

# Software Engineering

# Cloud Computing and Cloud Software Architecture

1112SE07

MBA, IM, NTPU (M5010) (Spring 2023)  
Wed 2, 3, 4 (9:10-12:00) (B8F40)



<https://meet.google.com/ish-gzmy-pmo>

aws  
educate | Cloud  
Ambassador  
2020 Cohort



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Associate Professor

Institute of Information Management, National Taipei University

<https://web.ntpu.edu.tw/~myday>



# Syllabus

Week	Date	Subject/Topics
1	2023/02/22	Introduction to Software Engineering
2	2023/03/01	Software Products and Project Management: Software product management and prototyping
3	2023/03/08	Agile Software Engineering: Agile methods, Scrum, and Extreme Programming
4	2023/03/15	Features, Scenarios, and Stories
5	2023/03/22	Case Study on Software Engineering I
6	2023/03/29	Software Architecture: Architectural design, System decomposition, and Distribution architecture

# Syllabus

Week	Date	Subject/Topics
7	2023/04/05	Tomb-Sweeping Day (Holiday, No Classes)
8	2023/04/12	Midterm Project Report
9	2023/04/19	Cloud-Based Software: Virtualization and containers, Everything as a service, Software as a service
10	2023/04/26	Cloud Computing and Cloud Software Architecture
11	2023/05/03	Microservices Architecture, RESTful services, Service deployment
12	2023/05/10	Security and Privacy; Reliable Programming; Testing: Test-driven development, and Code reviews; DevOps and Code Management: DevOps automation

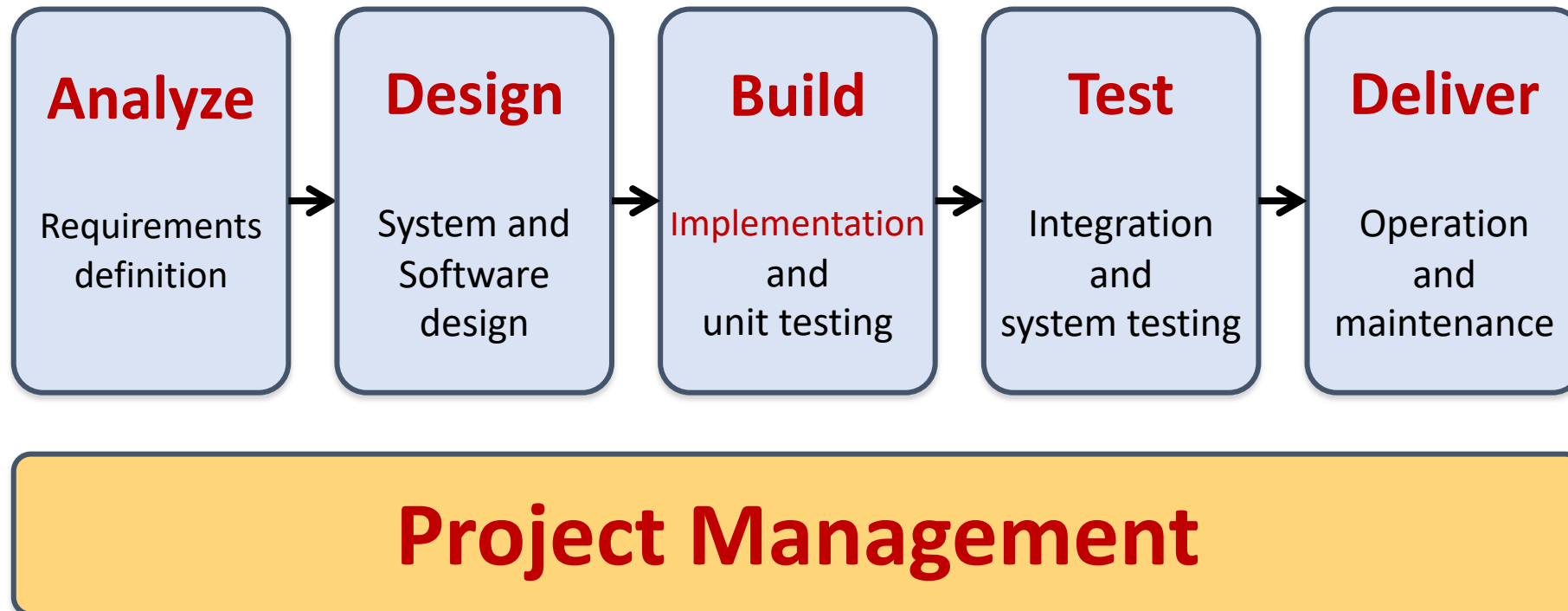
# Syllabus

## Week Date Subject/Topics

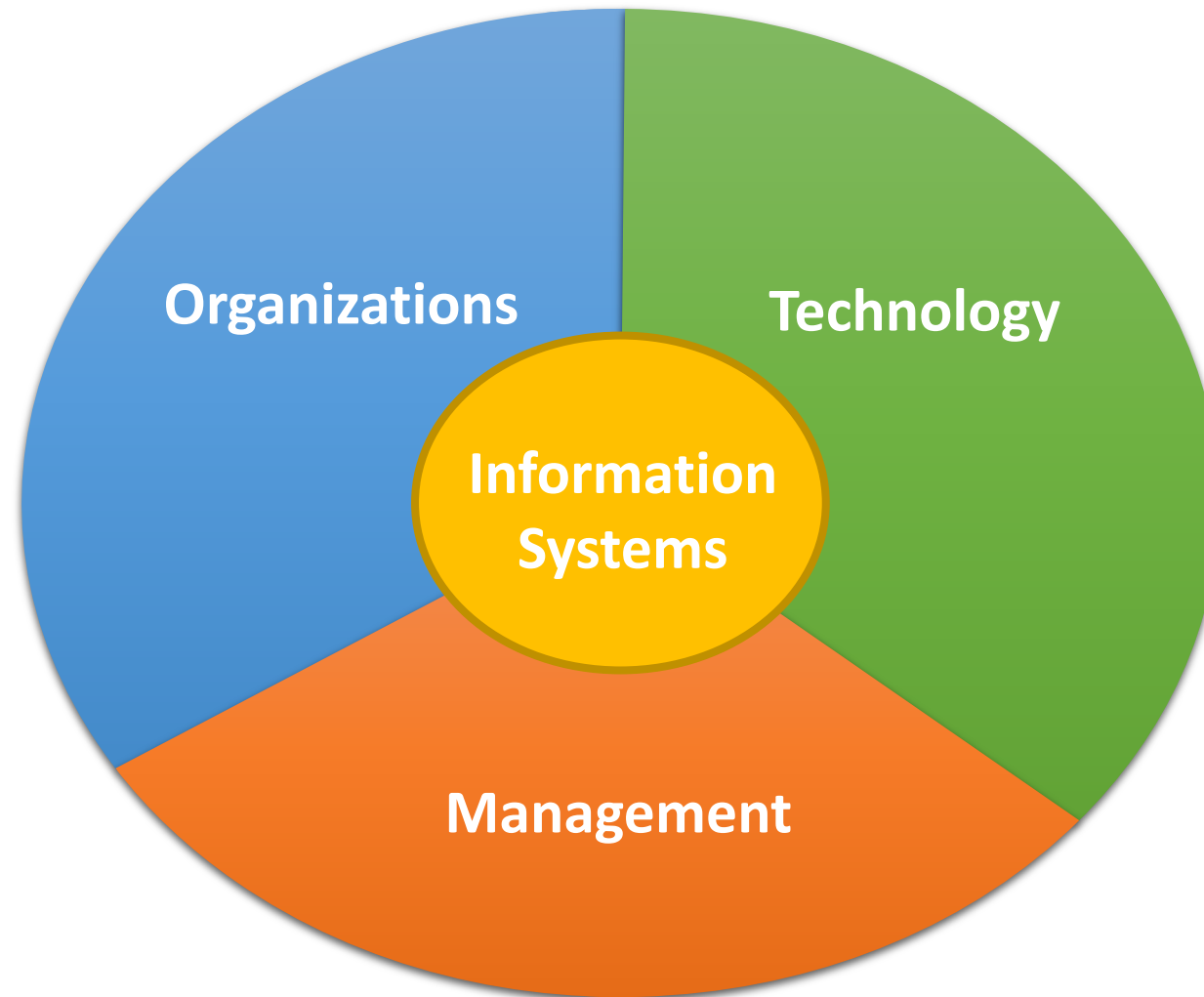
<b>13</b>	<b>2023/05/17</b>	<b>Industry Practices of Software Engineering</b>  [Agile Principles Patterns and Practices using AI and ChatGPT, Invited Speaker: Shihyu (Alex) Chu, Division Director, Software Industry Research Center, Market Intelligence & Consulting Institute (MIC)]
<b>14</b>	<b>2023/05/24</b>	<b>Case Study on Software Engineering II</b>
<b>15</b>	<b>2023/05/31</b>	<b>Final Project Report I</b>
<b>16</b>	<b>2023/06/07</b>	<b>Final Project Report II</b>
17	2023/06/14	Self-learning
18	2023/06/21	Self-learning

# Cloud Computing and Cloud Software Architecture

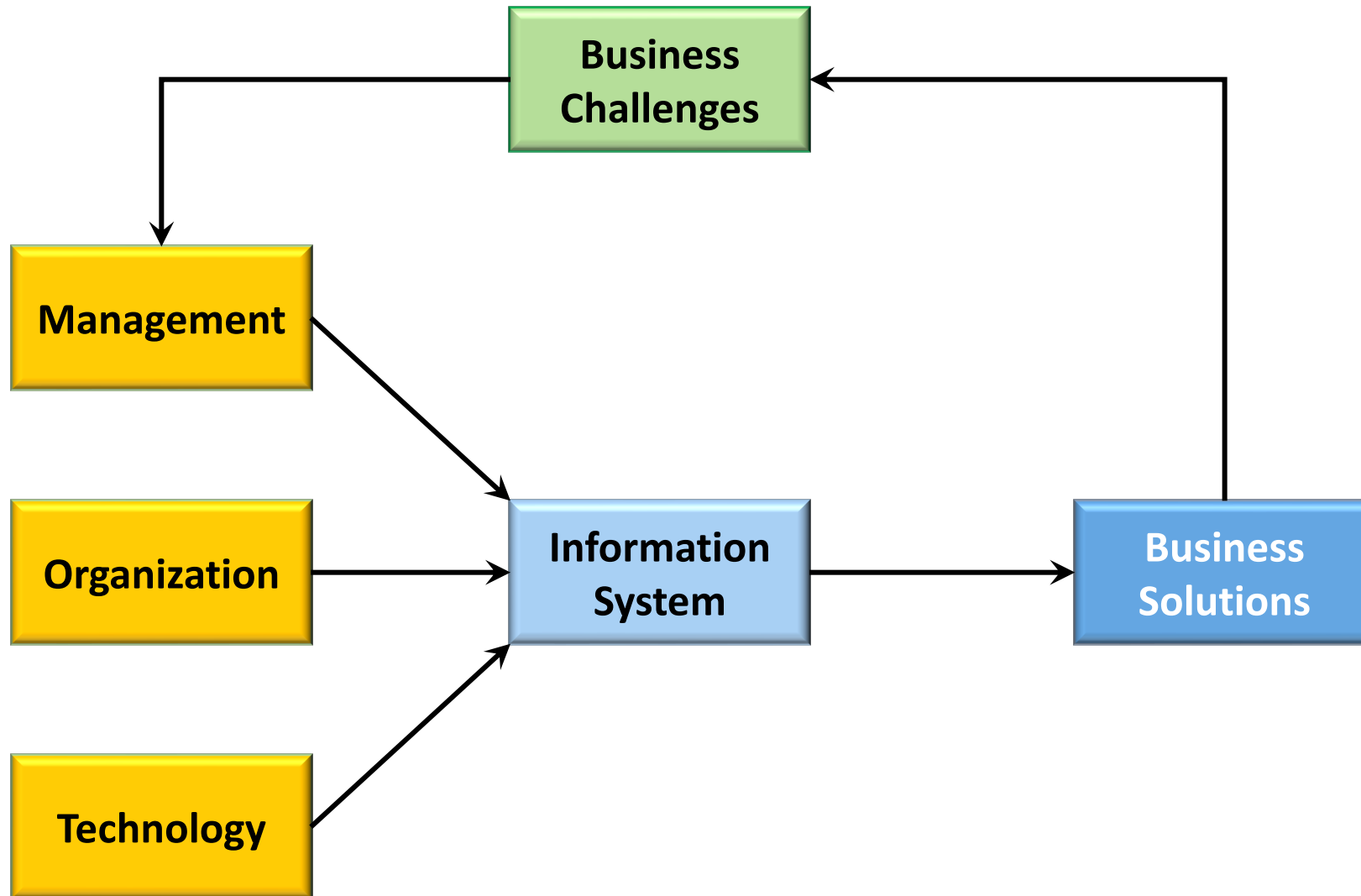
# Software Engineering and Project Management



# Information Management (MIS) Information Systems

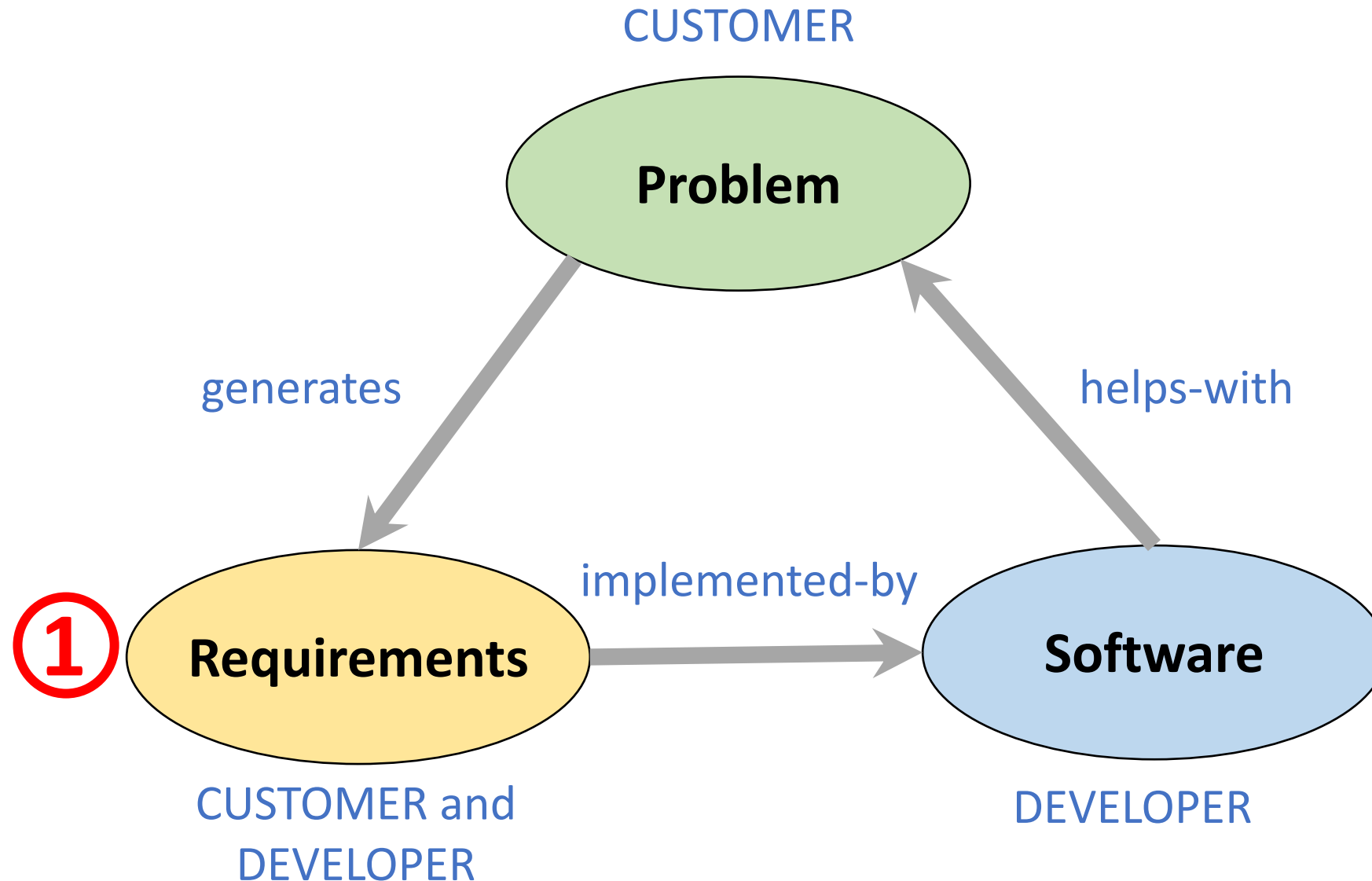


# Fundamental MIS Concepts

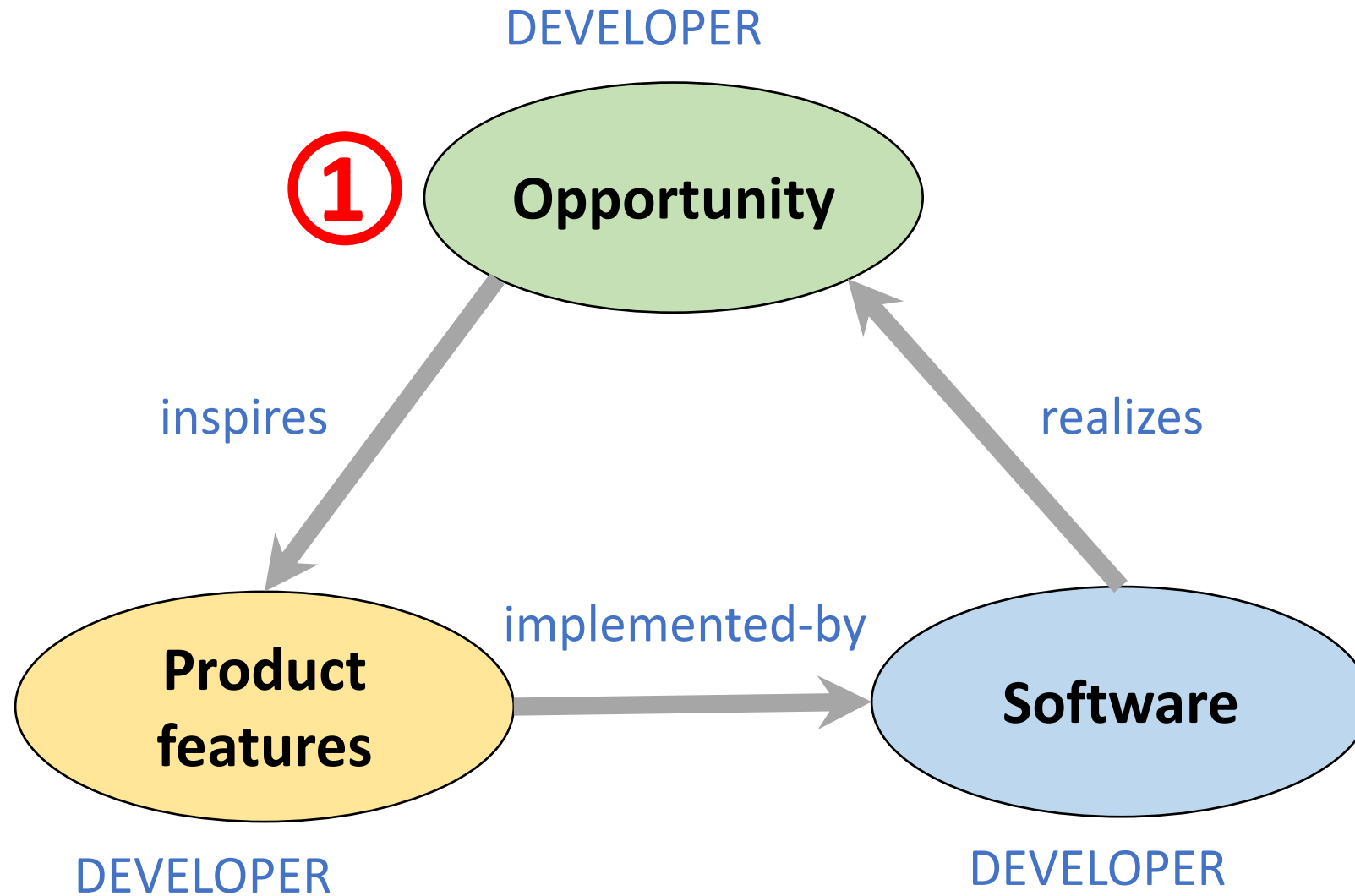




# Project-based software engineering

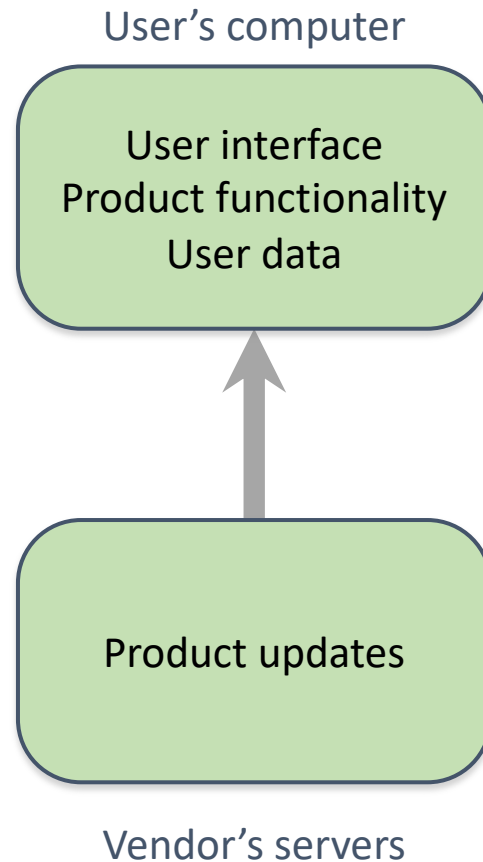


# Product software engineering

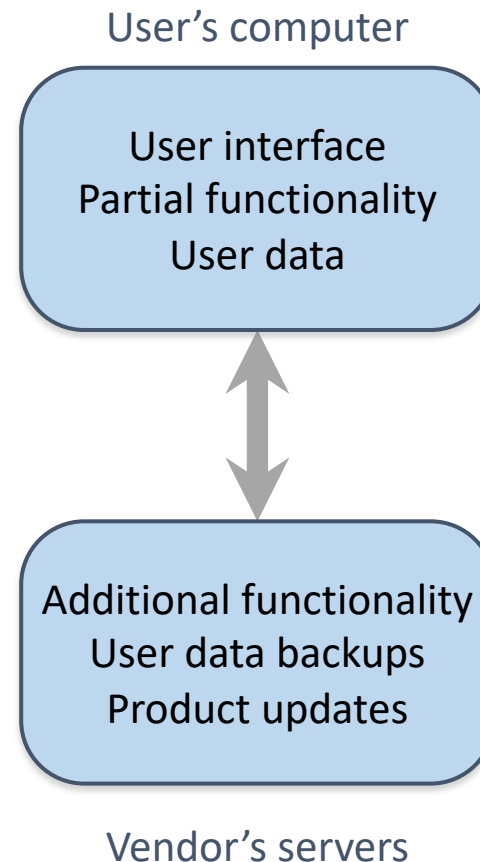


# Software execution models

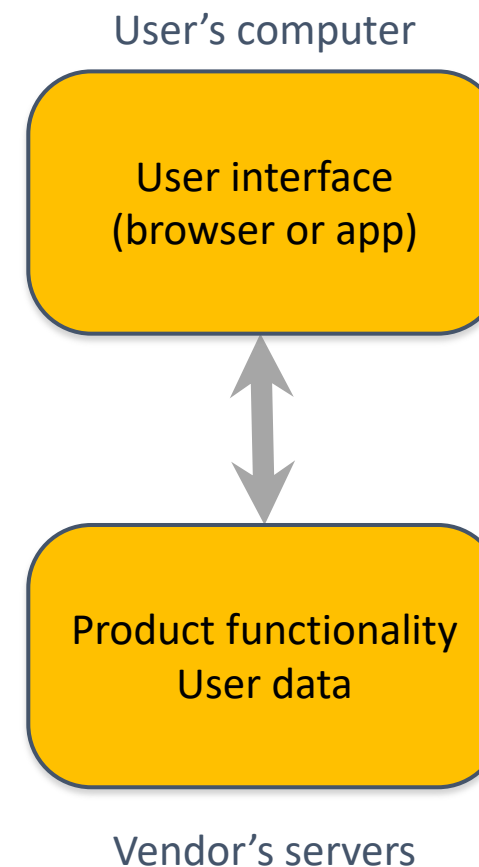
## Stand-alone execution



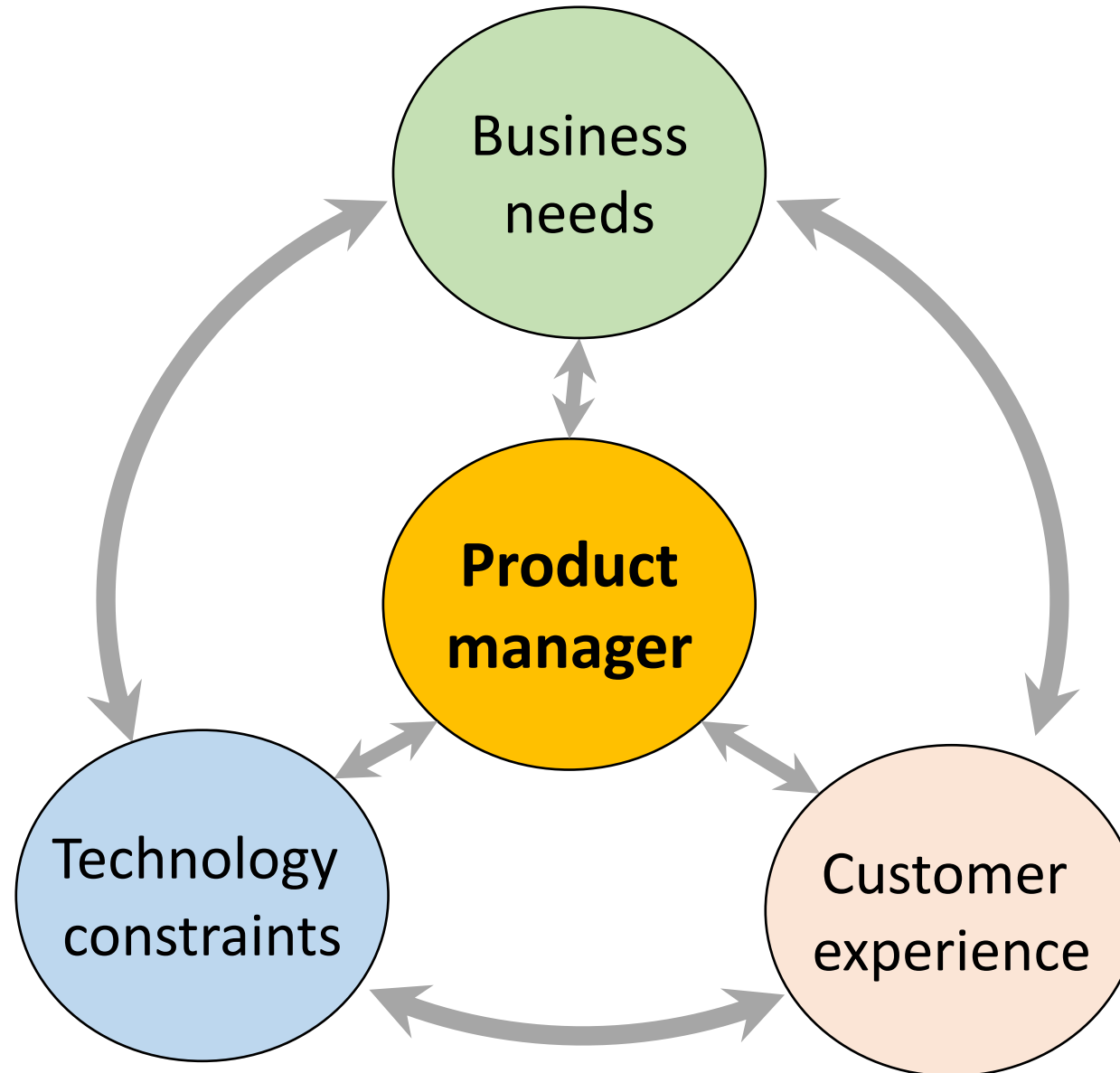
## Hybrid execution



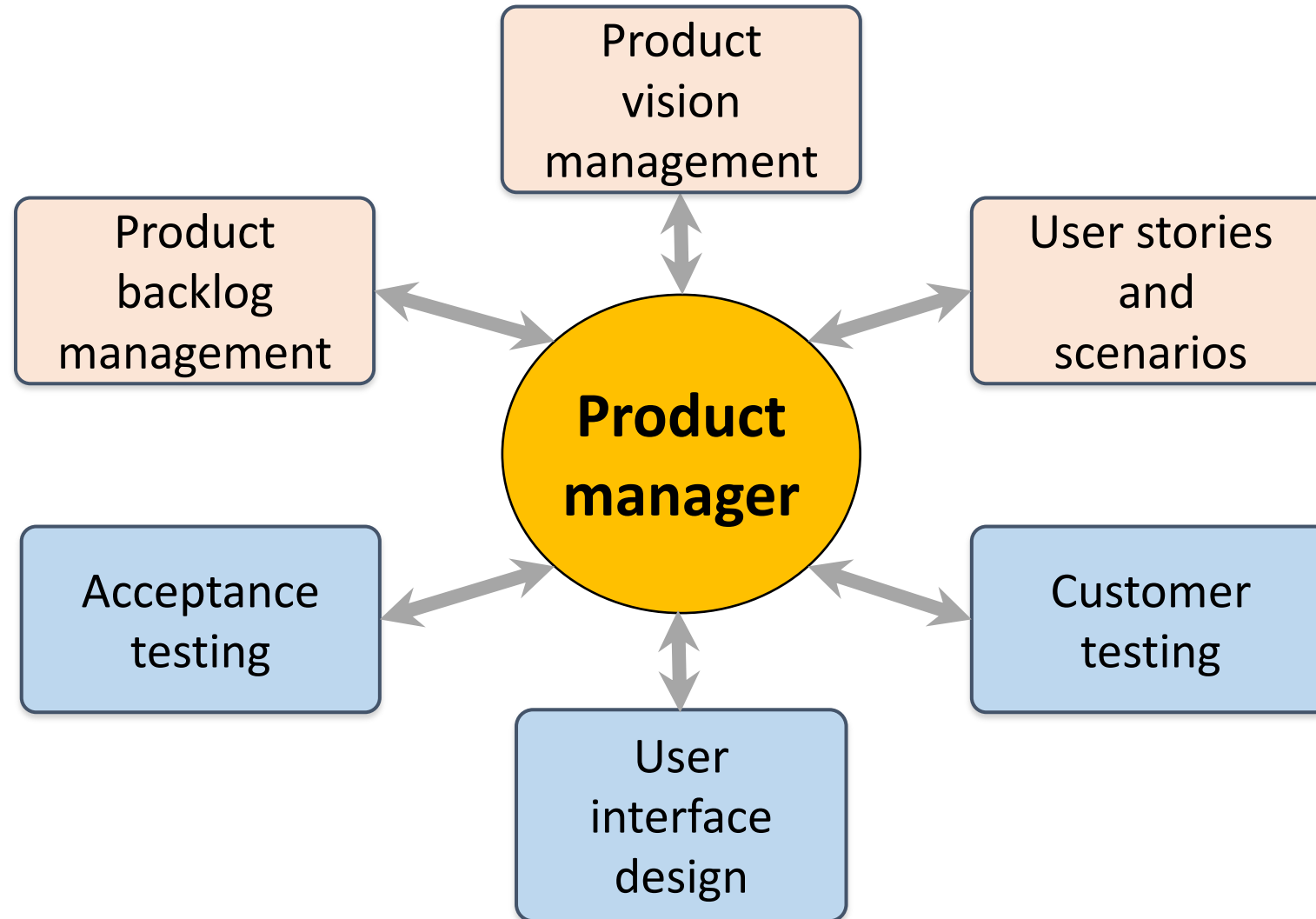
## Software as a service



# Product management concerns

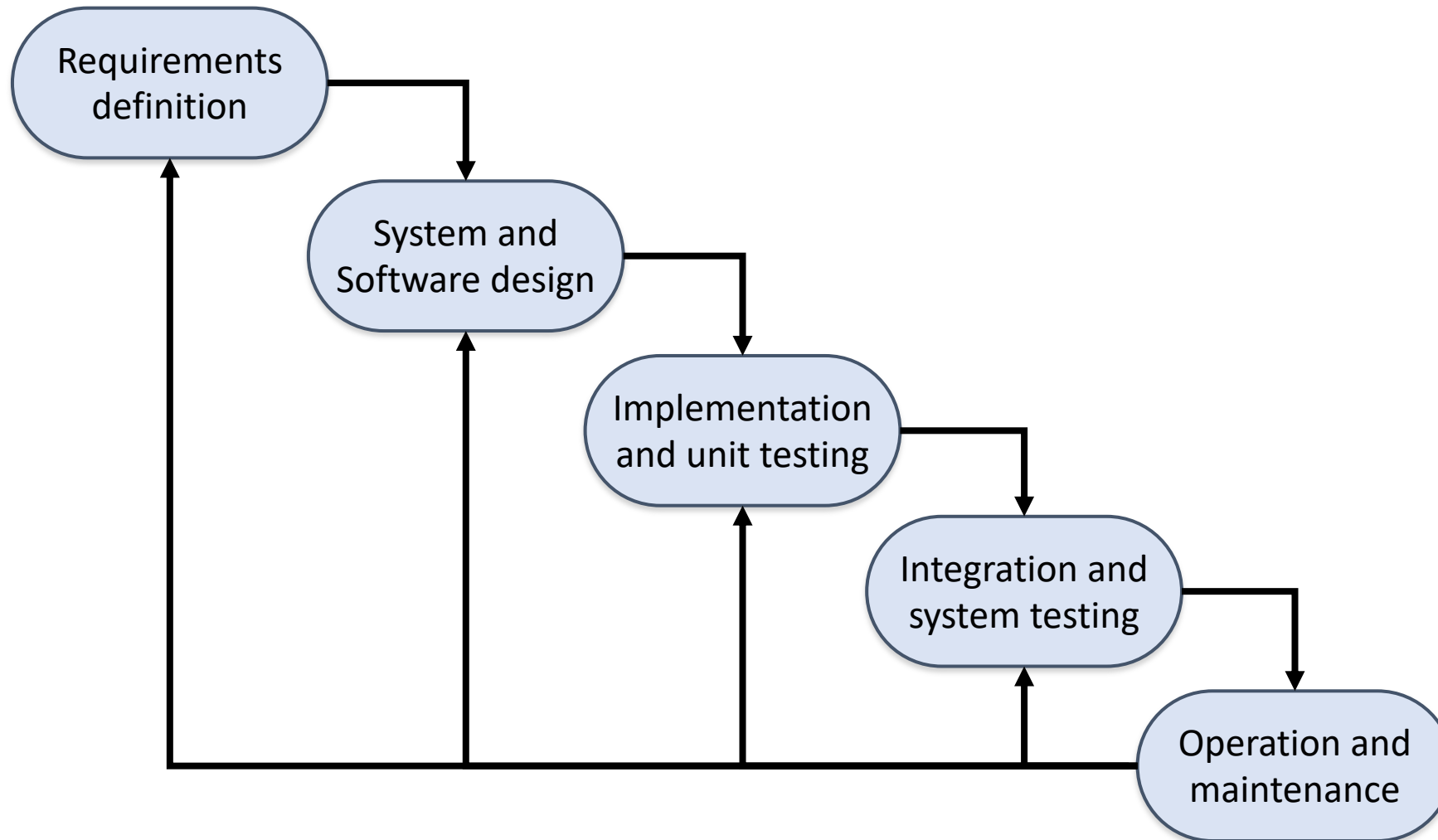


# Technical interactions of product managers



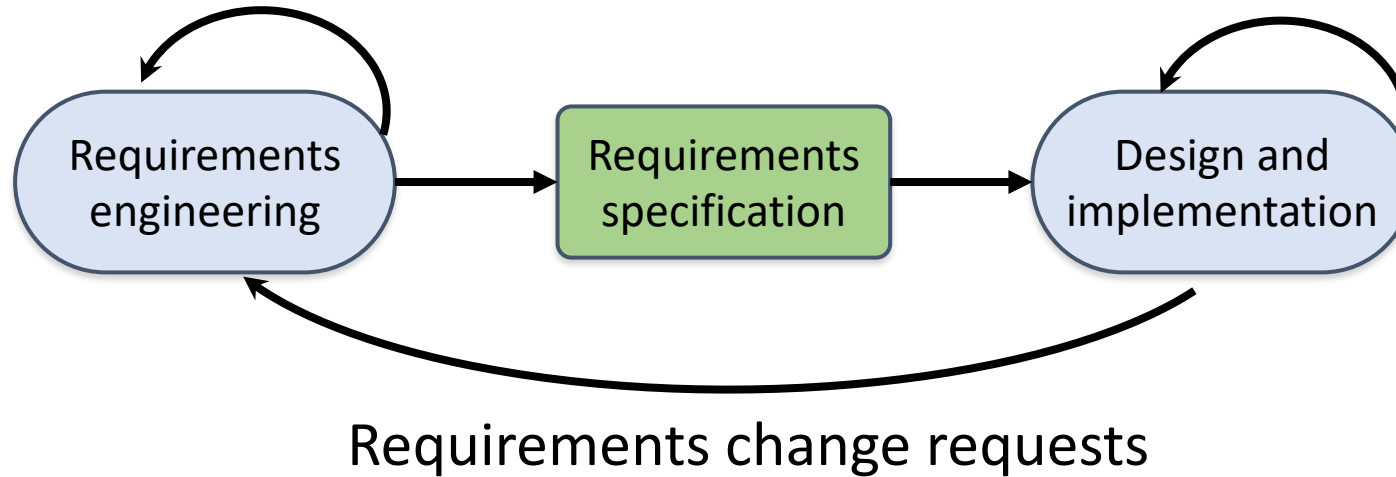
# Software Development Life Cycle (SDLC)

## The waterfall model

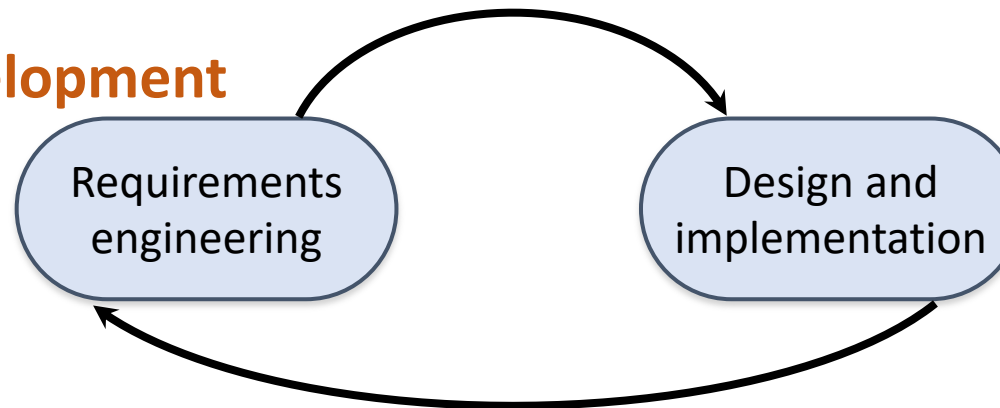


# Plan-based and Agile development

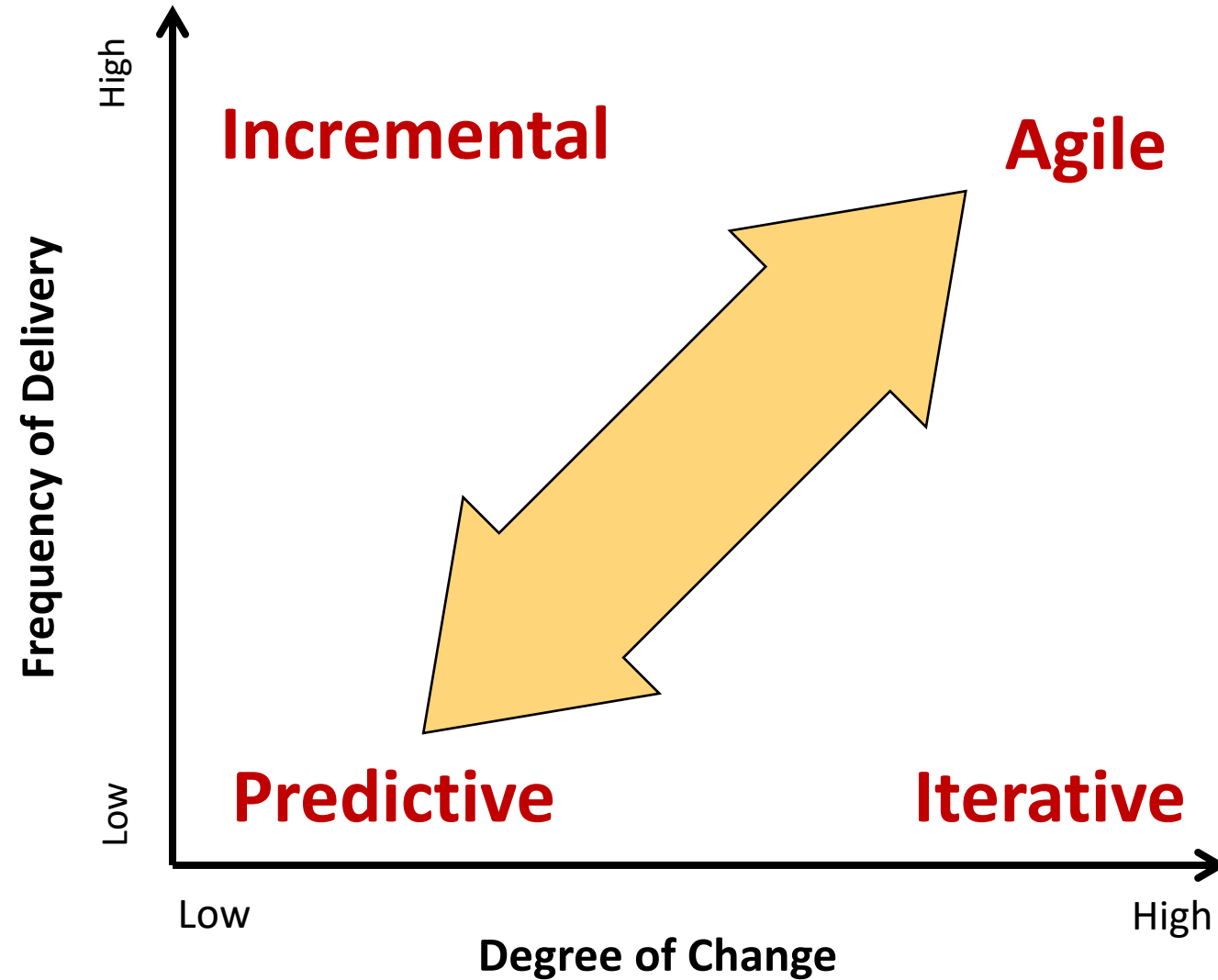
## Plan-based development



## Agile development

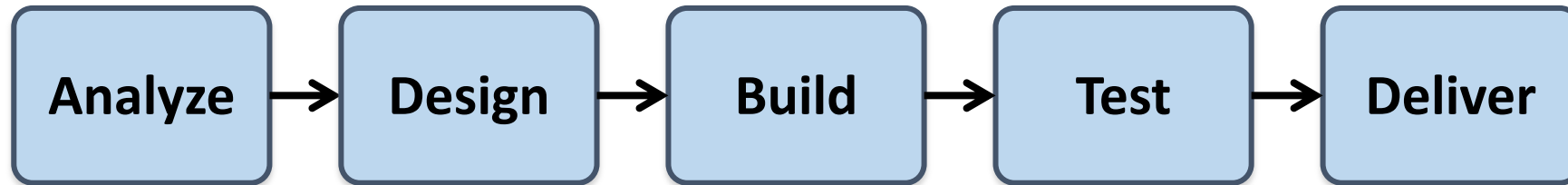


# The Continuum of Life Cycles

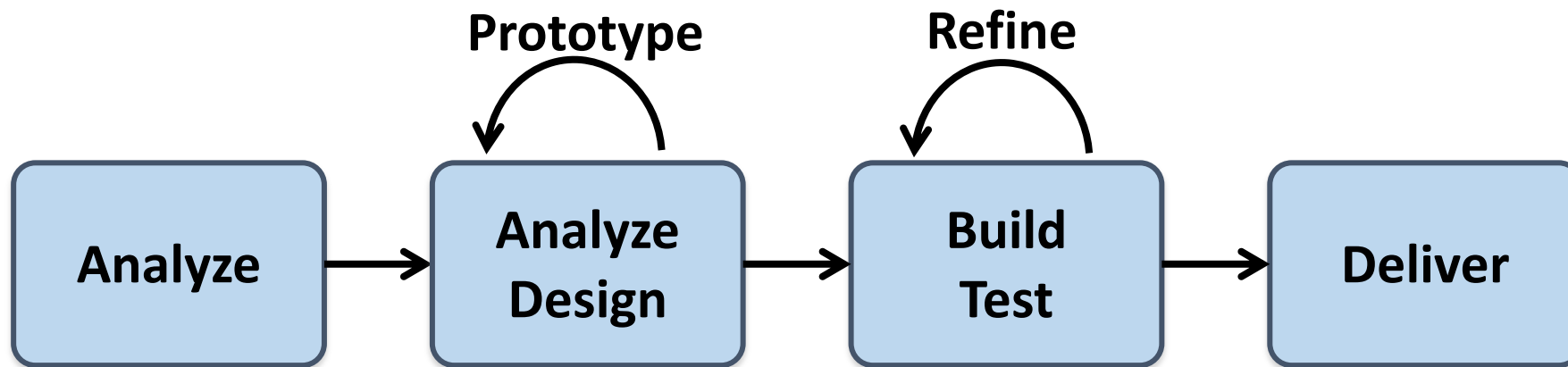




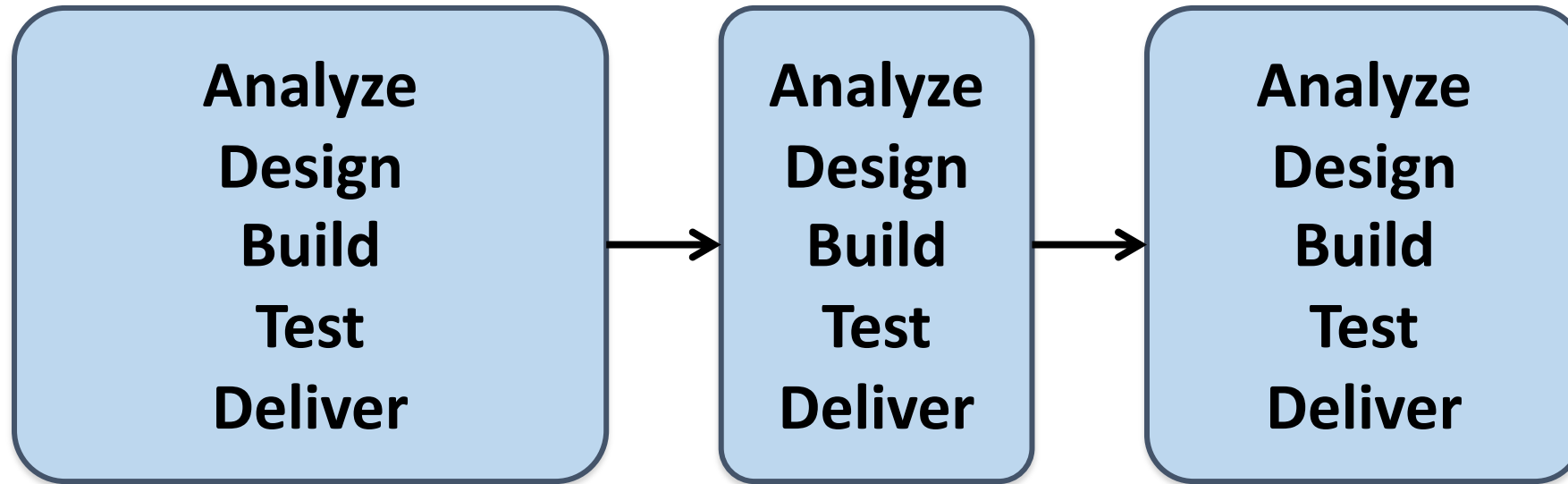
# Predictive Life Cycle



# Iterative Life Cycle

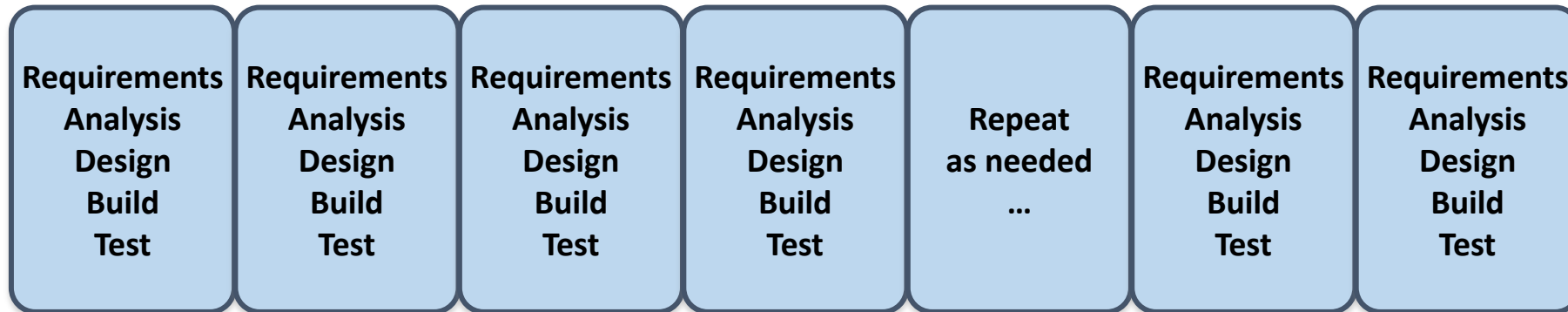


# A Life Cycle of Varying-Sized Increments

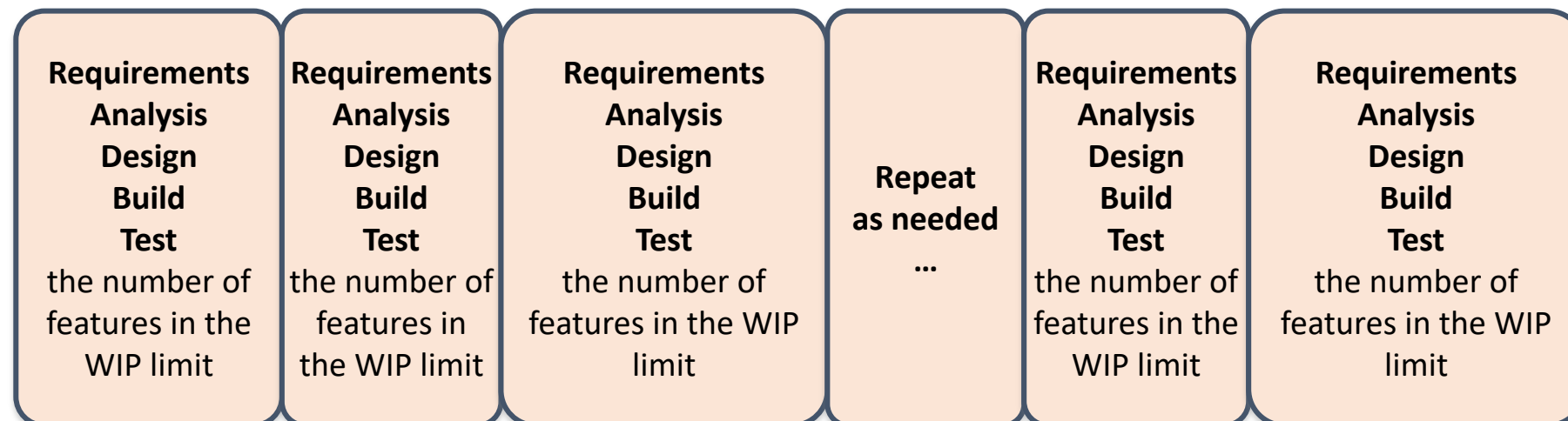


# Iteration-Based and Flow-Based Agile Life Cycles

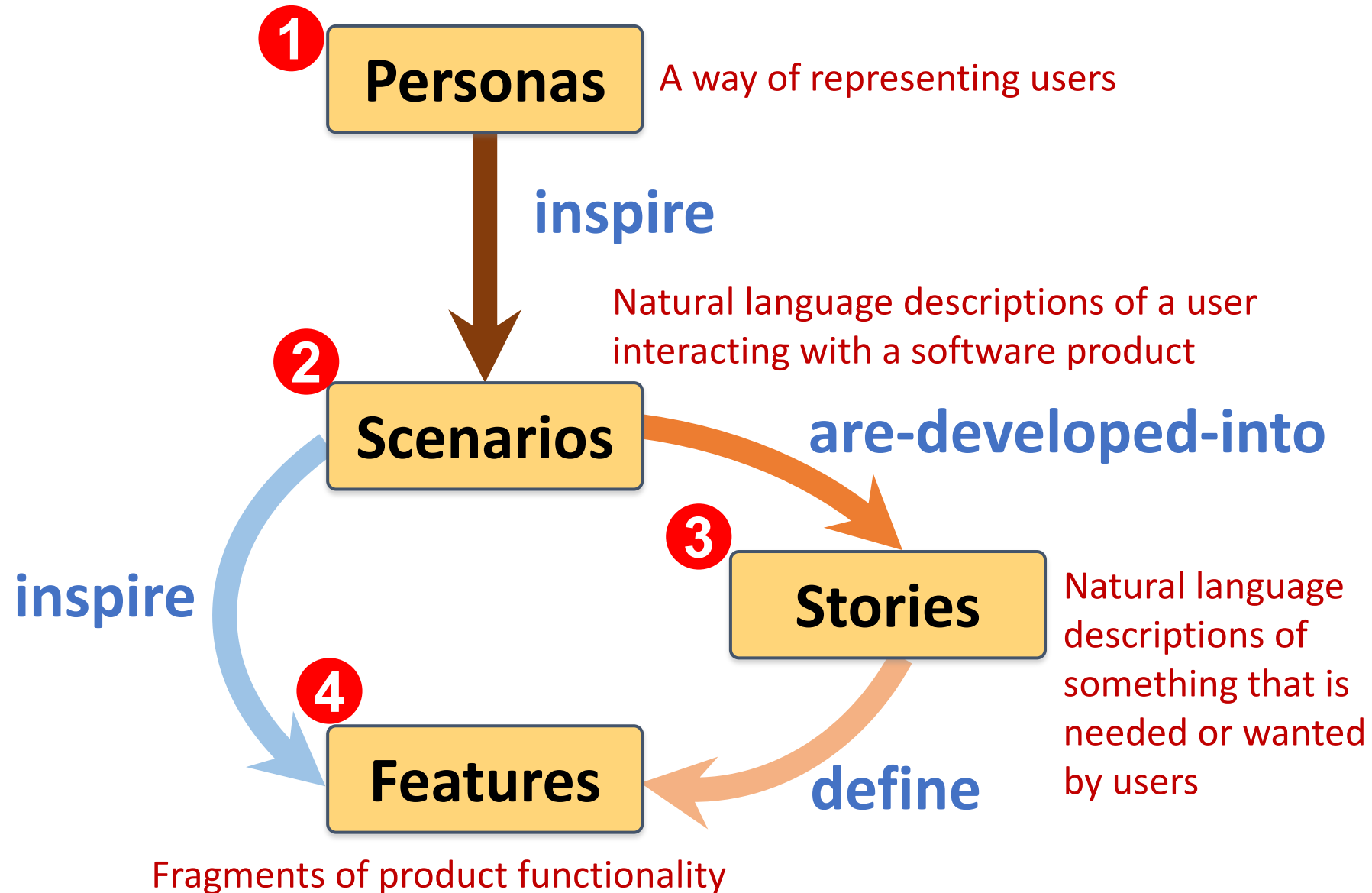
## Iteration-Based Agile



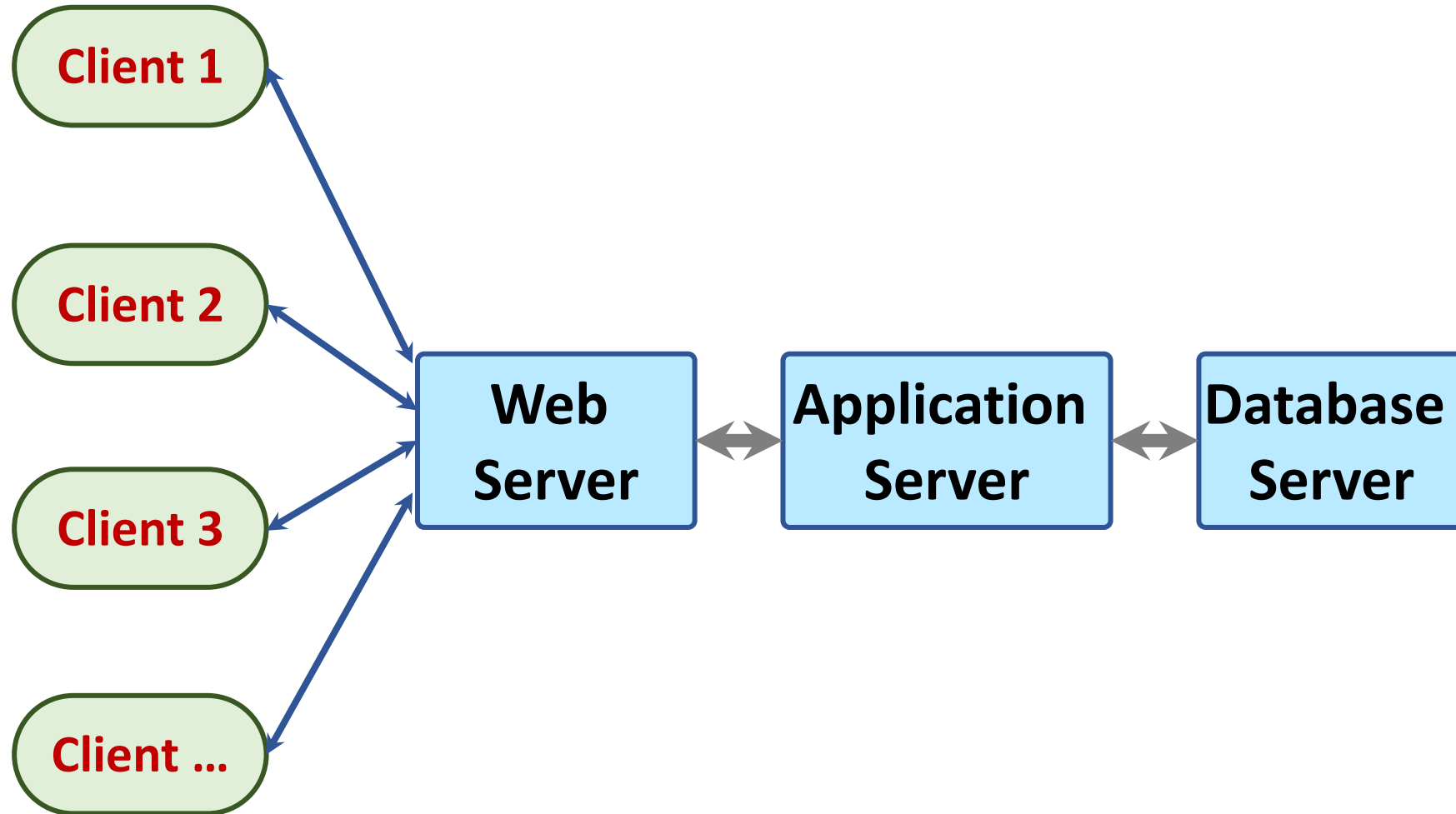
## Flow-Based Agile



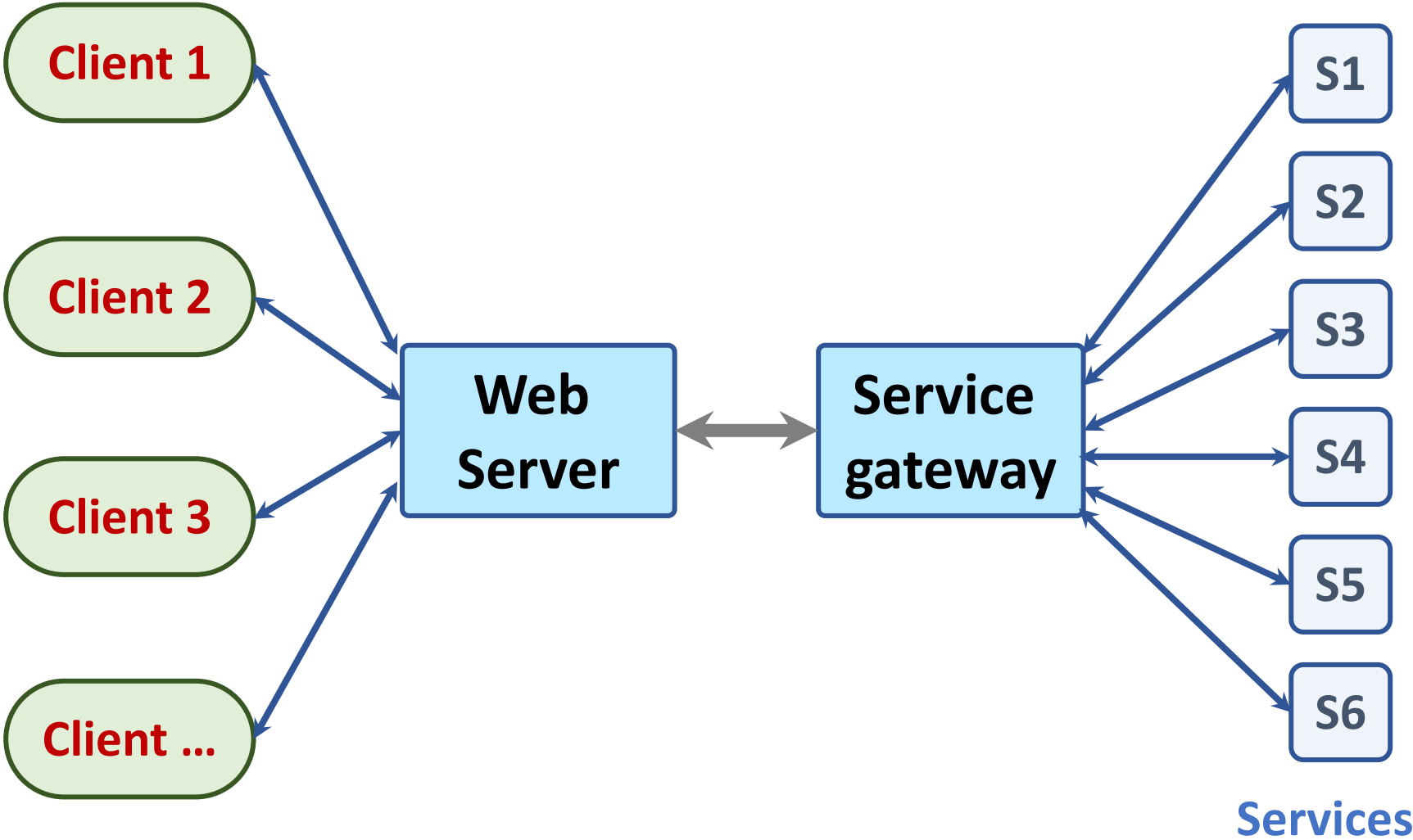
# From personas to features



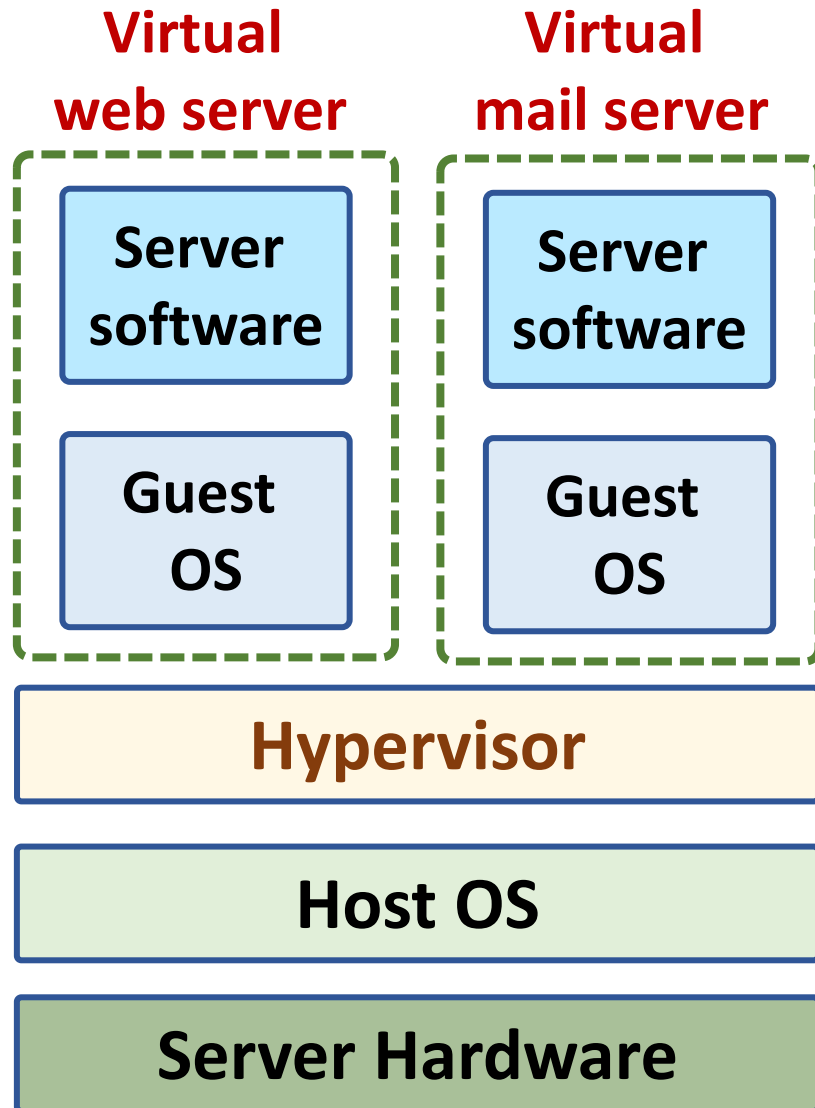
# Multi-tier client-server architecture



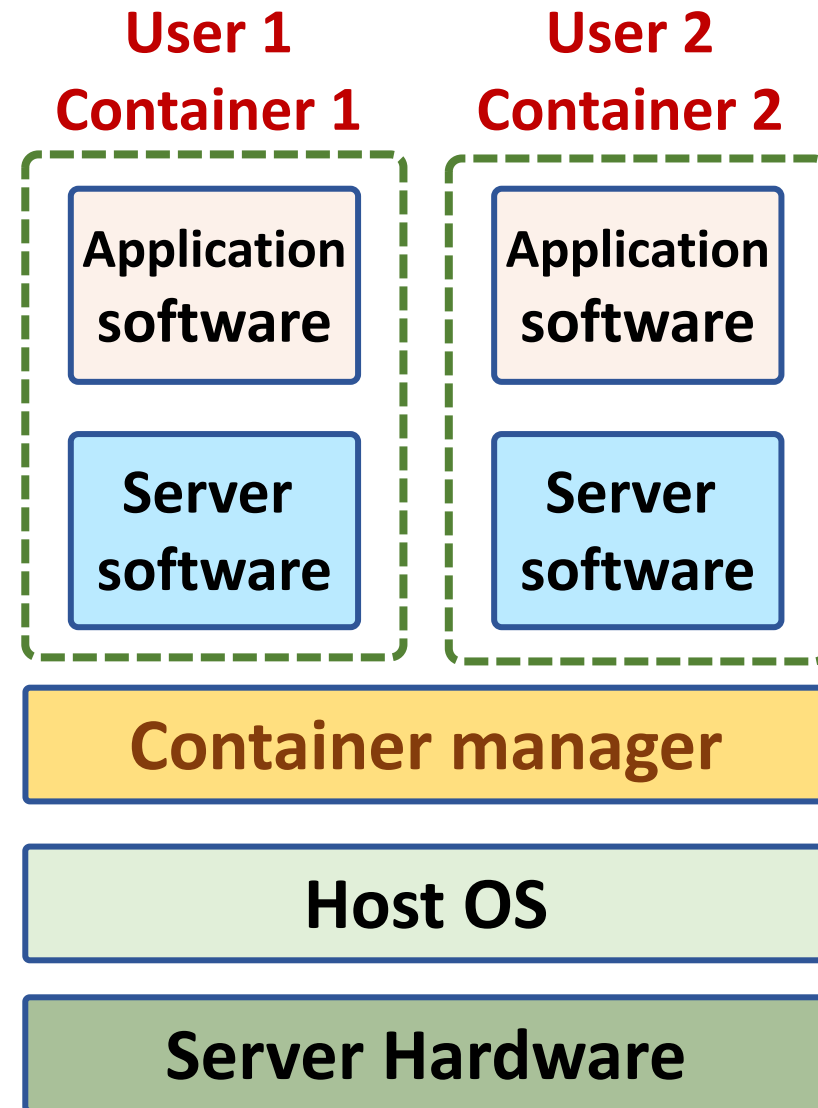
# Service-oriented Architecture



# VM

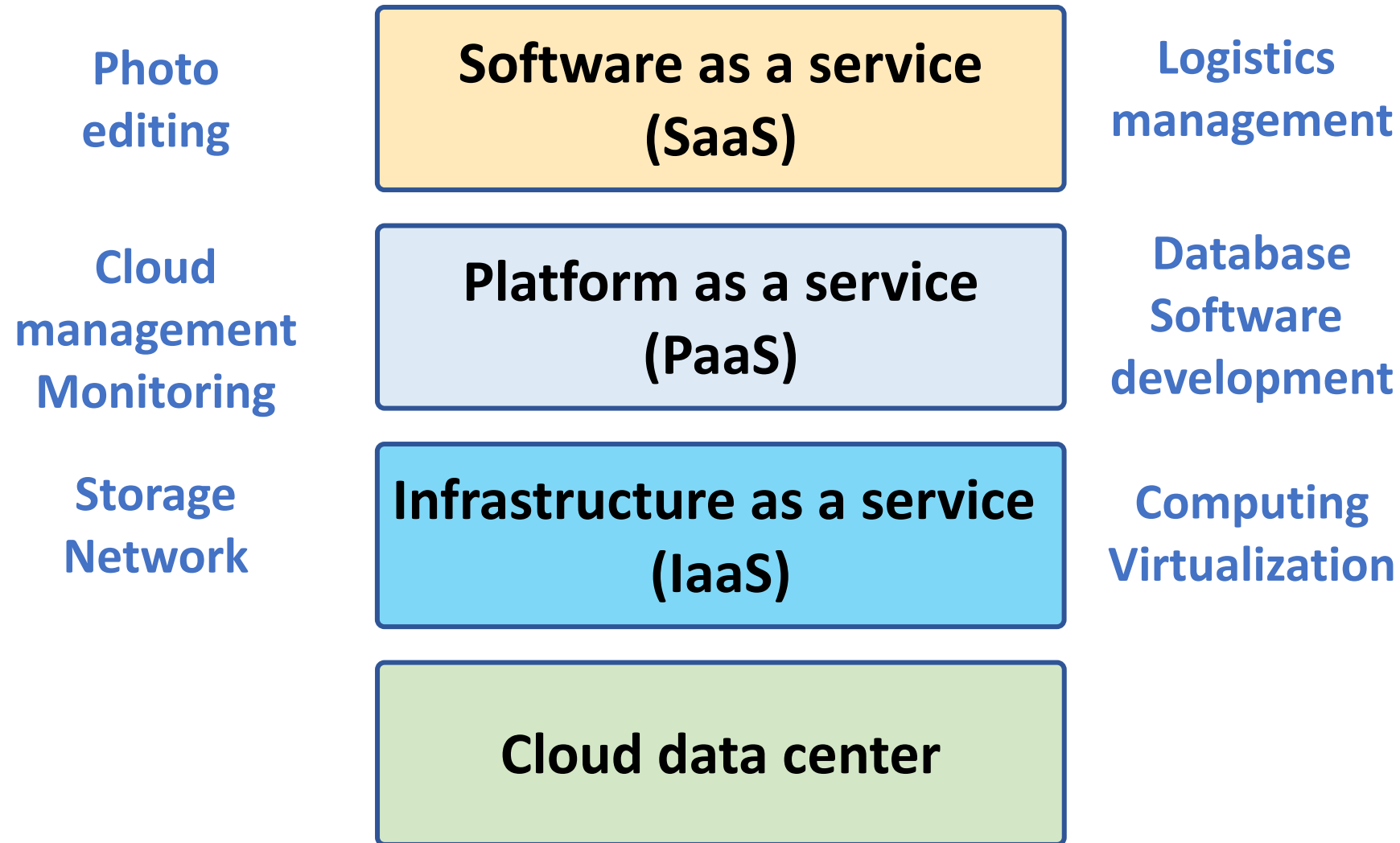


# Container

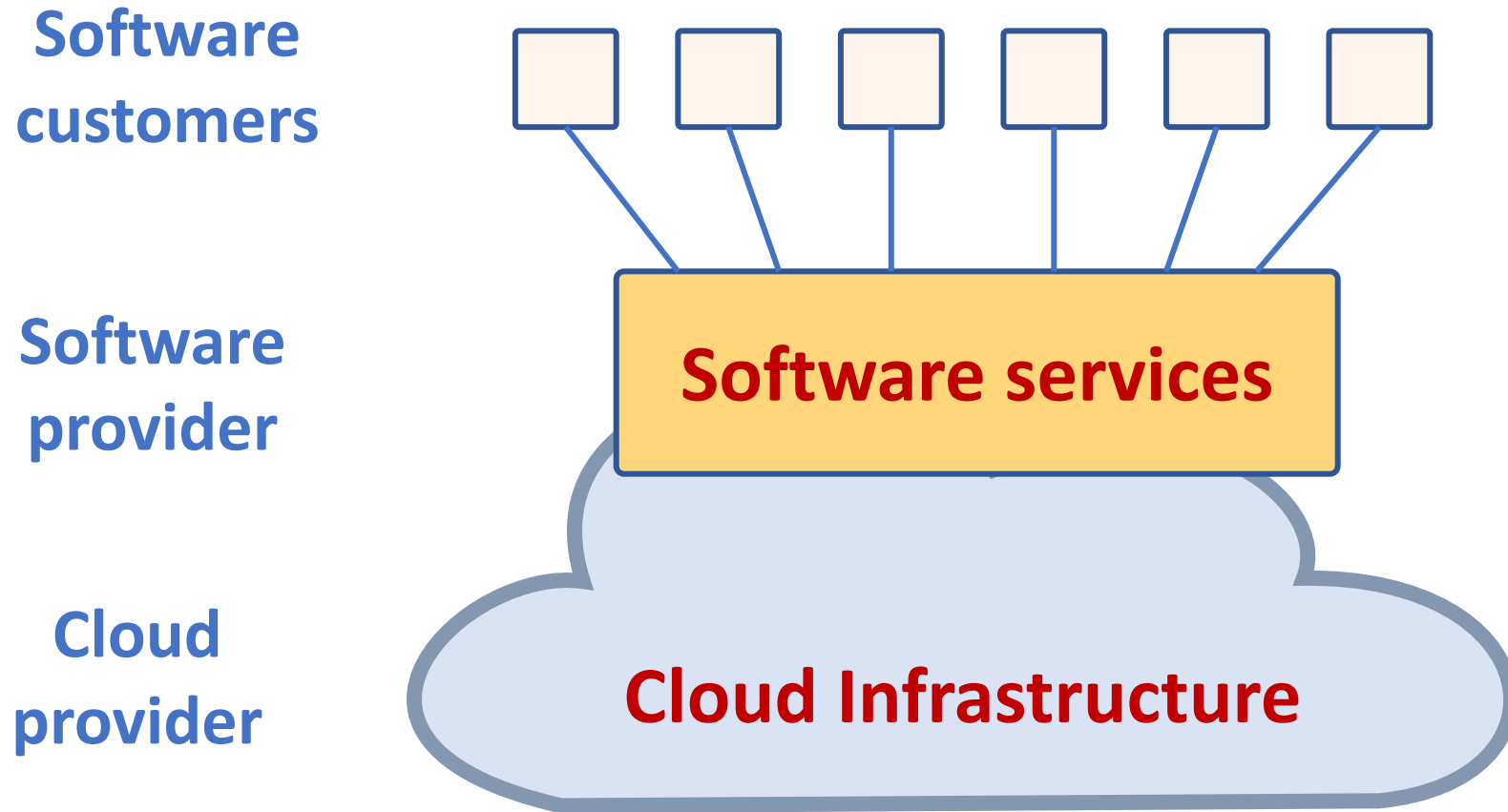




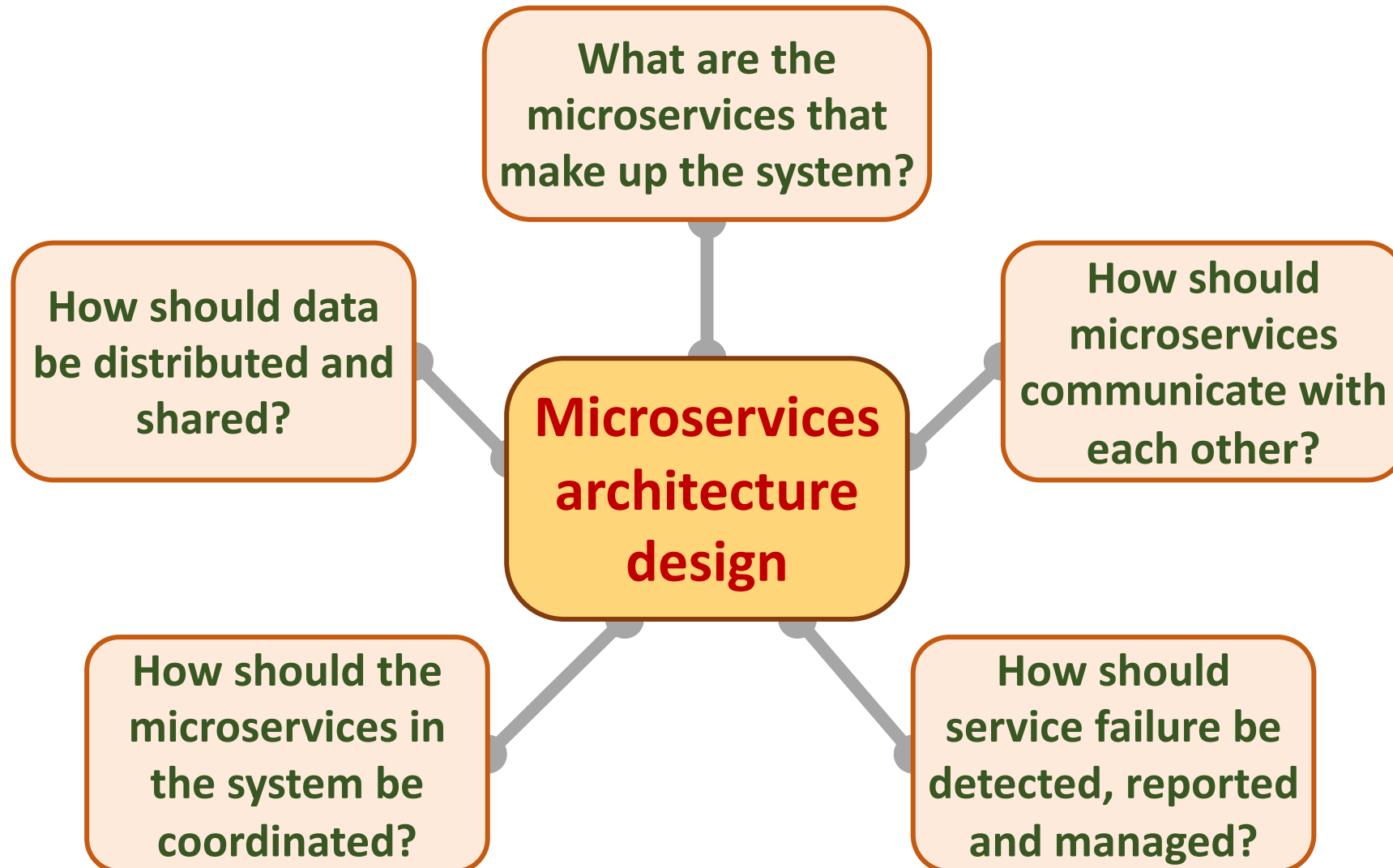
# Everything as a service



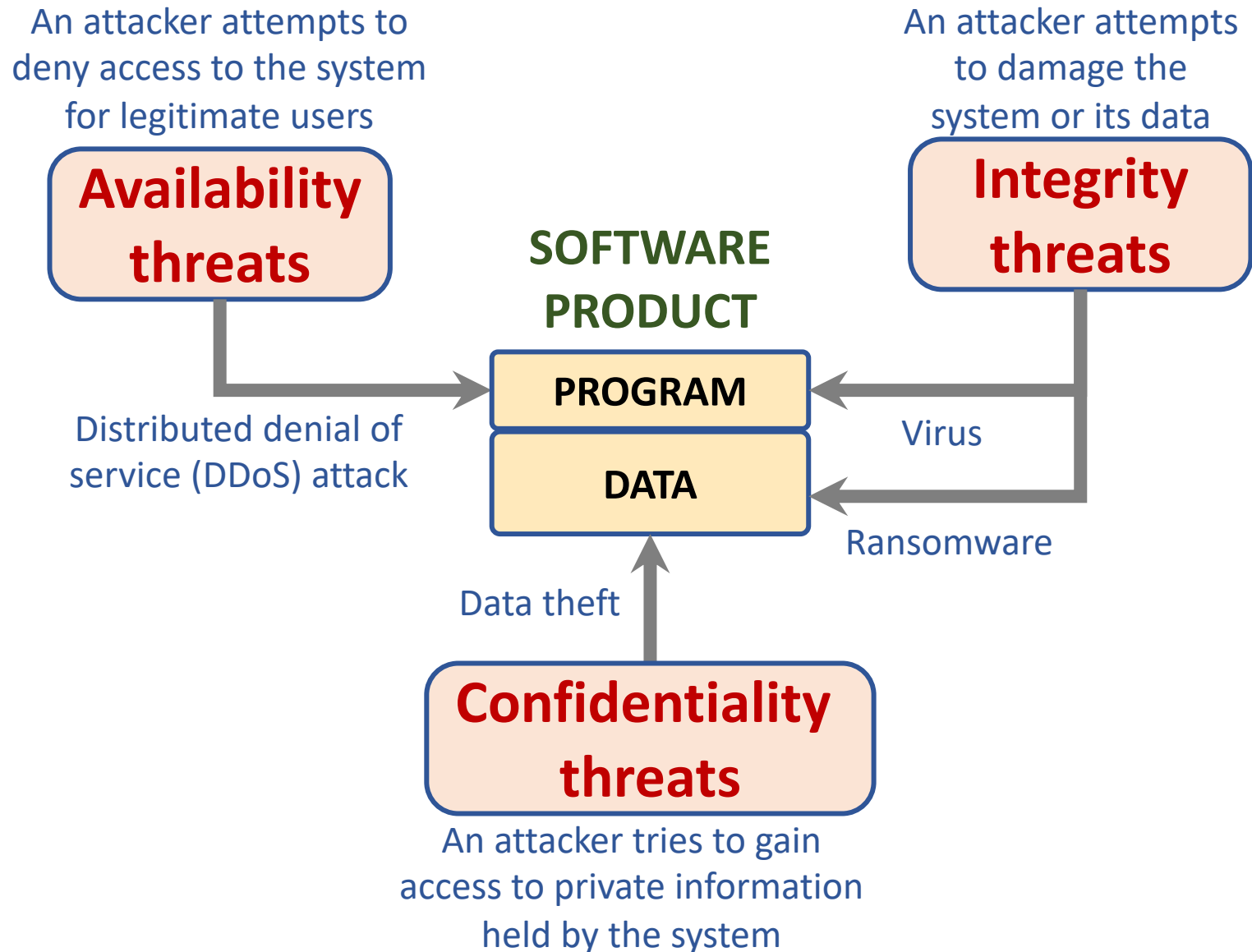
# Software as a service



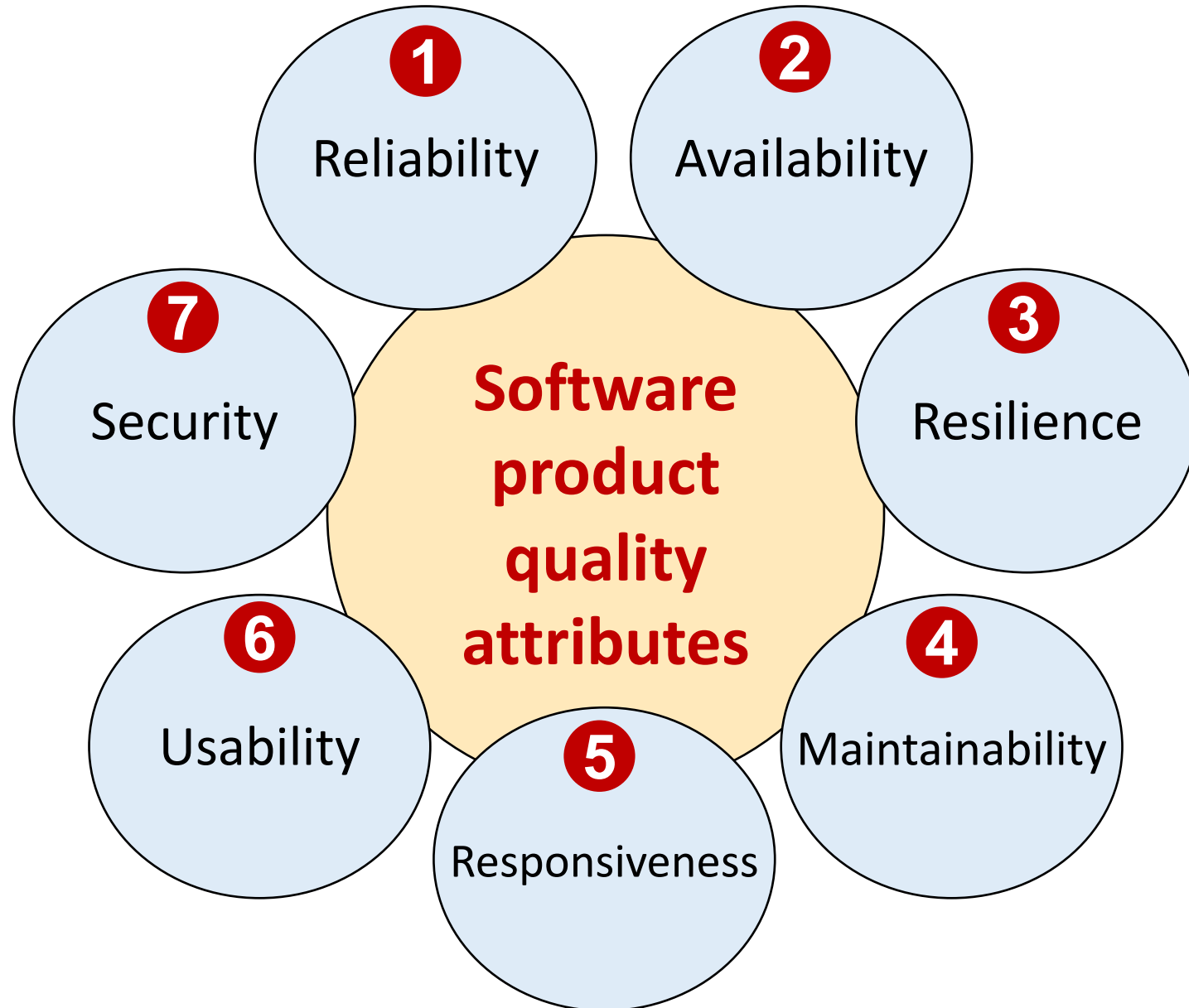
# Microservices architecture – key design questions



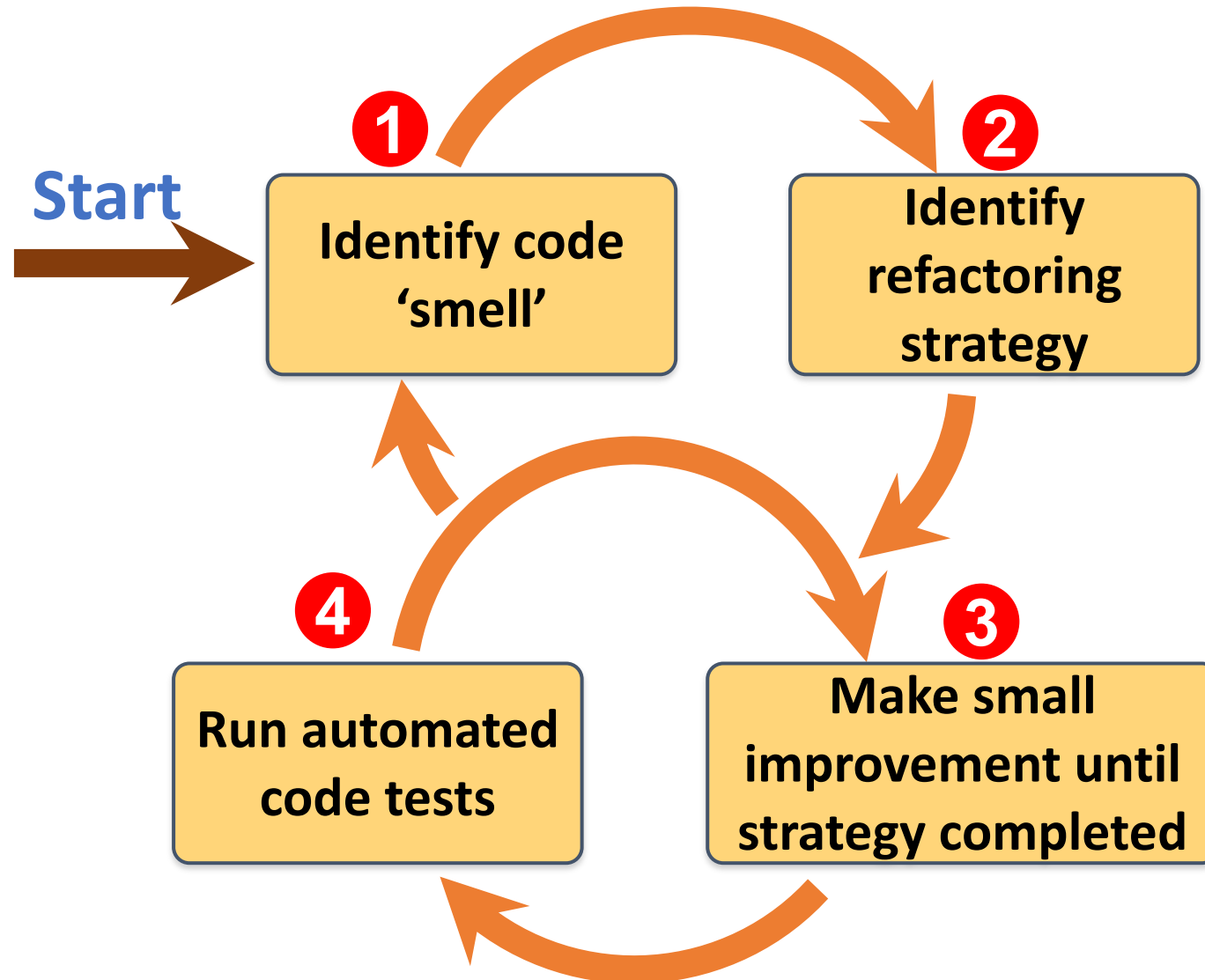
# Types of security threat



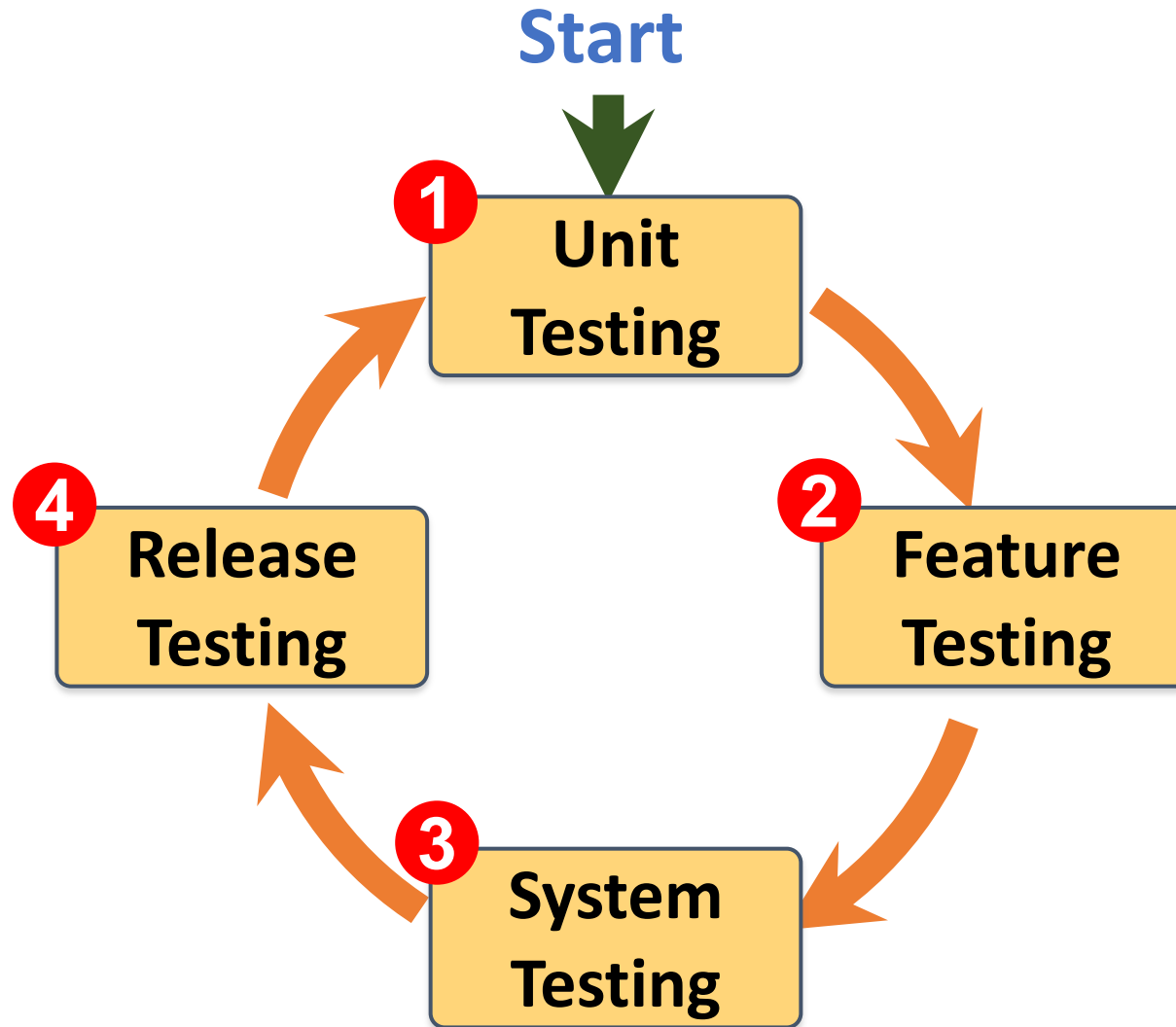
# Software product quality attributes



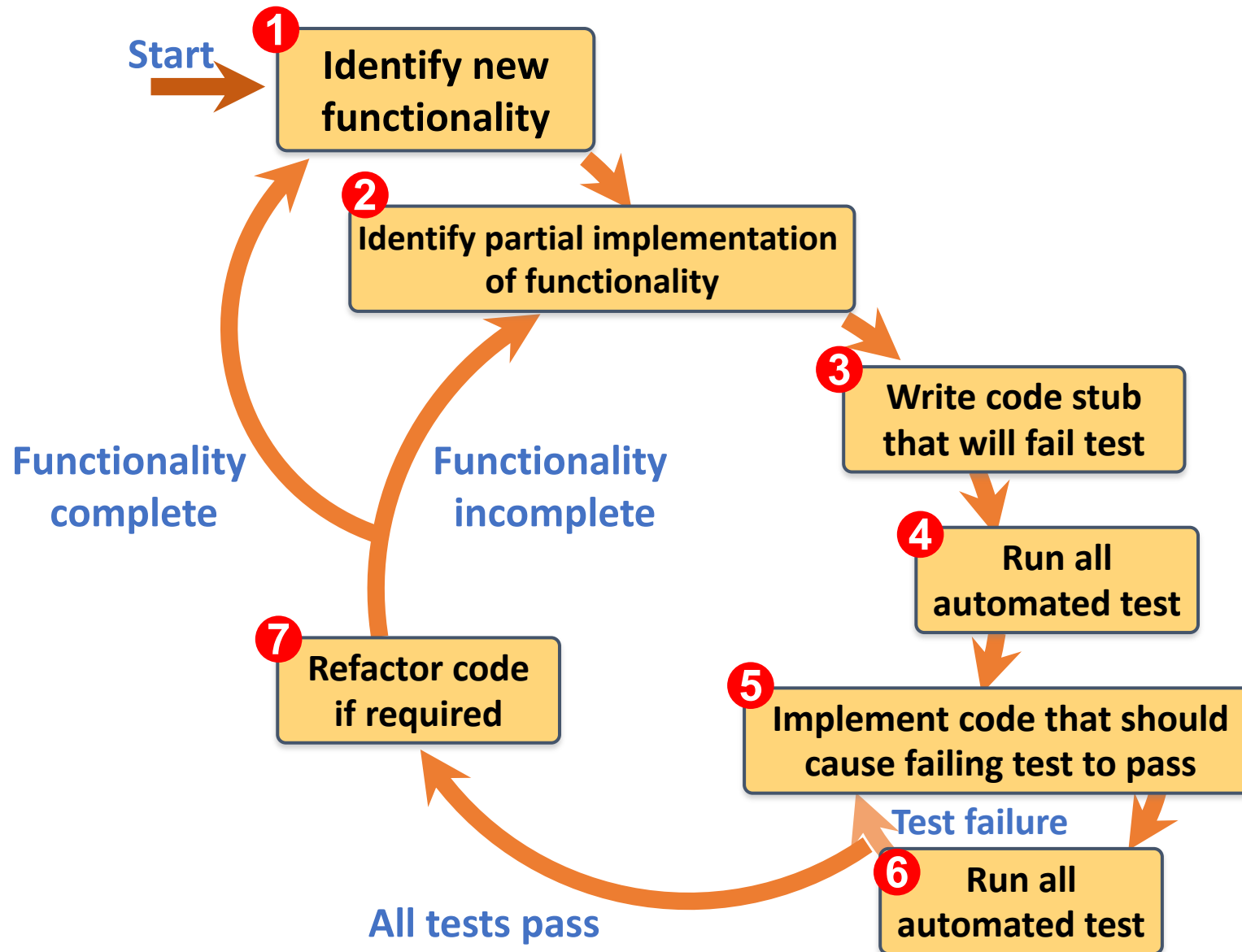
# A refactoring process



# Functional testing

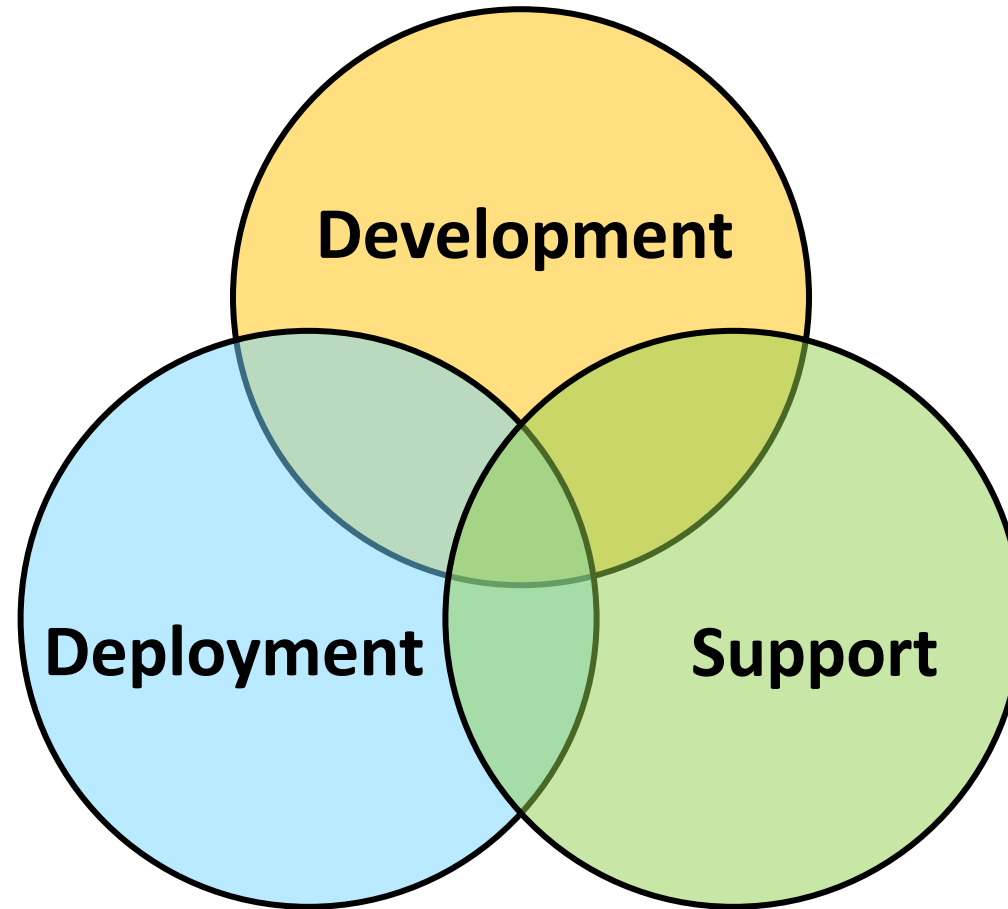


# Test-driven development (TDD)



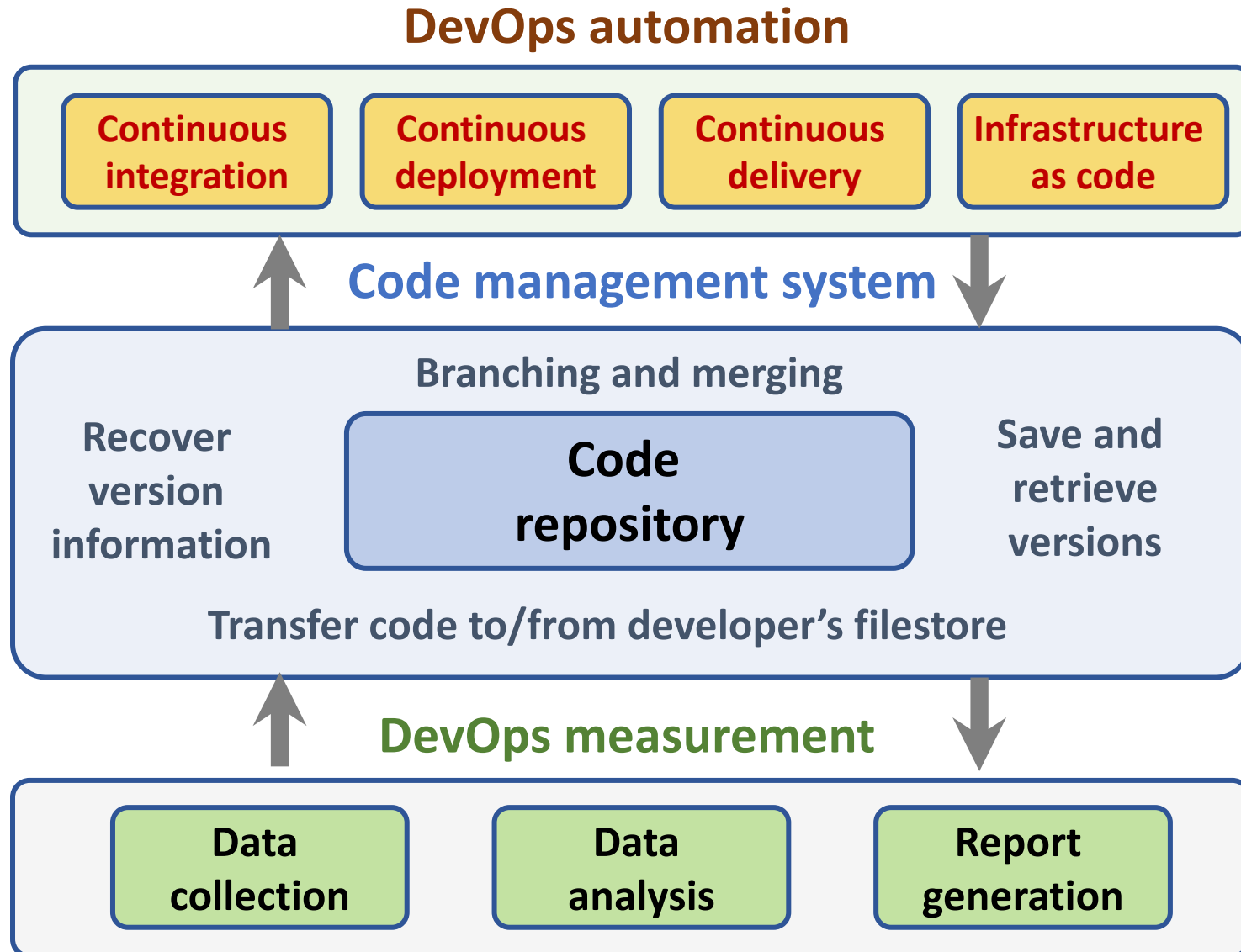


# DevOps



## Multi-skilled DevOps team

# Code management and DevOps



# Cloud Computing and Cloud Software Architecture

# Outline

- **Cloud Computing and Cloud Software Architecture**
- **AWS Certified Cloud Practitioner (CLF-C01)**
- **AWS Certified Solutions Architect – Associate (SAA-C02)**
- **Web Application with AWS Core Services**
- **AWS Serverless Architecture**
- **Build a Serverless Web Application with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito**

# AWS Certifications



aws academy

Accredited  
Educator



aws  certified  
**Cloud  
Practitioner**



aws  certified  
**Solutions  
Architect**  
Associate



# AWS Products and Services



Analytics



Application Integration



AR & VR



AWS Cost Management



Blockchain



Business Applications



Compute



Customer Engagement



Database



Developer Tools



End User Computing



Game Tech



Internet of Things



Machine Learning



Management & Governance



Media Services



Migration & Transfer



Mobile



Networking & Content Delivery



Quantum Technologies



Robotics



Satellite



Security, Identity & Compliance



Storage



# AWS Compute



Compute

## Amazon EC2

Virtual servers in the cloud

## Amazon EC2 Auto Scaling

Scale compute capacity to meet demand

## Amazon Elastic Container Registry

Store and retrieve docker images

## Amazon Elastic Container Service

Run and manage docker containers

## Amazon Elastic Kubernetes Service

Run managed Kubernetes on AWS

## Amazon Lightsail

Launch and manage virtual private servers

## AWS Batch

Run batch jobs at any scale

## AWS Elastic Beanstalk

Run and manage web apps

## AWS Fargate

Run containers without managing servers or clusters

## AWS Lambda

Run code without thinking about servers

## AWS Outposts

Run AWS infrastructure on-premises

## AWS Serverless Application Repository

Discover, deploy, and publish serverless applications

## AWS Wavelength

Deliver ultra-low latency applications for 5G devices

## VMware Cloud on AWS

Build a hybrid cloud without custom hardware



# AWS Database



## Amazon Aurora

High Performance Managed Relational Database

## Amazon DynamoDB

Managed NoSQL Database

## Amazon DocumentDB (with MongoDB compatibility)

Fully managed document database

## Amazon ElastiCache

In-memory Caching System

## Amazon Managed Apache Cassandra Service

Managed Cassandra-compatible database

## Amazon Neptune

Fully Managed Graph Database Service

## Amazon Quantum Ledger Database (QLDB)

Fully managed ledger database

## Amazon RDS

Managed Relational Database Service for MySQL, PostgreSQL, Oracle, SQL Server, and MariaDB

## Amazon RDS on VMware

Automate on-premises database management

## Amazon Redshift

Fast, Simple, Cost-effective Data Warehousing

## Amazon Timestream

Fully managed time series database

## AWS Database Migration Service

Migrate Databases with Minimal Downtime





# AWS Storage



**Amazon Simple Storage Service (S3)**  
Scalable Storage in the Cloud

**Amazon Elastic Block Store (EBS)**  
EC2 block storage volumes

**Amazon Elastic File System (EFS)**  
Fully managed file system for EC2

**Amazon FSx for Lustre**  
High-performance file system integrated with S3

**Amazon FSx for Windows File Server**  
Fully managed Windows native file system

**Amazon S3 Glacier**  
Low-cost Archive Storage in the Cloud

**AWS Backup**  
Centralized backup across AWS services

**AWS Snow Family**  
Physical devices to migrate data into and out of AWS

**AWS Storage Gateway**  
Hybrid Storage Integration

**CloudEndure Disaster Recovery**  
Highly automated disaster recovery



# AWS Networking & Content Delivery



Networking & Content Delivery

## Amazon VPC

Isolated Cloud Resources

## Amazon API Gateway

Build, Deploy, and Manage APIs

## Amazon CloudFront

Global Content Delivery Network

## Amazon Route 53

Scalable Domain Name System

## AWS PrivateLink

Securely Access Services Hosted on AWS

## AWS App Mesh

Monitor and control microservices

## AWS Cloud Map

Application resource registry for microservices

## AWS Direct Connect

Dedicated Network Connection to AWS

## AWS Global Accelerator

Improve application availability and performance

## AWS Transit Gateway

Easily scale VPC and account connections

## Elastic Load Balancing

Distribute incoming traffic across multiple targets



# AWS Security, Identity & Compliance



Security, Identity &  
Compliance

**AWS Identity & Access Management**  
Manage User Access and Encryption Keys

**Amazon Cognito**  
Identity Management for your Apps

**Amazon Detective**  
Investigate potential security issues

**Amazon GuardDuty**  
Managed Threat Detection Service

**Amazon Inspector**  
Analyze Application Security

**Amazon Macie**  
Discover, Classify, and Protect your Data

**AWS Artifact**  
On-demand access to AWS compliance reports

**AWS Certificate Manager**  
Provision, Manage, and Deploy SSL/TLS Certificates

**AWS CloudHSM**  
Hardware-based Key Storage for Regulatory Compliance

**AWS Directory Service**  
Host and Manage Active Directory

**AWS Firewall Manager**  
Central Management of Firewall Rules

**AWS Key Management Service**  
Managed Creation and Control of Encryption Keys

**AWS Resource Access Manager**  
Simple, secure service to share AWS resources

**AWS Secrets Manager**  
Rotate, Manage, and Retrieve Secrets

**AWS Security Hub**  
Unified security and compliance center

**AWS Shield**  
DDoS Protection

**AWS Single Sign-On**  
Cloud Single Sign-On (SSO) Service

**AWS WAF**  
Filter Malicious Web Traffic



# AWS Cost Management



AWS Cost Management

## AWS Cost Explorer

Analyze Your AWS Cost and Usage

## AWS Budgets

Set Custom Cost and Usage Budgets

## AWS Cost and Usage Report

Access Comprehensive Cost and Usage Information

## Reserved Instance Reporting

Dive Deeper into Your Reserved Instances (RIs)

## Savings Plans

Save up to 72% on compute usage with flexible pricing



# AWS Services

- **Amazon EC2**
  - Virtual servers in the cloud
- **Amazon Simple Storage Service (S3)**
  - Scalable storage in the cloud
- **Amazon Aurora**
  - High performance managed relational database
- **Amazon DynamoDB**
  - Managed NoSQL database
- **Amazon RDS**
  - Managed relational database service for MySQL, PostgreSQL, Oracle, SQL Server, and MariaDB



# AWS Services

- **AWS Lambda**
  - Run code without thinking about servers
- **AWS Elastic Beanstalk**
  - Run and manage web apps
- **Amazon VPC**
  - Isolated cloud resources
- **Amazon Lightsail**
  - Launch and manage virtual private servers
- **Amazon SageMaker**
  - Build, train, and deploy machine learning models at scale

# Available AWS Certifications

3

## Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud

**SAP**



2

## Associate

One year of experience solving problems and implementing solutions using the AWS Cloud

**SAA**



1

## Foundational

Six months of fundamental AWS Cloud and industry knowledge

**CLF**

Cloud Practitioner



## Specialty

Technical AWS Cloud experience in the Specialty domain as specified in the exam guide





# AWS Certification

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aws training and certification

## AWS Certification

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### Get started

#### Certification exam guides and details

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Select ▼

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<https://aws.amazon.com/certification/>





# AWS Certification

## Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud



## Associate

One year of experience solving problems and implementing solutions using the AWS Cloud



## Specialty

Technical AWS Cloud experience in the Specialty domain as specified in the exam guide



2

**SAA**

Architect

Operations

Developer

1

## Foundational

Six months of fundamental AWS Cloud and industry knowledge

Cloud Practitioner



**CLF**

<https://aws.amazon.com/certification/>



# AWS Certification



## Format

65 questions; either multiple choice or multiple response



## Type

Foundational



## Delivery Method

Testing center or online proctored exam



## Time

90 minutes to complete the exam



## Cost

100 USD (Practice Exam: 20 USD)



## Language

Available in English, Indonesian (Bahasa), Japanese, Korean, and Simplified Chinese

## Foundational

Six months of fundamental AWS  
Cloud and industry knowledge

Cloud  
Practitioner



<https://aws.amazon.com/certification/>



# AWS Certification



## Format

65 questions; either multiple choice or multiple response



## Type

Associate



## Delivery Method

Testing center or online proctored exam



## Time

130 minutes to complete the exam



## Cost

150 USD (Practice exam: 20 USD)



## Language

Available in English, Japanese, Korean, and Simplified Chinese

## Associate

One year of experience solving problems and implementing solutions using the AWS Cloud



Architect



Operations



Developer



# AWS Certification

## Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud



### Format

75 questions; either multiple choice or multiple response



### Type

Professional



### Delivery Method

Testing center or online proctored exam



### Time

180 minutes to complete the exam



### Cost

300 USD (Practice Exam: 40 USD)



### Language

Available in English, Japanese, Korean, and Simplified Chinese



# AWS Certification



## Format

65 questions; either multiple choice or multiple response



## Type

Associate



## Delivery Method

Testing center or online proctored exam



## Time

130 minutes to complete the exam



## Cost

150 USD (Practice exam: 20 USD)



## Language

Available in English, Japanese, Korean, and Simplified Chinese

## Associate

**One year** of experience solving problems and implementing solutions using the AWS Cloud



**Architect**



**Operations**



**Developer**



# AWS Certification



## Format

65 questions; either multiple choice or multiple response



## Type

Associate



## Delivery Method

Testing center or online proctored exam



## Time

130 mins to complete the exam



## Cost

150 USD (Practice exam: 20 USD)



## Language

Available in English, Japanese, Korean, and Simplified Chinese

## Associate

One year of experience solving problems and implementing solutions using the AWS Cloud



Architect



Operations



Developer



# AWS Certification

## Professional

Two years of comprehensive experience designing, operating, and troubleshooting solutions using the AWS Cloud



### Format

75 questions; either multiple choice or multiple response



### Type

Professional



### Delivery Method

Testing center or online proctored exam



### Time

180 minutes to complete the exam



### Cost

300 USD (Practice exam: 40 USD)



### Language

Available in English, Japanese, Korean, and Simplified Chinese



# AWS Certification

## Specialty

Technical AWS Cloud experience in the Specialty domain as specified in the **exam guide**



### Format

65 questions; either multiple choice or multiple response



### Type

Specialty



### Delivery Method

Testing center or online proctored exam



### Time

180 minutes to complete the exam



### Cost

300 USD (Practice exam: 40 USD)



### Language

Available in English, Japanese, Korean, and Simplified Chinese



# AWS Certifications Roadmap



# AWS Certifications Roadmap

## Cloud Architect



# AWS Certifications Roadmap

## Cloud Developer



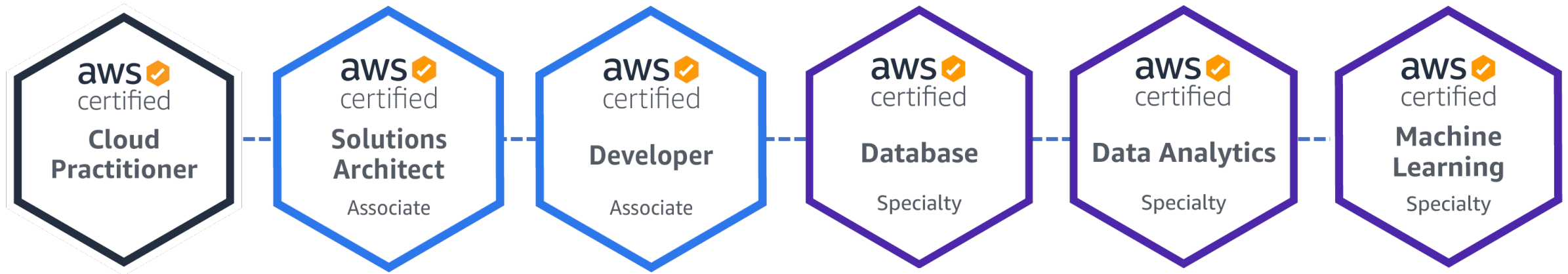
# AWS Certifications Roadmap

## DevOps



# AWS Certifications Roadmap

## Data Analytics / Machine Learning



# AWS Certifications Roadmap

## Security



# AWS Certified Cloud Practitioner (CLF-C01)





# AWS Certified Cloud Practitioner

- **This certification provides individuals in a larger variety of cloud and technology roles with a way to validate their AWS Cloud knowledge and enhance their professional credibility.**
- **This exam covers four domains, including cloud concepts, security, technology, and billing and pricing.**





# AWS Certified Solutions Architect – Associate (SAA-C02)





# AWS Certified Solutions Architect – Associate

- **This certification validates your ability to effectively demonstrate knowledge of how to architect and deploy secure and robust applications on AWS technologies.**
- **This exam is for anyone with at least one year of hands-on experience designing available, cost-efficient, fault-tolerant, and scalable and distributed systems on AWS.**



# AWS Academy and Certifications

- **AWS Academy Cloud Foundations (ACF)**

- **AWS Certified Cloud Practitioner (CLF-C01)**

- <https://aws.amazon.com/certification/certified-cloud-practitioner/>

- **AWS Academy Cloud Architecting (ACA)**

- **AWS Certified Solutions Architect – Associate (SAA-C02)**

- <https://aws.amazon.com/certification/certified-solutions-architect-associate/>

<https://aws.amazon.com/training/awsacademy/>

1



2





# AWS Certified Cloud Practitioner (CLF-C01)

Domain	% of Examination
Domain 1: <b>Cloud Concepts</b>	26%
Domain 2: <b>Security and Compliance</b>	25%
Domain 3: <b>Technology</b>	33%
Domain 4: <b>Billing and Pricing</b>	16%
<b>TOTAL</b>	<b>100%</b>



# AWS Certified Solutions Architect – Associate (SAA-C02)

Domain	% of Examination
Domain 1: Design <b>Resilient</b> Architectures	30%
Domain 2: Design <b>High-Performing</b> Architectures	28%
Domain 3: Specify <b>Secure</b> Applications and Architectures	24%
Domain 4: Design <b>Cost-Optimized</b> Architectures	18%
TOTAL	100%

# AWS Certified Cloud Practitioner (CLF-C01)





# AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 1: Cloud Concepts**
  - **1.1 Define the AWS Cloud and its value proposition**
  - **1.2 Identify aspects of AWS Cloud economics**
  - **1.3 List the different cloud architecture design principles**



# AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 2: Security and Compliance**
  - **2.1 Define the AWS shared responsibility model**
  - **2.2 Define AWS Cloud security and compliance concepts**
  - **2.3 Identify AWS access management capabilities**
  - **2.4 Identify resources for security support**





# AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 3: Technology**
  - **3.1 Define methods of deploying and operating in the AWS Cloud**
  - **3.2 Define the AWS global infrastructure**
  - **3.3 Identify the core AWS services**
  - **3.4 Identify resources for technology support**



# AWS Certified Cloud Practitioner (CLF-C01)

- **Domain 4: Billing and Pricing**
  - **4.1 Compare and contrast the various pricing models for AWS**
  - **4.2 Recognize the various account structures in relation to AWS billing and pricing**
  - **4.3 Identify resources available for billing support**

# AWS Certified Solutions Architect – Associate (SAA-C02)





# AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 1: Design Resilient Architectures**
  - **1.1 Design a multi-tier architecture solution**
  - **1.2 Design highly available and/or fault-tolerant architectures**
  - **1.3 Design decoupling mechanisms using AWS services**
  - **1.4 Choose appropriate resilient storage**



# AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 2: Design **High-Performing** Architectures**
  - 2.1 Identify elastic and scalable compute solutions for a workload
  - 2.2 Select high-performing and scalable storage solutions for a workload
  - 2.3 Select high-performing networking solutions for a workload
  - 2.4 Choose high-performing database solutions for a workload



# AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 3: Design **Secure** Applications and Architectures**
  - **3.1 Design secure access to AWS resources**
  - **3.2 Design secure application tiers**
  - **3.3 Select appropriate data security options**



# AWS Certified Solutions Architect – Associate (SAA-C02)

- **Domain 4: Design **Cost-Optimized** Architectures**
  - **4.1 Identify cost-effective storage solutions**
  - **4.2 Identify cost-effective compute and database services**
  - **4.3 Design cost-optimized network architectures**



# AWS Certifications

## Exam Pricing

Exam Type	Price in USD
Foundational	\$100
Associate	\$150
Professional	\$300
Specialty	\$300





**AWS Certified Security – Specialty**

validates expertise in securing data and workloads in the AWS Cloud



# AWS Certified Security - Specialty

- AWS Certified Security – Specialty is intended for individuals who perform a security role and have at least two years of hands-on experience securing AWS workloads.
  - Five years of IT security experience in designing and implementing security solutions and at least two years of hands-on experience in securing AWS workloads
  - Working knowledge of AWS security services and features of services to provide a secure production environment and an understanding of security operations and risks
  - Knowledge of the AWS shared responsibility model and its application; security controls for workloads on AWS; logging and monitoring strategies; cloud security threat models; patch management and security automation; ways to enhance AWS security services with third-party tools and services; and disaster recovery controls, including BCP and backups, encryption, access control, and data retention
  - Understanding of specialized data classifications and AWS data protection mechanisms, data-encryption methods and AWS mechanisms to implement them, and secure internet protocols and AWS mechanisms to implement them
  - Ability to make tradeoff decisions with regard to cost, security, and deployment complexity to meet a set of application requirements



# AWS Certified Cloud Practitioner

- **This certification provides individuals in a larger variety of cloud and technology roles with a way to validate their AWS Cloud knowledge and enhance their professional credibility.**
- **This exam covers four domains, including cloud concepts, security, technology, and billing and pricing.**





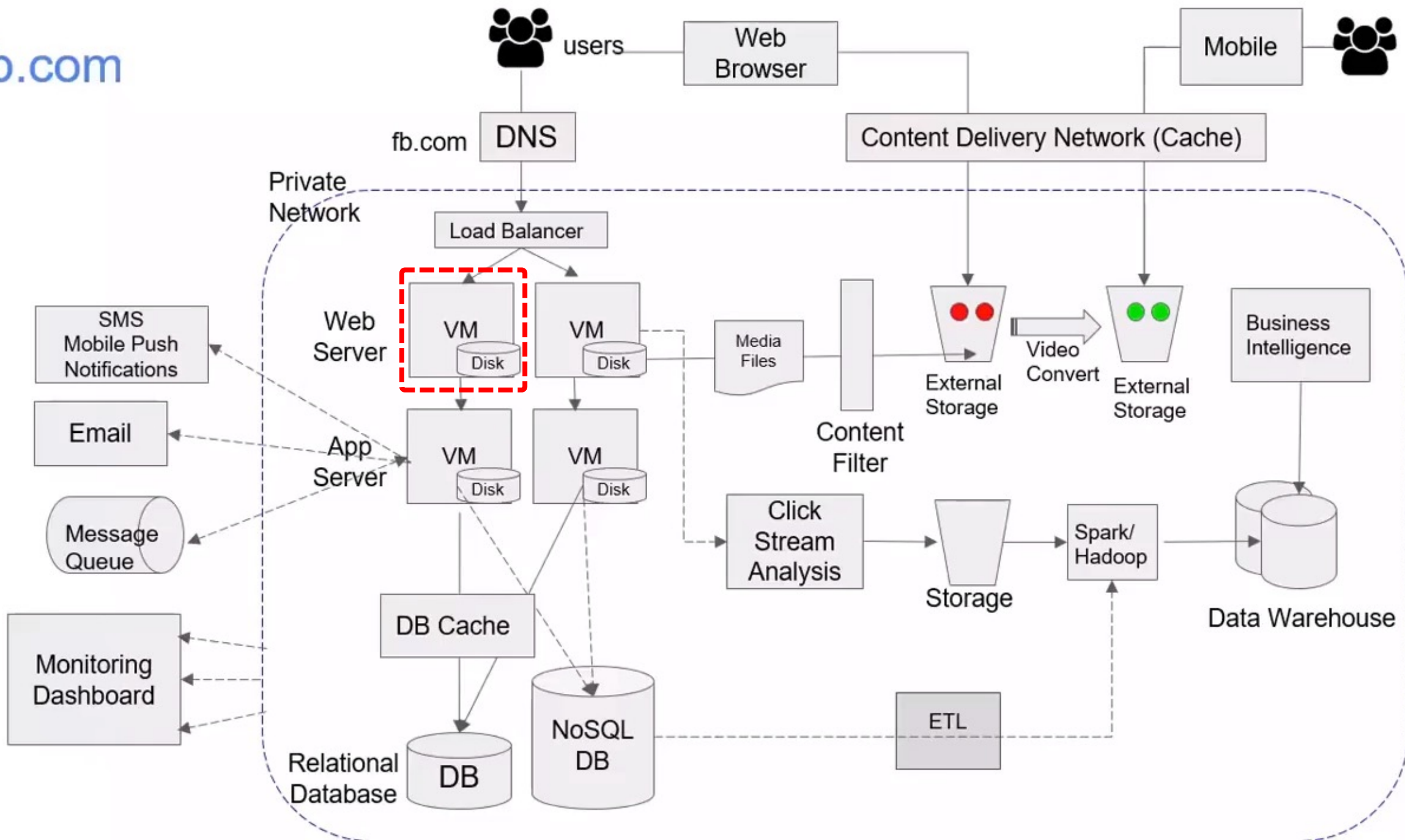
# AWS Certified Solutions Architect – Associate

- **This certification validates your ability to effectively demonstrate knowledge of how to architect and deploy secure and robust applications on AWS technologies.**
- **This exam is for anyone with at least one year of hands-on experience designing available, cost-efficient, fault-tolerant, and scalable and distributed systems on AWS.**

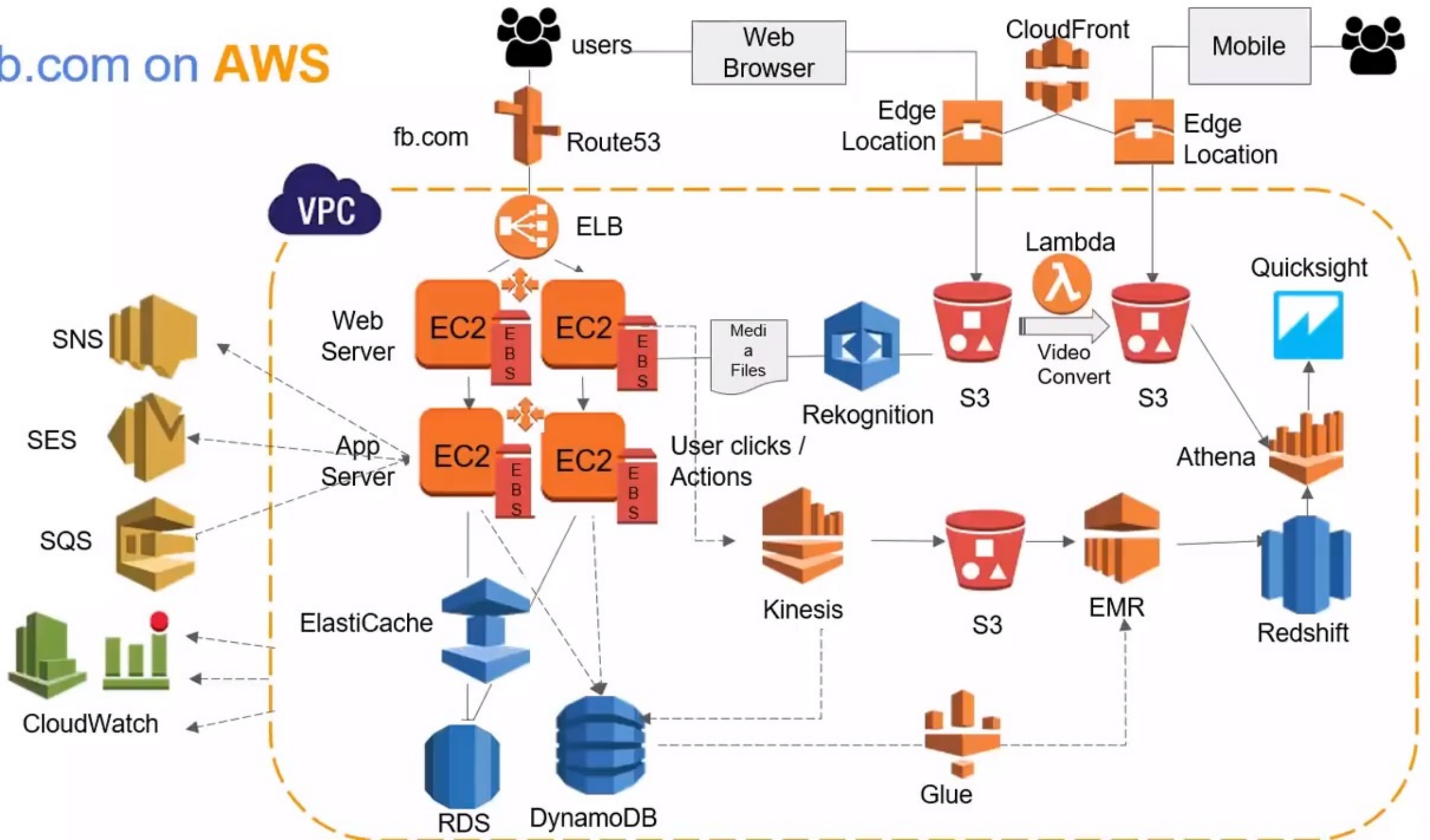




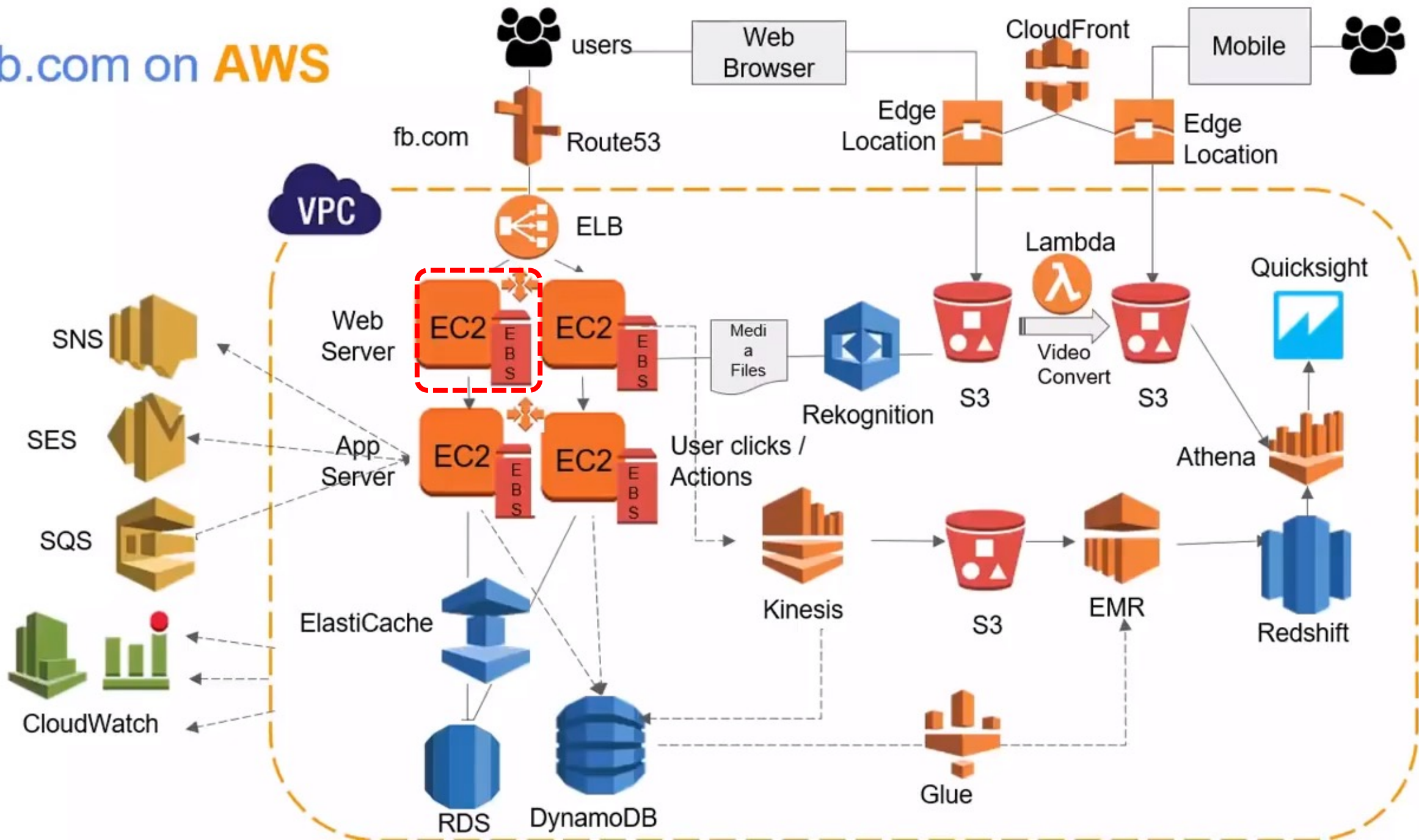
# Web Application with AWS Core Services



# fb.com on AWS

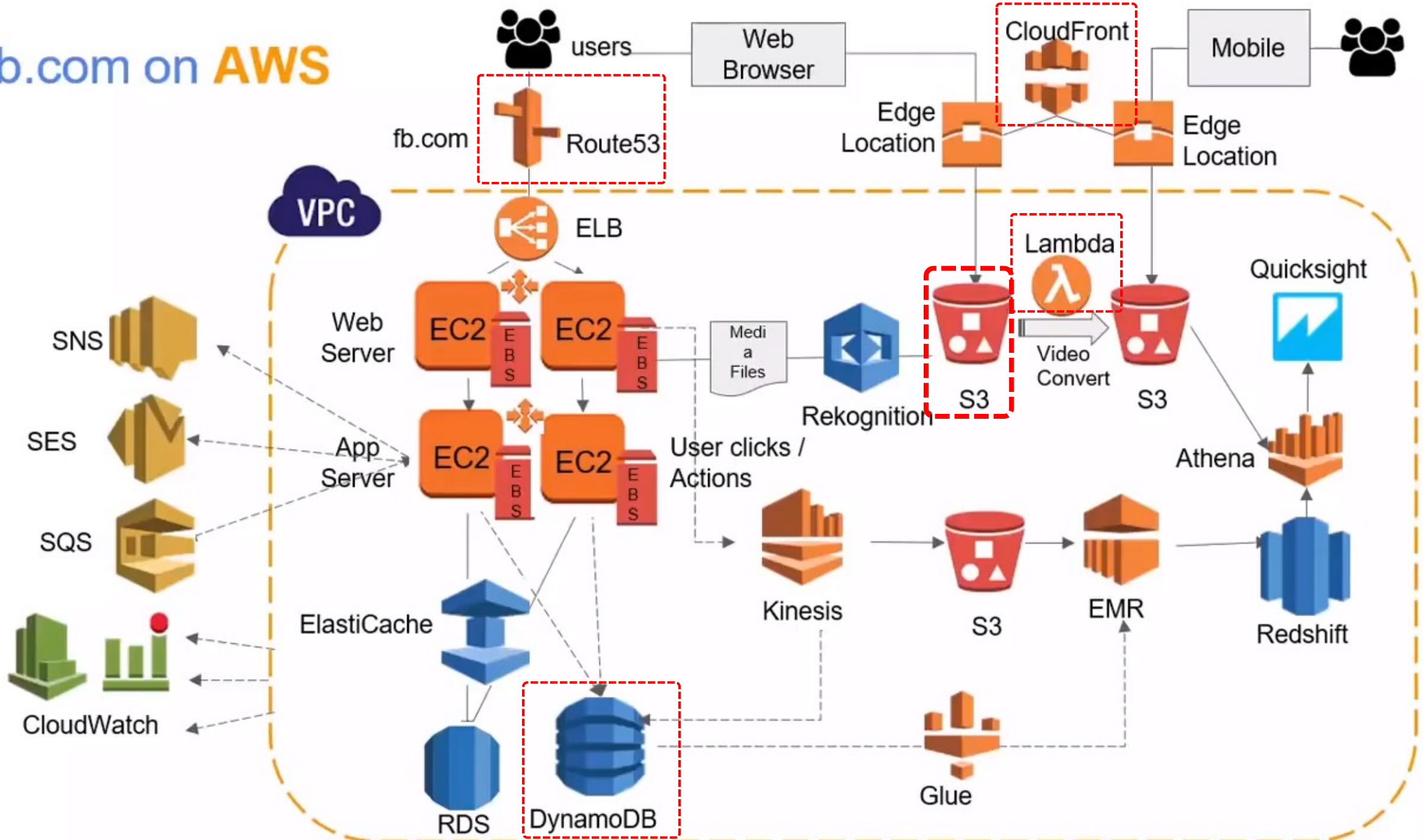


# fb.com on AWS

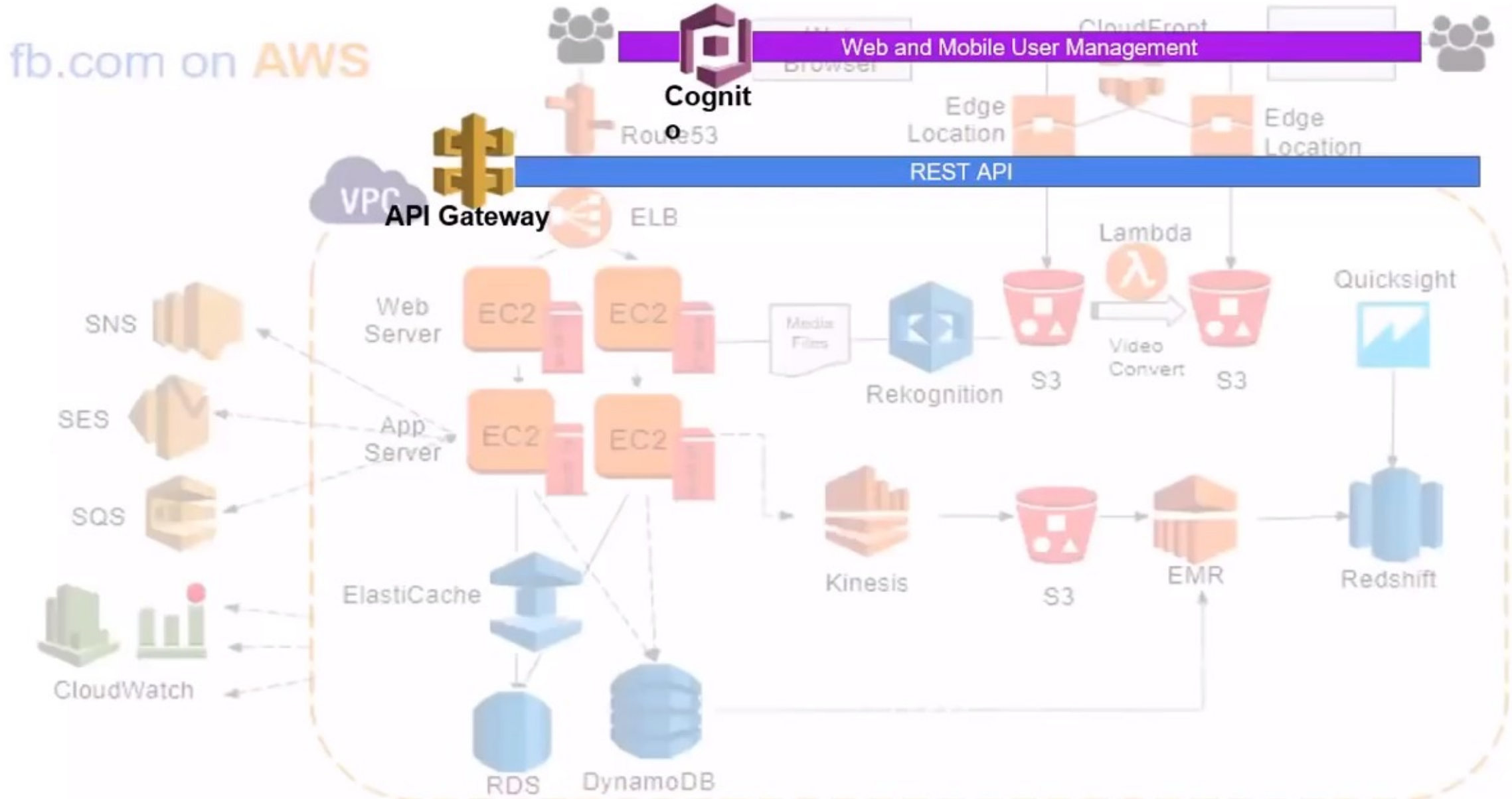




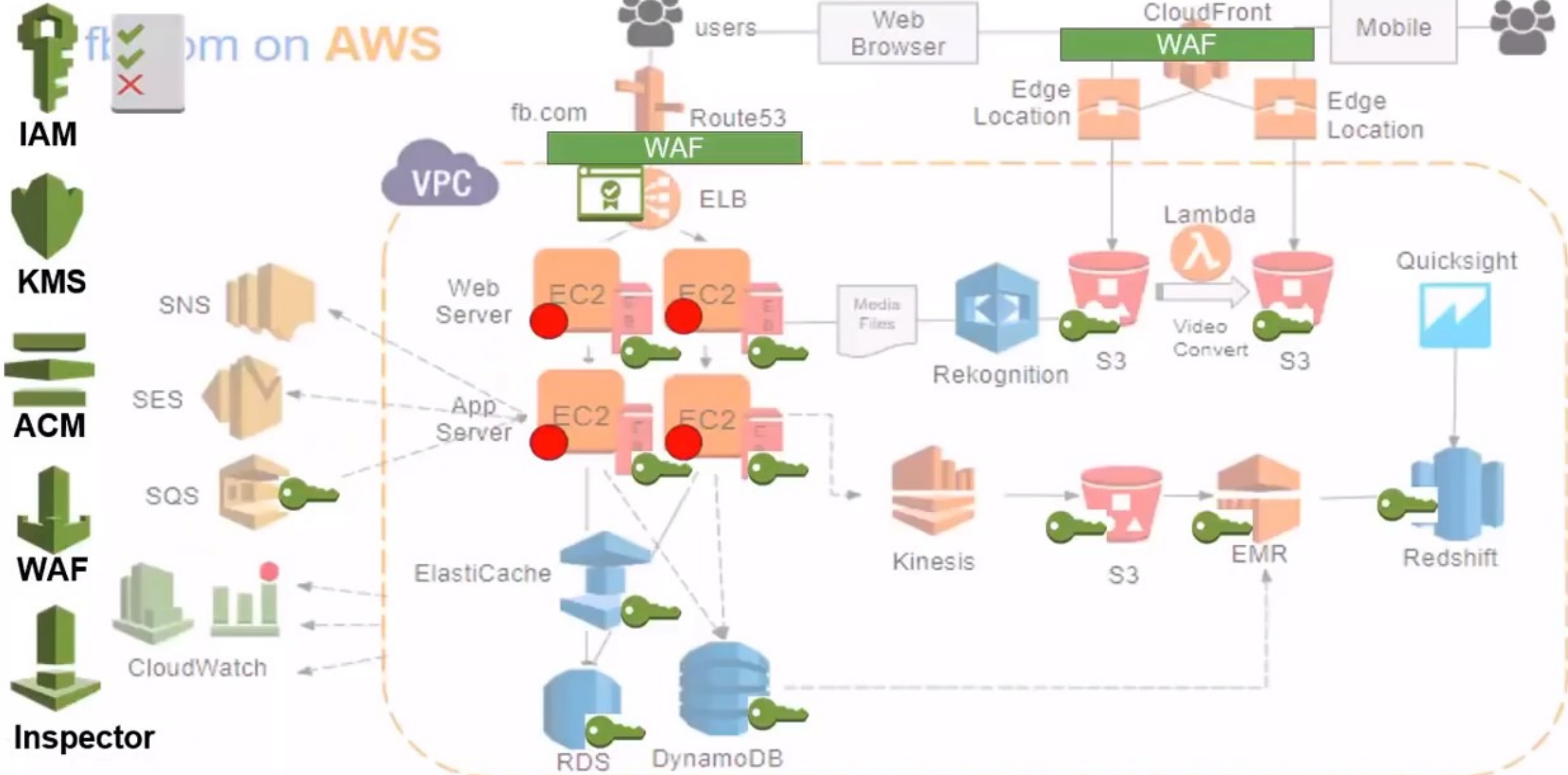
# fb.com on AWS



# AWS Application Services

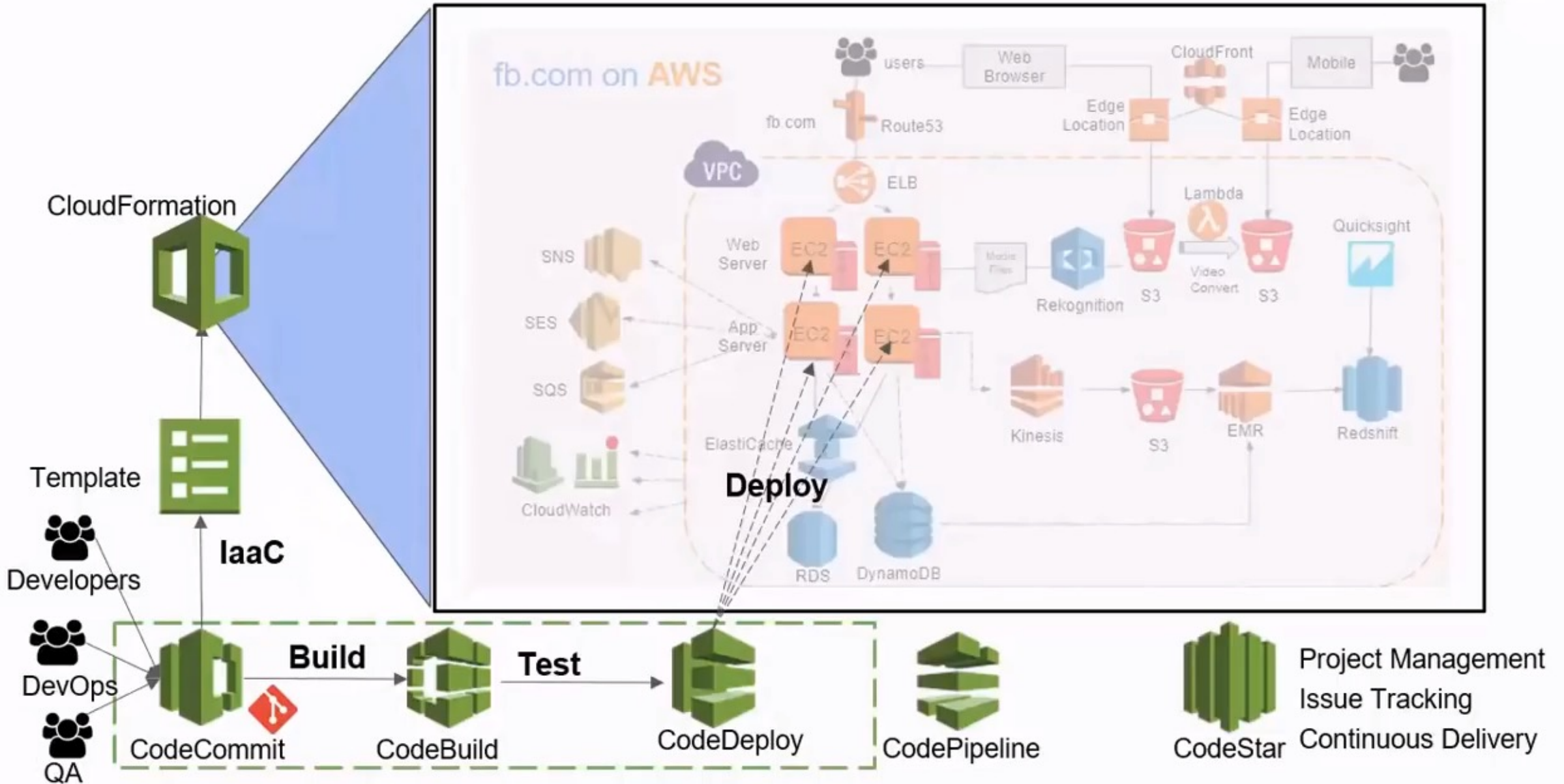


# AWS Security Services



# AWS Development and DevOps Services

AWS Region





# AWS Serverless Architecture



# AWS Serverless Airline Booking

Flight App

## Where next?

Departure airport  
LGW

Arrival airport  
MAD

Pick a date  
Wed, 24 Apr 2019

**SEARCH FLIGHTS >**

Flight App

LGW ↔ MAD

### Select your flight

DEPARTURE LGW 16 JAN 2019 MAD  
London Gatwick Madrid Barajas

08:00 2h15m 11:15

400 EUR Flight No #1812

DEPARTURE LGW 16 JAN 2019 MAD  
London Gatwick Madrid Barajas

10:30 2h15m 13:45

200 EUR Flight No #1813

DEPARTURE LGW 16 JAN 2019 MAD  
London Gatwick Madrid Barajas

12:00 2h15m 15:15

1000 EUR Flight No #1814

Flight App

LGW ↔ MAD

### Review your selection

DEPARTURE LGW 16 JAN 2019 MAD  
London Gatwick Madrid Barajas

08:00 2h15m 11:15

400 EUR Flight No #1812

### Payment details

Name Name on card

Country

Postcode Postcode

Card number 1234 1234 1234 1234

Expiry date MM / YY

CVC CVC

**AGREE AND PAY NOW >**

Flight App

## Heitor F. Lessa

purple  
4,554,234

50,241 Points

10% Next Tier Progress

### Preferences

Dietary requirements

Luggage

**SIGN OUT**



# AWS Serverless Airline Booking Stack

## UI/UX



Quasar framework



Vue.js



AWS Amplify



Stripe Elements

## Data/Lang



Amazon DynamoDB



Python



Typescript



JavaScript

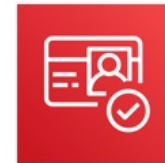
## API/Auth



AWS AppSync

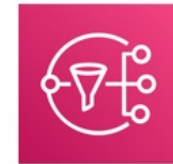


Amazon API Gateway



Amazon Cognito

## Messaging



Amazon SNS

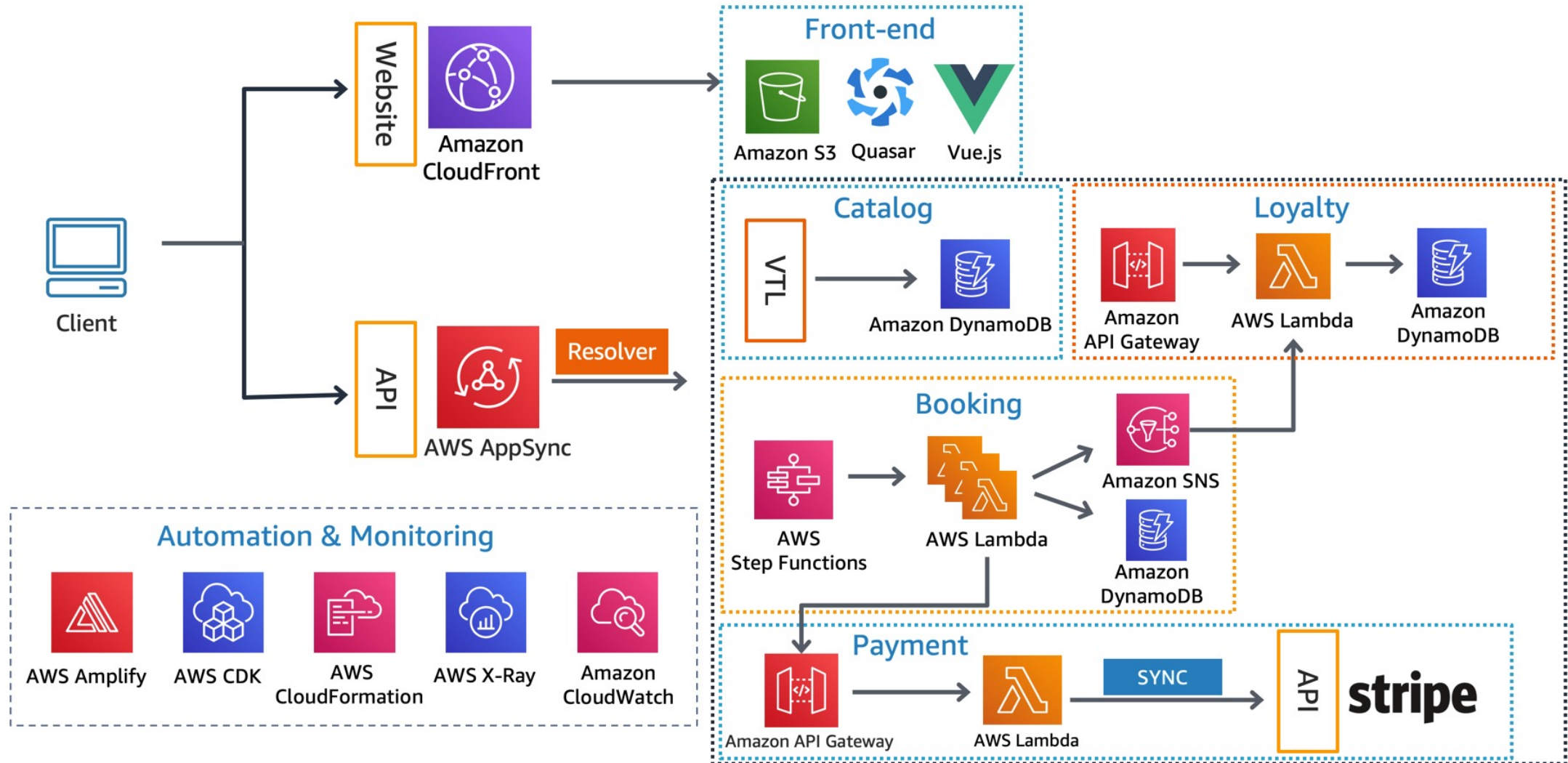


AWS Step Functions



# AWS Serverless Airline Booking

## High level infrastructure architecture



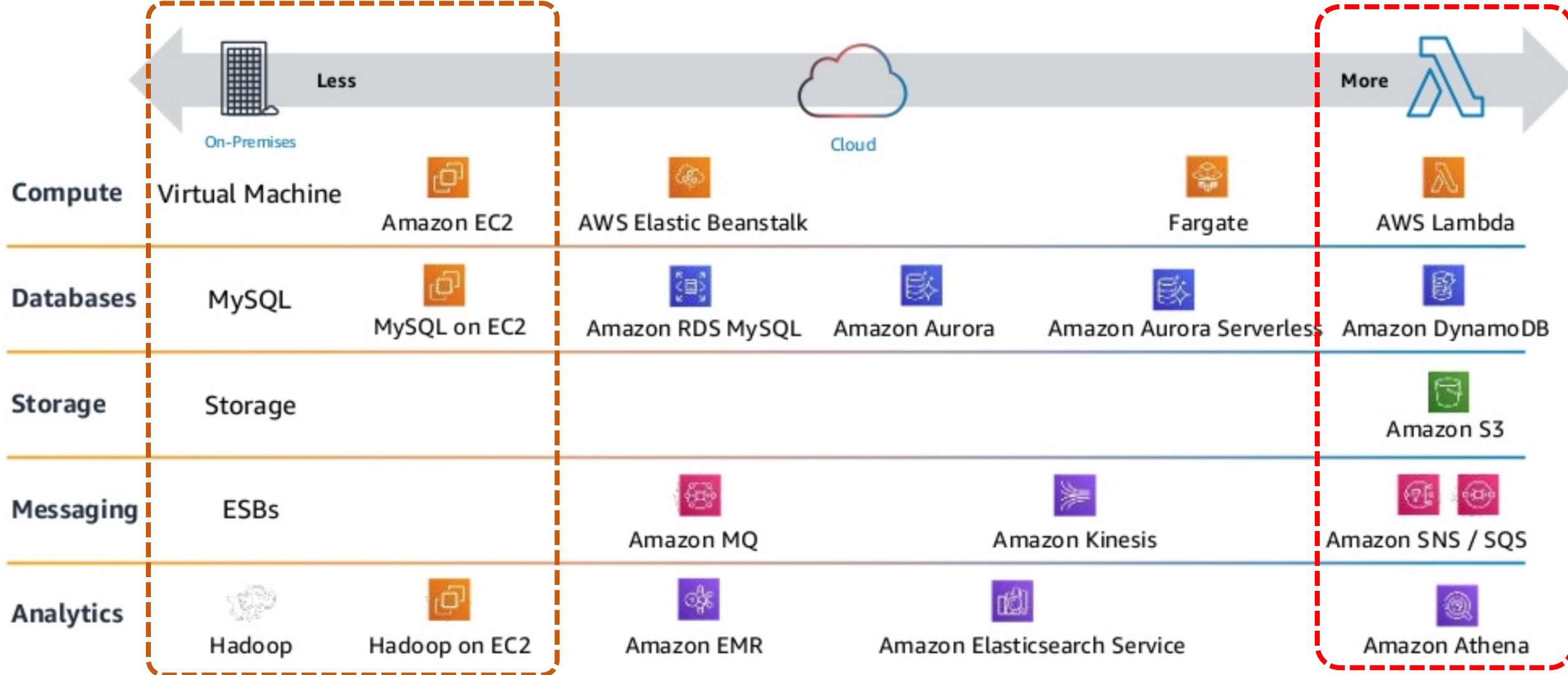
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# AWS Serverless Architecture

## AWS Operational Responsibility Models





# Build a Serverless Web Application

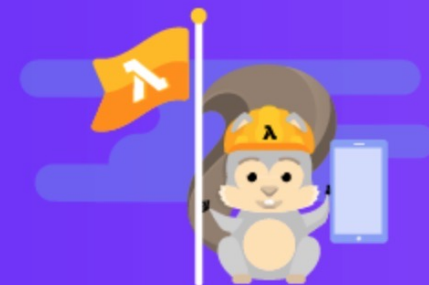


# Build a Serverless Web Application

Projects on AWS:

## Build a Serverless Web Application

with AWS Lambda, Amazon API Gateway, Amazon S3, Amazon DynamoDB, and Amazon Cognito



Introduction

1

Host a static website

2

Manage users

3

Build a serverless backend

4

Deploy a RESTful API

5

Terminate resources

## Overview

In this tutorial, you'll create a simple serverless web application that enables users to request unicorn rides from the [Wild Rydes](#) fleet. The application will present users with an HTML based user interface for indicating the location where they would like to be picked up and will interface on the backend with a RESTful web service to submit the request and dispatch a nearby unicorn. The application will also provide facilities for users to register with the service and log in before requesting rides.

## Application Architecture

**AWS Experience:** Beginner

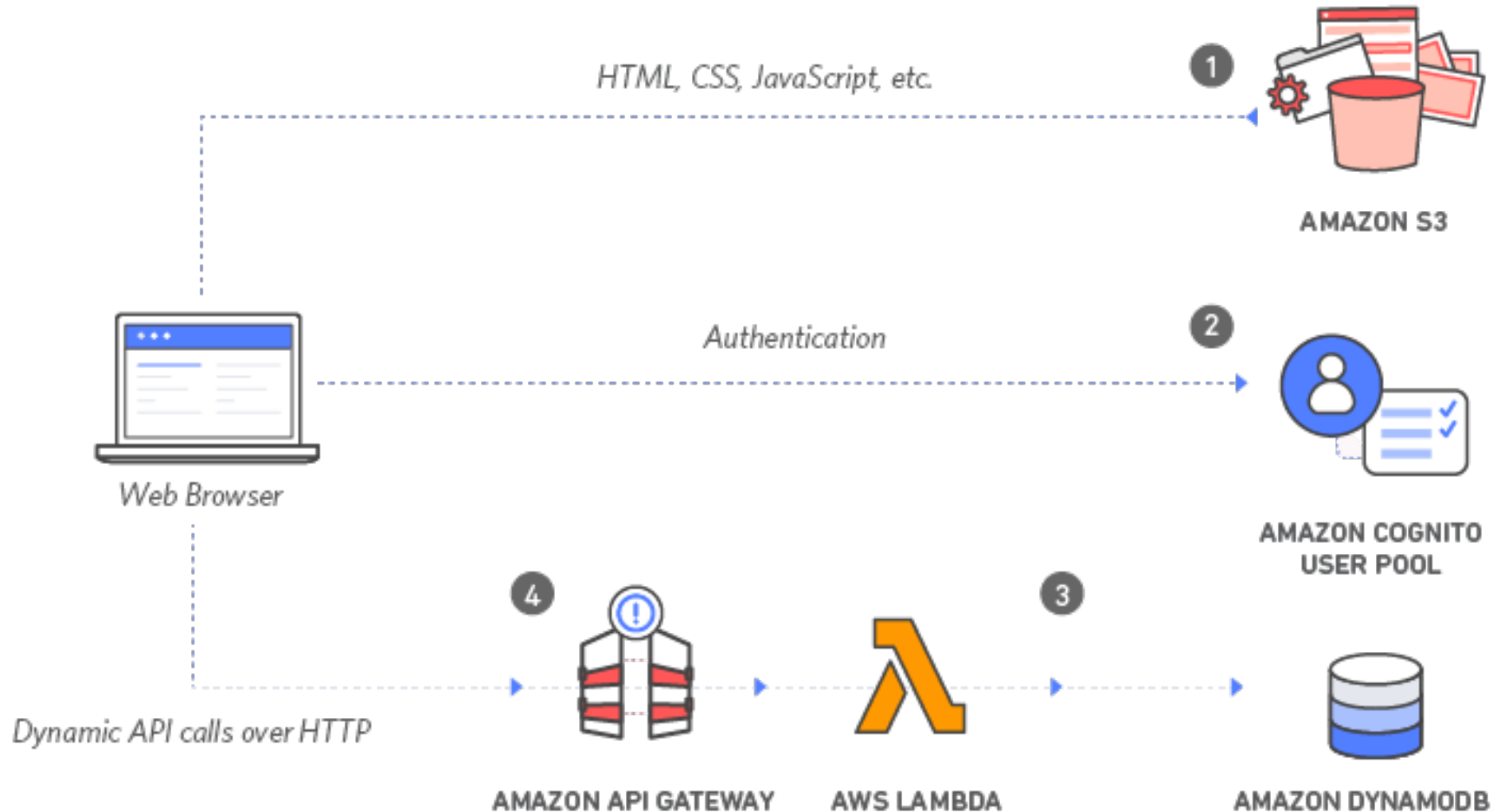
**Time to complete:** 2 hours

**Cost to complete:** Each service used in this architecture is eligible for the [AWS Free Tier](#). If you are outside the usage limits of the Free Tier, completing this tutorial will cost you less than \$0.25\*.



# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito





# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

1





# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway,  
Amazon DynamoDB, and Amazon Cognito

# 1

## Static Web Hosting

**Amazon S3** hosts static web resources including HTML, CSS, JavaScript, and image files which are loaded in the user's browser.

HTML, CSS, JavaScript, etc.

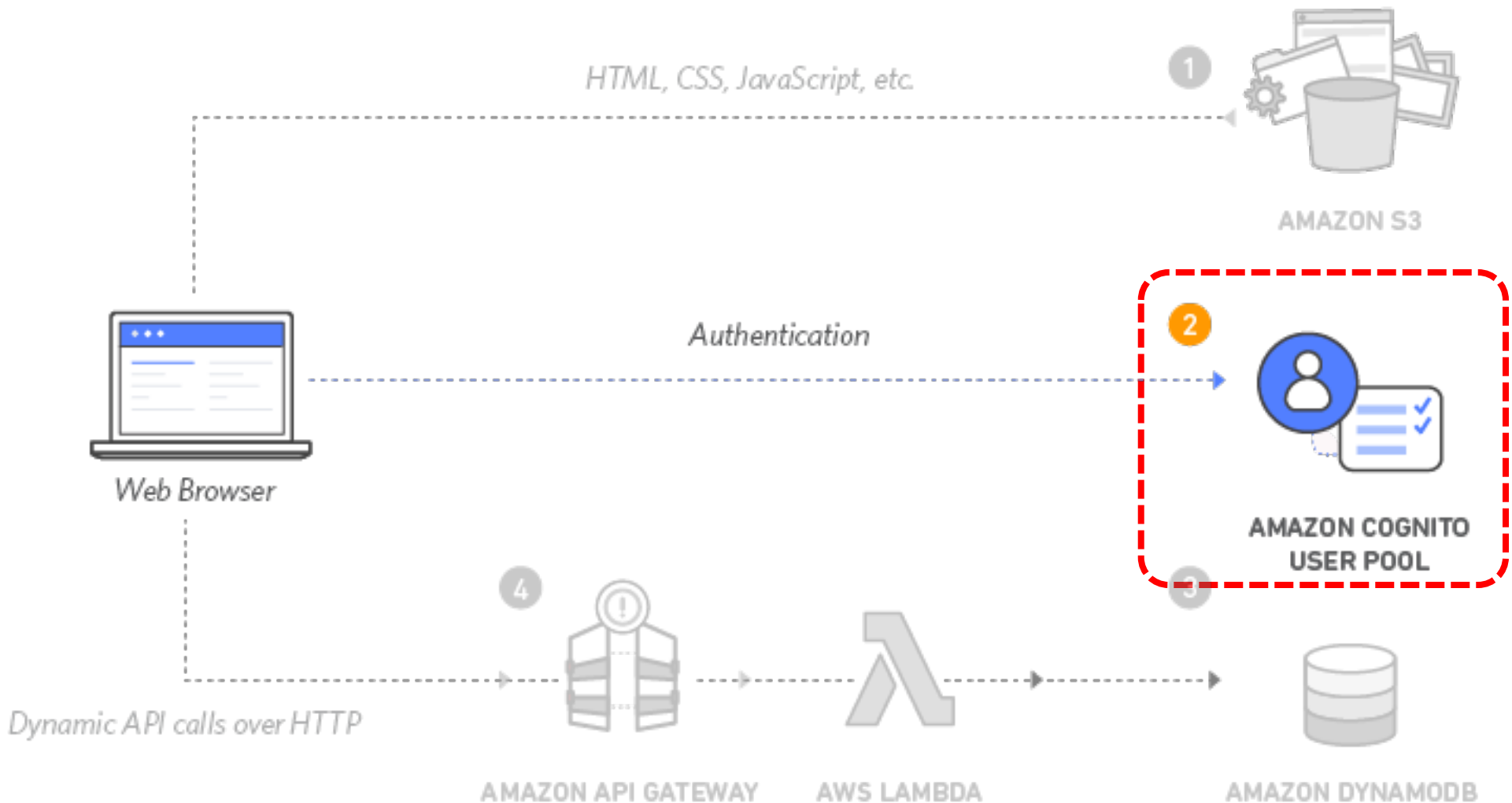




# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

2





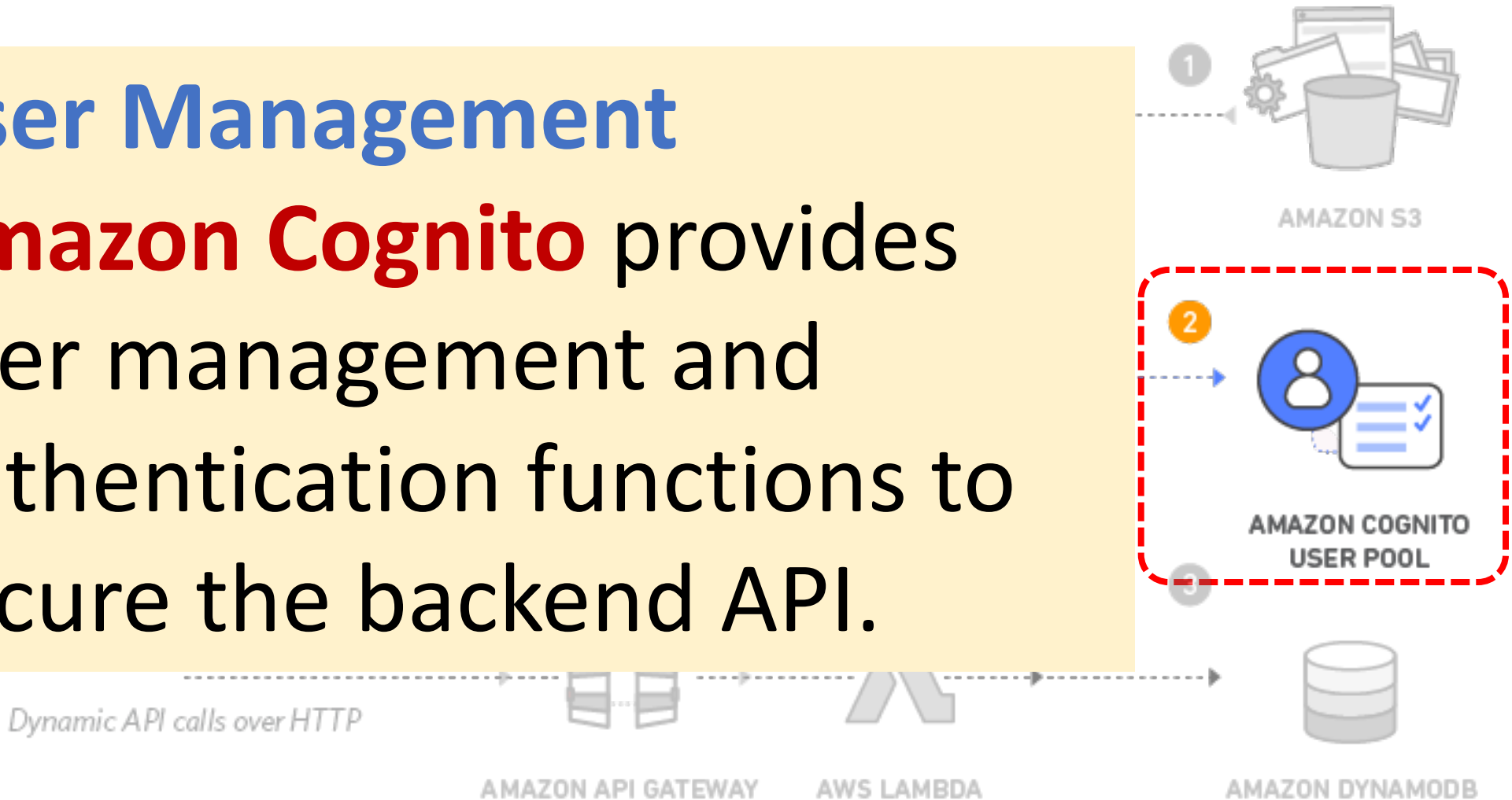
# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

## 2

## User Management

**Amazon Cognito** provides user management and authentication functions to secure the backend API.



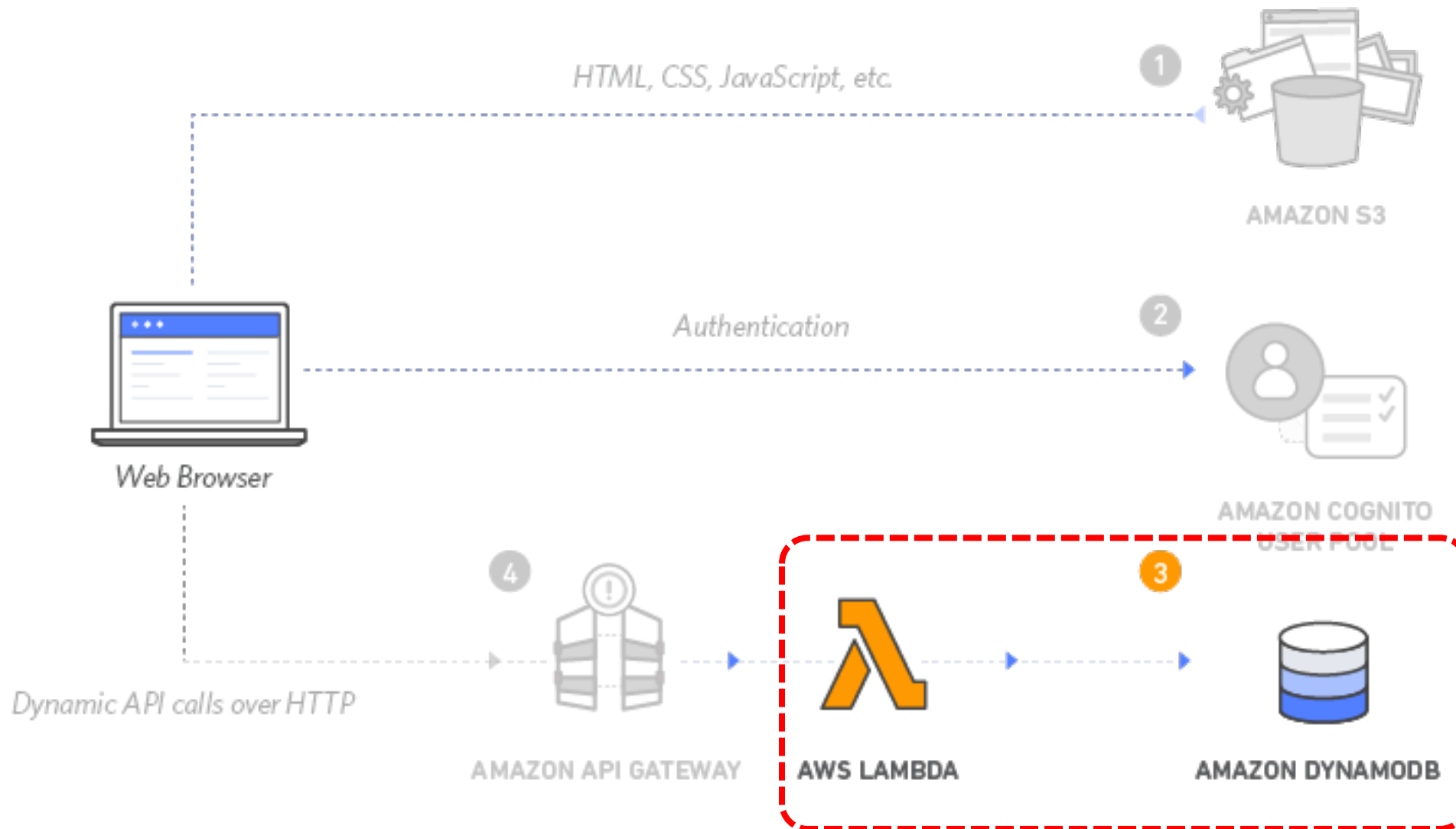




# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

3





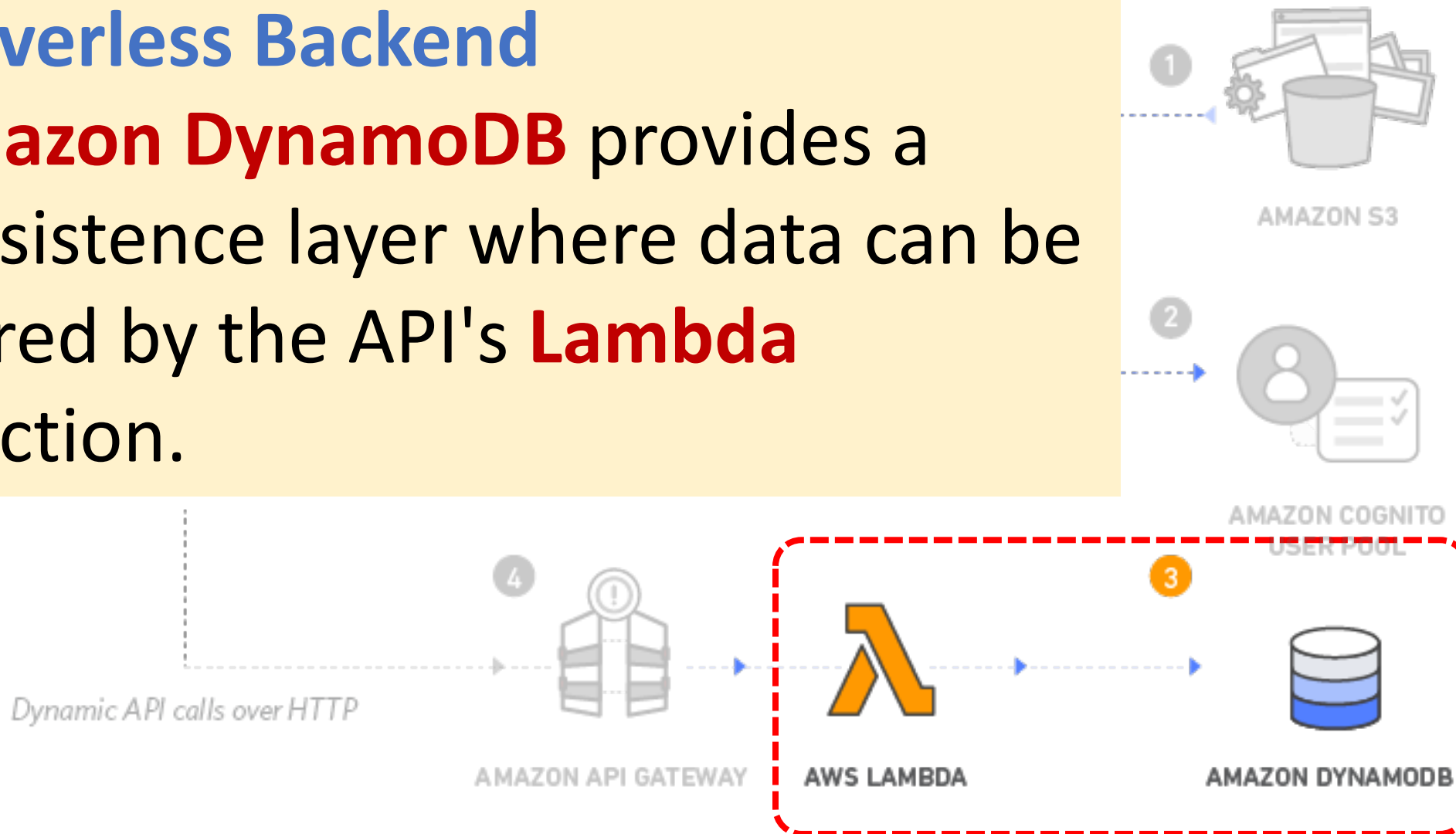
# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

## 3

### Serverless Backend

**Amazon DynamoDB** provides a persistence layer where data can be stored by the API's **Lambda** function.

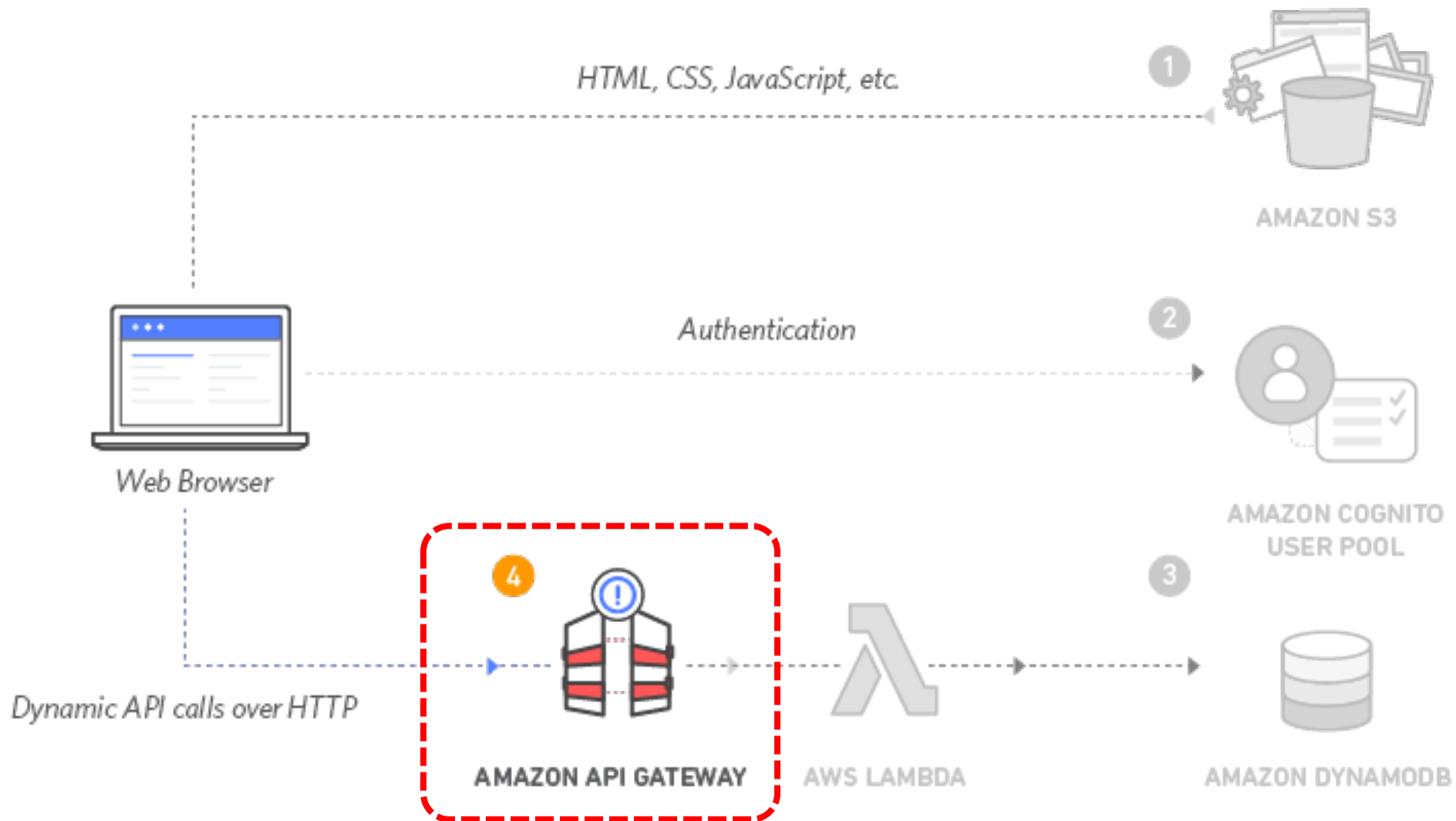




# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

4





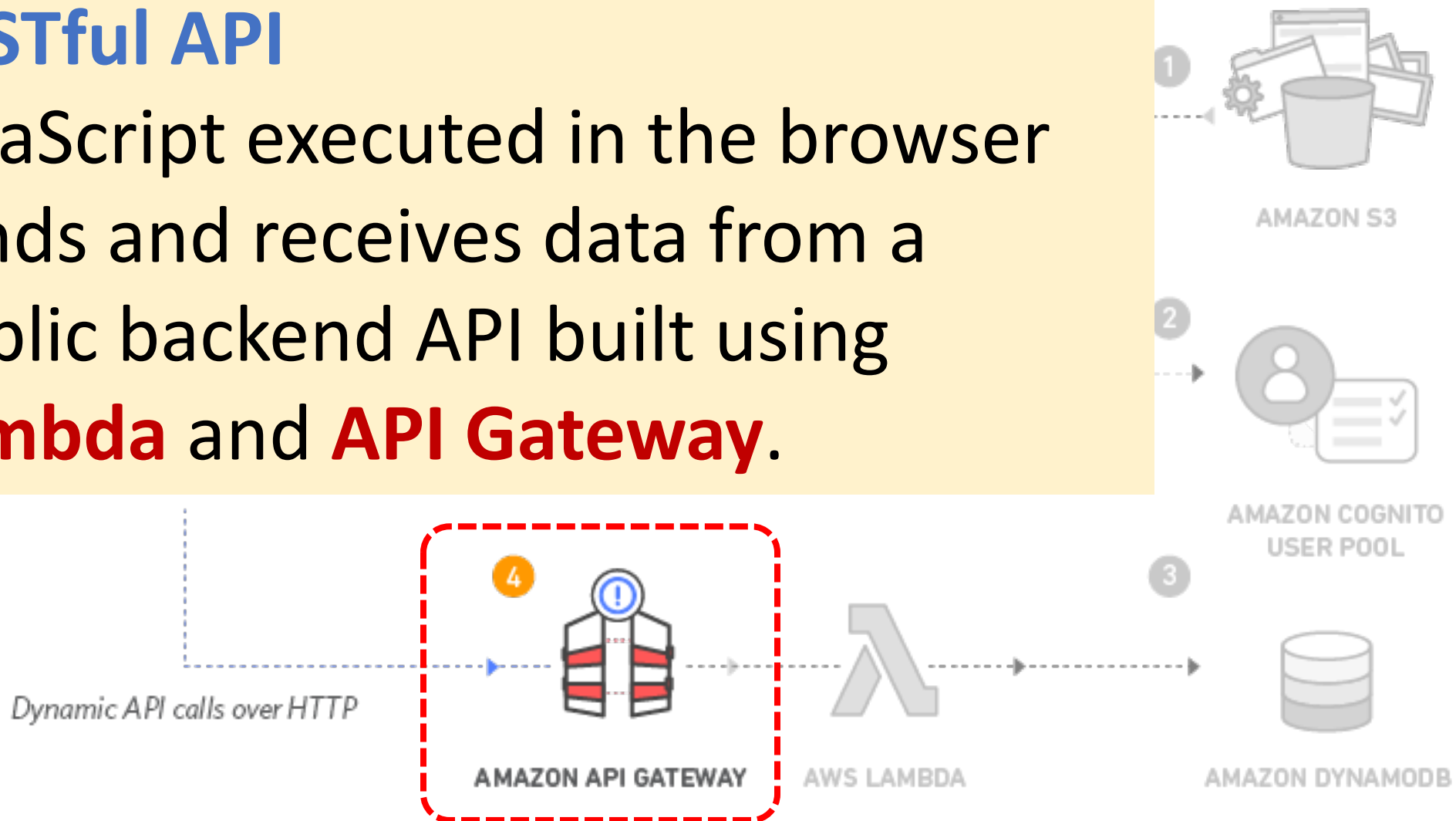
# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito

## 4

### RESTful API

JavaScript executed in the browser sends and receives data from a public backend API built using **Lambda** and **API Gateway**.





# Build a Serverless Web Application

with Amazon S3, AWS Lambda, Amazon API Gateway,  
Amazon DynamoDB, and Amazon Cognito

## 5 Terminate resources

### Resource Cleanup

You will terminate an **Amazon S3** bucket, an **Amazon Cognito** User Pool, an **AWS Lambda** function, an **IAM** role, a **DynamoDB** table, a **REST API**, and a **CloudWatch** Log.

It is a best practice to **delete resources** you are no longer using to avoid unwanted charges.

# Summary

- **Cloud Computing and Cloud Software Architecture**
- **AWS Certified Cloud Practitioner (CLF-C01)**
- **AWS Certified Solutions Architect – Associate (SAA-C02)**
- **Web Application with AWS Core Services**
- **AWS Serverless Architecture**
- **Build a Serverless Web Application with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito**

# References

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  - <https://aws.amazon.com/certification/certified-cloud-practitioner/>
- **AWS Certified Solutions Architect – Associate**
  - <https://aws.amazon.com/certification/certified-solutions-architect-associate/>
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