

# Distributed Computing I

## *Software Architecture*

Brae Webb

March 20, 2023



**Mathias Verras**  
@mathiasverraes

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

*Previously in CSSE6400...*

## Service-based Architecture

## Previously in CSSE6400...

Simplicity For a distributed system



Modularity Services



Extensibility New services



Deployability Independent services



Testability Independent services



Security API layer



Reliability Independent services



Interoperability Service APIs



Scalability Coarse-grained services



## Previously in CSSE6400...

Simplicity For a distributed system



Reliability Independent services



Scalability Coarse-grained services



Previously in CSSE6400...

Simplicity *For a distributed system*



Previously in CSSE6400...

Simplicity



# § *Fallacies*

*Question*

What is a *fallacy*?

### *Definition 1.* Fallacy

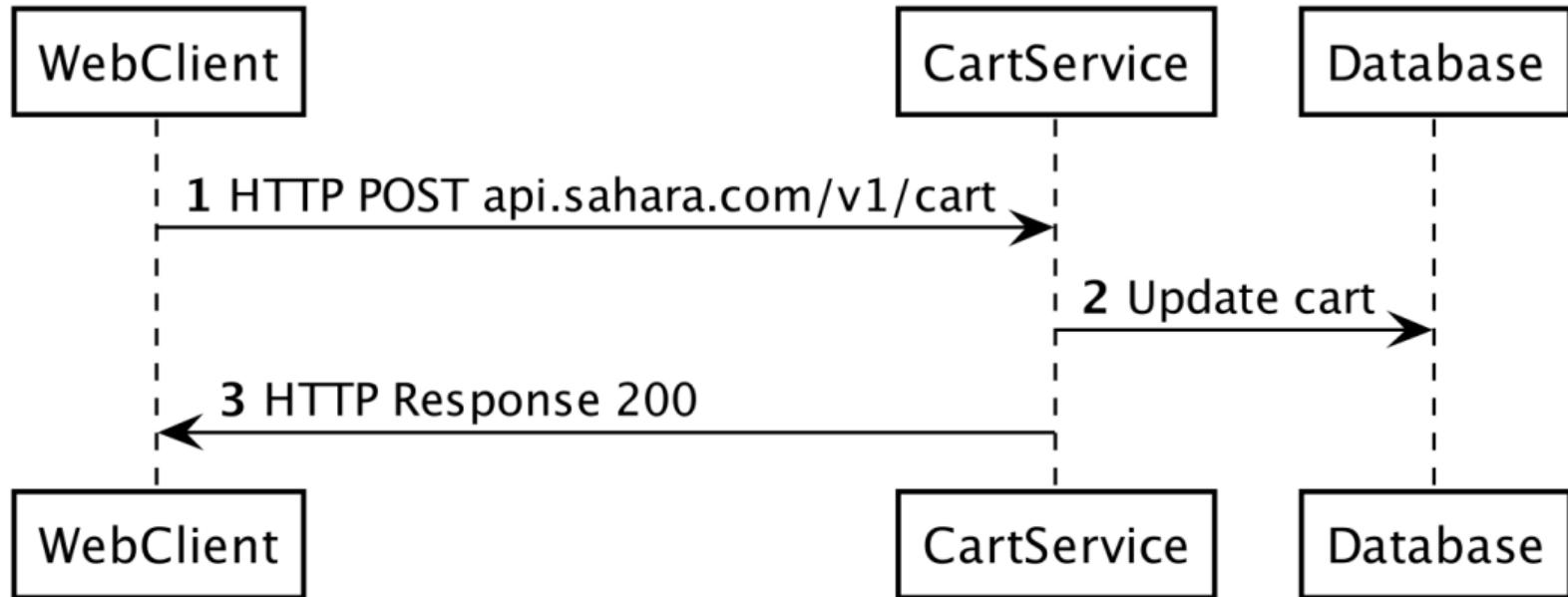
Something that is believed or assumed to be true but is not.

*A few reasons for complexity*

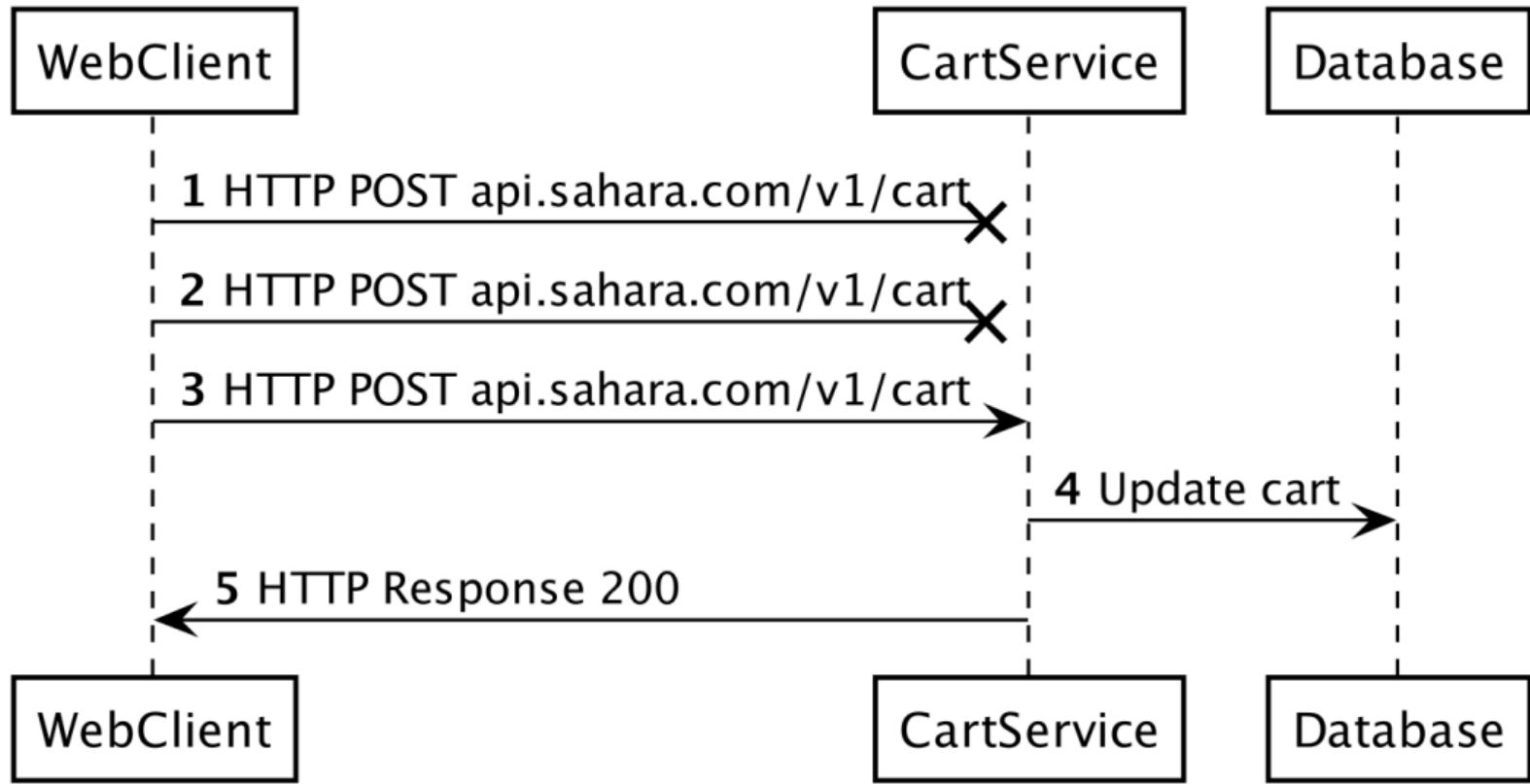
The Fallacies of *Distributed Computing*

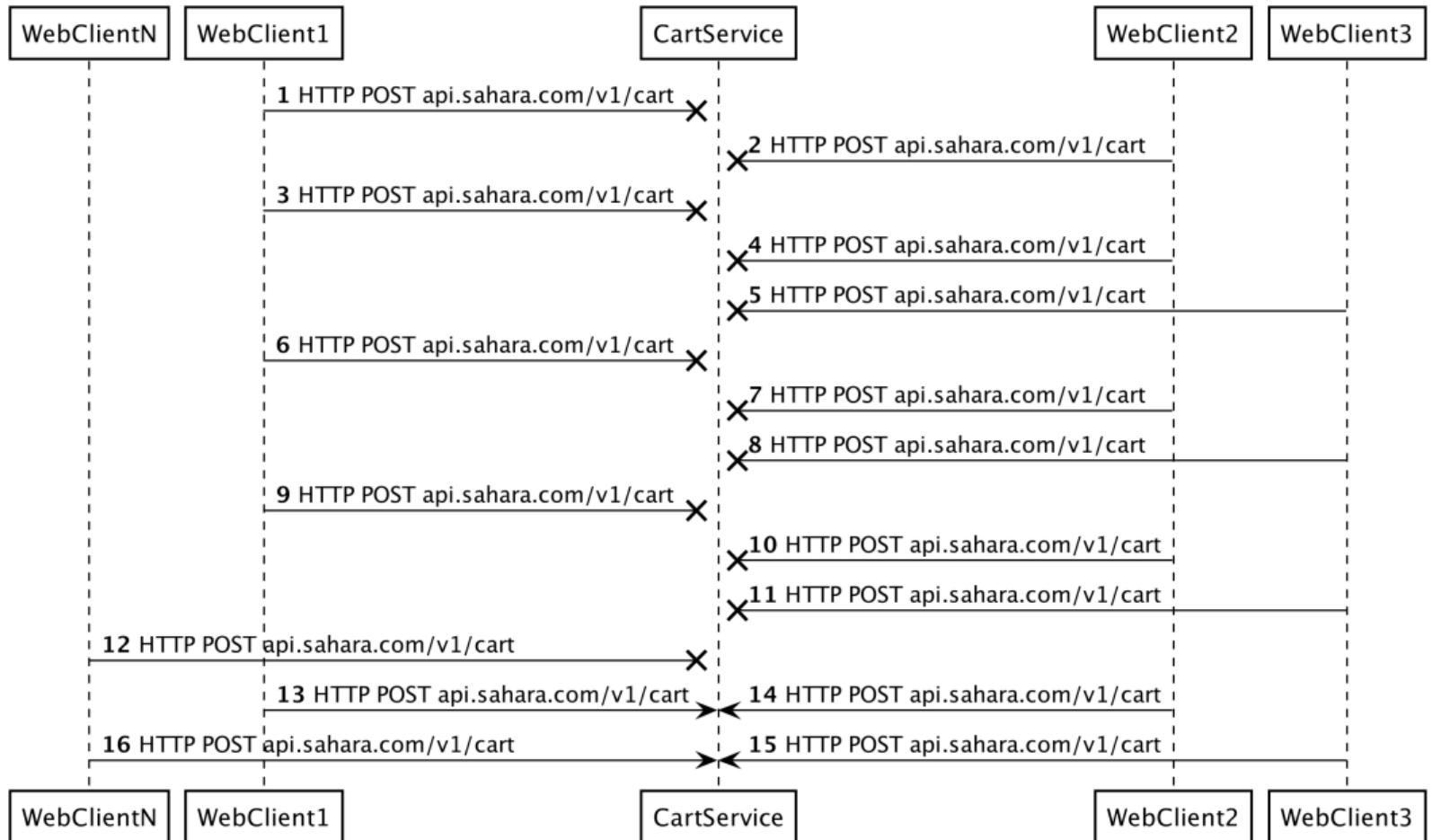
*Fallacy #1*

The network is reliable



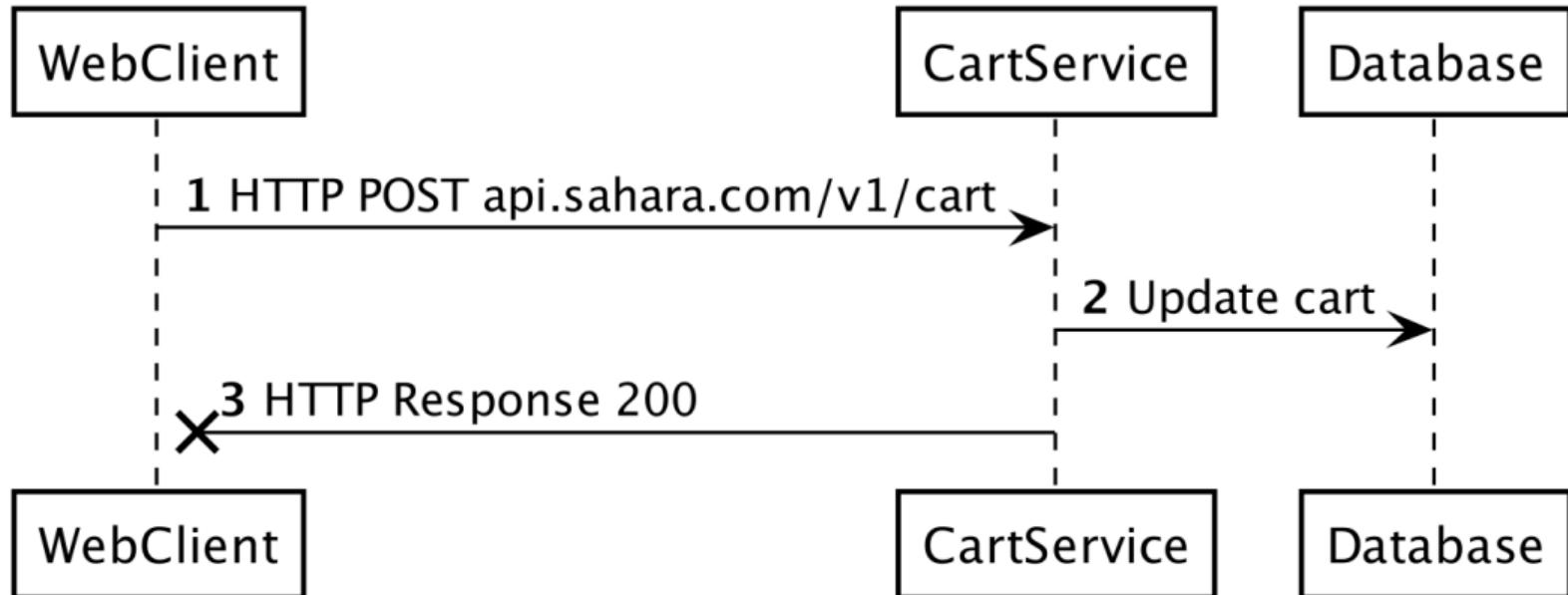


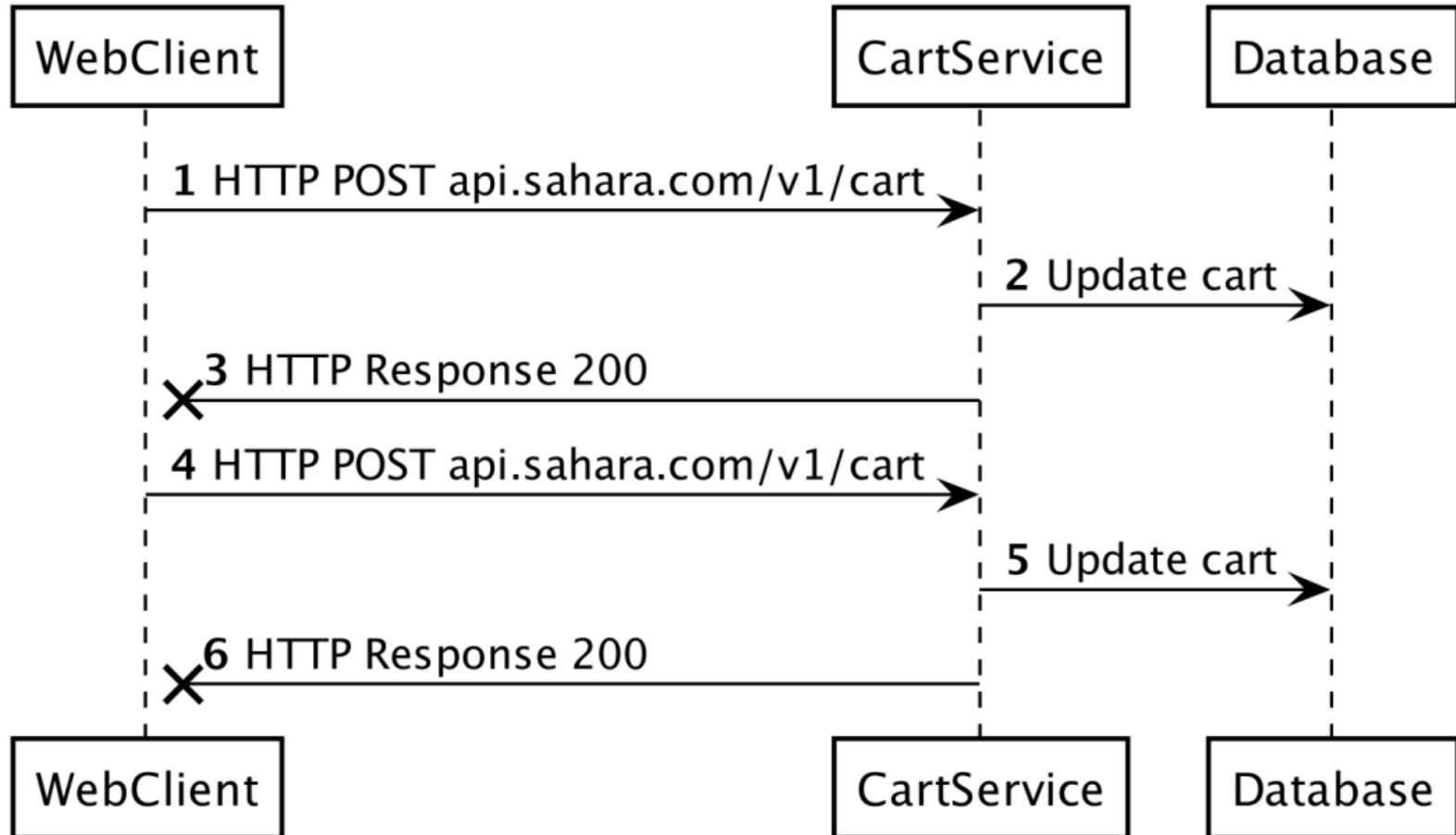


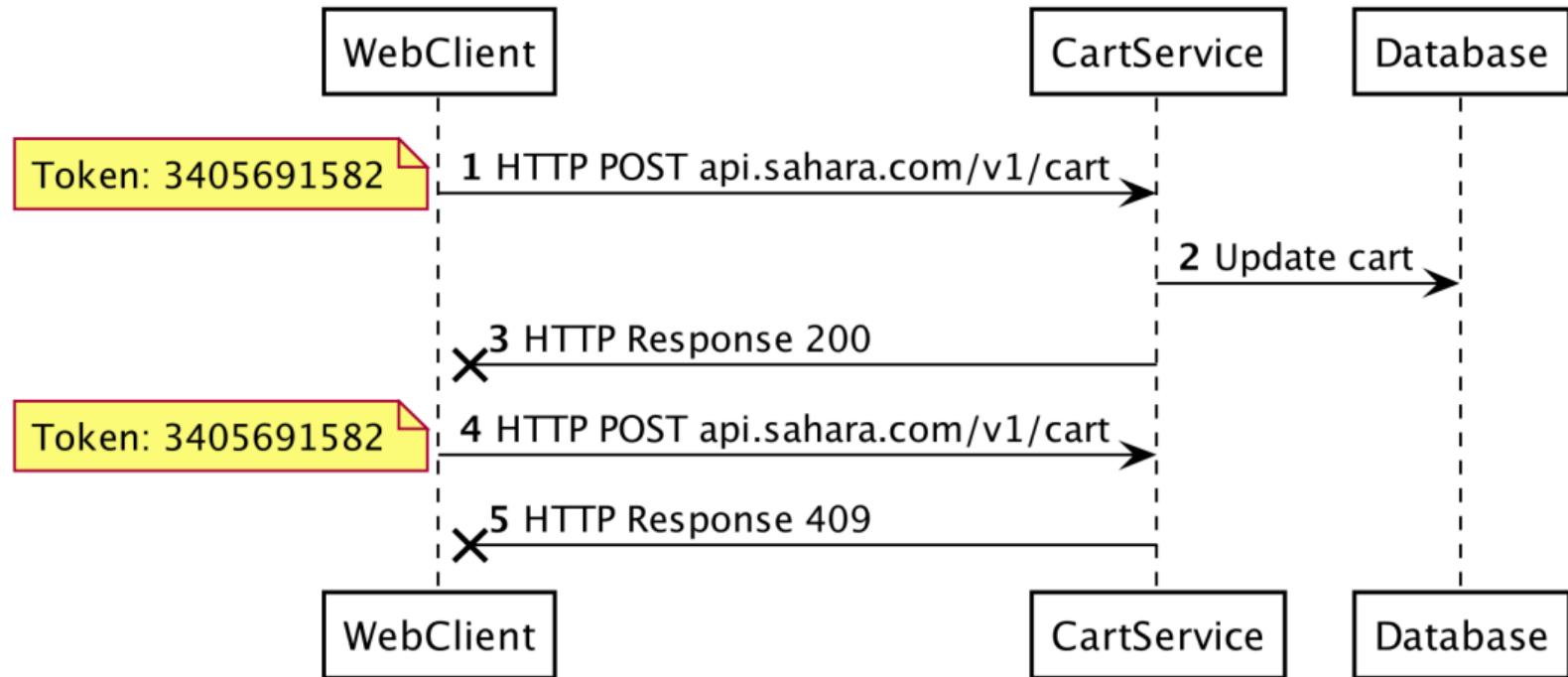


## Exponential backoff

```
1  retry = True
2  do:
3      status = service.request()
4
5      if status != SUCCESS:
6          wait(2 ** retries)
7      else:
8          retry = False
9  while (retry and retries < MAX_RETRIES)
```







*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

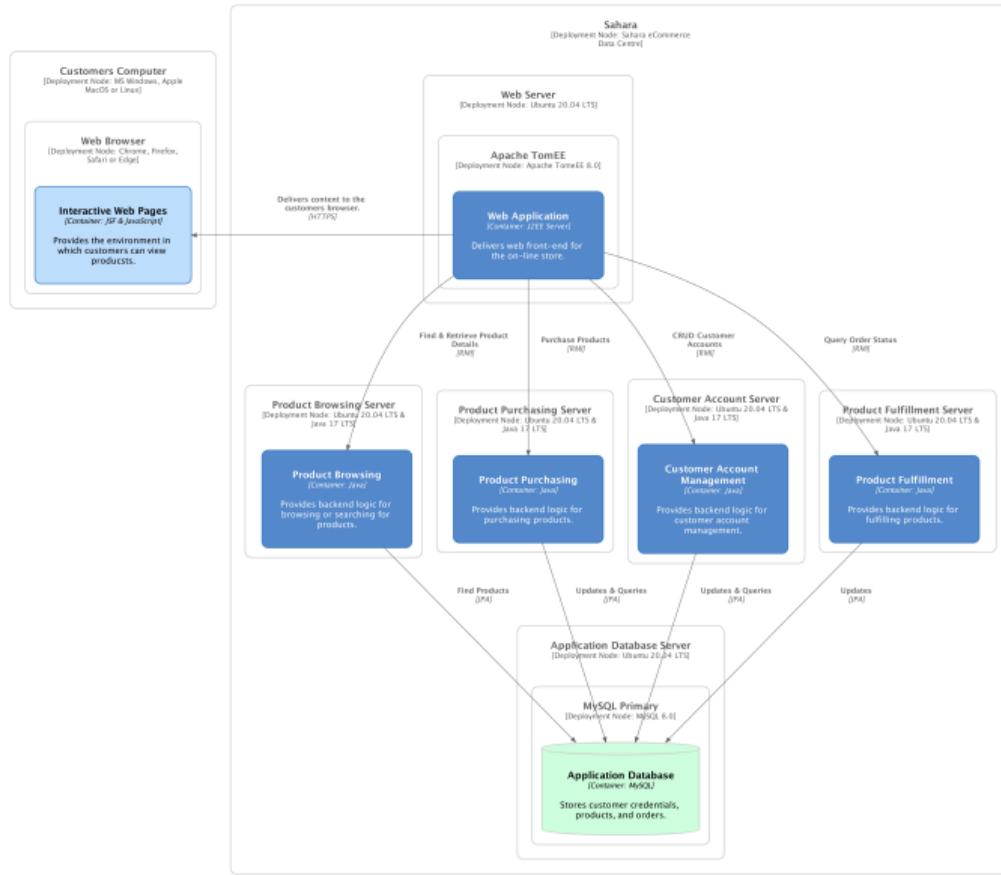
EC2 to EC2 0.662ms

*Fallacy #3*

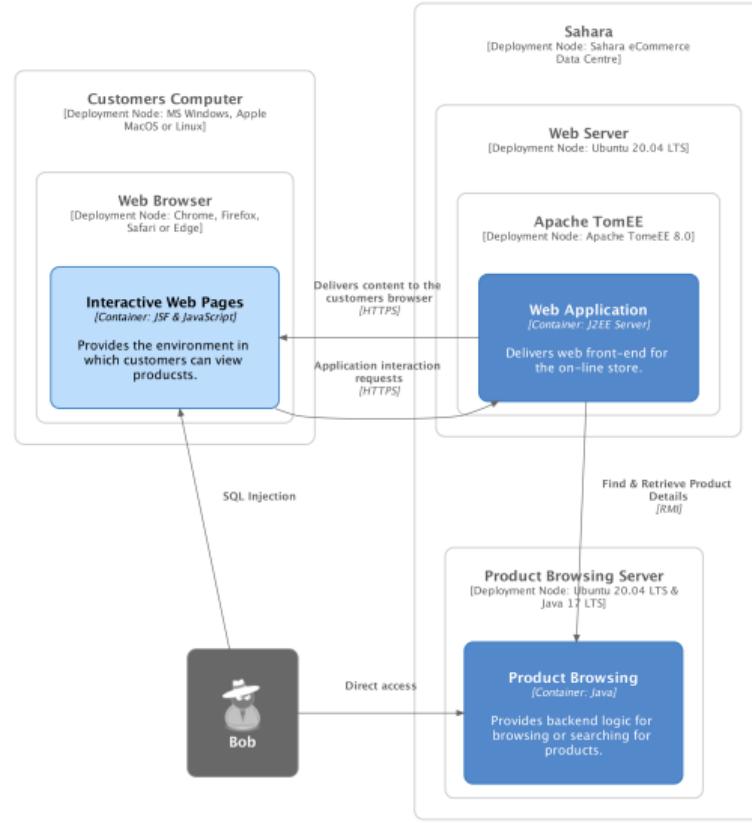
Bandwidth is infinite

*Fallacy #4*

The network is secure



Legend



Legend

*Fallacy #5*

The topology never changes

*Fallacy #6*

There is only one administrator

*Scenario*

- Deployments are banned on the weekend.

*Scenario*

- Deployments are banned on the weekend.
- Sunday night users start complaining.

### *Scenario*

- Deployments are banned on the weekend.
- Sunday night users start complaining.
- There have been no deployments since Friday.

### *Scenario*

- Deployments are banned on the weekend.
- Sunday night users start complaining.
- There have been no deployments since Friday.
- You can still access the system.

### *Scenario*

- Deployments are banned on the weekend.
- Sunday night users start complaining.
- There have been no deployments since Friday.
- You can still access the system.
- Who do you talk to?

*Fallacy #7*

Transport cost is zero

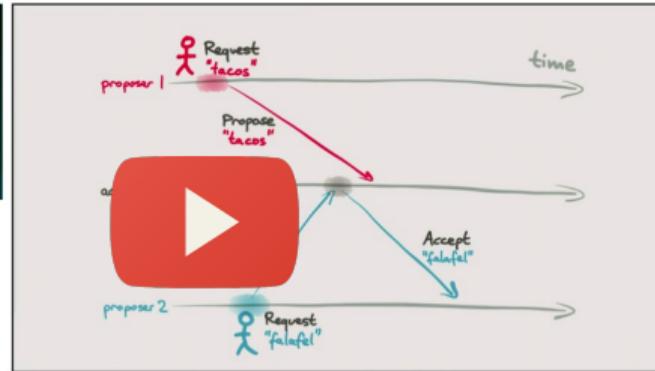
*Remember*

Distributed systems are *hard*.

*Remember*

Distributed systems are often *not your friend.*

*When you need to, prove it*



Sept 13-14, 2019  
[thestrangeloop.com](http://thestrangeloop.com)

## Previously in CSSE6400...

Simplicity For a distributed system



Reliability Independent services



Scalability Coarse-grained services



Previously in CSSE6400...

Reliability Independent services



*Question*

What makes software *reliable*?

*‘Working’ software*

Satisfies the functional requirements

*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*

### *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.

### *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.

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

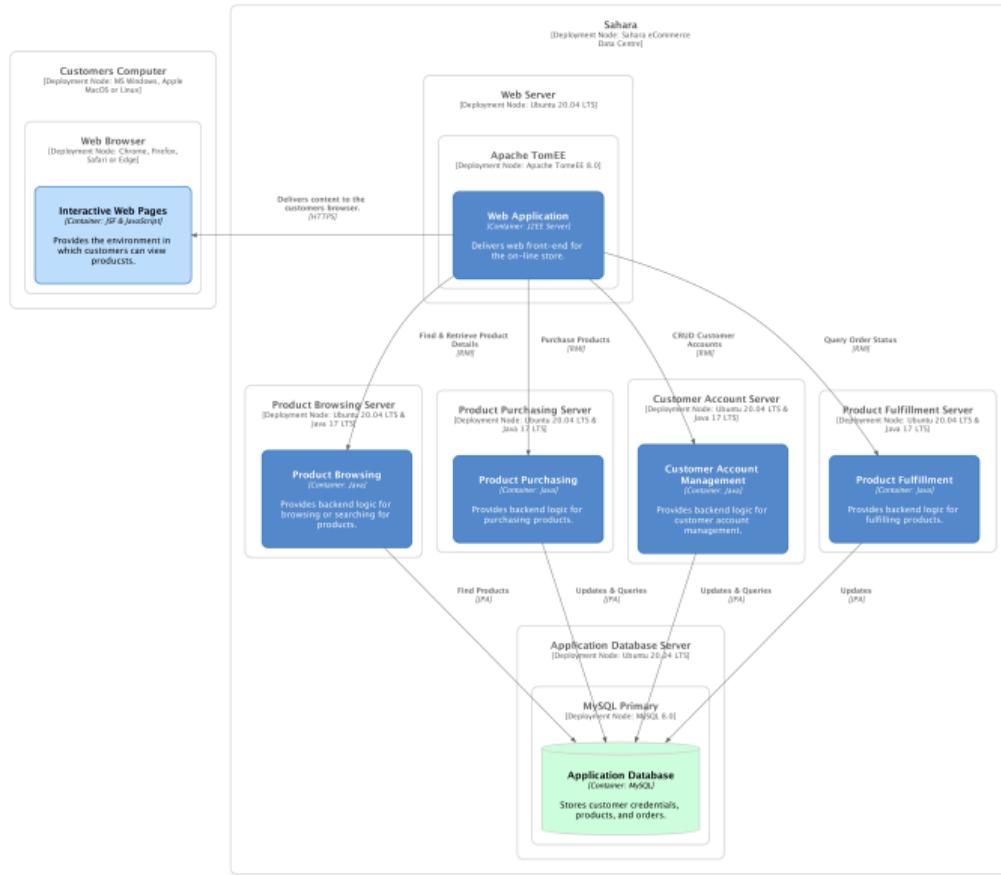
### *Spreading Risk*

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

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

---

Of course, there are other reasons you might want run software on multiple computers.



Legend

## Previously in CSSE6400...

Simplicity For a distributed system



Reliability Independent services



Scalability Coarse-grained services



Previously in CSSE6400...

Scalability Coarse-grained services



*Question*

Who has used *auto-scaling*?

## *Auto-scaling Terminology*

**Auto-scaling group** A *collection of instances* managed by auto-scaling.

## *Auto-scaling Terminology*

**Auto-scaling group** A *collection of instances* managed by auto-scaling.

**Capacity** Amount of instances *currently* in an auto-scaling group.

## *Auto-scaling Terminology*

**Auto-scaling group** A *collection of instances* managed by auto-scaling.

**Capacity** Amount of instances *currently* in an auto-scaling group.

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

## *Auto-scaling Terminology*

**Auto-scaling group** A *collection of instances* managed by auto-scaling.

**Capacity** Amount of instances *currently* in an auto-scaling group.

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

**Scaling Policy** How to determine the desired capacity.

## *Auto-scaling Terminology*

**Auto-scaling group** A *collection of instances* managed by auto-scaling.

**Capacity** Amount of instances *currently* in an auto-scaling group.

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

**Scaling Policy** How to determine the desired capacity.

**Minimum/Maximum Capacity** *Hard limits* on the minimal and maximum amount of instances.

*What we really want*

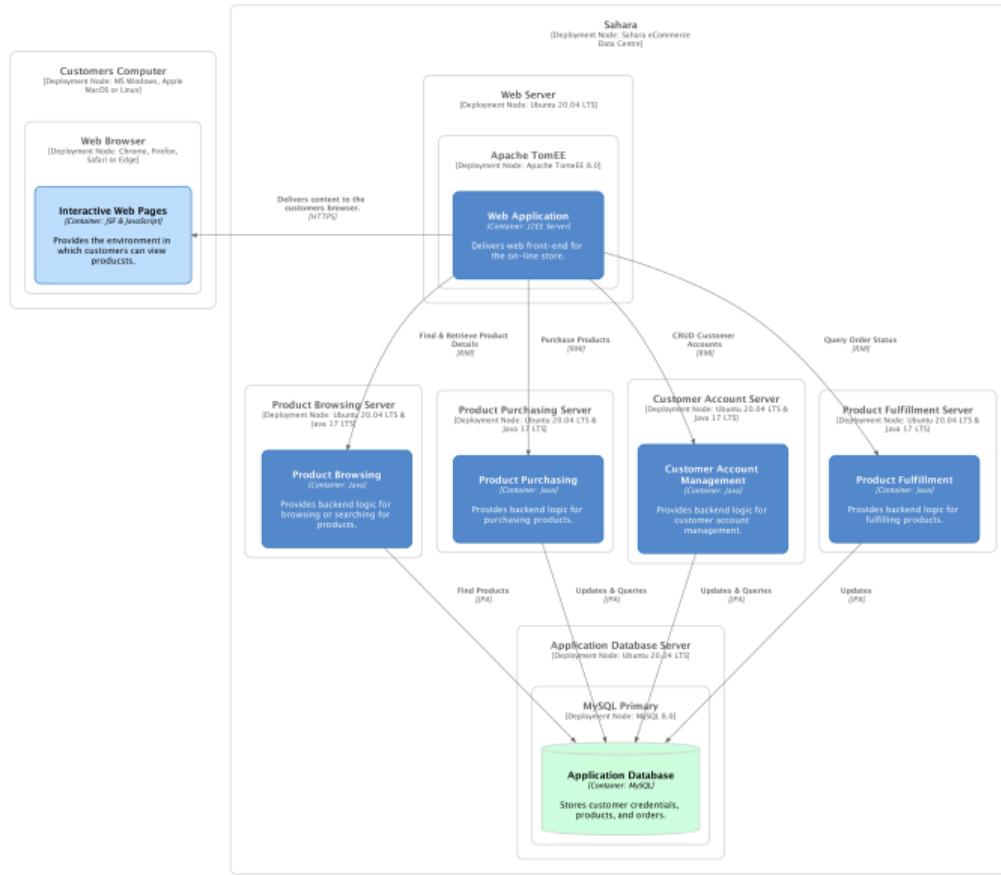
Desired Capacity Amount of *healthy* instances we want to have in an auto-scaling group.

### *Health check*

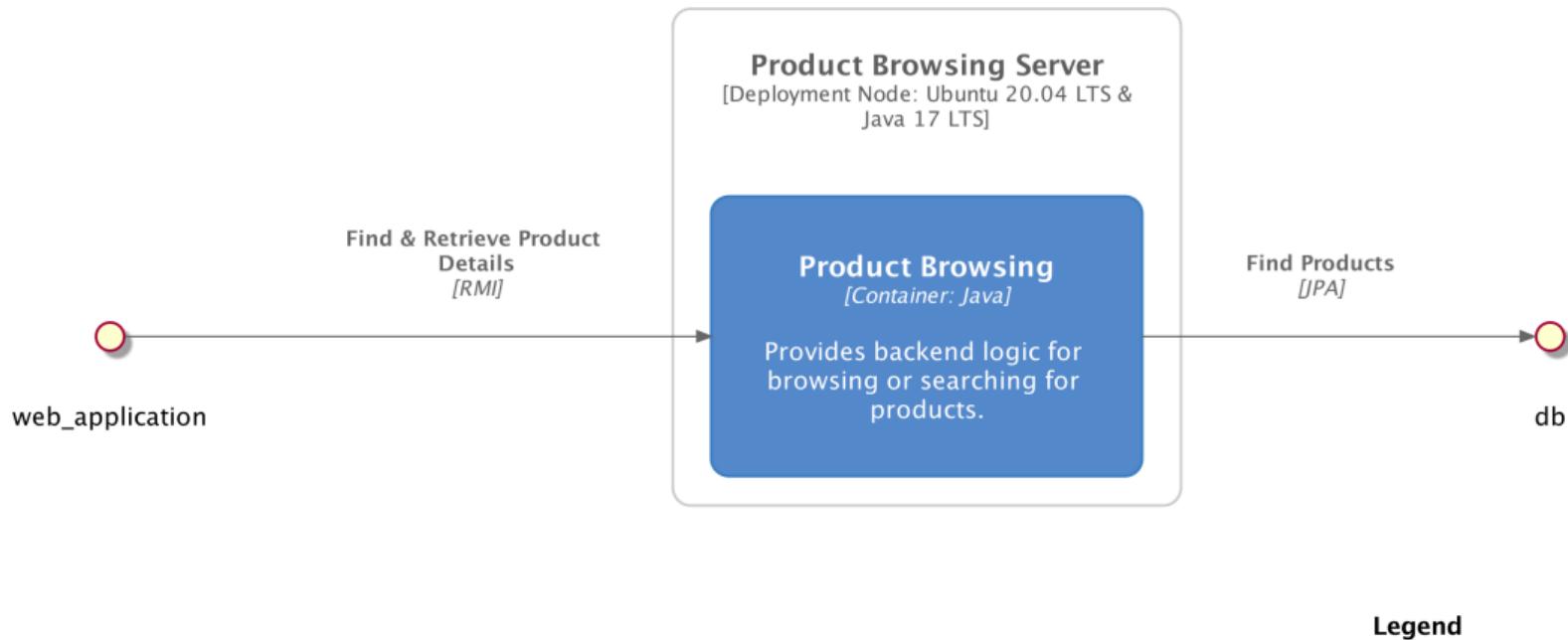
User defined method to determine whether an instance is *healthy*.

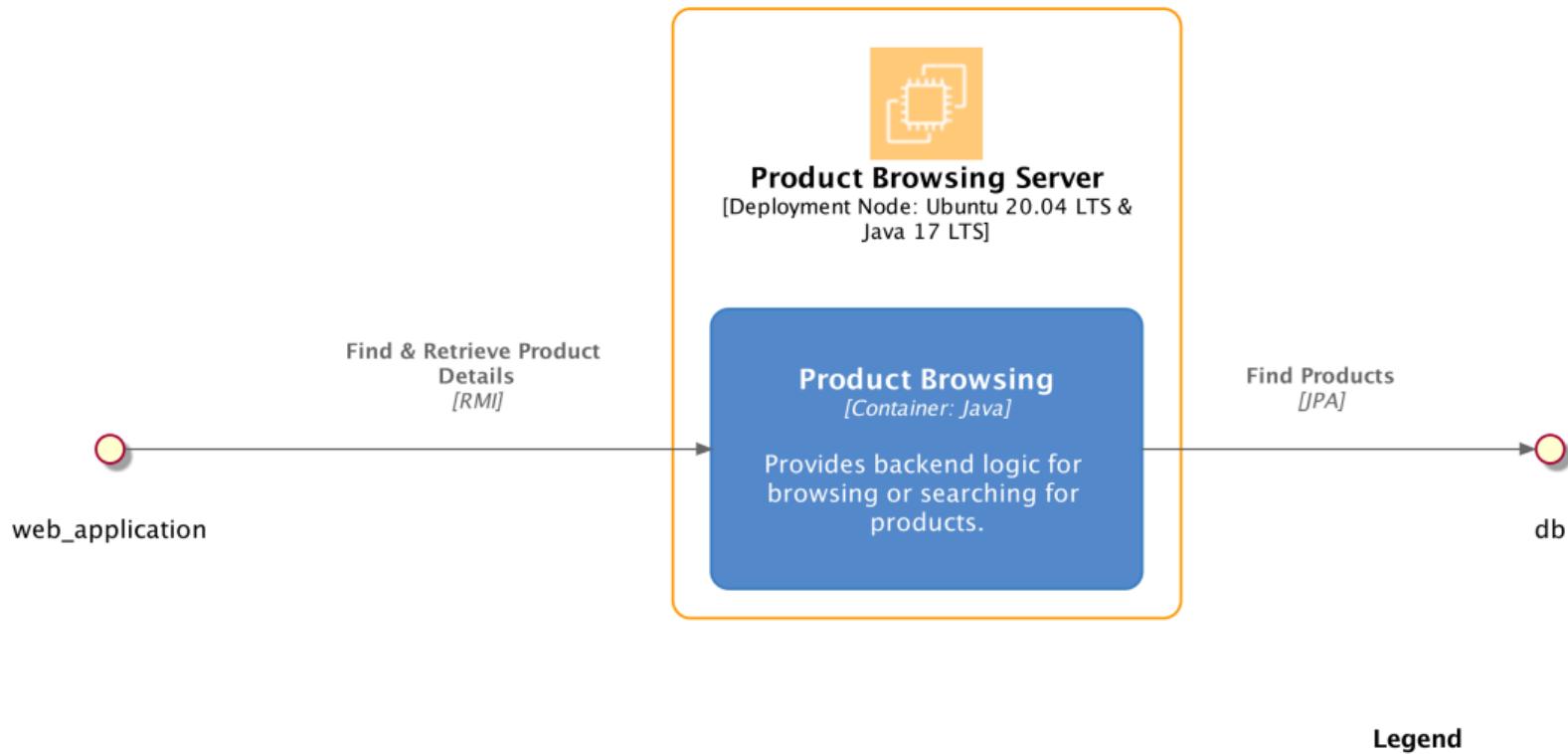
*Auto-scaling*

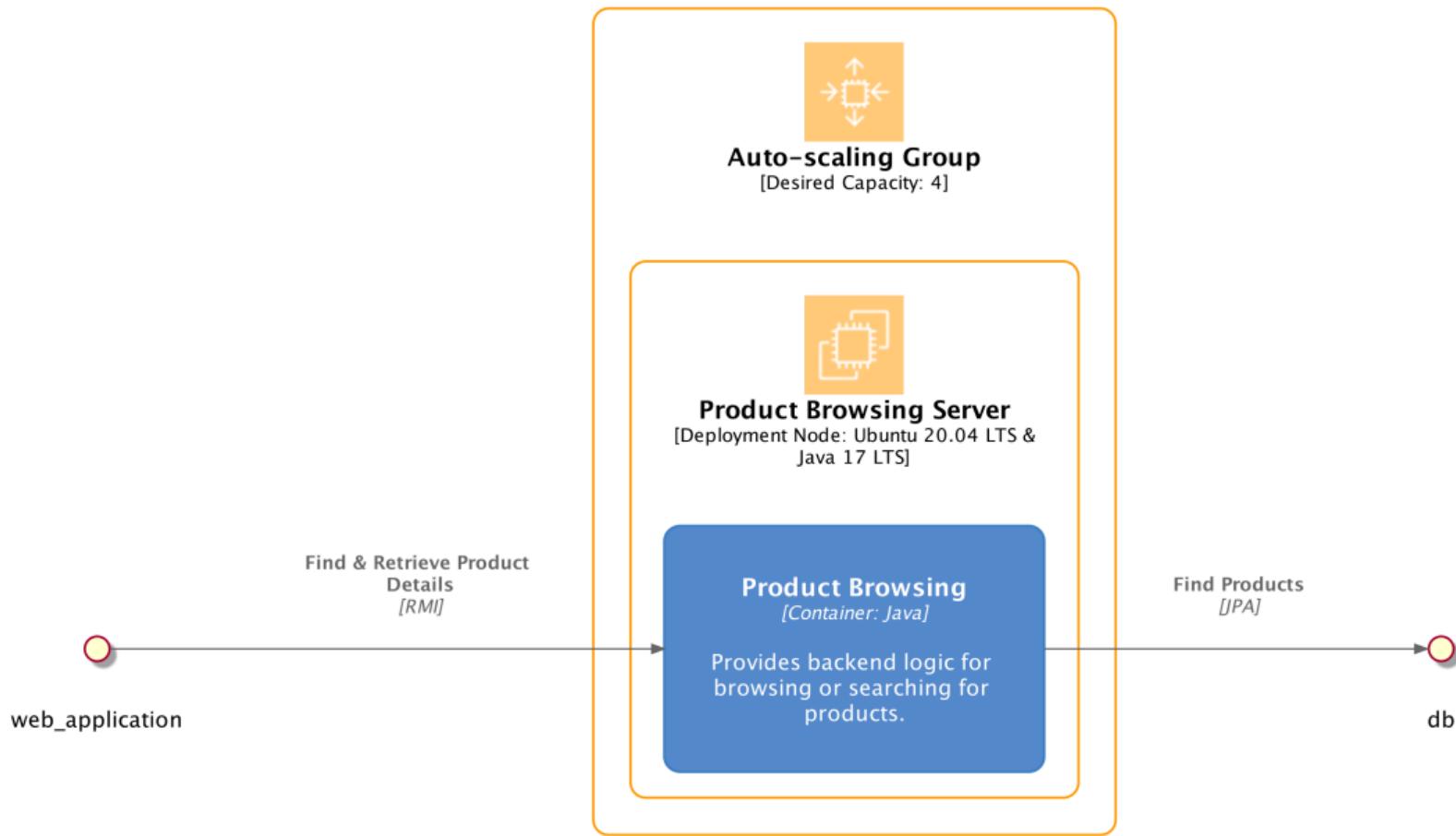
An example

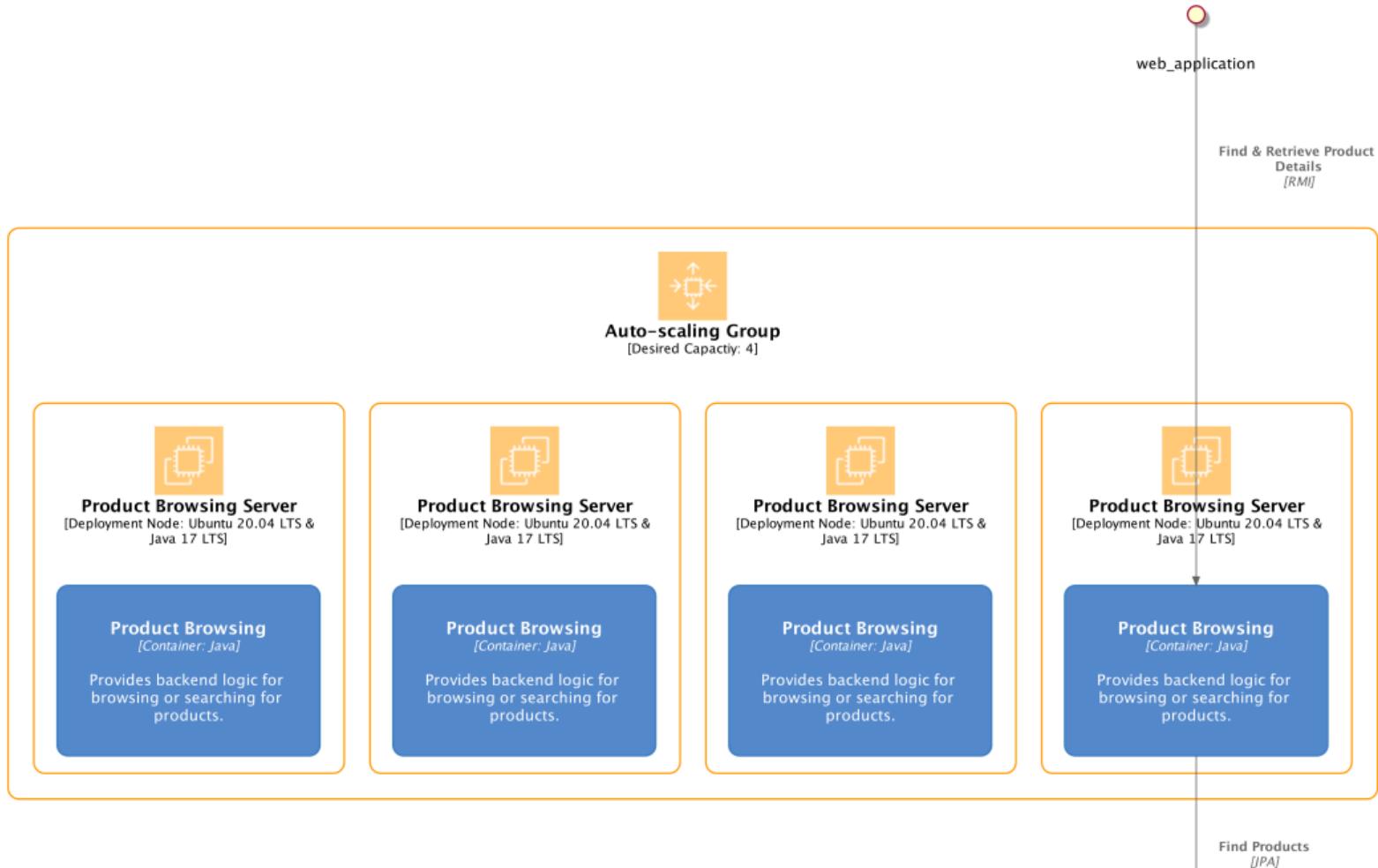


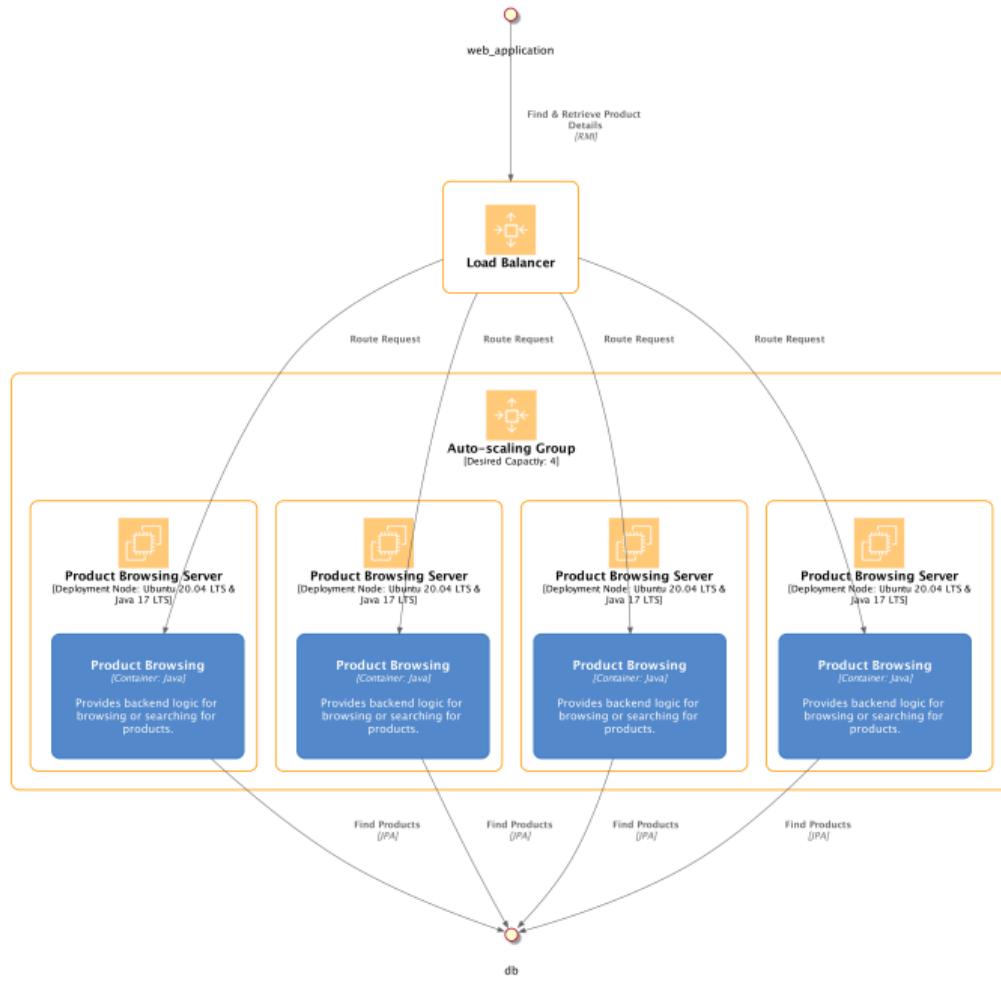
Legend

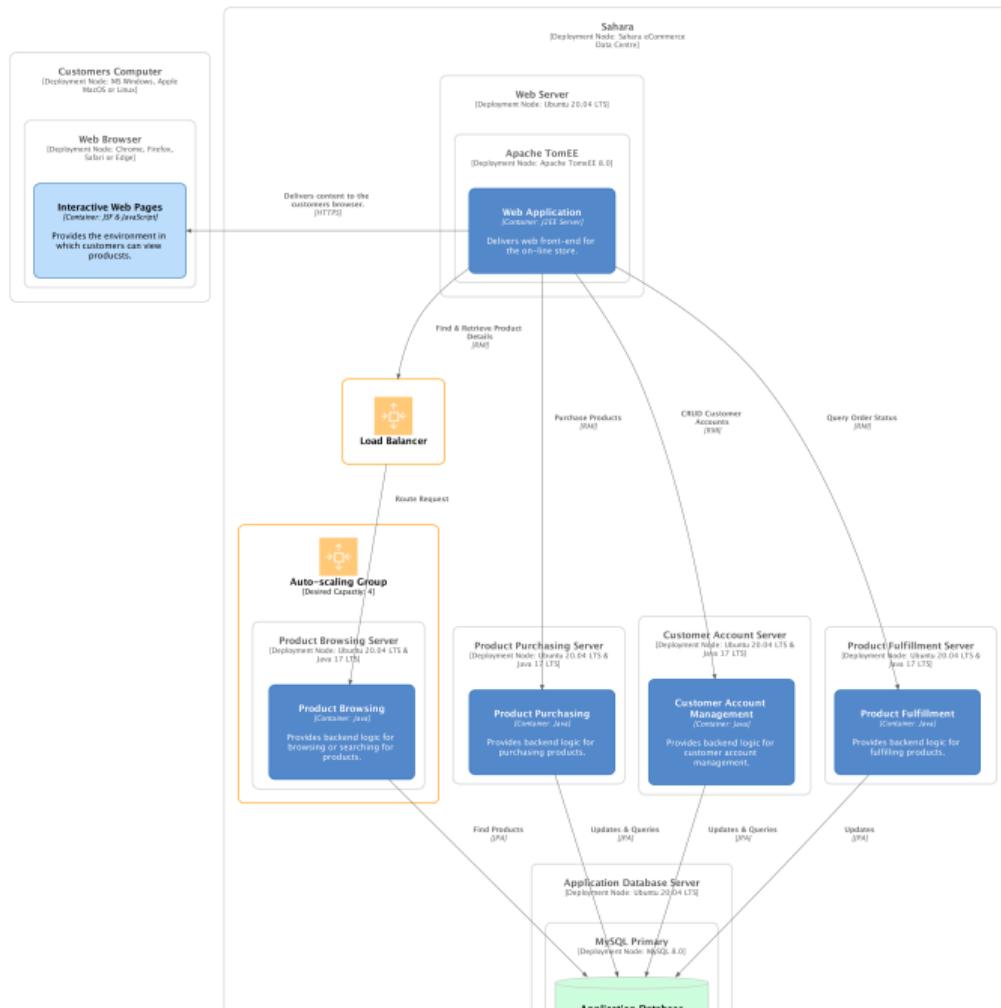












## In Summary

Simplicity

Reliability

Scalability

## In Summary

Simplicity *Minimal network communication* (compared to other distributed systems), less impacted by fallacies.

Reliability

Scalability

## In Summary

Simplicity *Minimal network communication* (compared to other distributed systems), less impacted by fallacies.

Reliability Traffic is spread to various services, still *partially operational* if one goes down. Auto-scaling allows for *basic replication*.

Scalability

## In Summary

Simplicity *Minimal network communication* (compared to other distributed systems), less impacted by fallacies.

Reliability Traffic is spread to various services, still *partially operational* if one goes down. Auto-scaling allows for *basic replication*.

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