Distributed Systems

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期末專題的展現方式

1、各組錄製一段影片+投影片、上傳到moodle

(1) 系統demo (要突顯各項要求，例如至少三個節點(可在同一個實體電腦運行)，若未突顯而導至評分有誤差需自行負責) 上傳到youtube，網址請內含在投影片中;

(3) 作業繳交方式: 上傳投影片，在投影片最後一頁，顯示上述影片的網址。

(請每組一人代表上傳即可)　2022/6/13 (一) 00:00 due

2、5-8分鐘的期末口頭報告

請依個別時段加入，點名後由一人進行報告並接受線上詢問，每位組員必須出席，未出席同學將嚴重影響期末分數。

6/13 (一) 13:00-14:00 第1組-第4組

6/13 (一) 14:00-15:00 第5組-第8組

6/13 (一) 15:00-16:00 第9組-第12組

接受詢問的線上會議網址 (提早5分鐘登入，避免因操作問題點名未到):

視訊通話連結：https://meet.google.com/zse-bbdo-sri

Distributed Systems

SOA and Microservices

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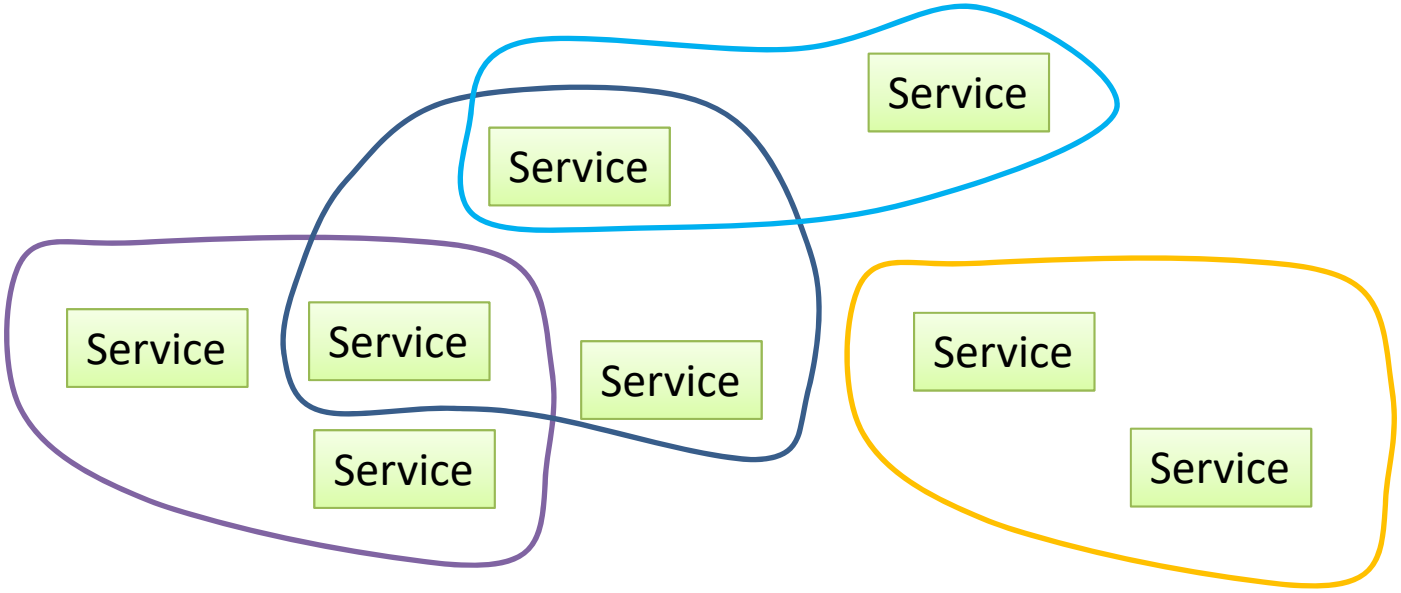
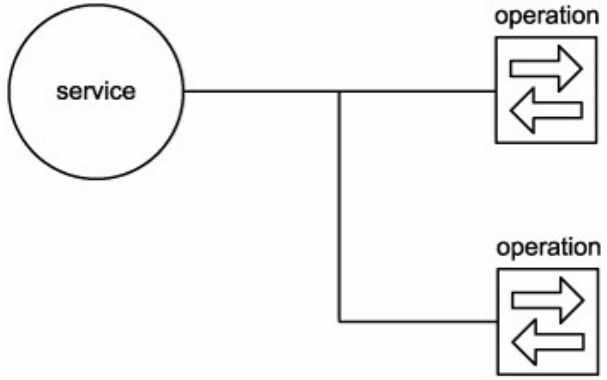
Service-Oriented Architecture

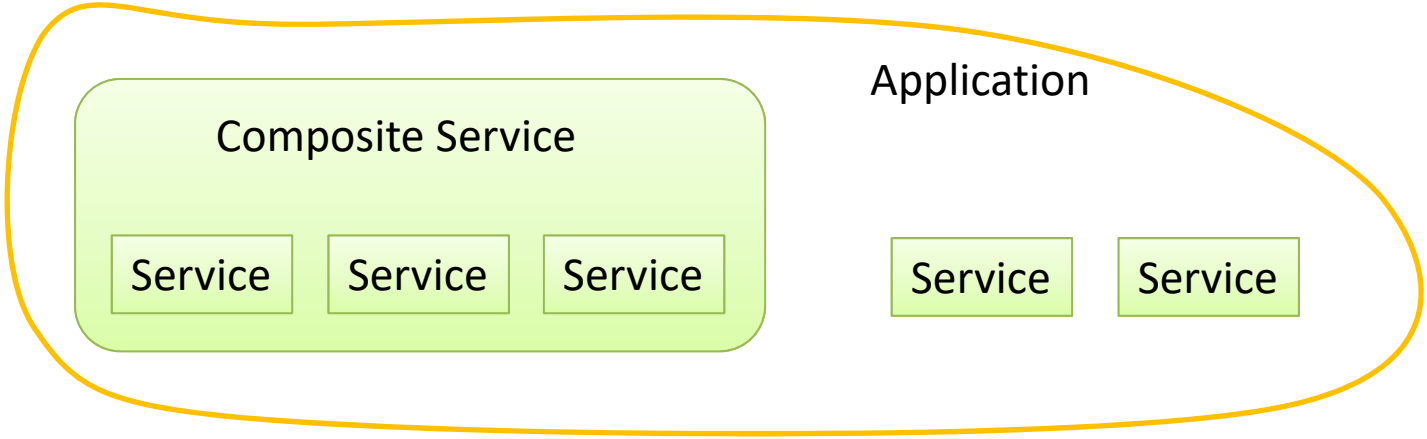
- An architectural style, in which:
  - Services are building blocks of applications
  - Services can be reused to build new applications
  - Services integration is based on open standards



Service

- A reusable component
  - Units of processing logic
  - Consists of a set of operations
- Can be building blocks of
  - Larger, more complex applications
  - Larger, more complex another services

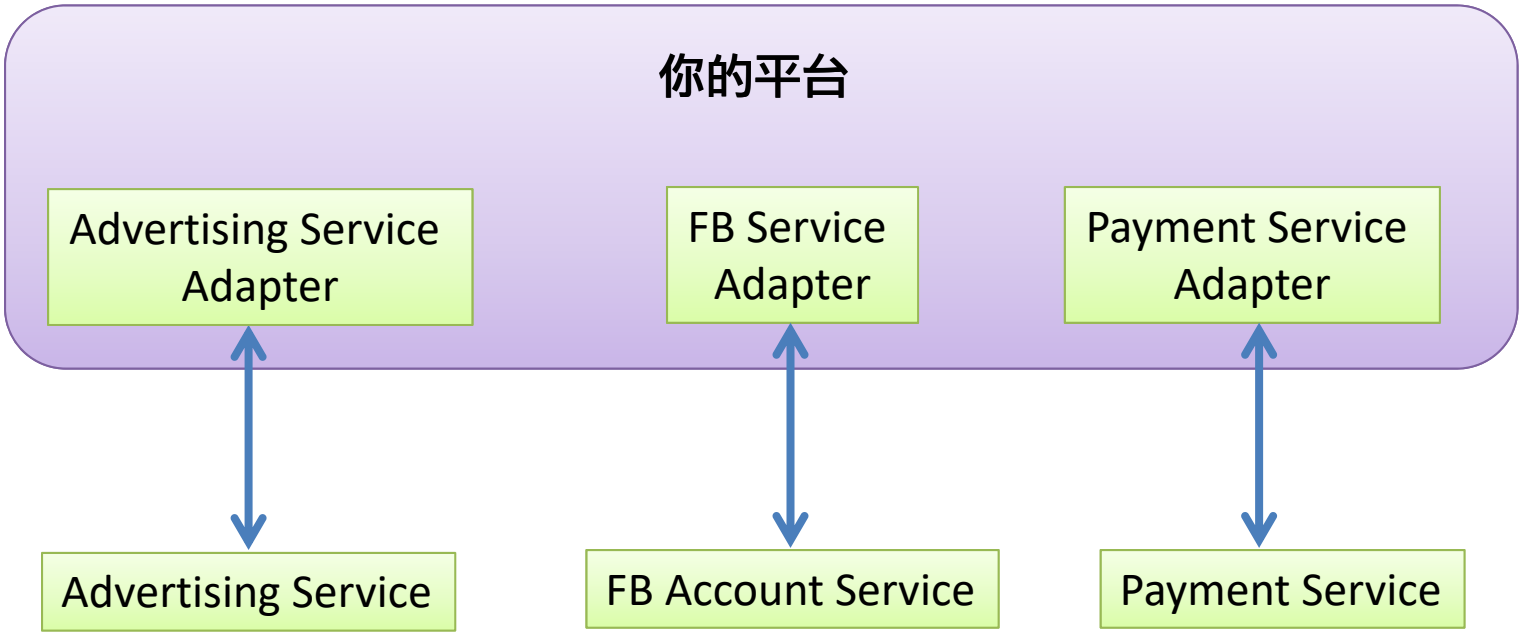




範例

- 新創公司希望能透過廣告及電子商務營利
- 必須整合多個廠商提供的服務
  - 廣告平台 (API) Advertising Service
    - XX廣告公司提供專屬的Java RMI API
  - 銀行信用卡服務 Payment Service
    - XX銀行透過專屬的c-based library由遠端進行加密呼叫
  - 帳號認證機制 FB Account Service
    - FB 提供RESTful API

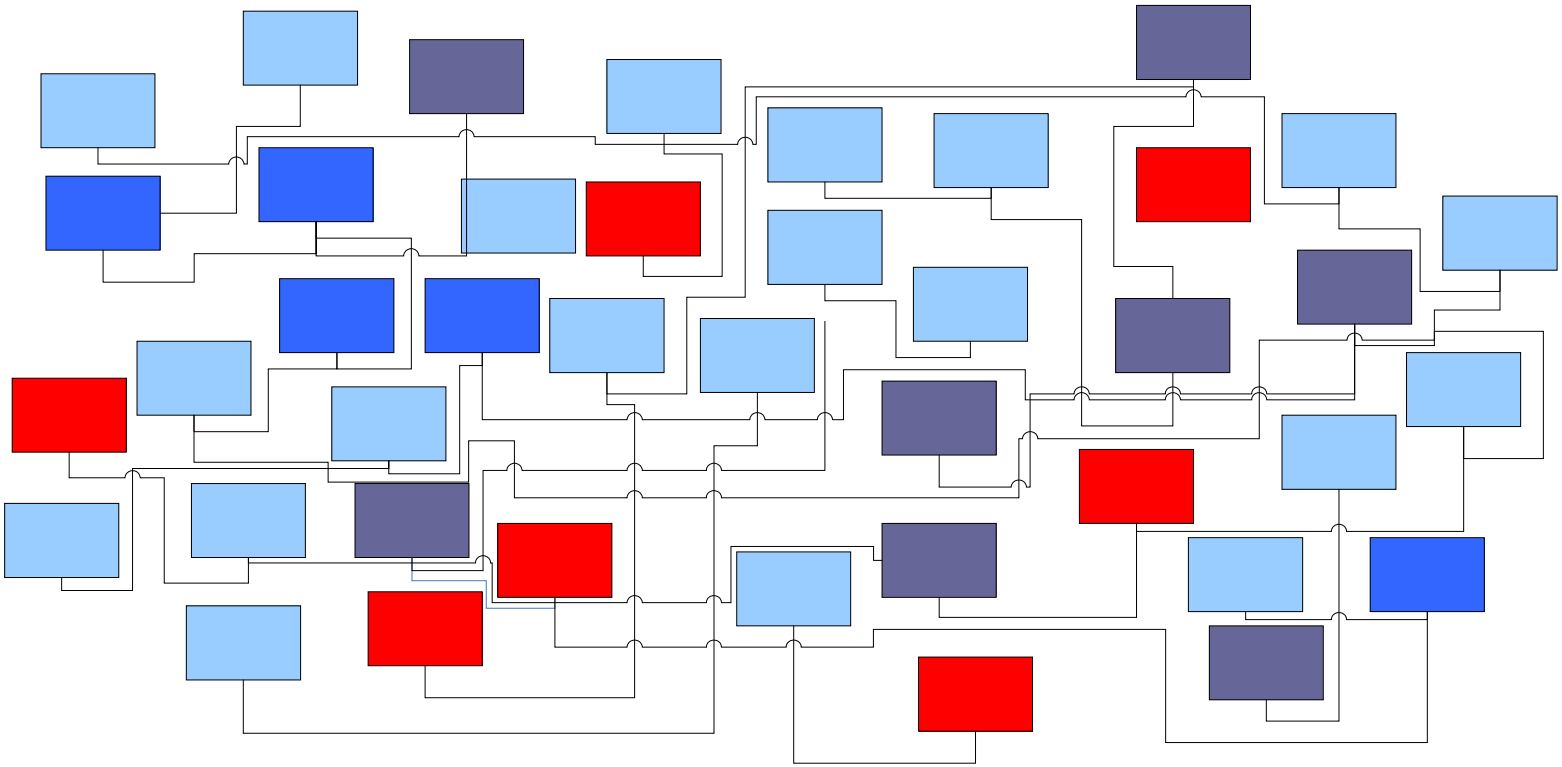
一開始


你的平台
Advertising Service Adapter
FB Service Adapter
Payment Service Adapter
Advertising Service
FB Account Service
Payment Service

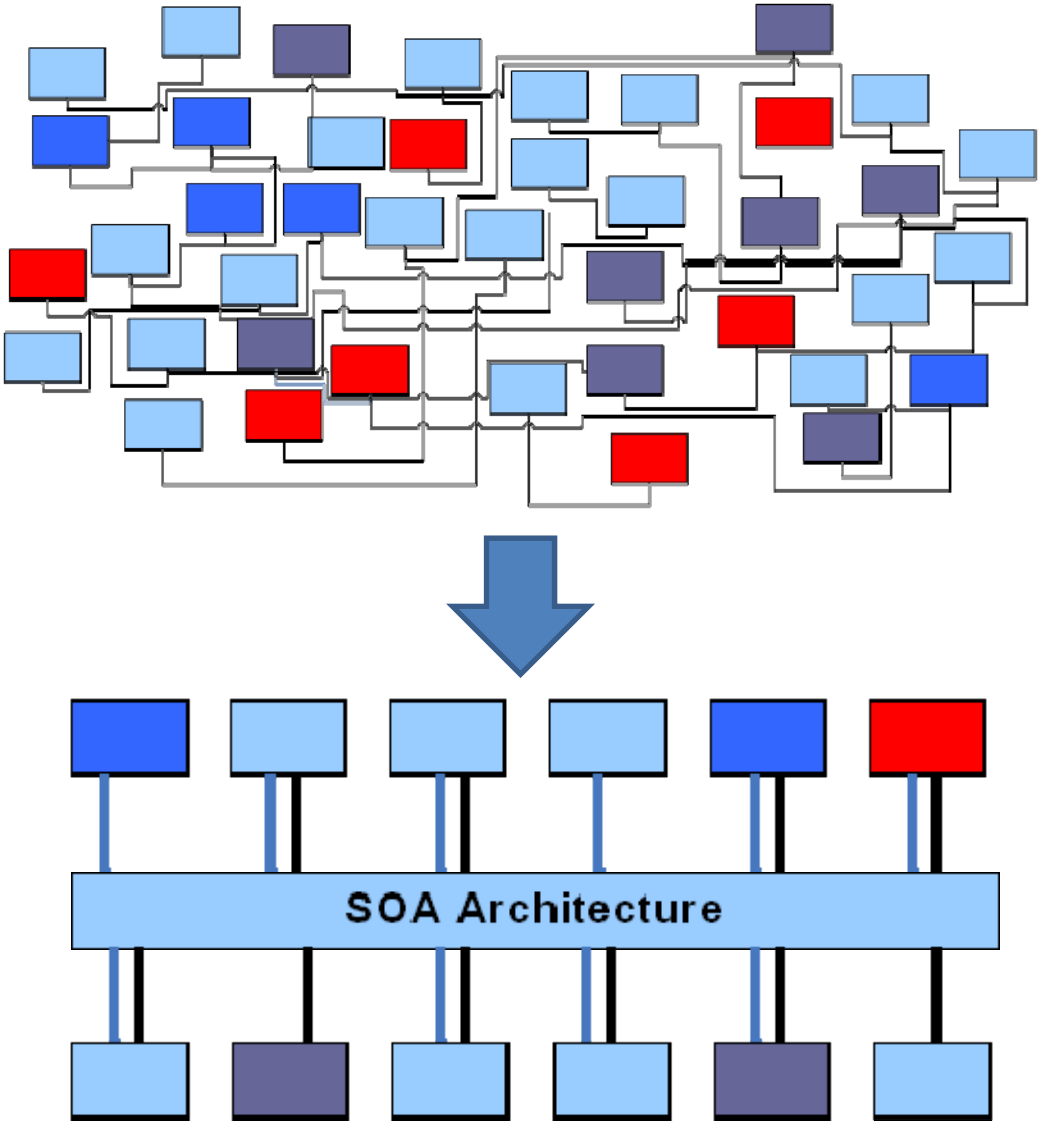
傳統服務整合

- 提供服務的廠商
  - 不太能確保其服務的品質
- 開發Adapter
  - 為每個廠商的API開發一份整合用的code接到自己的平台
  - 異質語言有可能無法整合
    - 依廠商而需學習多種平台的code (人力、時間成本!)
- 要更換廠商或更新時
  - 重新再找廠商
  - 要重新修改自己平台的原始碼
    - 而要新語言or技術要再學一次→人力、時間成本!

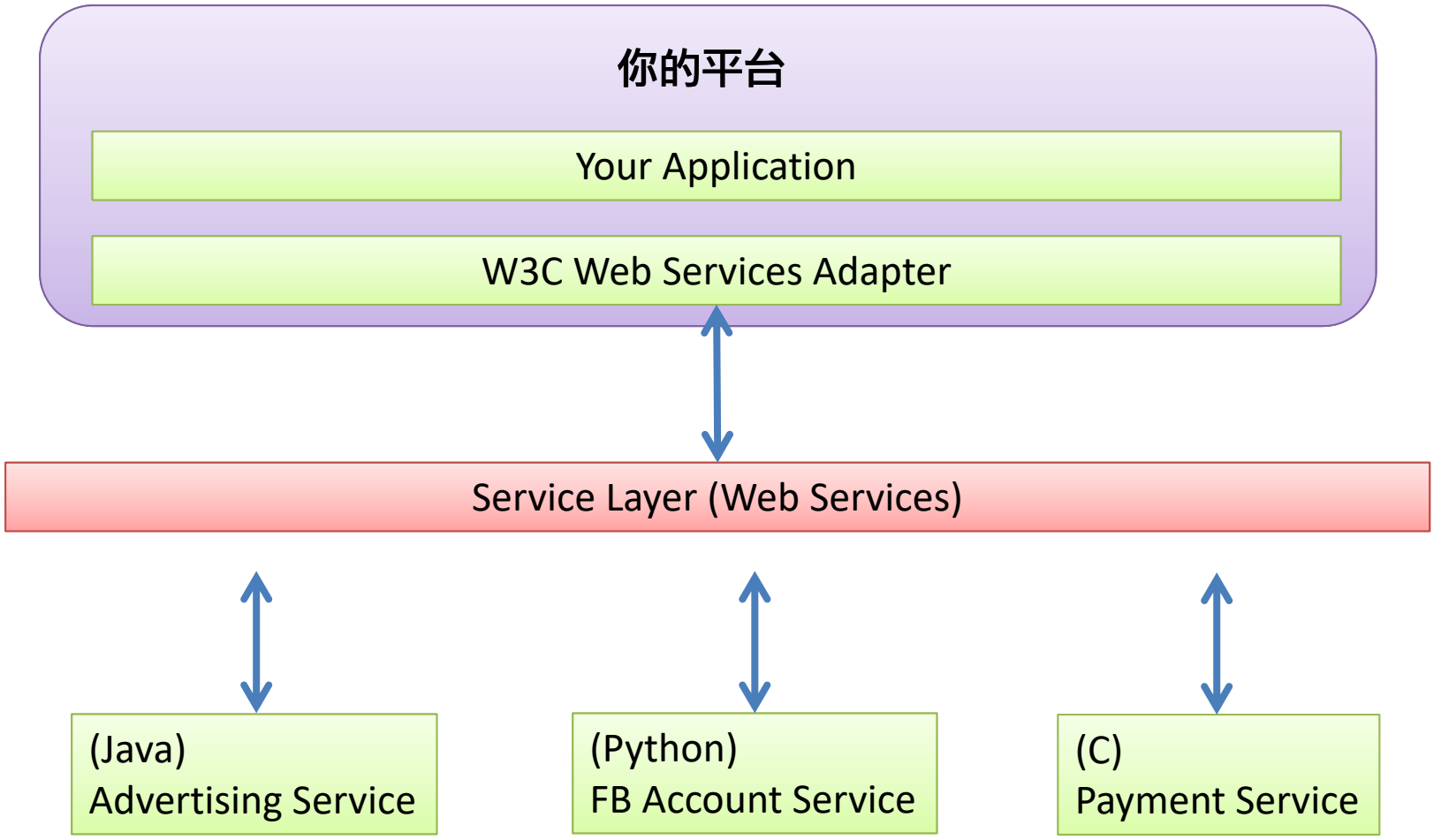
一年後



SOA的目標



Service-Oriented Integration

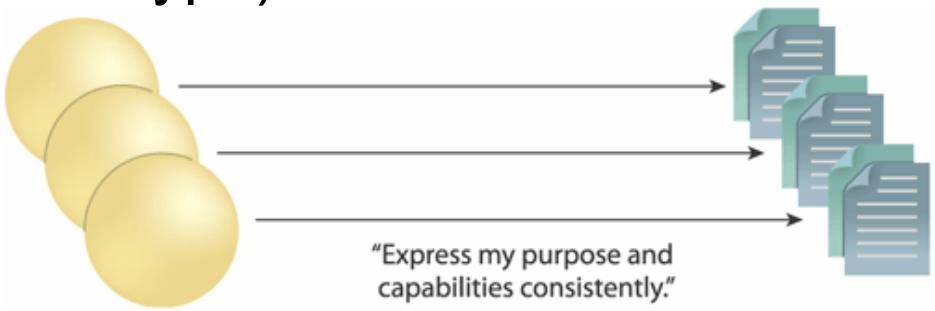


服務導向整合特色

- Standardization
- Loosely coupling
- Statelessness
- Discoverability
- Composability

Standardized Service Contracts

- Services use standardized service contract to
  - Express their capabilities
  - Express their quality
- Focus on the areas of
  - Interface description (signature)
  - Data representation (data type)
  - Policy (rule)

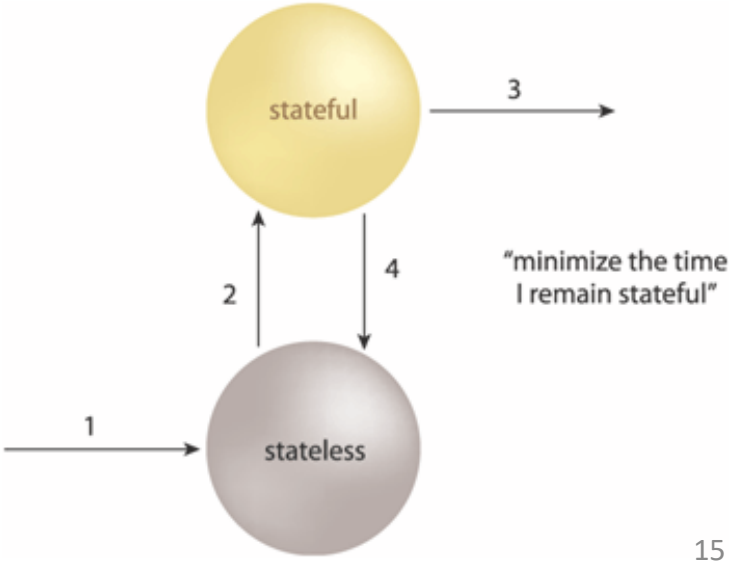


Loose Coupling

- The consumer of the service provides only the required interface definition
- Expect only the specified results on the interface definition
- The service is capable of handling all processing (including exception processing)

Minimal Statefulness

- Minimize resource consumption by deferring the management of state information when necessary
- Most services do not maintain state between invocations
- Benefits
  - Increase scalability (why?)
  - Minimize dependency



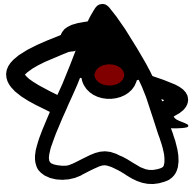
Discoverability

服務目錄

視訊電話應用程式

Hi, 請給我一個電話服務和視訊服務，電話服務最好是機動性高的，視訊服務最好是在廚房...

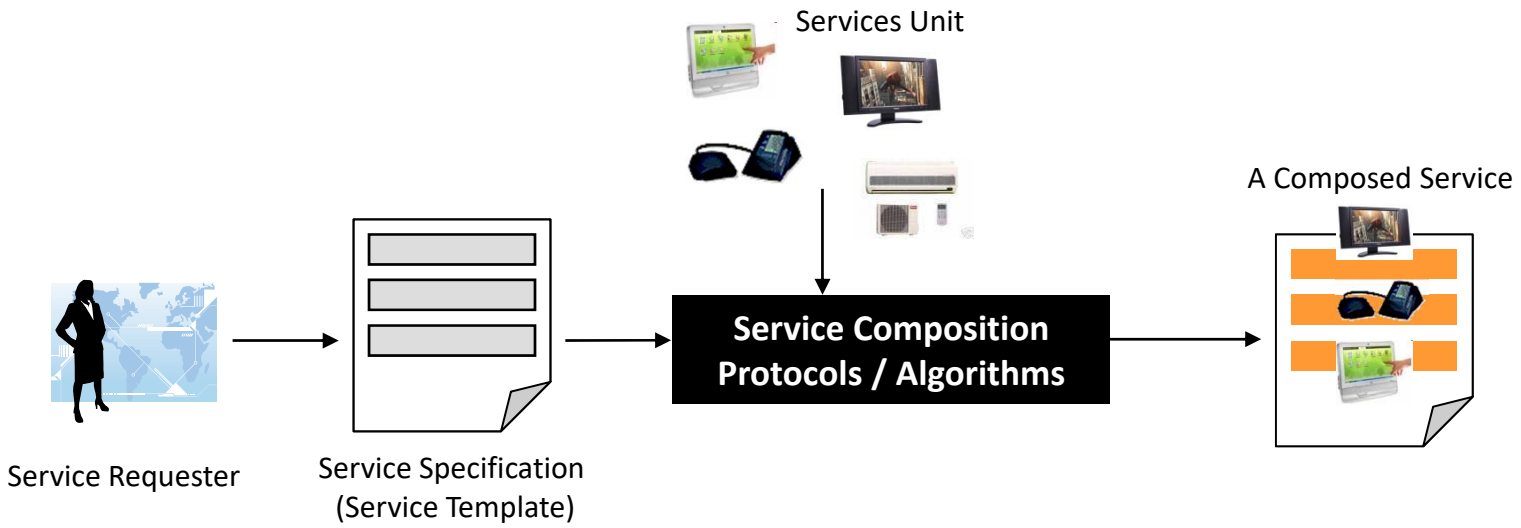
最符合您的要求的只有這些，你要不要?



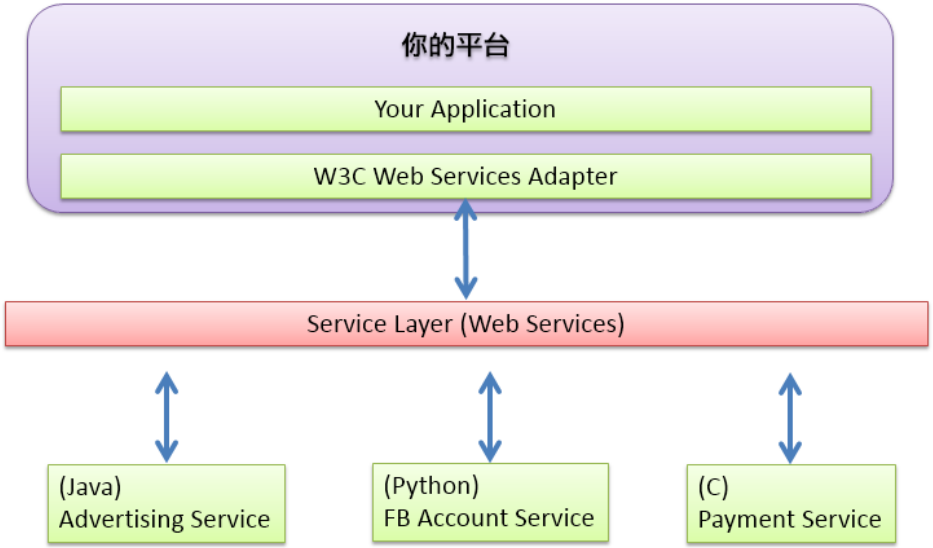
服務目錄管理員

Composability

- Services are able be aggregated to solve larger problems
- If multiple qualified candidates are discovered the runtime picks the one with highest “quality”



問題



服務使用者

如何呼叫別人的服務?

如何知道服務的功能、特色與品質?

如何找到有那些服務可以用?

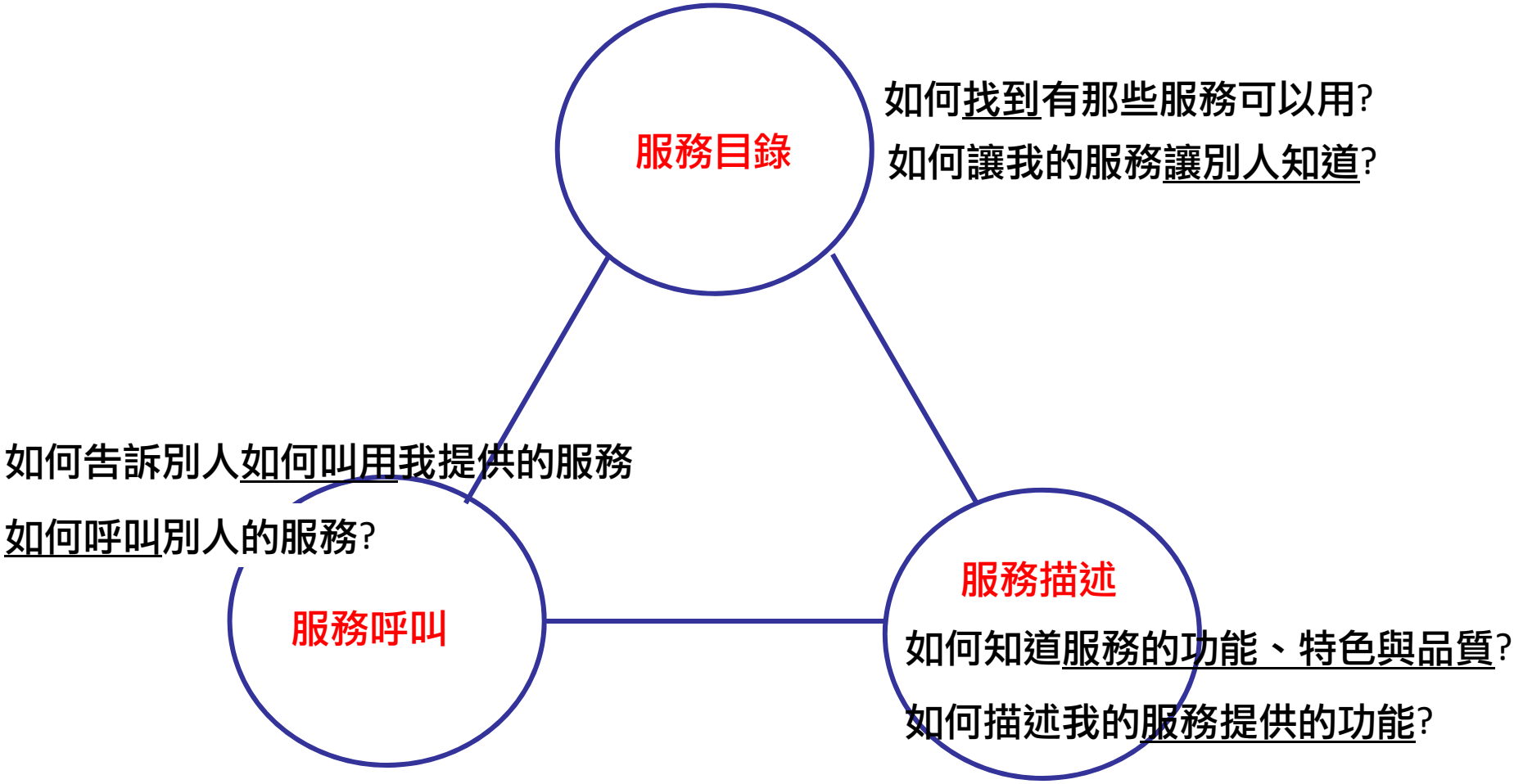
服務提供者

如何描述我的服務提供的功能?

如何告訴別人如何叫用我提供的服務

如何讓我的服務讓別人知道?

Essential SOA Requirements



Microservice

- Definition
  - Structure the application as a collection of loosely coupled, independently deployable services
- Service
  - A standalone component that implements some useful functionality
  - A service's API encapsulates its internal implementation
  - The API can not be bypassed: enforcing the modularity
  - Each service has its own architecture and technology stack

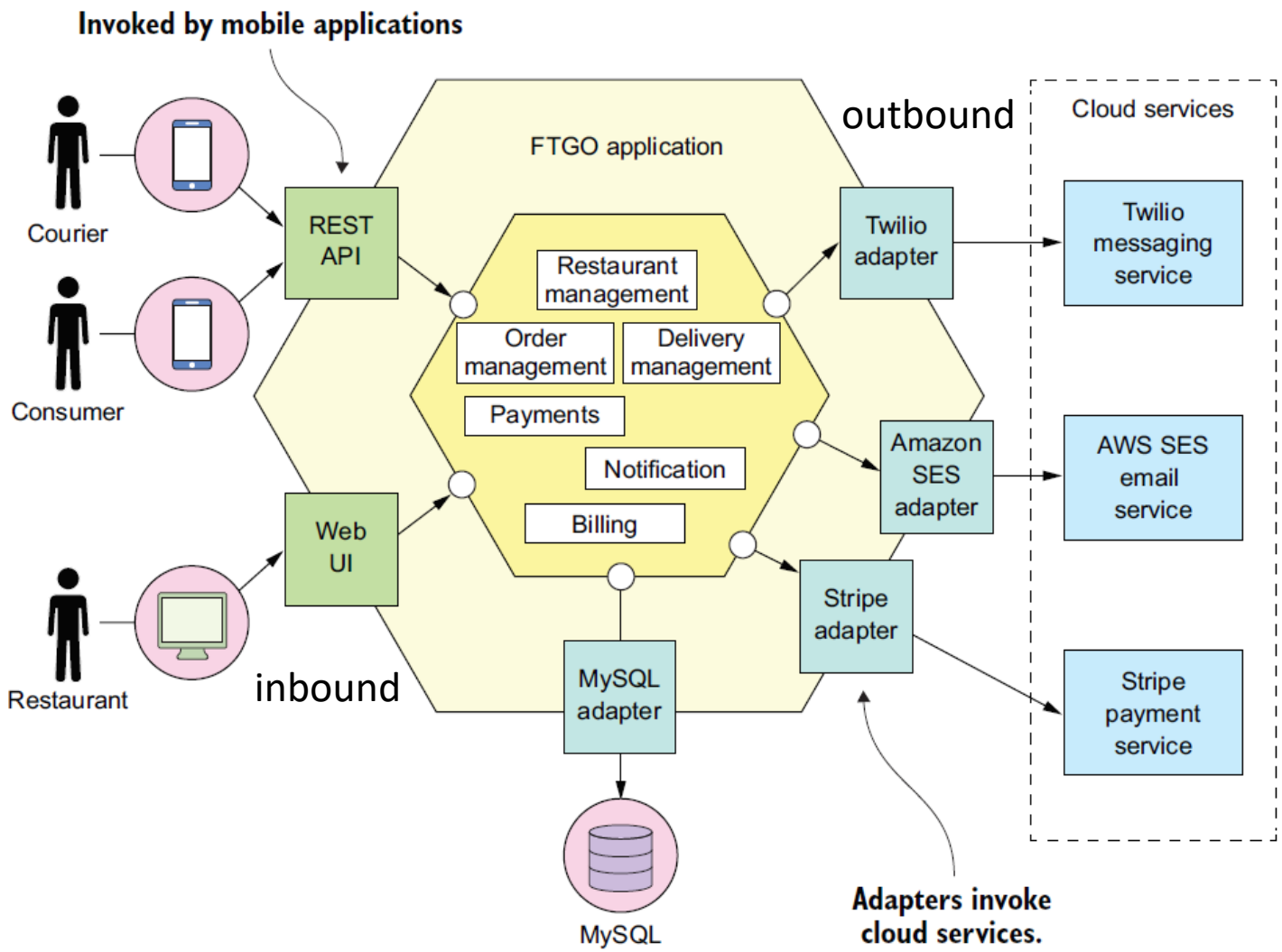
SOA and Microservices

Dumb endpoints　　Smart endpoints

	SOA	Microservices
Inter-service communication	Smart pipes, such as Enterprise Service Bus, using heavyweight protocols, such as SOAP and the other WS* standards. Pipe: 指通訊媒介	Dumb pipes, such as a message broker, or direct service-to-service communication, using lightweight protocols such as REST or gRPC kafka
Data	Global data model and shared databases	Data model and database per service
Typical service	Larger monolithic application	Smaller service

The FTGO Application

傳統SOA架構



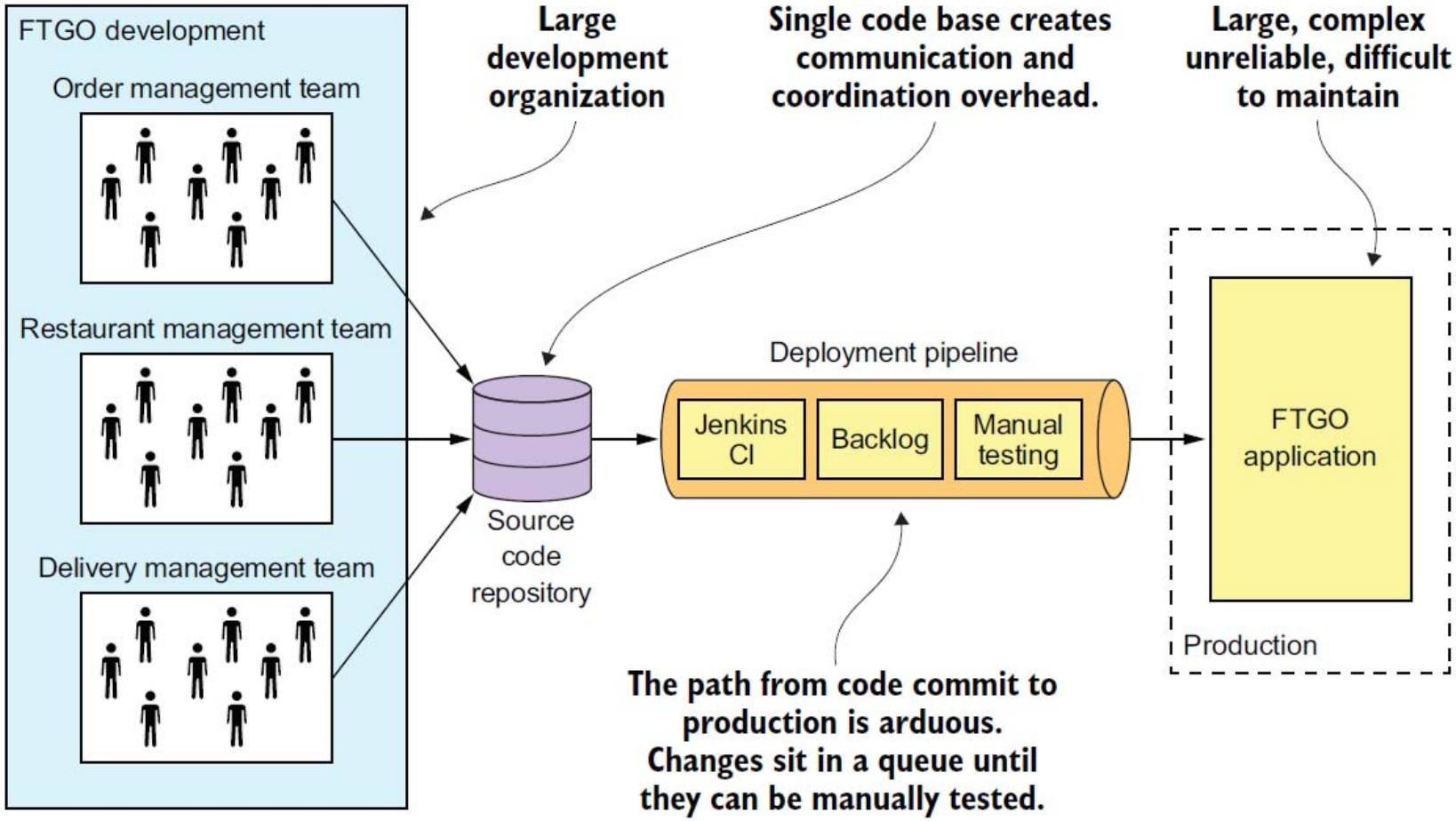
The FTGO Application

- Hexagonal architecture
  - Core: business logic; surrounding: external services
- A typical Java EE application
  - Packaged as a single WAR file

Benefits of Monolithic Architecture

- (前提) When the application was relatively small
  - **Simple to develop**: less IPC
  - **Easy to make changes**: change the code and the database schema, build, and deploy
  - **Straightforward to test**: the developers wrote end-to-end tests that launched the application
  - **Straightforward to deploy**: copy the WAR file to a server
  - **Easy to scale**: run multiple instances of the application behind a load balancer

Step into the Monolithic Hell

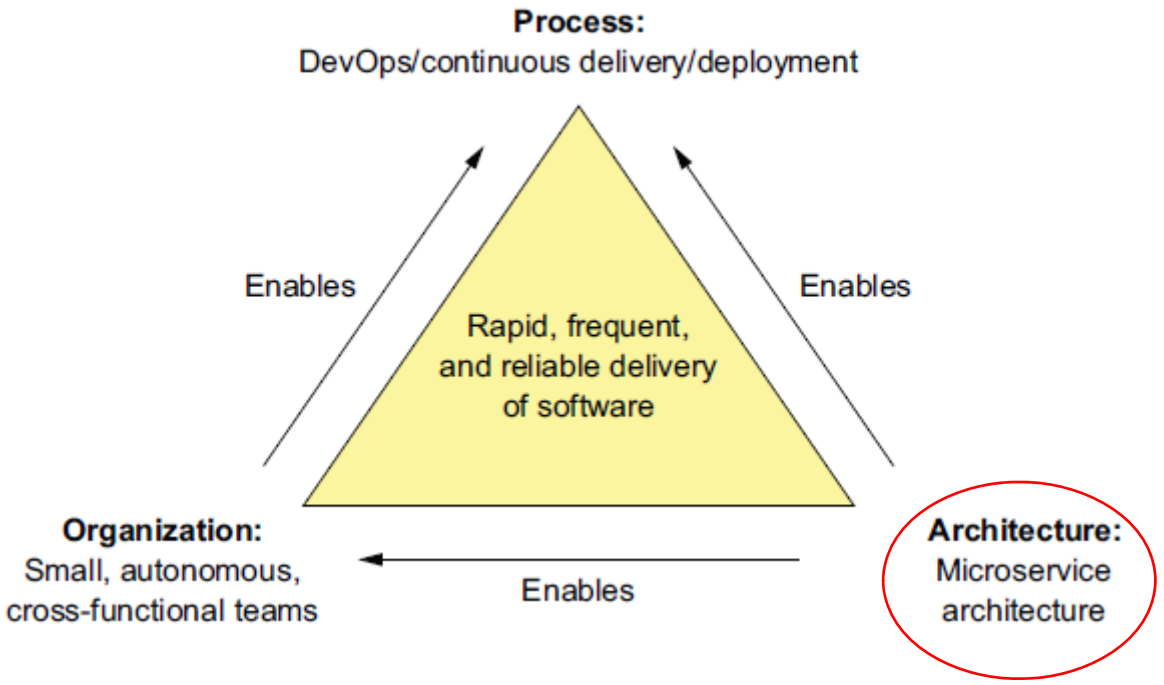


Monolithic Hell

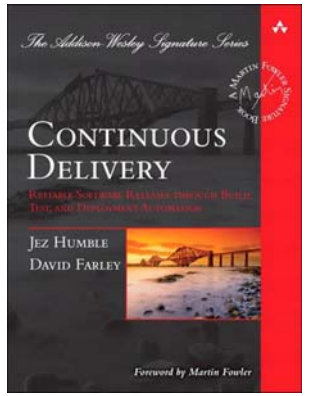
- 前提: After the application grows
  - Development becomes slow
  - Path from commit to deployment is long and arduous 費力的；困難的
  - Scaling becomes difficult
  - Locked into obsolete technology stack

當代企業應用程式特色

- 3大需求
  - Rapid delivery
  - Frequent delivery
  - Reliable delivery
- 3大策略
  - 製程
    - DevOps/CI/CD
  - 組織
    - 小型全端團隊
  - 架構
    - 微服務



製程: DevOps

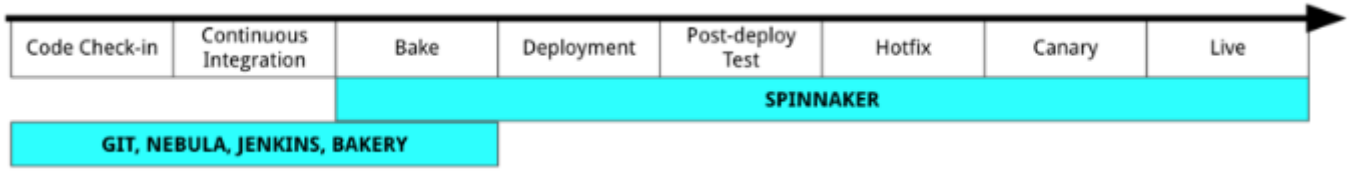


- Continuous Delivery (Jez Humble)
  - Software is always releasable
  - The ability to get changes of all types into production safely and quickly in a sustainable way
  - Changes includes: new features, configuration changes, bug fixes and experiments
- Continuous Deployment
  - Automatically deploying releasable code into production

Move fast without breaking things

Google State of DevOps Reports https://www.devops-research.com/research.html

- Metrics for software delivery and operational performance
  - Deployment frequency (DevOps: High)
  - Lead time : 開發人員commit程式到上線的時間 (DevOps: Short)
  - MTTR (Mean time to recover)
  - Change failure percentage: 由於改動導致的系統失效
- Examples
  - Amazon deploys changes into production every 11.6 seconds
  - Netflix lead time = 16 minutes



https://medium.com/netflix-techblog/how-we-build-code-at-netflix-c5d9bd727f15

組織: 逆Conway定律

The reverse Conway maneuver

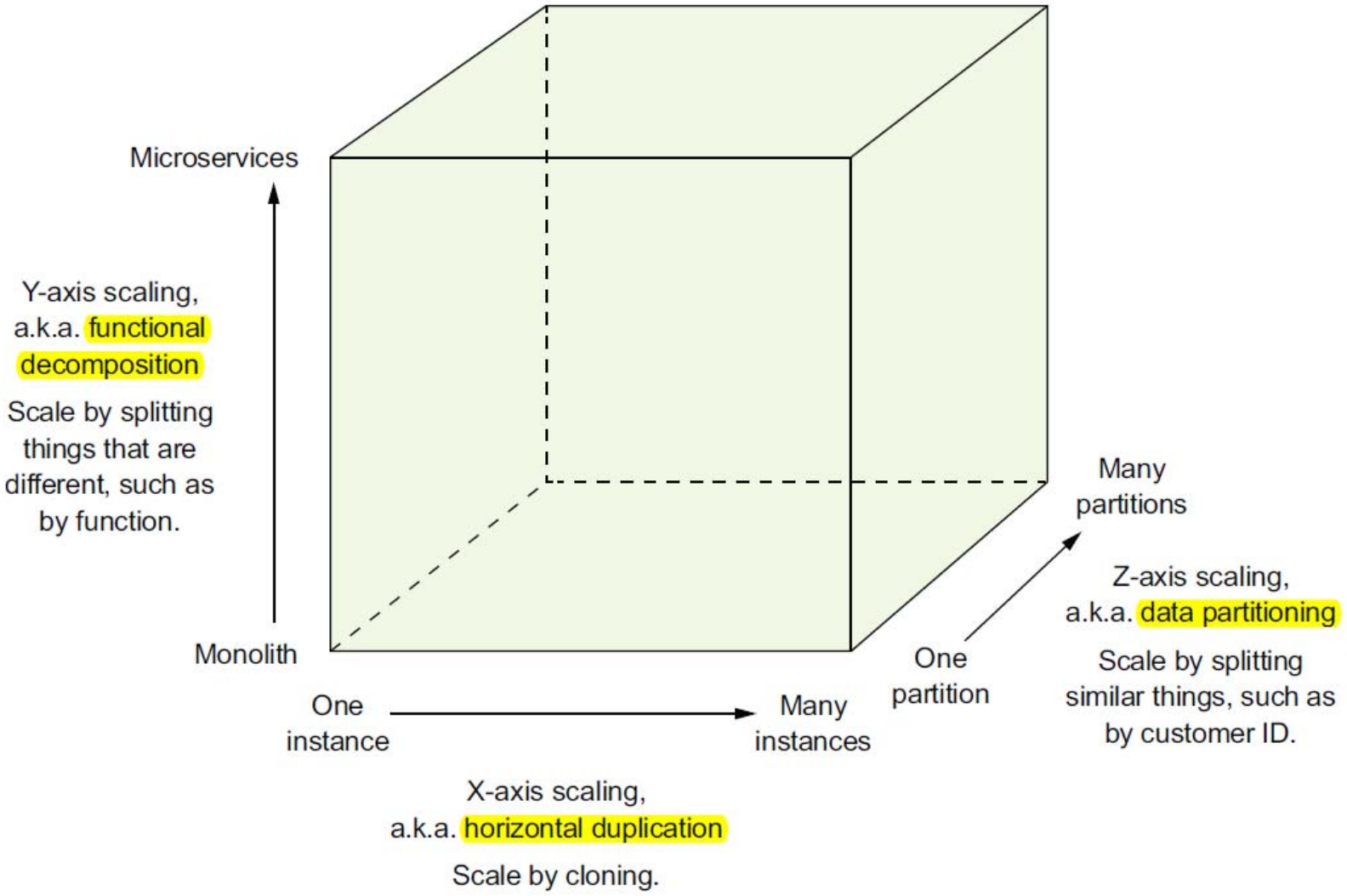
In order to effectively deliver software when using the microservice architecture, you need to take into account Conway's law (https://en.wikipedia.org/wiki/Conway%27s_law), which states the following:

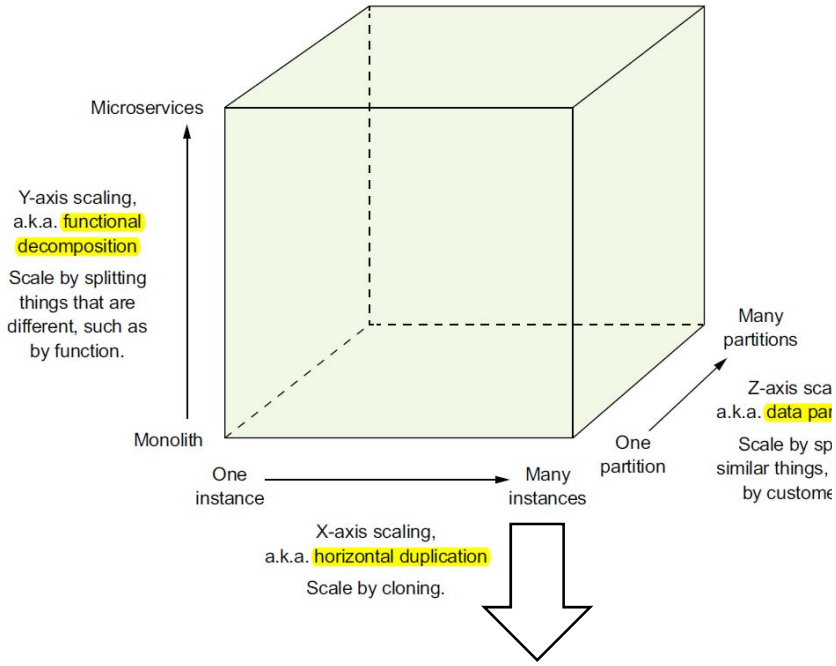
> *Organizations which design systems ... are constrained to produce designs which are copies of the communication structures of these organizations.*
>
> 組織慢慢會變成和系統結構相似 — Melvin Conway

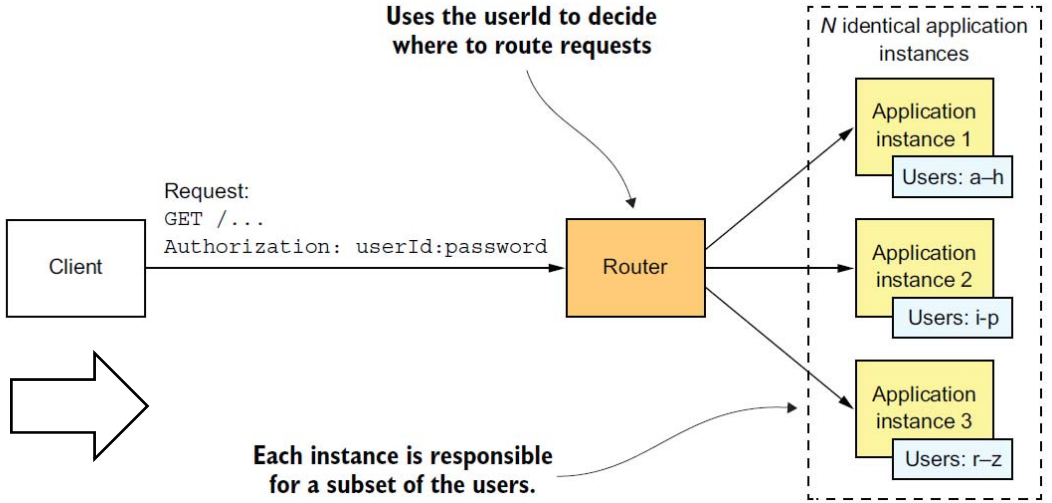
In other words, your application's architecture mirrors the structure of the organization that developed it. It's important, therefore, to apply Conway's law in reverse (www.thoughtworks.com/radar/techniques/inverse-conway-maneuver) and design your organization so that its structure mirrors your microservice architecture. By doing so, you ensure that your development teams are as loosely coupled as the services.

一開始就根據系統結構來設計組織

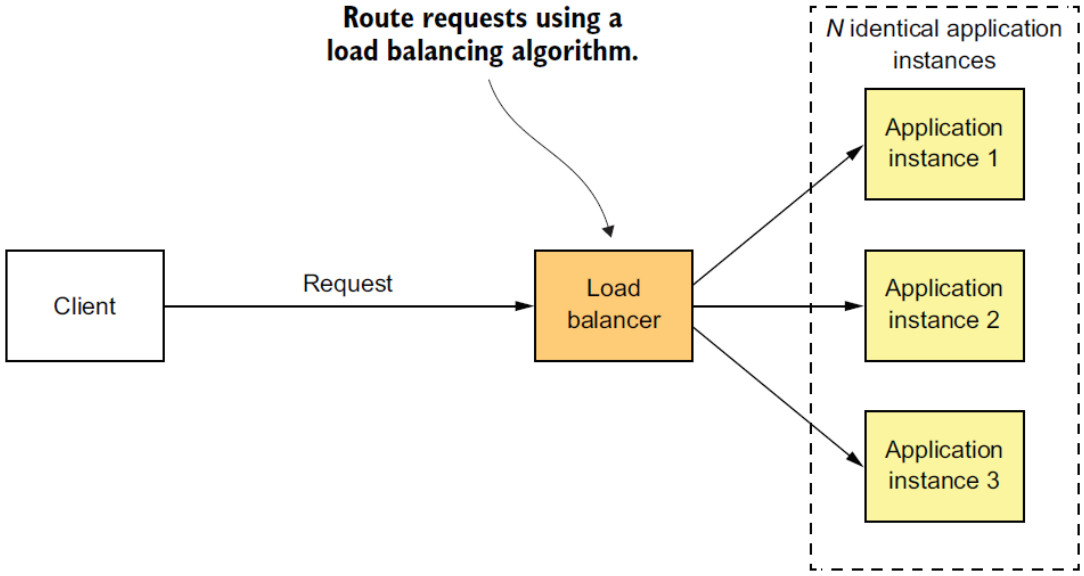
The Scale Cube



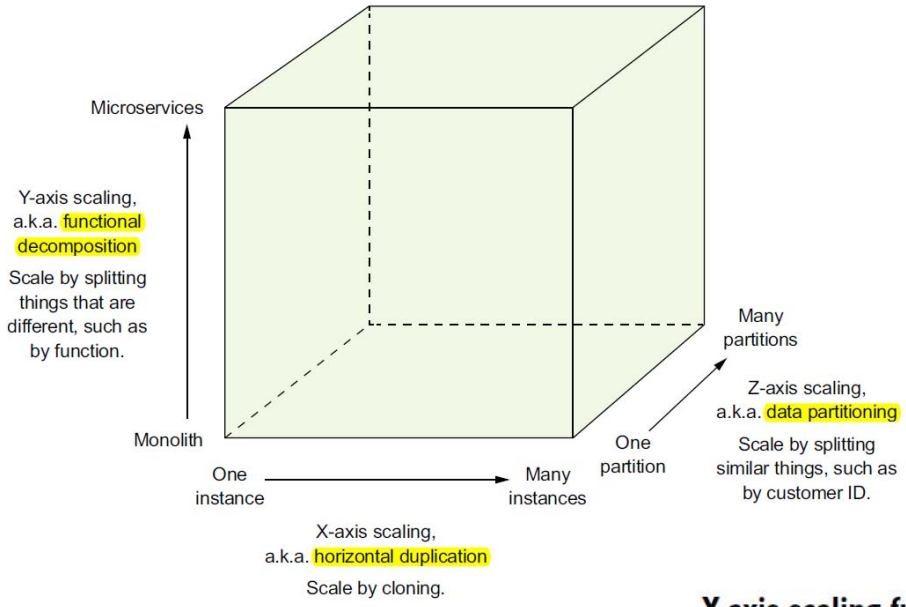




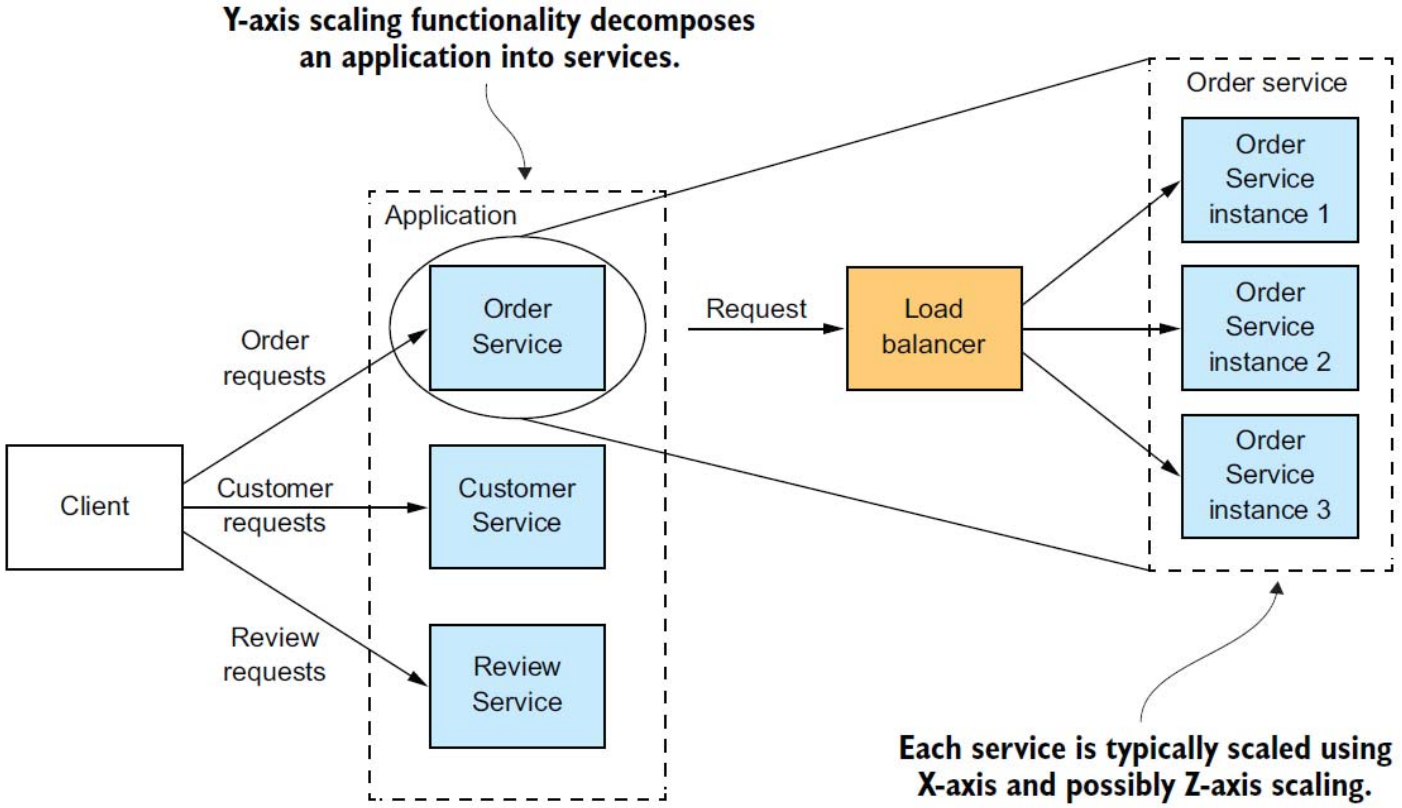
Scale by data partitioning



Scale by cloning



Microservice scaling
Layer 1: Functional Decomposition (Y)
Layer 2: Horizontal (X) + data (Z)



Microservice Architecture Style

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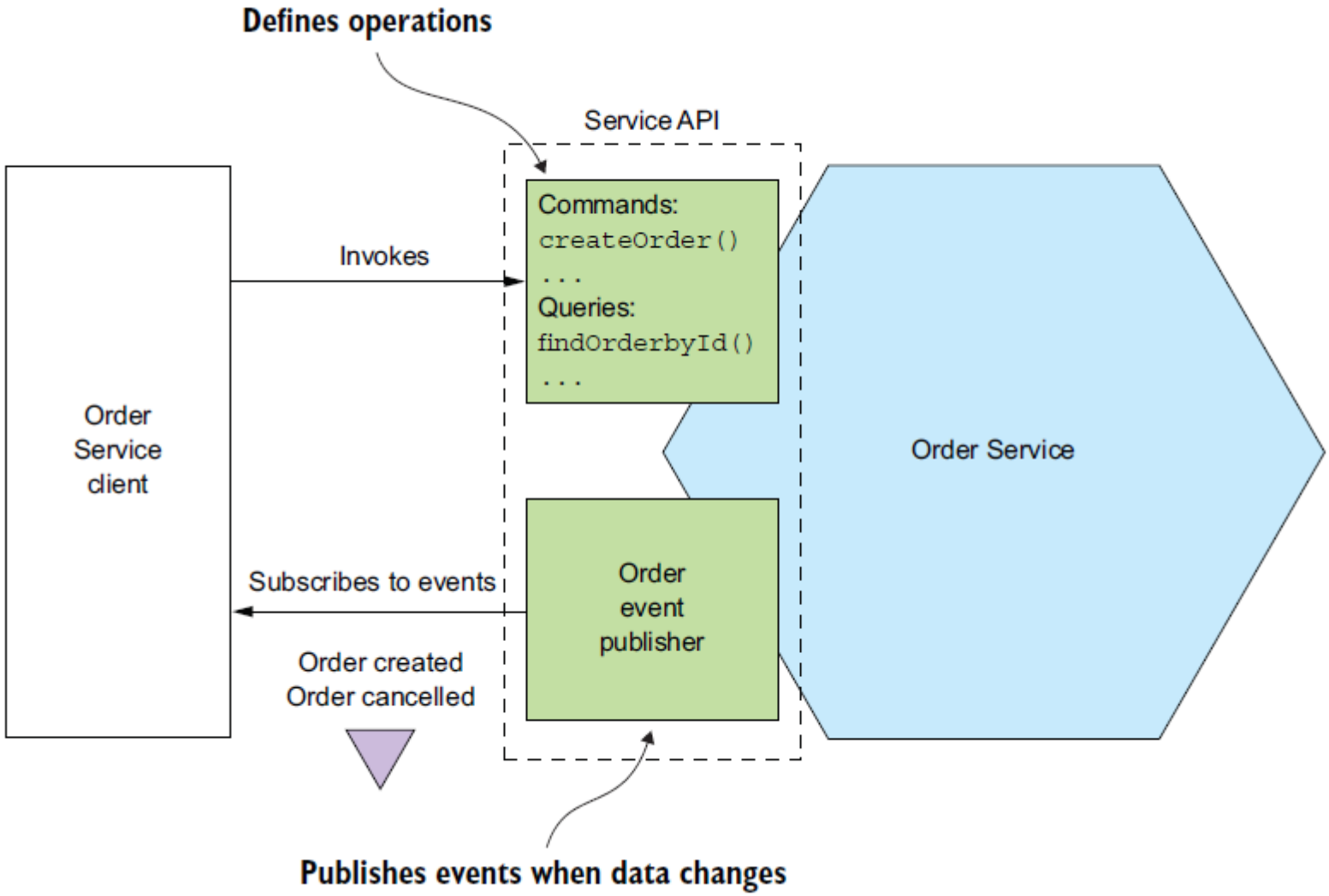
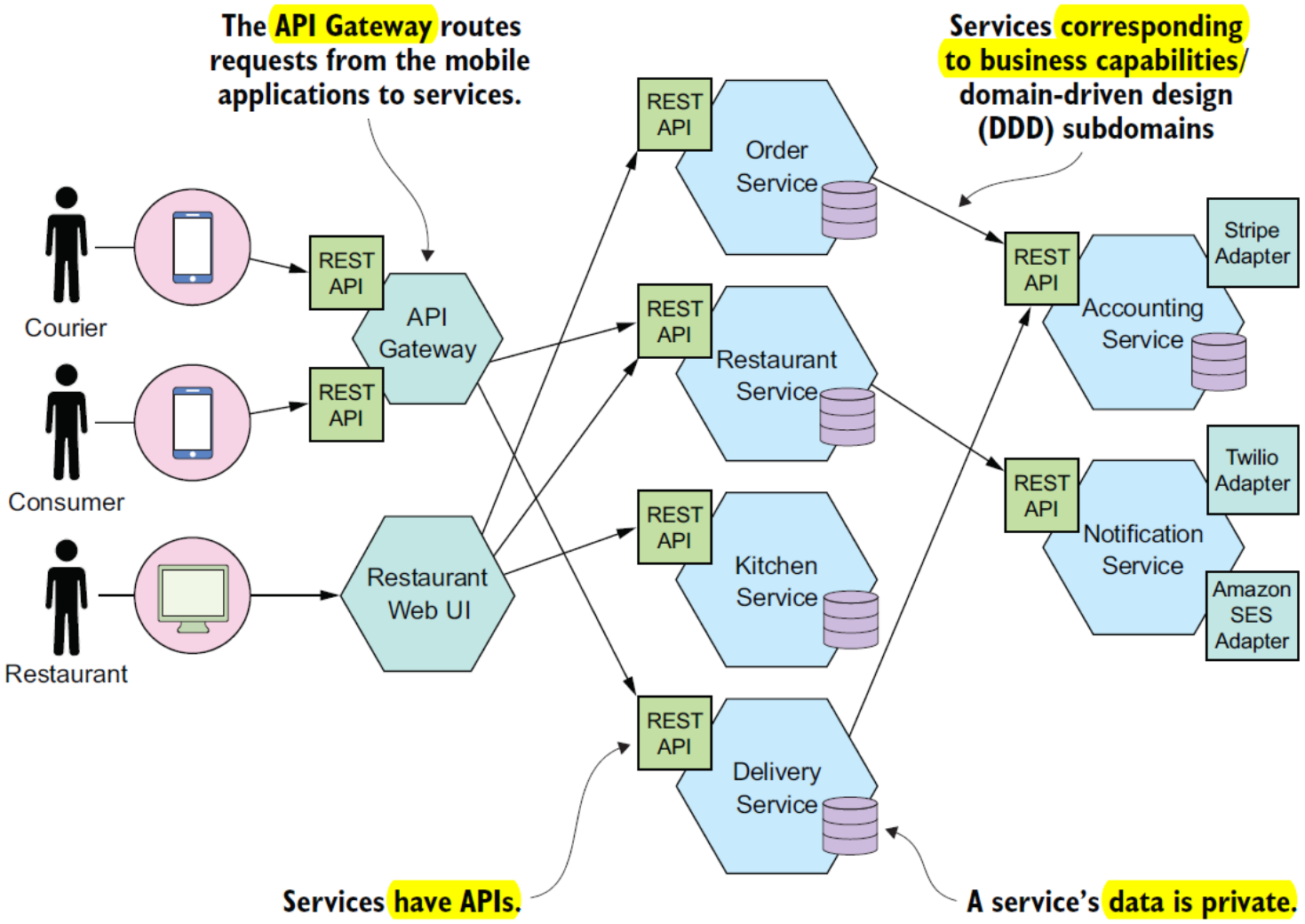
Service


Defines operations
Service API
Commands:
createOrder()
...
Queries:
findOrderbyId()
...
Invokes
Order
Service
client
Order Service
Subscribes to events
Order
event
publisher
Order created
Order cancelled
Publishes events when data changes

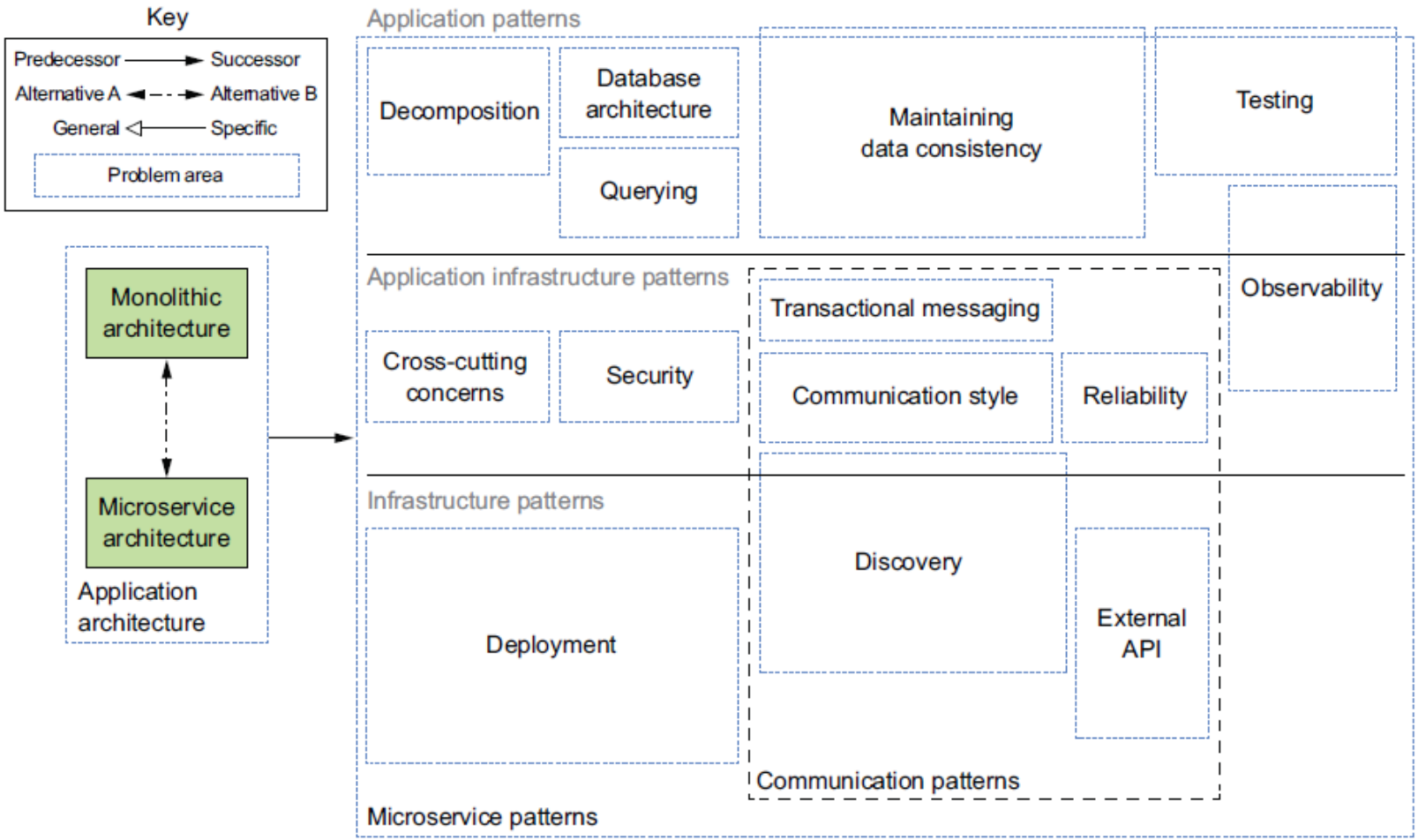
FTGO Microservice Architecture



Issues: 交易、備份、APIGW single point of failure? Another ESB? 和SOA有何不同?

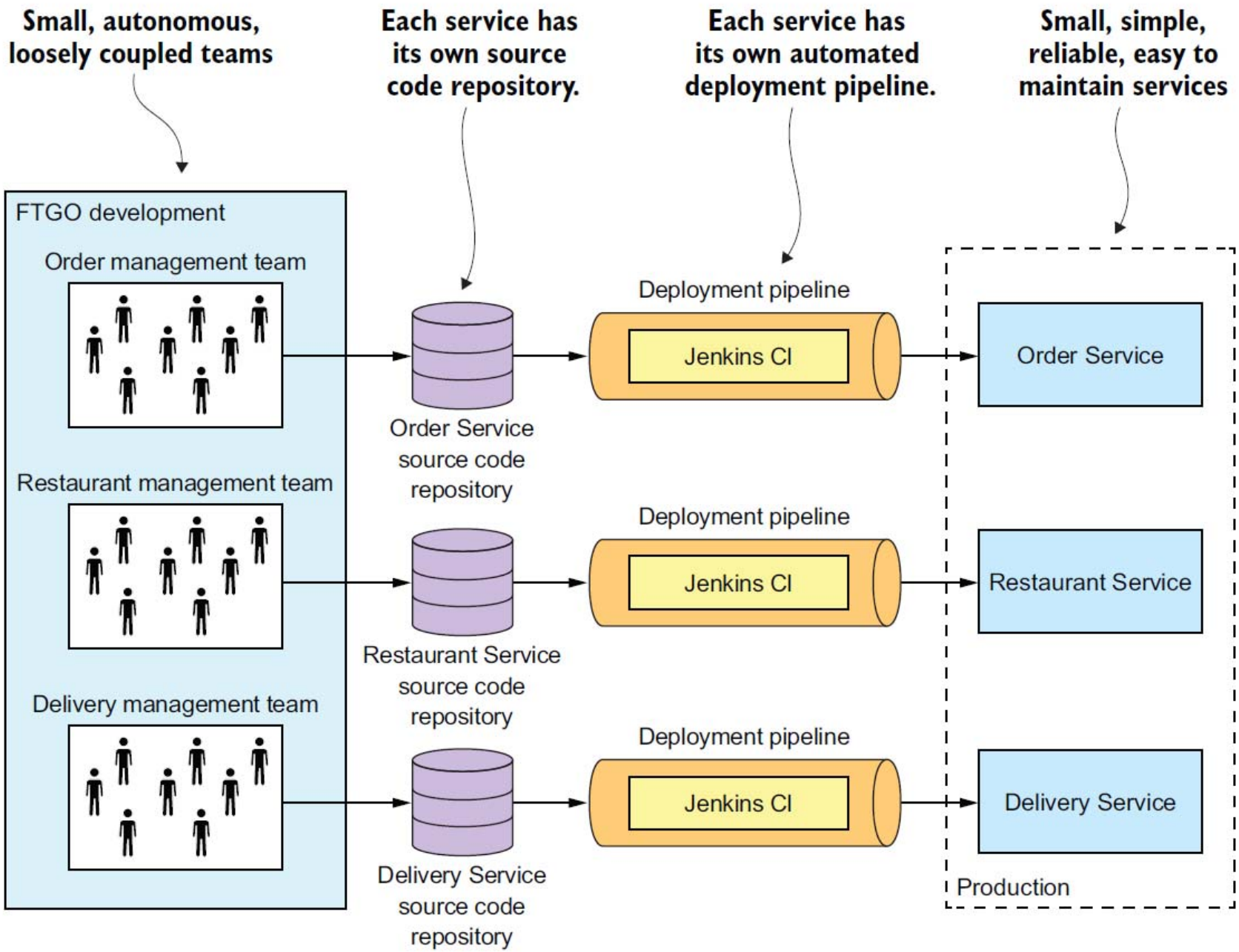
Microservices相關架構議題

https://microservices.io/patterns/index.html



Advantages of Microservices

- Enables the continuous delivery and deployment of large, complex applications
- Services are small and easily maintained
- Services are independently deployable
- Services are independently scalable
- Enables teams to be autonomous
- Allows easy experimenting and adoption of new technologies
- Better fault isolation


Small, autonomous, loosely coupled teams
Each service has its own source code repository.
Each service has its own automated deployment pipeline.
Small, simple, reliable, easy to maintain services
FTGO development
Order management team
Restaurant management team
Delivery management team
Order Service source code repository
Restaurant Service source code repository
Delivery Service source code repository
Deployment pipeline
Jenkins CI
Deployment pipeline
Jenkins CI
Deployment pipeline
Jenkins CI
Order Service
Restaurant Service
Delivery Service
Production

Drawbacks of Microservices

- Finding the right set of services is challenging
  - Bounded context
- Distributed systems are complex
  - CQRS and Sagas
- Deploying features that span multiple services requires careful coordination
- Deciding when to adopt the microservice architecture is difficult
  - For complex applications, it is always the right choice
  - Ex: consumer-facing web applications, SaaS applications

Q & A