Case Study

E-commerce Flash Sale Platform

Scenario Overview

A major online retailer is preparing for its annual **"Mega-Deal Day,"** a 24-hour promotional event. Based on historical data, the platform is expected to experience a **massive, unprecedented spike** in traffic, reaching potentially **100 times the normal volume** within the first hour.

The core issue is the current reliance on a **monolithic application** with a **traditional SQL database**, which frequently crashes during even minor promotional events. The monolithic architecture is a single point of failure and cannot scale components independently to handle the anticipated surge.

To handle this load, the retailer requires a complete **architectural overhaul** based on the **Microservices Architectural Style**. This transition is necessary to achieve the required resilience, independent scaling, and diverse data handling capabilities of the new system.

Decomposed Core Functionality (Microservices)

The system is divided into distinct, independently deployable microservices based on core business domains and logic, allowing failures to be isolated and scaling to be targeted:

- **Product Catalog Service:** Responsible for managing product browsing, inventory checks, and related metadata.
- **Order Processing Service:** Responsible for validating orders and accepting client requests.
- **Fulfillment Service:** Responsible for managing payment processing, logistics initiation, and inventory deduction.

Critical Business Requirements

The new architecture must satisfy the following essential requirements:

A. External Traffic Management & Protection (R1)

- **High Availability & Low Latency:** The system must guarantee high availability and deliver a low-latency experience for global users browsing the product catalog.
- **Backend Protection:** The entire backend system must be shielded from overwhelming demand. Specifically, the **Order Processing Service** is highly sensitive and **must not sustain traffic beyond a specific, limited rate of incoming client requests** per second.

B. Internal Reliability & Observability (R2)

- Communication between the **Order Processing Service** and the **Fulfillment Service** must be secure, reliable, and observable. This requires mandatory **mutual TLS (mTLS)**, **automatic request retries**, and built-in **latency metrics** collection, all **without requiring code changes** within the individual microservices.

C. Data Consistency & Speed (R3)

- **Read Speed:** Product inventory must support **instantaneous, high-speed read access** across all scaling instances during the flash sale.
- **Write Consistency:** Conversely, the financial **order ledger** requires **absolute transactional integrity (ACID)** for all payment and fulfillment records.

D. Asynchronous Decoupling (R4)

- **Reliable Handoff:** Once an order is accepted, it must be **immediately confirmed to the user** and then reliably handed off to the Fulfillment Service. This handoff must succeed even if the Fulfillment Service is momentarily overwhelmed or unavailable. **No accepted order should ever be lost.**

E. Scalability & Session Management (R5)

- **Horizontal Scaling:** All services must be designed to be horizontally scalable to meet peak demand.
- **Centralized State:** User session data (e.g., cart contents) must be managed **centrally** so that **any instance of any service can pick up the session** without state being tied to a specific server.

F. Client Data Efficiency (R6)

- The external client applications must be able to fetch complex, related product data (such as details, reviews, and inventory status) **in a single API request** to minimize network round-trips and maximize perceived performance.

Task: Architectural Component Identification & Justification

The scenario demands that you, the architect, identify the specific architectural services necessary to meet the Critical Business Requirements (R1-R6).

Your Task:

1. Identify **maximum** distinct architectural **components/patterns/approach/features** required to build the new Flash Sale Platform.
2. For each identified component, briefly explain its purpose in this specific scenario and cite the primary Critical Business Requirement (R1-R6) that makes its inclusion mandatory.

Architectural Component/Patterns /Approach/Features	Primary Requirement (R#)	Justification (Why it's Mandatory)