สยามชำนาญกิจ
SIAM CHAMNAN KIT

Cloud Native Application Container and 12-Factor

https://github.com/up1/course-12-factors-app

Foundation to build Cloud Native Application

https://github.com/cncf/toc/blob/main/DEFINITION.md

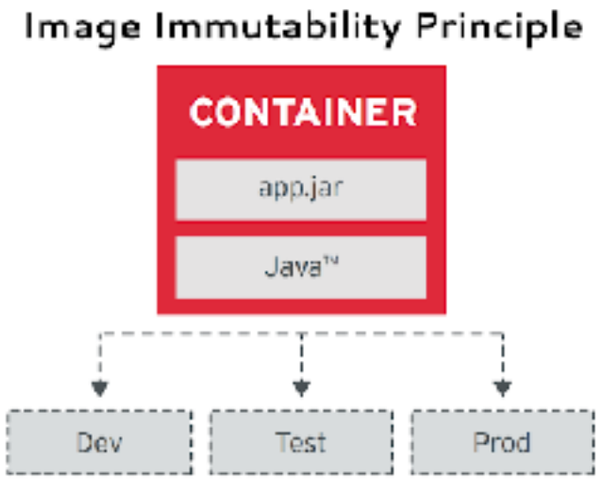
Cloud Native Application

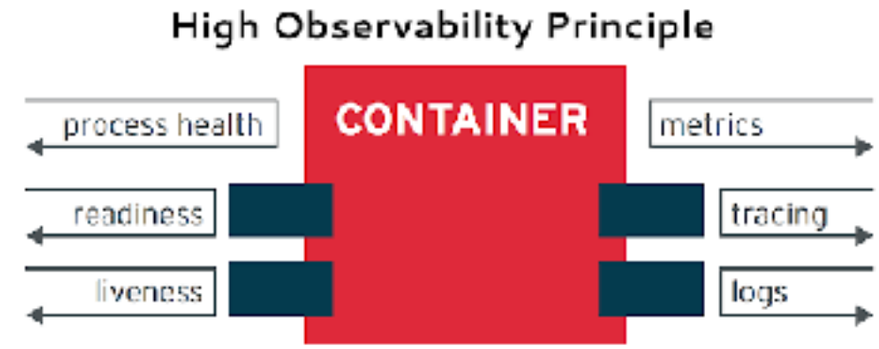
Increase efficiency
Reduce cost
Ensure availability and **scalability**

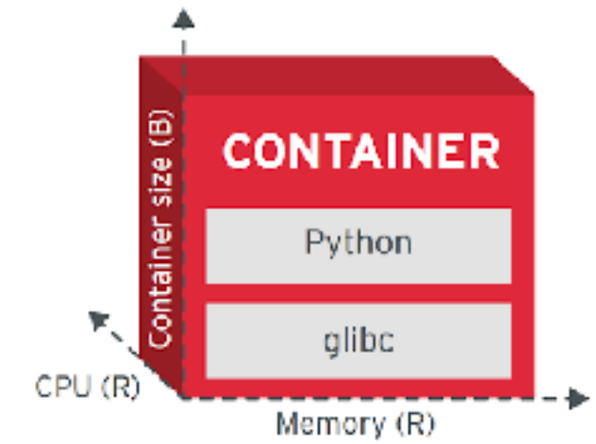
https://learn.microsoft.com/en-us/dotnet/architecture/cloud-native/definition

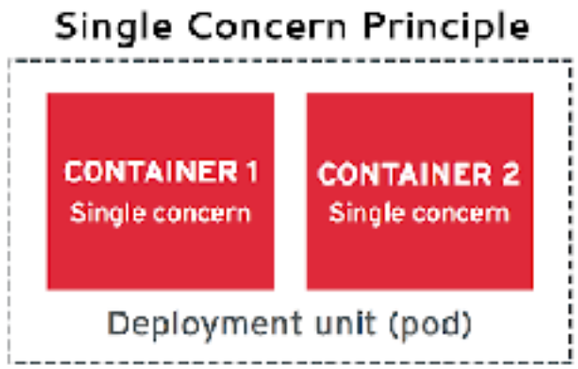
Container Design Principles

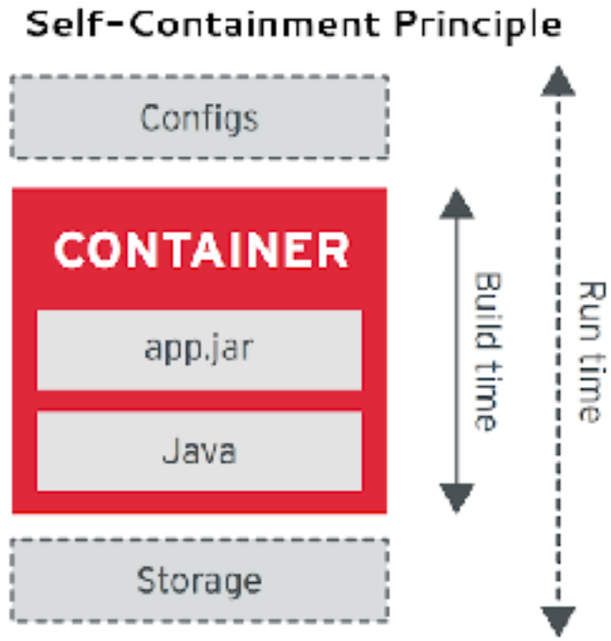
Container Design Principles









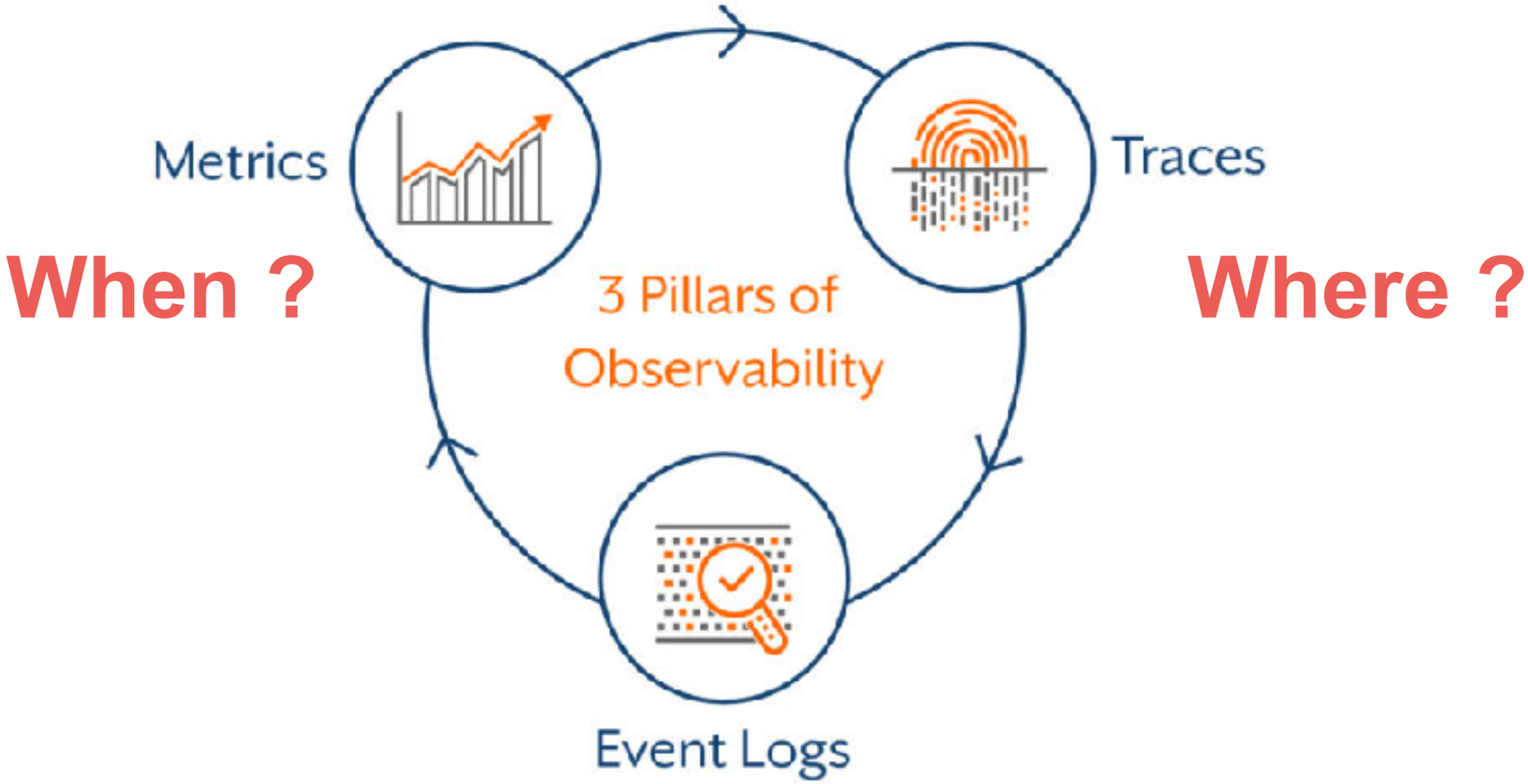


https://kubernetes.io/blog/2018/03/principles-of-container-app-design/

Container Design Principles

Build time	Runtime
Single concern	Runtime confinement
Self-containment	Process disposable
Image immutable	Lifecycle conformance
	High observability

Pillar of Observability

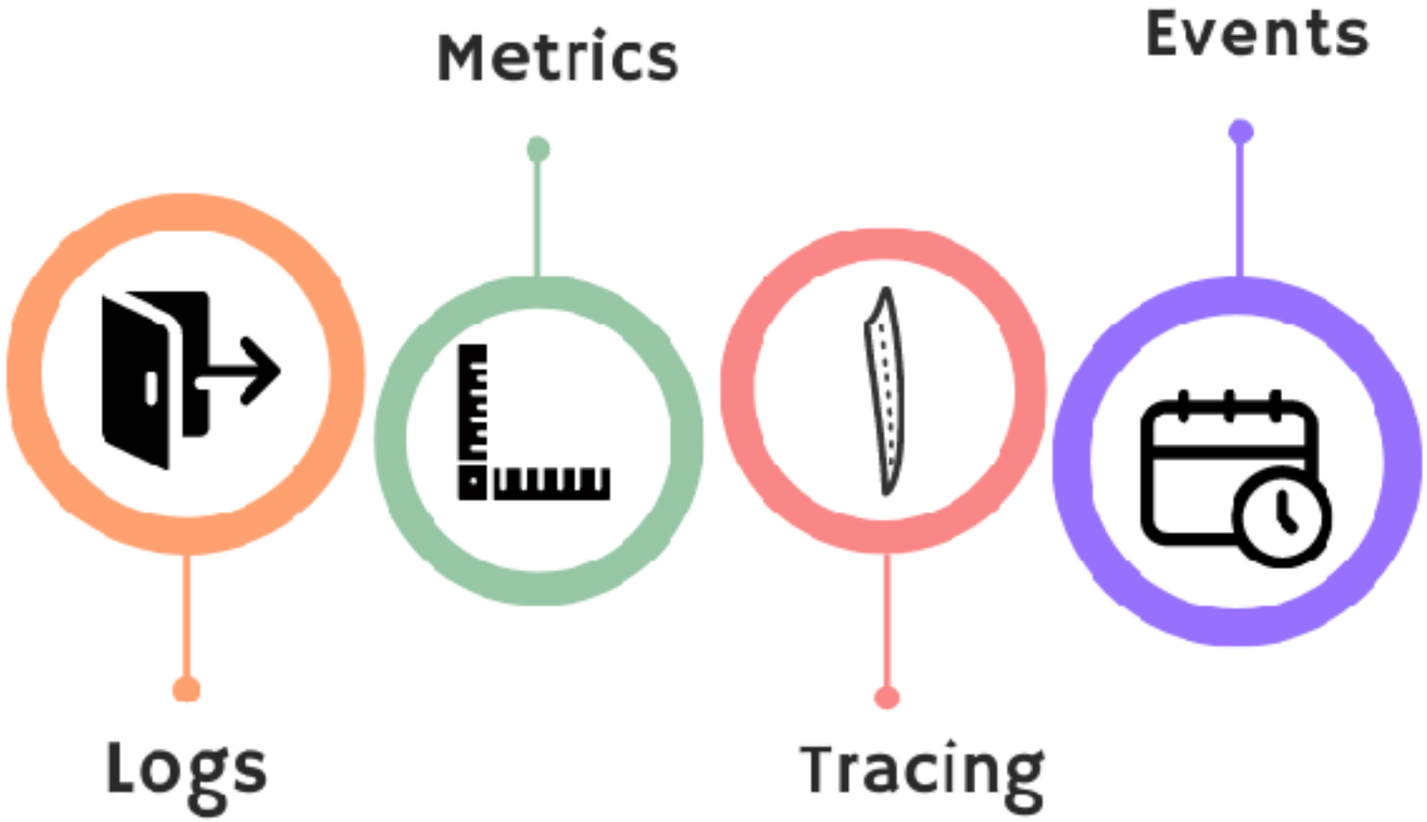


When ?

Where ?

What ?

THE FOUR PILLARS OF
API OBSERVABILITY



https://apitoolkit.io/blog/the-four-pillars-of-api-observability/

12 Factor App

https://12factor.net/

12 Factor App

Methodology for building software-as-a-service app
Declarative formats for setup automation
Portability
Deployment on modern platform
Minimize divergence (dev vs prod)
Easy to scale up/out

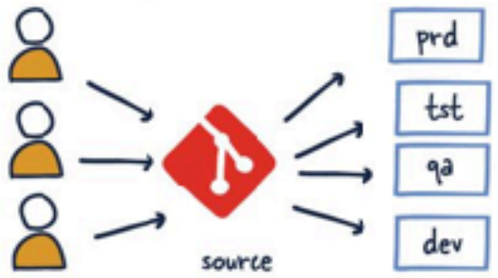
https://12factor.net/

12 Factor

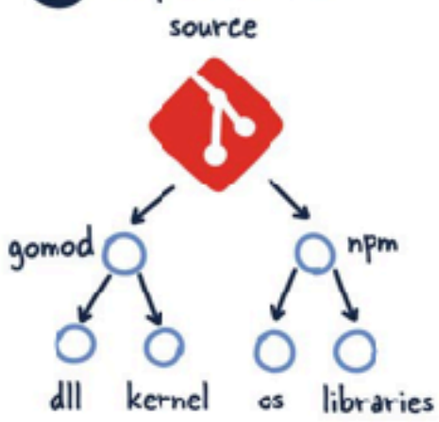
Build	Scalable	Maintainable
Portability	Security	Minimize divergence
Monitoring/Observability		

12 FACTOR APP REVISITED

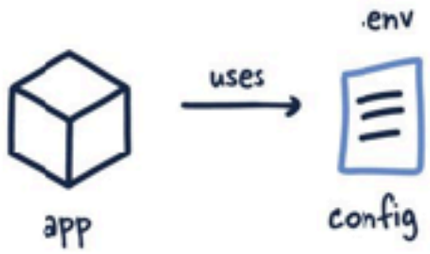
1 code base



2 dependencies



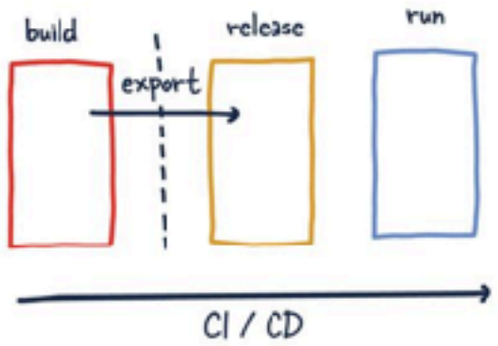
3 configuration



architecture notes

4 backing services

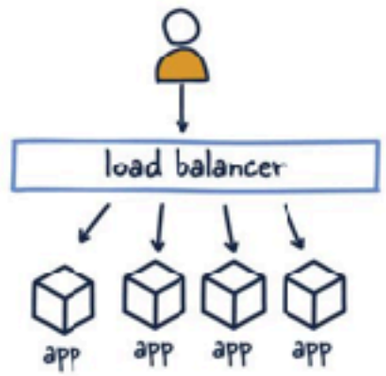
5 build, release, run



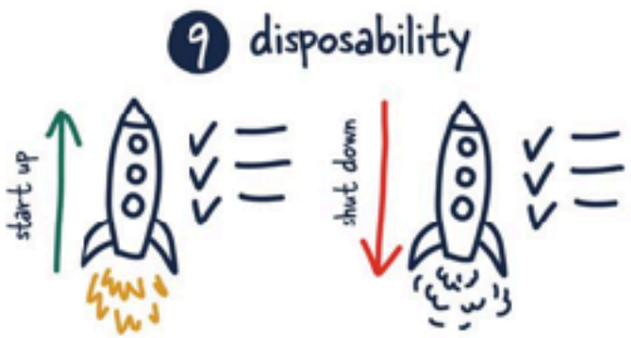
6 Processes

7 port binding

8 concurrency

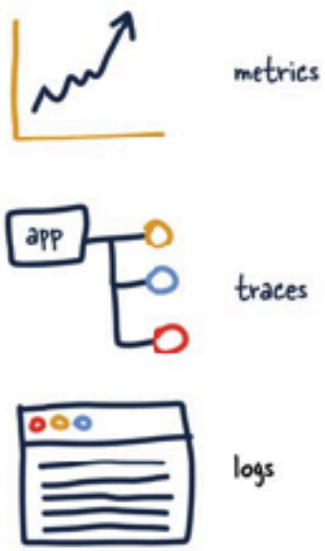


9 disposability



10 dev/prod parity

11 logs



12 admin processes

https://architecturenotes.co/12-factor-app-revisited/

12 + 3 Factor

Codebase
One codebase tracked in version control, many deploys

Dependencies
Explicitly declare and isolate dependencies

Config
Store config in the environment

Backing services
Treat backing services as attached resources

Build, Release and Run
Strictly separate build and run stages

Processes
Execute the app as one or more stateless processes

Port Binding
Expose services via port binding

Concurrency
Scale out via process model

Disposability
Maximize robustness with fast startup and graceful shutdown

Dev/Prod Parity
Keep development, staging and production as similar as possible

Logs
Treat Logs as event streams

Admin Processes
Run admin/management tasks as one-off processes

API First
Define service contract

Telemetry
Monitor process performance

Authentication
Secure applications across hardware, network, and software layers

https://www.handsonarchitect.com/2022/08/cloud-native-fifteen-factor-apps.html

12 Factor

Build

Scalable

Maintainable

1. Codebase
2. Dependencies
3. Config
4. Backing services
5. Build release run

API first

12 Factor

Build

Scalable

Maintainable

6. Processes
7. Port binding
8. Concurrency
9. Disposability

12 Factor

Build

Scalable

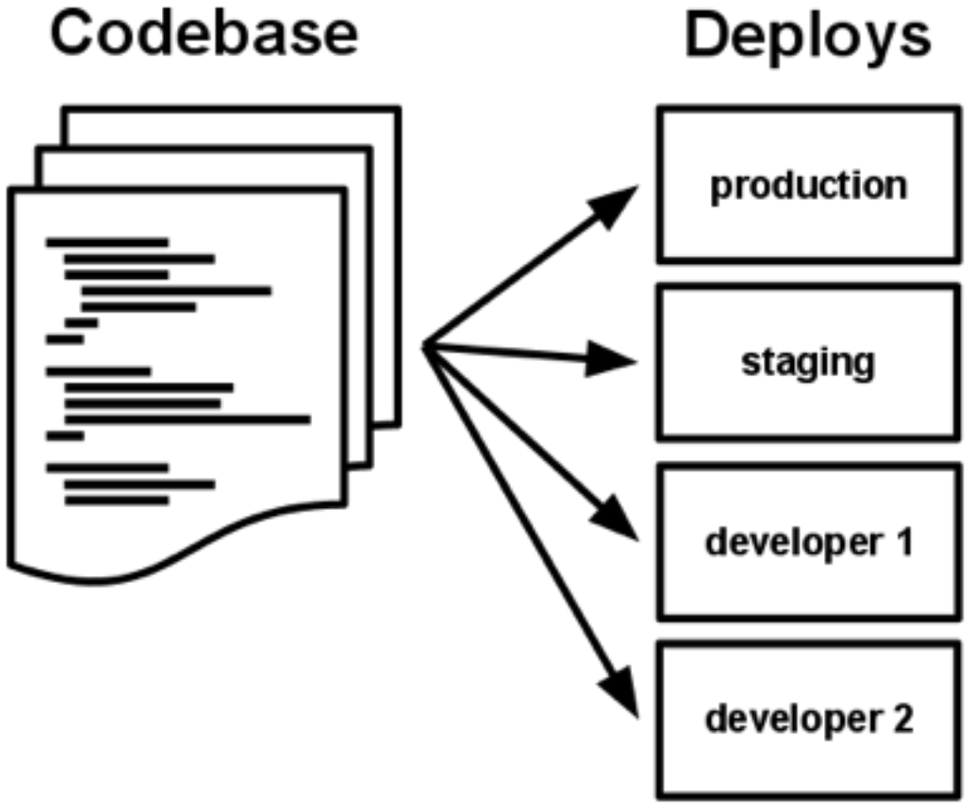
Maintainable

10. Dev/prod parity
11. Logs
12. Admin process

1. Codebase

1. Codebase

One codebase tracked in revision control, many deploys



Version Control System

https://git-scm.com/

Git Branching Strategies

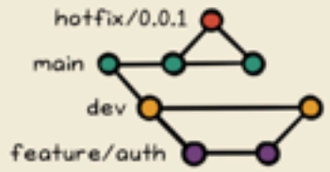
by levelupcoding.co

Feature branching

Each new feature has its own branch. Once the changes are complete and merged in, the branch can be deleted.

Gitflow

Has branches for features, releases, hotfixes, and a dedicated branch for production and development.

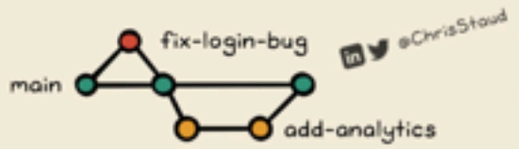


GitLab Flow

Branches are created for features, releases, and environments. The main branch is always production-ready.

GitHub Flow

Branches are created for new features, bug fixes, and experiments. The main branch is the only deployable branch, it is kept production-ready.



@NikkiSiapno

Trunk-based

All branches other than the main branch are short-lived and merged in within a defined timeframe (usually a day). Large features are built incrementally and hidden behind feature flags.

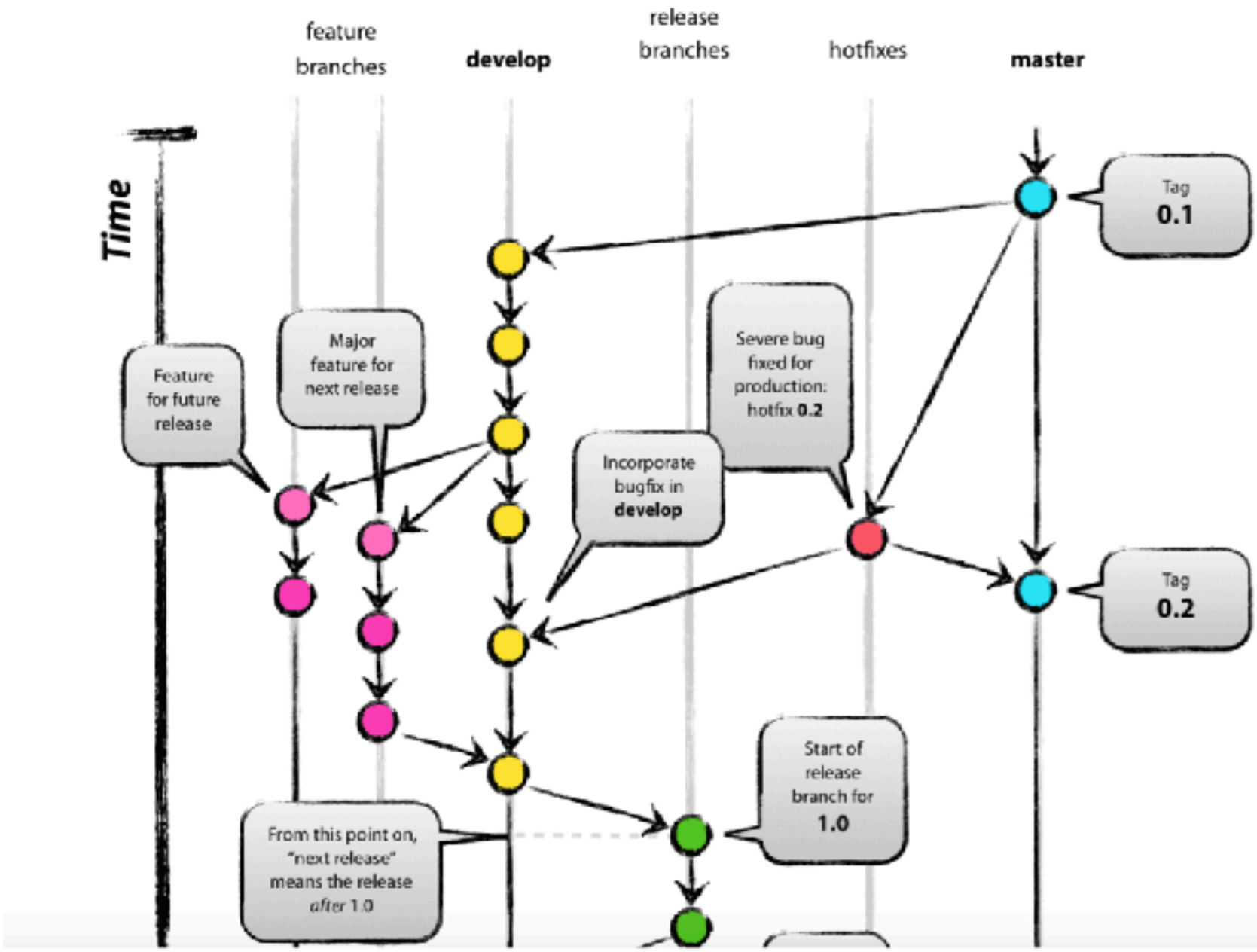
@ChrisStaud

Brought to you by

LEVEL UP CODING

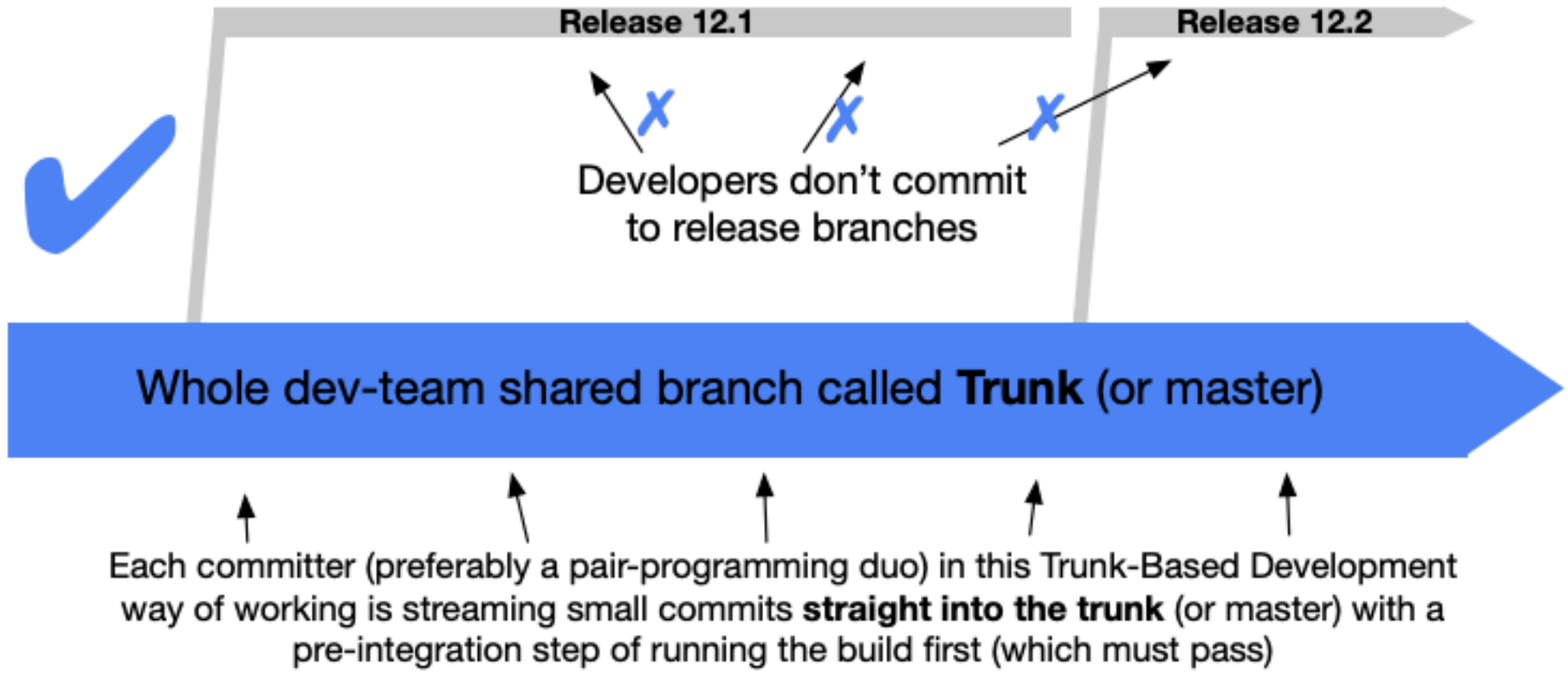
https://twitter.com/ChrisStaud/status/1752341883198853588

Git branching model



https://nvie.com/posts/a-successful-git-branching-model/

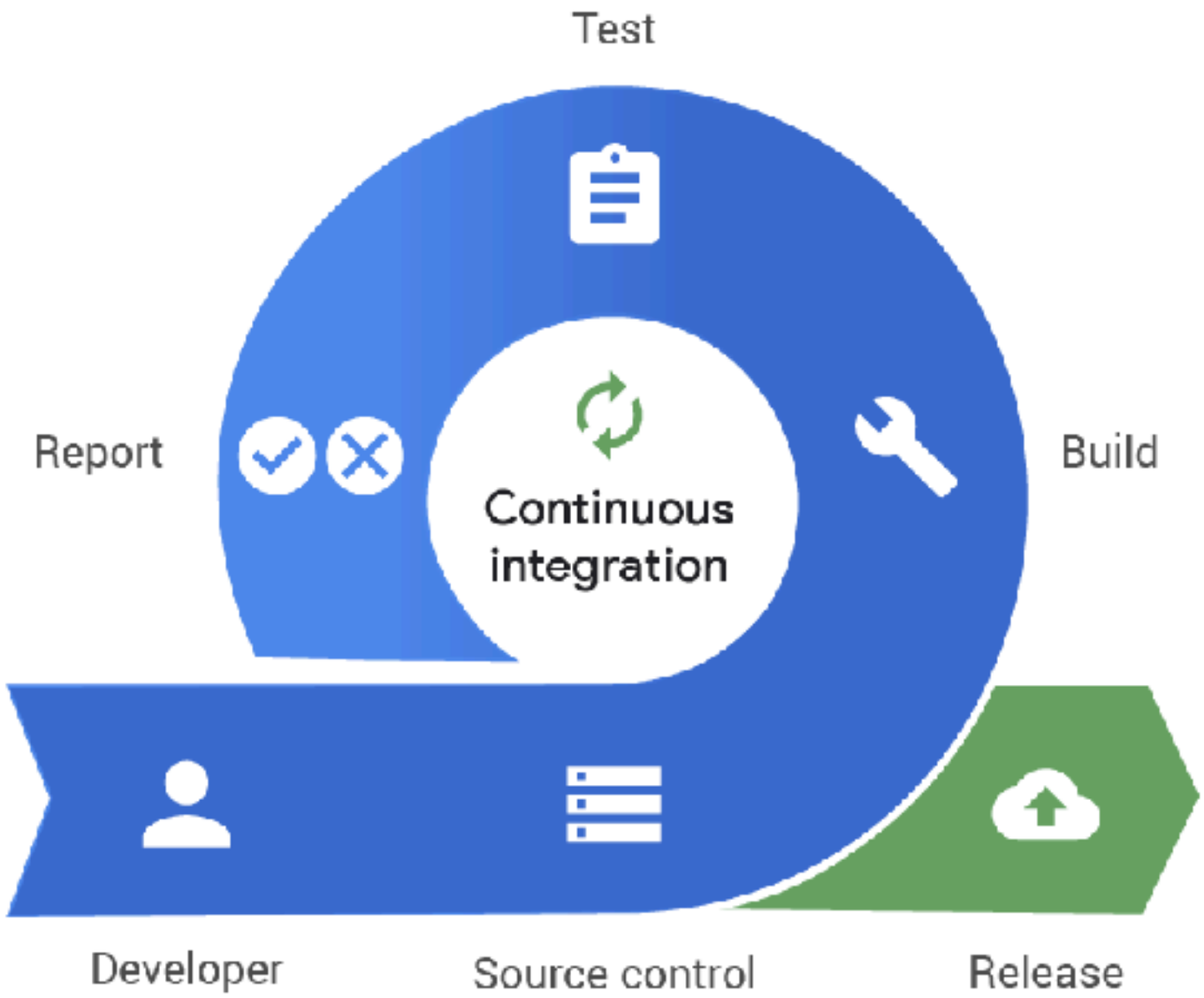
Trunk Based Development



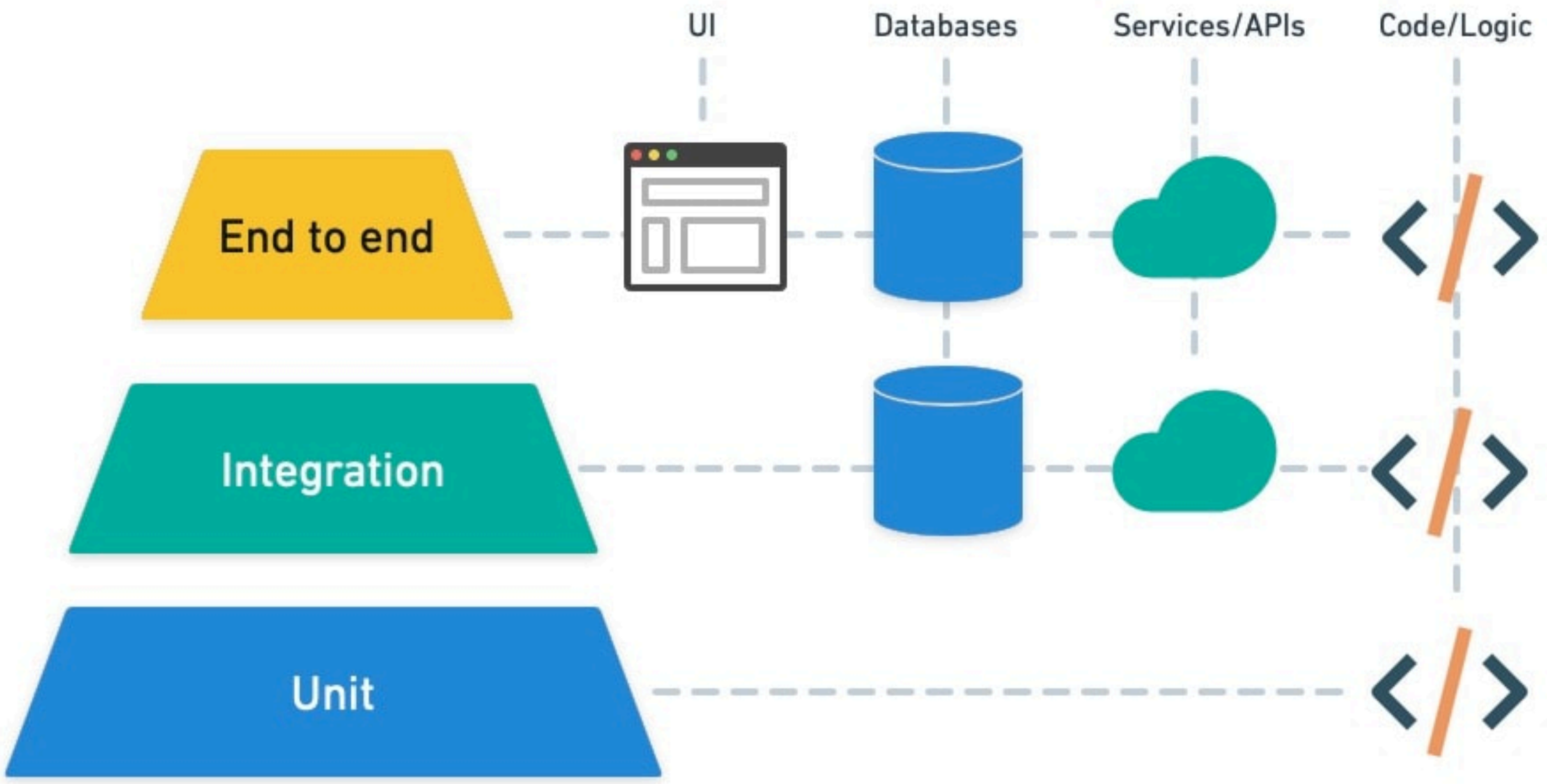
https://trunkbaseddevelopment.com/

Repository ?

Continuous Integration



Automated Testing



2. Dependencies

2. Dependencies

Explicitly declare and isolate dependencies
Dependency management

3. Config

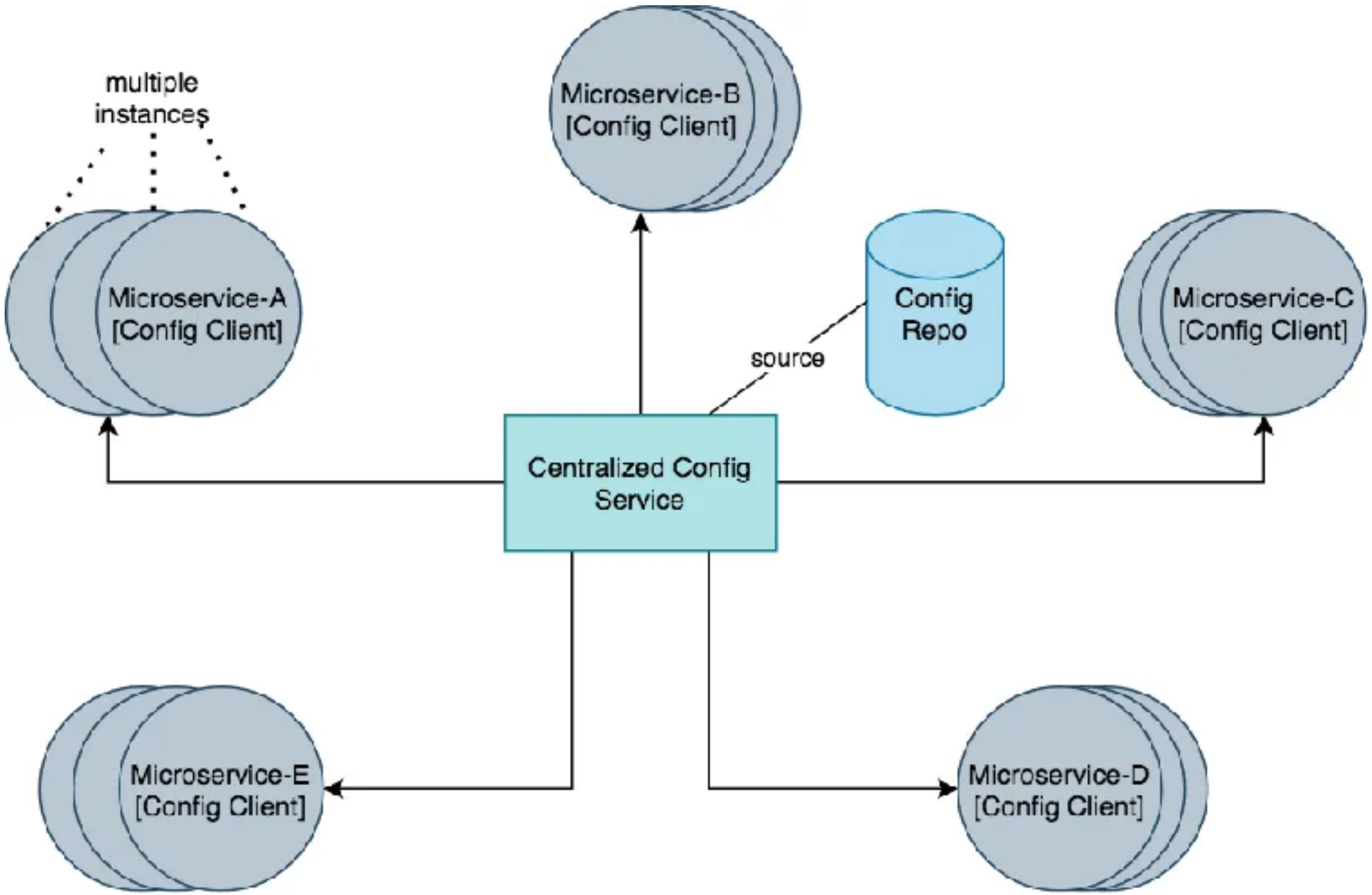
3. Config

Store config in environment

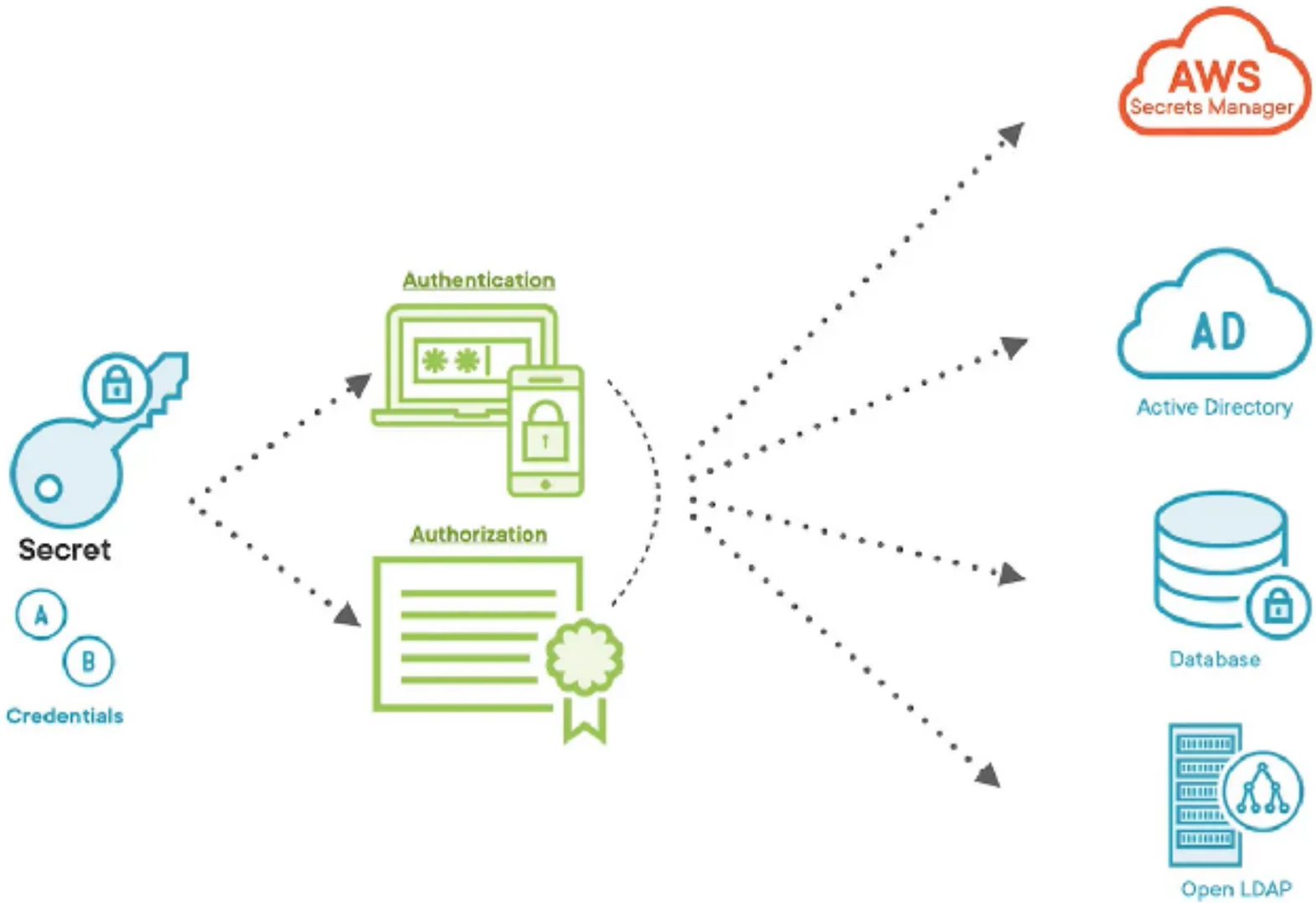
Configuration management

Environment variables (.env file)
Centralized management

Centralized ?

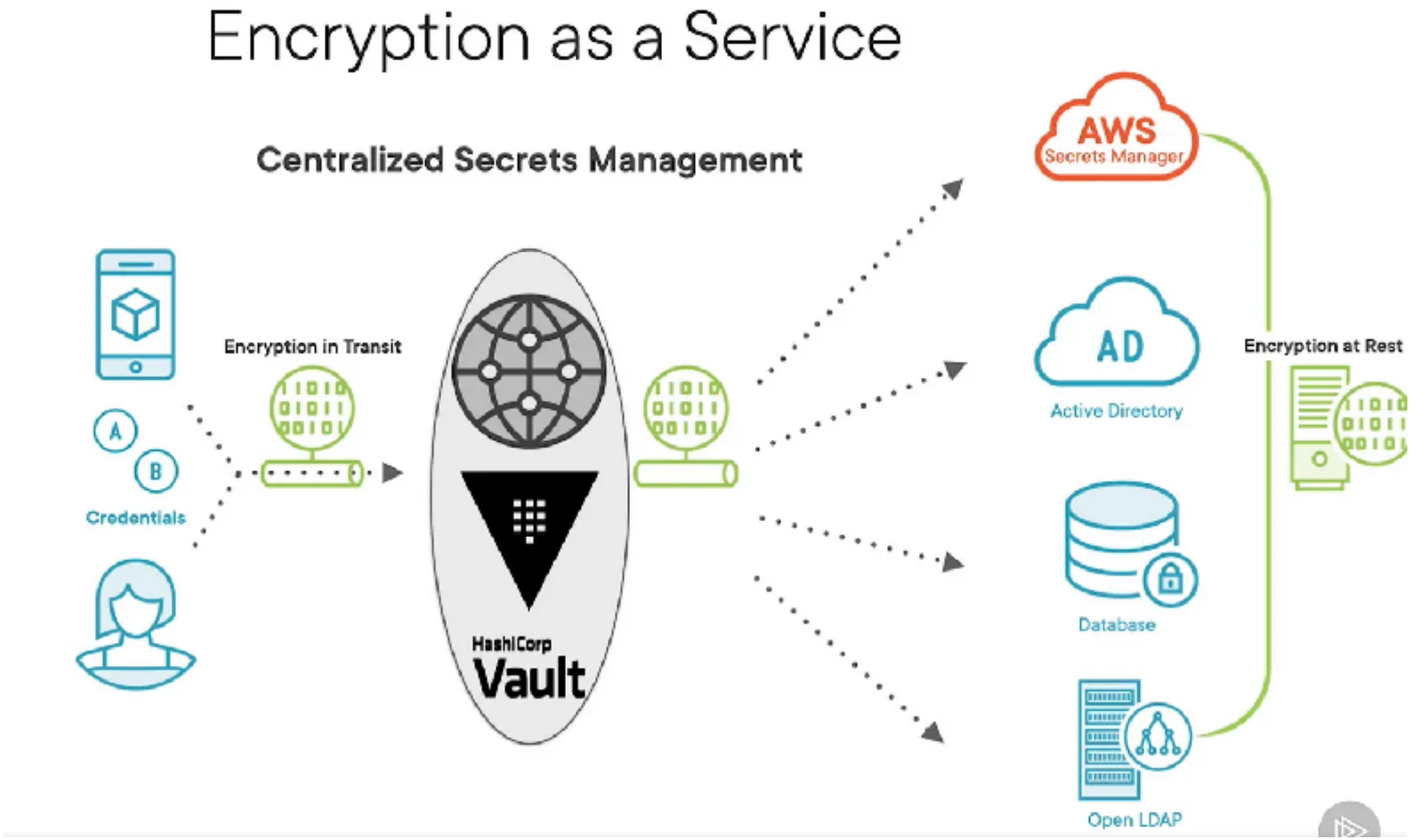


Credential/Secret management



https://medium.com/@pgpg05/secret-management-in-ci-cd-pipeline-982846596181

HashiCorp Vault



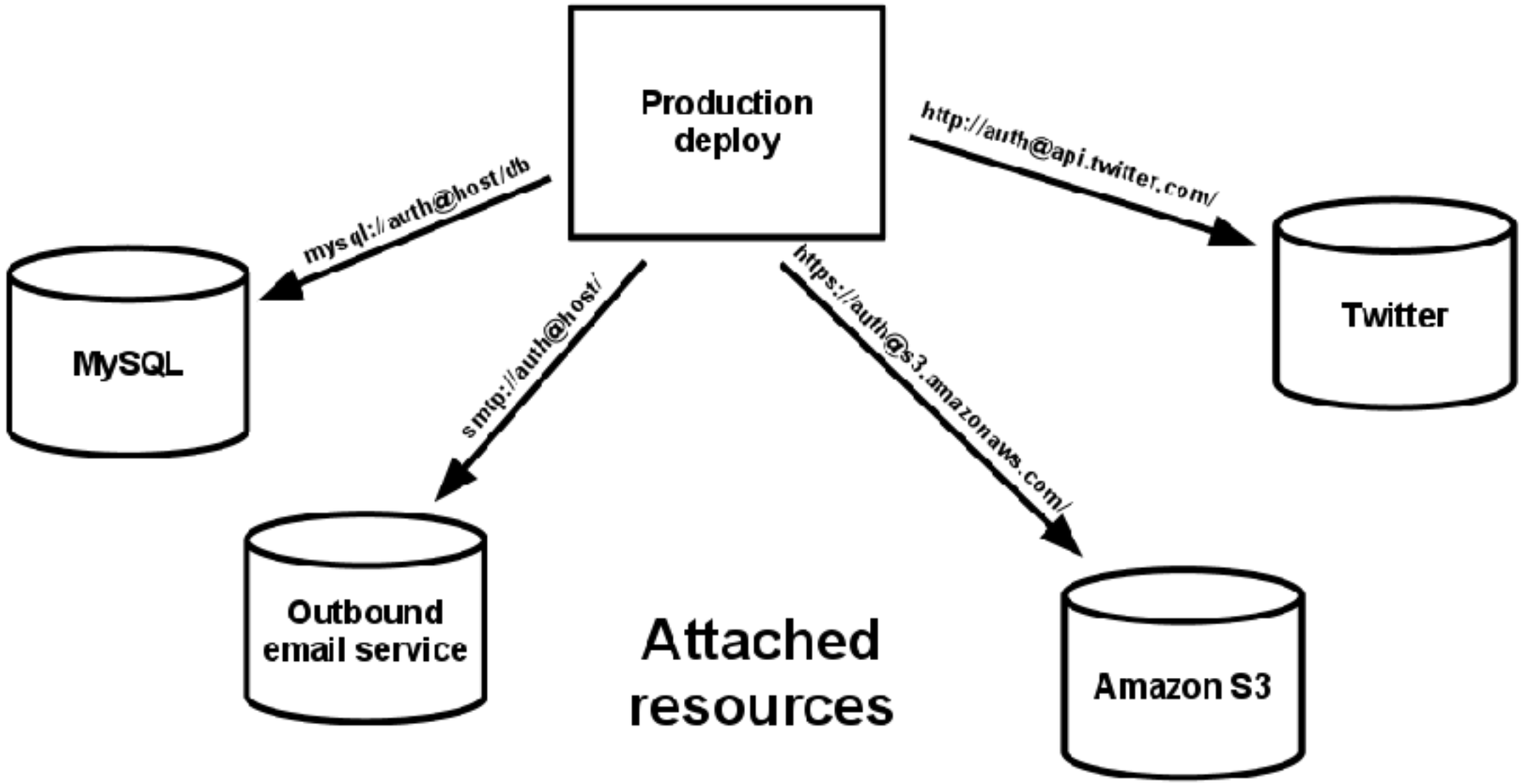
https://medium.com/@pgpg05/secret-management-in-ci-cd-pipeline-982846596181

4. Backing services

4. Backing services

Treat backing services as attached resources
Expose via addressable URL
Decouple resources from app

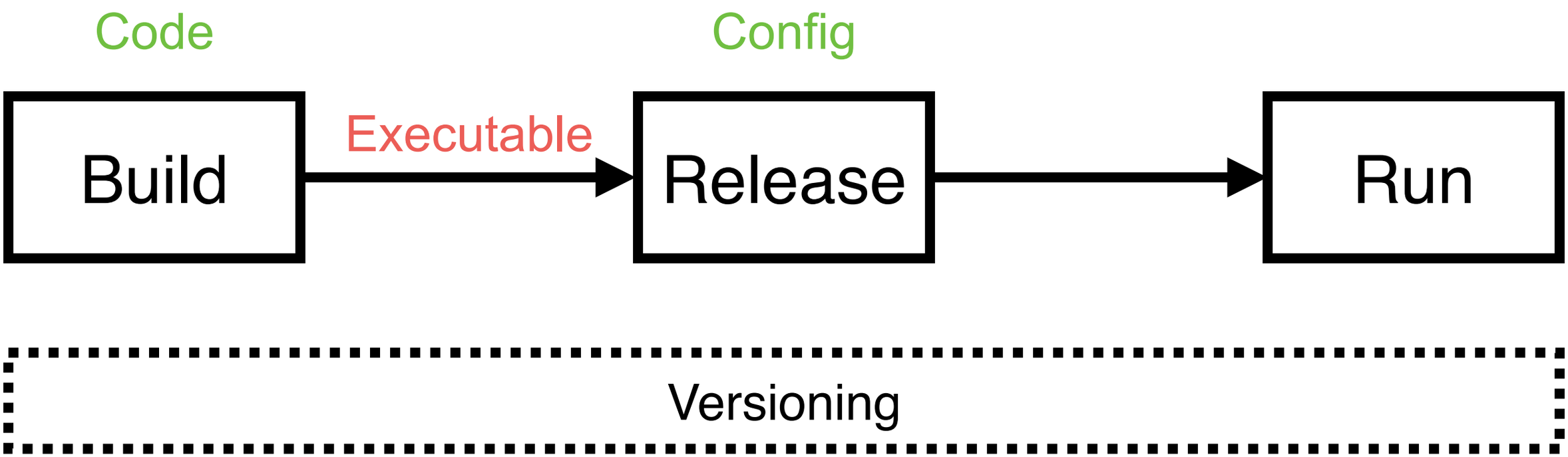
Backing services



5. Build, release, run

5. Build, release, run(time)

Strictly separate build and run stages



6. Processes

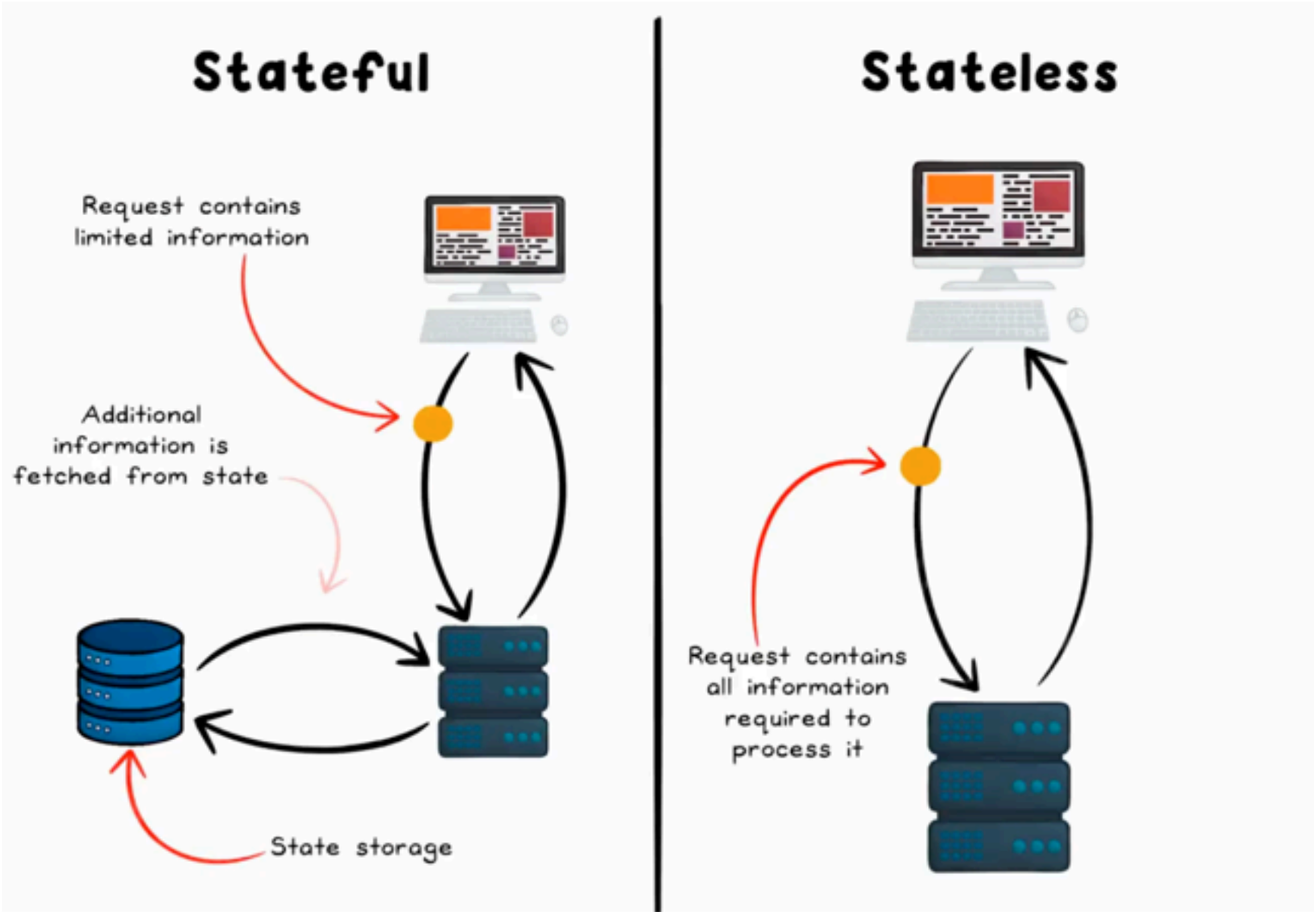
6. Processes

Execute the app as one or more **stateless** processes

Shared nothing

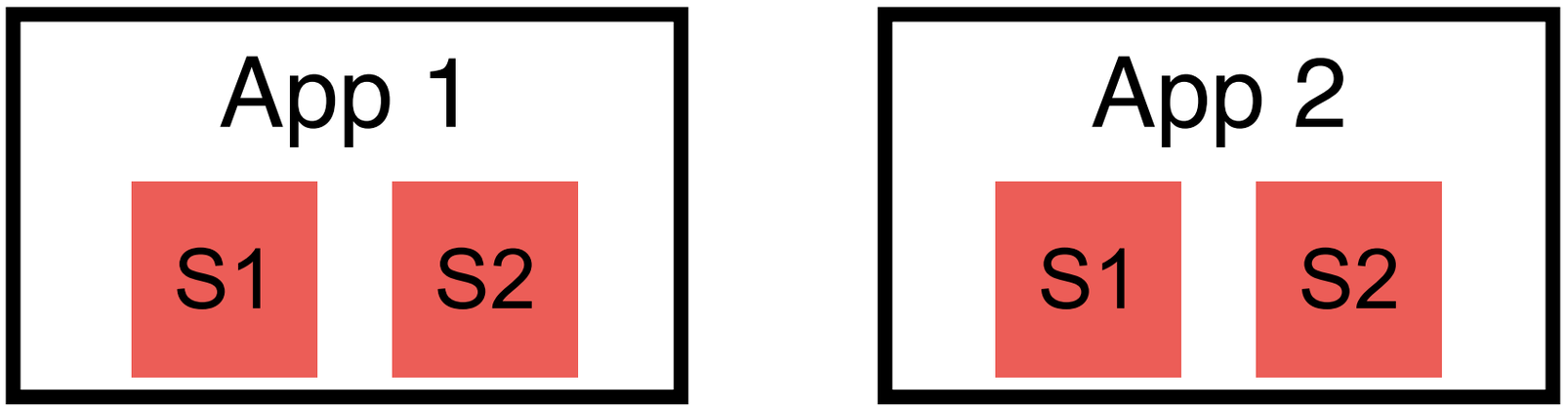
Isolated from other running services

Stateful vs Stateless

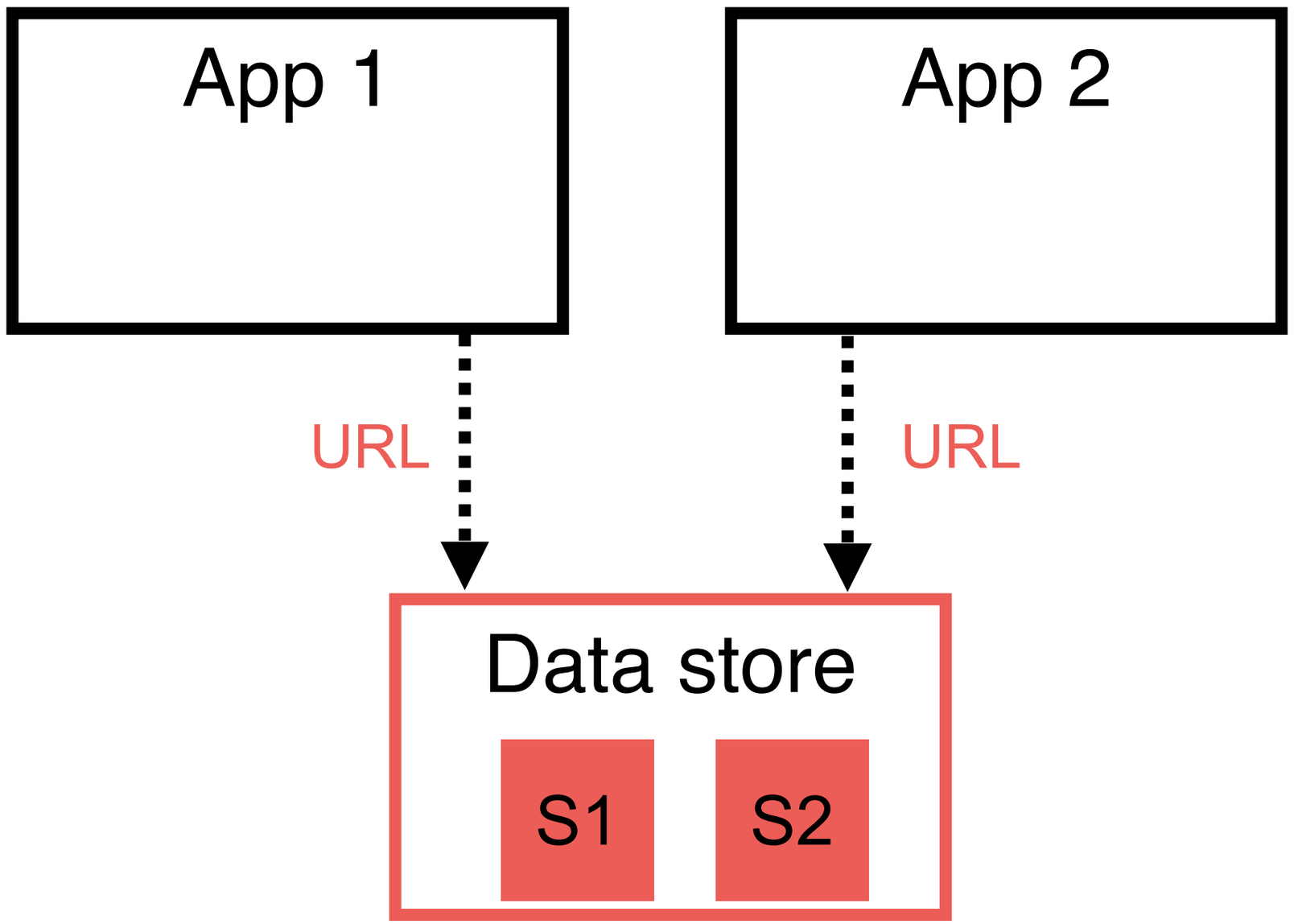


https://x.com/ChrisStaud/status/1737481416307323316

Isolated ?



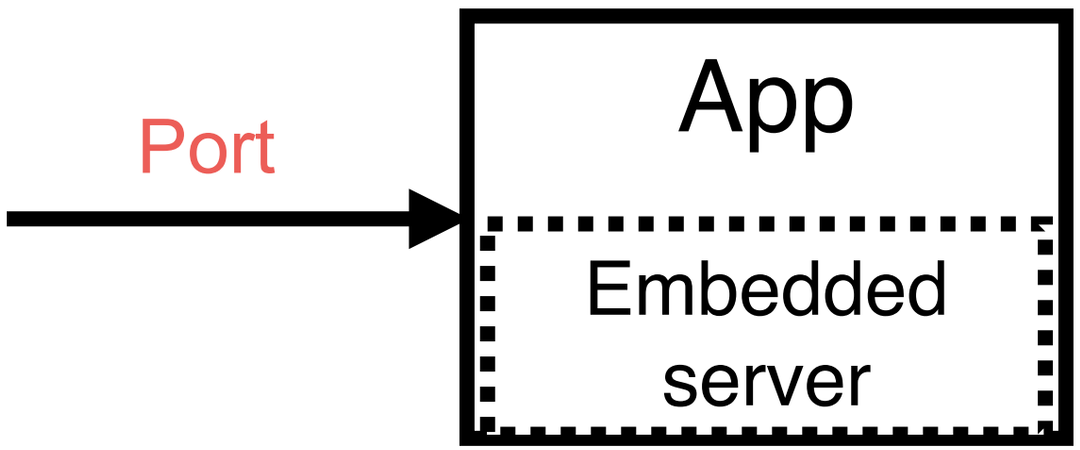
Sharing with backing service



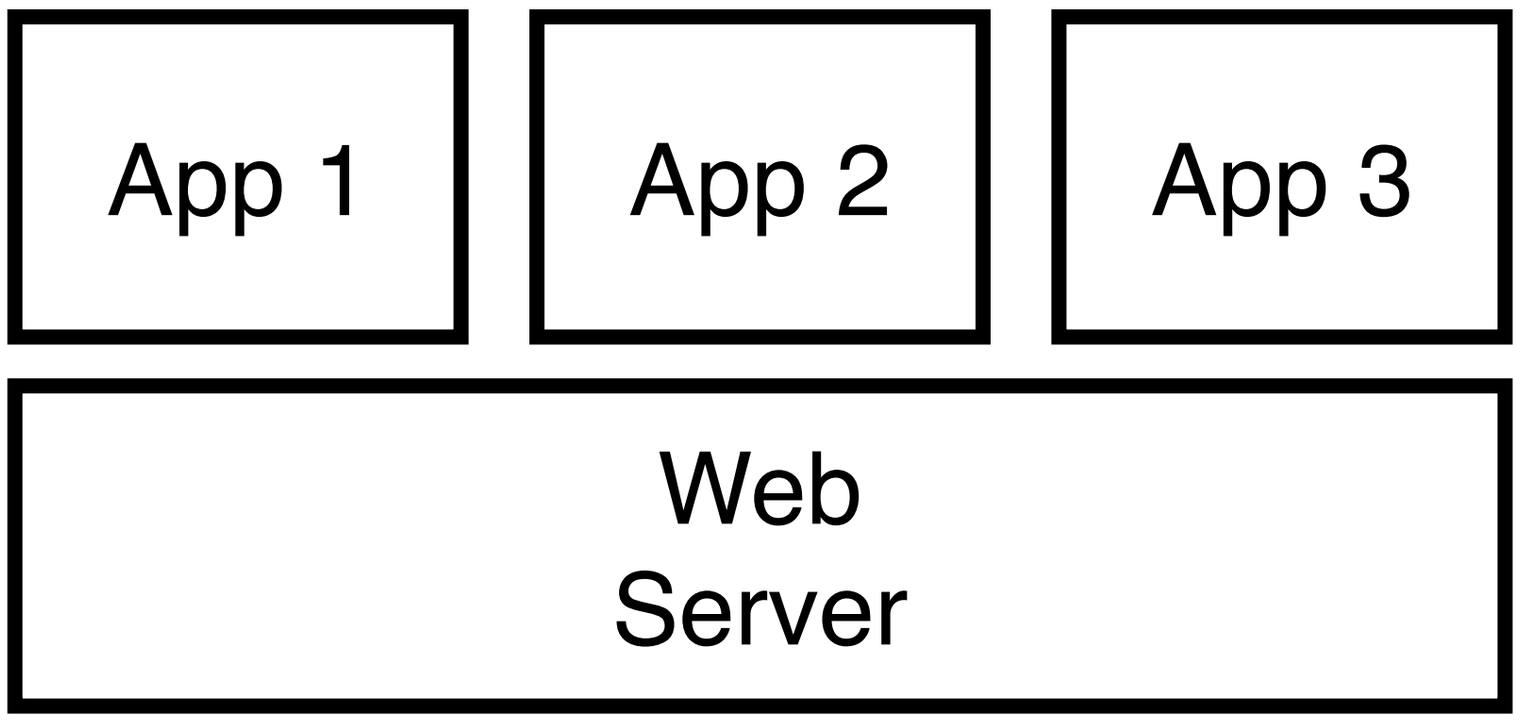
7. Port binding

7. Port binding

Export services via port binding
Self-contained



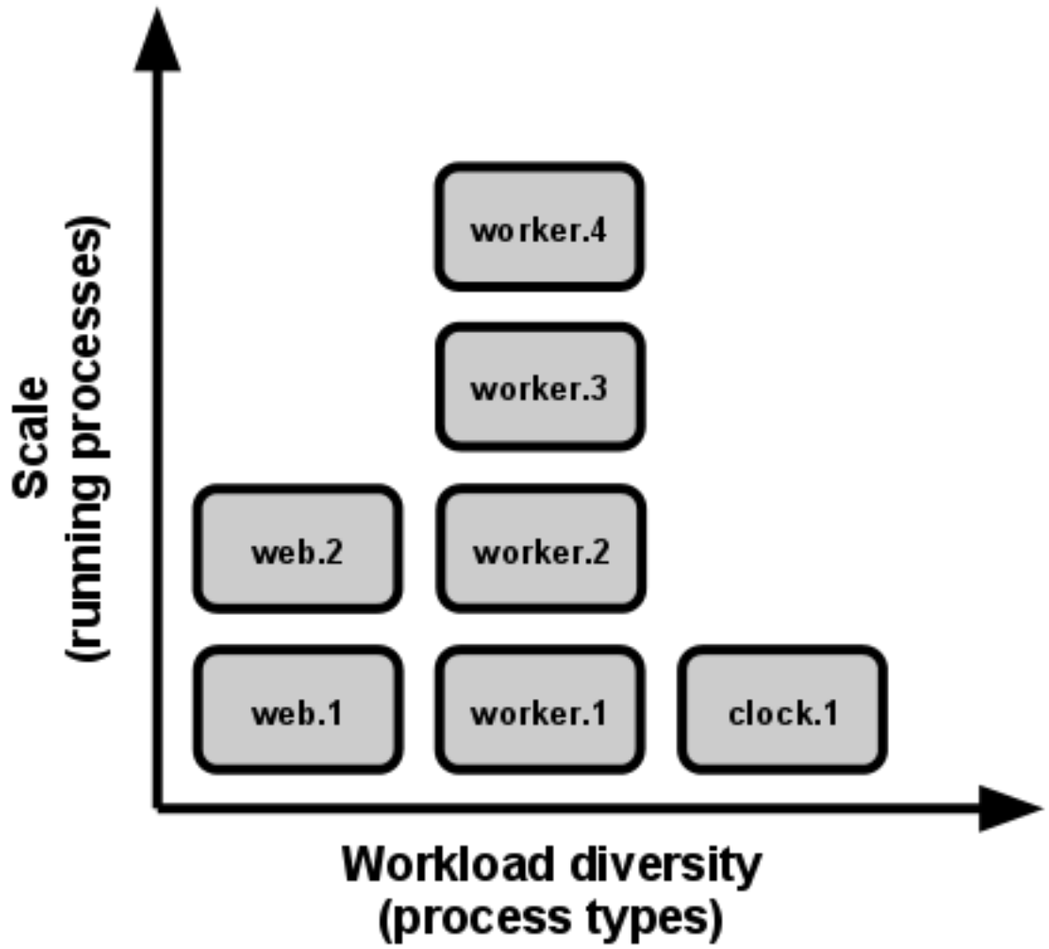
Don’t



8. Concurrency

8. Concurrency

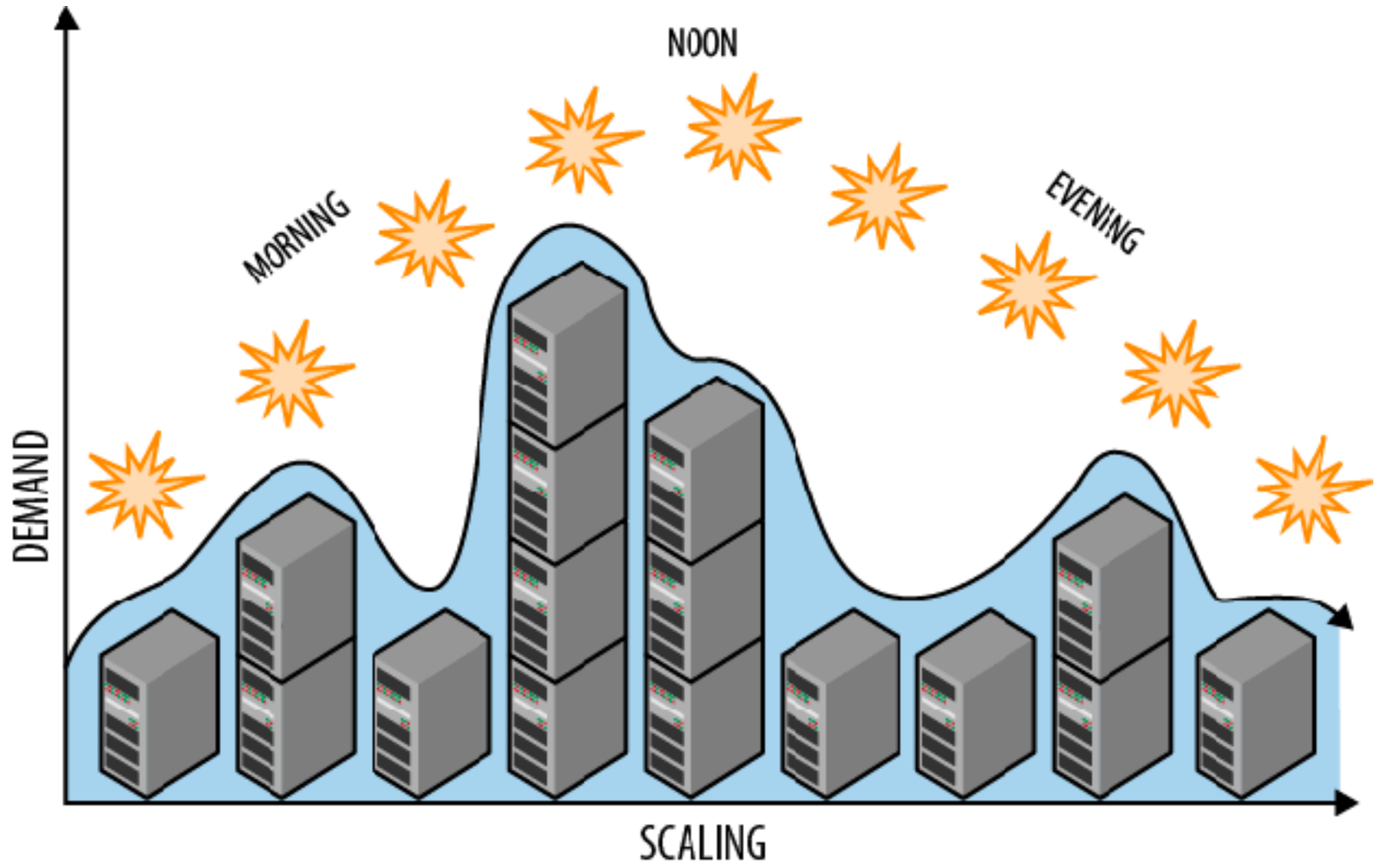
Scale out via the **process** model



Scaling ?

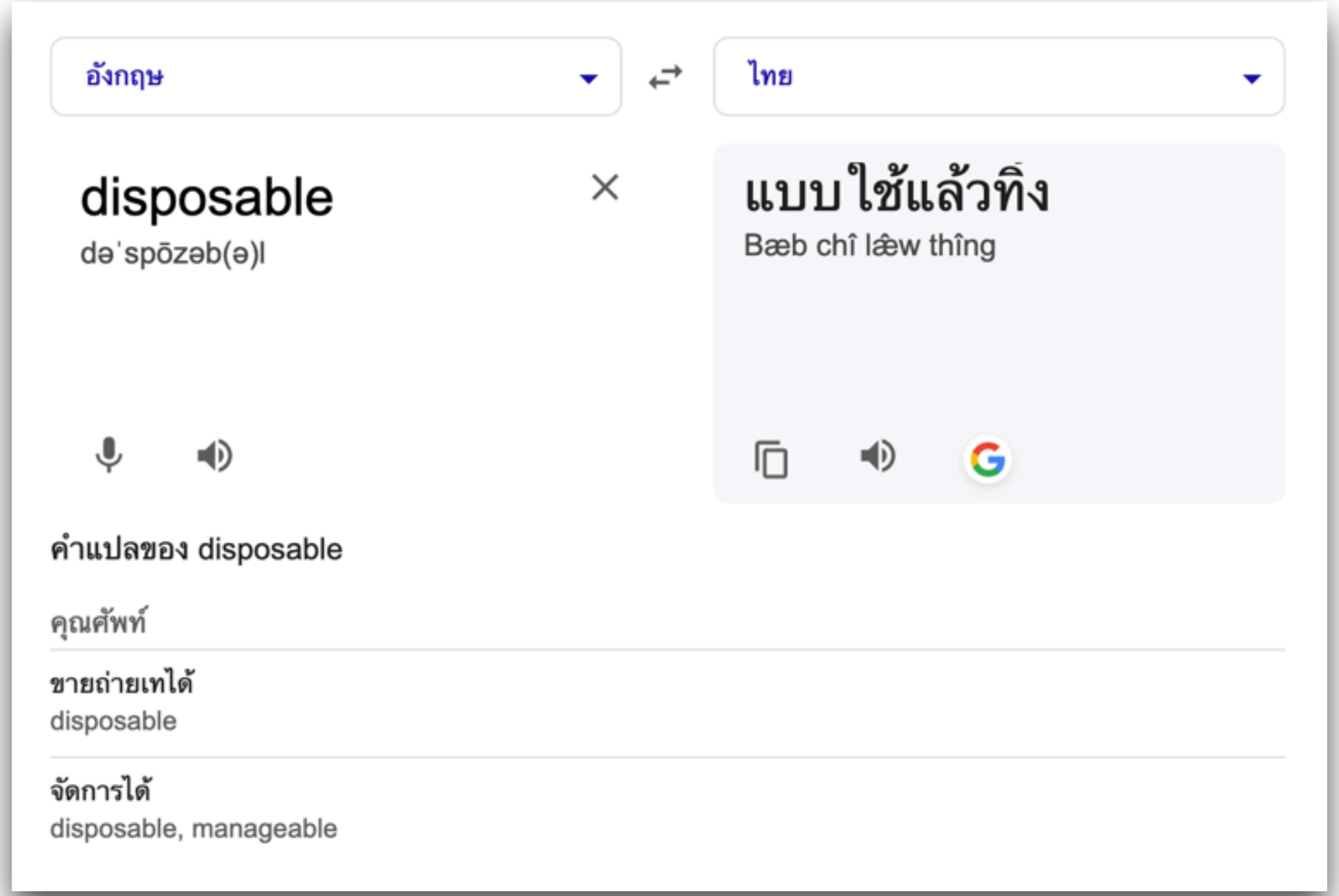
Elasticity Scaling

Reduce cost and improve performance by scaling automatically !!



9. Disposability

Disposable



9. Disposability

Maximize robustness
Fast startup and graceful shutdown

Fast startup to increase scalability opportunity

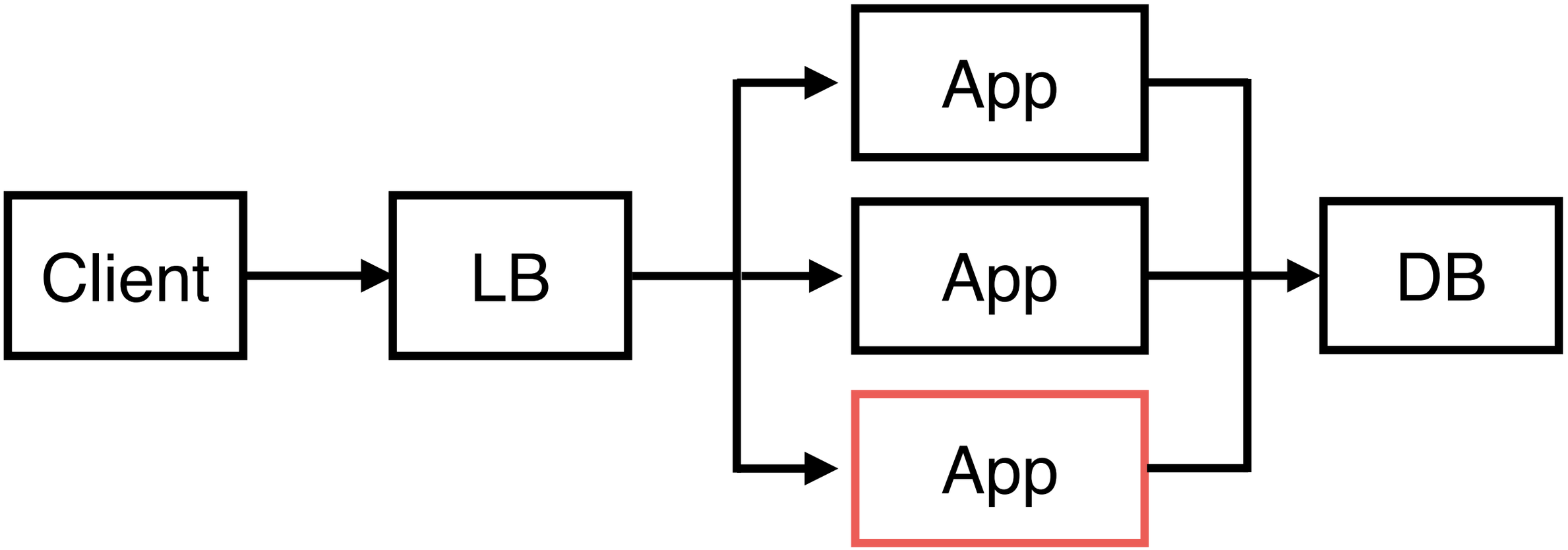
Graceful shutdown to leave the system in a correct state

Why graceful shutdown ?

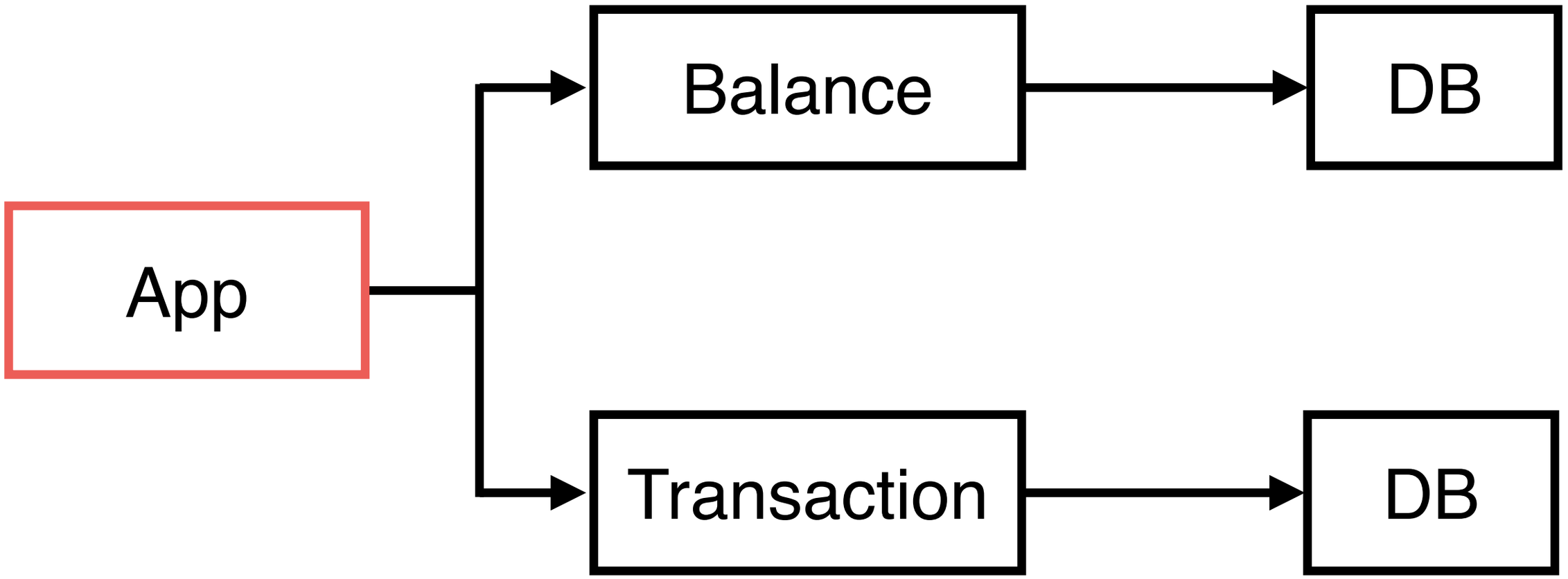
Resource cleanup
Transaction integrity

https://levelup.gitconnected.com/maximizing-resilience-with-graceful-shutdown-in-cloud-native-golang-applications-7f0b2edef4a8

Resource cleanup ?



Transaction integrity ?



Design for Failure

“Everything fails all the time”

-Werner Vogels-

https://docs.aws.amazon.com/whitepapers/latest/running-containerized-microservices/design-for-failure.html

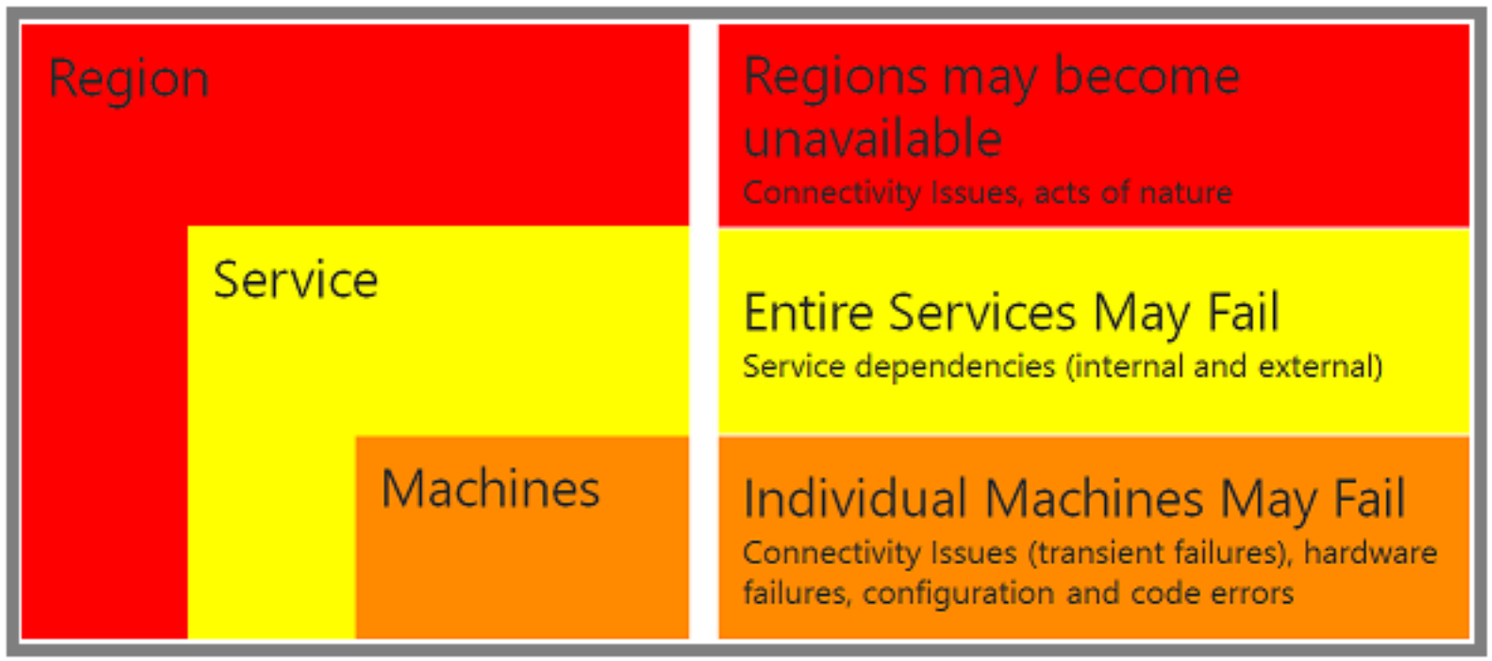
Design for Failures in 12-factor

Disposability

Logs

Dev/Prod parity

Design for Failure



https://learn.microsoft.com/en-us/aspnet/aspnet/overview/developing-apps-with-windows-azure/building-real-world-cloud-apps-with-windows-azure/design-to-survive-failures

Failures ?

Network latency

Long running sync operation

Connection error

Server restart

Overload traffic

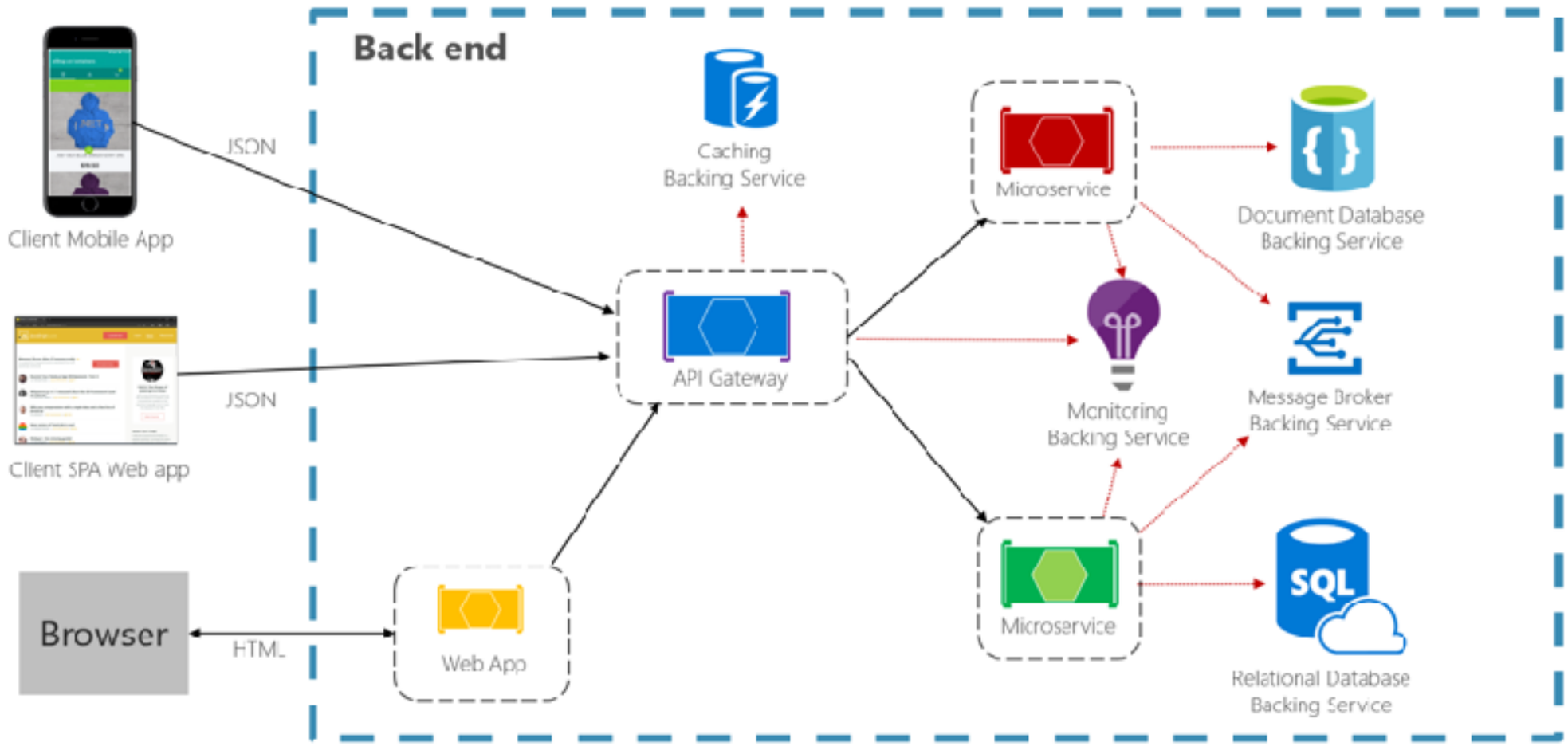
Rolling update

Hardware failure

https://simplicable.com/design/design-for-failure#google_vignette

Cloud Native Resilience

Ability of your system to react to failure
System still remain functional



https://learn.microsoft.com/en-us/dotnet/architecture/cloud-native/resiliency

How to plan/design to handle failures ?

Design for Failure patterns

Timeout
Retry
Caching
Buikhead
Circuit breaker
Fallback
Messaging

Infrastructure design

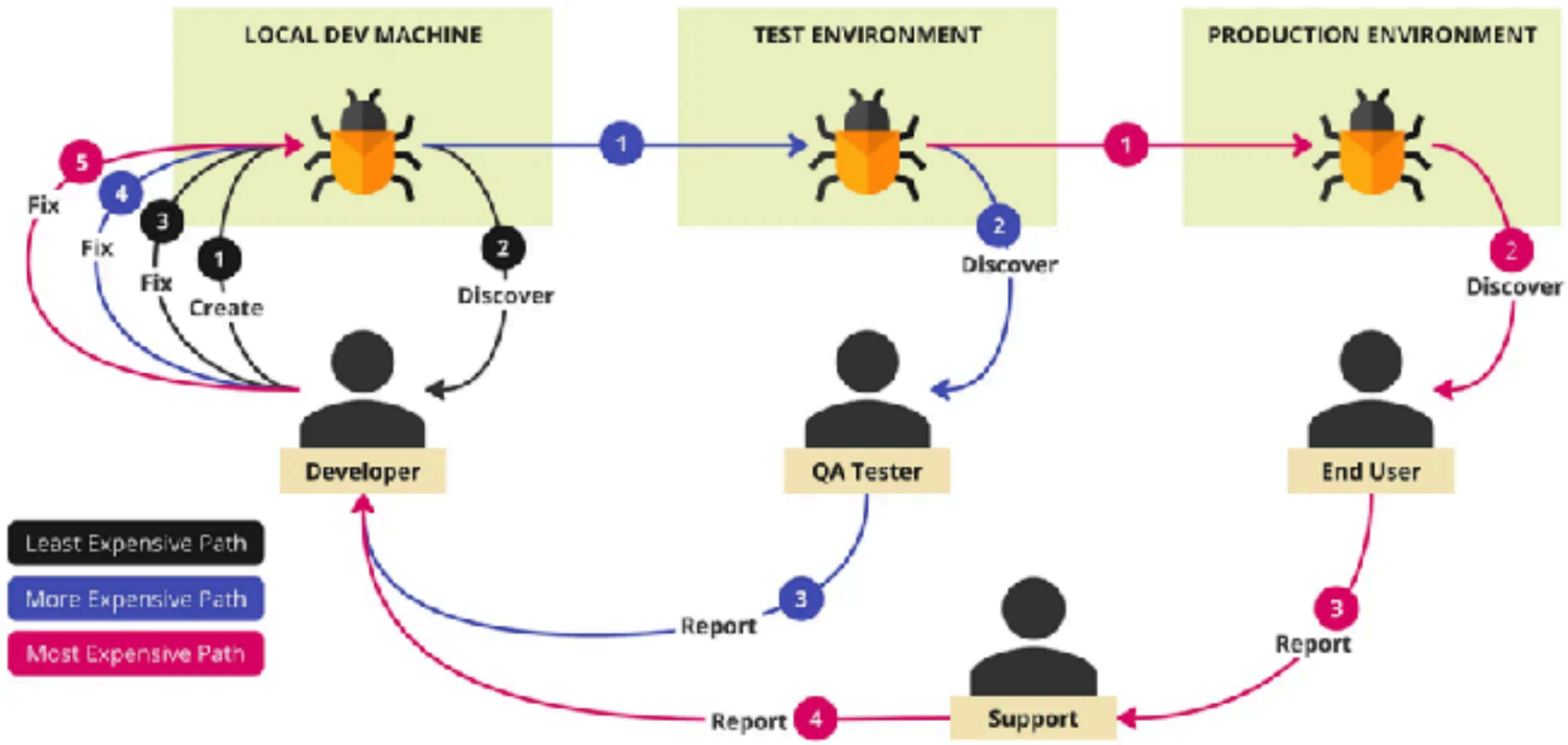
Active-standby
Auto healing
Replication
Clustering
Multi-region

10. Dev/prod parity

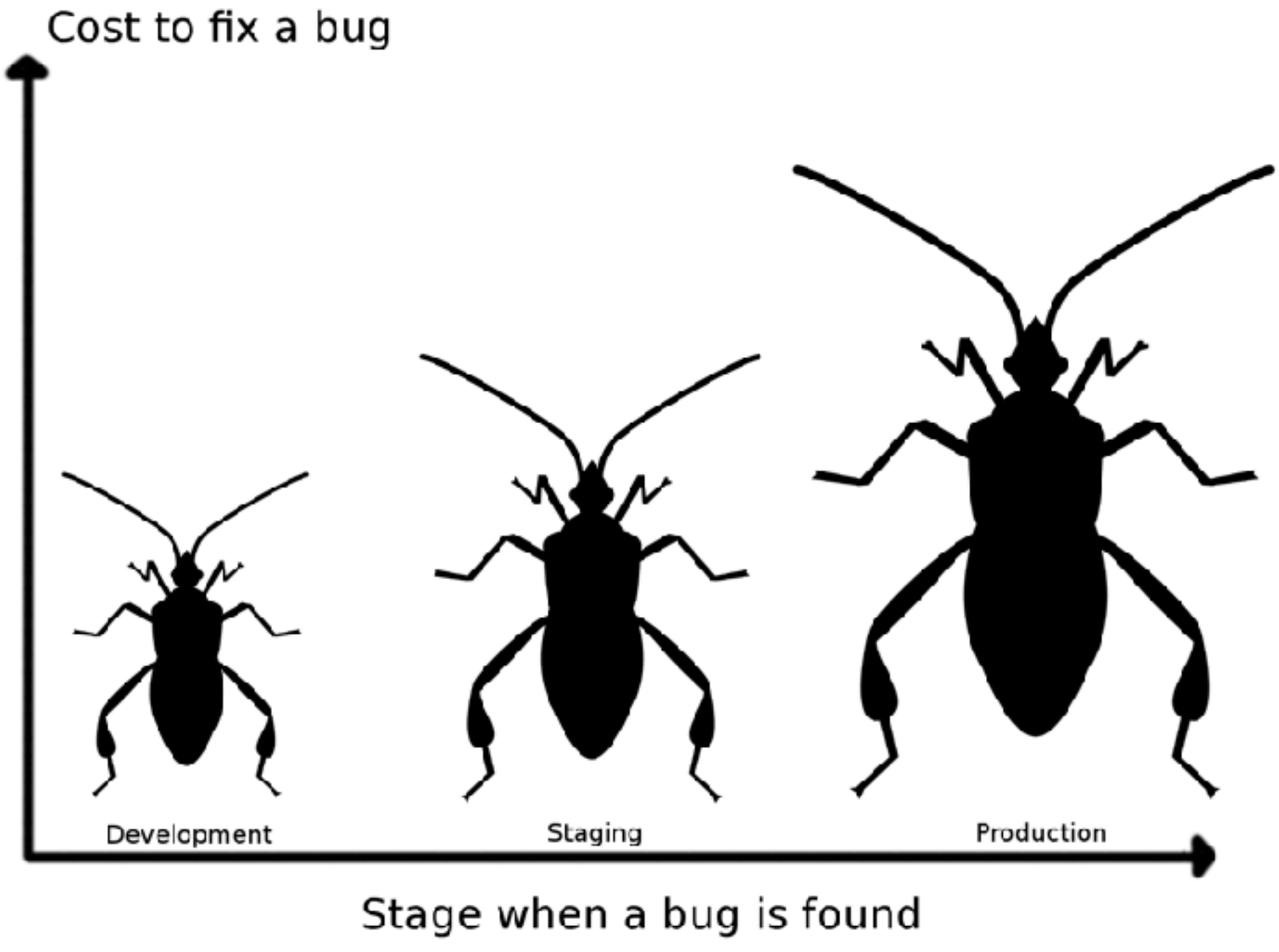
10. Dev/prod parity

Keep development, staging and production as similar as possible

Detect problems early



Cost of Bug



Gap between Dev and Prod

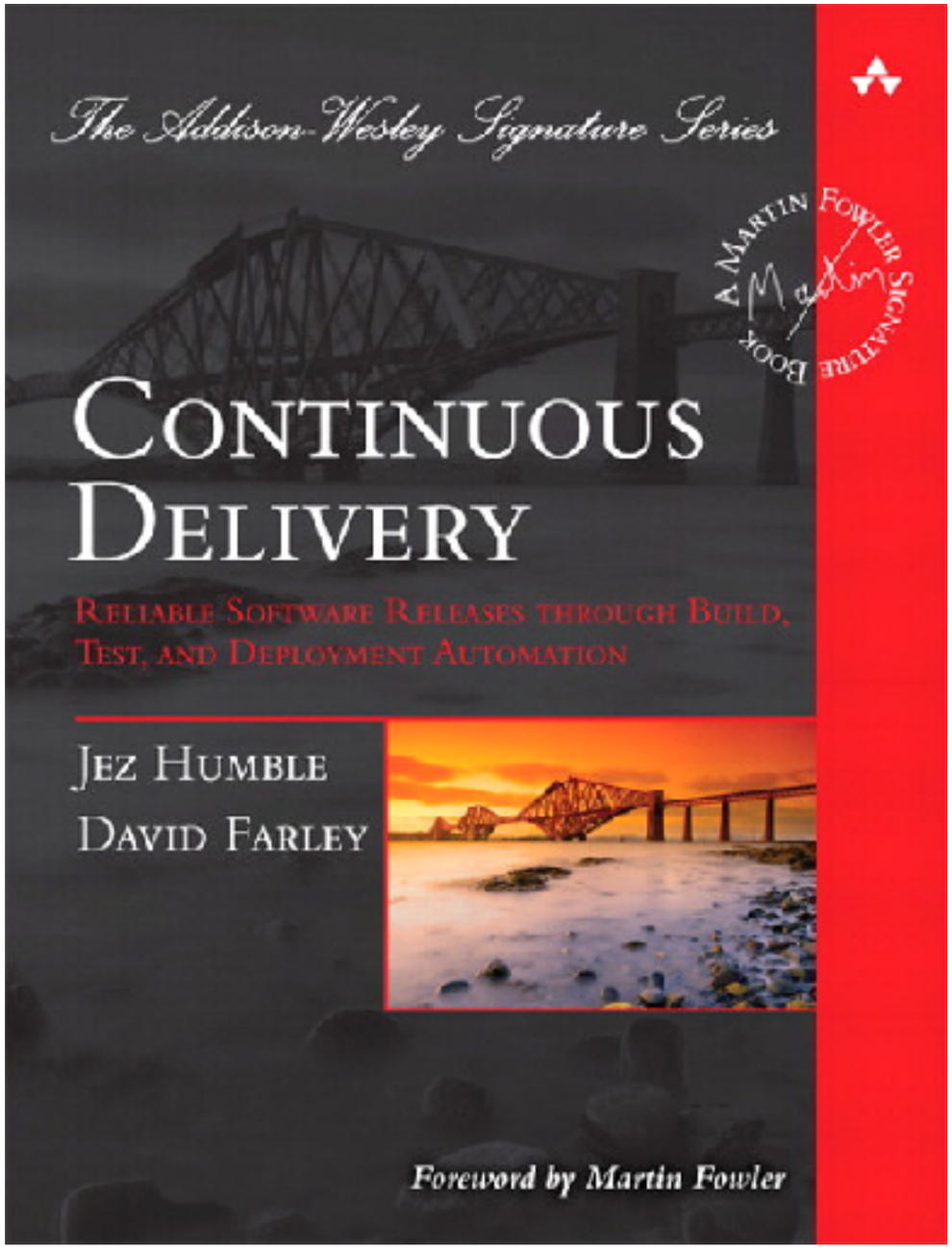
Time-gap
Personal-gap
Tool-gab

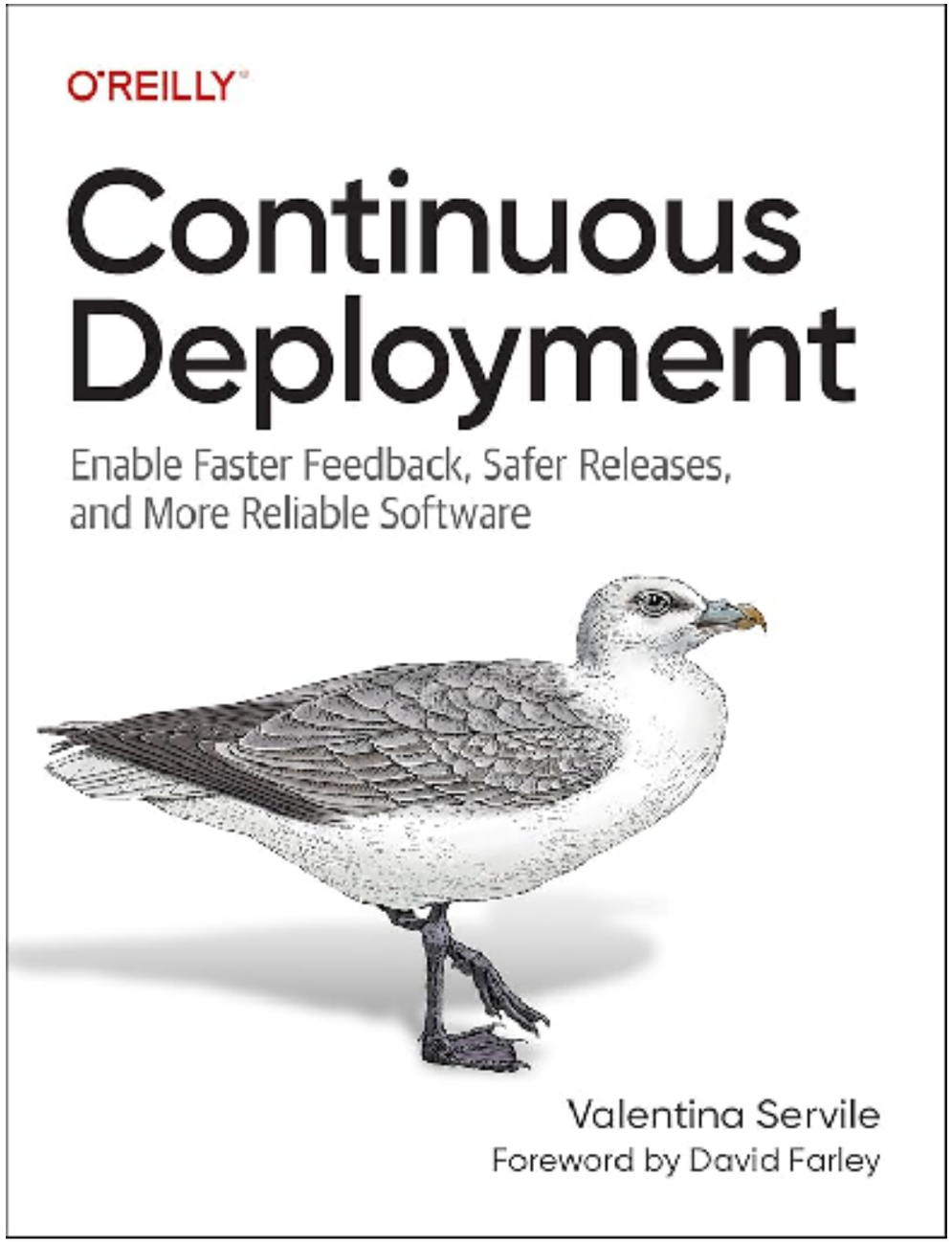
12-factor designed for **Continuous Deployment**
by keeping the gab between dev and prod small

Gap between Dev and Prod

	Traditional	12-factor
Time between deploys	Weeks	Hours
Code author and code deployer	Different people	Same people
Dev vs Prod environments	Divergent	As similar as posible

Continuous Deployment





“If it hard, do it more often”

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

Continuous Deployment

Fast feedback

Reduce risk

Safety release

Increase reliable of software

Tools

Docker

Chef/puppet

Kubernetes

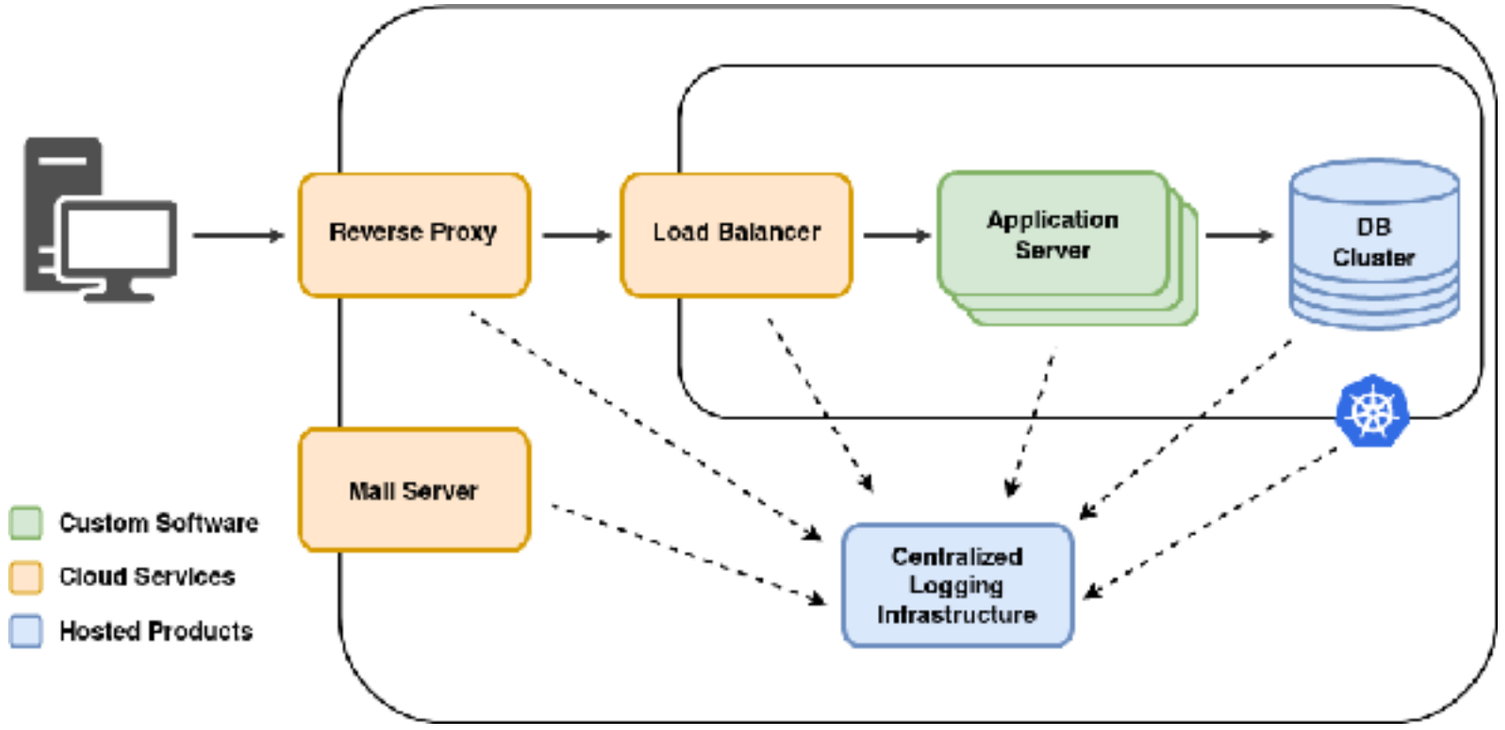
Terraform

11. Logs

11. Logs

Treat log as event streams

Logs provide visibility into the **behavior** of a running app

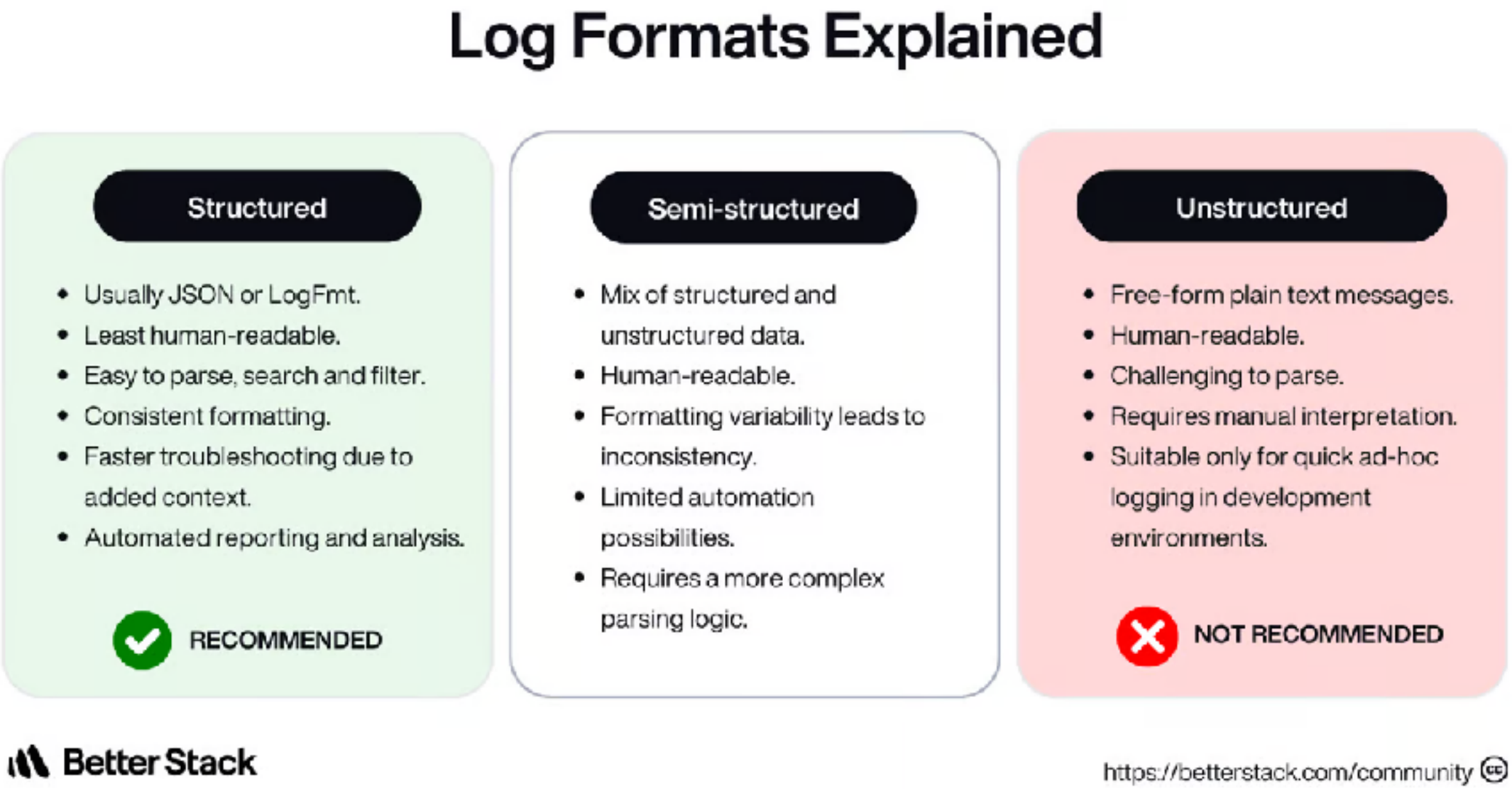


Structured logging !!

Don’t keep !!

```
com.framework.FrameworkException: Error in web request
    at com.framework.ApplicationStarter.lambda$start$0(ApplicationStarter.java:15)
    at spark.RouteImpl$1.handle(RouteImpl.java:72)
    at spark.http.matching.Routes.execute(Routes.java:61)
    at spark.http.matching.MatcherFilter.doFilter(MatcherFilter.java:134)
    at spark.embeddedserver.jetty.JettyHandler.doHandle(JettyHandler.java:50)
    at org.eclipse.jetty.server.session.SessionHandler.doScope(SessionHandler.java:1568)
    at org.eclipse.jetty.server.handler.ScopedHandler.handle(ScopedHandler.java:144)
    at org.eclipse.jetty.server.handler.HandlerWrapper.handle(HandlerWrapper.java:132)
    at org.eclipse.jetty.server.Server.handle(Server.java:503)
    at org.eclipse.jetty.server.HttpChannel.handle(HttpChannel.java:364)
    at org.eclipse.jetty.server.HttpConnection.onFillable(HttpConnection.java:260)
    at org.eclipse.jetty.io.AbstractConnection$ReadCallback.succeeded(AbstractConnection.java:305)
    at org.eclipse.jetty.io.FillInterest.fillable(FillInterest.java:103)
    at org.eclipse.jetty.io.ChannelEndPoint$2.run(ChannelEndPoint.java:118)
    at org.eclipse.jetty.util.thread.QueuedThreadPool.runJob(QueuedThreadPool.java:765)
    at org.eclipse.jetty.util.thread.QueuedThreadPool$2.run(QueuedThreadPool.java:683)
    at java.base/java.lang.Thread.run(Thread.java:834)
Caused by: com.project.module.MyProjectFooBarException: The number of FooBars cannot be zero
    at com.project.module.MyProject.anotherMethod(MyProject.java:20)
    at com.project.module.MyProject.someMethod(MyProject.java:12)
    at com.framework.ApplicationStarter.lambda$start$0(ApplicationStarter.java:13)
    ... 16 more
Caused by: java.lang.ArithmeticException: The denominator must not be zero
    at org.apache.commons.lang3.math.Fraction.getFraction(Fraction.java:143)
    at com.project.module.MyProject.anotherMethod(MyProject.java:18)
    ... 18 more
```

Structured logging



https://betterstack.com/community/guides/logging/structured-logging/

Effective Log Aggregation

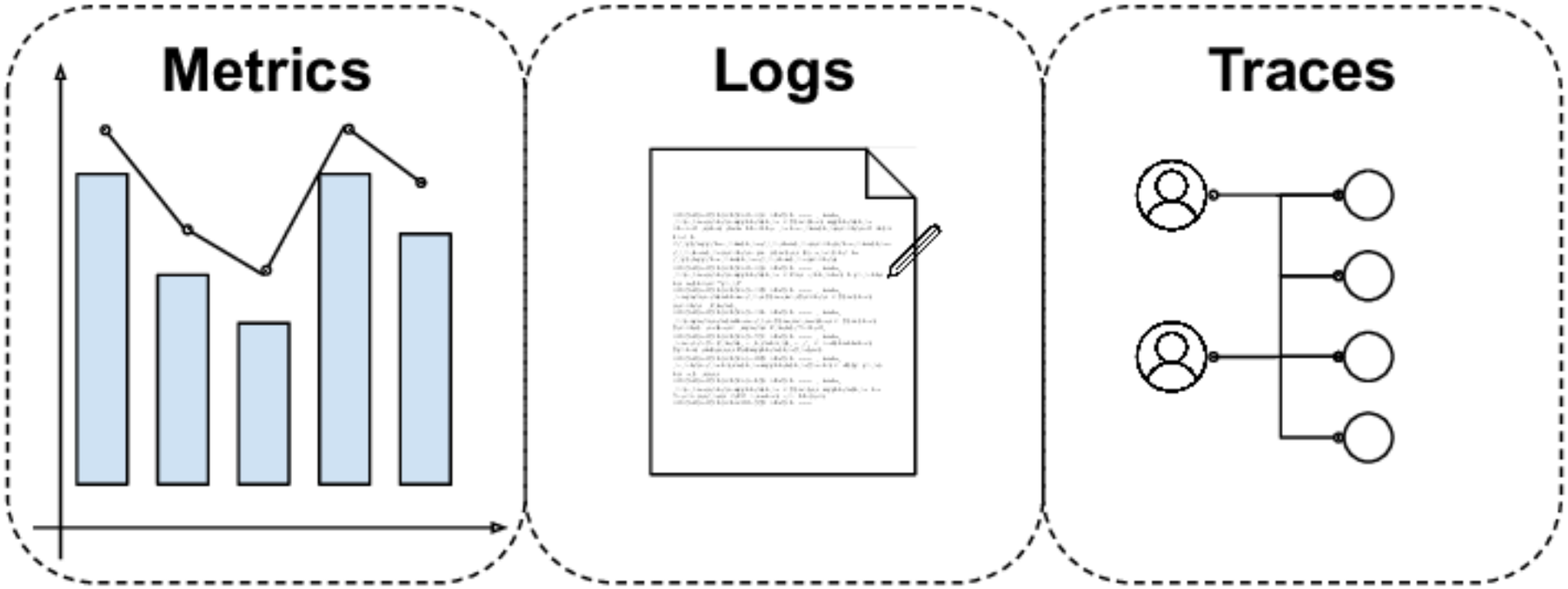
Define event to log
Use structured logging
Exclude sensitive information
Log at the correct level
Be specific in your message
Don’t log large message
Make sure you keep trace Id in the log

https://github.com/OWASP/CheatSheetSeries/blob/master/cheatsheets/Logging_Cheat_Sheet.md

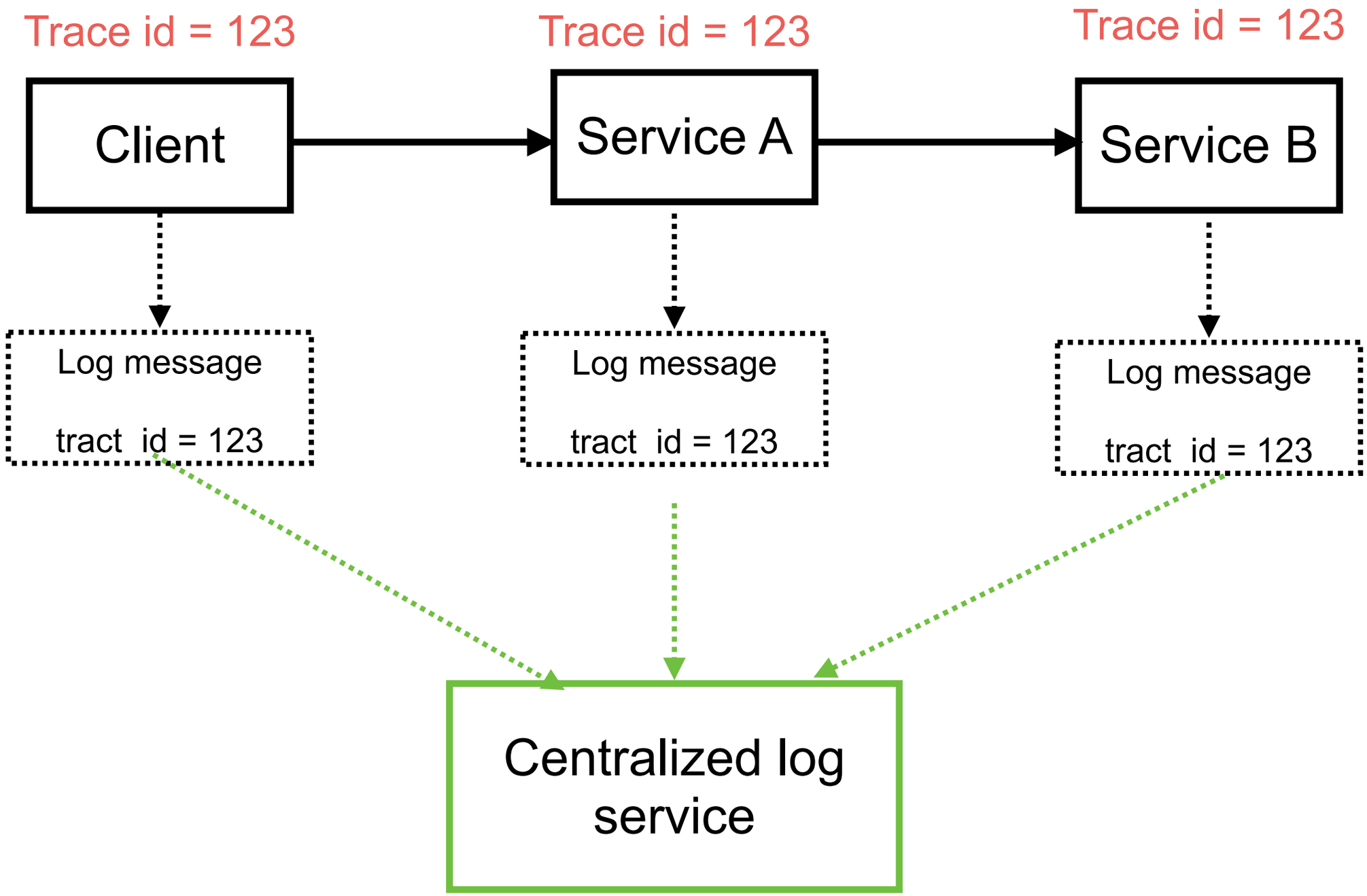
Consistent Structure across all logs

Property	Description	Example
Timestamp	Date and time of the log	2023-07-01
Log level	DEBUG, INFO, ERROR	
Trace Id or Correlation Id	Unique identifier that refer to other logs from all services	
Event/Action Name	Identify to event or action of log	Authentication fail
Service ID/ Name	Identify to service	
Request path	Path for the request	/api/products

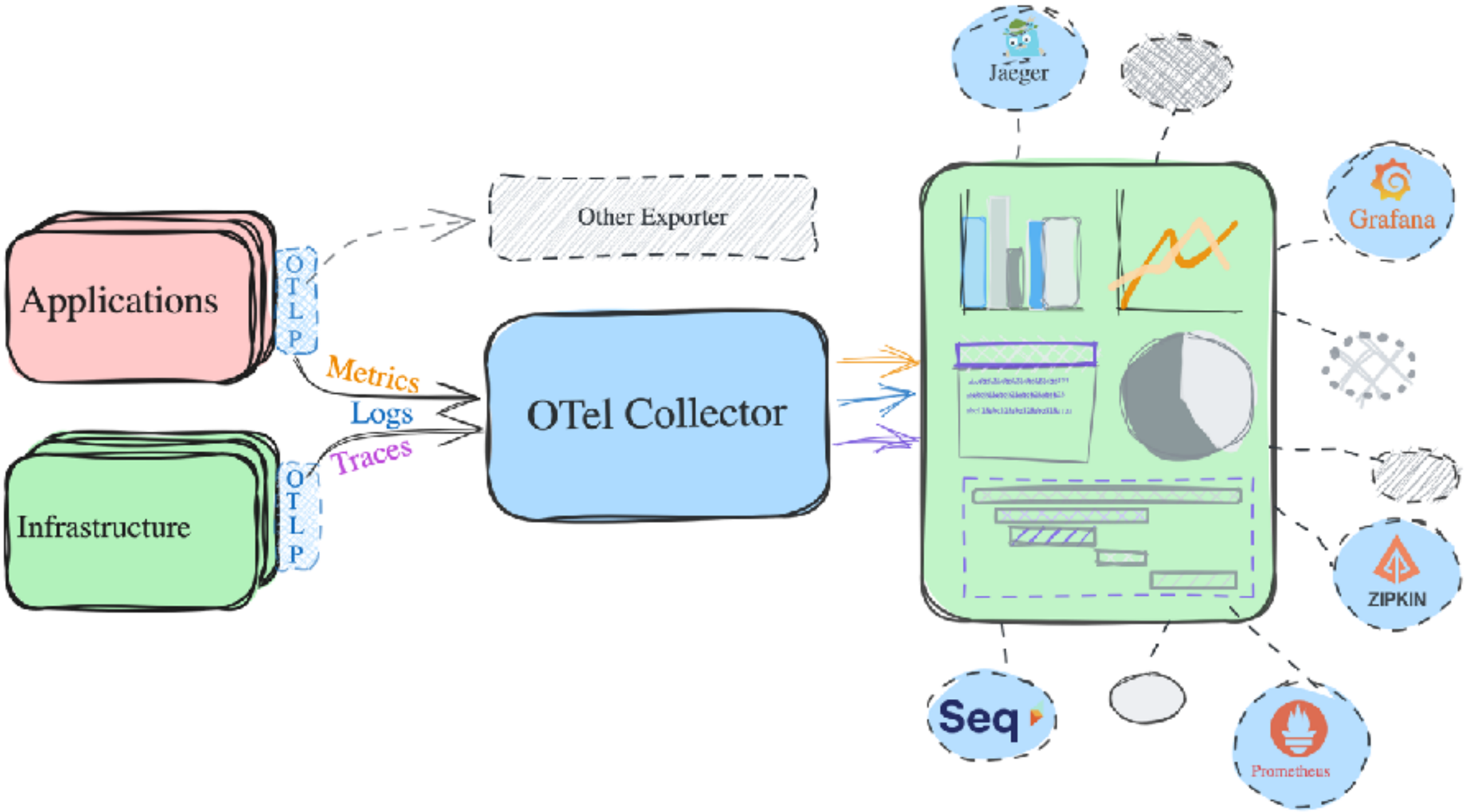
Not Only Log !!



Centralized log with trace



OpenTelemetry



12. Admin processes

12. Admin processes

Run admin/management tasks as one-off processes

Reduce ad-hoc tasks
Separated from app

Data migration

Data cleanup

Computing analytics

12 + 3 Factor

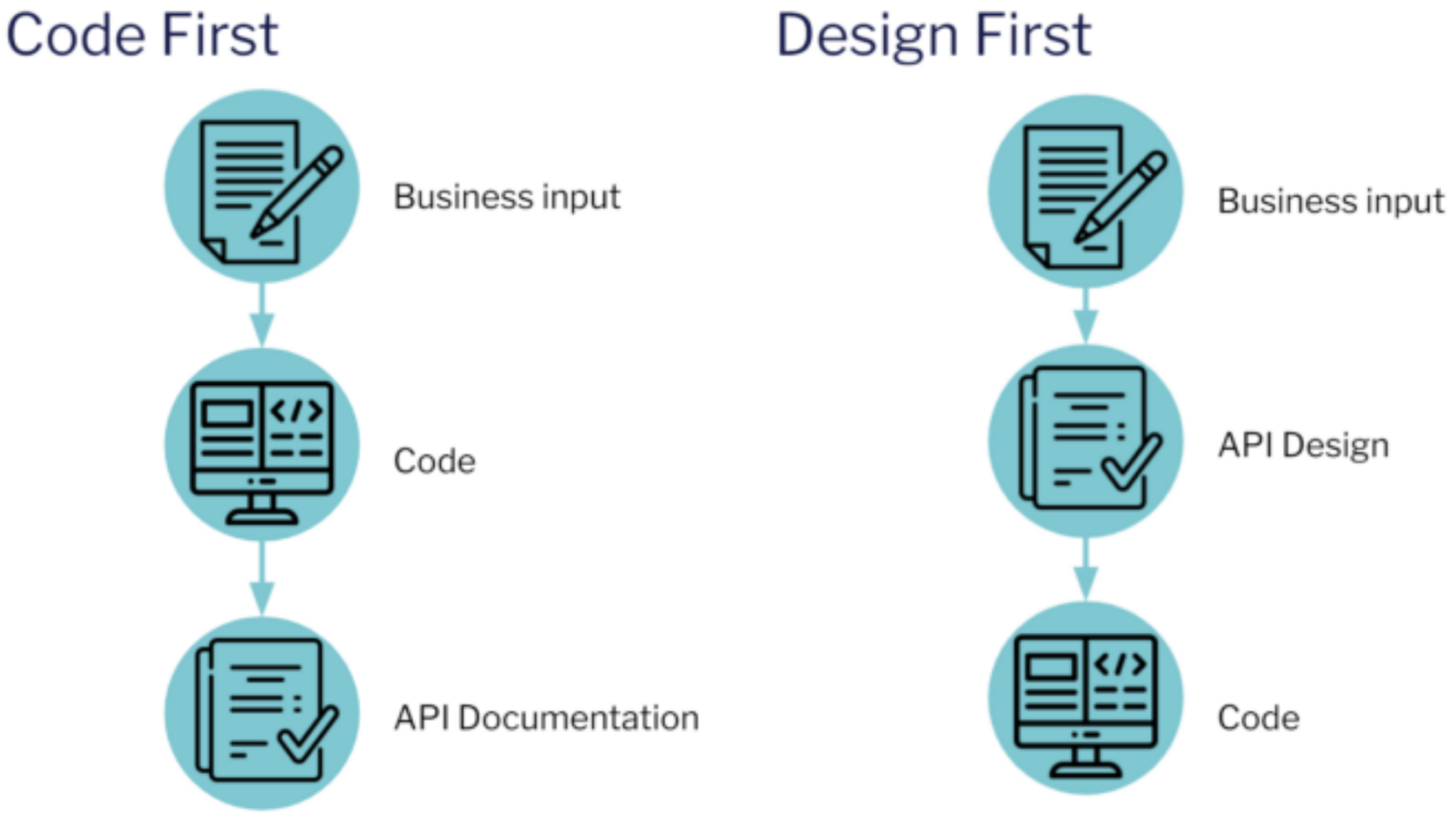
https://raw.githubusercontent.com/ffisk/books/master/beyond-the-twelve-factor-app.pdf

13. API First

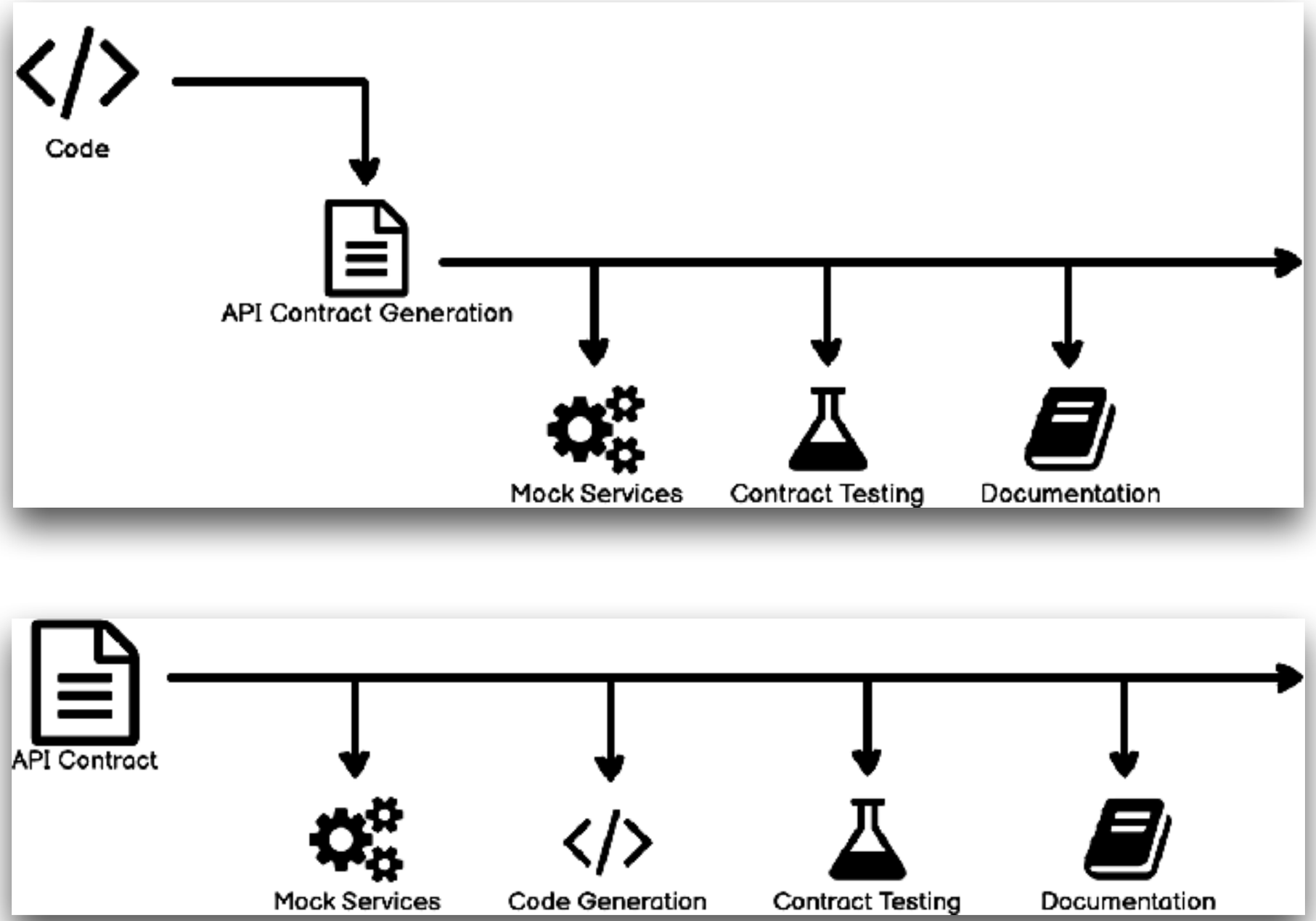
13. API First

Define the service contract first
Help consumer understand request/response
How to communicate with service ?
Help to reduce bottlenecks

Code First vs API First (design)

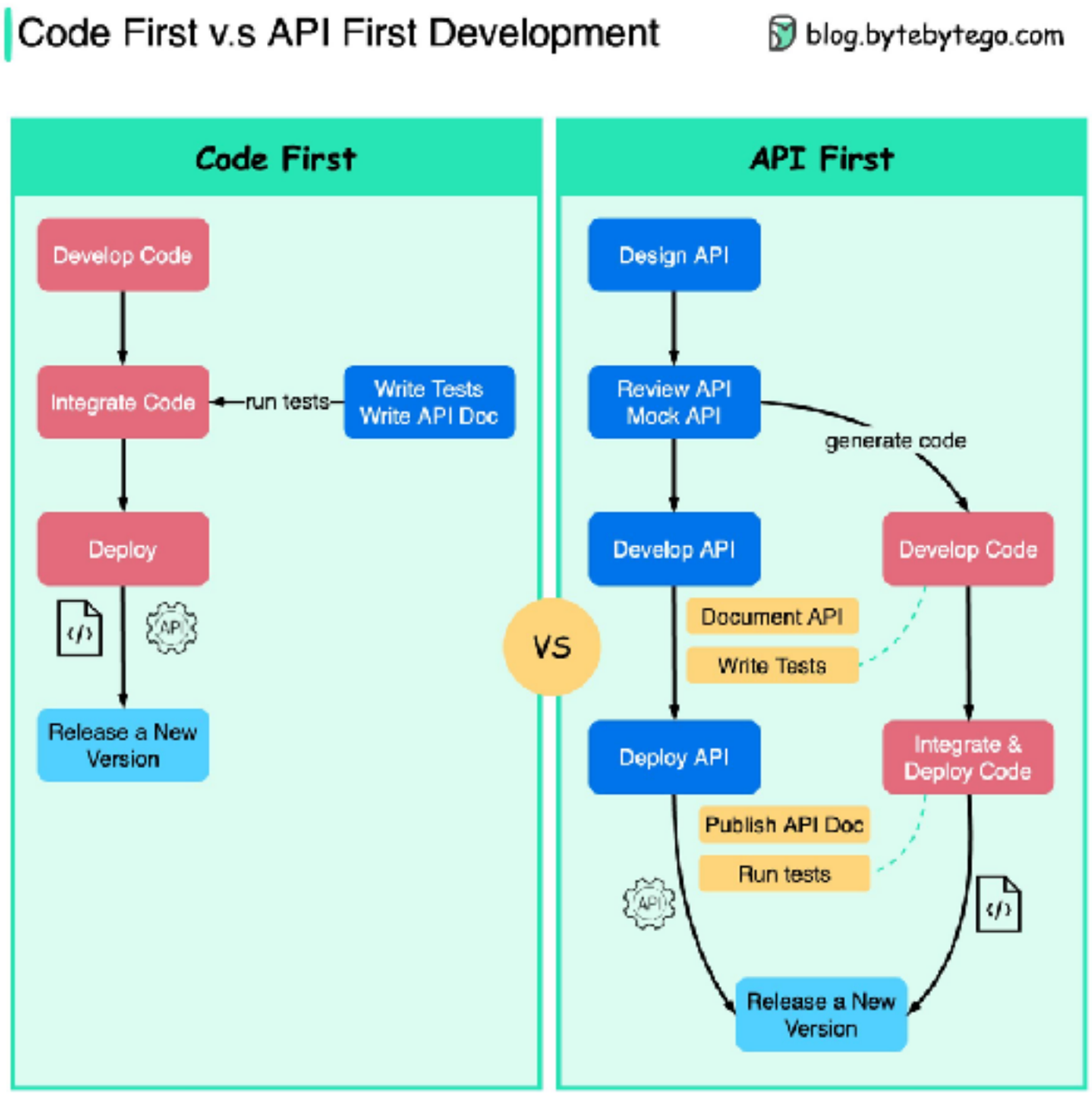


Code First vs API First (design)



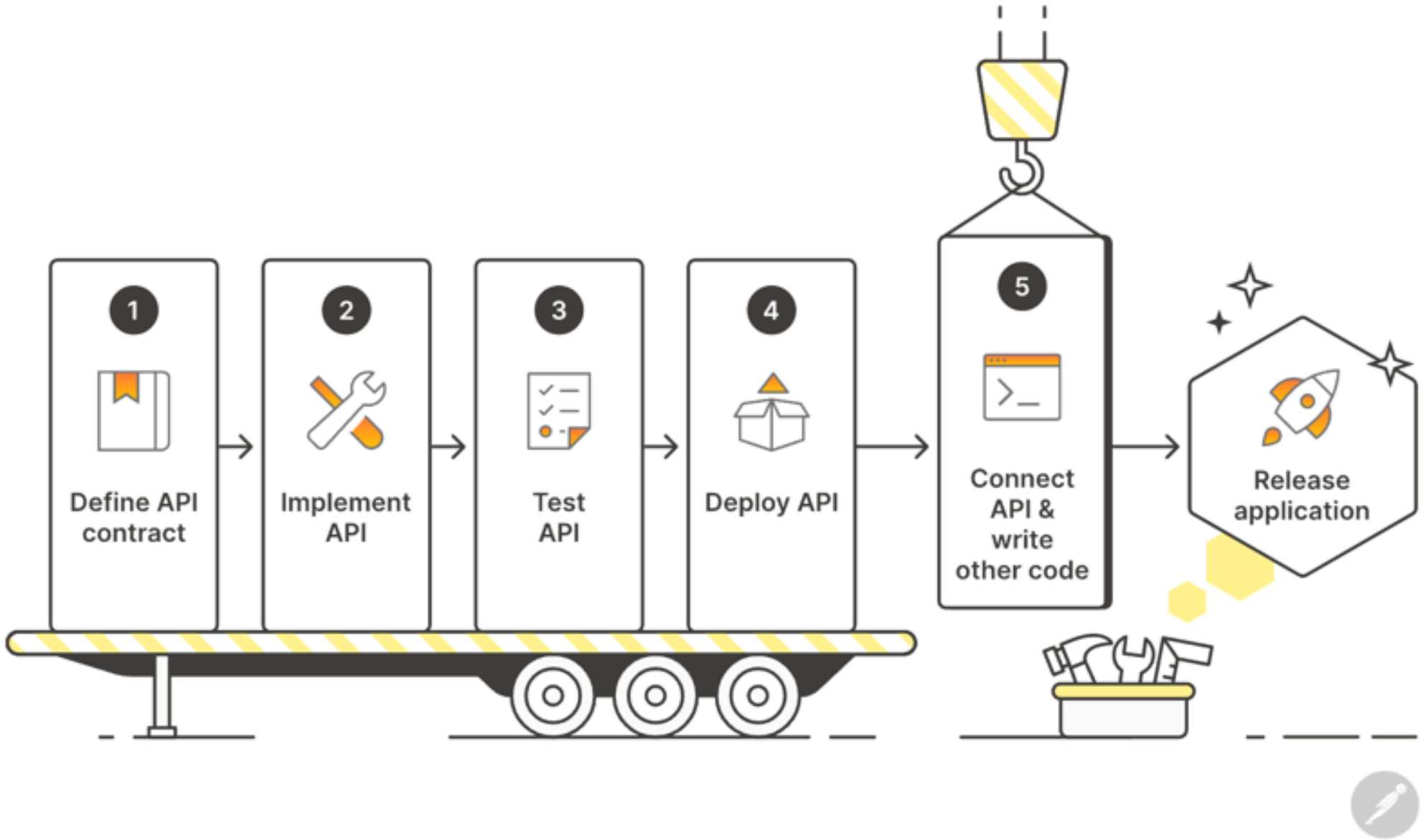
https://sookocheff.com/post/api/the-false-dichotomoy-of-design-first-and-code-first-api-development/

Code First vs API First (design)



https://twitter.com/bytebytego/status/1665965464512790528

API First from Postman



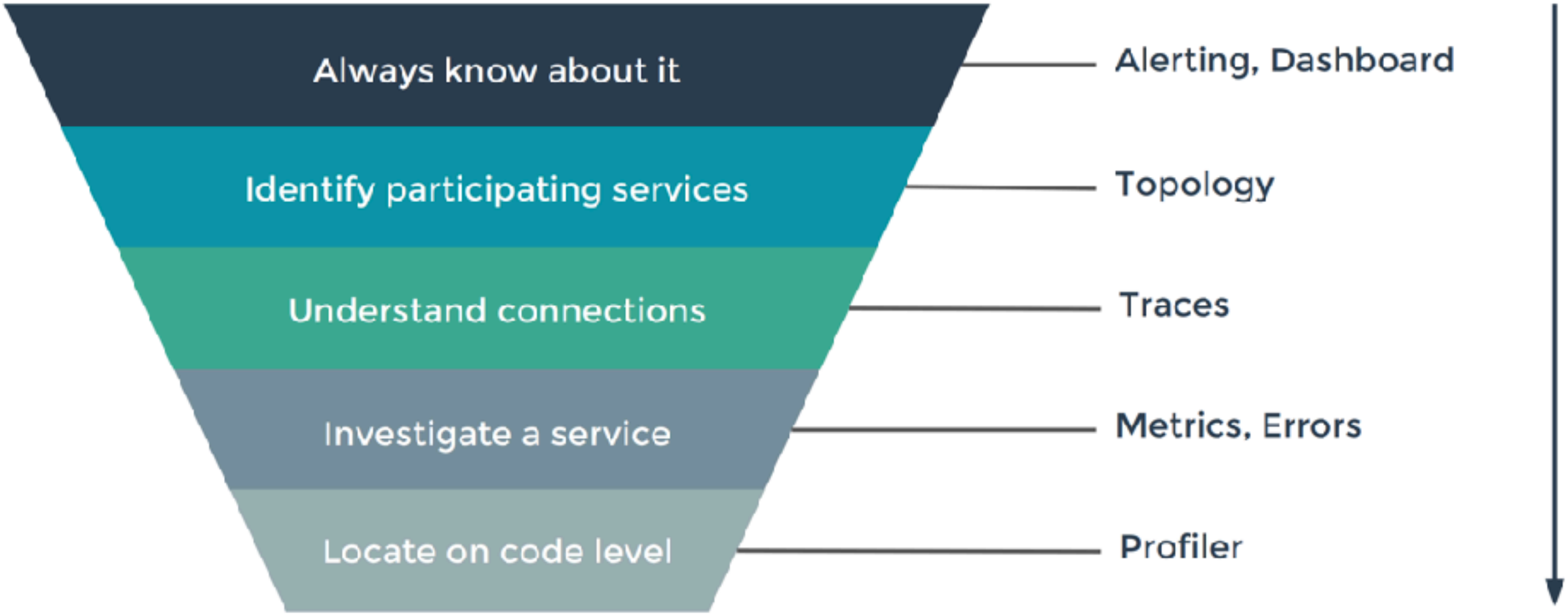
https://www.postman.com/api-first/

Backstage Software Catalog

https://backstage.io/

14. Telemetry

How to find an issue ?



Category of monitoring

APM (Application Performance Monitoring)
Domain-specific telemetry
Health and system log

Telemetry :: specific-domain

Health check API
Log aggregation
Distributed tracing
Exception tracking
Application metrics
Audit logging

Domain specific domain

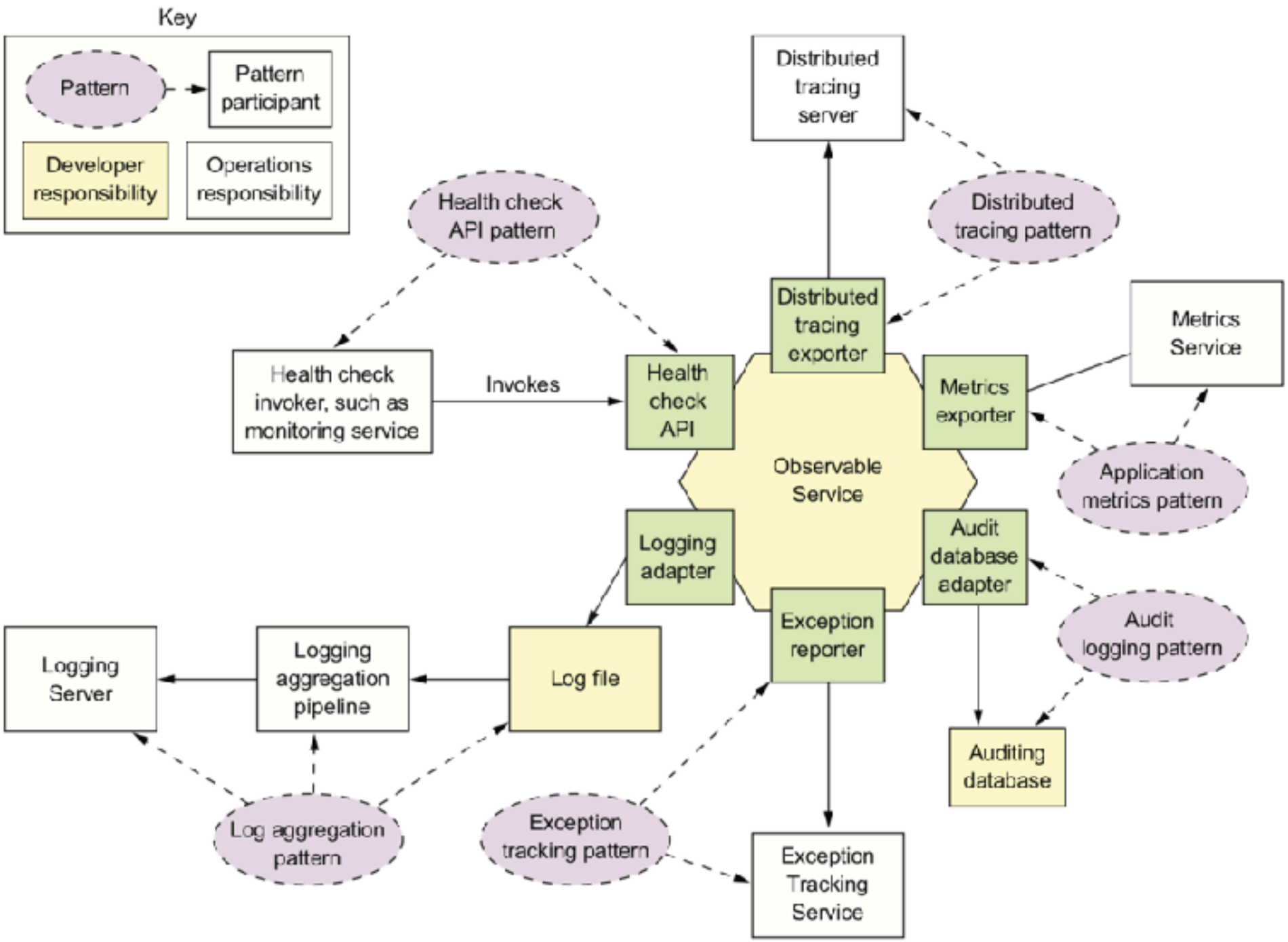
Stream of events and data
Data for business goals

Store

Analysis

Forecast

Observable services



15. Authentication and Authorization

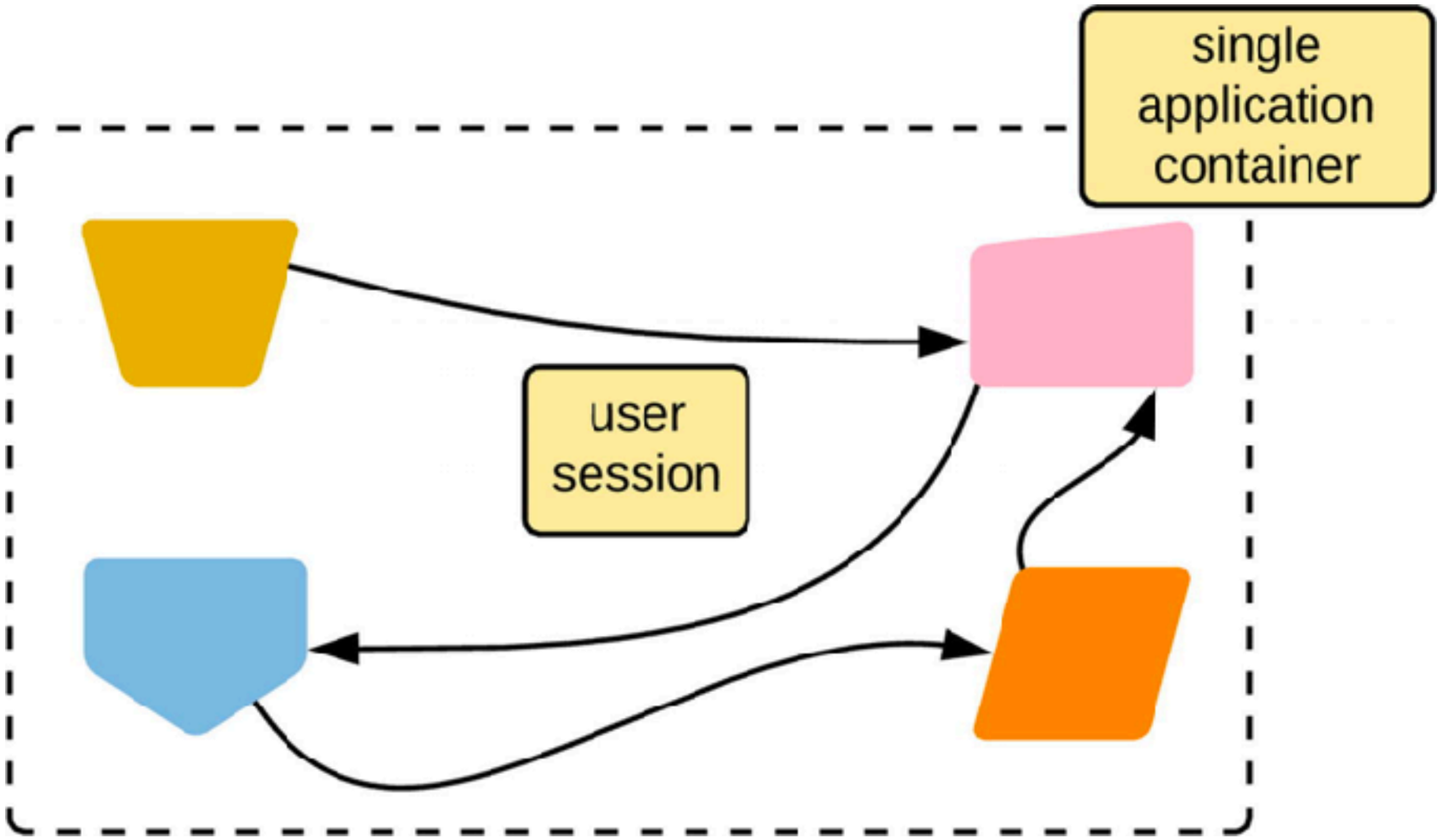
Security by design

Develop secure services

Authentication
Authorization
Auditing
Secure interprocess communication

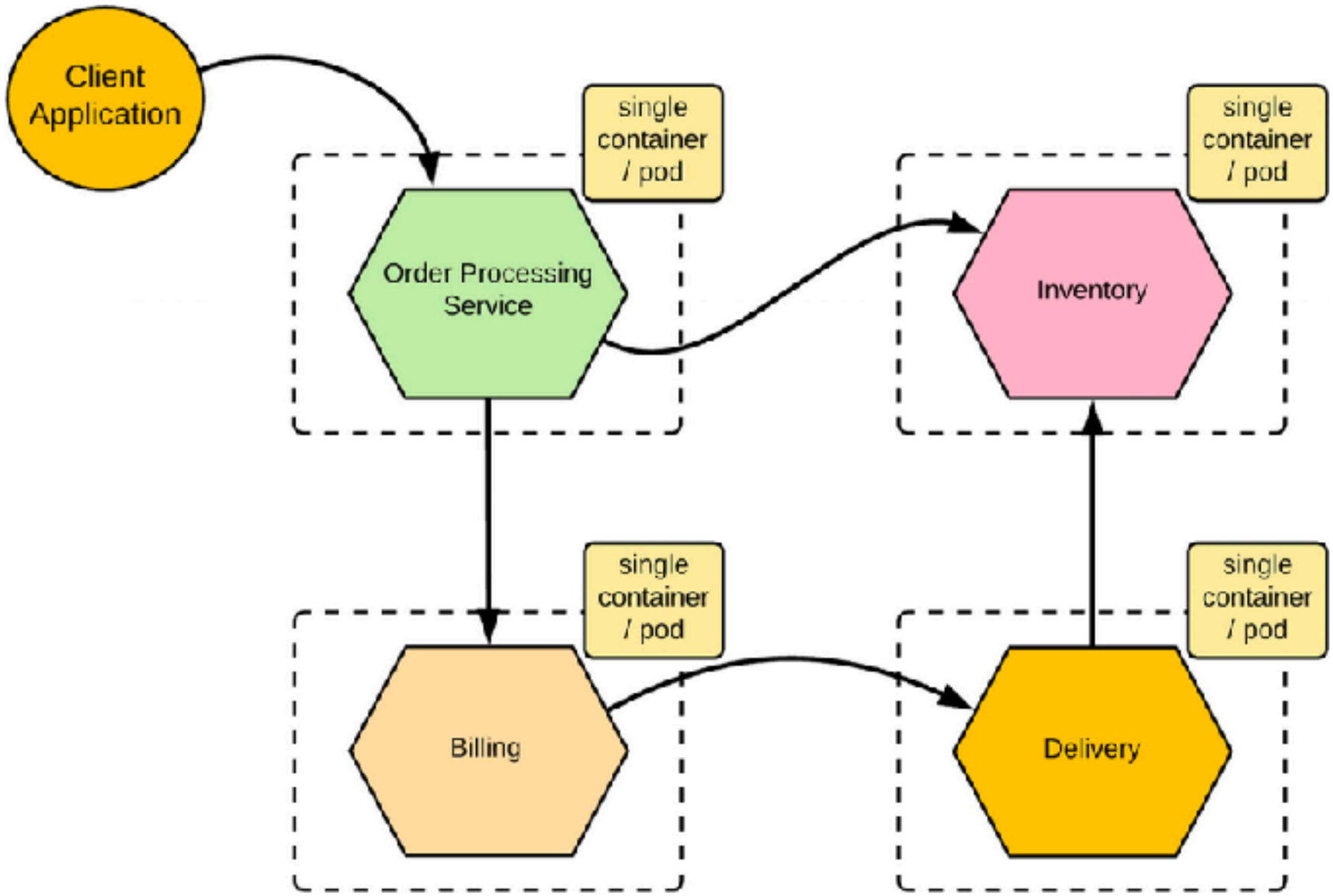
Security in traditional application

Sharing a user session in application



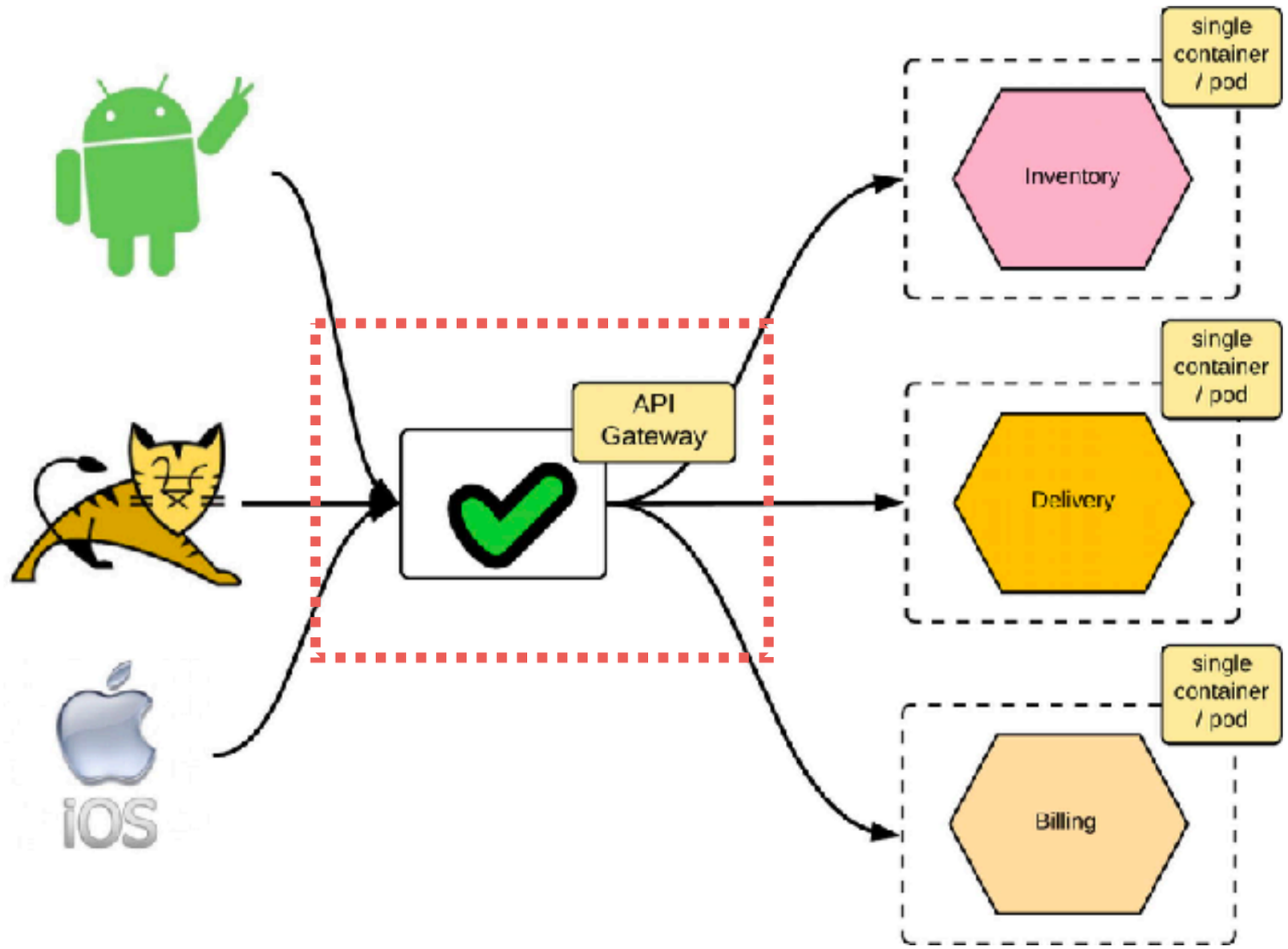
Security in multiple services ?

Interaction between multiple services



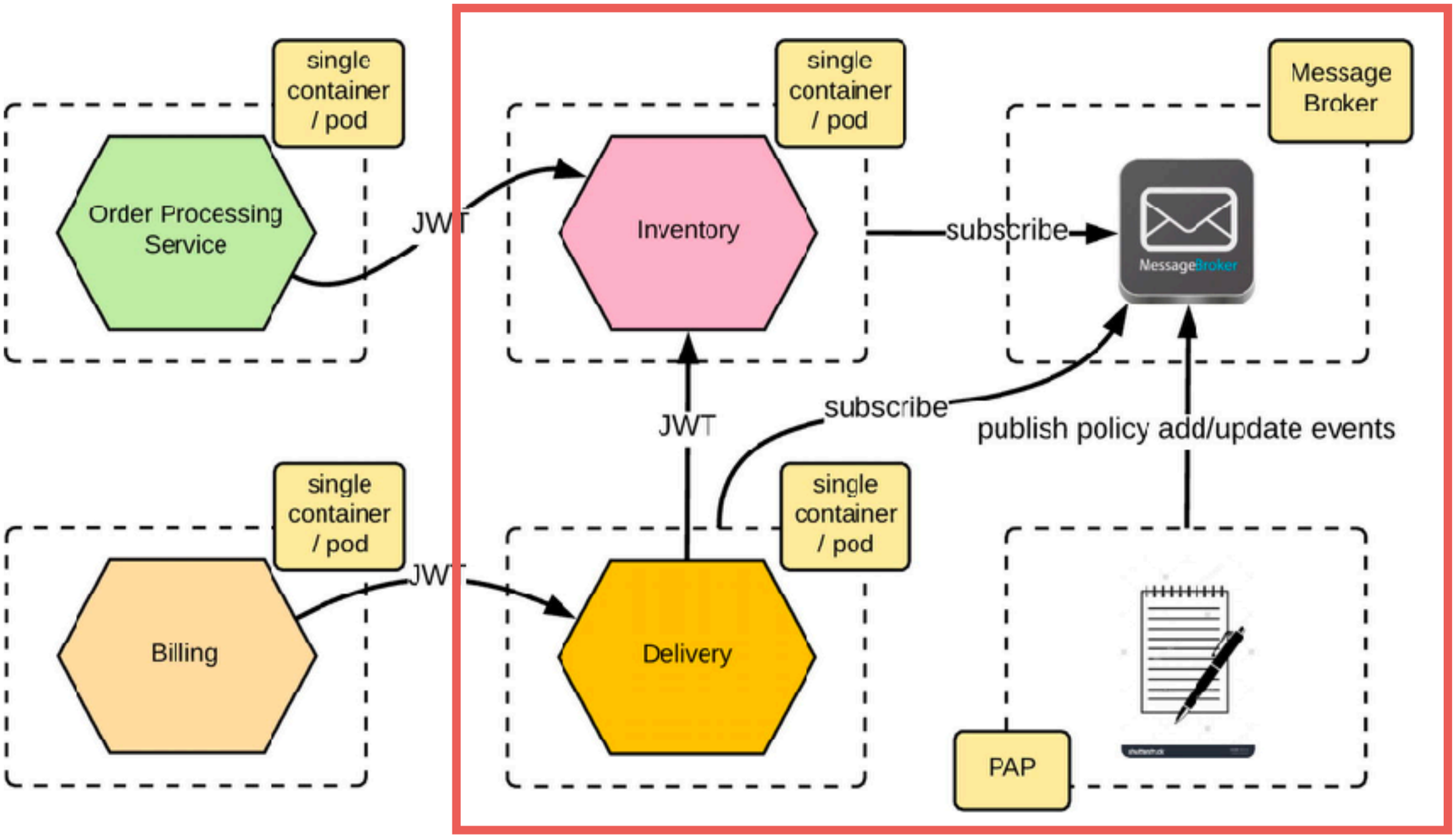
Centralize pattern

Using API gateway pattern



Access control of services

Policy Administration Point



Workshop

C#

Go

Docker

Q/A