

軟體工程

(Software Engineering)

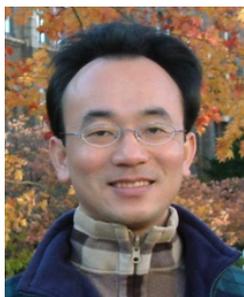
雲端運算與雲軟體架構

(Cloud Computing and Cloud Software Architecture)

1091SE07

MBA, IM, NTPU (M5118) (Fall 2020)

Tue 2, 3, 4 (9:10-12:00) (B8F40)



Min-Yuh Day

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Associate Professor

副教授

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國立臺北大學 資訊管理研究所

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

2020-11-03



課程大綱 (Syllabus)

週次 (Week)	日期 (Date)	內容 (Subject/Topics)
1	2020/09/15	軟體工程概論 (Introduction to Software Engineering)
2	2020/09/22	軟體產品與專案管理：軟體產品管理，原型設計 (Software Products and Project Management: Software product management and prototyping)
3	2020/09/29	敏捷軟體工程：敏捷方法、Scrum、極限程式設計 (Agile Software Engineering: Agile methods, Scrum, and Extreme Programming)
4	2020/10/06	功能、場景和故事 (Features, Scenarios, and Stories)
5	2020/10/13	軟體架構：架構設計、系統分解、分散式架構 (Software Architecture: Architectural design, System decomposition, and Distribution architecture)
6	2020/10/20	軟體工程個案研究 I (Case Study on Software Engineering I)

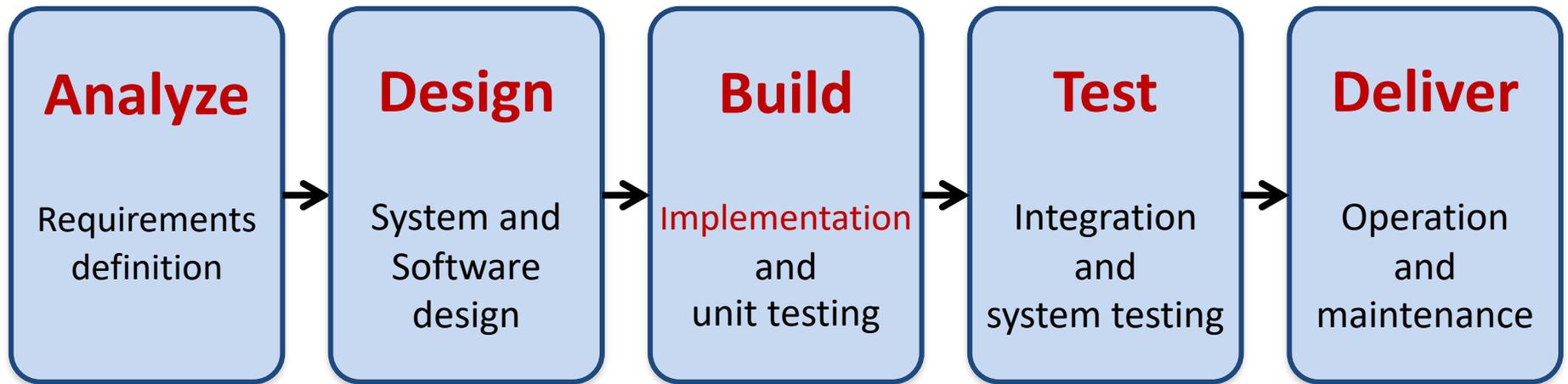
課程大綱 (Syllabus)

- | 週次 (Week) | 日期 (Date) | 內容 (Subject/Topics) |
|-----------|------------|--|
| 7 | 2020/10/27 | 基於雲的軟體：虛擬化和容器、軟體即服務
(Cloud-Based Software: Virtualization and containers, Everything as a service, Software as a service) |
| 8 | 2020/11/03 | 雲端運算與雲軟體架構
(Cloud Computing and Cloud Software Architecture) |
| 9 | 2020/11/10 | 期中報告 (Midterm Project Report) |
| 10 | 2020/11/17 | 微服務架構：RESTful服務、服務部署
(Microservices Architecture, RESTful services, Service deployment) |
| 11 | 2020/11/24 | 軟體工程產業實務
(Industry Practices of Software Engineering) |
| 12 | 2020/12/01 | 安全和隱私 (Security and Privacy) |

課程大綱 (Syllabus)

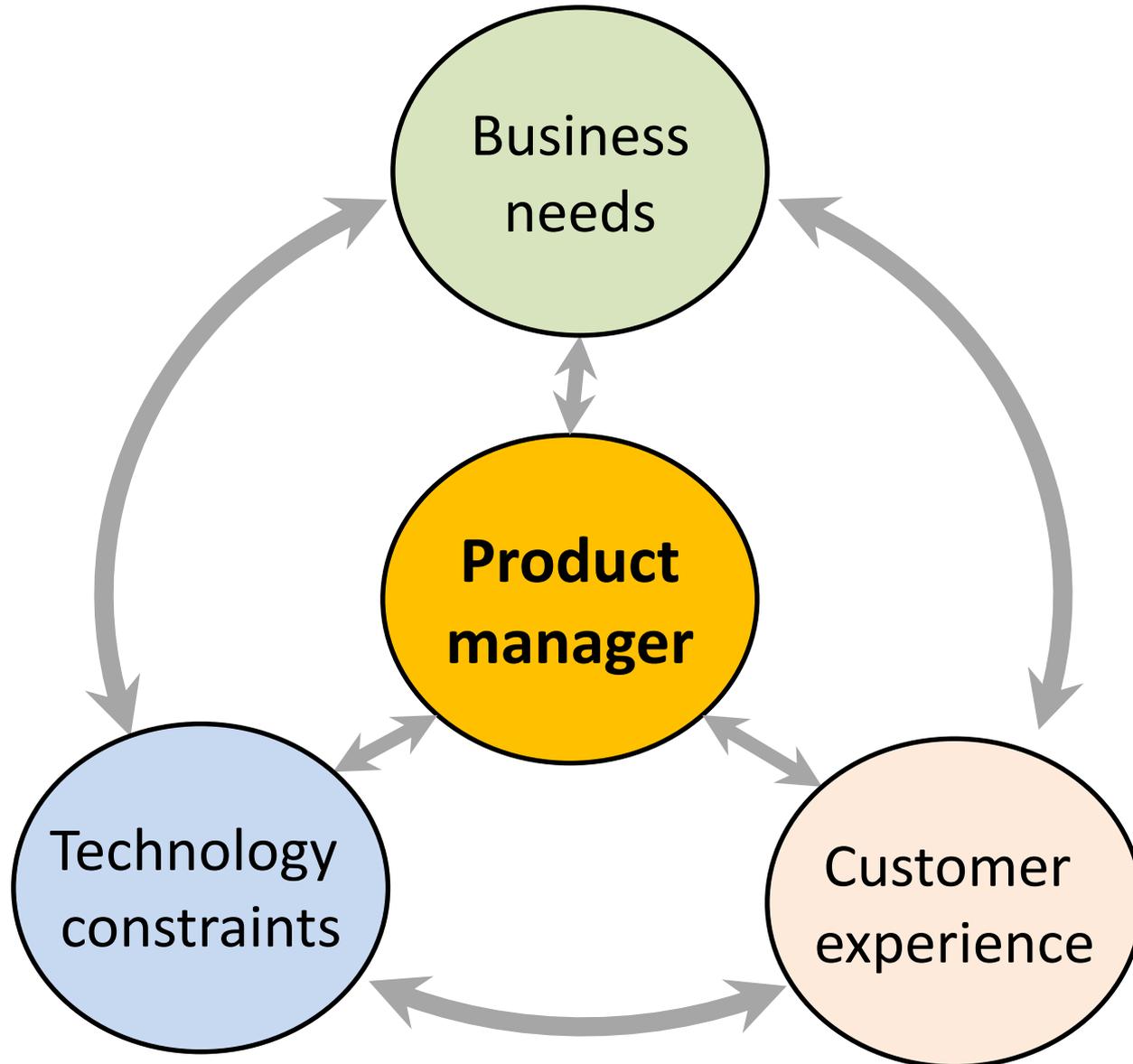
週次 (Week)	日期 (Date)	內容 (Subject/Topics)
13	2020/12/08	軟體工程個案研究 II (Case Study on Software Engineering II)
14	2020/12/15	可靠的程式設計 (Reliable Programming)
15	2020/12/22	測試：功能測試、測試自動化、 測試驅動的開發、程式碼審查 (Testing: Functional testing, Test automation, Test-driven development, and Code reviews)
16	2020/12/29	DevOps和程式碼管理： 程式碼管理和DevOps自動化 (DevOps and Code Management: Code management and DevOps automation)
17	2021/01/05	期末報告 I (Final Project Report I)
18	2021/01/12	期末報告 II (Final Project Report I)

Software Engineering and Project Management

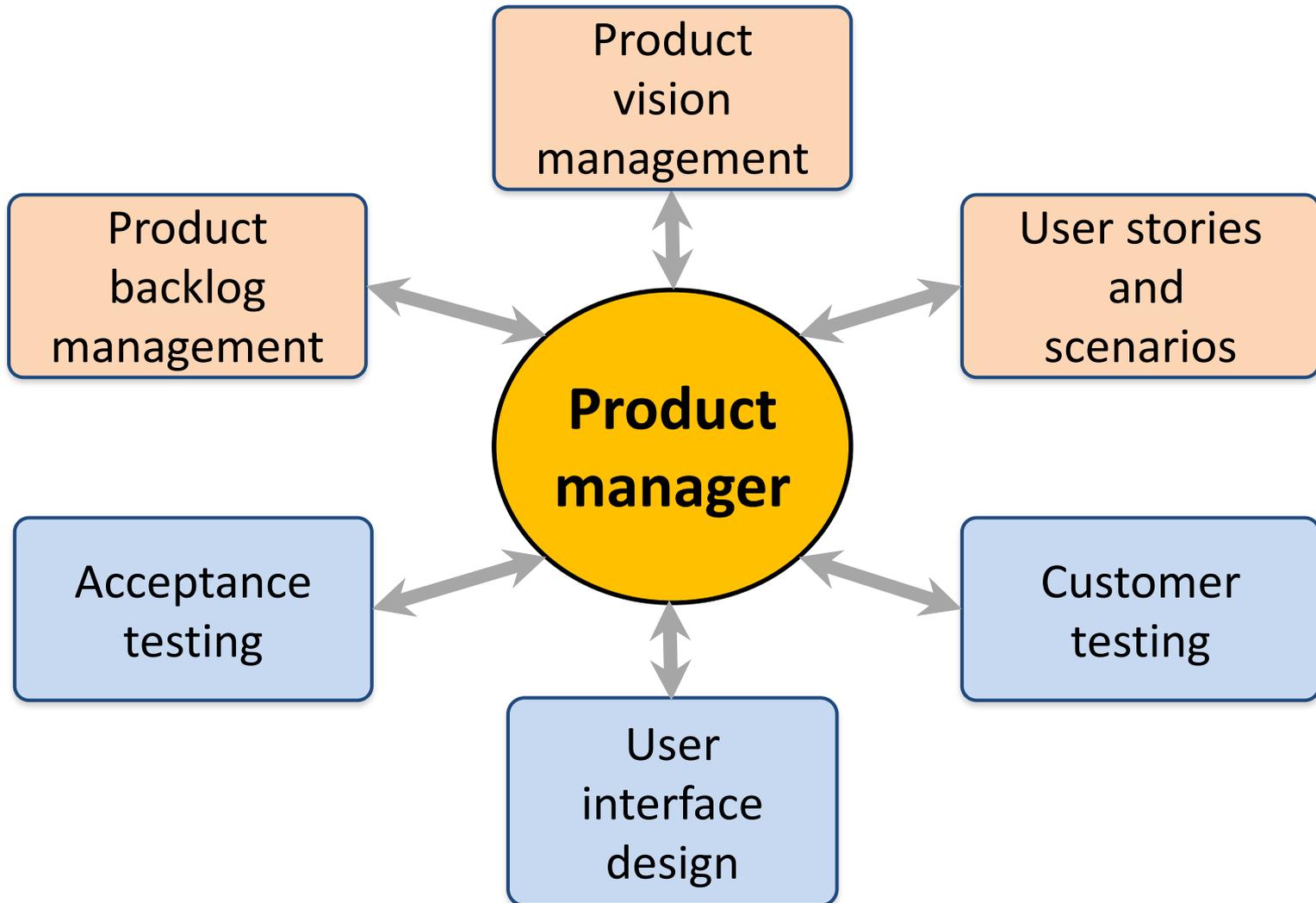


Project Management

Product management concerns

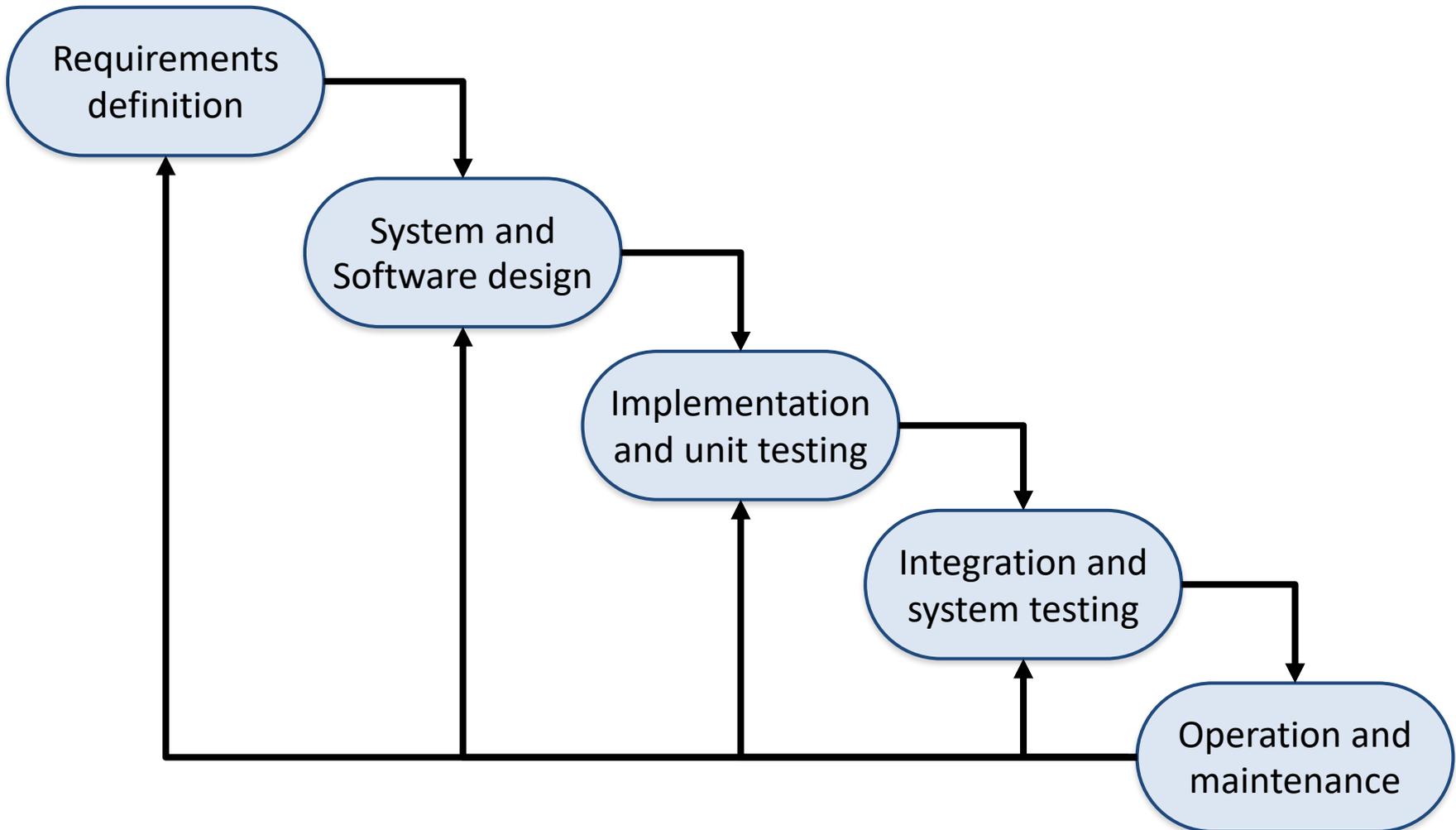


Technical interactions of product managers



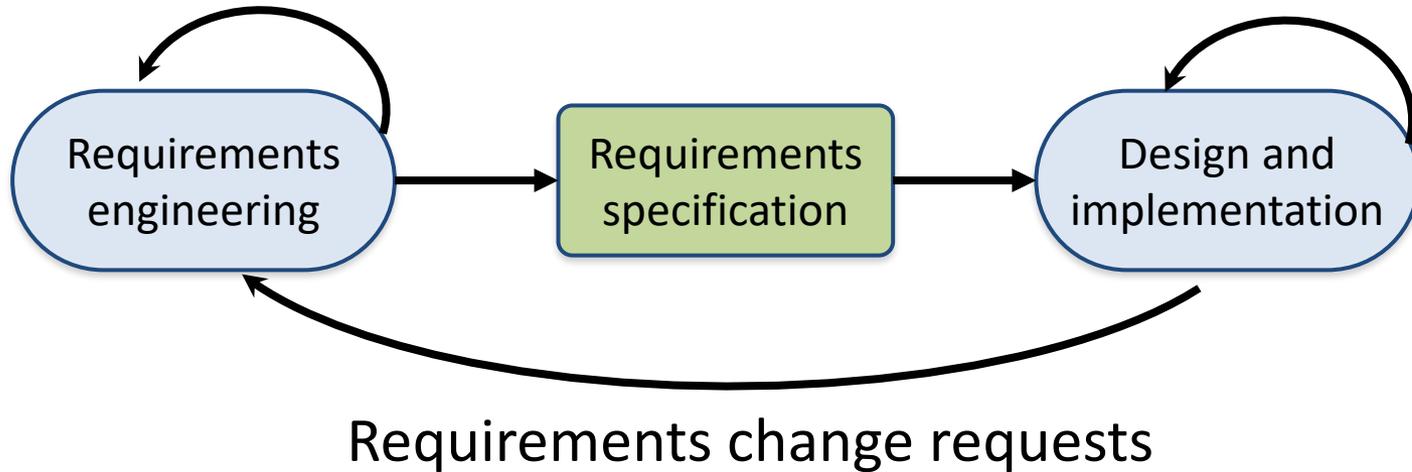
Software Development Life Cycle (SDLC)

The waterfall model

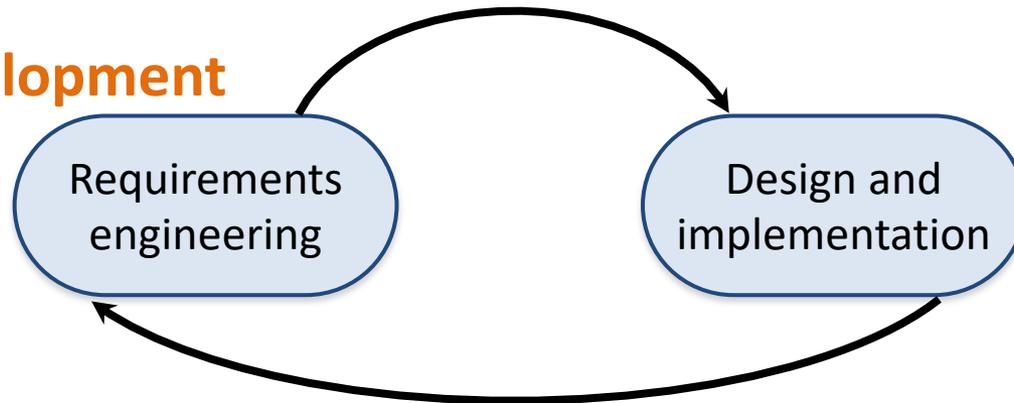


Plan-based and Agile development

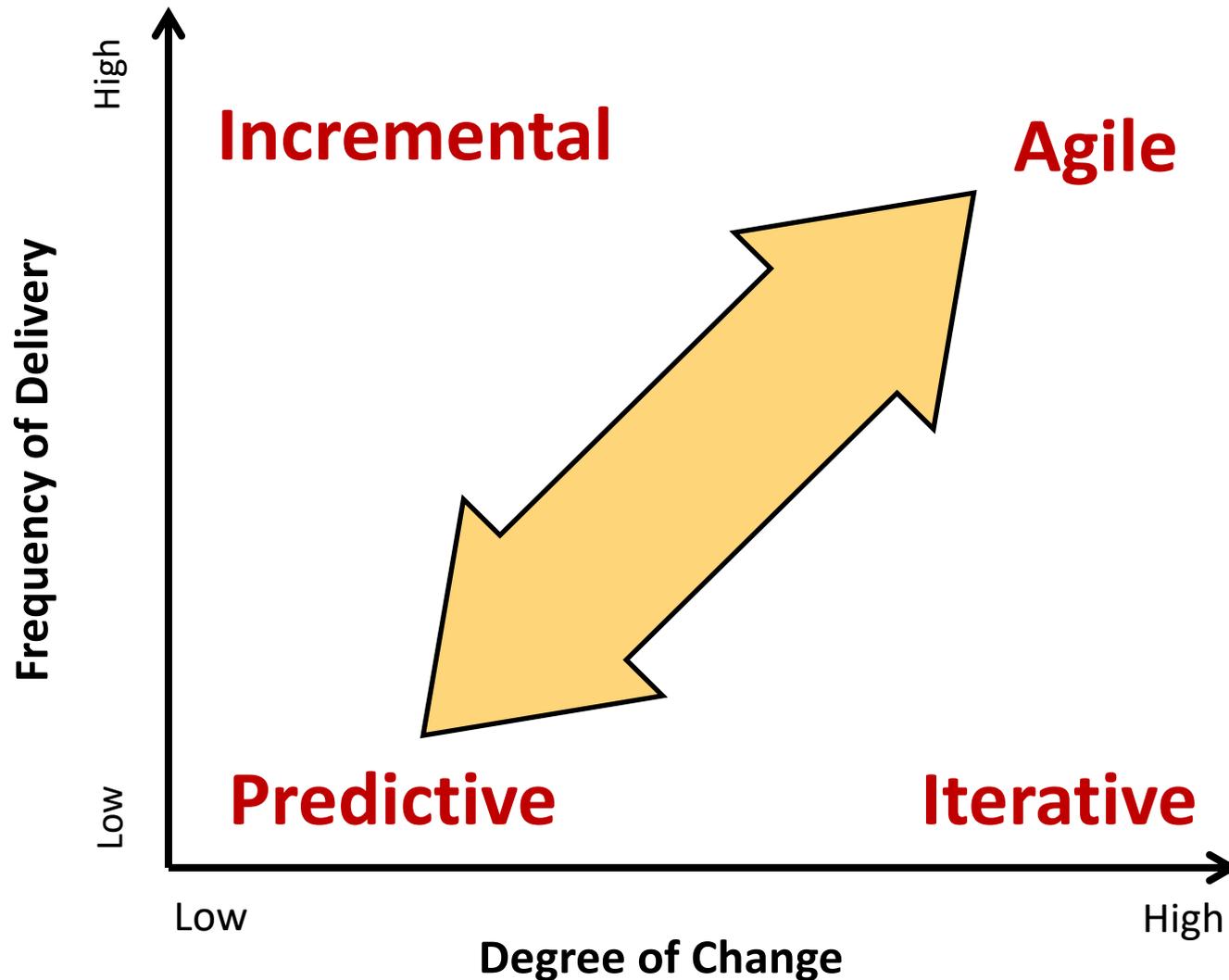
Plan-based development



Agile development



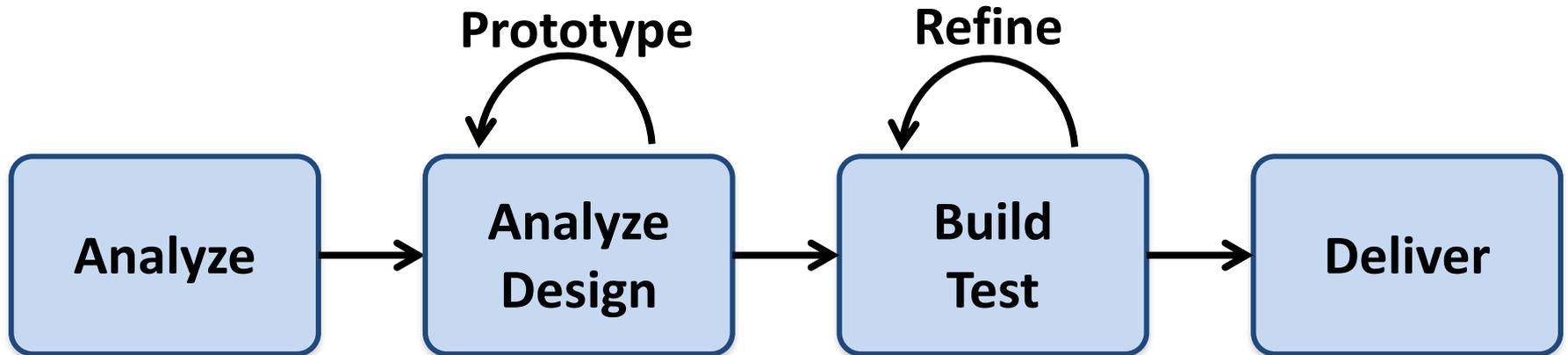
The Continuum of Life Cycles



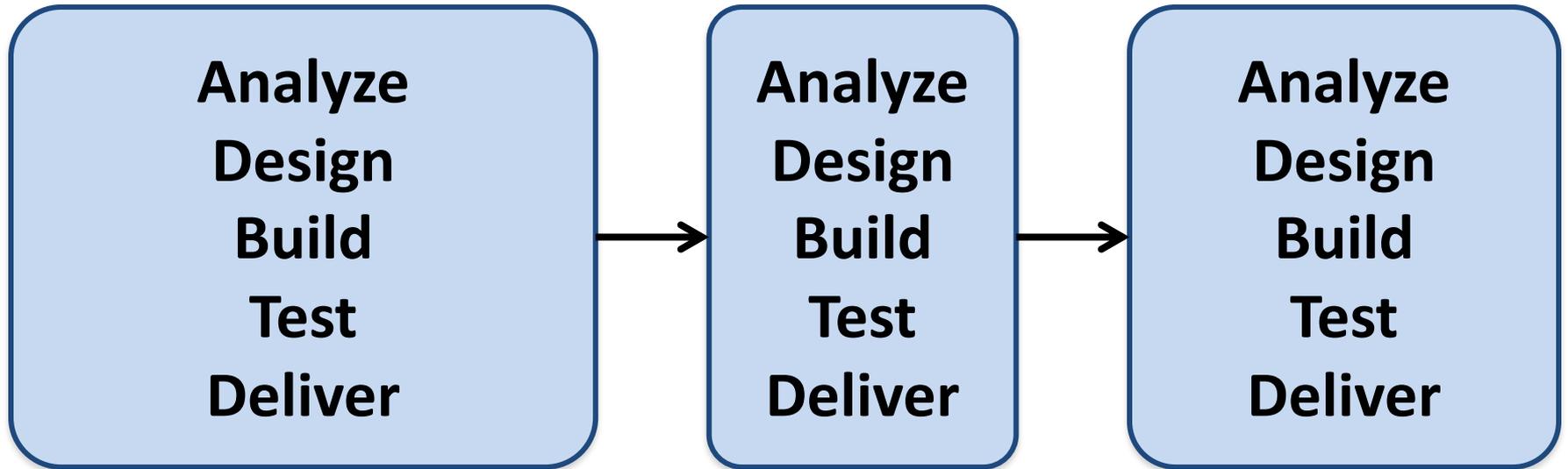
Predictive Life Cycle



Iterative Life Cycle

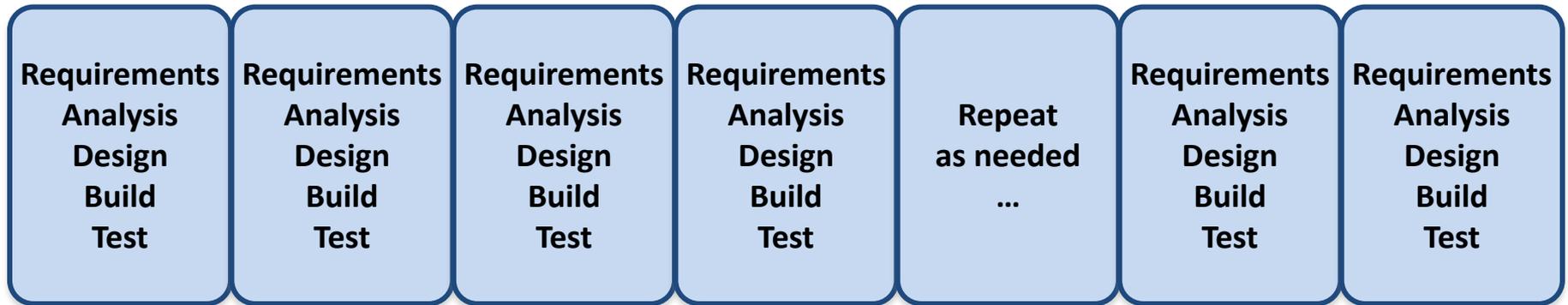


A Life Cycle of Varying-Sized Increments

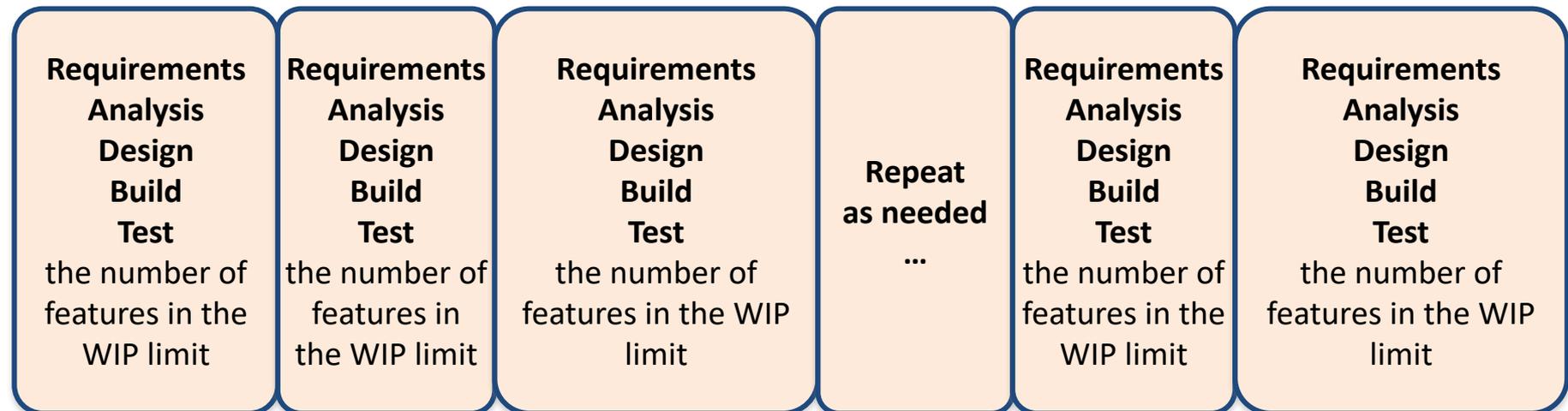


Iteration-Based and Flow-Based Agile Life Cycles

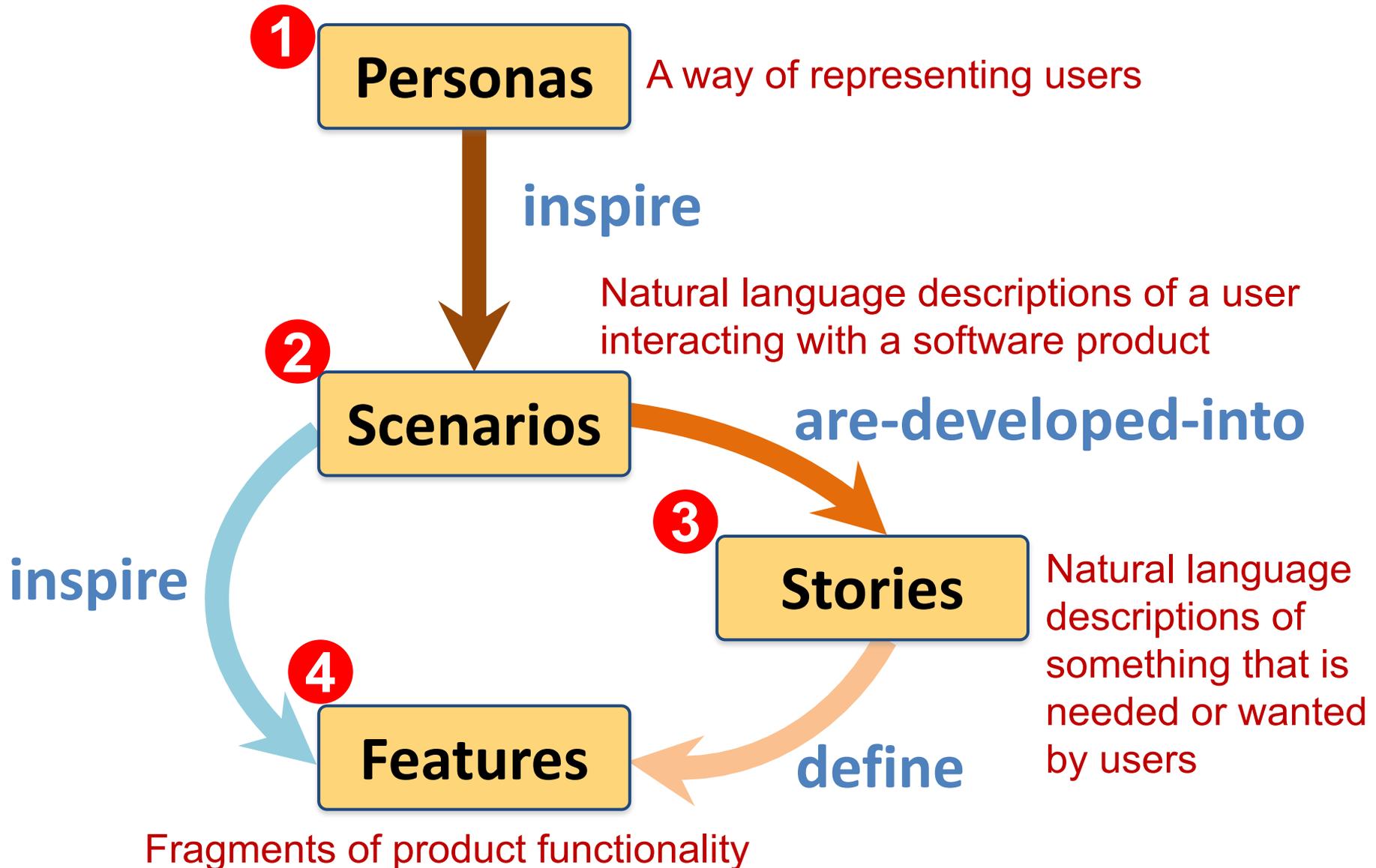
Iteration-Based Agile



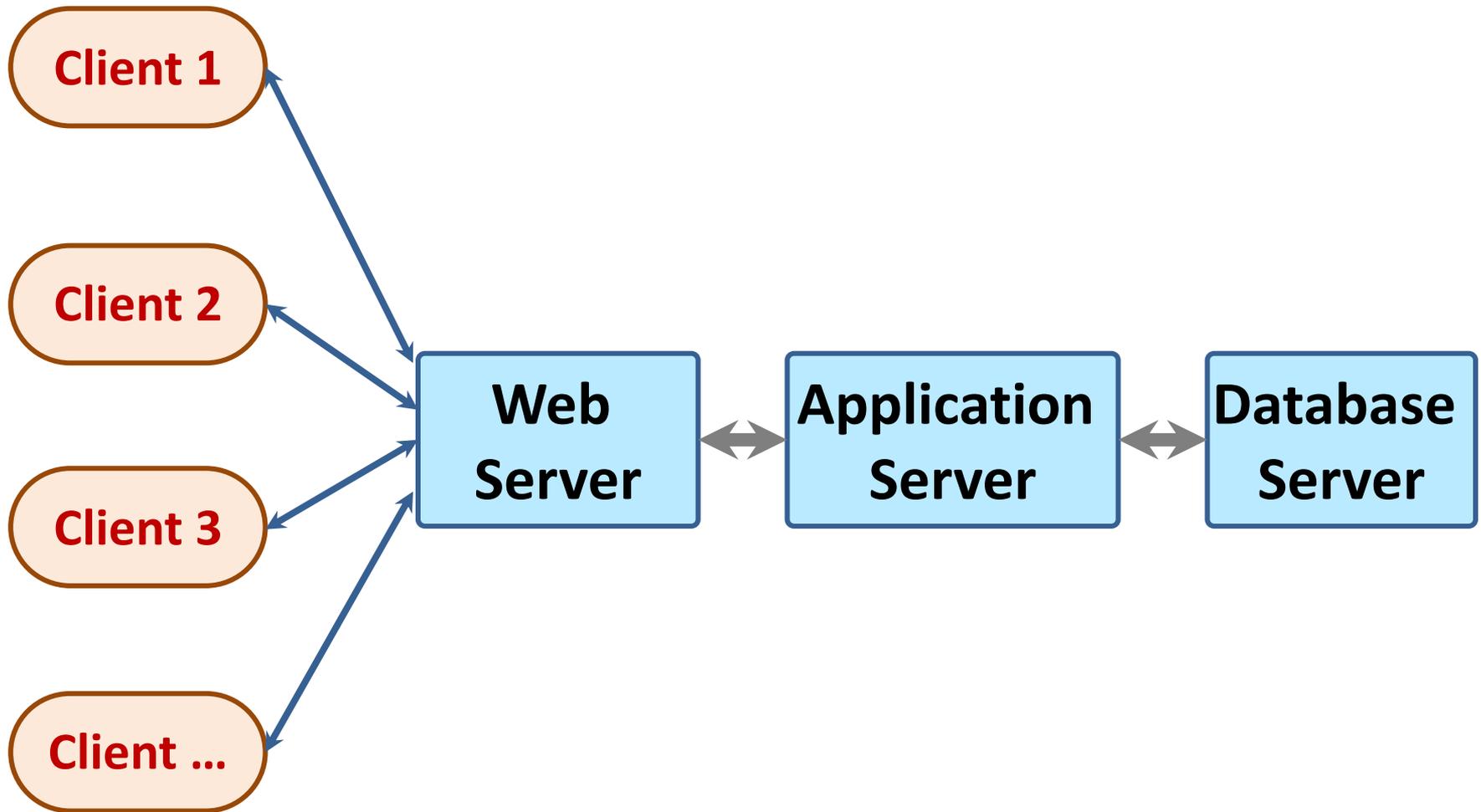
Flow-Based Agile



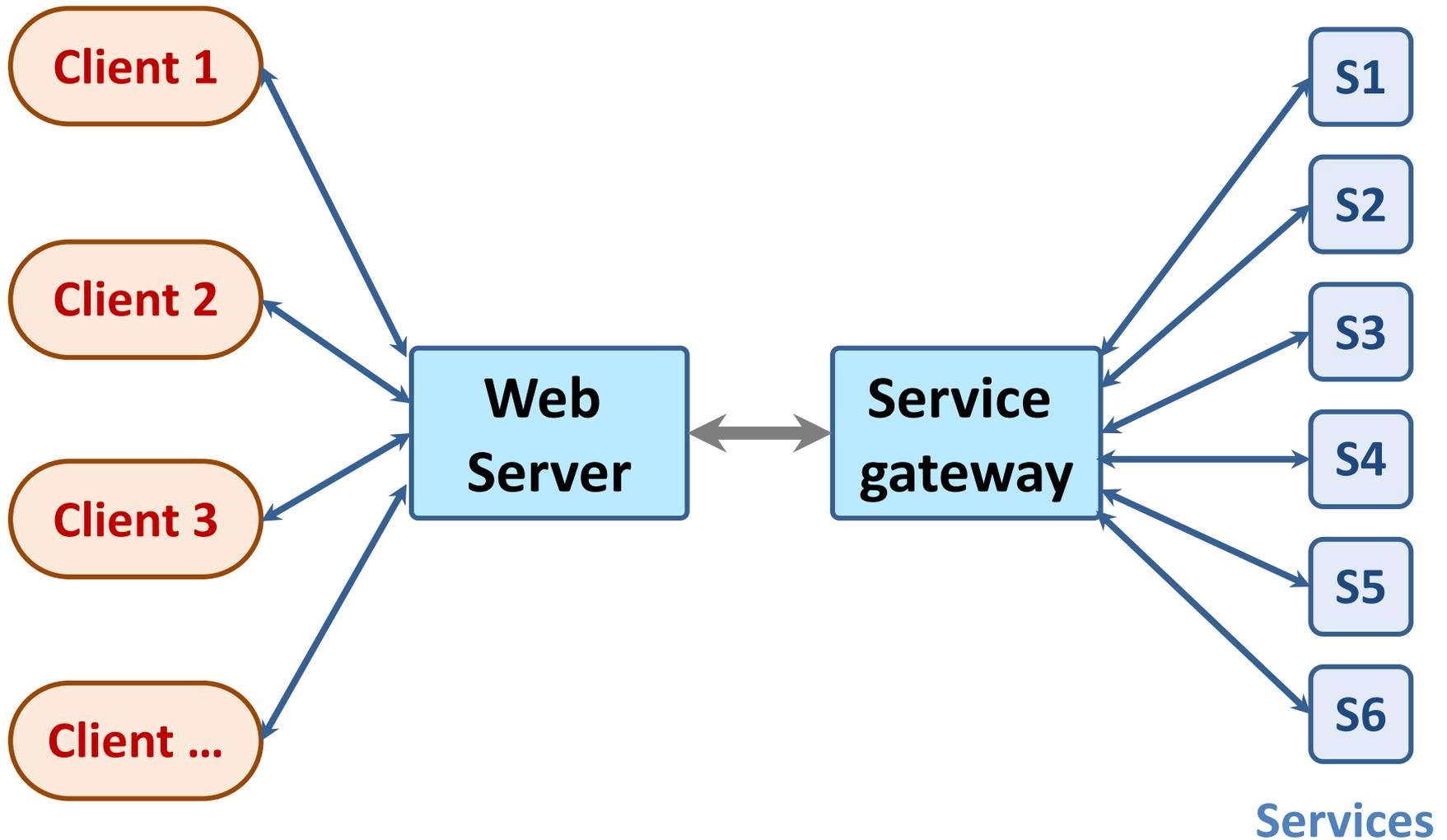
From personas to features



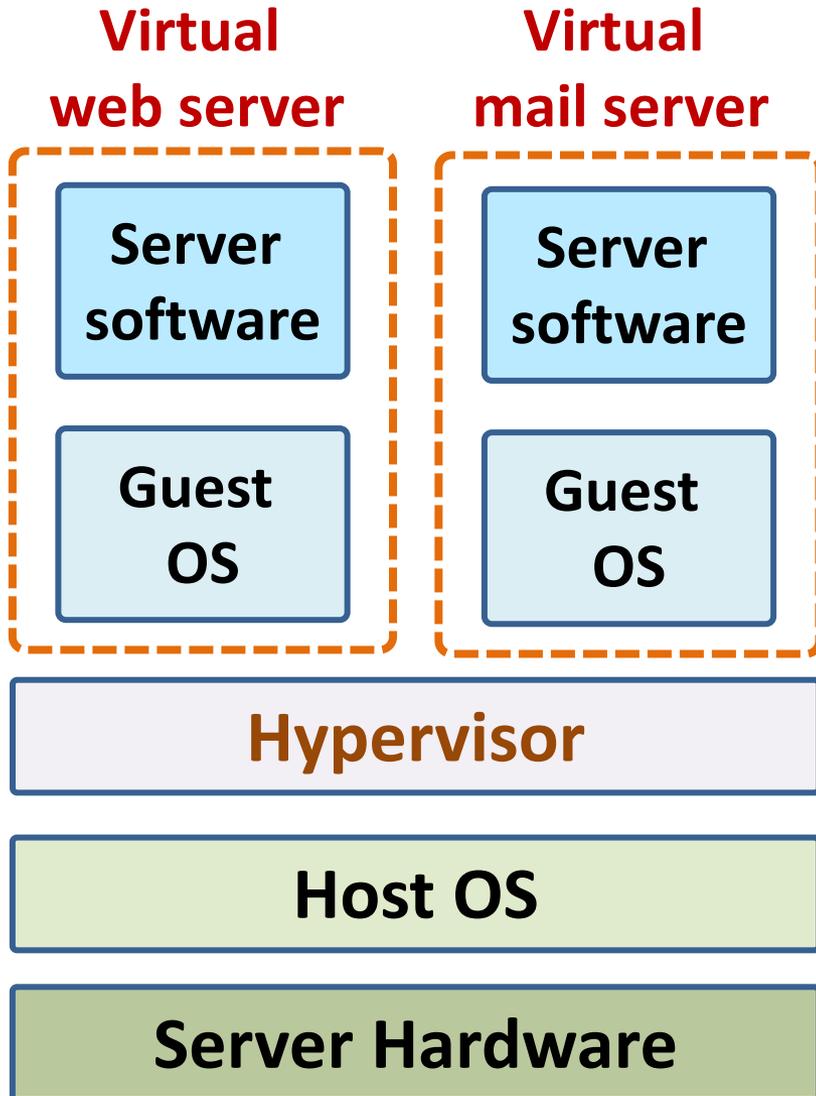
Multi-tier client-server architecture



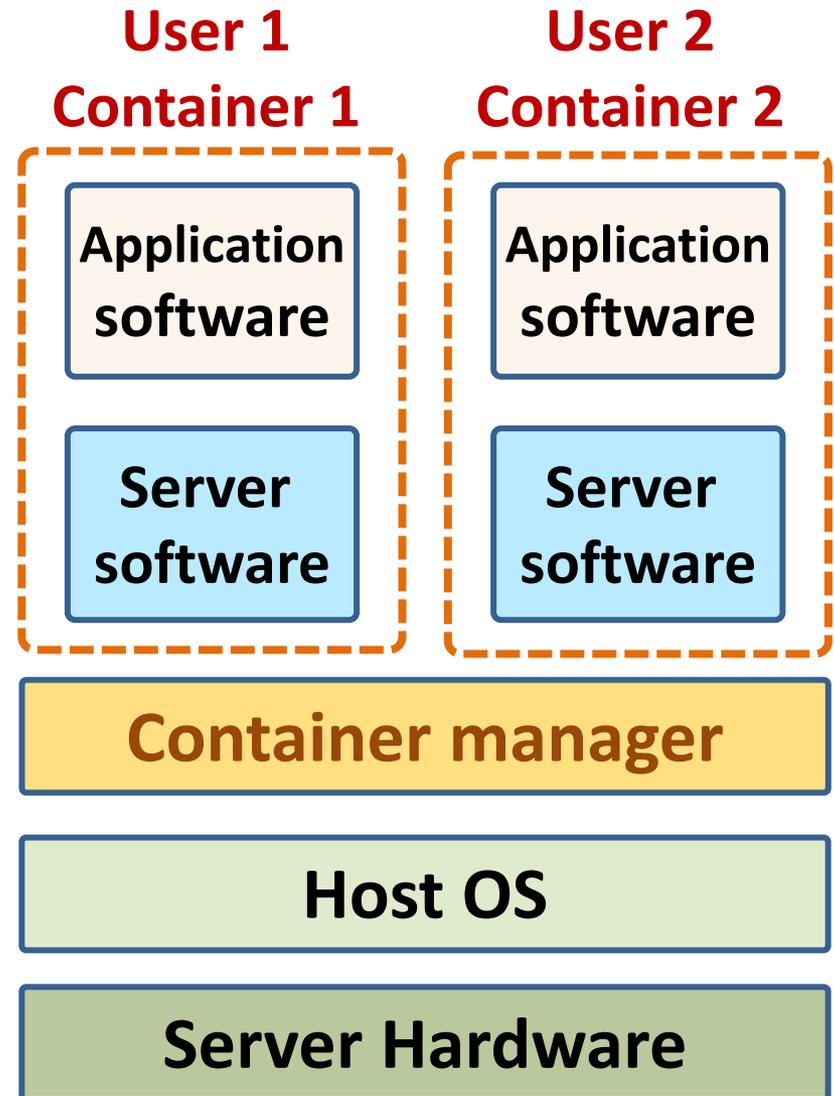
Service-oriented Architecture



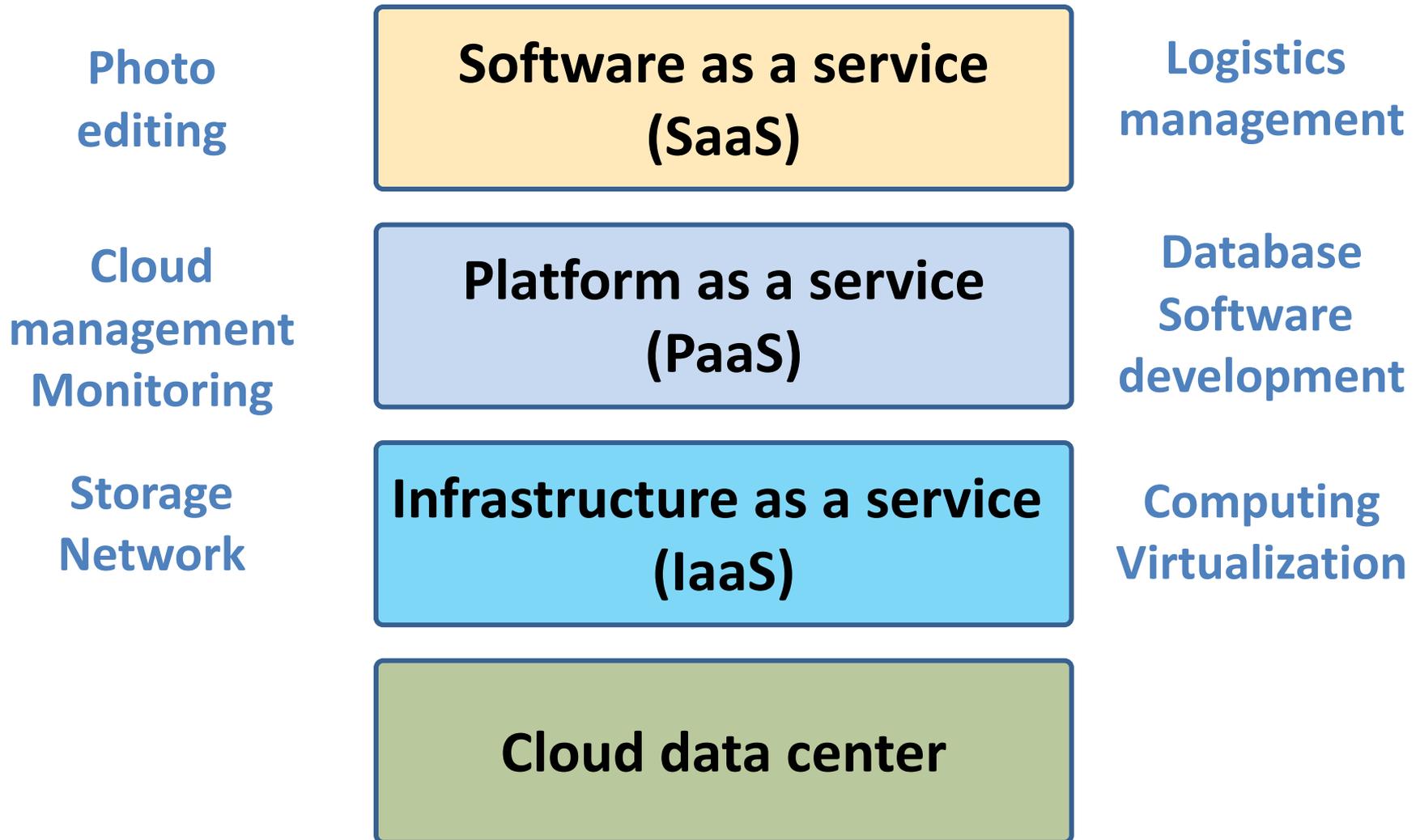
VM



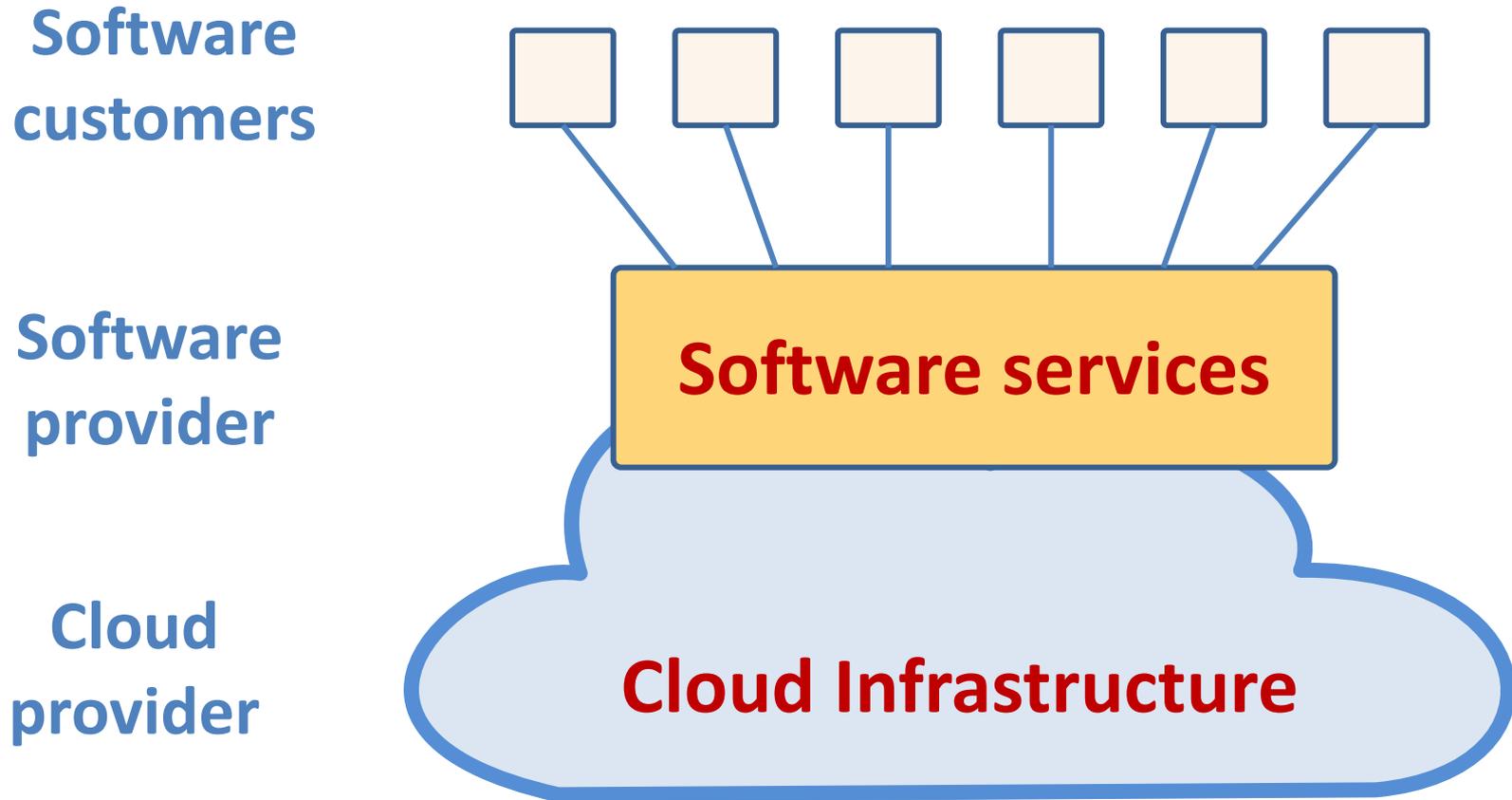
Container



Everything as a service



Software as a service



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

Available AWS Certifications

aws certified
Updated May 2019

Professional

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



Specialty

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

Associate

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



SAA

Foundational

Six months of fundamental AWS Cloud and industry knowledge

Cloud Practitioner



CLF

AWS Certifications



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.



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/>



AWS Certified Cloud Practitioner (CLF-C01)



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

AWS Certified Solutions Architect – Associate (SAA-C02)



Domain	% of Examination
Domain 1: Design Resilient Architectures	30%
Domain 2: Design High-Performing Architectures	28%
Domain 3: Specify Secure Applications and Architectures	24%
Domain 4: Design Cost-Optimized 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 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 Elastic Container Service

Run and manage docker containers

AWS Batch

Run batch jobs at any scale

AWS Lambda

Run code without thinking about servers

AWS Wavelength

Deliver ultra-low latency applications for 5G devices

Amazon EC2 Auto Scaling

Scale compute capacity to meet demand

Amazon Elastic Kubernetes Service

Run managed Kubernetes on AWS

AWS Elastic Beanstalk

Run and manage web apps

AWS Outposts

Run AWS infrastructure on-premises

VMware Cloud on AWS

Build a hybrid cloud without custom hardware

Amazon Elastic Container Registry

Store and retrieve docker images

Amazon Lightsail

Launch and manage virtual private servers

AWS Fargate

Run containers without managing servers or clusters

AWS Serverless Application Repository

Discover, deploy, and publish serverless applications



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



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

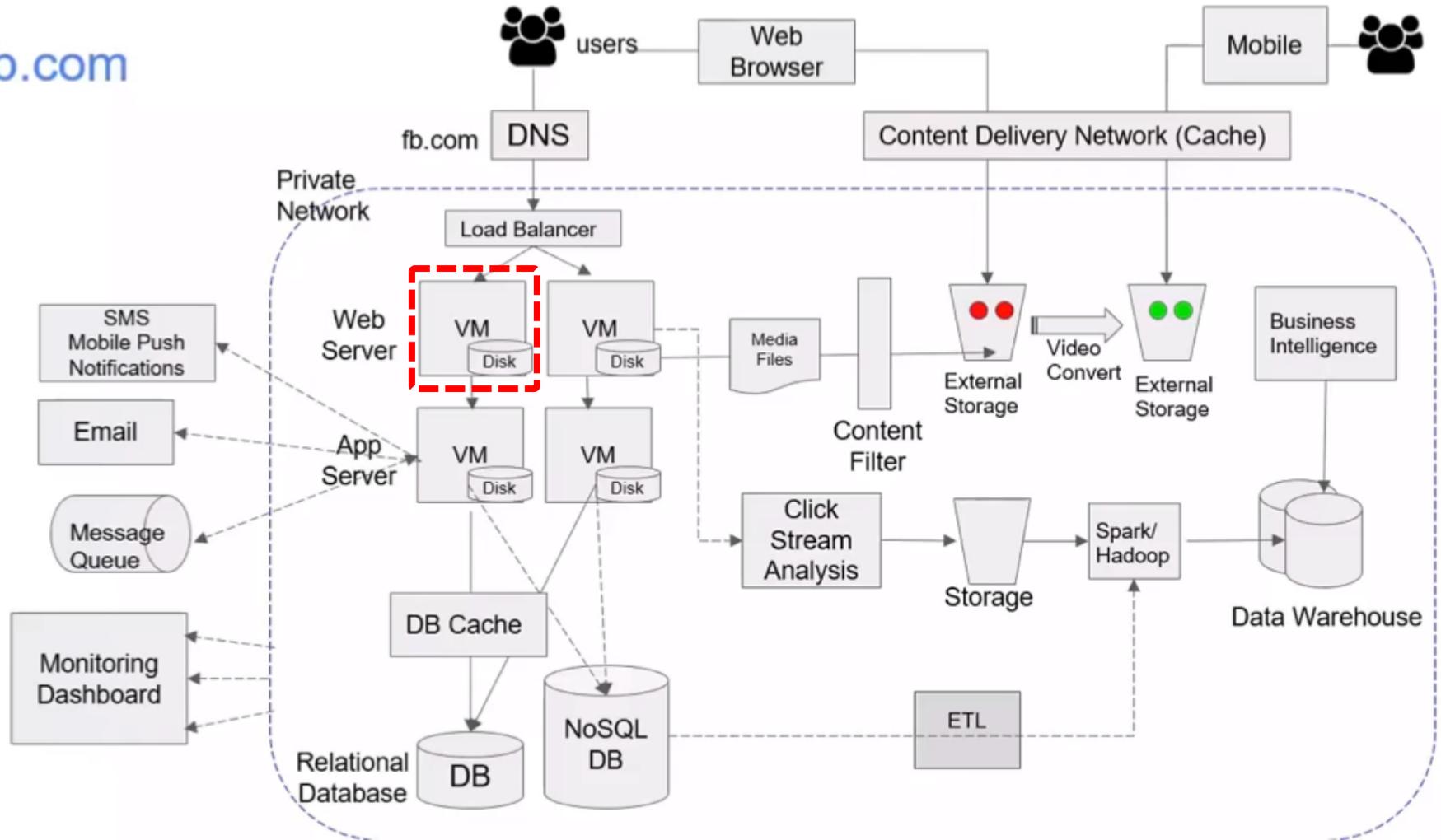
- **AWS Lambda**
 - Run code without thinking about servers
- **AWS Elastic Beanstalk**
 - Run and manage web apps
- **Amazon VPC**
 - Isolated cloud resources
- **Amazon Lightsail**
 - Launch and manage virtual private servers
- **Amazon SageMaker**
 - Build, train, and deploy machine learning models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



Web Application with AWS Core Services

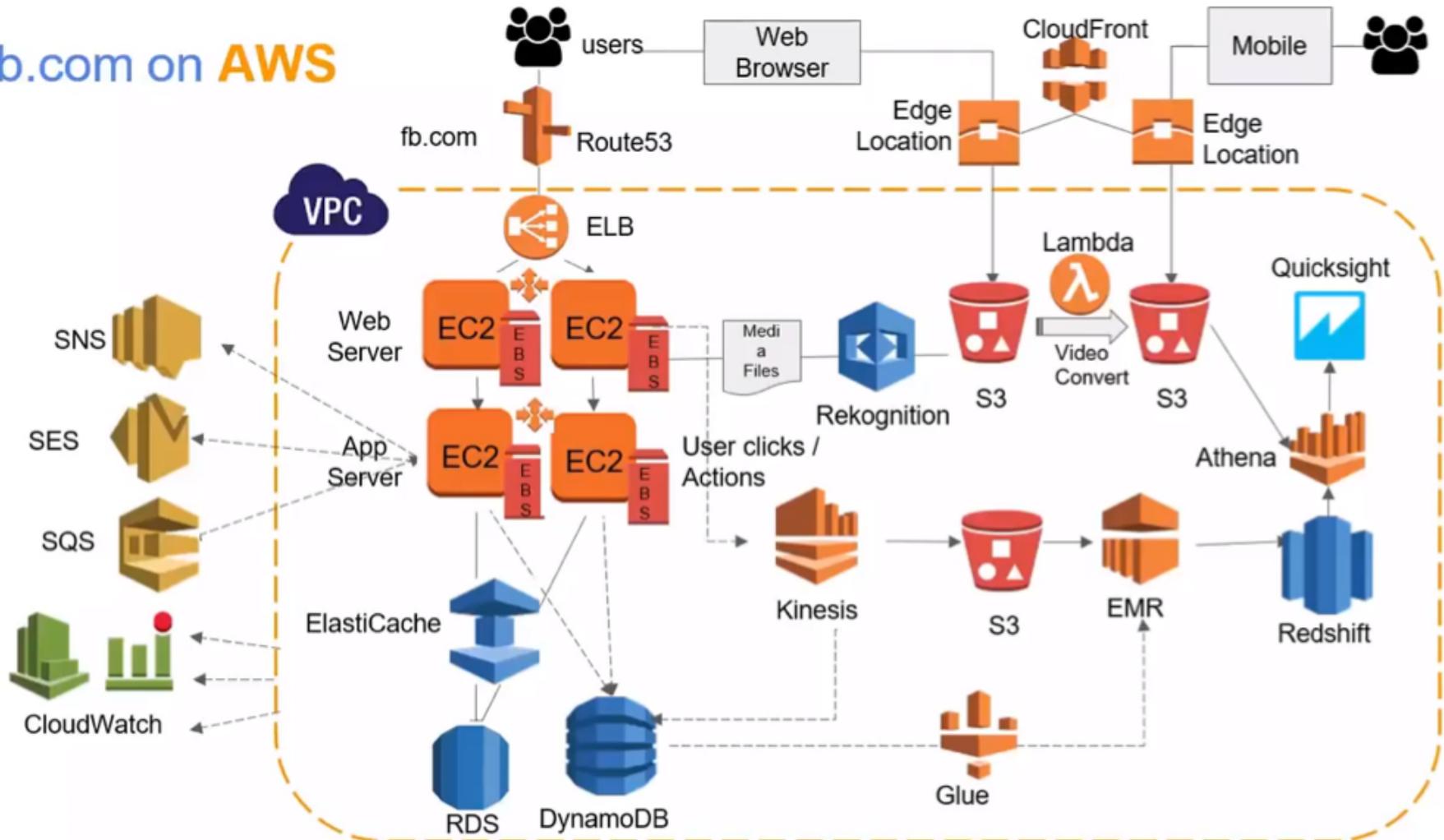
Software Architecture

fb.com



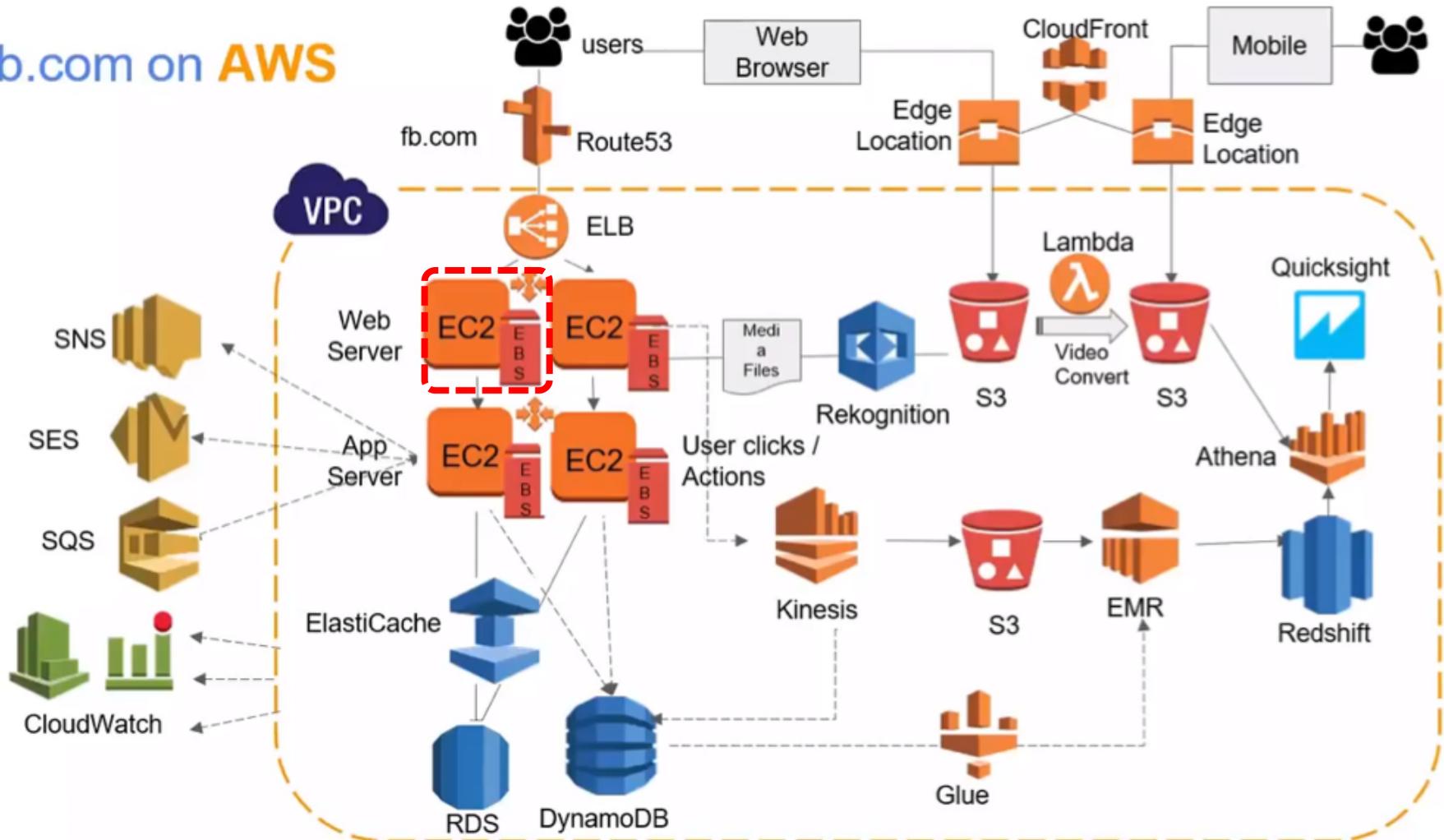
Cloud Software Architecture

fb.com on AWS



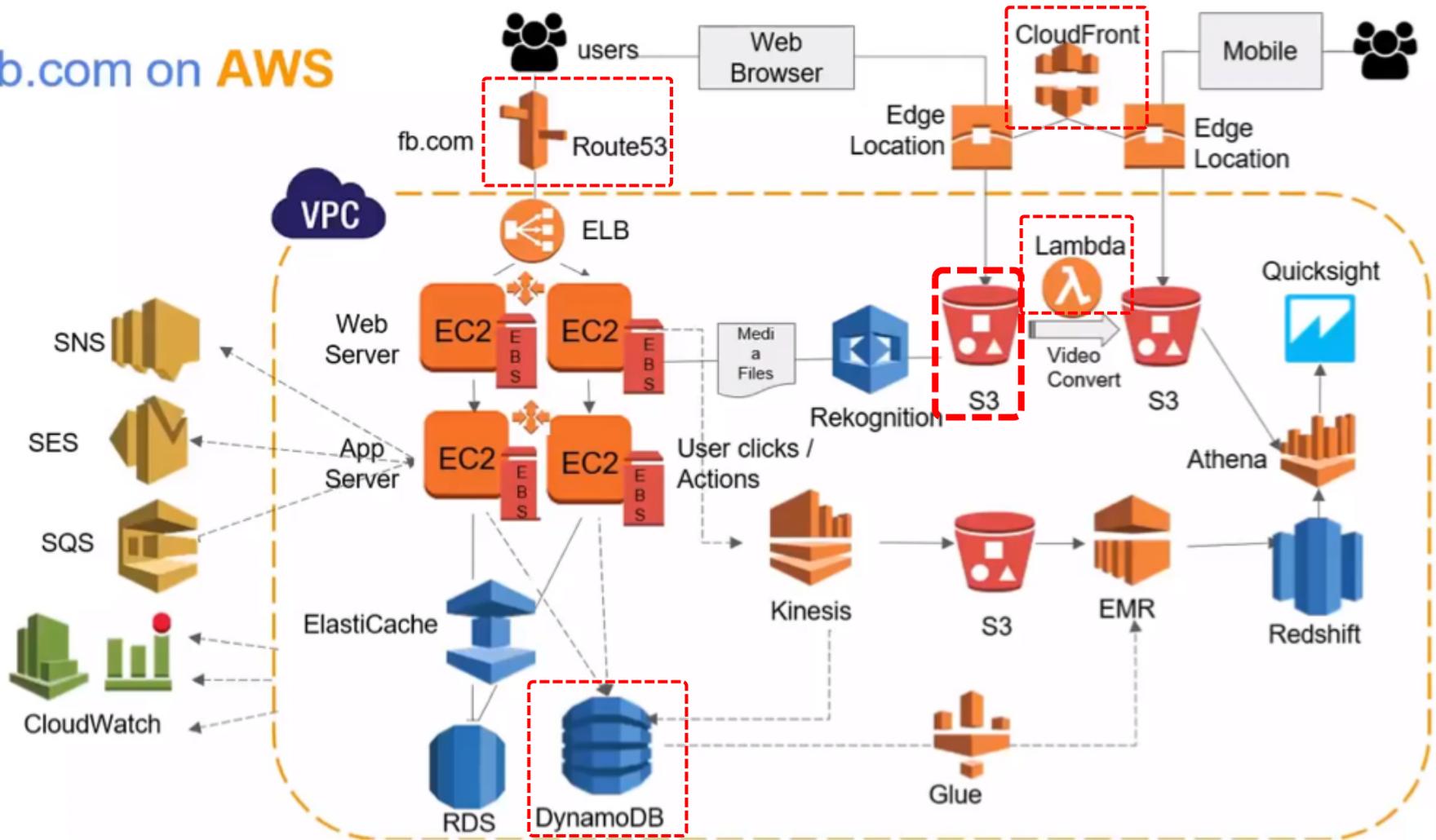
Cloud Software Architecture

fb.com on AWS



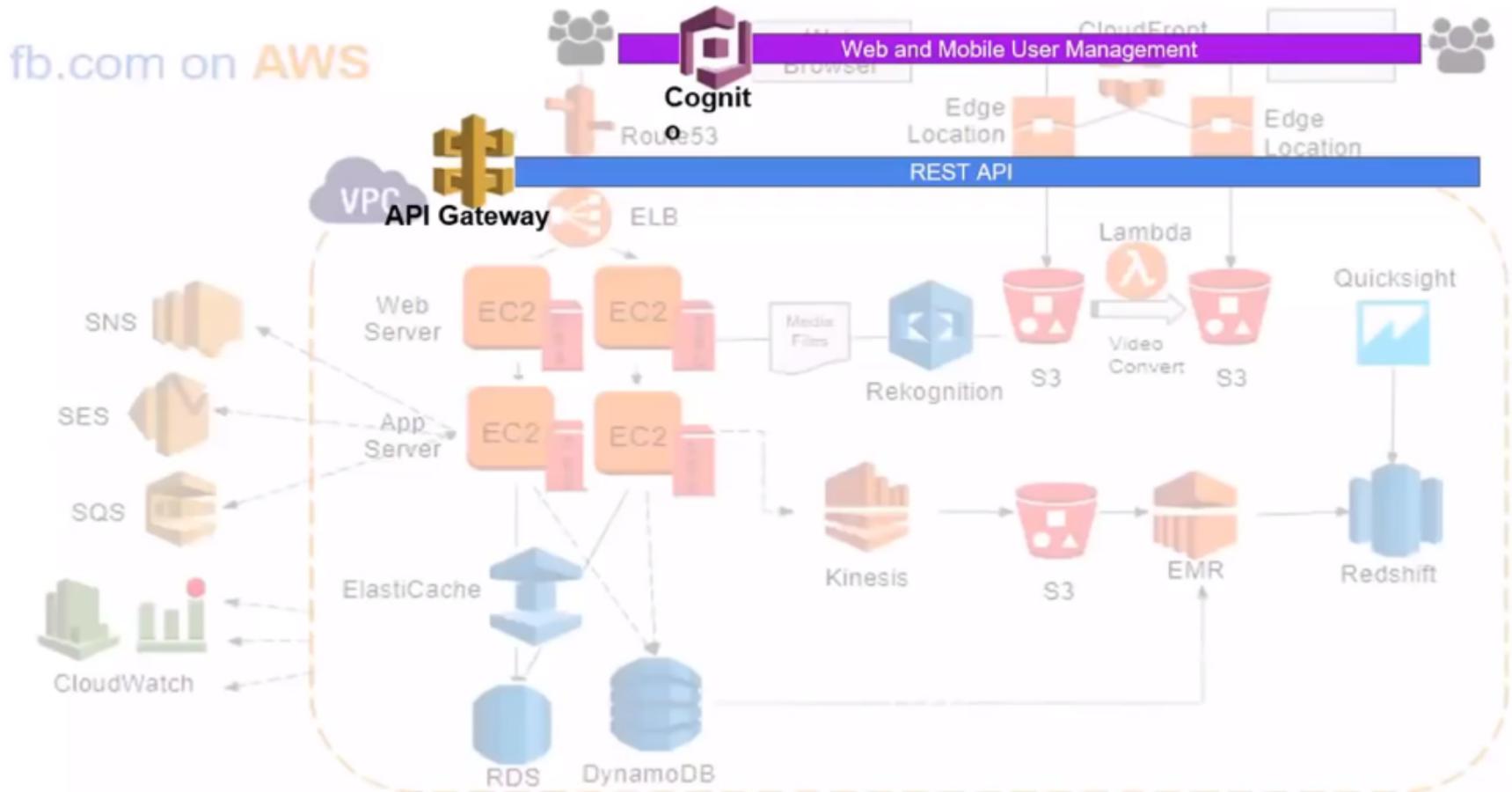
Cloud Software Architecture

fb.com on AWS



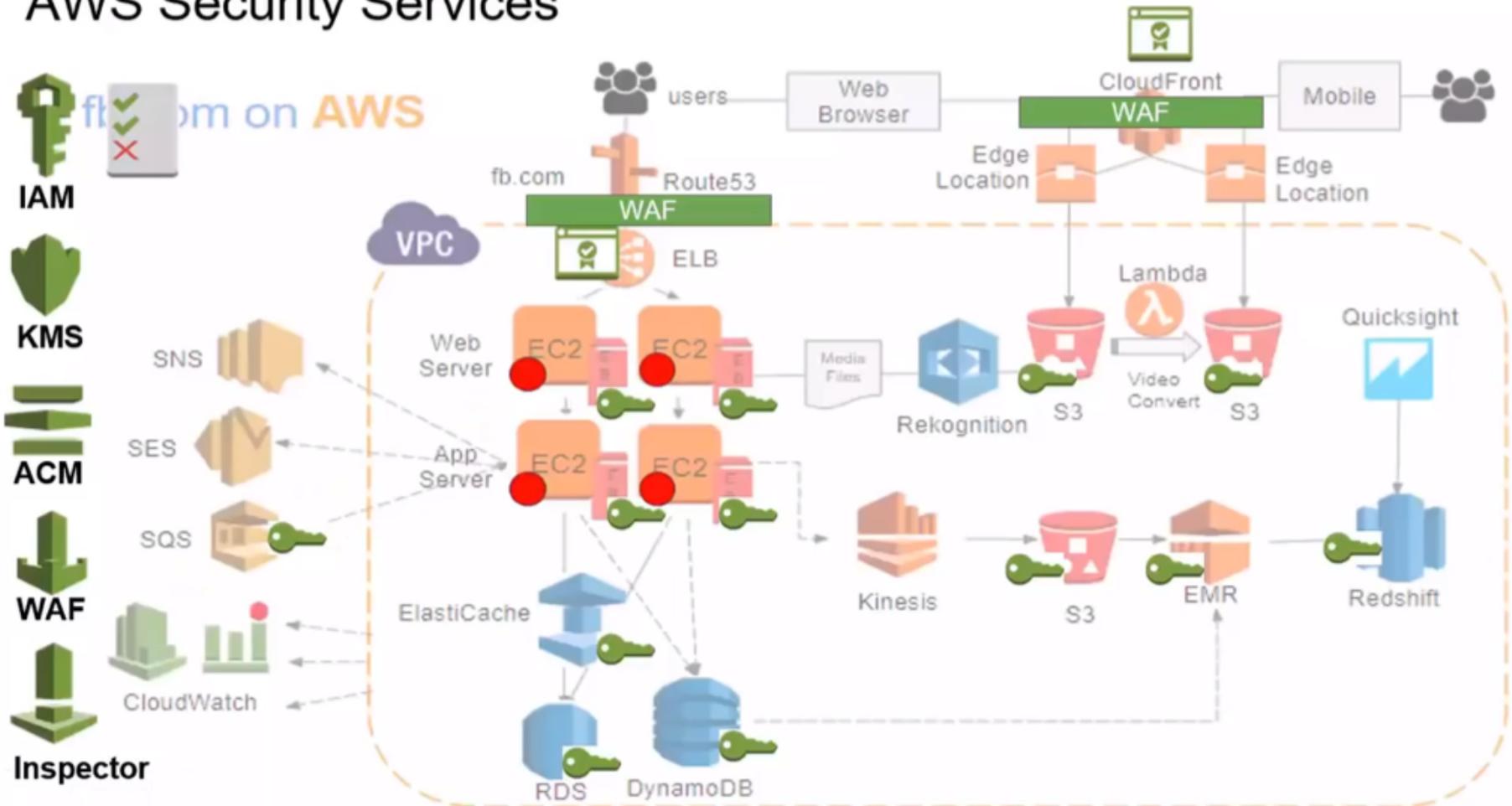
Cloud Software Architecture

AWS Application Services



Cloud Software Architecture

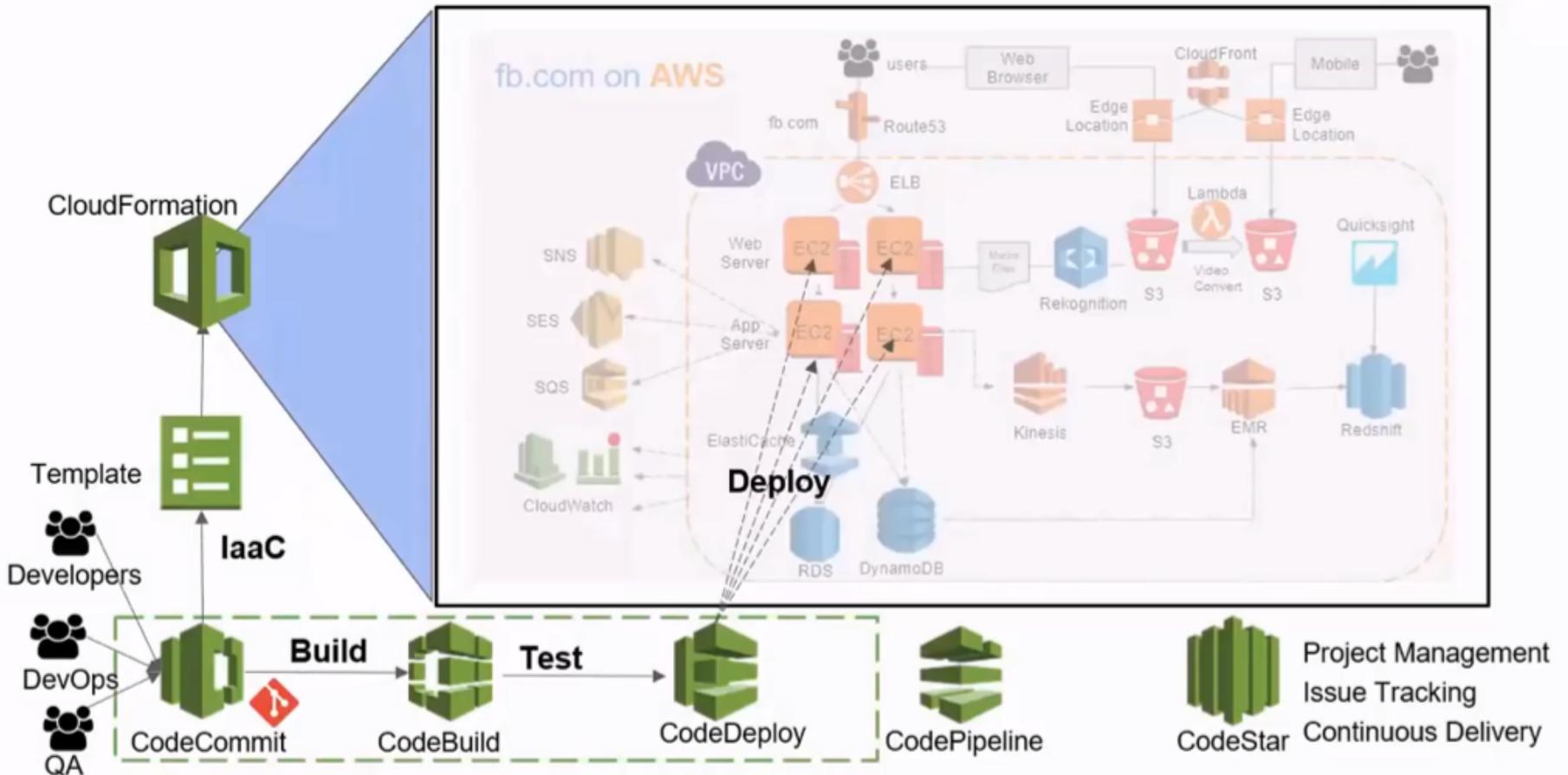
AWS Security Services



Cloud Software Architecture

AWS Development and DevOps Services

AWS Region





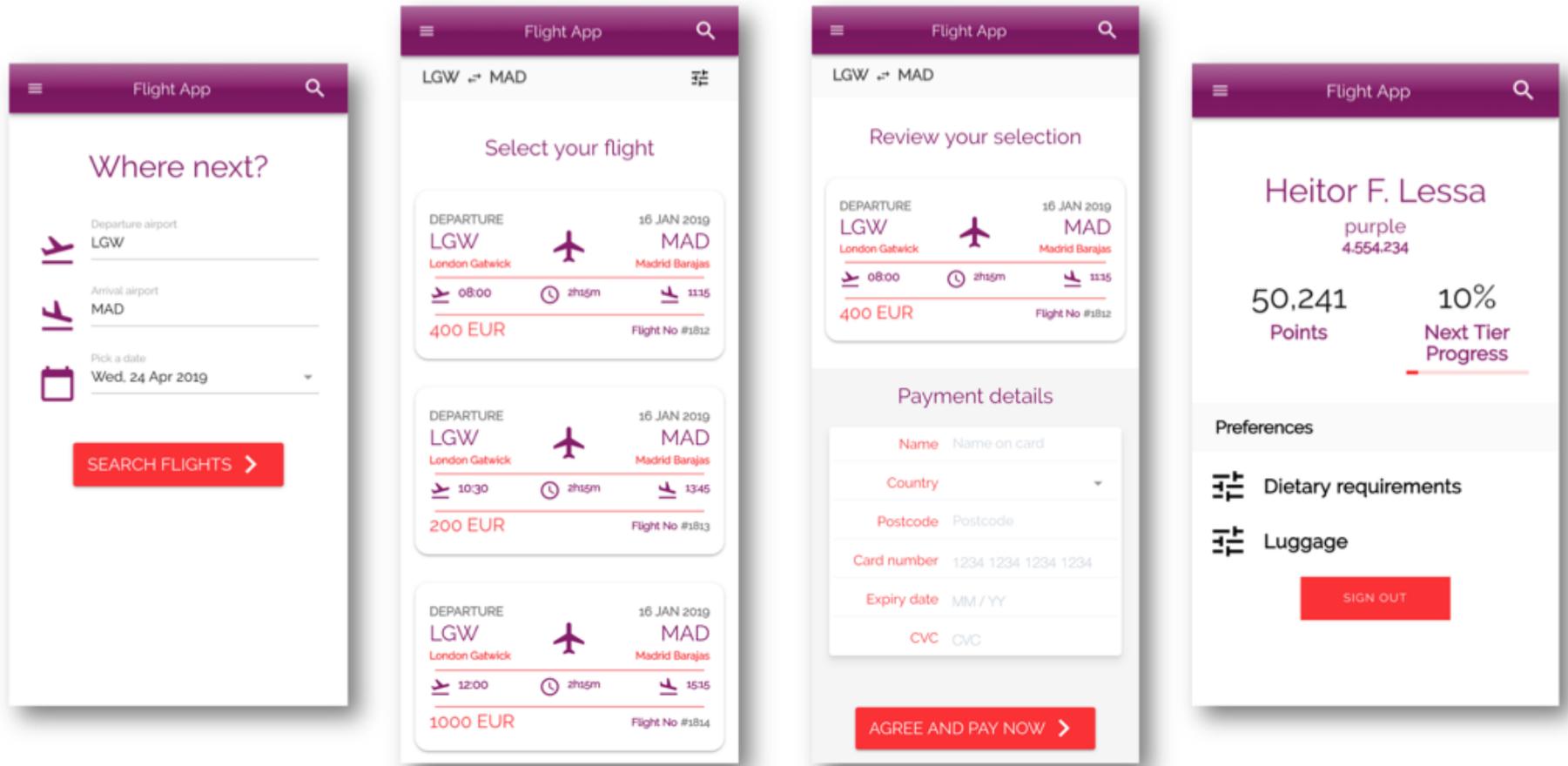
AWS

Serverless

Architecture



AWS Serverless Airline Booking



aws **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

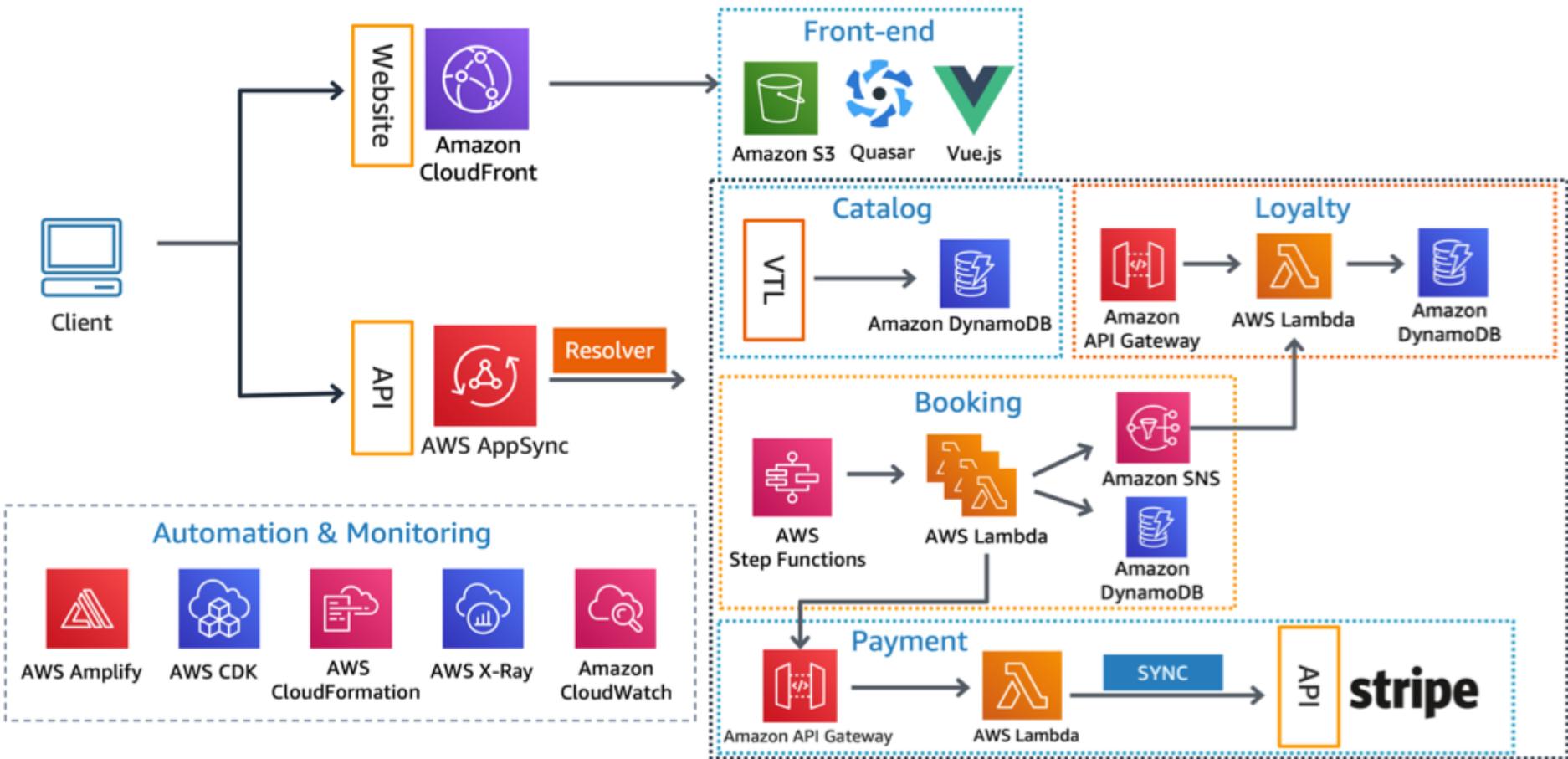


AWS Step Functions



AWS Serverless Airline Booking

High level infrastructure architecture

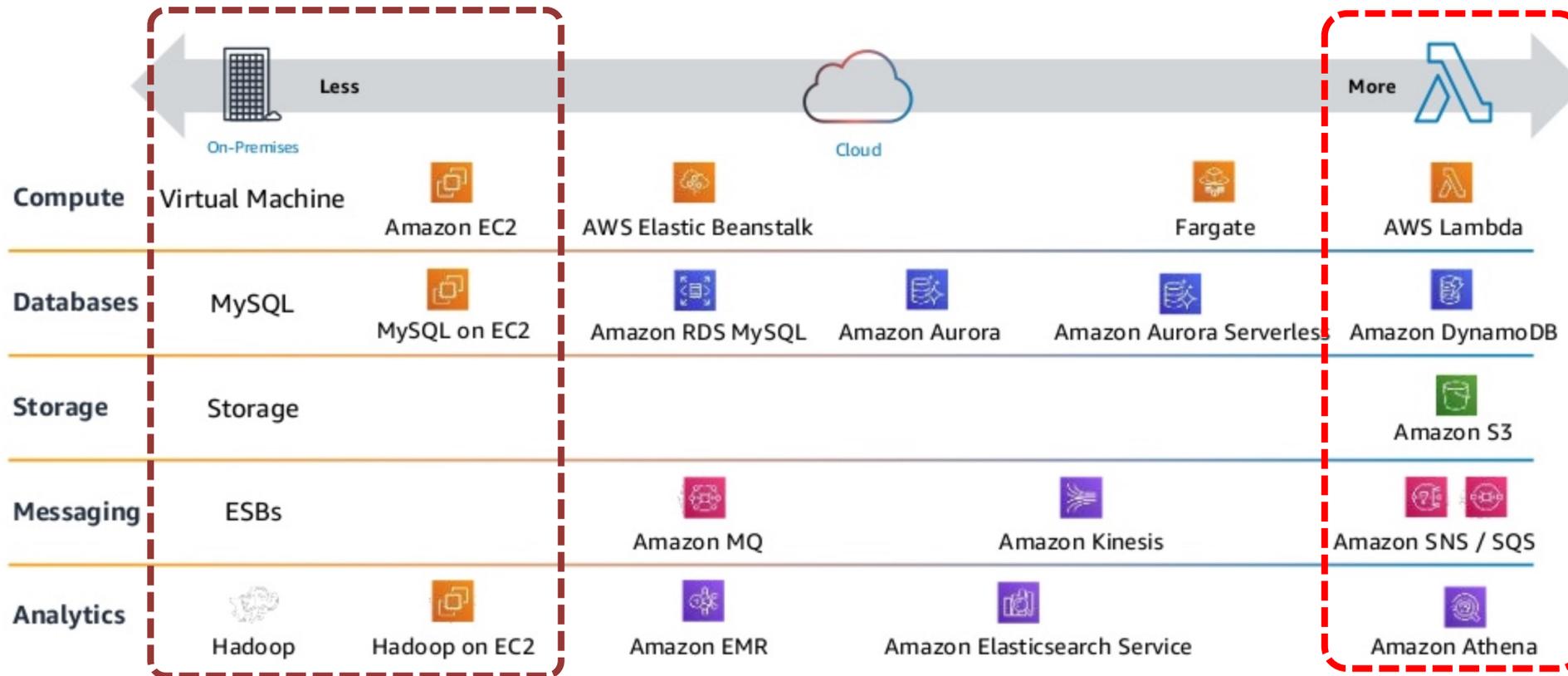


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AWS Serverless Architecture

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

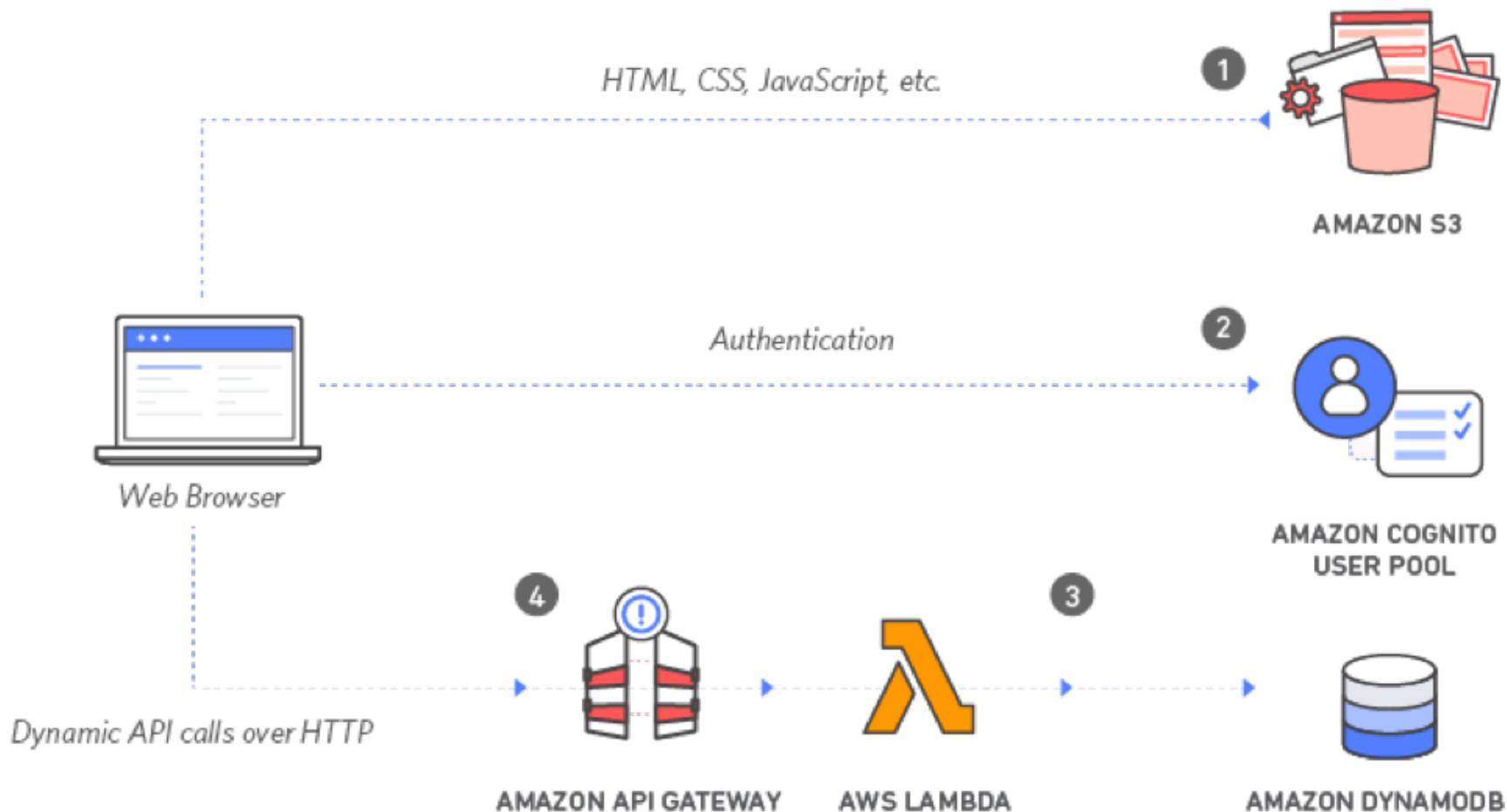
AWS Experience: Beginner

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

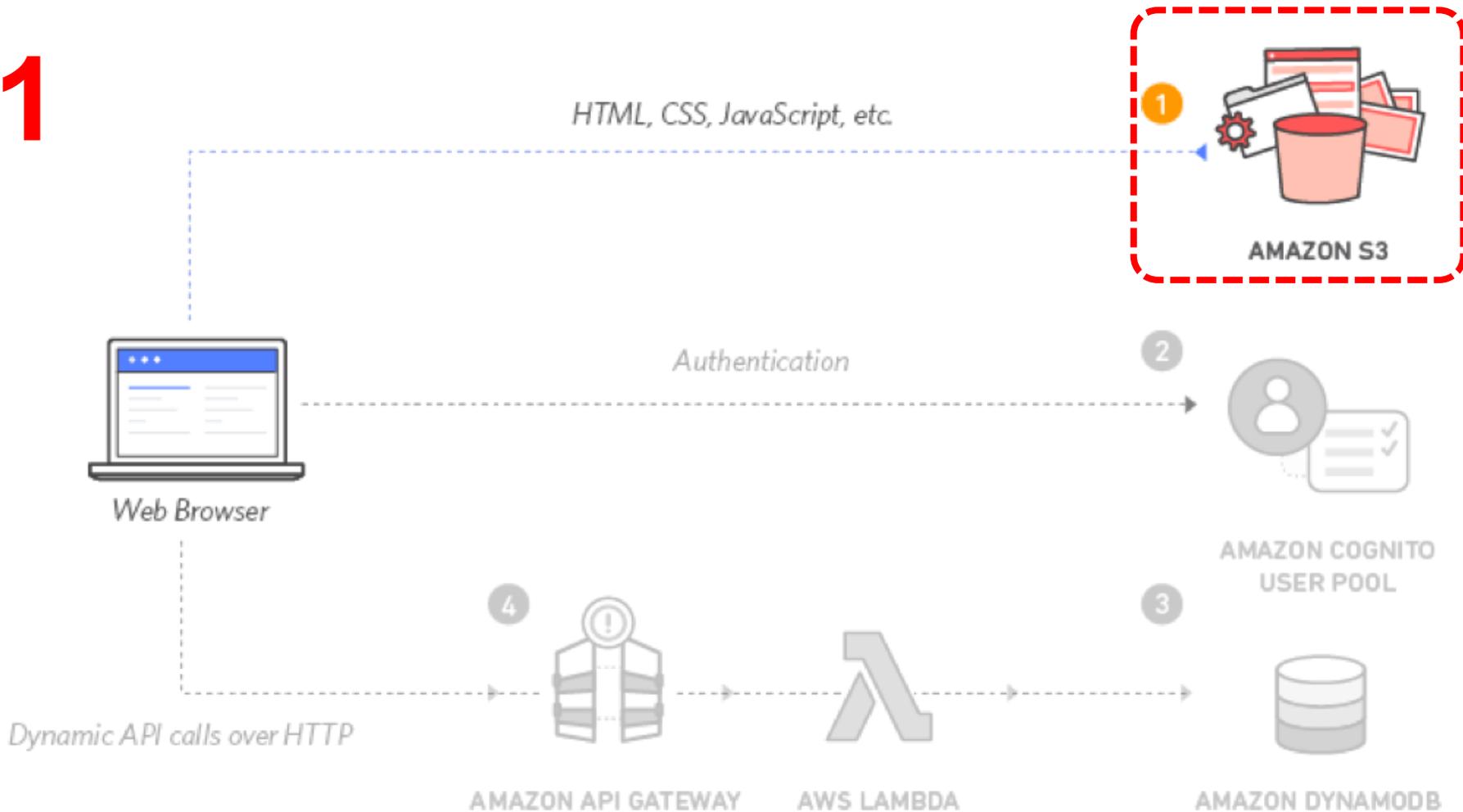
with Amazon S3, AWS Lambda, Amazon API Gateway, Amazon DynamoDB, and Amazon Cognito



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

HTML, CSS, JavaScript, etc.

Static Web Hosting

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



Dynamic API calls over HTTP

AMAZON API GATEWAY

AWS LAMBDA

AMAZON DYNAMODB

Build a Serverless Web Application

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

2



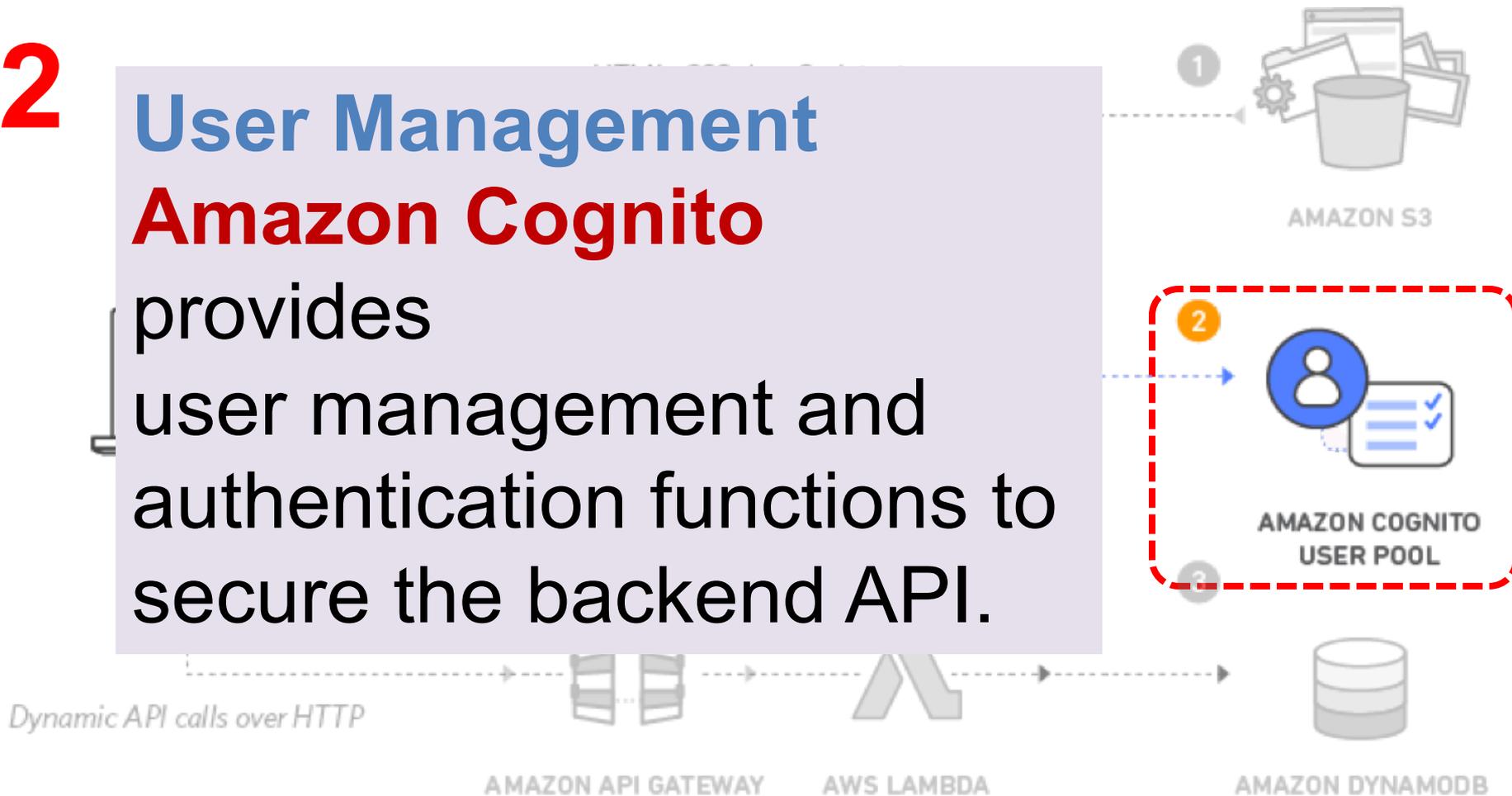
Build a Serverless Web Application

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

2

User Management Amazon Cognito

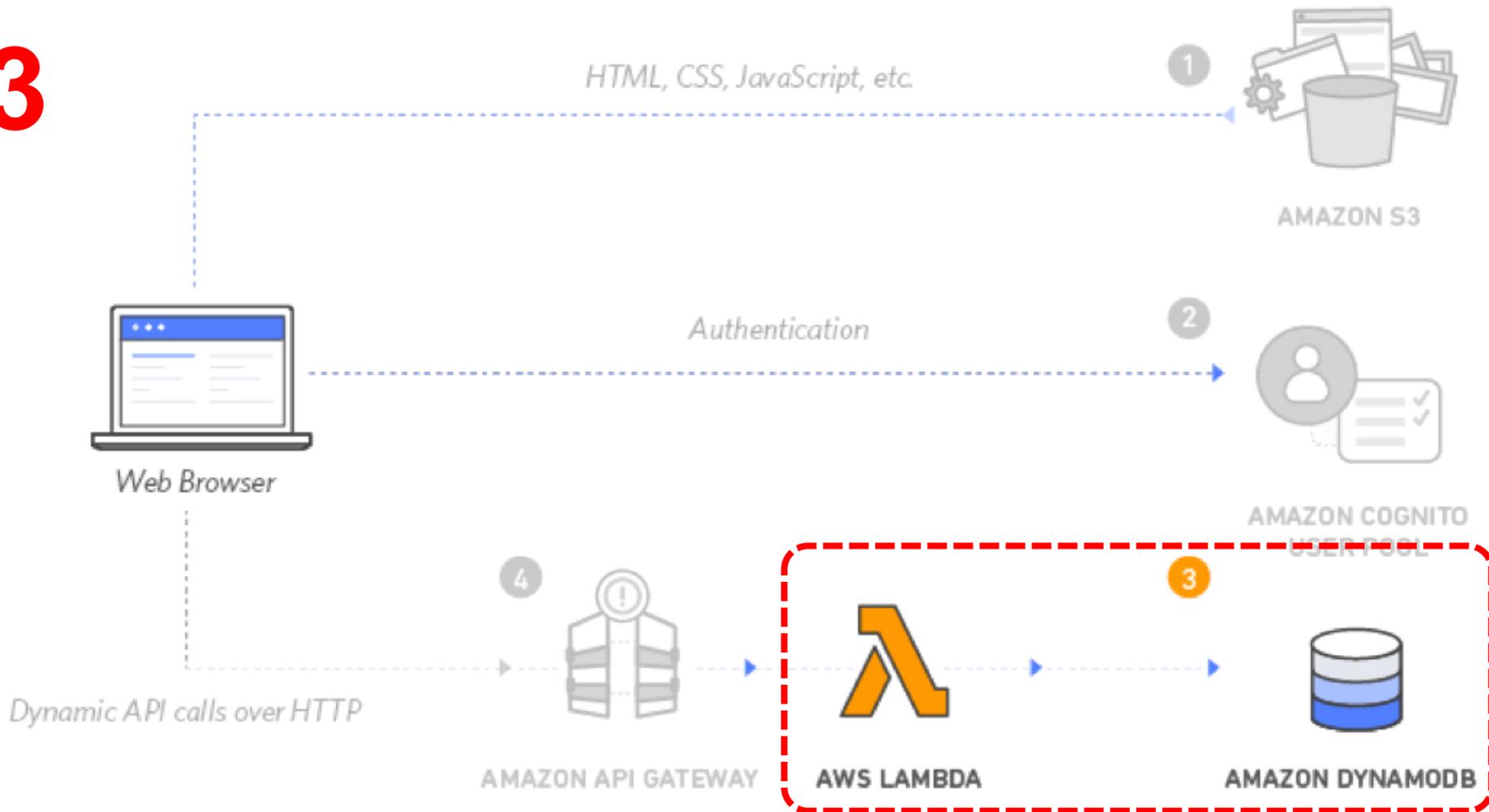
provides user management and authentication functions to secure the backend API.



Build a Serverless Web Application

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

3



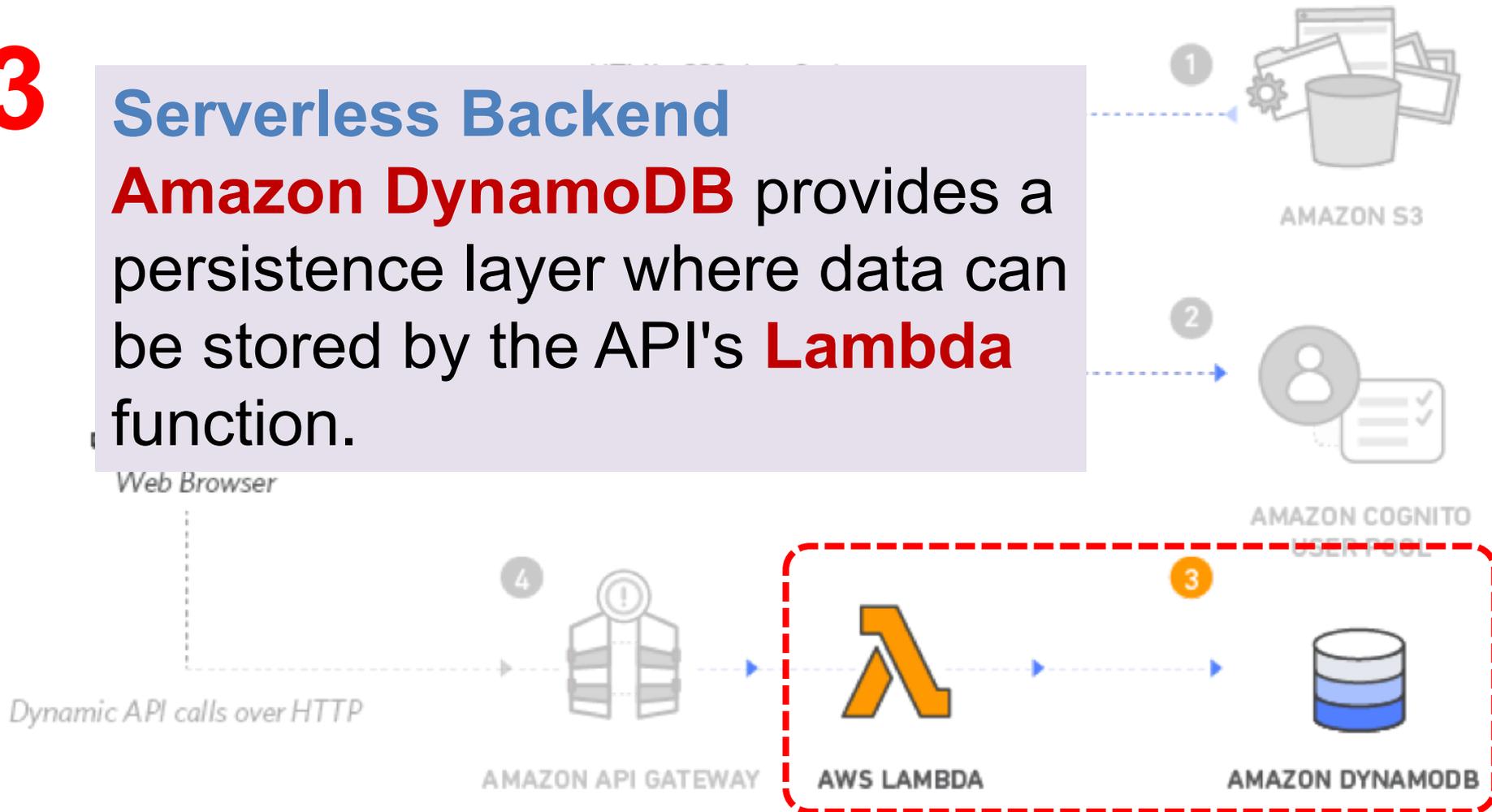
Build a Serverless Web Application

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

3

Serverless Backend

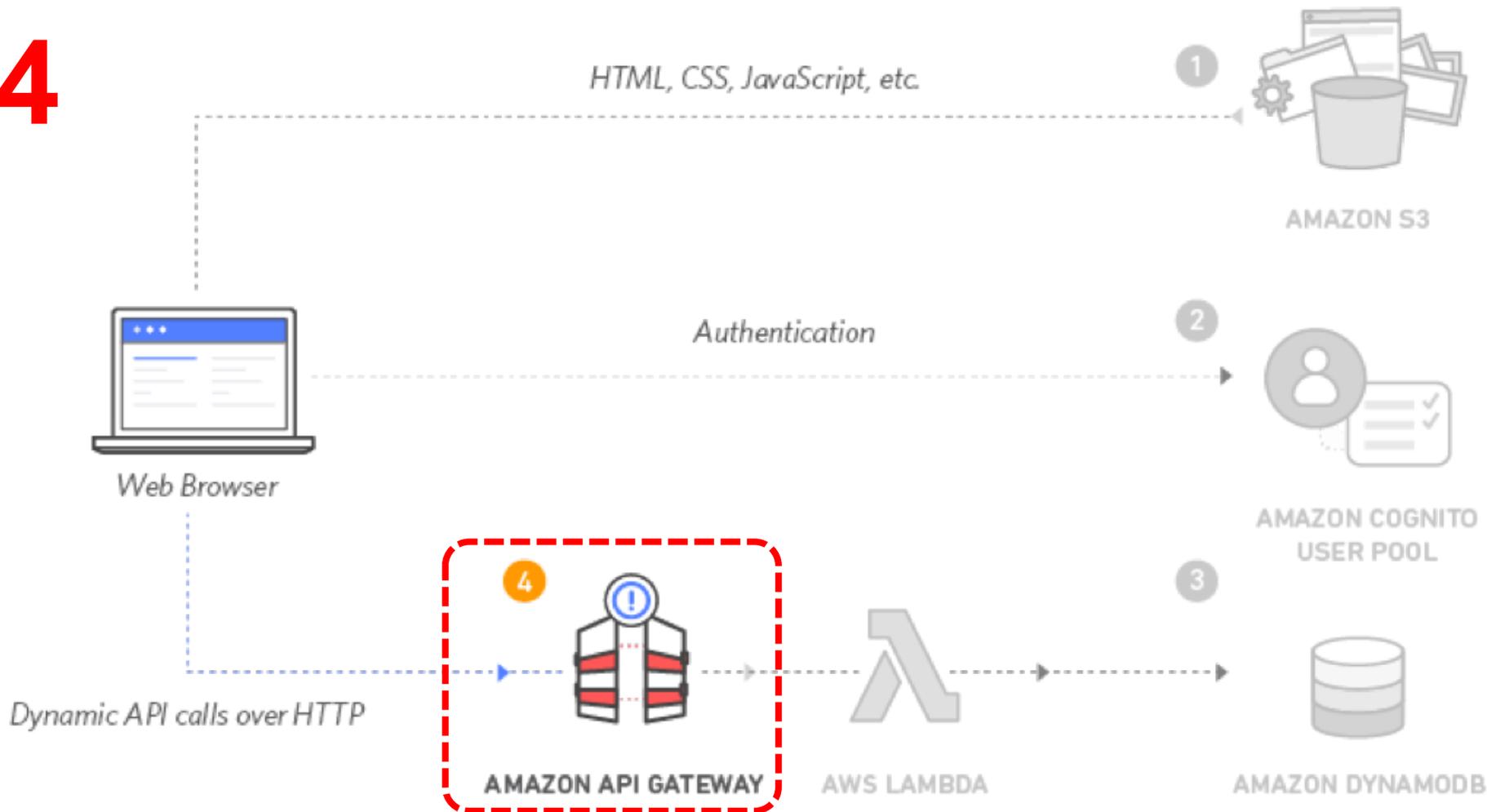
Amazon DynamoDB provides a persistence layer where data can be stored by the API's **Lambda** function.



Build a Serverless Web Application

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

4



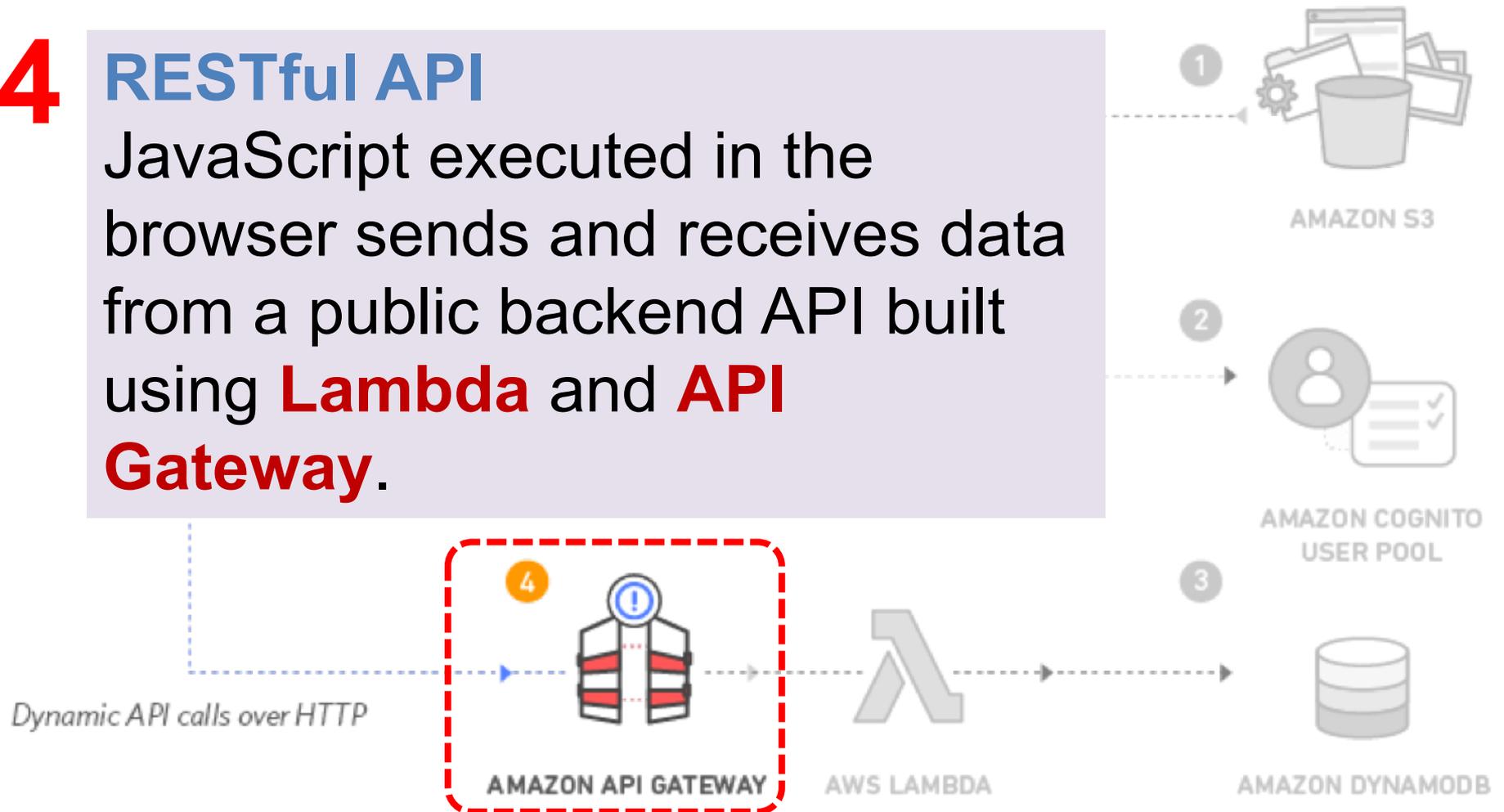
Build a Serverless Web Application

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.

Dynamic API calls over HTTP



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**

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