Kubernetes Config Management Landscape

Tomasz Tarczyński, Gigaset
Agenda

1. Configuration Management
2. Kubernetes
3. Declarative application management
4. Tools Landscape

@ttarczynski
“Of all the problems we have confronted, the ones over which the most brainpower, ink, and code have been spilled are related to managing configurations.”

Borg, Omega, and Kubernetes (2016)
Brendan Burns, Brian Grant, David Oppenheimer, Eric Brewer, John Wilkes
Configuration Management

- Infrastructure as Code
- GIT – as a single source of truth
- Tools:
  - CFEngine / Puppet / Chef / Ansible
Configuration Management

- **Tools:**
  - **CFEngine** (1993)  Mark Burgess
  - **Chef** (2009)      Adam Jacob
  - **Ansible** (2012)   Michael DeHaan
- **Declarative** – describe the desired state
- **Resources automation** – Types / providers
- **DSL** – a simple and constrained language
- **Templates** – ERB
- **Modules** – public and private
- **Code / data separation** – Hiera
1. Configuration Management
2. Kubernetes
3. Declarative application management
4. Tools Landscape
● Control plane provides a Declarative API
● Declare the desired state
● Control plane makes sure that the actual state converges to the desired state
Kubernetes

```yaml
apiVersion: apps/v1
kind: Deployment

metadata:
  name: nginx-deployment

spec:
  selector:
    matchLabels:
      app: nginx
  replicas: 2

template:
  metadata:
    labels:
      app: nginx
  spec:
    containers:
      - name: nginx
        image: nginx:1.14.2
        ports:
          - containerPort: 80

apiVersion: v1
kind: Service

metadata:
  name: nginx

labels:
  app: nginx

spec:
  ports:
  - port: 80
    protocol: TCP
  selector:
    app: nginx
```
Counting the YAMLs (real env example)

- 54 standard k8s resource types
- 50 CRD types
- 790 API object (user-provided)
- 5,500 API objects (total)
- 107,000 lines of YAML (user-provided)
- 507,000 lines of YAML (total)
“Are we all YAML engineers now?”
– Bob Walker at CfgMgmtCampt 2018
● “Are we all YAML engineers now?”
  – Bob Walker at CfgMgmtCampt 2018
1. Configuration Management
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3. Declarative application management
4. Tools Landscape
“Declarative application management in Kubernetes”
– article by Brian Grant, 2017
Kubernetes: Declarative application management

● **Central Idea:**
  ○ Composable tools
  ○ Manipulate configuration data
  ○ Declarative data model

● **NOT:** Configuration as Code
Configuration as Data
- Code goes into controllers (control loops)
- Data in native Kubernetes API format
Kubernetes: Declarative application management

- Declarative – k8s API
- Resources automation – k8s controllers
- DSL
- Templates
- Modules
- Code / data separation – controllers / API
1. Configuration Management
2. Kubernetes
3. Declarative application management
4. Tools Landscape
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
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- List by Brian Grant
- Currently 125 tools on the list
Approaches to config:
- Fork
- Overlay / patch
- Parametrization
- Generation
- DSL (domain-specific language)
- GPL (general-purpose language)
Tools Landscape – tools (1–3)

- **3 most widely used tools:**
  - Jsonnet (2014) 4,5k ⭐
  - Helm (2015) 18,6k ⭐
  - Kustomize (2018) 6,5k ⭐
Tools Landscape – tools (1–3)

- **Jsonnet**
  - Data templating language (DSL)
  - Generates JSON
  - Hermetic / side-effect free
  - Superset of JSON
Tools Landscape – tools (1–3)

- **Helm**
  - Template YAML (with Go template)
  - Package cfg into charts
  - Simple sharing (public / private repos)
  - Manage releases (in Kubernetes)
Kustomize
- Template-free / DSL-free
- Plain YAML
- Customize Kubernetes objects
- Built into kubectl
Tools Landscape – tools (4–5)

- **GitOps tools:**
  - Flux CD (2016) 5,9k ★
  - Argo CD (2018) 4,6k ★
Tools Landscape – tools (4–5)

- **GitOps tools:**
  - Keep Kubernetes clusters in sync with Git
  - Use operator in the cluster

- **Integrations:**
  - Flux CD – Helm, Kustomize
  - Argo CD – Helm, Kustomize, Jsonnet
More tools:
- Kapitan (2017) 1,3k⭐️
- Tanka (2019) 1,2k⭐️
- Kpt (2019) 0,7k⭐️
Tools Landscape – tools (6–8)

- Kapitan:
  - Template engines – Jsonnet, Jinja2, Kadet, Helm
  - Inventory – YAML-based, hierarchical
  - Compile k8s manifests and store in git
Tools Landscape – tools (6–8)

- Tanka:
  - By Grafana Labs
  - Powered by Jsonnet
  - Jsonnet Kubernetes library
  - Replacement for ksonnet
  - Integrates with: Helm, Kustomize
Tools Landscape – tools (6–8)

- **Kpt:**
  - Treat configuration as data
  - Provides a packaging solution (Git-based)
  - Run functions to: generate, transform, validate cfg
  - Integrates with: Kustomize, Helm, (anything via fns)
More tools:

- Ytt (2019) 0,7k ⭐
- Cue (2019) 2,4k ⭐
- **ytt:**
  - YAML structure-aware templating
  - Based on Starlark (Python-like language)
  - Conceptually close to Jsonnet
  - Supports patch/overlay approach
Tools Landscape – tools (9–10)

- **Cue:**
  - Data constraint language
  - Superset of JSON
  - Data validation
  - Reduce boilerplate
• **IaC tools:**
  - Terraform (2014) 25,2k ★
  - Pulumi (2016) 7,3k ★
  - Cdk8s (2020) 1,9k ★
Tools Landscape – tools (11–13)

- **Terraform:**
  - **HCL** (HashiCorp Configuration Language)
    - JSON compatible DSL
    - Declarative
  - **Providers:**
    - **Kubernetes** – 34 core resource types
    - **Kubernetes-alpha** – any resource (incl. CRDs)
    - **Helm** – manage charts
Tools Landscape – tools (11–13)

- **Pulumi:**
  - Infrastructure as Code **SDK**
  - General-purpose programming language:
    - JavaScript, TypeScript, Python, Go, .NET
  - Supports: **Helm**, **Kustomize**, plain YAML
  - **SDK API:**
    - 100% compatible with the Kubernetes API
    - Supports CRDs
Cdk8s:
  - CDK for Kubernetes
  - General-purpose programming language:
    - Typescript, JavaScript, Python, and Java
  - Supports: Helm, plain YAML
  - Covers:
    - 100% of the Kubernetes API
    - CRDs
# Tools Landscape – summary

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<th>Forks</th>
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<th>Kustomize</th>
<th>Jsonnet</th>
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Tools Landscape – CNCF Tech Radar

CNCF Technology Radar

Continuous Delivery, June 2020

GitHub Actions

Team City

Tekton CD

Travis CI

Jenkins

ASSESS

Spinnaker

Jenkins X

Kustomize

ARGO CD

TRIAL

Circle CI

GitLab

Flux

Helm

jsonnet

ADOPT

@ttarczynski
# Tools Landscape – CNCF Tech Radar

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3. **Declarative application management in Kubernetes** – Brian Grant, 2017
4. **Kubernetes application management tools** – Brian Grant, 2017
5. **CNCF End User Technology Radar – Continuous Delivery** – CNCF, 2020
6. **All materials used for this talk** – me, 2021
7. **Tools comparison spreadsheet** – me, 2021
Thanks!

Tomasz Tarczynski
@ttarczynski

Gigaset