

Desenvolvimento de Aplicações com Arquitetura Baseada em Microservices

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[IF1007] - Tópicos Avançados em SI 4
<https://github.com/IF1007/if1007>

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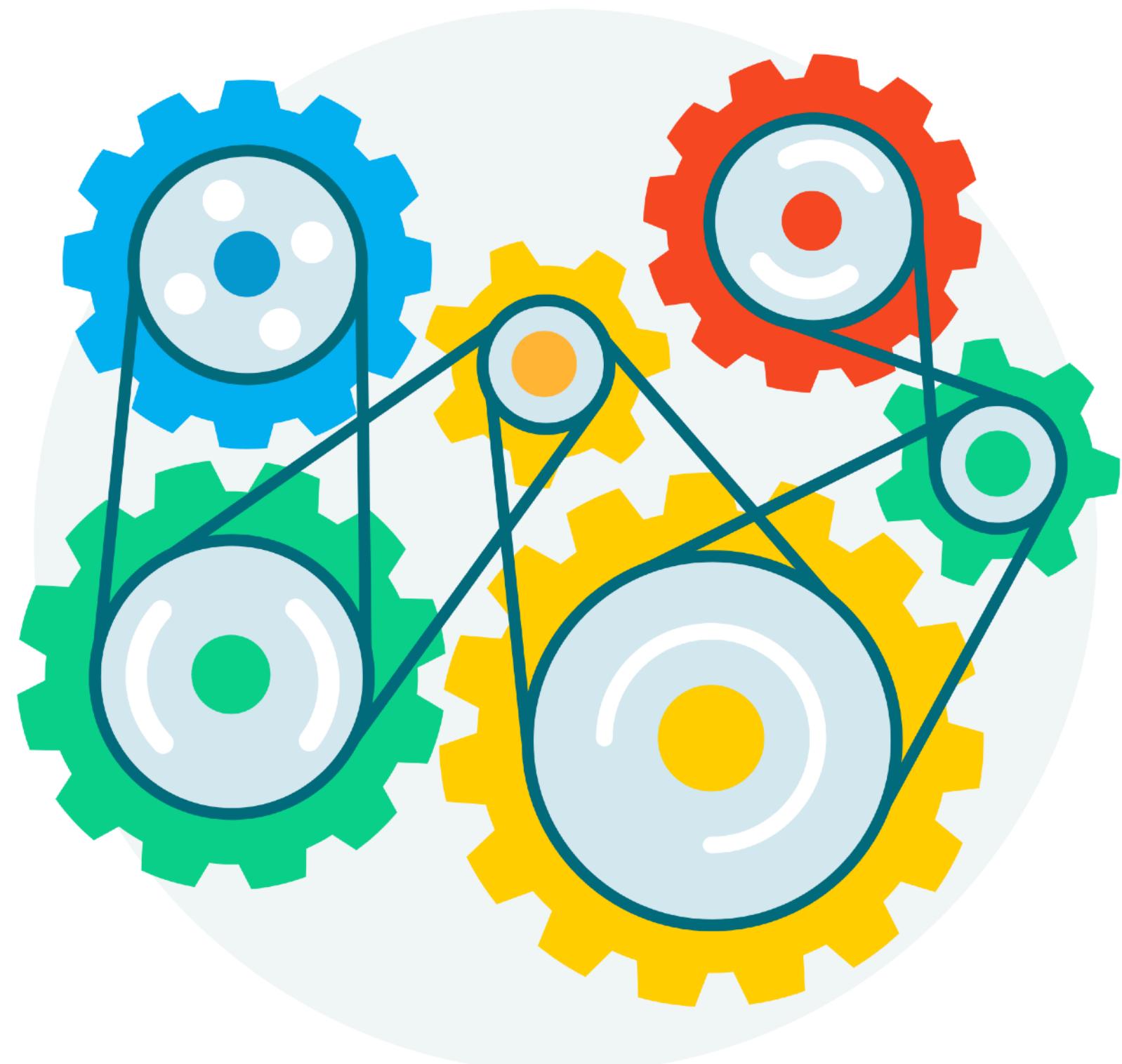
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Resources

- There is no textbook required. However, the following are some books that may be recommended:
 - [Building Microservices: Designing Fine-Grained Systems](#)
 - [Spring Microservices](#)
 - [Spring Boot: Acelere o desenvolvimento de microserviços](#)
 - [Microservices for Java Developers A Hands-on Introduction to Frameworks and Containers](#)
 - [Migrating to Cloud-Native Application Architectures](#)
 - [Continuous Integration](#)

DOES YOUR COMPANY NEED MICROSERVICES?



Demystifying Microservices

Micro-what????

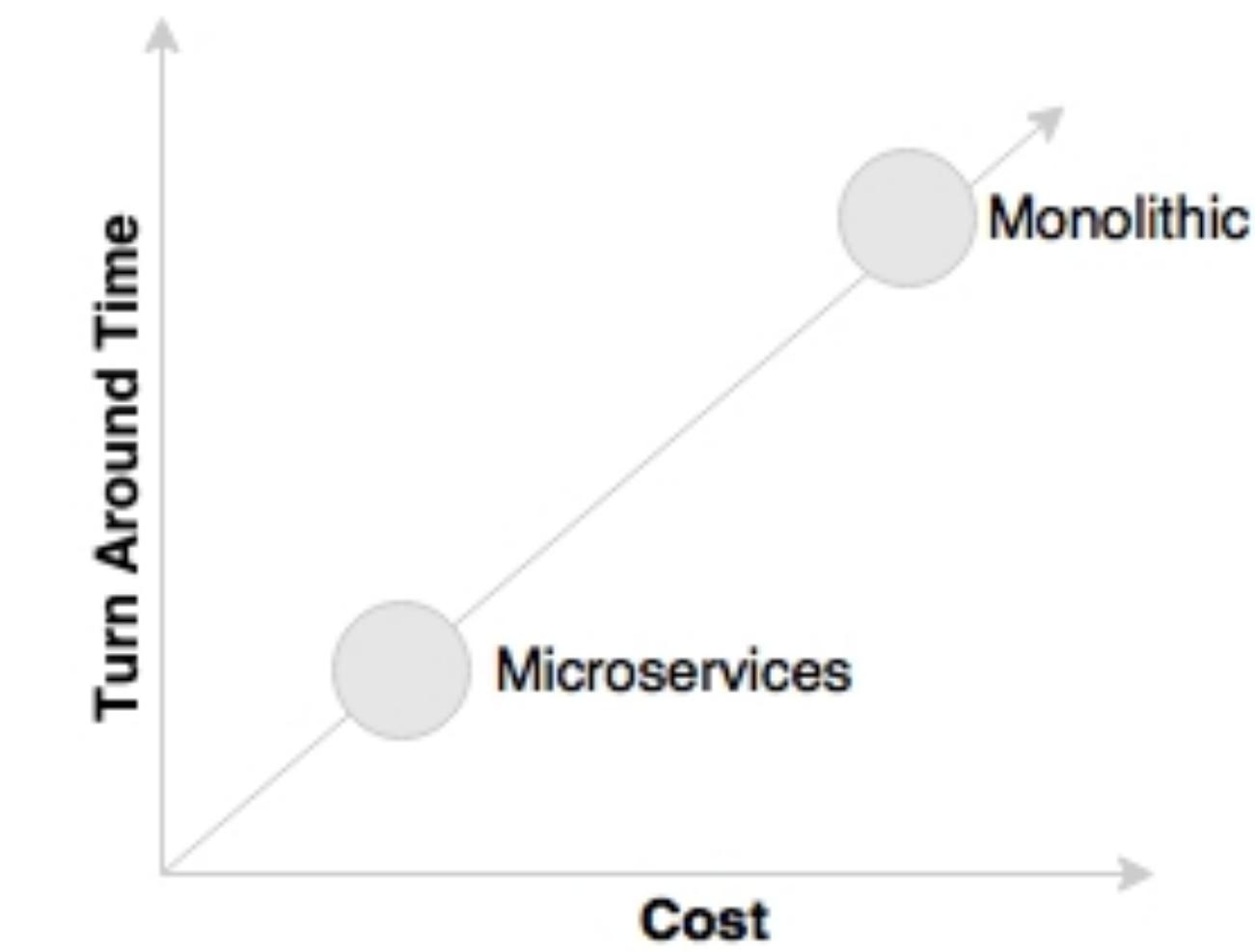
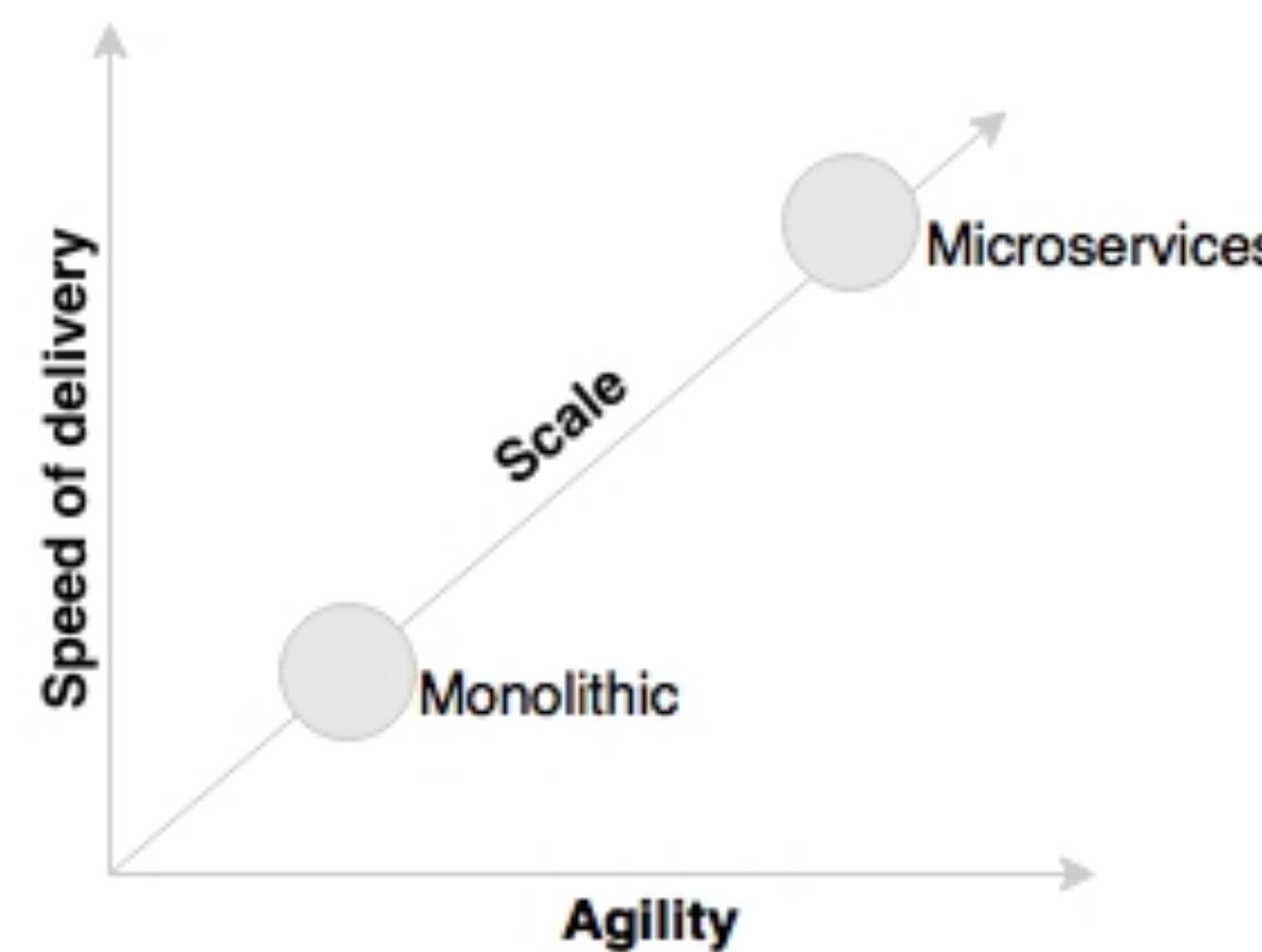
- Microservices are an **architecture style** and an **approach** for software development to **satisfy** modern **business** demands
- We will see...
 - The evolution of microservices
 - The definition of the microservices architecture with examples
 - Concepts and characteristics of the microservices architecture
 - Typical use cases of the microservices architecture
 - The relationship of microservices with SOA and Twelve-Factor Apps

The evolution of microservices

- One of the increasingly popular architecture patterns next to SOA
 - ... complemented by DevOps and cloud
- Evolution is greatly influenced by the **disruptive digital innovation trends** in modern business and the **evolution of technologies** in the last few years.

Business demand as a catalyst for microservices evolution

- Technologies as one of the **key enablers** for **radically increasing** their revenue and customer base

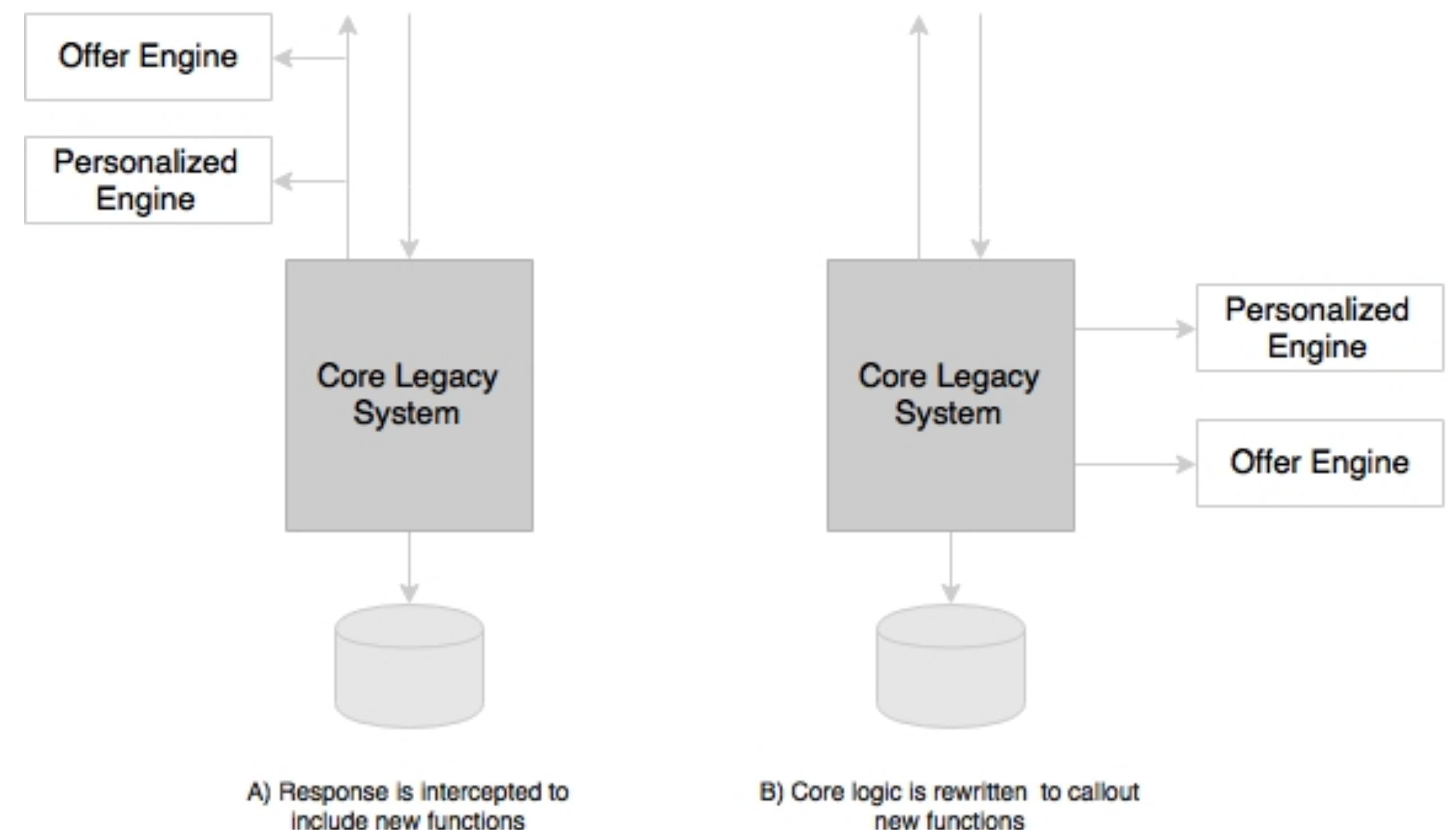


Business demand as a catalyst for microservices evolution

- Institutions do not invest in **rebuilding** their core mainframe systems as another monolithic monster
- Retailers and other industries do not **rebuild** heavyweight supply chain management applications, such as their traditional ERPs
- Focus has shifted to **building quick-win point solutions** that cater to specific needs of the business in the most agile way possible

Shift to building quick-win point solutions

- Modern architectures are expected to **maximize** the **ability** to **replace** their parts and **minimize** the **cost** of replacing their parts



- The microservices approach is a means to achieving this

Technology as a catalyst for the microservices evolution

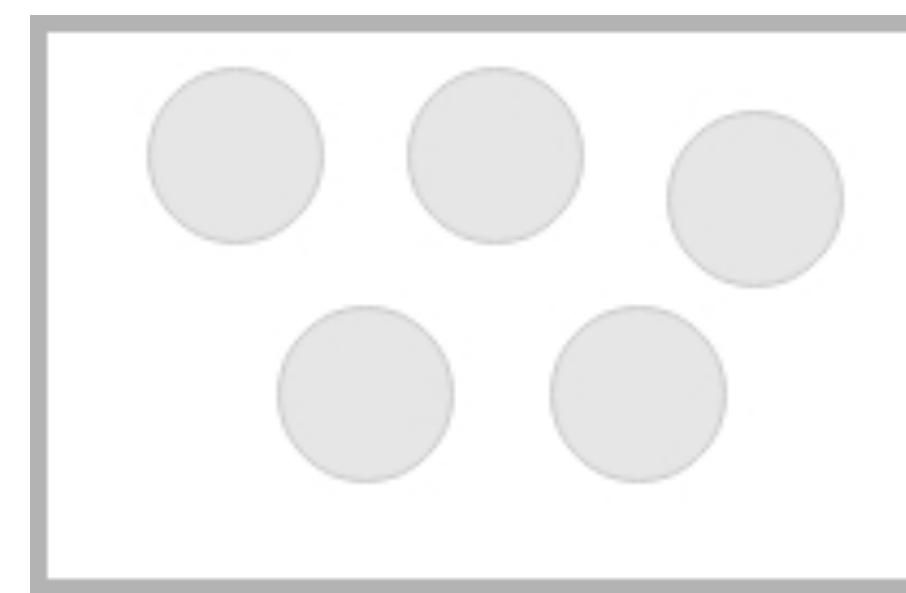
- A few decades back, we couldn't even imagine a distributed application without a two-phase commit. Later, NoSQL databases made us think differently
- Platform as a Services (PaaS) providers made us rethink the way we build middleware components
 - Integration Platform as a Service (iPaaS)

Imperative architecture evolution

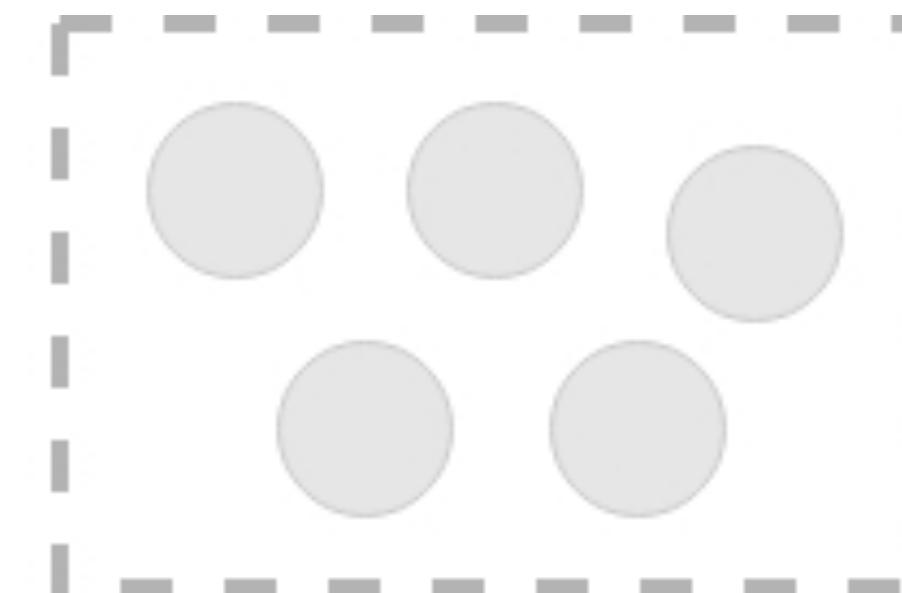
- Architectures have gone through the evolution of age-old mainframe systems to fully abstract cloud services such as AWS Lambda
- Irrespective of the choice of architecture styles, we always used to build one or the other forms of monolithic architectures

Imperative architecture evolution

- The microservices architecture evolved as a result of modern **business demands** [agility and speed of delivery], **emerging technologies**, and **learning** from previous generations of architectures



Monolithic
Architecture



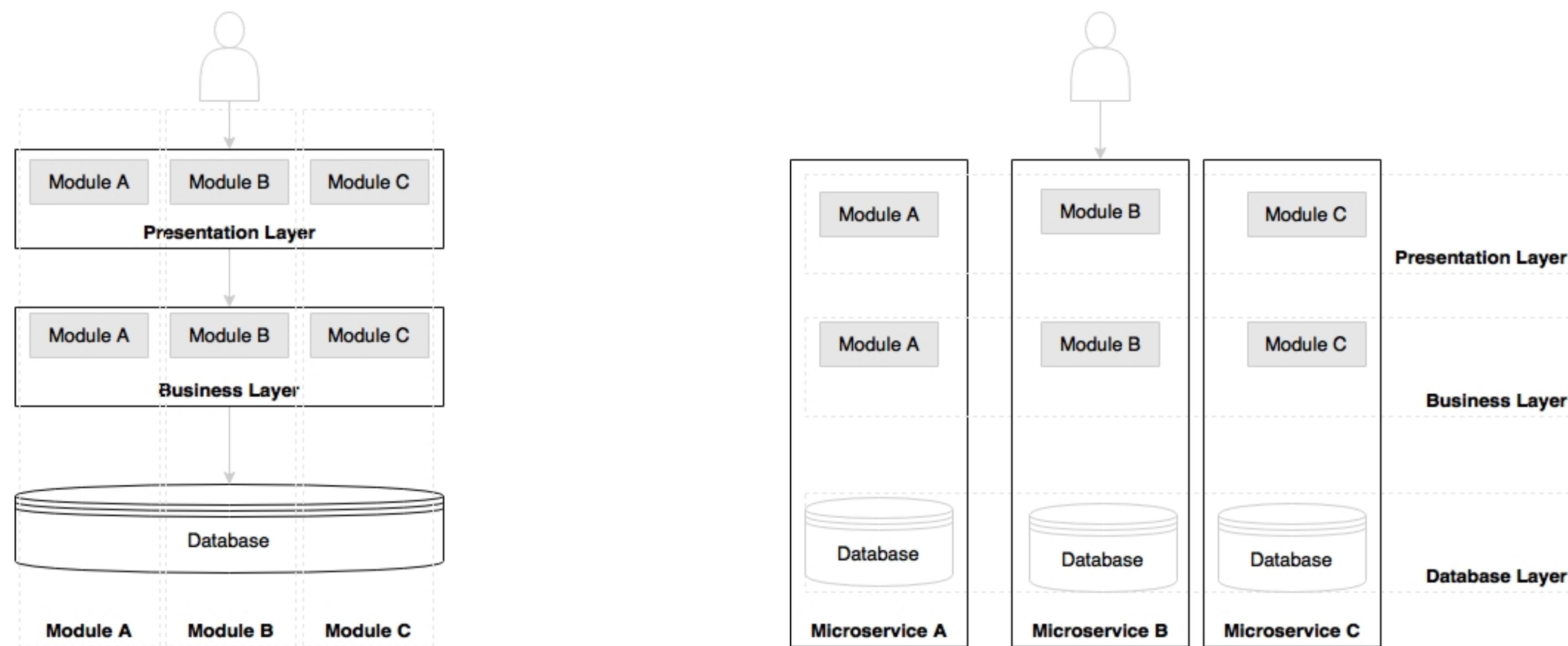
Microservices
Architecture

So, what are microservices?

- Microservices are an **architecture style** and **an approach** for software development to **satisfy** modern business demands
- Originated from the idea of hexagonal architecture coined by Alistair Cockburn
 - Hexagonal architecture is also known as the **Ports and Adapters** pattern

Architectural style

- Microservices are an **architectural style** or an approach to **building** IT systems as a set of business capabilities that are **autonomous**, **self-contained**, and **loosely coupled**

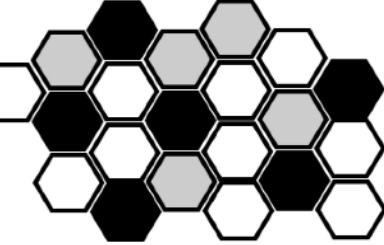


Communication

- There is **no standard** for communication or transport mechanisms for microservices
- Widely adopted **lightweight protocols**, such as HTTP and REST, or messaging protocols, such as JMS or AMQP
 - ...such as Thrift, ZeroMQ, Protocol Buffers, or Avro

Independently manageable life cycles

- As microservices are more aligned to business capabilities and have independently manageable life cycles
- The ideal choice for enterprises embarking on DevOps and cloud.
 - DevOps and cloud are two facets of microservices

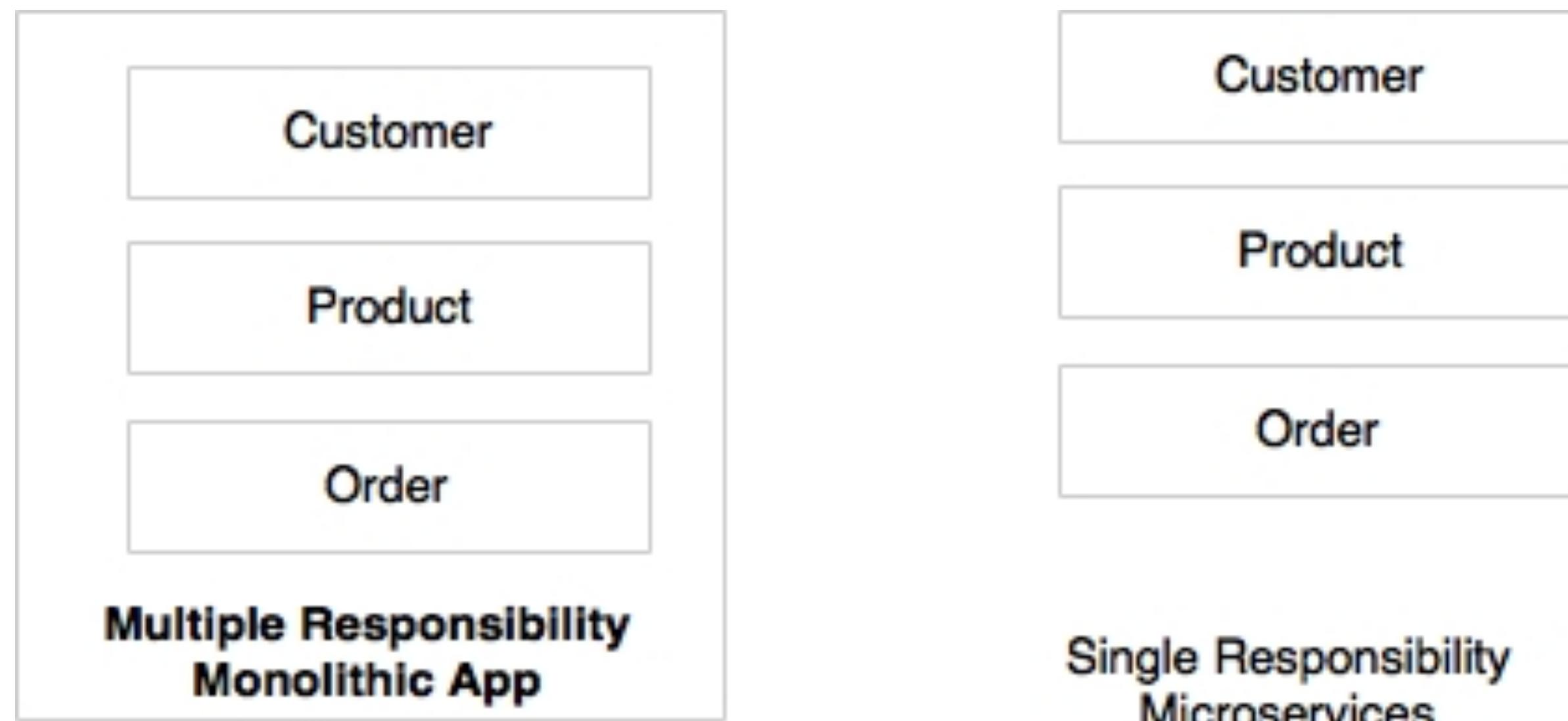


The honeycomb analogy

- They **start** small, using different materials to build the cells
- Construction is based on **what is available at the time** of building
- Repetitive cells form a **pattern** and result in a **strong fabric structure**
- Each cell in the honeycomb is **independent** but also **integrated** with other cells
- By adding new cells, the honeycomb **grows organically** to a big, solid **structure**
- The content inside each cell is **abstracted** and **not visible outside**
- Damage to one cell does not damage other cells, and bees can reconstruct these cells without impacting the overall honeycomb.

Principles of microservices

- Single responsibility per service
 - One of the principles defined as part of the [SOLID](#) design pattern
 - It states that a unit should only have one responsibility

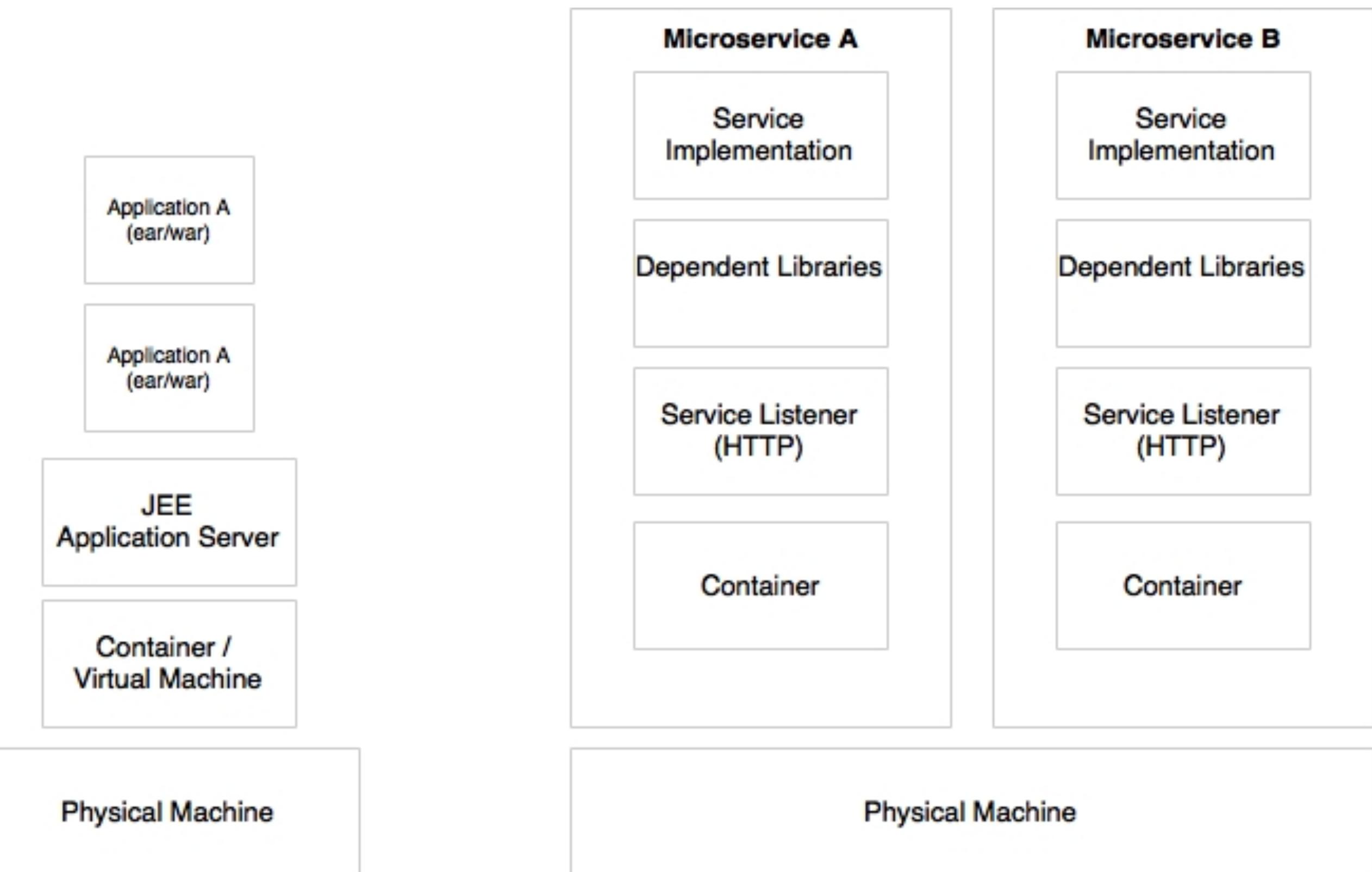


Principles of microservices

- Microservices are autonomous
 - Microservices are self-contained, independently deployable, and autonomous services that take full responsibility of a business capability and its execution
 - They bundle all dependencies, including library dependencies, and execution environments
 - such as web servers and containers or virtual machines
- SOA vs Microservices
 - SOA implementations provide service-level abstraction
 - Microservices go further and abstract the realization and execution environment

Microservices are autonomous

- Microservices may also get their own containers for execution
- Containers are portable, independently manageable, lightweight runtime environments
- Container technologies, such as Docker, are an ideal choice for microservices deployment

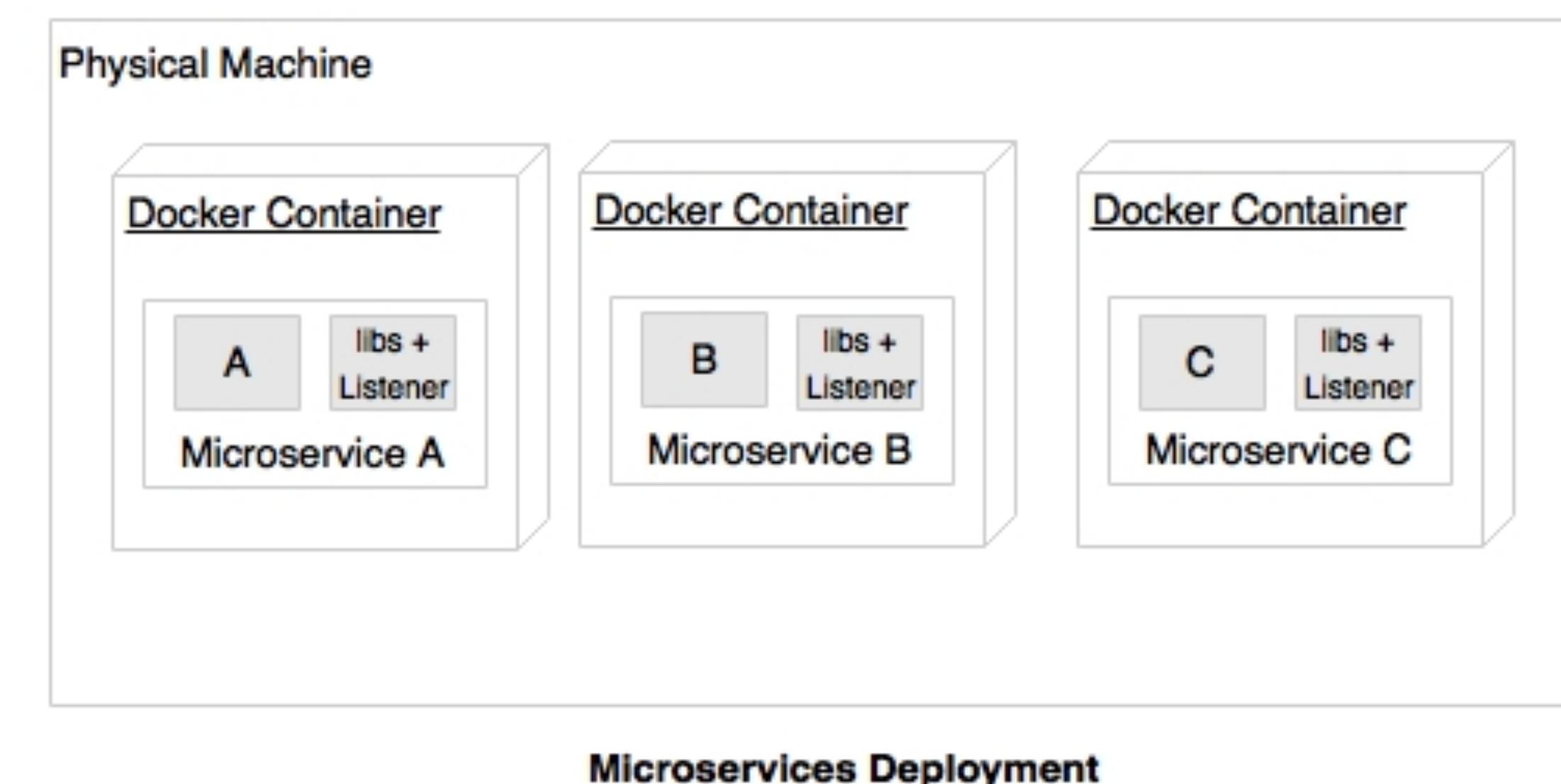
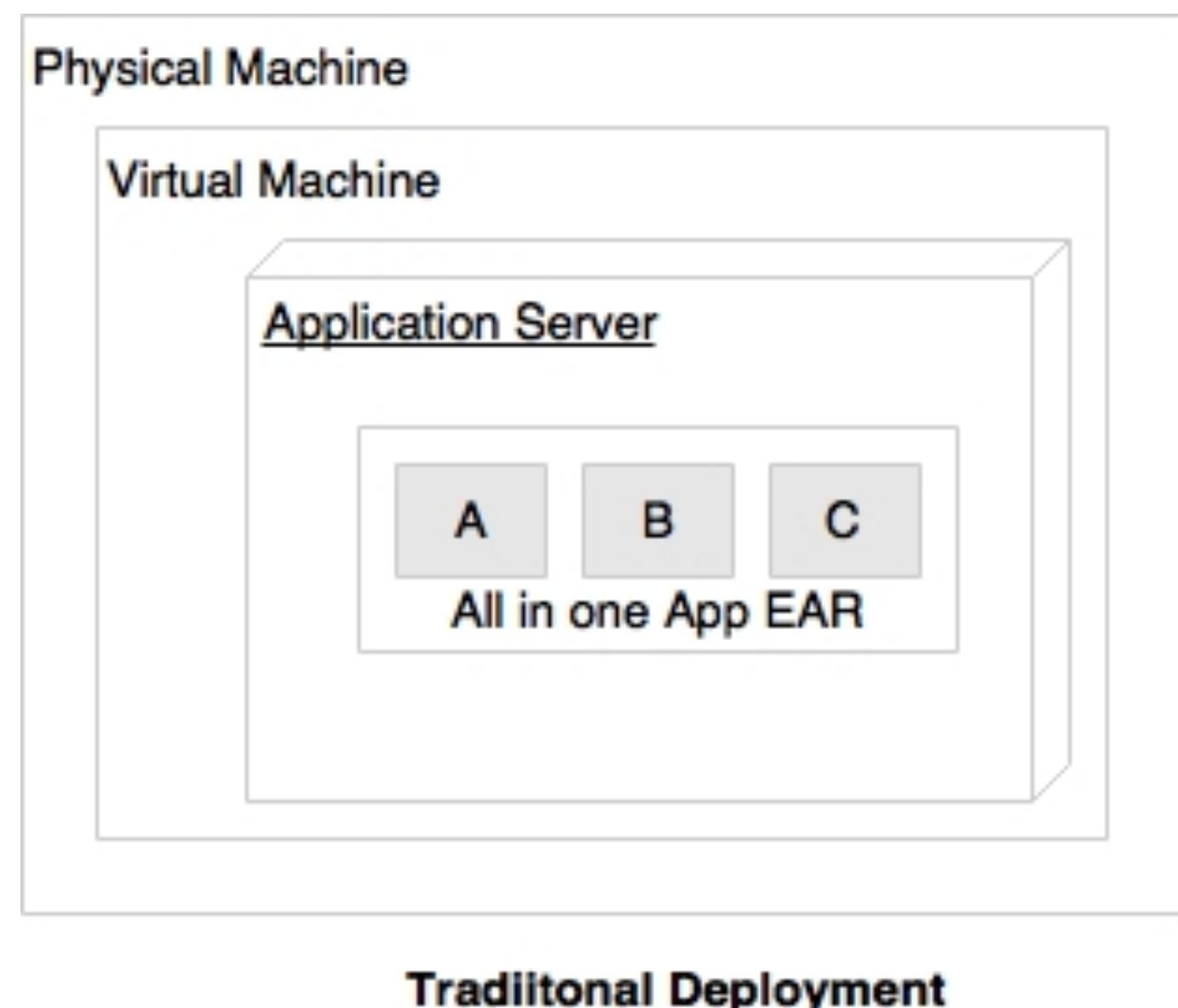


Characteristics of microservices

- Services are first-class citizens
 - expose service endpoints as APIs and abstract all their realization details
 - there is no more application development; instead, organizations focus on service development
 - From SOA...
 - Service contract; Loose coupling; Service abstraction; Service reuse; Statelessness; Services are discoverable; Service interoperability; Service composeability
 - More detail on SOA principles can be found [here](#)

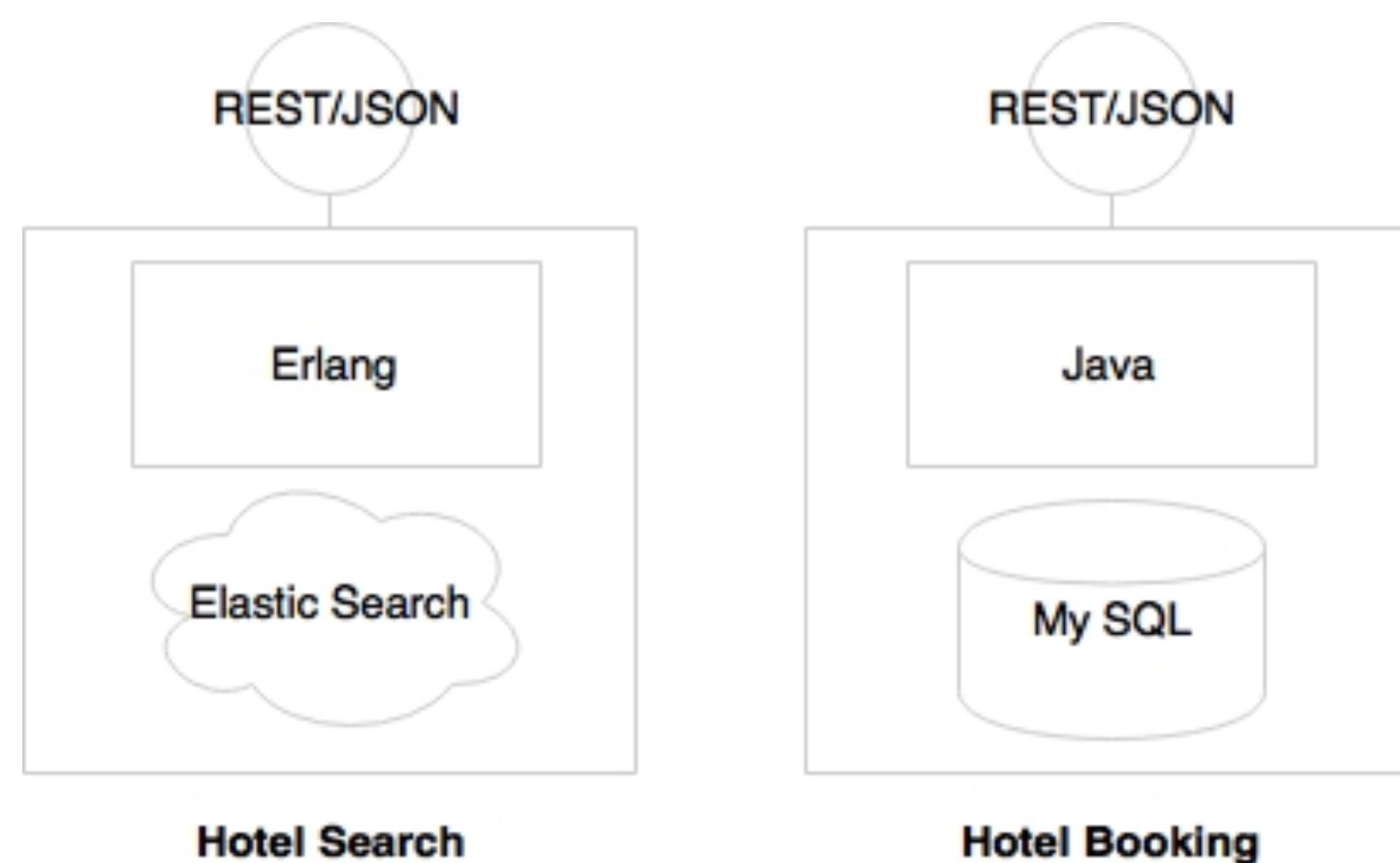
Characteristics of microservices

- Microservices are **lightweight**
 - A single business capability, so they perform only one function ~> smaller footprints
 - When selecting supporting technologies, we will have to ensure that they are **also lightweight** so that the overall footprint remains manageable



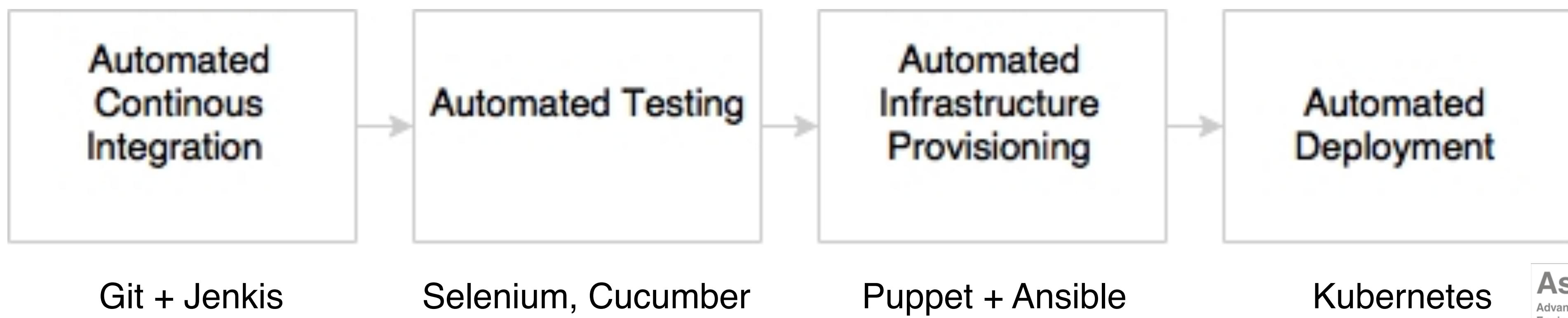
Characteristics of microservices

- Microservices with polyglot architecture
 - Different architectures for different microservices
 - Different services use different versions of the same technologies
 - Different languages are used to develop different microservices



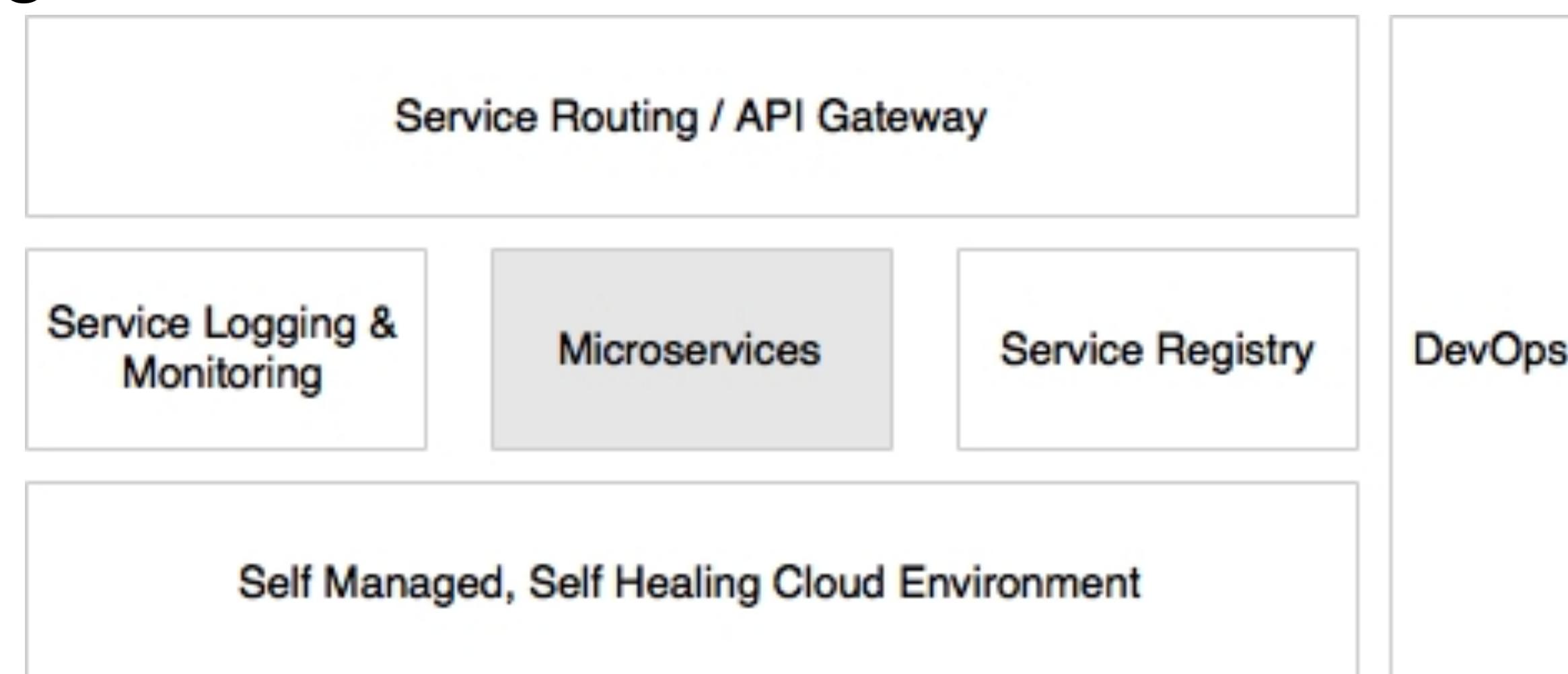
Characteristics of microservices

- Automation in a microservices environment
 - A large number of microservices is hard to manage until and unless automation is in place
 - microservices are automated end to end: automated builds, automated testing, automated deployment, and elastic scaling



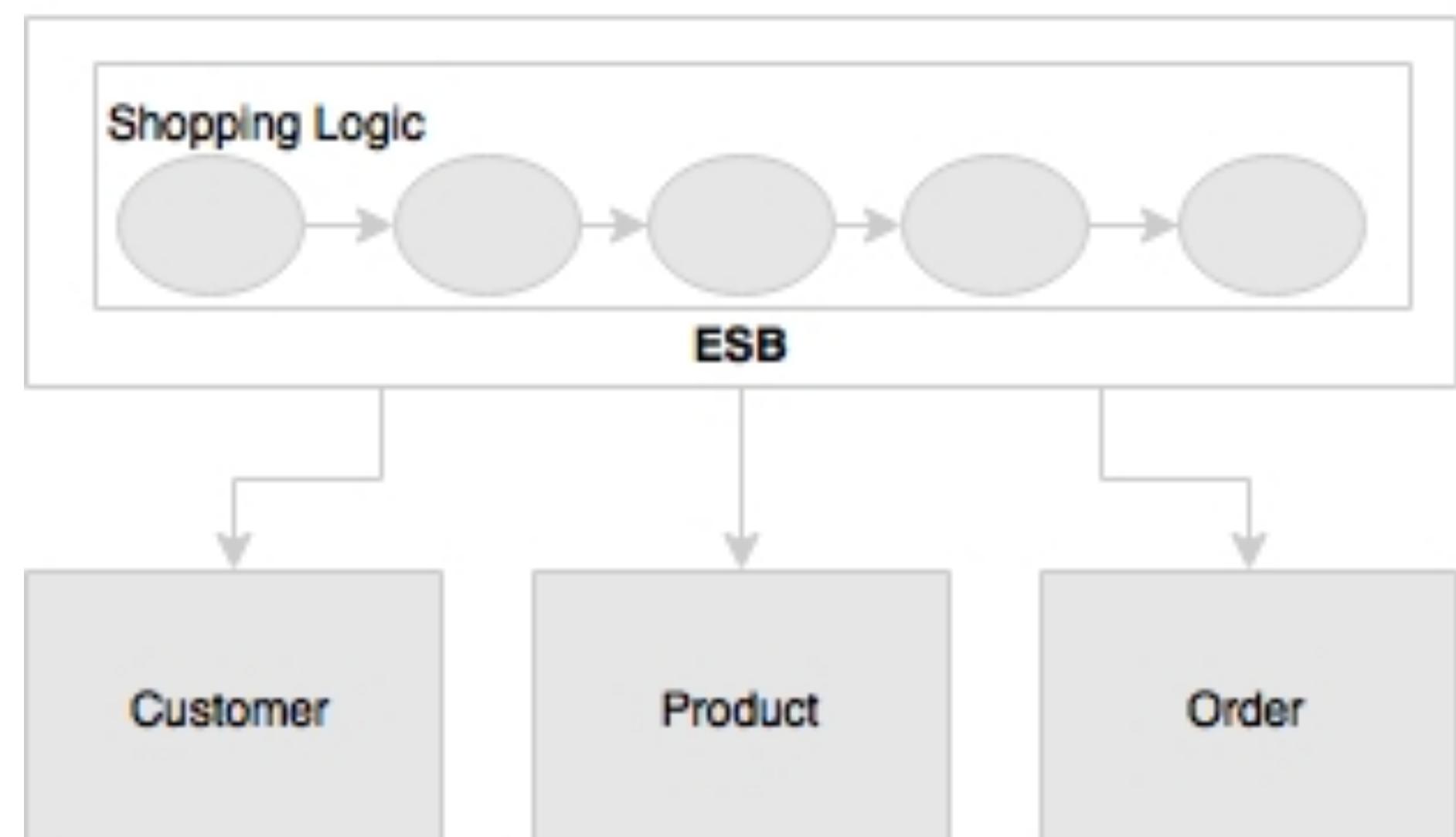
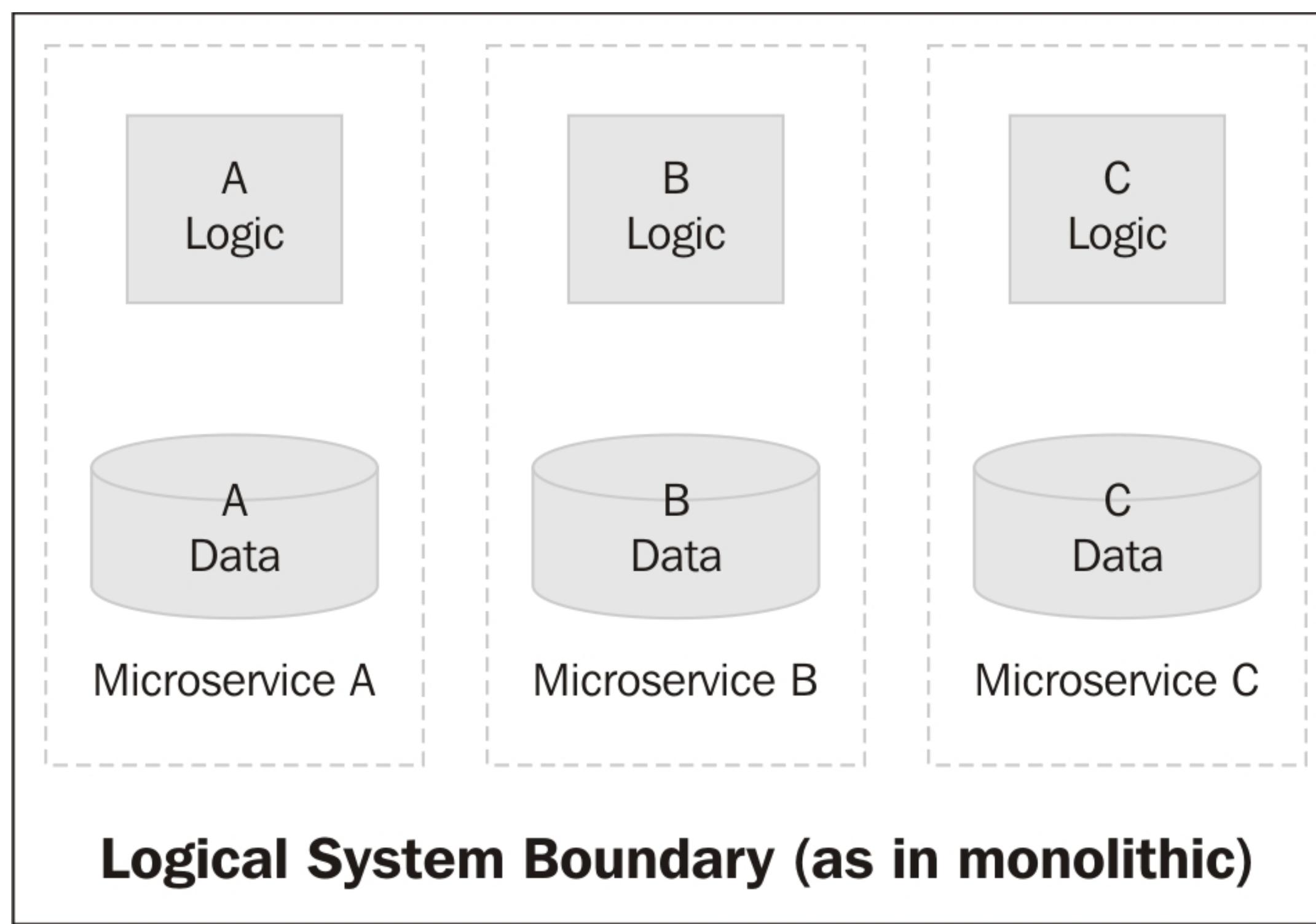
Characteristics of microservices

- Microservices with a supporting ecosystem
 - Most of the large-scale microservices implementations have a supporting ecosystem in place
 - The ecosystem capabilities include DevOps processes, centralized log management, service registry, API gateways, extensive monitoring, service routing, and flow control mechanisms



Characteristics of microservices

- Microservices are distributed and dynamic
 - Distributed data and logic and decentralized governance!



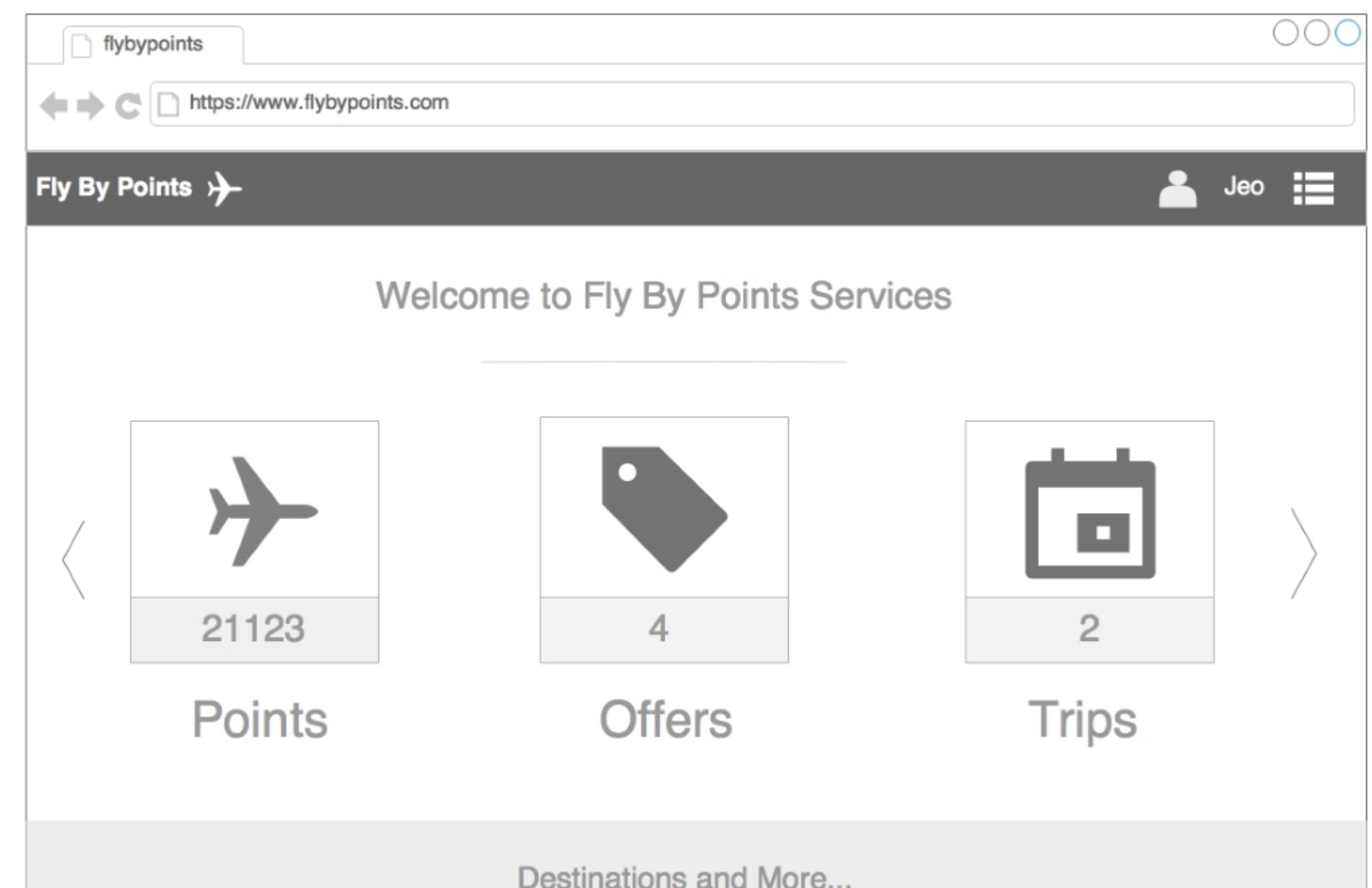
Characteristics of microservices

- **Antifragility, fail fast, and self-healing**
 - The opposite of fragility is antifragility, or the quality of a system that gets stronger when subjected to stressors
 - How quickly the system can fail and if it fails, how quickly it can recover from this failure
 - Mean Time Between Failures (MTBF) to Mean Time To Recover (MTTR)
 - Self-healing ~> the system automatically learns from failures and adjusts itself

Warm up

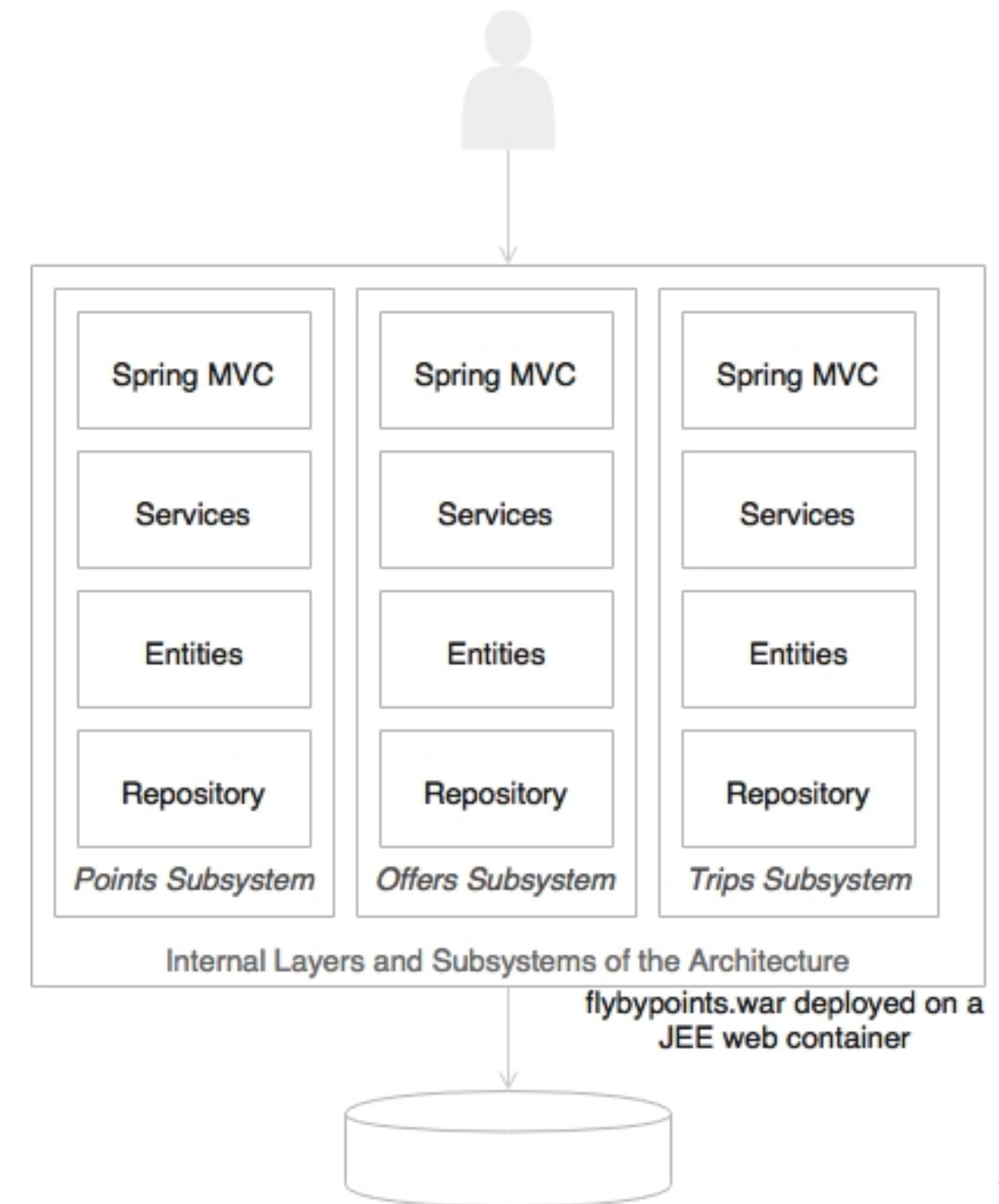
Microservices examples

- A holiday portal: FLY BY POINTS
 - Fly By Points collects points that are accumulated when a customer books a hotel, flight, or car through the online website.
 - When the customer logs in to the Fly By Points website, he/she is able to see the points accumulated, personalized offers that can be availed of by redeeming the points, and upcoming trips if any.



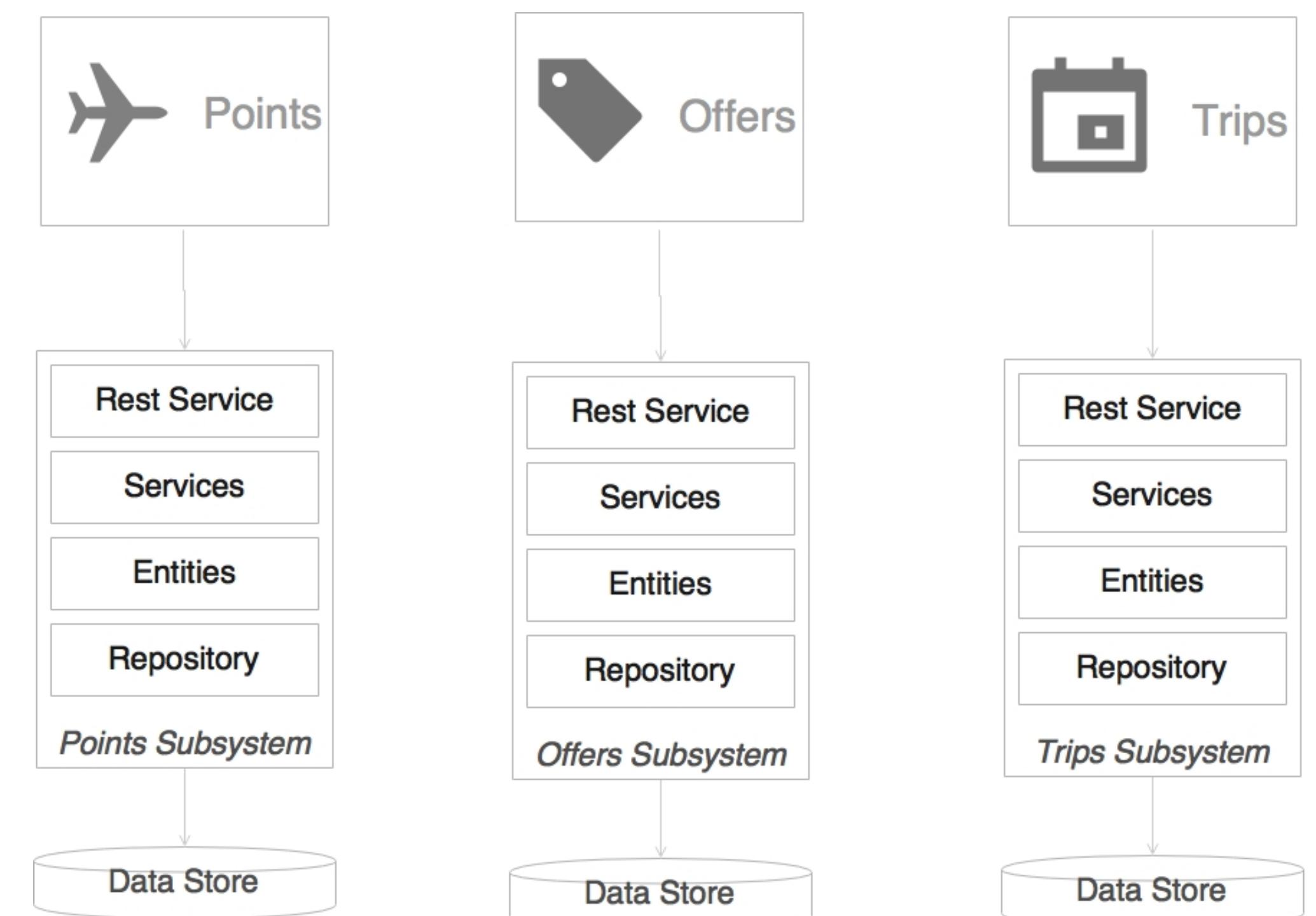
Fly By Points

- The holiday portal has a Java Spring-based traditional monolithic application architecture
- Following the usual practice, the holiday portal is also deployed as a single WAR file on a web server such as Tomcat
- As the business grows, the user base expands, and the complexity also increases



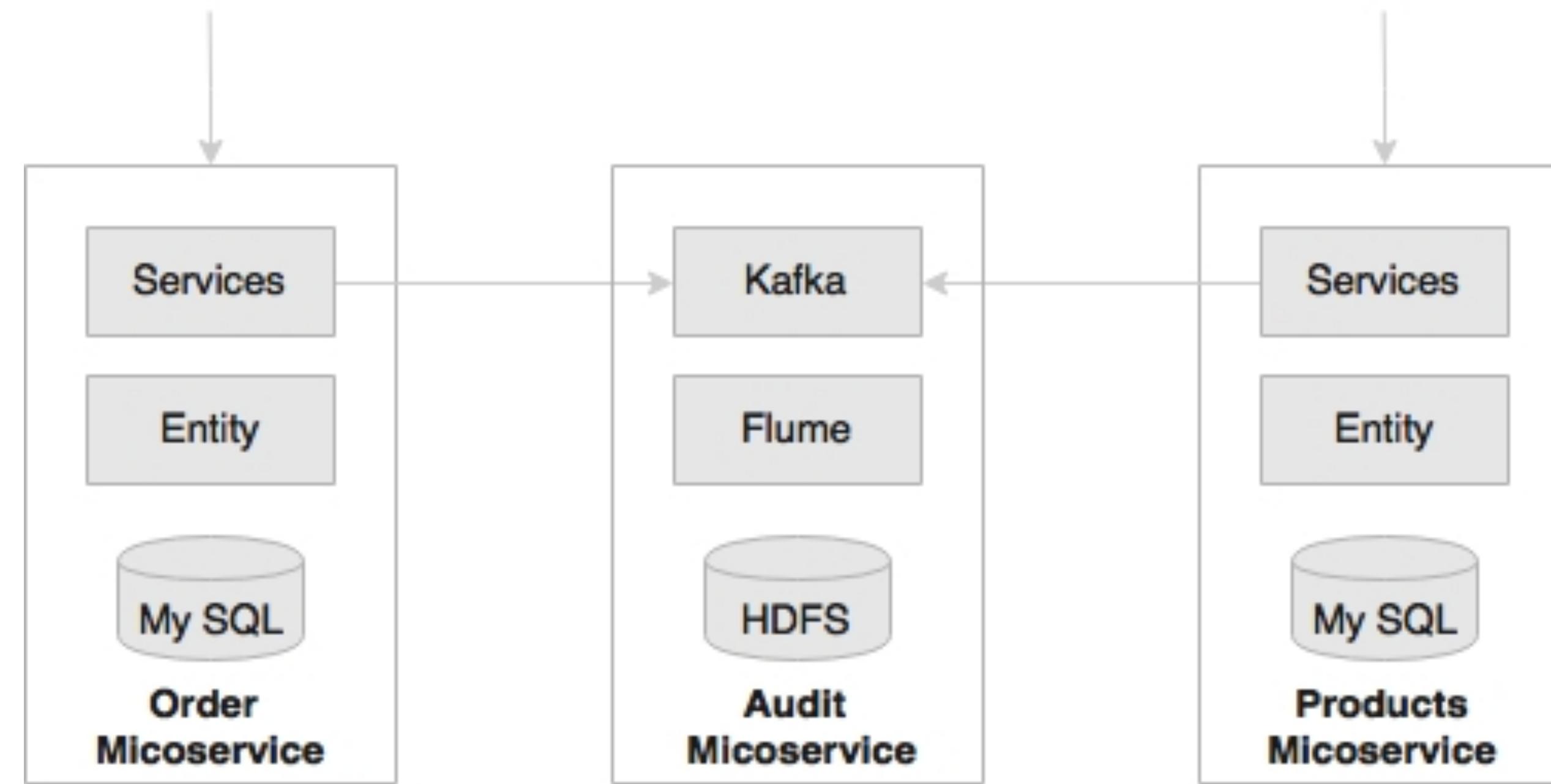
Fly By Points

- Rearchitecting the monolithic application to microservices for better speed of delivery, agility, and manageability
 - Each subsystem has now become an independent system by itself, a microservice
 - Each service encapsulates its own database as well as its own HTTP listener
 - Each microservice exposes a REST service to manipulate the resources/entity that belong to this service



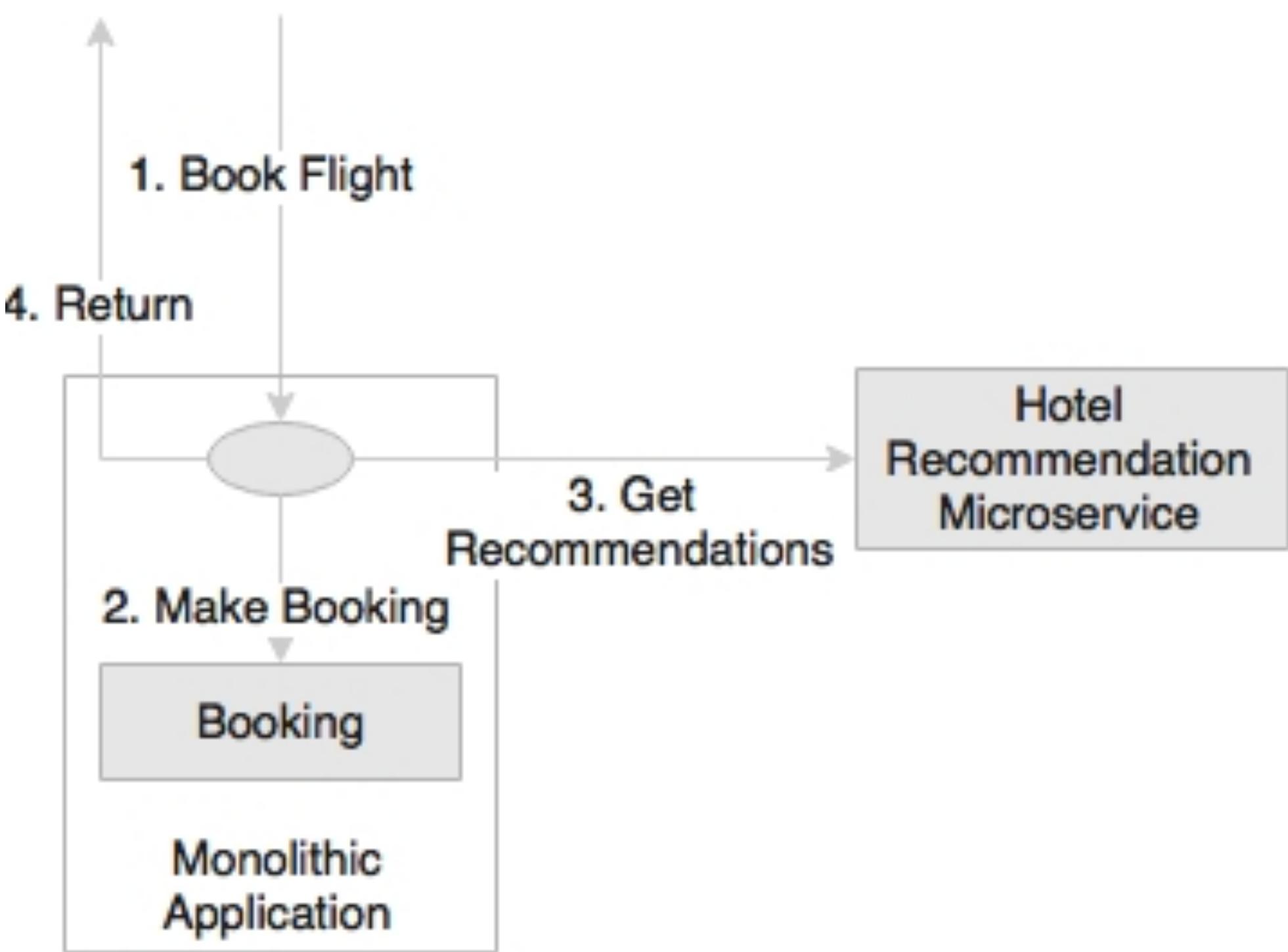
Microservices benefits

- Supports polyglot architecture



Microservices benefits

- Enabling experimentation and innovation

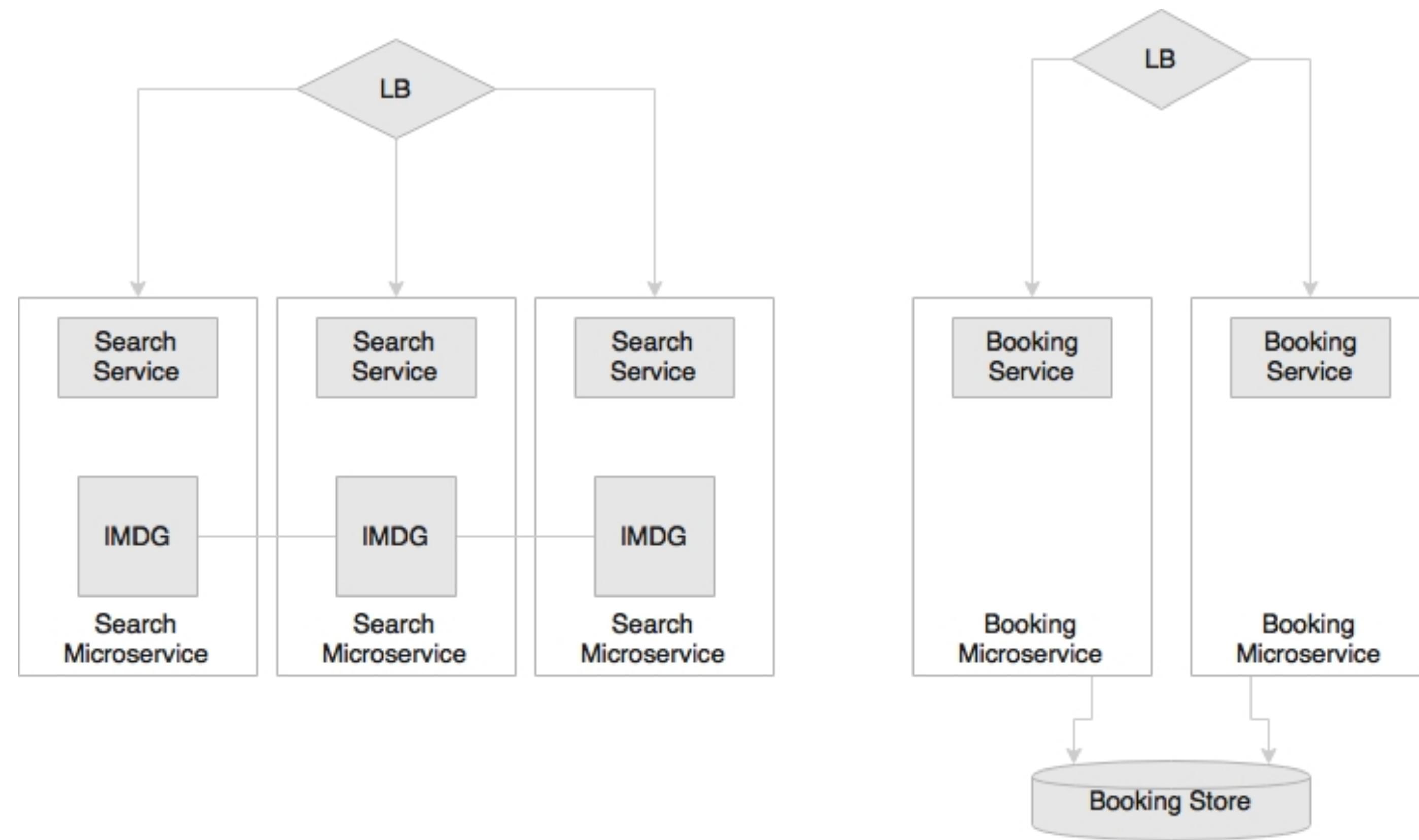


Microservices benefits

- Elastically and selectively scalable
 - As microservices are smaller units of work, they enable us to implement selective scalability
 - [Scale Cube](#) defines primarily three approaches to scaling an application:
 - Scaling the x axis by horizontally cloning the application
 - Scaling the y axis by splitting different functionality
 - Scaling the z axis by partitioning or sharding the data

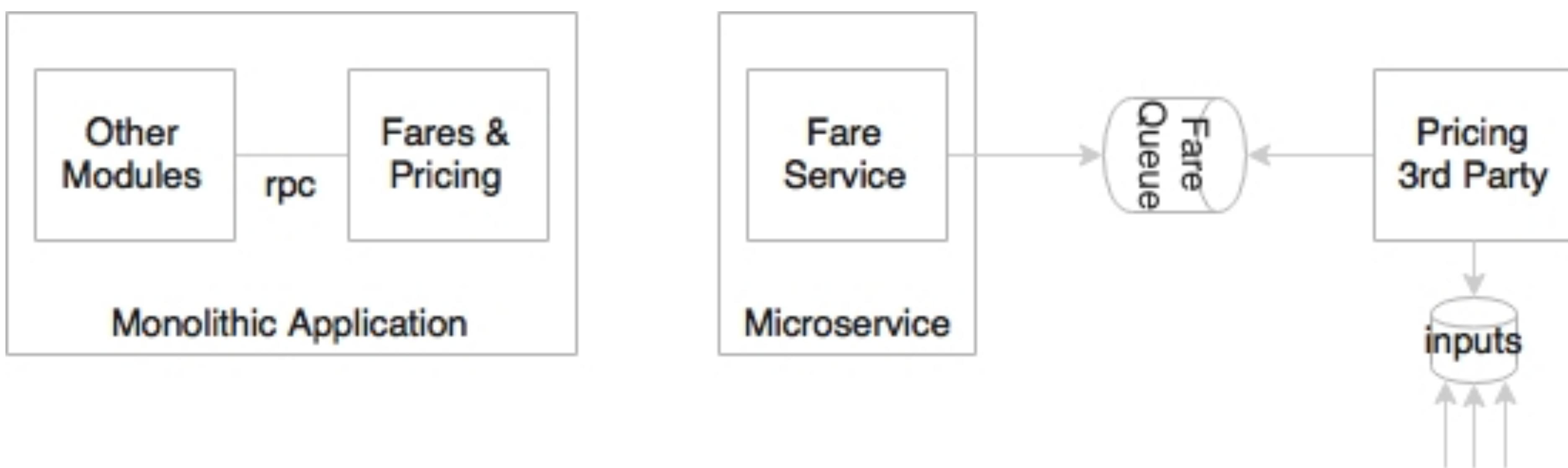
Microservices benefits

- Elastically and selectively scalable



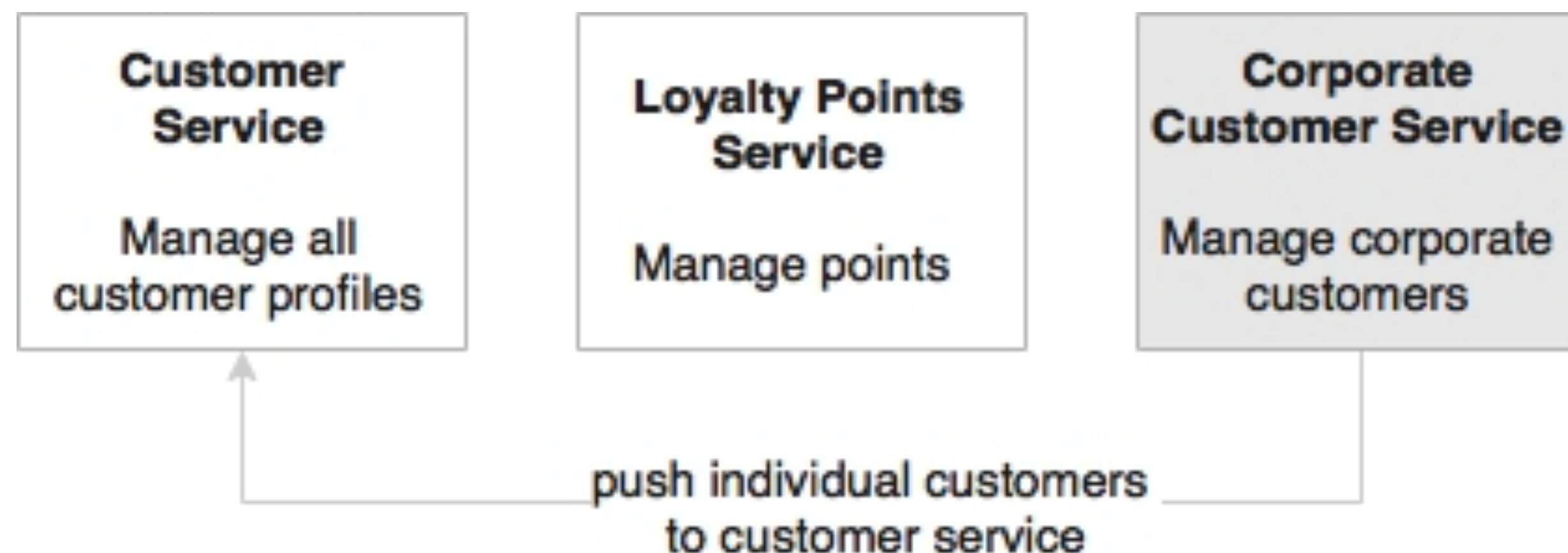
Microservices benefits

- Allowing substitution
 - Architecturally, a microservice can be easily replaced by another microservice developed either in-house or even extended by a microservice from a third party



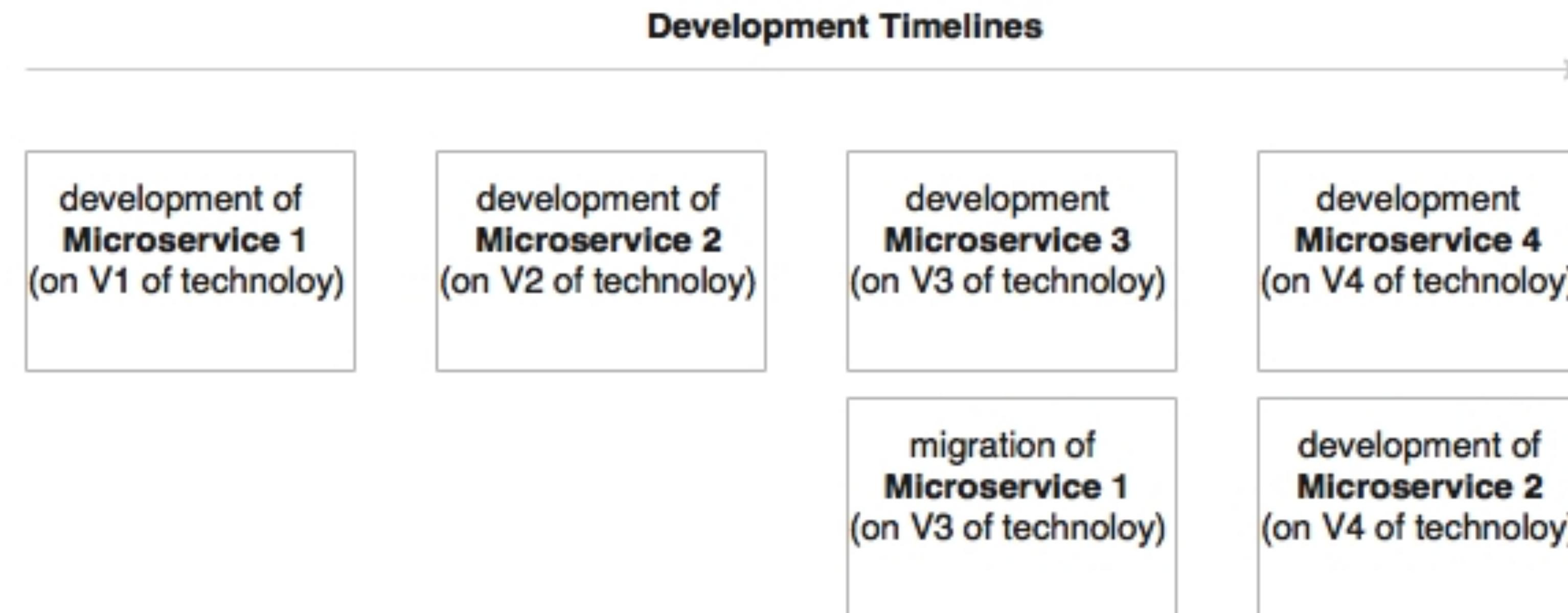
Microservices benefits

- Enabling to build organic systems
 - Organic systems are systems that grow laterally over a period of time by adding more and more functions to it
 - This enable us to keep adding more and more services as the need arises with minimal impact on the existing services



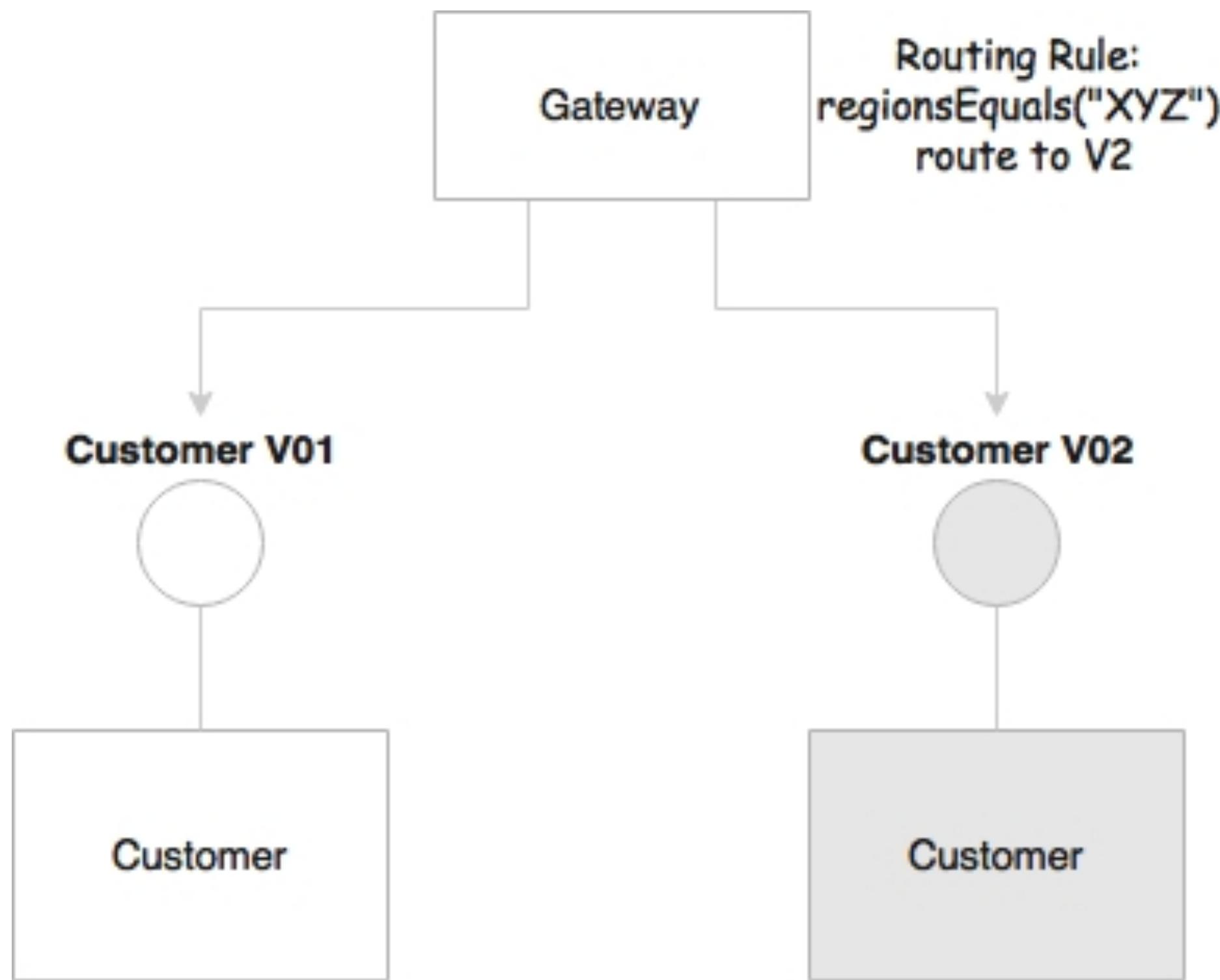
Microservices benefits

- Helping reducing technology debt
 - As microservices are smaller in size and have minimal dependencies, they allow the migration of services that use end-of-life technologies with minimal cost



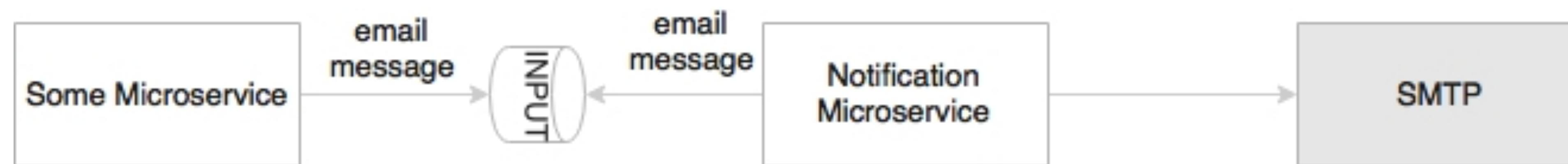
Microservices benefits

- Allowing the coexistence of different versions



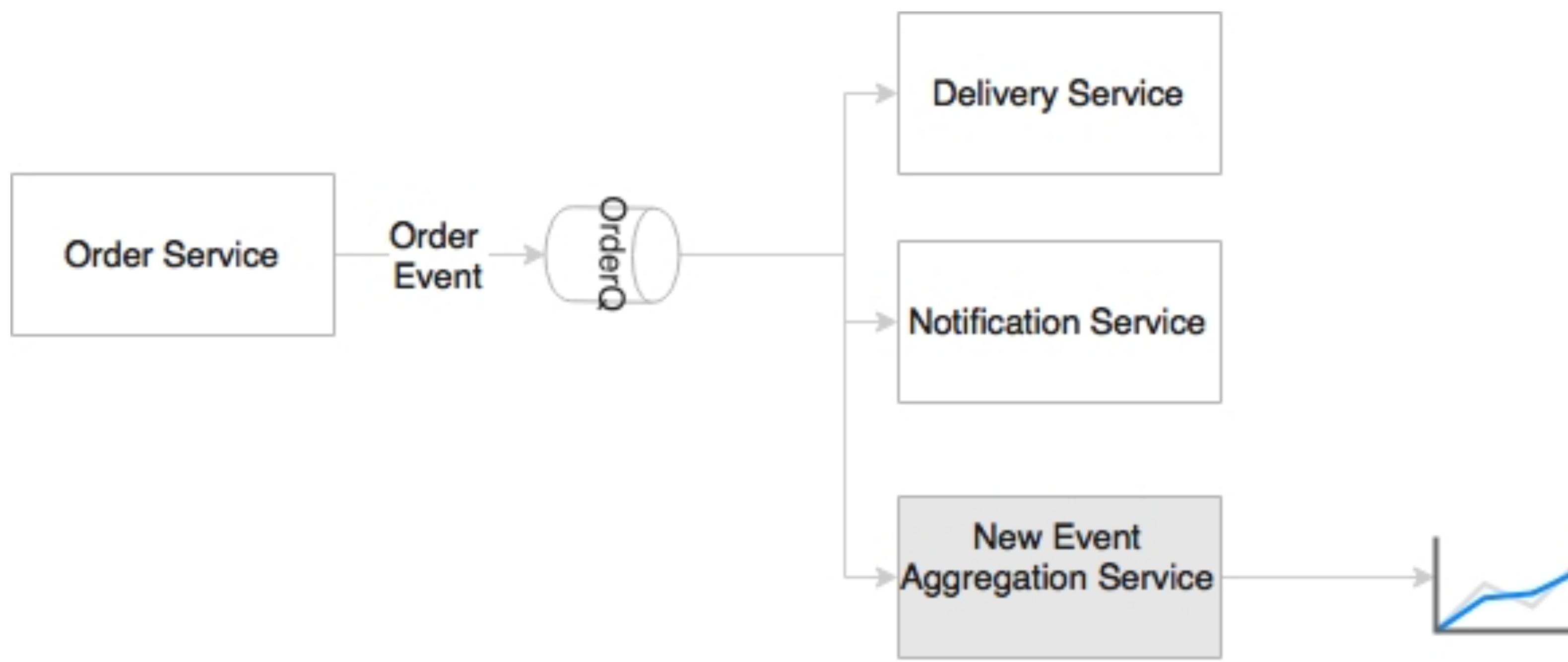
Microservices benefits

- Supporting the building of self-organizing systems
 - A self-organizing system support will automate deployment, be resilient, and exhibit self-healing and self-learning capabilities



Microservices benefits

- Supporting event-driven architecture
 - A well-architected microservice always works with events for both input and output. Once extracted, events can be used for a variety of use cases



Microservices benefits

- Enabling DevOps
 - Microservices are not the ultimate answer, but microservices are at the center stage in many DevOps implementations

Homework 2.1

- What are the relationships with other architecture styles?
 - Relations with SOA: Concepts & Principles; Service-oriented integration; Legacy modernization; Service-oriented application; Monolithic migration using SOA

Twelve-Factor Applications

- [twelve-factor app](#) é uma coleção de [padrões](#) para aplicações nativas pra nuvem, originalmente desenvolvido pelo time de engenheiros da Heroku
- Cloud Foundry, Heroku, e Amazon Elastic Beanstalk são otimizados para implantação de aplicações twelve-factor
- Se refere a uma **única unidade** de implantação

Twelve-Factor Applications

- I. **Codebase**: One codebase tracked in revision control, many deploys
- II. **Dependencies**: Explicitly declare and isolate dependencies
- III. **Config**: Store config in the environment
- IV. **Backing services**: Treat backing services as attached resources
- V. **Build, release, run**: Strictly separate build and run stages
- VI. **Processes**: Execute the app as one or more stateless processes
- VII. **Port binding**: Export services via port binding
- VIII. **Concurrency**: Scale out via the process model
- IX. **Disposability**: Maximize robustness with fast startup and graceful shutdown
- X. **Dev/prod parity**: Keep development, staging, and production as similar as possible
- XI. **Logs**: Treat logs as event streams
- XII. **Admin processes**: Run admin/management tasks as one-off processes

Características 12factor

- Fazem **poucas ou nenhuma** suposição sobre os ambientes nos quais serão implantados
- Mecanismo **simples e consistente**, **facilmente automatizado**, para fornecer **rapidamente** novos ambientes e **implantar** as apps neles
- Também se prestam bem à idéia de **efemeridade**, ou aplicações que podemos "jogar fora" com **muito pouco custo**.
 - Recuperação automática de eventos de falha muito rapidamente

Homework 2.2

- What are the relations between microservices and Twelve-Factor apps?

Microservice use cases

- A microservice is not a silver bullet and will not solve all the architectural challenges
 - Migrating a monolithic application due to improvements required in scalability, manageability, agility, or speed of delivery
 - Utility computing scenarios such as integrating an optimization service, forecasting service, price calculation service... independent stateless computing units that accept certain data, apply algorithms, and return the results
 - Highly agile applications, applications demanding speed of delivery or time to market

Microservice use cases

- There are few scenarios in which we should consider avoiding microservices:
 - If the organization's policies are forced to use centrally managed heavyweight components such as [ESB](#)
 - If the organization's culture, processes, and so on are based on the traditional waterfall delivery model, lengthy release cycles, matrix teams, manual deployments...
- Tip: Read more about the [Conway's Law](#)

Microservice use cases

- Microservices early adopters
 - Netflix (www.netflix.com)
 - Uber (www.uber.com)
 - Airbnb (www.airbnb.com)
 - Orbitz (www.orbitz.com)
 - eBay (www.ebay.com)
 - Amazon (www.amazon.com)
 - Gilt (www.gilt.com)
 - Twitter (www.twitter.com)
 - Nike (www.nike.com)

Homework 2.3

- Choose 3 early adopters case to tell (briefly) the history

Microservice use cases

- The common theme is monolithic migrations
 - Advantage: they have all the information upfront, readily available for refactoring
 - There is no state called "definite or ultimate microservices".
 - It is a journey and is evolving and maturing day by day