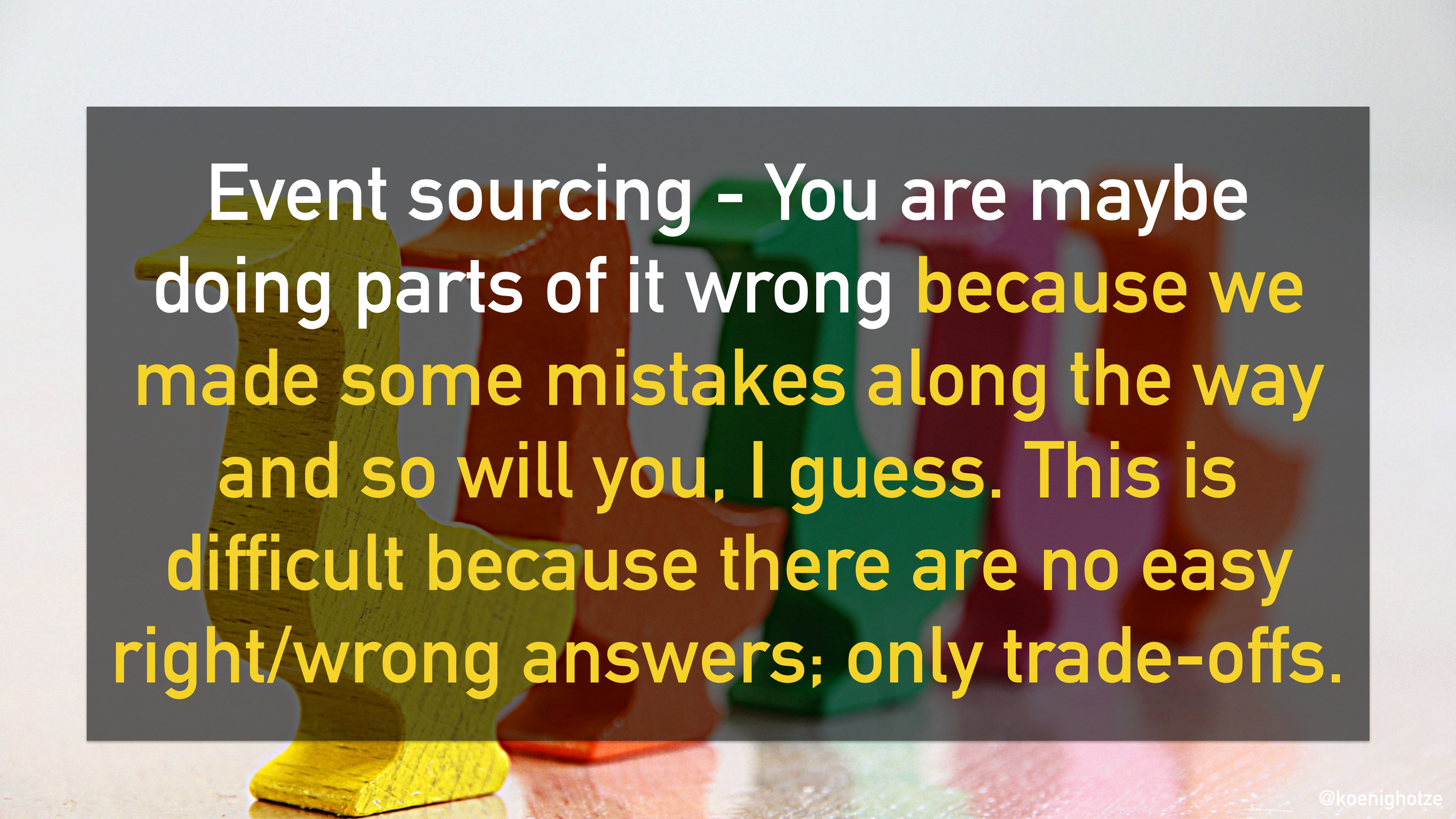
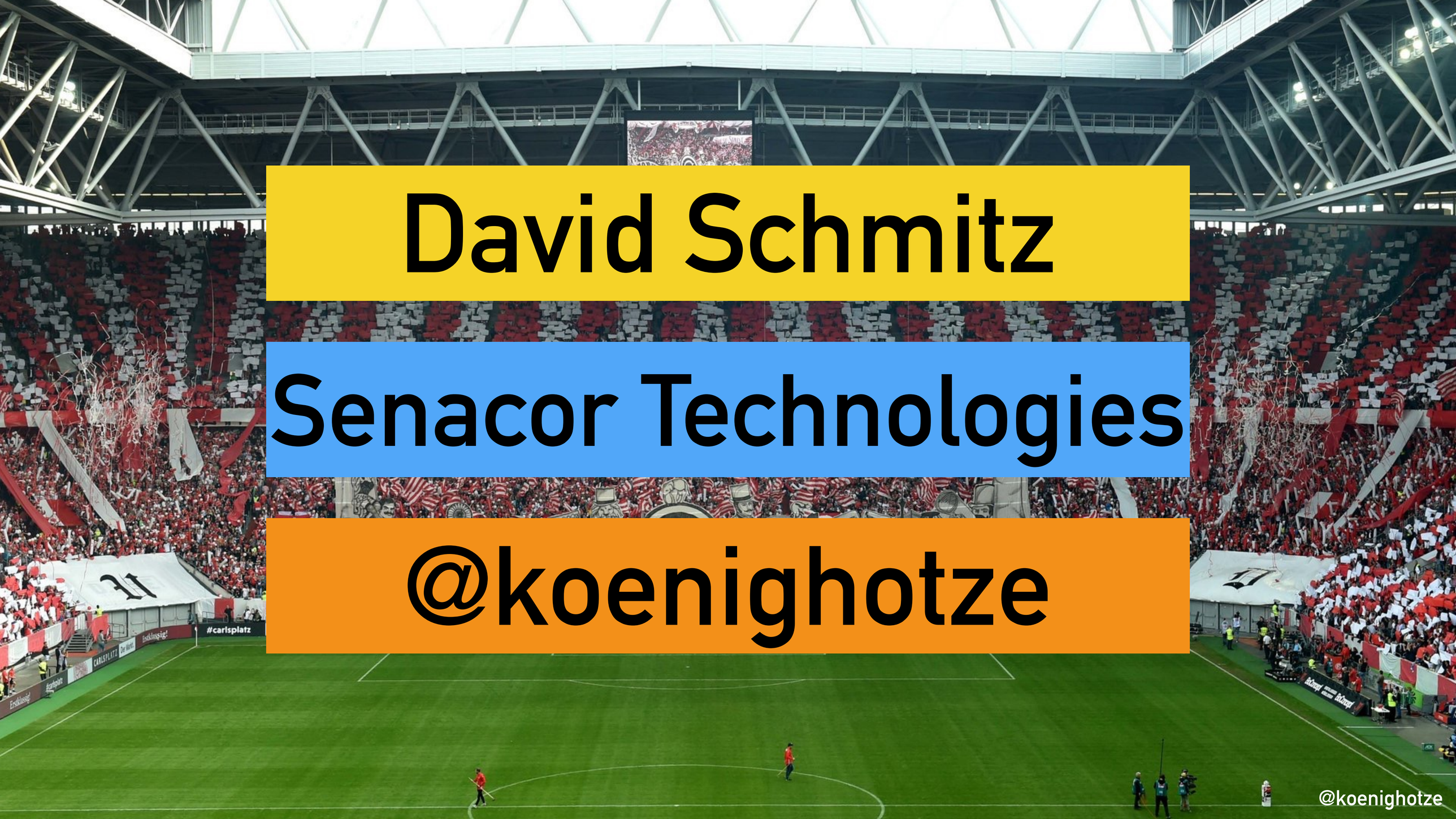

Event sourcing
You are doing it wrong
@koenighotze


Event sourcing
You are doing it wrong
because I know best
@koenighotze


Event sourcing - You are maybe doing parts of it wrong because we made some mistakes along the way and so will you, I guess. This is difficult because there are no easy right/wrong answers; only trade-offs.


Event sourcing
You are probably doing it wrong
@koenighotze


David Schmitz
Senacor Technologies
@koenighotze
#carlsplatz
@koenighotze

Are YOU

…building microservices?
…doing Domain Driven Design?
…applying event sourcing?
…using Kafka as an event store?

Typical misconceptions
Patterns “we” found useful
Traps to avoid
Not a Kafka-rant
No silver bullets


What we'll cover!

Event sourcing bootcamp

@koenighotze

Event driven business

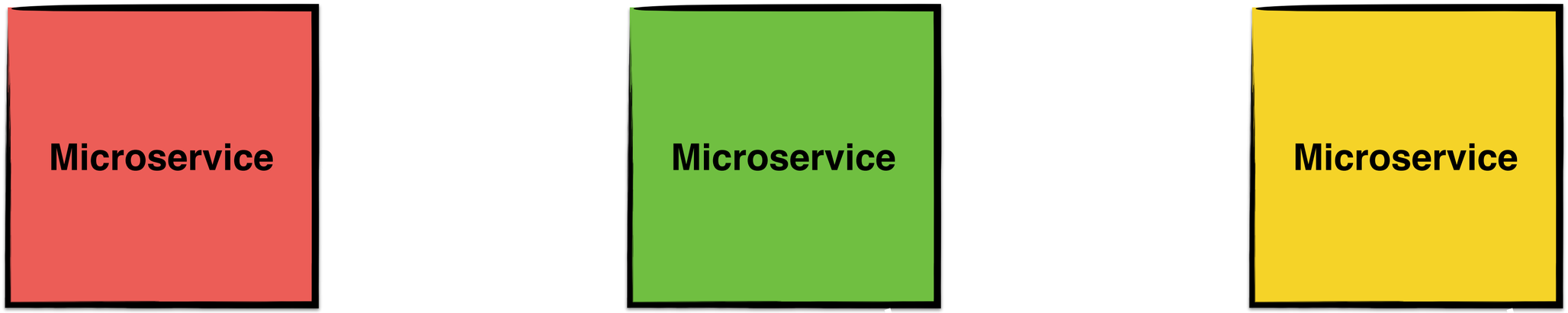

Coffee ordered


Order payed
Sip If You Dare!
Chilling White Mocha with a Haunting of Raspberry
AMAZING INGREDIENTS
CLASSIC WHOLE-GRAIN OATMEAL

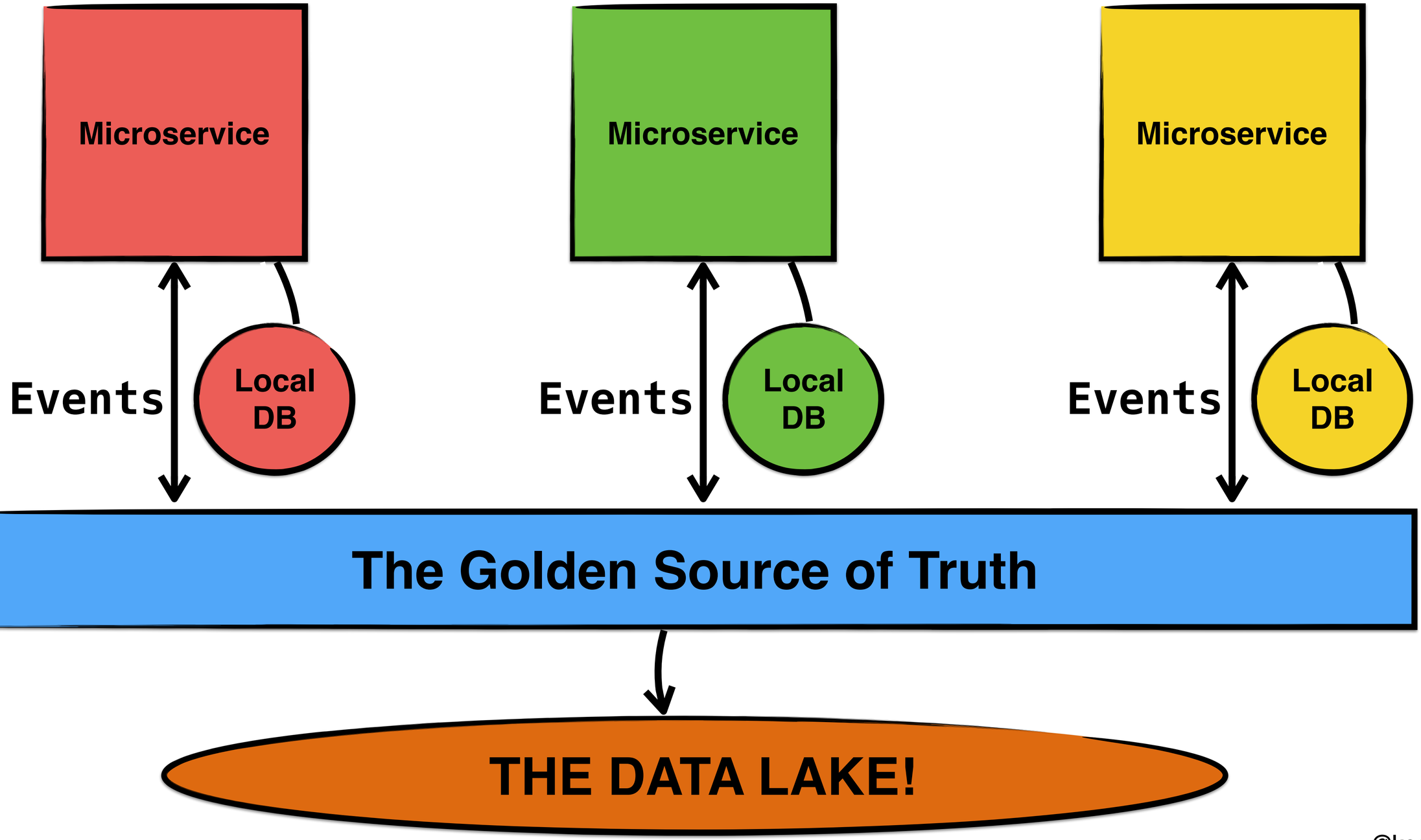

Coffee prepared
Chilling White Mocha with a Haunting of Raspberry
CLASSIC WHOLE-GRAIN OATMEAL

Behaviour of a domain made explicit as a first class concept

And on a technical level?

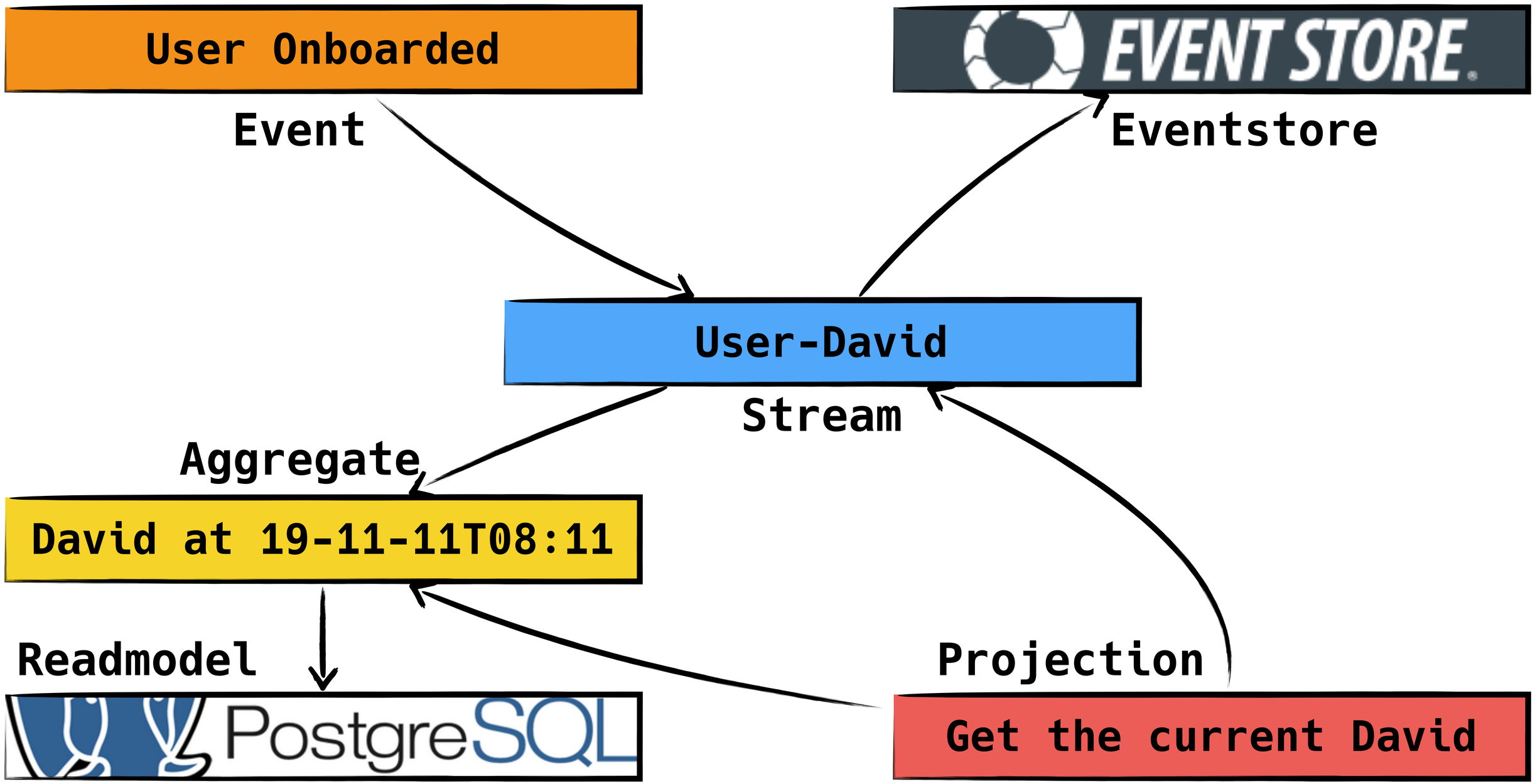


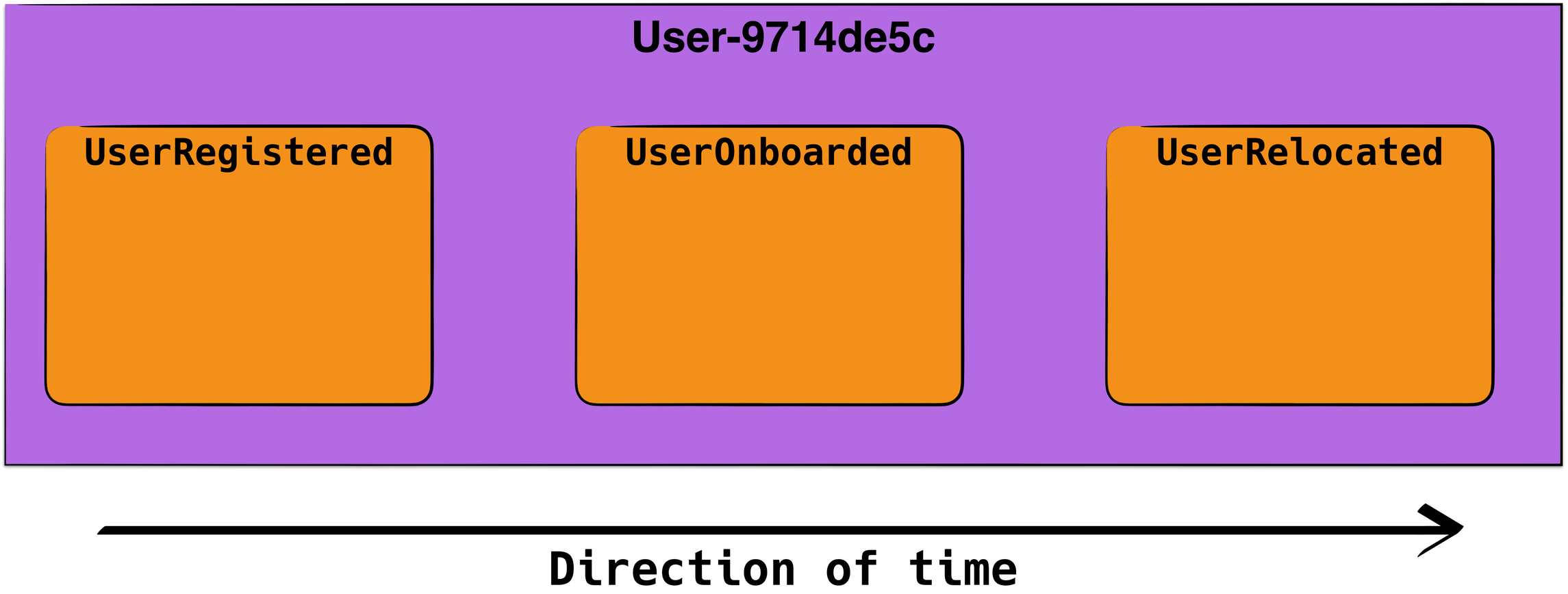
How to represent data and how to represent behaviour?

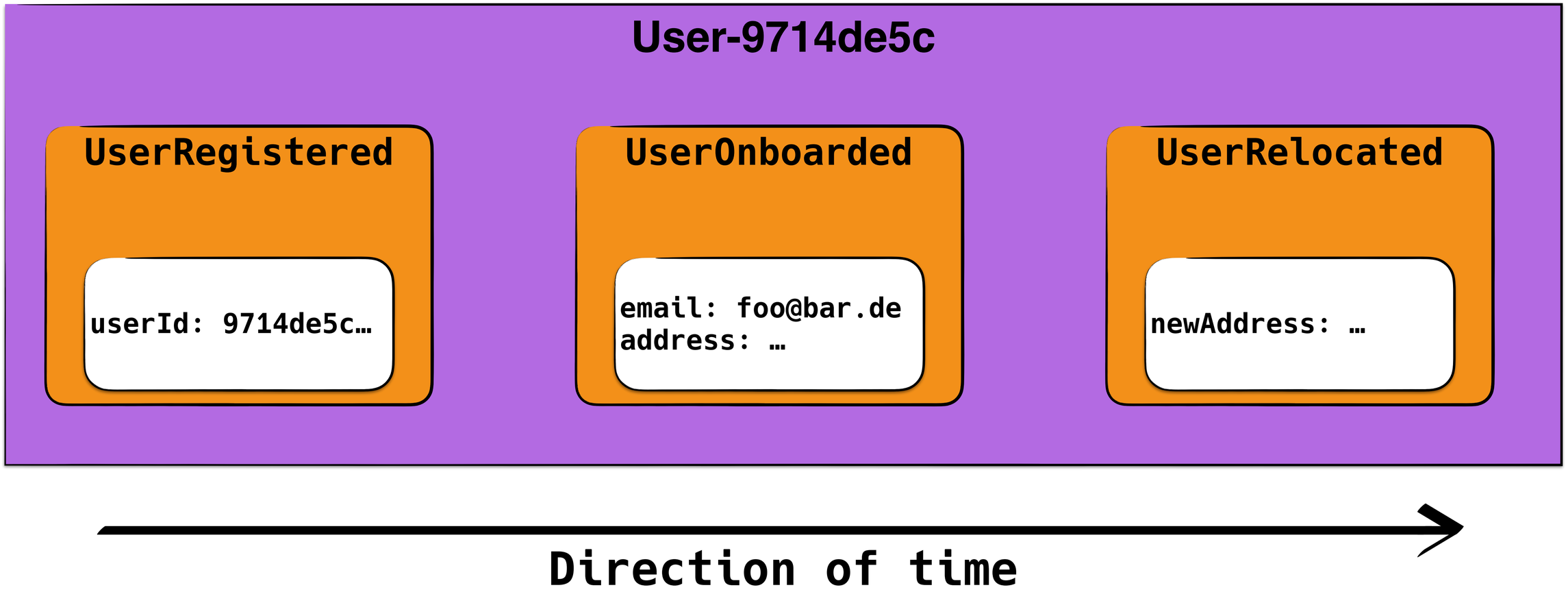

Microservice
Microservice
Microservice
Events
Local DB
Events
Local DB
Events
Local DB
The Golden Source of Truth
THE DATA LAKE!

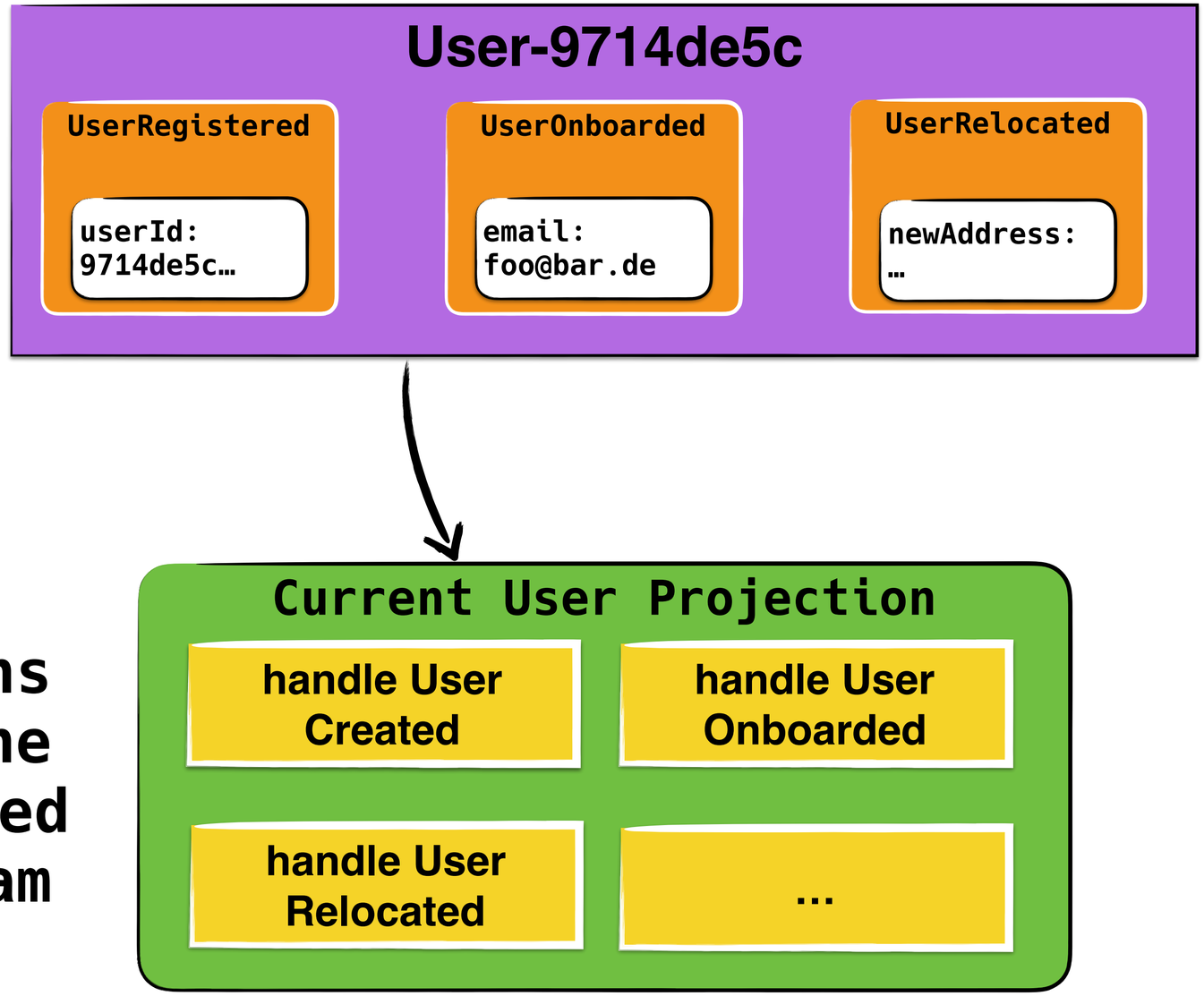

Microservice
Microservice
Microservice
Even
Never mind the details.
That is event sourcing
magic.
Just do the Right Thing!
THE DATA LAKE!

Just use magic

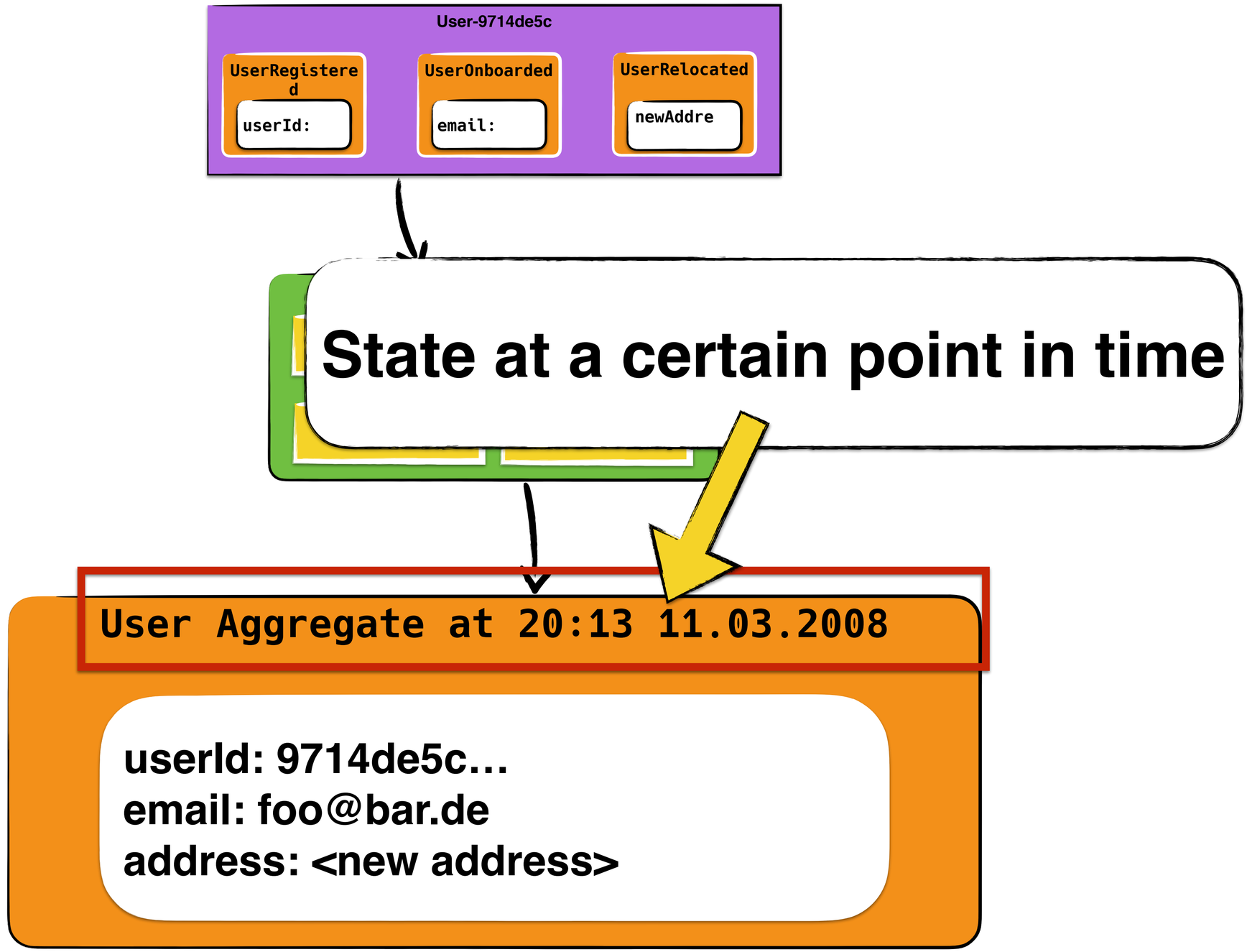

User Onboarded
Event
EVENT STORE
Eventstore
User-David
Stream
Aggregate
David at 19-11-11T08:11
Readmodel
PostgreSQL
Projection
Get the current David


User-9714de5c
UserRegistered
UserOnboarded
UserRelocated
Direction of time


User-9714de5c
UserRegistered
userId: 9714de5c…
UserOnboarded
email: foo@bar.de
address: …
UserRelocated
newAddress: …
Direction of time



Projections hydrate the state stored in a stream



Represents the user at the time of the last event read

Read models

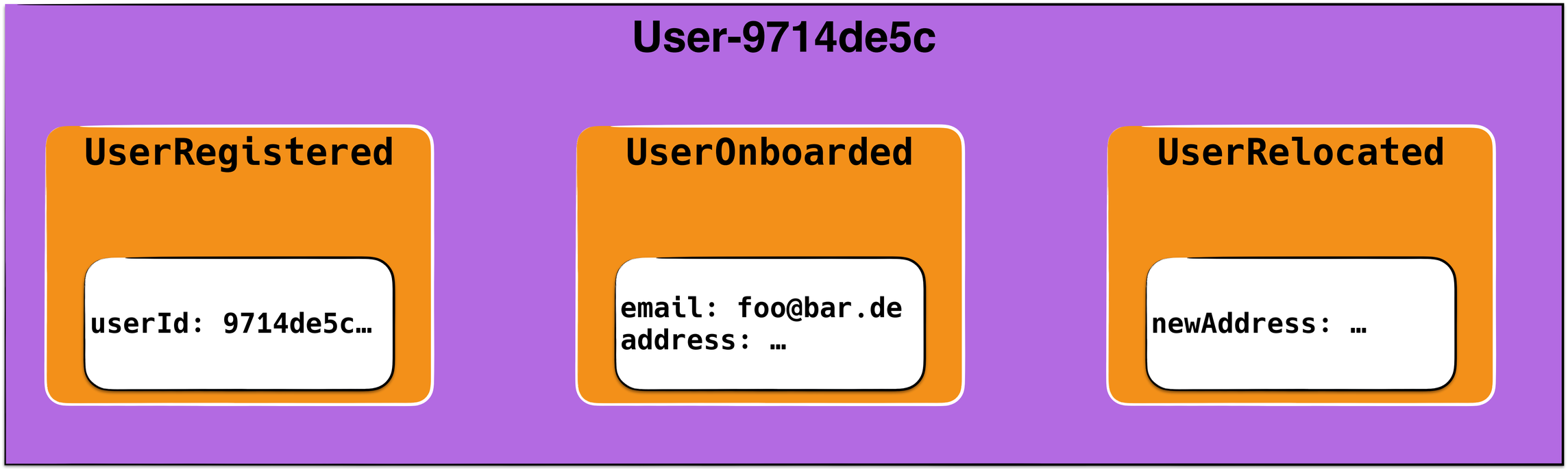
Transactions and concurrency

Versions, up-front-design

Dealing with errors

GDPR, compliance and eventsourcing


Read models
…and why you may not need to them (initially)
@koenighotze

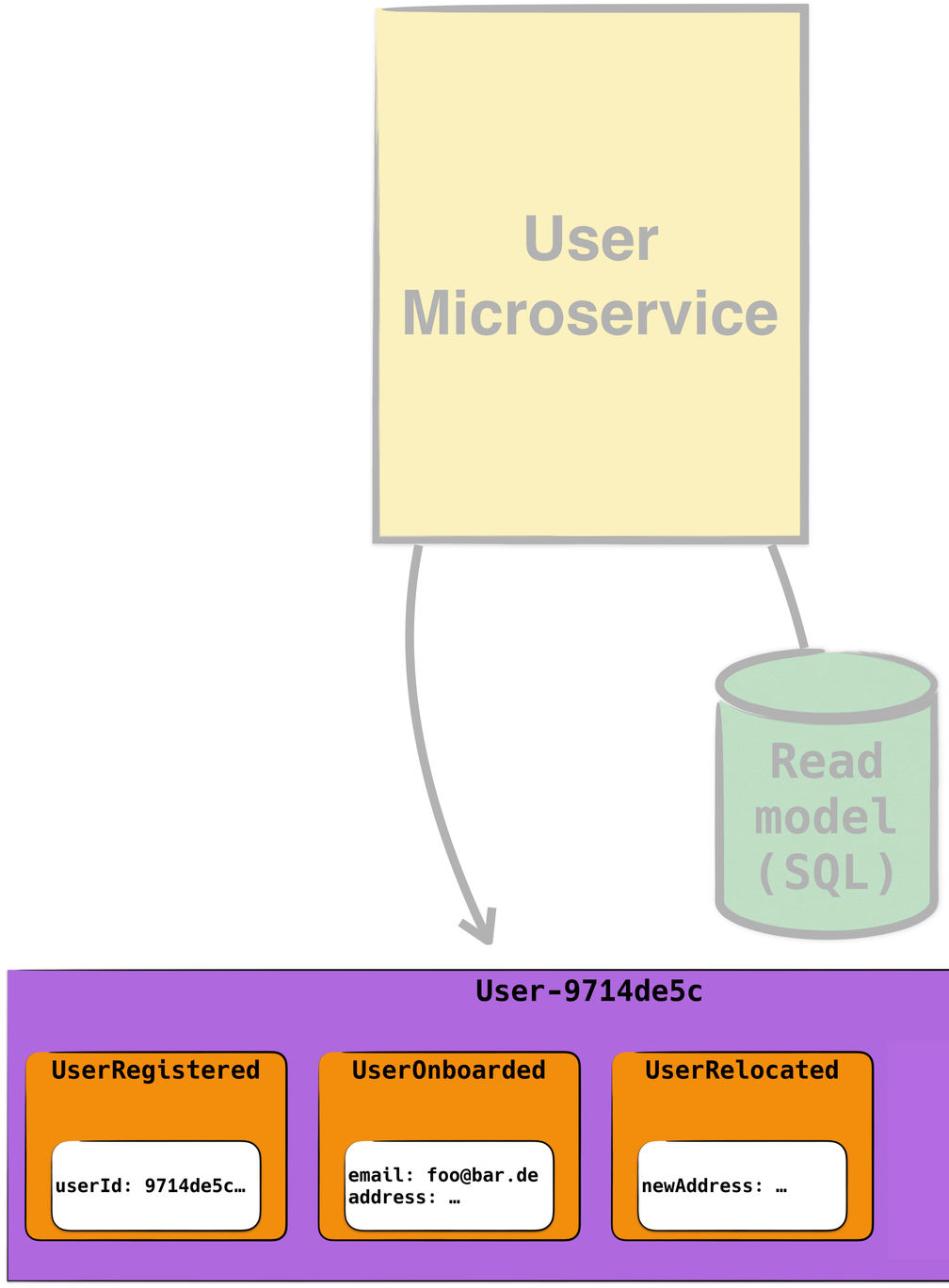

User-9714de5c
UserRegistered
userId: 9714de5c…
UserOnboarded
email: foo@bar.de
address: …
UserRelocated
newAddress: …


User-9714de5c
UserRelocated
newAddress: …

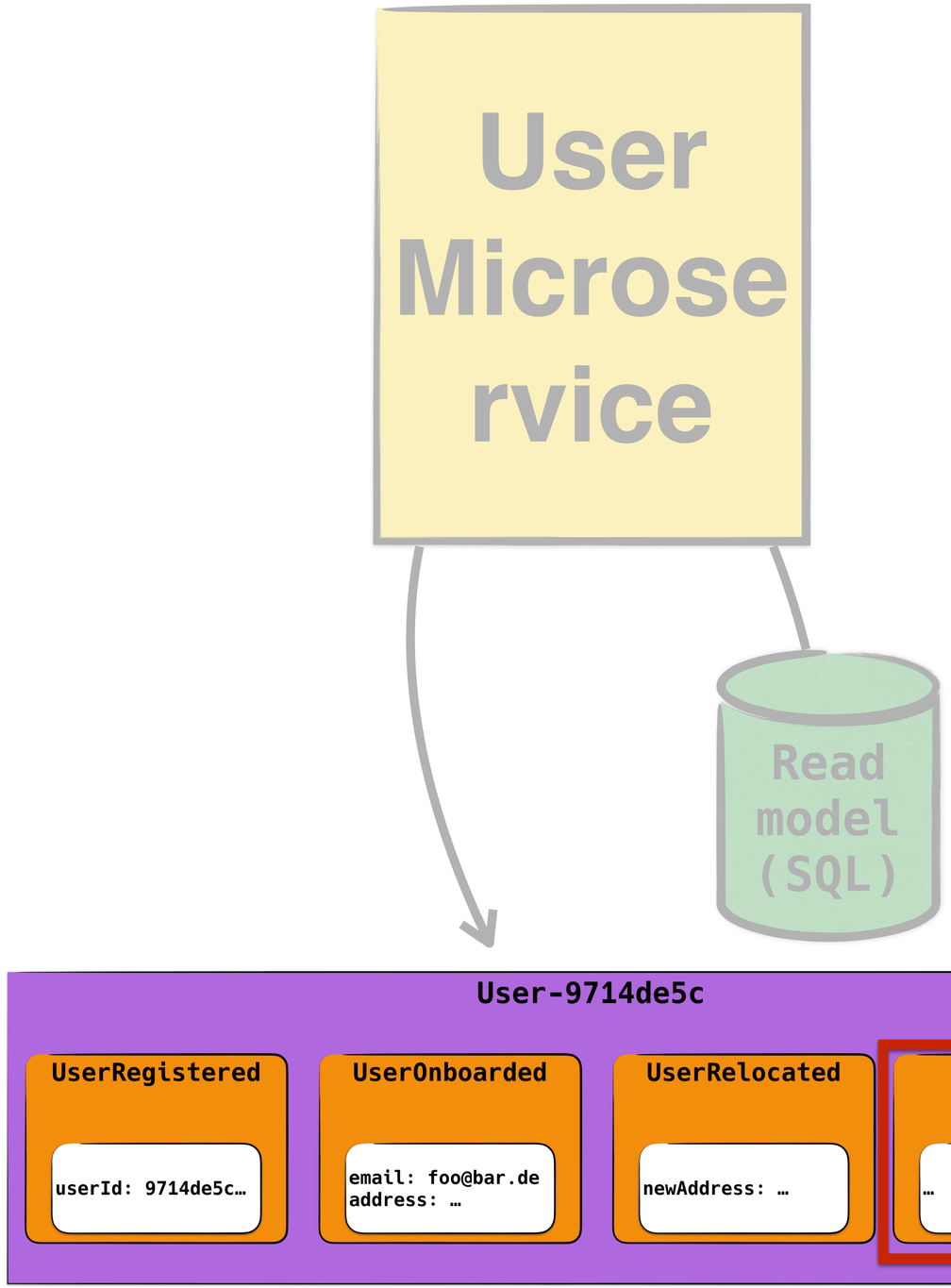

User Aggregate at 20:13 11.03.2008
userId: 9714de5c…
email: foo@bar.de
address: <new address>

How can we store read models?

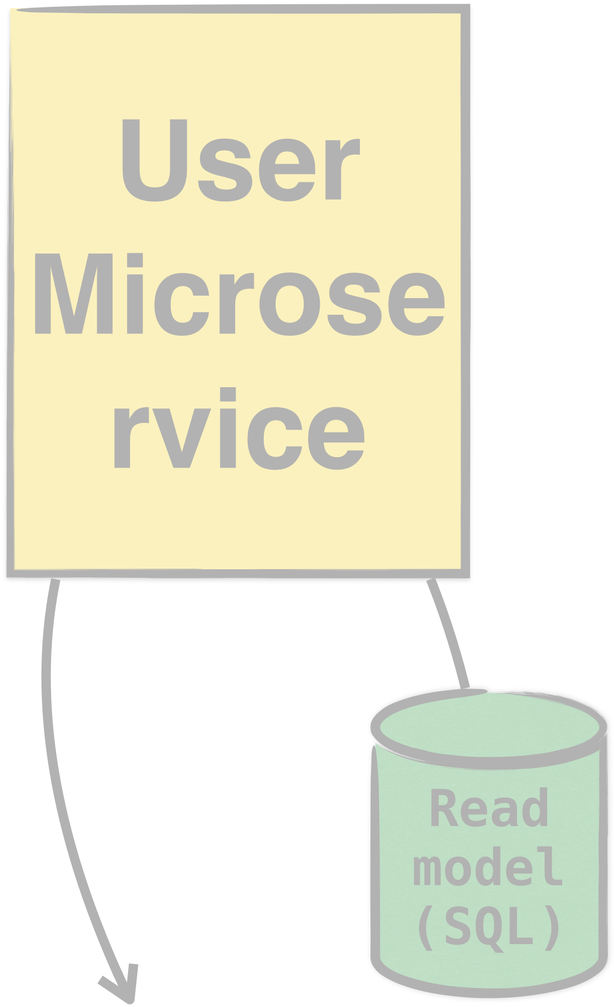
Just use a local database



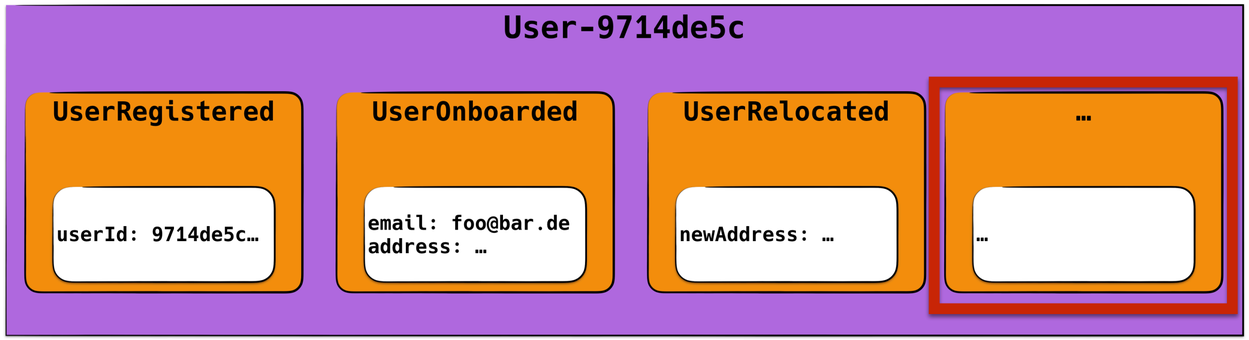
user id	last event id	user name	email	street
9741…	3	David	foo@bar.de	…
4532…	7	Martin	null	…

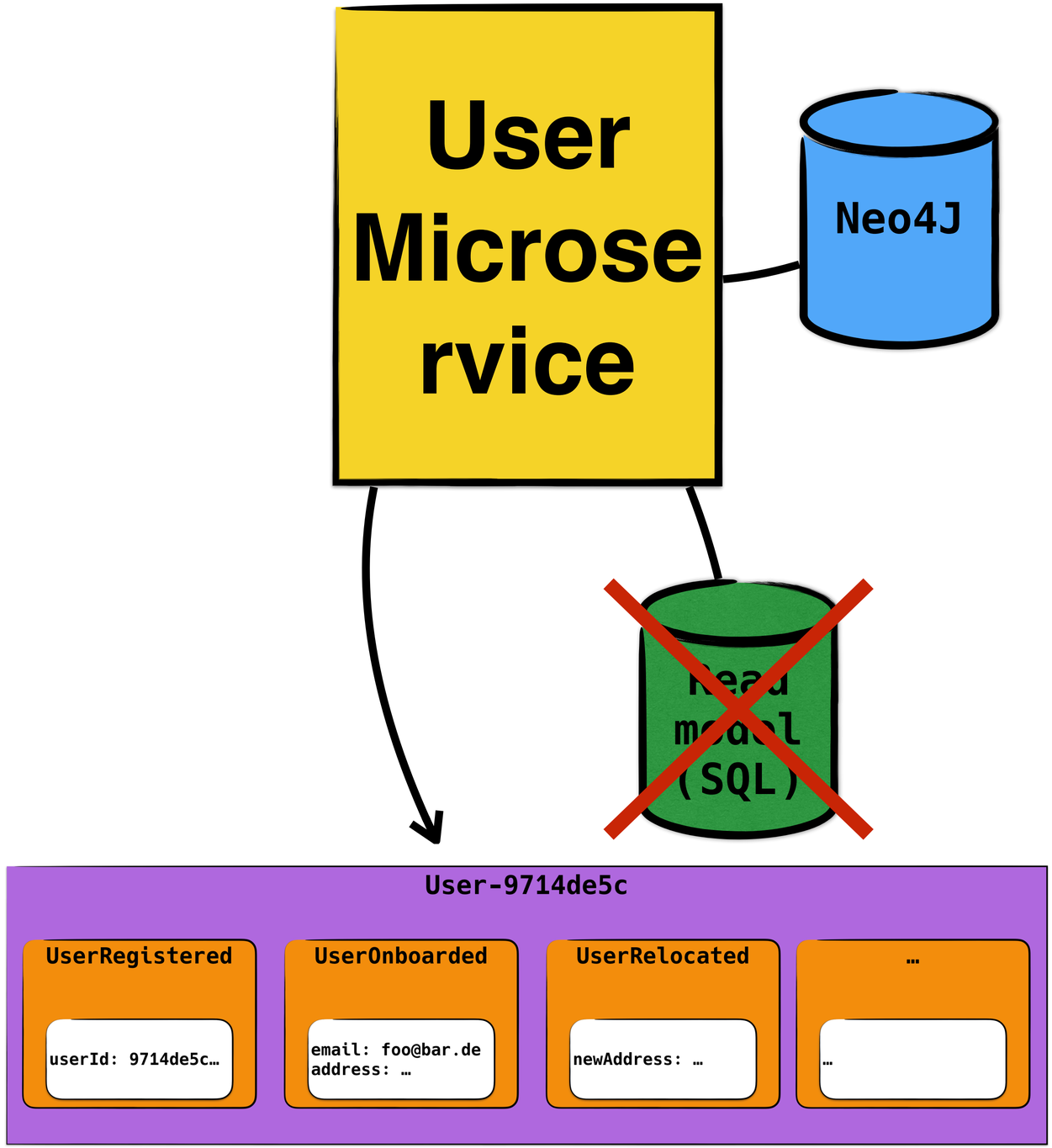


user id	last event id	user name	email	street
9741…	3	David	foo@bar.de	…
4532…	7	Martin	null	…



user id	last event id	user name	email	street
9741…	**4**	David	**qux@ba.ze**	…
4532…	7	Martin	null	…



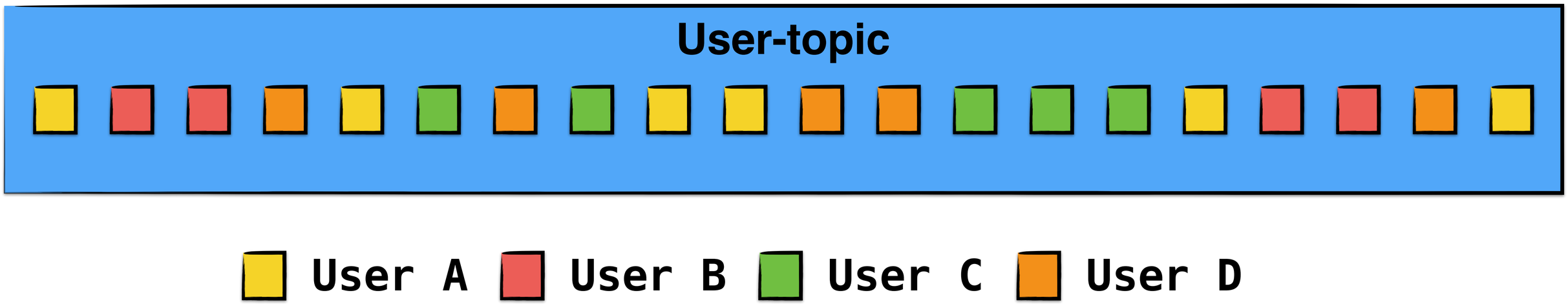

User Microse rvice
Neo4J
Read model (SQL)
User-9714de5c
UserRegistered
userId: 9714de5c…
UserOnboarded
email: foo@bar.de
address: …
UserRelocated
newAddress: …
…
…

Challenges?

Eventual consistency
Zero downtime replays and rebuilds
Re-deliveries and effectively once
Operational complexity

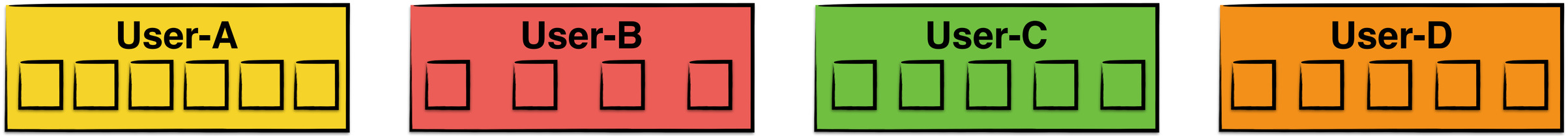
You may not need a read model

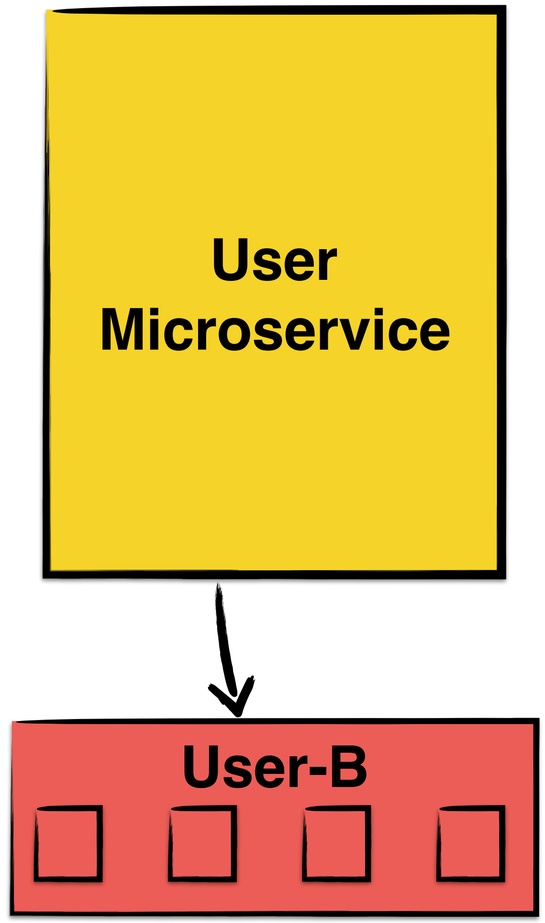
Typical strategies for storing events


User-topic
User A
User B
User C
User D

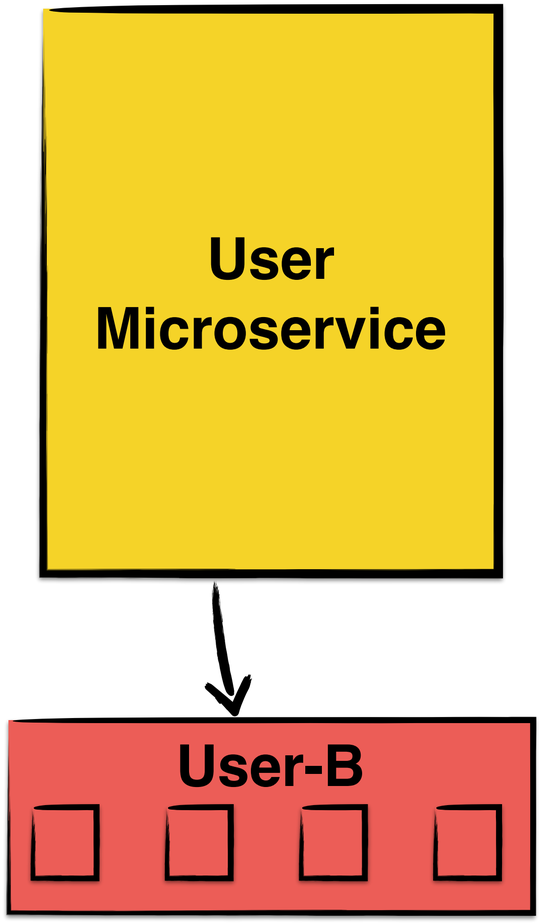
Better: One stream per aggregate

User-topic




User
Microservice
User-B

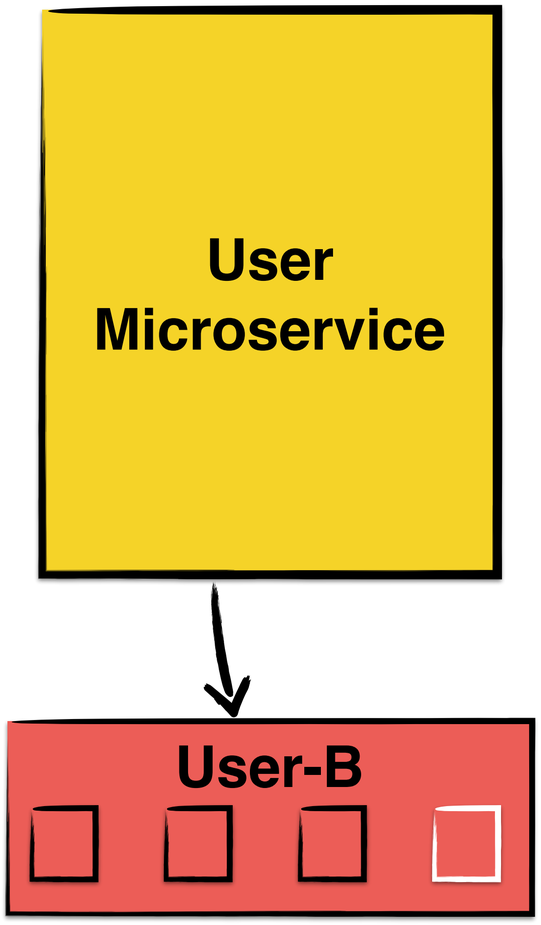
GET /users/B




```
handlers = {
  'UserCreated':    (current, event) => {},
  'UserOnboarded': (current, event) => {},
  'UserDeleted': ...
}

aggregate = readAggregateFromStream(
  'user',
  'B',
  {},
  fromStartOfStream,
  handlers
)
```

GET /users/B

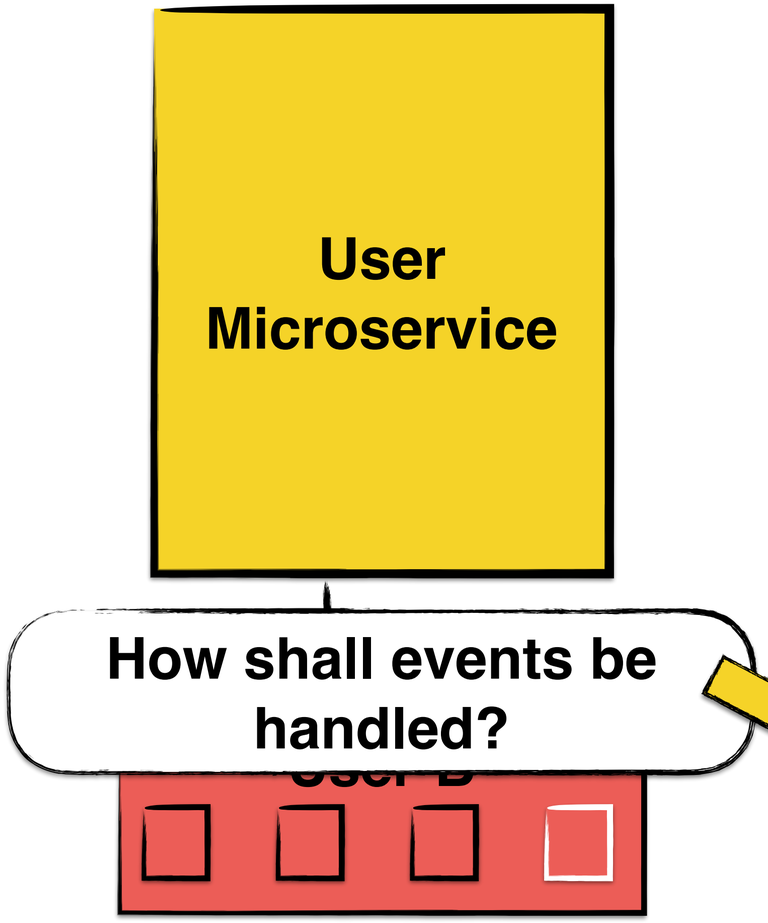



```
handlers = {
  'UserCreated':    (current, event) => {},
  'UserOnboarded': (current, event) => {},
  'UserDeleted': ...
}
```

Each event type has a corresponding handler function

```
  fromStartOfStream,
  handlers
)
```

GET /users/B




```
handlers = {
  'UserCreated':   (current, event) => {},
  'UserOnboarded': (current, event) => {},
  'UserDeleted': ...
}

aggregate = readAggregateFromStream(
  'user',
  'B',
  {},
  fromStartOfStream,
  handlers
)
```

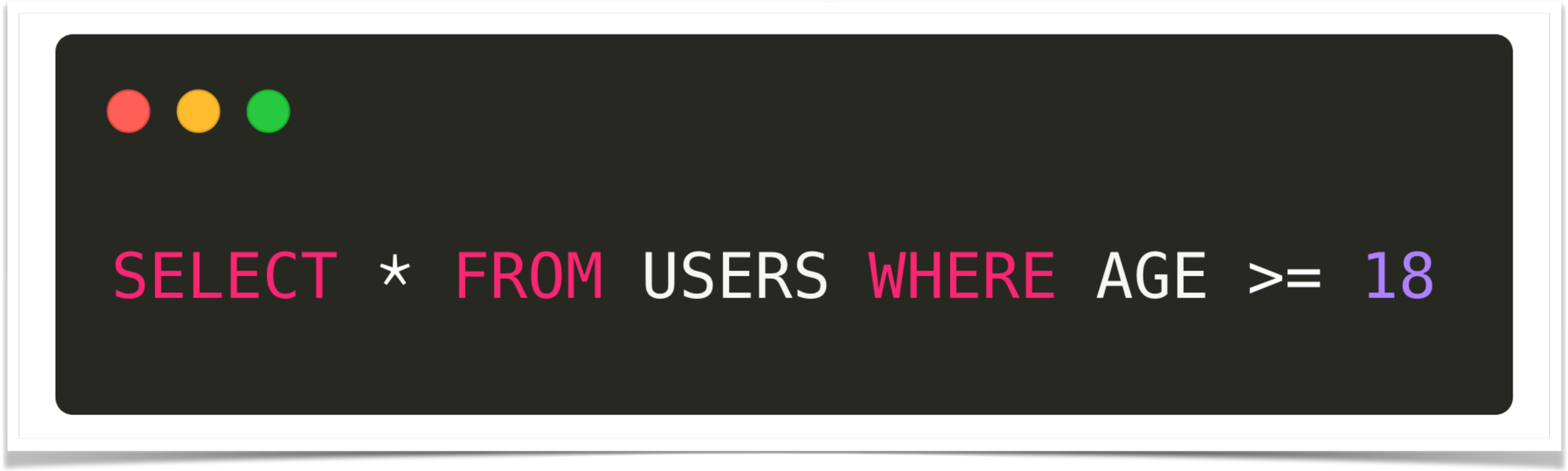
Which aggregate?

Consistent read
No operational overhead
Super-simple programming logic

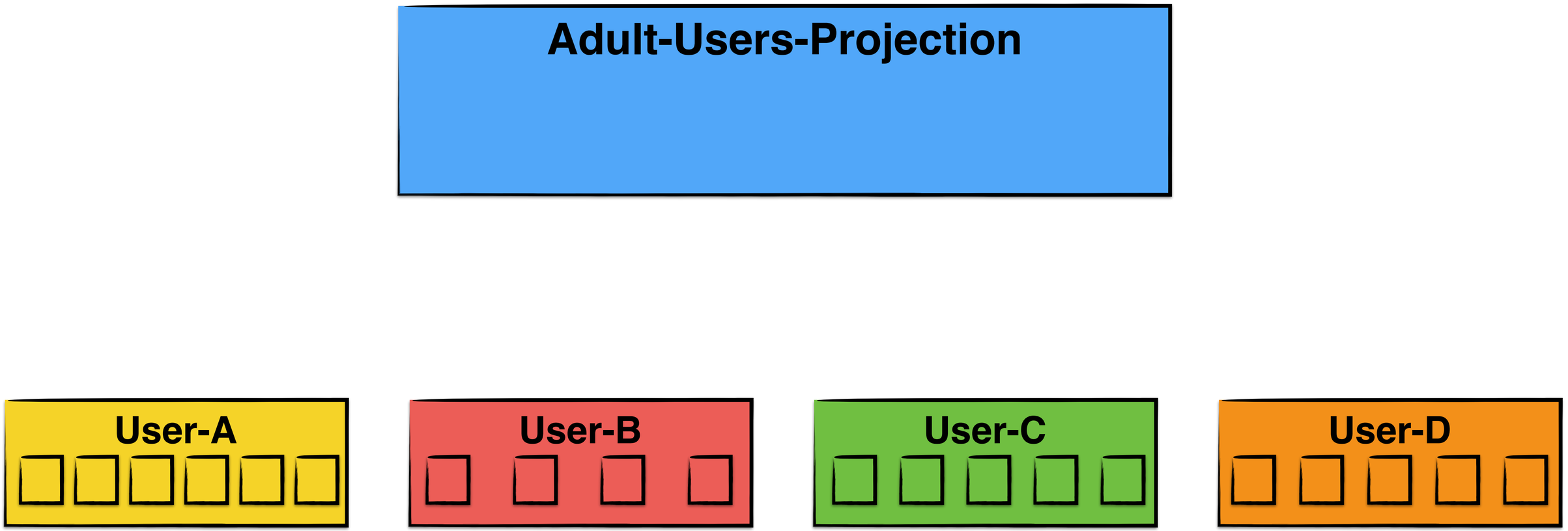
But, what about speed?

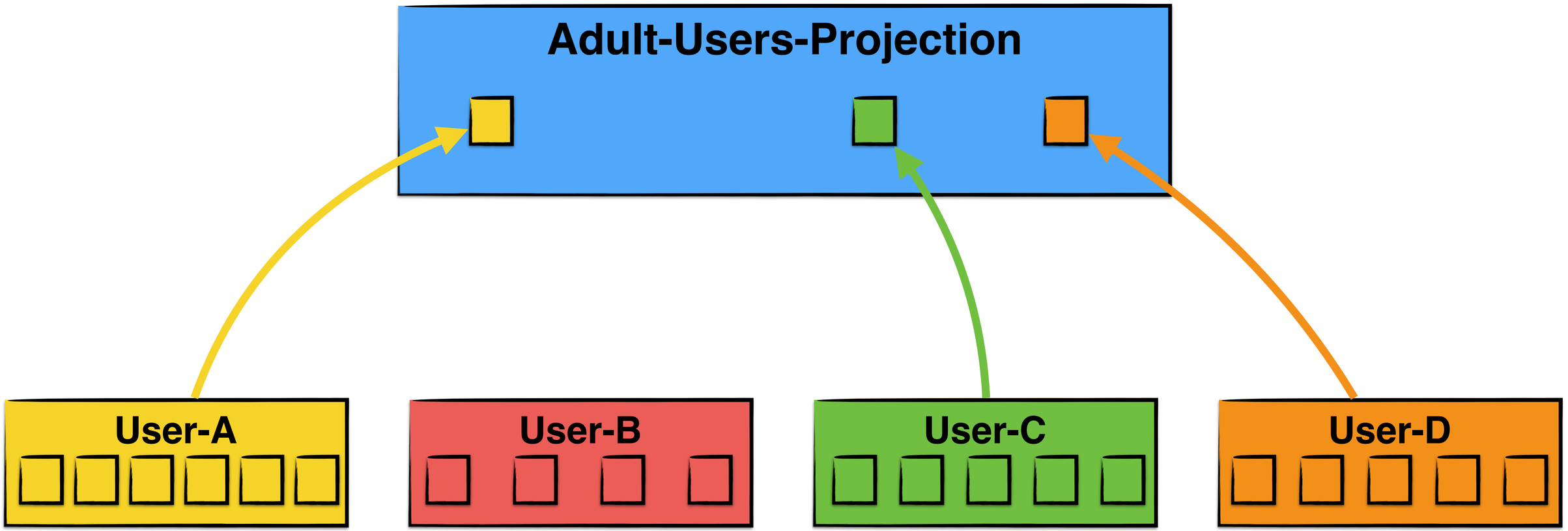
100 events: 66.047ms

But, what about queries?


SELECT * FROM USERS WHERE AGE >= 18

Build specific query projections


Adult-Users-Projection
User-A
User-B
User-C
User-D


Adult-Users-Projection
User-A
User-B
User-C
User-D

Handlers are often trivial

Prefer small aggregates

Measure first

Introduce read models only if needed

Transactions, concurrency and your eventstore

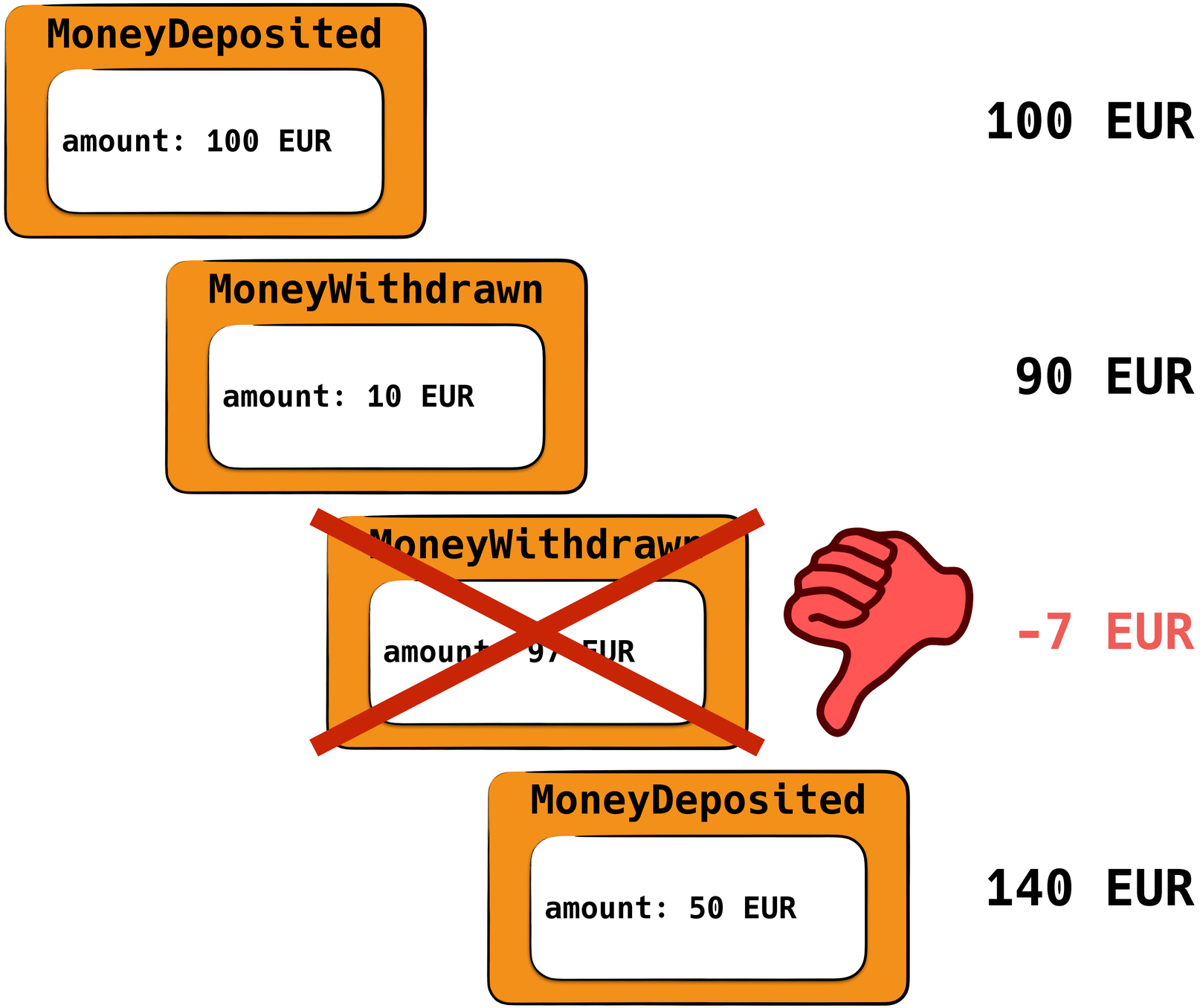
How can we guarantee correctness when writing?

The outcome of a business operation depends on the order of events

"Only withdraw money, if the bank account holds enough money!"

"Only withdraw money, if the bank account holds enough money!"*

**Actually, a real bank would not want such a business rule. They earn money if you overdraw your account. An overdraft fee is one of the most expensive fees banks charge. Just saying…*


MoneyDeposited
amount: 100 EUR
100 EUR
MoneyWithdrawn
amount: 10 EUR
90 EUR
-7 EUR
MoneyDeposited
amount: 50 EUR
140 EUR

Let's shuffle

MoneyDeposited

amount: 100 EUR

100 EUR

MoneyWithdrawn

amount: 10 EUR

90 EUR

MoneyWithdrawn

amount: 97 EUR

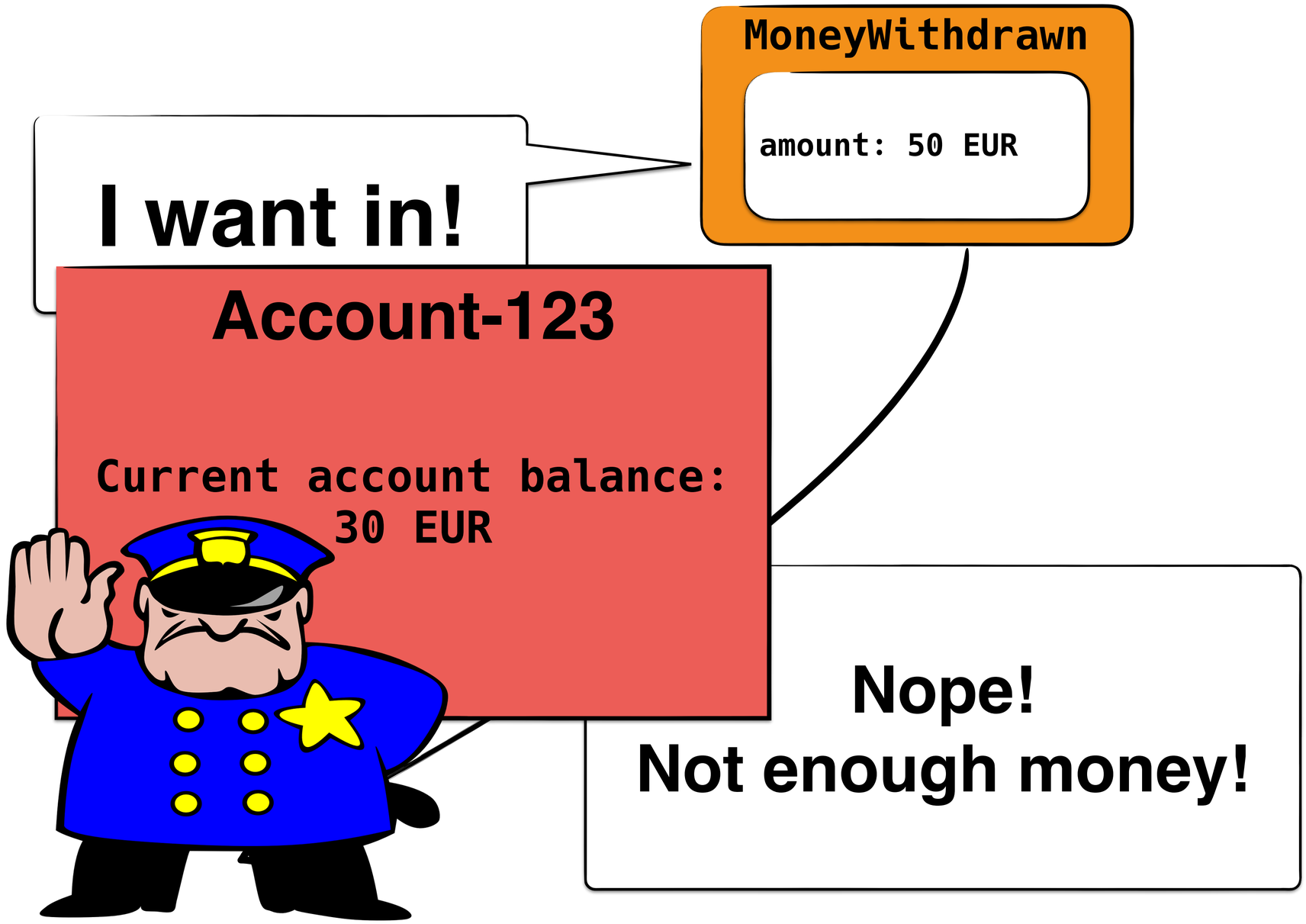
140 EUR

MoneyDeposited

amount: 50 EUR

43 EUR

The aggregate is responsible for enforcing business invariants

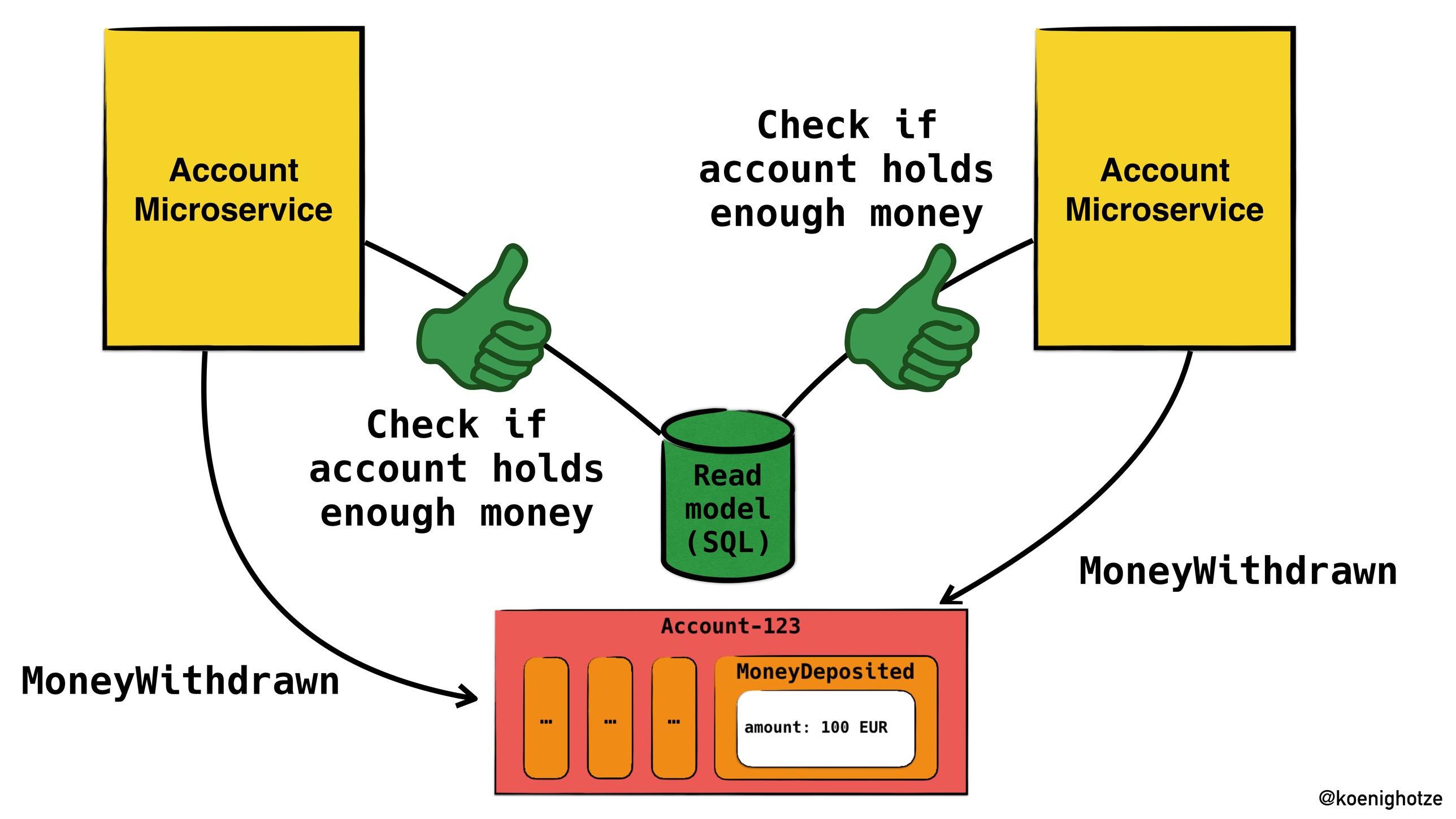

MoneyWithdrawn
amount: 50 EUR
I want in!
Account-123
Current account balance:
30 EUR
Nope!
Not enough money!

The aggregate is the
“transaction boundary”

Just use a database for handling transactions

Maybe not

Are YOUR systems single-threaded?



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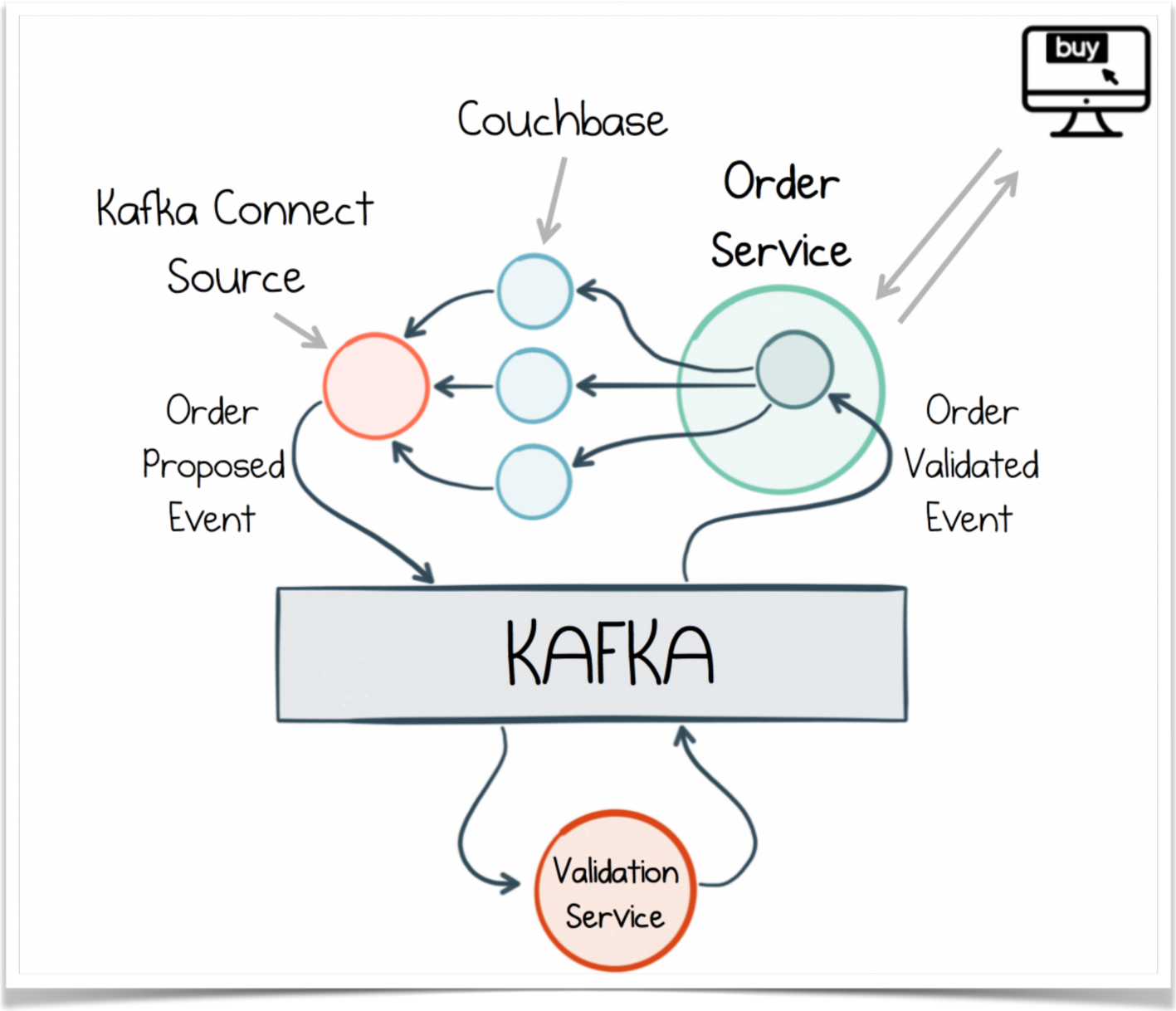
Validation against a read model is prone to inconsistencies

Just use distributed transactions!

...just joking

Just manage transactions with a database and use single-writer



https://www.confluent.io/blog/messaging-single-source-truth/

Quick tip for finding friends in ops:

Ask them just to install and maintain production grade Kafka and Couchbase installations on AWS

Optimistic concurrency control

From Wikipedia, the free encyclopedia

Optimistic concurrency control (**OCC**) is a concurrency control method applied to transactional systems such as relational database management systems and software transactional memory. OCC assumes that multiple transactions can frequently complete without interfering with each other. While running, transactions use data resources without acquiring locks on those resources. Before committing, each transaction verifies that no other transaction has modified the data it has read. If the check reveals conflicting modifications, the committing transaction rolls back and can be restarted.[1] Optimistic concurrency control was first proposed by H.T. Kung and John T. Robinson.[2]

https://en.wikipedia.org/wiki/Optimistic_concurrency_control

Optimistic concurrency control

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Optimistic concurrency control

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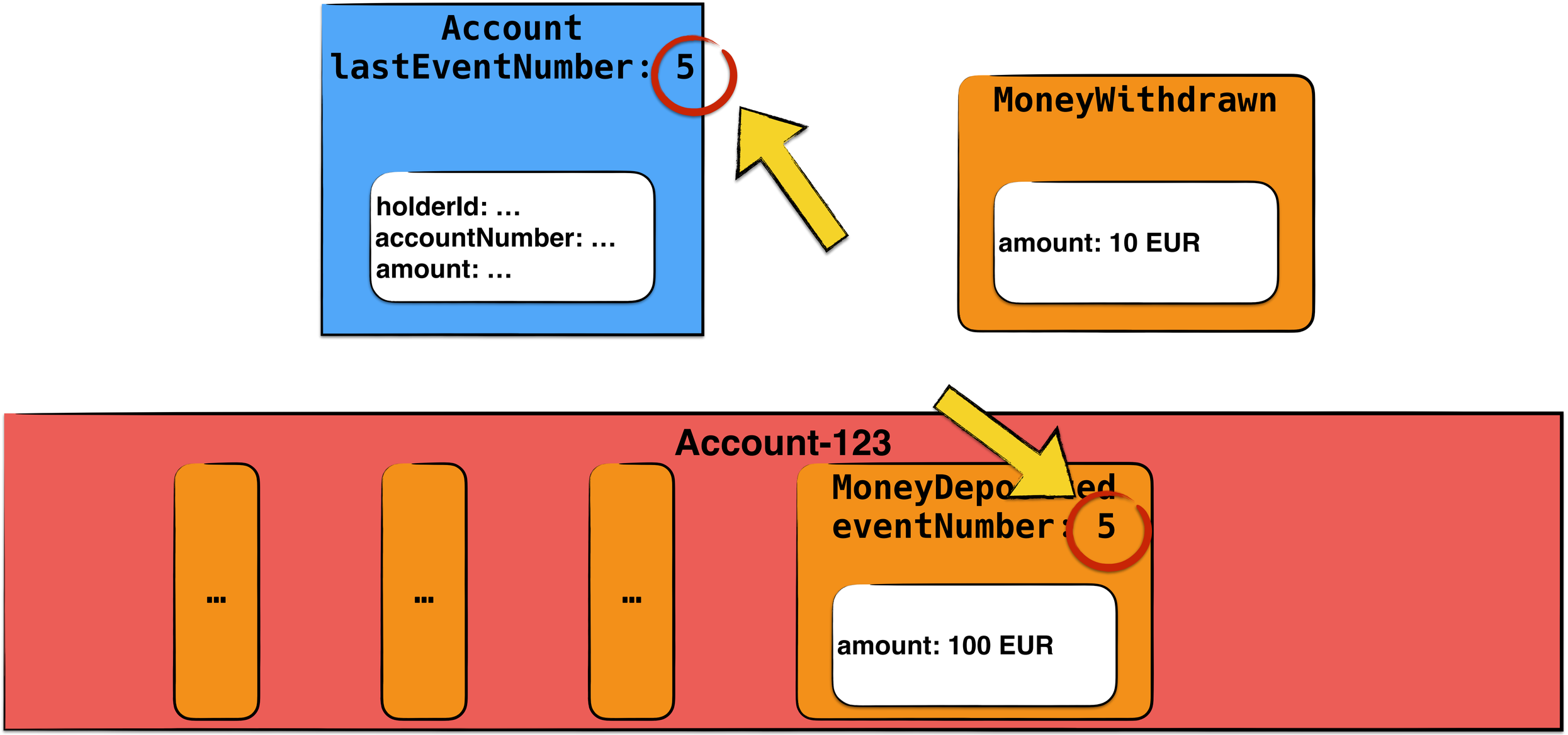
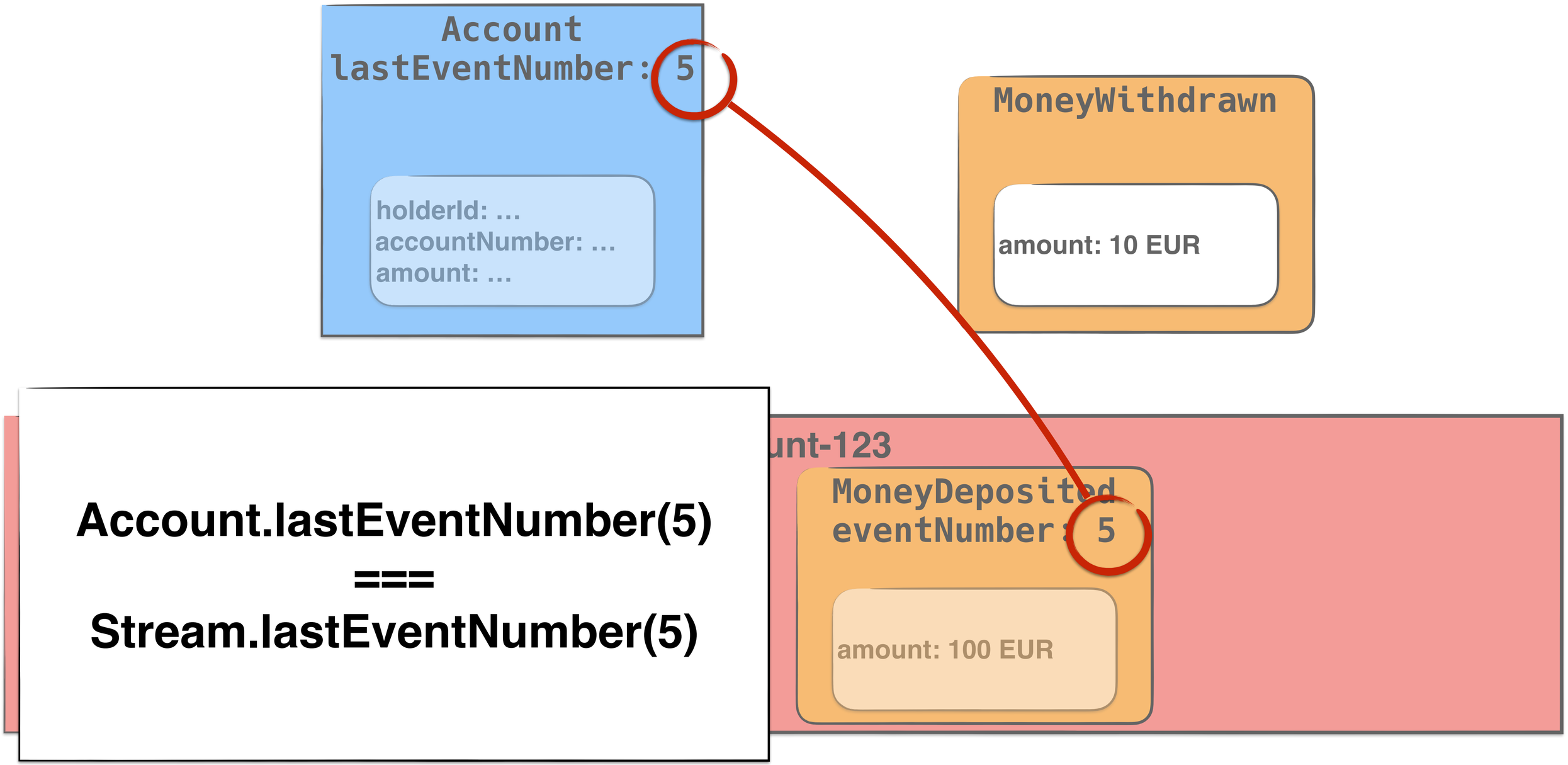
transaction has modified the data it has read. If the check reveals conflicting modifications, the committing transaction rolls back and can be restarted.[1] Optimistic concurrency control was first proposed by H.T. Kung and John T. Robinson.[2]

https://en.wikipedia.org/wiki/Optimistic_concurrency_control

The happy path

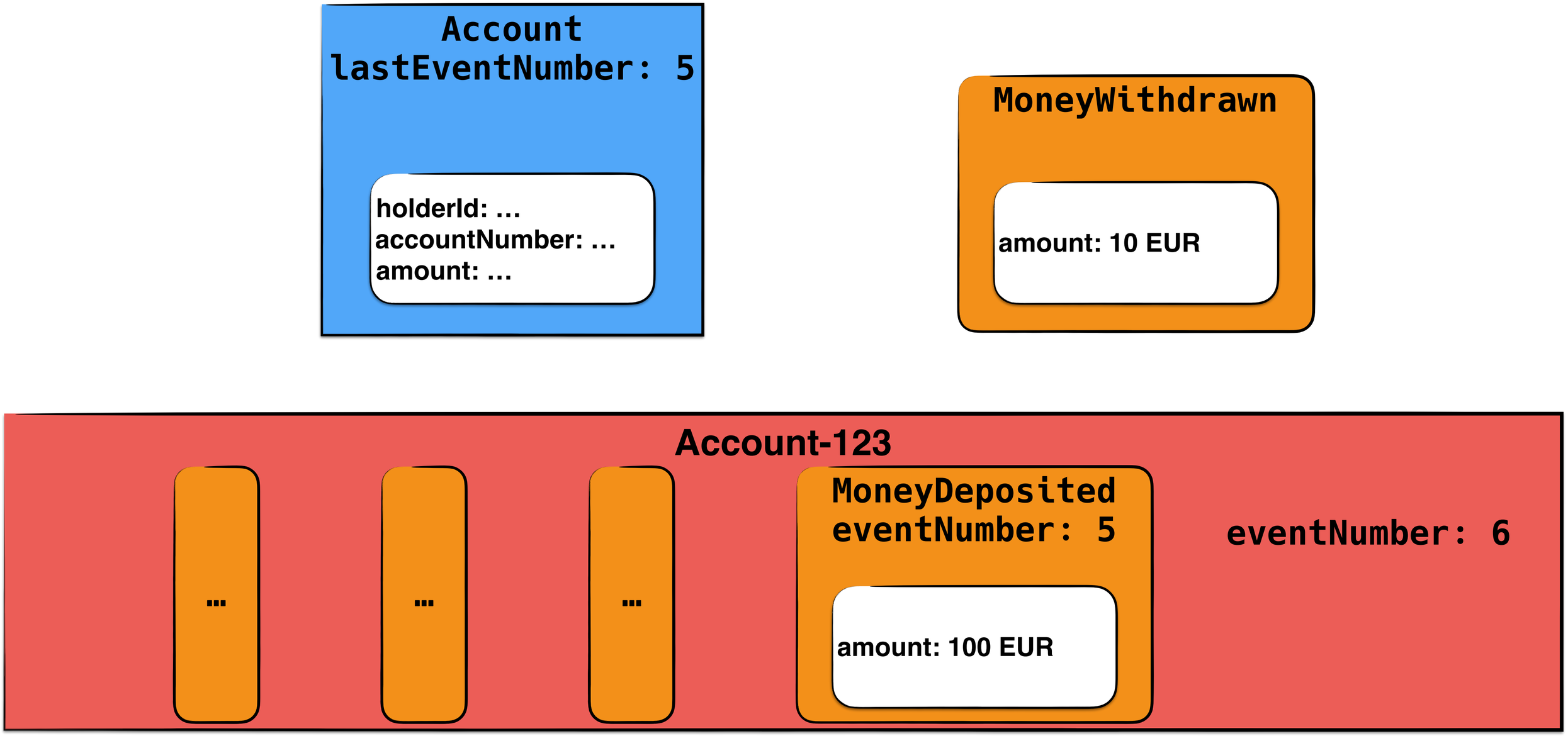

Account
lastEventNumber: 5
holderId: ...
accountNumber: ...
amount: ...
MoneyWithdrawn
amount: 10 EUR
Account-123
...
...
...
MoneyDepo ed
eventNumber: 5
amount: 100 EUR



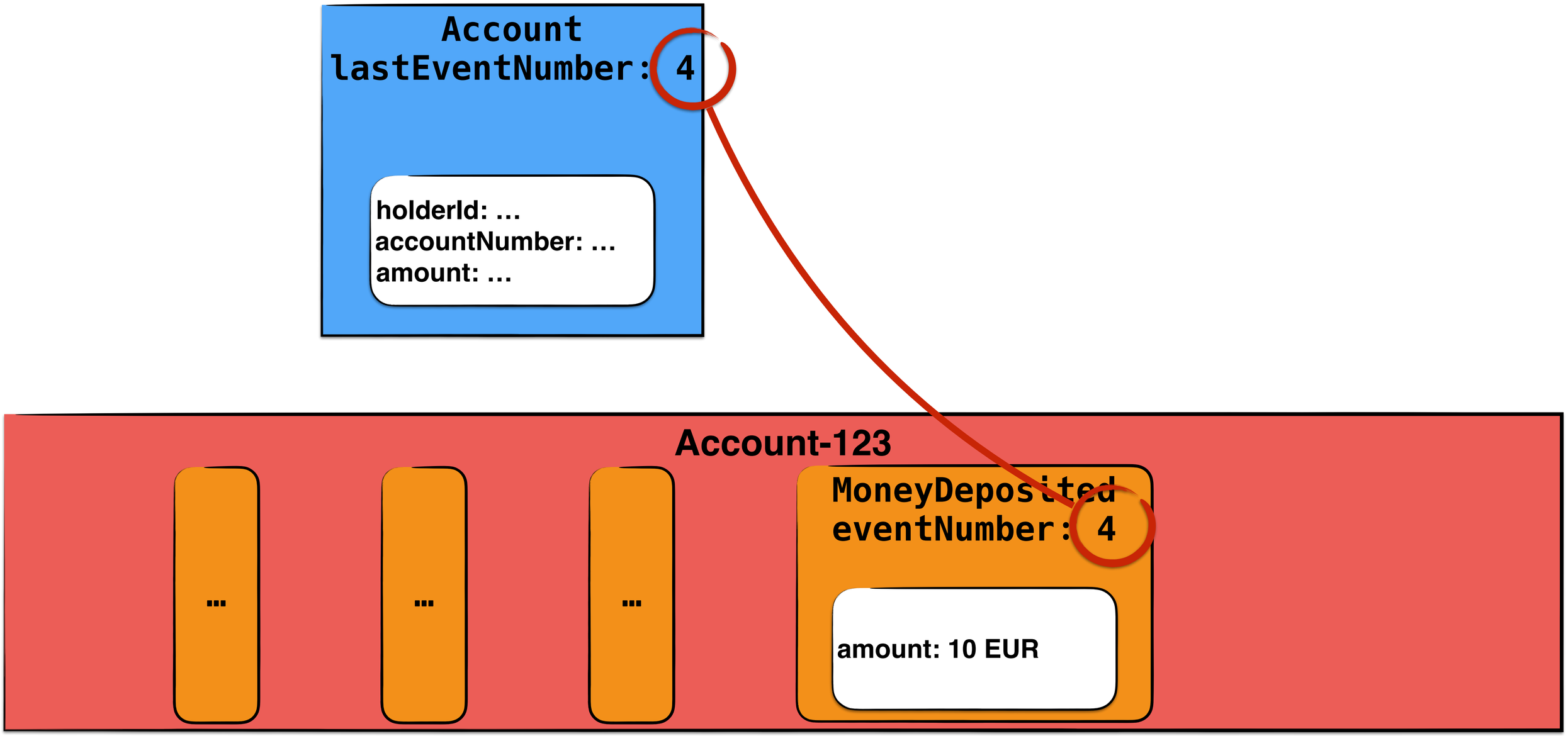
Account.lastEventNumber(5)

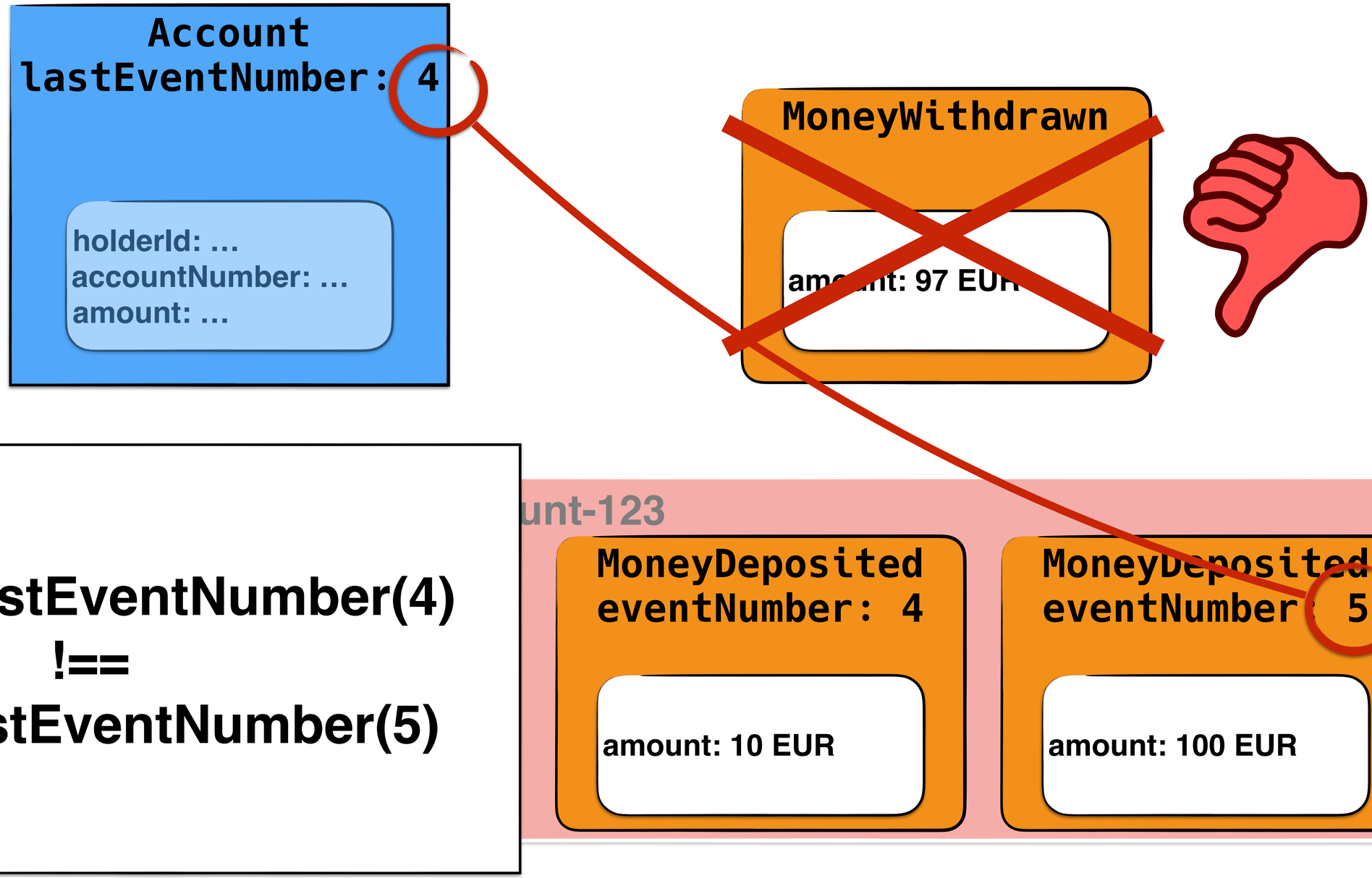
===

Stream.lastEventNumber(5)


Account
lastEventNumber: 5
holderId: ...
accountNumber: ...
amount: ...
MoneyWithdrawn
amount: 10 EUR
Account-123
...
...
...
MoneyDeposited
eventNumber: 5
amount: 100 EUR
eventNumber: 6

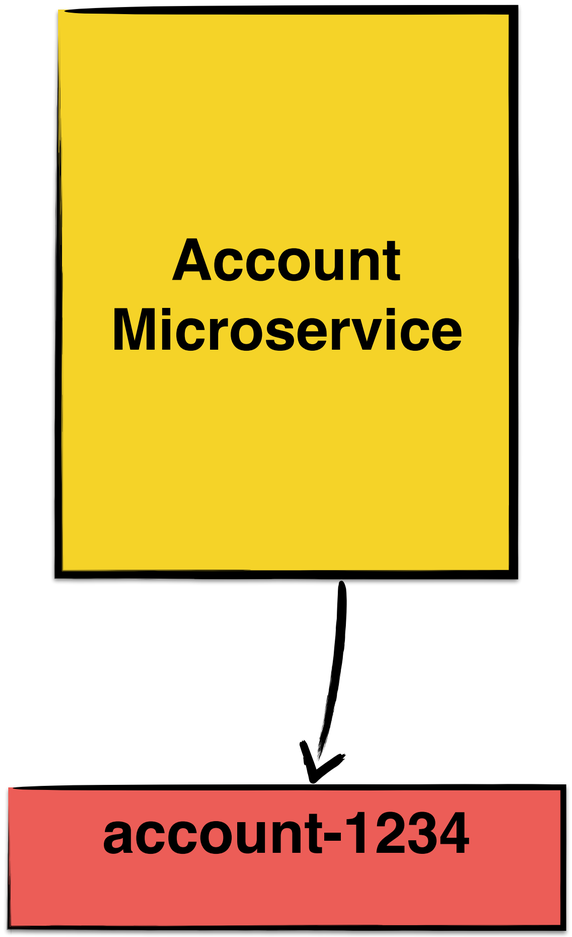
The not-so-happy path


Account
lastEventNumber: 4
holderId: ...
accountNumber: ...
amount: ...
Account-123
...
...
...
MoneyDeposited
eventNumber: 4
amount: 10 EUR

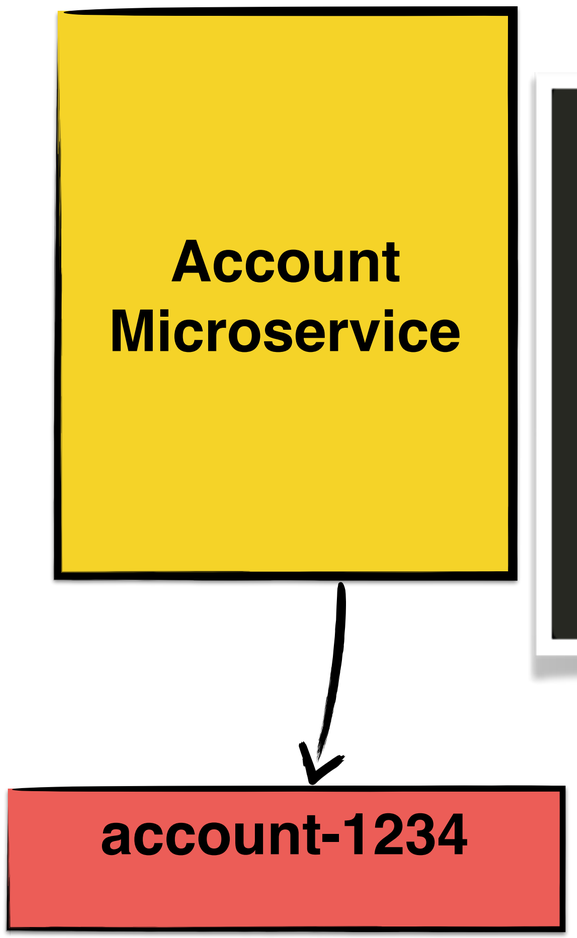


Account.lastEventNumber(4)
!==
Stream.lastEventNumber(5)

PUT /account/1234



PUT /account/1234

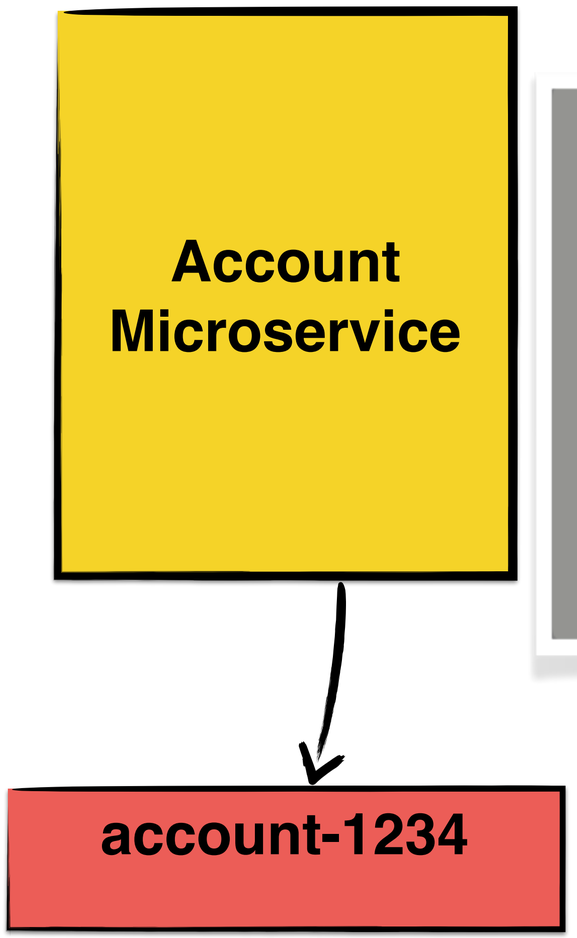



```
{ aggregate, lastVersionNumber } = readAggregateFromStream(...)

events = executeBusinessLogic(...)

emitEvents('account', '1234', events, lastVersionNumber)
```

PUT /account/1234




```
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emitEvents('account', '1234', events, lastVersionNumber)
```
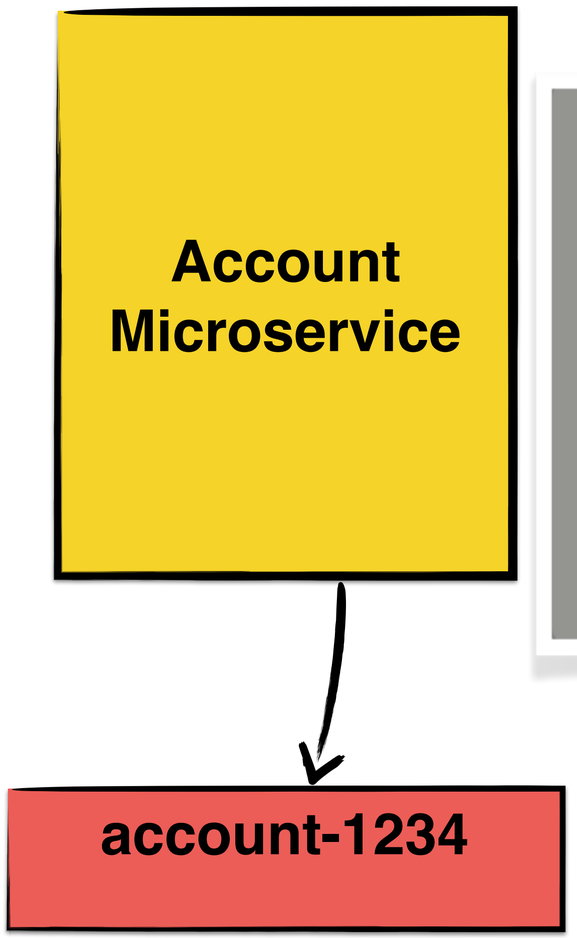
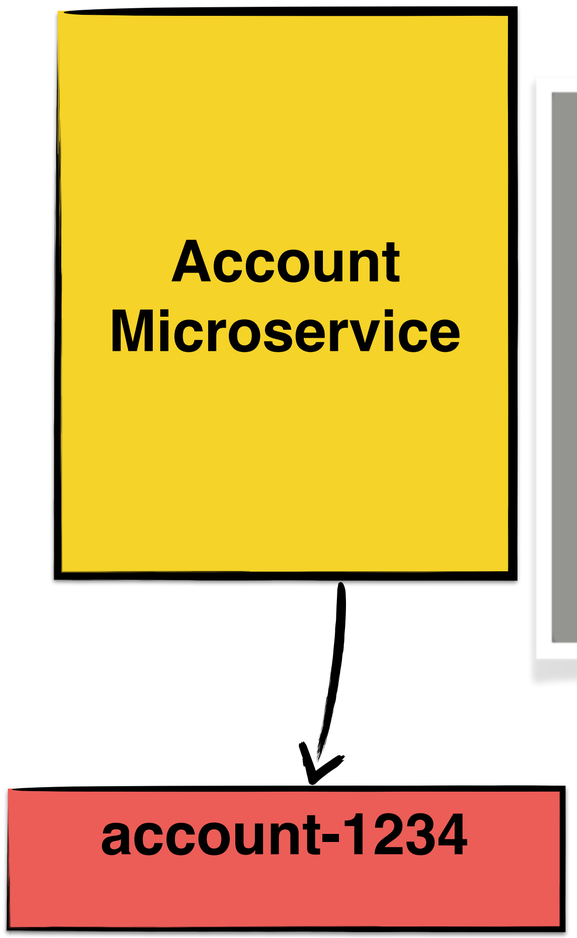

PUT /account/1234



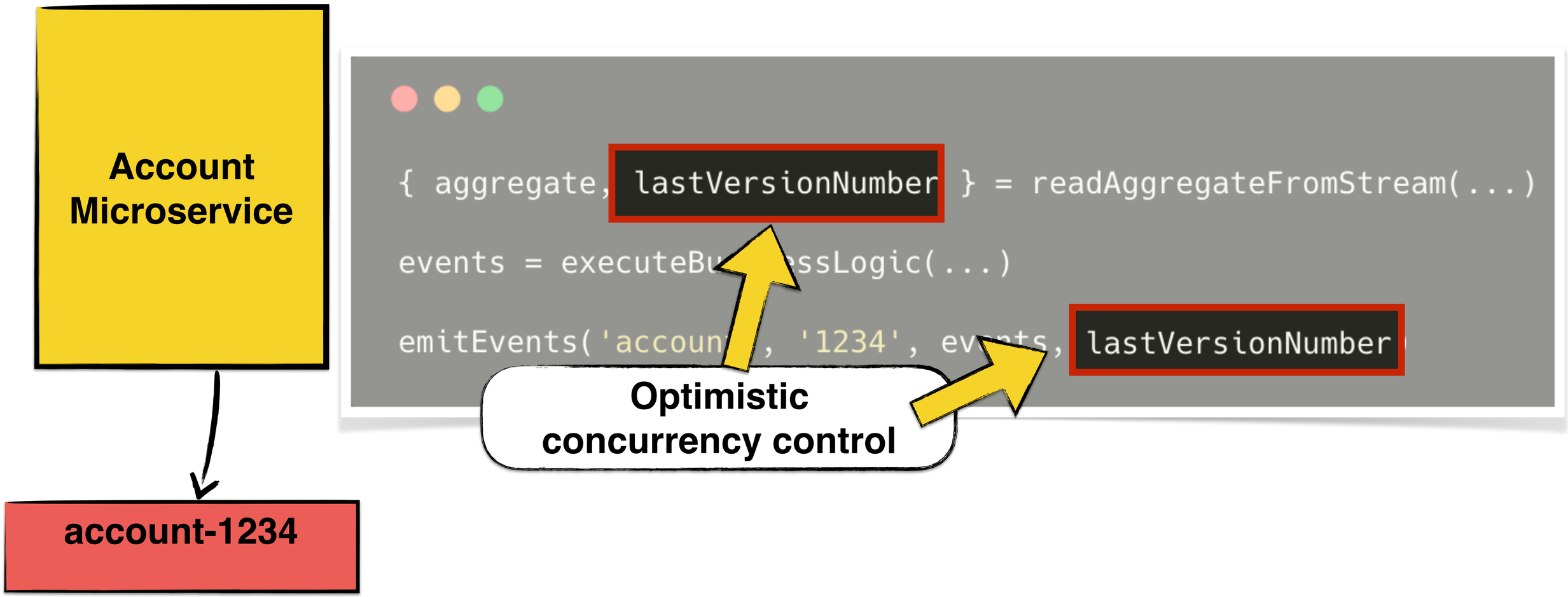

```
{ aggregate, lastVersionNumber } = readAggregateFromStream(...)

events = executeBusinessLogic(...)

emitEvents('account', '1234', events, lastVersionNumber)
```

PUT /account/1234




```
{ aggregate, lastVersionNumber } = readAggregateFromStream(...)

events = executeBusinessLogic(...)

emitEvents('account', '1234', events, lastVersionNumber)
```

PUT /account/1234



And Kafka?

Kafka / KAFKA-2260

Allow specifying expected offset on produce

Details

Type:	Improvement	Status:	OPEN
Priority:	Minor	Resolution:	Unresolved
Affects Version/s:	None	Fix Version/s:	None
Component/s:	producer		
Labels:	None		

Description

I'd like to propose a change that adds a simple CAS-like mechanism to the Kafka producer. This update has a small footprint, but enables a bunch of interesting uses in stream processing or as a commit log for process state.

Andy Bryant added a comment - 27/Jul/18 04:14

👍🏽 Would prove very handy in event source based designs

Russell Ferriday added a comment - 9 hours ago

This would enable full-on eventsourcing on Kafka, without having to restrict to single-thread designs.
One example of a great (>250 github star) FOSS project being held back by this:

https://github.com/johnbywater/eventsourcing/issues/108

Can we see this soon?

Kafka / KAFKA-2260

Allow specifying expected offset on produce

Details

Type:	Improvement	Status:	OPEN
Priority:	Minor	Resolution:	Unresolved
Affects Version/s:	None	Fix Version/s:	None

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Details

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Priority:	Minor	Resolution:	Unresolved
Affects Version/s:	None	Fix Version/s:	None
Component/s:	producer		

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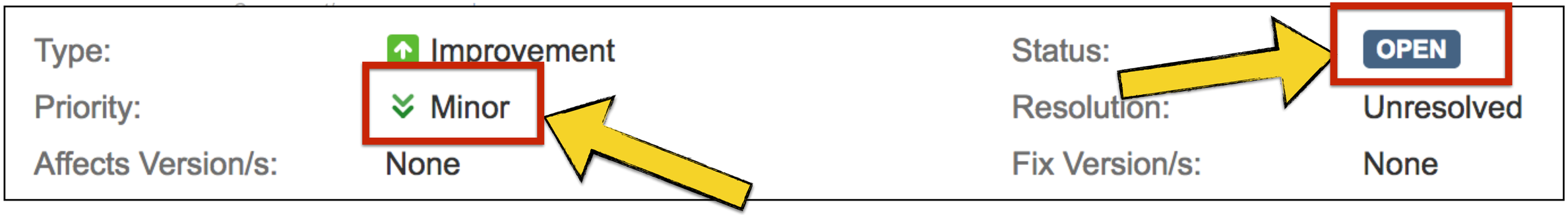
Priority:	Minor	Resolution:	Unresolved
Affects Version/s:	None	Fix Version/s:	None



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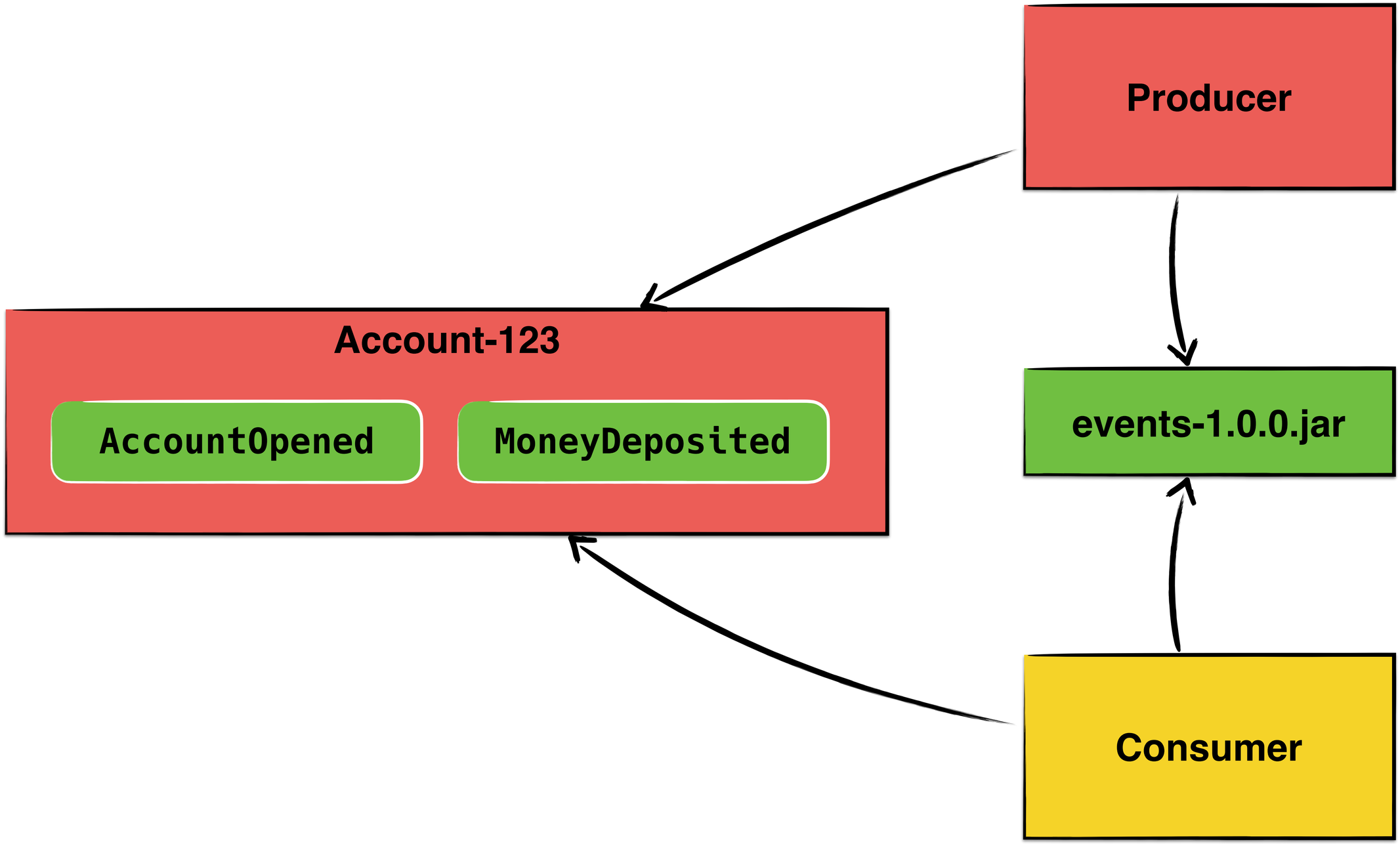
Can we see this soon?

Scalability without locks
Consistency
Design choice
Super-simple programming logic

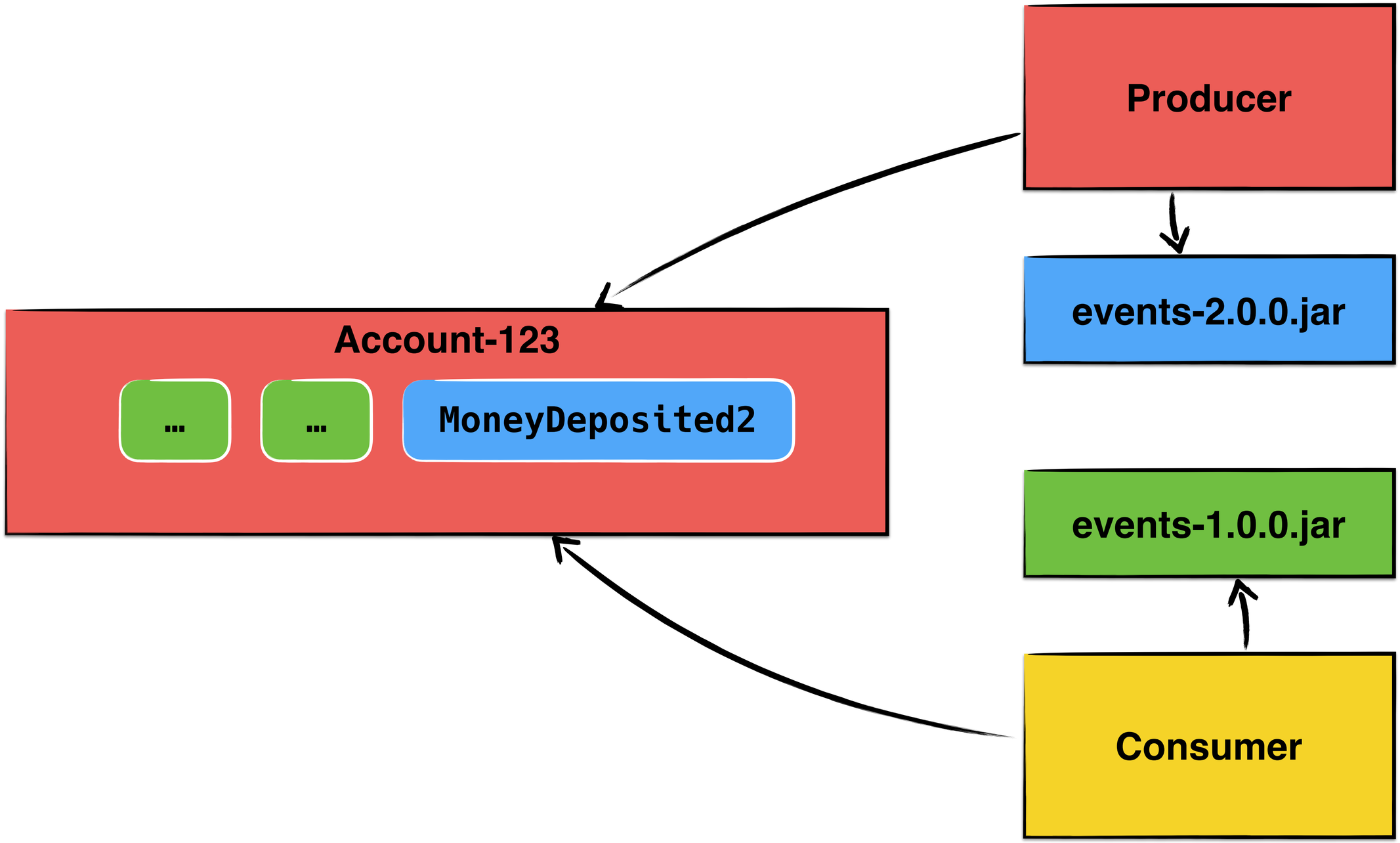

Versions, up-front-design and breaking things down the road
@koenighotze

How can we deal with versions without going crazy?

Just use semantic versioning and typed events


Producer
Account-123
AccountOpened
MoneyDeposited
events-1.0.0.jar
Consumer

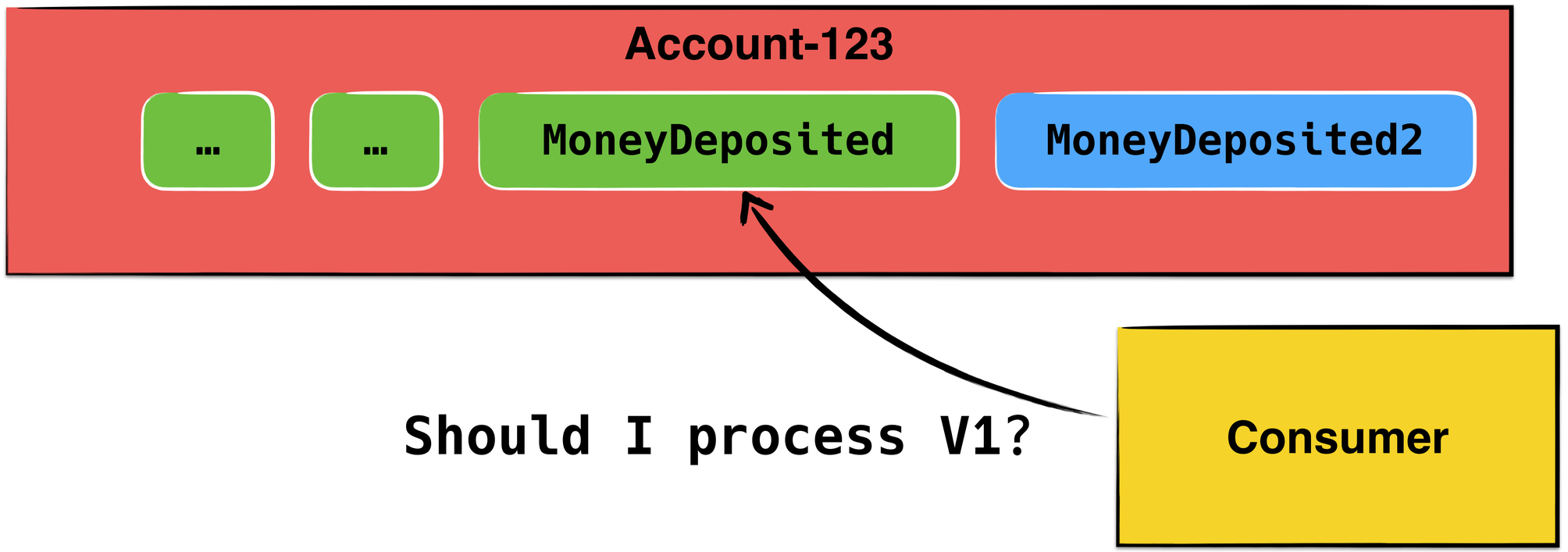
…then change some event types


Producer
events-2.0.0.jar
Account-123
...
...
MoneyDeposited2
events-1.0.0.jar
Consumer


public class InvalidClassException extends ObjectStreamException {
...
}

Gosh…just apply
“Double Write”


Account-123
…
…
MoneyDeposited
MoneyDeposited2

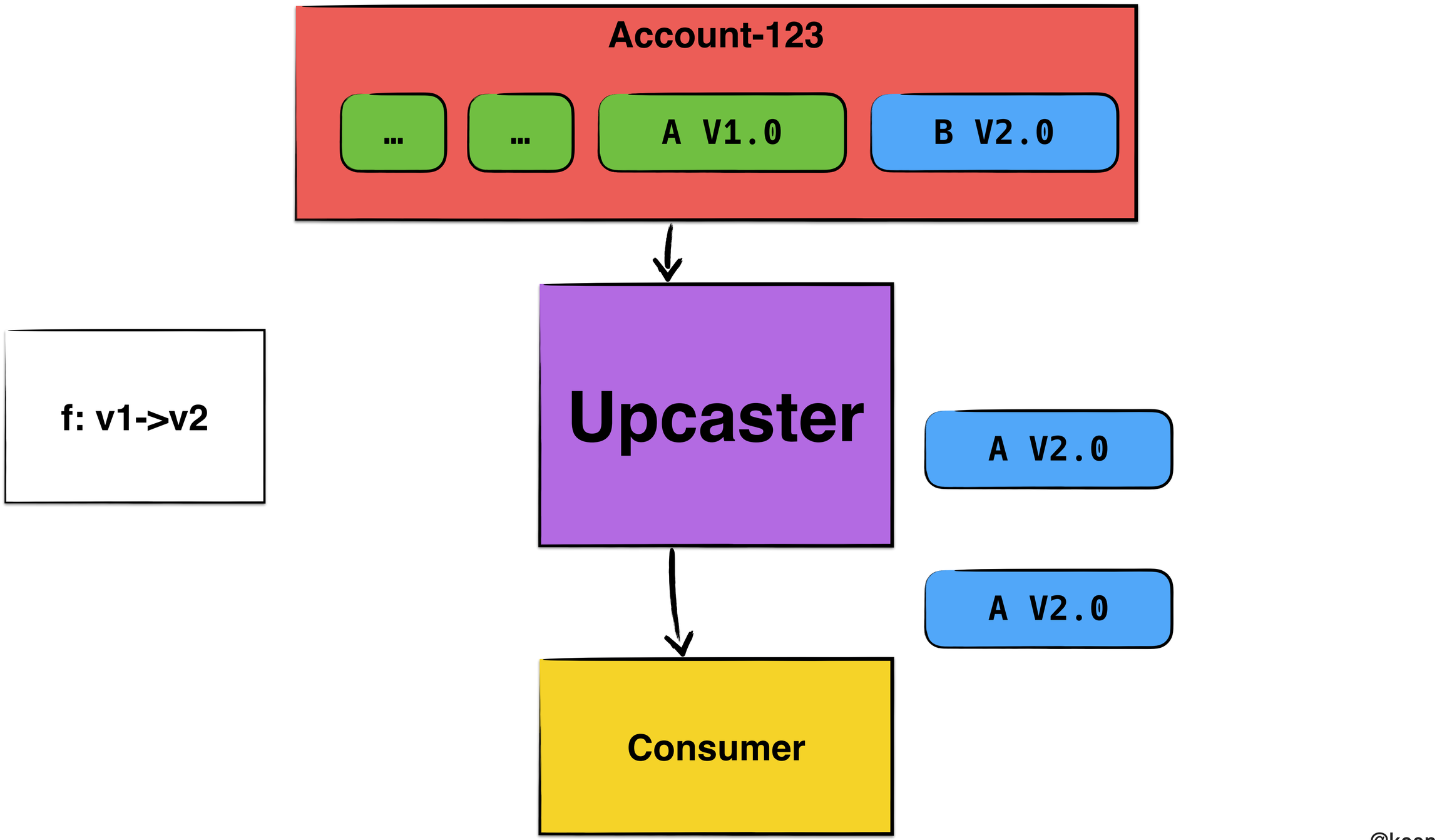

Account-123
…
…
MoneyDeposited
MoneyDeposited2
Should I process V1?
Consumer

Or wait for a V2…which might never arrive?

MoneyDeposited_v1
MoneyDeposited_v2
...
MoneyDeposited_v100

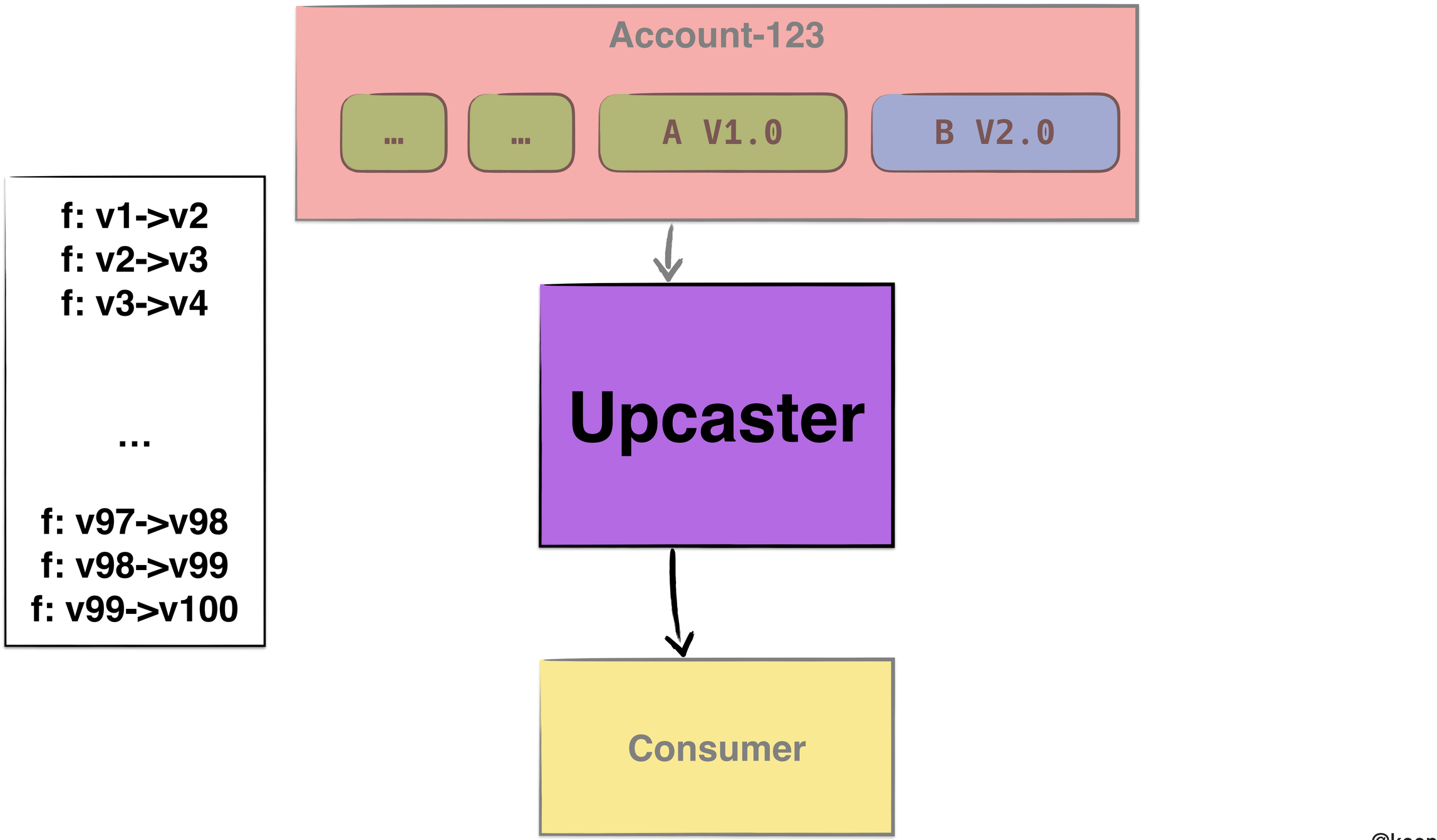
MoneyDeposited_v1Handler
MoneyDeposited_v2Handler
...
MoneyDeposited_v100Handler

Just use an Upcaster



@koenighotze

5 months later…

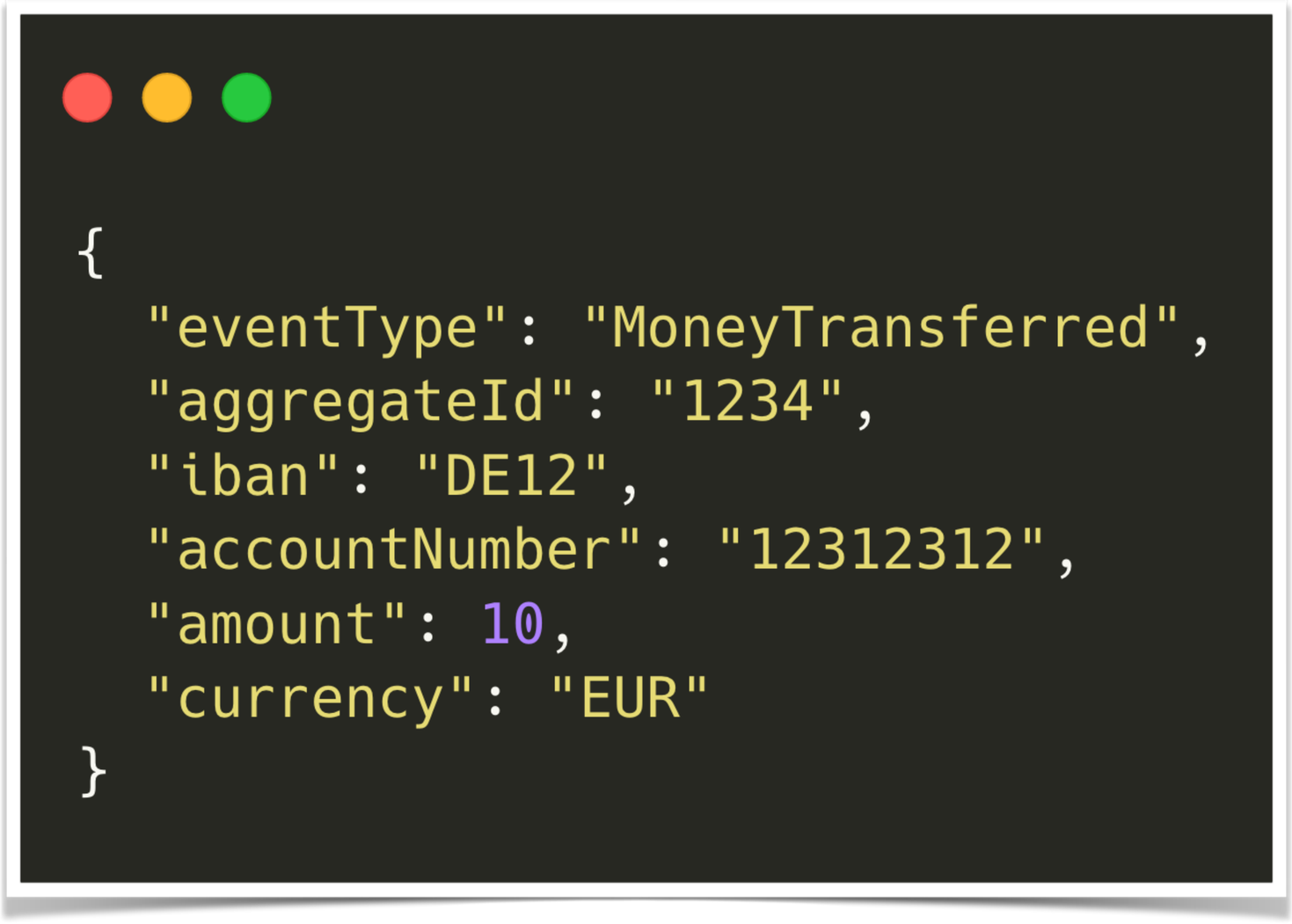

Account-123
...
...
A V1.0
B V2.0
f: v1->v2
f: v2->v3
f: v3->v4
...
f: v97->v98
f: v98->v99
f: v99->v100
Upcaster
Consumer

Good luck maintaining
that monster

Incompatible event changes indicate a new event

Prefer simple, text-based, human readable events

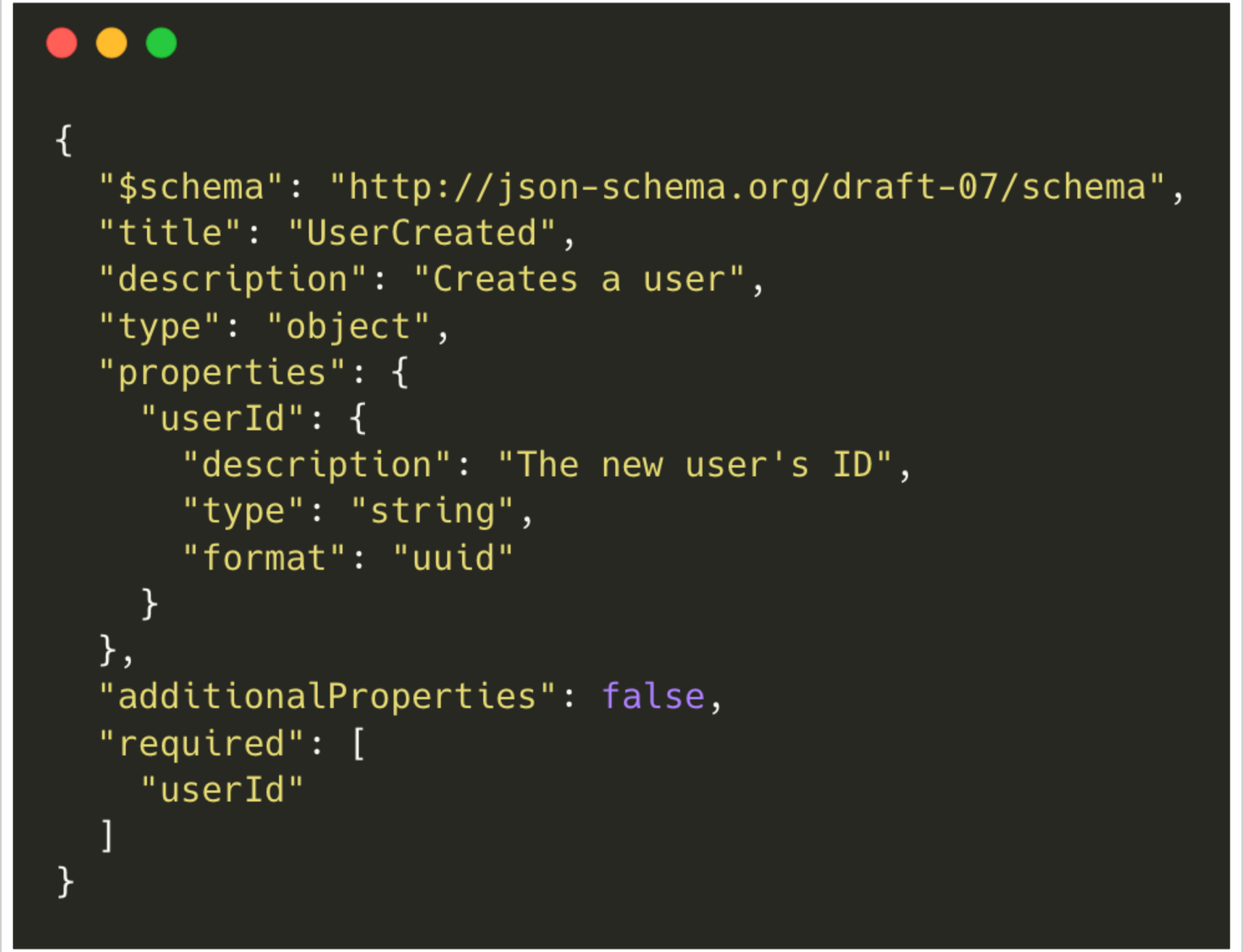
Fancy speak for JSON


{
"eventType": "MoneyTransferred",
"aggregateId": "1234",
"iban": "DE12",
"accountNumber": "12312312",
"amount": 10,
"currency": "EUR"
}

And correctness?

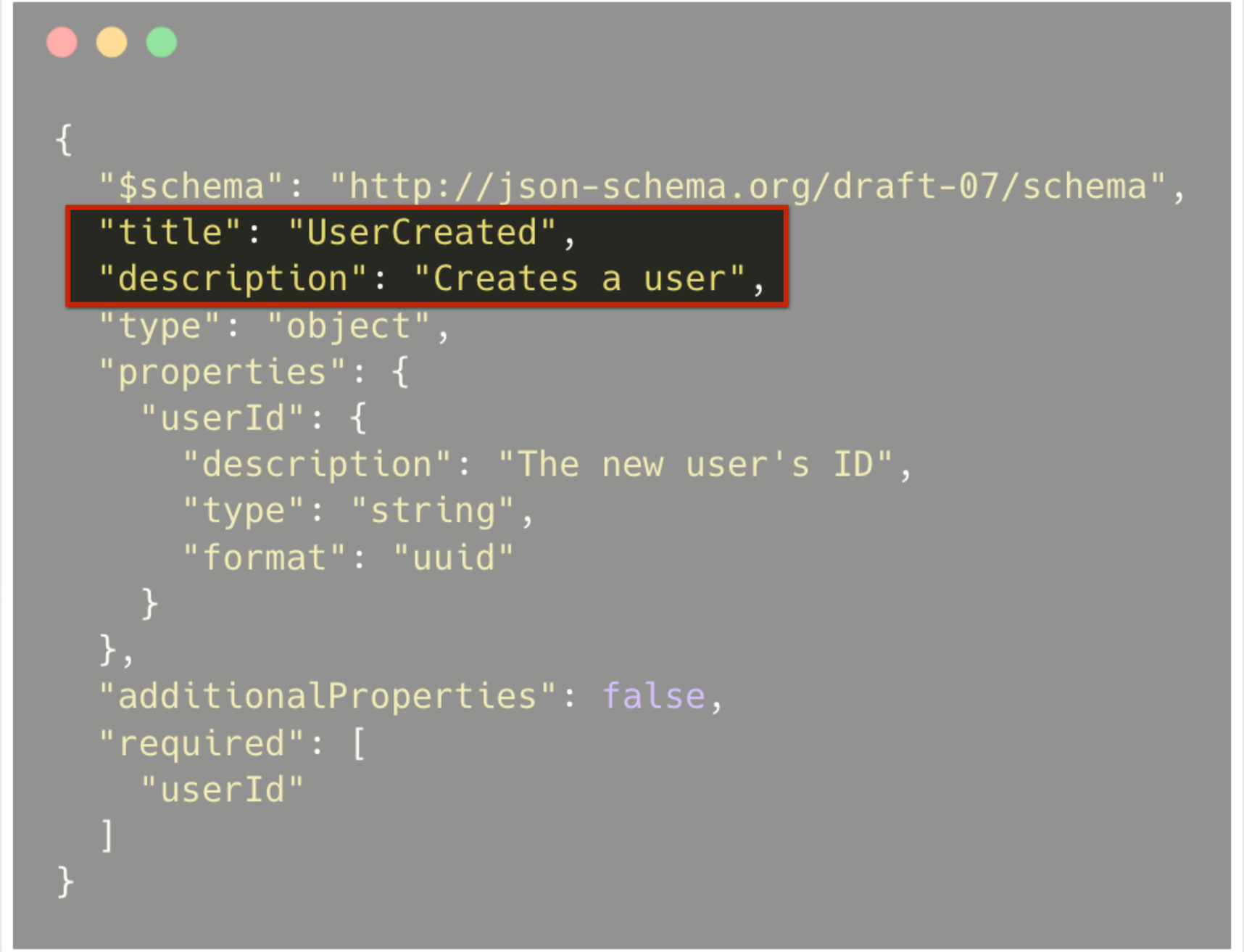
String-ly typed events work really well

Weak schema to the rescue



```
{
  "$schema": "http://json-schema.org/draft-07/schema",
  "title": "UserCreated",
  "description": "Creates a user",
  "type": "object",
  "properties": {
    "userId": {
      "description": "The new user's ID",
      "type": "string",
      "format": "uuid"
    }
  },
  "additionalProperties": false,
  "required": [
    "userId"
  ]
}
```

@koenighotze


{
"$schema": "http://json-schema.org/draft-07/schema",
"title": "UserCreated",
"description": "Creates a user",
"type": "object",
"properties": {
"userId": {
"description": "The new user's ID",
"type": "string",
"format": "uuid"
}
},
"additionalProperties": false,
"required": [
"userId"
]
}

```
{
  "$schema": "http://json-schema.org/draft-07/schema",
  "title": "UserCreated",
  "description": "Creates a user",
  "type": "object",
  "properties": {
    "userId": {
      "description": "The new user's ID",
      "type": "string",
      "format": "uuid"
    }
  },
  "additionalProperties": false,
  "required": [
    "userId"
  ]
}
```

@koenighotze

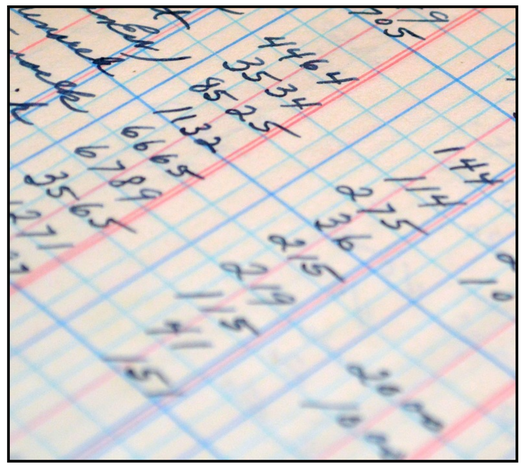

assertIsValid(eventData, ajv.compile(schema))
event = newEvent(
{
aggregateId,
aggregateType,
eventData
}
)


assertIsValid(eventData, ajv.compile(schema))
event = newEvent(
{
aggregateId,
aggregateType,
eventData
}
)

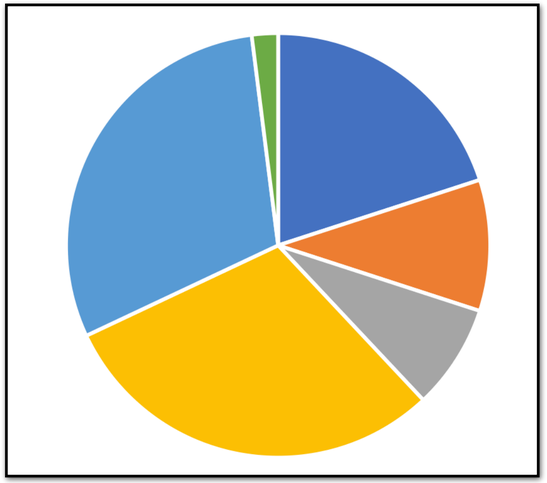
Schema-on-Read

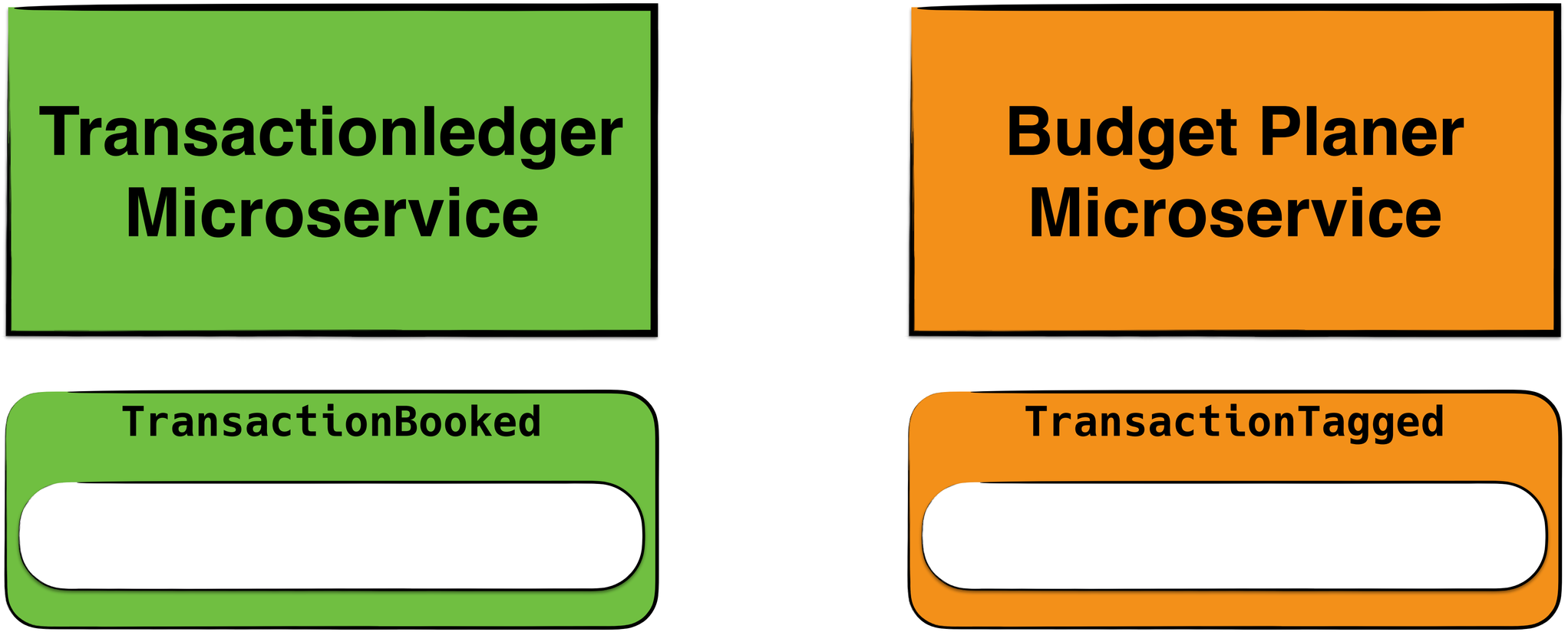
Reusing event data?

Transactionledger Microservice

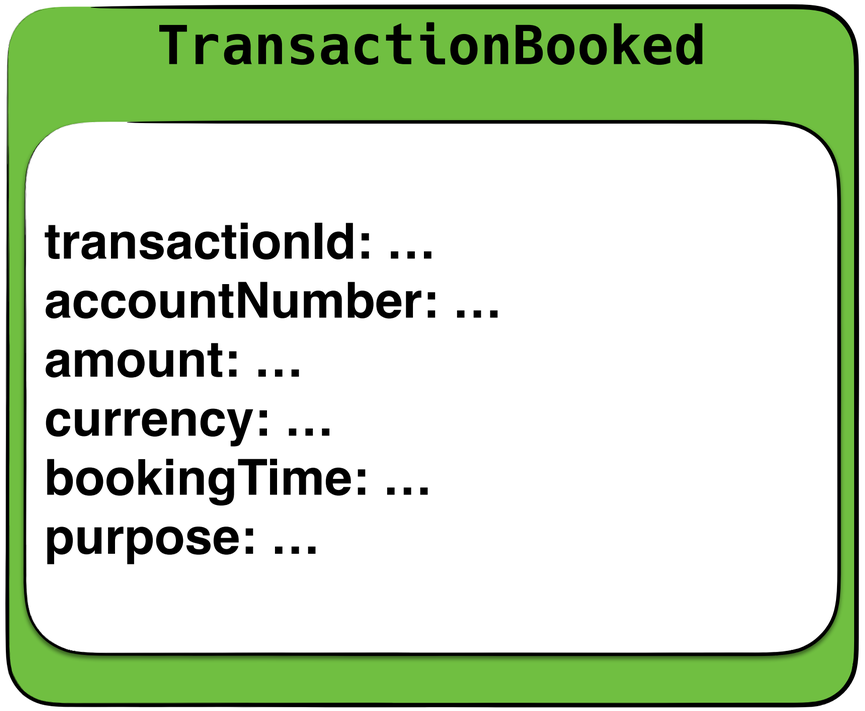


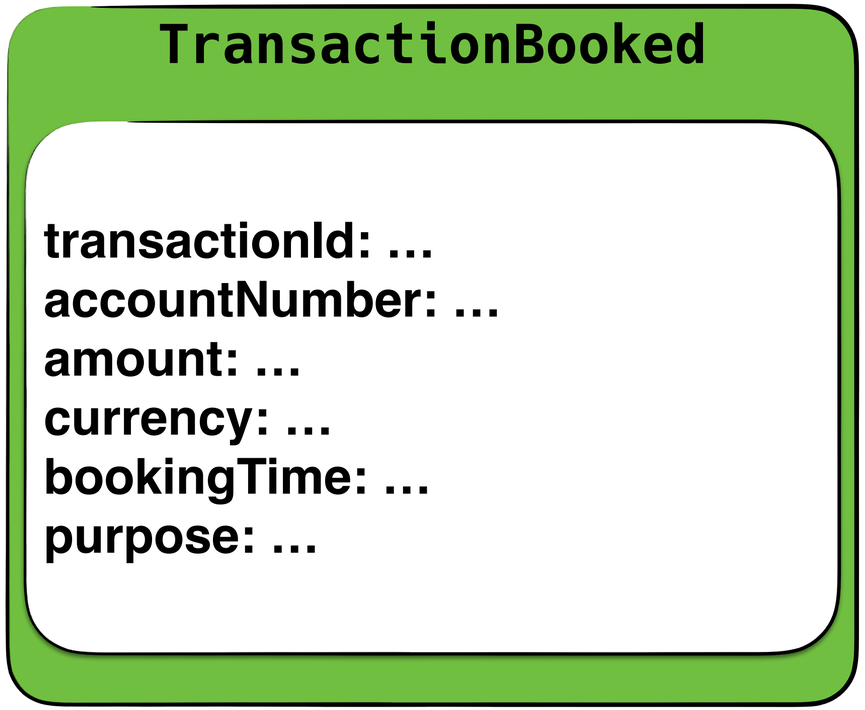
Budget Planer Microservice

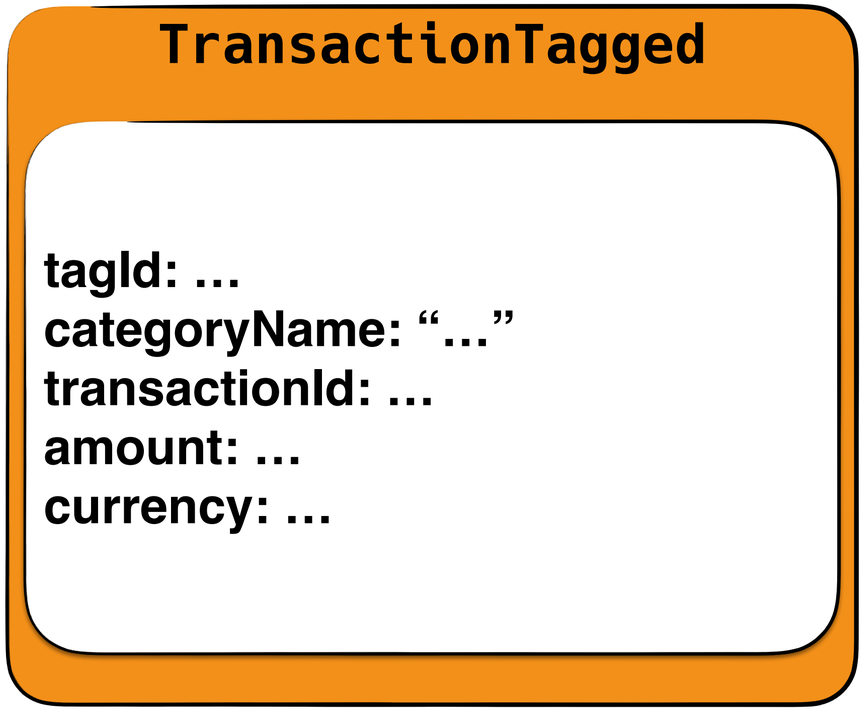


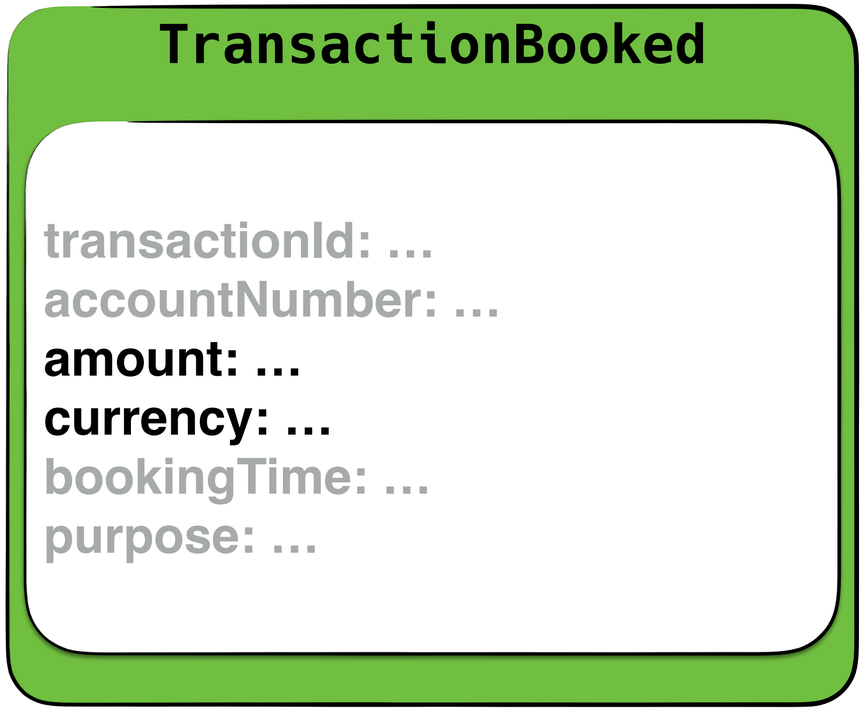

Transactionledger Microservice
Budget Planer Microservice
TransactionBooked
TransactionTagged

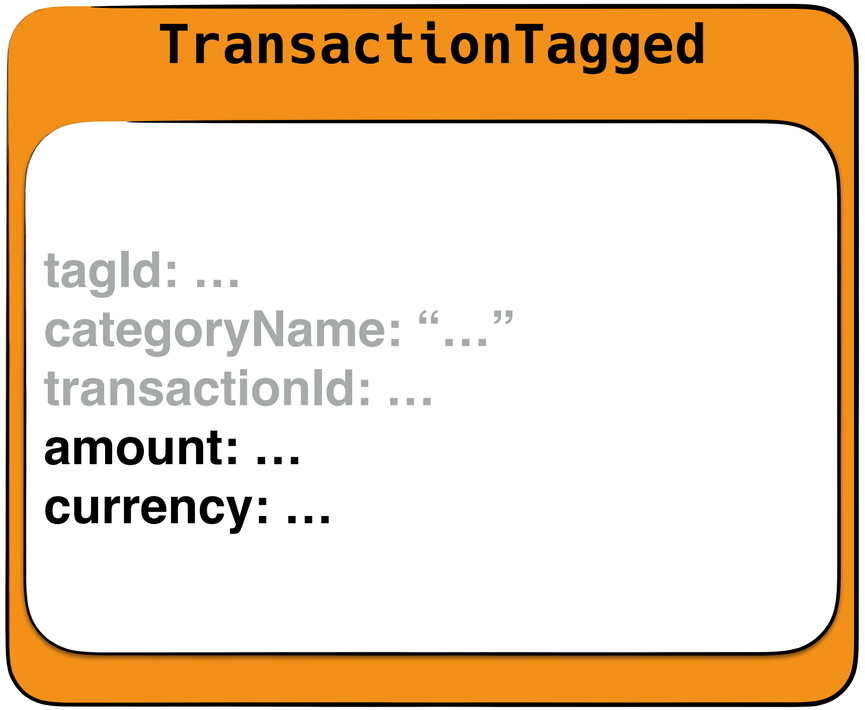
Just copy data into different events, just so convenient

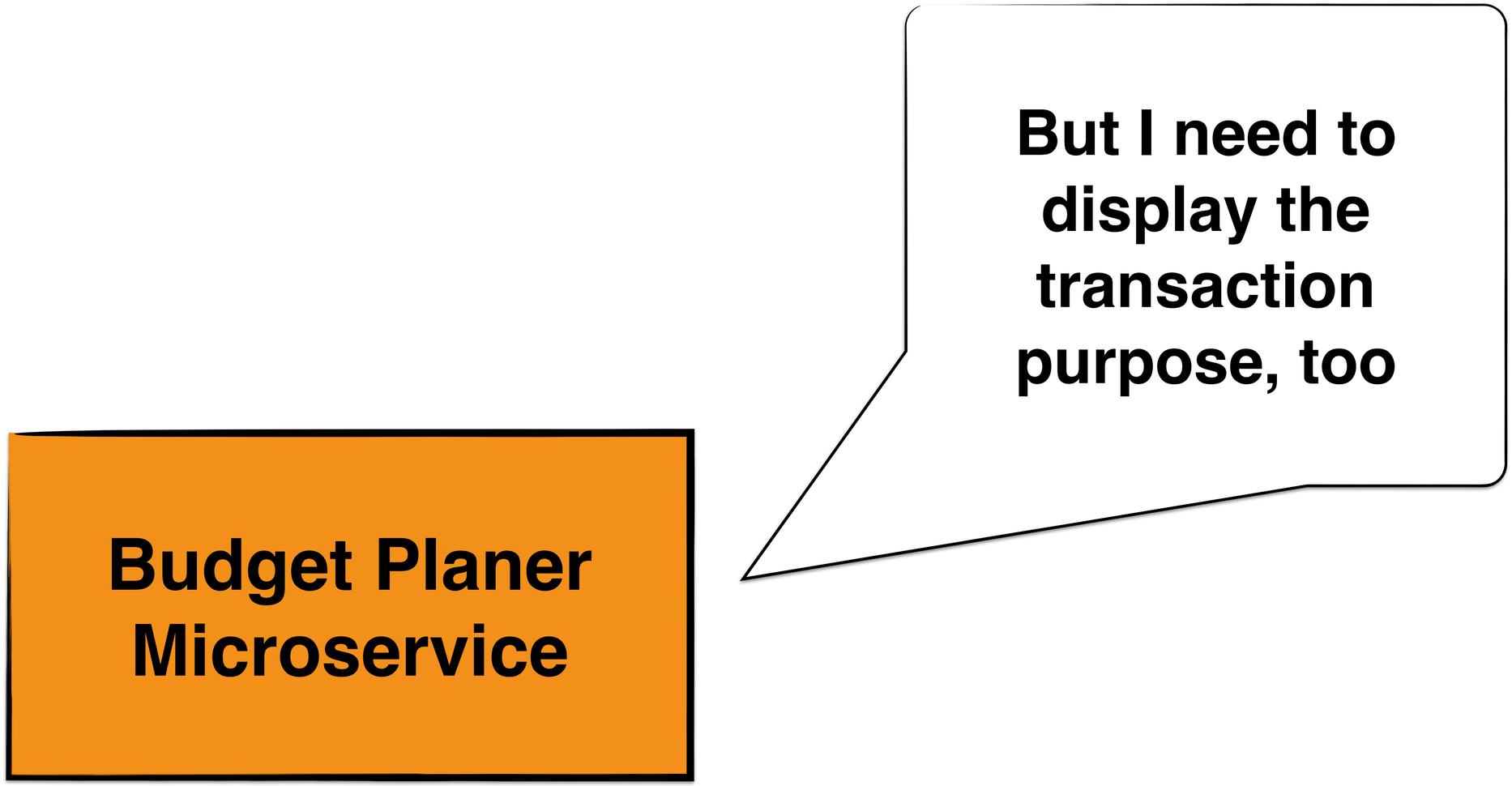

TransactionBooked
transactionId: ...
accountNumber: ...
amount: ...
currency: ...
bookingTime: ...
purpose: ...

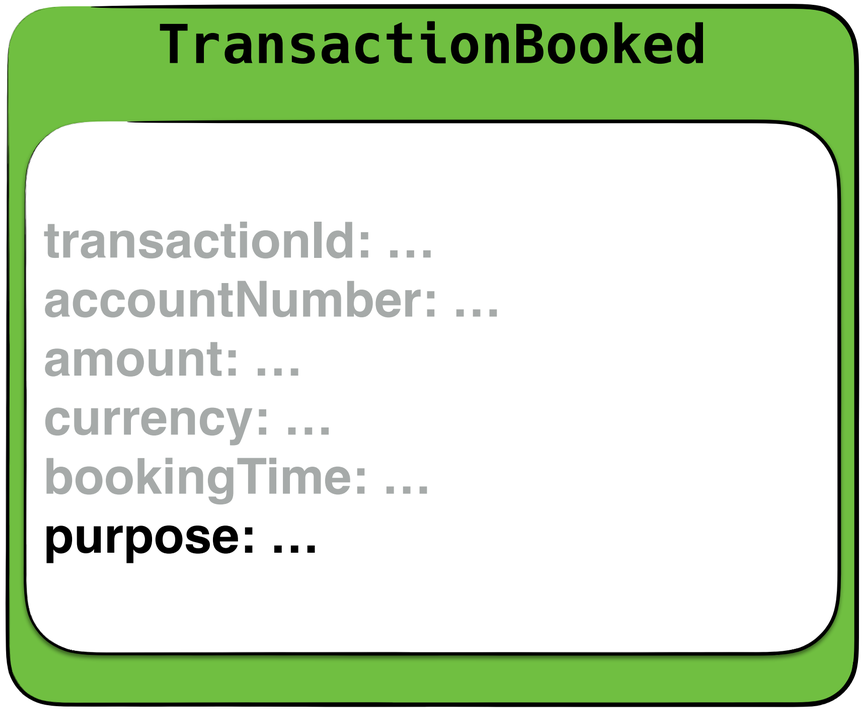

TransactionBooked
transactionId: …
accountNumber: …
amount: …
currency: …
bookingTime: …
purpose: …

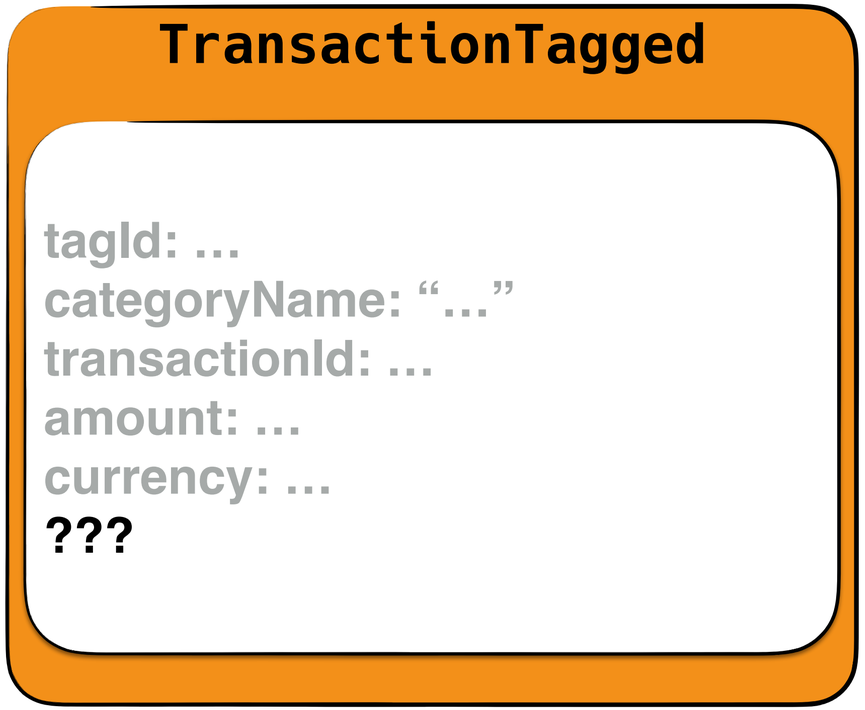

TransactionTagged
tagId: …
categoryName: “…”
transactionId: …
amount: …
currency: …


TransactionBooked
transactionId: …
accountNumber: …
amount: …
currency: …
bookingTime: …
purpose: …


TransactionTagged
tagId: …
categoryName: “…”
transactionId: …
amount: …
currency: …

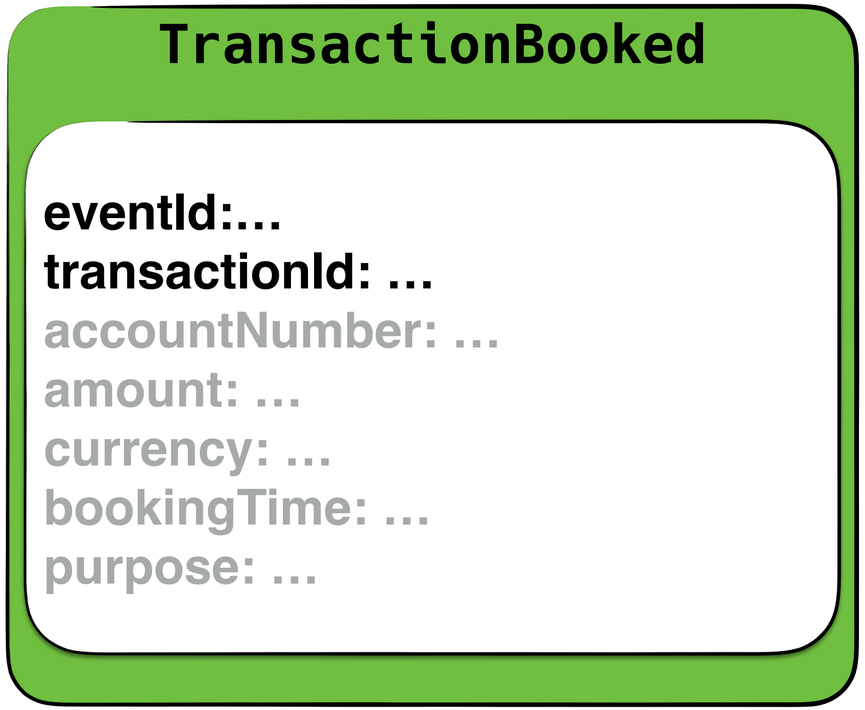

But I need to display the transaction purpose, too
Budget Planer Microservice

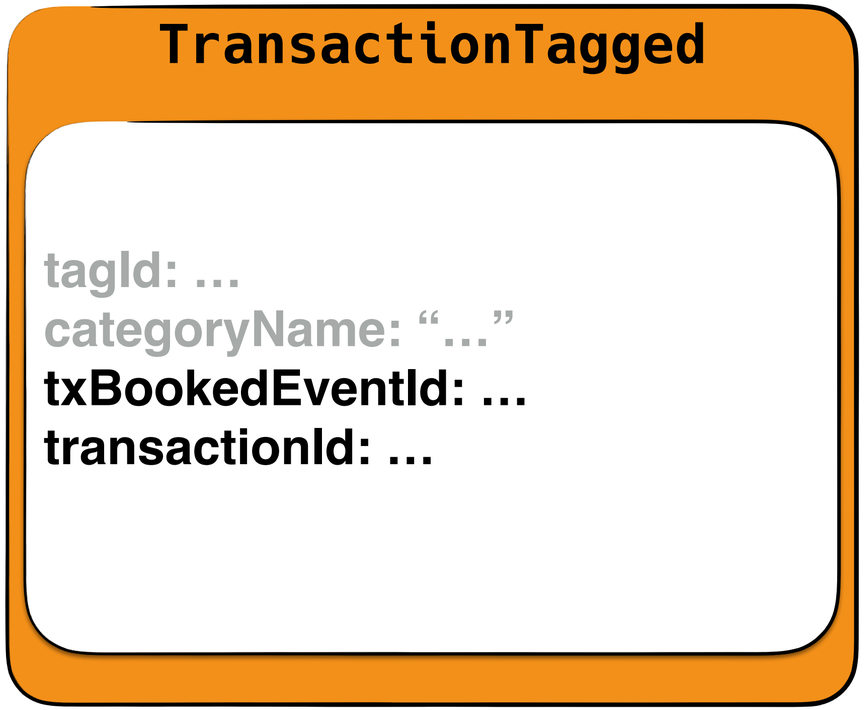

TransactionBooked
transactionId: …
accountNumber: …
amount: …
currency: …
bookingTime: …
purpose: …

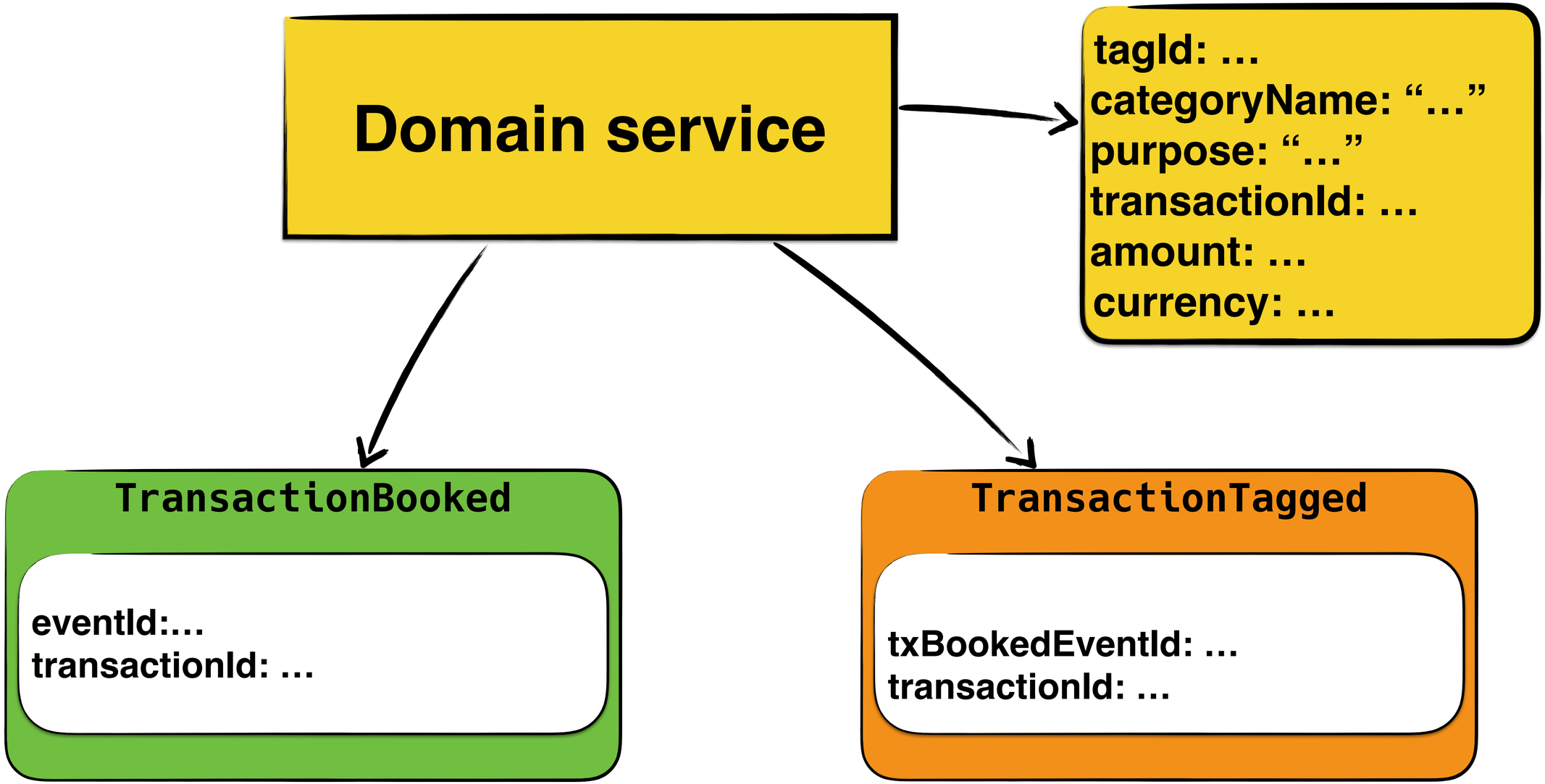

TransactionTagged
tagId: …
categoryName: “…”
transactionId: …
amount: …
currency: …
???

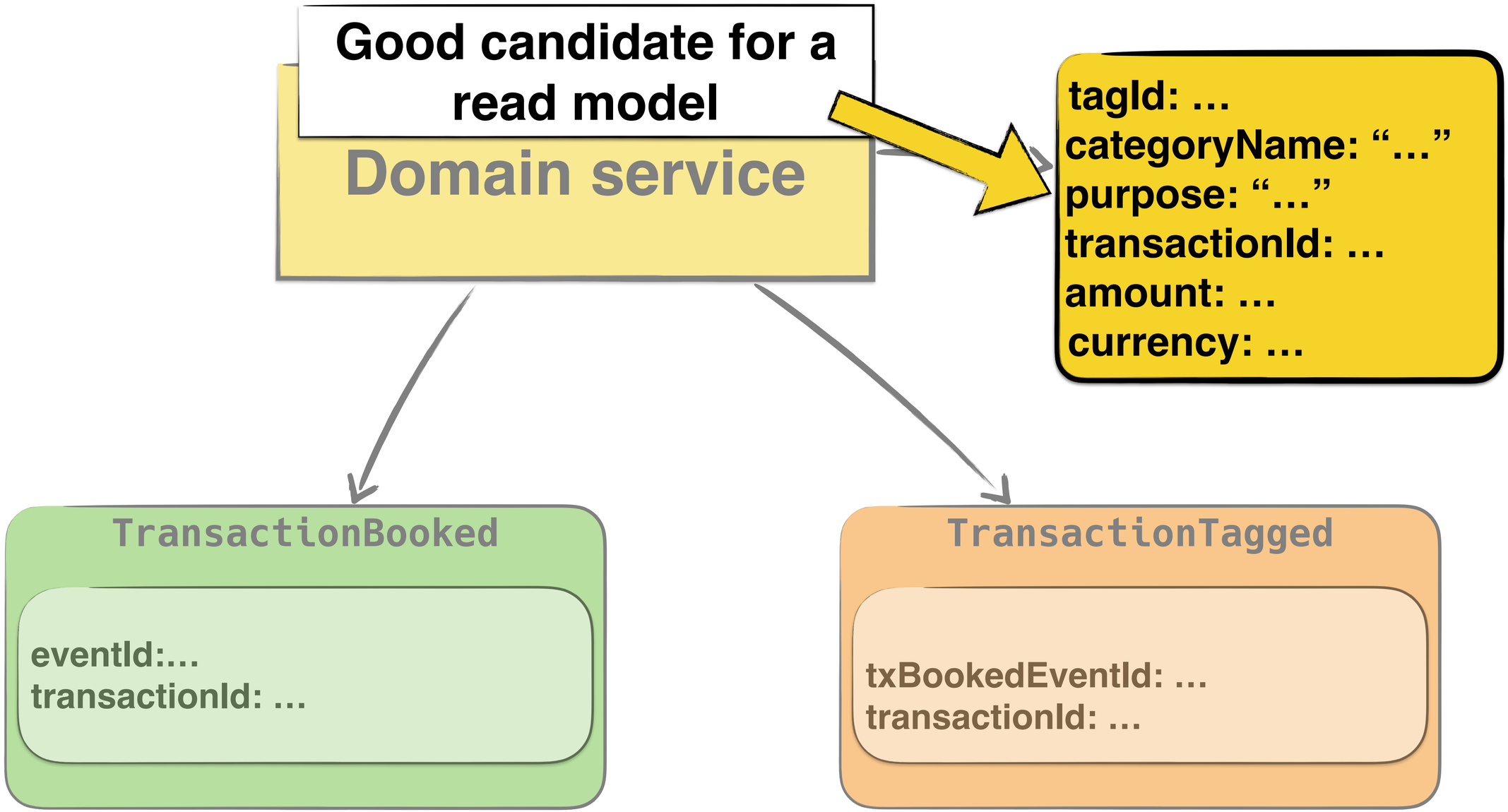
The lossy event

Only reference aggregates via their root id or event ids


TransactionBooked
eventId:…
transactionId: …
accountNumber: …
amount: …
currency: …
bookingTime: …
purpose: …


TransactionTagged
tagId: …
categoryName: “…”
txBookedEventId: …
transactionId: …


Domain service
tagId: …
categoryName: “…”
purpose: “…”
transactionId: …
amount: …
currency: …
TransactionBooked
eventId:…
transactionId: …
TransactionTagged
txBookedEventId: …
transactionId: …


Good candidate for a read model
Domain service
tagId: …
categoryName: “…”
purpose: “…”
transactionId: …
amount: …
currency: …
TransactionBooked
eventId:…
transactionId: …
TransactionTagged
txBookedEventId: …
transactionId: …

Don't copy parts of an event

Prefer building use case specific projections

How do I handle large streams?

How can you handle event data over a long period of time?

You don’t

Just create a snapshot of the stream

Year's end procedure

Year end – also known as an accounting reference date – is the completion of an accounting period. At this time, businesses need to carry out specific procedures to close their books.

https://debitoor.com/dictionary/year-end

Year end – also known as an accounting reference date – is the completion of an accounting period. At this time, **businesses need to carry out specific procedures to close their books.**

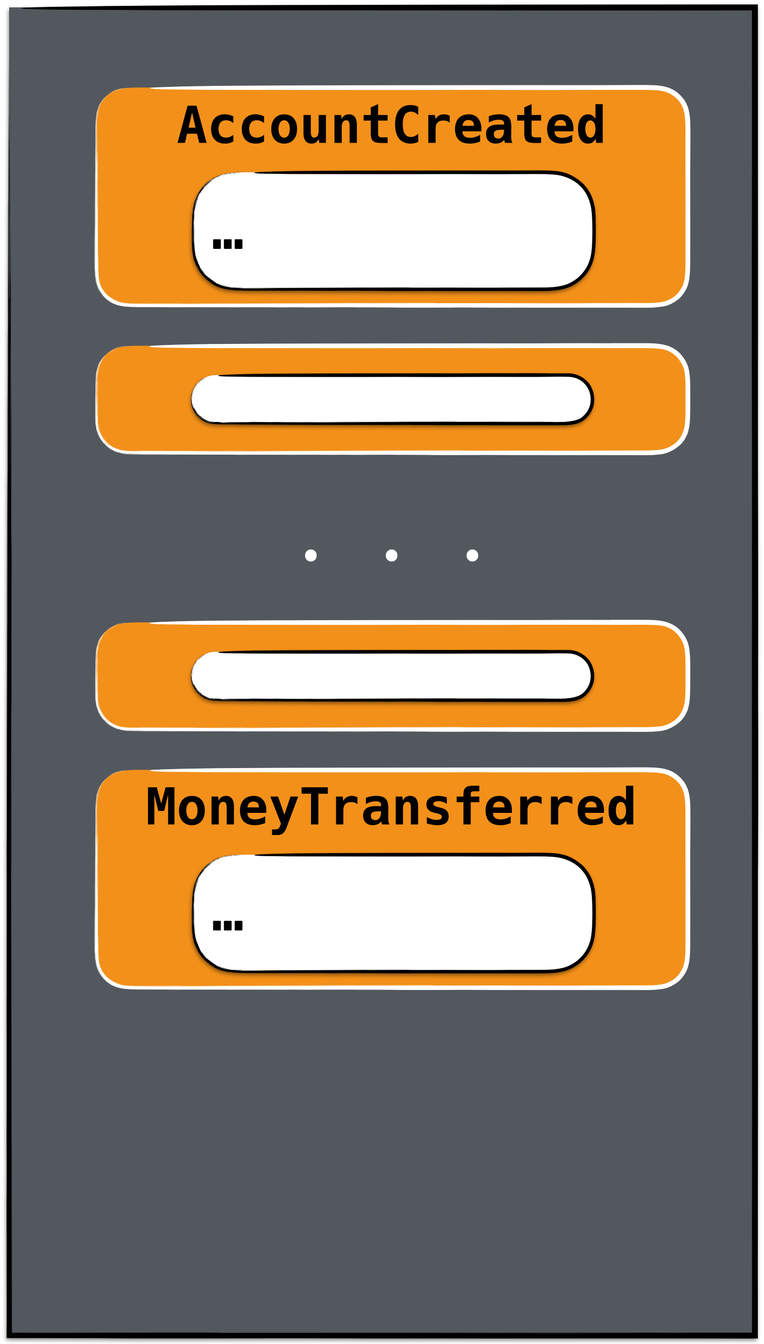
https://debitoor.com/dictionary/year-end

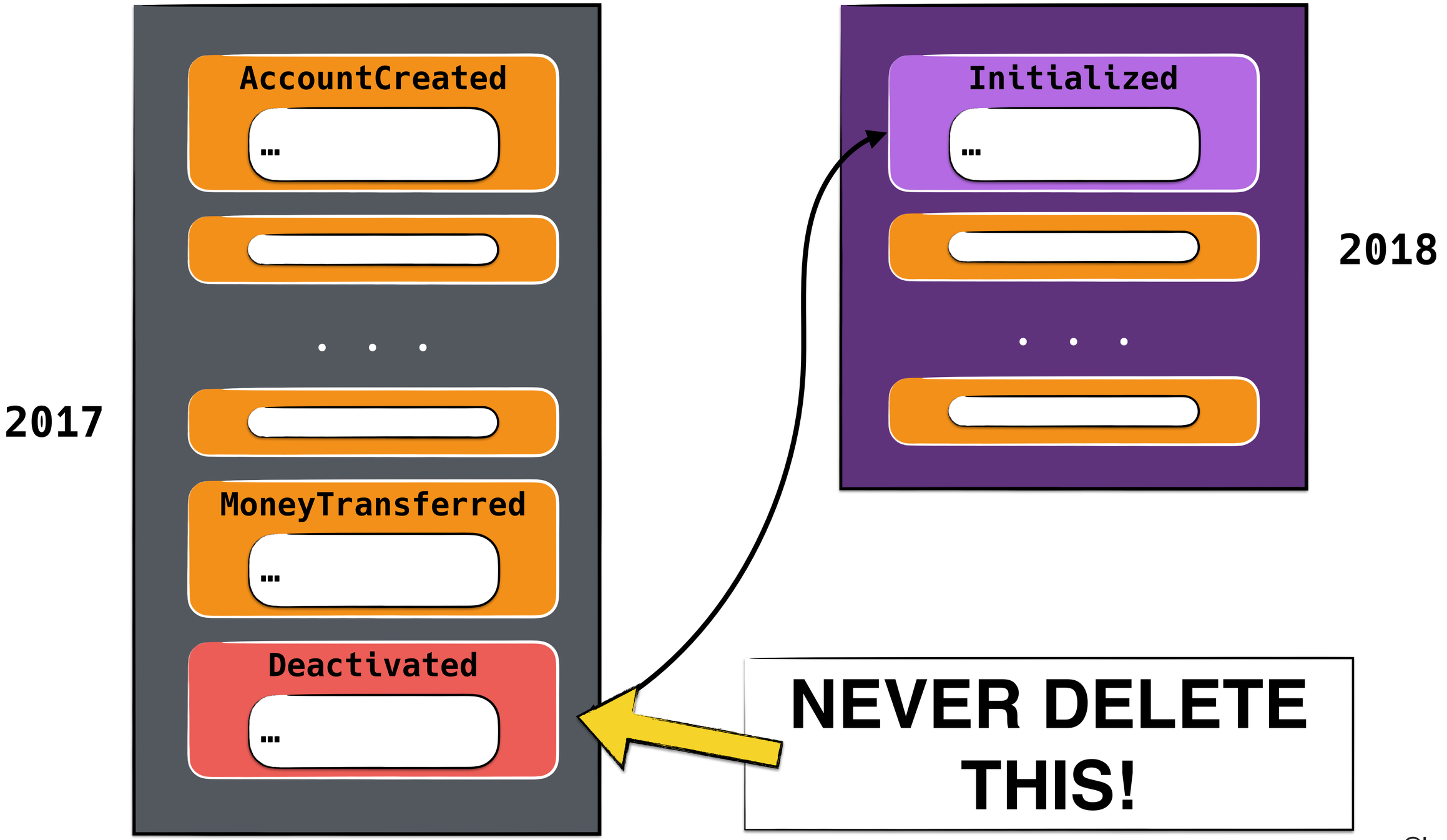
Copy-Transform

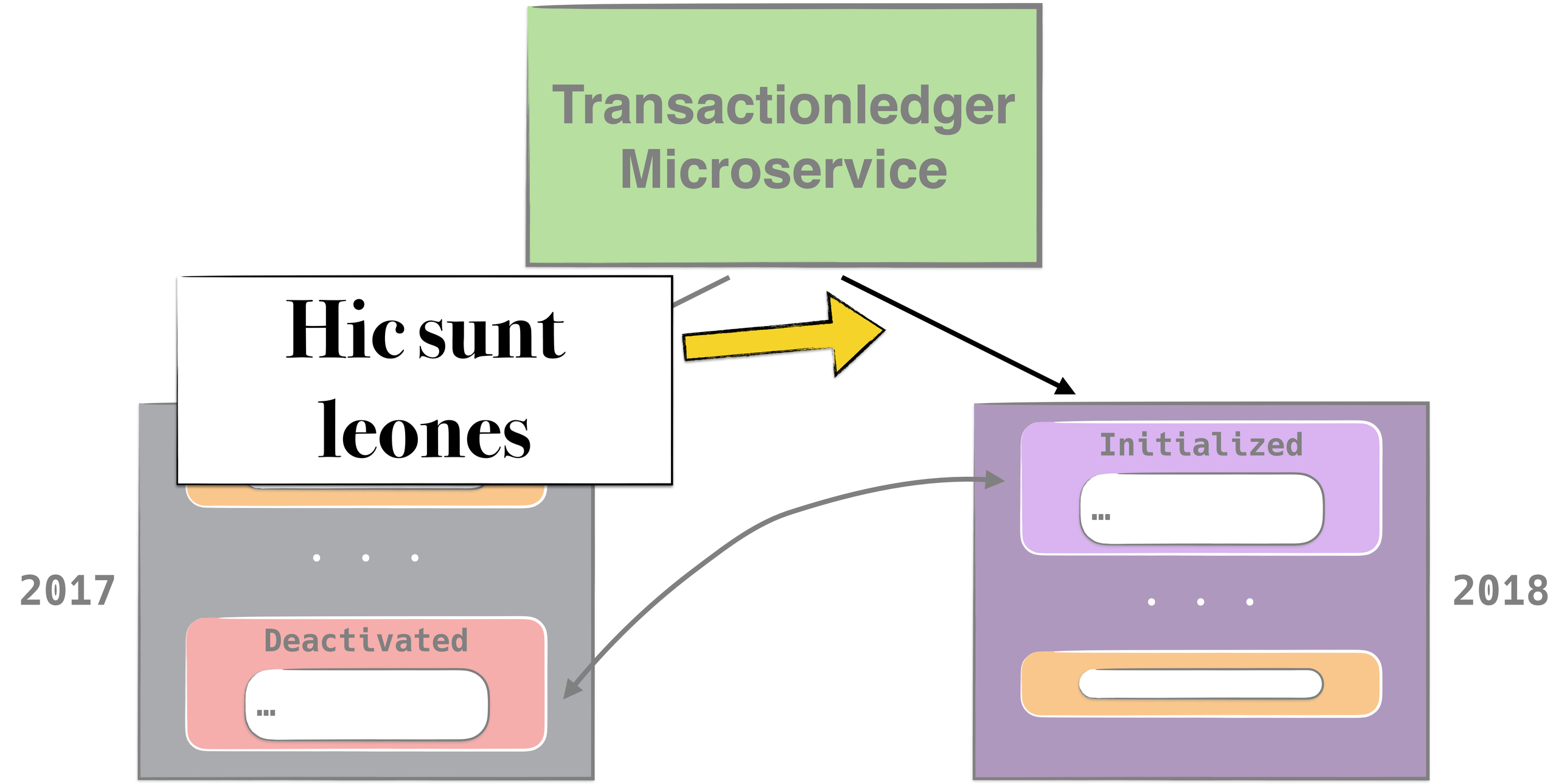
a.k.a. event sourcing

refactoring powertool

2017

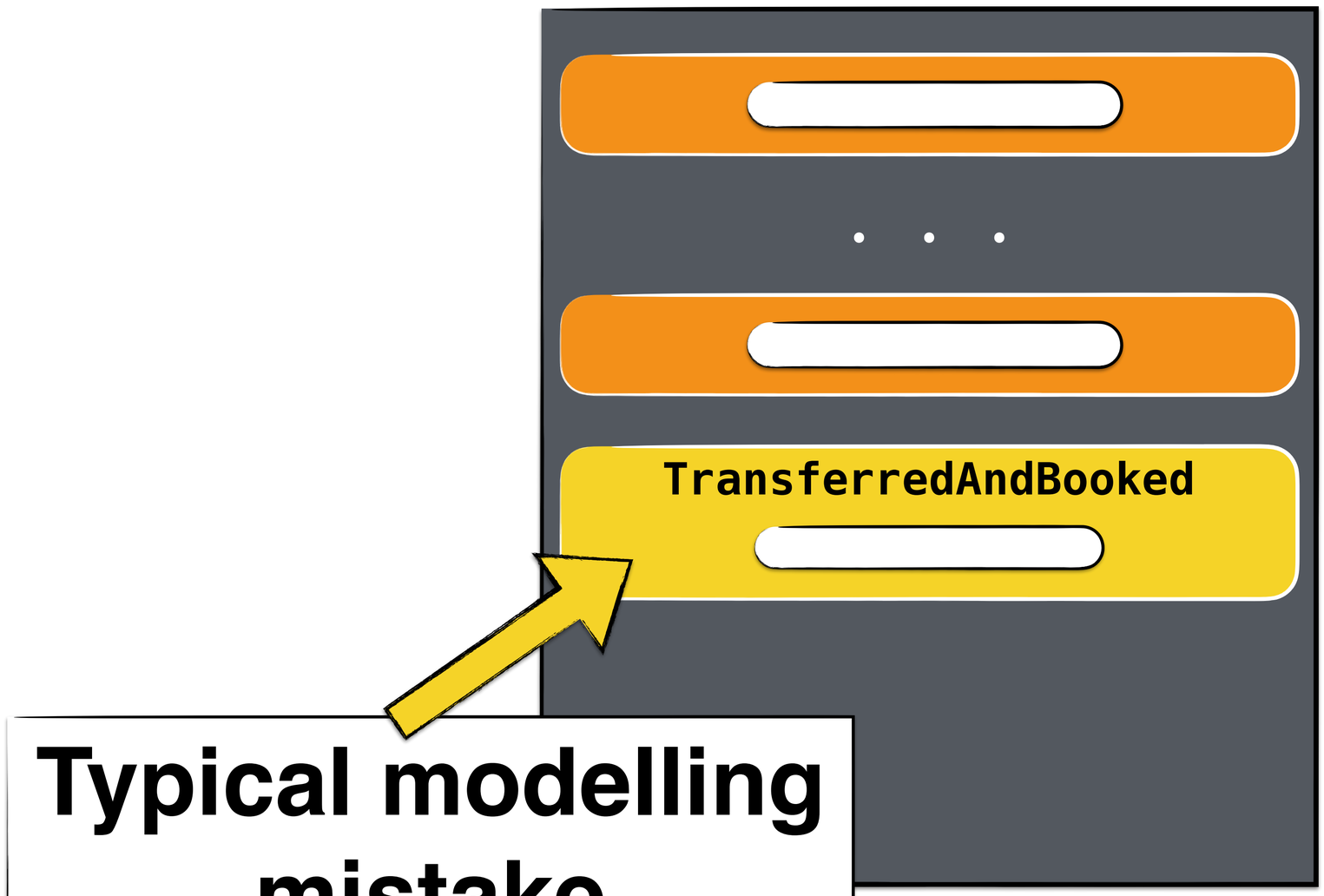



AccountCreated
...
MoneyTransferred
...
Deactivated
...
2017
Initialized
...
2018
NEVER DELETE THIS!

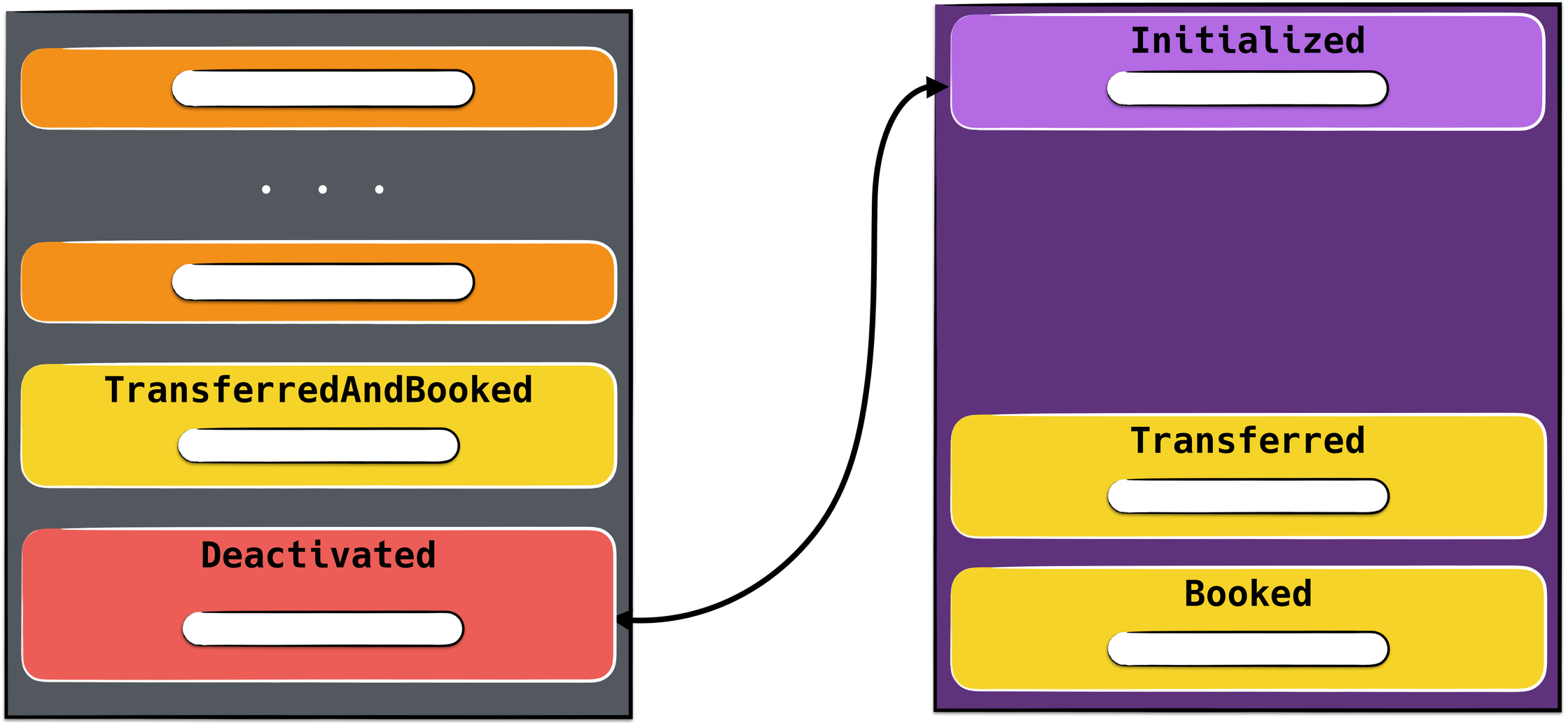

Transactionledger Microservice
Hic sunt leones
2017
Deactivated
...
Initialized
...
2018

Same idea if you need to remodel your domain!

The FooANDBarEvent



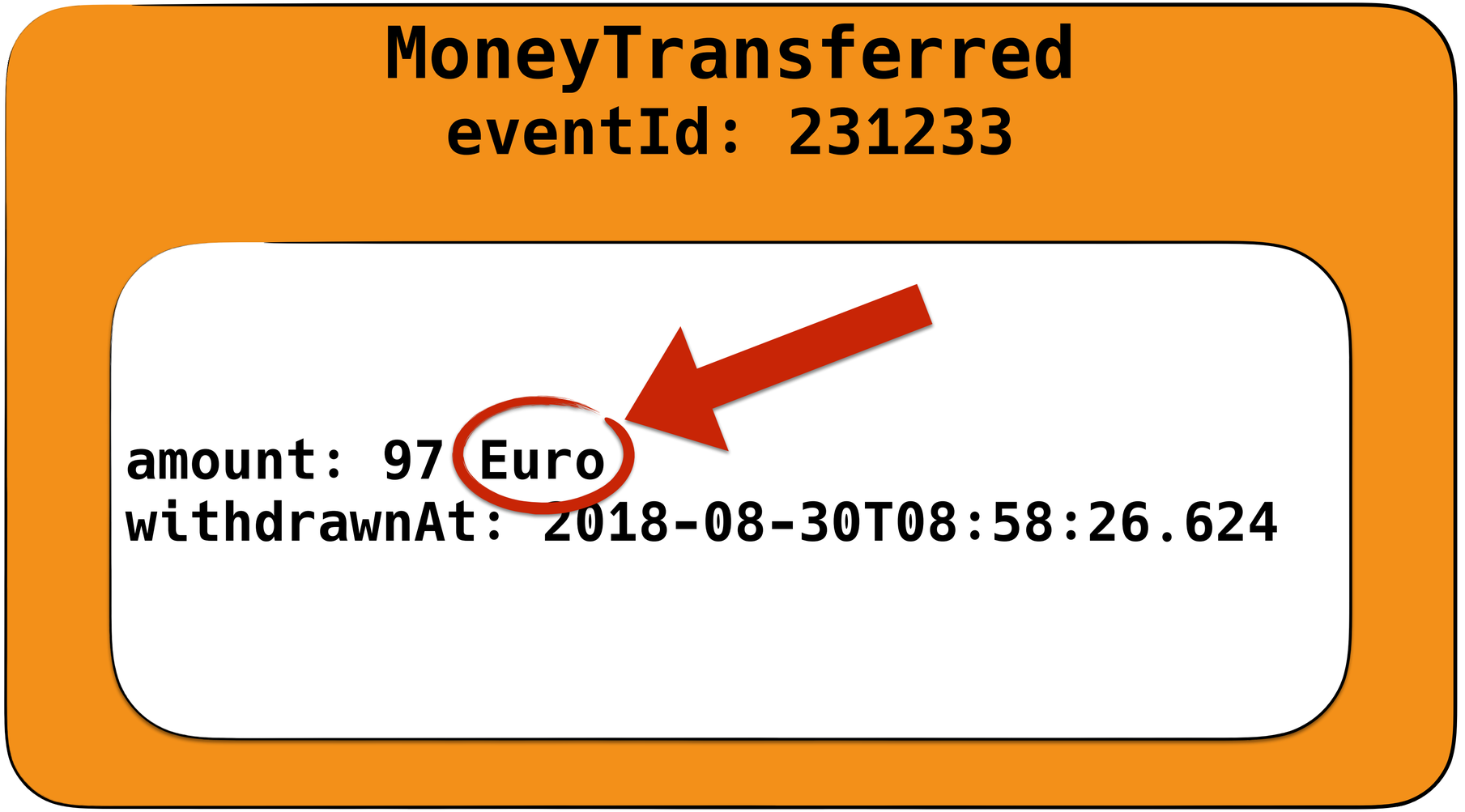
Typical modelling mistake


TransferredAndBooked
Deactivated
Initialized
Transferred
Booked

The devil is in the detail

Dealing with errors

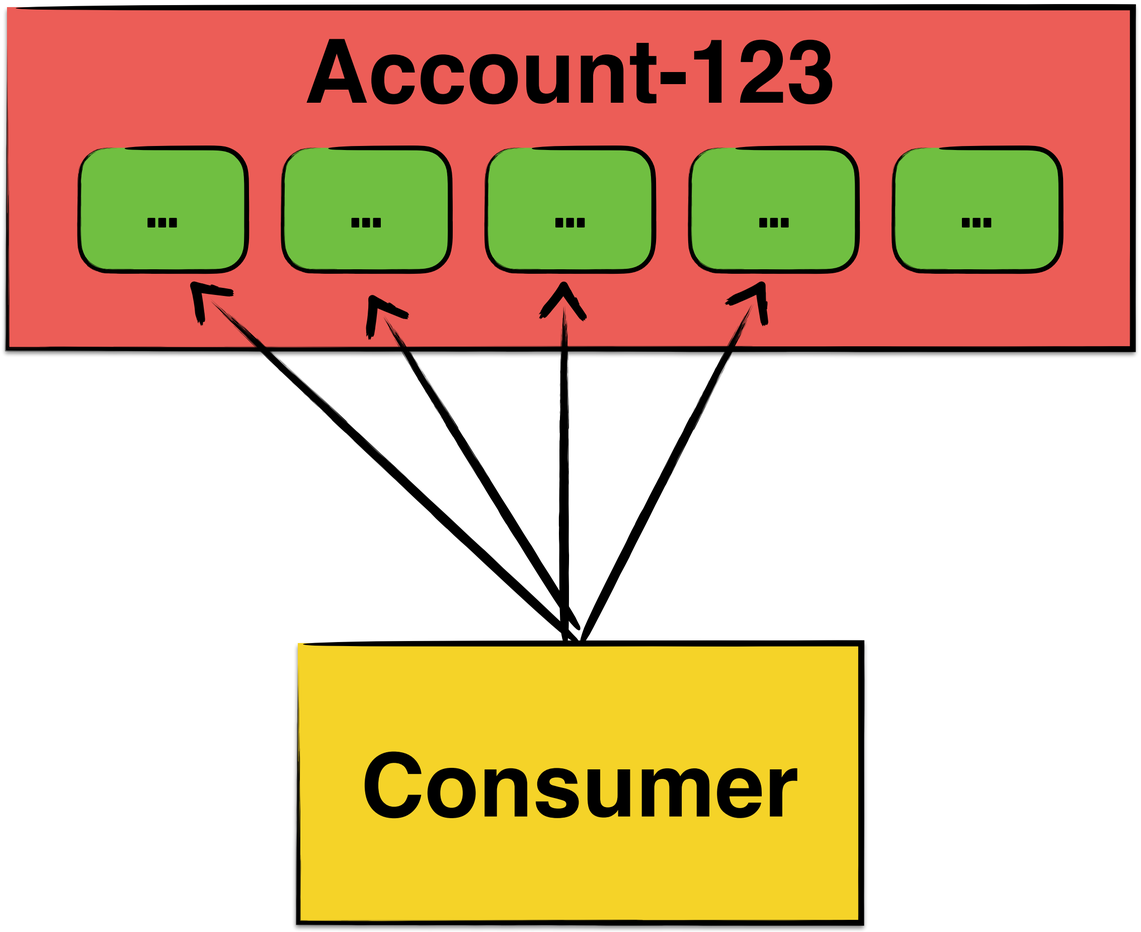
@koenighotze

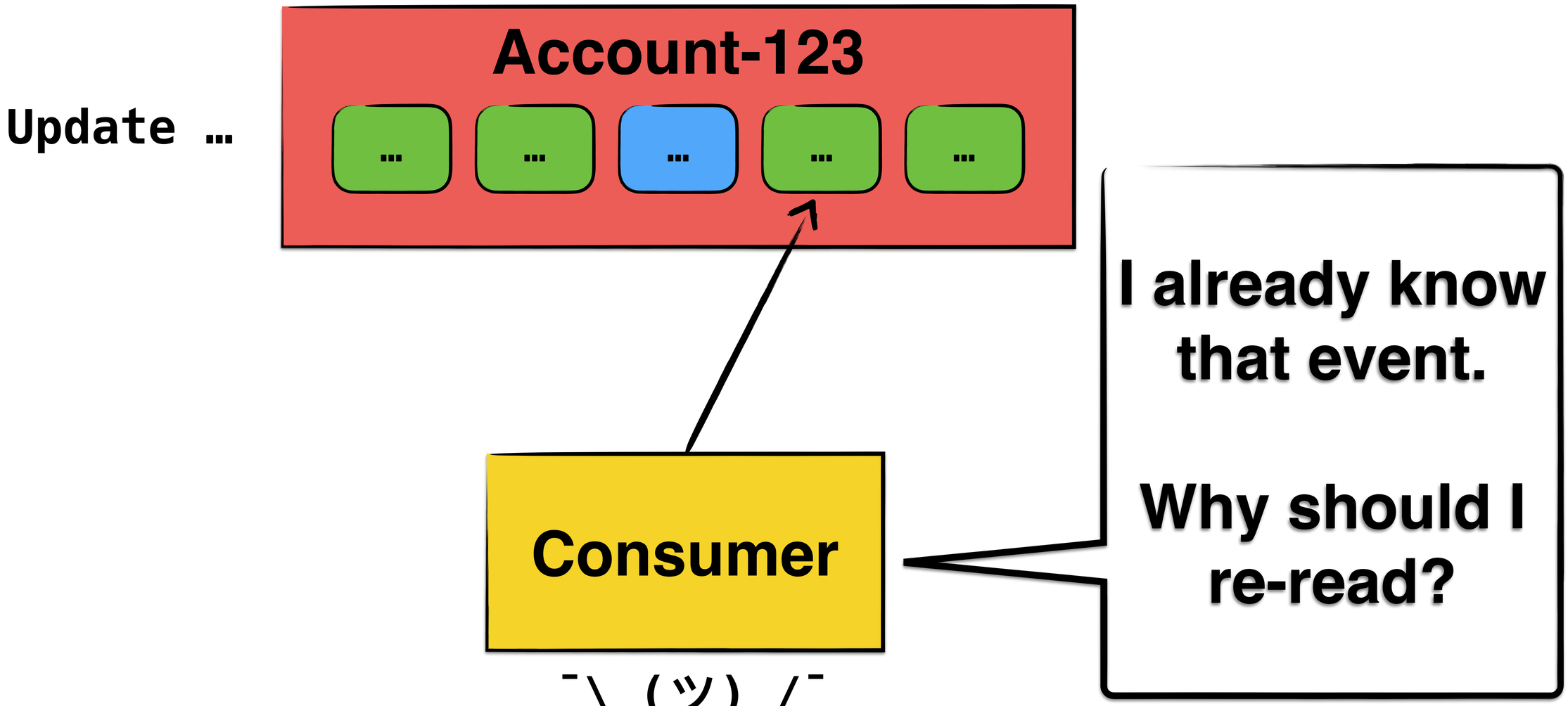

MoneyTransferred
eventId: 231233
amount: 97 Euro
withdrawnAt: 2018-08-30T08:58:26.624

Just update the event in the eventstore!


UPDATE transactions
SET currency='EUR'
WHERE eventId='231233'

Challenges?

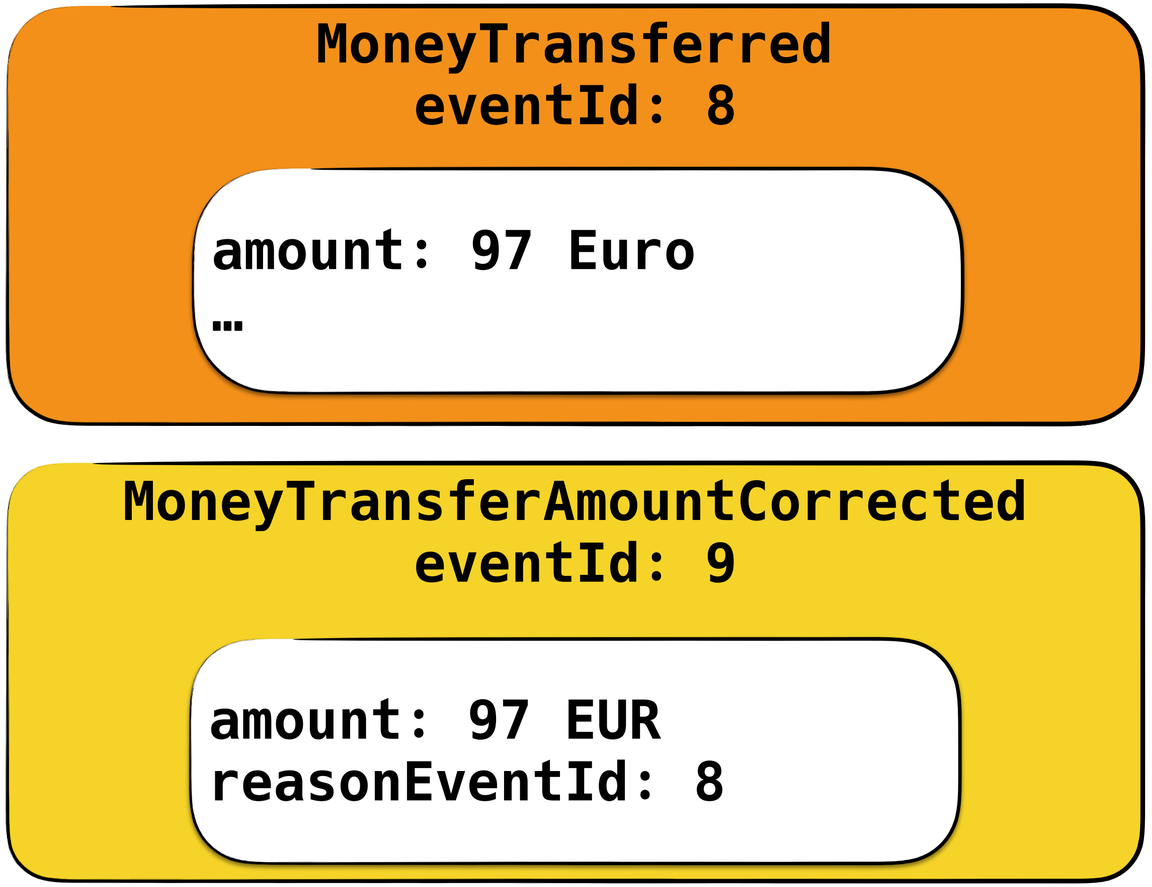

Account-123
...
...
...
...
...
Consumer


Update …
Account-123
…
…
…
…
…
Consumer
¯_(ツ)_/¯
I already know that event.
Why should I re-read?

Ok. Then just use compensation events

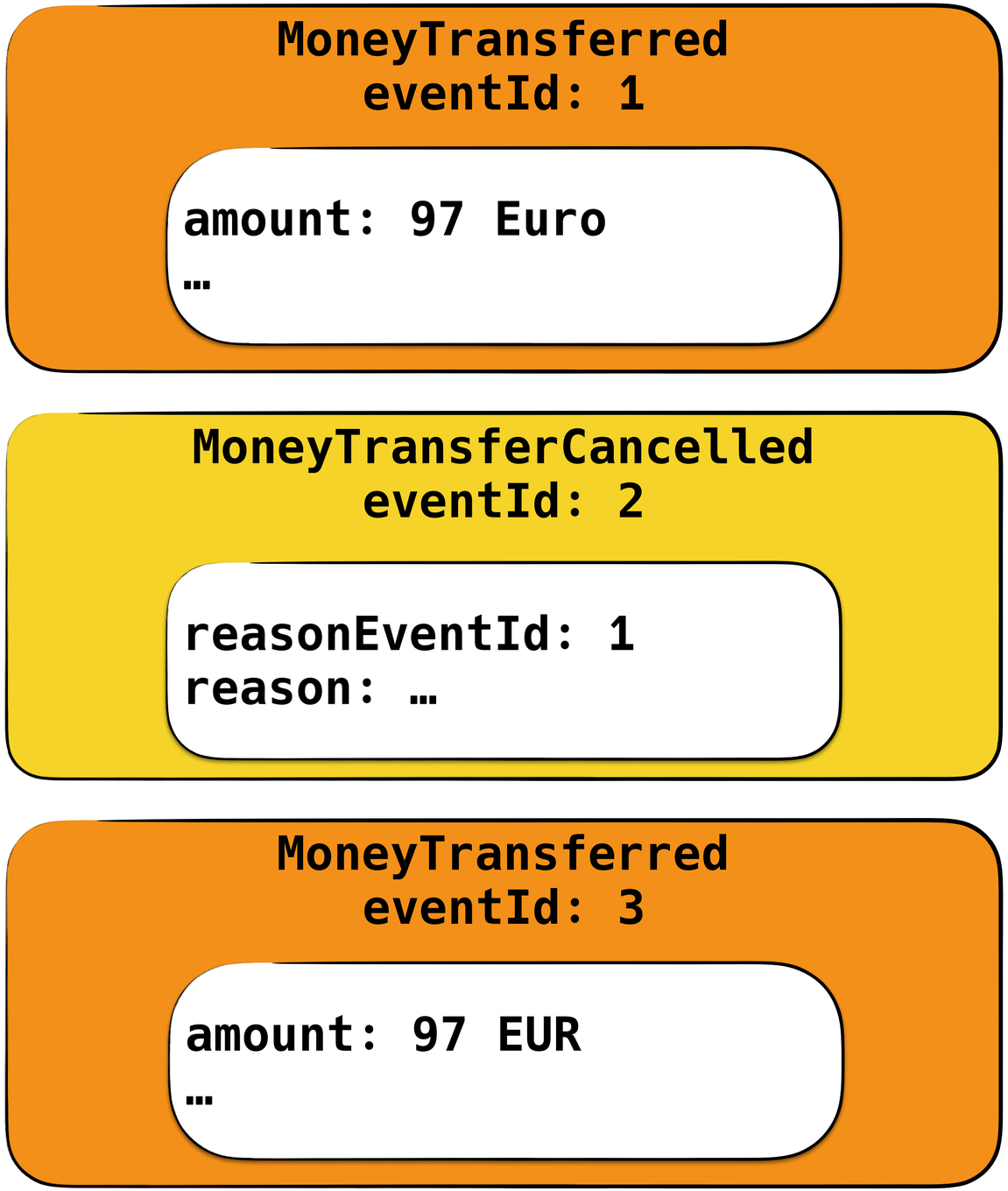
The cancelled or corrected event

Partial compensation?


MoneyTransferred
eventId: 8
amount: 97 Euro
…
MoneyTransferAmountCorrected
eventId: 9
amount: 97 EUR
reasonEventId: 8

Full compensation

do as accountants do

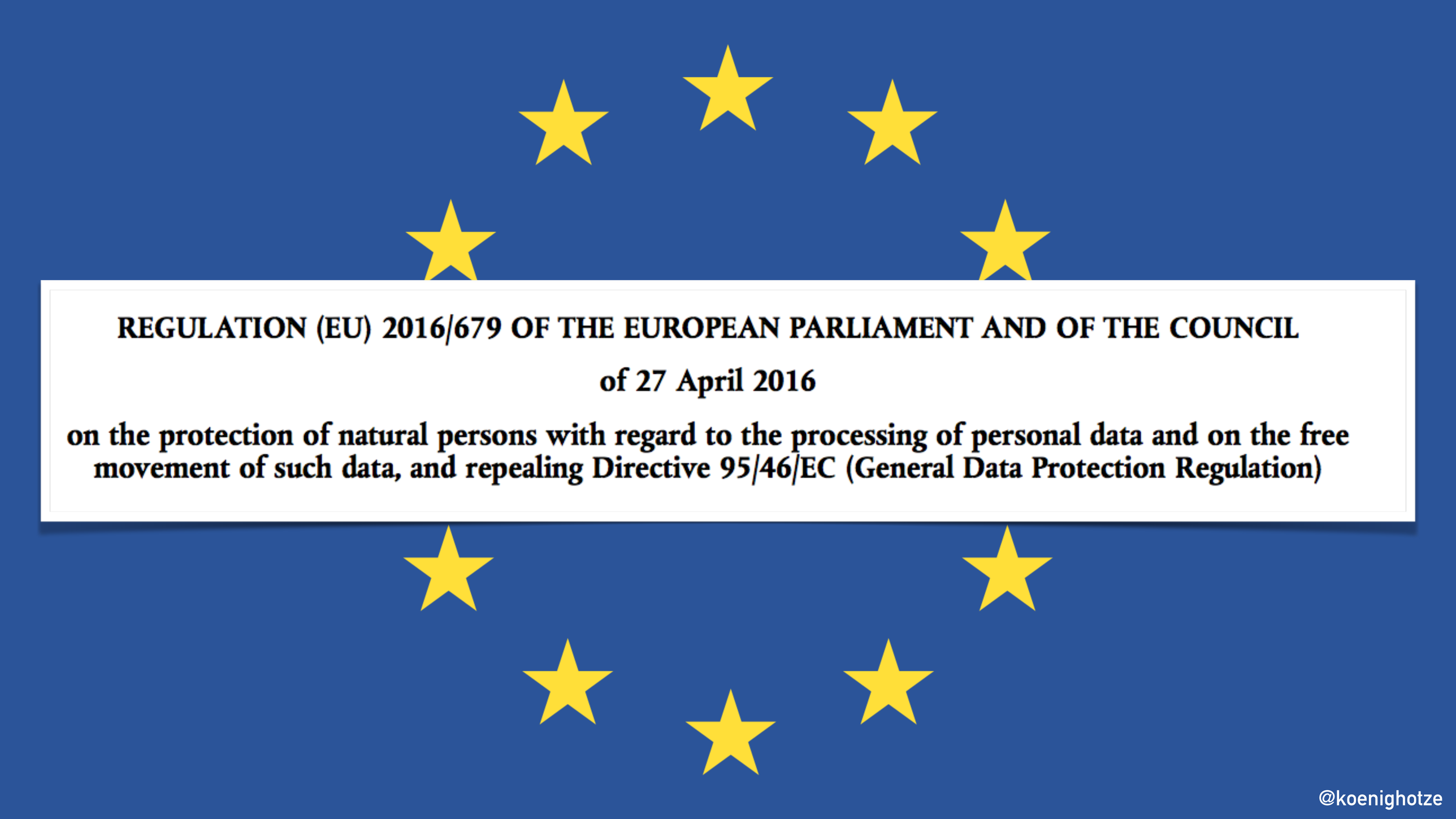

MoneyTransferred
eventId: 1
amount: 97 Euro
…
MoneyTransferCancelled
eventId: 2
reasonEventId: 1
reason: …
MoneyTransferred
eventId: 3
amount: 97 EUR
…

A full compensation is the explicit reason for compensation

GDPR, compliance and eventsourcing

@koenighotze

@koenighotze


REGULATION (EU) 2016/679 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL
of 27 April 2016
on the protection of natural persons with regard to the processing of personal data and on the free movement of such data, and repealing Directive 95/46/EC (General Data Protection Regulation)
@koenighotze

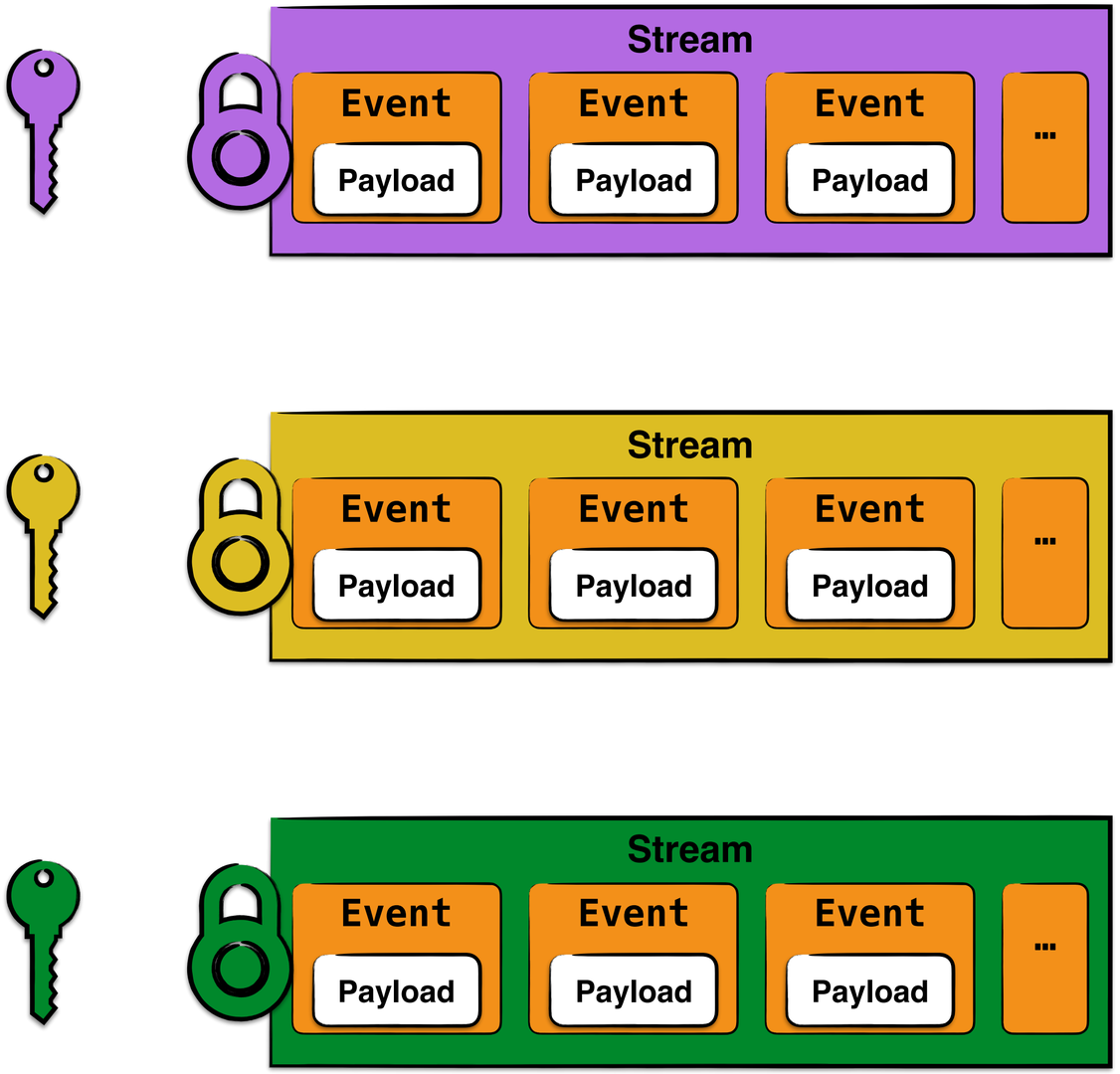
Article 17

Right to erasure ('right to be forgotten')

1. The data subject shall have the right to obtain from the controller the erasure of personal data concerning him or her without undue delay and the controller shall have the obligation to erase personal data without undue delay where one of the following grounds applies:

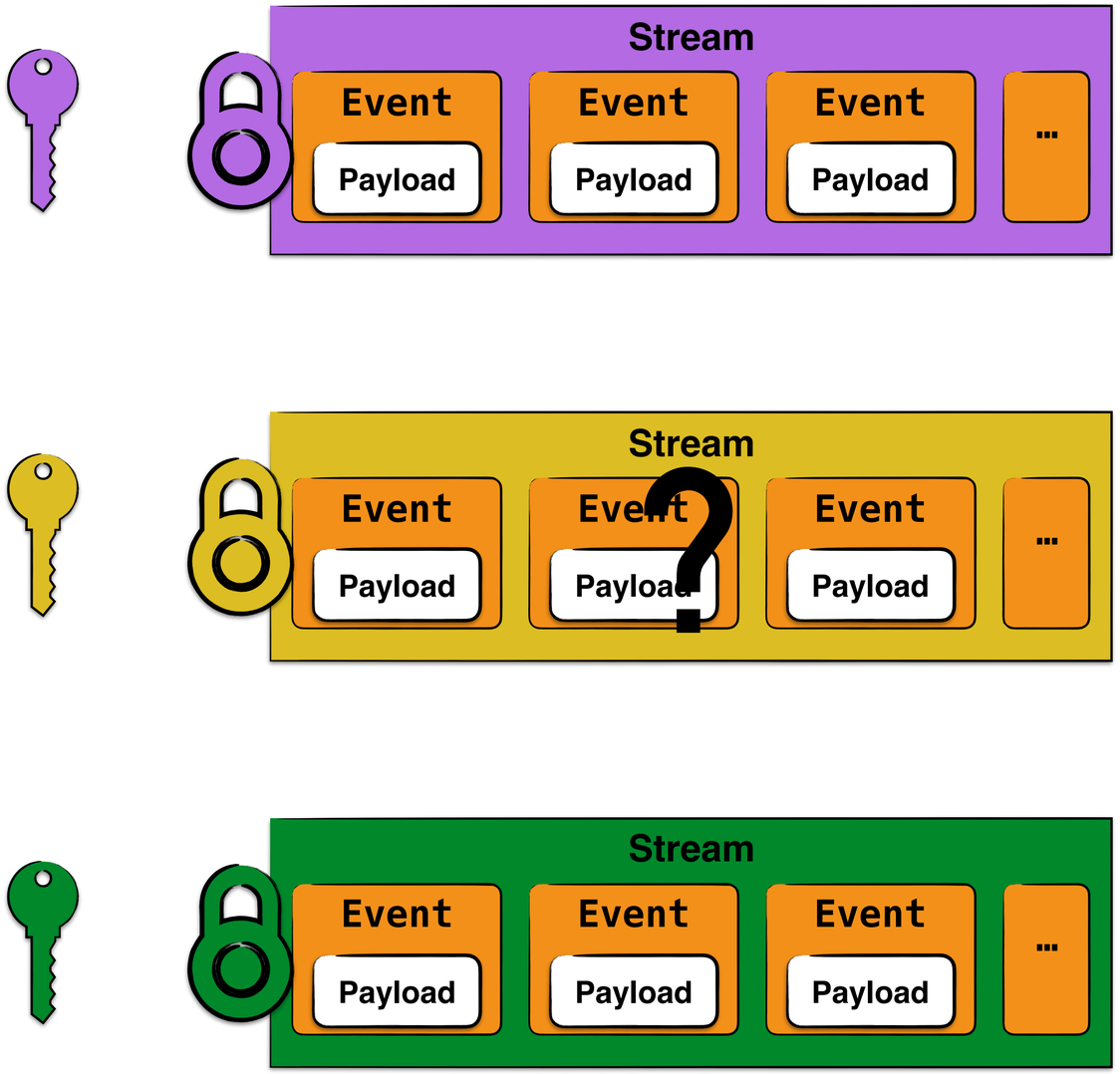
@koenighotze

Just encrypt and throw the key away


Stream
Event
Payload
Event
Payload
Event
Payload
...
Stream
Event
Payload
Event
Payload
Event
Payload
...
Stream
Event
Payload
Event
Payload
Event
Payload
...

“Please delete all my data”

Deletion is effectively deleting the stream-specific key


Stream
Event
Payload
Event
Payload
Event
Payload
...
Stream
Event
Payload
Event
Payload
Event
Payload
...
Stream
Event
Payload
Event
Payload
Event
Payload
...

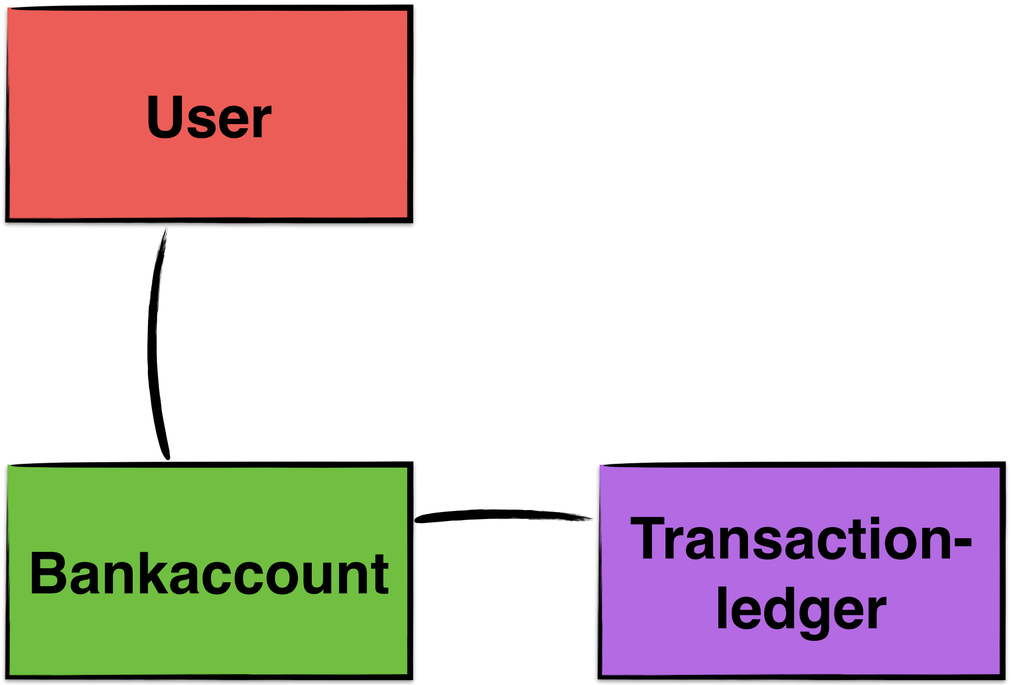
Challenges?

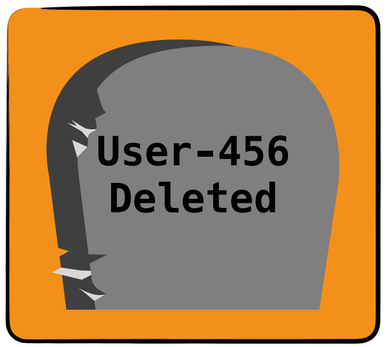
Key administration
Finding what needs to be deleted
Storage implications
Coding complexity
Dashboards, Monitoring

Being able to delete is awesome

Cascading deletes with tombstones

“Please delete USER-456”

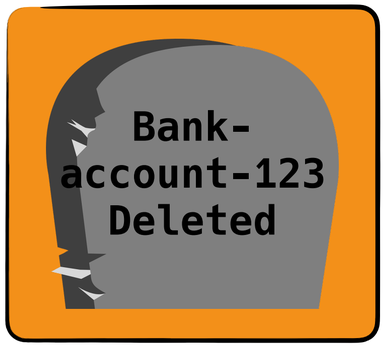

User
Bankaccount
Transaction-
ledger



User Microservice

Bankaccount Microservice

Transactionledger Microservice



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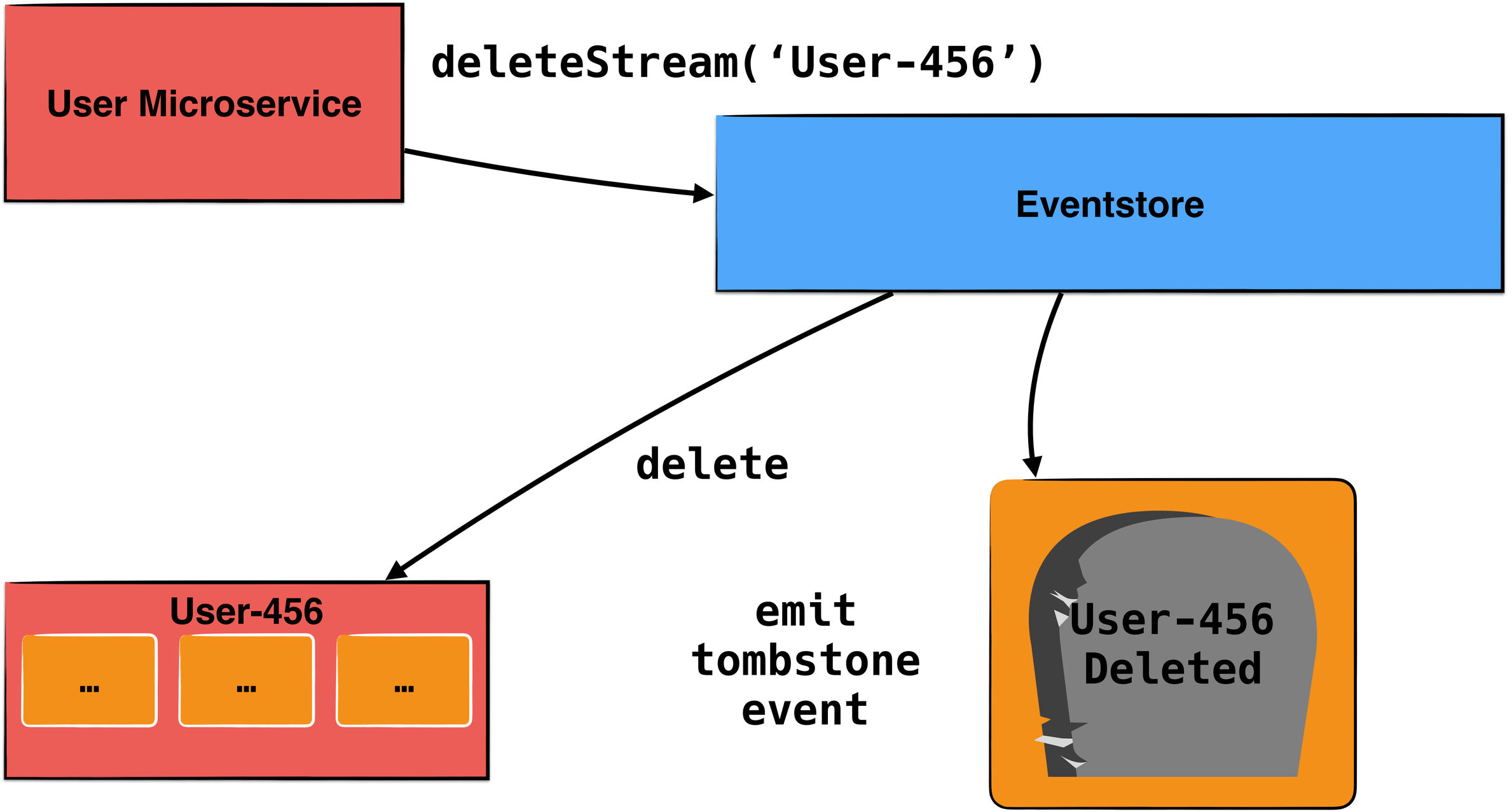
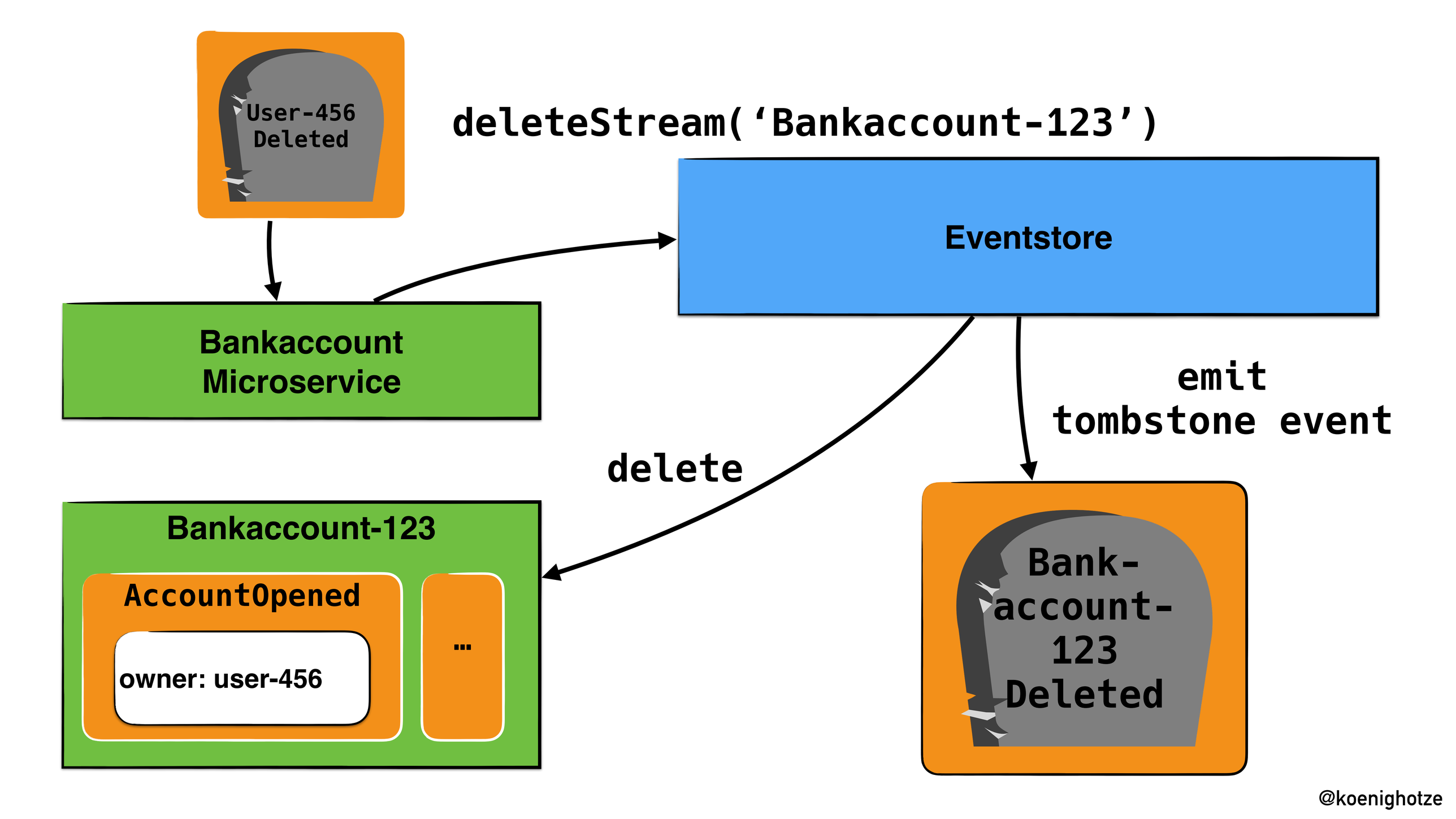

User Microservice
deleteStream('User-456')
Eventstore
delete
User-456
...
...
...
emit
tombstone
event
User-456
Deleted


User-456
Deleted
deleteStream(‘Bankaccount-123’)
Eventstore
Bankaccount
Microservice
emit
tombstone event
delete
Bankaccount-123
AccountOpened
owner: user-456
...
Bank-
account-
123
Deleted

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What about dependencies between aggregates?

Just anonymise the data

Recital 26
EU GDPR

(26) The principles of data protection should apply to any information concerning an identified or identifiable natural person.

Personal data which have undergone pseudonymisation, which could be attributed to a natural person by the use of additional information should be considered to be information on an identifiable natural person.

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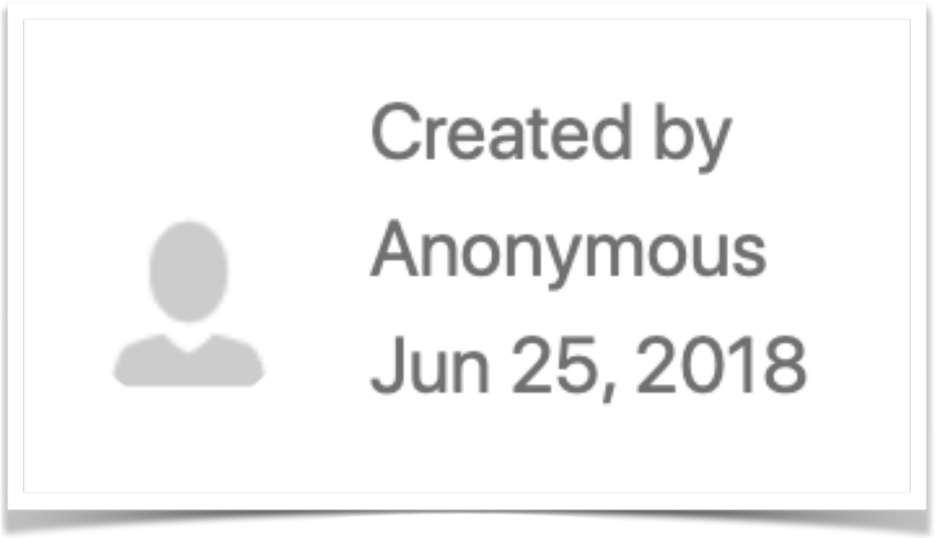
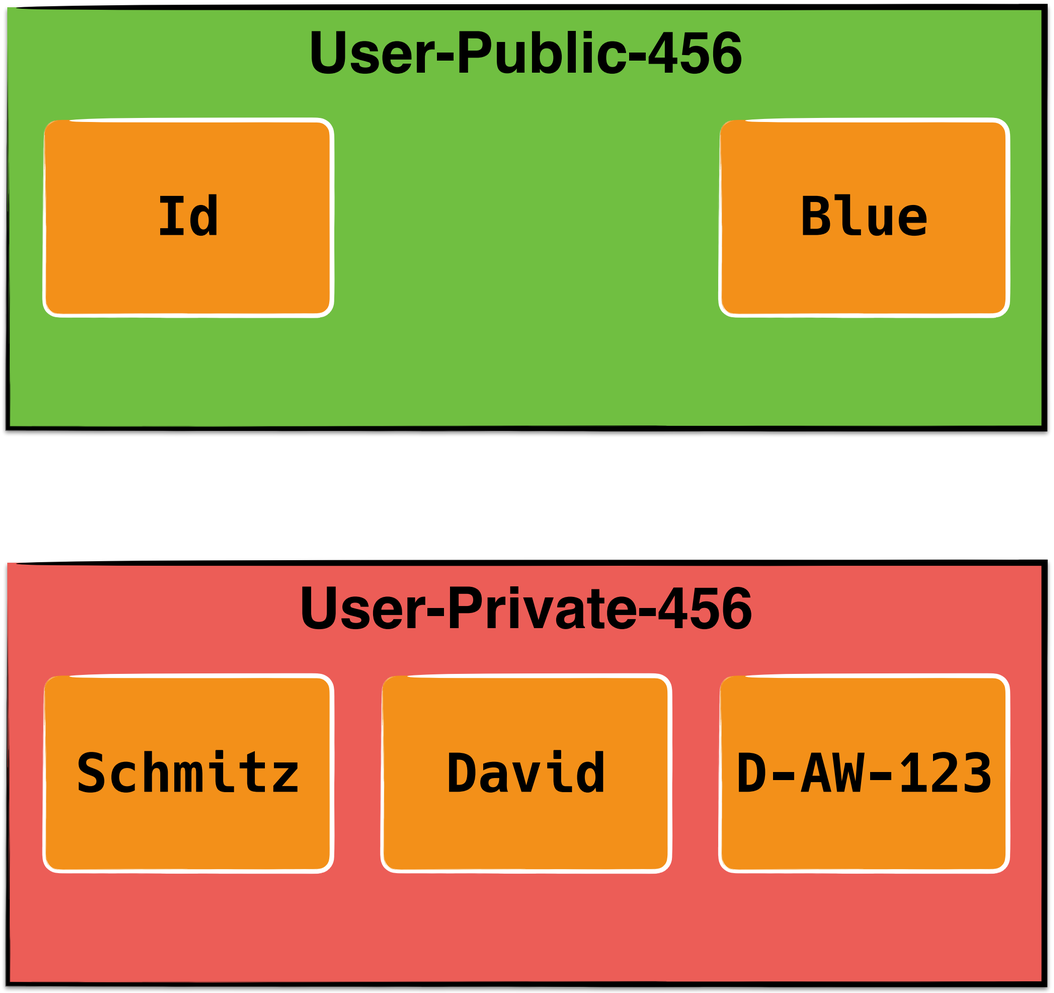
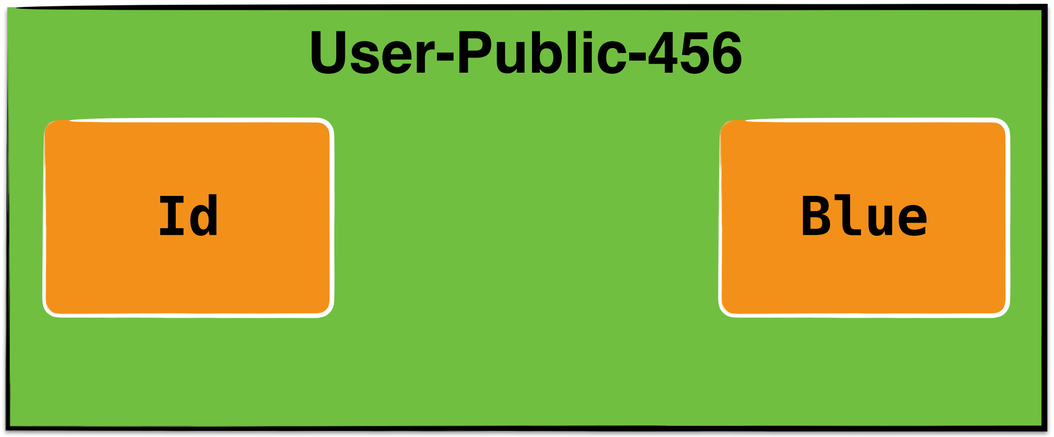
What if I delete a confluence account?

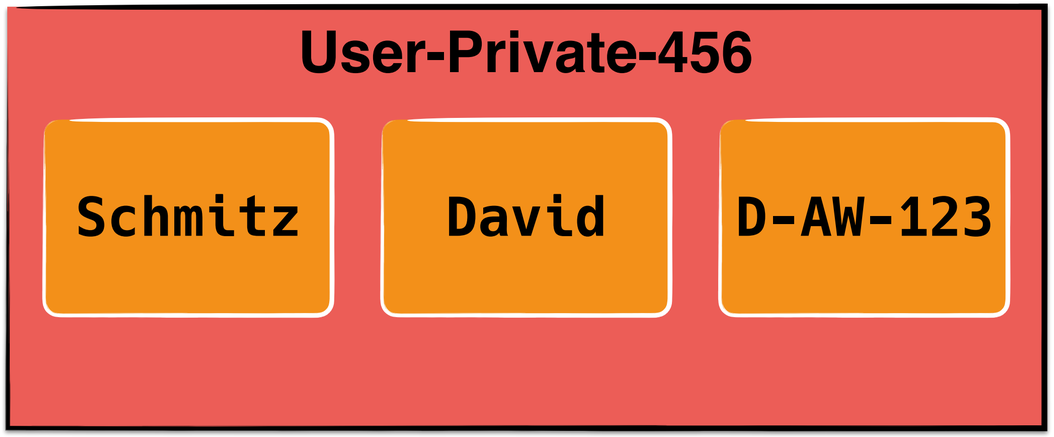

Created by
Anonymous
Jun 25, 2018

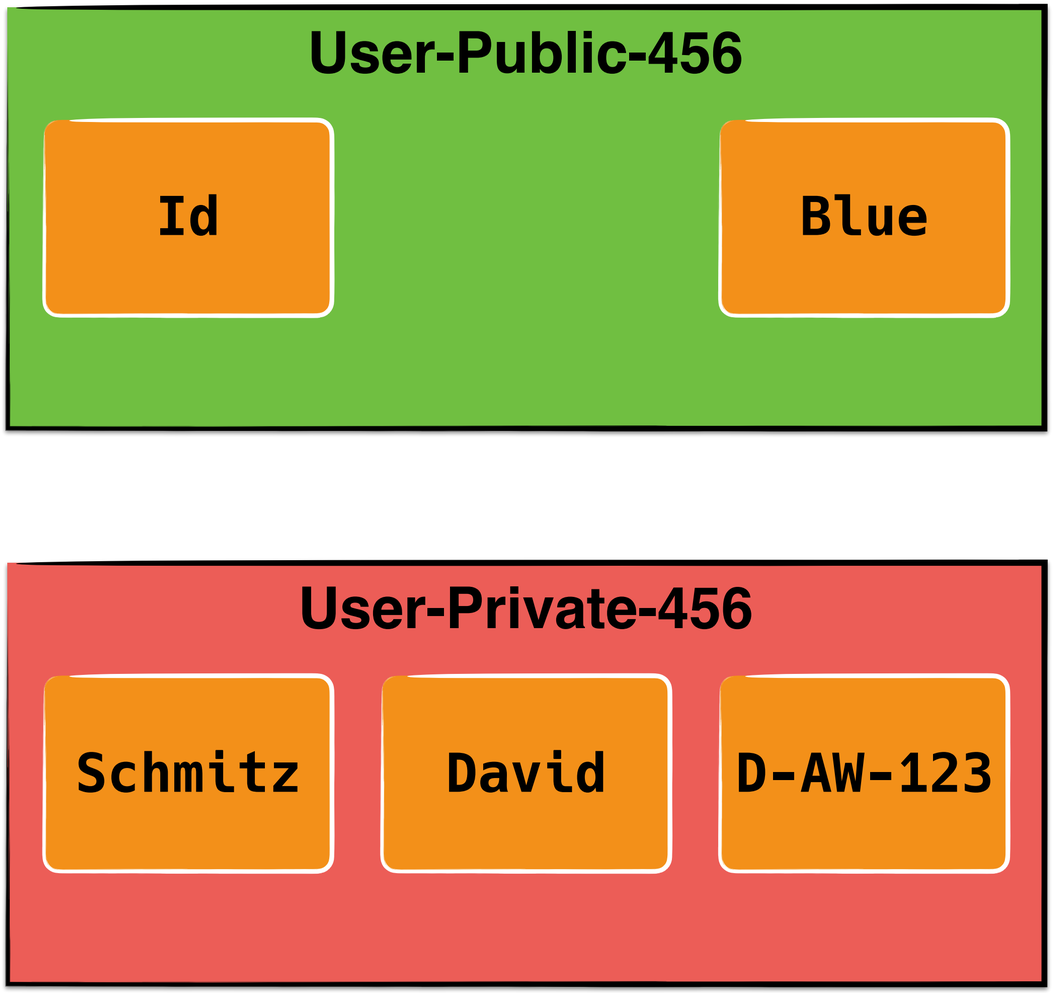
Public/private data


User-Public-456
Id
Blue
User-Private-456
Schmitz
David
D-AW-123

Keep this


User-Public-456
Id
Blue


User-Private-456
Schmitz
David
D-AW-123


User-Public-456
Id
Blue
User-Private-456
Schmitz
David
D-AW-123
Delete this

You may be able to keep references to the public data

Surprise: No easy answers

Ask your lawyer or CISO


That's it?
@koenighotze

Microservices + DDD + ES= 

Needs more up-front design

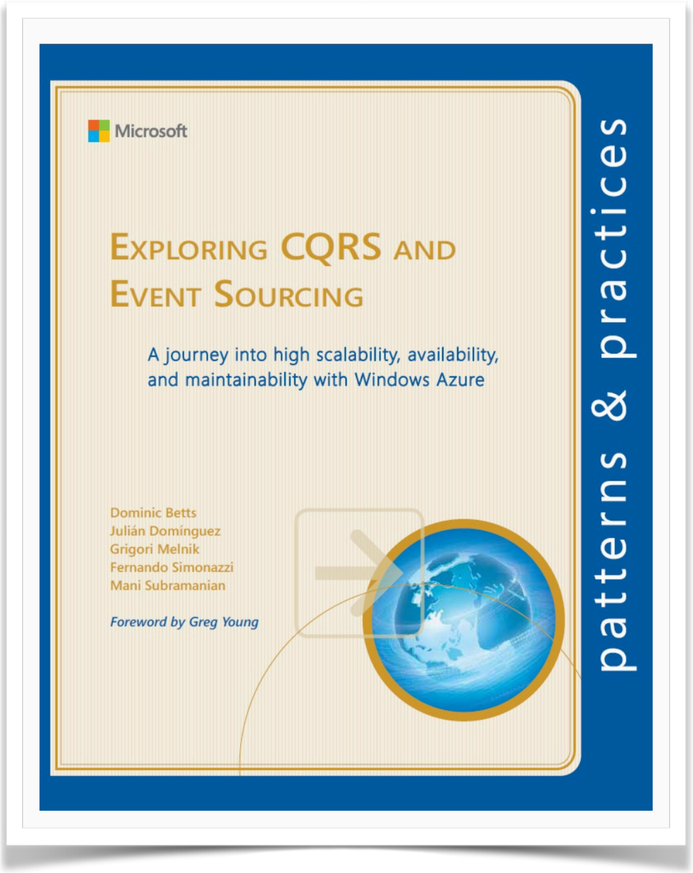
You can refactor, you can clean up

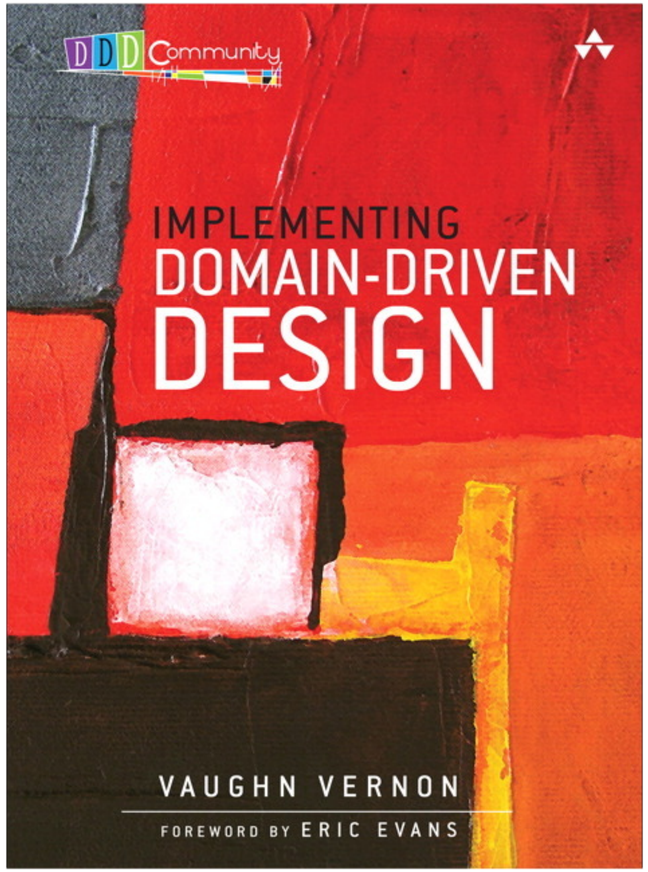
Not enough in-depth books

Avoid framework lock-in

Beware: “just…” or “…made easy”

Forget this talk…
read some papers





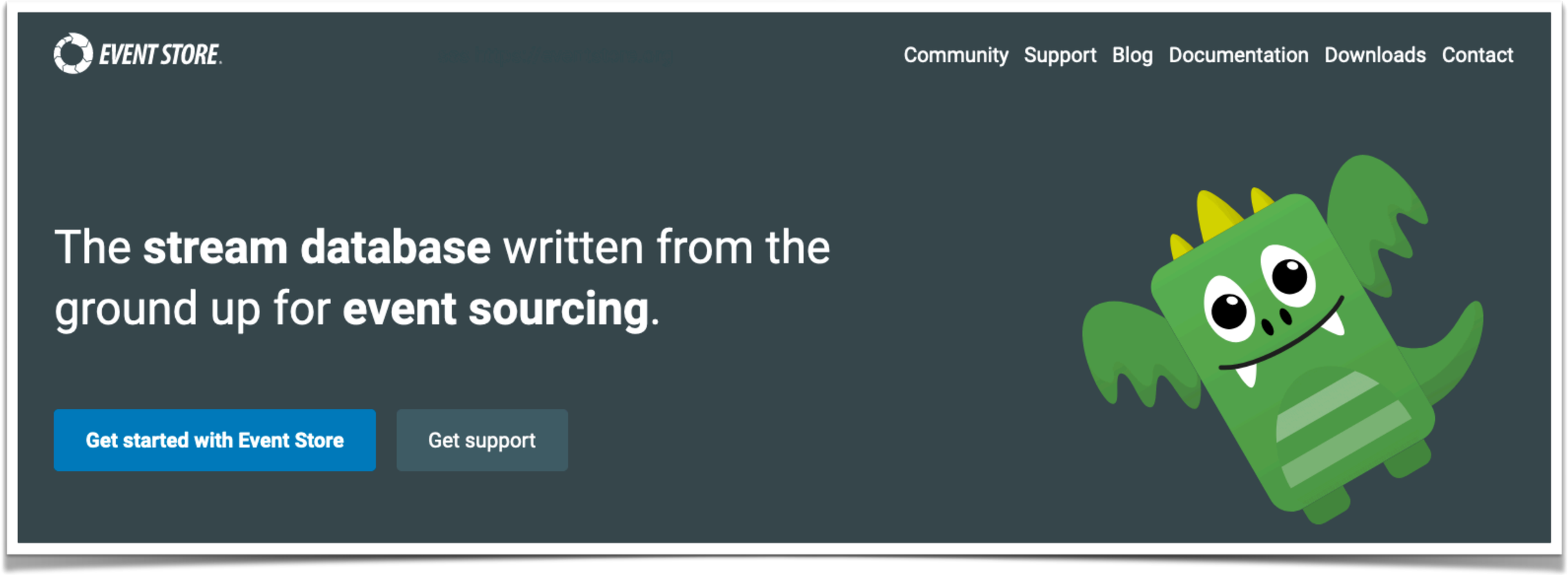
The Dark Side of Event Sourcing: Managing Data Conversion

Michiel Overeem[1], Marten Spoor[1], and Slinger Jansen[2]

Versioning in an Event Sourced System

Gregory Young

Choose the “right” tool?



eventstore.org

Thank you!

Questions and Feedback?
@Koenighotze