EVENT STORE®

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What is an Event Store?

It’s a database which supports concept of event sourcing.

Event Store Features

- Open Source
- Event Sourcing
- Append only
- Projections

Event Store Features:

Client Interfaces

Multiplatform

High Availability

How can be used?

- CQRS architectures
- Message queuing
- Storing events and notifications
- Auditing and archiving

Event Store

Old World

Relational Database Management Systems (RDBMS) like SQL Server

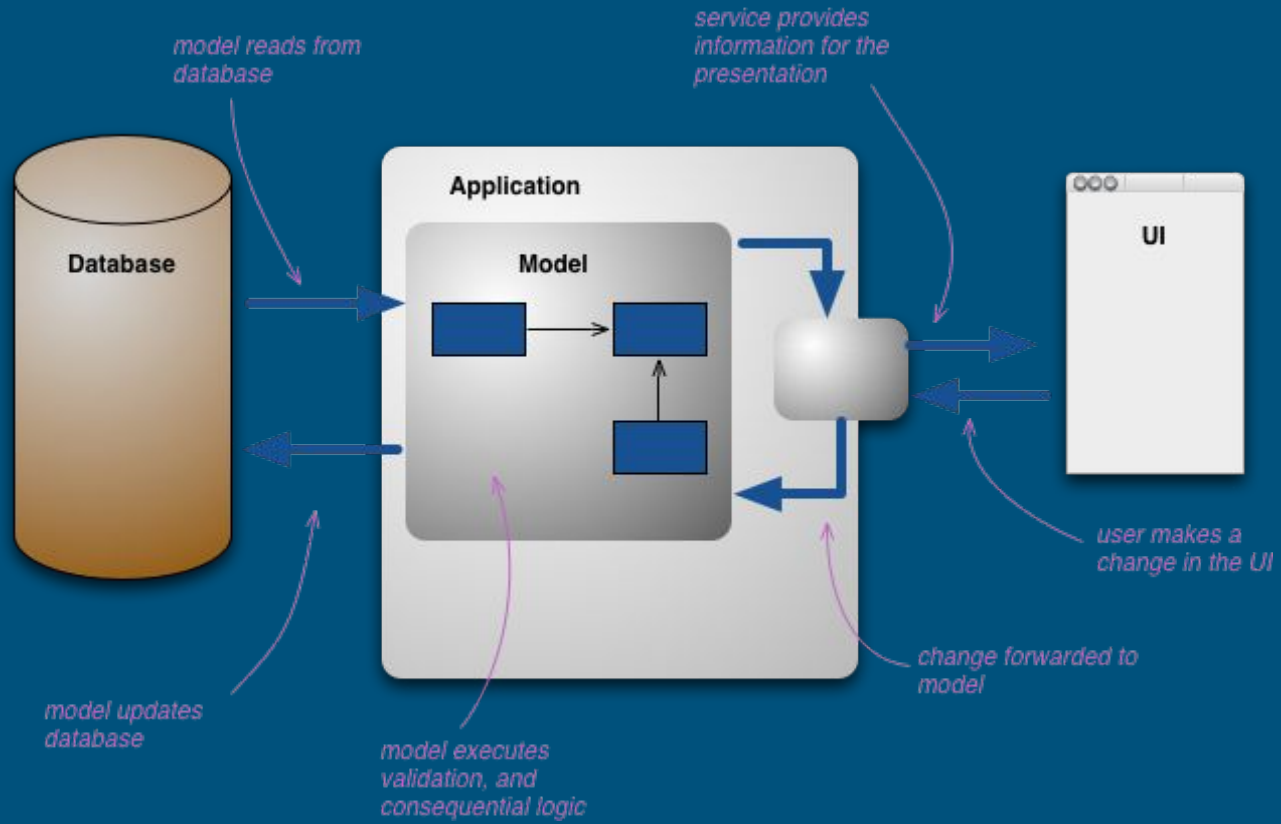
- Optimised for write, read *and* update
- Flexible, dynamic queries
- Indices help with returning data, but are often incorrectly defined, or aren’t even created
- Object-relational impedance mismatch
- Designed for client/server operation rather than HTTP/TCP based communication

New World

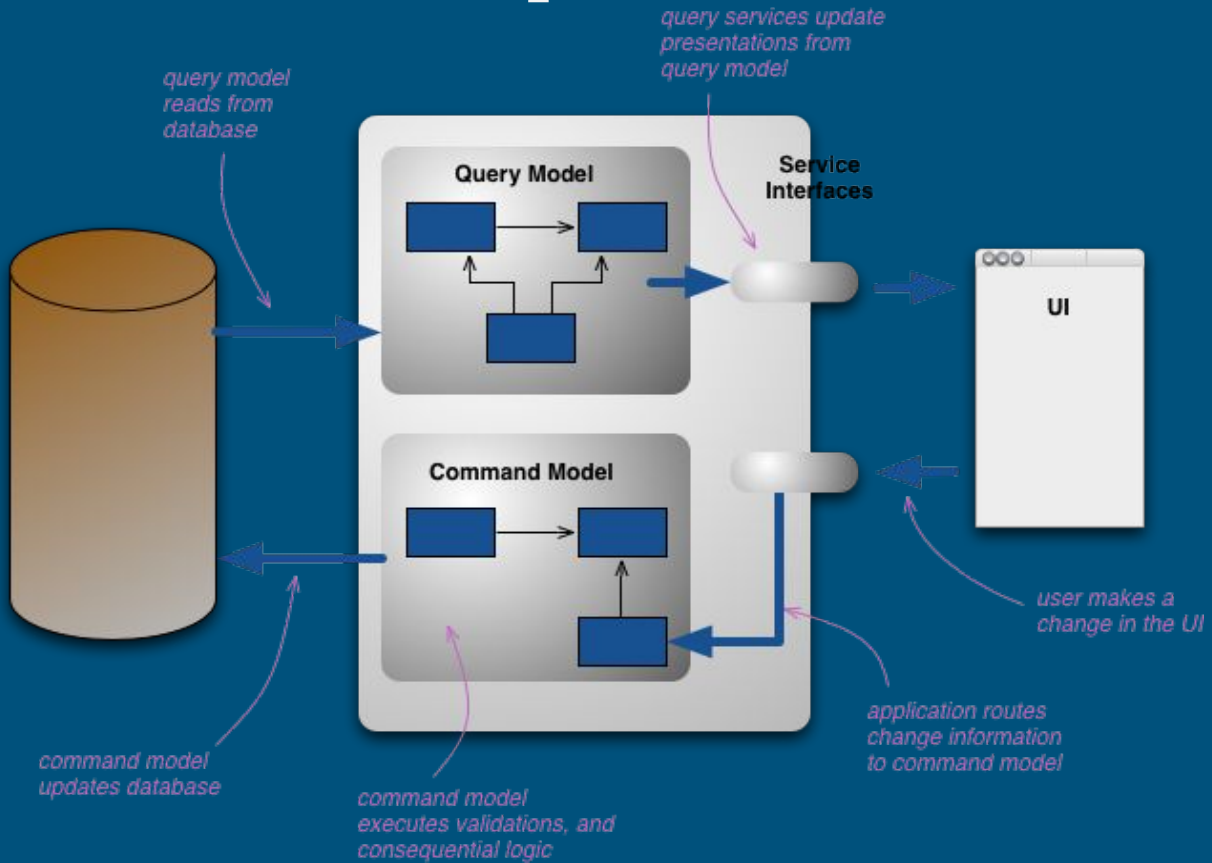
Document databases such as … MongoDB, CouchDB, RavenDB and Event Store (strictly a streaming database)

- Store objects, as … well objects, in JSON, BSON (Binary JSON-ish), XML
- Often include REST and HTTP interfaces for GET, POST, UPDATE, DELETE
- Metadata can be as important as the object data itself – not just versioning

Architecture with CRUD operations



Different Read and Update Models:



Event Store Fundamentals

- CQRS
- Event Sourcing

CQRS

- Command Query Responsibility Segregation
- Pattern first heard from Greg Young
- Notion of using different model to update information
- Can be valuable
- Can add risky complexity

Event

- Event is something that happened in the past and has a business meaning.
- Events are persisted in event streams.
- Event stream is a time ordered sequence of events in time.
- Conceptually its append only.

Event Model

Consists of event data and some system data

eventId - event identifier (could be generated by db)

eventType - defines type of event

data - custom event data

metadata - event metadata

Sample Event


```
{
    "eventId": "8cfedd64-7e40-47ee-a16c-e57e2987783b",
    "eventType": "TemperatureMeasured",
    "data": {
        "zone": "Ireland",
        "server": "web1",
        "temperature": 64
    }
```

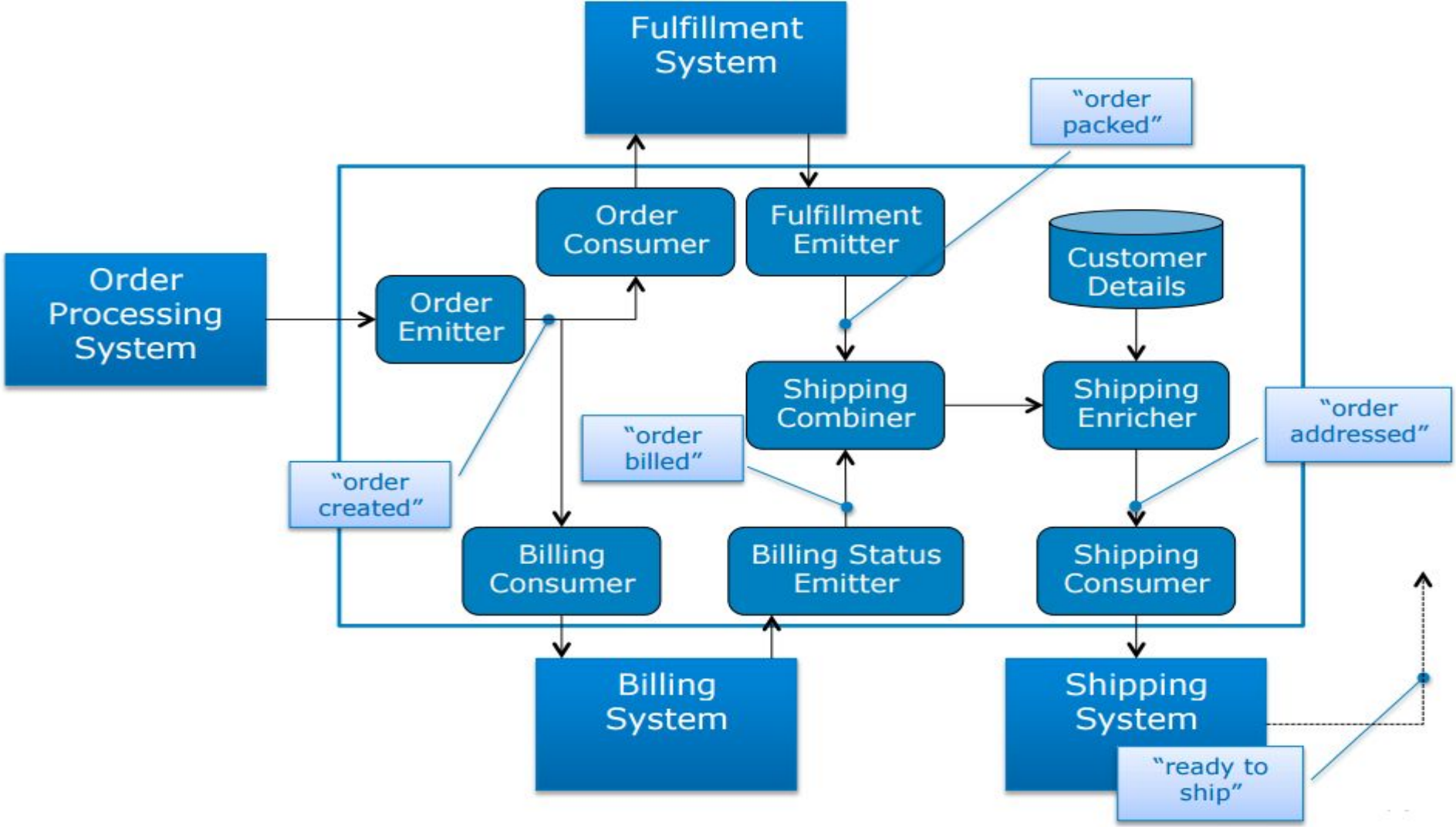
Event Metadata

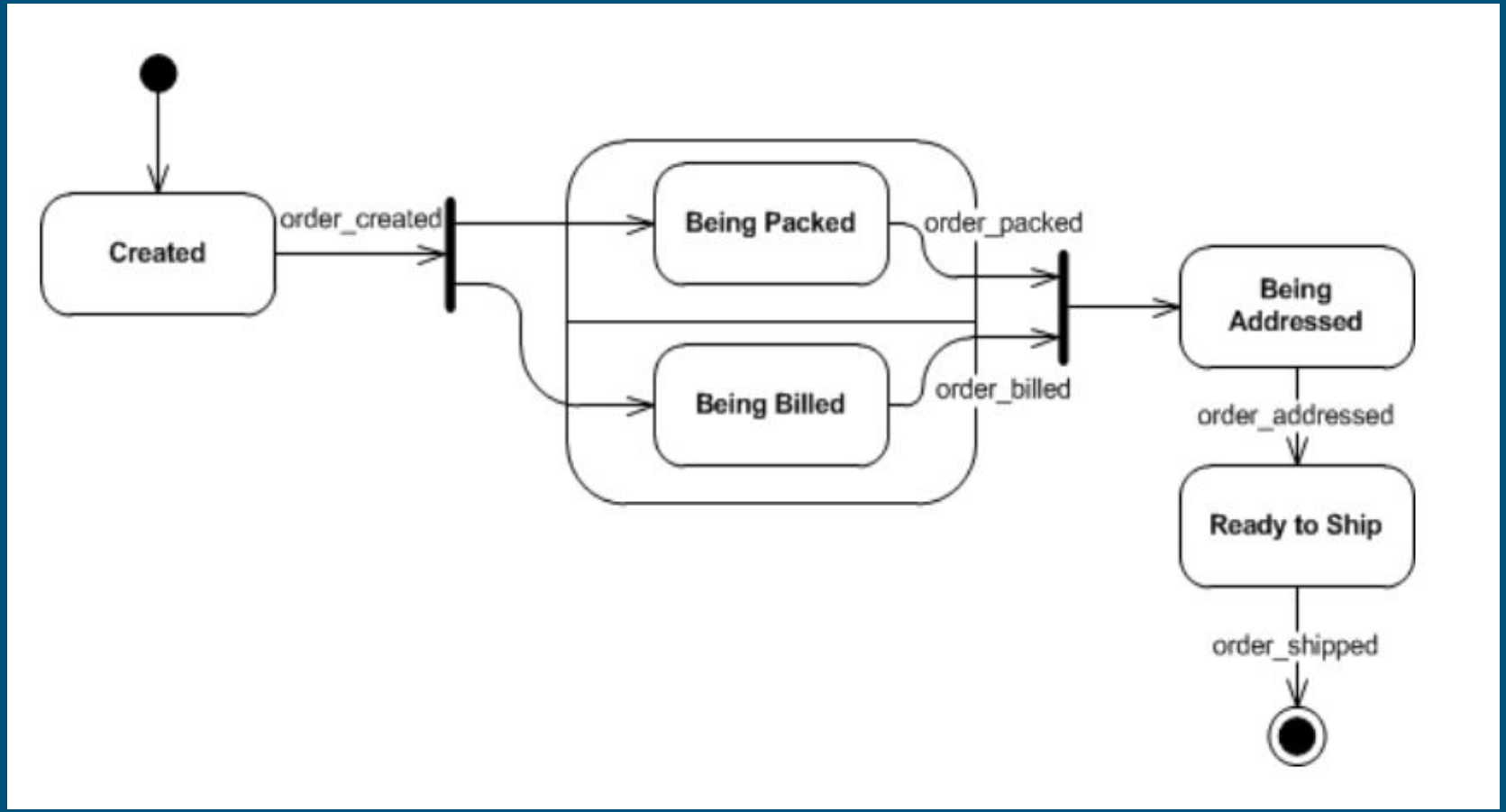
$correlationId - application level correlation id

$causationId - application level causation id

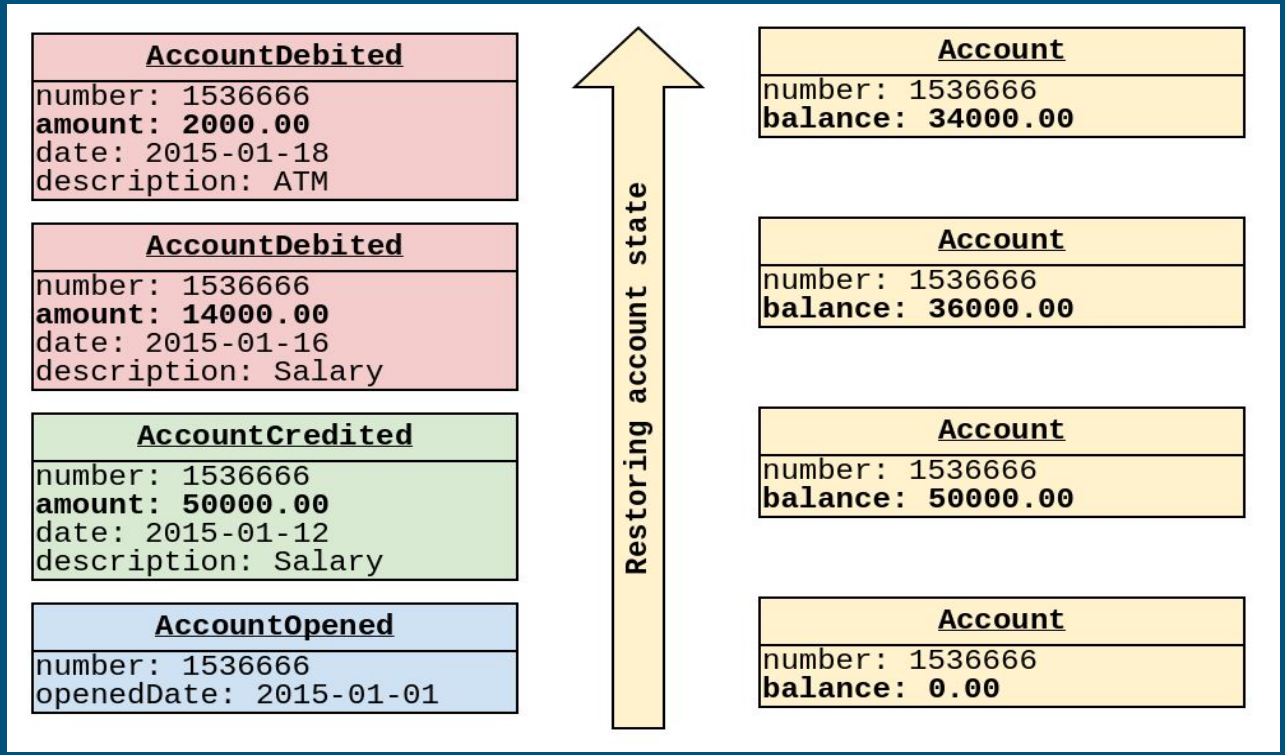
Event Sourcing

- In traditional systems, we persist the current state of an object.
- In event sourced systems, we persist all changes that lead to the current state of an object.
- Every change is an immutable event

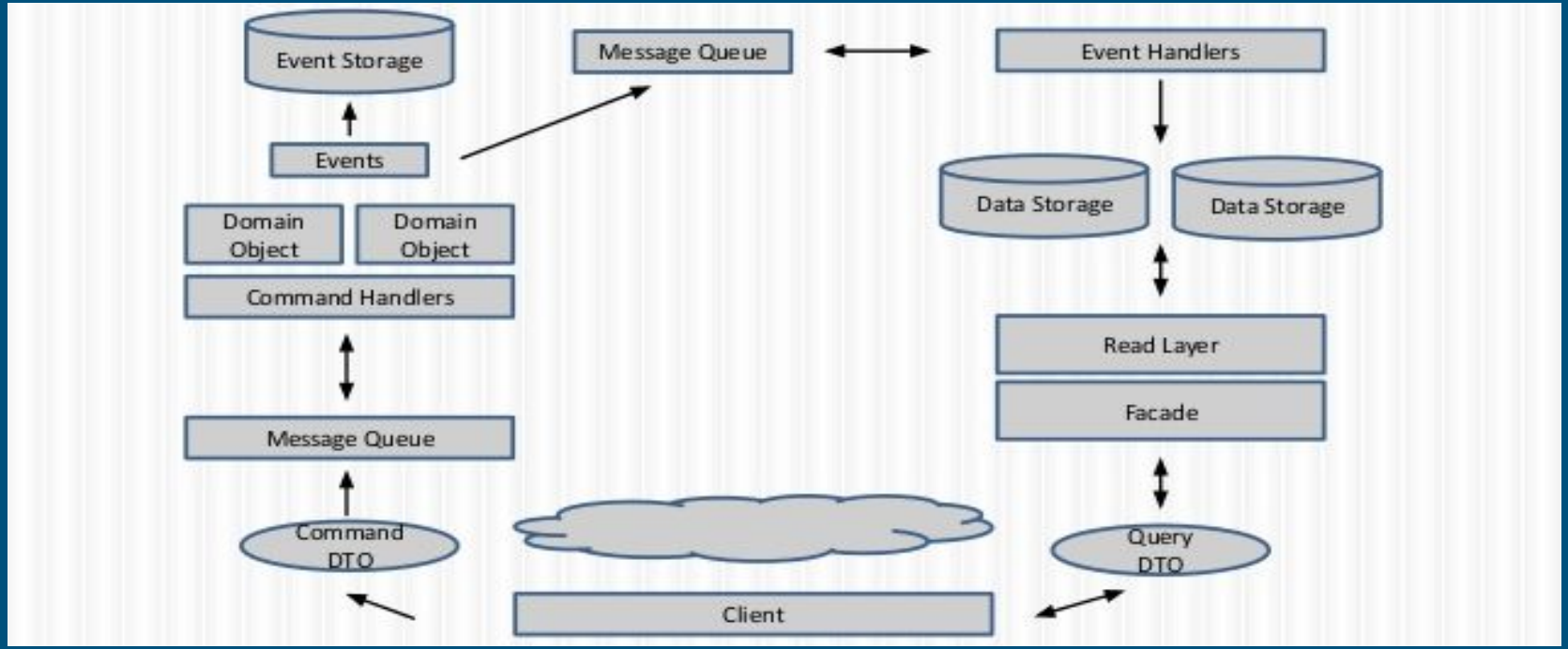

Fulfillment System
"order packed"
Order Consumer
Fulfillment Emitter
Customer Details
Order Processing System
Order Emitter
Shipping Combiner
Shipping Enricher
"order addressed"
"order billed"
"order created"
Billing Consumer
Billing Status Emitter
Shipping Consumer
Billing System
Shipping System
"ready to ship"


Created
order_created
Being Packed
Being Billed
order_packed
order_billed
Being Addressed
order_addressed
Ready to Ship
order_shipped

Object state is restored by replaying the entire stream of events



Event Sourcing with CQRS



Types of Event Processing

- Simple Event Processing
  - events created for state changes or external occurrences, usually drive state machines
  - often all that is needed for enterprise applications
- Event Stream Processing (ESP)
  - filtering and processing of streams of events
- Complex Event Processing (CEP)
  - complex events are those derived from other events
  - CEP is the process of creating & processing complex events

Storage

Event stream

- Ordered sequence of events in time
- The partition point of the system

Stream category

- Streams could be categorized
- Category is resolved from stream name (after character "-")

  [stream name]-[category]

Examples:

temperatures_by_zone-Ireland
temperatures_by_server-web1

Stream Metadata

$maxAge - maximum age of events in a stream

$maxCount - maximum number of events in a stream

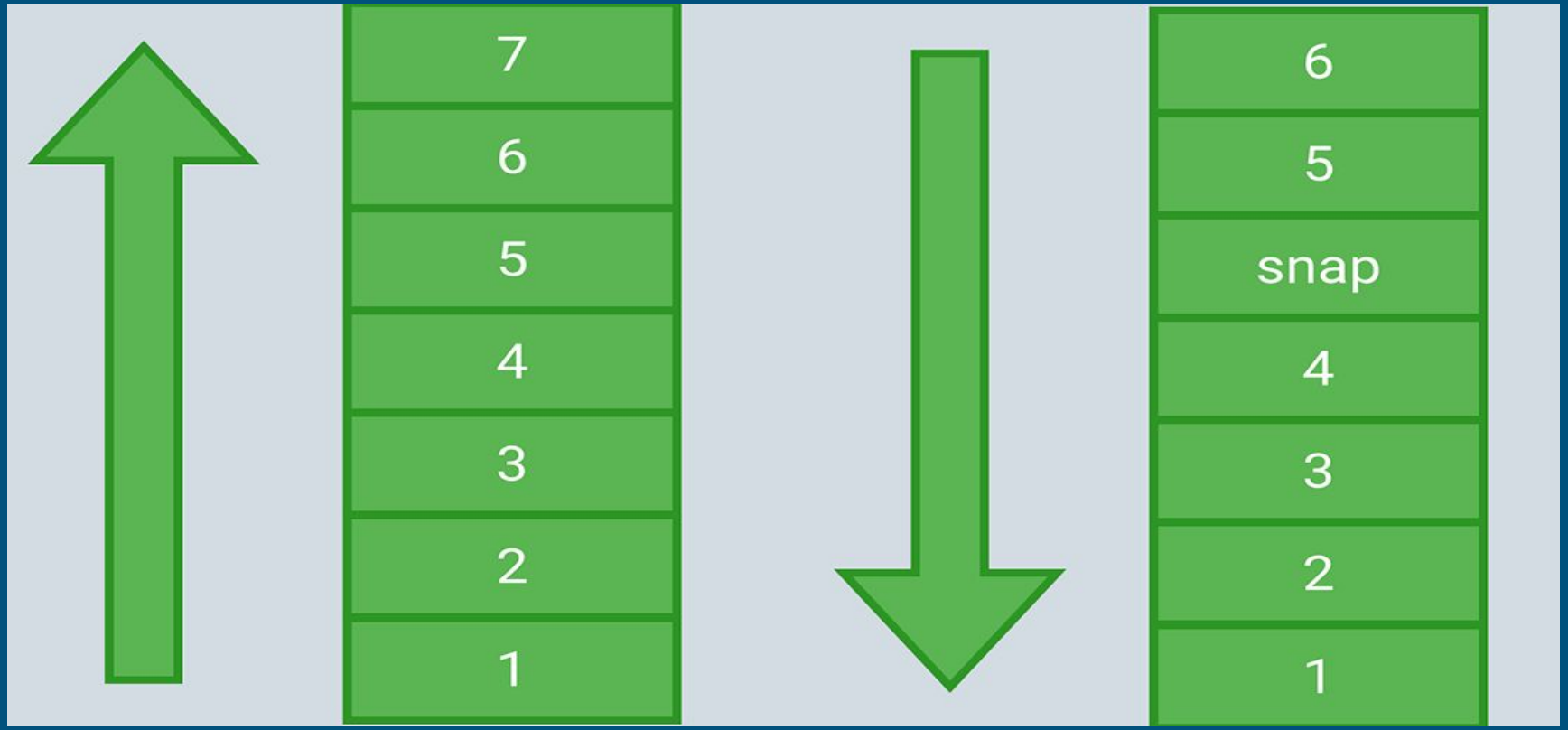
$cacheControl - controls the cache of the head of a stream

$acl - access control list

Event Snapshots

- Summary of arbitrary amount of continuous past events
- Why we need Snapshots?
  - Aggregates lifetime
  - Current State changes
  - Large amount of Events
- Rebuilding aggregate state will have a performance impact

Event Snapshots



Data Model

CRUD : **C**reate **R**ead **U**pdate **D**elete (Relational Database Models)

Event Store : Append Only!! (NO Update) in CRUD

Basic Stream Operations

- Create
- Append
- Read
- Delete
- Subscriptions

Basic Stream Operations : Create

Implicit Creation

curl -i -d @event.txt "http://127.0.0.1:2113/streams/**newstream**" -H "Content-Type:application/json"

events.txt

```
[
  {
    "eventId": "fbf4a1a1-b4a3-4dfe-a01f-ec52c34e16e4",
    "eventType": "event-type",
    "data": {

      "a": "1"
    }
  }
]
```

Basic Stream Operations : Append

- Single event write
- Batch write

Basic Stream Operations : Append

Events.txt

```
{
  "something" : "has data"
}
```

- Single event write
- Batch write

```
curl -i -d@myevent.txt
"http://127.0.0.1:2113/streams/newstream"
-H "Content-Type:application/json" -H
"ES-EventType: SomeEvent" -H "ES-EventId:
C322E299-CB73-4B47-97C5-5054F920746E"
```

ES : Events Media Types

Content-Type for Posting Events :

- application/(json/xml)
- application/vnd.eventstore.events(+json/+xml)

Basic Stream Operations : Append

- Single event write
- Batch write

```
[
  {
    "eventId": "fbf4b1a1-b4a3-4dfe-a01f-ec52c34e16e4",
    "eventType": "event-type",
    "data": {

      "a": "1"
    }
  },
  {
    "eventId": "0f9fad5b-d9cb-469f-a165-70867728951e",
    "eventType": "event-type",
    "data": {

      "a": "1"
    }
  }
]
```

All Batch Events are Transactional

curl -i -d@myevent.txt "http://127.0.0.1:2113/streams/newstream" -H "Content-Type:application/vnd.eventstore.events+json" -H "ES-EventType: SomeEvent" -H "ES-EventId: C322E299-CB73-4B47-97C5-5054F920746E"

Basic Stream Operations : Append

What happens when you post the same query repetitively to the ES?

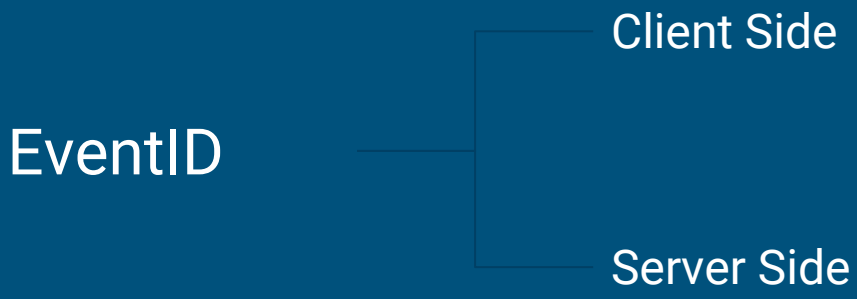
Basic Stream Operations : Append

Are the writes Idempotent?

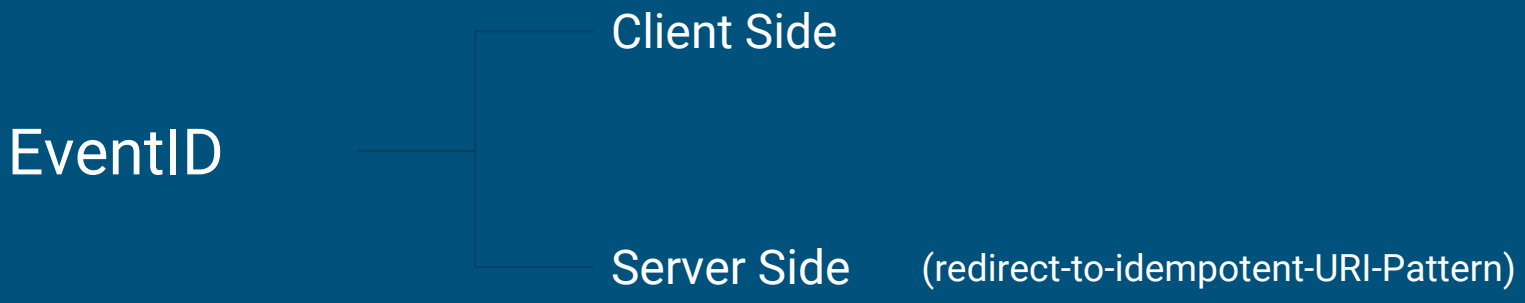
Basic Stream Operations : Append

EventID

Basic Stream Operations : Append



Basic Stream Operations : Append



Redirect-to-idempotent URI Pattern

Query : curl -i -d @myevent.json "http://127.0.0.1:2113/streams/newstream" -H "Content-Type:application/json" -H "ES-EventType: SomeEvent" ---- NO EVENT ID

Redirect-to-idempotent URI Pattern

Query : curl -i -d @myevent.json "http://127.0.0.1:2113/streams/newstream" -H "Content-Type:application/json" -H "ES-EventType: SomeEvent" ---- NO EVENT ID

Response :

```
HTTP/1.1 301 FOUND
Access-Control-Allow-Methods: POST, DELETE, GET, OPTIONS
Access-Control-Allow-Headers: Content-Type, X-Requested-With, X-PINGOTHER, Authorization, E
Access-Control-Allow-Origin: *
Access-Control-Expose-Headers: Location, ES-Position
Location: http://127.0.0.1:2113/streams/newstream/incoming/c7248fc1-3db4-42c1-96aa-a071c926
Content-Type: ; charset=utf-8
Server: Mono-HTTPAPI/1.0
Date: Mon, 21 Apr 2014 21:11:59 GMT
Content-Length: 28
Keep-Alive: timeout=15,max=100
```

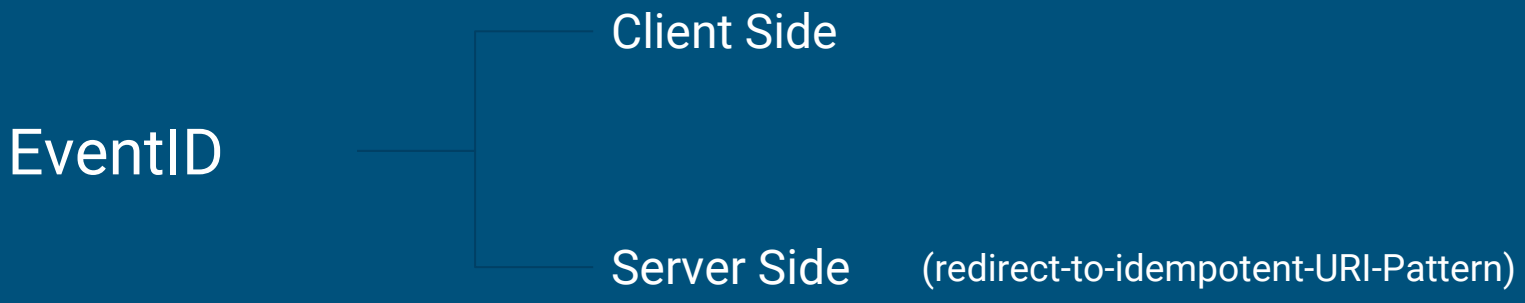
Redirect-to-idempotent URI Pattern

New Query : curl -i -d @myevent.json "http://127.0.0.1:2113/streams/newstream/incoming/c7248fc1-3db4-42c1-96aa-a071c92649d1" -H "Content-Type: application/json" -H "ES-EventType: SomeEvent"

Response :

```
HTTP/1.1 201 Created
Access-Control-Allow-Methods: GET, POST, OPTIONS
Access-Control-Allow-Headers: Content-Type, X-Requested-With, X-PINGOTHER, Authorization,
Access-Control-Allow-Origin: *
Access-Control-Expose-Headers: Location, ES-Position
Location: http://127.0.0.1:2113/streams/newstream/0
Content-Type: text/plain; charset=utf-8
Server: Mono-HTTPAPI/1.0
Date: Mon, 21 Apr 2014 21:14:28 GMT
Content-Length: 0
Keep-Alive: timeout=15,max=100
```

Basic Stream Operations : Append



Basic Stream Operations : Read

- All streams are exposed as atom feeds.

Accepted Content Types for GET are :

- application/xml
- application/atom+xml
- application/json
- application/vnd.eventstore.atom+json
- text/xml
- text/html

Deleting a Stream

Soft delete - stream could be recreated later

Hard delete - stream couldn't be recreated later

Deleting a Stream

Soft delete :

Hard delete

Using http DELETE Method

curl -v -X **DELETE** http://127.0.0.1:2113/streams/foo

Deleting a Stream

Using ES header attribute & http DELETE Method

Soft delete

curl -v-X DELETE http://127.0.0.1:2113/streams/foo -H “**ES-HardDelete:true**”

Hard delete : Scavenging : Disk space retention

Subscriptions

Live Only

Catch Up

From this point onwards.

Subscriptions

Live Only

Catch Up

From any point onwards (position passed as argument).

Projections

The process of taking an event Stream/s and converting it to some other form (event state / stream)

Projections

Indexing : Build state, emit new events or link to existing events

Temporal Queries : Concept of continuous queries

Projections : Functional Principles

Transform(f3(f2(f1(initial(), e1), e2), e3)

f(state, event) => state f is run over the series of events

transform(state) => result transform can transform the state to the form of result you want to receive

initial() => state initial returns the initial state

Projections : Event Selection

fromAll : $any

fromStream : select all events from a specific stream

fromStreams* : select all events from all categories from all streams

fromCategory : selecting streams from categories of many streams (subset)

Projections : Event Matching

Custom Event Matchers :

$init

$any

```
when([

        [SomePatternMatch]: function(state, event) {
return new state; },

         [OtherPatternMatch]: function(state, event) {
return new state; }

        ])
```

Projections : Event Indexing

Before Indexing :

Stream : Chat 1	Stream : Chat 2	Stream : Chat 3
Greg : hi	John : yo	Jill : anyone there?
John : Hey Greg	Jill: donuts!	Greg : sure

Event Indexing

After Indexing :

Stream : Chat 1 Greg : hi John : Hey Greg	Stream : Chat 2 John : yo Jill: donuts!	Stream : Chat 3 Jill : anyone there? Greg : sure
Stream : Greg Chat1 : hi Chat3 : sure	Stream : John Chat2 : yo Chat2 : Hey Greg	Stream : Jill Chat3: anyone there? Chat2 : donuts!

Projections : Internal Indexing

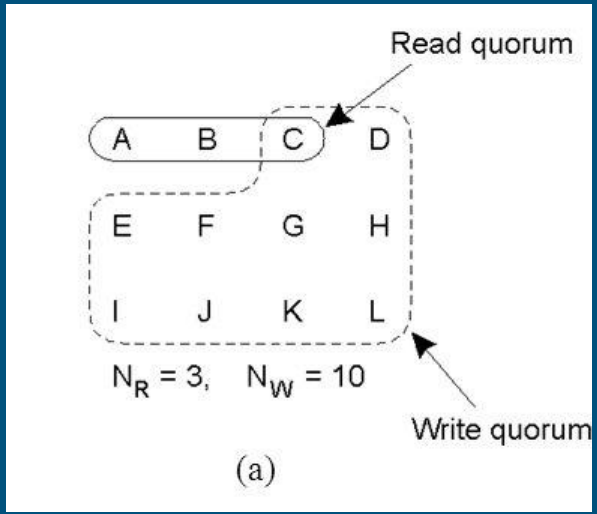
‘UseEventIndices’ - Indexing based on $et-<eventtype>

Replication

2 Quorums used - Read, Write

No quorum yet - Paxos Election !

Client Retries if transaction fails.



Security

1. Internal authentication : Using stream’s Access Control List

Example :

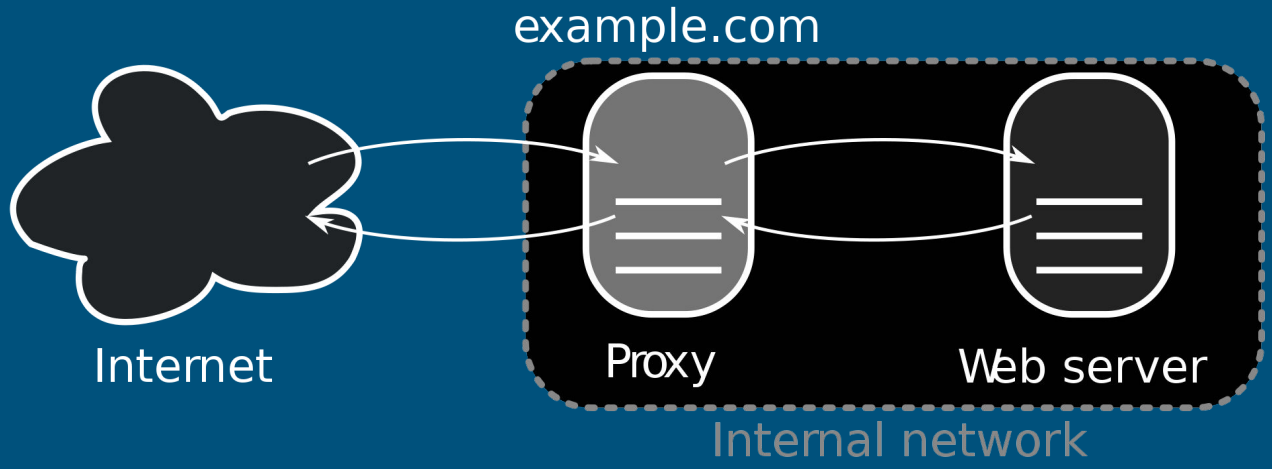
```
{
  "$acl" : {
    "$w"  : "greg",
    "$r"  : ["greg", "john"],
    "$d"  : "$admins",
    "$mw" : "$admins",
    "$mr" : "$admins"
  }
}
```

Mw : write for metadata

Mr : read for metadata

Security Cont..

2. External authentication : Use reverse Proxy servers



Security Cont..

3. Hybrid Option - trusted intermediary header

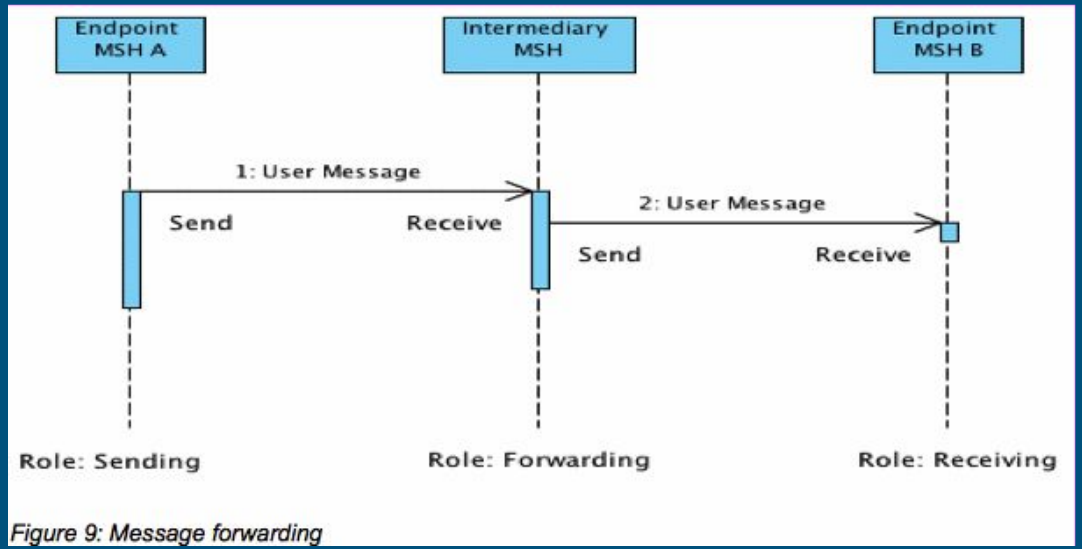


Figure 9: Message forwarding

Communication with ES

TCP

- Push events to subscribers
- Suggested for high-performance environment

HTTP

- Subscribers pool to check events availability
- AtomPub Interface
- Intermediary caching of Atom feeds

HTTP vs TCP

	HTTP	TCP
Scalability	High	Low
Network traffic	Low	High
Time for a transaction	1 second	10 ms
Write/sec	2000	15,000-20,000
Environment	Heterogeneous	Homogeneous

Use cases

- Audit log [who, when]
- BI applications : Fraud detection - incorrect CVV (4 attempts)
- Complex historical analysis of data

Drawbacks and Limitations

Every database on a planet sucks. And they all suck it their own unique original ways.
Greg Young, Polyglot Data talk

- Complex - Not ready to learn technologies
- Eventual consistency

Questions?