CONTINUOUS DELIVERY PIPELINE

nexa

Rodrigo Botti

nexa

Backend, Frontend, Ops, Fullstack (?)

NEXA: Integrations Team - Crawler, APIs, Ops, Fullstack (?)

GDG Campinas: Organizer

node JS
Java
HTML
CSS
JS
C#.NET

Blind Guardian
Ibanez
THE WITCHER WILD HUNT
GOD OF WAR
IRON MAIDEN

AGENDA

- Current Scenario
- Continuous Delivery
- Canary Release
- Tooling
- Future
- Q&A

!!! DISCLAIMER !!!

1.

SCENARIO

Technology
Platforms

MAIN TECHNOLOGIES

kubernetes

MAIN TECHNOLOGIES

MICROSERVICES
Advantages

MODULARITY

Reduced codebase, easier to reason about, develop, test and deploy.

Single responsibility.

PARALLELISM

Multiple teams working on separate services.

SCALABLE

Faster feature delivery.

Independent horizontal/vertical scaling and failure handling.

MICROSERVICES
Requirements

*** AUTOMATION ***

Automation is key for having speed, scalability / elasticity specially when dealing with a distributed services application.

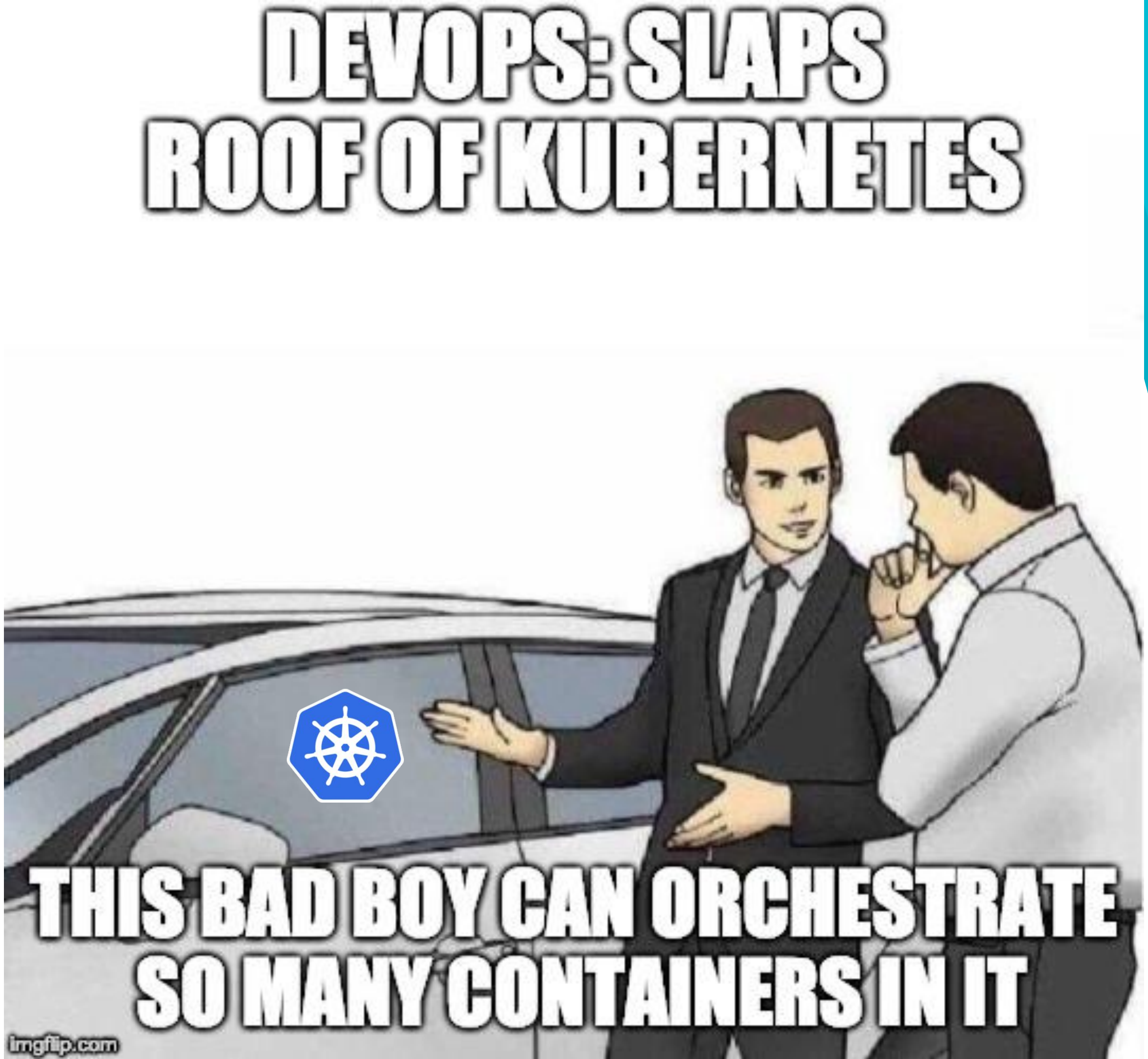
DISCOVERY

Service discovery by name: cloud-level DNS, service-mesh level DNS, registration, client-side load balancing.

OBSERVABILITY

Monitoring, metrics/health gathering, central tracing, APM, alarm management.

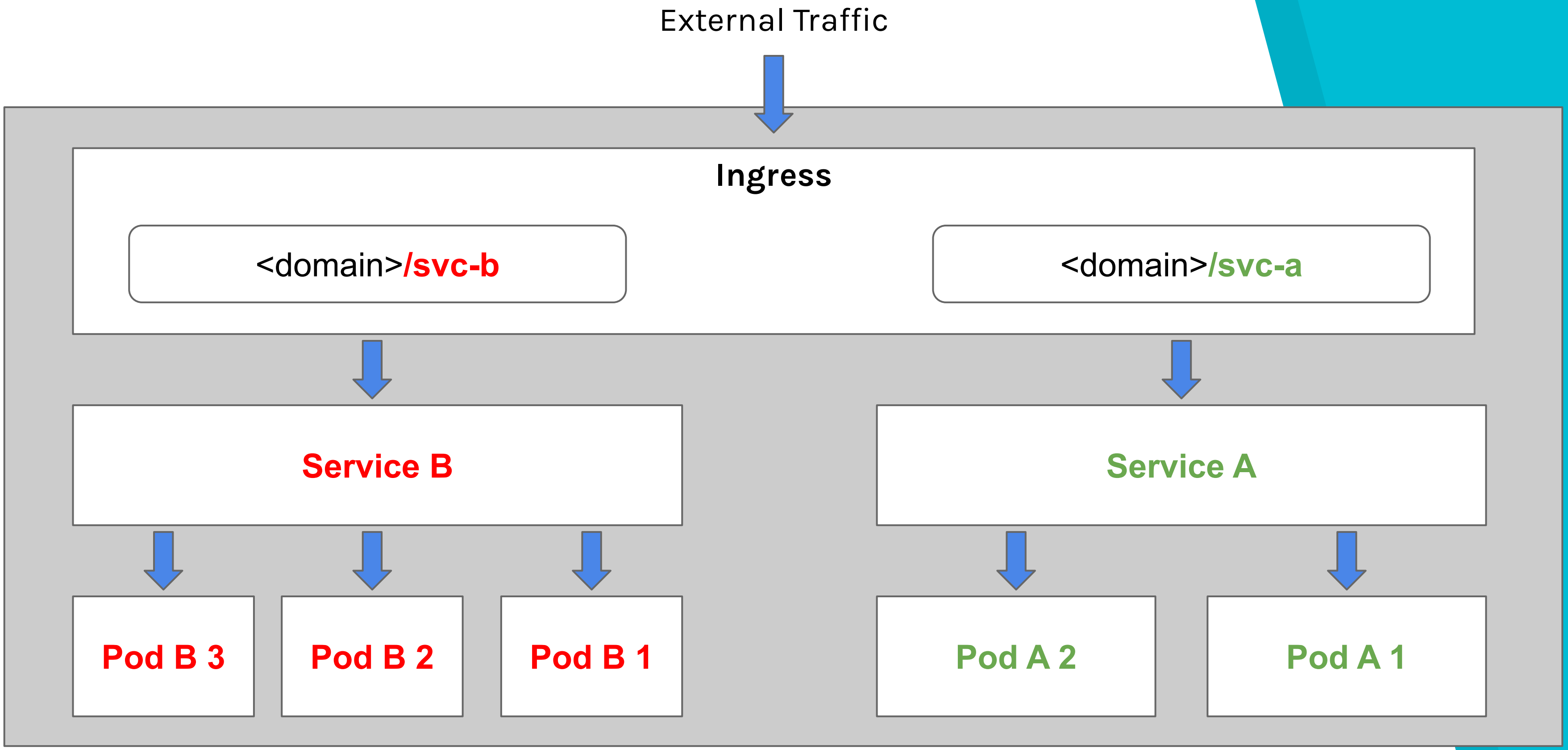
Avoid "needle in a haystack" debugging.


DEVOPS: SLAPS ROOF OF KUBERNETES
THIS BAD BOY CAN ORCHESTRATE SO MANY CONTAINERS IN IT
imgflip.com

MICROSERVICES
Anatomy (Kubernetes)

- Deployment
  - Pod: Container (Image) + Resource limits
  - Replica set: count + deploy strategy
- Service
  - Deployment load balancer
  - Ingress traffic
- HorizontalPodAutoScaler
  - Deployment replica set horizontal scaling
- ServiceMonitor
  - Prometheus metrics exporter
- Ingress (*)
  - Cluster gateway L7 router

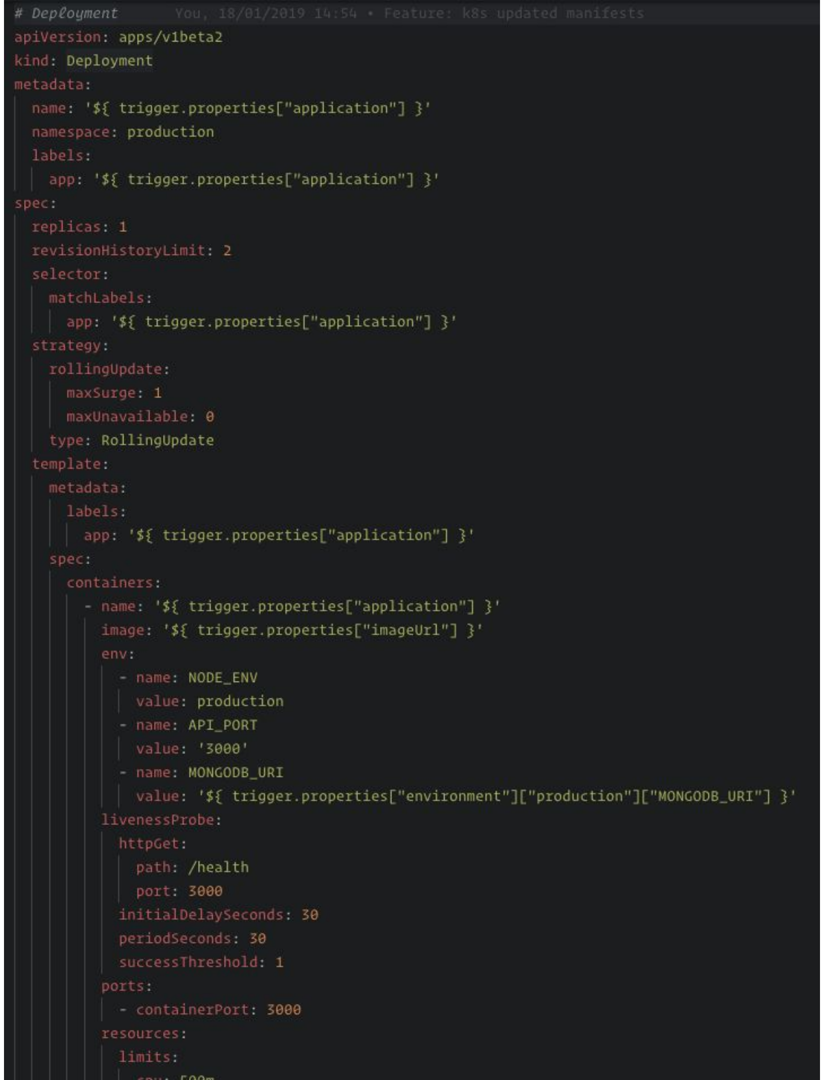
MICROSERVICES
Anatomy (Kubernetes)



SHOW ME THE CODE!

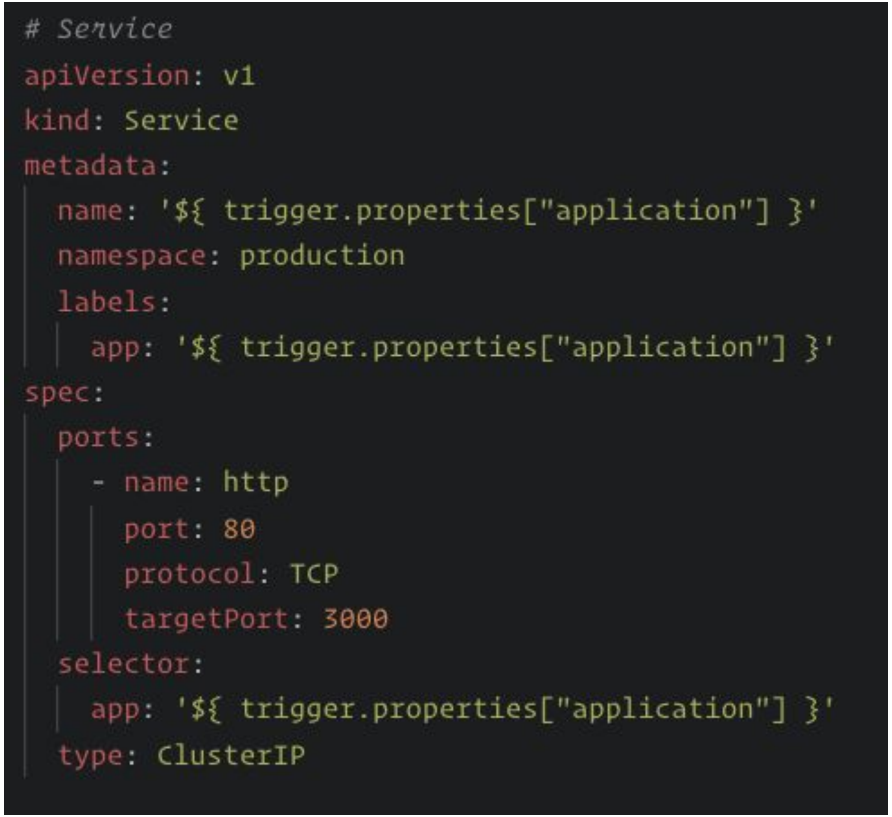
kubernetes

Deployment



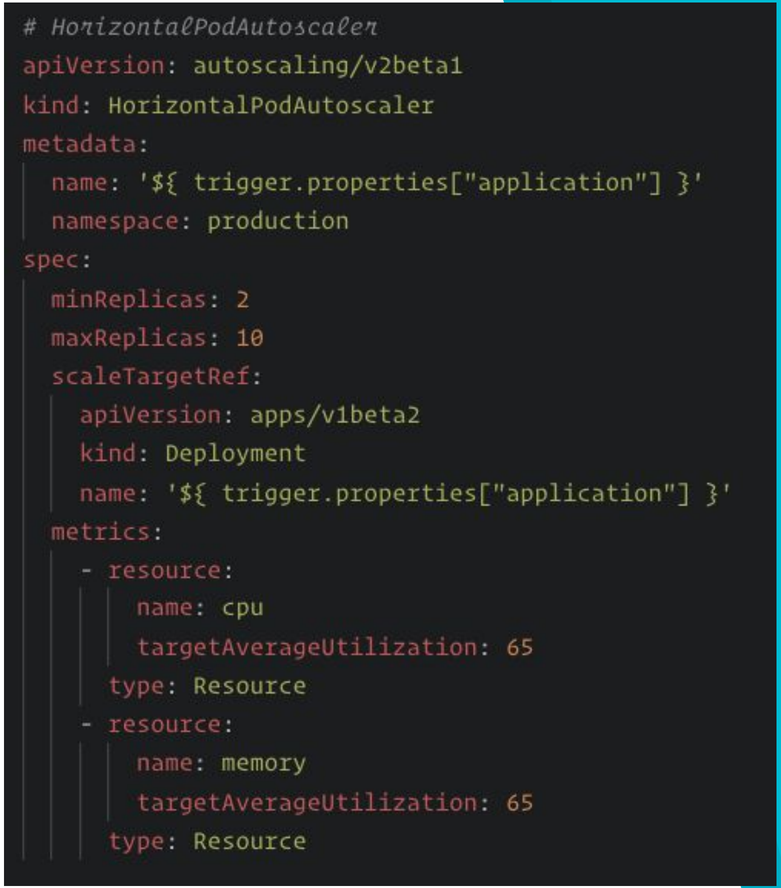
```
# Deployment        You, 18/01/2019 14:54 • Feature: k8s updated manifests
apiVersion: apps/v1beta2
kind: Deployment
metadata:
  name: '${ trigger.properties["application"] }'
  namespace: production
  labels:
    app: '${ trigger.properties["application"] }'
spec:
  replicas: 1
  revisionHistoryLimit: 2
  selector:
    matchLabels:
      app: '${ trigger.properties["application"] }'
  strategy:
    rollingUpdate:
      maxSurge: 1
      maxUnavailable: 0
    type: RollingUpdate
  template:
    metadata:
      labels:
        app: '${ trigger.properties["application"] }'
    spec:
      containers:
        - name: '${ trigger.properties["application"] }'
          image: '${ trigger.properties["imageUrl"] }'
          env:
            - name: NODE_ENV
              value: production
            - name: API_PORT
              value: '3000'
            - name: MONGODB_URI
              value: '${ trigger.properties["environment"]["production"]["MONGODB_URI"] }'
          livenessProbe:
            httpGet:
              path: /health
              port: 3000
            initialDelaySeconds: 30
            periodSeconds: 30
            successThreshold: 1
          ports:
            - containerPort: 3000
          resources:
            limits:
              cpu: 500m
```

Service



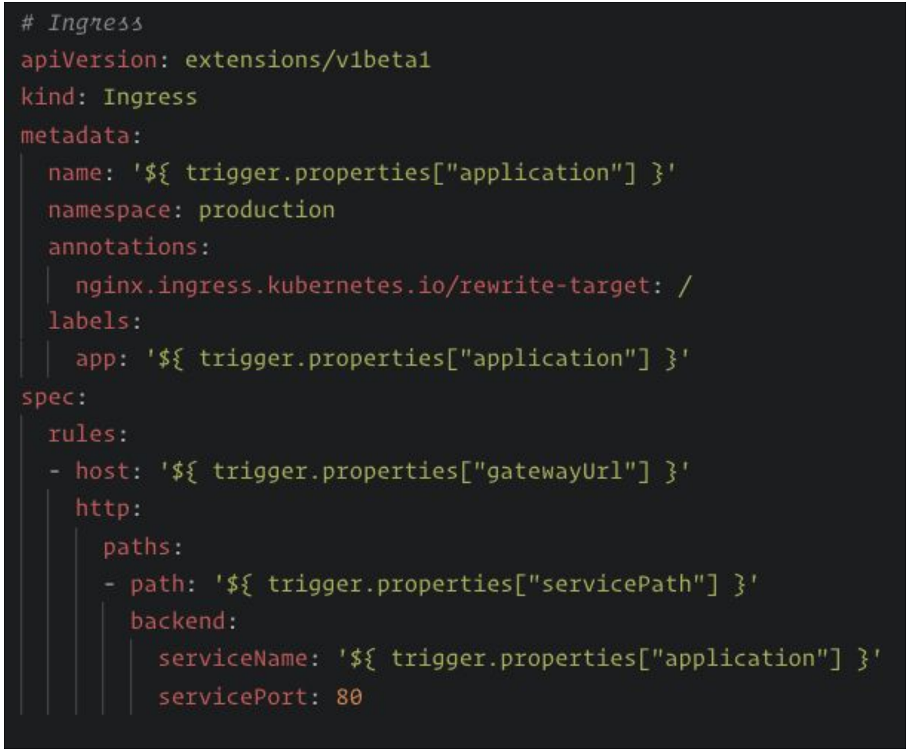
```yaml
# Service
apiVersion: v1
kind: Service
metadata:
  name: '${ trigger.properties["application"] }'
  namespace: production
  labels:
    app: '${ trigger.properties["application"] }'
spec:
  ports:
    - name: http
      port: 80
      protocol: TCP
      targetPort: 3000
  selector:
    app: '${ trigger.properties["application"] }'
  type: ClusterIP
```

HPA



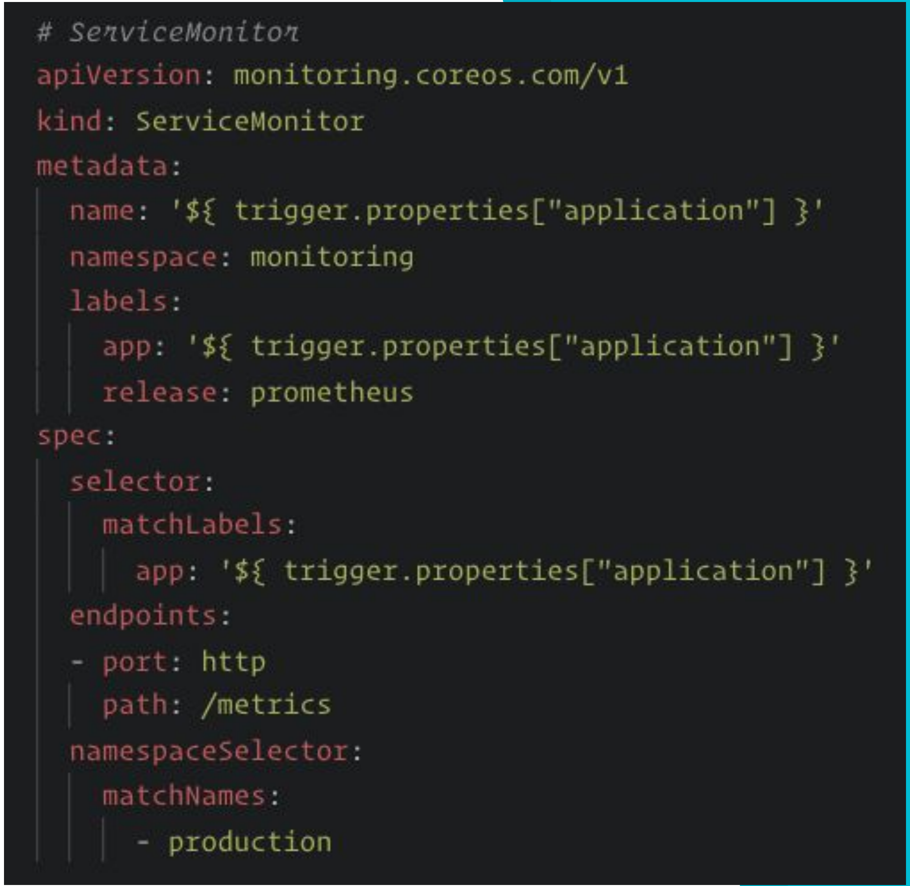
```yaml
# HorizontalPodAutoscaler
apiVersion: autoscaling/v2beta1
kind: HorizontalPodAutoscaler
metadata:
  name: '${ trigger.properties["application"] }'
  namespace: production
spec:
  minReplicas: 2
  maxReplicas: 10
  scaleTargetRef:
    apiVersion: apps/v1beta2
    kind: Deployment
    name: '${ trigger.properties["application"] }'
  metrics:
    - resource:
        name: cpu
        targetAverageUtilization: 65
      type: Resource
    - resource:
        name: memory
        targetAverageUtilization: 65
      type: Resource
```

Ingress



```yaml
# Ingress
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: '${ trigger.properties["application"] }'
  namespace: production
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
  labels:
    app: '${ trigger.properties["application"] }'
spec:
  rules:
  - host: '${ trigger.properties["gatewayUrl"] }'
    http:
      paths:
      - path: '${ trigger.properties["servicePath"] }'
        backend:
          serviceName: '${ trigger.properties["application"] }'
          servicePort: 80
```

SVC Monitor



```yaml
# ServiceMonitor
apiVersion: monitoring.coreos.com/v1
kind: ServiceMonitor
metadata:
  name: '${ trigger.properties["application"] }'
  namespace: monitoring
  labels:
    app: '${ trigger.properties["application"] }'
    release: prometheus
spec:
  selector:
    matchLabels:
      app: '${ trigger.properties["application"] }'
  endpoints:
  - port: http
    path: /metrics
  namespaceSelector:
    matchNames:
      - production
```

2.

CONTINUOUS DELIVERY

Concept
Pipeline

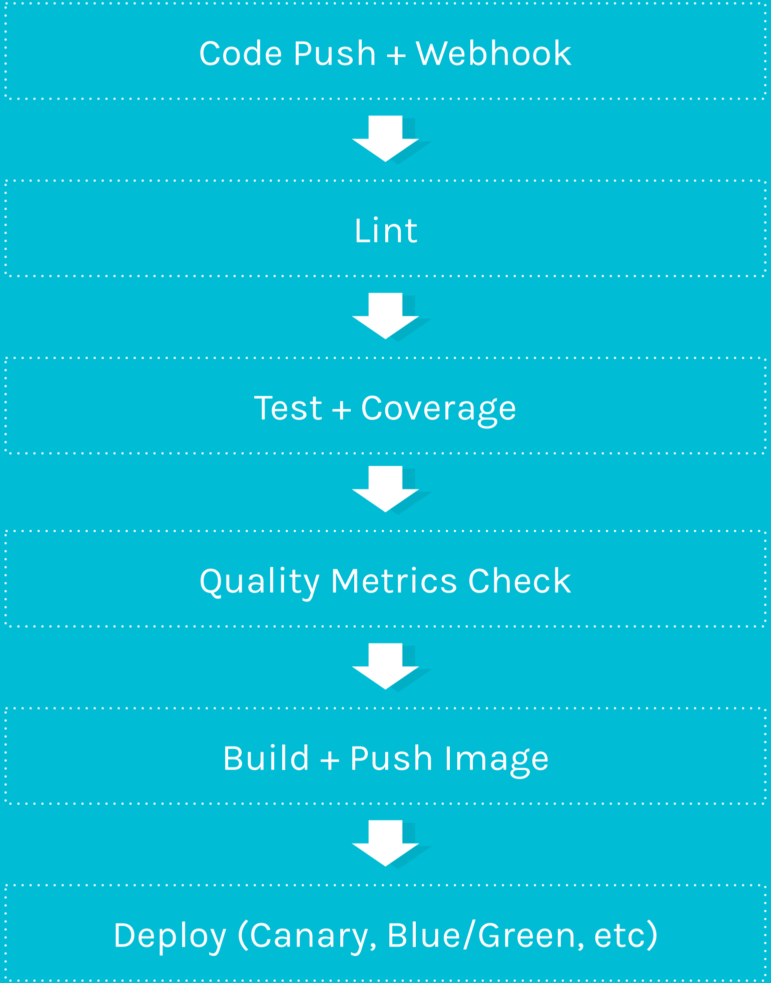
Produce software in short cycles

Reliably released at any time

Building, testing and releasing faster and more frequently

Straightforward and repeatable deployment process

PIPELINE



Code Push + Webhook

Lint

Test + Coverage

Quality Metrics Check

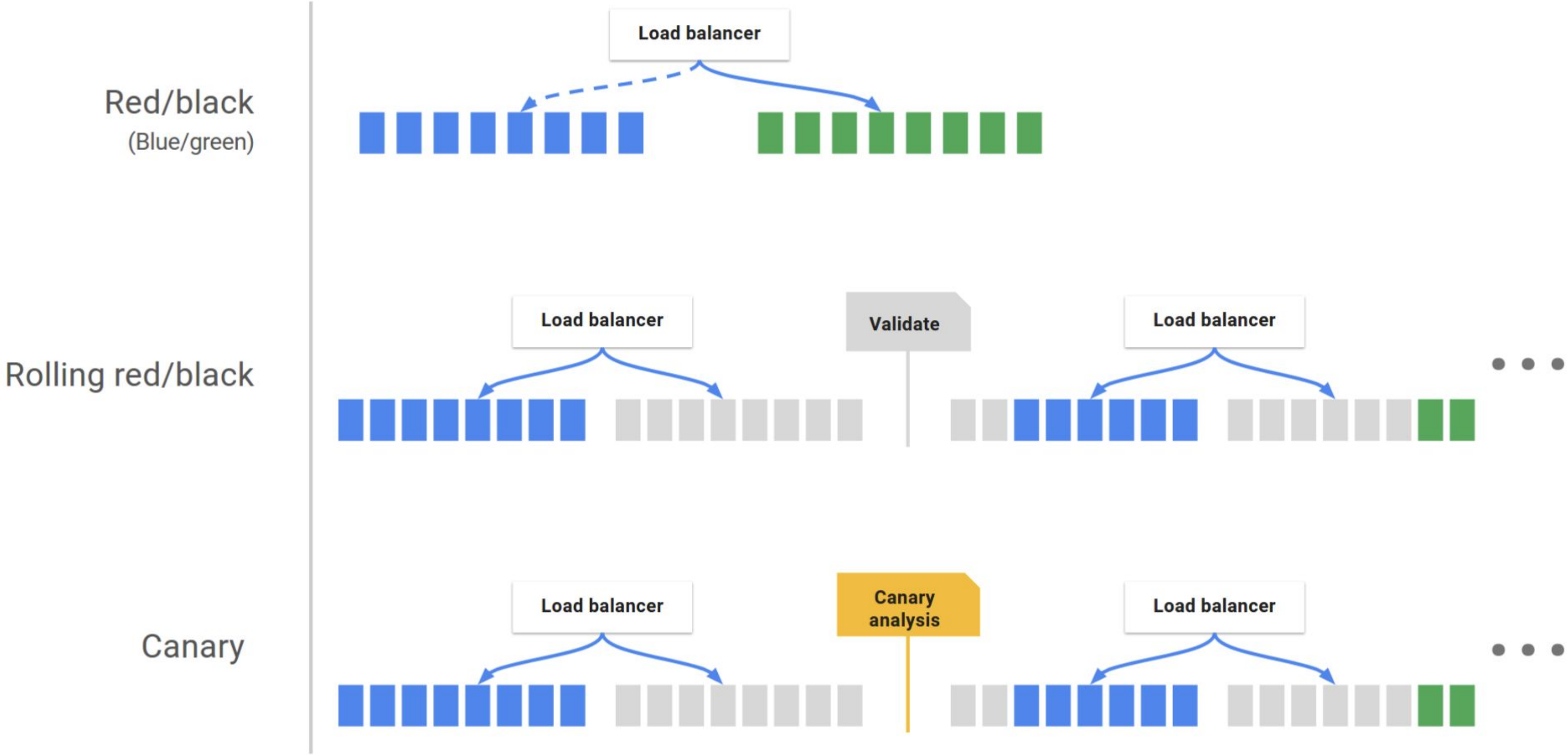
Build + Push Image

Deploy (Canary, Blue/Green, etc)

3.

CANARY RELEASE

Concept
Pipeline



Red/black
(Blue/green)

Load balancer

Rolling red/black

Load balancer

Validate

Load balancer

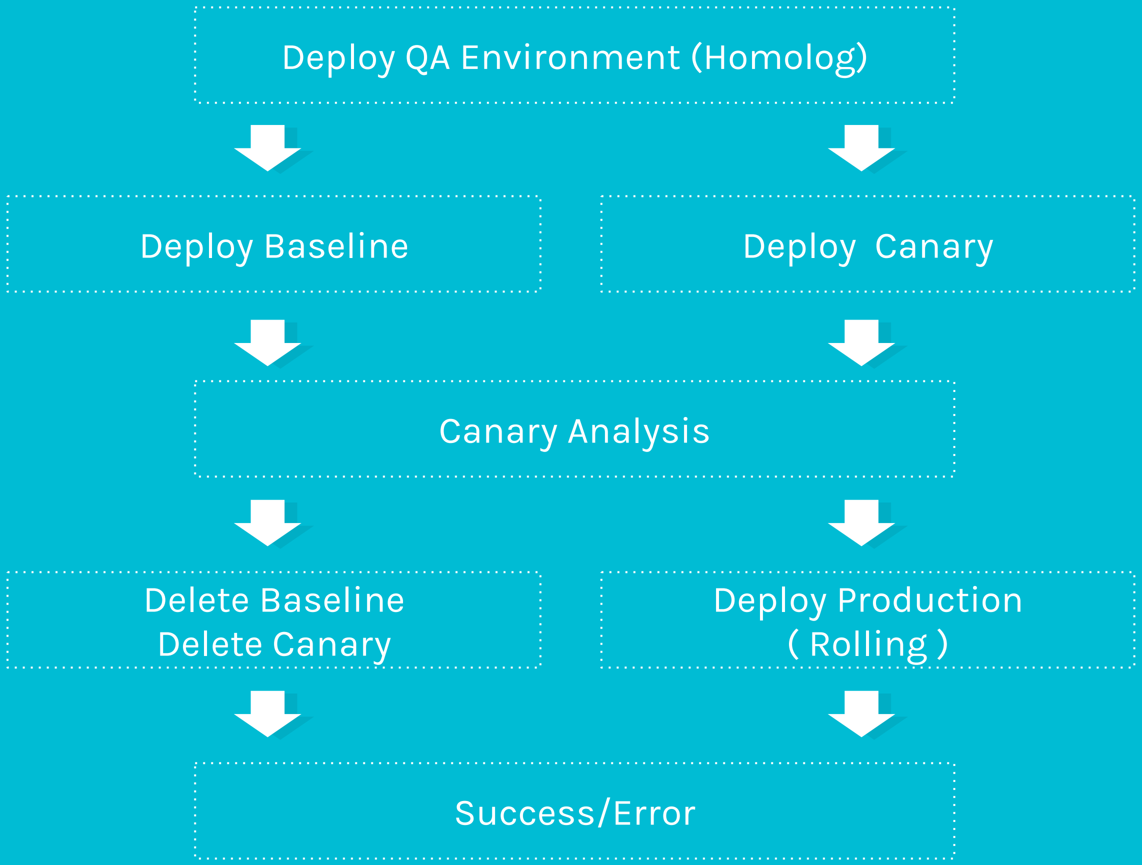
Canary

Load balancer

Canary analysis

Load balancer

PIPELINE



Deploy QA Environment (Homolog)

Deploy Baseline

Deploy Canary

Canary Analysis

Delete Baseline
Delete Canary

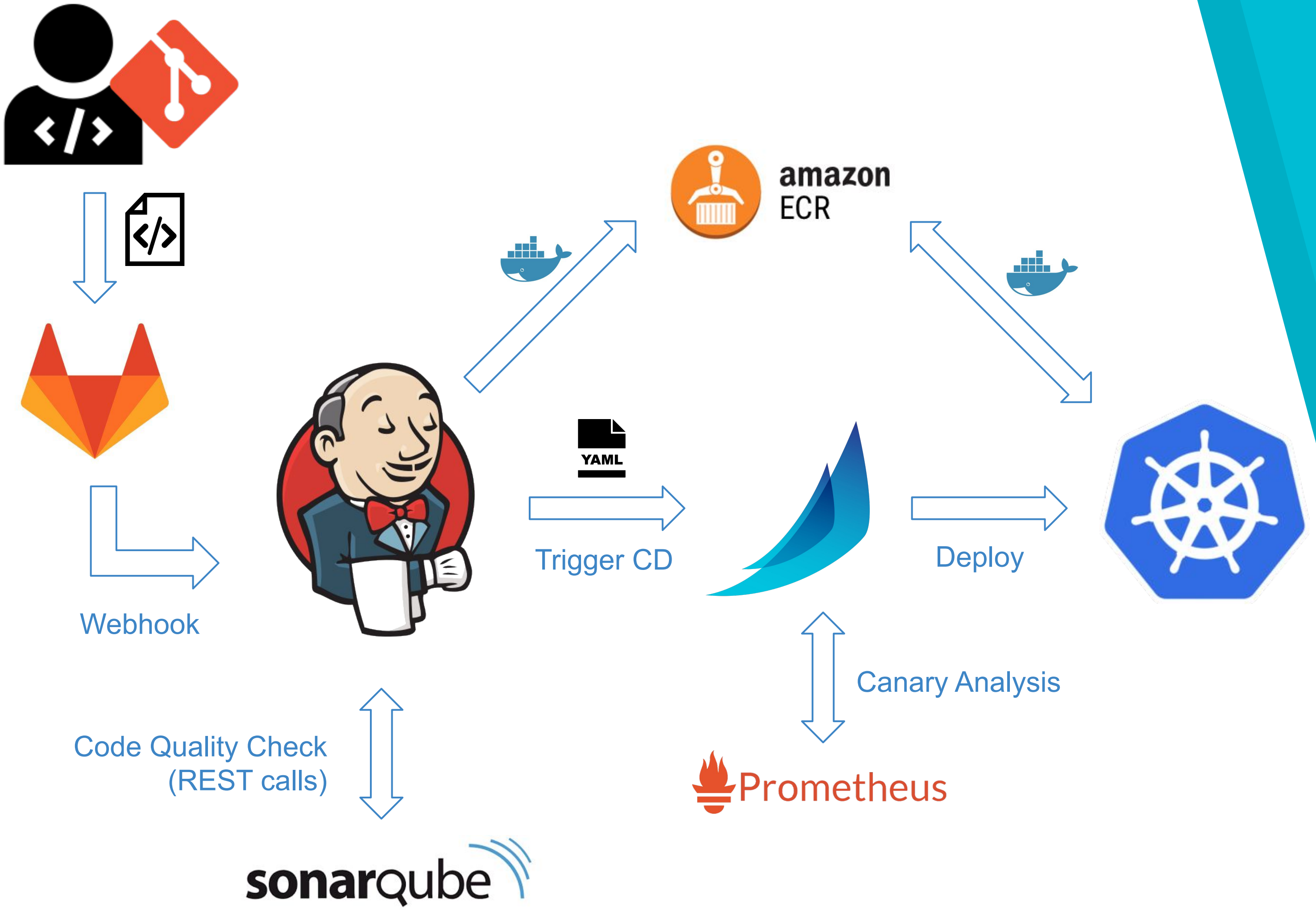
Deploy Production
(Rolling)

Success/Error

4.

TOOLS

Topology
Automation Server
Integration Tests
Code Quality
Deploy
Canary



Webhook

Trigger CD

Deploy

Canary Analysis

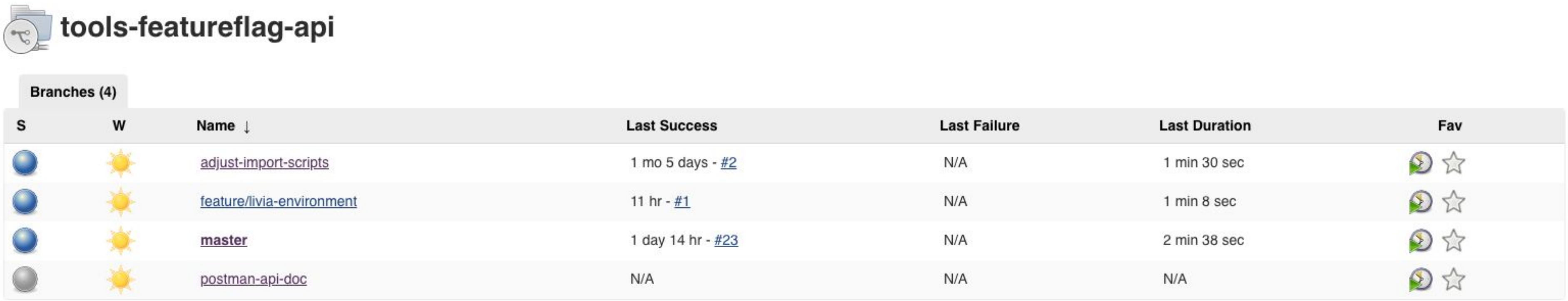
Code Quality Check
(REST calls)

(LEEEROOOOOOOOOOY…)
JENKINS

- Automation Server
- Pipeline
- Groovy DSL
- Plugins

(LEEEROOOOOOOOOY...)
JENKINS

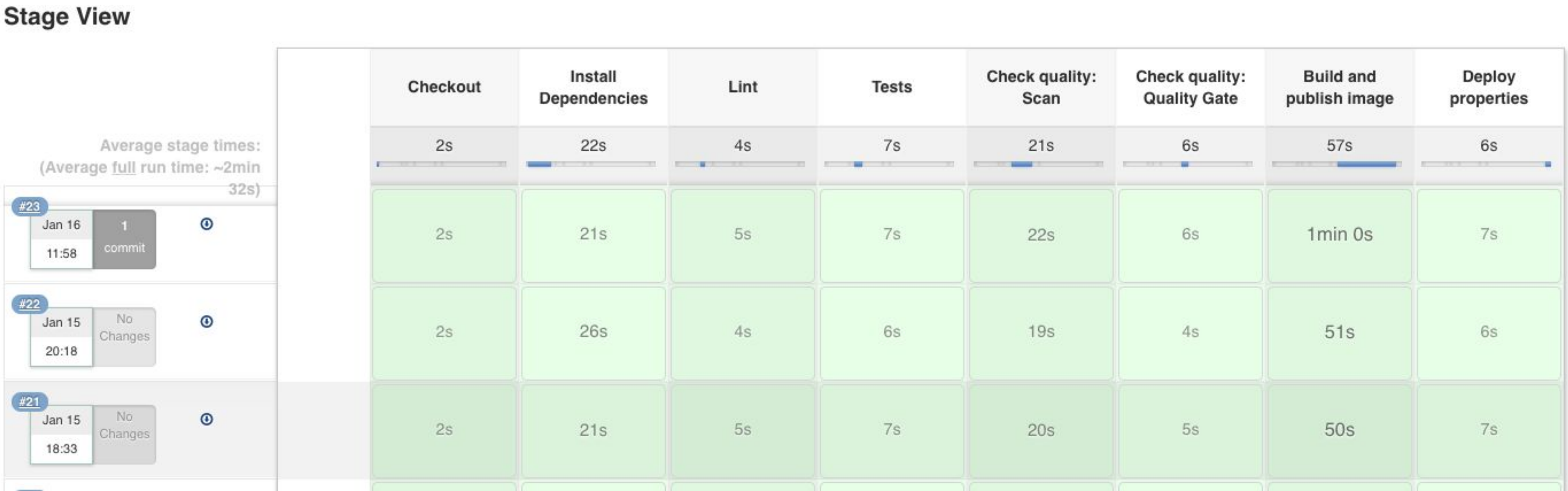
- Kubernetes Plugin
- Custom Library
- Opinionated DSL



tools-featureflag-api

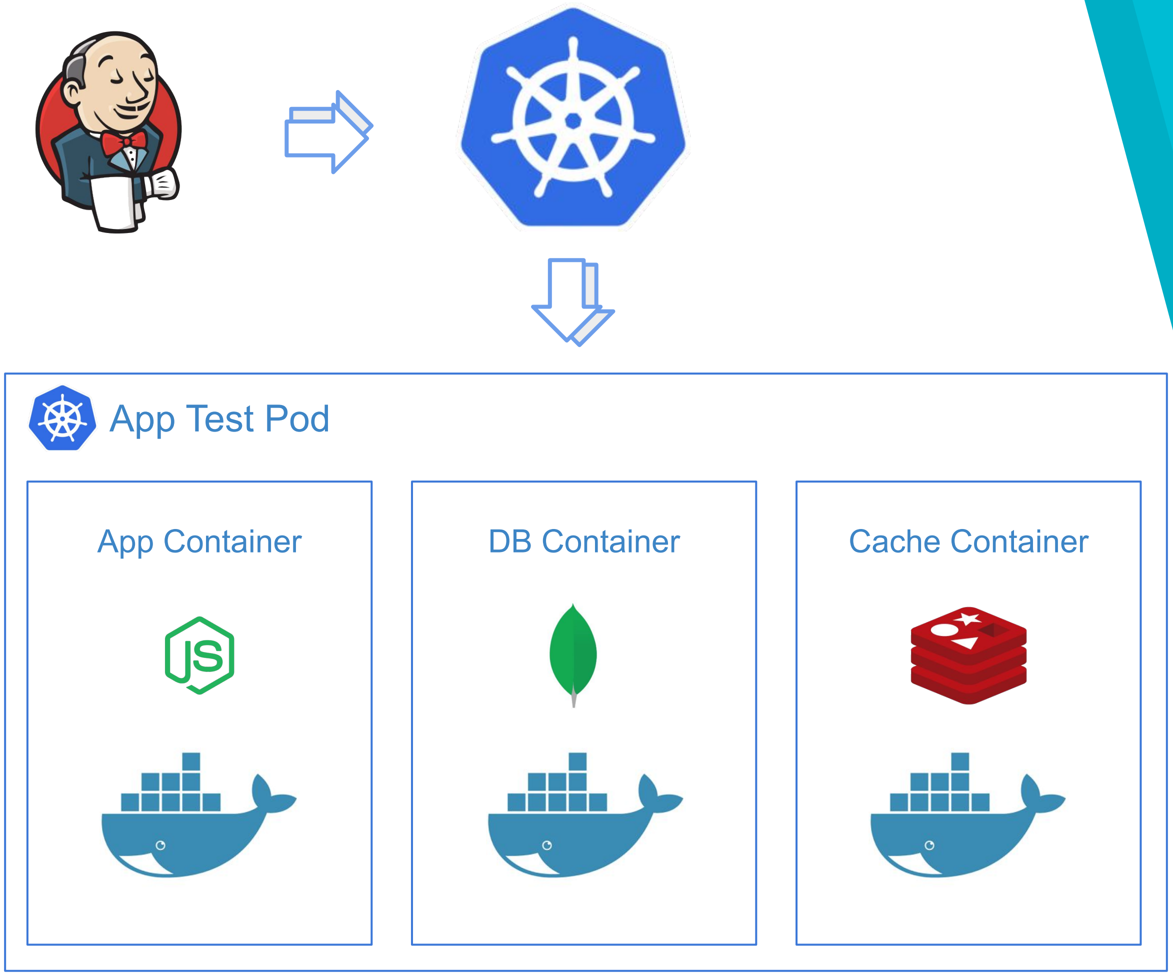
Branches (4)

S	W	Name ↓	Last Success	Last Failure	Last Duration	Fav
●	☀	adjust-import-scripts	1 mo 5 days - #2	N/A	1 min 30 sec	☆
●	☀	feature/livia-environment	11 hr - #1	N/A	1 min 8 sec	☆
●	☀	**master**	1 day 14 hr - #23	N/A	2 min 38 sec	☆
●	☀	postman-api-doc	N/A	N/A	N/A	☆



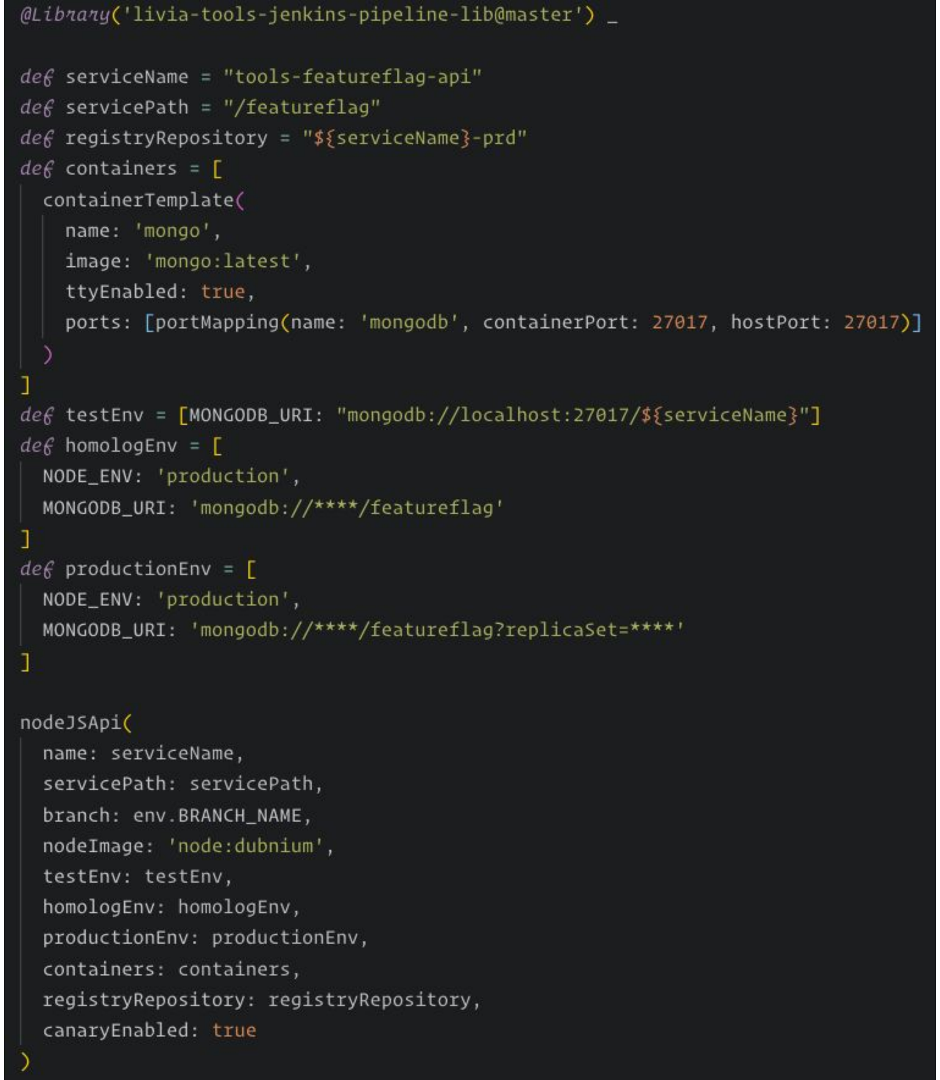
Stage View

	Checkout	Install Dependencies	Lint	Tests	Check quality: Scan	Check quality: Quality Gate	Build and publish image	Deploy properties
Average stage times: (Average full run time: ~2min 32s)	2s	22s	4s	7s	21s	6s	57s	6s
#23 Jan 16 11:58 1 commit	2s	21s	5s	7s	22s	6s	1min 0s	7s
#22 Jan 15 20:18 No Changes	2s	26s	4s	6s	19s	4s	51s	6s
#21 Jan 15 18:33 No Changes	2s	21s	5s	7s	20s	5s	50s	7s


App Test Pod
App Container
DB Container
Cache Container

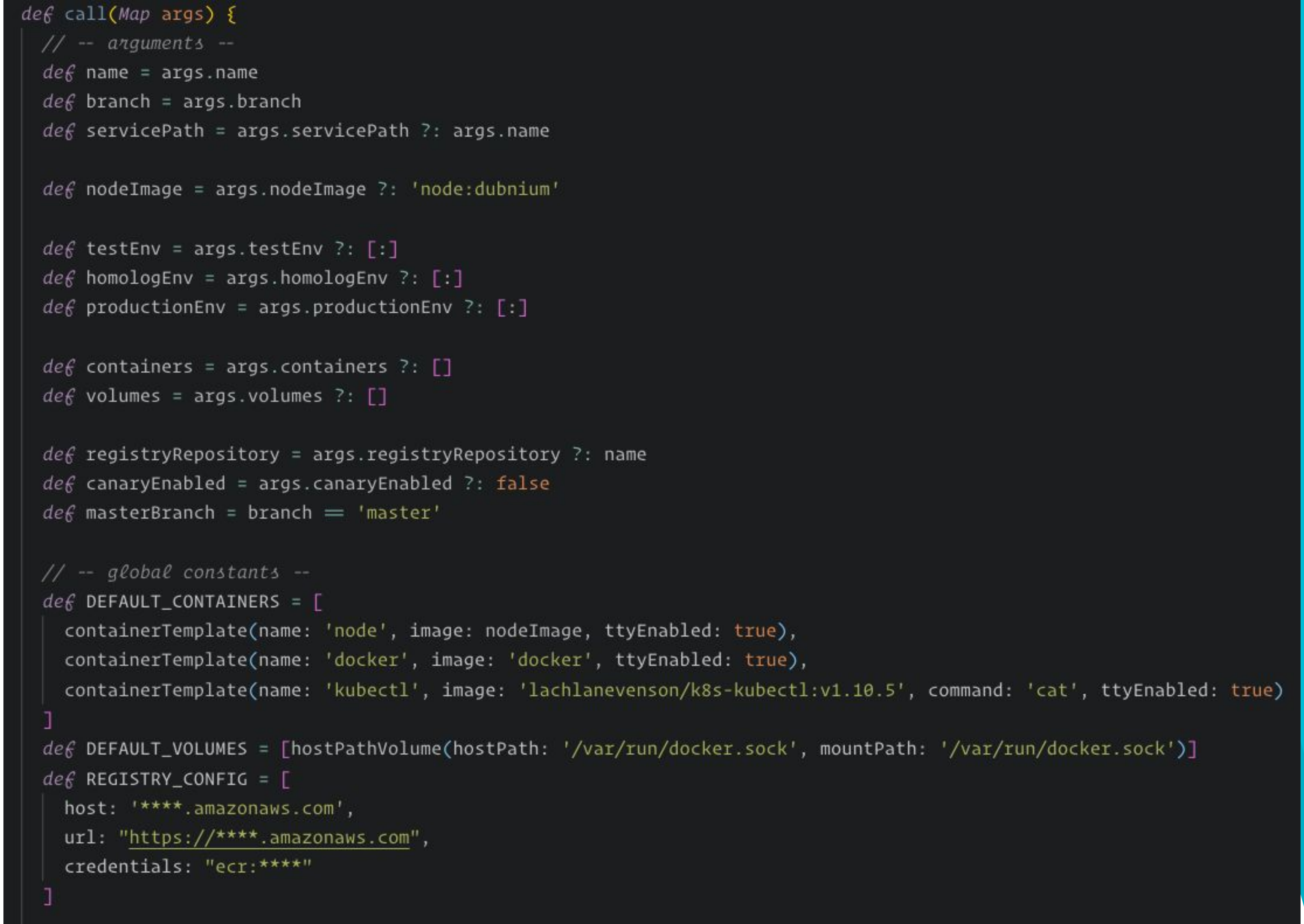
SHOW ME THE CODE!

Pipeline



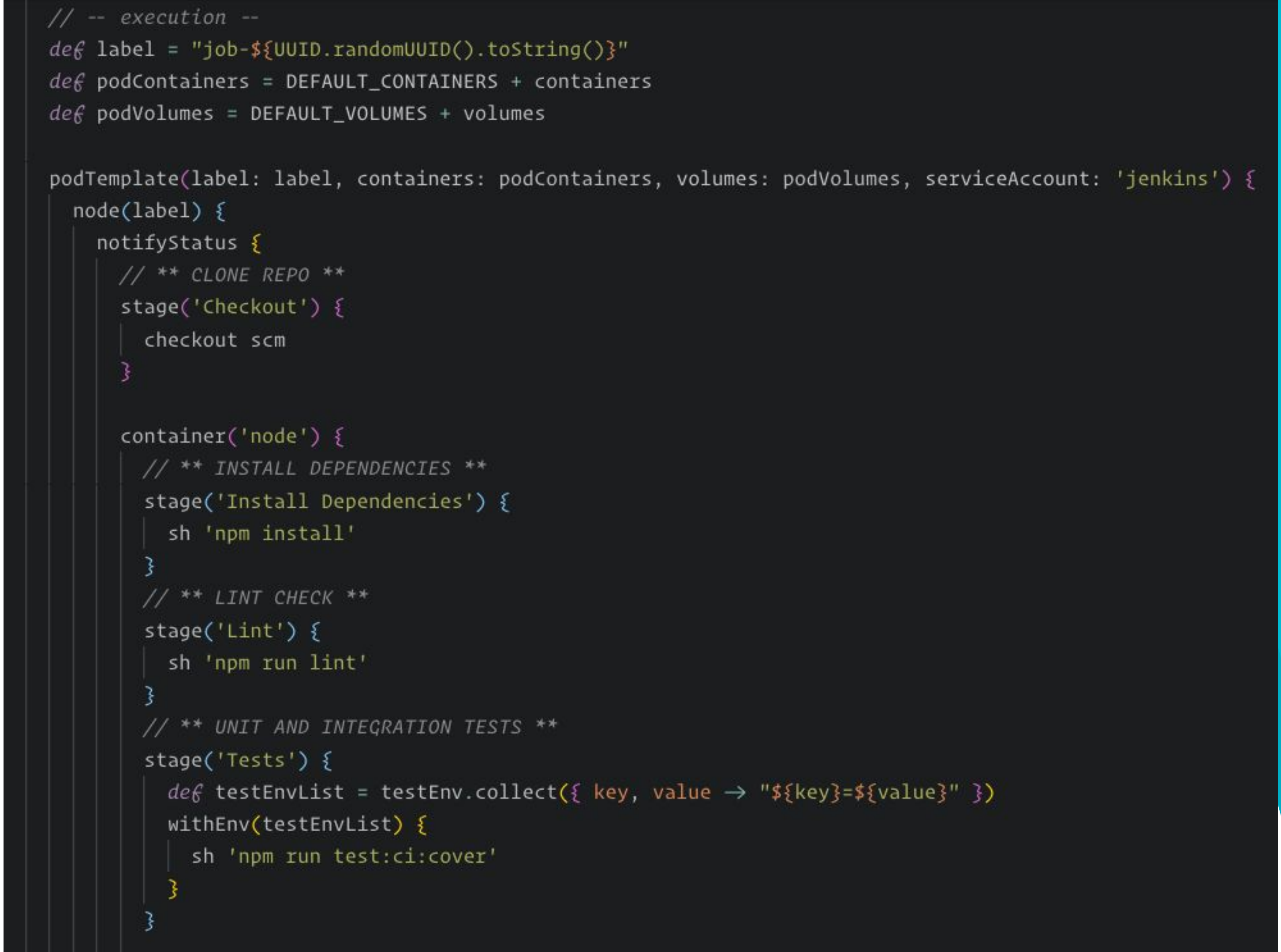
```
@Library('livia-tools-jenkins-pipeline-lib@master') _

def serviceName = "tools-featureflag-api"
def servicePath = "/featureflag"
def registryRepository = "${serviceName}-prd"
def containers = [
  containerTemplate(
    name: 'mongo',
    image: 'mongo:latest',
    ttyEnabled: true,
    ports: [portMapping(name: 'mongodb', containerPort: 27017, hostPort: 27017)]
  )
]
def testEnv = [MONGODB_URI: "mongodb://localhost:27017/${serviceName}"]
def homologEnv = [
  NODE_ENV: 'production',
  MONGODB_URI: 'mongodb://****/featureflag'
]
def productionEnv = [
  NODE_ENV: 'production',
  MONGODB_URI: 'mongodb://****/featureflag?replicaSet=****'
]

nodeJSApi(
  name: serviceName,
  servicePath: servicePath,
  branch: env.BRANCH_NAME,
  nodeImage: 'node:dubnium',
  testEnv: testEnv,
  homologEnv: homologEnv,
  productionEnv: productionEnv,
  containers: containers,
  registryRepository: registryRepository,
  canaryEnabled: true
)
```

DSL



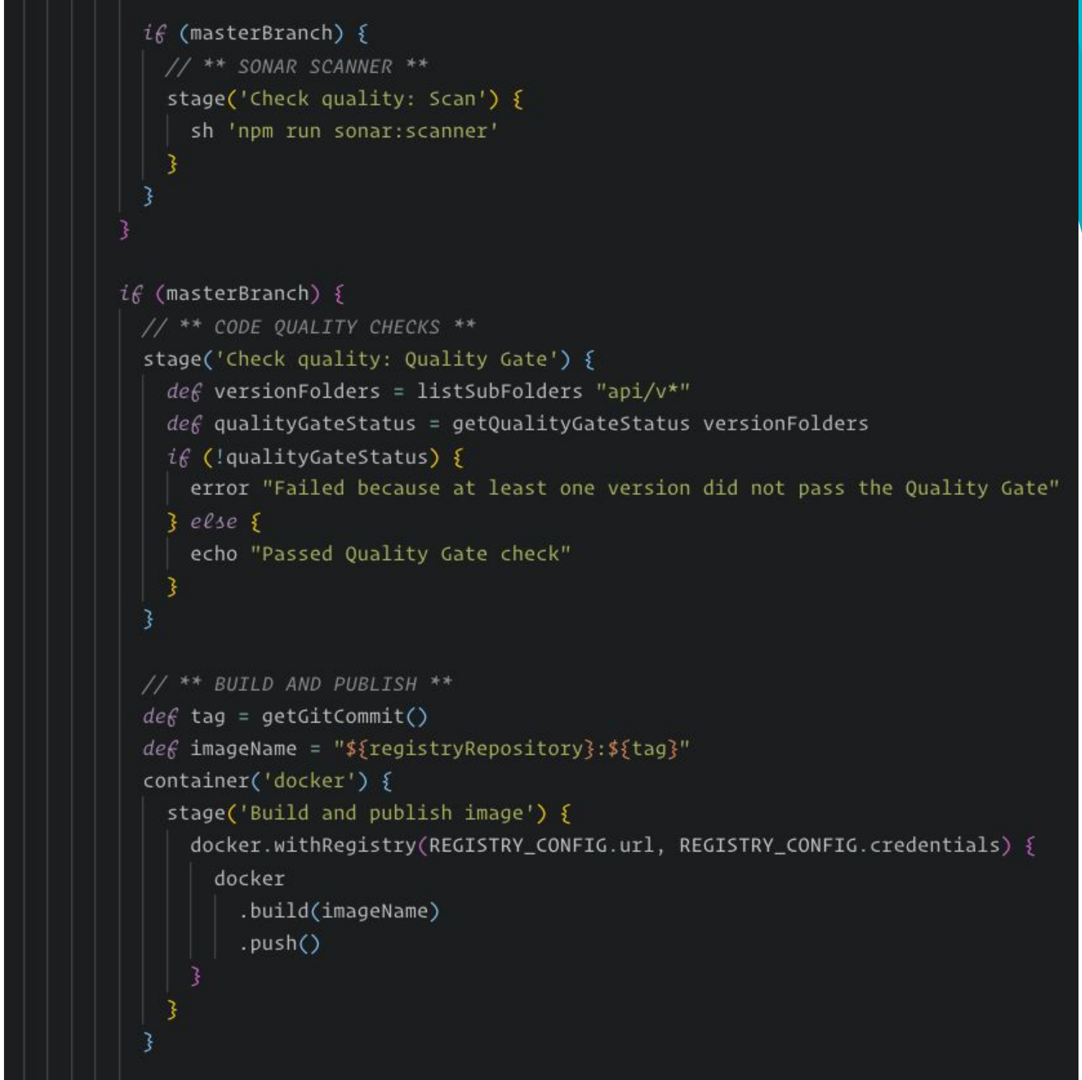
```
def call(Map args) {
  // -- arguments --
  def name = args.name
  def branch = args.branch
  def servicePath = args.servicePath ?: args.name

  def nodeImage = args.nodeImage ?: 'node:dubnium'

  def testEnv = args.testEnv ?: [:]
  def homologEnv = args.homologEnv ?: [:]
  def productionEnv = args.productionEnv ?: [:]

  def containers = args.containers ?: []
  def volumes = args.volumes ?: []

  def registryRepository = args.registryRepository ?: name
  def canaryEnabled = args.canaryEnabled ?: false
  def masterBranch = branch == 'master'

  // -- global constants --
  def DEFAULT_CONTAINERS = [
    containerTemplate(name: 'node', image: nodeImage, ttyEnabled: true),
    containerTemplate(name: 'docker', image: 'docker', ttyEnabled: true),
    containerTemplate(name: 'kubectl', image: 'lachlanevenson/k8s-kubectl:v1.10.5', command: 'cat', ttyEnabled: true)
  ]
  def DEFAULT_VOLUMES = [hostPathVolume(hostPath: '/var/run/docker.sock', mountPath: '/var/run/docker.sock')]
  def REGISTRY_CONFIG = [
    host: '****.amazonaws.com',
    url: "https://****.amazonaws.com",
    credentials: "ecr:****"
  ]
```

DSL



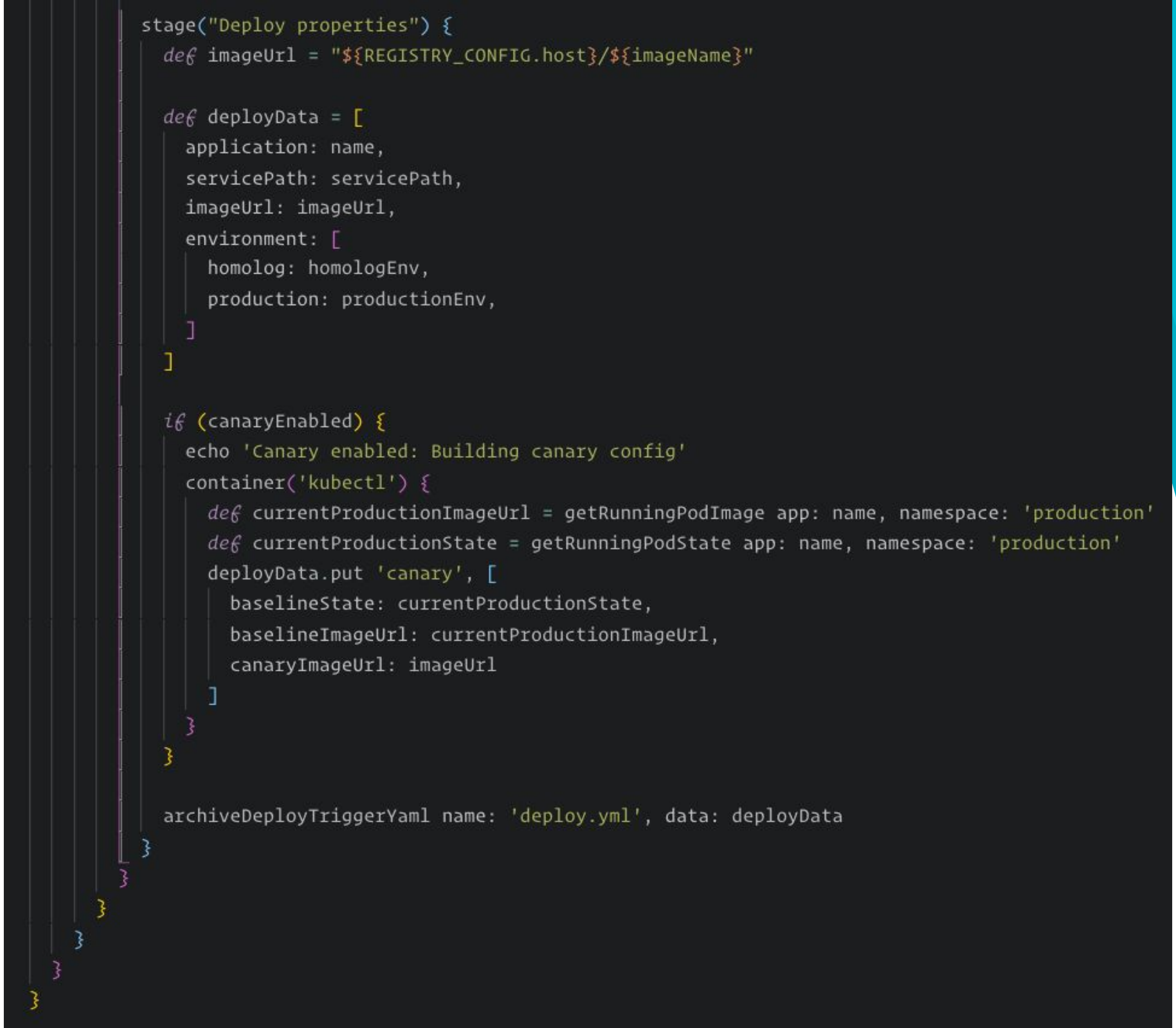
```
// -- execution --
def label = "job-${UUID.randomUUID().toString()}"
def podContainers = DEFAULT_CONTAINERS + containers
def podVolumes = DEFAULT_VOLUMES + volumes

podTemplate(label: label, containers: podContainers, volumes: podVolumes, serviceAccount: 'jenkins') {
  node(label) {
    notifyStatus {
      // ** CLONE REPO **
      stage('Checkout') {
        checkout scm
      }

      container('node') {
        // ** INSTALL DEPENDENCIES **
        stage('Install Dependencies') {
          sh 'npm install'
        }
        // ** LINT CHECK **
        stage('Lint') {
          sh 'npm run lint'
        }
        // ** UNIT AND INTEGRATION TESTS **
        stage('Tests') {
          def testEnvList = testEnv.collect({ key, value -> "${key}=${value}" })
          withEnv(testEnvList) {
            sh 'npm run test:ci:cover'
          }
        }
```

DSL



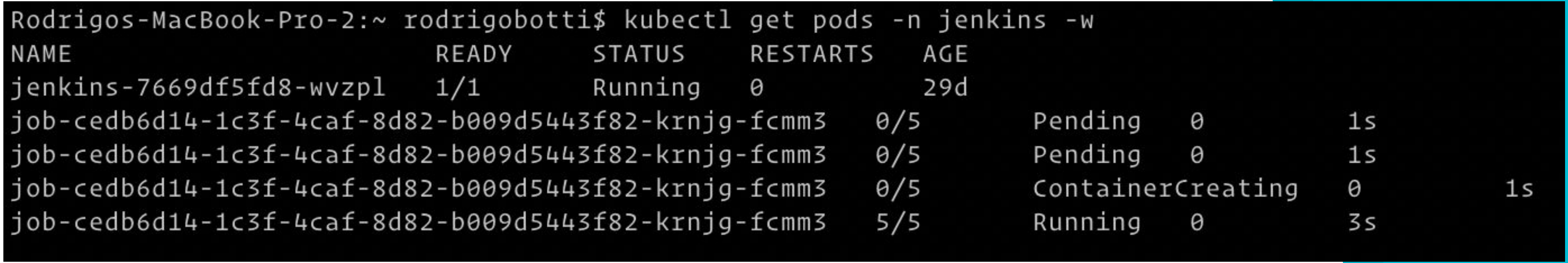
```
  if (masterBranch) {
    // ** SONAR SCANNER **
    stage('Check quality: Scan') {
      sh 'npm run sonar:scanner'
    }
  }
}

if (masterBranch) {
  // ** CODE QUALITY CHECKS **
  stage('Check quality: Quality Gate') {
    def versionFolders = listSubFolders "api/v*"
    def qualityGateStatus = getQualityGateStatus versionFolders
    if (!qualityGateStatus) {
      error "Failed because at least one version did not pass the Quality Gate"
    } else {
      echo "Passed Quality Gate check"
    }
  }

  // ** BUILD AND PUBLISH **
  def tag = getGitCommit()
  def imageName = "${registryRepository}:${tag}"
  container('docker') {
    stage('Build and publish image') {
      docker.withRegistry(REGISTRY_CONFIG.url, REGISTRY_CONFIG.credentials) {
        docker
          .build(imageName)
          .push()
      }
    }
  }
```

DSL



```
          stage("Deploy properties") {
            def imageUrl = "${REGISTRY_CONFIG.host}/${imageName}"

            def deployData = [
              application: name,
              servicePath: servicePath,
              imageUrl: imageUrl,
              environment: [
                homolog: homologEnv,
                production: productionEnv,
              ]
            ]

            if (canaryEnabled) {
              echo 'Canary enabled: Building canary config'
              container('kubectl') {
                def currentProductionImageUrl = getRunningPodImage app: name, namespace: 'production'
                def currentProductionState = getRunningPodState app: name, namespace: 'production'
                deployData.put 'canary', [
                  baselineState: currentProductionState,
                  baselineImageUrl: currentProductionImageUrl,
                  canaryImageUrl: imageUrl
                ]
              }
            }

            archiveDeployTriggerYaml name: 'deploy.yml', data: deployData
          }
        }
      }
    }
  }
}
```

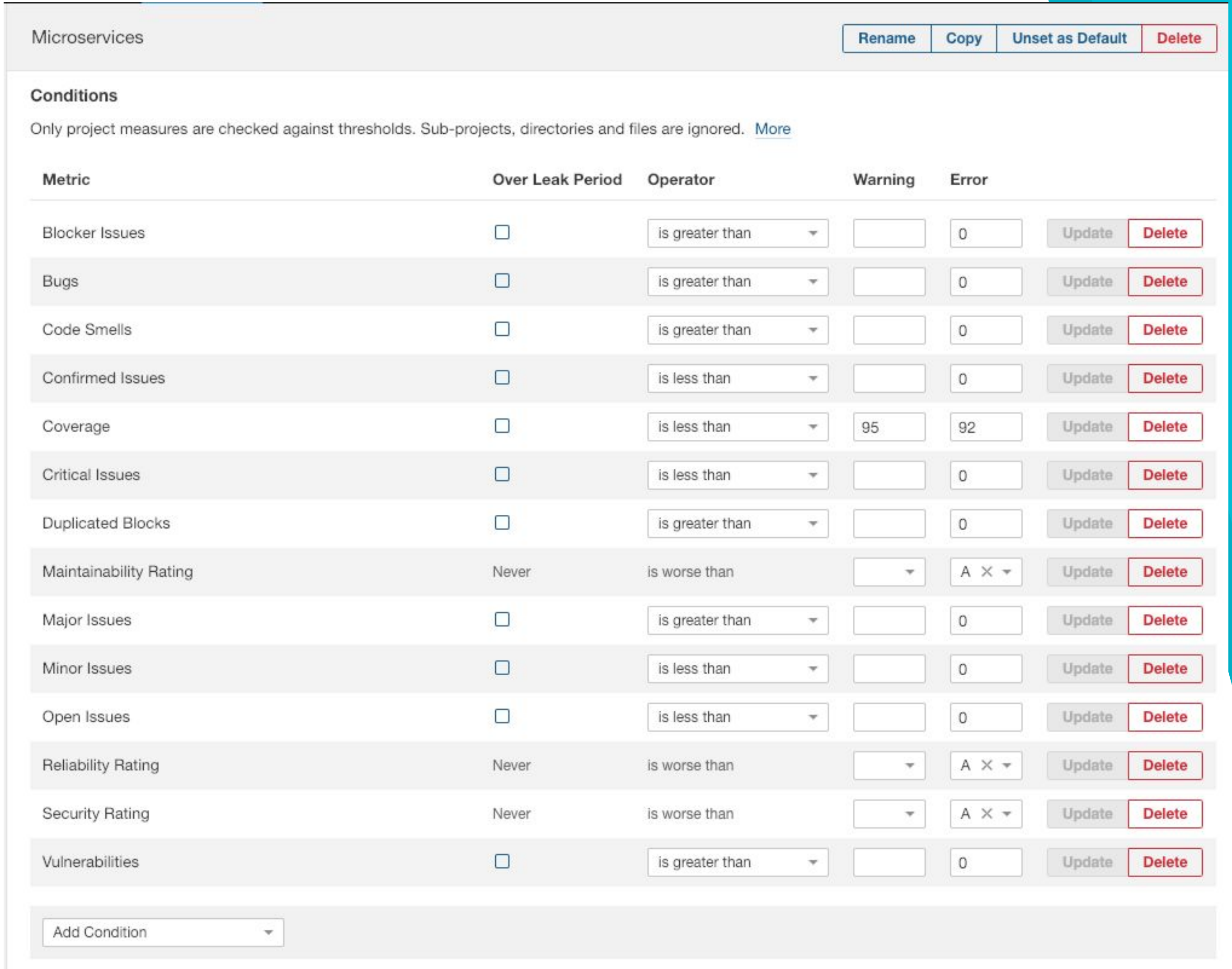
Running Pipeline Pod



```
Rodrigos-MacBook-Pro-2:~ rodrigobotti$ kubectl get pods -n jenkins -w
NAME                       READY     STATUS    RESTARTS   AGE
jenkins-7669df5fd8-wvzpl   1/1       Running   0          29d
job-cedb6d14-1c3f-4caf-8d82-b009d5443f82-krnjg-fcmm3   0/5       Pending   0         1s
job-cedb6d14-1c3f-4caf-8d82-b009d5443f82-krnjg-fcmm3   0/5       Pending   0         1s
job-cedb6d14-1c3f-4caf-8d82-b009d5443f82-krnjg-fcmm3   0/5       ContainerCreating   0         1s
job-cedb6d14-1c3f-4caf-8d82-b009d5443f82-krnjg-fcmm3   5/5       Running   0         3s
```

QUALITY CHECKS
SONARQUBE

- Quality Metrics
  - Code smells
  - Bugs
  - Vulnerabilities
  - Code coverage
- Quality Profiles
- Quality Gate



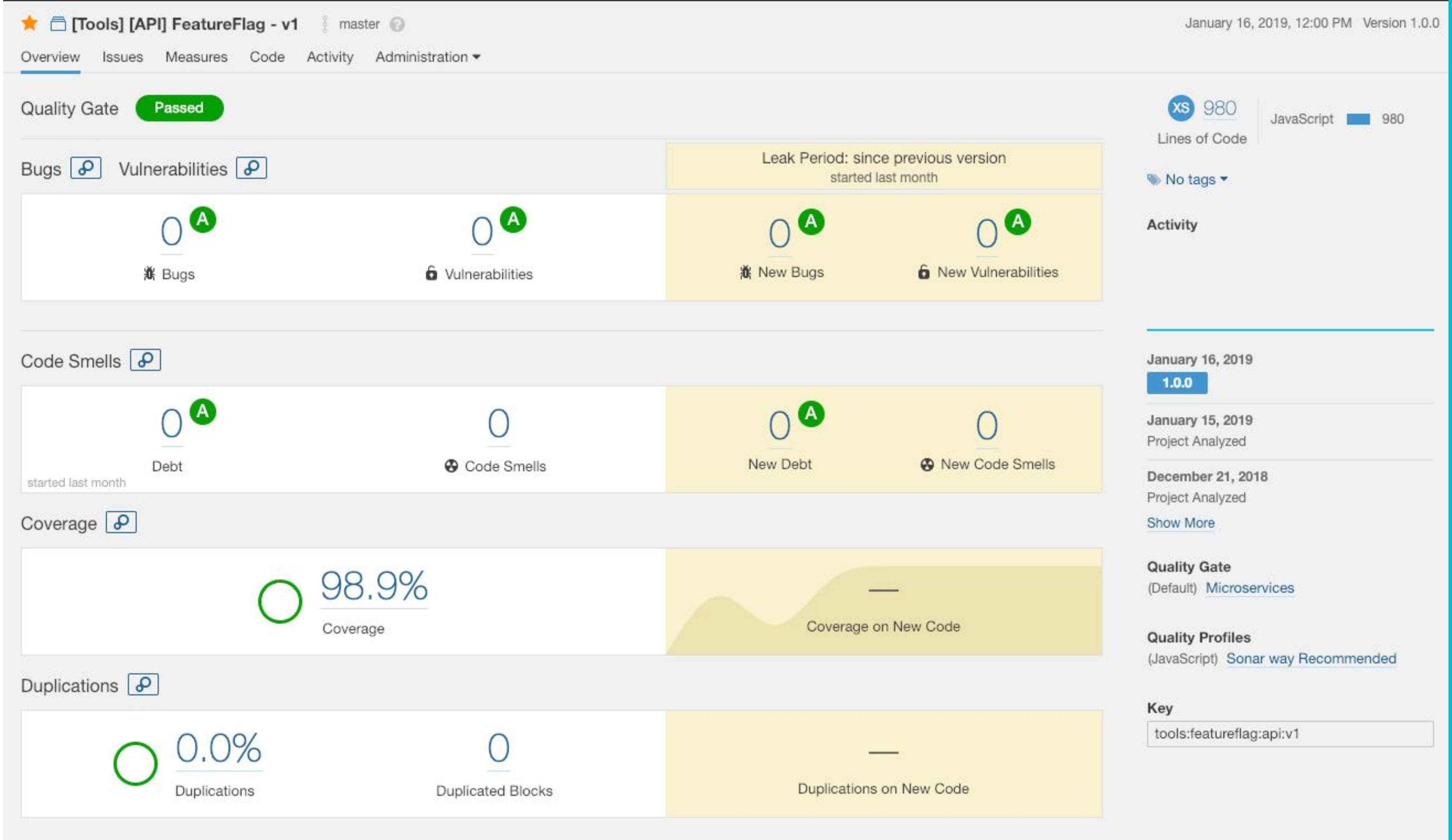
Microservices

Conditions

Only project measures are checked against thresholds. Sub-projects, directories and files are ignored. More

Metric	Over Leak Period	Operator	Warning	Error		
Blocker Issues	☐	is greater than		0	Update	Delete
Bugs	☐	is greater than		0	Update	Delete
Code Smells	☐	is greater than		0	Update	Delete
Confirmed Issues	☐	is less than		0	Update	Delete
Coverage	☐	is less than	95	92	Update	Delete
Critical Issues	☐	is less than		0	Update	Delete
Duplicated Blocks	☐	is greater than		0	Update	Delete
Maintainability Rating	Never	is worse than		A ×	Update	Delete
Major Issues	☐	is greater than		0	Update	Delete
Minor Issues	☐	is less than		0	Update	Delete
Open Issues	☐	is less than		0	Update	Delete
Reliability Rating	Never	is worse than		A ×	Update	Delete
Security Rating	Never	is worse than		A ×	Update	Delete
Vulnerabilities	☐	is greater than		0	Update	Delete

Add Condition



[Tools] [API] FeatureFlag - v1   master

January 16, 2019, 12:00 PM   Version 1.0.0

Overview   Issues   Measures   Code   Activity   Administration ▾

Quality Gate   Passed

Bugs   Vulnerabilities

Leak Period: since previous version
started last month

0 A Bugs
0 A Vulnerabilities
0 A New Bugs
0 A New Vulnerabilities

Code Smells

0 A Debt
started last month
0 Code Smells
0 A New Debt
0 New Code Smells

Coverage

98.9% Coverage
— Coverage on New Code

Duplications

0.0% Duplications
0 Duplicated Blocks
— Duplications on New Code

XS 980
Lines of Code

JavaScript 980

No tags ▾

Activity

January 16, 2019
1.0.0

January 15, 2019
Project Analyzed

December 21, 2018
Project Analyzed

Show More

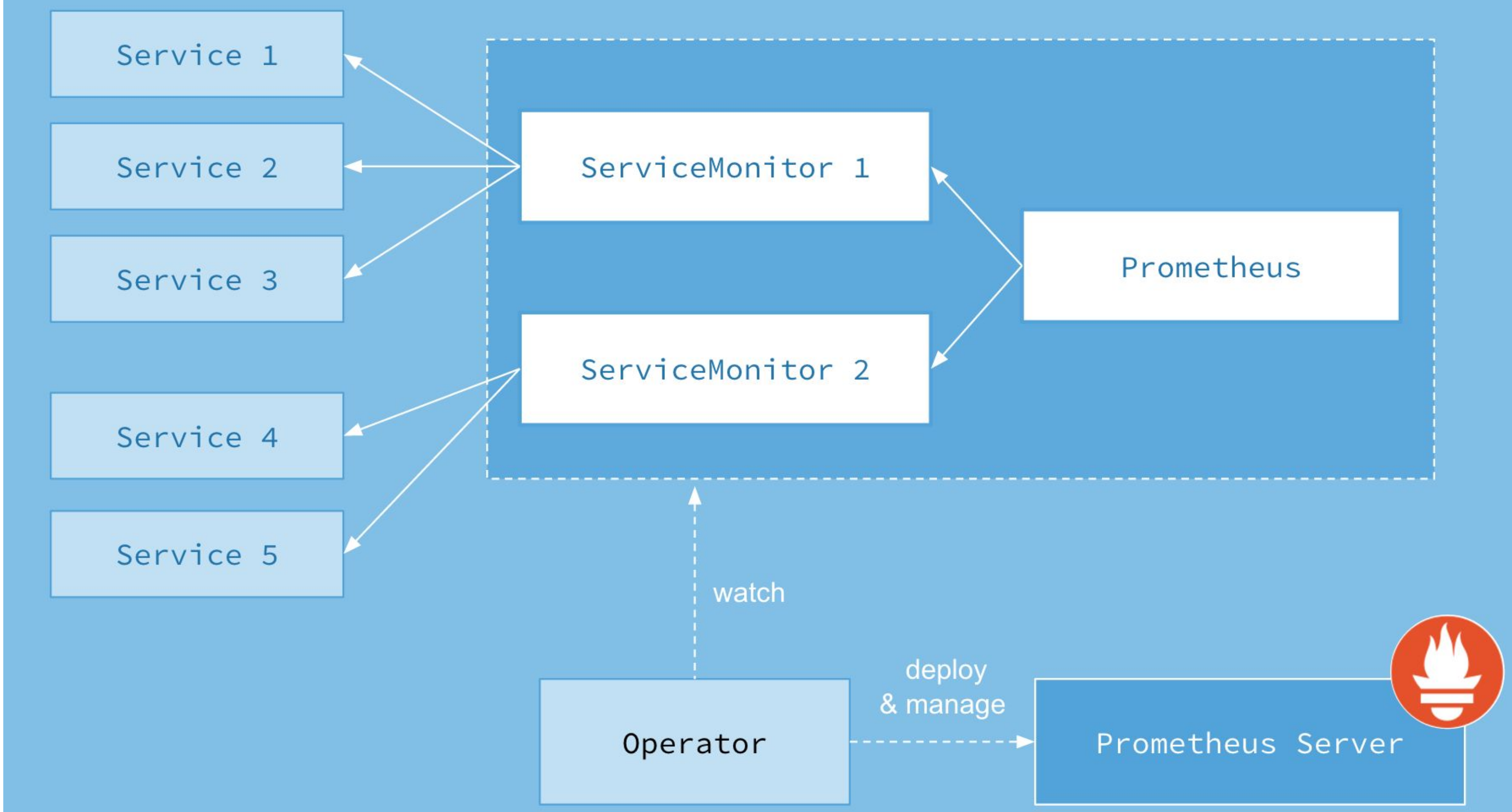
Quality Gate
(Default) Microservices

Quality Profiles
(JavaScript) Sonar way Recommended

Key
tools:featureflag:api:v1

MONITORING
PROMETHEUS (OPERATOR)

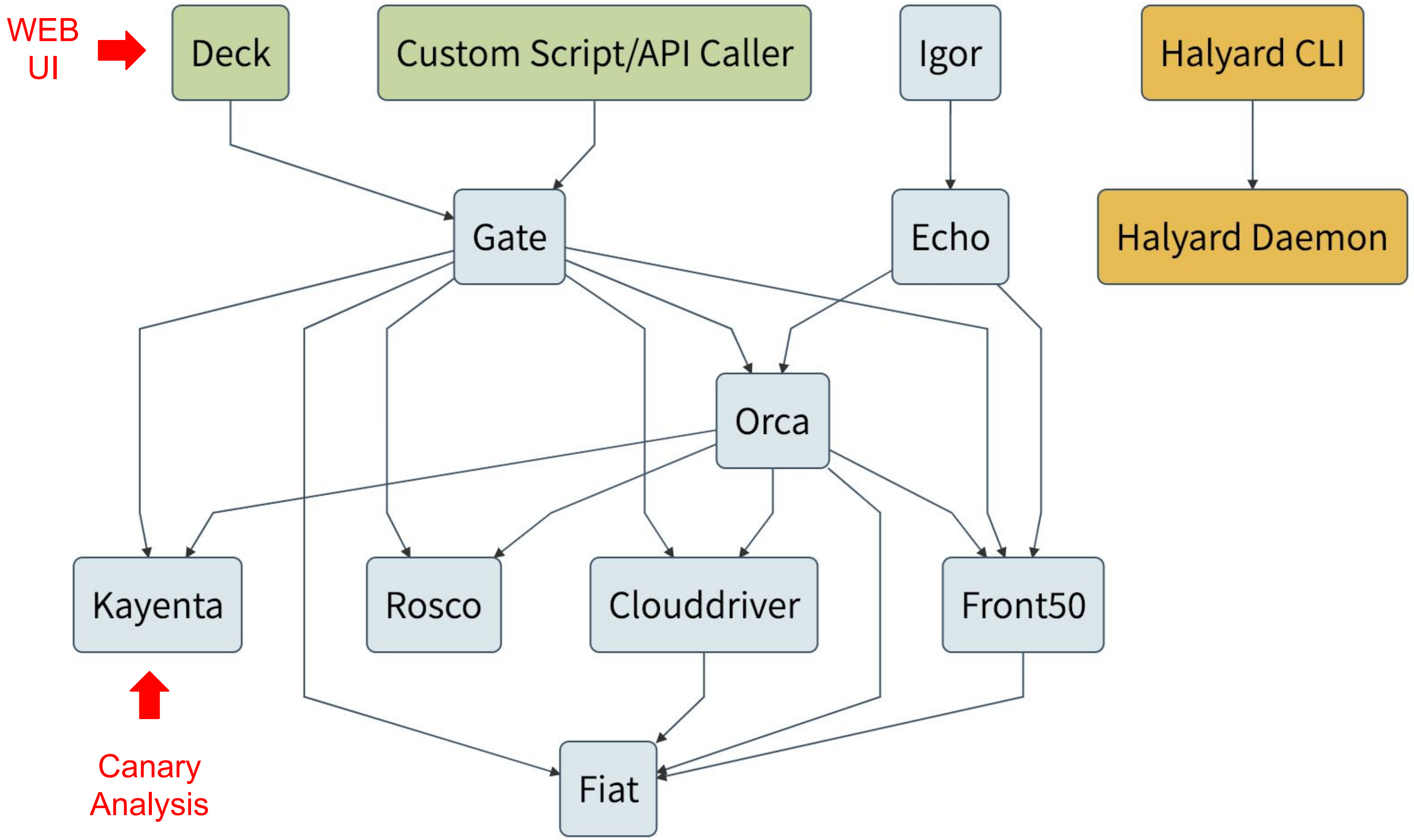
- Monitoring
- Time-series database
- PromQL
- Alerting



Service 1
Service 2
Service 3
Service 4
Service 5
ServiceMonitor 1
ServiceMonitor 2
Prometheus
watch
Operator
deploy & manage
Prometheus Server

DELIVERY
SPINNAKER

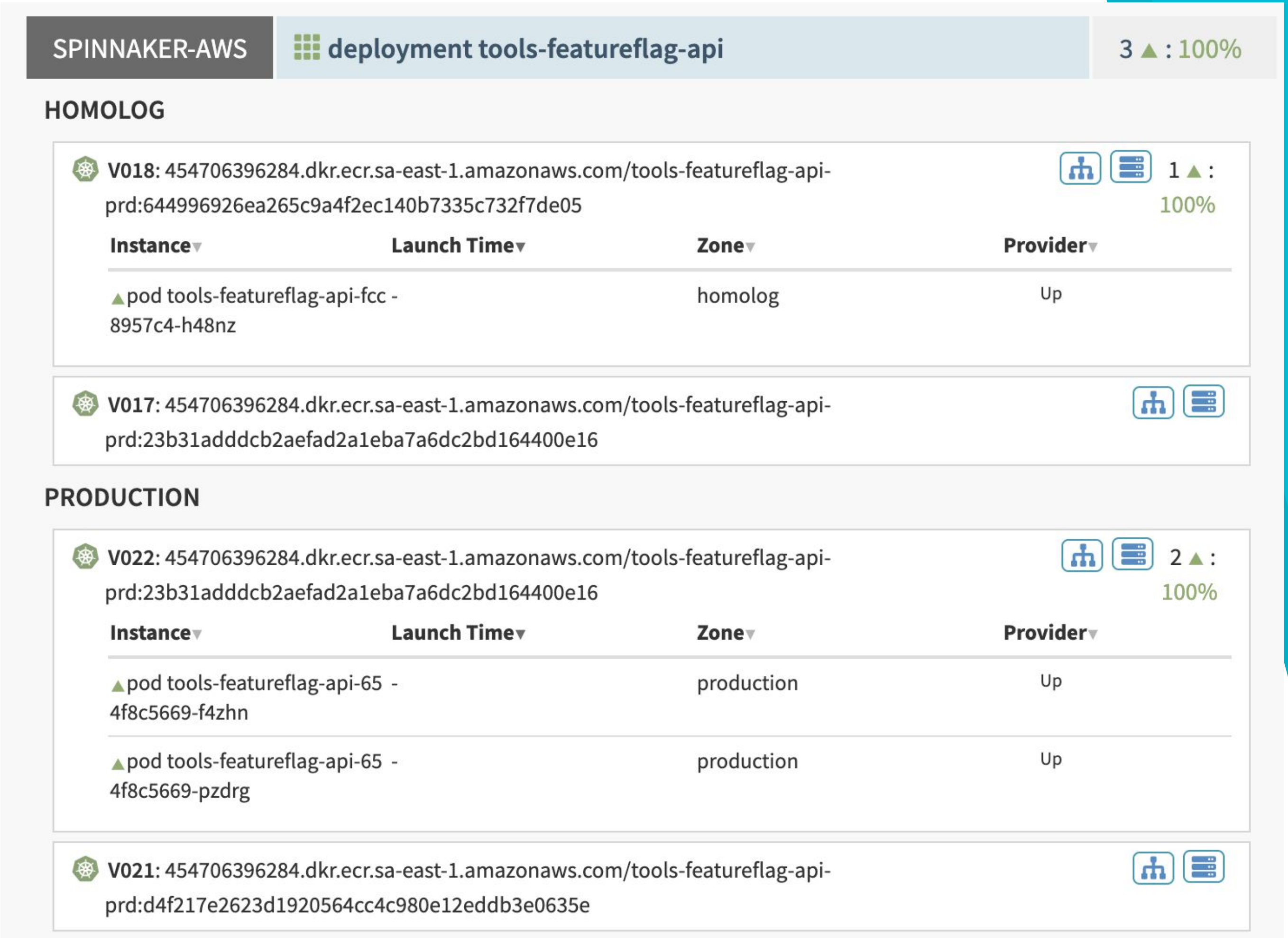
- CD Pipeline
- Canary Release
- Multi-cloud
  - Kubernetes
- Abstracts infrastructure elements (*)
- Netflix


WEB UI
Deck
Custom Script/API Caller
Igor
Halyard CLI
Gate
Echo
Halyard Daemon
Orca
Kayenta
Rosco
Clouddriver
Front50
Fiat
Canary Analysis

YO DAWG, HEARD YOU LIKE SERVICES
N
SO WE PUT SERVICES IN A SERVICE SO YOU CAN DEPLOY SERVICES USING A SERVICE
imgflip.com

CONCEPTS/ABSTRACTIONS
SPINNAKER

- Application
- Cluster == **Namespace**
- Server Group == **Deployment**
- Load Balancer == **Service**



SPINNAKER-AWS

deployment tools-featureflag-api

3 ▲ : 100%

HOMOLOG

V018: 454706396284.dkr.ecr.sa-east-1.amazonaws.com/tools-featureflag-api-prd:644996926ea265c9a4f2ec140b7335c732f7de05

1 ▲ : 100%

Instance	Launch Time	Zone	Provider
▲pod tools-featureflag-api-fcc8957c4-h48nz	-	homolog	Up

V017: 454706396284.dkr.ecr.sa-east-1.amazonaws.com/tools-featureflag-api-prd:23b31adddcb2aefad2a1eba7a6dc2bd164400e16

PRODUCTION

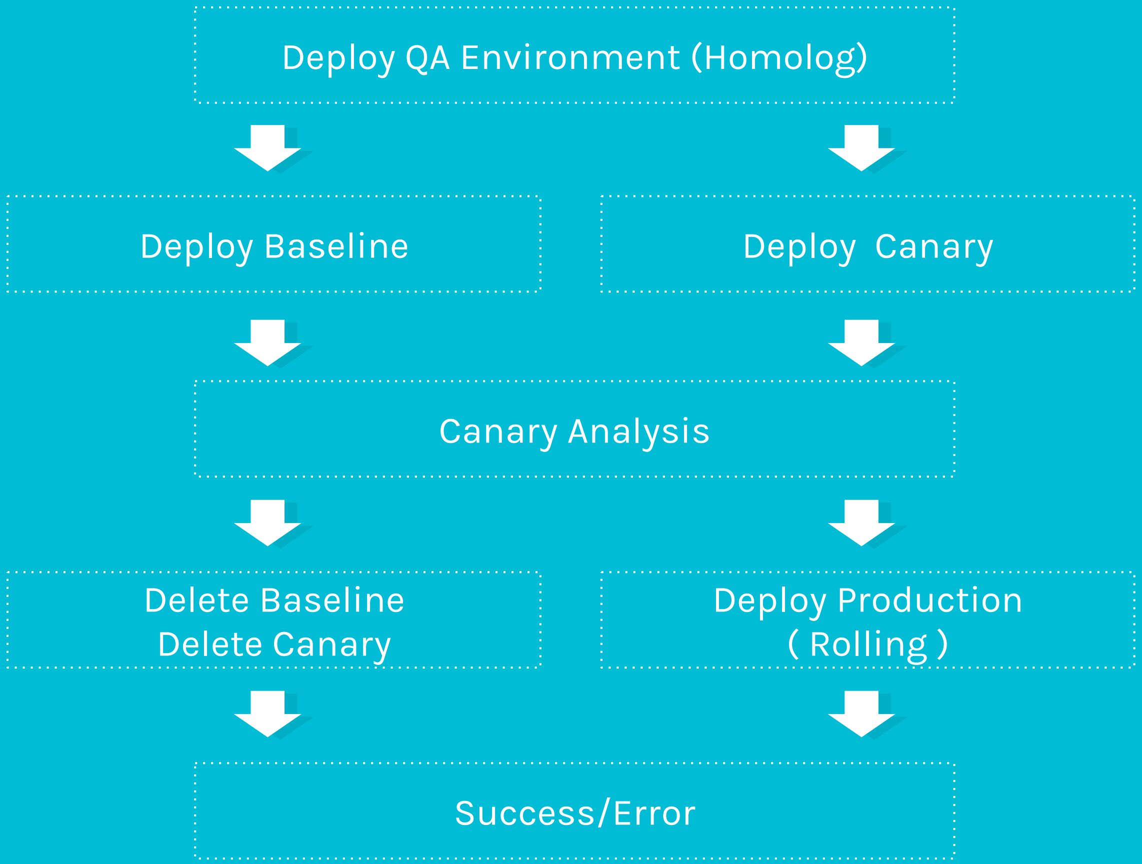
V022: 454706396284.dkr.ecr.sa-east-1.amazonaws.com/tools-featureflag-api-prd:23b31adddcb2aefad2a1eba7a6dc2bd164400e16

2 ▲ : 100%

Instance	Launch Time	Zone	Provider
▲pod tools-featureflag-api-654f8c5669-f4zhn	-	production	Up
▲pod tools-featureflag-api-654f8c5669-pzdrg	-	production	Up

V021: 454706396284.dkr.ecr.sa-east-1.amazonaws.com/tools-featureflag-api-prd:d4f217e2623d1920564cc4c980e12eddb3e0635e

PIPELINE



Deploy QA Environment (Homolog)

Deploy Baseline

Deploy Canary

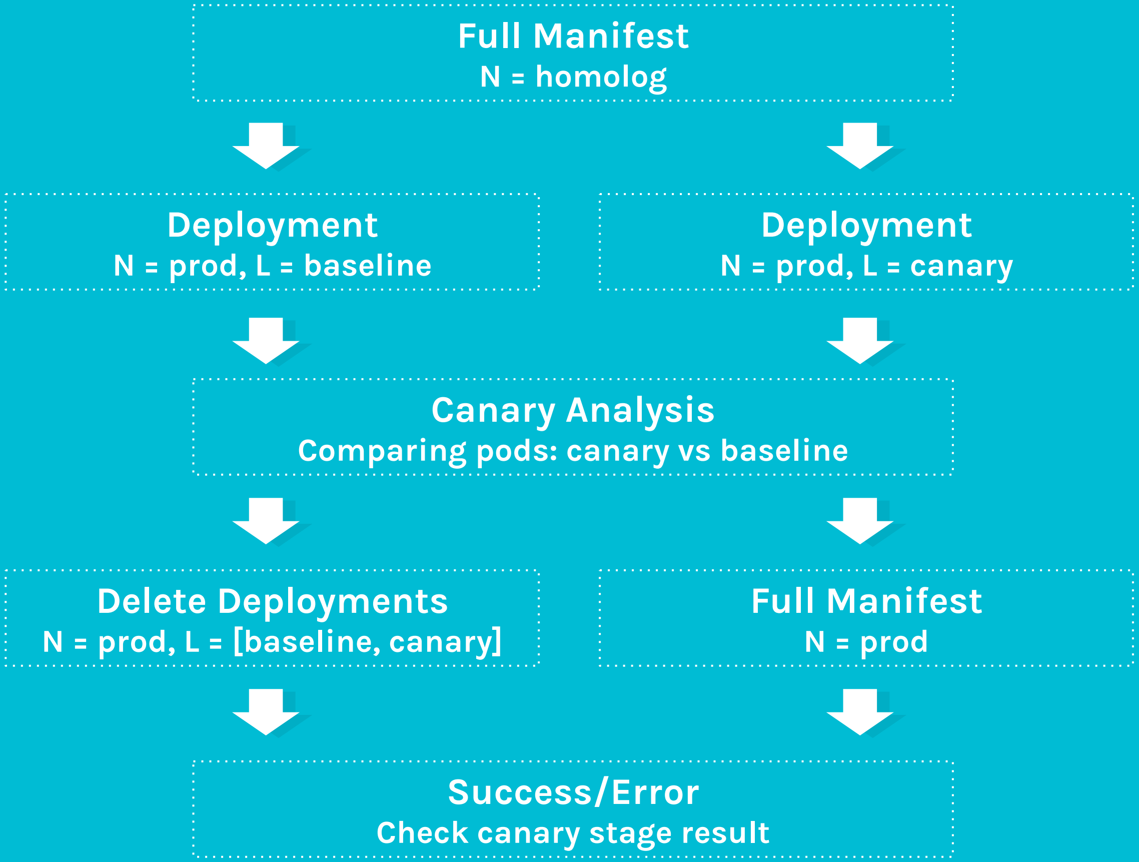
Canary Analysis

Delete Baseline
Delete Canary

Deploy Production
(Rolling)

Success/Error

PIPELINE



Full Manifest
N = homolog

Deployment
N = prod, L = baseline

Deployment
N = prod, L = canary

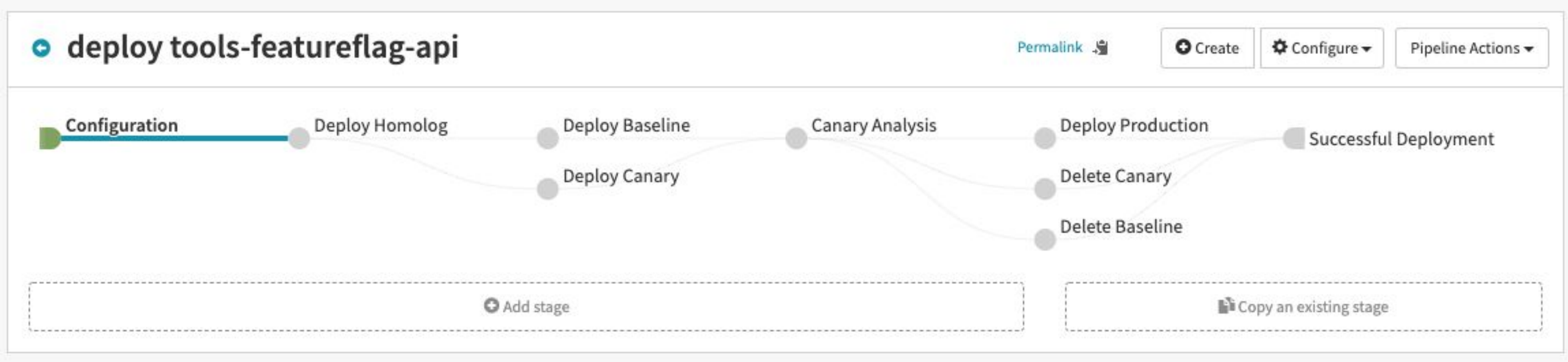
Canary Analysis
Comparing pods: canary vs baseline

Delete Deployments
N = prod, L = [baseline, canary]

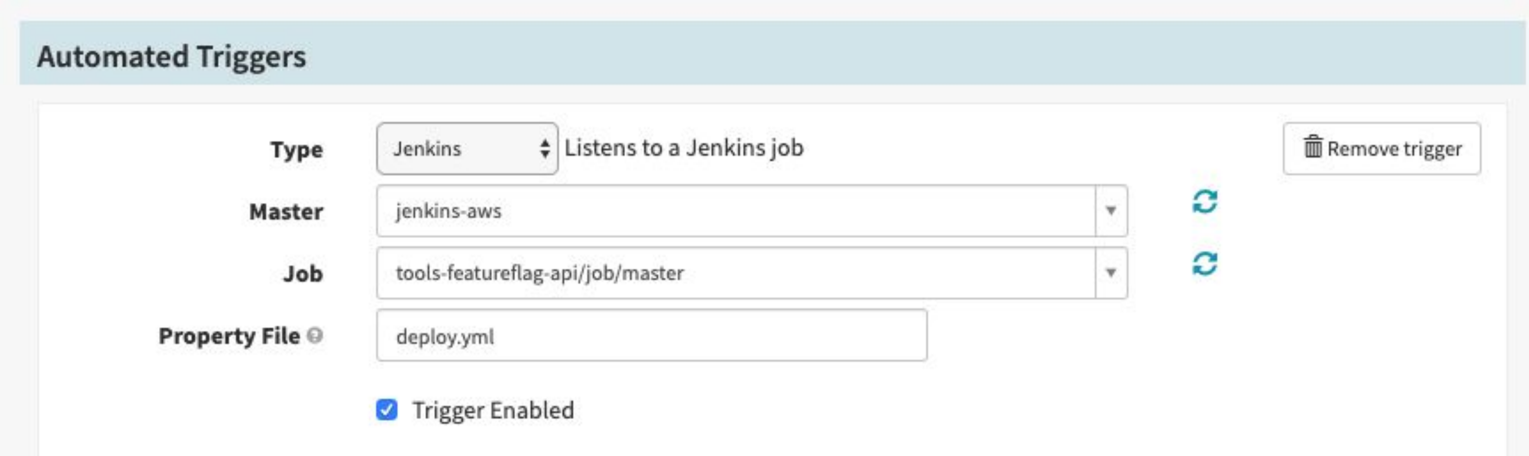
Full Manifest
N = prod

Success/Error
Check canary stage result

Pipeline Overview



Stage: Configuration



Automated Triggers

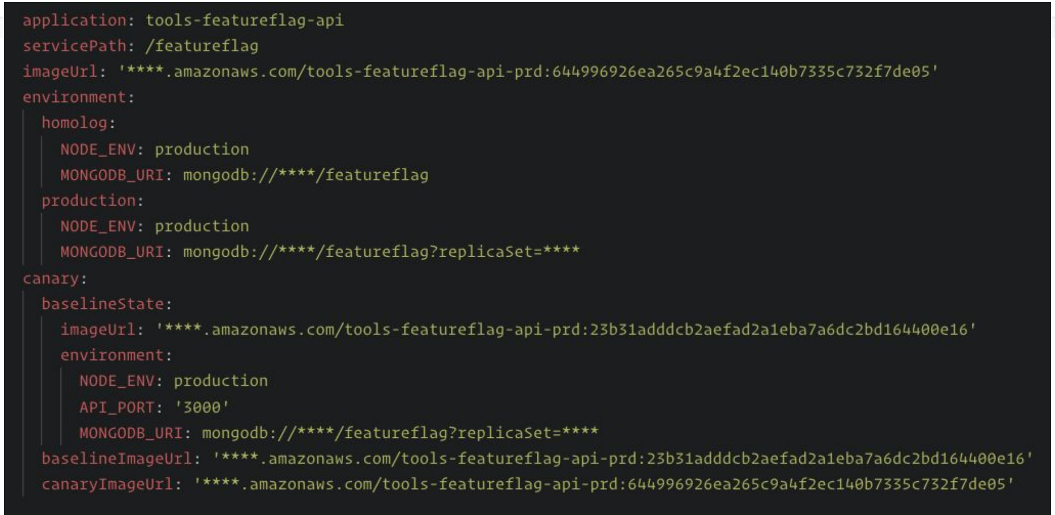
Type: Jenkins — Listens to a Jenkins job

Master: jenkins-aws

Job: tools-featureflag-api/job/master

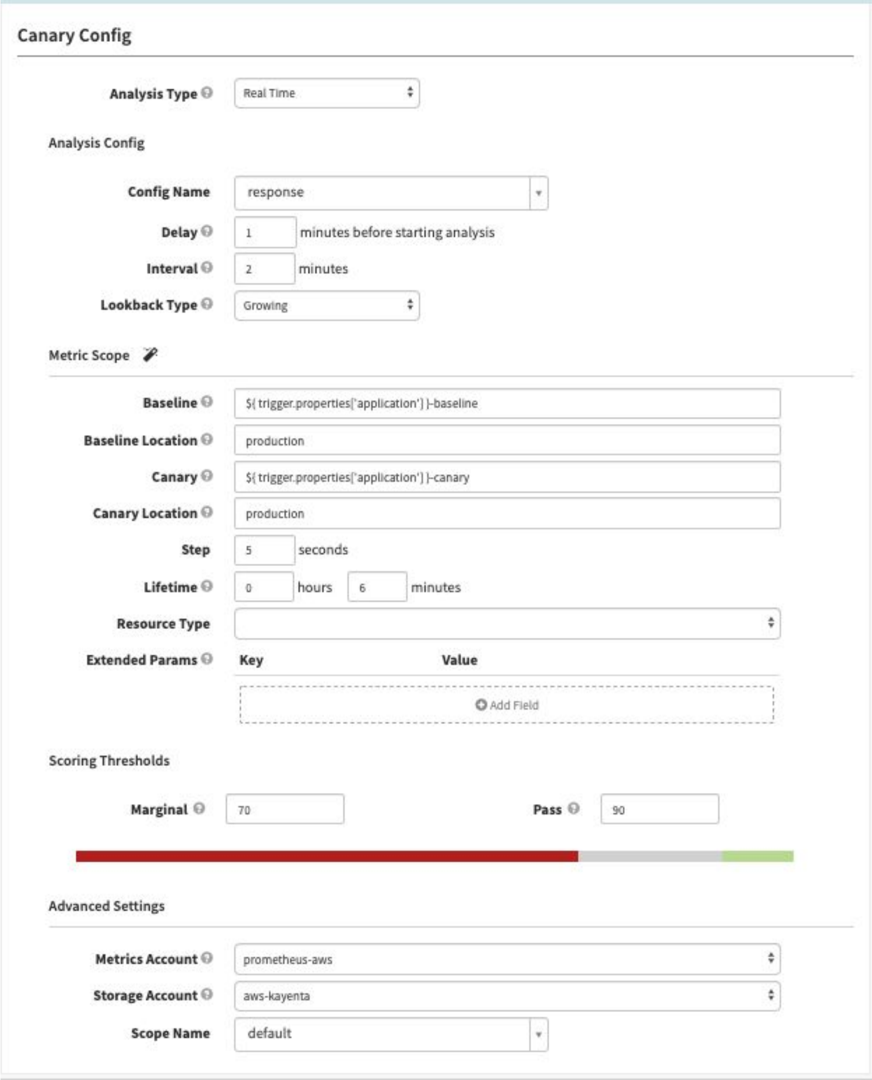
Property File: deploy.yml

☑ Trigger Enabled



```
application: tools-featureflag-api
servicePath: /featureflag
imageUrl: '****.amazonaws.com/tools-featureflag-api-prd:644996926ea265c9a4f2ec140b7335c732f7de05'
environment:
  homolog:
    NODE_ENV: production
    MONGODB_URI: mongodb://****/featureflag
  production:
    NODE_ENV: production
    MONGODB_URI: mongodb://****/featureflag?replicaSet=****
canary:
  baselineState:
    imageUrl: '****.amazonaws.com/tools-featureflag-api-prd:23b31adddcb2aefad2a1eba7a6dc2bd164400e16'
    environment:
      NODE_ENV: production
      API_PORT: '3000'
      MONGODB_URI: mongodb://****/featureflag?replicaSet=****
  baselineImageUrl: '****.amazonaws.com/tools-featureflag-api-prd:23b31adddcb2aefad2a1eba7a6dc2bd164400e16'
  canaryImageUrl: '****.amazonaws.com/tools-featureflag-api-prd:644996926ea265c9a4f2ec140b7335c732f7de05'
```

Stage: Canary Analysis



Canary Config

Analysis Type Real Time

Analysis Config

Config Name response

Delay 1 minutes before starting analysis

Interval 2 minutes

Lookback Type Growing

Metric Scope

Baseline ${ trigger.properties['application'] }-baseline

Baseline Location production

Canary ${ trigger.properties['application'] }-canary

Canary Location production

Step 5 seconds

Lifetime 0 hours 6 minutes

Resource Type

Extended Params **Key** **Value**

Scoring Thresholds

Marginal 70 **Pass** 90

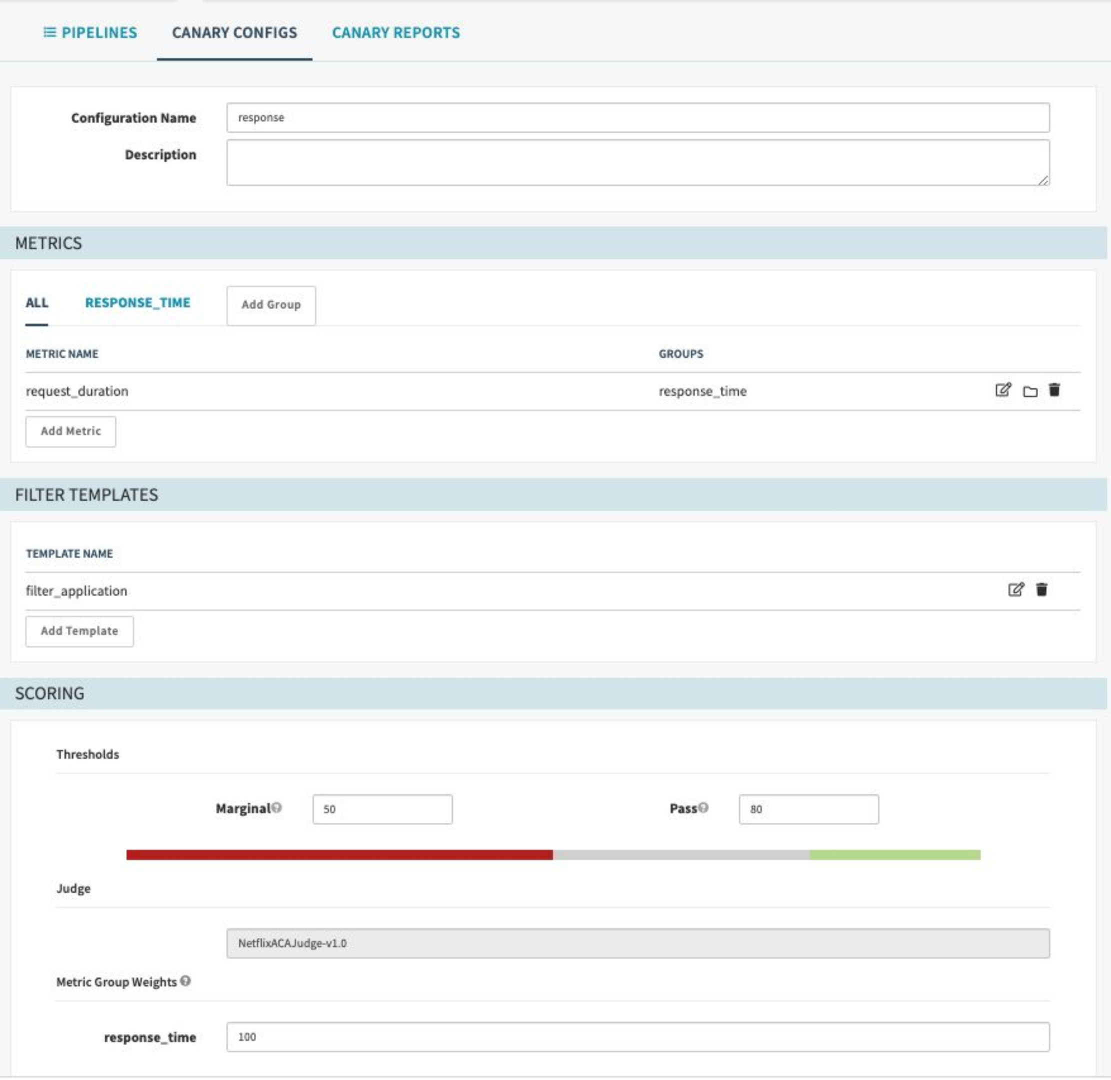
Advanced Settings

Metrics Account prometheus-aws

Storage Account aws-kayenta

Scope Name default

Canary Config



Configuration Name response

Description

METRICS

METRIC NAME	GROUPS
request_duration	response_time

FILTER TEMPLATES

TEMPLATE NAME
filter_application

SCORING

Thresholds

Marginal 50 **Pass** 80

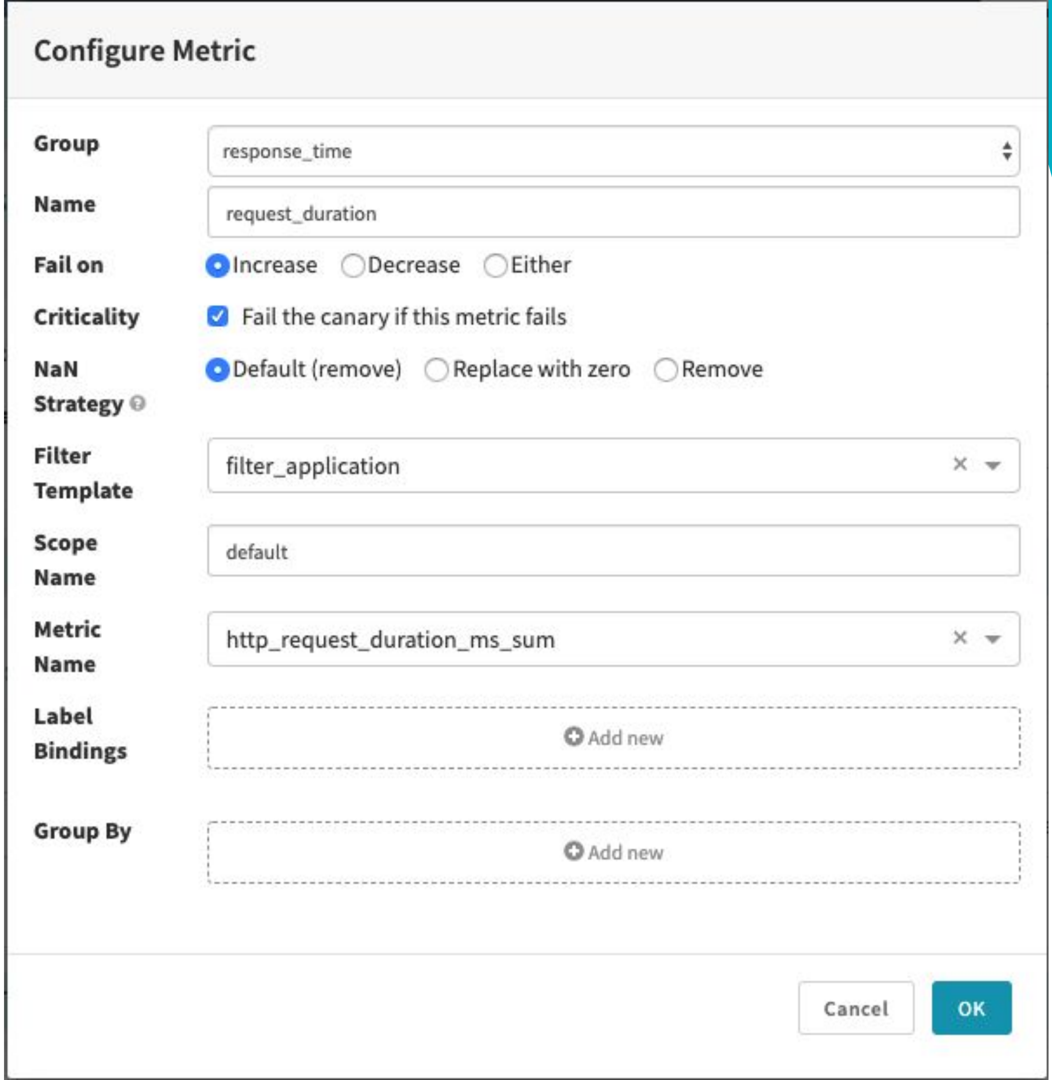
Judge

NetflixACAJudge-v1.0

Metric Group Weights

response_time 100

Canary Config Metric



Configure Metric

Group: response_time

Name: request_duration

Fail on: ● Increase ○ Decrease ○ Either

Criticality: ☑ Fail the canary if this metric fails

NaN Strategy: ● Default (remove) ○ Replace with zero ○ Remove

Filter Template: filter_application

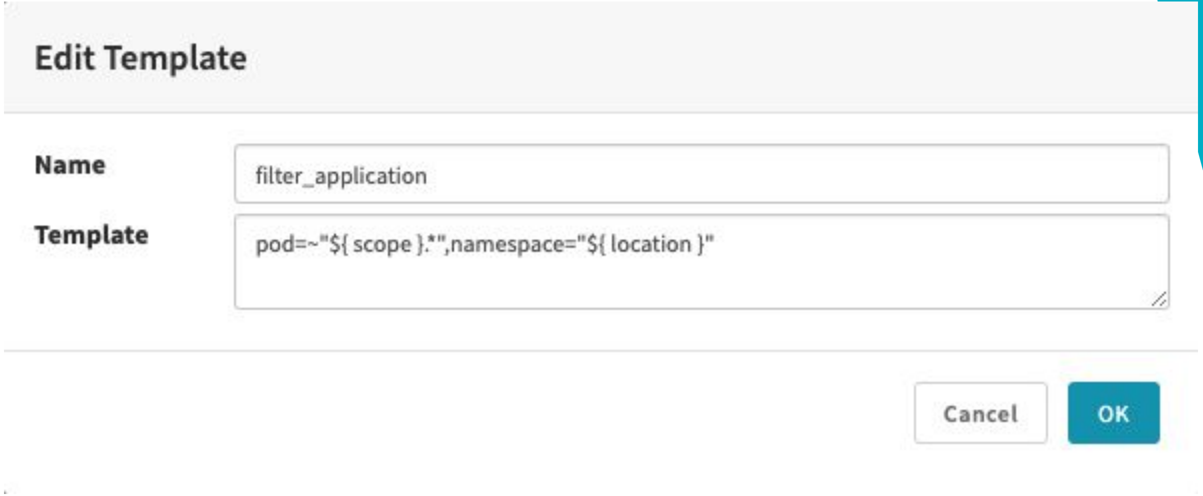
Scope Name: default

Metric Name: http_request_duration_ms_sum

Label Bindings: Add new

Group By: Add new

Canary Config Filter



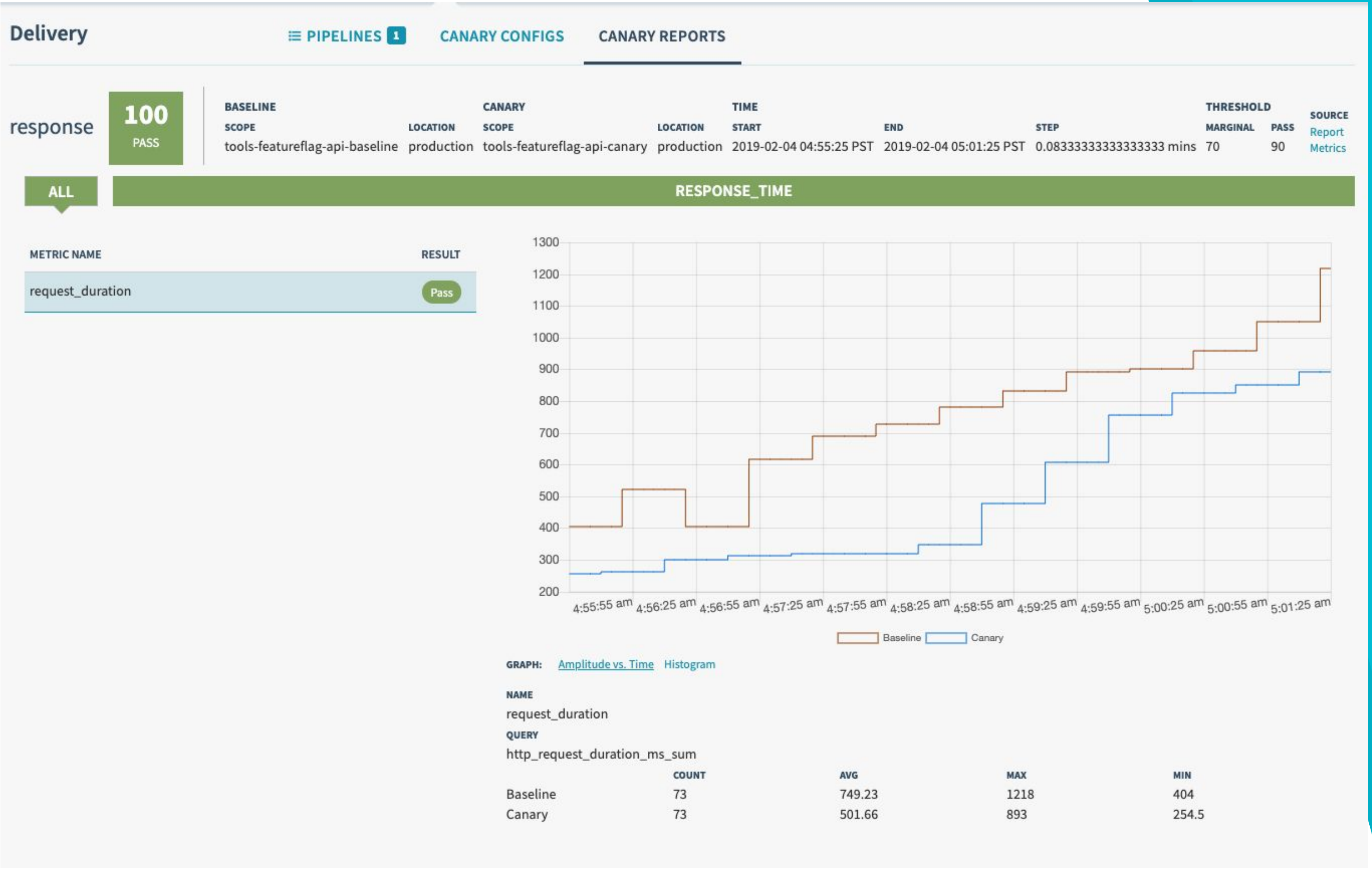
Edit Template

Name filter_application

Template

```
pod=~"${ scope }.*",namespace="${ location }"
```

Canary Analysis Report: Success



response **100** PASS

BASELINE		CANARY		TIME			THRESHOLD		SOURCE
SCOPE	LOCATION	SCOPE	LOCATION	START	END	STEP	MARGINAL	PASS	Report
tools-featureflag-api-baseline	production	tools-featureflag-api-canary	production	2019-02-04 04:55:25 PST	2019-02-04 05:01:25 PST	0.08333333333333333 mins	70	90	Metrics

RESPONSE_TIME

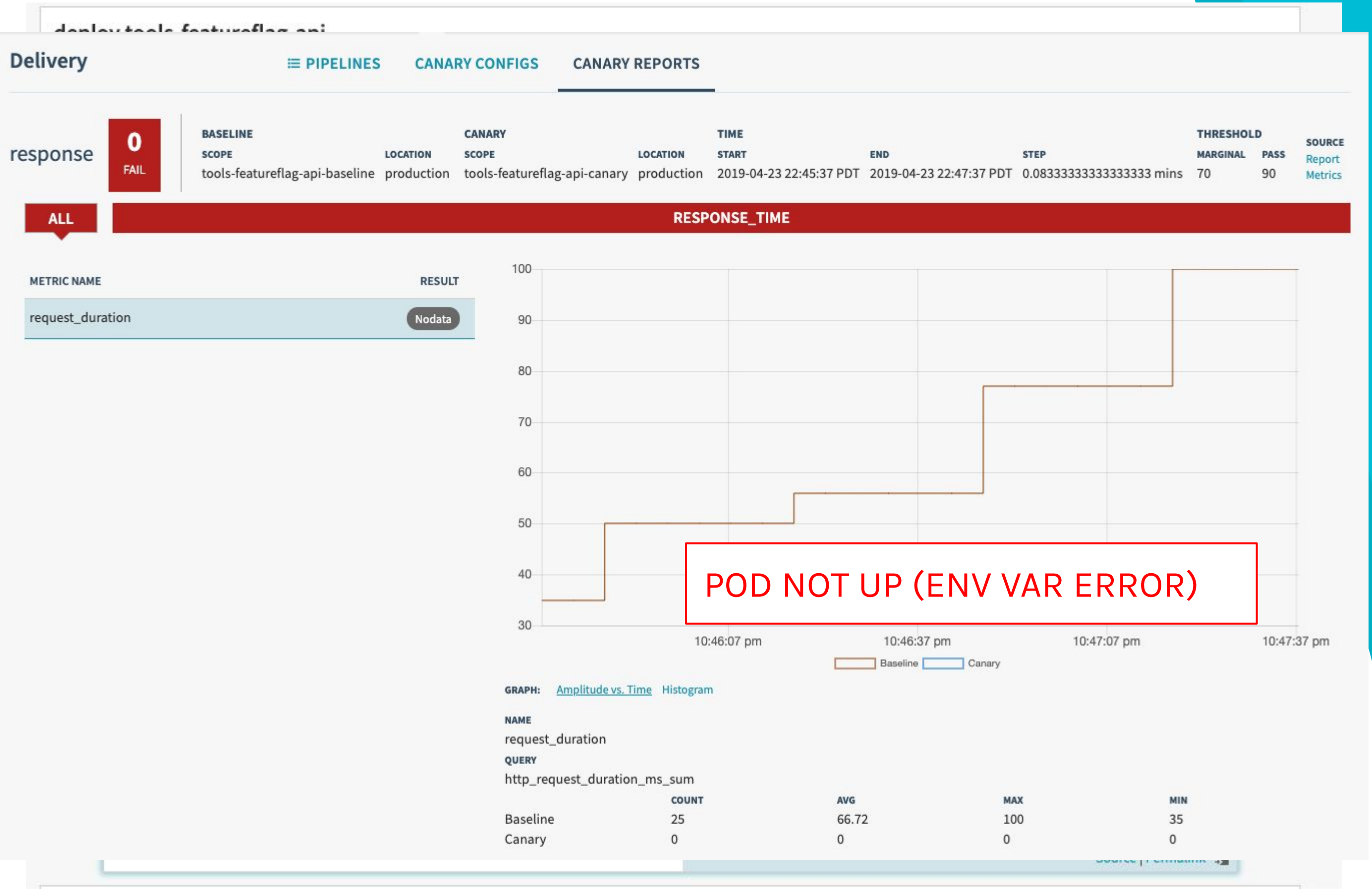
METRIC NAME	RESULT
request_duration	Pass

NAME
request_duration

QUERY
http_request_duration_ms_sum

	COUNT	AVG	MAX	MIN
Baseline	73	749.23	1218	404
Canary	73	501.66	893	254.5

Canary Analysis Report: Failed



deploy-tools-featureflag-api

Delivery

☰ PIPELINES | CANARY CONFIGS | CANARY REPORTS

response — 0 FAIL

BASELINE		CANARY		TIME			THRESHOLD		SOURCE
SCOPE	LOCATION	SCOPE	LOCATION	START	END	STEP	MARGINAL	PASS	Report
tools-featureflag-api-baseline	production	tools-featureflag-api-canary	production	2019-04-23 22:45:37 PDT	2019-04-23 22:47:37 PDT	0.08333333333333333 mins	70	90	Metrics

ALL | RESPONSE_TIME

METRIC NAME	RESULT
request_duration	Nodata

POD NOT UP (ENV VAR ERROR)

GRAPH: Amplitude vs. Time Histogram

NAME

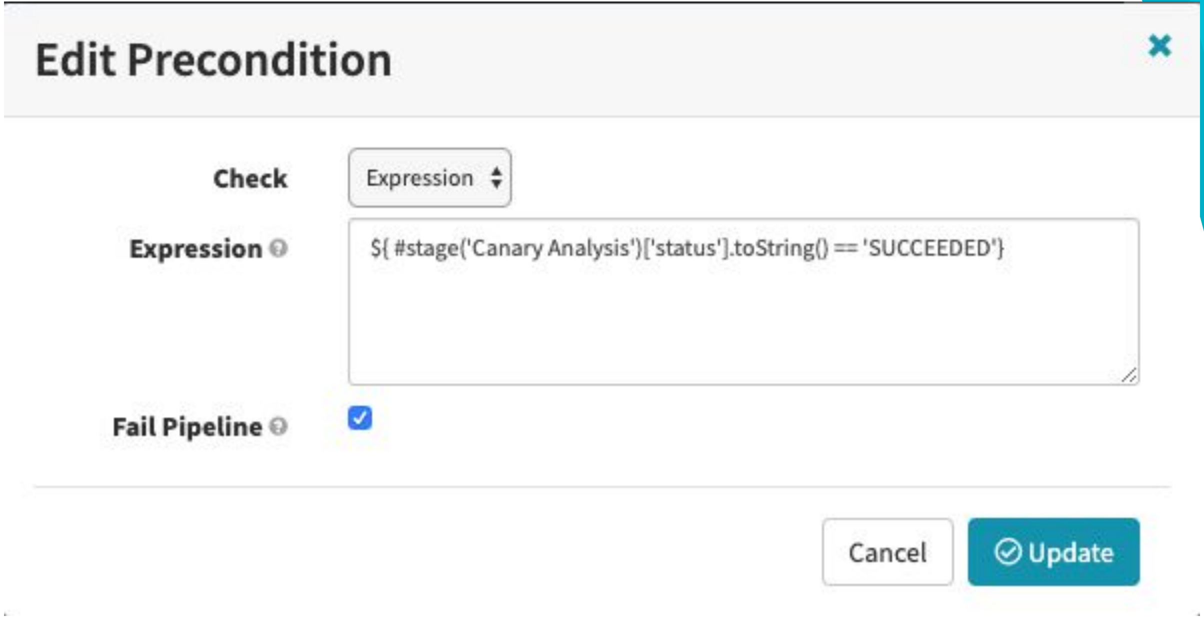
request_duration

QUERY

http_request_duration_ms_sum

	COUNT	AVG	MAX	MIN
Baseline	25	66.72	100	35
Canary	0	0	0	0

Stage: Check



Edit Precondition

Check: Expression

Expression: ${ #stage('Canary Analysis')['status'].toString() == 'SUCCEEDED'}

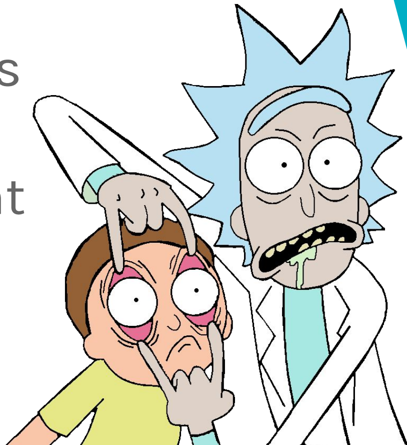
Fail Pipeline ☑

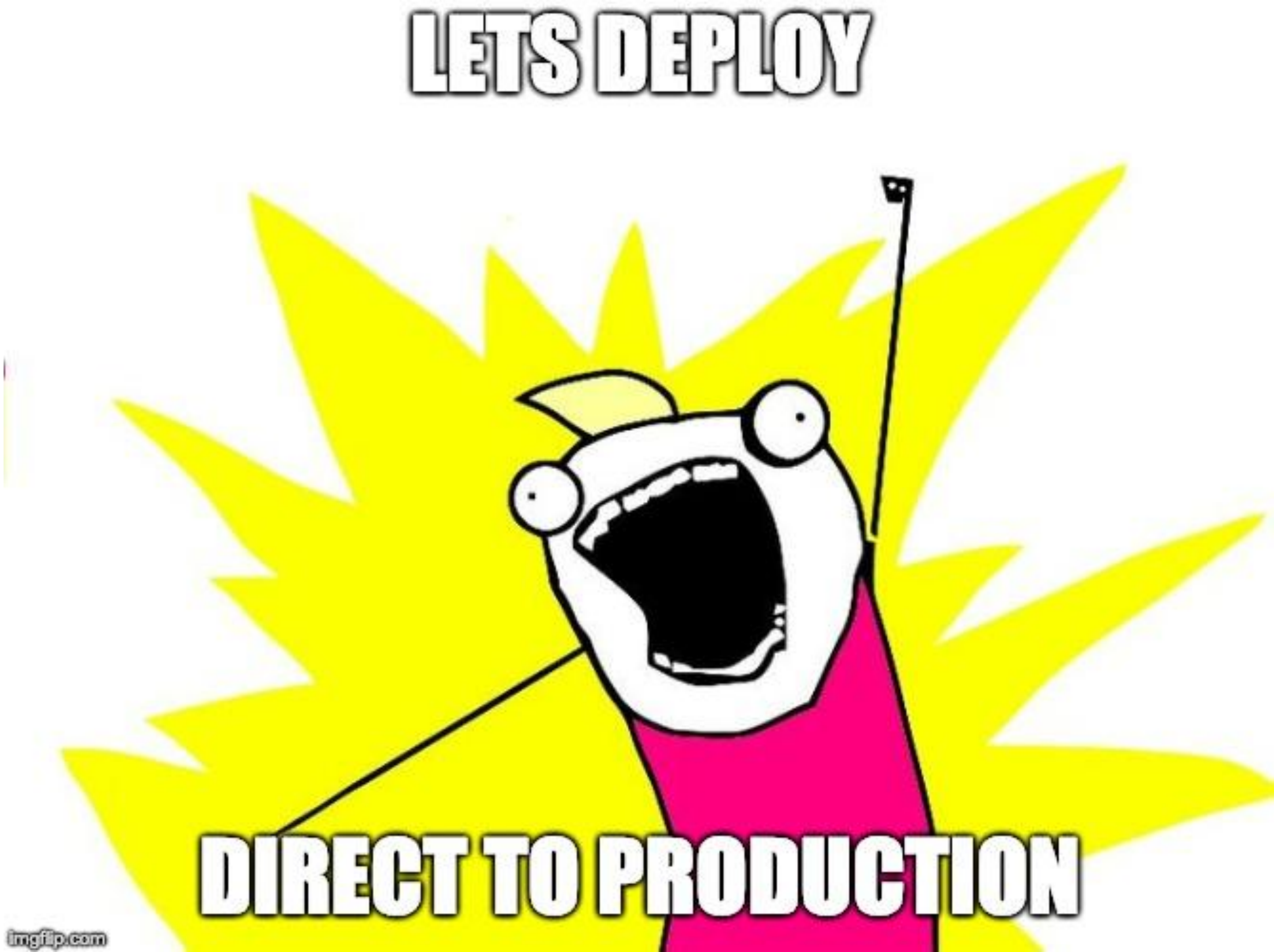
5.

FUTURE

FUTURE

- Canary Analysis config improvement
  - What metrics?
  - Groups weights
  - Length/Windows
- Service Mesh?
- Manifests from SCM
- Pipeline in SCM
- Canary Analysis with business metrics
  - Custom collector?
- Automatic feature toggle management




LETS DEPLOY
DIRECT TO PRODUCTION
imgflip.com

6.

Q&A

7.

"THANK YOU" NOTES

rivendel

Livia

Reúna todos os seus exames em um só lugar

https://liviasaude.com.br

THE
DEVELOPER'S
CONFERENCE

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