
KubeCon
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BUILDING FOR THE ROAD AHEAD
DETROIT 2022

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BUILDING FOR THE ROAD AHEAD

DETROIT 2022

SIG Autoscaling

Updates and Feature Highlights

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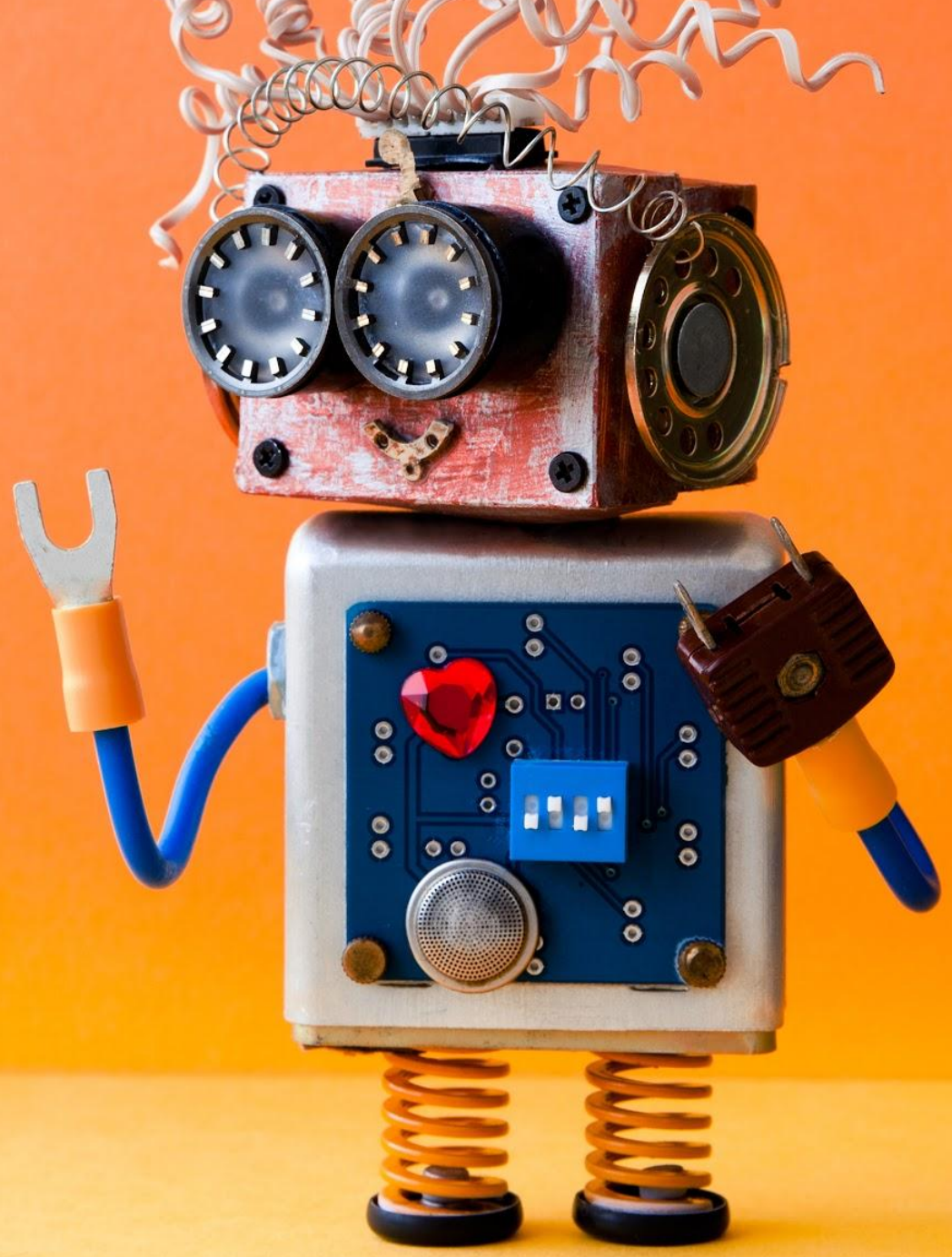
Diego Bonfigli

What is
SIG-Autoscaling

Owned
Components

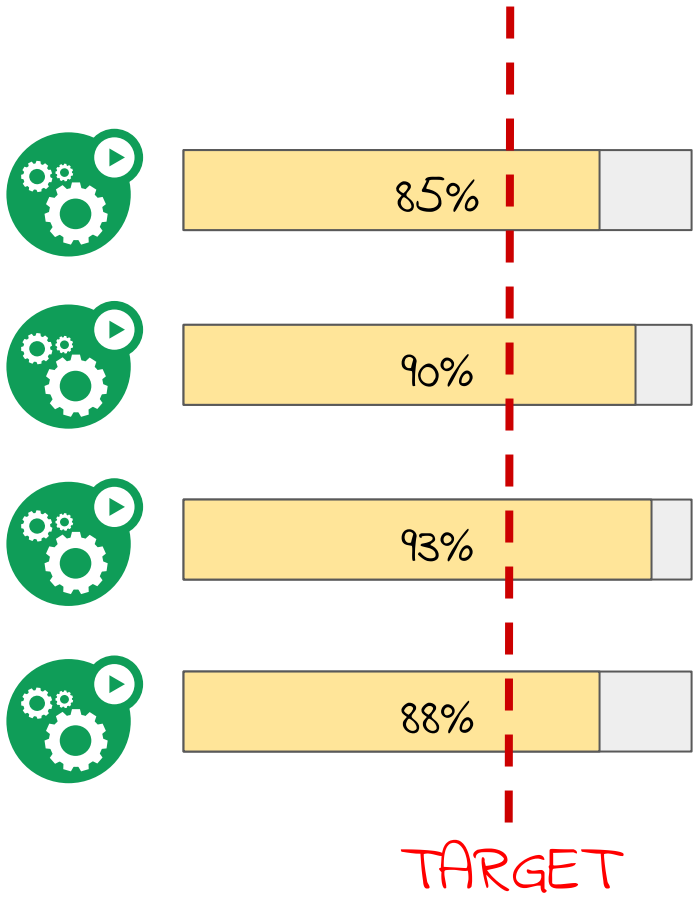
Horizontal Pod Autoscaler



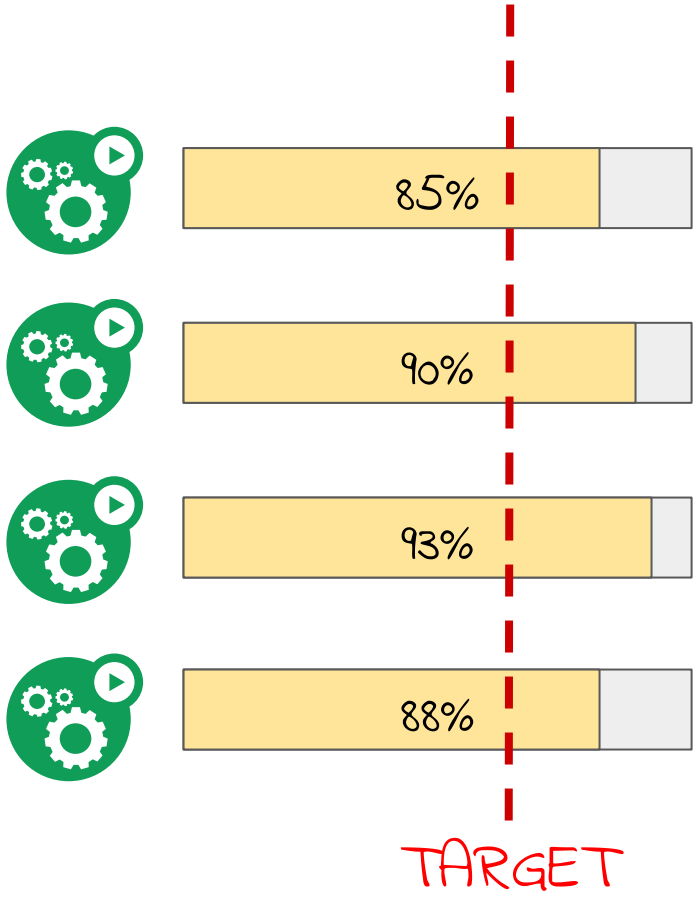
Horizontal Pod Autoscaler

- Based on load-like metrics
  - CPU usage
  - Custom metrics like:
    - Query per second
    - Queue length

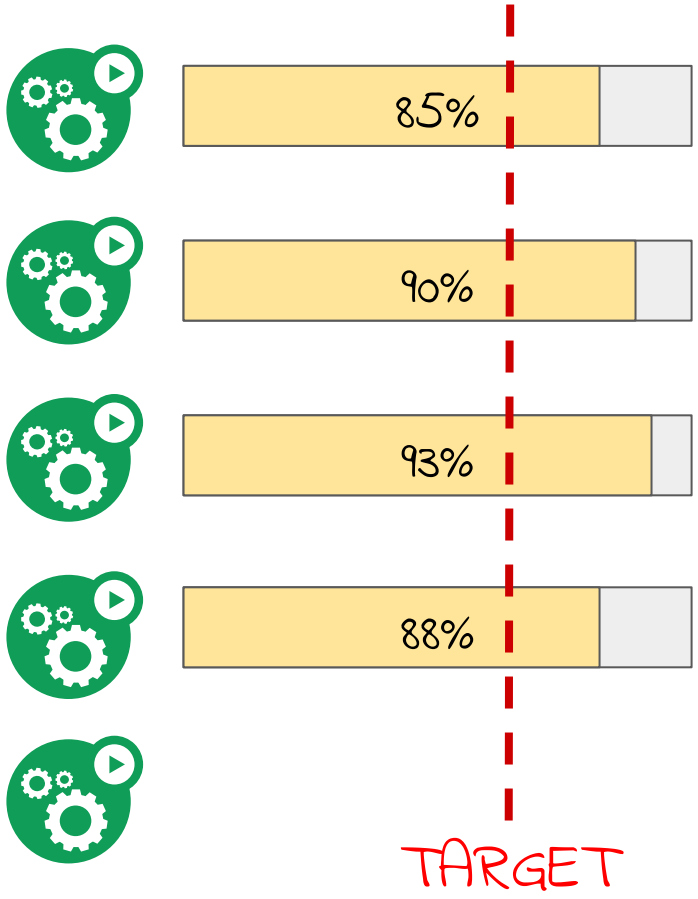
- Adds and removes pod replicas to keep per pod load close to the desired target value.



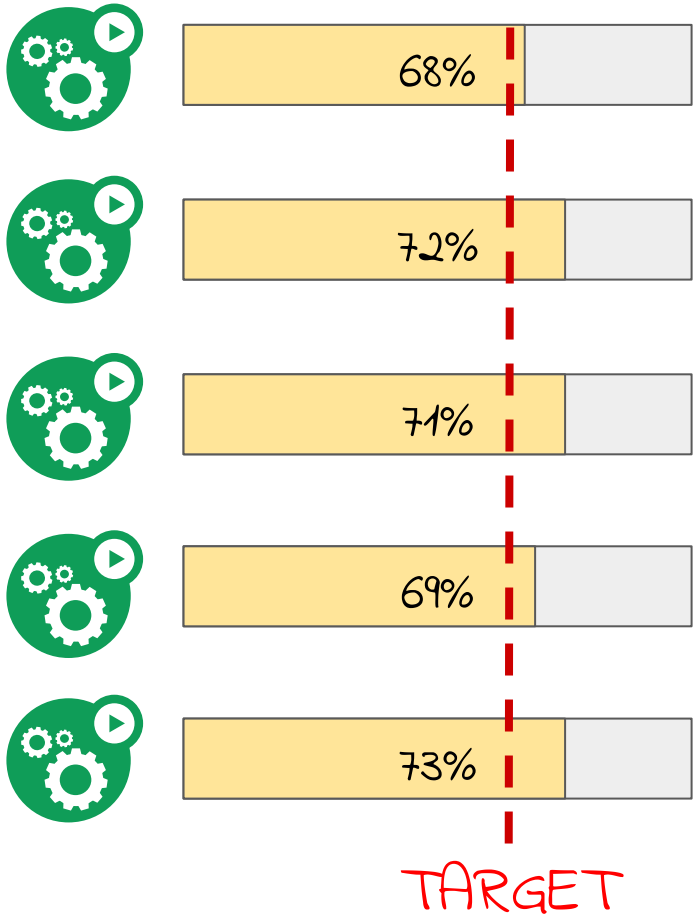
Horizontal Pod Autoscaler



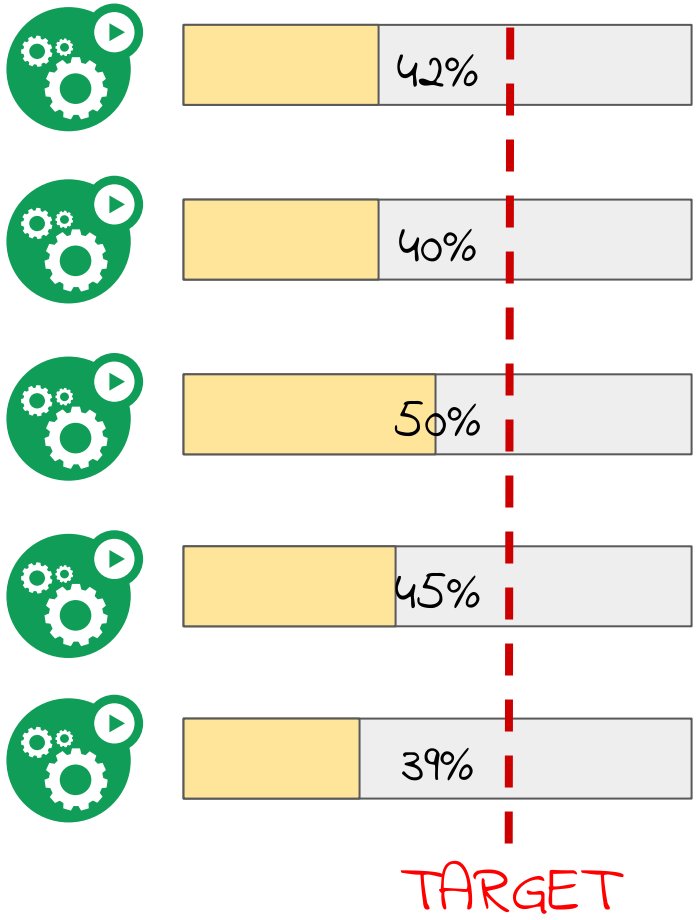
Horizontal Pod Autoscaler



Horizontal Pod Autoscaler



Horizontal Pod Autoscaler



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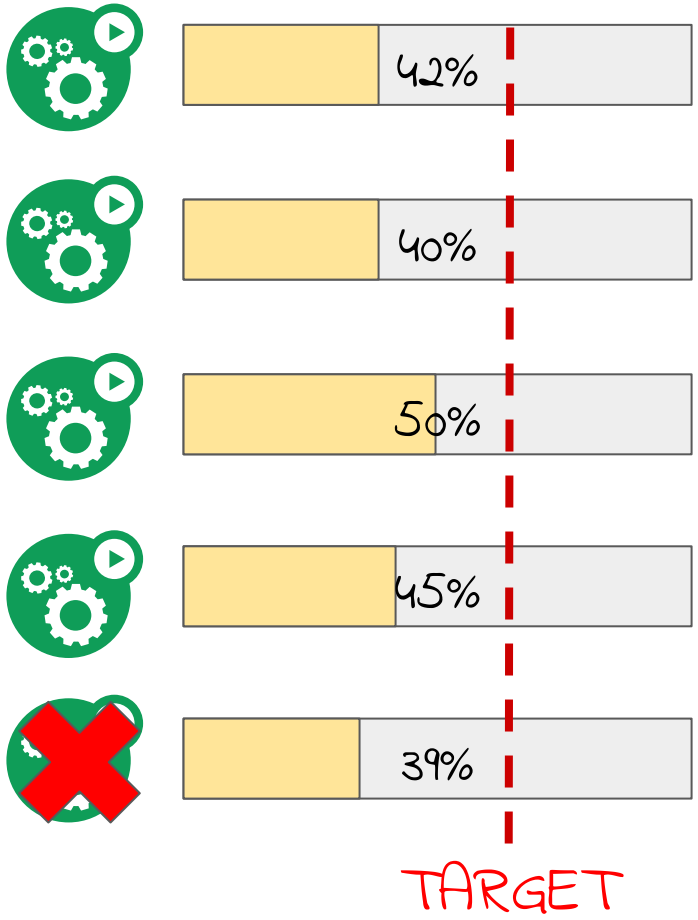
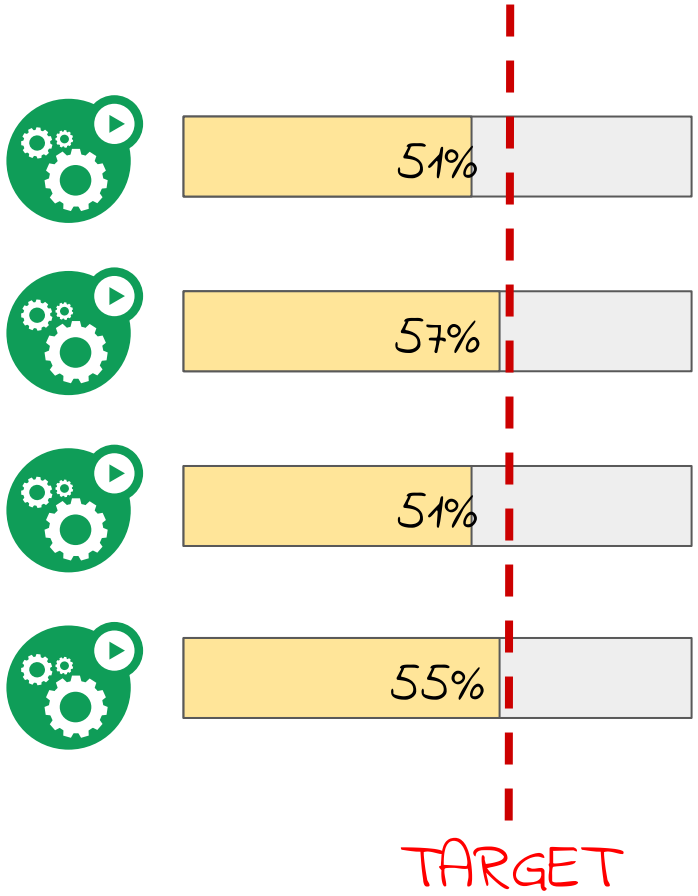
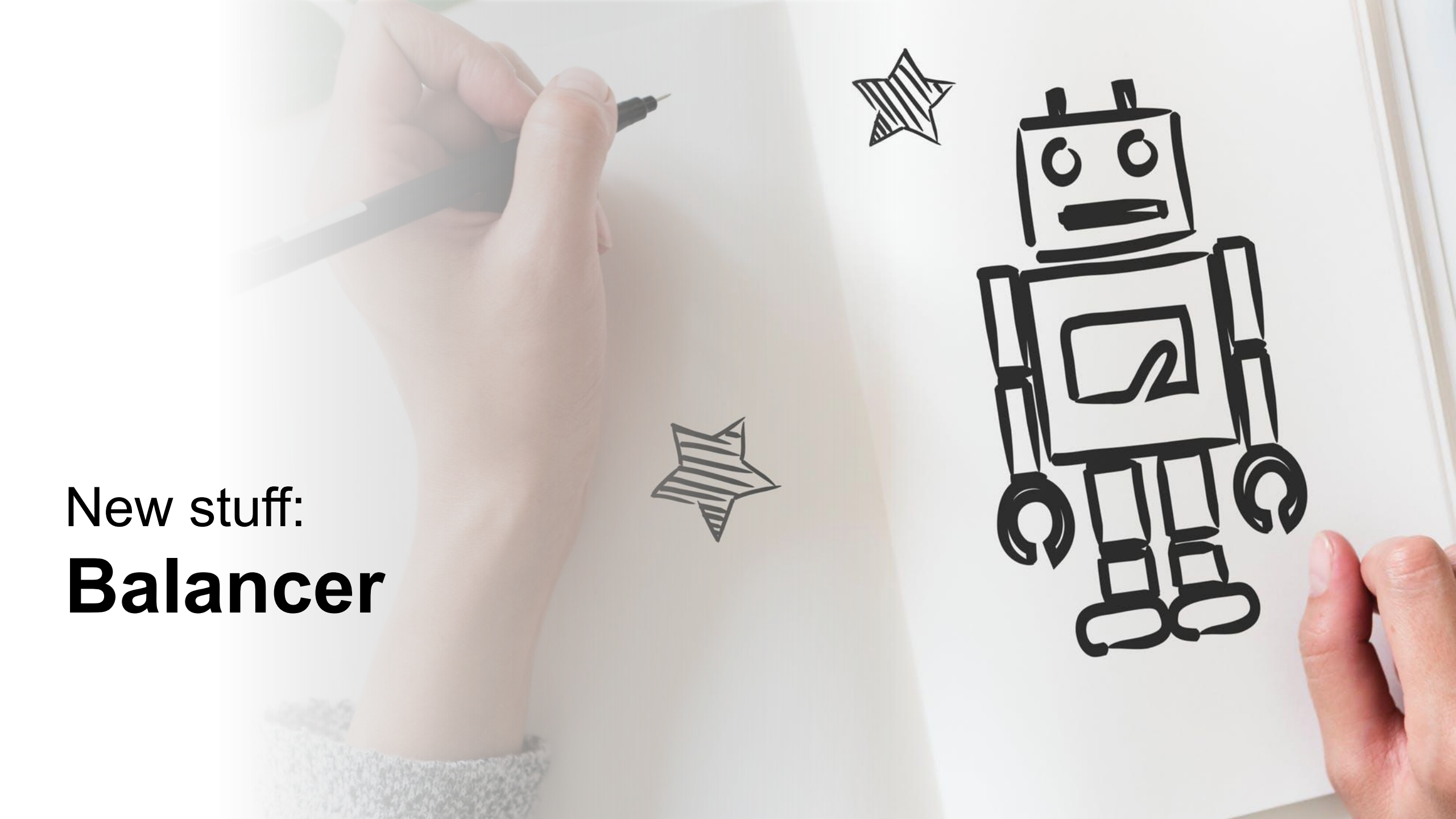


Horizontal Pod Autoscaler



HPA - recent and upcoming changes

- API Graduation to V2
  - v2beta1 went away in 1.25
  - v2beta2 goes away in 1.26
- HPA Controller gained multithreading support (1.26)
  - `--concurrent-horizontal-pod-autoscaler-syncs`
- Improved behavior for targets > 100% (1.26)
- Scale to 0 support for custom metrics (hopefully in 1.26)
- Explicit dry run mode (probably post 1.26)



New stuff:

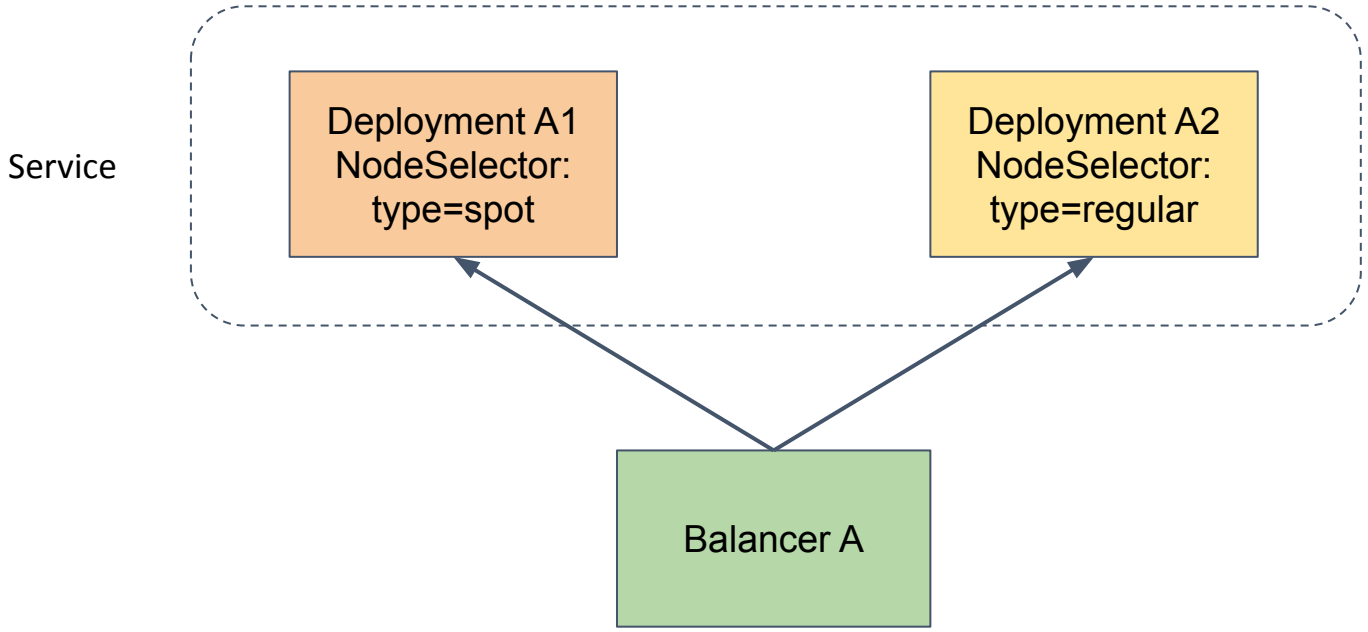
Balancer

Balancer

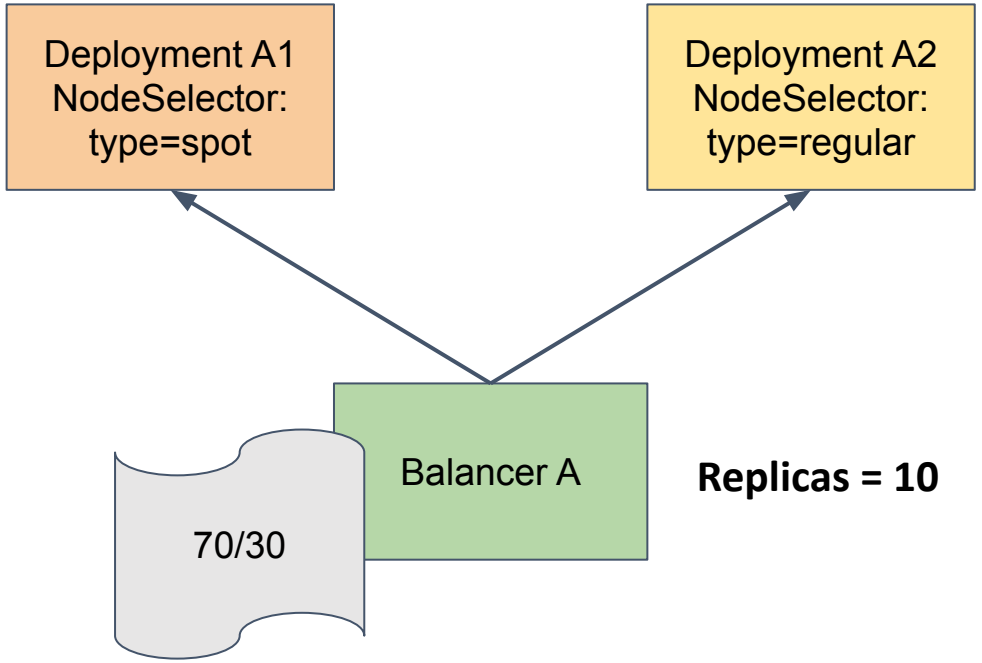
Problem:

- How to ensure equal spreading of pods in 3 zones of a region. With fallback and rebalance?
- How to split pods 70%-30% between spot/preemptible and regular vms? And temporarily use only regulars if spots are not available.
- How to consume nodes with negotiated rates first?
- How to horizontally and vertically autoscale such deployments and make CA work well with them?

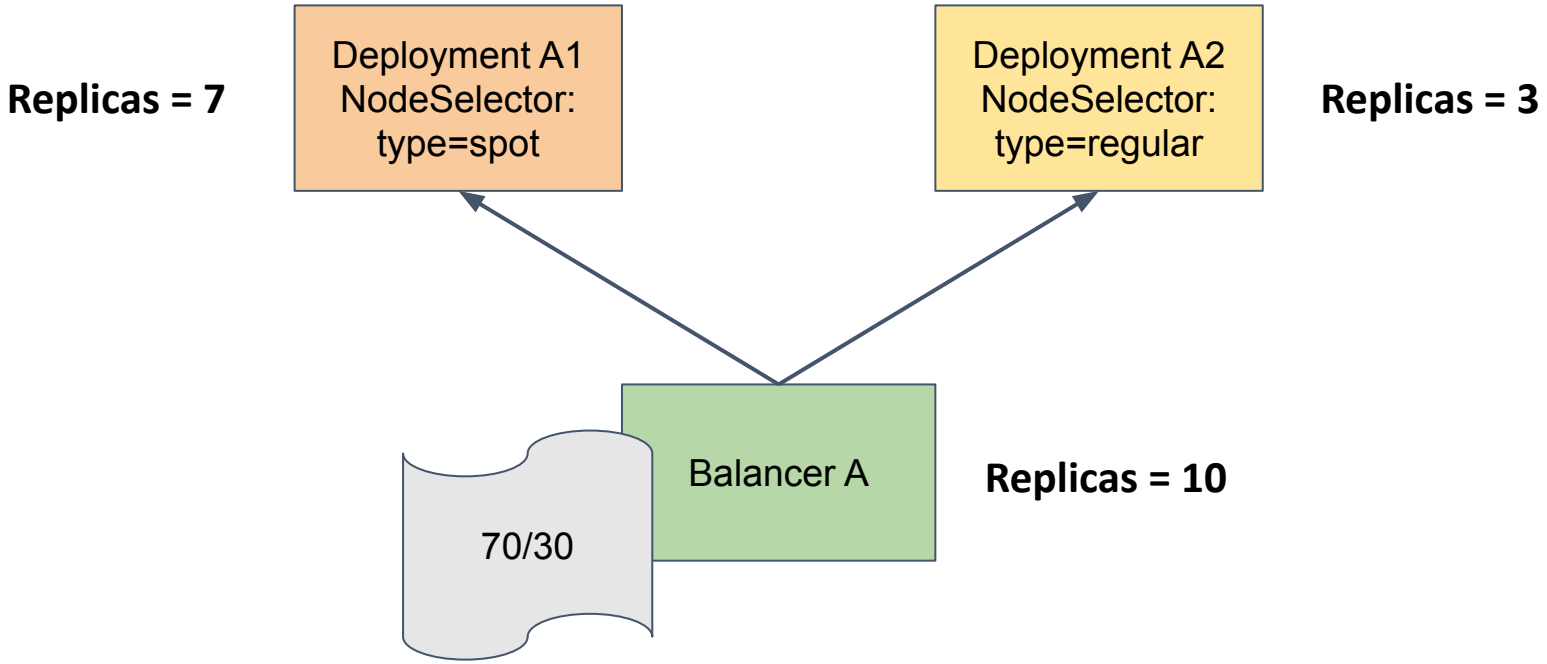
Balancer


Service
Deployment A1
NodeSelector:
type=spot
Deployment A2
NodeSelector:
type=regular
Balancer A

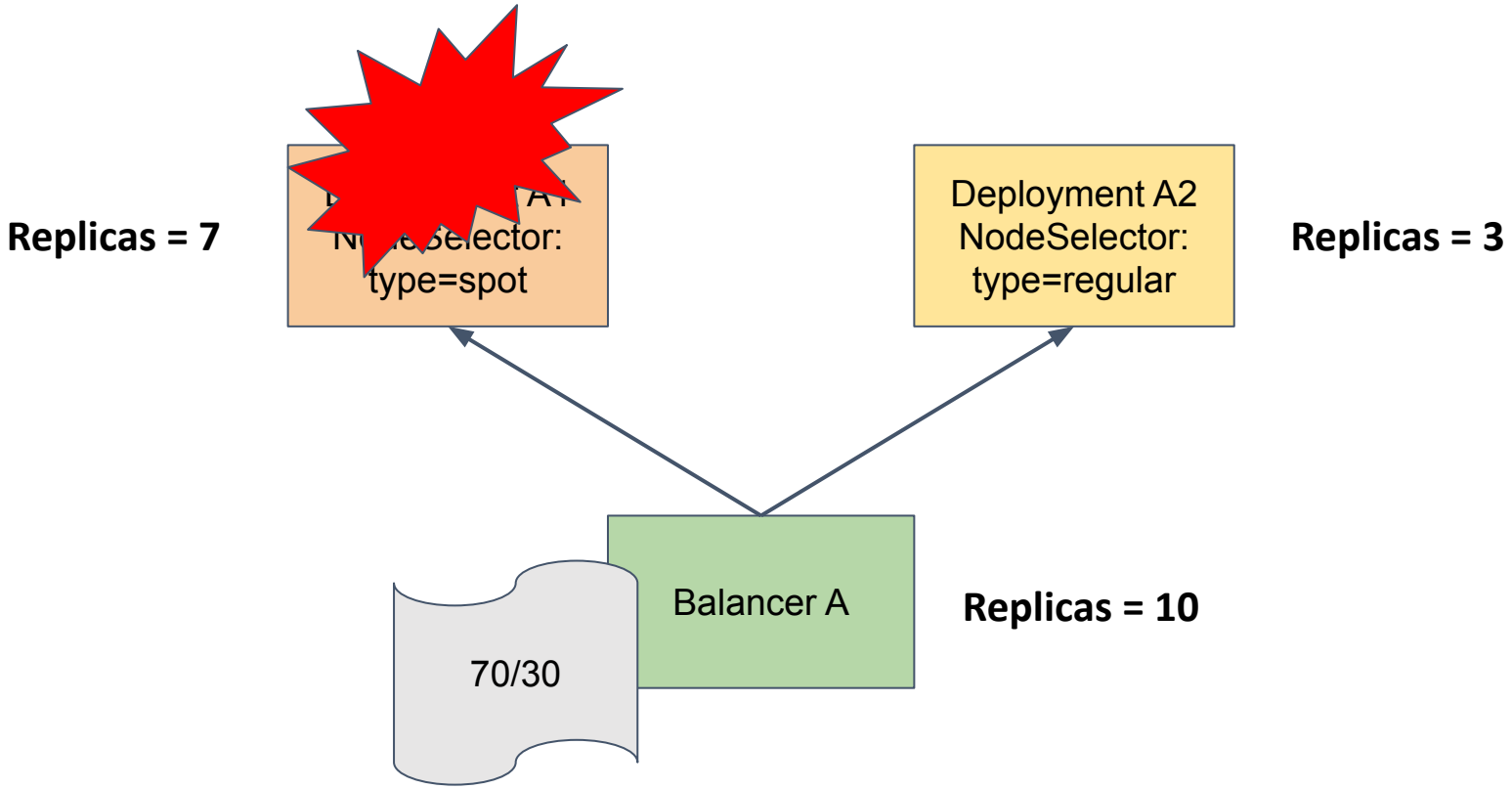
Balancer


Deployment A1
NodeSelector:
type=spot
Deployment A2
NodeSelector:
type=regular
Balancer A
70/30
Replicas = 10

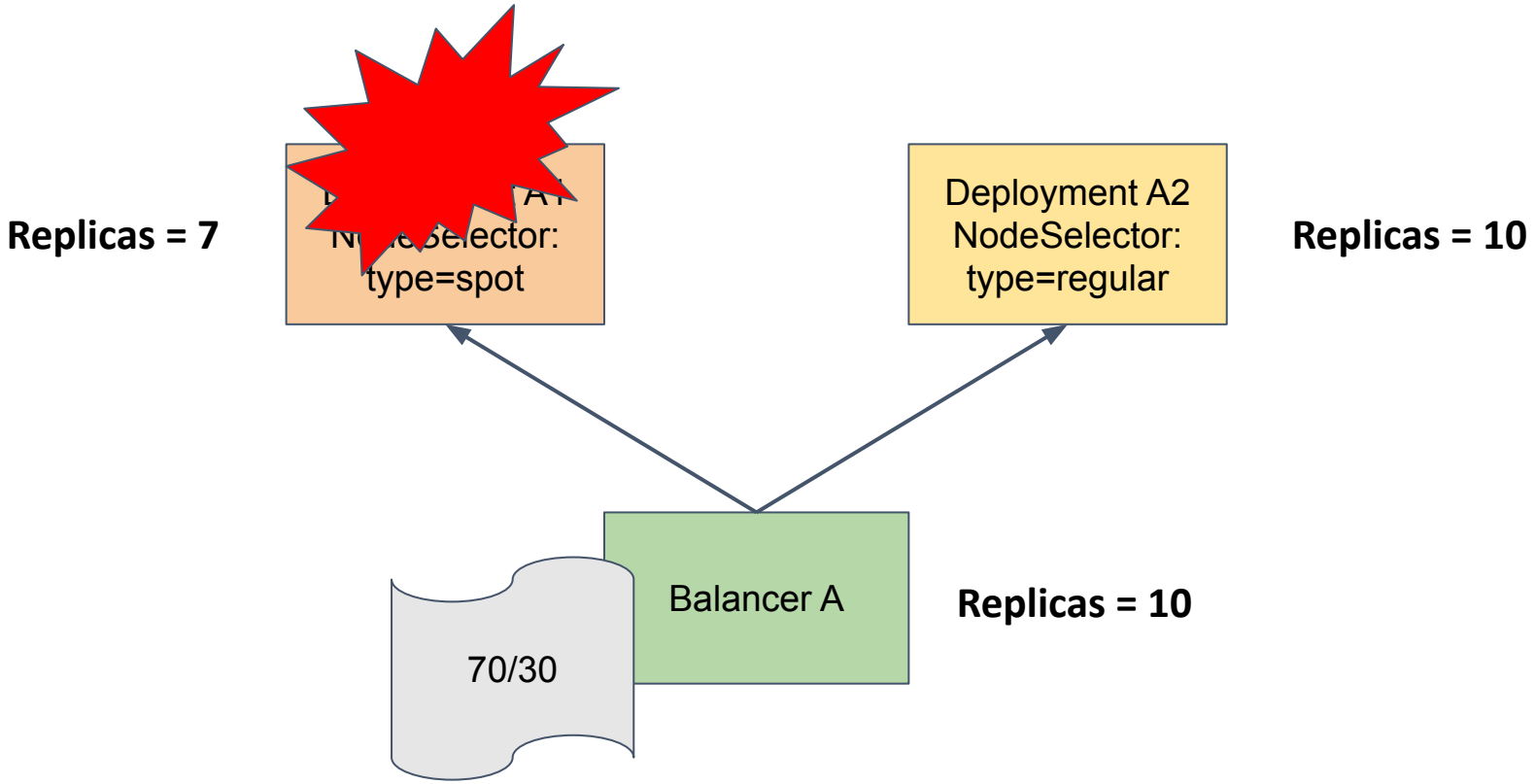
Balancer


Replicas = 7
Deployment A1
NodeSelector:
type=spot
Deployment A2
NodeSelector:
type=regular
Replicas = 3
Balancer A
Replicas = 10
70/30

Balancer


Replicas = 7
type=spot
Deployment A2
NodeSelector:
type=regular
Replicas = 3
Balancer A
Replicas = 10
70/30

Balancer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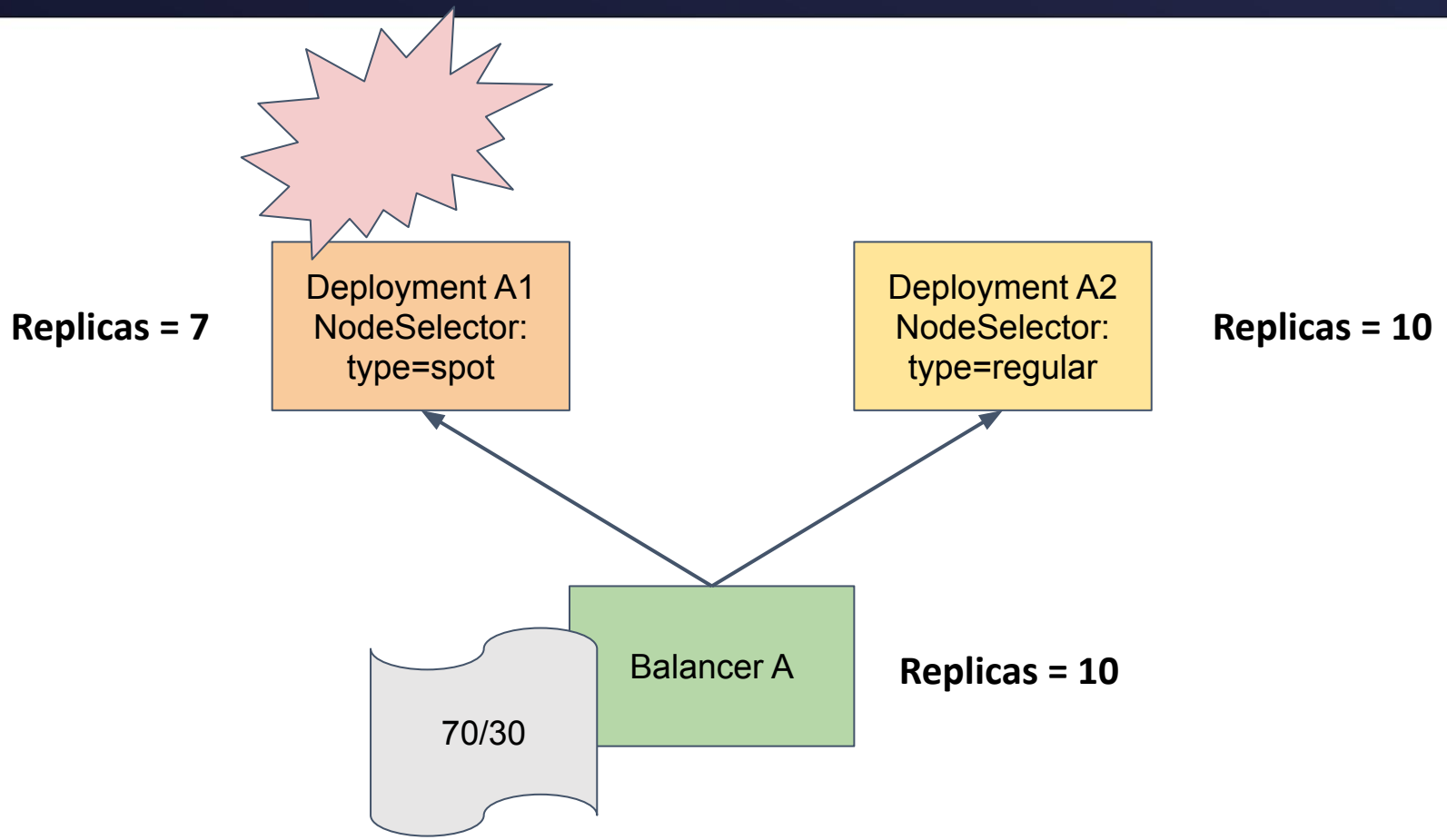
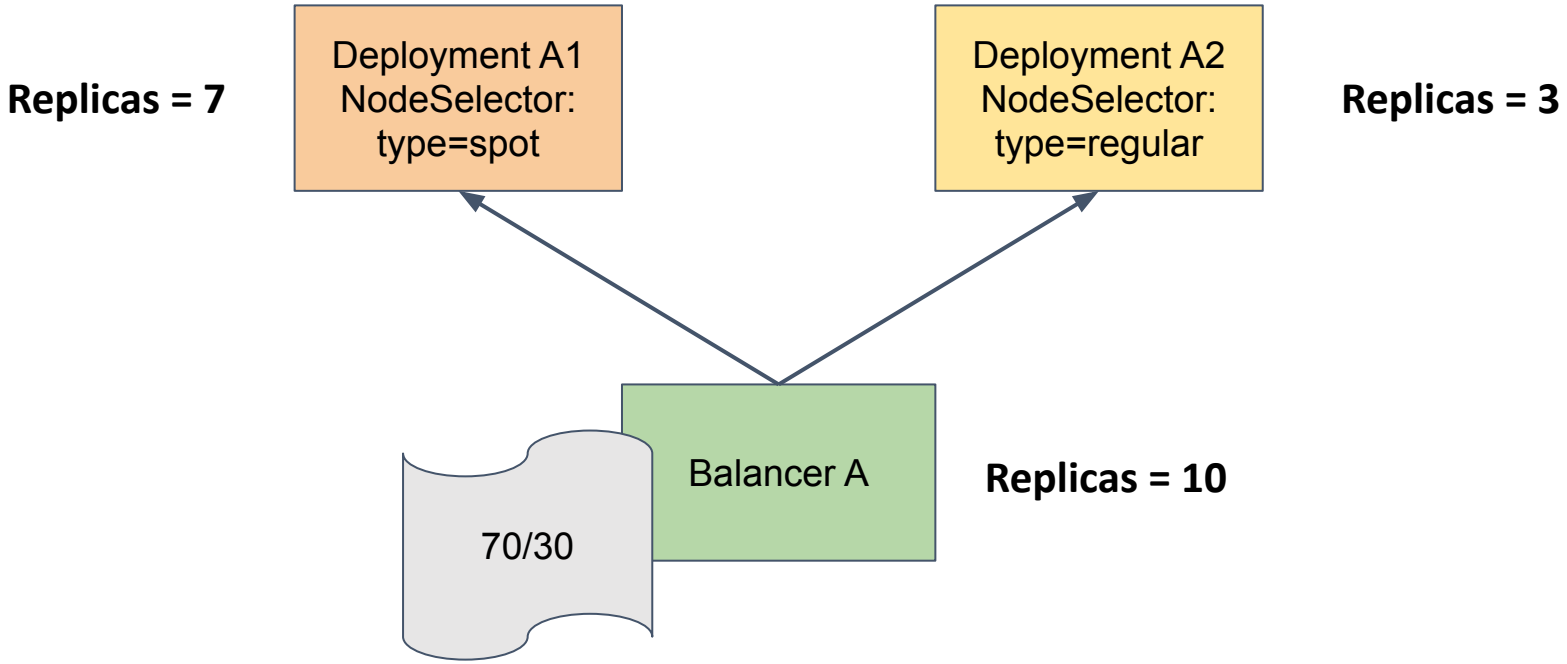
type=spot
Deployment A2
NodeSelector:
type=regular
Replicas = 10
Balancer A
Replicas = 10
70/30

Balancer


Replicas = 7
Deployment A1
NodeSelector:
type=spot
Deployment A2
NodeSelector:
type=regular
Replicas = 10
Balancer A
Replicas = 10
70/30

Balancer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Deployment A1
NodeSelector:
type=spot
Deployment A2
NodeSelector:
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Replicas = 3
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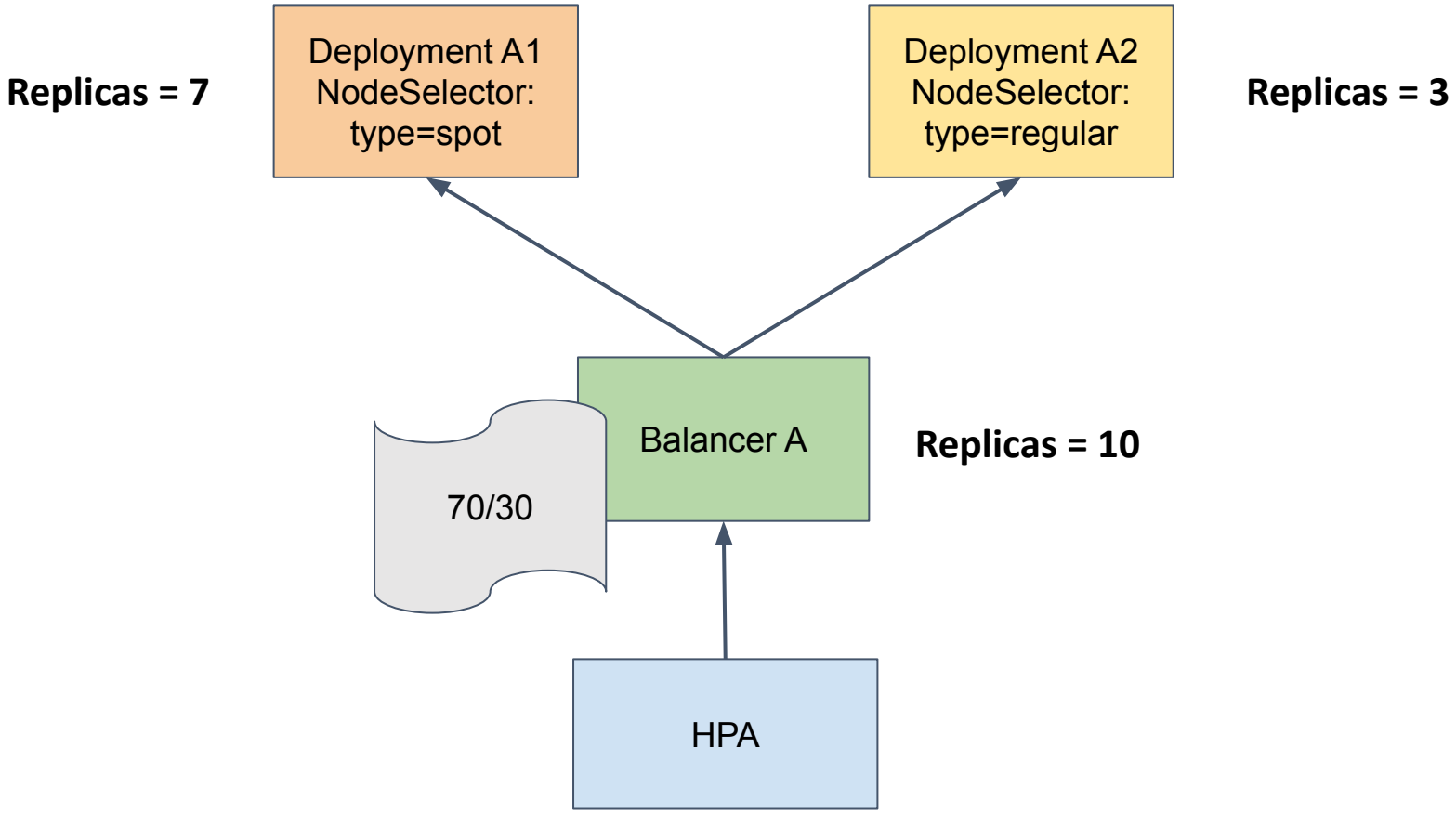
70/30

Balancer


Replicas = 7
Deployment A1
NodeSelector:
type=spot
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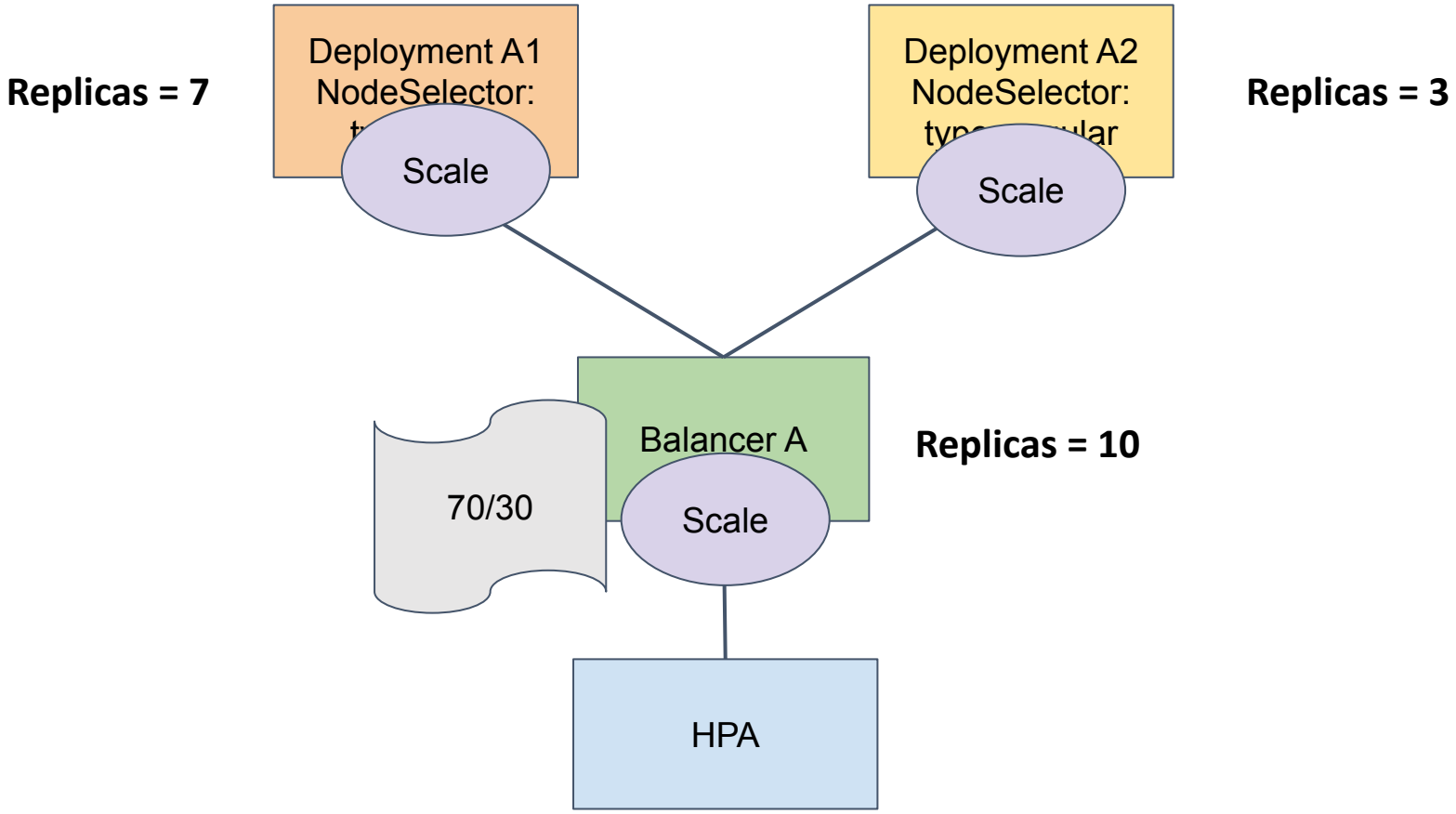
NodeSelector:
type=regular
Replicas = 3
Balancer A
Replicas = 10
70/30
HPA

Balancer

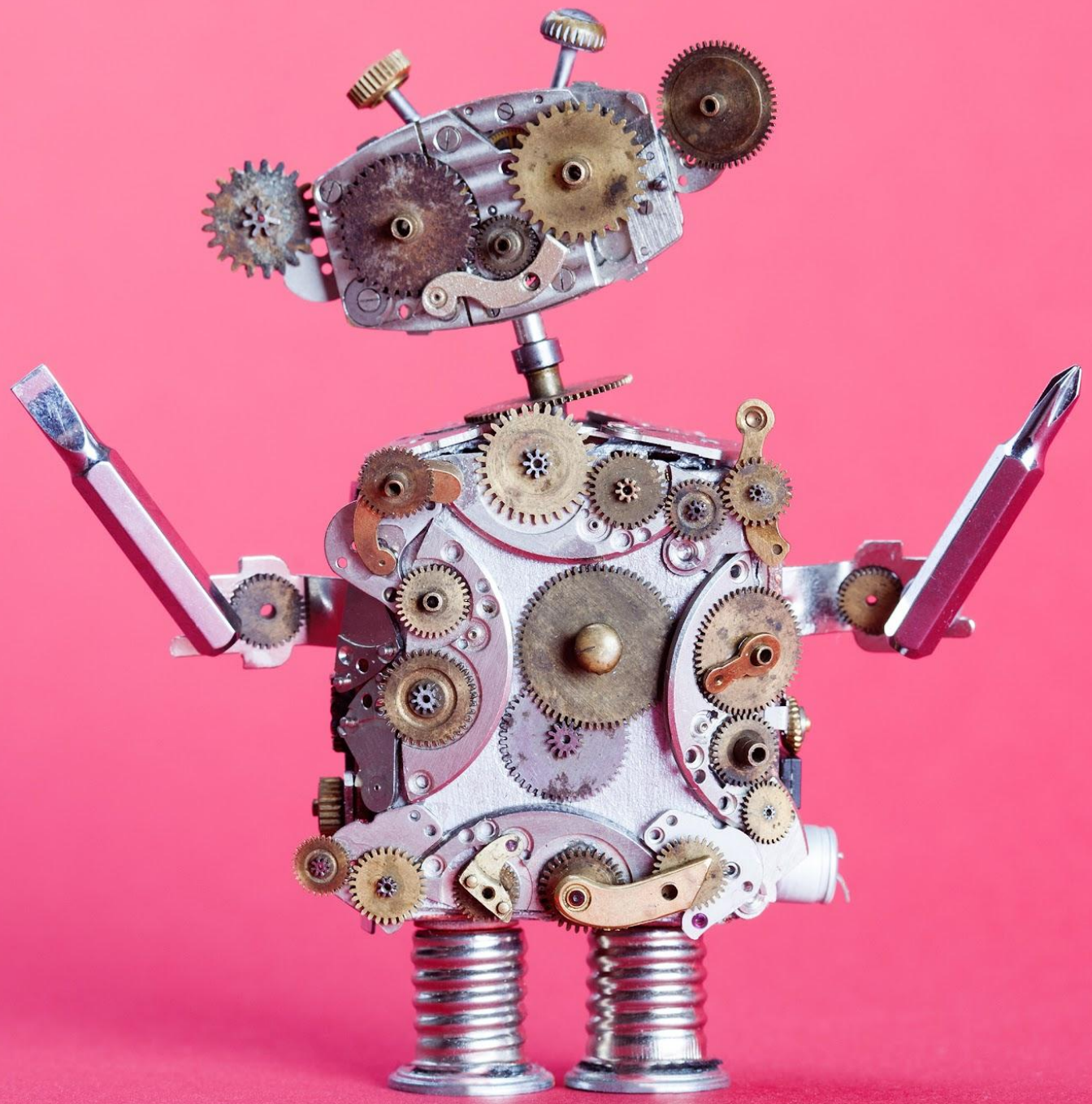

Replicas = 7
Deployment A1
NodeSelector:
Scale
Deployment A2
NodeSelector:
Scale
Replicas = 3
Balancer A
Scale
70/30
Replicas = 10
HPA

Balancer

Status:

- SIG-internal KEP merged
- Largely already coded in a private Google-internal repository
- To be open sourced in November
- Alpha release this year

Vertical Pod Autoscaler

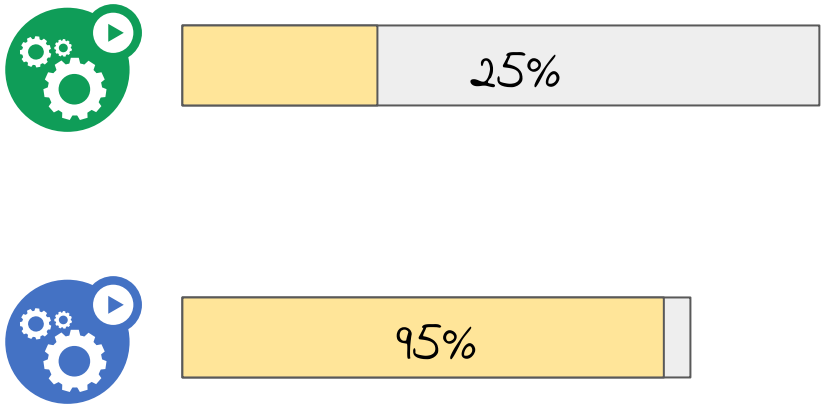


Vertical Pod Autoscaler

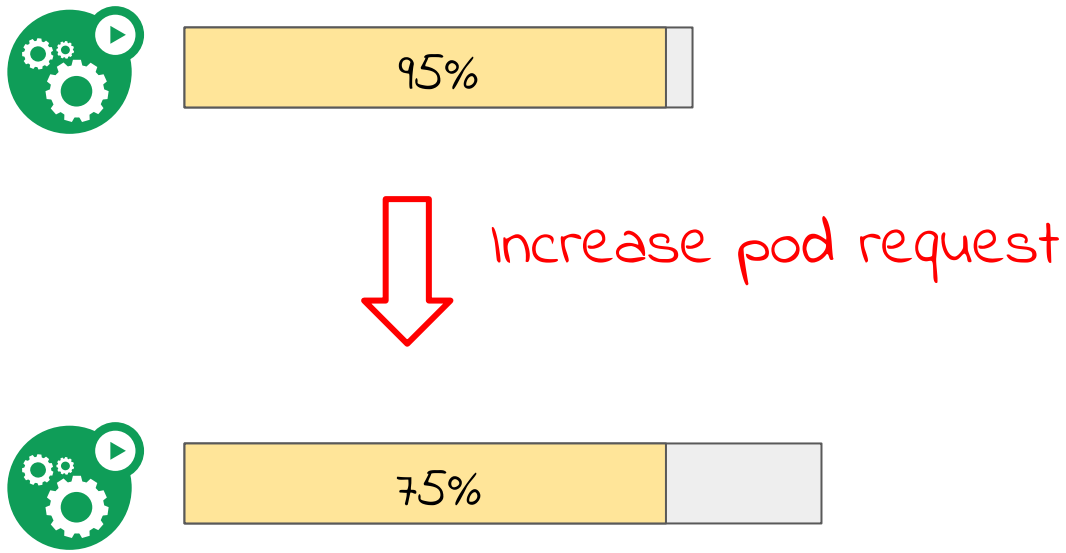
- Pod size should not be to big or too small.

- Based on resource data
  - CPU usage
  - Memory usage
  - OOM events

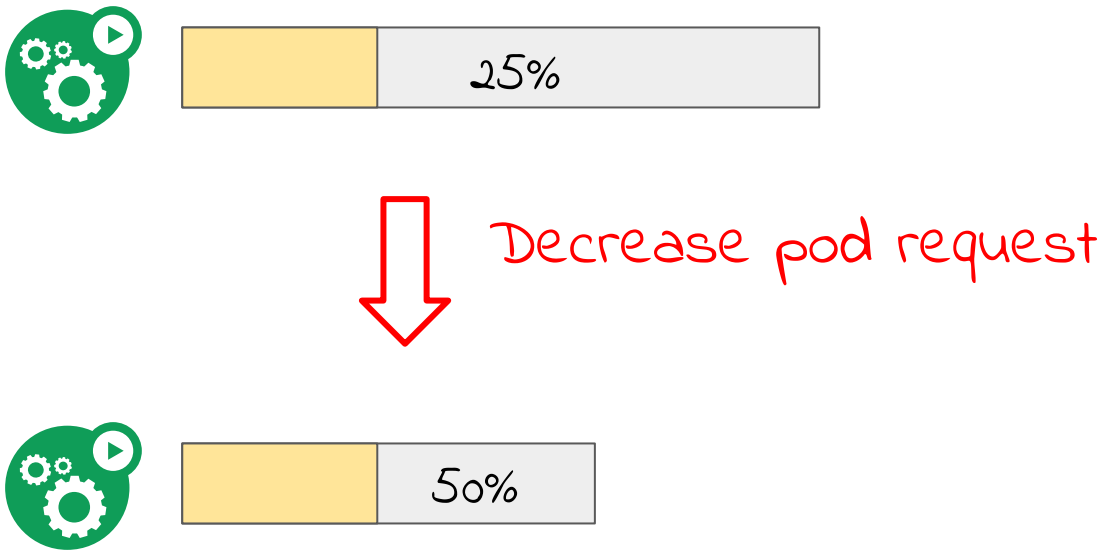
- Recommends pod sizes to keep real usage well within the requested pod capacity.



Vertical Pod Autoscaler



Vertical Pod Autoscaler



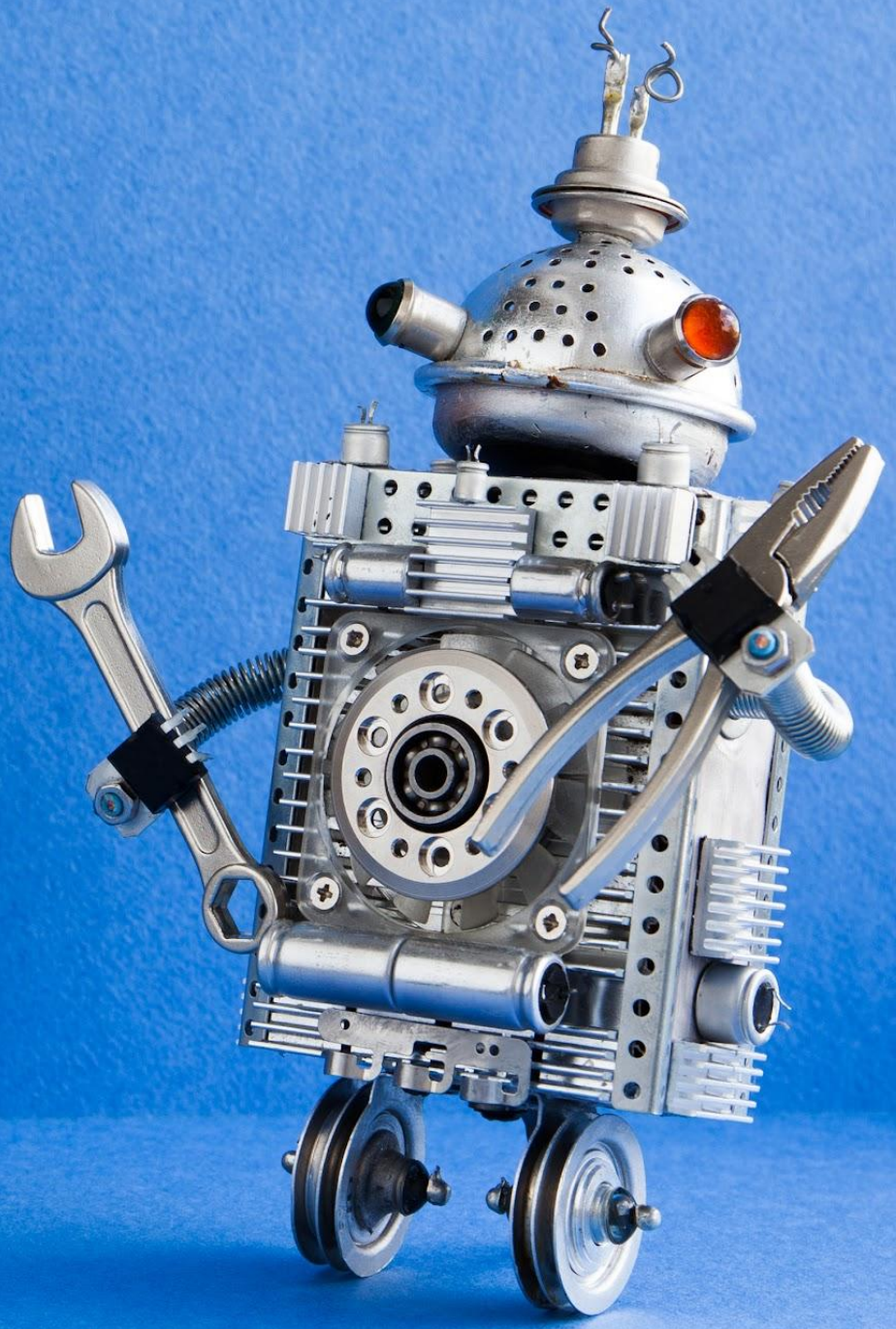
VPA - recent and upcoming changes

- Pluggable/multiple recommender support

- Configurable:
  - limit for minimum number replicas to start actuation
  - percentile used by recommendations

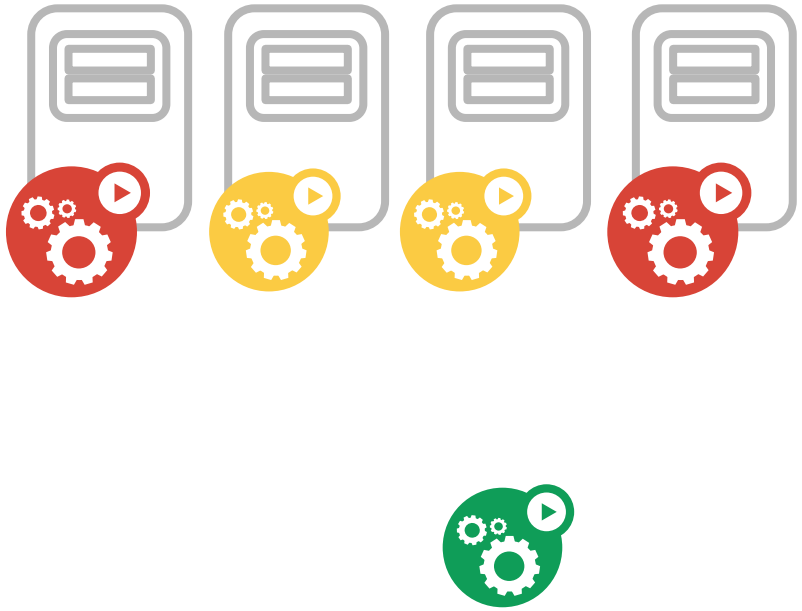
- Coming (hopefully) soon:
  - Fixed ratio between CPU/Mem
  - Limit for the direction of updates
  - In place updates for VPA (once k/k/#102884 is merged)

Cluster Autoscaler

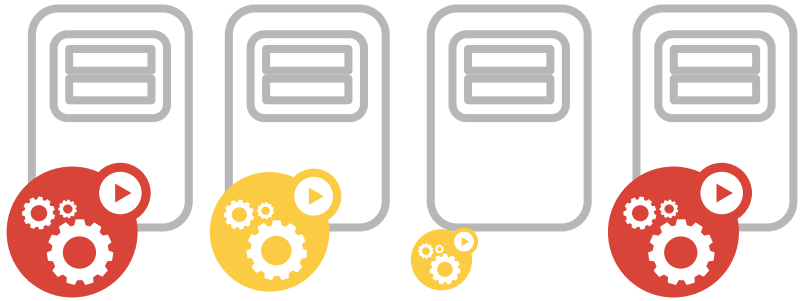


Cluster Autoscaler

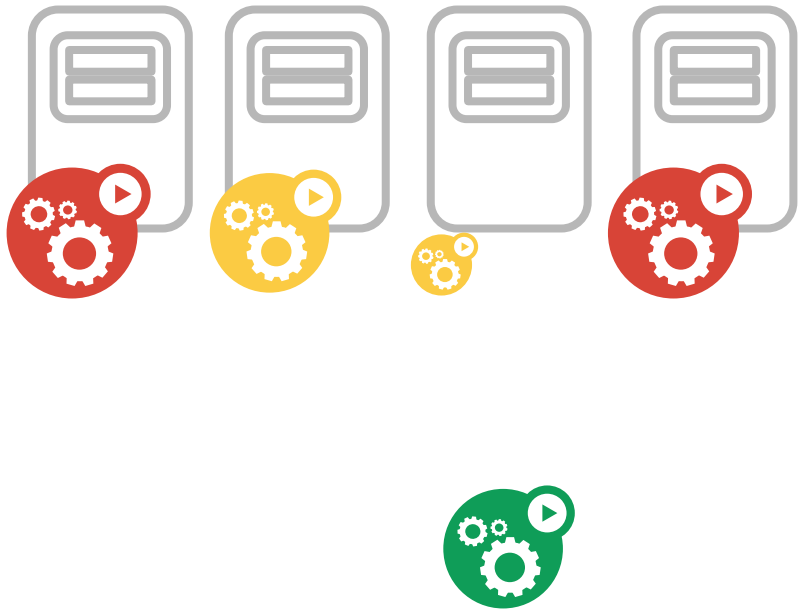
- Provides nodes for pods that don't have a place to run.
- Removes underutilised nodes.
- Uses scheduling simulations and declared pod requests.



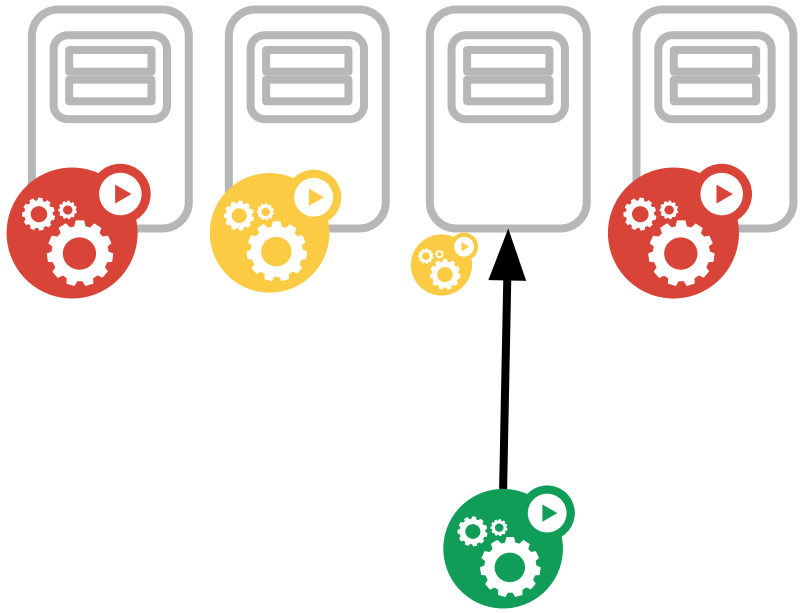
Cluster Autoscaler



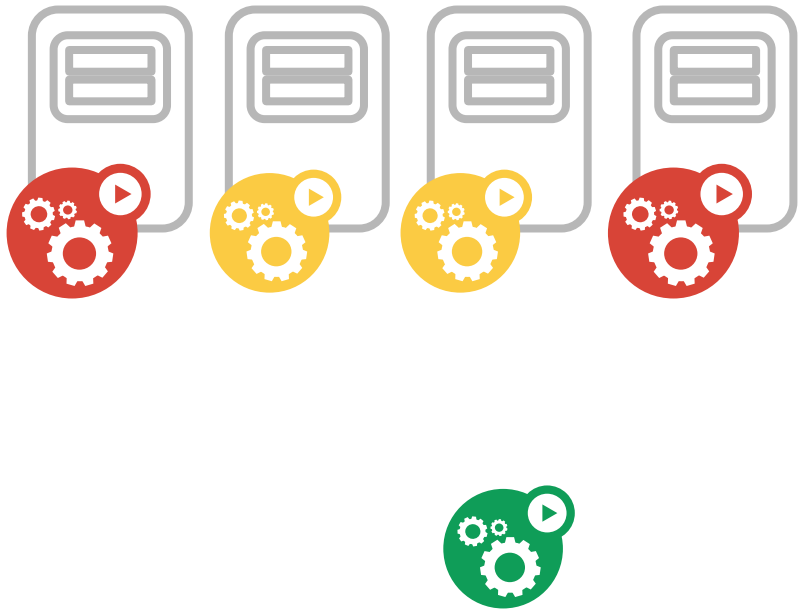
Cluster Autoscaler



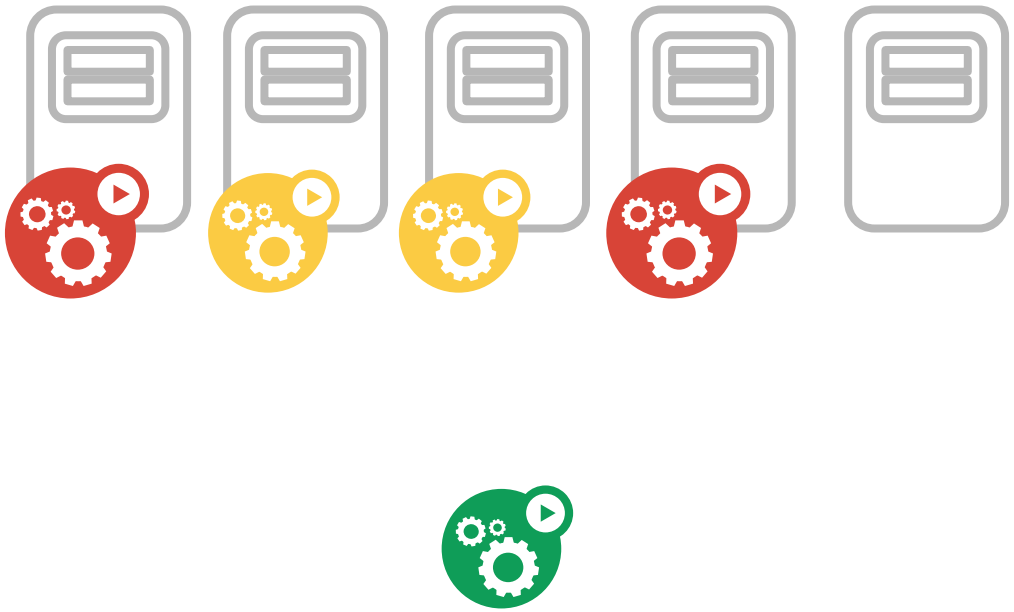
Cluster Autoscaler



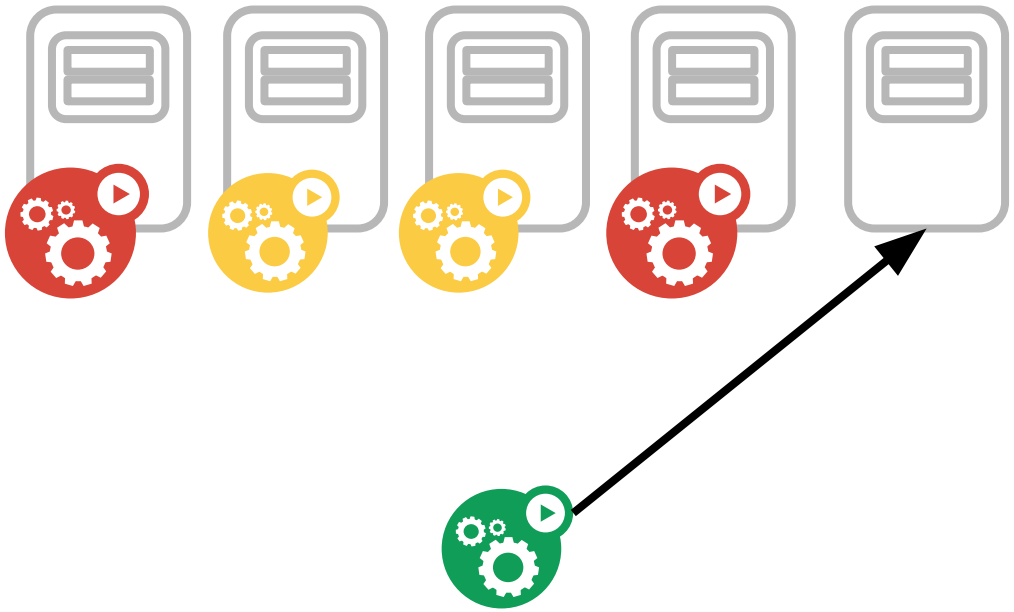
Cluster Autoscaler



Cluster Autoscaler



Cluster Autoscaler



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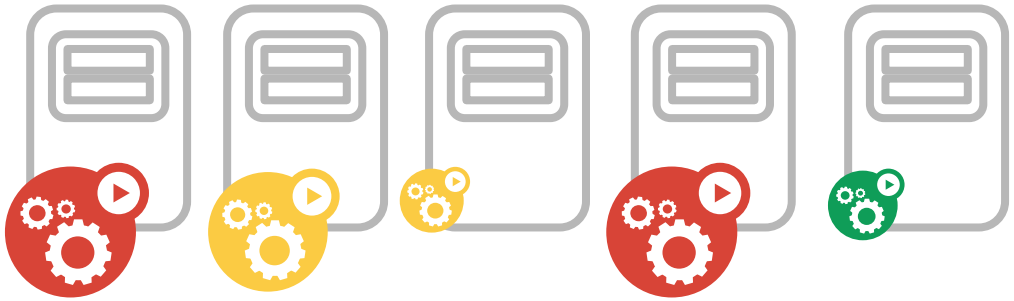

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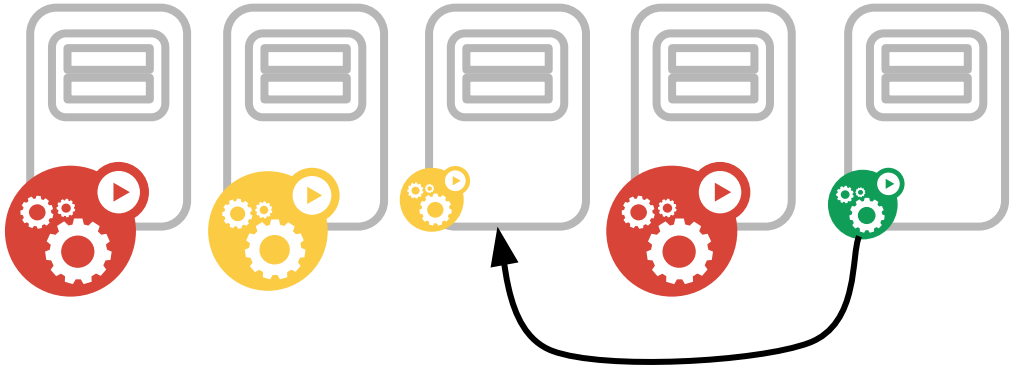

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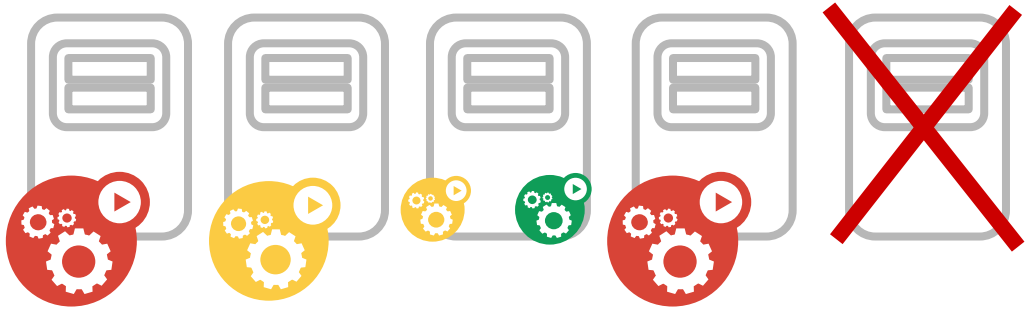


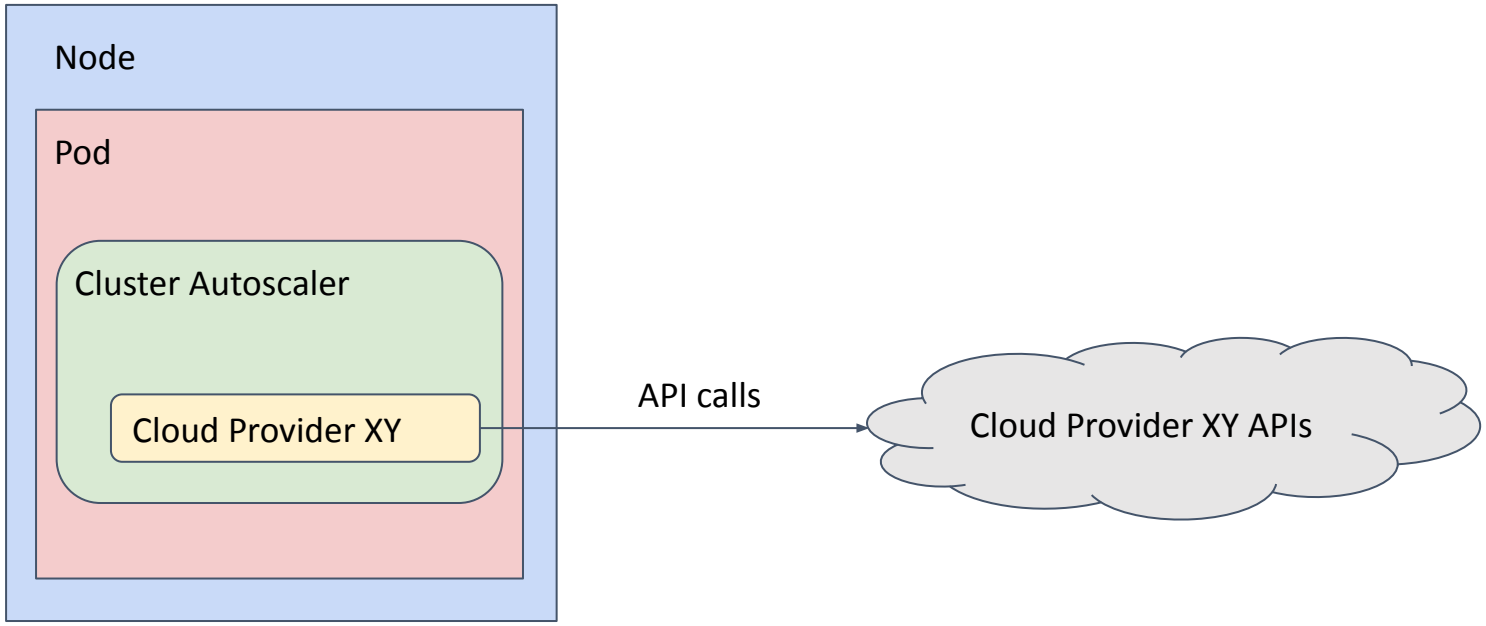
CA - recent and upcoming changes

- Parallel scale down (hopefully 1.26)
- Scale down not blocking on pending pods (1.24)
- gRPC:
  - cloud provider (1.25)
  - expander (1.24)
- Better batch use cases support - Kqueue integration (1.27+)

External gRPC Cloud Provider

What is a cloud provider in the Cluster Autoscaler (CA)?

Cloud specific logic hardcoded inside CA used to interact with specific cloud providers

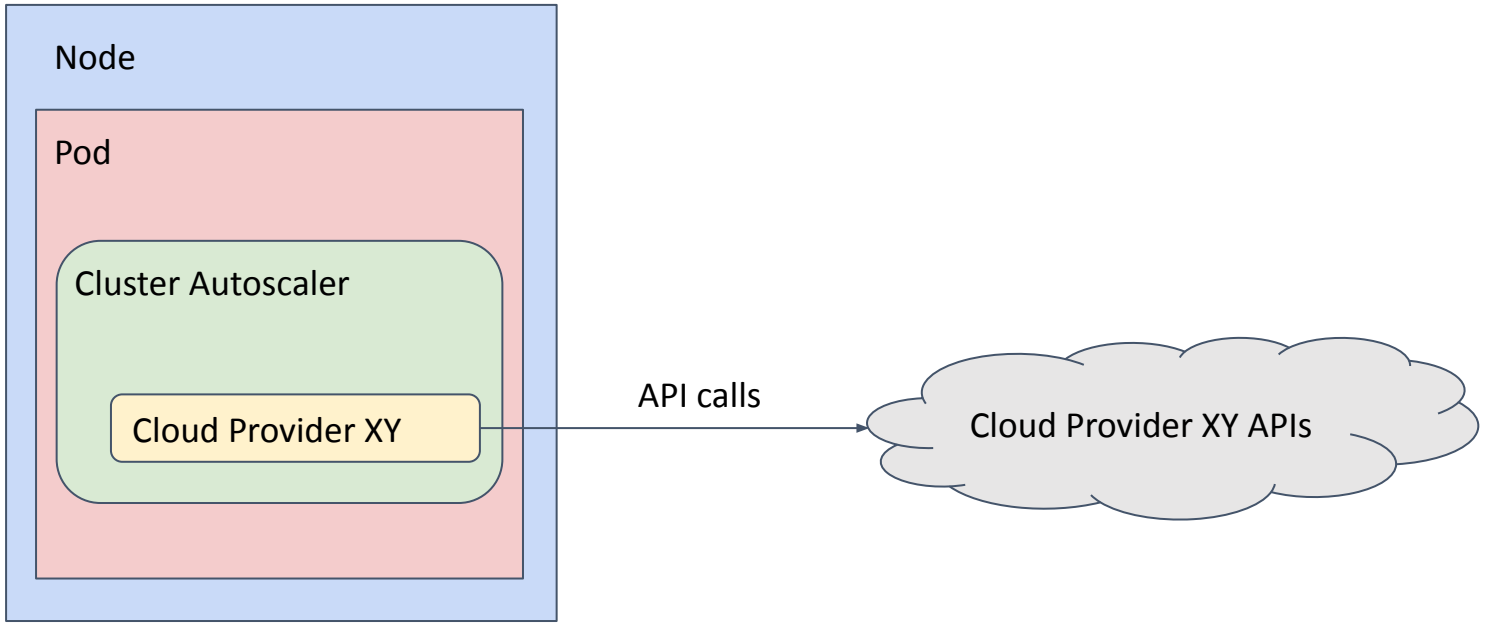


External gRPC Cloud Provider

How to implement a cloud provider in CA?

- Fork CA code
- Implement cloud provider logic as `CloudProvider` and **NodeGroup** go interfaces
- Add it to the cloud provider builder

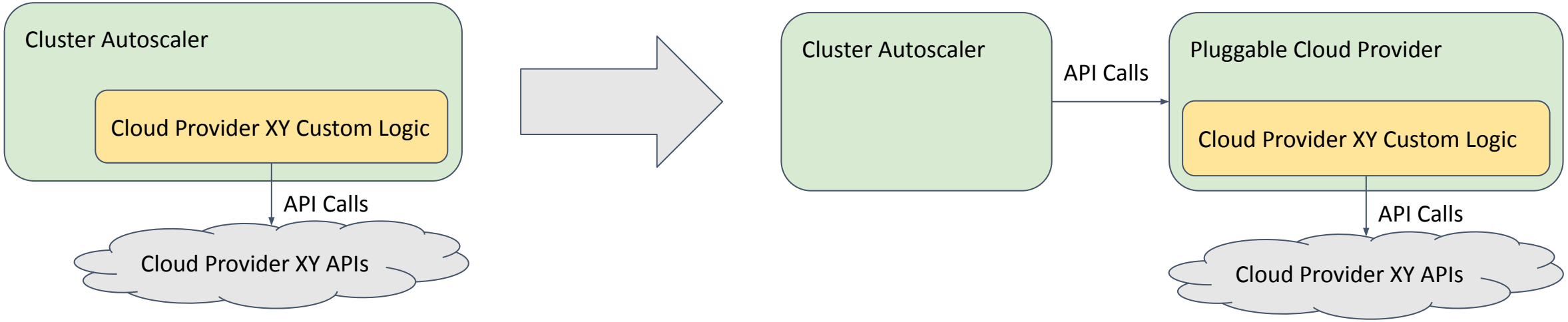
contributing rules: no new dependencies



External gRPC Cloud Provider

Pluggable Cloud Provider - why?

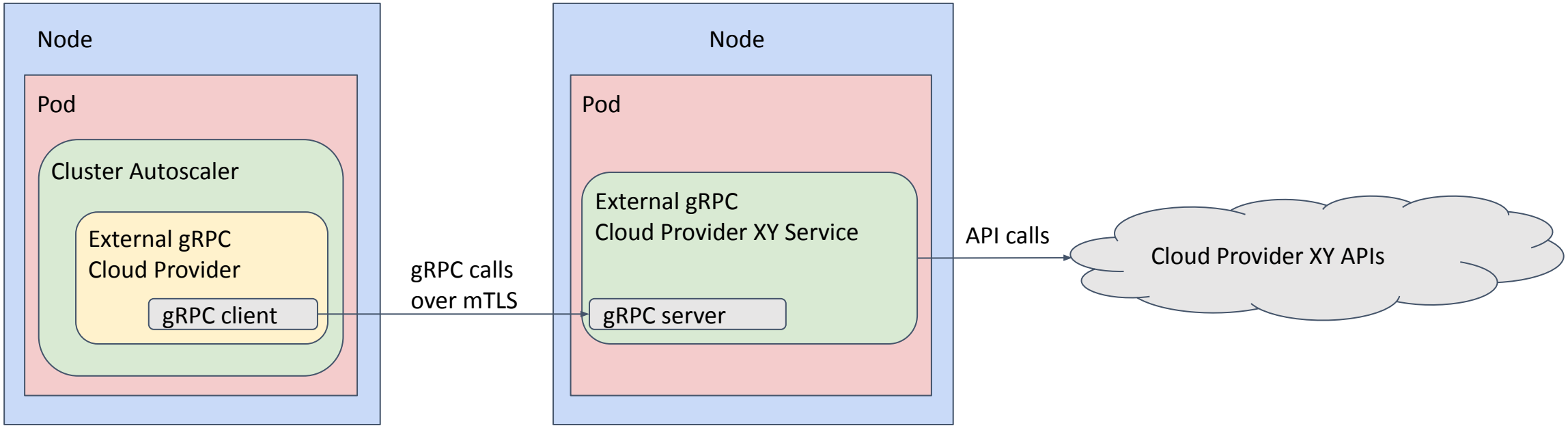
- No need to fork CA
- Decouple CA core and cloud provider dependencies
- No need to follow CA development lifecycle



External gRPC Cloud Provider

Pluggable Cloud Provider over gRPC

- Out-of-tree cloud provider support
- Custom cloud provider logic in an external service, exposed as gRPC APIs
- CA acts as gRPC client, implemented as a classic in-tree cloud provider



External gRPC Cloud Provider

How to create an external gRPC cloud provider service? - general requirements

- CA assumes nodes belong to *node groups*, all nodes within a group:
  - Must be of the same machine type
  - Have the same set of labels and taints
  - Are located in the same availability zone
- There must be a way to delete a specific node
- There must be a way to match a Kubernetes node to the instance it is running on, e.g. `ProviderId` field

External gRPC Cloud Provider

How to create an external gRPC cloud provider service? - implementation

- Create a standalone service with your language of choice
- Implement the server side of the `CloudProvider` gRPC service defined in [`externalgrpc.proto`]
- Fill it with your cloud provider logic
- Expose the gRPC endpoint with mTLS

```
service CloudProvider {
 // CloudProvider specific RPC functions
 rpc NodeGroups
 rpc NodeGroupForNode
 rpc PricingNodePrice //optional
 rpc PricingPodPrice  //optional
 rpc GPULabel
 rpc GetAvailableGPUTypes
 rpc Cleanup
 rpc Refresh

 // NodeGroup specific RPC functions
 rpc NodeGroupTargetSize
 rpc NodeGroupIncreaseSize
 rpc NodeGroupDeleteNodes
 rpc NodeGroupDecreaseTargetSize
 rpc NodeGroupNodes
 rpc NodeGroupTemplateNodeInfo //optional
 rpc NodeGroupGetOptions       //optional
}
```

External gRPC Cloud Provider

Caveats

- gRPC calls are cached on the CA side, but performances for very large clusters have not been tested yet

- The **CloudProvider** gRPC service mimics the **`CloudProvider`** and **`NodeGroup`** go interfaces with some differences:
    - **`NodeInfo`** does not return information about initial pods for a node (e.g. static pods), calculations when scaling from 0 nodes could be wrong if such pods exist
    - **`GetResourceLimiter`** function (unpopular) has not been implemented
    - Deprecated functions have not been implemented

External gRPC Cloud Provider

Learn more

- Design Proposal (PR)
- Implementation (PR)
- README
- Protobuf definition file
- Example Code

More
about SIG-Autoscaling

Meetings

Monday 10:30 EDT

https://zoom.us/j/944410904

Slack

#sig-autoscaling

kubernetes.slack.com

Github

https://github.com/kubernetes/autoscaler


Thank You!


Time for
Questions!