EVENT SOURCING

in production systems

LARS VONK & BOB FORMA

zilverline

Let's take a look how we currently develop software

```ruby
class Invoices < Sinatra::Base
  post '/pay' do
    invoice = Invoice.find(params[:invoice_id])
    invoice.pay(pay_date: Date.today)
    invoice.save!
    redirect "/invoices/paid"
  end
end
```

```ruby
class Invoices < Sinatra::Base
  post '/pay' do
    invoice = Invoice.find(params[:invoice_id])
    invoice.pay(pay_date: Date.today)
    invoice.save!
    redirect "/invoices/paid"
  end
end
```

```erb
<table><tbody>
  <% Invoice.where(status: :paid).each do |invoice| %>
    <tr>
      <td><%= invoice.invoice_number %></td>
      <td><%= invoice.total_amount %></td>
      <td>...</td>
    </tr>
    <% end %>
</tbody></table>
```

One model to rule them all

```
class Invoices < Sinatra::Base
  post '/pay' do
    invoice = Invoice.find(params[:invoice_id])
    invoice.pay(pay_date: Date.today)
    invoice.save!
    redirect "/invoices/paid"
  end
end
```

```
<table><tbody>
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    <tr>
      <td><%= invoice.invoice_number %></td>
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    <% end %>
</tbody></table>
```

Mix of concerns

- Querying
- Transactions (commands)
- Reporting

	invoice_number character varying(255)	invoice_status character varying(255)	invoice_date_sent date
1	201209-001	sent	2012-09-07
2	201206-002	sent	2012-06-22
3	201209-021	paid	2012-09-07
4	201209-001	sent	2012-09-21

	invoice_number character varying(255)	invoice_status character varying(255)	invoice_date_sent date
1	201209-001	sent	2012-09-07
2	201206-002	sent	2012-06-22
3	201209-021	paid	2012-09-07
4	201209-001	sent	2012-09-21

How did this Invoice get to status :sent?

	invoice_number character varying(255)	invoice_status character varying(255)	invoice_date_sent date
1	201209-001	sent	2012-09-07
2	201206-002	sent	2012-06-22
3	201209-021	paid	2012-09-07
4	201209-001	sent	2012-09-21

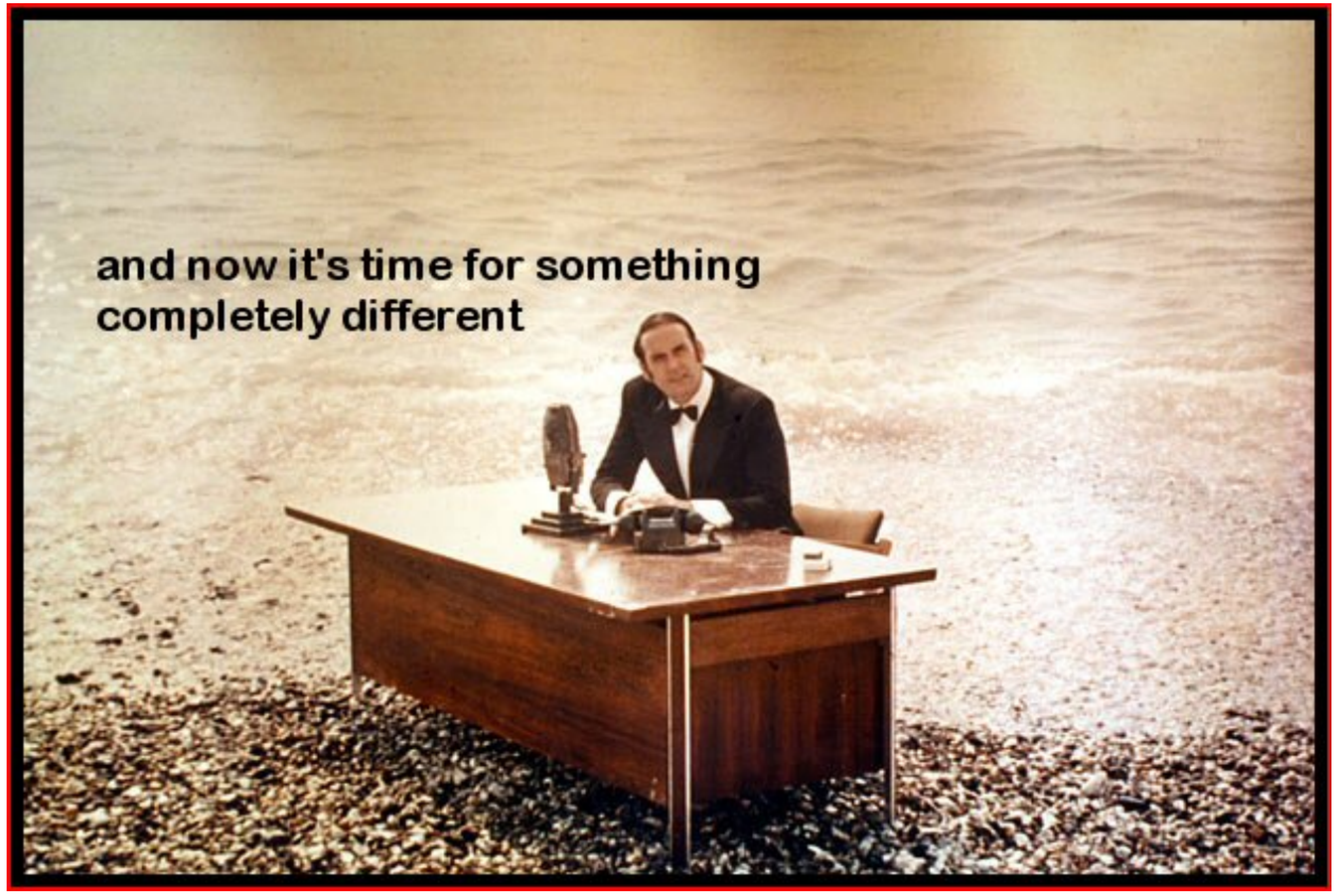
- How did this Invoice get to status :sent?

- How many items are deleted from the shopping cart *just* before an order is placed?

Information is lost

	invoice_number character varying(255)	invoice_status character varying(255)	invoice_date_sent date
1	201209-001	sent	2012-09-07
2	201206-002	sent	2012-06-22
3	201209-021	paid	2012-09-07
4	201209-001	sent	2012-09-21

- How did this Invoice get to status :sent?
- How many items are deleted from the shopping cart *just* before an order is placed?


and now it's time for something
completely different

Event Sourcing

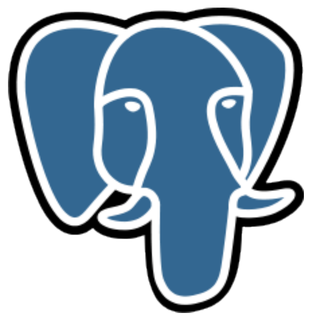
Capture all changes to an application state as a sequence of events

martinfowler.com/eeaDev/EventSourcing.html – Martin Fowler

Or maybe not so different...

Rabobank

github
SOCIAL CODING



Trivial example

Current state

id	amount	status	recipient
ed3456f	121	sent	bob@zilverline.com

Trivial example

Current state

id	amount	status	recipient
ed3456f	121	sent	bob@zilverline.com

Event sourced

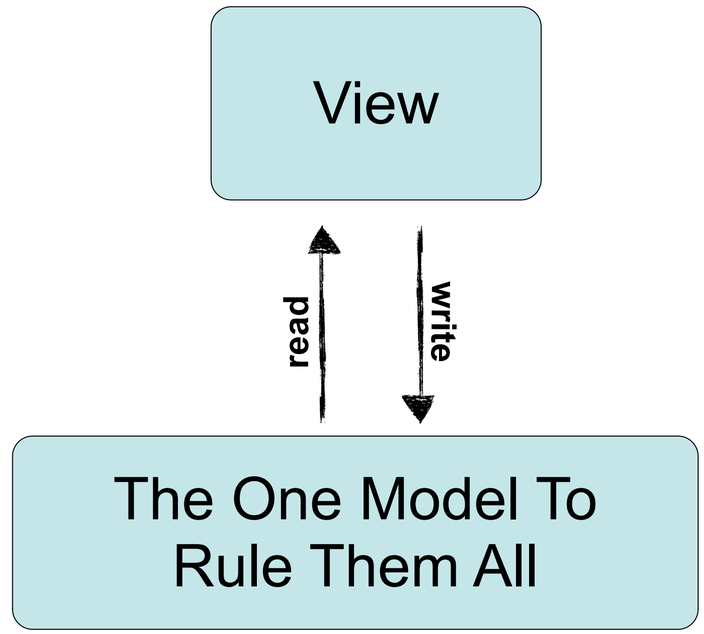
id	event_type	event_json
ed3456f	InvoiceCreatedEvent	{id:“ed3456f”}
ed3456f	LineItemAddedEvent	{id:“ed3456f”, line_item: {id: 1, amount: 100, vat: 21}}
ed3456f	InvoiceSentEvent	{id:“ed3456f”, to: “bob@zilverline.com”}

How many line items are deleted just before...

Event sourced

id	event_type	event_json
ed3456f	InvoiceCreatedEvent	{id:“ed3456f”}
ed3456f	LineItemAddedEvent	{id:“ed3456f”, line_item: {id: 1, amount: 100, vat: 21}}
ed3456f	LineItemRemovedEvent	{id:“ed3456f”, line_item_id: 1}
ed3456f	LineItemAddedEvent	{id:“ed3456f”, line_item: {id: 2, amount: 150, vat: 21}}
ed3456f	InvoiceSentEvent	{id:“ed3456f”, to: “bob@zilverline.com”}

So how do you query stuff?



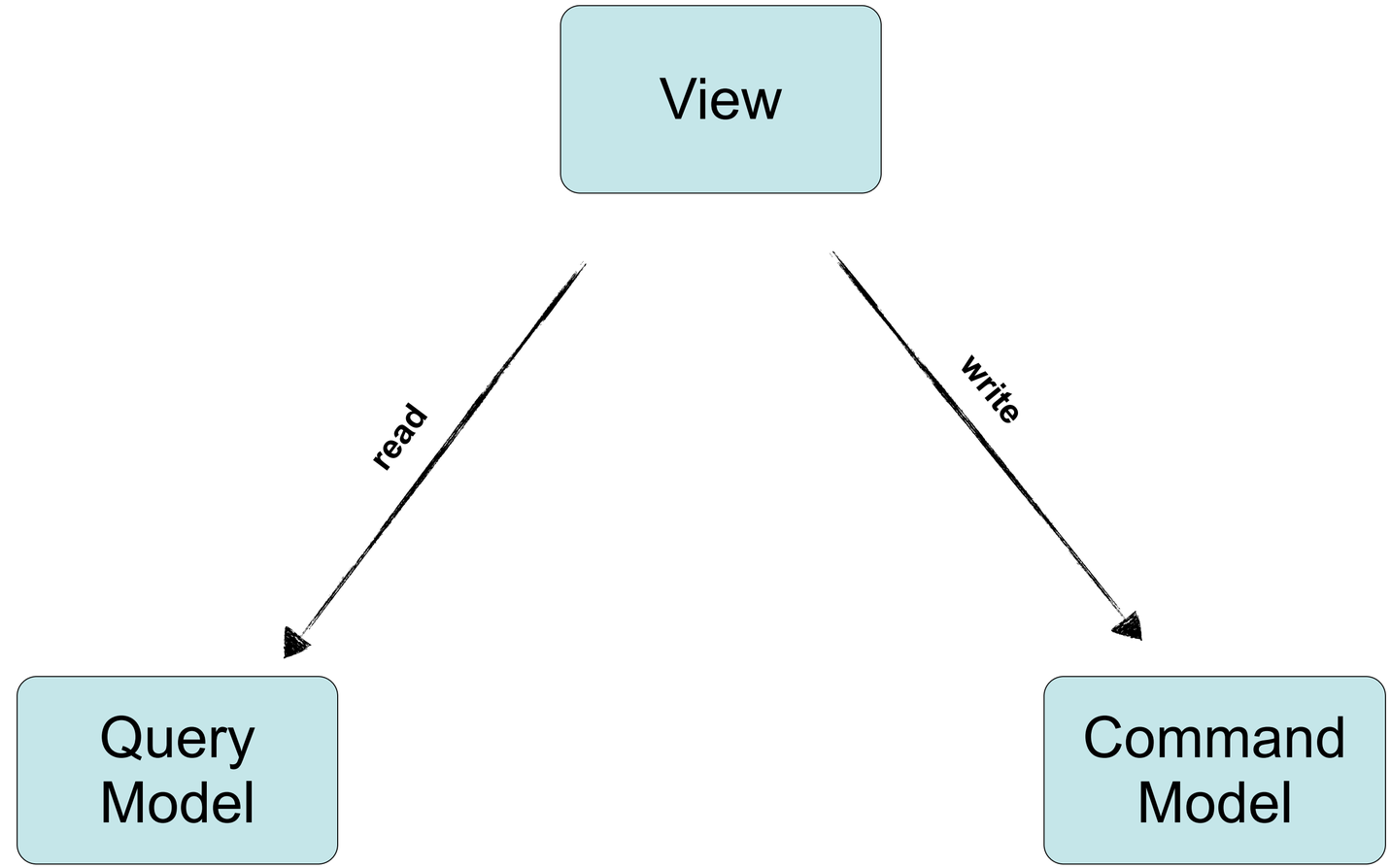
So how do you query stuff?

View

Query Model

Command Model

So how do you query stuff?



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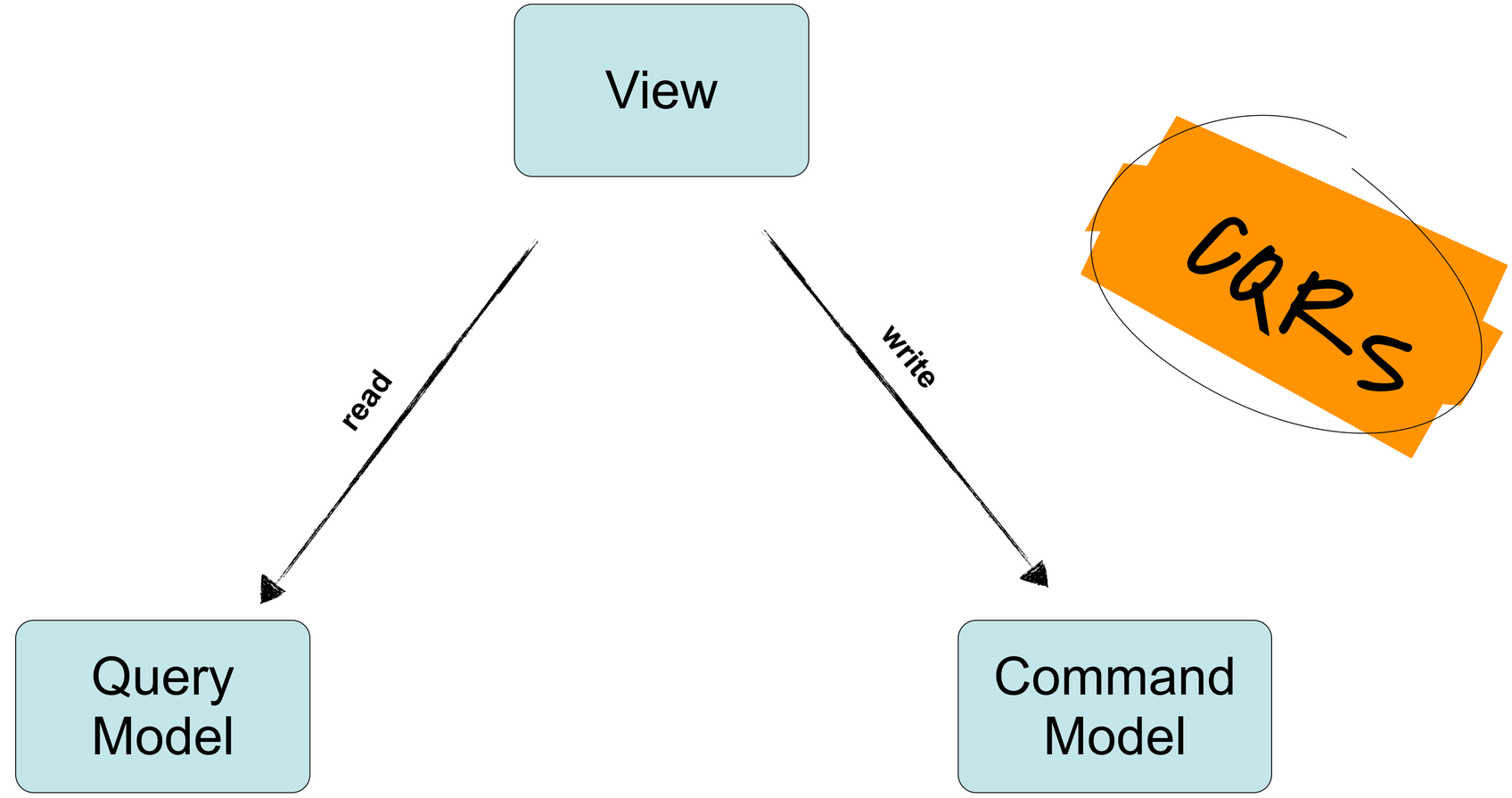

So how do you query stuff?

View

read

write

‘generates using events’

Query Model

Command Model

CQRS

Concrete example...

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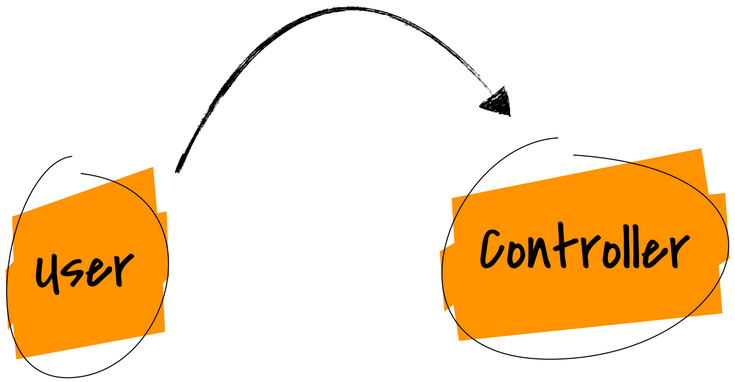
Concrete example...

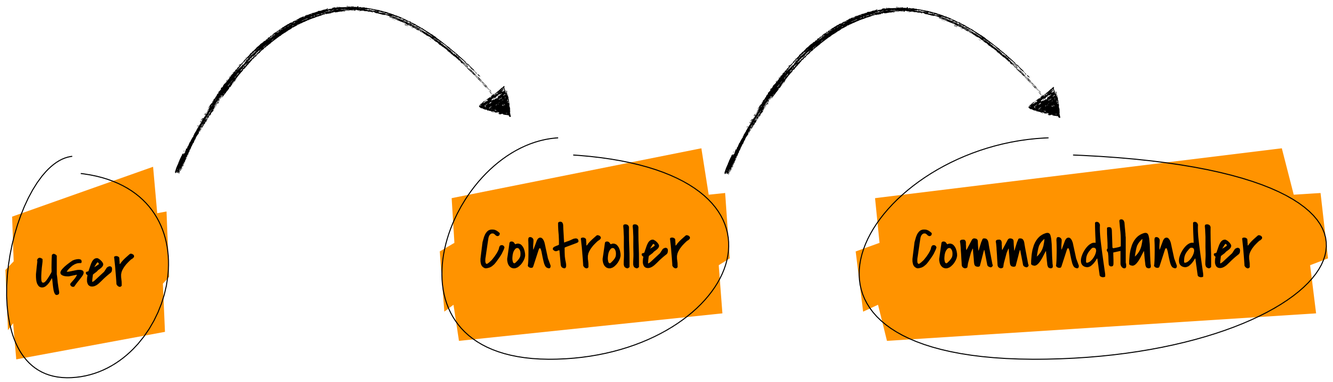
POST /invoices/:id/send



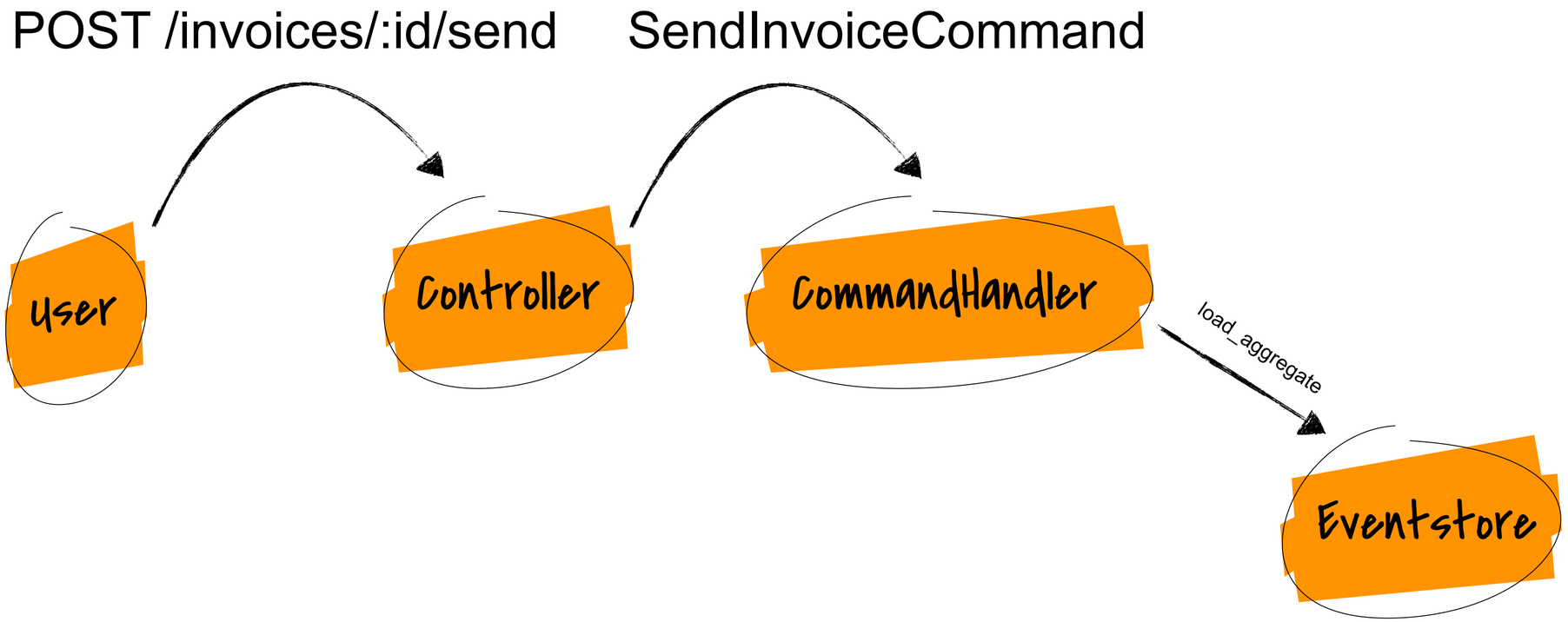
Concrete example...

POST /invoices/:id/send

SendInvoiceCommand



Concrete example...



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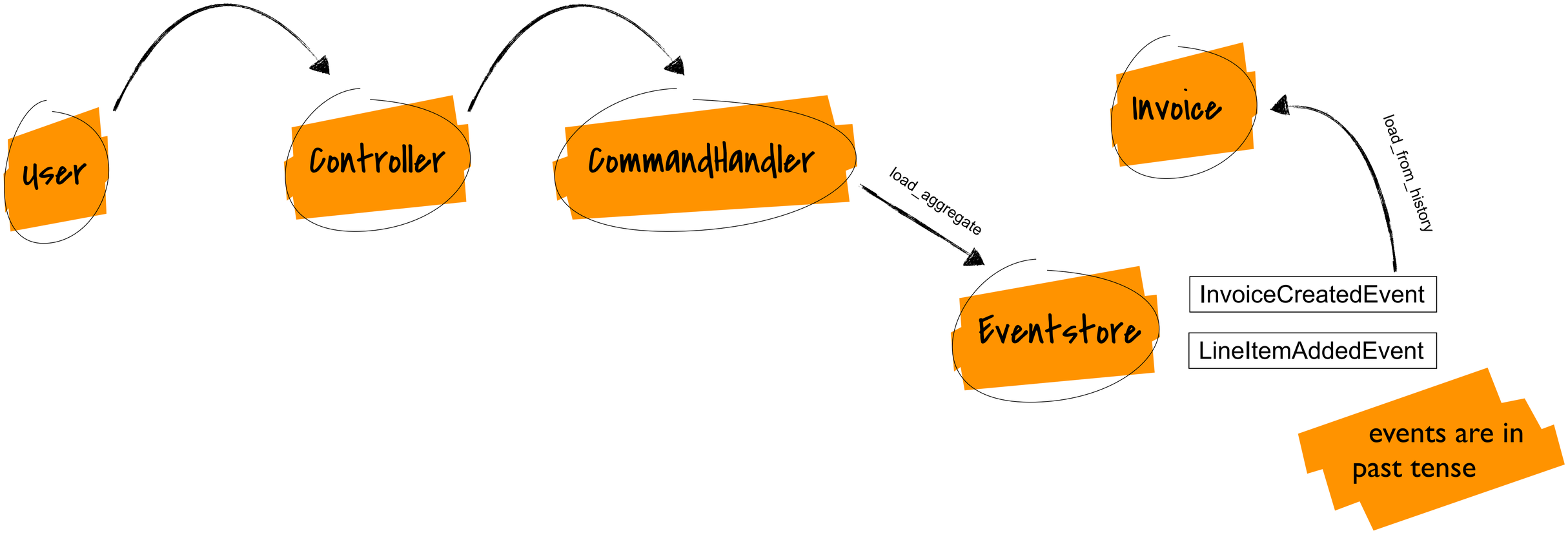

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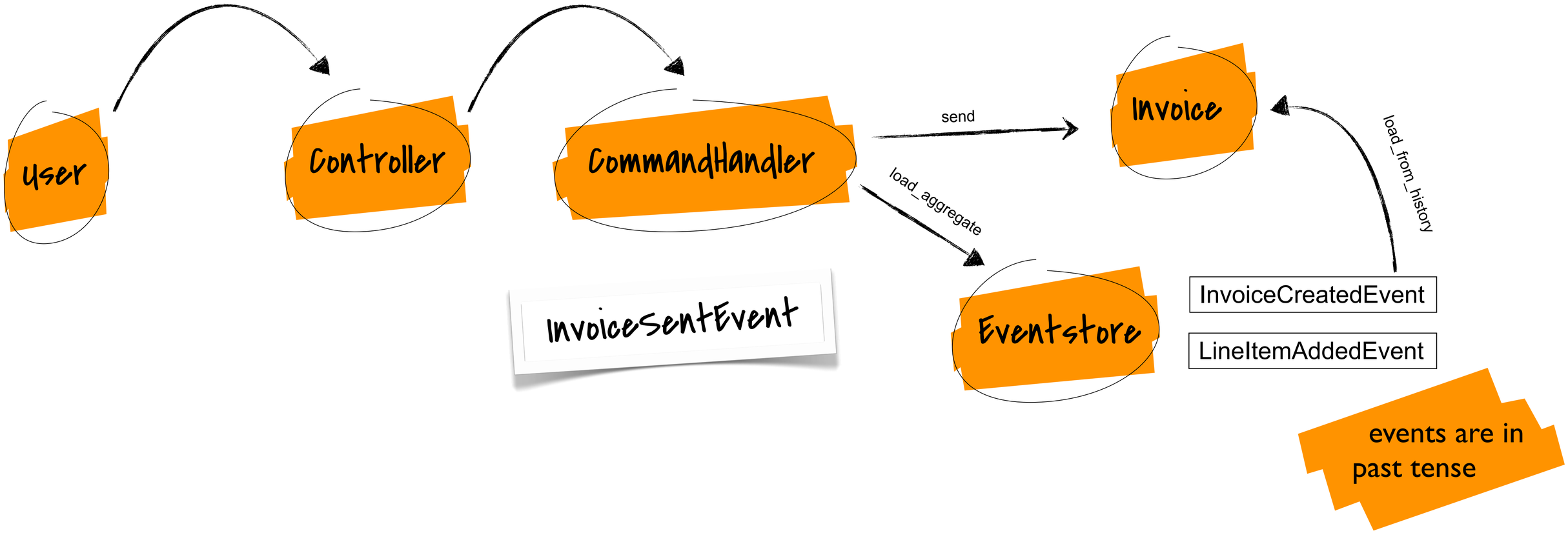

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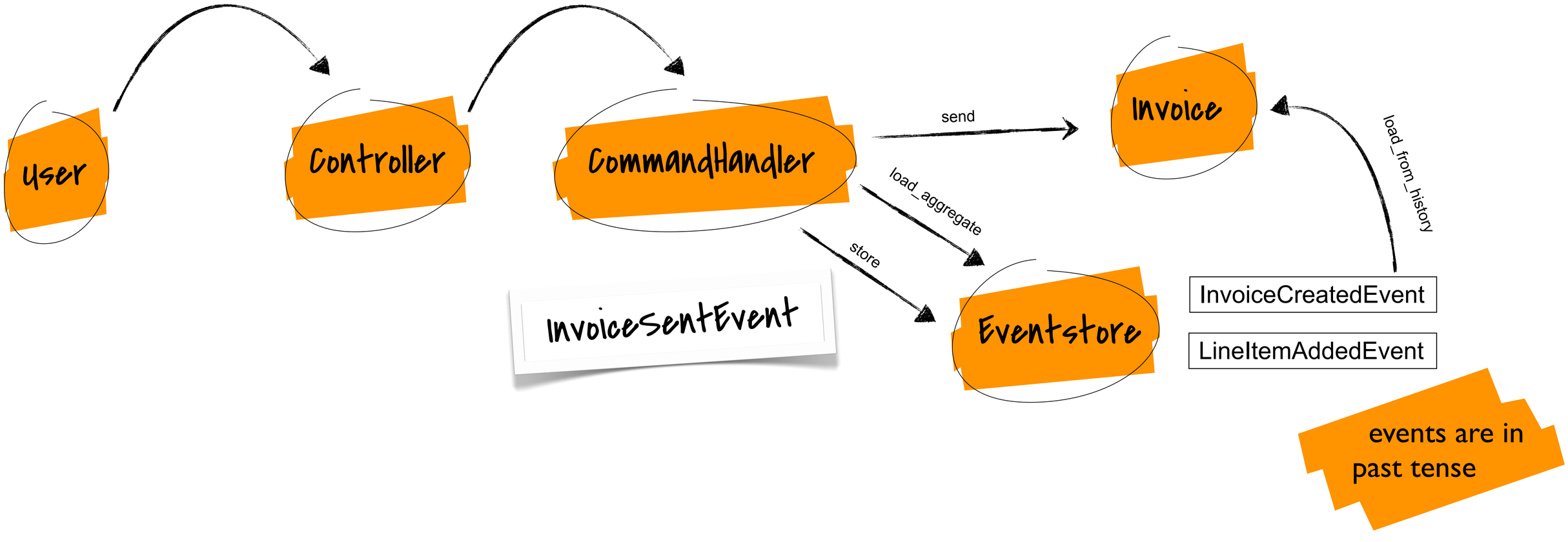

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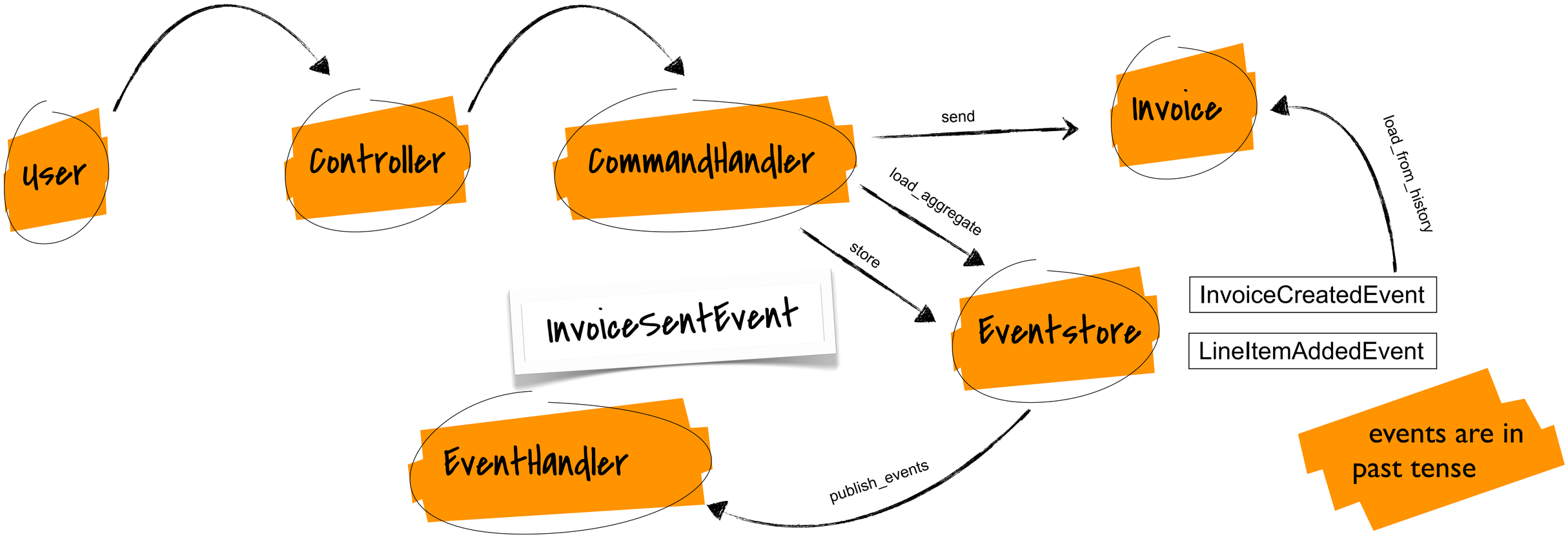

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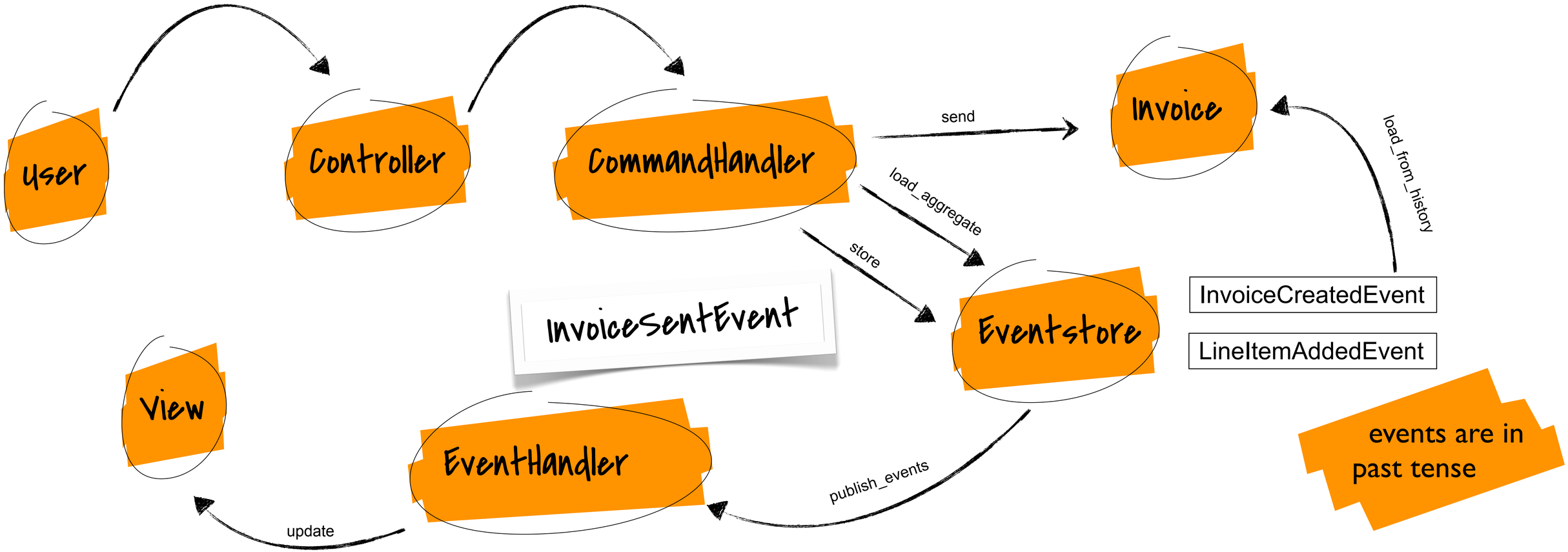

Why Event Sourcing

Part 1: For the business

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To capture user intent

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- To capture user intent
- Historic information

Why Event Sourcing

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- To capture user intent
- Historic information
- Storage decoupling

Why Event Sourcing

Part 1: For the business

- To capture user intent
- Historic information
- Storage decoupling
- Defer decisions

Why Event Sourcing

Part 2: For us nerds

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Tell, don’t ask

Why Event Sourcing

Part 2: For us nerds

- Tell, don’t ask
- Isolated domain tests

Why Event Sourcing

Part 2: For us nerds

- Tell, don't ask
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```
All examples were filtered out; ignoring {:focus=>true}
.....................................................
.....................................................
.....................................................
.....................................................
.....................................................
.....................................

Finished in 1.63 seconds
326 examples, 0 failures
```

Why Event Sourcing

Part 2: For us nerds

- Tell, don’t ask
- Isolated domain tests
- Debug information

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Why Event Sourcing

Part 2: For us nerds

- Tell, don’t ask
- Isolated domain tests
- Debug information
- Conflict resolution

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326 examples, 0 failures
```

It is not a Silver bullet

It is not a Silver bullet

- Not for CRUD

It is not a Silver bullet

- Not for CRUD
- Learning curve

It is not a Silver bullet

- Not for CRUD
- Learning curve
- More work to do simple stuff

Case study Freemle.com

- Financial administration system
- Integrates with various systems
- Web-based
- Event source approved

THE INTERNALS

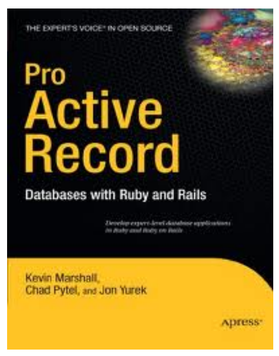
Stack

Ruby
A Programmer's Best Friend

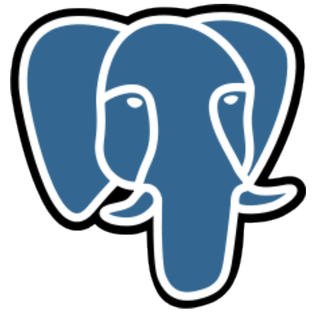
APACHE HTTP SERVER

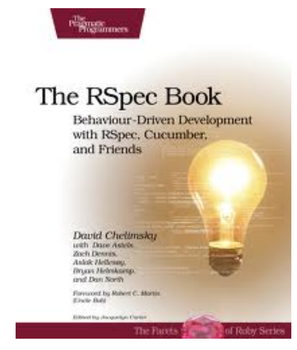
Sinatra

passenger
Rails deployment that just works

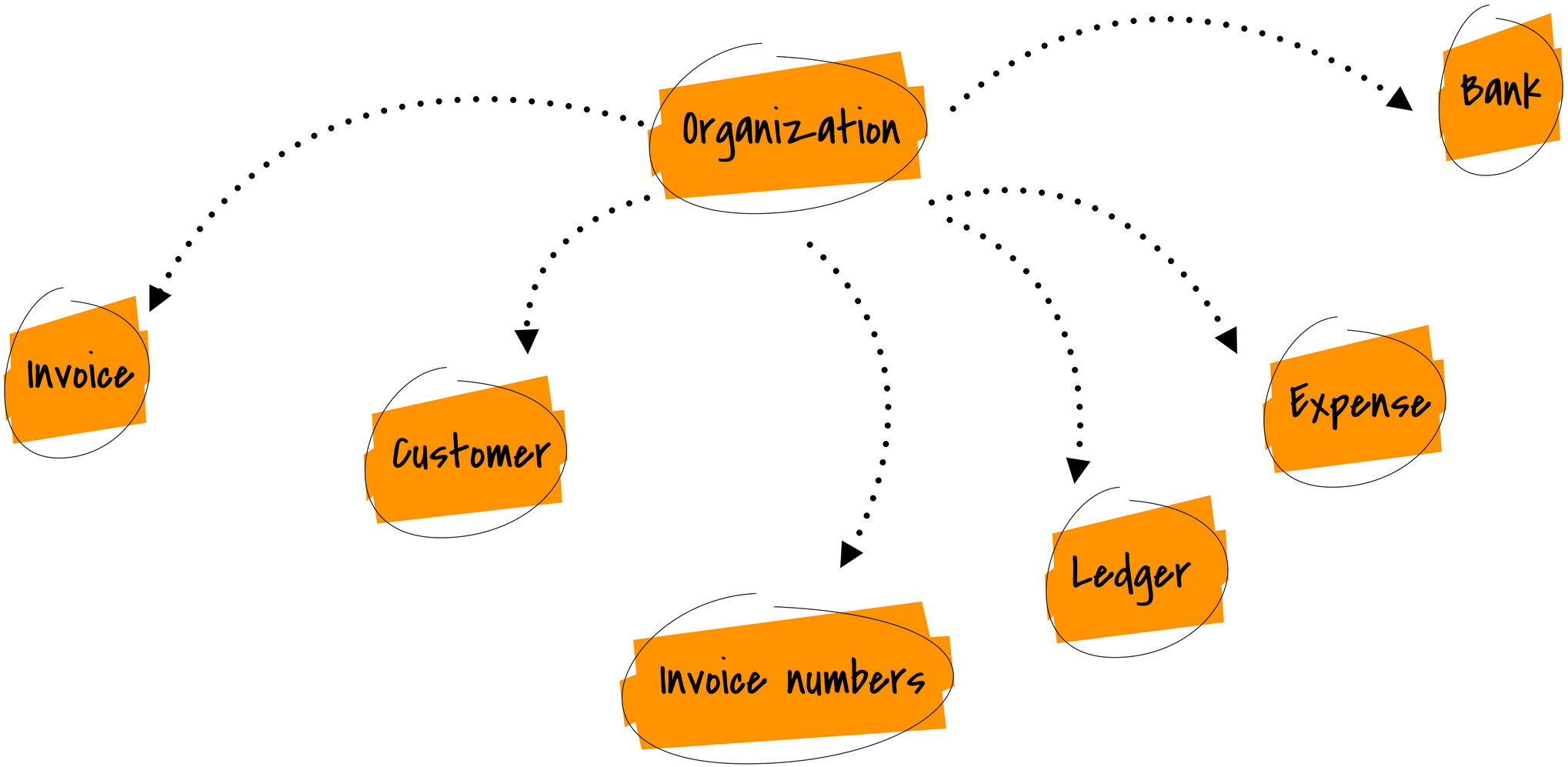


Scala



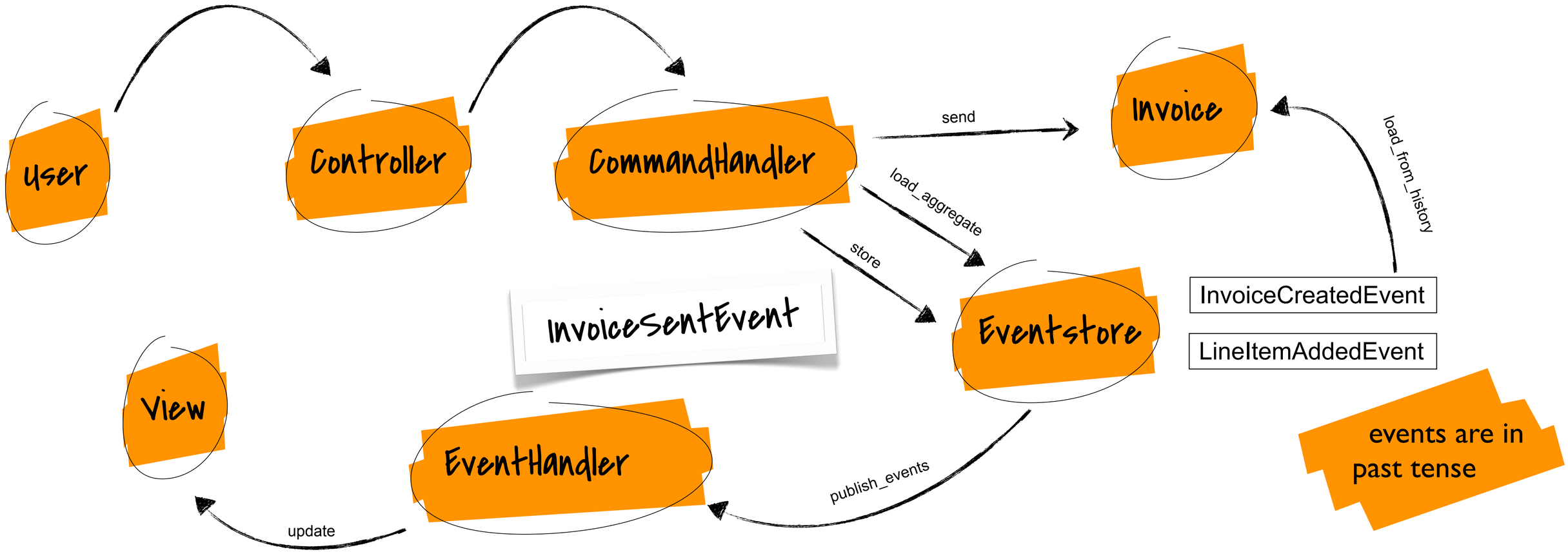


Domain


Organization
Bank
Invoice
Customer
Invoice numbers
Ledger
Expense

Remember this picture?

POST /invoices/:id/send SendInvoiceCommand



User wants to mark an invoice as paid

```
class Invoices < Sinatra::Base

  post '/pay' do
    execute MarkInvoicePaidCommand, on: invoice, with: {pay_date: Date.today}
    redirect "/invoices/id/#{aggregate_id}"
  end

end
```

Request is translated to specific command

```
class MarkInvoicePaidCommand < UpdateCommand
  include InvoiceCommand

  attrs pay_date: Date
  validates_presence_of :pay_date
  validate :valid_date
end
```

Propagates to correct Domain object

```
class InvoiceCommandHandler < BaseCommandHandler

  on MarkInvoicePaidCommand do |command|
    do_with_aggregate(command, Invoice) do |invoice|
      invoice.mark_paid(command.pay_date)
    end
  end

end
```

Retrieves all events for Aggregate

```
class EventStore

  def load_events(aggregate_id)
    to_events EventRecord.where(aggregate_id: aggregate_id).order(:sequence_number).all
  end

end
```

What does an event look like?

```ruby
class Event
  include ActiveModel::Serializers::JSON

  attrs aggregate_id: String,
        sequence_number: Integer,
        created_at: DateTime,
        organization_id: String
end
```

```json
{"aggregate_id":"273b29de-8b62-41f8-968f-9ef2f4f87649",
 "created_at":"2012-09-14T16:37:00+02:00",
 "organization_id":"88cca57a-c177-4b89-a941-3f4c1fae0f93",
 "pay_date":"2012-09-14",
 "sequence_number":8}
```

```ruby
class InvoiceCreatedEvent < Event
  attrs creditor: Creditor, recipient: Recipient, line_items: array(LineItem)
end

class InvoiceSentEvent < Event
  attrs send_date: Date, mail_data: MailData,
        customer_id: String, invoice_date: Date,
        invoice_due_date: Date
end
```

Rebuild yourself from history

```
class AggregateRoot

  attr_reader :id, :uncommitted_events

  def self.load_from_history(events)
    aggregate_root = allocate()
    aggregate_root.load_from_history(events)
    aggregate_root
  end

end
```

Events are applied

```ruby
class Invoice < AggregateRoot

  private

  def on_invoice_sent_event(event)
    @invoice_sent = true
    @due_amount = @invoice_total + @invoice_vat_total
    @due_date = event.invoice_due_date
    @invoice_date = event.invoice_date
  end

end
```

Propagates to correct Domain object

```
class InvoiceCommandHandler < BaseCommandHandler

  on MarkInvoicePaidCommand do |command|
    do_with_aggregate(command, Invoice) do |invoice|
      invoice.mark_paid(command.pay_date)
    end
  end

end
```

Tell the invoice it has been paid

```
class Invoice < AggregateRoot

  def mark_paid(pay_date)
    raise("pay_date is mandatory. aggregate_id: #@id") unless pay_date
    raise("can only mark an invoice as paid when it is sent. aggregate_id: #@id") unless @invoice_sent
    raise("cannot pay an invoice that is already paid. aggregate_id: #@id") if @marked_paid
    apply InvoiceMarkedPaidEvent, pay_date: pay_date
  end

end
```

Apply events on yourself

```
class AggregateRoot

  def apply(event, params={})
    event = build_event(event, params)
    apply_message_to_self(event)
    @uncommitted_events << event
    @sequence_number += 1
  end

end
```

Update your state

```
class Invoice < AggregateRoot

  private

  def on_invoice_marked_paid_event(event)
    @marked_paid = true
  end

end
```

Commit the events in the EventStore

```
class EventStore

  def commit_events(command, events)
    store_events command, events
    publish_events events
  end

end
```

Publish the events to registered Handlers

```
class EventStore

  private

  def publish_events(events)
    events.each do |event|
      @event_handlers.each do |handler|
        handler.handle_message event
      end
    end
  end

end
```

Update view model

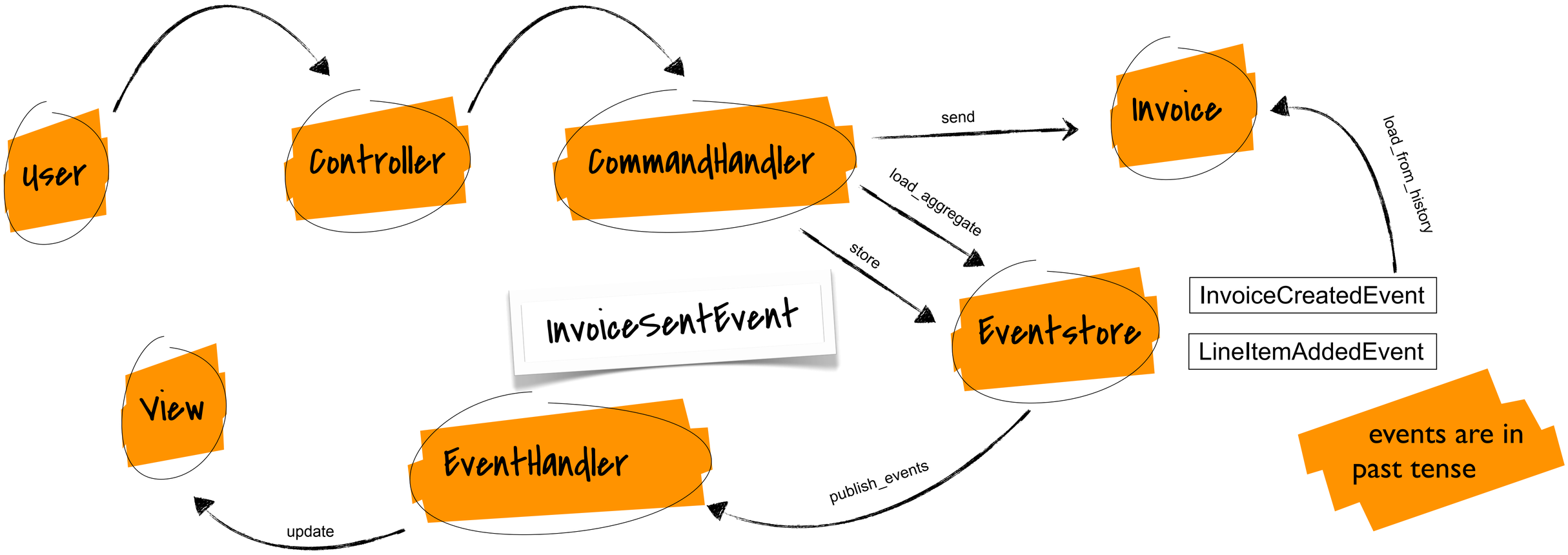
```
class InvoiceEventHandler

  on InvoiceMarkedPaidEvent do |event|
    update_record(InvoiceRecord, event) do |invoice|
      invoice.invoice_status = :paid
      invoice.invoice_pay_date = event.pay_date
    end
  end

end
```

Render view

```
<table><tbody>
  <% InvoiceRecord.where(status: :paid).each do |invoice_record| %>
    <tr>
      <td><%= invoice_record.invoice_number %></td>
      <td><%= invoice_record.total_amount %></td>
      <td>...</td>
    </tr>
    <% end %>
</tbody></table>
```

Summary

POST /invoices/:id/send SendInvoiceCommand



EXAMPLE HISTORIC INTEL

Introducing the timeline

What was easy?

What was easy?

- Querying (separate model)

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- Querying (separate model)
- Implementing business logic

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- Measuring feature usage

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- Querying (separate model)
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- Measuring feature usage
- Read performance (optimized view model)

What was easy?

- Querying (separate model)
- Implementing business logic
- Measuring feature usage
- Read performance (optimized view model)
- No BDUF for the data model

What was hard?

What was hard?

Mental model change (thinking in events)

What was hard?

- Mental model change (thinking in events)
- Event upcasting

What was hard?

- Mental model change (thinking in events)
- Event upcasting
- Defining events

Open challenges

Open challenges

Replay all events performance

Open challenges

- ~~Replay all events performance~~

Open challenges

- ~~Replay all events performance~~
- Asynchronous view model update

Open challenges

- ~~Replay all events performance~~
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- Zero downtime deployments

Open challenges

- ~~Replay all events performance~~
- Asynchronous view model update
- Zero downtime deployments
- Scaling

Questions?