

Service-Based Architecture

Software Architecture

Richard Thomas

March 17, 2025

Definition 0. Distributed System

A system with multiple components located on different machines that communicate and coordinate actions in order to appear as a single coherent system to the end-user.

Introduce idea of distributed systems and then move on to service-based being a simple approach.

Quote

A distributed system is one in which the failure of a computer you didn't even know existed can render your own computer unusable.

– Leslie Lamport [Turing Award, 2013]

Definition 0. Service-Based Architecture

System is partitioned into business domains that are deployed as distributed services. Functionality is delivered through a user interface that interacts with the domain services.

Explain why this leads to a fairly simple distributed architecture.

Service-Based Architecture



Terminology

User Interface Provides access to system functionality

Services Implement functionality for a single, independent business process

Service APIs Communication mechanism between UI and each service

Database Stores persistent data for the system

- Explain that the Service APIs are communication protocols and data formats, not just a Java-style interface.
- Usually all Service APIs use the same communication protocol (e.g. REST).
- Also point out that messages between the UI and services will typically be asynchronous.

Definition 0. API Abstraction Principle

Services should provide an API that hides implementation details.

- Each service publishes its own API.
- Hides service implementation details, reducing coupling between UI and service.
- Makes it easier to reuse service across systems or by supporting service (e.g. auditing).

Definition 0. Façade Design Pattern

Provide a simple, abstract interface to use a service domain's functionality. A component within the service coordinates how to deliver the requested functionality with the service's internal components.

- Summarise Façade Design Pattern and how it is used in a service-based architecture.
- Mention its from the GoF book.

Definition 0. Independent Service Principle

Services should be independent, with no dependencies on other services.

- Explain consequences of dependencies between services.
- Services can't easily be deployed separately if they depend on other services.
- They would require interfaces between services, increasing coupling.

Question

What are the consequences of having a shared database?

Question

What are the consequences of having a shared database?

Answer

Increased *data coupling*.

- If a row of a database is locked and another service wants to use it, it is blocked. Losing efficiency benefits of a distributed system.
- If one service changes the structure of its persistent data, all services using that data need to be updated and tested.
- If one service changes how it uses persistent data, all other services using the same data need to be retested.

Logical Partitioning of Persistent Data



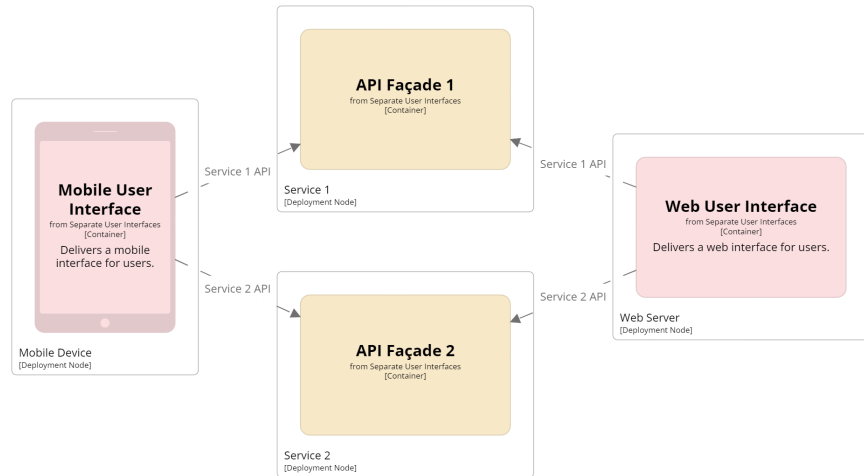
- Define a minimal set of shared persistent objects.
- Create a shared library to access these objects.
- Changes to shared persistent objects are restricted as they require changes to other services.
- Each service may have its own persistent objects stored in tables that are not shared with other services.

Separate Databases



- Discuss options of
- separate DB servers,
- multiple DBs on one server,
- DBs embedded in application.

Separate UIs



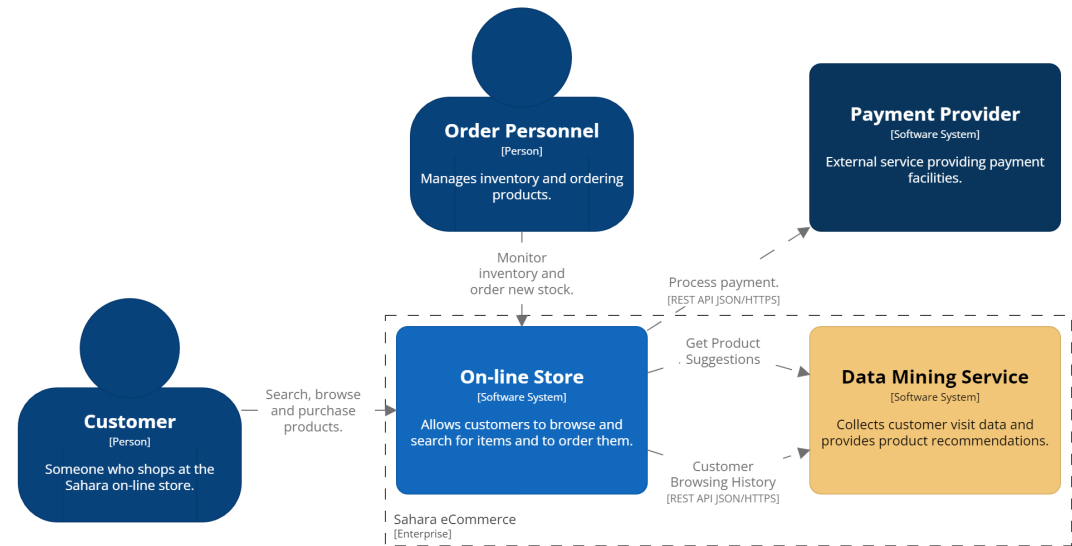
- UI Platform could be desktop, web or mobile app.
- Allows multiple concurrent users, even through one user interface.

Separate UIs



- UI Platform could be desktop, web or mobile app.
- Allows multiple concurrent users, even through one user interface.
- Allows *separate UIs* for different clients or roles.

Sahara: Context Diagram



- Summarise Sahara eCommerce example.
- Order Personnel & Payment Provider added to this example.

On-line Store Service Domains

Browsing Customers can find products & add to cart

Purchasing Customers can purchase products in cart

Fulfilment Customers & staff can track order fulfilment

Account Management Customers can manage their
account details

Inventory Management Staff can view stock levels and
order new stock

- Mention that service-based architectures are based on domain partitioning.
- Could provide examples of fulfilment, and inventory management activities.
- Customer's tracking order, staff generating pick lists and packaging details.
- Generating reports on stock levels and product popularity. Ordering new stock.

Partitioning

Services are defined by domain partitioning

Coarse Services

- Domains are large
 - *Coarse-grained* services
- Each service will have an internal architecture
 - Technical or domain partitioning

Sahara: On-line Store Container Diagram



- Review Domain Services in context of the overall system.
- Mobile App relationships not shown to reduce clutter.
- Single DB for simplicity of diagram, not good practice. Should be split.
- Cart shared with Browsing & Purchasing.
- Order shared with Purchasing & Fulfilment.
- Product shared with everything except Account Mgt.
- User shared with almost everything.
- Most of these will be query only, or only locking a single row.
- Repeat idea that Service APIs mean you may have multiple UIs (Web, Mobile, Inventory Apps).
- Inventory app is example of completely separate UI delivery a different app.

Sahara: Product Browsing Component Diagram



- Summarise the components making up the key parts of the Product Browsing Service (container).
- Product Browsing Façade provides the Service API.

Product Browsing Service API

[Search](https://api.sahara.com/v1/search?keywords=...) https://api.sahara.com/v1/search?keywords=...

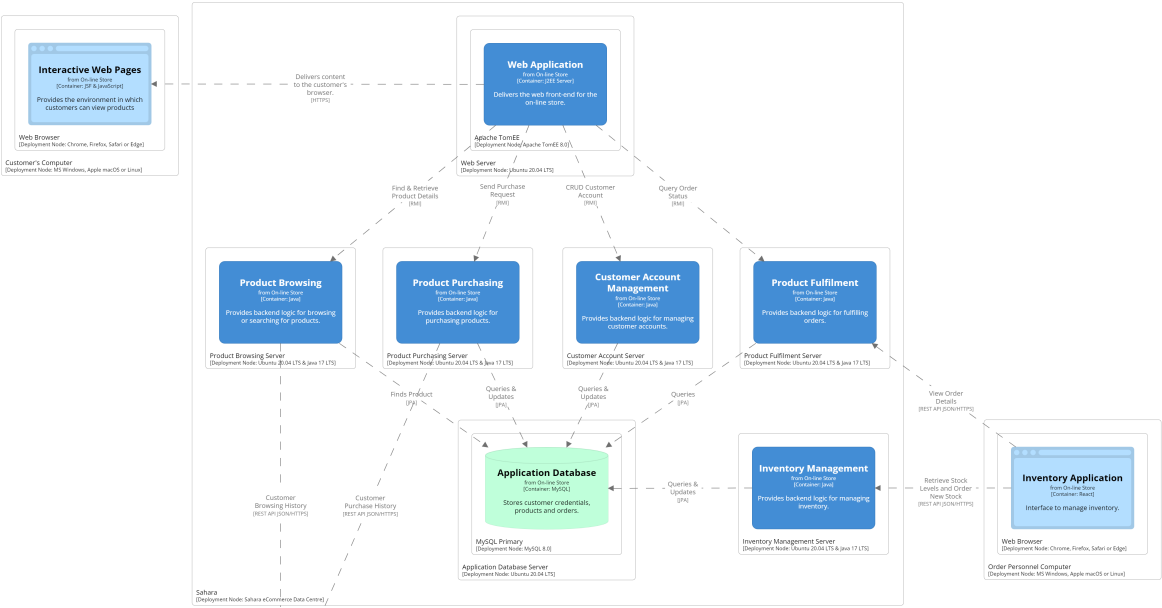
[Browse](https://api.sahara.com/v1/browse?category=...) https://api.sahara.com/v1/browse?category=...

[Add to Cart](https://api.sahara.com/v1/cart) https://api.sahara.com/v1/cart

- JSON to pass data
- JSF action controller handles request

- Search & Browse are GET requests passing parameters.
- Add to Cart is a POST request passing product id and quantity to be added to cart.
- Authentication needs to be part of requests.
- API Versioning shown in URIs.

Sahara: Deployment Diagram



- UI Platform could be desktop, web, mobile app, VR, ...
- Allows multiple concurrent users, even through one user interface.

Sahara: Concurrent Access



- Emphasise many users from different UIs accessing distributed services concurrently.
- Point out that this & REST require stateless services.

Question

What happens if a service goes down?

Question

What happens if a service goes down?

Answer

Need to manage timeouts, retries, graceful failure, ...

- Some of this can be managed by infrastructure, which requires monitoring systems.
- Some issues are harder to deal with due to coarse service domains.
- Some of this needs to be managed within the application.

Consider Network Failure

If customer tried to add product to cart:

- What happens if Product Browsing didn't receive it?
- What happens if UI didn't get a response?
- What happens if Database wasn't updated?








API Layer



API Layer Advantages

- Acts as a reverse proxy or gateway to services
- Hides internal network structure
- Easier to implement *cross-cutting* concerns
 - e.g. security policies
- Allows service discovery
 - Interface to register service
 - Clients can find out what services are available
- **Reverse proxy** hides internal network structure of architecture.
- Can expose different interfaces to external & internal systems.
- Facilitates delivering the security principle of least privilege.
- **Gateway** adds “intelligence” to the reverse proxy.
- Can process requests & responses.
- Orchestrate or aggregate requests / responses to improve performance.
- Translate protocols.

Pros & Cons

Simplicity	<i>For a distributed system</i>	
Modularity	Services	
Extensibility	New services	
Deployability	Independent services	
Testability	Independent services	
Security	API layer	
Reliability	Independent services	
Interoperability	Service APIs	
Scalability	Coarse-grained services	