CQRS / EventSourcing

Softwerkskammer Leipzig

2016-10-18

Agenda

- CQRS in 10 mins
- EventSourcing in 10 mins
- Q&A
- Workshop intro
- Workshop (yes, **you** code) 1-3
- break
- Workshop (yes, **you** code) 4-7
- Q&A

... and yes, WE HIRE!

Kudos

Oliver Wolf

https://innoq.com

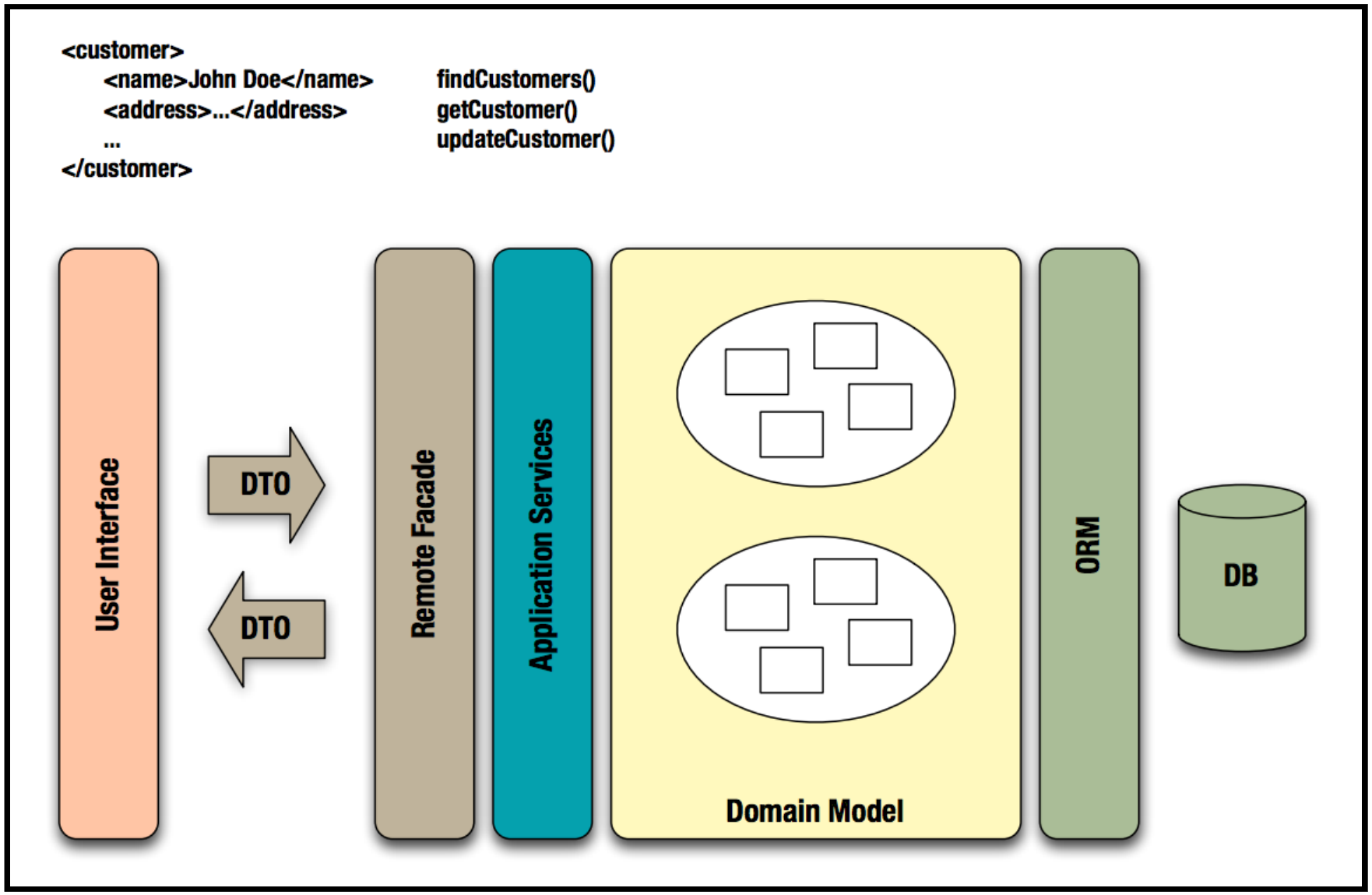
Greg Young

https://goodenoughsoftware.net/

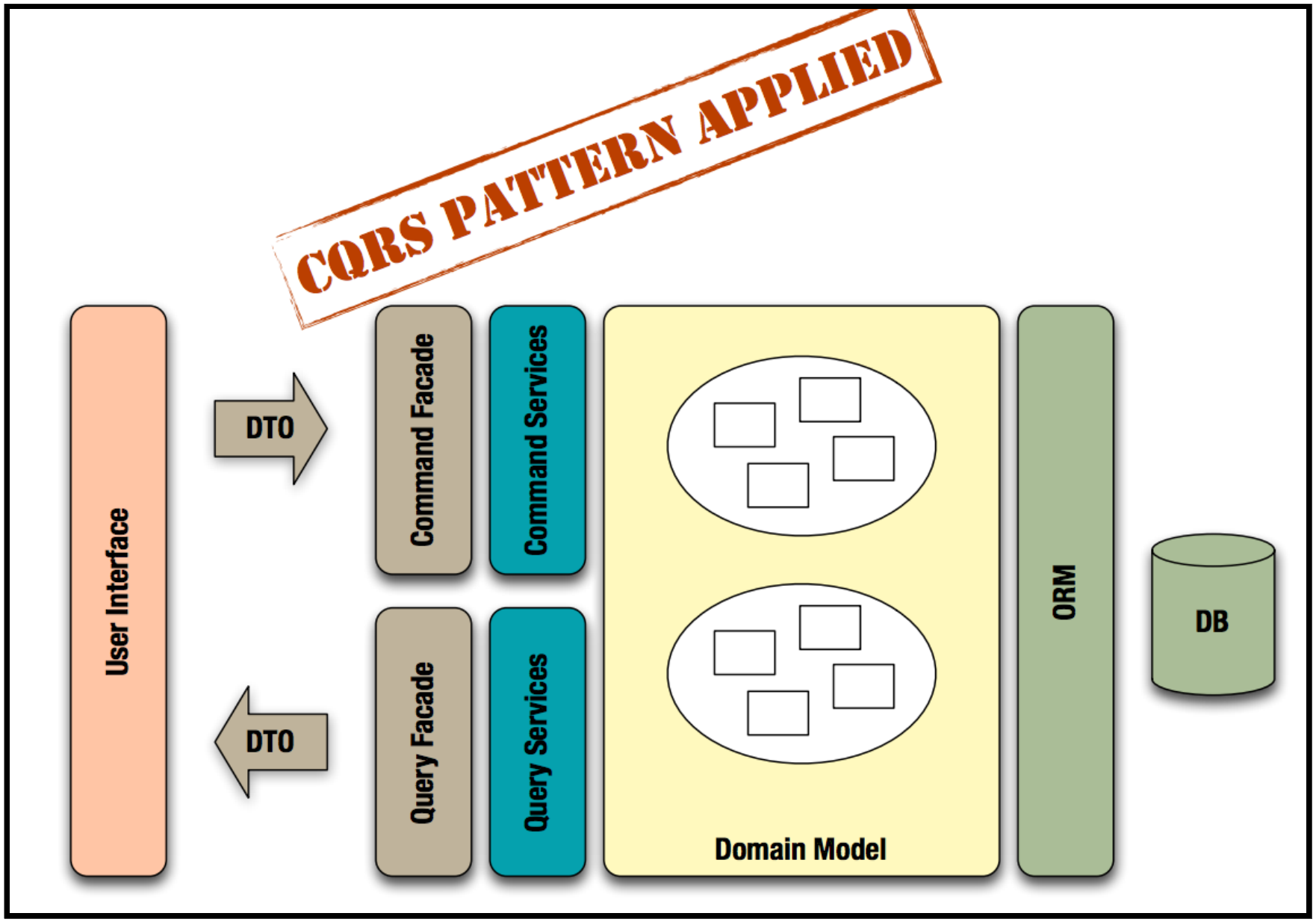
"You can do CQRS without EventSourcing, but you cannot do EventSourcing without CQRS."

CQRS

COMMAND QUERY RESPONSIBILITY SEGREGATION



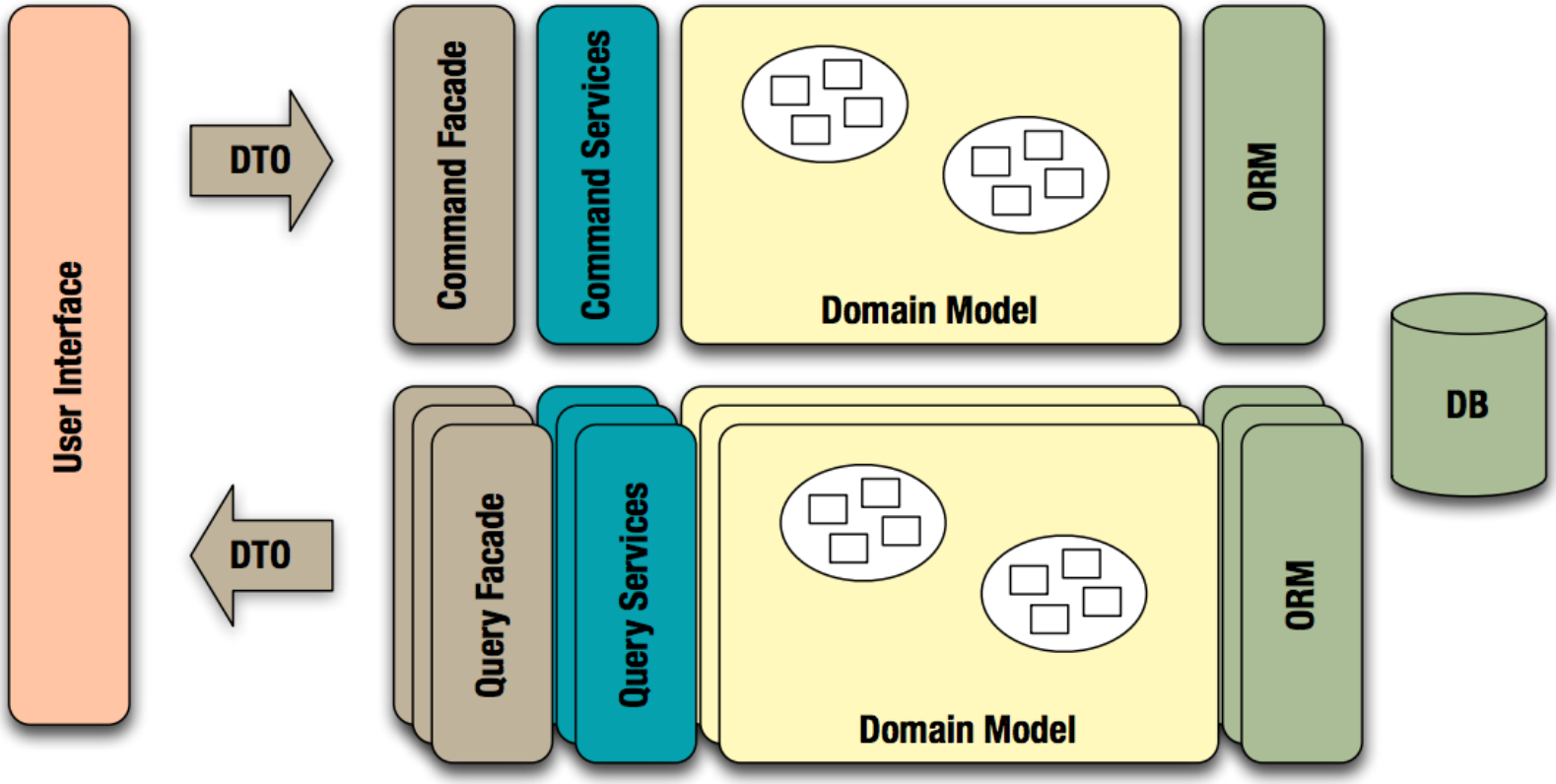
Traditional Layered Architecture



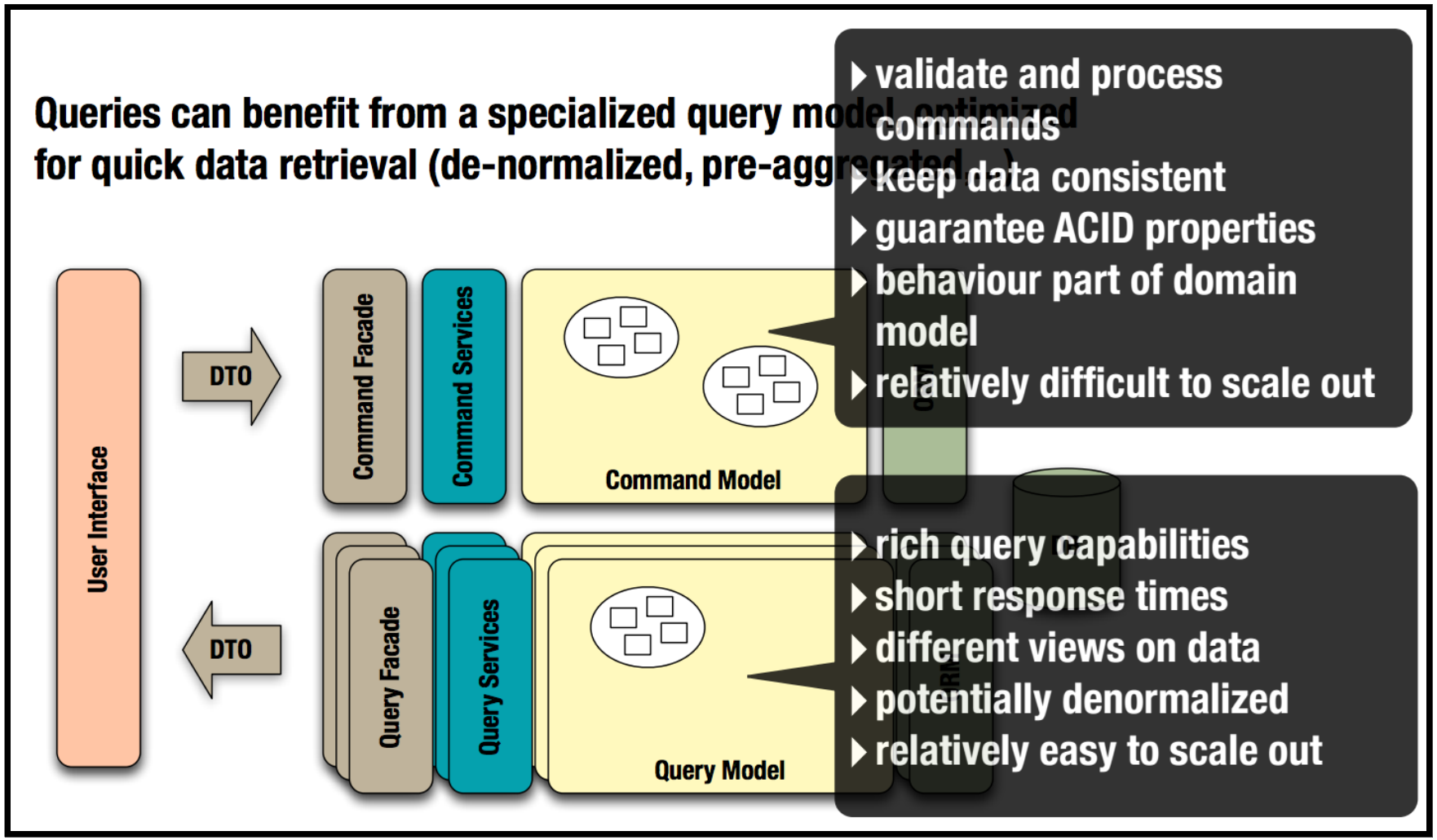
CQRS Pattern applied – done.

THAT IS IT!?

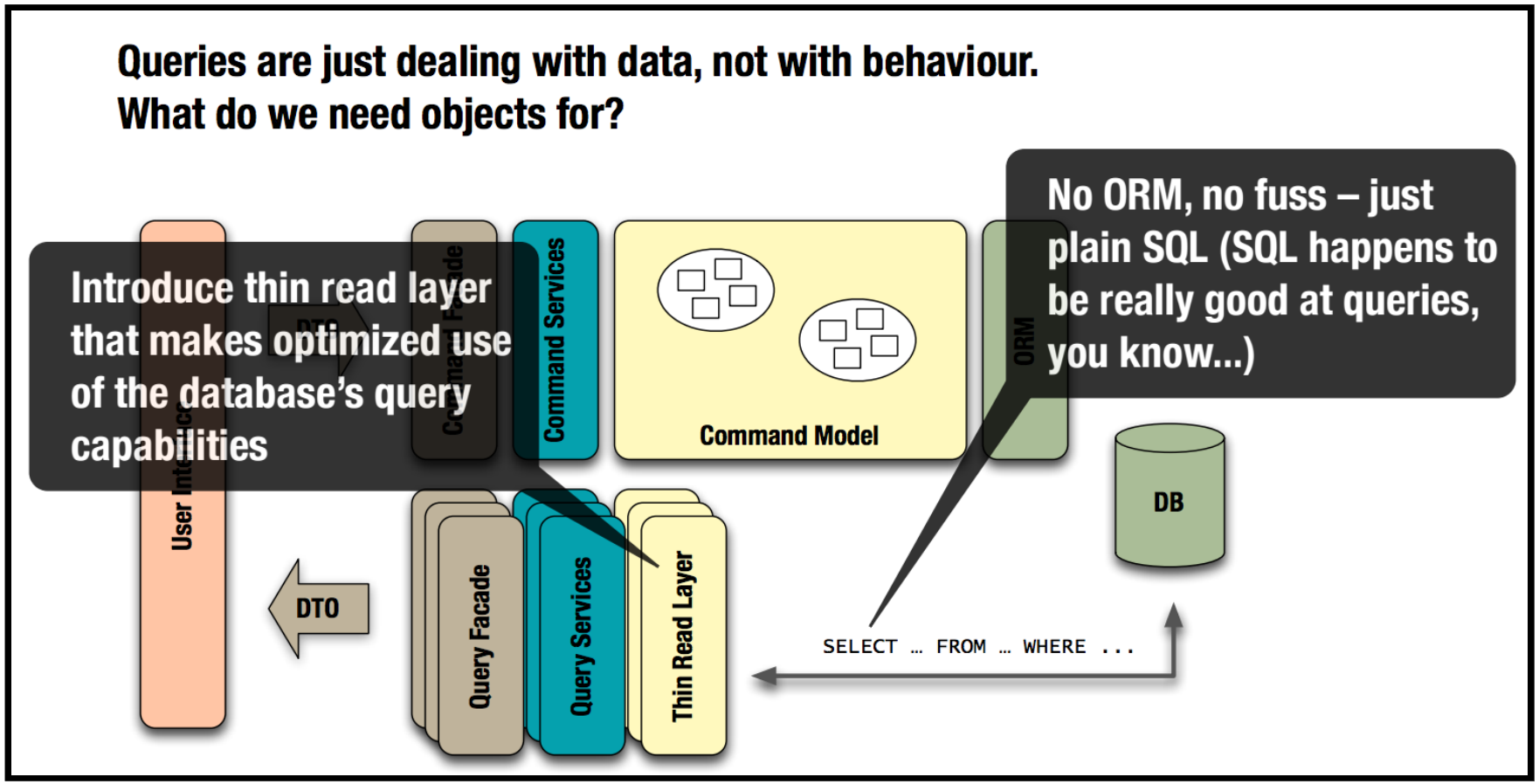
Command and query parts can scale independently, e.g. to accommodate highly asymmetric load.



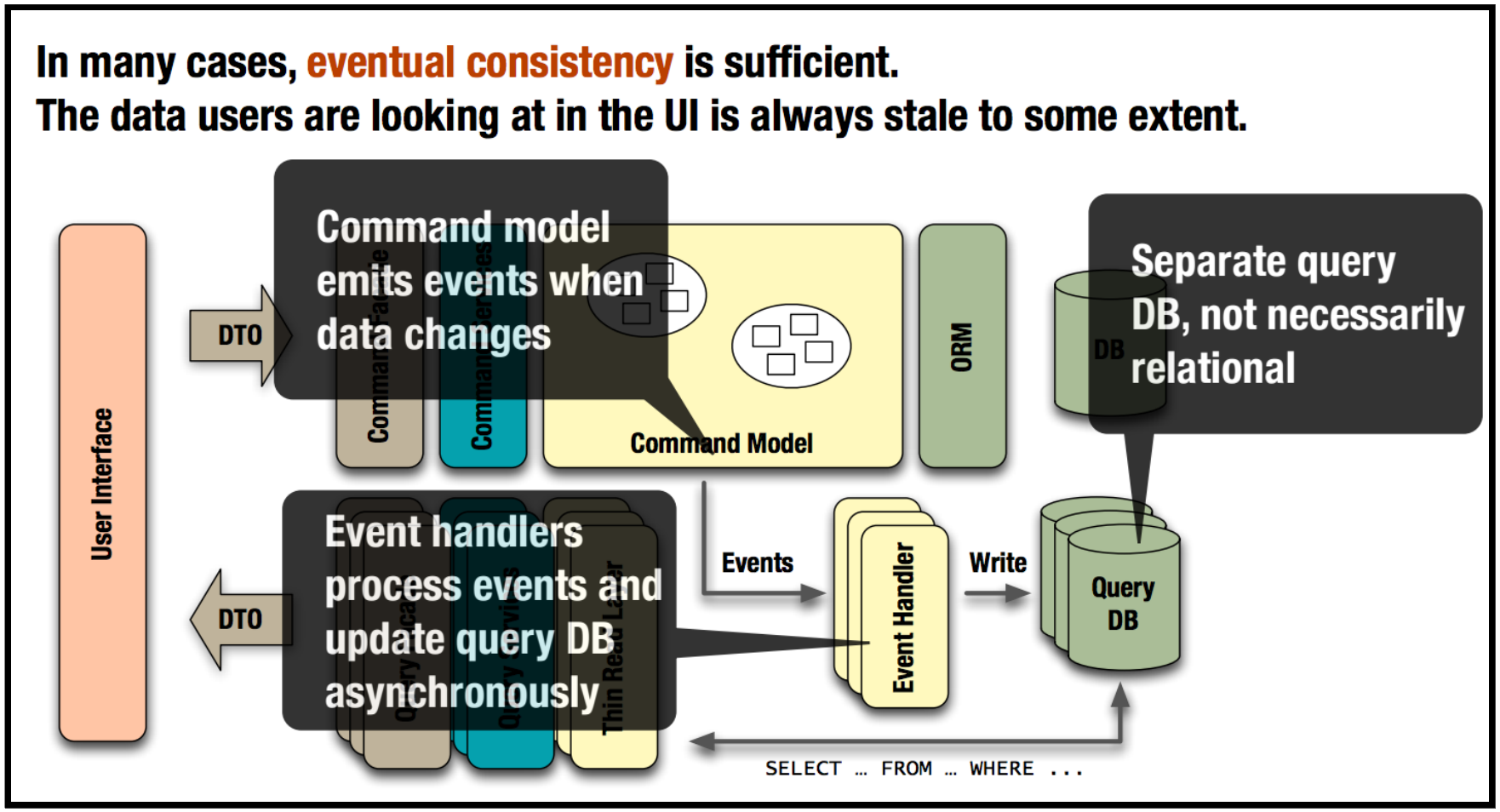
pro: scale independently



pro: optimized Query-Models (denormalization)



pro: **thin** read layer



pro: Eventual Consistency & Read-Replicas

Conclusion

CQRS helps with

- asymmetric load / read replicas
- gain from different QueryModels / Technologies
- helps Time-to-Market
- avoids technology Lock-In
- enables local optimization on Query-Models

EventSourcing

as a Concept

"An architectural pattern which warrants that your entities (as per Eric Evans' definition) do not track their internal state by means of *direct serialization or O/R mapping*, but by means of **reading and committing events** to an event store."

EventSourcing

- Architectural Pattern
- EventStore keeps log of Events (Facts)
- 'current' State is
  - transient
  - disposable
  - fully/reliably reconstructible from series of Events

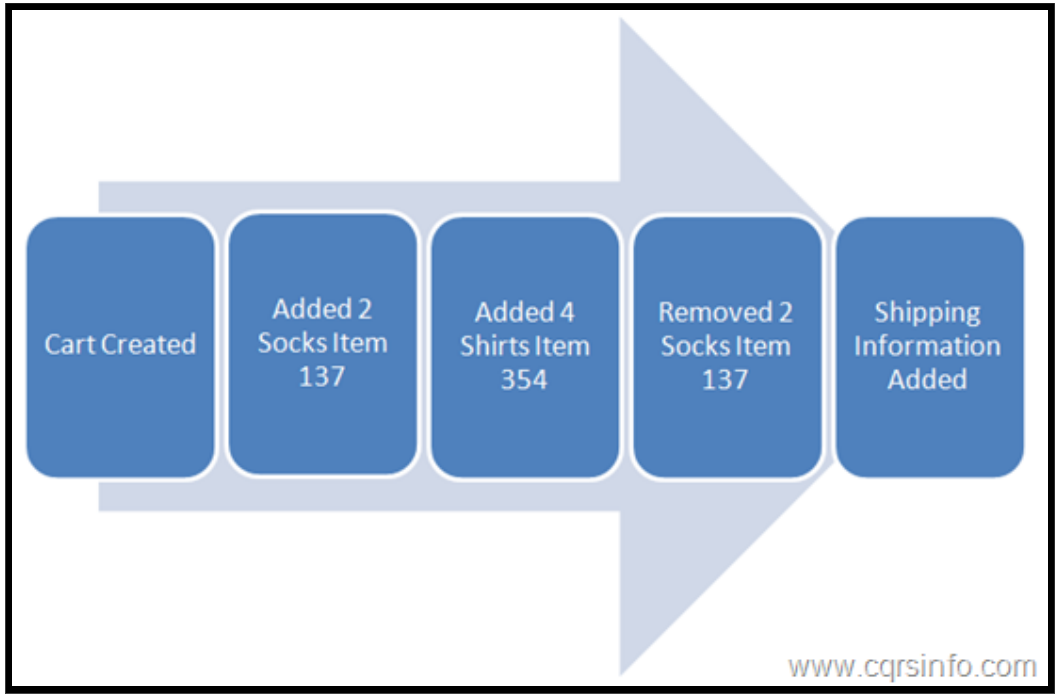
Current State is a Left Fold of Events λ

- FP: Left Fold aggregates a collection via a function and an initial value
  - Ruby:
  - Scala:

```
[1, 2, 3].inject(0, :+)            ==   6   # symbol fn name
List(1, 2, 3).foldLeft(0)(_ + _)   ==   6   // anon function
```

- Provide an initial state s_0 and a function f : (S, E) => S

- Current State after event e_3 is:
  - $= leftFold([e_1, e_2, e_3], s_0, f)$
  - $= f(f(f(s_0, e_1), e_2), e_3)$


Cart Created
Added 2 Socks Item 137
Added 4 Shirts Item 354
Removed 2 Socks Item 137
Shipping Information Added
www.cqrsinfo.com

Pros

- focus on **state transitions**, rather than data structure
- audit log already included
- reports over the past
- no Information-loss (Socks, Item 137)
- replayable
  - basically Time Machine (travel back and forth)
  - history of System state
  - helps debugging
  - no infamous SQL-migration-scripts, just change aggregation and replay

Cons

- maybe different angle to modeling
- (little) more complex than a CRUD System
- new Challenges like:
  - aggregation performance
  - evolving events
  - capacity

proven Patterns for the new challenges ***do*** exist!

Myths

- artificial approach to modeling (**not** true)
- requires eventual consistent (**not** true)
- inherently difficult & complex (**not** true)
- bad performance (**not** true)

Questions up to here?

EventSourcing Basics

Workshop

Disclaimer

the code here is

- **NOT** an EventSourcing framework !
- just for demonstration of concepts
- oversimplified
- Java, but can be done in any language
- very basic DI with Spring, but can be done without
- uses Lombok for brevity (just syntactical sugar)

There are many ways to skin a Cat

This Workshop is about

Discussion

not Code

EventSourcing Basics

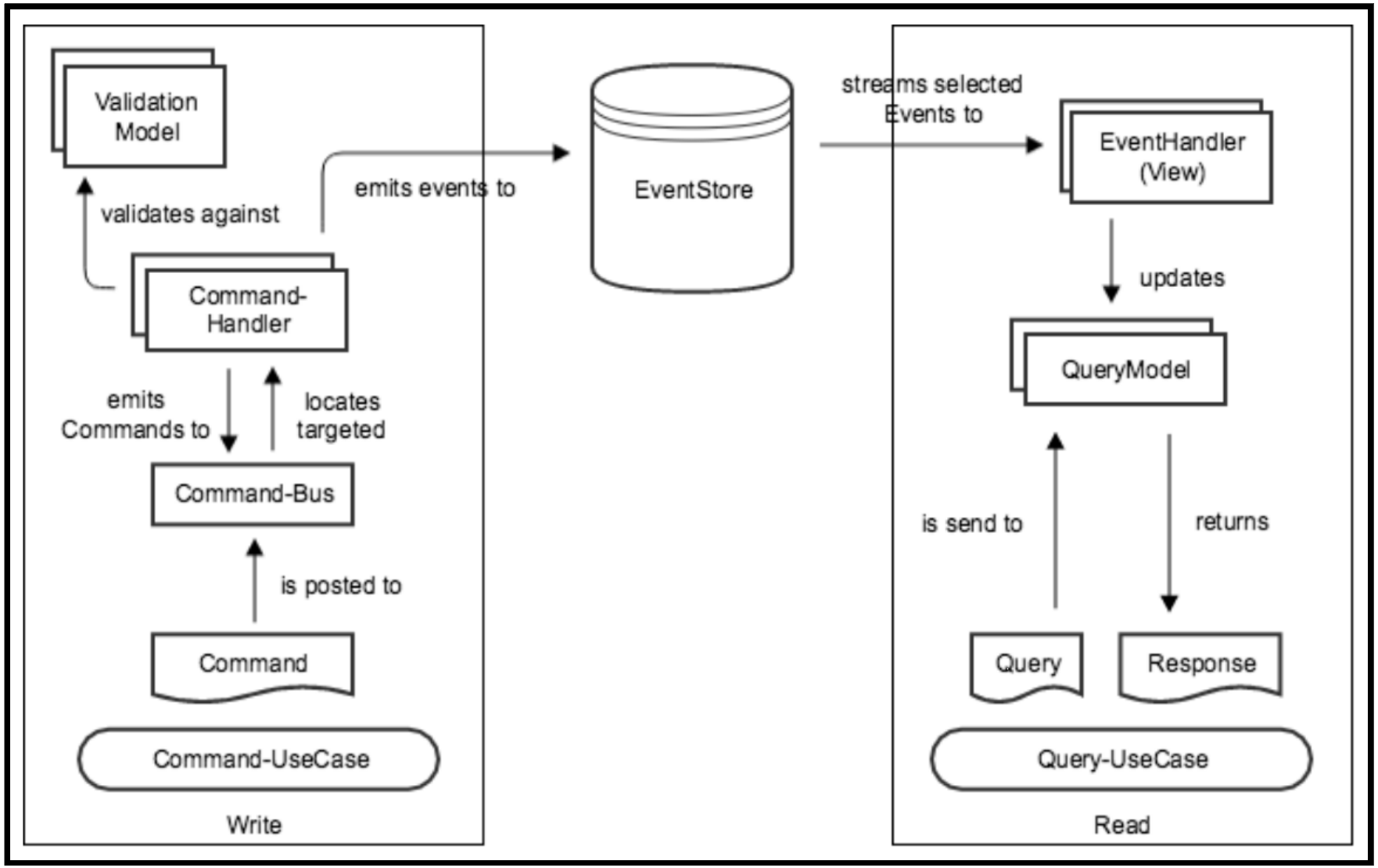
Intro

Hello, we are FooBank !

Our Domain

- Local Bank
- physical Counter
- will expand into online-banking

Infrastructure



Component	Responsibility

Glossary

Component	Responsibility
ApplicationFacade	single Entry Point / internal API (optional)
Command	Request for the System to *do* something
CommandBus	find CmdHandler for given Cmd
CommandHandler	accept or reject Command, emit Effects
Effects	List of Messages
Message	Event or Command
Event	a given Fact
EventStore	a log of Events *that have happened*
EventHandler/View	process Events, project useful Model
Query	a Question to a Model
QueryModel	queried by the outside world, query-optimized data
ValidationModel	answers Queries while validating

EventSourcing Basics

Session 1

Aggregating to the canonical Domain Model

Canonical Domain Model

```
public class Account {
    private final UUID id;
    private final String firstName;
    private final String lastName;
    private int balance = 0;

    void credit(int amount) { balance += amount; }
    void debit(int amount)  { balance -= amount; }
}
```

UseCase Deposition

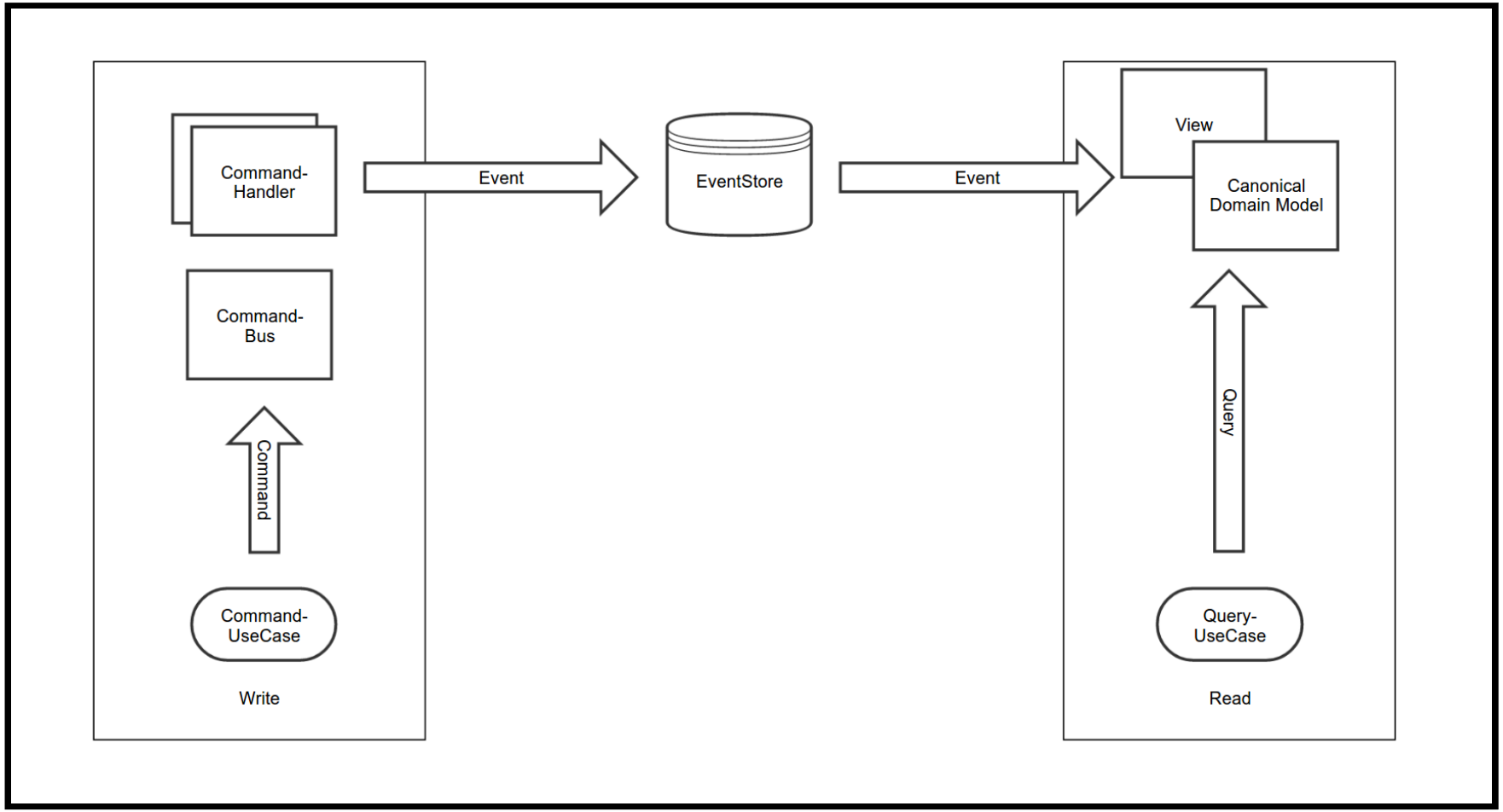
UseCase Deposition

As a Customer
i want to **deposit** cash at the counter
in order to credit it to my account.

UseCase Withdrawal

UseCase Withdrawal

As a Customer
i want to **withdraw** money from my account at the counter
in order to cash it out.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Handler
Command-
Bus
Command
Command-
UseCase
Write
Event
EventStore
Event
View
Canonical
Domain Model
Query
Query-
UseCase
Read

What we learn

- Implement **write** side
  - minimal Commands
  - minimal CommandHandlers
  - minimal Events
- Implement **read** side
  - minimal EventHandlers (Views)
  - that populate the canonical Domain Model

git clone https://github.com/uweschaefer/es-basics.git

Session 1

1. Implement **ApplicationFacade.deposit/withdraw**
2. Create **Command classes** for both UseCases (see *CreateAccountCommand*)
3. Create **CommandHandlers** for both UseCases (see *CreateAccountHandler*)
4. Create **Event** classes for every UseCase (see *AccountCreatedEvent*)
5. Extend **AccountView** to aggregate Accounts
6. Pass the Tests

What just happened?

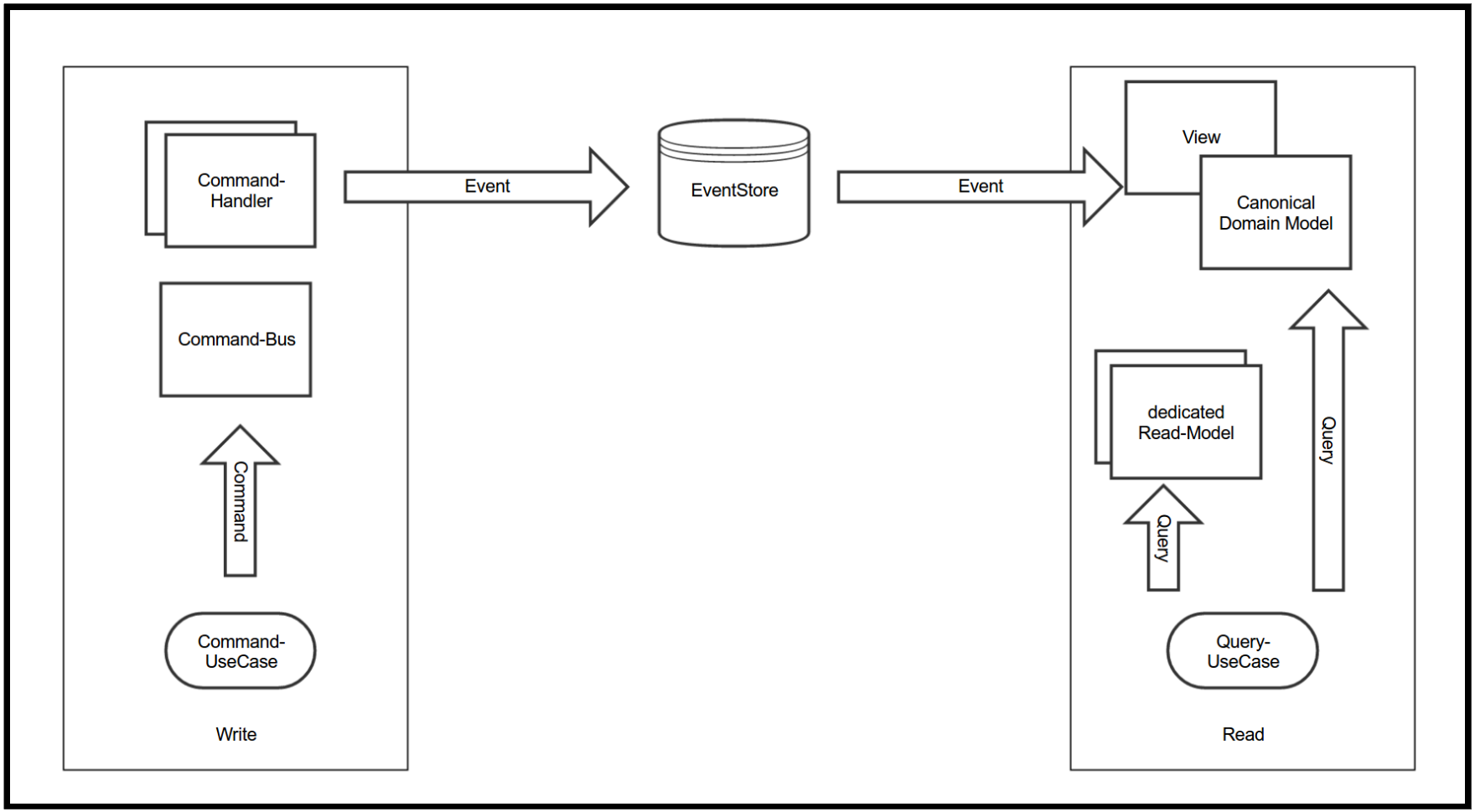
- complete Roundtrip
  - Command -> CommandHandler
  - Event -> EventHandler (View)
  - Query via DomainModel

EventSourcing Basics

Session 2

Dedicated QueryModel

Overview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Query
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Aggregation

AccountView = EventHandler that aggregates Events to an Account.

Not every Query within one Account

UseCase ValuedCustomerReport

UseCase ValuedCustomerReport

As a Manager, i want
a complete report the lists all *valued customers*
in order to free them from handling charges.

Specification ValuedCustomer

Specification ValuedCustomer

a *valued Customer*
has deposited an amount of **>=1000€ at least twice**.

How **not** to do that

Iterate Accounts and inspect their Depositions one by one.

What we learn

- Aggregate beyond Entity-Boundaries
- Create **dedicated Read Model**
  - find appropriate DataStructure
  - select Event-Types by @EventConsumer Methods

Session 2

1. git clean -fd && git reset --hard session2
2. implement ValuedCustomerReportView
3. pass the Tests

What just happened?

- we added a dedicated Read/Query-Model
  - beyond aggregate boundaries
  - Query-optimized Datastructure
  - PullViews have to actually **pull** the events from the ES at some point.

EventSourcing Basics

Session 3 (Bonuslevel)

Rolling Snapshot QueryModel

Overview

- ValuedCustomerSupport aggregates ALL depositions in the System
- gets slower & slower
- how to tacle that?

Problematic

every time a Report is needed, a new View has to be created.

```
facade.deposit(...);

ValuedCustomerReportView report1 = new ValuedCustomerReportView(es);
assertTrue(report1.isValuedCustomer(...));

facade.deposit(...);

ValuedCustomerReportView report2 = new ValuedCustomerReportView(es);
assertTrue(report2.isValuedCustomer(...));
```

What if?

we could reuse a QueryModel, that is being updated, rather than re-created?

```
ValuedCustomerReportView report = new ValuedCustomerReportView(es);

facade.deposit(...);
assertTrue(report.isValuedCustomer(...));

facade.deposit(...);
assertTrue(report.isValuedCustomer(...));
```

---

discuss what would be necessary, conceptually?

No, really – **Discuss**

What we just learned?

- Concept of Rolling Snapshot

Session 3

1. git clean -fd && git reset --hard session3
2. look at *View.last*, *View.accept* and *PullView.pullEvents*
3. change ValueCustomerReport appropriately.
4. pass the Tests

What just happened?

- Rolling Snapshot
  - keeps latest
- Eventstore provides query of EventStream from **after** a particular event
- And yes, we can have more snapshots than one, if needed

Have a break.

Have a KitKat

EventSourcing Basics

Session 4

Event Design

UseCase Transfer

UseCase Transfer

As a user, i want to
transfer Money from my account to someone else's
in order to pay my rent online.

Acceptance Criteria

- *AccountUnknownException* if receiver or sender account does not exist
- *UnfundedTransferException* if sender does not have enough money (no debt allowed)

What we learn

- Event granularity matters
- Events need to reveal their intent
- Use of a ValidationModel
- Commands can be rejected

Session 4

1. git clean -fd && git reset --hard session4
2. implement *TransferHandler*
3. apply necessary changes AccountView
4. pass the Tests

What just happened?

- Granularity: Events belong to ONE Aggregate
  - we need SendTransfer, RecieveTransfer
- Events reveal intent
  - do not reuse WithdrawnEvent etc, its a different UseCase!

EventSourcing Basics

Session 5 (Bonuslevel)

Dedicated WriteModel / ValidationModel

Command validation sometimes needs Context

Your take on Criteria 1?

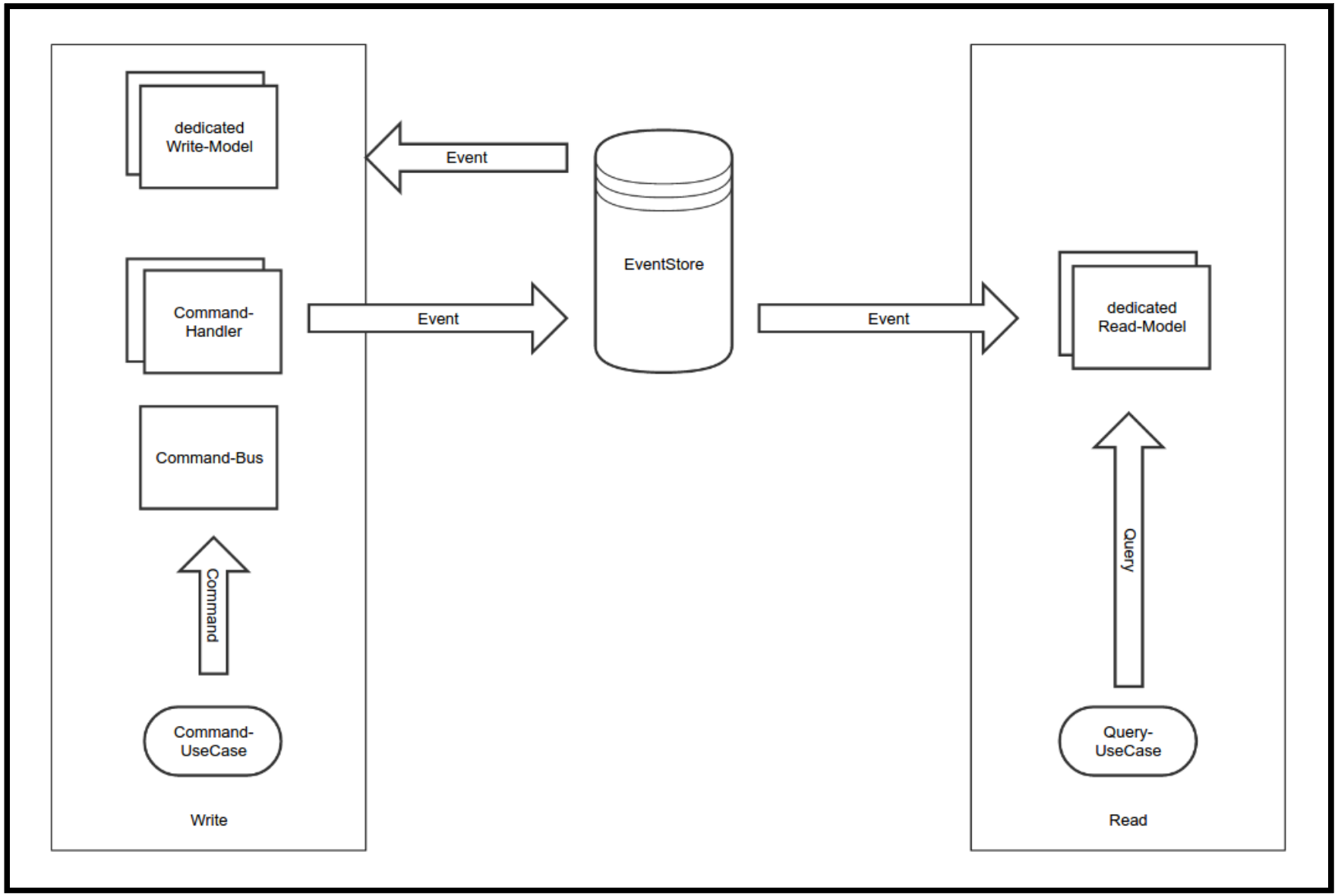
- *AccountUnknownException* if receiver or sender account does not exist

```
private boolean exists(UUID id) {
    return repo.find(id) != null;
}
```

Using AccountView just to find out, if an Account exists is wasteful.

All we really need to know
is if the aggregate exists.

Overview


dedicated
Write-Model
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EventStore
Command-
Handler
Event
Event
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Read-Model
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Command
Query
Command-
UseCase
Query-
UseCase
Write
Read

CommandHandler

Responsibilities

- validate command
- accept or reject command based on that validation
- emit Messages on accepting

Session 5

1. git clean -fd && git reset --hard session5
2. implement KnownAccountsView
3. pass the Tests

What just happened?

- dedicated WriteModel / ValidationModel
- does not have to be DomainModel, as it does not need behaviour

EventSourcing Basics

Session 6

Side-Effects

- Some Commands may trigger external behavior.
- Replaying that would be problematic.

UseCase Notification

UseCase Notification

As a user, i want to
be notified by email when i recieve a transfer
in order to buy champagne asap.

What we learn

- how/where to model Side-Effect

Session 6

1. git clean -fd && git reset --hard session6
2. use *CreditNotificationService* to send mail
3. discuss where/how to do it properly
4. hint: see *CommandBus.publish()*
5. pass the Tests

What just happened?

- CommandBus has to be reliable
- Commands can be Effects, too
- Side-Effects can be modeled as Commands / CommandHandlers

Intermission

What about Consistency?

Did we relax Consistency compared to a normal CRUD/ORM implementation?

NO!

But where we could, how can we take advantage?

EventSourcing Basics

Session 7 (Bonuslevel)

Push-Views

Up to now, all views have been *PullView*s, that call *pullEvents()* to stream events into them.

Pro

- we can define when to update the View's State

Con

- we have to Query the EventStore in order to know, if View's State is stale
  - the more Queries we run, the more catastrophic this is:
  - bad Latency for Queries
  - high Contention on EventStore

UseCase GoldCustomers

UseCase GoldCustomers

As an accountant, i want to
know all the Gold-Customers
in order to be extra nice to them.

Specification Gold Customer

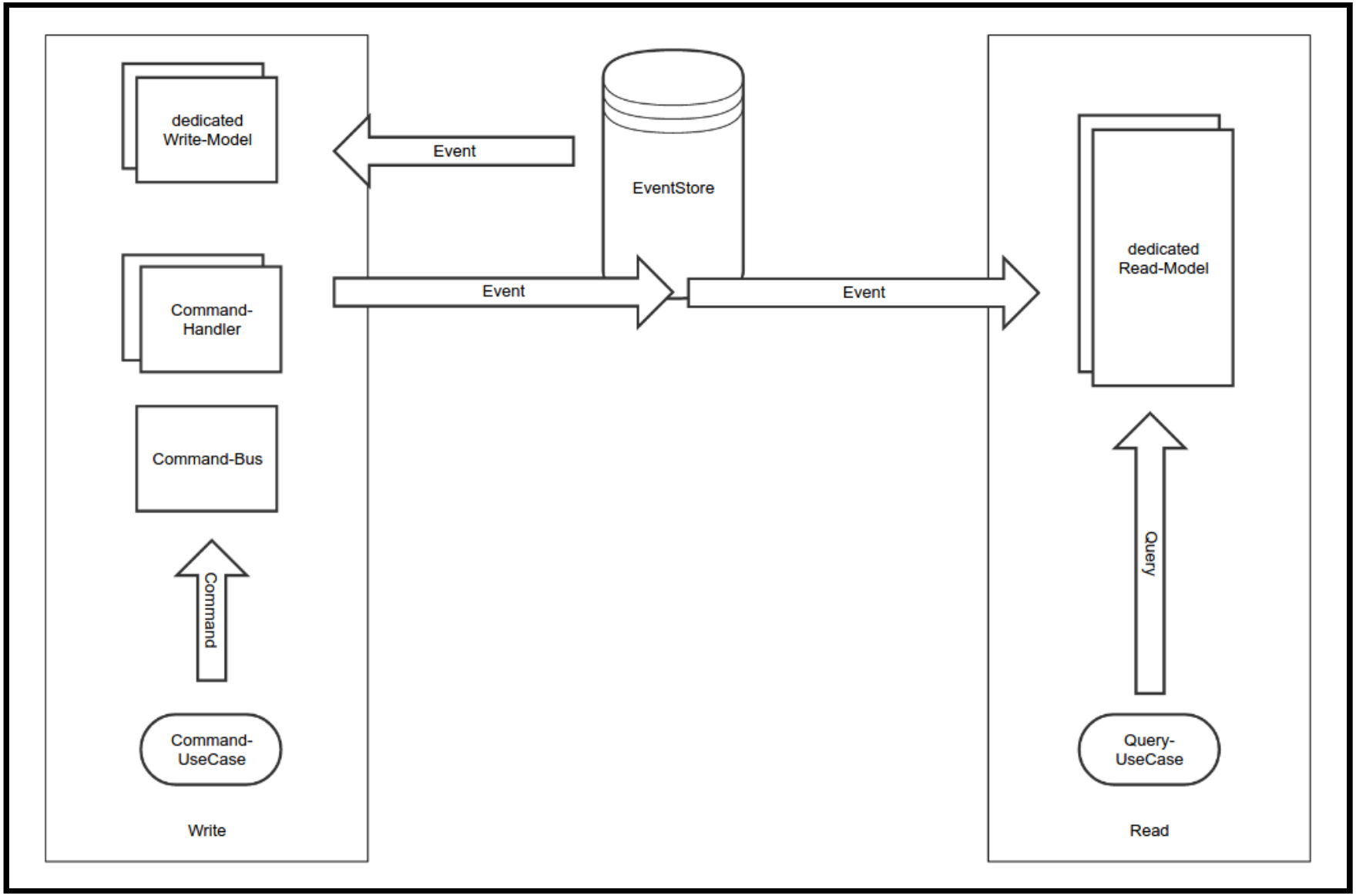
Specification Gold Customer

someone who recieved a transfer **>=10.000€**
at least once

Acceptance Criteria

- report must be **instant!** (low-latency)
- report must be a collection of Strings "<LASTNAME>, <FIRSTNAME>"
- order is not important
- only Transfers count – Depositions **must not** be examined
- report does not need to include GoldCustomer that recieved the status in the last few seconds...

... which means **Eventual Consistency** is ok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Read-Model
Query
Query-
UseCase
Read

What would be necessary to push events to the view?

What we learn

- Use Push-Model for Views
- pros and cons of push vs pull

Session 7

1. git clean -fd && git reset --hard session7
2. implement *GoldCustomersView extends PushView*
3. pass the Tests

What just happened?

- Implemented a push-View that is updated by processing Events asynchronously
- Push reduces read latency
- introduces eventual consistency
- introduces concurrency
- PushViews mostly unusable as Validation Model (not strictly consistent)

One possible solution can be found here

git clean -fd && git reset --hard theend

Links

- O.Wolfs CQRS Slides
  - https://speakerdeck.com/owolf/cqrs-for-great-good-2
- Greg Young's Blog
  - https://goodenoughsoftware.net/
- Axon mature ES Framework
  - http://www.axonframework.org/
- Lagom Modern ES Framework based on Akka
  - https://www.lightbend.com/lagom
- Microsofts CQRS/ES Patterns & Practices
  - https://msdn.microsoft.com/en-us/library/jj554200.aspx

... and yes, WE HIRE!

Q & A