# Spring for Architects

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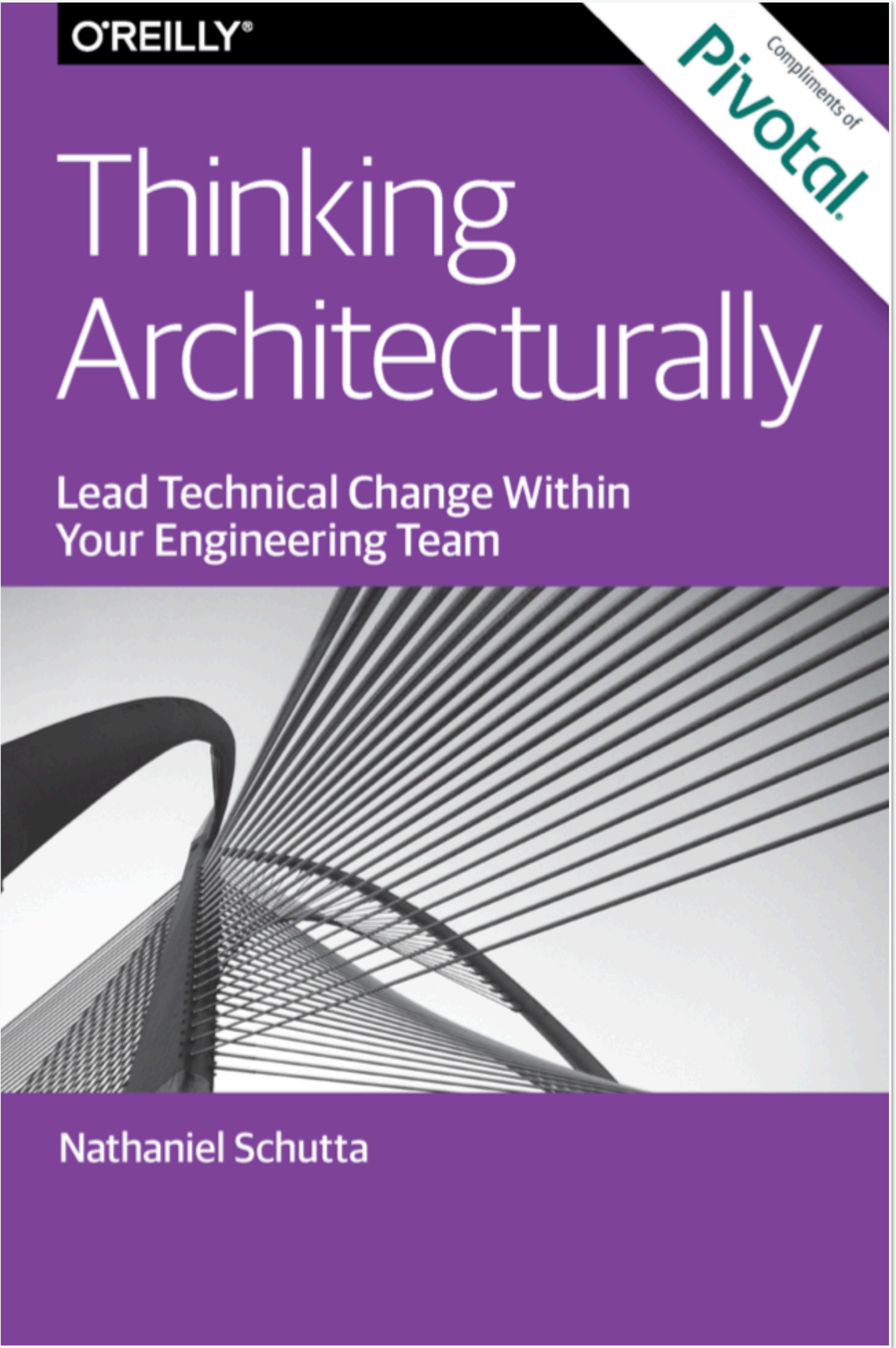
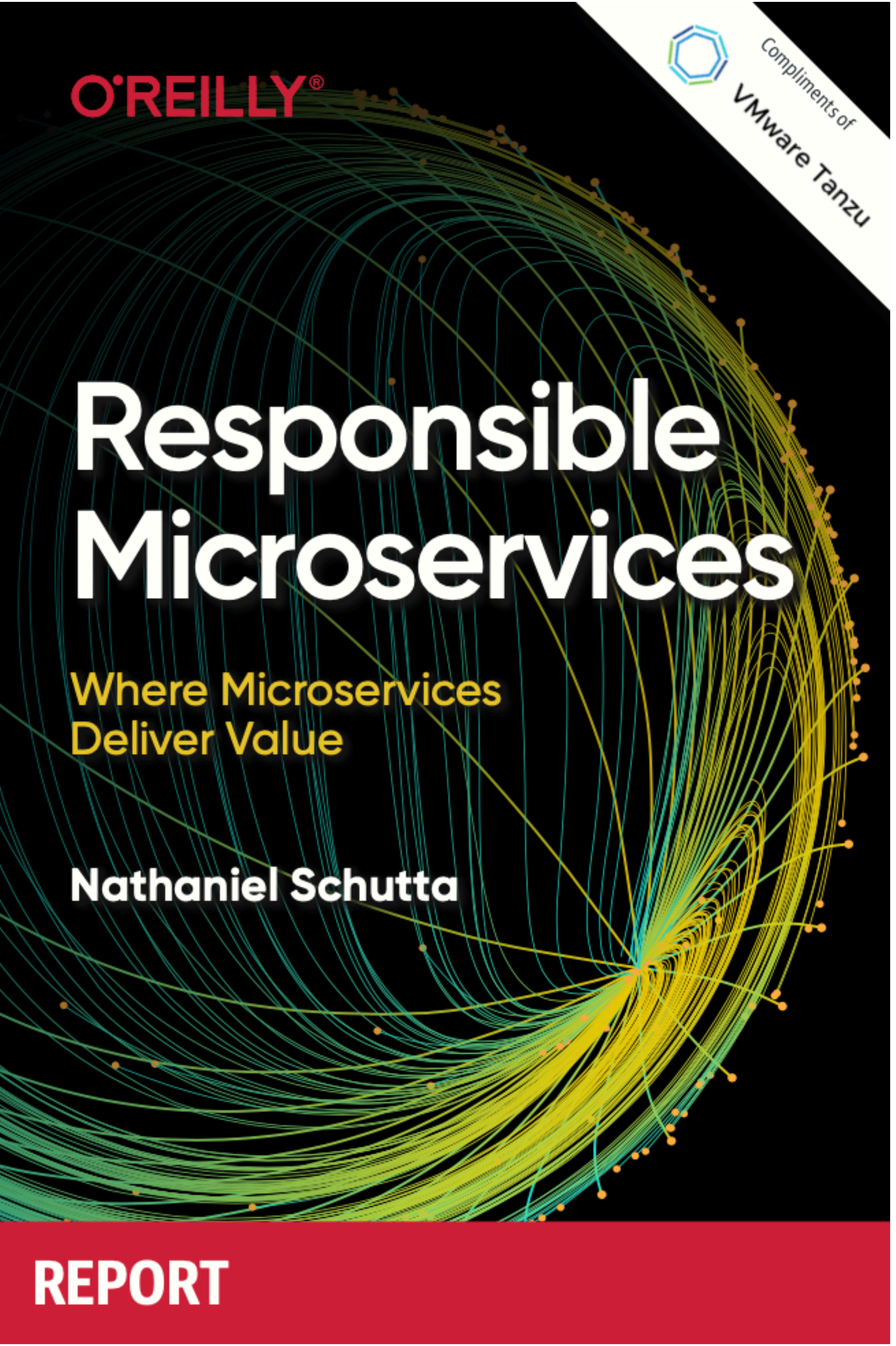
@jakubpilimon


O'REILLY
Compliments of Pivotal
Thinking Architecturally
Lead Technical Change Within Your Engineering Team
Nathaniel Schutta

https://tanzu.vmware.com/content/ebooks/thinking-architecturally



https://tanzu.vmware.com/content/ebooks/responsible-microservices-ebook

It used to be so simple.

You had a monolith. Maybe two.

You released new versions semi annually.

Your team all worked on the same floor.

Or at least within walking distance.

But that isn’t the case today is it?

Now you have dozens, hundreds… maybe thousands of services.

New versions drop daily.

Your team is scattered around the globe.

Architecting was never easy!

Now? Massively distributed apps with geographically dispersed teams.

We are spread thin.

Can’t be everywhere at all times!

We can’t be involved with every decision.

We must empower our teams.

## Distributed decision making.

We can establish principles.

Leverage the power of defaults.

jstor.org

Have library access? Log in through your library

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JOURNAL ARTICLE

# The Power of Suggestion: Inertia in 401(k) Participation and Savings Behavior

**Brigitte C. Madrian and Dennis F. Shea**

The Quarterly Journal of Economics
Vol. 116, No. 4 (Nov., 2001), pp. 1149-1187 (39 pages)
Published By: Oxford University Press

https://www.jstor.org/stable/2696456

Cite this Item

**Read and download**
Log in through your school or library

**Alternate access options**
For independent researchers

## Abstract

This paper analyzes the impact of automatic enrollment on 401(k) savings behavior. We have two key findings. First, 401(k) participation is significantly higher under automatic enrollment. Second, a substantial fraction of 401(k) participants hired under automatic enrollment retain both the default contribution rate and fund allocation even though few employees hired before automatic enrollment picked this particular outcome. This "default" behavior appears to result from participant inertia and from employee perceptions of the default as investment advice. These findings have implications for the design of 401(k) savings plans as well as for any type of Social Security reform that includes personal accounts over which individuals have control. They also shed light more generally on the importance of both economic and noneconomic (behavioral) factors in the determination of individual savings behavior.

## Journal Information

The Quarterly Journal of Economics (QJE) is the oldest professional journal of economics in the English language. Edited at Harvard University's Department of Economics, it covers all aspects of the field -- from the journal's traditional emphasis on microtheory, to both empirical and theoretical macroeconomics. QJE is invaluable to professional and academic economists and students around the world.

THE
QUARTERLY JOURNAL
OF ECONOMICS

Vol. CXVI    November 2001    Issue 4

THE POWER OF SUGGESTION: INERTIA IN 401(k)
PARTICIPATION AND SAVINGS BEHAVIOR*

BRIGITTE C. MADRIAN AND DENNIS F. SHEA

This paper analyzes the impact of automatic enrollment on 401(k) savings behavior. We have two key findings. First, 401(k) participation is significantly higher under automatic enrollment. Second, a substantial fraction of 401(k) participants hired under automatic enrollment retain both the default contribution rate and fund allocation even though few employees hired before automatic enrollment picked this particular outcome. This "default" behavior appears to result from participant inertia and from employee perceptions of the default as investment advice. These findings have implications for the design of 401(k) savings plans as well as for any type of Social Security reform that includes personal accounts over which individuals have control. They also shed light more generally on the importance of both economic and noneconomic (behavioral) factors in the determination of individual savings behavior.

I. INTRODUCTION

In this paper we analyze the 401(k) savings behavior of employees in a large U. S. corporation before and after an interesting change in the company 401(k) plan. Before the plan change, employees who enrolled in the 401(k) plan were required to affirmatively elect participation. After the plan change, employees were automatically enrolled in the 401(k) plan immedi-

* Research support from the National Institute on Aging is gratefully acknowledged. A special thanks to Hewitt Associates for their help in providing the data. Thanks also to Richard Thaler, Anna Lusardi, Amil Petrin, Judith Chevalier, Kara Anderson, and David Docherty for helpful discussions. Comments from seminar participants at the University of North Carolina, Brigham Young University, Western Michigan University, the University of Chicago, the University of Wisconsin, Harvard University, the Massachusetts Institute of Technology, the U. S. Bureau of Labor Statistics, and the National Bureau of Economic Research are also appreciated.

*The Quarterly Journal of Economics*, November 2001

1149

View Preview

Behavioral Economics…

Powerful enough to earn
Richard Thaler a Noble Prize.

“…if you want to get somebody to do something, make it easy.”

–Richard Thaler

https://www.mckinsey.com/industries/public-and-social-sector/our-insights/nudging-the-world-toward-smarter-public-policy-an-interview-with-richard-thaler

Use that to *our* advantage.

Wait? What?

Architects must wield the power of defaults.

Make the right choice
the easy choice.

Distributed systems
have similar needs.

Monitoring. Circuit breakers.
Consumer Driven Contracts.

Gateways. Streams.
Externalized configuration.

Functions. Service discovery. Load balancing. Documentation.

We can’t afford to reinvent the wheel on every project.

Spring frees architects to focus on critical design decisions.

While empowering teams to
solve critical business problems.

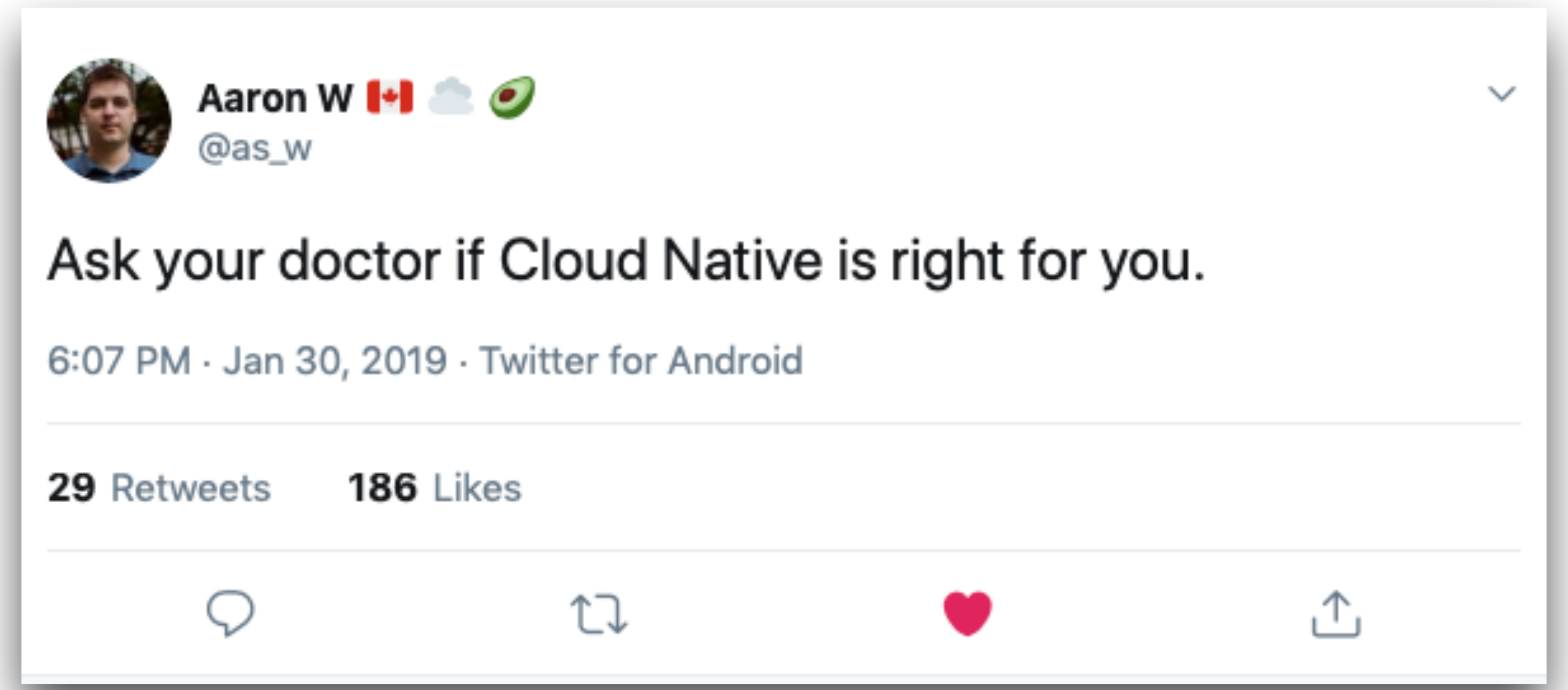
There are many ways to fail with distributed applications.

Spring is here to help you, your teams and your applications.

Help everyone sleep better at night.

Ultimately, it is about delivering business value to production.

## What is Cloud Native?


Aaron W 🇨🇦 ☁️ 🥑
@as_w

Ask your doctor if Cloud Native is right for you.

6:07 PM · Jan 30, 2019 · Twitter for Android

**29** Retweets **186** Likes

https://mobile.twitter.com/as_w/status/1090763452241534976

Applications designed to take advantage of cloud computing.

Fundamentally about how we create and deploy applications.

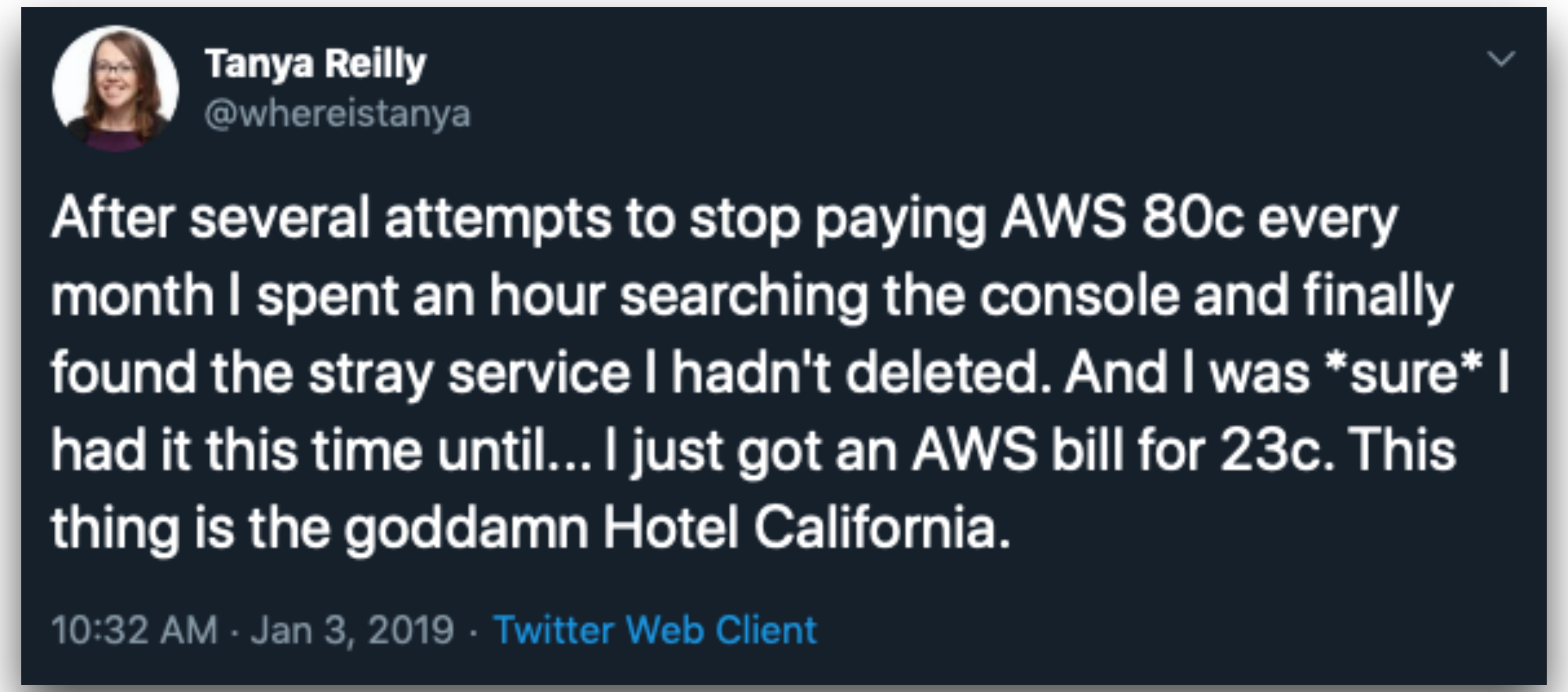
Cloud computing gives us some very interesting abilities.

Scale up. Scale down. On demand.

Limitless compute.*

* Additional fees may apply.

Said fees can be…opaque.

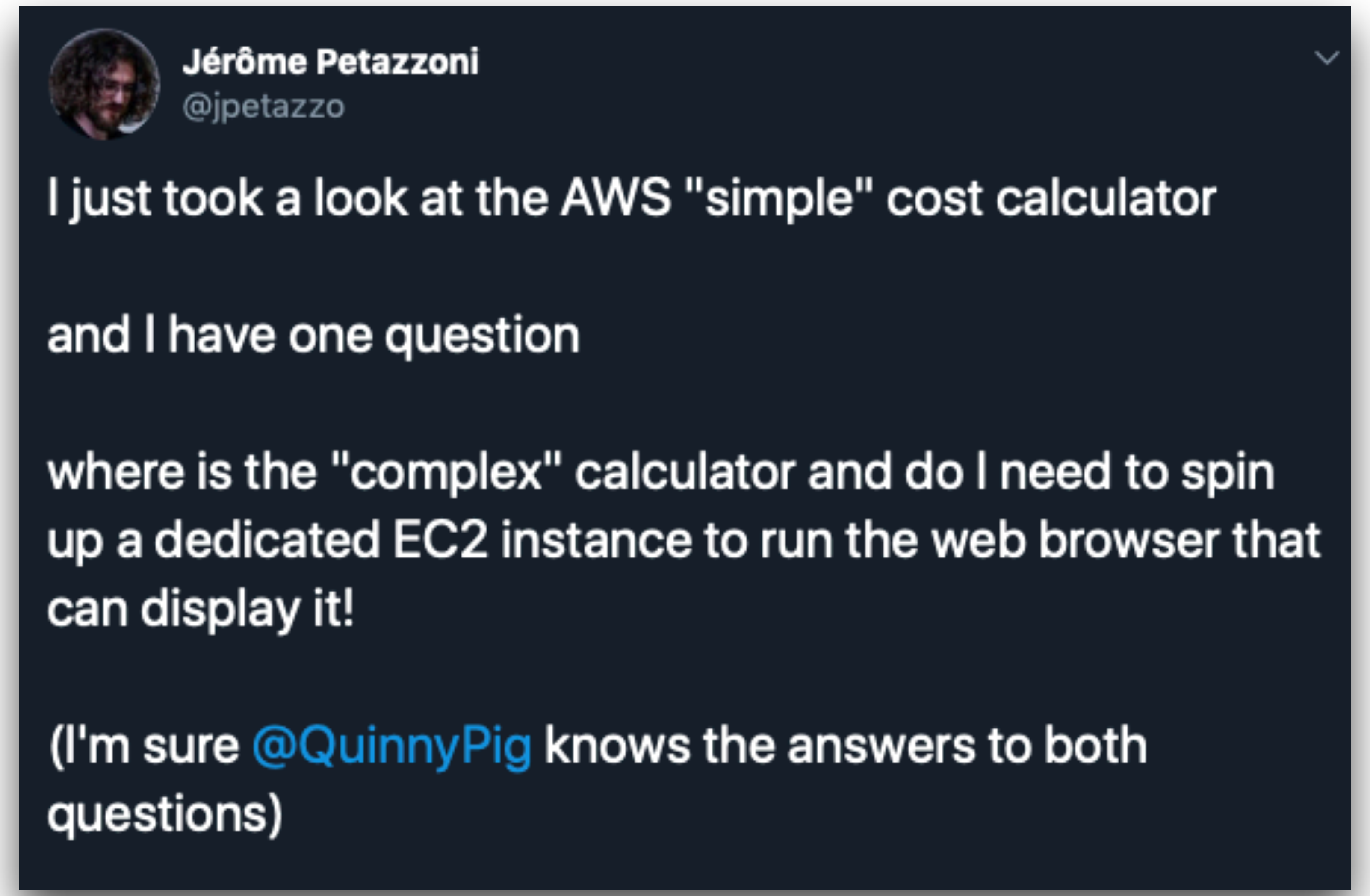


Tanya Reilly
@whereistanya

After several attempts to stop paying AWS 80c every month I spent an hour searching the console and finally found the stray service I hadn't deleted. And I was *sure* I had it this time until... I just got an AWS bill for 23c. This thing is the goddamn Hotel California.

10:32 AM · Jan 3, 2019 · Twitter Web Client

https://mobile.twitter.com/whereistanya/status/1080864493108776961


Jérôme Petazzoni
@jpetazzo

I just took a look at the AWS "simple" cost calculator

and I have one question

where is the "complex" calculator and do I need to spin up a dedicated EC2 instance to run the web browser that can display it!

(I'm sure @QuinnyPig knows the answers to both questions)

https://mobile.twitter.com/jpetazzo/status/1227638126602080256

calculator.s3.amazonaws.com

SIMPLE MONTHLY CALCULATOR

Language: English

Need Help? Watch the Videos or Read How AWS Pricing Works or Contact Sales

Get Started with AWS: Learn more about our Free Tier or Sign Up for an AWS Account »

[✓] FREE USAGE TIER: New Customers get free usage tier for first 12 months

Reset All

Services | Estimate of your Monthly Bill ($ 0.00)

Choose region: US East (N. Virginia)

Inbound Data Transfer is Free and Outbound Data Transfer is 1 GB free per region per month

Amazon EC2
Amazon S3
Amazon Route 53
Amazon CloudFront
Amazon RDS
Amazon Elastic Load Balancing
Amazon DynamoDB
Amazon ElastiCache
Amazon CloudWatch
Amazon SES
Amazon SNS
Amazon Elastic Transcoder
Amazon WorkSpaces
Amazon WorkDocs
AWS Directory Service
Amazon Redshift
Amazon Glacier
Amazon SQS
Amazon SWF
Amazon Elastic MapReduce
Amazon Kinesis Streams
Amazon CloudSearch
AWS Snowball
AWS Direct Connect
Amazon VPC
Amazon SimpleDB

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers. Amazon Elastic Block Store (EBS) provides persistent storage to Amazon EC2 instances.

Clear Form

**Compute: Amazon EC2 Instances:**

| | Description | Instances | Usage | Type | Billing Option | Monthly Cost |
|---|---|---|---|---|---|---|
| ⊕ | Add New Row | | | | | |

**Compute: Amazon EC2 Dedicated Hosts:**

| | Description | Number of Hosts | Usage | Type | Billing Option |
|---|---|---|---|---|---|
| ⊕ | Add New Row | | | | |

**Storage: Amazon EBS Volumes:**

| | Description | Volumes | Volume Type | Storage | IOPS | Baseline Throughput | Snapshot Storage |
|---|---|---|---|---|---|---|---|
| ⊕ | Add New Row | | | | | | |

**Compute: Amazon Elastic Graphics:**

| | Description | Number of Elastic Graphics | Usage | Elastic Graphics Size and Memory |
|---|---|---|---|---|
| ⊕ | Add New Row | | | |

**Additional T2/T3 Unlimited vCPU Hours per month:**

| | |
|---|---|
| For Linux, RHEL and SLES: | 0 |
| For Windows and Windows with SQL Web: | 0 |

**Elastic IP:***

[✓ Enter values below] Calculate

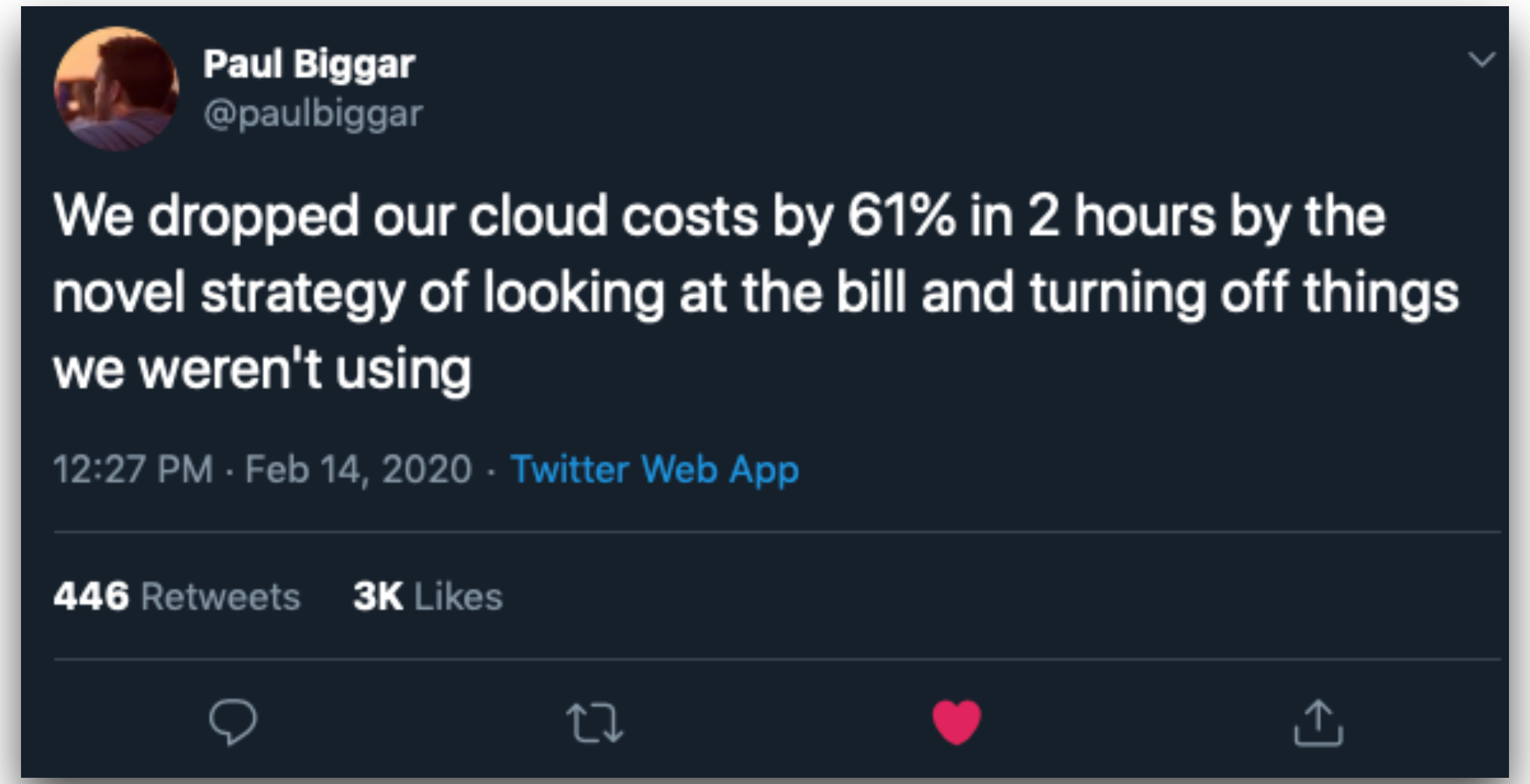
| | | |
|---|---|---|
| Total time the additional Elastic IPs are attached to running EC2 instances**: | 0 | Hours/Month |
| Total Non-attached time for all the Elastic IPs: | 0 | Hours/Month |
| Number of Elastic IP Remaps: | 0 | Per Month |

**Data Transfer:**

| | | |
|---|---|---|
| Inter-Region Data Transfer Out: | 0 | GB/Month |
| Data Transfer Out: | 0 | GB/Month |
| Data Transfer In: | 0 | GB/Month |

Common Customer Samples

Free Website on AWS
AWS Elastic Beanstalk Default
Marketing Web Site
Large Web Application (All On-Demand)
Media Application
European Web Application
Disaster Recovery and Backup


Paul Biggar
@paulbiggar

We dropped our cloud costs by 61% in 2 hours by the novel strategy of looking at the bill and turning off things we weren't using

12:27 PM · Feb 14, 2020 · Twitter Web App

446 Retweets 3K Likes

https://mobile.twitter.com/paulbiggar/status/1228385370439467009

Cloud native isn’t just an architectural pattern.

Combination of practices, techniques, technologies.

## Agile development.

## Continuous delivery.

## Automation.

## Containers.

Microservices.

## Functions.

Changes our culture.

DevOps.

Infrastructure is a different game today isn’t it?

We’ve seen this massive shift.

Servers used to be home grown.

Bespoke. Artisanal.

Spent days hand crafting them.

Treated them like pets…

Did whatever it took to keep them healthy and happy.

Servers were a heavily constrained resource.

They were really expensive!

Had to get our money’s worth…

Thus was born app servers.

Put as many apps as possible on a server.

Maximize the return on investment.

But that has some unintended side effects.

Shared resources.

One application’s bug could take down multiple apps.

Coordinating changes hurts.

"Your app can't get this feature until all other apps are ready."

Currency === 18 months of freezes, testing, frustration.

Organizations ignored currency issues…pain wasn’t “worth it”.

“Fear is the path to the dark side. Fear leads to anger. Anger leads to hate. Hate leads to suffering.”

–Yoda

#YodaOps

Move code from one server to another…

## Worked in dev…but not test.

Why?!?

The environments are
the same…right?

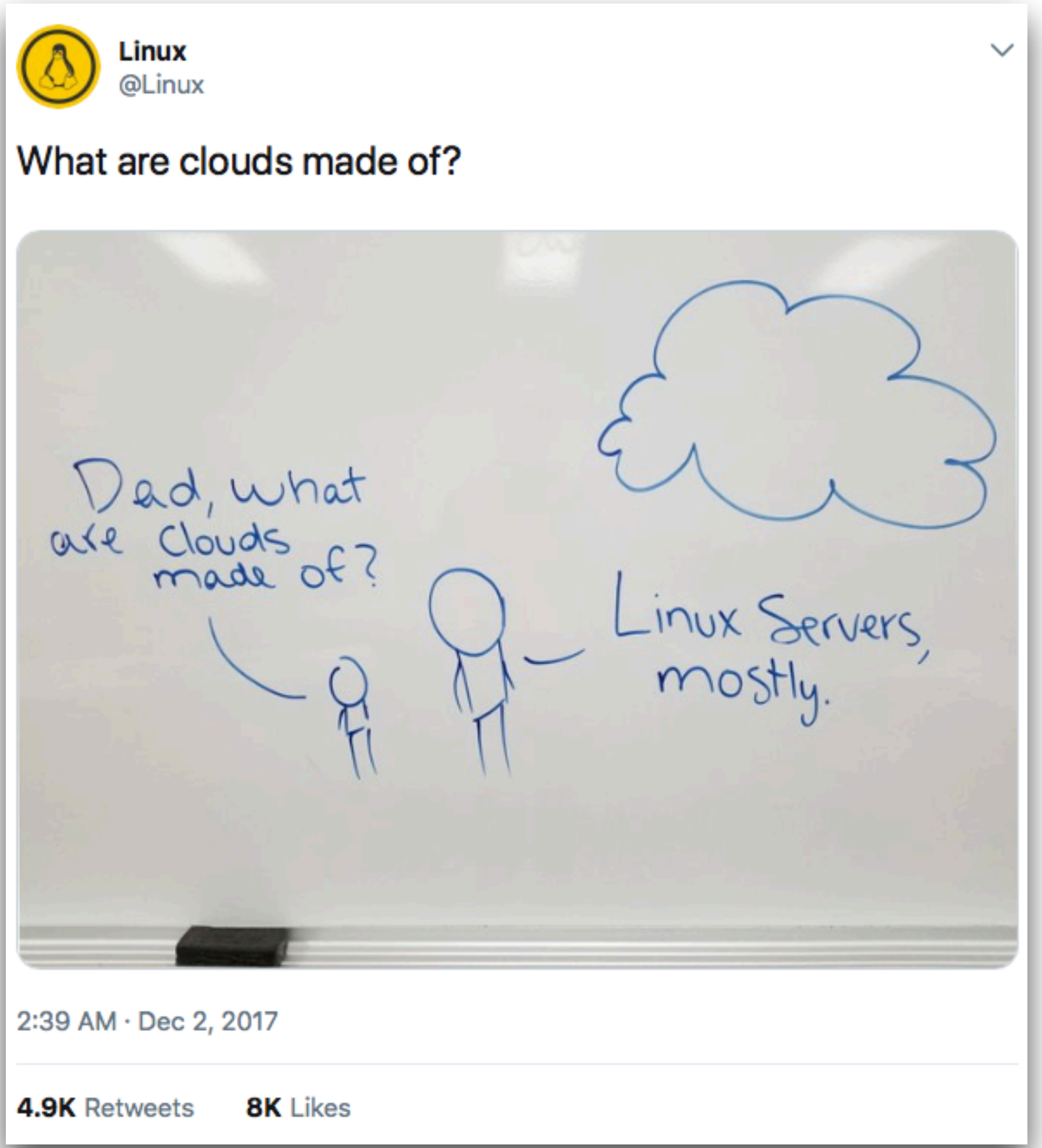
“Patches were applied in a different order…”

## Can I change careers?

Things started to change.

Servers became commodities.

Linux and Intel chips replaced custom OS on specialized silicon.



Linux
@Linux

What are clouds made of?

2:39 AM · Dec 2, 2017

4.9K Retweets 8K Likes

https://mobile.twitter.com/linux/status/936877536780283905?lang=en

Prices dropped.

Servers were no longer the constraining factor.

People costs eclipsed hardware costs.

Heroku, AWS, Google App Egine, Cloud Foundry, Azure.

Shared servers became a liability.

Treat them like cattle…when they get sick, get a new one.

15

New abstractions.

Containers and PaaS changed the game.

Package the app up with everything it needs.

Move *that* to a different environment.

Works in dev? You're testing the exact same thing in test.

So. Much. Win.

Your app needs a spiffy new library? Go ahead!

It doesn’t impact any other app because you are isolated.

Moves the value line.

Less “undifferentiated heavy lifting”.

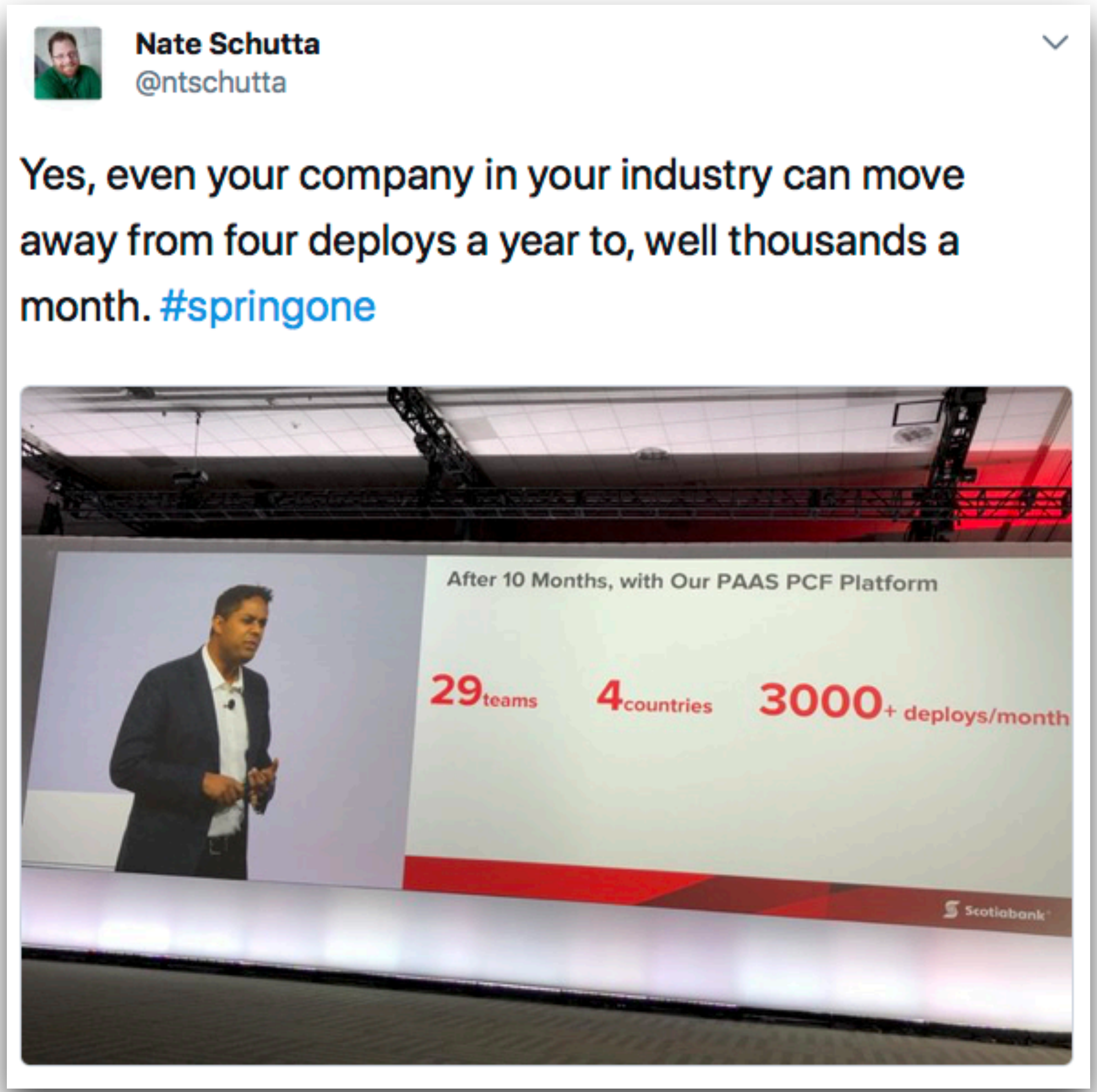
Changes development.

Always be changing.

Run experiments. A/B testing.

Respond to business changes.

Deliver in days not months.



Nate Schutta
@ntschutta

Yes, even your company in your industry can move away from four deploys a year to, well thousands a month. #springone

https://mobile.twitter.com/ntschutta/status/938109379995353088

Speed matters.

Disruption impacts every business.

Your industry is not immune.

Amazon Prime customers can order from Whole Foods.

Some insurance companies view Google as a competitor.

We're all technology companies today.

# 12 FACTORS

# Twelve Factor App.

https://12factor.net

## Characteristics shared by successful apps.

At least at Heroku.

1. One codebase in version control, multiple deploys.
2. Explicitly define your dependencies.
3. Configuration must be separate from the code.
4. Backing services are just attached resources.
5. Build, release, run.

6. Stateless - share nothing.
7. Export services via port binding.
8. Scale via process.
9. Start up fast, shut down gracefully.
10. Dev/Prod parity.
11. Logs as event streams.
12. Admin tasks run as one off processes.

## I. One codebase in version control, multiple deploys.

Version control isn’t controversial. Right?!?

Sharing code? It better be in a library then…

## II. Explicitly define your dependencies.

Do not rely on something just “being there” on the server.

If you need it, declare it.

III. Configuration must be separate from the code.

The things that vary from environment to environment.

Could you open source that app right now?

## IV. Backing services are just attached resources.

Should be trivial to swap out a local database for a test db.

In other words, loose coupling.

## V. Build, release, run.

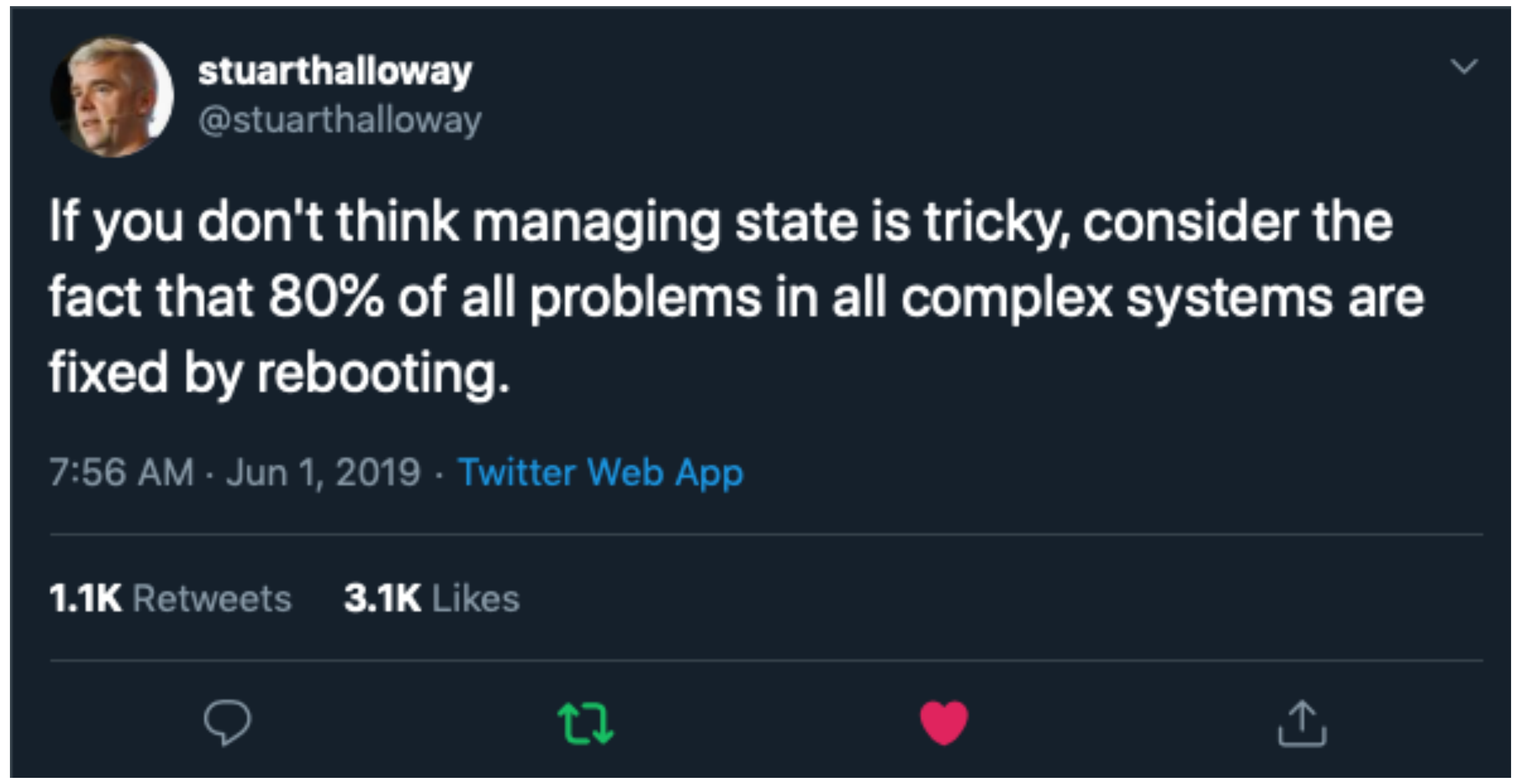
Deployment pipeline anyone?

## Build the executable…

Deploy the executable with the proper configuration…

Launch the executable in a given environment.

## VI. Stateless - share nothing.


stuarthalloway
@stuarthalloway

If you don't think managing state is tricky, consider the fact that 80% of all problems in all complex systems are fixed by rebooting.

7:56 AM · Jun 1, 2019 · Twitter Web App

1.1K Retweets 3.1K Likes

https://mobile.twitter.com/stuarthalloway/status/1134806008528809985

State must be stored via some kind of backing service.

In other words, you cannot rely on the filesystem or memory.

Recovery. Scaling.

## VII. Export services via port binding.

App exports a port, listens for incoming requests.

Localhost for development,
load balancer for public facing.

## VIII. Scale via process.

In other words, scale horizontally.

## IX. Start up fast, shut down gracefully.

Processes aren’t pets,
they are disposable.

Processes can be started (or stopped) quickly and easily.

Ideally, start up is seconds.

Also can handle unexpected terminations!

## X. Dev/Prod parity.

From commit to production should be hours…maybe days.

Definitely not weeks.

Developers should be involved in deploys and prod ops.

Regions should be identical. Or as close as possible to identical.

Backing services should be the same in dev and prod.

Using one DB in dev and another in prod invites pain.

## XI. Logs as event streams.

Don’t write logs to the filesystem!

It won’t be there later…

Write to stdout.

Stream can be routed any number of places.

And then consumed via a wide variety of tools.

## XII. Admin tasks run as one off processes.

Database migrations for instance.

## REPL for the win.

Run in an identical environment to the long running processes.

Your legacy apps will violate some factors.

Maybe all 12!

In general…

## II. Explicitly define your dependencies.

Probably one of the harder ones to satisfy.

Do we really need this library?

"It works, don't touch it."

III. Configuration must be separate from the code.

Many an app has hardcoded credentials.

Hardcoded database connections.

## VI. Stateless - share nothing.

Also can be challenging.

Many apps were designed around a specific flow.

Page 2 left debris for Page 3!

“Just stash that in session”.

## IX. Start up fast, shut down gracefully.

Many apps take way
too long to start up…

Impacts health checks.

## X. Dev/Prod parity.

Environments should be consistent!

Shorten code to prod cycle.

"It worked in test…"

Do your applications have to be fully 12 factor compliant?

Nope.

## Is it a good goal?

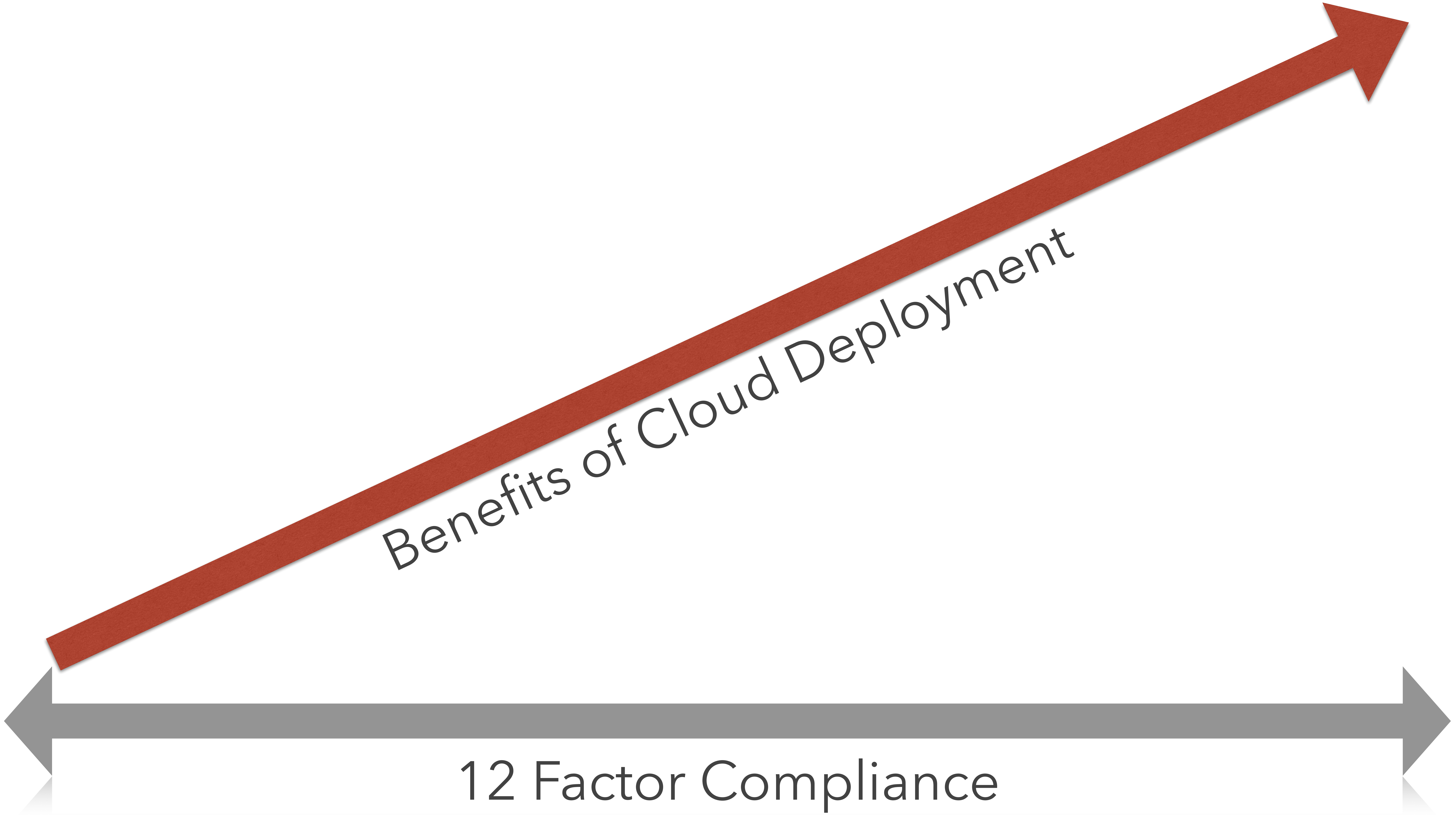
Sure.

But be pragmatic.

Certain attributes lessen the advantages of cloud.

Long startup time hurts elastic scaling & self healing.

Think of it as a continuum.


Benefits of Cloud Deployment
12 Factor Compliance

Developers also talk about 15 factor apps.

aka Beyond the Twelve-Factor App.

https://content.pivotal.io/blog/beyond-the-twelve-factor-app

However you define it…

To maximize what
the cloud gives us…

Applications need to be designed properly.

Legacy applications will fall short.

## Opportunistically refactor!

## Building greenfield?

## Go cloud native!

Don’t build legacy.

## What is Spring?

## Integration framework.

Combines a lot of different things together.

Consistent programming model.

Simplify Java development.

Supports other JVM languages,
Kotlin and Groovy.

Family of projects built atop the Spring Framework.

Provides support for any number of application architectures.

Message driven. Web applications.
Reactive. Microservices.

Spring provides choices.

Want to switch out your message broker? No problem.

Time for a different datastore?

No worries.

Backwards compatible.

Range of JDK versions,
minimize breaking changes.

Thoughtful APIs.

## User centered API design.

High code quality.

Clean code with top notch documentation.

Mature - first release in mid 2003.

Twitter, Inc.

Thread

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
It's said that "senior" developers tend to be afraid of learning new things. This has always struck me as absurd, because who hasn't learned a ton of new things over the course of 10+ years of programming? Almost impossible not to.
4 5 18

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
It almost feels as though less experienced developers are projecting their own fears onto others with more experience.
1 1 8

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
I get the sense that many programmers are afraid to learn *old* things. As if the older things are impossibly arcane and complex, compared to the supposed simplicity and elegance of new tech.
1 6 18

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
They have a strong preference for the new. They'd rather use unfinished, buggy, unproven technology than older, refined, stable, tested tech. Even if it reinvents or indeed breaks the wheel.
2 7 15

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
So now there's a of excitement about a "UnicornKit" that combined UIKit and AppKit into one. But do people realize that unless UnicornKit is simply UIKit, you're going to have to learn something else anyway?
1 3 9

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
Why is learning UnicornKit harder than learning AppKit? Many developers have successfully written both Mac and iOS apps. It's not as hard as you may think if you have no experience with AppKit.
2 3 8

Jeff Johnson (Mac/iOS developer for hire) @lapcats... · Dec 21
Also, any new technology is going to be chock full of bugs. AppKit has its bugs, yes, but it's assuredly vastly more reliable and stable than UnicornKit

Built to simplify JEE development.

Deliver the promise of EJB without…the overhead.

POJO - Plain Old Java Object.

## Inversion of Control aka Dependency Injection.

## Loose coupling.

## Declarative programming.

## Eliminate boilerplate.

Has grown considerably…

spring.io
spring
Why Spring
Learn
Projects
Training
Support
Community

Spring Boot
Spring Framework
Spring Data
Spring Cloud
Spring Cloud Data Flow
Spring Security
Spring Session
Spring Integration
Spring HATEOAS
Spring REST Docs
Spring Batch
Spring AMQP
Spring for Android
Spring CredHub
Spring Flo
Spring for Apache Kafka
Spring LDAP
Spring Mobile
Spring Roo
Spring Shell
Spring Statemachine
Spring Vault
Spring Web Flow
Spring Web Services

# Spring Boot 2.4.1

OVERVIEW
LEARN
SAMPLES

Spring Boot makes it easy to create stand-alone, production-grade Spring based Applications that you can "just run".

We take an opinionated view of the Spring platform and third-party libraries so you can get started with minimum fuss. Most Spring Boot applications need minimal Spring configuration.

If you're looking for information about a specific version, or instructions about how to upgrade from an earlier release, check out the project release notes section on our wiki.

## Features

- Create stand-alone Spring applications
- Embed Tomcat, Jetty or Undertow directly (no need to deploy WAR files)
- Provide opinionated 'starter' dependencies to simplify your build configuration
- Automatically configure Spring and 3rd party libraries whenever possible
- Provide production-ready features such as metrics, health checks, and externalized configuration
- Absolutely no code generation and no requirement for XML configuration

## Getting Started

- Super quick — try the Quickstart Guide.
- More general — try Building an Application with Spring Boot
- More specific — try Building a RESTful Web Service.
- Or search through all our guides on the Guides homepage.

## Spring Boot.

Opinionated view of Spring, simplifies building apps.

Not an application server.

Embeds a servlet container.

Doesn’t implement Java specs,
configures beans that do.

It is not a code generator.

Automatically configures beans.

Frees you from boilerplate configuration.

## Spring Initializr.

start.spring.io

spring initializr

**Project**

[✓ Maven Project] Gradle Project

**Language**

[✓ Java] Kotlin Groovy

**Spring Boot**

2.5.0 (SNAPSHOT) 2.4.2 (SNAPSHOT) [✓ 2.4.1] 2.3.8 (SNAPSHOT) 2.3.7

**Project Metadata**

| | |
|---|---|
| Group | com.example |
| Artifact | demo |
| Name | demo |
| Description | Demo project for Spring Boot |
| Package name | com.example.demo |
| Packaging | [✓ Jar] War |
| Java | 15 [✓ 11] 8 |

**Dependencies**

ADD DEPENDENCIES... ⌘ + B

*No dependency selected*

GENERATE ⌘ + ↵ EXPLORE CTRL + SPACE SHARE...

Pick your language, build preferences, Boot version.

Set the project metadata, select packaging and Java level.

Allows you to select the dependencies your project needs.

start.spring.io
spring initializr
ADD DEPENDENCIES... ⌘ + B

Project
[✓ Maven Project] Gradle Project

Spring Boot
2.5.0 (SNAPSHOT) 2.4.2 (SNAPSHOT
2.3.7

Project Metadata

| | |
|---|---|
| Group | com.example |
| Artifact | demo |
| Name | demo |
| Description | Demo project for Spring Boot |
| Package name | com.example.demo |
| Packaging | [✓ Jar] War |
| Java | 15 [✓ 11] 8 |

Web, Security, JPA, Actuator, Devtools...

Press ⌘ for multiple adds

DEVELOPER TOOLS

**Spring Boot DevTools**
Provides fast application restarts, LiveReload, and configurations for enhanced development experience.

**Lombok**
Java annotation library which helps to reduce boilerplate code.

**Spring Configuration Processor**
Generate metadata for developers to offer contextual help and "code completion" when working with custom configuration keys (ex.application.properties/.yml files).

WEB

**Spring Web**
Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.

**Spring Reactive Web**
Build reactive web applications with Spring WebFlux and Netty.

**Rest Repositories**
Exposing Spring Data repositories over REST via Spring Data REST.

**Spring Session**
Provides an API and implementations for managing user session information.

**Rest Repositories HAL Explorer**
Browsing Spring Data REST repositories in your browser.

**Rest Repositories HAL Browser**
Browsing Spring Data REST repositories in your browser.
Requires Spring Boot >= 2.0.0.RELEASE and < 2.2.0.M1.

**Spring HATEOAS**
Eases the creation of RESTful APIs that follow the HATEOAS principle when working with Spring / Spring

Generates a starter project.

## Don’t like GUIs? There is a CLI.

https://docs.spring.io/spring-boot/docs/current/reference/html/spring-boot-cli.html

Open the project in your favorite IDE and away you go!

## Spring Cloud.

Distributed applications share a number of patterns.

Spring Cloud is an umbrella project with out the box solutions.

spring.io

Why Spring | Learn | Projects | Training | Support | Community

- Spring Boot
- Spring Framework
- Spring Data
- Spring Cloud
  - Spring Cloud Azure
  - Spring Cloud Alibaba
  - Spring Cloud for Amazon Web Services
  - Spring Cloud Bus
  - Spring Cloud CLI
  - Spring Cloud for Cloud Foundry
  - Spring Cloud - Cloud Foundry Service Broker
  - Spring Cloud Cluster
  - Spring Cloud Commons
  - Spring Cloud Config
  - Spring Cloud Connectors
  - Spring Cloud Consul
  - Spring Cloud Contract
  - Spring Cloud Function
  - Spring Cloud Gateway
  - Spring Cloud GCP
  - Spring Cloud Netflix
  - Spring Cloud Open Service Broker
  - Spring Cloud Pipelines
  - Spring Cloud Schema Registry
  - Spring Cloud Security
  - Spring Cloud Skipper

## Spring Cloud 2020.0.0

OVERVIEW | LEARN | SAMPLES

Spring Cloud provides tools for developers to quickly build some of the common patterns in distributed systems (e.g. configuration management, service discovery, circuit breakers, intelligent routing, micro-proxy, control bus, one-time tokens, global locks, leadership election, distributed sessions, cluster state). Coordination of distributed systems leads to boiler plate patterns, and using Spring Cloud developers can quickly stand up services and applications that implement those patterns. They will work well in any distributed environment, including the developer's own laptop, bare metal data centres, and managed platforms such as Cloud Foundry.

### Features

Spring Cloud focuses on providing good out of box experience for typical use cases and extensibility mechanism to cover others.

- Distributed/versioned configuration
- Service registration and discovery
- Routing
- Service-to-service calls
- Load balancing
- Circuit Breakers
- Global locks
- Leadership election and cluster state
- Distributed messaging

Useful defaults for Cloud Native applications.

Cloud agnostic.

Generate a project via
start.spring.io

Externalized configuration.

Integration with various Netflix components.

Security. Distributed tracing.
Event driven applications.

Deployment pipelines. Service Discovery. Connectors.

And on and on…

We’ll talk more about this topic!

## Spring Data.

Spring based model
for data access.

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Spring Data

- Spring Data JDBC
- Spring Data JPA
- Spring Data LDAP
- Spring Data MongoDB
- Spring Data Redis
- Spring Data R2DBC
- Spring Data REST
- Spring Data for Apache Cassandra
- Spring Data for Apache Geode
- Spring Data for Apache Solr
- Spring Data for Pivotal GemFire
- Spring Data Couchbase
- Spring Data Elasticsearch
- Spring Data Envers
- Spring Data Neo4j
- Spring Data JDBC Extensions
- Spring for Apache Hadoop

Spring Cloud

Spring Cloud Data Flow

Spring Security

Spring Session

Spring Integration

Spring HATEOAS

# Spring Data 2020.0.2

OVERVIEW LEARN

Spring Data's mission is to provide a familiar and consistent, Spring-based programming model for data access while still retaining the special traits of the underlying data store.

It makes it easy to use data access technologies, relational and non-relational databases, map-reduce frameworks, and cloud-based data services. This is an umbrella project which contains many subprojects that are specific to a given database. The projects are developed by working together with many of the companies and developers that are behind these exciting technologies.

## Features

- Powerful repository and custom object-mapping abstractions
- Dynamic query derivation from repository method names
- Implementation domain base classes providing basic properties
- Support for transparent auditing (created, last changed)
- Possibility to integrate custom repository code
- Easy Spring integration via JavaConfig and custom XML namespaces
- Advanced integration with Spring MVC controllers
- Experimental support for cross-store persistence

## Main modules

- Spring Data Commons - Core Spring concepts underpinning every Spring Data module.
- Spring Data JDBC - Spring Data repository support for JDBC.

Simplify data access regardless of the datastore.

Relational, non-relational, cloud based, map-reduce.

Broad support for a variety of databases.

We could go on and on…

In fact there are full talks just on the topic!

Schedule

# What Is Spring?

What Is Spring?

Glenn Renfro, Software Developer at VMware

SpringOne

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Presentation slides

What is Spring?

Have you asked yourself, “What is Spring and what does it do?” Well, this talk is for you! We’ll begin with a brief history of Spring Framework. From there, we’ll discuss the layers of Spring  and what each layer does. As we cover each layer, we’ll give an overview on the key projects that comprise the layer.

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Spring in Action, Sixth Edition

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Craig Walls

MEAP began May 2020 · Publication in Summer 2021 *(estimated)*

ISBN 9781617297571 · 520 pages *(estimated)* · printed in black & white

free previous edition eBook included

An eBook copy of the previous edition of this book is included at no additional cost. It will be automatically added to your Manning Bookshelf within 24 hours of purchase.

To me, this has always been the defacto standard for documentation on the Spring Framework. I bought the 1st edition when it first came out as we were converting alegacy app to Spring and this book was essential in learning how the current version worked.

Tony Sweets

A new edition of the classic bestseller! *Spring in Action, 6th Edition* covers all of the new features of Spring 5.3 and Spring Boot 2.4 along with examples of reactive programming, Spring Security for REST Services, and bringing reactivity to your databases. You'll also find the latest Spring best practices, including Spring Boot for application setup and configuration.

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LEARNING PATH

# Spring and Spring Boot Fundamentals

Instructor Ken Kousen

TIME TO COMPLETE:
7h 20m

TOPICS:
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PUBLISHED BY:
O'Reilly Media, Inc.

CREATED:
April 2019

**What is this learning path about, and why is it important?**

For many developers, Spring is the go-to framework for quickly and easily creating web-based enterprise applications. With its comprehensive ecosystem that includes an extensive array of tools and testing capabilities, Spring relieves developers of much of the drudge work when building out web-based, RESTful applications. Spring Boot helps out even further by enabling autoconfiguration of many of the tedious chores that you need to do when starting a

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Spring

Spring is the world's most popular framework for writing high performing and easily testable Java code. There are many Spring projects, covering everything from configuration to security, web apps to integration, and plenty more. Start with the Spring guides and learn even more at Spring.io.

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Wavefront for Spring Boot: Getting Started

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# DOCUMENTATION

Documentation?
You’re kidding right?

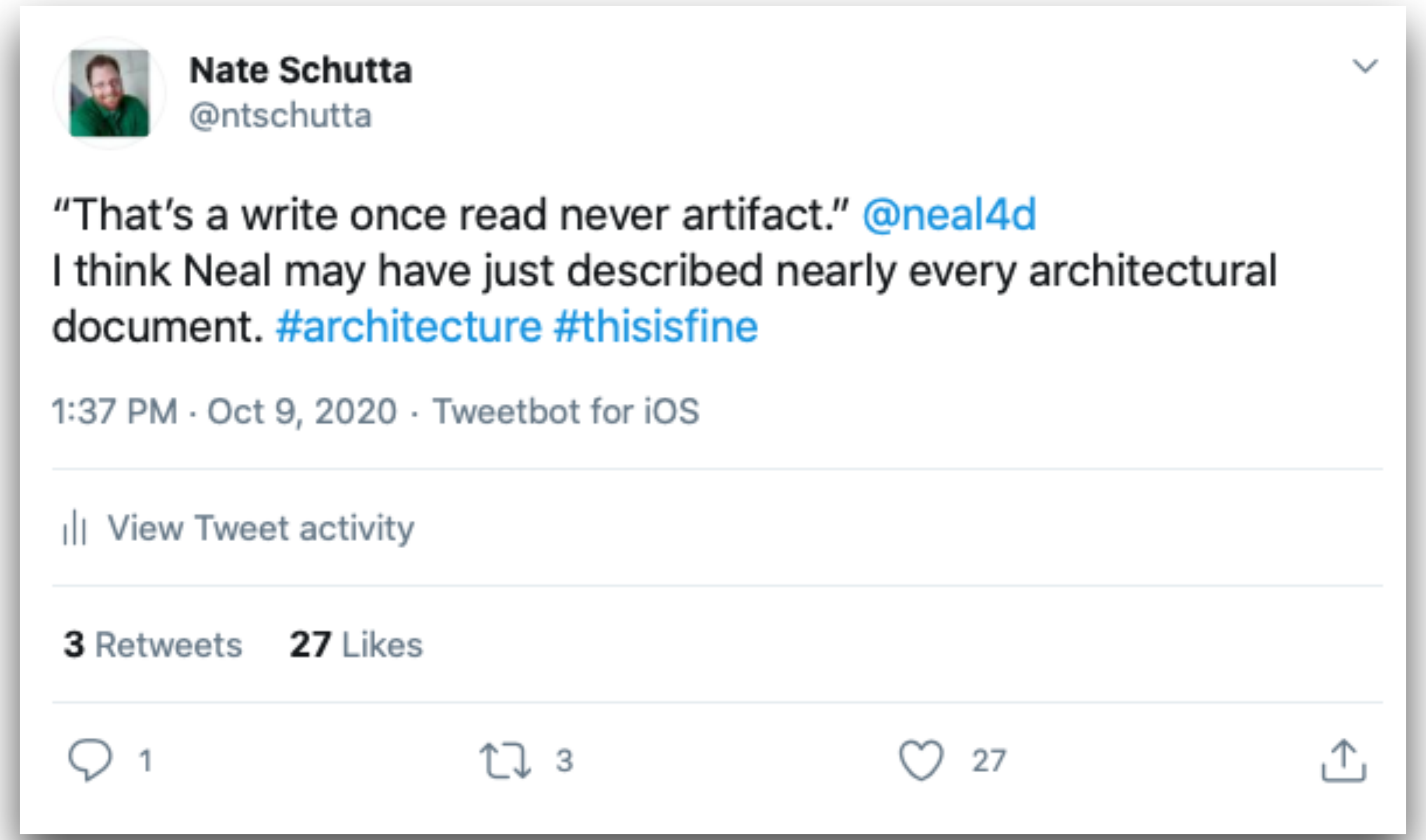
I know what some of you are thinking…

I don’t have time for all this.

We need to MOVE FAST.
And break things…

We’re Agile. With a capital A.

Besides, “the documentation is useless” #amirite?



Nate Schutta
@ntschutta

“That’s a write once read never artifact.” @neal4d
I think Neal may have just described nearly every architectural document. #architecture #thisisfine

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That is not, in fact, an inviolable requirement.

Documentation doesn’t have to be high ceremony.

Should answer basic questions!

## What does your service do?

## How does it work?

## What does it depend on?

## Golden rule!

Do it for those that come after you.

Don’t forget, sometimes *you* are the person that comes after you!

How long does it take for a new team member to be productive? Weeks?

## Months?

Solid onboarding guide.

Make sure it is updated.

Documentation should be easy to find.

Probably a website/wiki.

Updating the wiki should be part of the developer workflow.

Consider a simple (low ceremony) template.

Description - what does your service do? Don’t skimp here.

An architectural diagram or three.

Contact information as well as the on call rotation.

Links to helpful things like the repo, dashboard link, on call book.

## FAQ.

Onboarding/development guide.

## Coding standards.

## Development pipeline.

## Glossary.

Whatever helps the team understand.

Everyone should “get it” and be able to describe it. So have them do it.

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# Spring REST Docs 2.0.5.RELEASE

OVERVIEW LEARN SAMPLES

Spring REST Docs helps you to document RESTful services.

It combines hand-written documentation written with Asciidoctor and auto-generated snippets produced with Spring MVC Test. This approach frees you from the limitations of the documentation produced by tools like Swagger.

It helps you to produce documentation that is accurate, concise, and well-structured. This documentation then allows your users to get the information they need with a minimum of fuss.

## Spring Boot Config

Spring Boot provides an `@AutoConfigureRestDocs` annotation to leverage Spring REST Docs in your tests.

**Quickstart Your Project**
Bootstrap your application with Spring Initializr.

Word processors don’t lend themselves to a pipeline.

Takes hand crafted Asciidoctor (or Markdown) text…

Combined with autogenerated snippets from test code.

Output is HTML, style away.

And deriving documentation from tests keeps it up to date.

Your developers focus on describing requests & responses.

Change implementation details to your heart’s content!

Shouldn’t be a static thing!

Documentation should be reviewed along with the architecture.

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Documenting RESTful APIs with Spring REST Docs - Jenn Strater

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RESTful APIs are eating the world, yet all too often the documentation can cause indigestion for the APIs' developers and their users. Developers have to deal with annotation overload, repetition, and an unpleasant writing environment. Users are then left with documentation that's inaccurate and

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# If Hemingway Wrote JavaDocs

If Hemingway Wrote JavaDocs

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If Hemingway Wrote JavaDocs

Jay Bryant, Senior Technical Writer at VMware;
Josh Cummings, Software Engineer at VMware

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Building an Accessibility Culture

You write the docs, but does anyone read them?

This talk covers how to write so well that developers value your documentation. It also addresses the related issues of SEO, internationalization, and accessibility.

# MONITORING

Monitoring is vital to a thriving distributed architecture.

## Four components to monitoring.

## Logging.

What would you say my service is doing?

Log anything that is useful.

Just don’t put in any personally identifying information (PII).

Ever.

Some things alone aren’t PII but when combined with other items…

Tracing can be difficult.

Can’t just put in a breakpoint and step through the code…

Calls bounce between 5 or 10 (or more) services.

Correlation IDs help.

Speaking of which…

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# Spring Cloud Sleuth 3.0.0

Spring Cloud Sleuth provides Spring Boot auto-configuration for distributed tracing.

## Features

Sleuth configures everything you need to get started. This includes where trace data (spans) are reported to, how many traces to keep (sampling), if remote fields (baggage) are sent, and which libraries are traced.

Specifically, Spring Cloud Sleuth...

- Adds trace and span ids to the Slf4J MDC, so you can extract all the logs from a given trace or span in a log aggregator.
- Instruments common ingress and egress points from Spring applications (servlet filter, rest template, scheduled actions, message channels, feign client).
- If `spring-cloud-sleuth-zipkin` is available then the app will generate and report Zipkin-compatible traces via HTTP. By default it sends them to a Zipkin collector service on localhost (port 9411). Configure the location of the service using `spring.zipkin.baseUrl`.

## Spring Boot Config

Add Sleuth to your classpath:

Maven

```
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${release.train.version}</version>
            <type>pom</type>
            <scope>import</scope>
```

## Auto-configured for distributed tracing!

Covers spans, sampling and key:value pairs.

Adds trace and span IDs and to stock ingress & egress points.

Instruments common ingress & egress points.

Generates Zipkin compatible traces if desired.

Basically add Sleuth to your classpath…

## And your Boot app can generate trace data!

## Dashboards.

View the health of a service.

Metrics should be displayed on a dashboard of some sort.

But we should be alerted when things start to go wonky.

## Alerting.

A key metric is out of band.

Allows us to detect an issue and fix it before our customers even notice.

Pager duty.

Must be sustainable.

Provide clear, concise on call documentation.

“We don't rise to the level of our expectations, we fall to the level of our training.”

– Archilochus

Vital that we think about just what we should be monitoring.

## What *is* a key metric?

Some pertain solely to the infrastructure our service runs on.

CPU utilization, RAM utilization, threads, database connections…

These often impact more than just our service.

Others key metrics are specific to our service.

Additionally we need to know the availability, latency, response time…

Basically anything that we identified earlier as part of our SLO.

Monitor errors and exceptions as well.

Identify normal, warning and critical thresholds for your metrics.

Can be hard to figure out early on.
Need a certain amount of history.

Not just a prod thing. We need to monitor staging.

Validates the monitors.

Metrics should be displayed on a dashboard of some sort.

But we should be alerted when things start to go wonky.

We shouldn’t be staring at our dashboards all day!

Alert on all of our key metrics, SLOs etc.

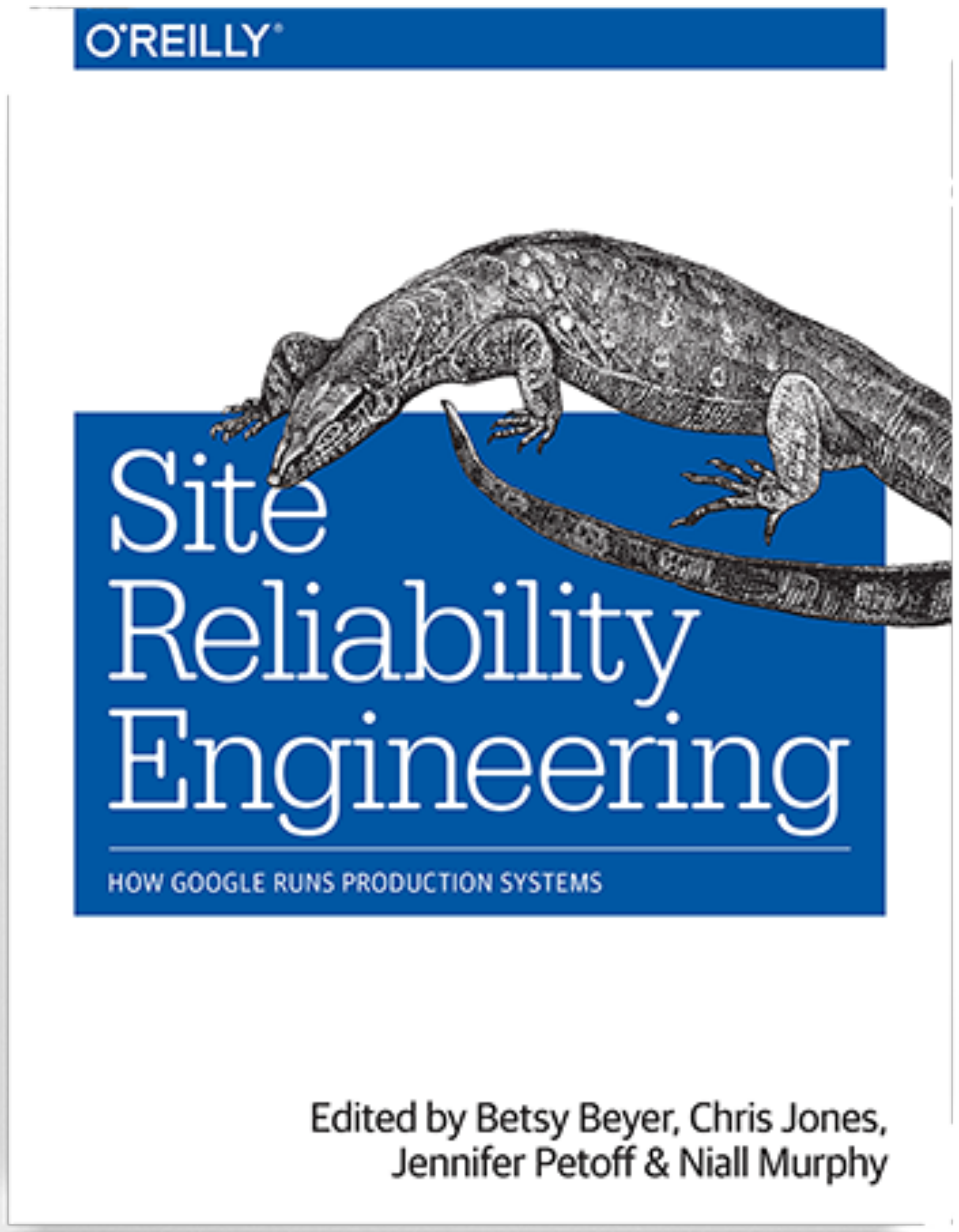
Absence of a key metric is also an alertable offense!

Alerts should be actionable.

Alerts should be urgent.

Alerts should require human intervention.

System can “fix” itself? Not an alert - monitor and/or report.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Site Reliability Engineering
HOW GOOGLE RUNS PRODUCTION SYSTEMS
Edited by Betsy Beyer, Chris Jones, Jennifer Petoff & Niall Murphy

https://landing.google.com/sre/book.html

## Four Golden Signals.

https://landing.google.com/sre/book/chapters/monitoring-distributed-systems.html#xref_monitoring_golden-signals

Latency - how long does it take to service a request.

Traffic - level of demand on the system. Requests/second. I/O rate.

Errors - failed requests. Can be explicit, implicit or policy failure.

Saturation - how much of a constrained resource is left.

Important to consider the sampling frequency.

High resolution can be costly.

Aggregate data.

Number of tools from Wavefront to Dynatrace to New Relic.

## Spring Boot Actuator!

https://docs.spring.io/spring-boot/docs/current/reference/html/production-ready-metrics.html

docs.spring.io

## 6. Metrics

Spring Boot Actuator provides dependency management and auto-configuration for Micrometer, an application metrics facade that supports numerous monitoring systems, including:

- AppOptics
- Atlas
- Datadog
- Dynatrace
- Elastic
- Ganglia
- Graphite
- Humio
- Influx
- JMX
- KairosDB
- New Relic
- Prometheus
- SignalFx
- Simple (in-memory)
- Stackdriver
- StatsD
- Wavefront

To learn more about Micrometer's capabilities, please refer to its reference documentation, in particular the concepts section.

### 6.1. Getting started

Spring Boot auto-configures a composite `MeterRegistry` and adds a registry to the composite for each of the supported implementations that it finds on the classpath. Having a dependency on `micrometer-registry-{system}` in your runtime classpath is enough for Spring Boot to configure the registry.

Metrics can’t afford to be hand-rolled solutions.

Take advantage of Actuator’s built in endpoints.

## 2. Endpoints

Actuator endpoints let you monitor and interact with your application. Spring Boot includes a number of built-in endpoints and lets you add your own. For example, the `health` endpoint provides basic application health information.

Each individual endpoint can be enabled or disabled and exposed (made remotely accessible) over HTTP or JMX. An endpoint is considered to be available when it is both enabled and exposed. The built-in endpoints will only be auto-configured when they are available. Most applications choose exposure via HTTP, where the ID of the endpoint along with a prefix of `/actuator` is mapped to a URL. For example, by default, the `health` endpoint is mapped to `/actuator/health`.

The following technology-agnostic endpoints are available:

| ID | Description |
|---|---|
| `auditevents` | Exposes audit events information for the current application. Requires an `AuditEventRepository` bean. |
| `beans` | Displays a complete list of all the Spring beans in your application. |
| `caches` | Exposes available caches. |
| `conditions` | Shows the conditions that were evaluated on configuration and auto-configuration classes and the reasons why they did or did not match. |
| `configprops` | Displays a collated list of all `@ConfigurationProperties`. |
| `env` | Exposes properties from Spring's `ConfigurableEnvironment`. |
| `flyway` | Shows any Flyway database migrations that have been applied. Requires one or more `Flyway` beans. |
| `health` | Shows application health information. |
| `httptrace` | Displays HTTP trace information (by default, the last 100 HTTP request-response exchanges). Requires an `HttpTraceRepository` bean. |
| `info` | Displays arbitrary application info. |
| `integrationgraph` | Shows the Spring Integration graph. Requires a dependency on `spring-integration-core`. |
| `loggers` | Shows and modifies the configuration of loggers in the application. |
| `liquibase` | Shows any Liquibase database migrations that have been applied. Requires one or more `Liquibase` beans. |

You can create your own custom endpoints as well.

Takes time to get monitoring right.

## Do you even SRE?

Beware the metric that is easy to measure…

Might not be meaningful. Sorry.

Also key to understand the business drivers.

What could cause a spike in demand?

## How does that translate to specific services?

Be realistic!

We can’t all be a third of internet traffic!

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# Application Monitoring With Spring Boot Actuator

The Spring Boot Actuator is a module built into Spring Boot that has a number of features that make it easy to manage and monitor applications.

by Sanjoy Kumer Deb ‹/›CORE · Mar. 27, 20 · Java Zone · Tutorial

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Monitoring production is an important part of a software service provider. Many companies providing monitoring systems for maintaining the production environment. Spring Boot comes with different awesome modules that developers can easily configure and maintain development and production environments with. The actuator module provides production-ready features by which we can easily maintain the production environment. The actuator exposes JMX and HTTP endpoints.

## Features

- **Endpoints:** Spring Boot Actuator provides some default endpoints by which we can access application information. We can also monitor the production environment with those endpoints. Endpoints can also be accessed by third-party monitoring tools.

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Spring Boot's Actuator provides a powerful set of production-ready features that have been recently updated for Spring Boot 2.0. In this talk we'll look in detail at the Actuator, focusing on the new features including the new endpoint infrastructure that introduces support for Jersey and Web Flux

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# Spring Tips: The Wavefront Observability Platform

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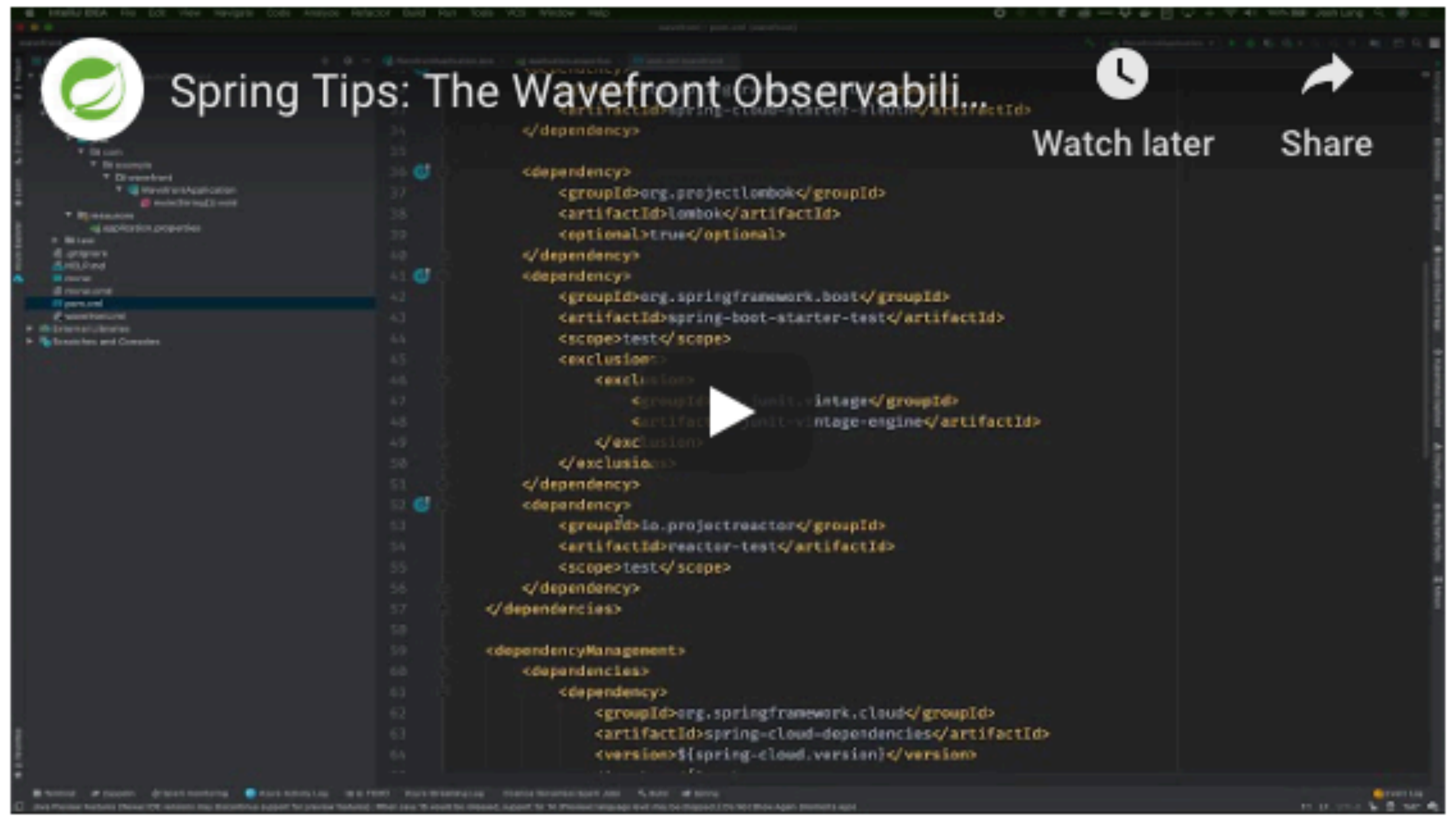
speaker: Josh Long (@starbuxman)



```
        </dependency>

        <dependency>
            <groupId>org.projectlombok</groupId>
            <artifactId>lombok</artifactId>
            <optional>true</optional>
        </dependency>
        <dependency>
            <groupId>org.springframework.boot</groupId>
            <artifactId>spring-boot-starter-test</artifactId>
            <scope>test</scope>
            <exclusions>
                <exclusion>
                    <groupId>org.junit.vintage</groupId>
                    <artifactId>junit-vintage-engine</artifactId>
                </exclusion>
            </exclusions>
        </dependency>
        <dependency>
            <groupId>io.projectreactor</groupId>
            <artifactId>reactor-test</artifactId>
            <scope>test</scope>
        </dependency>
    </dependencies>

    <dependencyManagement>
        <dependencies>
            <dependency>
                <groupId>org.springframework.cloud</groupId>
                <artifactId>spring-cloud-dependencies</artifactId>
                <version>${spring-cloud.version}</version>
```

Hi, Spring fans! Welcome to another installment of Spring Tips! In this installment, we'll revisit two topics that we've addressed in two previous videos (distributed tracing and metrics collection) in terms of the superb Tanzu Wavefront observability platform.

The first video of the two videos, as mentioned above, dating way back in early 2017, looked at distributed tracing with spring cloud sleuth and openzipkin. Spring Cloud Sleuth is an abstraction for capturing the flow of messages from one node to another. It's useful to help you see how messages move through a system. Spring cloud sleuth integrates with all the usual ingress and egress points in a Spring Boot application. Make an HTTP request using either the `Restteplat` or the reactive `WebClient` or Spring Cloud Feign? It works. Receive an HTTP request to a traditional (Servlet-based) or reactive HTTP endpoint built with Spring? It works. Send or receive a message using Spring Cloud Stream or Spring Integration? Yep. You guessed it. It just works. You don't have to do anything

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# FAULT TOLERANCE

Distributed systems are not islands unto themselves.

Services fail.

Failures, uh find a way.

Our customers don’t care why.

You cannot prevent failure…but you can be prepared for it.

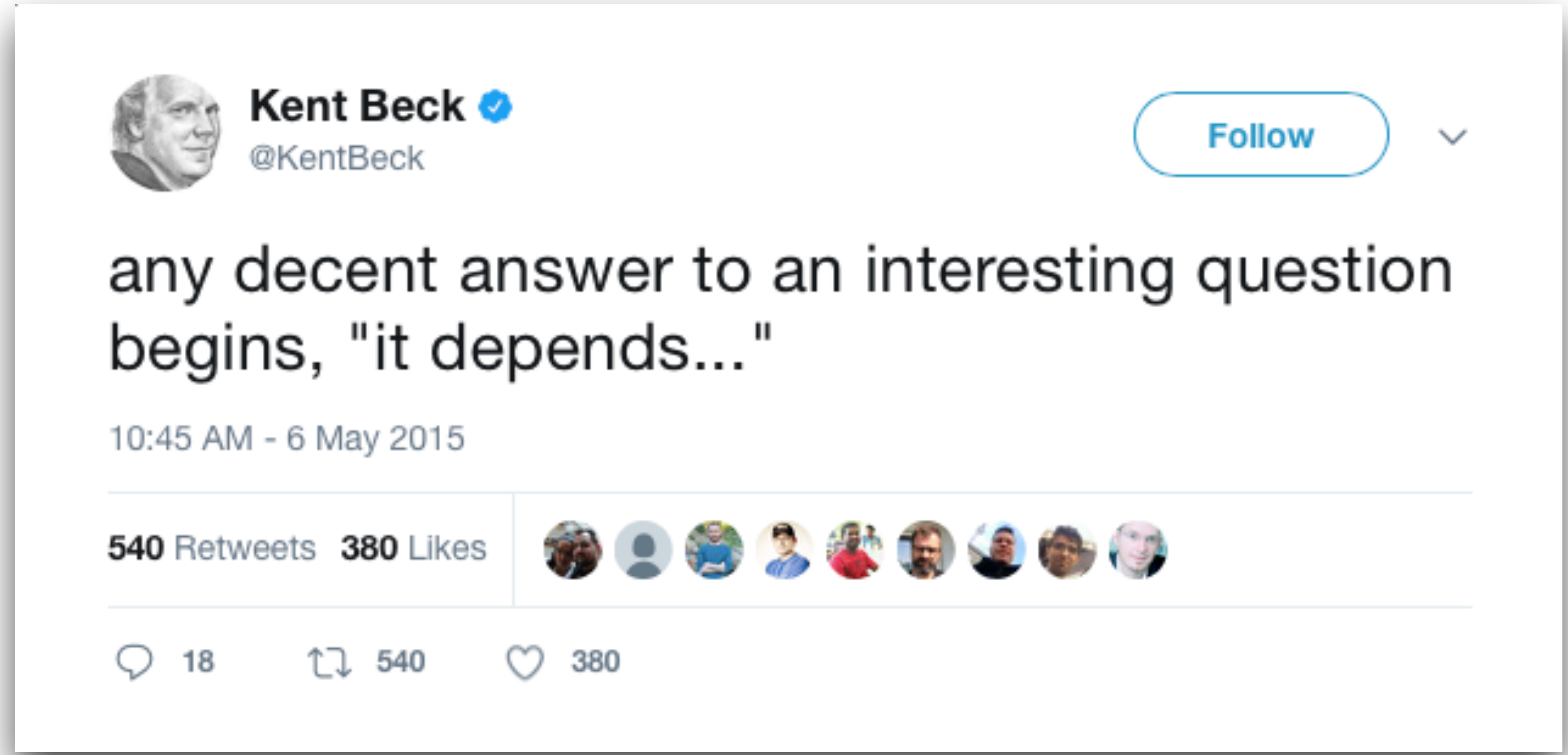
## How should we react?

Error message?

Call a backup service?

## Do we need to cache data?

Do we return a default answer?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https://twitter.com/KentBeck/status/596007846887628801

## The circuit breaker pattern.

https://martinfowler.com/bliki/CircuitBreaker.html

Originally described by Michael Nygard.

Closed
on call / pass through
call succeeds / reset count
call fails / count failure
threshold reached / trip breaker
trip breaker
Open
on call / fail
on timeout / attempt reset
trip breaker
reset
Half-Open
on call / pass through
call succeeds / reset
call fails / trip breaker

Circuit breaker watches the calls.

Once they exceed a failure threshold, the circuit is opened.

Redirects to the
fallback mechanism.

Periodically checks to see if the service is repaired.

If so, circuit is closed.

Multiple circuit breaker implementations to pick from.

## Spring Cloud Circuit Breaker to the rescue!

spring.io

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# Spring Cloud Circuit Breaker

1.0.4.RELEASE

OVERVIEW LEARN SAMPLES

## Introduction

Spring Cloud Circuit breaker provides an abstraction across different circuit breaker implementations. It provides a consistent API to use in your applications allowing you the developer to choose the circuit breaker implementation that best fits your needs for your app.

### Supported Implementations

- Netfix Hystrix
- Resilience4J
- Sentinel
- Spring Retry

## Core Concepts

To create a circuit breaker in your code you can use the `CircuitBreakerFactory` API. When you include a Spring Cloud Circuit Breaker starter on your classpath a bean implementing this API will automatically be created for you. A very simple example of using this API is given below

COPY

```
@Service
public static class DemoControllerService {
        private RestTemplate rest;
        private CircuitBreakerFactory cbFactory;

        public DemoControllerService(RestTemplate rest, CircuitBreakerFactory cbFactory) {
                this.rest = rest;
                this.cbFactory = cbFactory;
        }

        public String slow() {
                return cbFactory.create("slow").run(() -> rest.getForObject("/slow",
```

Consistent API, allows developers to pick the implementation.

Supports Netflix Hystrix, Resilience4j, Sentinel, Spring Retry.

Add the proper starter to the class path, call the factory…

You can now inject the circuit breaker wherever you see fit.

Each circuit breaker can be individually configured.

Can also create default configuration for all circuit breakers.

Free to change failure thresholds, slow call thresholds…

## Minimum number of calls, sliding window size…

Circuit breakers are vital for a healthy micro(services)biome.

It isn’t hard to add!

Your customers will thank you…

And you can avoid 3 AM pages.

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# Circuit Breaker

This guide walks you through the process of applying circuit breakers to potentially failing method calls by using the Netflix Hystrix fault tolerance library.

## What You Will Build

You will build a microservice application that uses the circuit breaker pattern to gracefully degrade functionality when a method call fails. Use of the Circuit Breaker pattern can let a microservice continue operating when a related service fails, preventing the failure from cascading and giving the failing service time to recover.

## What You Need

- About 15 minutes
- A favorite text editor or IDE
- JDK 1.8 or later
- Gradle 4+ or Maven 3.2+
- You can also import the code straight into your IDE:
  - Spring Tool Suite (STS)
  - IntelliJ IDEA

## How to complete this guide

Like most Spring Getting Started guides, you can start from scratch and complete each step or you can bypass basic setup steps that are already familiar to you. Either way, you end up with working code.

Get the Code

Go To Repo

Spring Tips: Spring Cloud Circuit Breaker

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Hi Spring fans! In this installment we look at the just-announced Spring Cloud Circuit Breaker project, which provides an abstraction atop Netflix' Hystrix, Resilience4J, Alibaba's Sentinel and Spring Retry and supports reactive and non-reactive circuits.

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SC NETFLIX

Should be obvious …distributed systems have similar needs.

## Common patterns!

## Service discovery.

## Circuit breaker (we already touched on this!)

## Routing. Client side load balancing.

You know who has a lot of distributed app experience?

Netflix.

## Who has built out several OSS components to help?

Netflix.

Add some annotations and you’re good to go!

Integration of Netflix OSS into Boot apps.

Eureka.

Service discovery is a key part of distributed applications.

Services come and go, they’re scaled up and down.

Don’t try to configure by hand!

Two pieces - Eureka Server and Eureka Client.

Eureka Server can be configured to be HA.

Default is to run multiple instances and peer them.

Can also run standalone.

Clients register with Eureka.

Provide common info: port, host, health check, etc.

Put the Eureka client starter on the classpath & apps auto register.

Eureka gets a regular heartbeat from the service instances.

Heartbeat fails? Removed from the registry.

Uses the default `/info` and `/health` actuator endpoints.

Can be configured to register secure applications.

It can take up to 3 heartbeats to get everyone on the same page.

You can shorten the default heartbeat time period.

EurekaClient can then be use to find service instances.

There are alternative clients.

## Running in multiple zones?

You can configure it to use services in the same zone.

We don't just need service discovery though do we?

## Ribbon - client side load balancer.

Works with (or without) Eureka.

Add the starter.

Bet you saw that coming.

External properties configured via Boot configuration files.

You can create default configurations…

Can also customize by setting properties by environment.

You can also directly access the Ribbon API.

Configuration can be lazy loaded on first request.

Or set to load it eagerly.

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ALL GUIDES

# Service Registration and Discovery

This guide walks you through the process of starting and using the Netflix Eureka service registry.

## What You Will Build

You will set up a Netflix Eureka service registry and then build a client that both registers itself with the registry and uses it to resolve its own host. A service registry is useful because it enables client-side load-balancing and decouples service providers from consumers without the need for DNS.

## What You Need

- About 15 minutes
- A favorite text editor or IDE
- JDK 1.8 or later
- Gradle 4+ or Maven 3.2+
- You can also import the code straight into your IDE:
  - Spring Tool Suite (STS)
  - IntelliJ IDEA

## How to complete this guide

Like most Spring Getting Started guides, you can start from scratch and complete each step or you can bypass basic setup steps that are already familiar to you. Either way, you end up with working code.

To **start from scratch**, move on to Starting with Spring Initializr.

Get the Code

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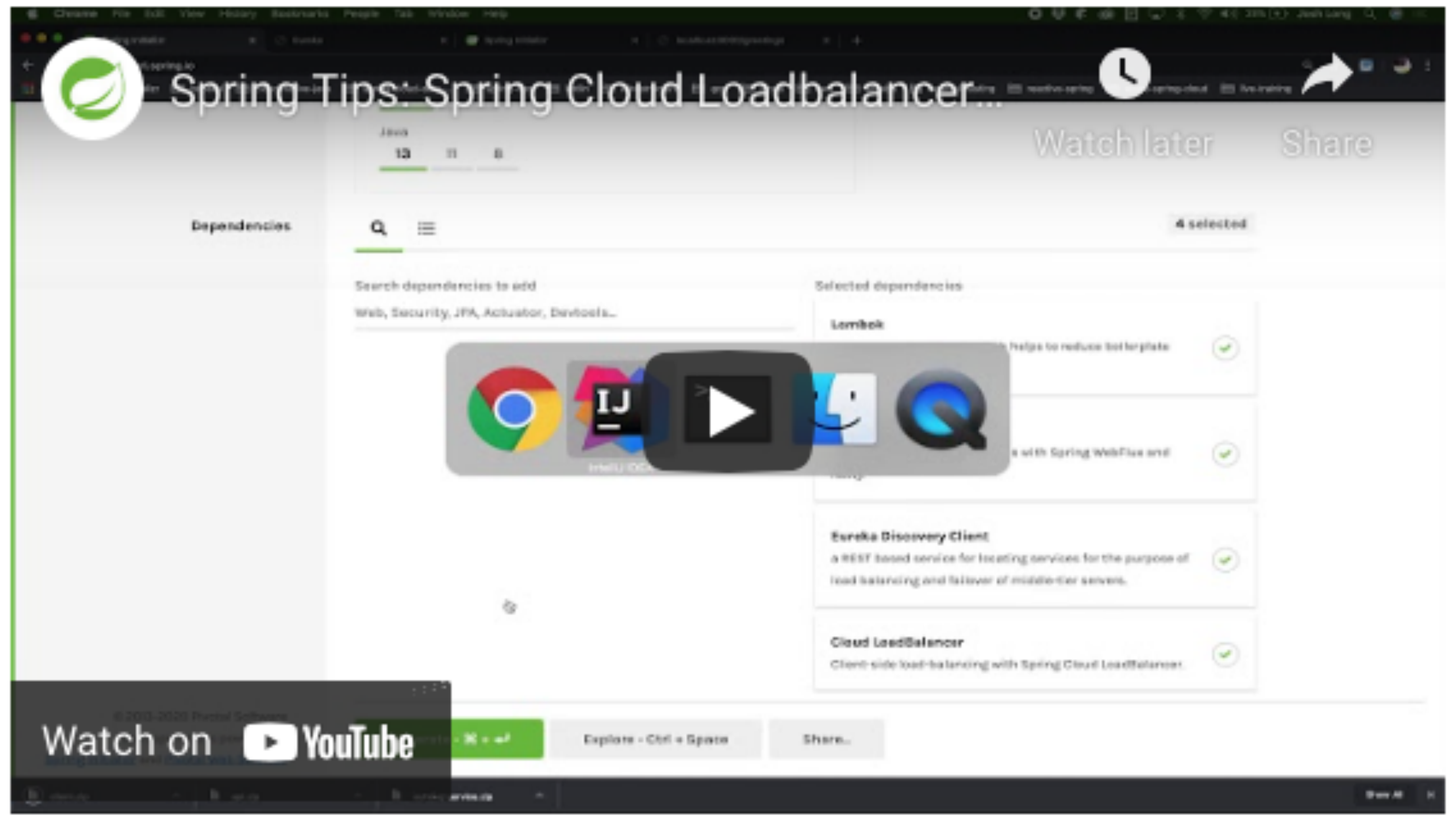
**ENGINEERING | JOSH LONG | MARCH 25, 2020 14 COMMENTS**

speaker: Josh Long (@starbuxman)



Hi, Spring fans! Welcome to another installment of Spring Tips! In this installment, we're going to look at a new feature in Spring Cloud, Spring Cloud Loadbalancer. Spring Cloud Loadbalancer is a generic abstraction that can do the work that we used to do with Netflix's Ribbon project. Spring Cloud still supports Netflix Ribbon, but Netflix Ribbons days are numbered, like so much else of the Netflix microservices stack, so we've provided an abstraction to support an alternative.

## The Service Registry

For us to use the Spring Cloud Load Balancer, we need to have a service registry up and running. A service registry makes it trivial to programmatically query for the location of a given service in a system. There are several popular implementations, including Apache Zookeeper, Netflix's Eureka, Hashicorp Consul, and others. You can even use Kubernetes and Cloud Foundry as service registries. Spring Cloud provides an abstraction, `DiscoveryClient`, that you can use to talk to these service

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Living on the Edge with Spring Cloud Gateway

## SC STREAM

Many distributed apps utilize event driven architectures.

Wait. What do *you* mean by events?

Depends on who you ask!

# What do you mean by “Event-Driven”?

Martin Fowler

07 February 2017

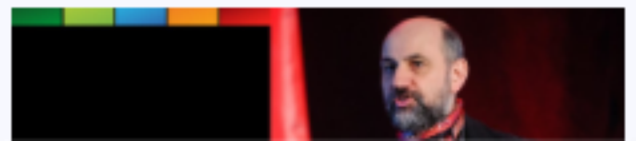
**Translations:** Japanese
DESIGN
EVENT ARCHITECTURES

Towards the end of last year I attended a workshop with my colleagues in ThoughtWorks to discuss the nature of “event-driven” applications. Over the last few years we've been building lots of systems that make a lot of use of events, and they've been often praised, and often damned. Our North American office organized a summit, and ThoughtWorks senior developers from all over the world showed up to share ideas.

The biggest outcome of the summit was recognizing that when people talk about “events”, they actually mean some quite different things. So we spent a lot of time trying to tease out what some useful patterns might be. This note is a brief summary of the main ones we identified.

## Event Notification

This happens when a system sends event messages to notify other systems of a change in its domain. A key element of event notification is that the source system doesn't really care much about the response. Often it doesn't expect any answer at all, or if there is a response that the source does care about, it's indirect. There would be a marked separation between the logic flow that sends the event and any logic flow that responds to some reaction to that event.



Event notification is nice because it implies a low level of coupling, and is pretty simple to set up. It can become problematic, however, if there really is a logical flow that runs over various event notifications. The problem is that it can be hard

## In the eye of the beholder?

There are multiple event patterns.
Which one are you using?

Event notification.

Something happens, source system shouts into the void.

"A new customer signed up!"

Event emitter doesn’t care what happens next.

Highly asynchronous.

## The 0th Law of Computer Science:

High cohesion, low coupling…

But there are downsides.

What would you say you do around here?

Hard to debug, difficult to reason about the system.

Monitoring, monitoring, monitoring.

Easy to lose sight of the flow.

Event-carried state transfer.

Event includes details.

Customer address updated and here is the new address.

Event subscribers don’t have to ask.

Aka Tell Don‘t Ask.

You know, object oriented programming 101.

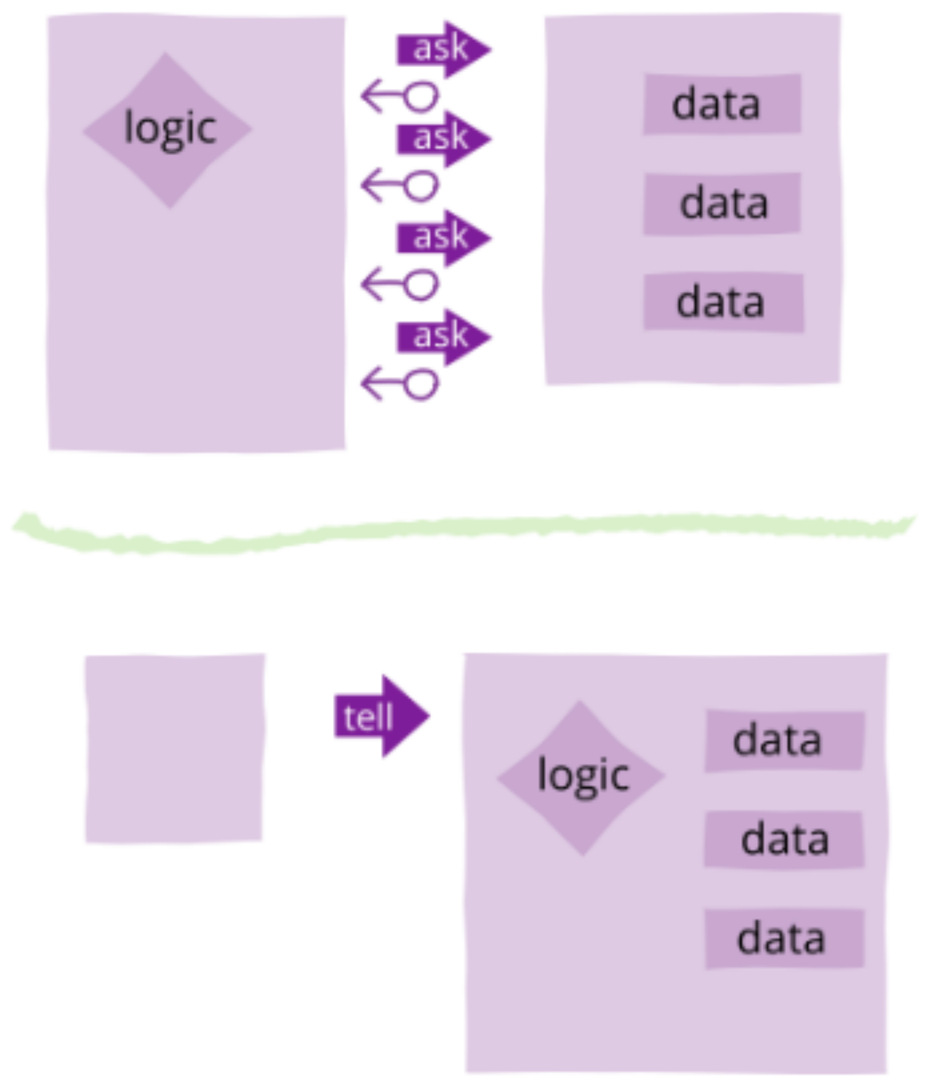
# TellDontAsk

5 September 2013

Martin Fowler

ENCAPSULATION
API DESIGN
OBJECT COLLABORATION DESIGN

Tell-Don't-Ask is a principle that helps people remember that object-orientation is about bundling data with the functions that operate on that data. It reminds us that rather than asking an object for data and acting on that data, we should instead tell an object what to do. This encourages to move behavior into an object to go with the data.



Let's clarify with an example. Let's imagine we need to monitor certain values, signaling an alarm should the value rise above a certain limit. If we write this in an "ask" style, we might have a data structure to represent these things…

*class AskMonitor…*

```
  private int value;
  private int limit;
  private boolean isTooHigh;
```

Reduced latency.

Lower overhead on the source systems.

Lots of data thrown around.

And receivers have to handle state.

Event sourcing.

Record every state change.

Event store is the source of truth.

## Did someone say Kafka?

# INTRODUCTION

*Everything you need to know about Kafka in 10 minutes*

## What is event streaming?

Event streaming is the digital equivalent of the human body's central nervous system. It is the technological foundation for the 'always-on' world where businesses are increasingly software-defined and automated, and where the user of software is more software.

Technically speaking, event streaming is the practice of capturing data in real-time from event sources like databases, sensors, mobile devices, cloud services, and software applications in the form of streams of events; storing these event streams durably for later retrieval; manipulating, processing, and reacting to the event streams in real-time as well as retrospectively; and routing the event streams to different destination technologies as needed. Event streaming thus ensures a continuous flow and interpretation of data so that the right information is at the right place, at the right time.

## What can I use event streaming for?

Event streaming is applied to a wide variety of use cases across a plethora of industries and organizations. Its many examples include:

- To process payments and financial transactions in real-time, such as in stock exchanges, banks, and insurances.

Strong audit log. Easy to recreate history.

Run hypotheticals.

Evolving schema can hurt.

Challenging to replay when we interact with outside systems.

CQRS.

Command Query Responsibility Segregation.

# CQRS

14 July 2011

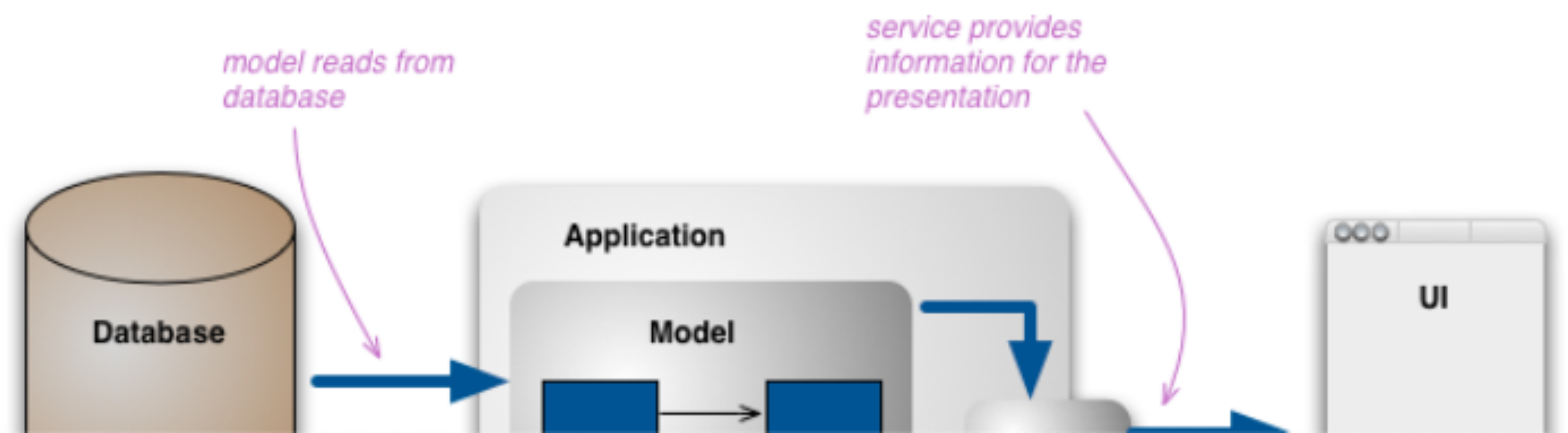
Martin Fowler

DOMAIN DRIVEN DESIGN
APPLICATION ARCHITECTURE
API DESIGN
EVENT ARCHITECTURES

CQRS stands for **Command Query Responsibility Segregation**. It's a pattern that I first heard described by Greg Young. At its heart is the notion that you can use a different model to update information than the model you use to read information. For some situations, this separation can be valuable, but beware that for most systems CQRS adds risky complexity.

The mainstream approach people use for interacting with an information system is to treat it as a CRUD datastore. By this I mean that we have mental model of some record structure where we can **c**reate new records, **r**ead records, **u**pdate existing records, and **d**elete records when we're done with them. In the simplest case, our interactions are all about storing and retrieving these records.

As our needs become more sophisticated we steadily move away from that model. We may want to look at the information in a different way to the record store, perhaps collapsing multiple records into one, or forming virtual records by combining information for different places. On the update side we may find validation rules that only allow certain combinations of data to be stored, or may even infer data to be stored that's different from that we provide.


model reads from database
service provides information for the presentation
Database
Application
Model
UI

One data structure for reads,
another for writes.

Not really event driven per se.

But often combined with.

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# Event Streaming

Event streaming can be thought of as flipping the flow of requests in the opposite direction. Instead of a standard call-response cadence to communicate with each other, services simply emit an “event”—any significant change-of-state—that is open for any interested services to consume. Some frameworks like Spring Cloud Stream ease the integration with these messaging services.

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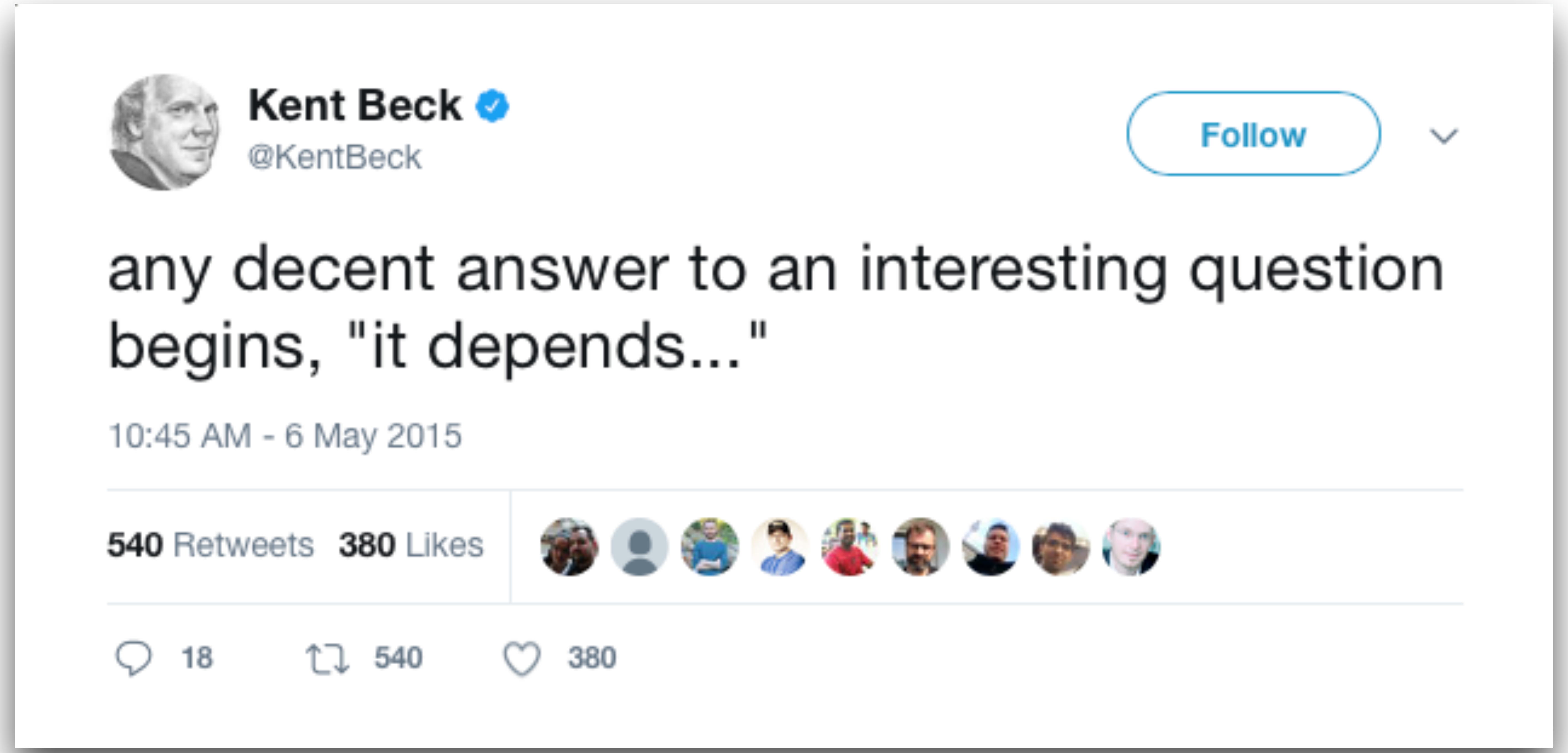
## Which approach is right for you?



Kent Beck
@KentBeck

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any decent answer to an interesting question begins, "it depends..."

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All about trade offs!

But you knew that.

By the way, this is usually when someone asks…

“How do distributed transactions work in the cloud?”

They don’t!

It’s like the real world.

You buy a shirt at a store.
There is a return policy.

They don’t keep the transaction open until the return period expires!

The sale is committed!

You return the shirt?

## Compensating transactions!

Put the shirt back into inventory.
Issue you a credit.

Same thing for us.

## OK, so how does Spring help us out when it comes to events?

## Spring Cloud Stream.

Here’s the thing.

As architects, we want flexibility.

One constant - change.

Architecture is often defined as the decisions that are hard to change.

Or the decisions we wish we got right.

But we *know* things will change!

We don’t want to paint ourselves into a corner…

SCS lets you swap brokers.

Use what is right for your team.

Supports what you’d expect.

Kafka, RabbitMQ, Kinesis plus various partner maintained bits.

Provides a binder to the external brokers.

Middleware neutral.

Also includes a test binder for integration testing.

You can alway build
your own binder…

Destination binder connects you to your messaging system.

Handles the boilerplate configuration bits.

Bindings are the bridge between your app and the broker.

Your functions then consume and produce messages.

There are binder specific health indicators.

And so very much more!

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# Spring Cloud Stream - demystified and simplified

**ENGINEERING | OLEG ZHURAKOUSKY | OCTOBER 14, 2019 2 COMMENTS**

This is the first post in a series of blog posts meant to clarify and preview what's coming in the upcoming releases of spring-cloud-stream and spring-cloud-function (both 3.0.0).

Recently, I had a discussion with a user and heard something that prompted me to begin a series of blog posts (starting with this one) with the goal of both demystifying the true goals of *Spring Cloud Stream* and *Spring Cloud Function* projects as well as demonstrating their new features.

## Spring Integration Wrapper?

The specific phrase that prompted all this was - *"Spring Cloud Stream, being a light Spring Integration input/output router…"*. That's an interesting perception, but I have to disagree. While it may have been inspired by Enterprise Integration Patterns (EIP) and builds on top of Spring Integration (SI), that last part is really just an implementation detail. Spring Cloud Stream (SCSt) as a framework was never about *"being a light Spring Integration input/output router"*. In fact, this statement shows part of the problem, where SI (the framework of choice to support some of the internal requirements of SCSt) was somehow perceived to be the core of SCSt in such way that many perceive SCSt to be an extension or a wrapper to SI. It is not. It has always been about pure microservices and binding them to *sources* and *targets* of data (i.e., messaging systems) . Simple as that.
If you abstract yourself far enough from knowing the internals of SCSt, you quickly realize that it is really a binding and activation framework. It binds a piece of code (provided by the user) to source/target of data exposed by the binder and activates such code according to binder implementation (for example, message arrival and so on). That is pretty much it.

## To Function or Not to Function?

Historically, Spring Cloud Stream exposed an annotation-based configuration model that required the user to provide a lot of information that could be otherwise easily inferred, thus simplifying

# Spring Cloud Stream - Event Routing

ENGINEERING | OLEG ZHURAKOUSKY | OCTOBER 31, 2019 0 COMMENTS

Welcome to another post in a series of posts showcasing the new features of Spring Cloud Stream (SCSt).
In previous posts (available here, here and here), we tried to provide justification for our shift to a functional programming model in Spring Cloud Stream (SCSt). It is less code and less configuration, and your code remains completely decoupled from the internals of SCSt.

Today, we'll talk about routing with functions.
Routing, in the context of SCSt, is the ability to either *a) route events to a particular event subscriber* or *b) route an event produced by an event subscriber to a particular destination*. To help more with the context, let's quickly look at how things work in the annotation-based programming model. In this post, we'll refer to it as route 'TO' and route 'FROM'.

For routing ***TO*** an event subscriber, we used the `condition` attribute of the `StreamListener` annotation, as follows:

```
@StreamListener(target = Sink.INPUT, condition = "headers['type']=='order'")
public void receiveOrders(Order order) {...}
```

Here are more details on this approach.

And, for routing ***FROM*** an event subscriber, we used Dynamically Bound Destinations - the approach that allows framework to bind to a destination based on some instruction provided within the individual event.

## Event Routing with Functions

With the functional approach, we can do all of the above in a more clean and concise way with a few additional features.

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# Event Streaming

Event streaming can be thought of as flipping the flow of requests in the opposite direction. Instead of a standard call-response cadence to communicate with each other, services simply emit an “event”—any significant change-of-state—that is open for any interested services to consume. Some frameworks like Spring Cloud Stream ease the integration with these messaging services.

## Spring Cloud Stream

Discover how to use Spring Cloud Stream, a framework for building highly scalable, event-driven microservices connected with shared messaging systems.

## Spring Cloud Stream Kafka

A simple demonstration of how to implement your Java application with Kafka (Spring Cloud Stream) with the least amount of code in your Spring Boot application.

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# CONTRACTS

Services evolve.

To be expected!

## How do you avoid breaking changes to consumers?

You might not even know who is calling your service!

## Consumer Driven Contracts.

https://martinfowler.com/articles/consumerDrivenContracts.html

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# Spring Cloud Contract 3.0.0

OVERVIEW LEARN SAMPLES

Spring Cloud Contract is an umbrella project holding solutions that help users in successfully implementing the Consumer Driven Contracts approach. Currently Spring Cloud Contract consists of the Spring Cloud Contract Verifier project.

Spring Cloud Contract Verifier is a tool that enables Consumer Driven Contract (CDC) development of JVM-based applications. It is shipped with Contract Definition Language (DSL) written in Groovy or YAML. Contract definitions are used to produce following resources:

- by default JSON stub definitions to be used by WireMock (HTTP Server Stub) when doing integration testing on the client code (client tests). Test code must still be written by hand, test data is produced by Spring Cloud Contract Verifier.
- Messaging routes if you're using one. We're integrating with Spring Integration, Spring Cloud Stream and Apache Camel. You can however set your own integrations if you want to.
- Acceptance tests (by default in JUnit or Spock) used to verify if server-side implementation of the API is compliant with the contract (server tests). Full test is generated by Spring Cloud Contract Verifier.

Spring Cloud Contract Verifier moves TDD to the level of software architecture.

To see how Spring Cloud Contract supports other languages just check out this blog post.

## Features

When trying to test an application that communicates with other services then we could do one of two things:

- deploy all microservices and perform end to end tests
- mock other microservices in unit / integration tests

Both have their advantages but also a lot of disadvantages. Let's focus on the latter. Deploy all

Contracts can be written in Groovy or YAML.

Add the Spring Cloud Contract Verifier dependency.

Running a clean build will generate test stubs.

You implement the test code.

Publish the stub artifacts along with your production code.

Living documentation!

Evolves with your services.

Consumers leverage Spring Cloud Contract Stub Runner.

Add the dependency and install the producer stubs.

Add the proper annotation to your test class.

Your test will get a stubbed version of the HTTP response.

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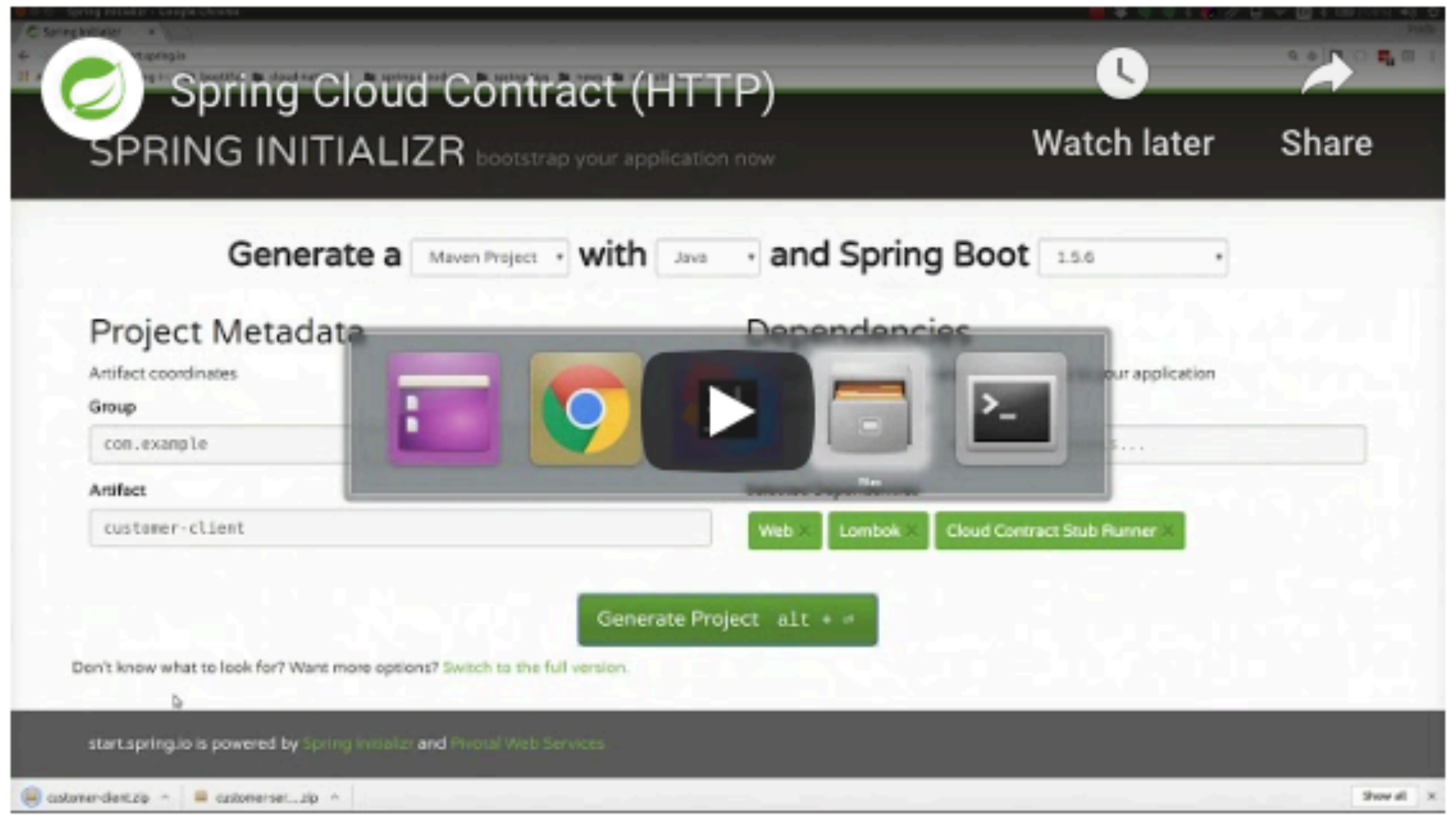
# Spring Tips: Spring Cloud Contract (HTTP)

**ENGINEERING | JOSH LONG | OCTOBER 24, 2017 11 COMMENTS**

Speaker: Josh Long

Hi Spring fans! In this tip, we'll look at how to get fast-feedback *and* do integration testing with Spring Cloud Contract. In this video, we'll focus on HTTP-based services.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Consumer Driven Contract Testing with Spring Cloud Contract

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In the microservices world, testing can sound easy since developers should focus in just one domain. In the real world, testing microservices can be tough as we also need to take into account the communication between the many services in our system. In this session about Spring Cloud

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# REACTIVE

## Remember Moore’s Law?

“the number of transistors in a [chip] doubles about every two years.”

Processor clock speeds got faster and faster.

A new chip would be twice as fast as a six month old model.

Today? Not so much..but, we have more cores.

That reality changes things for how we architect systems.

Take advantage of the cores!

Many apps need high throughput and low latency.

## Non-blocking, asynchronous applications to the rescue!

Do more with fewer resources.

Spring gives you two stacks:
Reactive and Servlet.

Spring MVC builds on the Servlet API.

## Synchronous, blocking IO.

Aka - the traditional approach.

And that’s fine!

Still fits a number of use cases!

But we do have options today…

WebFlux is non-blocking, taking advantage of multi-core processors.

Designed for massive concurrent connections.

Project Reactor interacts with functional API of Java.

Twp APIs: Flux and Mono.

Back pressure ready,
fully non-blocking.

Low memory footprint, tens of millions of messages per second.

Datastores have evolved too.

There are a set of reactive repositories.

Spring Data has native support for Mongo, Redis and Cassandra.

Others are supported via R2DBC.

You may not always need reactive architectures…

But when you do,
Spring has you covered!

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# Reactive

Reactive systems have certain characteristics that make them ideal for low-latency, high-throughput workloads. Project Reactor and the Spring portfolio work together to enable developers to build enterprise-grade reactive systems that are responsive, resilient, elastic, and message-driven.

**What is reactive processing?**

Reactive processing is a paradigm that enables developers build non-blocking, asynchronous applications that can handle back-pressure (flow control).

**Why use reactive processing?**

Reactive systems better utilize modern processors. Also, the inclusion of back-pressure in reactive programming ensures better resilience between decoupled components.

## Project Reactor

Project Reactor is a fully non-blocking foundation with back-pressure support included. It's the foundation of the reactive stack in the Spring ecosystem and is featured in projects such as Spring WebFlux, Spring Data, and Spring Cloud Gateway.

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https://github.com/joshlong/flux-flix-service | spring.io/guides

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ANALYTICS · EDIT VIDEO

Hi, Spring fans! Spring is an inversion-of-control container. Inversion of control insulates objects from the knowledge of how a collaborating object on which they depend are created. It also insulates objects from their environment, letting them exist blissfully unaware of where

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# SC GATEWAY

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# Spring Cloud Gateway 3.0.0

This project provides a library for building an API Gateway on top of Spring WebFlux. Spring Cloud Gateway aims to provide a simple, yet effective way to route to APIs and provide cross cutting concerns to them such as: security, monitoring/metrics, and resiliency.

## Features

Spring Cloud Gateway features:

- Built on Spring Framework 5, Project Reactor and Spring Boot 2.0
- Able to match routes on any request attribute.
- Predicates and filters are specific to routes.
- Circuit Breaker integration.
- Spring Cloud DiscoveryClient integration
- Easy to write Predicates and Filters
- Request Rate Limiting
- Path Rewriting

## Getting Started

```
 @SpringBootApplication
public class DemogatewayApplication {
        @Bean
        public RouteLocator customRouteLocator(RouteLocatorBuilder builder) {
                return builder.routes()
                        .route("path_route", r -> r.path("/get")
                                .uri("http://httpbin.org"))
                        .route("host_route", r -> r.host("*.myhost.org")
```

## A Spring approach to the gateway problem!

Based on Spring 5,
Reactor and Boot 2.

## Non blocking IO.

## Backpressure.

## Event loop!

## Spring WebFlux.

Lives along side Spring MVC.

Non-blocking, reactive.

Streams!

HandlerMapping - what code is going to handle this request.

WebFilter - manipulate the request/response.

Predicate - test some aspect of the request…

And determine whether to route it.

ServerWebExchange: access all parts of the http request/response.

Configure routes in Java, YAML
or via repositories.

Can route on path, host, headers, parameters…

Anything in the request.

## Filters!

Rewrite path.

Add or remove request/ response headers.

## Rate limiting.

## Circuit Breaker integration.

With so many options, why should I use Spring Cloud Gateway?

It is programmer centric routing.

Antithesis of tickets with a side of tickets. And more tickets.

Would you rather
refresh a configuration?

Or fill out another ticket?

Java centric, Spring centric, configuration centric.

You are in control.

Instead of one of these…

You can craft your own…

Except *you* decide what tools, blades etc. you want.

Lightweight, simple.

Use it as you will. You aren’t forced down a certain path.

Think of it as an ESB with inversion of control.

It is not a SaaS, it is a tool.

You can just “run” SC Gateway.

It is just an app.

Developer focussed.

You know how to build
and run applications.

You build it, you push it.

It is in your hands, not some random enterprise group.

Anything you could do in Zuul 1 is supported in SC Gateway.

## But what about performance?

There was a benchmark published in December 2017.

SC Gateway was not officially released at that time.

There are no performance issues today.

Many large companies rely on it.

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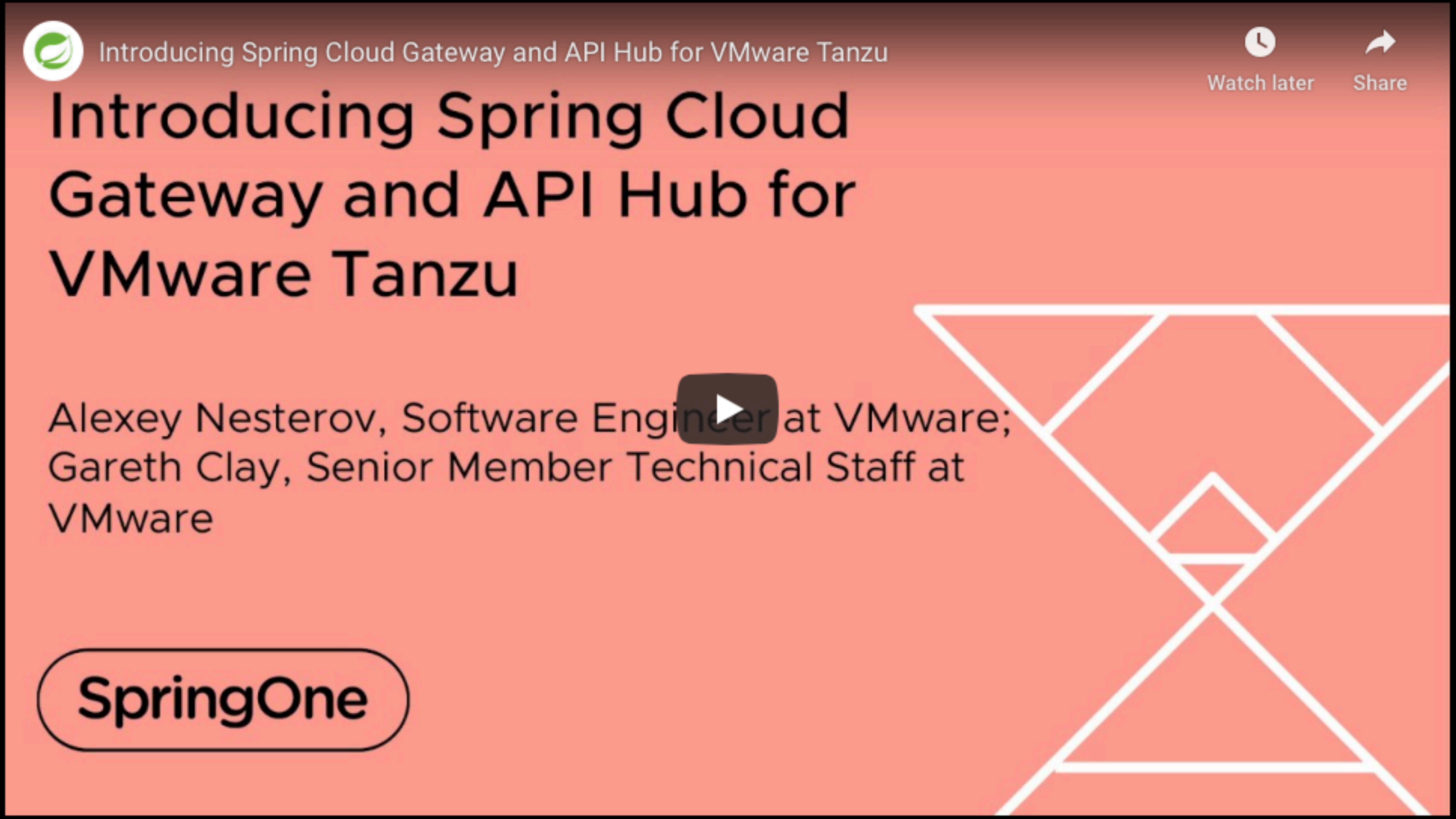
# Introducing Spring Cloud Gateway and API Hub for VMware Tanzu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Alexey Nesterov, Software Engineer at VMware; Gareth Clay, Senior Member Technical Staff at VMware

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Presentation slides

Spring Cloud Gateway: Getting Started

Spring Cloud Gateway for VMware Tanzu was made generally available in January of this year. In this talk, we'll introduce this new product, which gives developers the ability to create easily configurable, on-demand API Gateway

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Spring Cloud Gateway introduced a flexible API for configuring the edge service of our applications. Built upon Project Reactor, Spring WebFlux, and Spring Boot 2.0, Spring Cloud Gateway provided a modern and efficient architecture to handle a large number of concurrent requests. However, as

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# Spring Cloud Kubernetes

## Did someone say Kubernetes?

## Spring Cloud Kubernetes!

Spring Boot

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## Spring Cloud Kubernetes 2.0.2

OVERVIEW LEARN SAMPLES

Spring Cloud Kubernetes provides implementations of well known Spring Cloud interfaces allowing developers to build and run Spring Cloud applications on Kubernetes. While this project may be useful to you when building a cloud native application, it is also not a requirement in order to deploy a Spring Boot app on Kubernetes. If you are just getting started in your journey to running your Spring Boot app on Kubernetes you can accomplish a lot with nothing more than a basic Spring Boot app and Kubernetes itself. To learn more, you can get started by reading the Spring Boot reference documentation for deploying to Kubernetes and also working through the workshop material Spring and Kubernetes.

### Features

- Kubernetes awareness
- `DiscoveryClient` implementation
- `PropertySource` objects configured via ConfigMaps
- Client side loadbalancing via Netflix Ribbon

### Getting Started

The easiest way to get started is by including the Spring Cloud BOM and then adding `spring-cloud-starter-kubernetes-all` to your application's classpath. If you don't want to include all of the Spring Cloud Kubernetes features you can add individual starters for the features you would like. By default Spring Cloud Kubernetes will enable the `kubernetes` profile when it detects it is running inside a Kubernetes cluster. You can take advantage of this by creating a `kubernetes-application` configuration properties for anything specific to Kubernetes you might want to configure. Once the starter is on the classpath the application should behave as any other Spring Cloud application.

**Quickstart Your Project**

Bootstrap your application with Spring Initializr.

First off, not required.

Boot is ready to roll on a multitude of popular cloud options.

Spring Boot will auto detect Kubernetes.

You can export the K8s probes via Actuator.

## Liveness and Readiness.

Just point your configuration to the actuator endpoints.

## What does Spring Cloud Kubernetes give me?

Kuberentes awareness.

DiscoveryClient implementation.

PropertySource objects.

## Client side load balancing via Ribbon.

You are free to add individual K8s starters…

Or pull in everything.

You can also use Spring to extend Kubernetes.

## Custom Resource Definition.

## Evolving space!

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# Spring on Kubernetes

**Get the Code**

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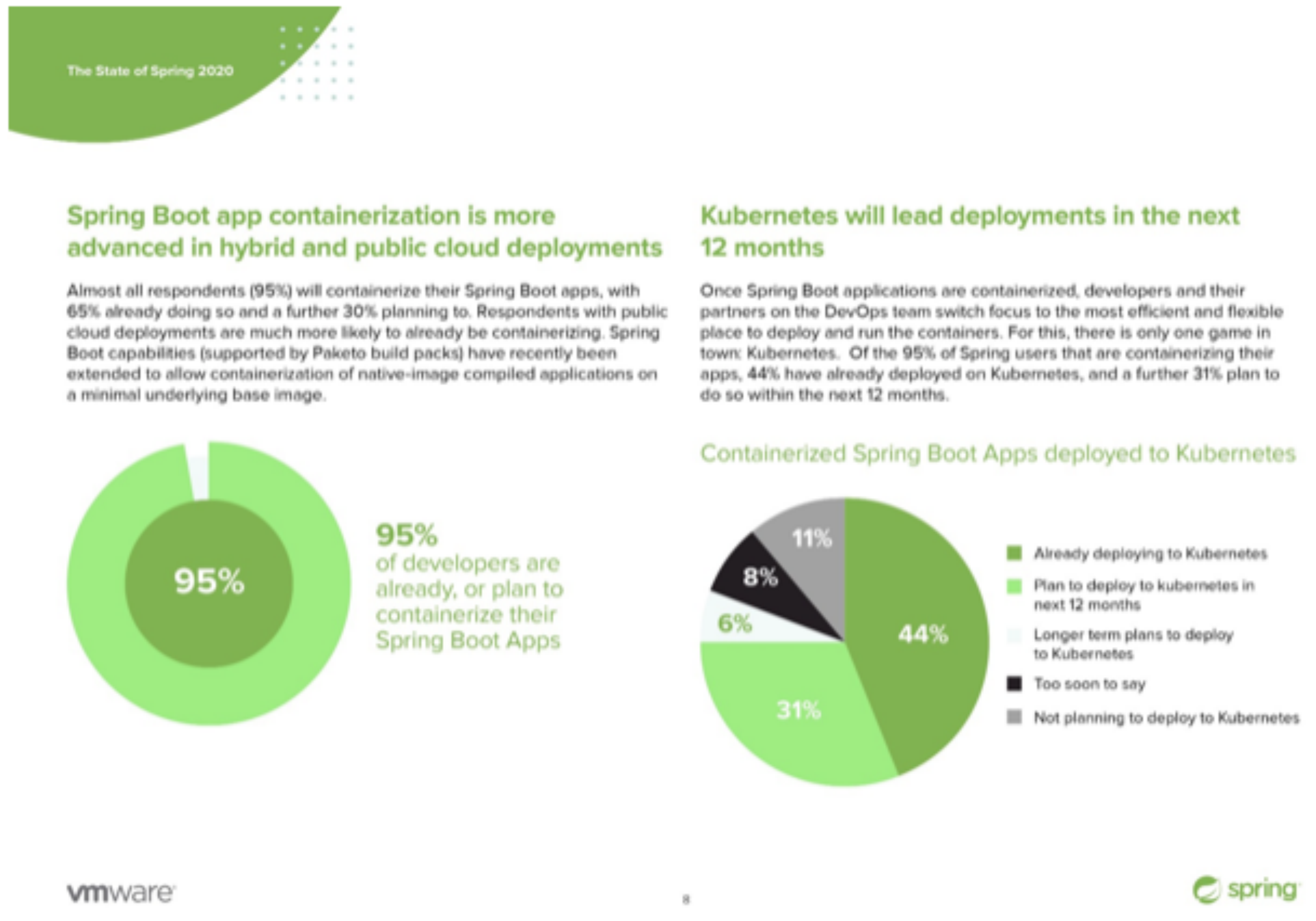
When it comes to building Java apps that run in the cloud, Spring and Spring Boot are clear favorites. It is also increasingly clear that technologies such as Docker and Kubernetes play an important role in the Spring community.


The State of Spring 2020

**Spring Boot app containerization is more advanced in hybrid and public cloud deployments**

Almost all respondents (95%) will containerize their Spring Boot apps, with 65% already doing so and a further 30% planning to. Respondents with public cloud deployments are much more likely to already be containerizing. Spring Boot capabilities (supported by Paketo build packs) have recently been extended to allow containerization of native-image compiled applications on a minimal underlying base image.

**Kubernetes will lead deployments in the next 12 months**

Once Spring Boot applications are containerized, developers and their partners on the DevOps team switch focus to the most efficient and flexible place to deploy and run the containers. For this, there is only one game in town: Kubernetes. Of the 95% of Spring users that are containerizing their apps, 44% have already deployed on Kubernetes, and a further 31% plan to do so within the next 12 months.

95%
95%
of developers are already, or plan to containerize their Spring Boot Apps
Containerized Spring Boot Apps deployed to Kubernetes
44%
31%
6%
8%
11%
Already deploying to Kubernetes
Plan to deploy to kubernetes in next 12 months
Longer term plans to deploy to Kubernetes
Too soon to say
Not planning to deploy to Kubernetes
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Packing your Spring Boot app in a Docker container and deploying that application to Kubernetes has been possible for a while now and took very little effort. Due to the "make jar not war" motto, all that was required to containerize a Spring Boot app was a container with a JRE to run the jar. Once you had a Docker container, running the containerized Spring Boot application in Kubernetes was just a matter of running the container.

That said, as more and more of you deployed Spring Boot applications to Kubernetes, it became clear we could do better. To that end, we have made several enhancements in Spring Boot 2.3 and are making even more in the forthcoming Spring Boot 2.4 release to make running Spring Boot on

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In this video Ryan Baxter of Pivotal takes a look at Spring Cloud Kubernetes, a project that allows developers to use native Kubernetes features in their Spring applications.

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Deploying a Spring Application on K8s has become increasingly straightforward with new features in Spring Boot, such as OCI image building and micrometer metric exporting. In this talk, Ollie will demonstrate a number of tools and techniques that make deploying apps to Kubernetes as

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Workshops / Spring on Kubernetes

# Spring on Kubernetes

Create a Spring Boot application. Containerize it, and push the container to a registry. Deploy it to Kubernetes.

Approximate time: 120 minutes

START WORKSHOP *(Login Required)*

During this workshop you will learn the finer details of how to create, build, run, and debug a basic Spring Boot app on Kubernetes by doing the following:

- Create a basic Spring Boot app
- Build a Docker image for the app
- Push the image to a Docker registry
- Deploy and run the app on Kubernetes
- Test the app using port-forwarding and ingress
- Use skaffold to iterate easily as you work on your app
- Use kustomize to manage configurations across environments
- Externalize application configuration using ConfigMaps
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The Spring team has always prioritized performance.

And there are a number of things you can tweak.

And now Spring Native.

Currently beta!

Allows you to compile to GraalVM native images.

Nearly instant startup experience and lower memory usage.

But longer build times and fewer runtime optimizations.

## Trade offs!

Native images have different characteristics. That’s the point.

## Ahead of time transformations.

Not everything can be inferred…

Useful for functions.

Lower overhead Microservices.

Supports Java and Kotlin.

Don’t forget. It is in beta.

Expect breaking changes.

Let me repeat that.
Expect breaking changes.

docs.spring.io
spring

# Spring Native documentation

Version 0.9.2 - Andy Clement · Sébastien Deleuze · Filip Hanik · Dave Syer · Esteban Ginez · Jay Bryant · Brian Clozel · Stéphane Nicoll · Josh Long

## 1. Overview

Spring Native provides support for compiling Spring applications to native executables using the GraalVM native-image compiler.

Compared to the Java Virtual Machine, native images can enable cheaper and more sustainable hosting for many types of workloads. These include microservices, function workloads, well suited to containers, and Kubernetes

Using native image provides key advantages, such as instant startup, instant peak performance, and reduced memory consumption.

There are also some drawbacks and trade-offs that the GraalVM native project expect to improve on over time. Building a native image is a heavy process that is slower than a regular application. A native image has fewer runtime optimizations after warmup. Finally, it is less mature than the JVM with some different behaviors.

The key differences between a regular JVM and this native image platform are:

- A static analysis of your application from the main entry point is performed at build time.
- The unused parts are removed at build time.
- Configuration is required for reflection, resources, and dynamic proxies.
- Classpath is fixed at build time.
- No class lazy loading: everything shipped in the executables will be loaded in memory on startup.
- Some code will run at build time.
- There are some limitations around some aspects of Java applications that are not fully supported.

The goal of this project is to incubate the support for Spring Native, an alternative to Spring JVM, and provide a native

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Announcing Spring Native Beta!

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Sébastien Deleuze, Andy Clement, Brian Clozel, Jens Schauder, Ria Stein & David Syer announce Spring Native Beta v0.9.0. For more details check out the blog post at https://spring.io/blog/2021/03/11/ann...

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5,423 views • Sep 25, 2020

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"In this talk, Andy and Sébastien are going to share the latest status of their work on Spring GraalVM Native, the incubating project that allows Spring Boot applications to run as native images.

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The Beginner's Guide To Spring Cloud - Ryan Baxter
SpringDeveloper
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Walking Through Spring Cloud

It isn’t easy to architect cloud native applications.

Lot of moving parts.

Distributed architectures require a fair amount of plumbing.

Spring can help!

Hopefully something here caught your eye.

Remember…

Make the right choice
the easy choice.

How do you keep up with everything happening in Spring?

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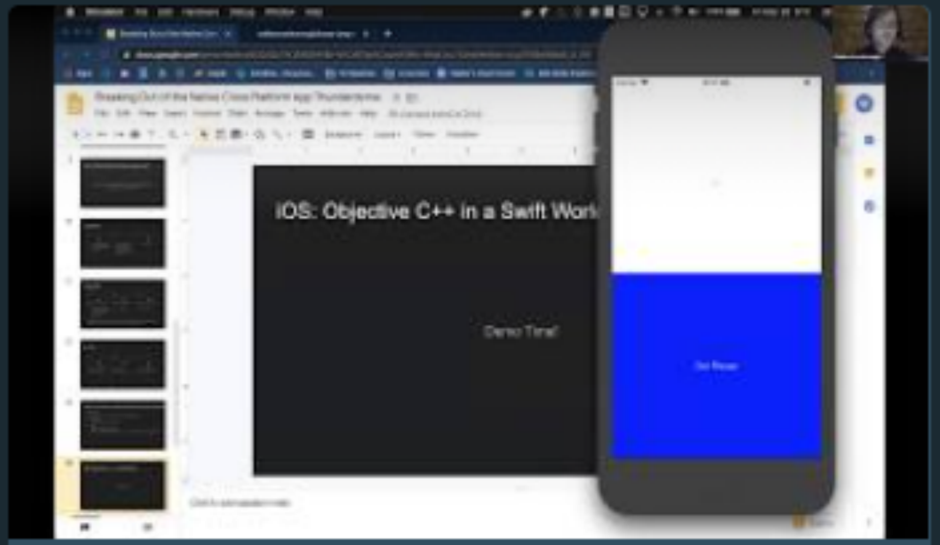

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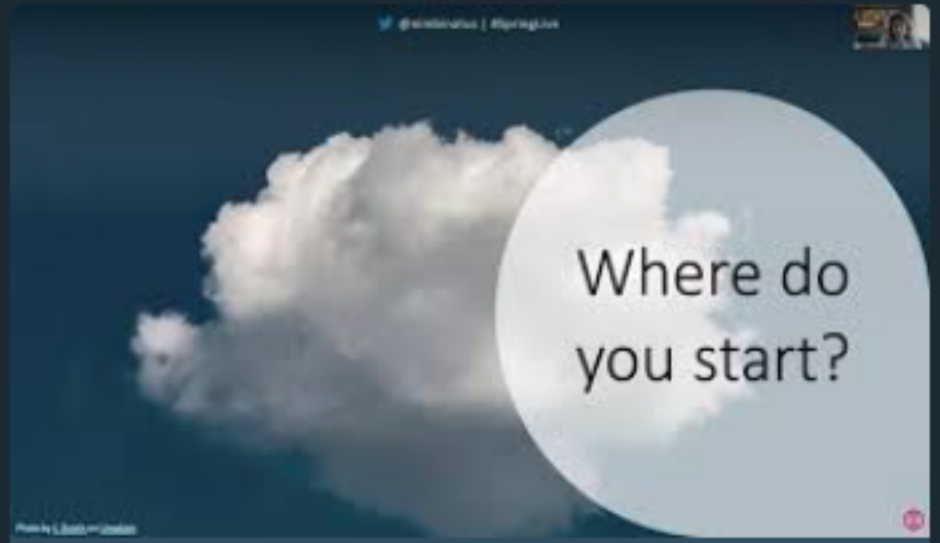

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# Reactive Spring and Spring Boot

## Using the Spring WebFlux module to build high-performance reactive systems

What you'll learn Is this course for you? Schedule

The latest major releases of the Spring Framework, Spring 5 and Spring Boot 2, take full advantage of the new functional features provided by Java SE 8 as well as the Reactive Streams specification. The new WebFlux module adds Spring's ease of use and Spring Boot's ease of configuration to the design and development of reactive applications, while Reactive Streams allow applications to more efficiently make use of limited resources by adding nonblocking capabilities.

Join expert Ken Kousen to gain the foundation you need to take advantage of reactive programming, the Reactive Streams specification (a widely adopted industry standard), and the WebFlux module.

APAC friendly time.

## What you'll learn and how you can apply it

**By the end of this live online course, you'll understand:**

- Spring's convention over configuration and dependency injection
- Spring Boot autoconfiguration and rapid prototyping capabilities
- The Reactive Streams specification and how it contributes to building asynchronous, reactive applications

May 4, 2021
4:00 a.m. - 8:00 a.m. CDT

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YOUR INSTRUCTOR

Ken Kousen

Ken Kousen is the author of the Kotlin Cookbook (O'Reilly), Modern Java Recipes (O'Reilly), Gradle Recipes for Android (O'Reilly), and Making Java Groovy (Manning), as well as O'Reilly video courses in Android, Groovy,

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I’m sure I missed several…

And I am very sorry for that!

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To me, this has always been the defacto standard for documentation on the Spring Framework. I bought the 1st edition when it first came out as we were converting alegacy app to Spring and this book was essential in learning how the current version worked.

Tony Sweets

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## Spring Boot: Up and Running

by Mark Heckler
Released February 2021
Publisher(s): O'Reilly Media, Inc.
ISBN: 9781492076988

Explore a preview version of *Spring Boot: Up and Running* right now.

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## Book description

With over 75 million downloads per month, Spring Boot is the most widely used Java framework available. Its ease and power have revolutionized application development from monoliths to microservices. Yet Spring Boot's simplicity can also be confounding. How do developers learn enough to be productive immediately? This practical book shows you how to use this framework to write successful mission-critical applications.

Mark Heckler from VMware, the company behind Spring, guides you through Spring Boot's architecture and approach, covering topics such as debugging, testing, and deployment. If you want to develop cloud native Java or Kotlin applications with Spring

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Spring makes Java cloud-ready.

WHY SPRING QUICKSTART

NEWS Announcing Spring Native Beta! | SpringOne returns Sep 1-2, 2021

What Spring can do

**Microservices**

Quickly deliver production-grade features with independently evolvable microservices.

**Reactive**

Spring's asynchronous, nonblocking architecture means you can get more from your computing resources.

**Cloud**

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**Web apps**

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# Projects

From configuration to security, web apps to big data—whatever the infrastructure needs of your application may be, there is a Spring Project to help you build it. Start small and use just what you need—Spring is modular by design.

**Spring Boot**

Takes an opinionated view of building Spring applications and gets you up and running as quickly as possible.

**Spring Framework**

Provides core support for dependency injection, transaction management, web apps, data access, messaging, and more.

**Spring Data**

Provides a consistent approach to data access – relational, non-relational, map-reduce, and beyond.

**Spring Cloud**

Provides a set of tools for common patterns in distributed systems. Useful for building and deploying microservices.

Deep dive documentation?

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# Spring Boot 2.4.5

OVERVIEW | LEARN | SAMPLES

Spring Boot makes it easy to create stand-alone, production-grade Spring based Applications that you can "just run".

We take an opinionated view of the Spring platform and third-party libraries so you can get started with minimum fuss. Most Spring Boot applications need minimal Spring configuration.

If you're looking for information about a specific version, or instructions about how to upgrade from an earlier release, check out the project release notes section on our wiki.

## Features

- Create stand-alone Spring applications
- Embed Tomcat, Jetty or Undertow directly (no need to deploy WAR files)
- Provide opinionated 'starter' dependencies to simplify your build configuration
- Automatically configure Spring and 3rd party libraries whenever possible
- Provide production-ready features such as metrics, health checks, and externalized configuration
- Absolutely no code generation and no requirement for XML configuration

## Getting Started

- Super quick — try the Quickstart Guide.
- More general — try Building an Application with Spring Boot
- More specific — try Building a RESTful Web Service.
- Or search through all our guides on the Guides homepage.

Want some hands on coding?

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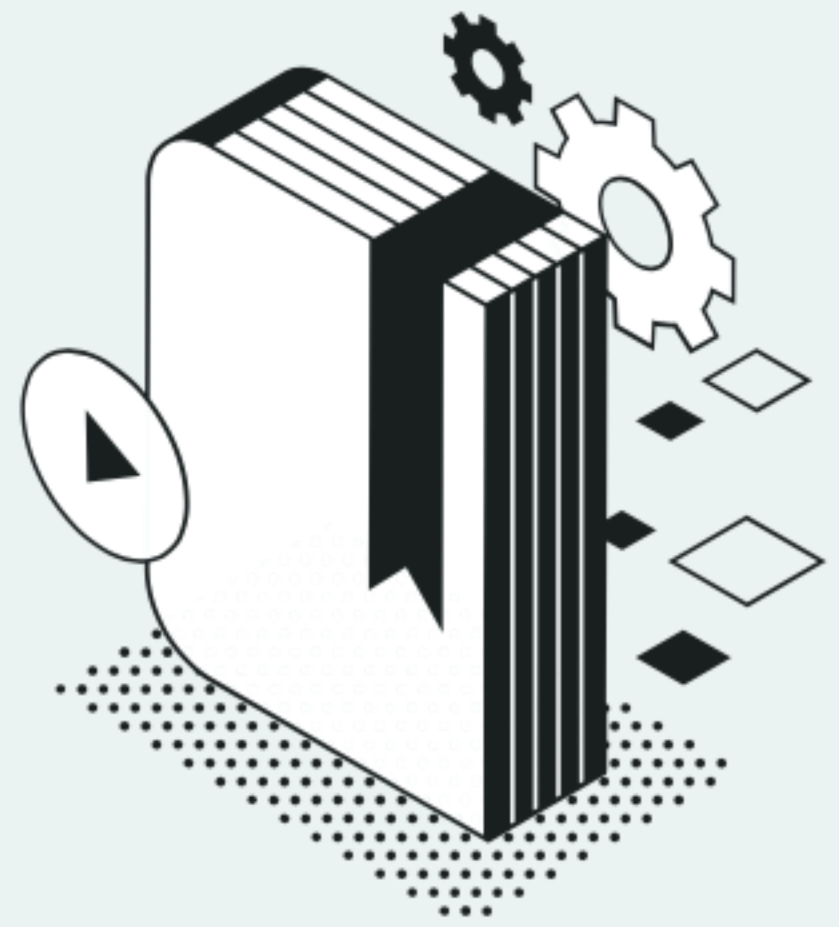

Guides

Whatever you're building, these guides are designed to get you productive as quickly as possible – using the latest Spring project releases and techniques as recommended by the Spring team.

**Getting Started Guides**
15-30 minutes

**Topical Guides**
60 minutes or less

**Tutorials**
2-3 hours

Getting Started Guides

Designed to be completed in 15-30 minutes, these guides provide quick, hands-on instructions for building the "Hello World" of any development task with Spring. In most cases, the only prerequisites are a JDK and a text editor.

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I'm Josh Long (twitter.com/Starbuxman), a humble Spring advocate at @Pivotal and this is a (twitter.com/BootifulPodcast) a Bootiful Podcast, a celebration of the real heroes that drive ecosystems.

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Rich ecosystem with a large, thriving community.

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Ask questions!

Good luck!

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- ✦ Spring Boot Actuator
  https://docs.spring.io/spring-boot/docs/current/reference/html/production-ready-features.html
- ✦ Application Monitoring With Spring Boot Actuator
  https://dzone.com/articles/application-monitoring-with-spring-boot
- ✦ Spring Tips: The Wavefront Observability Platform
  https://spring.io/blog/2020/04/29/spring-tips-the-wavefront-observability-platform
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- ✦ Mastering Spring Boot's Actuator
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- Spring REST Docs
  https://spring.io/projects/spring-restdocs
- If Hemingway Wrote JavaDocs
  https://springone.io/post-event/sessions/if-hemingway-wrote-javadocs
- Documenting RESTful APIs with Spring REST Docs
  https://www.youtube.com/watch?v=CaARz49u1Mc
- Spring Cloud Contract
  https://spring.io/projects/spring-cloud-contract
- Spring Tips: Spring Cloud Contract
  https://spring.io/blog/2017/10/25/spring-tips-spring-cloud-contract-http
- Consumer Driven Contract Testing with Spring Cloud Contract
  https://www.youtube.com/watch?v=QHlhYQQa7bg

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- ✦ Spring Cloud Gateway
  https://spring.io/projects/spring-cloud-gateway#overview
- ✦ Introducing Spring Cloud Gateway and API Hub for VMware Tanzu
  https://springone.io/post-event/sessions/introducing-spring-cloud-gateway-and-api-hub-for-vmware-tanzu
- ✦ Reactive Architectures with RSocket and Spring Cloud Gateway
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- ✦ Spring Cloud Gateway for Stateless Microservice Authorization
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- ✦ Top tips for running Spring Boot applications on Kubernetes with Ollie Hughes
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- ✦ Spring on Kubernetes Workshop
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- ✦ SpringOne Tour 2021: # Booternetes
  https://www.youtube.com/watch?v=LfbU5xuR7Ck
- ✦ Spring on Kubernetes
  https://spring.io/guides/topicals/spring-on-kubernetes/
- ✦ Getting Started with Spring Cloud Kubernetes
  https://www.youtube.com/watch?v=u64jexEX_RY
- ✦ Spring Native documentation
  https://docs.spring.io/spring-native/docs/current/reference/htmlsingle/
- ✦ Announcing Spring Native Beta!
  https://www.youtube.com/watch?v=96n_YpGx-JU
- ✦ The Path Towards Spring Boot Native Applications
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- How Fast is Spring?
  https://www.youtube.com/watch?v=T22i3WAa6dI
- SpringDeveloper on YouTube
  https://www.youtube.com/channel/UC7yfnfvEUlXUIfm8rGLwZdA
- SpringOne Tour
  https://tanzu.vmware.com/developer/tv/springone-tour/
- Tanzu.TV Shows
  https://tanzu.vmware.com/developer/tv/
- Spring.io
  https://spring.io
- Spring Documentation
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- ✦ Spring Tips: Spring Cloud Loadbalancer
  https://spring.io/blog/2020/03/25/spring-tips-spring-cloud-loadbalancer
- ✦ How to Live in a Post-Spring-Cloud-Netflix World
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# THANK YOU!

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## Between Chair and Keyboard

Most Mondays,
around noon Central
https://www.twitch.tv/vmwaretanzu

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