Erwin de Gier - Trifork Amsterdam

Event-Driven Architecture with Spring WebFlux

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edegier.nl

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We are BLOX.

Crypto currency trading made easy.
Sign up, verify, deposit, trade in 60 seconds

REST services?

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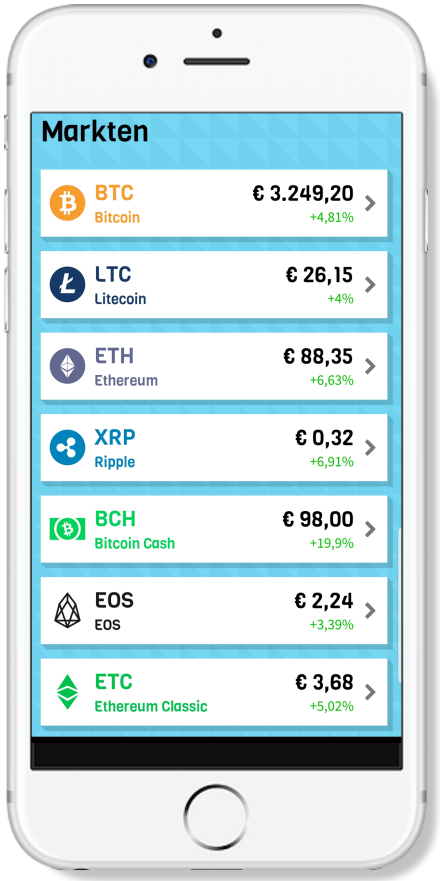

Ledger

Market Data

User

Order Process

Reading data

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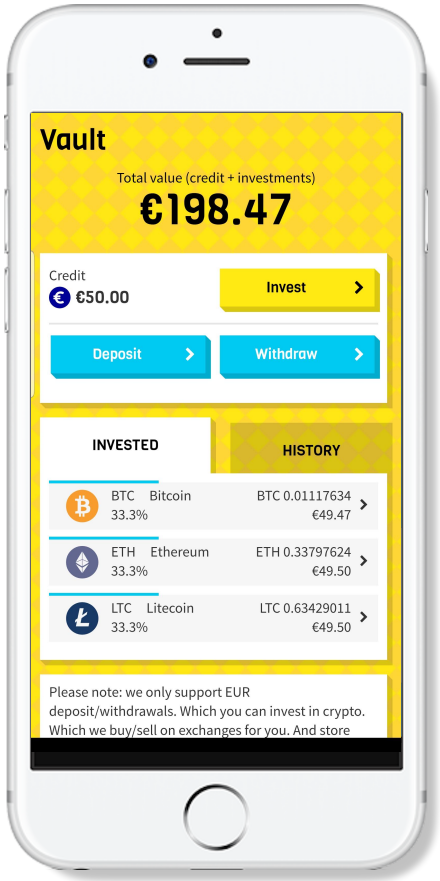

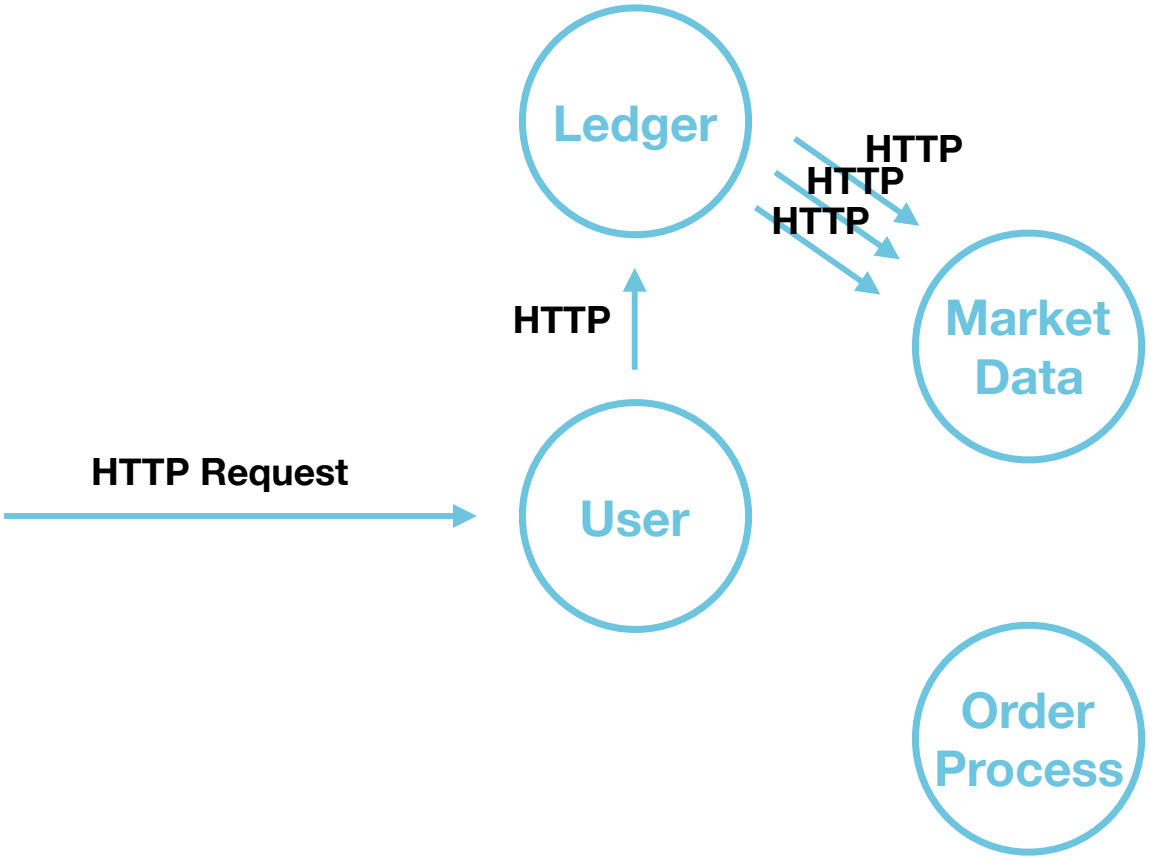

Inner join over HTTP

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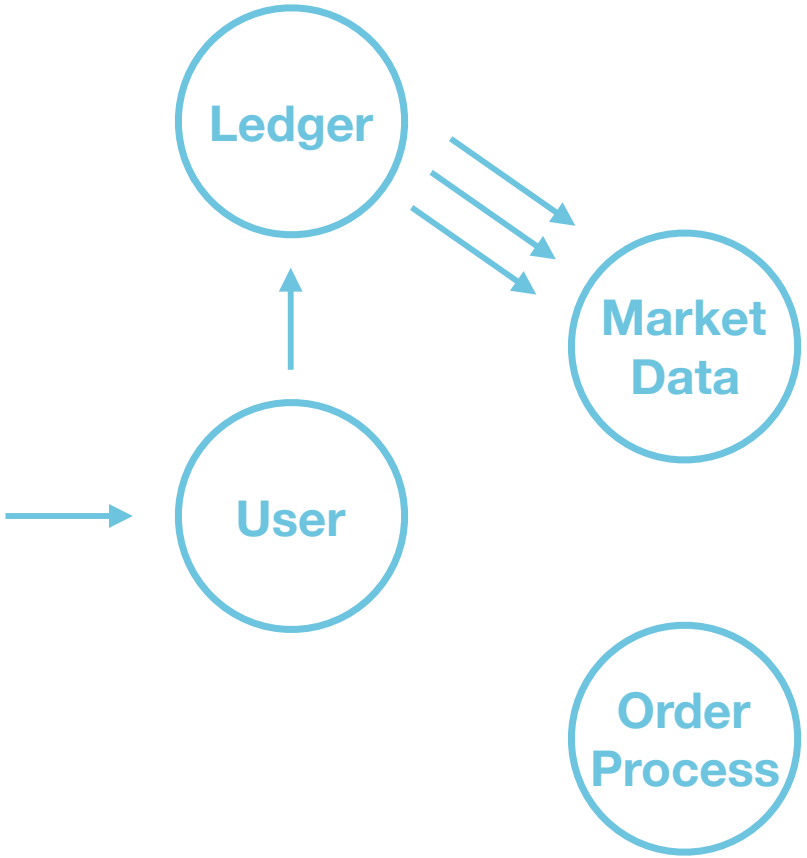
Latency

Making 5 HTTP calls of 20 ms. per call
will in total be 100 ms just for the HTTP calls

Availability

5 calls to 99,999% available services
will result in a total availability of $99{,}999^5 \approx 99{,}99\%$



Distributed transaction

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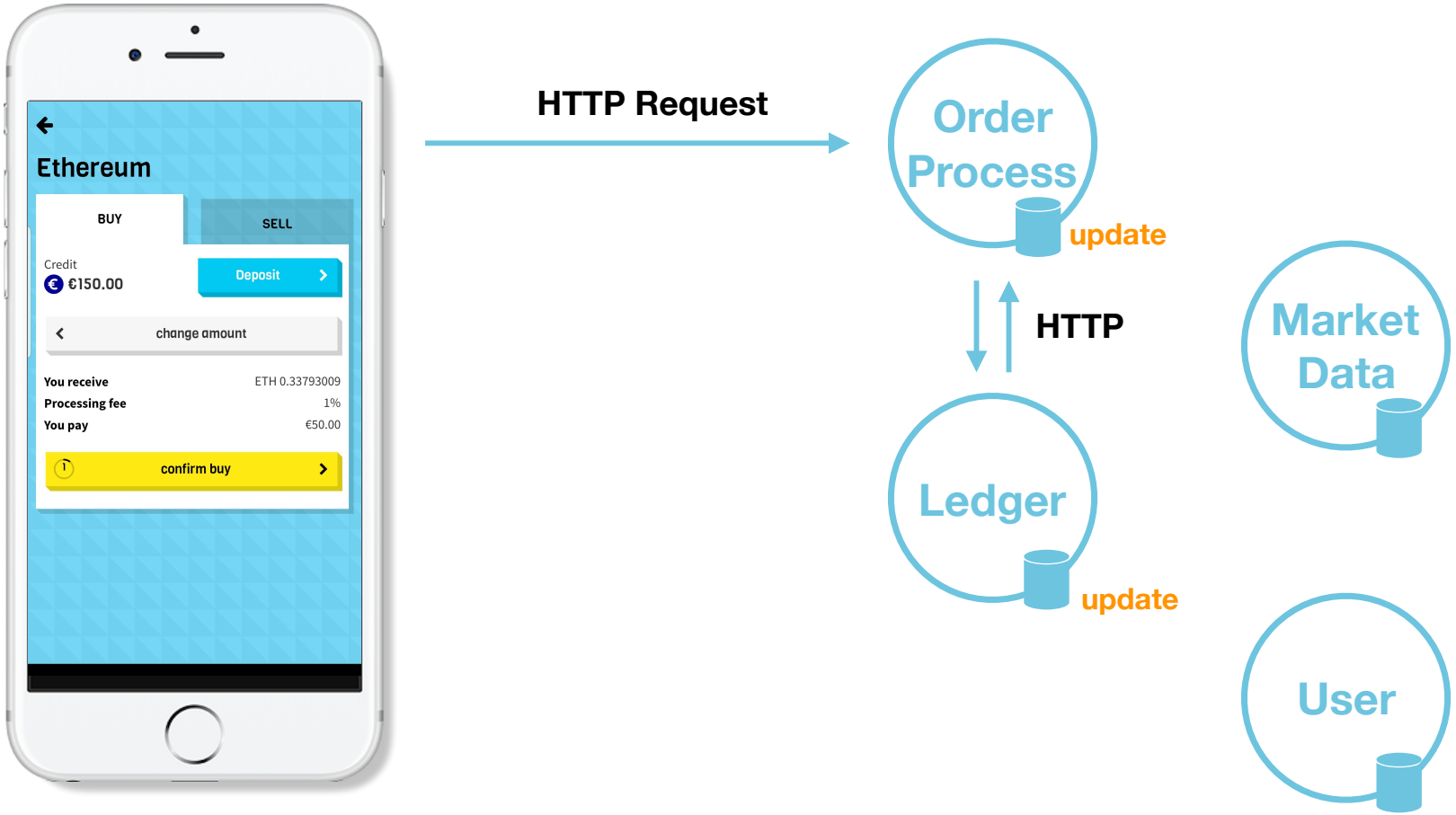

https://dzone.com/articles/event-driven-data-management-for-microservices-1

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Events

https://www.reactivemanifesto.org

Event Driven Communication

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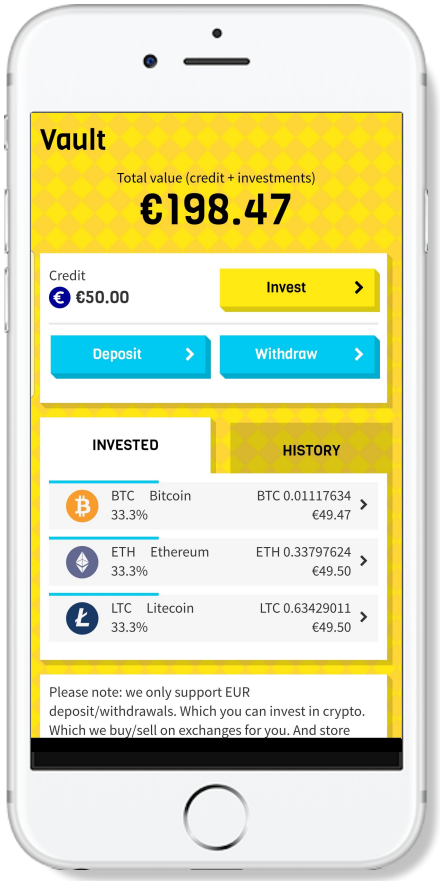

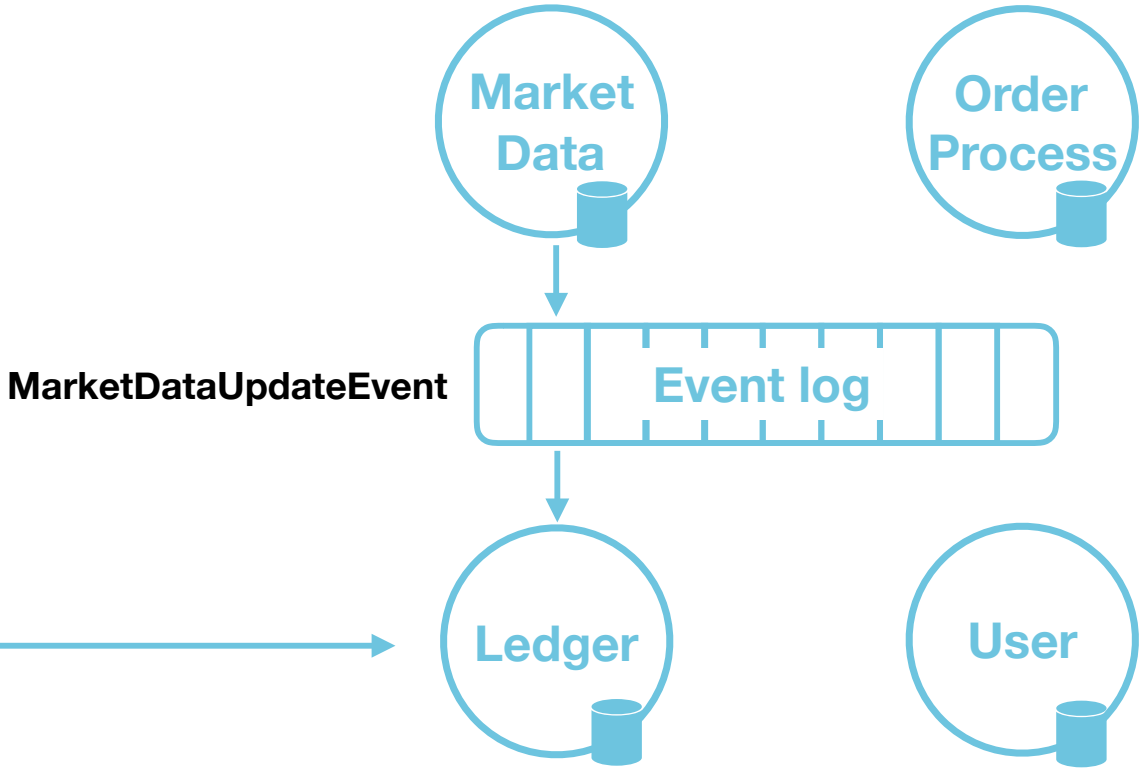

https://martinfowler.com/articles/201701-event-driven.html

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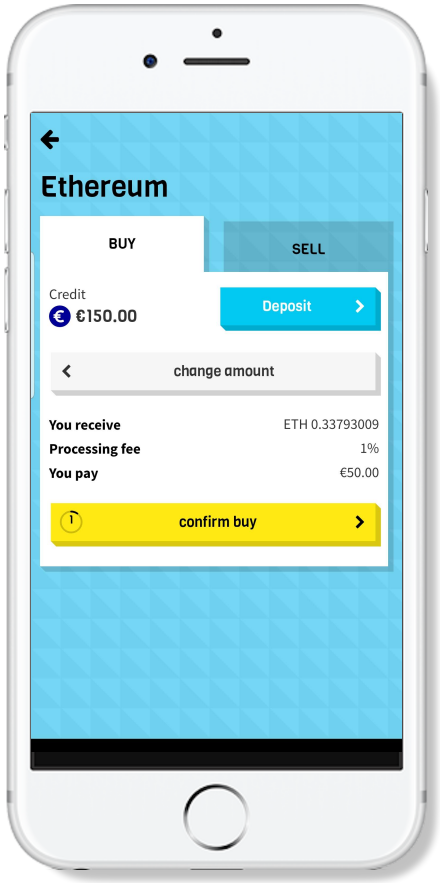

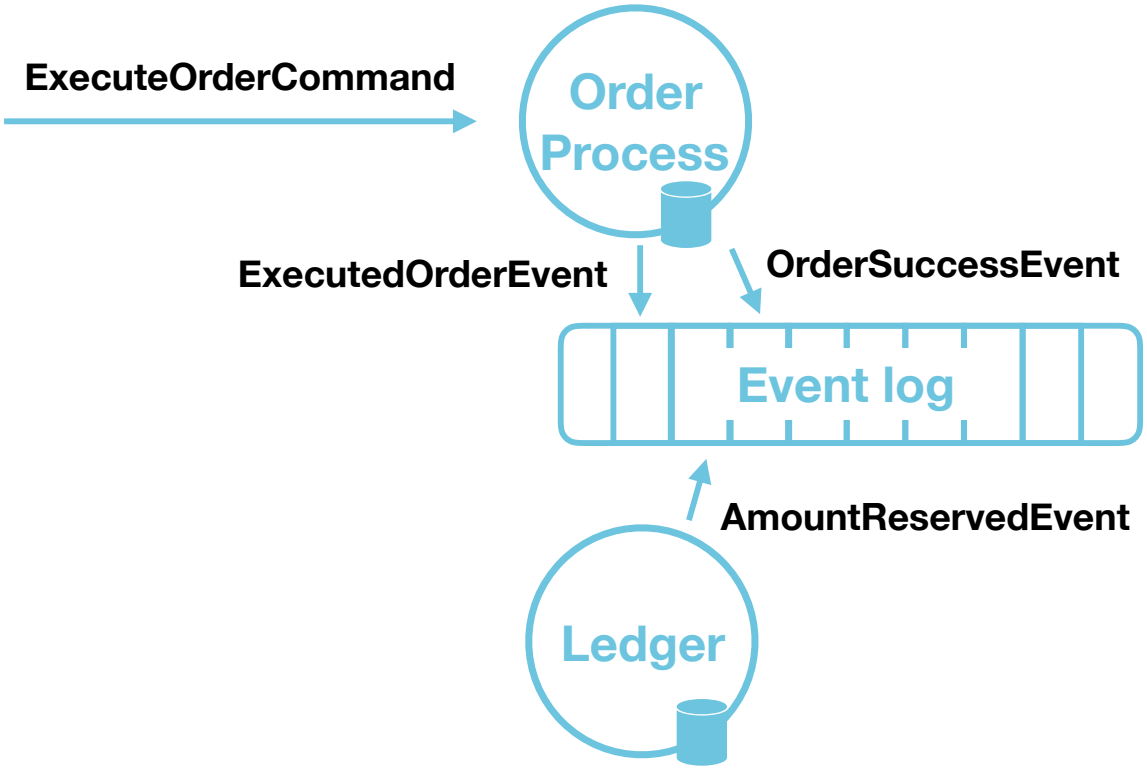

Event Sourcing

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https://www.martinfowler.com/eaaDev/EventSourcing.html

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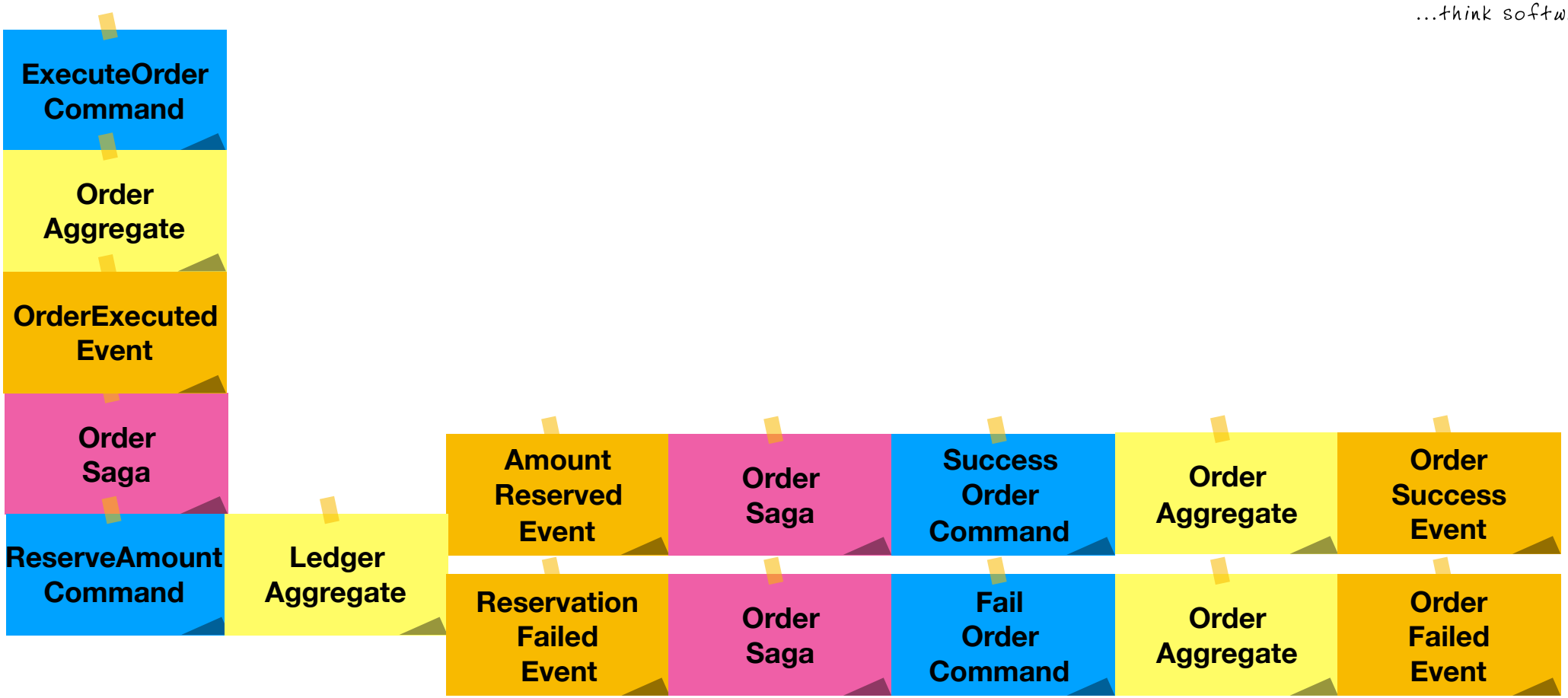

https://www.eventstorming.com

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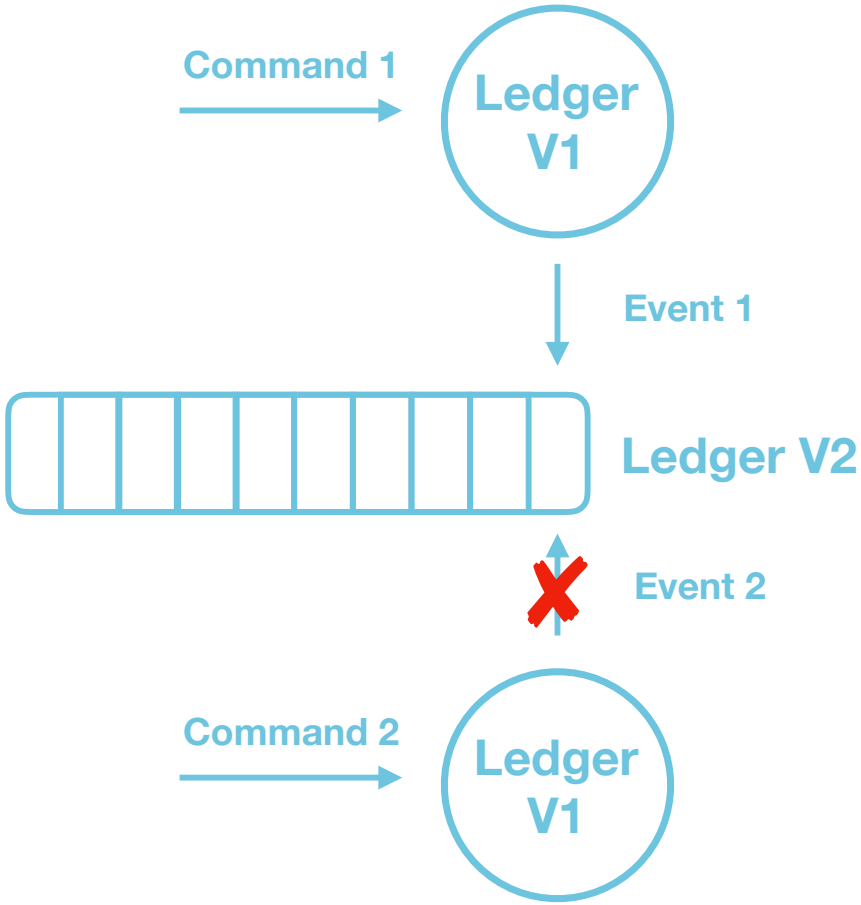

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Not Only Events

Not Only Events

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I want the system to do something

Something has happened

I want to know something

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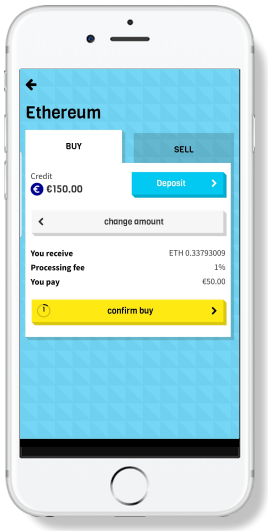

Request

Response

REST Facade

Market Data

Order Process

Command

Event

Query

NoEventStore

User

Ledger

Blox Rest Events CQRS/ES Reactive

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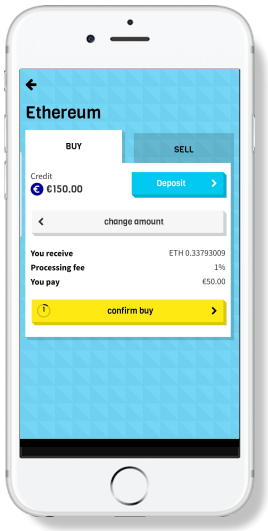

Request

Response

Spring Webflux

Axon

Axon

Command

Event

Query

AxonServer

Axon

Axon

Blox Rest Events CQRS/ES Reactive

Axon Framework with AxonServer

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- CQRS + Event Sourcing
- Aggregate & Saga
- Handlers: events, commands, queries
- Message Routing
- NoEventstore
- Location transparency

Distributed systems

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- Async communication
- Time is important!

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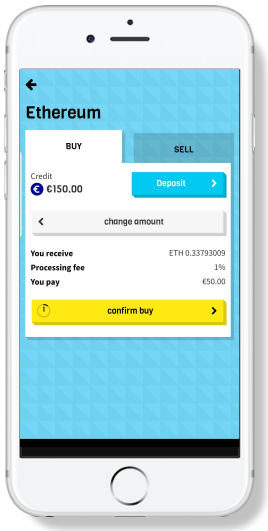

Request

Response

REST Facade

Command

Query

Order Process

Ledger

Event

Event

Blox Rest Events CQRS/ES Reactive

Subscription Queries

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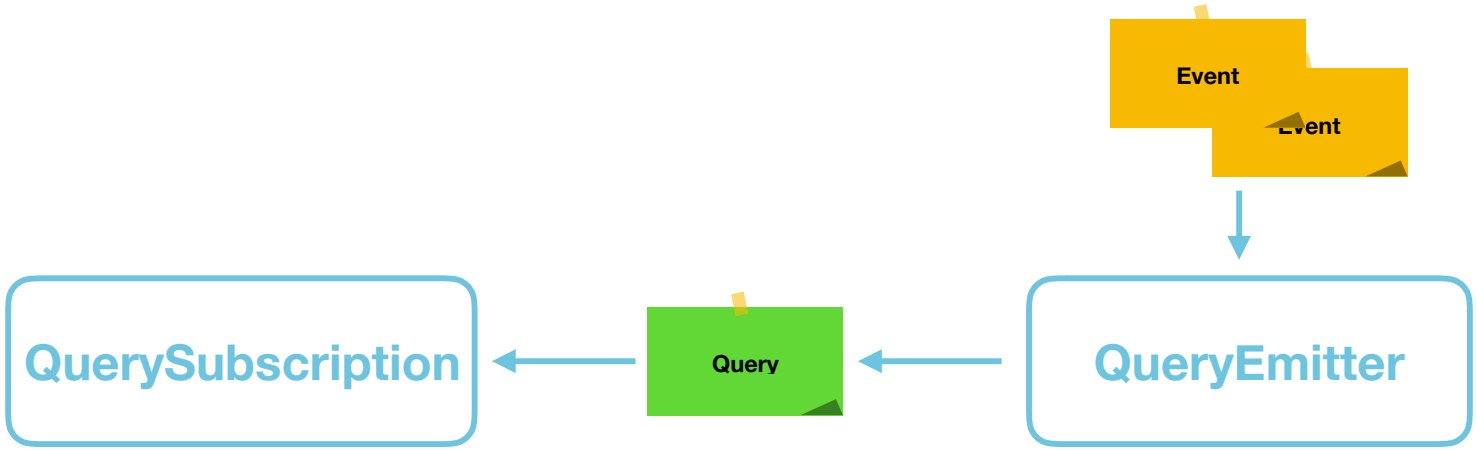

Subscription Queries

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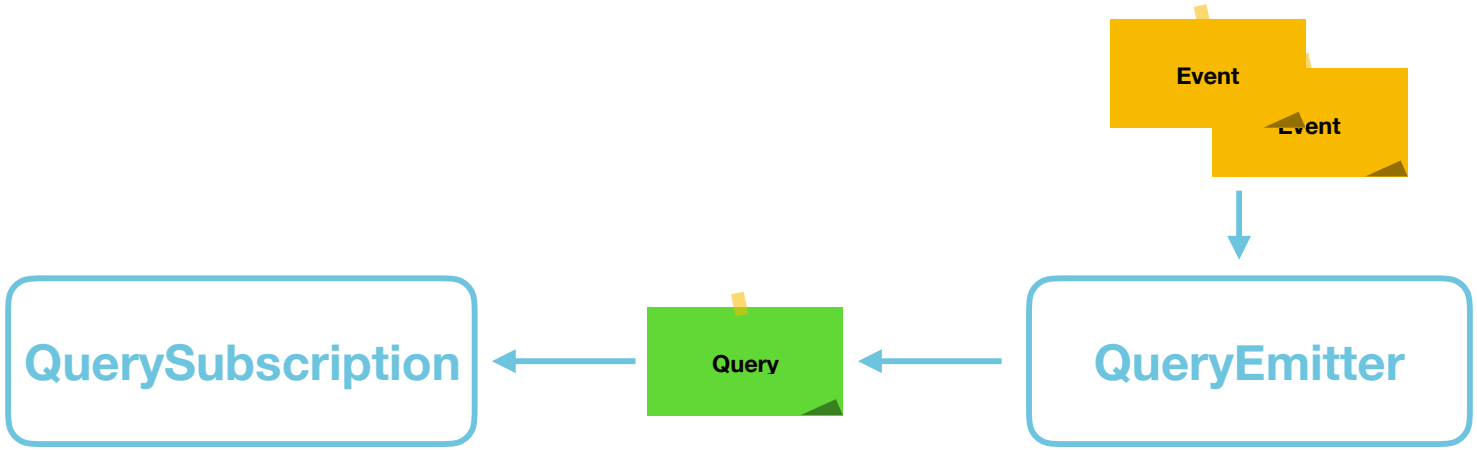


```
Flux<Order> orders =
    queryGateway.subscriptionQuery(
    new GetOrderQuery(orderId), OrderDto.class,
    OrderDto.class)
        .updates();
```

```
queryUpdateEmitter.emit(GetOrderQuery.class,
    query -> query.getId().equals(order.getId()), order);
```

https://axoniq.io/blog-overview/introducing-subscription-queries

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Reactive Programming

Reactive programming

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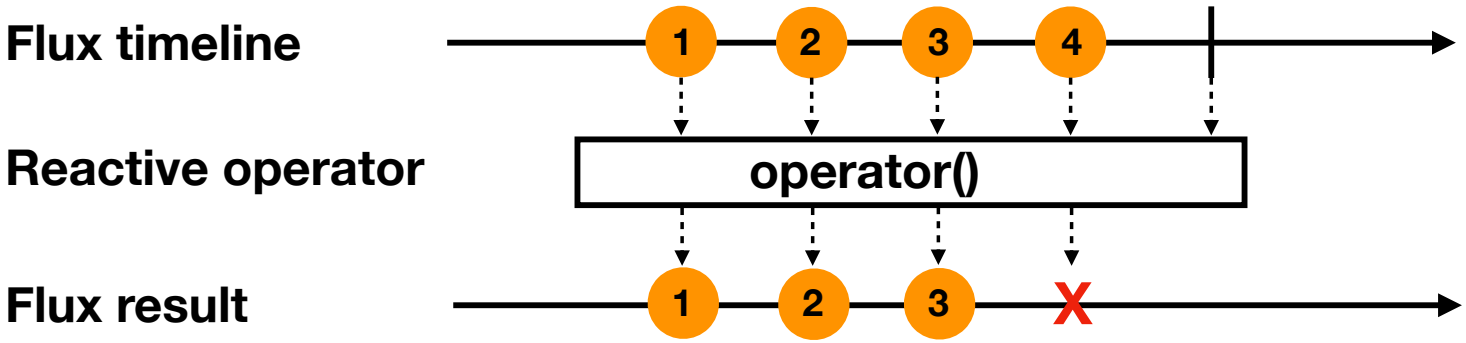

Reactive programming

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https://www.youtube.com/watch?v=fXWywFRwHOk

Reactive programming

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```
Flux.range(0,10)                                    //Create a flux
        .map(i -> i)                                //operator
        .subscribe(v -> System.out.print(v)); //subscriber
```

will print:

0123456789

Reactive operators

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Mono	**Source of 0 or 1 items**
Flux	**Source of 0 or N items**
subscribe()	**Activate reactive chain en create a subscription**
map()	**Transform using a synchronous function**
flatMap()	**Transform using an asynchronous function**
timeout()	**Throw error if item doesn't arrive in time**
filter()	**Only allows items which match predicate to pass**
onErrorReturn()	**Return a value on Exception**

Spring WebFlux

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- Annotation mapping
- Functional mapping
- Reactor pattern
- Single thread programming model
- Project Reactor
- Reactor Netty

Spring WebFlux

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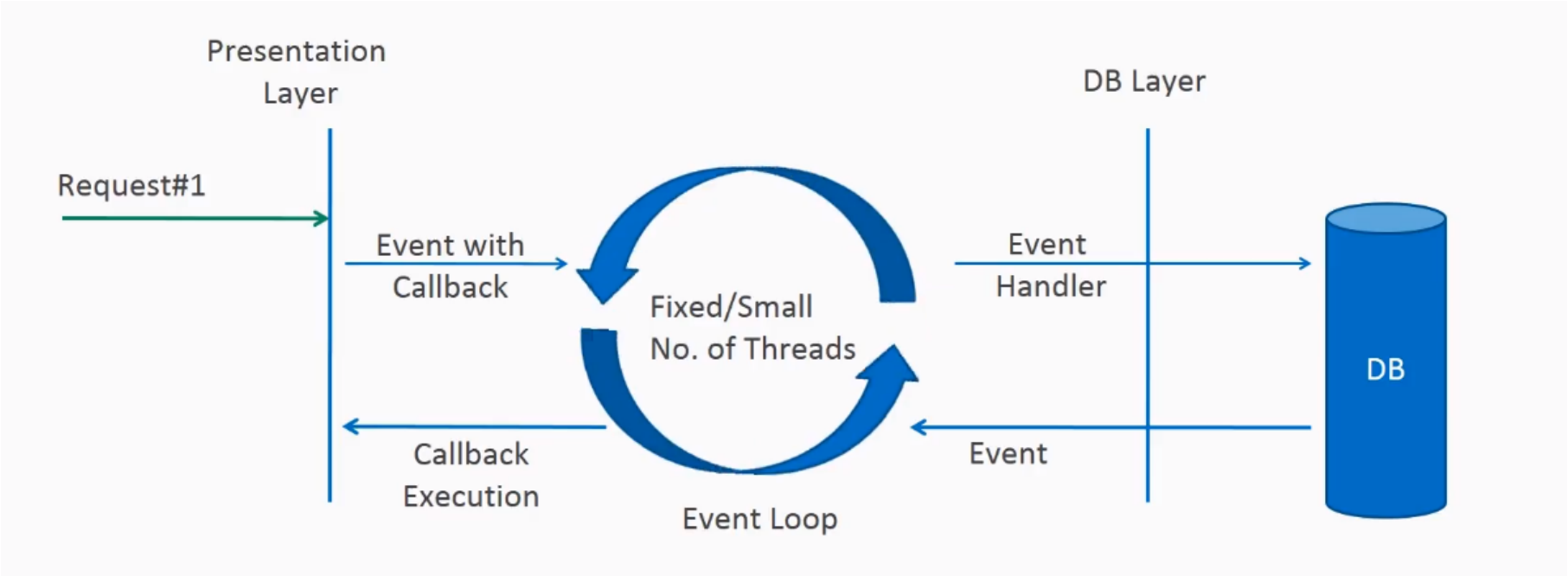

Example

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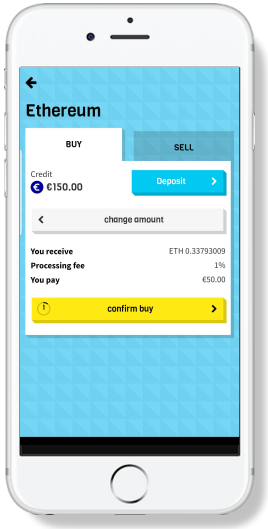


Request

Response

Order Controller

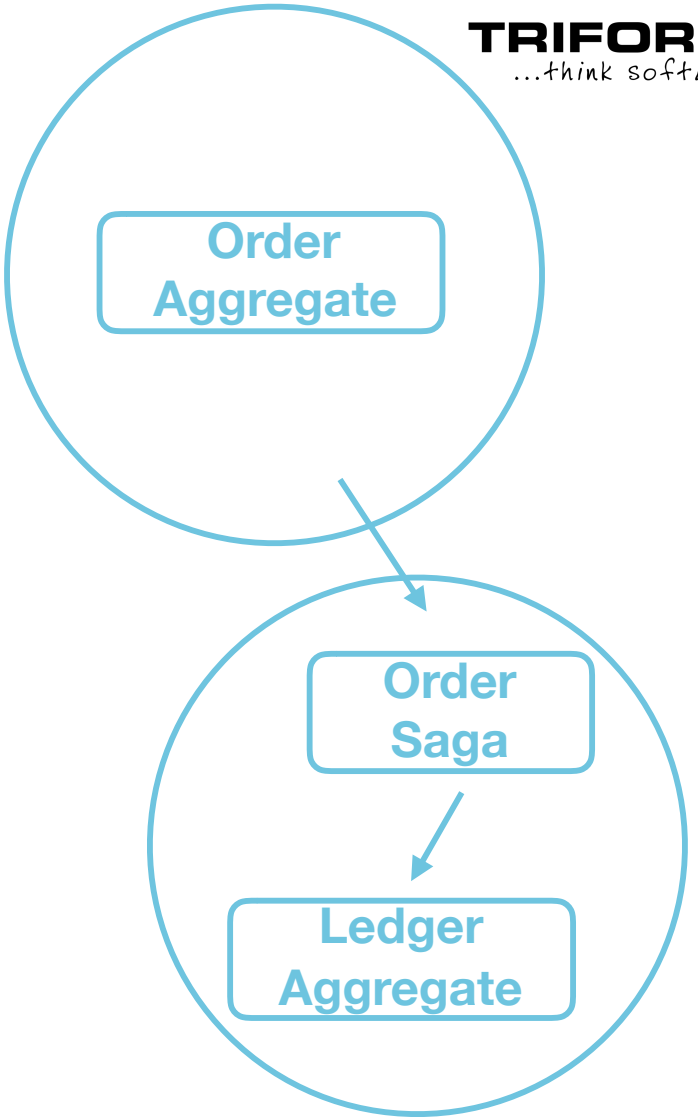
Execute Order Command

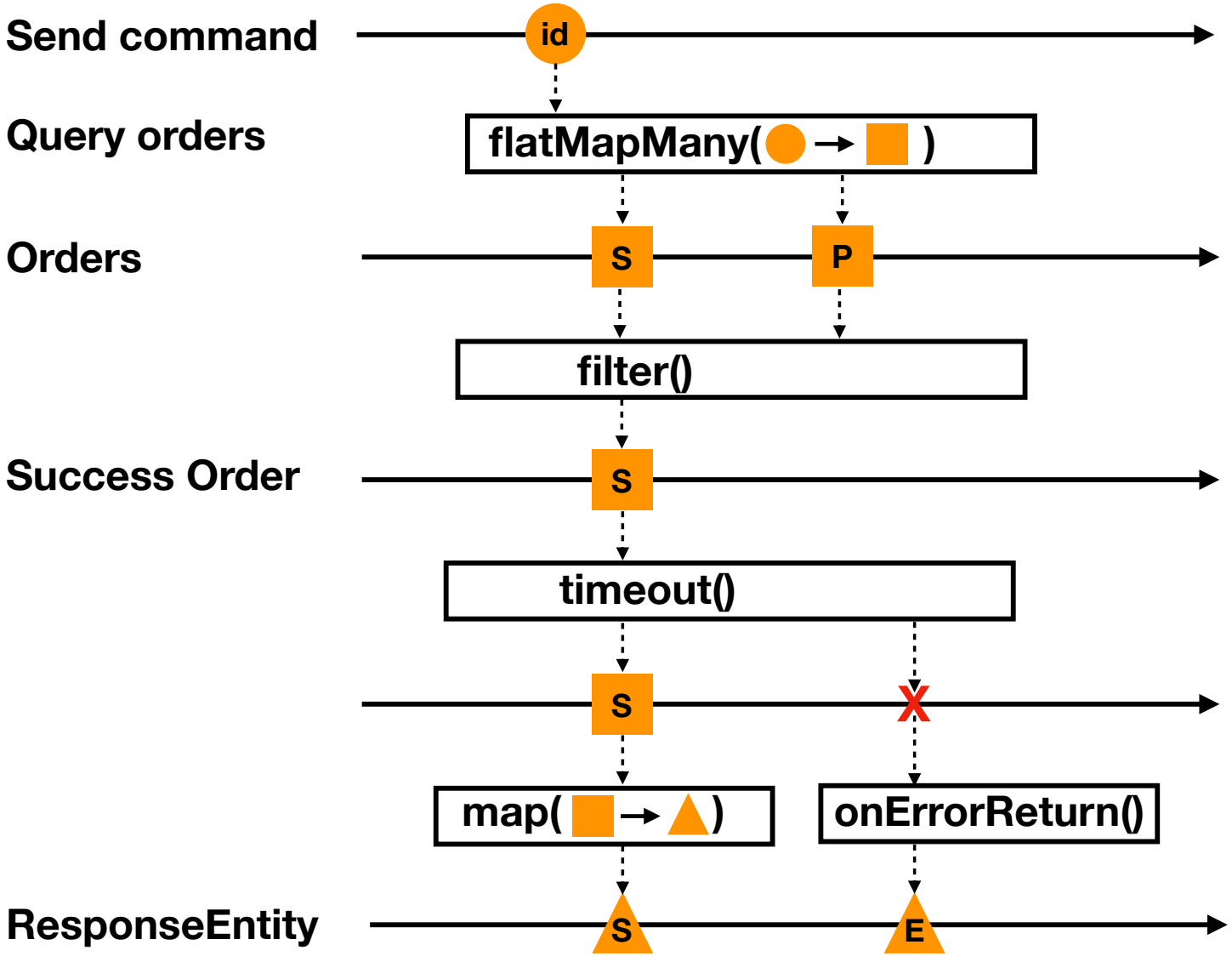
Query

Order Created

Order Pending

Order Success





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Example “subscription query”: unit test

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```
when(queryResultMock.updates())
        .thenReturn(
                Flux.just(
                        new OrderDto("orderId", EUR, BTC, ONE, TEN, PENDING),
                        new OrderDto("orderId", EUR, BTC, ONE, TEN, COMPLETED)
                ));

ResponseEntity<OrderDto> orderResponse = this.orderController.executeOrder(
    new OrderRequestDto("userId", "quoteId")).block(ofSeconds(1));

assertEquals(orderResponse.getStatusCode(), HttpStatus.OK);
assertEquals(COMPLETED, orderResponse.getBody().getStatus());
```

Example “subscription query”: implementation

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```
Flux<OrderDto> orderResponseFlux = this.queryGateway.subscriptionQuery(
    new GetOrderQuery(orderId), OrderDto.class, OrderDto.class)
    .updates();

return sendCommand(new ExecuteOrderCommand(orderId, orderRequest.getUserId()))
        .flatMapMany(id -> orderResponseFlux)
        .filter(order -> !order.getStatus().equals(OrderStatus.PENDING))
        .timeout(ofSeconds(2))
        .next()
        .map(ResponseEntity::ok)
        .onErrorReturn(this::clientException, ResponseEntity.badRequest().build())
        .onErrorReturn(this::serverException, status(SERVICE_UNAVAILABLE).build());
```

Example “subscription query”: unit test timeout

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```
when(queryResultMock.updates())
        .thenReturn(Flux.never());

ResponseEntity<OrderDto> orderResponse = this.orderControllerController.executeOrder(
    new OrderRequestDto("userId", "quoteId")).block();

assertEquals(SERVICE_UNAVAILABLE, orderResponse.getStatusCode());
```

Testing

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- Blocking subscribe with timeout
- Flux.never() / Flux.error()
- Mockito.verify (mock, times(n))
- Mockito.verify (mock, timeout(ms))
- Reactor StepVerifier
- WebTestClient / @WebFluxTest

```
StepVerifier.create(Flux.just("foo", "bar"))
        .expectNext("foo")
        .expectNext("bar")
        .expectComplete()
        .verify();
```

Debugging

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- Hooks.onOperatorDebug() (not for prod)
- ReactorDebugAgent (reactor-tools)
- Lambda breakpoints (IDE)
- Flux.log() / doOnNext()
- BlockHound

https://spring.io/blog/2019/03/28/reactor-debugging-experience

Blocking code

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```
java.lang.Error: Blocking call! java.lang.Thread.yield
    at reactor.blockhound.BlockHound$Builder.lambda$new$0(BlockHound.java:154) ~[blockhound-1.0.0.M3.jar:na]
    at reactor.blockhound.BlockHound$Builder.lambda$install$8(BlockHound.java:254) ~[blockhound-1.0.0.M3.jar:na]
    at reactor.blockhound.BlockHoundRuntime.checkBlocking(BlockHoundRuntime.java:43) ~[blockhound-1.0.0.M3.jar:na]
    at java.lang.Thread.yield(Thread.java) ~[na:1.8.0_172]
    at java.util.concurrent.ConcurrentHashMap.initTable(ConcurrentHashMap.java:2227) ~[na:1.8.0_172]
    at java.util.concurrent.ConcurrentHashMap.putVal(ConcurrentHashMap.java:1017) ~[na:1.8.0_172]
    at java.util.concurrent.ConcurrentHashMap.put(ConcurrentHashMap.java:1006) ~[na:1.8.0_172]
```

```
Caused by: java.lang.Error: Blocking call! java.io.FileInputStream#readBytes
    at reactor.blockhound.BlockHound$Builder.lambda$new$0(BlockHound.java:154)
    at reactor.blockhound.BlockHound$Builder.lambda$install$8(BlockHound.java:254)
    at reactor.blockhound.BlockHoundRuntime.checkBlocking(BlockHoundRuntime.java:43)
    at java.io.FileInputStream.readBytes(FileInputStream.java)
    at java.io.FileInputStream.read(FileInputStream.java:255)
    at sun.security.provider.NativePRNG$RandomIO.readFully(NativePRNG.java:424)
    at sun.security.provider.NativePRNG$RandomIO.ensureBufferValid(NativePRNG.java:525)
    at sun.security.provider.NativePRNG$RandomIO.implNextBytes(NativePRNG.java:544)
    at sun.security.provider.NativePRNG$RandomIO.access$400(NativePRNG.java:331)
    at sun.security.provider.NativePRNG.engineNextBytes(NativePRNG.java:220)
    at java.security.SecureRandom.nextBytes(SecureRandom.java:468)
    at java.util.UUID.randomUUID(UUID.java:145)
```

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Conclusion

Conclusion

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- Events are 1 trait of Reactive Systems (Manifesto)
- Events are Async
- Reactive provides a concise async programming model
- Functional operators
- Testing is not that hard…
- … but debugging is.
- DIY / Workarounds

https://github.com/erwindeg/eventdriven-examples

Please

Remember to rate this session

Thank you!

goto; amsterdam

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gotoams.nl