Microservices Architecture "The new normal"

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Objectives

1. Provide good Arabic content for the topic

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2. Overview of Microservices

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2. Overview of Microservices
3. Move step forwards towards recent cloud tools
4. Leave your fear, and let's do it

Contents

Definition

Monolithic

A monolithic application is self-contained, and independent from other computing applications. The design philosophy is that the application is responsible not just for a particular task, but can perform every step needed to complete a particular function.

Microservices

Microservices is a software development technique that arranges an application as a collection of loosely coupled services.

https://en.wikipedia.org/wiki/Monolithic_application
https://en.wikipedia.org/wiki/Microservices

Why Microservices?

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   - The application consists of loosely coupled services.
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5. Scalability
   - Each microservice can be scaled independently of the other services.

Microservices vs Monolithic

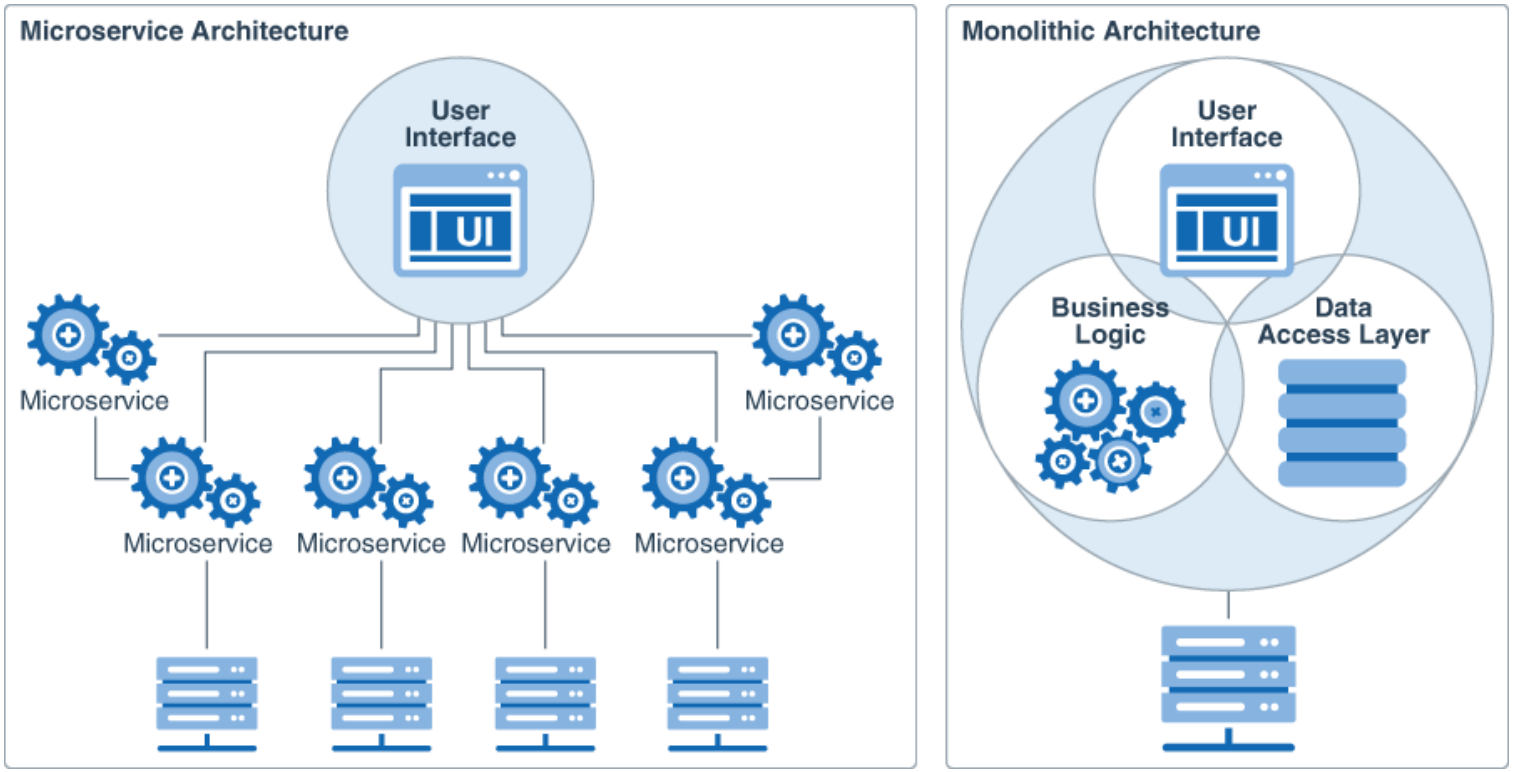

Figure: mivroservices vs monolithic

https://docs.oracle.com/en/solutions/learn-architect-microservice/index.html

Closer Look

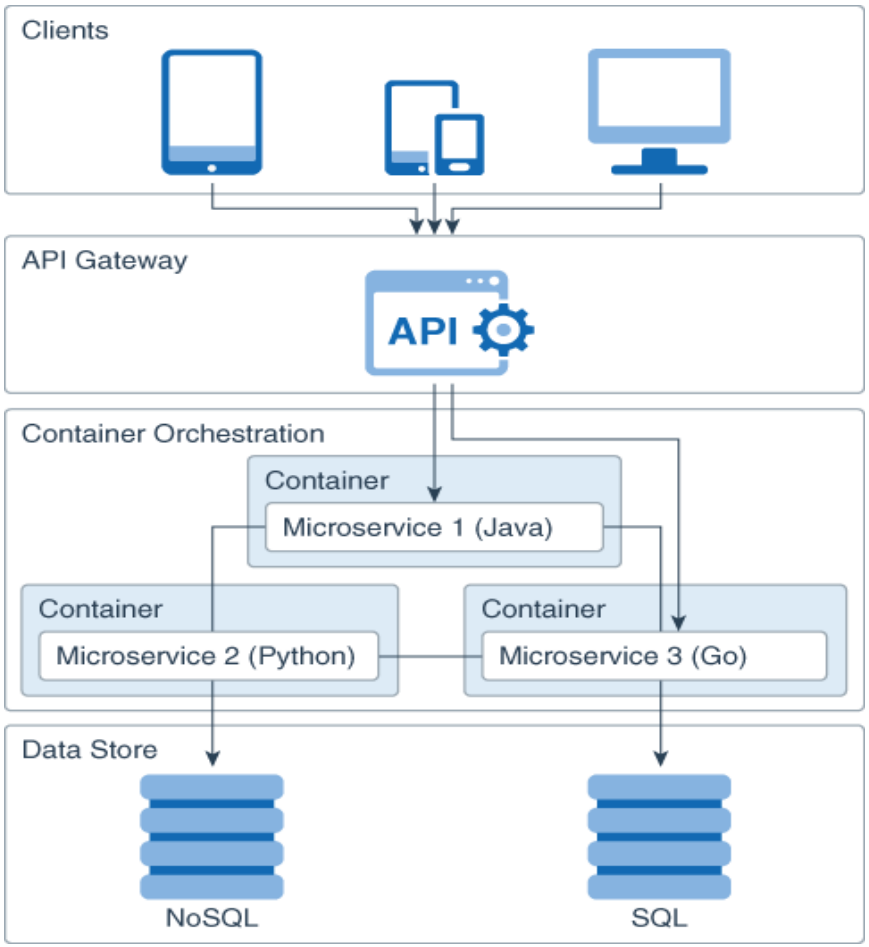

Figure: Microservices In Depth

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Microservices Architecture

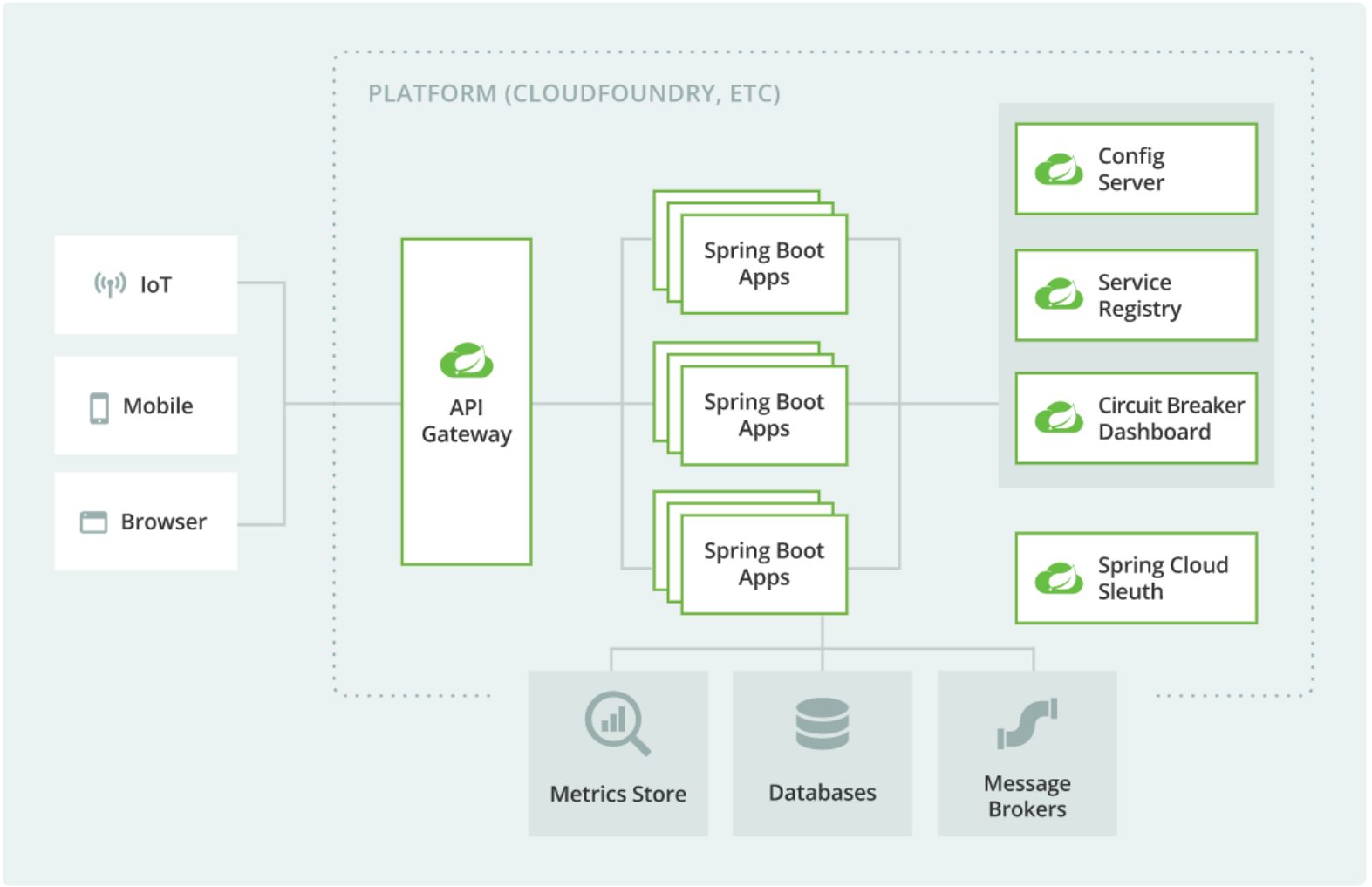
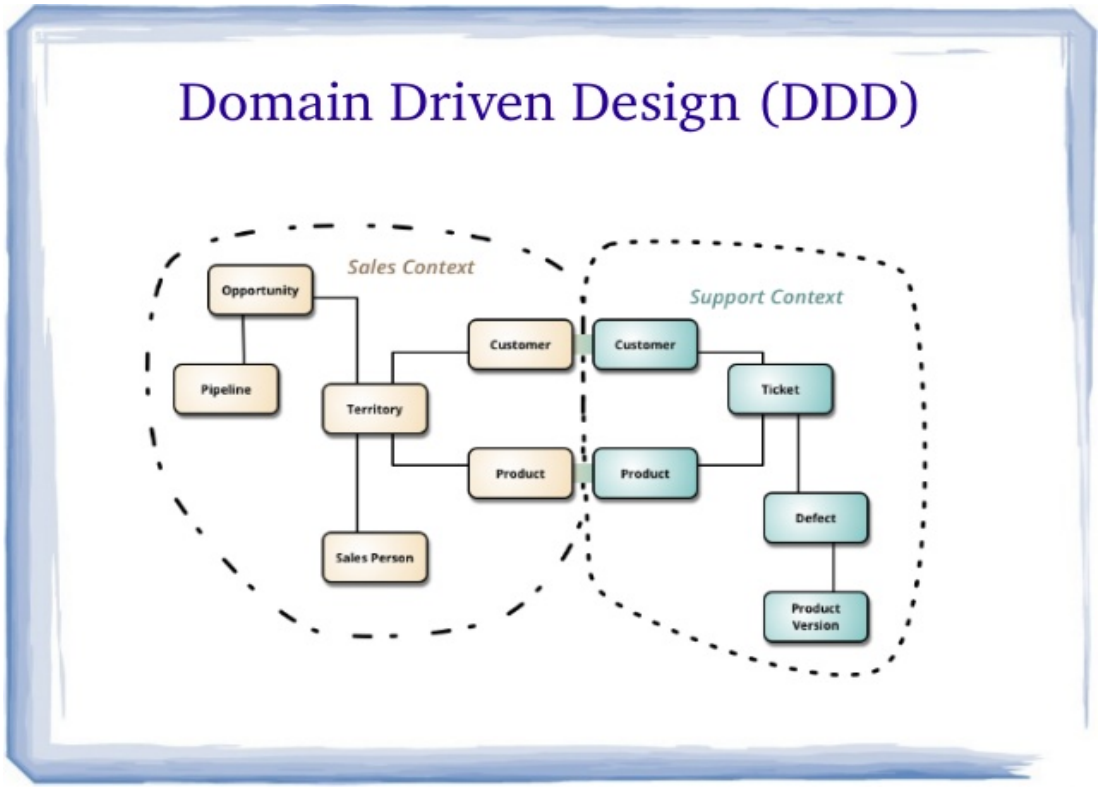


Figure: Microservices with Spring Cloud

Microservice characteristics

Single Responsibility

- Business Boundary
- Function Boundary



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

Communication Design

HTTP communication

Also known as **Synchronous communication**, the calls between services is a viable option for **service-to-service** via REST API.

Message communication

Also known as **Asynchronous communication**, the services push messages to a message broker that other services subscribe to.

Event-driven communication

Another type of **Asynchronous communication**, the services does not need to know the common message structure. Communication between services takes place via events that individual services produce.

https://blog.logrocket.com/methods-for-microservice-communication

HTTP communication

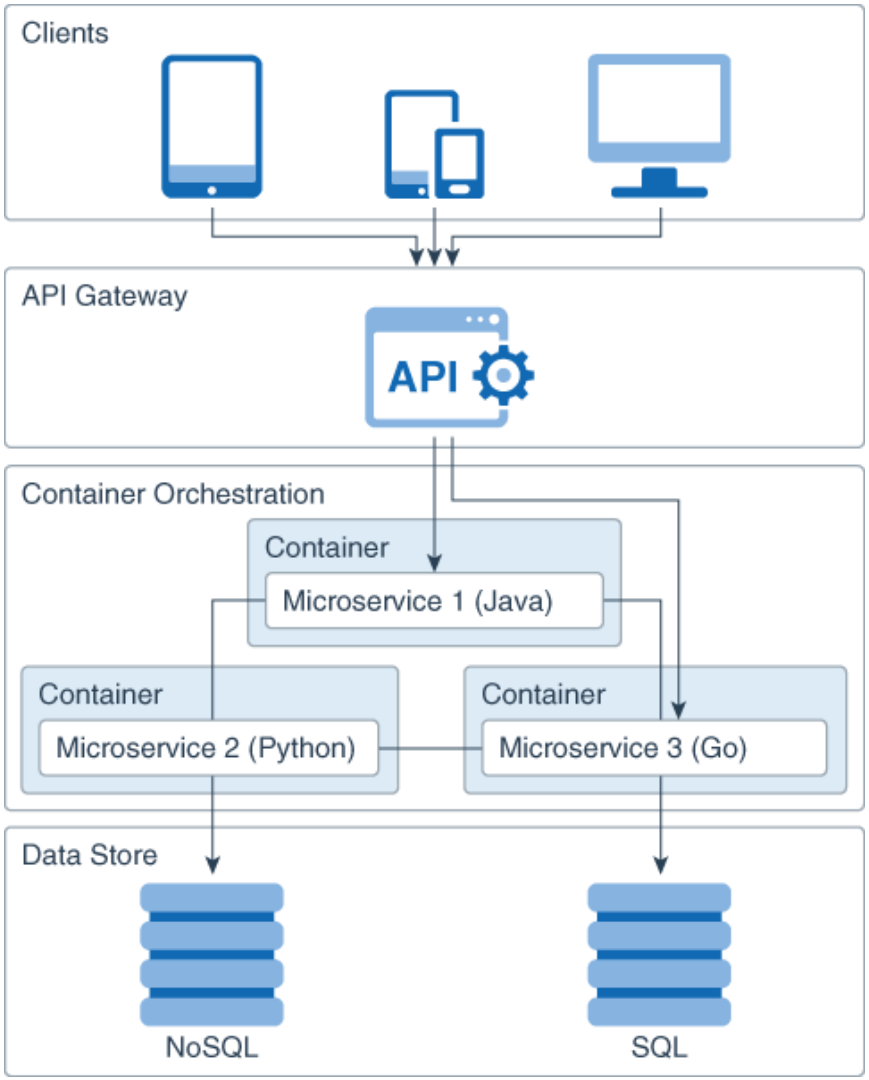


Figure: Synchronous calls

Event-driven communication

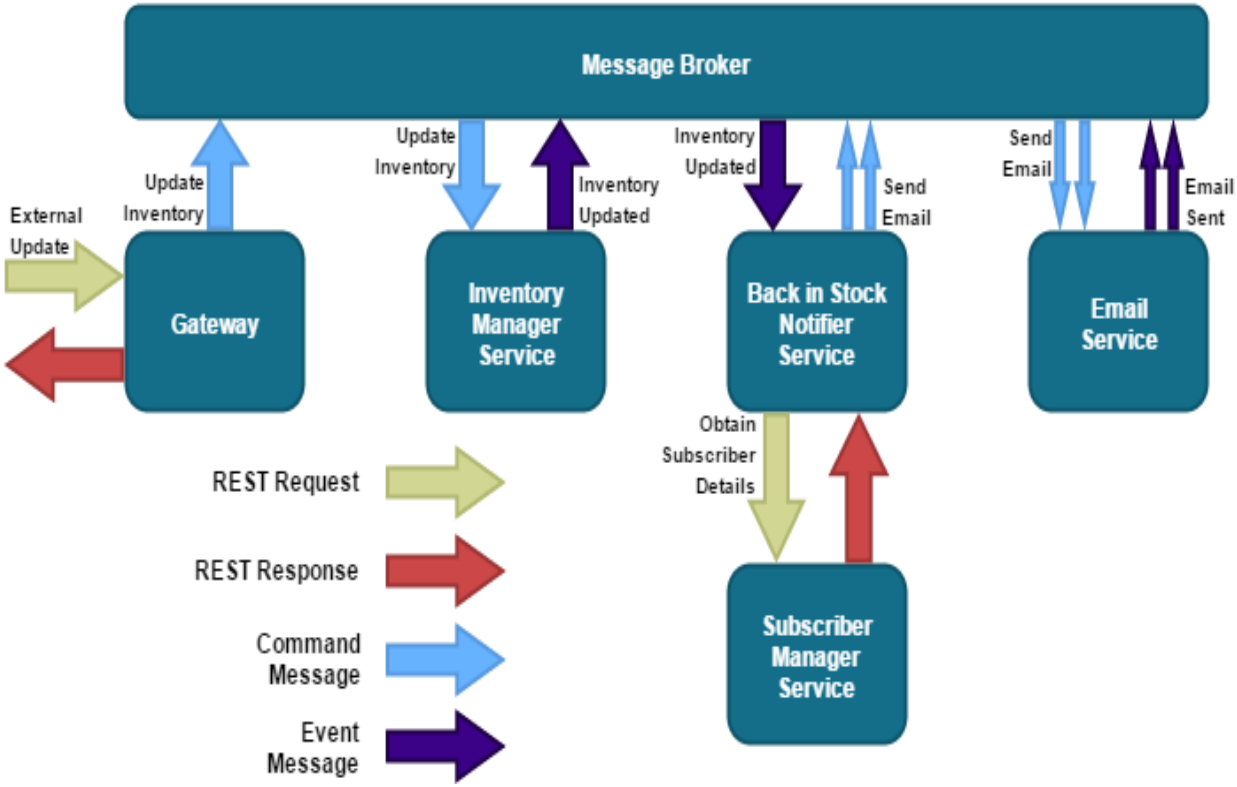


Figure: Asynchronous calls

https://capgemini.github.io/architecture/is-rest-best-microservices

Why not SOAP?

It is possible to build a microservices-based architecture using SOAP which uses HTTP. But:

- it only uses POST messages to transfer data to a server.
- SOAP lacks concepts such as HATEOAS that enable relationships between microservices to be handled flexibly.
- The interfaces have to be completely defined by the server and known on the client.

Microservices; Flexible Software Architecture. "Eberhard Wolff"

API Gateway

API Gateway is a tool that makes it easy for developers to create(1), publish(2), maintain(3), monitor(4), and secure(5) APIs at any scale. APIs act as the "front door" for applications to access data, business logic, or functionality from your backend services.

Figure: Amazon Gateway

https://aws.amazon.com/api-gateway/

Orchestration and API Gateway cont...

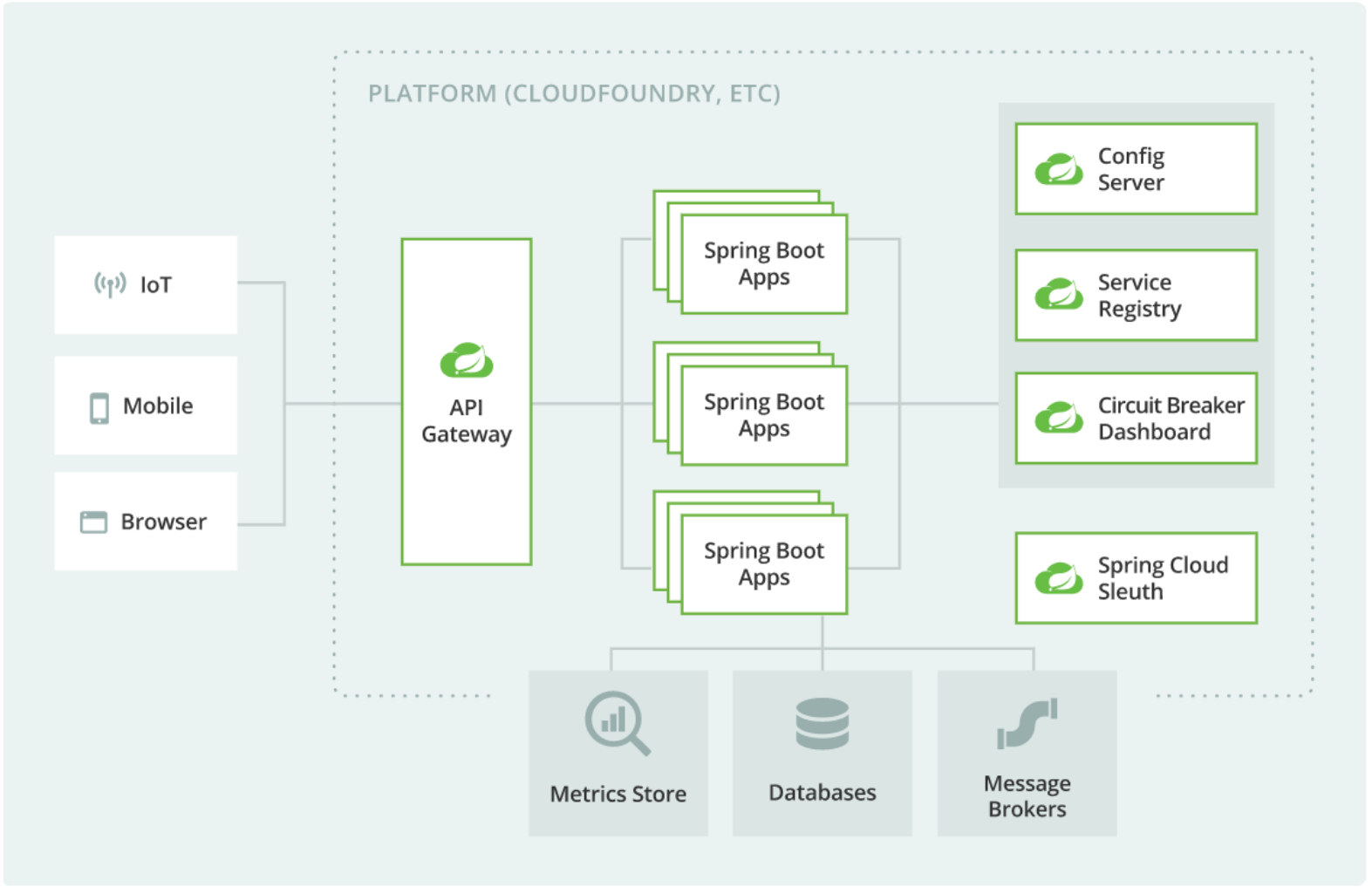


Figure: Microservices with Spring Cloud

Available Market Options

Figure: API Gateway Products

Service Discovery

Problem

In any distributed architecture, we need to find the physical address of where a machine is located.

Solution

Using service discovery, a service can register itself when it is up and healthy. By using such technology you can achieve:

1. Load balanced
   - dynamically load balance requests across all service instances to ensure that the service invocations are spread across all the service instances managed by it.

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   - client should "cache" service information locally. Local caching allows for gradual degradation of the service discovery feature so that if service discovery service does become unavailable, applications can still function and locate the services based on the information maintained in its local cache.

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3. Fault-tolerant
   - detect when a service instance isn't healthy and remove the instance from the list of available services.

Service Discovery with Gateway

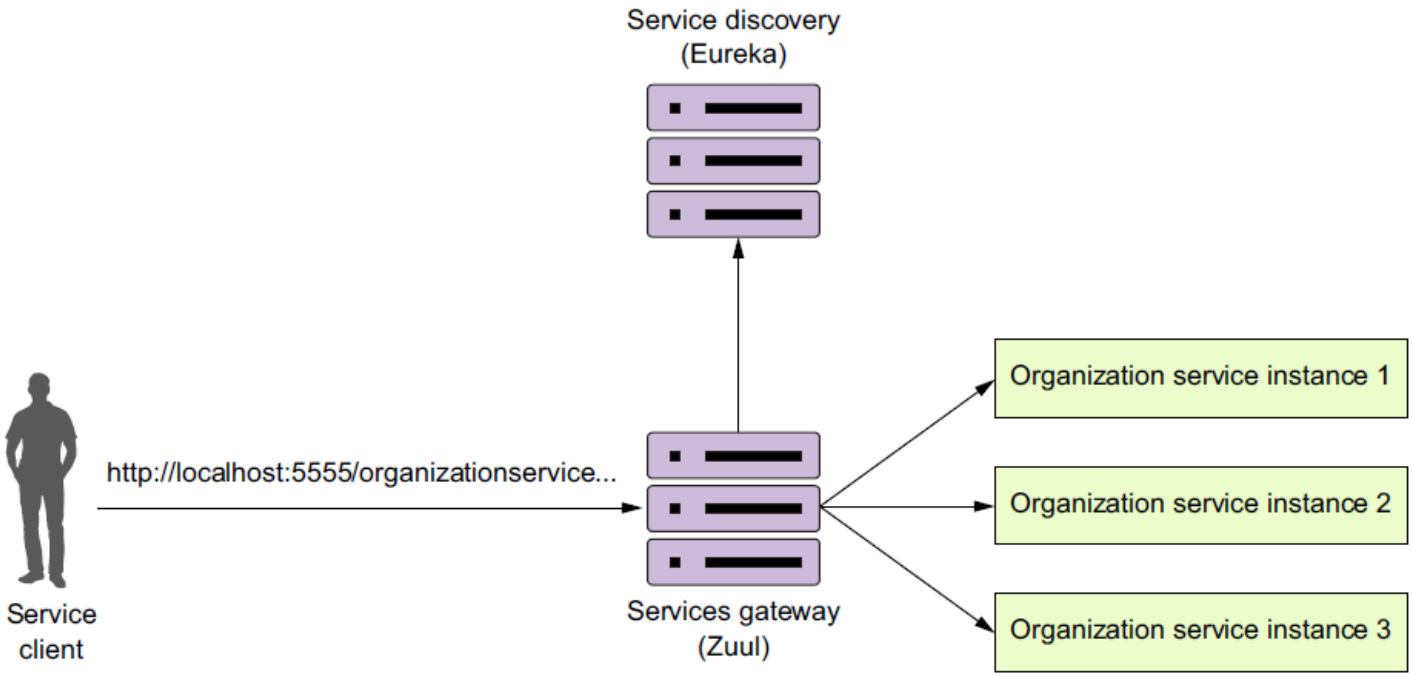


Figure: Service Registry and Gateway

Spring Microservices in Action, "JOHN CARNELL"

Available Market Options

Figure: Service Registry Products

The Twelve-Factor App

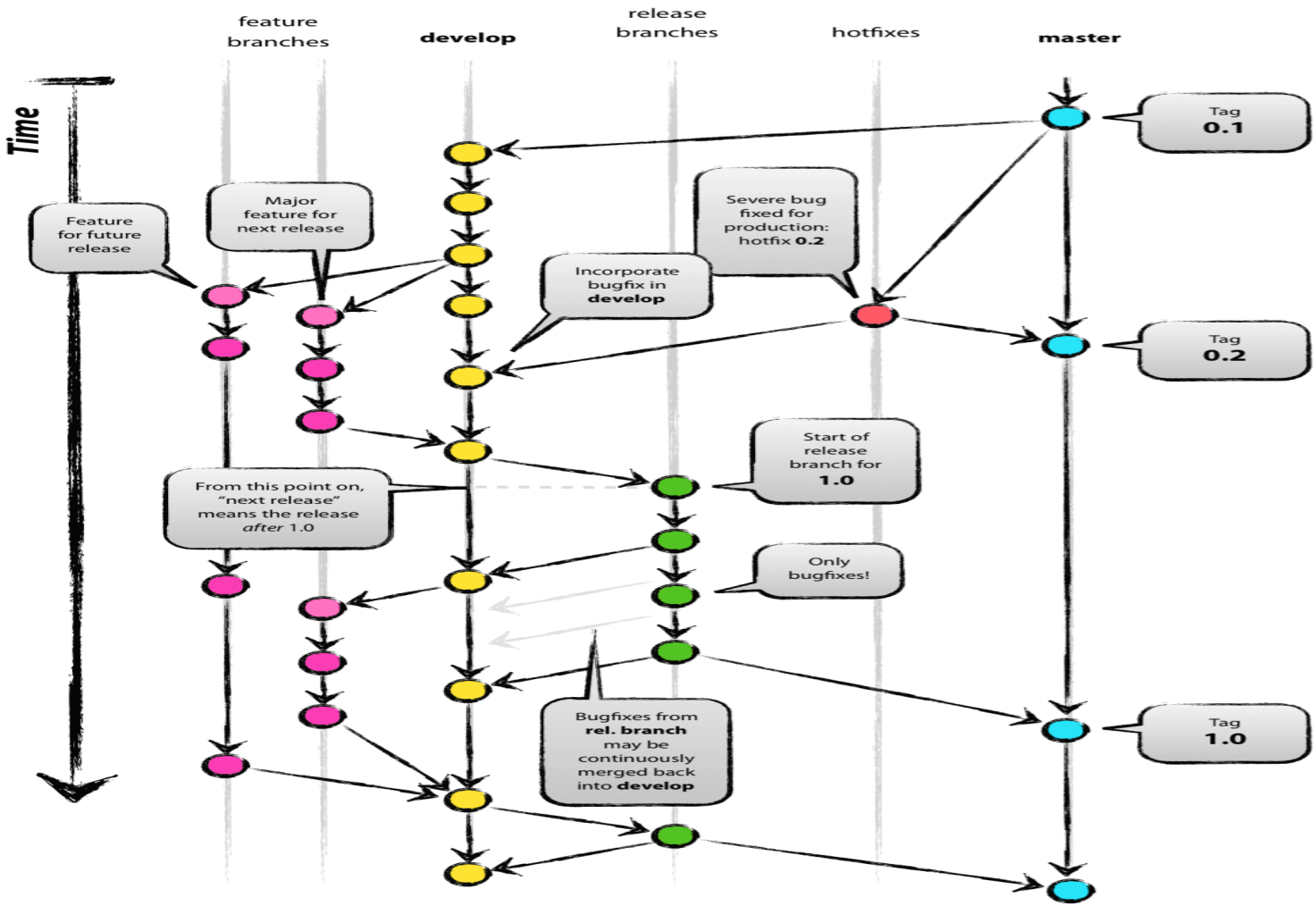
The Twelve-Factor App methodology is a methodology for building **software-as-a-service** applications

1. Codebase
2. Dependencies
3. Config
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://12factor.net

The Twelve-Factor App

1. Codebase
   - One codebase tracked in revision control, many deploys



The Twelve-Factor App

2. Dependencies
   - Explicitly declare and isolate dependencies
   - Consider the magic key **Portability**

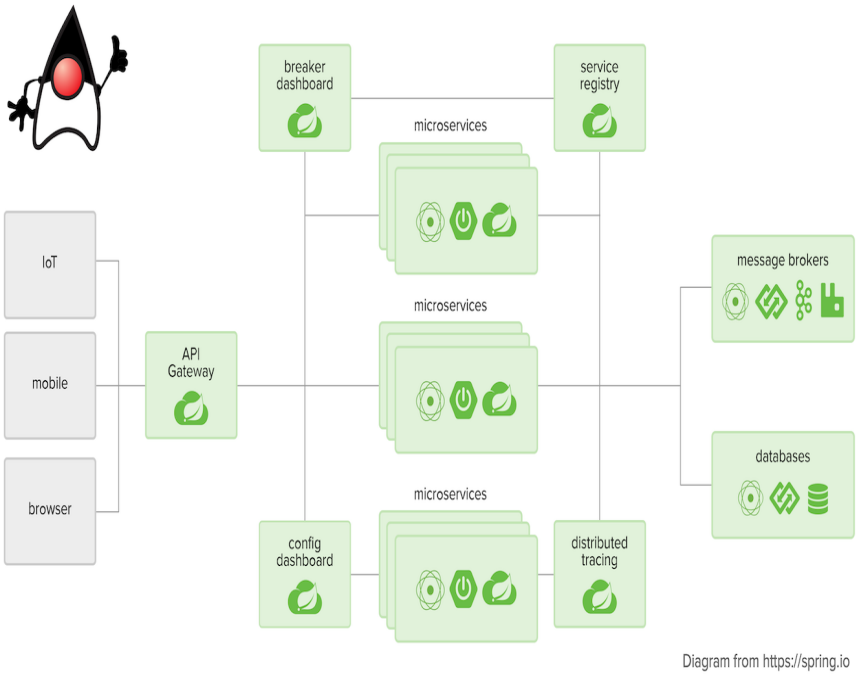


Diagram from https://spring.io

```
<dependencies>
    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-data-jpa</artifactId>
    </dependency>
    <dependency>
        <groupId>mysql</groupId>
        <artifactId>mysql-connector-java</artifactId>
    </dependency>
    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-tomcat</artifactId>
        <scope>compile</scope>
    </dependency>
    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-web</artifactId>
    </dependency>
    <dependency>
        <groupId>org.springframework.boot</groupId>
        <artifactId>spring-boot-starter-actuator</artifactId>
        <version>2.3.0.RELEASE</version>
    </dependency>
    <dependency>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-starter-config</artifactId>
    </dependency>
    <dependency>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-starter-zipkin</artifactId>
    </dependency>
    <dependency...>
    <dependency...>
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</dependencies>
```

Never ever depend on operating system

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   - Config is what is changed from environment to another
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   - **Credentials are not configuration, but secrets**
     - Never ever store credentials in code
     - Don't save credentials in PLAINTEXT with config, but hashed
   - **Configuration in Legacy system is a challenge**
     - Unlike missing dependencies, System will not immediately crashed if configuration is missed
     - Give attention to URLs in legacy code

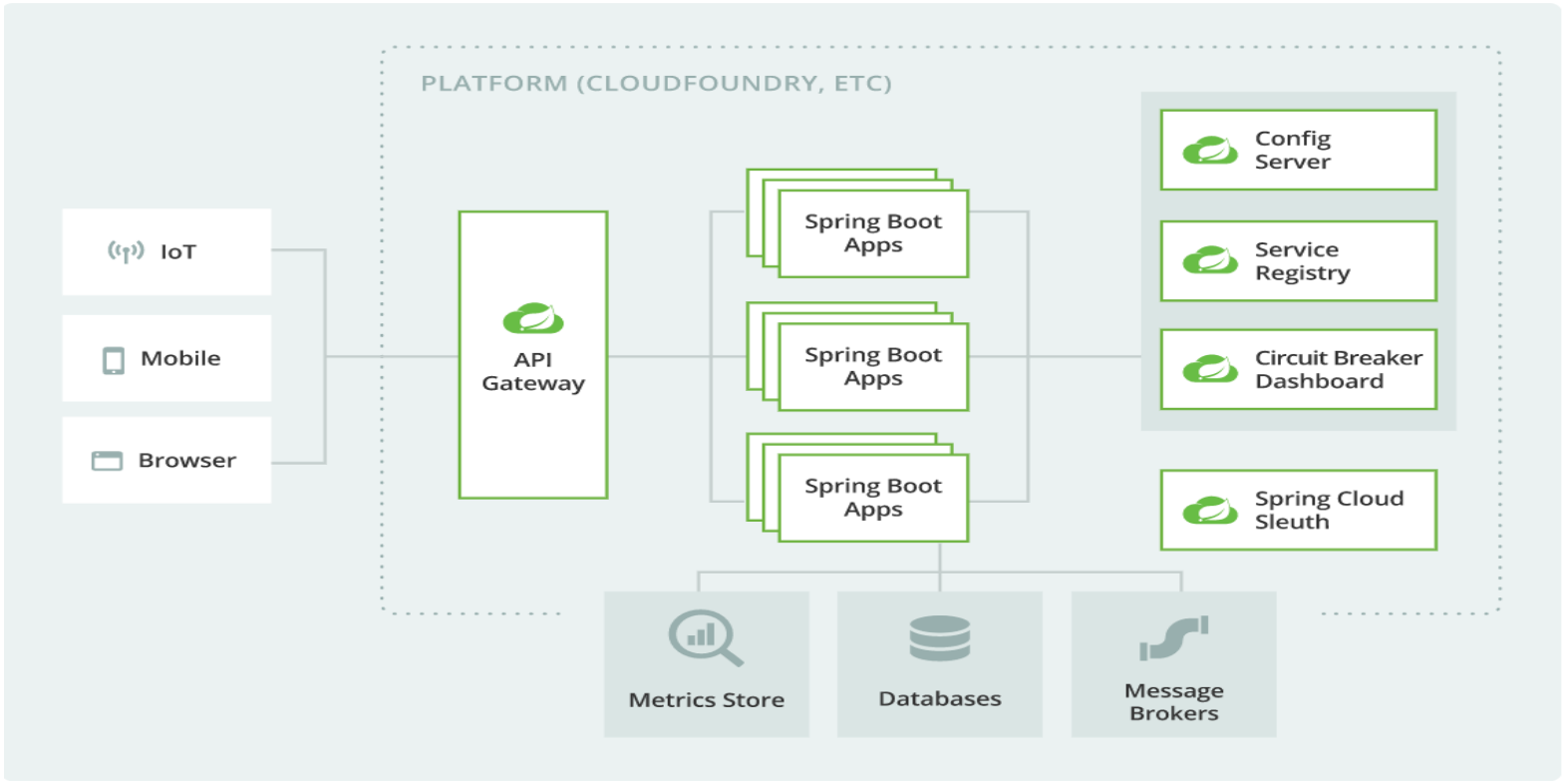
Externalized and Dynamic Configurations

Problem

Configurations will vary from environment to another, How to manage them?

Solution

Centralize your configuration



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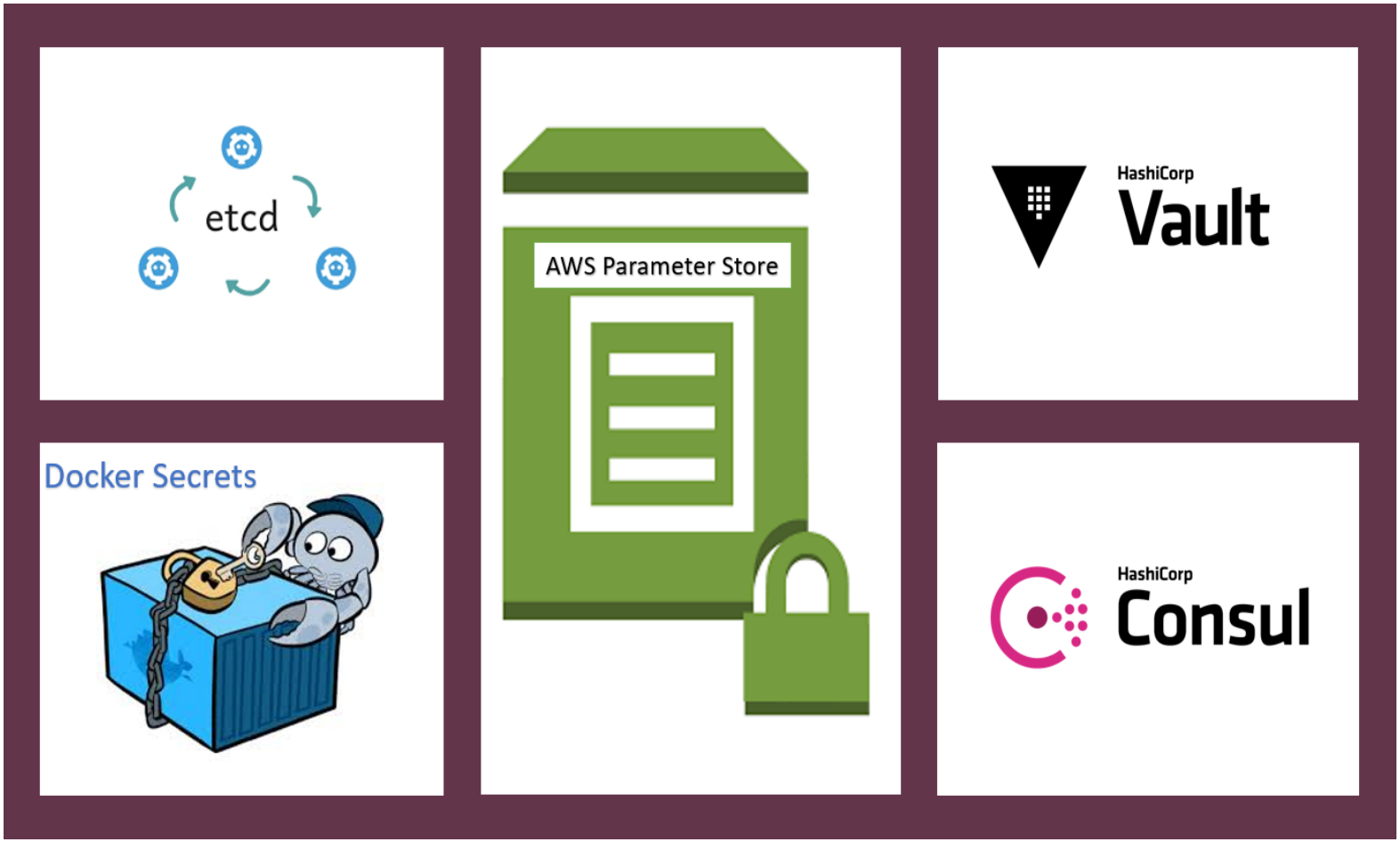


Figure: Popular Config Stores

Circuit Breaker Pattern

Problem

- One of the big differences between in-memory calls and remote calls is that remote calls can fail, or hang without a response until some timeout limit is reached.

Solution

Fault Tolerance

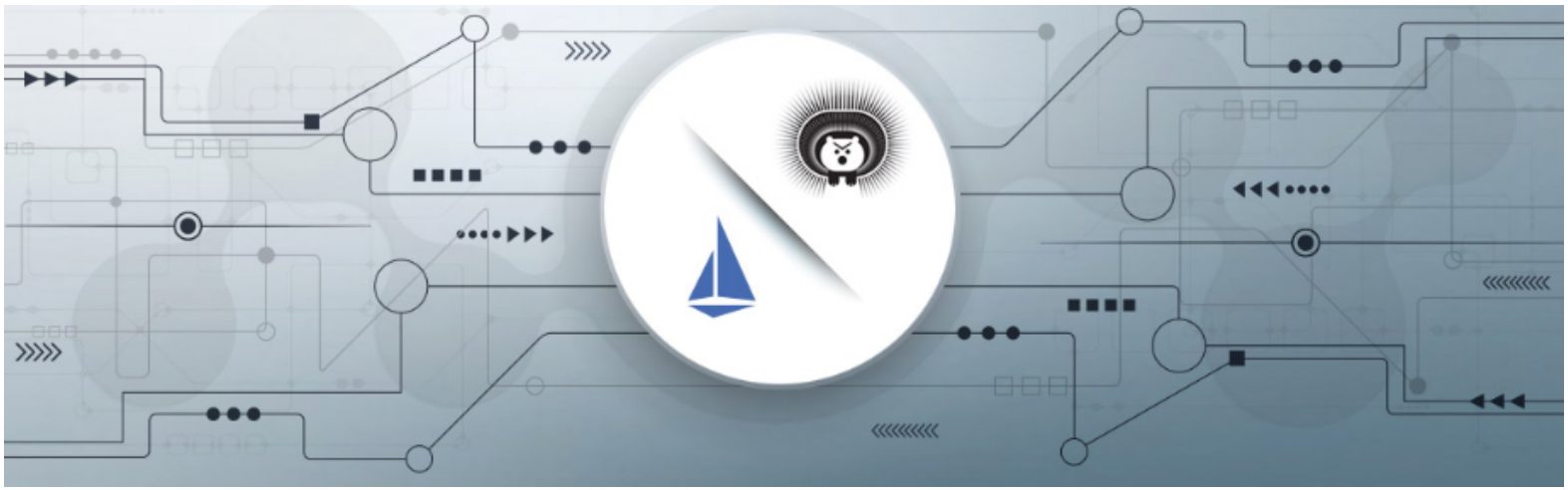


Figure: Circuit Breaker

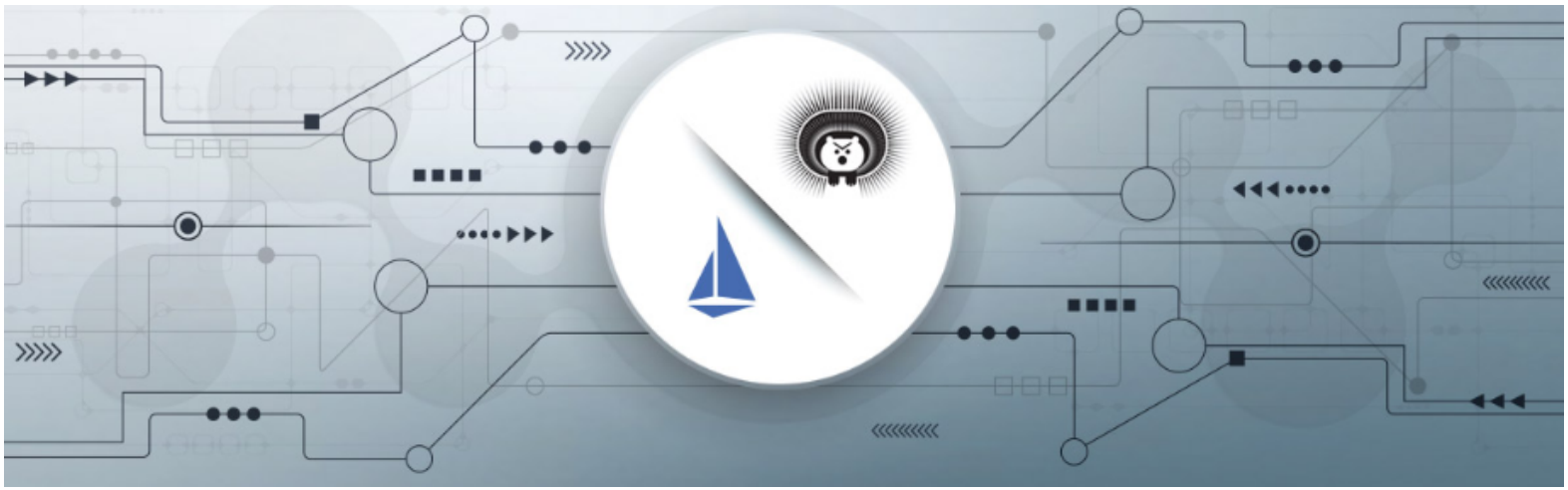
Circuit Breaker Pattern

Problem

- One of the big differences between in-memory calls and remote calls is that remote calls can fail, or hang without a response until some timeout limit is reached.
- What's worse if you have many callers on a unresponsive supplier, then you can run out of critical resources leading to cascading failures across multiple systems.

Solution

Fault Tolerance



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- A good way for this is as mentioned in config talk.

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2    final String URL = "https://10.20.30.90/api/user/";
3    User user = restTemplate.getObject(URL + userId, User.class);
4    ...
5  }
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   - This way you can switch between services smoothly on different environments via configurations provided by the environment.

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Agile

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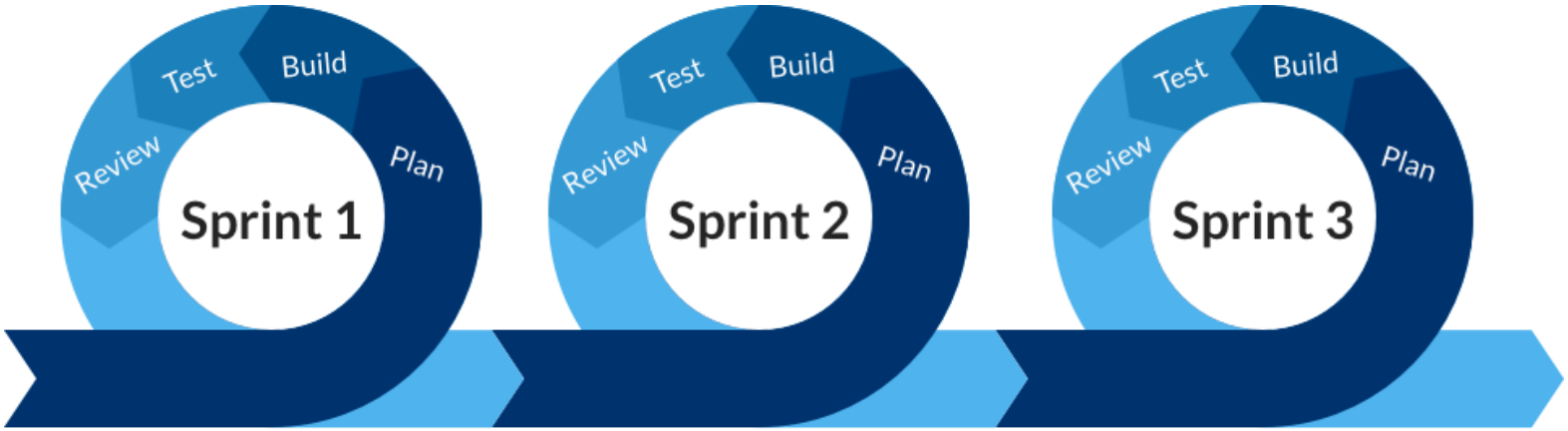

Figure: Agile Methodology

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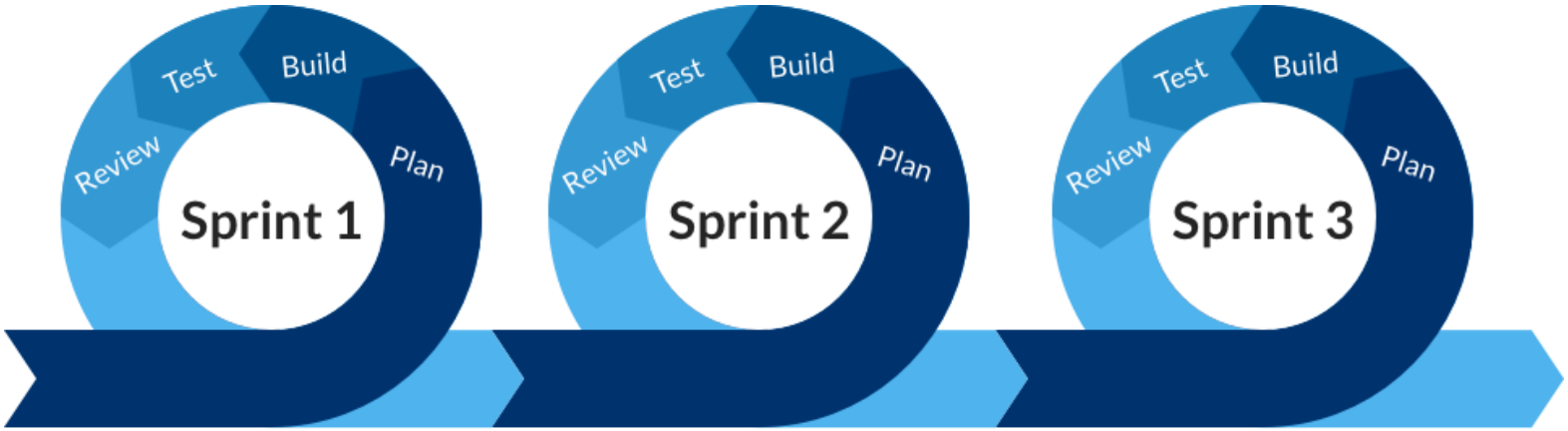

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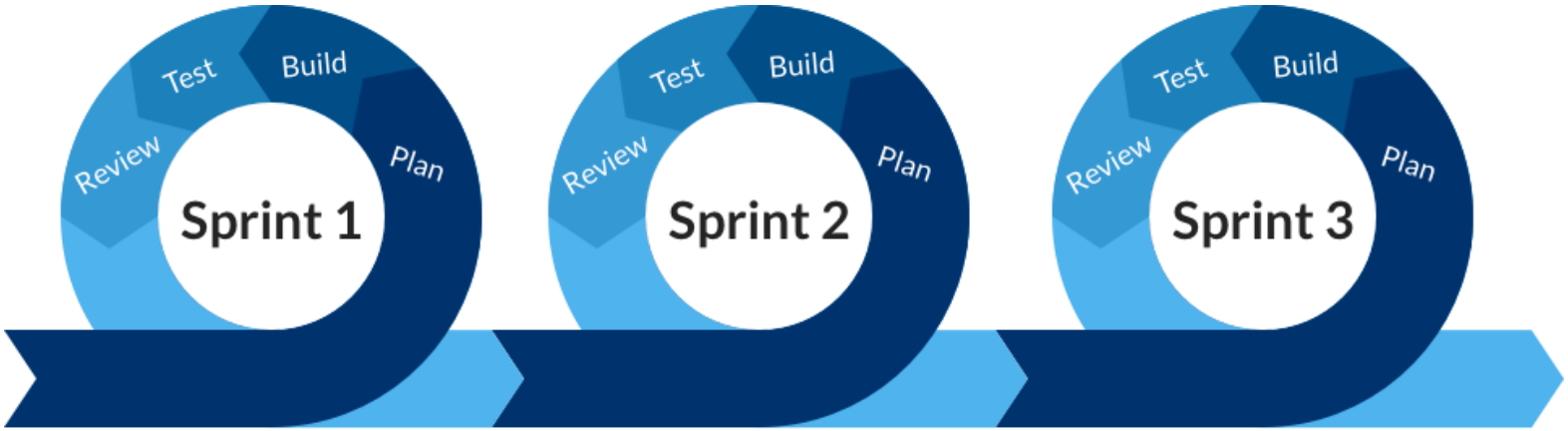

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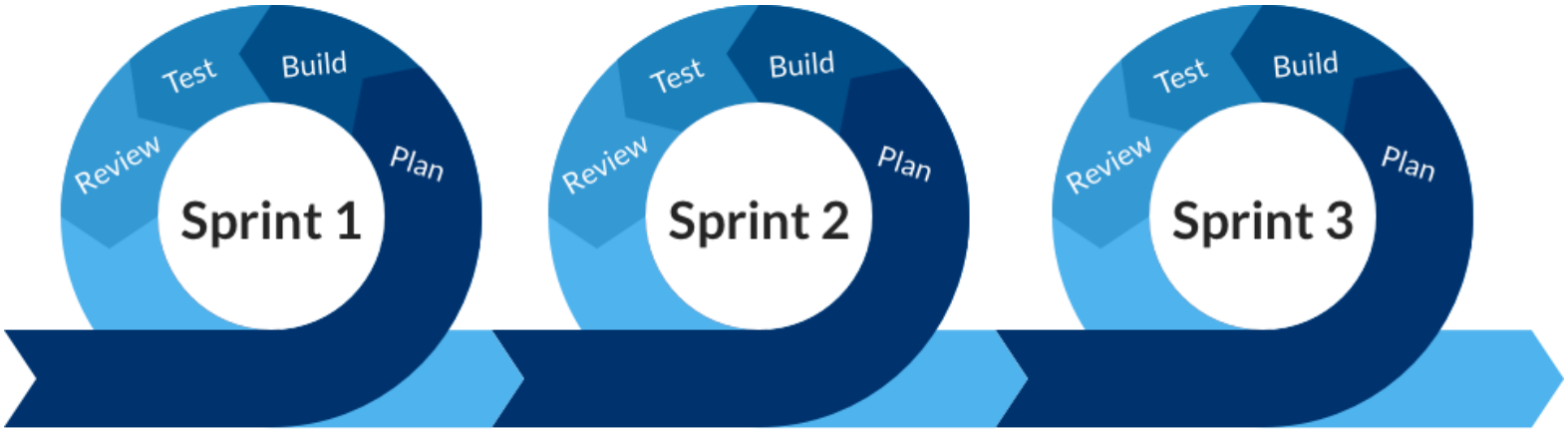
4. Feedback and Retrospective meetings after each sprint is very important



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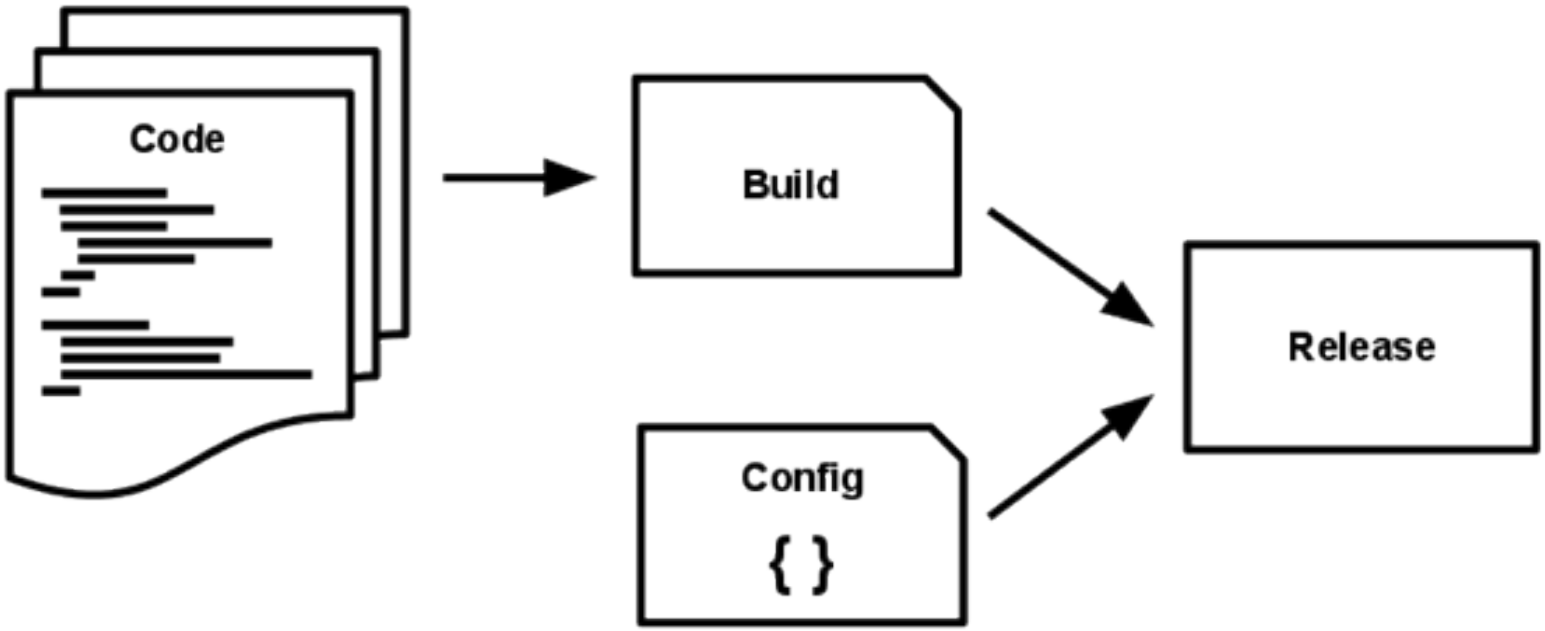
The Twelve-Factor App

5. Build, Release and Run (CI & CD)
   Strictly separate build and run stages. In Microservices, this process is always related directly to development culture; How to be sure each time work will be delivered correctly?



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Continuous Delivery, “JEZ HUMBLE“ & “DEVID FARLEY“

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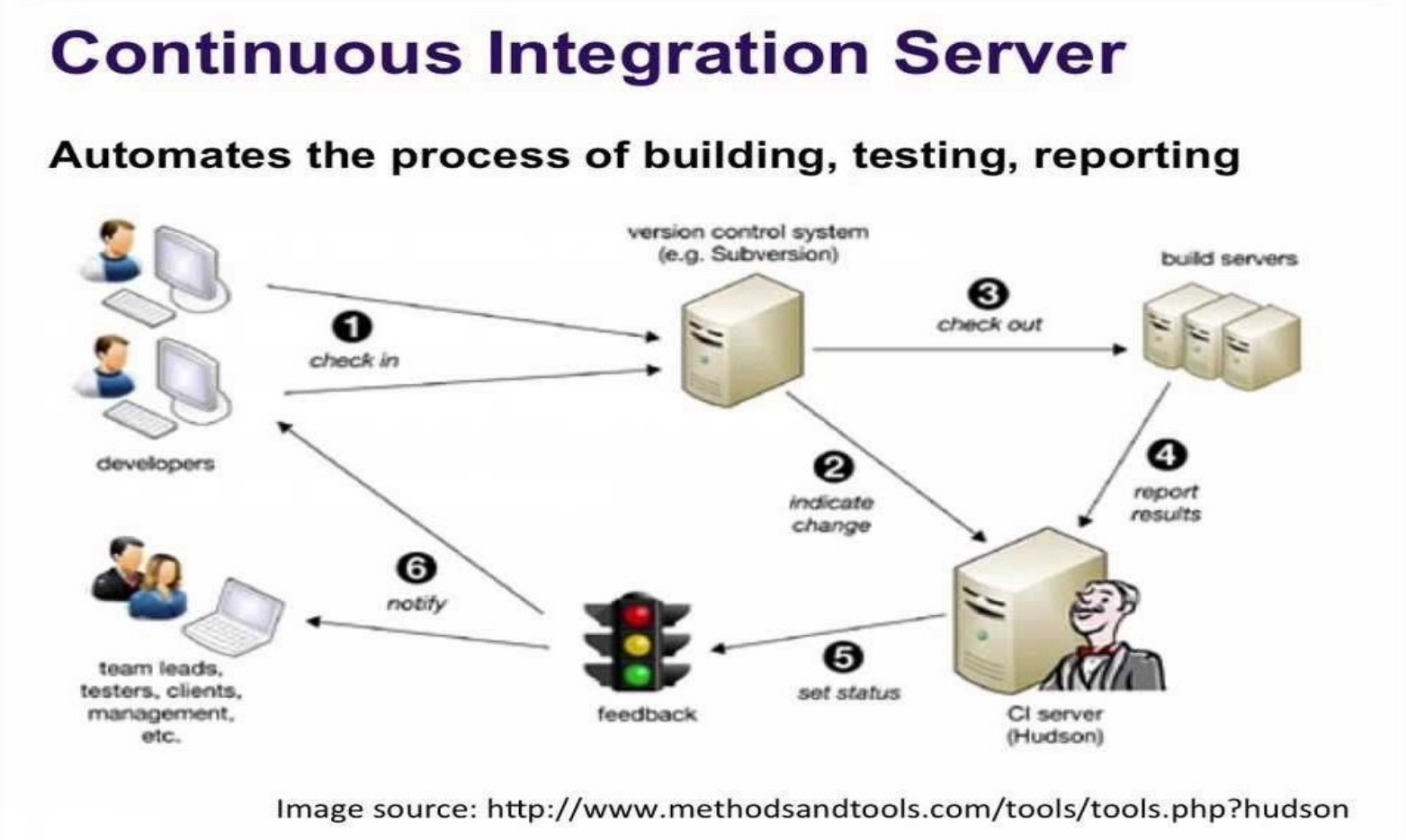

Figure: CI Workflow

The Twelve-Factor App

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     - Using tagging, unique IDs and timestamp will be the only way to apply rollback if you want.

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The Twelve-Factor App

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The Twelve-Factor App

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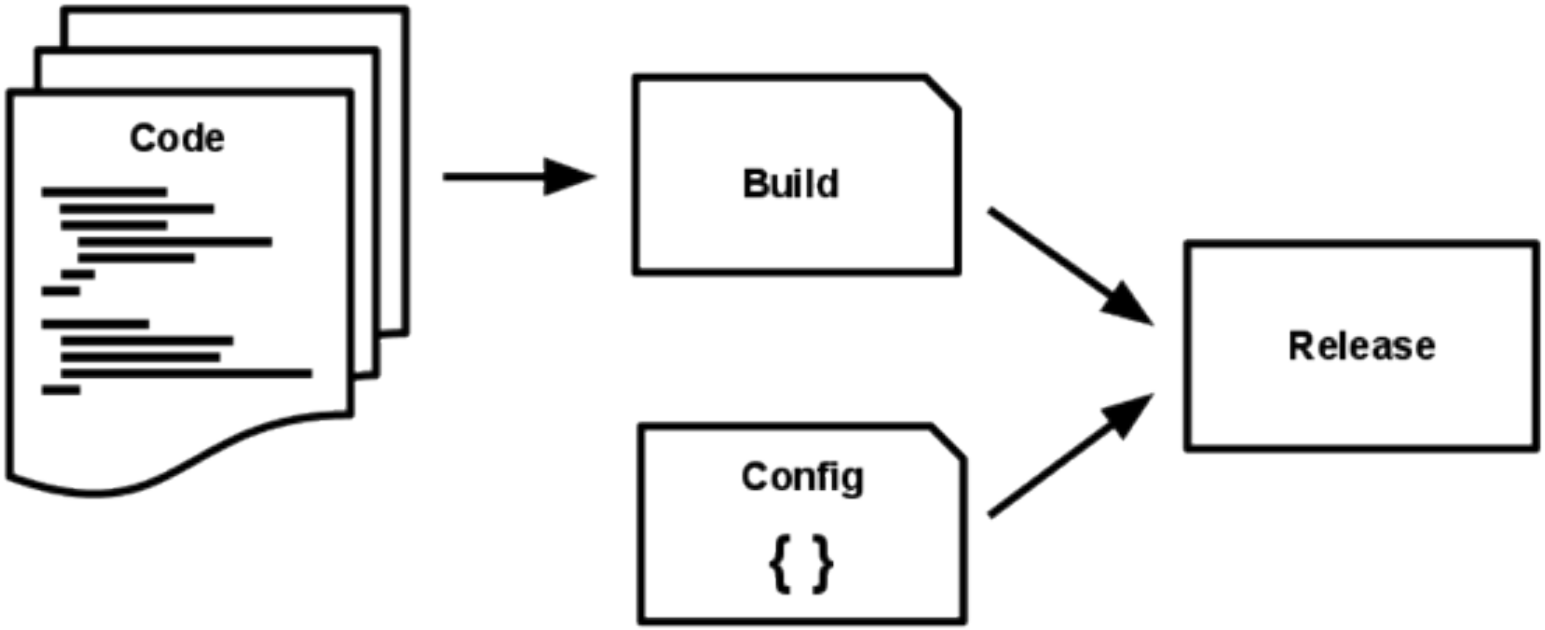
   Strictly separate build and run stages. In Microservices, this process is always related directly to development culture; How to be sure each time work will be delivered correctly?



The Twelve-Factor App

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   - Session state data is a good candidate for a datastore that offers time-expiration, such as Memcached or Redis.
   - It is important to know also that, Microservices must be totally stateless, and there is no way to keep state for backend services http requests.

The Twelve-Factor App

7. Port Binding
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The Twelve-Factor App

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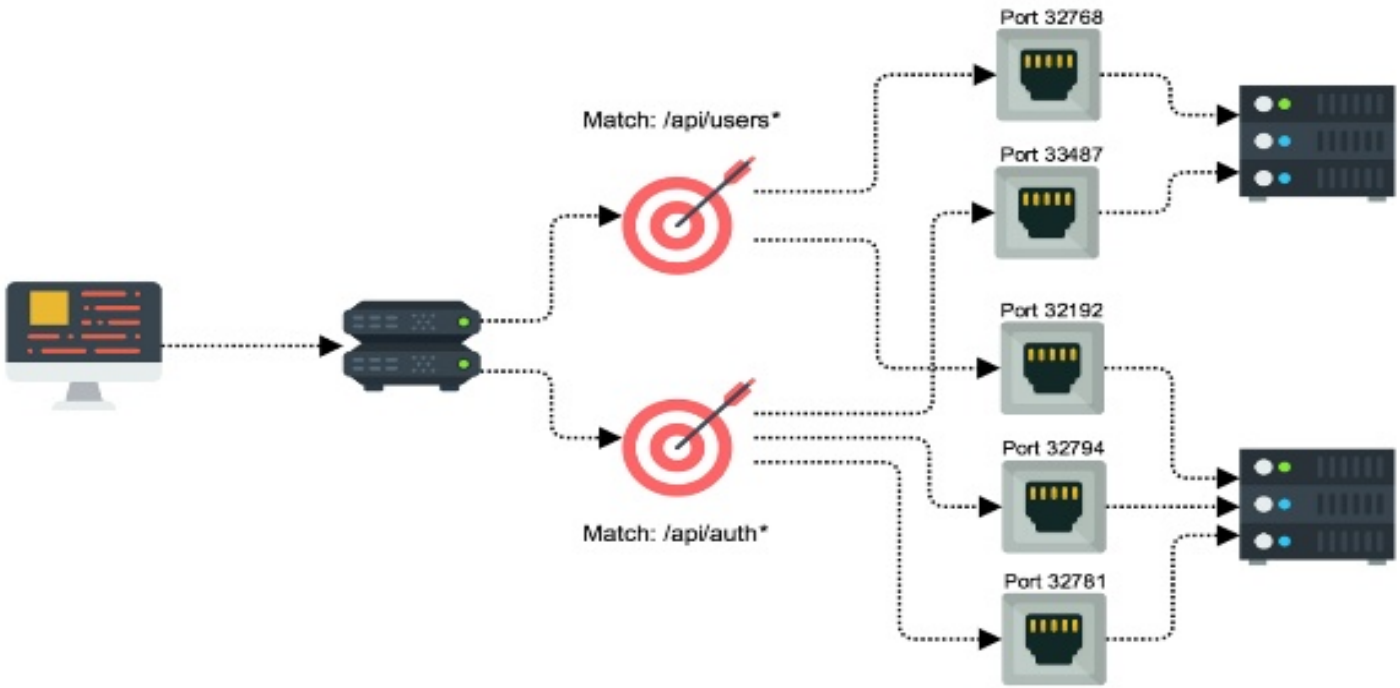

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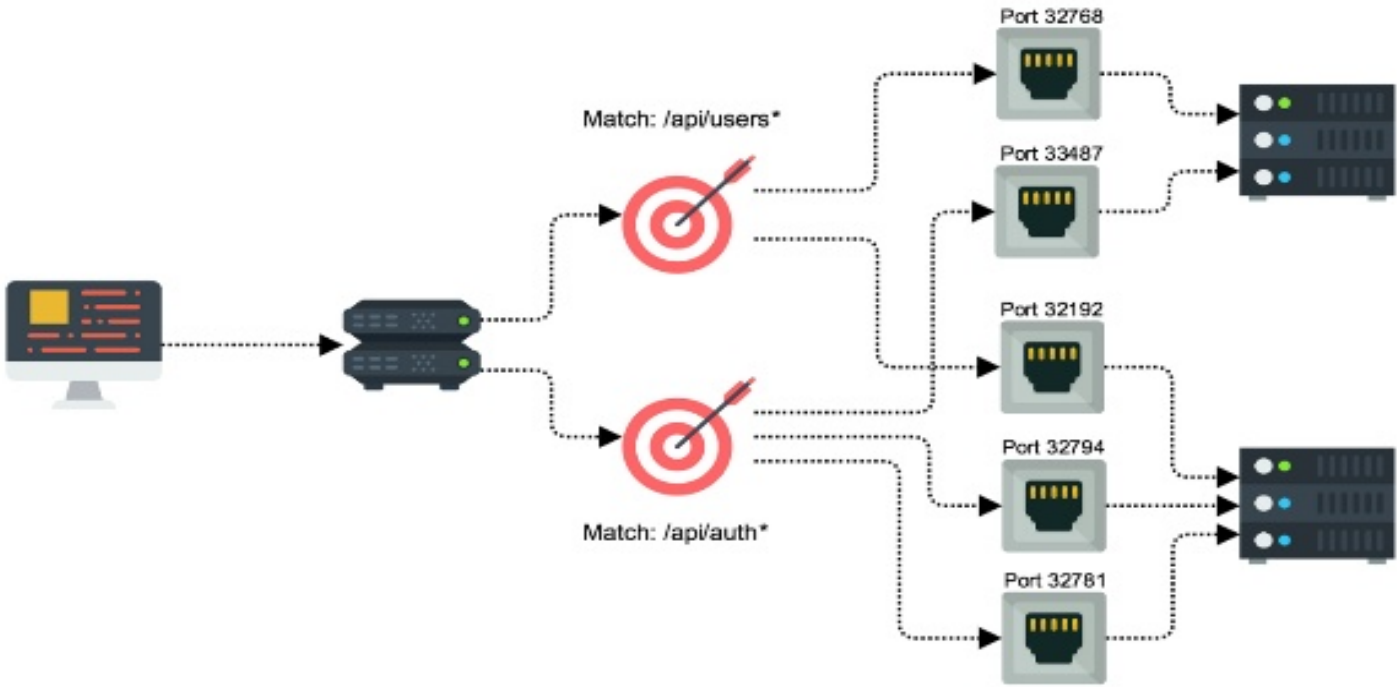

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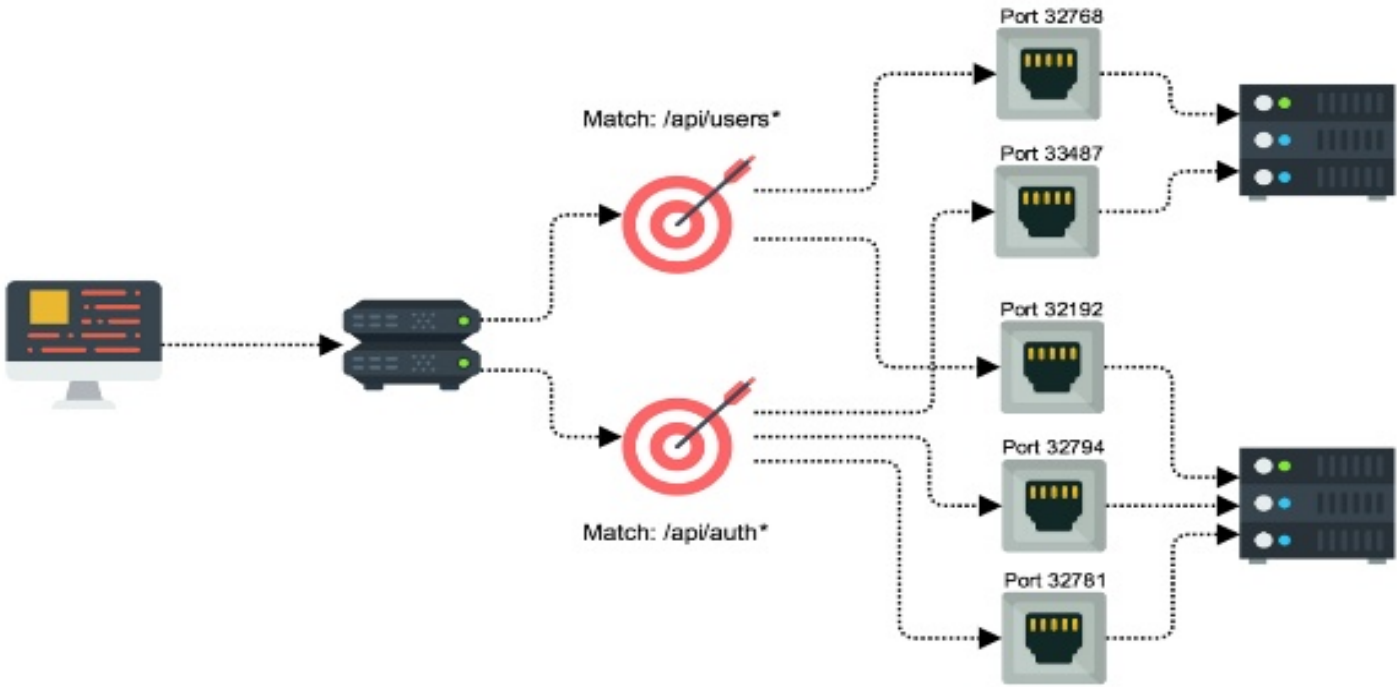
- In deployment, a routing layer handles routing requests from a public-facing hostname to the port-bound web processes.



Data Sharing and Management

In old monilithic style, life was someway easy, but with microservices data management; you need to play harder.

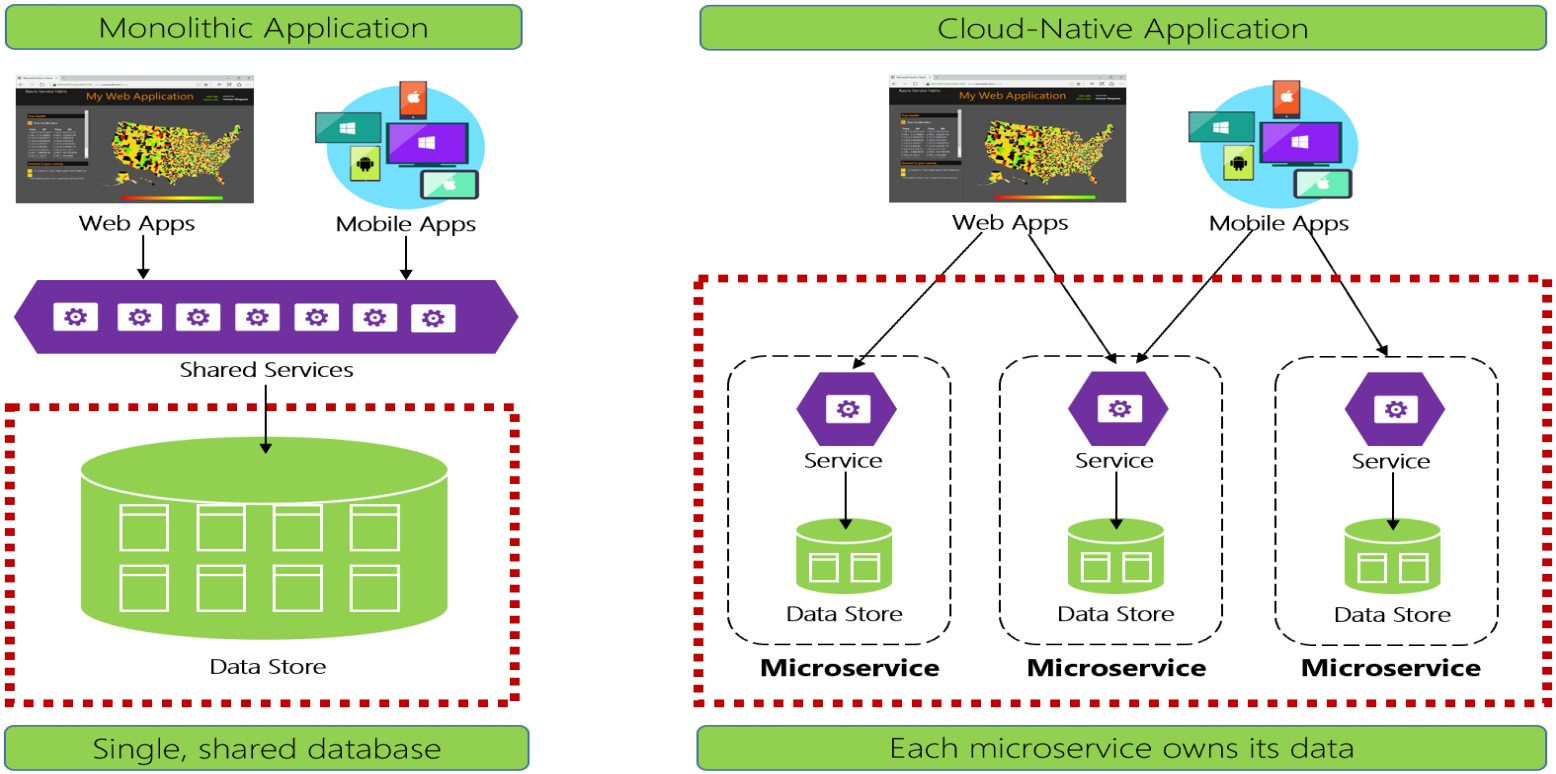


Figure: Distributed Data Architecture

https://docs.microsoft.com/en-us/dotnet/architecture/cloud-native/distributed-data

Data Sharing and Management

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The more simple and focused service you have, the easier management you get. A perfect way to do that, is applying DDD principles.

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While encapsulating data into separate microservices can increase agility, performance, and scalability, it also presents many challenges.

Data Sharing and Management

Cross-Service Queries

Usually you need to integrate to get\query data from other services

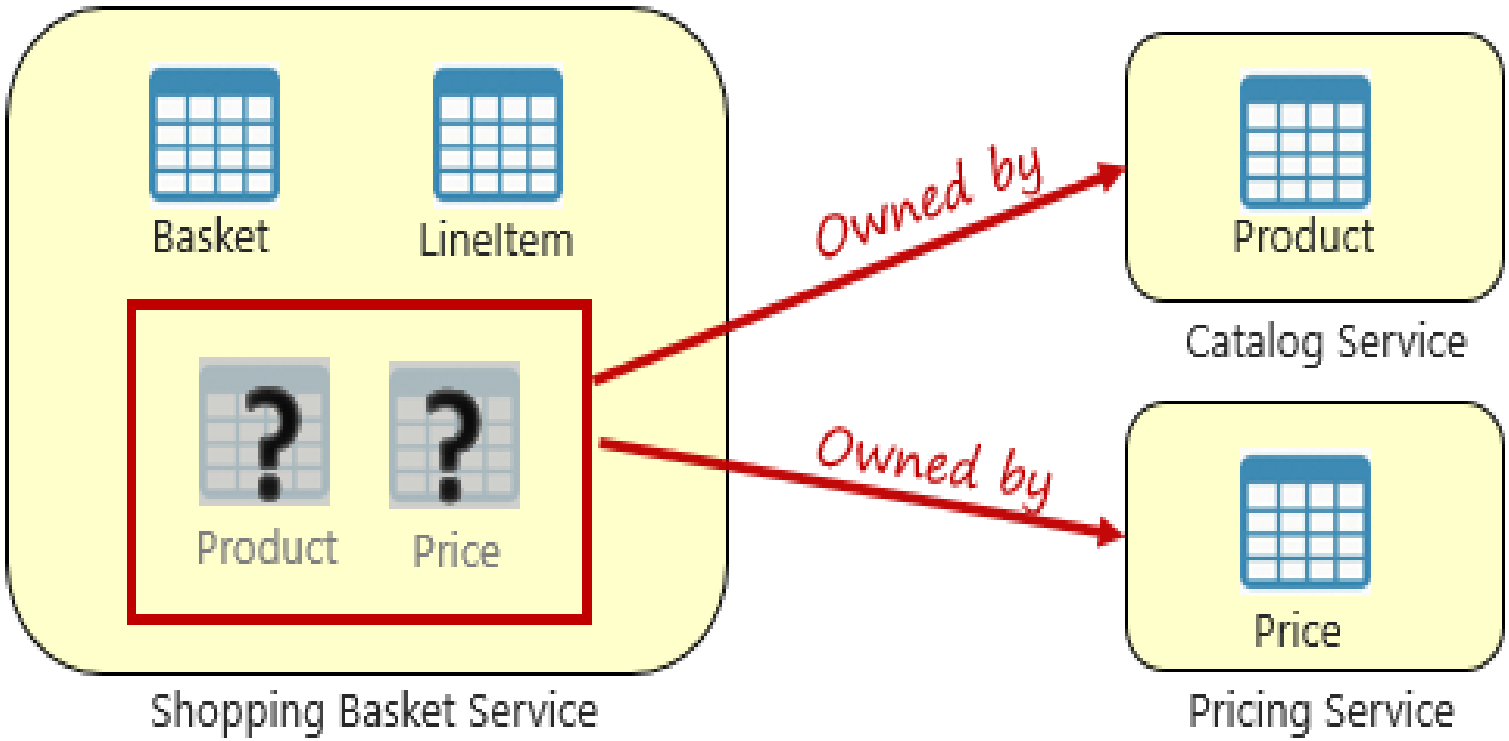

Figure: Querying across microservices

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- If the data volume is huge, and is not changed quickly, good way to use is

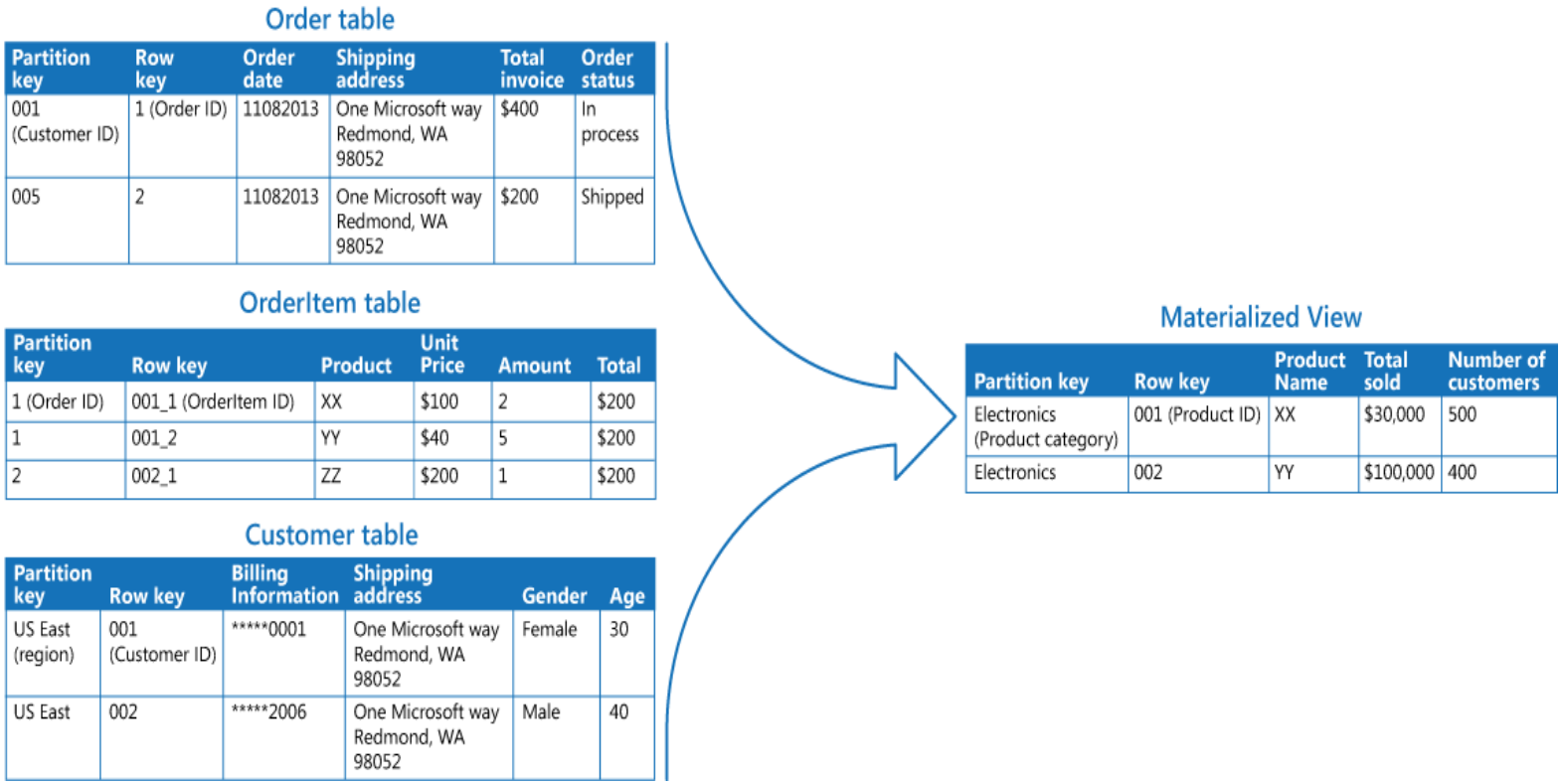

Figure: Materialized Views Pattern

Distributed Transactions

We move from a world of **immediate consistency** to that of **eventual consistency**
That is; in microservices. You can't depend on ACID transaction, but
BASE which is acronym for **B**asic **A**vailability, **S**oft-state, and **E**ventual consistency

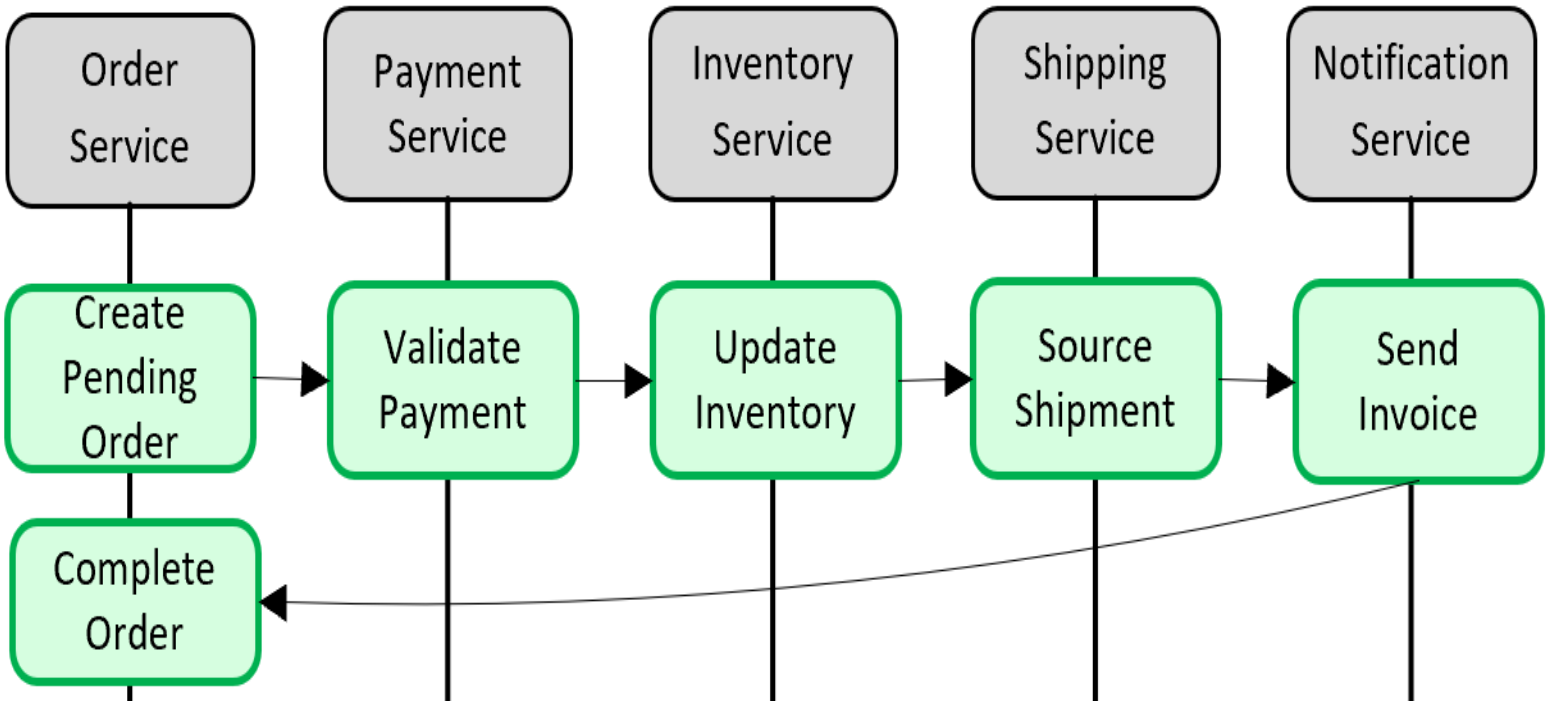

Figure: Transaction across microservices

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Data Sharing and Management

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https://www.sciencedirect.com/topics/computer-science/two-phase-commit

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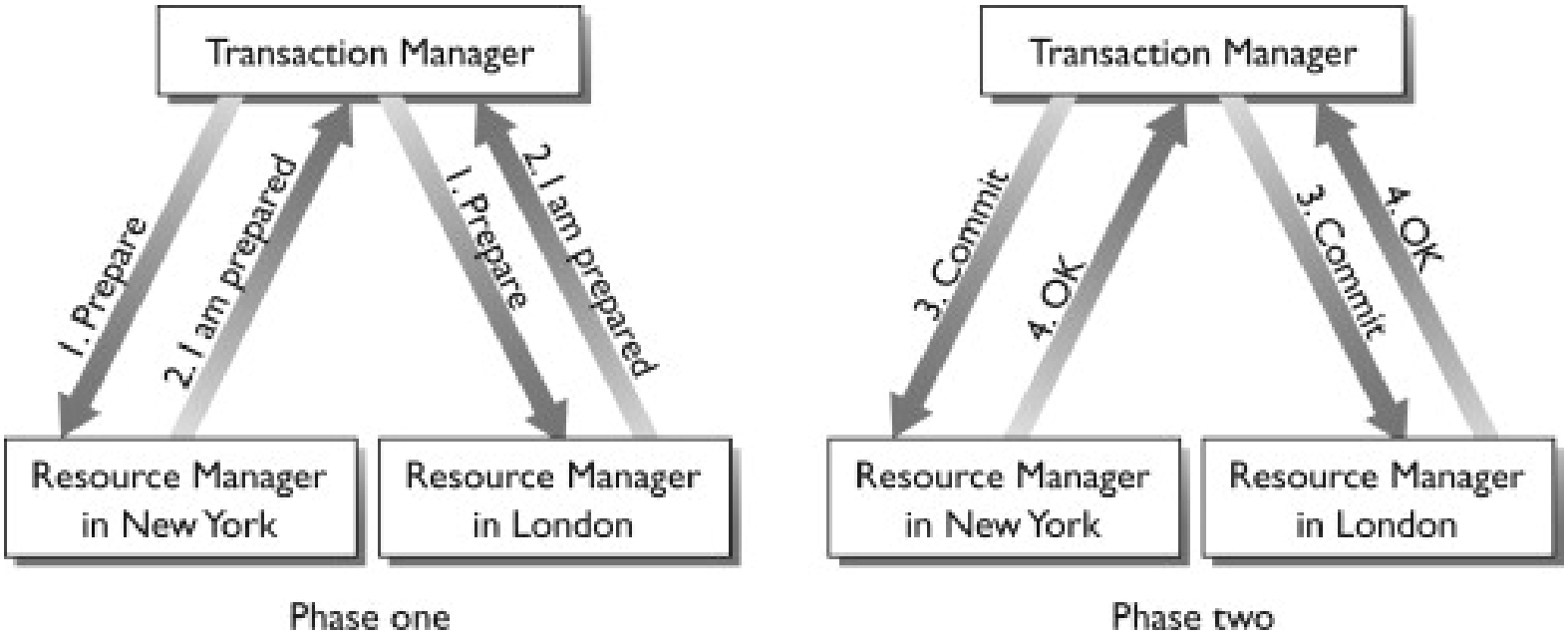

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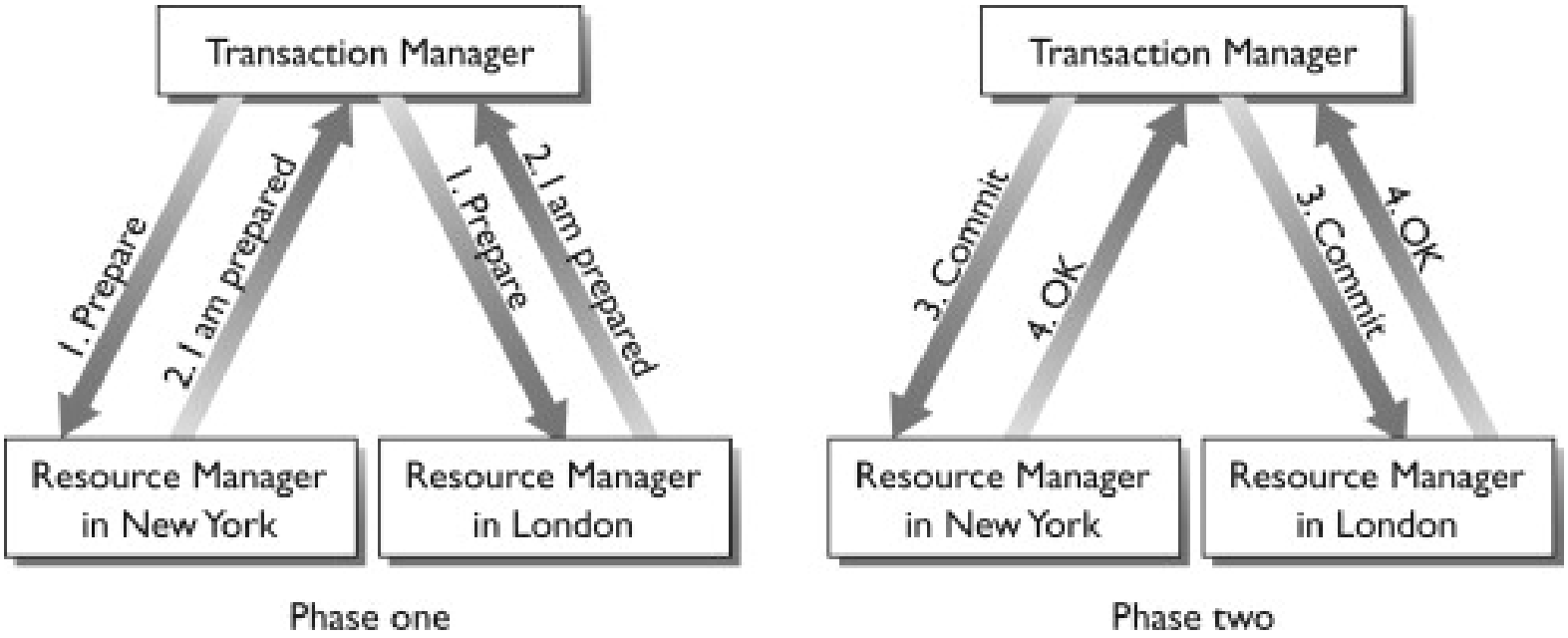

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- In real case, this is impractical, and will lead to locking and time consuming issue

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- The big father of this approach is **Saga pattern**

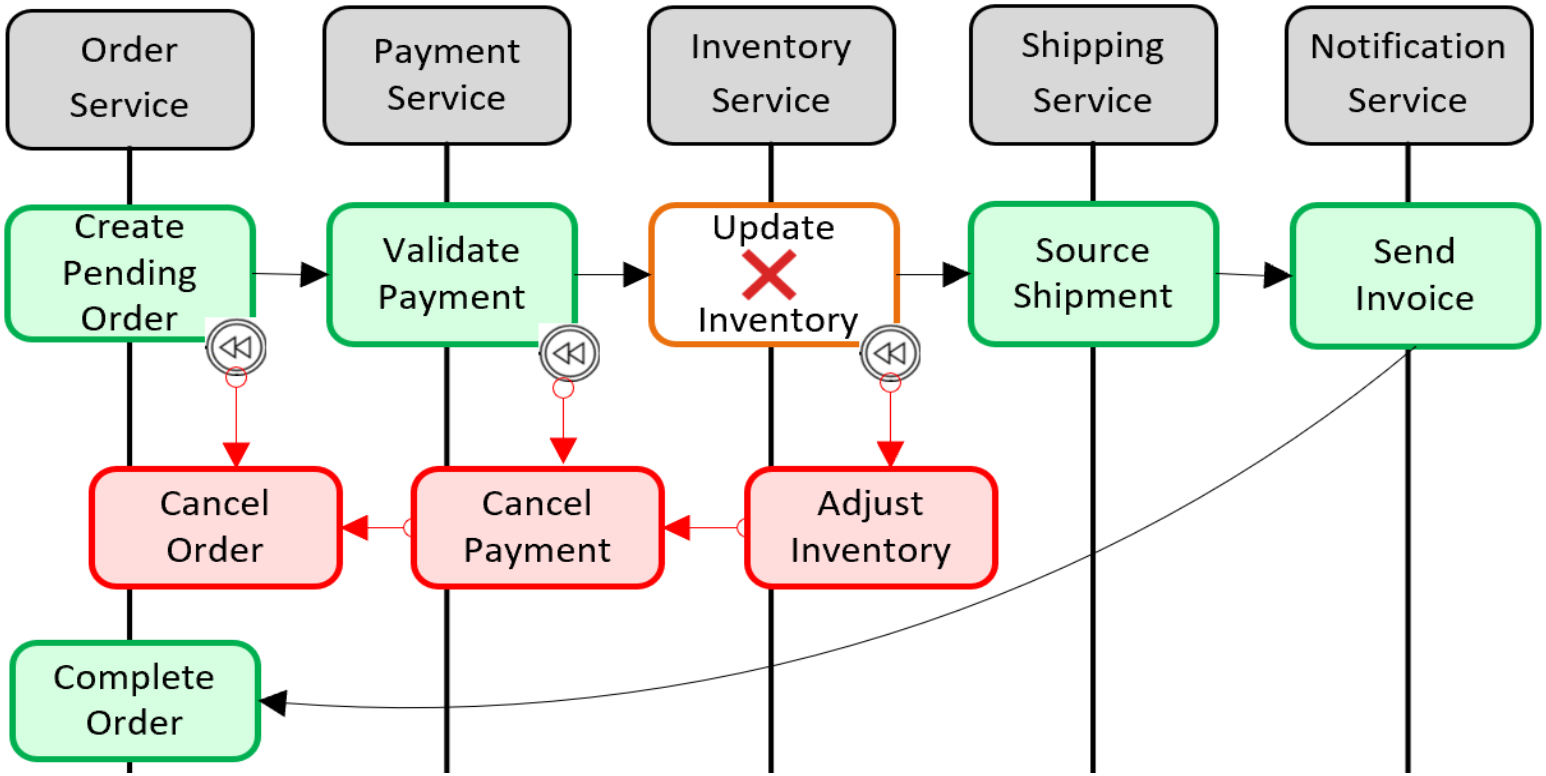

Figure: Rolling back a transaction

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Command and Query Responsibility Segregation (**CQRS**)

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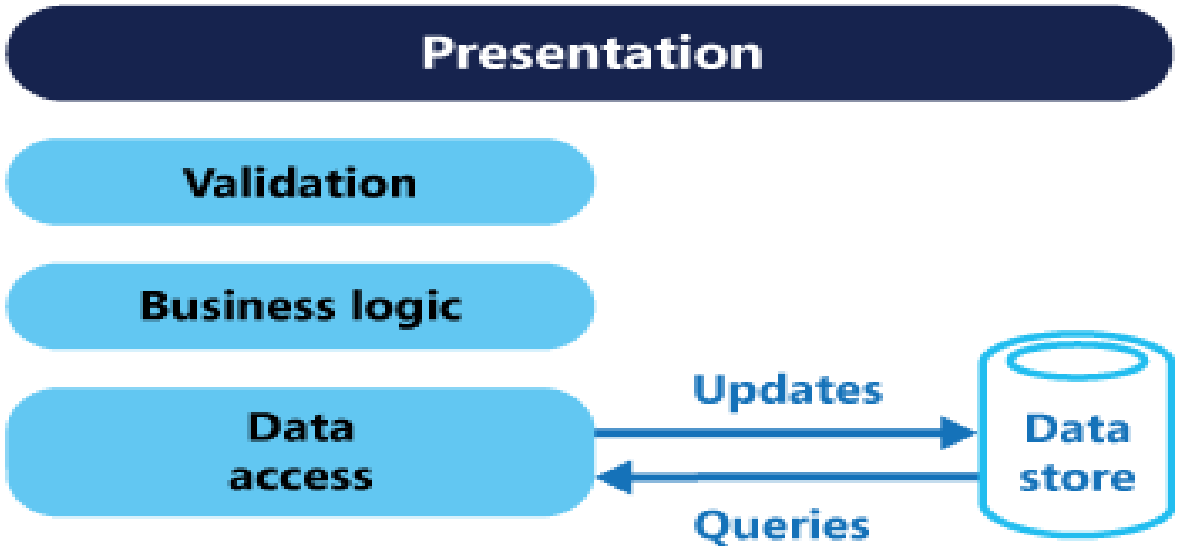

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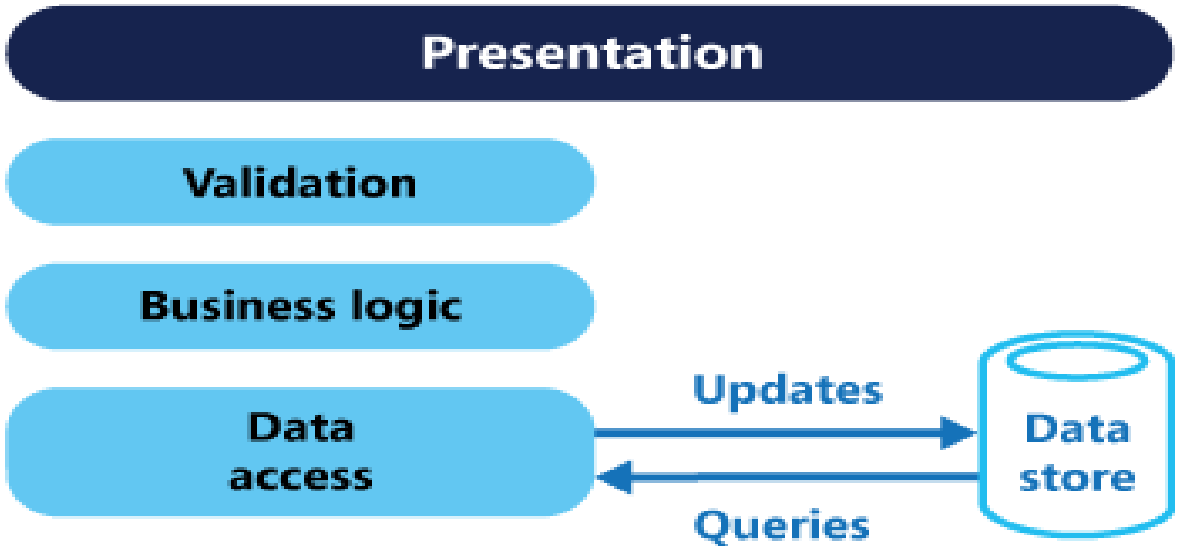

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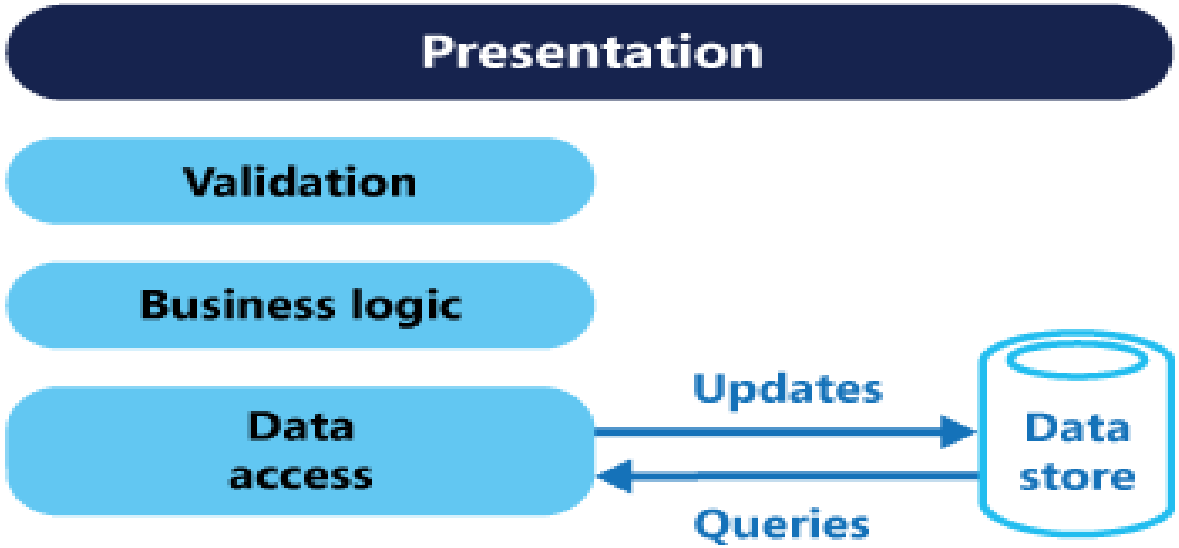

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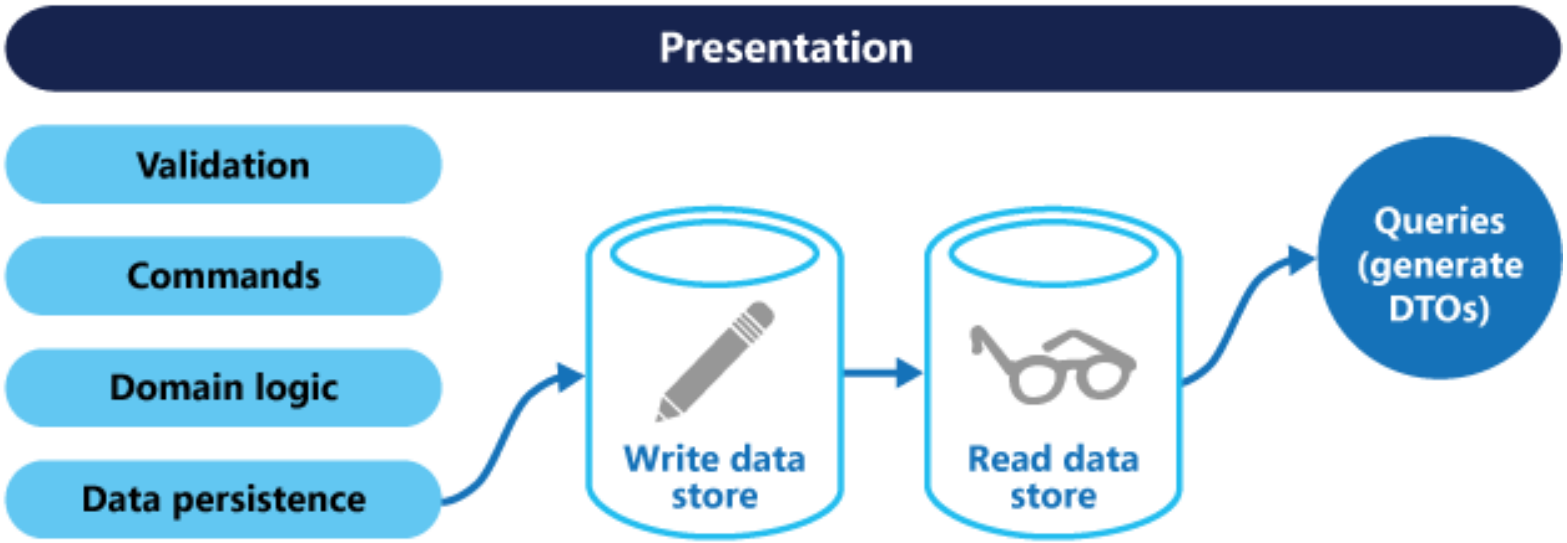

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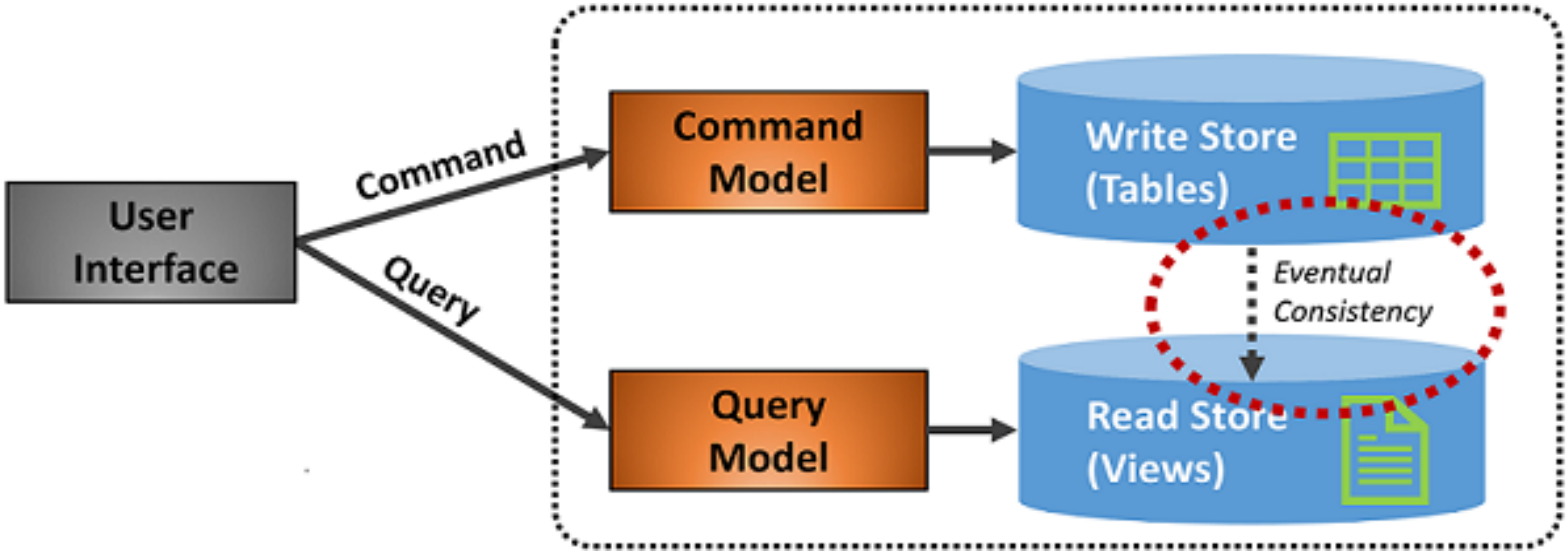

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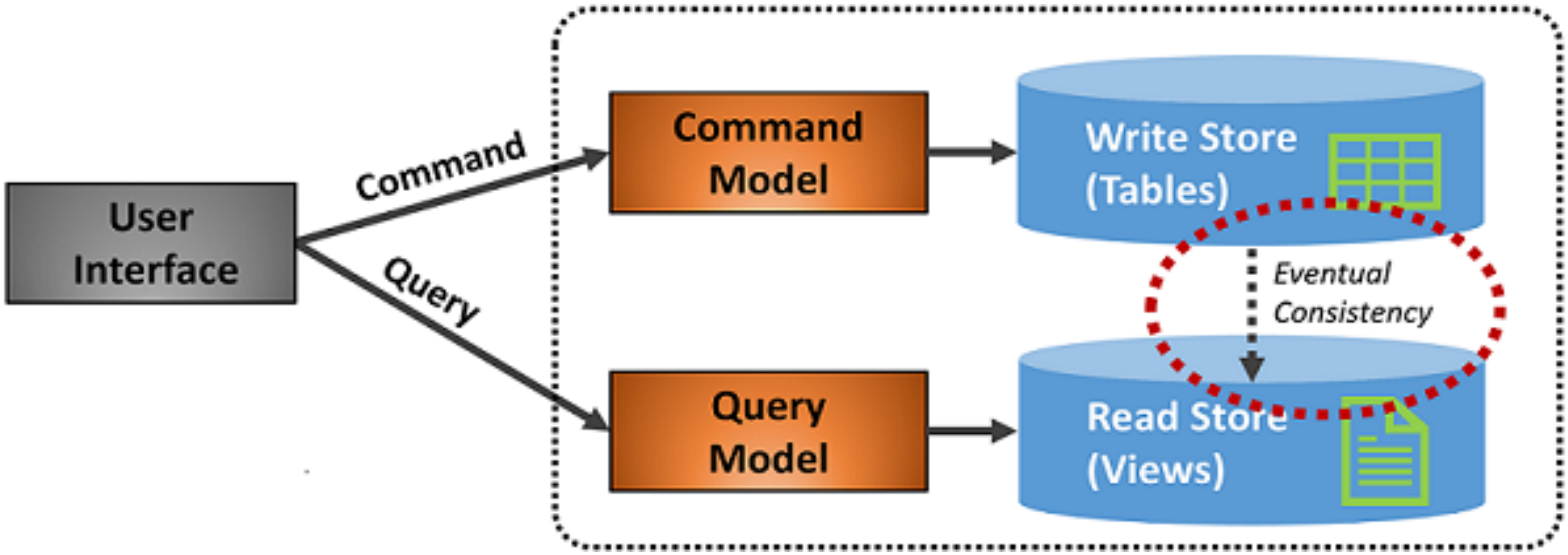
- A good way to achieve this, is to use **Event Sourcing Pattern**



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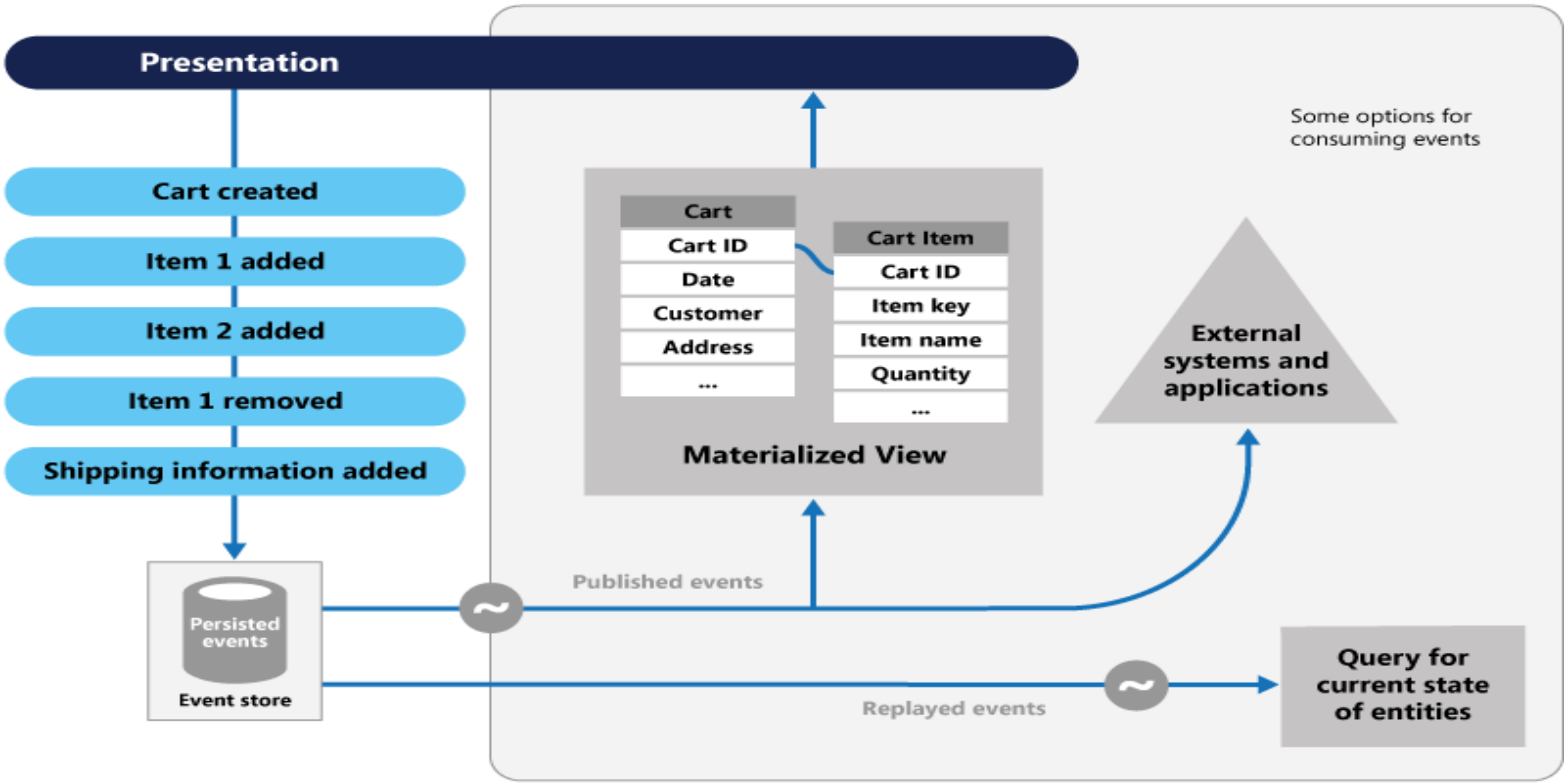
- An approach to handling operations on data that's driven by a sequence of events, each of which is recorded in an **append-only store**



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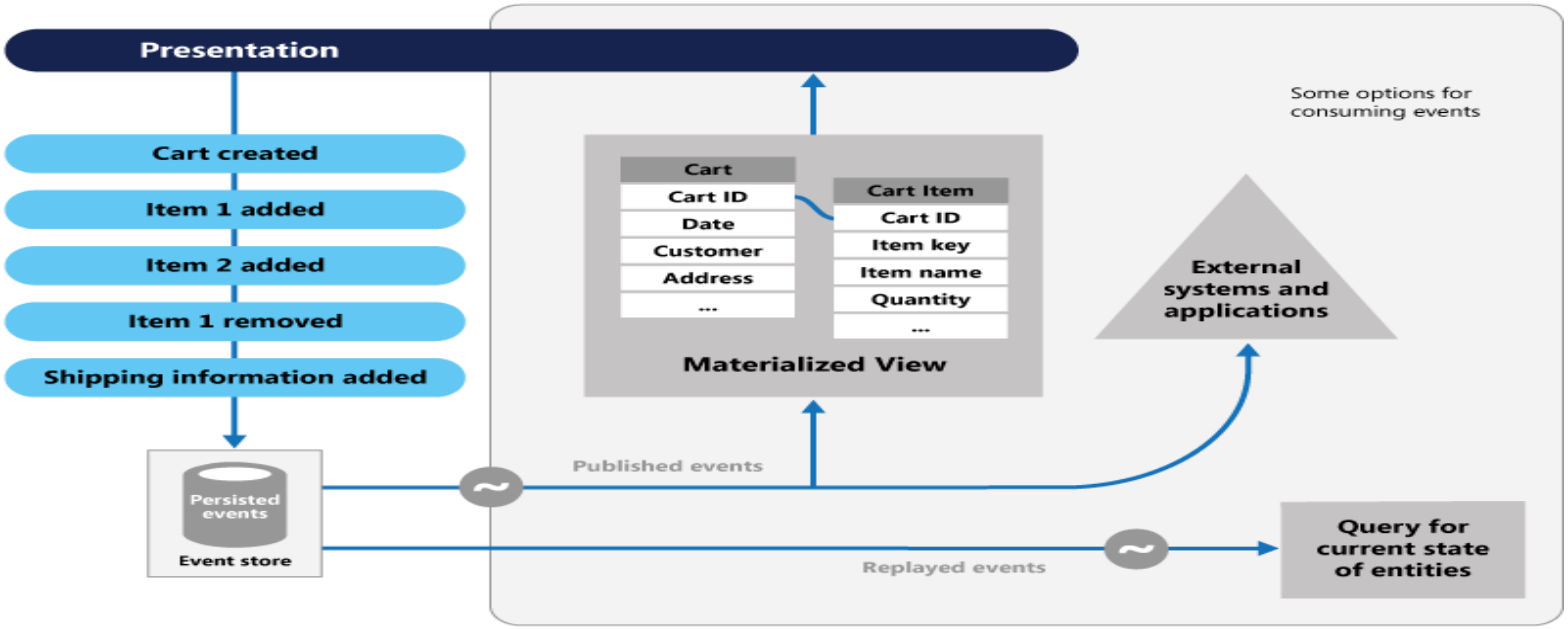

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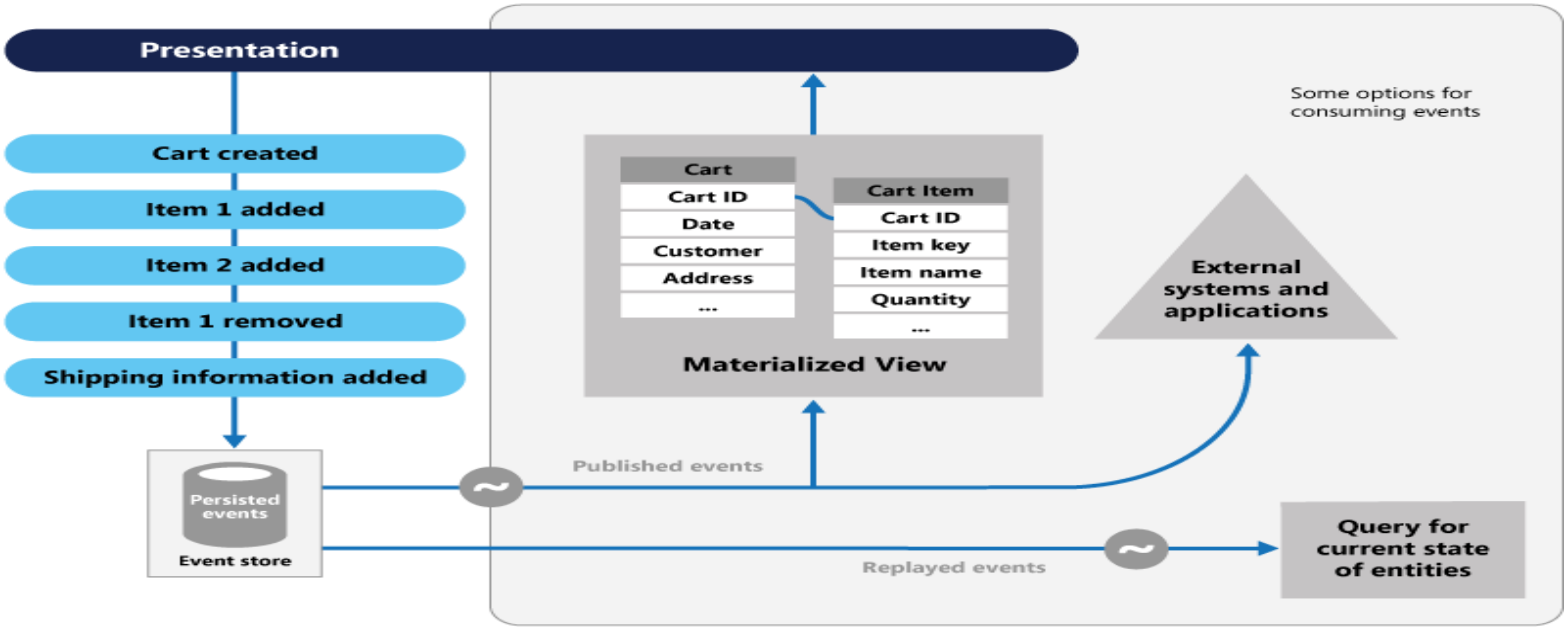

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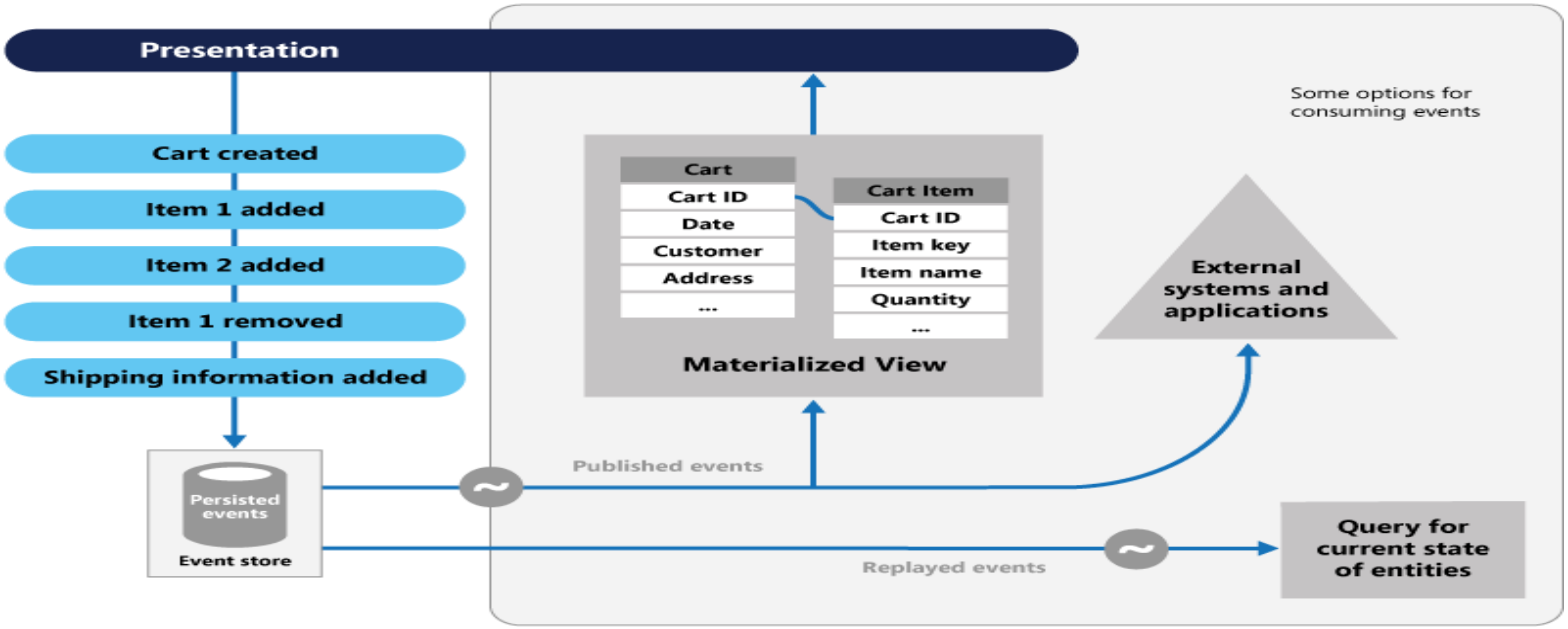

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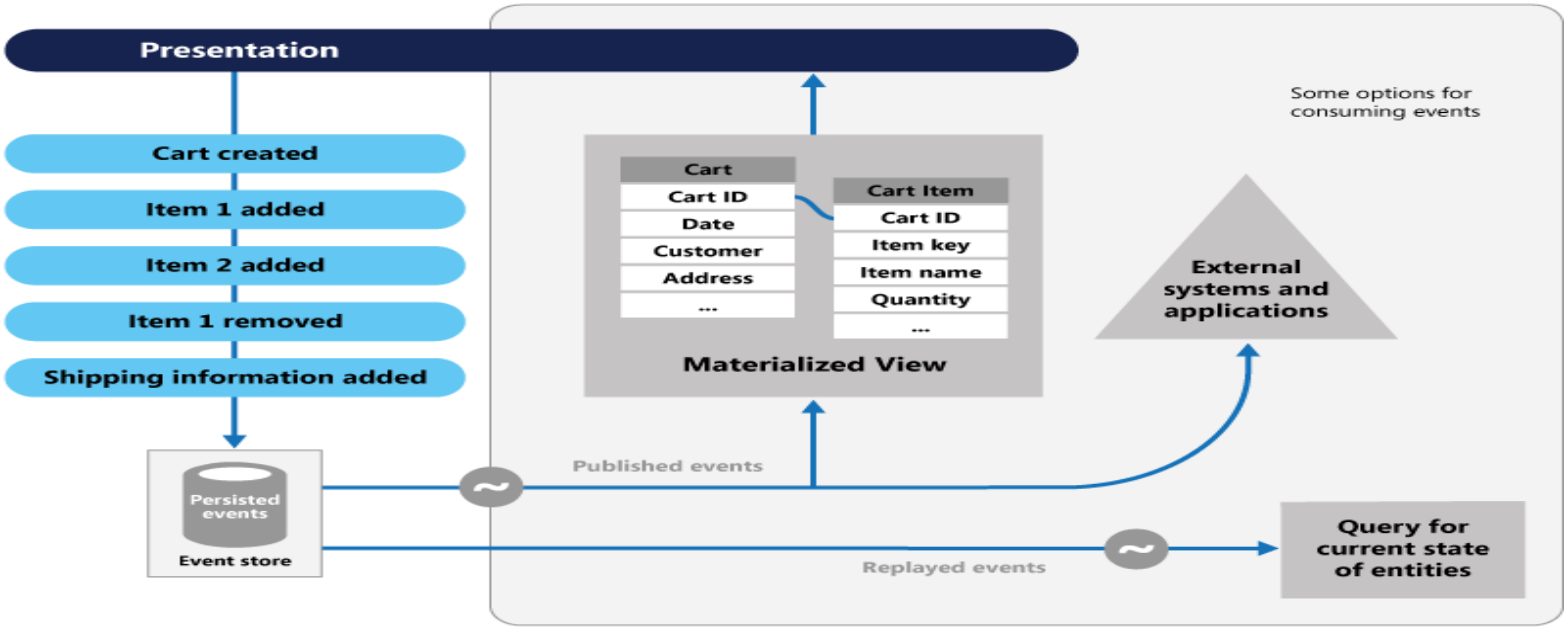
- Log history which is fundamental need in any project



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Event Sourcing Pattern

By applying this pattern, you will have

- Better performance, that is your the application code that generates the events will be decoupled from the actual code
- More power to scale up!
- Log history which is fundamental need in any project
- prevent concurrent updates from causing conflicts because it avoids the requirement to directly update objects in the data store

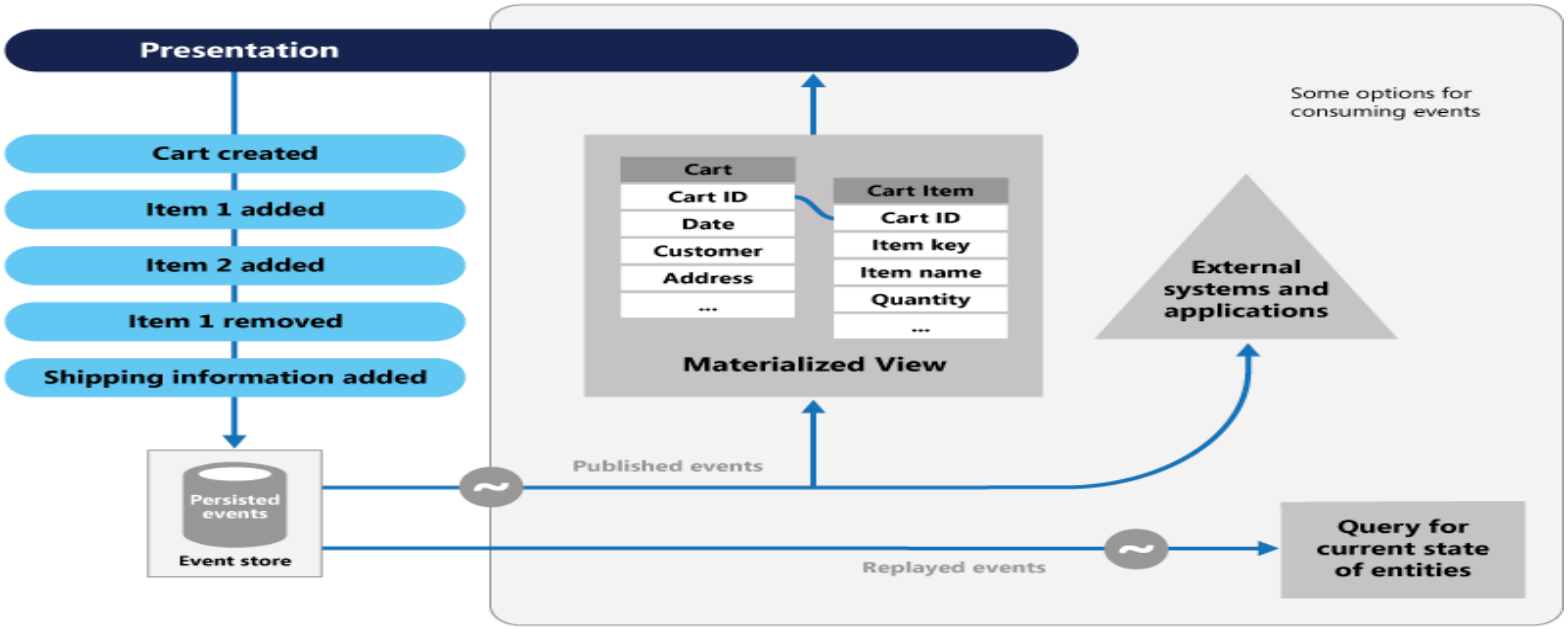

Figure: Event Sourcing

Data Sharing and Management

Caching Pattern

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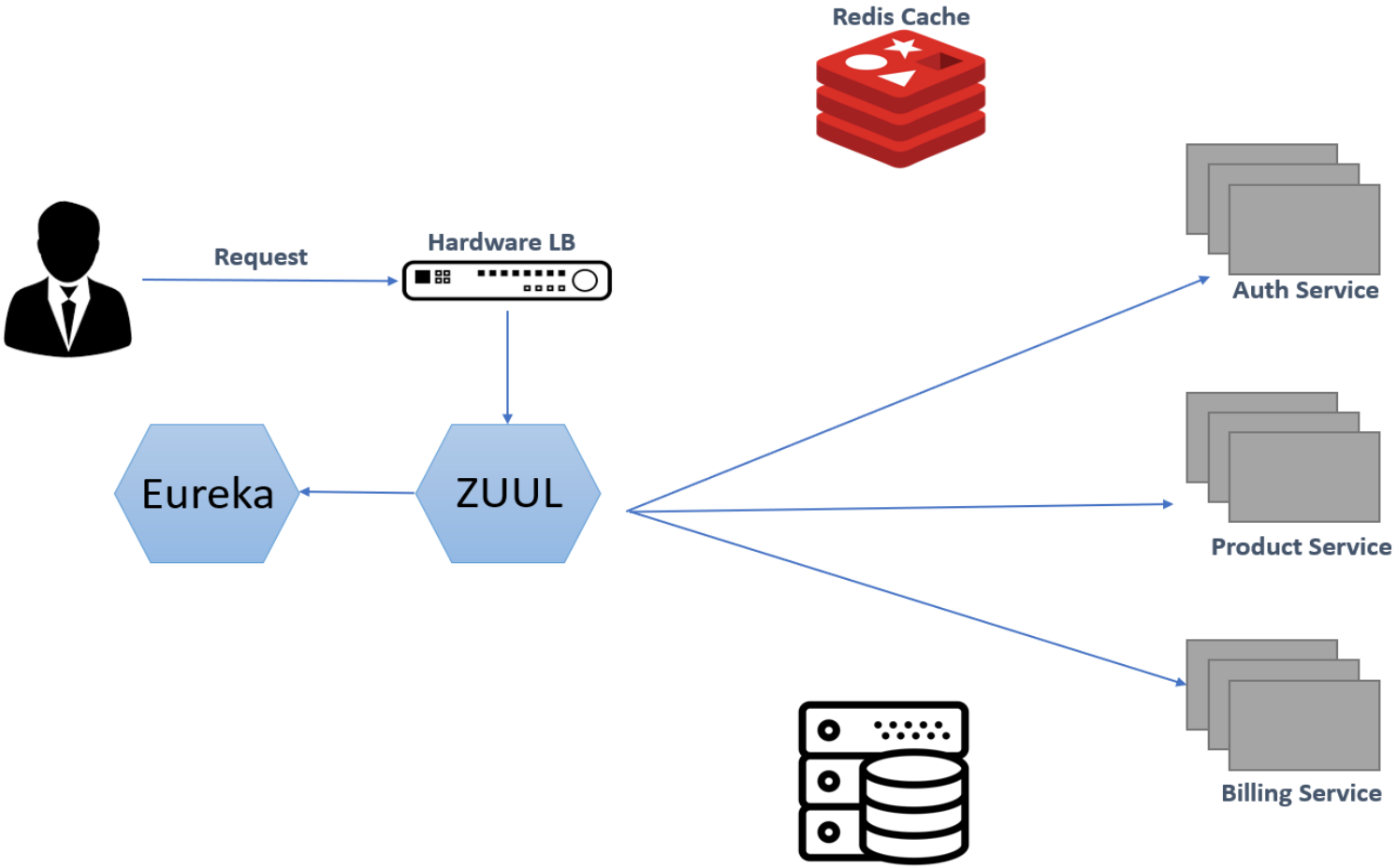

Figure: Typical Scenario

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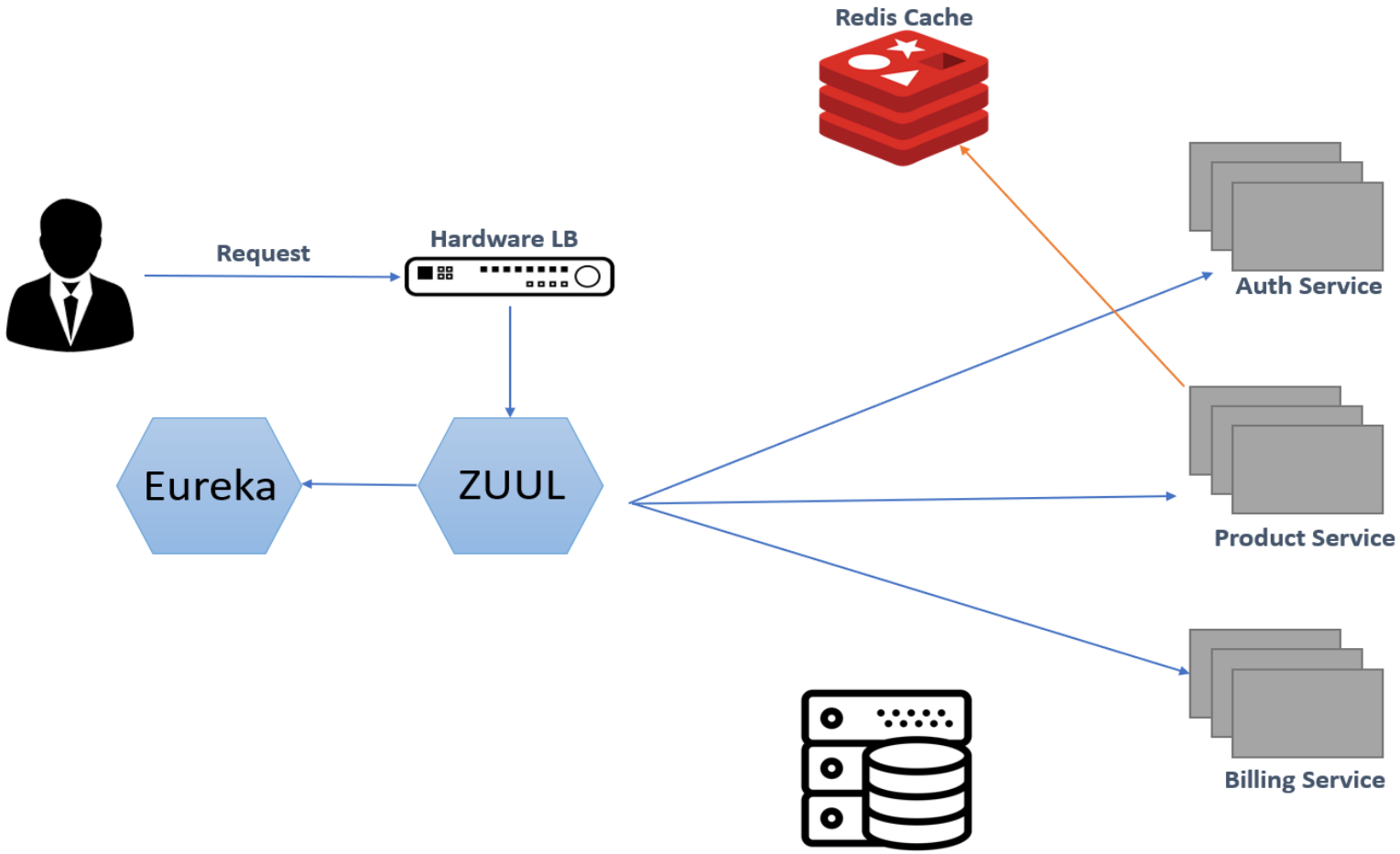

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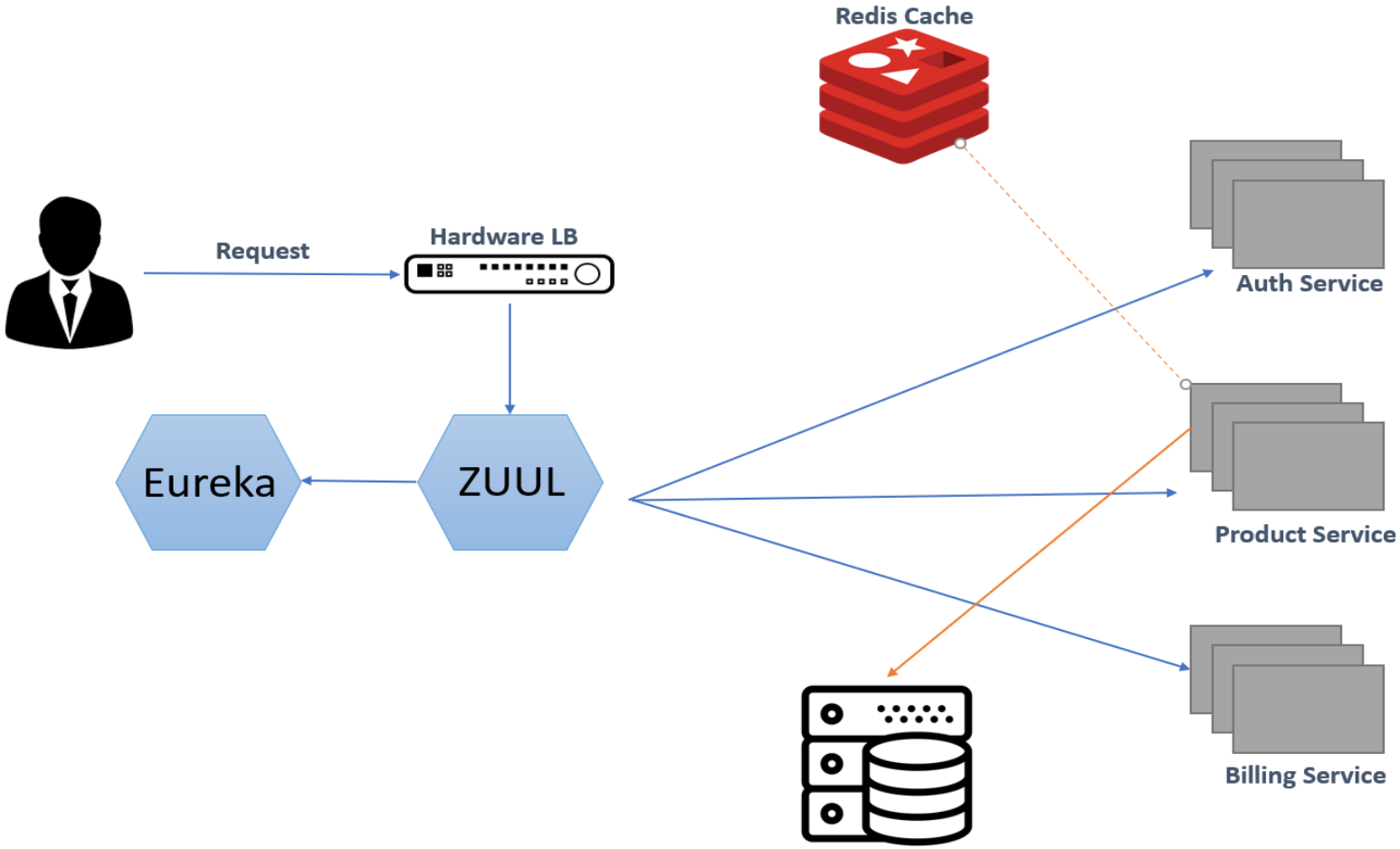

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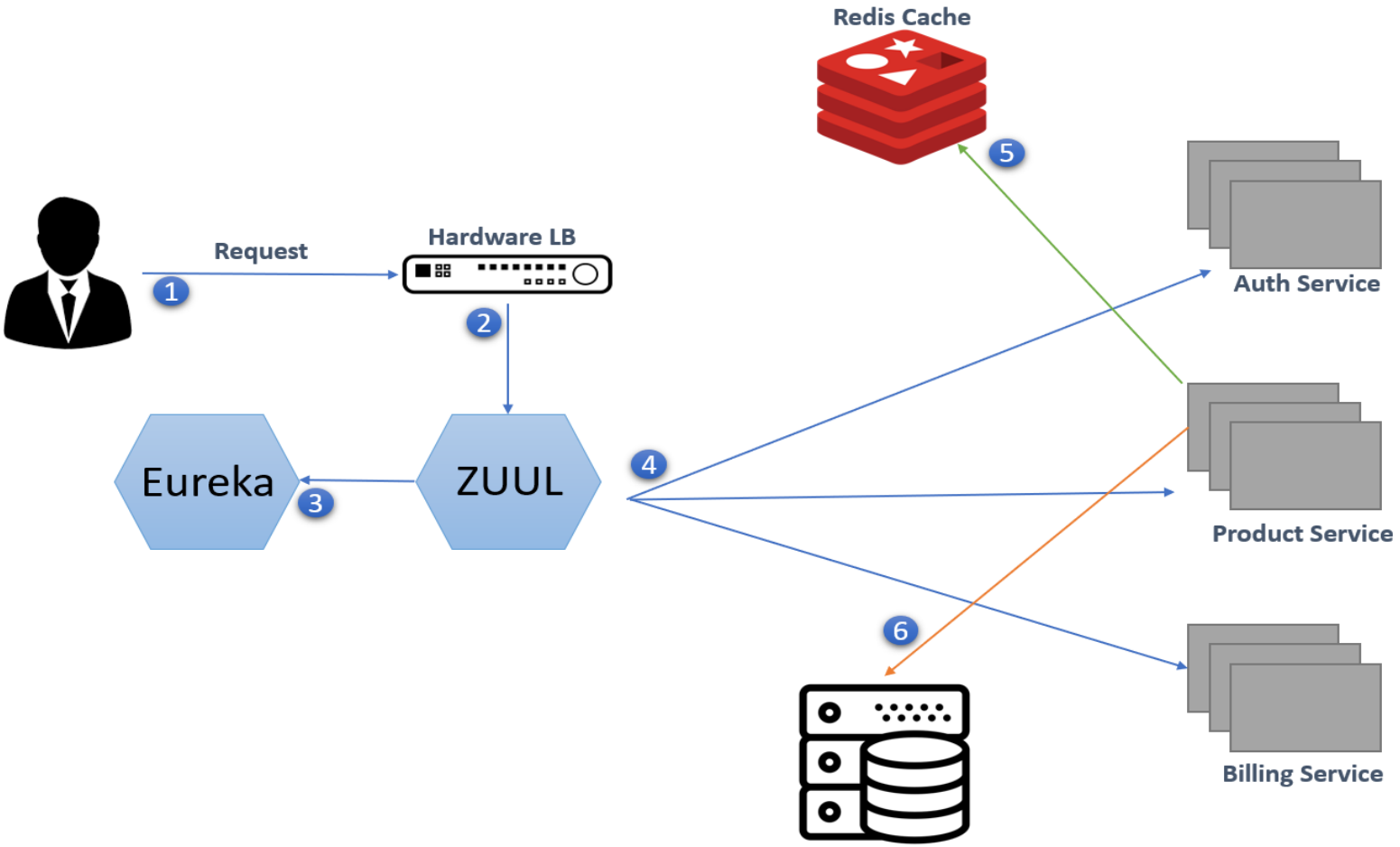

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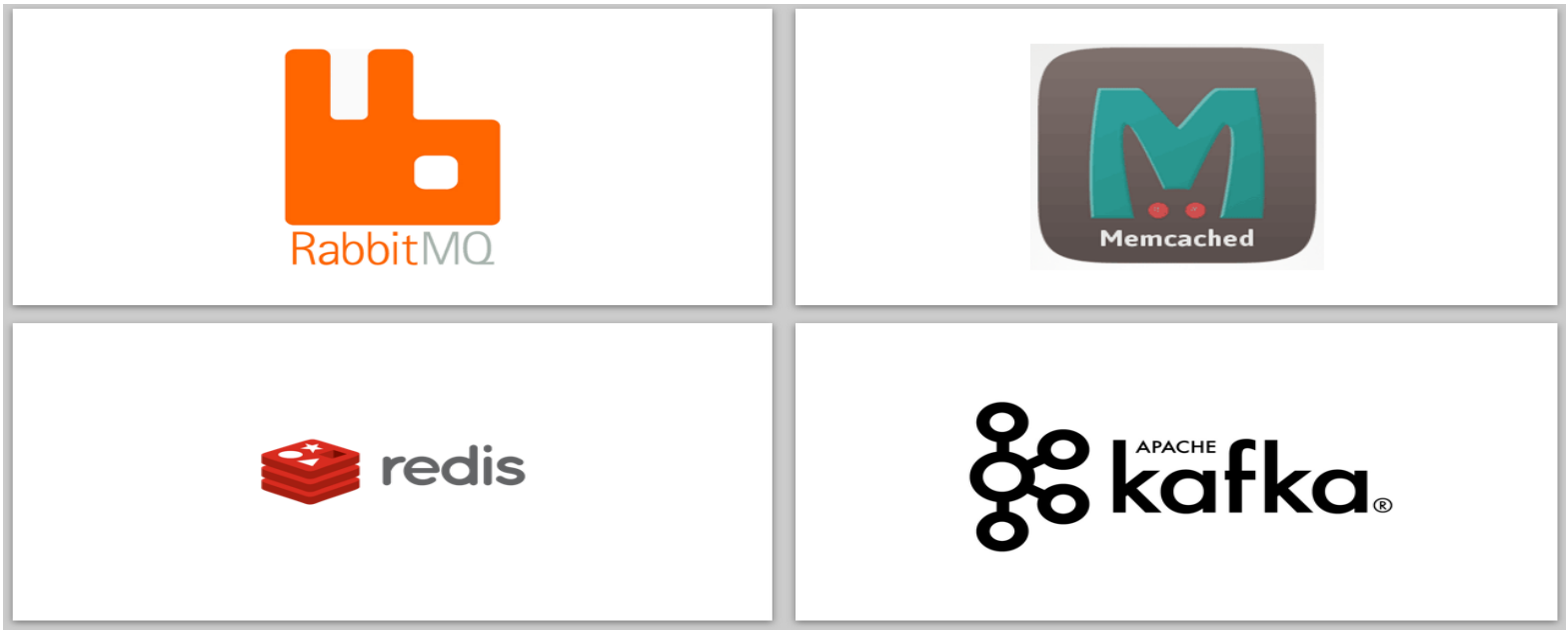

Figure: Shared DS Market Availability

Data Sharing and Management

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- You should consider also availability and data consistency

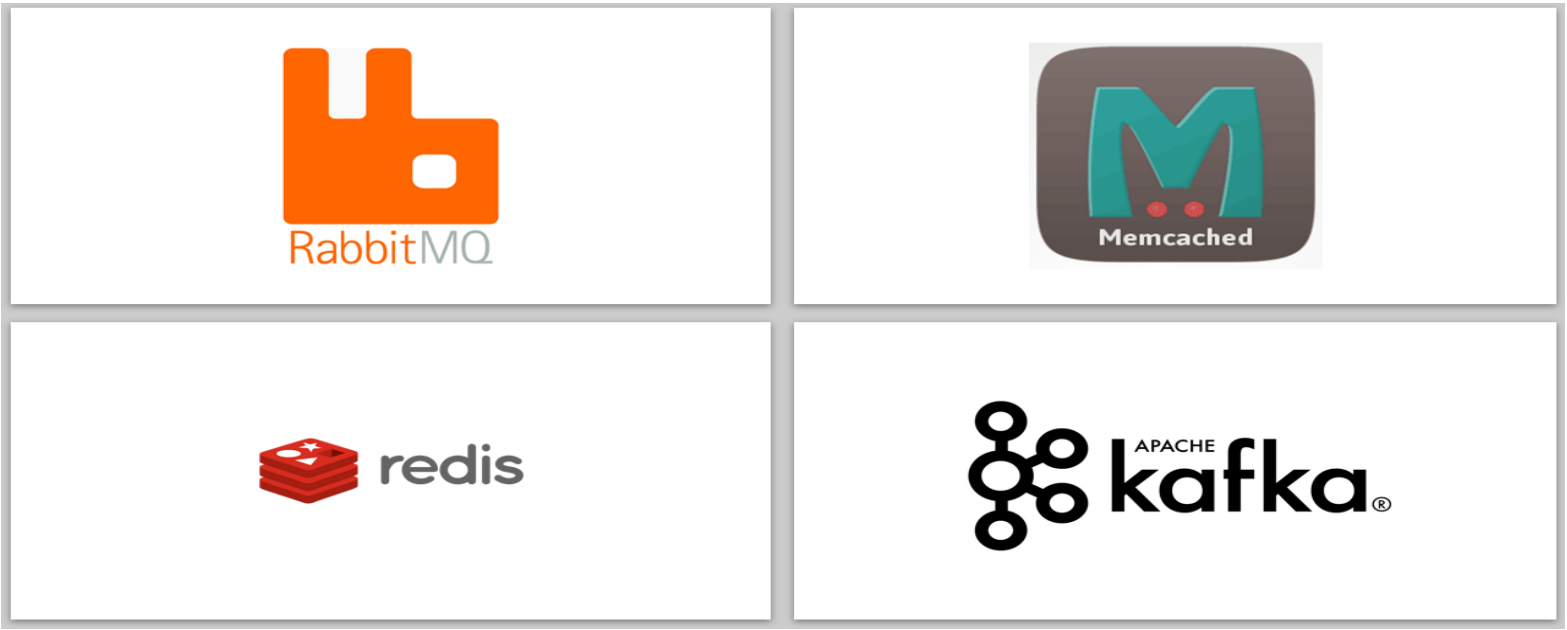


Figure: Shared DS Market Availability

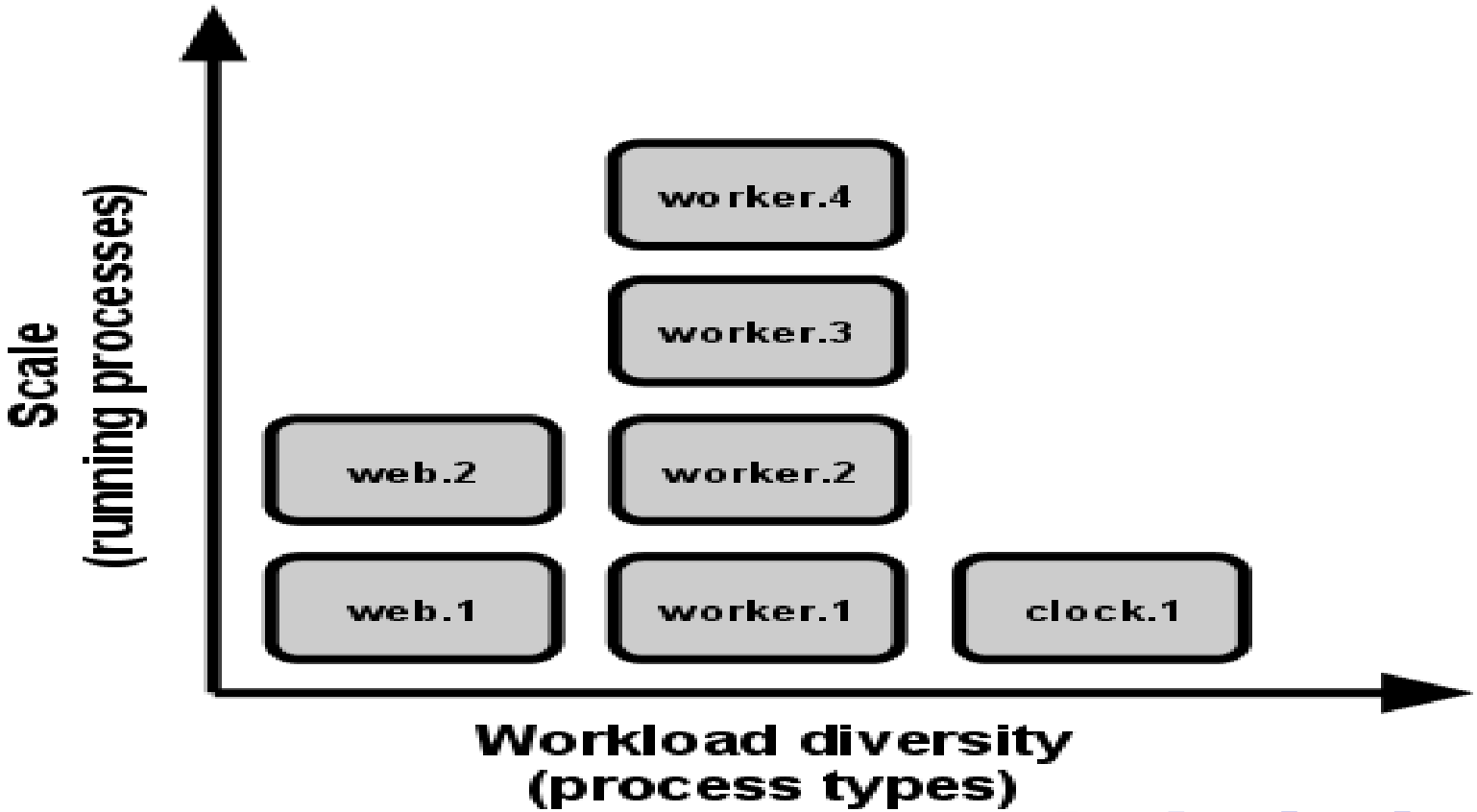
The Twelve-Factor App

8. Concurrency

   Build your app like unix process model based

```
$ wget http://memcached.googlecode.com/files/memcached-1.4.5.tar.gz
$ make
$ ./memcached -vv
```

- Download the application, Install and Start



Service Orchestrators

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- Load balancing network traffic across service instances.
- Service discovery
- Scaling the number of instances of a service

Service Orchestration Options

Popular Orchestrators

- Docker Swarm
- Kubernates
- Service Fabric
- Openshift

Cloud Services' Deployment

The old and known style is called On-Premise deployment, and it has its cons.

Today we have awesome cloud tools for deployment.

- AWS
- Microsoft Azure

Monitoring

One of the most hassle part in Microservices is **tracing**! What, How and Why this error occurred?

- Logging
- Tracing
- Monitor matrices

References

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Continuous Delivery

Addison-Wesley Professional

Thanks for Watching