GitOps

Introduction

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GitOps Principles

v0.1.0

1 The principle of declarative desired state

A system managed by GitOps must have its Desired State expressed declaratively as data in a format writable and readable by both humans and machines.

2 The principle of immutable desired state versions

Desired State is stored in a way that supports versioning, immutability of versions, and retains a complete version history.

3 The principle of continuous state reconciliation

Software agents continuously, and automatically, compare a system's Actual State to its Desired State. If the actual and desired states differ for any reason, automated actions to reconcile them are initiated.

4 The principle of operations through declaration

The only mechanism through which the system is intentionally operated on is through these principles.

GitOps in K8s

In the case of Kubernetes, GitOps deployments happen in the following manner:

A GitOps agent is deployed on the cluster.

- The GitOps agent is monitoring one or more Git repositories that define applications and contain Kubernetes manifests (or Helm charts or Kustomize files).
- Once a Git commit happens the GitOps agent is instructing the cluster to reach the same state as what is described in Git.
- Developers, operators. and other stakeholders perform all changes via Git operations and never directly touch the cluster (or perform manual kubectl commands).

Traditional deployment without GitOps:

1 - A developer commits source code for the application.

2 - A CI system builds the application and may also perform additional actions such as unit tests, security scans, static checks, etc.

3 - The container image is stored in a Container registry.

4 - The CI platform (or other external system) with direct access to the Kubernetes cluster creates a deployment using a variation of the “kubectl apply” command.

5 - The application is deployed on the cluster.

- The cluster state is manually decided by kubectl commands or other API access.
- The platform that deploys to the cluster is having full access to the Kubernetes cluster from an external point.

Modifying the process with GitOps

The first steps are the same.

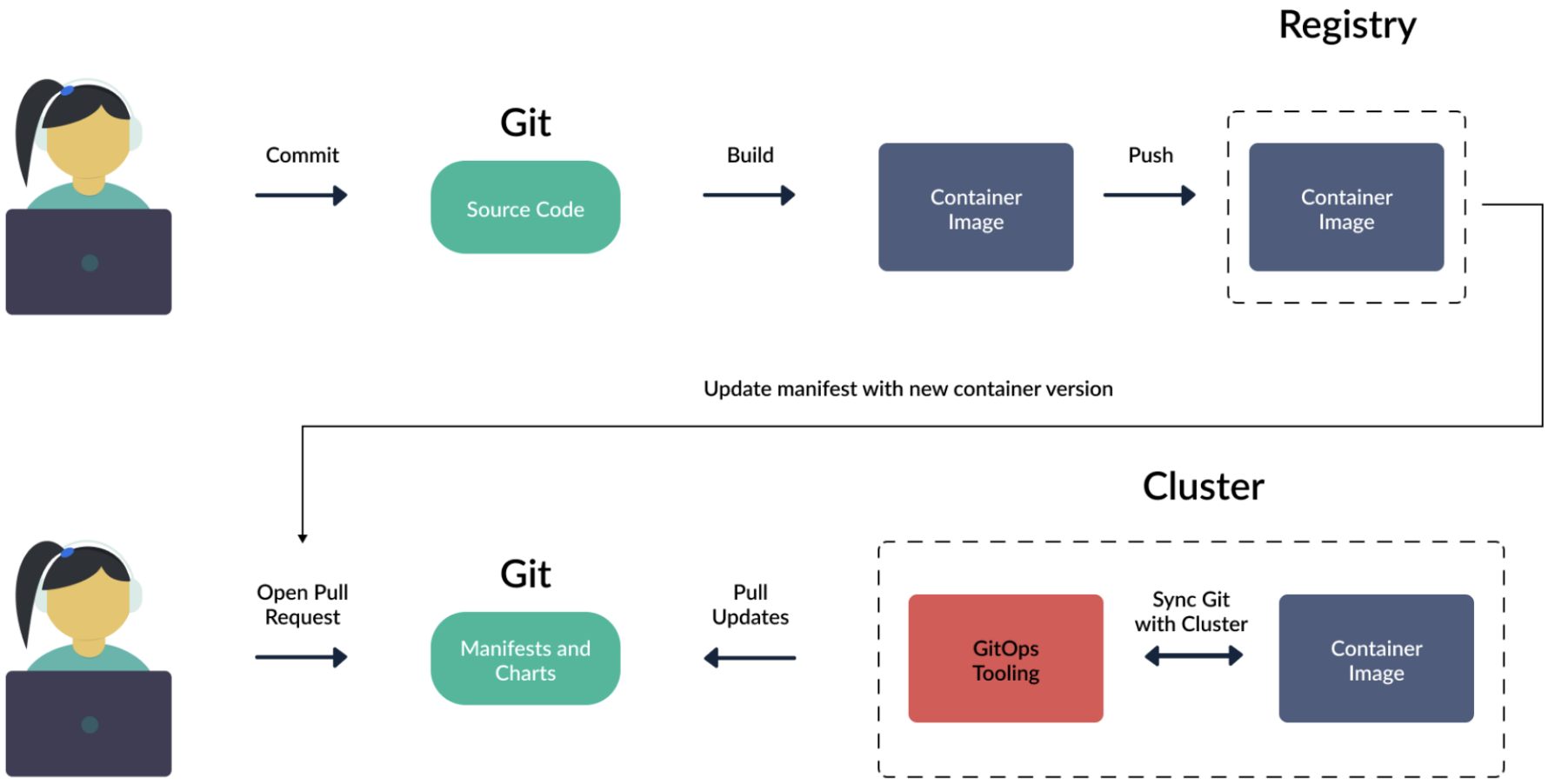
1 - A developer commits source code for the application and the CI system creates a container image that is pushed to a registry.

2 - Nobody has direct access to the Kubernetes cluster.

3 - There is a second Git repository that has all manifests that define the application.

4 - Another human or an automated system changes the manifests in this second Git repository.

5 - A GitOps controller that is running inside the cluster is monitoring the Git repository and as soon as a change is made, it changes the cluster state to match what is described in Git.


Registry
Git
Commit
Source Code
Build
Container Image
Push
Container Image
Update manifest with new container version
Cluster
Open Pull Request
Git
Manifests and Charts
Pull Updates
GitOps Tooling
Sync Git with Cluster
Container Image

The key points here are:

- The state of the cluster is always described in Git. Git holds everything for the application and not just the source code.
- There is no external deployment/CI system with full access to the cluster. The cluster itself is pulling changes and deployment information.
- The GitOps controller is running in a constant loop and always matches the Git state with the cluster state.