


KubeCon | CloudNativeCon
Europe 2022

SIG Autoscaling

Updates and Feature Highlights

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Forecast

- Introductions
- Horizontal Pod Autoscaler
  - API v2
- Cluster Autoscaler
  - gRPC custom expander interface
- Vertical Pod Autoscaler
  - Support for alternative recommenders
  - Support for updating controllers with only 1 pod
  - Expect releases with each K8s release in the future
- SIG Autoscaling Community

Introductions

- Michael McCune
- David Morrison
- Joachim Bartosik
- Guy Templeton


Horizontal Pod Autoscaler

HPA API v2 Status

- v2 API is stable
  - from Kubernetes 1.23
- v2beta2 API is deprecated
  - must be served in Kubernetes 1.23, 1.24, 1.25
  - will be removed in Kubernetes 1.26
- v2beta1 API is deprecated as of May 2018
  - will be removed in Kubernetes 1.25

HPA API v2 Changes

- No changes to serialized fields
- Minor changes to internal Go API
  - `MaxPolicySelect` -> `MaxChangePolicySelect`
- See [GitHub Kubernetes/Kubernetes pull request #102534]


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Cluster Autoscaler
Custom Expander Interface

What is an expander?

```
func ScaleUp(...) {
  podEquivalenceGroups := buildPodEquivalenceGroups(unschedulablePods)

  for _, nodeGroup := range nodeGroups {
    option, err := computeExpansionOption(
       context, podEquivalenceGroups, nodeGroup, nodeInfo, upcomingNodes)
  }

  bestOption := context.ExpanderStrategy.BestOption(options, nodeInfos)

  if bestOption != nil && bestOption.NodeCount > 0 {
    // Scale up the chosen node group
  }
}
```

What is an expander?

```
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```

Types of Expanders (source)

- random (default) - does what it says on the tin
- most pods - picks the node group that would be able to accommodate the largest number of pods on scale-up
- least waste - picks the node group that has the least unused CPU/memory after scaling up
- price - picks the node group which costs the least (GKE only)
- priority - picks a node group according to a user-specified priority ladder
- custom gRPC expander (this is new!) - allows for arbitrary, user-specified expansion behaviour

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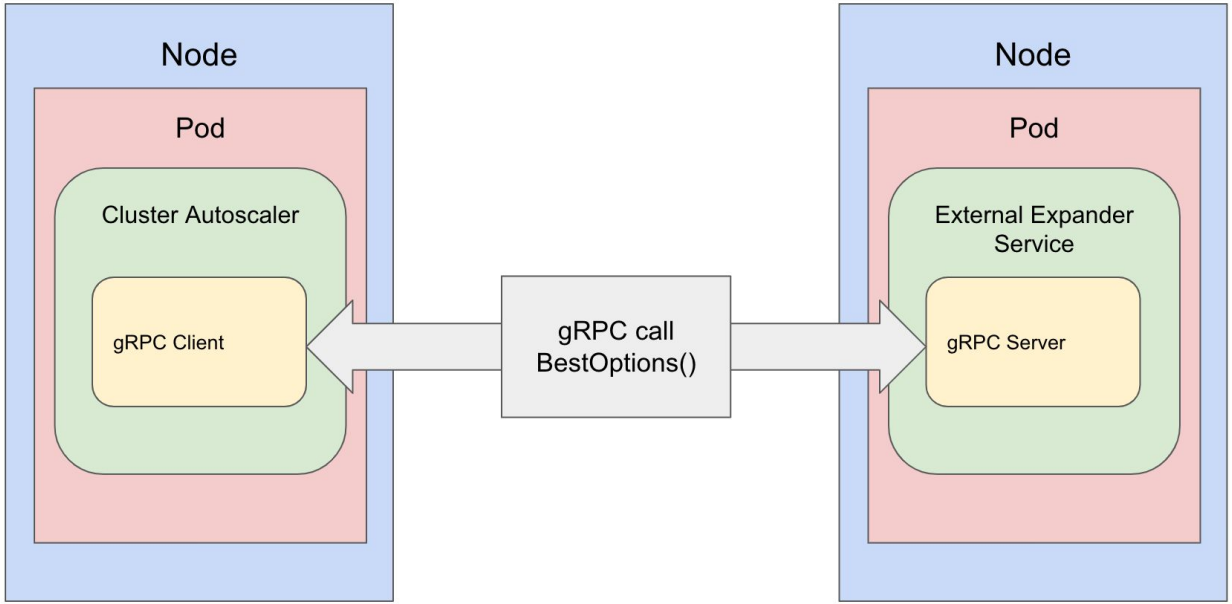
- **custom gRPC expander (this is new!) - allows for arbitrary, user-specified expansion behaviour**

Why a custom expander type?

- Allows for custom (business-specific) scale-up logic to be specified
  - Example: selecting different spot markets depending on time of day
- Expander logic can be developed out-of-band with Cluster Autoscaler releases, providing more flexibility

Expander Design



Expander Interface

```
service Expander {
  rpc BestOptions (BestOptionsRequest)
    returns (BestOptionsResponse) {}
}

message Option {
  // only need the ID of node to uniquely
  // identify the nodeGroup, used in the
  // nodeInfo map.
  string nodeGroupId = 1;
  int32 nodeCount = 2;
  string debug = 3;
  repeated Pod pod = 4;
}
```

```
message BestOptionsRequest {
  repeated Option options = 1;
  // key is node id from options
  map<string, Node> nodeInfoMap = 2;
}

message BestOptionsResponse {
  repeated Option options = 1;
}
```

Example Expander Code

```
func Serve(certPath string, keyPath string, port uint) {
     var grpcServer *grpc.Server
     // set up server here

     expanderServerImpl := NewExpanderServerImpl()
     protos.RegisterExpanderServer(grpcServer, expanderServerImpl)

     if err := grpcServer.Serve(netListener); err != nil {
          log.Fatalf("failed to serve: %s", err)
     }
}
```

Example Expander Code

```
func BestOptions(req *protos.BestOptionsRequest) (*protos.BestOptionsResponse, error) {
    longest := 0
    var choice *protos.Option
    for _, opt := range req.GetOptions() {
        if len(opt.NodeGroupId) > longest {
            choice = opt
        }
    }
    return &protos.BestOptionsResponse{Options: []*protos.Option{choice}}, nil
}
```

How to configure the custom expander?

```
./cluster-autoscaler \
  --expander=grpc,priority \
  --grpc-expander-url=ca-grpc-expander.svc.cluster.local:12345 \
  --grpc-expander-cert=/etc/ssl/certs/ca-grpc-expander.crt
```

For More Info

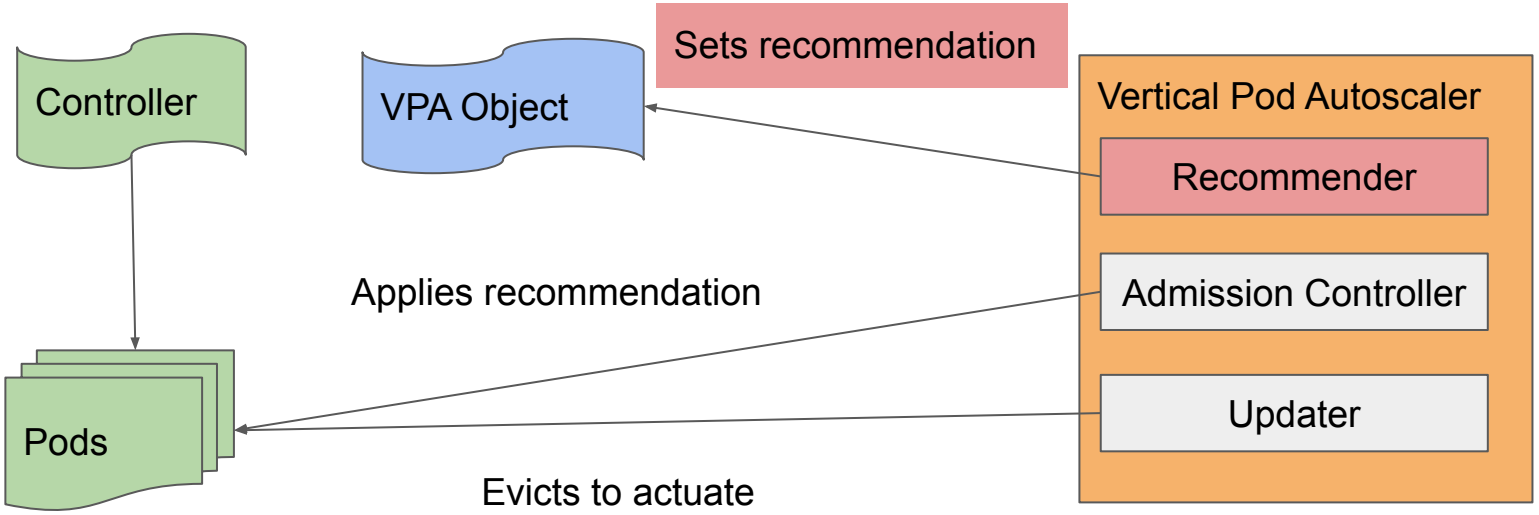
- Design Proposal
- Pull Request
- gRPC Expander README
- gRPC Expander Example Code
- Dynamic Kubernetes Cluster Scaling at Airbnb


Vertical Pod Autoscaler Updates

Overview

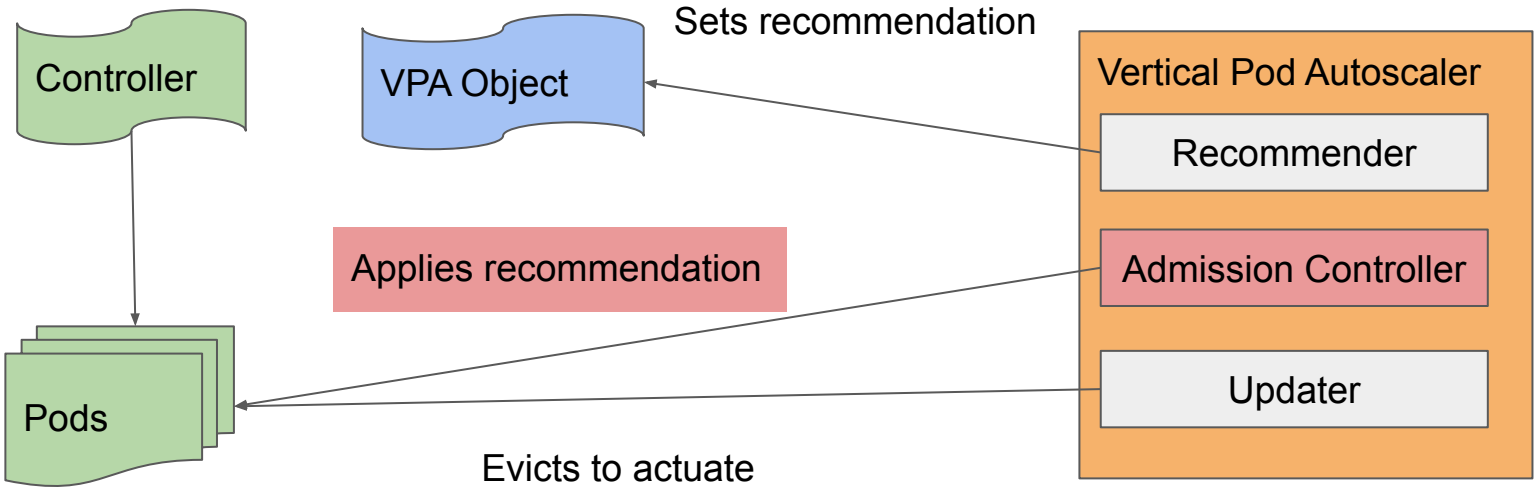
- What does Vertical Pod Autoscaler do;
- Enhancement: Alternative recommender support;
- Enhancement: Per VPA object min replicas;
- Releases.

What Vertical Pod Autoscaler does



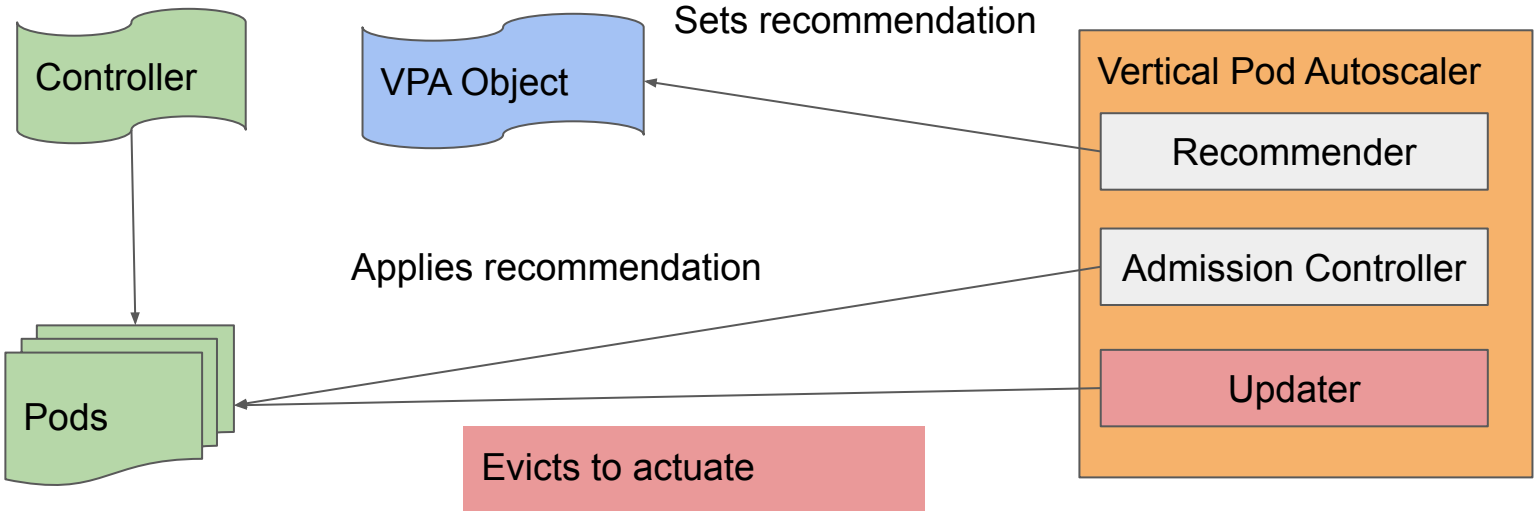
All modes: Off, Initial, and Auto / Recreate.

What Vertical Pod Autoscaler does



Modes: Initial, and Auto / Recreate.

What Vertical Pod Autoscaler does



Only in Auto / Recreate mode.

Alternative Recommender Support - Why

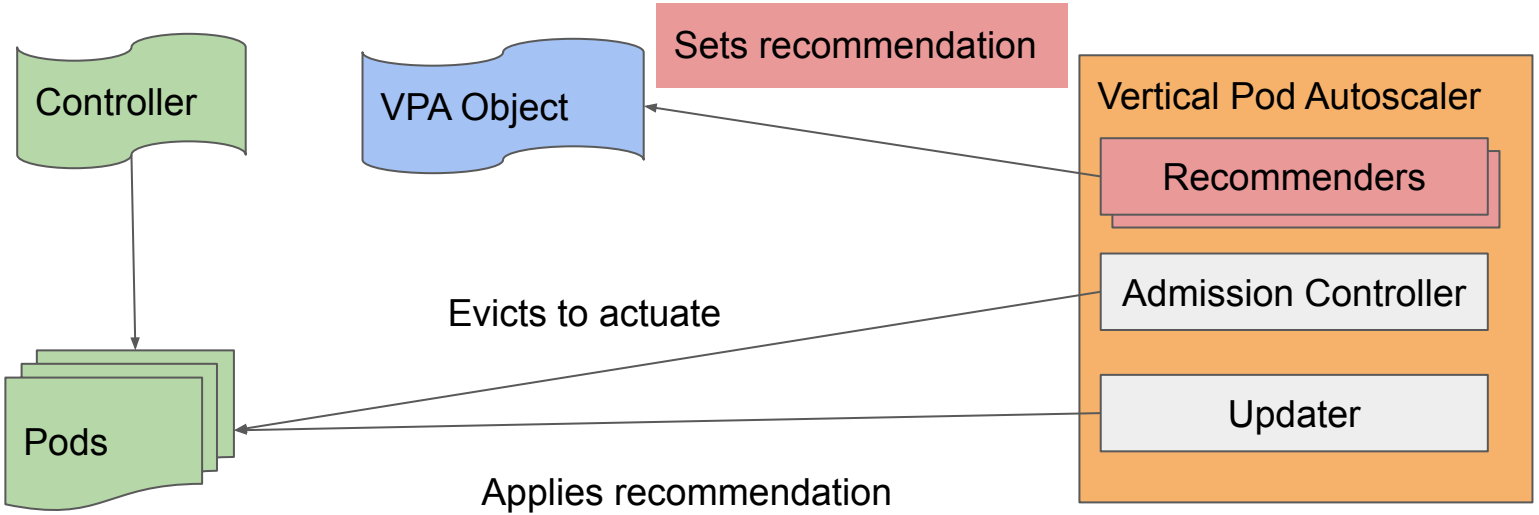
Different usage patterns:

- Weekly vs longer;
- Making window longer slows down reaction.

Different requirements:

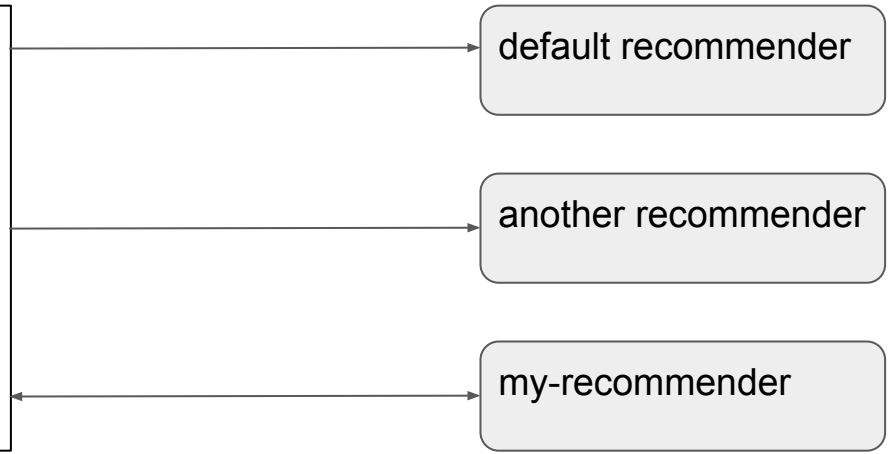
- Need to process load increase when it happens vs can take a while.

Alternative Recommender Support - what



Alternative Recommender Support - usage

```
apiVersion: autoscaling.k8s.io/v1
kind: VerticalPodAutoscaler
  ...
  spec:
  recommenders:
  - name: my-recommender
```



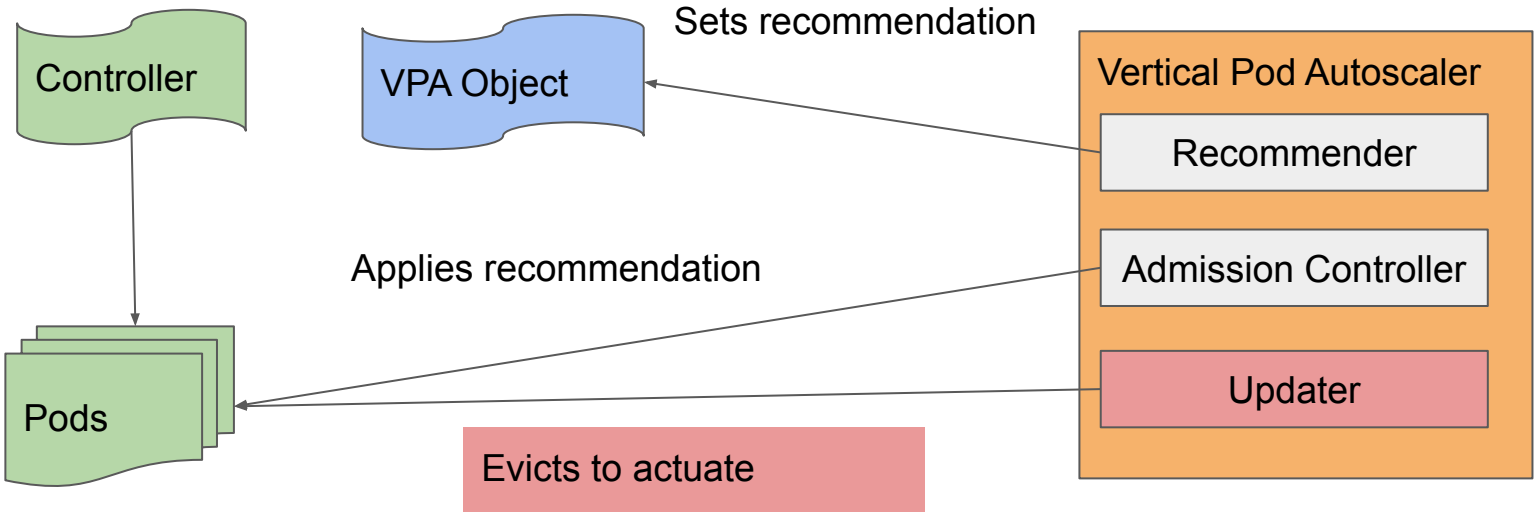
Setting up recommenders

- You have to implement your own
  - For now (hopefully)
- Only one recommender can write to a VPA object
  - Otherwise recommendations will flap
- Recommender can recognize more than one name
- Default recommender writes recommendation:
  - When no recommender is specified (for backward compatibility)
  - When “default” recommender is explicitly specified

Per VPA object MinReplicas - what & why

- It’s about evicting pods to apply a new recommendation
- By default VPA Updater won’t evict pod if it’s the only one running in its controller
  - Because that will definitely disrupt operations while the pod restarts
- This is a problem if expect to have only one pod in a controller
- There was `--min-replicas` flag but:
  - It changes behavior for all controllers (and possibly you might want different behavior for different controllers)
  - It doesn’t work if you don’t manage the cluster

Per VPA object MinReplicas - Where



Per VPA object MinReplicas - how

```
apiVersion:
autoscaling.k8s.io/v1
kind:
VerticalPodAutoscaler
  name: vpa2
  updatePolicy:
    minReplicas: 1
```

Releases

- Ad-hoc before
  - 0.9.2 on 2021-01-18
  - 0.10.0 on 2022-01-26
- We want to do them when new K8s release happens (so 3 / year)

Learn More

- KEP: Support Customized Recommenders for Vertical Pod Autoscalers
- KEP: MinReplicas per VPA object
- Ideas for the future:
  - Recommender-specific params
  - Multiple recommendations visible in one VPA object to make comparison and choice easier
  - Making default recommender more flexible so you can tweak its params and run multiple instances with different params under different names



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SIG Autoscaling Community

The SIG Wants Your Help

We own a lot for the number of maintainers we have, this also means we have lots of opportunities!

- Feature requests and implementation
- Bug triage/response
- Infrastructure Improvements

The SIG Wants Your Help

- Expand our maintainers
- Improve extensibility of our owned subprojects

Thanks!

Community Charter

- https://github.com/kubernetes/community/tree/master/sig-autoscaling

Mailing List

- https://groups.google.com/g/kubernetes-sig-autoscaling

Office Hours

- https://docs.google.com/document/d/1RvhQAEIrVLHbyNnuaT99-6u9ZUMp7BfkPupT2LAZK7w

Join us on Kubernetes Slack in the #sig-autoscaling channel