How Kubernetes Initializers Work

Di Xu
Kubernetes Member
@dixudx

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Admission Controllers

Comm only Used

AlwaysPullImages, DefaultStorageClass, DefaultTolerationSeconds, LimitRanger, NamespaceLifecycle, NamespaceAutoProvision, NamespaceExists, NodeRestriction, PersistentVolumeLabel, PodPreset, PodSecurityPolicy, Priority, ResourceQuota, ServiceAccount, SecurityContextDeny

New Added in v1.9

ExtendedResourceToleration

Admission Controllers: Disadvantages

- Must compiled together with Kubernetes binaries;
- Hard to customized by maintaining a fork;
- Not dynamic:
  - Only configurable with *--admission-control* flag;
  - Re-deploy (may have no authority);

Use Cases

Dynamic Admission Control

- Adding new nodes to the cluster, but don't want them get scheduled by default. (Easier than adding taints and tolerations, pod affinity/anti-affinity)
  - Want to reserve resources for dev/test for a team, for a single service;
  - Testing GPU nodes;
  - Temporary/Unstable nodes
    - Node flapping between Ready/NotReady with PLEG issues (#45419);
    - Node maintainence;
- Time-based Resources Allocation (Day and Night, Holidays, etc);
- Enforcing all container images to come from a particular registry, and prevent other images;
- TPR (Third Party Resources);
- ……

Initializers And Web Hooks

- Initializers
- Webhooks
  - HTTP callbacks to receive admission requests;
  - Not allowed to mutate the admission request in any way;
  - Must support TLS;
  - Better performance than Initializers;

What Are Initializers

- Similar to admission controller plug-ins, but different;
- A list of pending pre-initialization tasks (uninitialized), stored in every object's *METADATA* (e.g., "AddMyCorporatePolicySidecar");
- *A customized controller;*

Initializers: Status Quo

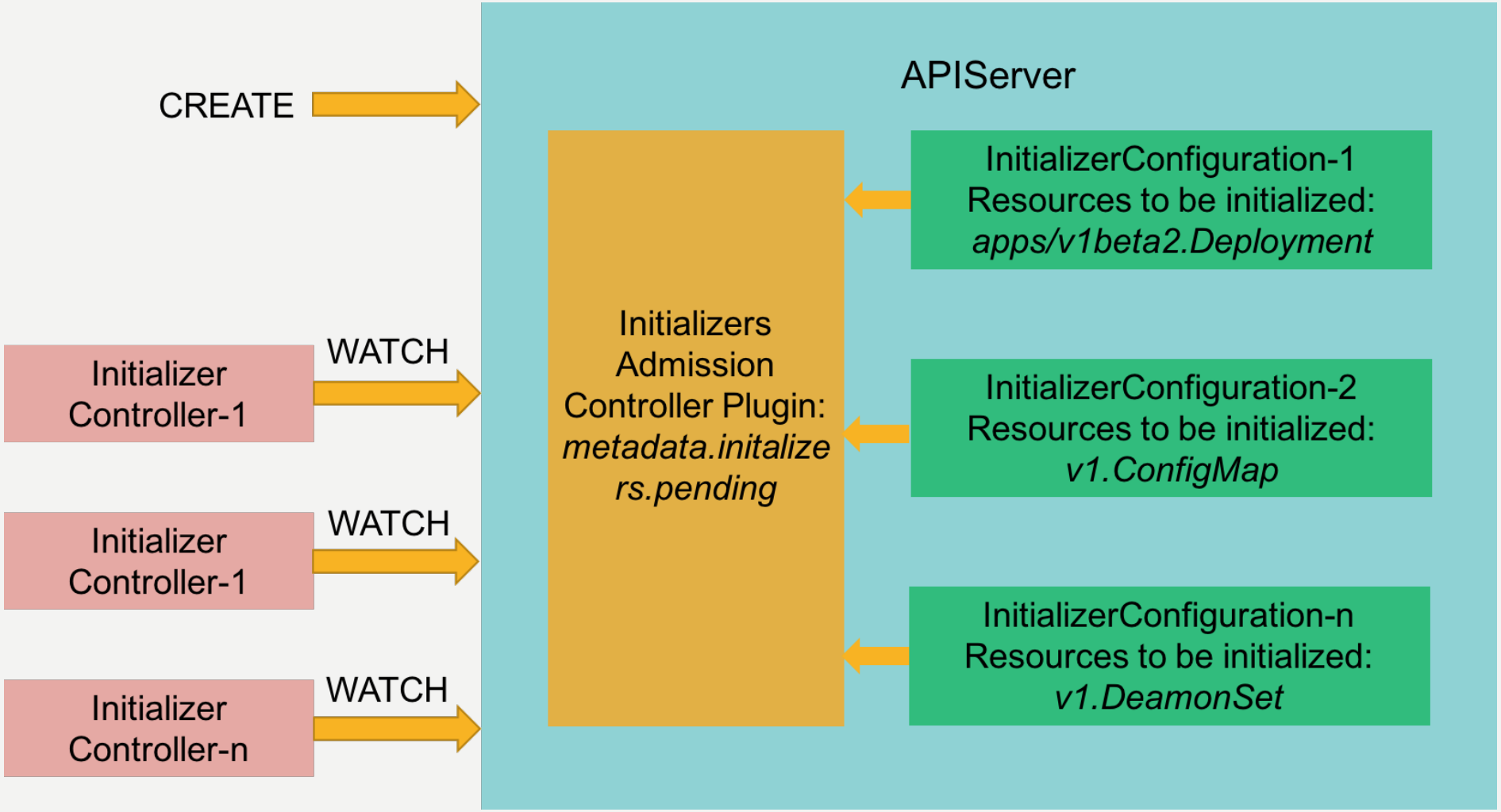
- First introduced in v1.7 (alpha). Only enabled in API.
  - requested by using the query parameter, "*?includeUninitialized=true*"
- Enabled in CLI in v1.8 (PR #50497).
  - New global flag *"--include-uninitialized*";
  - Add flag to kubectl annotate, apply, edit-last-applied, delete, describe, edit, get, label, set;
  - Ignored by default only if the names of the objects are provided.

CLI Usage

	annotate/edit-last-applied/delete/edit/label/get/set xyz	apply	describe
Default Value	false	--prune	true
--all=true	true	true	true
--selector=xyz	false	false	false
Explicit set flag			

- *--all*
  - include the uninitialized objects by default unless explicitly set *--include-uninitialized=false*
- *--selector*
  - does not include the uninitialized objects by default unless explicitly set *--include-uninitialized=true*

How Initializers Work



Enable Initializers

- Alpha feature. disabled by default.
- *--admission-control=Initializers* flag when starting kube-apiserver;
- *--runtime-config=admissionregistration.k8s.io/v1alpha1* when starting kube-apiserver;
- *--feature-gate=Initializers=true* since v1.8;

Initializers: Under The Covers

- Not scheduled directly?
- Saved on APIServer? *?includeUninitialized=true*
- Invisible for schedulers and controller managers?
- Initializers block Create requests
- Parallel? Too slow? (API support for partial orders among initializers #50714)

Initializers: Under The Covers (Cont.)

- Allow administrators to bypass initialization by setting an empty initializers list;
- *sub-resource action should be denied until the object is initialized?*
- Mirror pods are exempt from initialization;
- Pending initializers are *SORTED*!!!

PodPreset VS Initializers

- PodPreset:
  - injects certain information into pods (use label selectors) at creation time.
  - The information can include secrets, volumes, volume mounts, and environment variables;
- Intializers:
  - Dynamic and pluggable;
  - More customized; For all kinds of objects;
  - Easy to use *client-go* to handle common actions;

Developing Your Own Initializer

- List/Watch functions specifying IncludeUninitialized=true and targeting all namespaces
- Use a PATCH to perform the update;
- Set empty pending initializers to skip blocking initializer controller;
- Make sure your initializer doesn't go down and handles the objects quickly;
- Sample Gist

Some Warnings

- Never forget about the ORDER!!!
  - matches *metadata.initializers.pending[0]*
  - Ensure PVL controller is next pending initializer before labeling the PV (#56831)
- Cautious with the powerful initializers.
- Not everyone should be required to write an initializer.
- Uptime of Initializers: resources will get stuck in “uninitialized” state indefinitely

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Q&A