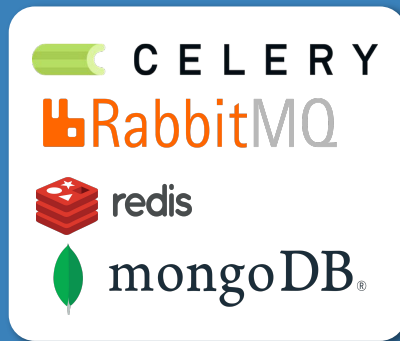


IN4331 - Group 2

A reactive solution using Celery/RabbitMQ

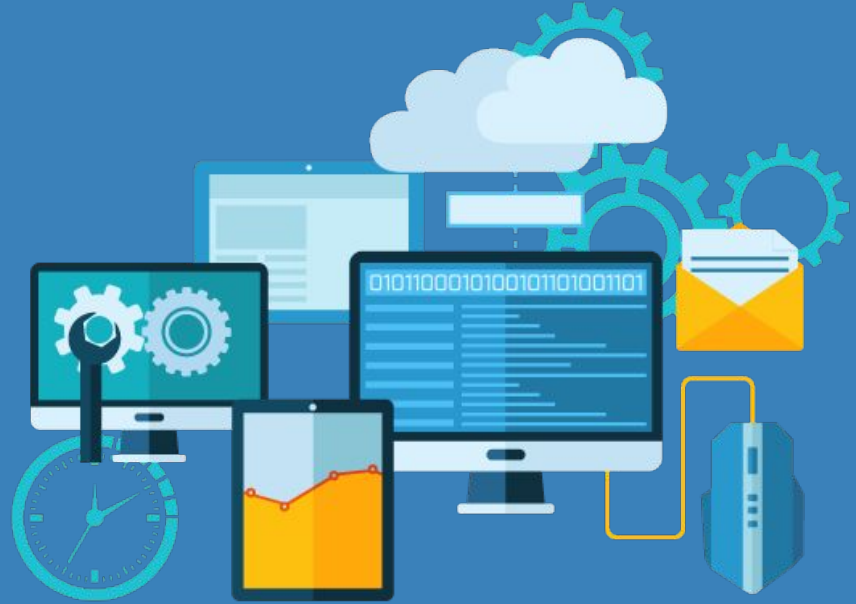


...to serve and
protect data.

Enrique Barba Roque, Philippe de Bekker, Arjan Hasami, Jokūbas de Kort, Simcha Vos



Our System



Databases & Logging



- For the main services: MongoDB
 - Easy to use, highly mature and popular.
 - Horizontal scaling through sharding.
 - Atomic, by checking on the database server.
- Logging and recovery: Redis
 - Flexible data structures, highly mature and popular.
 - In-memory, so extremely fast.
 - Logs the steps in the saga.

Task Management & Messaging

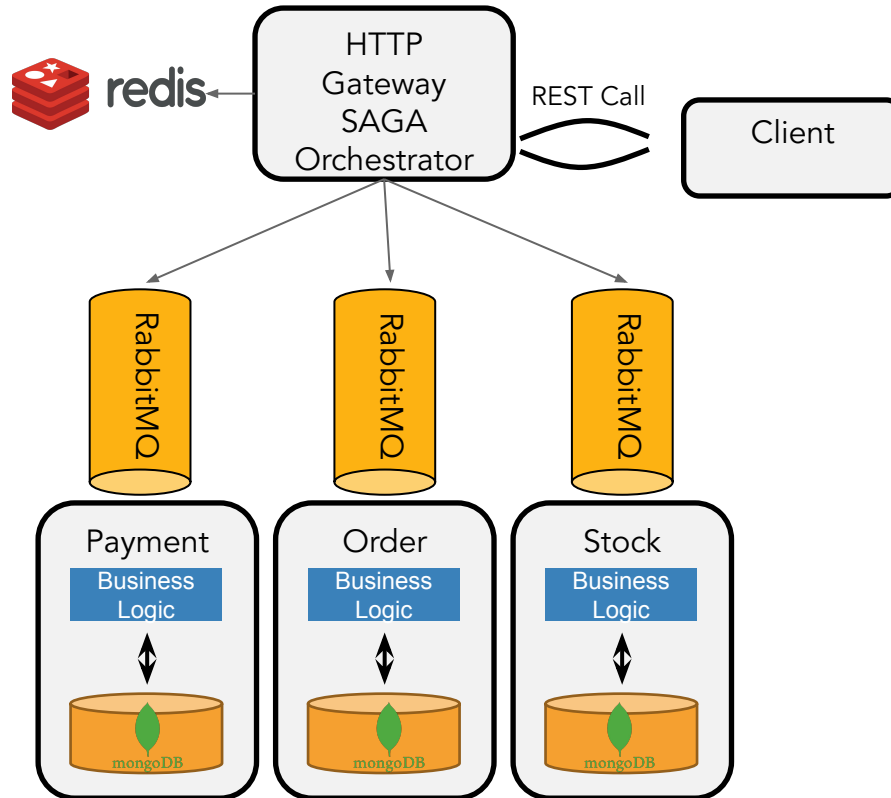


- Distributed task queue: Celery
 - Allows distributed task processing, ideal for large amounts of concurrent tasks.
 - Highly mature and popular; robust and flexible.
- Message broker: RabbitMQ
 - Implements Advanced Message Queuing Protocol; reliable message delivery. Highly mature and popular.
 - Celery workers grab from the queues.

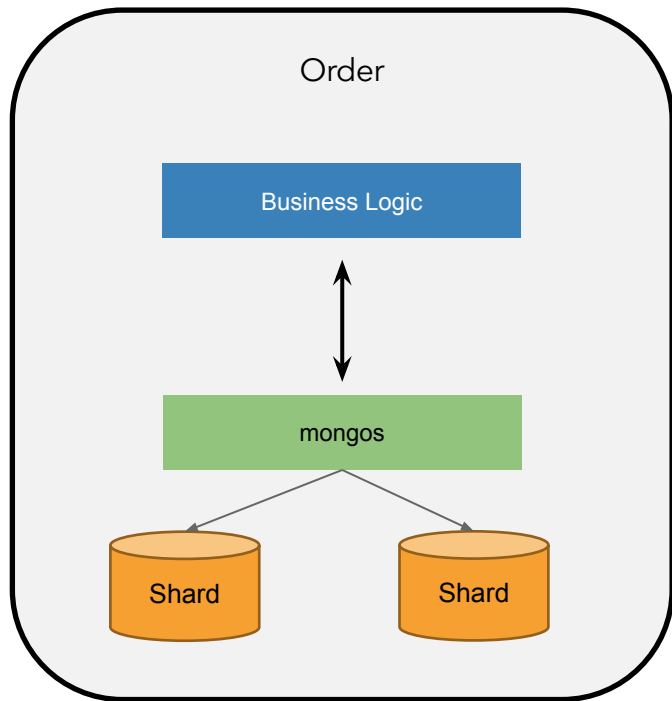
Our Solution



Global overview

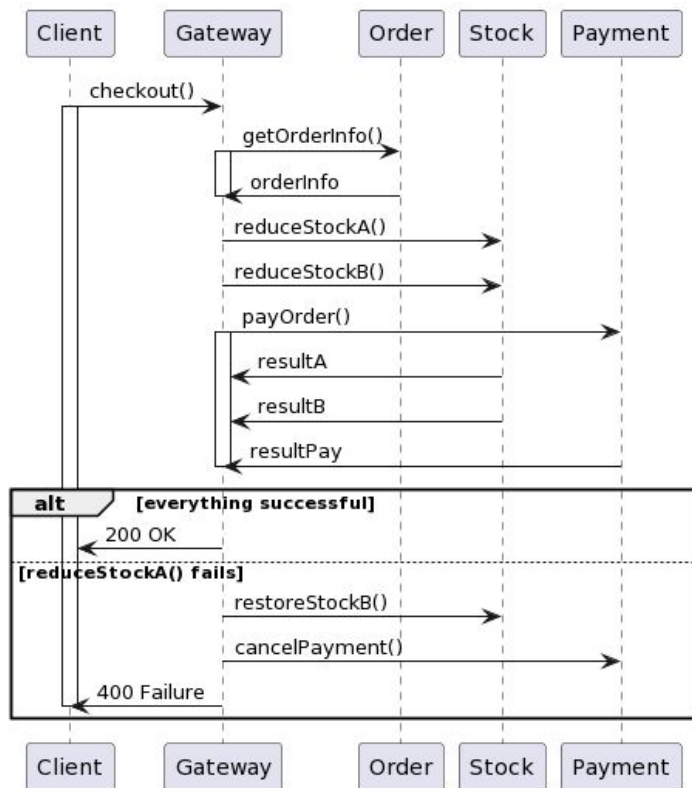


MongoDB Sharding



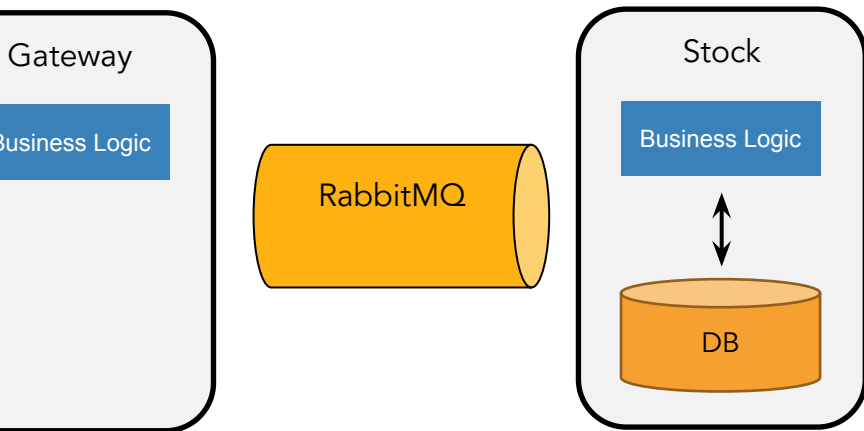
- MongoDB Sharding for DBscaling capabilities
- Operations by entity ID
- Partitioned by ID hashing
 - Equal distribution across shards

SAGA



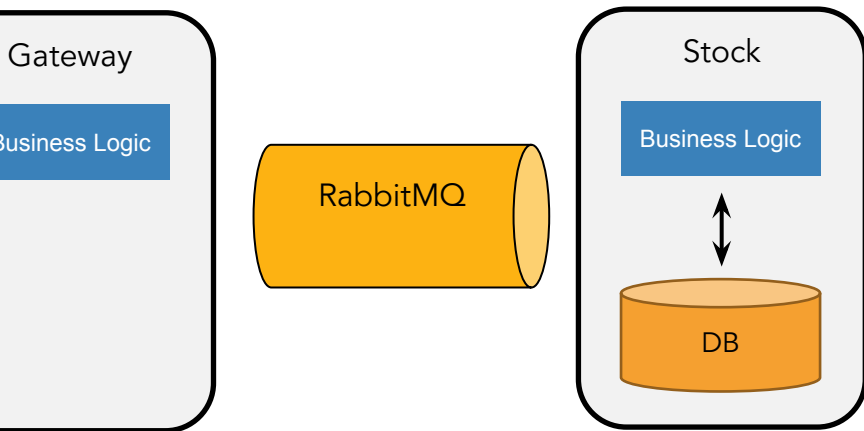
- Gateway acts as SAGA orchestrator.
 - Launch tasks to workers
 - Wait and track status
 - Compensate in case of failure

RabbitMQ for internal communication



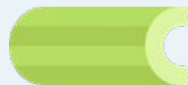
- RabbitMQ for communication between services
 1. Gateway publishes a message on RabbitMQ's message queue;
 2. Stock consumes messages on the queue and processes;
 3. Stock publishes response on queue;
 4. Gateway consumes messages on the queue and continues processing the request.

But what about REST?



- Classic microservices:
 - REST calls in the place of the queues makes all services synchronous
 - Result: horizontal scaling becomes less trivial due to synchronous exchanges
 - Services need to wait for a response and cannot handle other requests in the meantime
- Asynchronous communication makes optimal use of processing time and scaling specific services becomes easy

Celery



- If the API is different this would improve performance
- Celery used in code through `.delay()` and `.get()` functions

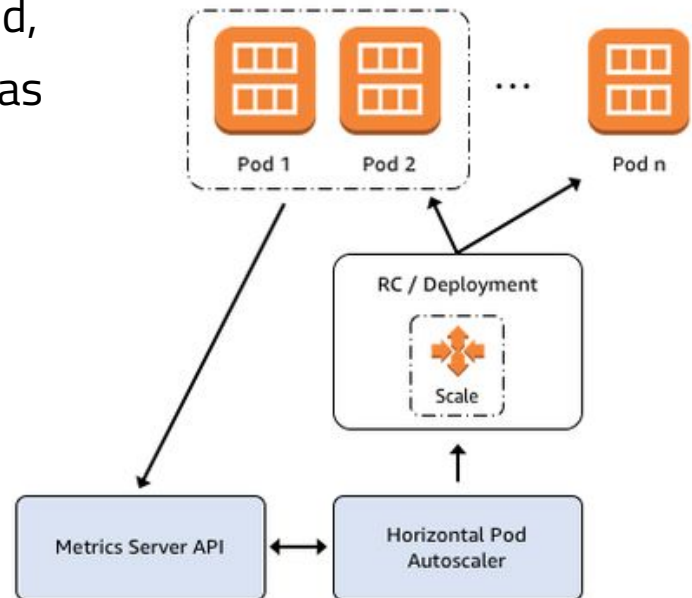
```
@router.get('/stock/find/{item_id}', status_code=status.HTTP_200_OK)
async def find_item(item_id: str):
    task = stock.find_item.delay(item_id)
    item = task.get()
    if item and not task.failed():
        return item
    else:
        raise HTTPException(status_code=404, detail="Item not found")
```

`.get()` blocks until it gets the actual result of the task

`.delay()` returns temporary object while queueing the execution of the task

Potential theoretical optimization: Load balancing

- Not effective in local environment with hardware limitations
- Dynamic scaling through **Horizontal Pod Autoscaling (HPA)**
- If CPU utilization reaches predefined threshold, scale between **min** and **max** number of replicas

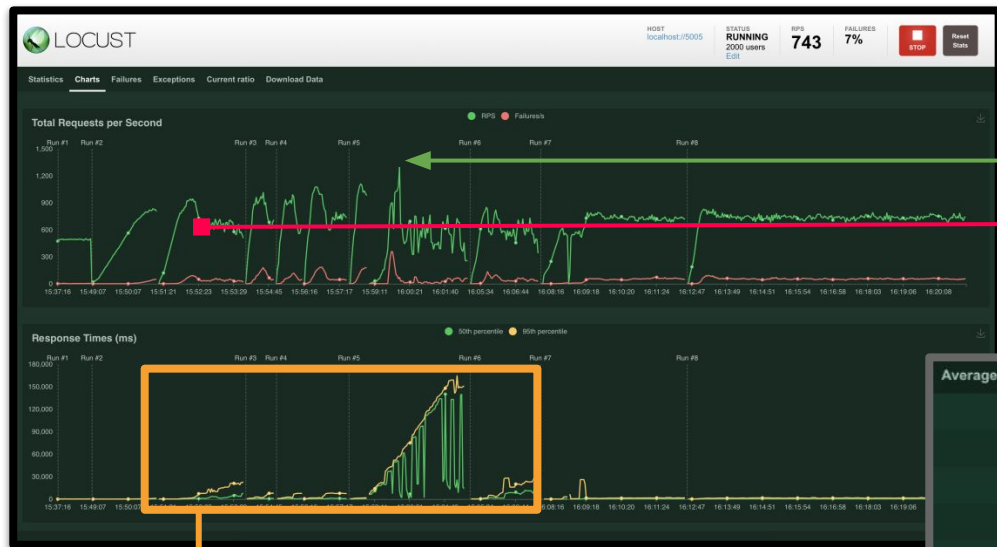


Results

No AWS credits received; ran locally on Macbook Pro M2 Pro 16GB RAM

Throughput

Overview of total requests per second



STATUS **RUNNING**
3000 users
[Edit](#)

RPS
1111.7

maximum of
1100+ RPS

700 RPS
on average

Average (ms)

787
770
715
760
727
683
528
1053
766

RPS: **730.4**
Failures/s: **43.9**
Users: 2000

STATUS **SPAWNING**
9000 users
[Edit](#)

RPS
630.4

RPS: **719.5**
Failures/s: **56.3**
Users: 4750

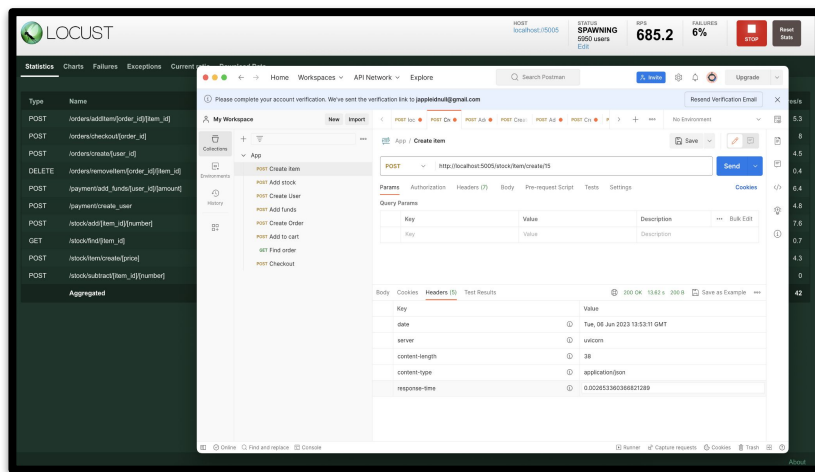
STATUS **RUNNING**
50000 users
[Edit](#)

RPS
768.3

considering 2K-50K users

latency slope indicates bottleneck

Latency



POST Request to create stock item (using Postman)

STATUS
SPAWNING
5950 users
[Edit](#)

RPS
685.2

Number of users and requests per second
(General example scenario; consider extensive runtime)

200 OK 13.62 s

Bottleneck occurs in processing requests,
gateway = suspect

response-time 0.002653360366821289

Task completion is still fast,
which is also confirmed by the Docker logs:

```
5] succeeded in 0.000820
lved
succeeded in 0.00075345
lved
succeeded in 0.00057508
lved
succeeded in 0.00047395
lved
2] succeeded in 0.000619
succeeded in 0.00100595
lved
9] succeeded in 0.001181
received
62] succeeded in 0.0006
lved
3] succeeded in 0.000657
lved
succeeded in 0.00052620
lved
2] succeeded in 0.000795
lved
c] succeeded in 0.000811
received
3ce] succeeded in 0.0006
received
52] succeeded in 0.0016
lved
succeeded in 0.00093058
lved
lved
b] succeeded in 0.00112
bd] succeeded in 0.00076
```

Consistency

The screenshot shows the LOCUST web interface with the 'Failures' tab selected. The table lists failed requests with columns for '# fails', 'Method', and 'Name'. A red box highlights a specific failure: 'Not enough stock'.

# fails	Method	Name
1	POST	/orders/checkout[order_id]
8	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
4	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]
1	POST	/orders/checkout[order_id]

Failures

Type

```
CatchResponseError({"detail":{"Decrease 647f356ded599a198b04b107":"SUCCESS","Payment user 647f35f98fb1d724babf6a62:5":"FAILURE"}})
```

CatchResponseError("This was supposed to fail: Not enough stock") 🙄 **Not enough stock**

```
CatchResponseError({"detail":{"Decrease 647f3566a2fba2358104add1":"SUCCESS","Payment user 647f35fc8fb1d724babf6af0:2":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f3557ed599a198b04adda":"SUCCESS","Payment user 647f35fb866ddde119bf5239:2":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f357aed599a198b04b420":"SUCCESS","Payment user 647f35fc8fb1d724babf6ae6:8":"FAILURE"}})
```

CatchResponseError({"detail":{"Decrease 647f3581ed599a198b04b632":"SUCCESS","Payment user 647f3605866ddde119bf5286:1":"FAILURE"}})

CatchResponseError("This was supposed to fail: Not enough credits") 🙄 **Not enough credits**

```
CatchResponseError({"detail":{"Decrease 647f3578ed599a198b04b39a":"SUCCESS","Payment user 647f3611866ddde119bf52d9:3":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f357aed599a198b04b424":"SUCCESS","Payment user 647f36158fb1d724babf6c7:0":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f3554a2fba2358104ad67":"SUCCESS","Decrease 647f3559ed599a198b04ae0e":"SUCCESS","Payment user 647f36198fb1d724babf7090:14":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f3560ed599a198b04aed3":"SUCCESS","Payment user 647f361d8fb1d724babf7157:9":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f356fed599a198b04b177":"SUCCESS","Decrease 647f3573ed599a198b04b283":"SUCCESS","Payment user 647f3611866ddde119bf533a:11":"FAILURE"}})
```

```
CatchResponseError({"detail":{"Decrease 647f3551ed599a198b04ad6b":"SUCCESS","Payment user 647f36228fb1d724babf724e:8":"FAILURE"}})
```

Missing *processed-by-test-design* requests due to performance bottleneck causes (chain of) failures, however, failure \neq consistency error

What can be done better?

Considering a few more months of project time

Potential improvements

- Try different frameworks (e.g. Spring WebFlux)
- Make the API calls asynchronous
- Amazon Web Services
- Logging and Crash Recovery

Any questions?
And thanks for listening!

