

# Serverless Architecture

CSSE6400

Richard Thomas

May 23, 2022

## Oxymoron 1. Serverless

Logic running on someone else's server.

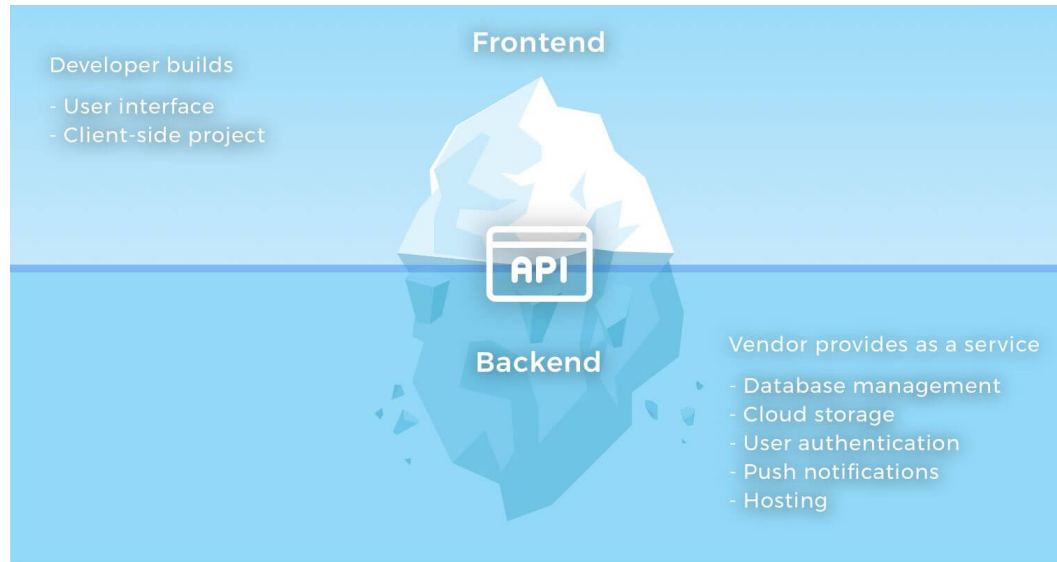
Developers can focus on logic, not infrastructure to deliver it.

### Definition 1. Backend as a Service (BaaS)

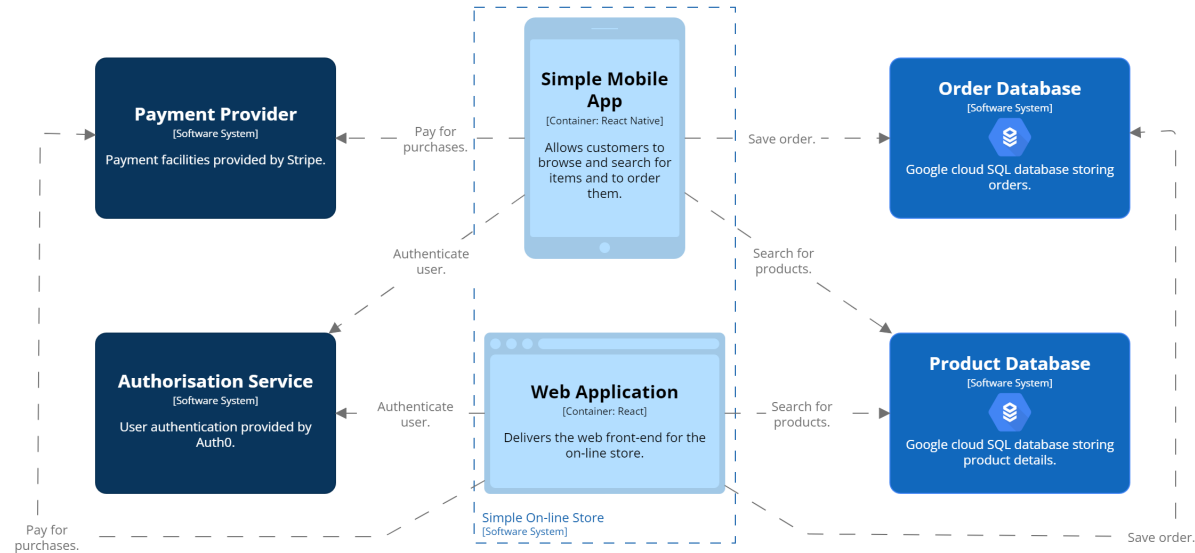
Cloud-hosted applications or services that deliver functionality used by an application front-end.

- Front-end may be a SPA or mobile app.
- Back-end provides sophisticated functionality (e.g. database, machine learning, location services, authentication, ...).
- Front-end ties back-end services together to deliver the application's functionality.

## BaaS Iceberg [1]



## BaaS Example



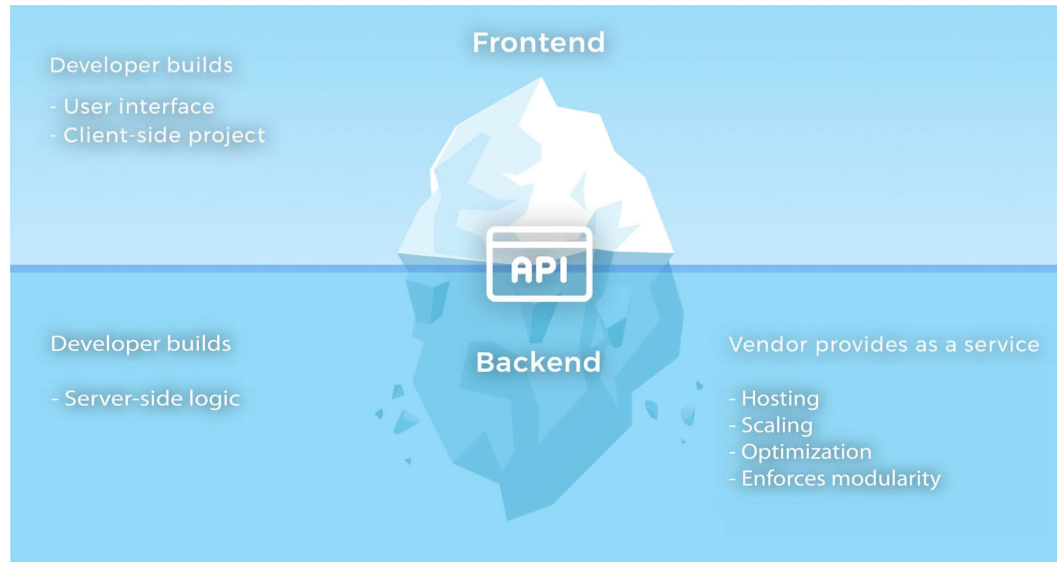
- Example of simple system with back-end functionality delivered entirely via BaaS.
- Feature-rich front-ends coordinate behaviour delivered by BaaS.
- Consequence: Front-ends are tightly coupled to BaaS.
- Consequence: Front-ends are have both UI and functional behaviour logic.
- Front-end could have a layered design, though many SPAs don't.

## Definition 2. Functions as a Service (FaaS)

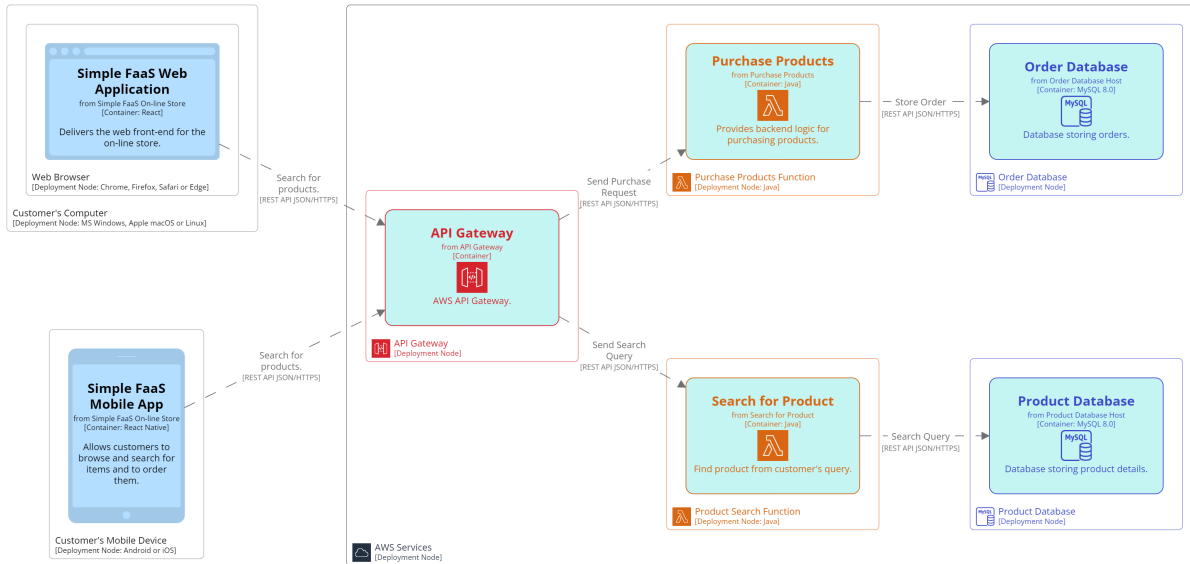
Application logic that is triggered by an event and runs in a transient, stateless compute node.

- Node may only exist for duration of function call.
- Server infrastructure (e.g. type of node, lifespan, scaling, ...) are managed by hosting provider.
- e.g. AWS Lambda, Google App Engine, Azure Automation, ....

## FaaS Iceberg [1]



# FaaS Example



- Example of simple system with back-end functionality delivered entirely by FaaS.
- Feature-rich front-ends coordinate behaviour delivered by FaaS.
- Front-ends invoke functions via an API.
- API Gateway provides some separation between front-end and functions.
- May allow a bit more separation between UI and logic.

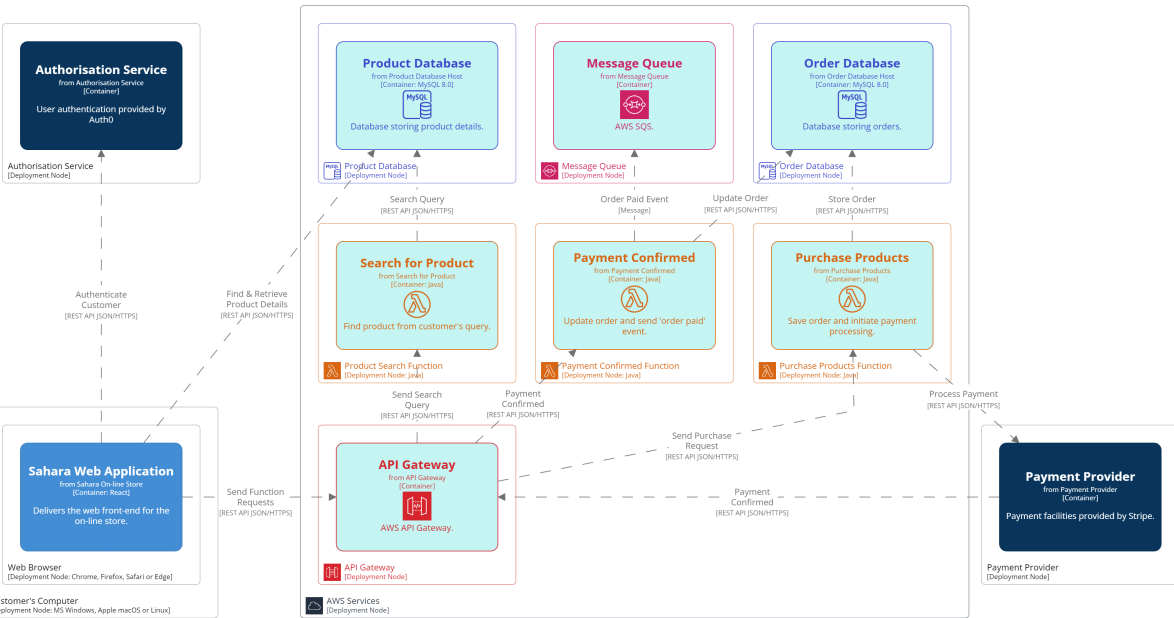


### Definition 3. Serverless Architecture

Software system delivering functionality through BaaS or FaaS.

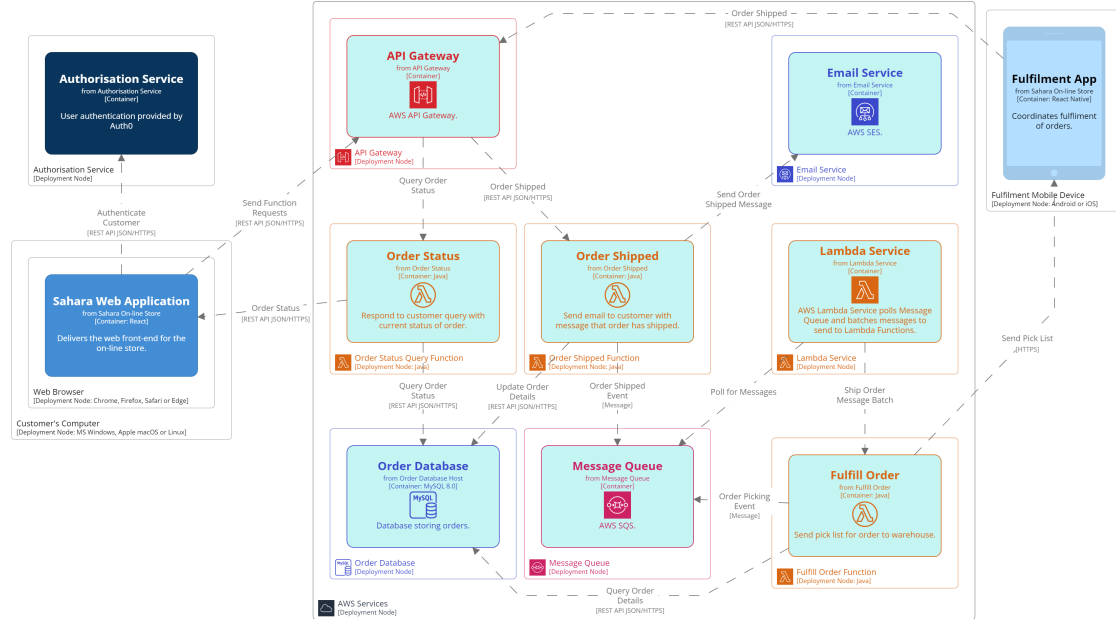
- Many people focus on FaaS when considering Serverless.
- Some simple Single Page Web Apps (SPA) coordinate.
- Front-end ties back-end services together to deliver the application's functionality.

# Sahara Browse & Order



- Sahara eCommerce example as a serverless app.
- Only browse, search and purchase are shown.
- Point out that it uses both BaaS & FaaS.
- Shopping cart is implemented within the web and mobile app for this architecture.
- Order Scenario 1: Customer checks out their shopping cart in the web or mobile app.
- Order Scenario 2: App calls Purchase Products function via API Gateway.
- Order Scenario 3: Purchase Products stores order in DB and sends a payment request to Payment Provider.
- Order Scenario 4: We provide Payment Provider with API end point to call to report payment result.
- Order Scenario 5: Payment success causes Payment

# Sahara Fulfilment



- Sahara eCommerce example as a serverless app.
- Only fulfilment functions are shown.
- Shows Lambda Service polling Queue, demonstrating how Lambda Functions are invoked via events in a message queue.
- Fulfilment Scenario 1: Lambda Service monitors Queue for 'ship order' messages.
- Fulfilment Scenario 2: Lambda Service batches groups of 'ship order' messages and sends them to Fulfill Order function.
- Fulfilment Scenario 3: Fulfill Order gets order details from DB and sends pick list to Fulfilment App.
- Fulfilment Scenario 4: When order is shipped, Fulfilment App calls Order Shipped function via API Gateway.
- Fulfilment Scenario 5: Order Shipped sends email to customer and updates order status in DB.

## Serverless Benefits

- Automatic scaling
  - Multiple instances of function

## Serverless Benefits

- Automatic scaling
  - Multiple instances of function
- Reduced cost for dynamic loads
  - No server idle time

## Serverless Benefits

- Automatic scaling
  - Multiple instances of function
- Reduced cost for dynamic loads
  - No server idle time
- Reduced server management

## Serverless Benefits

- Automatic scaling
  - Multiple instances of function
- Reduced cost for dynamic loads
  - No server idle time
- Reduced server management
- Easier to run closer to client
  - Launch in same zone as client

## BaaS Tradeoffs

- Front-end accesses database directly
  - Front-end needs to sanitise inputs
  - Easy to spoof messages from front-end
    - Hope DB provider is secure



## BaaS Tradeoffs

- Front-end accesses database directly
  - Front-end needs to sanitise inputs
  - Easy to spoof messages from front-end
    - Hope DB provider is secure
- Application logic is in front-end
  - Less modularisation
  - Duplication of logic with multiple front-ends
    - Web, mobile, ...

## BaaS Tradeoffs

- Front-end accesses database directly
    - Front-end needs to sanitise inputs
    - Easy to spoof messages from front-end
      - Hope DB provider is secure
  - Application logic is in front-end
    - Less modularisation
    - Duplication of logic with multiple front-ends
      - Web, mobile, ...
  - No control over server optimisation
- Spoofing messages is an issue for all BaaS services.
  - Modern expectations are that almost all systems will have multiple front-ends.
  - Duplication of front-end logic is a smaller, but still partial, concern for FaaS.

## FaaS Tradeoffs

- No server state
  - All state needs to be saved (e.g. Redis, S3, ...)
    - Not just persistent state

## FaaS Tradeoffs

- No server state
  - All state needs to be saved (e.g. Redis, S3, ...)
    - Not just persistent state
- Execution duration
  - Can't be long running process
    - AWS Lambda is up to 15 minutes

## FaaS Tradeoffs

- No server state
  - All state needs to be saved (e.g. Redis, S3, ...)
    - Not just persistent state
- Execution duration
  - Can't be long running process
    - AWS Lambda is up to 15 minutes
- Startup latency
  - Functions take time to start
    - Some languages worse than others (e.g. Java)

## FaaS Tradeoffs

- **No server state**
    - All state needs to be saved (e.g. Redis, S3, ...)
      - Not just persistent state
  - **Execution duration**
    - Can't be long running process
      - AWS Lambda is up to 15 minutes
  - **Startup latency**
    - Functions take time to start
      - Some languages worse than others (e.g. Java)
  - **Proliferation of functions**
    - Loss of encapsulation
- Server running function can be killed when function is not running.
  - Can occasionally send messages to functions to keep them alive.
  - Java has concurrency benefits over other languages.

Question

When is serverless appropriate?

#### Question

When is serverless appropriate?

#### Answer

- Rich client apps with common backend
  - BaaS



### Question

When is serverless appropriate?

### Answer

- Rich client apps with common backend
  - BaaS
- High latency processing
  - Within function duration constraints

### Question

When is serverless appropriate?

### Answer

- Rich client apps with common backend
  - BaaS
- High latency processing
  - Within function duration constraints
- Apps with variable load
  - Take advantage of auto-scaling

Question

When is serverless *not* appropriate?

#### Question

When is serverless *not* appropriate?

#### Answer

- Quick response required
  - Can't wait for FaaS to start

#### Question

When is serverless *not* appropriate?

#### Answer

- Quick response required
  - Can't wait for FaaS to start
- Compute intensive processing

#### Question

When is serverless *not* appropriate?

#### Answer

- Quick response required
  - Can't wait for FaaS to start
- Compute intensive processing
- Apps with steady load
  - Server-based approaches are cheaper

#### Self-Study Exercise

- Redesign your scalability assignment to be serverless.
  - Would this have been beneficial for your assignment?
- Implement your design.

## Pros & Cons

Modularity



Extensibility



Reliability



Interoperability



Scalability



Deployability



Testability



Security



Simplicity



- Unit testing FaaS functions is easy.
- Integration testing is hard.
- Security BaaS: Front-end access database directly. No server-side protection of db.
- Security FaaS: Every function needs its own security policy (e.g. IAM), which is easy to get wrong.



## References

[1] Pavlo Brunko.

Serverless architecture: When to use this approach and what benefits it gives.

<https://apiko.com/blog/serverless-architecture-benefits//>, March 2019.