สยามชำนาญกิจ
SIAM CHAMNAN KIT

Microservices

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สยามชำนาญกิจ
SIAM CHAMNAN KIT

SHU HA RI
SOFTWARE DEVELOPMENT SCHOOL

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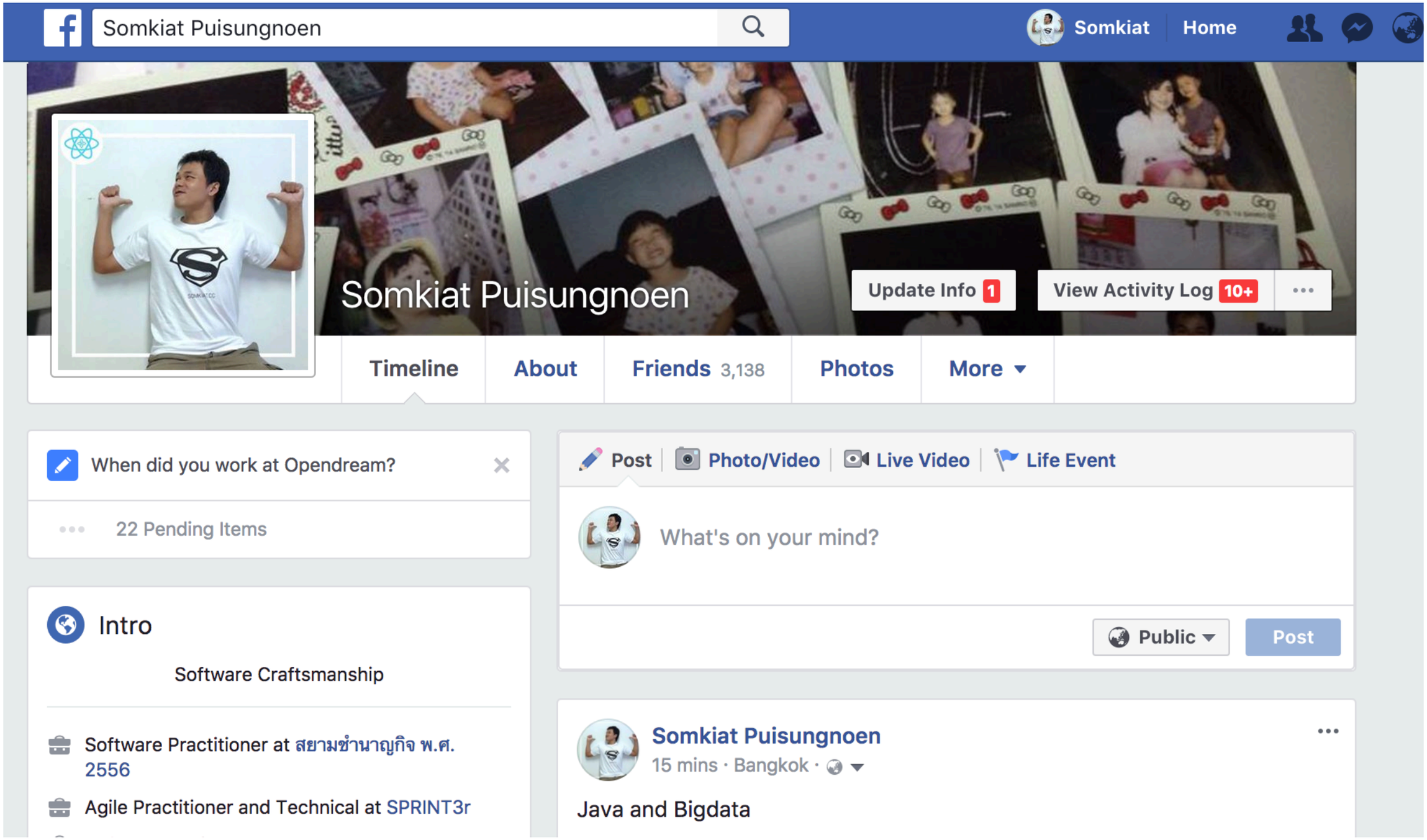

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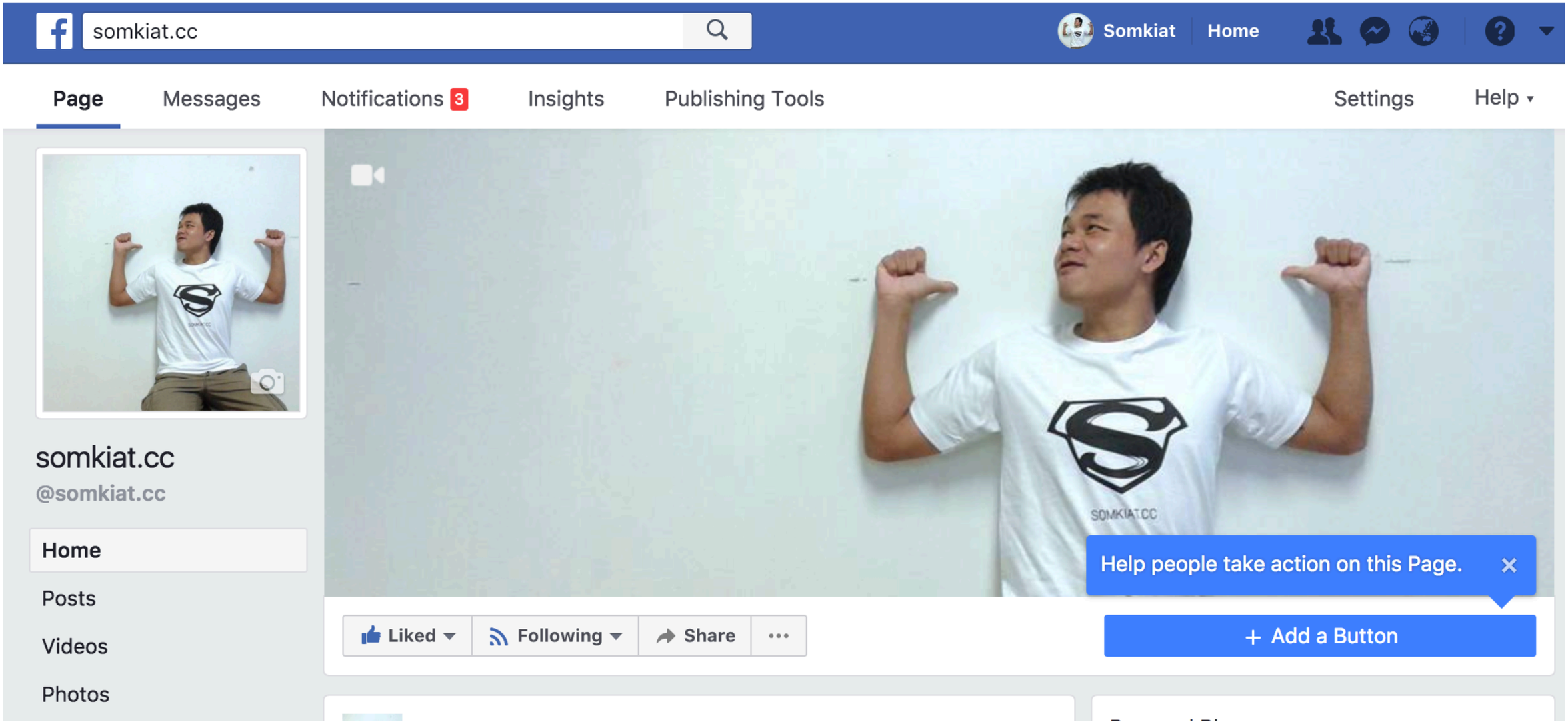

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Topics

Cloud Native Application
Evolution of architecture
Microservice architecture
How to decompose app to Microservice
Communication between services
Data consistency
Workshop

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”organizations which design systems ... are constrained to produce designs which are copies of the communication structures of these organizations”

- Melvin Conwey, 1968 -

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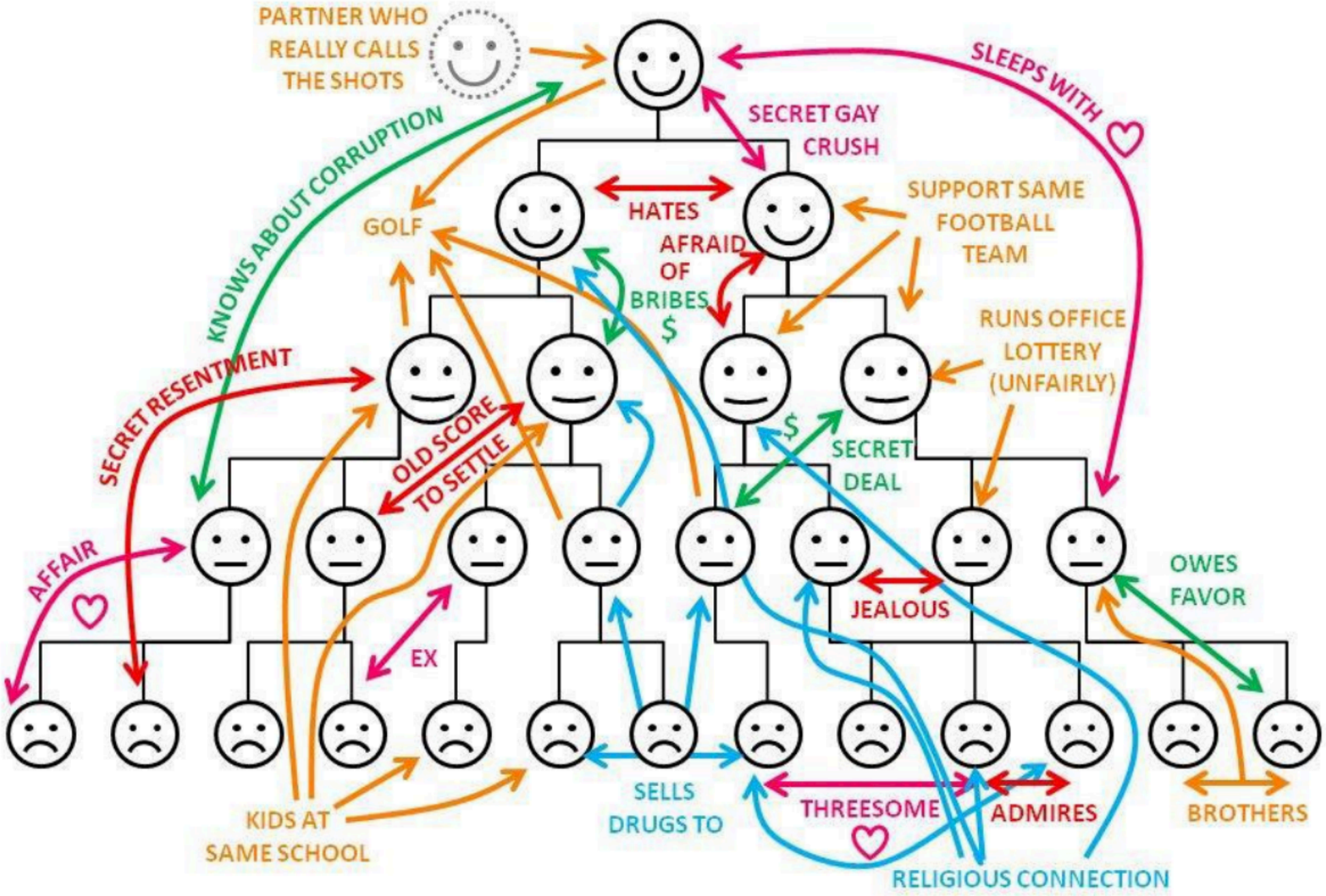

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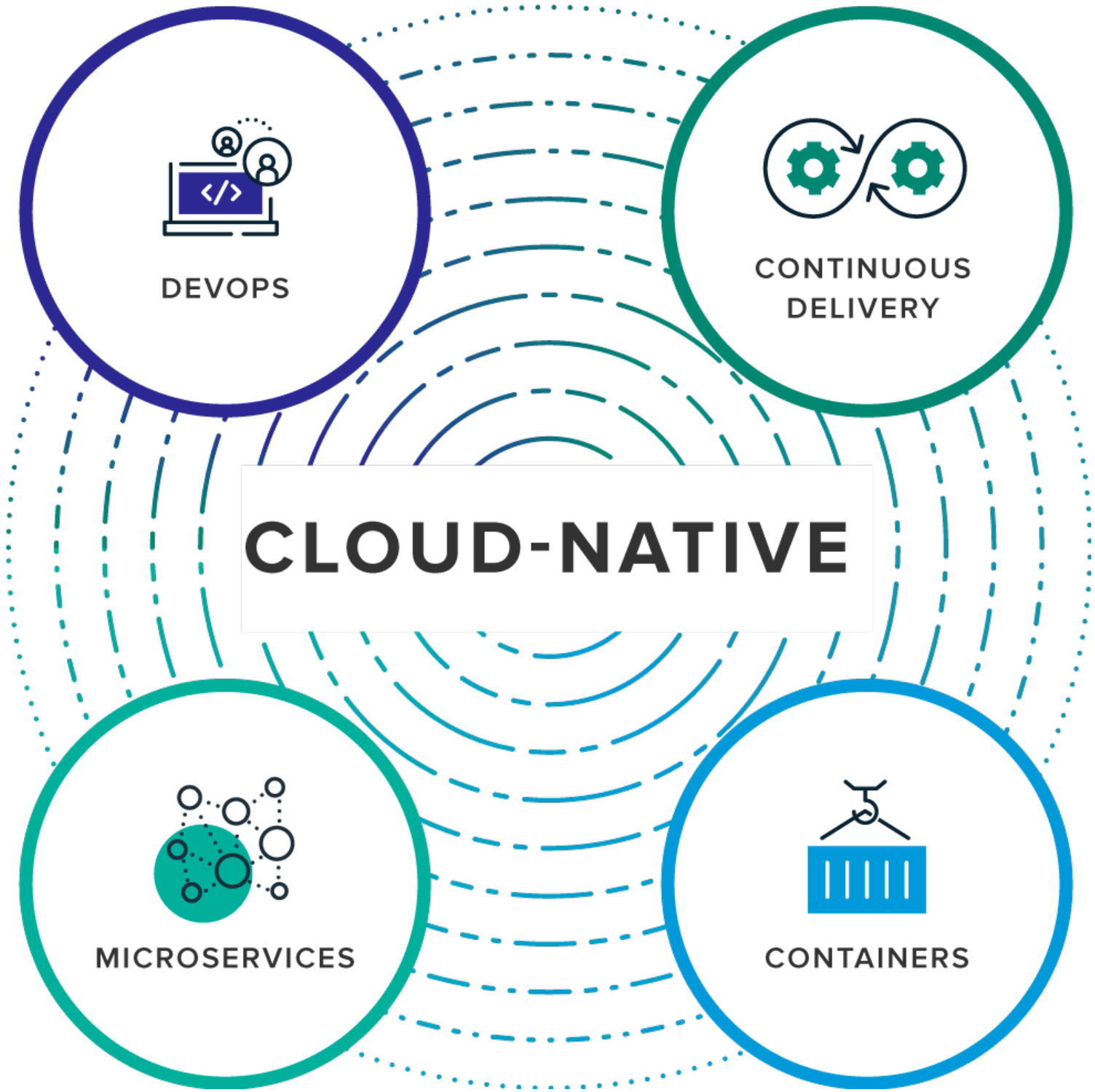

https://pivotal.io/cloud-native

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Evolution of Architecture

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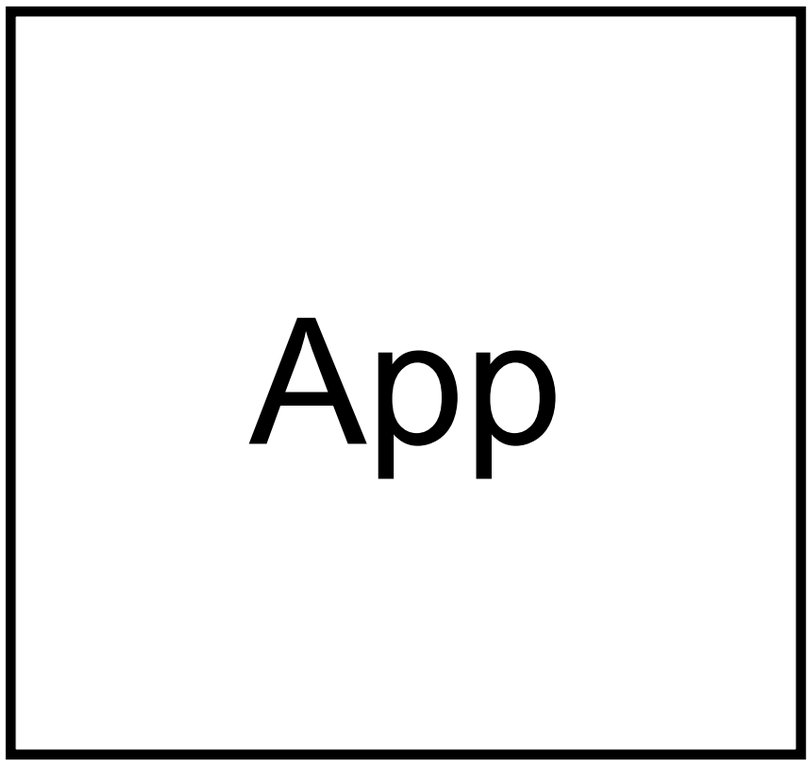
Monolith



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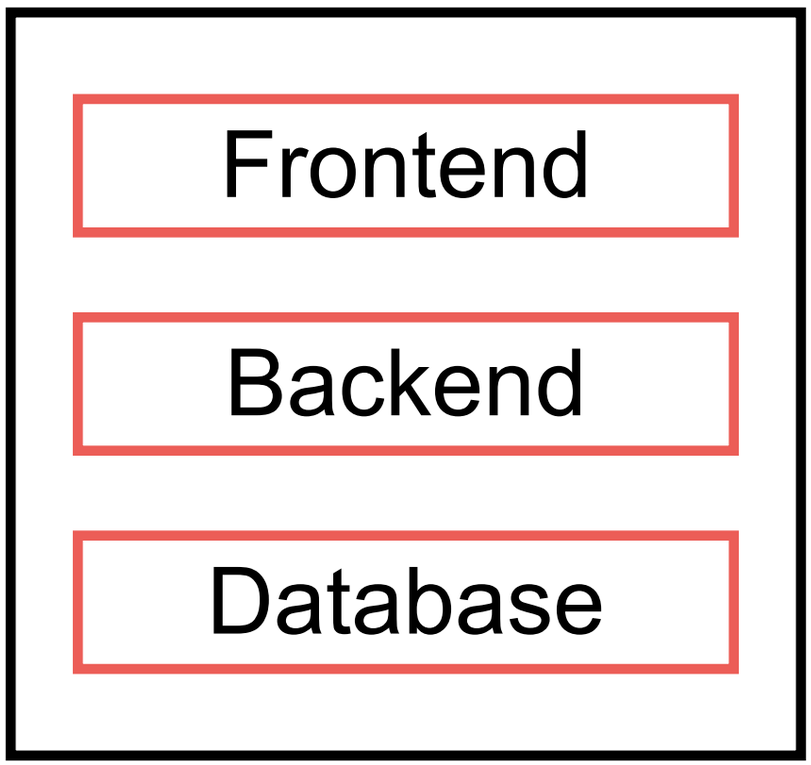
Layer



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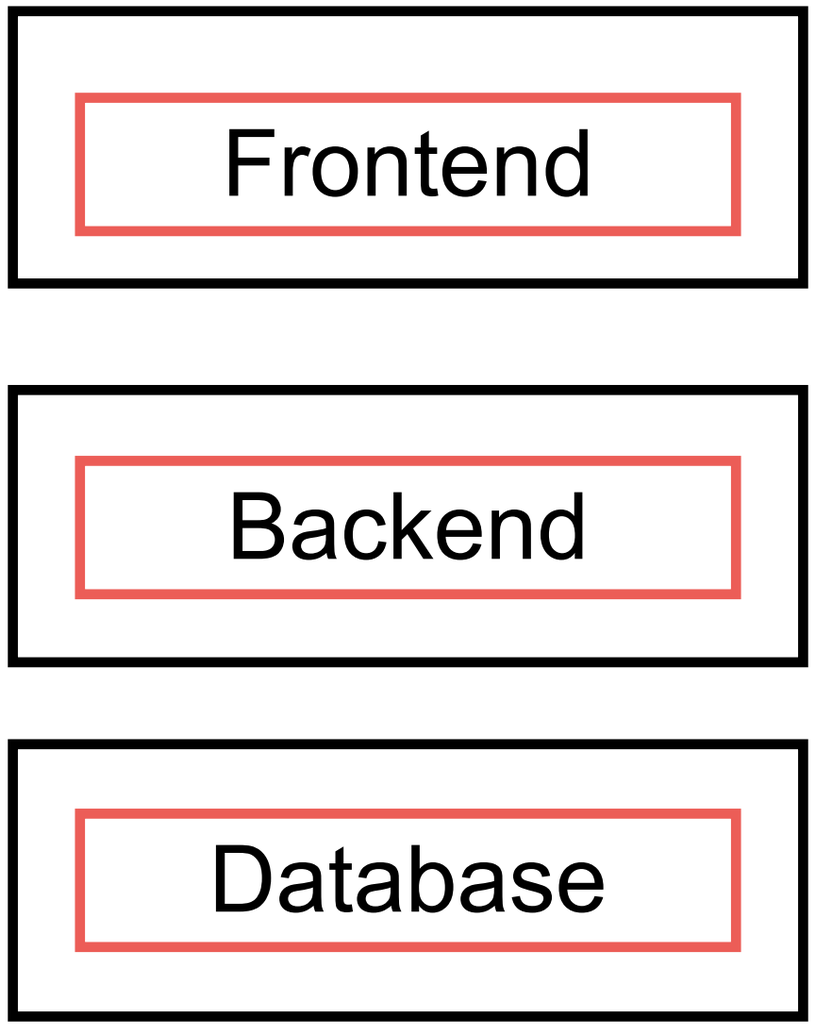

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Monolith

Easy to develop
Easy to change
Easy to testing
Easy to deploy
Easy to scale

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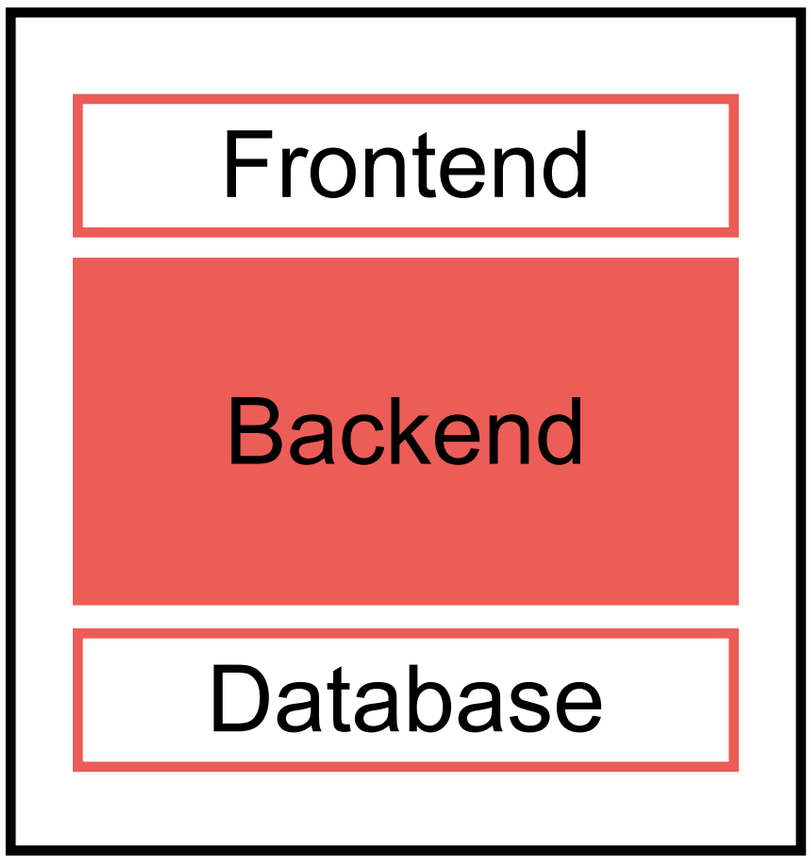
More features …



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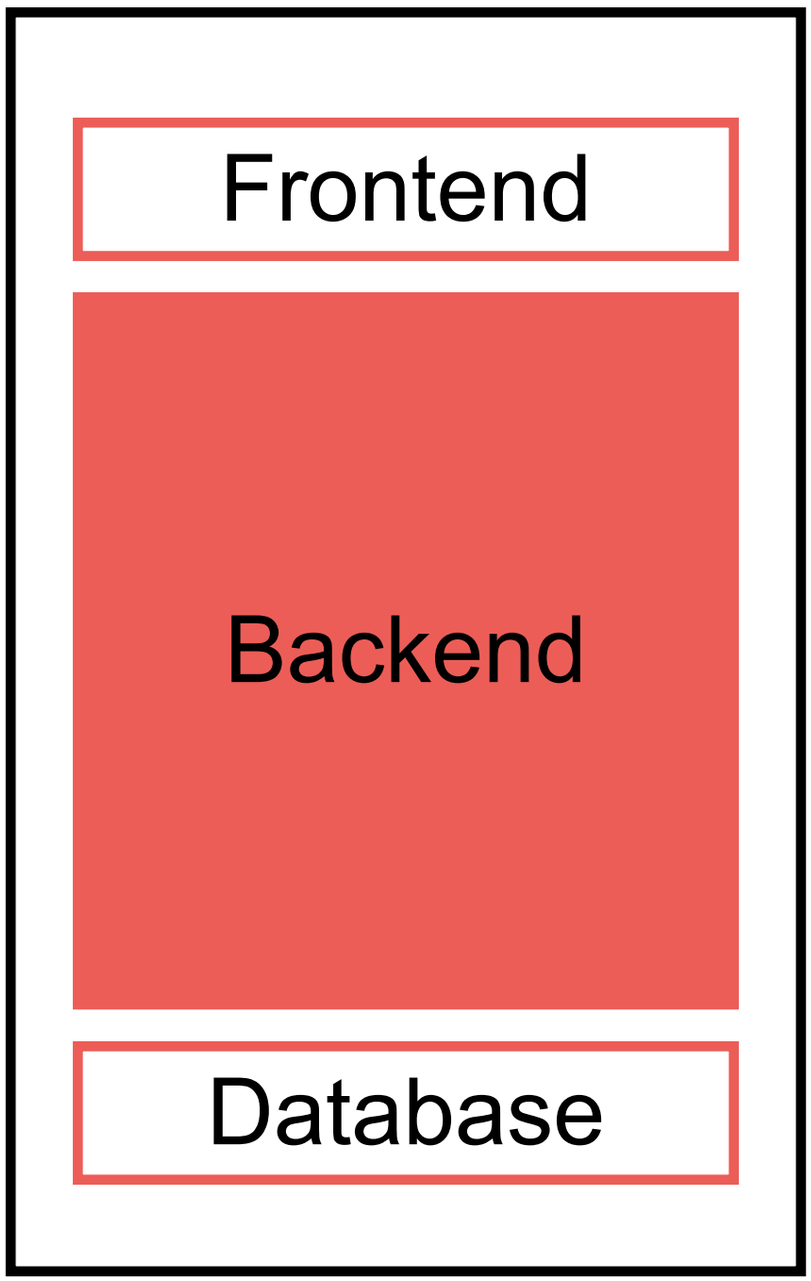
More features ...



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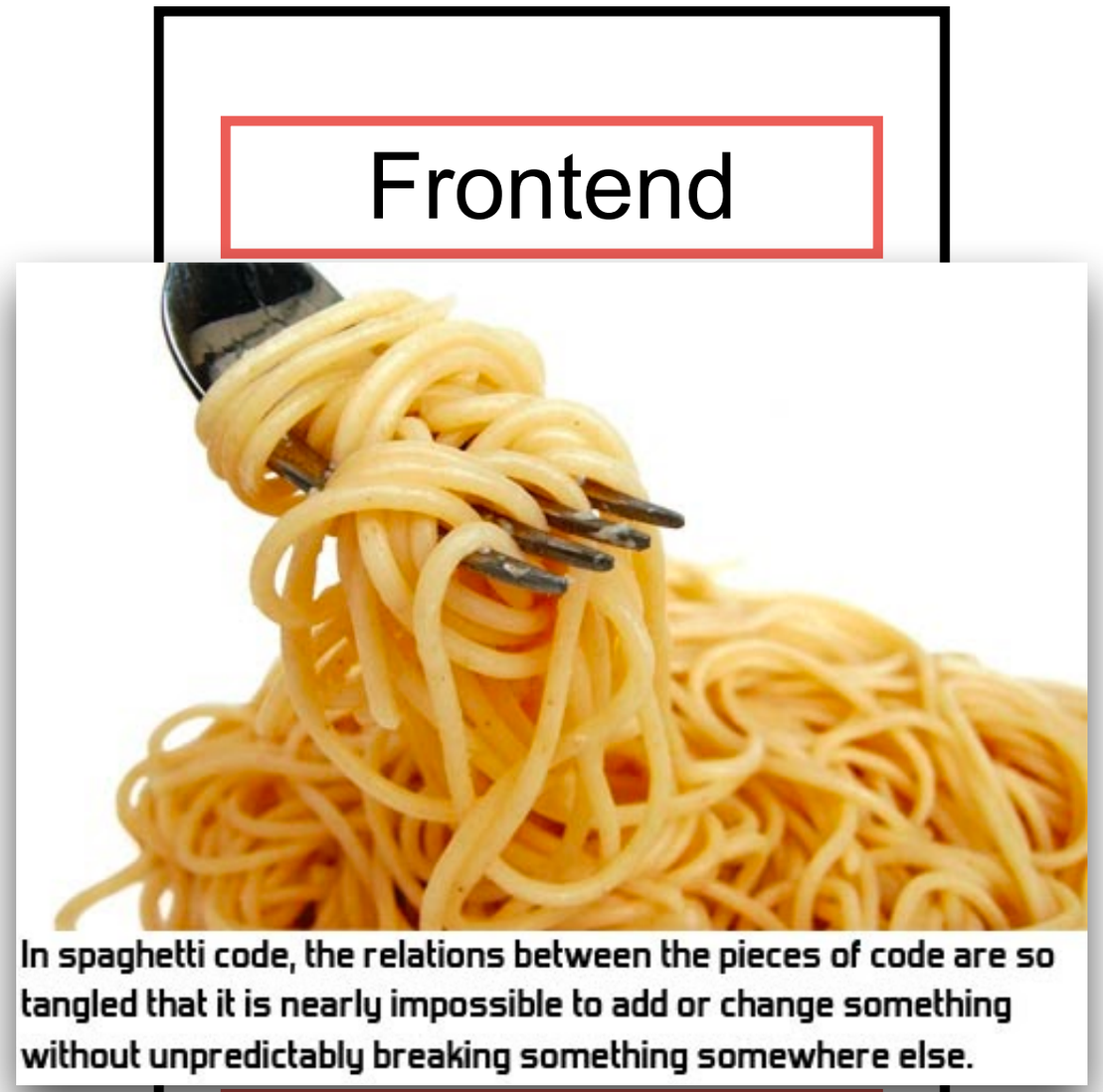
More features …



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More features …

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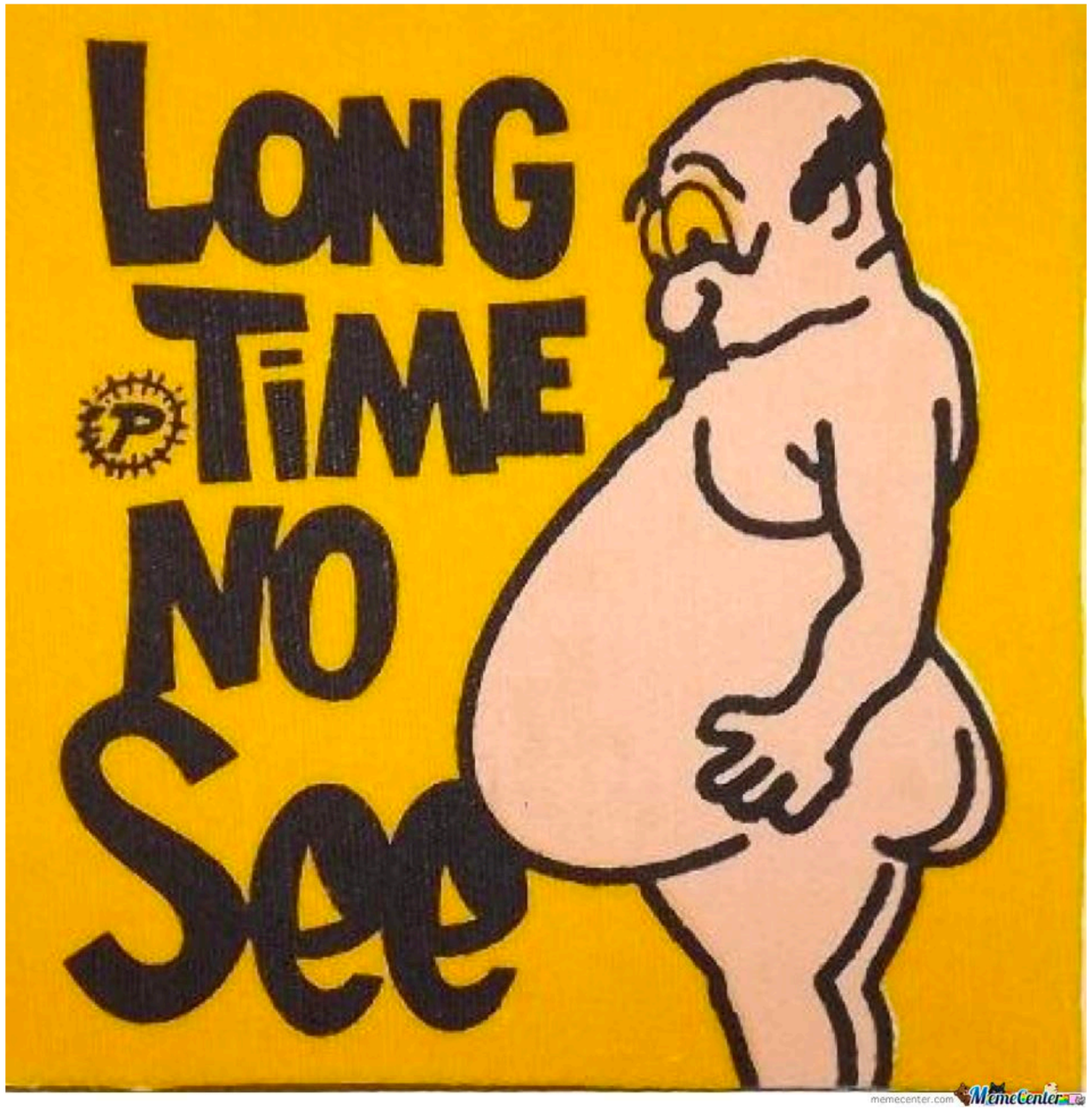

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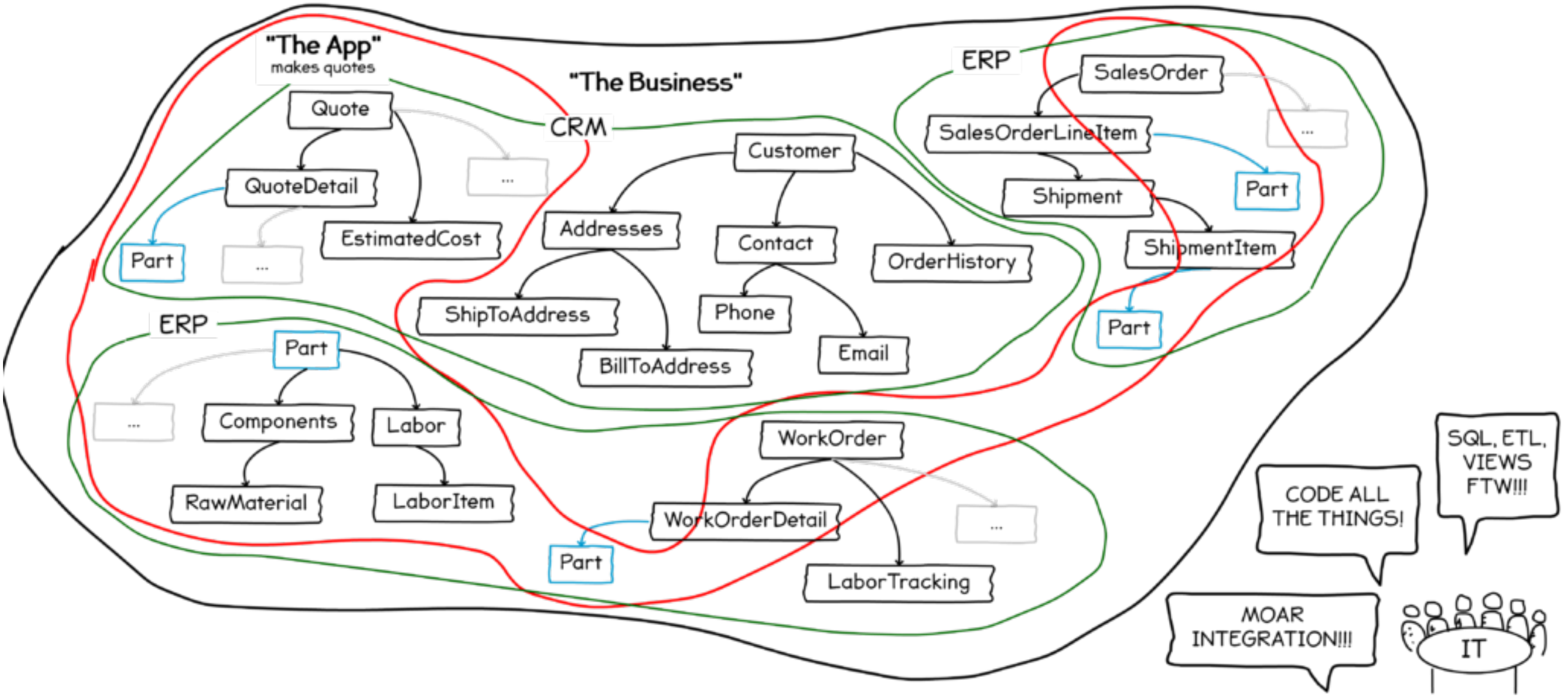
Monolith Hell



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We need to improve

We need to get better

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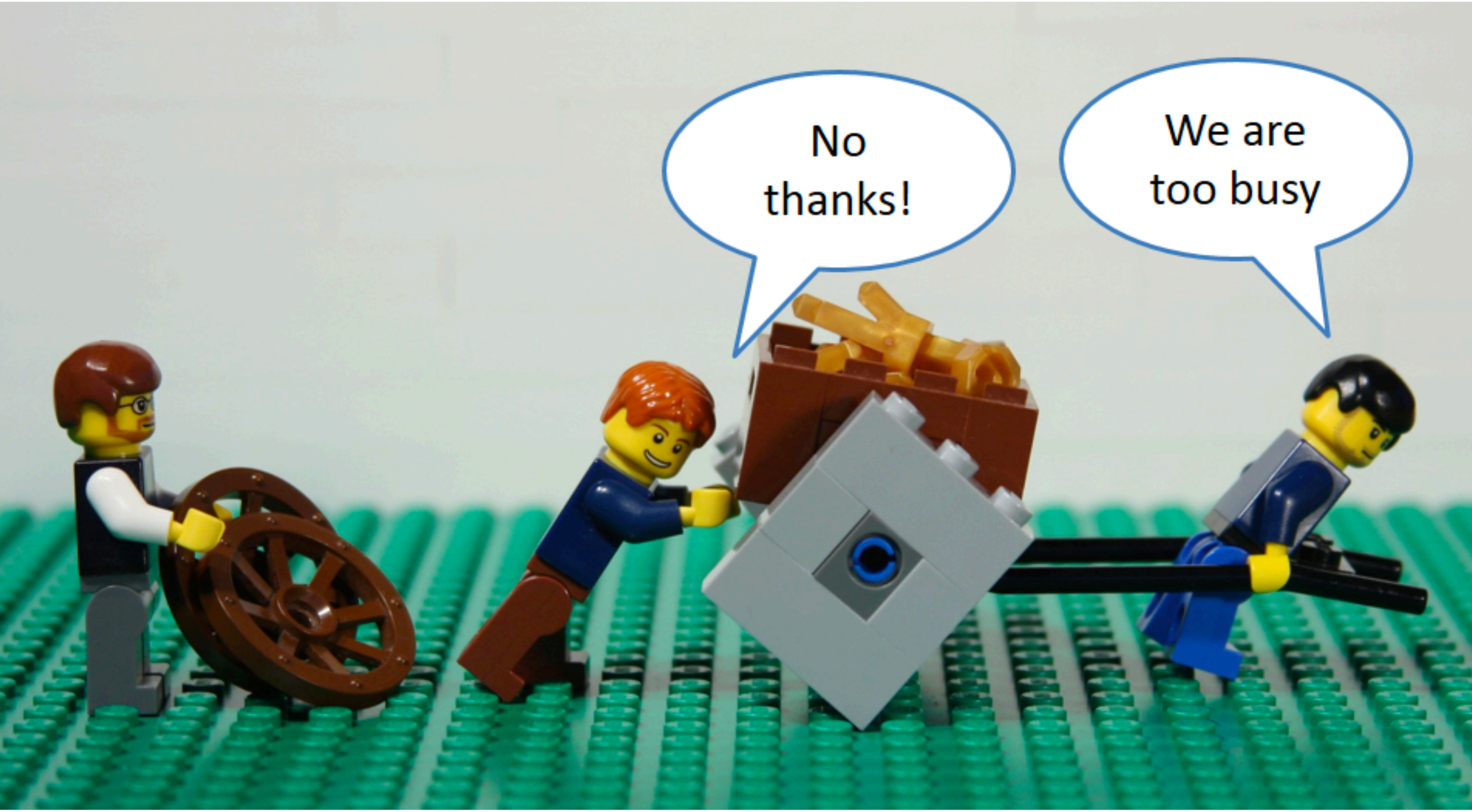

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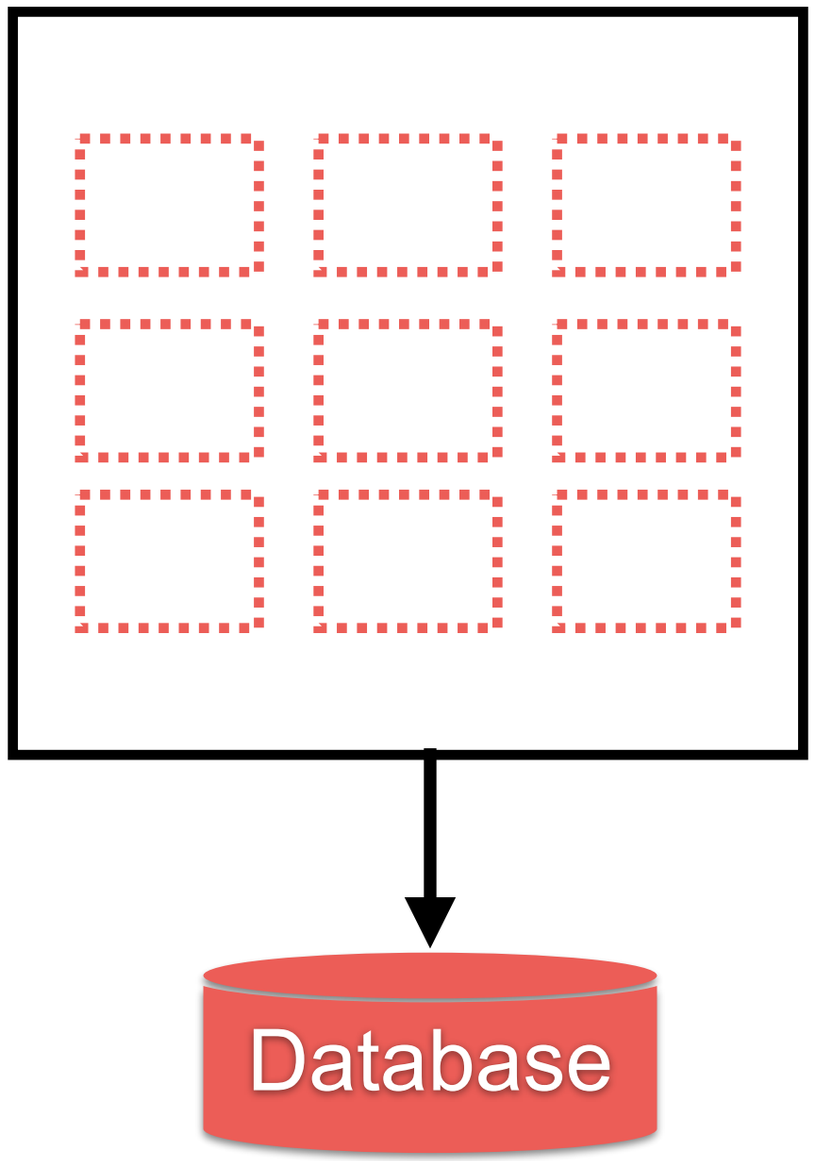
Modular monolith



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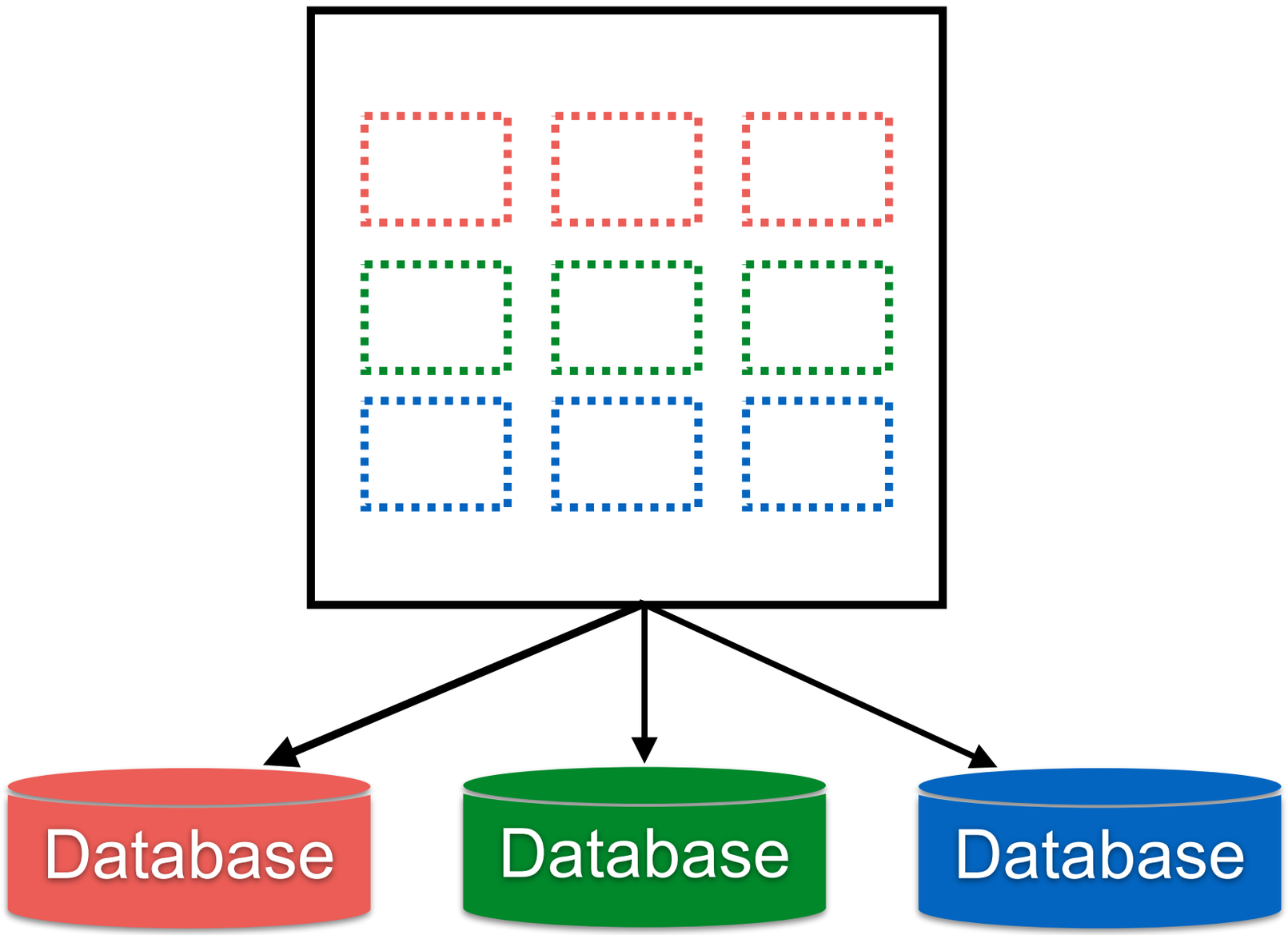
Modular monolith with a decompose database



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How to scale ?

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What if we don’t use all modules equally ?

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How can we update individual database ?

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Do all modules need to use the same Database, Language and Runtime … ?

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We need to improve

We need to get better

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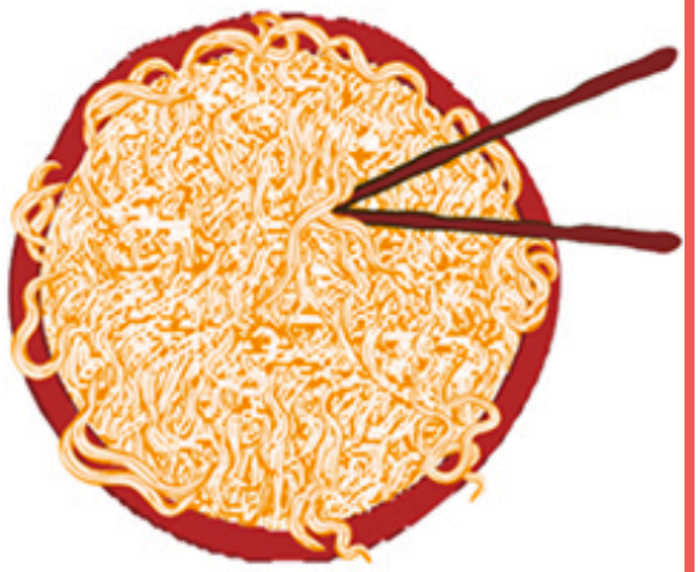
SOA

1990s and earlier

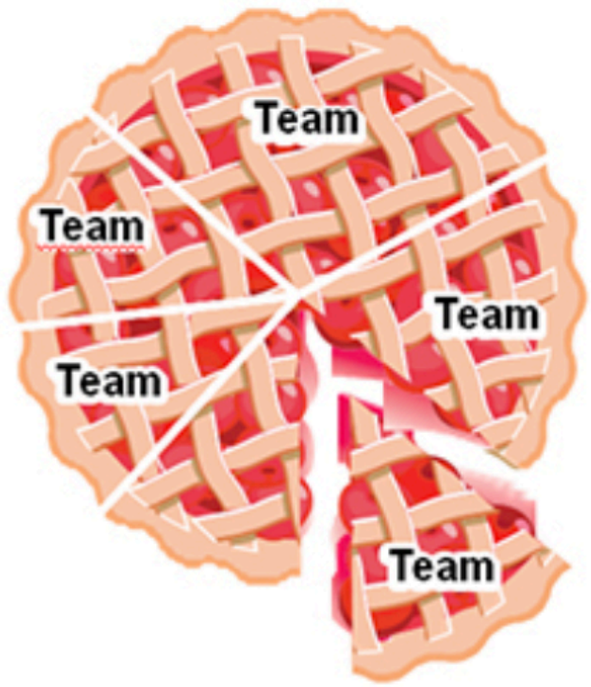
Pre-SOA (monolithic)
Tight coupling



For a monolith to change, all must agree on each change. Each change has unanticipated effects requiring careful testing beforehand.

2000s

Traditional SOA
Looser coupling



Elements in SOA are developed more autonomously but must be coordinated with others to fit into the overall design.

2010s

Microservices
Decoupled

Developers can create and activate new microservices without prior coordination with others. Their adherence to MSA principles makes continuous delivery of new or modified services possible.

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Service-Oriented Architecture

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What is service ?

Standalone and loosely couple
Independently deployable software component
Implement some useful functionality

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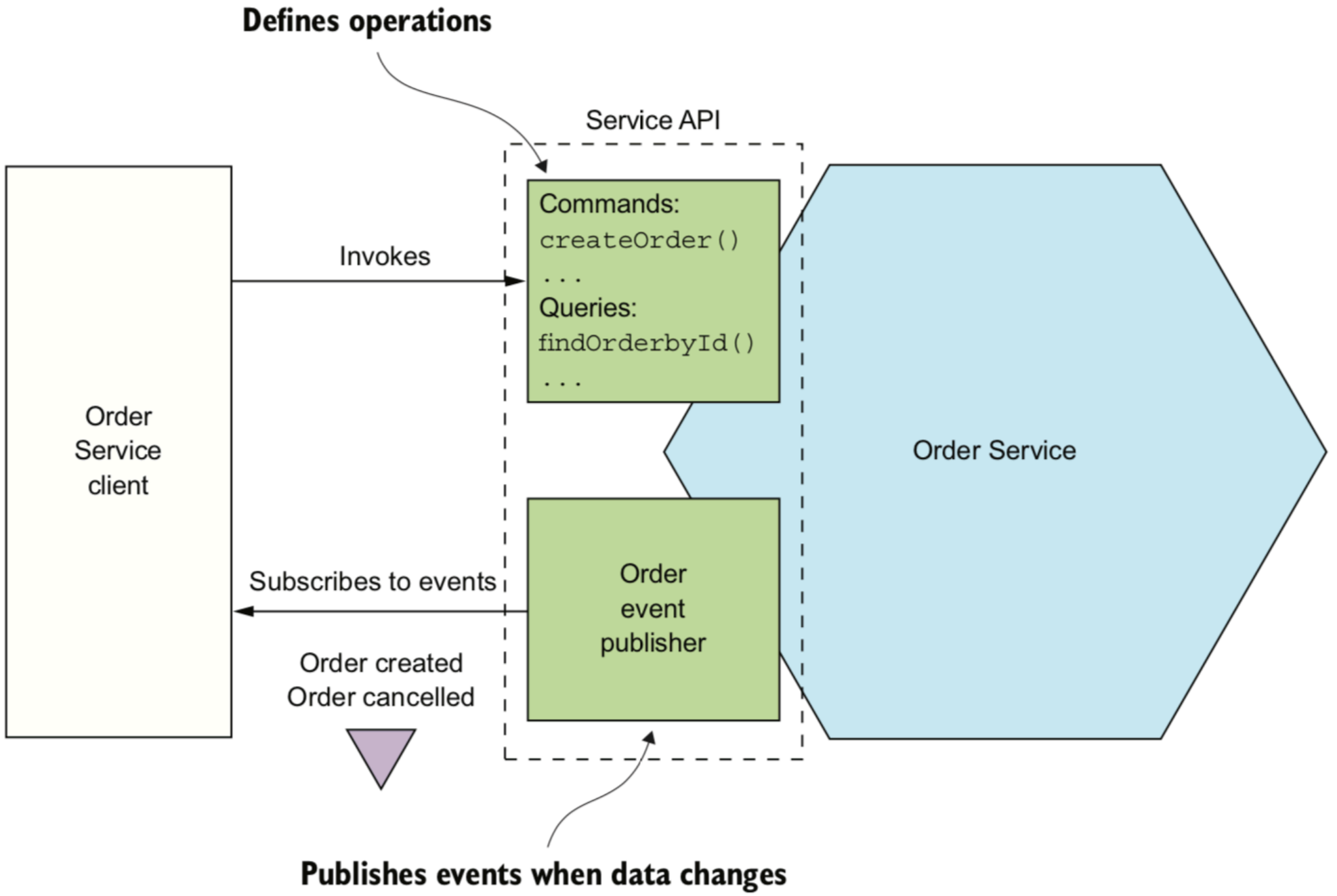
Example of service



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Service-Oriented Architecture

SOA Manifesto

Service orientation is a paradigm that frames what you do.
Service-oriented architecture (SOA) is a type of architecture
that results from applying service orientation.

We have been applying service orientation to help organizations consistently deliver sustainable business value, with increased agility and cost effectiveness, in line with changing business needs.

http://www.soa-manifesto.org/

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Service-Oriented Architecture

Through our work we have come to prioritize:

Business value over technical strategy

Strategic goals over project-specific benefits

Intrinsic interoperability over custom integration

Shared services over specific-purpose implementations

Flexibility over optimization

Evolutionary refinement over pursuit of initial perfection

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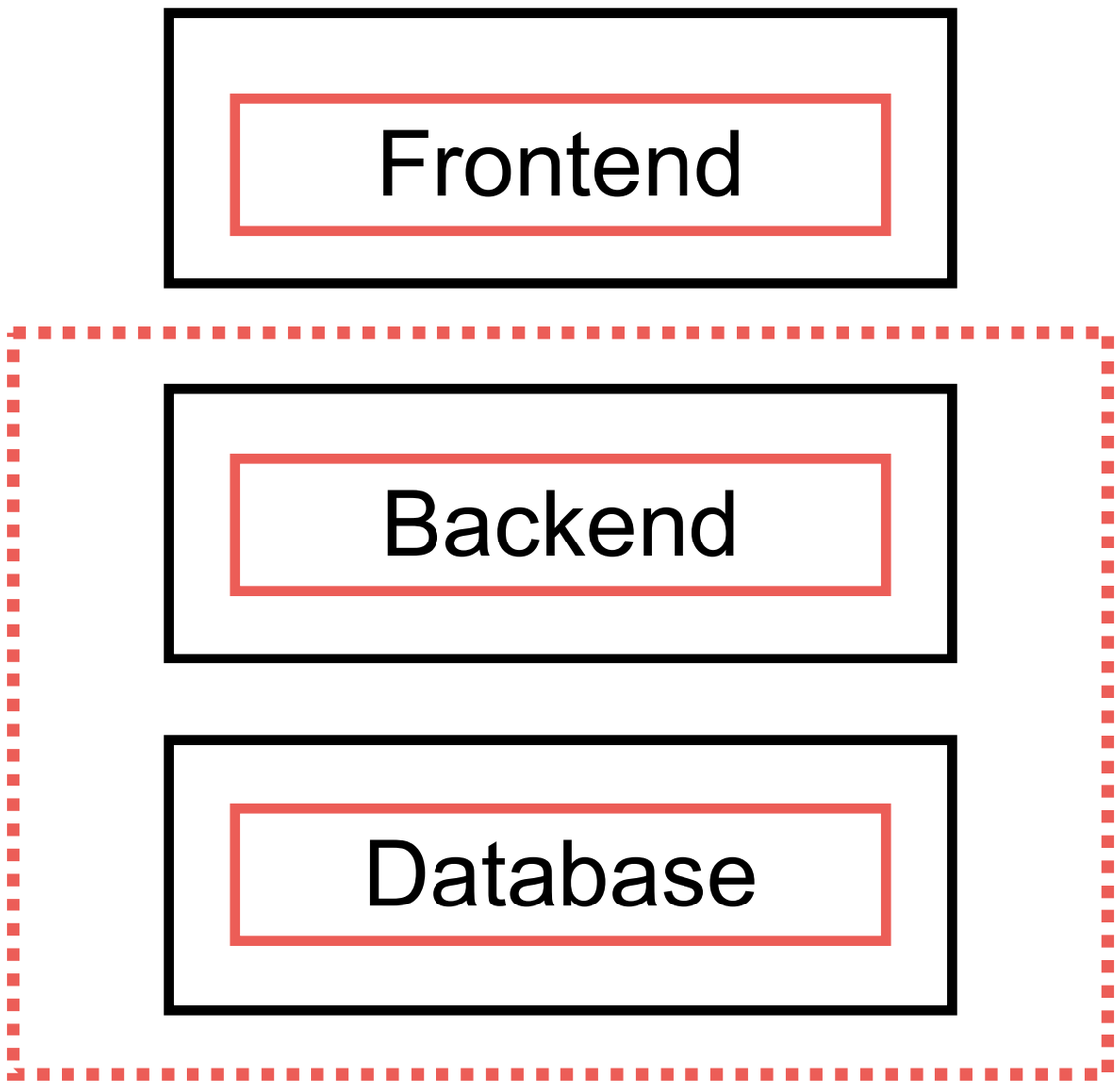
Focus on services



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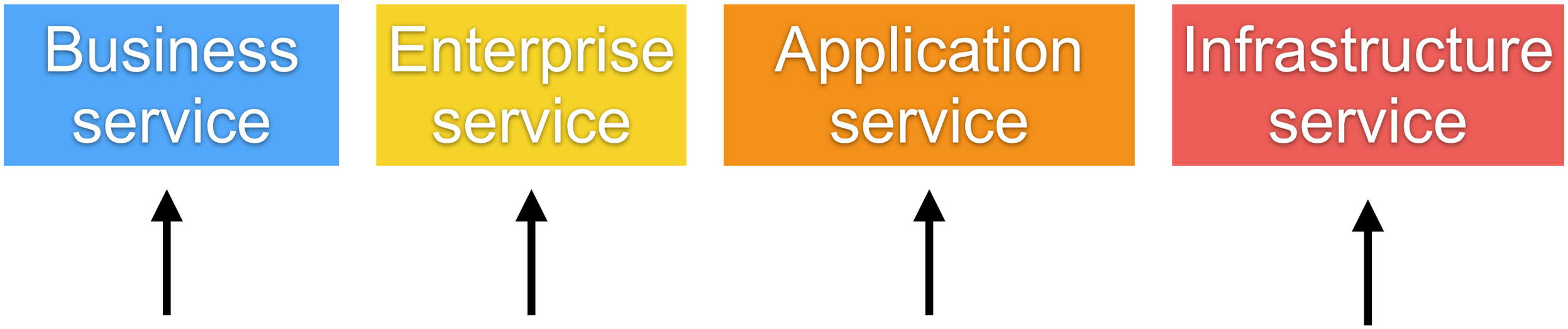
Service-Oriented Architecture



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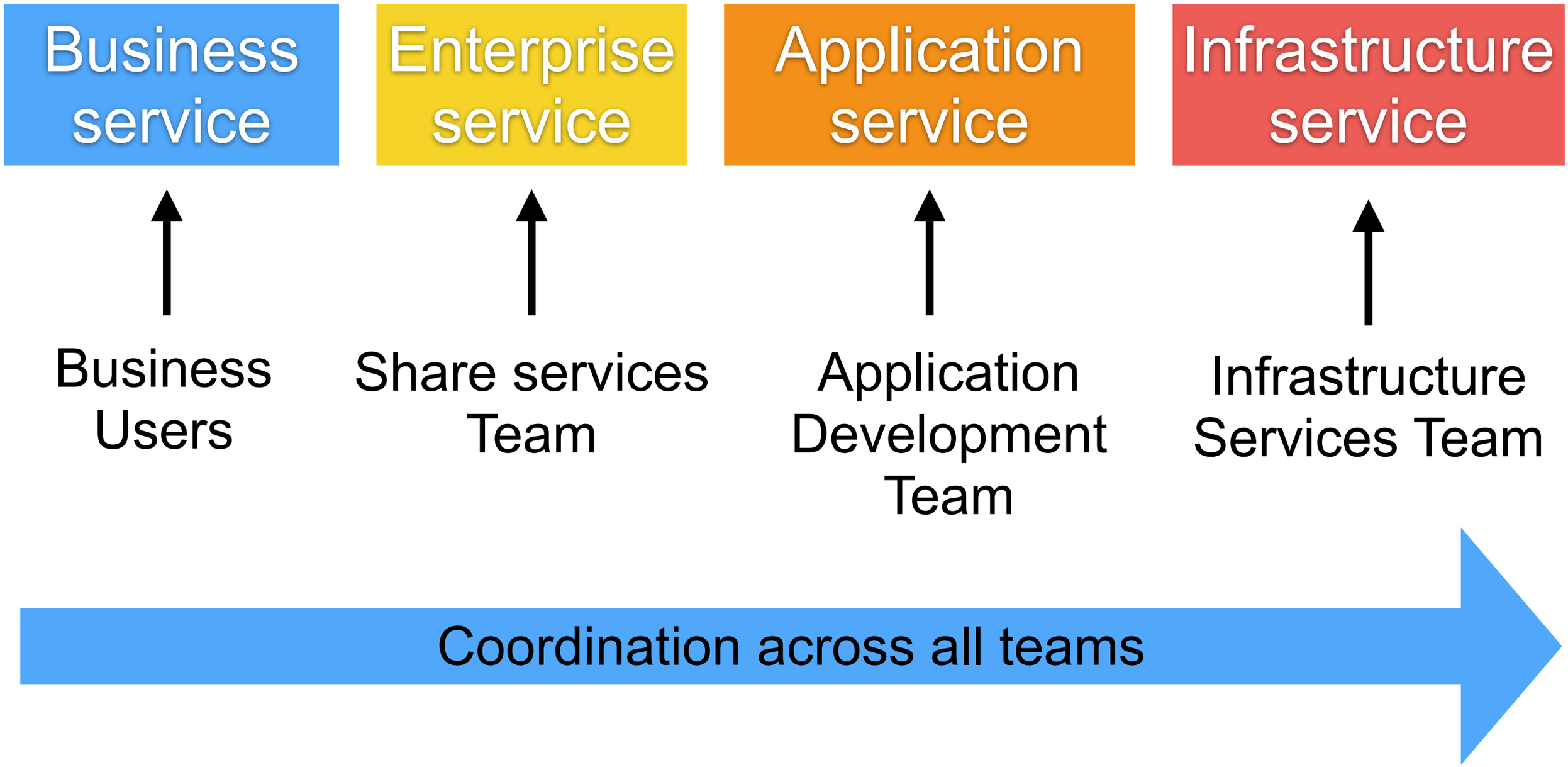
Service-Oriented Architecture



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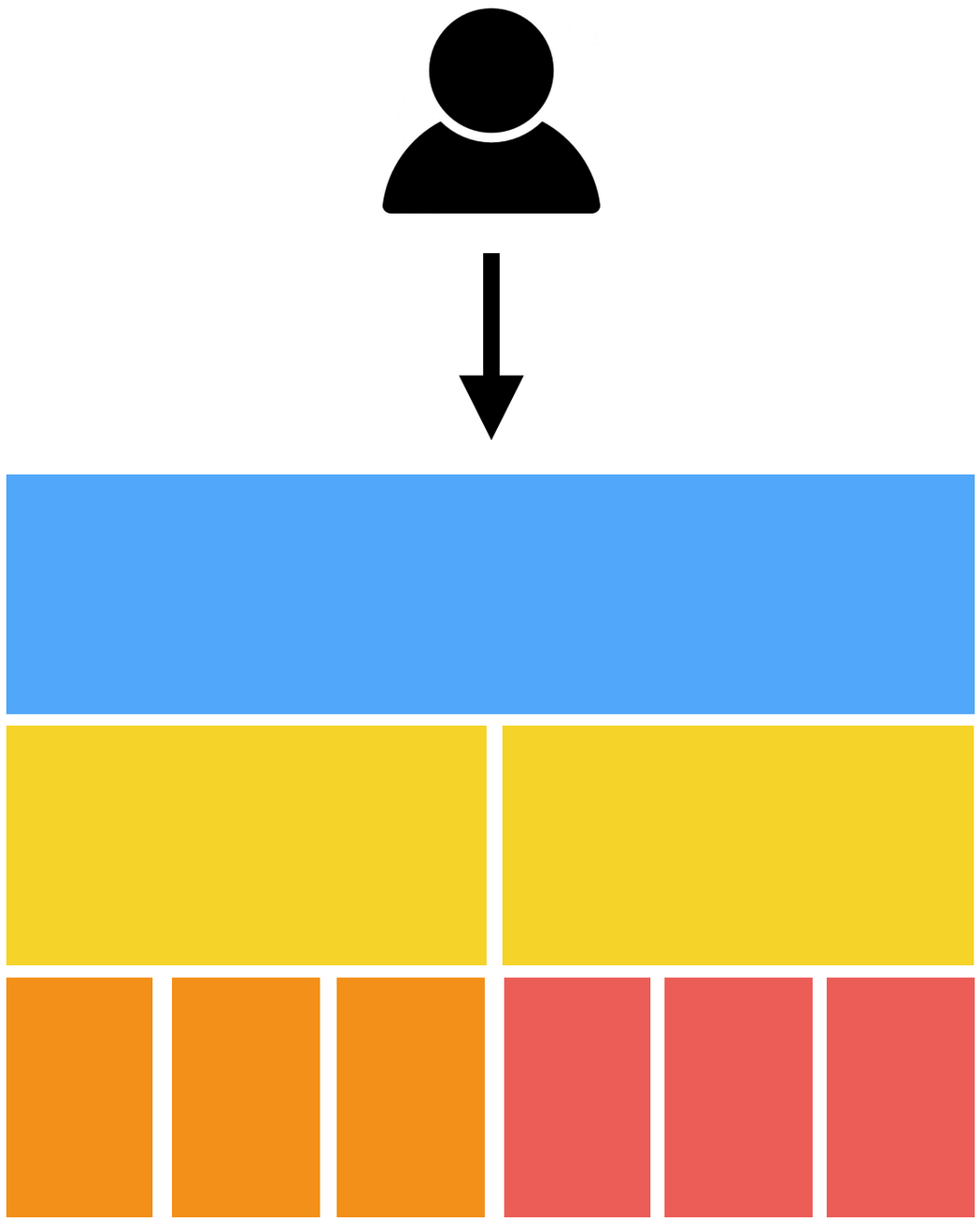
Service-Oriented Architecture !!



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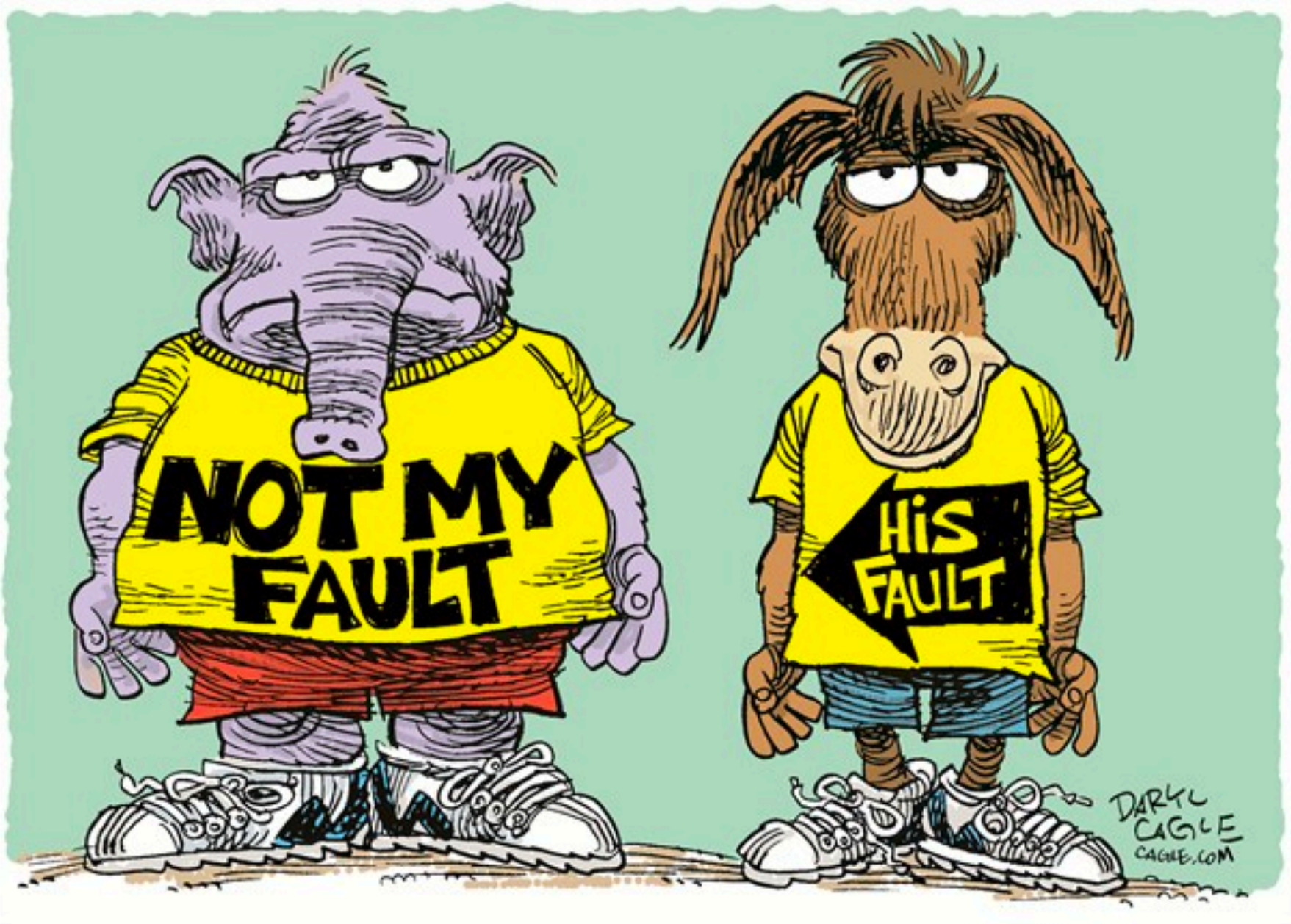

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Microservice

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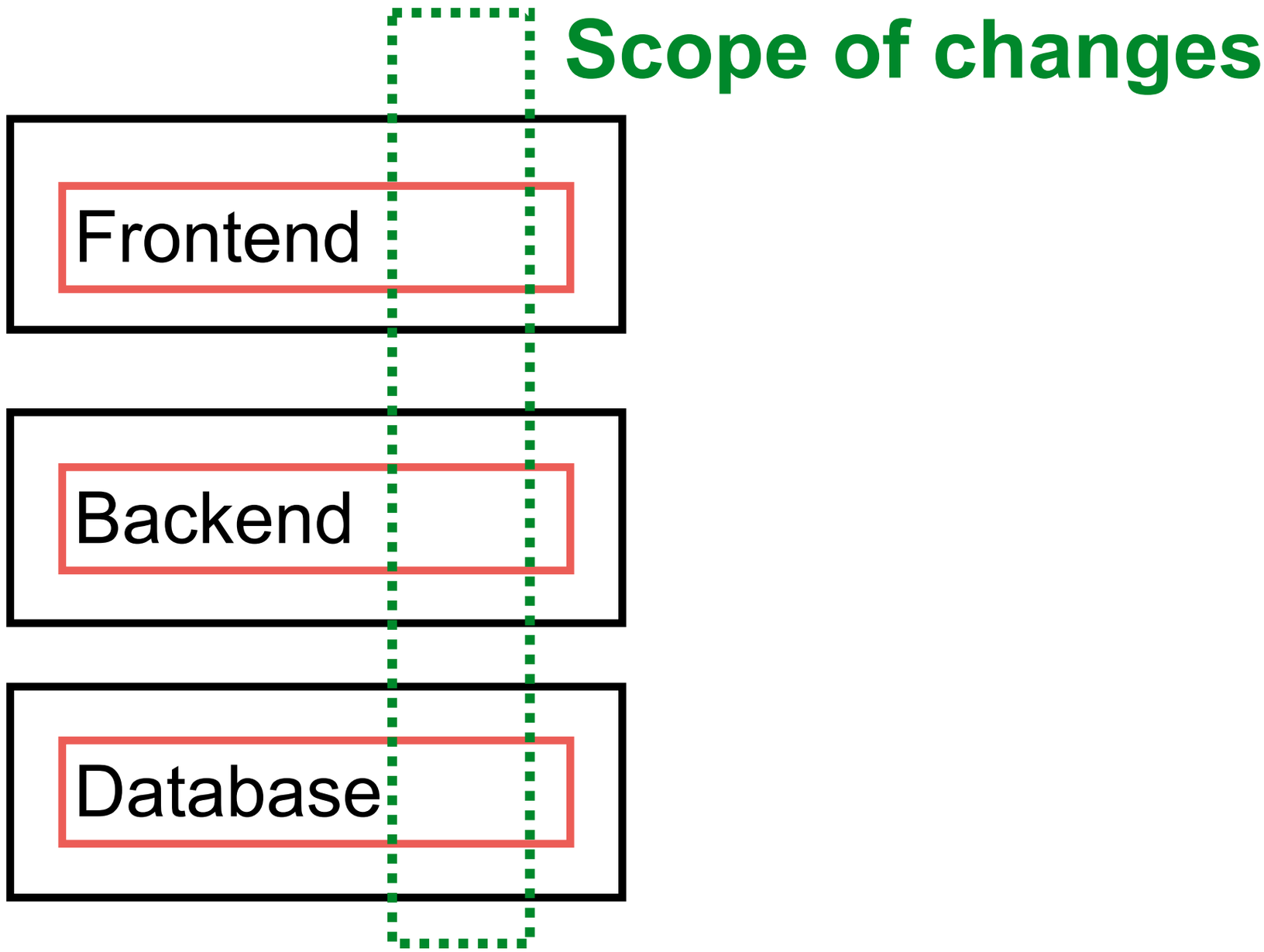
Focus on all tiers/layers



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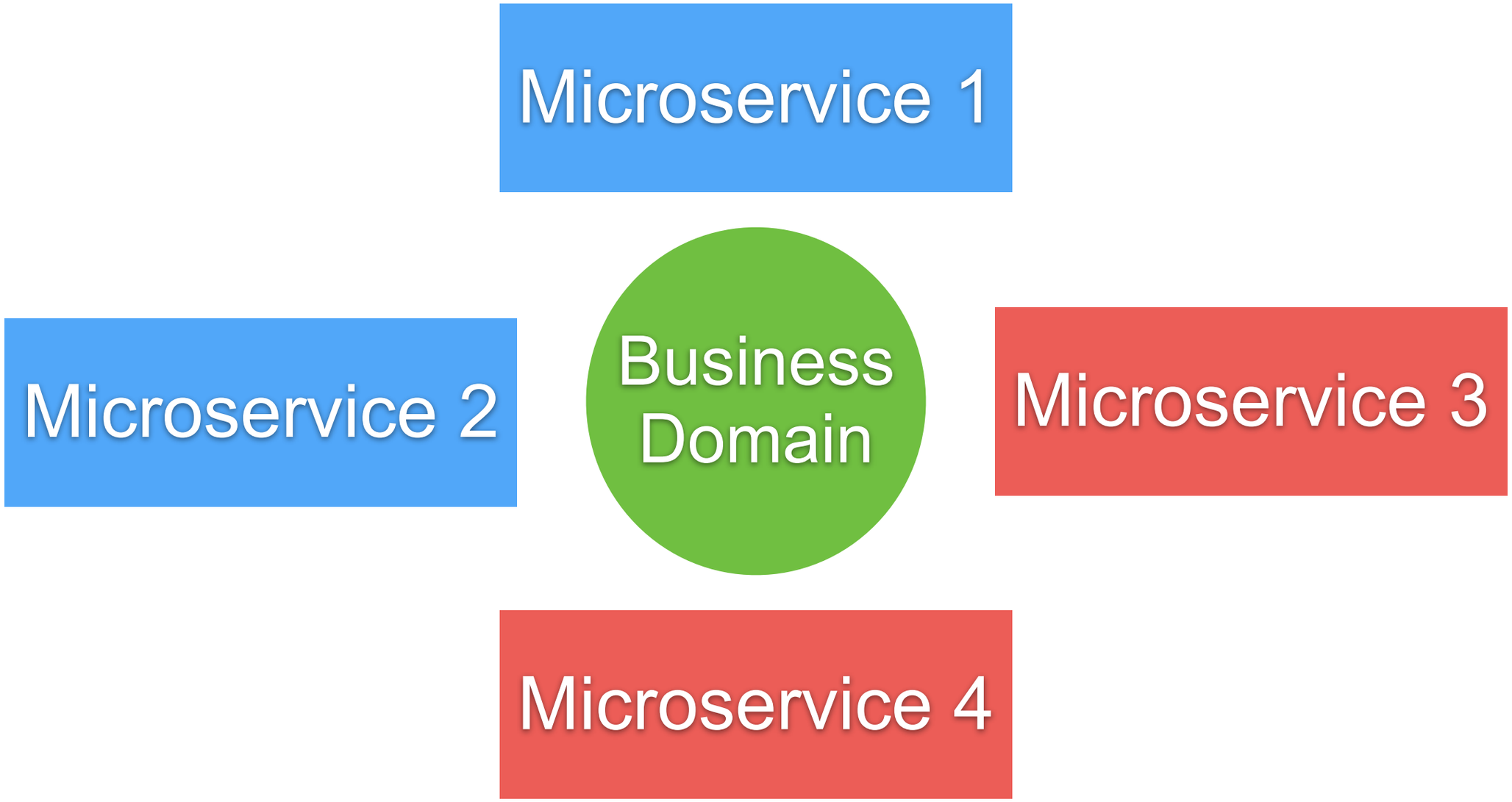
Microservice



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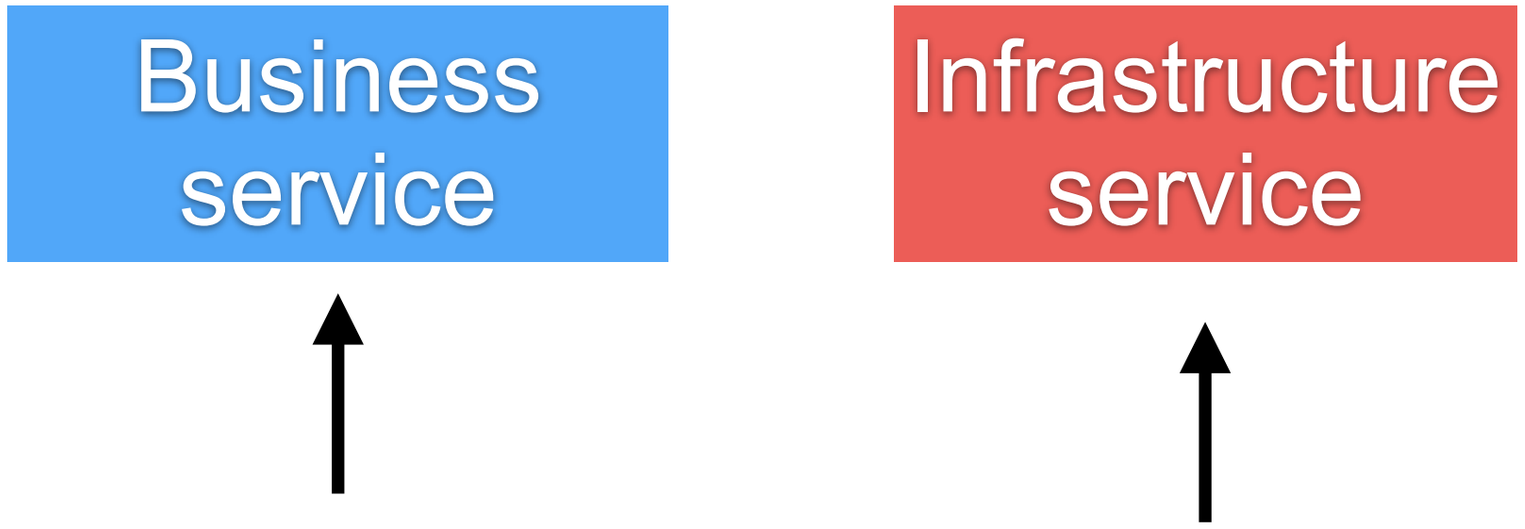
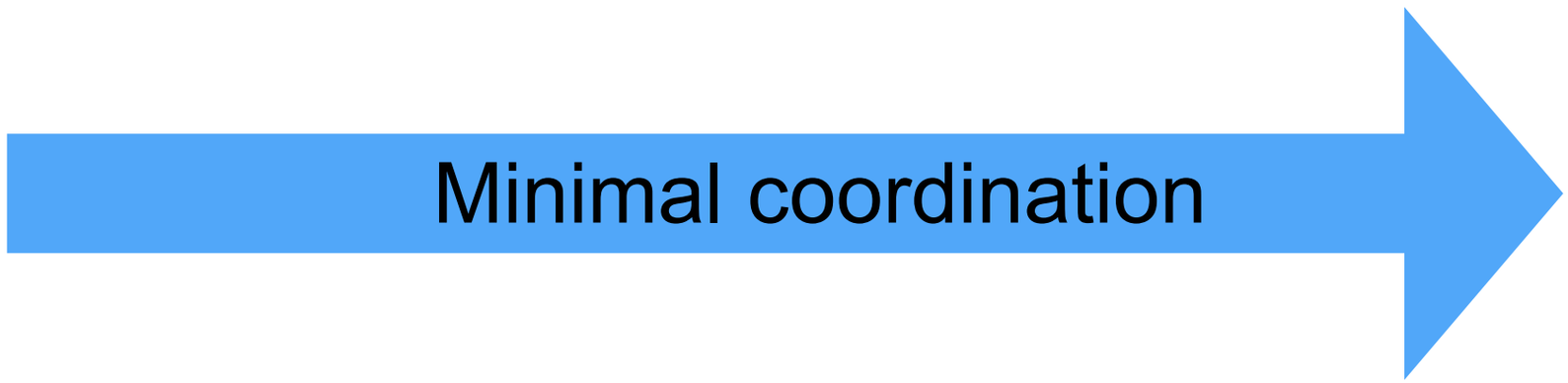
Microservice



Application Development Team



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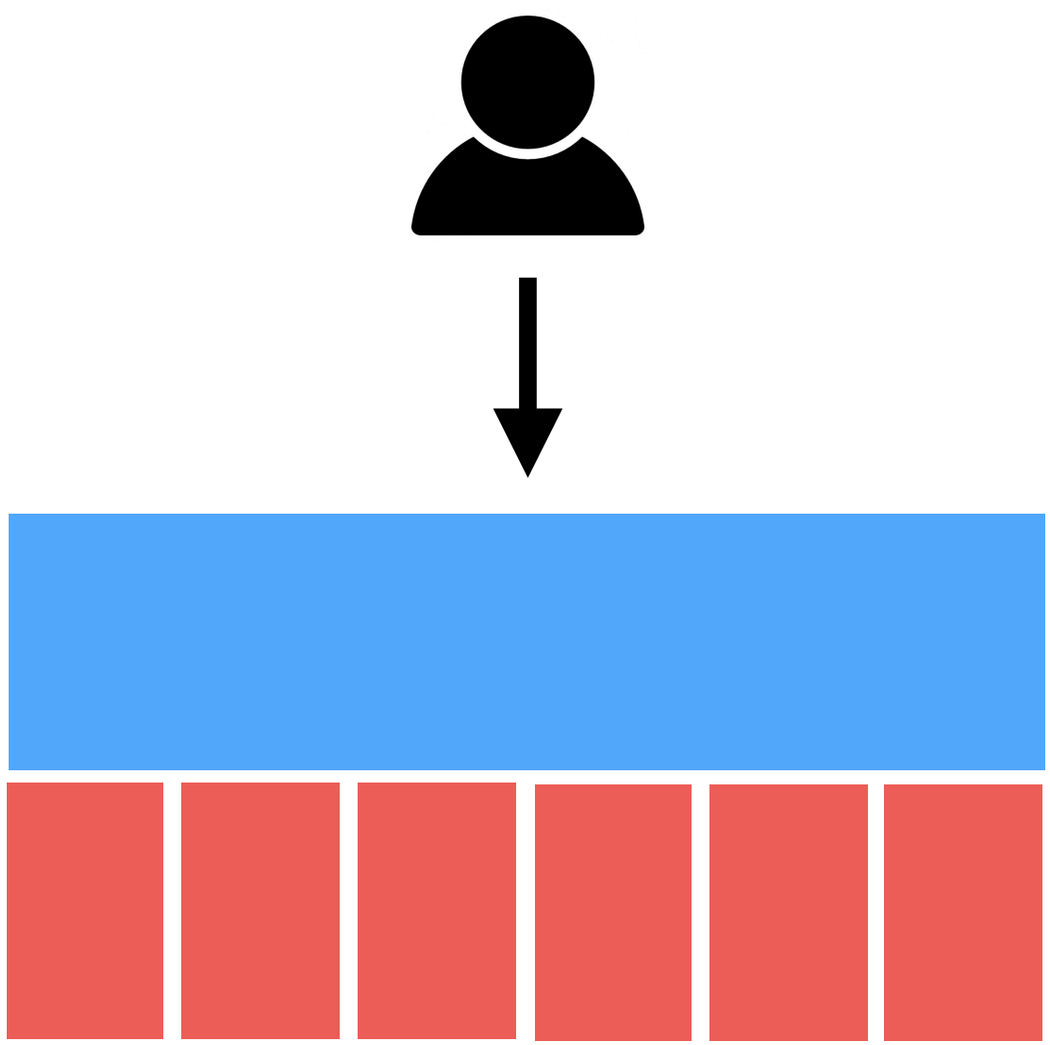
Microservice



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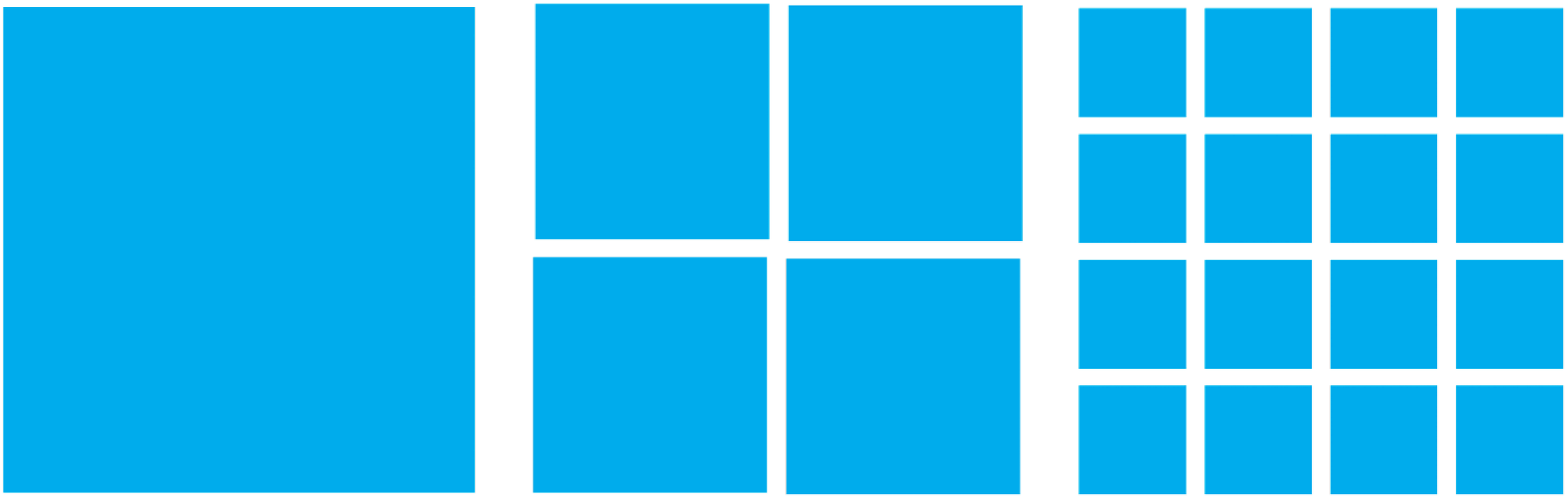

Monolithic

Service Oriented

Microservices

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Microservice history

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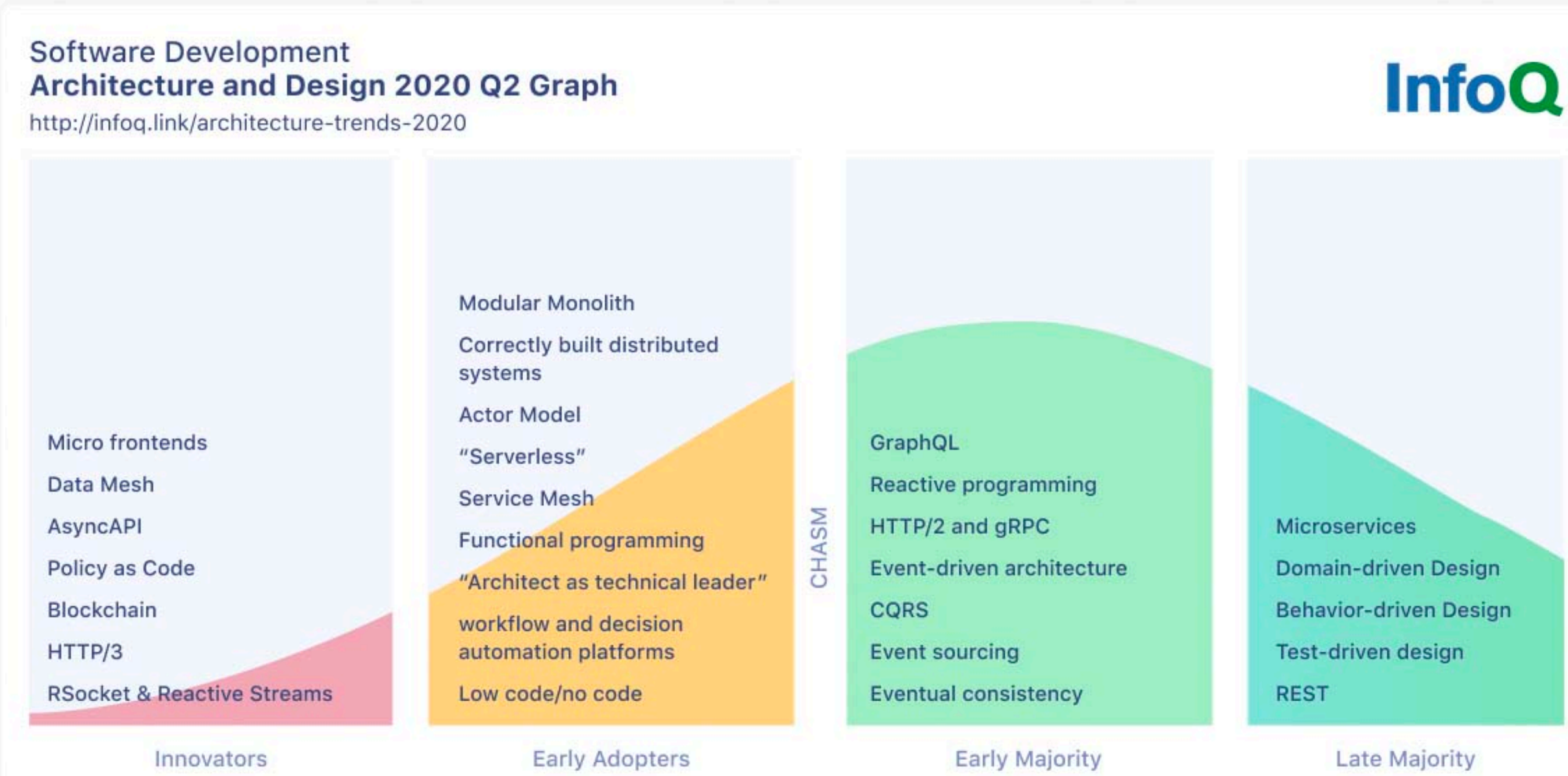
Microservice 2020



https://www.infoq.com/articles/architecture-trends-2020/

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Microservice

Small, Do one thing (Single Responsibility)
Modular and **loosely coupled**
Easy to **understand**
Easy to **develop** by small team
Deploy independently
Focus on **business** first
Scale independently

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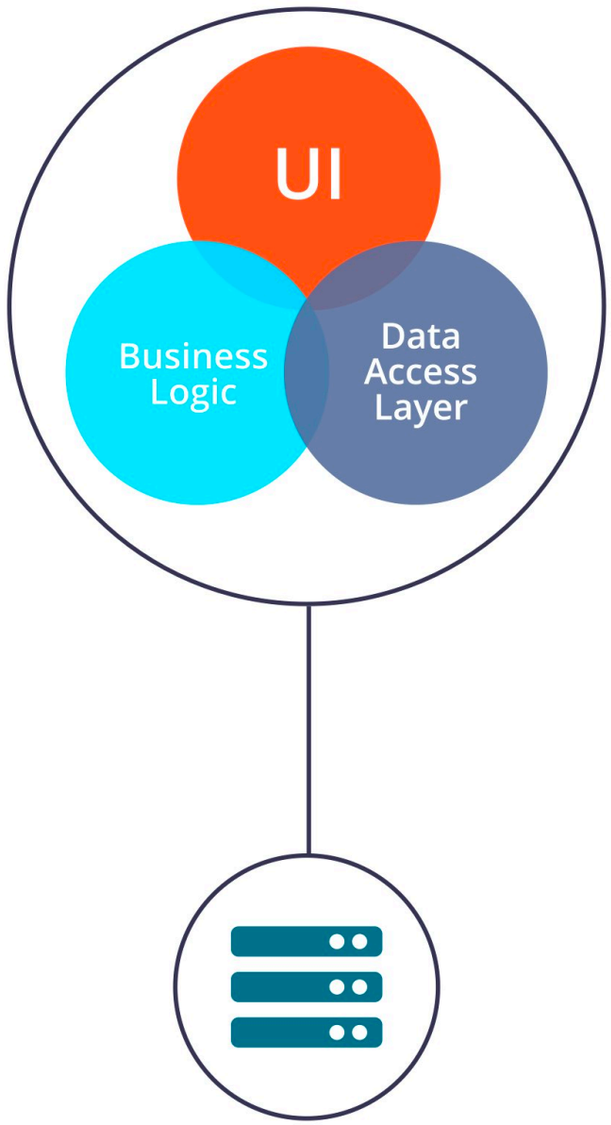
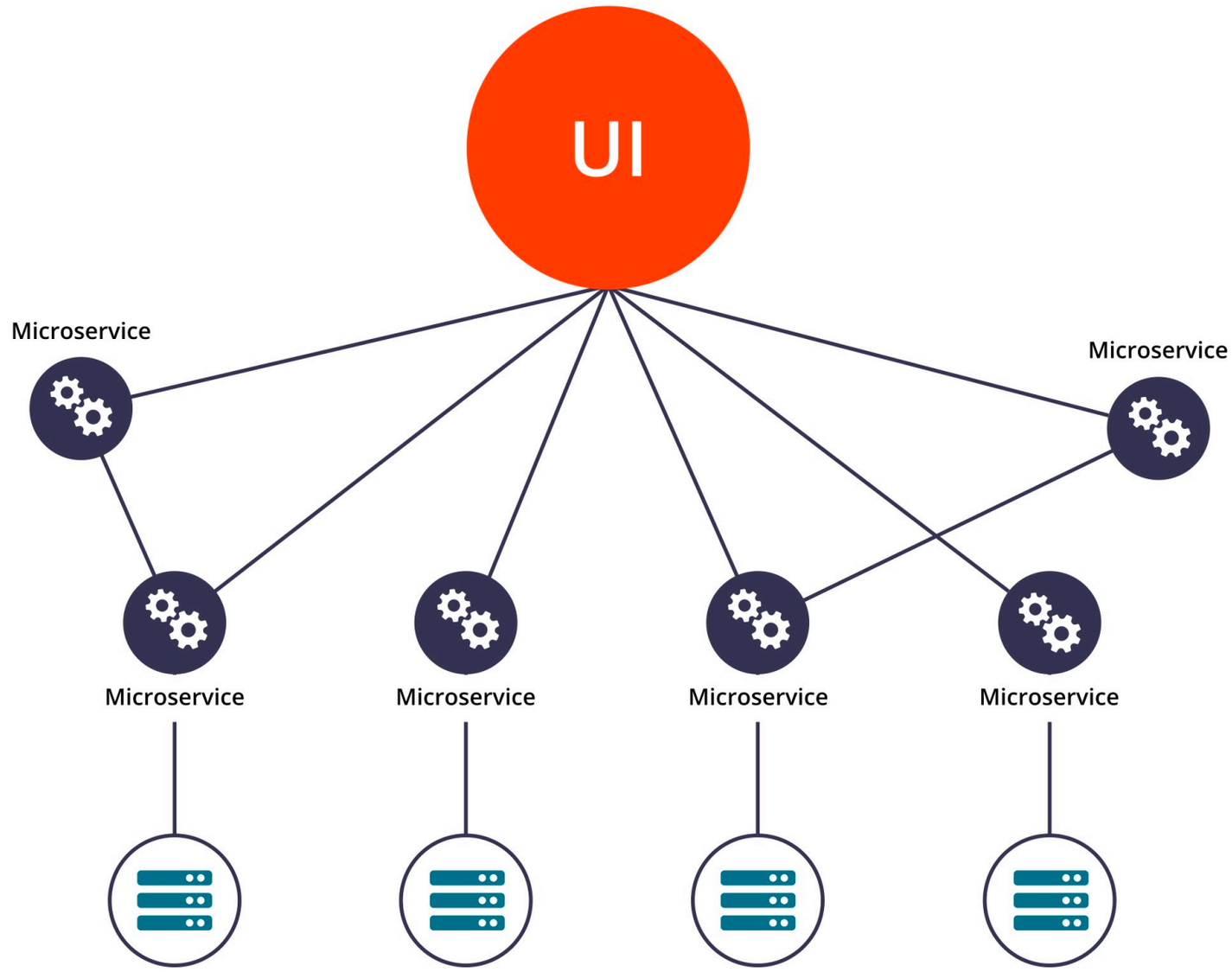


Monolithic Architecture



Microservice Architecture

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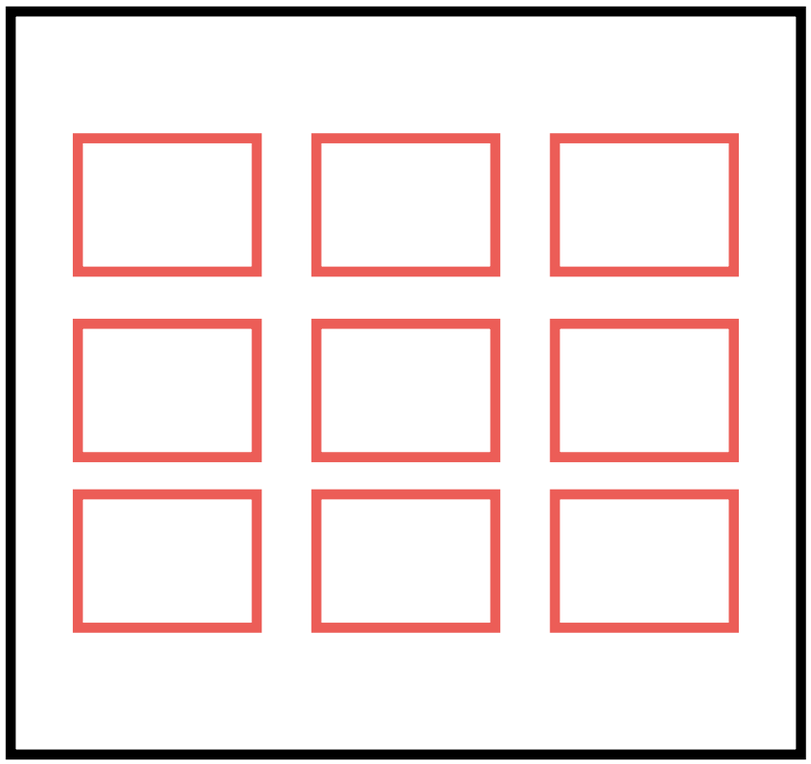
Microservice



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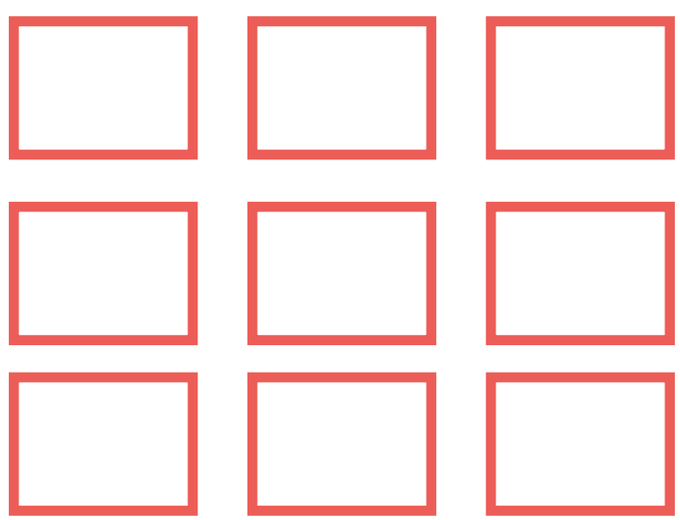
Microservice



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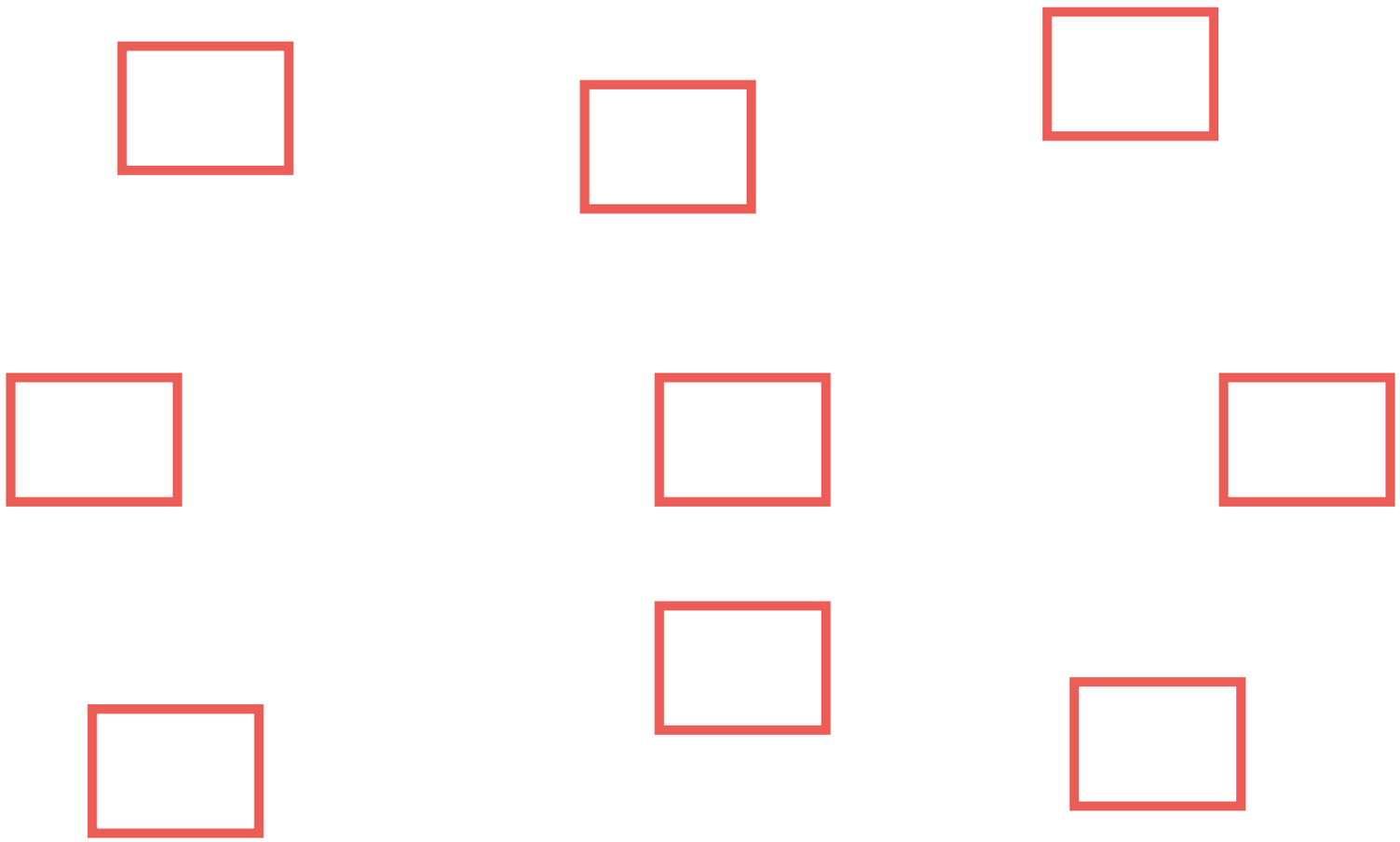
Microservice



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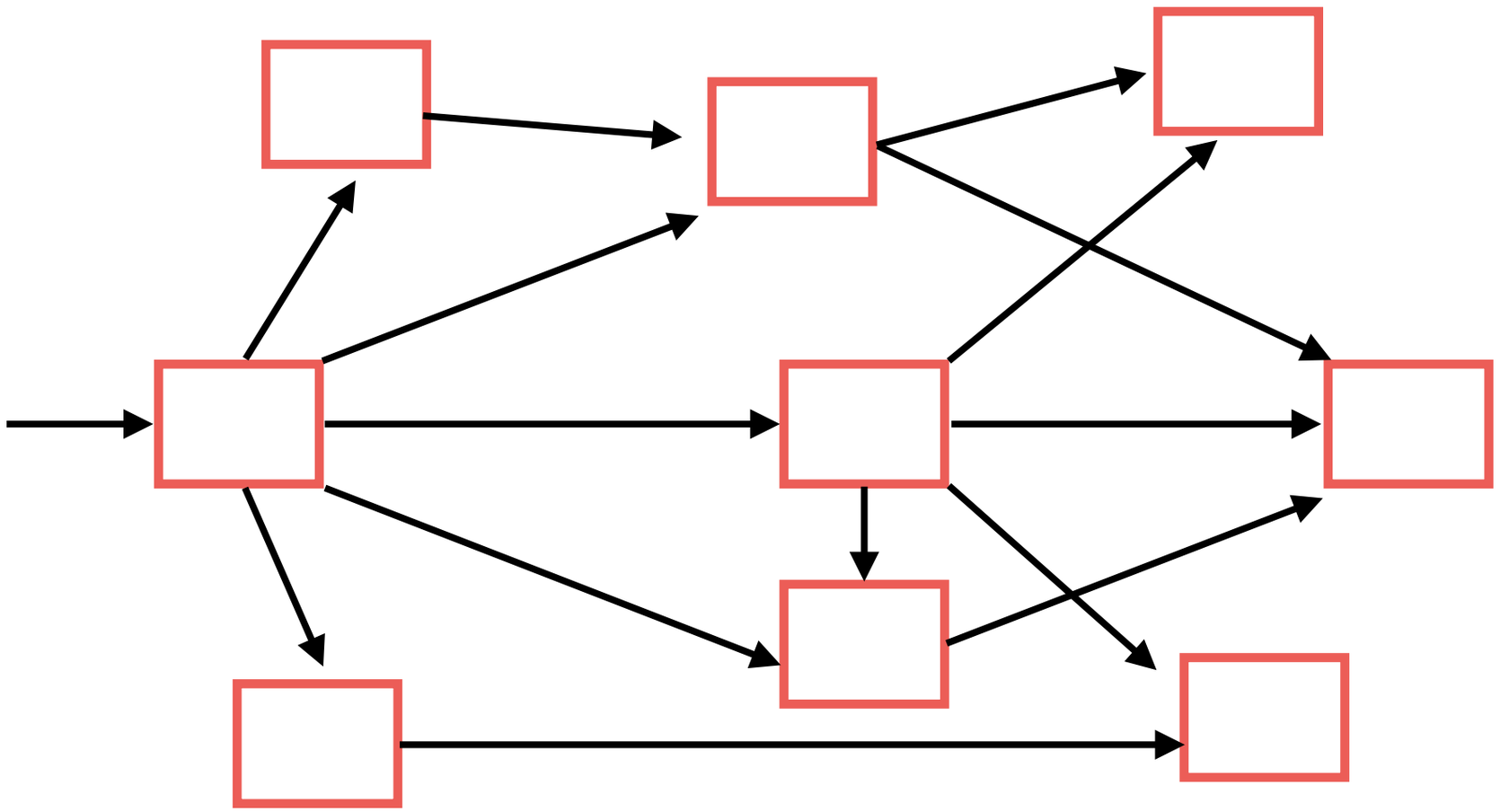
Microservice == Distributed



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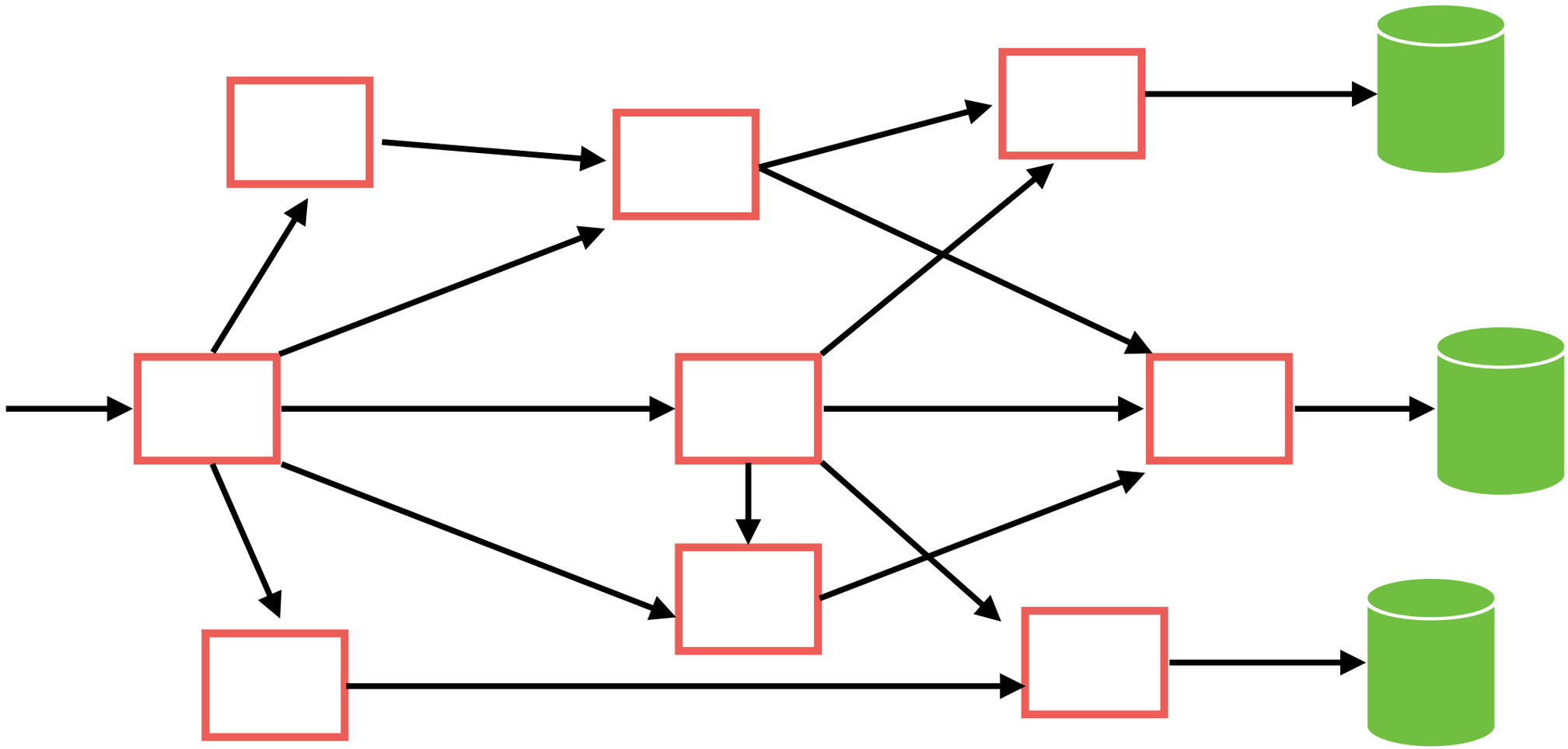
Own data



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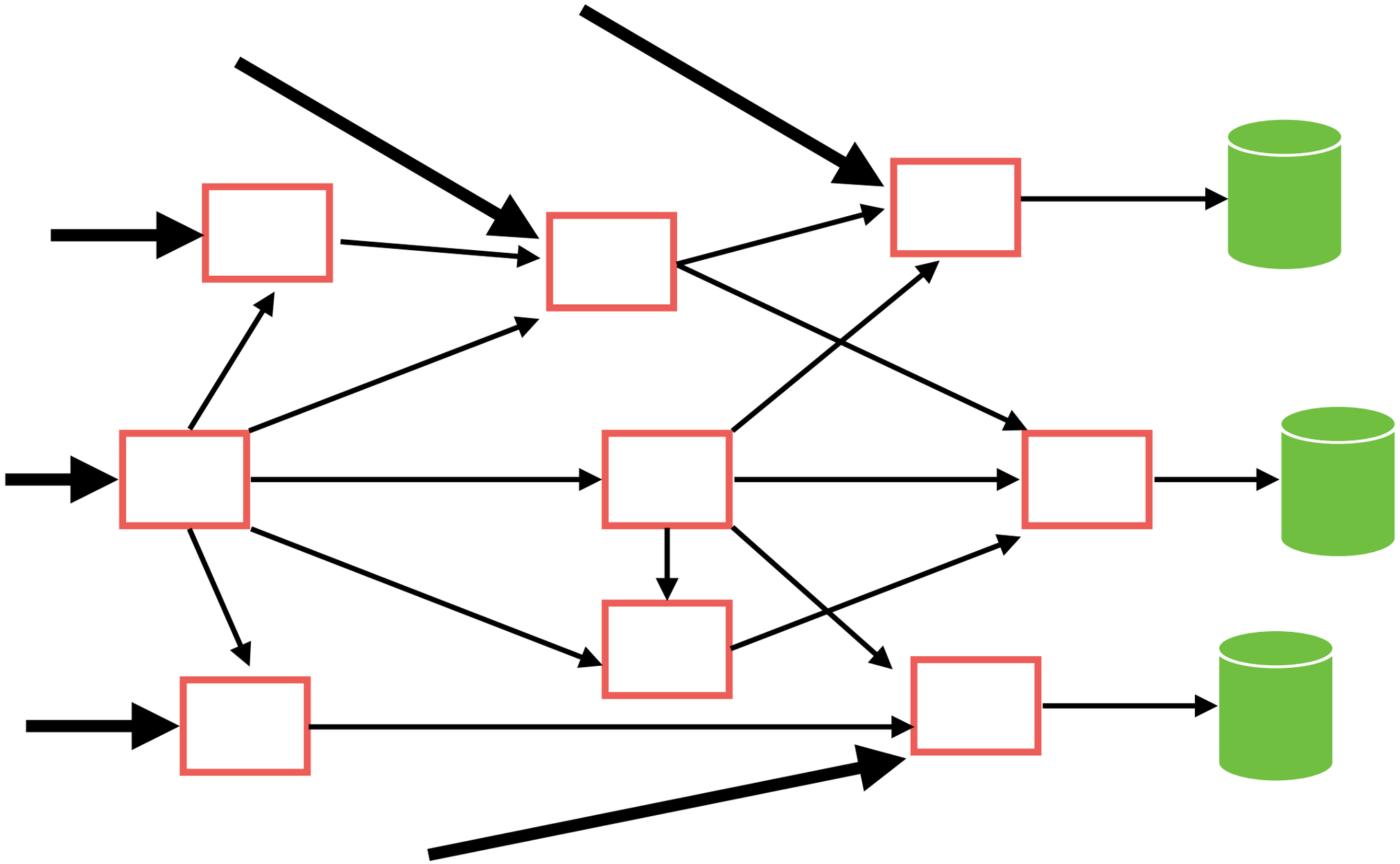
Multiple entry points



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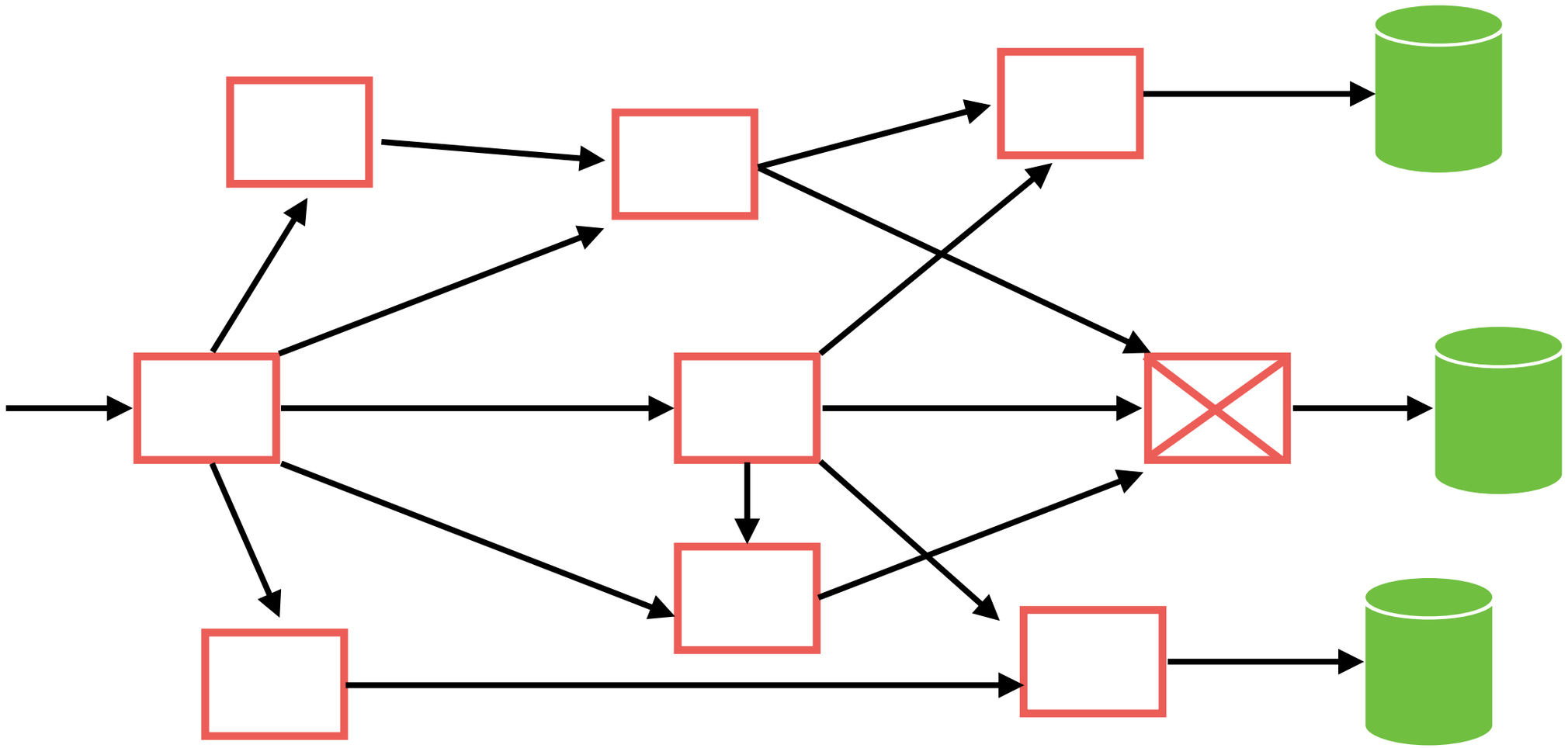
Failure !!



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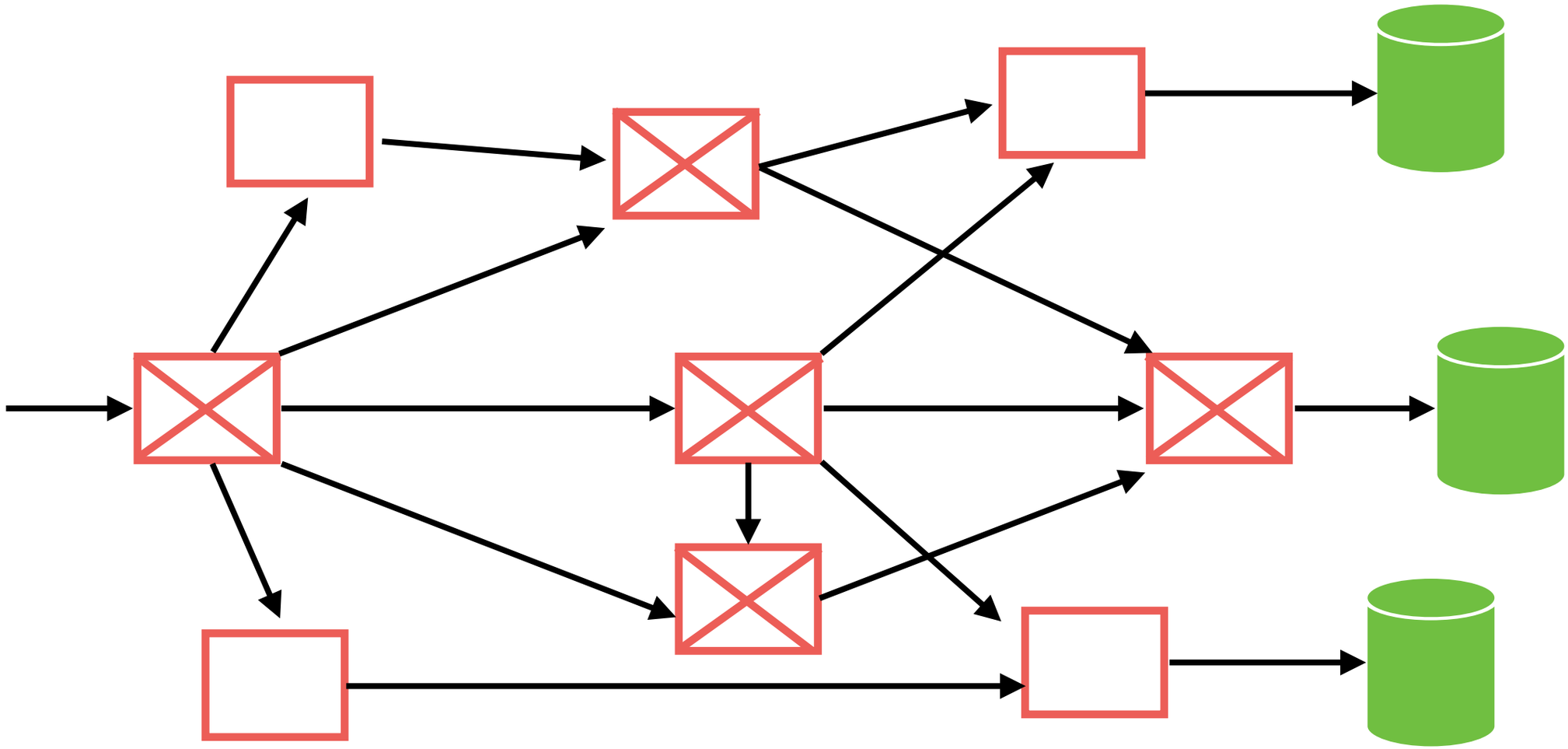
Cascading Failure !!



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Don’t design for failure

Design for recovery

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Key Benefits

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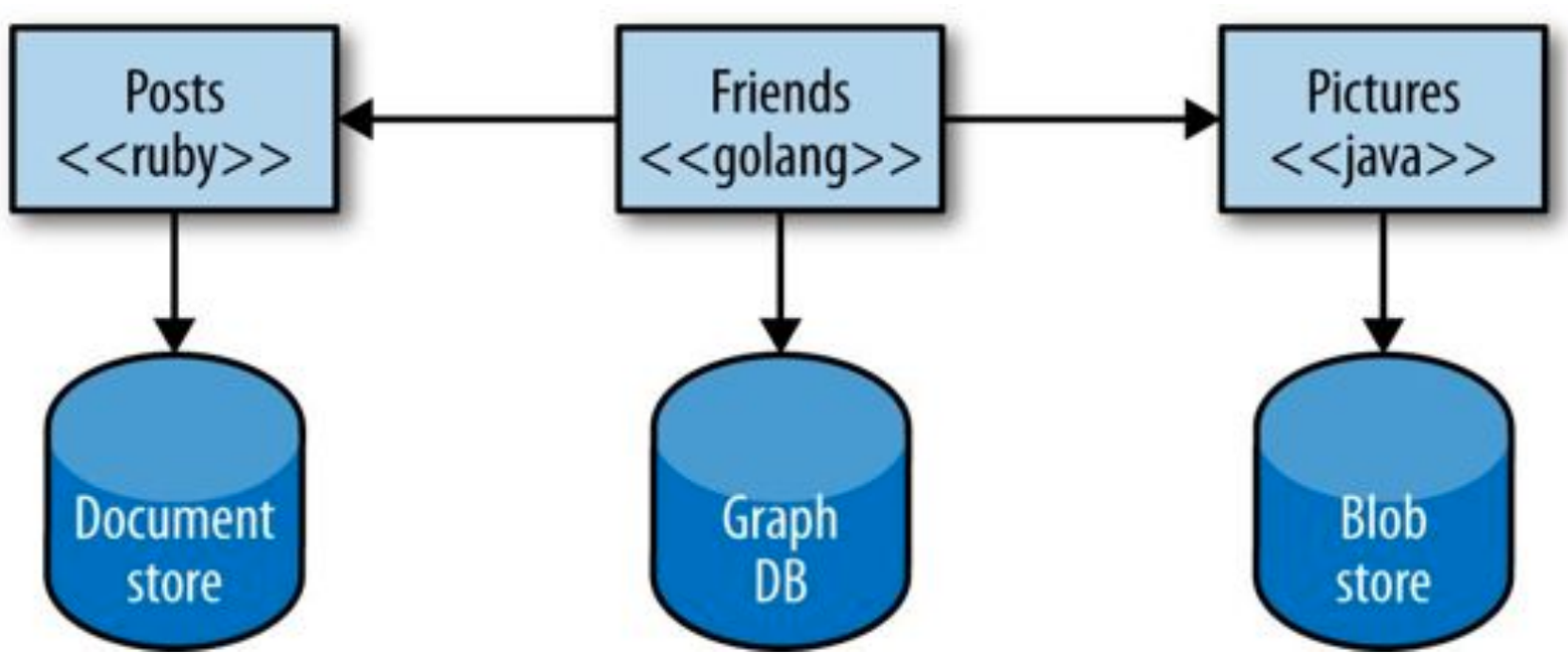
1. Technology heterogeneous

The right tool for each job

Allow easy experimenting and adoption of new technology



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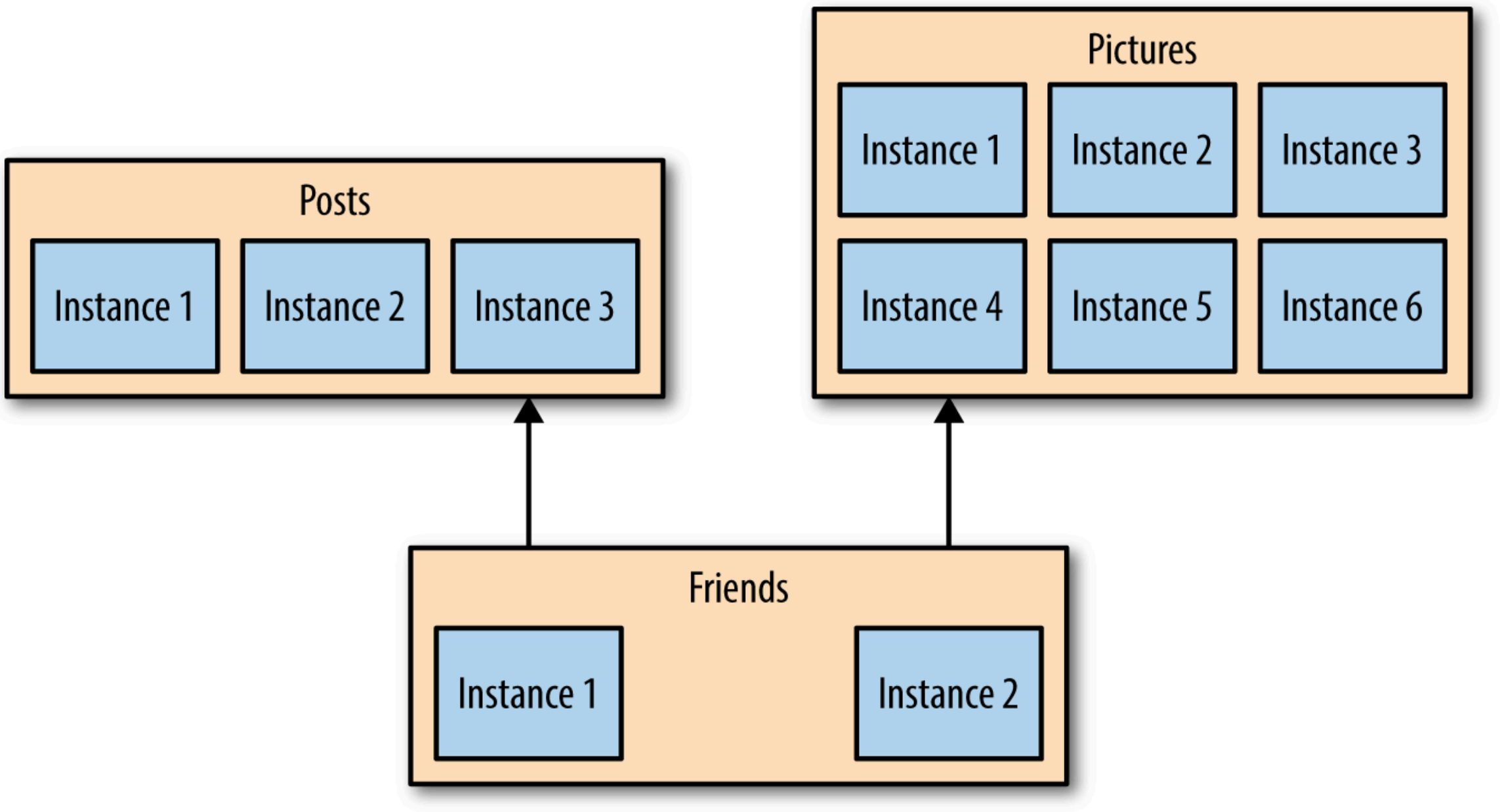
2. Scaling



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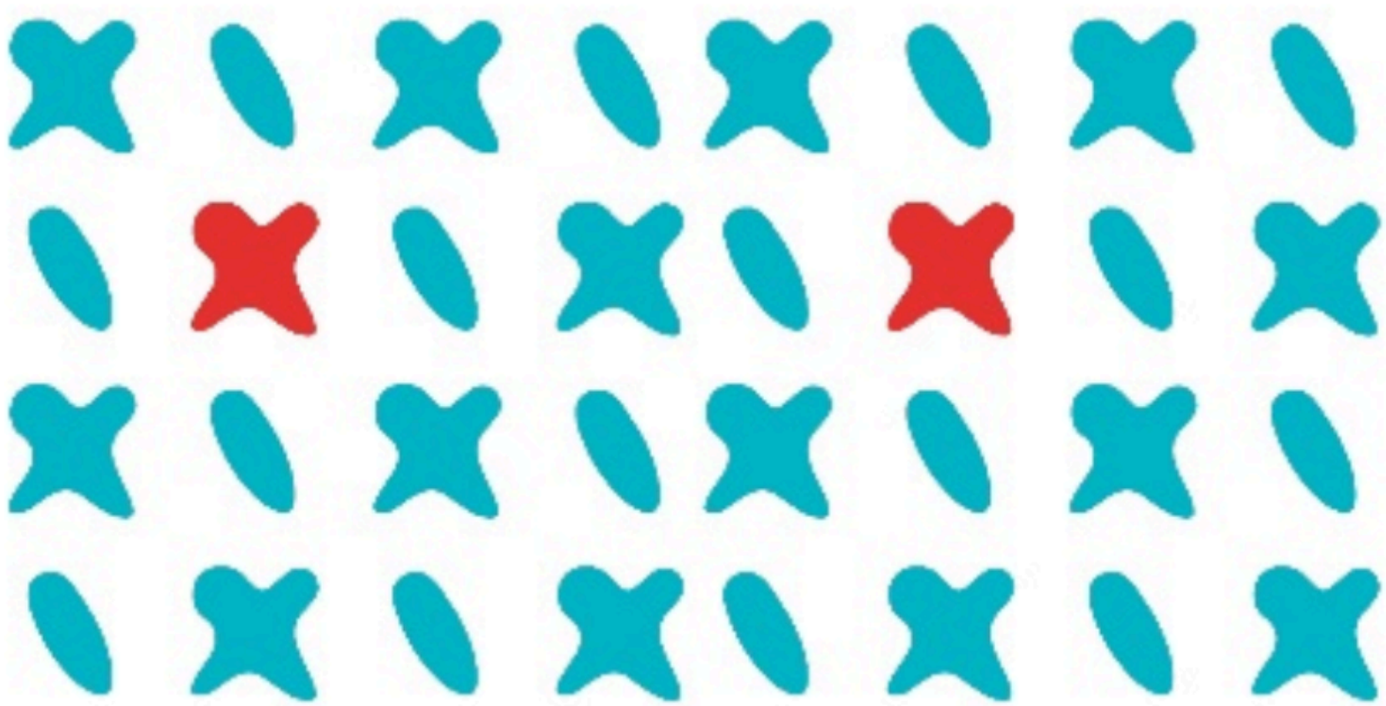
3. Ease of deployment

Deploys are faster, independent and problems can be isolated more easily



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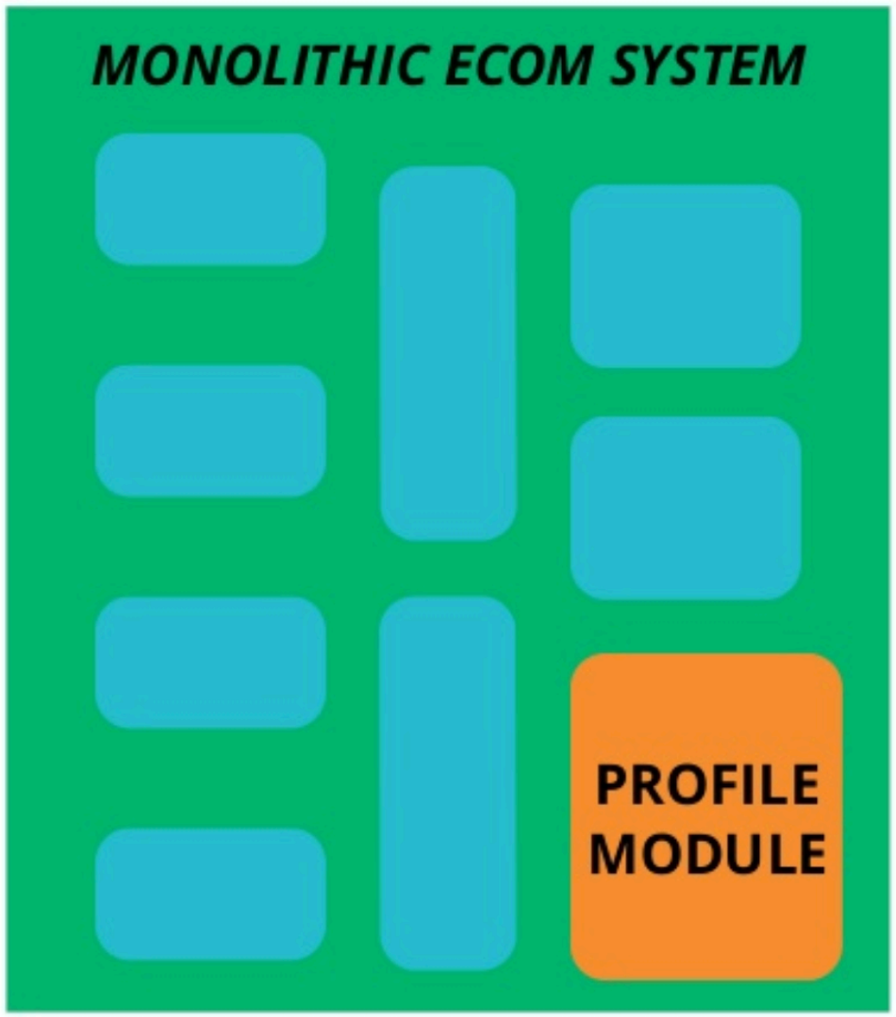
4. Composability and replaceability



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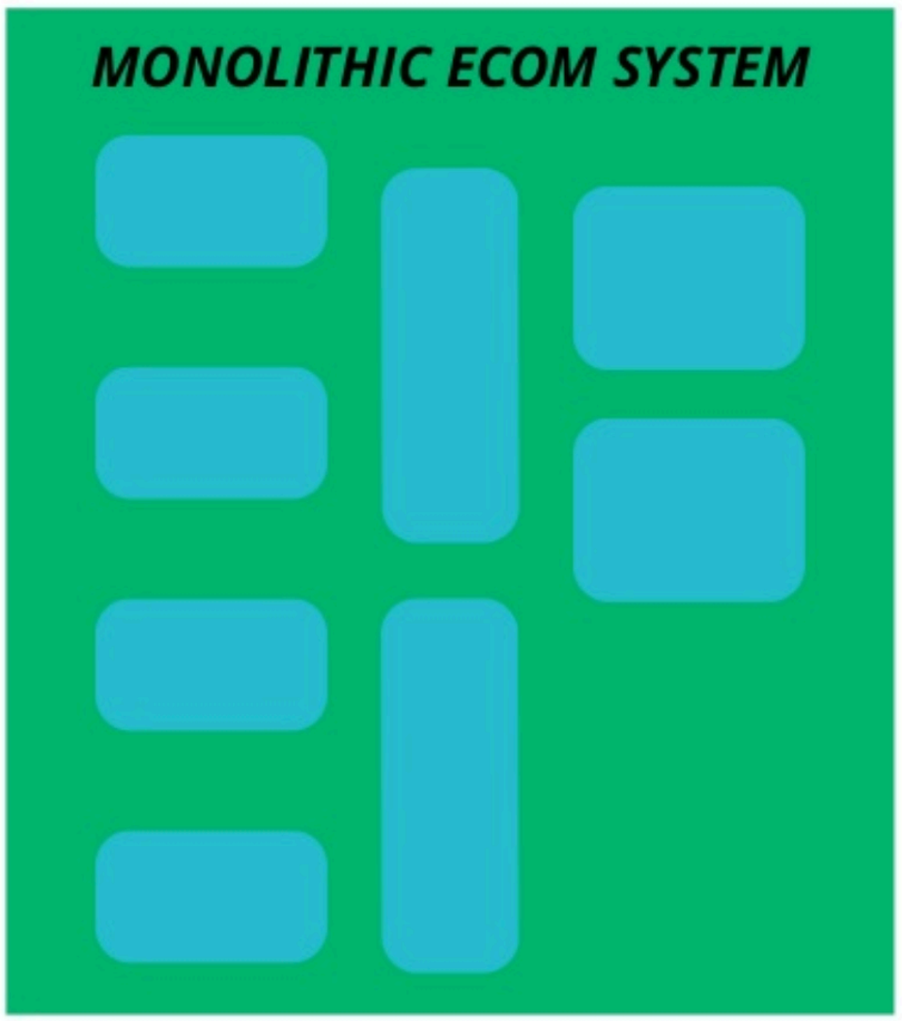
4. Composability and replaceability



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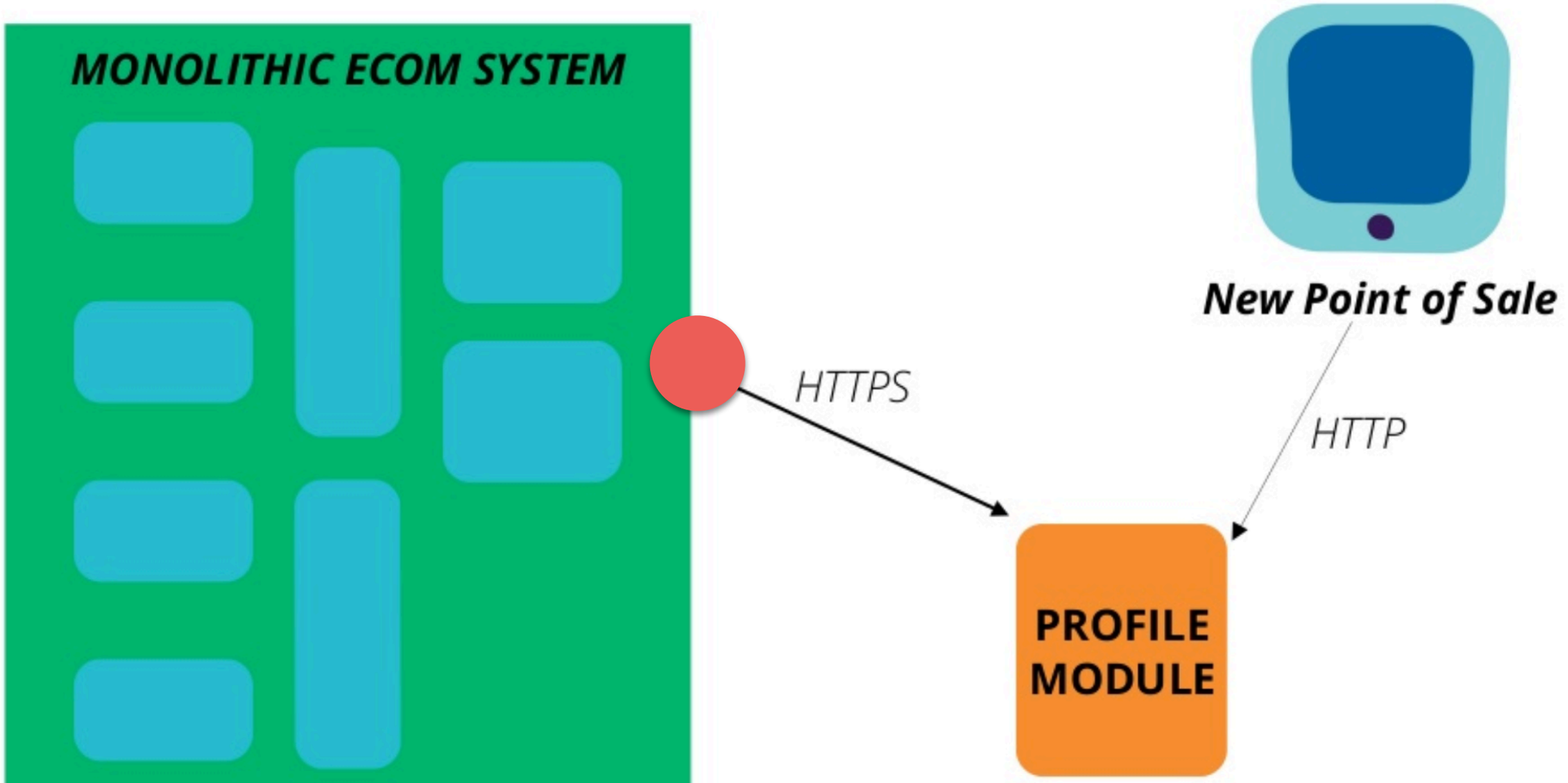
4. Composability and replaceability



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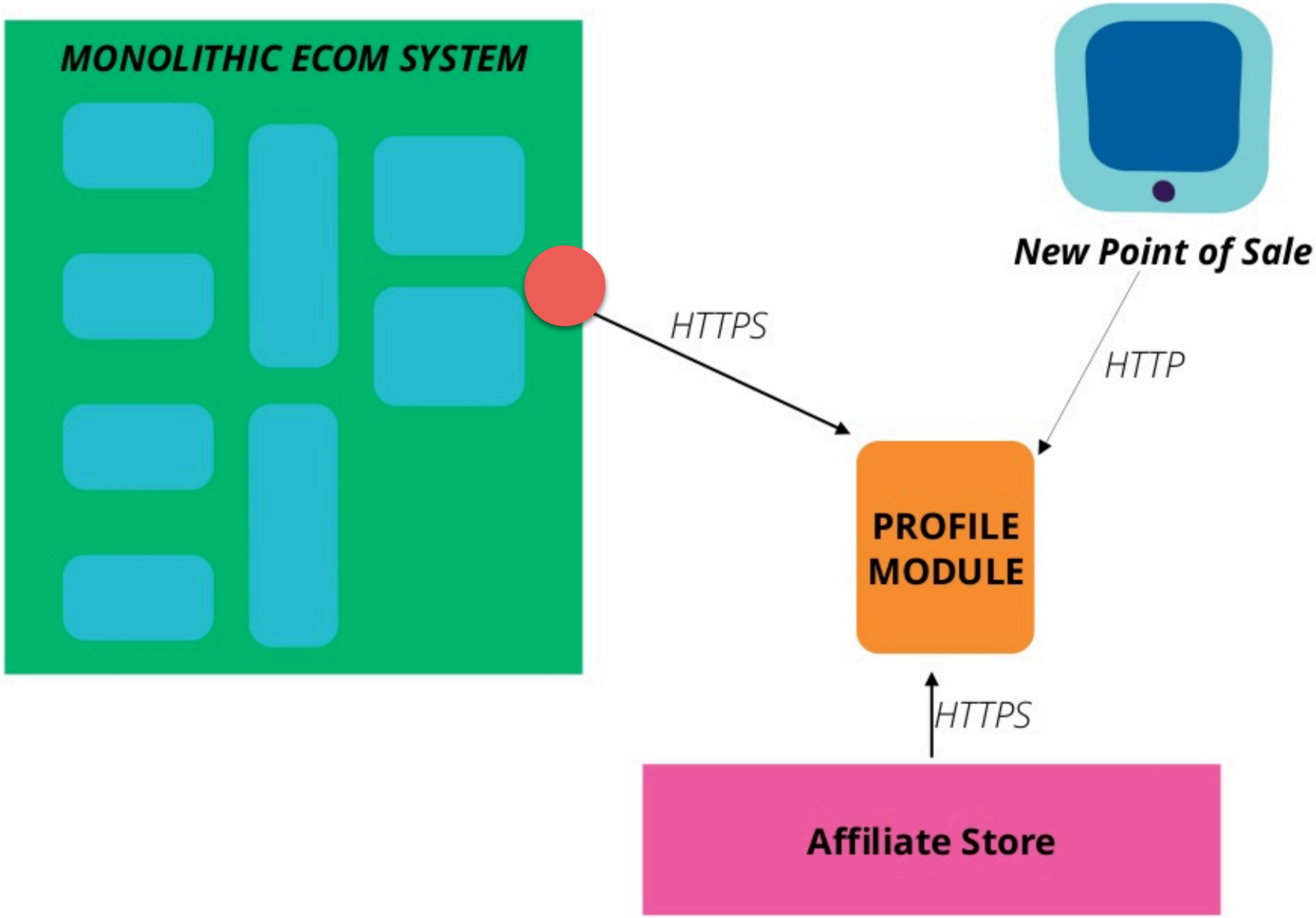
4. Composability and replaceability



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5. Organization alignment

Small teams and smaller codebases

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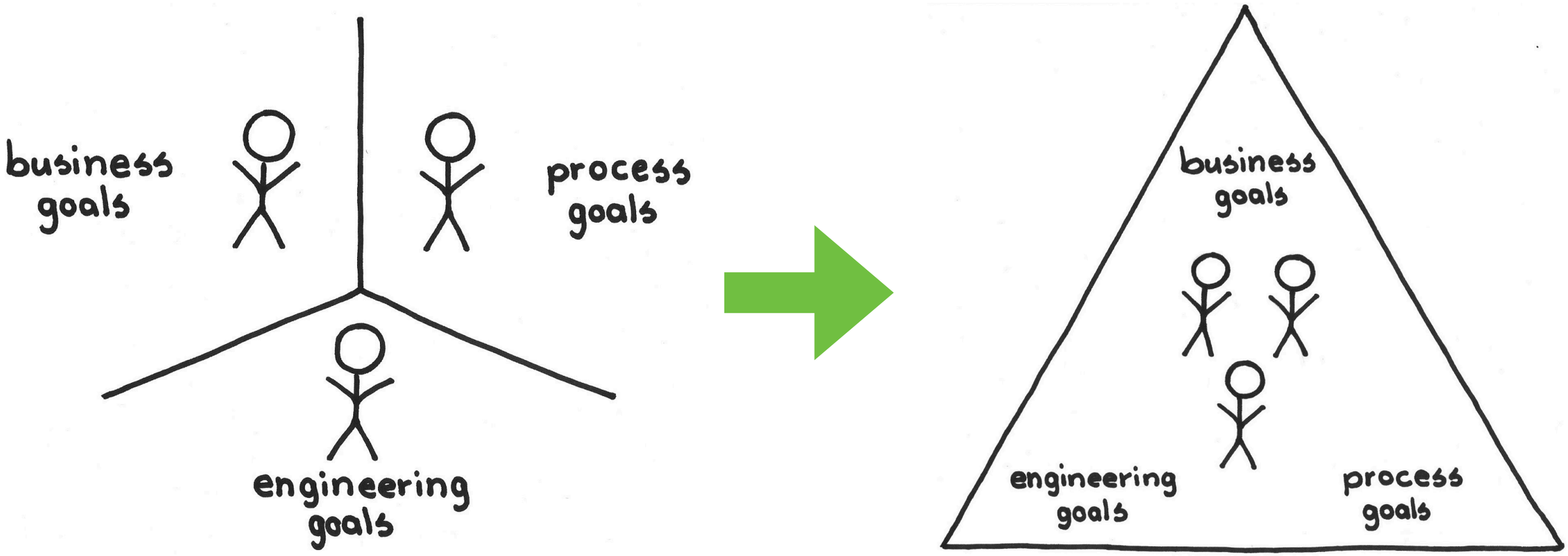
Autonomous team



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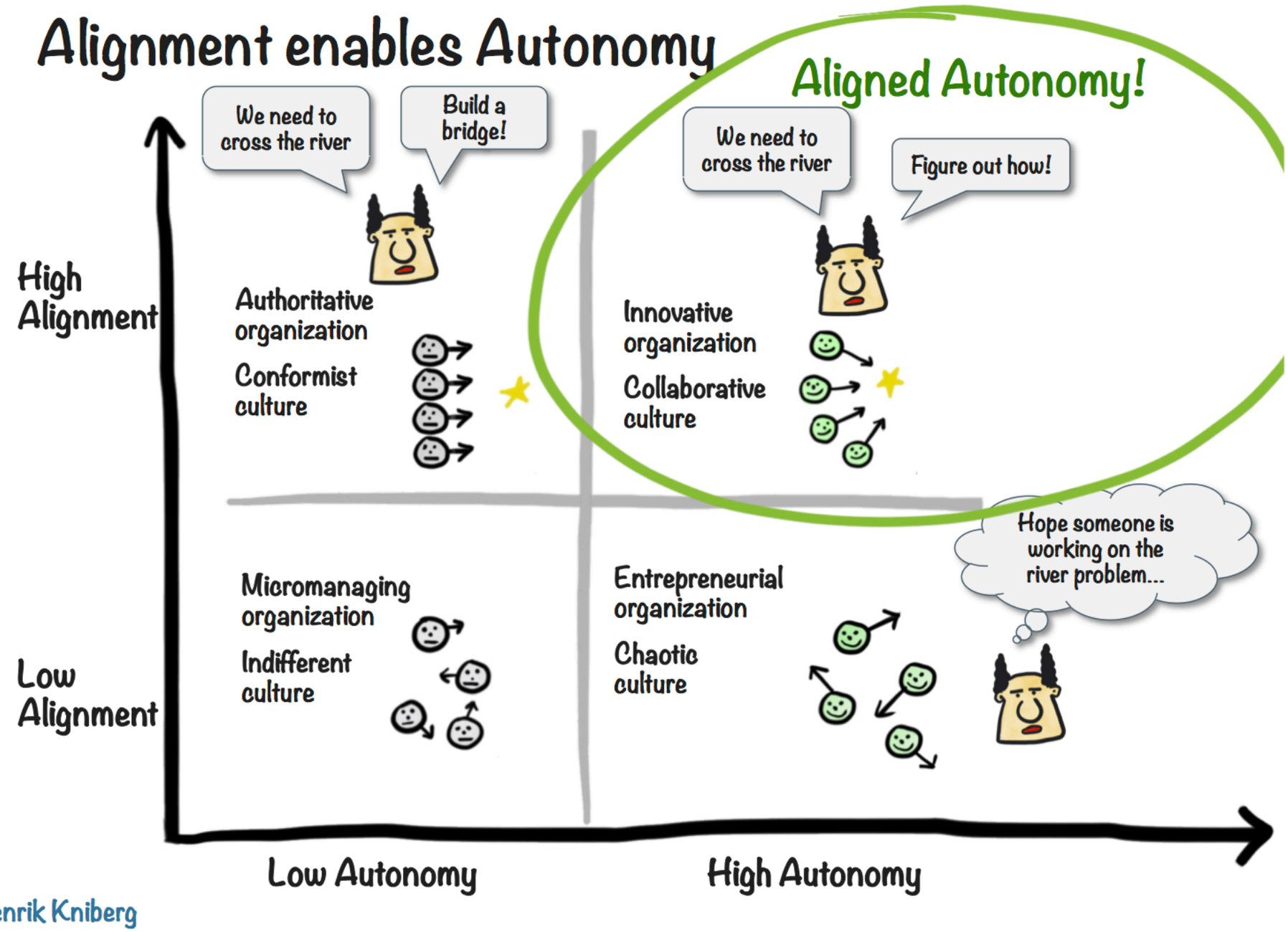
Autonomous team



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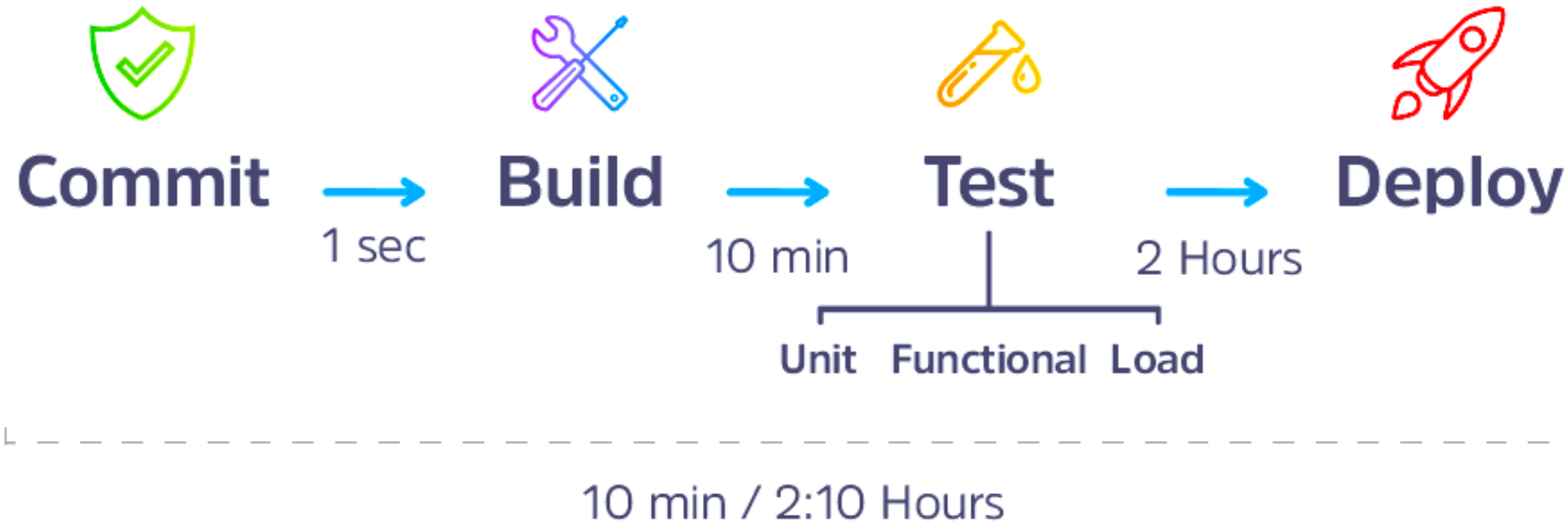
Autonomous team



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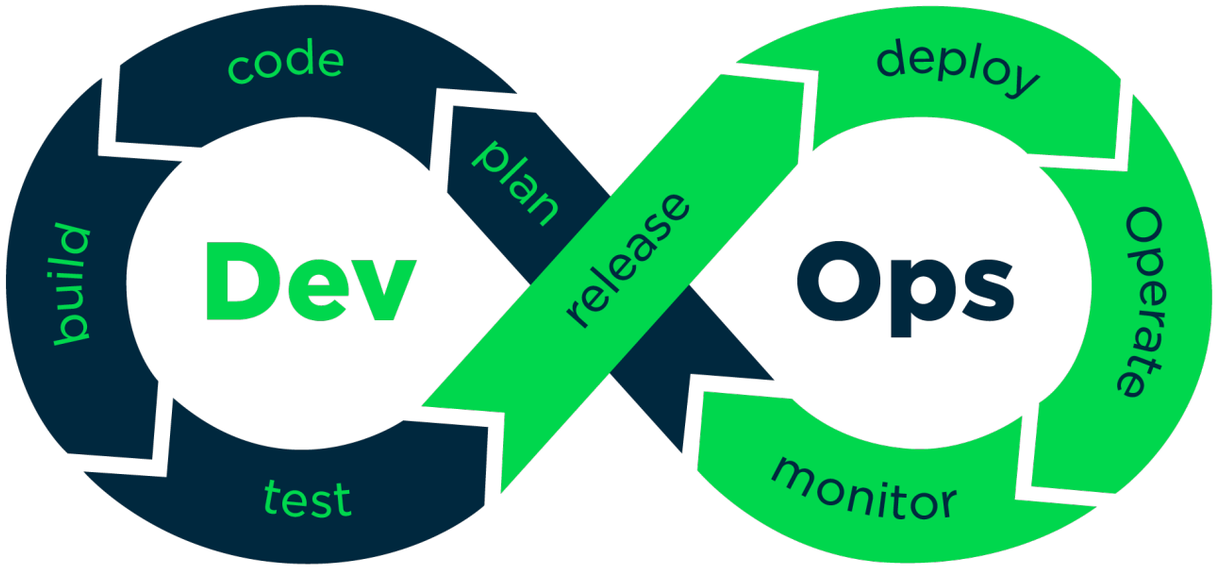
6. Enable Continuous Delivery

A part of **DevOps**

Set of practices for the **rapid**, **frequent** and **reliable delivery** software



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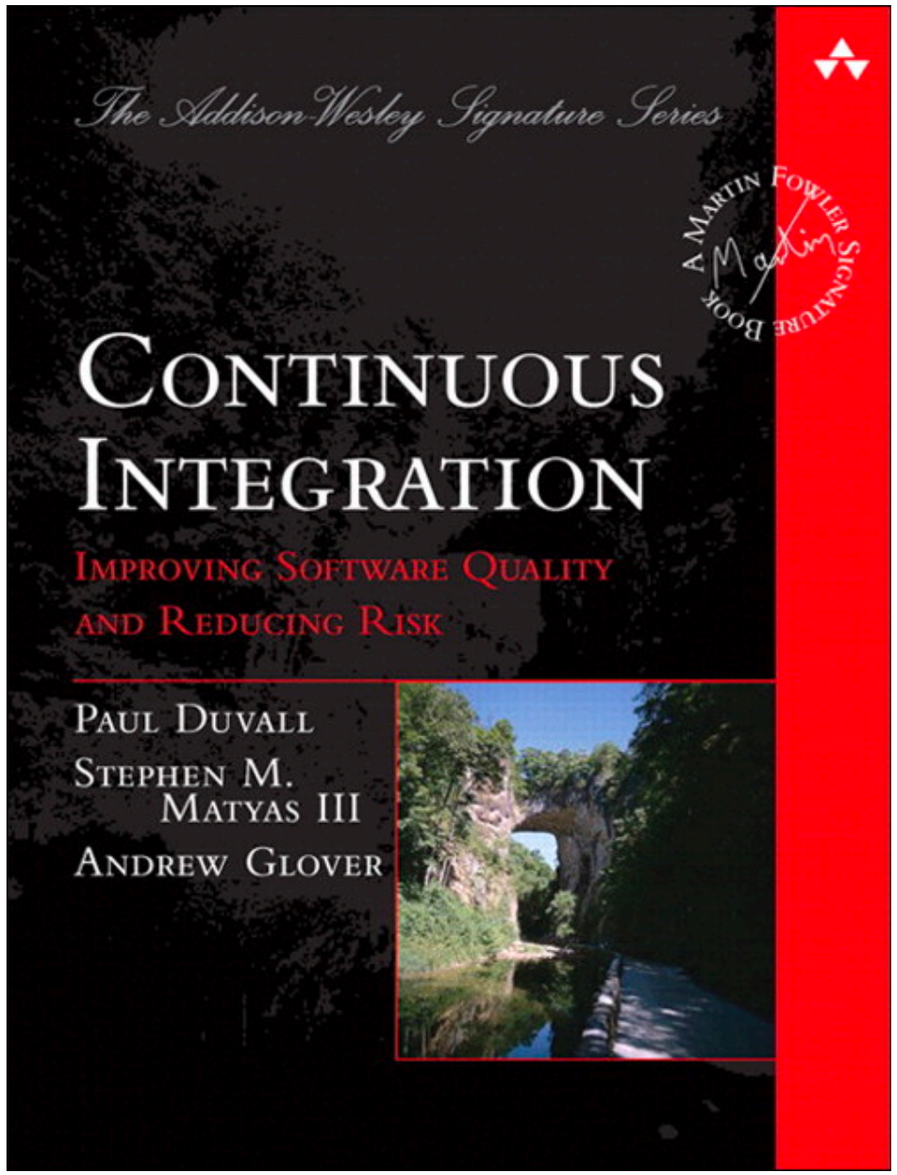
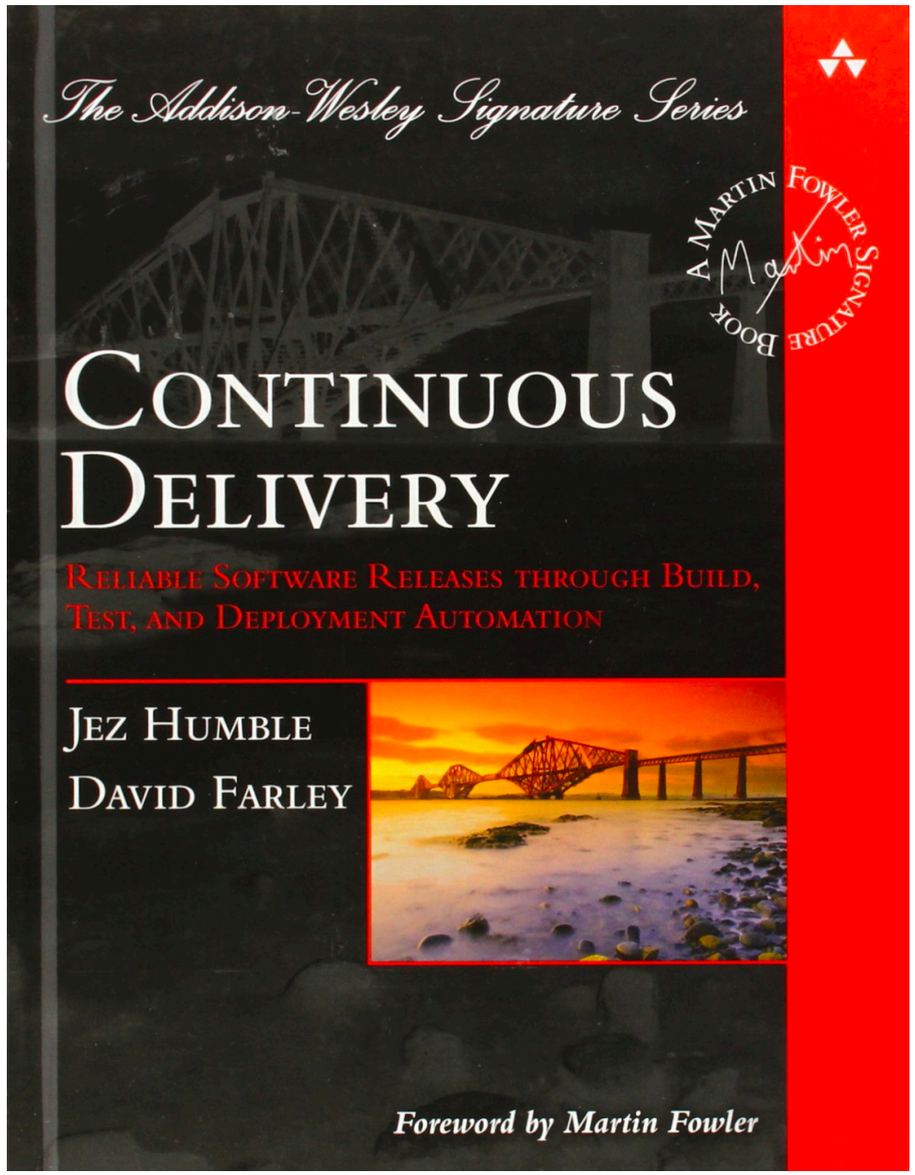
Continuous Delivery/Deployment





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Continuous Delivery/Deployment

Testability
Deployability
Autonomous team and loose coupling

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Benefits of Continuous Delivery

Reduce time to market
Enable **business** to provide reliable service
Employee satisfaction is higher

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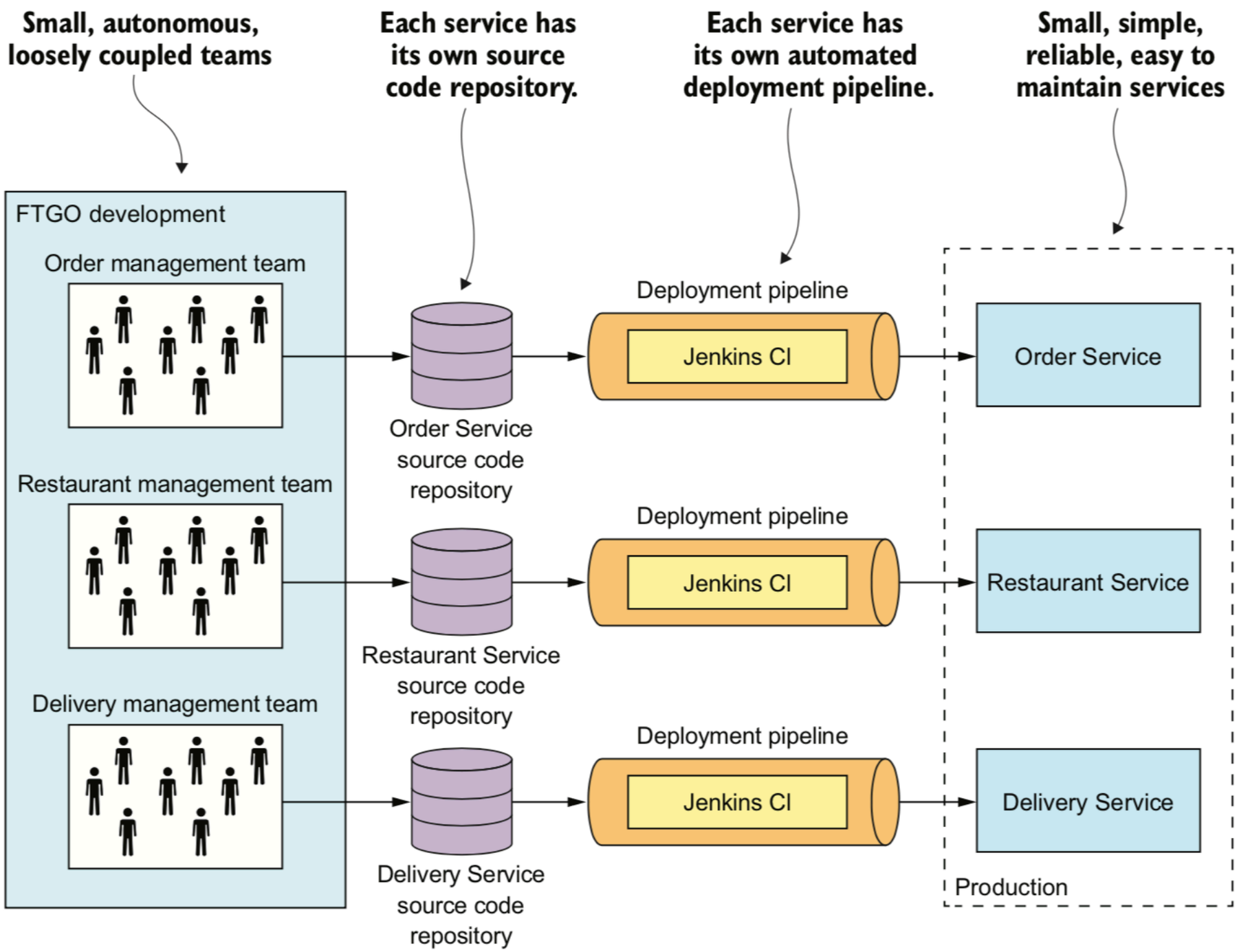
Continuous Delivery for service



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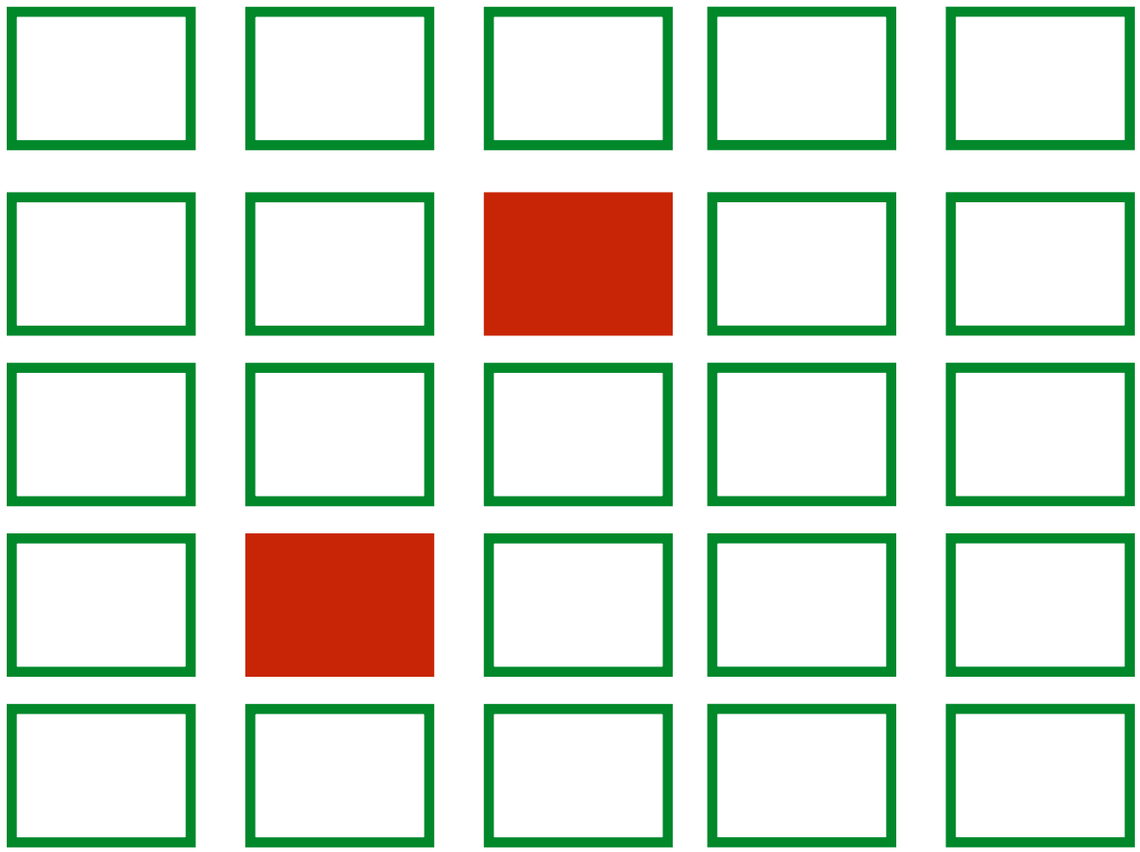
7. Better Fault isolation



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Drawbacks of Microservice

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Drawbacks of Microservice

Find the right set of services
Distributed systems are complex
How to develop, testing and deploy ?

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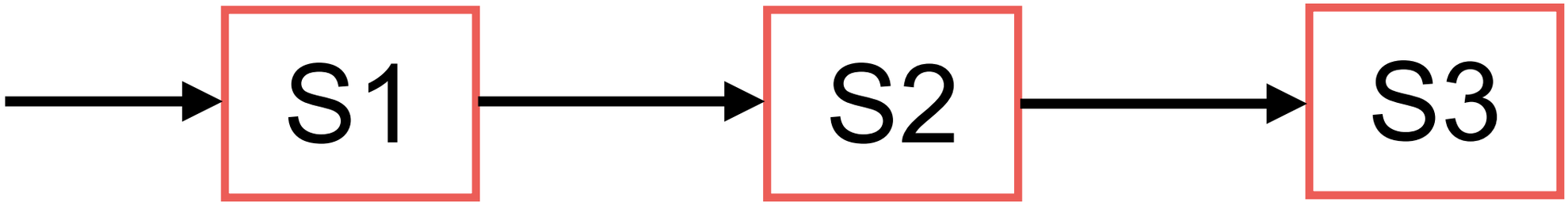
Drawbacks of Microservice

Deploy feature that required multiple service ?



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Coupling and Cohesion

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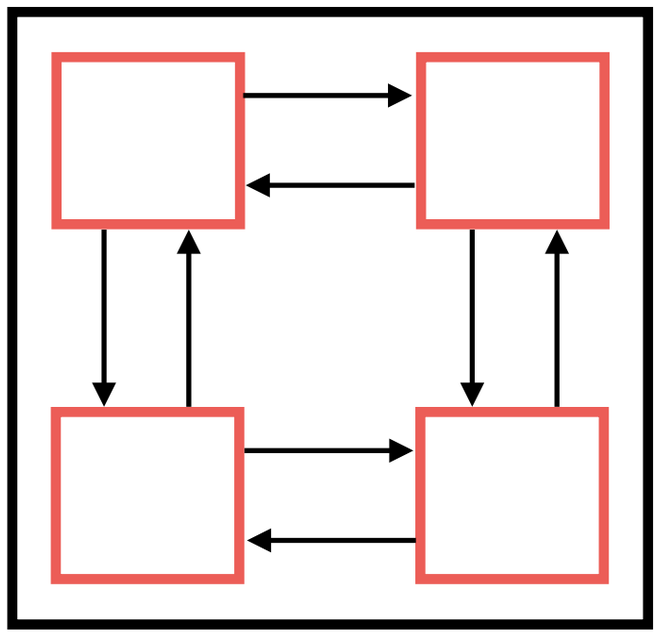
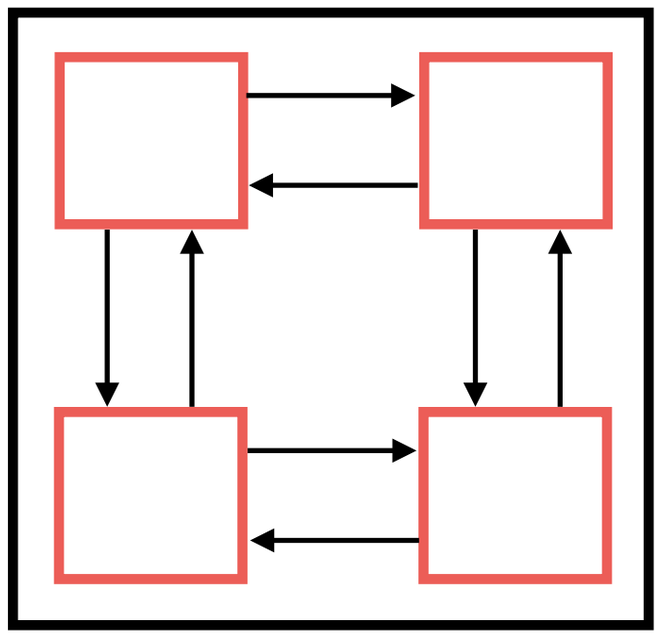
Cohesion

The code that changes together,
stay together





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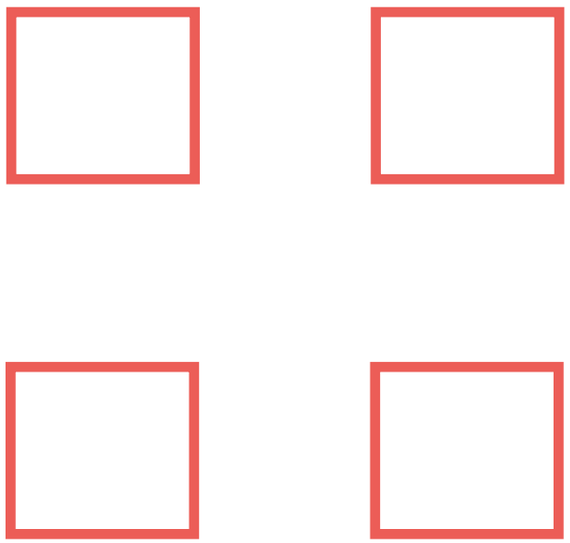
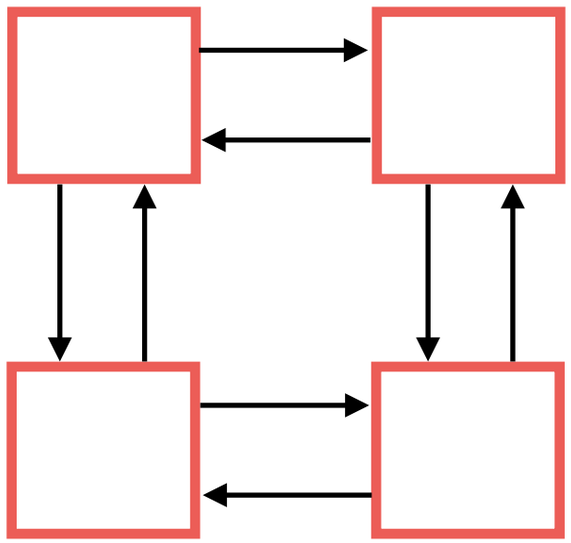
Coupling

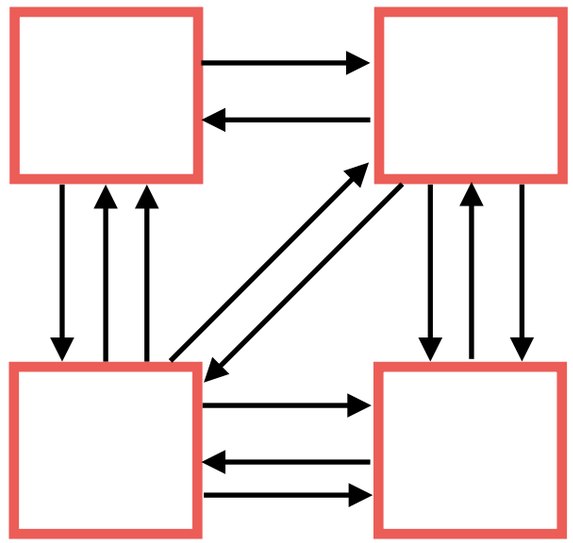
Degree of interdependence between services



Uncoupled



Loosely coupled



Tightly coupled

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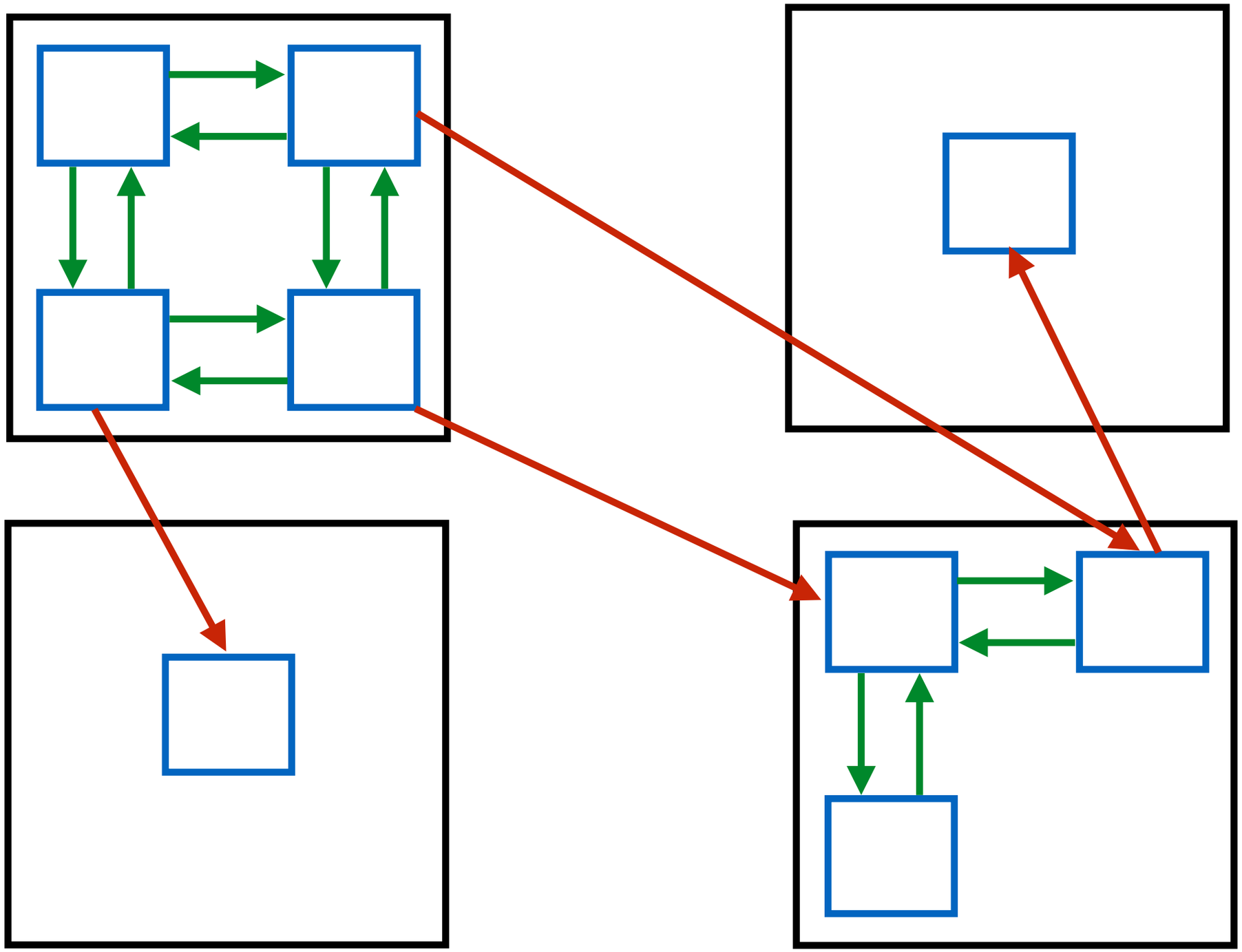
Cohesion and Coupling



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Good system
Low Coupling
High Cohesion

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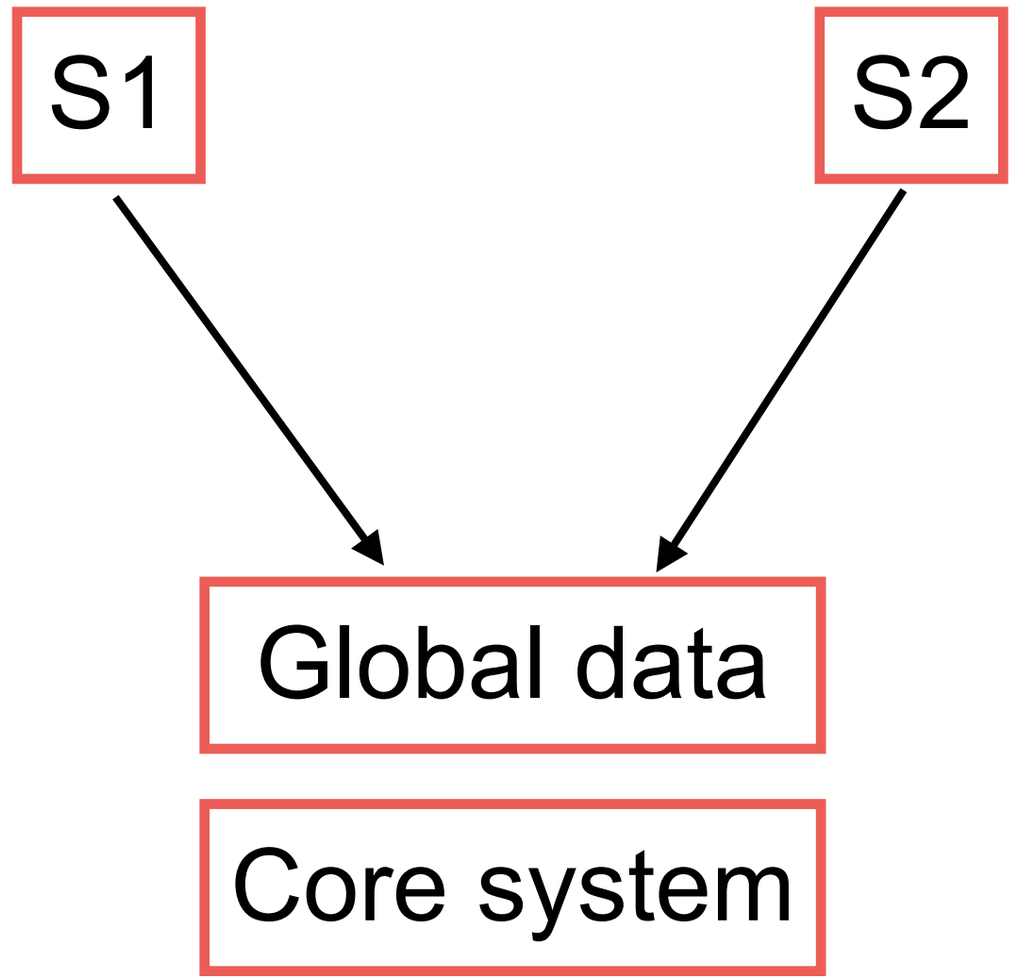
Common Coupling



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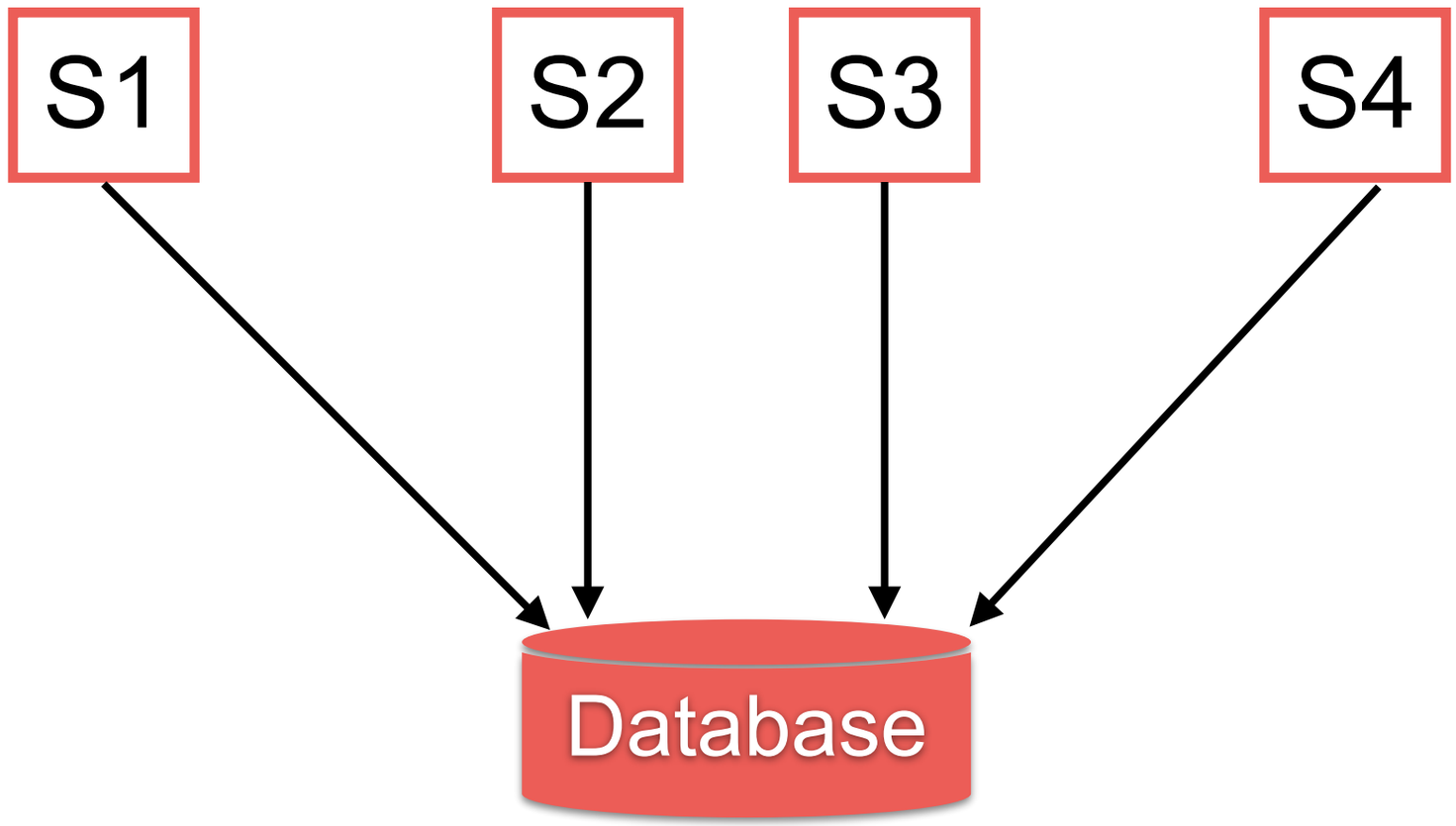
Database Coupling



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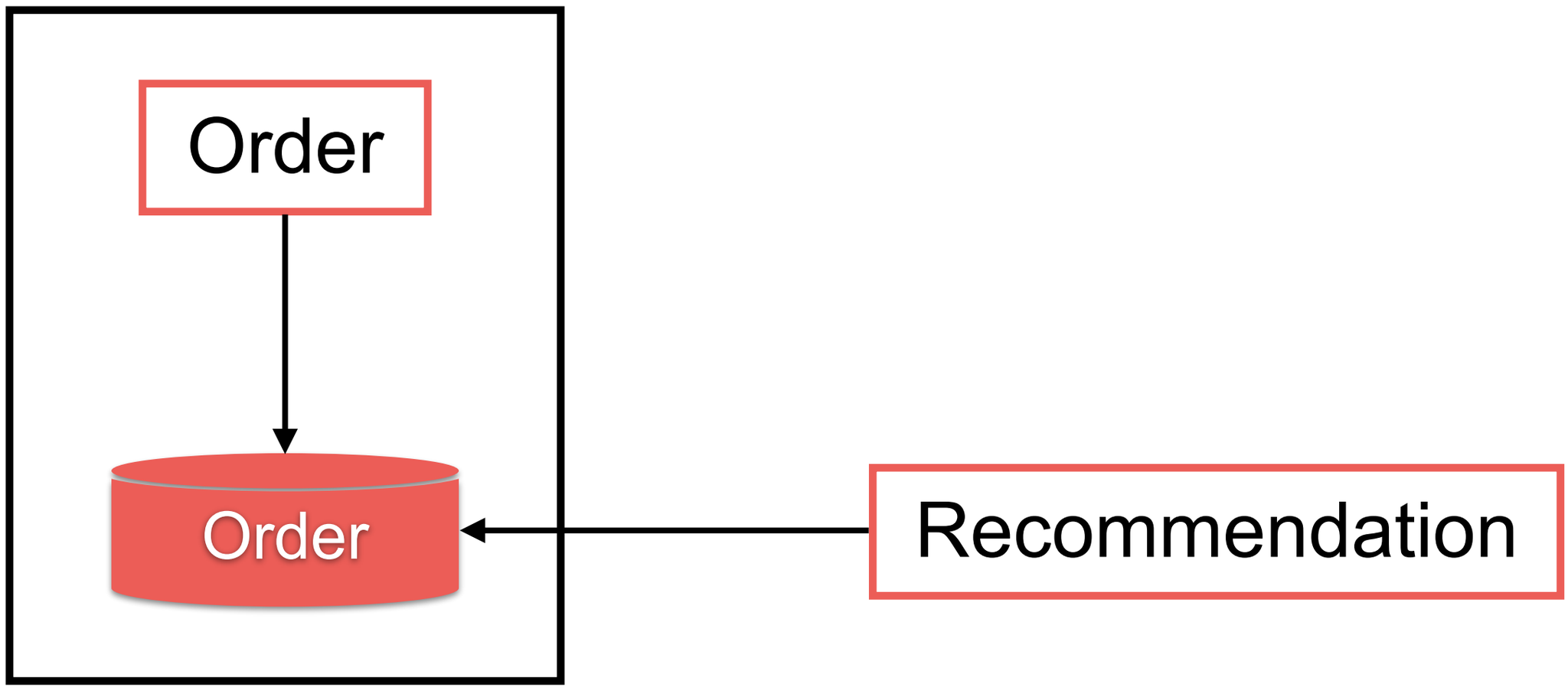
Example of problem ?



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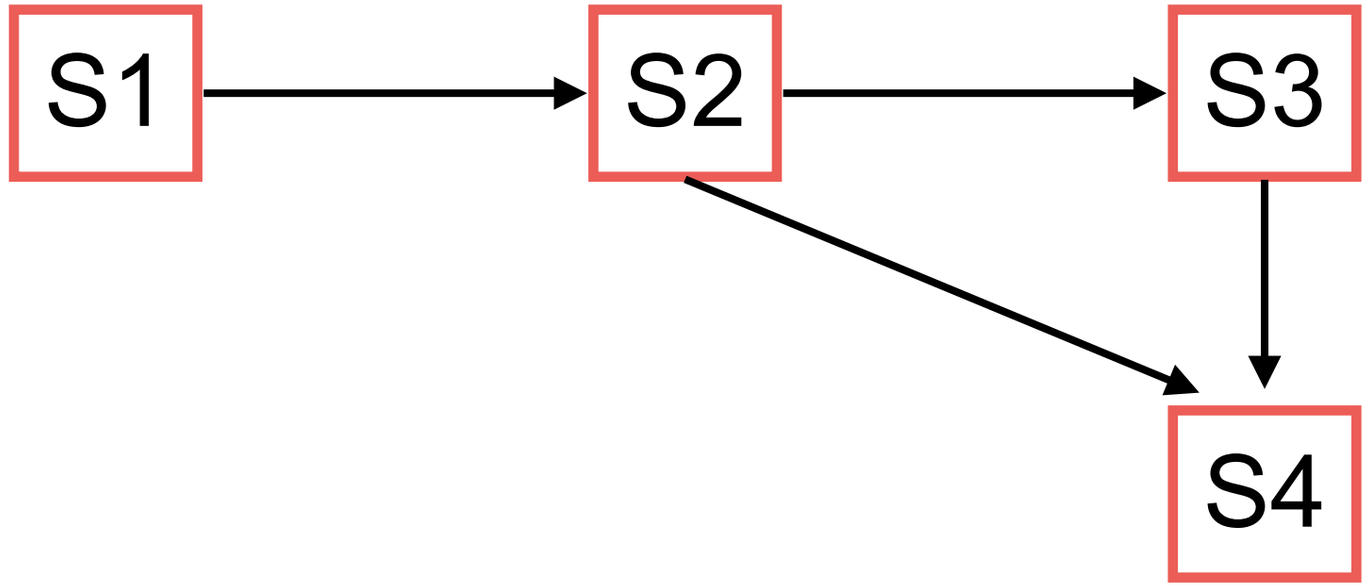
Communication Coupling



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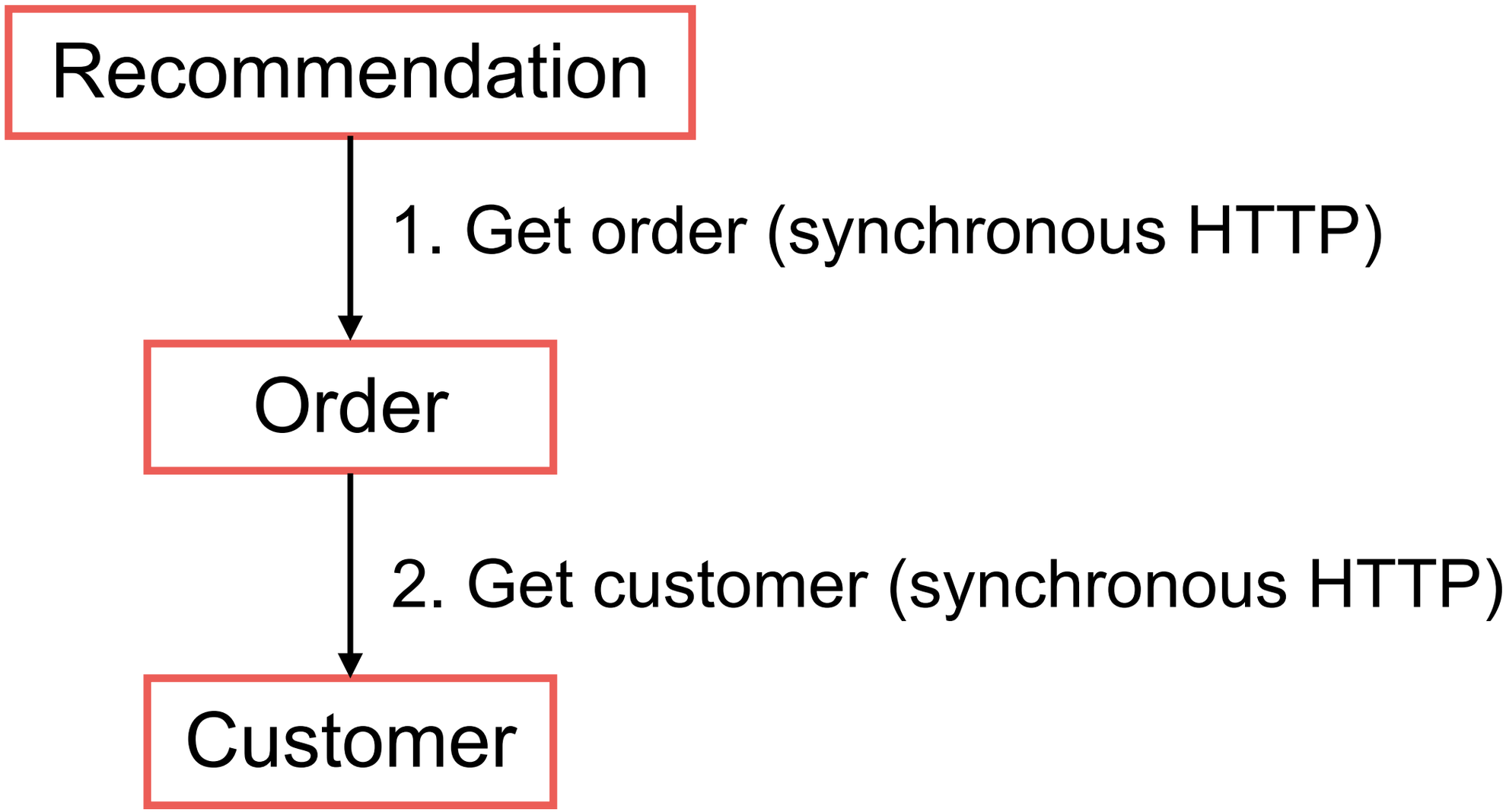
Example of problem ?



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Deployment Coupling

Reduce deployment coupling not require Microservice

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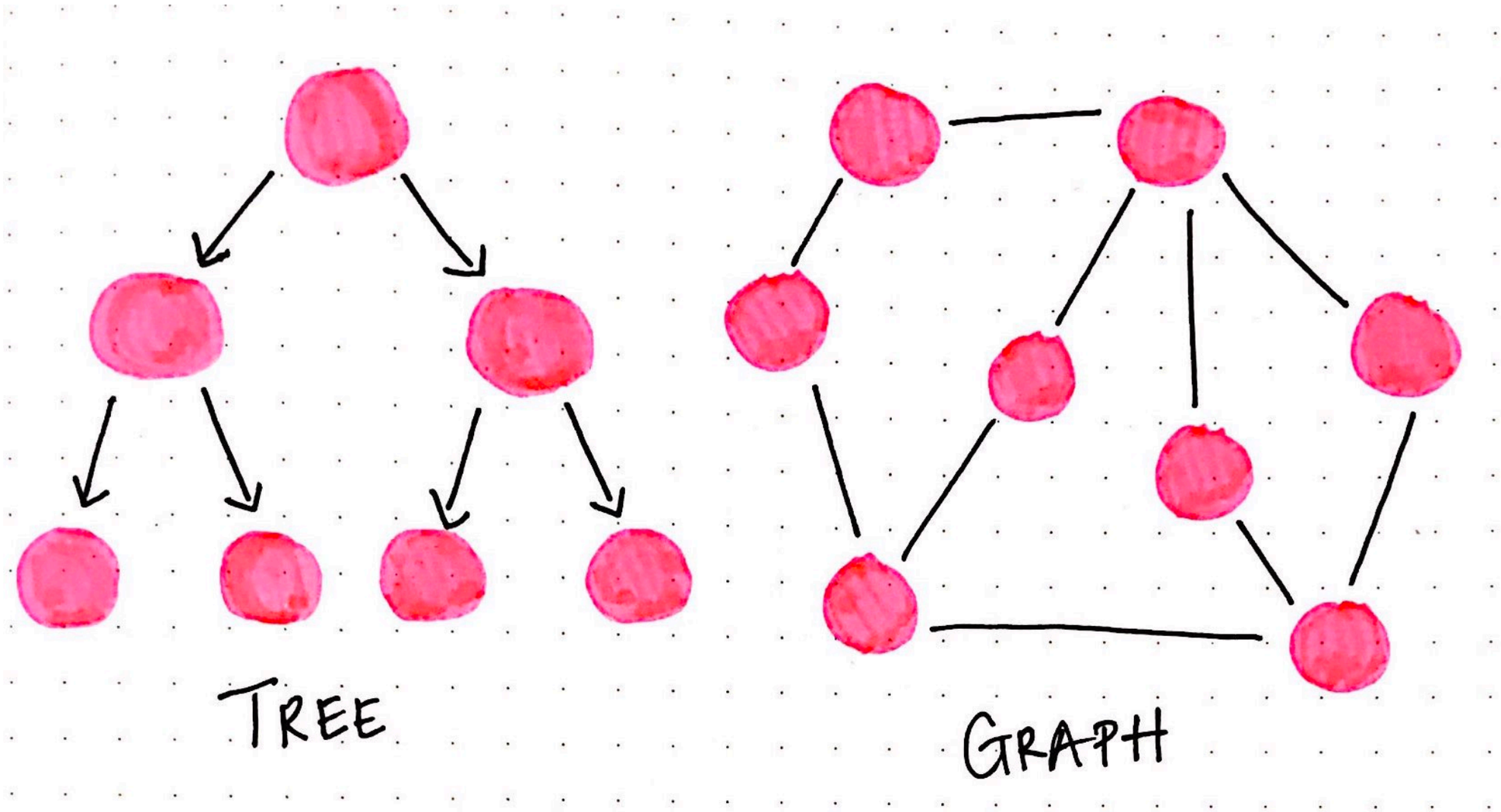
Service Principles

Minimize the depth of the service call-graph



https://github.com/Yelp/service-principles

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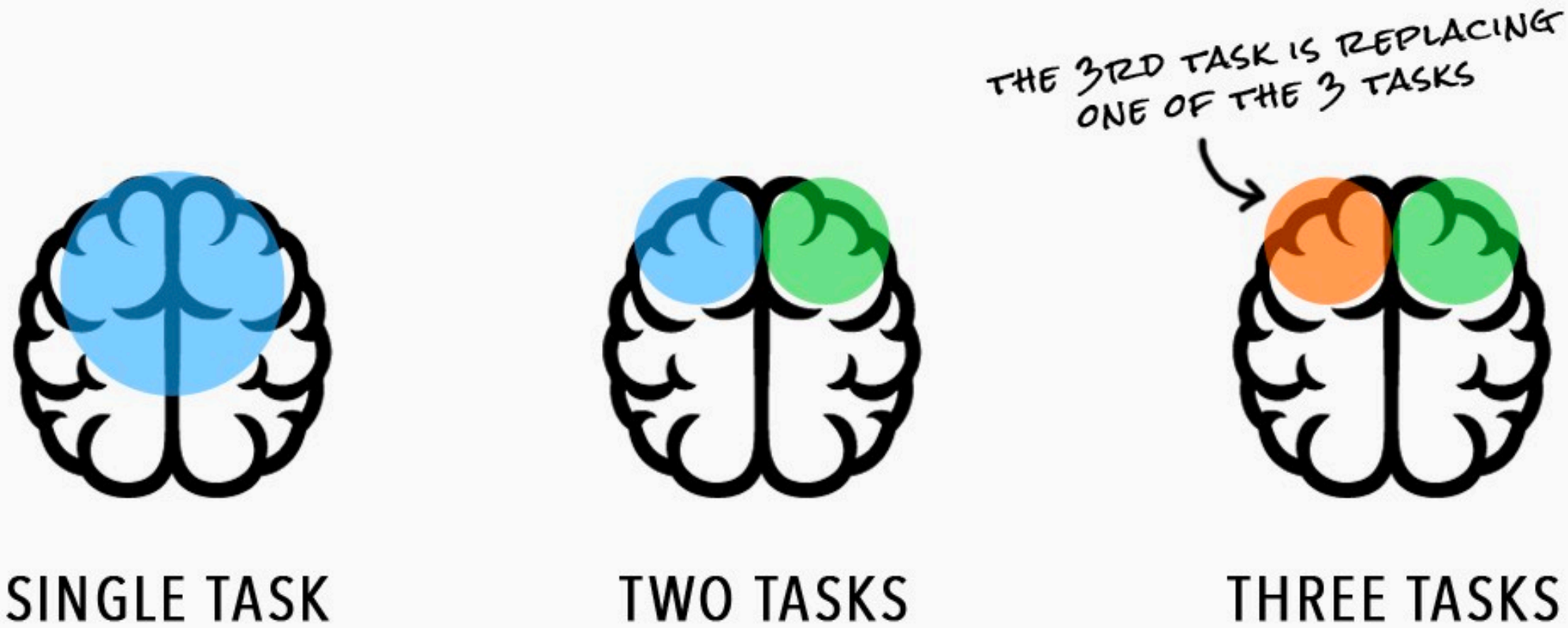
Service Principles

Minimize the number of services owned by your team



https://github.com/Yelp/service-principles

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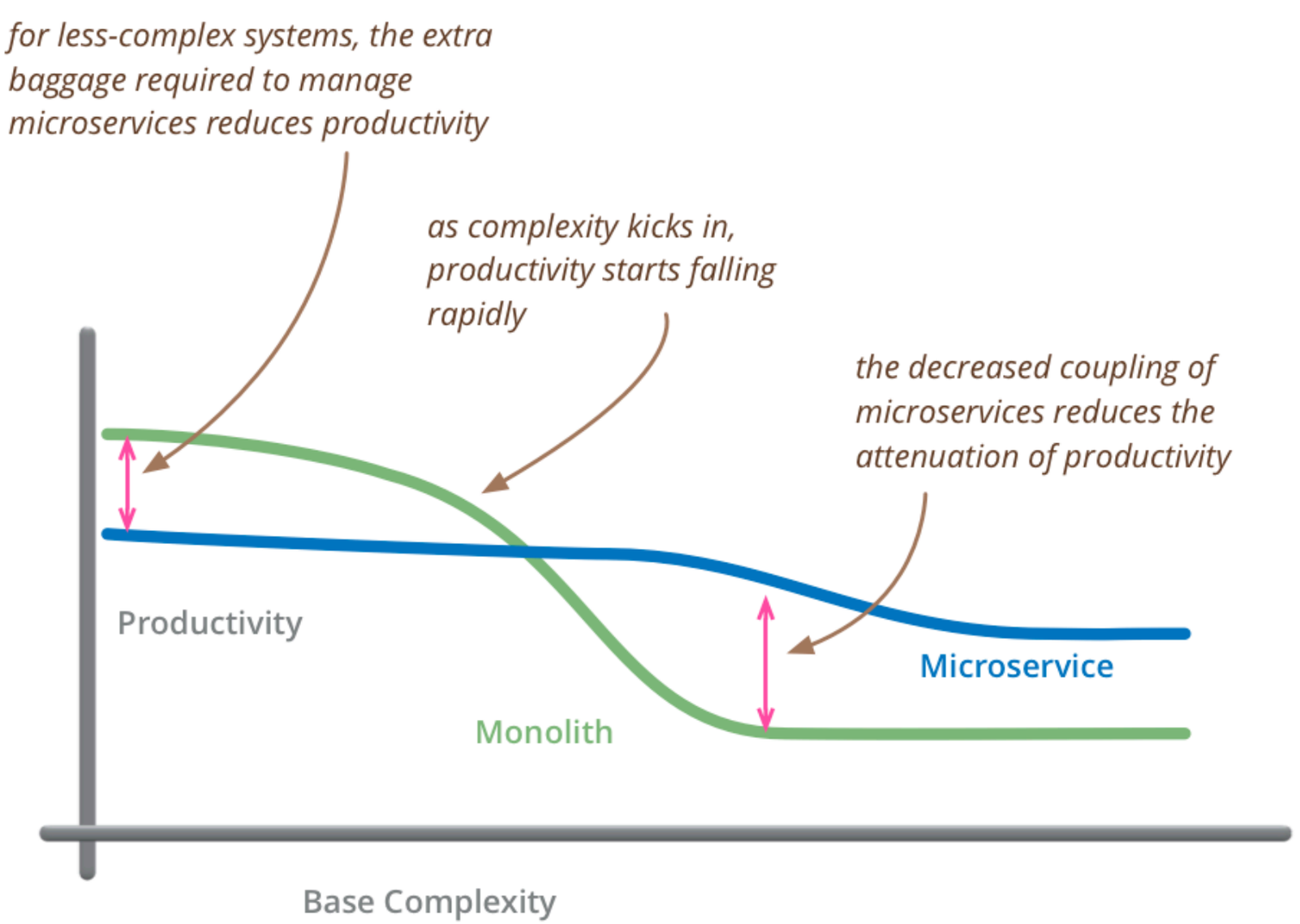
Drawbacks of Microservice

Decide to use when adopt is difficult !!



but remember the skill of the team will outweigh any monolith/microservice choice

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Microservice architecture patterns

https://microservices.io/

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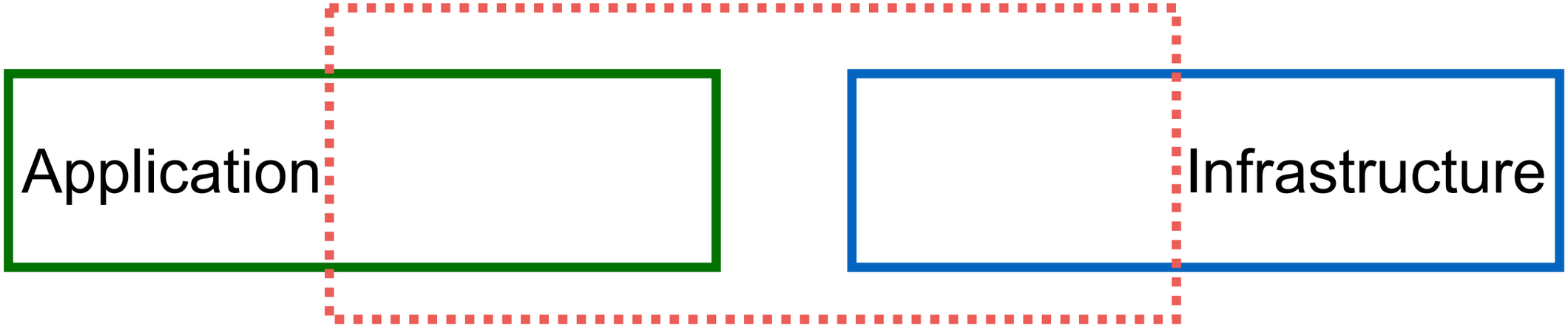
3 Layers of service patterns

Application patterns
Application infrastructure pattern
Infrastructure pattern



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Patterns for Microservice

Decompose application into services
Communication patterns
Data consistency patterns
Service deployment patterns
Observability patterns
Automated testing of services
Security patterns

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Decompose application into services

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Premature splitting is the root of all **evil**.

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Every time you make the decision to split out a new microservice, there's a **risk** of ending up with a bloated app.

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4 View model of Software Architecture

1. Logical View
2. Implementation View
3. Process View
4. Deployment View

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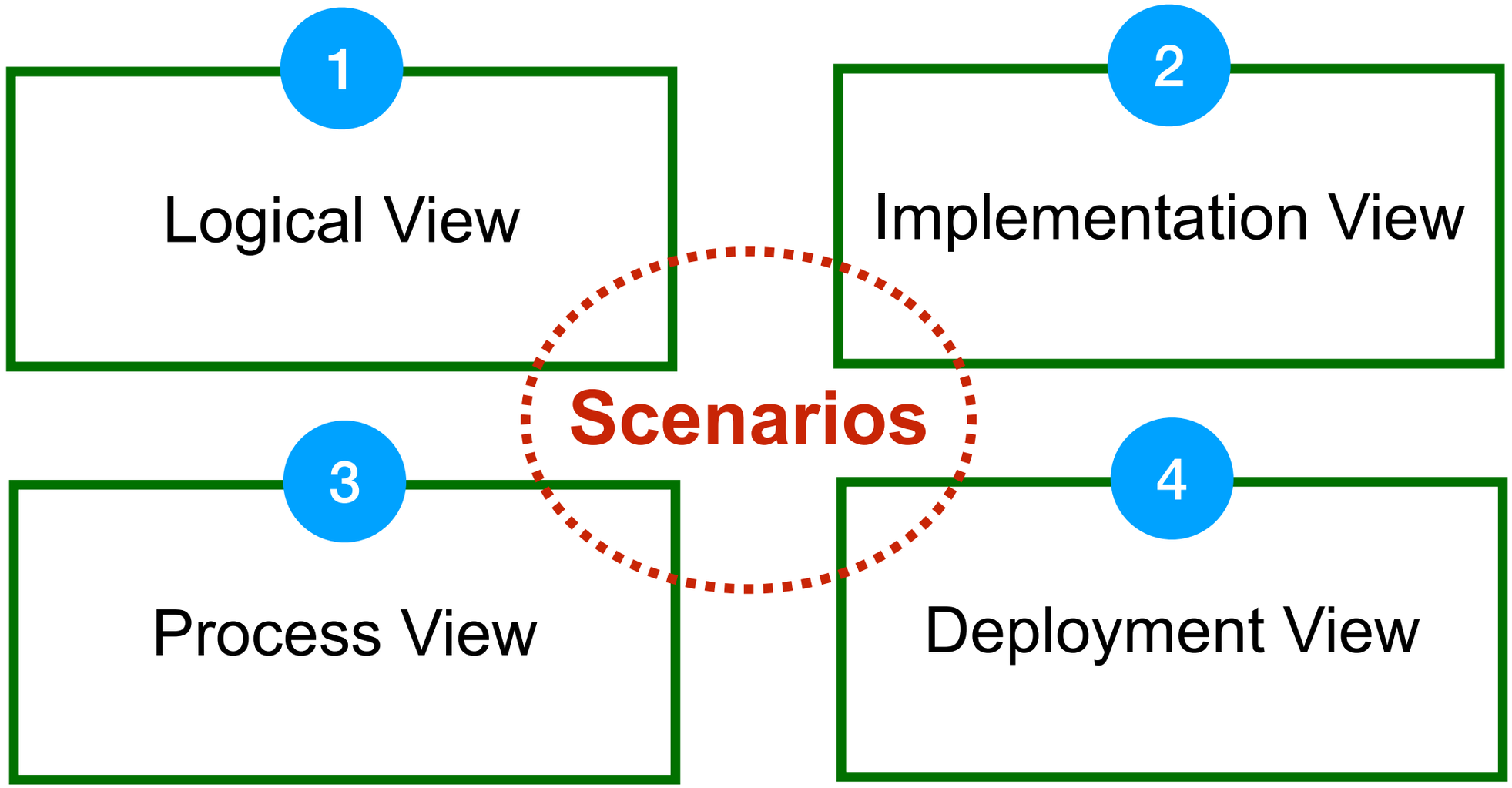
4 View model of Software Architecture



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Decompose application into services

By business capability ?
By subdomain/technical ?

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Step to define services

1. Identify system operations
2. Identify services
3. Define service APIs and collaboration

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1. Identify system operations

Start with functional requirements

User story

1

ลูกค้าต้องการสั่งซื้ออาหาร

2

ร้านอาหารรับคำสั่งซื้อ

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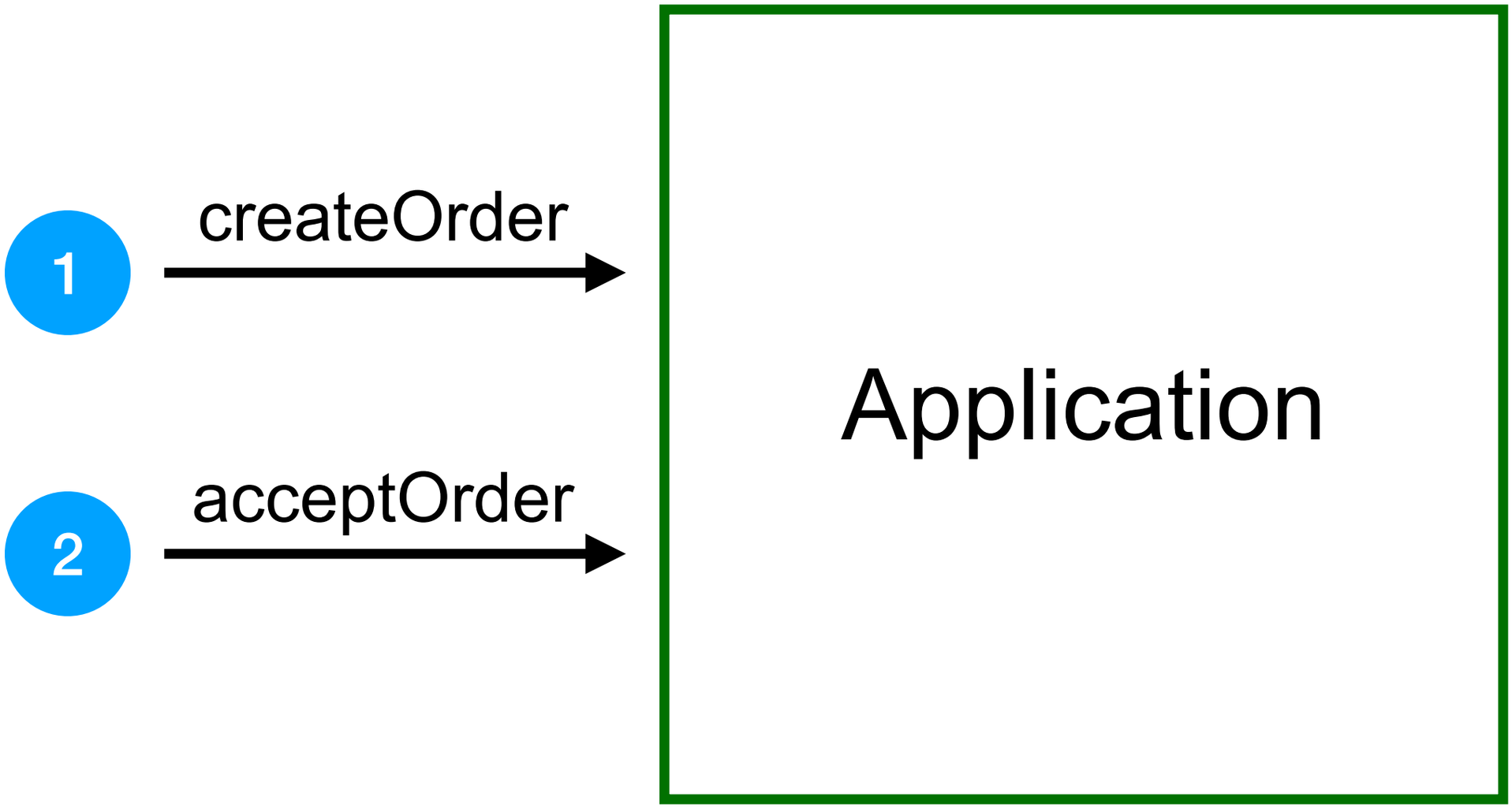
1. Identify system operations



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2. Identify services

Try to decomposition into services

Business > Technical concept

What > How

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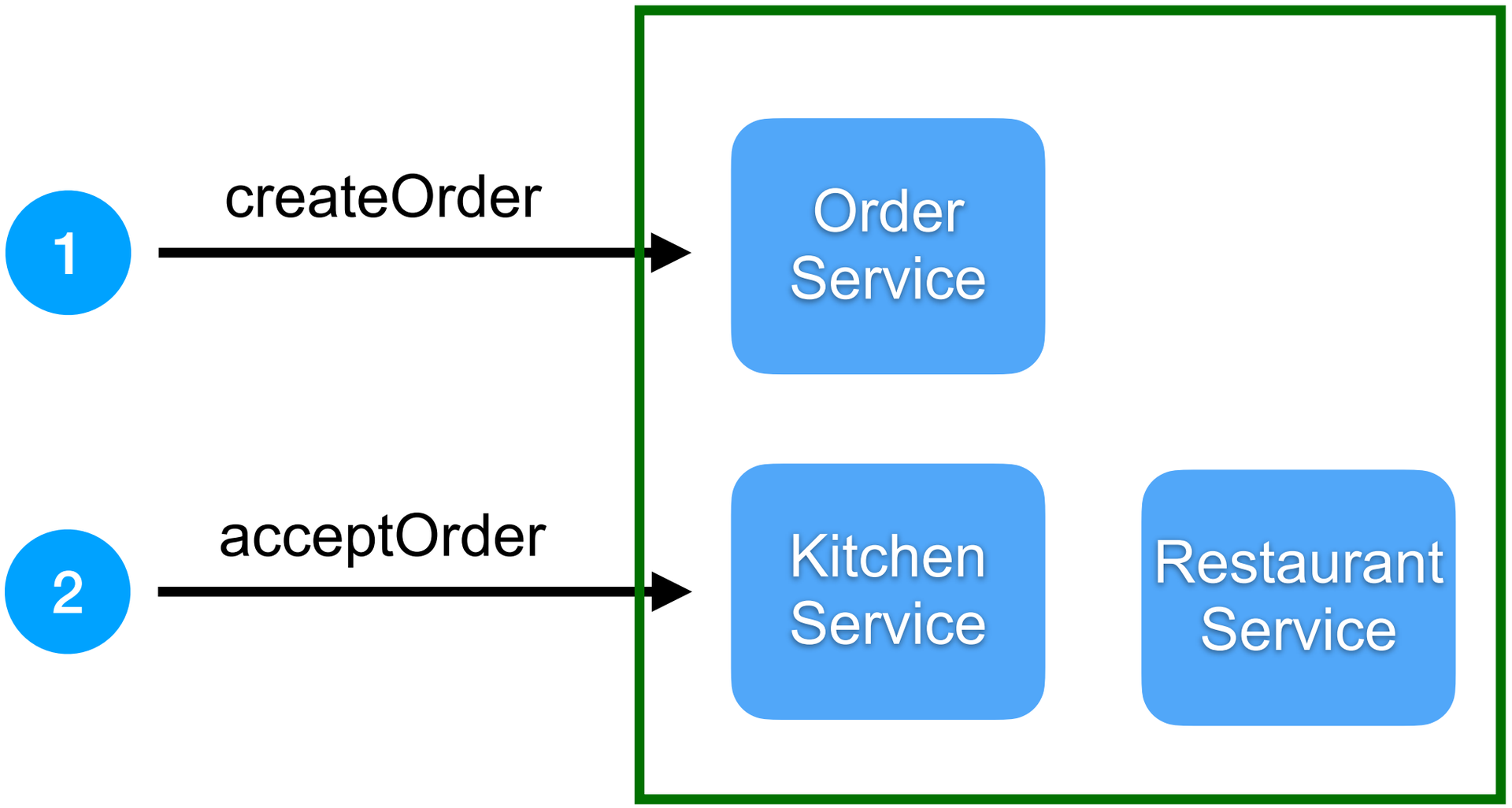
2. Identify services



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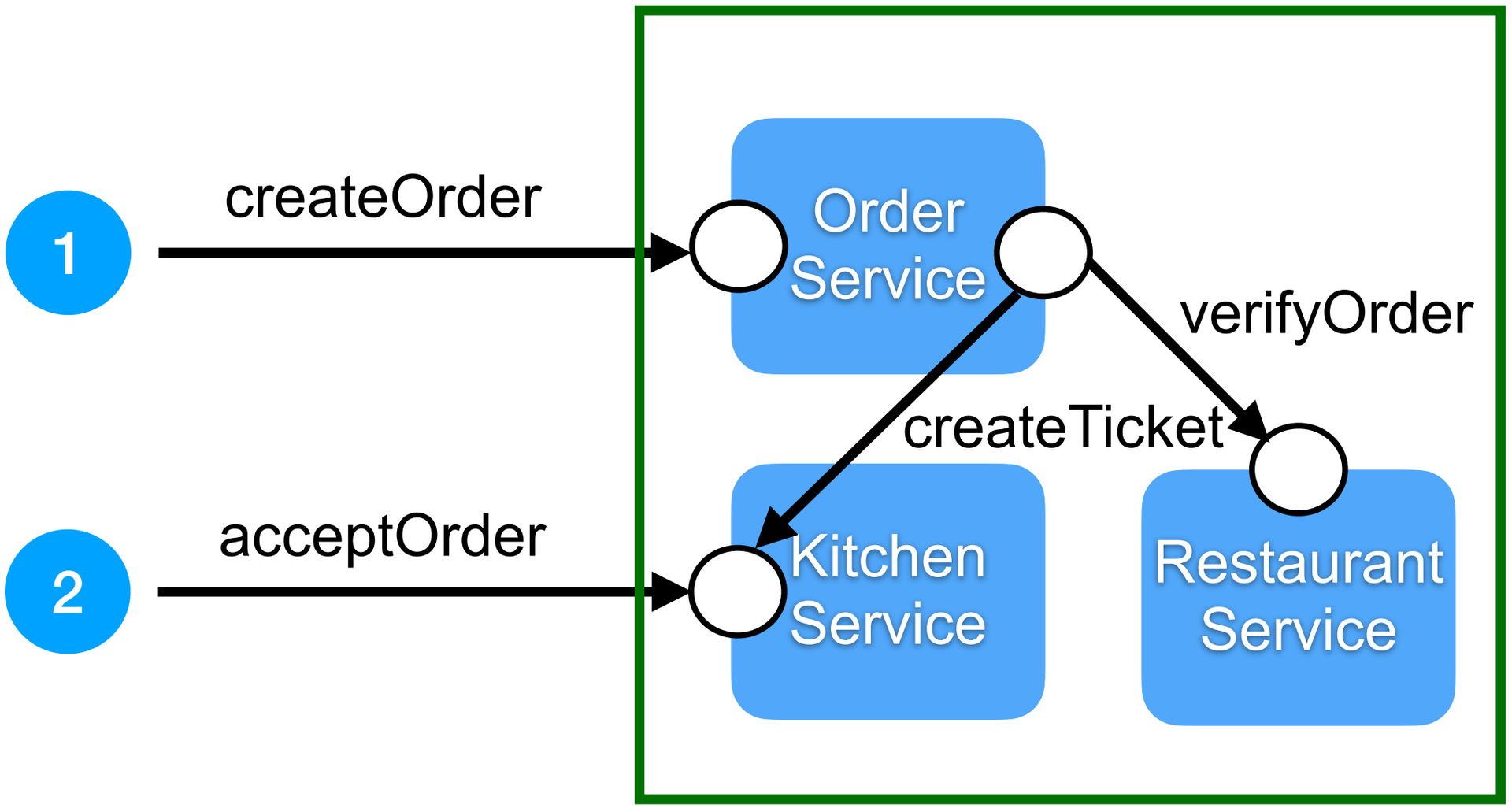
3. Define service APIs and collaborations



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Problems when decompose services ?

Network latency
Reliability of communication (sync)
Maintain data consistency
God classes

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Communication patterns

Communication style
Discovery service
Reliability of communication
Transactional messaging
External API

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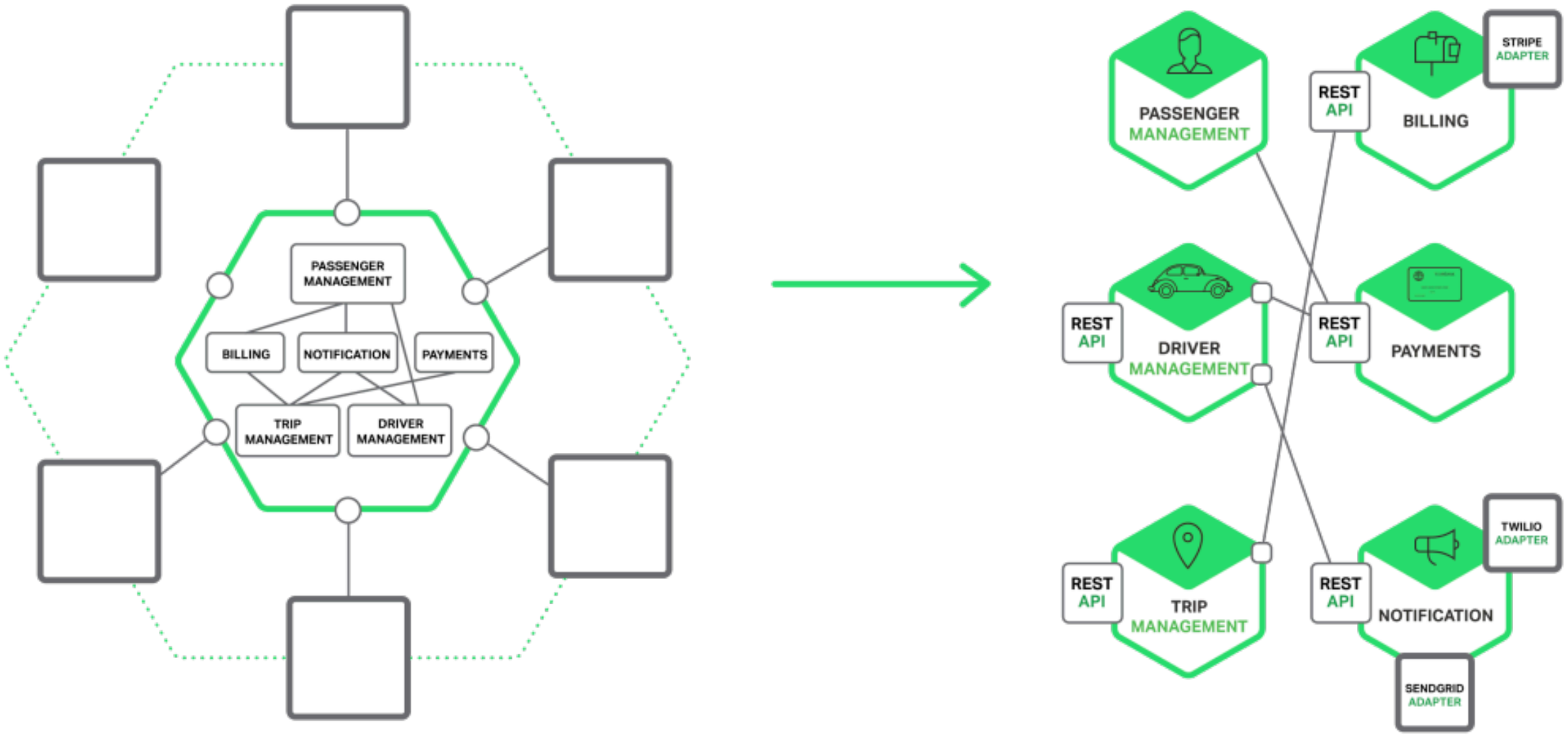
Inter Process Communication (IPC)



https://www.nginx.com

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Interaction Styles

	One-to-one	**One-to-many**
Synchronous	Request/response	-
Asynchronous	Async request/response	Publish/subscribe
	Notification	Publish/async response

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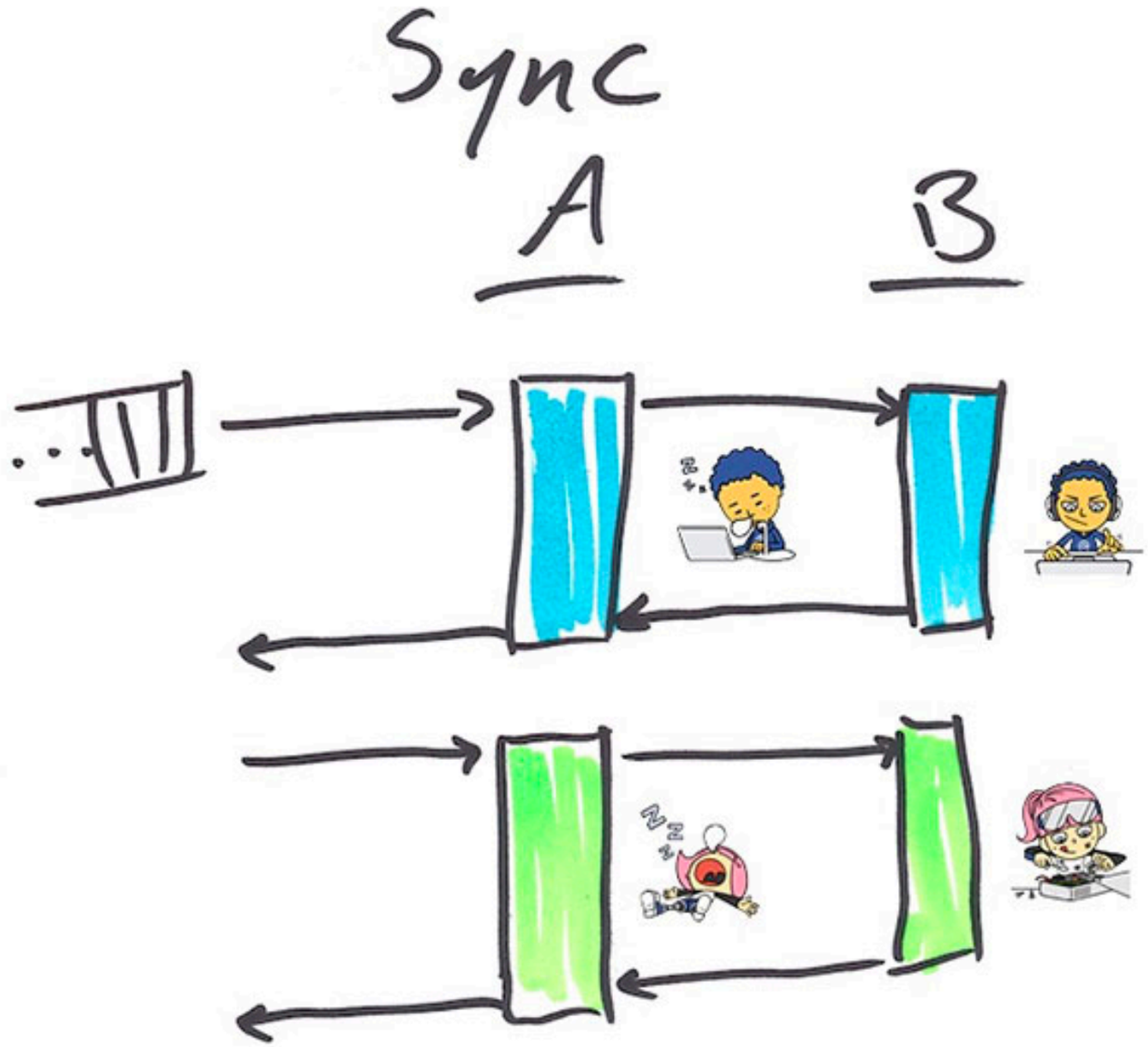
Synchronous



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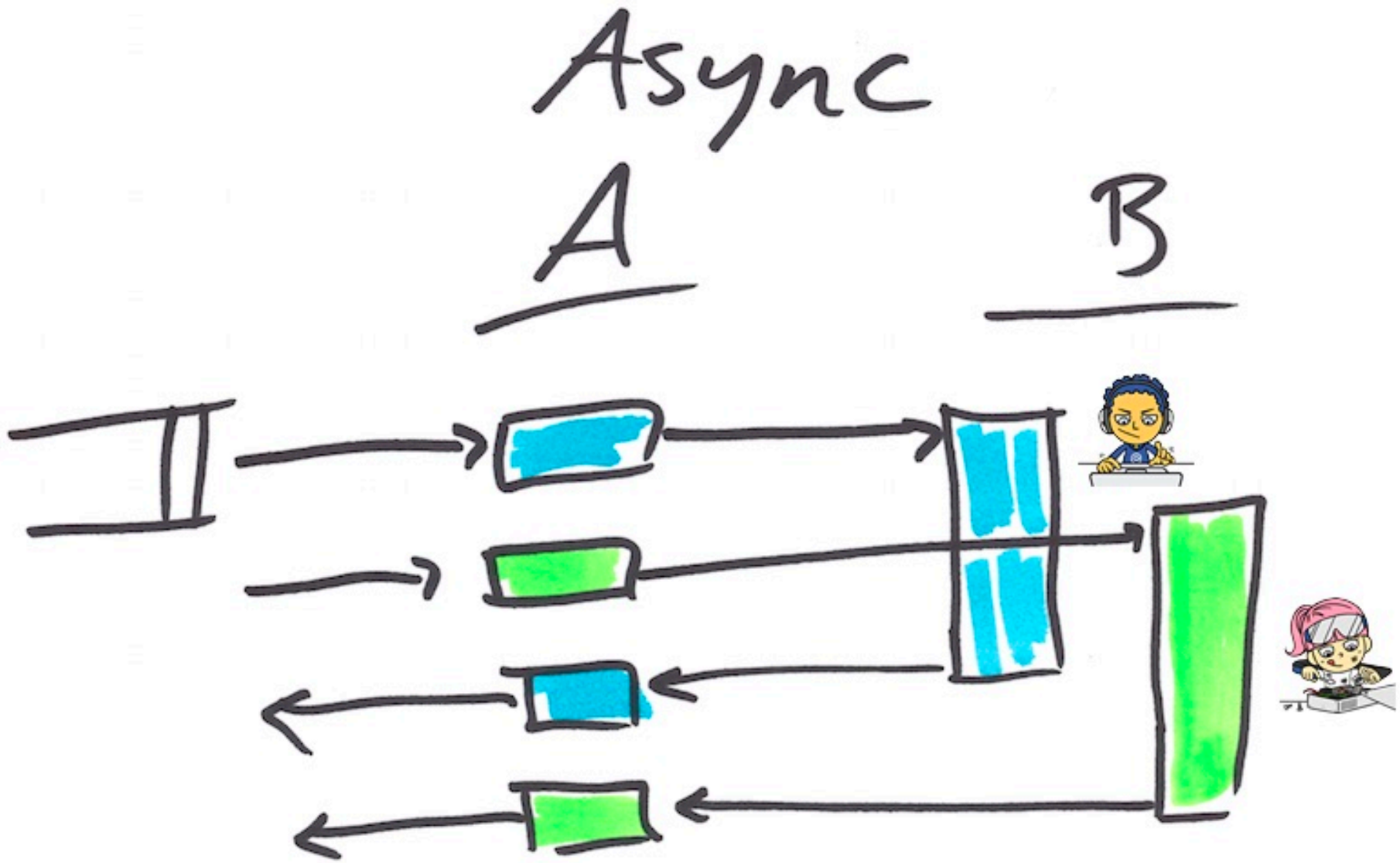
Asynchronous



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Synchronous
Remote **P**rocedure **I**nvocation

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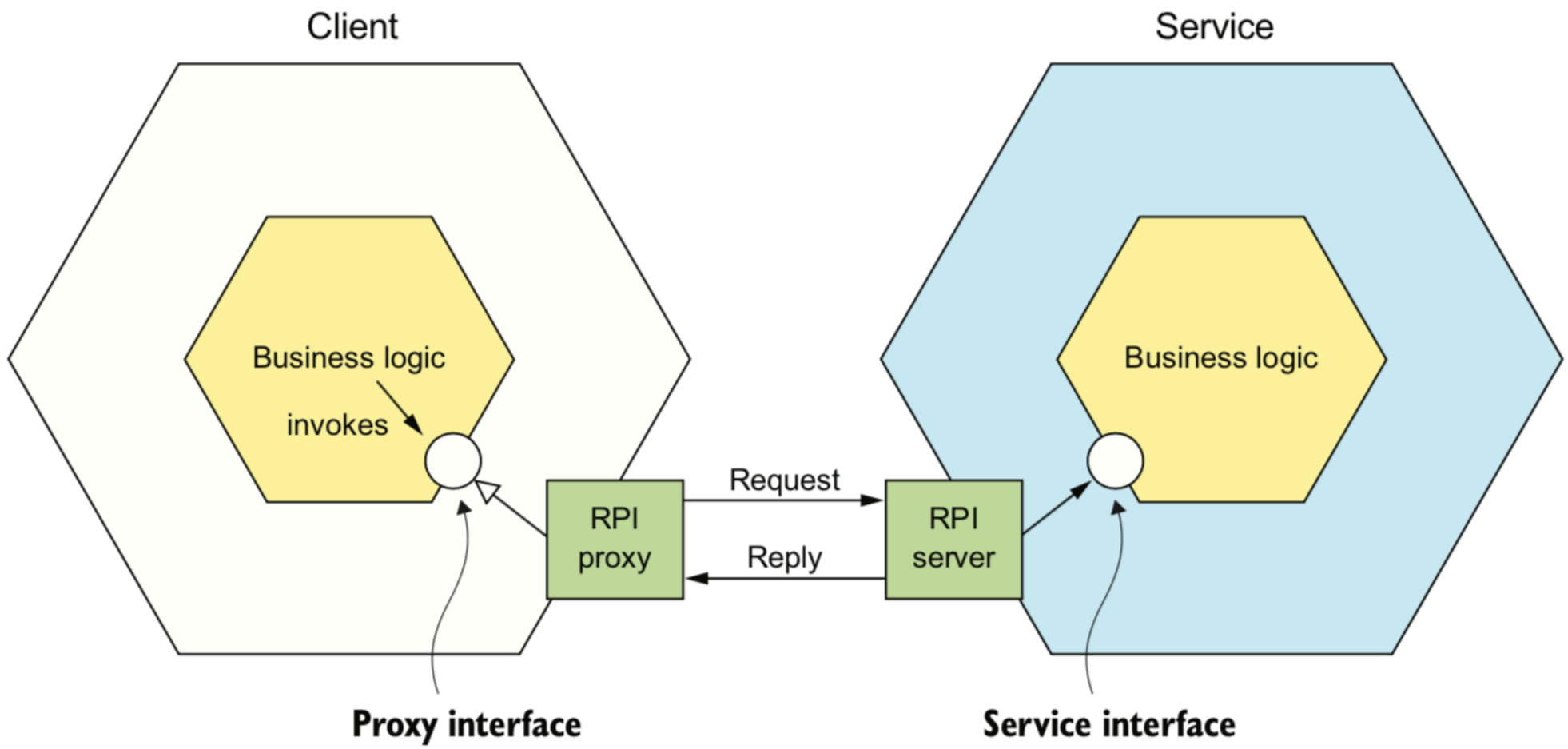
Remote Procedure Invocation



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Synchronous Remote Procedure Invocation

REST

gRPC

Handling failure with **Circuit breaker**

Service discovery

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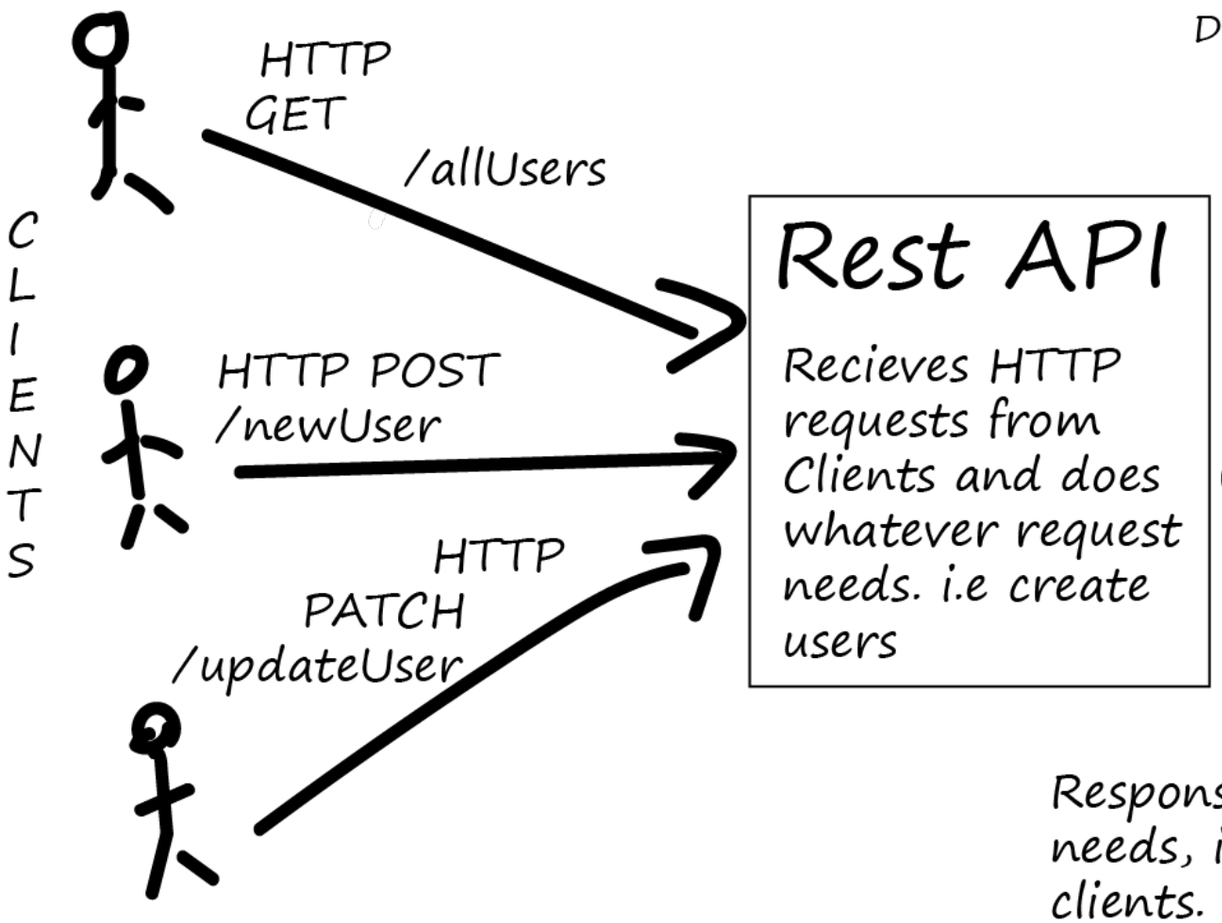
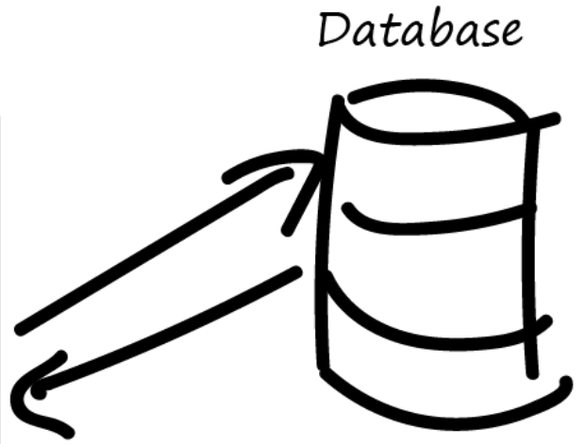
REpresentational **S**tate **T**ransfer

Rest API Basics

Typical HTTP Verbs:
GET -> Read from Database
PUT -> Update/Replace row in Database
PATCH -> Update/Modify row in Database
POST -> Create a new record in the database
DELETE -> Delete from the database



Our Clients, send HTTP Requests and wait for responses



Our Rest API queries the database for what it needs

Response: When the Rest API has what it needs, it sends back a response to the clients. This would typically be in JSON or XML format.

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REST :: mapping with HTTP verbs

Activity	HTTP Method
Retrieve data	GET
Create new data	POST
Update data	PUT
Delete data	DELETE

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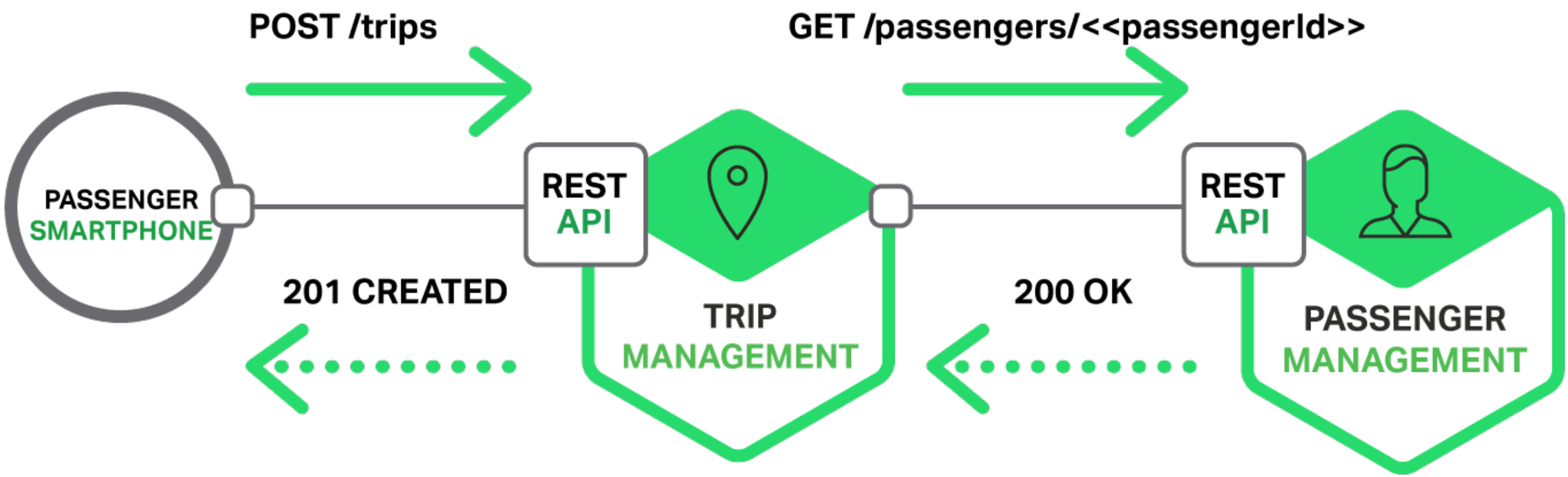
Request and response format



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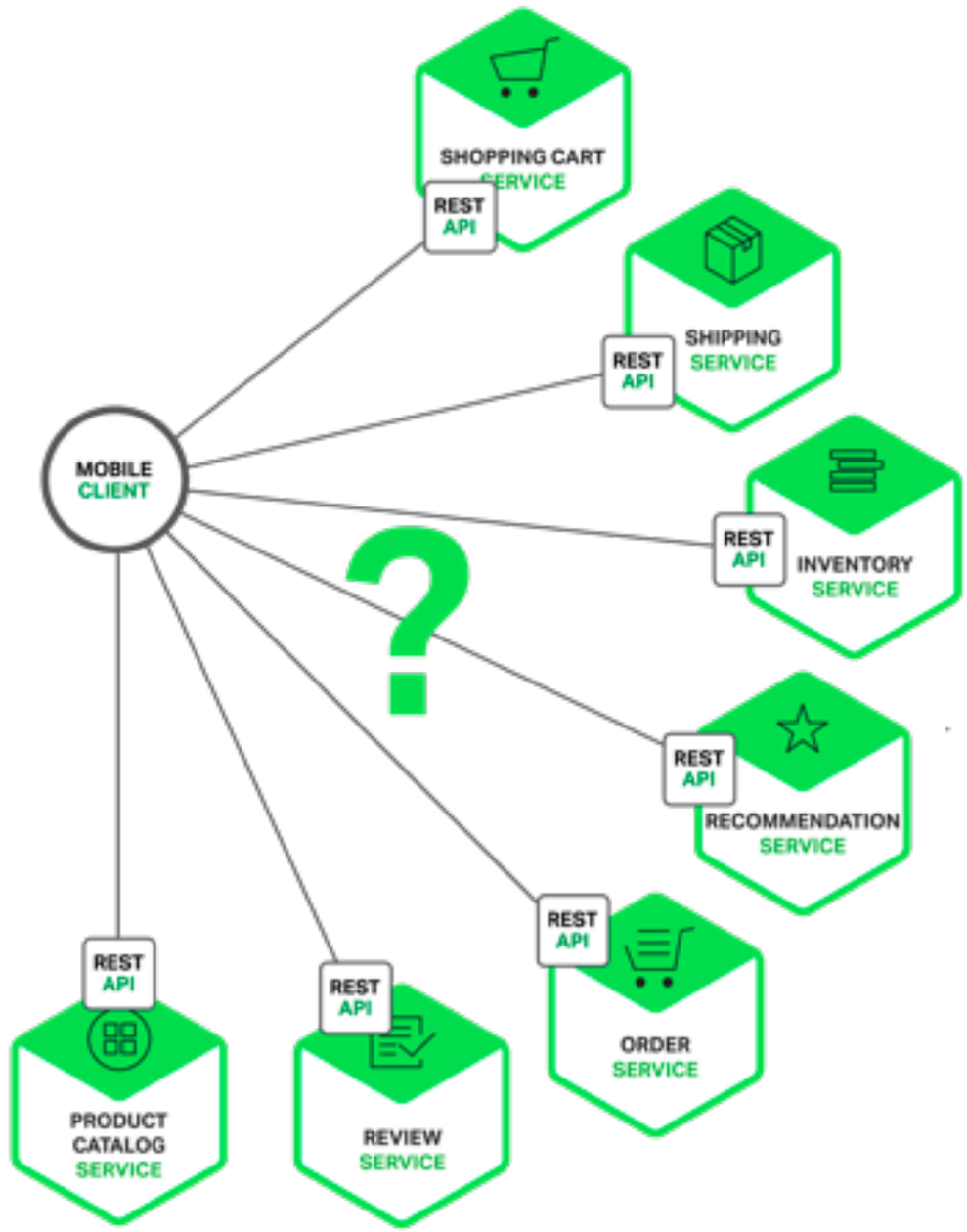
Direct communication !!



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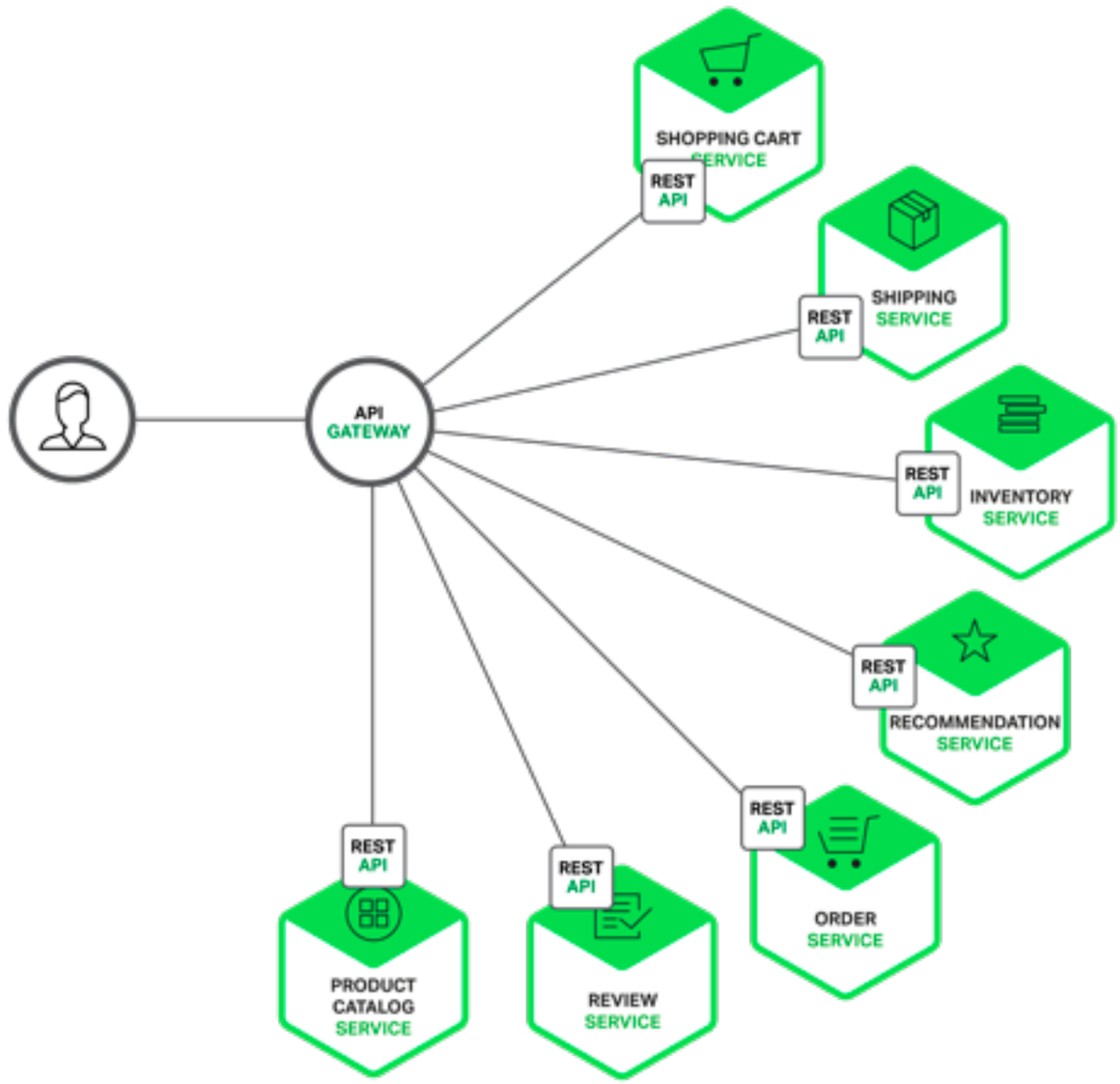
Working with API gateway



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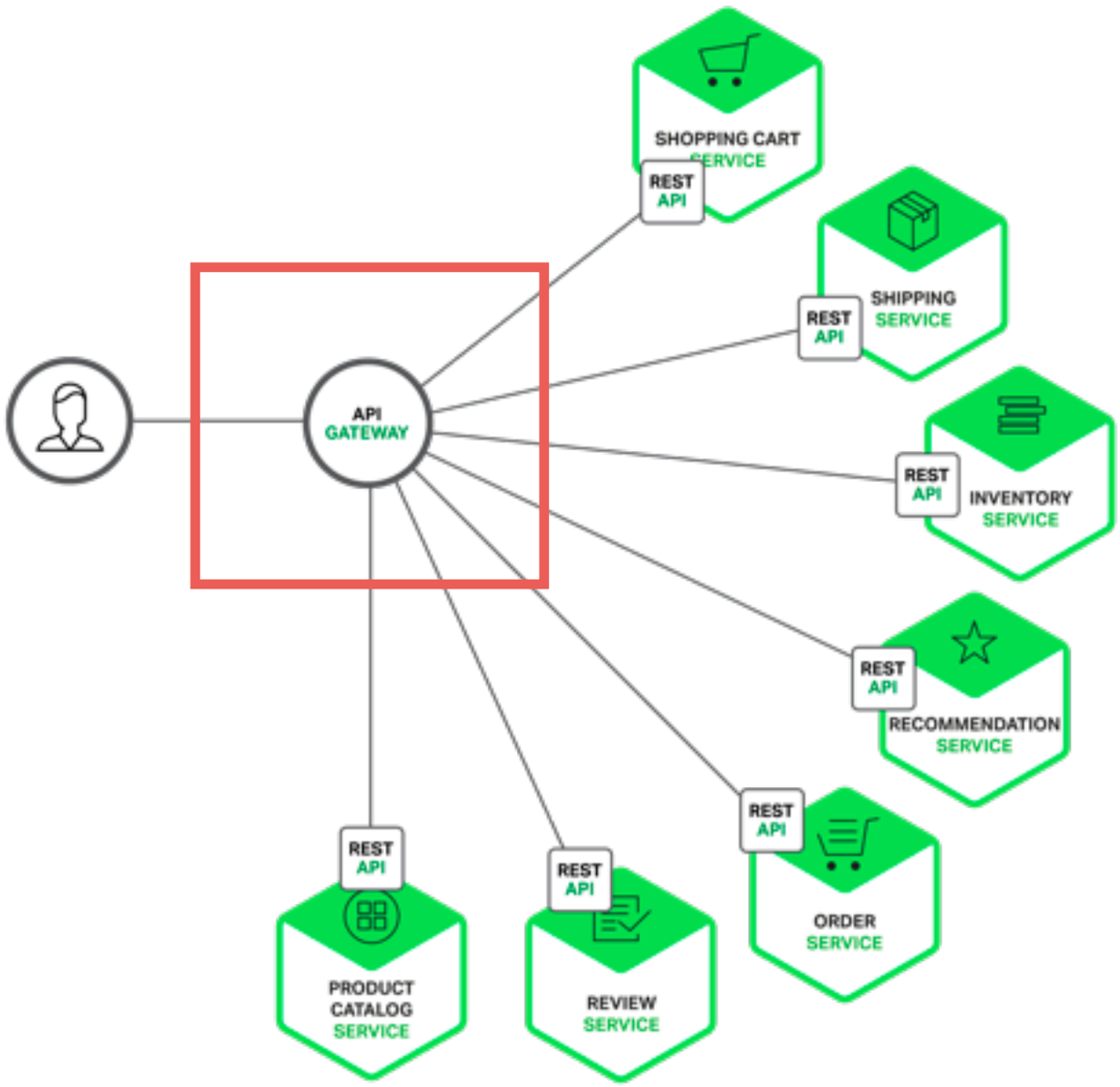
Avoid Single Point of Failure !!



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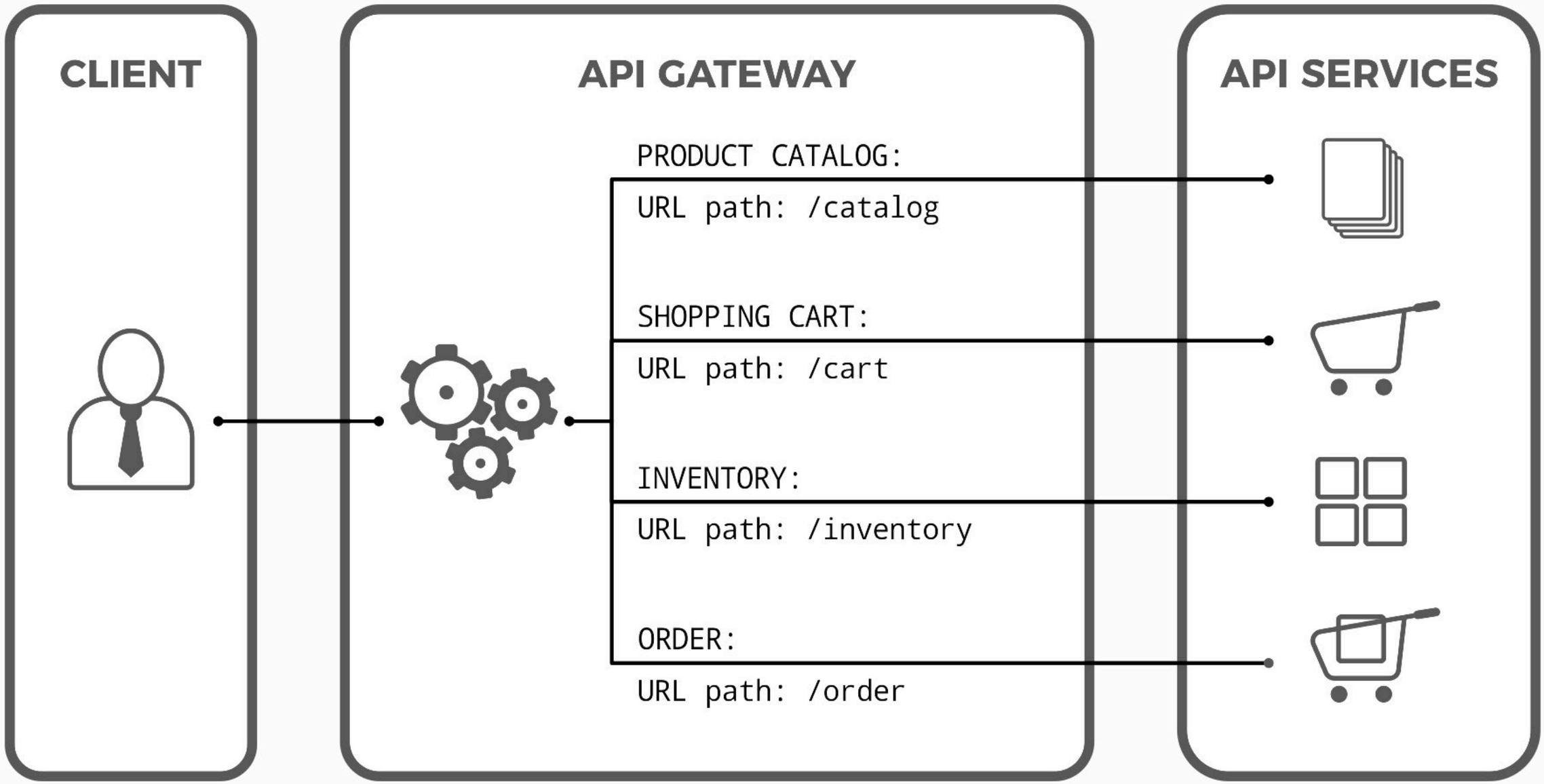
Working with API gateway



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Functions of API gateway

Authentication
Authorization
Rate limiting
Caching
Metrics collection
Request logging
Load balancing
Circuit breaking

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Benefits

Encapsulation interface structure
Client talk to service via gateway
Reduce round trip between service

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Drawbacks

Development/Performance bottleneck

Single point of failure

Waiting for update data in gateway

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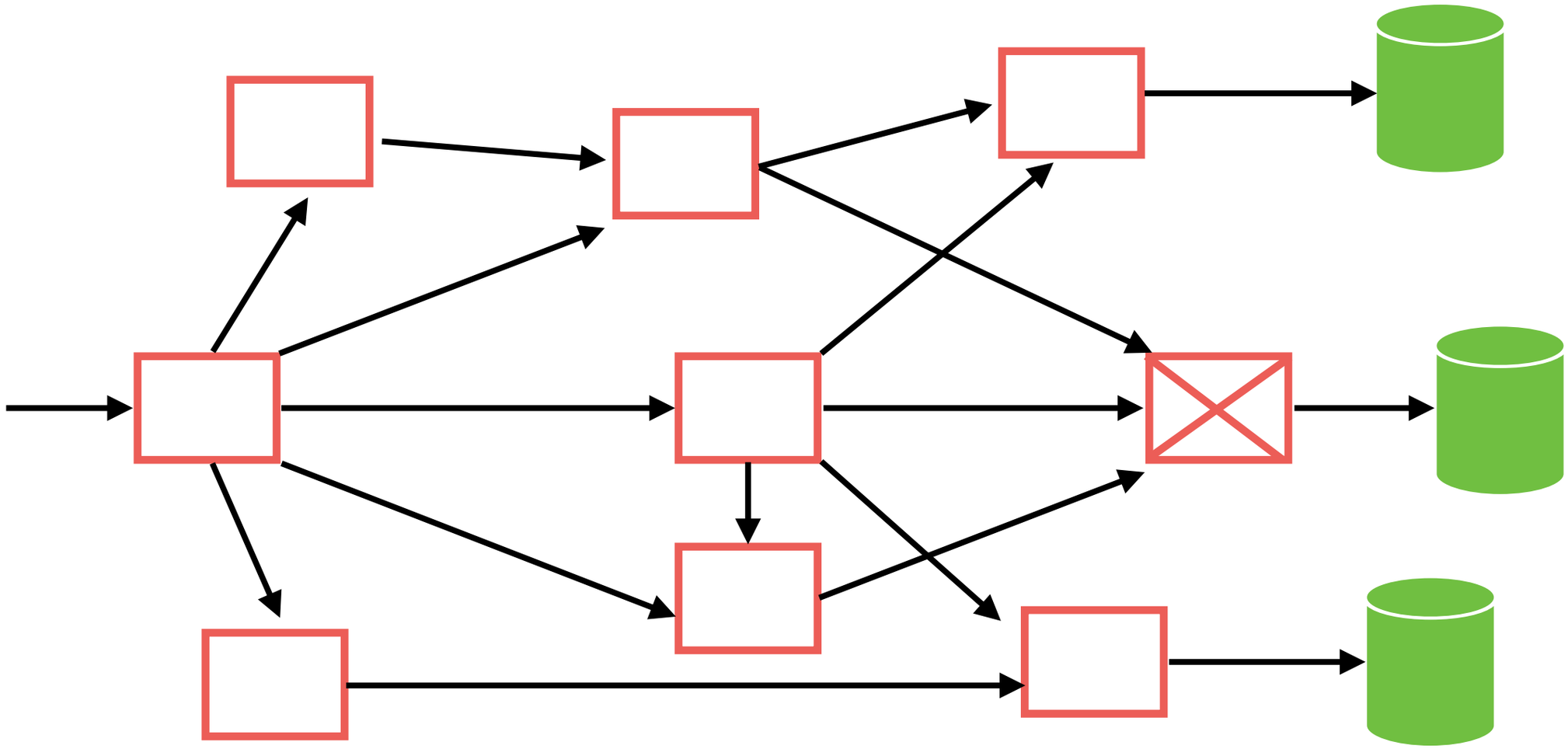
Circuit Breaker pattern

How to handling partial failure ?



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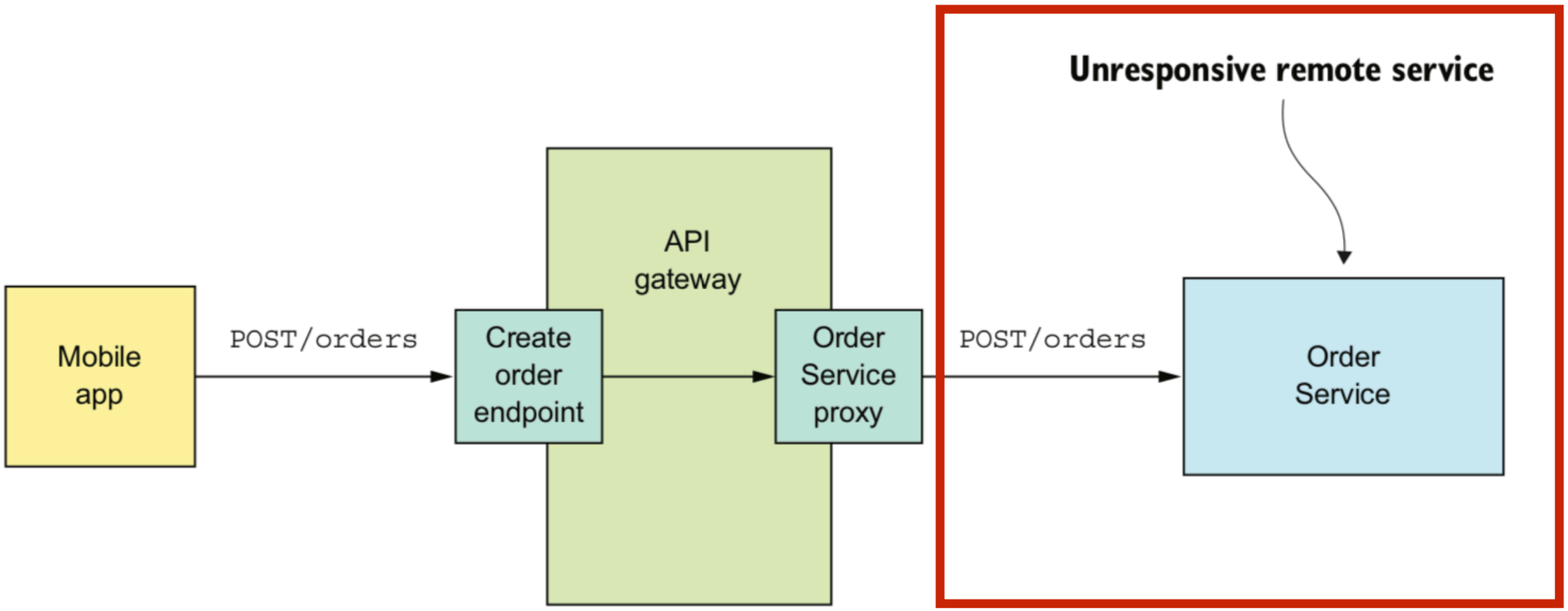
Circuit Breaker pattern

How to handling partial failure ?



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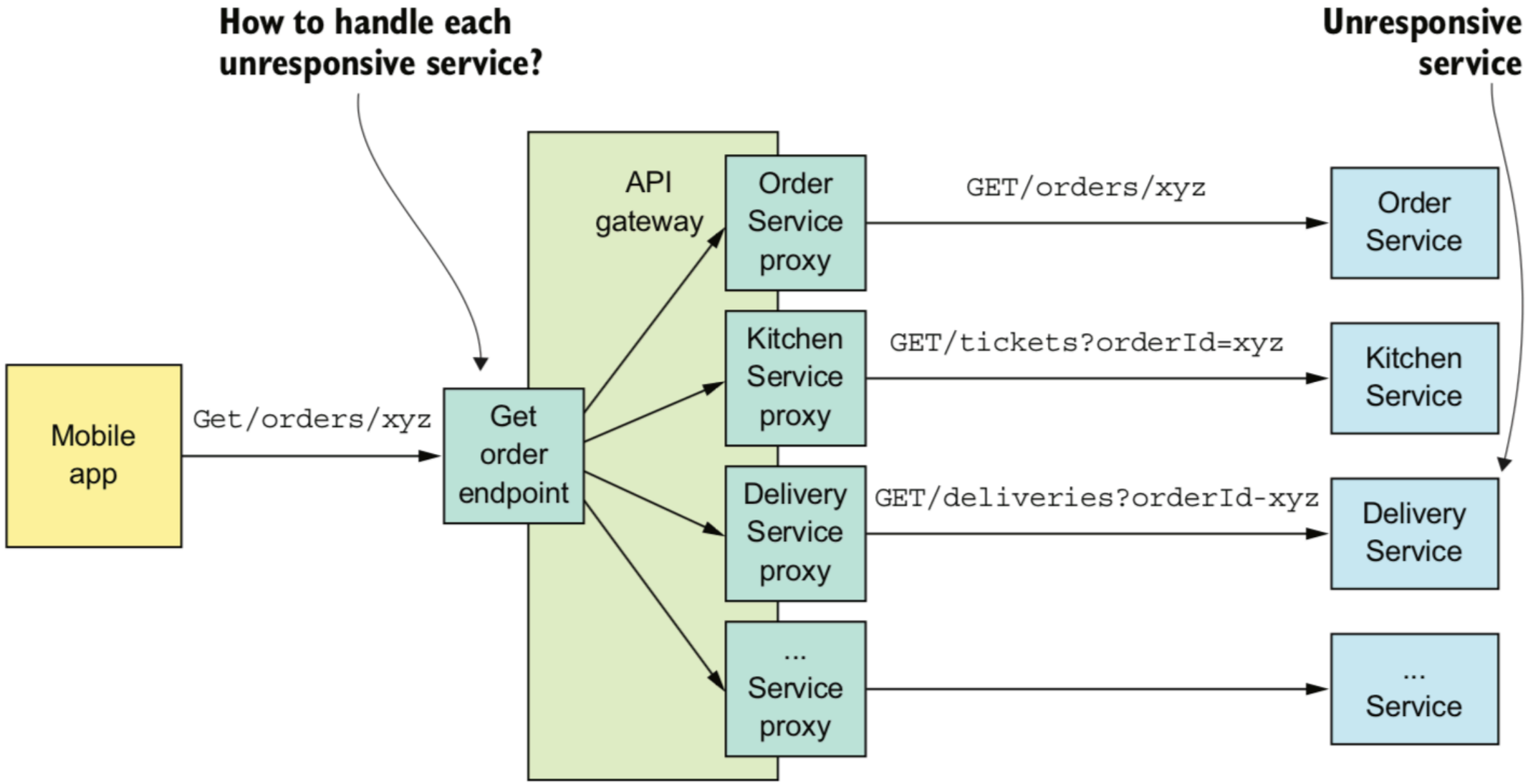
Circuit Breaker pattern

How to handling partial failure ?



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Develop robust patterns

Network timeout
Limit request from client to service
Circuit breaker pattern

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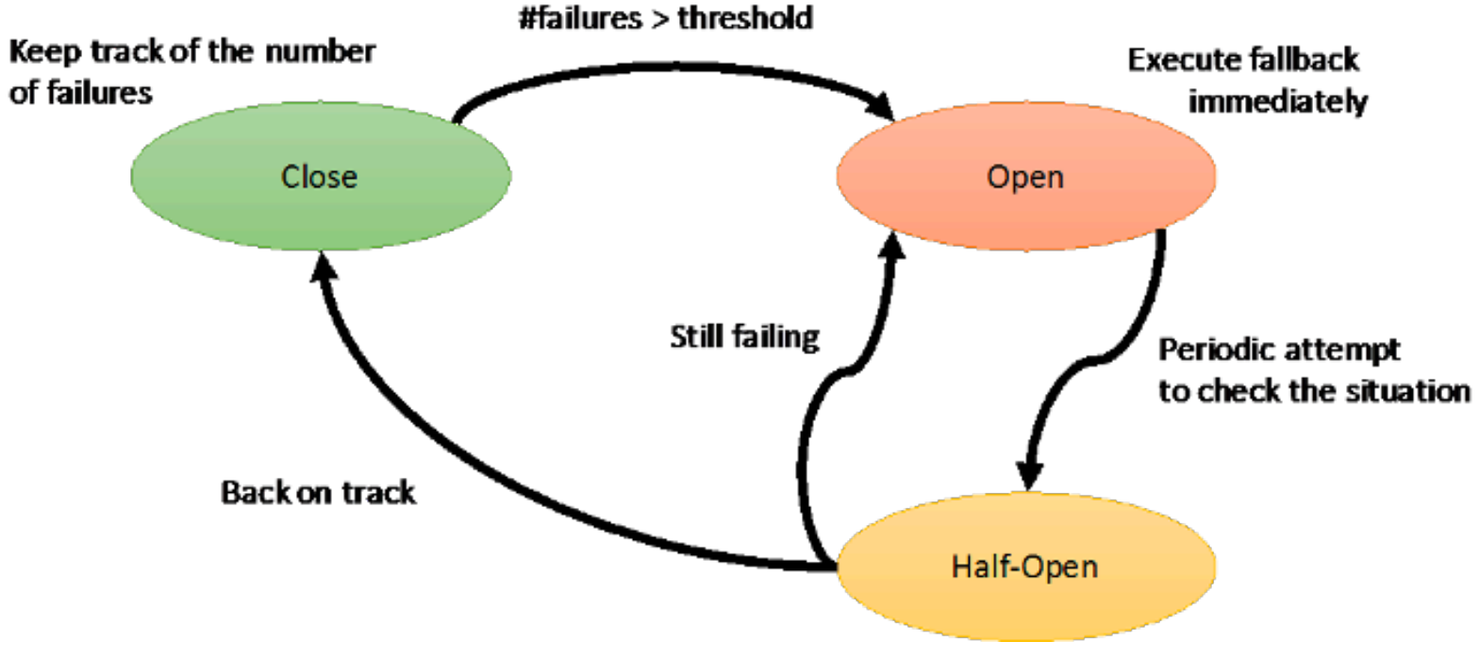
Circuit Breaker pattern

Track the number of success and failure

If error rate exceed some threshold then enable circuits breaker



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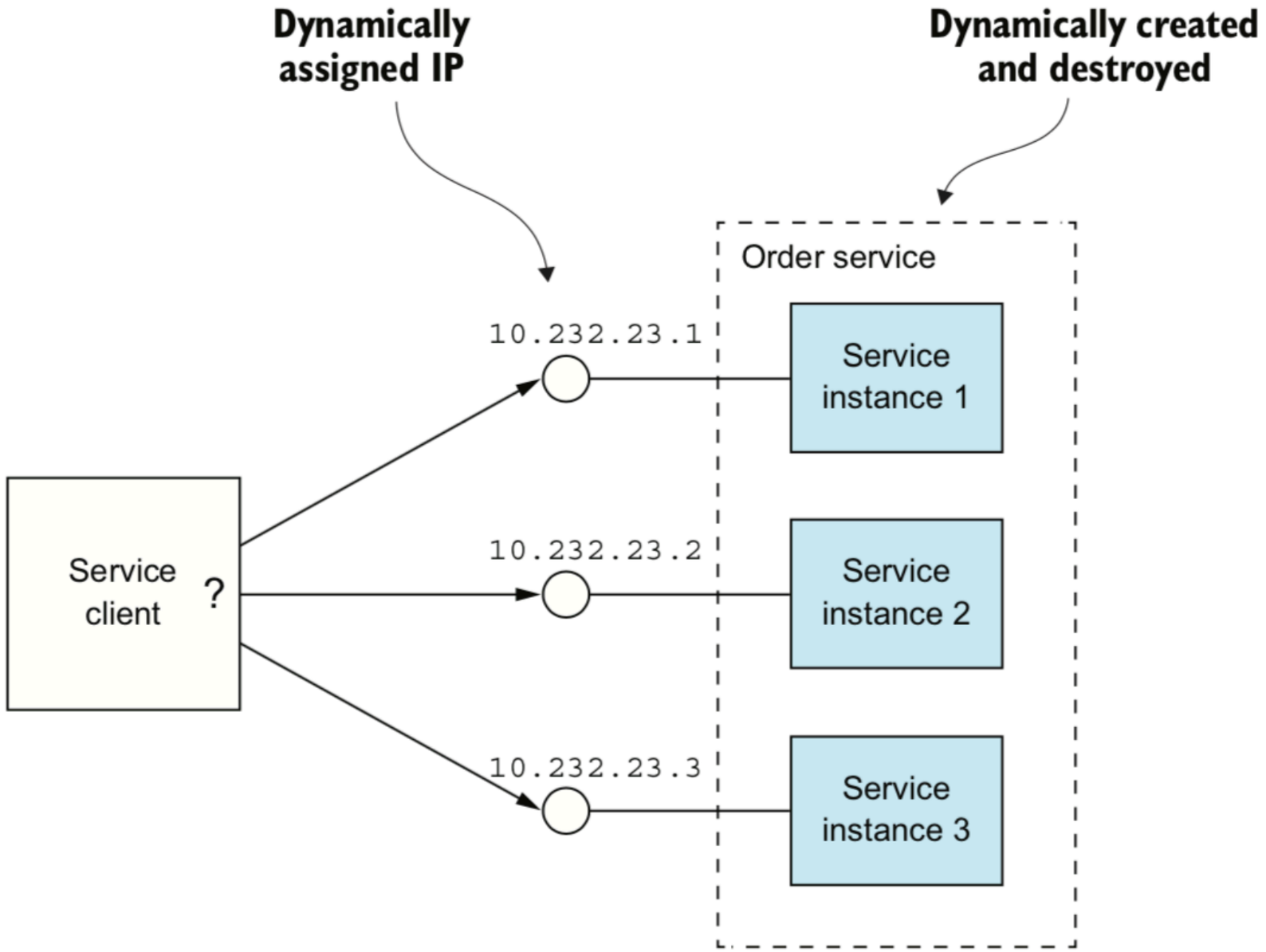
Service Discovery

How to call another services ?



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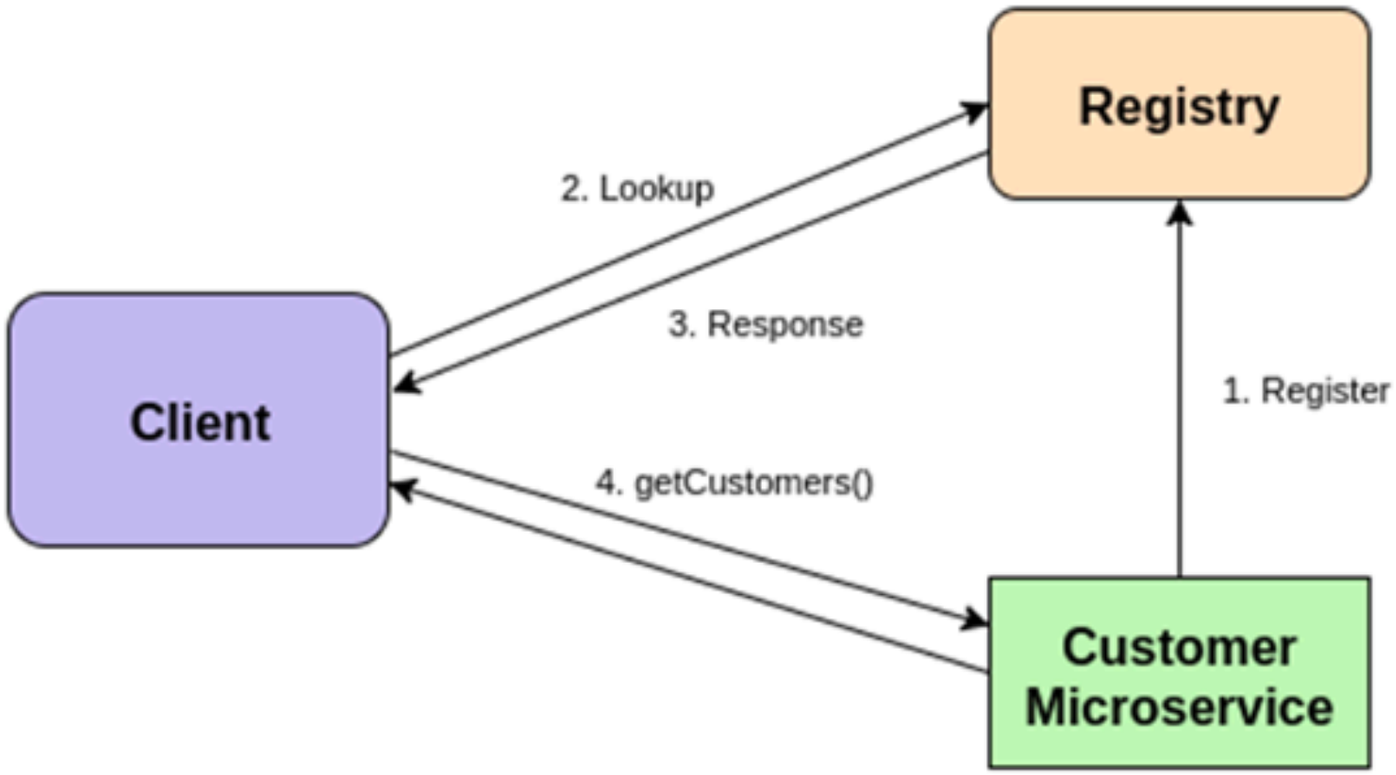
Service Discovery



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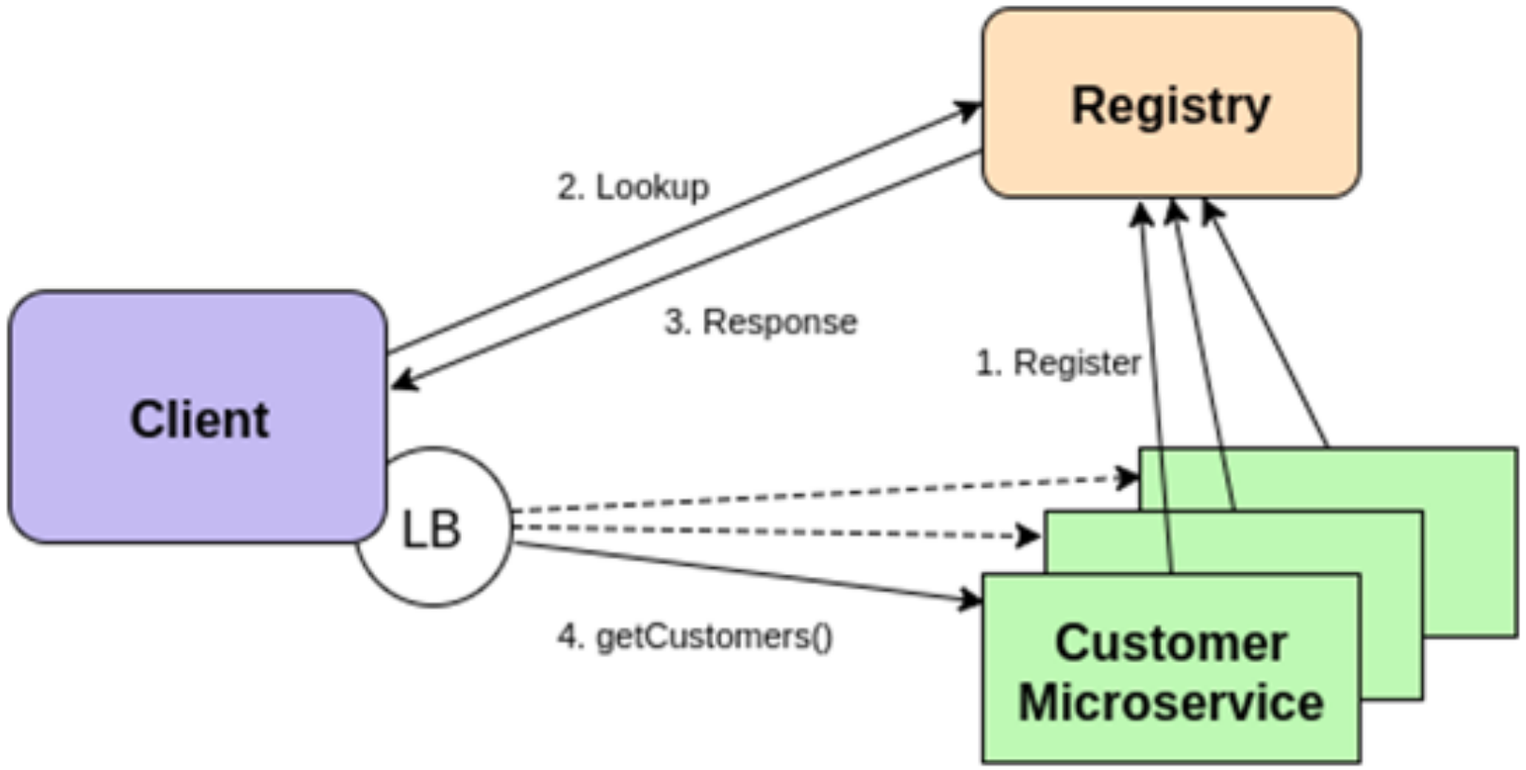
Service discovery with Load balance



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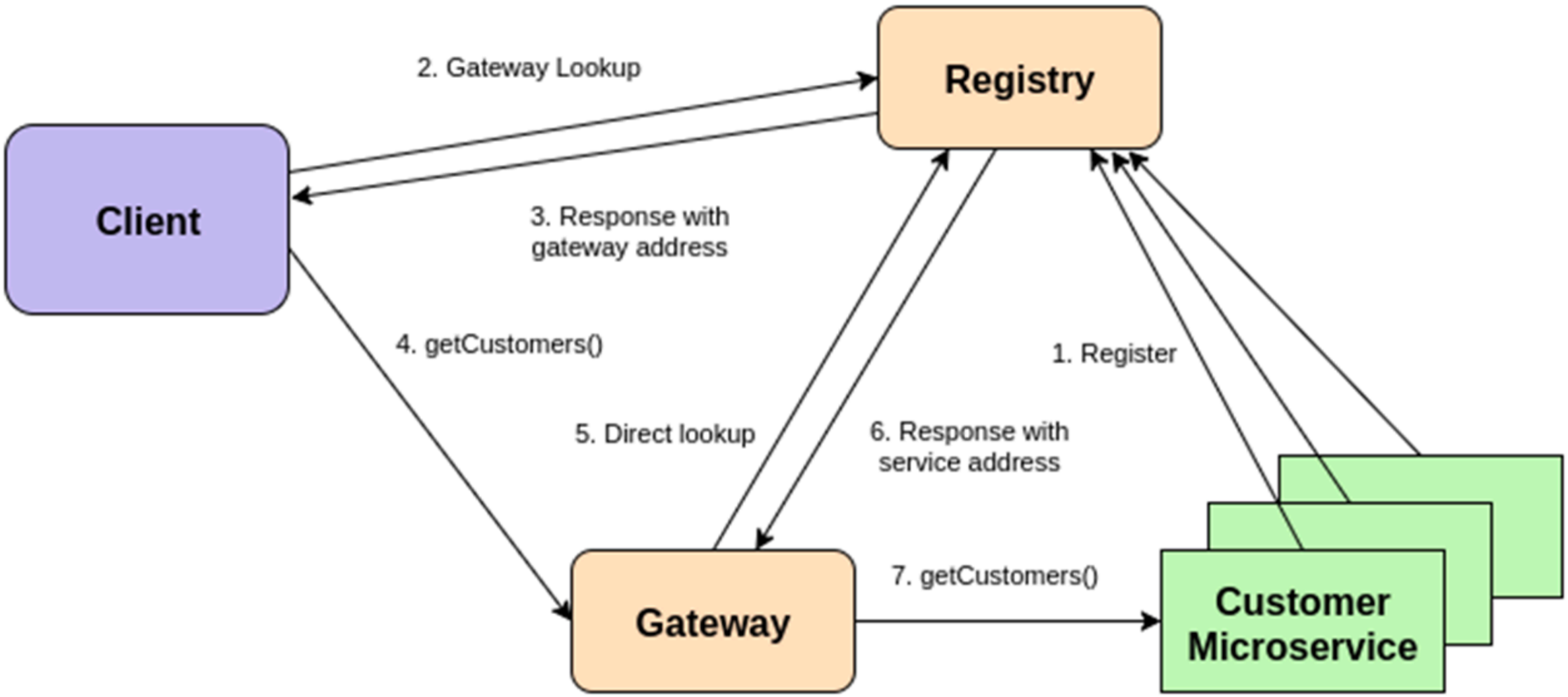
Service discovery with API gateway



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Asynchronous messaging pattern

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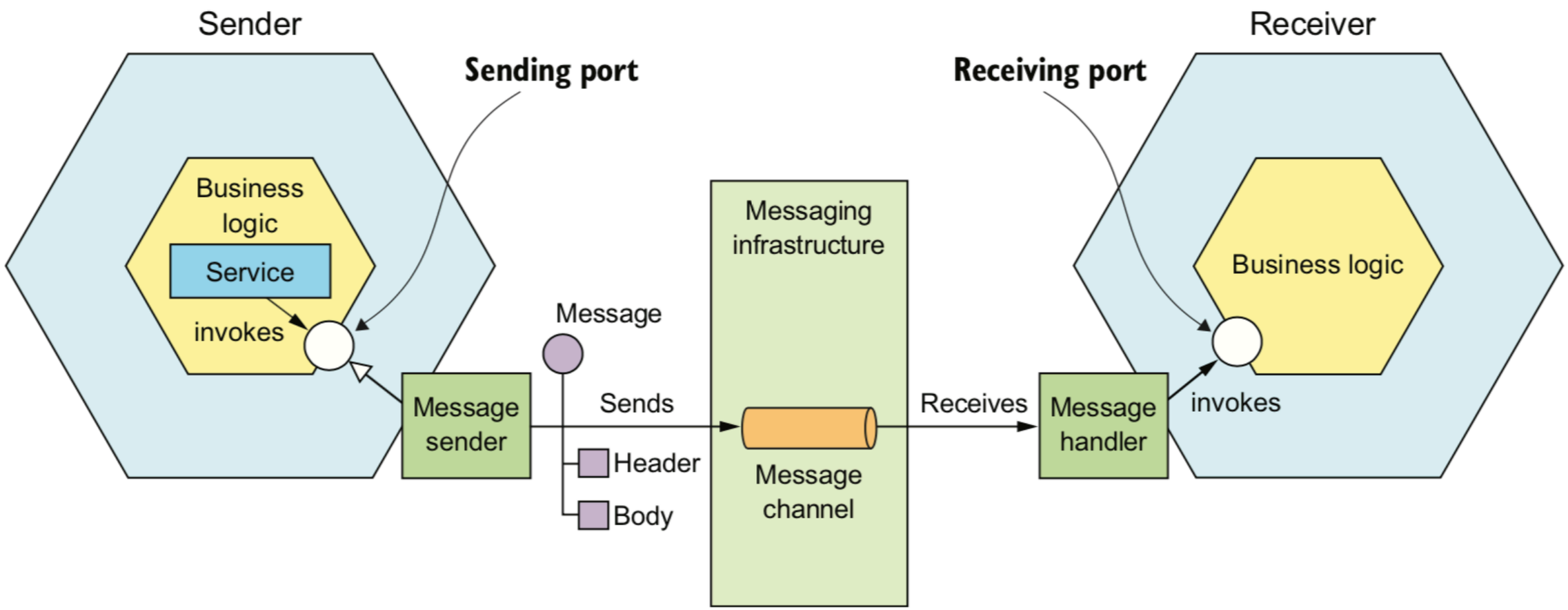
Asynchronous messaging pattern



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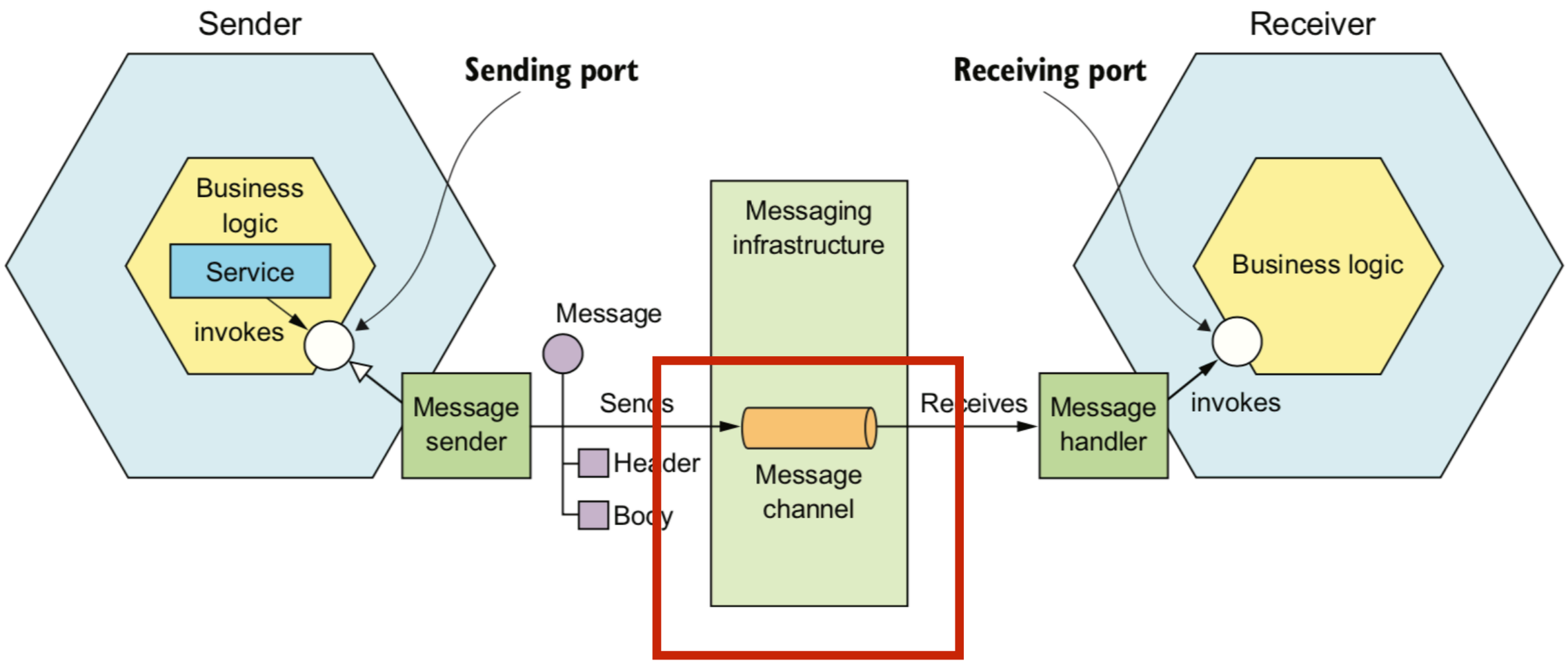
Asynchronous messaging pattern



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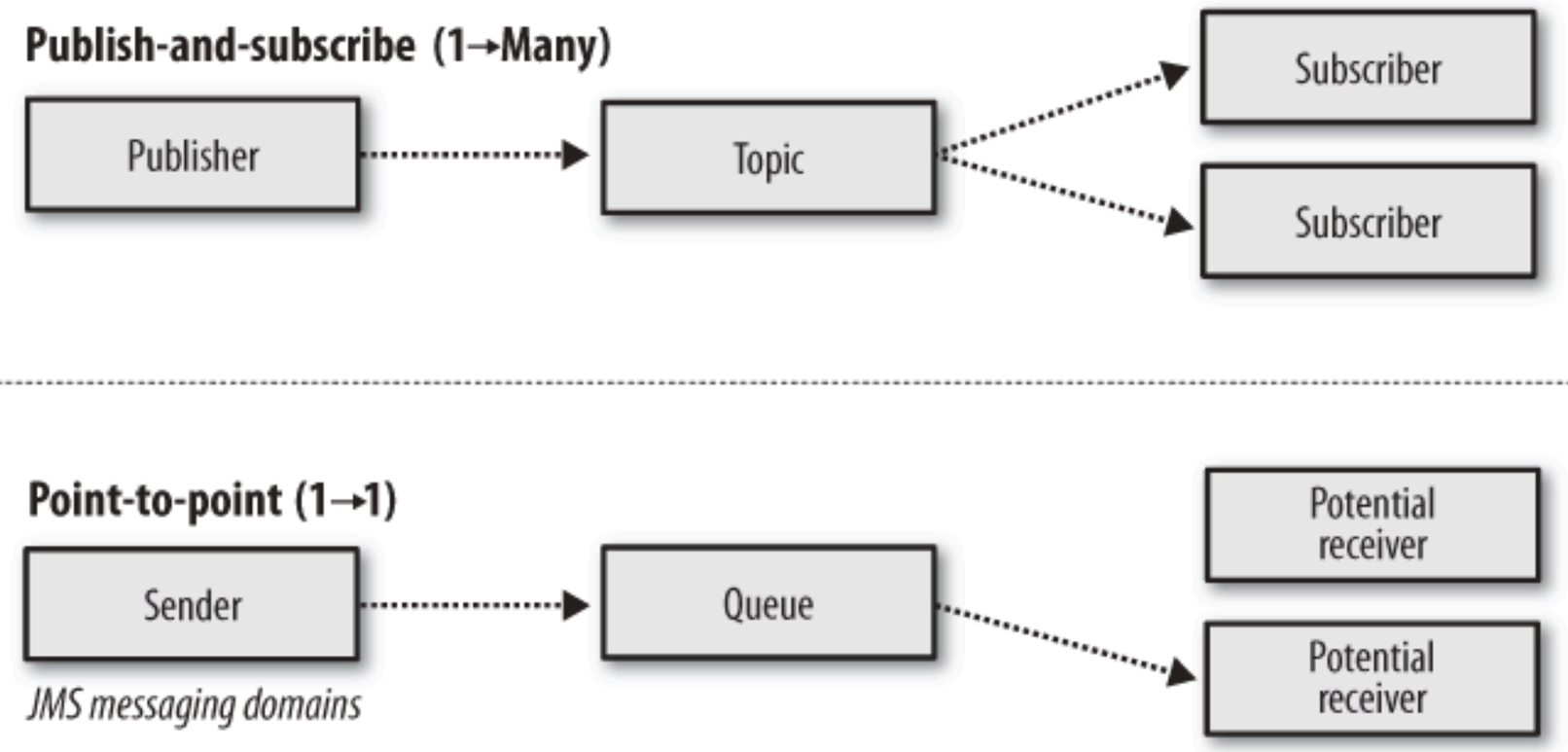
Messaging channels

Point-to-point
Publish-subscribe



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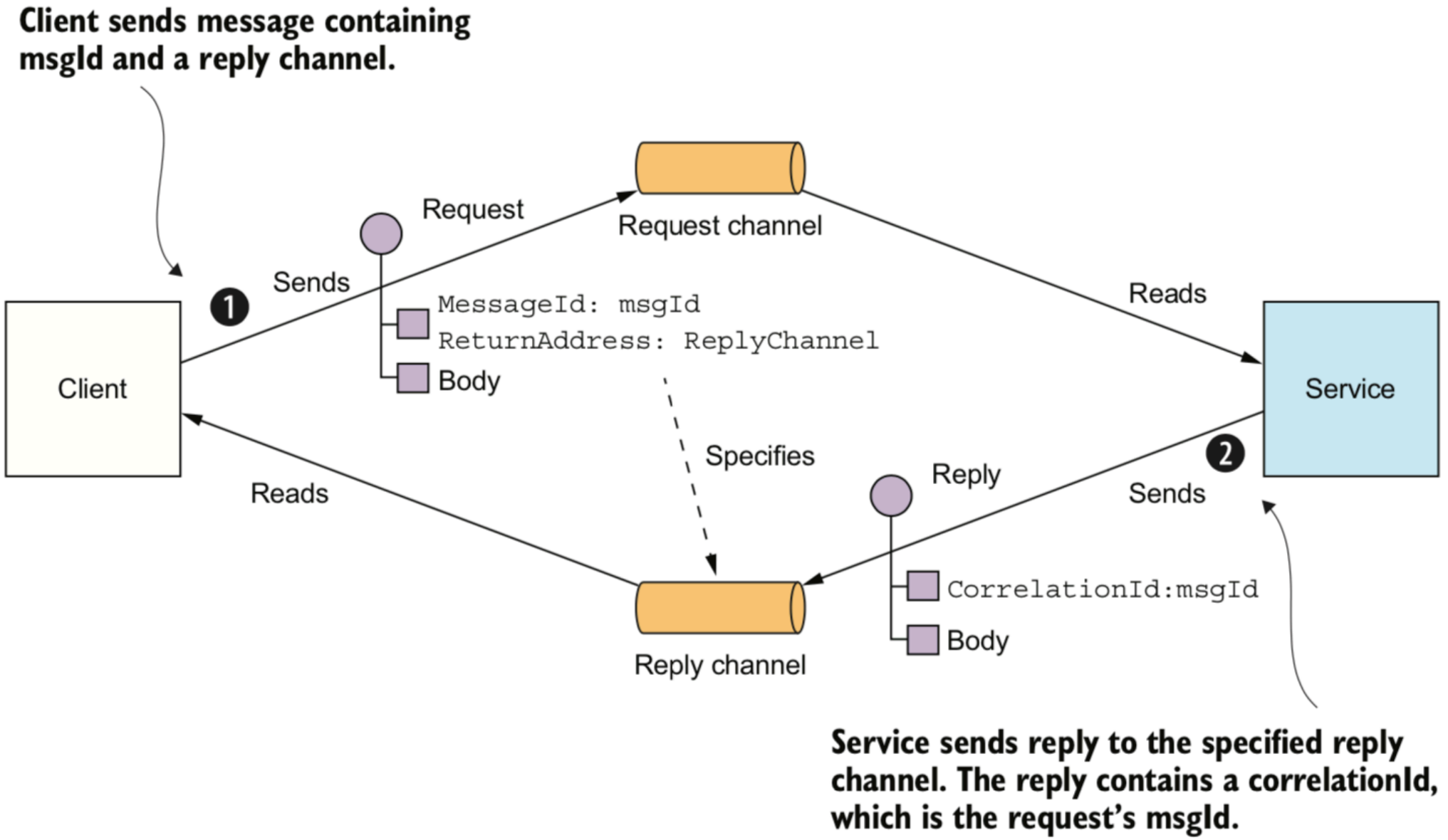
Async request/response (1)



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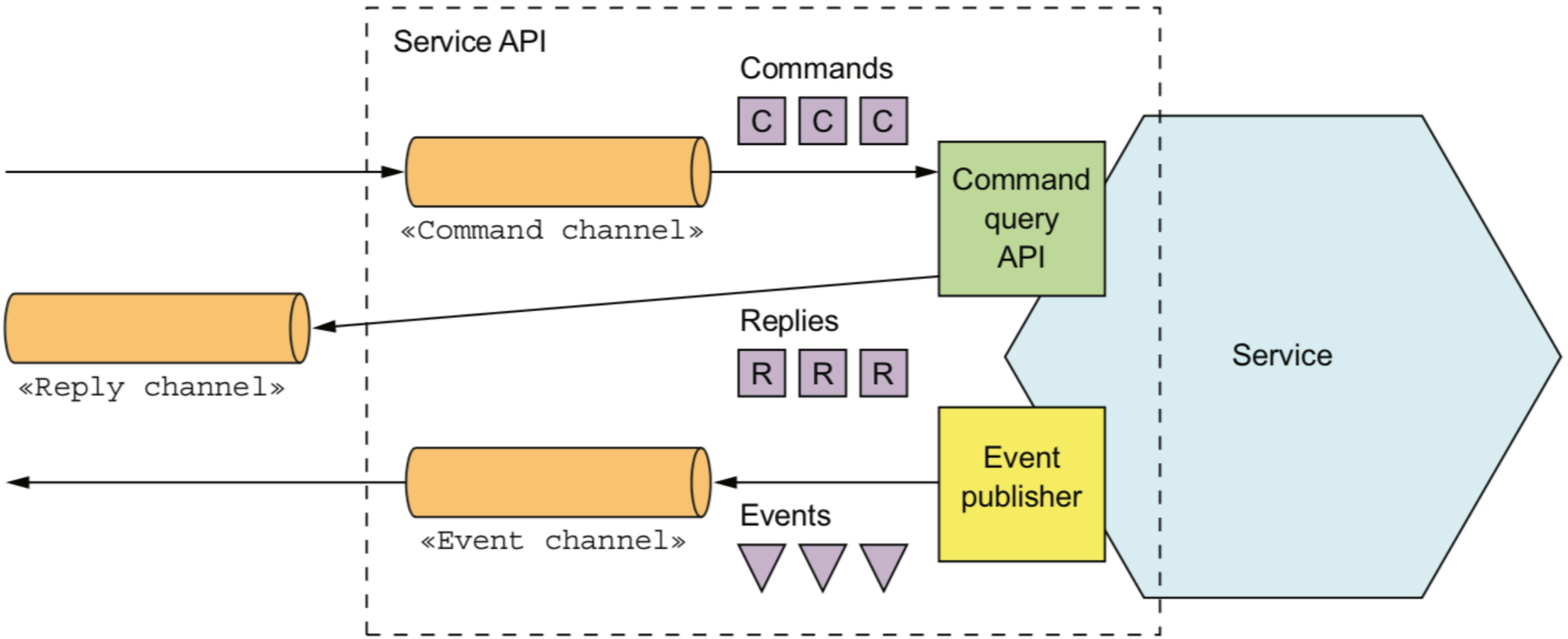
Async request/response (2)



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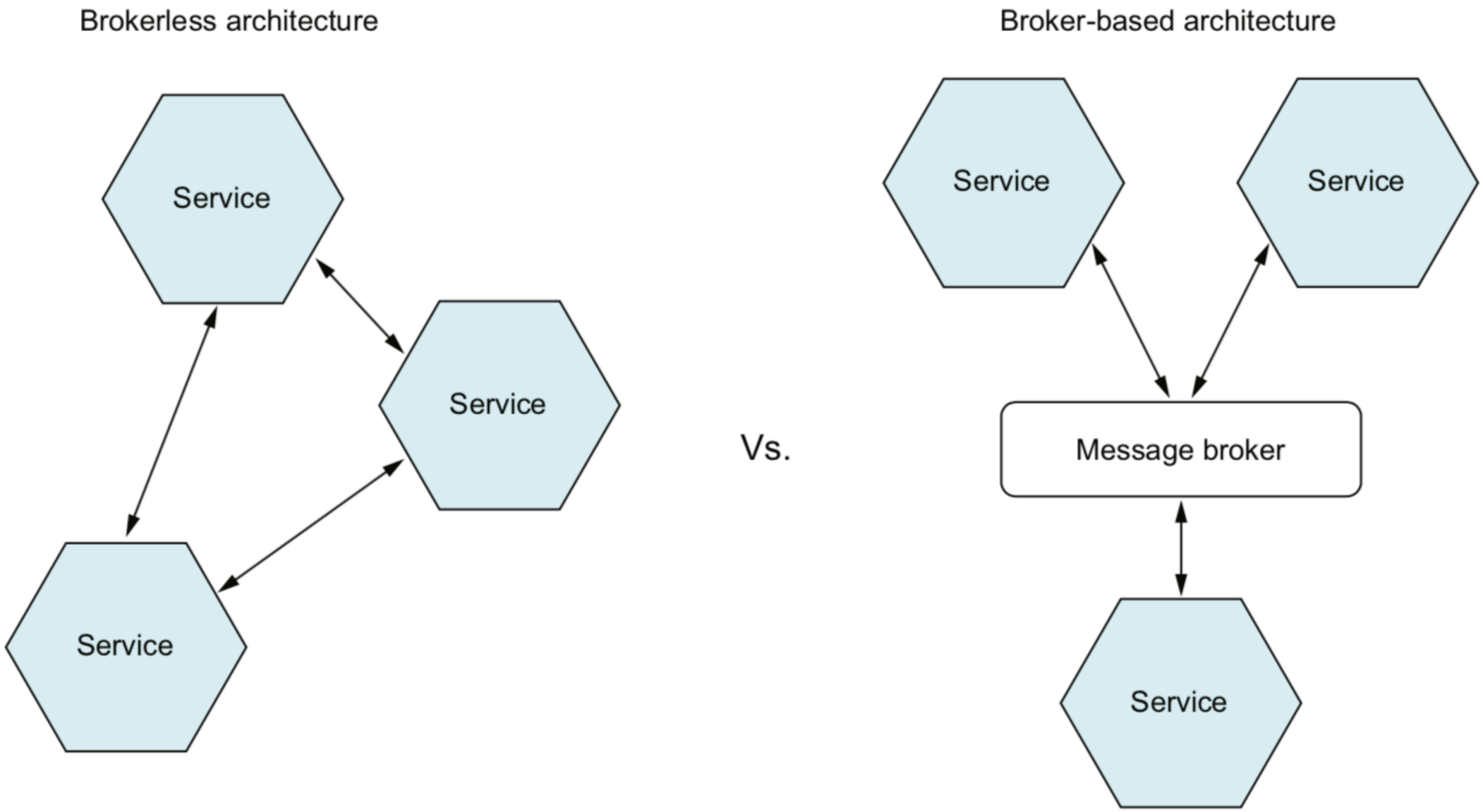
Messaging-based use message broker



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Message brokers

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Benefits

Loose-coupling
Message buffer
Flexible communication

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Drawbacks

Performance bottleneck
Single point of failure
Operational complexity

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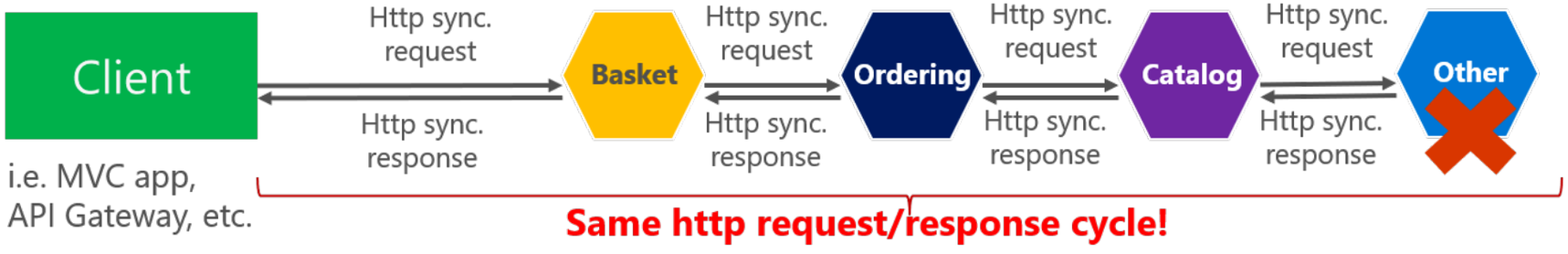
Communication

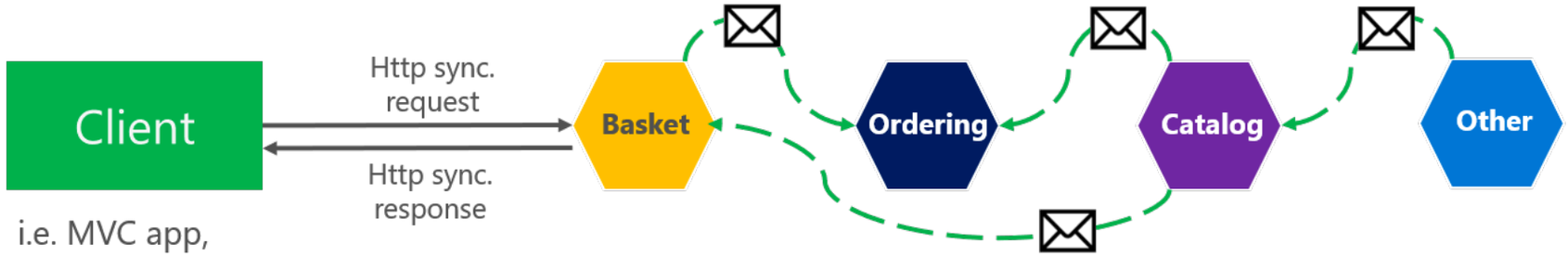
Synchronous vs. async communication across microservices

Anti-pattern

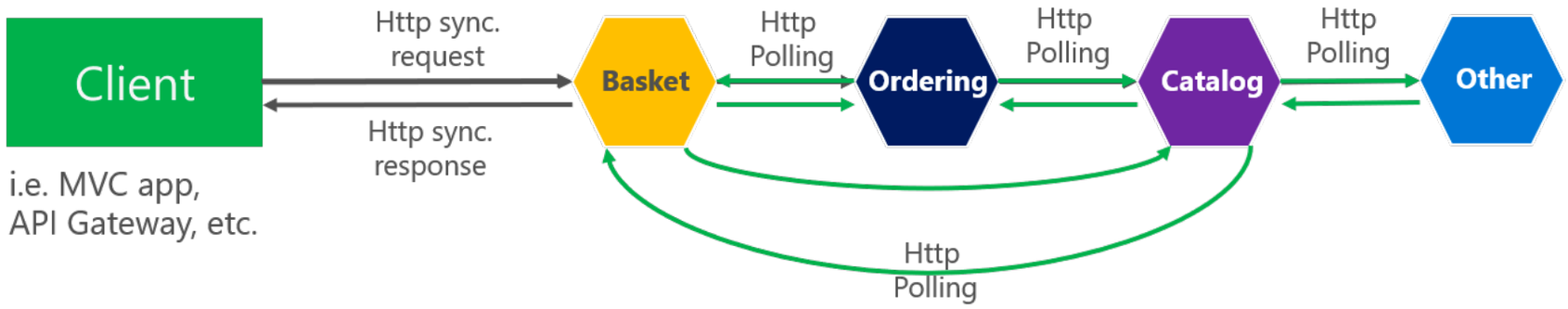
Synchronous
all req./resp. cycle



Asynchronous
Comm. across
internal microservices
(EventBus: i.e. **AMPQ**)



"Asynchronous"
Comm. across
internal microservices
(Polling: **Http**)



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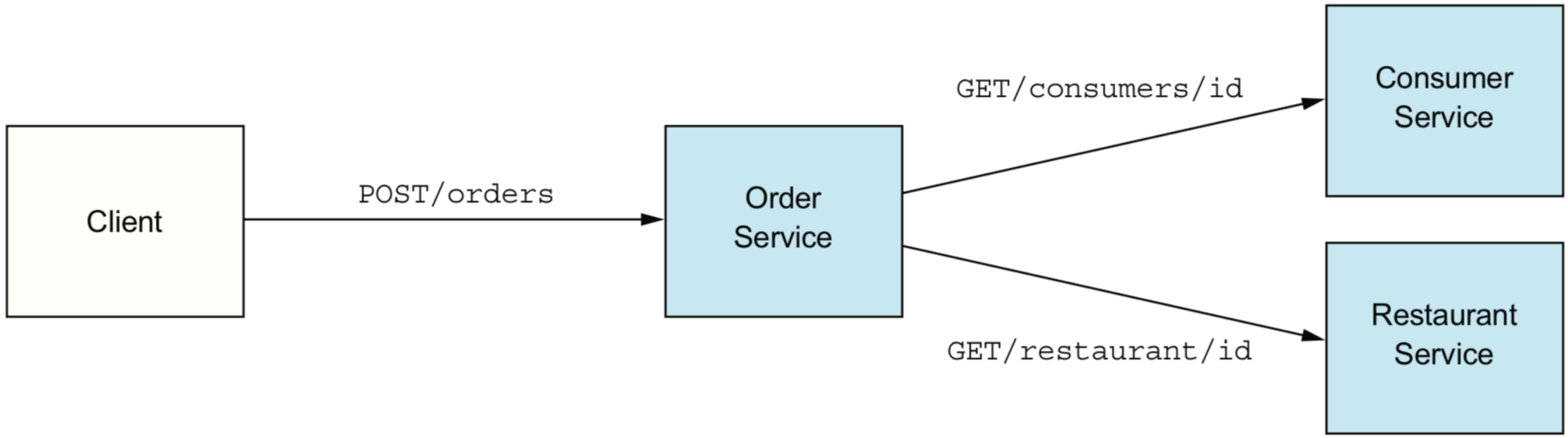
Synchronous reduce availability



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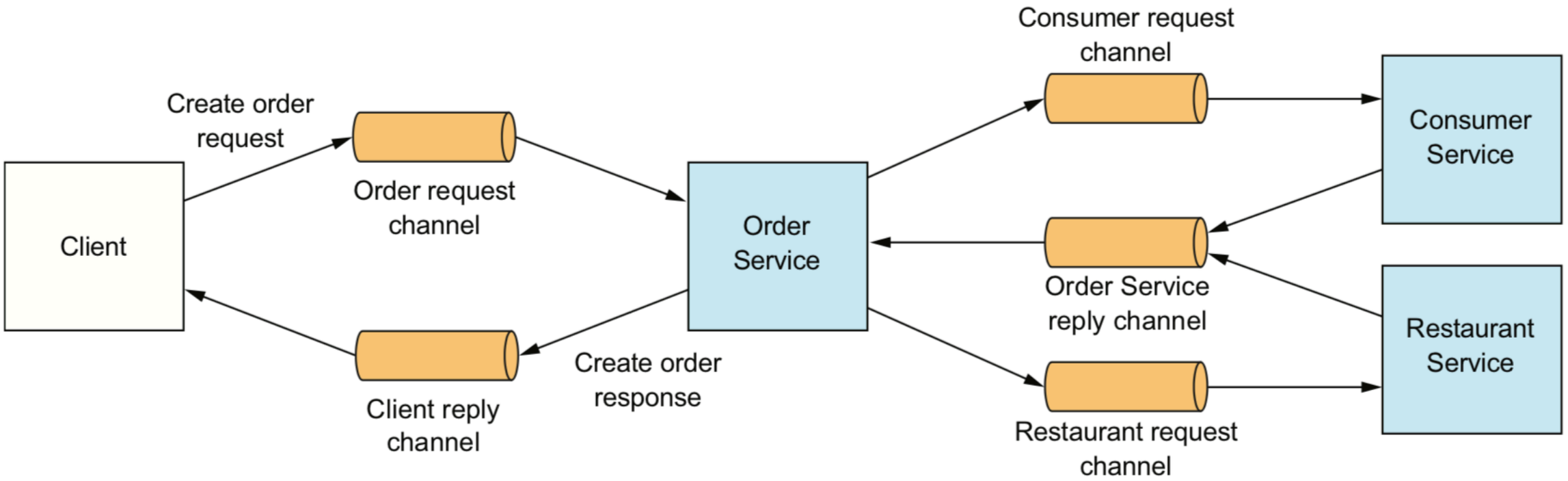
Replace with asynchronous (1)



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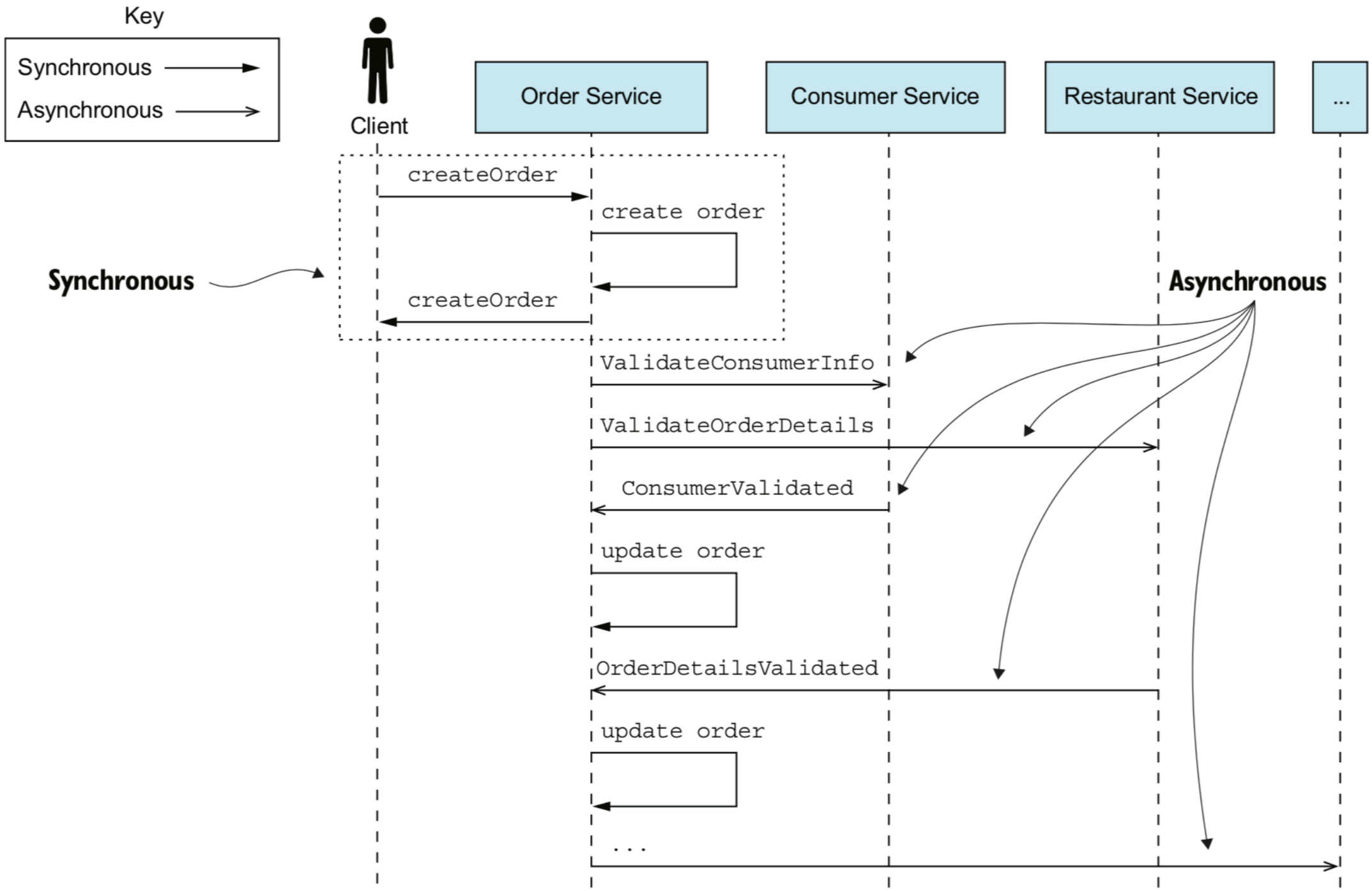
Replace with asynchronous (2)



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Manage data consistency

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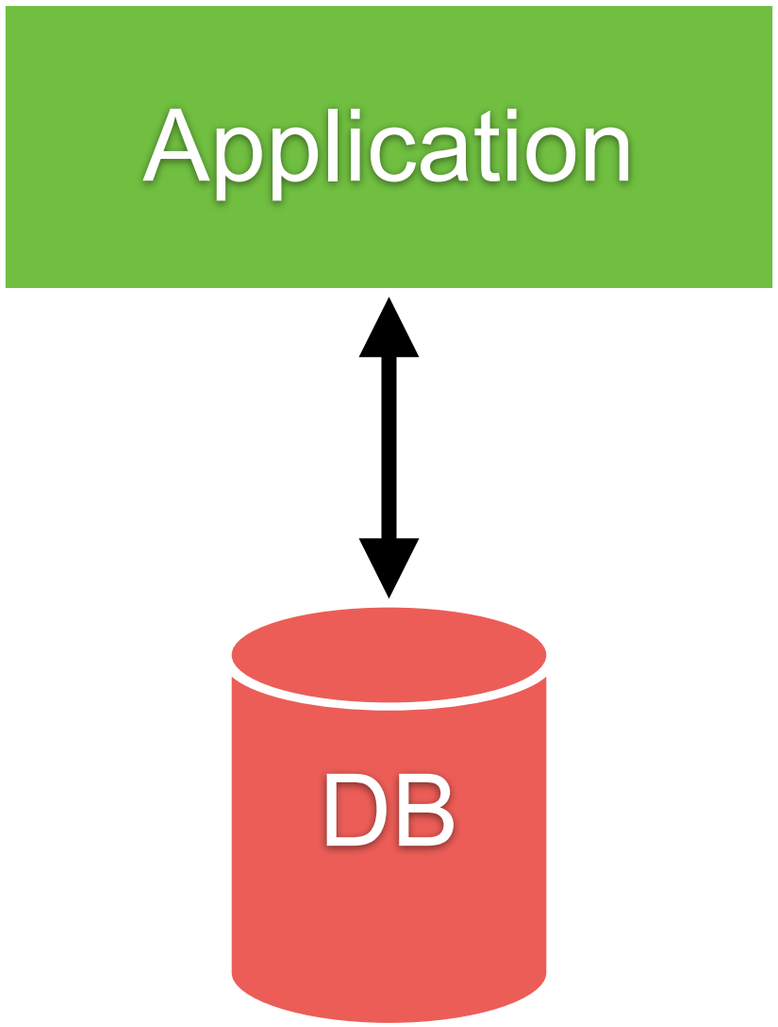
Monolith



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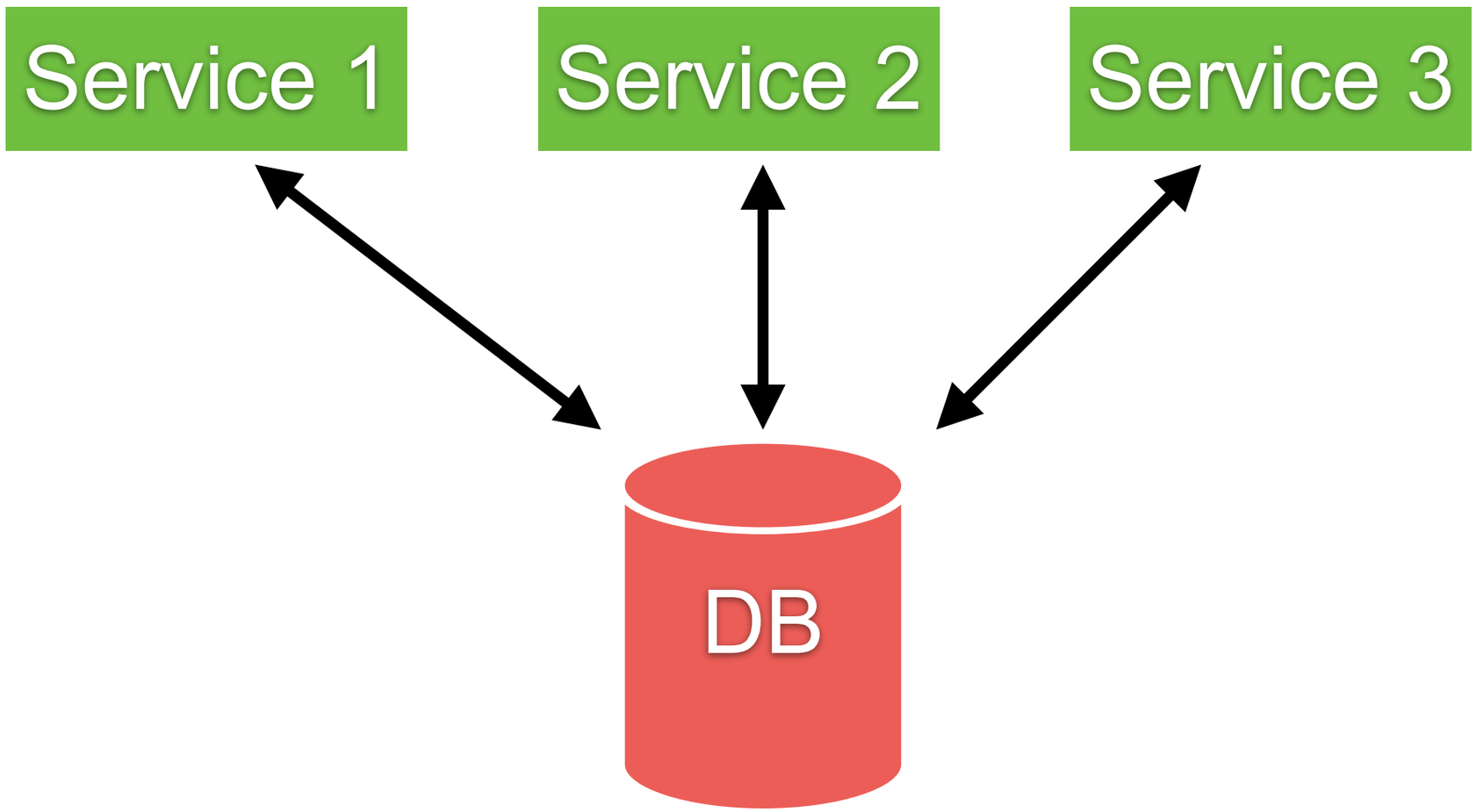
Microservices

Shared database



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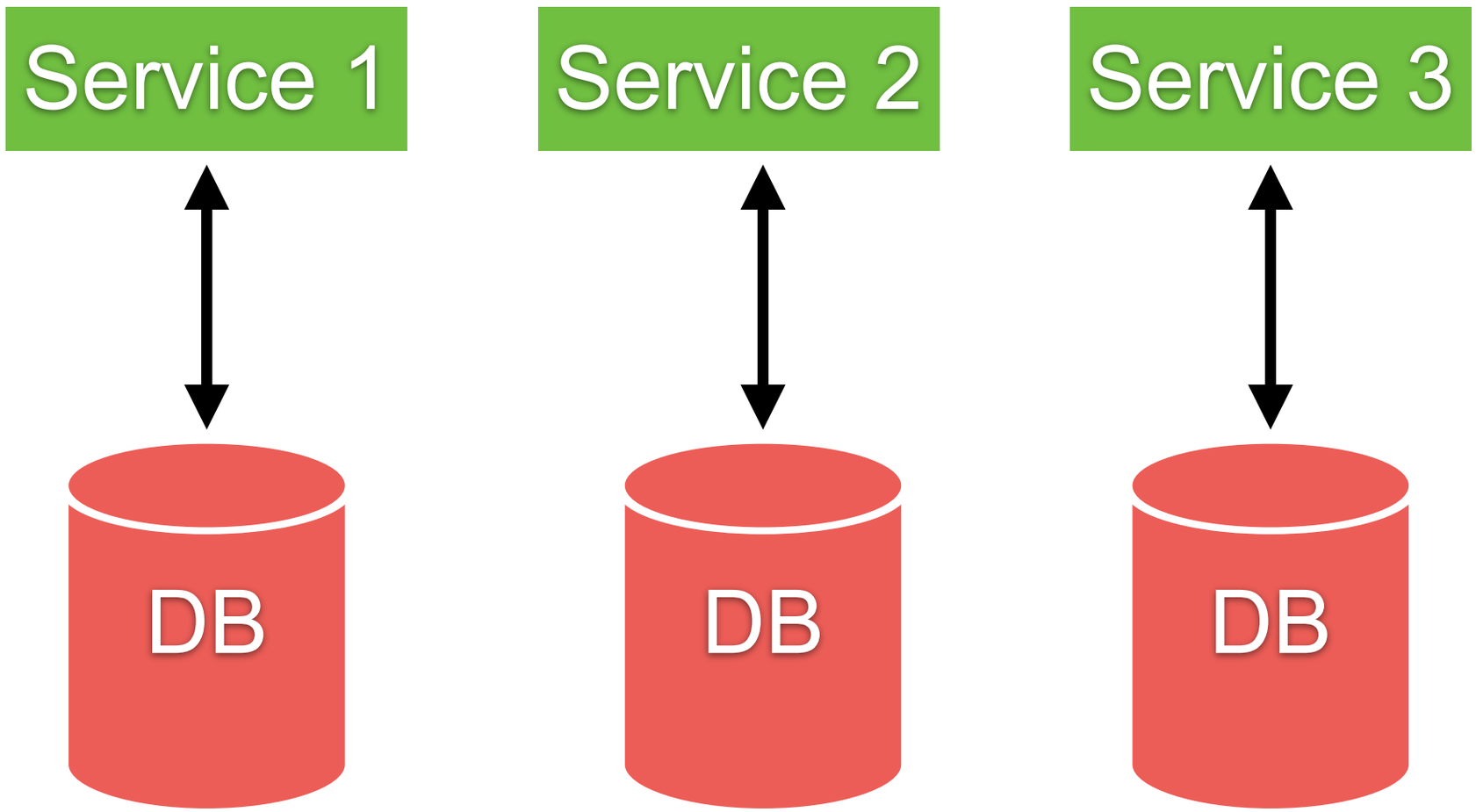
Microservices

Database per service



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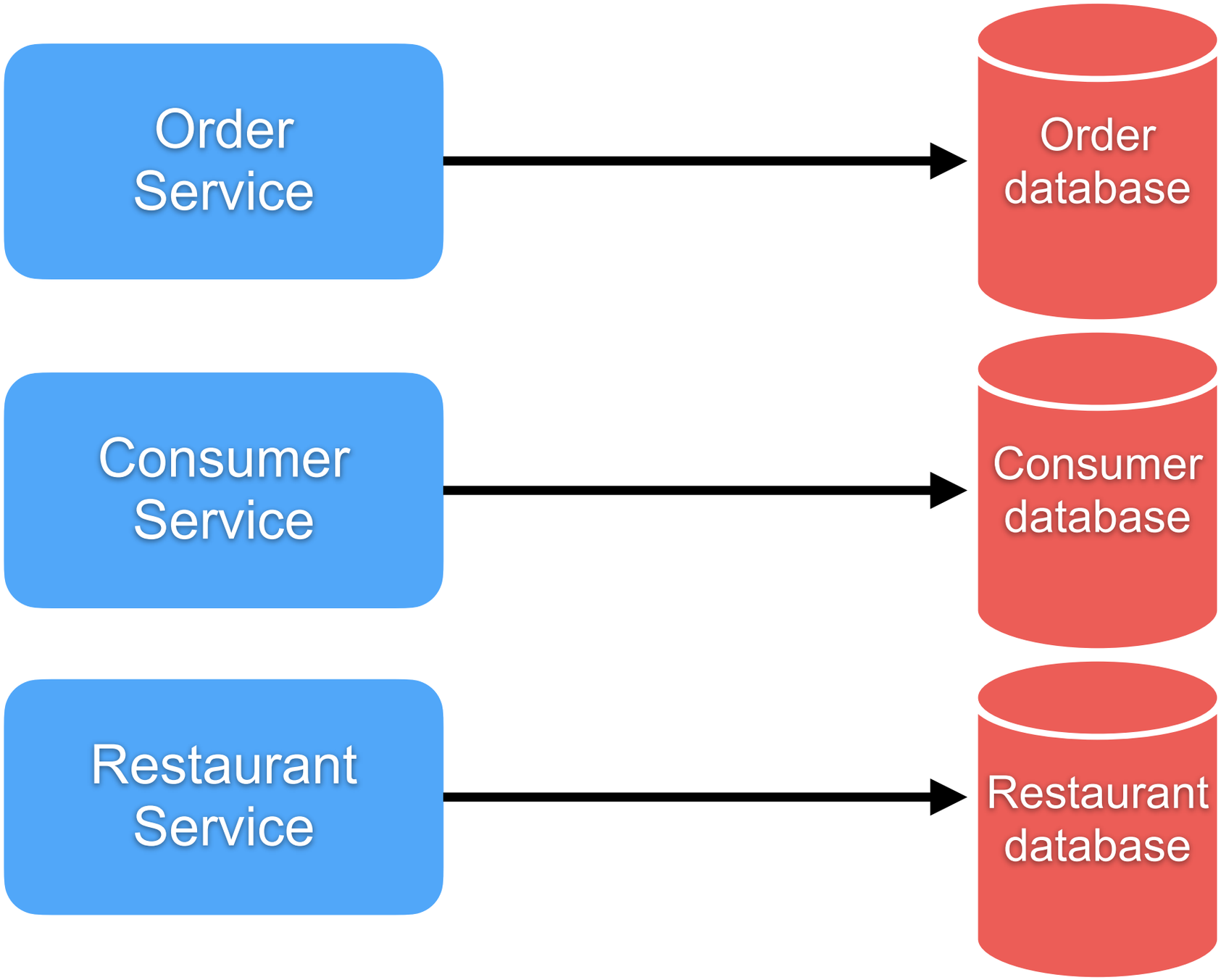
Database per service



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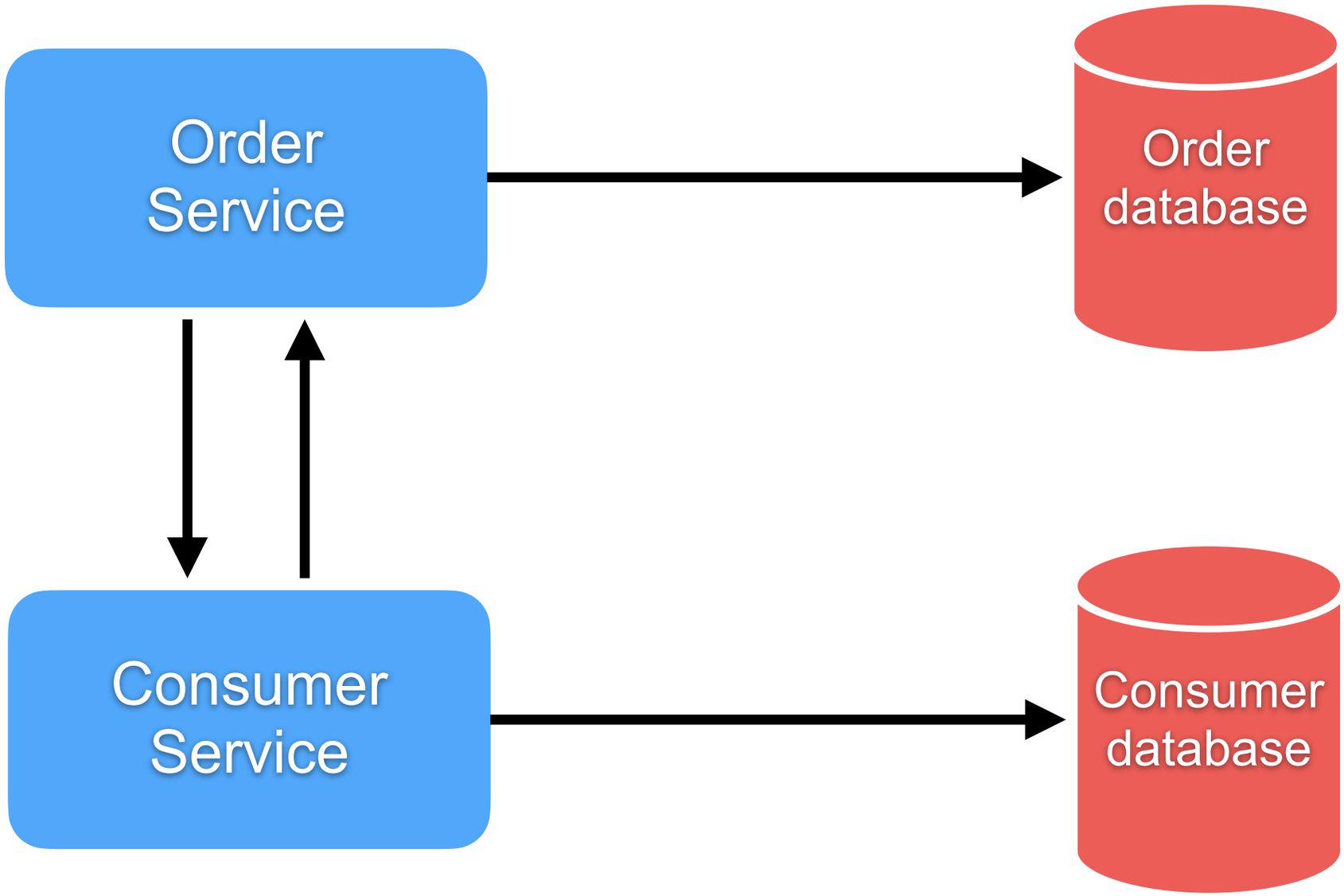
Loose coupling = encapsulation data



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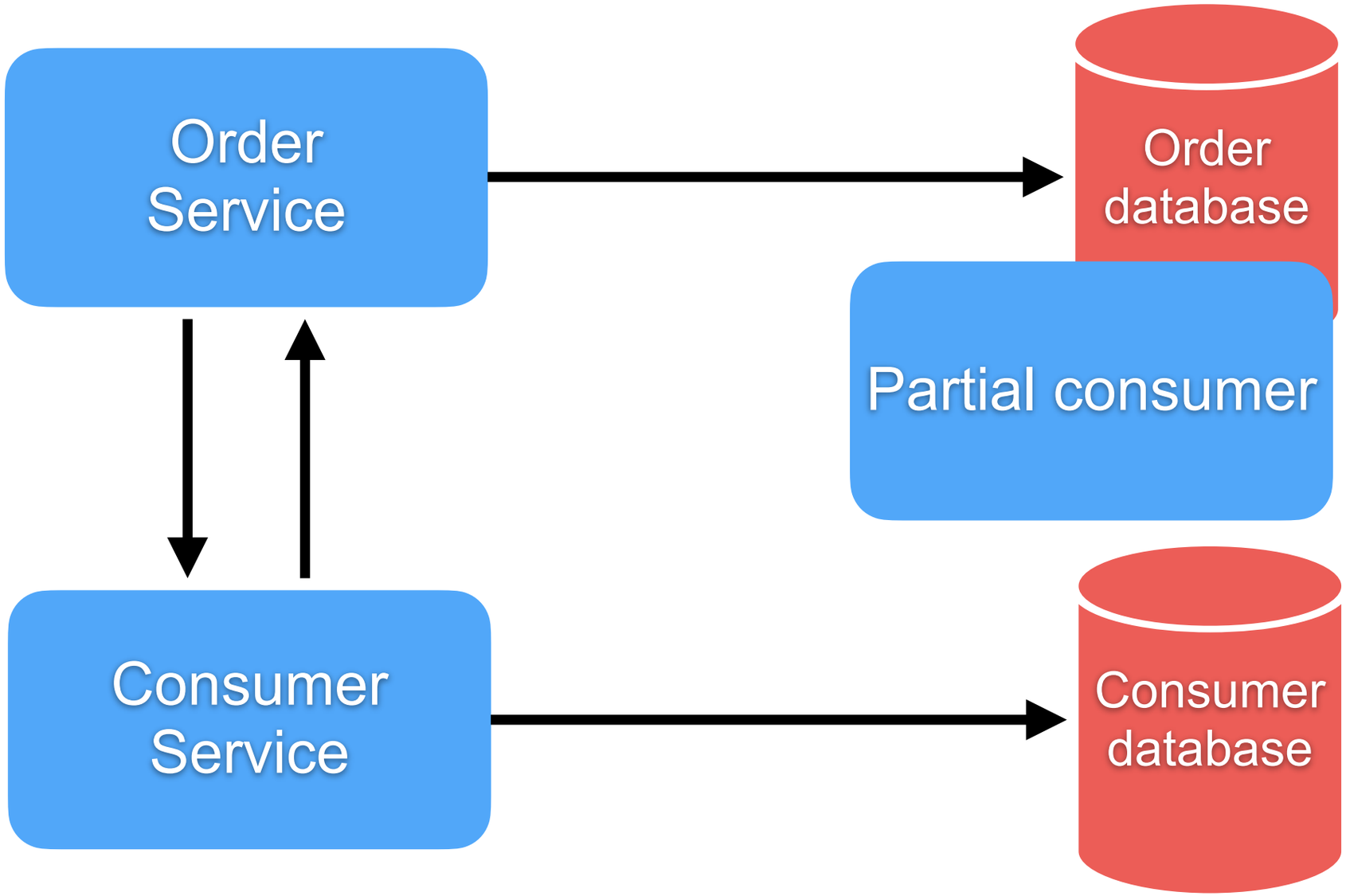

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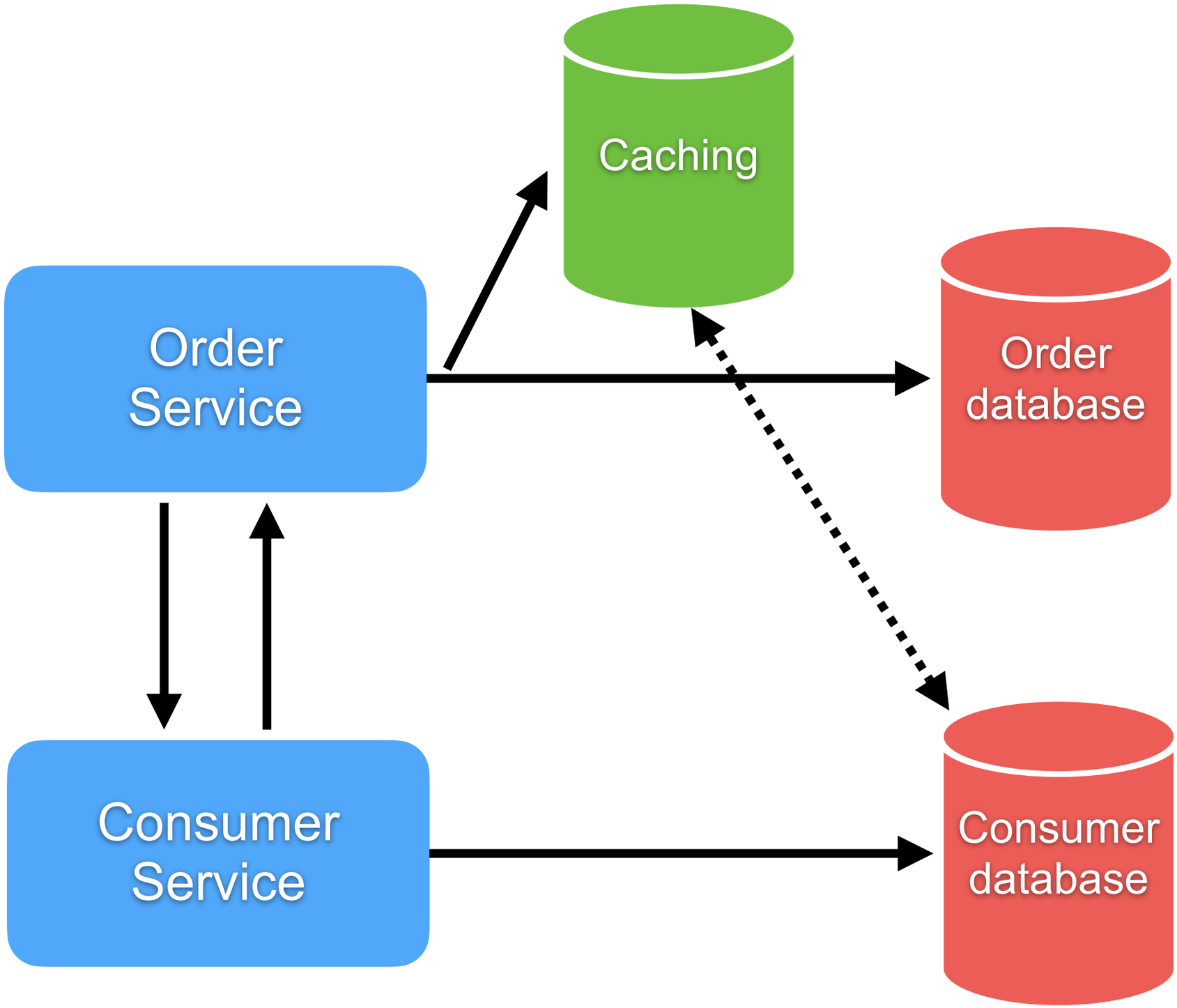

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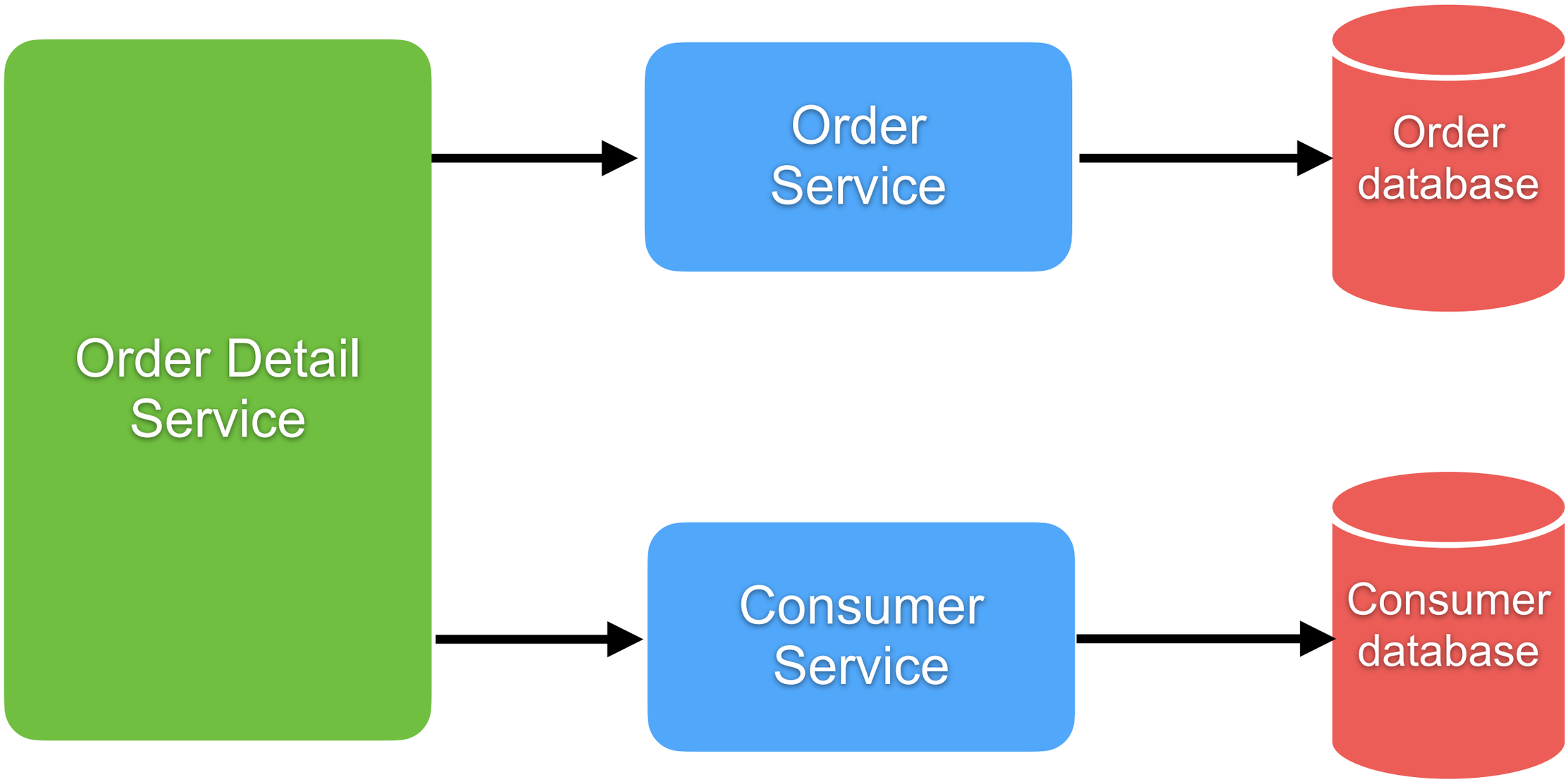
Order detail orchestration service



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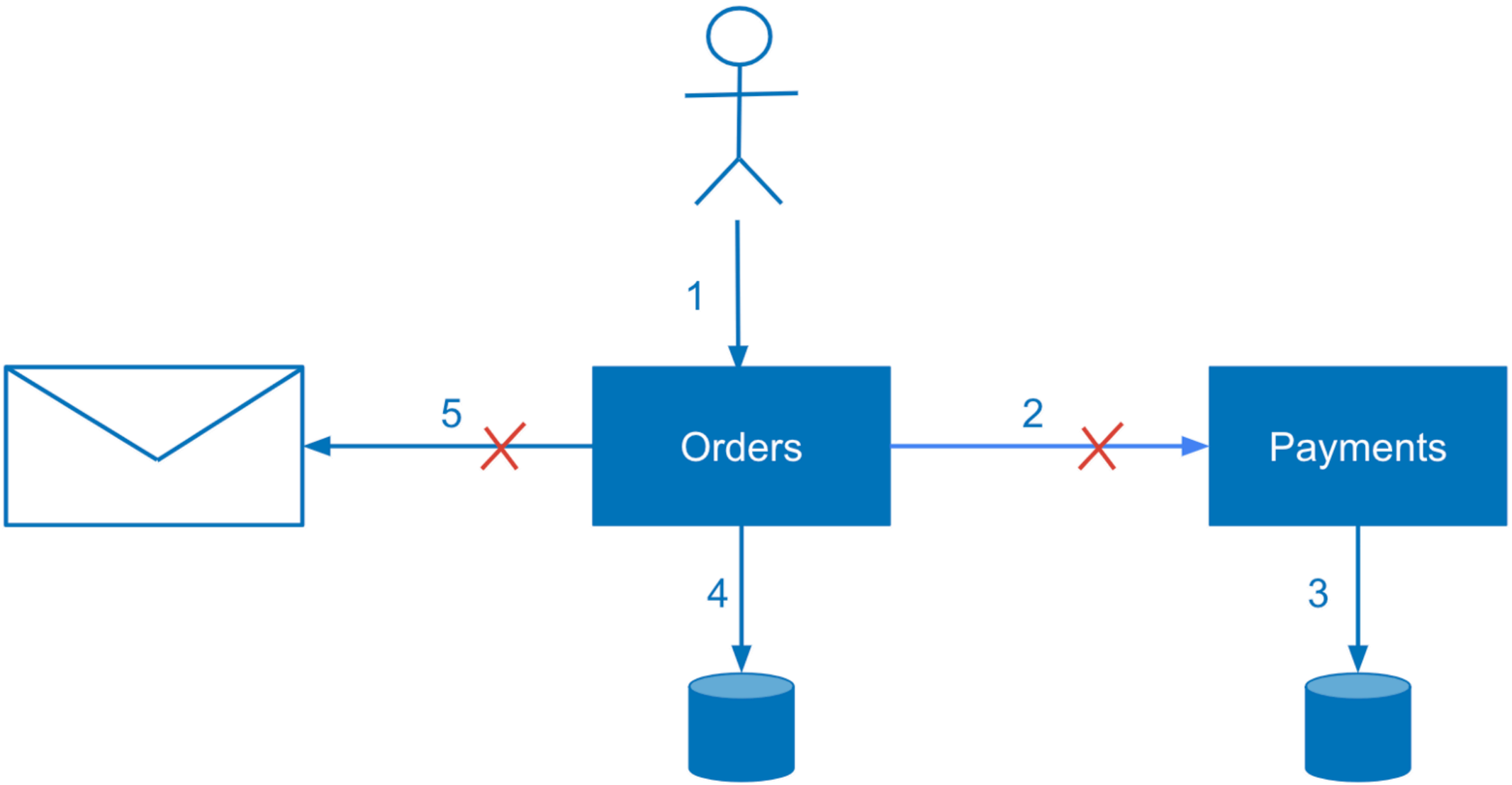
Distributed process failure !!



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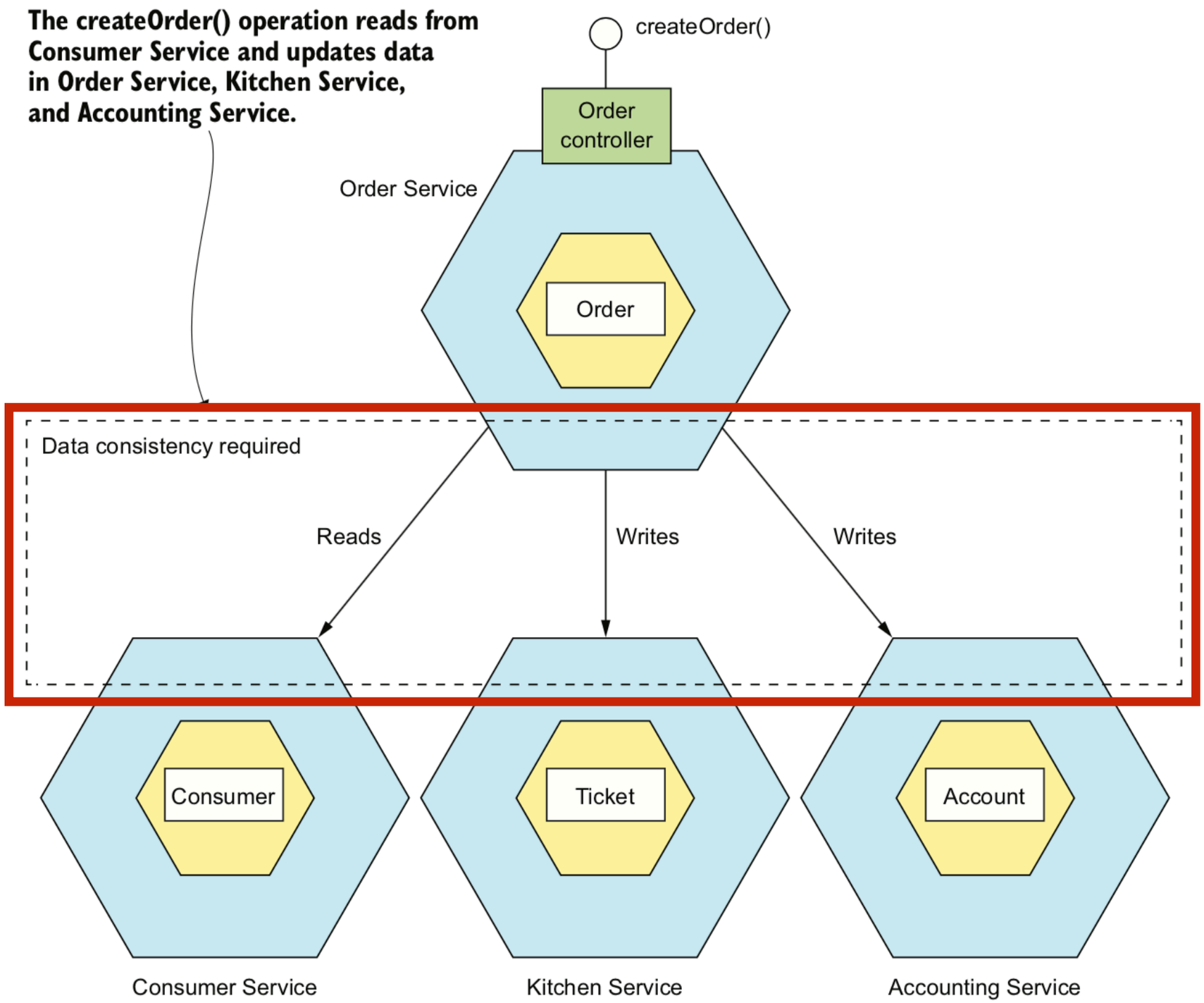
Problem ?



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Can’t use ACID transaction !!

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A - Atomicity

All or Nothing Transactions

C - Consistency

Guarantees Committed Transaction State

I - Isolation

Transactions are Independent

D – Durability

Committed Data is Never Lost

(c) http://blog.sqlauthority.com

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CAP Theorem

Consistency

Availability

Partition Tolerance

http://robertgreiner.com/2014/08/cap-theorem-revisited/

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Database per service

High complexity

Query data across multiple databases

Challenge “How to join data ?”

Maintain database consistency

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How to maintain data consistency across services ?

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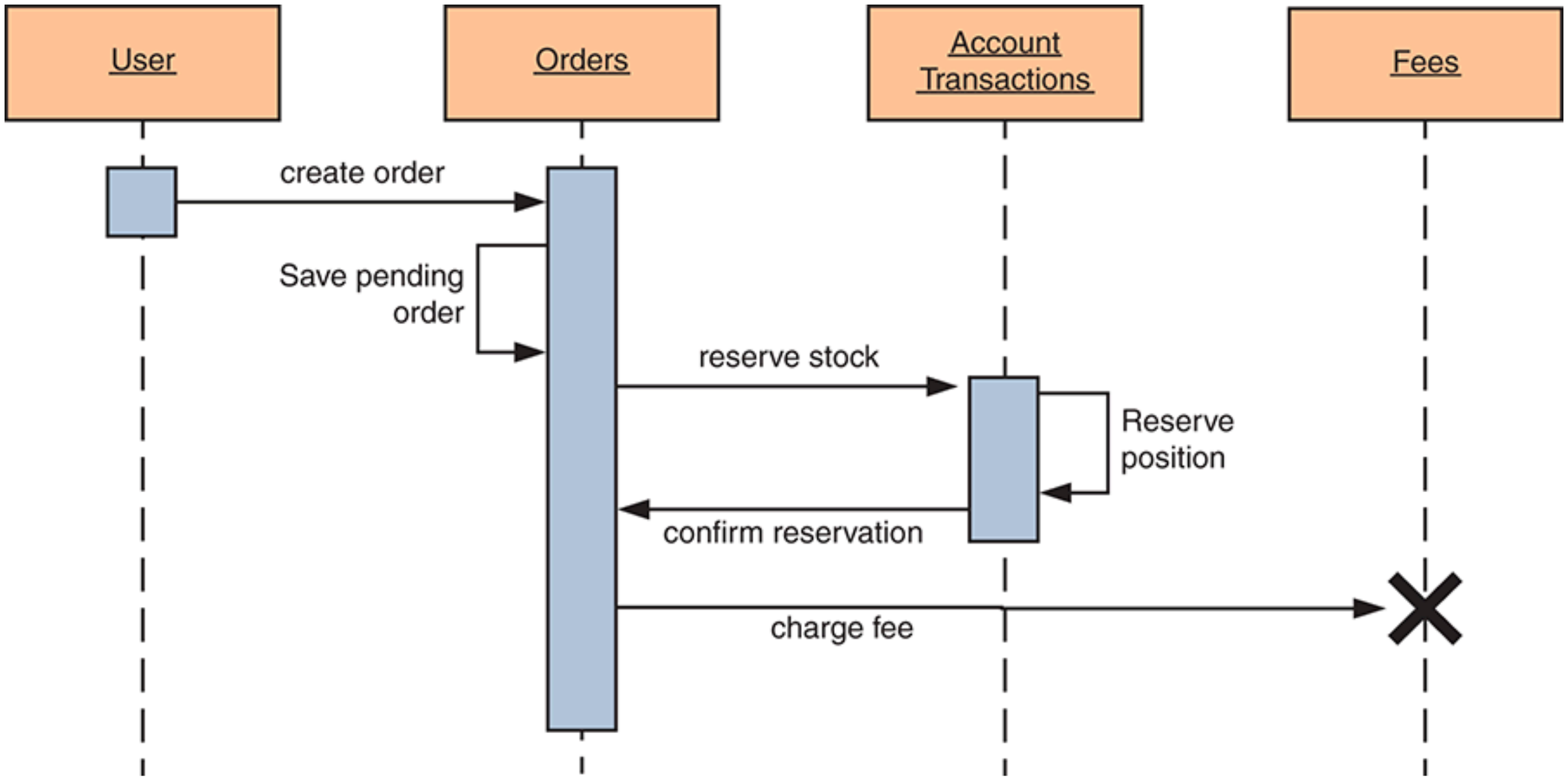
Problem



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Distributed transaction

Common approach is Two-phase commit(2PC)

Use transaction manager to split operations across multiple resources in 2 phases

1. Prepare

2. Commit

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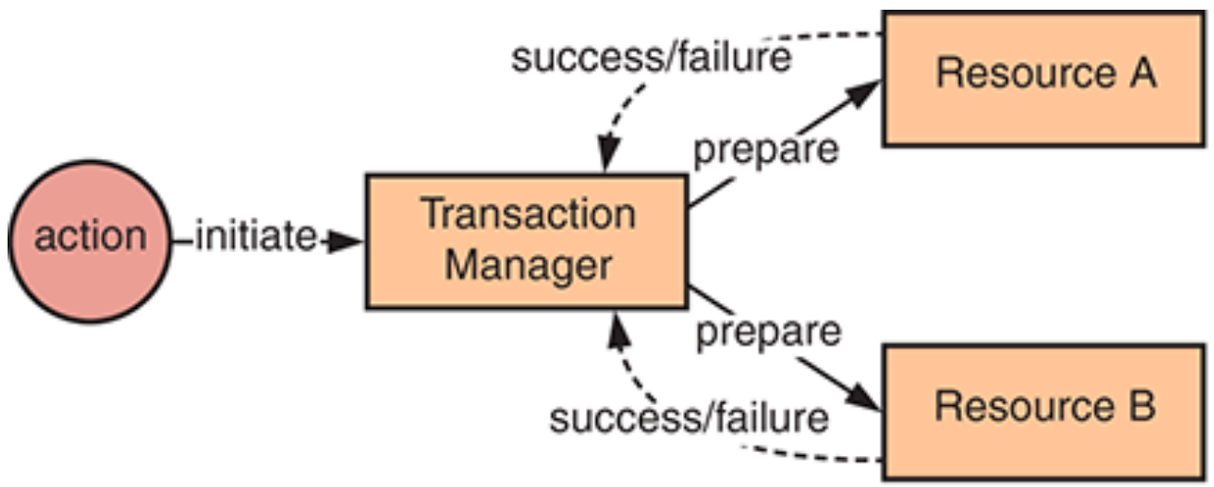
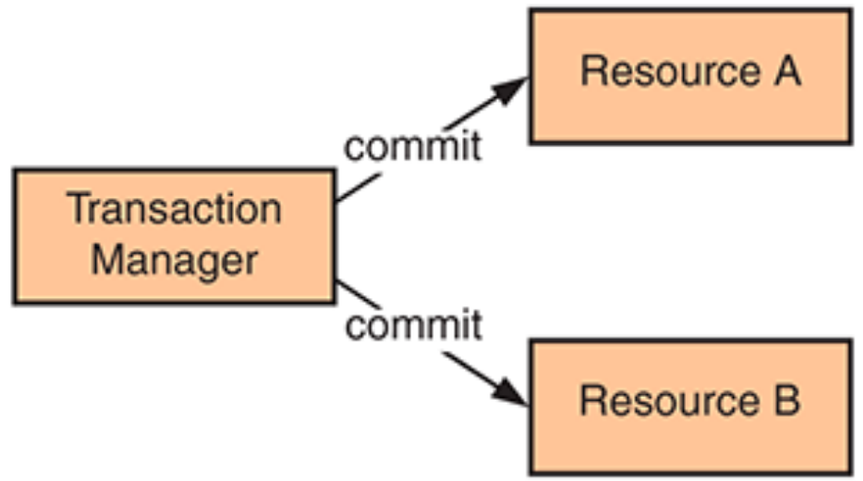
Two-phase commit

Phase 1: prepare



In the **prepare** phase, the transaction manager instructs resources to prepare their relevant action.



In the **commit** phase, the transaction manager instructs resources to commit or abort the prepared action.

https://en.wikipedia.org/wiki/Two-phase_commit_protocol

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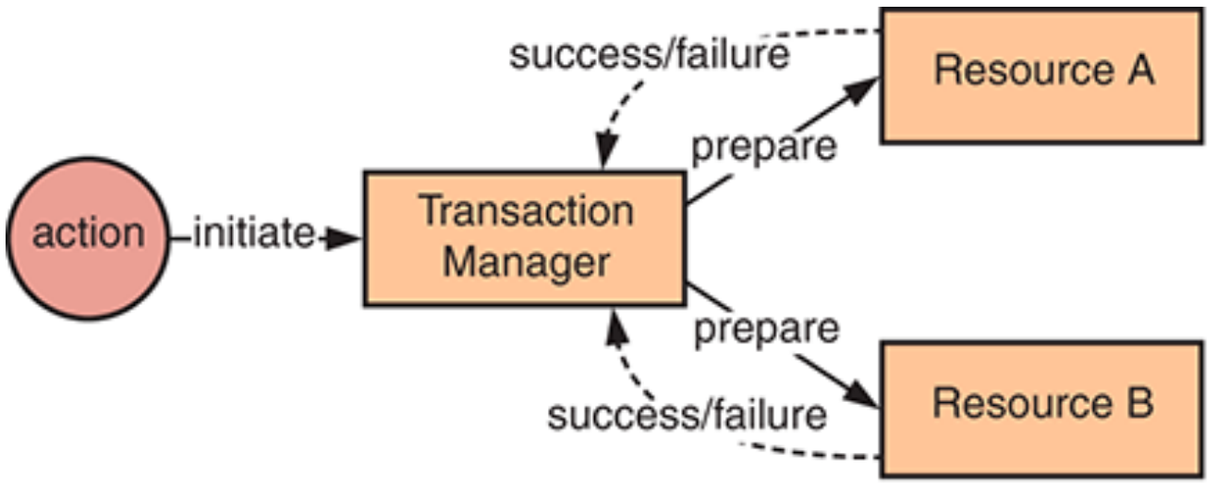
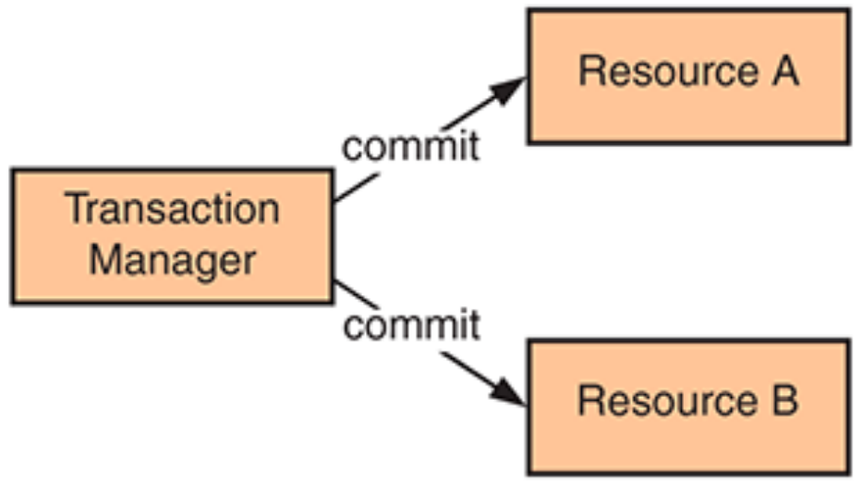
Two-phase commit



In the **prepare** phase, the transaction manager instructs resources to prepare their relevant action.

Phase 2: commit



In the **commit** phase, the transaction manager instructs resources to commit or abort the prepared action.

https://en.wikipedia.org/wiki/Two-phase_commit_protocol

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Distributed transaction places a lock on resources under transaction to ensure isolation

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Inappropriate for long-running operations

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Increase risk of contention and deadlock

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We need …

Don’t need distributed transaction
Reduce complexity of code
Reliable

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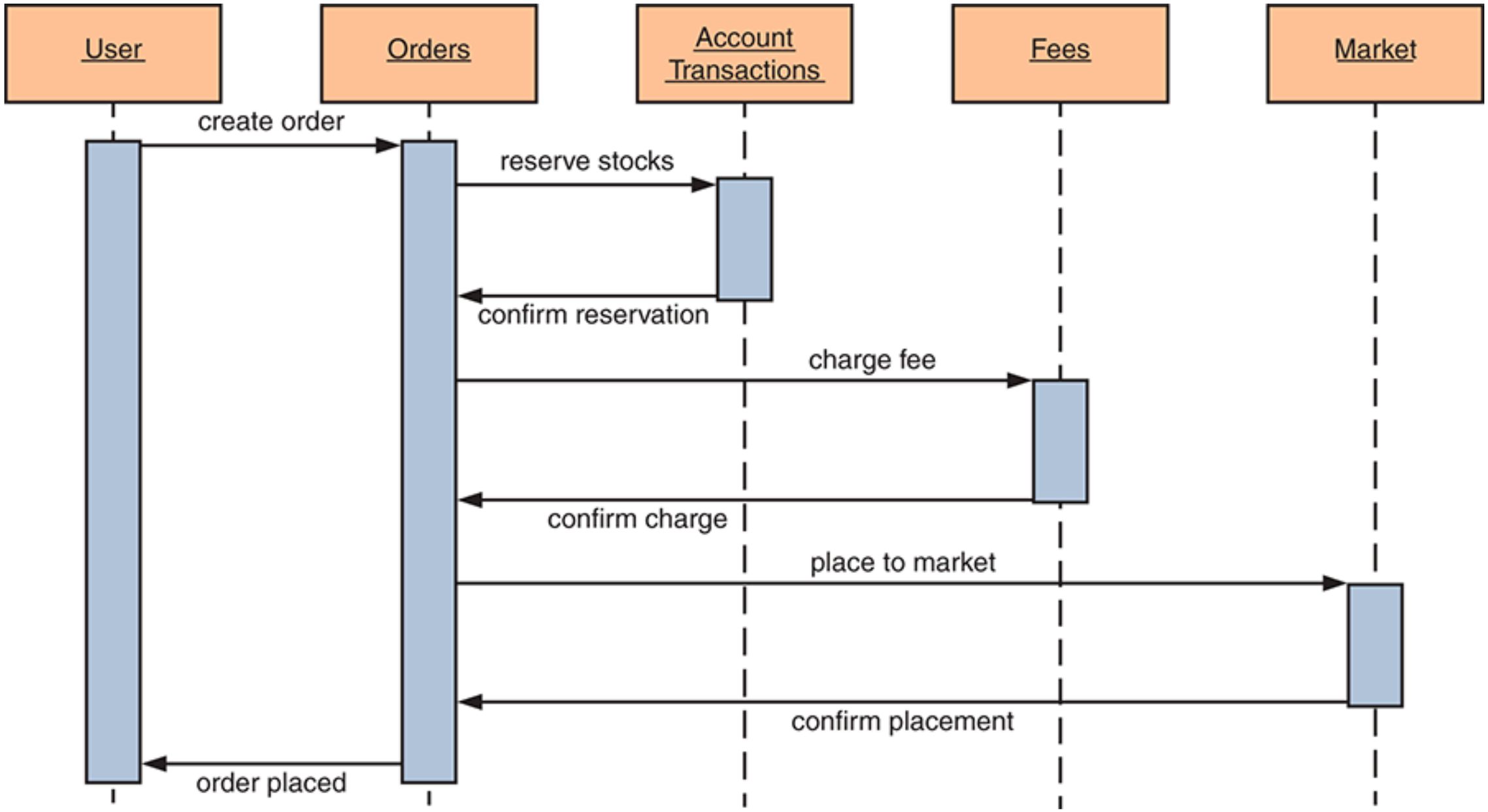
Synchronous process



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Event-based communication

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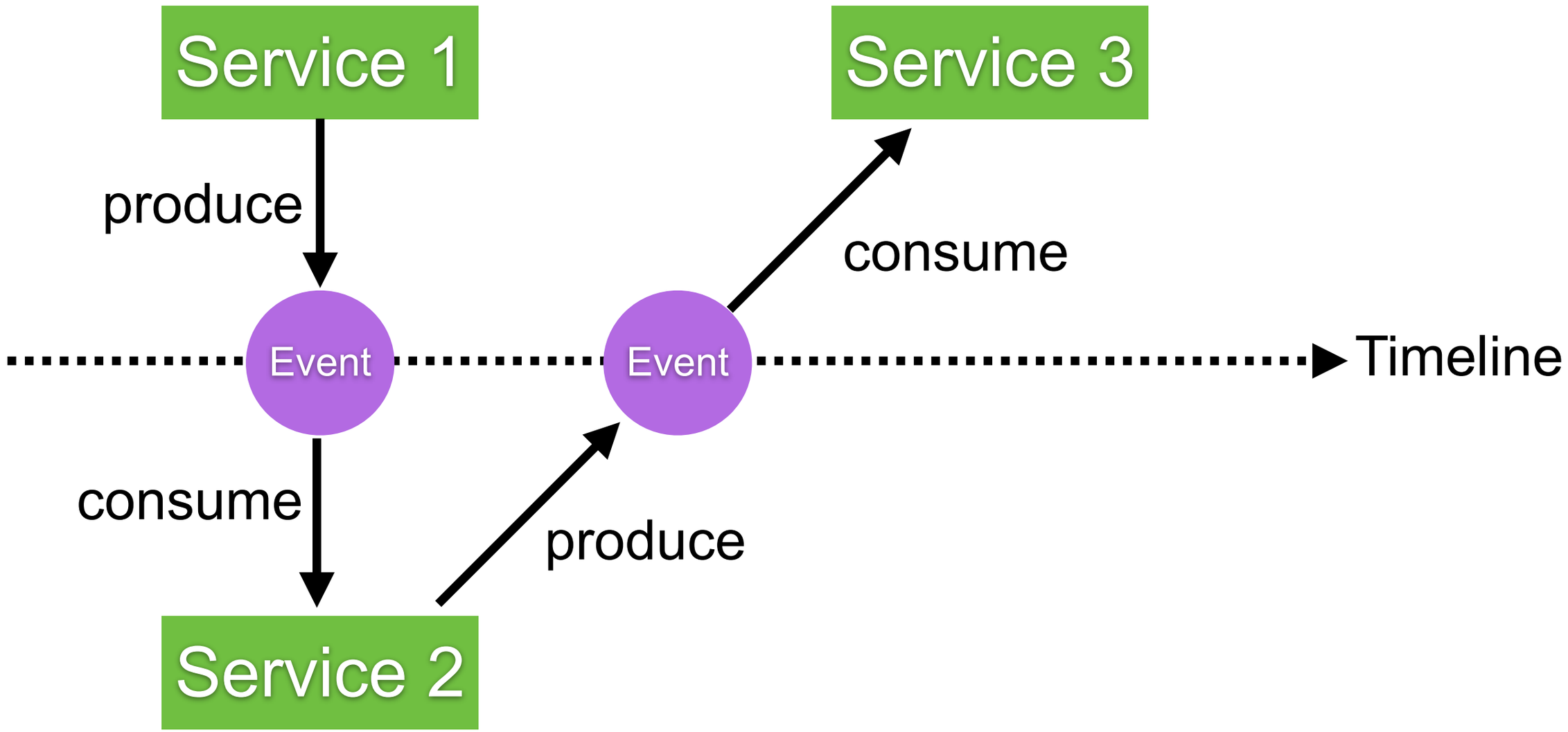
Choreography pattern

Sequence of Tx and emit **event** or **message** that trigger the next process in Tx



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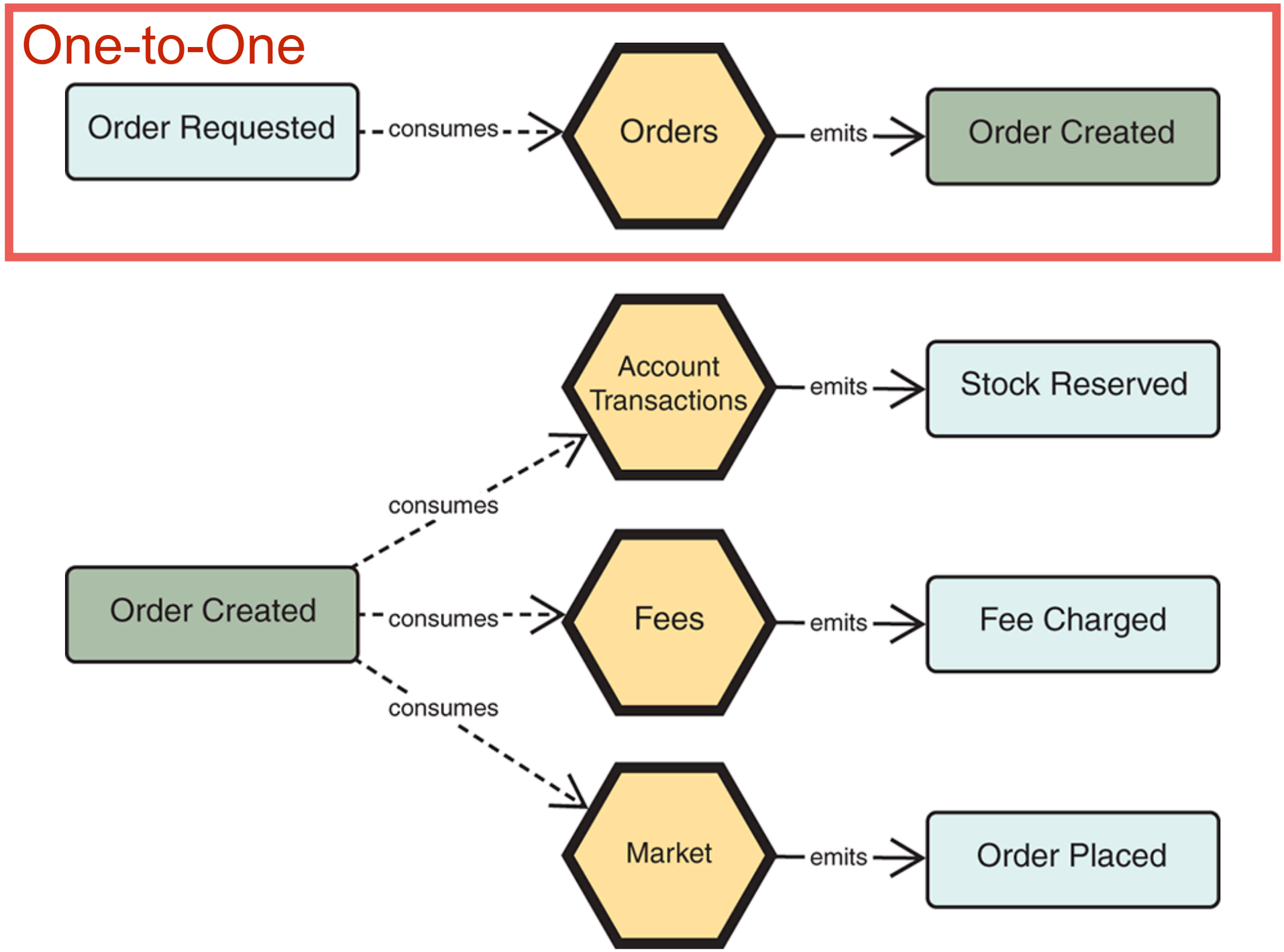
Service consume and emit event



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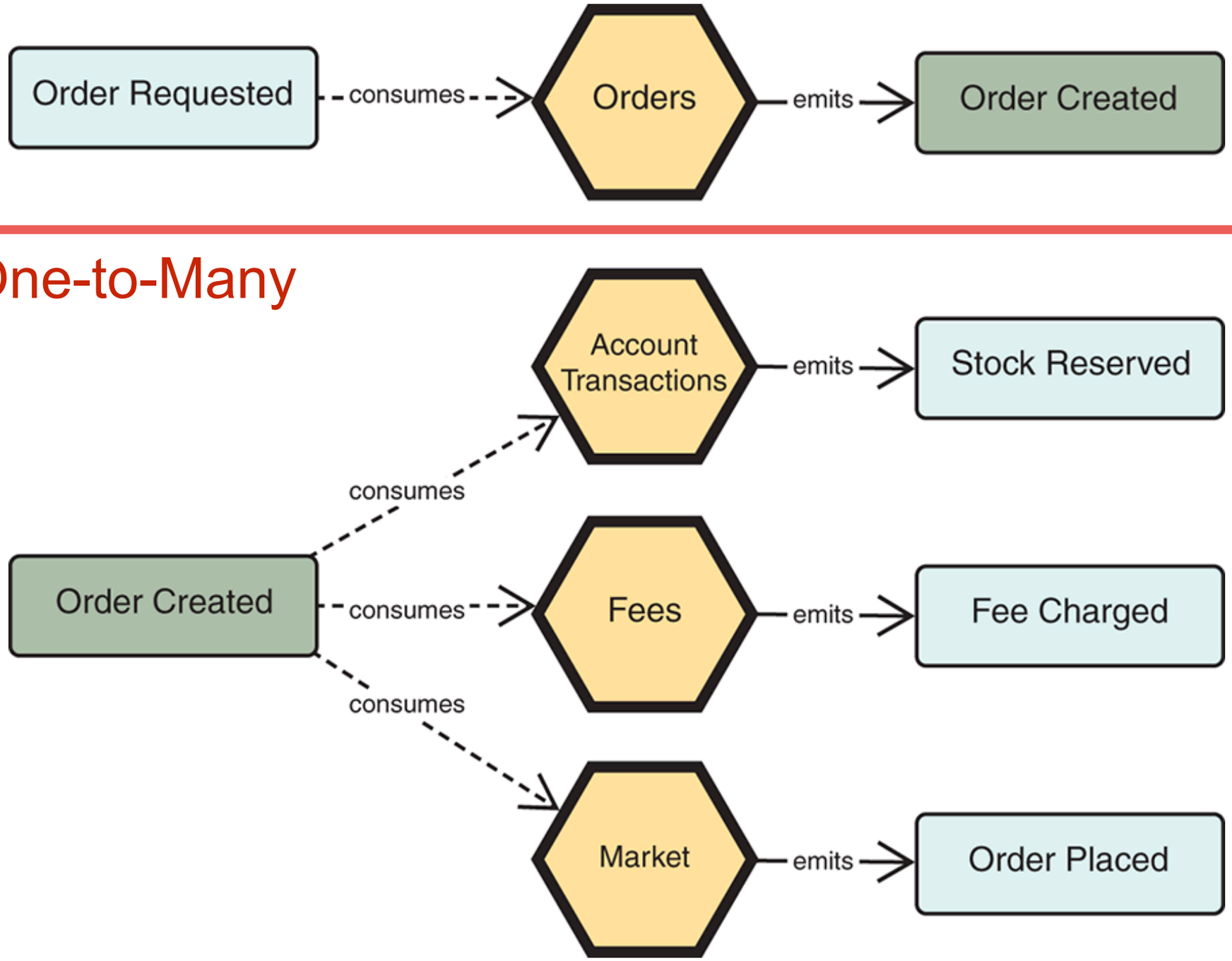
Service consume and emit event



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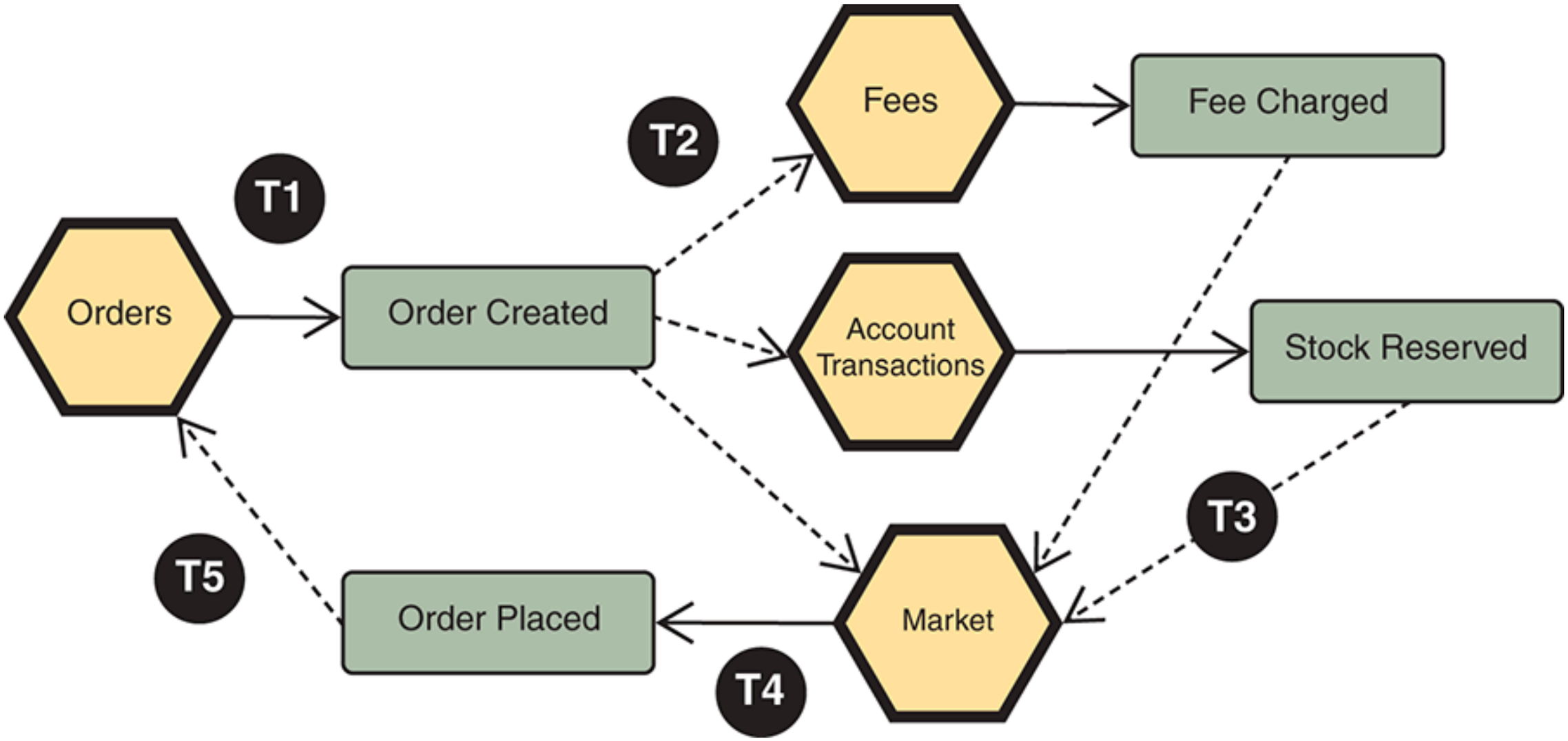
Example (Success)



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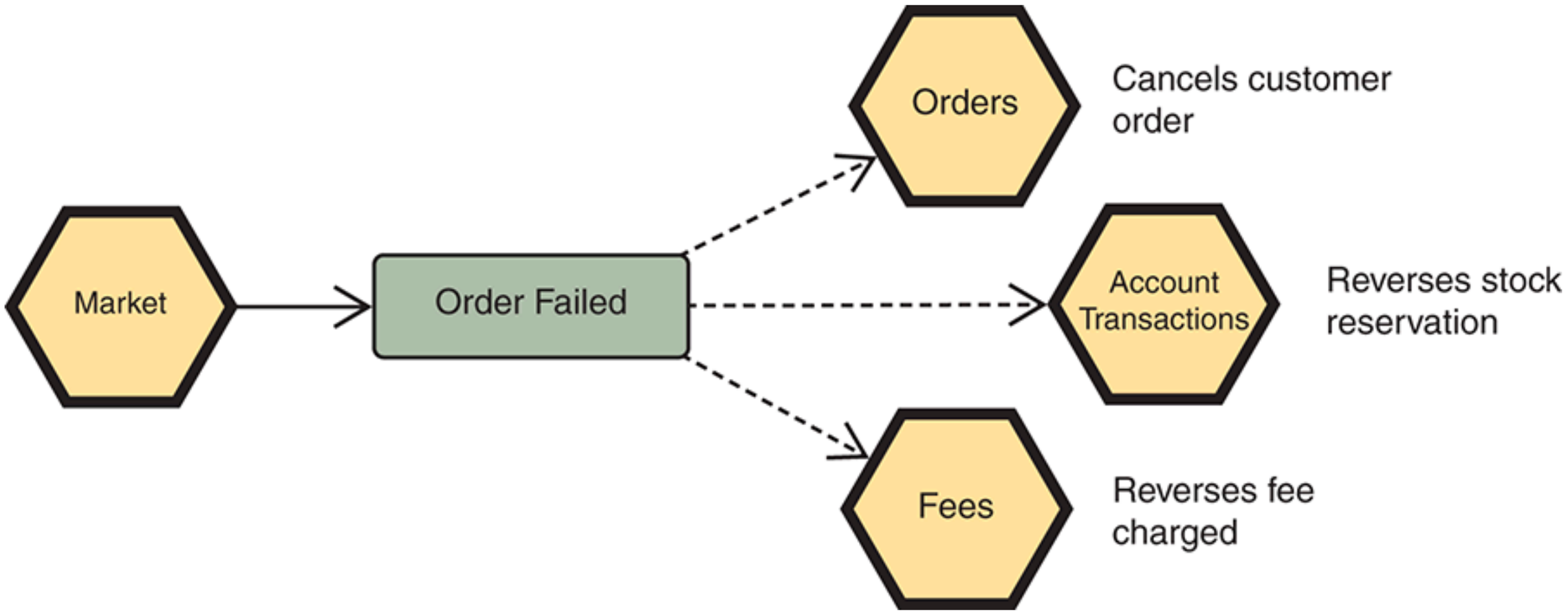
Example (Fail)



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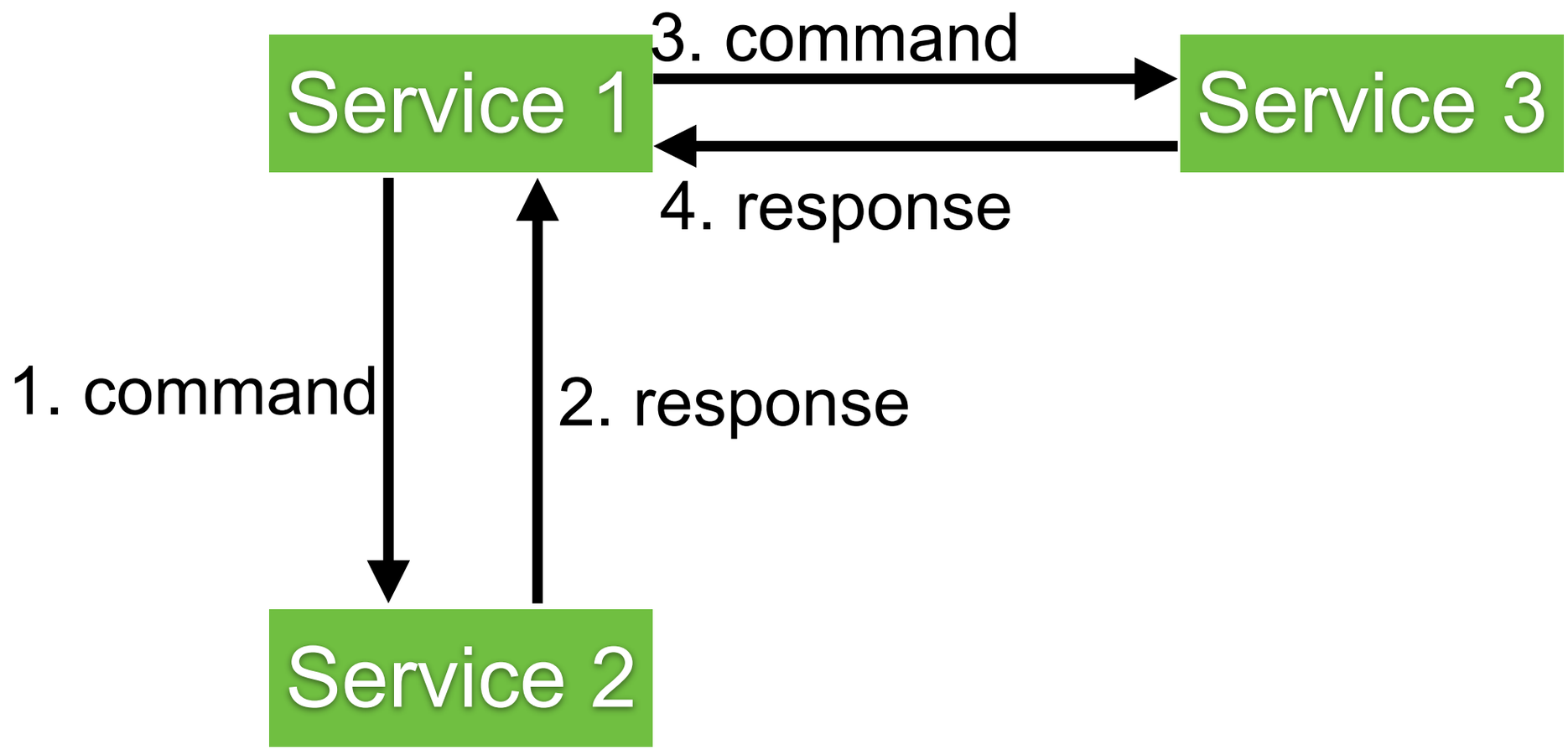
Orchestrate pattern

Sequence of Tx and emit **event** or **message** that trigger the next process in Tx



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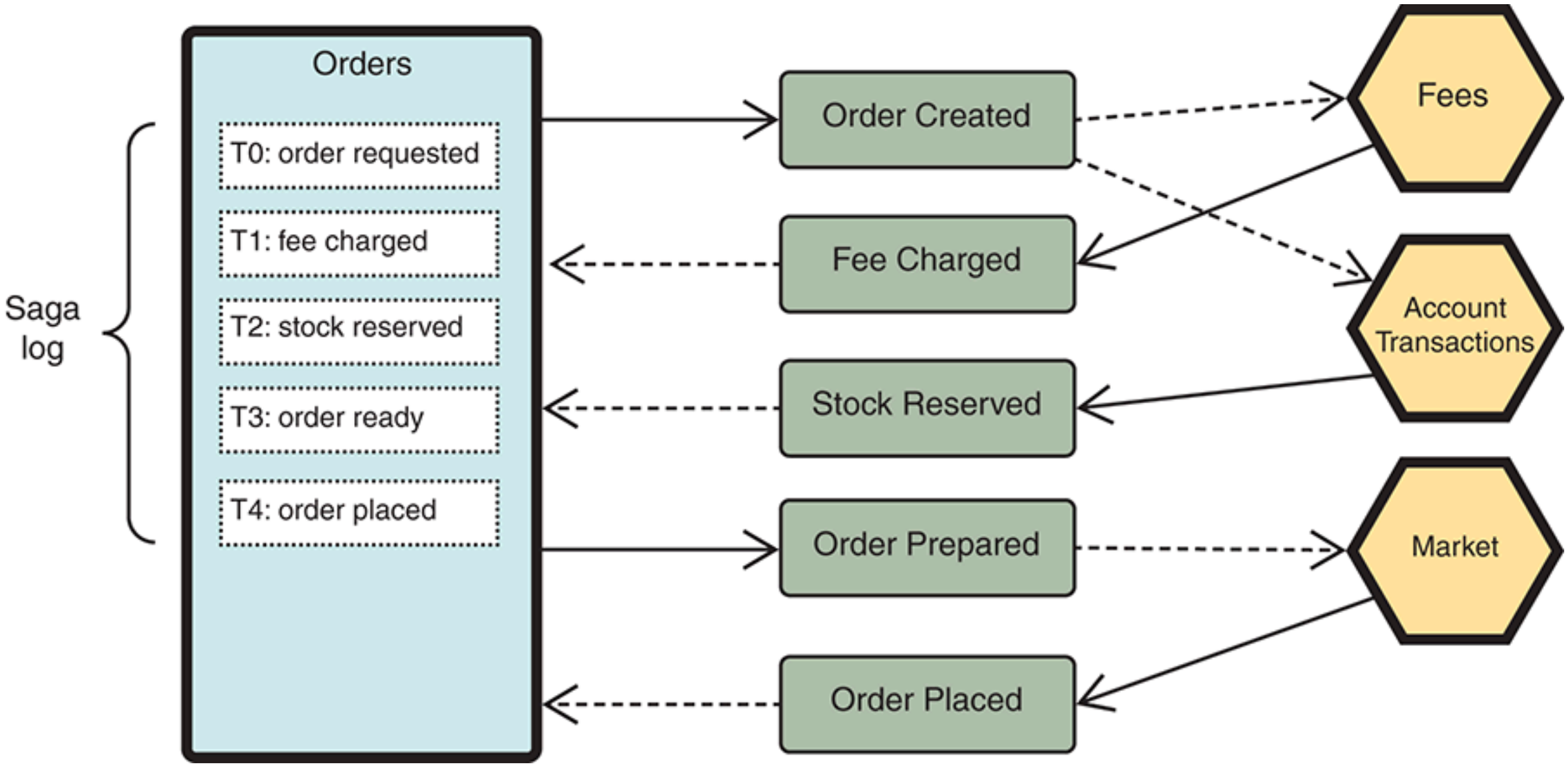
Example (Success)



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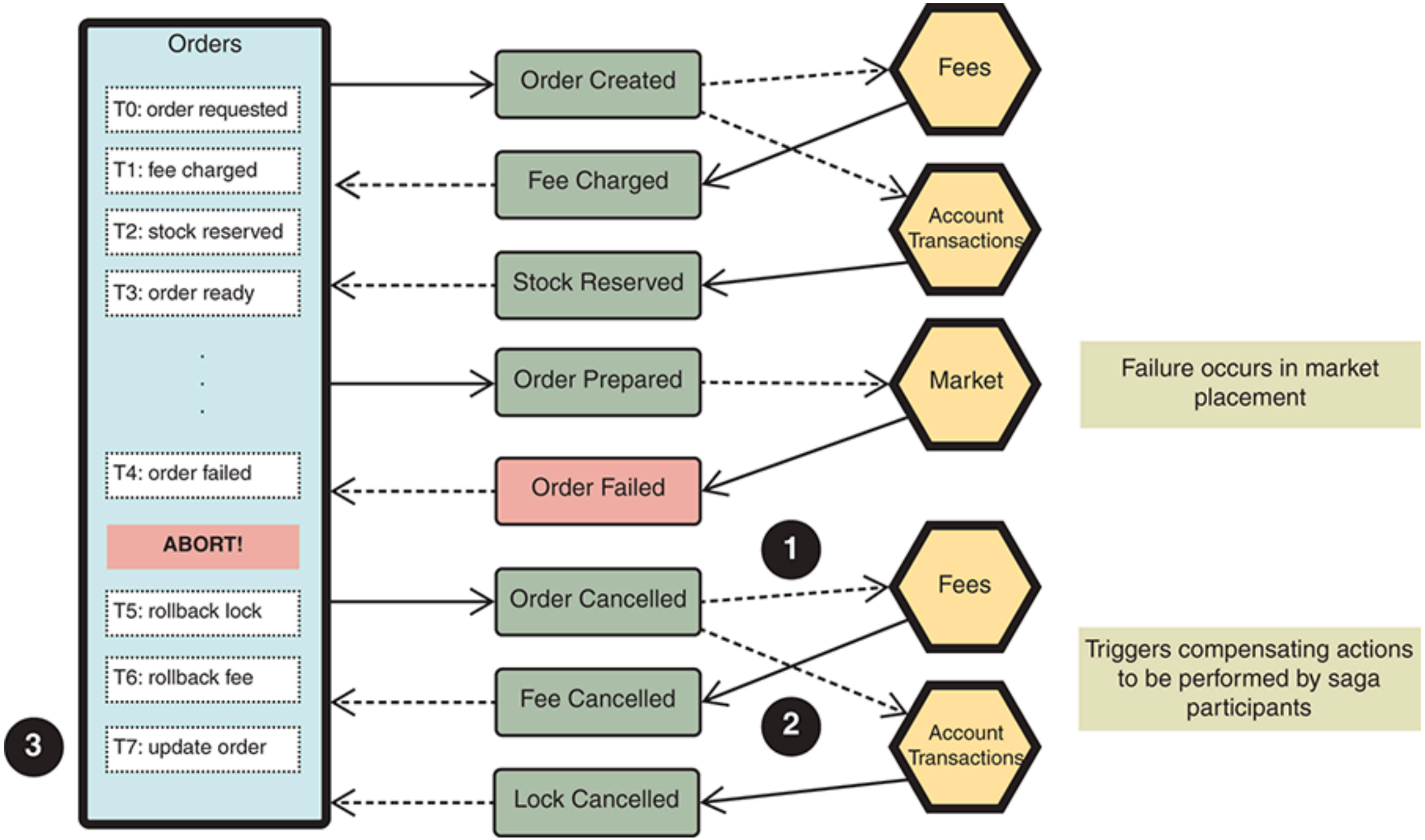
Example (Fail)



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Consistency patterns

Name	Strategy
Compensating action	Perform action that undo prior action(s)
Retry	Retry until success of timeout
Ignore	Do nothing in the event of errors
Restart	Reset to the original state and start again
Tentative operation	Perform a tentative operation and confirm (or cancel) later

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“Saga”

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Message vs Event

Message is addressed to someone

Event is something that happen and someone can react to that

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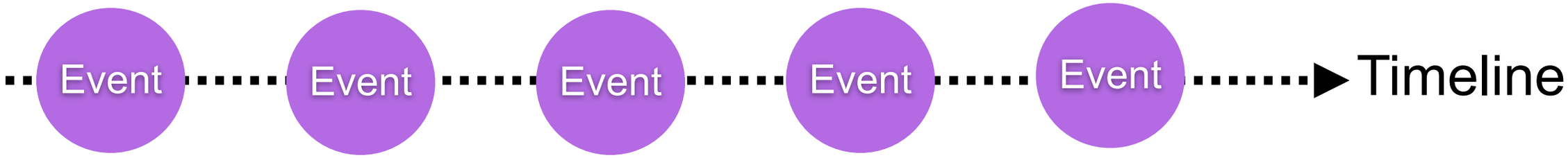
Event sourcing

Maintain source of truth of business
Immutable sequence of events



Sequence of event is keep in **Event store**

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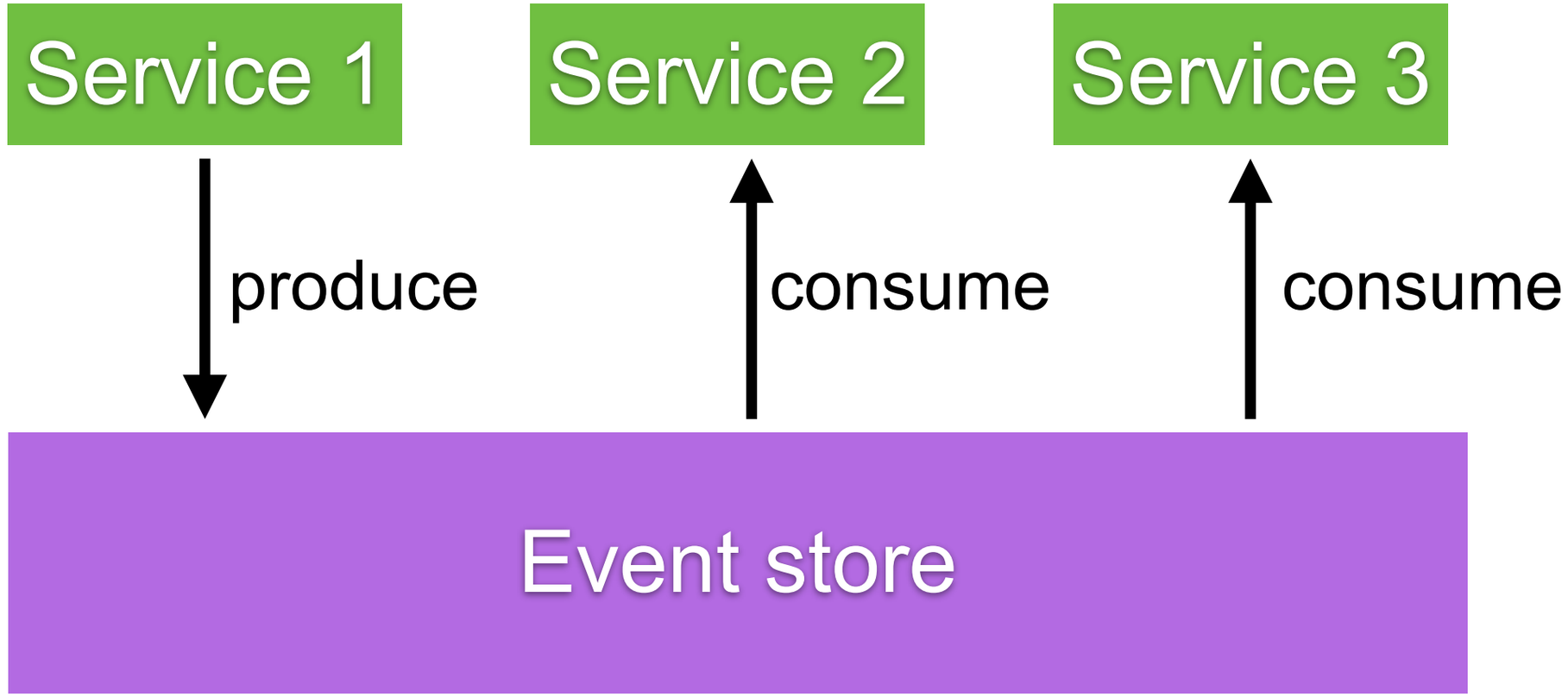
Event store

Keep events in order
Broadcast new event



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With Event sourcing, we can **decouple services** (query and command)

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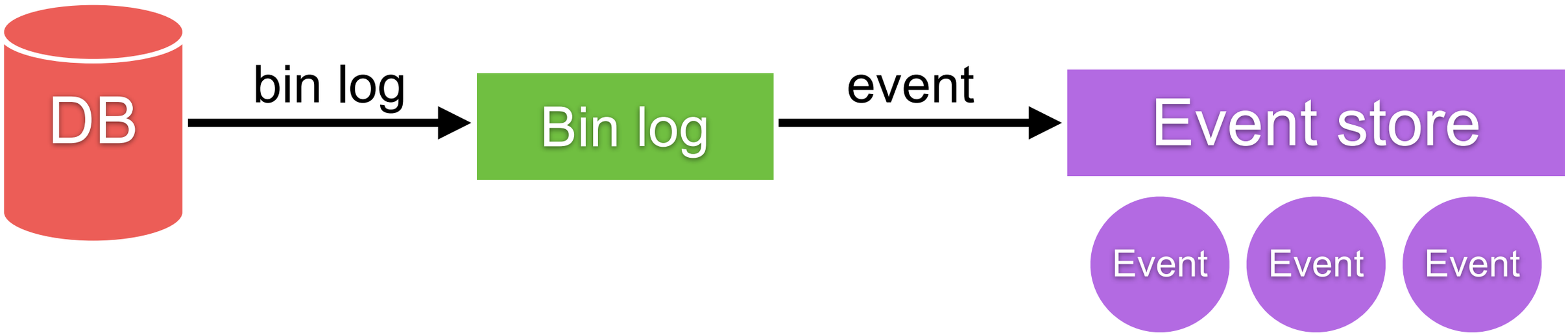
Event sourcing with database

Working with database



Binlog or Binary log event is information about data modification made to database

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Event sourcing

Duplication data (denormalize database)
Complexity (separate query and command)
Difficult to maintain

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Event sourcing can’t solve all problems

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Start with **understand** your **purpose**

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Start with understand your
problem to resolve

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How to implement queries ?

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Query data from multiple services

API composition

Cold data from services

CQRS (Command Query Responsibility Segregation)

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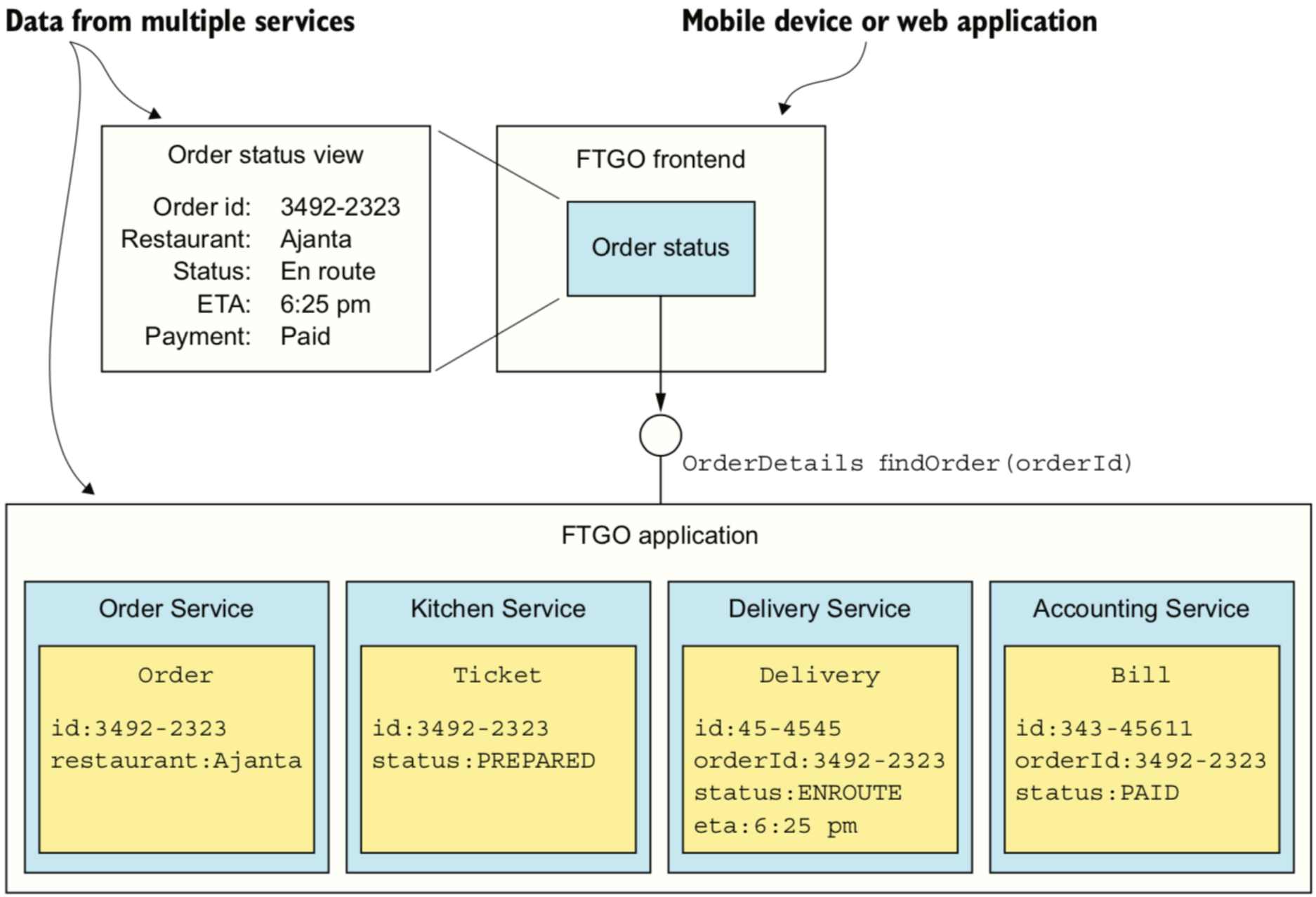
Problem ?



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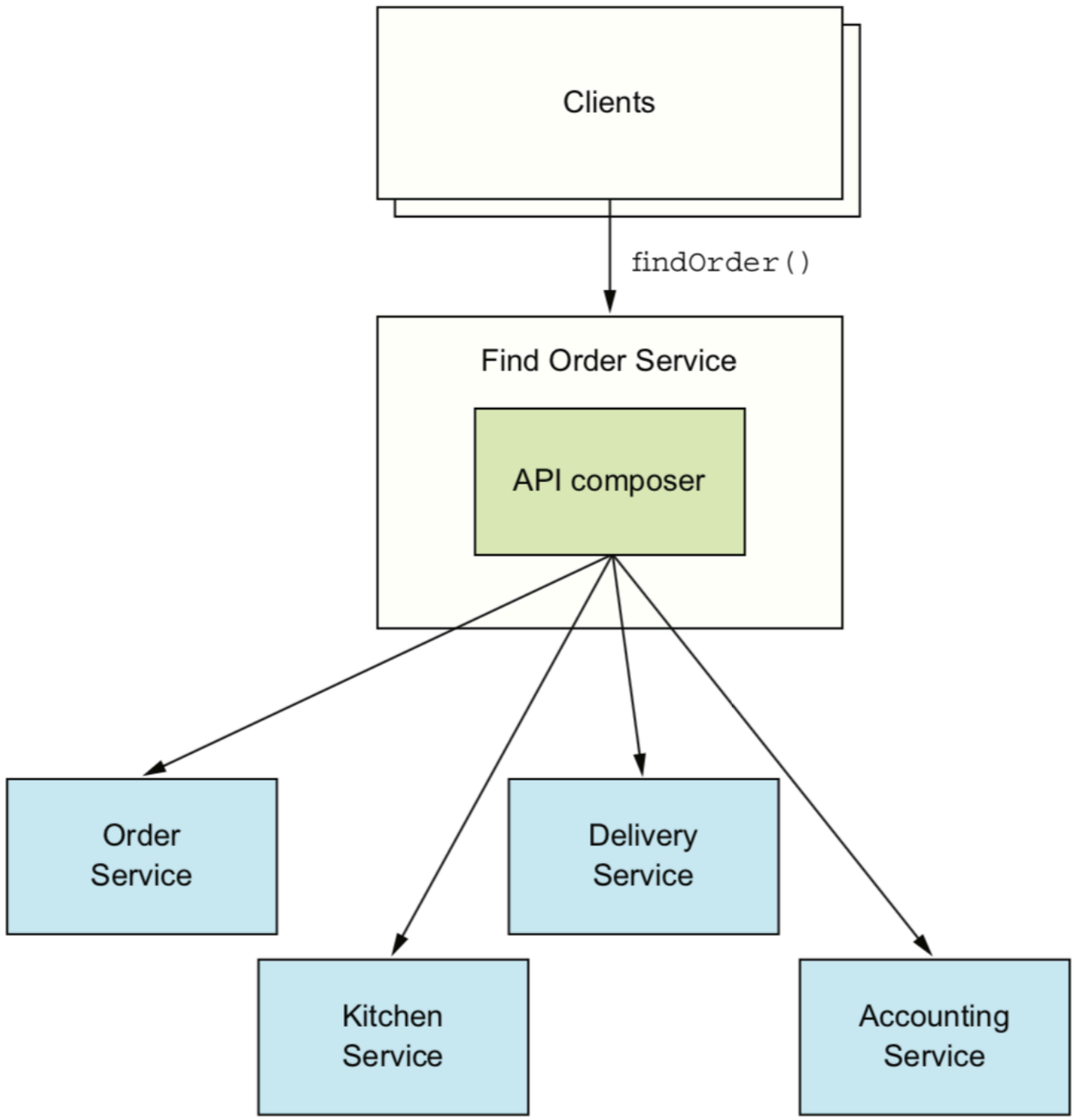
API composition pattern



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Drawbacks

Increase overhead

Lack of transactional data consistency

Reduce availability

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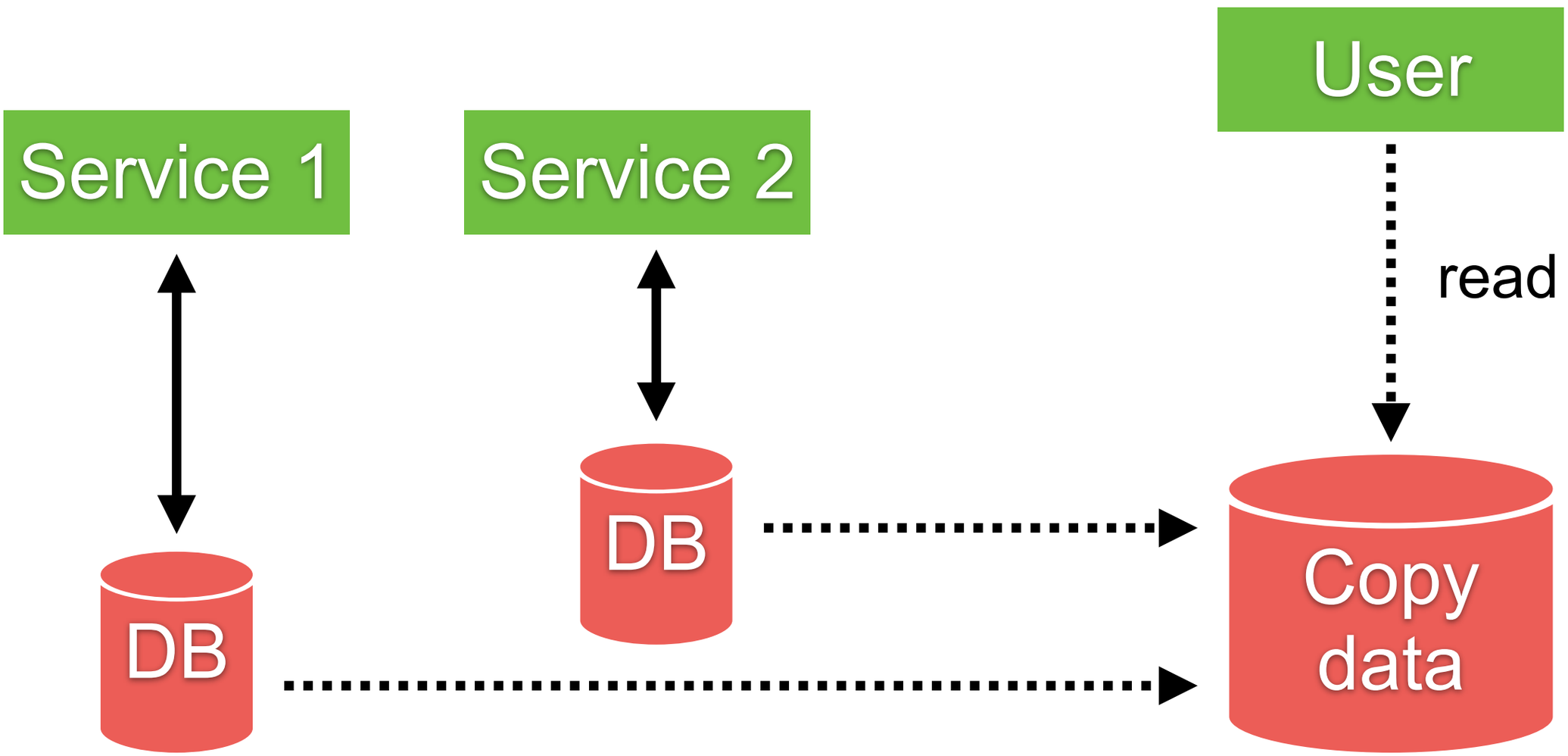
Storing copy data

Copy or caching data to other database



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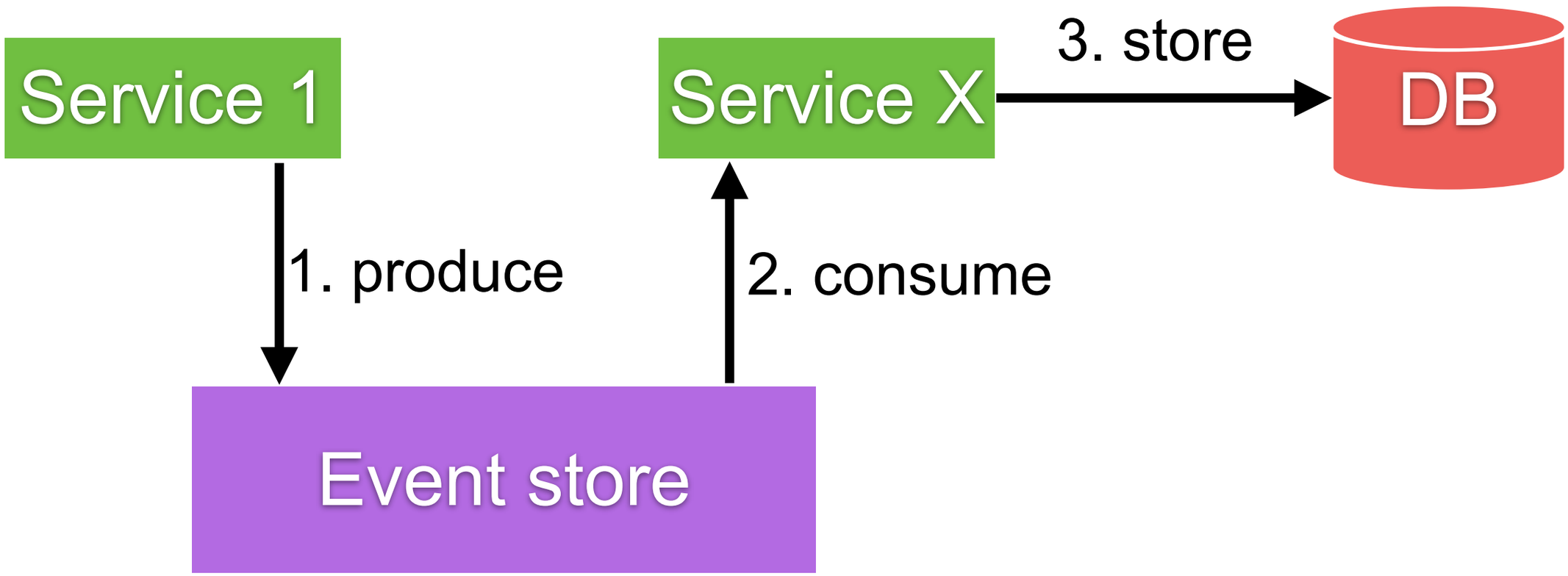
Working with Event-based

Publish event to store copy data



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Separate query and command

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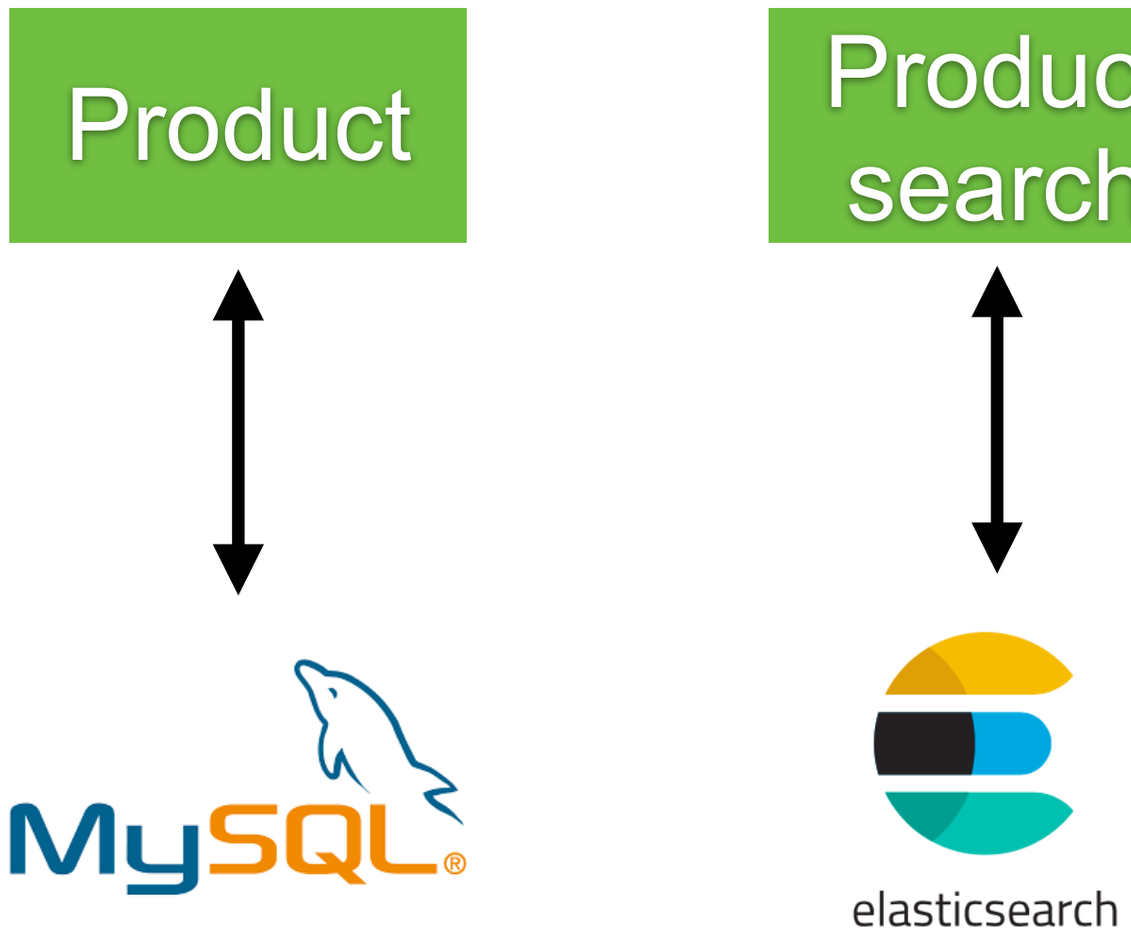
Separate data for read and write

For example MySQL to write, Elasticsearch to search



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CQRS

Command **Q**uery **R**esponsibility **S**egregation

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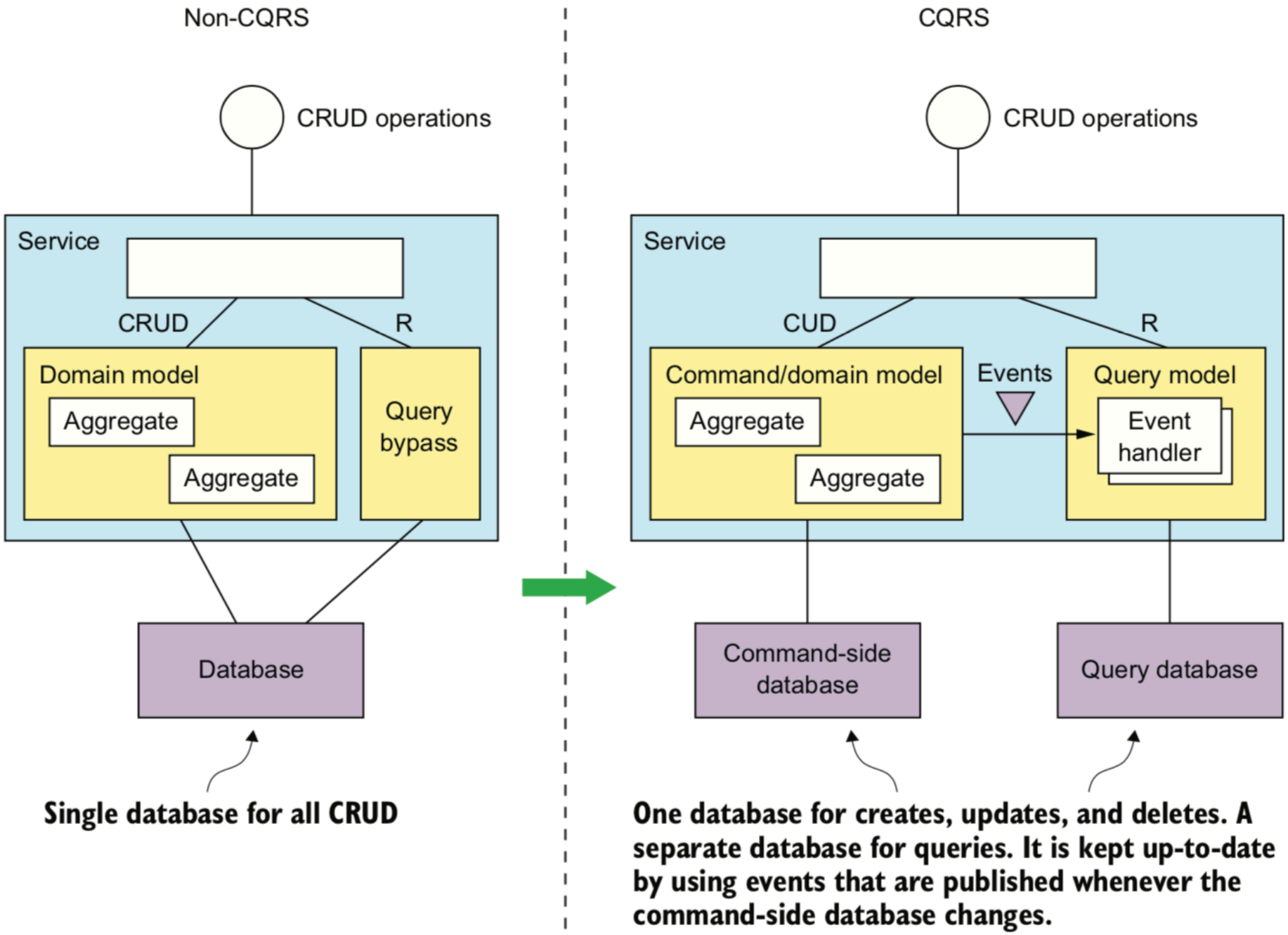
CQRS = Separate command from query



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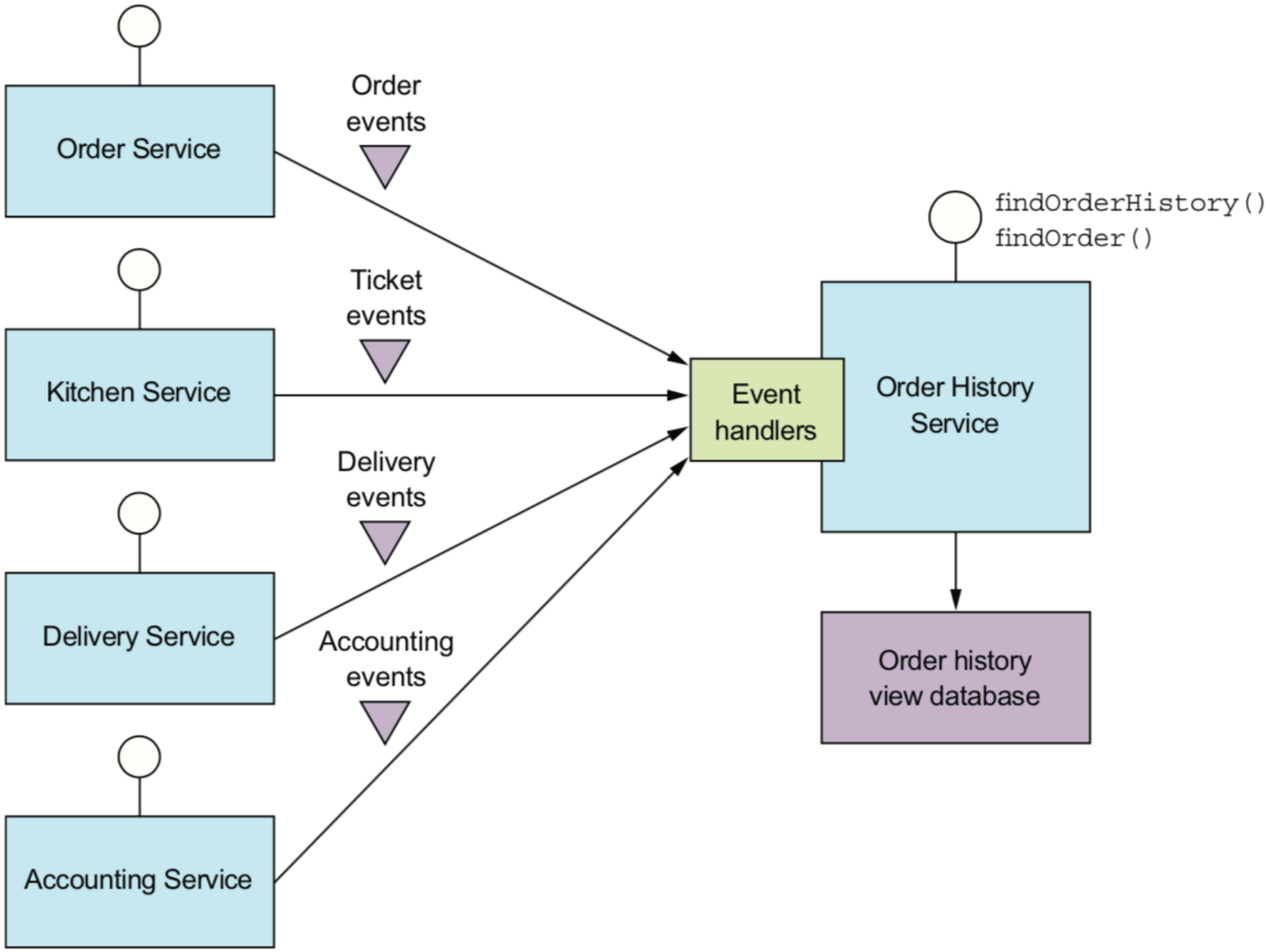
CQRS = Query-side service



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Benefits

Improve separation of concern
Efficiency query

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Drawbacks

More complex

Lag between command and query side

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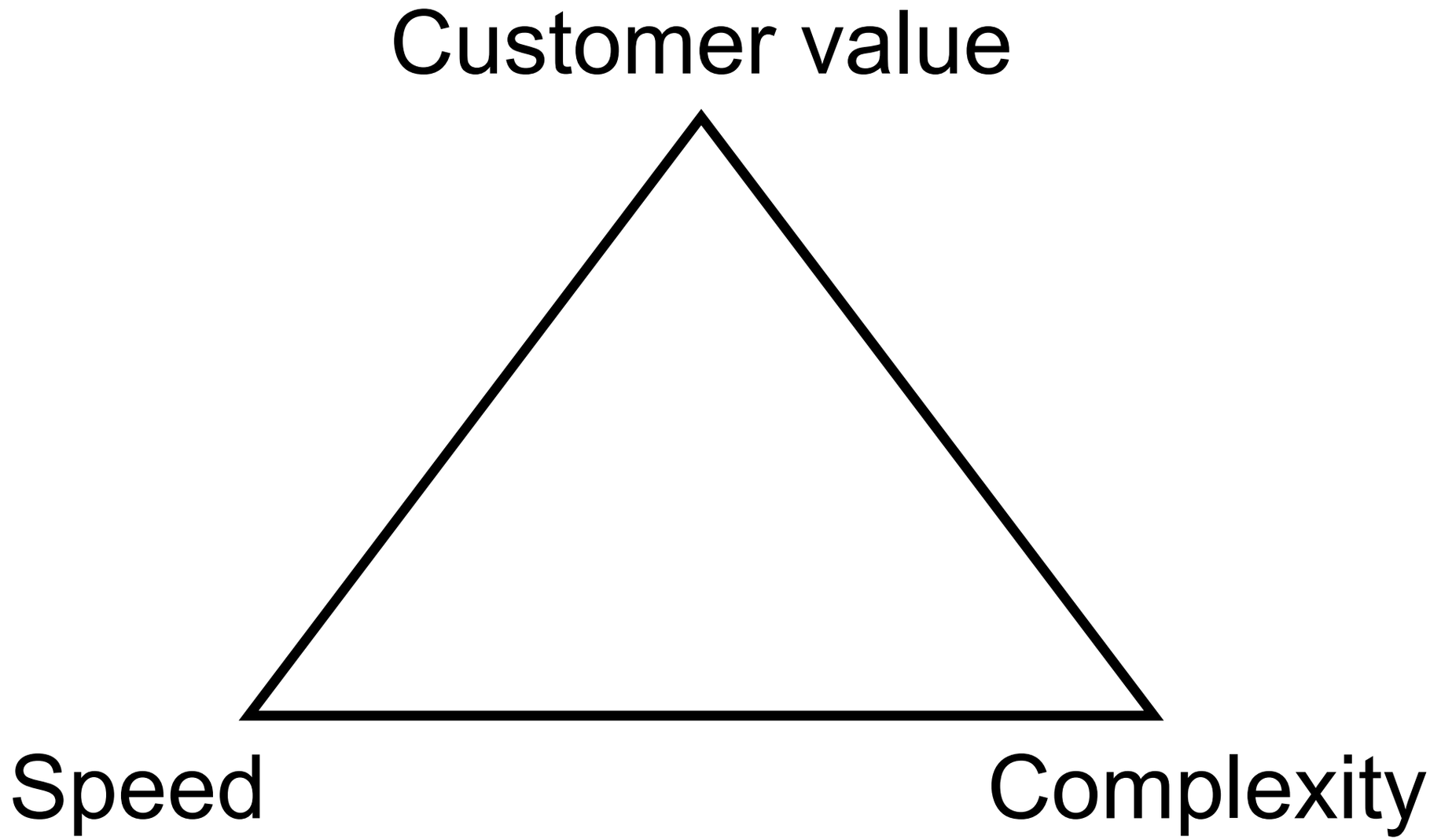

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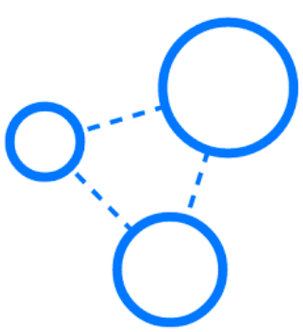
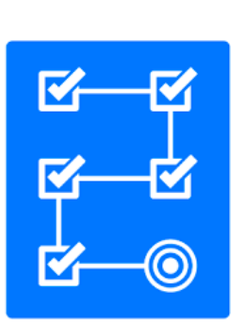
Beyond Microservice
Process and **Organization**



Flexible organizational structure

With clear roles and accountabilities



Efficient meeting formats

Geared toward action and eliminating over-analysis

More autonomy to teams and individuals

Individuals solve issues directly without bureaucracy

Unique decision-making process

To continuously evolve the organization's structure.

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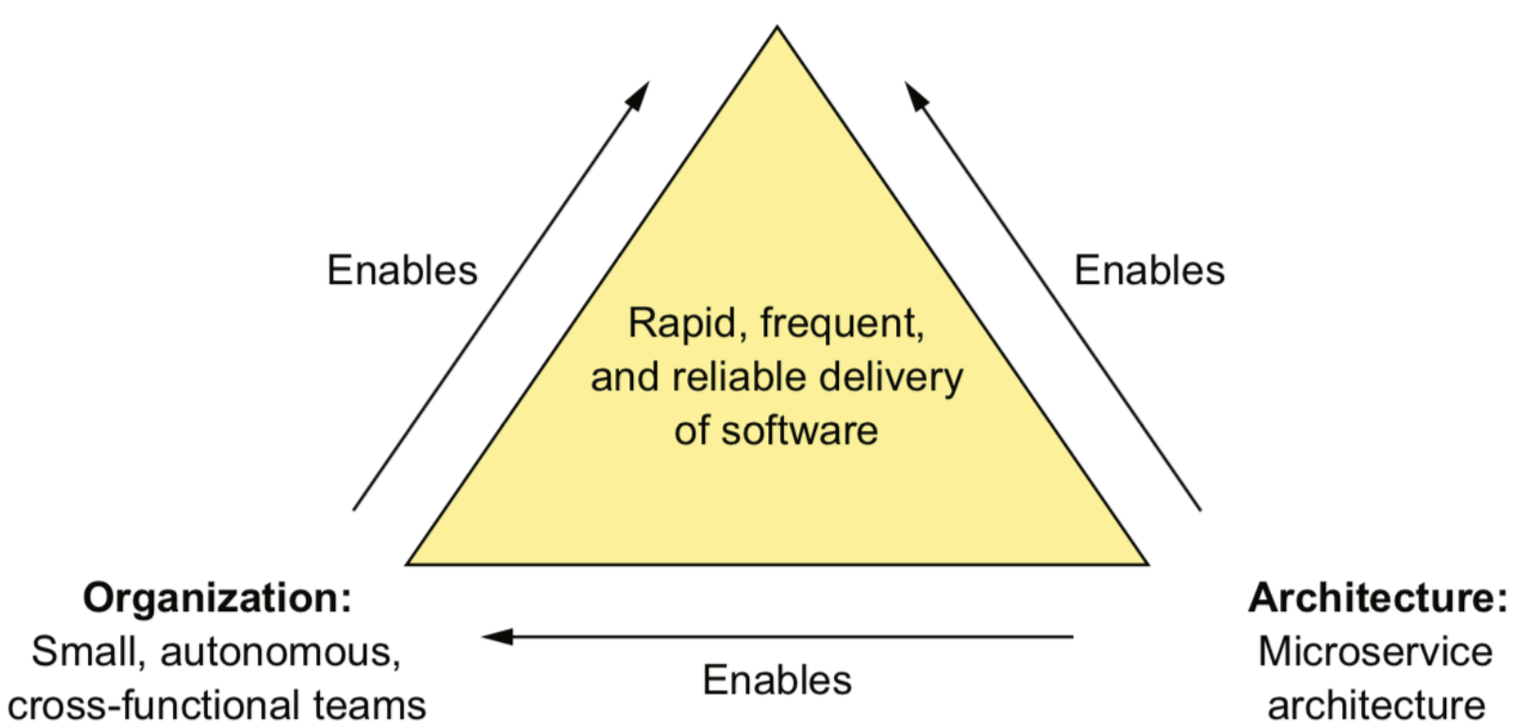
Success project needs …

Organization process
Development process
Delivery process



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Don’t forget about the **human** side when adopt Microservice

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Integrate services with User Interface

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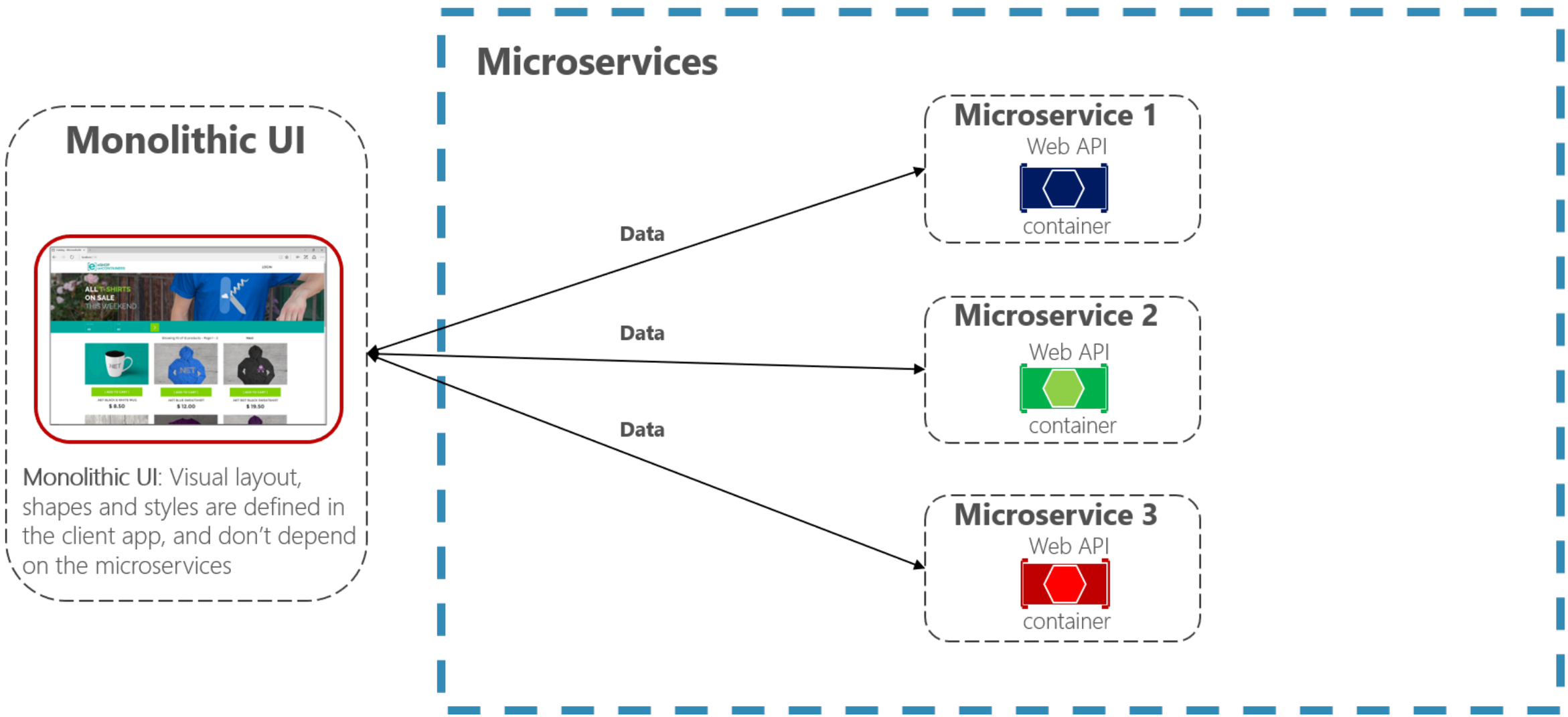
Monolithic UI consuming microservices



https://docs.microsoft.com

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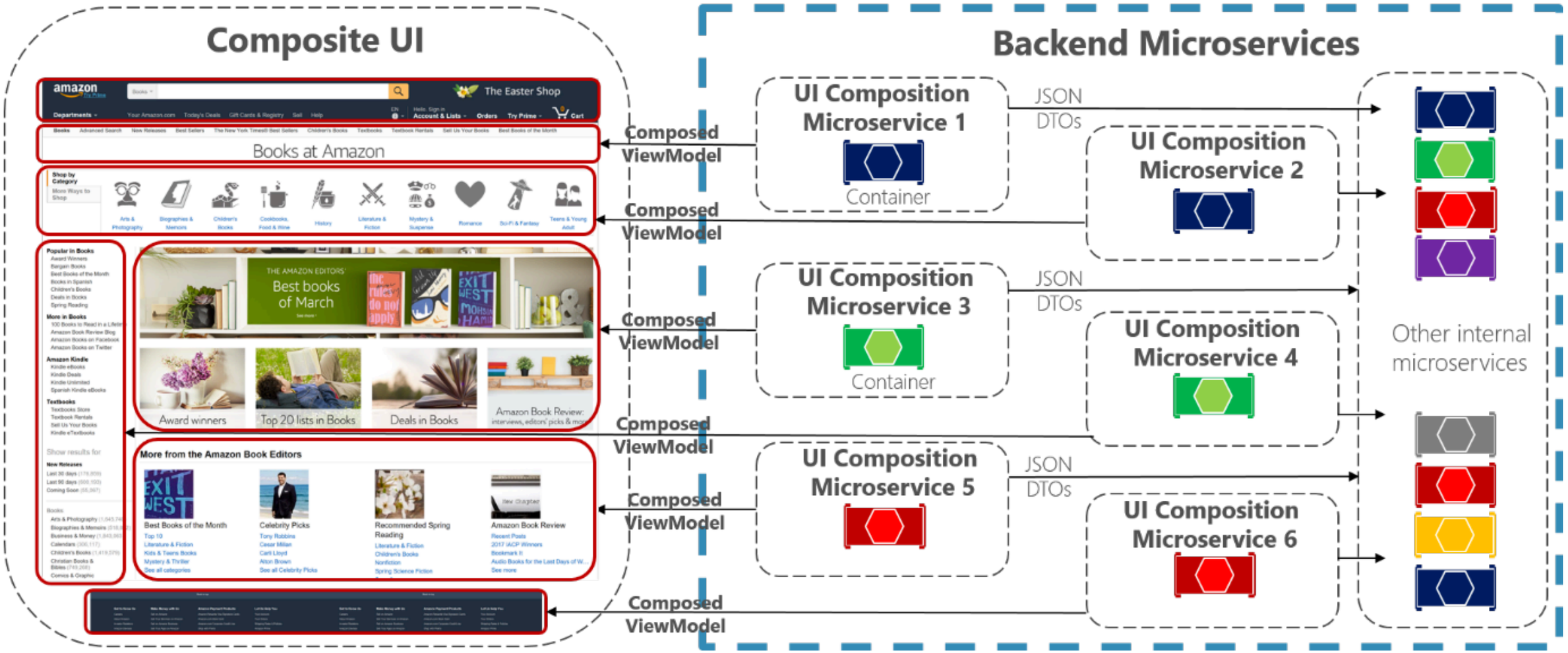
Composite UI *generated* by microservices



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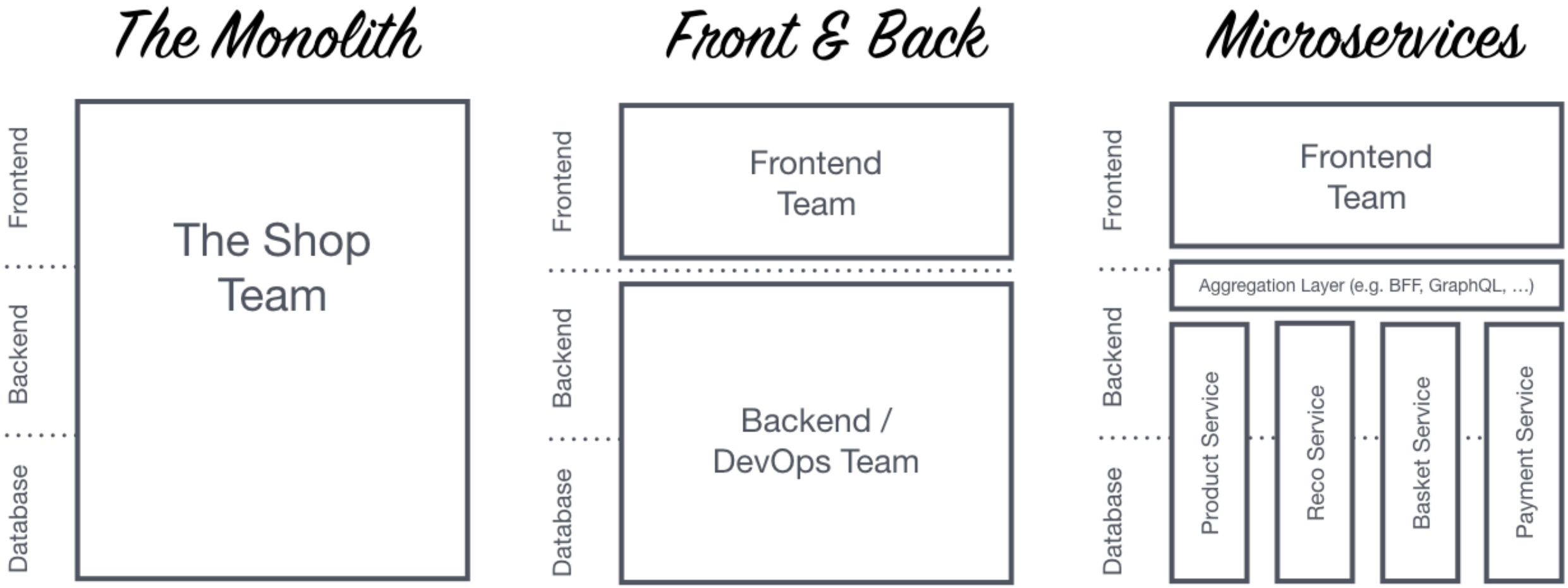
Monolith frontend



https://micro-frontends.org/

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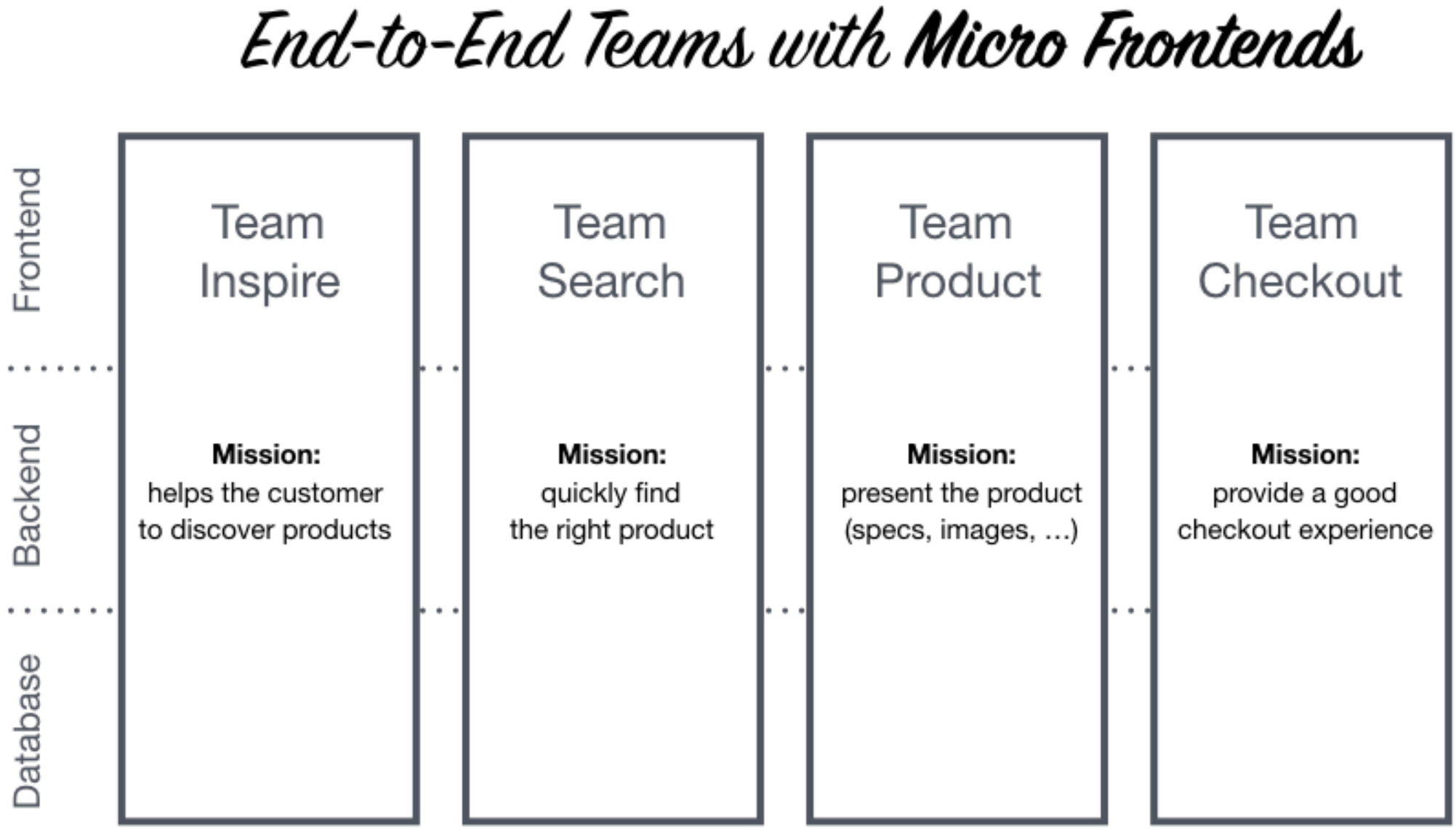
Micro frontend



https://micro-frontends.org/

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Summary

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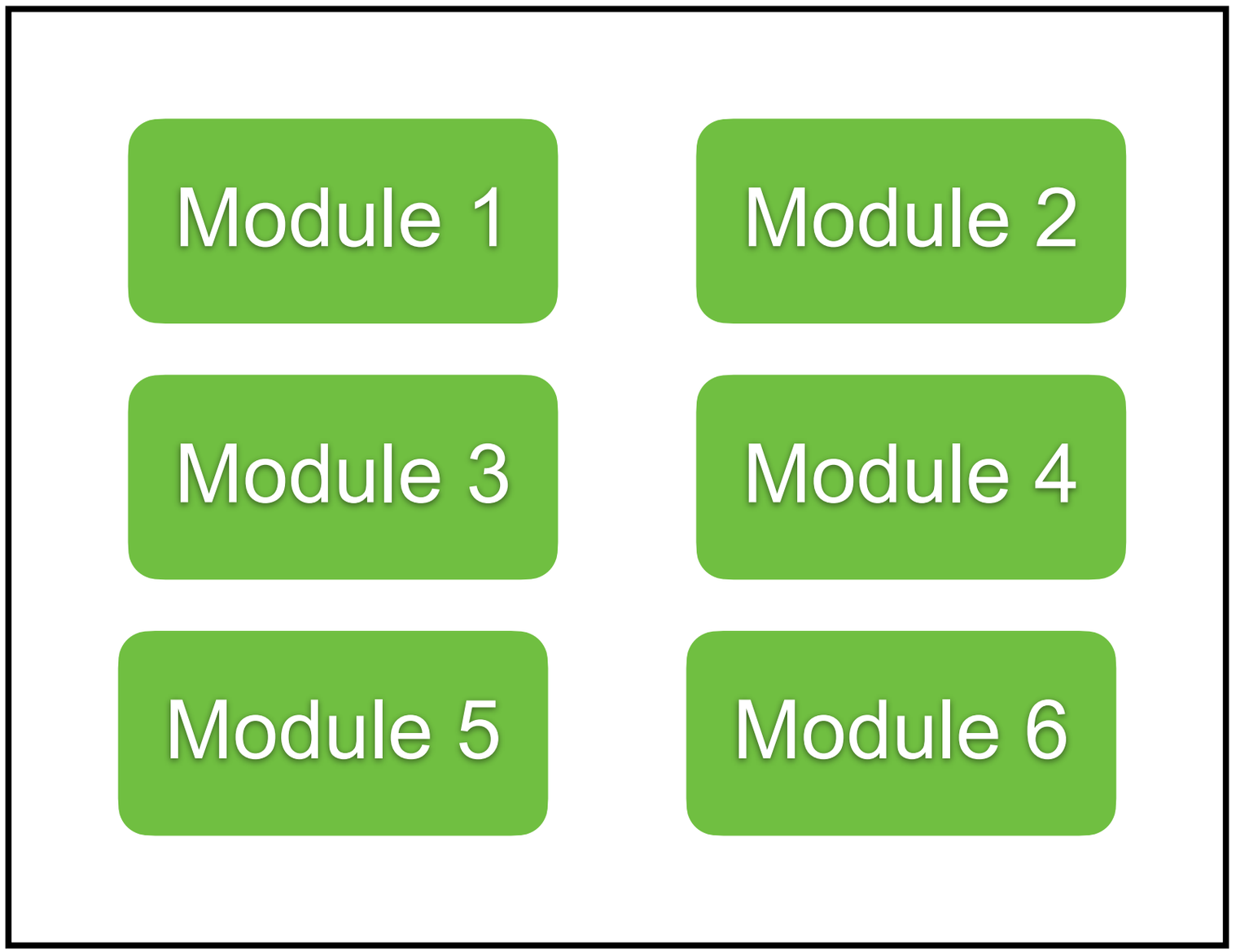
Let’s start with good monolith



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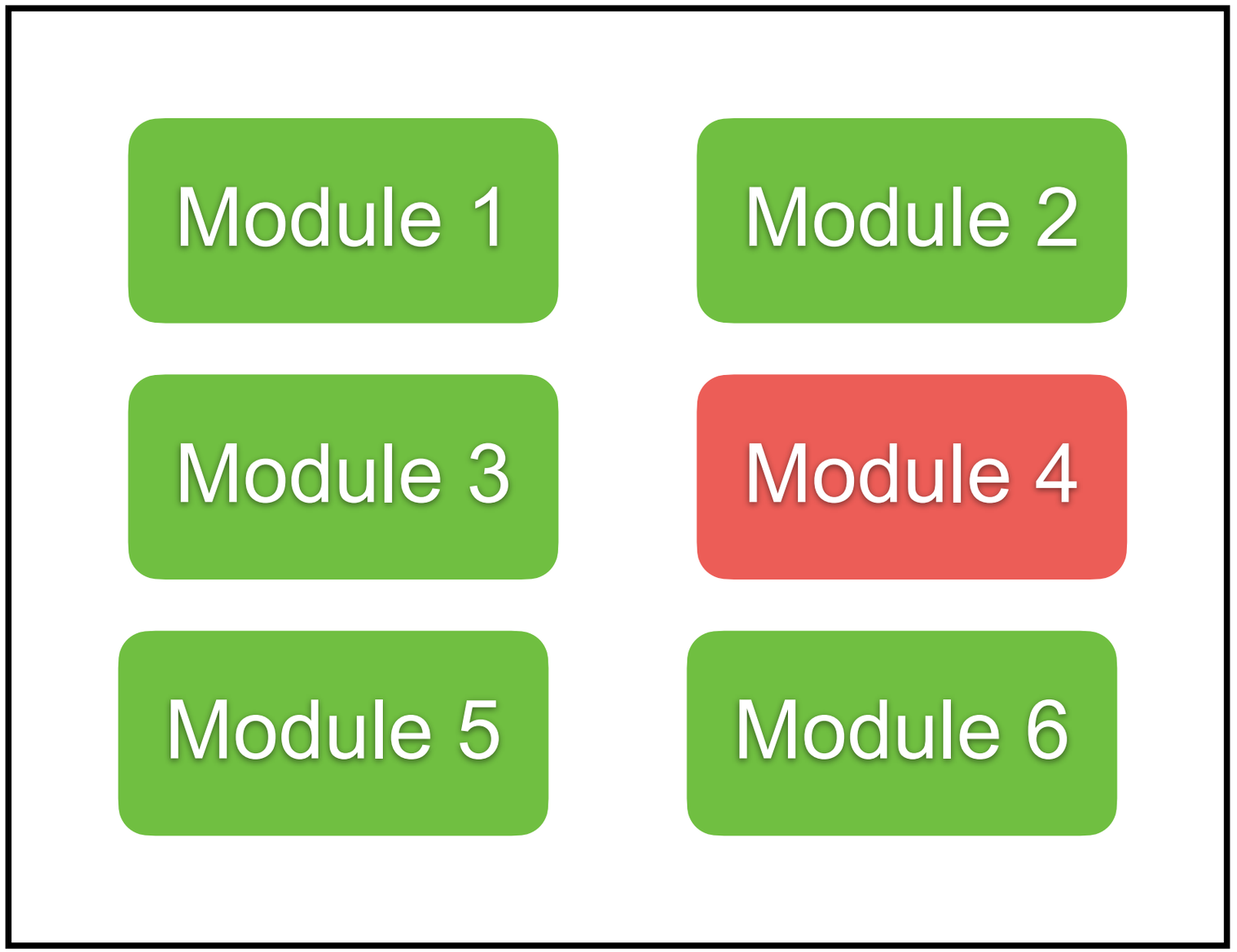
Find your problem



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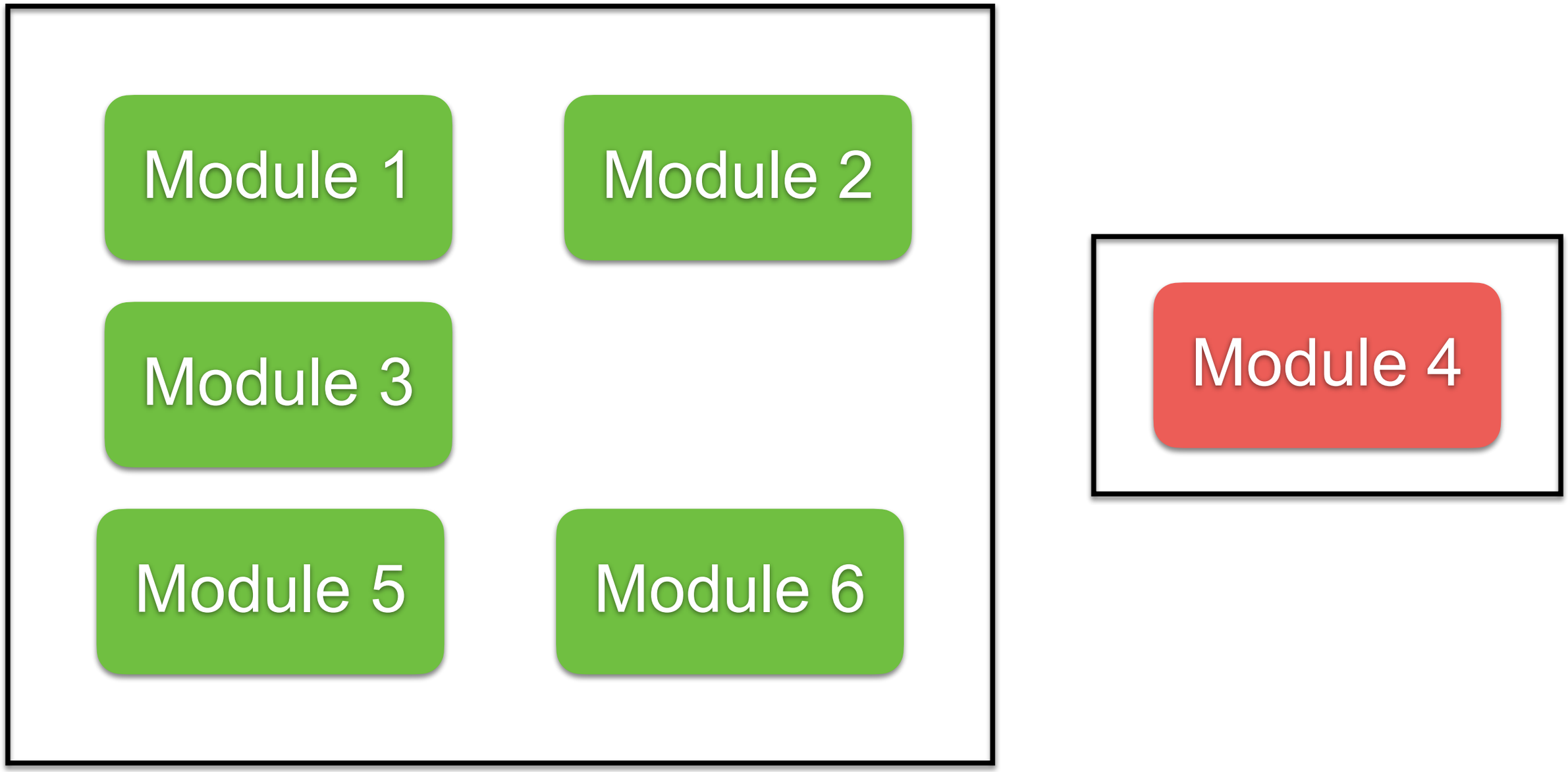

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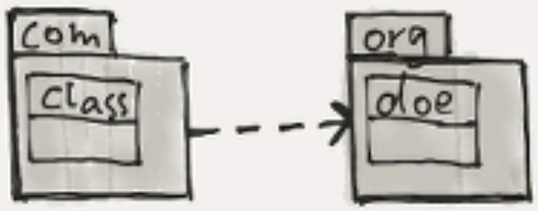
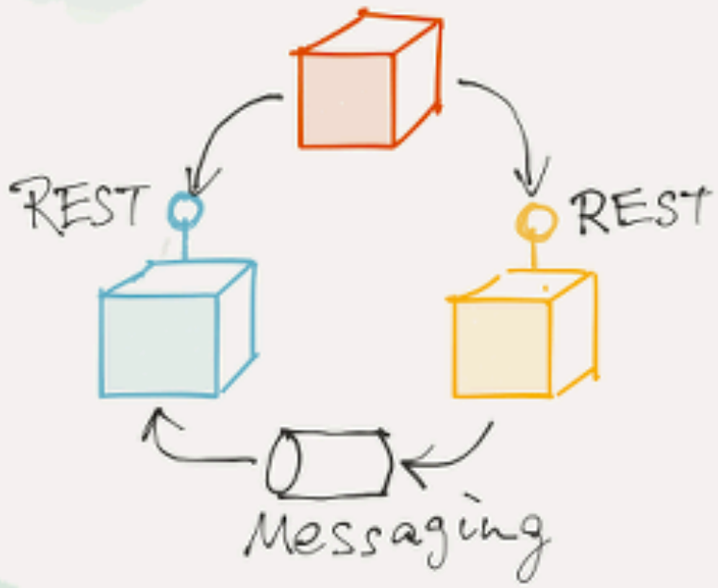
Architecture



Microservices

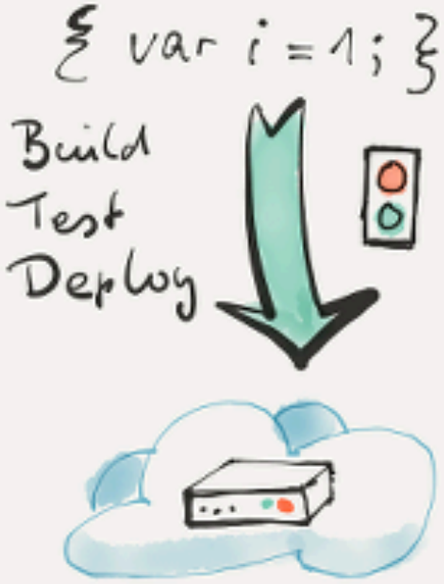


People & Teams

Communication
Collaboration

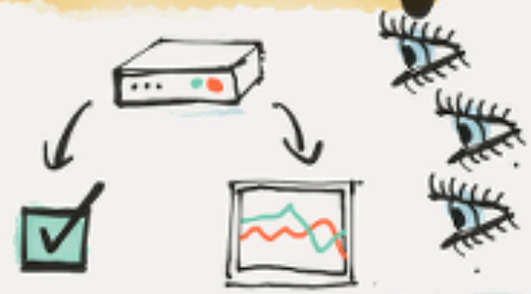
Deployment

Continous Delivery



Infrastructure

Monitoring



Features & Technology

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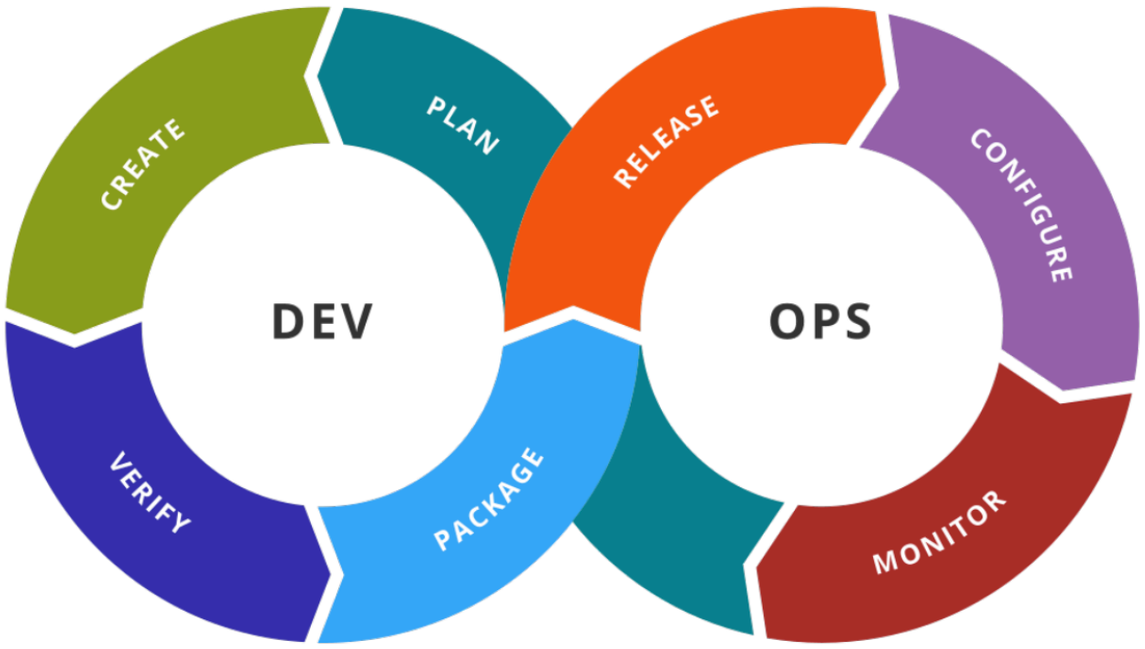
Microservice prerequisites

Rapid provisioning
Basic monitoring
Rapid Application Deployment
DevOps culture



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Design Workshop

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More topics of Microservice

Testing

Deployment

Monitoring

Security

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Let’s start your journey

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