Designing

Events First

Microservices

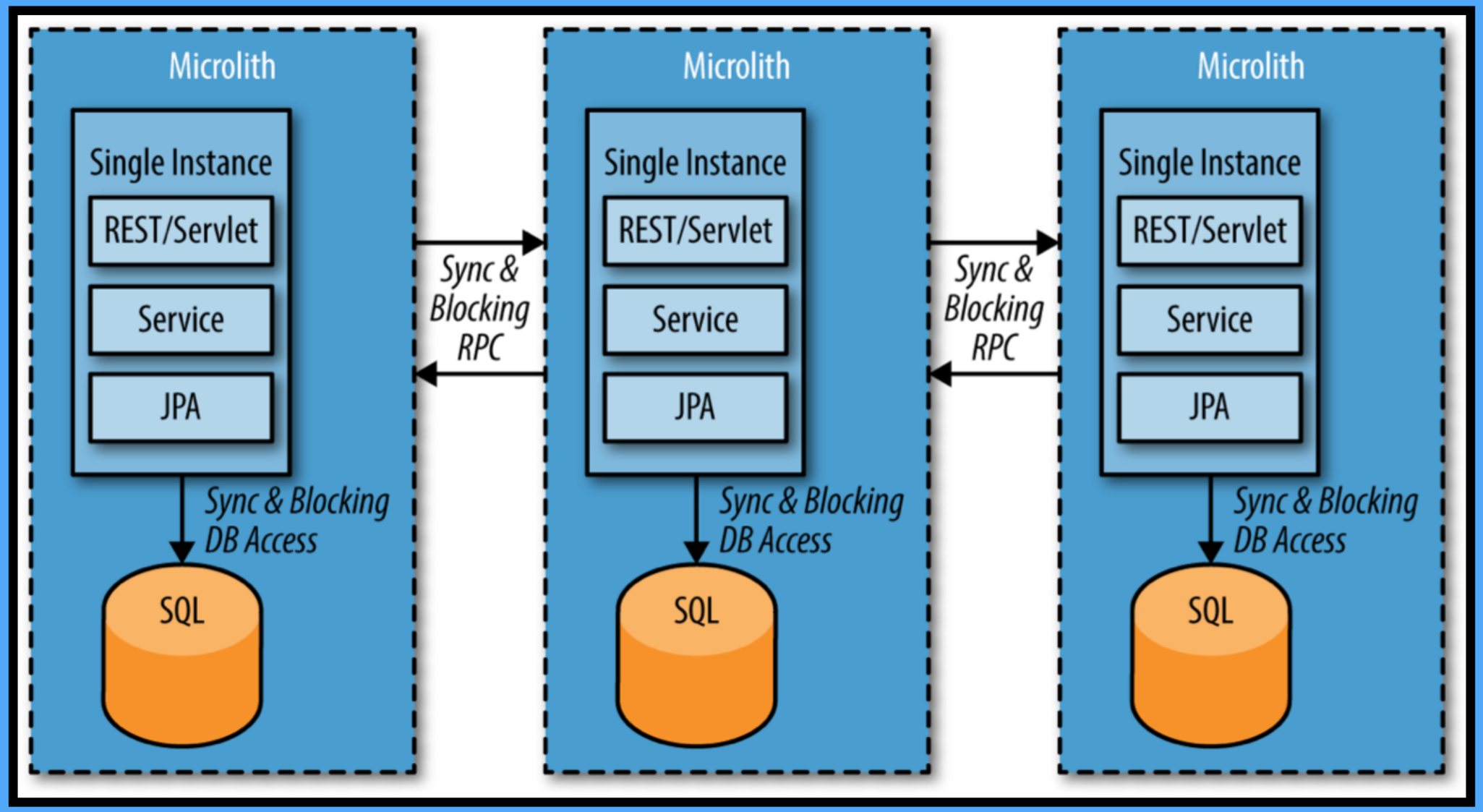
Jonas Bonér

@jboner

SO, YOU WANT TO DO MICROSERVICES?

MAKE SURE YOU DON'T END UP WITH

MICROLITHS



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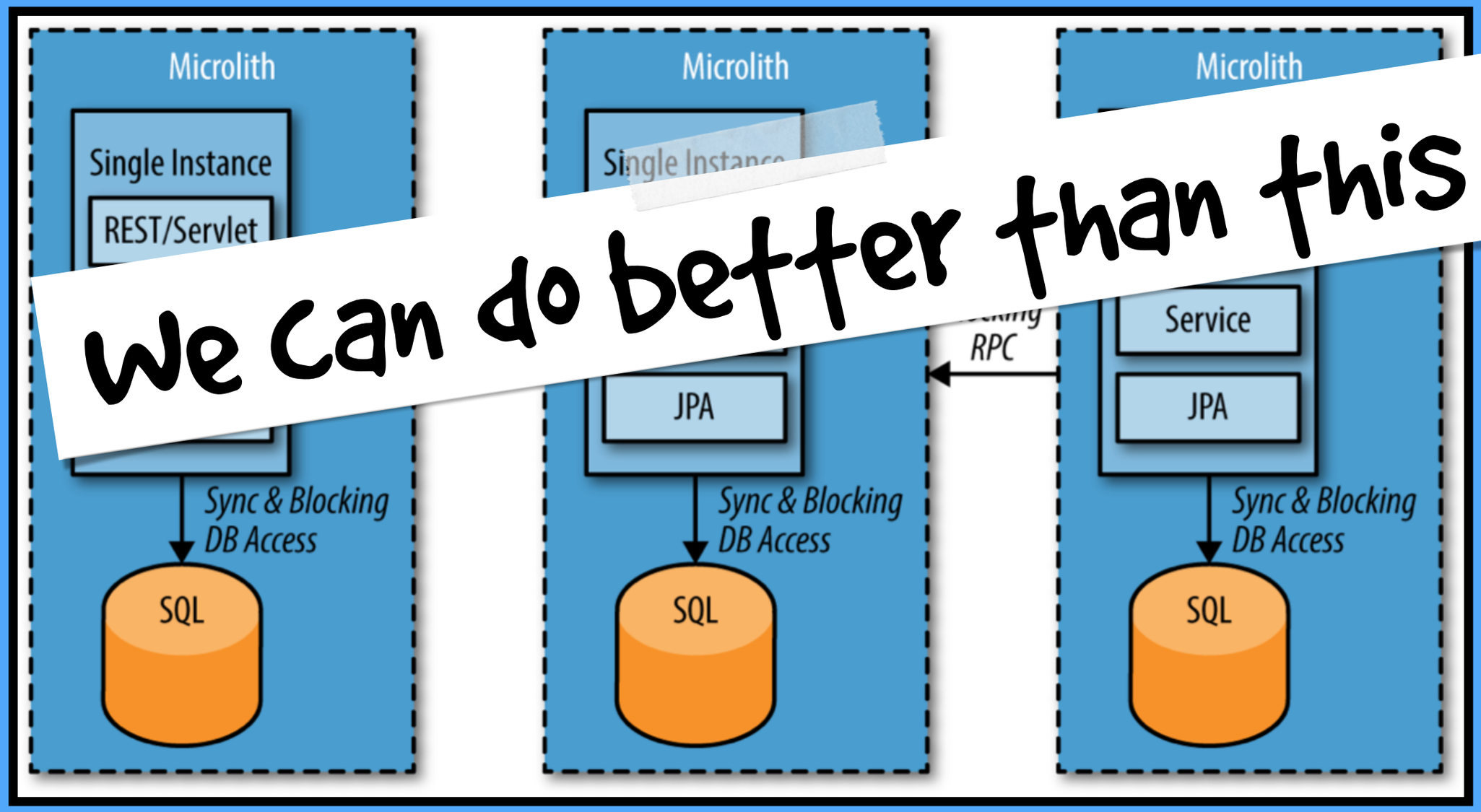

Events First Domain Driven Design

“When you start modeling events, it forces you to think about the behaviour of the system. As opposed to thinking about the structure of the system.”

- GREG YOUNG

A Decade of DDD, CQRS, Event Sourcing, Greg Young (Presentation from 2016)

✳ DON'T FOCUS ON THE THINGS

The Nouns

The Domain Objects

✳ DON'T FOCUS ON THE THINGS

The Nouns

The Domain Objects

✳ FOCUS ON WHAT HAPPENS

The Verbs

The Events

WHAT IS AN EVENT?

The Nature of Events

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- Events represent FACTS OF INFORMATION
  - ➡ FACTS ARE IMMUTABLE
  - ➡ FACTS ACCRUE - KNOWLEDGE CAN ONLY GROW

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- Events/Facts (new) CAN INVALIDATE existing Facts

Mine the Facts

Event Storming

Event Driven Design

Event Driven Design

- INTENTS
  - Communication
  - Conversations
  - Expectations
  - Contracts
  - Control Transfer

Event Driven Design

✶ INTENTS

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- ➡ Conversations
- ➡ Expectations
- ➡ Contracts
- ➡ Control Transfer

✶ FACTS

- ➡ State
- ➡ History
- ➡ Causality
- ➡ Notifications
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Event Driven Design

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Events

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  - ➡ **IMPERATIVE:** `CreateOrder`, `ShipProduct`

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  - ➡ **IMPERATIVE:** `CreateOrder`, `ShipProduct`
- **REACTIONS**
  - ➡ Represents **SIDE-EFFECTS**
- **EVENTS**
  - ➡ Represents something that **HAS HAPPENED**
  - ➡ **PAST-TENSE:** `OrderCreated`, `ProductShipped`

COMMANDS vs EVENTS

COMMANDS vs EVENTS

1. All about intent

1. Intentless

COMMANDS vs EVENTS

1. All about intent
2. Directed

1. Intentless
2. Anonymous

COMMANDS vs EVENTS

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3. Single addressable destination

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6. Command & Control

1. Intentless
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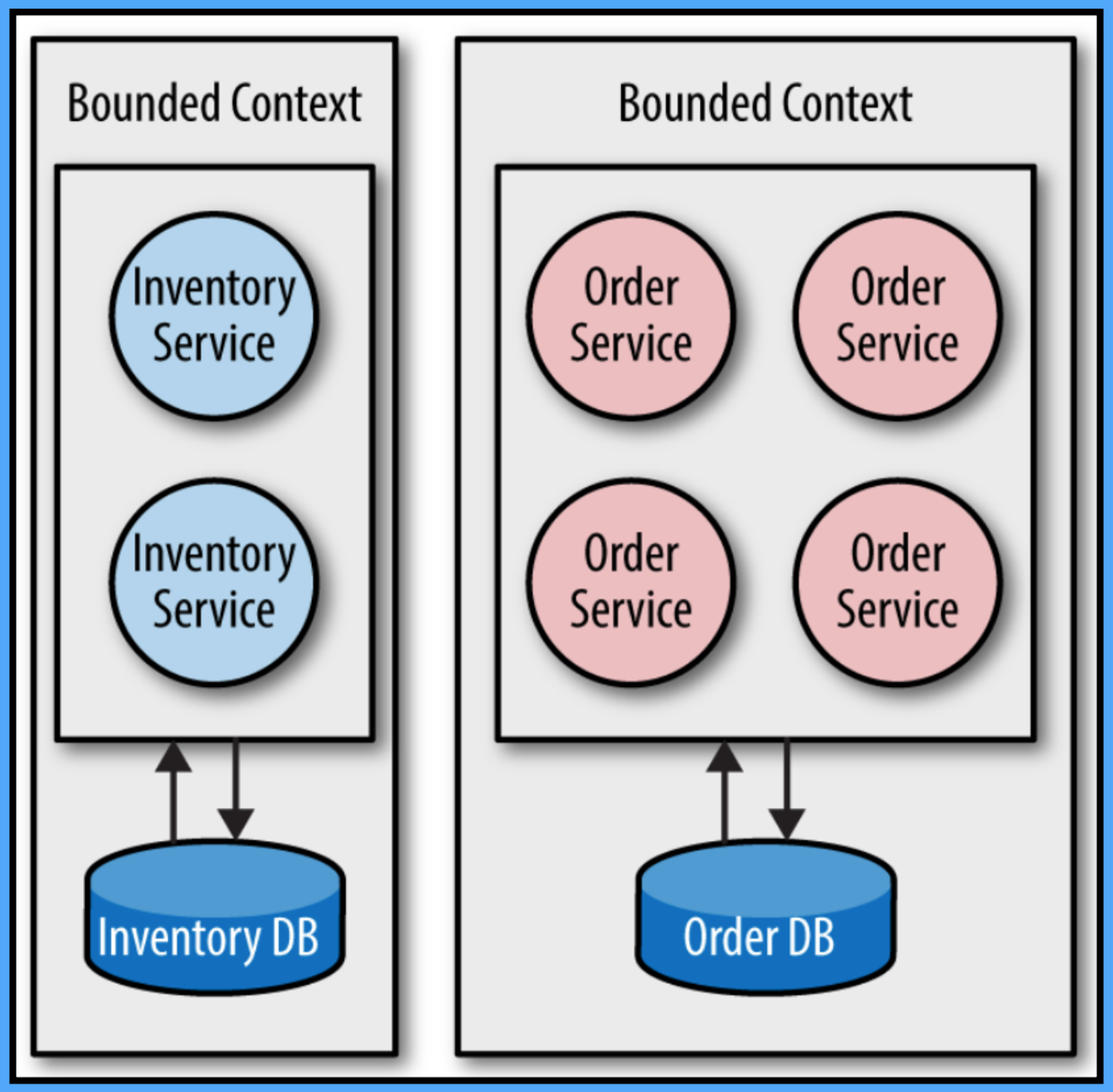
5. Local focus
6. Autonomy

Let the Events Define the Bounded Context



Event Driven Services

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   TO FACTS* that are coming its way

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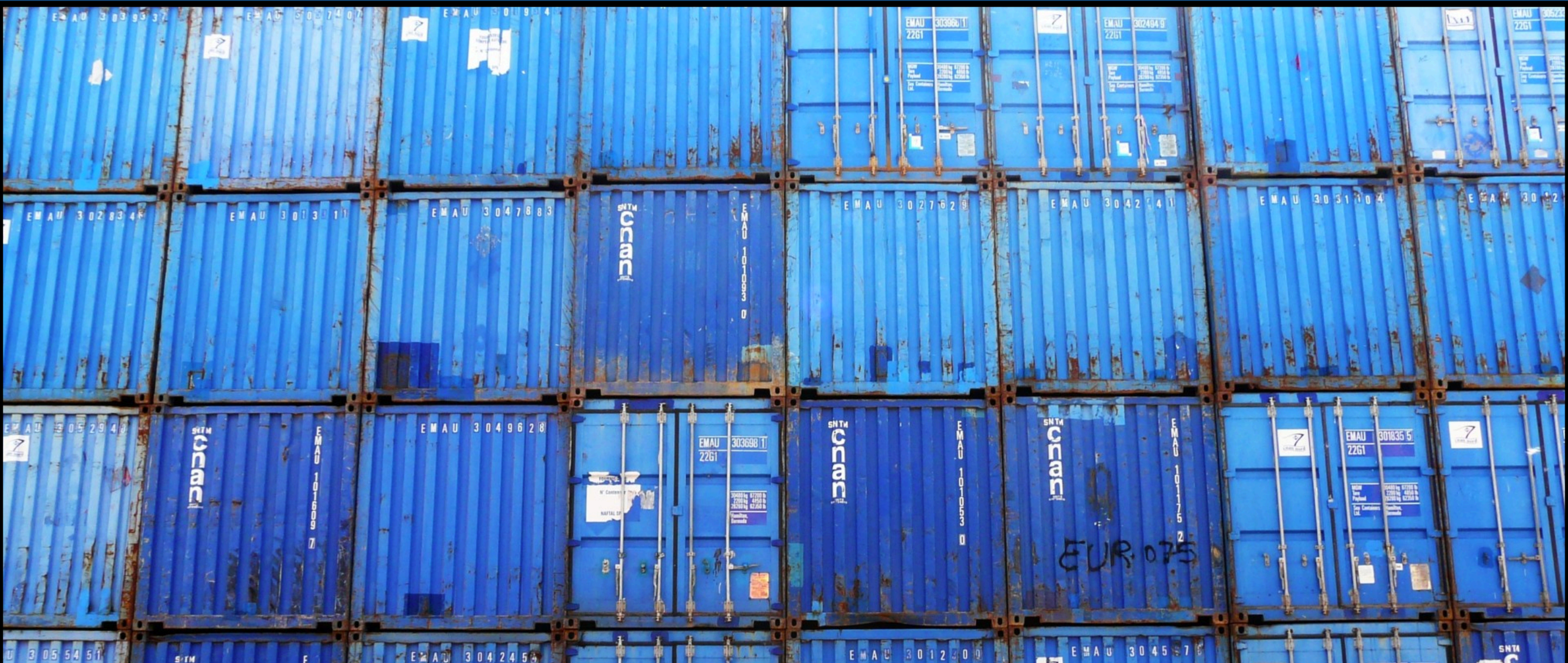
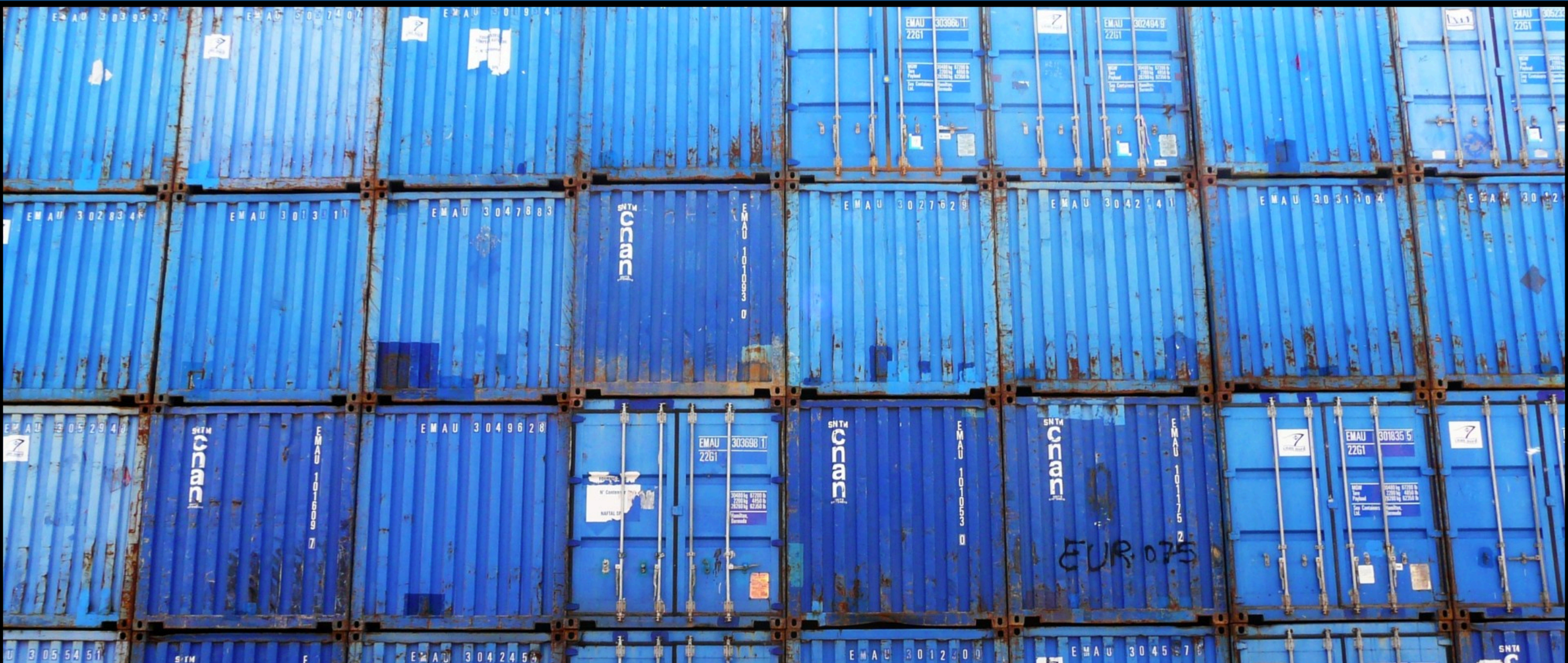
*Facts == Immutable Events

Mutable State Is Fine But Needs To Be Contained And Non Observable



Publish Facts
To Outside World

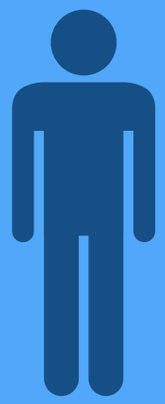


The Aggregate

- Maintains INTEGRITY & CONSISTENCY
- Is our UNIT OF CONSISTENCY
- Is our UNIT OF FAILURE
- Is our UNIT OF DETERMINISM
- Is fully AUTONOMOUS

Event Driven Services

Event Driven
Services



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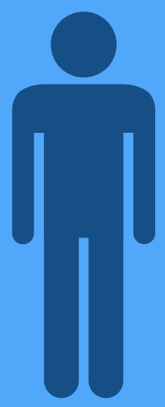

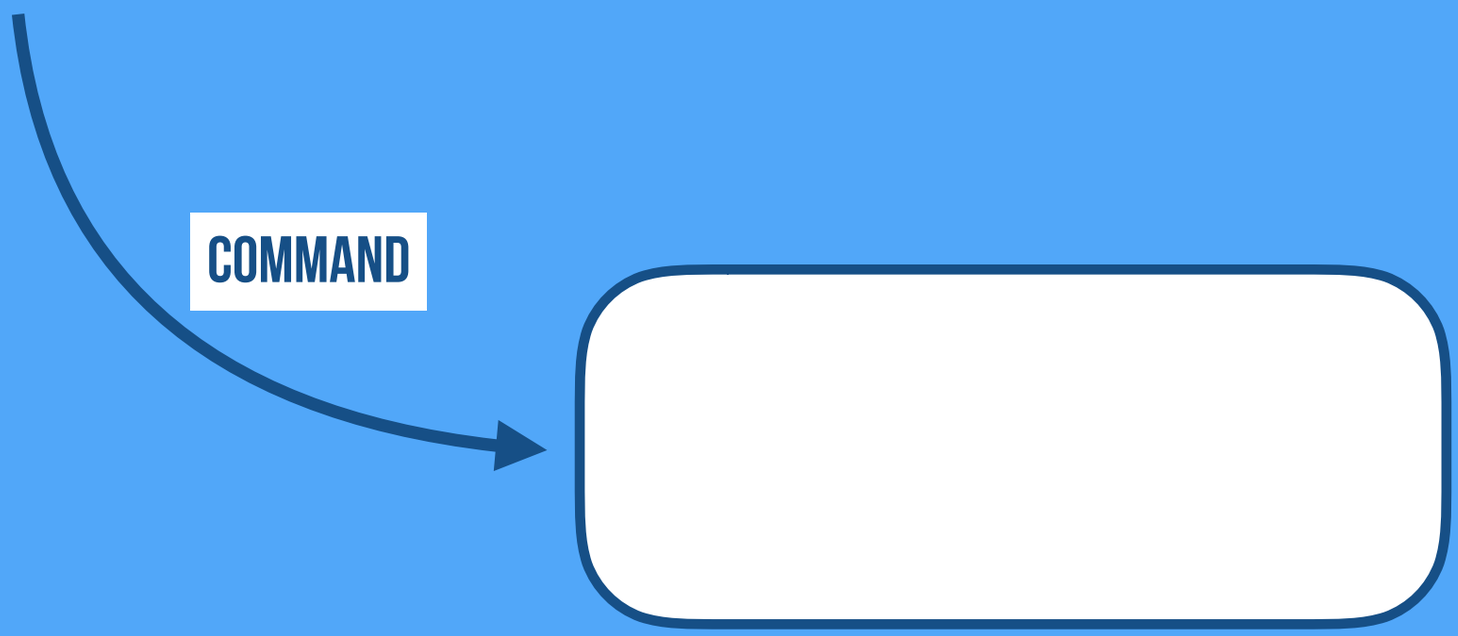

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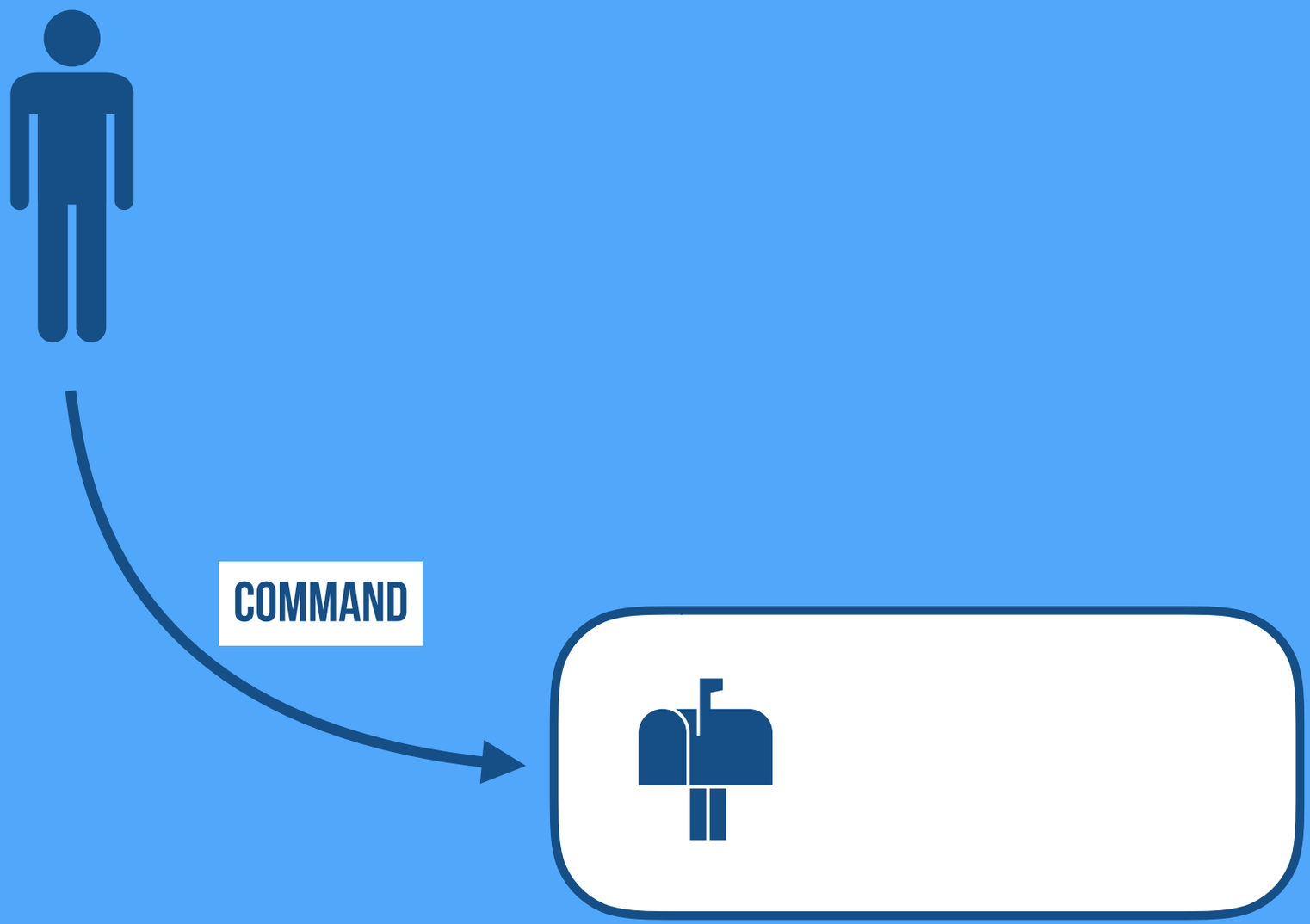

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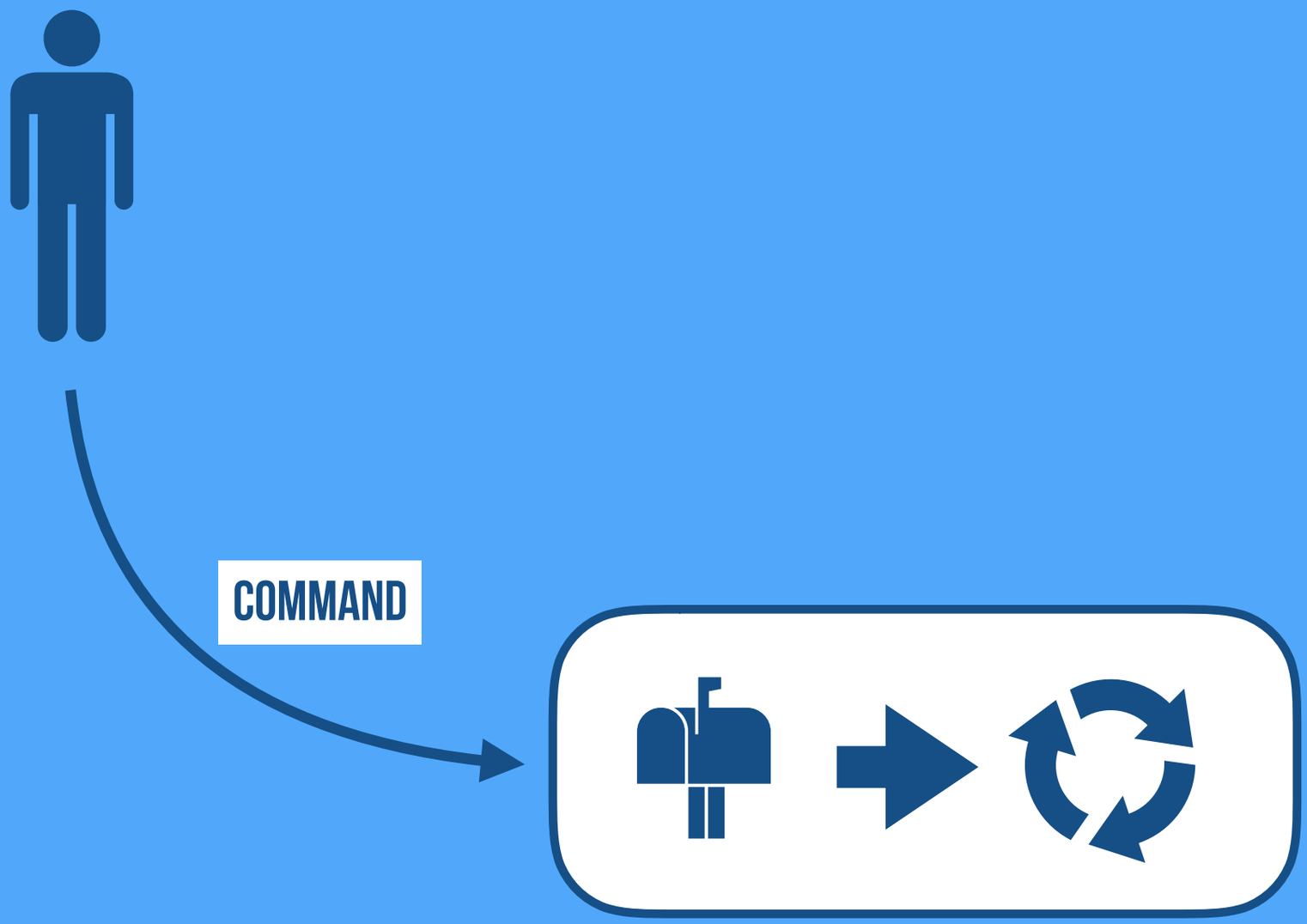

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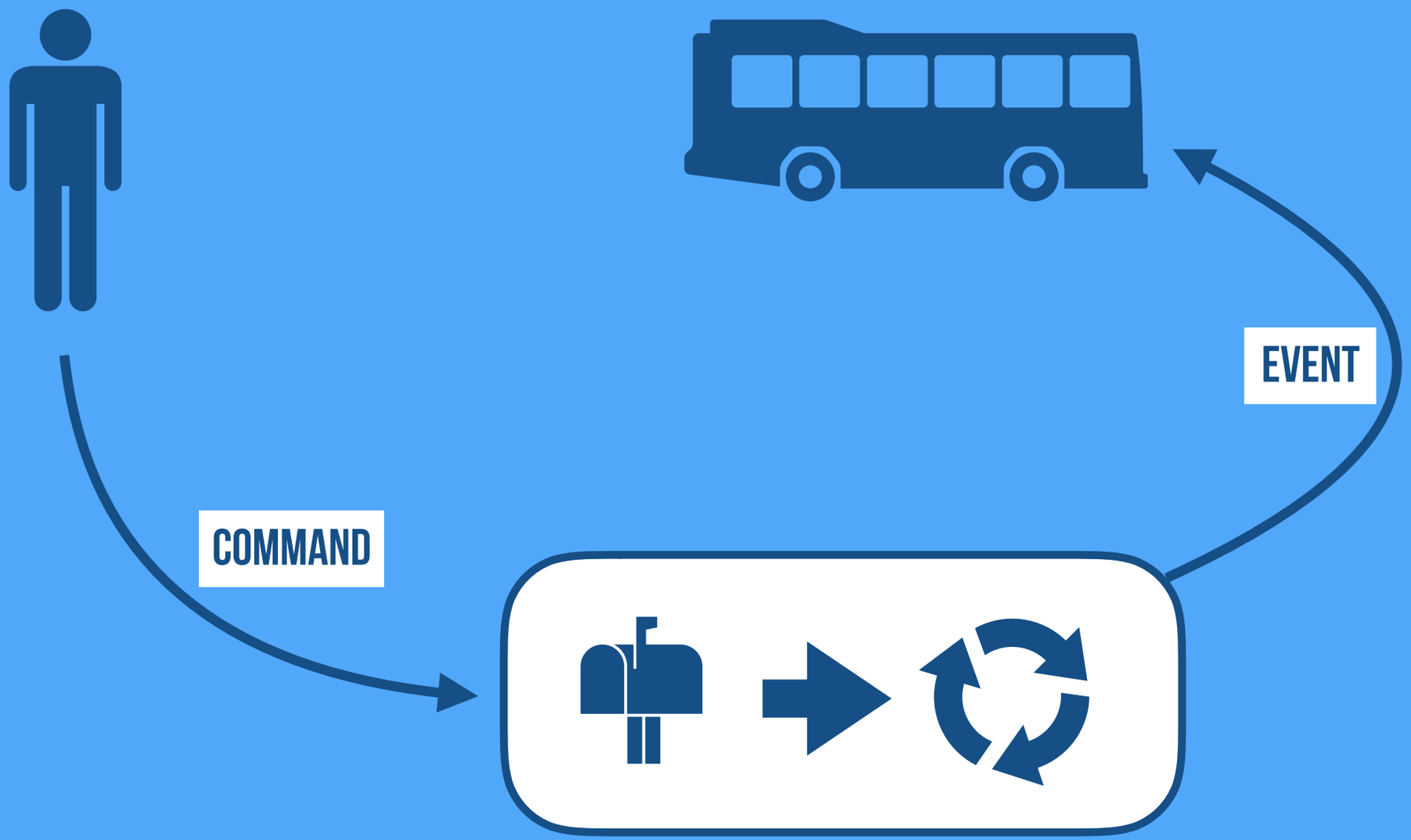


Event Driven Services

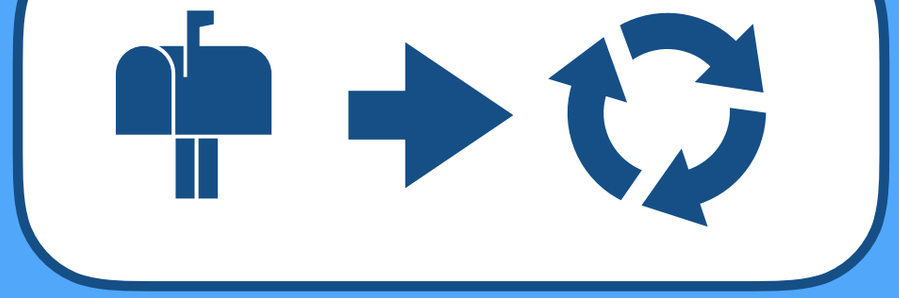
EVENT

EVENT STREAM

EVENT

EVENT

COMMAND



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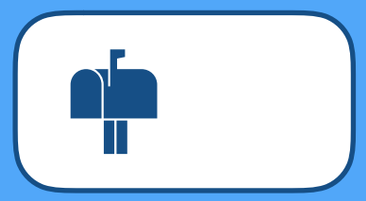

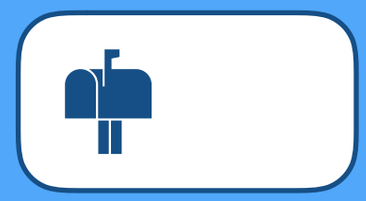

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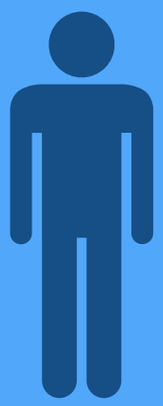

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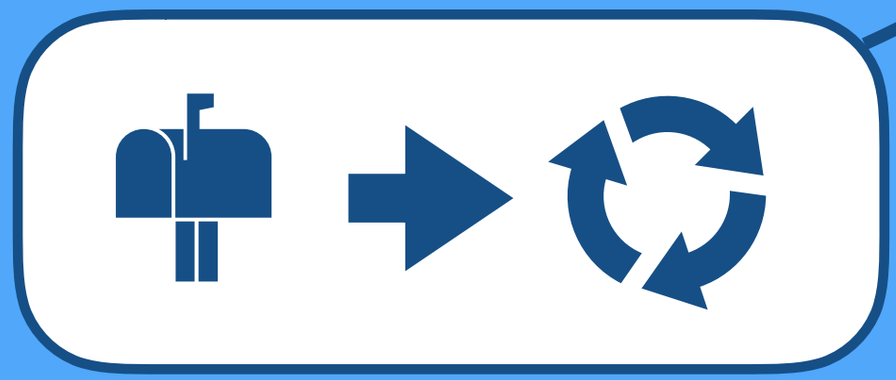

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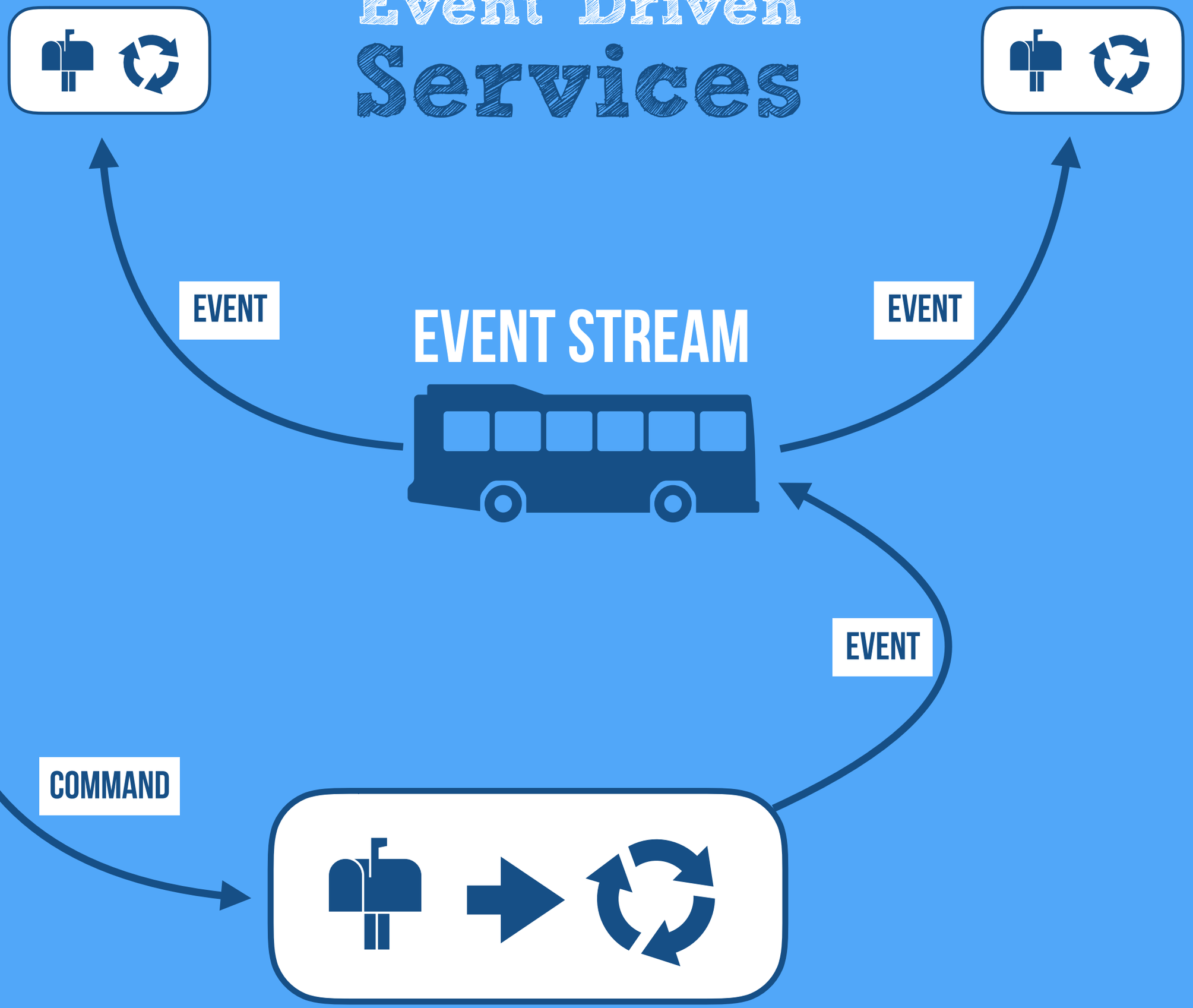

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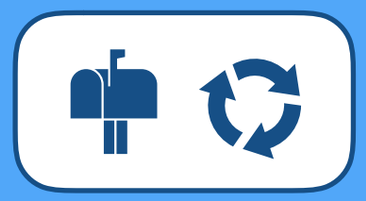

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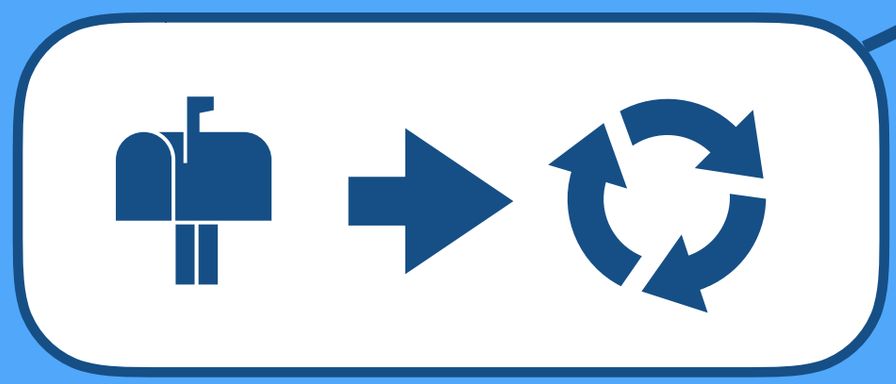

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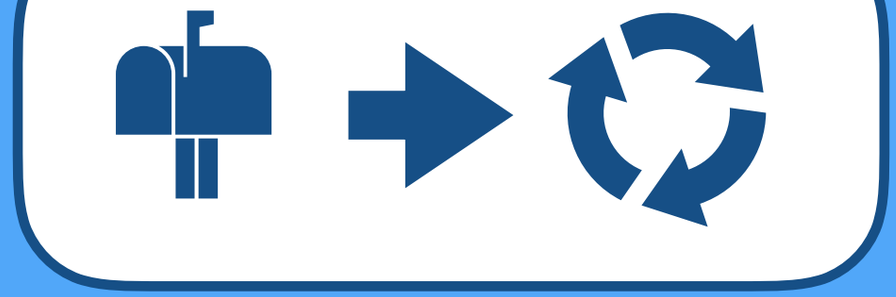

Event Driven Services

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EVENT STREAM

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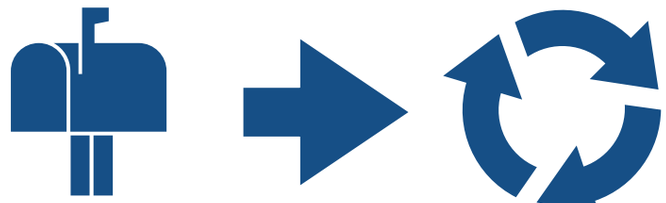
EVENTUAL CONSISTENCY

EVENT

COMMAND



USE THE

Event Stream

USE THE

Event

Stream

AS THE COMMUNICATION FABRIC

USE THE

Event Stream

USE THE

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Stream

AS THE INTEGRATION FABRIC

USE THE

Event Stream

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AS THE REPLICATION FABRIC

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AS THE CONSENSUS FABRIC

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AS THE PERSISTENCE FABRIC

The Problem With CRUD Services

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The Problem With CRUD Services

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- But, CROSS CRUD services CONSISTENCY
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  - ➡ Has AD-HOC & WEAK GUARANTEES

“Two-phase commit is the anti-availability protocol.”

- PAT HELLAND

STRONG Consistency

IS THE WRONG DEFAULT IN DISTRIBUTED SYSTEMS

consistency

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IN DISTRIBUTED SYSTEMS

WE HAVE TO RELY ON

Eventual Consistency

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Eventual Consistency

BUT RELAX—IT'S HOW THE WORLD WORKS

WE NEED TO

Embrace

Reality

WE NEED TO

Embrace

Reality

NOT FIGHT IT

Information Has Latency

Information Is Always From the Past

Welcome To The Wild Ocean Of

Non Determinism

Distributed Systems

We Need To Model Uncertainty

"In a system which cannot count on distributed transactions, the management of uncertainty must be implemented in the business logic."

- PAT HELLAND

Life Beyond Distributed Transactions, Pat Helland (2007)

Events Can Lead To Greater Certainty

“An autonomus component can only promise its own behavior.”

“Autonomy makes information local, leading to greater certainty and stability.”

- MARK BURGESS

In Search of Certainty, Thinking in Promises - Mark Burgess

Events Can Help Us Craft Autonomous Islands Of Determinism












Inside Data

OUR CURRENT PRESENT ⇨ STATE

Inside Data

OUR CURRENT PRESENT ⇨ STATE

Outside Data

BLAST FROM THE PAST ⇨ EVENTS/FACTS

Inside Data

OUR CURRENT PRESENT ⇨ STATE

Outside Data

BLAST FROM THE PAST ⇨ EVENTS/FACTS

Between Services

HOPE FOR THE FUTURE ⇨ COMMANDS

A system of microservices is a never ending stream towards convergence

A system of microservices is a
never ending stream towards convergence

Resilience is by Design

Photo courtesy of FEMA/Joselyne Augustino

EVENTS CAN HELP US

Manage Failure

INSTEAD OF TRYING TO AVOID IT

REQUIREMENTS FOR A

Sane Failure Model

FAILURES NEED TO BE

1. CONTAINED—AVOID CASCADING FAILURES
2. REIFIED—AS EVENTS
3. SIGNALLED—ASYNCHRONOUSLY
4. OBSERVED—BY 1-N
5. MANAGED—OUTSIDE FAILED CONTEXT

Event Based Persistence

You can use CRUD

Together with EVENT STREAMS

To get an internally consistent MATERIALIZED VIEW

You can use CRUD

Together with EVENT STREAMS

To get an internally consistent MATERIALIZED VIEW

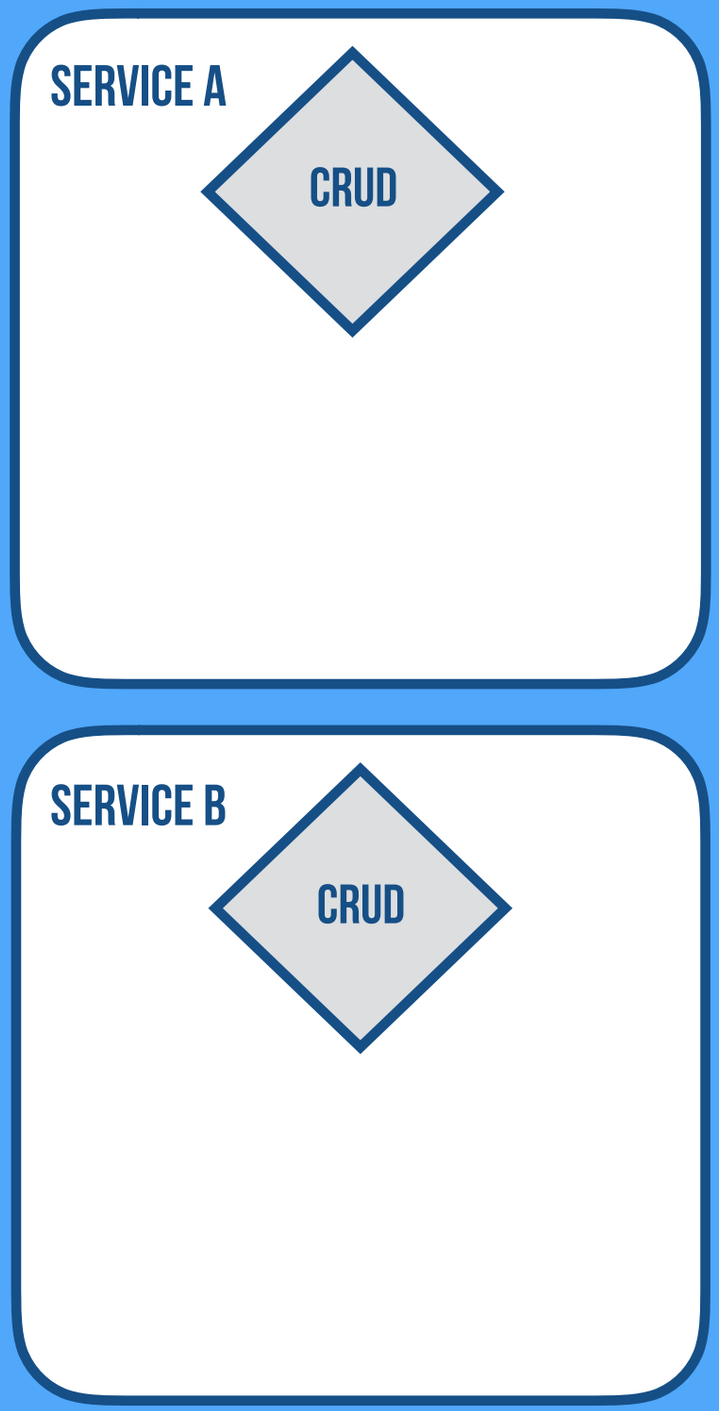
SERVICE A

SERVICE B

You can use CRUD

Together with EVENT STREAMS

To get an internally consistent MATERIALIZED VIEW



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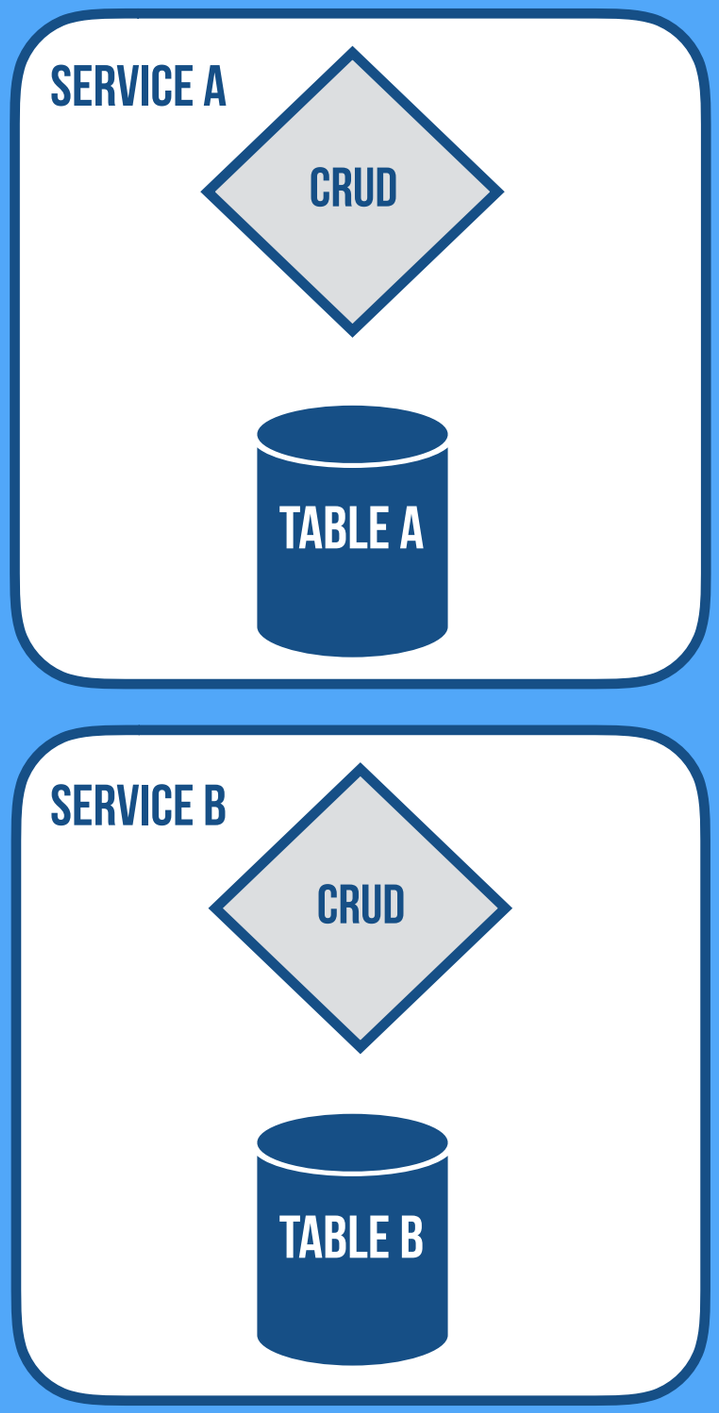

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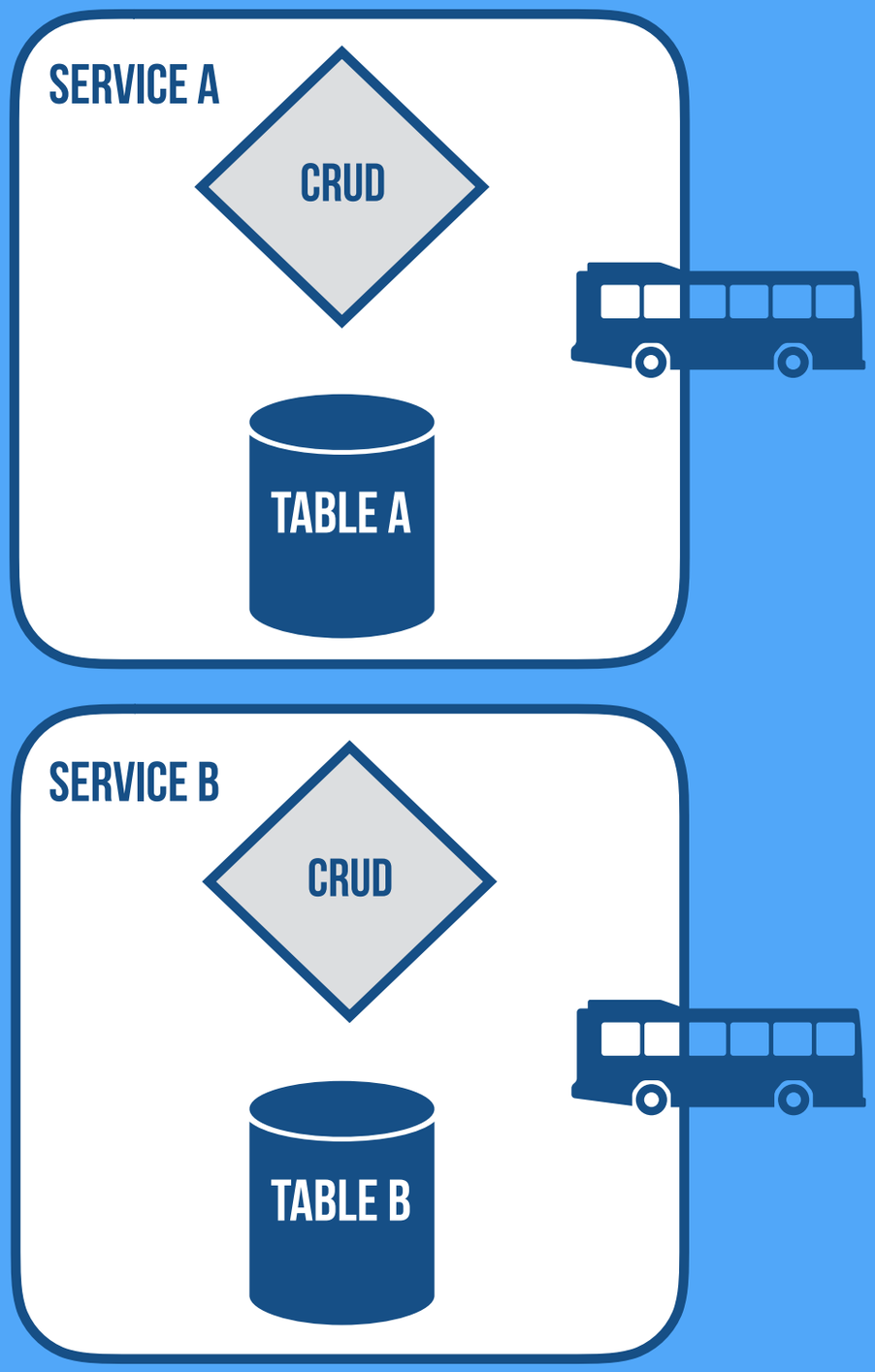

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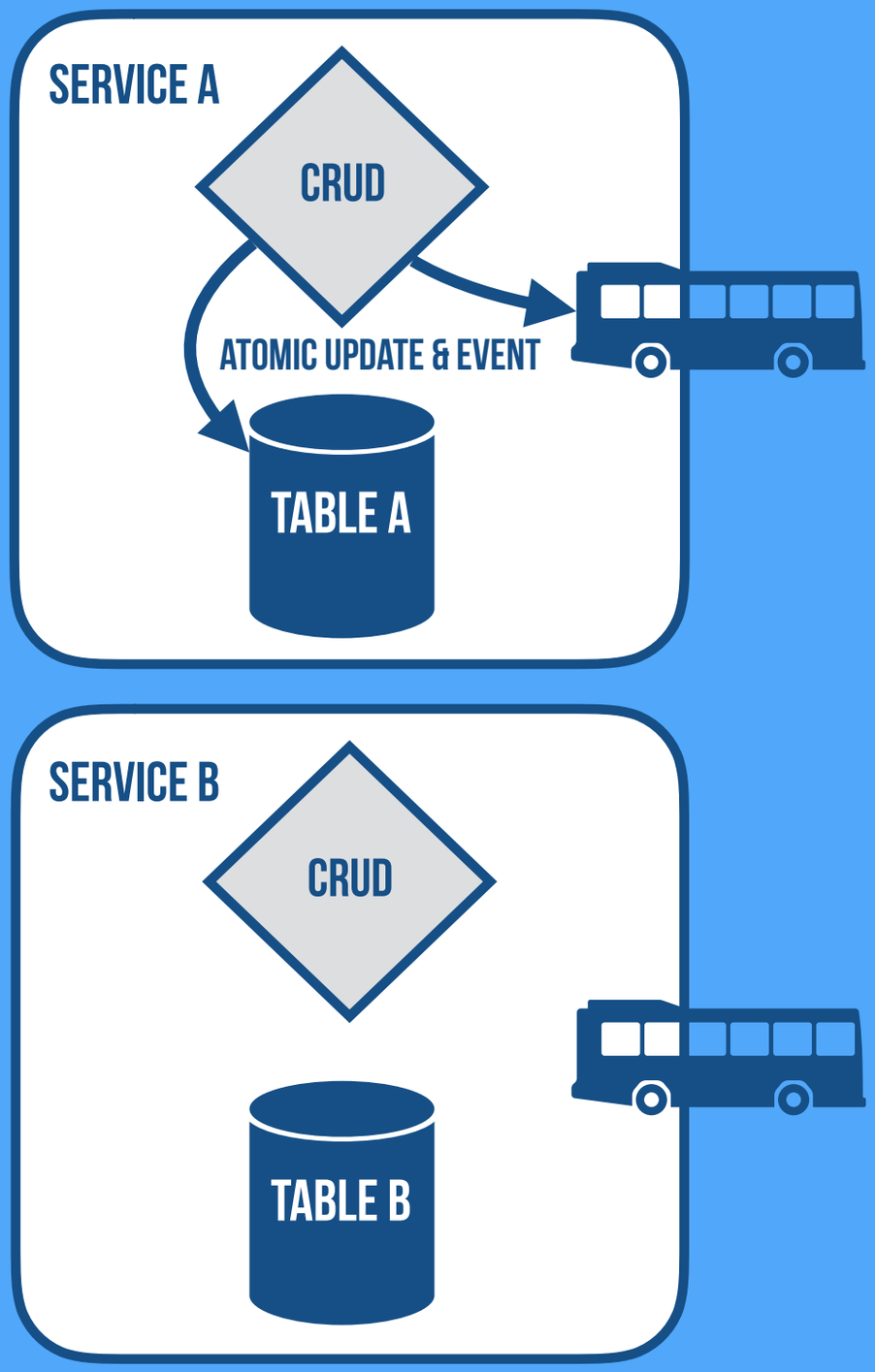

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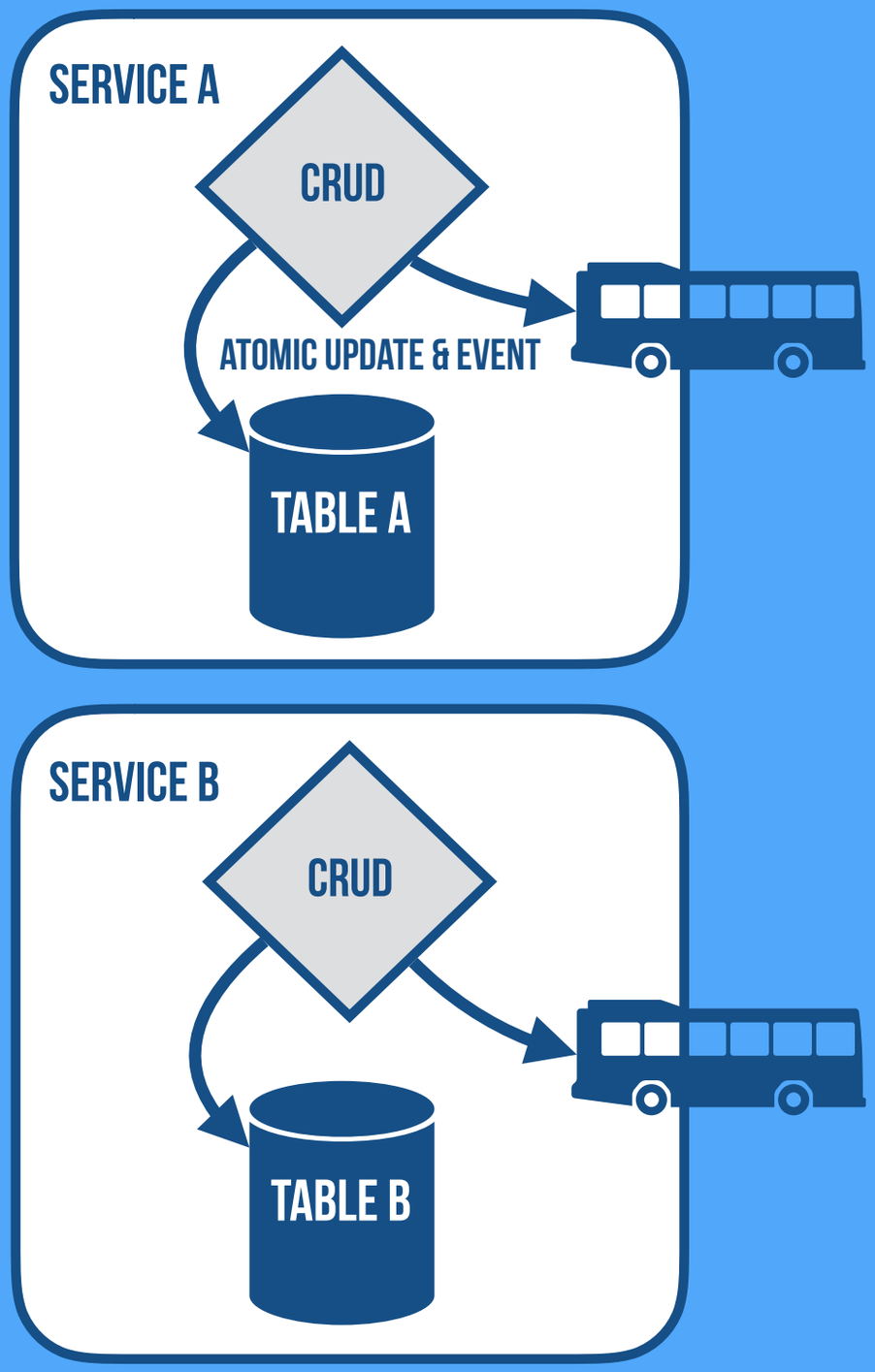

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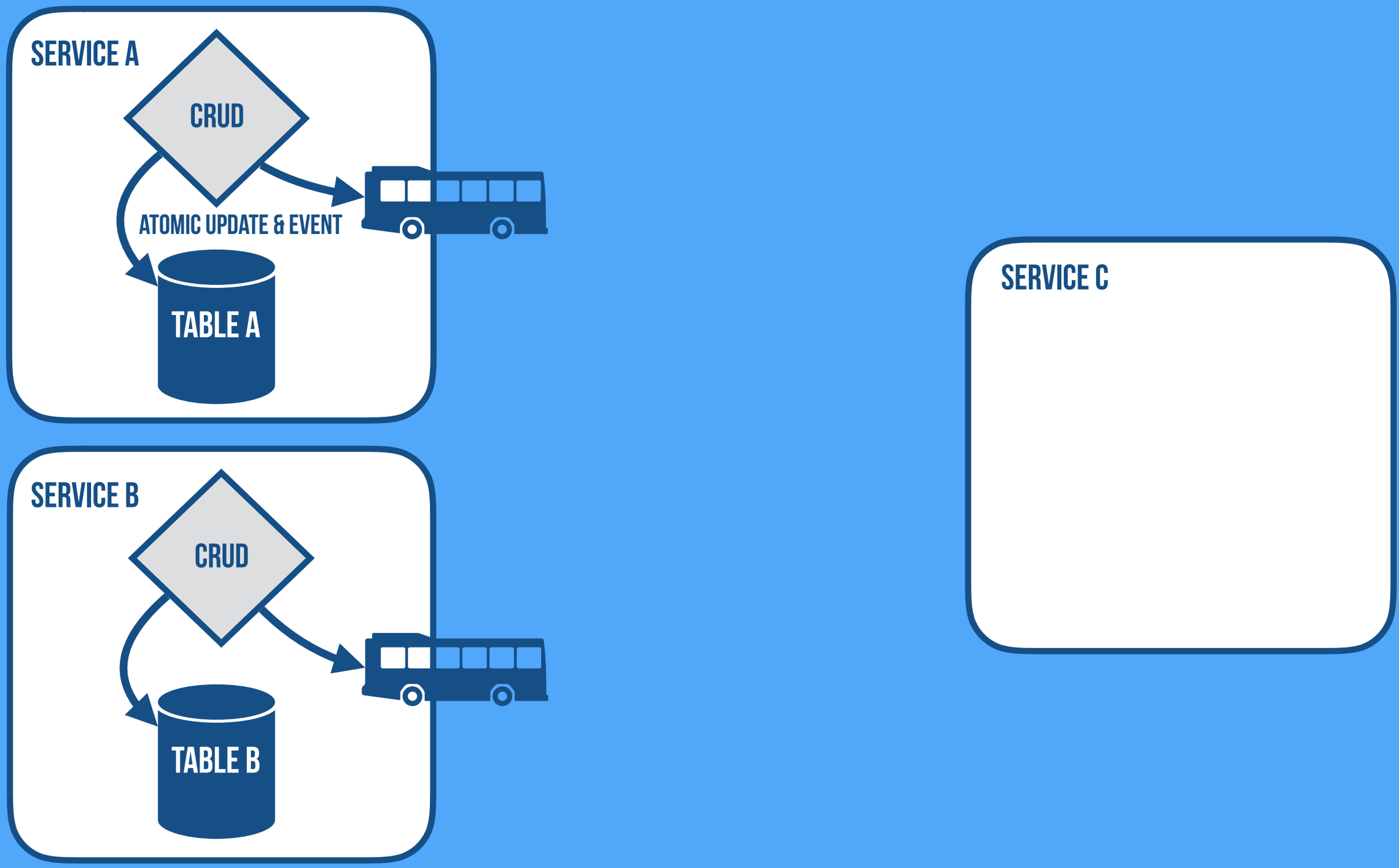

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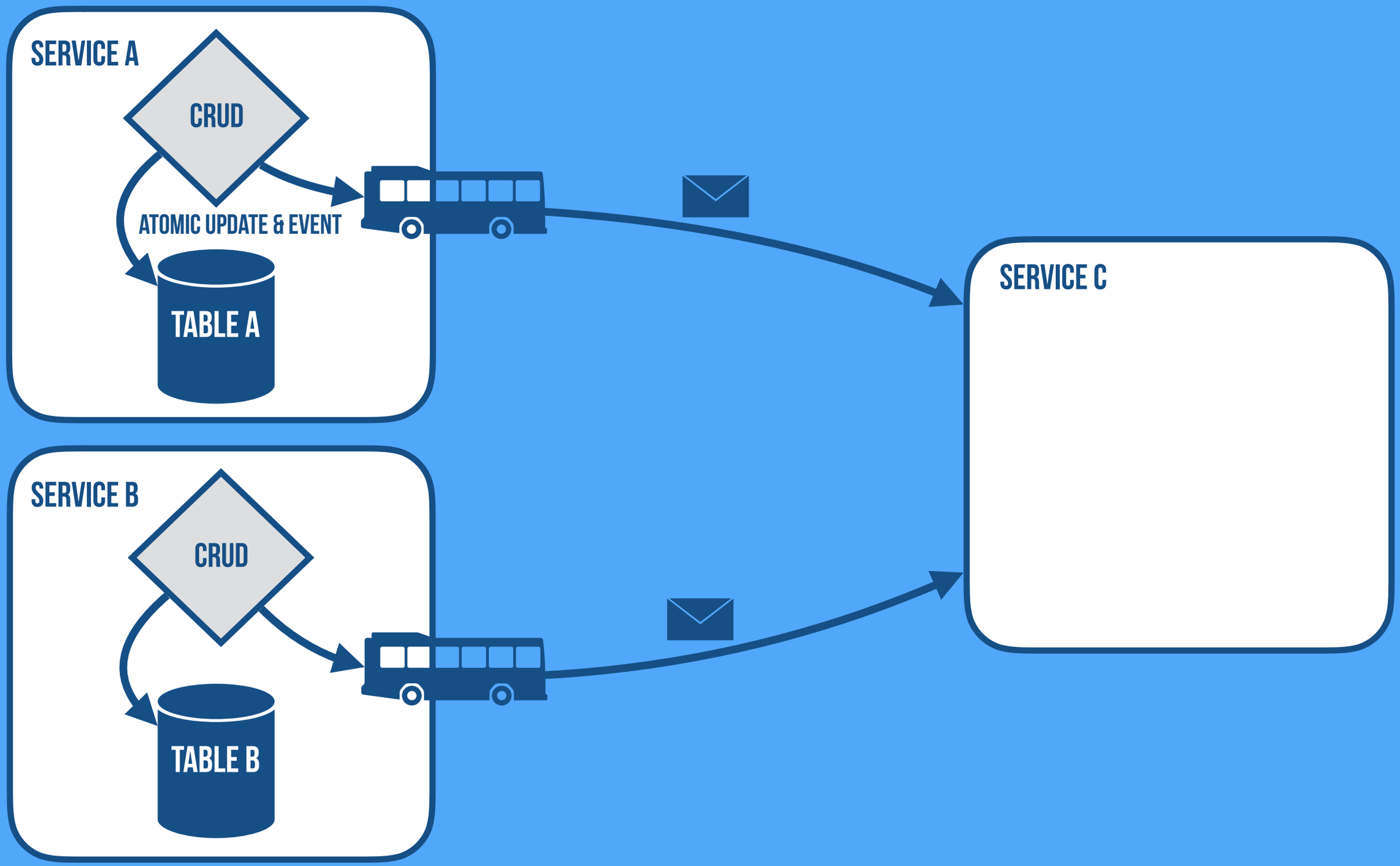

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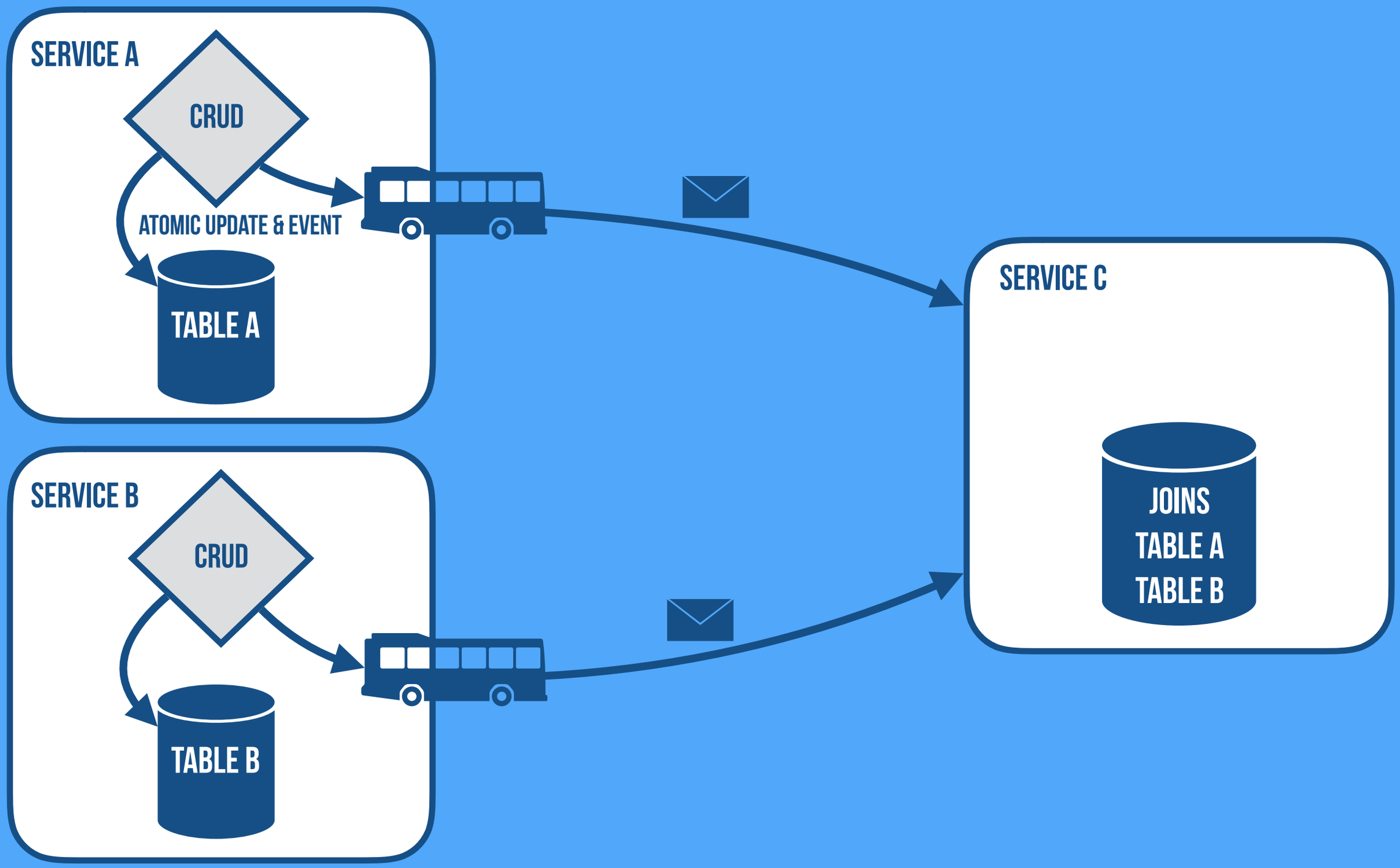

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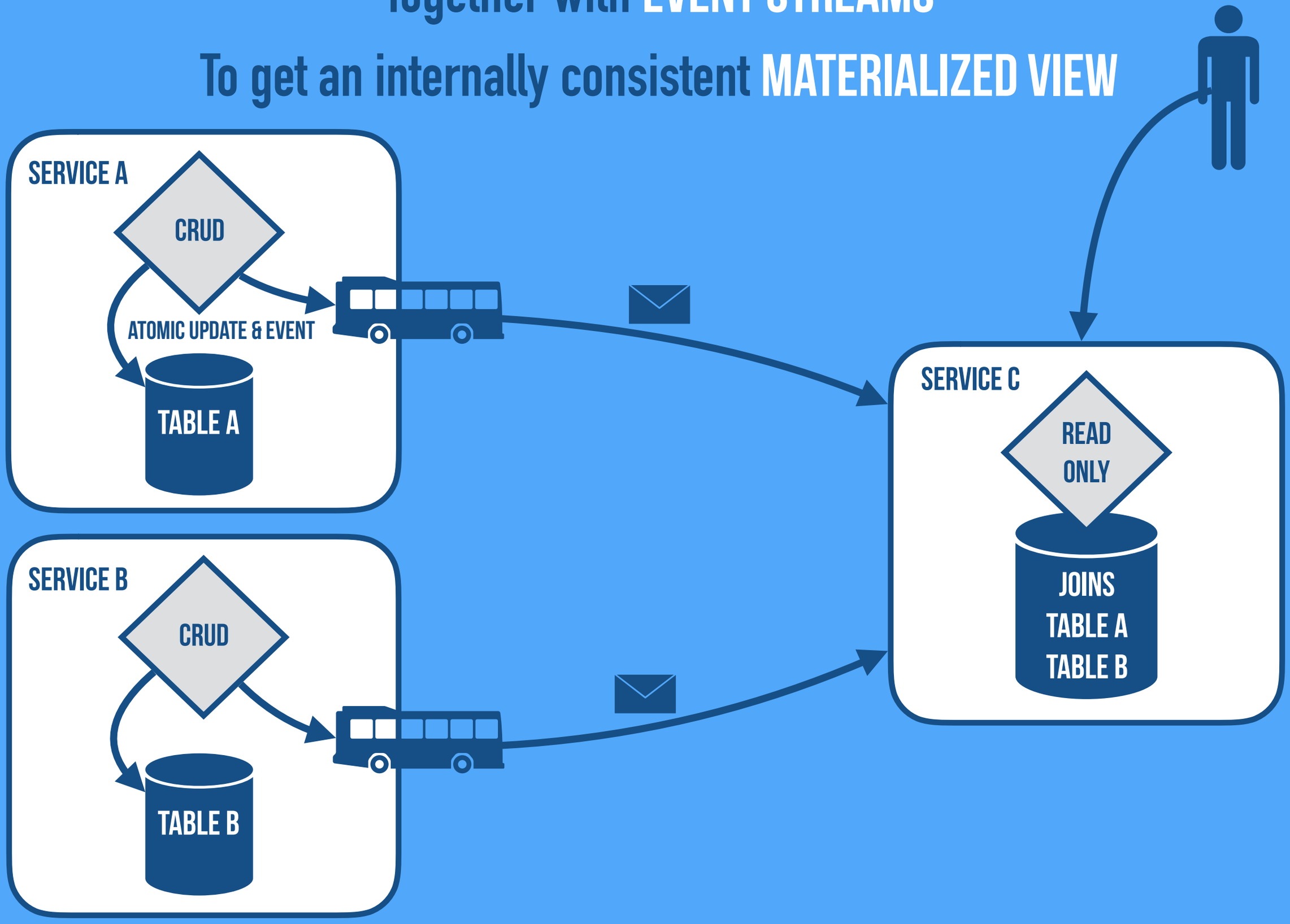

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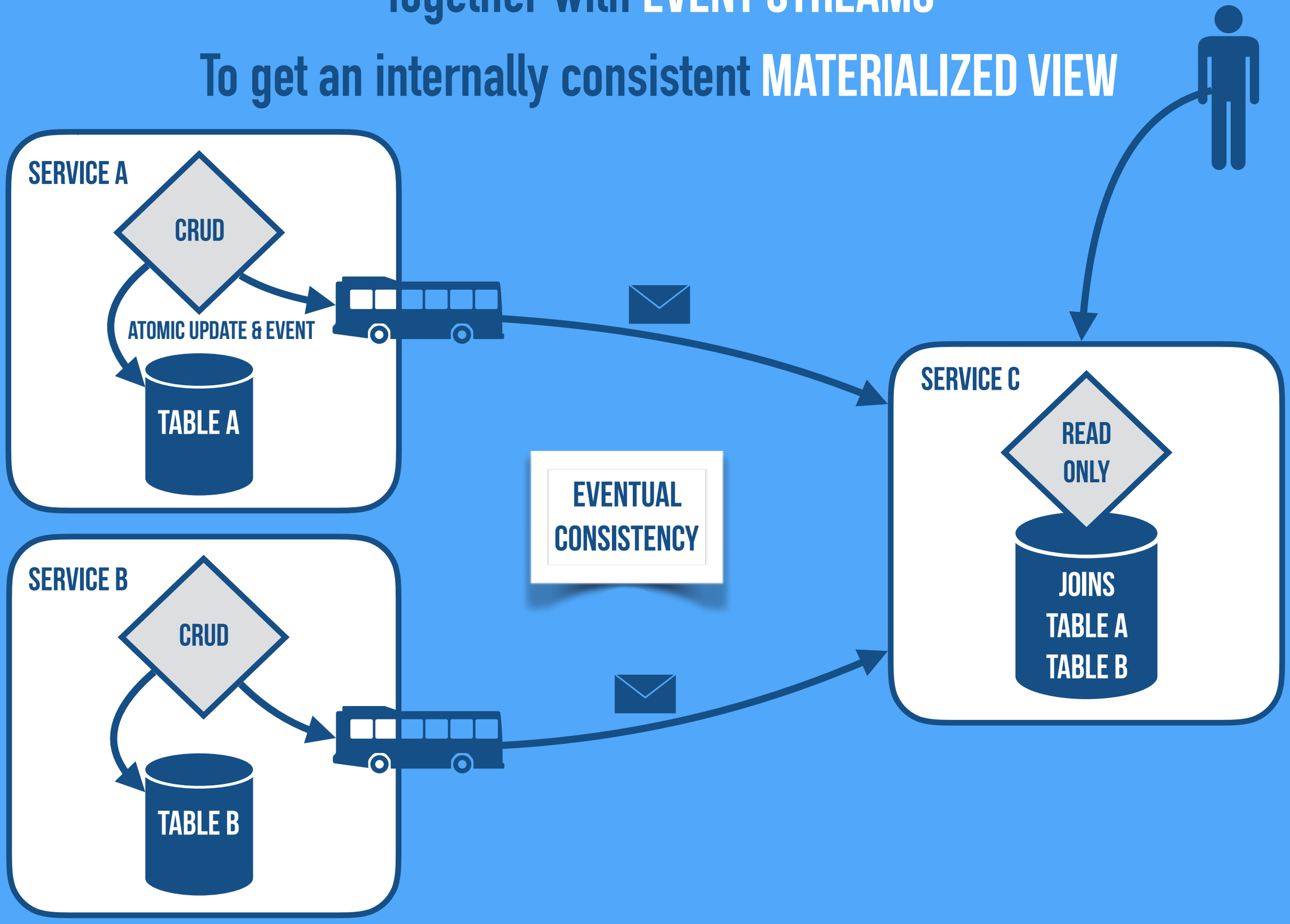


“Update-in-place strikes systems designers as a cardinal sin: it violates traditional accounting practices that have been observed for hundreds of years.”

- JIM GRAY

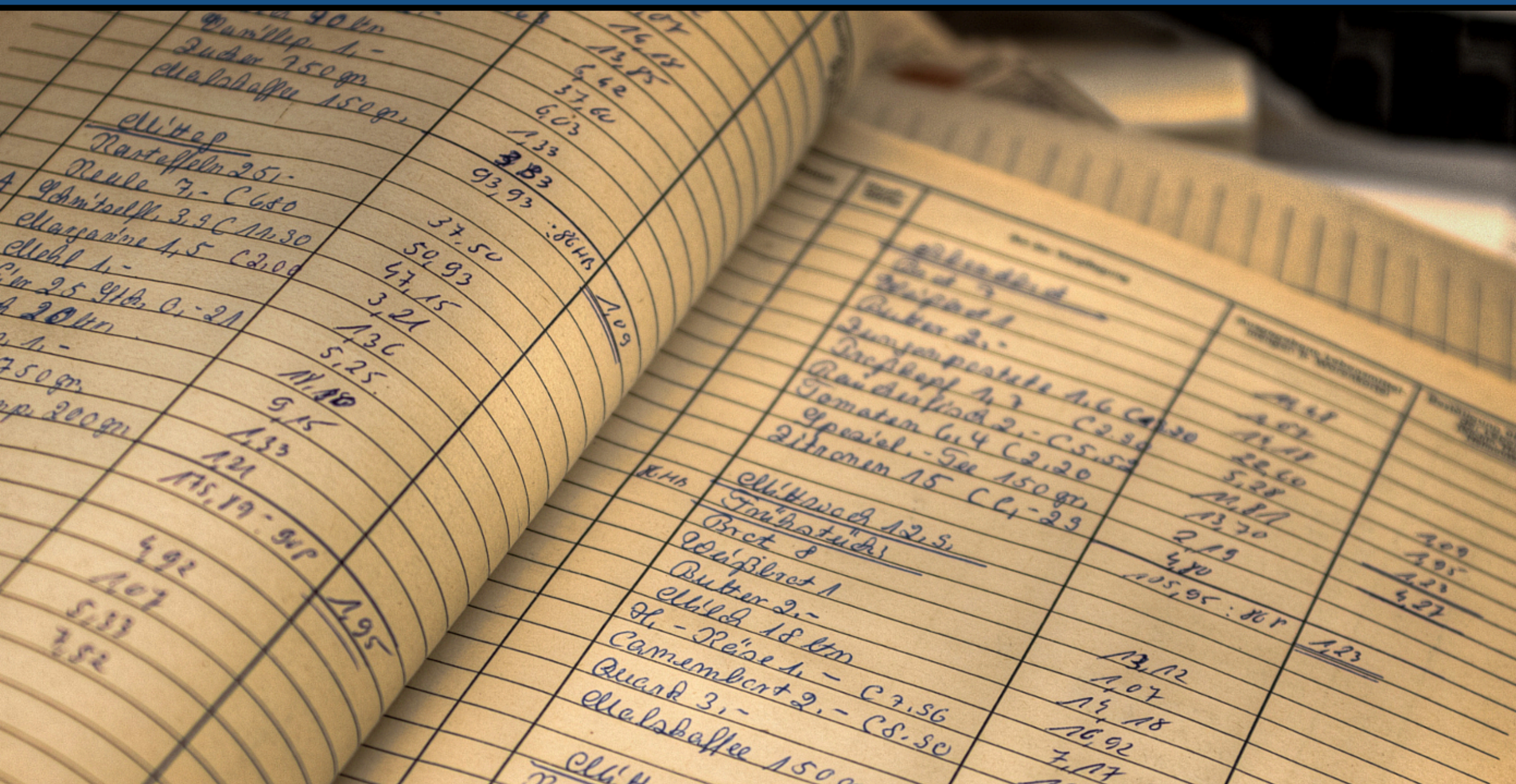
The Transaction Concept, Jim Gray (1981)

“The truth is the log.
The database is a cache
of a subset of the log.”

- PAT HELLAND

Immutability Changes Everything, Pat Helland (2015)

Event Logging
The Bedrock



Event Sourcing

A Cure For the Cardinal Sin

Event Sourced Services

Event Sourced Services

HAPPY PATH

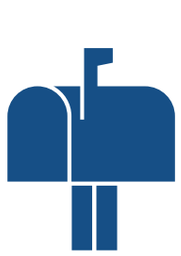
Event Sourced Services

HAPPY PATH

1) Receive and verify Command
("ApprovePayment")

Event Sourced Services

HAPPY PATH



1) Receive and verify Command ("ApprovePayment")

2) Create new Event ("PaymentApproved")

Event Sourced Services

HAPPY PATH

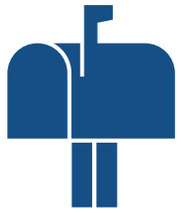
1) Receive and verify Command ("ApprovePayment")

2) Create new Event ("PaymentApproved")

3) Append Event to Event Log

Event Sourced Services

HAPPY PATH



1) Receive and verify Command ("ApprovePayment")

2) Create new Event ("PaymentApproved")

3) Append Event to Event Log

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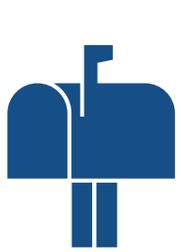

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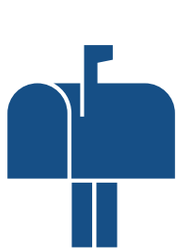

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Memory Image

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Event Sourcing

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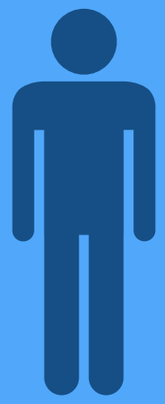
- Avoids the OBJECT-RELATIONAL MISMATCH
- Allows others to SUBSCRIBE TO STATE CHANGES
- Has good MECHANICAL SYMPATHY

  (Single Writer Principle etc.)

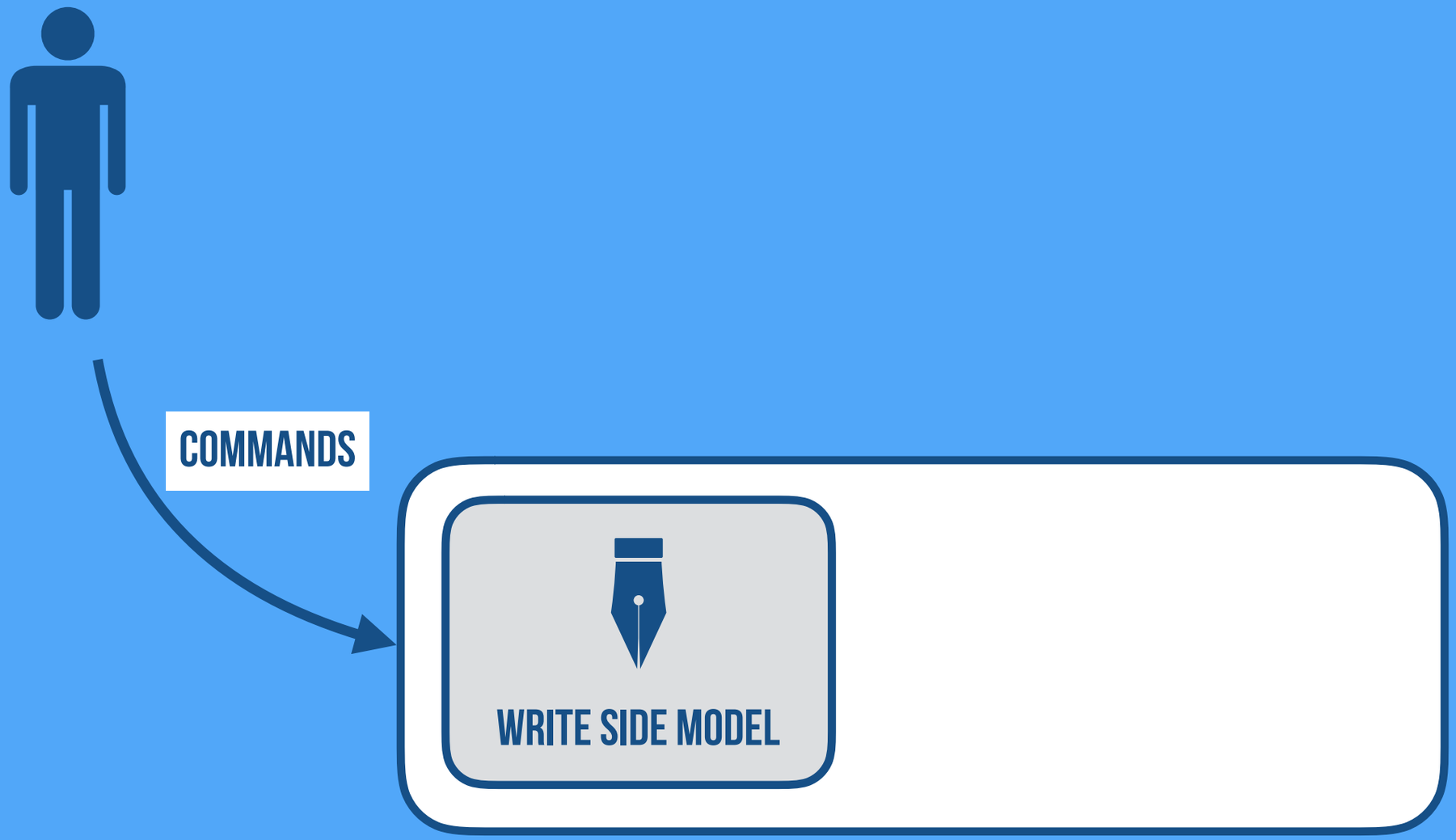
Untangle Your Read and Write Models With CQRS

CQRS

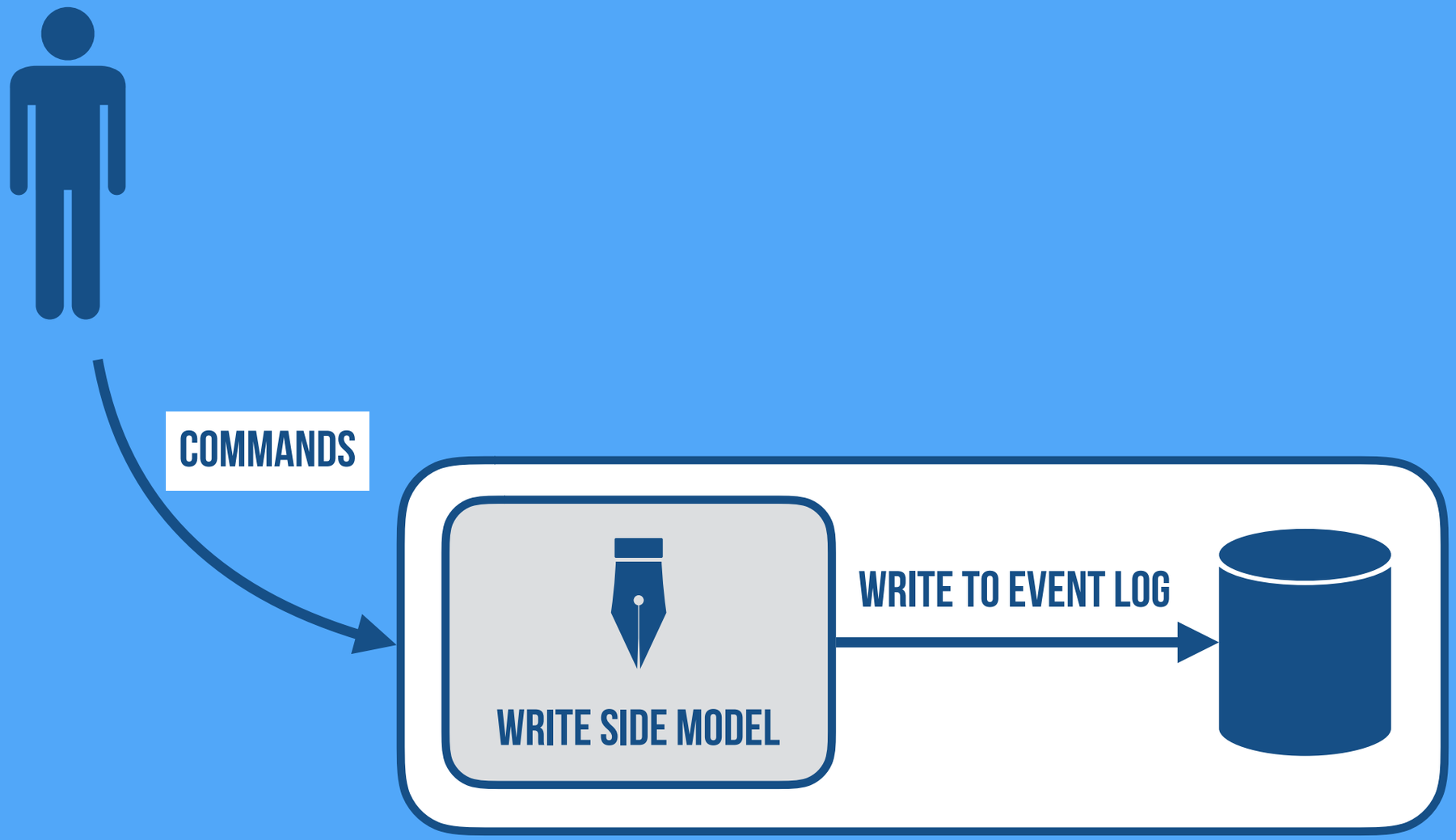
CQRS



CQRS



CQRS



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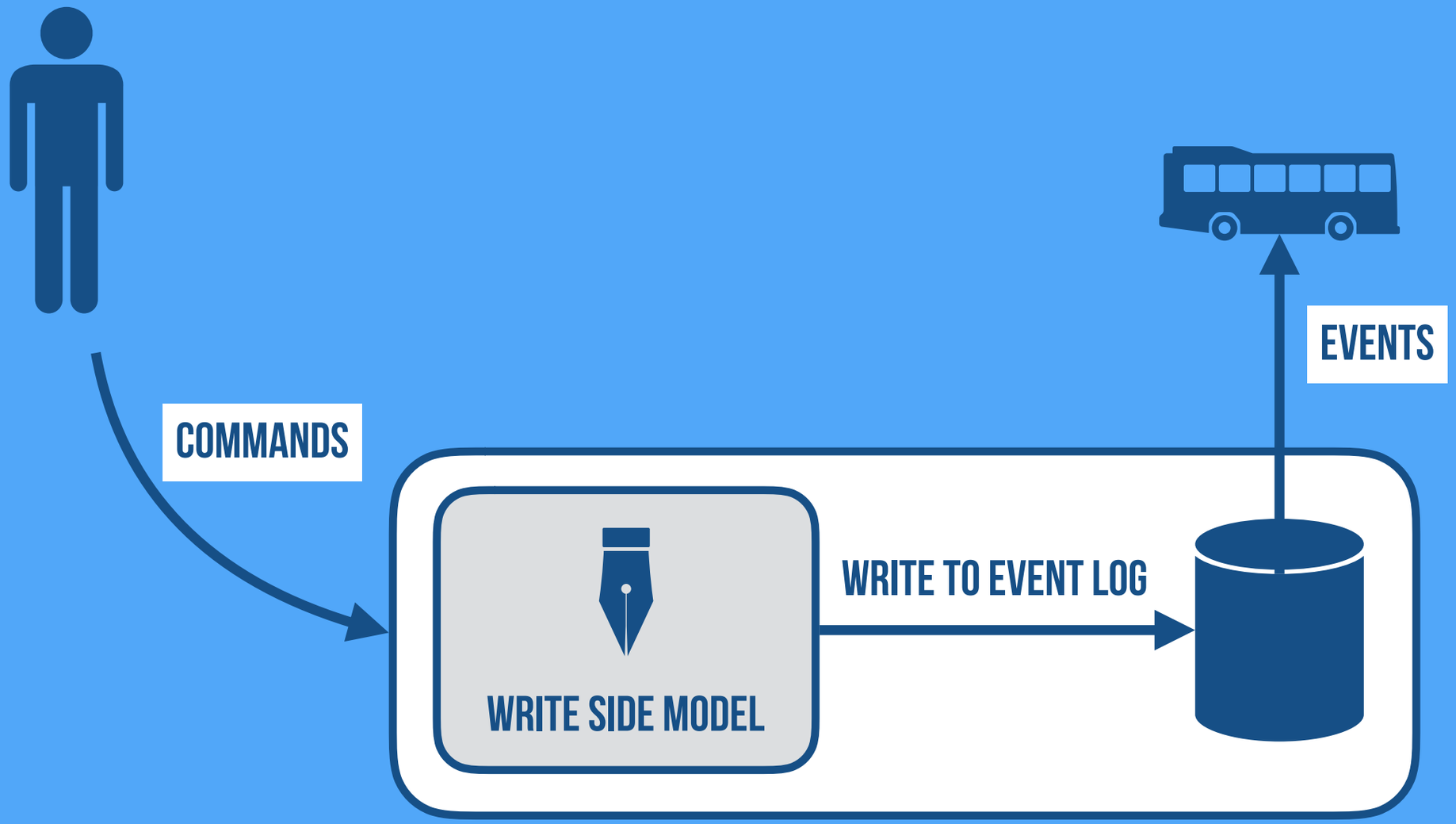

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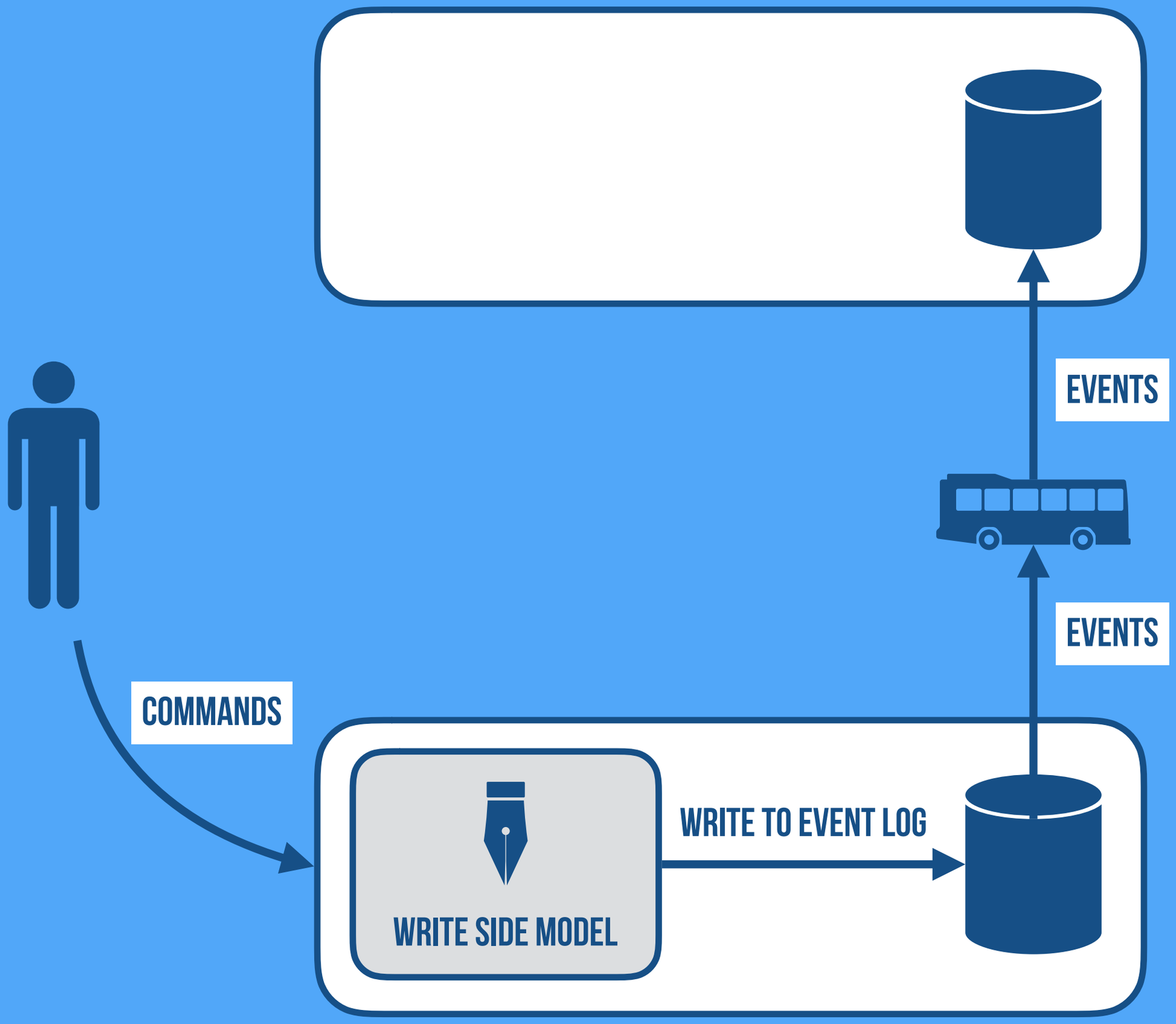

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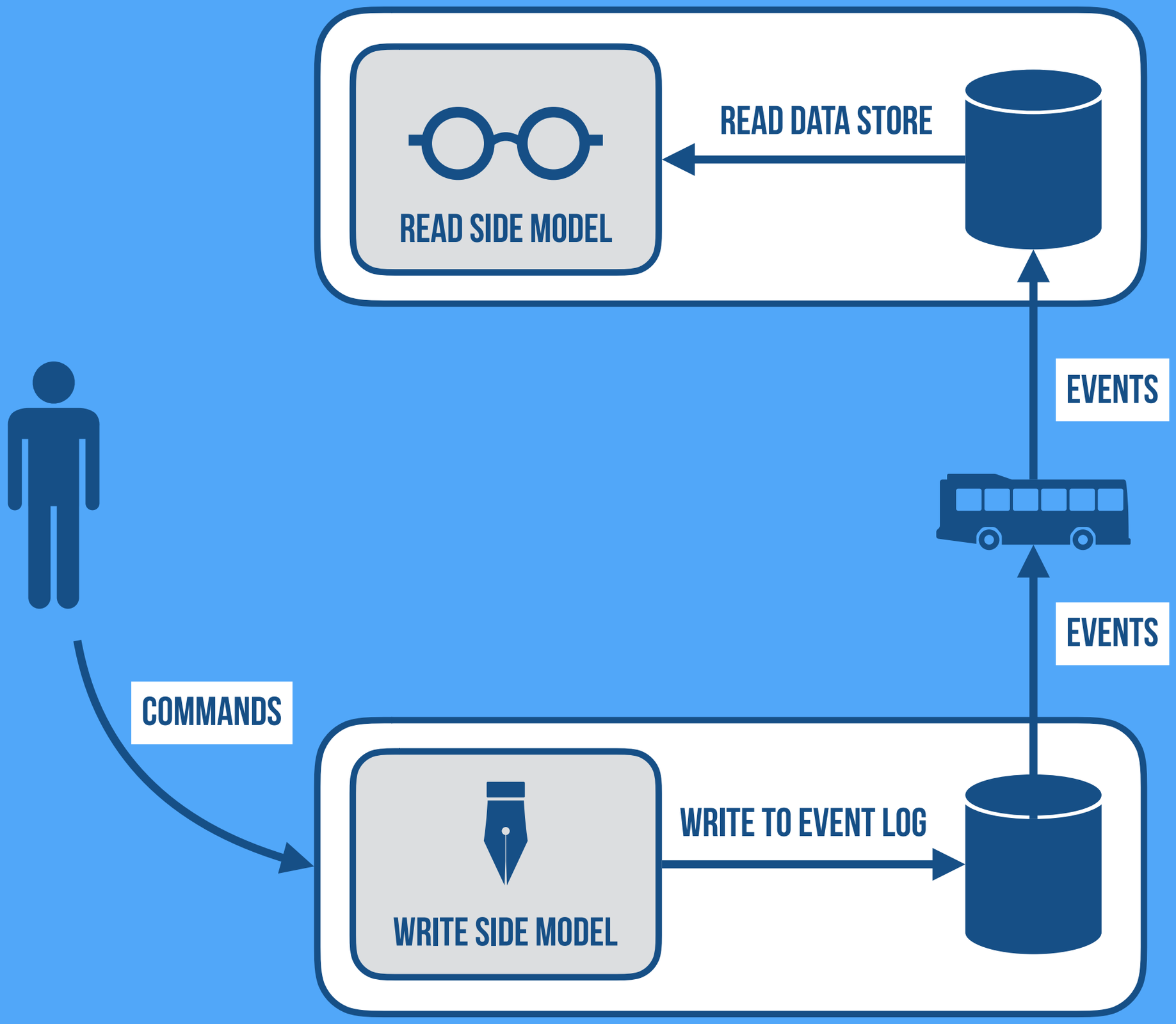
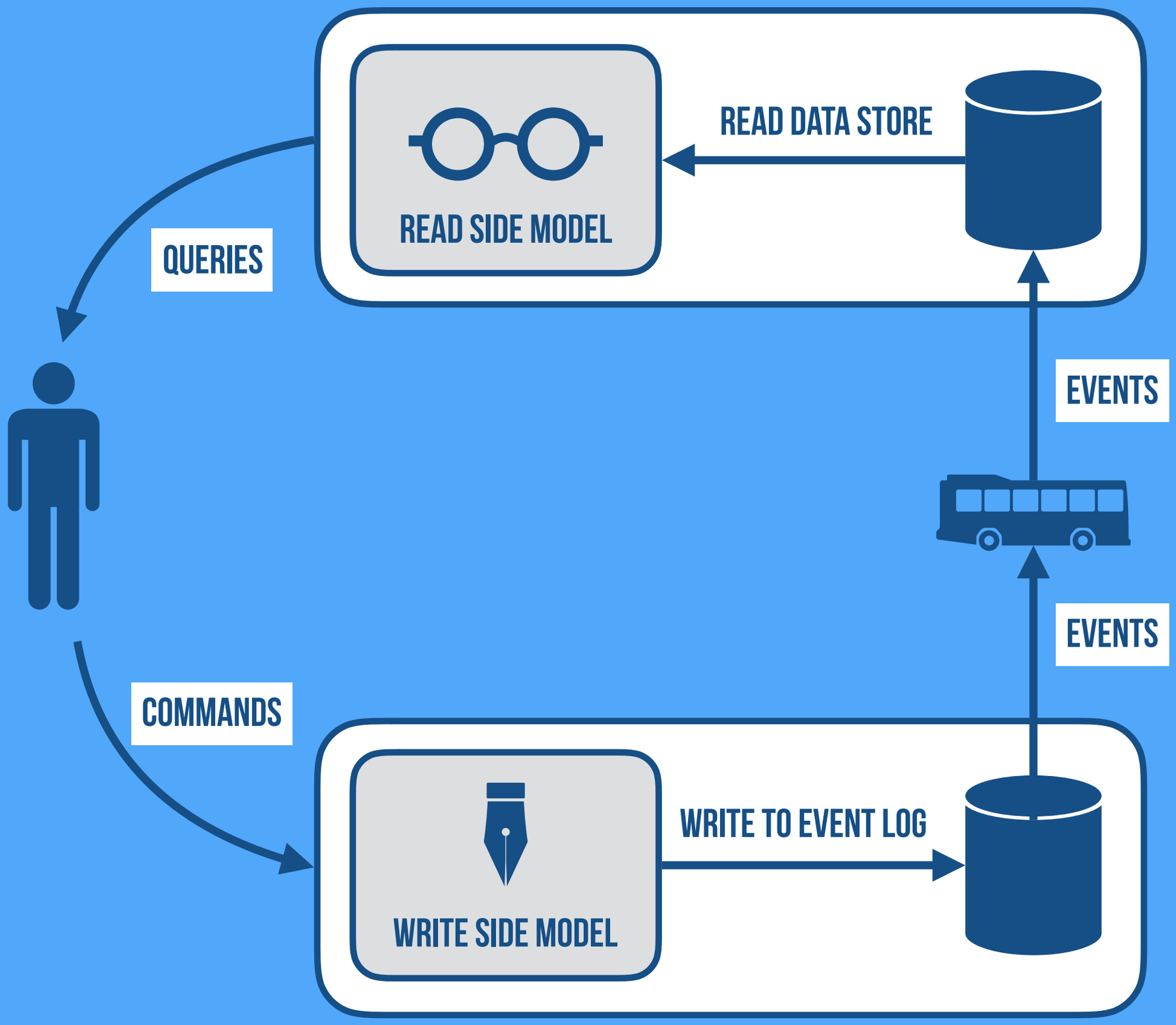

READ SIDE MODEL
READ DATA STORE
EVENTS
EVENTS
COMMANDS
WRITE SIDE MODEL
WRITE TO EVENT LOG

CQRS


READ DATA STORE
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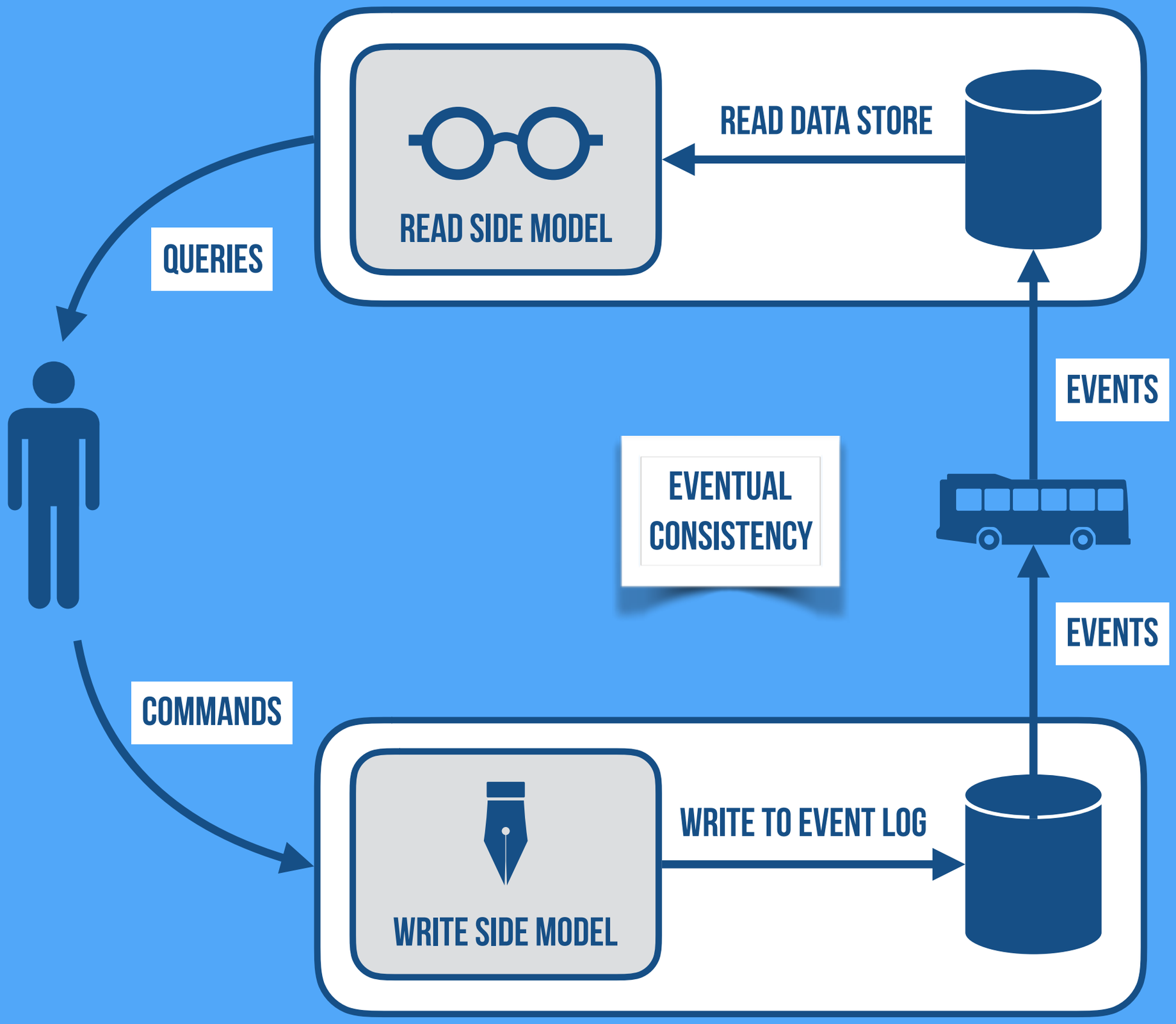

READ DATA STORE
READ SIDE MODEL
QUERIES
EVENTS
EVENTUAL CONSISTENCY
EVENTS
COMMANDS
WRITE TO EVENT LOG
WRITE SIDE MODEL

Events

Allow Us To Manage

Time

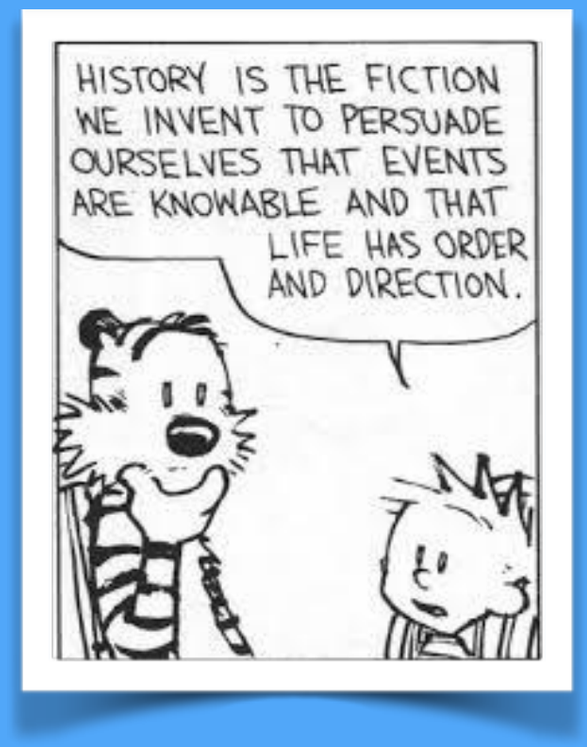
“Modelling events forces you to have a temporal focus on what’s going on in the system. Time becomes a crucial factor of the system.”

- GREG YOUNG

A Decade of DDD, CQRS, Event Sourcing, Greg Young (Presentation from 2016)

Event Sourcing
Allows Us To
Model Time

- Event is a SNAPSHOT IN TIME
- Event ID is an INDEX FOR TIME
- Event Log is our FULL HISTORY
  - The DATABASE OF OUR PAST
  - The PATH TO OUR PRESENT



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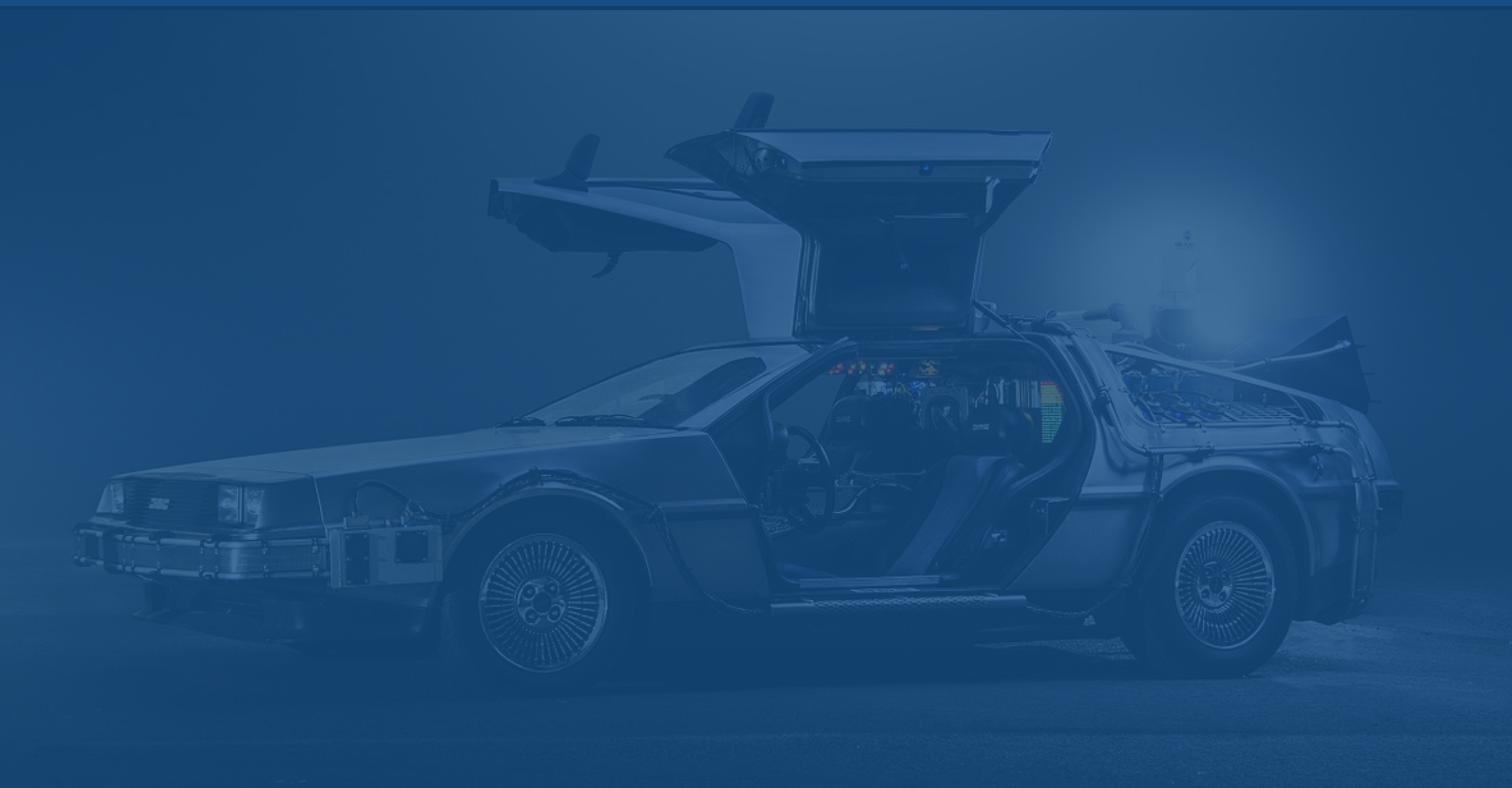
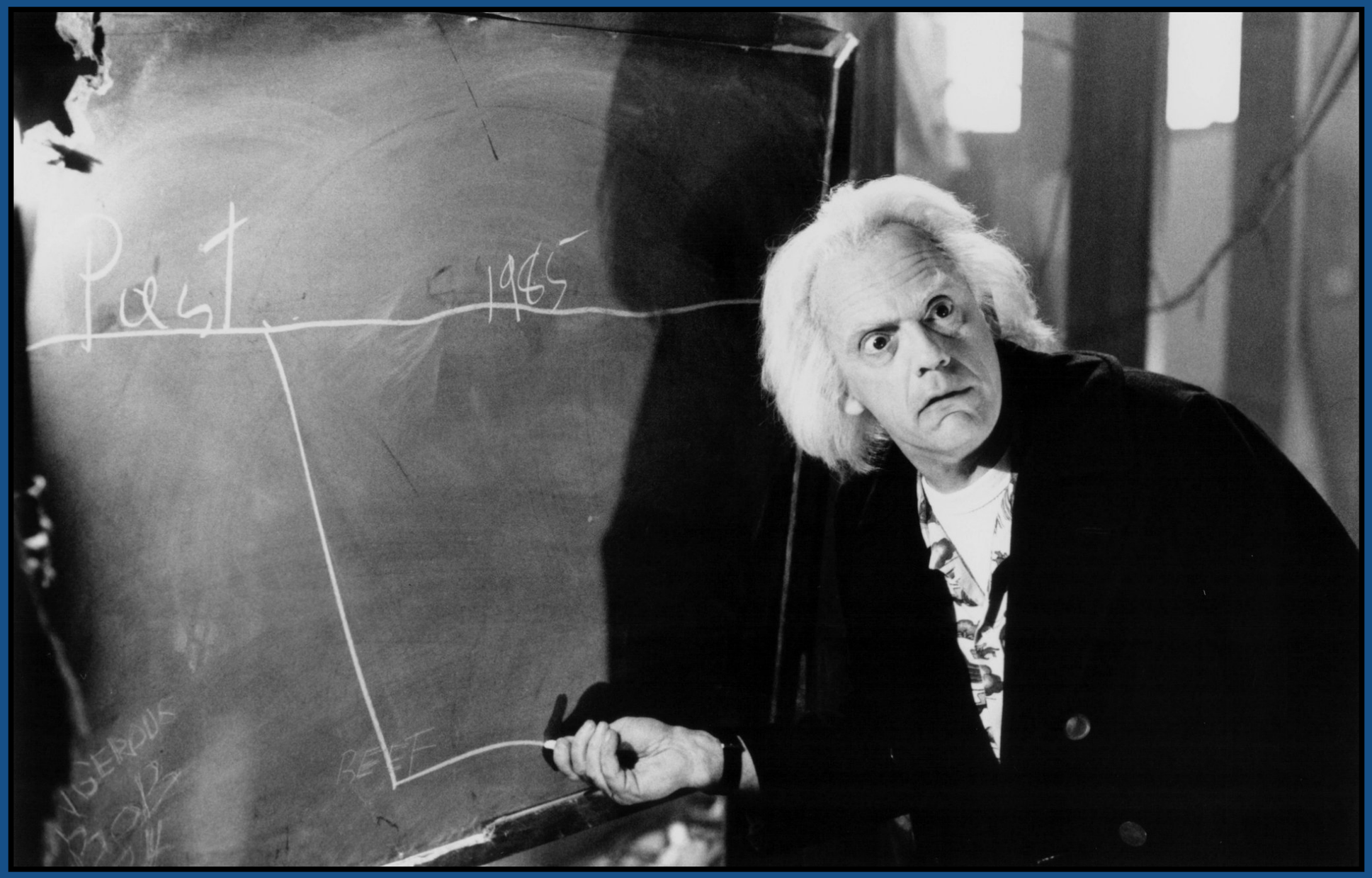


Event Sourcing Allows For Time Travel

- Replay the log FOR HISTORIC DEBUGGING
- Replay the log FOR AUDITING & TRACEABILITY
- Replay the log ON FAILURE
- Replay the log FOR REPLICATION

We Can Even Fork the Past



...Or Join Two Distinct Pasts

Key Takeaways

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EVENTS-FIRST DESIGN helps you to:

- REDUCE RISK when MODERNIZING applications
- MOVE FASTER towards a RESILIENT and SCALABLE architecture
- DESIGN AUTONOMOUS services
- BALANCE CERTAINTY and UNCERTAINTY

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EVENT LOGGING allows you to:

- AVOID CRUD and ORM
- TAKE CONTROL of your system's HISTORY
- TIME-TRAVEL
- BALANCE STRONG and EVENTUAL consistency

akka

http://akka.io

Learn More

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bit.ly/reactive-microsystems

Lightbend