

Desmistificando Microserviços e DevOps: Projetando Arquiteturas Efetivamente Escaláveis

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[IF1004] - Seminários em SI 3
<https://github.com/vinicius3w/if1004-DevOps>

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The Deployment Pipeline



Overall Architecture

A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable.

— Leslie Lamport

Introduction

- What are the structural implications of the DevOps practices?
 - both the **overall structure of the system** and **techniques that should be used** in the system's elements
- DevOps achieves its **goals** partially by **replacing explicit** coordination with **implicit and often less** coordination
 - the architecture of the system being developed **acts as the implicit coordination mechanism**



Do DevOps Practices Require Architectural Change?

- If you must **re-architect** your systems in order to take **advantage of DevOps**, a legitimate question is “**Is it worth it?**”
- Some DevOps practices are **independent** of architecture,
- whereas in order to get the **full benefit** of others, architectural **refactoring** may be necessary



Recall the 5 categories of DevOps practices

1. Treat Ops as **first-class citizens** from the point of view of **requirements**
 - Operations have a set of requirements that pertain to logging and monitoring
2. Make Dev more **responsible** for **relevant incident handling**
3. **Enforce** the deployment process **used by all**, including Dev and Ops personnel
 - Ensure a **higher quality**, avoids **errors** and the resulting **misconfiguration**
4. Use **continuous** deployment
 - **Shorten the time** between a developer **committing** code to a repository and the code being **deployed**
5. Develop **infrastructure code**, such as deployment scripts, with the **same set of practices** as application code



Overall Architecture Structure



Overall Architecture Structure

- Warm up
 - a **module** is a **code unit** with **coherent functionality**
 - a **component** is an **executable** unit
- Development teams using DevOps processes **are usually small** and should have **limited inter-team coordination**
 - integration and acceptance tests are mandatory



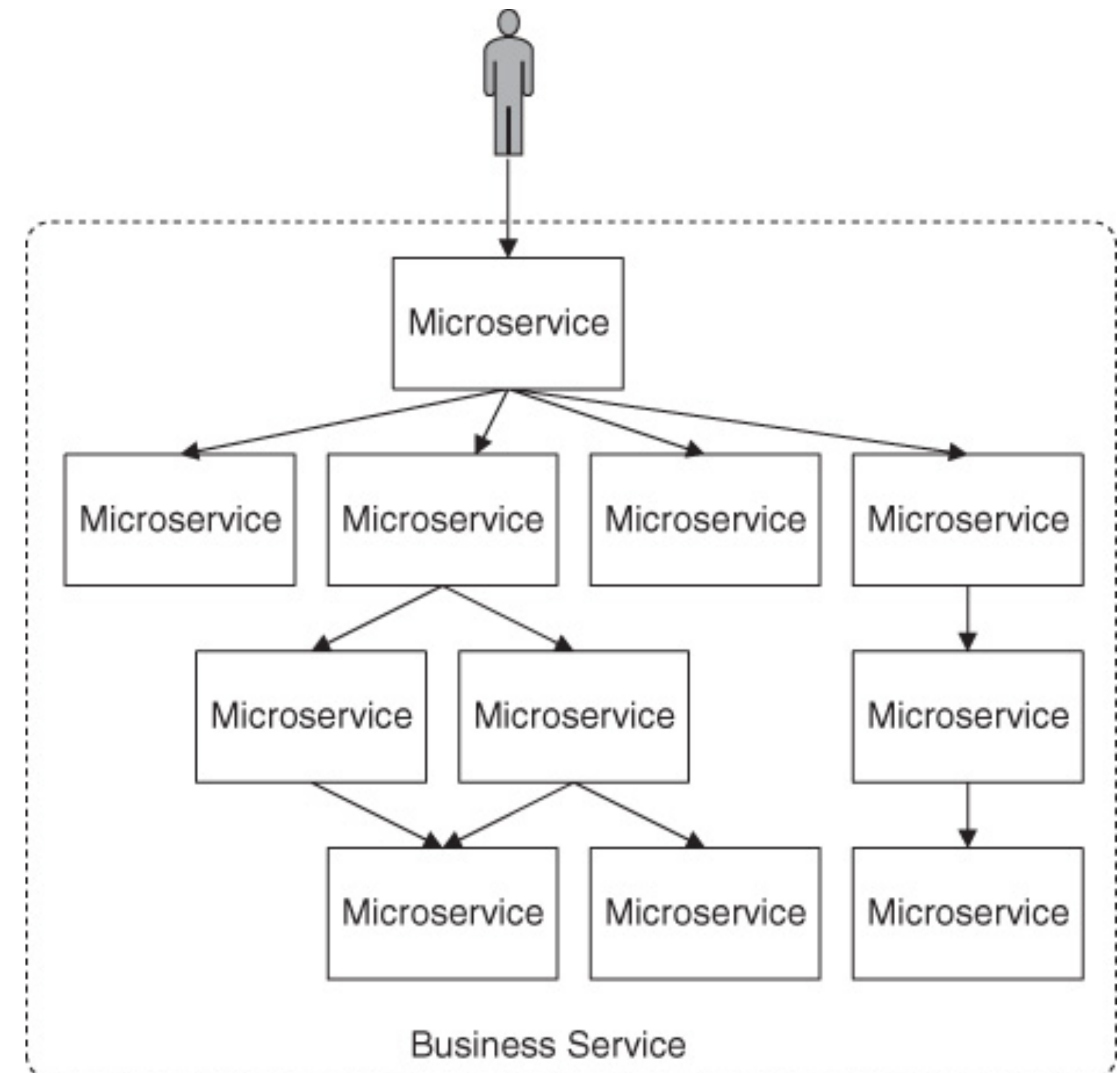
Overall Architecture Structure

- An organization can introduce continuous deployment **without** major architectural modifications
 - Deploying **without the necessity of explicit coordination** with other teams reduces the time required to place a component into production.
 - Allowing for **different versions of the same service** to be simultaneously in production leads to different team members deploying without coordination with other members of their team.
 - **Rolling back a deployment** in the event of errors allows for various forms of live testing
- **Microservice architecture** is an architectural style that **satisfies** these requirements



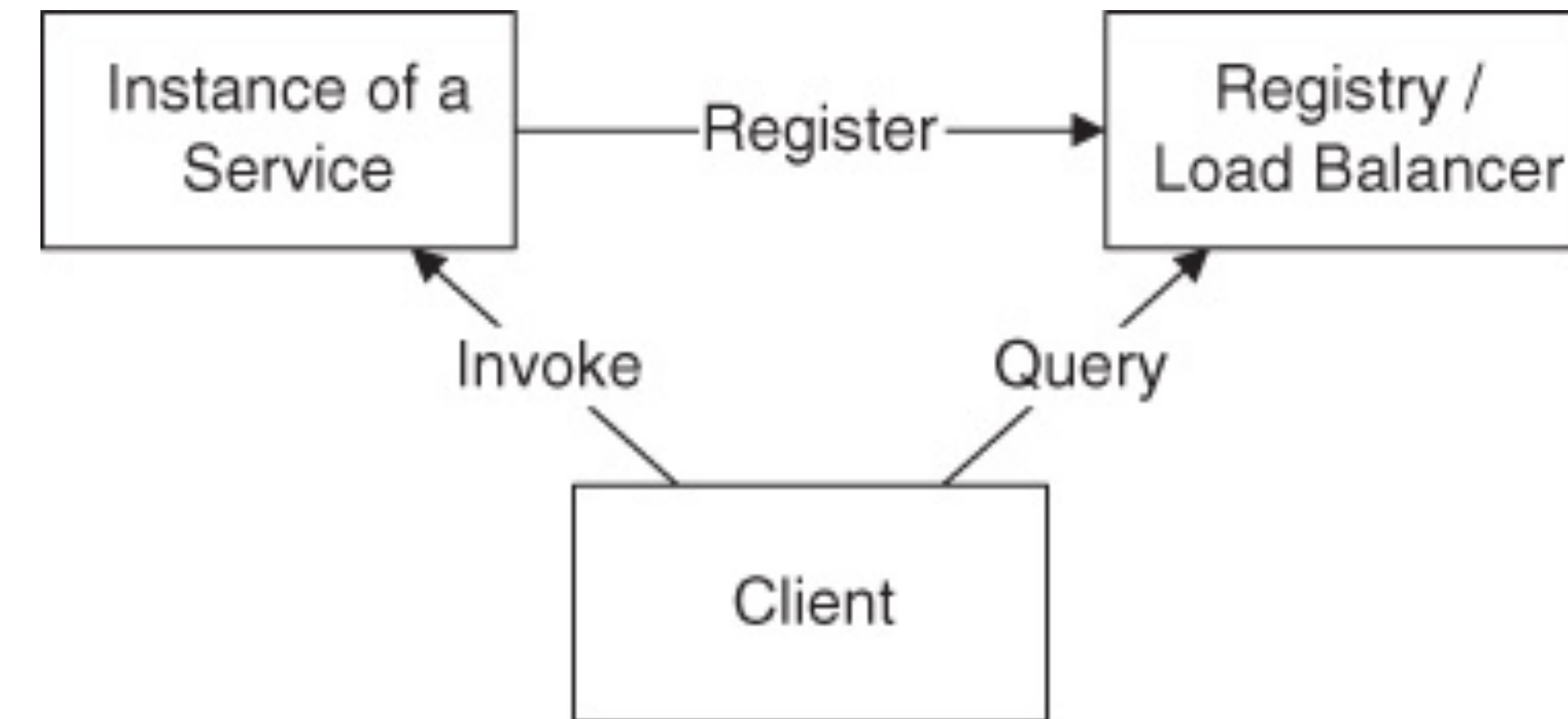
Microservice Architecture

“A microservice architecture consists of a collection of services where each service provides a small amount of functionality and the total functionality of the system is derived from composing multiple services”



Coordination Model

- If two services interact, the two development teams responsible for those services must coordinate in some fashion
 - How a client discovers a service that it wishes to use?
 - How the individual services communicate?
- Netflix Eureka is an example of a cloud service registry that acts as a DNS server.
 - The registry serves as a catalogue of available services, and can further be used to track aspects such as versioning, ownership, service level agreements (SLAs), etc., for the set of services in an organization.



Management of Resources

- Two types of resource management decisions can be made globally and incorporated in the architecture
- provisioning/deprovisioning VMs
- managing variation in demand.



Provisioning & Deprovisioning VMs

- New VMs can be created in response to client **demand** or to **failure**
 - If the instances are **stateless**, a new instance can be placed into service **as soon as** it is provisioned
 - Similarly, if **no state is kept in an instance**, deprovisioning becomes relatively **painless**
- An additional **advantage** of a stateless service is that messages can be routed to **any instance of that service**, which facilitates load sharing among the instances.



Provisioning & Deprovisioning VMs

- This leads to a global decision to maintain state external to a service instance (see [lecture #3](#))
- Determining which component controls the provisioning and deprovisioning of a new instance for a service is another important aspect
 - A service itself can be responsible for (de)provisioning additional instances
 - A client or a component in the client chain can be responsible for (de)provisioning instances of a service
 - An external component monitors the performance of service instances (e.g., their CPU load) and (de)provisions an instance when the load reaches a given threshold



Managing Demand

- The number of instances of an individual service that exist should reflect the demand on the service from client requests
- Monitor performance
- Use SLAs to control the number of instances



Mapping Among Architectural Elements

- The final type of coordination decision that can be specified in the architecture is the mapping among architectural elements
 - Work assignments
 - Allocation



Quality Discussion of Microservice Architecture



Dependability

- Three sources for dependability problems are:
 - the small amount of inter-team coordination
 - correctness of environment, and
 - the possibility that an instance of a service can fail



Small Amount of Inter-team Coordination

- May cause misunderstandings between the **team developing a client** and **the team developing a service** in terms of the **semantics** of an interface
 - Unexpected input to a service or unexpected output from a service can happen
 - defensive programming
 - integration and end-to-end testing [expensive to run these tests frequently]
 - Consumer Driven Contract (CDC)
 - The test cases for testing a microservice are decided and even co-owned by all the consumers of that microservice
 - Any changes to the CDC test cases need to be agreed on by both the consumers and the developers of the microservice



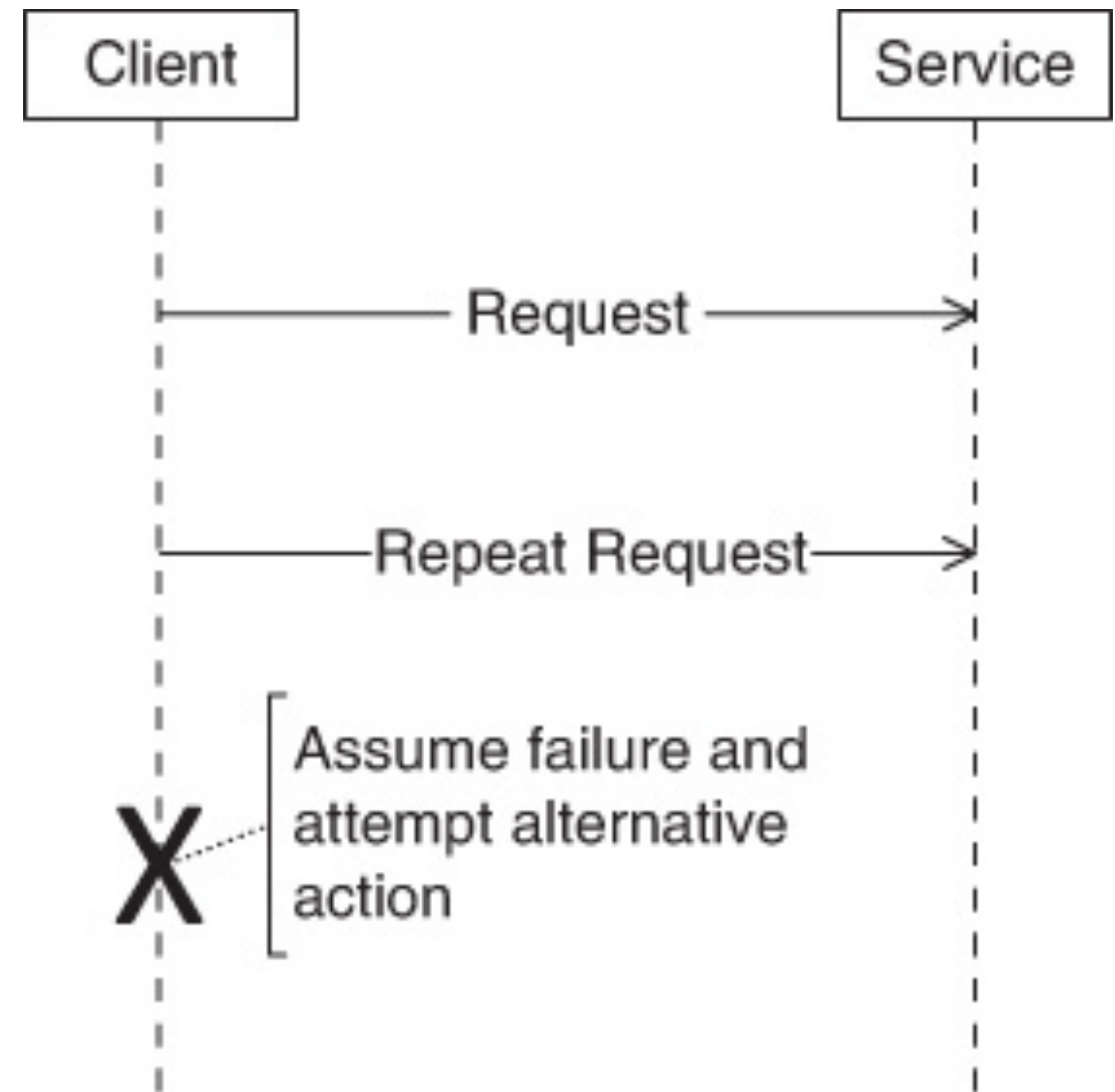
Correctness of Environment

- A service will operate in multiple different environments during the passage from unit test to post-production
 - Errors in code and configuration parameters are quite common
 - Inconsistent configuration parameters are also possible
 - Due to a degree of uncertainty in cloud-based infrastructure, even executing the correct code and configuration may lead to an incorrect environment
- Thus, the initialization portion of a service should test its current environment to determine whether it is as expected
- An important trend in DevOps is to manage all the code and parameters for setting up an environment just as you manage your application code, with proper version control and testing



Failure of an Instance

- Failure is always a possibility for instances
- Services should be designed so that multiple invocations of the same service will not introduce an error
- Idempotent is the term for a service that can be repeatedly invoked with the same input and always produces the same output —namely, no error is generated



Modifiability

- Making a service modifiable comes down to making likely changes easy and reducing the ripple effects of those changes
- In both cases, a method for making the service more modifiable is to encapsulate either the affected portions of a likely change or the interactions that might cause ripple effects of a change



Identifying Likely Changes

- The environments within which a service executes
 - A module goes through unit tests in one environment, integration tests in another, acceptance tests in a third, and is in production in a fourth
- The state of other services with which your service interacts
 - If other services are in the process of development, then the interfaces and semantics of those services are likely to change relatively quickly
- The version of third-party software and libraries that are used by your service
 - Third-party software and libraries can change arbitrarily, sometimes in ways that are disruptive for your service



Reducing Ripple Effects

- Once likely changes have been discovered, you should prevent these types of changes from rippling through your service
- This is typically done by introducing modules whose sole purpose is to localize and isolate changes to the environment, to other services, or to third-party software or libraries
- The remainder of your service interacts with these changeable entities through the newly introduced modules with stable interfaces



Amazon's Rules for Teams



Two pizzas

- All teams will henceforth expose their data and functionality through service interfaces
- Teams must communicate with each other through these interfaces
- There will be no other form of inter-service/team communication allowed:
 - no direct linking, no direct reads of another team's datastore, no shared-memory model, no backdoors whatsoever
 - The only communication allowed is via service interface calls over the network
- It doesn't matter what technology they [other services] use
- All service interfaces, without exception, must be designed from the ground up to be externalizable
 - That is to say, the team must plan and design to be able to expose the interface to developers in the outside world



Microservice Adoption for Existing Systems



Microservice Adoption for Existing Systems

- Operational concerns are considered during requirements specification
- The overarching structure of the system being developed should be a collection of small, independent services
- Each service should be distrustful of both clients and other required services
- Team roles have been defined and are understood
- Services are required to be registered with a local registry/load balancer
- Services must renew their registration periodically
- Services must provide SLAs for their clients
- Services should aim to be stateless and be treated as transient
- If a service has to maintain state, it should be maintained in external persistent storage
- Services have alternatives in case a service they depend on fails
- Services have defensive checks to intercept erroneous input from clients and output from other services
- Uses of external services, environmental information, and third-party software and libraries are localized (i.e., they require passage through a module specific to that external service, environment information, or external software or library)



For Further Reading

- For more information about software architecture, we recommend the following books:
 - [Documenting Software Architectures](#), 2nd Edition [Clements 10]
 - [Software Architecture in Practice](#), 3rd Edition [Bass 13]
- Service description, cataloguing, and management are discussed in detail in the [Handbook of Service Description](#) [Barros 12]
- The microservice architectural style is described in the book [Building Microservices: Designing Fine-Grained Systems](#) [Newman 15]
- The Netflix implementation of Eureka - their open source internal load balancer/registry - can be found at <https://github.com/Netflix/eureka/wiki/Eureka-at-a-glance>
- Consumer Driven Contracts (CDCs) are discussed in Martin Fowler's blog "[Consumer-Driven Contracts: A Service Evolution Pattern](#)"

