



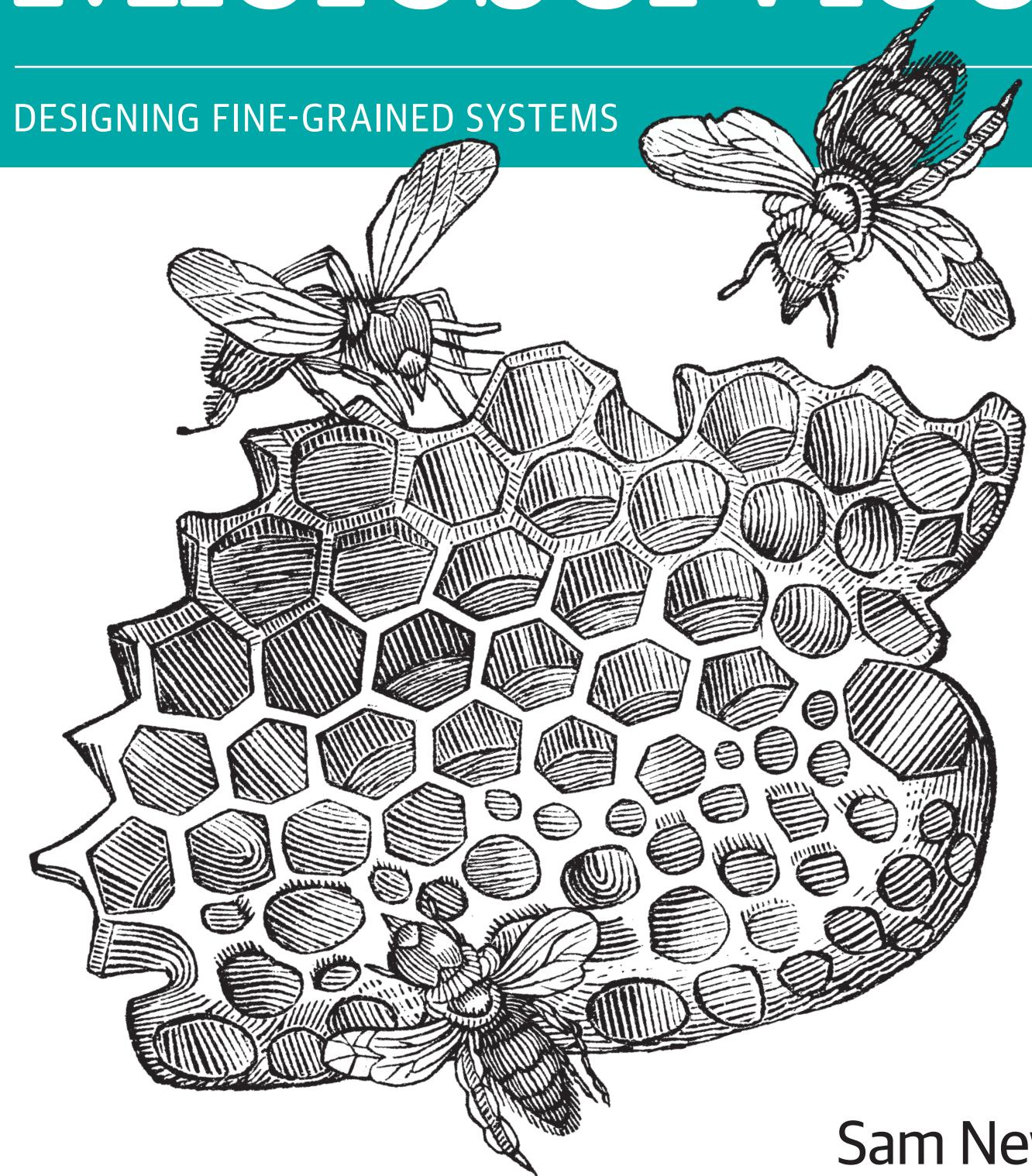
MICROSERVICE FUNDAMENTALS

Sam Newman

O'REILLY®

Building Microservices

DESIGNING FINE-GRAINED SYSTEMS

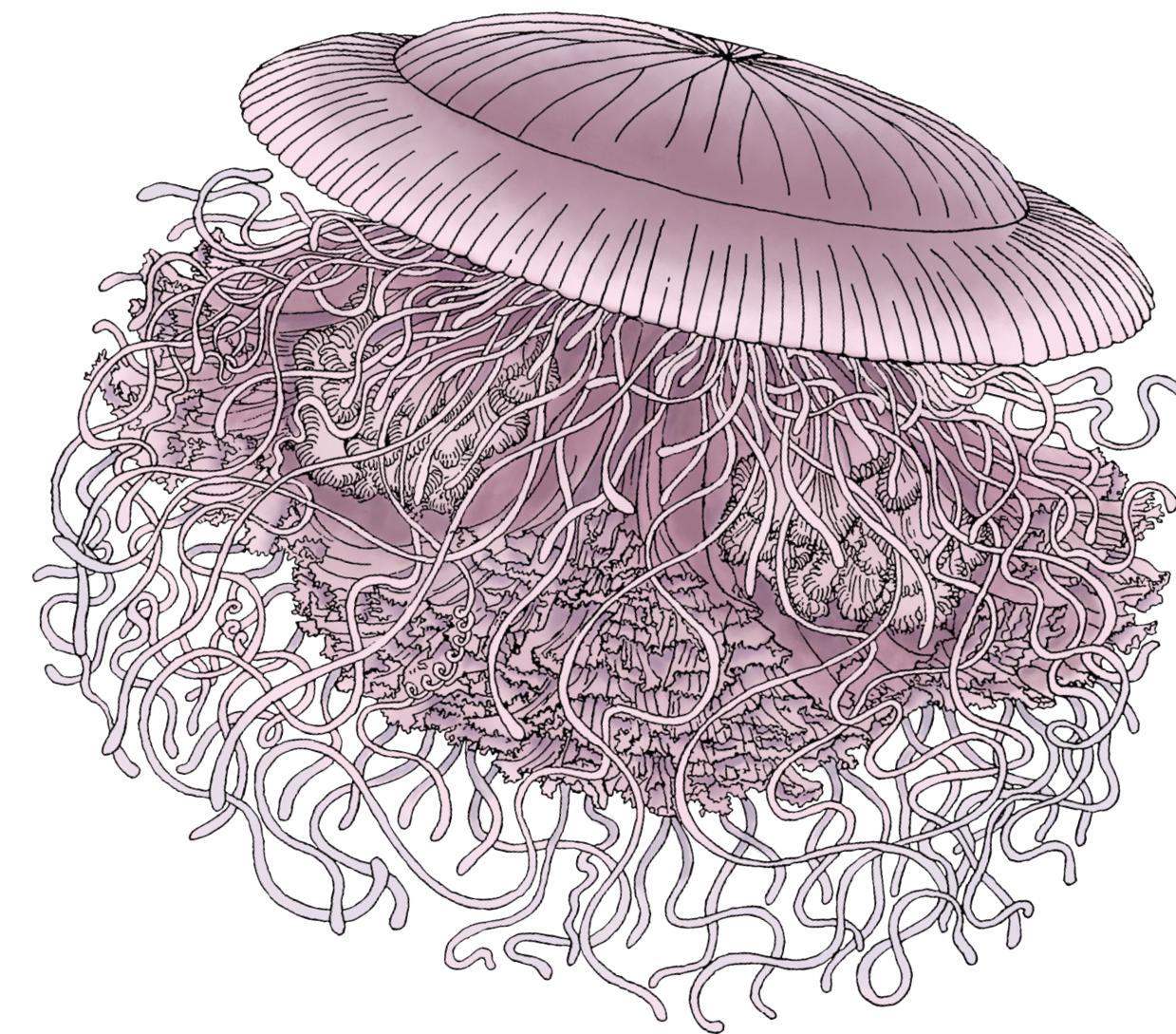


Sam Newman

O'REILLY®

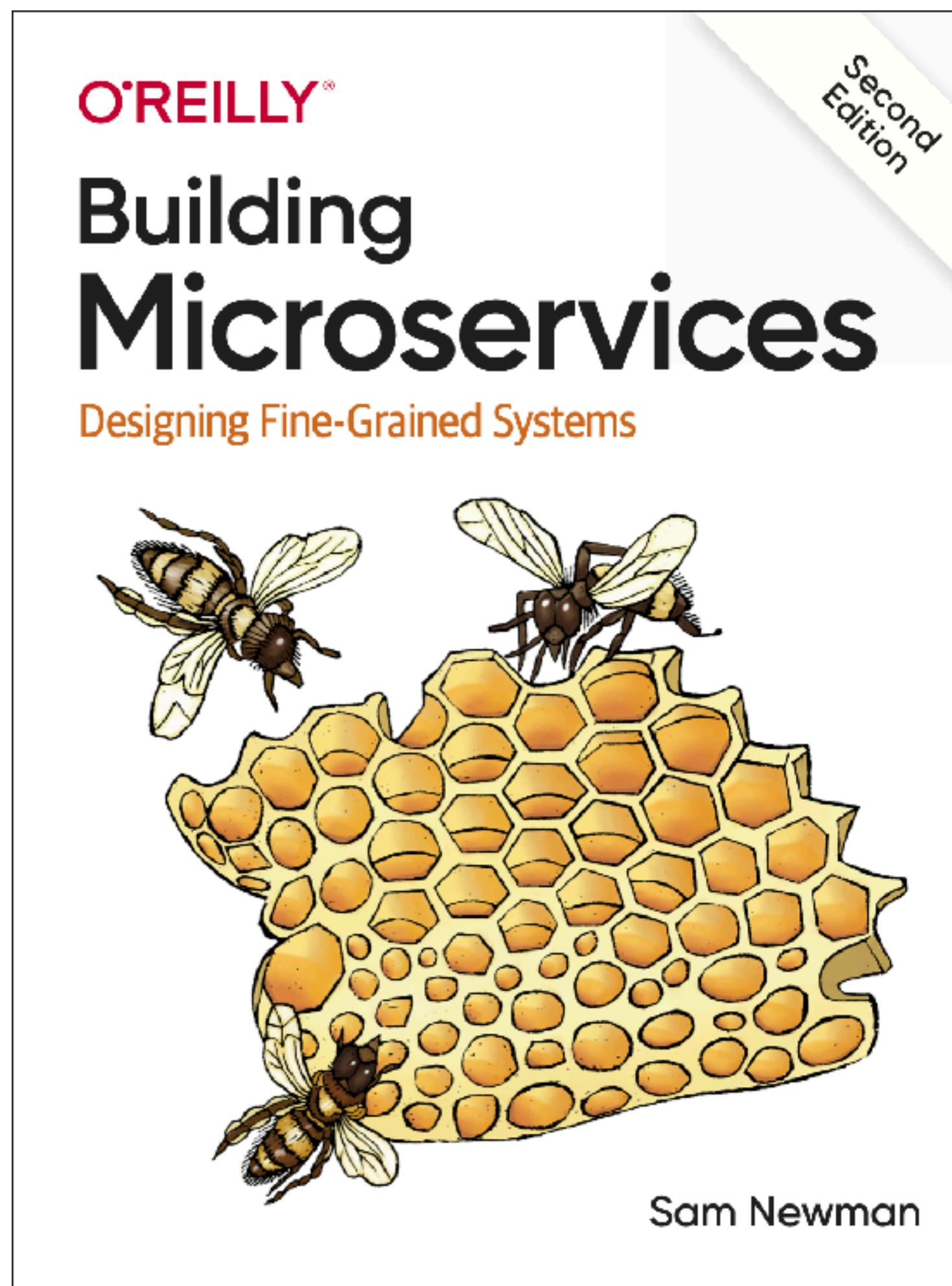
Monolith to Microservices

Evolutionary Patterns to Transform
Your Monolith



Sam Newman

2ND EDITION OF BUILDING MICROSERVICES



Building Microservices, 2nd Edition.

Building Microservices, 2nd Edition, is a forthcoming book on all aspects of Microservices

This book is aimed at giving a broad overview of all aspects related to microservices. Giving a firm foundation in the basics, it goes further, covering off all aspects of the software delivery process, and how they are impacted by adopting a microservice architecture.

What's New?

This 2nd edition involves every page of the best selling 1st edition being reviewed and where appropriate reworked, with new topics covered for the first time. This edition will be reflecting the shifts in the use of microservices over the last five years, including an exploration of some of the new technology which has emerged.

Status.

Currently, the book is in a very early form, with some chapters available for review at O'Reilly online. These chapters are in a rough form, and are made available to get feedback to help improve the final book.

New chapters will be released in rough form as they become available.

[Read on O'Reilly Learning Online](#)

https://samnewman.io/books/building_microservices_2nd_edition/

@samnewman

**Sam
Newman
& Associates**



<https://samnewman.io/>

WHAT WE'LL COVER

What are microservices?

WHAT WE'LL COVER

What are microservices?

What problems do they solve?

WHAT WE'LL COVER

What are microservices?

What problems do they solve?

Common misunderstandings

WHAT WE'LL COVER

What are microservices?

What problems do they solve?

Common misunderstandings

Introduce Domain-driven Design

We will have two 10-15min breaks

Please ask questions!

Poll

Where are you in your microservice journey?

Poll

Where are you in your microservice journey?

a.) Thinking about if they're right for me

Poll

Where are you in your microservice journey?

a.) Thinking about if they're right for me

Poll

Where are you in your microservice journey?

- a.) Thinking about if they're right for me
- b.) Just started using them

Poll

Where are you in your microservice journey?

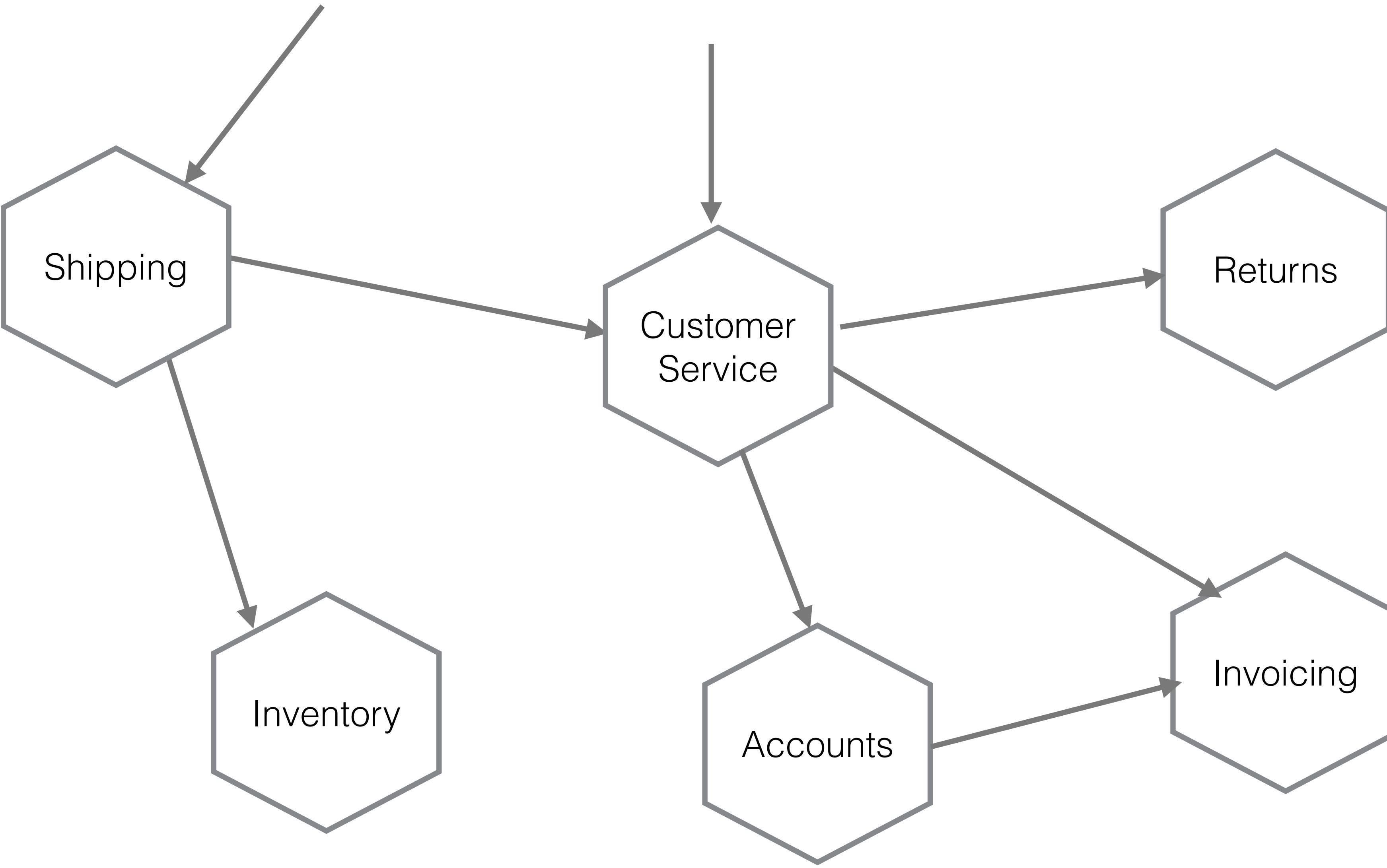
- a.) Thinking about if they're right for me
- b.) Just started using them

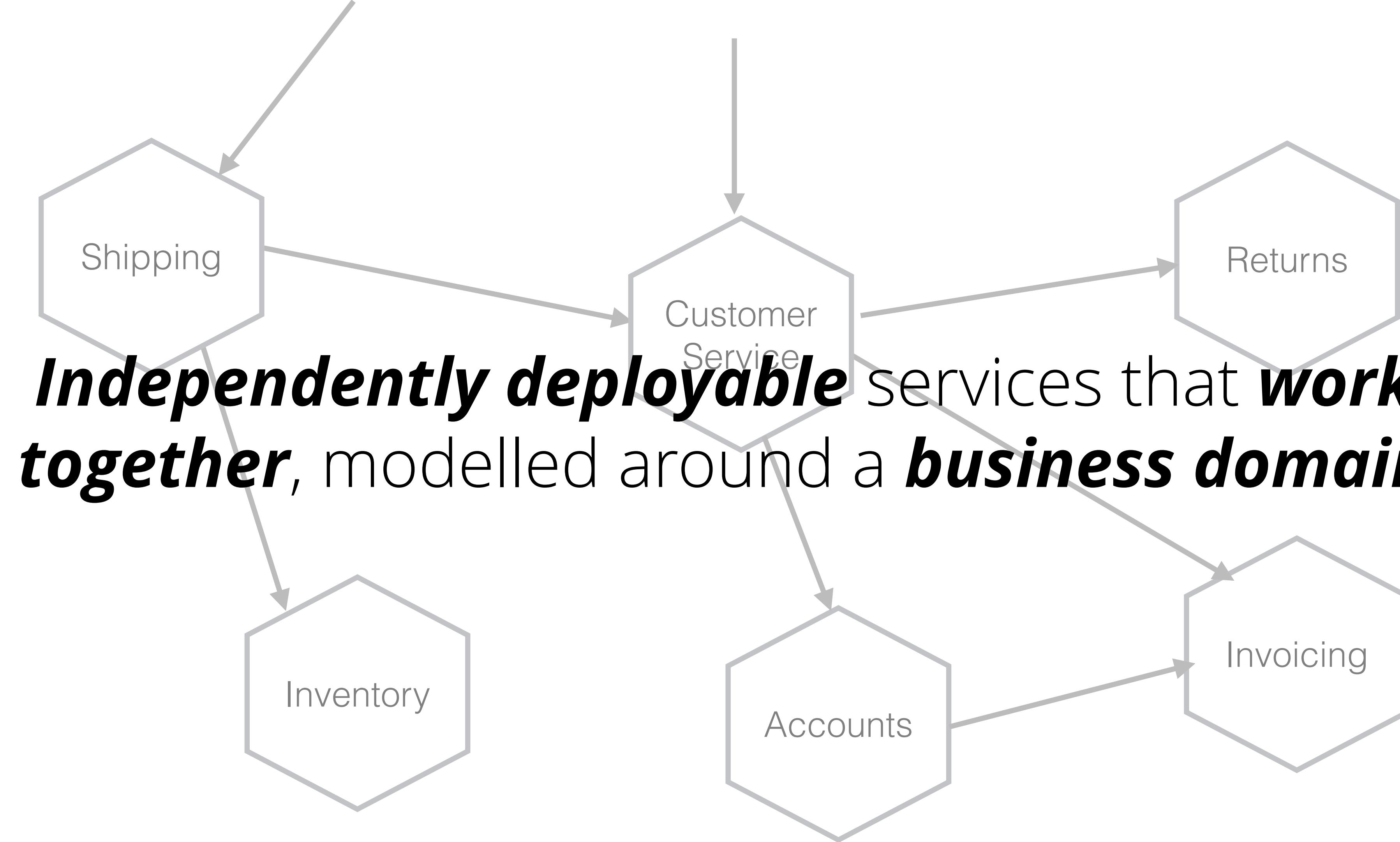
Poll

Where are you in your microservice journey?

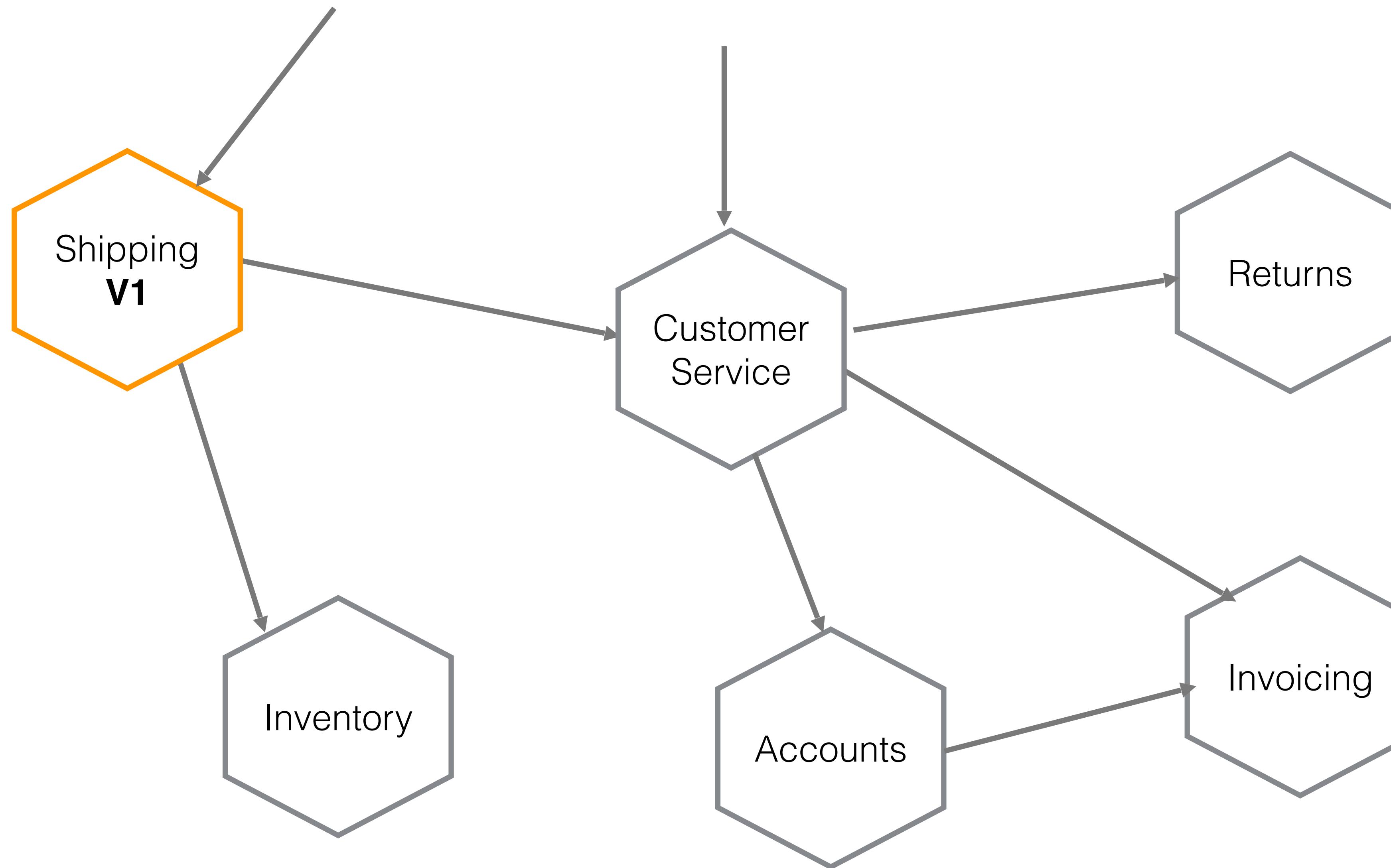
- a.) Thinking about if they're right for me
- b.) Just started using them
- c.) Been using them for a while!

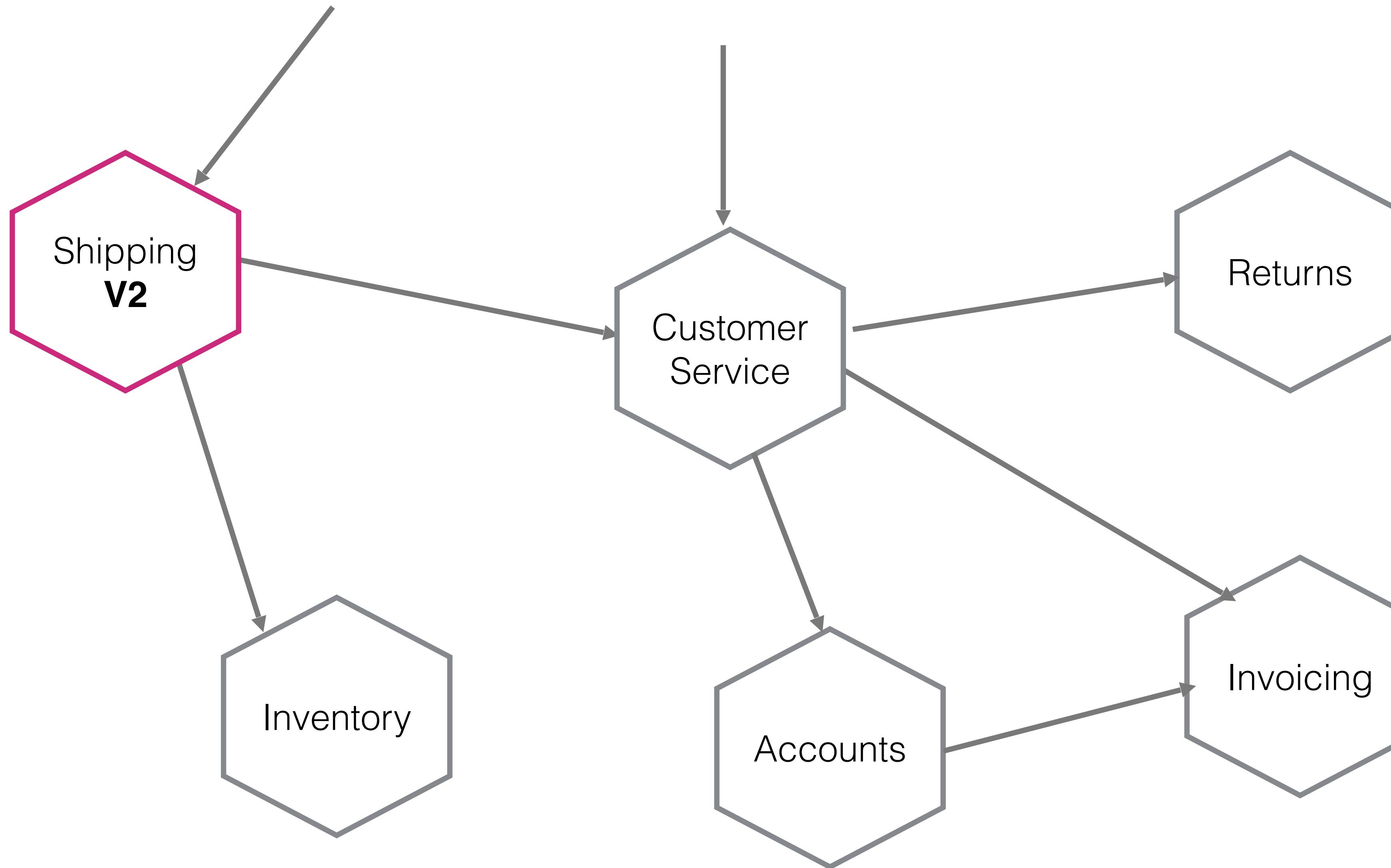
What are microservices?



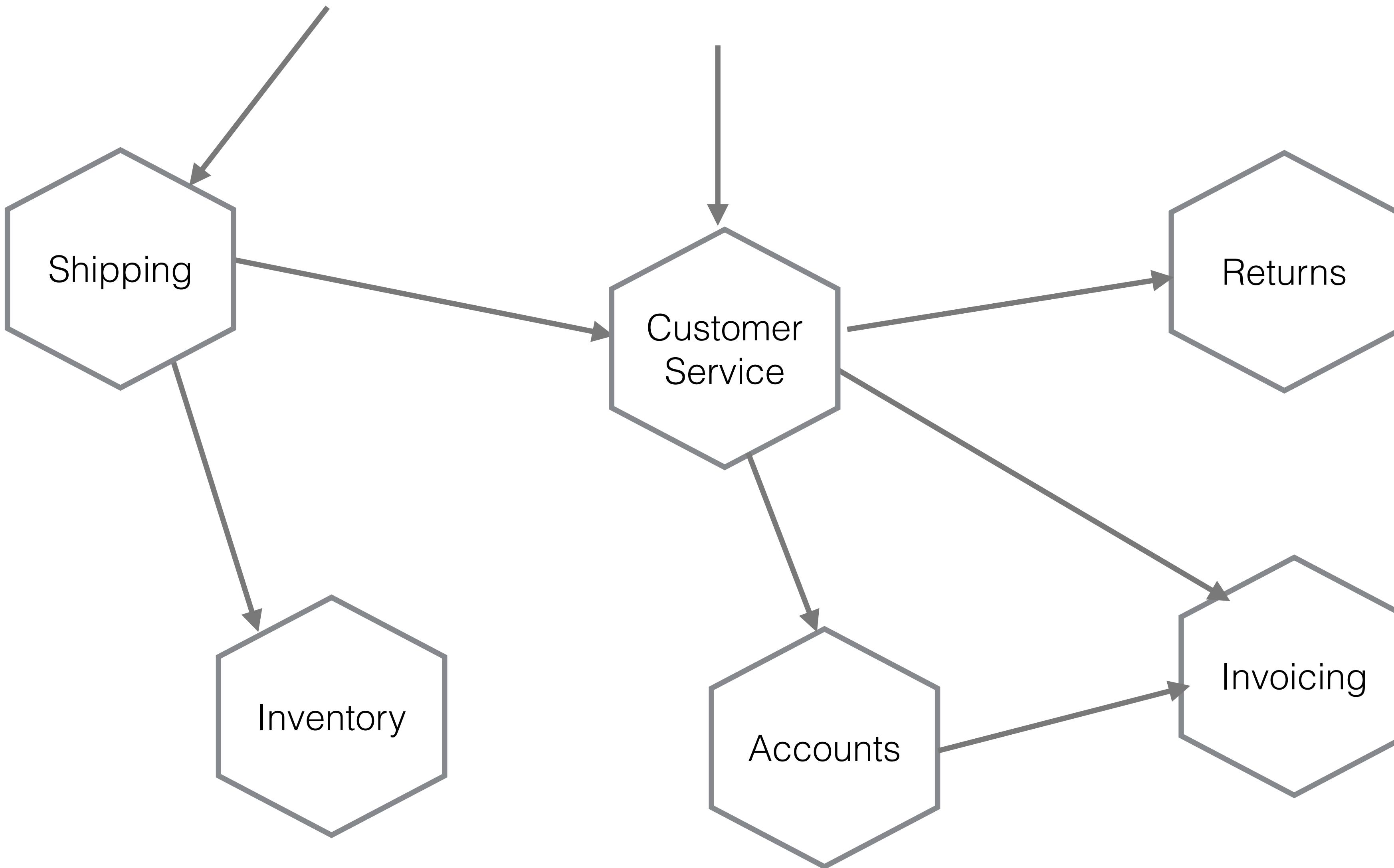


Independently Deployable?





Business Domain?



Size?

Because...*micro*!

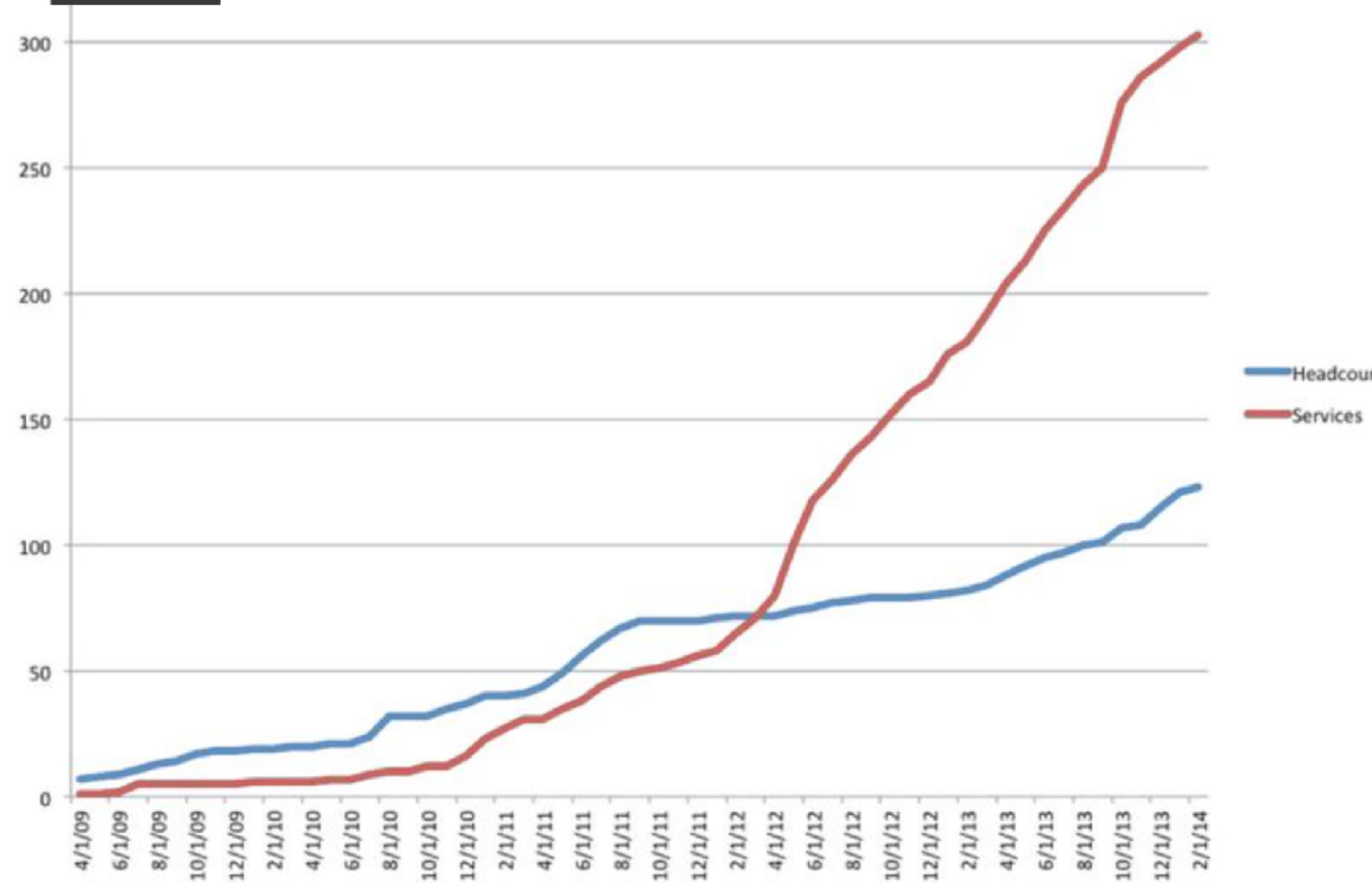
How do you measure size?

Question:

What are the signs that something is too big?

GILT

Startup to Dunbar



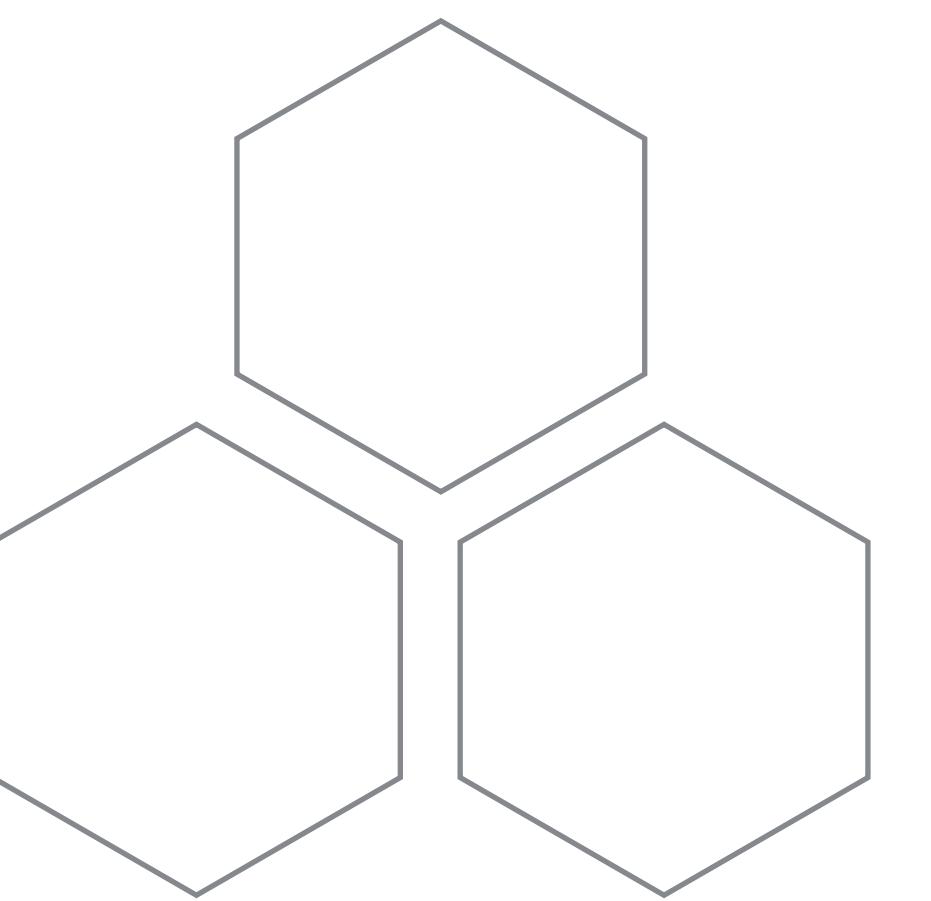
<http://www.infoq.com/presentations/scaling-gilt>

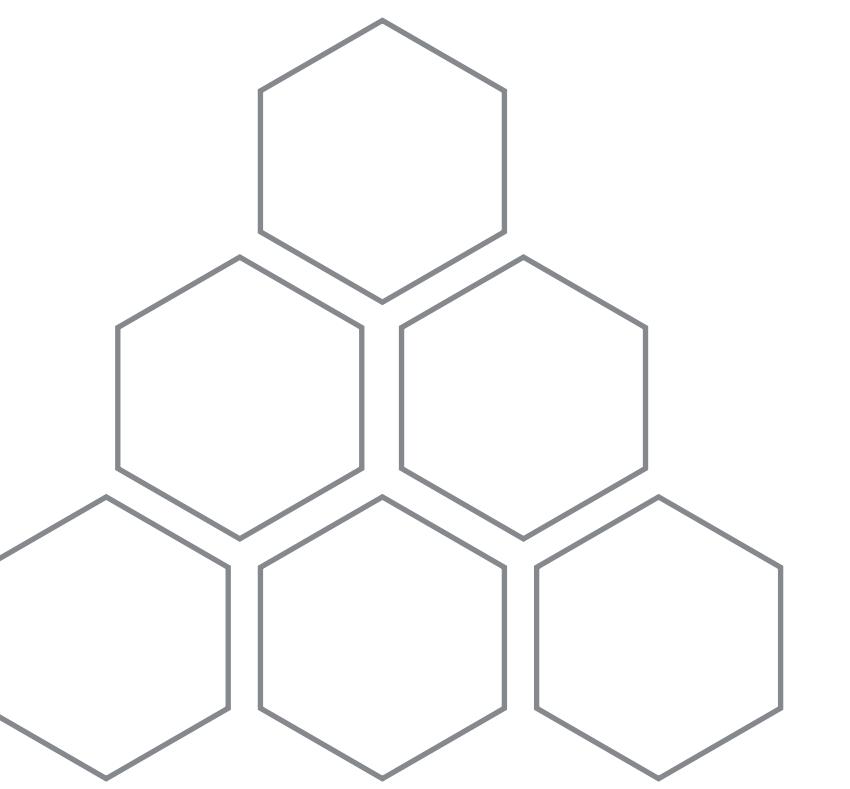
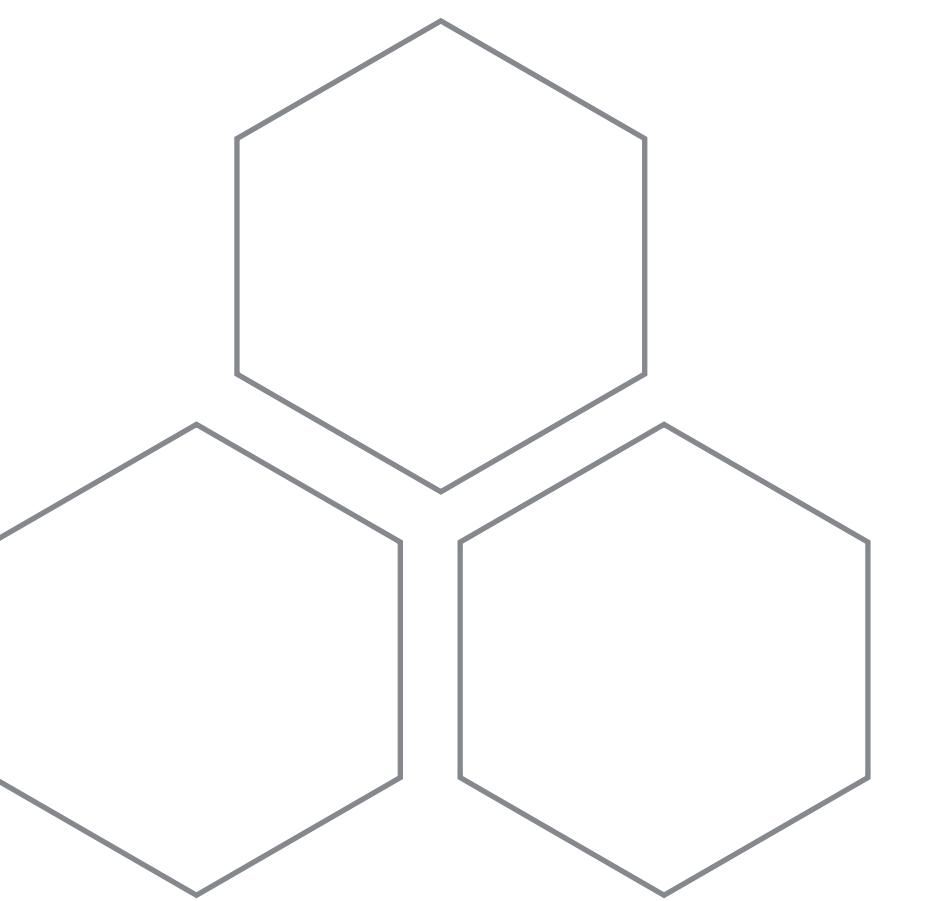
**Your concept of “size” will likely vary
over time...**

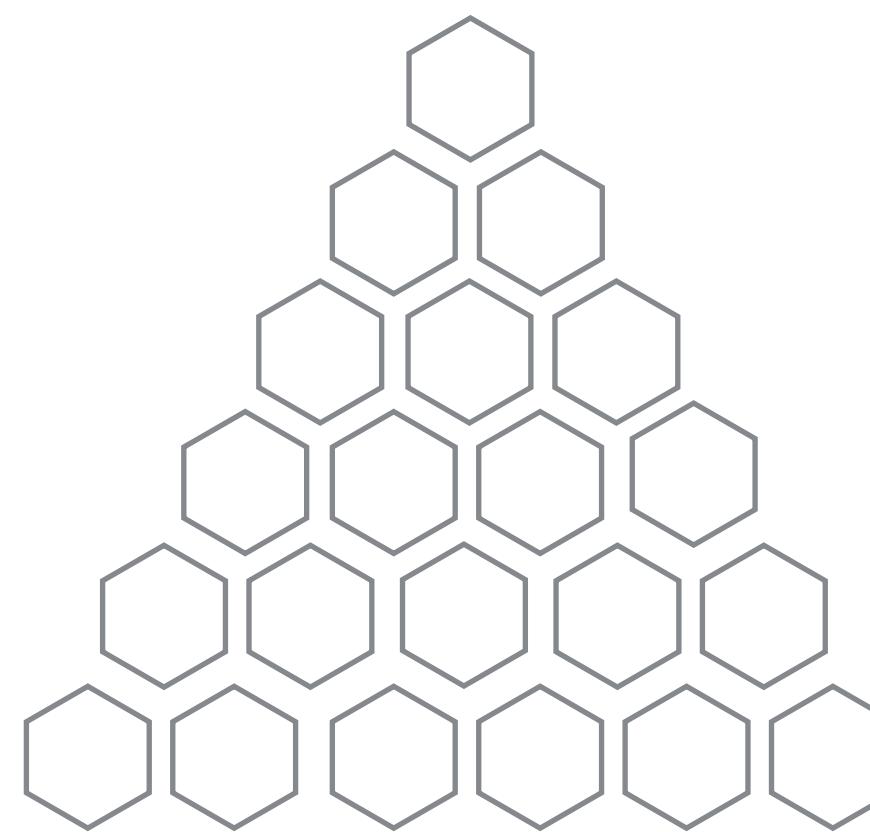
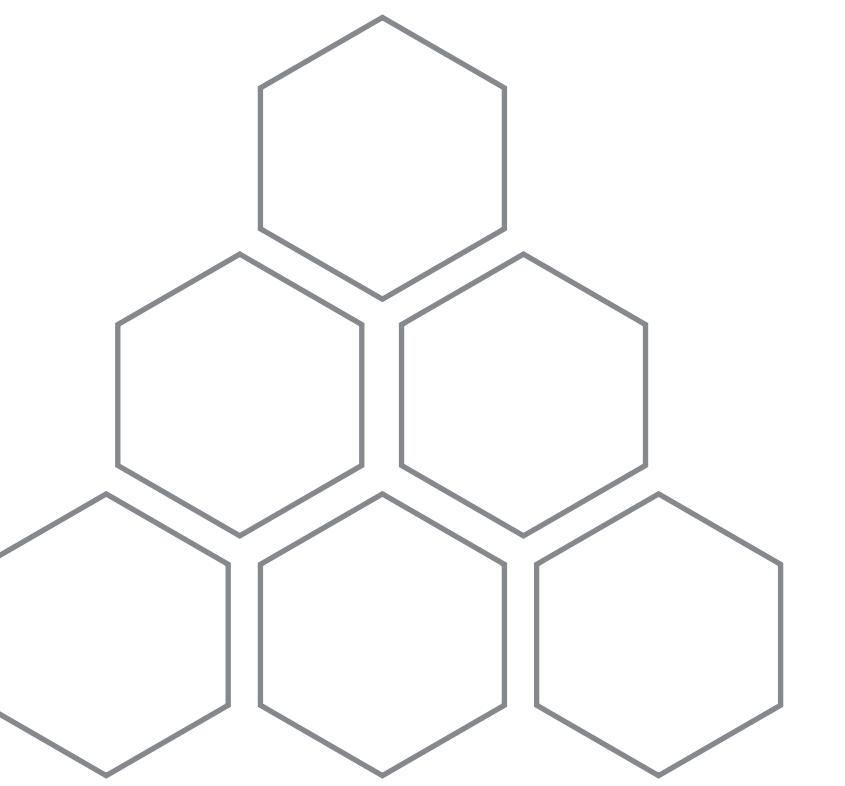
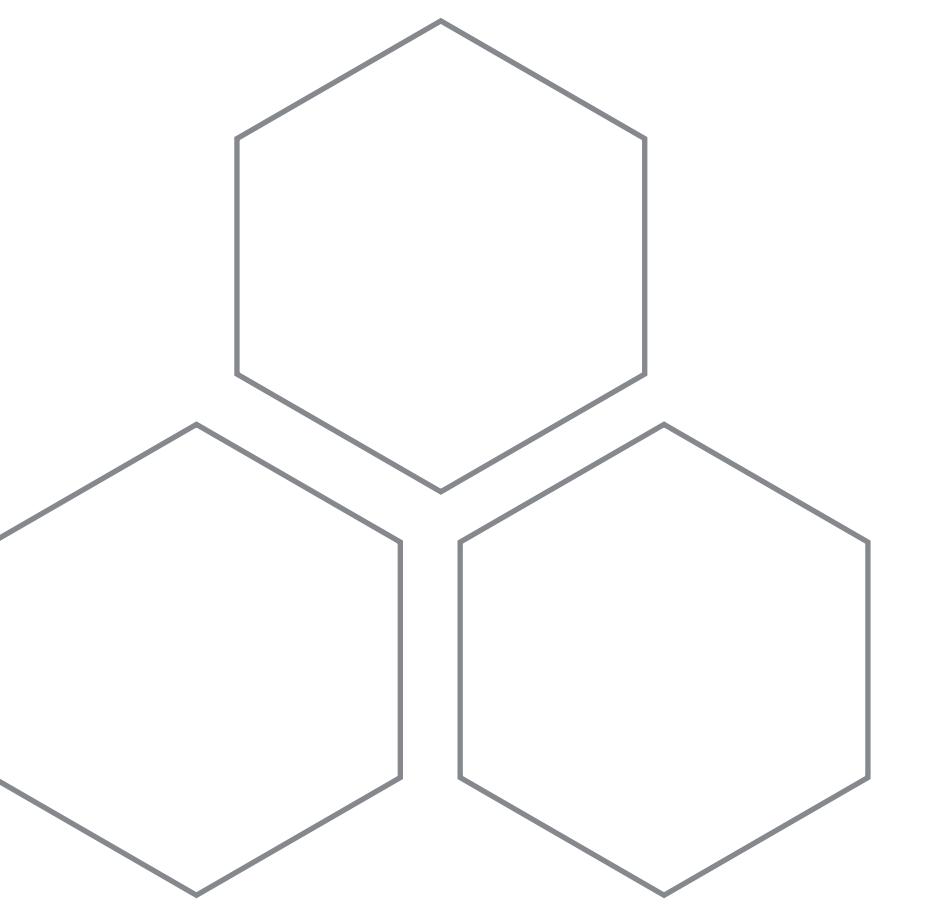
**Your concept of “size” will likely vary
over time...**

...it's all about your context

What is more important for you to focus on is how many services you can handle!







Poll

How many services do you have?

Poll

How many services do you have?

a.) None!

Poll

How many services do you have?

a.) None!

Poll

How many services do you have?

a.) None!

b.) 1 - 10

Poll

How many services do you have?

a.) None!

b.) 1 - 10

Poll

How many services do you have?

a.) None!

b.) 1 - 10

c.) 10 - 50

Poll

How many services do you have?

a.) None!

b.) 1 - 10

c.) 10 - 50

Poll

How many services do you have?

- a.) None!
- b.) 1 - 10
- c.) 10 - 50
- d.) 50 or more...

What about Service Oriented Architecture? (SOA)

Microservices are just a type of SOA

**Do I need to use any particular
technology?**

**Just focus on making things
independently deployable!**

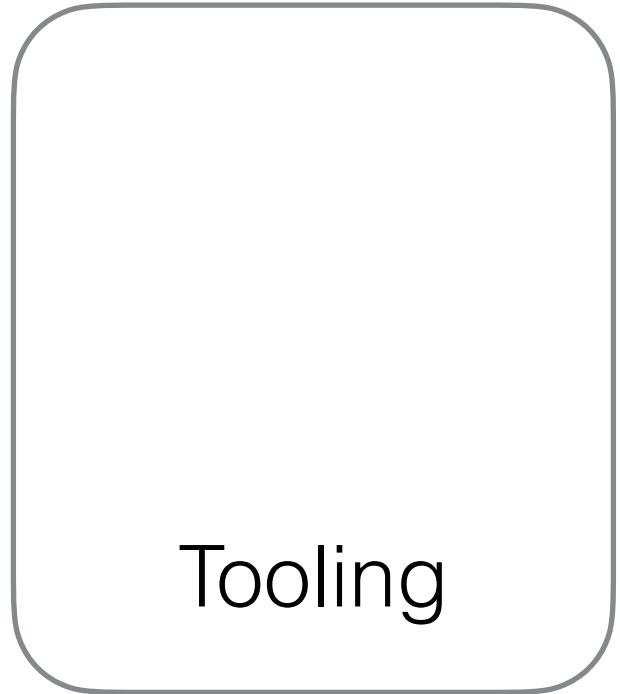
Beware - there are significant downsides!

COGNITIVE OVERLOAD

Based on a model from Adrian Cockcroft:

<http://www.slideshare.net/adriancockcroft/evolution-of-microservices-craft-conference>

COGNITIVE OVERLOAD

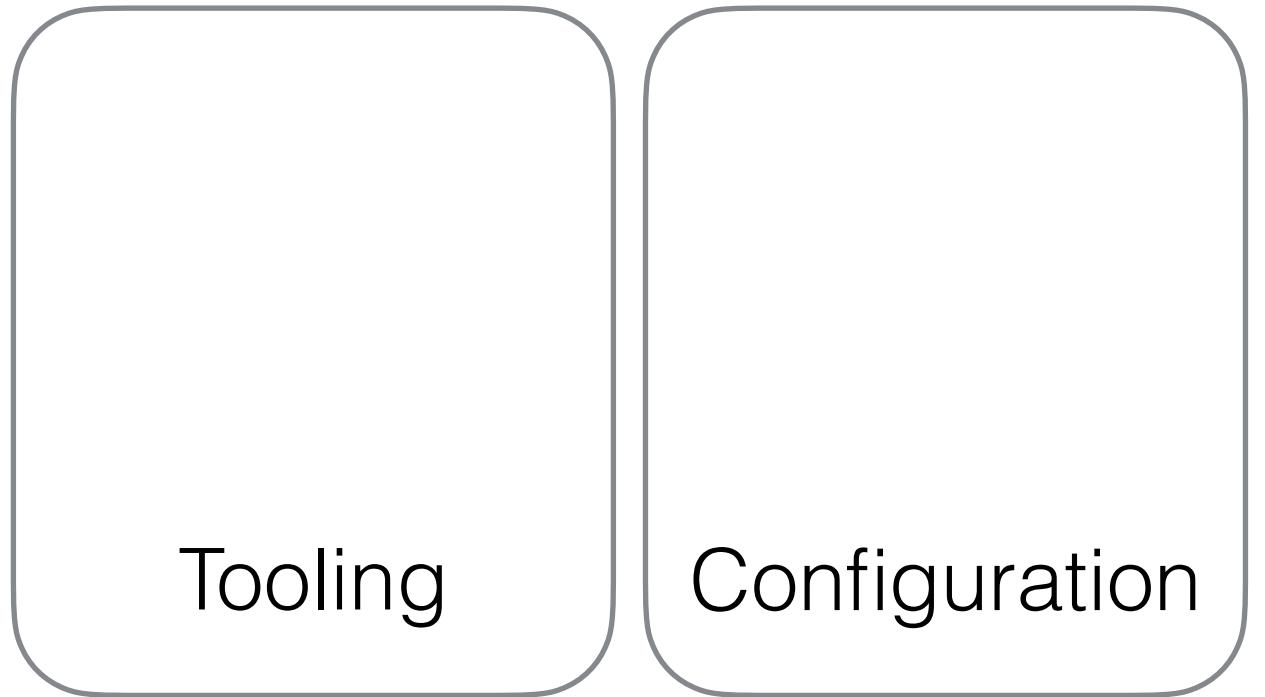


Tooling

Based on a model from Adrian Cockcroft:

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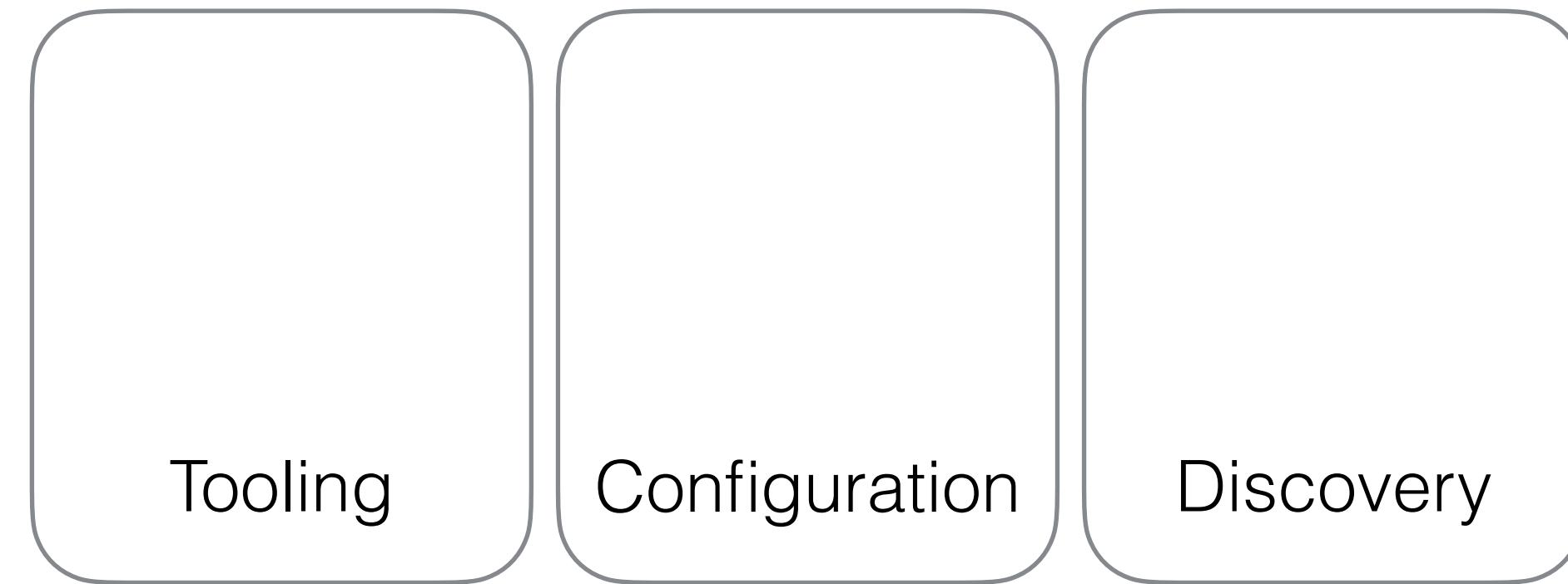
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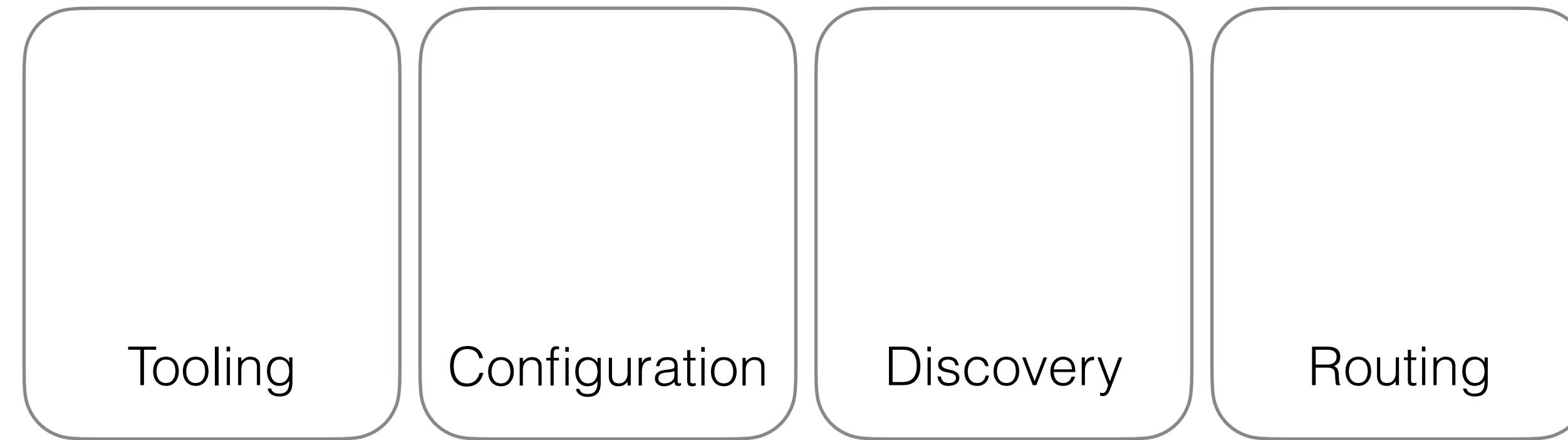
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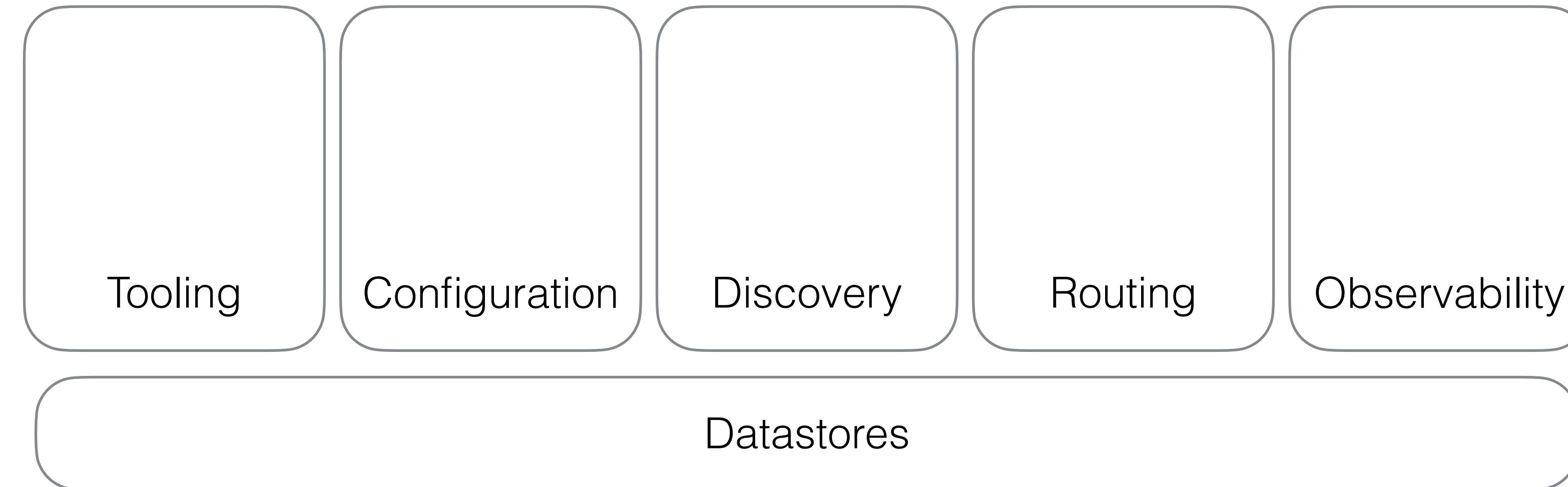
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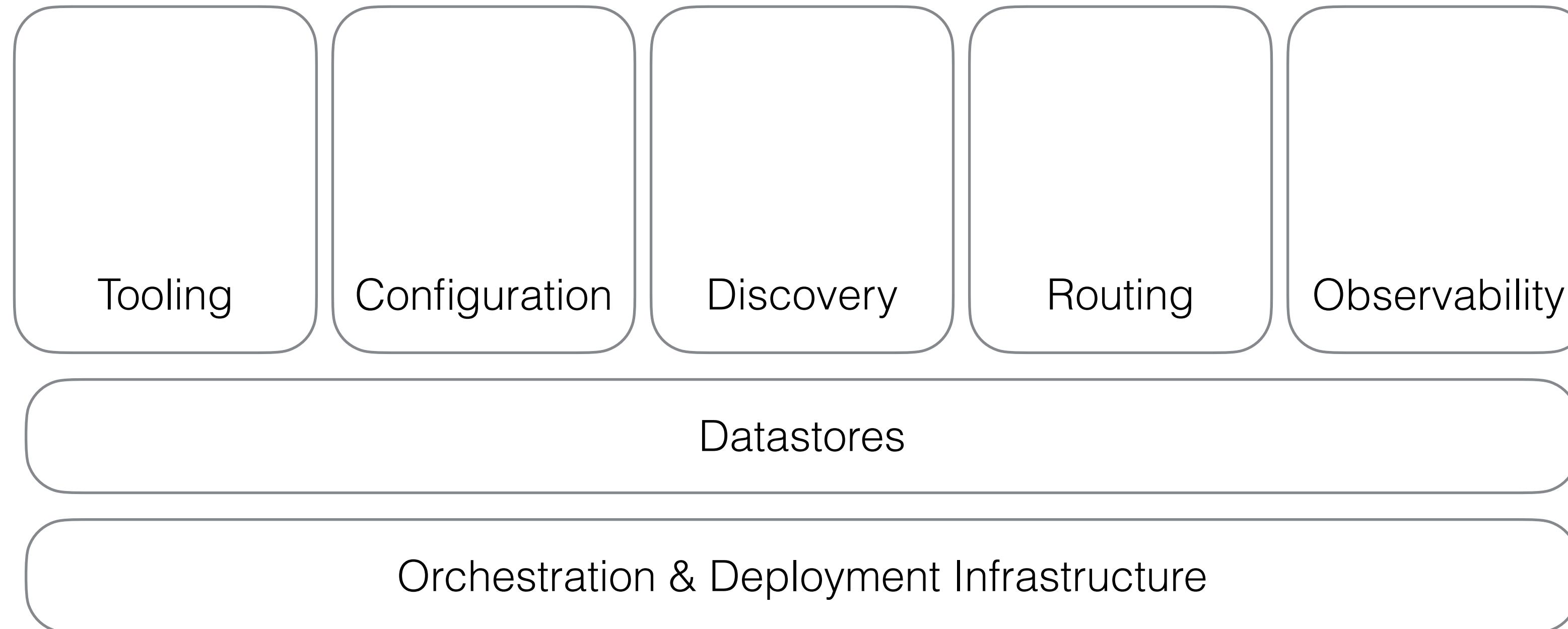
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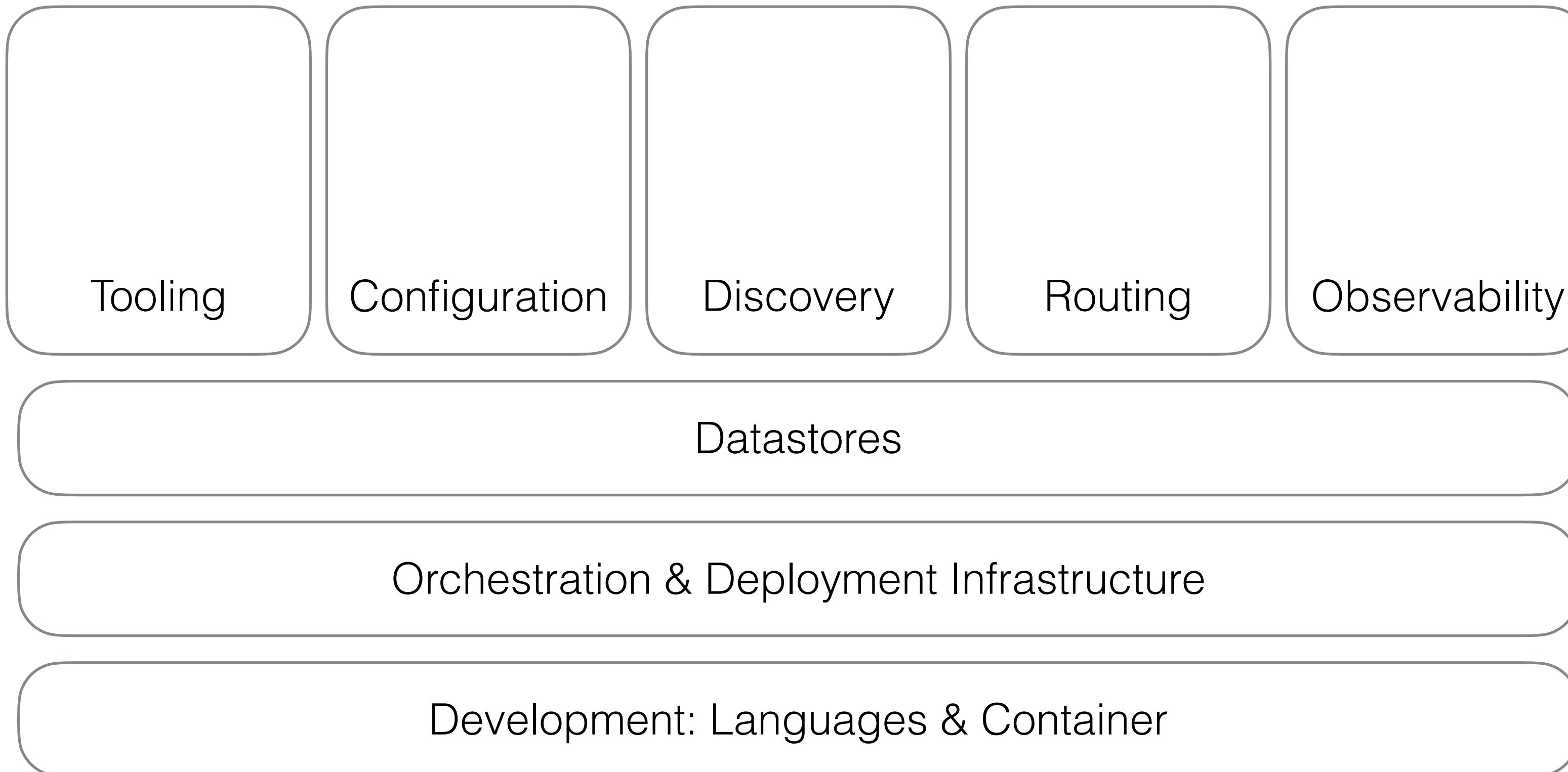
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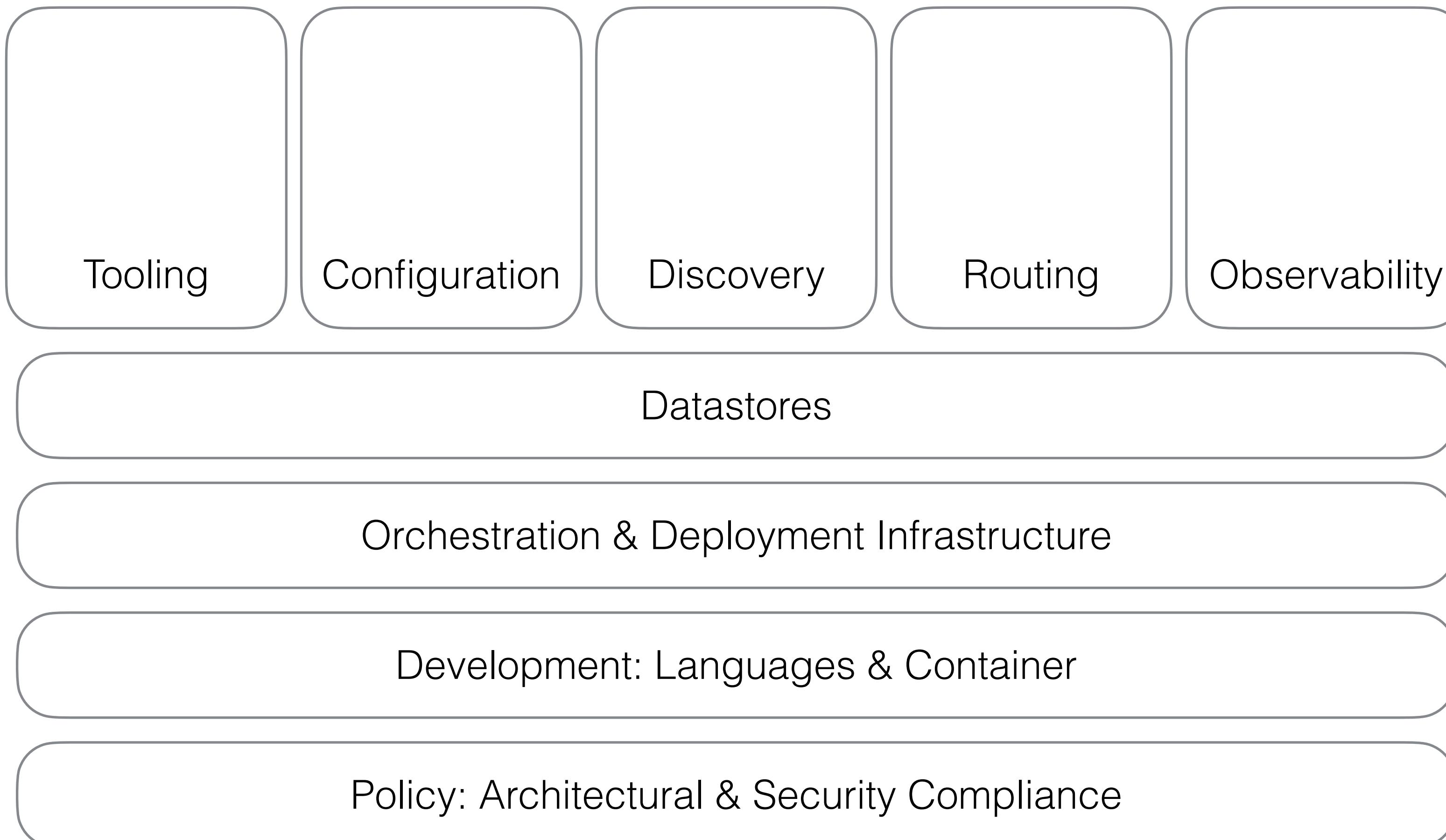
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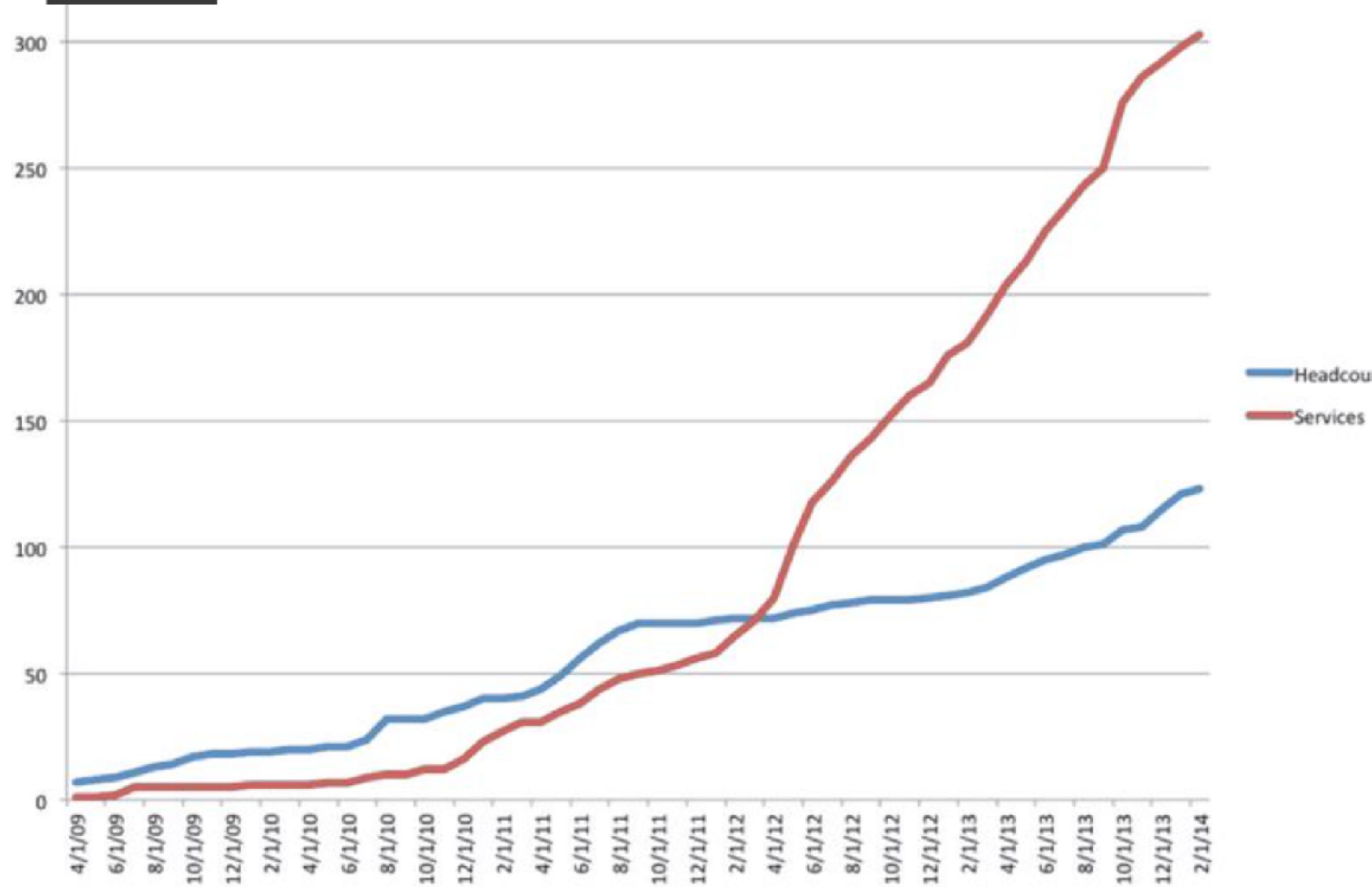


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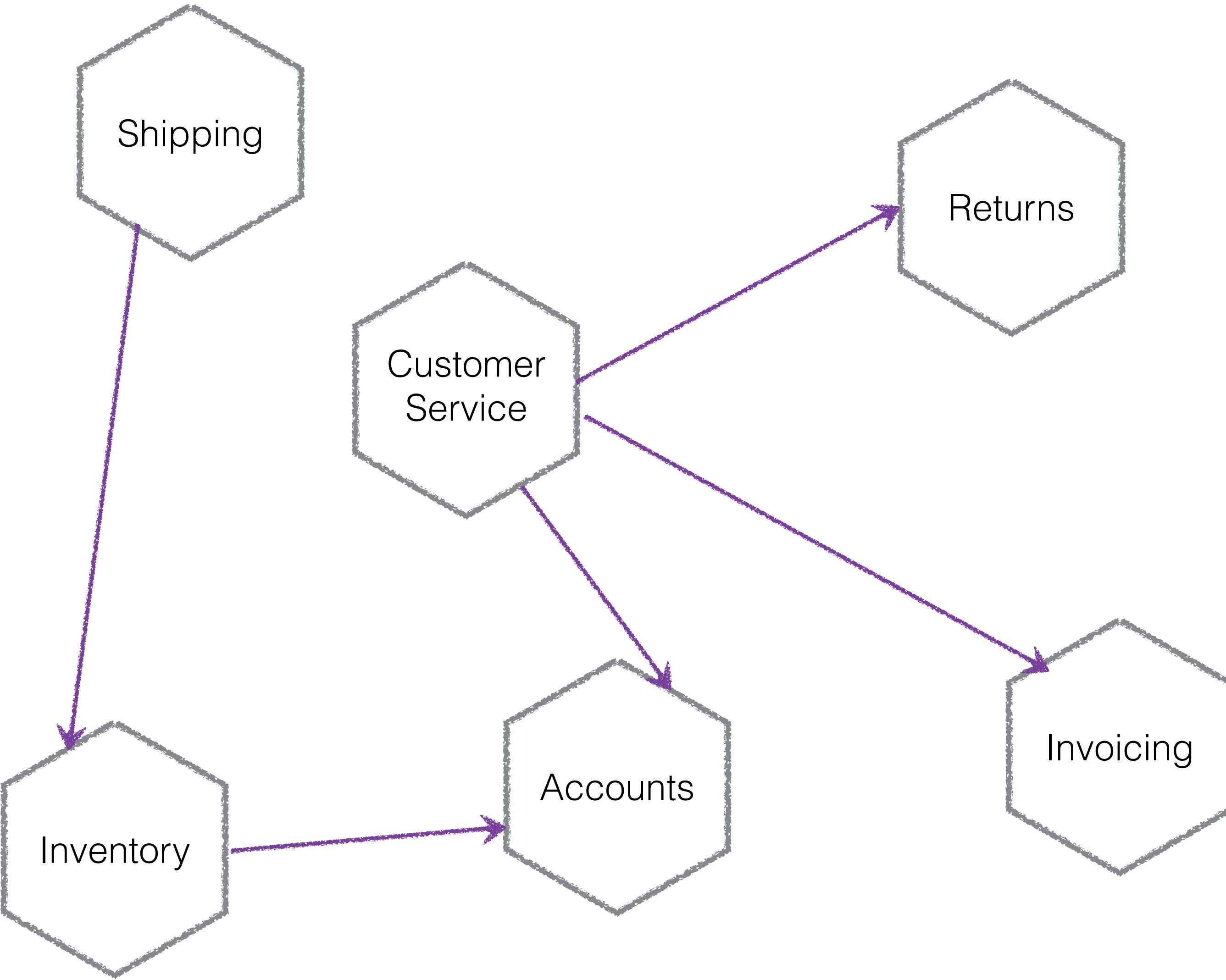
GILT

Startup to Dunbar

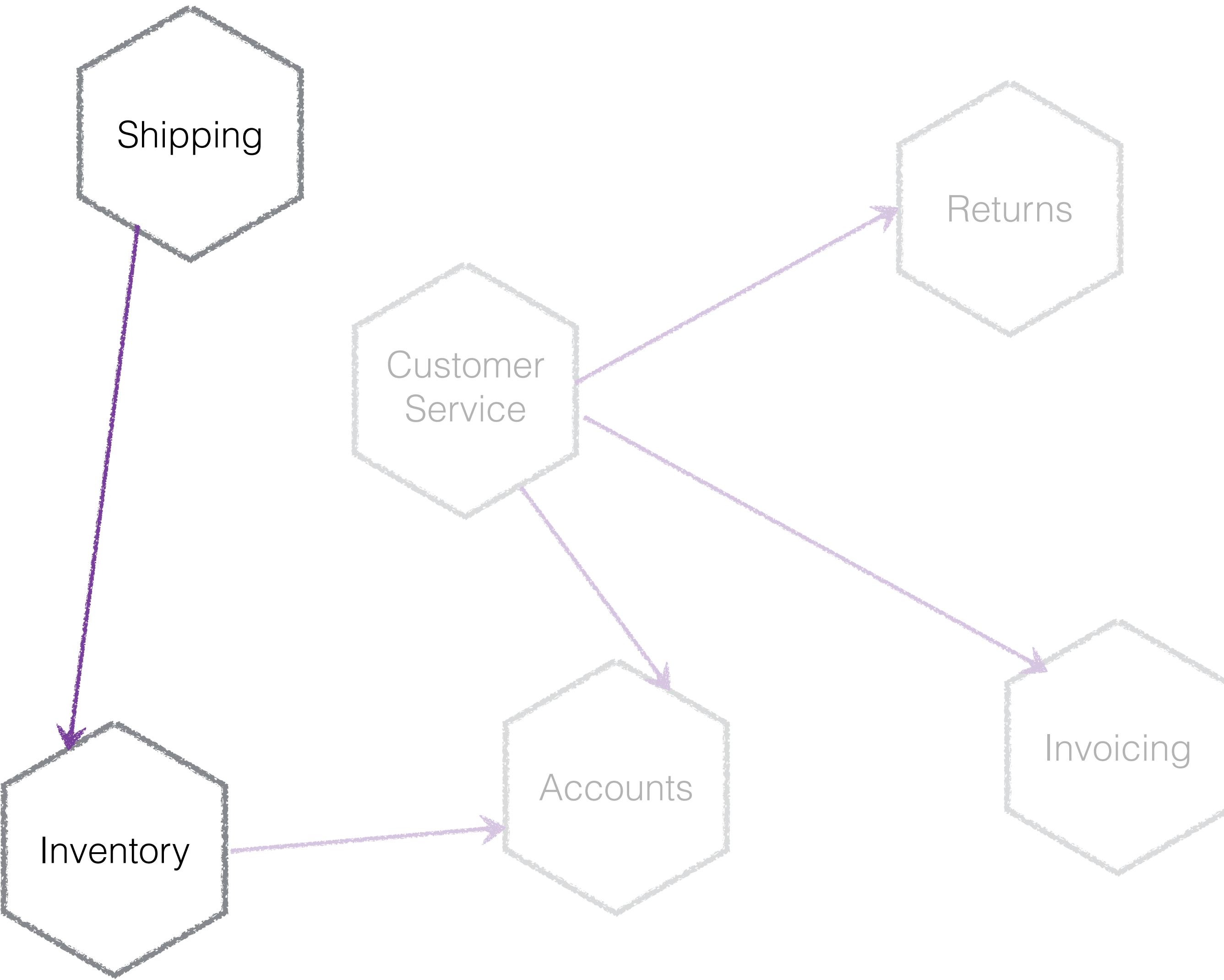


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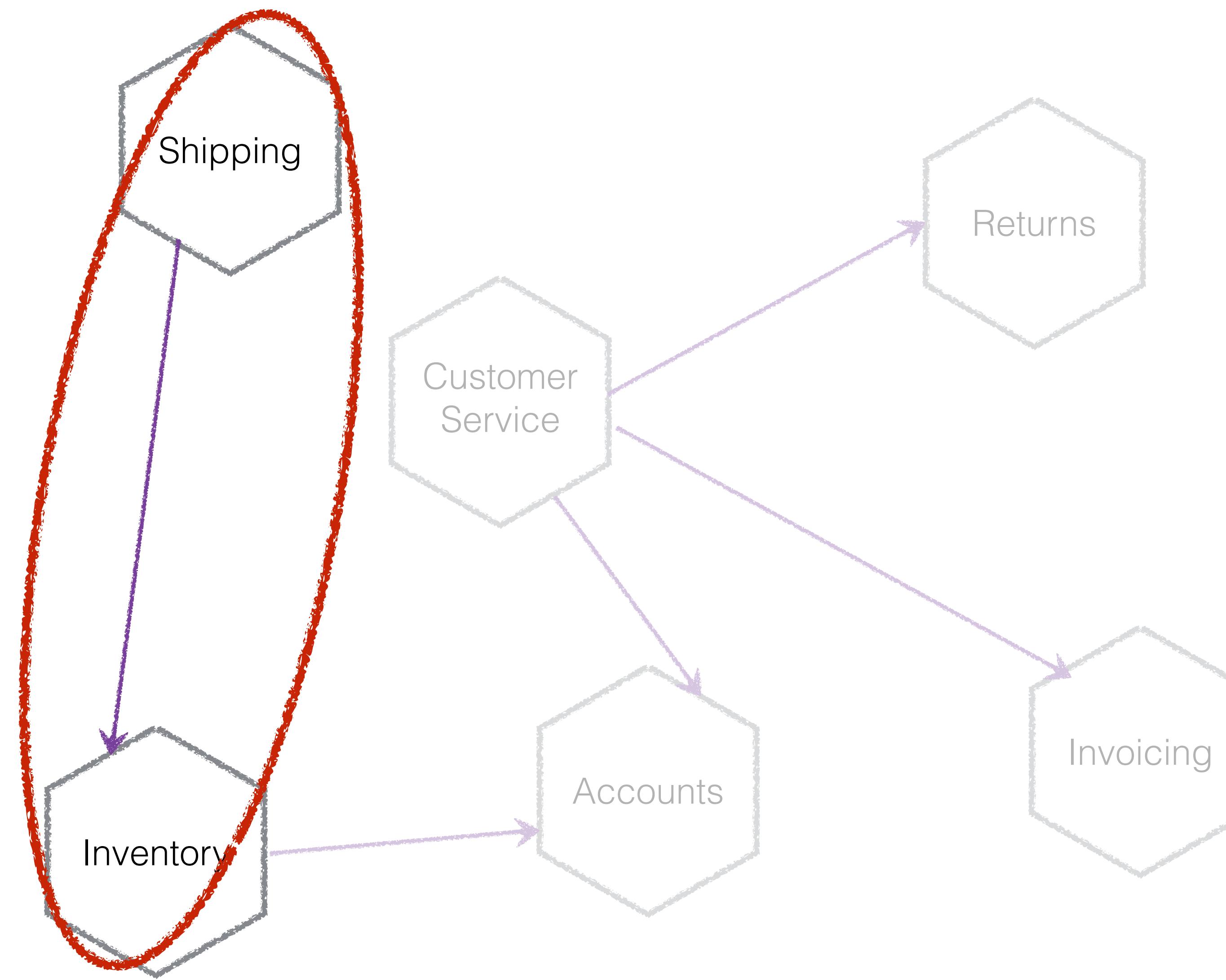
CROSS-SERVICE TESTING IS MORE INVOLVED



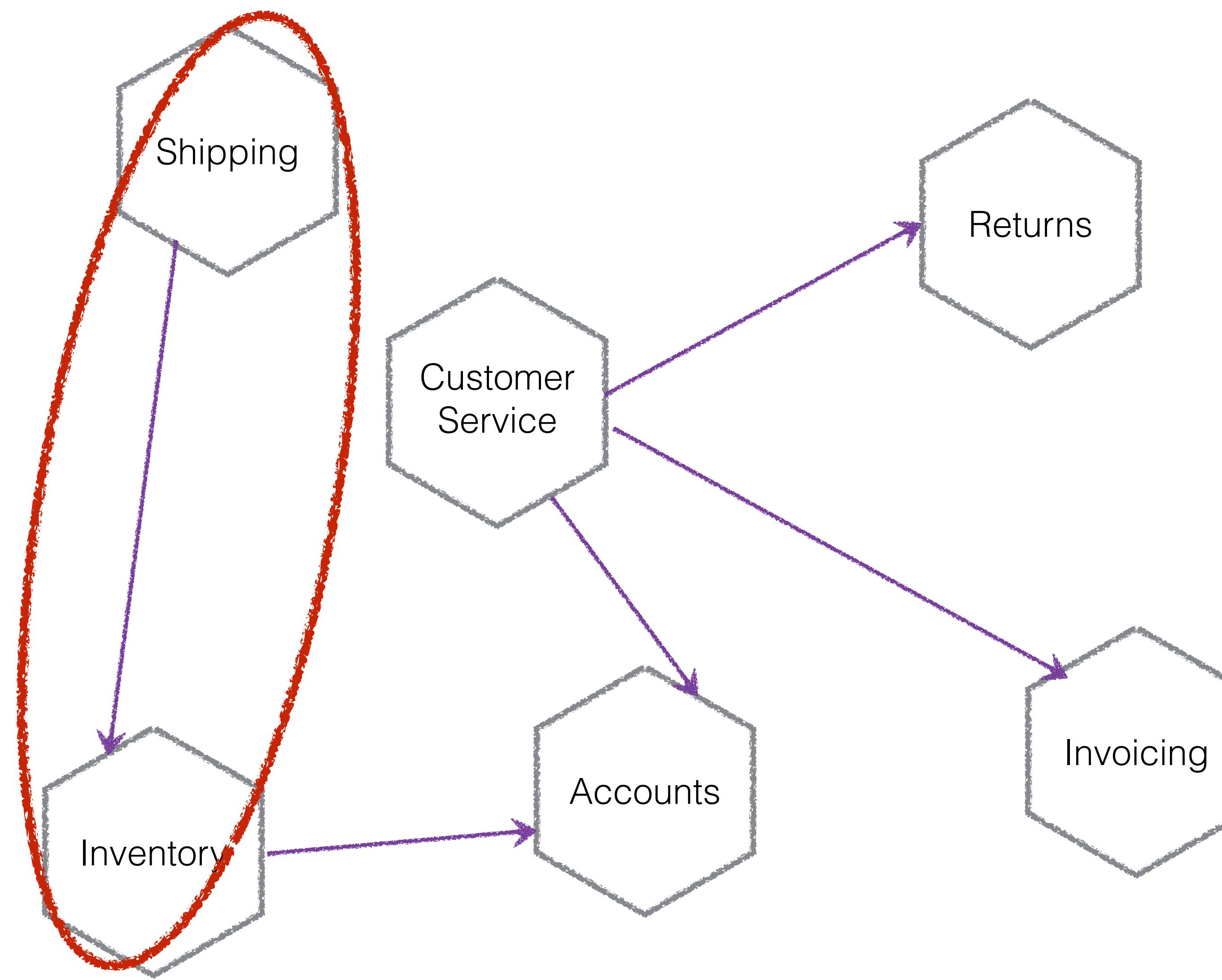
CROSS-SERVICE TESTING IS MORE INVOLVED



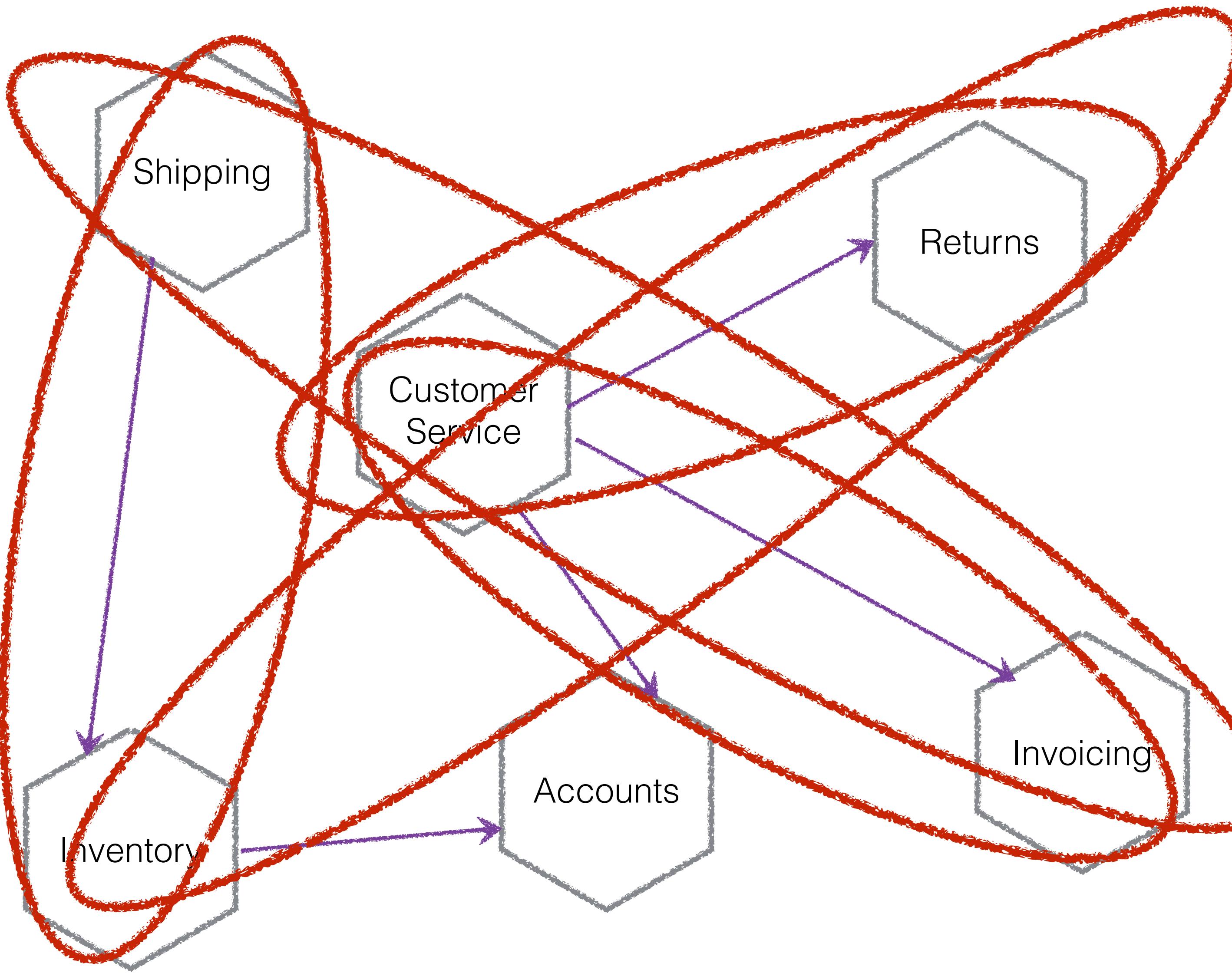
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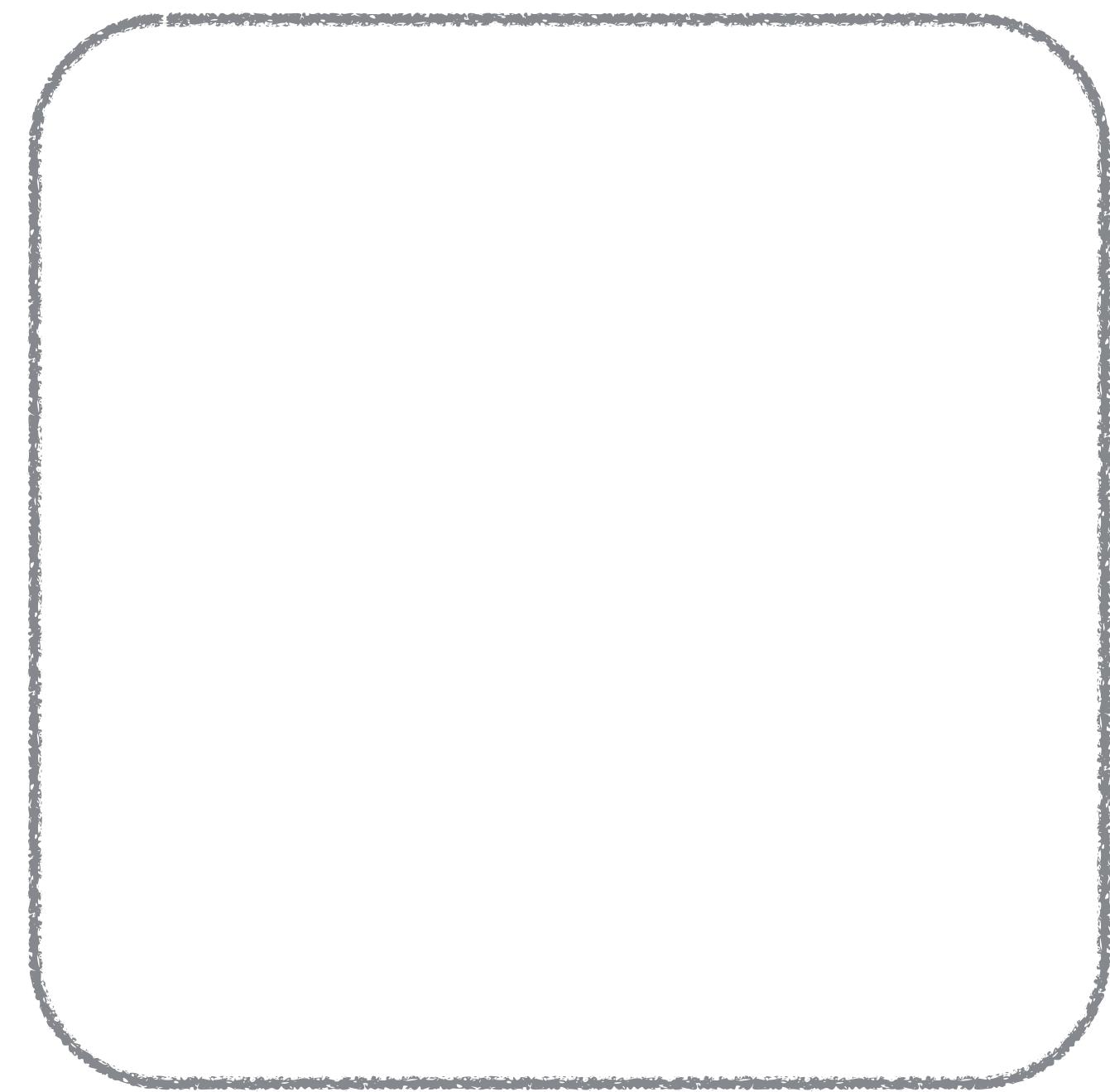


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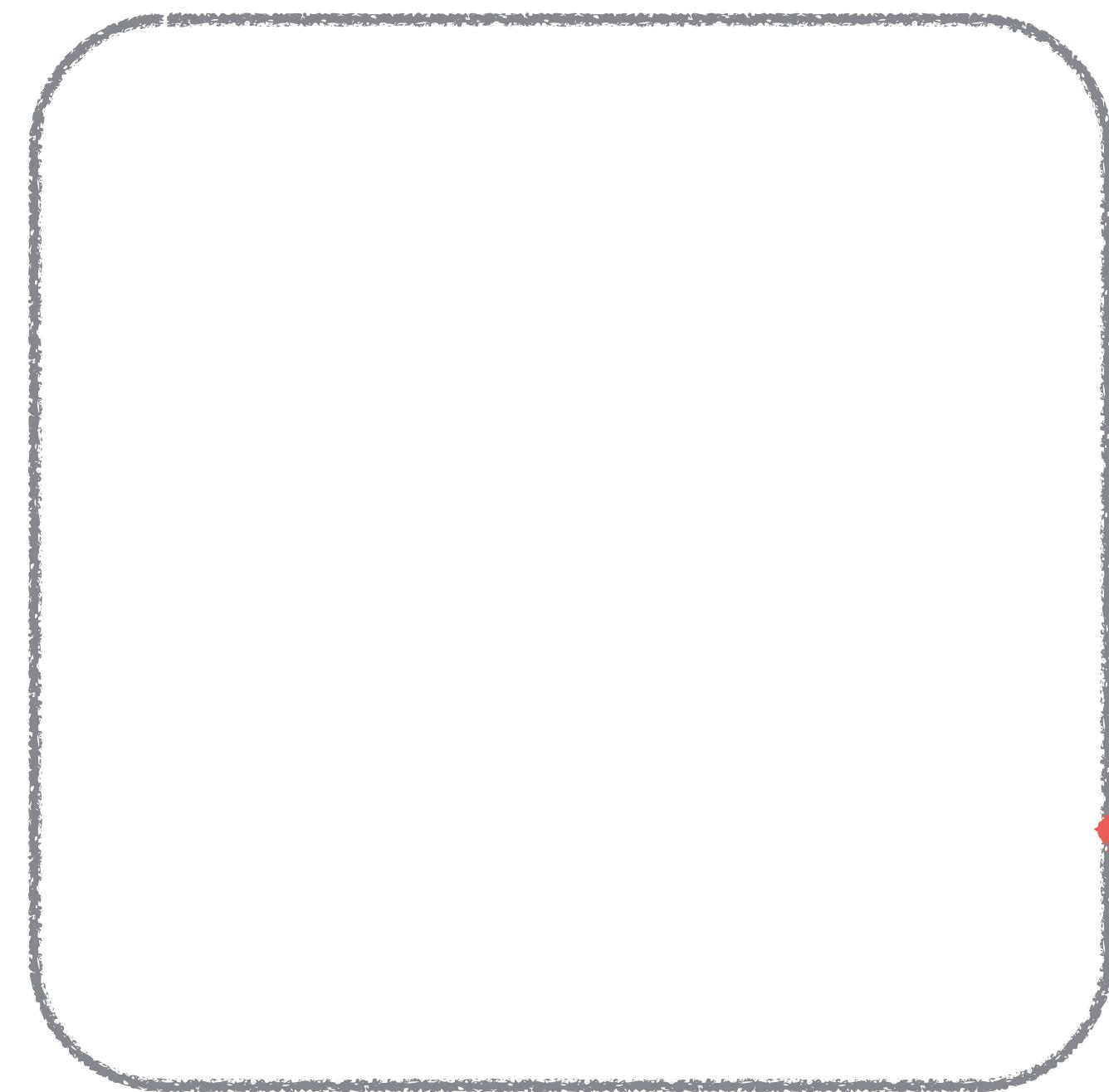
CROSS-SERVICE TESTING IS MORE INVOLVED







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<http://www.flickr.com/photos/kalexanderson/5421517469/>



Honest Status Page

@honest_update

 Follow



We replaced our monolith with micro services so that every outage could be more like a murder mystery.

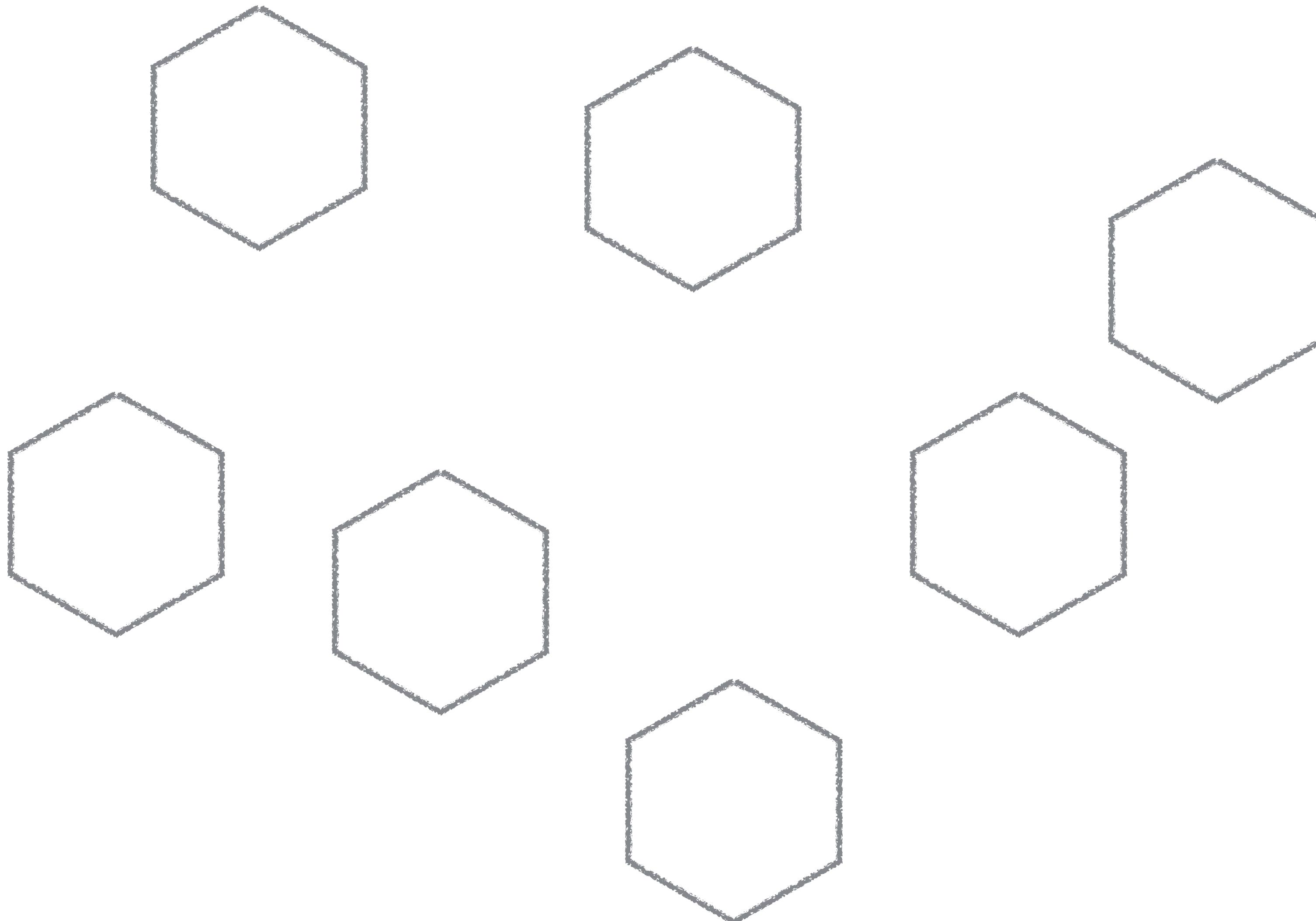
RETWEETS
2,880

LIKES
2,261

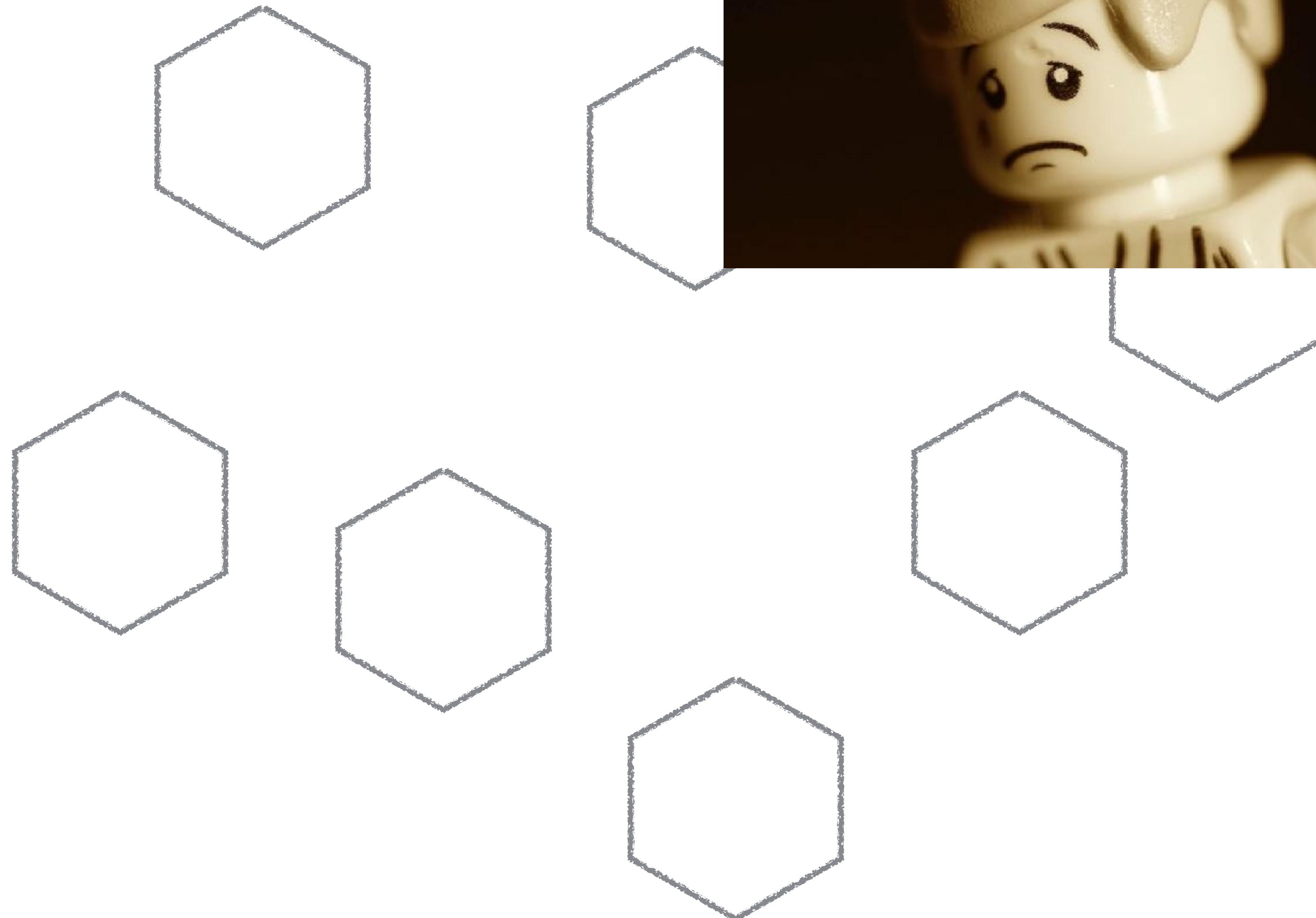


https://twitter.com/honest_update/status/651897353889259520

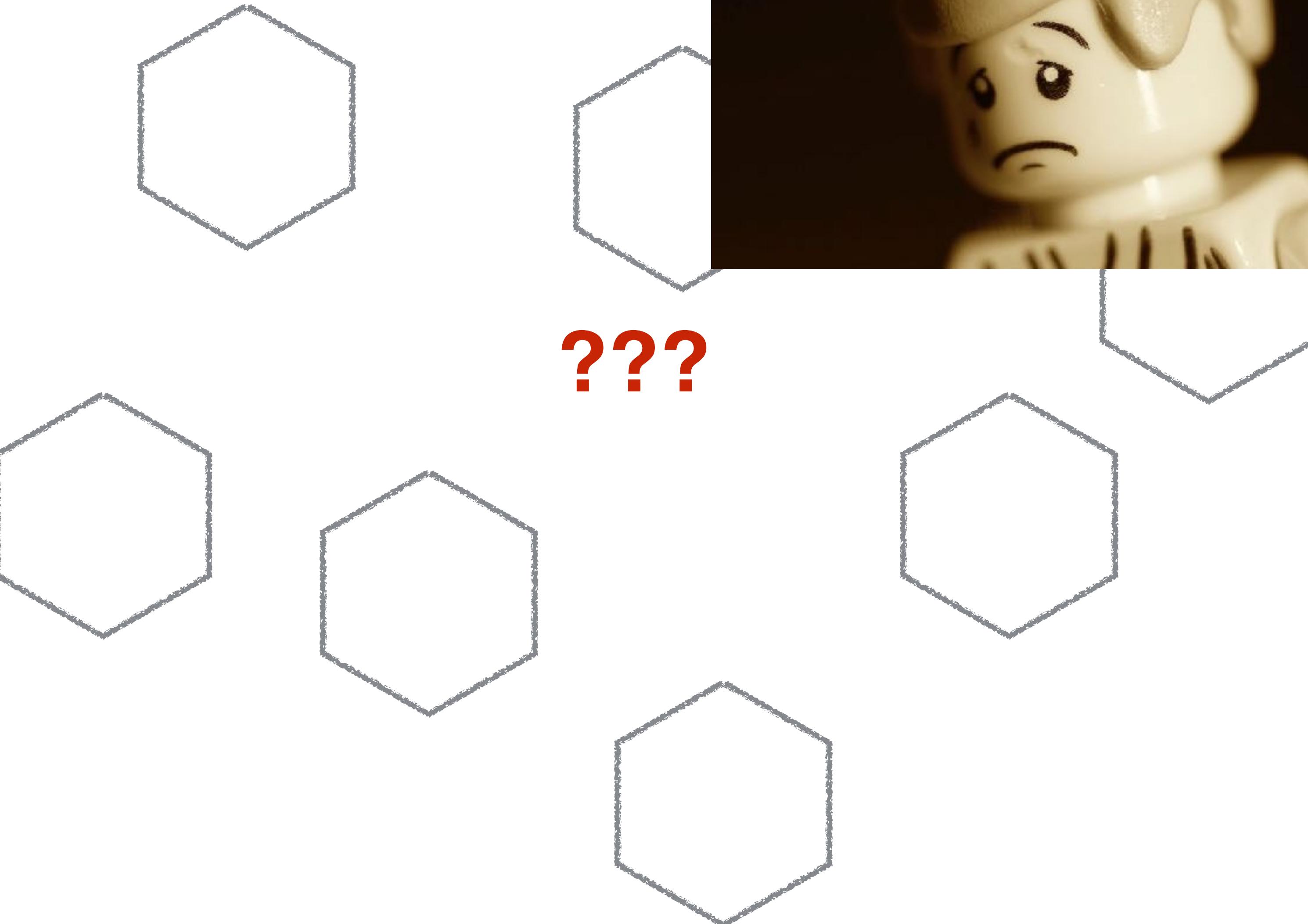
MONITORING IS MORE COMPLEX



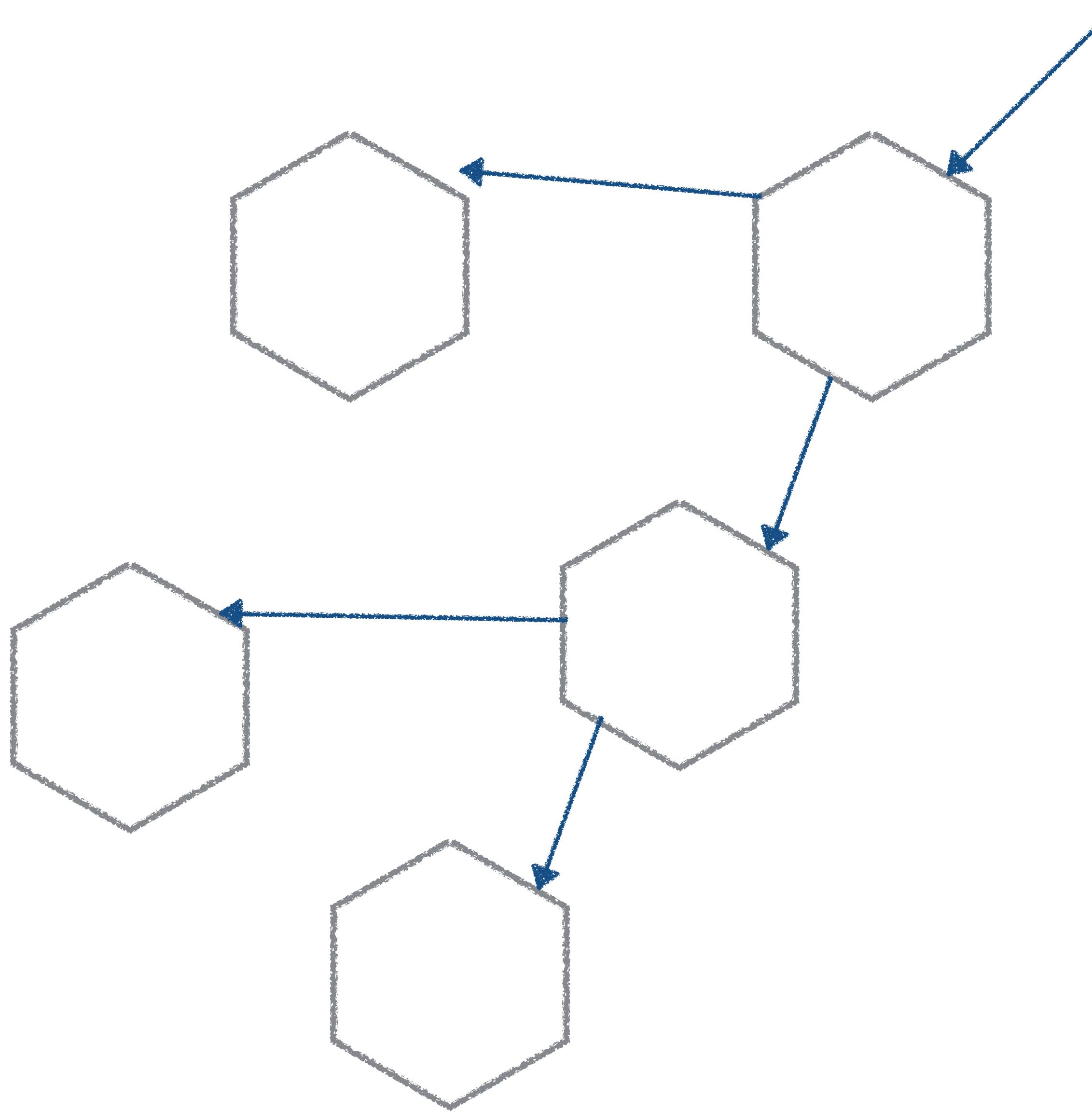
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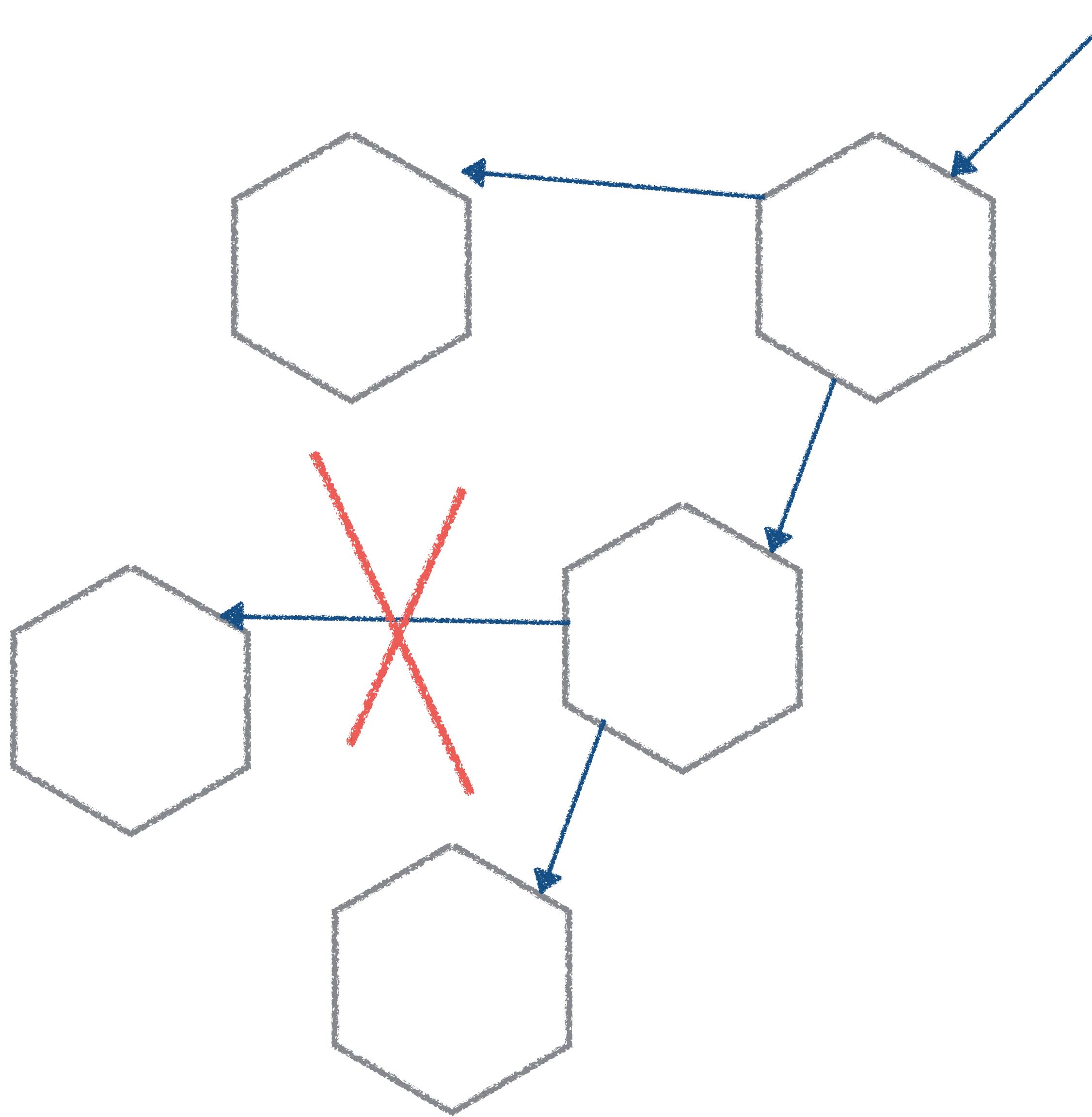
MONITORING IS MORE COMPLEX



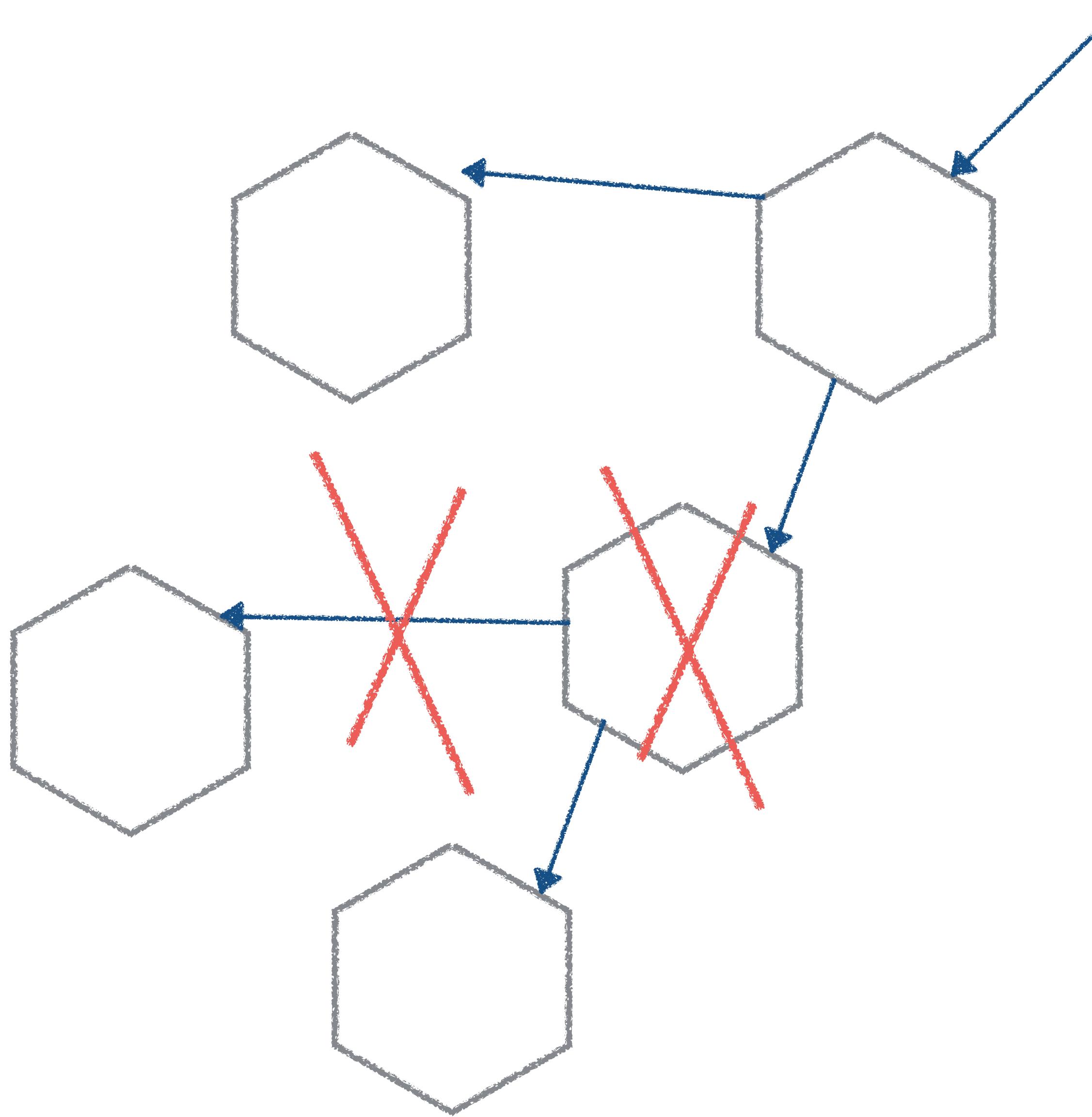
RESILIENCY ISN'T FREE



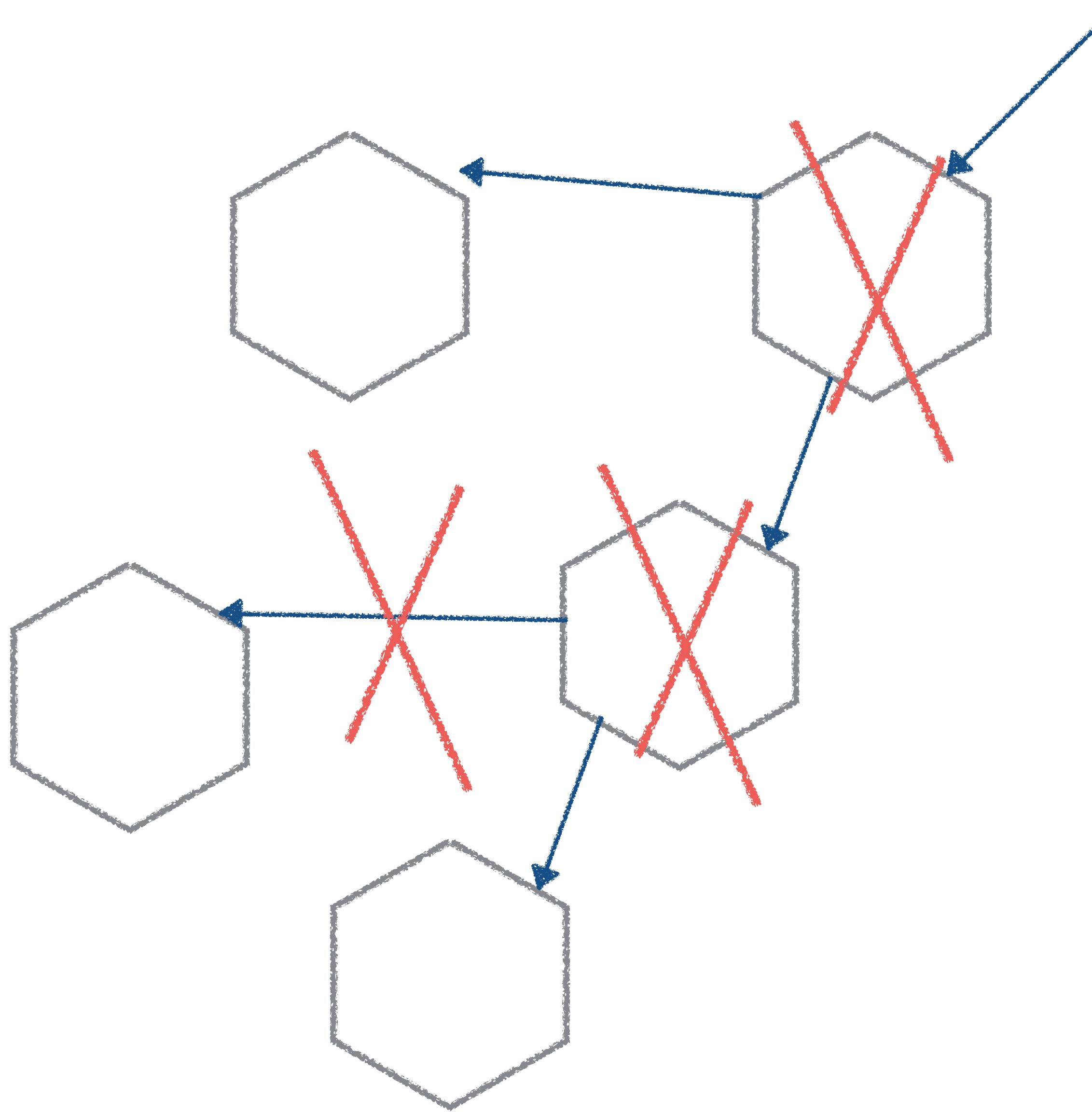
RESILIENCY ISN'T FREE



RESILIENCY ISN'T FREE



RESILIENCY ISN'T FREE





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AND THE FUNDAMENTALS...

Distributed transactions

AND THE FUNDAMENTALS...

Distributed transactions

Eventual consistency

AND THE FUNDAMENTALS...

Distributed transactions

Eventual consistency

CAP theory...

The problem with coupling

Types of coupling?

Domain Coupling

Domain Coupling

Implementation Coupling

Domain Coupling



Implementation Coupling

Temporal Coupling



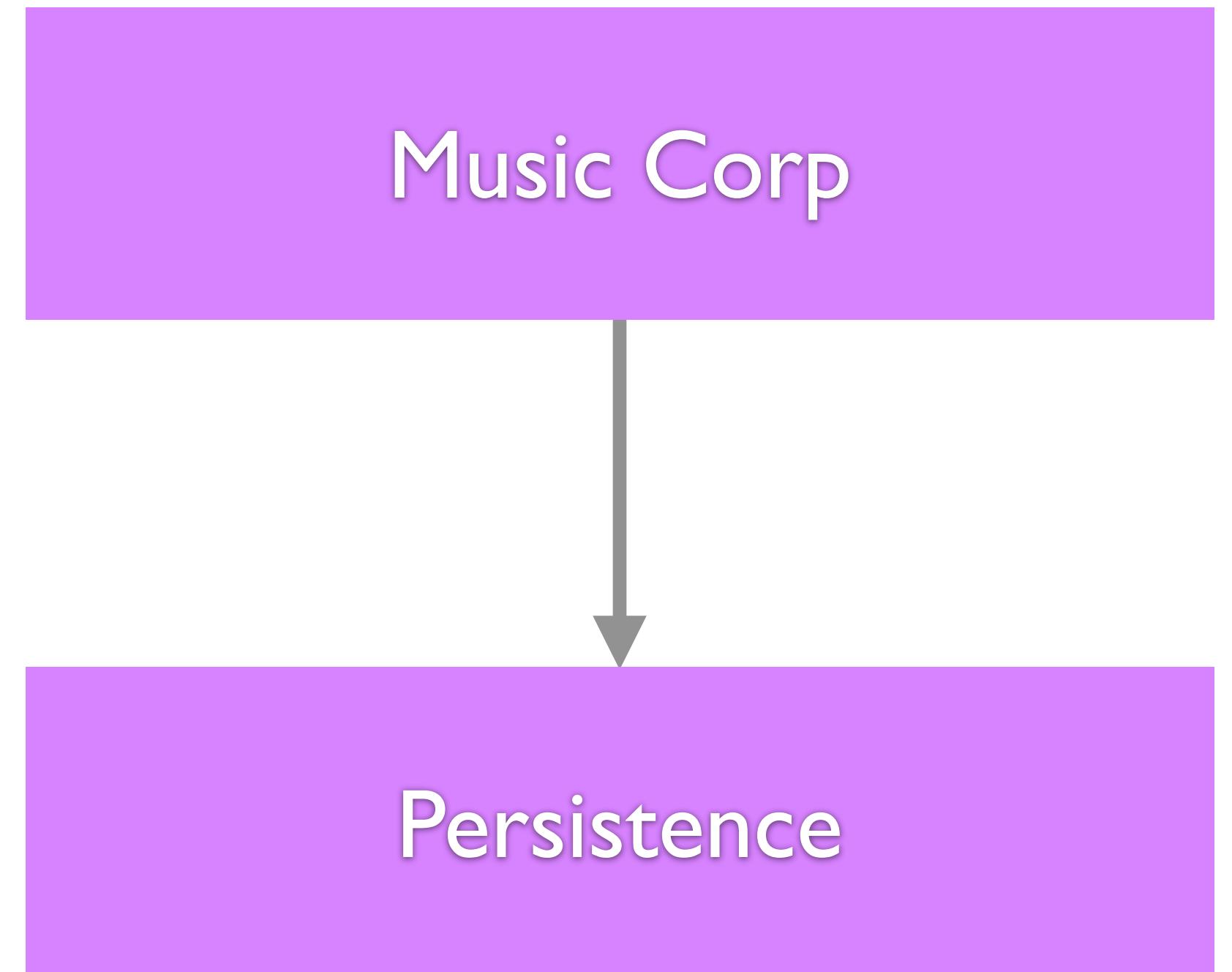
Music Corp

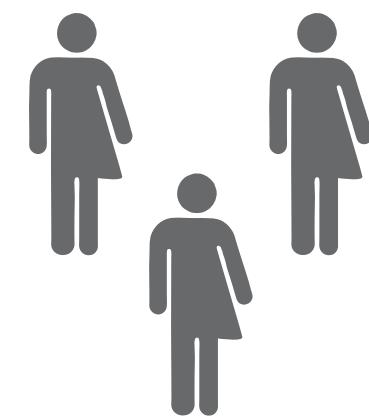


Music Corp



Persistence

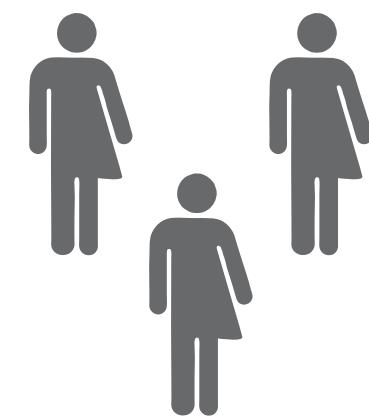




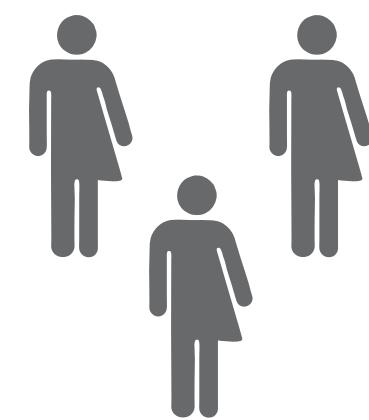
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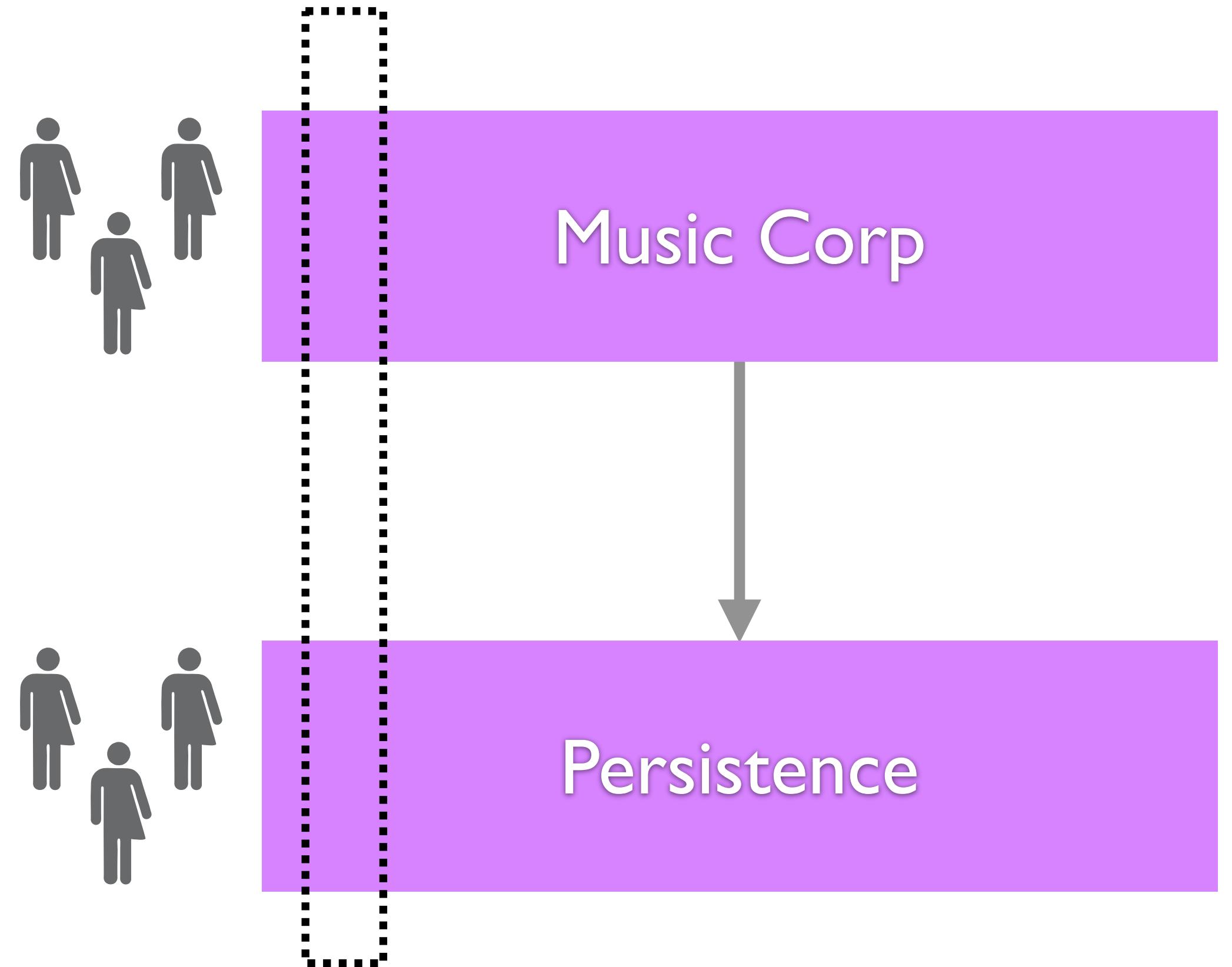
Persistence

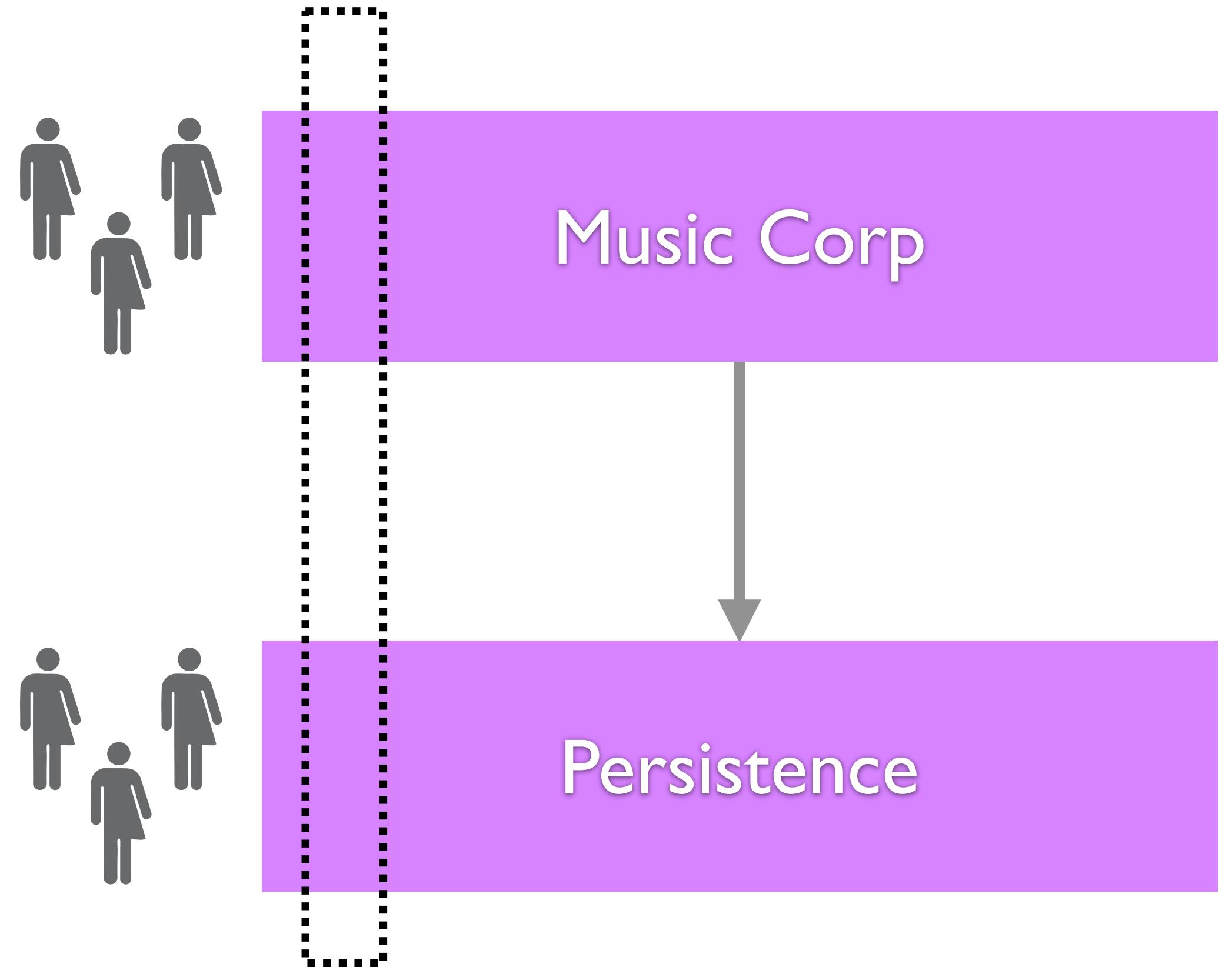


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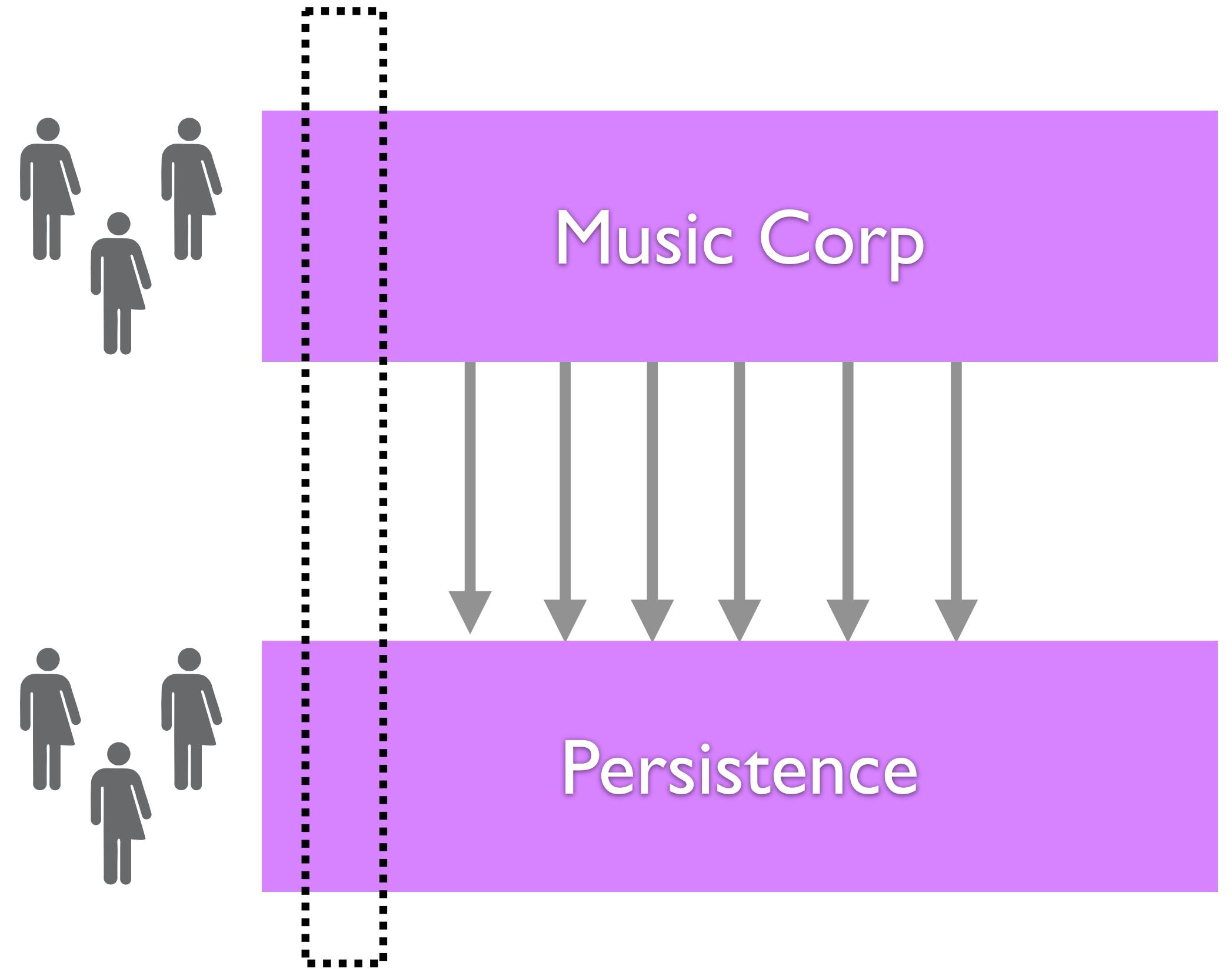


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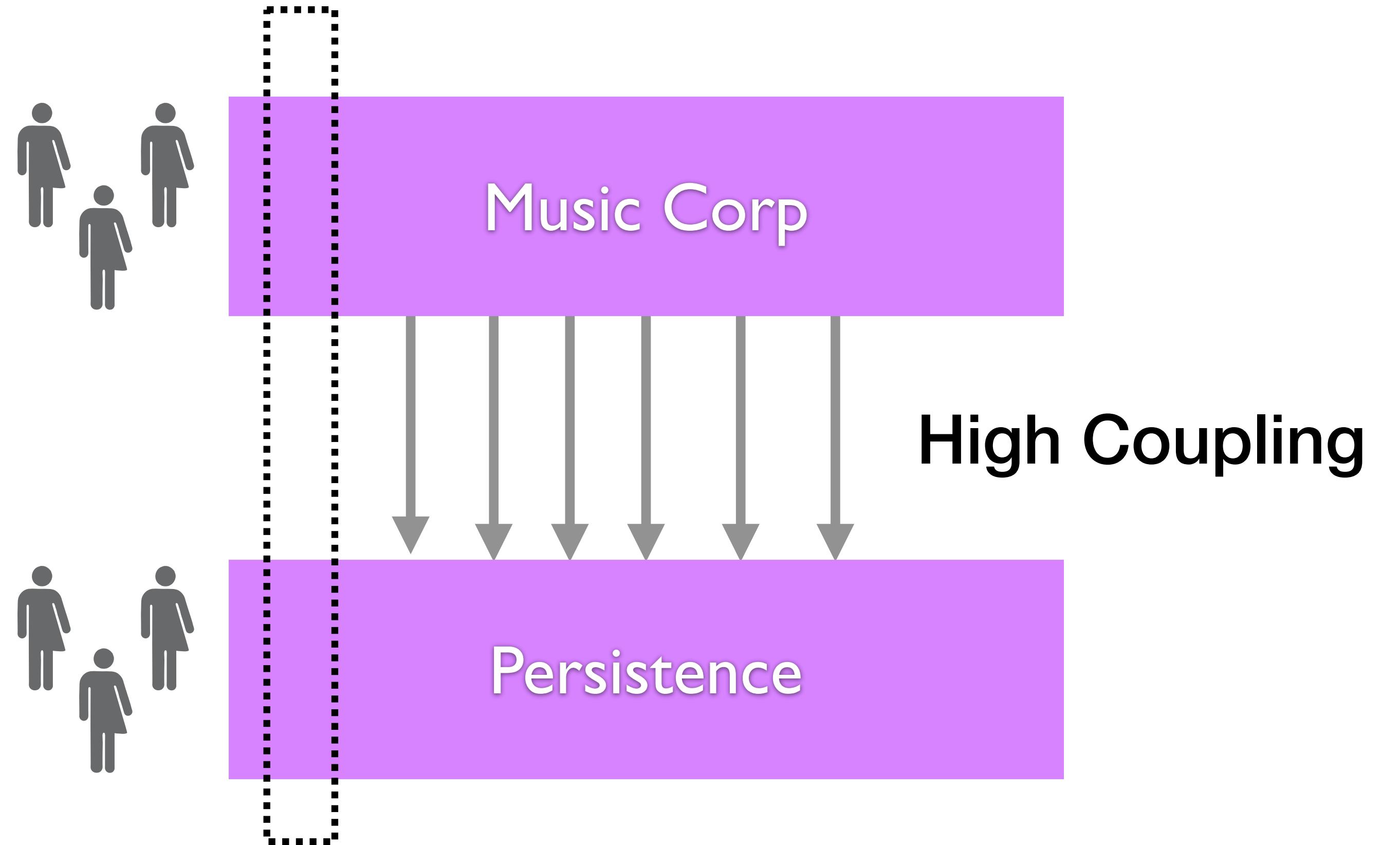




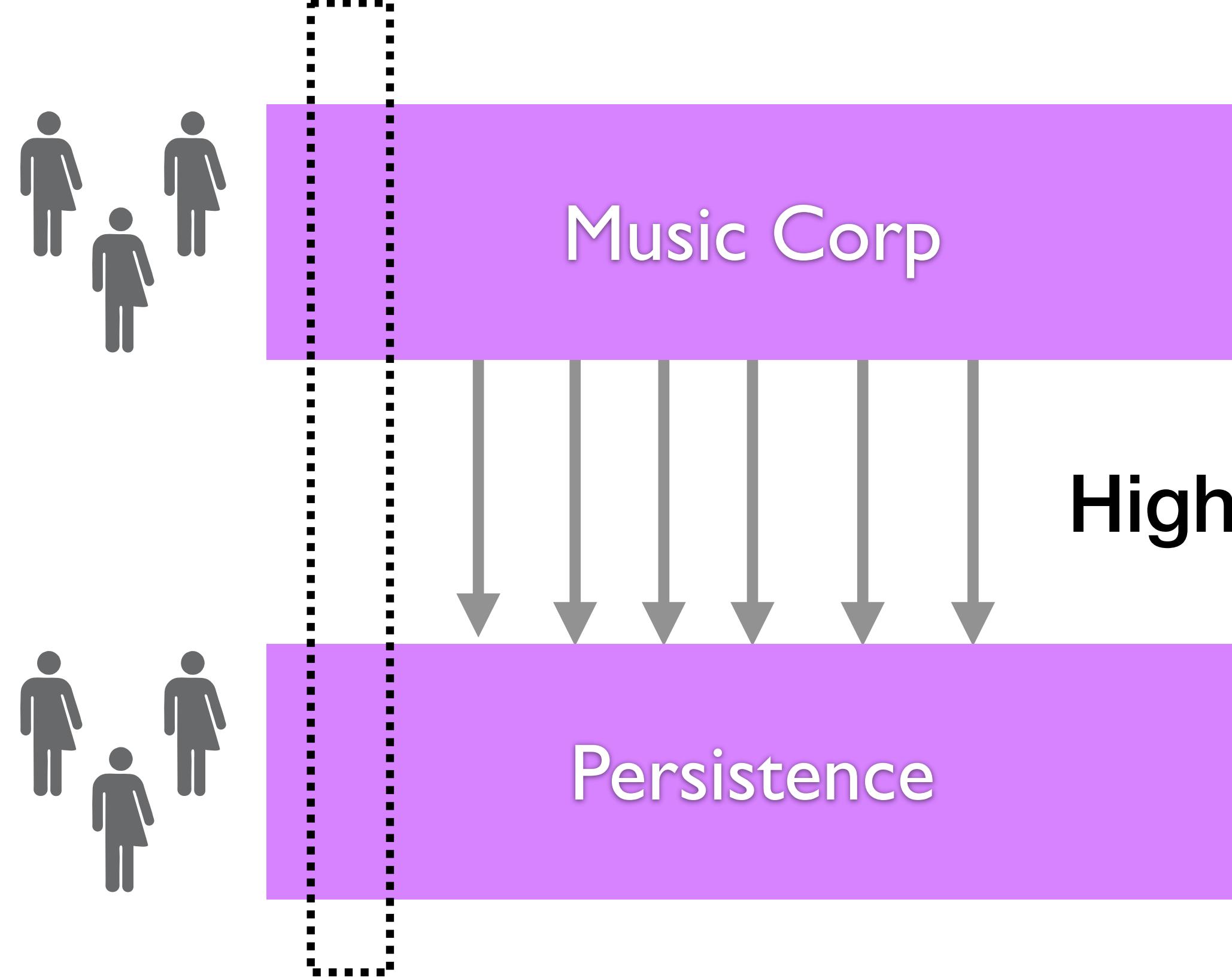
Low Cohesion



Low Cohesion

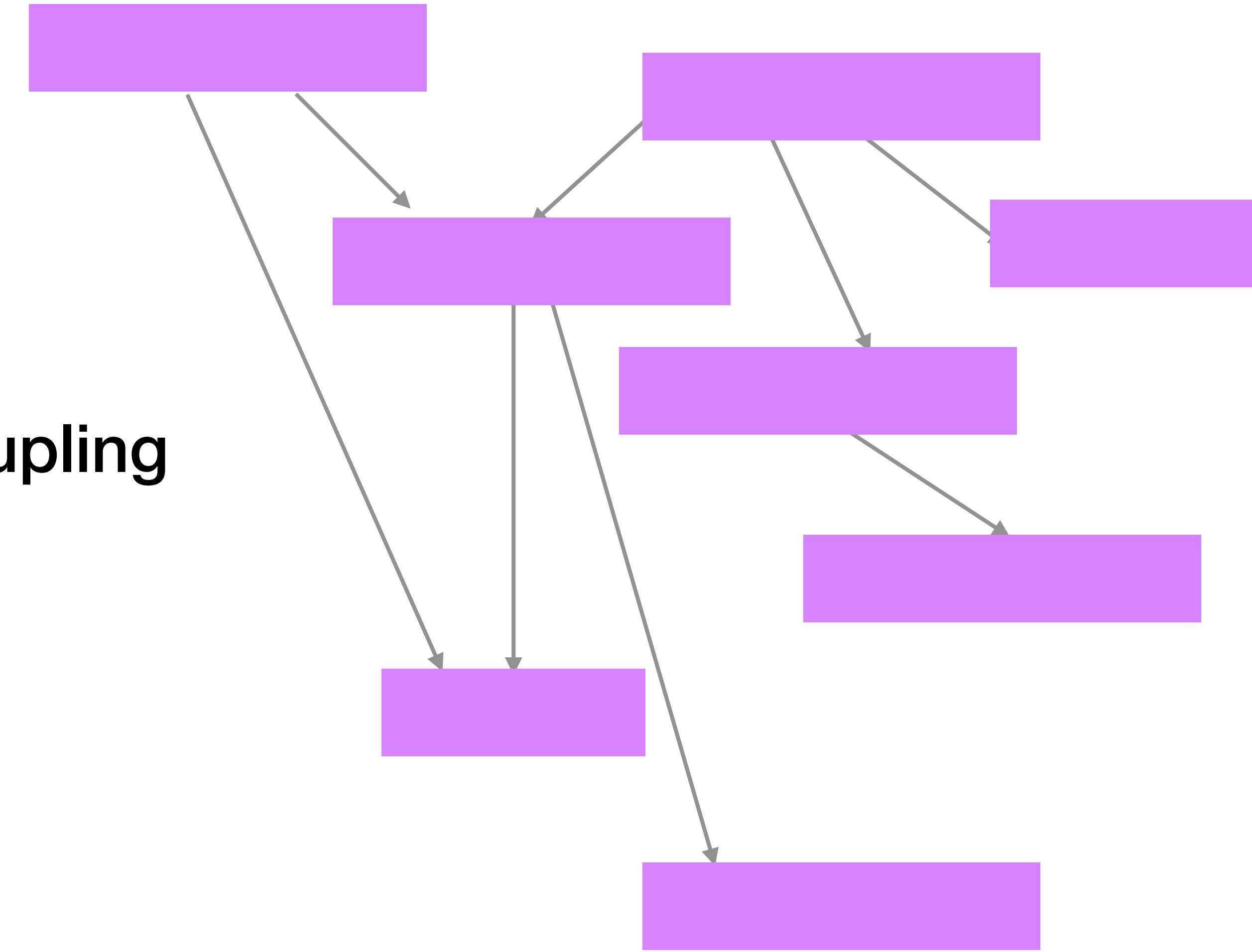


Low Cohesion

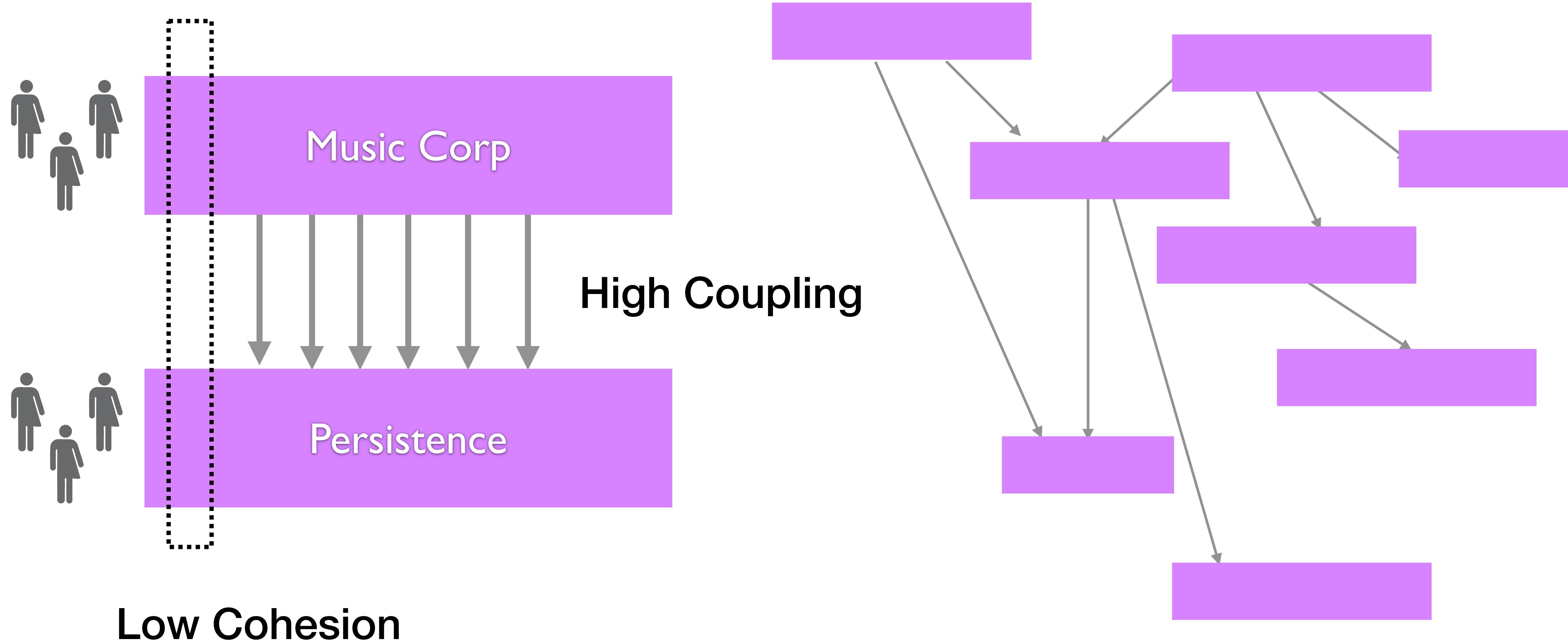


High Coupling

Low Cohesion



ONION ARCHITECTURE



3 TIERED ARCHITECTURE

3 TIERED ARCHITECTURE

Presentation

3 TIERED ARCHITECTURE

Presentation

Business

3 TIERED ARCHITECTURE

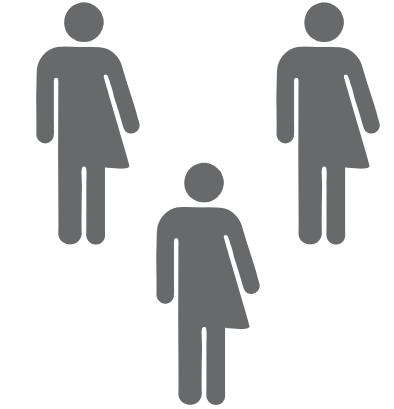
Presentation

Business

Data Access

3 TIERED ARCHITECTURE

FE Devs



Presentation

Business

Data Access

3 TIERED ARCHITECTURE



3 TIERED ARCHITECTURE



CONWAY'S LAW

CONWAY'S LAW

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

- Melvin Conway

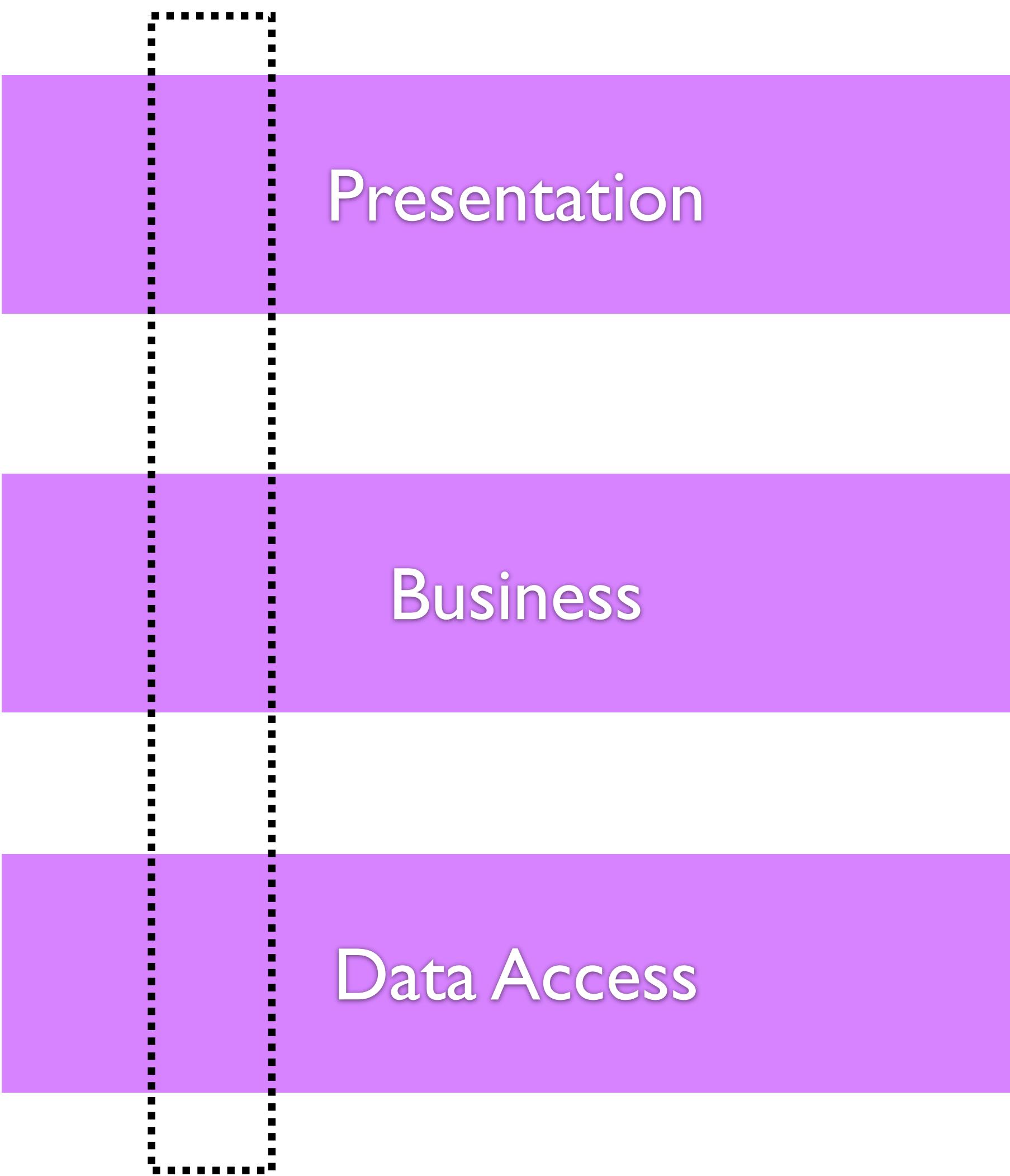
FEATURE-BASED TEAMS

Presentation

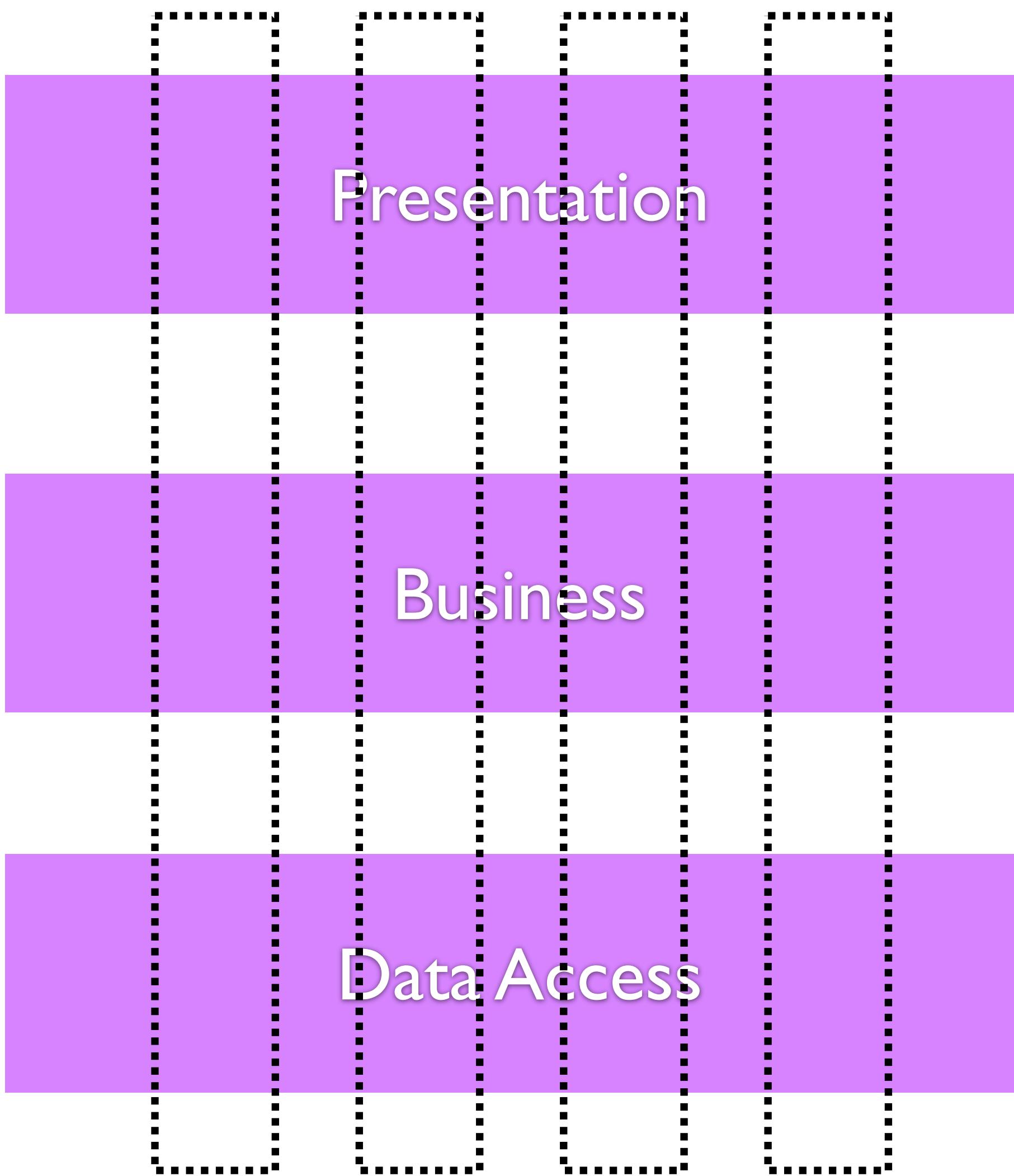
Business

Data Access

FEATURE-BASED TEAMS

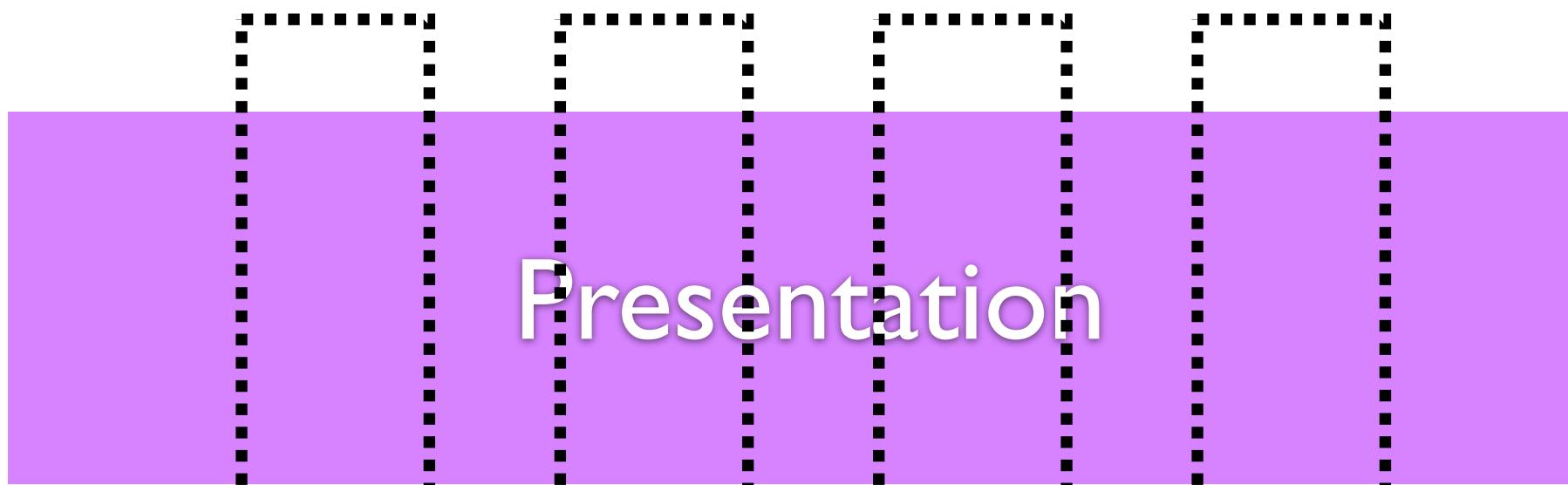


FEATURE-BASED TEAMS

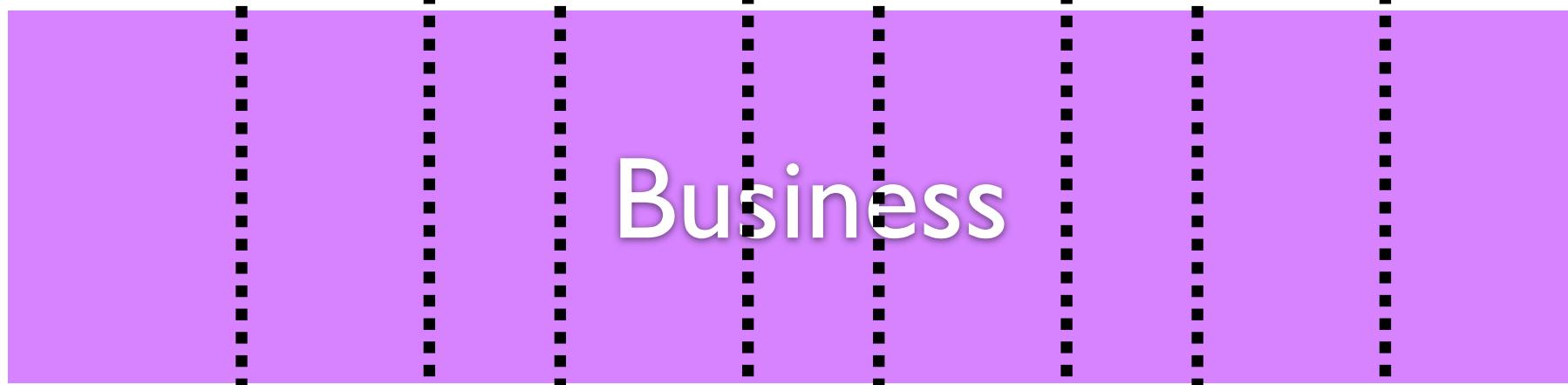


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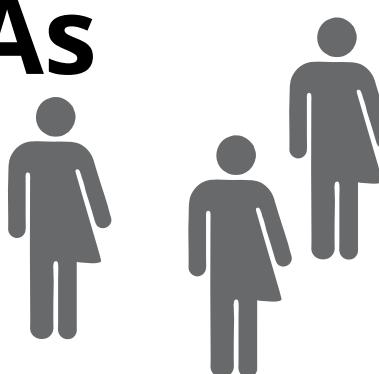
FE Devs



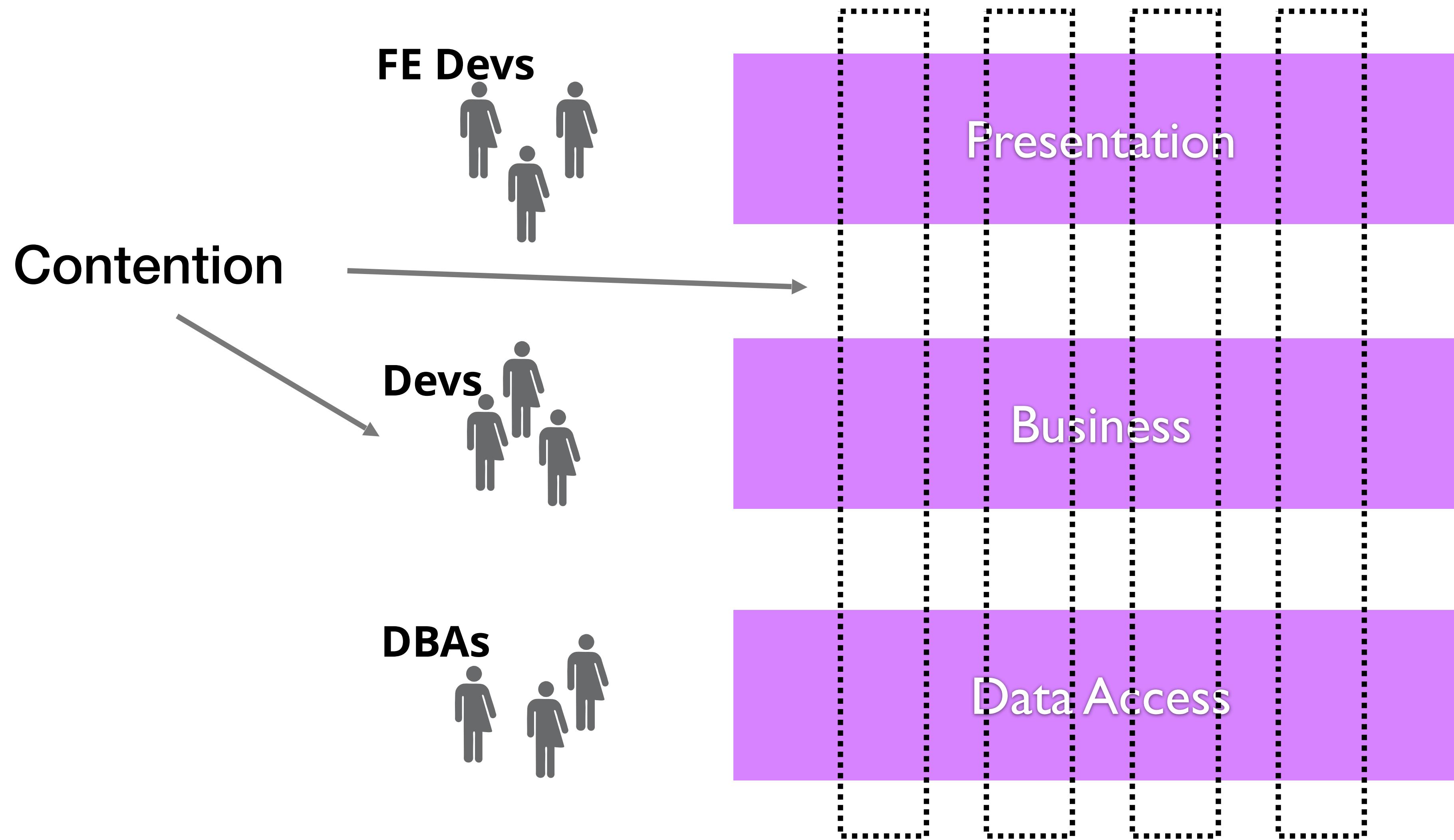
Devs



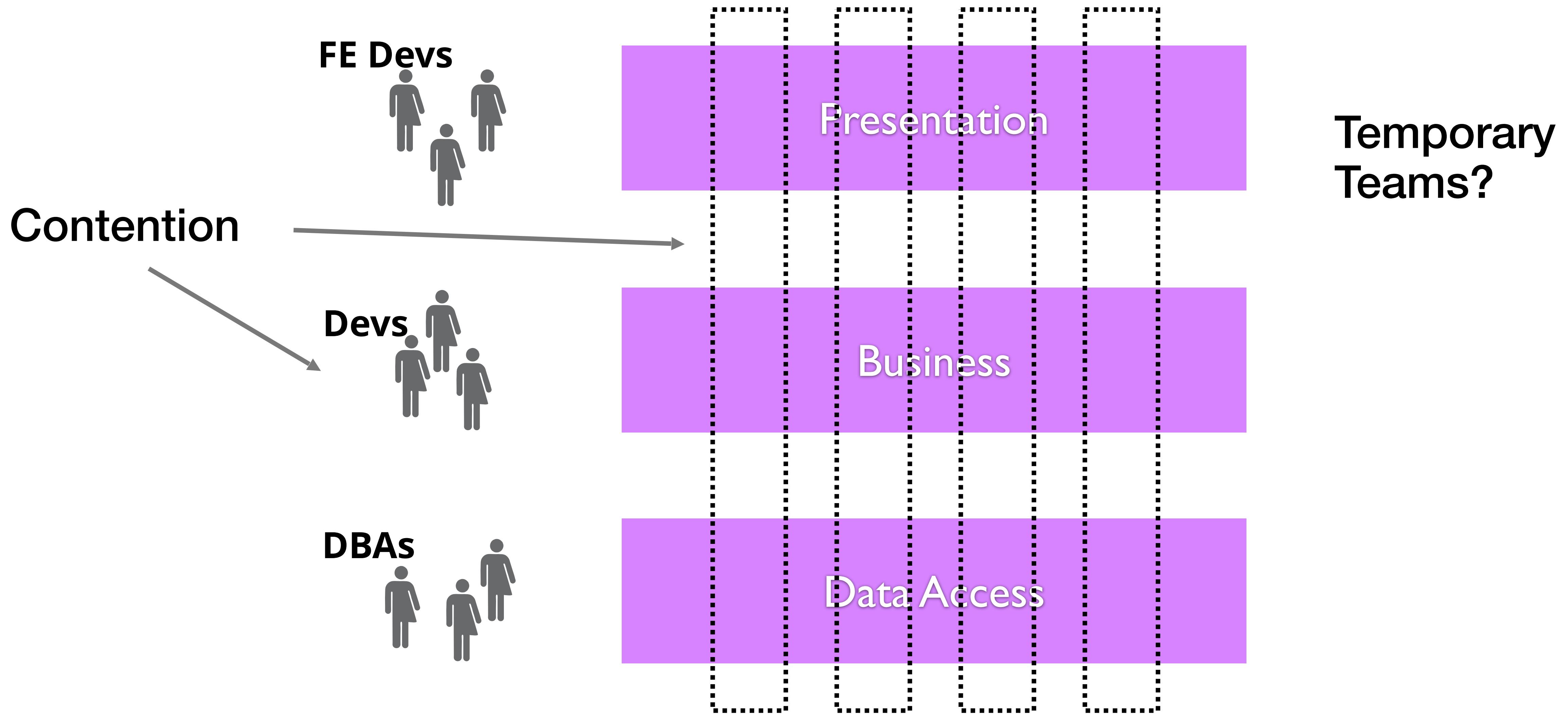
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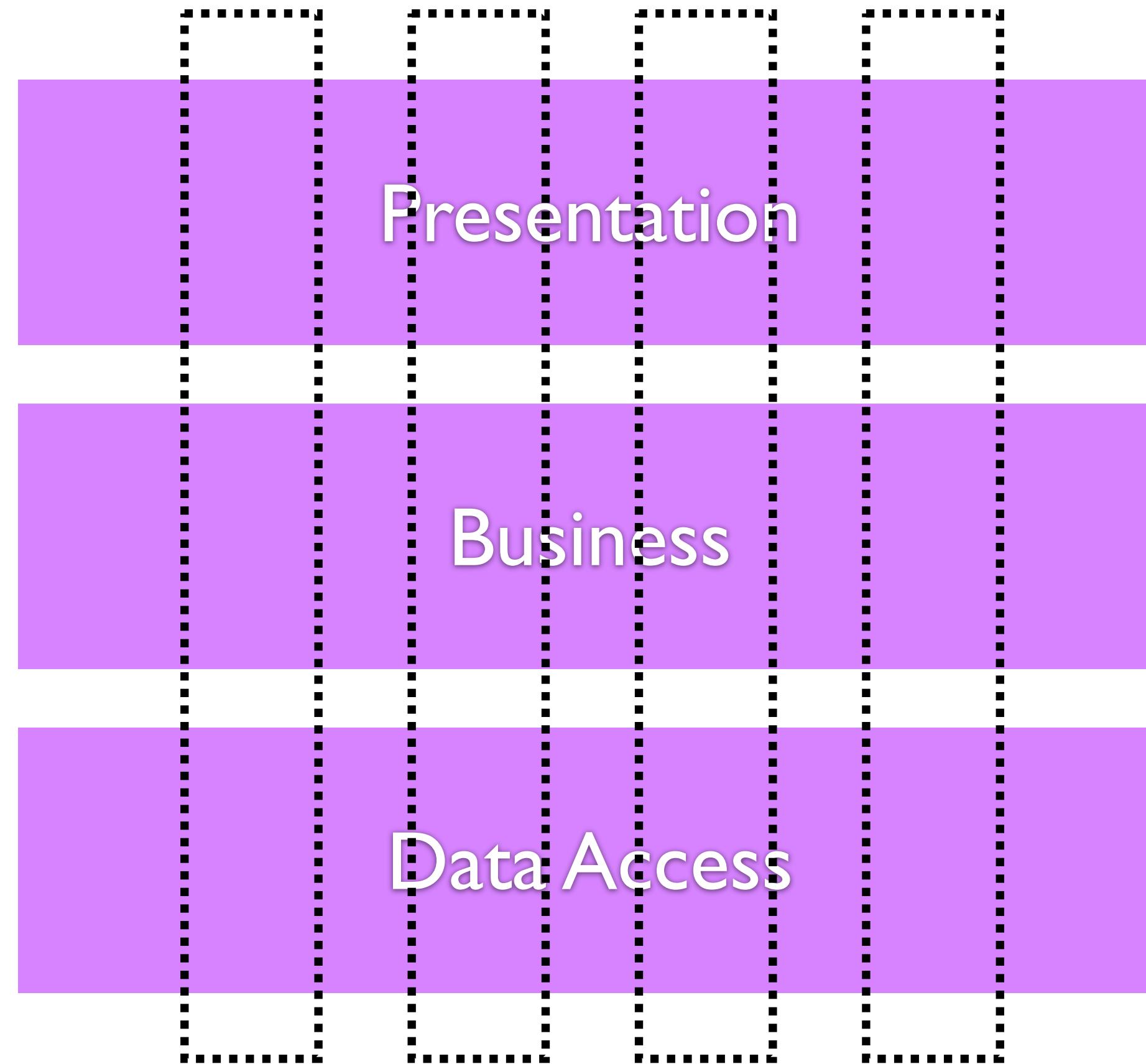
FEATURE-BASED TEAMS



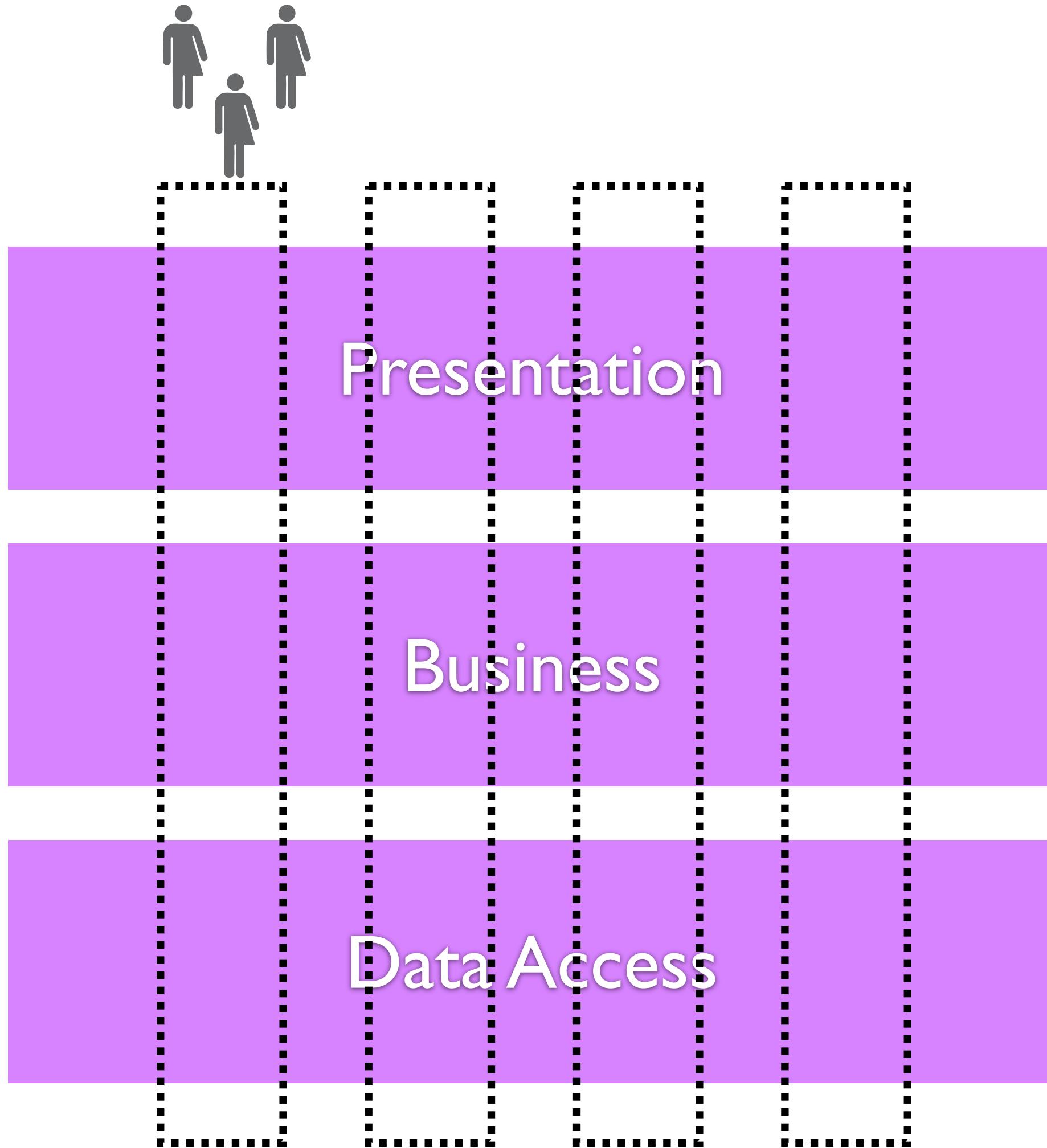
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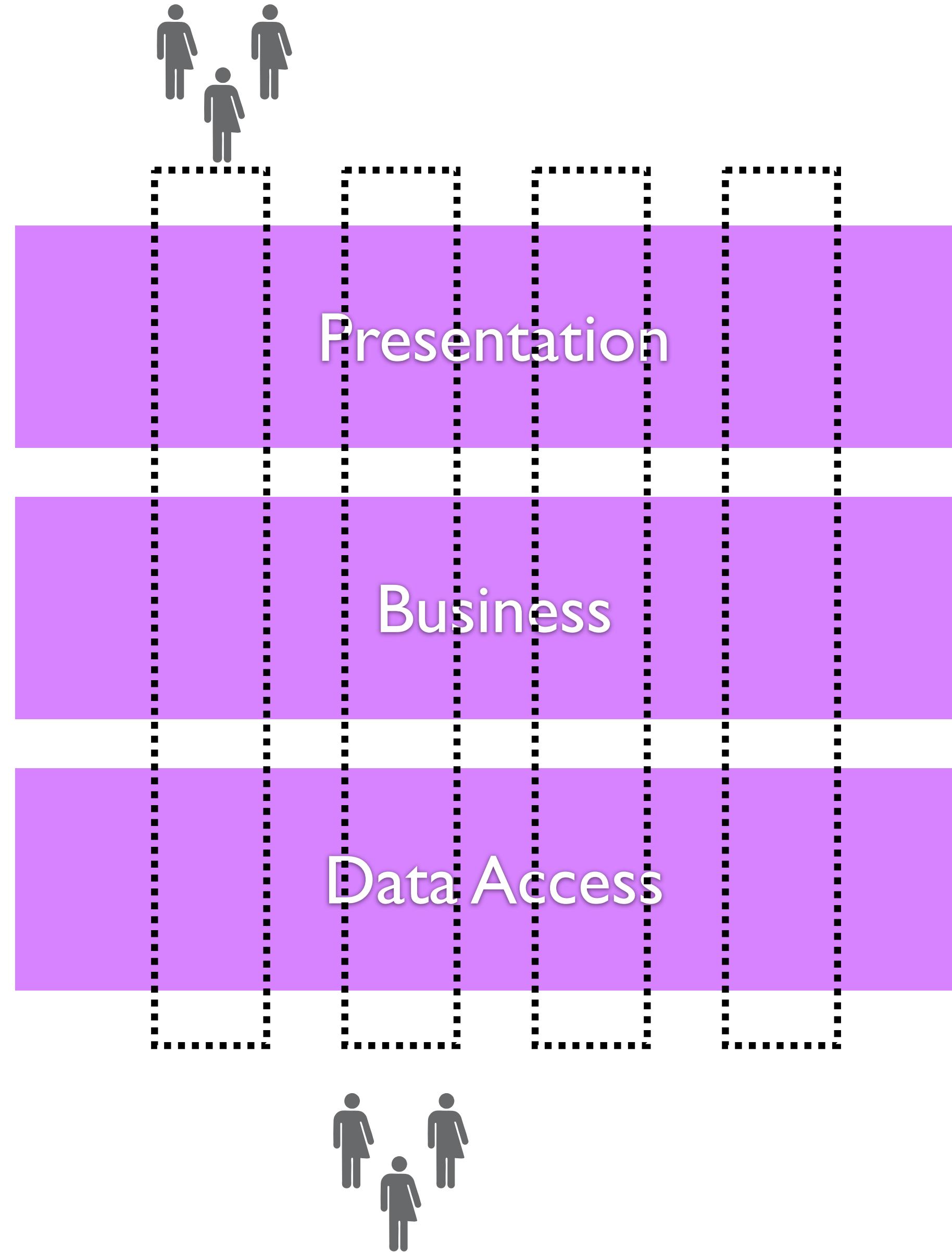
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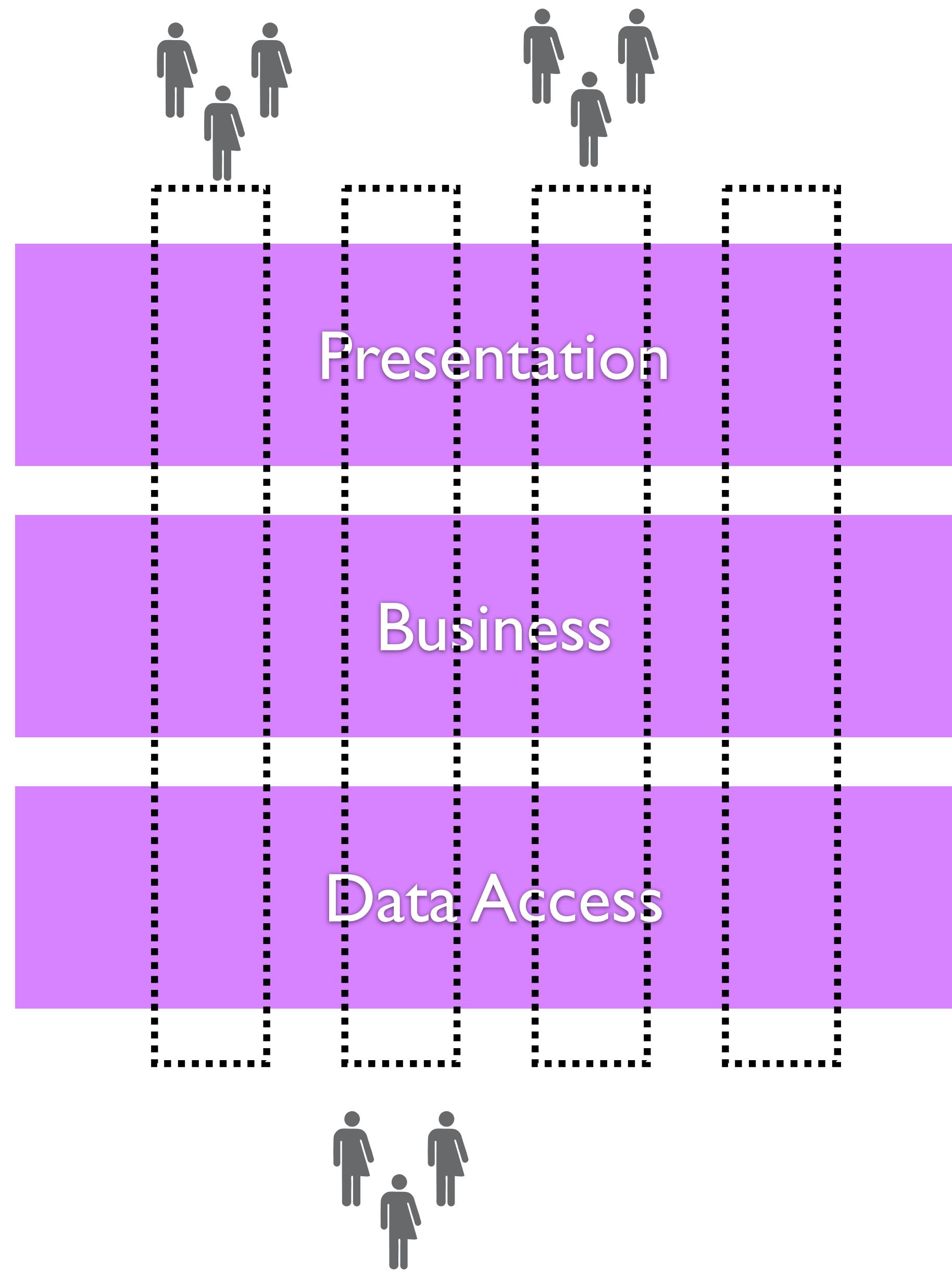
SLICING DIFFERENTLY



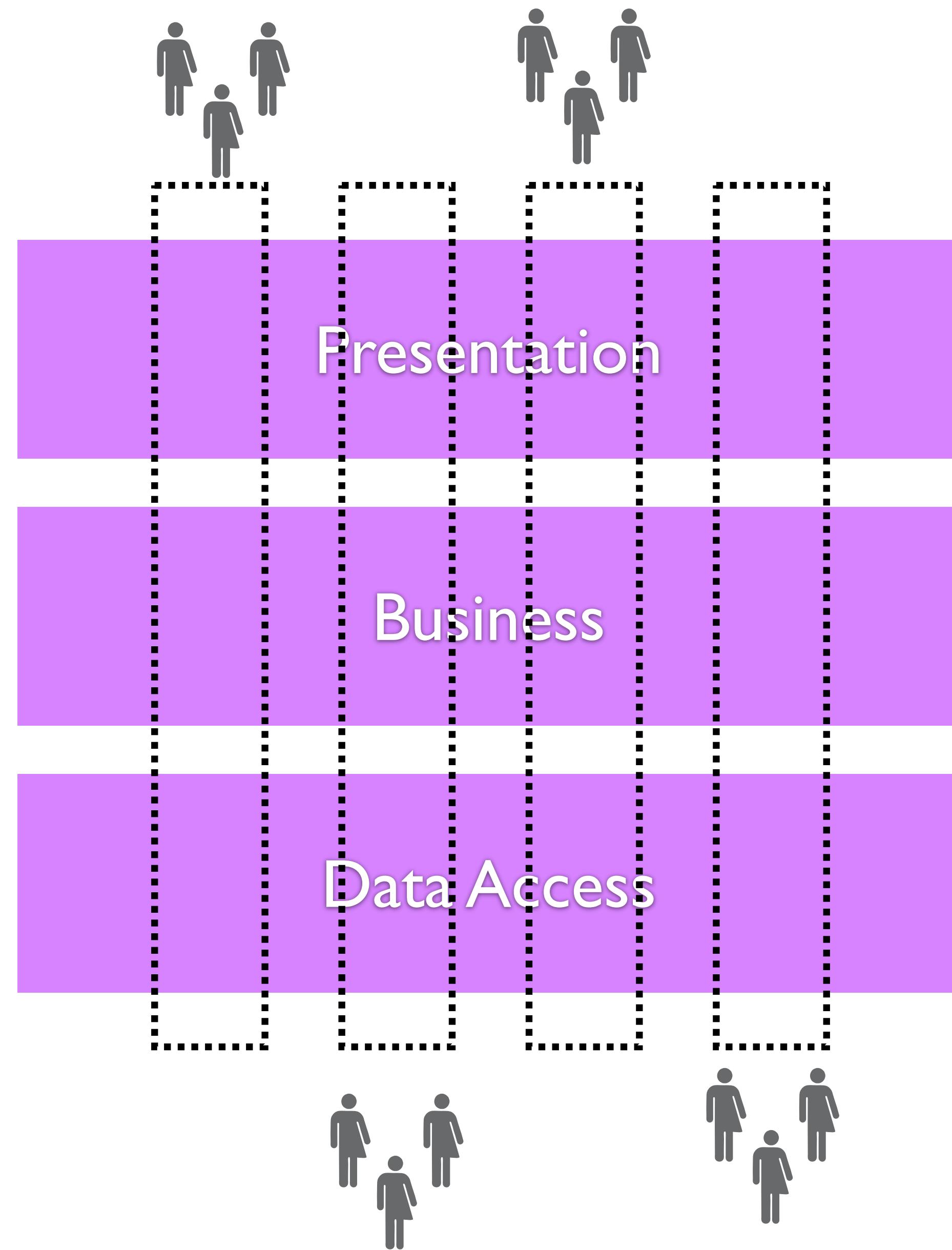
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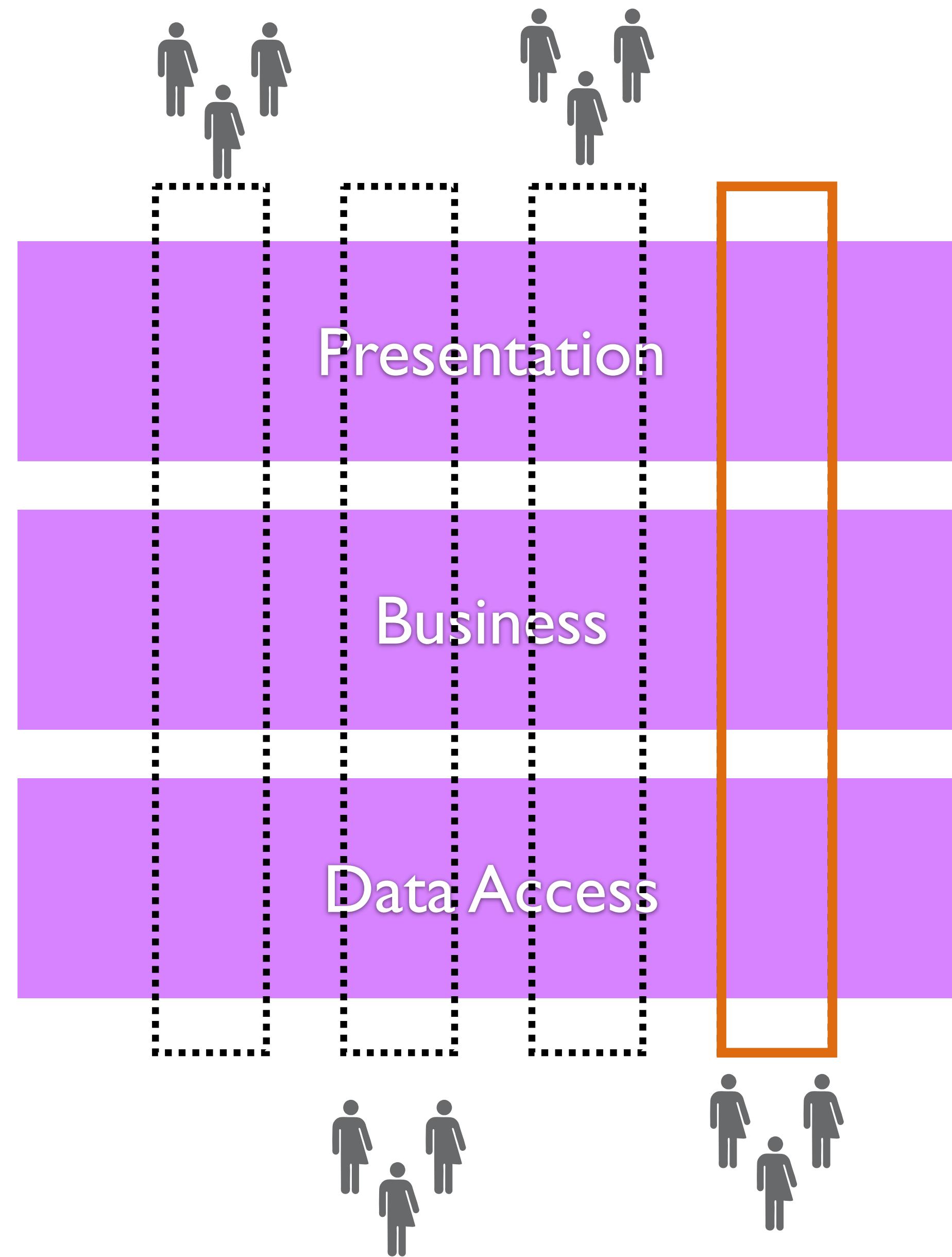
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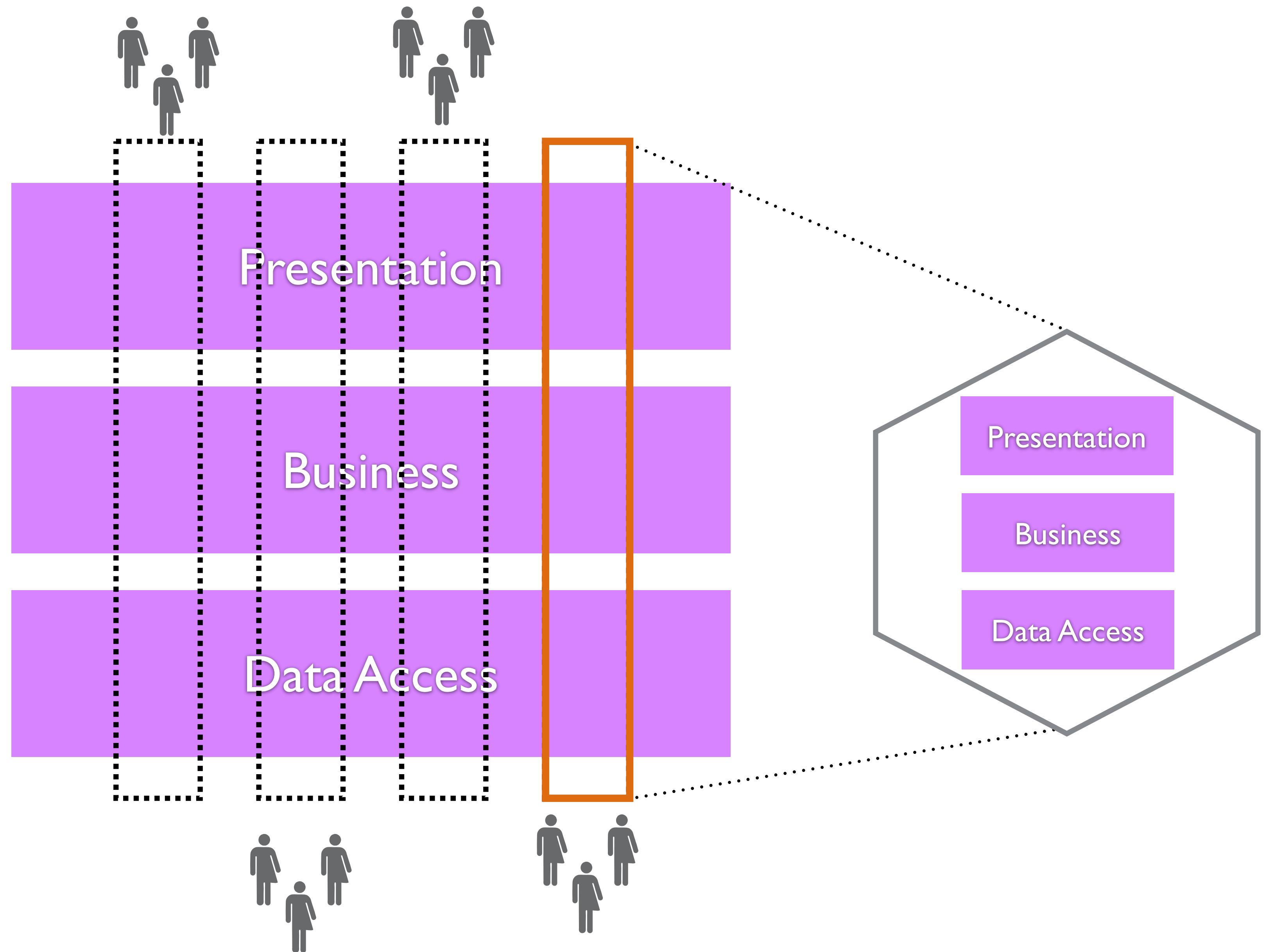
SLICING DIFFERENTLY



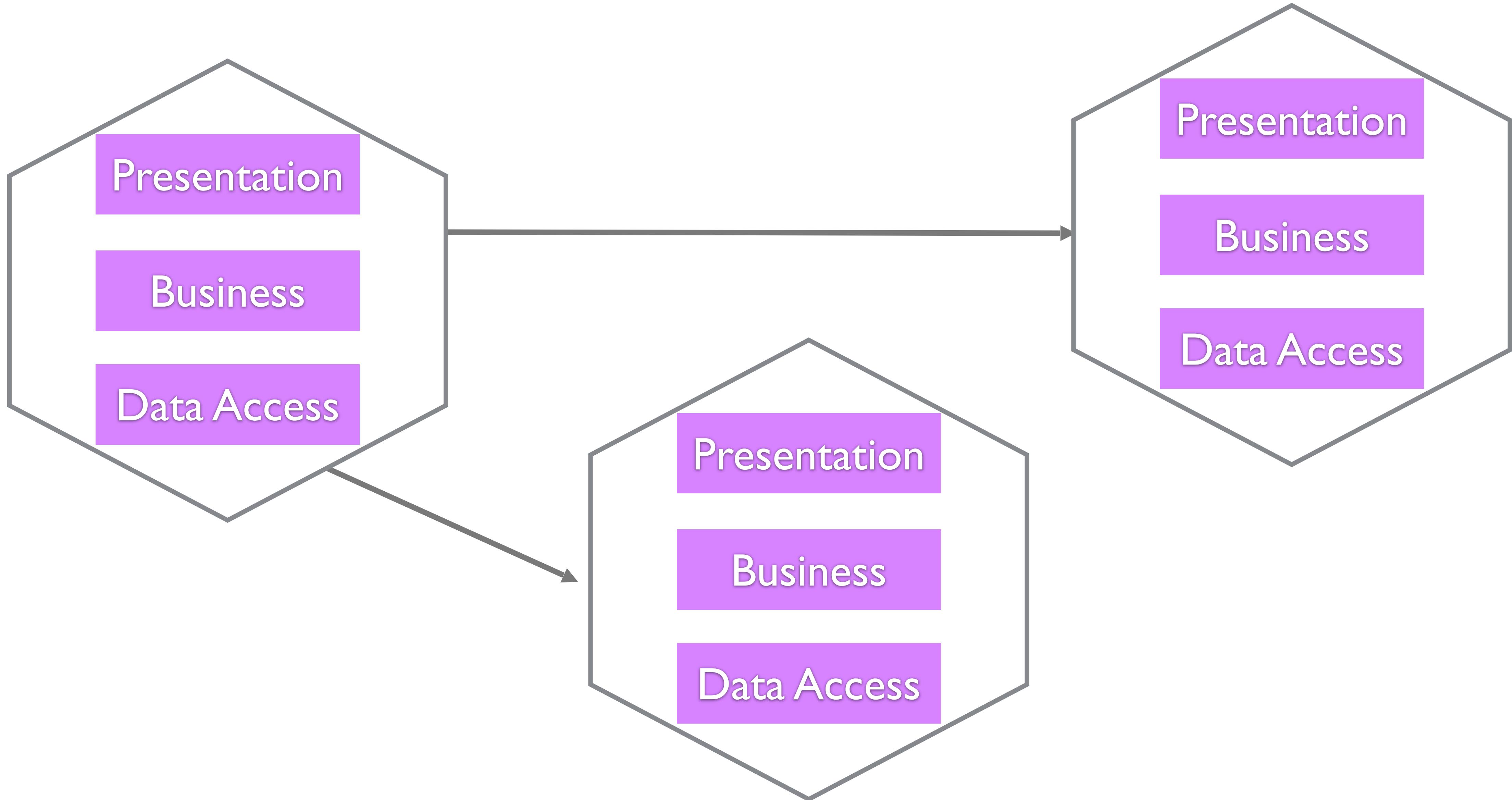
SLICING DIFFERENTLY



SLICING DIFFERENTLY

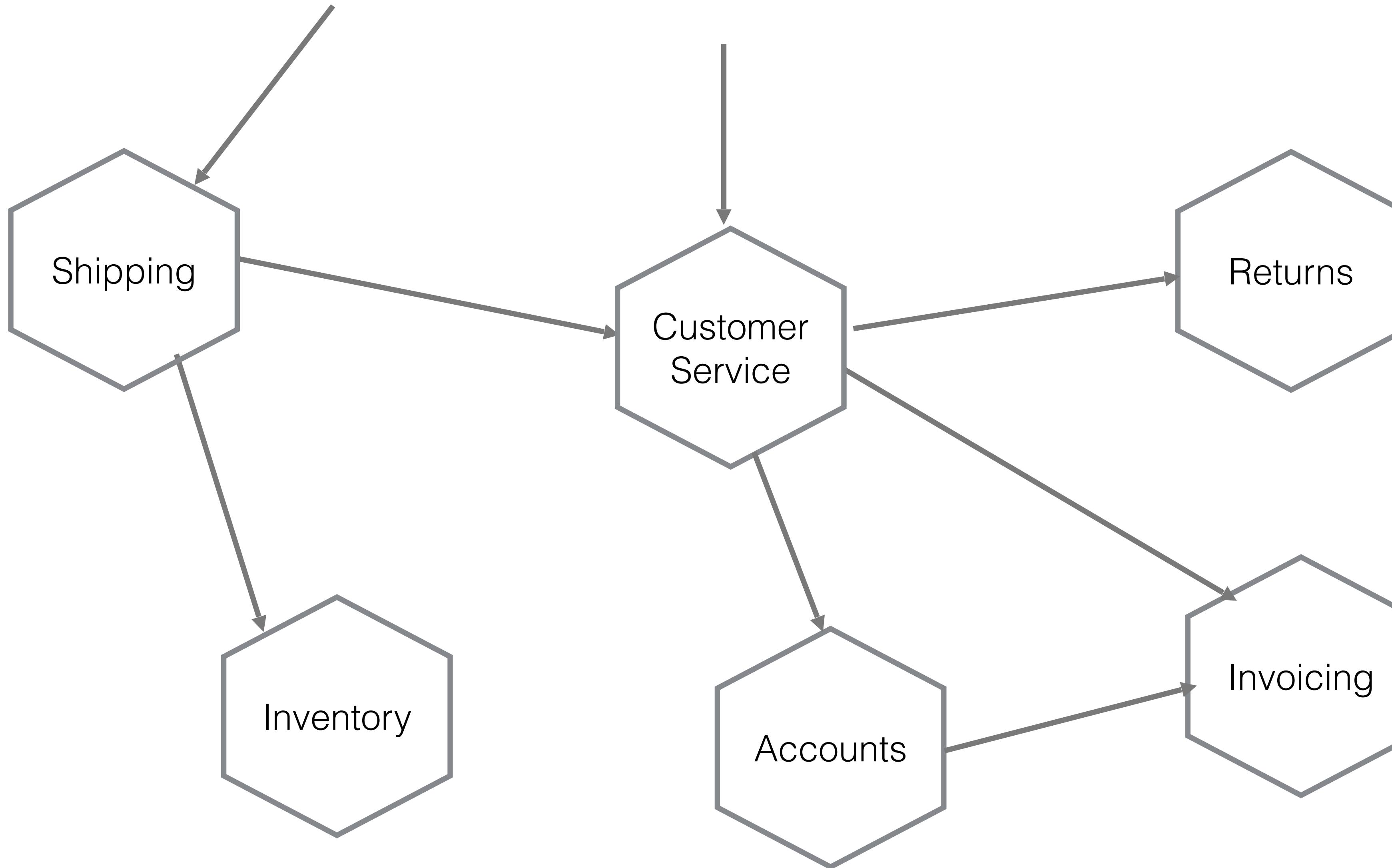


SPLIT DIFFERENTLY

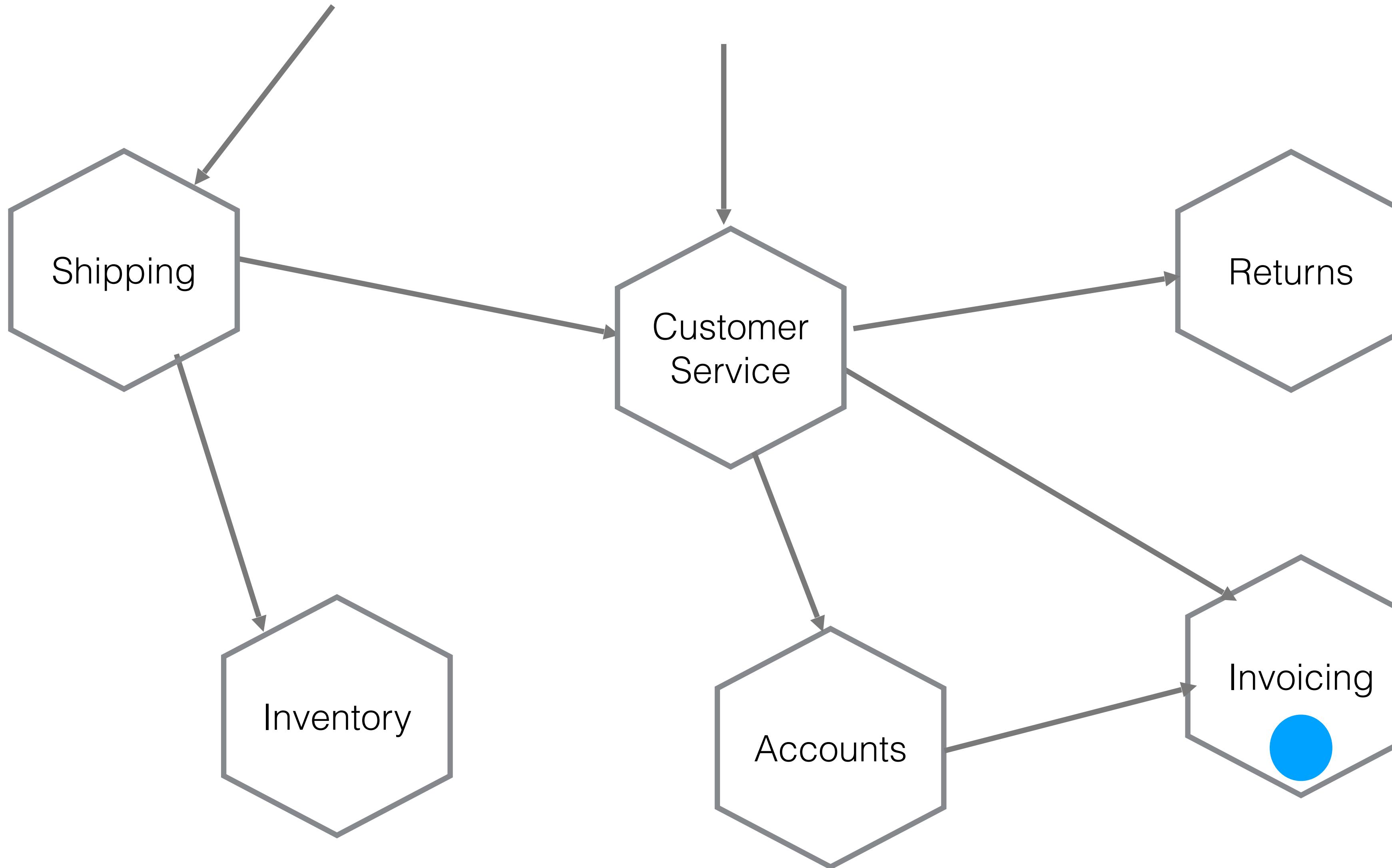


Aim for cohesion of related business functionality, NOT technical functionality

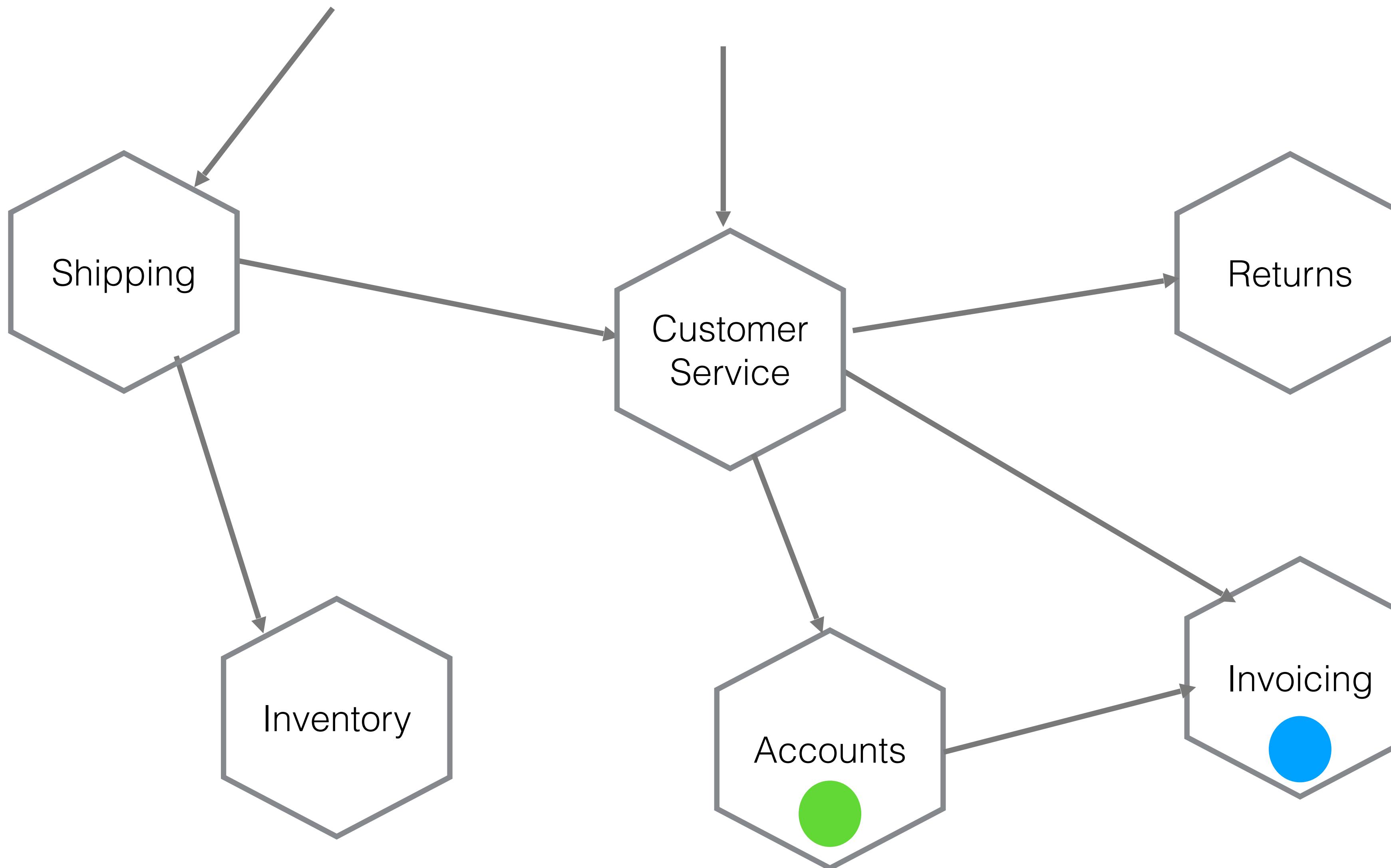
FASTER DELIVERY



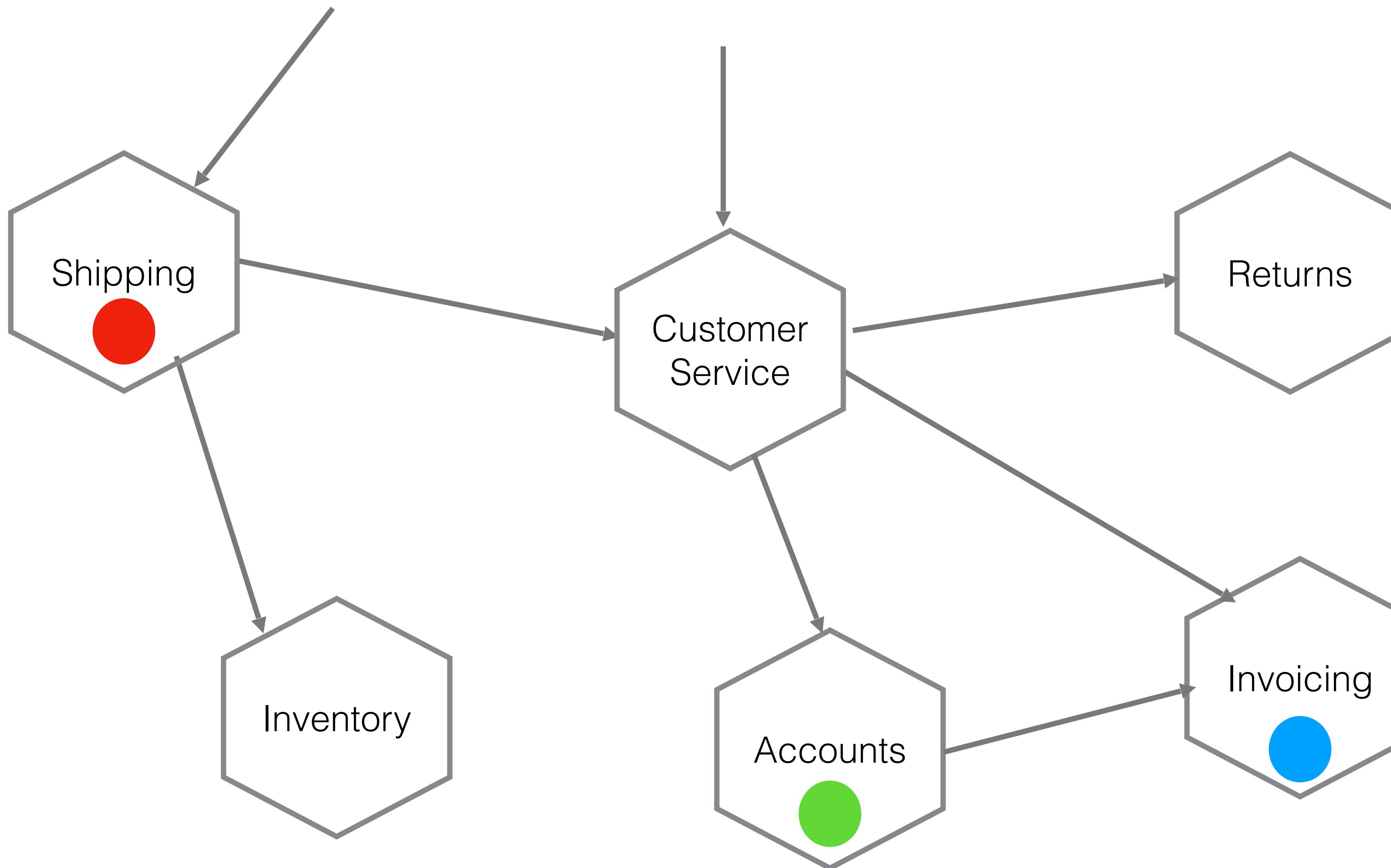
FASTER DELIVERY



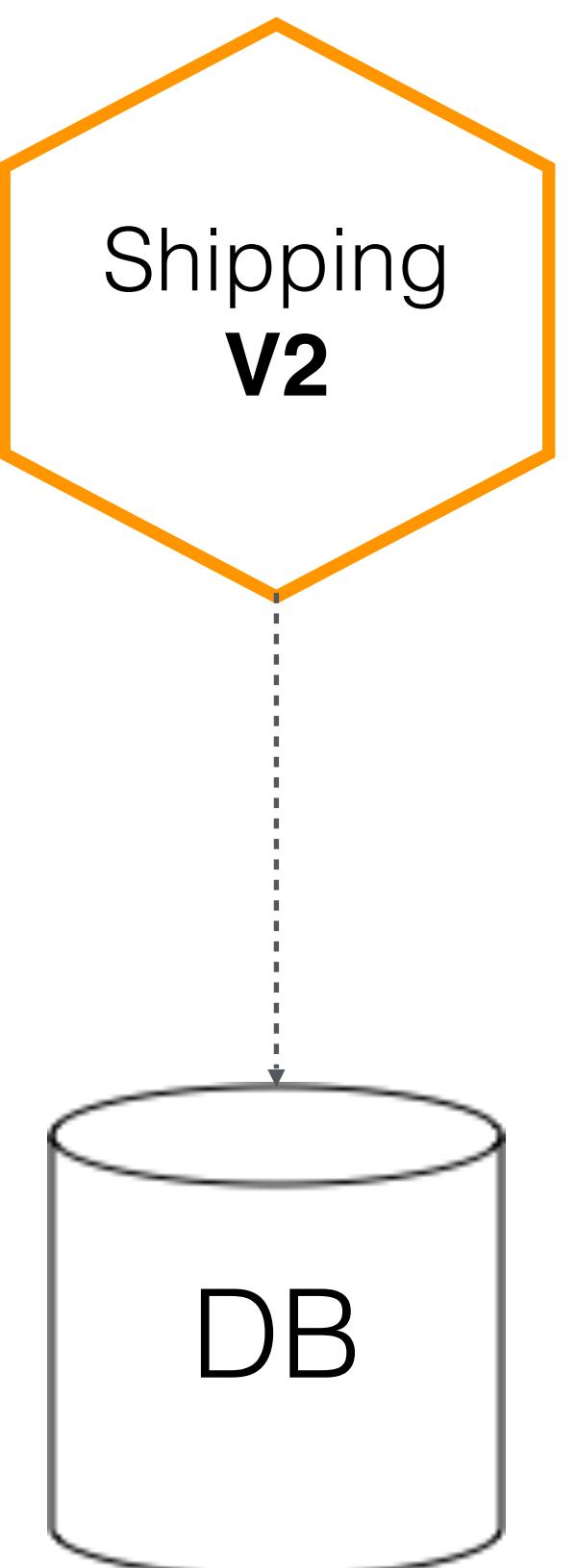
FASTER DELIVERY



FASTER DELIVERY

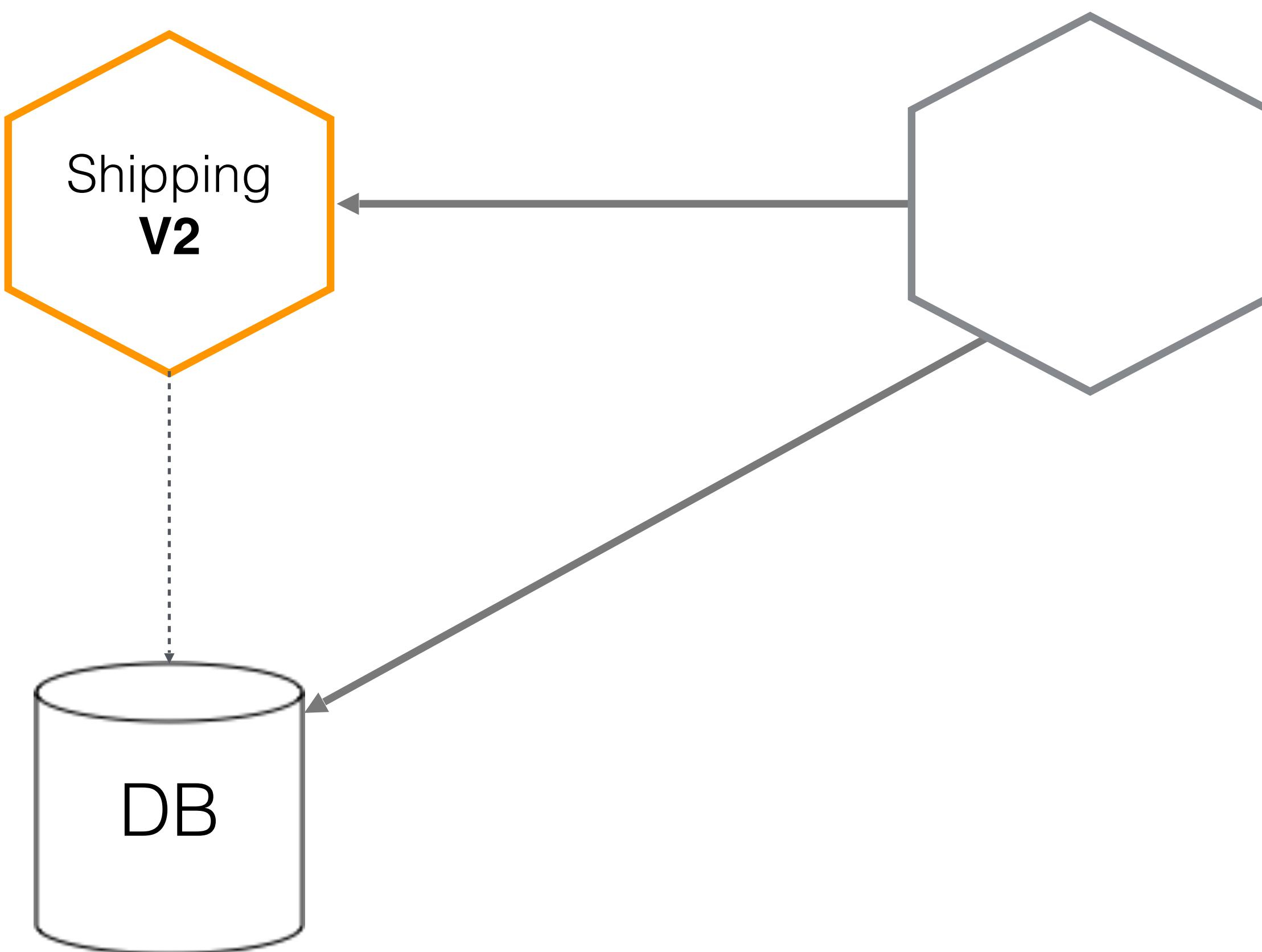


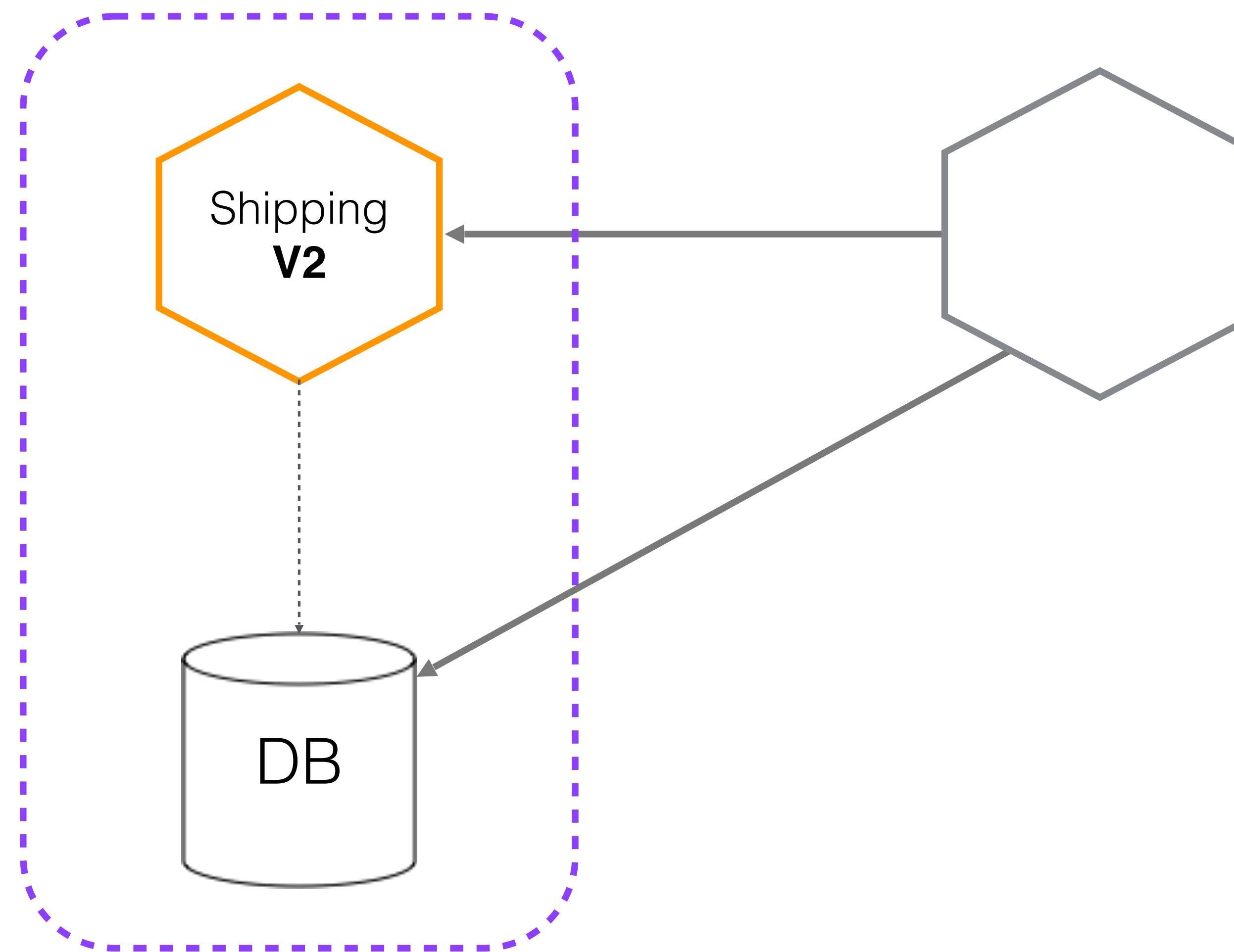
End-to-end slice - containing logic and data storage

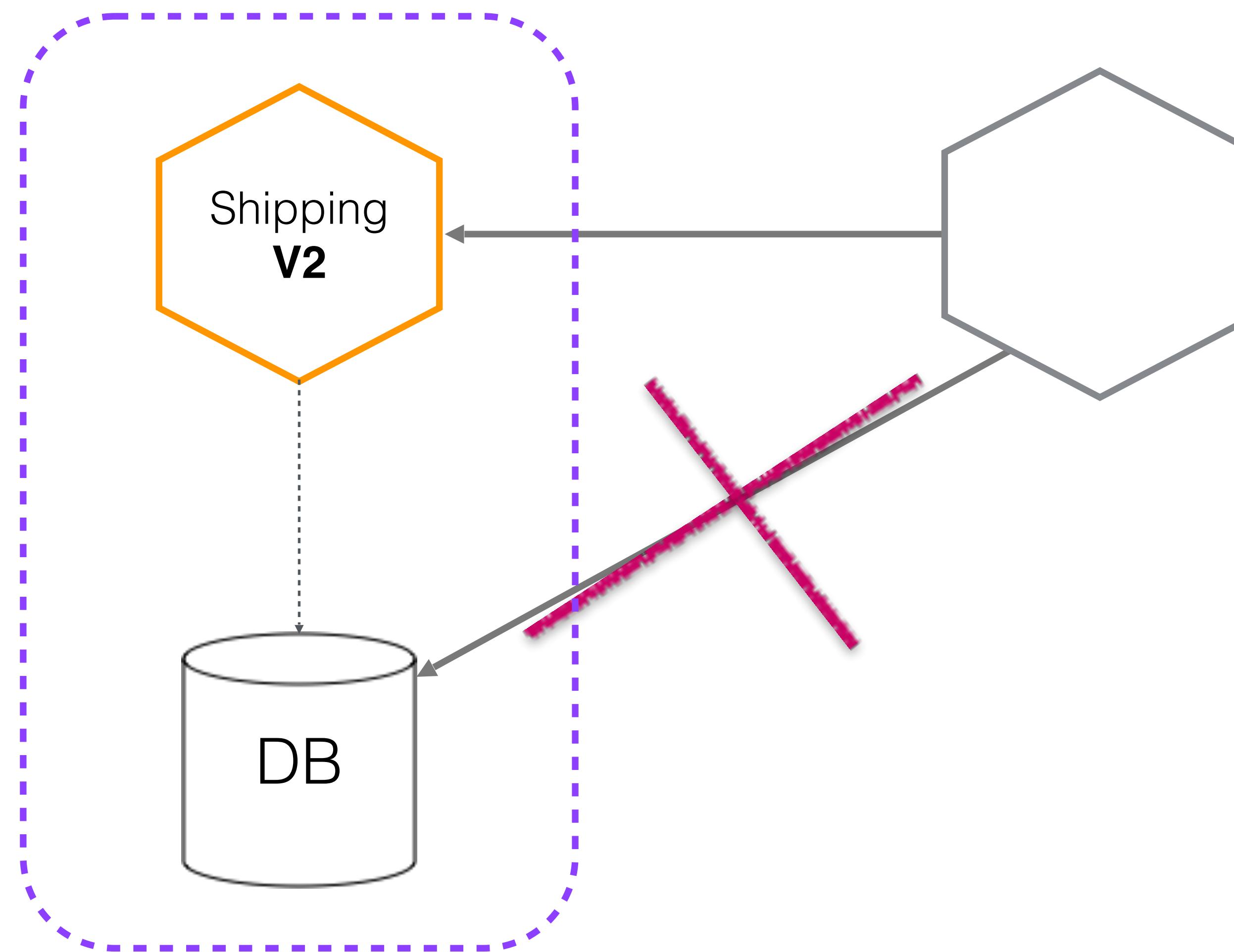




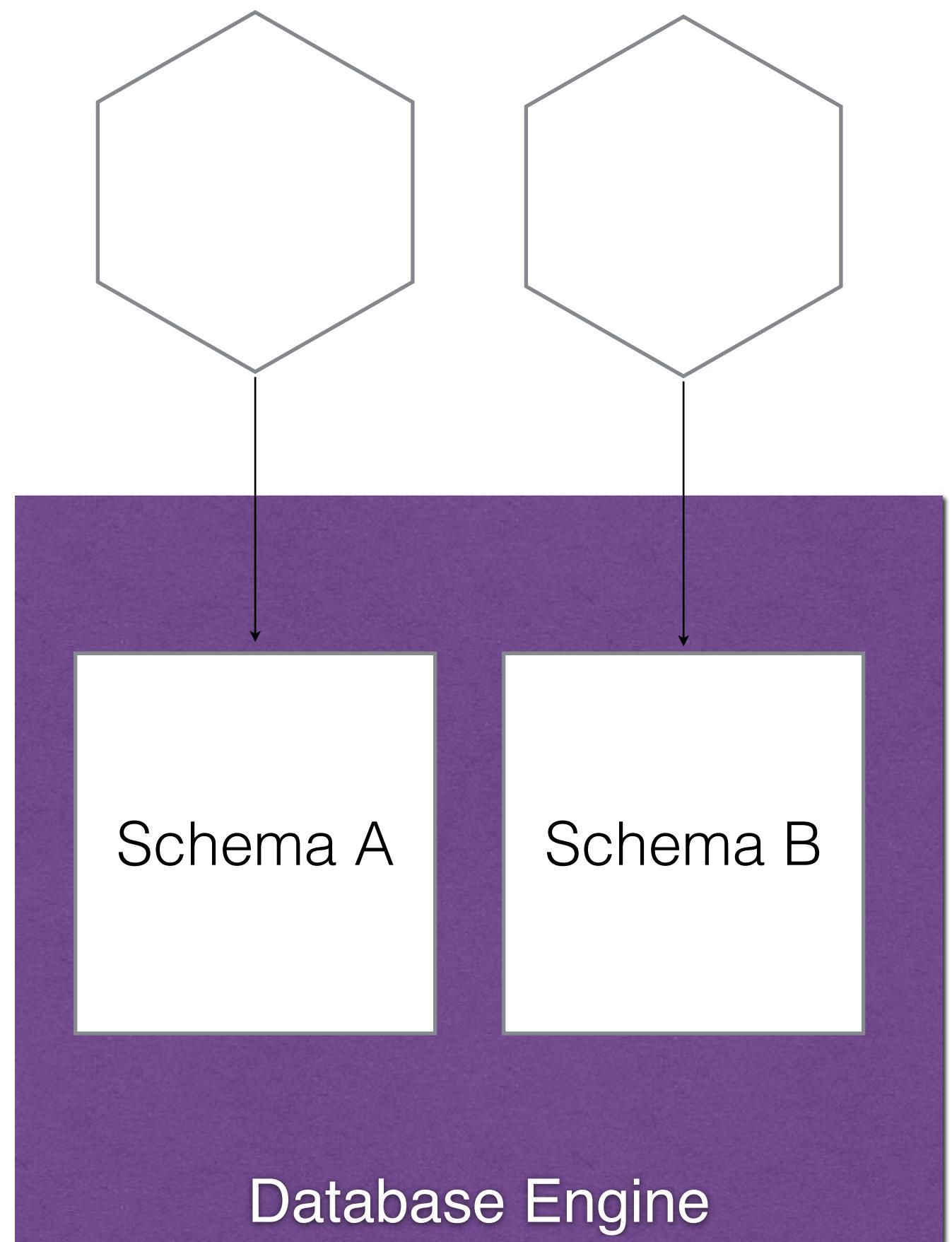




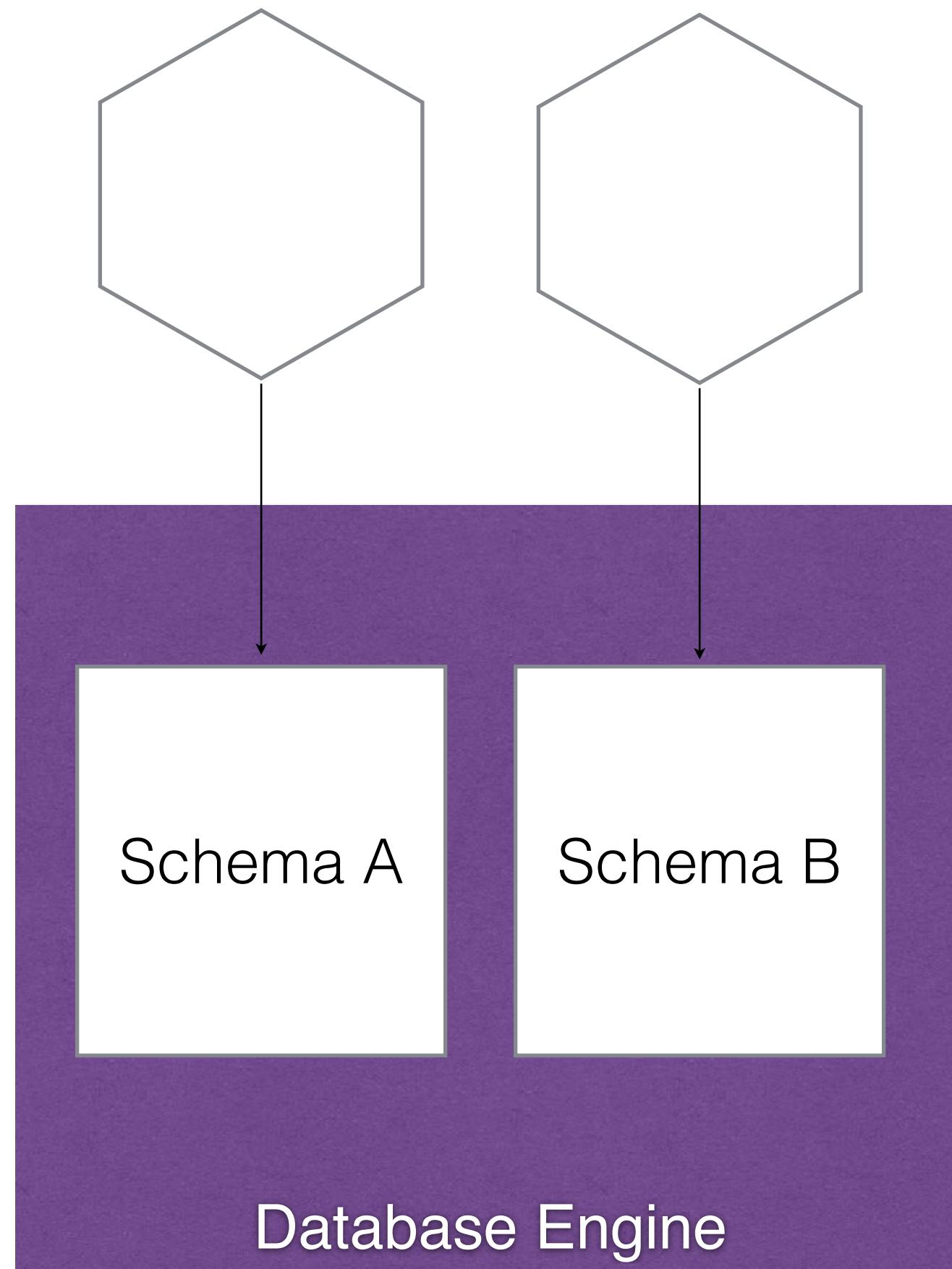




SEPARATE SCHEMAS, SAME DB ENGINE

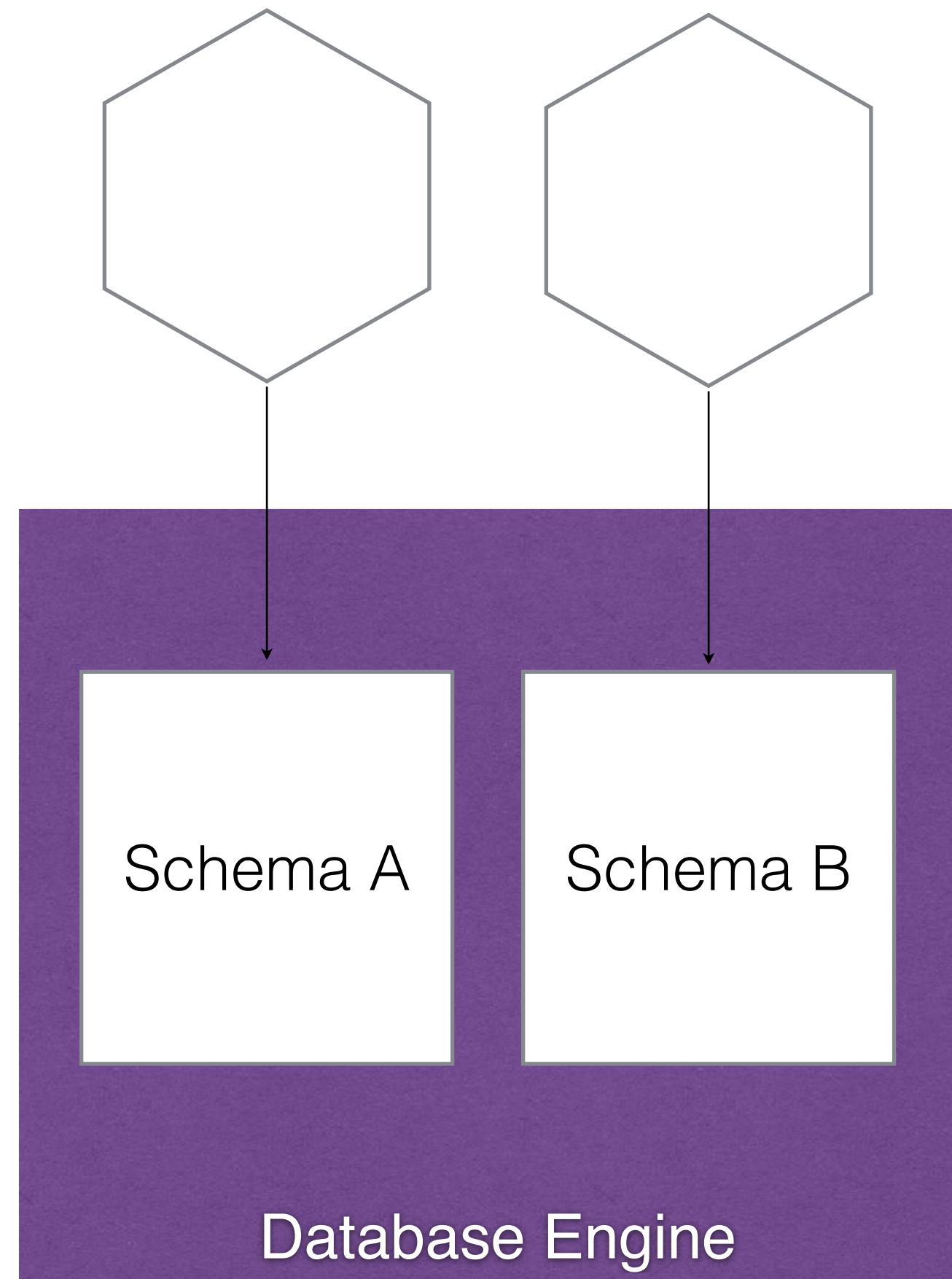


SEPARATE SCHEMAS, SAME DB ENGINE



**Can host multiple schemas
on the same DB instance**

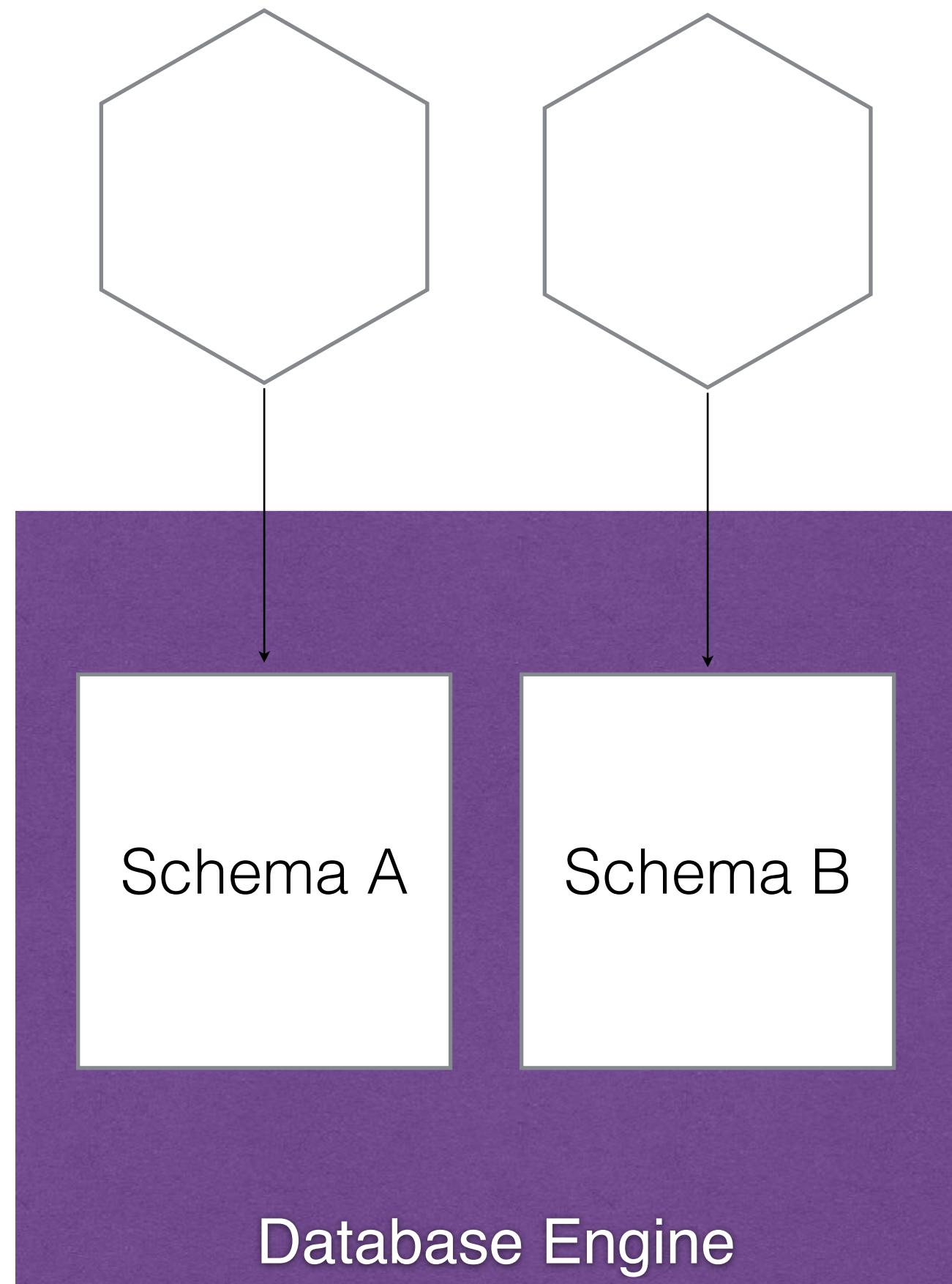
SEPARATE SCHEMAS, SAME DB ENGINE



**Can host multiple schemas
on the same DB instance**

**Little or no extra
infrastructure required**

SEPARATE SCHEMAS, SAME DB ENGINE



**Can host multiple schemas
on the same DB instance**

**Little or no extra
infrastructure required**

**Potential single point of
failure**

Poll

Do you have multiple services sharing the same schema?

Poll

Do you have multiple services sharing the same schema?

a.) Yes

Poll

Do you have multiple services sharing the same schema?

a.) Yes

Poll

Do you have multiple services sharing the same schema?

a.) Yes

b.) No

Poll

Do you have multiple services sharing the same schema?

a.) Yes

b.) No

Poll

Do you have multiple services sharing the same schema?

a.) Yes

b.) No

c.) Not sure!

ON THE CRITERIA TO BE USED IN DECOMPOSING SYSTEMS INTO MODULES

CMU-CS-71-101

ON THE CRITERIA TO BE USED
IN DECOMPOSING SYSTEMS INTO MODULES

D. L. Parnas

<http://repository.cmu.edu/cgi/viewcontent.cgi?article=2979&context=compsci>

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module boundaries

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CMU-CS-71-101

ON THE CRITERIA TO BE USED
IN DECOMPOSING SYSTEMS INTO MODULES

D. L. Parnas

Published in 1971

Looked at how best to define
module boundaries

Found that “information hiding”
worked best

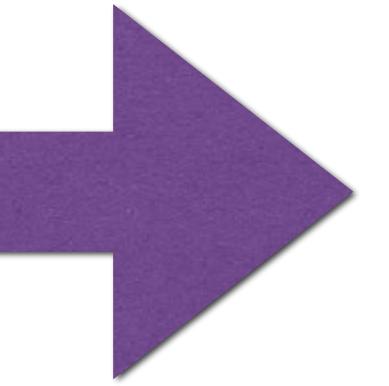
<http://repository.cmu.edu/cgi/viewcontent.cgi?article=2979&context=compsci>

BEWARE TIGHT COUPLING

BEWARE TIGHT COUPLING

Schema

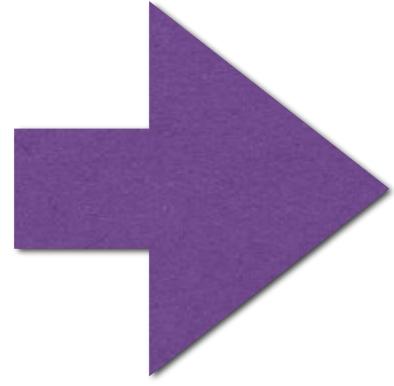
ID	Name	Age
123	sam	15



BEWARE TIGHT COUPLING

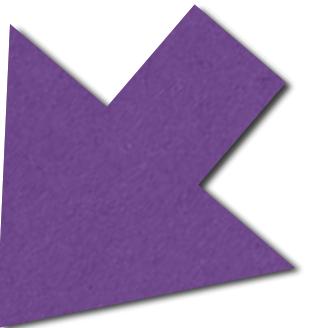
Schema

ID	Name	Age
123	sam	15

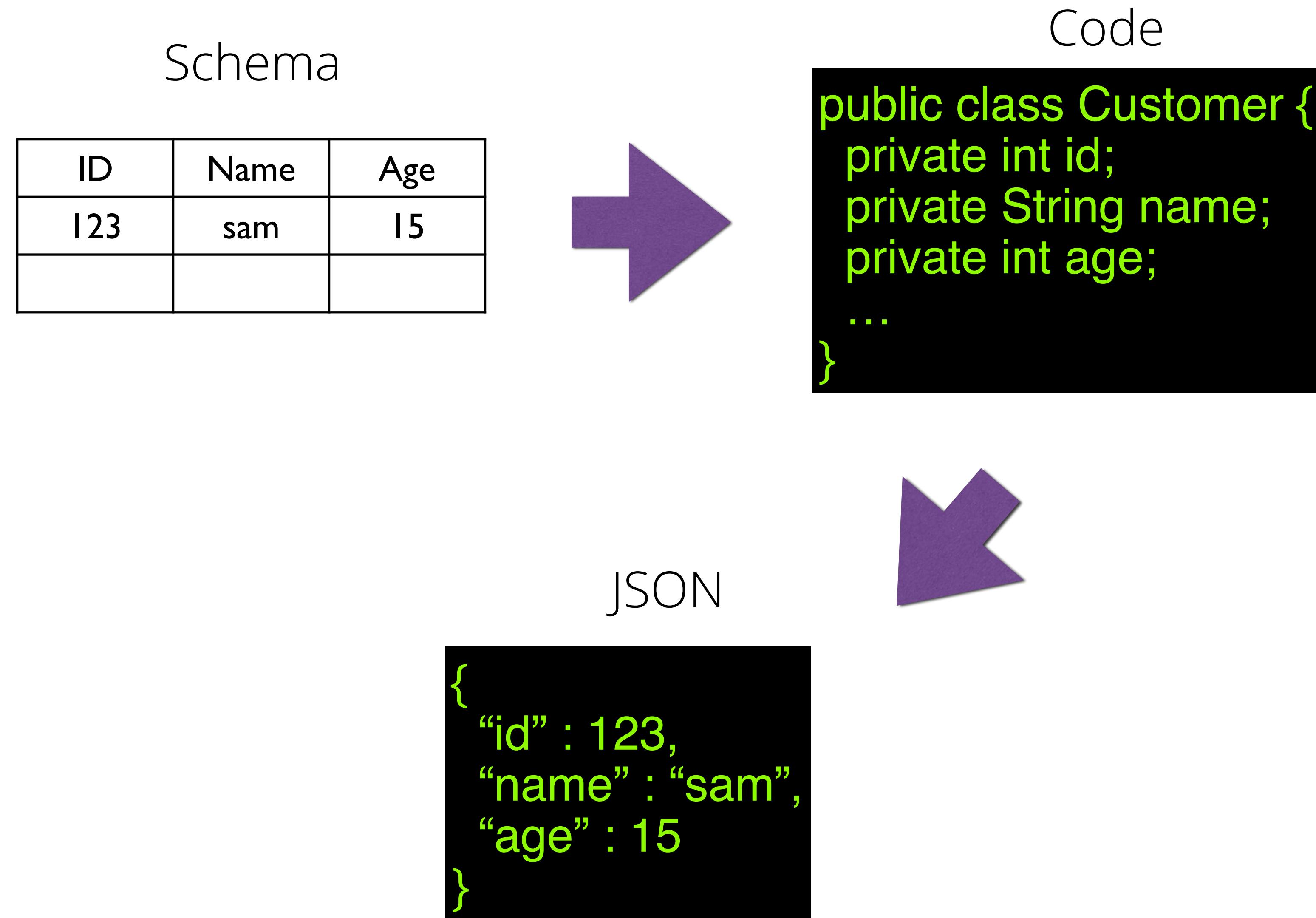


Code

```
public class Customer {  
    private int id;  
    private String name;  
    private int age;  
    ...  
}
```



BEWARE TIGHT COUPLING



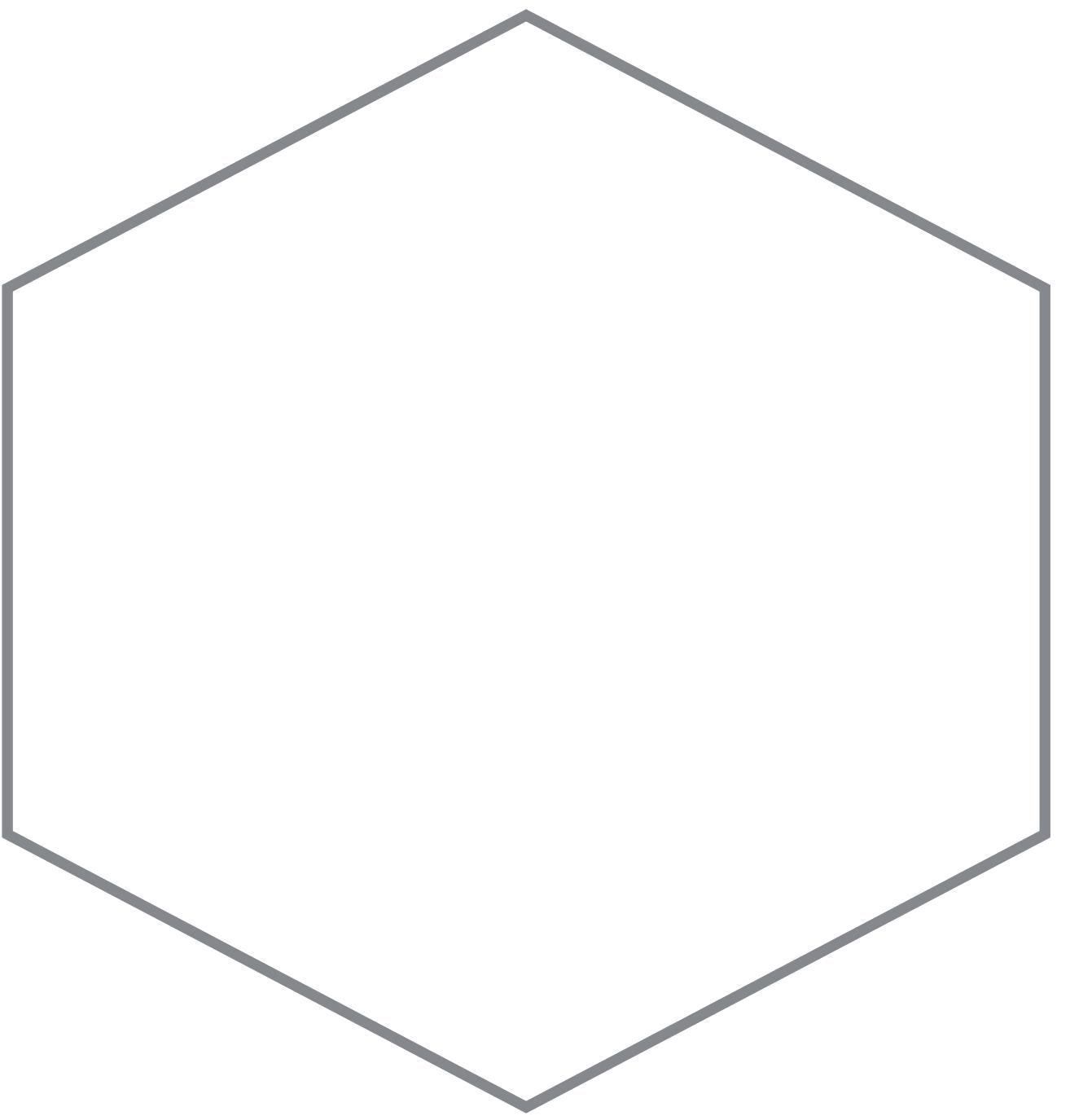
Question

What's wrong with this approach?

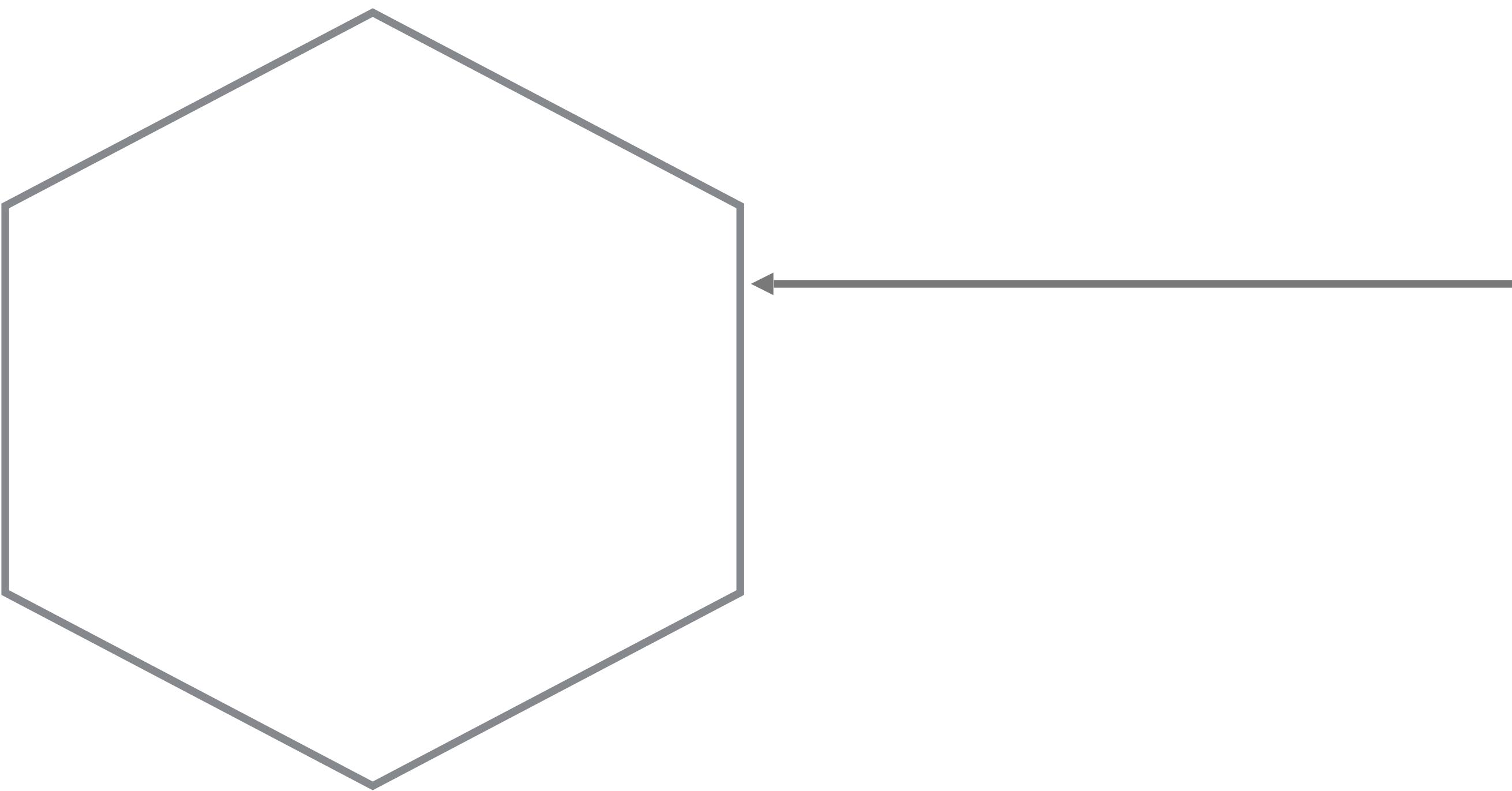
**Changing internal implementation detail
shouldn't change the contract!**

Also: Inside out thinking, not outside in

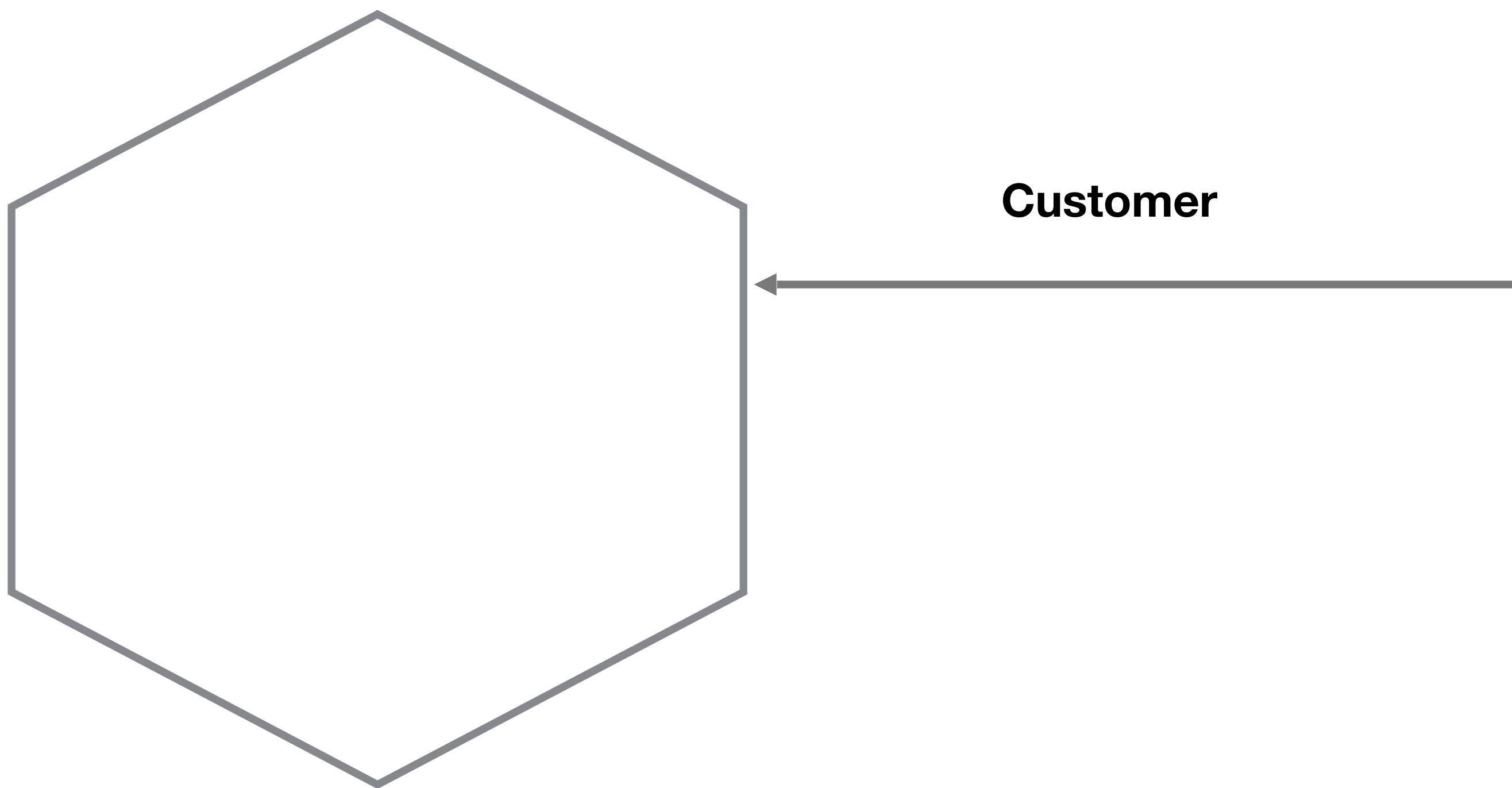
DON'T SHARE TOO MUCH!



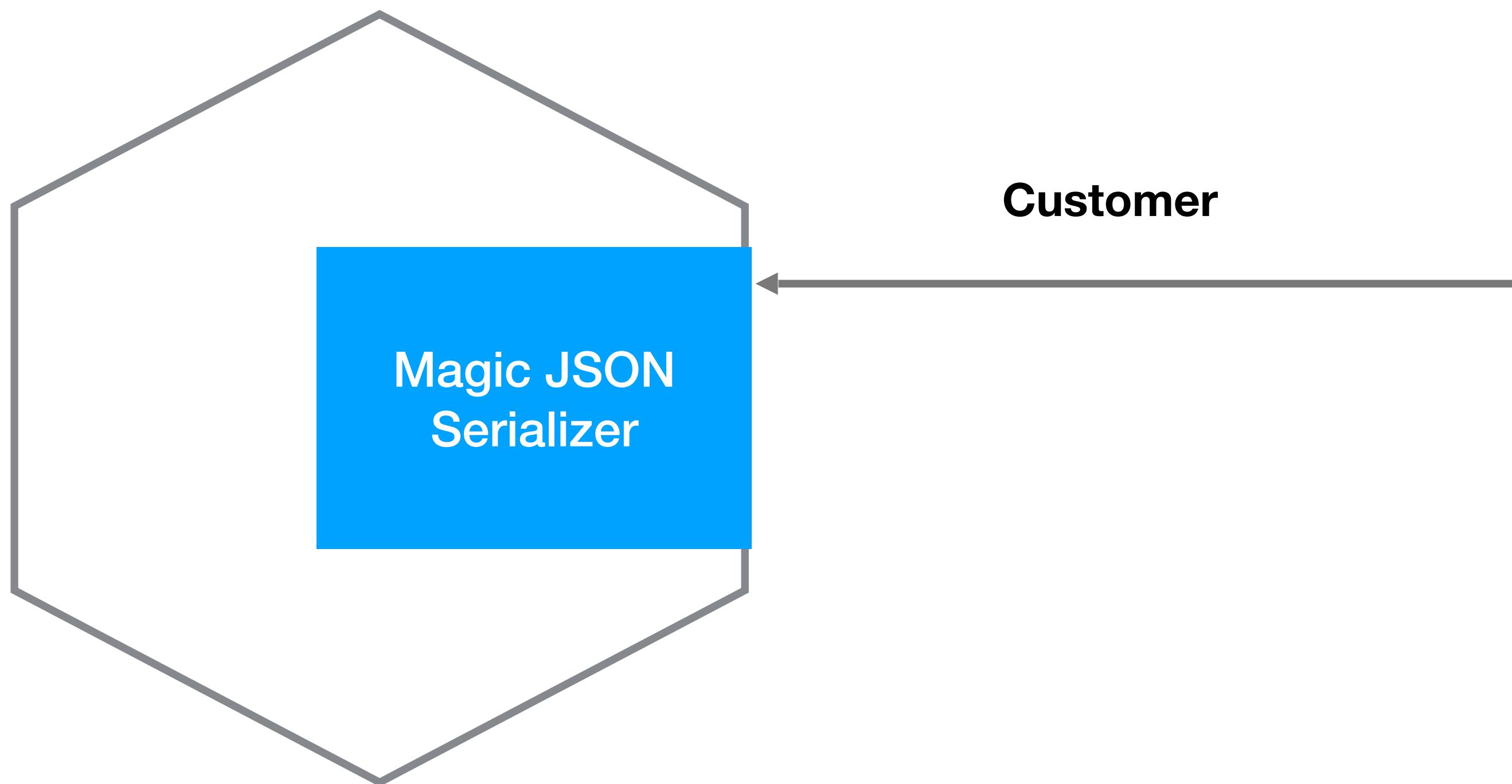
DON'T SHARE TOO MUCH!



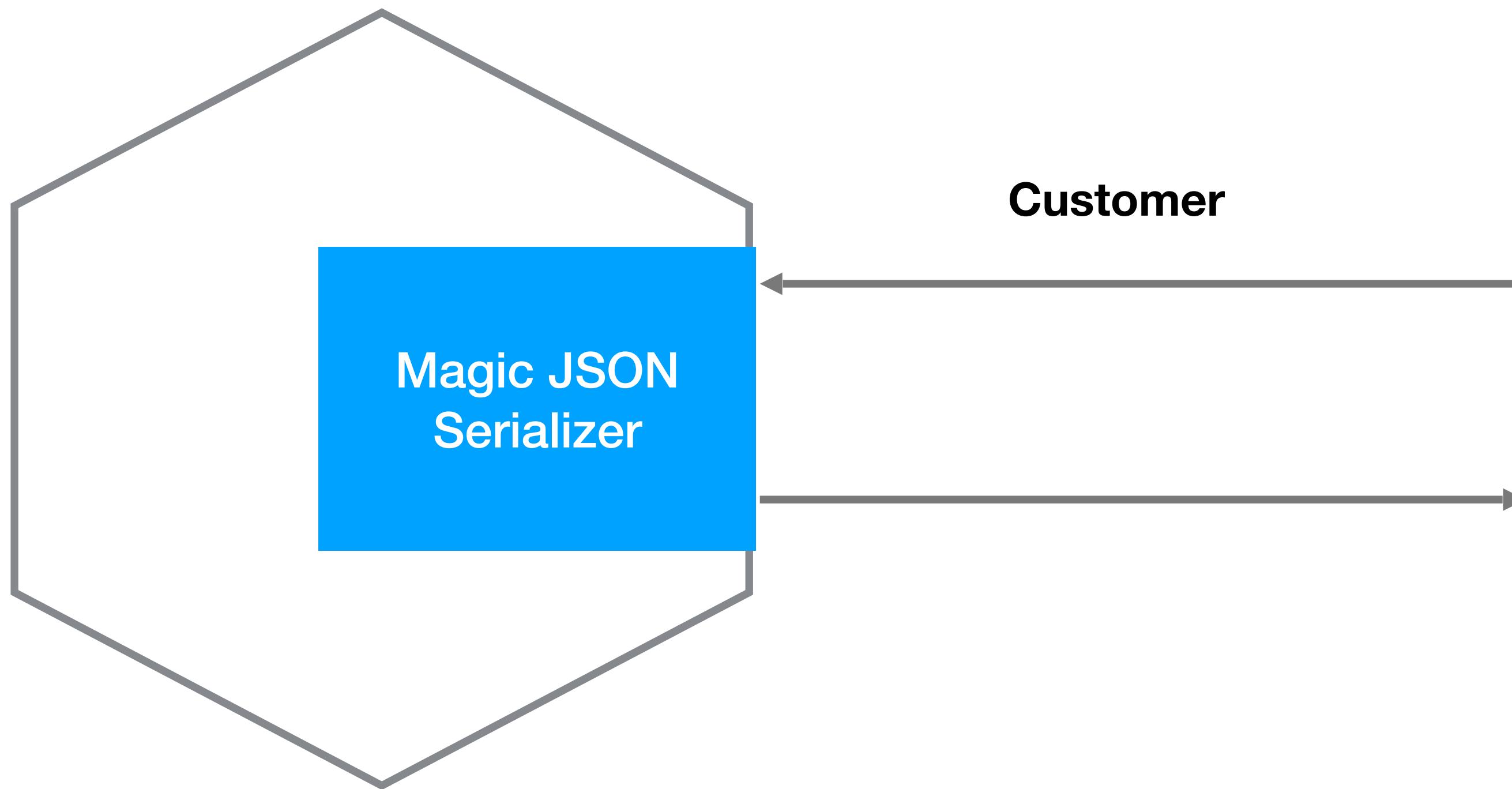
DON'T SHARE TOO MUCH!



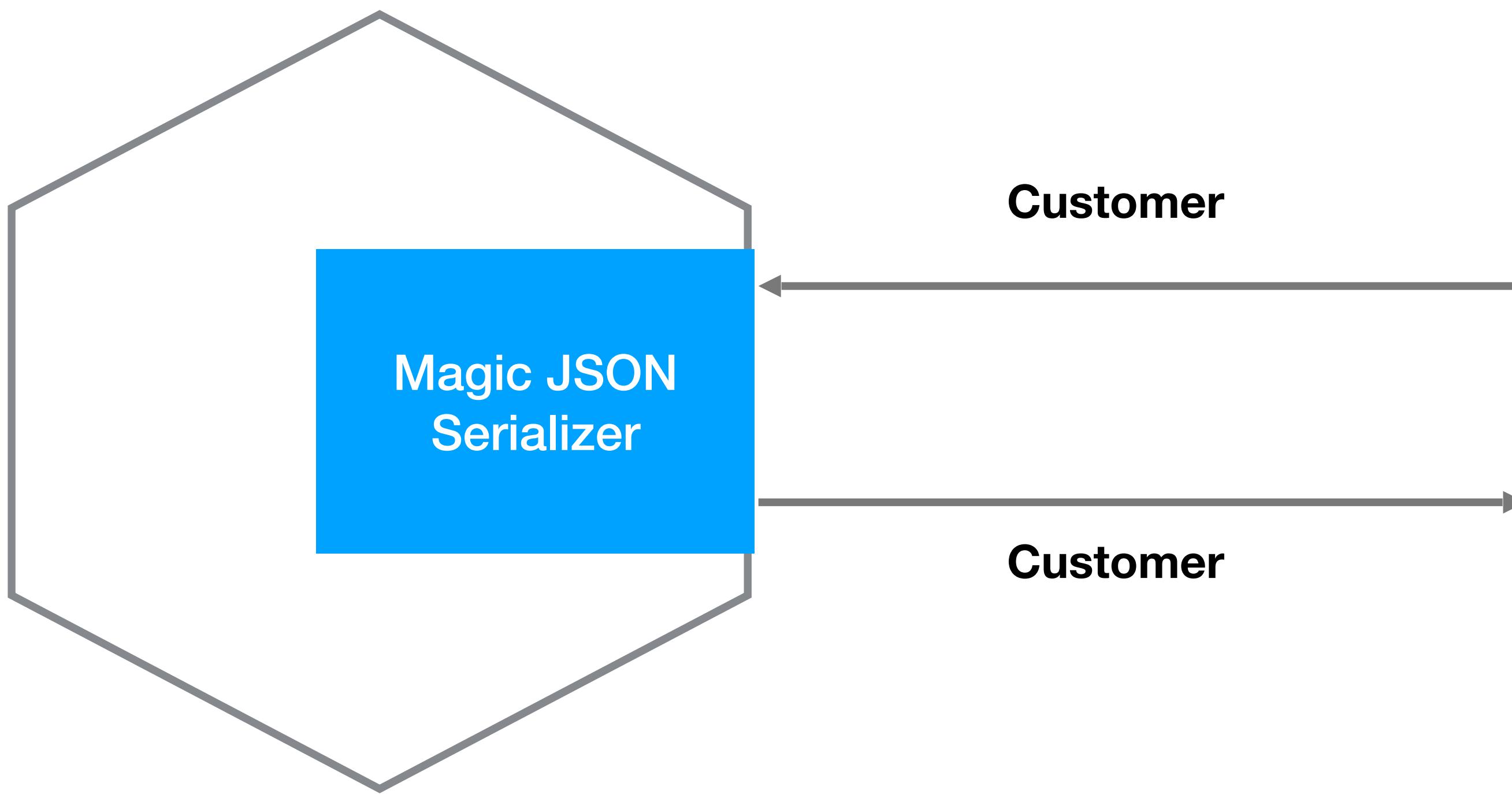
DON'T SHARE TOO MUCH!



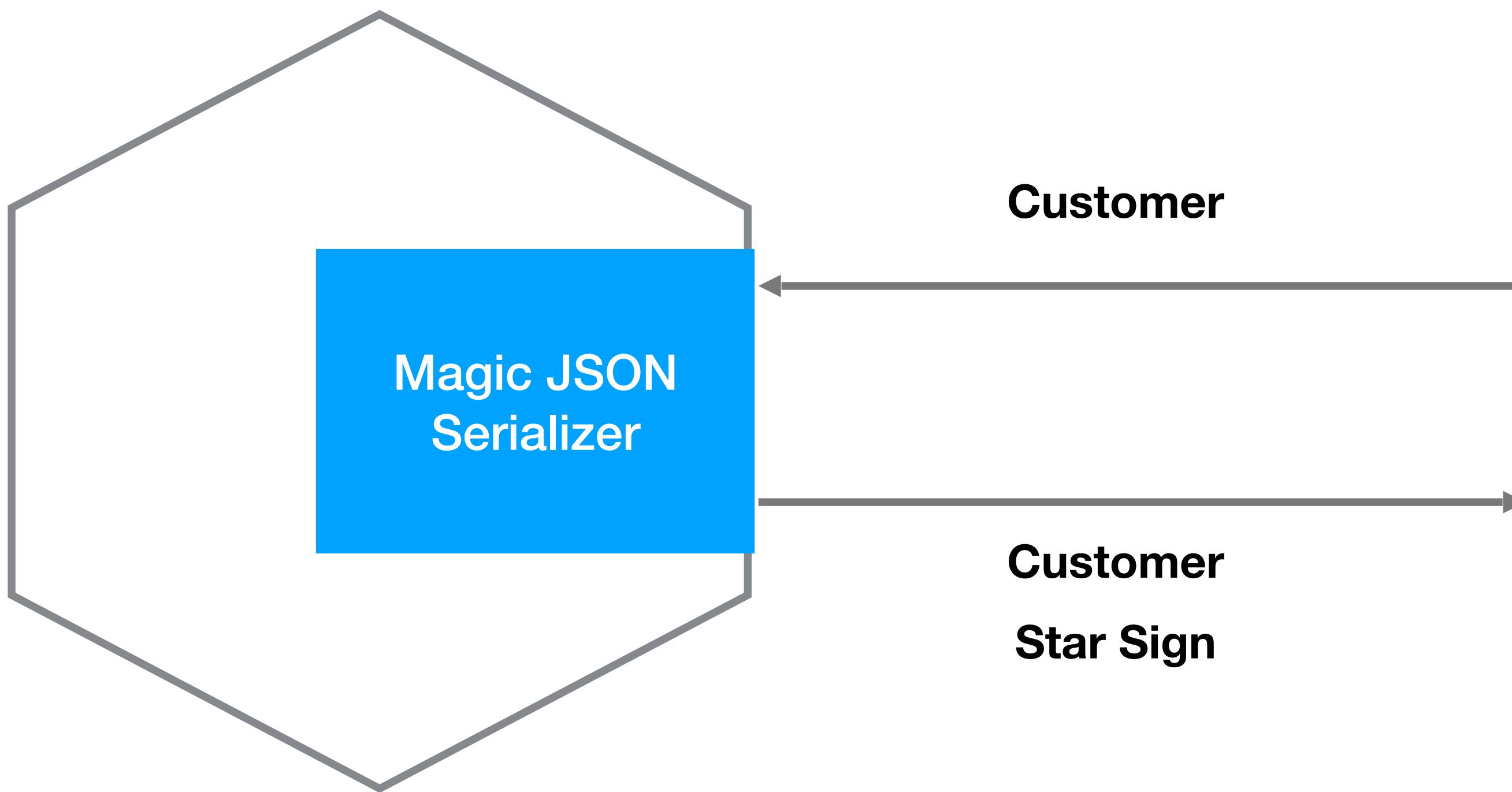
DON'T SHARE TOO MUCH!



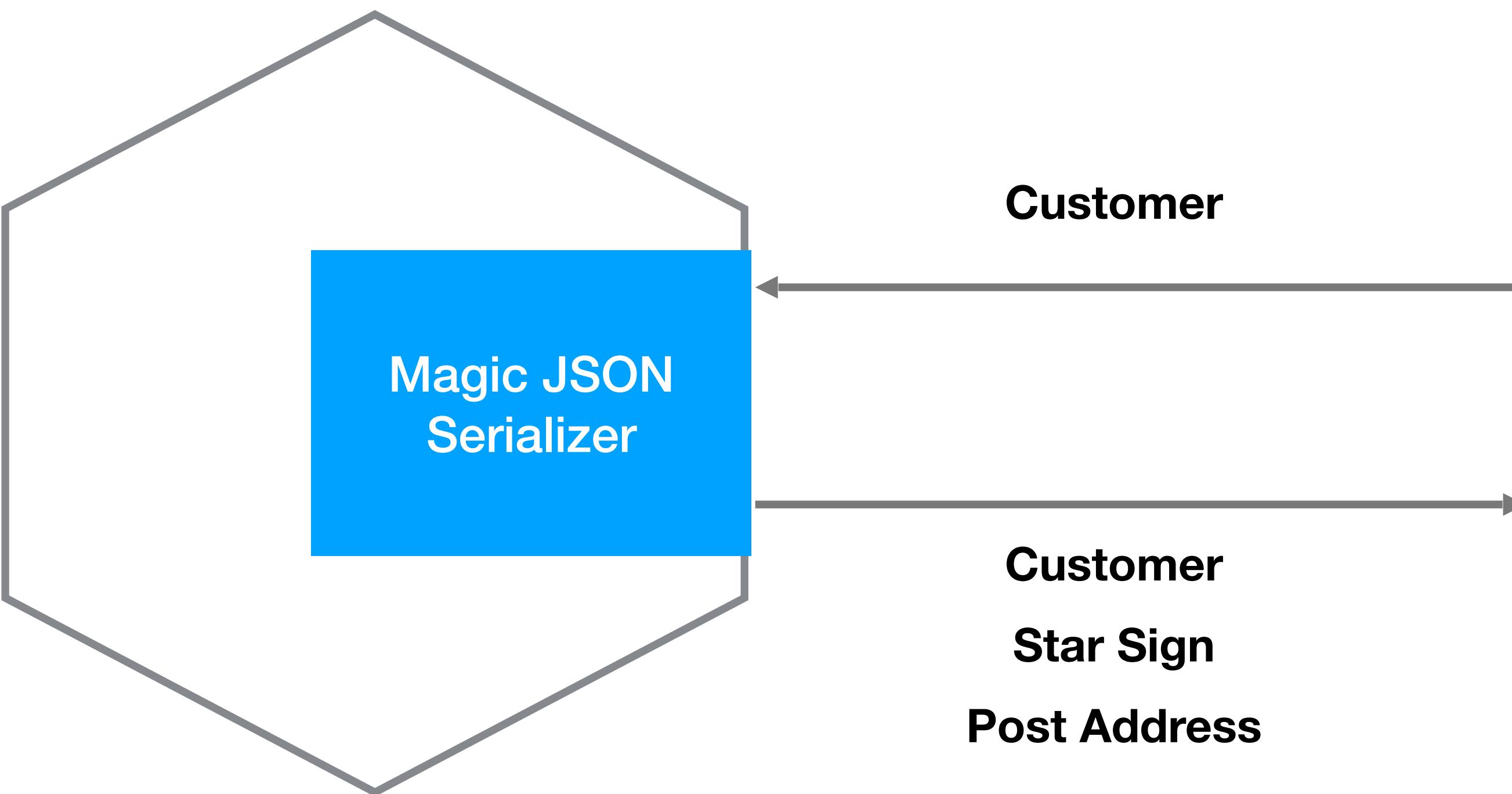
DON'T SHARE TOO MUCH!



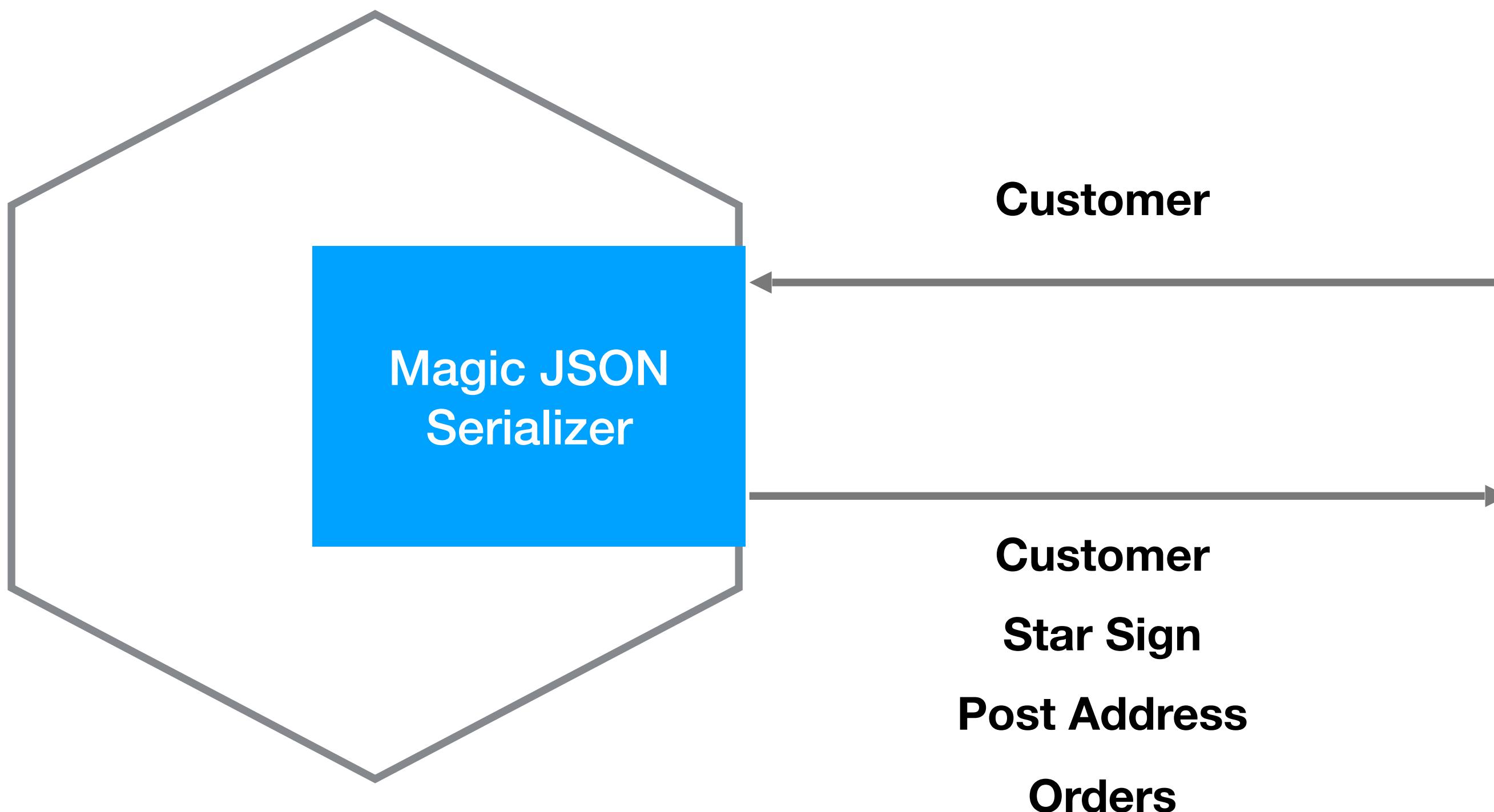
DON'T SHARE TOO MUCH!



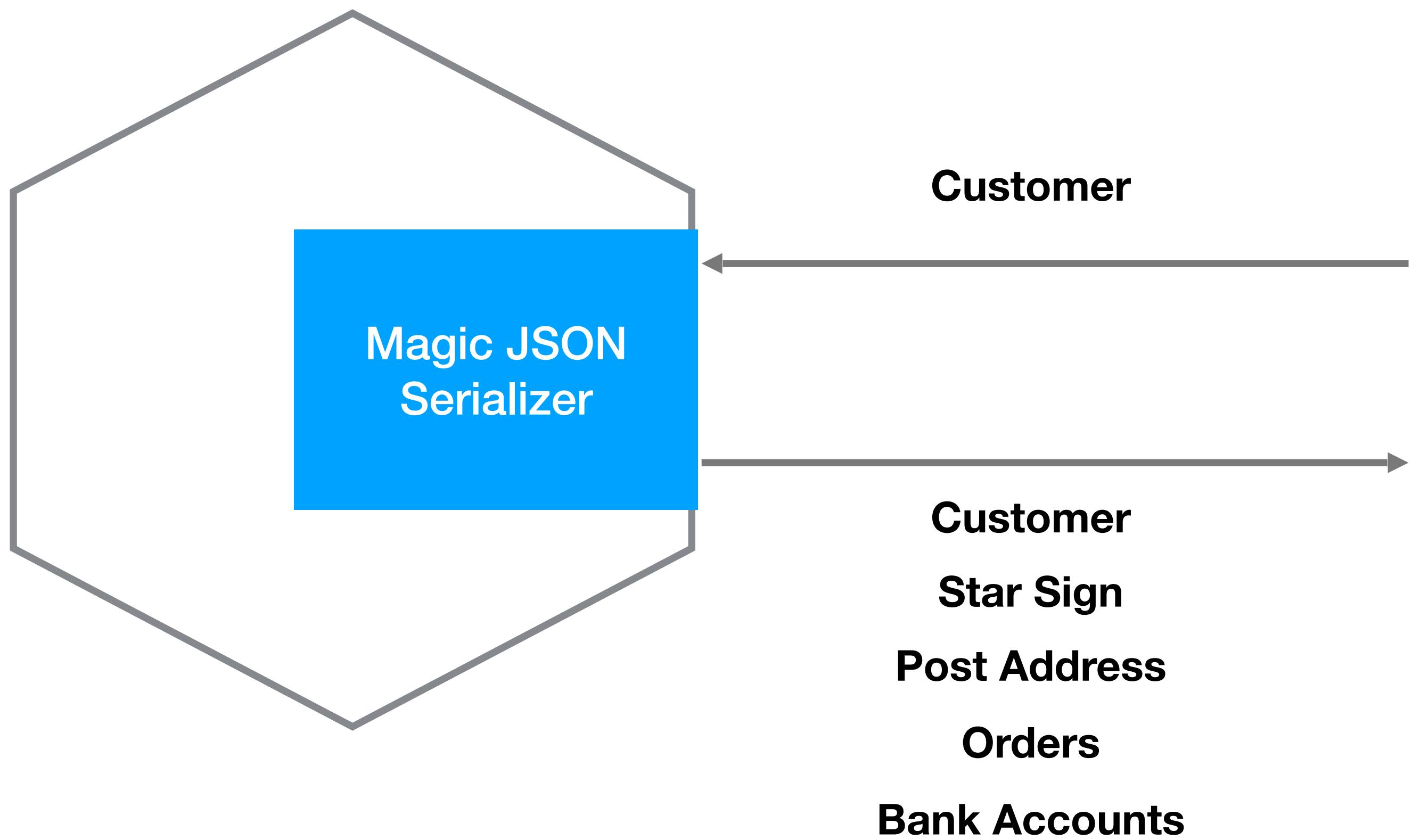
DON'T SHARE TOO MUCH!



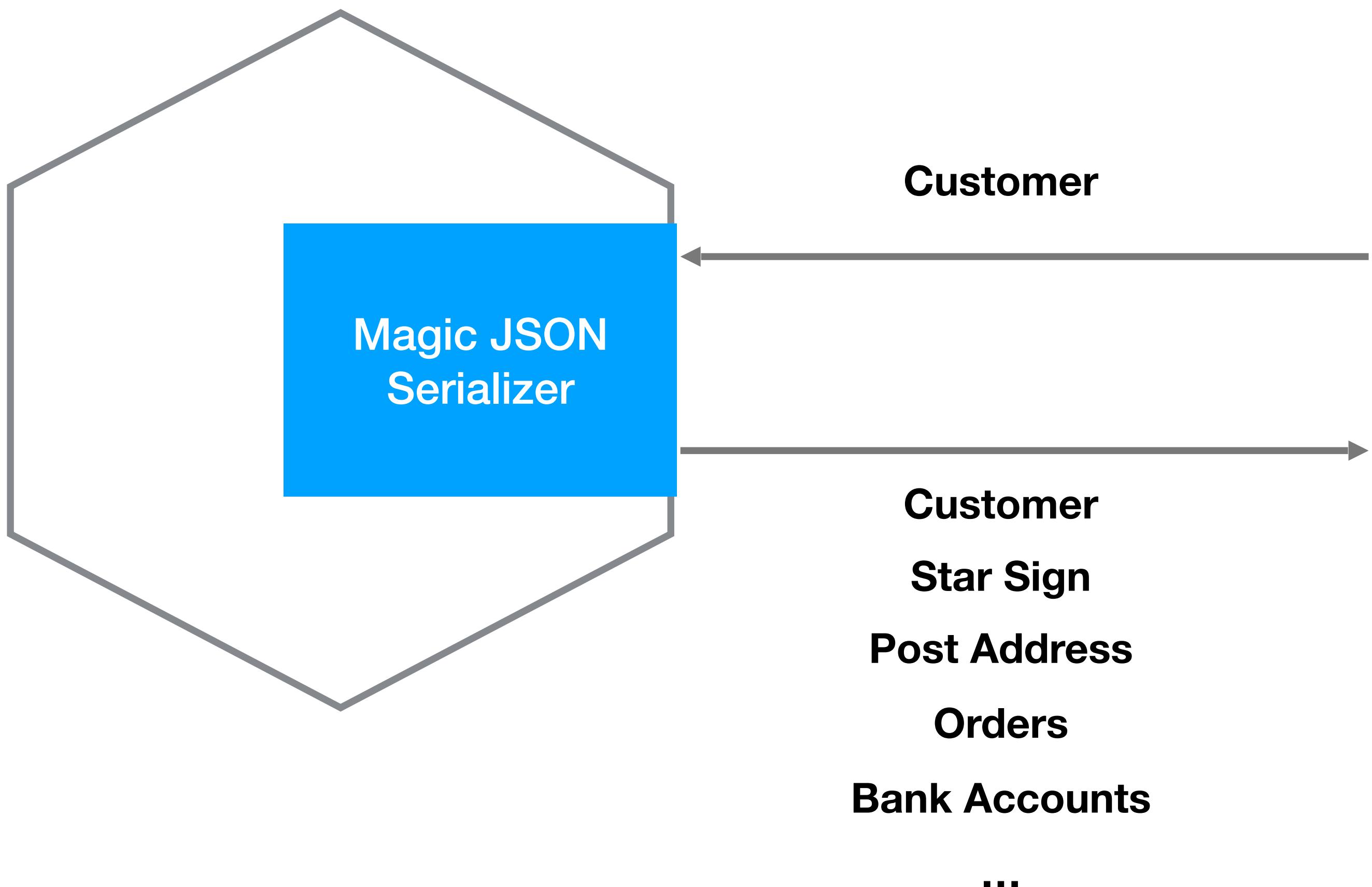
DON'T SHARE TOO MUCH!



DON'T SHARE TOO MUCH!

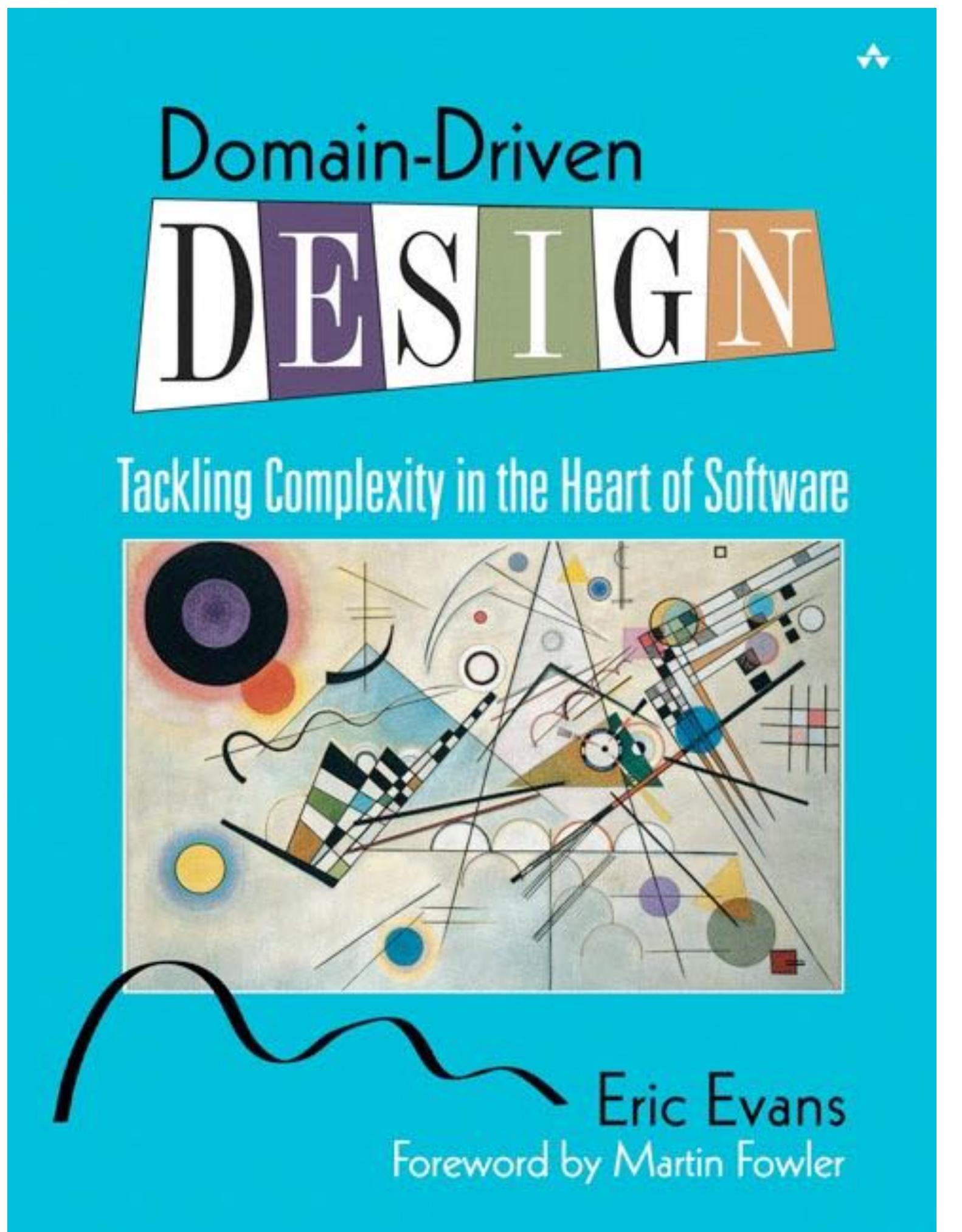


DON'T SHARE TOO MUCH!

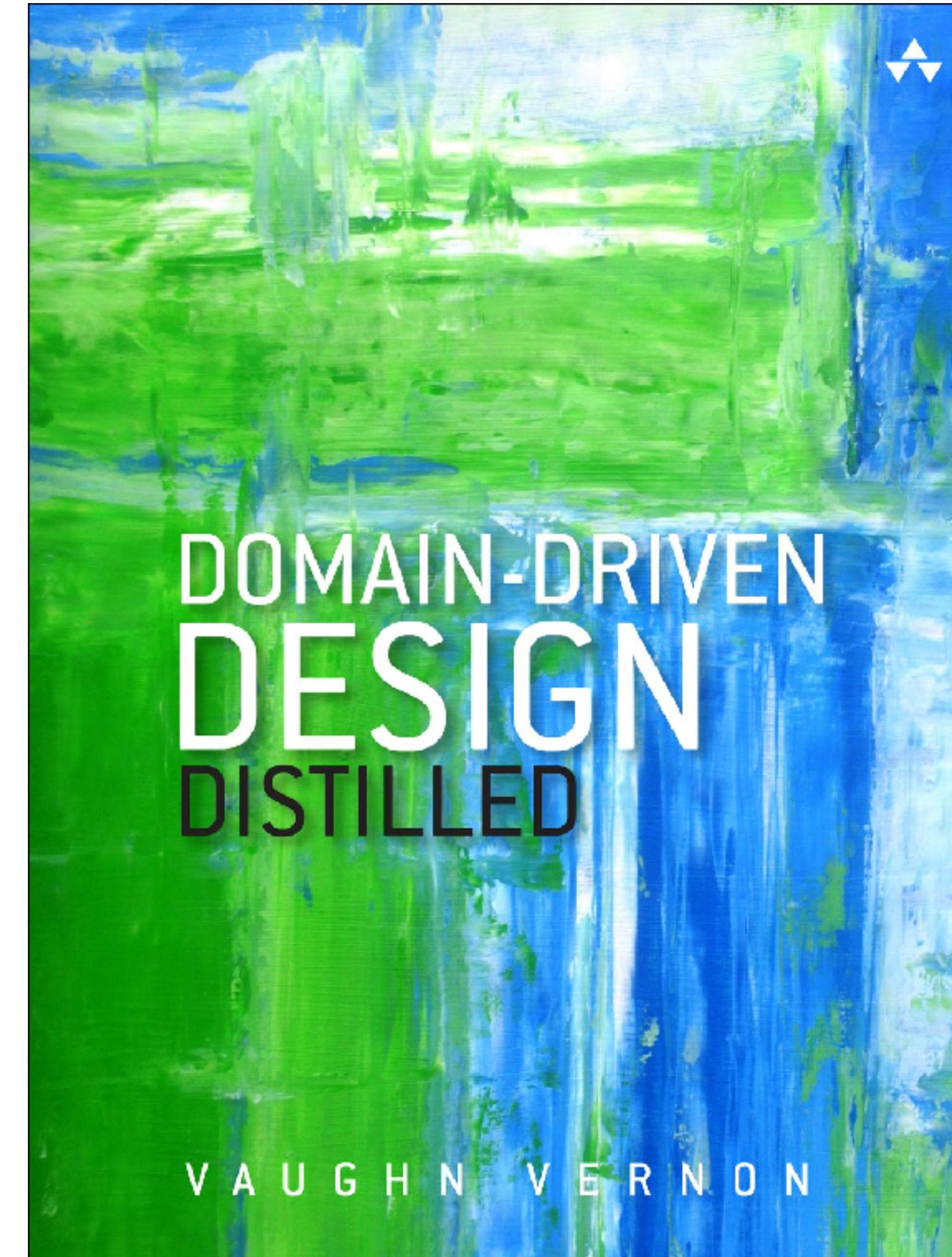
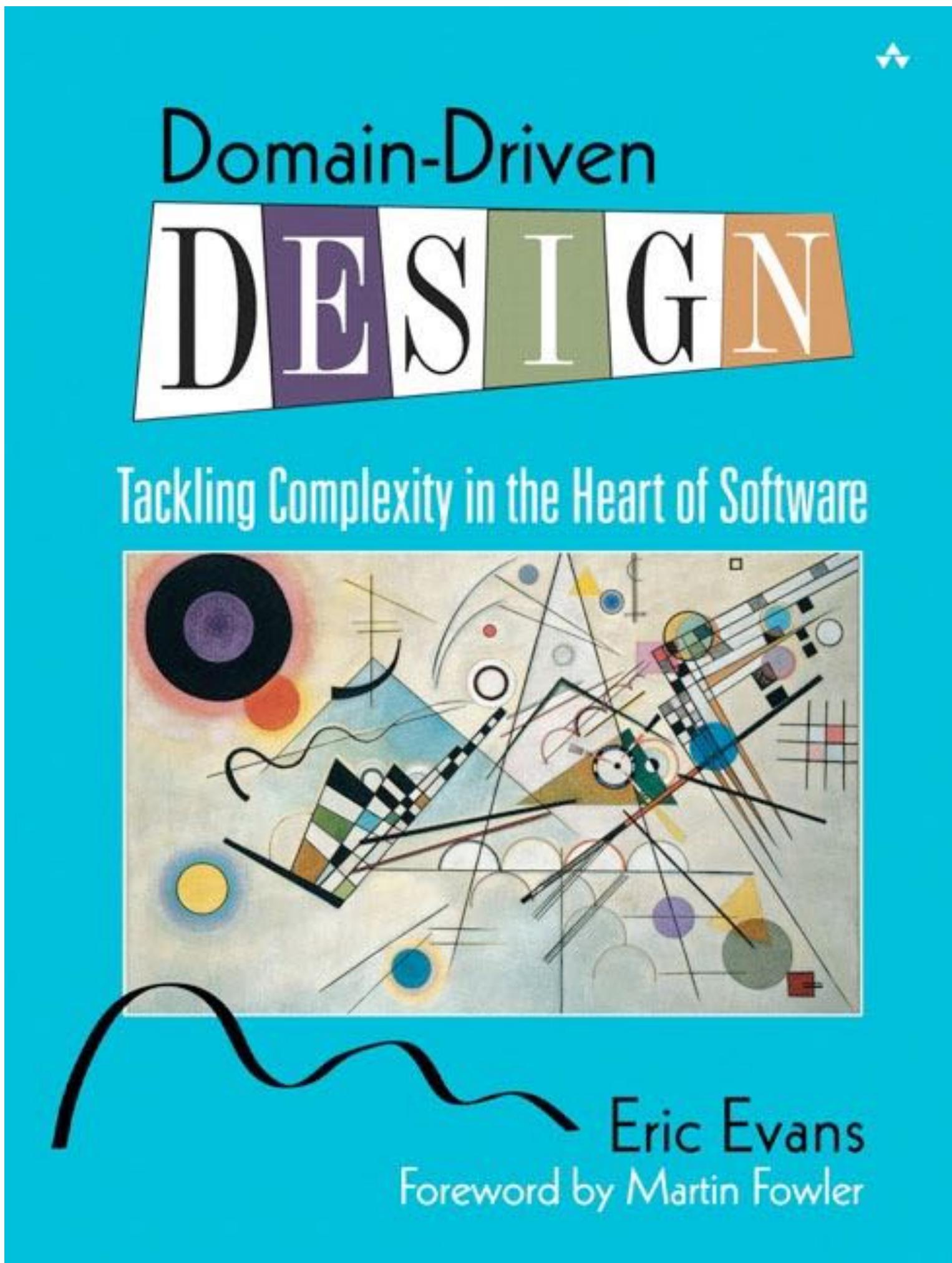


Domain-Driven Design

DOMAIN DRIVEN DESIGN

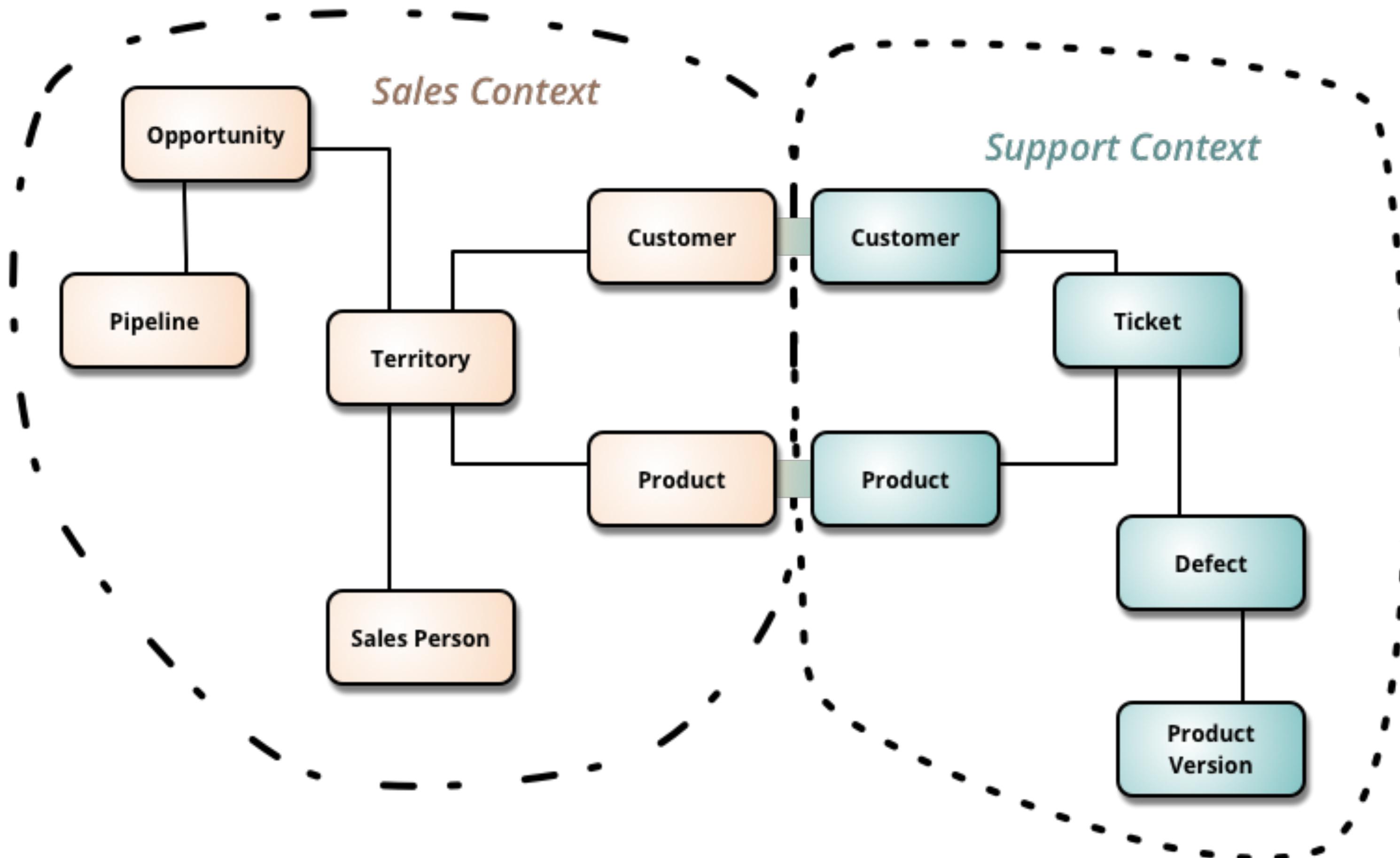


DOMAIN DRIVEN DESIGN



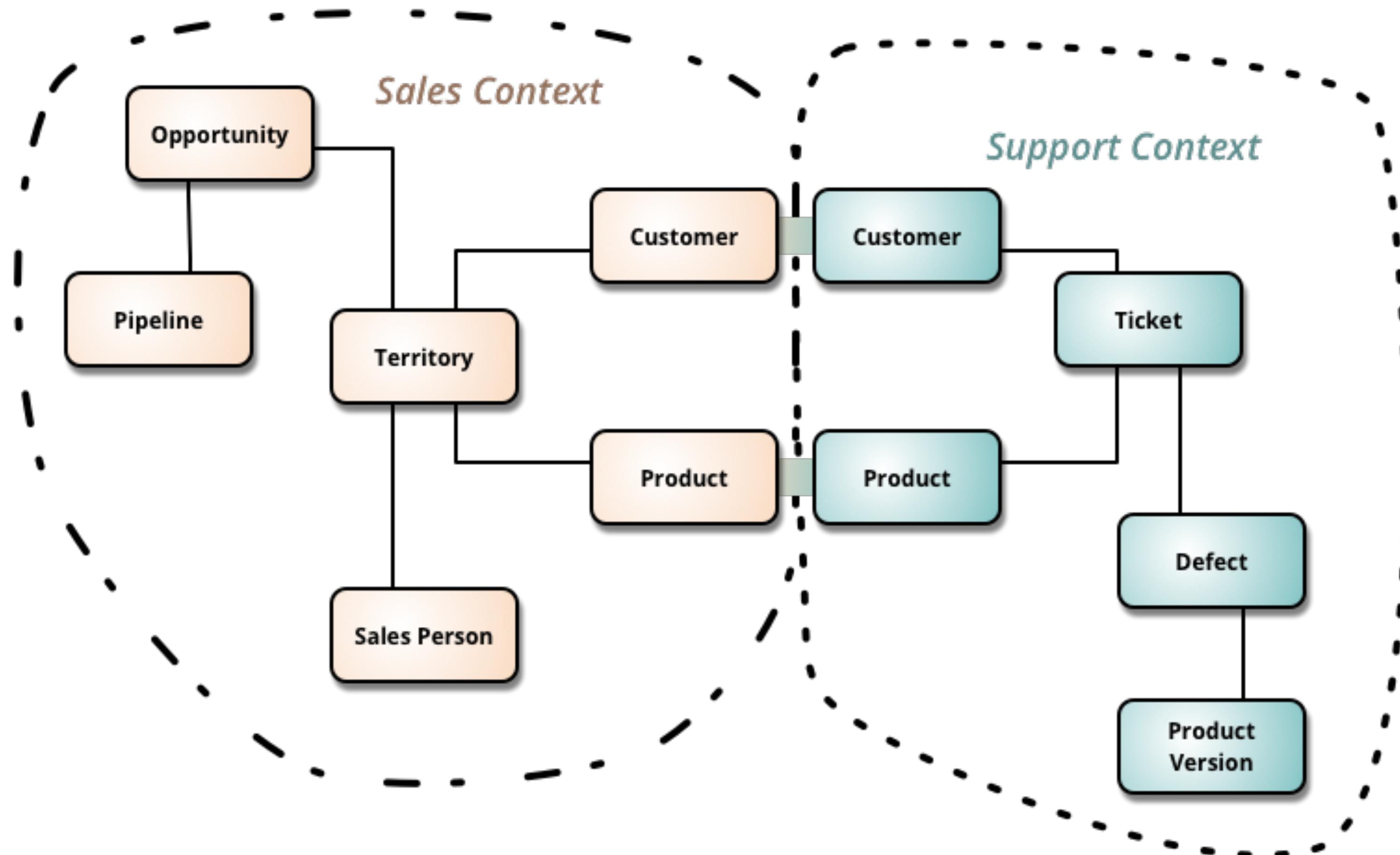
Bounded Context

BOUNDED CONTEXTS



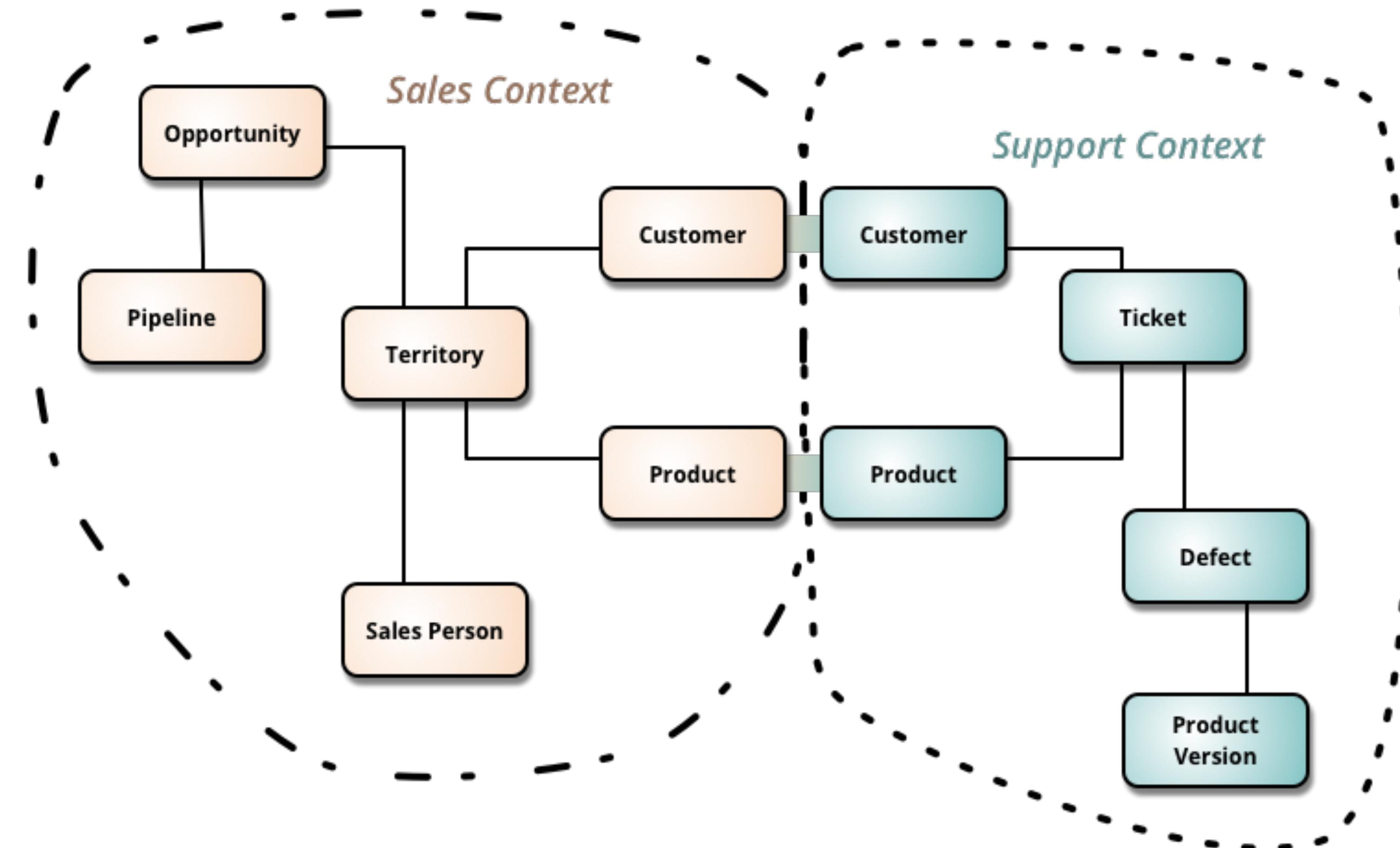
<https://martinfowler.com/bliki/BoundedContext.html>

BOUNDED CONTEXTS



Organisational groupings

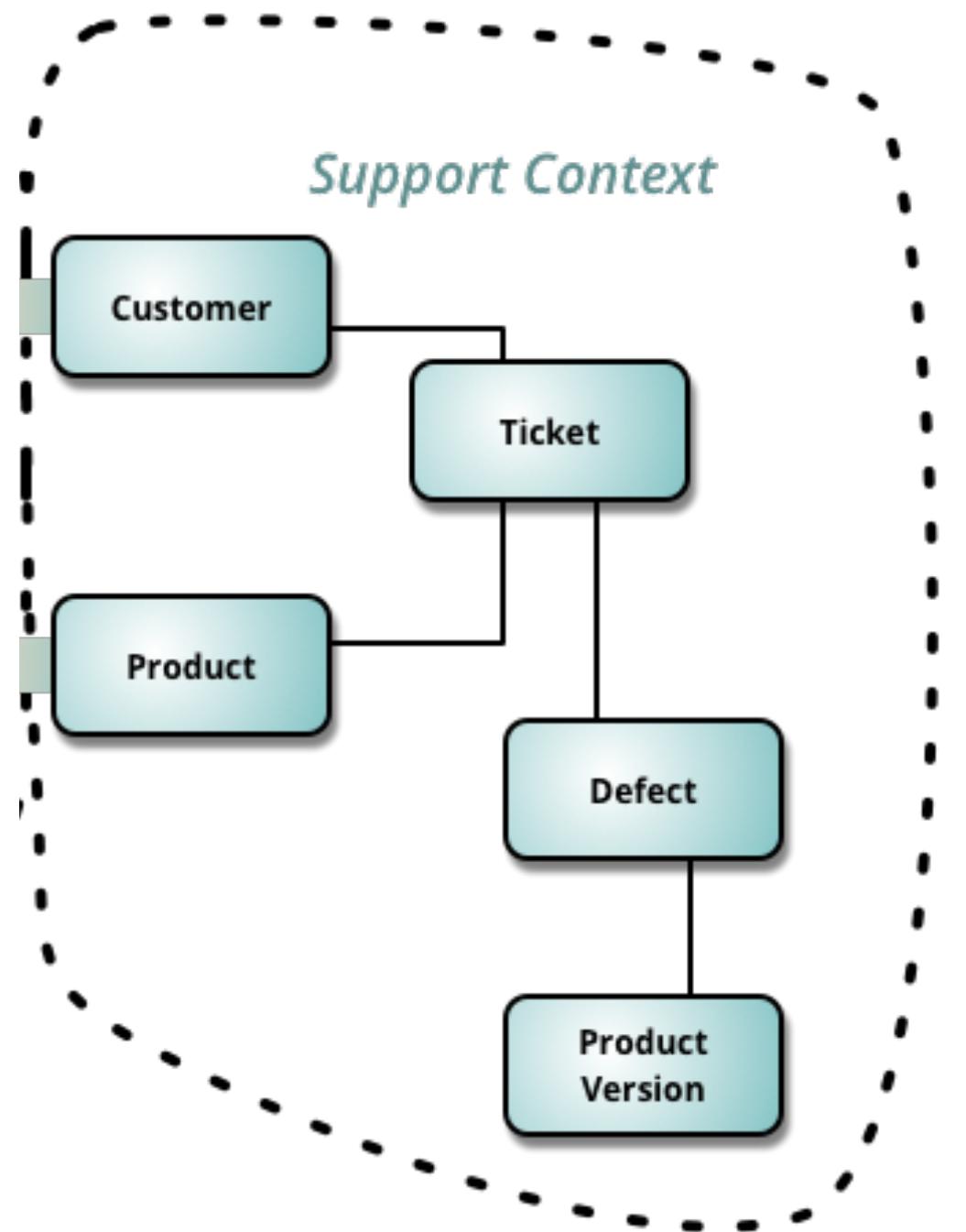
BOUNDED CONTEXTS



Organisational groupings

Hiding complexity

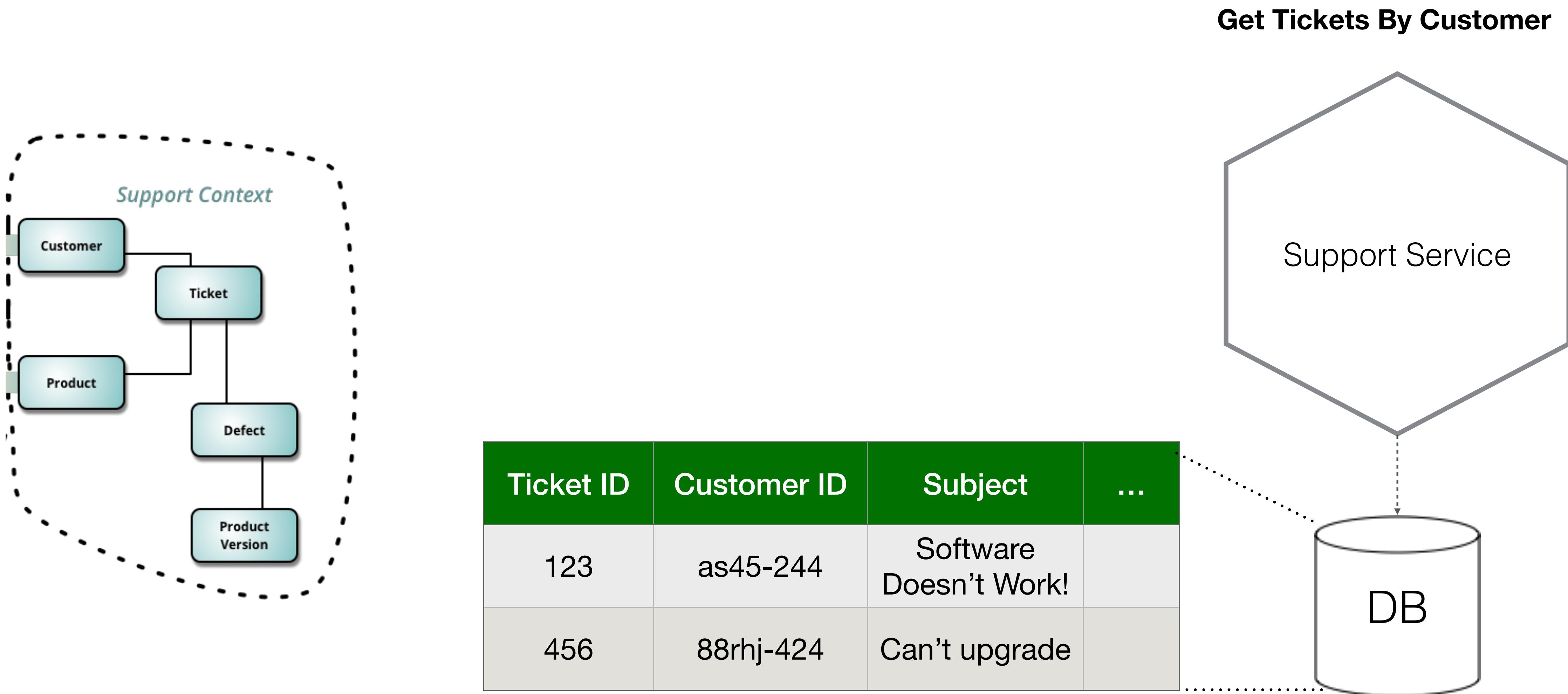
IMPLEMENTATION EXAMPLE...



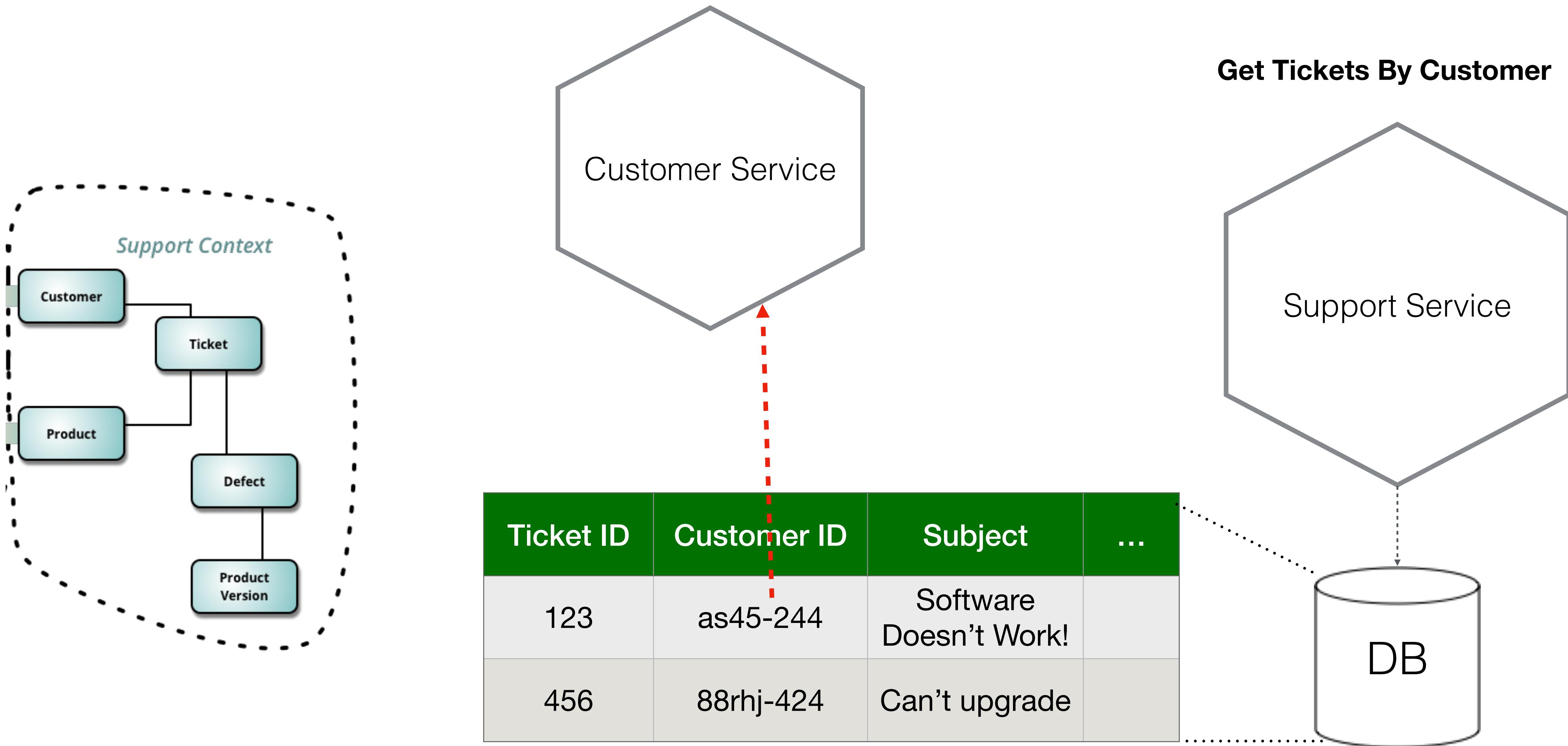
IMPLEMENTATION EXAMPLE...



IMPLEMENTATION EXAMPLE...



IMPLEMENTATION EXAMPLE...



**Finding bounded
context and aggregates?**

Event Storming!

Introducing EventStorming

An act of deliberate collective learning

The book is available on Leanpub (PDF, EPub and Mobi).
It's not finished, but there's already enough content to help
explorers and practitioners.

[Read the book >](#)

Paper version will follow



**A collaborative exercise involving technical and
non-technical stakeholders**

1. Identify Events

1. Identify Events

2. Identify Commands that trigger those events

1. Identify Events

2. Identify Commands that trigger those events

3. Group commands and events into aggregates

1. Identify Events

2. Identify Commands that trigger those events

3. Group commands and events into aggregates

4. Group aggregates into bounded contexts

**Example: A reader takes out a book from
the library**

Event

Something that happens in our system

Event

Something that happens in our system



Book Returned

Event

Something that happens in our system

Written in the past tense

Book Returned

Event

Something that happens in our system

Book Returned

Written in the past tense

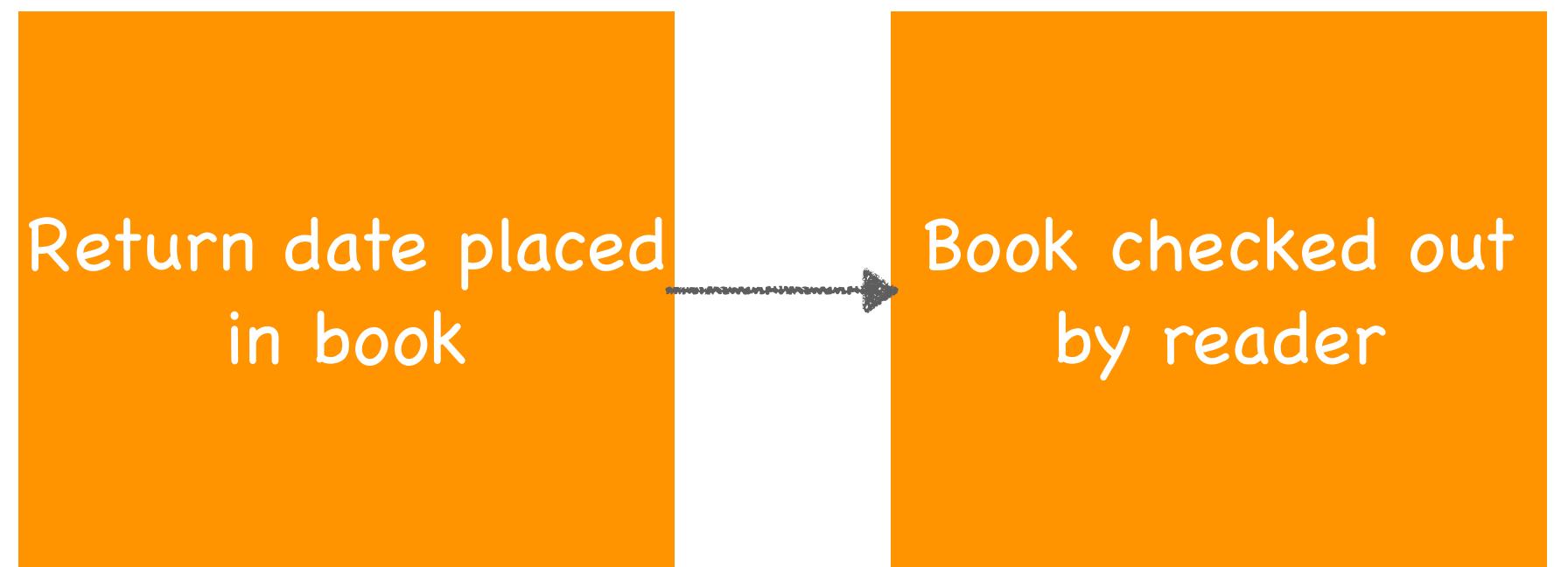
Typically in the form verb
happened in the past

IDENTIFY EVENTS

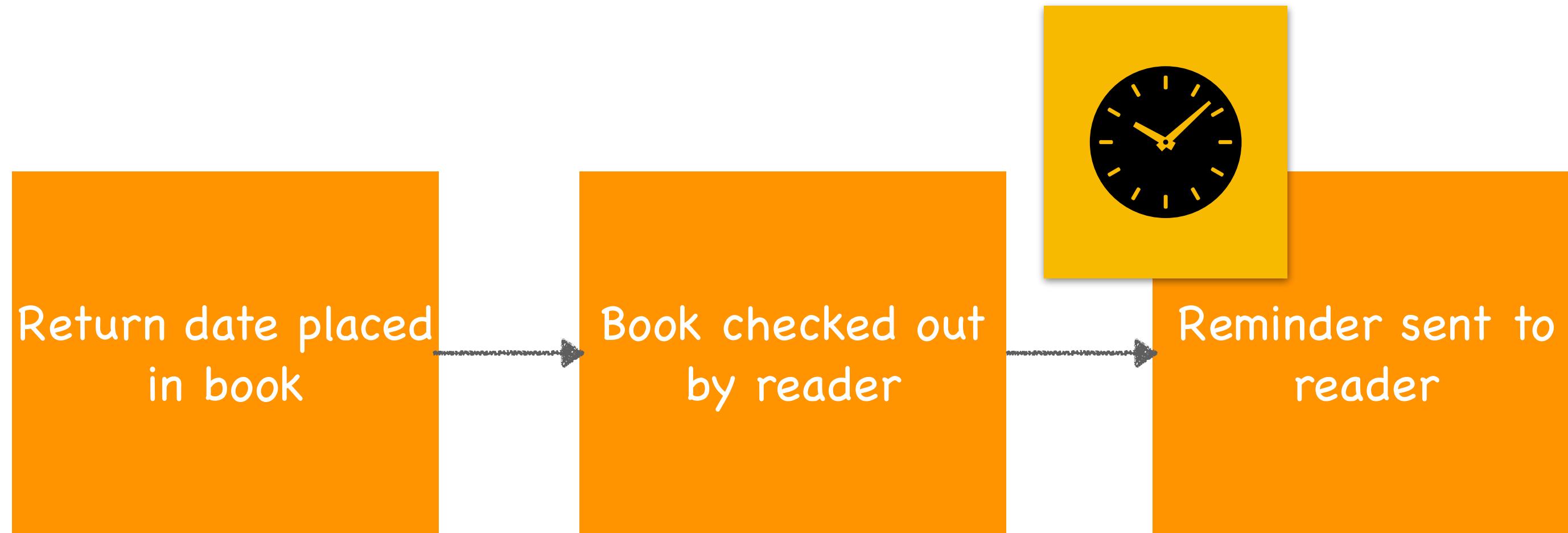
IDENTIFY EVENTS

Return date placed
in book

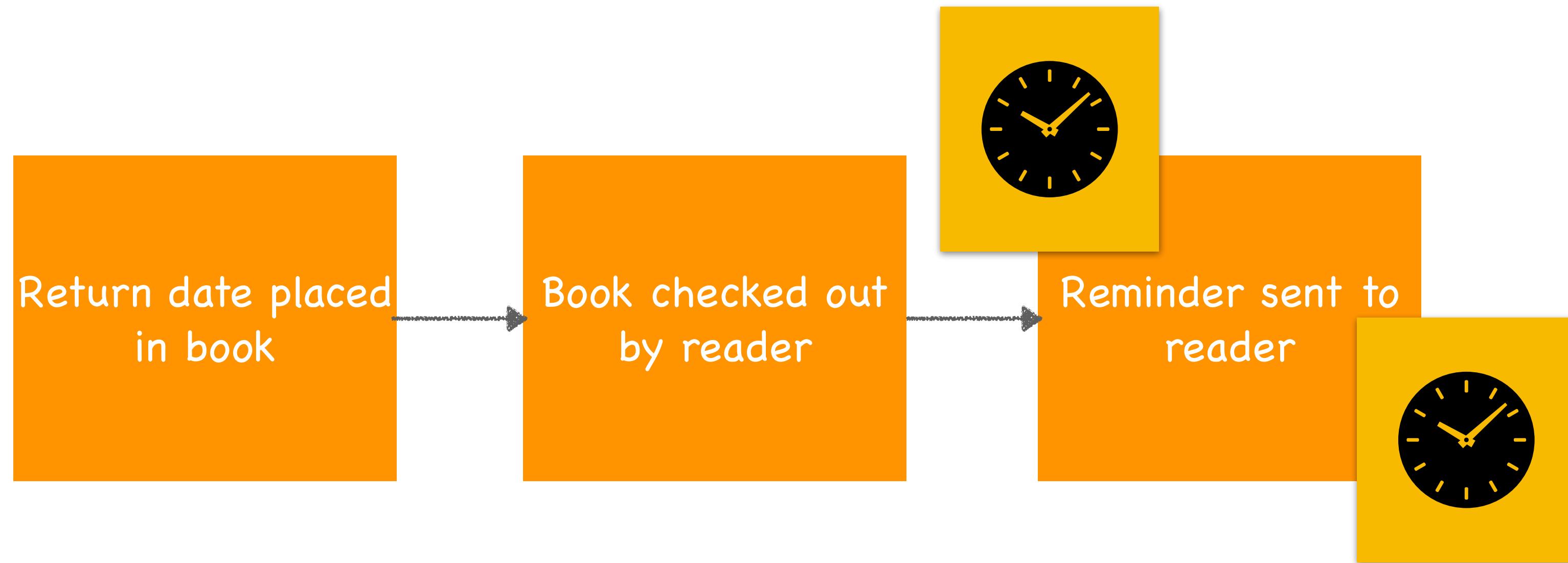
IDENTIFY EVENTS



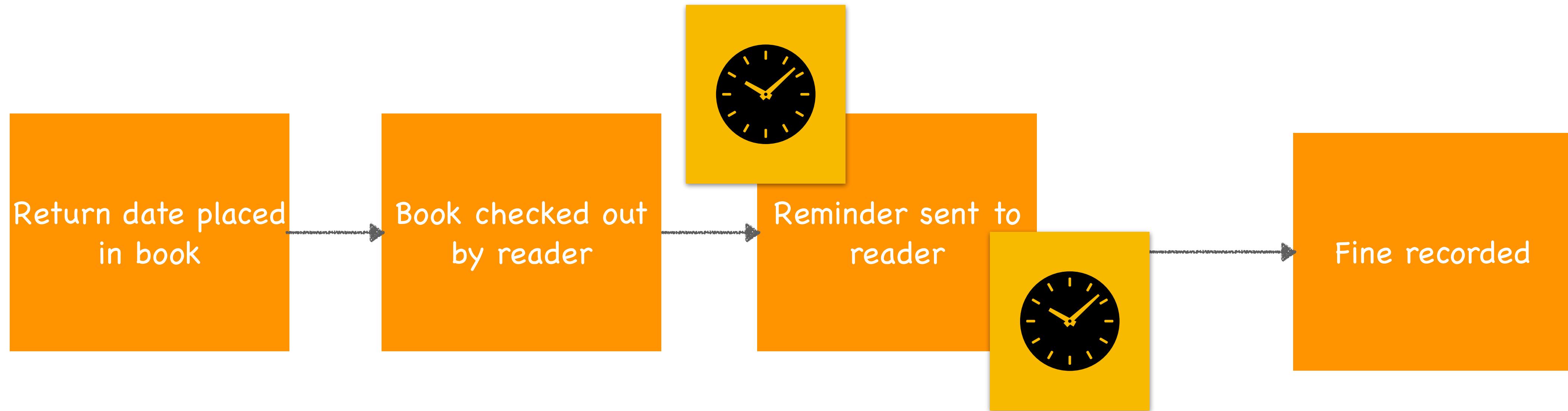
IDENTIFY EVENTS



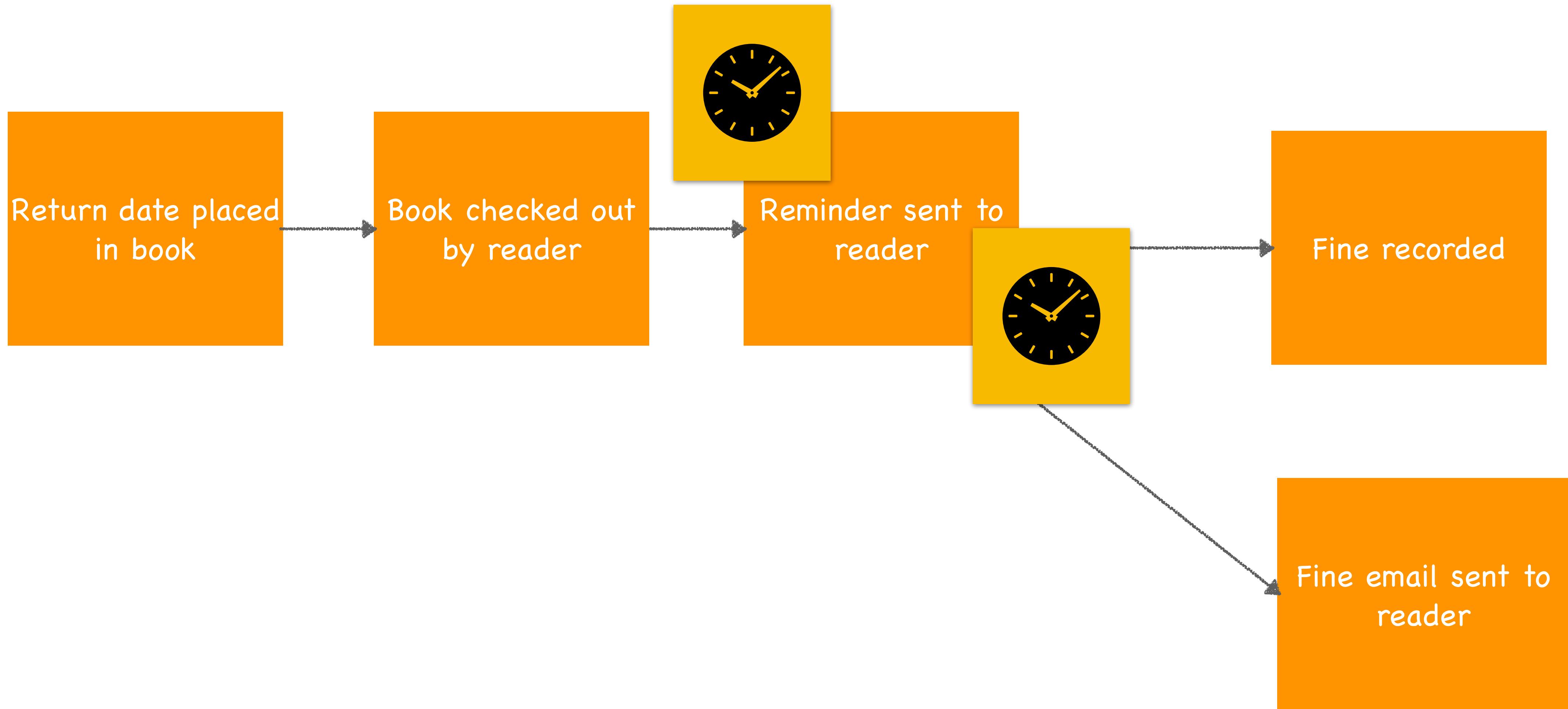
IDENTIFY EVENTS



IDENTIFY EVENTS



IDENTIFY EVENTS



Command

Something that triggers an event

Command

Something that triggers an event

Reader takes out
a book

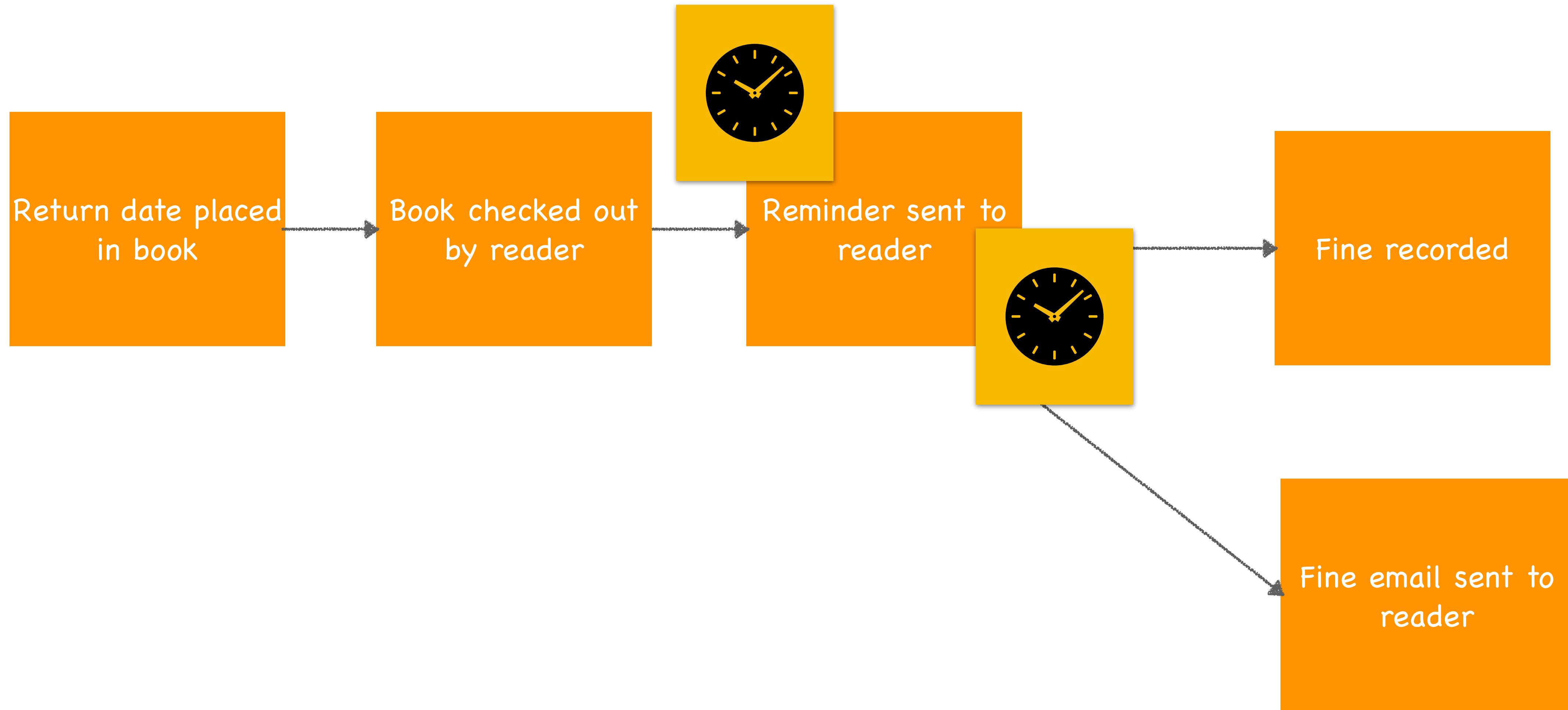
Command

Something that triggers an event

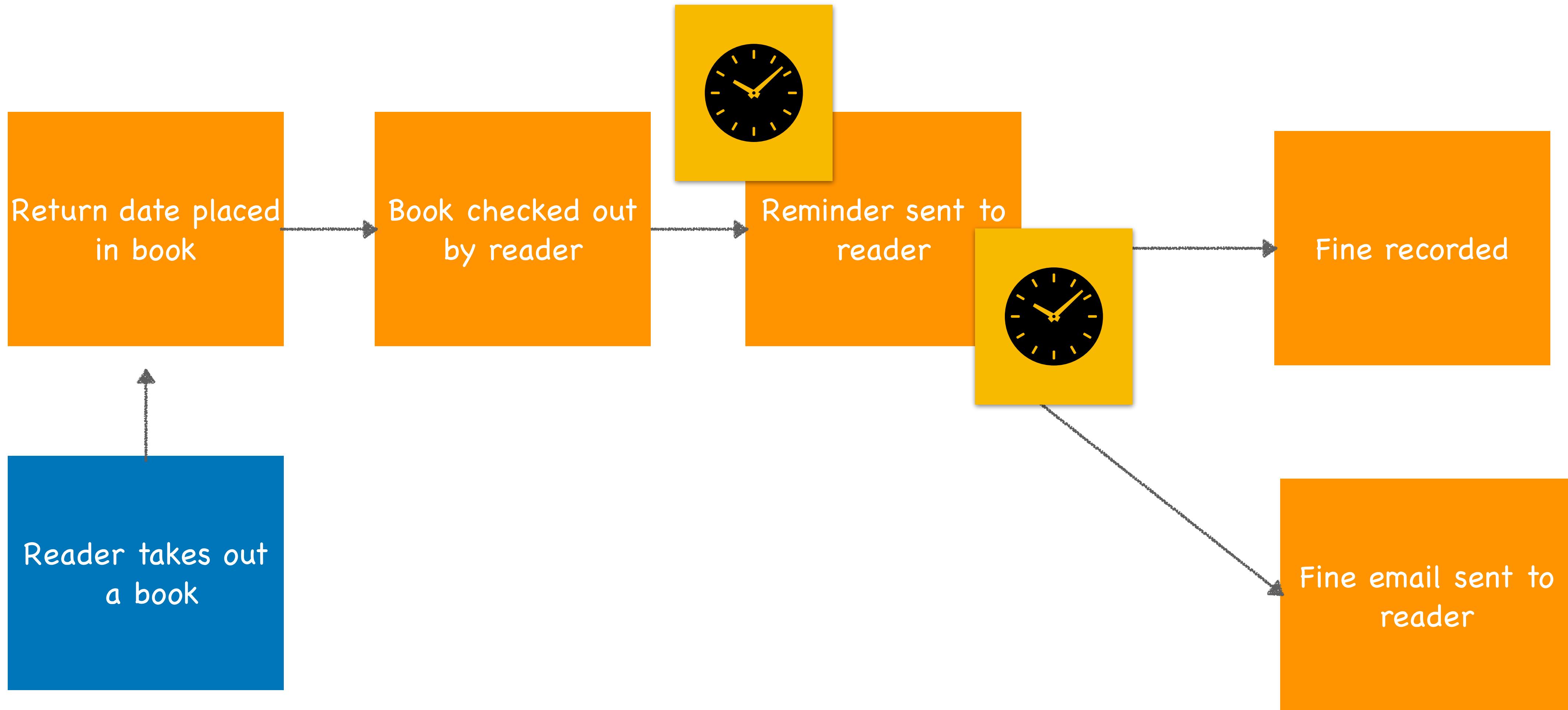
Reader takes out
a book

It's a decision taken by a user

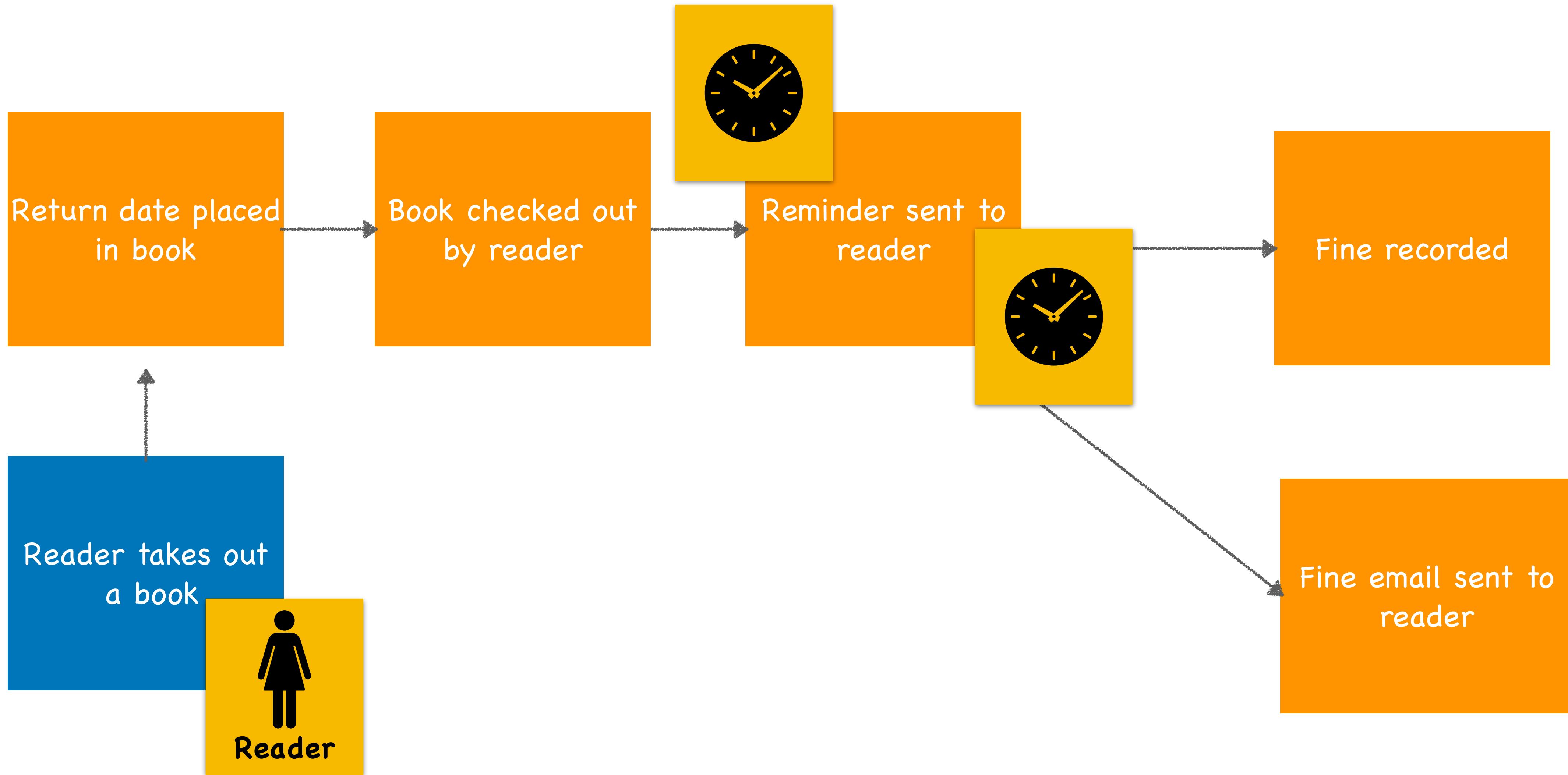
IDENTIFY COMMANDS & ACTORS



IDENTIFY COMMANDS & ACTORS



IDENTIFY COMMANDS & ACTORS



Aggregate

A group of commands and events

Aggregate

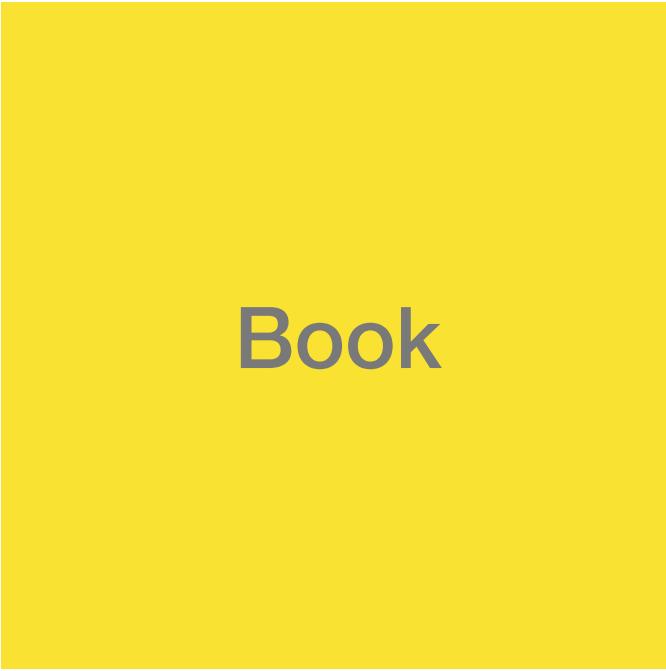
A group of commands and events



Book

Aggregate

A group of commands and events



Book

Think of it like a state machine

Aggregate

A group of commands and events



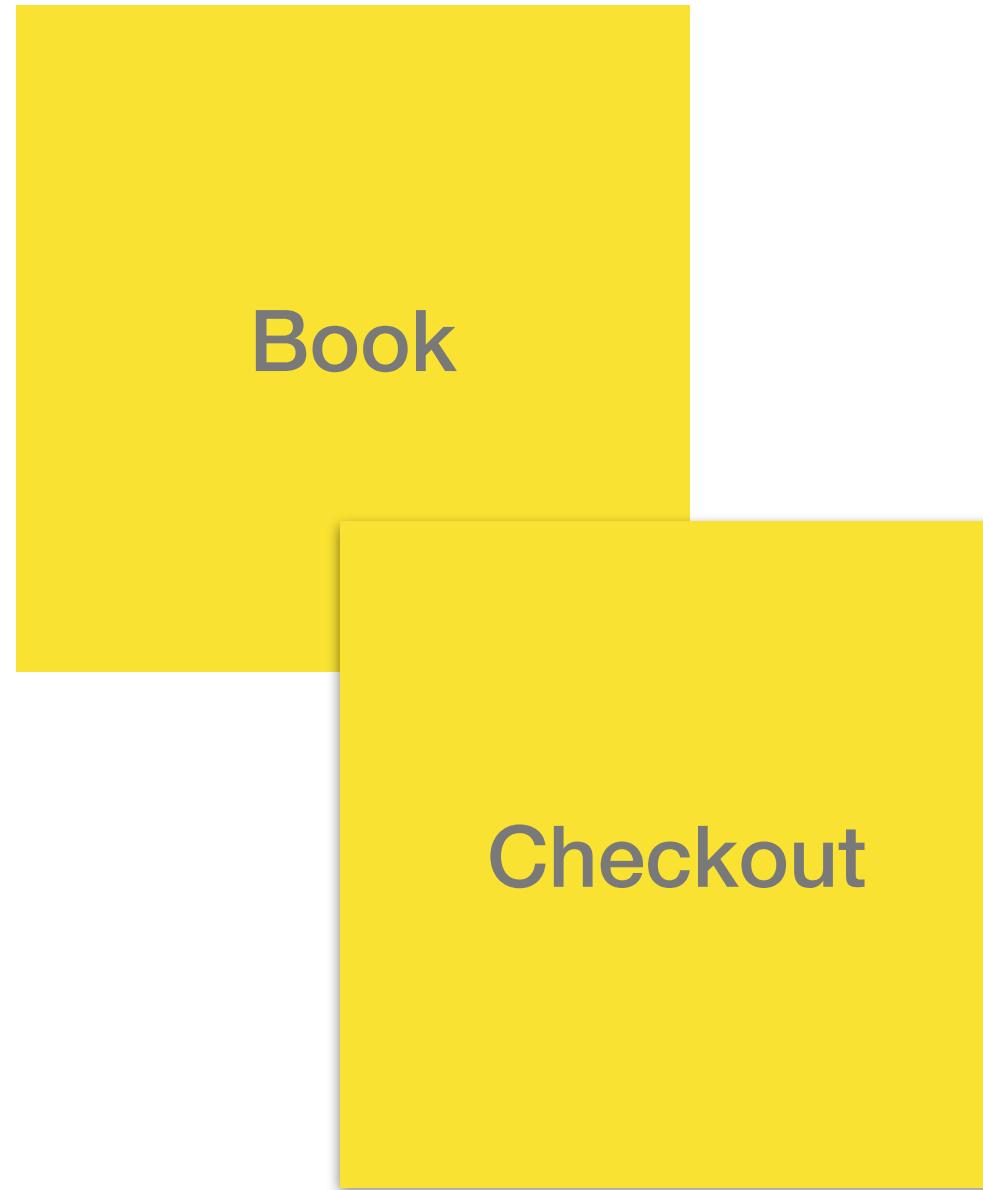
Book

Think of it like a state machine

Tip: Group things first, before trying to name the aggregate

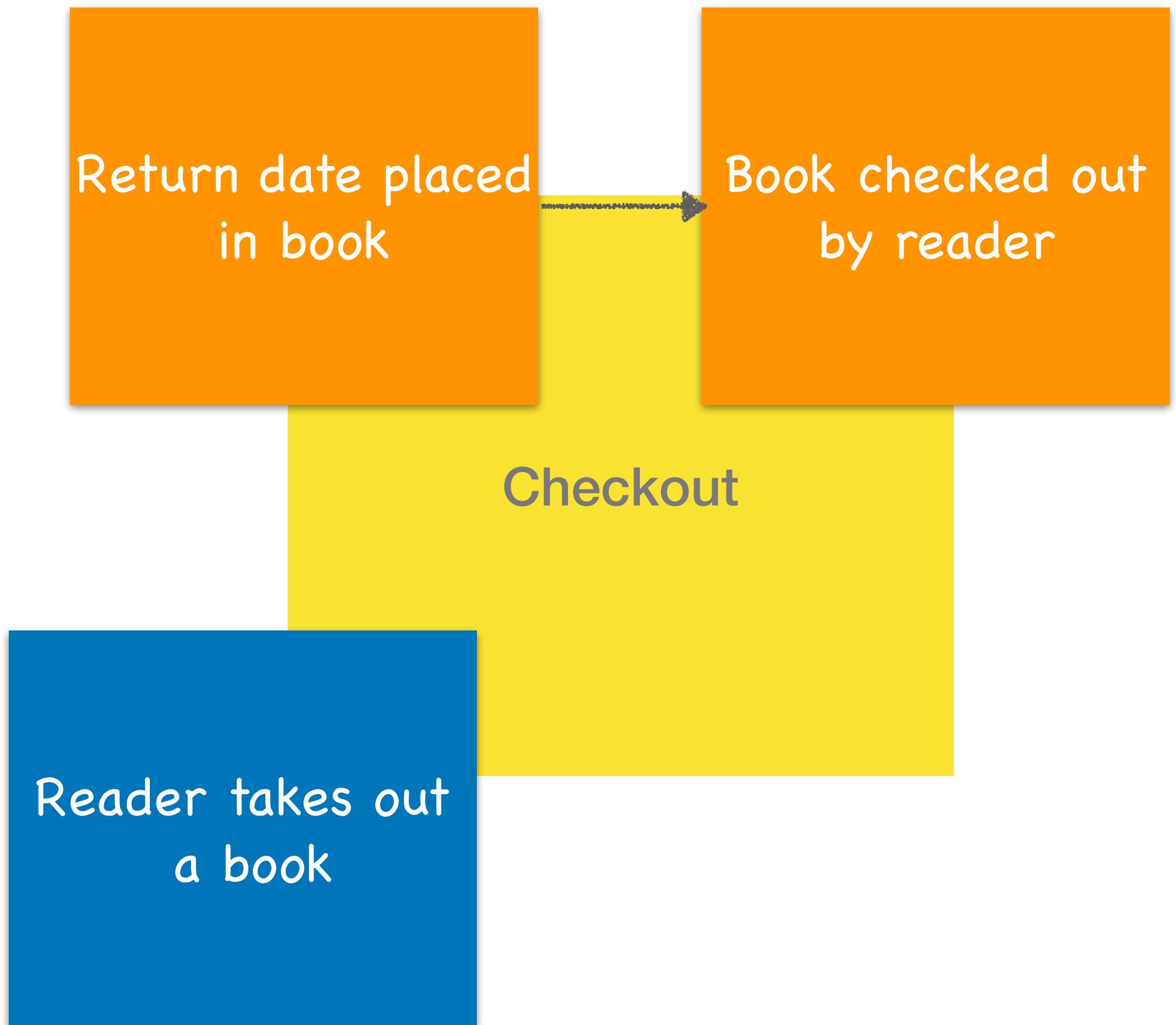
Aggregate

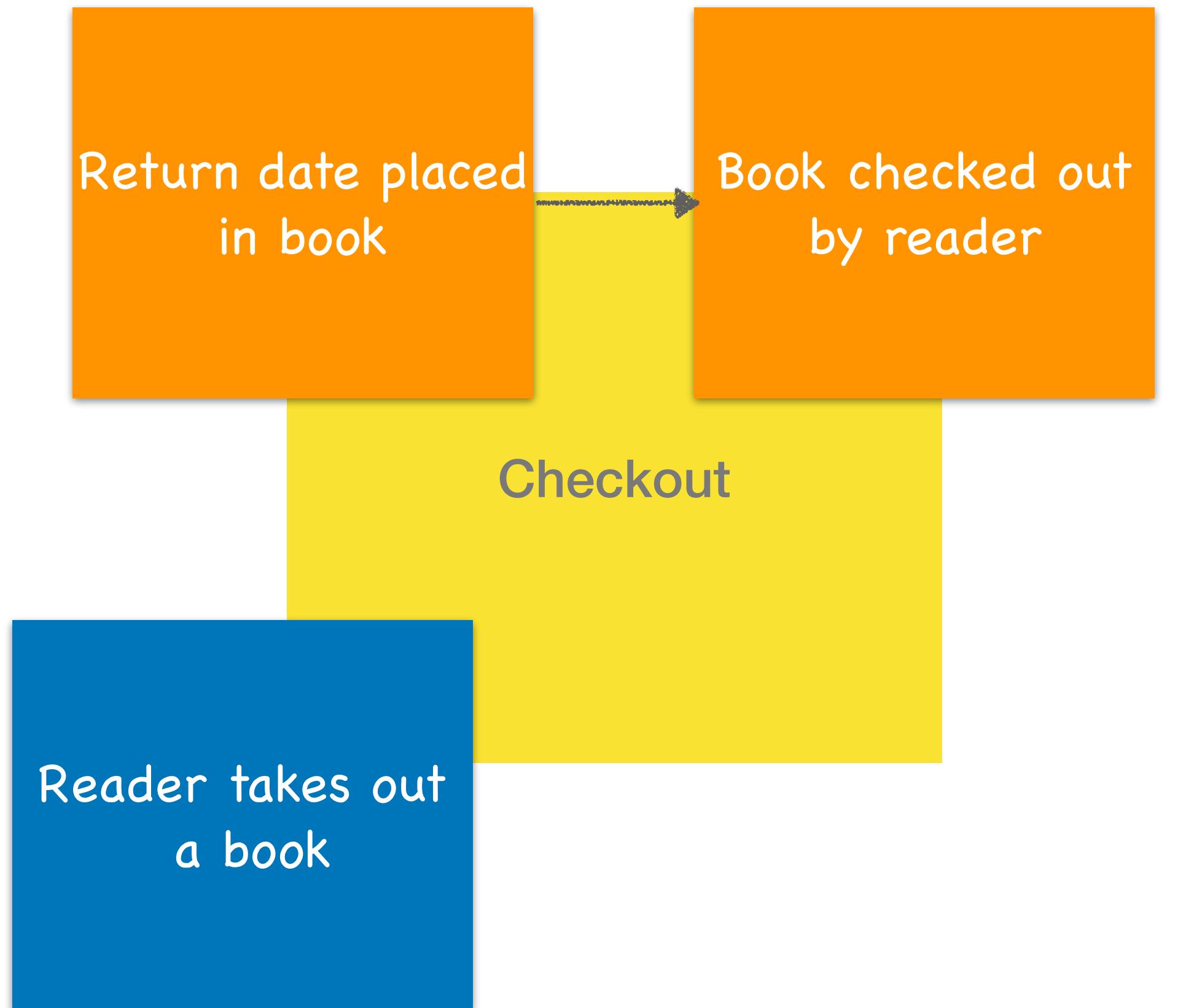
A group of commands and events



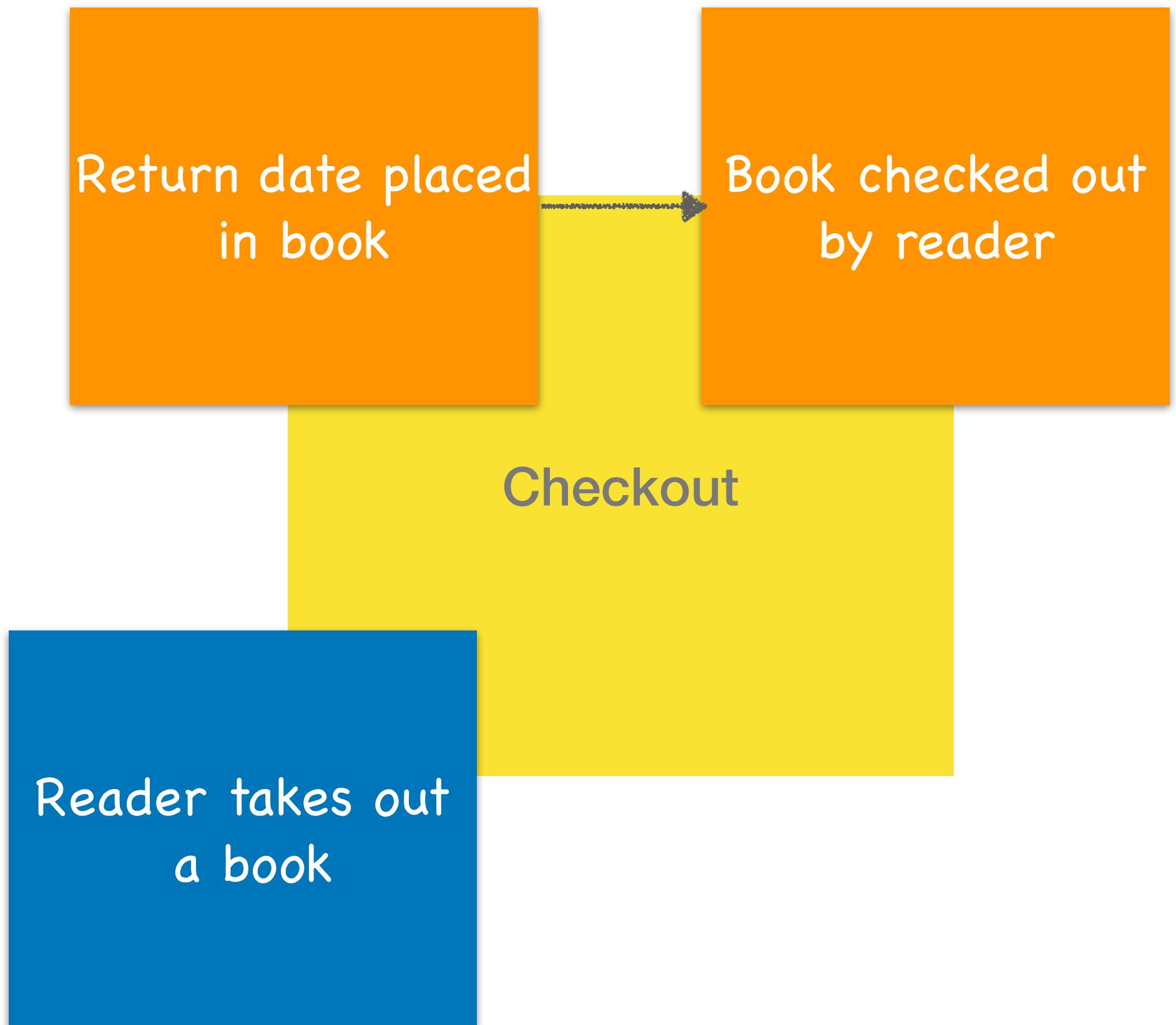
Think of it like a state machine

Tip: Group things first, before trying to name the aggregate



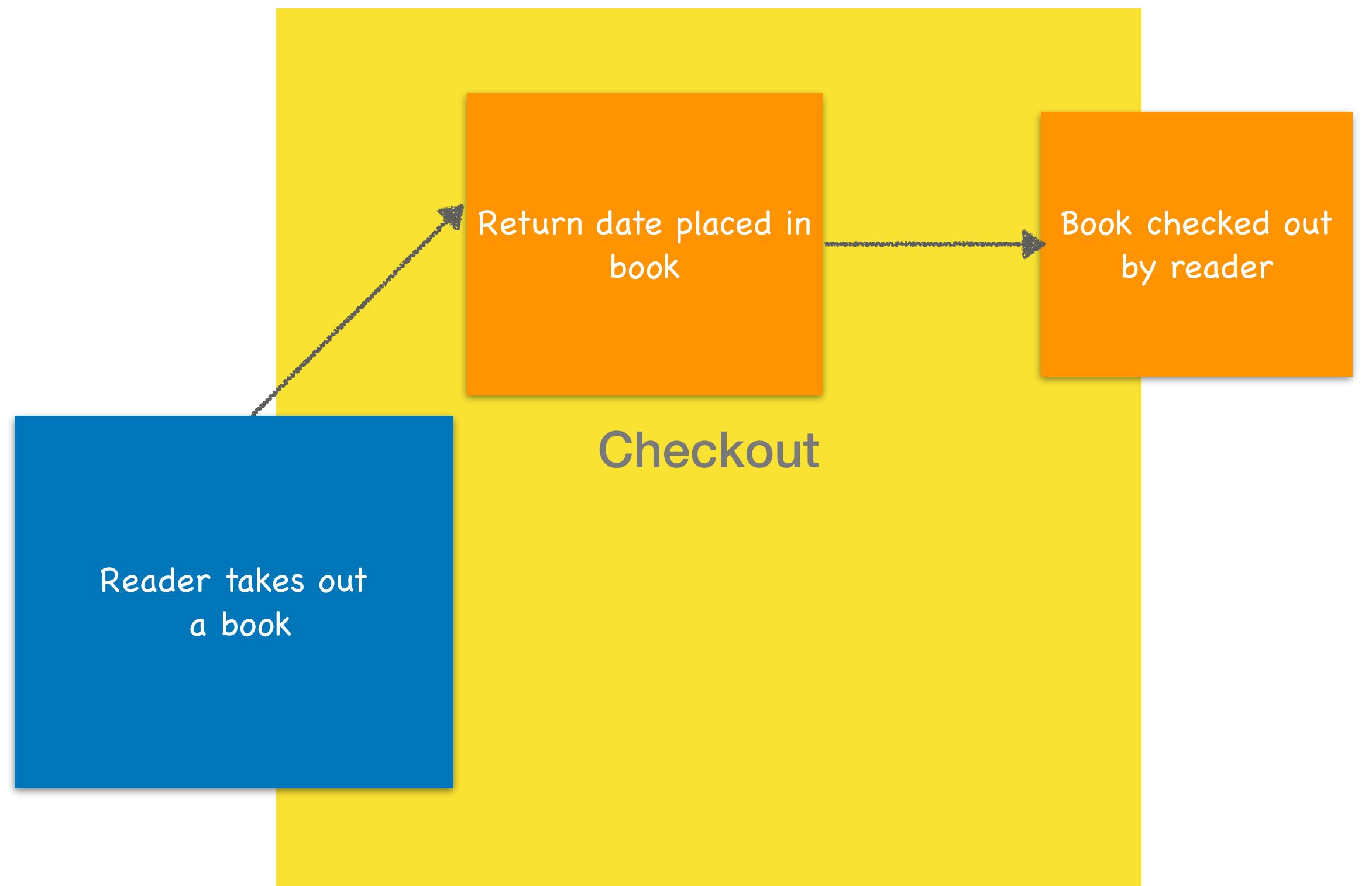


Moving more into implementation

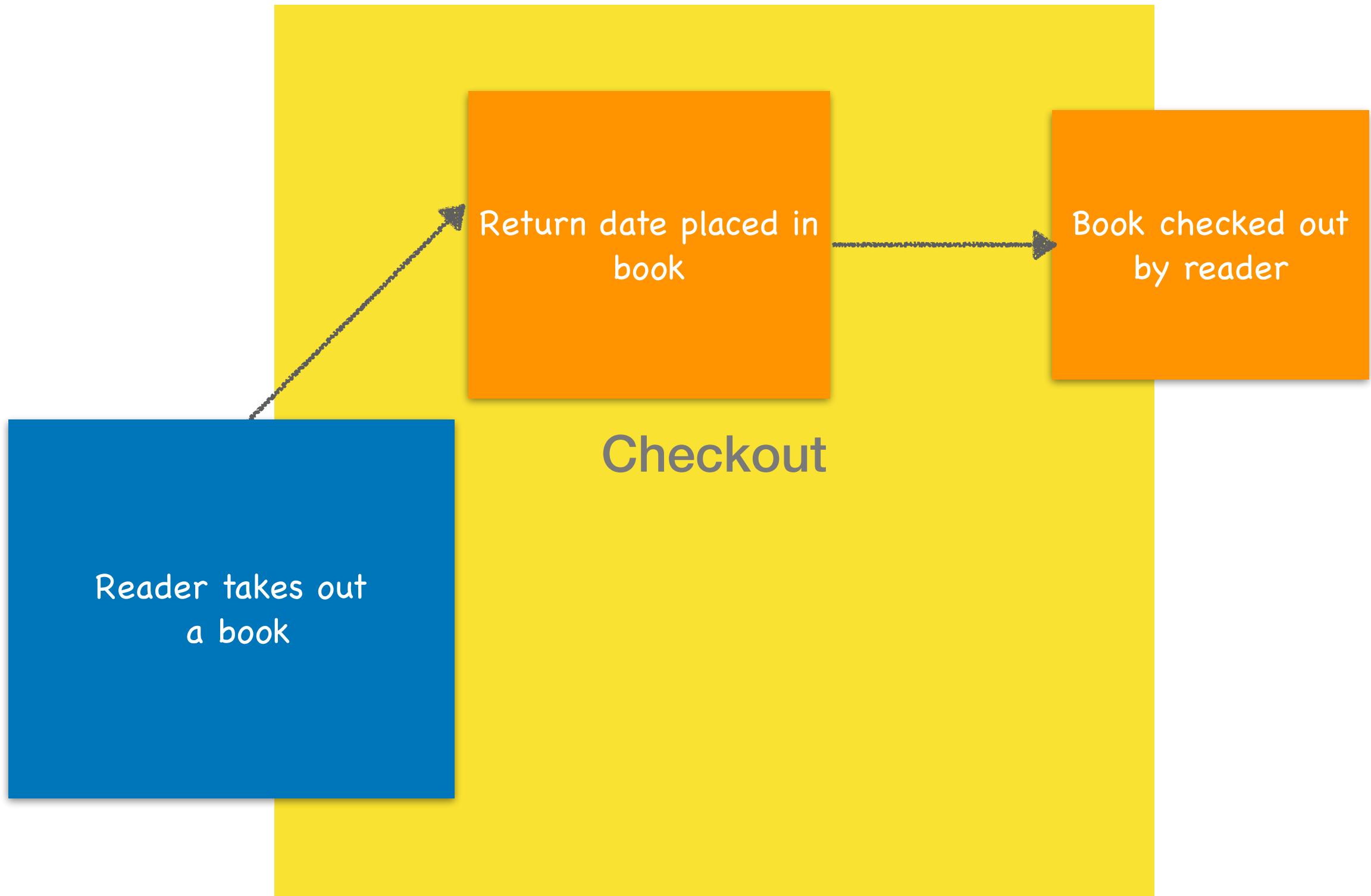


Moving more into implementation

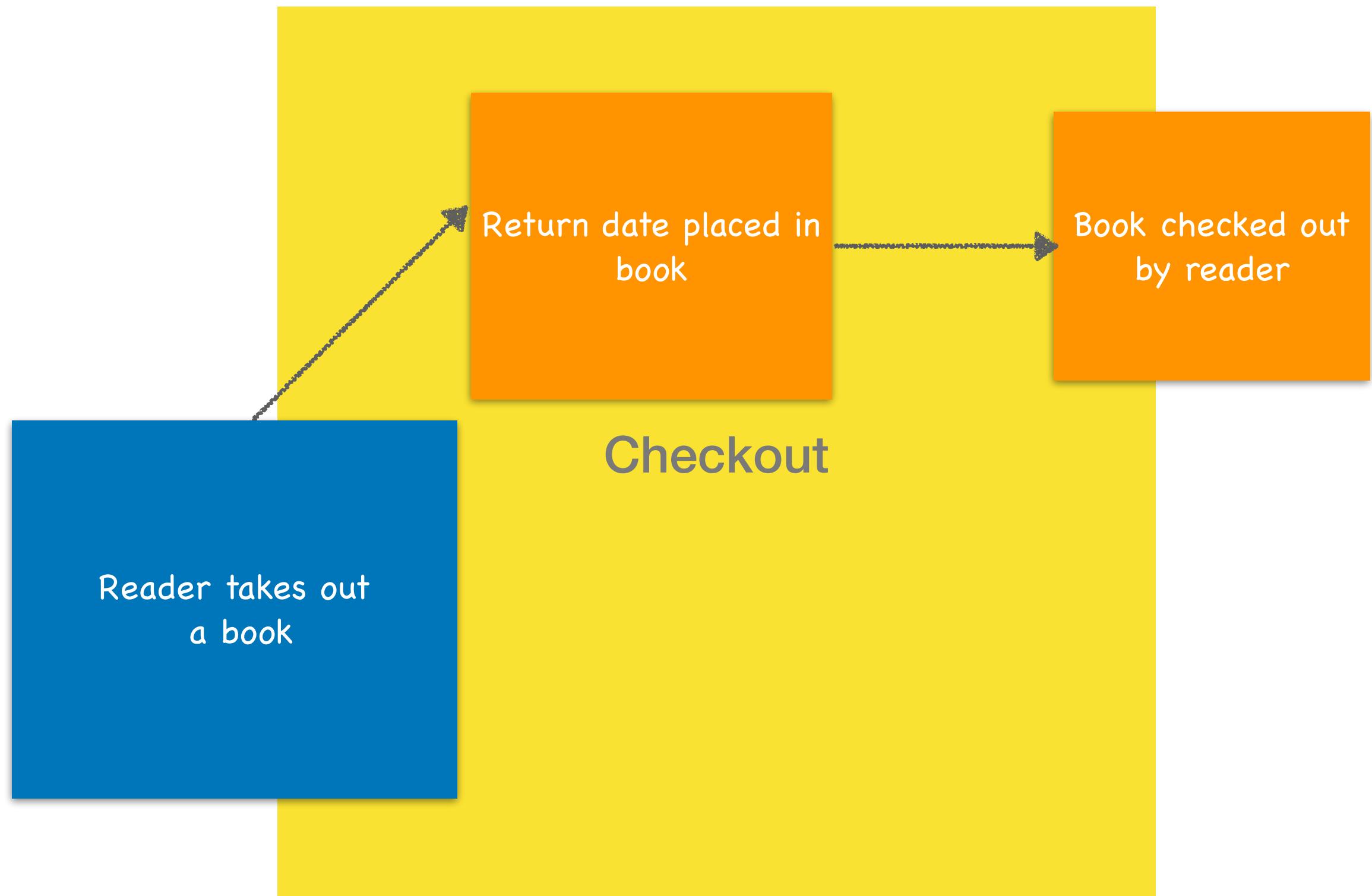
You may be able to break aggregates down into smaller pieces over time



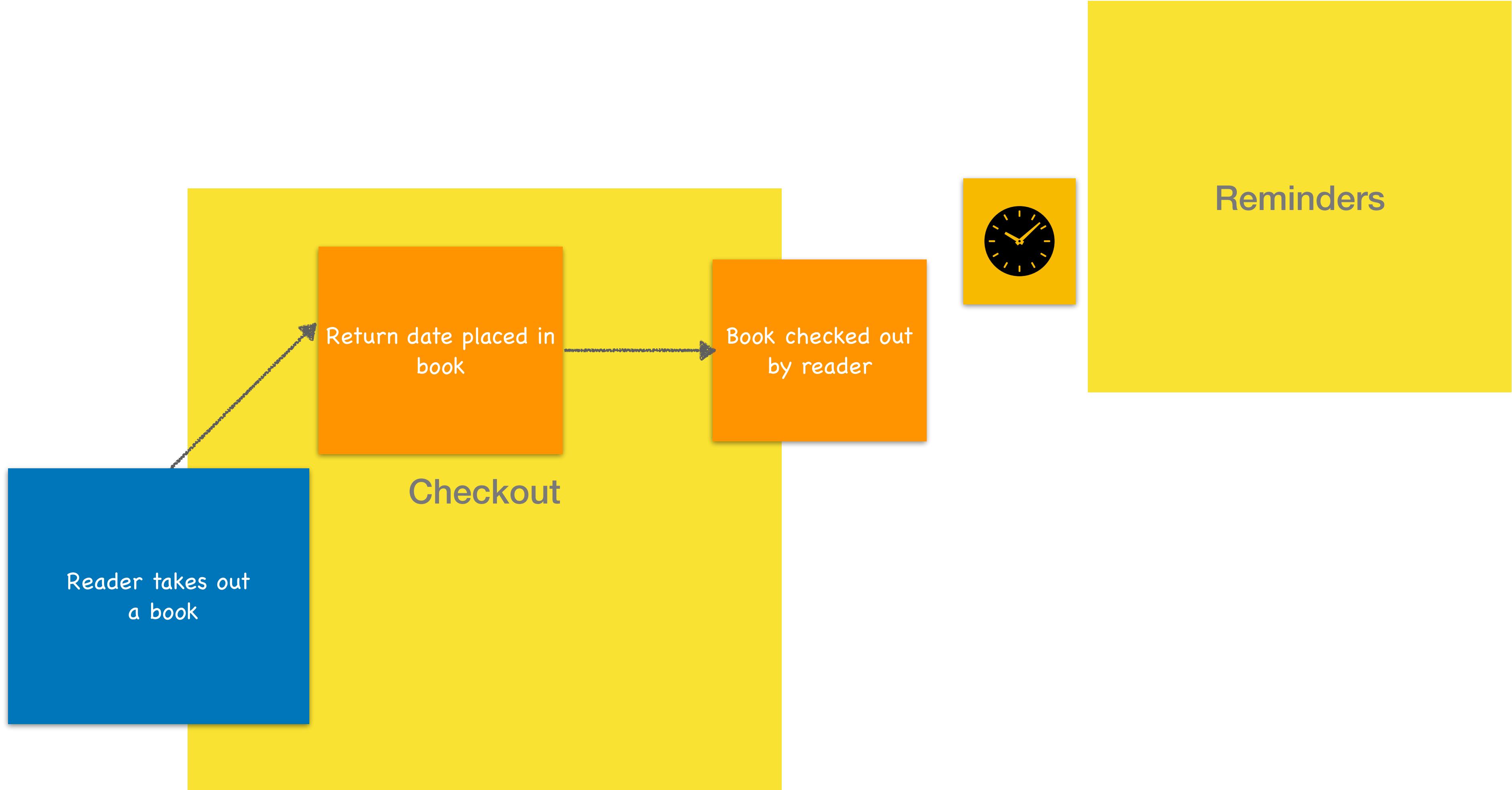
**Some events only exist
inside the aggregate**

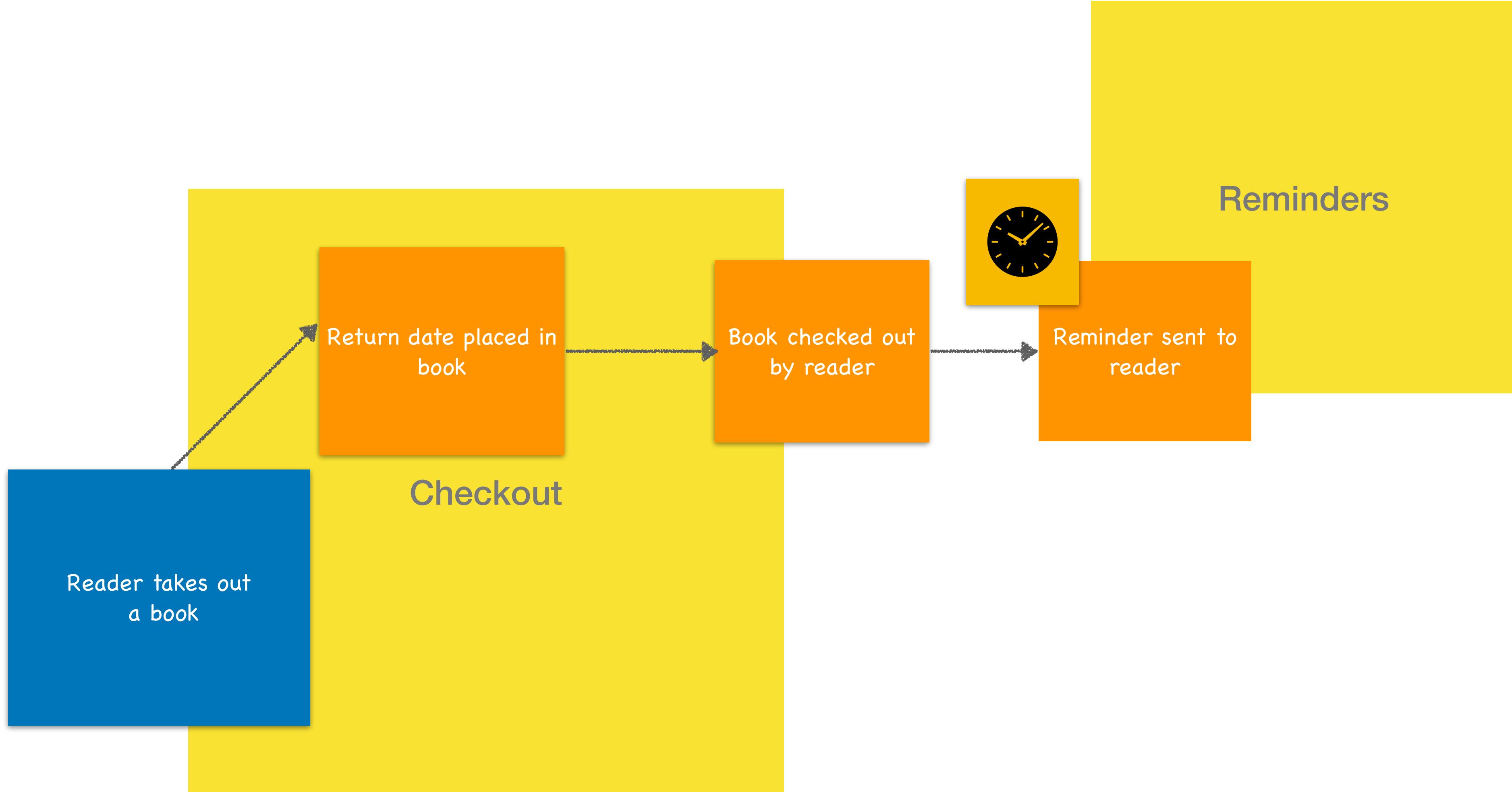


**Some events only exist
inside the aggregate**



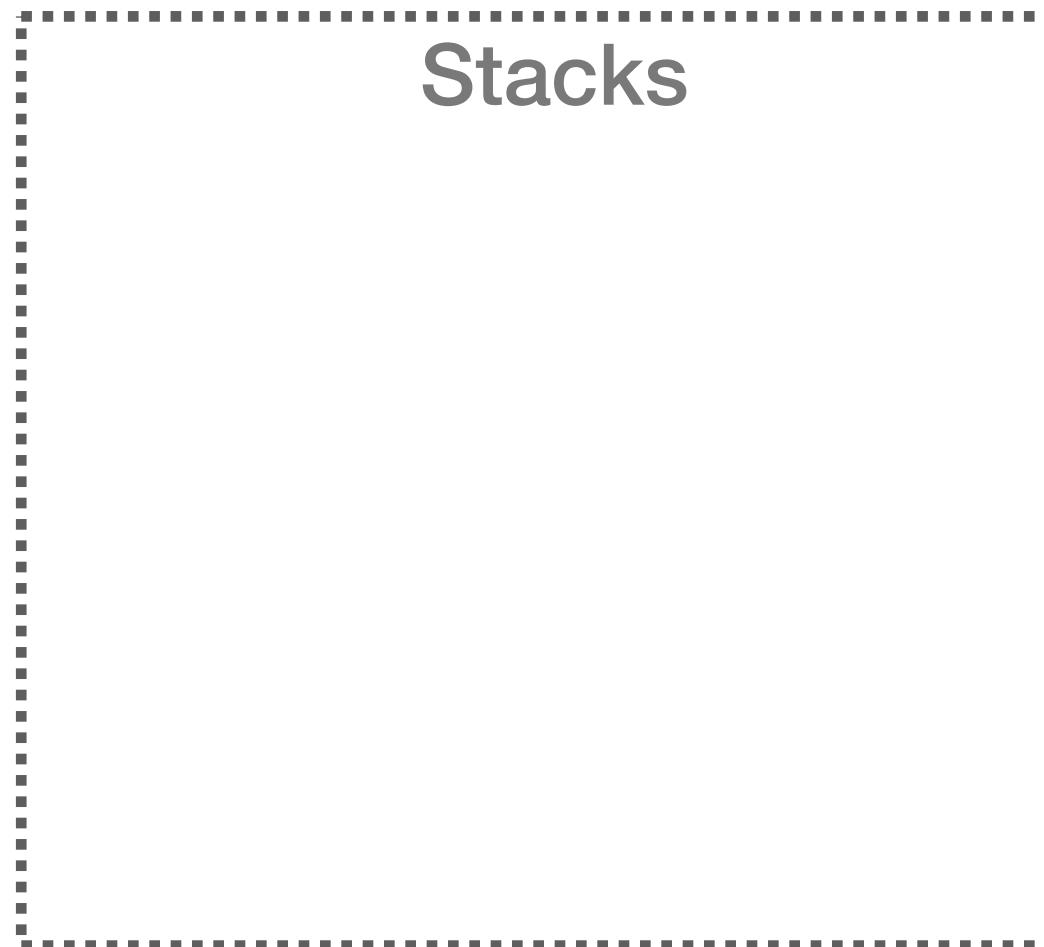
**Other events span
aggregates (Domain Events)**





Bounded Contexts

A group of aggregates



Bounded Contexts

A group of aggregates

Stacks

Useful for larger models

Bounded Contexts

A group of aggregates

Stacks

Useful for larger models

May have local language

Bounded Contexts

A group of aggregates

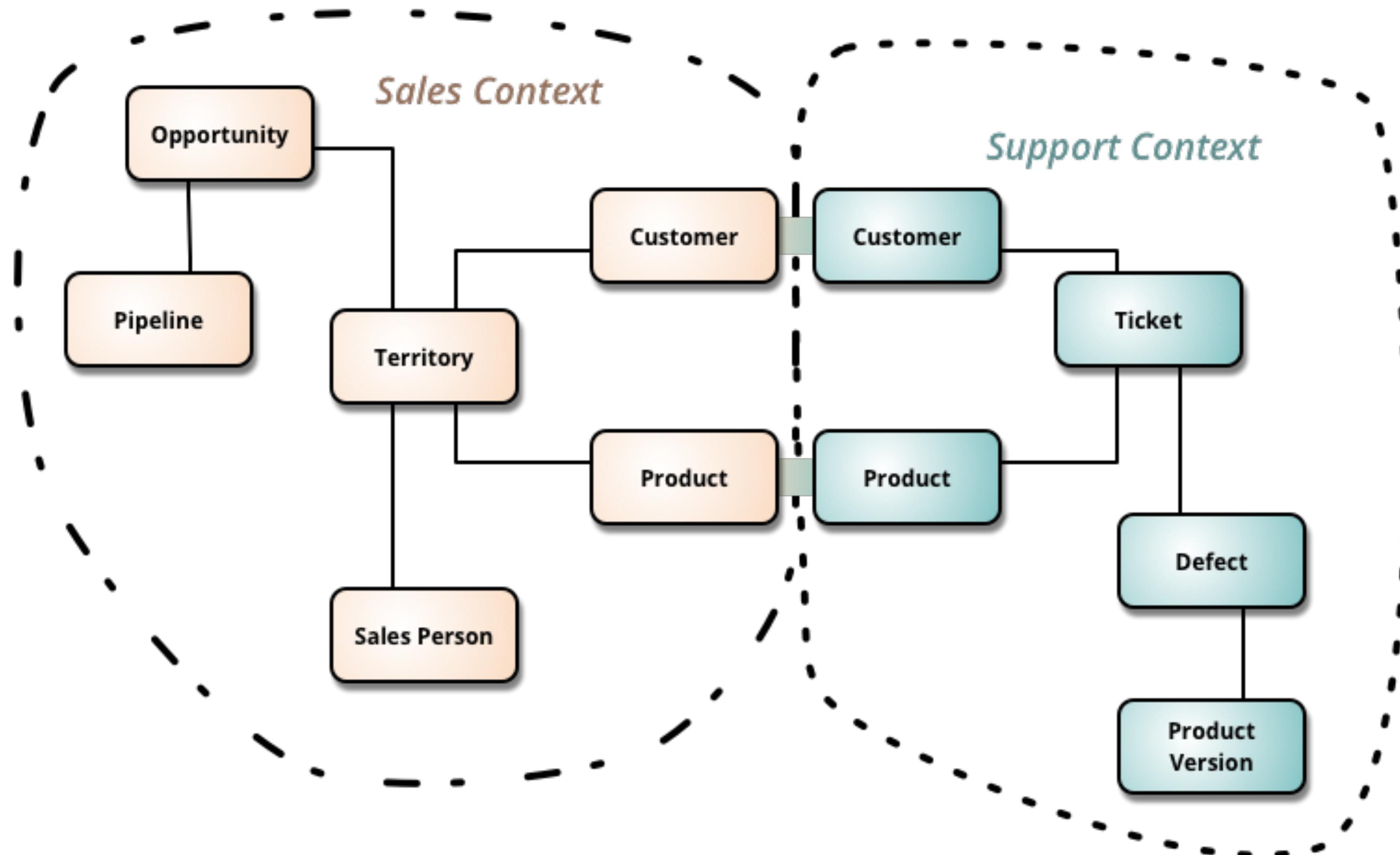
Stacks

Useful for larger models

May have local language

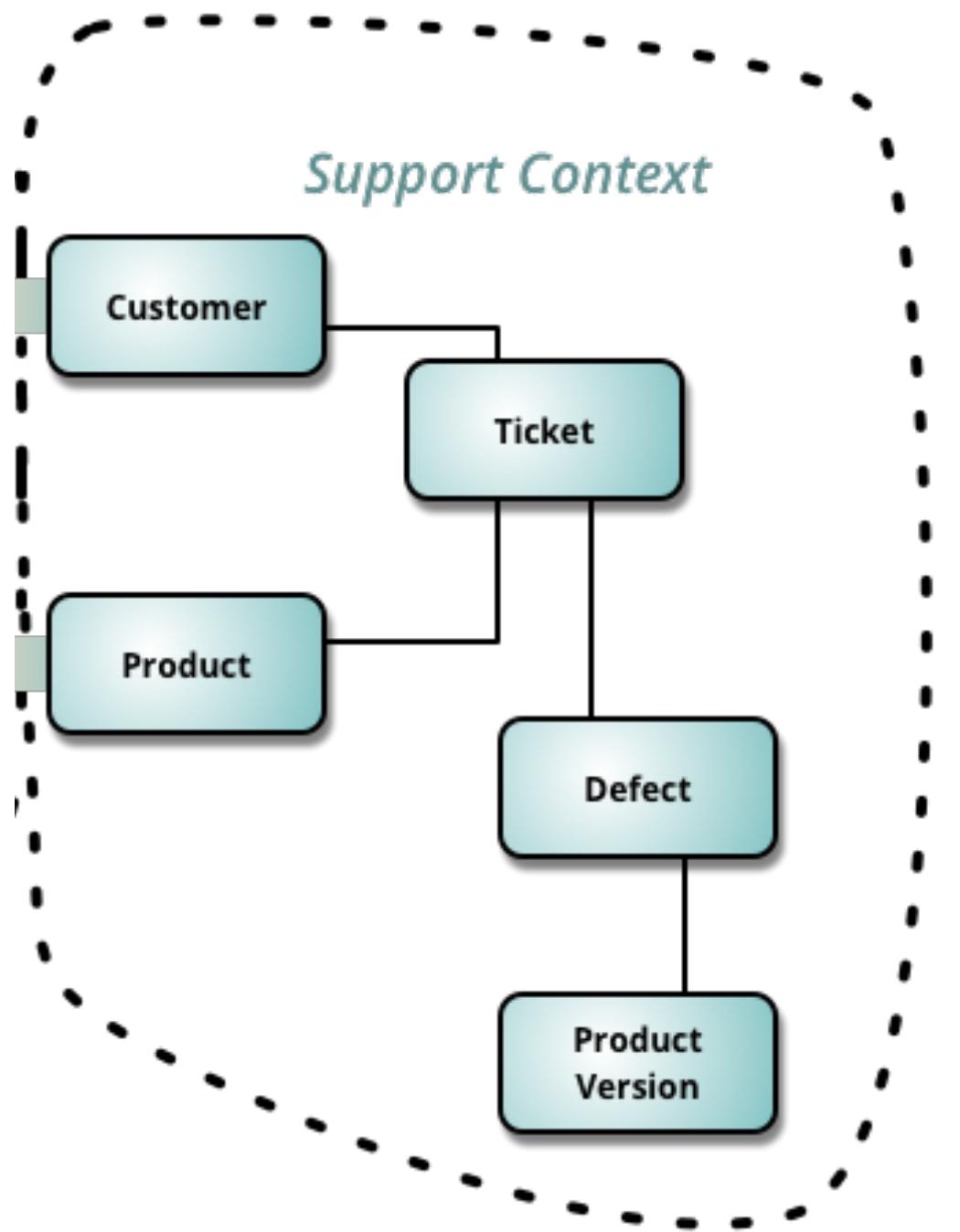
Well defined boundaries with
other bounded contexts

BOUNDED CONTEXTS

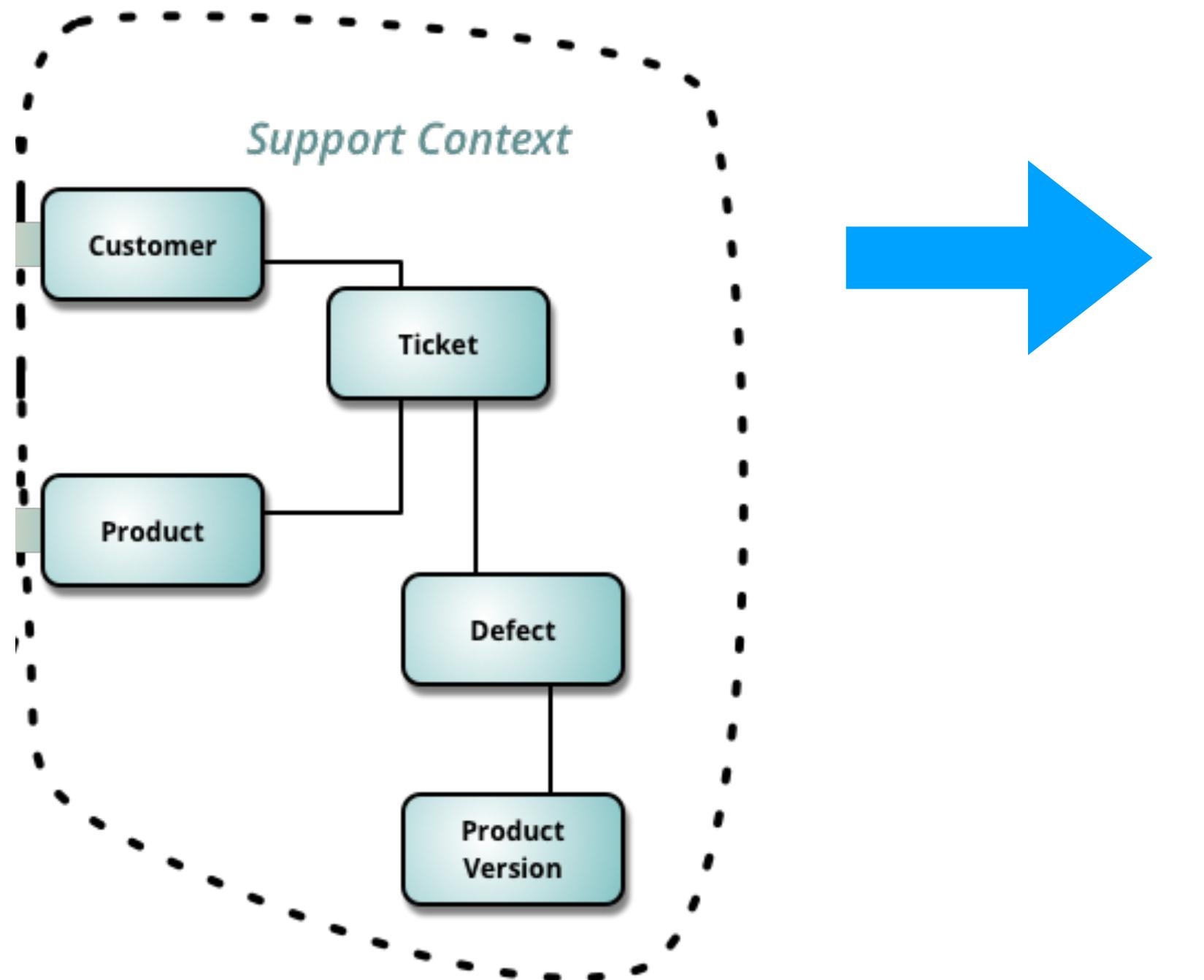


<https://martinfowler.com/bliki/BoundedContext.html>

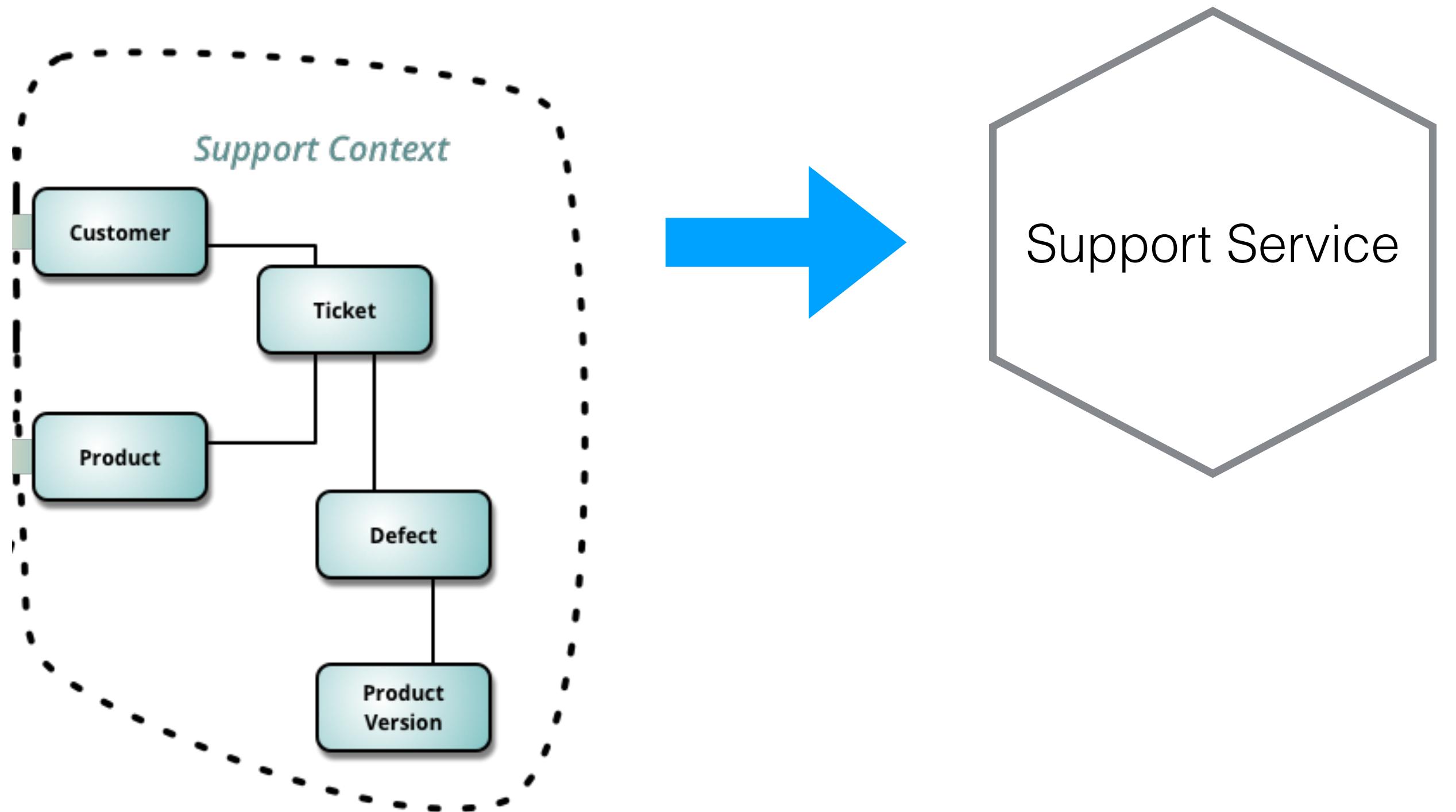
MAPPING TO MICROSERVICES?



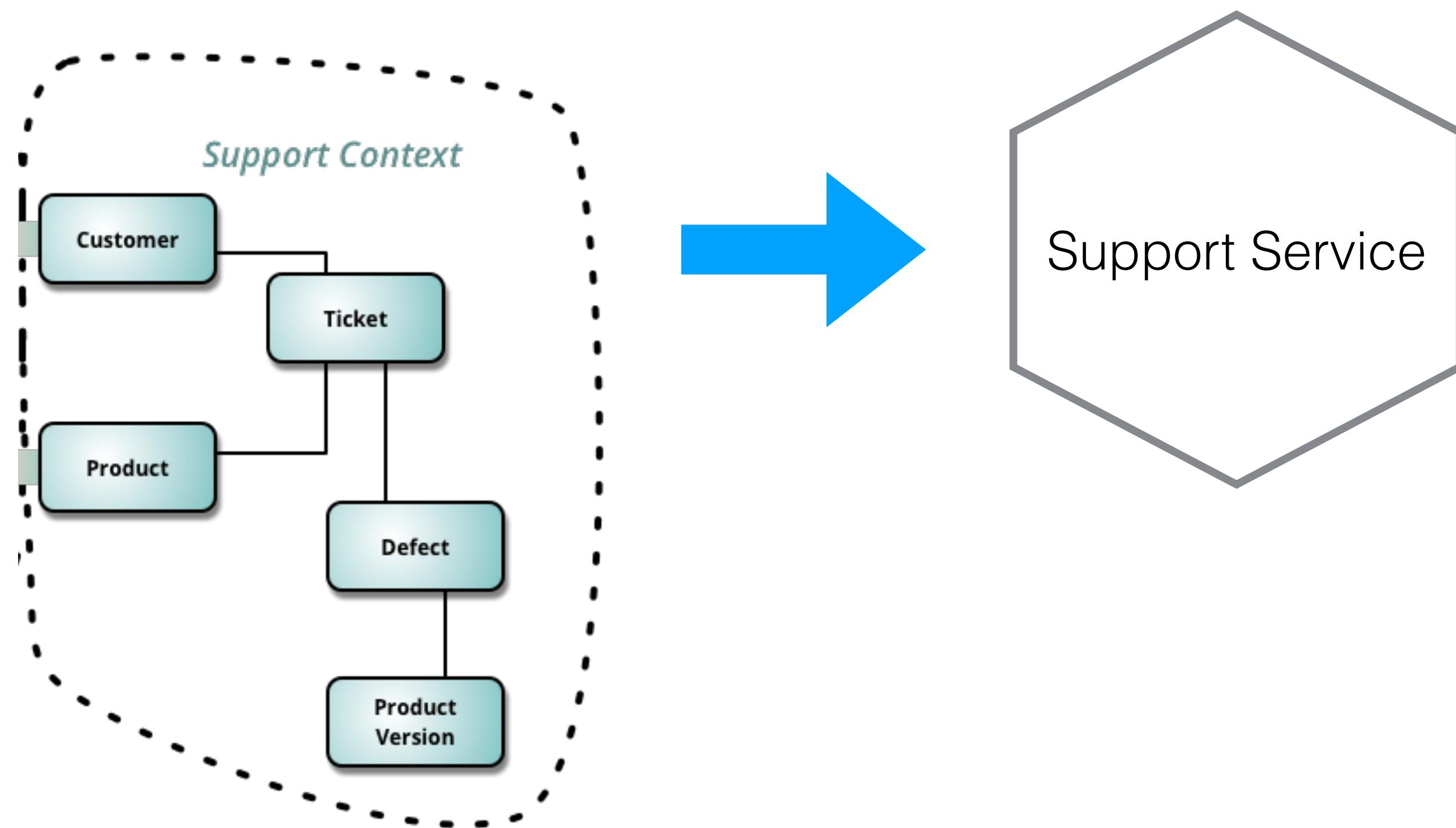
MAPPING TO MICROSERVICES?



MAPPING TO MICROSERVICES?

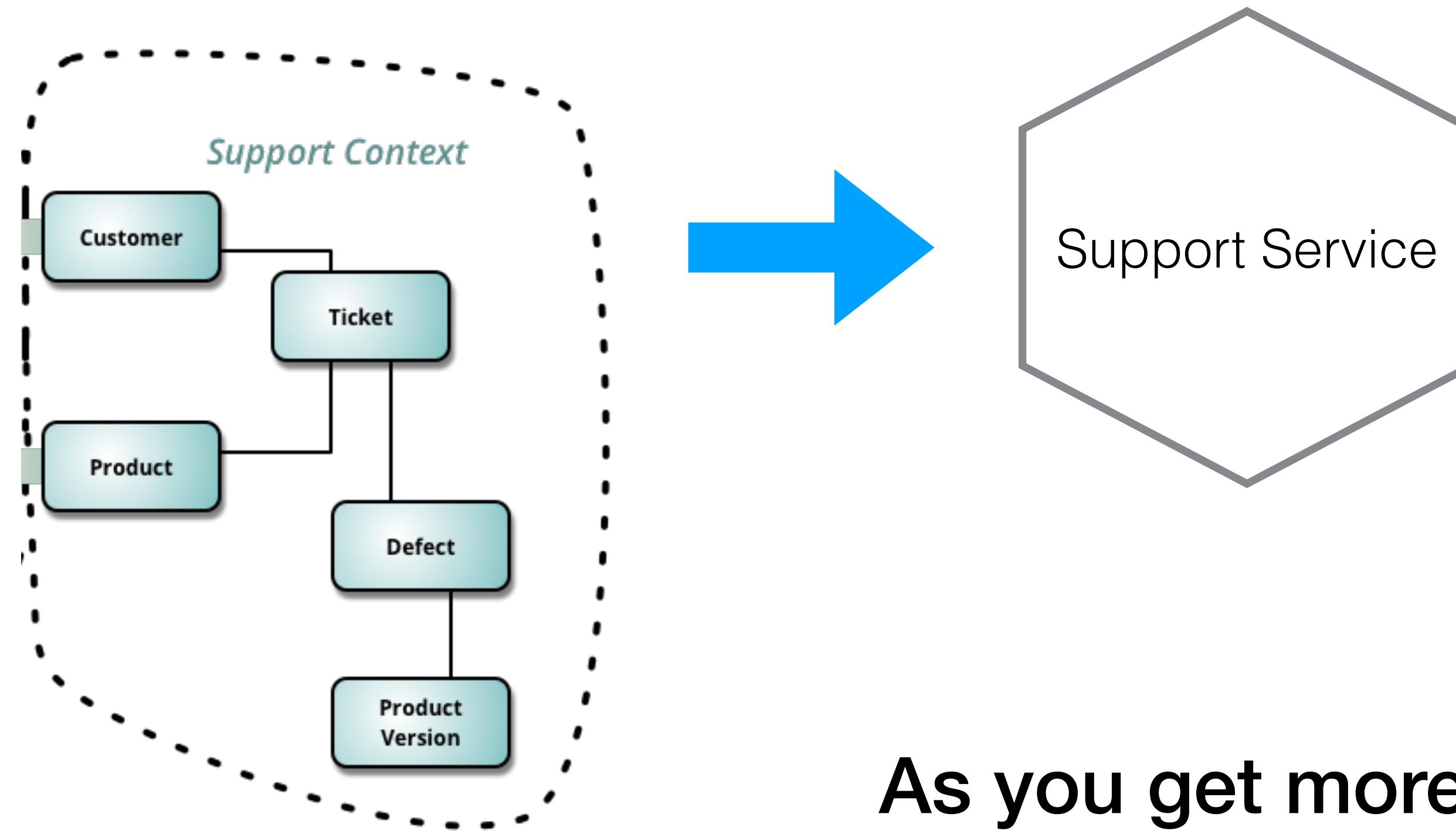


MAPPING TO MICROSERVICES?



**Mapping bounded contexts
to microservices is a good
starting point**

MAPPING TO MICROSERVICES?



**Mapping bounded contexts
to microservices is a good
starting point**

**As you get more confident you might get
more fine-grained...**

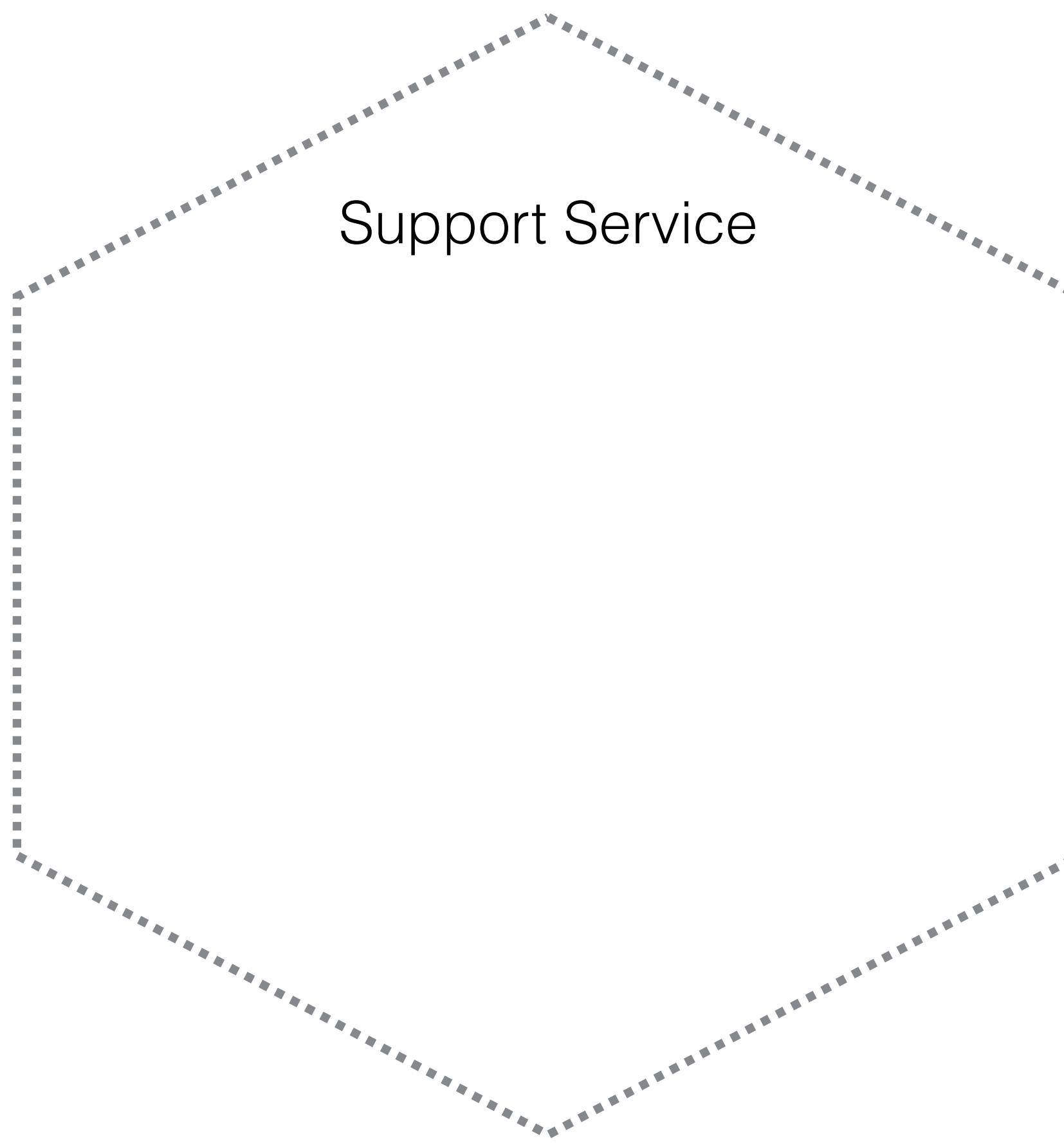
GETTING FINER-GRAINED

GETTING FINER-GRAINED

Can break down
around aggregate
boundaries

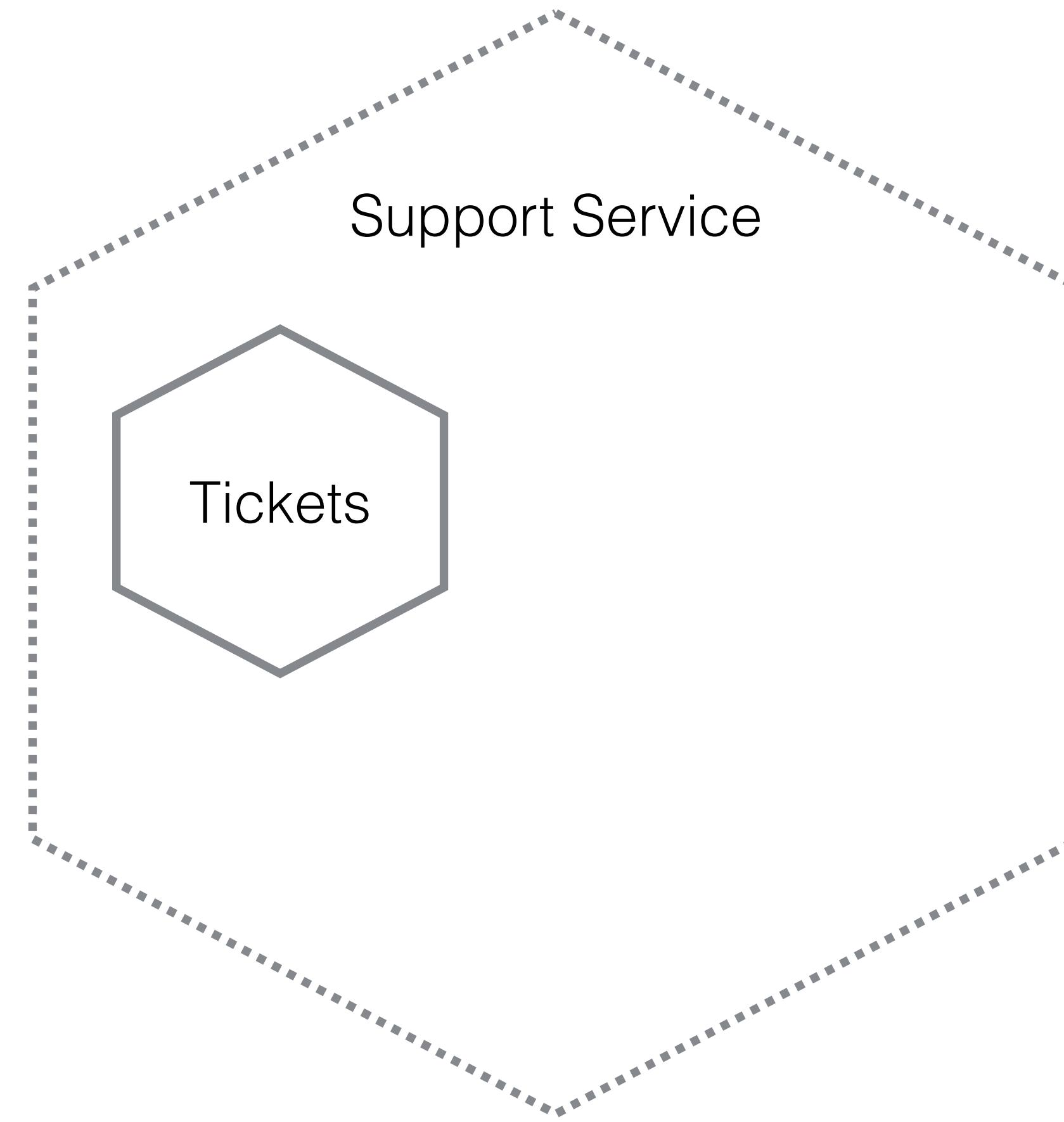
GETTING FINER-GRAINED

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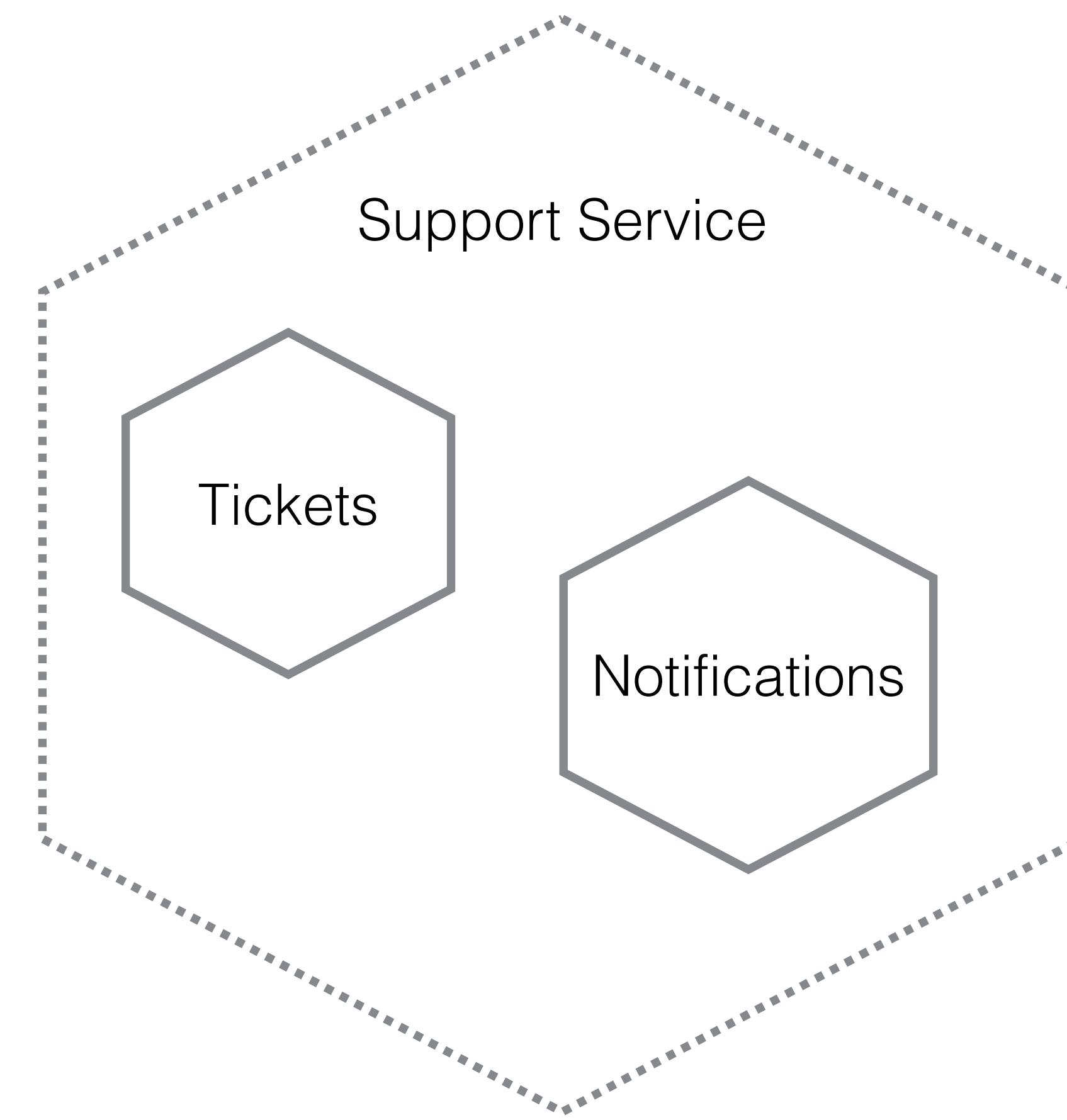
GETTING FINER-GRAINED

Can break down
around aggregate
boundaries



GETTING FINER-GRAINED

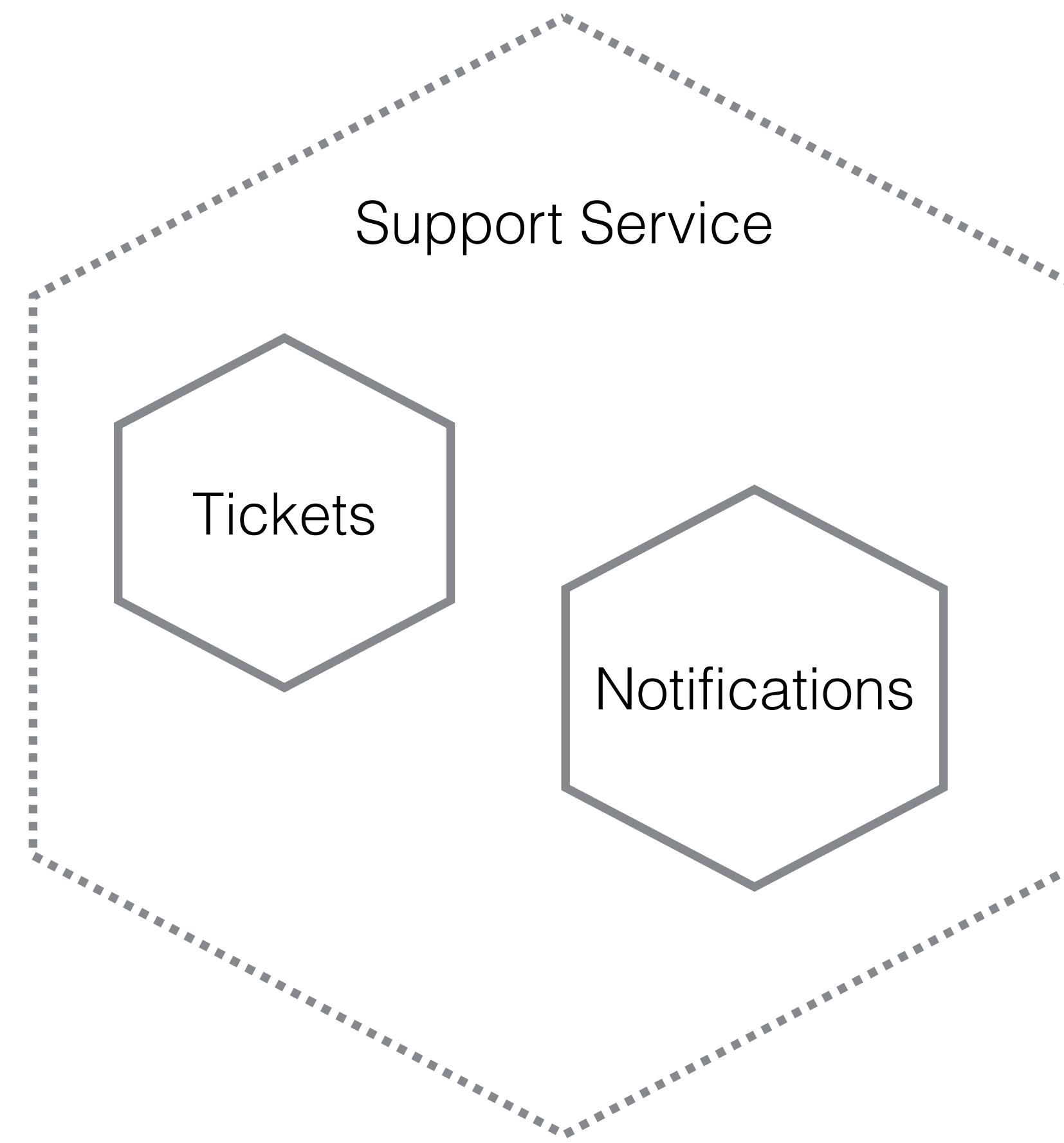
Can break down
around aggregate
boundaries



GETTING FINER-GRAINED

Can break down
around aggregate
boundaries

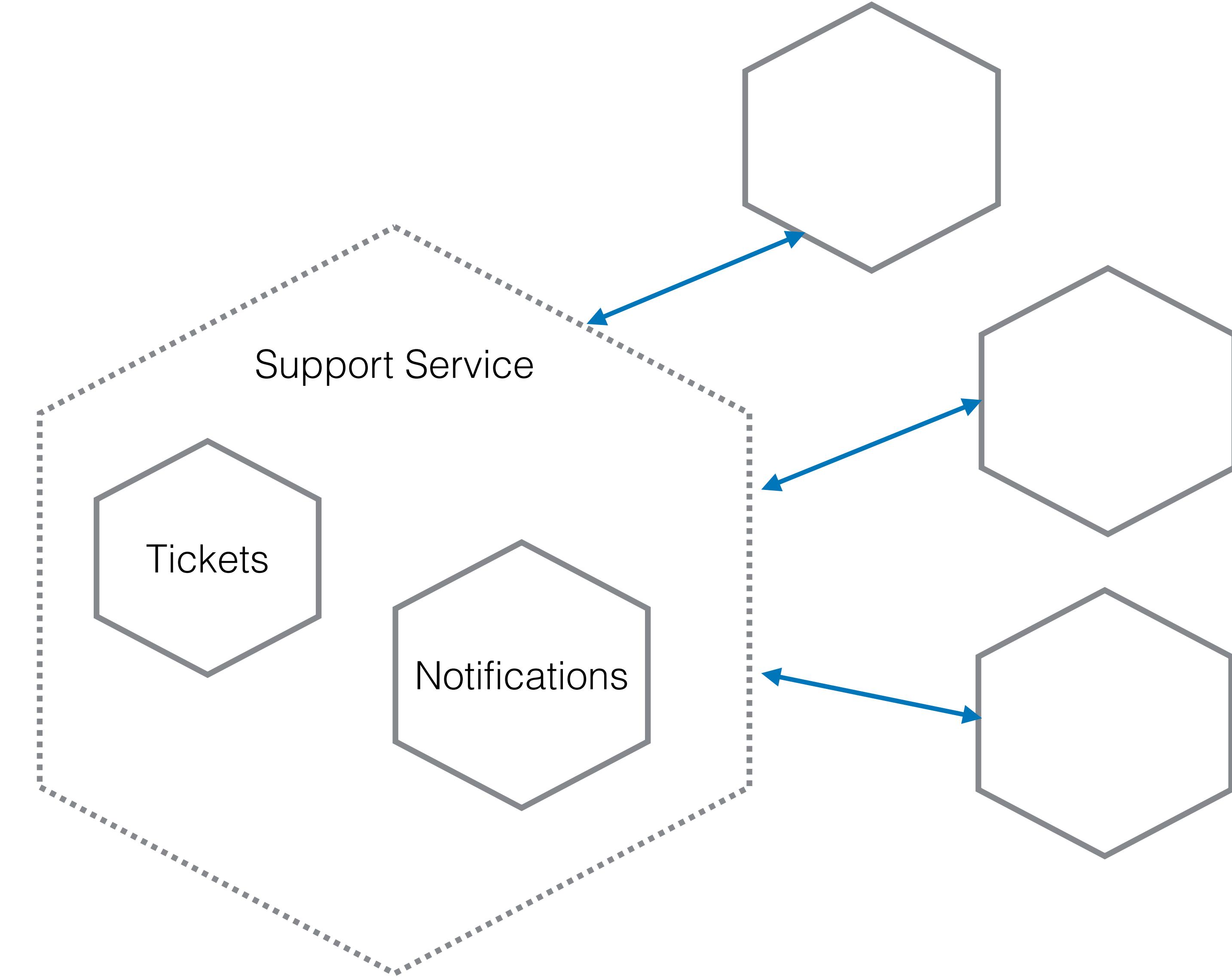
Keep the higher-
level abstraction
for outside parties



GETTING FINER-GRAINED

Can break down
around aggregate
boundaries

Keep the higher-
level abstraction
for outside parties



When wouldn't you use microservices?

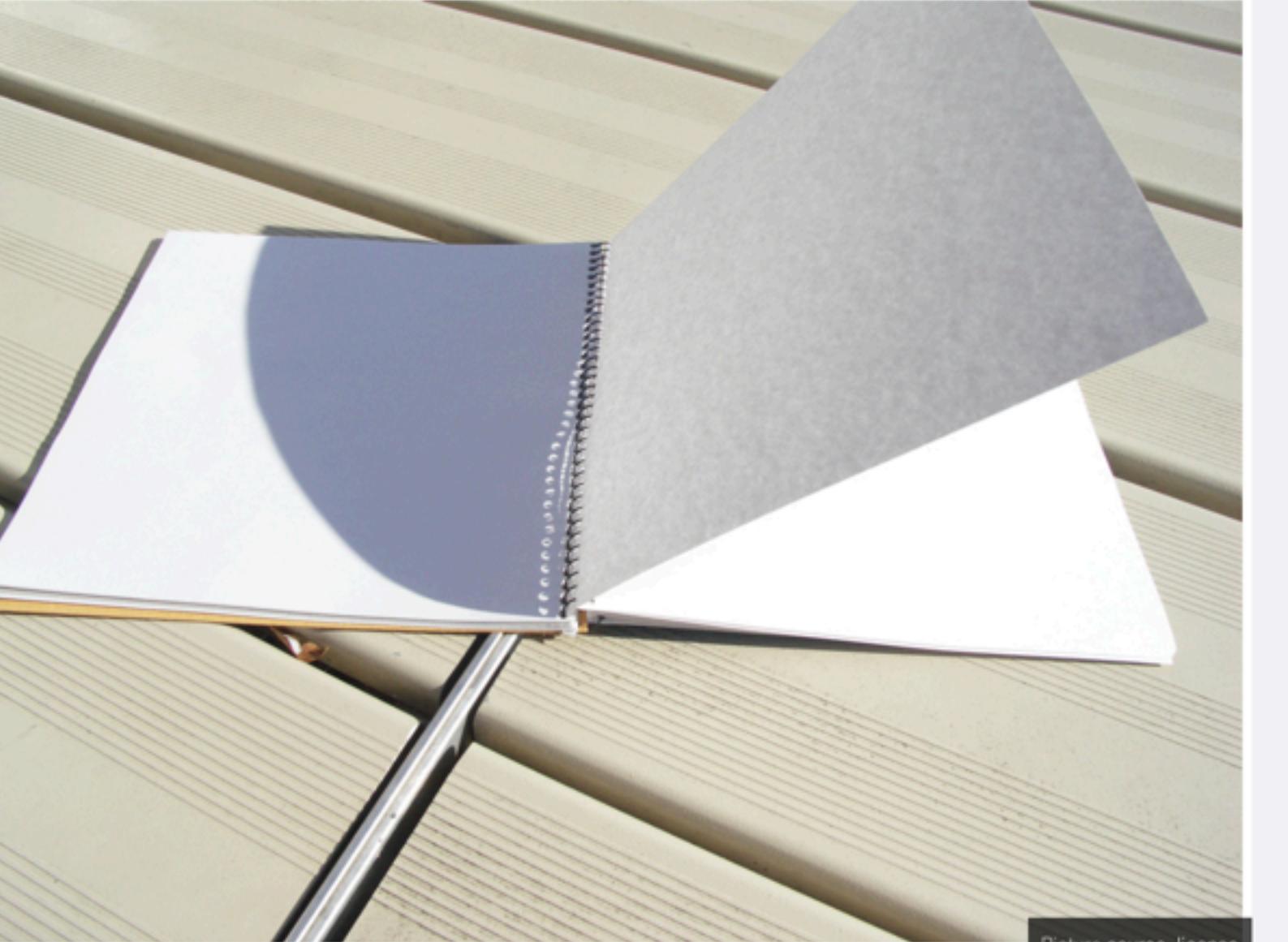
FOR STARTUPS/BRAND NEW PRODUCTS

Sam Newman & Associates

Home About Offerings Events **Writing** Contact

Microservices For Greenfield? .

Posted on Apr 7 2015



Picture source, license

I was having a chat with a colleague recently about the project (codename: Asterix) that they were working

Book! .



O'REILLY
Building Microservices
DESIGNING FINE-GAINED SYSTEMS
Sam Newman

I have written a book called "Building Microservices", which is available now. Want to know more? → [Read on...](#)

Video! .



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<https://samnewman.io/blog/2015/04/07/microservices-for-greenfield/>

FOR STARTUPS/BRAND NEW PRODUCTS

The screenshot shows a website header for "Sam Newman & Associates" with a green hexagonal logo. The navigation menu includes Home, About, Offerings, Events, Writing (which is highlighted in green), and Contact. Below the menu, a blog post titled "Microservices For Greenfield?" is displayed. The post is dated "Posted on Apr 7 2015". It features a large image of a stack of books, with one book standing upright showing its cover. A caption below the image reads: "I was having a chat with a colleague recently about the project (codename: Asterix) that they were working on." To the right of the image, there is a section titled "Book!" with a thumbnail of the book "Building Microservices" by Sam Newman. Below this, a text block says: "I have written a book called \"Building Microservices\", which is available now. Want to know more? [Read on...](#)". There is also a "Video!" section with a thumbnail for "The Principles of Microservices".

For domains that are still evolving, it can be hard to find boundaries

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FOR STARTUPS/BRAND NEW PRODUCTS

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For domains that are still evolving, it can be hard to find boundaries

For startups, you should be focusing on other things (like finding market fit)

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Customer-installed software

When you don't have a good reason

Poll

**Based on what you've learned today...do you still think
you should be using microservices?**

Poll

Based on what you've learned today...do you still think you should be using microservices?

a.) I don't think microservices are right for us!

Poll

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Based on what you've learned today...do you still think you should be using microservices?

- a.) I don't think microservices are right for us!
- b.) I think microservices are a good fit

Poll

Based on what you've learned today...do you still think you should be using microservices?

- a.) I don't think microservices are right for us!
- b.) I think microservices are a good fit

Poll

Based on what you've learned today...do you still think you should be using microservices?

- a.) I don't think microservices are right for us!
- b.) I think microservices are a good fit
- c.) I don't know!

SUMMARY

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Microservices are all about independent deployability

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As you get better at managing them, you can have more services - and those services will cover less scope

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Information hiding is key to reduce coupling

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Microservices are all about independent deployability

As you get better at managing them, you can have more services - and those services will cover less scope

Information hiding is key to reduce coupling

Use domain-driven design to find service boundaries

THANKS!

Sam Newman & Associates



Home About Offerings Events **Writing** Contact

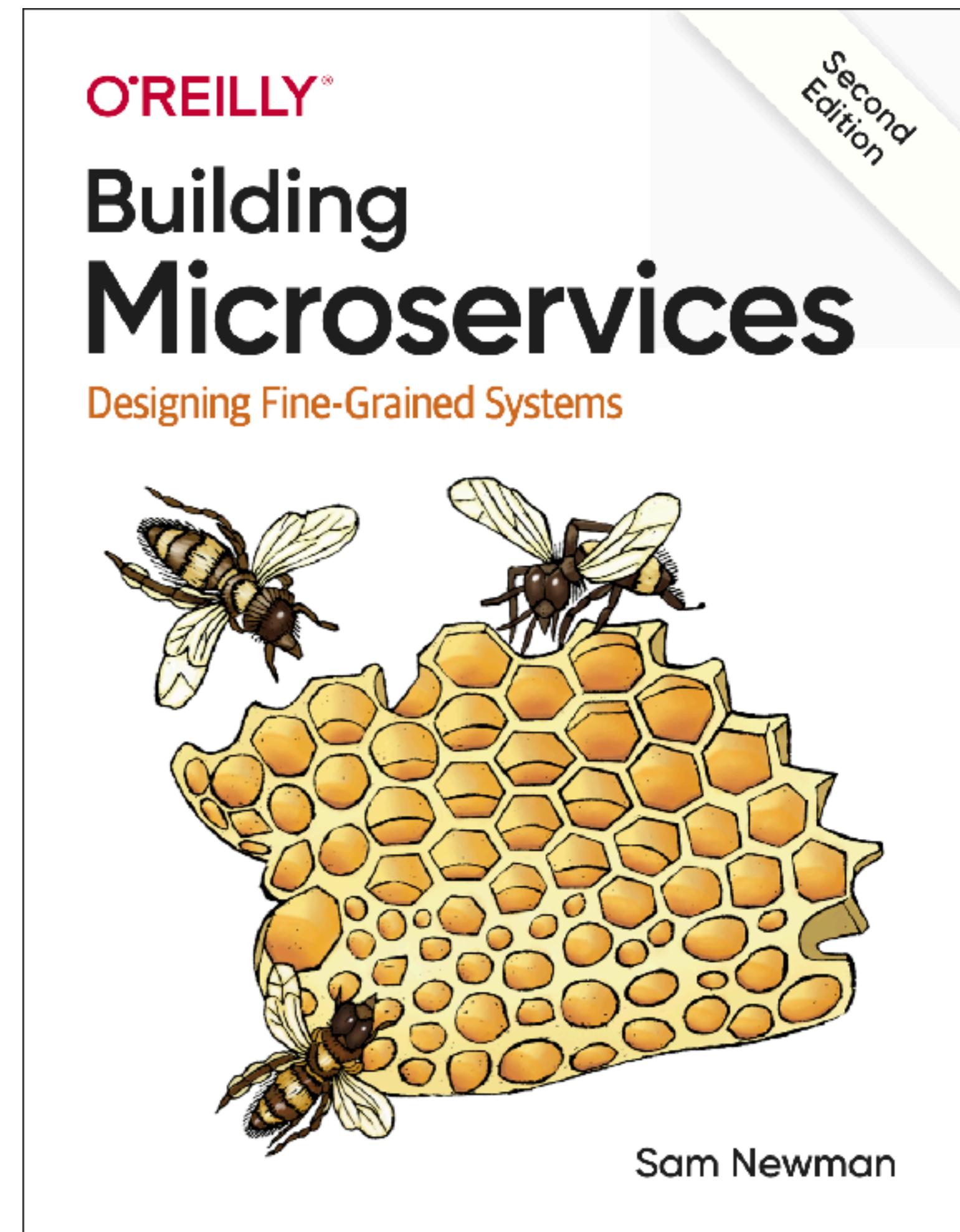
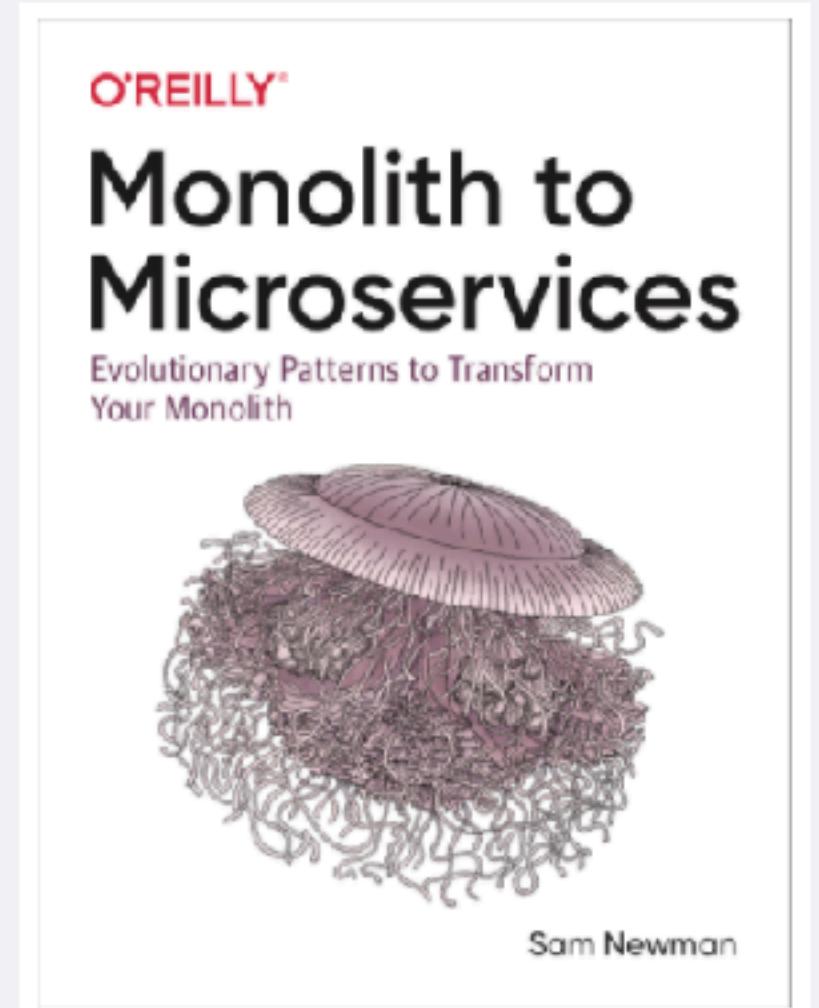
Monolith To Microservices.

Released on 2019-09-04 by O'Reilly

Monolith To Microservices is a new book on system decomposition from O'Reilly

If you're interested in migrating your existing systems to microservice architectures, or are struggling with services that are too big, then this book is for you

[→ Find Out More](#)



<https://samnewman.io/>