Distributed Systems I

Software Architecture

Brae Webb

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There are only two hard problems in distributed systems:
2. Exactly-once delivery
1. Guaranteed order of messages
2. Exactly-once delivery

Going forward

Investigating architectures that are *distributed*.

Distributed Systems Series

Distributed I *Reliability* and *scalability* of *stateless* systems.

Distributed II *Complexities* of *stateful* systems.

Distributed III *Hard problems* in distributed systems.

What are the benefits?

- Improved *reliability*
- Improved *scalability*
- Improved *latency*

What are the drawbacks?

- Increased *complexity*
- Increased *attack vector*
- Increased *latency*
- Introduce *consistency* problems

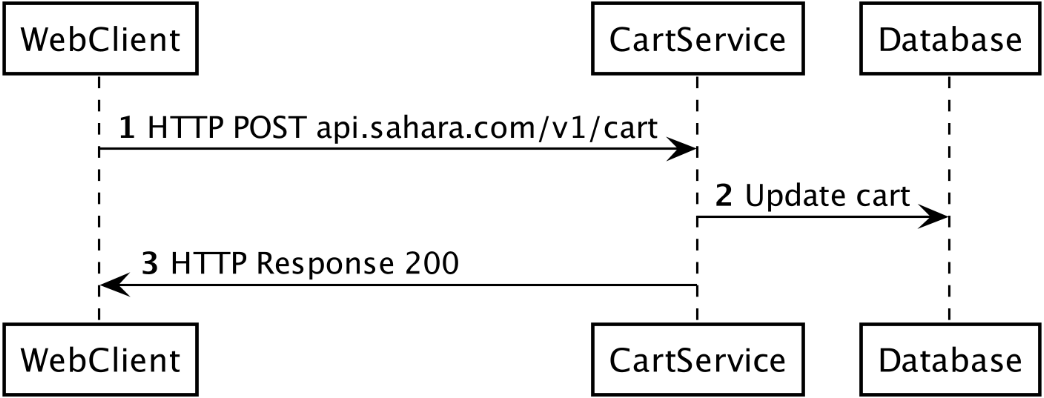
§ *Fallacies*

A few reasons for complexity

The Fallacies of *Distributed Computing*.

Fallacy #1

The network is reliable.


WebClient
CartService
Database
1 HTTP POST api.sahara.com/v1/cart
2 Update cart
3 HTTP Response 200
WebClient
CartService
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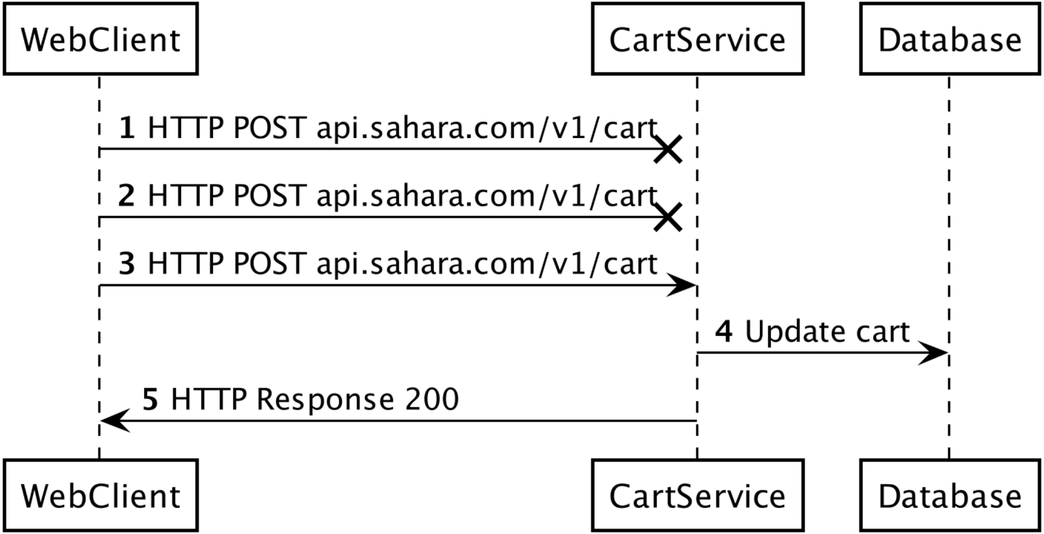
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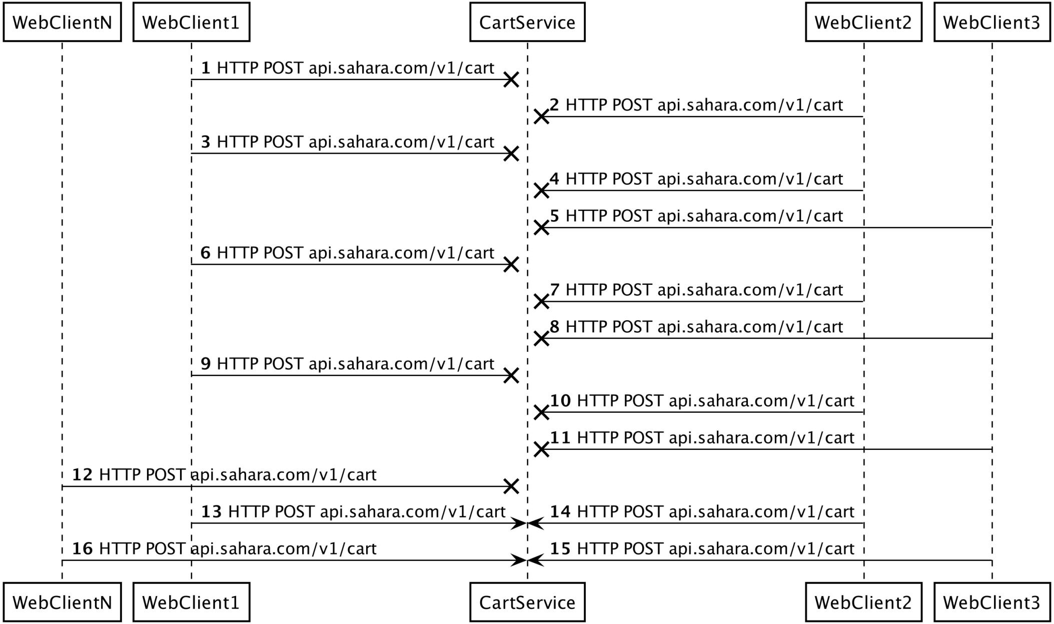
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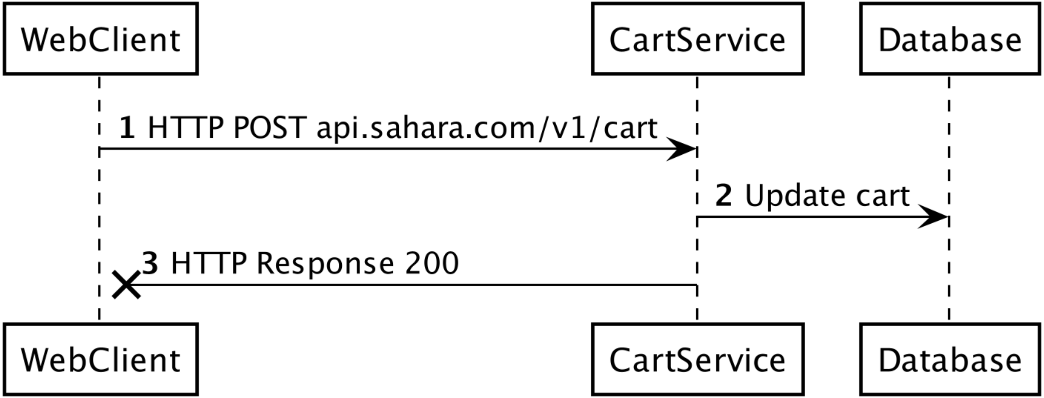
Exponential Backoff

```
retry = True
do:
    status = service.request()

    if status != SUCCESS:
        wait(2 ** retries)
    else:
        retry = False
while (retry and retries < MAX_RETIRES)
```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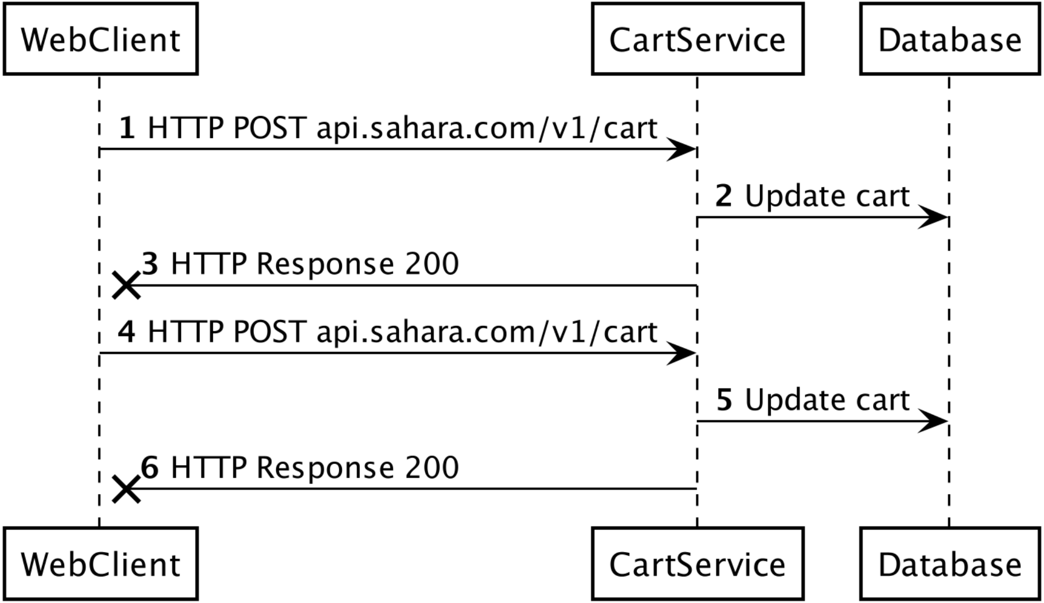
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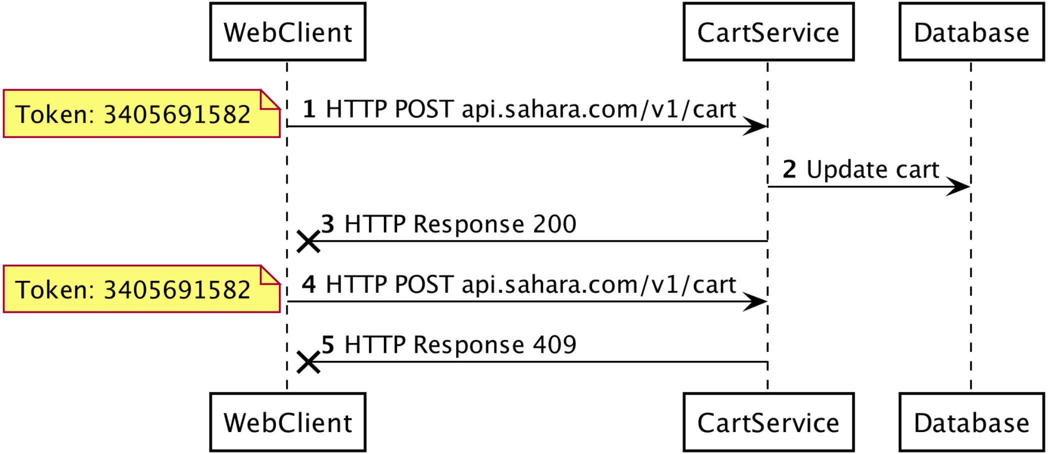
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4 HTTP POST api.sahara.com/v1/cart
5 HTTP Response 409
WebClient
CartService
Database

Fallacy #2

Latency is zero.

Network Statistics

Home to UQ

Home to us-east-1

EC2 to EC2

Network Statistics

Home to UQ 20.025ms

Home to us-east-1

EC2 to EC2

Network Statistics

Home to UQ 20.025ms

Home to us-east-1 249.296ms

EC2 to EC2

Network Statistics

Home to UQ	20.025ms
Home to us-east-1	249.296ms
EC2 to EC2	0.662ms

Fallacy #3

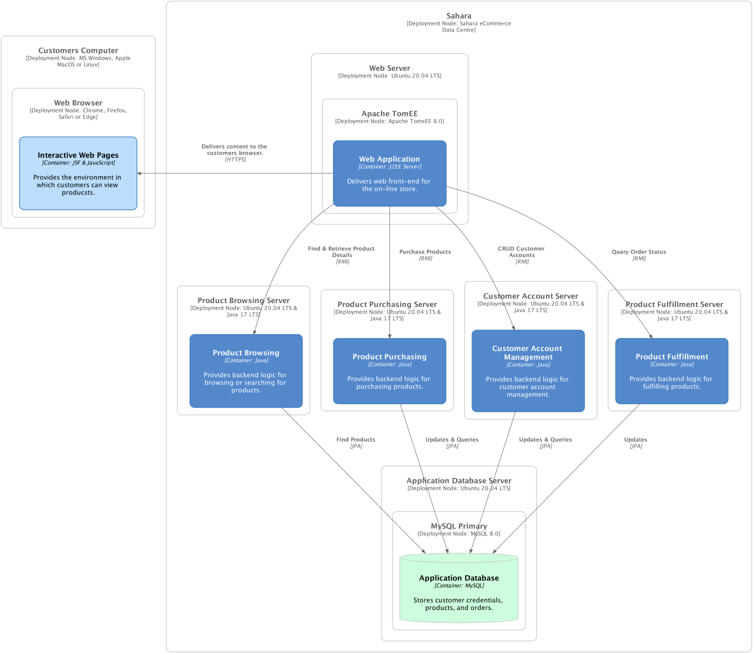
Bandwidth is infinite.

Definition 1. Stamp Coupling

Components which share a composite data structure.

Fallacy #4

The network is secure.



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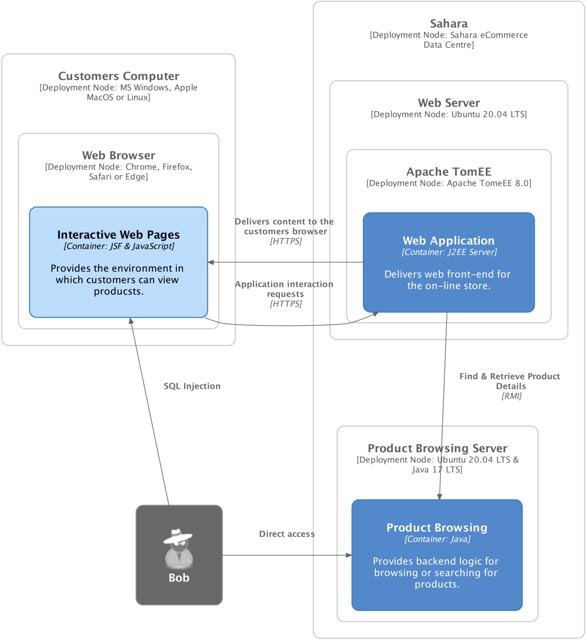
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Bob
Direct access

Fallacy #5

The topology never changes.

Fallacy #6

There is only one administrator.

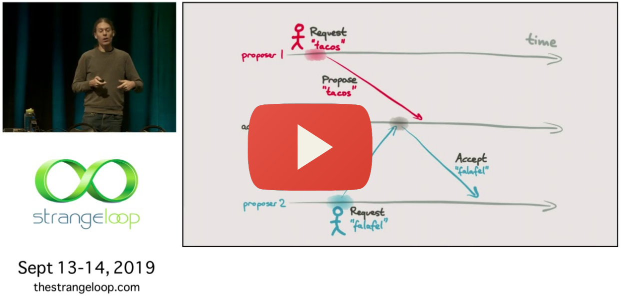
Fallacy #7

Transport cost is zero.

Remember

Distributed systems are *hard*.
The choice to use them should be *well considered*.

When you need to, maybe prove it?



Or, more realistically,

Use existing algorithms and software.

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Stateless vs. Stateful Systems

Stateless Does *not* utilise *persistent data*.

Stateful Does utilise *persistent data*.

Question

What makes software *reliable*?

Definition 2. Reliable Software

Continues to work, even when things go wrong.

Definition 3. Fault

Something goes wrong.

Death, taxes, and computer system failure are all inevitable to some degree.

Plan for the event.

- Howard and LeBlanc

Reliable software is

Fault *tolerant*.

Problem

Individual computers fail *all the time*.

Solution

Spread the risk of faults over *multiple computers* or *nodes*.

Spreading Risk

If you have software that works with *just one* computer, spreading the software over *two* computers *halves* the risk that your software will fail.

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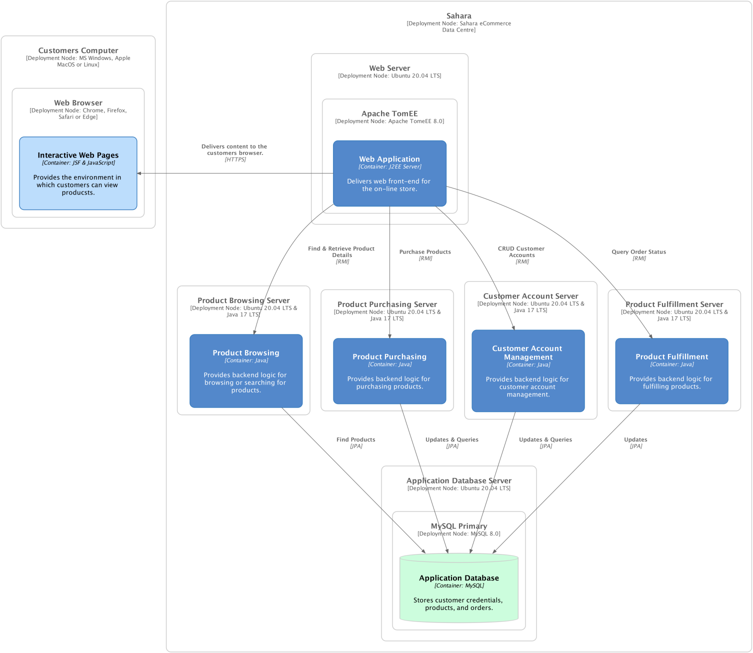
Adding *100* computers reduces the risk by *100*.



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Who has used *auto-scaling*?

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Scaling Policy How to determine the desired capacity.

Minimum/Maximum Capacity *Hard limits* on the minimum and maximum number of instances.

What we really want

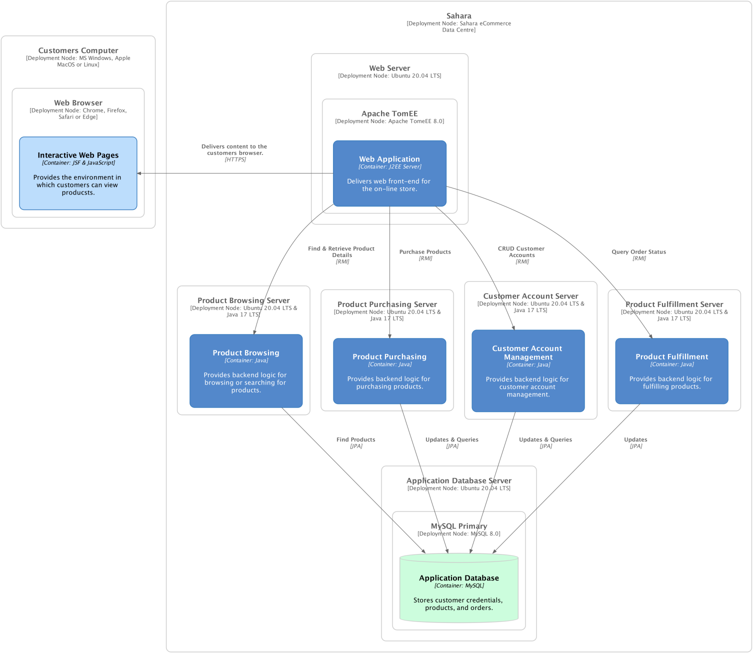
Desired Capacity Amount of *healthy* instances we want to have in an auto-scaling group.

Health check

Mechanism to determine whether an instance is *healthy*.

Auto-scaling

An example



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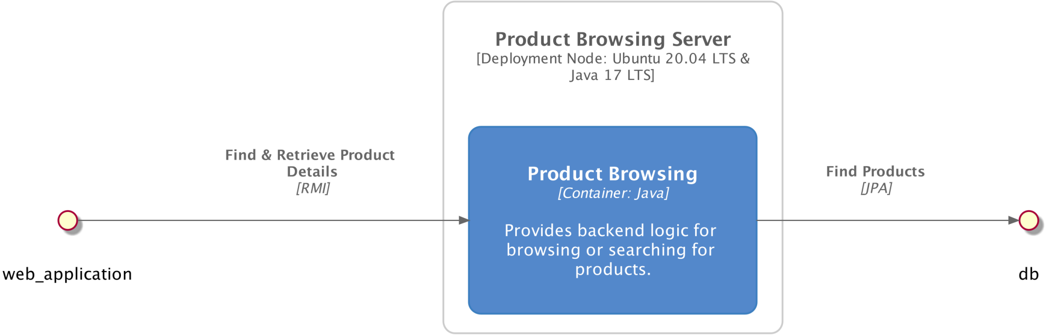
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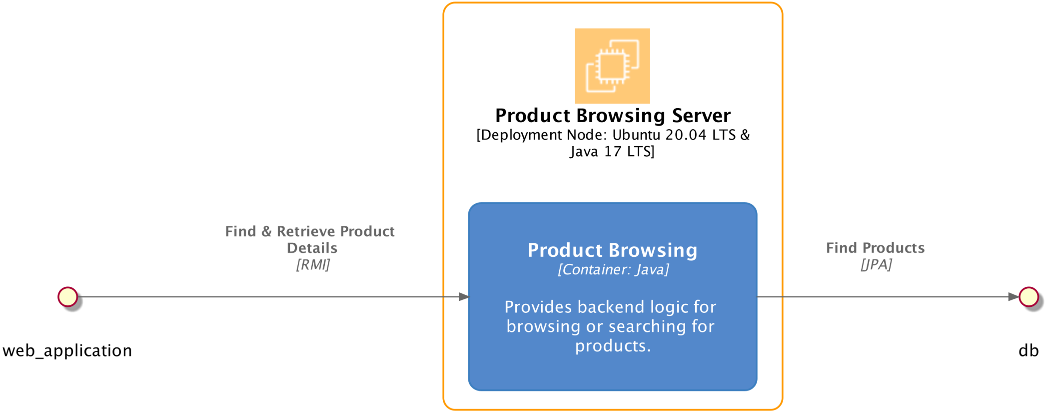
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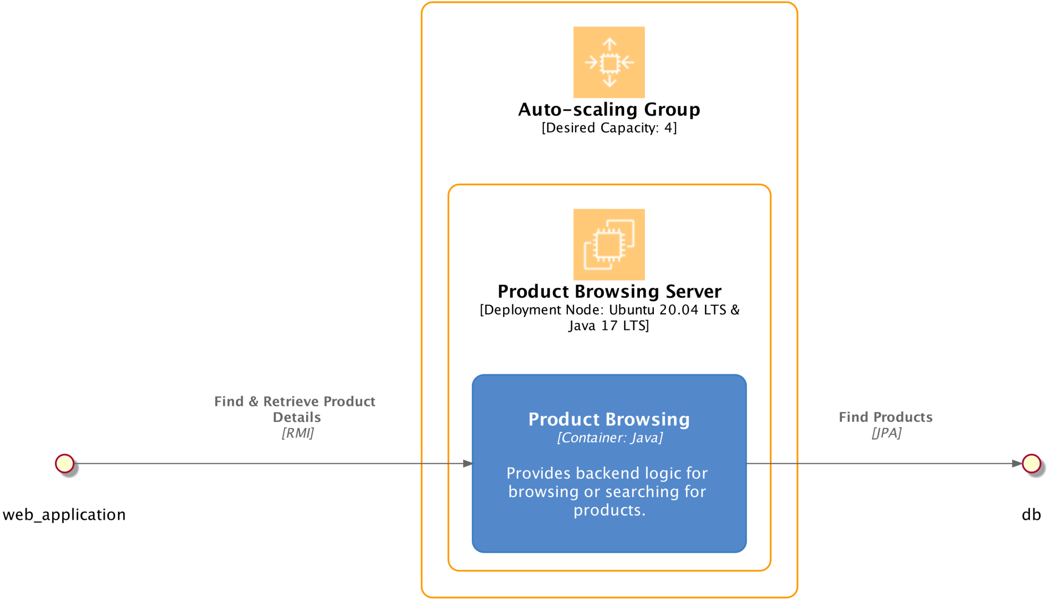
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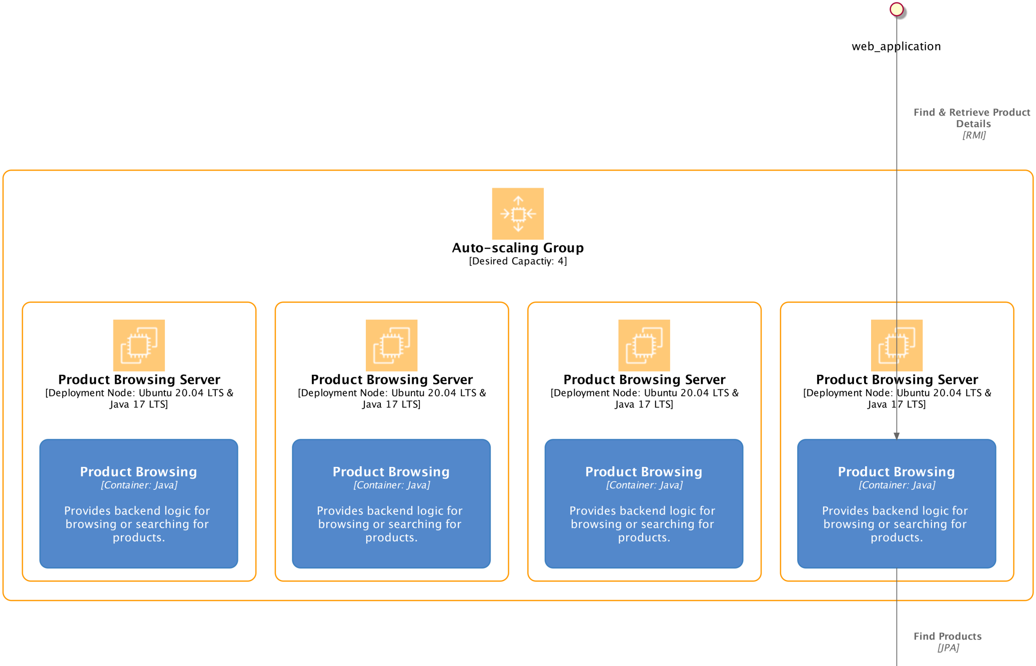
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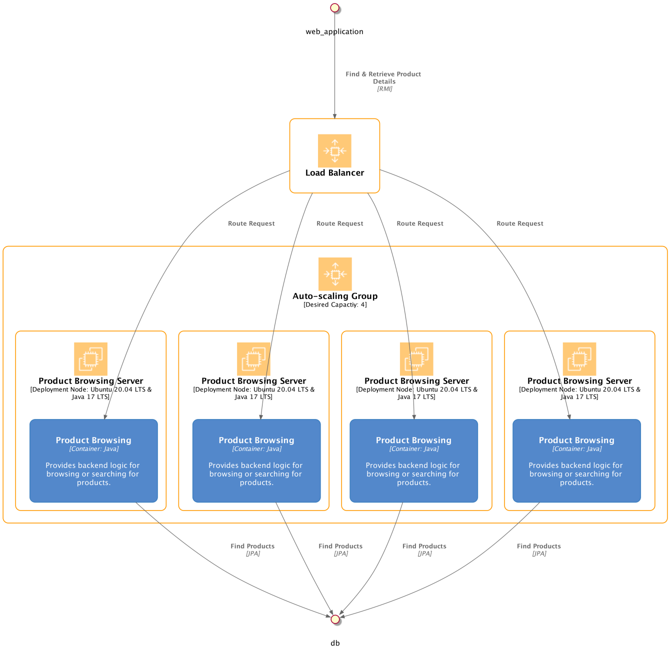

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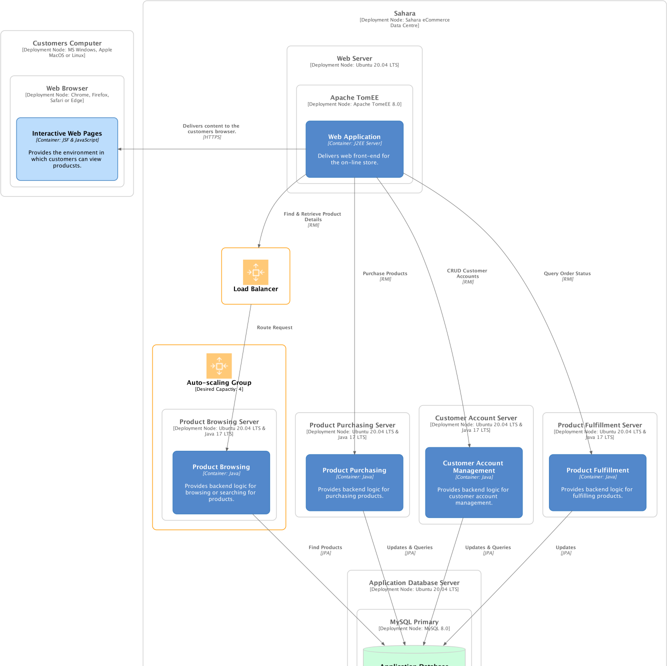
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Scalability

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Scalability Auto-scaling and load balancing allows *individual services to scale*. However, the *database is a bottle-neck*.