Release Engineering

Advanced Software Engineering FS17

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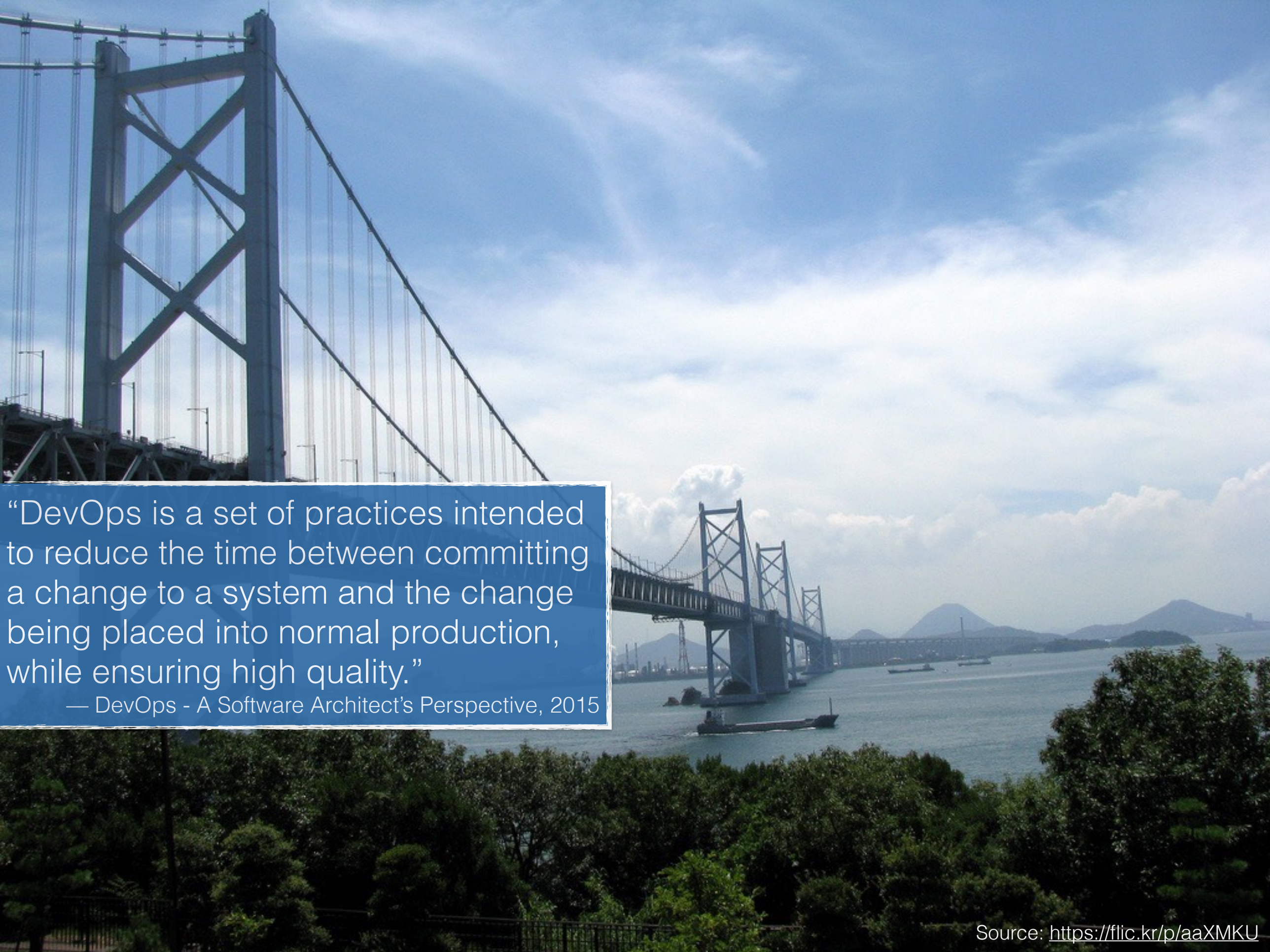
> “Release engineering is a software engineering discipline concerned with the development, implementation, and improvement of processes to deploy high-quality software reliably and predictably.”
>
> — Andrej Dyck, Towards Definitions for Release Engineering and DevOps, 2015

Release Engineering

Source: https://flic.kr/p/4fVq9G



"DevOps is a set of practices intended to reduce the time between committing a change to a system and the change being placed into normal production, while ensuring high quality."

— DevOps - A Software Architect's Perspective, 2015

Source: https://flic.kr/p/aaXMKU

DevOps - Benefits

Technical benefits:

> Continuous software delivery
> Less complex problems to fix
> Faster resolution of problems

Business benefits:

> Faster delivery of features (time to market)
> More stable operating environments
> More time available to add value (rather than fix/ maintain)

DevOps - Why

Common conflicts in software development or enterprise IT:

Adopt latest technology vs. long term planning

Increasing rate of technology change, the gap between leading edge and every-one-else is growing

Moving quickly vs. stability and security

Facebook’s move fast and break things

DevOps - Implications

Ensure quality of deployed change

by test automation, tests in production on a limited set of users (-> CD practices)

Ensure high velocity, thus highly automated, repeatable delivery mechanisms

avoid downtimes, keep system available

Two important time periods

- developer commits code: change enters deployment pipeline
- code is pushed to production: change is released to users

DevOps - Practices

Treat operations as first-class citizens from the point of view of requirements

i.e., ensure that they get the monitoring data and logs they need

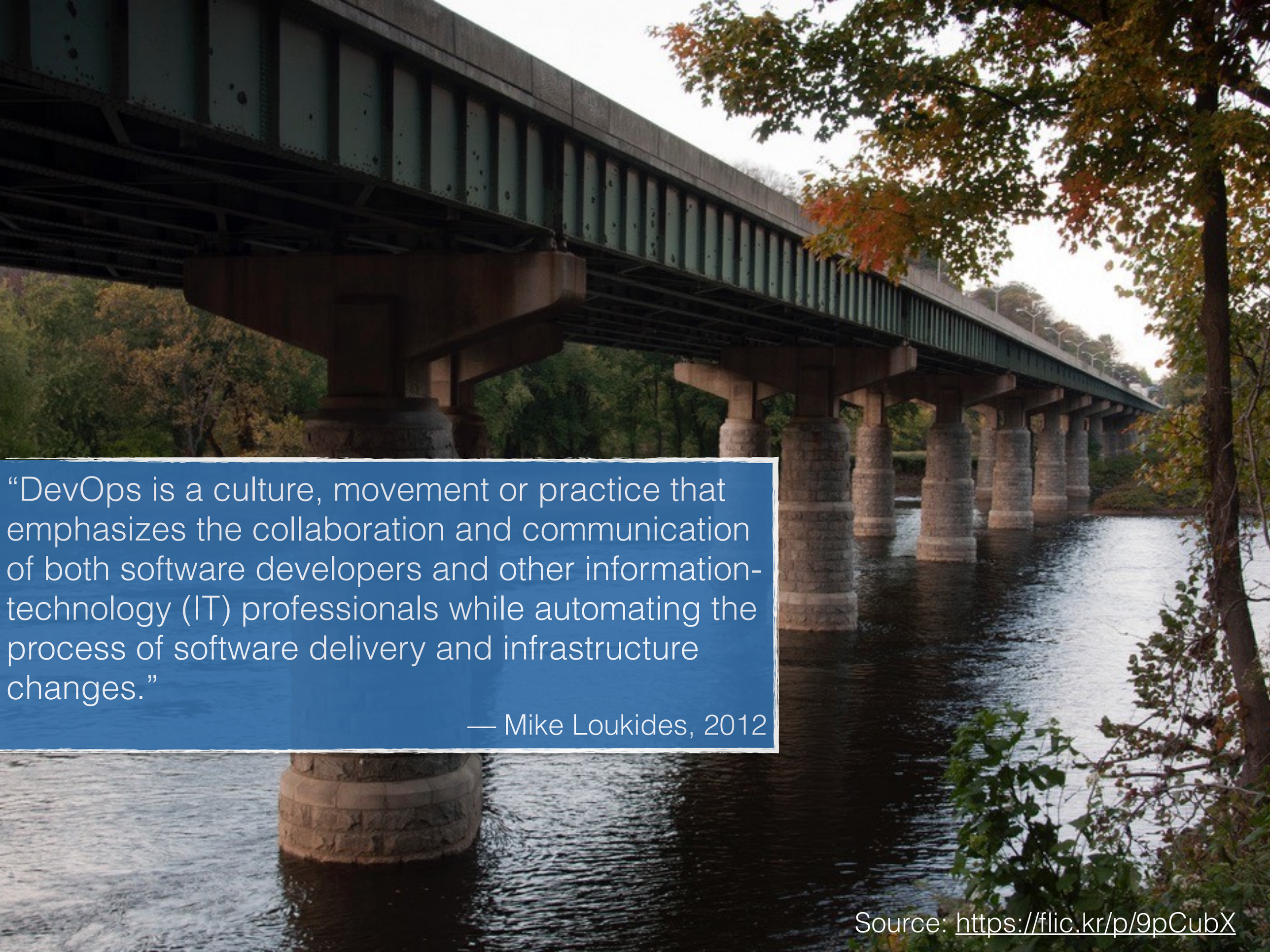
Make developers more responsible for relevant incident handling

i.e., Dev on Call, allows identifying and fixing issues fasters

Use continuous delivery/deployment

Develop infrastructure code, such as deployment scripts, with the same set of practices as application code

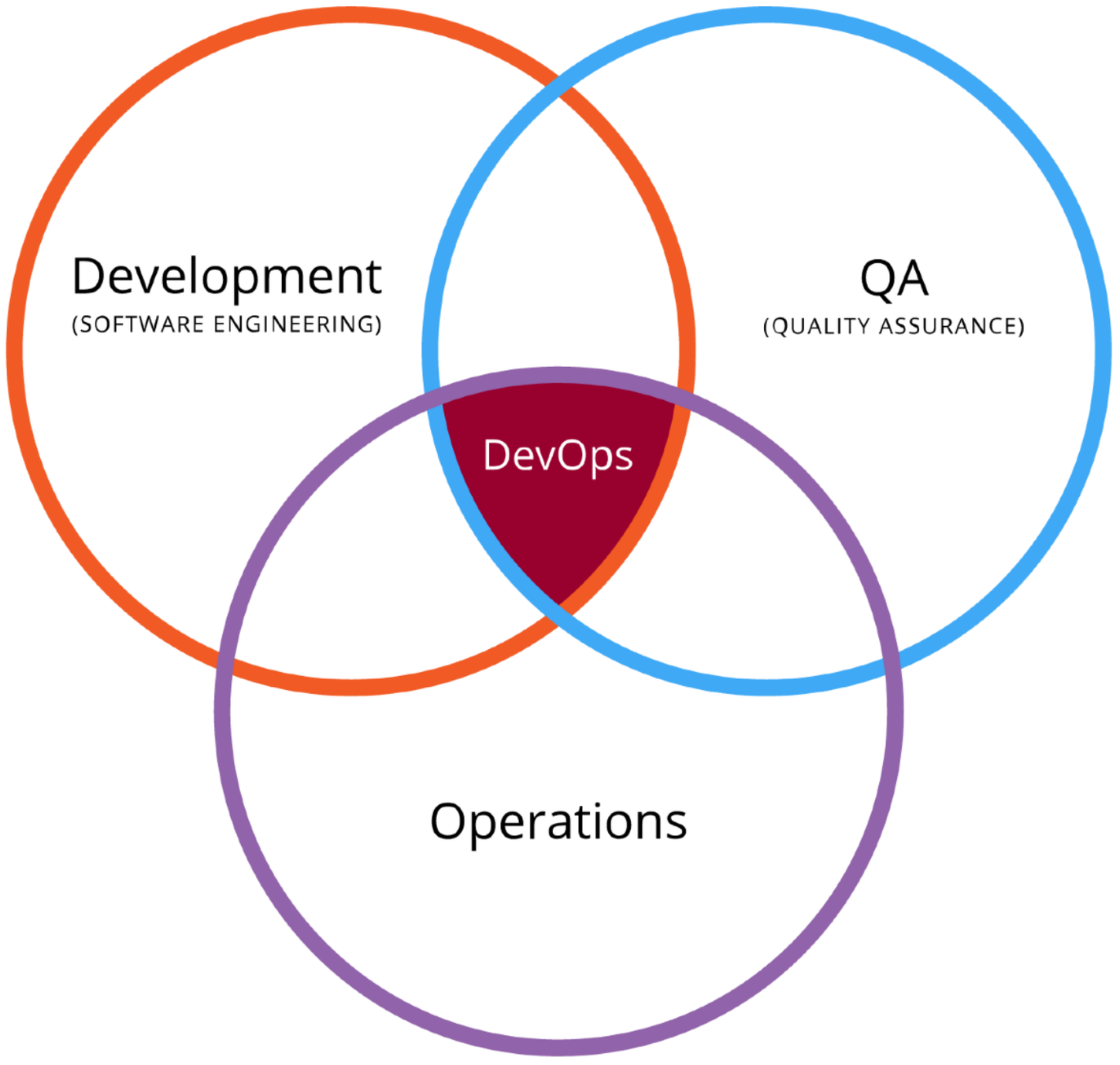
i.e., Infrastructure-as-Code, allows version-control and mitigates misconfiguration



"DevOps is a culture, movement or practice that emphasizes the collaboration and communication of both software developers and other information-technology (IT) professionals while automating the process of software delivery and infrastructure changes."

— Mike Loukides, 2012

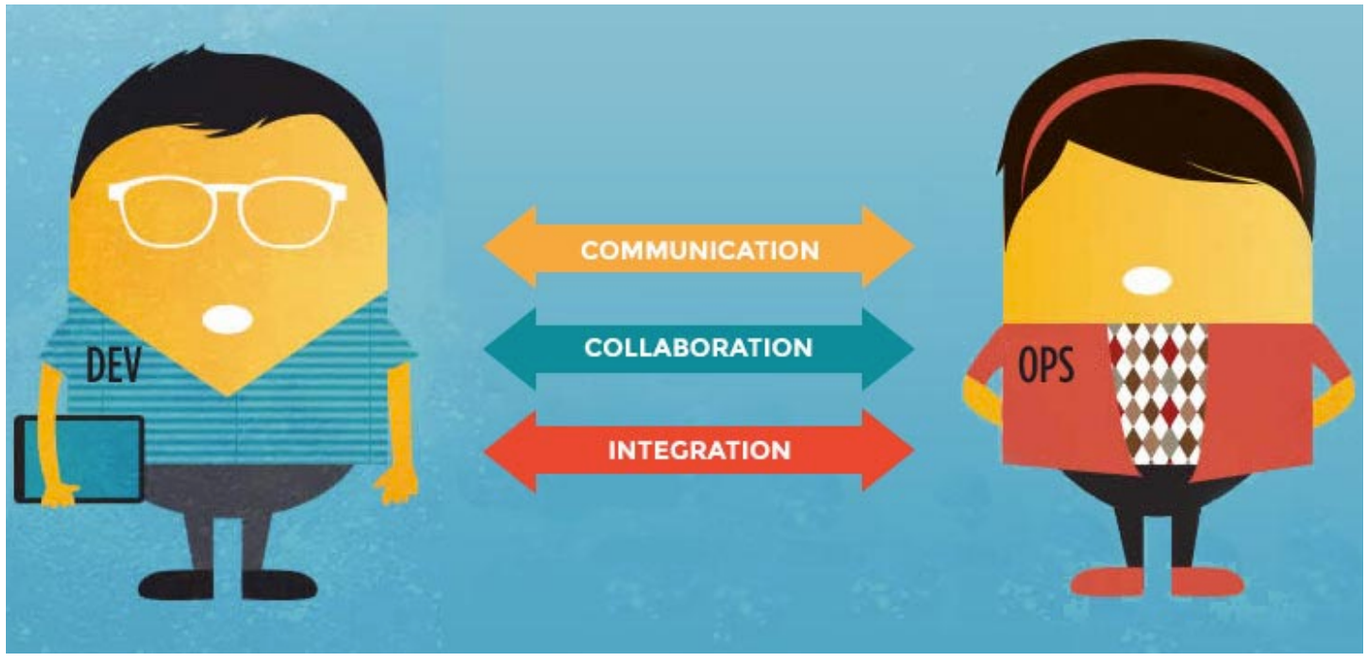
Source: https://flic.kr/p/9pCubX


Development
(SOFTWARE ENGINEERING)
QA
(QUALITY ASSURANCE)
DevOps
Operations

DevOps

DevOps is not purely technical, includes several aspects summarized under **CALMS**:

- Culture
- Automation
- Lean
- Measurement
- Sharing



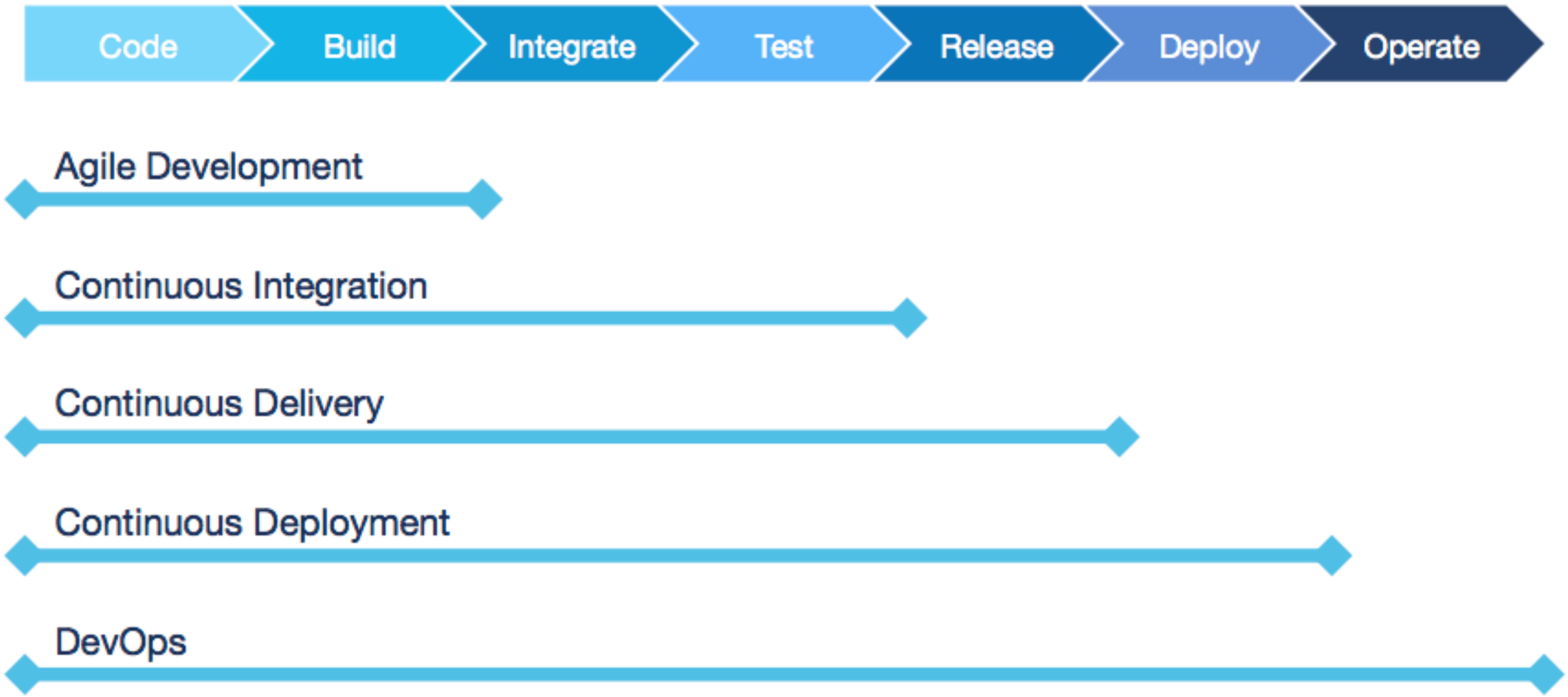
DevOps - CALMS

Culture

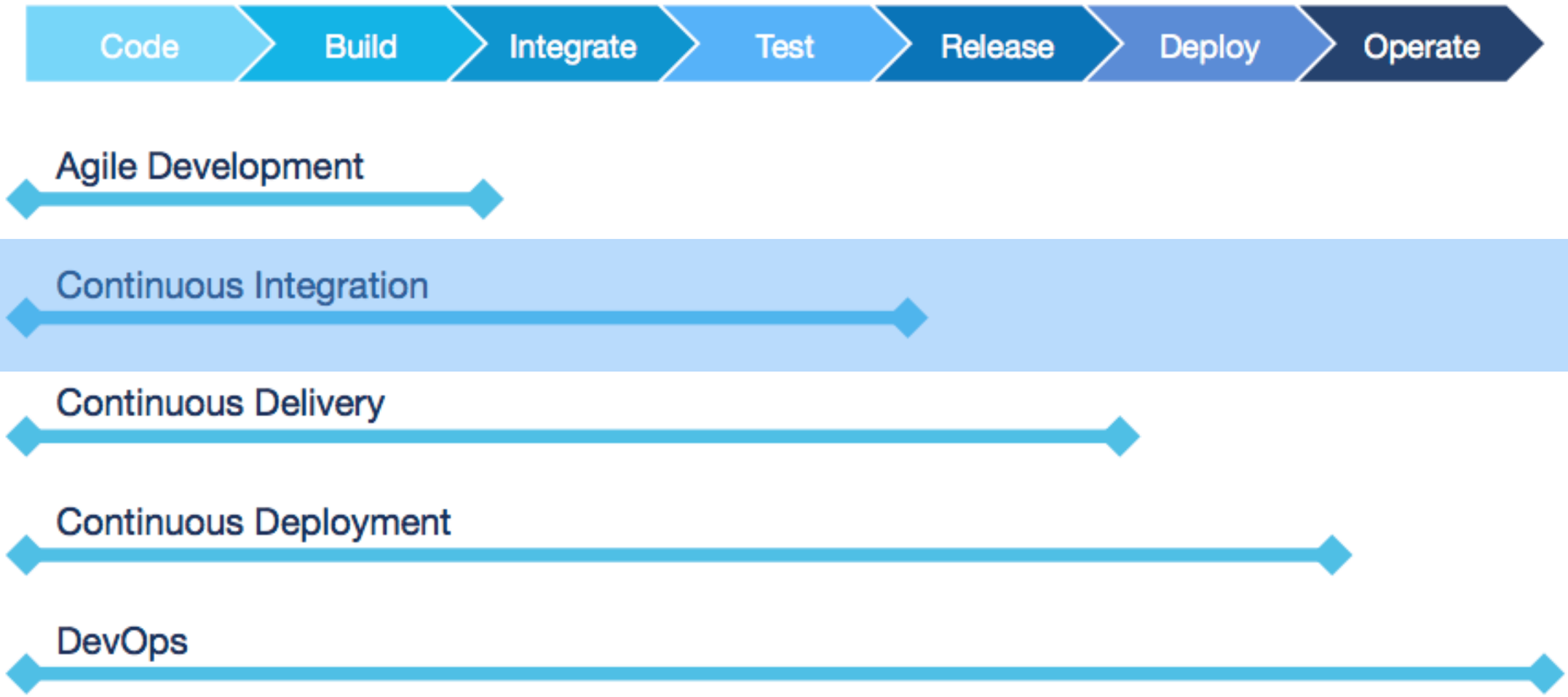
teams over individuals
cross-functional teams instead of “silos”
embrace change & experimentation

DevOps - CALMS

Culture	teams over individuals cross-functional teams instead of “silos” embrace change & experimentation
Automation	Continuous Delivery / Deployment Infrastructure as Code
Lean	be minimalistic (meeting numbers and times, team sizes, …) focus on producing value for the end user
Measurement	collect data on everything ensure to provide visibility into all systems and events (e.g., dashboards)
Sharing	collaboration & communication instead of “throwing things over the fence” not just reporting facts, regular exchange of ideas



Source: http://www.rightscale.com/blog/cloud-management-best-practices/continuous-integration-and-delivery-cloud-how-rightscale-does-it



Source: http://www.rightscale.com/blog/cloud-management-best-practices/continuous-integration-and-delivery-cloud-how-rightscale-does-it

"Continuous Integration is a software development practice where members of a team integrate their work frequently, usually each person integrates at least daily - leading to multiple integrations per day."

— Martin Fowler

Source: https://flic.kr/p/aoqZry

CI - Why

In many software projects, for long periods of time the application is **not in a working state**. Usually no one is interested in running the whole application until it is finished.

Drawbacks:

- Integration is a long and unpredictable process
  e.g., may take weeks or even months
- Testing happens late in the process, thus bugs being often detected late
- Delayed and infrequent releases
- Poor project visibility, not clear what is actually working
- High maintenance costs

Continuous Integration

CI requires that **every time** somebody **commits any change**, the entire **application is built** and a comprehensive set of **automated tests is run** against it. If the **build or test process fails**, the dev team **fixes** the problem **immediately**.

CI is a paradigm shift:

> Without CI, software is broken until somebody proves it works
> With CI, software is proven to work with every new change. The moment it breaks, you fix it.

Teams with CI are able to

> deliver software faster
> with fewer bugs and
> bugs are caught earlier in the process when they are cheaper to fix
> providing cost and time savings

CI - Prerequisites

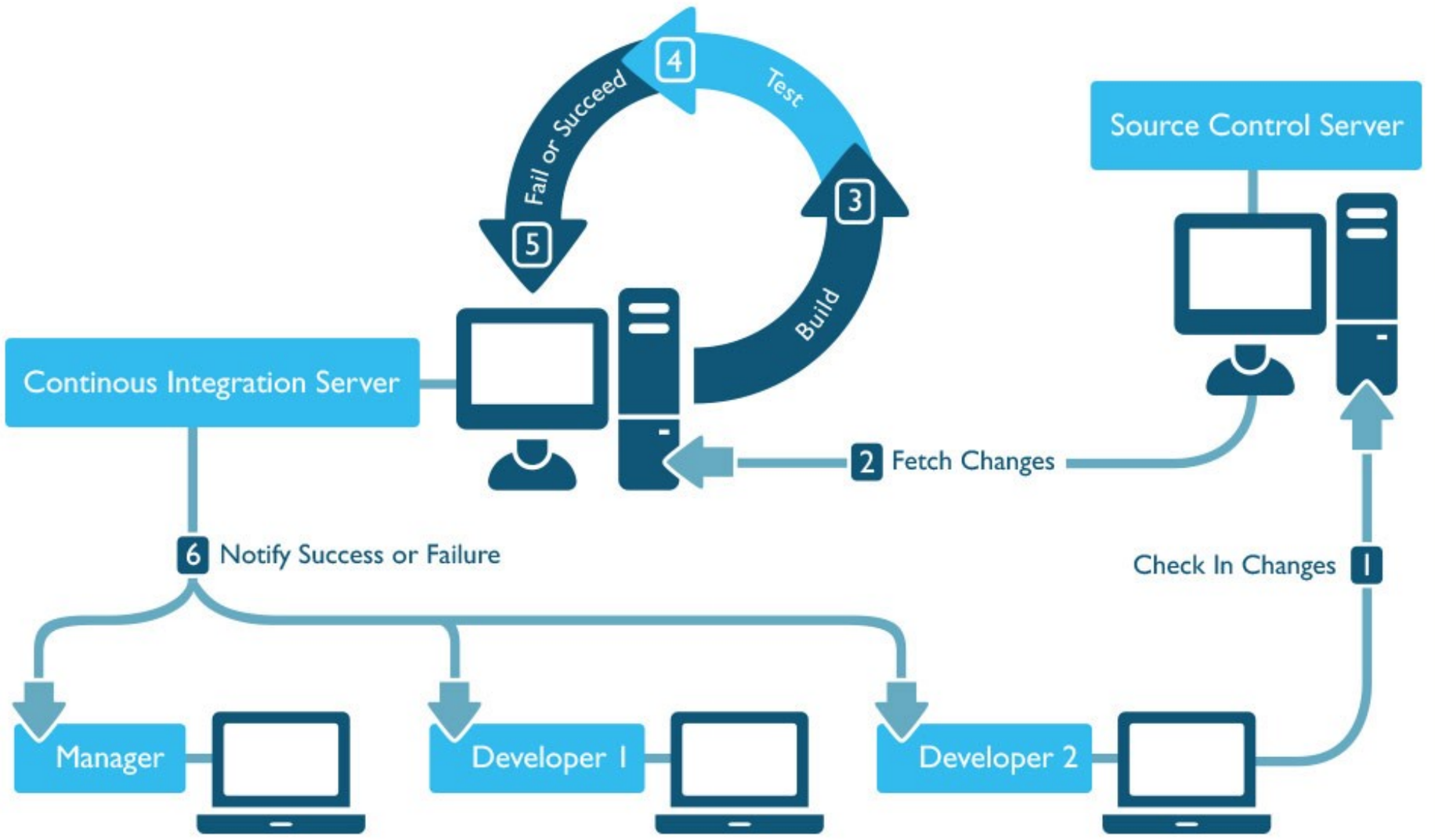
- Version control

- Automated build -
  able to build the application
  from the command line

- Automated test suite
  unit tests, integration tests, …

- Agreement and discipline across the teams, frequently
  check in small changes, fix failed builds before
  committing further changes

CI - Overview



Source: https://insights.sei.cmu.edu/devops/2015/01/continuous-integration-in-devops-1.html

CI - Tools

Jenkins

GitLab

circleci

Bamboo

CODESHIP

Travis CI

Zurück zum Projekt
Status
Änderungen
Console Output
View as plain text
Build-Informationen editieren
Build löschen
Git Build Data
No Tags
Vorheriger Build

Executed Gradle Tasks

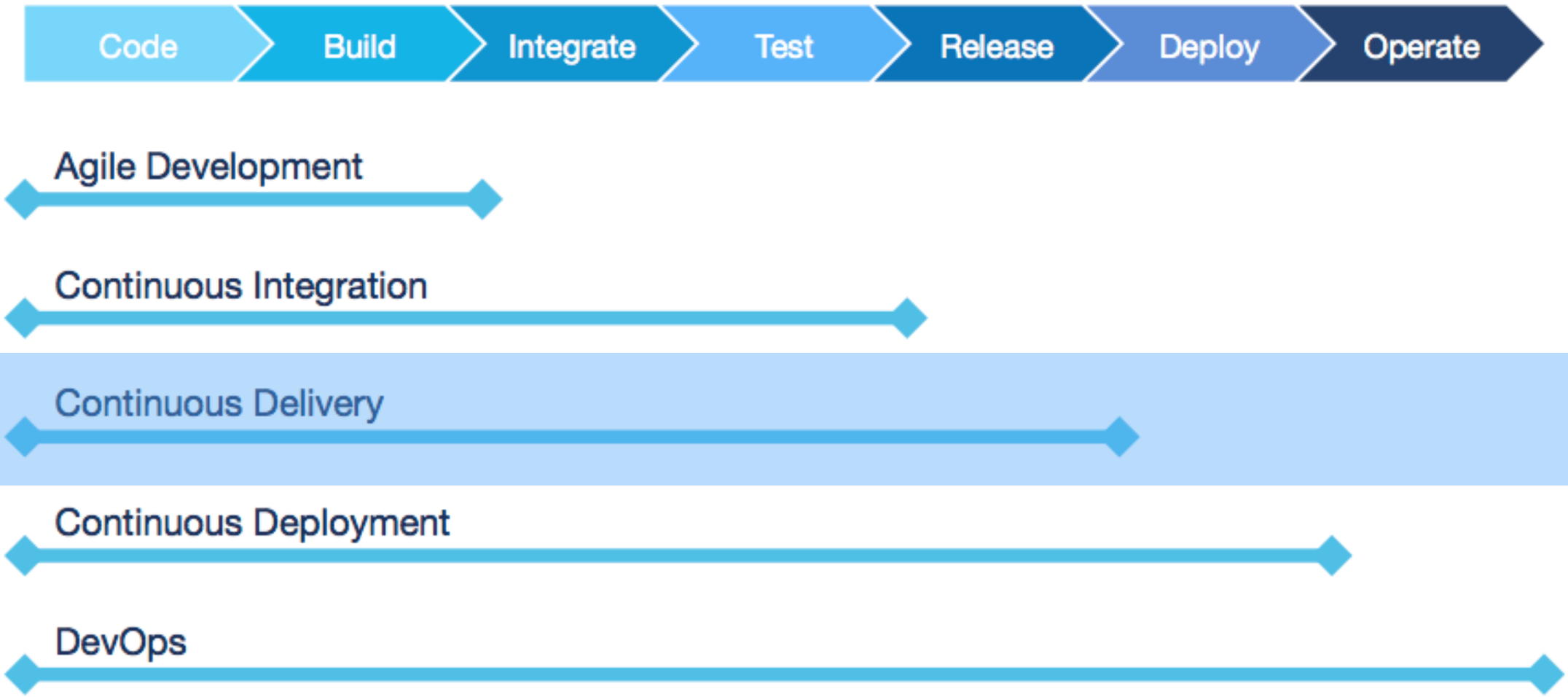
- compileJava
- processResources
- classes
- compileTestJava
- processTestResources
- testClasses
- test
- compileJava
- processResources
- classes
- compileTestJava
- processTestResources
- testClasses
- test
- sonarqube

Konsolenausgabe

```
Started by user group07
Building in workspace /var/lib/jenkins/jobs/sopra-fs16-group7/workspace
 > git rev-parse --is-inside-work-tree # timeout=10
Fetching changes from 2 remote Git repositories
 > git config remote.heroku.url git@heroku.com:sopra-fs16-group7.git # timeout=10
Fetching upstream changes from git@heroku.com:sopra-fs16-group7.git
 > git --version # timeout=10
using GIT_SSH to set credentials sopra-fs16-group7
 > git -c core.askpass=true fetch --tags --progress git@heroku.com:sopra-fs16-group7.git +refs/heads/*:refs/remotes/heroku/*
 > git config remote.origin.url git@github.com:sealuzh/sopra-fs16-group7-server.git # timeout=10
Fetching upstream changes from git@github.com:sealuzh/sopra-fs16-group7-server.git
using GIT_SSH to set credentials sopra-fs16-group7
 > git -c core.askpass=true fetch --tags --progress git@github.com:sealuzh/sopra-fs16-group7-server.git +refs/heads/*:refs/remotes/origin/*
Seen branch in repository heroku/master
Seen branch in repository origin/GameStateViews
Seen branch in repository origin/InitializeGameService
Seen branch in repository origin/OptimizedCarriageInitialization
Seen branch in repository origin/banditChooser
Seen branch in repository origin/cardOrder
Seen branch in repository origin/cardRelation
Seen branch in repository origin/datamodel
Seen branch in repository origin/dev
Seen branch in repository origin/facade
Seen branch in repository origin/feature/sonar-integration
Seen branch in repository origin/gameRelation
Seen branch in repository origin/initGameChanges
Seen branch in repository origin/jsonViewTest
Seen branch in repository origin/lobby
Seen branch in repository origin/lootService
Seen branch in repository origin/marshal
Seen branch in repository origin/master
Seen branch in repository origin/playerAPI
Seen branch in repository origin/playerService
Seen branch in repository origin/playerViews
Seen branch in repository origin/testUtil
Seen branch in repository origin/toString
Seen 23 remote branches
Checking out Revision cbe5a542053c17e2086cdae5bdf83a50e11c14aa (origin/master, heroku/master)
 > git config core.sparsecheckout # timeout=10
 > git checkout -f cbe5a542053c17e2086cdae5bdf83a50e11c14aa
 > git rev-list cbe5a542053c17e2086cdae5bdf83a50e11c14aa # timeout=10
 > git rev-list cbe5a542053c17e2086cdae5bdf83a50e11c14aa # timeout=10
[Gradle] - Launching build.
[workspace] $ /var/lib/jenkins/jobs/sopra-fs16-group7/workspace/gradlew test
:compileJava UP-TO-DATE
:processResources UP-TO-DATE
:classes UP-TO-DATE
:compileTestJava UP-TO-DATE
:processTestResources UP-TO-DATE
:testClasses UP-TO-DATE
:test UP-TO-DATE

BUILD SUCCESSFUL

Total time: 7.516 secs
```



Source: http://www.rightscale.com/blog/cloud-management-best-practices/continuous-integration-and-delivery-cloud-how-rightscale-does-it

> “Continuous Delivery is a software development discipline where you build software in such a way that the software can be released to production at any time.”
>
> — Martin Fowler

Source: https://flic.kr/p/gtmH7G

Continuous Delivery

- based on CI
- CI focuses on development teams, the output of CI is the input to manual testing process and to the rest of the release process
- much of time is wasted on this way through testing and operations (e.g., testers wait for “good” builds of the software, operations teams wait for documentation or fixes)
- software sometimes undeployable because it takes too long to get it into production-like environments and because of a slow feedback loop between dev, QA, and operations

CD prevents this by:

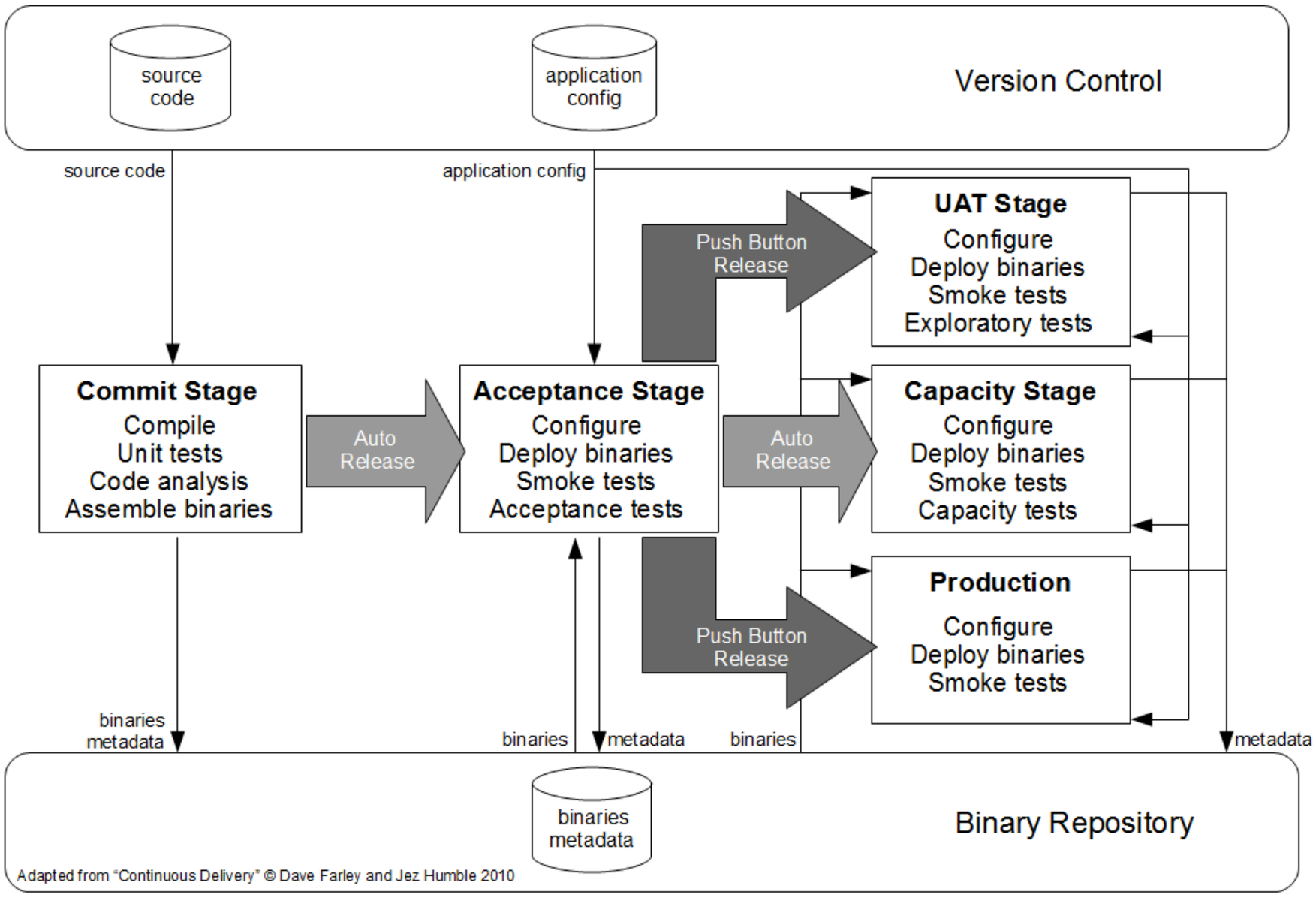
close, collaborative working relationship between the stakeholders involved in delivery

==> DevOps culture

extensive automation of all parts of the delivery process

==> CD pipeline

Continuous Delivery Pipeline



Continuous Delivery Pipeline

CI Phase:

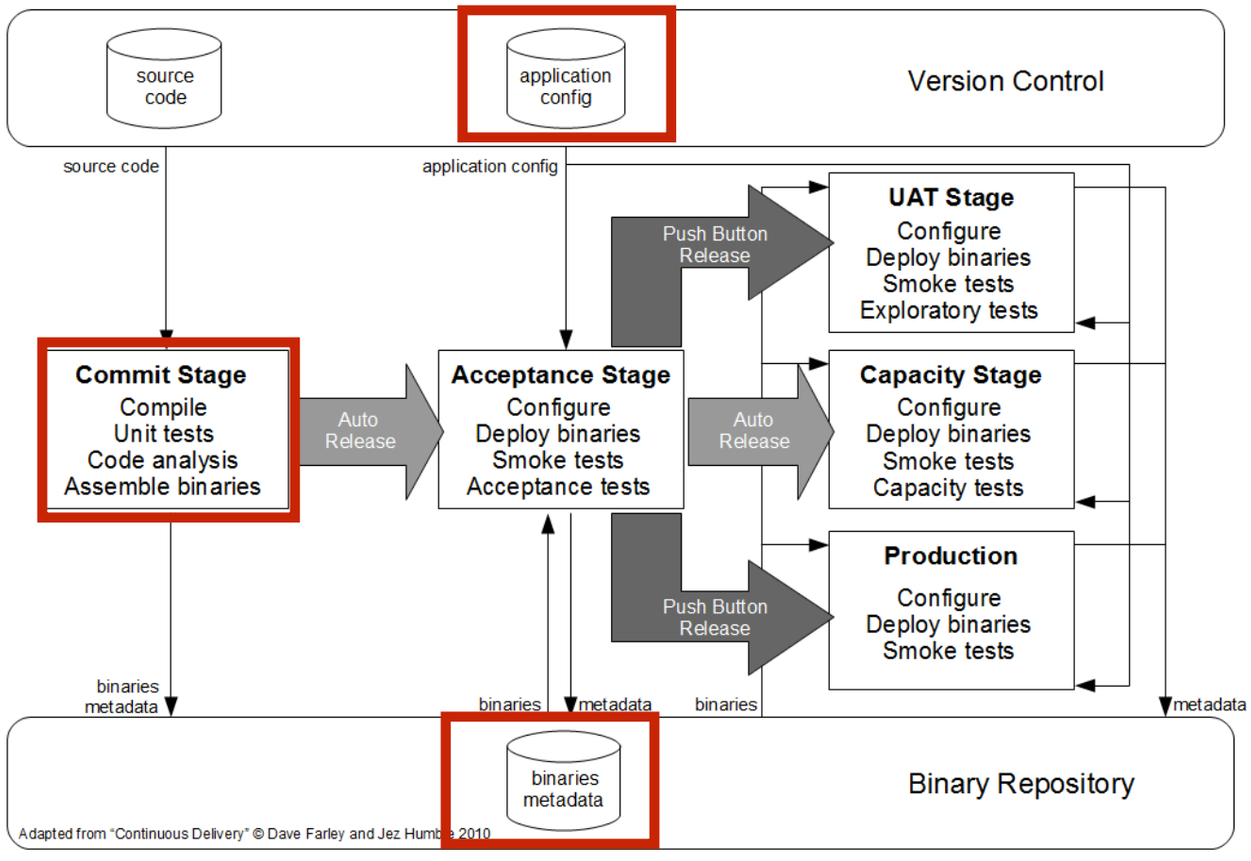
> build application only once throughout release process

> store resulting binary in repository

> reuse binary for all following environments (internal test stages as well as production)

> platform/environment specific configurations for binaries are version controlled

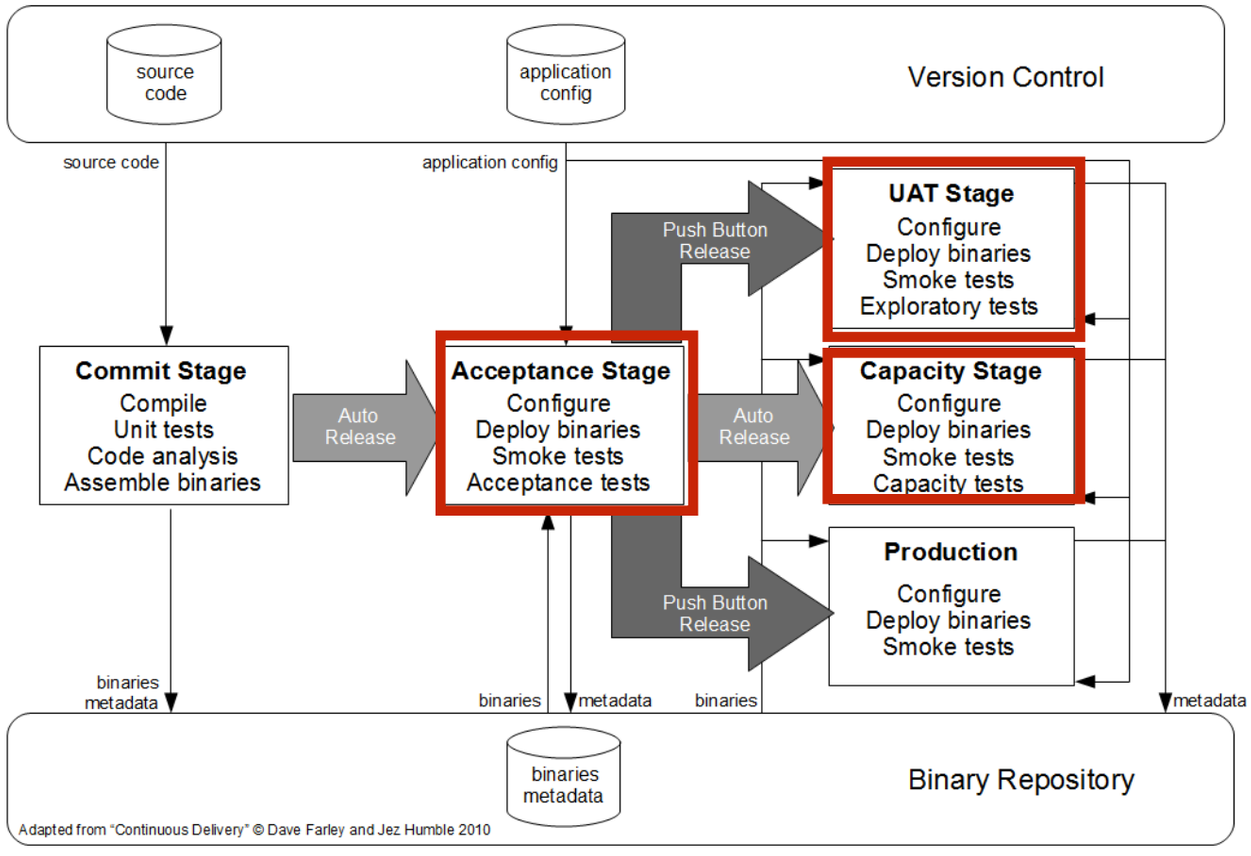
> binary repos including config files allow rolling back to specific previous versions in case of issues without the need of recompilation



Continuous Delivery Pipeline

Post CI Phases:

- consist of multiple environments/ stages for testing purposes
- include manual and automated testing
- some stages might run in parallel (e.g., user acceptance testing (UAT) on UI and performance tests on backend systems)
- stages are either automatically executed when previous stage is finished, or after manual approval (e.g., push of a button)

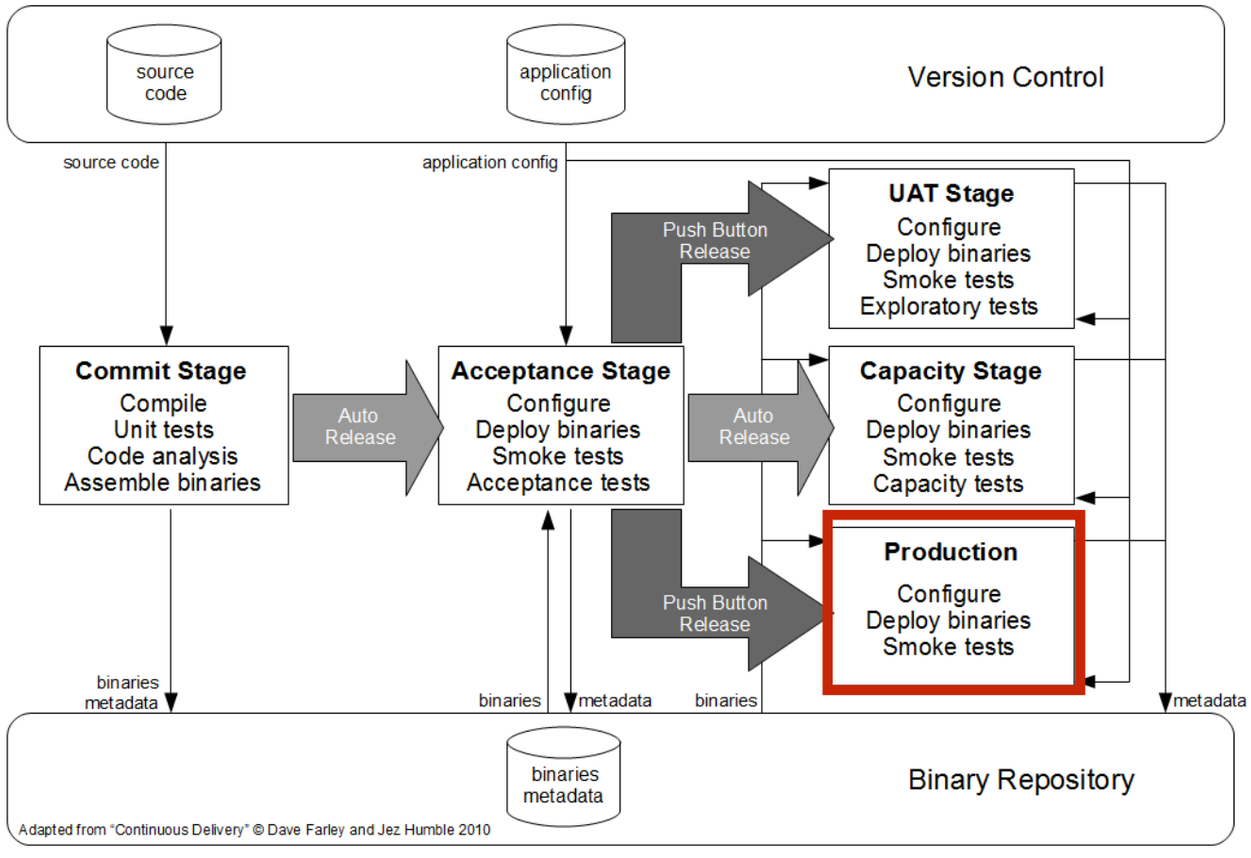


Continuous Delivery Pipeline

Deployment Phase:

> new version is available to be released to customers

> various strategies and practices exist for rolling out:
  - canary release
  - A/B testing
  - dark launches
  - gradual rollouts
  - blue/green deployments



Why CD?

"I think the faster you move, the more tolerant you have to be about small things going wrong. But, the slower you move the more tolerant you have to be with large change sets that can be unpredictable."

— Study participant

Source: https://flic.kr/p/6mBAgp

CD Benefits

> instead of releasing 3-4 times a year, releasing on a weekly or daily basis allows companies **staying ahead of competition**

> more frequent releases means obtaining user feedback more quickly, thus **building the right product**

> setting up a CD pipeline and automation leads to **increased productivity and efficiency**

> releases become routine, thus **more reliable** instead of having stressful releases 3-4 times a year

> highly automated quality checks **preserve human-caused errors** and increase product quality

> having reliable, frequent releases incorporating customer feedback leads to **customer satisfaction**

Source: Lianping Chen, IEEE Software, 2015

CD - How to

There is no “holy grail” for CD, usually this is a slow process and involves multiple challenges companies are faced with:

Organizational

- domain constraints and traditional processes (e.g., manual approvals)
- top-management must be convinced (added value of CD), rather high costs for automation
- suppliers that rely on the company’s software

Technical

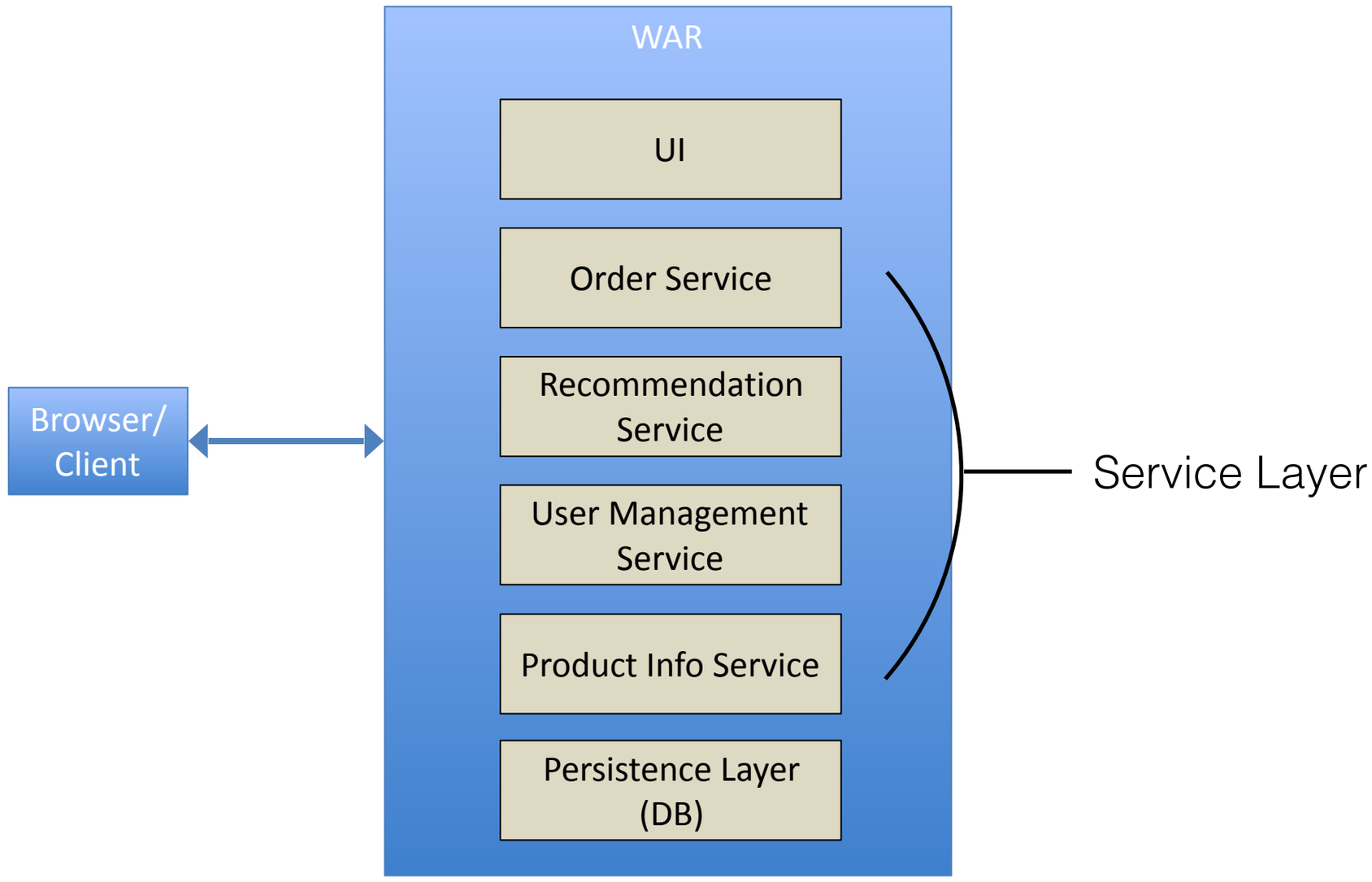
- legacy applications
- application architecture
- ensure product quality, automation (test and deployment)
- dealing with higher risks

Social

- resistance to change
- requires strong collaboration between teams, break down barriers and promote collaborative culture
- changing responsibilities (e.g., dev on call, code ownership)

Source: https://flic.kr/p/n3cTbR

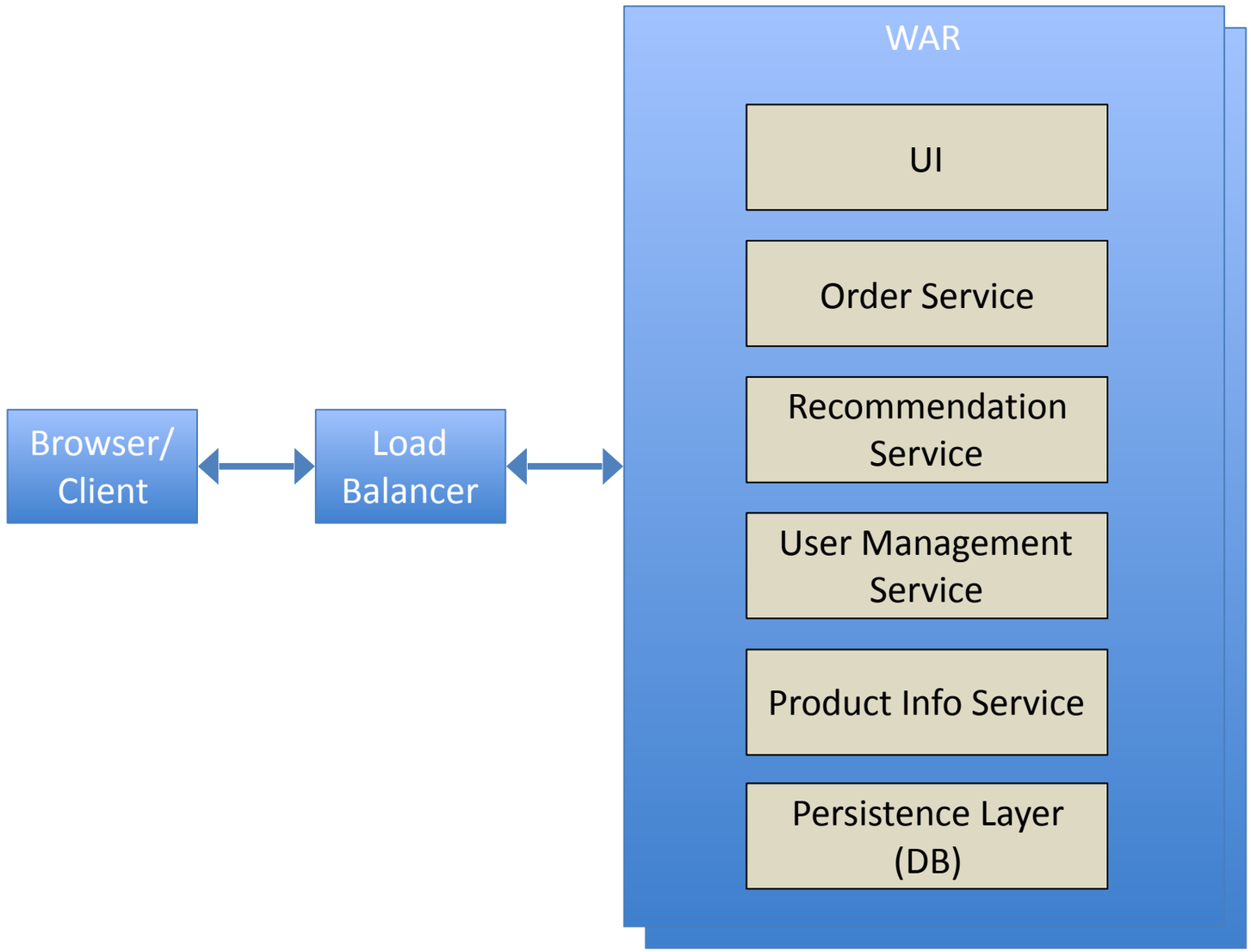
Traditional 3-tier Web Application Architecture - Example



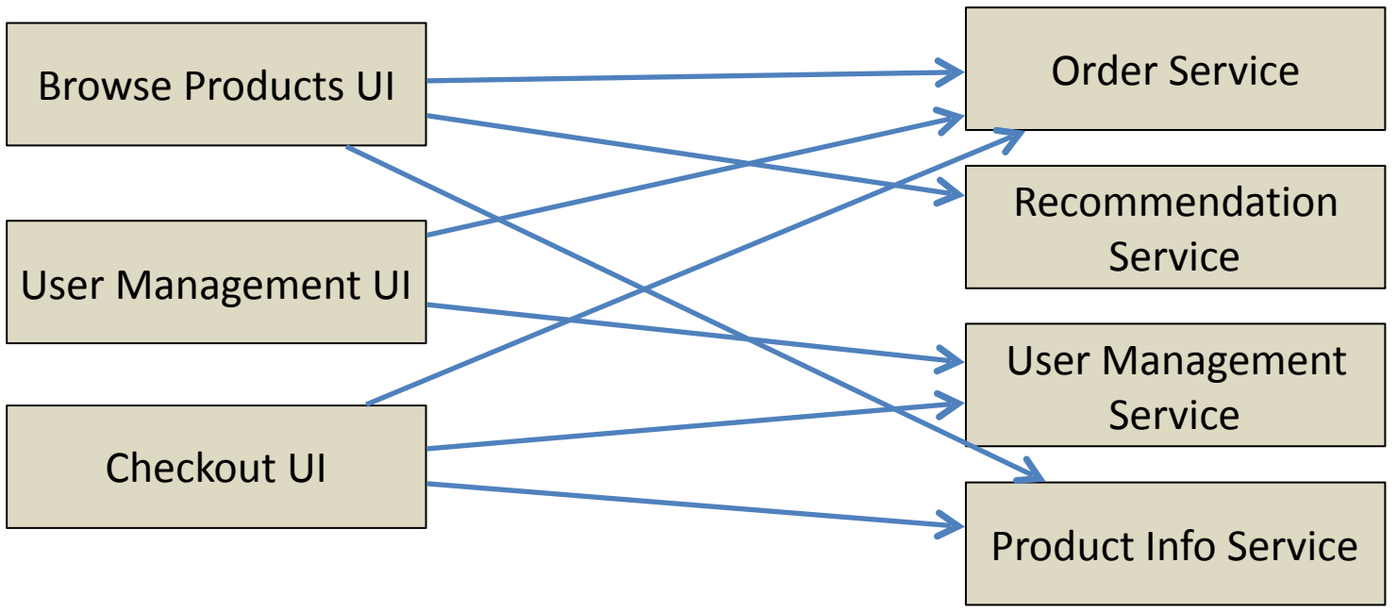
Traditional 3-tier Web Application Architecture - Example

Downsides:

- Scaling
- Every change requires redeployment of whole application



(Micro-)services Architecture

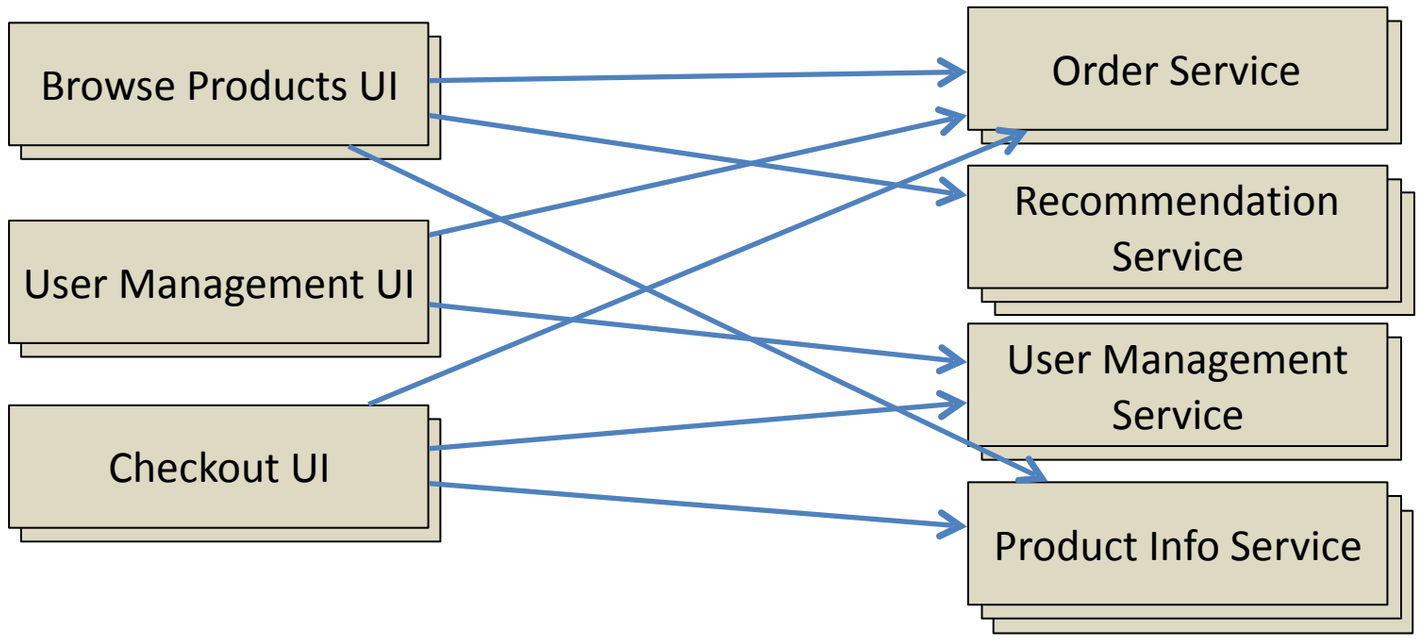


(Micro-)services Architecture

Advantages:

- scale on service level
- deploy new versions of single services
- run multiple versions at the same time (-> CD rollout practices)
- services communicate using standardized communication protocols (e.g., HTTP), thus single services can be based on the technology which fits best

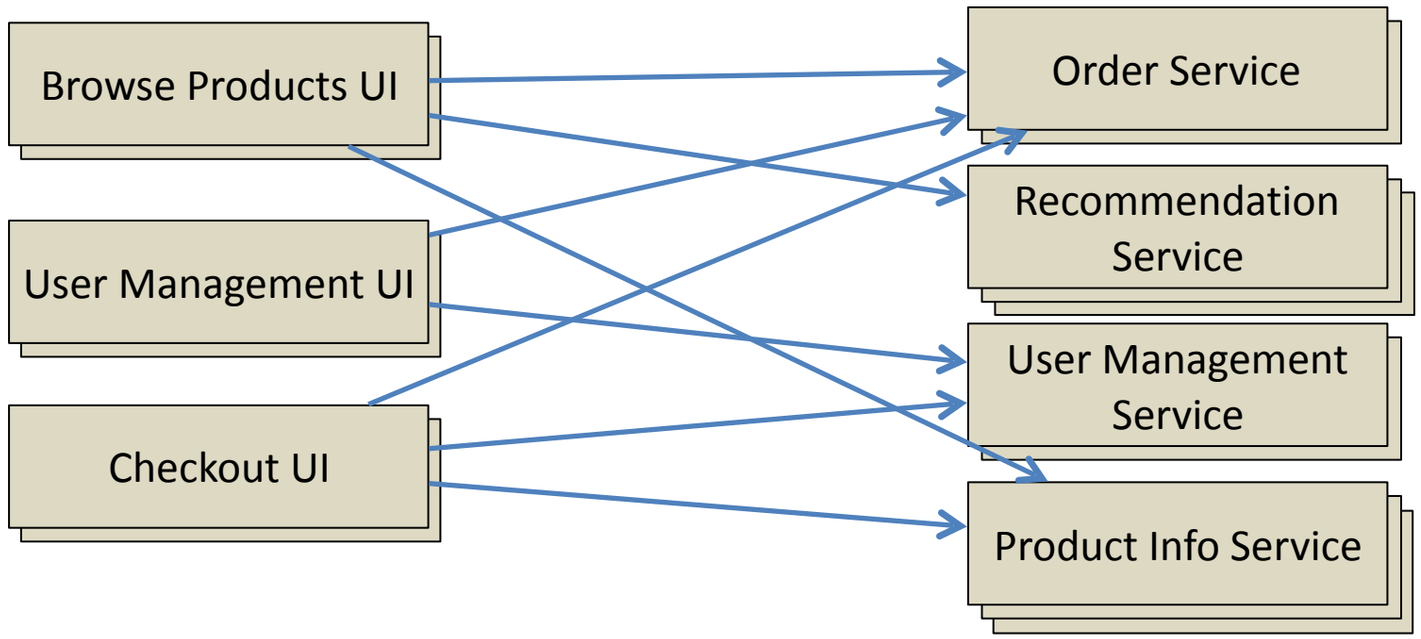
In DevOps, teams are often responsible for single services (both development and operating them)

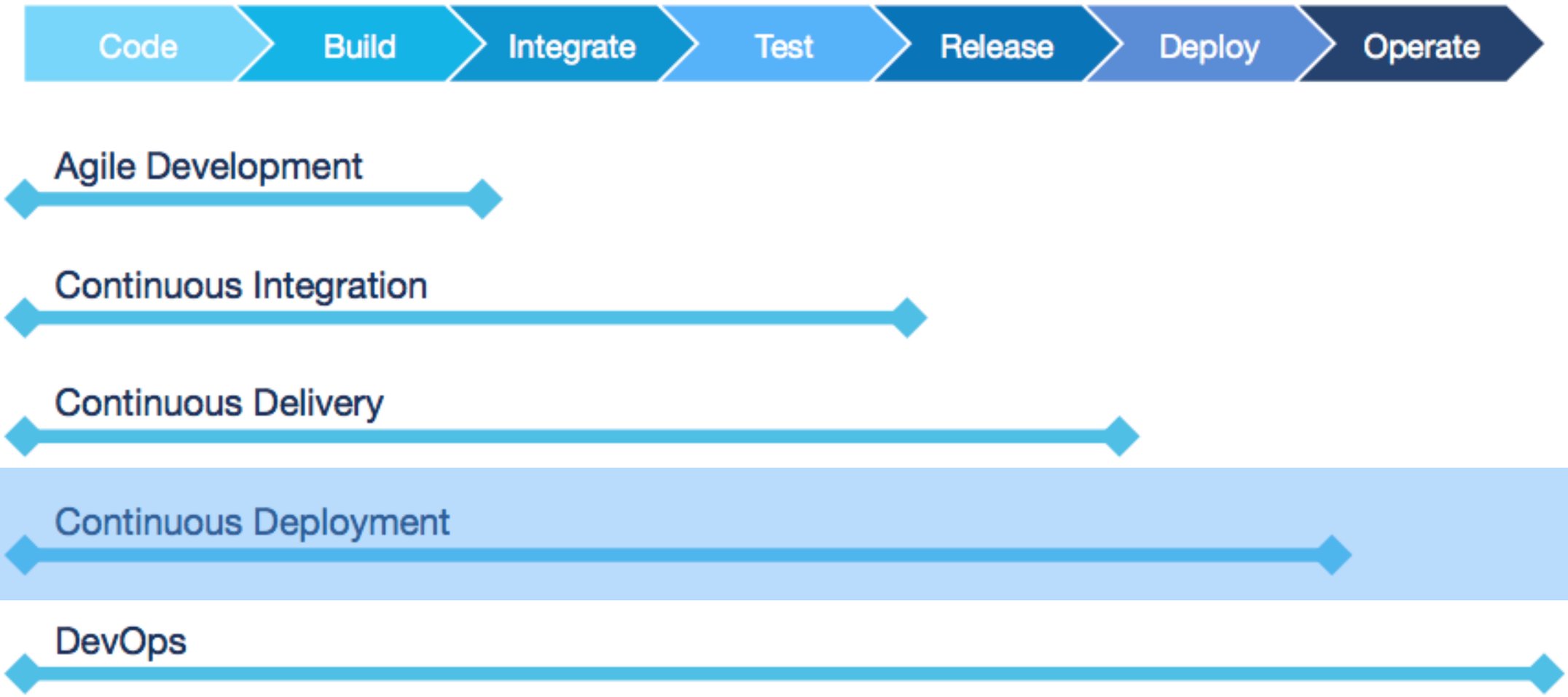


(Micro-)services Architecture

Downsides:

- higher communication costs
- hard to start from scratch with microservices, usually functionality is broken down once it gets too complex





Source: http://www.rightscale.com/blog/cloud-management-best-practices/continuous-integration-and-delivery-cloud-how-rightscale-does-it

Continuous Delivery or Continuous Deployment?

Continuous deployment is the “next step” of continuous delivery: every change that passes the automated tests is deployed to production **automatically**.

Continuous delivery doesn't mean every change is deployed to production. It means every change is proven to be **deployable at any time**. However, the decision to release a new version is made by a **human**.

Live Experimentation

Source: https://flic.kr/p/6ZBvPR

Live Experimentation

Releasing on a weekly or even daily basis implies a higher **risk that something might go wrong**. However, the change is “smaller”, thus problems can be identified and fixed faster.

Live experimentation and rollout practices can be seen as additional **risk mitigation strategies**, e.g., test a new feature on a small user group first, then decide about further rollouts.

Live Experimentation Practices

- Eat your own dog food
- Canary releases
- Gradual rollouts
- A/B testing
- Dark launches
- Blue/green deployments

Eat your own dog food

> “Eating your own dog food, also called dogfooding, is a slang term used to reference a scenario in which a company uses its own product to test and promote the product.”
>
> — wikipedia

facebook

Facebook employees use the newest version internally, if everything is as expected they roll it out to further users

Canary Releases

Idea: release a new version to a subset of users first, while all other users still see the old, stable version

In case of issues with new version, only a small amount of users is affected, thus the impact of the issue is kept small

Canary is compared to the existing version in terms of a set of criteria such as stability, performance, or correctness

User selection based on:
- (geographic) location
- role (admin, early, stable, etc.)
- random basis (e.g., 1% of traffic)

Gradual Rollouts

Idea: gradually/stepwisely increase the amount of users assigned to the newest version until it completely replaces the former version

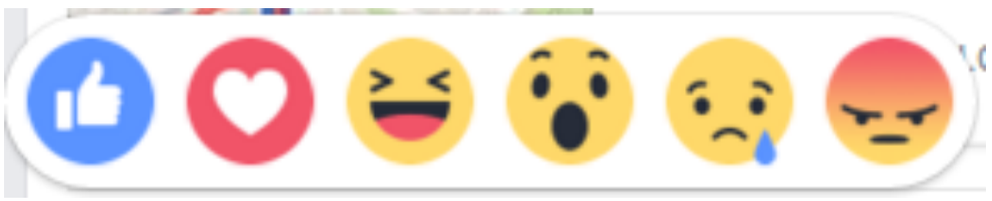
shows whether the new version can cope with increasing load and scales correctly

often used in combination with canary releases

Canary / Gradual Example

How they started in Spain and Ireland:

How they rolled it out globally (after months):



Dark Launches

Idea: Mitigate performance and reliability issues of new features when facing production-like load levels by deploying those features on production without being visible for users

Through monitoring, dev teams are able to identify and fix remaining bugs and scalability concerns before enabling the feature for users

Example: Facebook Chat
https://www.facebook.com/notes/facebook-engineering/facebook-chat/14218138919/

A/B Testing

Idea: Compare two versions of software with each other, often only differentiated in one tested aspect, to determine the effect of a certain change

form of statistical hypothesis testing, thus requires big enough sample size to have “statistical power”

mainly used on UI for testing various layouts or design aspects

A/B Testing

50% of users

50% of users

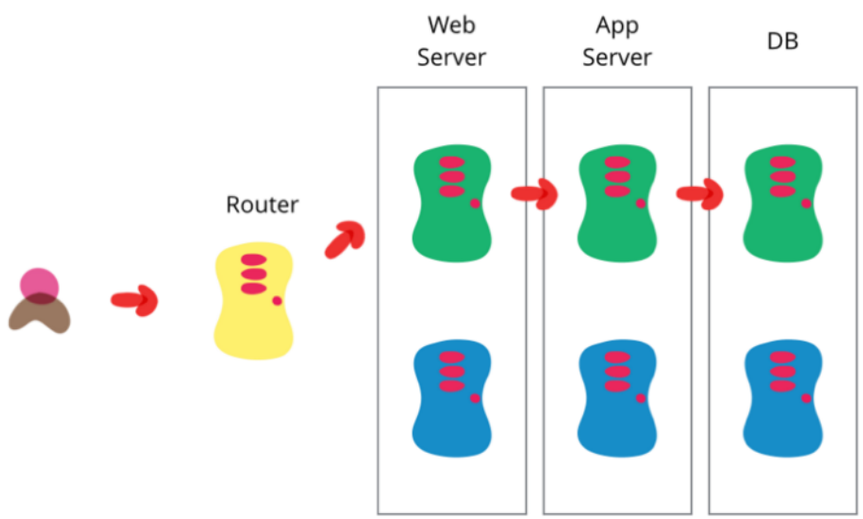
Blue/Green Deployments

Idea: Have two identical production environments, one hosting (green) the current, stable version, the other (blue) represents the final stage of testing for the new version.

Release: Simply switch the router so that all incoming traffic goes to the blue (or green) environment and use the green (or blue) environment for testing the next version.

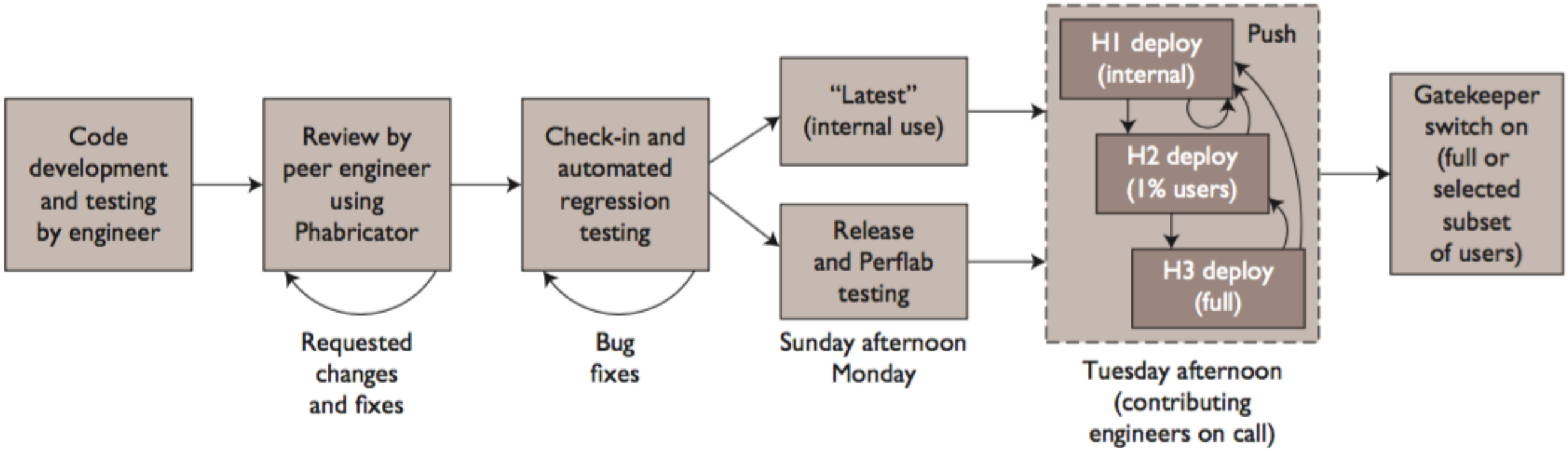
Advantage: In case of problems directly after the release, a quick rollback (switch) to the previous version is possible

Obstacle: DBs are part of both environments, thus a switch requires DB migration/ synchronization



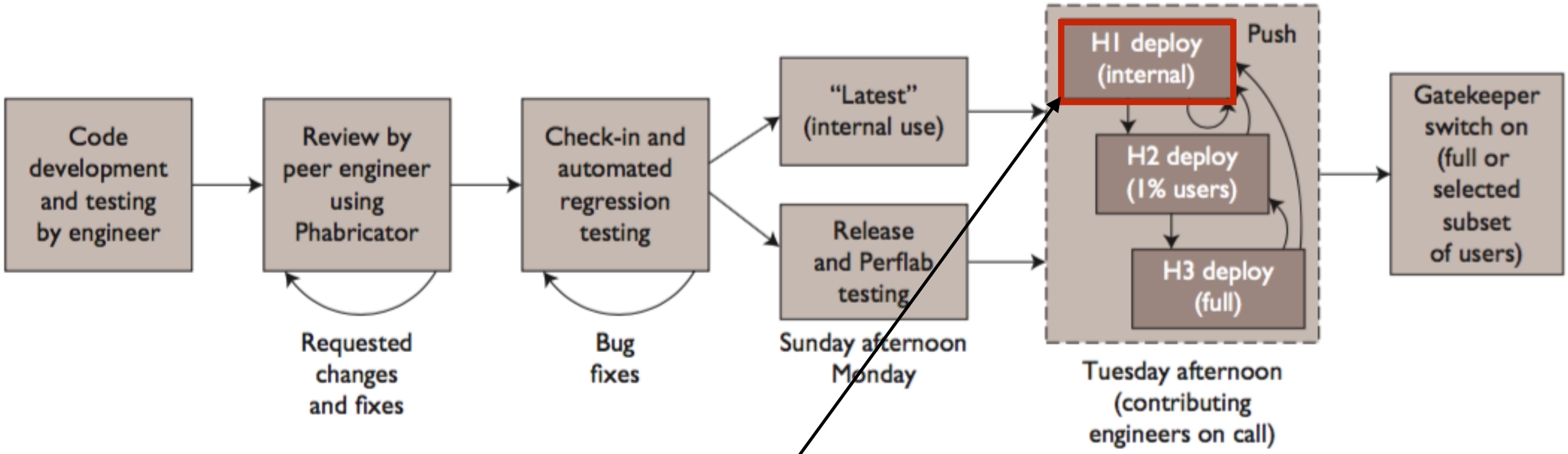
Source: http://martinfowler.com/bliki/BlueGreenDeployment.html

Facebook Deployment Pipeline



Source: Development and Deployment at Facebook, IEEE Internet Computing, 2013

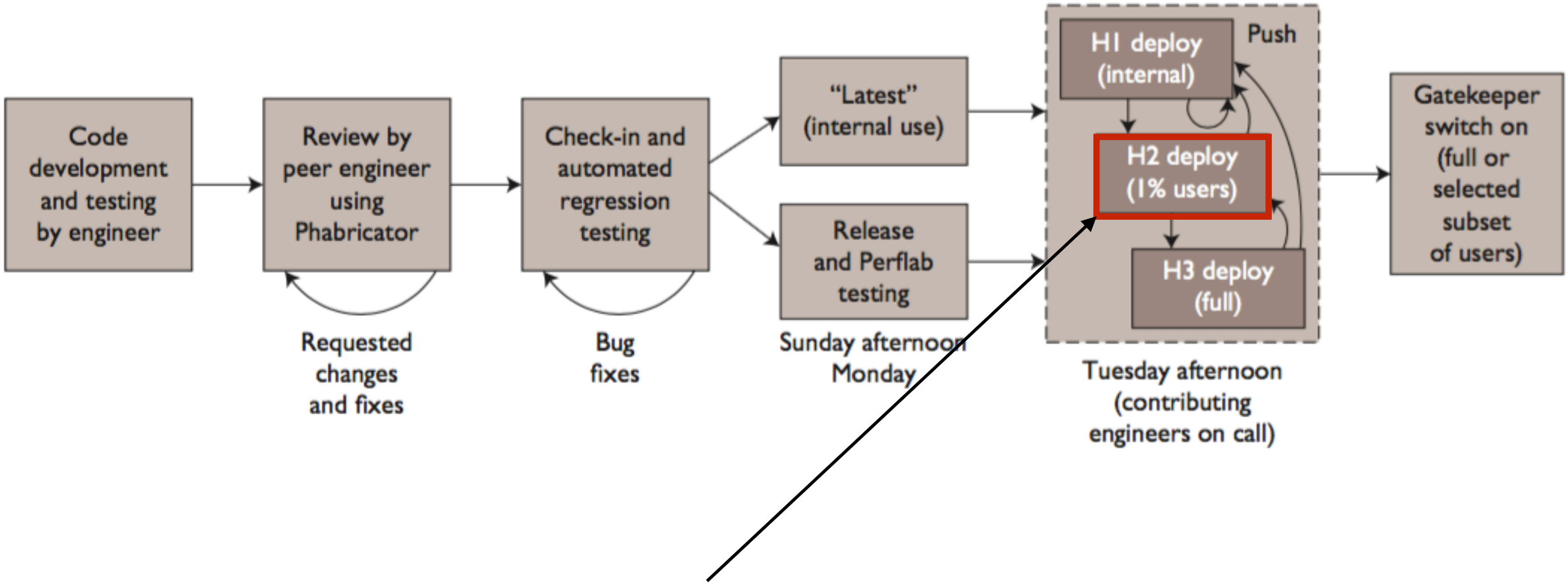
Facebook Deployment Pipeline



Dogfooding

Source: Development and Deployment at Facebook, IEEE Internet Computing, 2013

Facebook Deployment Pipeline



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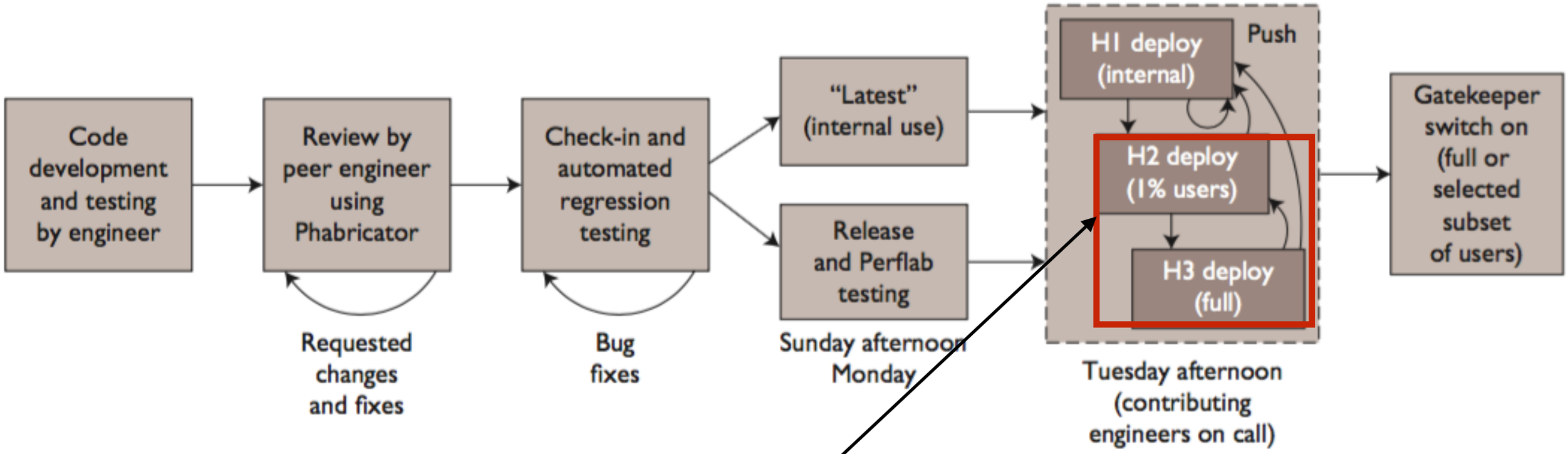
Facebook Deployment Pipeline



Gradual Rollout

Source: Development and Deployment at Facebook, IEEE Internet Computing, 2013

Monitoring

Source: https://flic.kr/p/HDsqJj

Monitoring

Monitoring is the process of observing and recording system state changes (e.g., logs) and data flows (e.g., communication between components).

Monitoring is important to

- verify that everything runs as expected (identify failures, performance problems)
- characterize workload (capacity planning, billing purposes)
- support rollout decisions (e.g., increase traffic assigned to canary based on measured user reactions)
- detecting intruders

Monitoring

Performance degradation observed by comparing current performance to historical data or by complaints from clients/users

Typical performance measures include
> latency
> throughput
> utilization

measured on application and infrastructure level

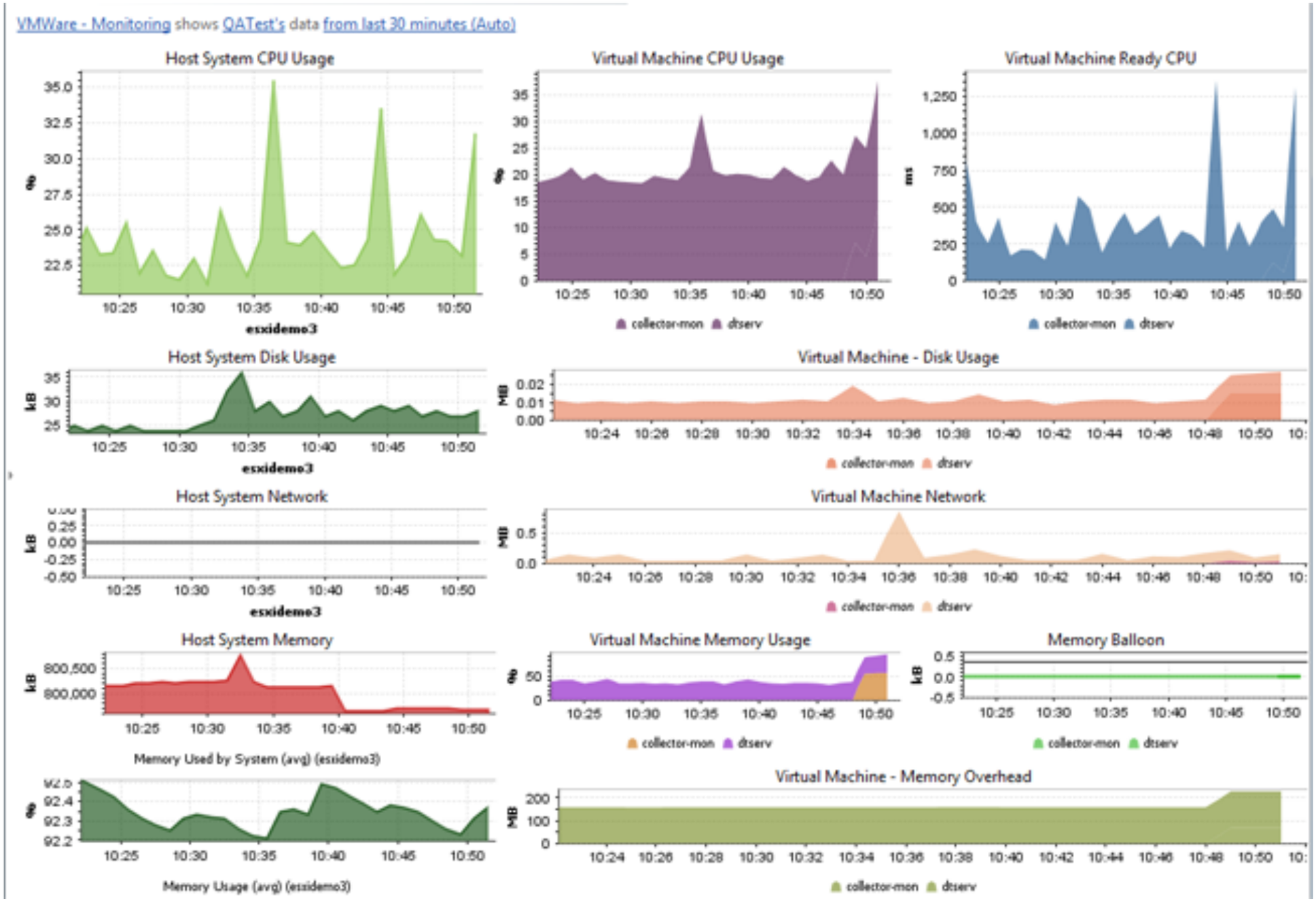
Business Metrics

A set of an organization's particular set of metrics to determine the effectiveness of their offerings and their support services.

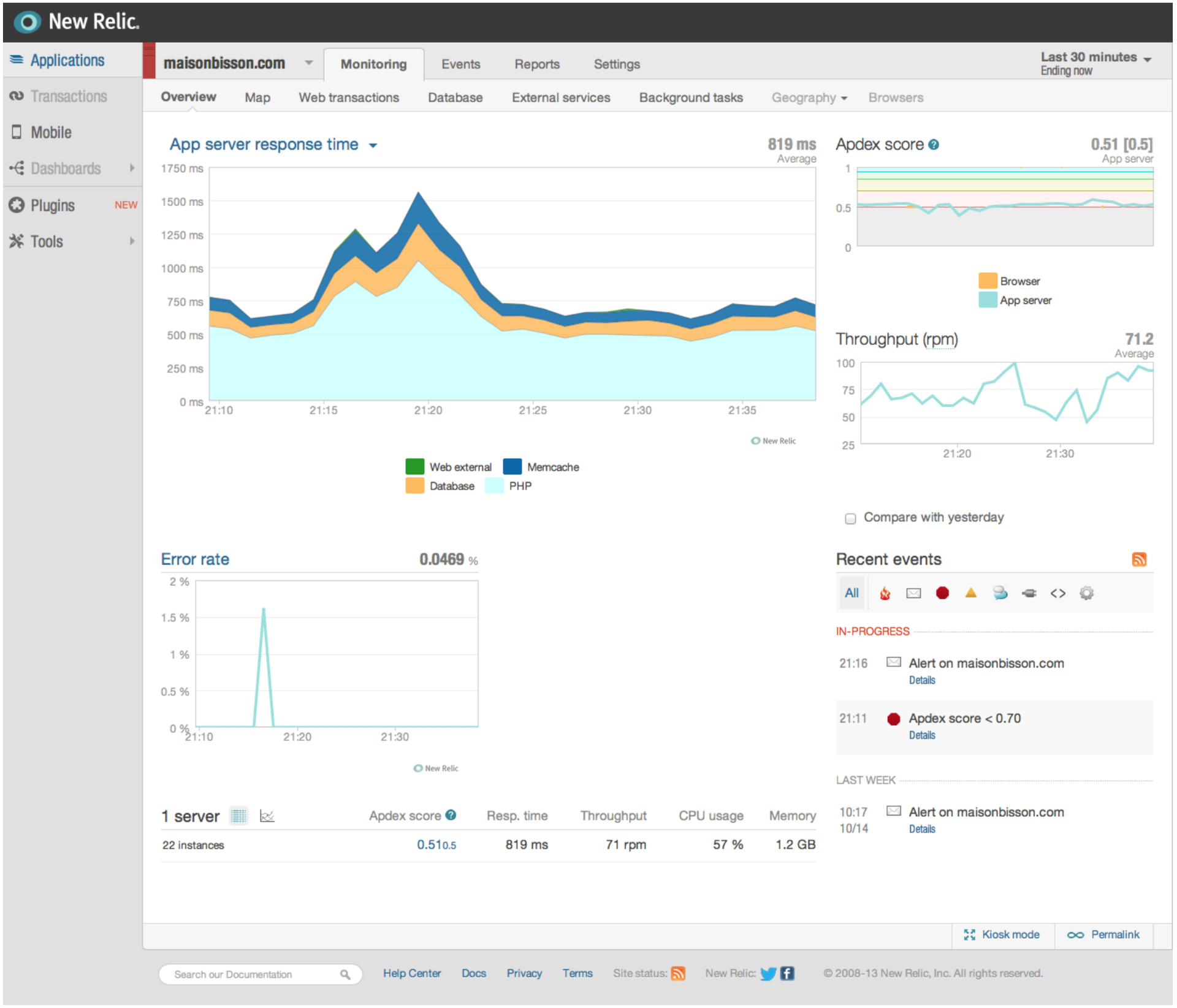
Examples:

photo gallery website: photo upload rate, photo processing times, …
online shop: number of sold products within 24 hours, number of added user reviews, levels of user activity, …
video platform: average of daily views, number of clicked ads, …

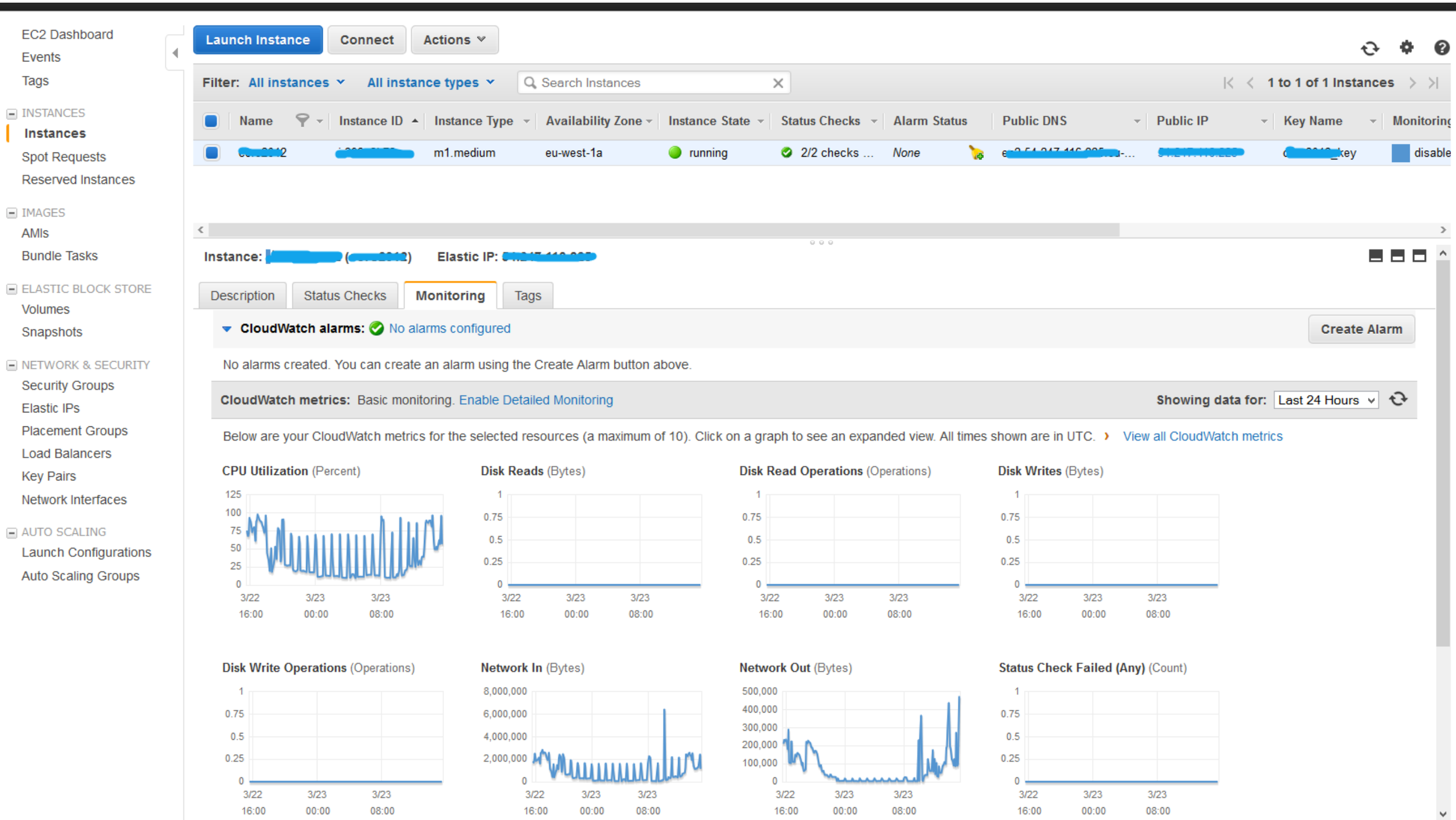
Dashboards - Example VM Utilization



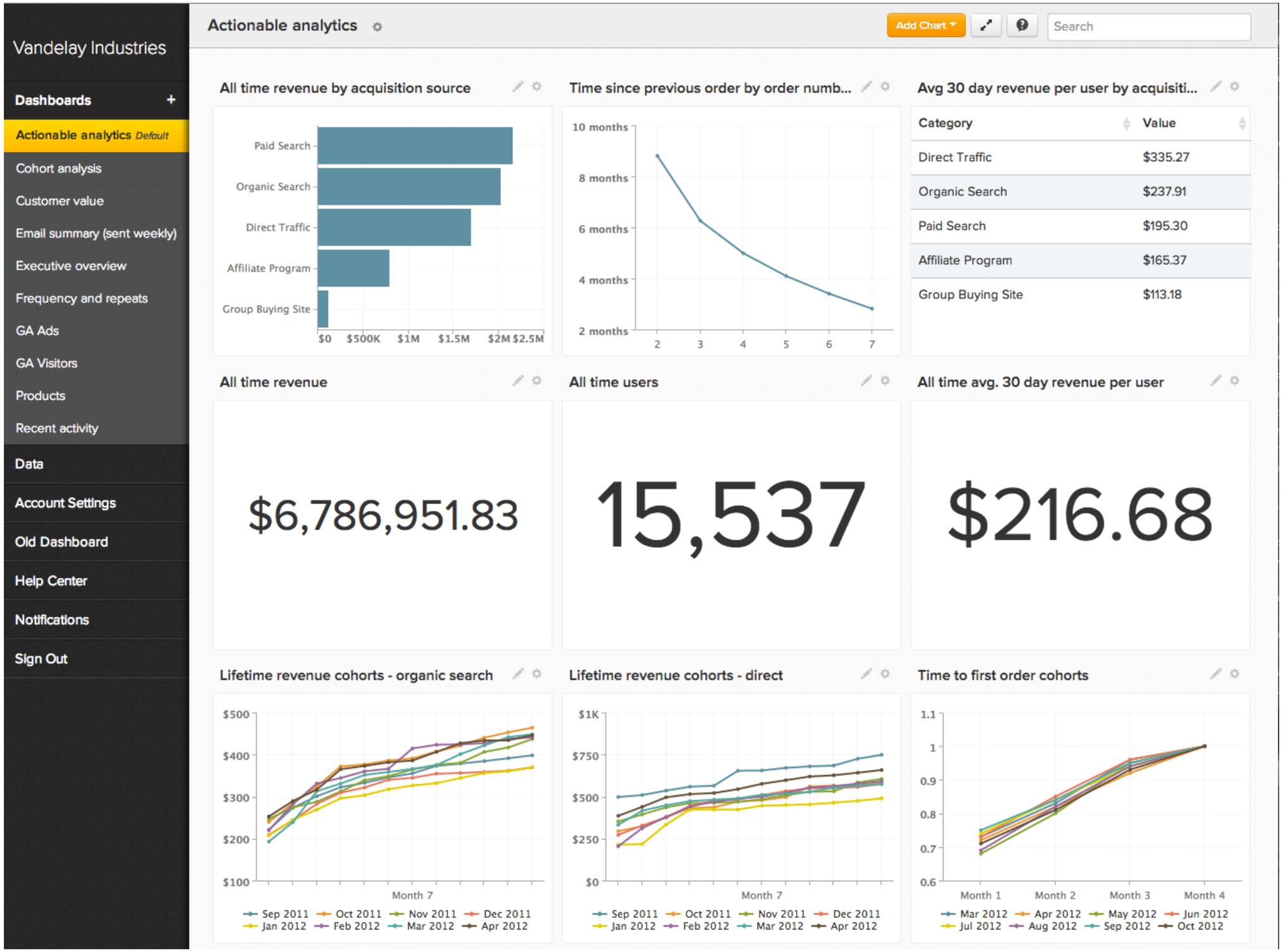
Dashboards - Example APM



Dashboards - Example Amazon EC2



Dashboards - Business Metrics



Source: https://blog.rjmetrics.com/2013/04/25/business-intelligence-dashboards-redefined/

Live Experimentation - Implementation Techniques

Feature Toggles

- dynamically enable and disable code segments (i.e., multiple “versions” in the code)
- basically as simple as an if-statement
- useful and cheap, might introduce complexity over time

Dynamic Routing

- use a router to determine what service (and thus which version) should receive and process a request
- multiple versions (thus instances) are running in parallel

Feature Toggles

```
function doSomething(){

  if( featureIsEnabled("use-new-algorithm") ){

    ...

  }else{

    ...
```

Usage scenarios:

- prevent incomplete features from being executed in production, i.e. enabled only on internal testing environments
- control rollout experimentation, e.g., which users see the newest version/feature (A/B testing, canary releases, gradual rollouts)

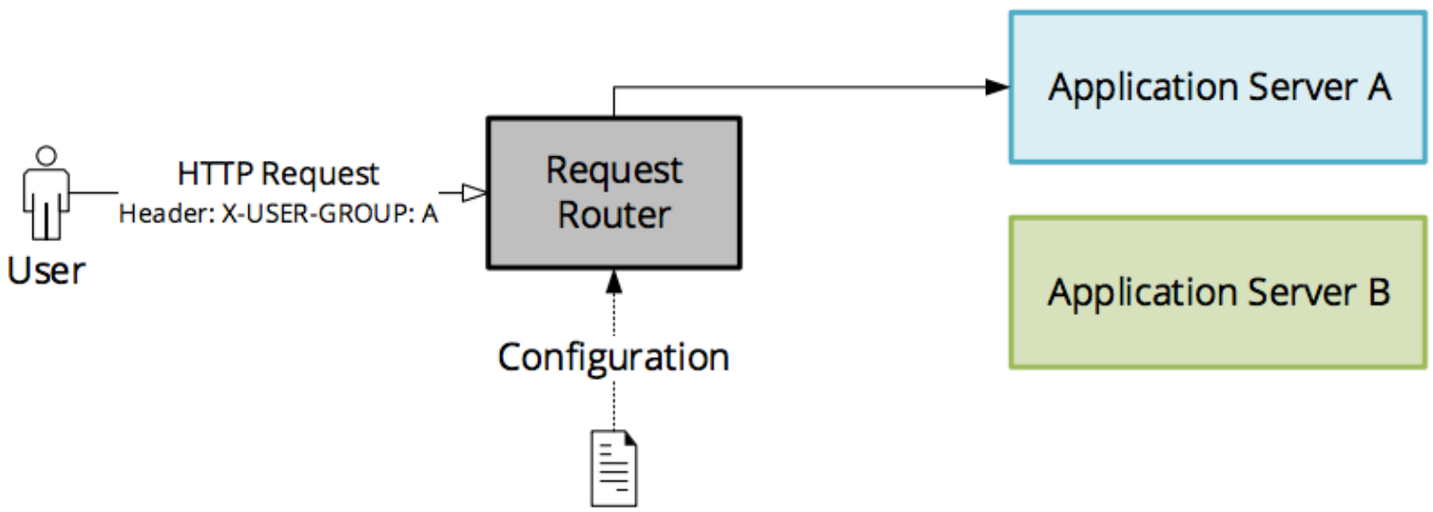
Feature Toggles

Feature toggles have to be **treated with care** as controlling and maintaining them could become problematic, especially the more feature toggles you have

toggles could interfere with each other (i.e., hard to test)

should be removed at some point from the code base, which might introduce new issues

Dynamic Routing



X-USER-GROUP: A => Application Server A
X-USER-GROUP: B => Application Server B

Removes feature toggle complexity from the code base, requires a properly managed router/proxy mechanism and multiple running instances

NGINX

HAPROXY

Empirical Study

Source: https://flic.kr/p/sdUQ7

State of Live Experimentation

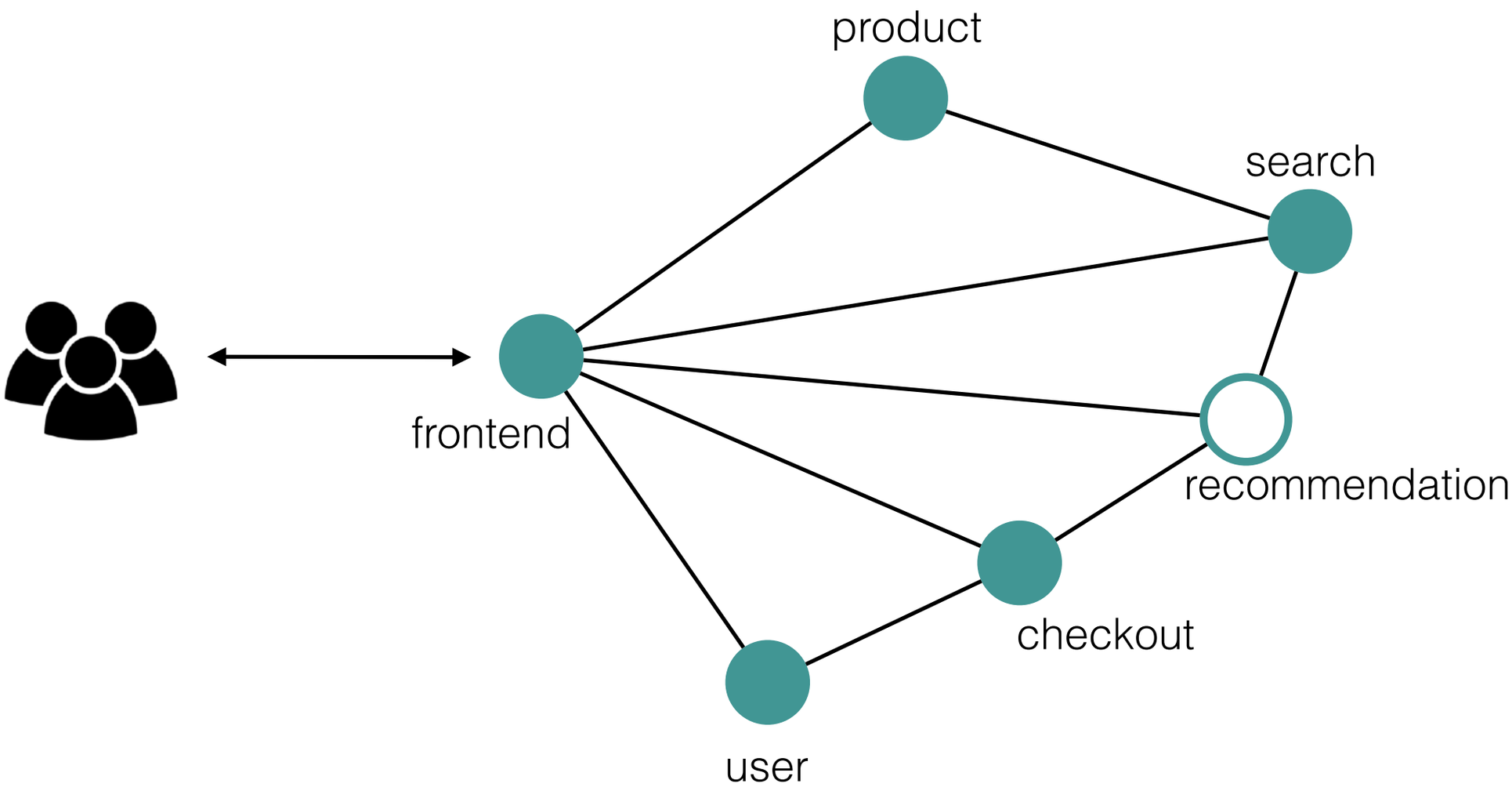
	Regression-Driven Experiments	Business-Driven Experiments
Main Goal	Mitigation of technical problems	Evaluation from a business perspective (e.g., monetary incentives)
Practices	Canary Releases, Dark Launches, Gradual Rollouts, Blue/Green Deployments	A/B Testing
Data Interpretation	Often intuitive, less process driven	Hypothesis- and data-driven
Duration	Minutes to multiple days	Order of weeks
User Selection	Small scoped, sometimes gradually increased	Two or more groups, constant size
Responsibility	Siloization	Multiple teams and services
Implementation	Feature toggles, traffic routing, distribution of binaries	
Obstacles	Architecture, limited number of users, missing business value or not worth investments, lack of expertise	

Bifrost

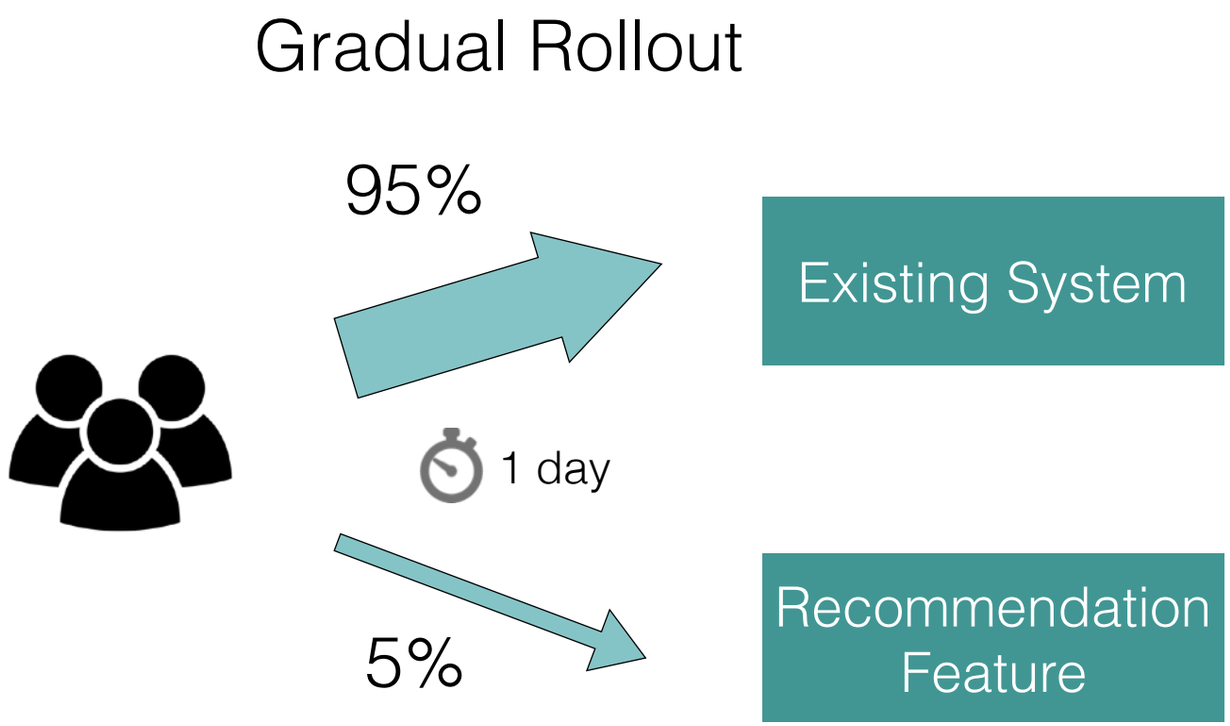
Multi-Phased Live Experimentation

Source: https://flic.kr/p/rsCPg1

Live Experimentation - Example

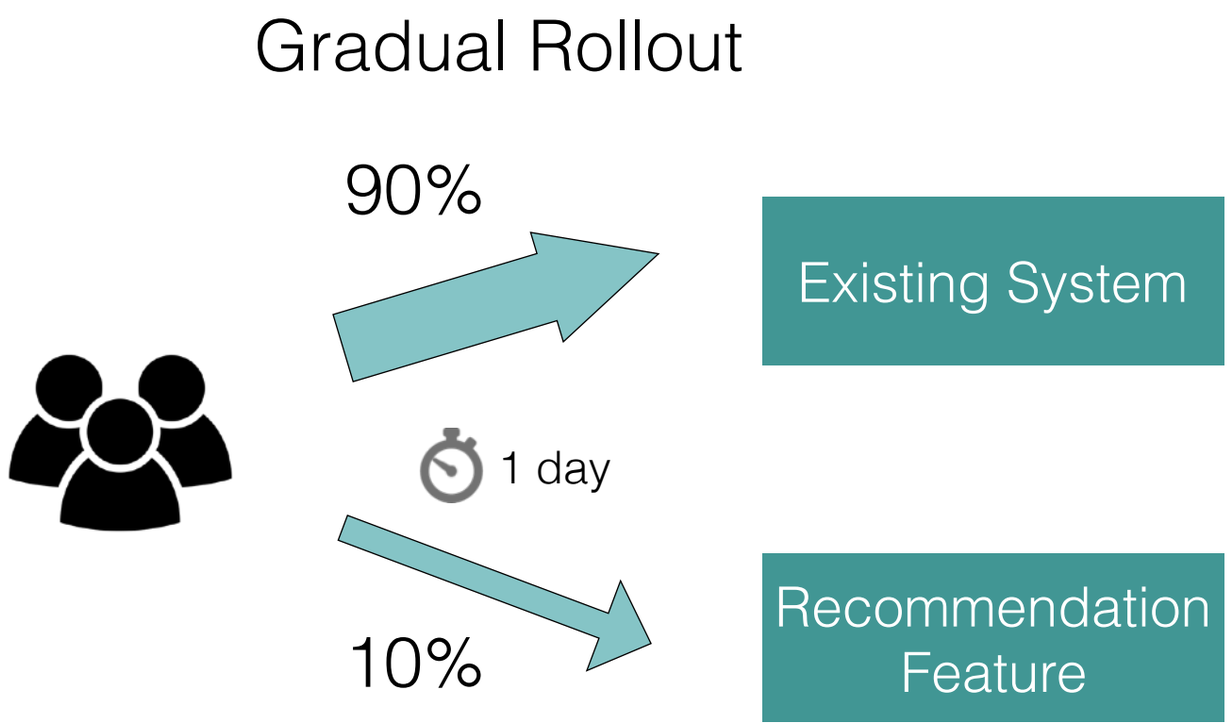


Live Experimentation - Example



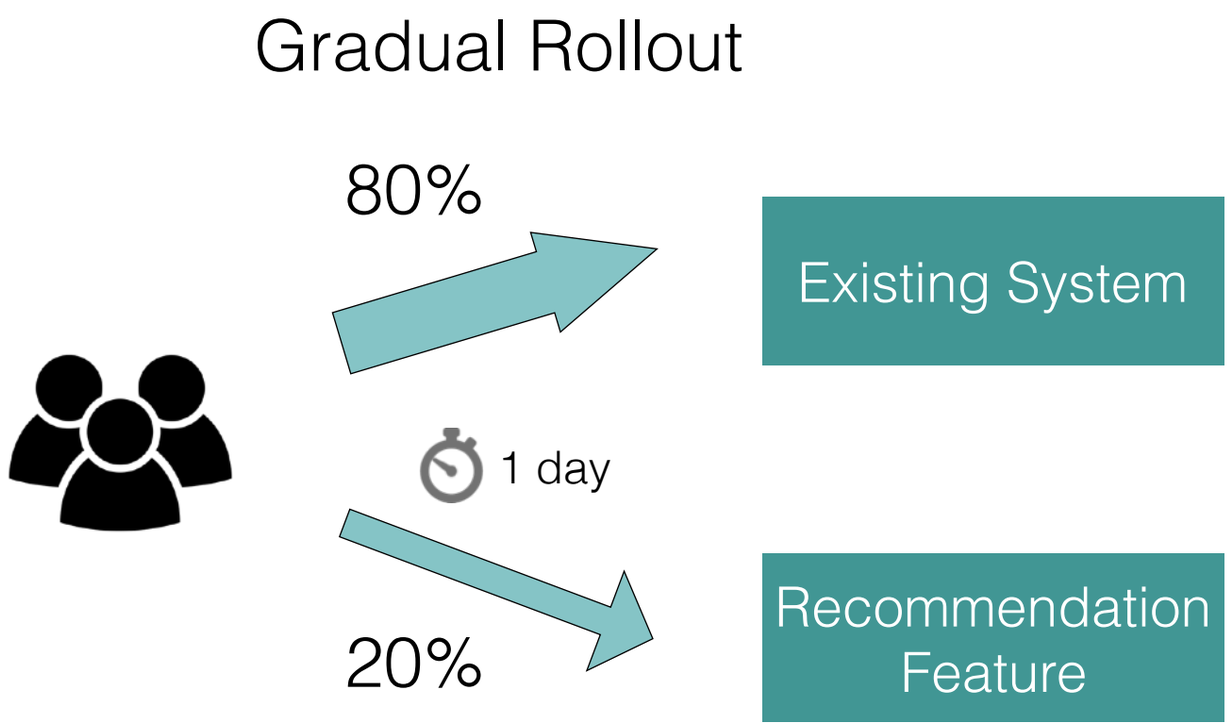
Response Time < 50 ms
CPU Utilization < 80 %

Live Experimentation - Example



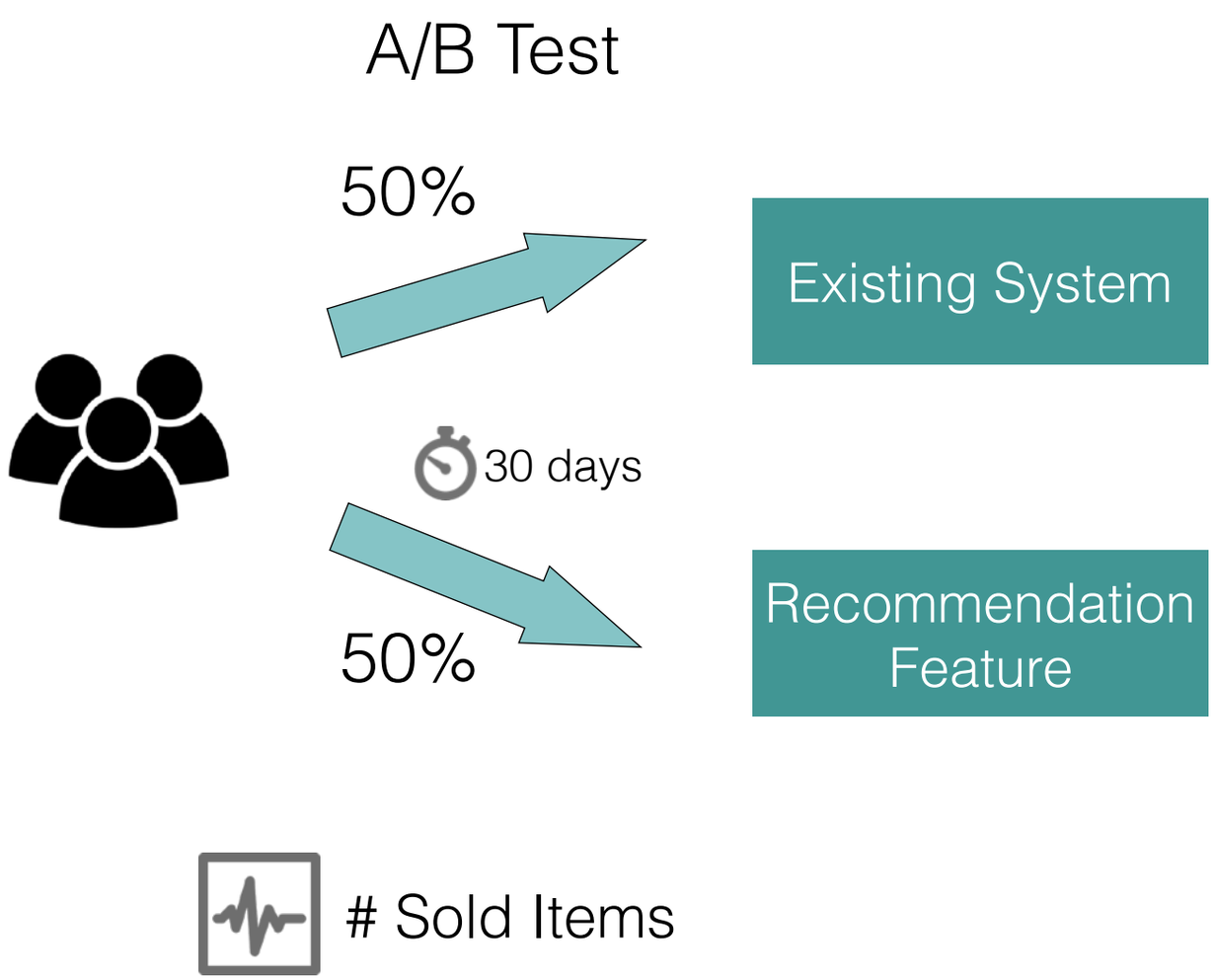
Response Time < 50 ms
CPU Utilization < 80 %

Live Experimentation - Example

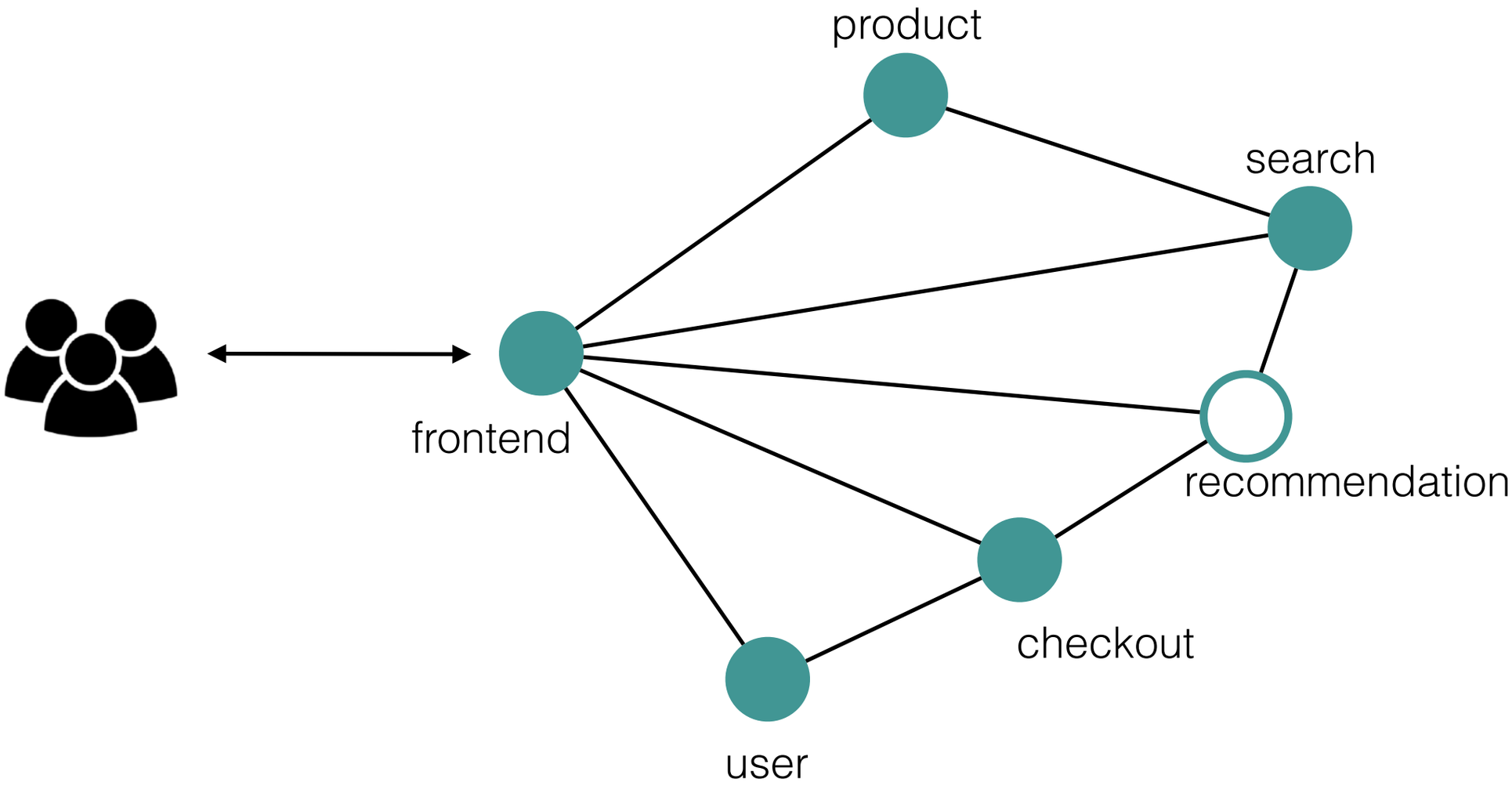


Response Time < 50 ms
CPU Utilization < 80 %

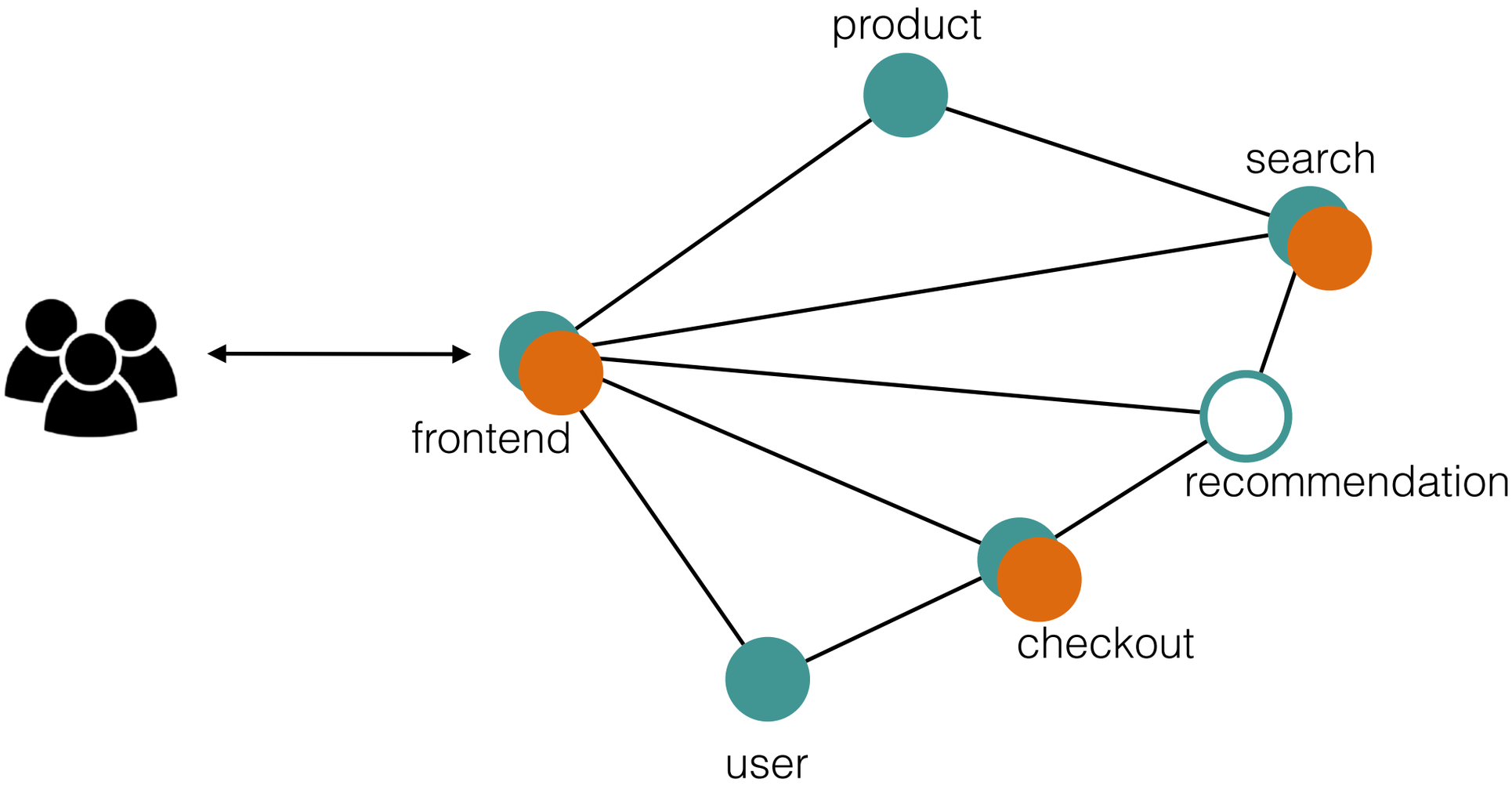
Live Experimentation - Example



Live Experimentation - Example



Live Experimentation - Example



- operate multiple versions at the same time
- metrics to monitor, duration of experiment, user groups

Bifrost: Conducting Automated, Data-Driven, Multi-Phased Live Experiments

Bifrost:

Middleware for executing multi-phased live experiments

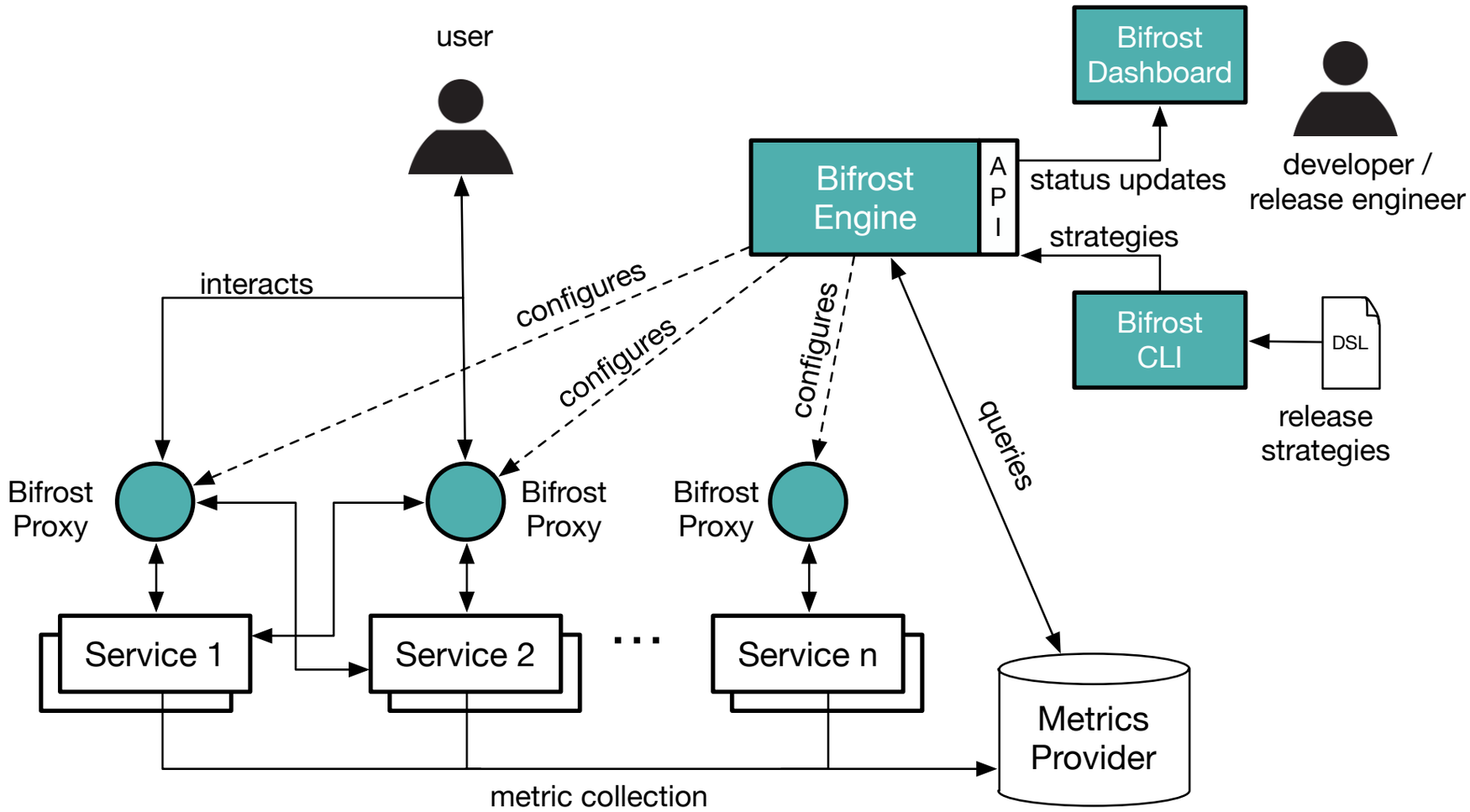
Designed for microservices-based applications

Existing tooling limited to specific types of live experimentation

e.g., Optimizely, CanaryAdvisor [Tarvo et al.'15], vamp.io

Gerald Schermann, Dominik Schöni, Philipp Leitner, and Harald C. Gall,
"Bifrost - Supporting Continuous Deployment with Automated Enactment of Multi-Phase Live Testing Strategies"
Middleware Conference 2016, Trento, Italy

Bifrost: Conducting Automated, Data-Driven, Multi-Phased Live Experiments



Bifrost Architecture

Bifrost: Conducting Automated, Data-Driven, Multi-Phased Live Experiments

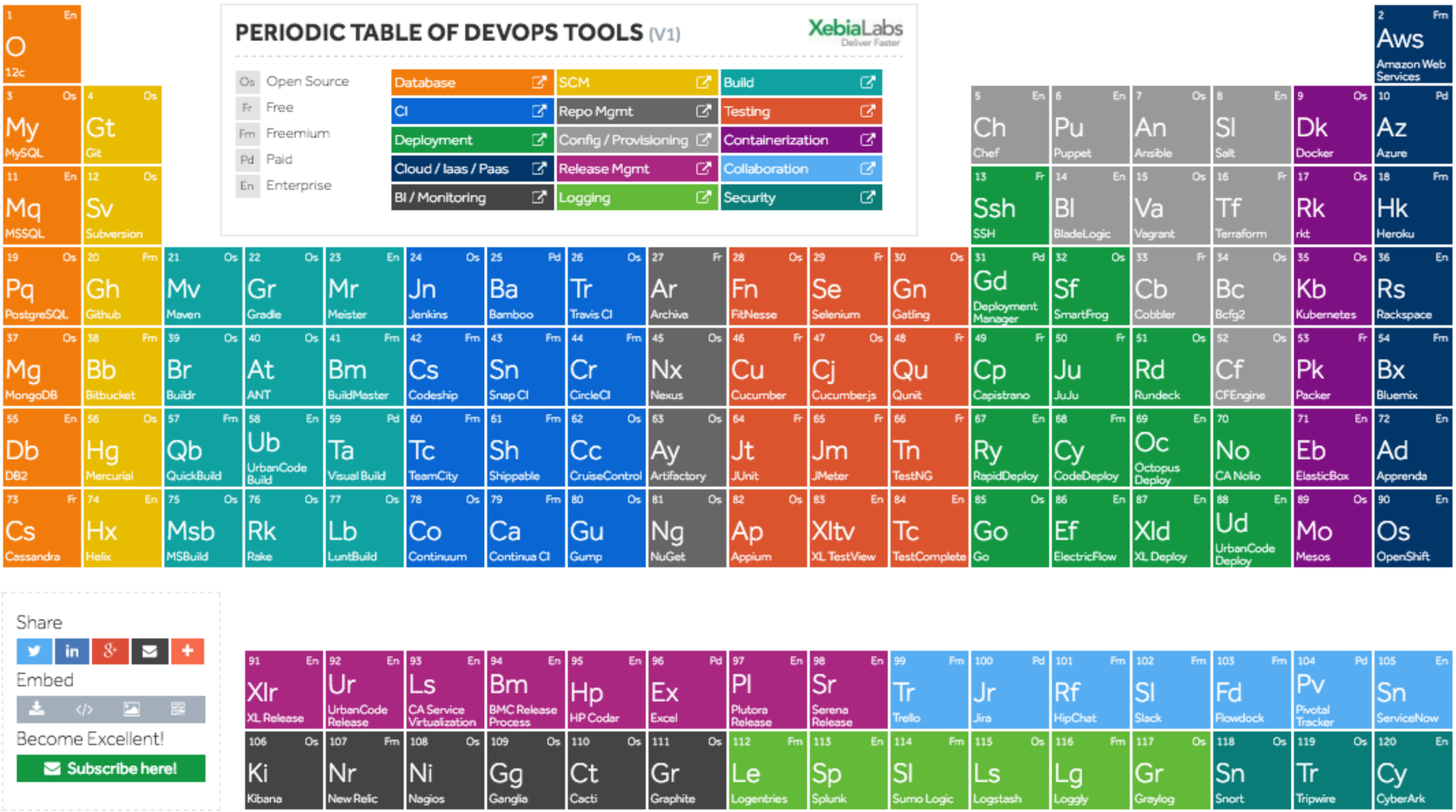
Explicit live experimentation using a DSL

```
12  12  strategies:
13  13   - name: Canary_Launch
14  14     actions:
15  15      - AND:
16  16        actions:
17  17         - route:
18  18             from: search
19  19             to: search_rec
20  20             intervalTime: 1h
21  21             filters:
22      -              - traffic:
23      -                  percentage: 5
    22  +              - header:
    23  +                  field: X-User-Group
    24  +                  value: Premium
24  25
25  26         - metric:
26  27             providers:
...
29  30                   query: request_errors{instance="search_rec:80"}
30  31             intervalTime: 5s
31  32             intervalLimit: 720
32      -          threshold: 600
33      -          validator: "<5"
    33  +          threshold: 650
    34  +          validator: "<4"
34  35
35  36       onTrue: Load_Test
36  37       onFalse: rollback
```

Experimentation as Code

Fosters version-controlling, sharing, and reusing of strategies

Traceability, which experiments are executed, what is monitored, which users are part of what experiments



Source: https://xebialabs.com/periodic-table-of-devops-tools/