Lecture 10

Automation

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03.11.2020

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Schedule for coming weeks

Week	Lecture	Plussa exercises (deadlines)
10/45	03.11 Testing and testing automation	
11/46	10.11 Guest Lecture, CD pipeline at cargotec	
12/47	17.11 Deployment, hosting and monitoring	
13/48	24.11 Introduction of some popular tools	
14/40	01.12 Recap	

Content of today

- Recap about gitlab CI
- Summary of Cloud Native
- Automation in the pipeline

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Example from:
https://docs.gitlab.com/ee/user/project/pages/getting_started/pages_from_scratch.html

```
image: ruby:2.7

workflow:
  rules:
    - if: '$CI_COMMIT_BRANCH'

before_script:
  - gem install bundler
  - bundle install

pages:
  stage: deploy
  script:
    - bundle exec jekyll build -d public
  artifacts:
    paths:
      - public
  rules:
    - if: '$CI_COMMIT_BRANCH == "master"'

test:
  stage: test
  script:
    - bundle exec jekyll build -d test
  artifacts:
    paths:
      - test
  rules:
    - if: '$CI_COMMIT_BRANCH != "master"'
```

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Is this correct?

Why not?

Empty

Before script

Test

Before script

deploy

```
gem install bundler
bundle install
```

```
gem install bundler
bundle install
```

```
bundle exec jekyll build -d test
```

```
bundle exec jekyll build -d build
```

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This is correct visualization!

Empty

Before script

Test

If branch != master

If branch == master

Before script

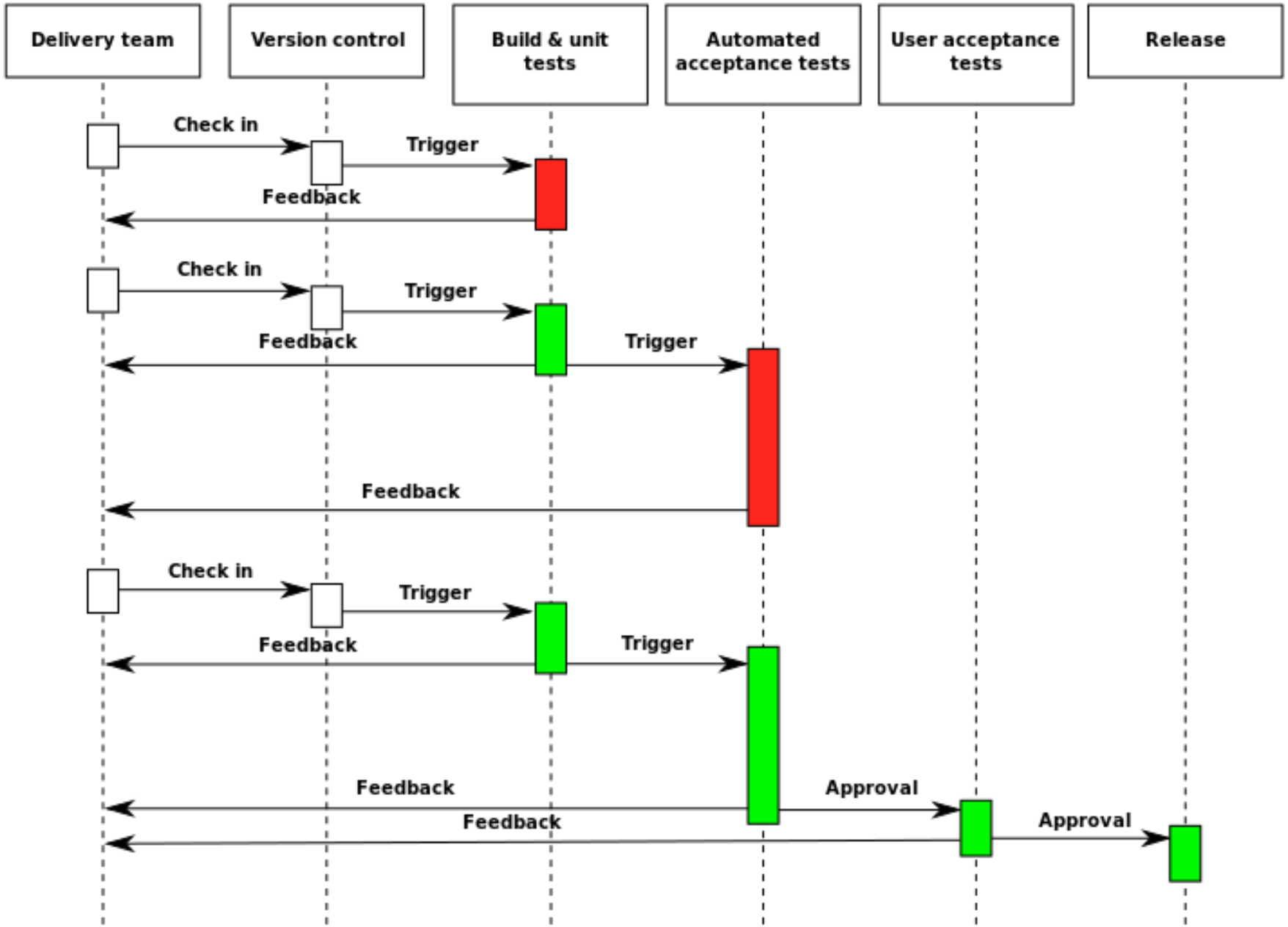
deploy

DevOps practices

- Organizational
  - increased scope of responsibilities for developers;
  - intensified cooperation between development and operations.

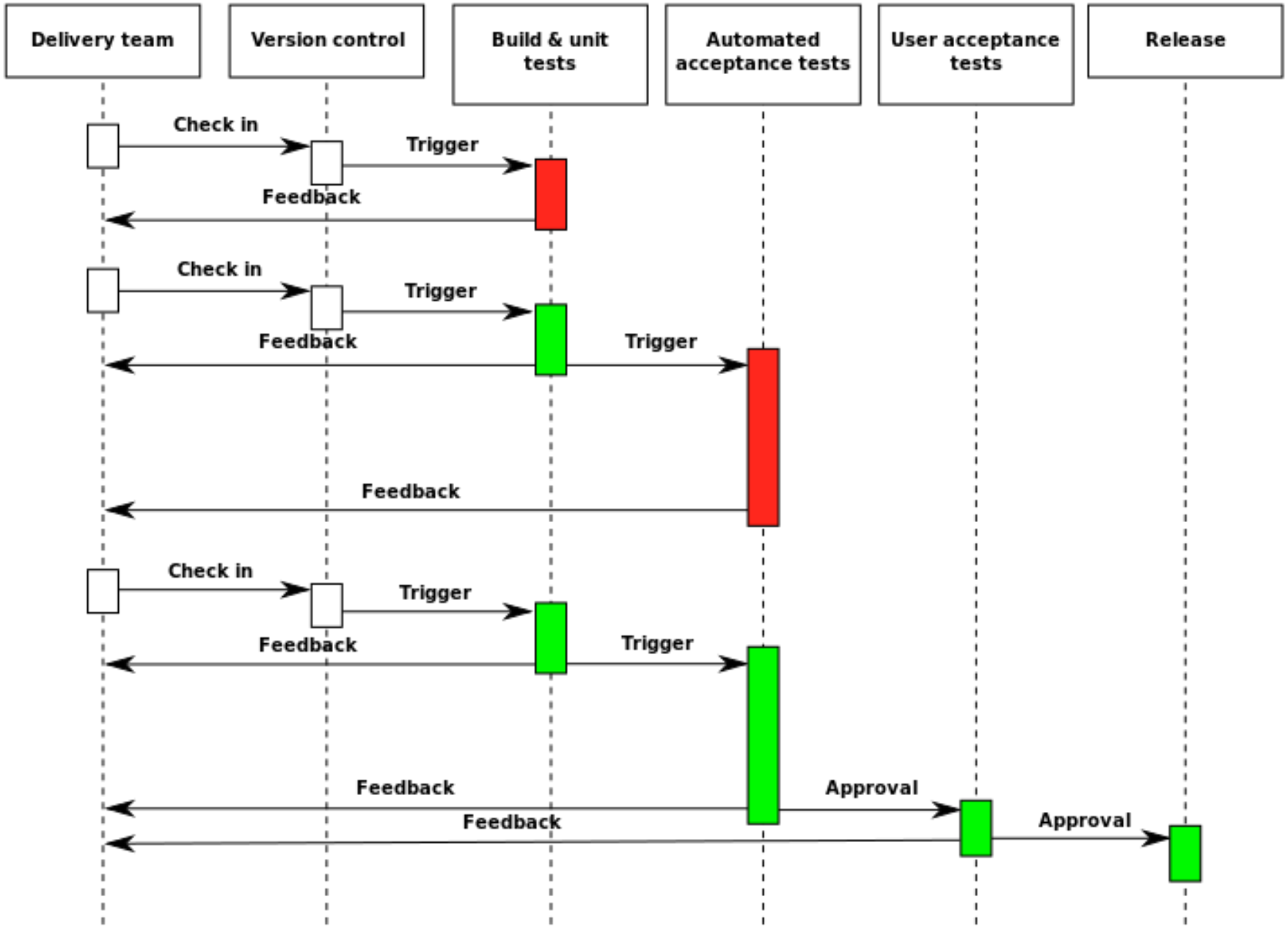
- Technical
  - **automation,**
  - monitoring
  - measurement

Deployment pipeline (a possible example)



About automation

Deployment pipeline (a possible example)



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Infrastructure as code

From: https://docs.microsoft.com/en-us/azure/devops/learn/what-is-infrastructure-as-code

Infrastructure as Code (IaC) is

- the management of infrastructure (networks, virtual machines, load balancers, and connection topology) in a descriptive model,
- using the same versioning as DevOps team uses for source code.
- Like the principle that the same source code generates the same binary, an IaC model generates the same environment every time it is applied.
- IaC is a key DevOps practice and is used in conjunction with continuous delivery.

Benefits of automation

- Prevent errors
- Is repeatable
- No need to write documentation
- Enables collaboration because everything is explicit in scripts
- Expertise encapsulated in scripts
- Manual work is boring
- Fast and relentless feedback
- Risk management: Automated checking and auditing

Automation includes

- Building
  -> no command-line tools needed
- Testing
  -> run frequently
- Other quality analysis
  -> less manual inspection needed;
- Deployment
  -> VMs and containers created automatically
  -> configuration management
- Database tools
  -> initialization
  -> management
- Scaling

Automated tests

- A common practice in CI and CD
- Does not invent the test (usually);
  - test are designed and implemented manually but
  - executed automatically
- Tests need to maintained
- Software needs to be testable
- Not a silver bullet for testing, but necessary helper in CI/CD

Testability

- Testbed can command the software
- Tests can investigate state and results
- Proper architecture and coding style helps
  e.g. Standard getters and setters
- Well-defined APIs

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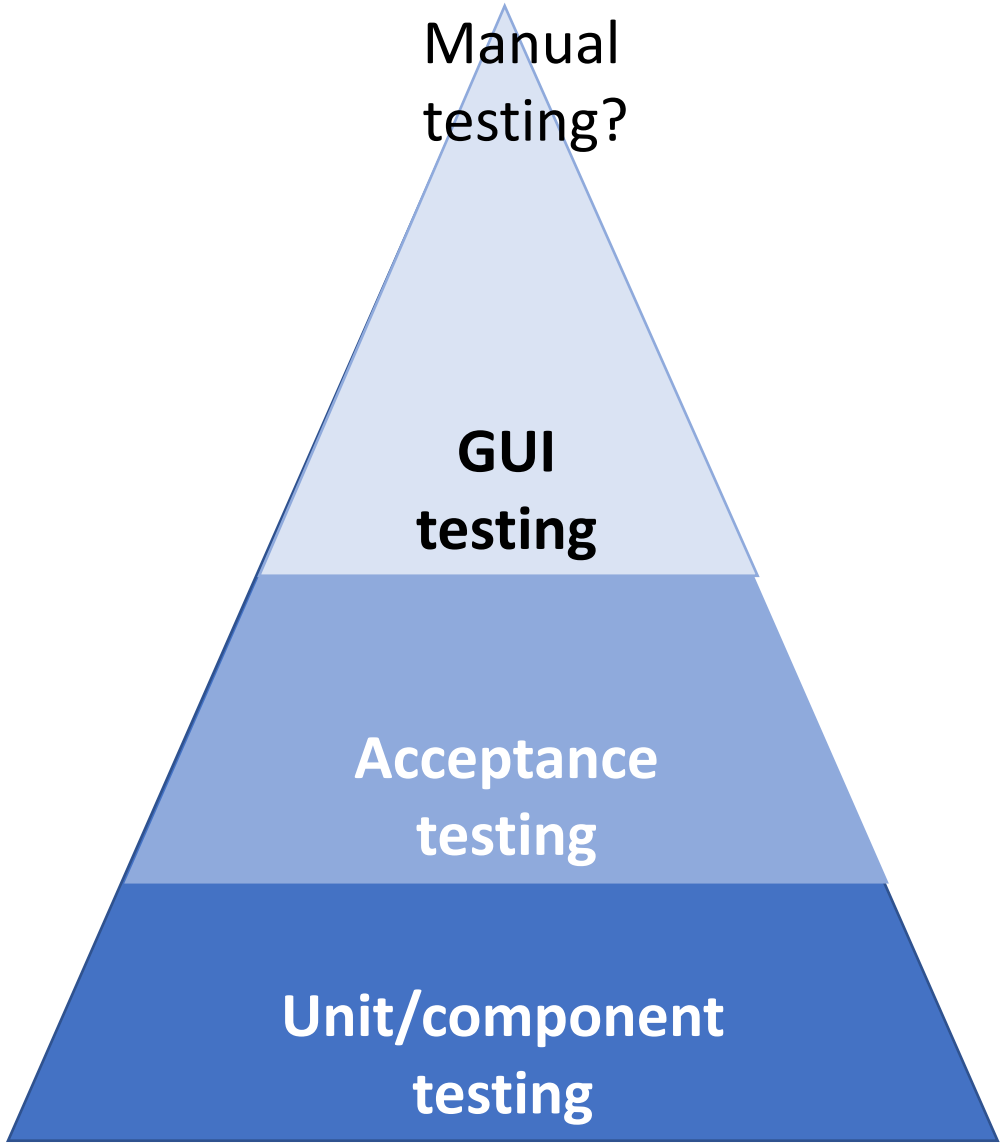

Automated acceptance tests

- Acceptance tests do not test everything but is an essential “gate” if deployment is automated.
- Some best practices (according to Humbley and Farley):
  - Test in realistic environment(s)
  - Acceptence tests are owned by the whole team (no separate team for it)
  - Developers should be able to run the tests in their own dev environment)
  - Tie to business value – not to technical solution of the system
- Nonfunctional testing
  - Capacity, scalability
  - Code quality analysis

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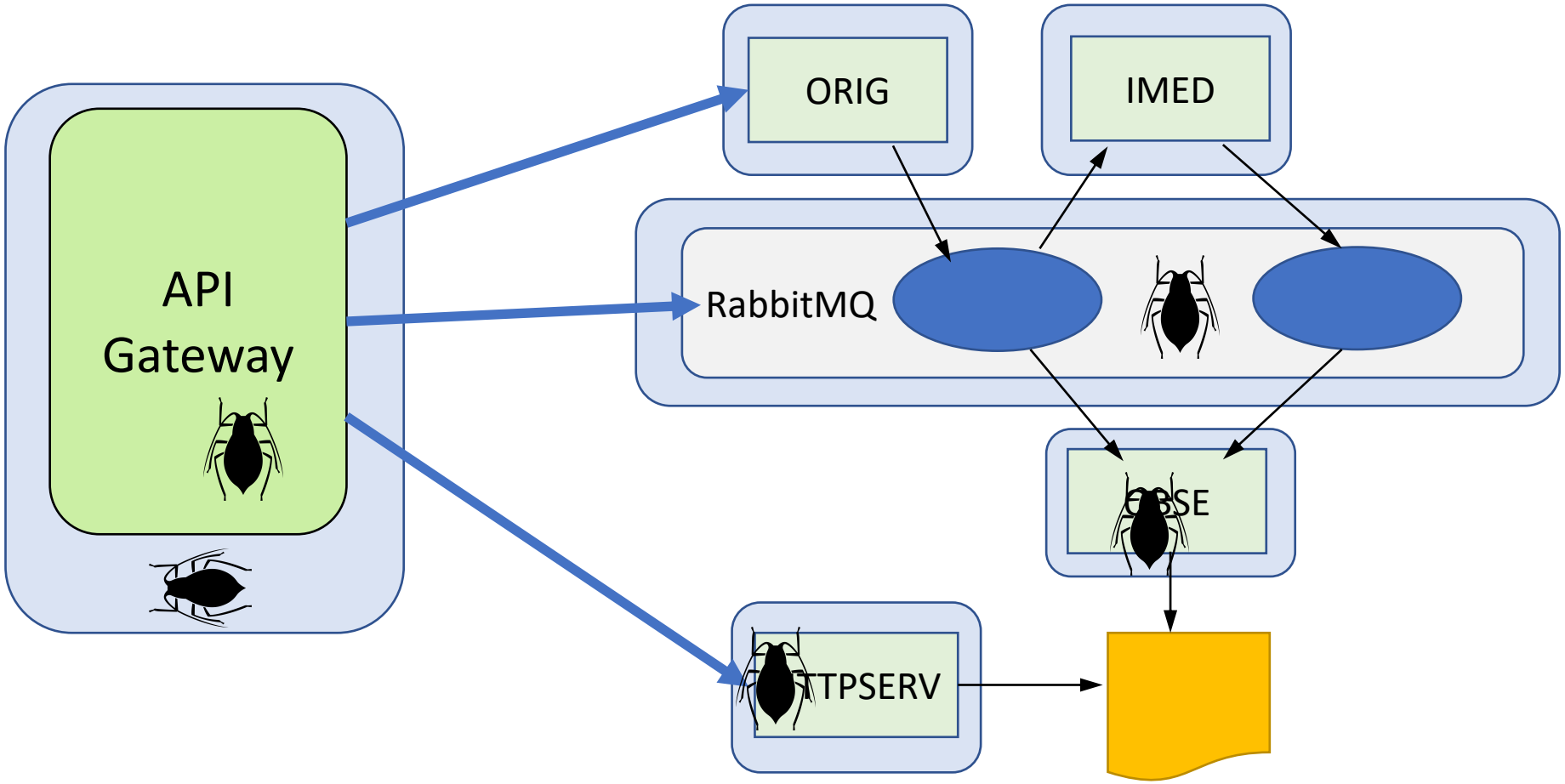
Testing cloud-native is difficult
And debugging even more difficult



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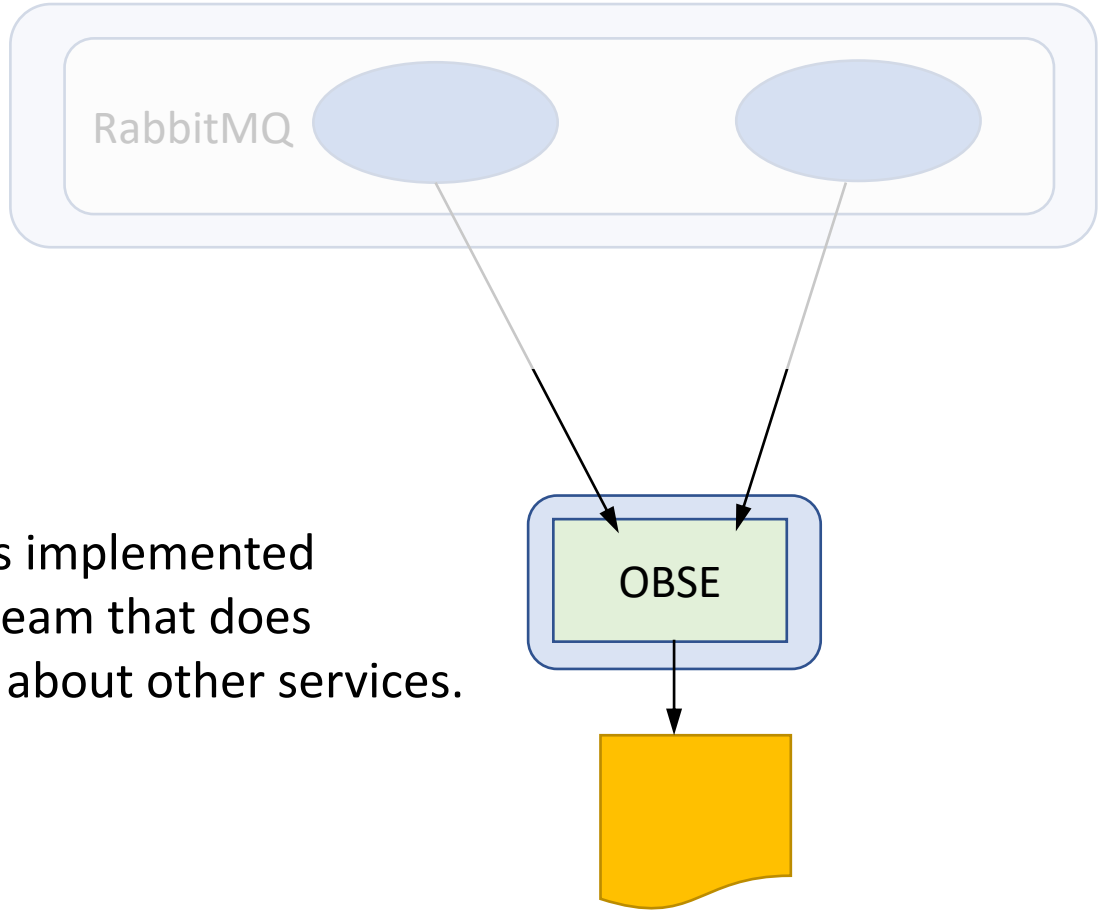
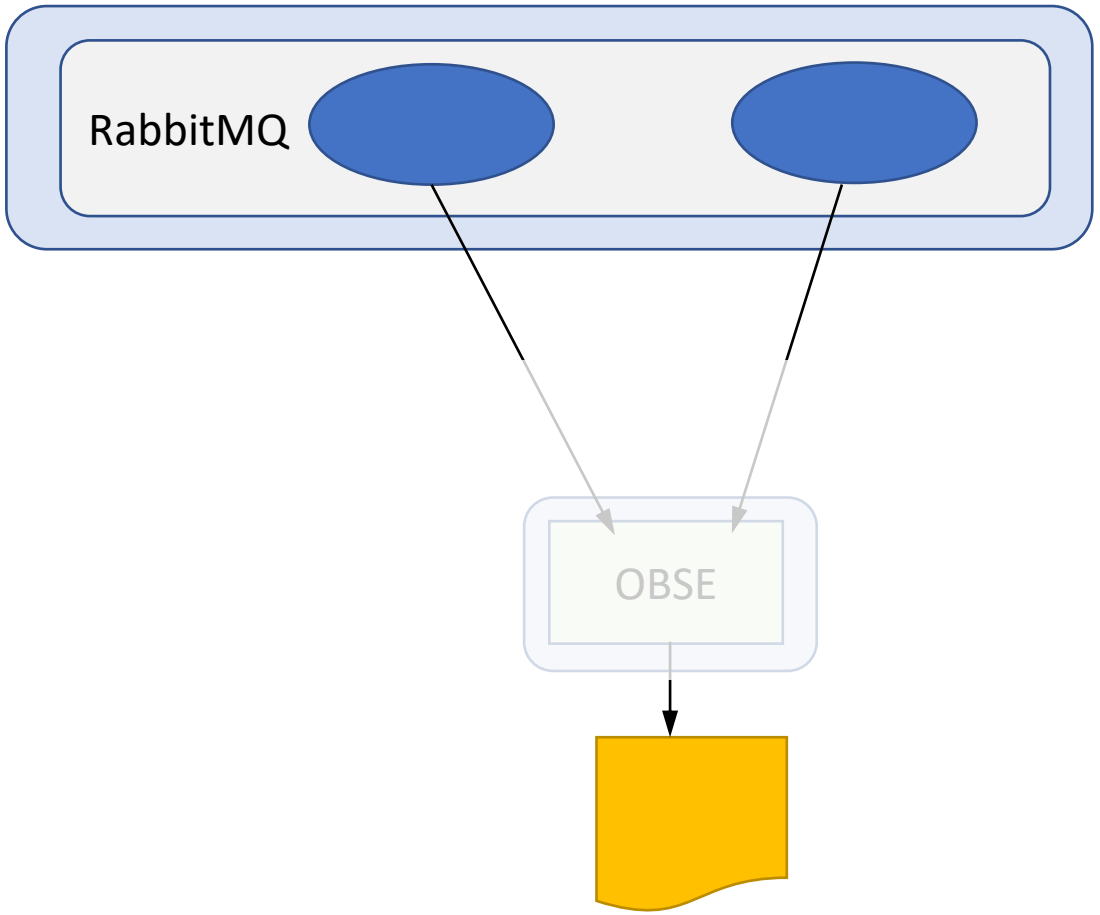


What if OBSE is implemented
by a separate team that does
not now much about other services.


RabbitMQ
OBSE

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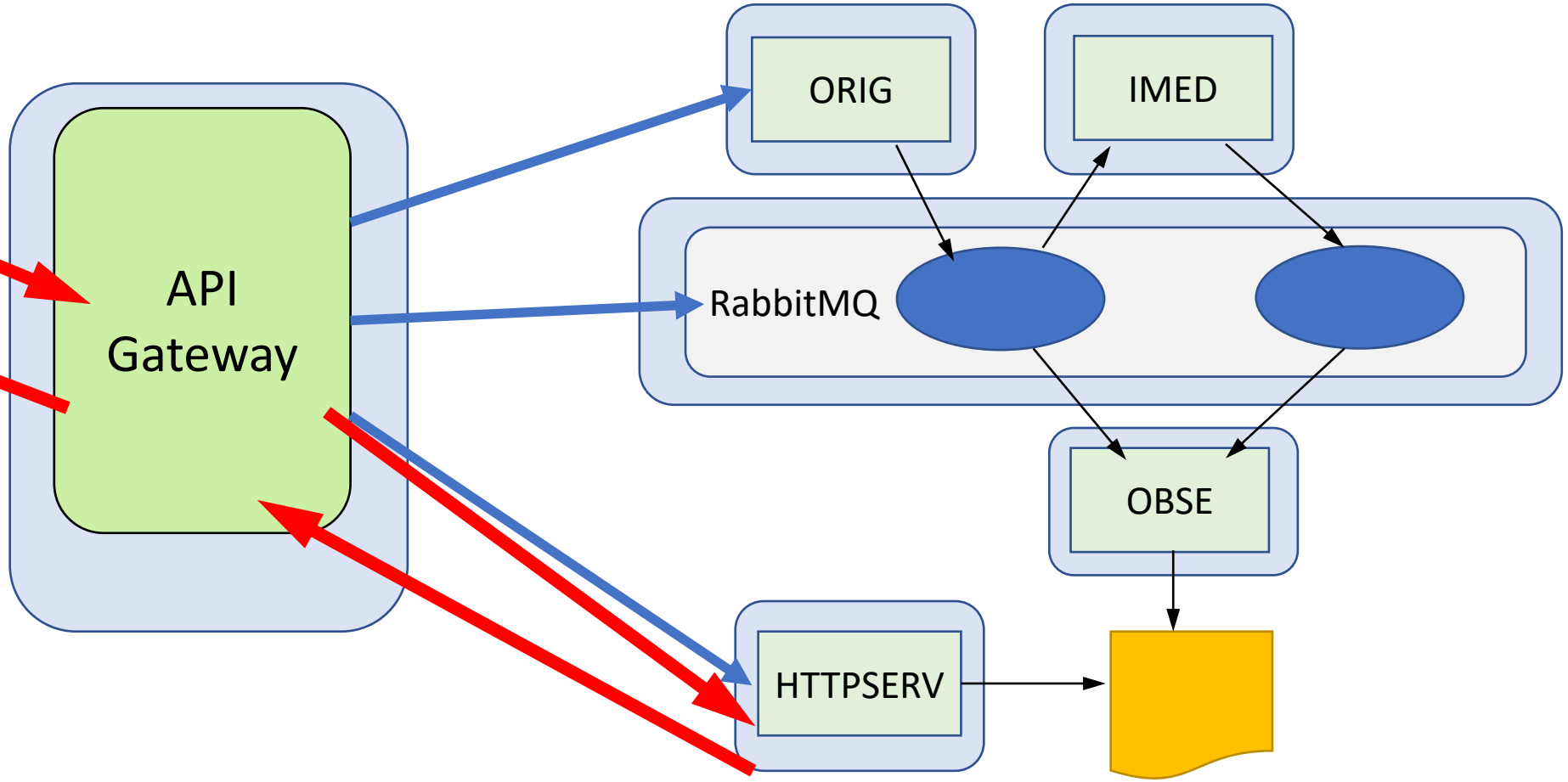
GET /messages

2020-10-01T06:35:01.373Z
Topic my.o: MSG_1

Correct?



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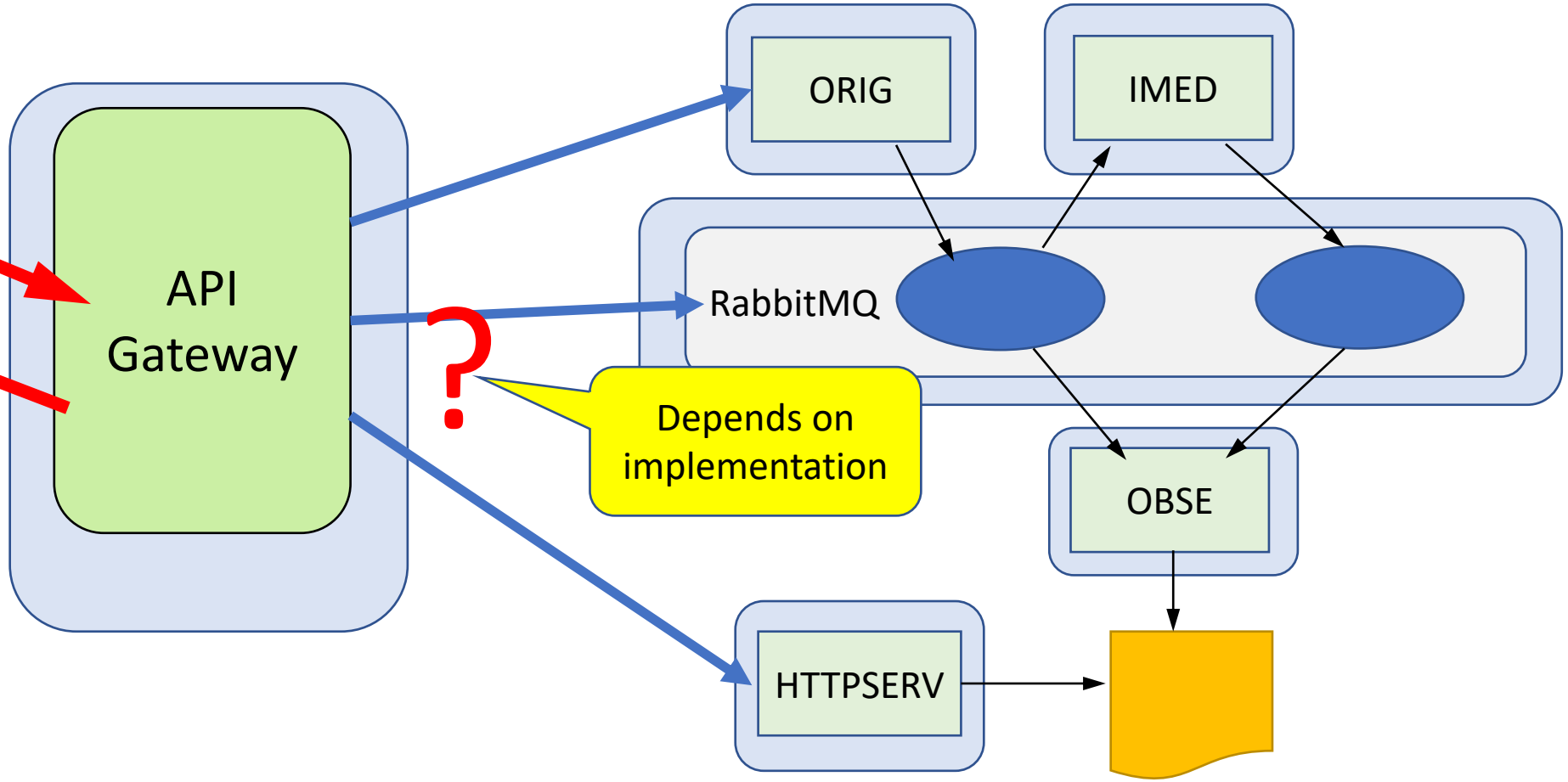
GET /run-log

2020-11-01T06:35:01.373Z: INIT
2020-11-01T06:40:01.373Z:
PAUSED
2020-11-01T06:40:01.373Z:
RUNNING

Correct?



Testing microservices

(https://www.infoq.com/articles/twelve-testing-techniques-microservices-intro/)

Key takeaways

- Because a microservice architecture relies more on over-the-wire (remote) dependencies and less on in-process components, your testing strategy and test environments need to adapt to these changes.
- When testing monoliths using existing techniques like service virtualization, you do not have to test everything together; instead, you can divide and conquer, and test individual modules or coherent groups of components.
- When working with microservices, there are also several more options available, because microservices are deployed typically in environments that use containers like Docker.
- You will need to manage the interdependent components in order to test microservices in a cost and time effective way. You can use test doubles in your microservice tests that pretend to be real dependencies for the purpose of the test.

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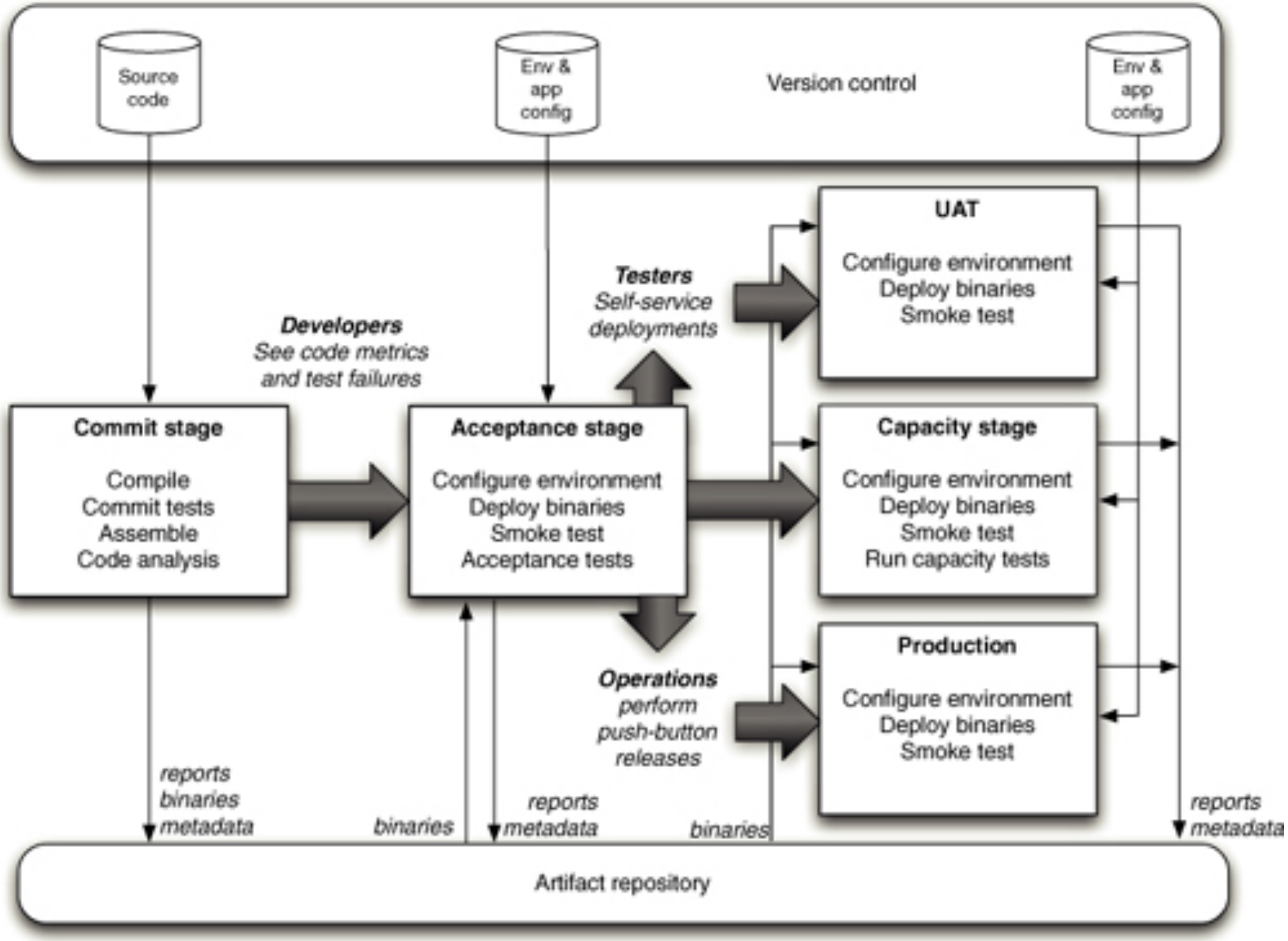
Artefact repository



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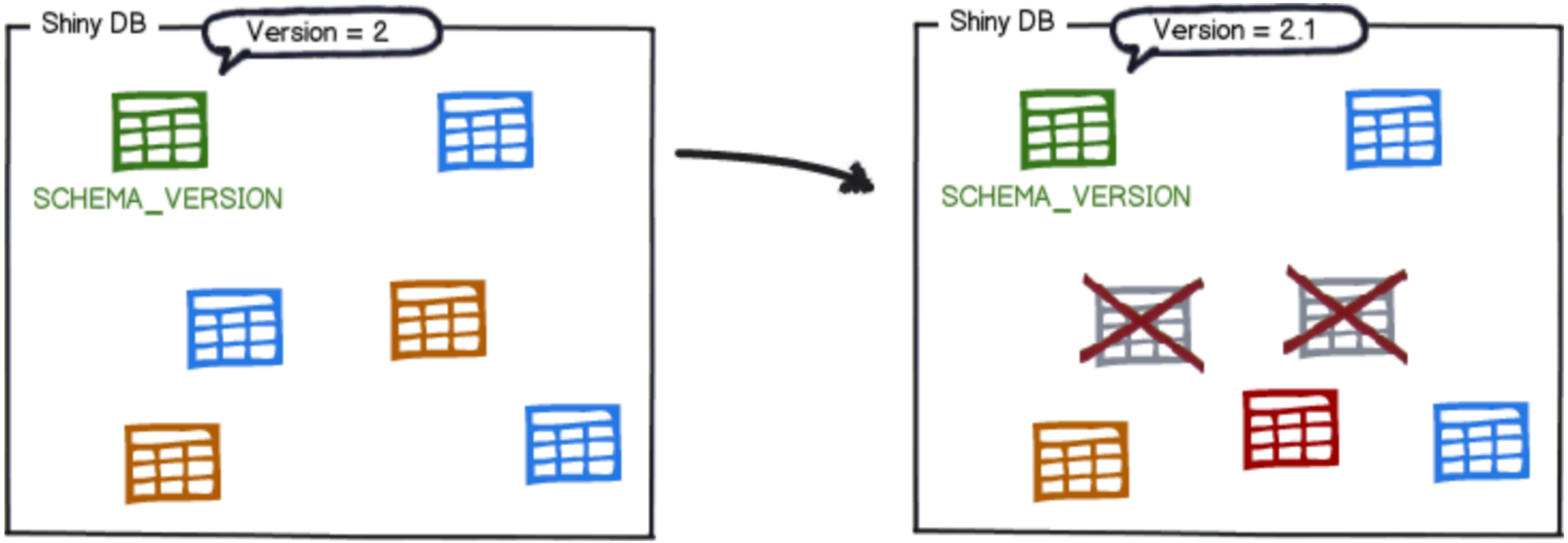
Example of data base automation https://flywaydb.org

” Flyway is an open-source database migration tool. It strongly favors simplicity and convention over configuration. It is based around just 6 basic commands: Migrate, Clean, Info, Validate, Baseline and Repair. Migrations can be written in SQL (database-specific syntax (such as PL/SQL, T-SQL, …) is supported) or Java (for advanced data transformations or dealing with LOBs).”

They are then **sorted by version number** and **executed in order**:



The **schema history table** is **updated** accordingly:

flyway_schema_history

installed_rank	version	description	type	script	checksum	installed_by	installed_on	execution_time	success
1	1	Initial Setup	SQL	V1__Initial_Setup.sql	1996767037	axel	2016-02-04 22:23:00.0	546	true
2	2	First Changes	SQL	V2__First_Changes.sql	1279644856	axel	2016-02-06 09:18:00.0	127	true
3	2.1	Refactoring	JDBC	V2_1__Refactoring		axel	2016-02-10 17:45:05.4	251	true

Automation challenges

- ”…provisioning scripts were considered error-prone and, according to developers, they did not work in some environments…”
- ”…automation of the network in was said to be difficult in addition to dealing with legacy system…”
- ”Networks are pretty hard. Some of the databases are pretty hard too because the old relational databases haven’t been designed to be clustered…”

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Automation scripts are programs Infrastructure as code

- ”Infrastructure as code (IaC) is the process of managing and provisioning computer data centers through machine-readable definition files, rather than physical hardware configuration or interactive configuration tools.”
- three approaches to IaC: declarative (functional) vs. imperative (procedural) vs. intelligent (environment aware)

```
tasks:
- name: ensure apache is at the
        latest version
  yum:
    name: httpd
    state: latest
- name: ensure that postgresql is started
    service:
      name: postgresql
      state: started
```

```
apt-get install …
```

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Infrastructure as code

All SW engineering principles should be applied.

- Testing
- Maintenance
- Documentation
- Version and configuration management

- Bugs may stop the whole engine

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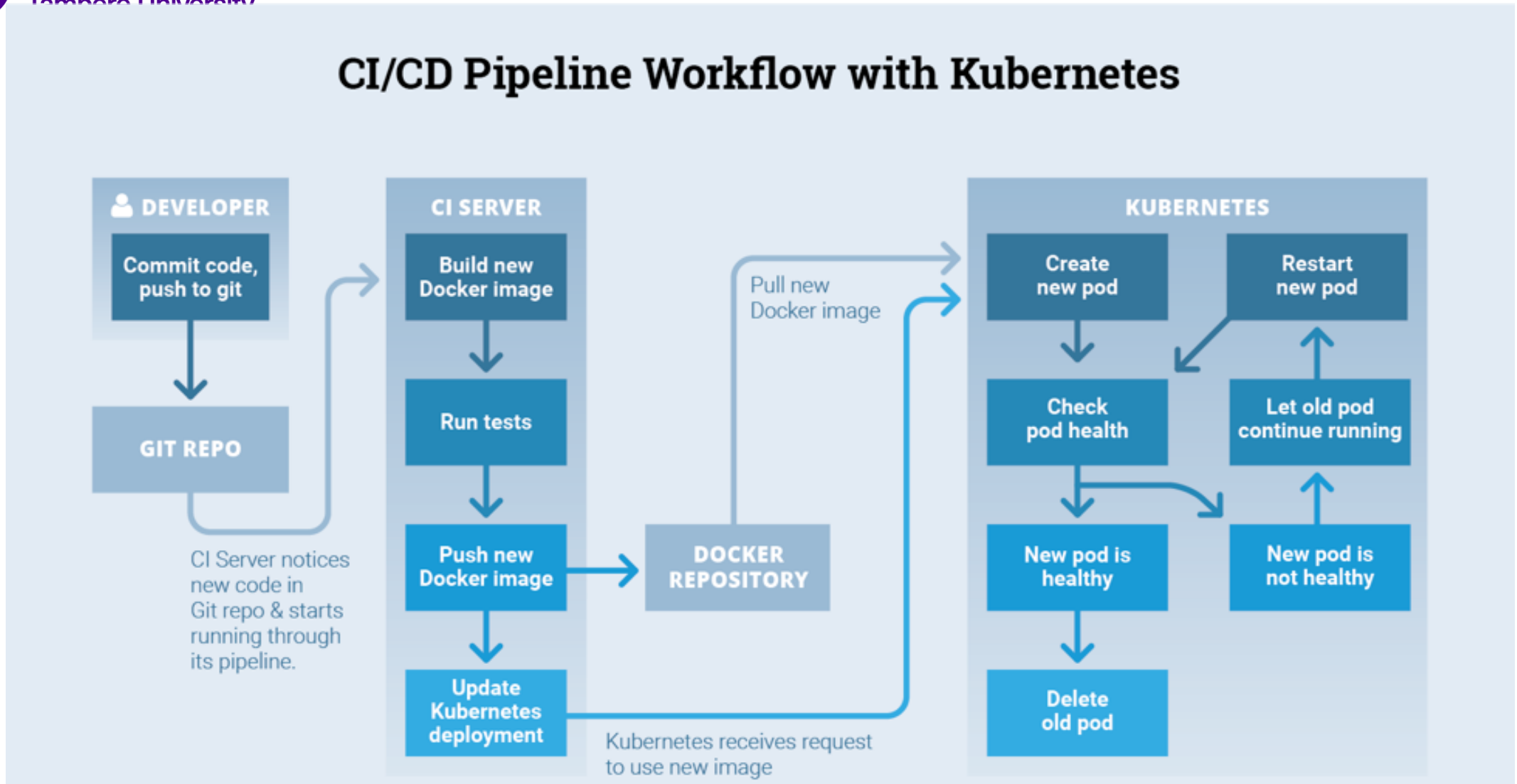
Huge number or tools available

- https://digital.ai/periodic-table-of-devops-tools
- https://landscape.cncf.io

Summary of cloud native

One proposal



Fine but drawn by a Kubernetes consultancy company

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What it means to be Cloud Native approach — the CNCF way

https://medium.com/developingnodes/what-it-means-to-be-cloud-native-approach-the-cncf-way-9e8ab99d4923

1. Containerization

- **Docker container** image is a lightweight, standalone, executable package of software that includes everything needed to run an application.

2. CI/CD

3. Orchestration

- **Kubernetes** is the market-leading orchestration solution.

4. Observability & Analysis

- Monitoring, logging, and tracing

5. Service MESH

6. Networking and Policy

- Flexibility with authorization, admission control and data filtering

7. Distributed Database

- When you need more resiliency and scalability than you can get from a single database

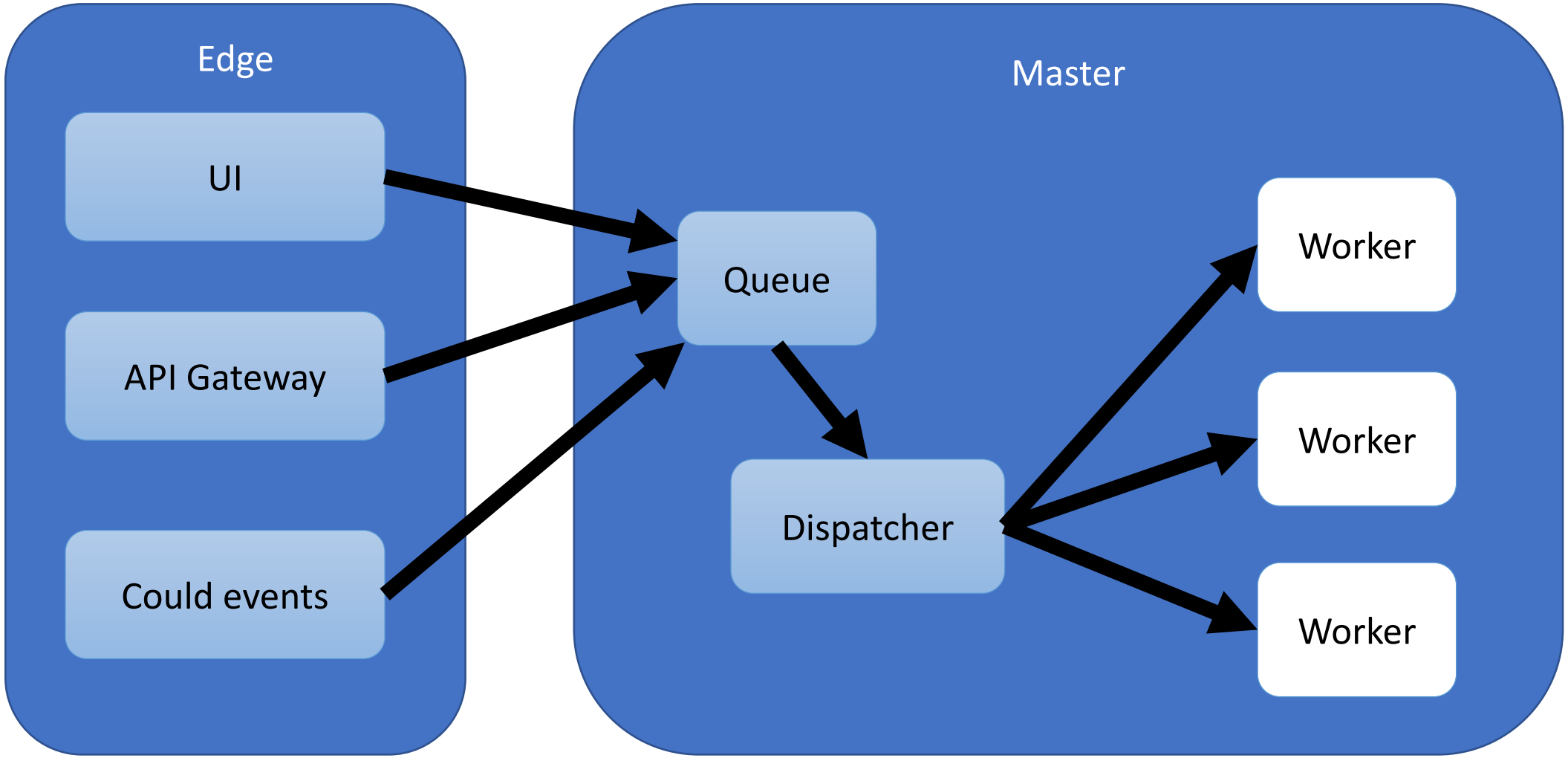
8. Messaging

9. Container registry and runtimes

10. Sofware distribution

Serverless

Baldini et al: Serverless Computing: Current Trends and Open Problems



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Microservices vs. Serverless/FaaS
(They are different – do not call serveless microservices)

- Microservice
  - Small services running in their own process and communicating with lightweight services
  - Can be stateful

- Serverless / FaaS
  - Short term execution triggered by a request, then closes down
  - For stateless computing

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Some comparison

	Microservice	Serverless / FaaS
Bug hunting	Easier (but not easy)	Difficult
Infrastructure code	May be complex	Minimal or even non-existent
Scaling	Need to be implemented	Automatic
Performance	Good	Possible cold-start issues
Running cost	May include cost of idle time	Pay only per use

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Microfront-ends

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All 91 Pending 0 Running 0 Finished 91 Branches Tags

Run Pipeline

Kari Systä
@systa

Set status
Profile
Settings
Sign out

Status	Pipeline	Triggerer	Commit	Stages		
passed	#10909 latest		release 4a643309 Saved modified emacs b...		00 3 da	
passed	#10908 latest		master 4a643309 Saved modified emacs b...		00:01:02 3 days ago	
passed	#10907		master 4e1301f7 fixed folder name in root ...		00:01:05 3 days ago	
passed	#8363		release a5954f38 Push deadline		00:00:57 2 weeks ago	
			release bd544248		00:00:56	

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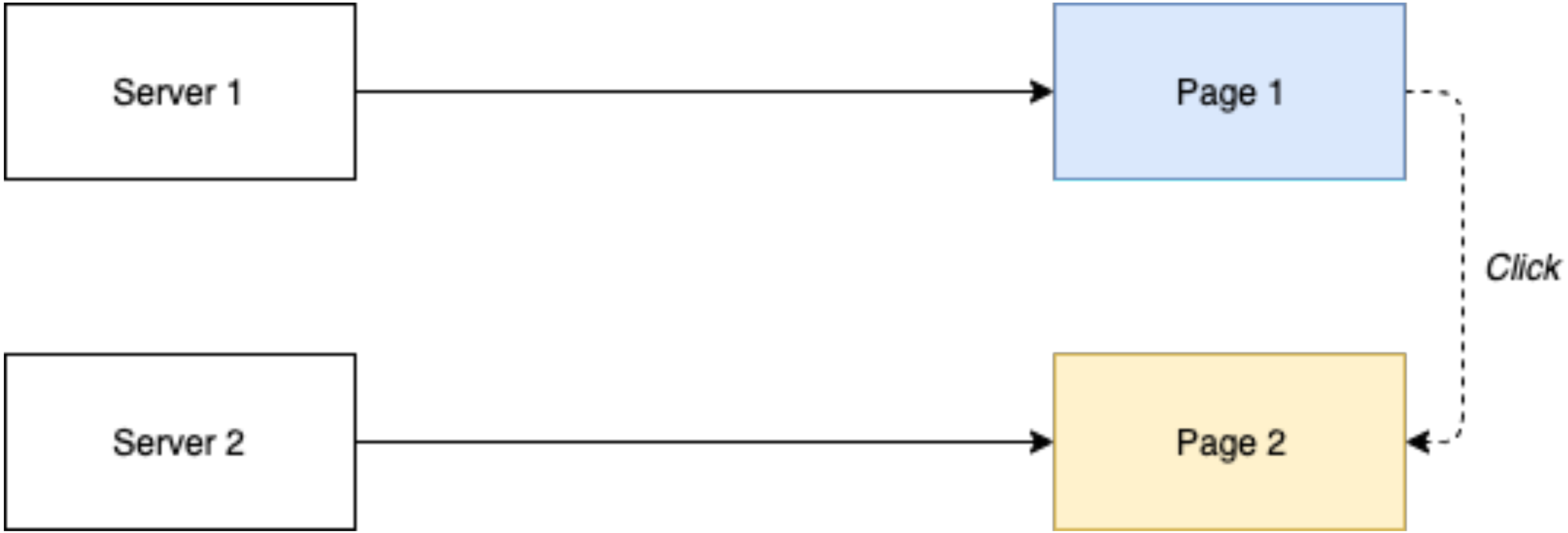
Alternative architectures

(from https://morioh.com/p/ee1b48c9de16)

1. Web Approach



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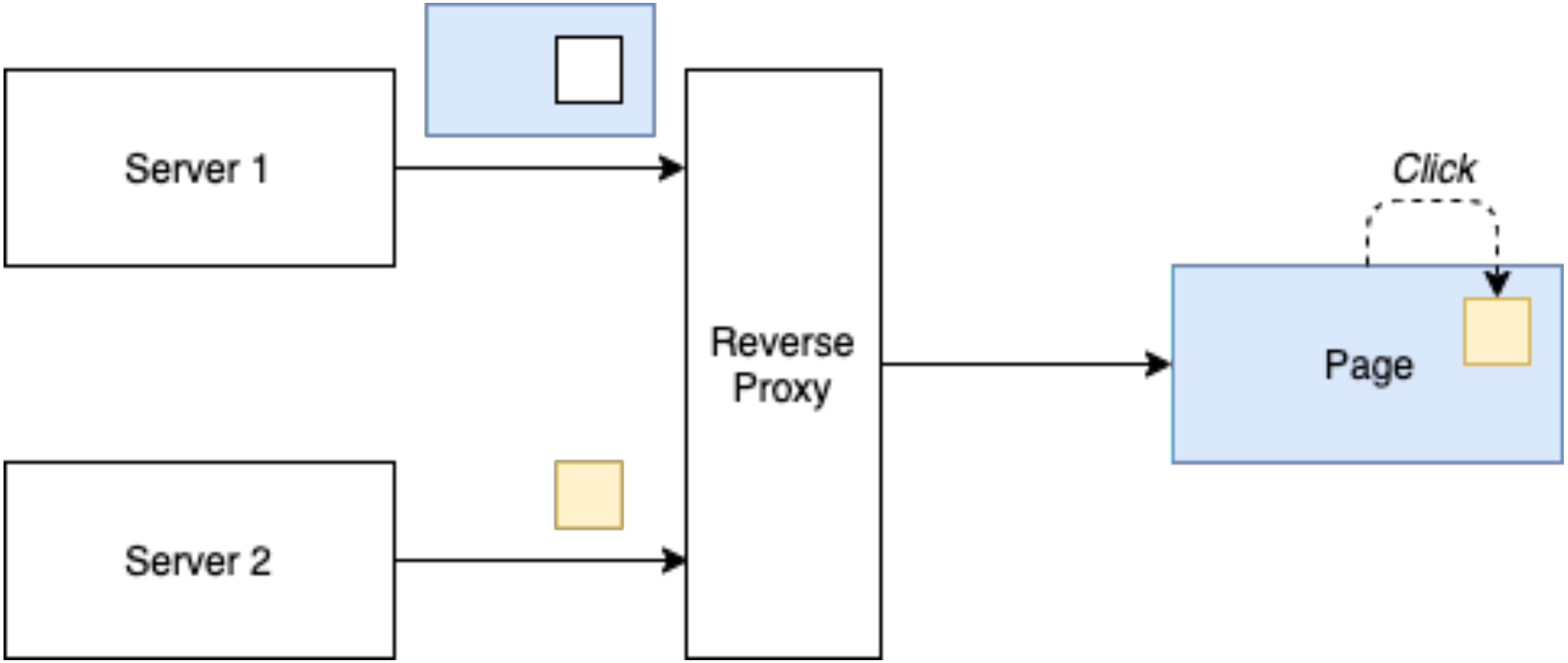
Alternative architectures

(from https://morioh.com/p/ee1b48c9de16)

2. Server-side composition



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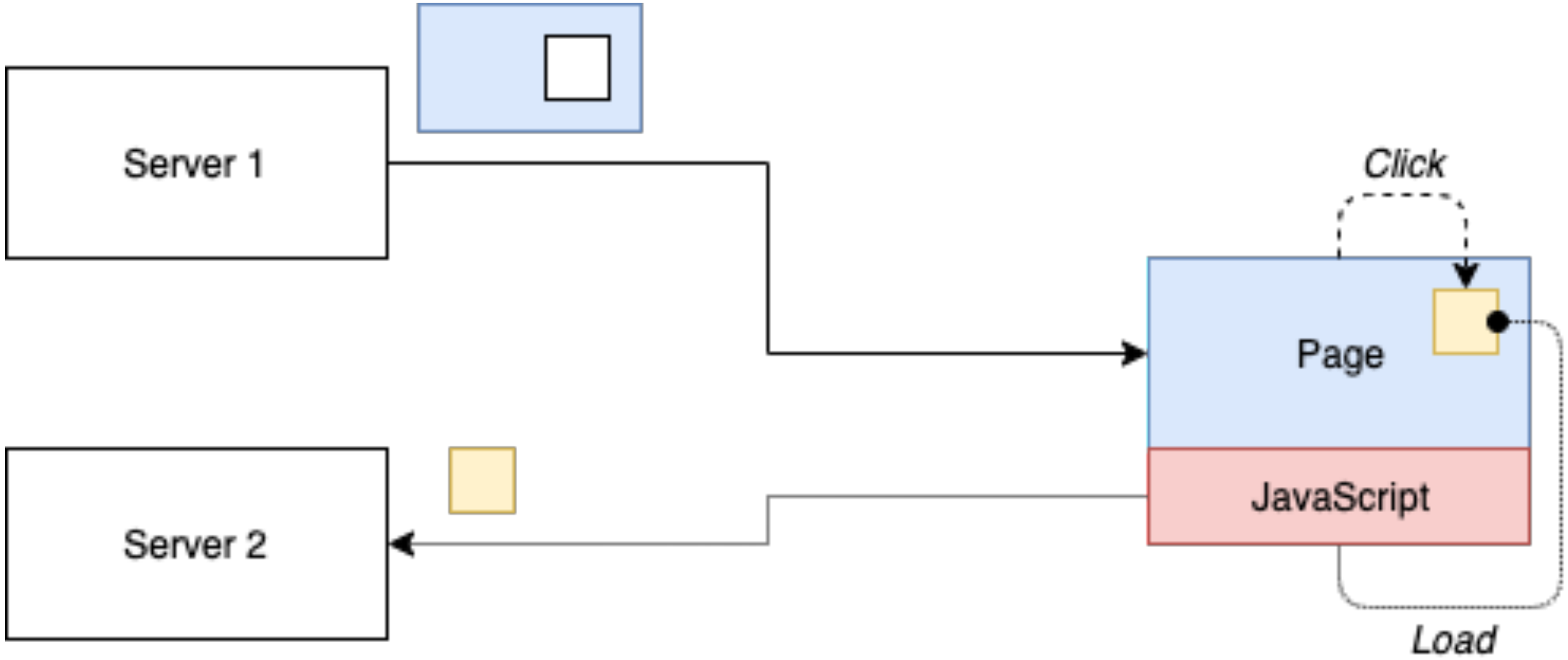
Alternative architectures

(from https://morioh.com/p/ee1b48c9de16)

3. Client-side composition



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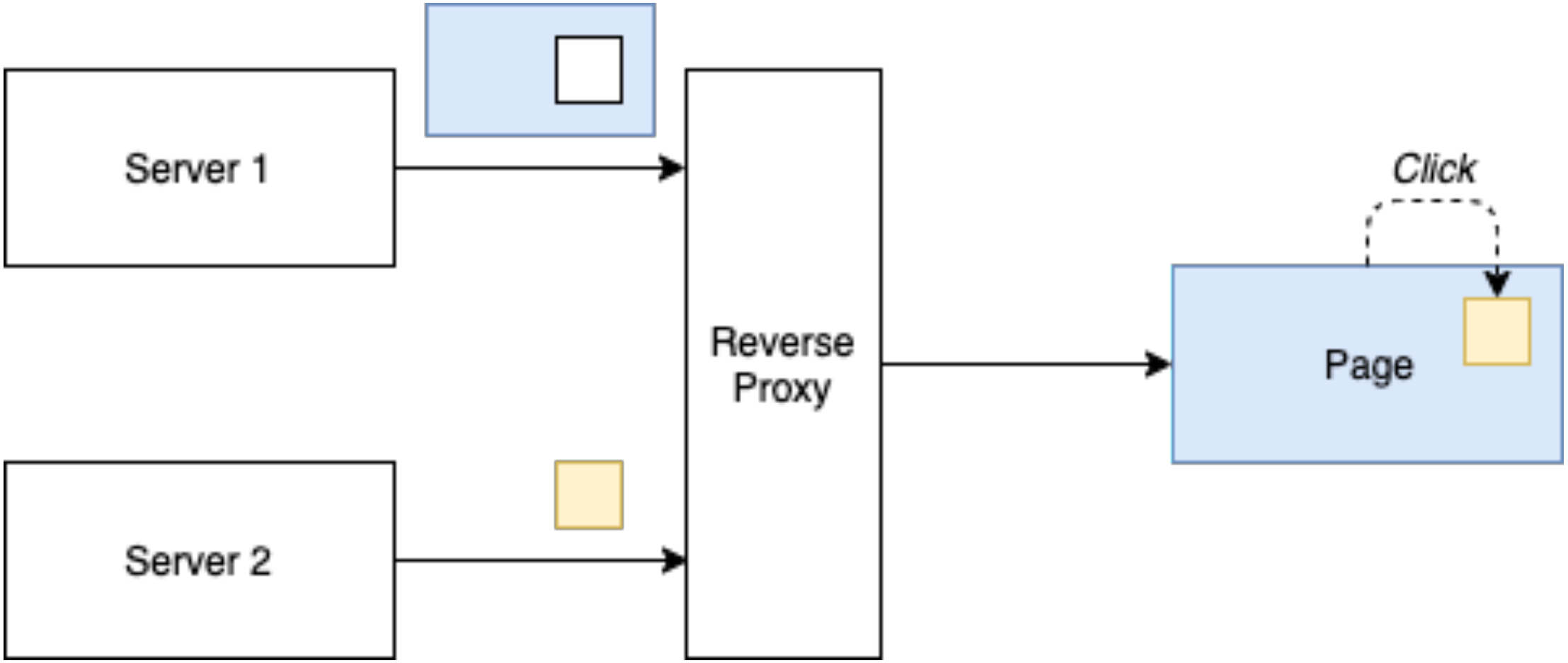
Alternative architectures

(from https://morioh.com/p/ee1b48c9de16)

4. Client-side rendering



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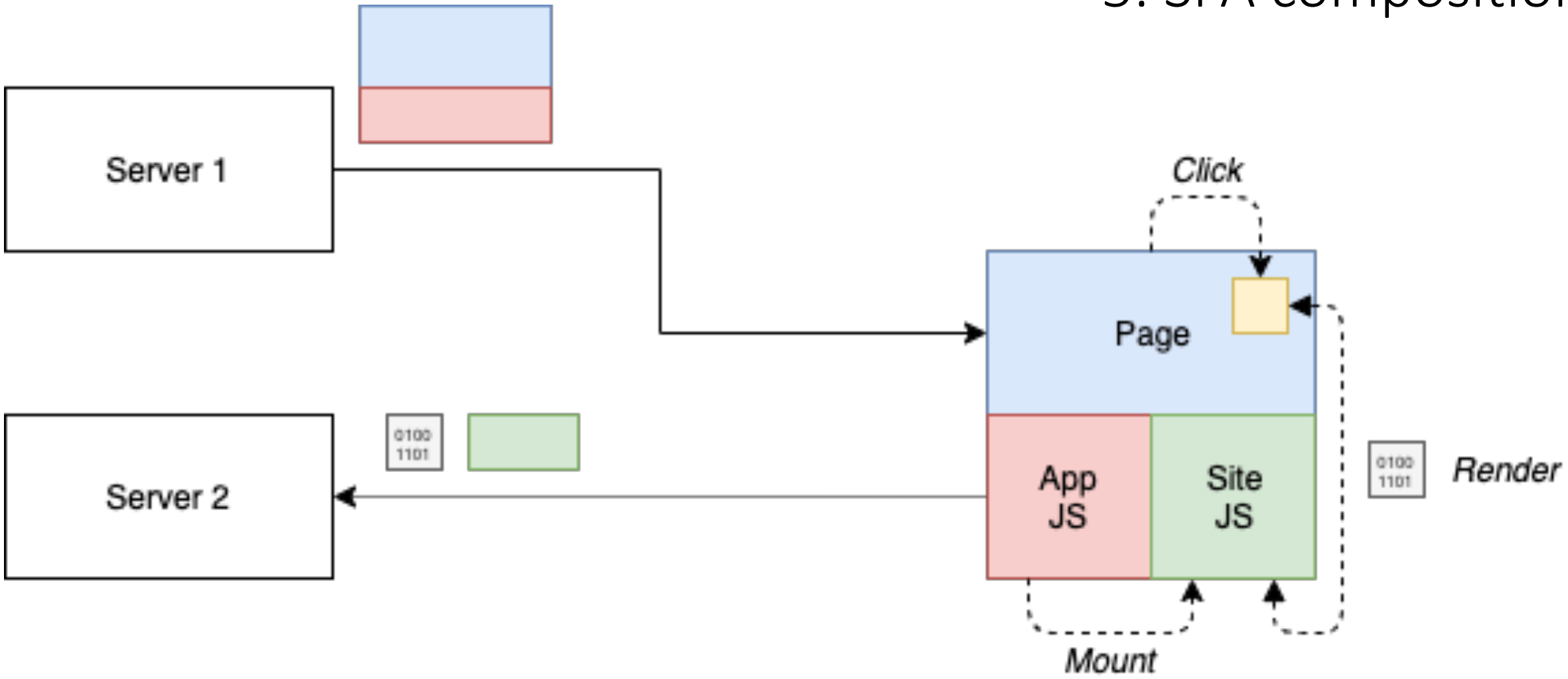
Alternative architectures

(from https://morioh.com/p/ee1b48c9de16)

5. SPA composition



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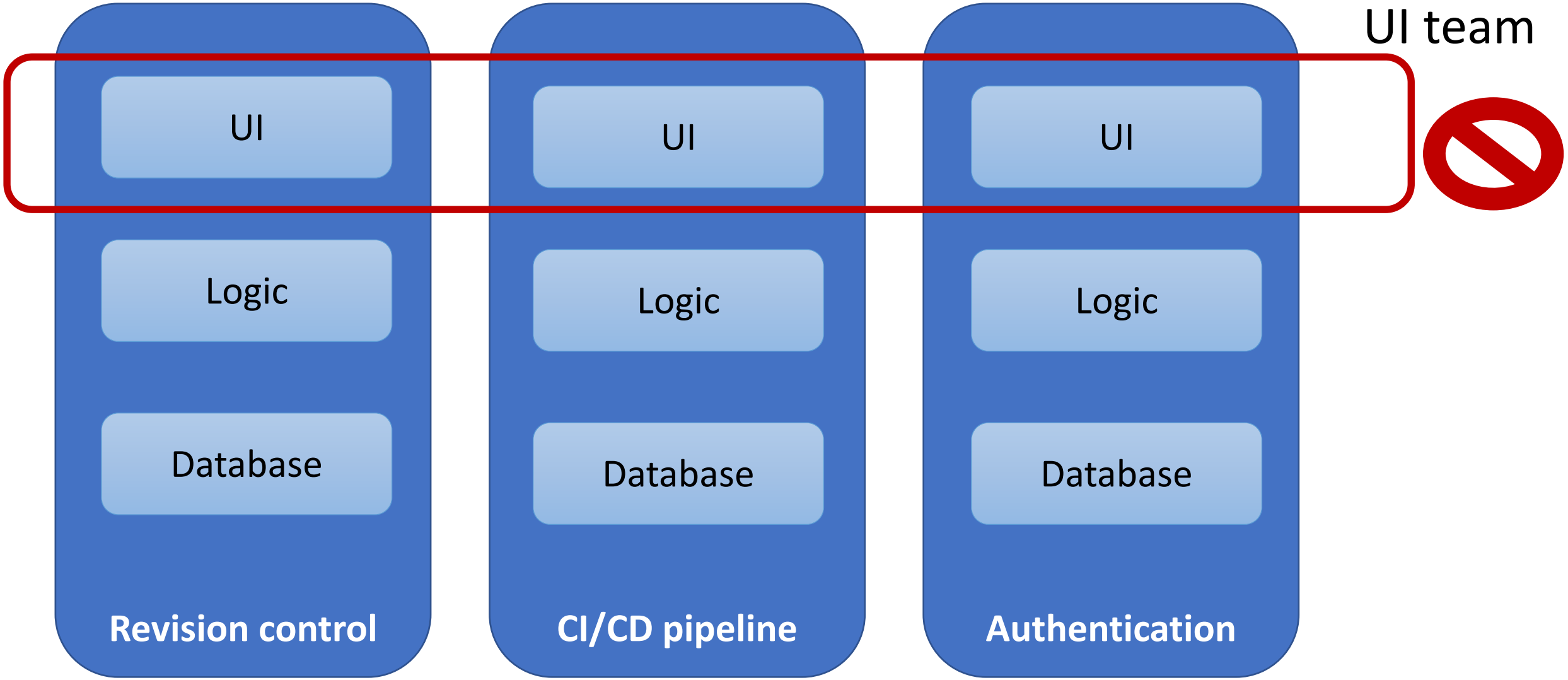
Organization and process issues



Stateful vs stateless computation

- If a service has an internal state it is difficult to
  - Scale it
  - Move it to other server or other hosting system

  => Stateless Services are subject to cloud-specific optimizations
- The internal state my be
  - volatile or
  - non-volatile
  - ... in memory, file local to container,

- Serverless / FaaS

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7R's of cloud Micration

Replace
with imilar or improved but SaaS

Reuse
in the new SaaS version

Refactor
towards cloud-native architecture

Replatform
by using cloud services

Rehost
to a VM

Retain

Retire

Reminder

https://thenewstack.io/10-key-attributes-of-cloud-native-applications/

- **Packaged as lightweight containers**
- **Developed with best-of-breed languages and frameworks**
- **Designed as loosely coupled microservices**
- **Centered around APIs for interaction and collaboration**
- **Architected with a clean separation of stateless and stateful services**
- **Isolated from server and operating system dependencies**
- **Deployed on self-service, elastic, cloud infrastructure**
- **Managed through agile DevOps processes**
- **Automated capabilities**
- **Defined, policy-driven resource allocation**