# Automated SLO-Based Testing

*"Testing as a Self-Service with Keptn"*

TestCon

15th October 2020 @ 11:10 (GMT+3)

TestCon Europe 2020
ONLINE EDITION
The biggest software testing conference in Europe
October 13-15 Online

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DevOps Activist at Dynatrace

DevRel for Keptn

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keptn

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CLOUD NATIVE
COMPUTING FOUNDATION

We are a Cloud Native Computing Foundation Sandbox project.

# What does Keptn do? End-2-End Capabilities overview!

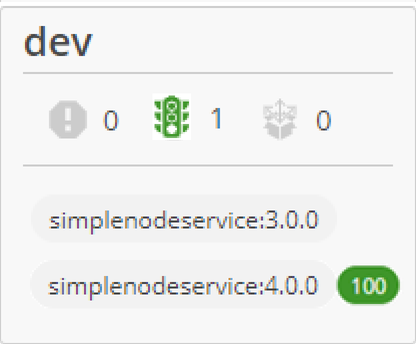
Increased **Speed** and **Quality** of Progressive Delivery through **Automation**

**Automate Operations**

Developer

Pull Request

simplenodeservice:4.0.0

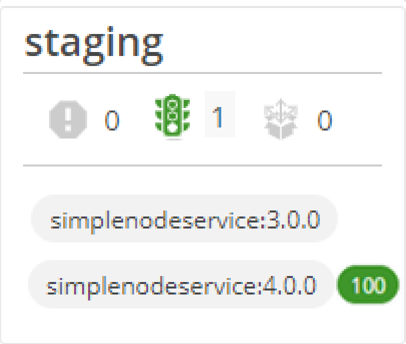


dev

0 1 0

simplenodeservice:3.0.0

simplenodeservice:4.0.0 100

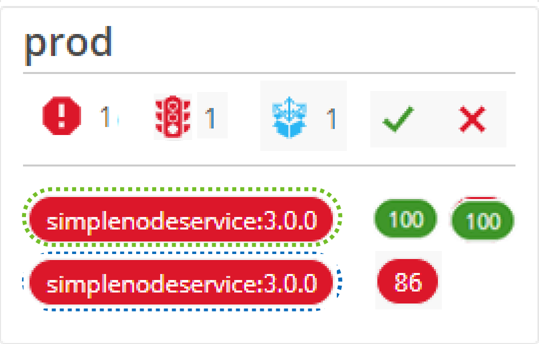


staging

0 1 0

simplenodeservice:3.0.0

simplenodeservice:4.0.0 100



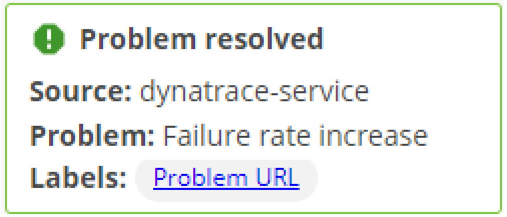
prod

1 1 1 ✓ ✗

simplenodeservice:3.0.0 100 100

simplenodeservice:3.0.0 86

Closed-Loop Remediation



**Problem resolved**

**Source:** dynatrace-service

**Problem:** Failure rate increase

**Labels:** Problem URL

(1) Deploy & **Test**

(2) Evaluate SLOs 100

(3) Auto-Promote ✓

(4) Deploy & **Test**

(5) Evaluate SLOs 100

(6) Promote? ✓ ✗

(7) Deploy Blue / Green

(8) Evaluate SLOs 86

(9) Toggle Blue / Green

(10) Re-Evaluate SLOs 100

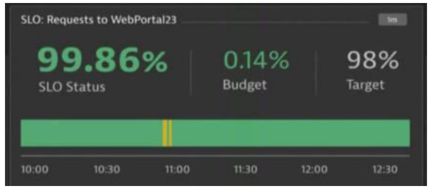
(1) Action 1: Scale Up

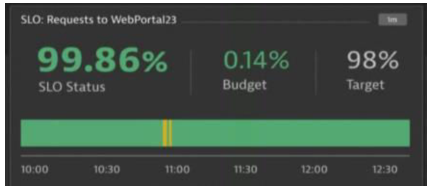
(2) Evaluate SLOs 86

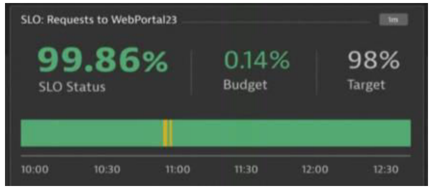
(3) Action 2: Roll Back

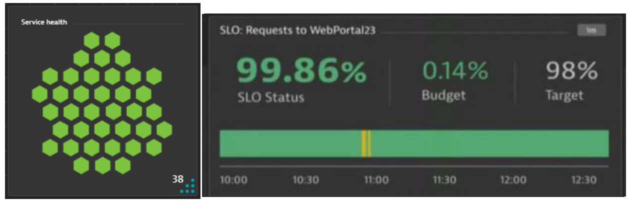
(4) Evaluate SLOs 100

Observabilty

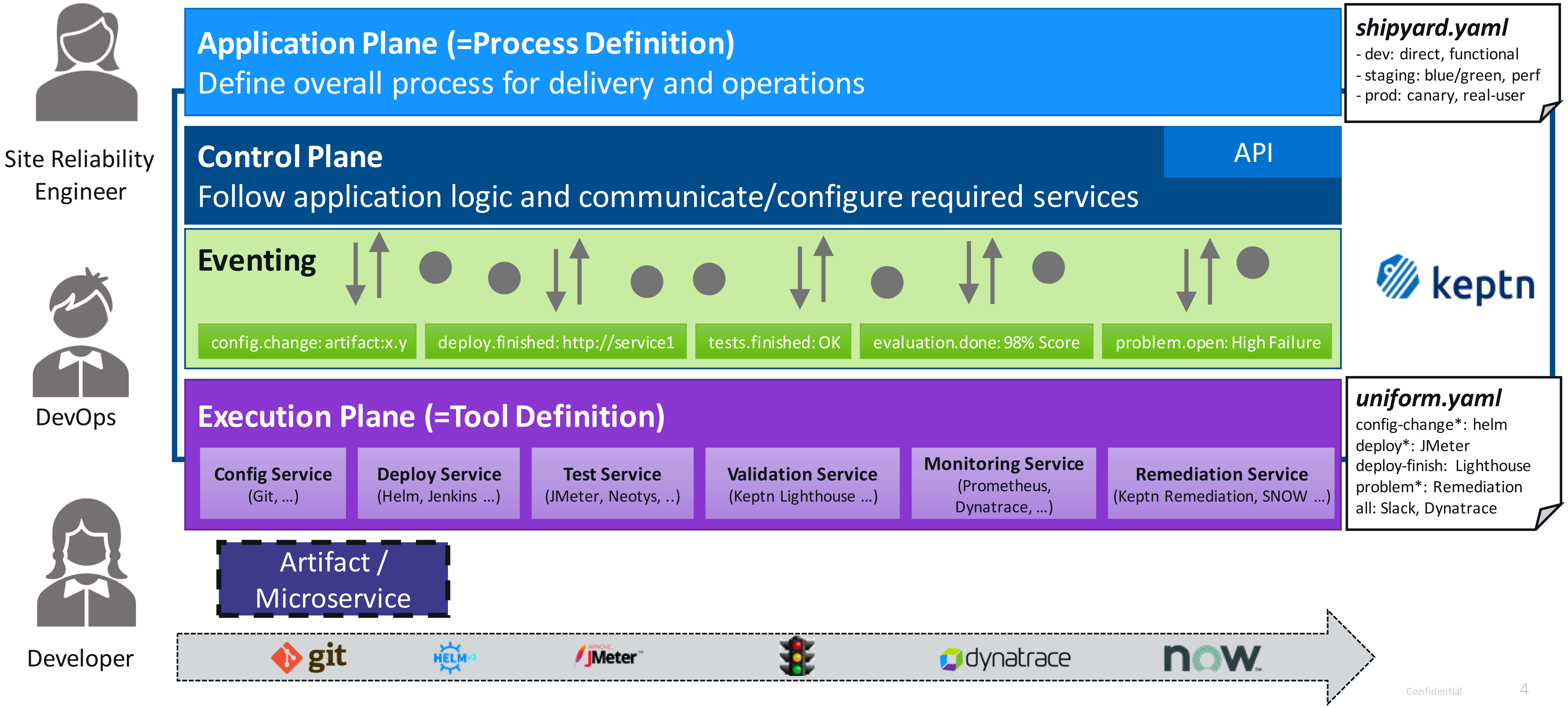








# Keptn's architecture and event-driven approach for delivery & operation



Site Reliability Engineer

DevOps

Developer

**Application Plane (=Process Definition)**
Define overall process for delivery and operations

***shipyard.yaml***
- dev: direct, functional
- staging: blue/green, perf
- prod: canary, real-user

**Control Plane**
Follow application logic and communicate/configure required services

API

**Eventing**

config.change: artifact:x.y

deploy.finished: http://service1

tests.finished: OK

evaluation.done: 98% Score

problem.open: High Failure

keptn

**Execution Plane (=Tool Definition)**

**Config Service**
(Git, ...)

**Deploy Service**
(Helm, Jenkins ...)

**Test Service**
(JMeter, Neotys, ..)

**Validation Service**
(Keptn Lighthouse ...)

**Monitoring Service**
(Prometheus, Dynatrace, ...)

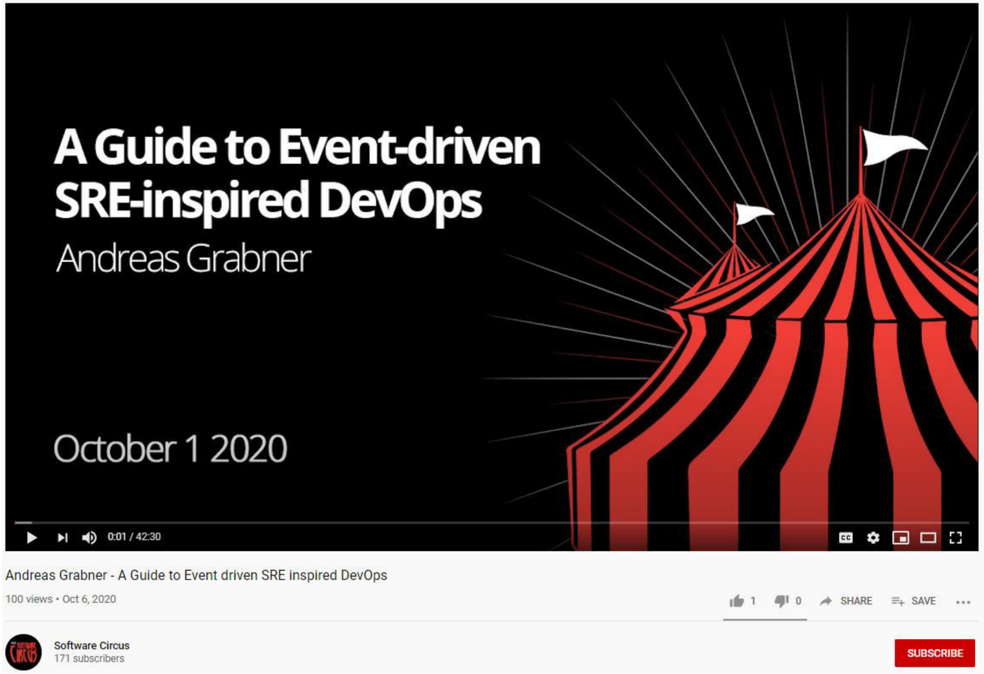
**Remediation Service**
(Keptn Remediation, SNOW ...)

***uniform.yaml***
config-change*: helm
deploy*: JMeter
deploy-finish: Lighthouse
problem*: Remediation
all: Slack, Dynatrace

Artifact / Microservice

# If you want to learn more about Keptn

- GitHub: https://github.com/keptn/keptn
- Website: www.keptn.sh , Tutorials: https://tutorials.keptn.sh
- 2 Minute install of Keptn on k3s: https://github.com/keptn-sandbox/keptn-on-k3s
- Meetup Recording: https://www.youtube.com/watch?v=qWq1rPKMFQI
- Slack: https://slack.keptn.sh



A Guide to Event-driven SRE-inspired DevOps

Andreas Grabner

October 1 2020

0:01 / 42:30

Andreas Grabner - A Guide to Event driven SRE inspired DevOps

100 views • Oct 6, 2020

Software Circus

171 subscribers

- **But now lets focus on the following Use Cases**
  - Automating Test Analysis using SLIs/SLOs
  - Providing Testing as a Self-Service

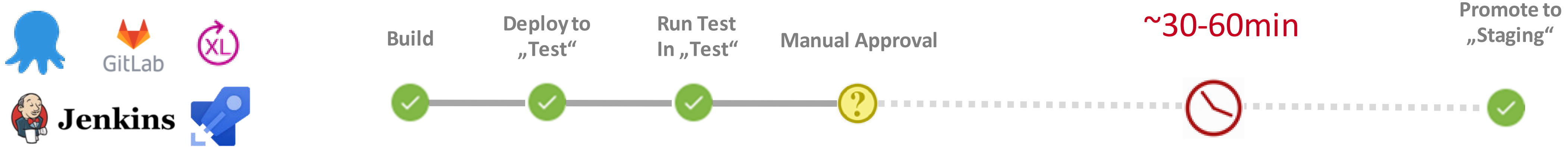
# Use Case #1

Automating Test Analysis using SLIs/SLOs

**80%** of lead time

spent in manual test result / deployment validation

# Root Cause: Lengthy manual approval

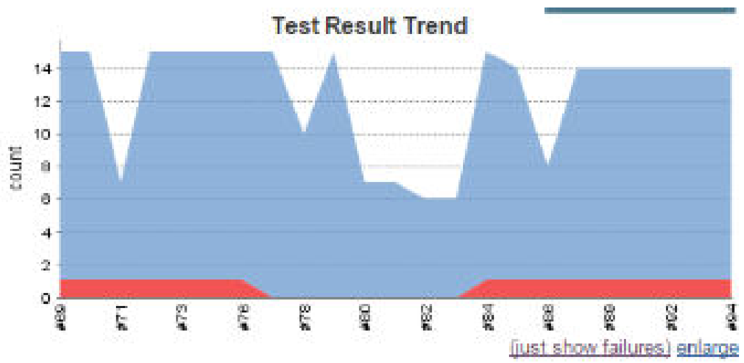


*Is this regression impacting key business use cases* ?

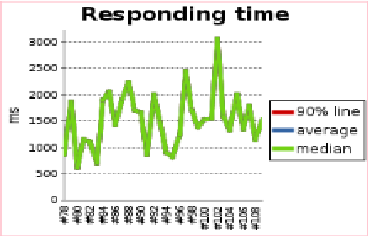
*Which metrics are important and which build is therefore better* ?

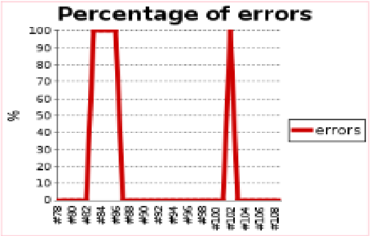
*Which data comes from my test and is relevant for business transactions* ?

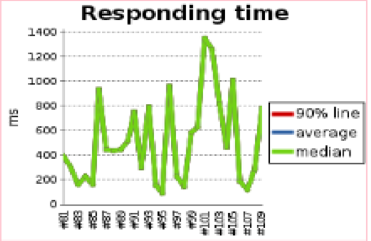
**Functional**: Test Result Trend Not Enough

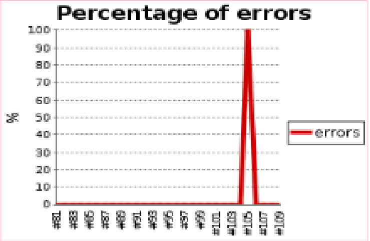


**Performance**: Manual Comparison Is Slow

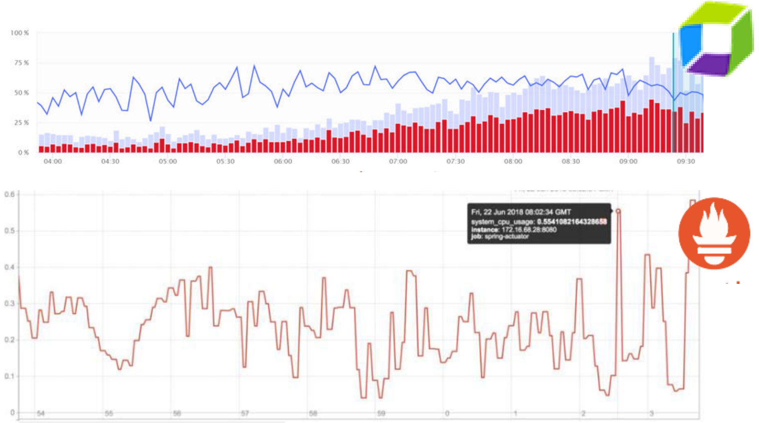








**Monitoring**: Too much unstructed data

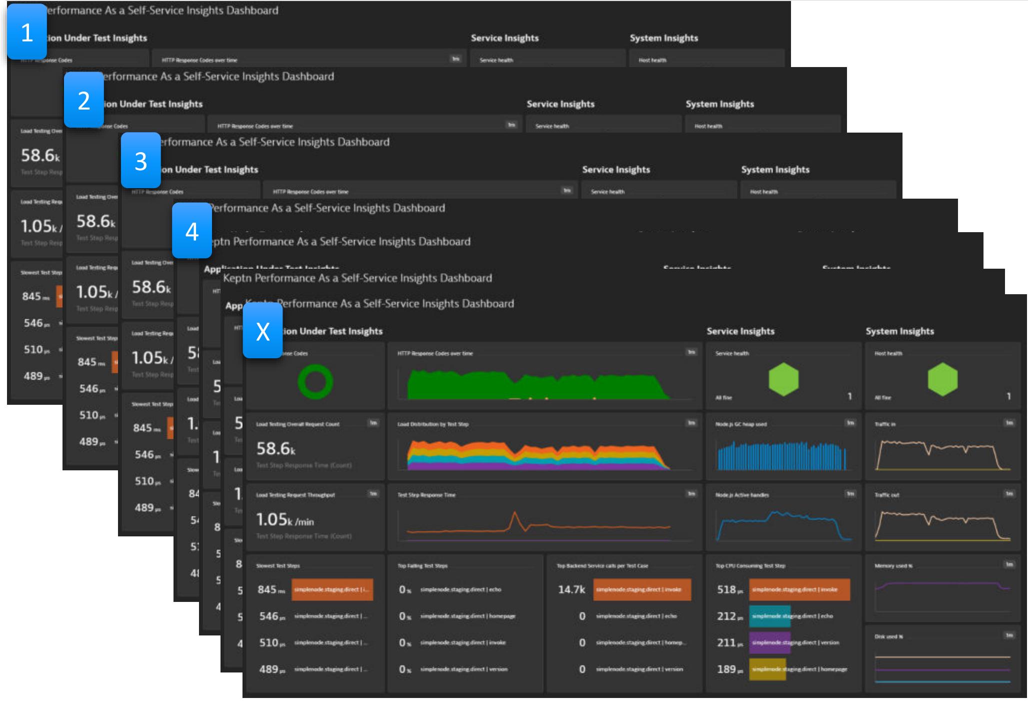


Speed up delivery lead time by **80%**

through Automated SLI/SLO-based Quality Gates

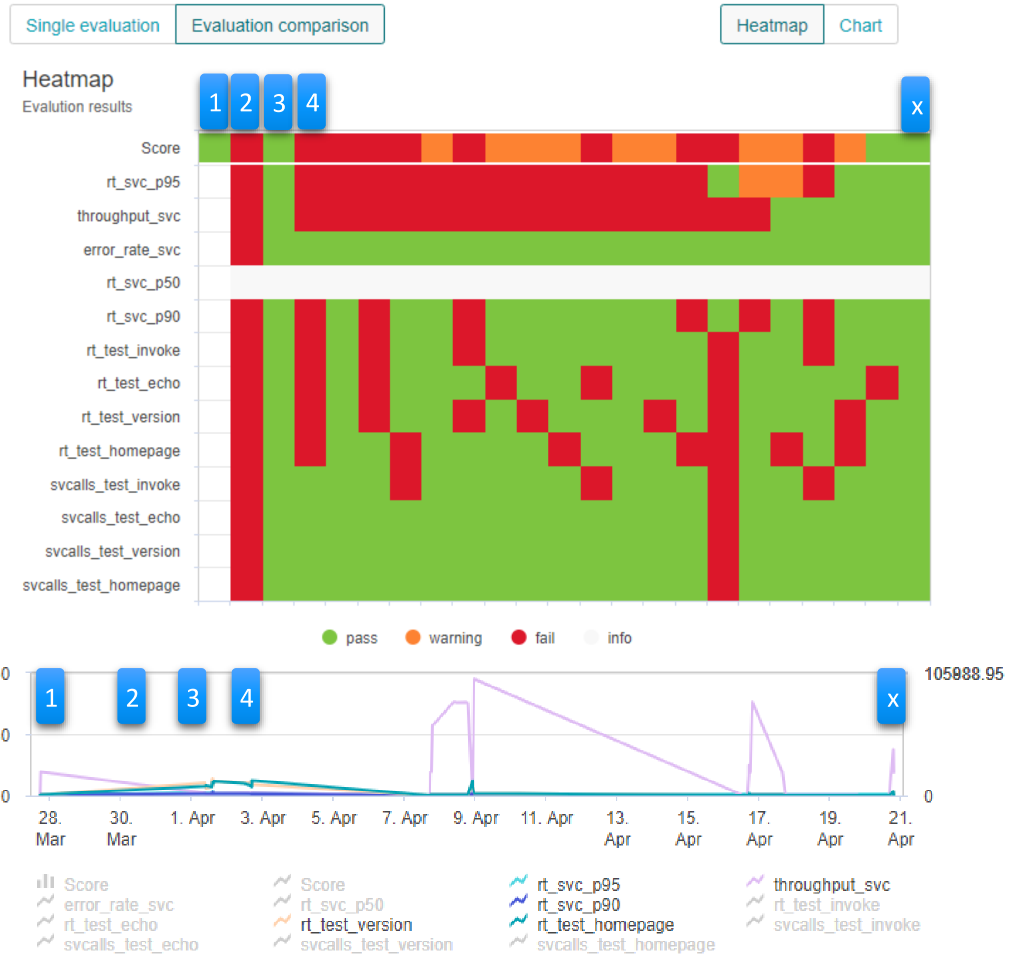
# The problem Keptn solves: Automates Data Analysis

Instead of manually analyzing and comparing test results



1
2
3
4
X
Keptn Performance As a Self-Service Insights Dashboard
Application Under Test Insights
Service Insights
System Insights
58.6k
1.05k /min
845
546
510
489
14.7k
518
212
211
189

Keptn automates that process based on **SLIs** & **SLOs**



# SLI/SLOs – Key Concept from Google's SRE Practices

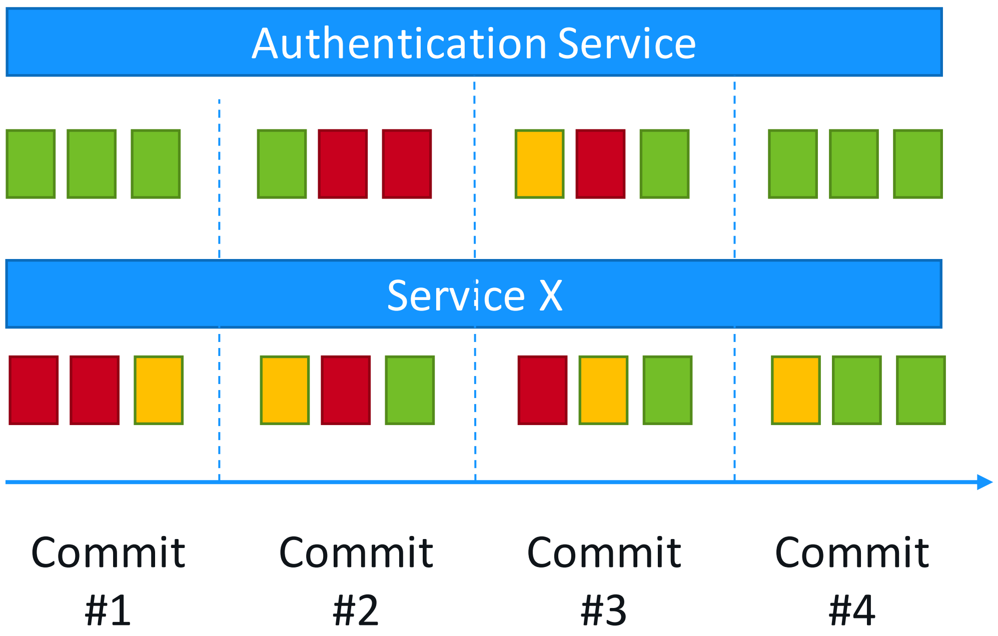
## SLIs drive SLOs which inform SLAs

- Service Level Indicators (SLIs)
  - Definition: Measurable Metrics as the base for evaluation
  - Example: Error Rate of Login Requests
- Service Level Objectives (SLOs)
  - Definition: Binding targets for Service Level Indicators
  - Example: Login Error Rate must be less than 2% over a 30 day period
- Service Level Agreements (SLAs)
  - Definition: Business Agreement between consumer and provider typically based on SLO
  - Example: Logins must be reliable & fast (Error Rate, Response Time, Throughput) 99% within a 30 day window
- Google Cloud YouTube Video
  - SLIs, SLOs, SLAs, oh my! (class SRE implements DevOps): https://www.youtube.com/watch?v=tEylFyxbDLE

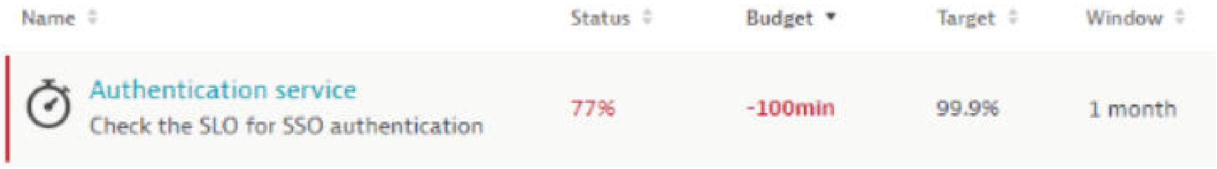
# Keptn applies SRE Best Practices across the lifecycle

**Continuous Delivery** ← Shift-Left **Production**

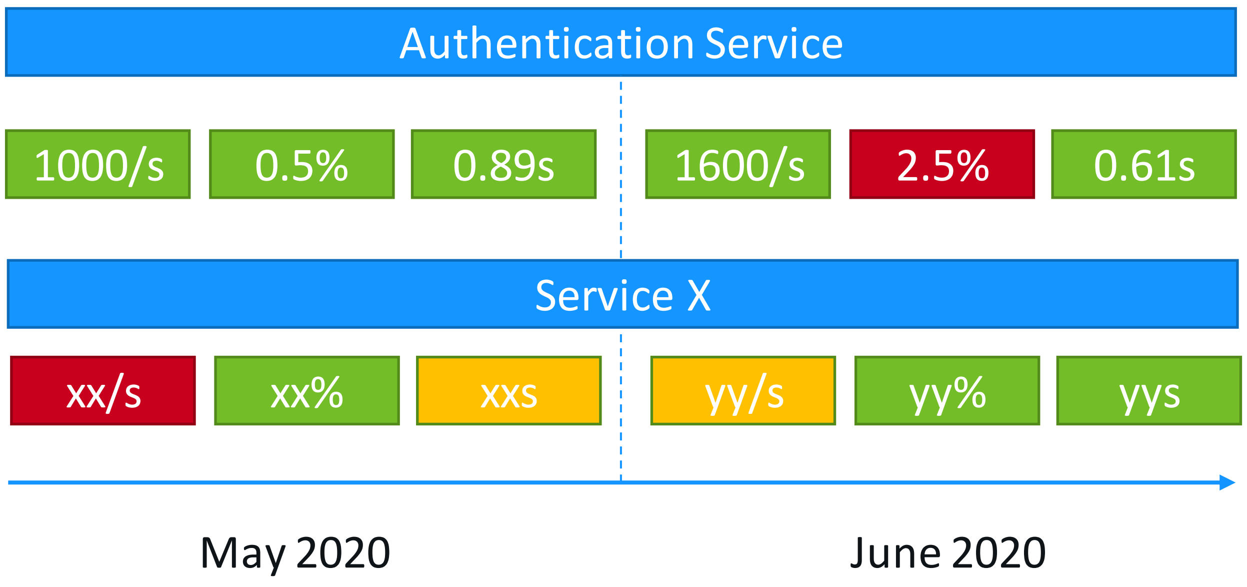
keptn Quality Gates



| | Commit #1 | Commit #2 | Commit #3 | Commit #4 |
|---|---|---|---|---|
| Authentication Service | 🟩 🟩 🟩 | 🟩 🟥 🟥 | 🟨 🟥 🟩 | 🟩 🟩 🟩 |
| Service X | 🟥 🟥 🟨 | 🟨 🟥 🟩 | 🟥 🟨 🟩 | 🟨 🟩 🟩 |



| Name | Status | Budget | Target | Window |
|---|---|---|---|---|
| Authentication service<br>Check the SLO for SSO authentication | 77% | -100min | 99.9% | 1 month |



| | May 2020 | | | June 2020 | | |
|---|---|---|---|---|---|---|
| Authentication Service | 🟩 1000/s | 🟩 0.5% | 🟩 0.89s | 🟩 1600/s | 🟥 2.5% | 🟩 0.61s |
| Service X | 🟥 xx/s | 🟩 xx% | 🟨 xxs | 🟨 yy/s | 🟩 yy% | 🟩 yys |

## Explainer on SLI/SLO Validation as part of Continuous Delivery with Dynatrace & Keptn!

```
$ keptn send event start-evaluation myproject myservice starttime=build4_teststart endtime=build4_testsend
```

| | SLIs (Service Level Indicators) | SLO pass | SLO warn | Build 1 | Build 2 | Build 3 | Build 4 |
|---|---|---|---|---|---|---|---|
| DevOps | **Response Time 95th Perc**<br>**Query**: builtin:service.responsetime(p95) | <=100ms | <= 250ms | 80ms | 120ms | 90ms | 95ms |
| | **Overall Failure Rate**<br>**Query**: builtin:service.errors.total | <= 2% | <= 5% | 0% | 4% | 1% | 0% |
| | **Test Step LOGIN Response Time**<br>**Query**: calc:service.teststeprt:filter(Test, LOGIN) | <=150ms & <=+10% | <= 400ms | 100ms | 90ms | 120ms | 95ms |
| | **Test Step LOGIN # Service Calls**<br>**Query**: calc:service.testsvc:filter(tx, LOGIN) | <= +0% | | 1 | 1 | 2 | 1 |
| | **SLO: Overall Score Goal** | 90% | 75% | 100% | 75% | 62.5% | 100% |

# SLI/SLO-based evaluation implementation in Keptn

## SLIs defined per SLI Provider as YAML

SLI Provider specific queries, e.g: Dynatrace Metrics Query

```
indicators:
  error_rate:     "builtin:service.errors.total.count:merge(0):avg"
  count_dbcalls: "calc:service.toptestdbcalls:merge(0):sum"
  jvm_memory:     "builtin:tech.jvm.memory.pool.committed:merge(0):sum"
```

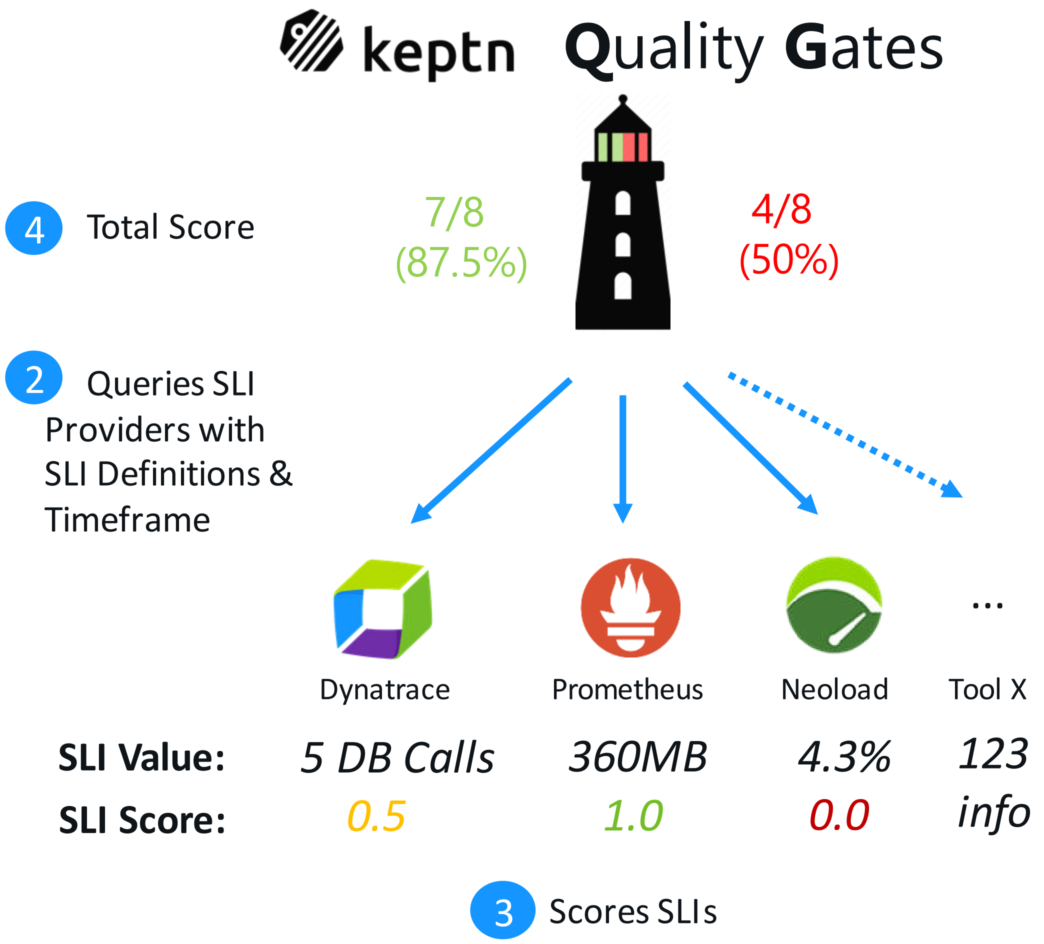
## SLOs defined on Keptn Service Level as YAML

List of objectives with fixed or relative pass & warn criteria

```
objectives:
  - sli: error_rate
    pass:
    - criteria:
      - "<=1“  # We expect a max error rate of 1%
  - sli: jvm_memory
  - sli: count_dbcalls
    pass:
    - criteria:
      - "=+2%"  # We allow a 2% increase in DB Calls to previous runs
    warning:
    - criteria:
      - "<=10"  # We expect no more than 10 DB Calls per TX
total_score:
  pass: "90%"
  warning: "75%"
```

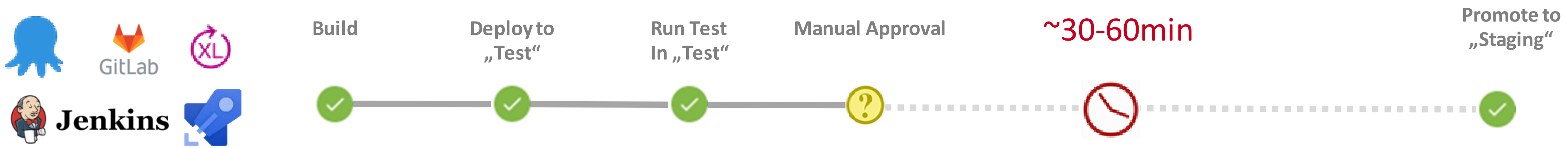
1

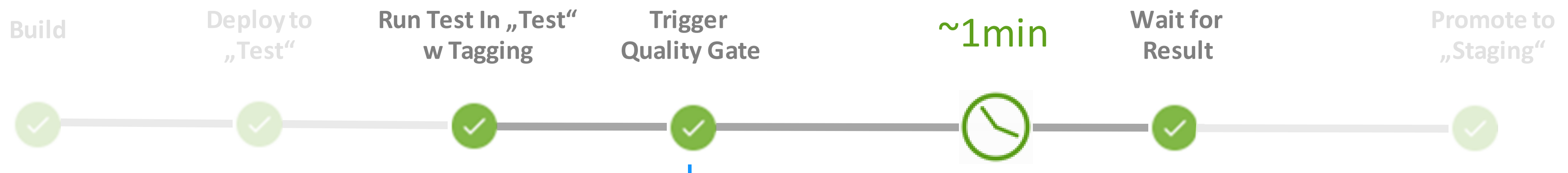
```
$ keptn start-evaluation 30m myservice sli.yaml slo.yaml
```



| | Dynatrace | Prometheus | Neoload | Tool X |
|---|---|---|---|---|
| **SLI Value:** | *5 DB Calls* | *360MB* | *4.3%* | *123* |
| **SLI Score:** | *0.5* | *1.0* | *0.0* | *info* |

# Integrate Automated SLI/SLO-based Analysis into your existing workflows





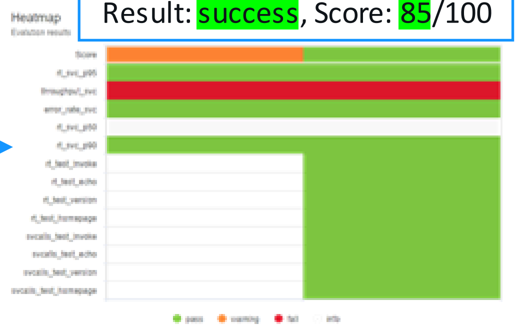
Tagging

**SLI & SLO**

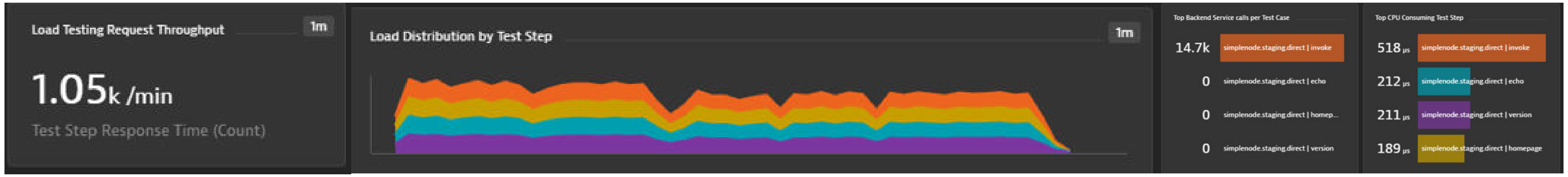
```
Rt(p95)  <  500ms
#ofSQLs  <=   5
cpu(max)<   80%
Java  GC  <    2%
...
```

Validate SLOs

Result: success, Score: 85/100



Pull SLIs for Testing time frame



Load Testing Request Throughput 1m

1.05k /min

Test Step Response Time (Count)

Load Distribution by Test Step 1m

Top Backend Service calls per Test Case

| | |
|---|---|
| 14.7k | simplenode.staging.direct \| invoke |
| 0 | simplenode.staging.direct \| echo |
| 0 | simplenode.staging.direct \| homep... |
| 0 | simplenode.staging.direct \| version |

Top CPU Consuming Test Step

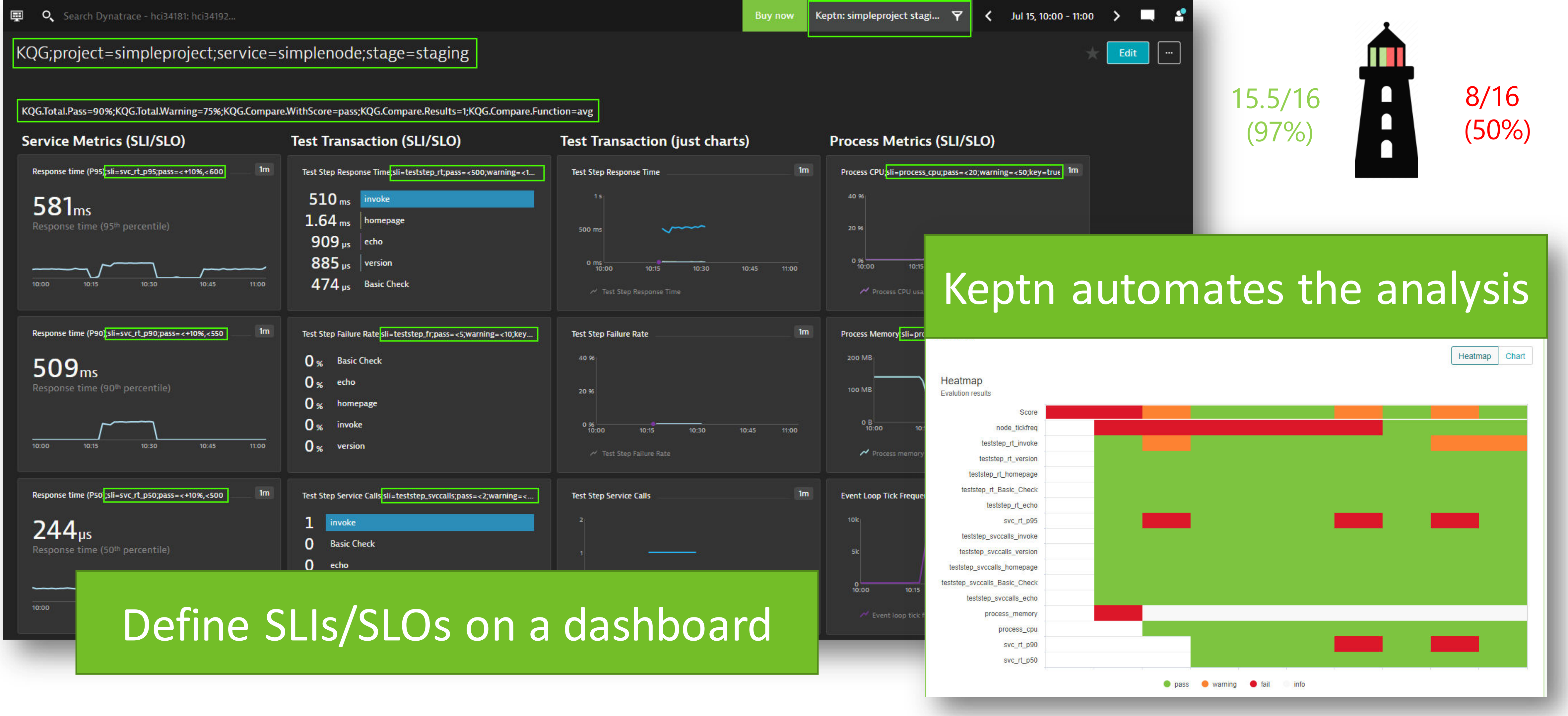
| | |
|---|---|
| 518 µs | simplenode.staging.direct \| invoke |
| 212 µs | simplenode.staging.direct \| echo |
| 211 µs | simplenode.staging.direct \| version |
| 189 µs | simplenode.staging.direct \| homepage |

# Demo: Automated SLI/SLO Validation based on Dynatrace Dashboards

keptn

15.5/16
(97%)

8/16
(50%)



Search Dynatrace - hci34181: hci34192...

Keptn: simpleproject stagi...

Jul 15, 10:00 - 11:00

KQG;project=simpleproject;service=simplenode;stage=staging

KQG.Total.Pass=90%;KQG.Total.Warning=75%;KQG.Compare.WithScore=pass;KQG.Compare.Results=1;KQG.Compare.Function=avg

## Service Metrics (SLI/SLO)

Response time (P95);sli=svc_rt_p95;pass=<+10%,<600

581ms
Response time (95th percentile)

Response time (P90);sli=svc_rt_p90;pass=<+10%,<550

509ms
Response time (90th percentile)

Response time (P50);sli=svc_rt_p50;pass=<+10%,<500

244µs
Response time (50th percentile)

## Test Transaction (SLI/SLO)

Test Step Response Time;sli=teststep_rt;pass=<500;warning=<1...

| | |
|---|---|
| 510 ms | invoke |
| 1.64 ms | homepage |
| 909 µs | echo |
| 885 µs | version |
| 474 µs | Basic Check |

Test Step Failure Rate;sli=teststep_fr;pass=<5;warning=<10;key...

| | |
|---|---|
| 0 % | Basic Check |
| 0 % | echo |
| 0 % | homepage |
| 0 % | invoke |
| 0 % | version |

Test Step Service Calls;sli=teststep_svccalls;pass=<2;warning=<...

| | |
|---|---|
| 1 | invoke |
| 0 | Basic Check |
| 0 | echo |

## Test Transaction (just charts)

Test Step Response Time

Test Step Failure Rate

Test Step Service Calls

## Process Metrics (SLI/SLO)

Process CPU;sli=process_cpu;pass=<20;warning=<50;key=true

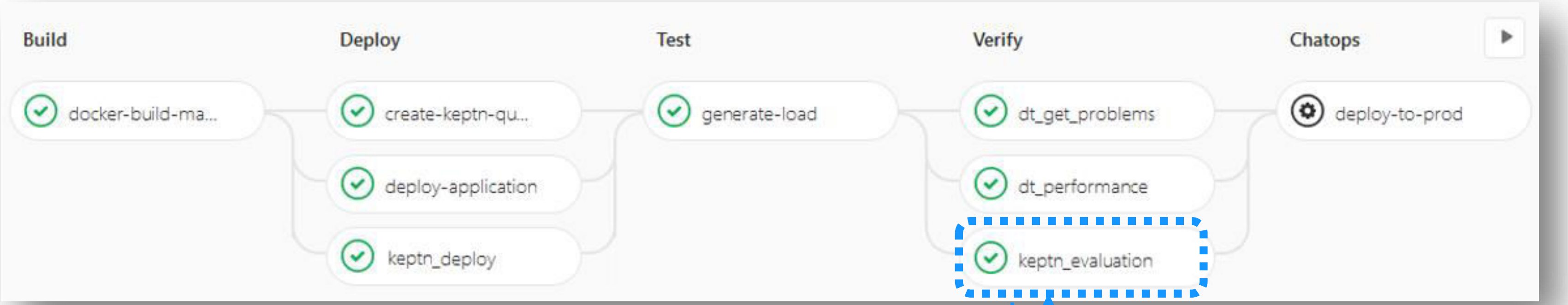
Process Memory;sli=pro

Event Loop Tick Freque

Keptn automates the analysis

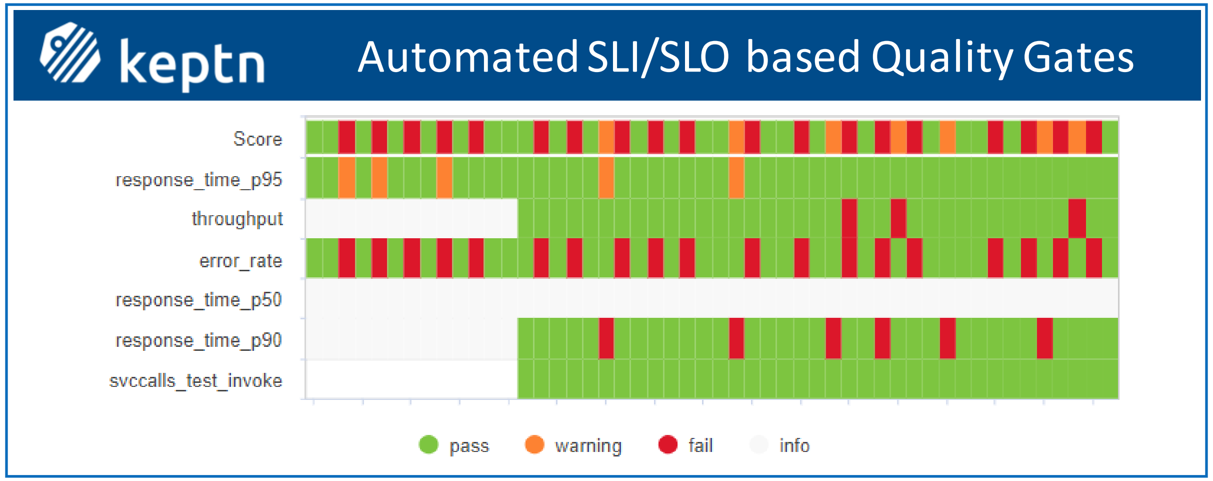
Define SLIs/SLOs on a dashboard

# User Example: Automating Build Approvals using Keptn's SLIs/SLOs in GitLab



Trigger Evaluation

87.5%: passed



**Christian Heckelmann**

Senior Systems Engineer

ERT®

Confidence at every turn™

# Build your own SLI Provider?

- Some ideas for custom SLI Providers
  - Pull in Testing Tool Result, e.g: Selenium, Load Runner, Gatling, …
  - Pull in Code Quality Metrics, e.g: SonarQube, Coverity, xTest …
  - Pull in Monitoring/Observability Data, e.g: Datadog, NewRelic, AppDynamics, …
- I built a custom SLI Provider for a recent conference parsing a JSON Result File
  - https://github.com/grabnerandi/pac-sliprovider
- You can start building our own SLI Provider
  - https://github.com/keptn-sandbox/keptn-service-template-go/

# Use Case #2

Testing as a Self-Service

# Challenge: Automating Performance with Jenkins requires managing tools & environments

Jenkins

- ✓ Build
- ✓ Deploy to „Test“
- ✓ Standup Test Infrastructure
- ✓ Execute Tests
- ✓ Gather Performance Data
- ✓ Evaluate Results

*Where do we run these tests?*

*How much hardware is needed to run these tests?*

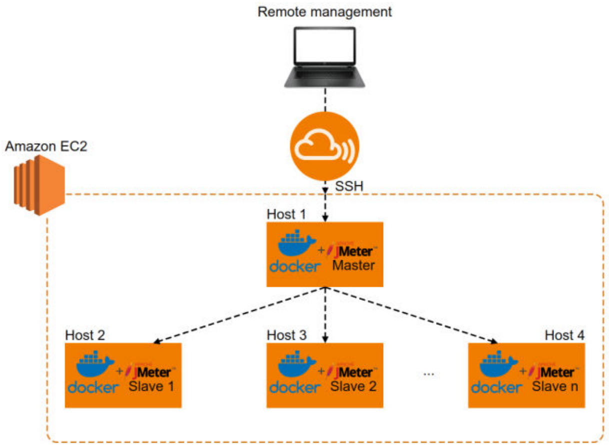
*Who manages this infrastructure?*

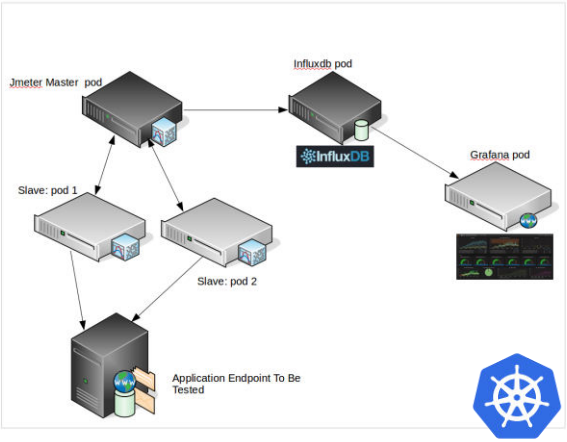
*How to enable different workloads?*

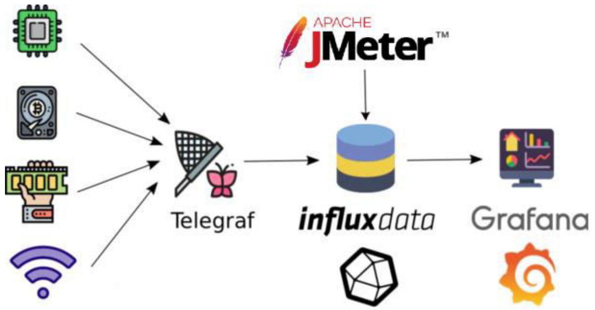
*Where do we stream test metrics to?*

*How to analyze the results?*

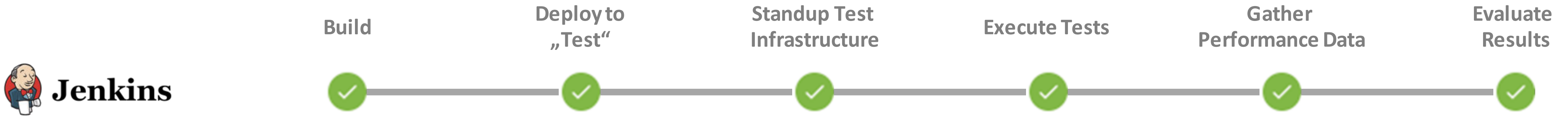
## DIY (Do It Yourself) approach: lots of online guides available!

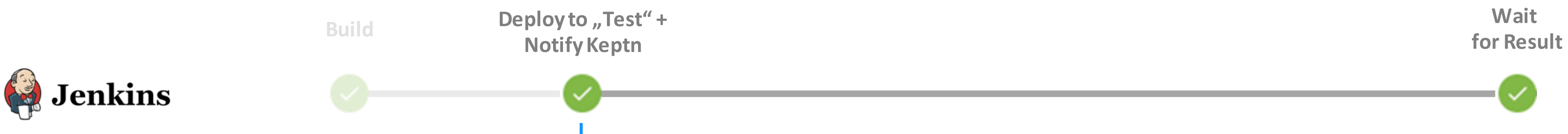


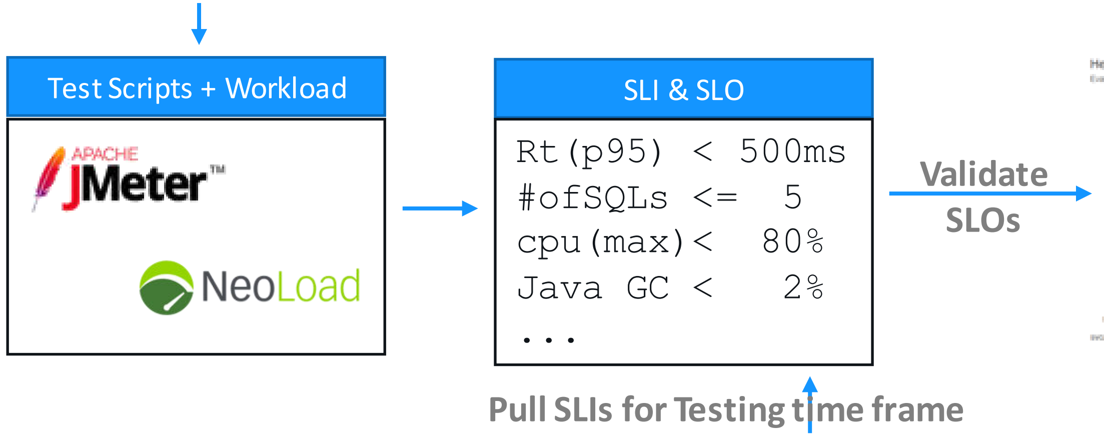




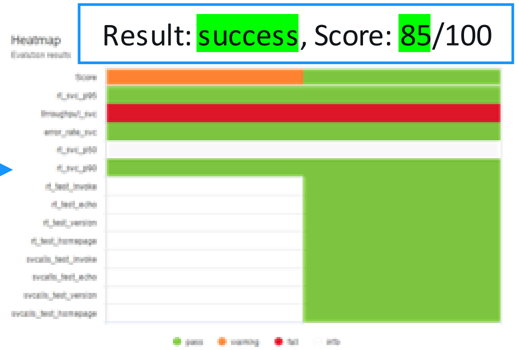
# Solution: Keptn automates Test Orchestration

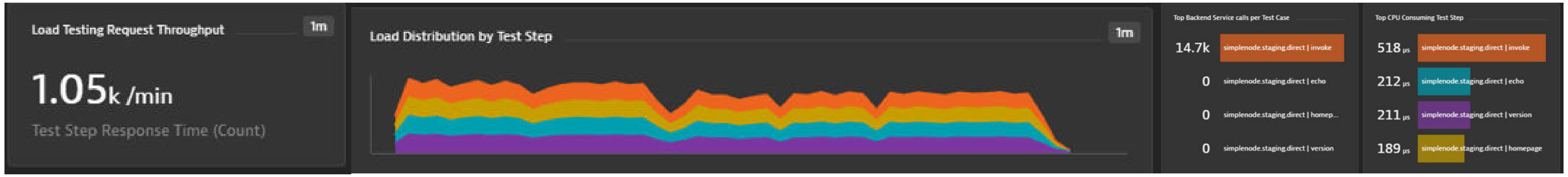






```
Rt(p95)  <  500ms
#ofSQLs  <=   5
cpu(max)<   80%
Java GC <    2%
...
```


Result: success, Score: 85/100


Load Testing Request Throughput 1m

1.05k /min

Test Step Response Time (Count)

Load Distribution by Test Step 1m

Top Backend Service calls per Test Case

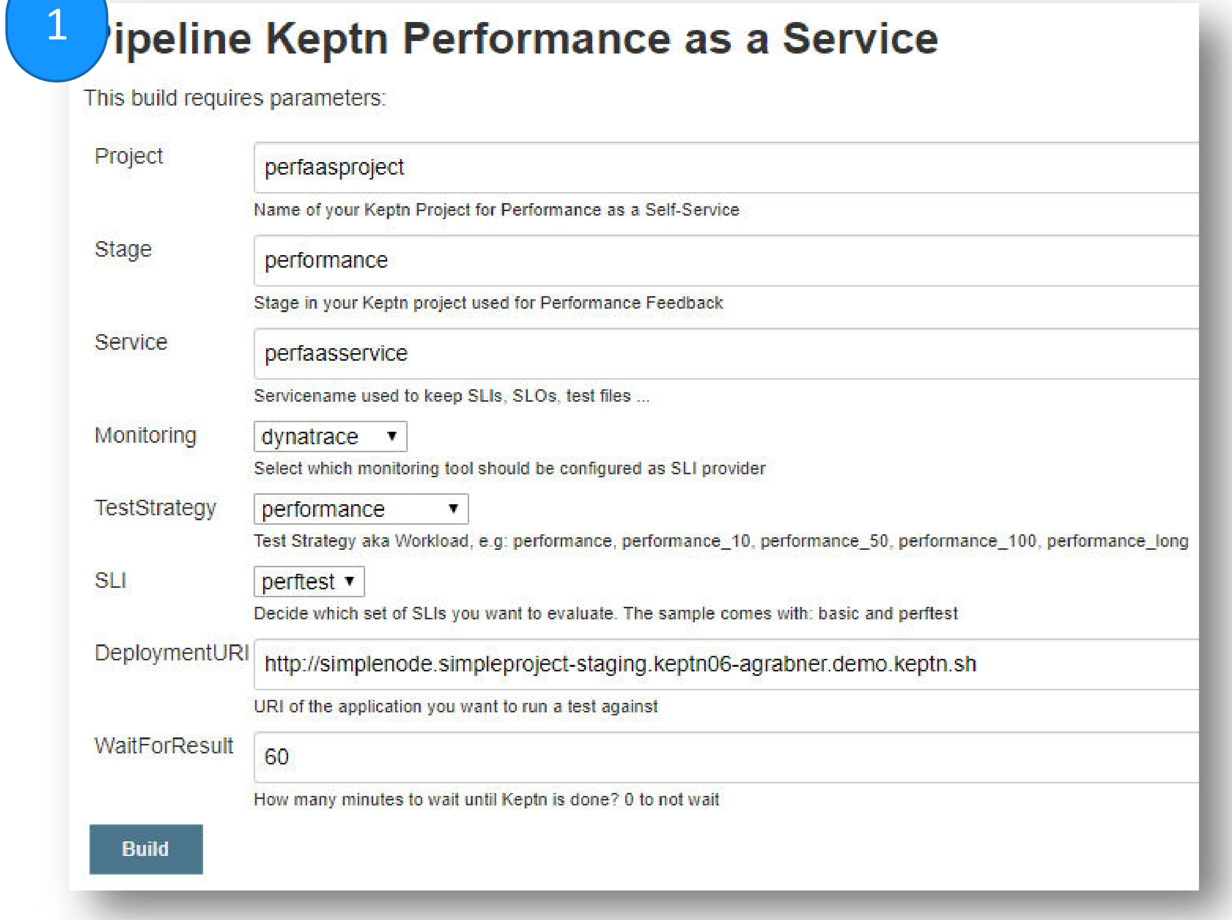
| | |
|---|---|
| 14.7k | simplenode.staging.direct \| invoke |
| 0 | simplenode.staging.direct \| echo |
| 0 | simplenode.staging.direct \| homep... |
| 0 | simplenode.staging.direct \| version |

Top CPU Consuming Test Step

| | |
|---|---|
| 518 µs | simplenode.staging.direct \| invoke |
| 212 µs | simplenode.staging.direct \| echo |
| 211 µs | simplenode.staging.direct \| version |
| 189 µs | simplenode.staging.direct \| homepage |

# Demo: based on https://github.com/keptn-sandbox/jenkins-tutorial

1



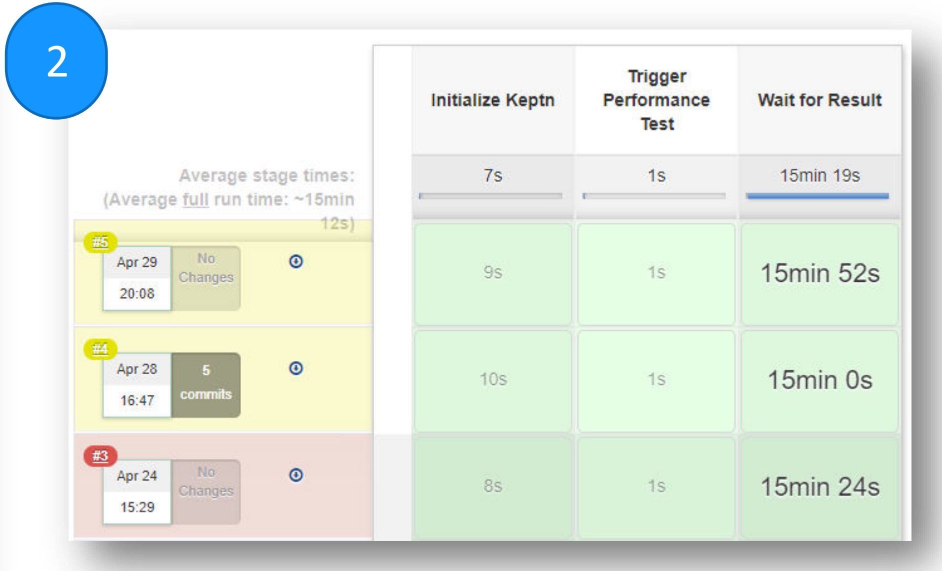
## Pipeline Keptn Performance as a Service

This build requires parameters:

| | |
|---|---|
| Project | perfaasproject<br>Name of your Keptn Project for Performance as a Self-Service |
| Stage | performance<br>Stage in your Keptn project used for Performance Feedback |
| Service | perfaasservice<br>Servicename used to keep SLIs, SLOs, test files ... |
| Monitoring | dynatrace ▼<br>Select which monitoring tool should be configured as SLI provider |
| TestStrategy | performance ▼<br>Test Strategy aka Workload, e.g: performance, performance_10, performance_50, performance_100, performance_long |
| SLI | perftest ▼<br>Decide which set of SLIs you want to evaluate. The sample comes with: basic and perftest |
| DeploymentURI | http://simplenode.simpleproject-staging.keptn06-agrabner.demo.keptn.sh<br>URI of the application you want to run a test against |
| WaitForResult | 60<br>How many minutes to wait until Keptn is done? 0 to not wait |

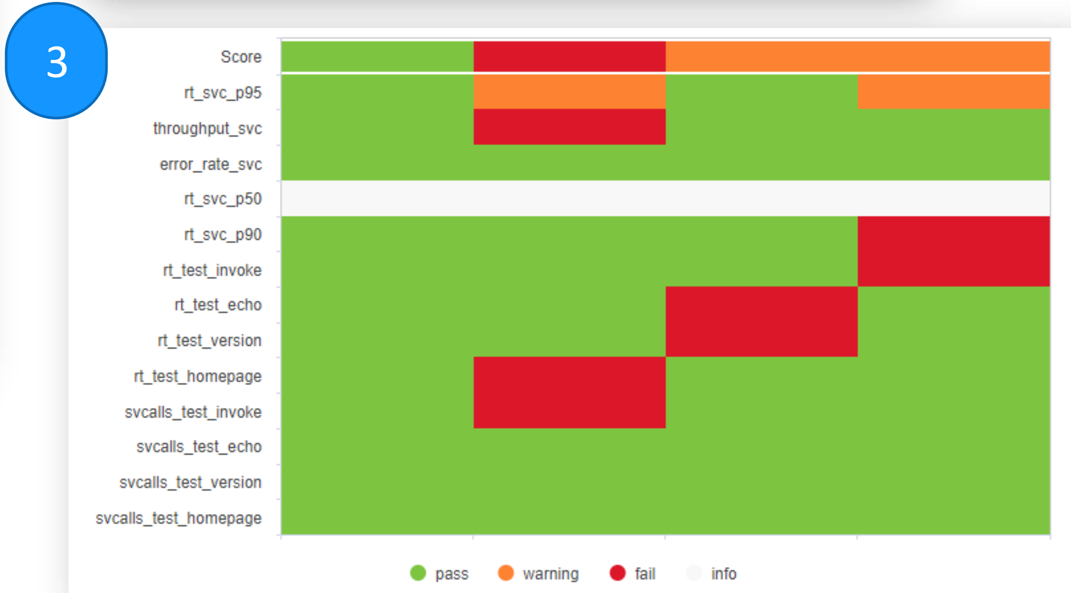
Build

2

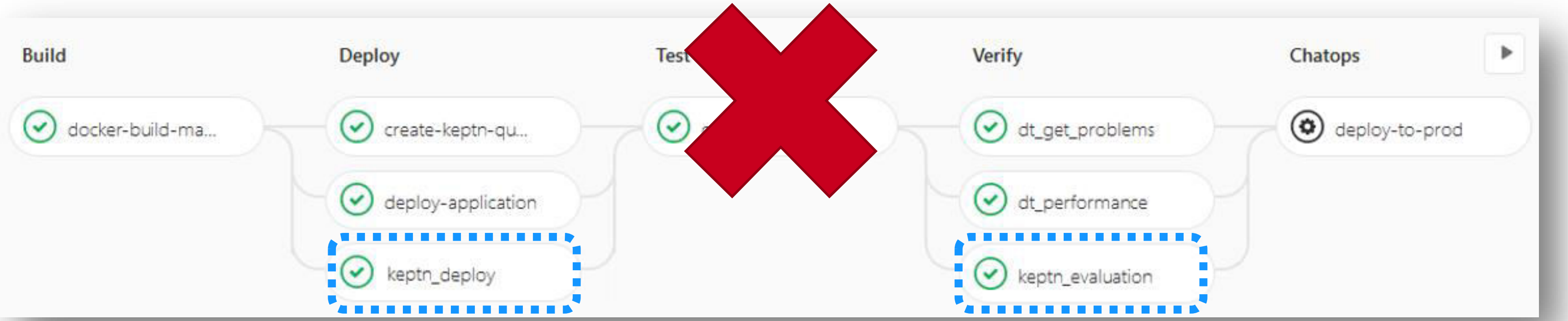


| | Initialize Keptn | Trigger Performance Test | Wait for Result |
|---|---|---|---|
| Average stage times:<br>(Average full run time: ~15min 12s) | 7s | 1s | 15min 19s |
| #5 Apr 29 20:08 No Changes | 9s | 1s | 15min 52s |
| #4 Apr 28 16:47 5 commits | 10s | 1s | 15min 0s |
| #3 Apr 24 15:29 No Changes | 8s | 1s | 15min 24s |

3



# User Example: Reduce pipeline complexity by using Keptn‘s Testing as a Self-Service



Notify about deployment

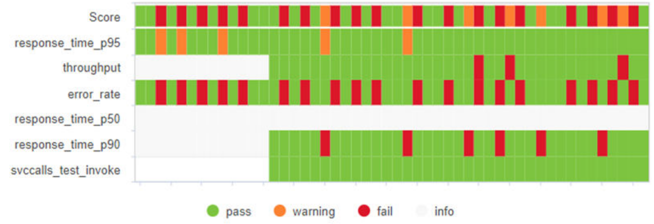
87.5%: passed

keptn Autonomous Cloud Control Plane

Performance as a Service

APACHE JMeter™

keptn Automated SLI/SLO based Quality Gates



**Christian Heckelmann**

Senior Systems Engineer

ERT® Confidence at every turn™

# Build your own Keptn Test Execution Service?

- Some ideas for additional Test Execution Services
  - Execute Tests, e.g: Selenium, Load Runner, Gatling, …
  - Pull in Monitoring/Observability  Data, e.g: Datadog, NewRelic, AppDynamics, …
- You can start building our own Keptn Test Execution Service
  - https://github.com/keptn-sandbox/keptn-service-template-go/

# Integrate Keptn with your existing CI/CD tools

# Keptn can be integrated with any existing tools

- Through the Keptn CLI or API
- Or through the existing integrations
  - Jenkins: https://github.com/keptn-sandbox/keptn-jenkins-library
  - GitLab: https://github.com/keptn-sandbox/gitlab-tutorial
  - Azure DevOps: https://github.com/keptn-sandbox/keptn-azure-devops-extension
- Want to build your own integration?
  - Check out existing integrations: https://github.com/keptn-sandbox
  - Let us know and contribute to keptn: https://slack.keptn.sh

# Let‘s wrap it up!

# What is Keptn?

keptn

www.keptn.sh

**an event-based control plane for continuous delivery and automated operations for cloud-native applications**

Define application delivery and operations processes **declaratively**

Use **predefined CloudEvents** to separate the process from the tools

**Easy way to integrate and switch between** different tools

Blue/Green Deployments

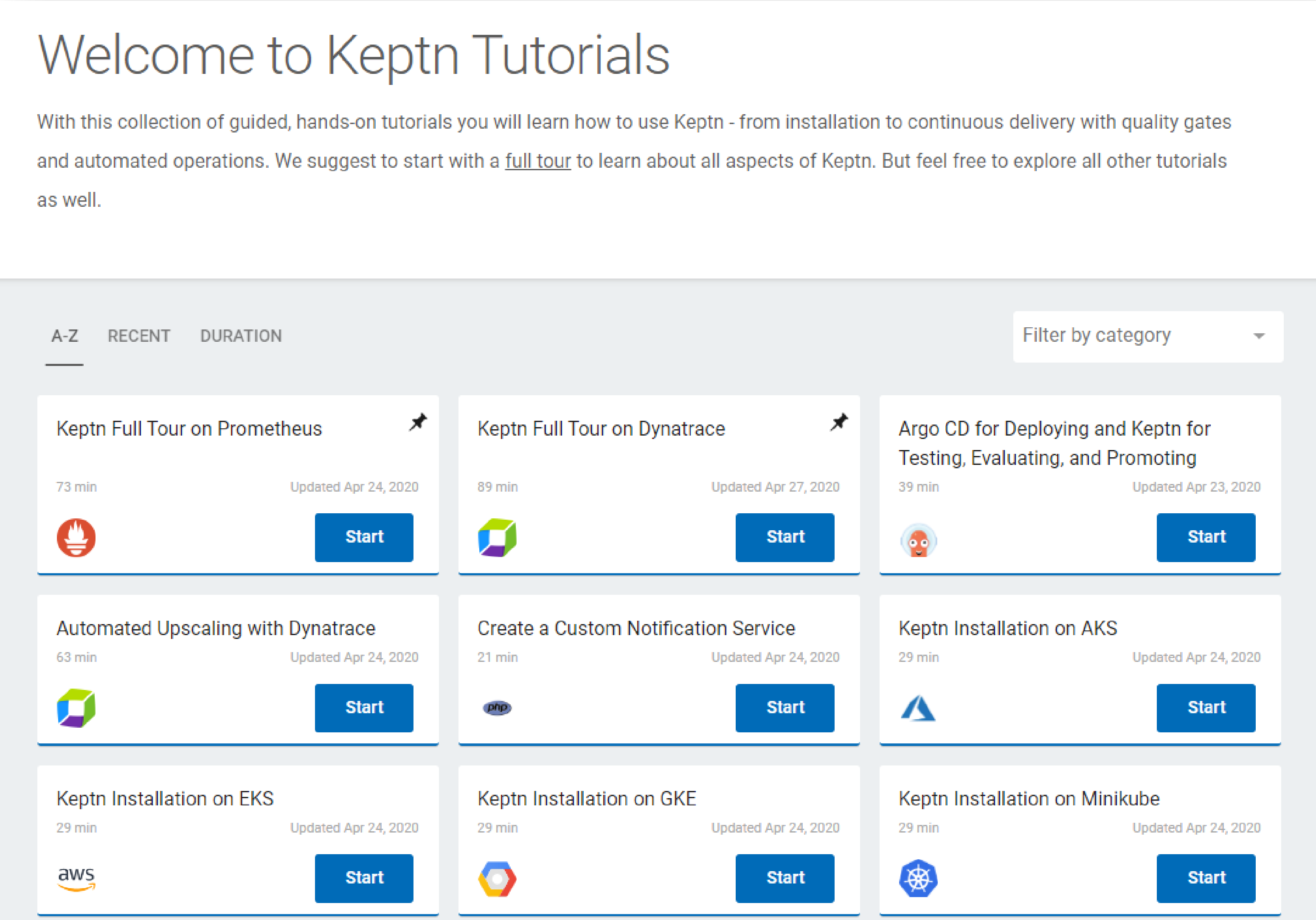
Automated Quality Gates

Automated Operations

Standardized communication protocol

Keptn's uniform

# Get started with our tutorials: tutorials.keptn.sh



## Welcome to Keptn Tutorials

With this collection of guided, hands-on tutorials you will learn how to use Keptn - from installation to continuous delivery with quality gates and automated operations. We suggest to start with a full tour to learn about all aspects of Keptn. But feel free to explore all other tutorials as well.

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# Questions & Answers

keptn

## Automated SLO-Based Testing

*“Testing as a Self-Service with Keptn”*

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**Andreas Grabner**

DevOps Activist at Dynatrace

DevRel for Keptn

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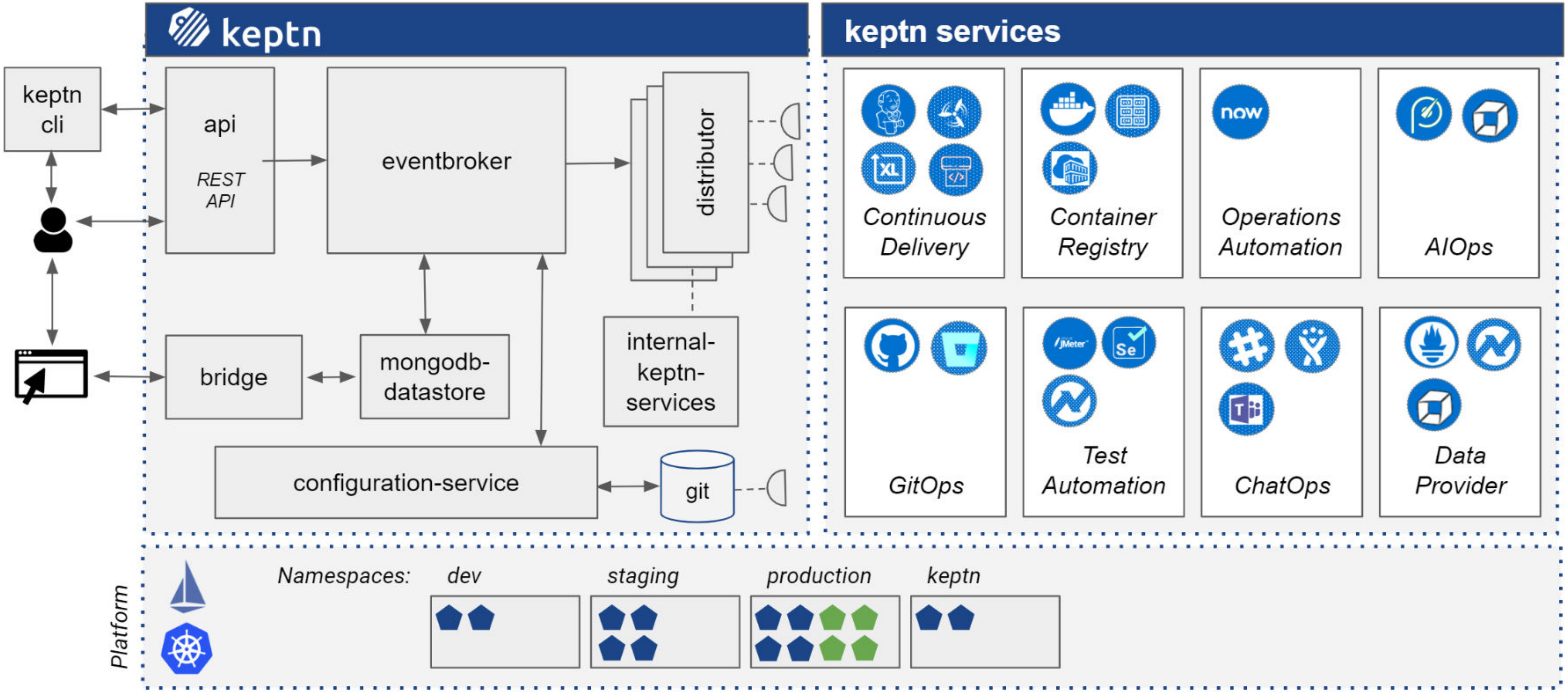
CLOUD NATIVE COMPUTING FOUNDATION

We are a Cloud Native Computing Foundation Sandbox project.

# Keptn Architecture


keptn
keptn cli
api
REST API
eventbroker
distributor
bridge
mongodb-datastore
internal-keptn-services
configuration-service
git
keptn services
Continuous Delivery
Container Registry
Operations Automation
AIOps
GitOps
Test Automation
ChatOps
Data Provider
Platform
Namespaces:
dev
staging
production
keptn