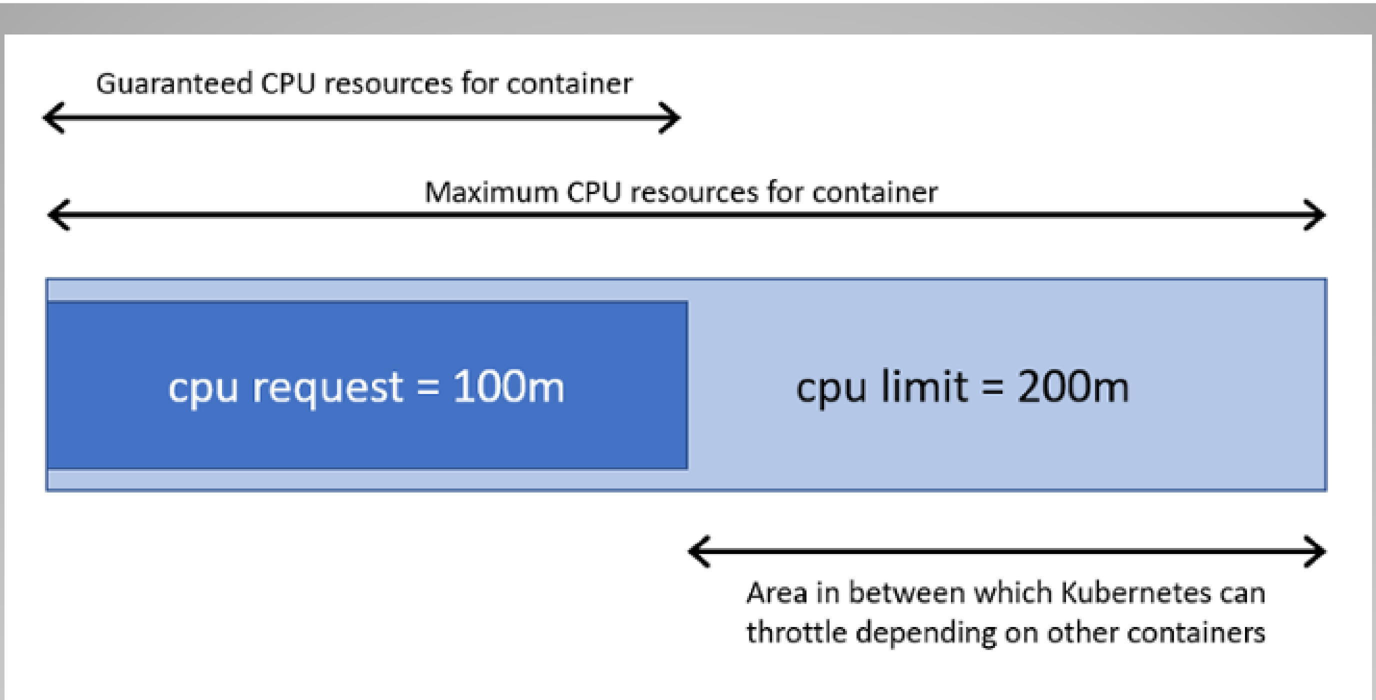
- Kubernetes employs requests and limits to control resources. Requests are guaranteed resources that a container is entitled to use. Limits, on the other hand, are the maximum resources or threshold a container can use.
- After reaching the limits, containers will be restricted. If a container requests a resource, Kubernetes will only schedule it on an available node that can provide those resources. These resources and limit are defined in the standard YAML configuration of your containers.
- In Kubernetes, there are two types of resources: CPU and Memory. CPU is measured in core units, and memory is specified in bytes.

CPU

- CPU resources are measured in millicore. If a node has 2 cores, the node’s CPU capacity would be represented as 2000m. The unit suffix m stands for “thousandth of a core.”
- 1000m or 1000 millicore is equal to 1 core. 4000m would represent 4 cores. 250 millicore per pod means 4 pods with a similar value of 250m can run on a single core. On a 4 core node, 16 pods each having 250m can run on that node.

Memory

- Memory is measured in bytes. However, you can express memory with various suffixes (E,P,T,G,M,K and Ei, Pi, Ti, Gi, Mi, Ki) to express mebibytes (Mi) to petabytes (Pi). **Most simply use Mi**.
- Like CPU, pods will never be scheduled if they require more resources than the capacity of a node. Unlike CPU, memory is not compressible. You can’t make memory run slower or faster like CPU or network throttling. Pods will be terminated if it reaches the memory limit.


Guaranteed CPU resources for container
Maximum CPU resources for container
cpu request = 100m
cpu limit = 200m
Area in between which Kubernetes can throttle depending on other containers

https://jaxenter.com/manage-container-resource-kubernetes-141977.html

https://vincentlauzon.com/2019/04/02/requests-vs-limits-in-kubernetes/

Limits, requests

Container limits

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: pod-quota-1
spec:
  containers:
  - name: pod-quota-1
    image: nginx
```

```yaml
apiVersion: v1
kind: Pod
metadata:
  name: pod-quota-2
spec:
  containers:
  - name: pod-quota-2
    image: redis
    resources:
      limits:
        memory: "1Gi"
        cpu: "800m"
      requests:
        memory: "700Mi"
        cpu: "400m"
```

Namespaces

- Beyond the individual container resources, you may want to investigate setting limits on namespaces. So what is a namespace? Namespaces can be used to define a cluster of applications, departments, or environments. Simply, Namespace refers to scope or grouping of objects in a Kubernetes cluster
- At the Namespace level, you can set up ResourceQuotas and LimitRanges.

Resource quota

```
apiVersion: v1
kind: ResourceQuota
metadata:
  name: compute-resources
spec:
  hard:
    pods: "20"
    requests.cpu: "1"
    requests.memory: 1Gi
    limits.cpu: "2"
    limits.memory: 2Gi
    requests.nvidia.com/gpu: 3
```

https://github.com/djkormo/k8s-AKS-primer/tree/master/examples/quotas

Limit range

```
apiVersion: v1
kind: LimitRange
metadata:
  name: limit-mem-cpu-per-container
spec:
  limits:
  - max:
      cpu: "800m"
      memory: "1Gi"
    min:
      cpu: "50m"
      memory: "50Mi"
    default:
      cpu: "200m"
      memory: "200Mi"
    defaultRequest:
      cpu: "100m"
      memory: "100Mi"
    type: Container
```

DEMO

Resources quota/limit range

Resource quotas

```yaml
apiVersion: v1
kind: ResourceQuota
metadata:
  name: compute-resources
spec:
  hard:
    pods: "20"
    requests.cpu: "1"
    requests.memory: 1Gi
    limits.cpu: "2"
    limits.memory: 2Gi
    requests.nvidia.com/gpu: 3
```

Nodes limits

- kubectl describe node
- kubectl top nodes
- kubectl top pods --all-namespaces

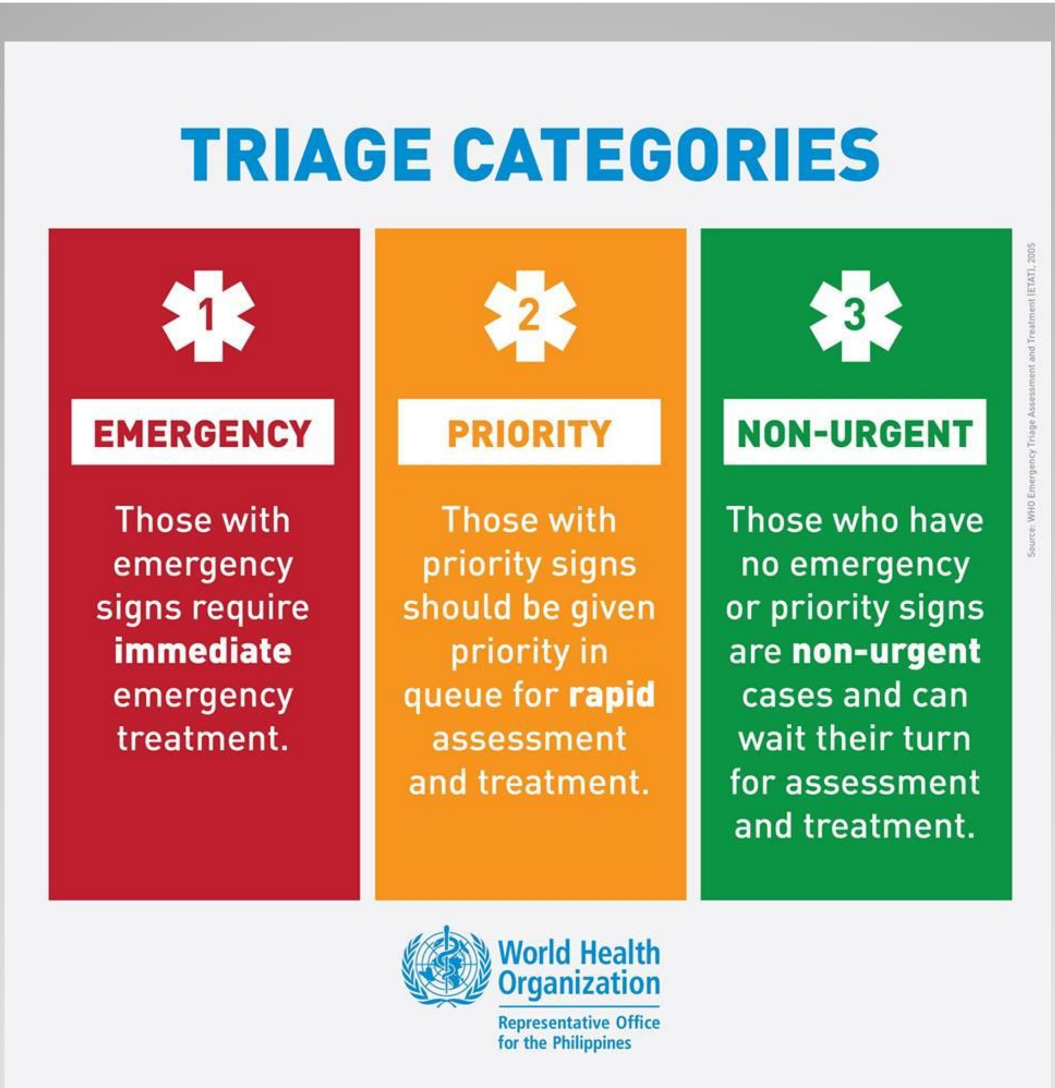
Node limits

https://github.com/Azure/aks-engine/blob/master/docs/topics/clusterdefinitions.md

"--max-pods"	"30", or "110" if using kubenet --network-plugin (i.e., "networkPlugin": "kubenet")

"--node-monitor-grace-period"	"40s"
"--pod-eviction-timeout"	"5m0s"

Triage



TRIAGE CATEGORIES

1 EMERGENCY

Those with emergency signs require **immediate** emergency treatment.

2 PRIORITY

Those with priority signs should be given priority in queue for **rapid** assessment and treatment.

3 NON-URGENT

Those who have no emergency or priority signs are **non-urgent** cases and can wait their turn for assessment and treatment.

World Health Organization
Representative Office
for the Philippines

Source: WHO Emergency Triage Assessment and Treatment (ETAT), 2005

Scheduler and QoS

QoS (Quality of Service) Classes

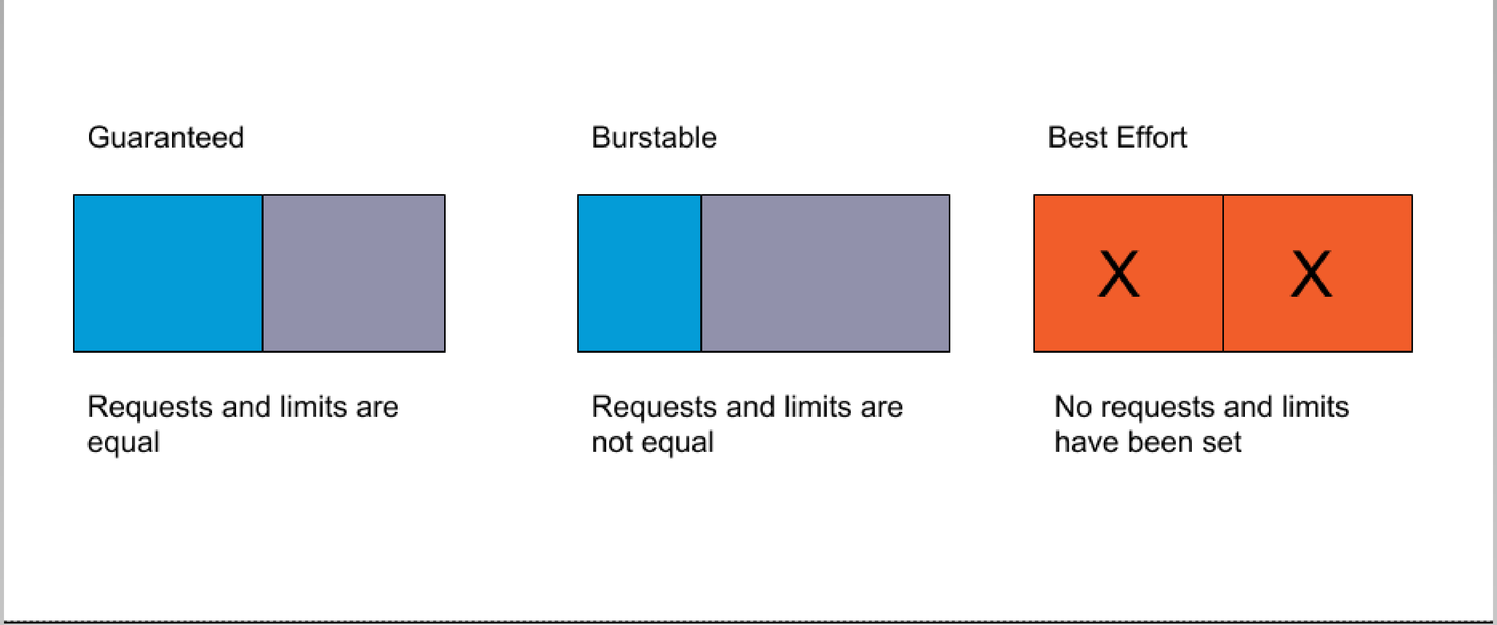
When Kubernetes creates a pod, it assigns one of these three QoS classes:

Guaranteed

Burstable

BestEffort

Quality of Service (QoS)



Guaranteed

Requests and limits are equal

Burstable

Requests and limits are not equal

Best Effort

No requests and limits have been set

https://www.weave.works/blog/kubernetes-pod-resource-limitations-and-quality-of-service

Guaranteed QoS

For a Pod to be given a QoS class of Guaranteed:

Every Container in the Pod must have a memory limit and a memory request, and they must be the same.

Every Container in the Pod must have a CPU limit and a CPU request, and they must be the same.

```
resources:
    limits:
      memory: "200Mi"
      cpu: "700m"
    requests:
      memory: "200Mi"
      cpu: "700m"
```

https://kubernetes.io/docs/tasks/configure-pod-container/quality-service-pod/#create-a-pod-that-gets-assigned-a-qos-class-of-guaranteed

Burstable QoS

Burstable class have two conditions:

They don’t meet the QoS guaranteed criteria.

They have at least one memory or CPU request.

BestEffort QoS

BestEffort is a container with no memory or CPU limits or requests. If you’ve never defined any resources before reading this, your pod is by default running in BestEffort.

Simply, BestEffort is when you don’t set anything at all.

- For production workloads, BestEffort is not recommended. Keep in mind, these containers will be killed first. Burstable is suitable for most generic workloads. For sensitive applications that may have spikes or anything that runs in a stateful set like databases, it is recommended to apply a QoS guaranteed class.

Quality of Service Best Practices

Node Failure

This is the workflow of what happens when a node gets down:

1- The Kubelet posts its status to the masters using ***–node-status-update-frequency=10s***

2- A node dies

3- The kube controller manager is the one monitoring the nodes, using ***--node-monitor-period=5s*** it checks, in the masters, the node status reported by the Kubelet.

4- Kube controller manager will see the node is unresponsive, and has this grace period ***–node-monitor-grace-period=40s*** until it considers the node unhealthy. This parameter must be N times ***node-status-update-frequency*** being N the number of retries allowed for the Kubelet to post node status. N is a constant in the code equals to **5**

Failure

DEMO

https://github.com/djkormo/k8s-AKS-primer/tree/master/examples/failure