Building an event sourced system in C#

Hannes Lowette

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Who am I?

- Father of Arne (12), Joren (8) and Marit (6)
- Partner of Barbara (?)
- Head of L&D @ Axxes
- .NET backend dev
- Loves knowledge sharing
- Amateur guitar builder
- Guitarist @
  Dylan Beattie & the Linebreakers
- Mountain biker
- Bad chess player
- Microsoft MVP

Who are you?

- What's your name?
- What is your background?
- What are you hoping to learn?
- Tell me 1 cool fact about you!

... or if you don't feel like sharing, just say:

I'm X and I'm here to see what happens.

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Disclaimer (what to expect)

I am here for you, not the other way around

This means:

- If you have questions, ask!
- If you feel we can do things better/differently, speak up!

→ This workshop goes differently every time

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PSA

1. Need a break? Others probably need one too.
   → Let me know! I tend to ramble on.

2. Learning happens best when you feel comfortable.
   → Eat snacks, drink, go to the bathroom, …

3. I can talk for 2 days, but my voice gets hoarse.
   → Let's turn the coding parts into a conversation!
   → You learn, I learn something too

4. Need me to commit and push?
   →Shout out!

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Agenda

1 _ What are we building?

2 _ DDD

3 _ Event Sourcing

4 _ CQRS

5 _ Optimizations

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What are we building?

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BeerSender.NET

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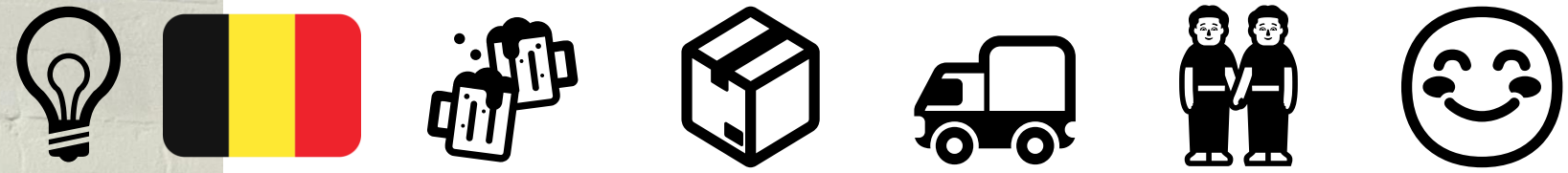
Lockdown boredom



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Execution

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Expectation

Reality

12/01/2022 15:41	**Returned** Returned to shipper MOL, BE
11/01/2022 19:07	**Returning to Sender** UPS initiated contact with receiver or importer for clearance information. Once received, UPS will submit for clearance. / The package will be returned to the sender. Lummen, Belgium

11/01/2022 13:02	UPS initiated contact with the sender to obtain clearance information. Once received, UPS will submit for clearance. / The information requested has been obtained and the hold has been resolved. Lummen, Belgium
10/01/2022 22:22	UPS initiated contact with the sender to obtain clearance information. Once received, UPS will submit for clearance. Lummen, Belgium
10/01/2022 22:21	A missing commercial invoice is causing a delay. We are currently waiting for information from the sender. Lummen, Belgium
10/01/2022 22:20	Warehouse Scan Lummen, Belgium
10/01/2022 19:40	Origin Scan Lummen, Belgium
10/01/2022 14:00	Collection Scan Lummen, Belgium
08/01/2022 11:41	Your parcel is currently at the UPS Access Point™ and is scheduled to be tendered to UPS. Lummen, Belgium
08/01/2022 11:41	Drop-Off Lummen, Belgium
07/01/2022 22:21	Your parcel is pending release from a Government Agency. Once they release it, your parcel will be on its way. Lummen, Belgium
07/01/2022 22:21	Your parcel is on the way
07/01/2022 22:20	Shipper created a label, UPS has not received the package yet. Belgium

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Ended up being

- Tracking
- Providing extra customs info
- Emails
- UPS helpdesk 😡
- Packages returned
- Recuperating shipping costs
- Re-sending
- No delivery attempts
- Re-re-sending

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Sending beer is tricky

- Making & filling boxes is fun
- The rest, not so much
- Follow-up is key!

→ We need an app for that!

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BeerSender.NET

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Because it's not written in VB6!

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DDD

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Domain Driven Design in a nutshell

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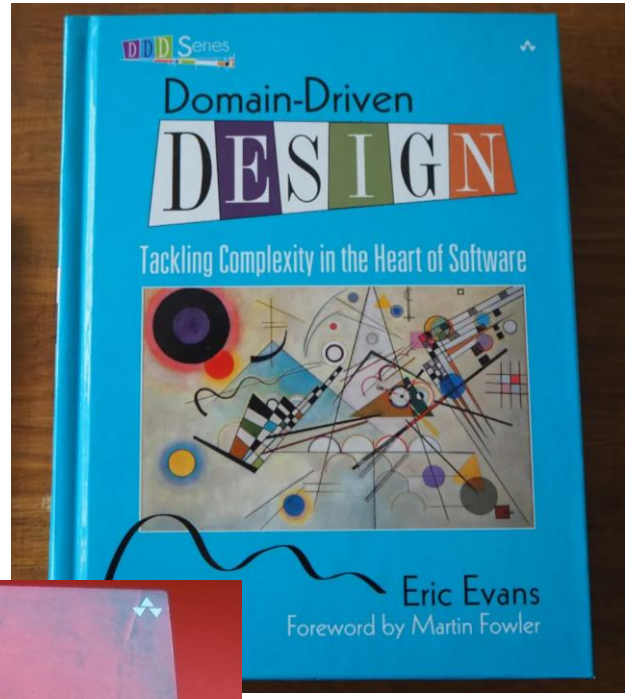
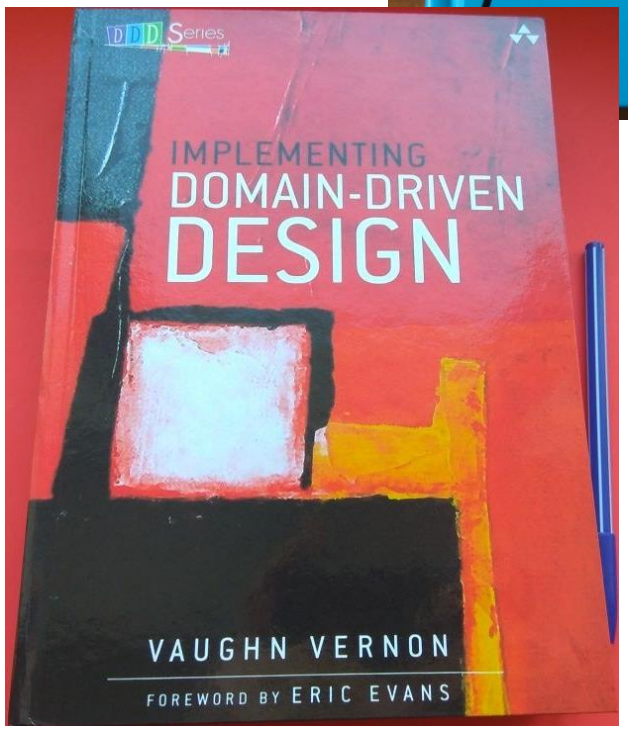
Where it started for me

- Eric Evans = the bible
- Vaugn Vernon = easier to digest

→ Written from an OOP perspective





How it often goes

Business need

→Analyst Interpretation

→Developer Interpretation

→Software

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To remove interpretations,
we must share a language

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Ubiquitous Language

A ubiquitous language is ***a vocabulary shared by everyone involved in a project****, from domain experts to stakeholders, to project managers, to developers*

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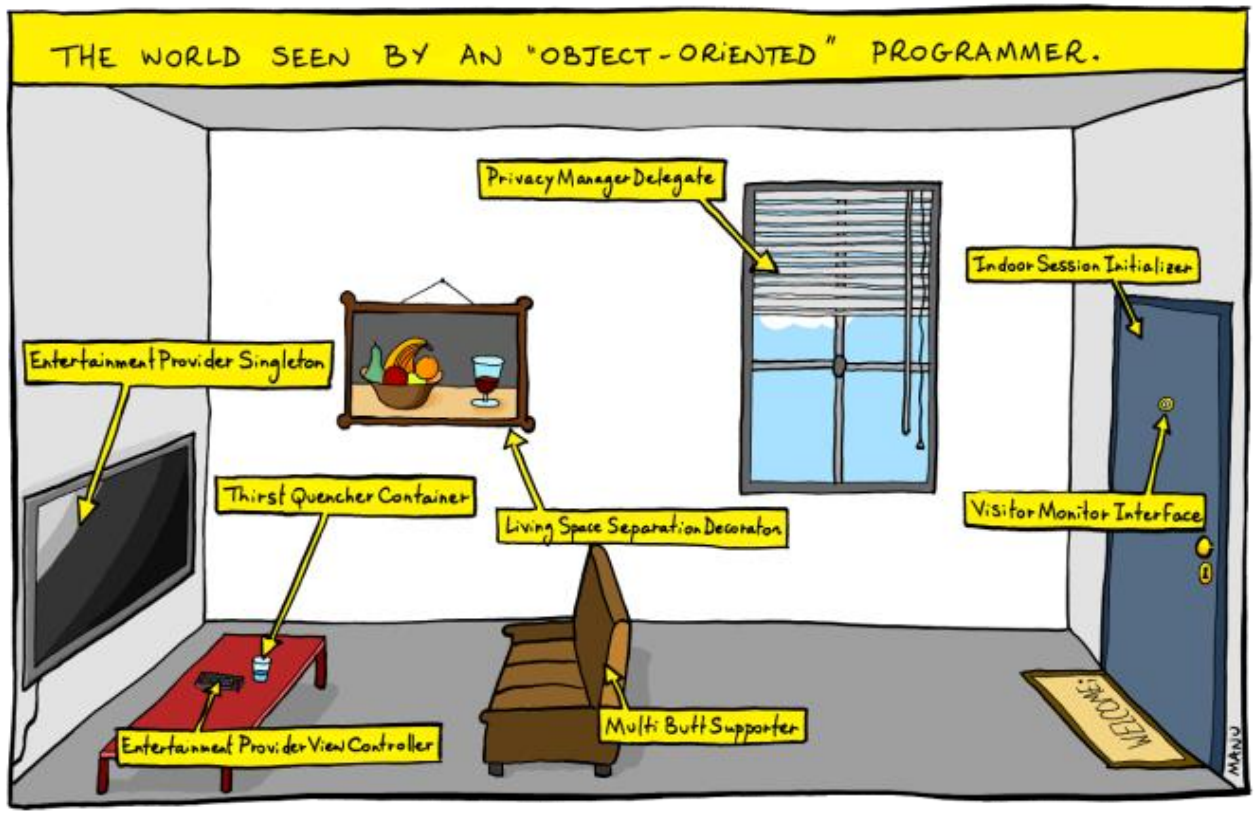
Ubiquitous Language

- Names in code
  = names in conversations
- Strip meaningless terms
- Strip implementation details



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Organizations which design systems are constrained to produce designs which are copies of the communication structures of these organizations

Melvin Conway

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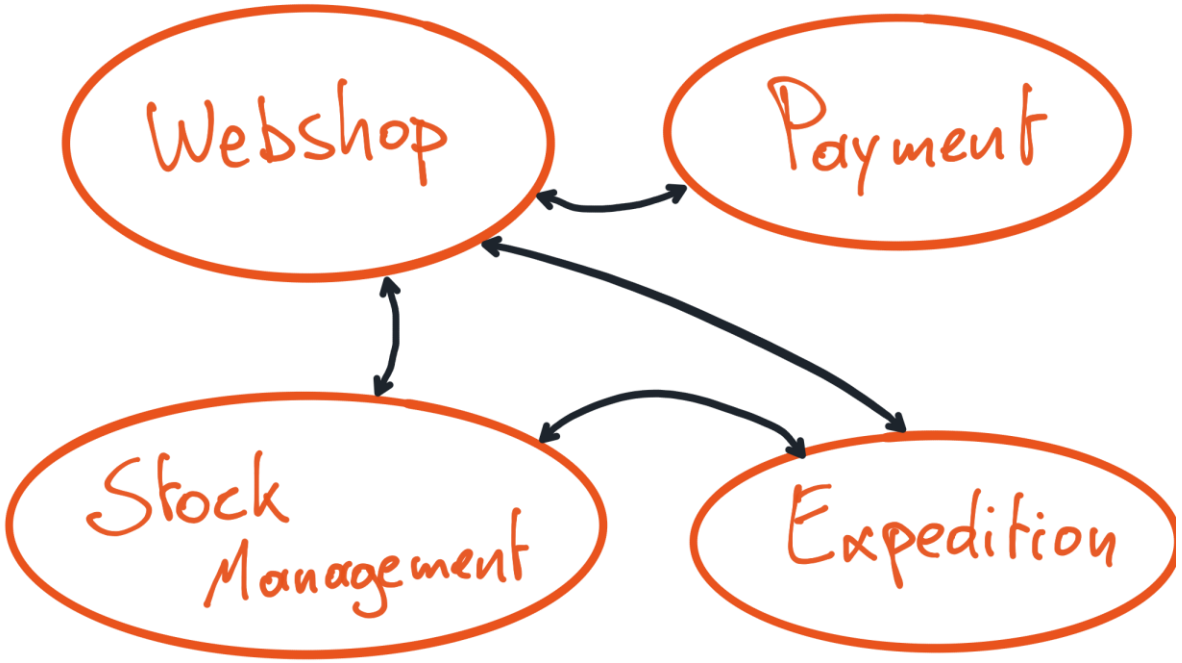
Bounded Context



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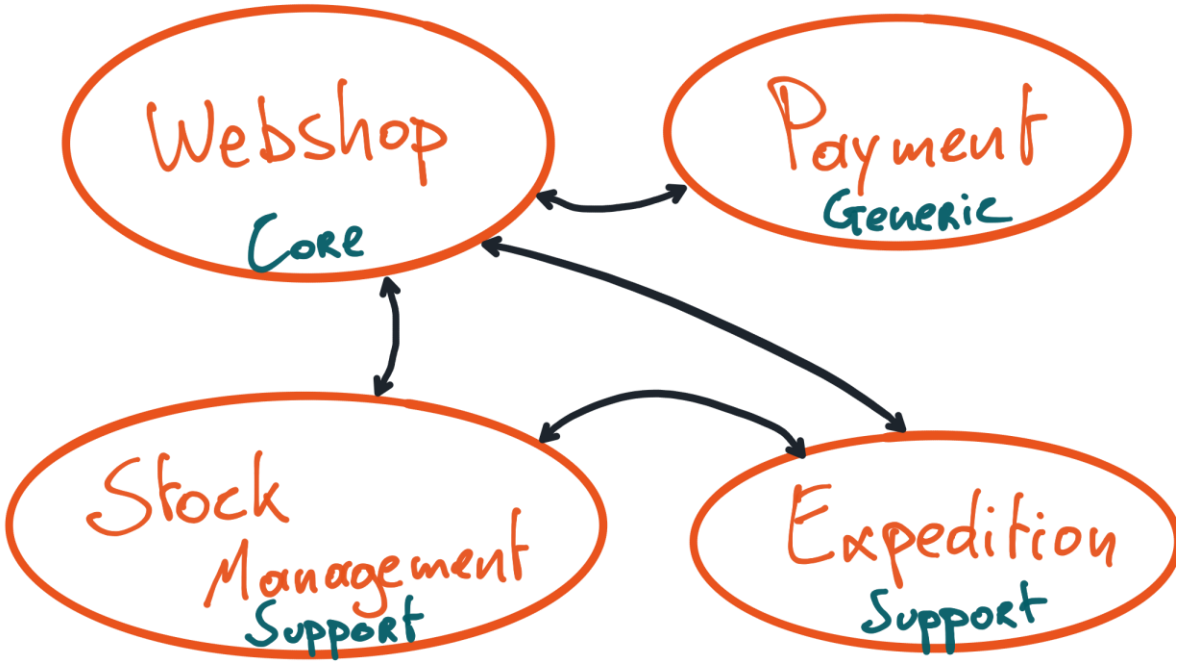
Bounded Context



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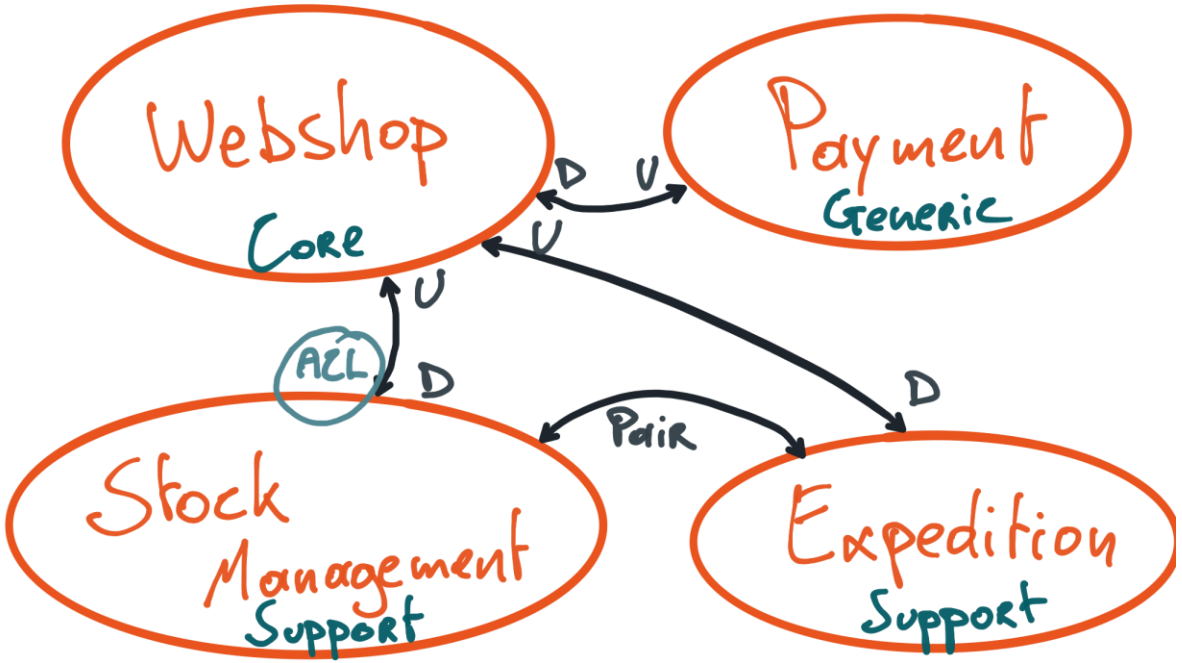
Bounded Context



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Commands & Events

Commands

- Imperative form
- Request to perform an action
- *E.g. SendBeer*

Events

- Past tense
- Communicates that an action has been performed
- *E.g. BeerReceived*

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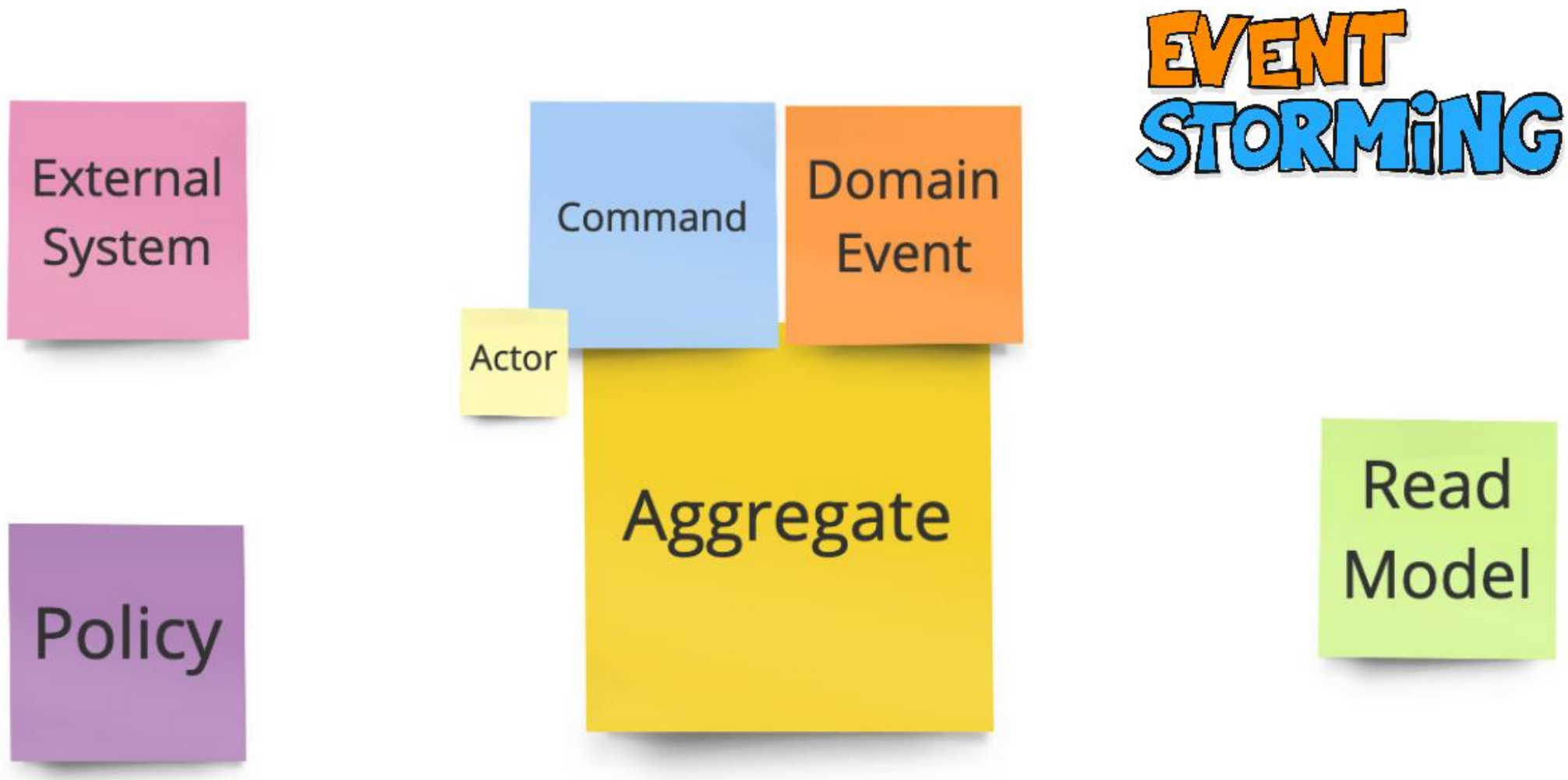
EVENT
STORMING
External System
Command
Domain Event
Actor
Aggregate
Policy
Read Model

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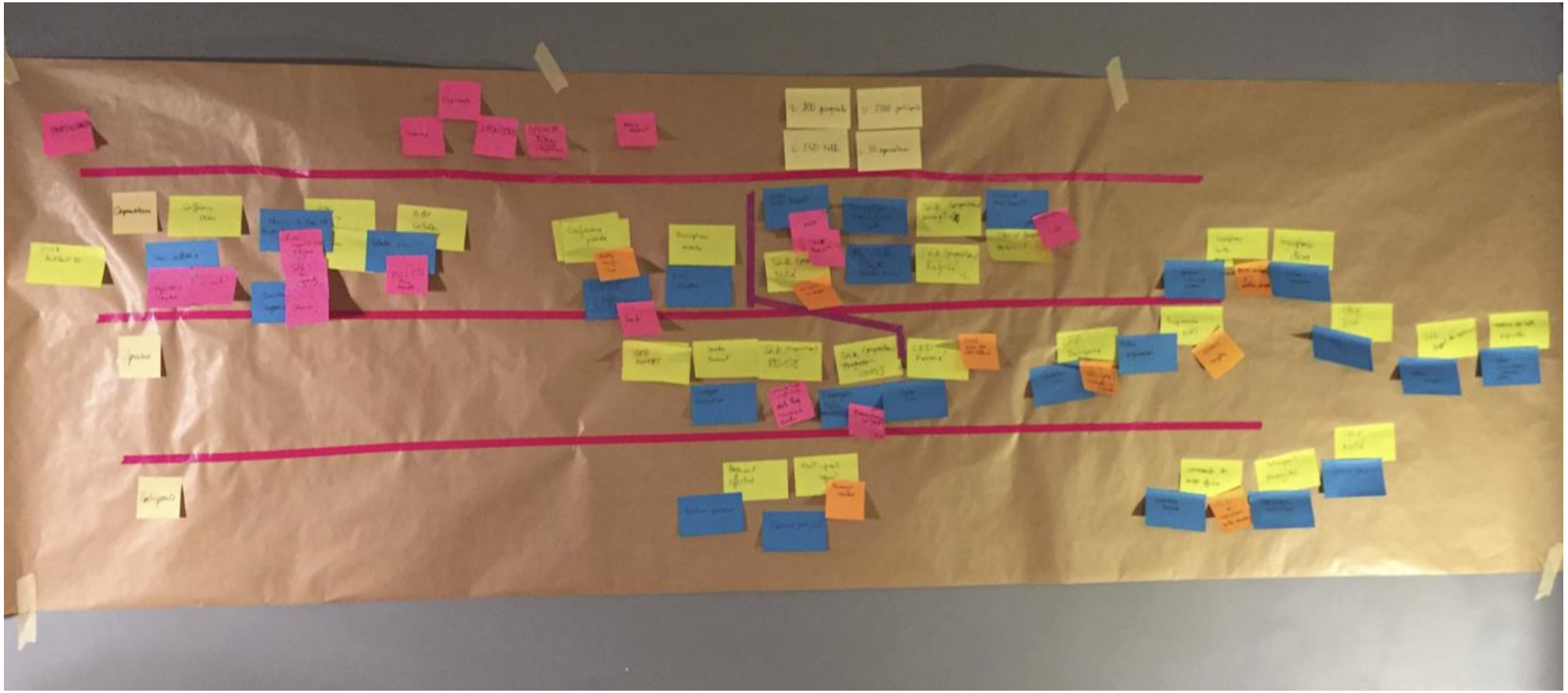
Event Storming



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Aggregate

- Handles Commands
- Raises Events
- Is the root of reasoning
- The ‘root entity’ for the aggregate is called ‘aggregate root’
- Holds all the info required to respond to Commands & Events
- Is small enough to reason about

After bounded contexts, aggregates are the hardest to define

Value Types

- Help in bringing Ubiquitous language to Code
- Make the implicit explicit
- Group logic with data
- Easier to reason about
- Easier to test

Now with C# records!

Let's start building!

tinyurl.com/ndc-oslo-2023-miro

Password: ???

tinyurl.com/ndc-oslo-2023-github

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Event Sourcing

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Keep track of our history

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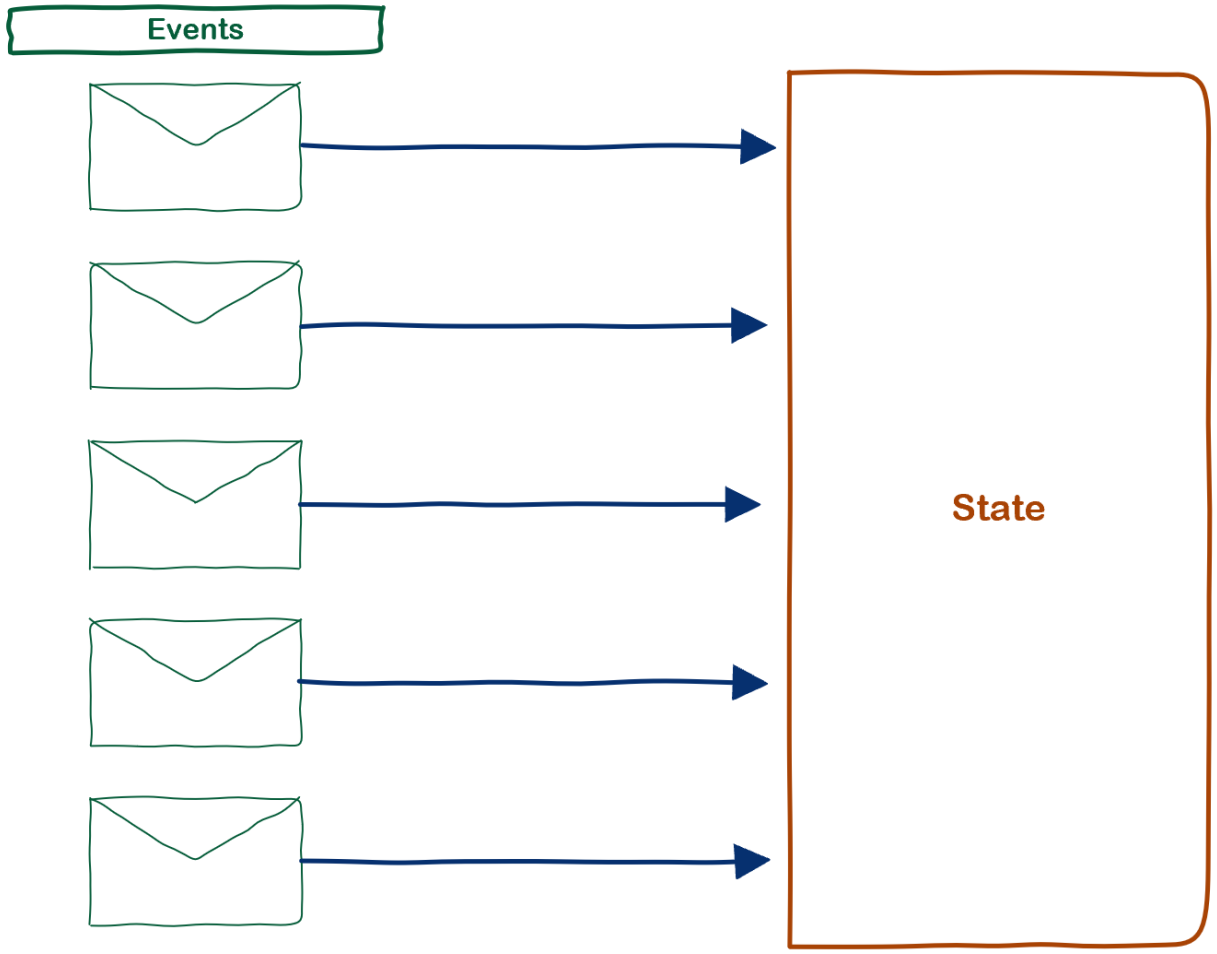
Event Sourcing



- Don't store state
- Store events
- Project state when needed

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Aggregate life cycle

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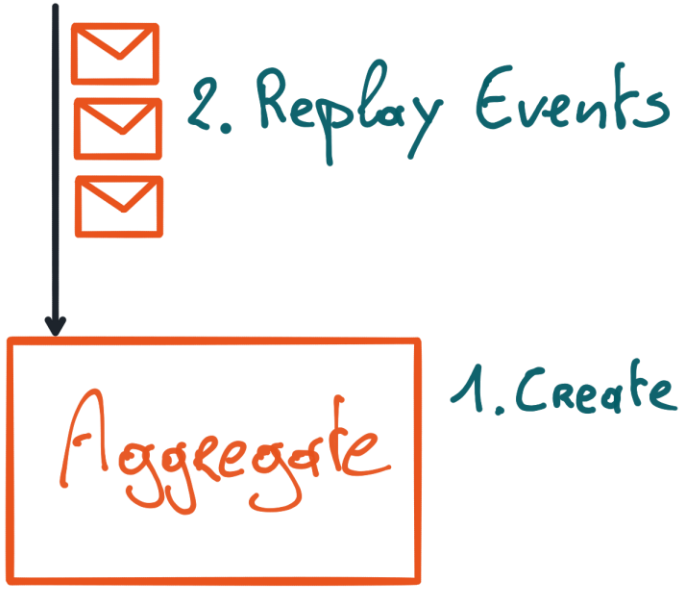
Aggregate life cycle



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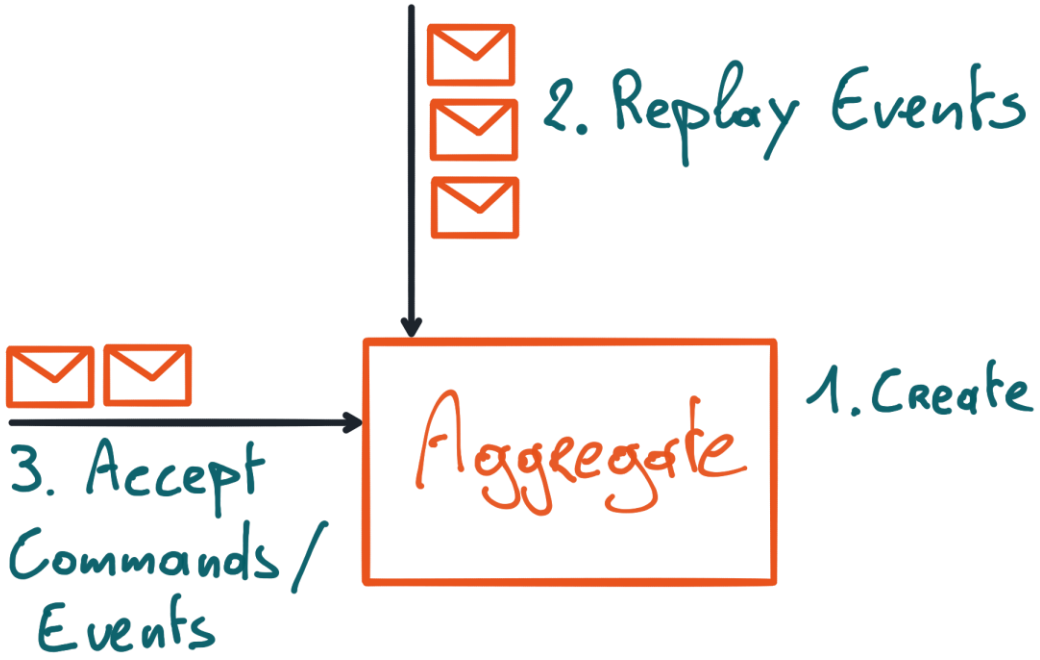
Aggregate life cycle



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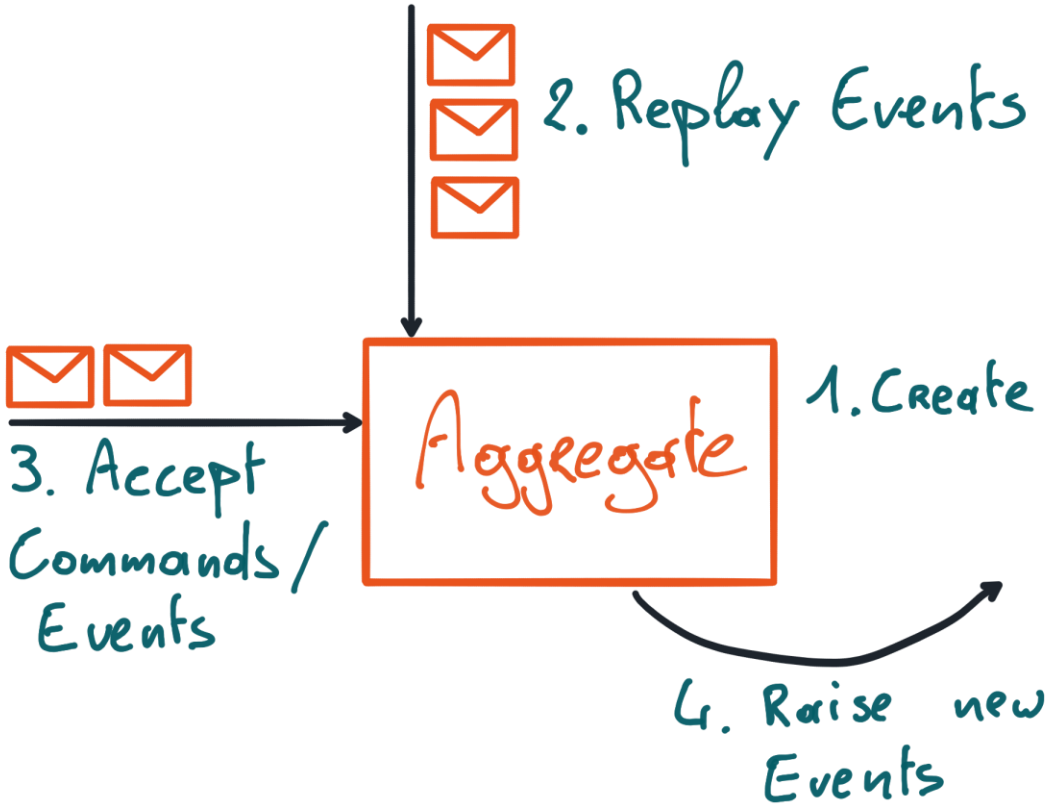
Aggregate life cycle



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CQRS

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Command – Query Responsibility Segregation

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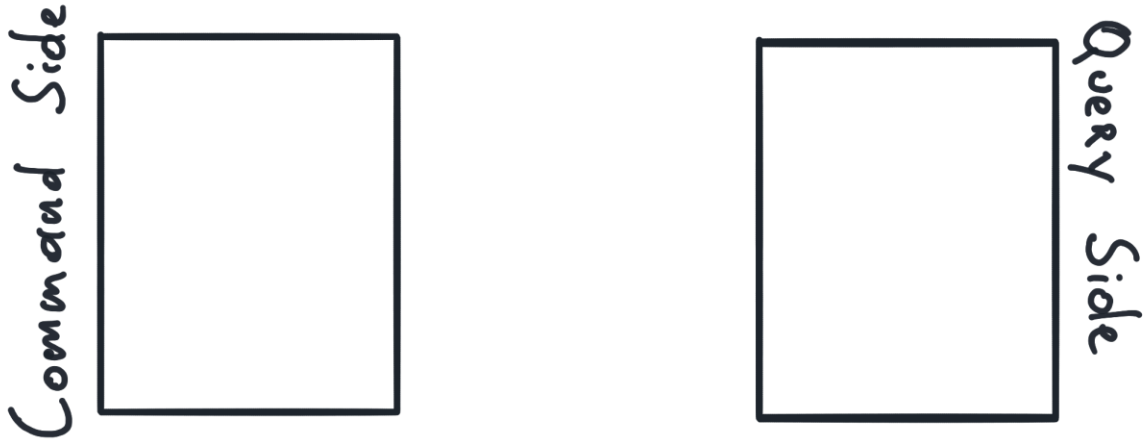
CQRS

- Separate the write from the read side
- Command side (write) responds to commands
- Query side (read) doesn't change state
- This enables:
  - Performance tuning sides separately
  - Eventual consistency
  - Keep history (when used with ES)
  - …

CQRS



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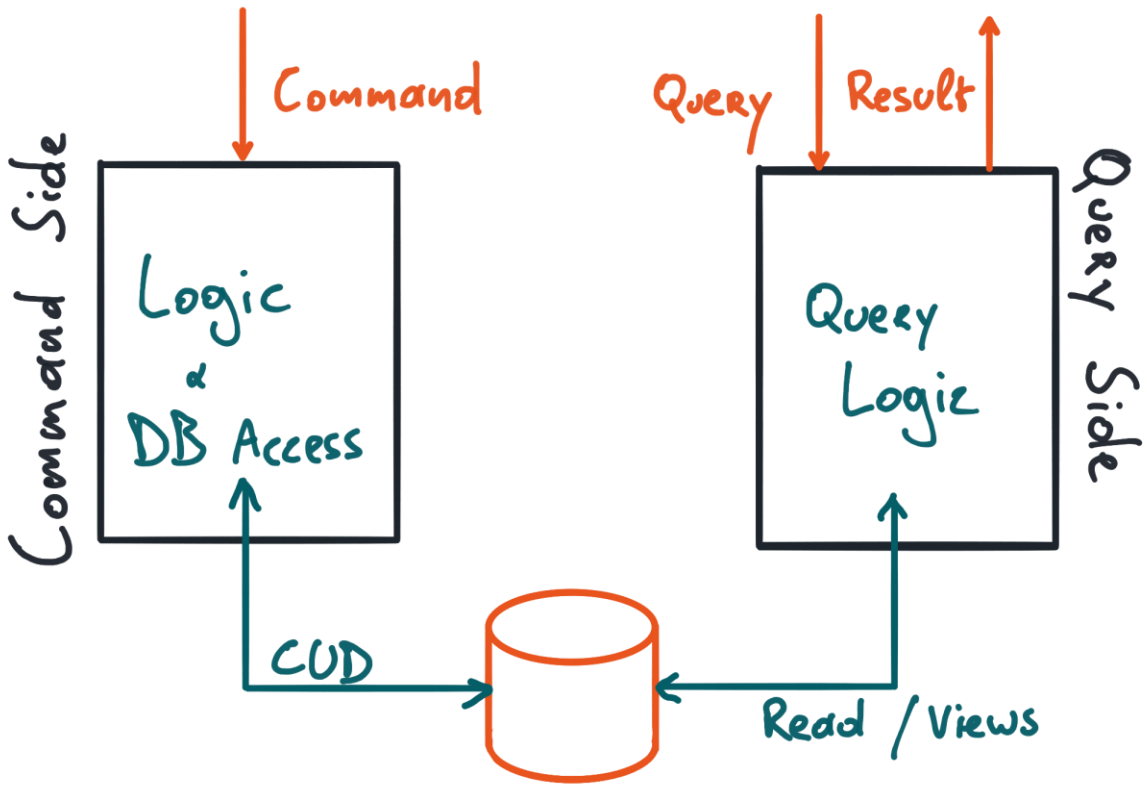
CQRS


Command
Query
Result
Command Side
Logic
&
DB Access
Query Side
Query
Logic
CUD
Read / Views

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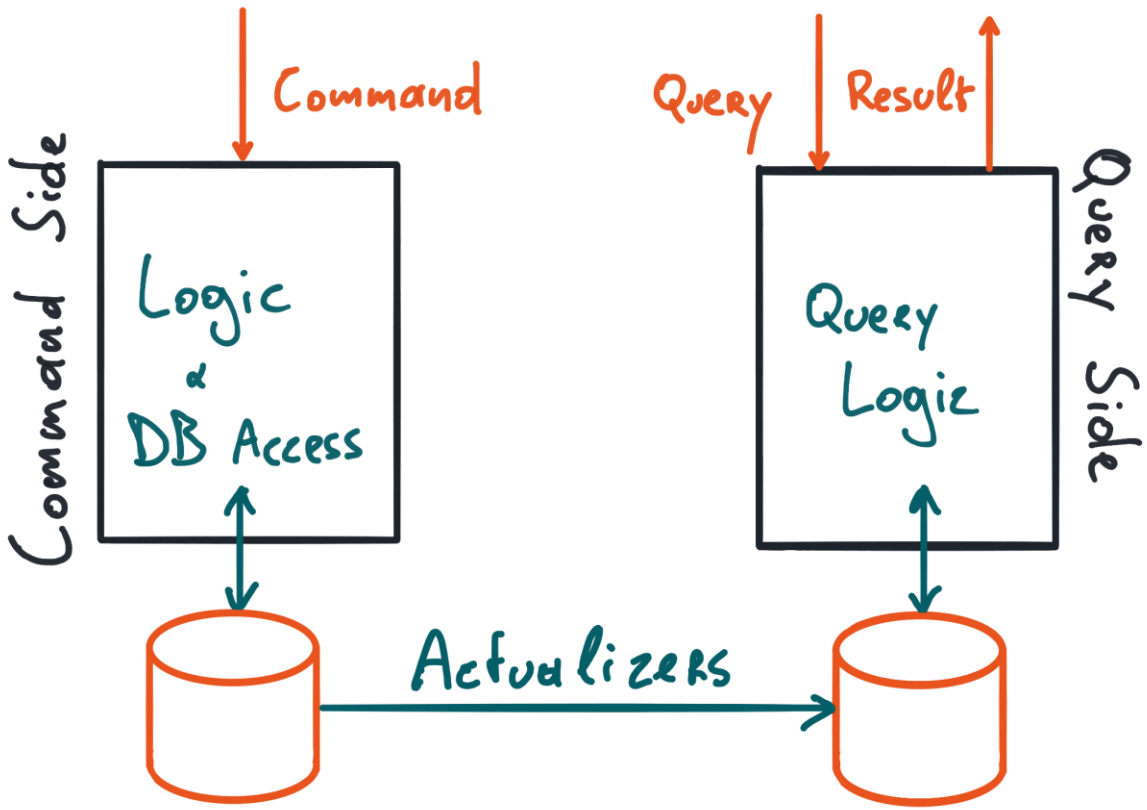
CQRS


Command
Query
Result
Command Side
Logic
&
DB Access
Query
Logic
Query Side
Actualizers

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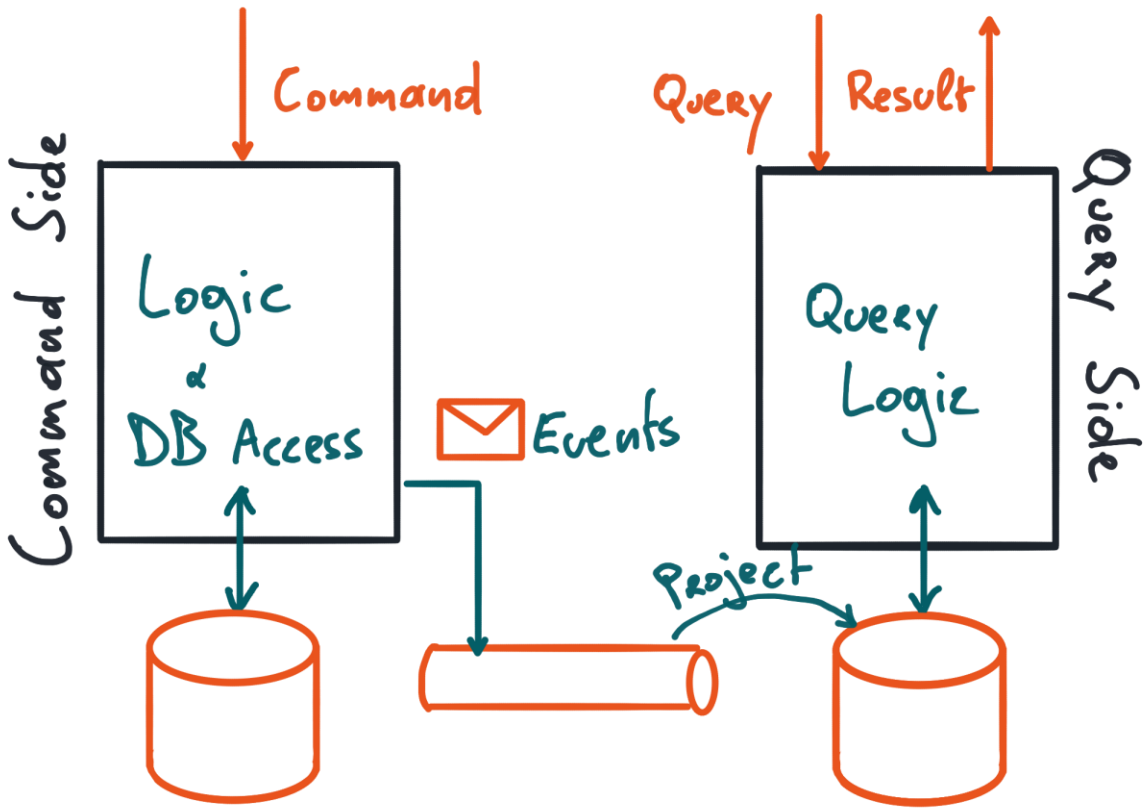
CQRS


Command
Query
Result
Command Side
Logic
&
DB Access
Events
Query
Logic
Query Side
Project

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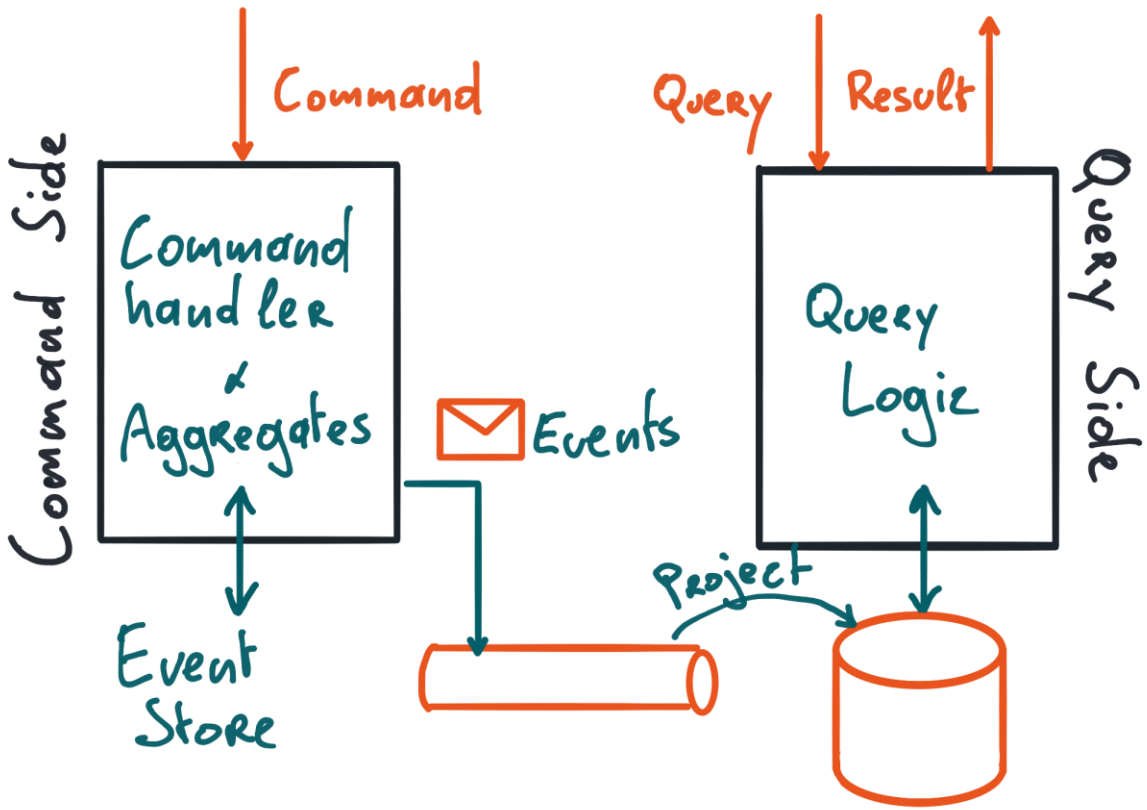
CQRS


Command
Query
Result
Command Side
Command handler & Aggregates
Events
Query Logic
Query Side
Project
Event Store

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Optimizations

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How can we optimize this system further?

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3 Types of projections

1. Immediate:
   Completes together with the Command
   Projected data is immediately available
   Slows down Commands
2. Eventual:
   Events get placed on a bus
   Projections are processed ASAP
   Slows down the availability
   Speeds up Commands
3. From source events:
   Queries are projected as required
   No unnecessary processing
   Might be slower with many source events

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Caching Aggregates

Keeping aggregates in memory

=

lightning fast command processing

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Snapshots

When aggregates get MANY events:

- Group the aggregate's state in a state object
- Save state sporadically
- Replay events from snapshot moment

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Query indexing & caching

Step 1:

- Every query hits an index
- Every query hits a single table (ideally)

Step 2:

- API output caching