Event-sourced architectures with Akka

@Sander_Mak
Luminis Technologies

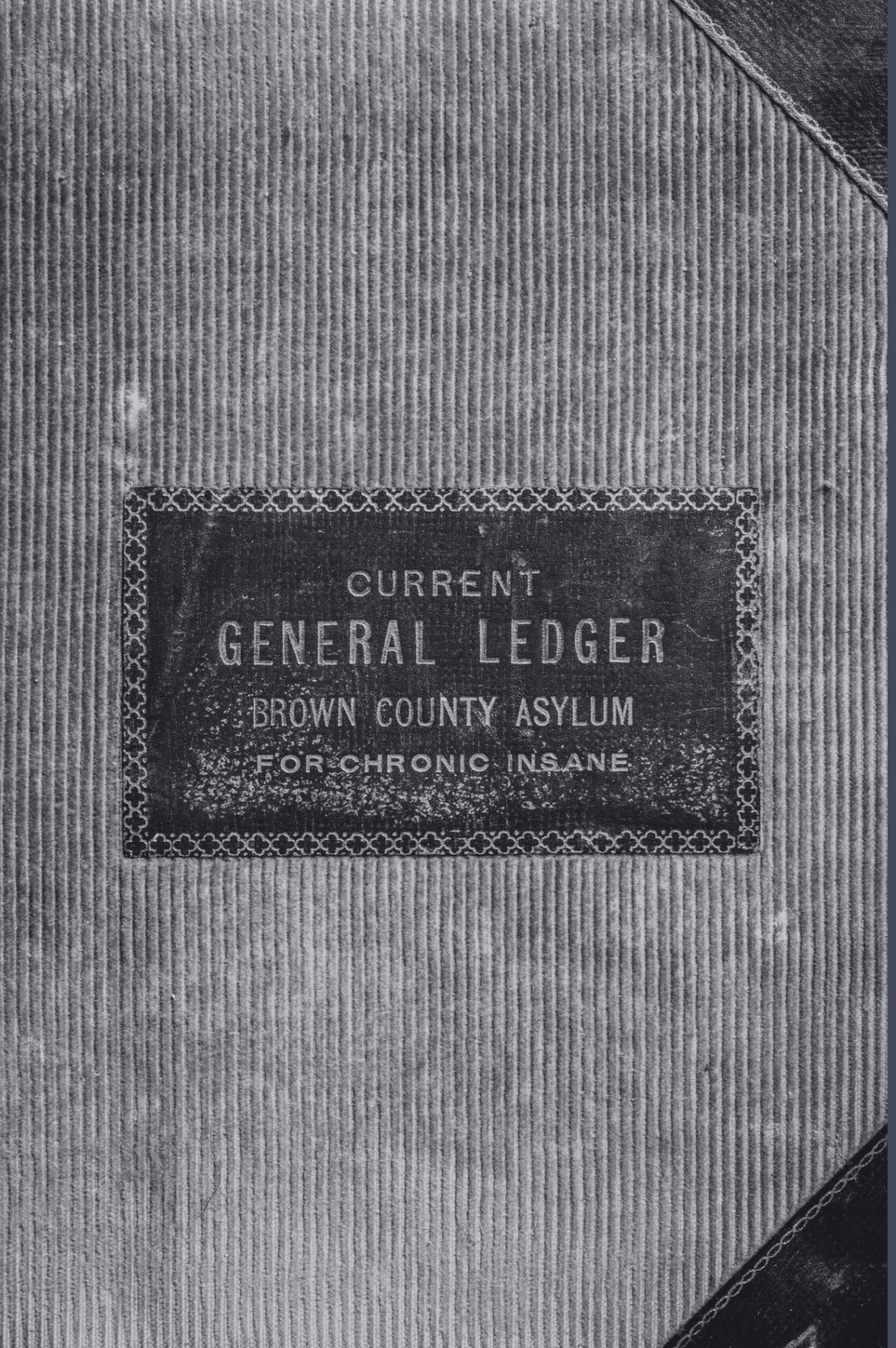
Today's journey

Event-sourcing

Actors

Akka Persistence

Design for ES



Event-sourcing

Is all about getting the **facts** straight

Typical 3 layer architecture

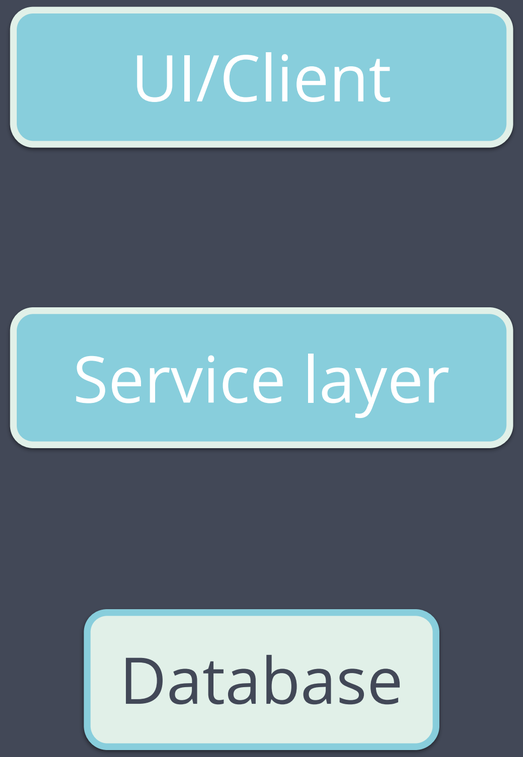
UI/Client

Service layer

Database

fetch ⇝ modify ⇝ store

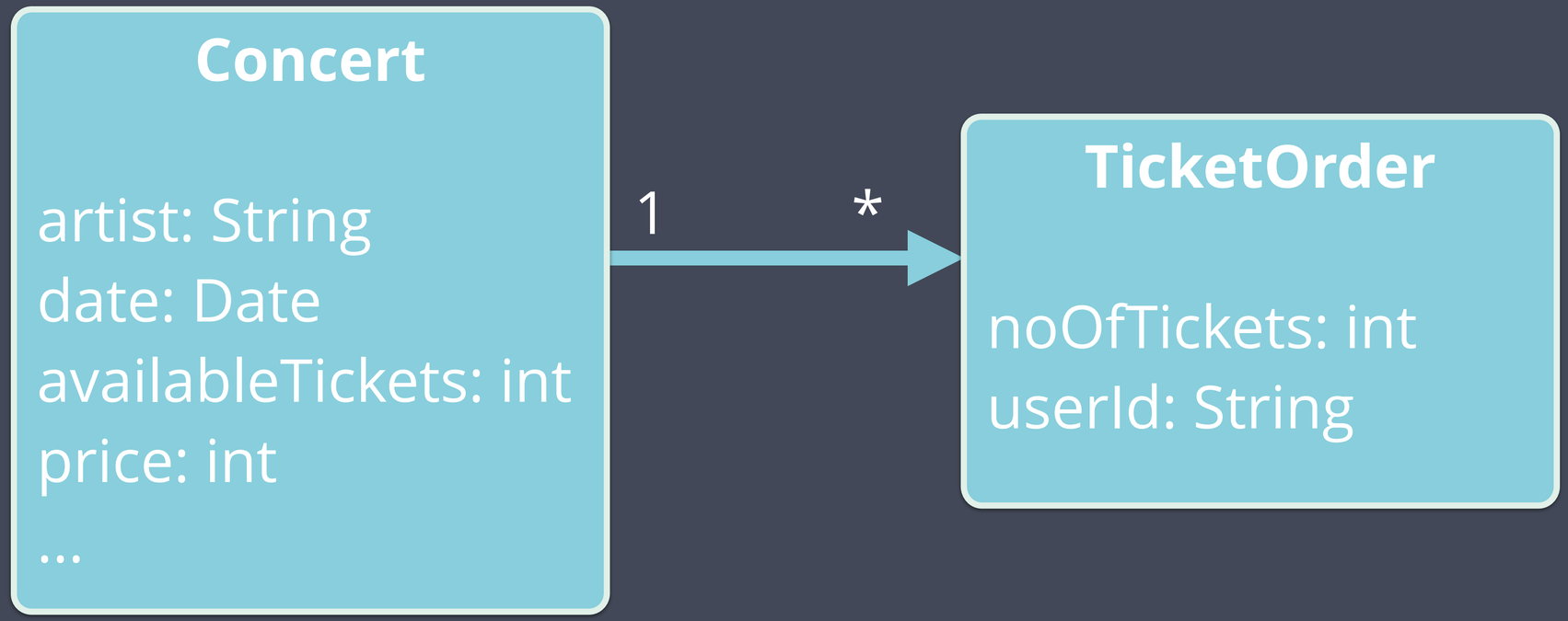
Typical 3 layer architecture



fetch → modify → store

Databases are
shared mutable state

Typical entity modelling



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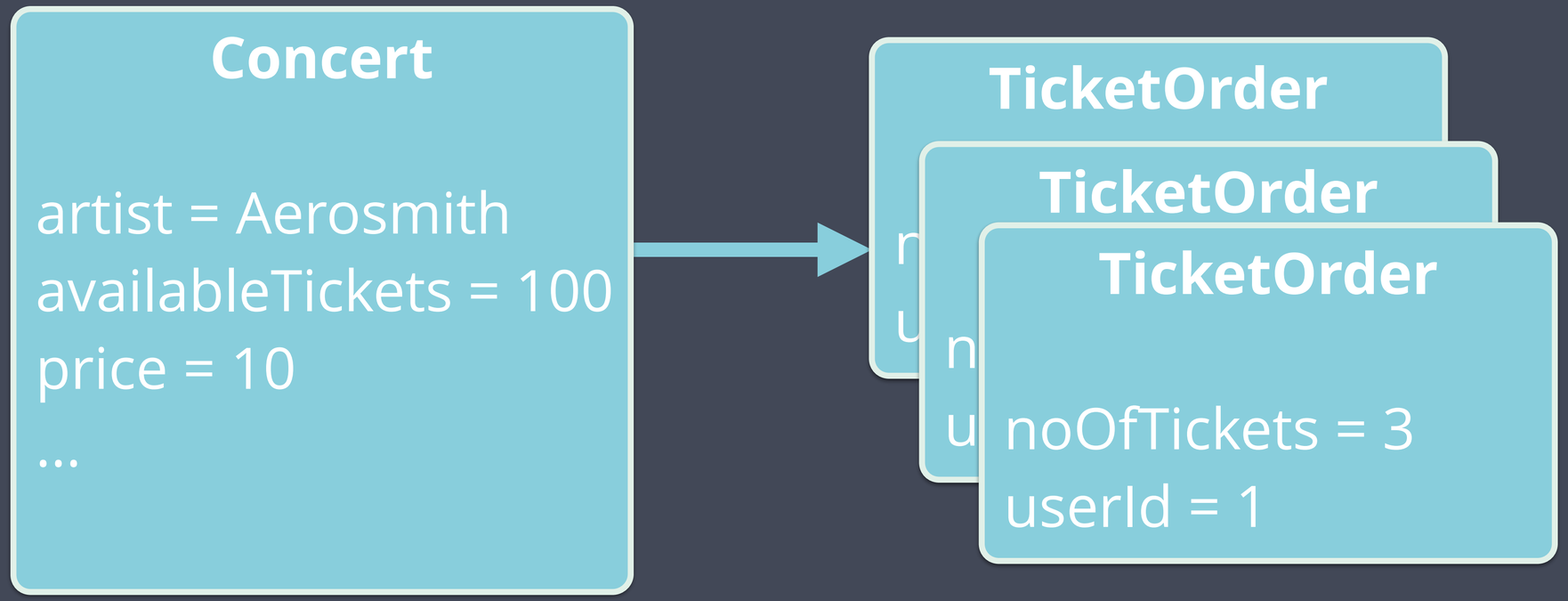

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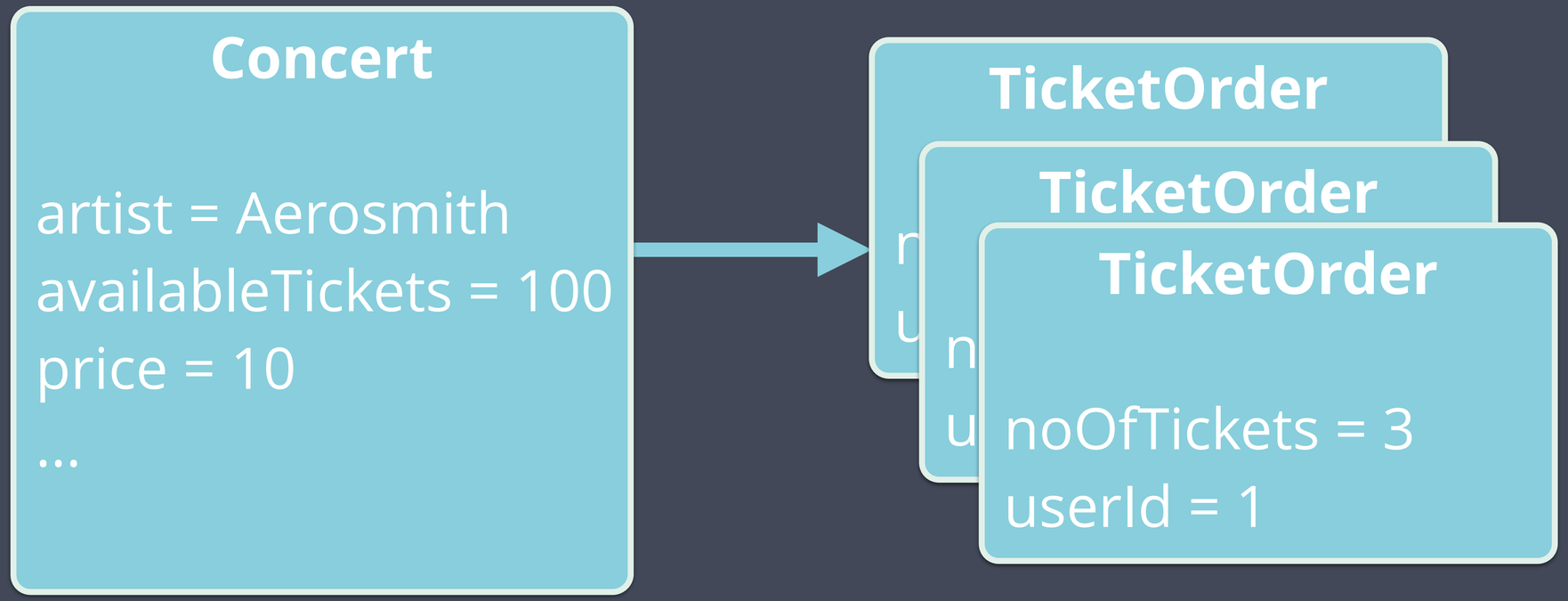
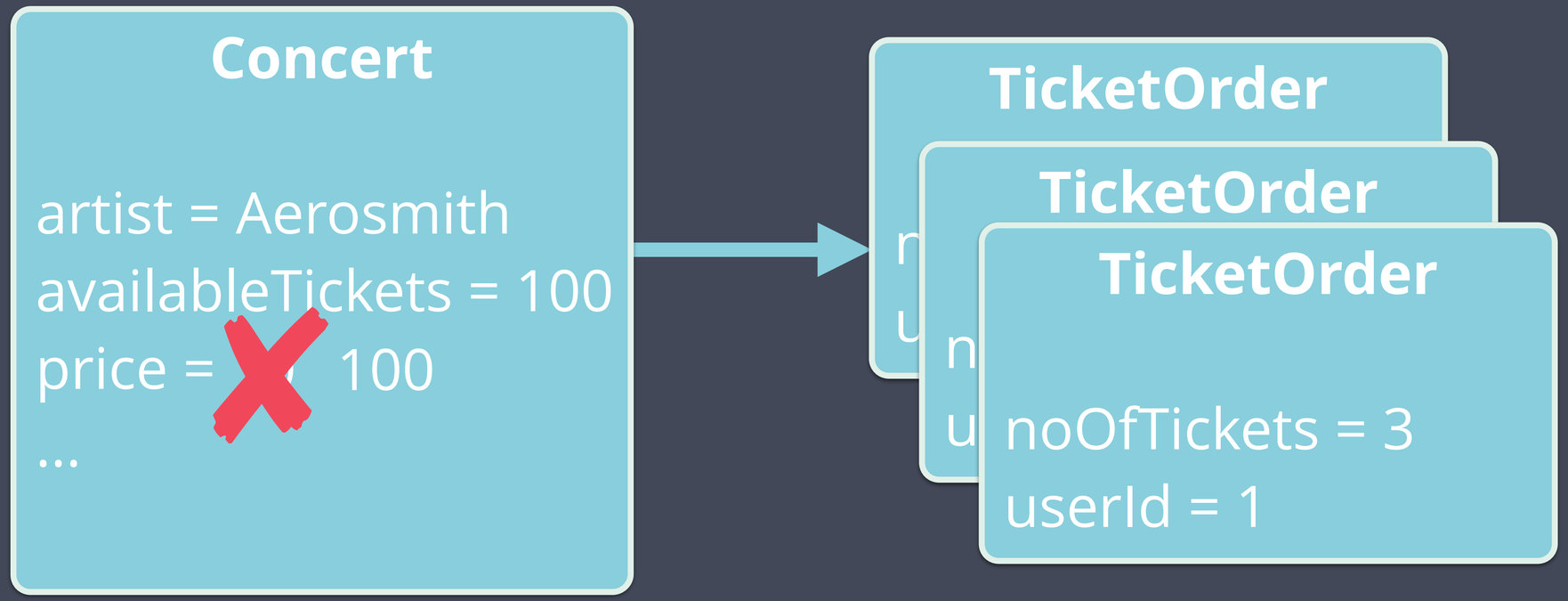


Changing the price

Typical entity modelling



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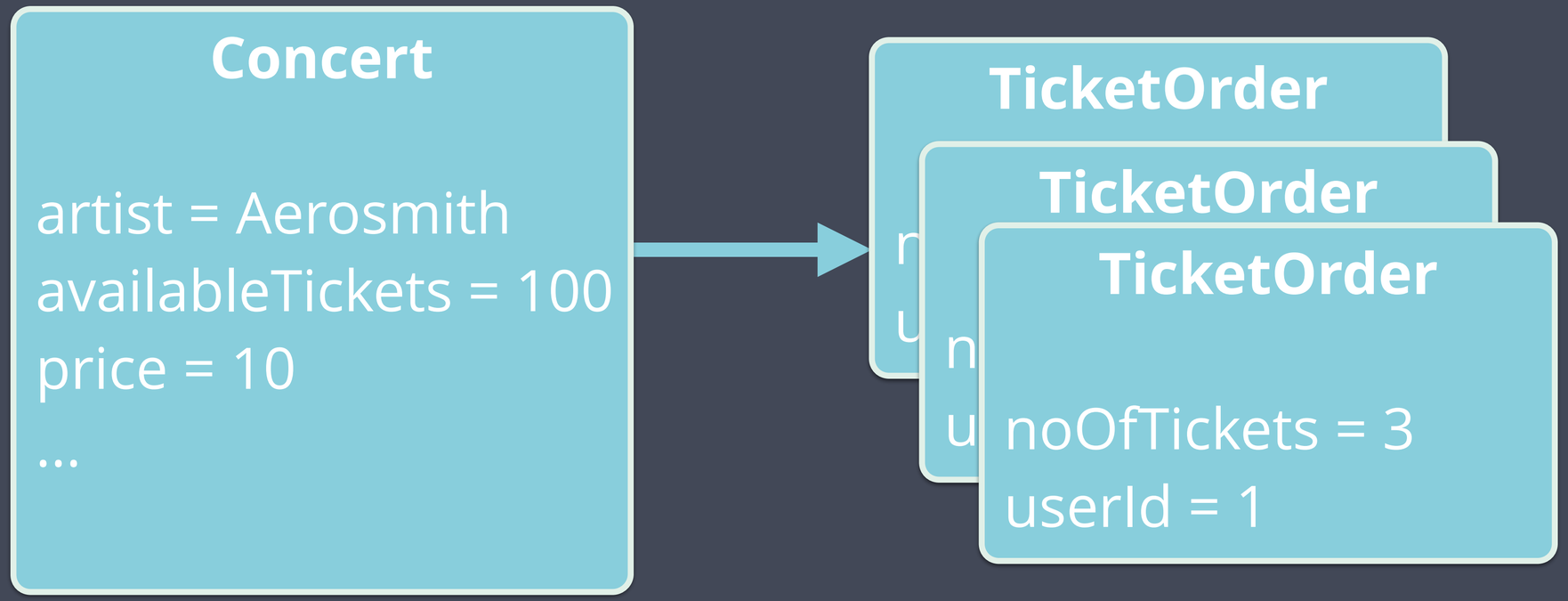
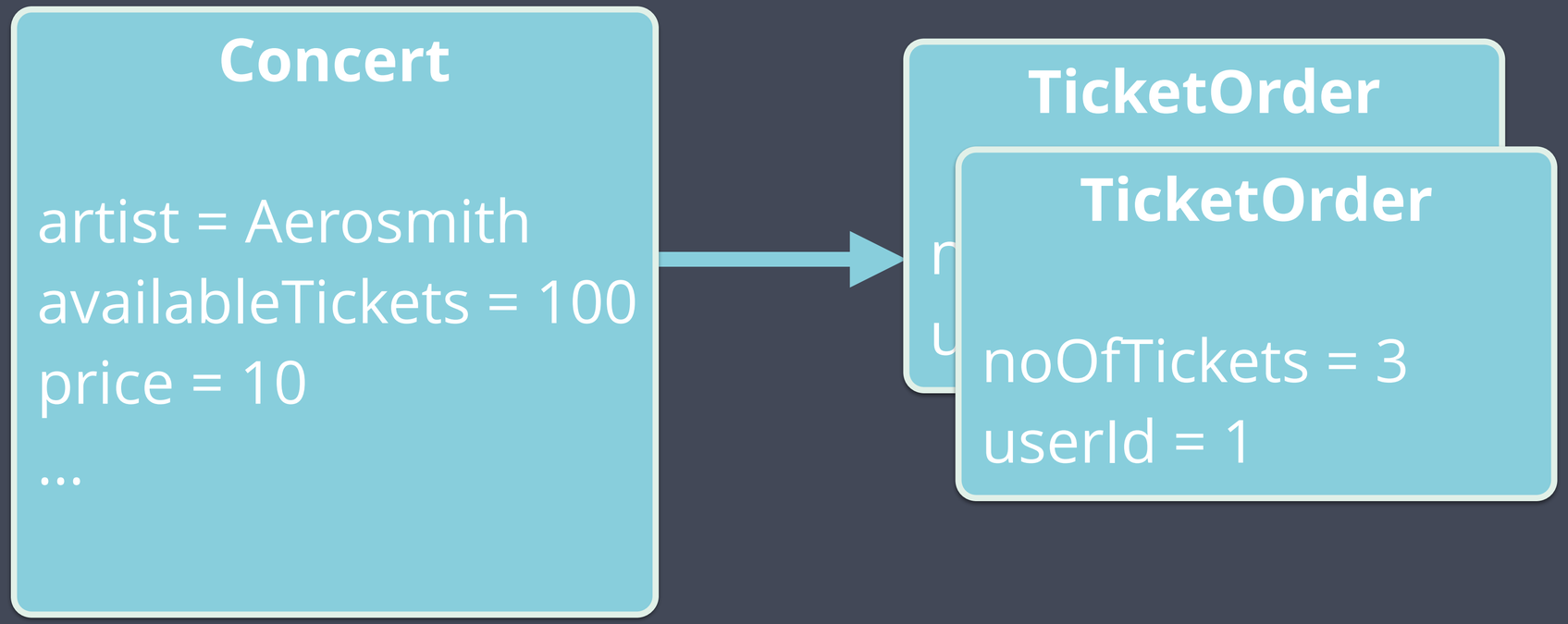


Canceling an order

Typical entity modelling



Canceling an order

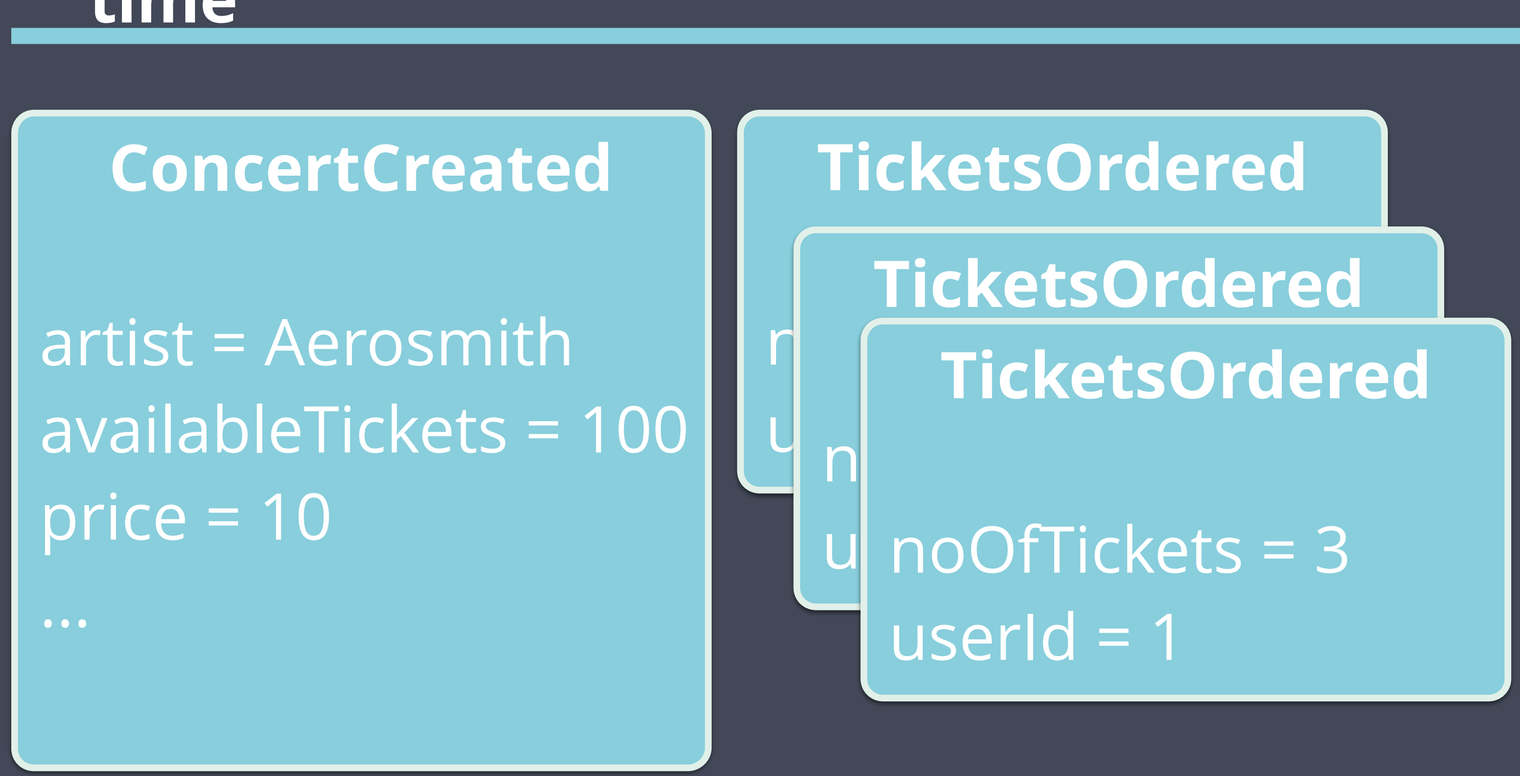
Update or **delete** statements in your app?

Congratulations, you are

LOSING DATA EVERY DAY

Event-sourced modelling

time



Event-sourced modelling

time

ConcertCreated

artist = Aerosmith
availableTickets = 100
price = 10
…

TicketsOrdered

TicketsOrdered

TicketsOrdered

noOfTickets = 3
userId = 1

Changing the price

Event-sourced modelling

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PriceChanged

price = 100

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Canceling an order

Event-sourced modelling

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TicketsOrdered

TicketsOrdered

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PriceChanged

price = 100

OrderCancelled

userId = 1

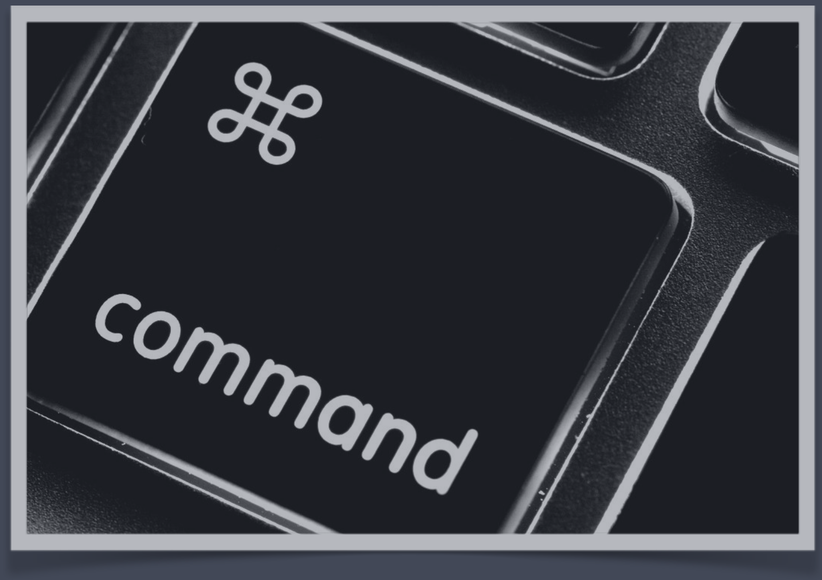
Canceling an order

Event-sourced modelling

- Immutable events
- Append-only storage (scalable)
- Replay events: reconstruct historic state
- Events as integration mechanism
- Events as audit mechanism

Event-sourcing: capture *all changes* to application state as a sequence of events

Events: where from?



Commands & Events

Do something (active)

Can be rejected (validation)

Can be responded to

It happened.
Deal with it.
(facts)

Querying & event-sourcing

How do you query a log?

Querying & event-sourcing

How do you query a log?

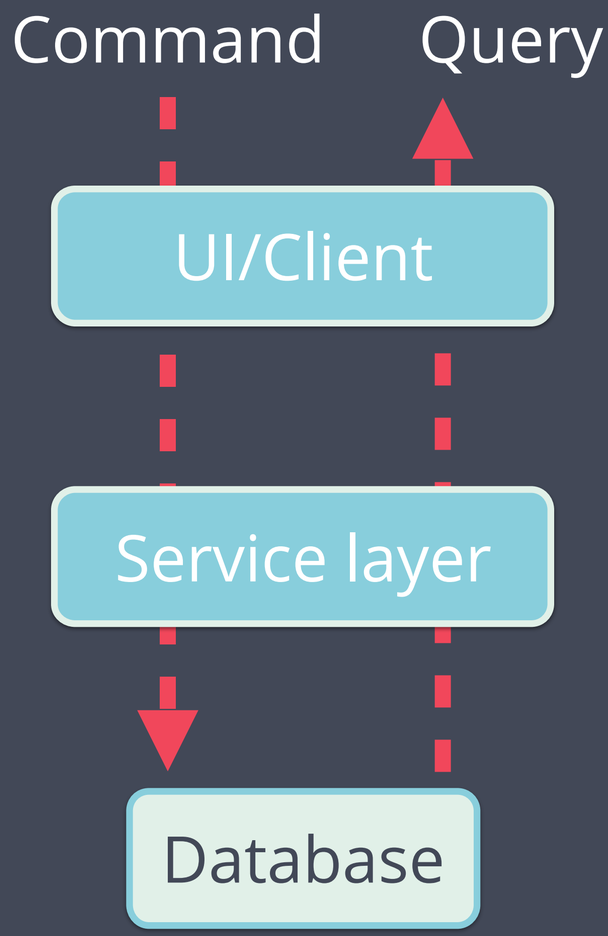
Command

Query

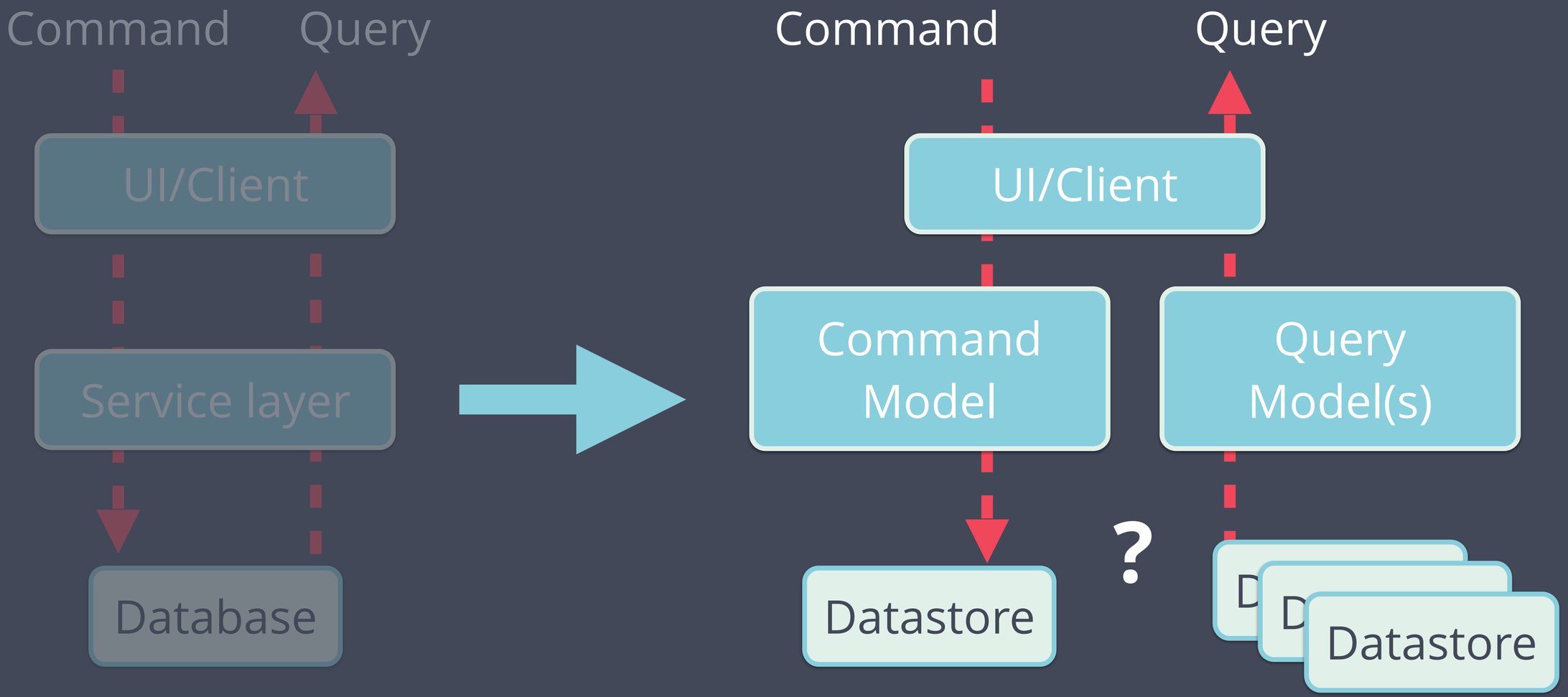
Responsibility

Segregation

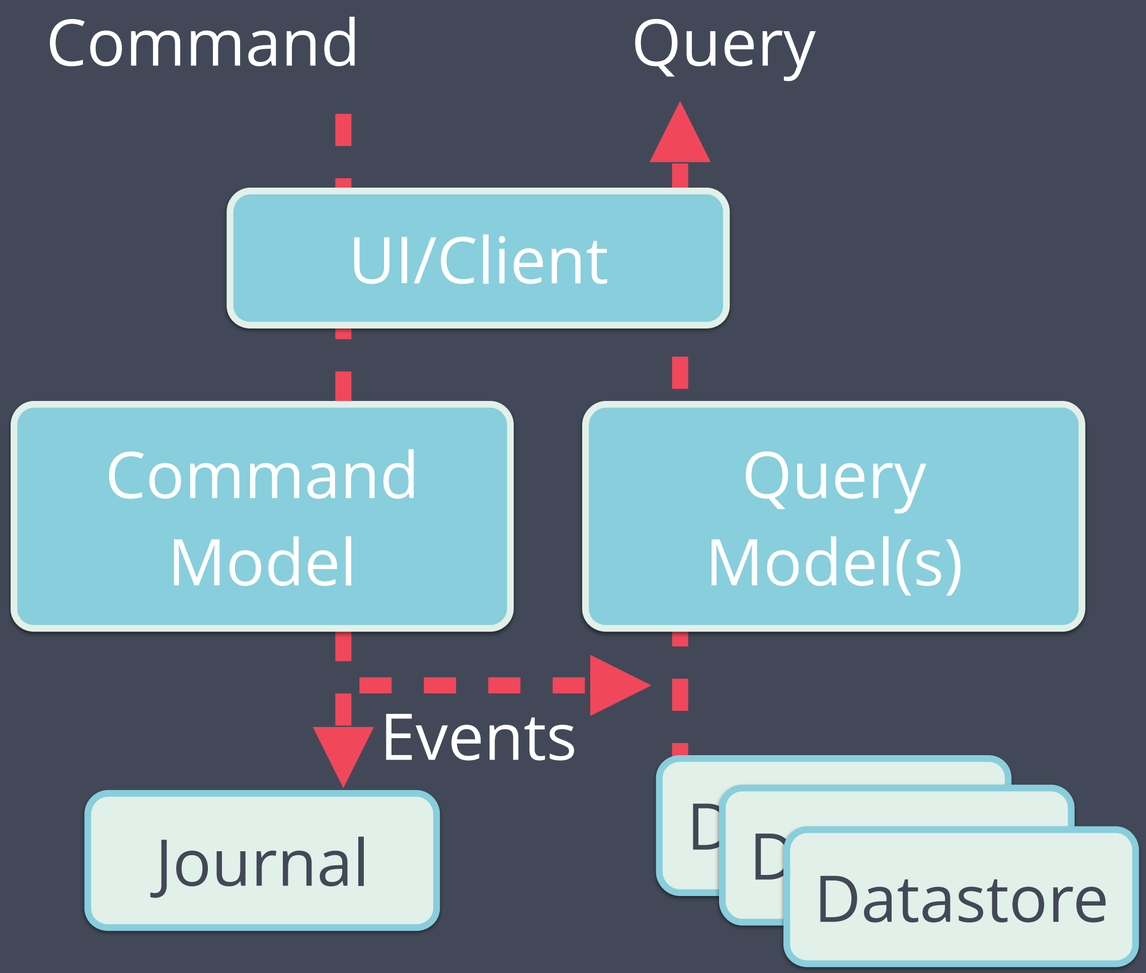
CQRS without ES



CQRS without ES



Event-sourced CQRS

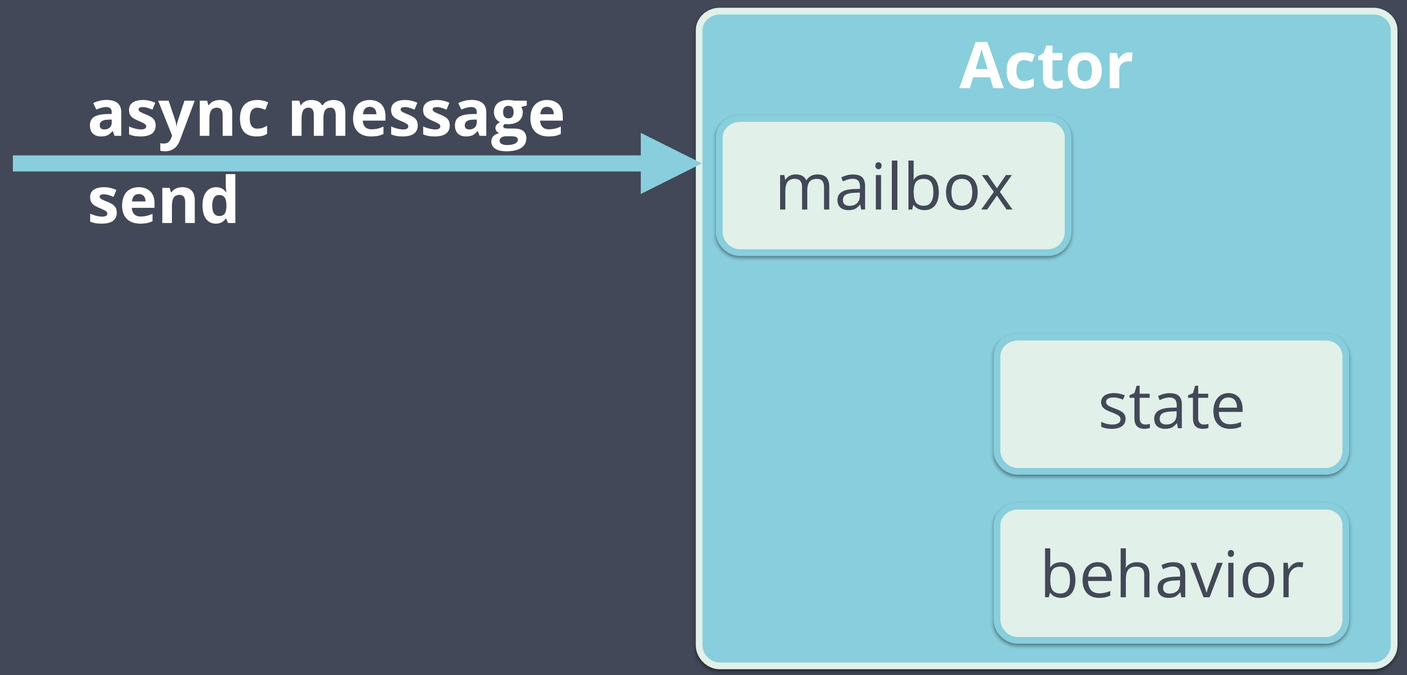


Actors

- Mature and open source
- Scala & Java API
- Akka Cluster

Actors

"an island of consistency in a sea of concurrency"



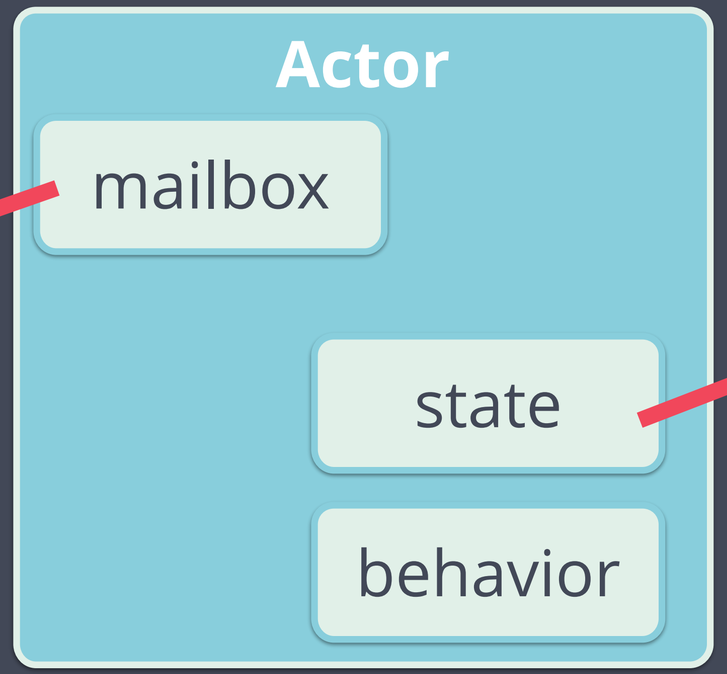
Process message:

- update state
- send messages
- change behavior

Don't worry about concurrency

Actors

A good fit for event-sourcing?

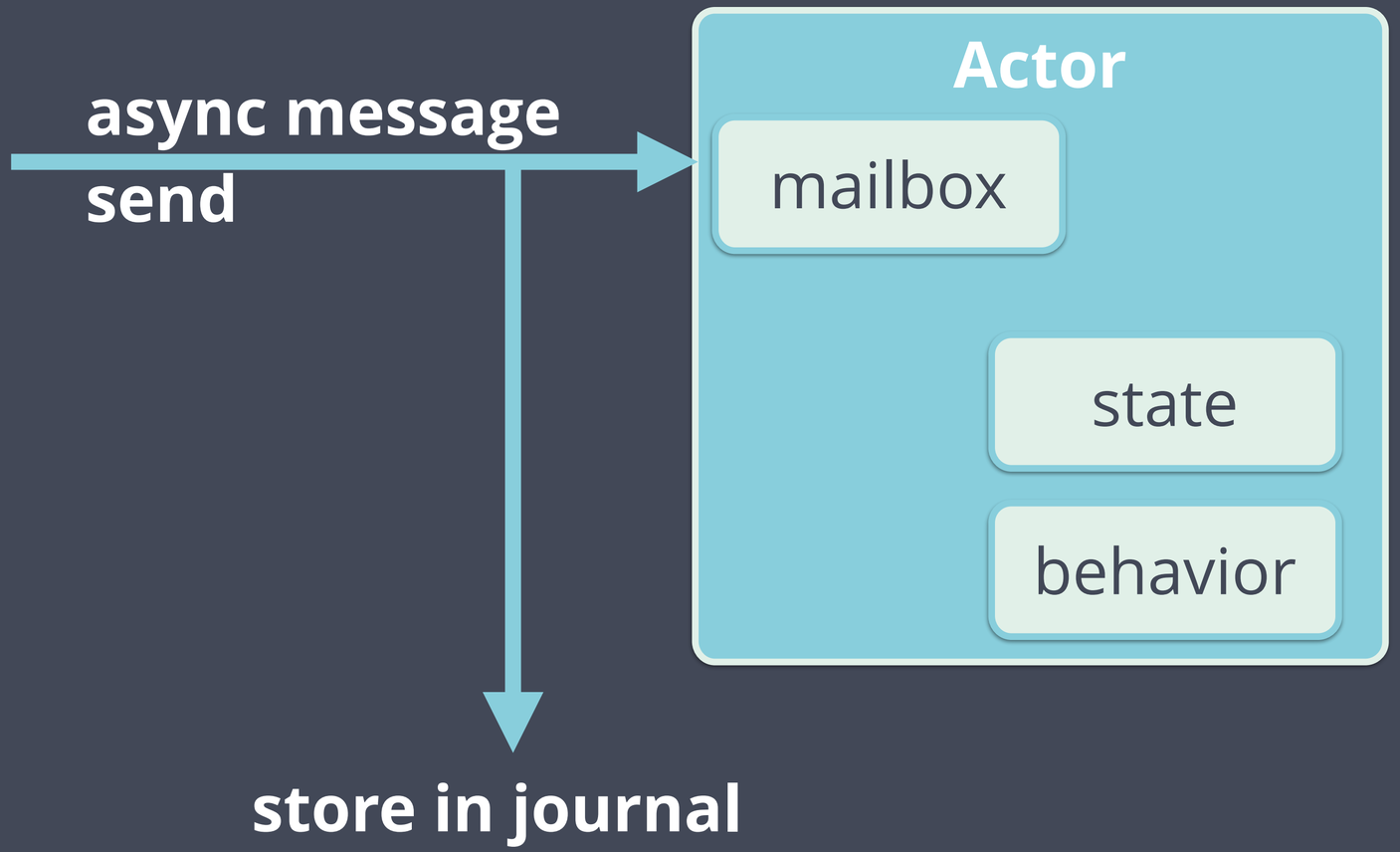


mailbox is non-durable (lost messages)

state is transient

Actors

Just store all incoming messages?



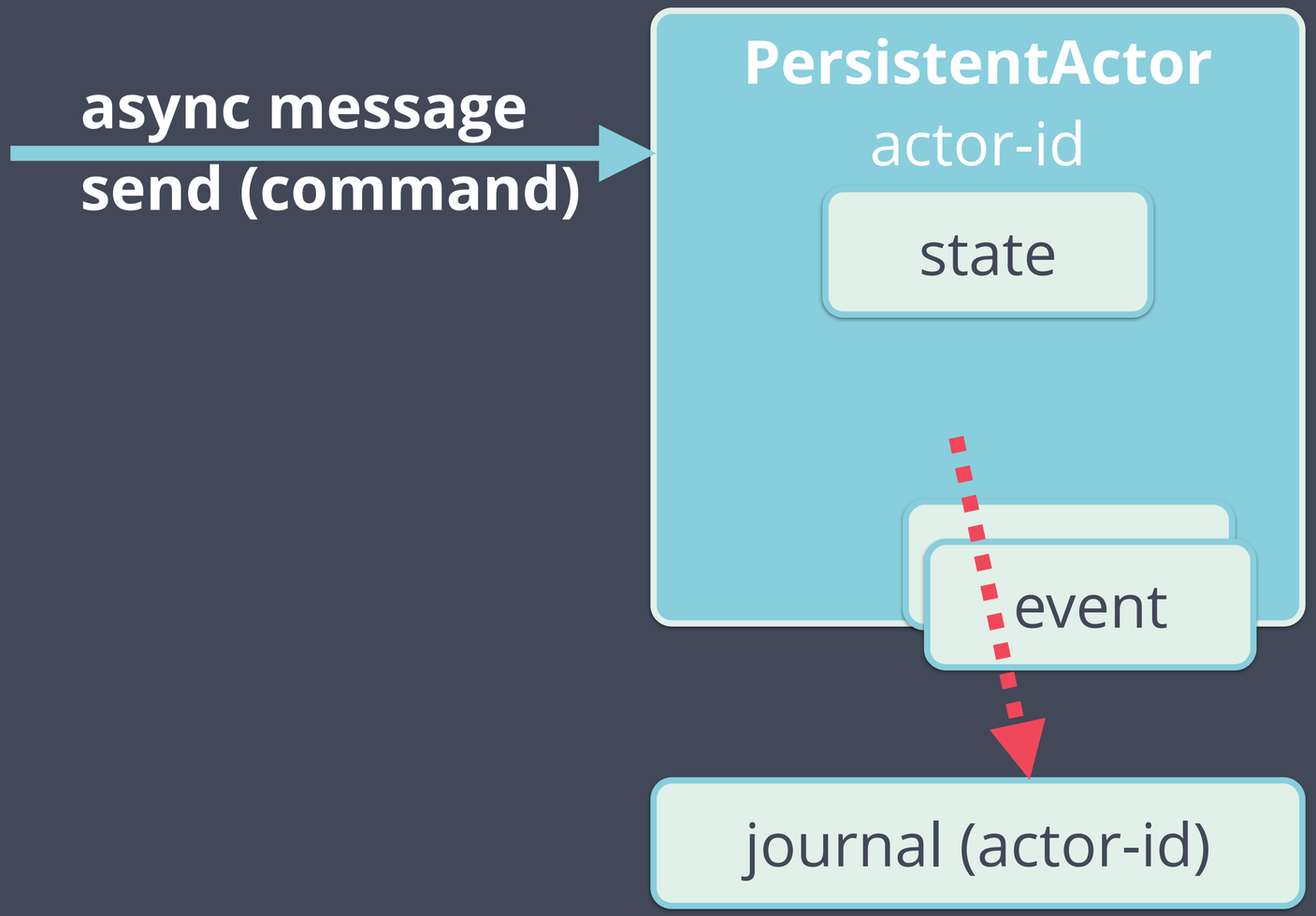
Problems with *command-sourcing:*

- side-effects
- poisonous (failing) messages

Persistence

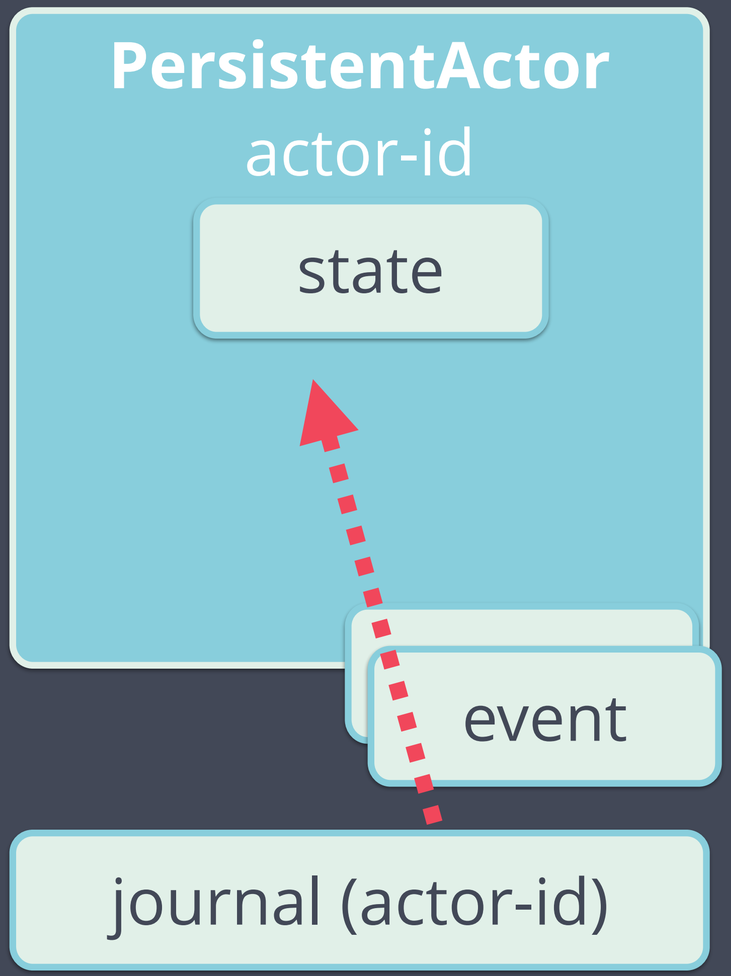
- Experimental Akka module
- Scala & Java API
- Actor state persistence based on event-sourcing

Persistent Actor



- Derive events from commands
- Store events
- Update state
- Perform side-effects

Persistent Actor



Recover by replaying events, that update the state (no side-effects)

Persistent Actor

```
case object Increment      // command
case object Incremented    // event

class CounterActor extends PersistentActor {
  def persistenceId = "counter"

  var state = 0

  val receiveCommand: Receive = {
    case Increment => persist(Incremented) { evt =>
      state += 1
      println("incremented")
    }
  }

  val receiveRecover: Receive = {
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async callback
(but safe to close
over state)

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  }
}
```

Isn't recovery with lots of events slow?

Snapshots

```
class SnapshottingCounterActor extends PersistentActor {
  def persistenceId = "snapshotting-counter"

  var state = 0

  val receiveCommand: Receive = {
    case Increment => persist(Incremented) { evt =>
      state += 1
      println("incremented")
    }
    case "takesnapshot" => saveSnapshot(state)
  }

  val receiveRecover: Receive = {
    case Incremented => state += 1
    case SnapshotOffer(_, snapshotState: Int) => state = snapshotState
  }
}
```

Snapshots

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```

Plugins: Journal & Snapshot

Journal	Snapshot
Cassandra	Cassandra
Kafka	Kafka
DynamoDB	
MongoDB	MongoDB
HBase	HBase
MapDB	
JDBC	JDBC

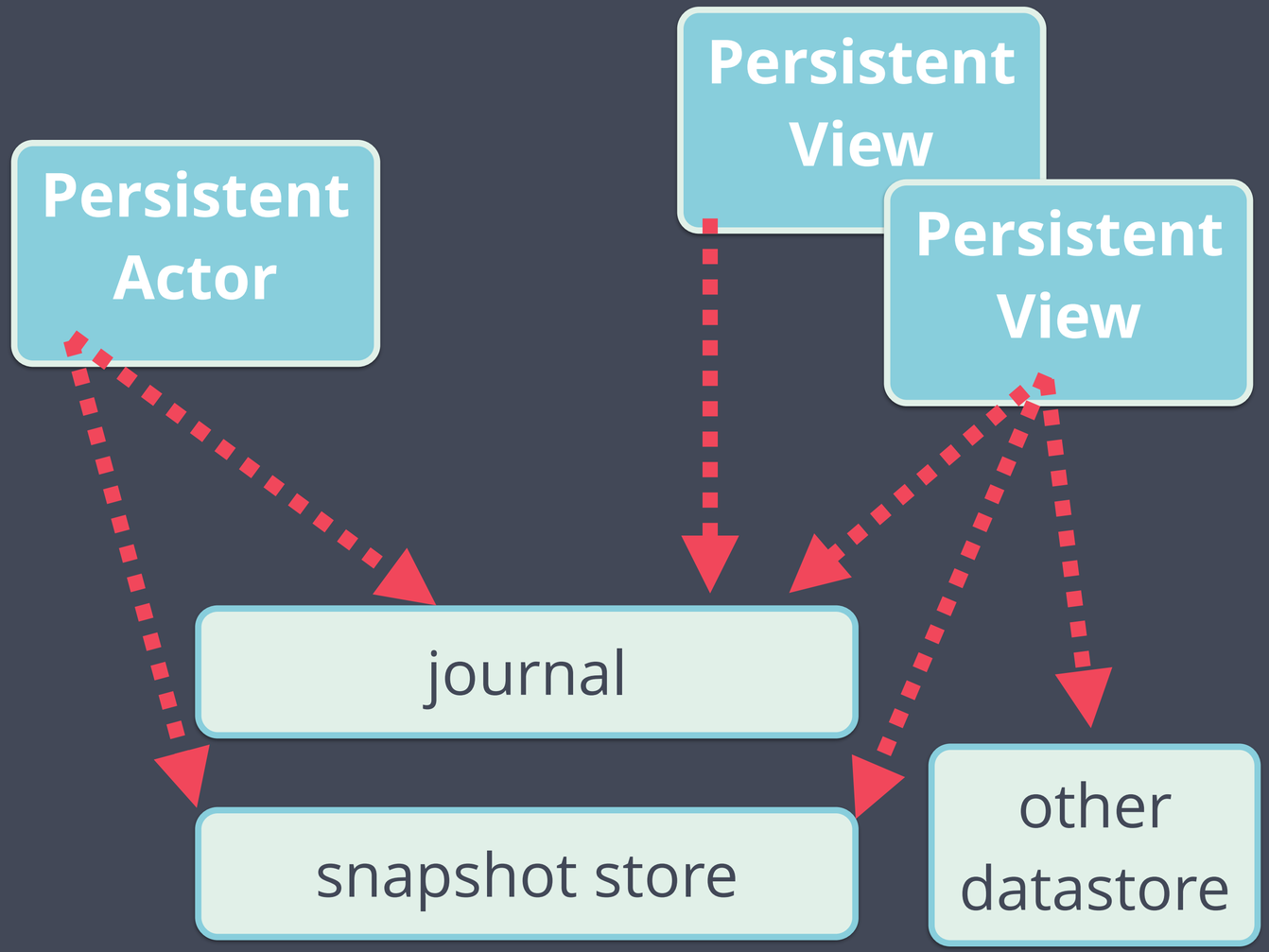
Plugins: Serialization

Default: Java serialization

Pluggable through Akka:

- Protobuf
- Kryo
- Avro
- Your own

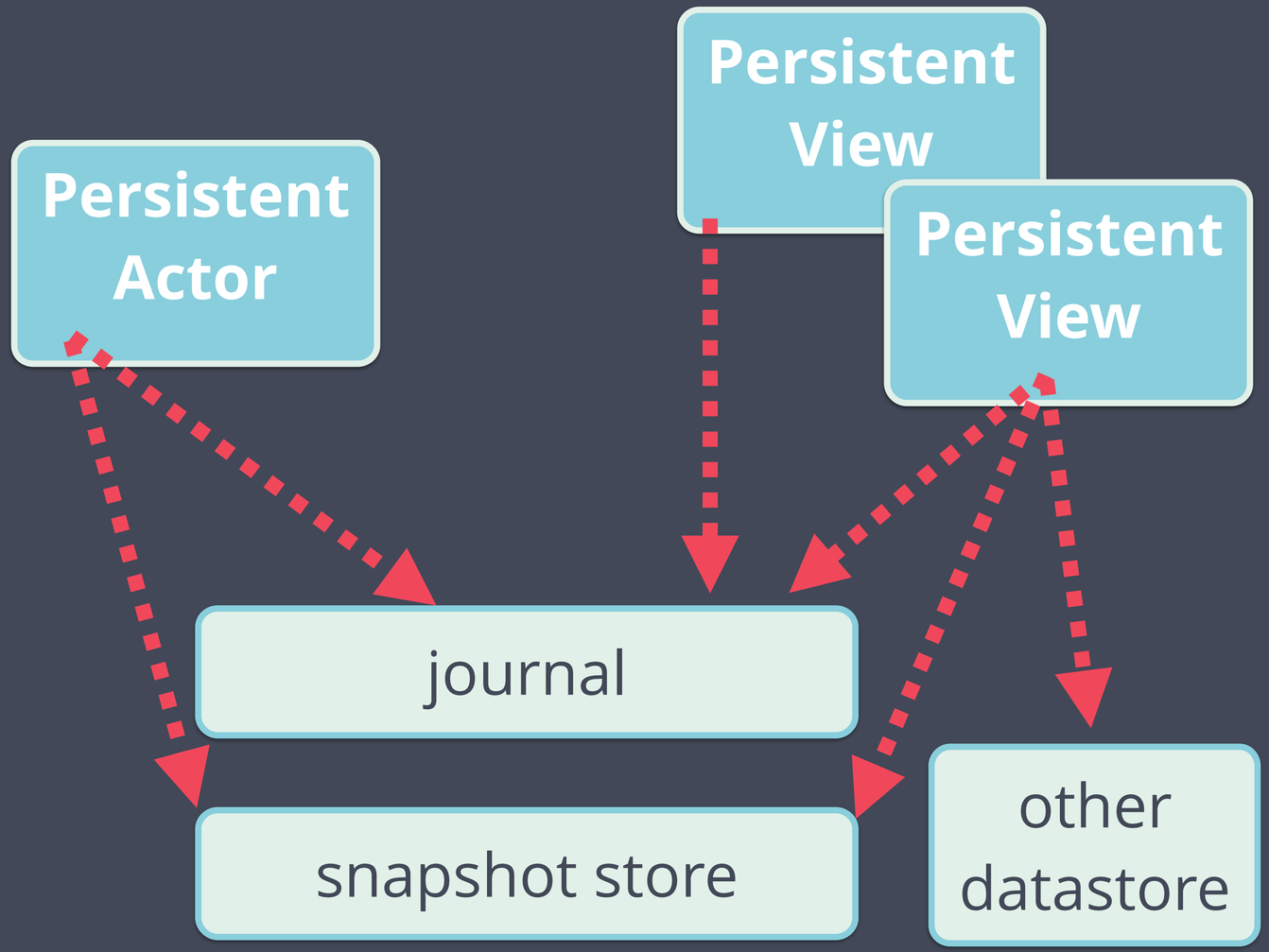
Persistent View



Views poll the journal

- Eventually consistent
- Polling configurable
- Actor may be inactive
- Views track single persistence-id
- Views can have own snapshots

Persistent View



"The Database is a cache of a subset of the log"

- Pat Helland

Persistent View

```
case object ComplexQuery
class CounterView extends PersistentView {
  override def persistenceId: String = "counter"
  override def viewId: String = "counter-view"

  var queryState = 0

  def receive: Receive = {
    case Incremented if isPersistent => {
      queryState = someVeryComplicatedCalculation(queryState)
      // Or update a document/graph/relational database
    }
    case ComplexQuery                => {
      sender() ! queryState;
      // Or perform specialized query on datastore
    }
  }
 }
```

Persistent View

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class CounterView extends PersistentView {
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    }
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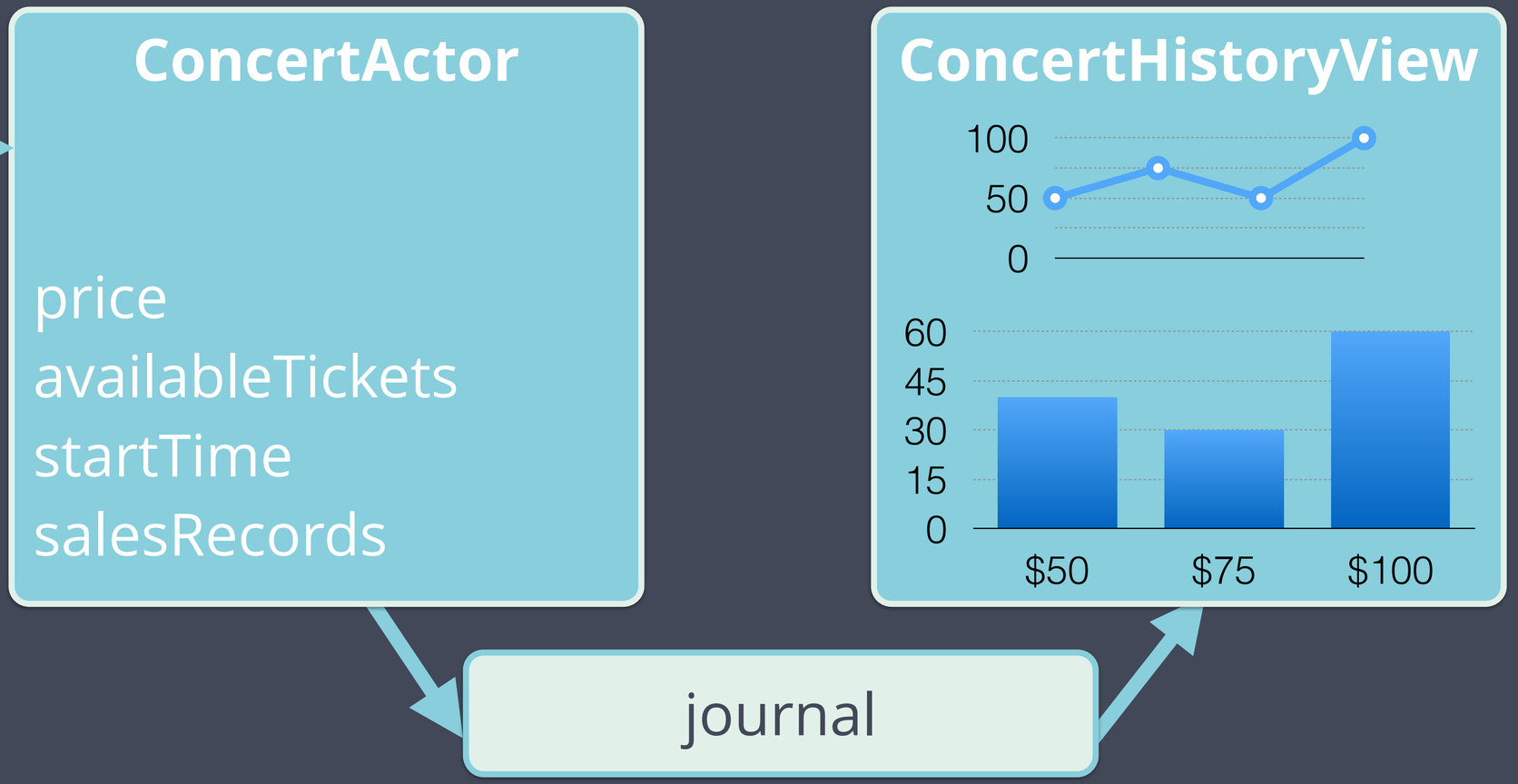
 }
```

Sell concert tickets

code @ bit.ly/akka-es

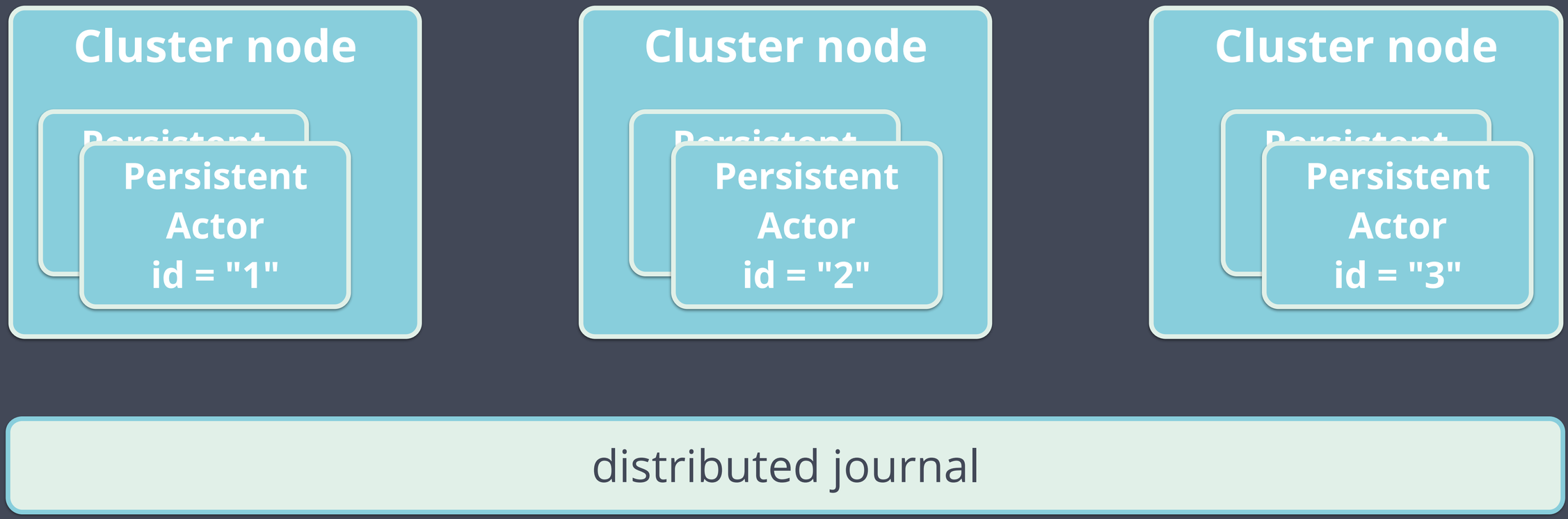
Commands:

CreateConcert
BuyTickets
ChangePrice
AddCapacity



Scaling out: Akka Cluster

Single writer: persistent actor must be singleton, views may be anywhere



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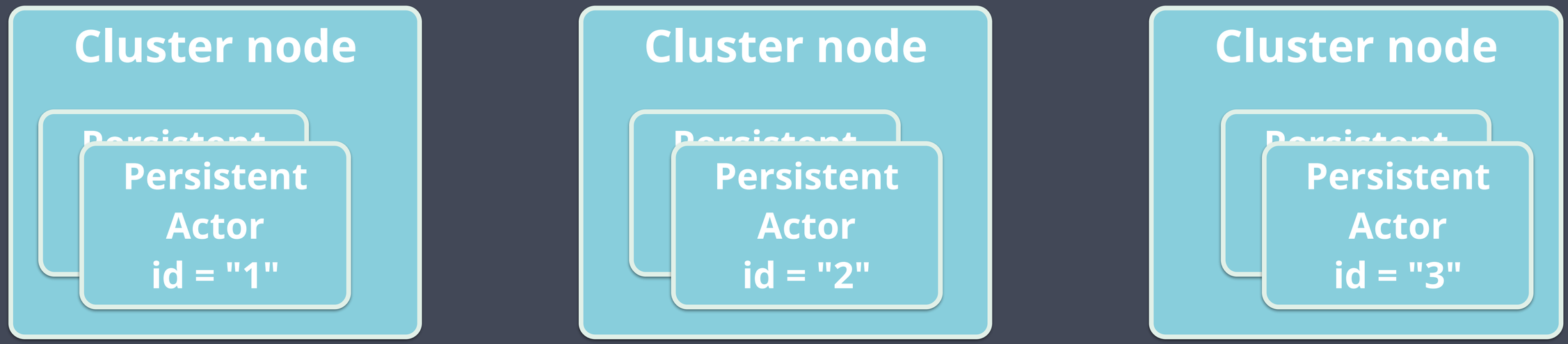
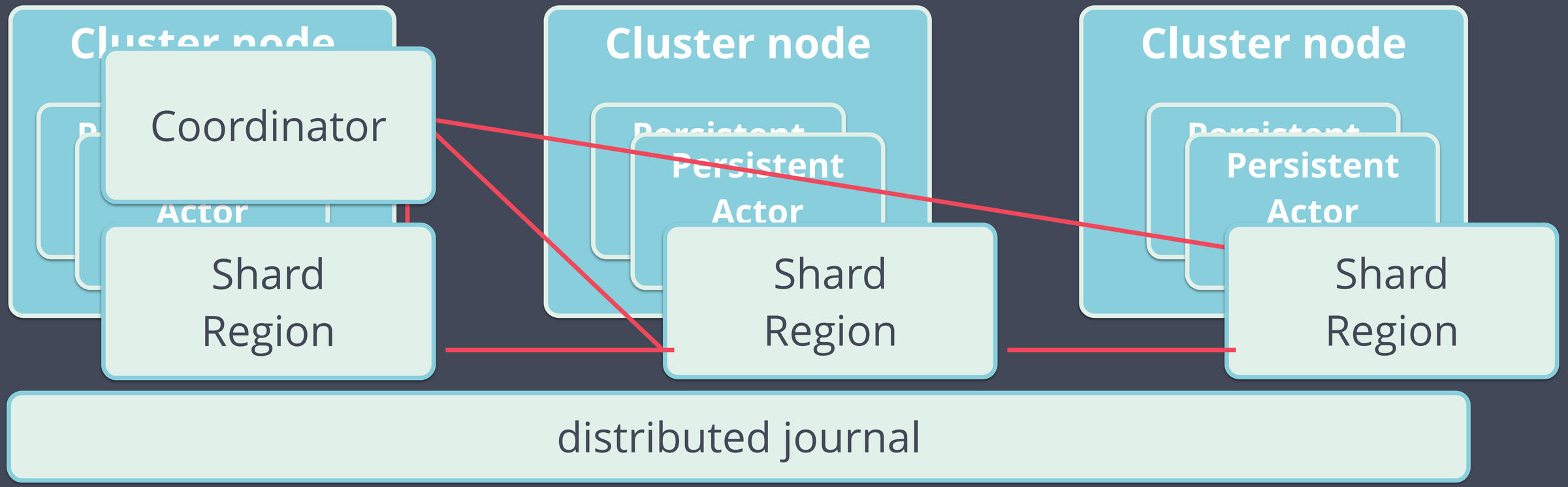
How are persistent actors distributed over cluster?



Scaling out: Akka Cluster

Sharding: Coordinator assigns ShardRegions to nodes (consistent hashing)
Actors in shard can be activated/passivated, rebalanced



Scaling out: Sharding

```
val idExtractor: ShardRegion.IdExtractor = {
    case cmd: Command => (cmd.concertId, cmd)
}
```

IdExtractor allows ShardRegion to route commands to actors

Scaling out: Sharding

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ShardResolver assigns new actors to shards

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```
ClusterSharding(system).start(
 typeName = "Concert",
 entryProps = Some(ConcertActor.props()),
 idExtractor = ConcertActor.idExtractor,
 shardResolver = ConcertActor.shardResolver)
```

Initialize ClusterSharding extension

Scaling out: Sharding

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 typeName = "Concert",
 entryProps = Some(ConcertActor.props()),
 idExtractor = ConcertActor.idExtractor,
 shardResolver = ConcertActor.shardResolver)
```

Initialize ClusterSharding extension

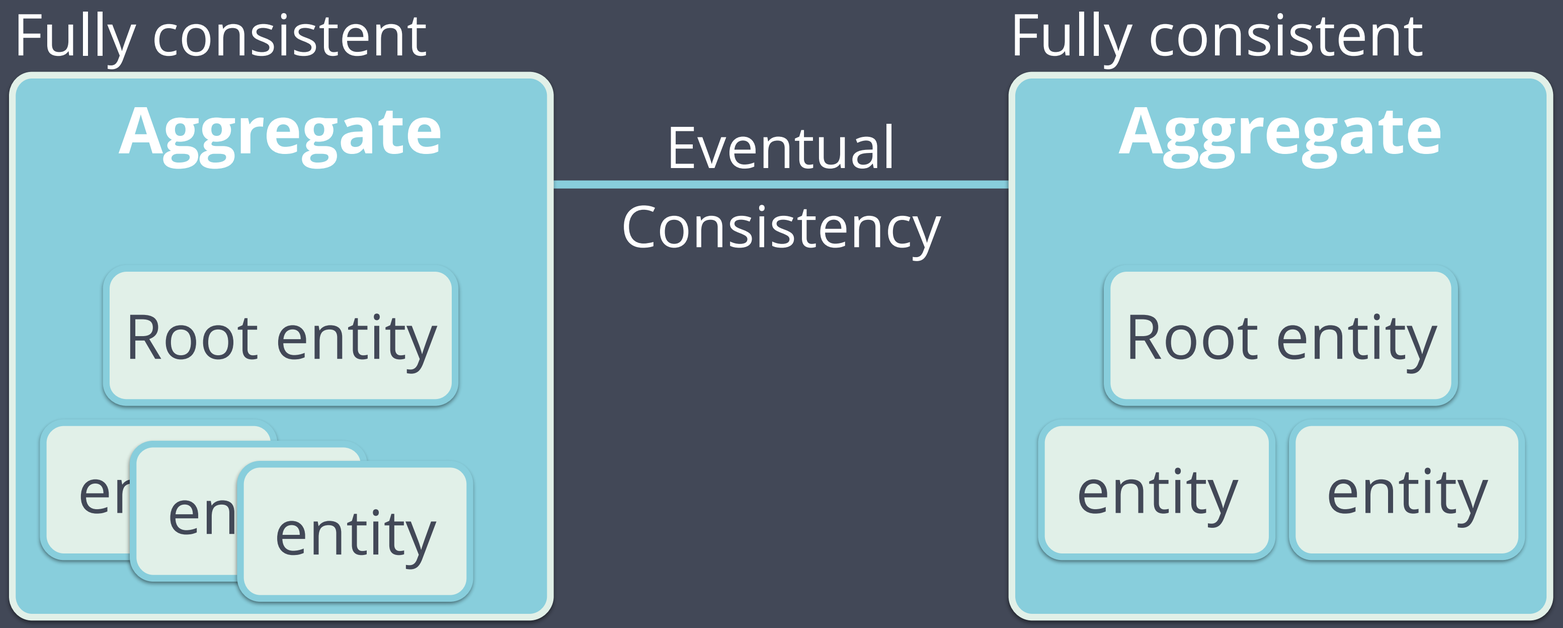
```
val concertRegion: ActorRef = ClusterSharding(system).shardRegion("Concert")

concertRegion ! BuyTickets(concertId = 123, user = "Sander", quantity = 1)
```

Design for event-sourcing

DDD+CQRS+ES

DDD: Domain Driven Design



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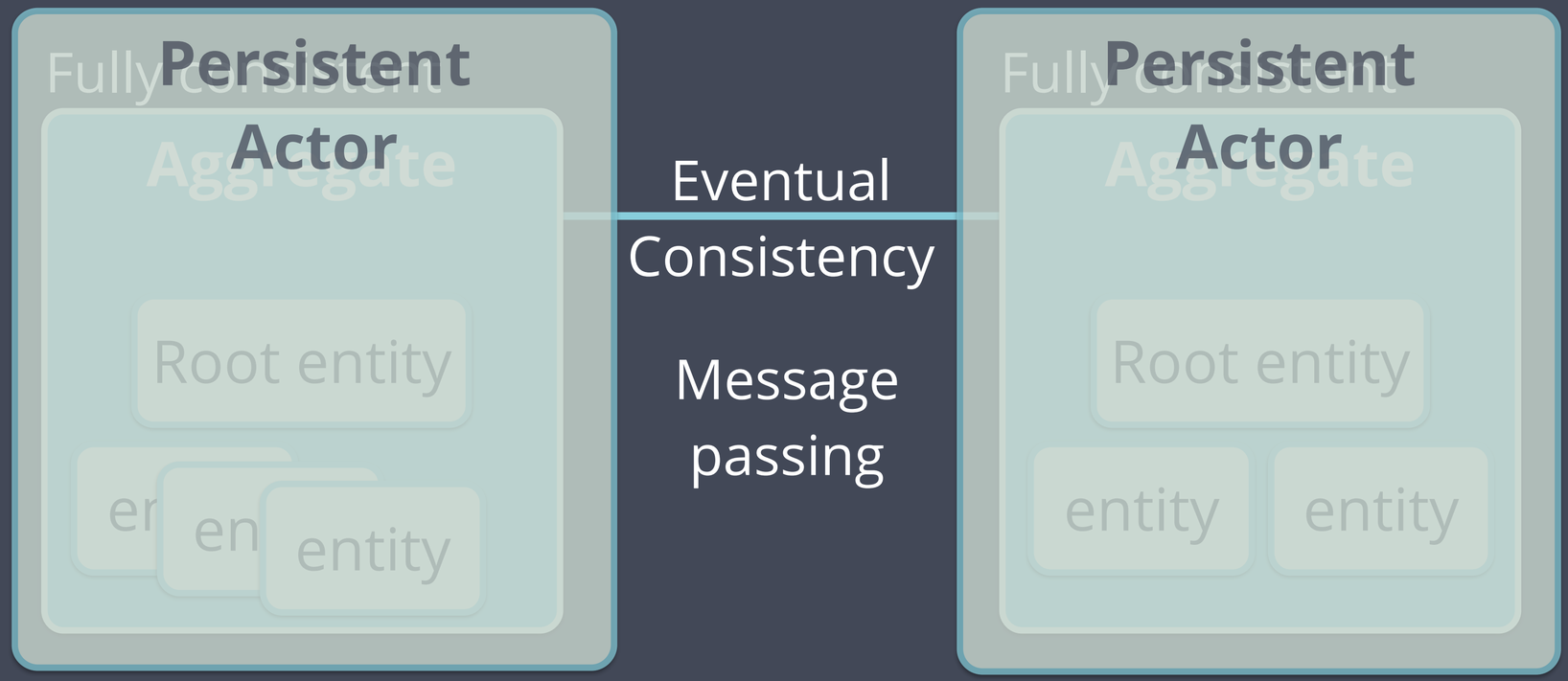

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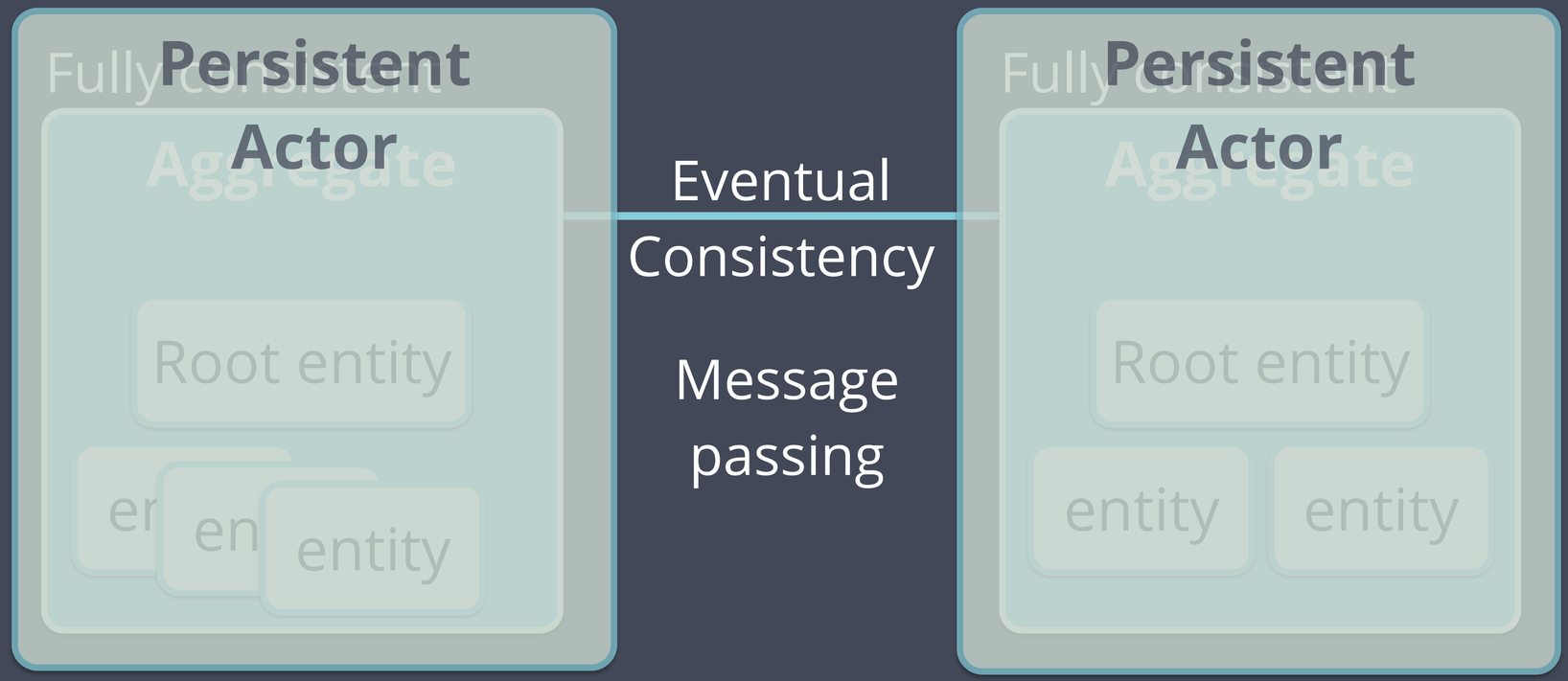

Akka Persistence is **not** a DDD/CQRS framework

But it comes awfully close

Designing aggregates

Focus on **events**

Structural representation(s) follow

Designing aggregates

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Size matters. Faster replay, less write contention
Don't store derived info (use views)

Designing aggregates

Focus on **events**
Structural representation(s) follow

Size matters. Faster replay, less write contention
Don't store derived info (use views)

With CQRS **read-your-writes** is not the default
When you need this, model it in a single Aggregate

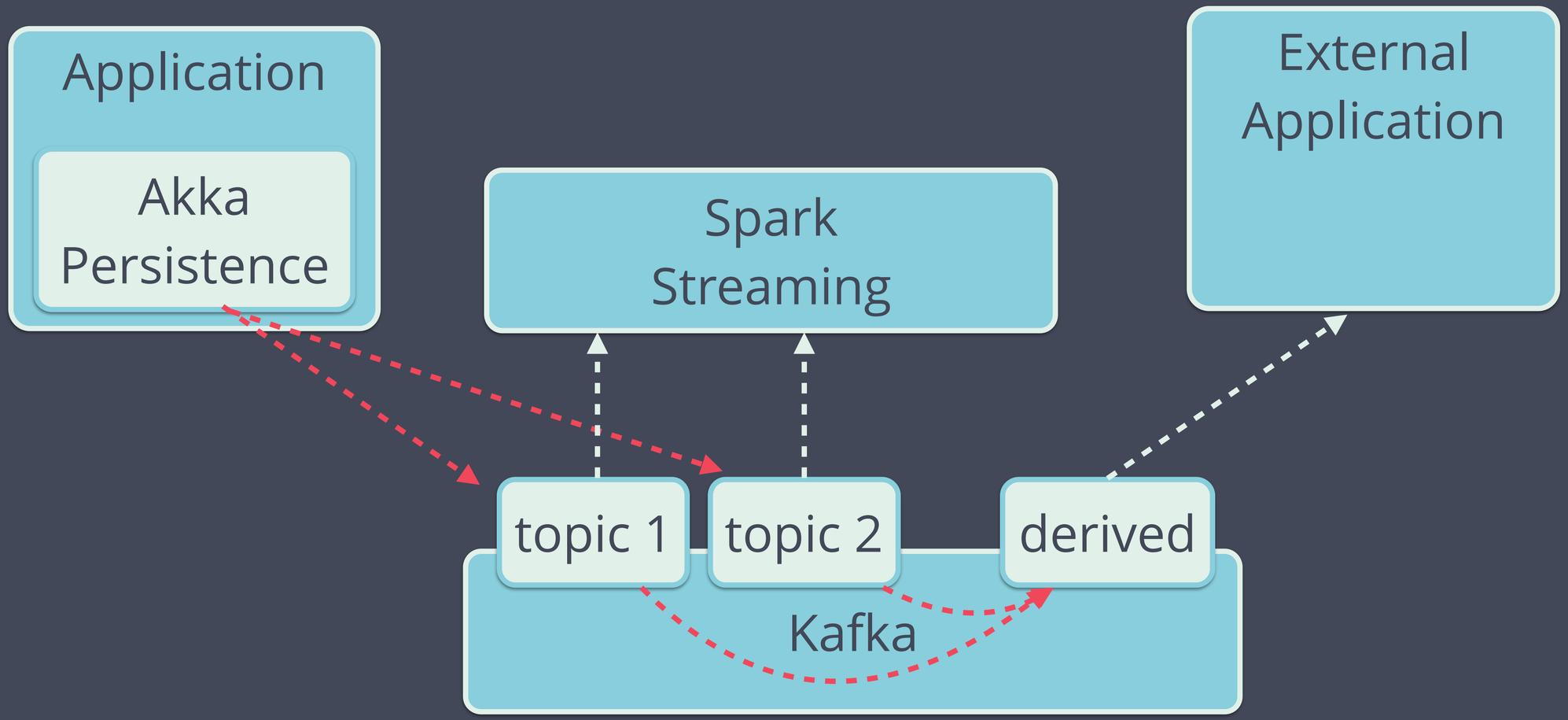
Between aggregates

- Send commands to other aggregates by id

- No distributed transactions
- Use business level ack/nacks
  - SendInvoice -> InvoiceSent/InvoiceCouldNotBeSent
  - Compensating actions for failure
- No guaranteed delivery
- Alternative: *AtLeastOnceDelivery*

Between systems

System integration through event-sourcing



Designing commands

- Self-contained
- Unit of atomic change
- Granularity and intent

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UpdateAddress
street = …
city = …

vs

ChangeStreet
street = …

ChangeCity
street = …

Designing commands

- Self-contained
- Unit of atomic change
- Granularity and intent

UpdateAddress
street = …
city = …

vs

ChangeStreet
street = …

ChangeCity
street = …

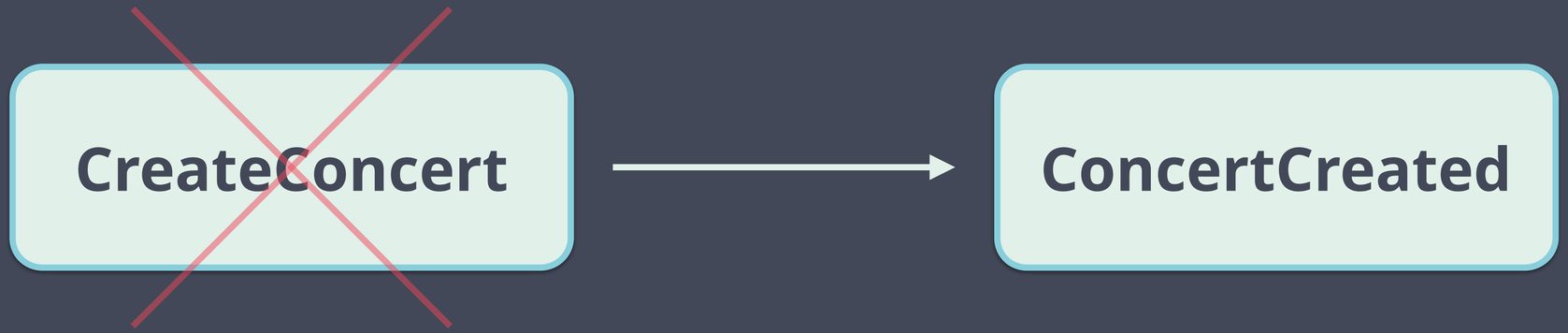
vs

Move
street = …
city = …

Designing events

CreateConcert

Designing events



Past tense
Irrefutable

Designing events

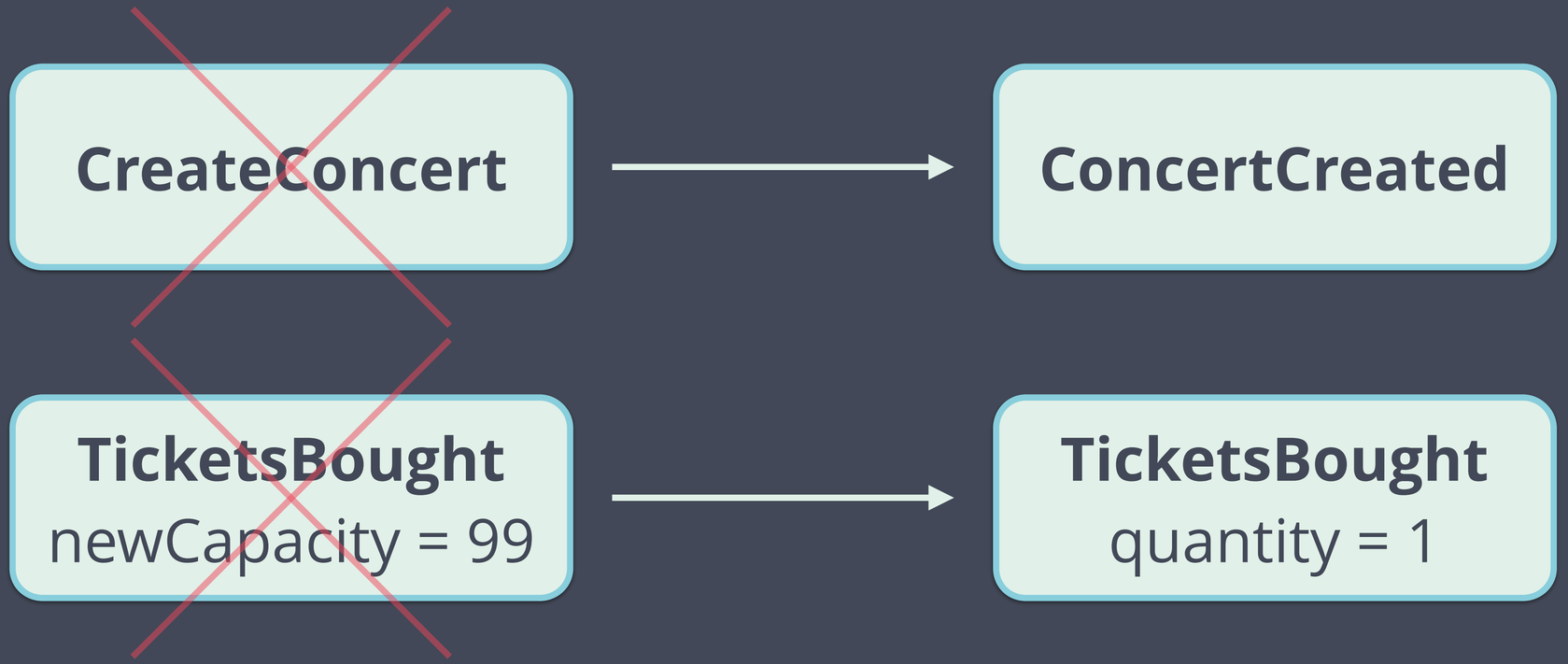
~~**CreateConcert**~~

ConcertCreated

Past tense
Irrefutable

TicketsBought
newCapacity = 99

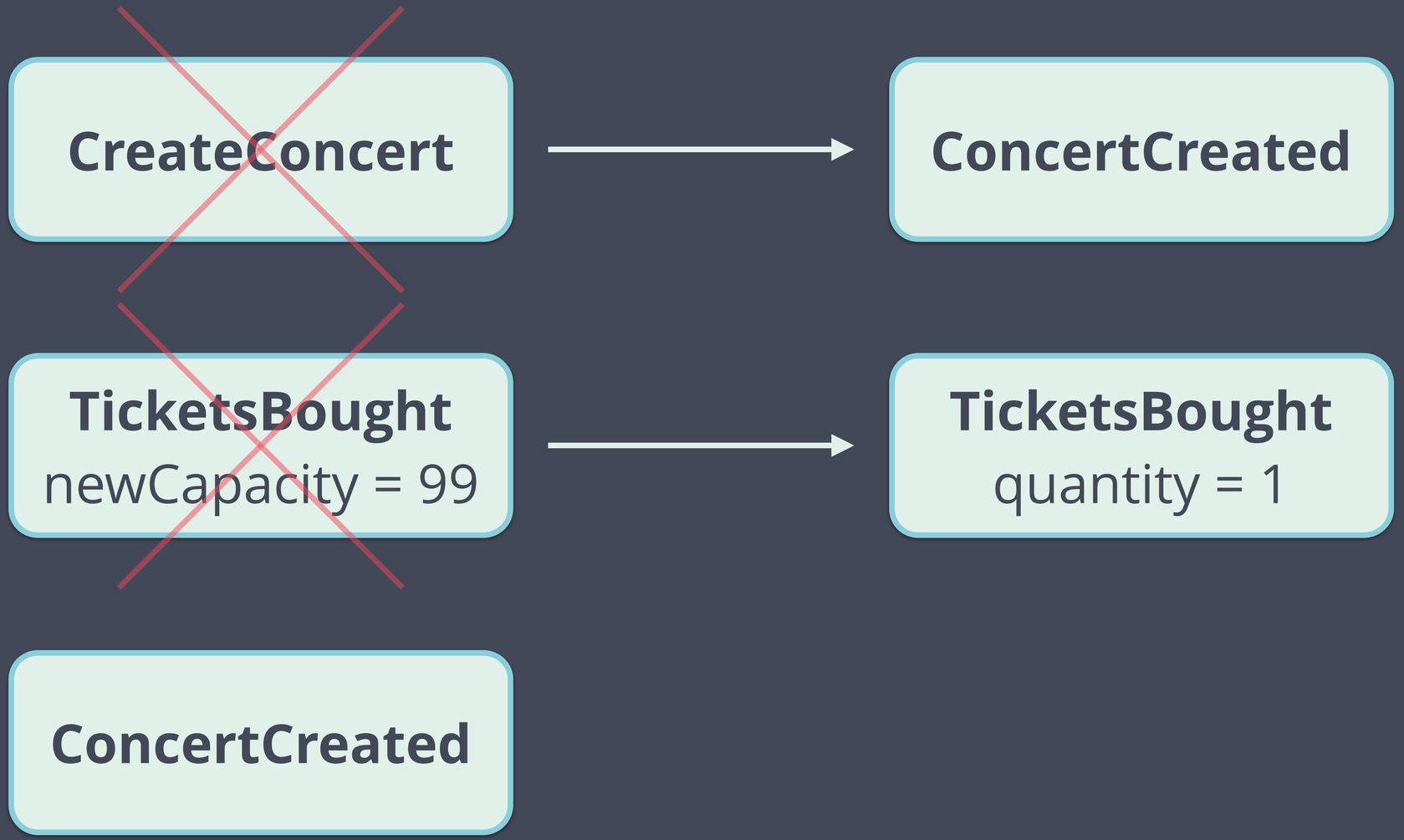
Designing events



Past tense
Irrefutable

Delta-based
No derived info

Designing events



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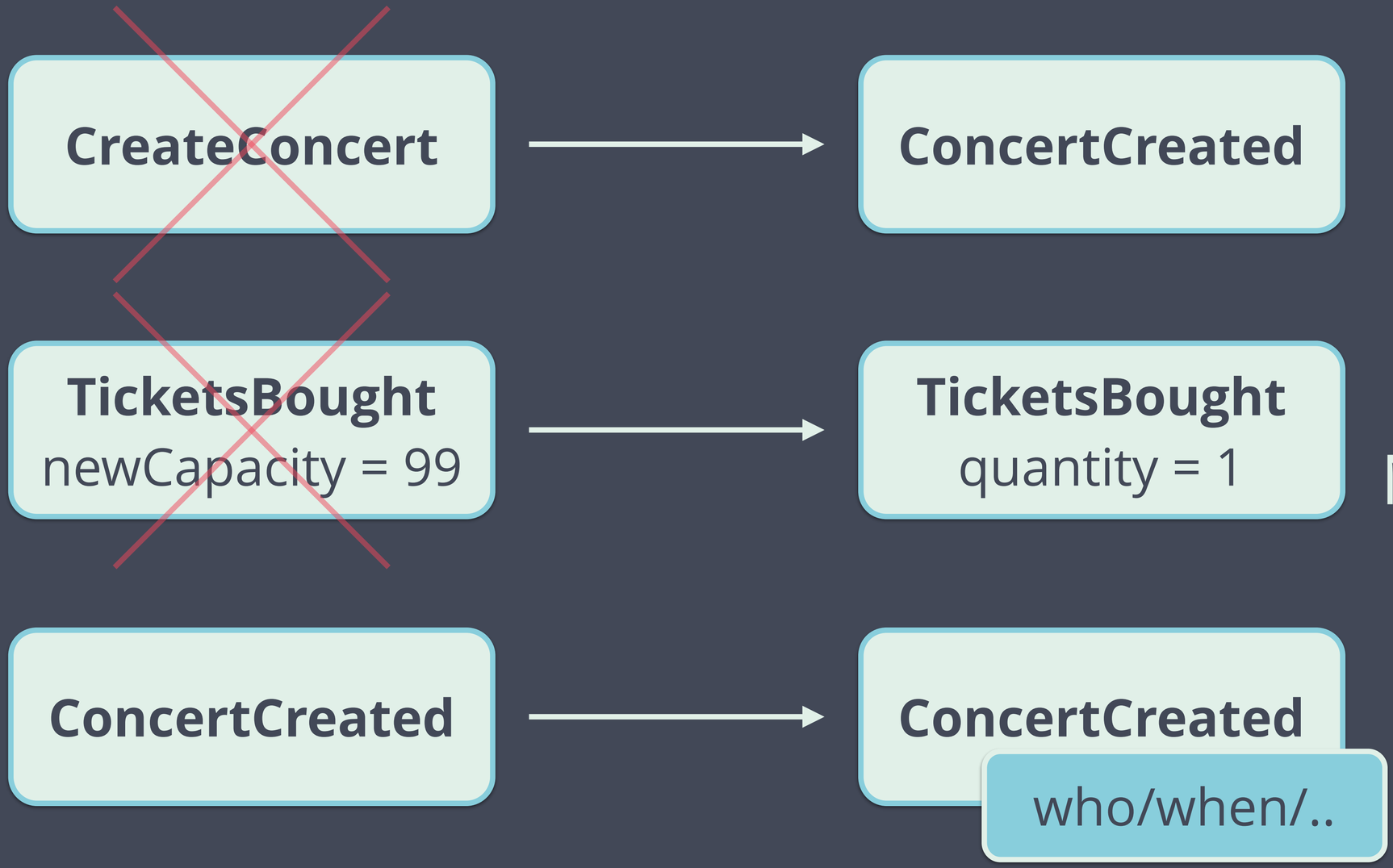
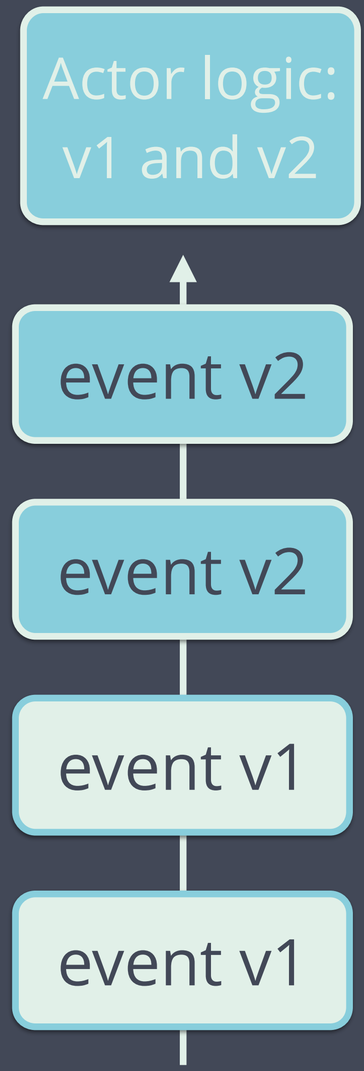
No derived info

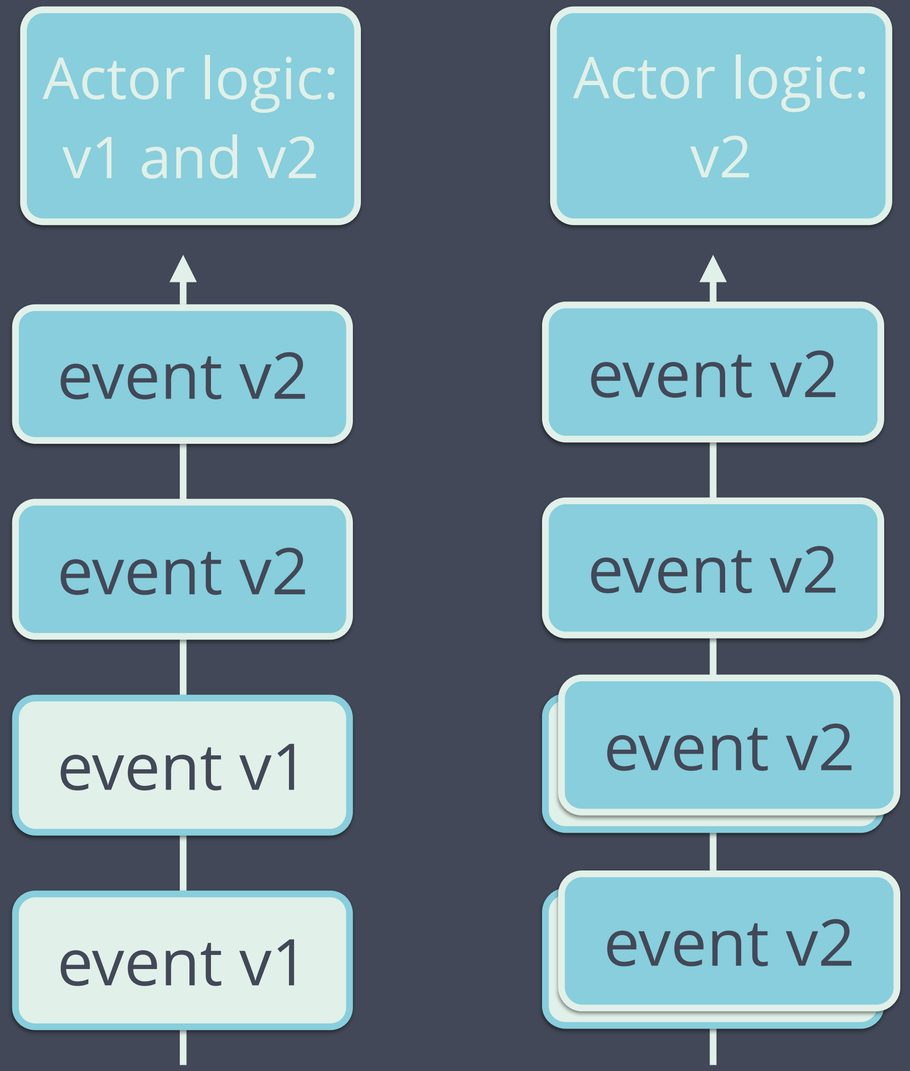
Designing events



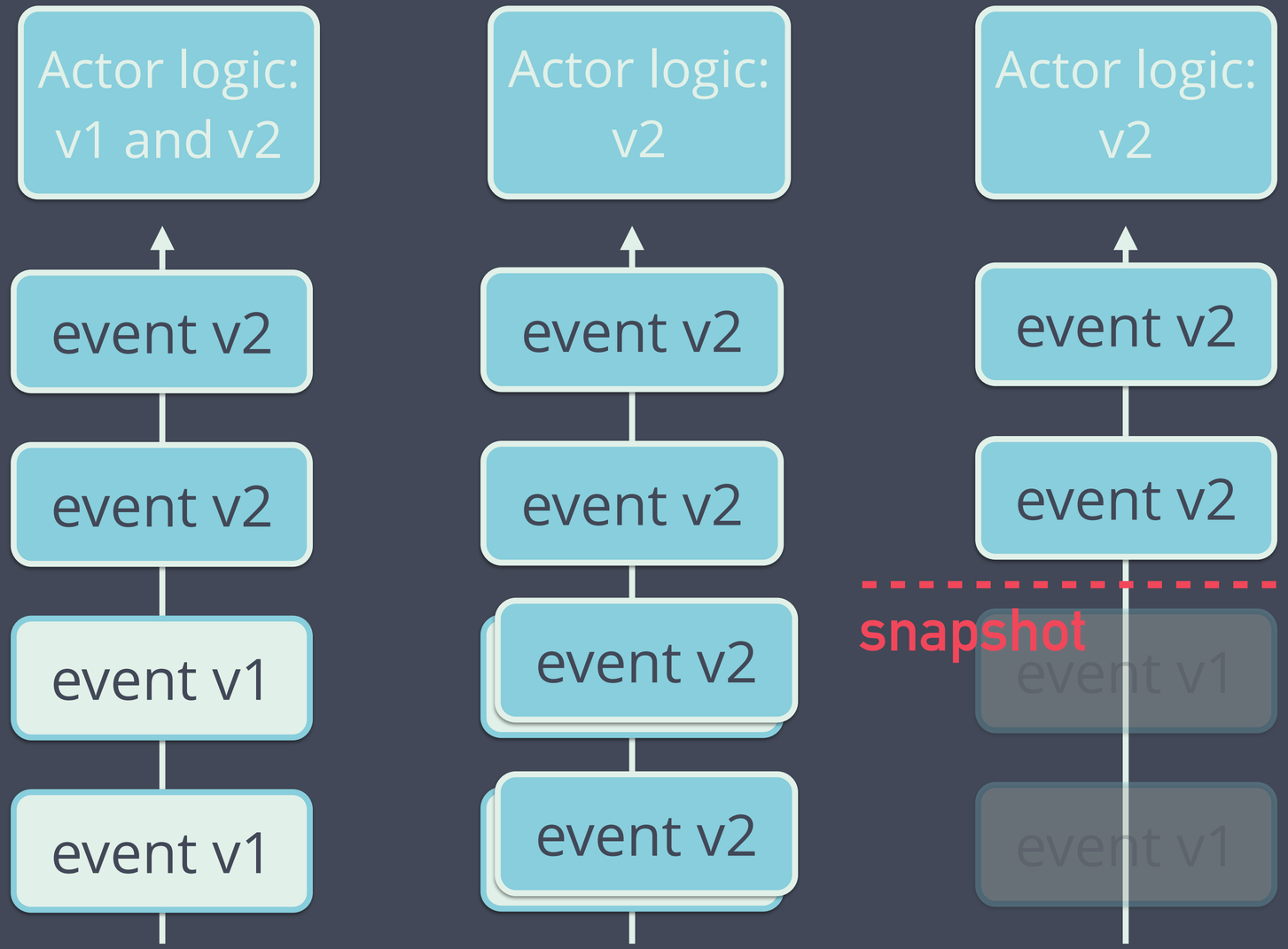
Versioning



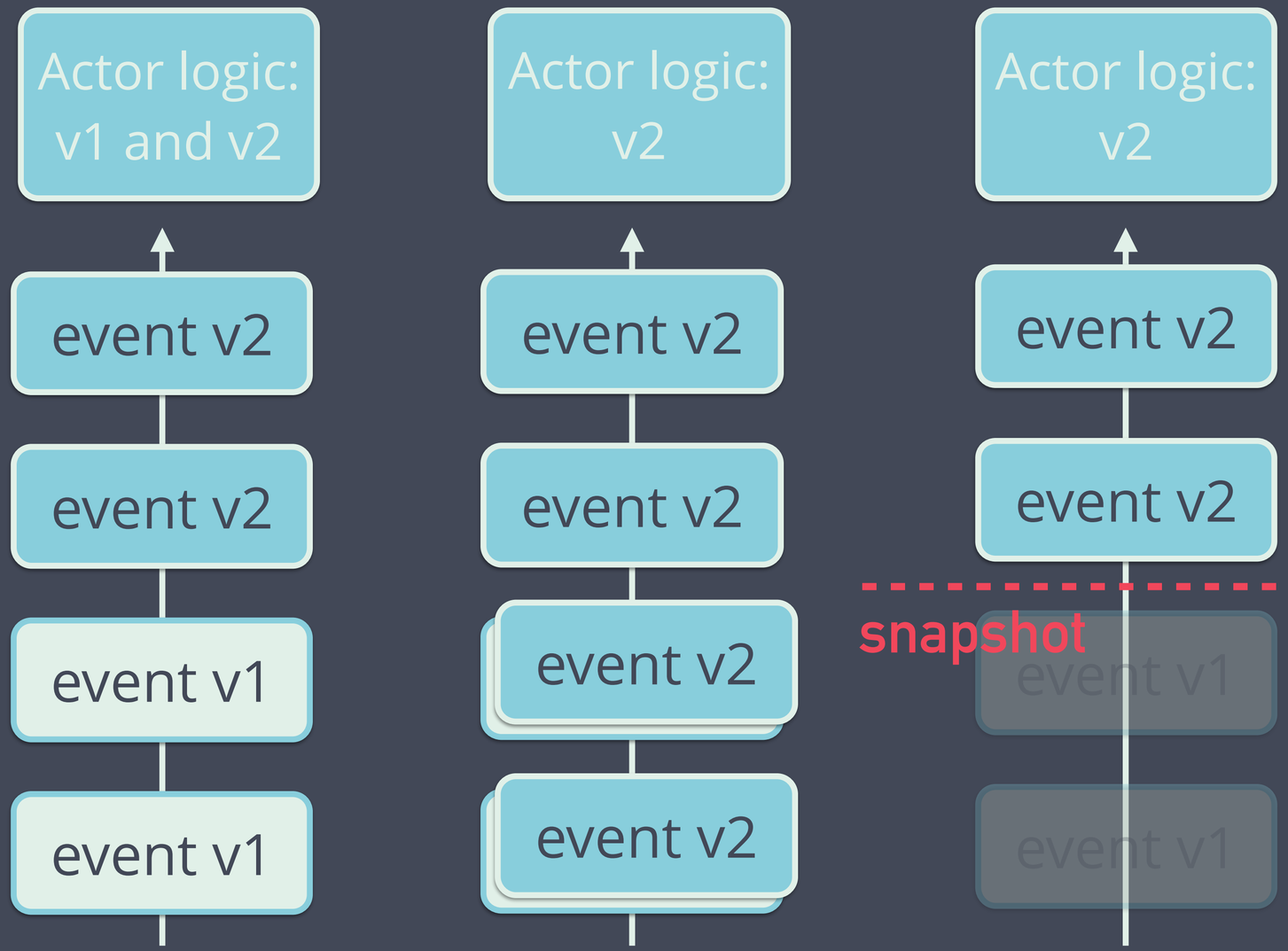
Versioning


Actor logic:
v1 and v2
event v2
event v2
event v1
event v1
Actor logic:
v2
event v2
event v2
event v2
event v2

Versioning


Actor logic: v1 and v2
Actor logic: v2
Actor logic: v2
event v2
event v2
event v1
event v1
event v2
event v2
event v2
event v2
event v2
event v2
snapshot
event v1
event v1

Versioning



- Be backwards compatible
- Avro/Protobuf
- Serializer can do translation

- Snapshot versioning: harder

In conclusion

Event-sourcing is...

Powerful

but unfamiliar

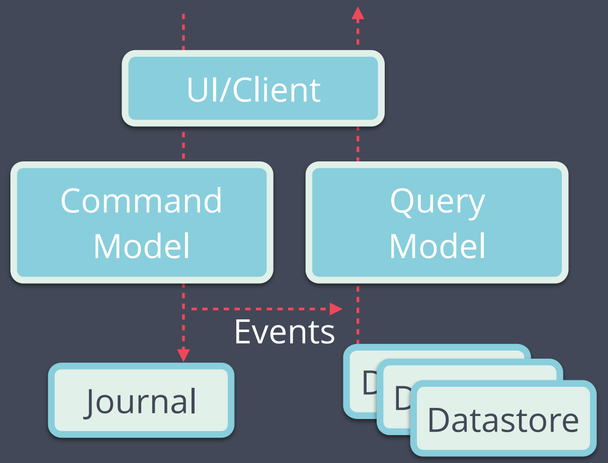
In conclusion

Event-sourcing is...

Powerful

but unfamiliar

Combines well with



DDD/CQRS

In conclusion

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Powerful

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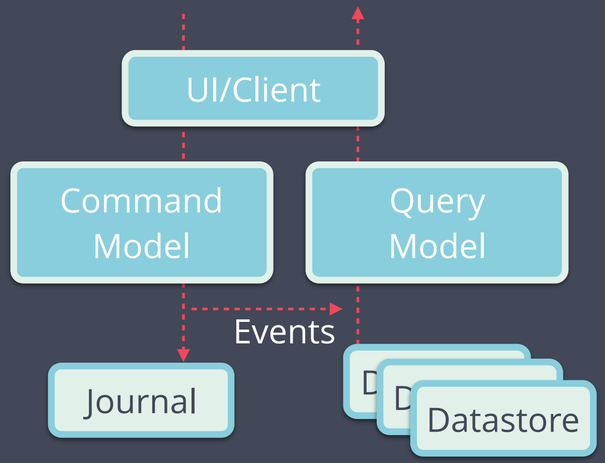


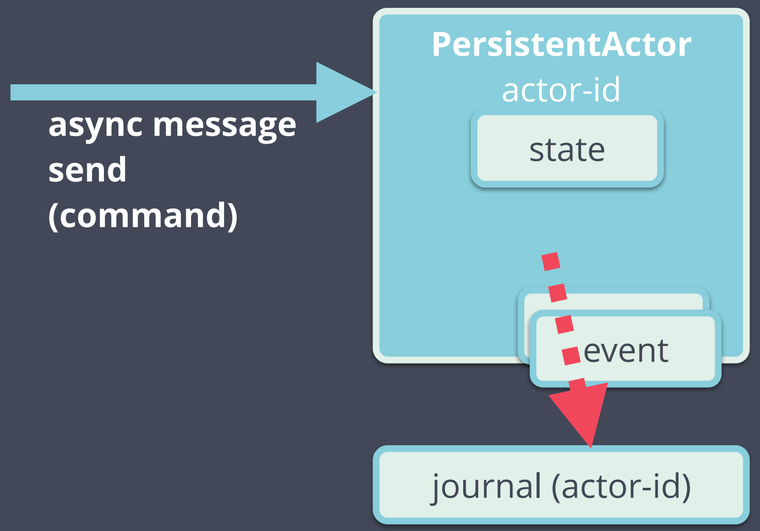
DDD/CQRS

Not a

In conclusion

Akka Actors & Akka Persistence

A good fit for event-sourcing



Experimental, view improvements needed

Thank you.

code @ bit.ly/akka-es

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Luminis Technologies