Clean Architecture

Patterns, Practices, and Principles

@MatthewRenze

#CodeMash

Overview

1. Clean Architecture

Overview

1. Clean Architecture
2. Domain-Centric Architecture

Overview

1. Clean Architecture
2. Domain-Centric Architecture
3. Application Layer

Overview

1. Clean Architecture
2. Domain-Centric Architecture
3. Application Layer
4. Commands and Queries

Overview

1. Clean Architecture
2. Domain-Centric Architecture
3. Application Layer
4. Commands and Queries
5. Functional Organization

Overview

1. Clean Architecture
2. Domain-Centric Architecture
3. Application Layer
4. Commands and Queries
5. Functional Organization
6. Microservices

Focus

Enterprise Architecture

Focus

Enterprise Architecture

Modern equivalent of 3-Layer

Focus

Enterprise Architecture

Modern equivalent of 3-Layer

Generally applicable

Focus

Enterprise Architecture

Modern equivalent of 3-Layer

Generally applicable

6 Key Points

Focus

Enterprise Architecture

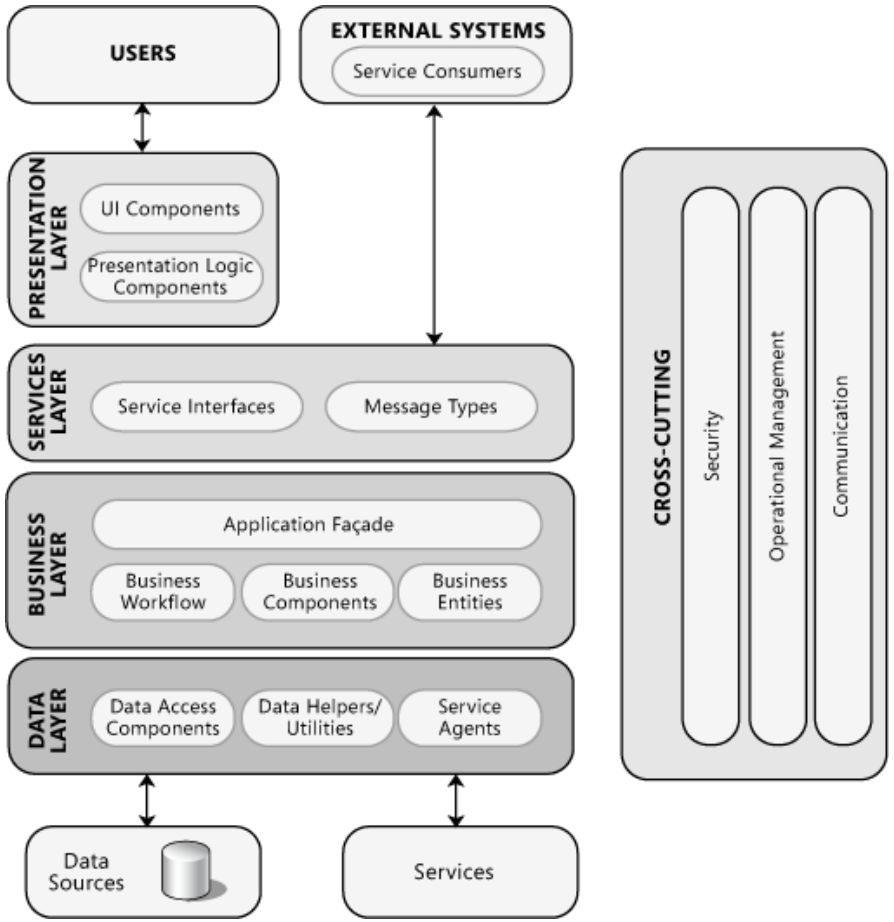
Modern equivalent of 3-Layer

Generally applicable

6 Key Points

Q & A

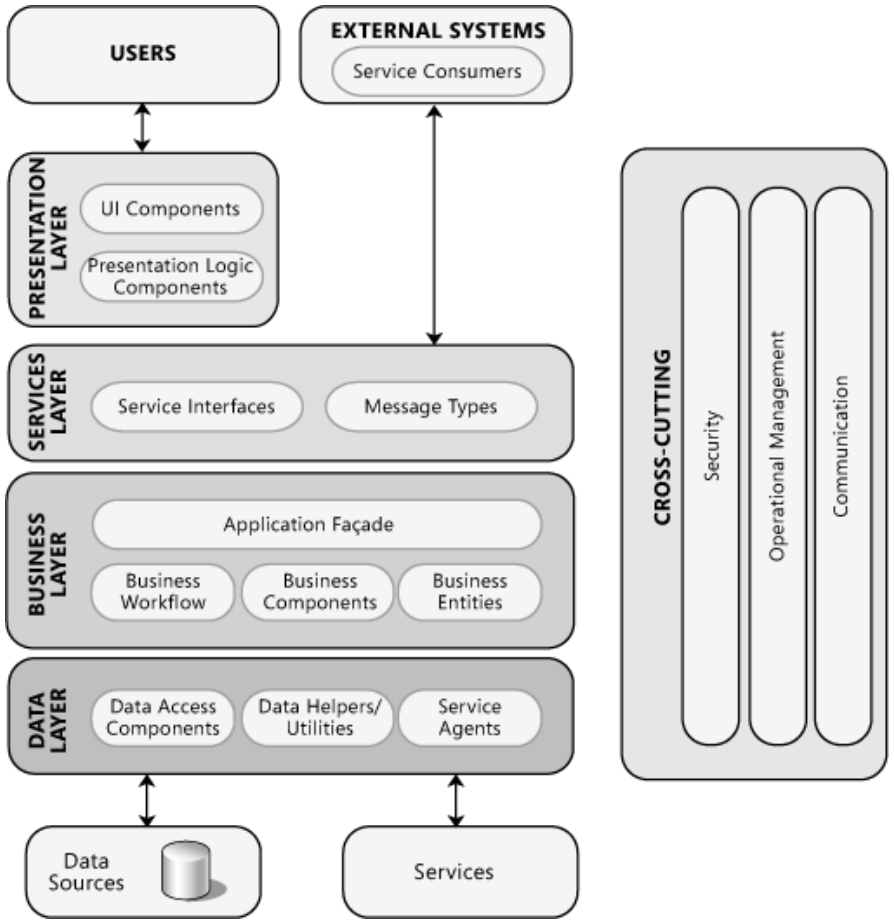
What is Software Architecture?



Source: http://msdn.microsoft.com/en-us/library/ff650706.aspx

What is Software Architecture?

High-level



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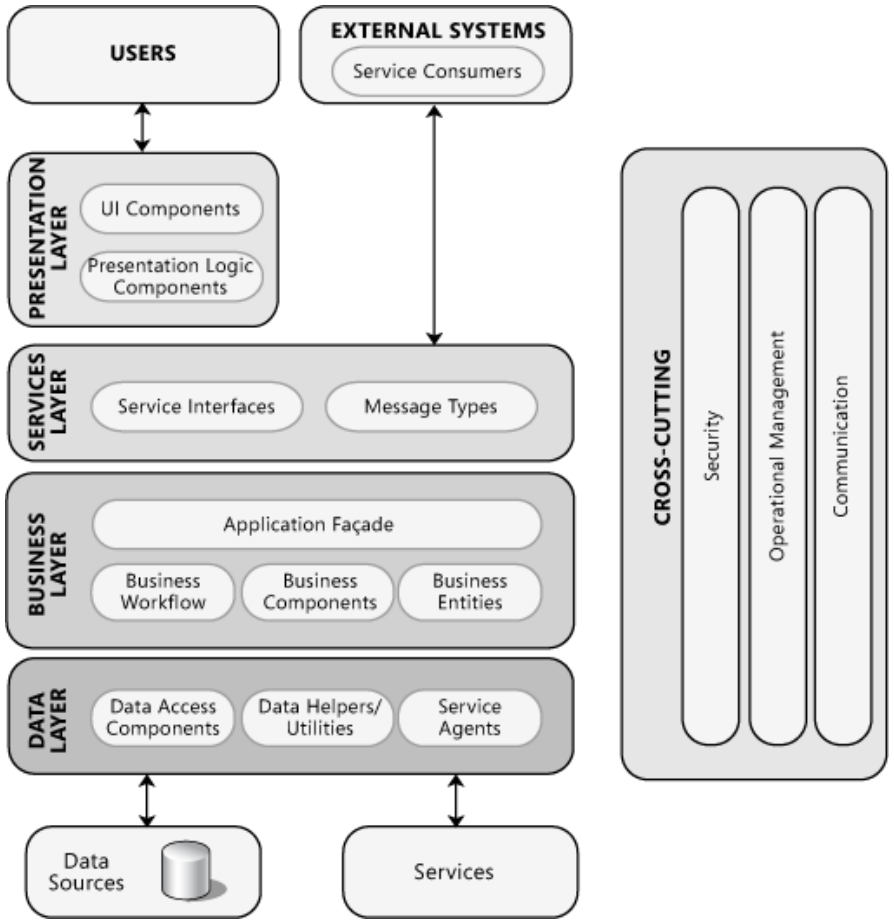
What is Software Architecture?

High-level
Structure



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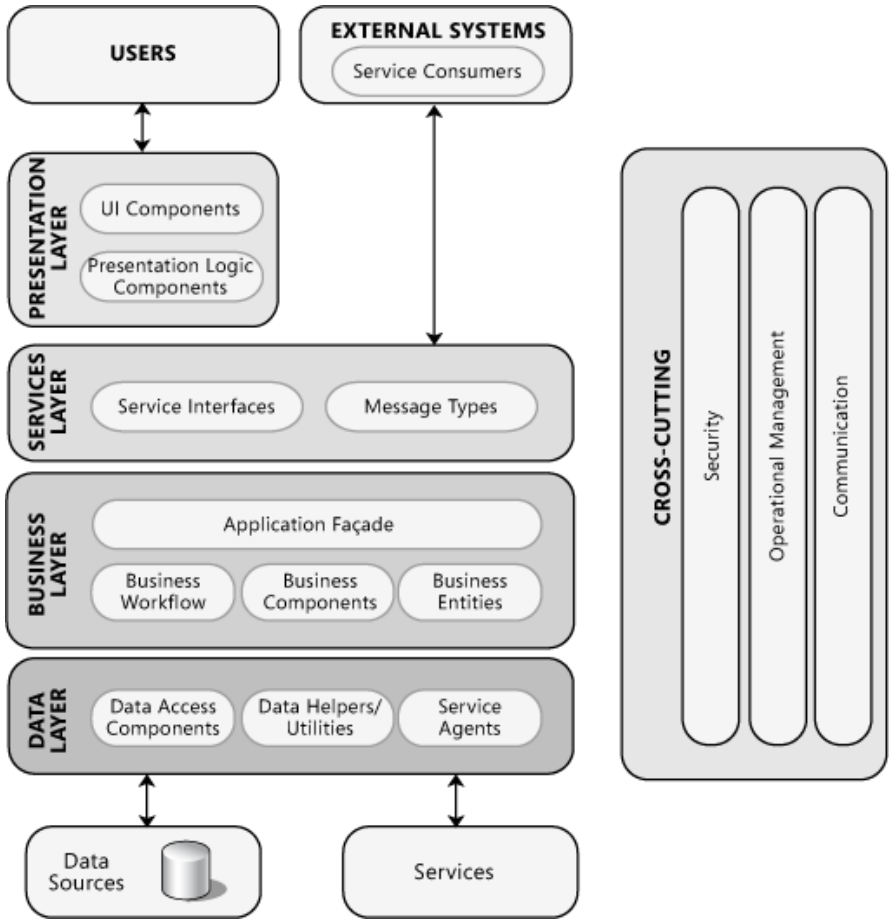
What is Software Architecture?

High-level

Structure

Layers



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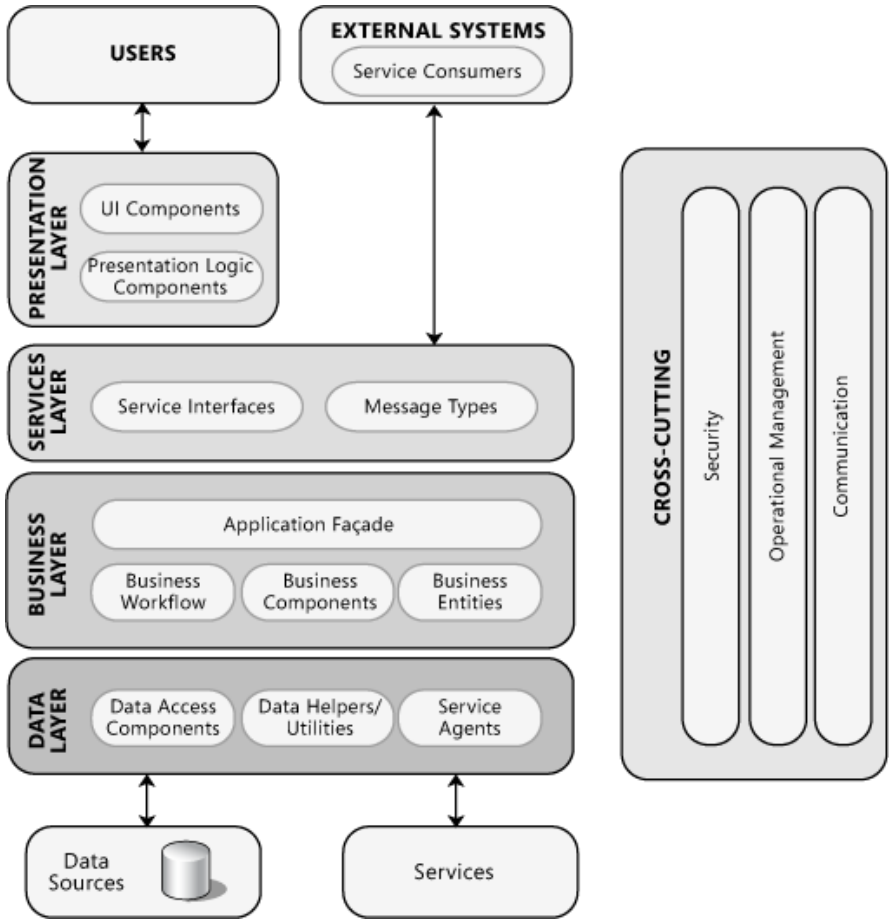
What is Software Architecture?

High-level
Structure
Layers
Components



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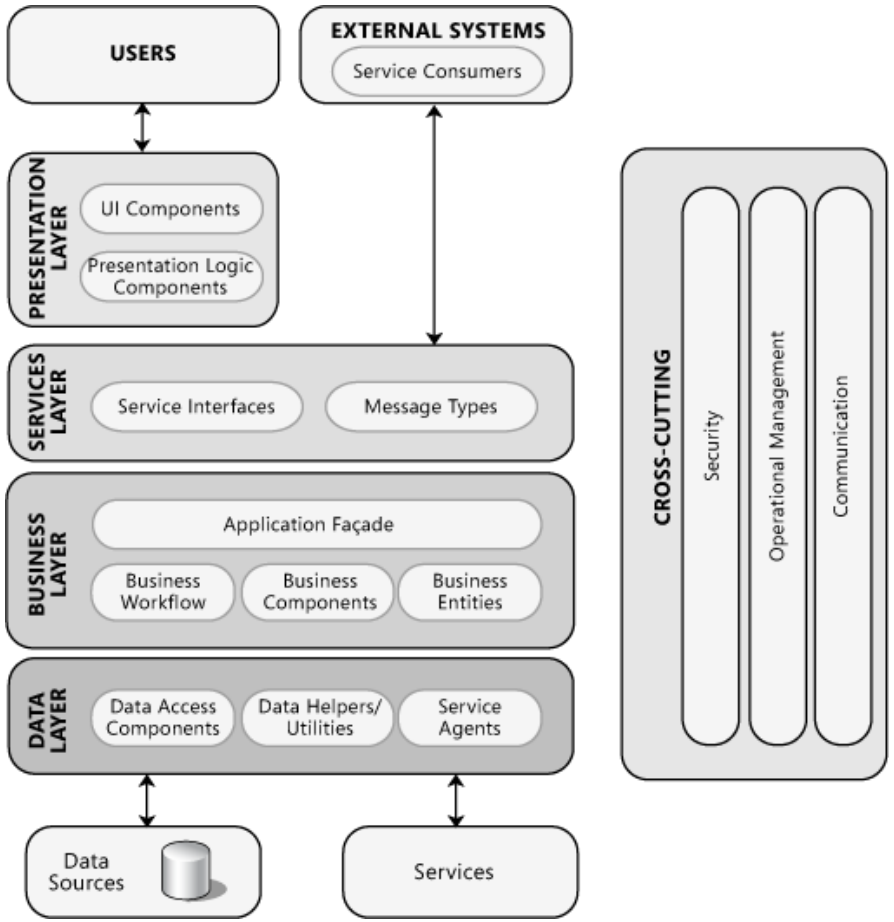
What is Software Architecture?

High-level
Structure
Layers
Components
Relationships



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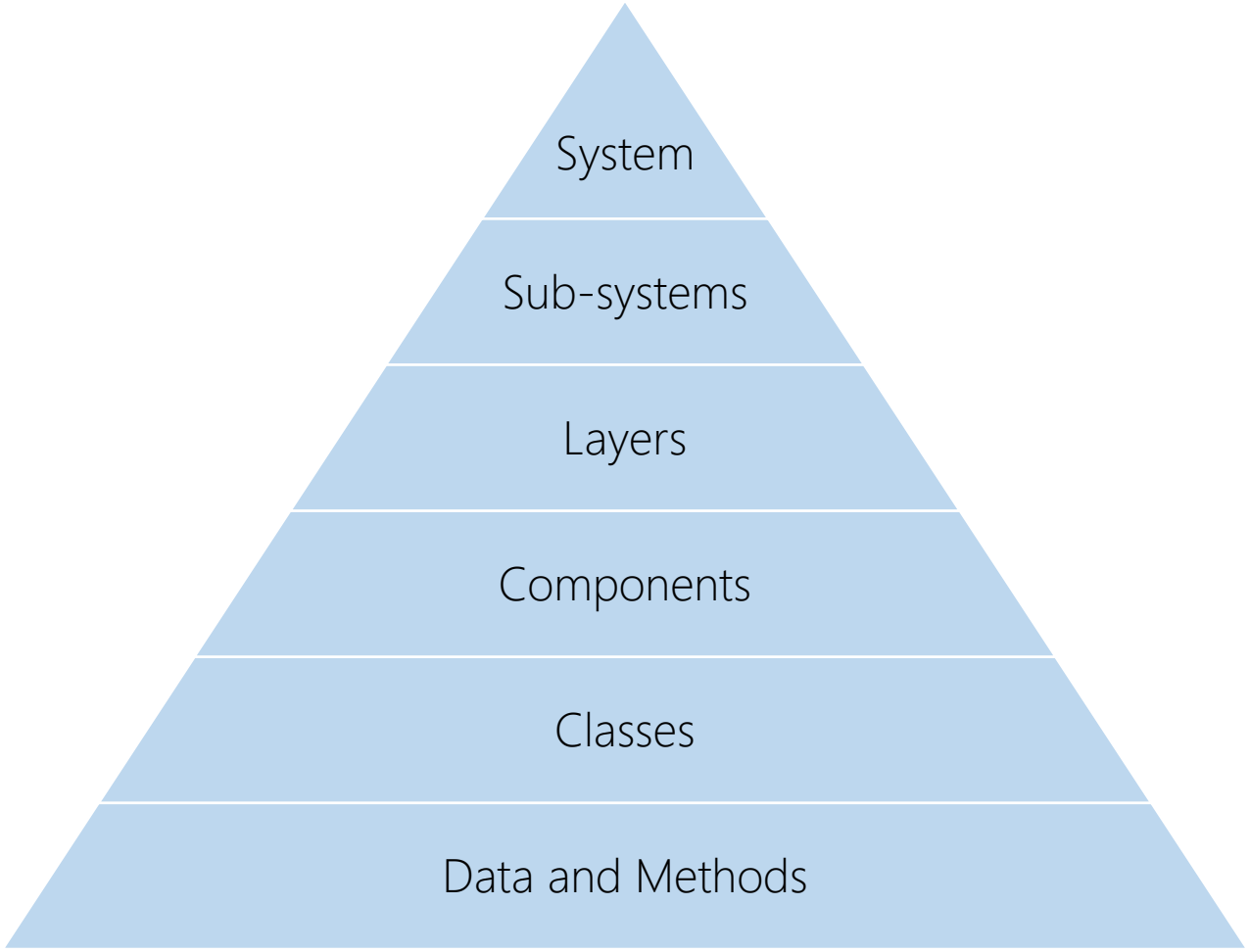
Levels of Architectural Abstraction



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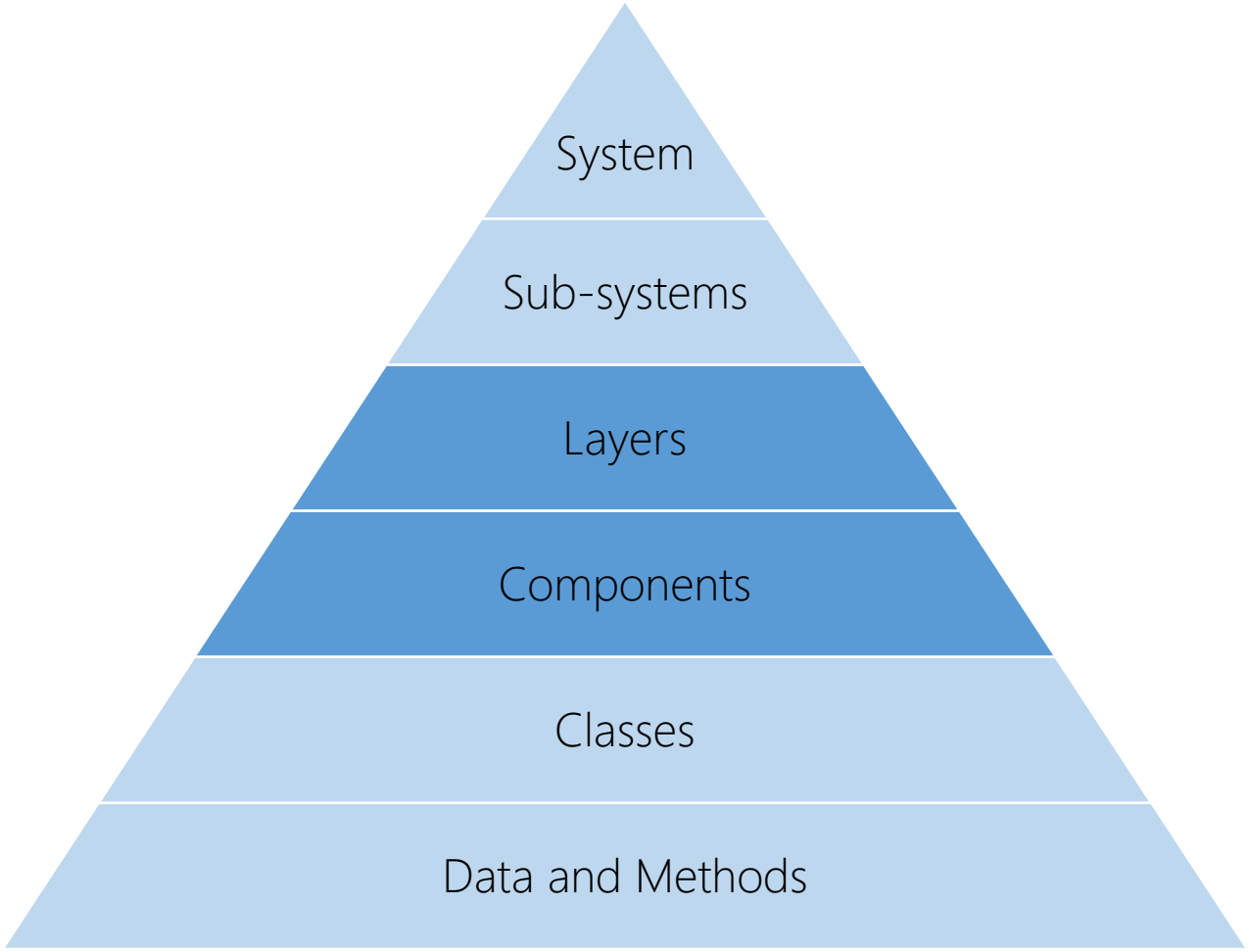

Messy vs Clean Architecture

Messy vs Clean Architecture

Messy vs Clean Architecture

What Is Bad Architecture?

Complex
Inconsistent
Incoherent
Rigid
Brittle
Untestable
Unmaintainable

What Is Clean Architecture?

Simple
Understandable
Flexible
Emergent
Testable
Maintainable

What Is Clean Architecture?

Architecture that is designed for the
inhabitants of the architecture…
not for the architect… or the machine

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Why Is Clean Architecture Important?

Cost/benefit

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Cost/benefit

Minimize cost to maintain

Why Is Clean Architecture Important?

Cost/benefit

Minimize cost to maintain

Maximize business value

Why Is Clean Architecture Important?

Cost/benefit

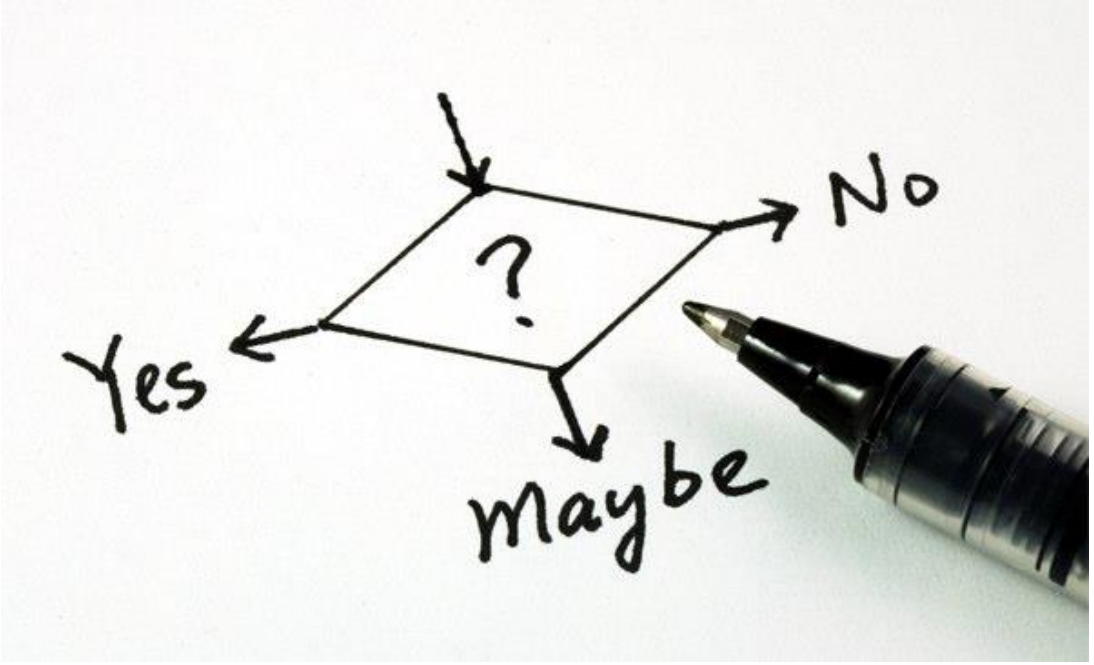
Minimize cost to maintain

Maximize business value

Maximize total ROI

Decisions, Decisions, Decisions…

Context is king



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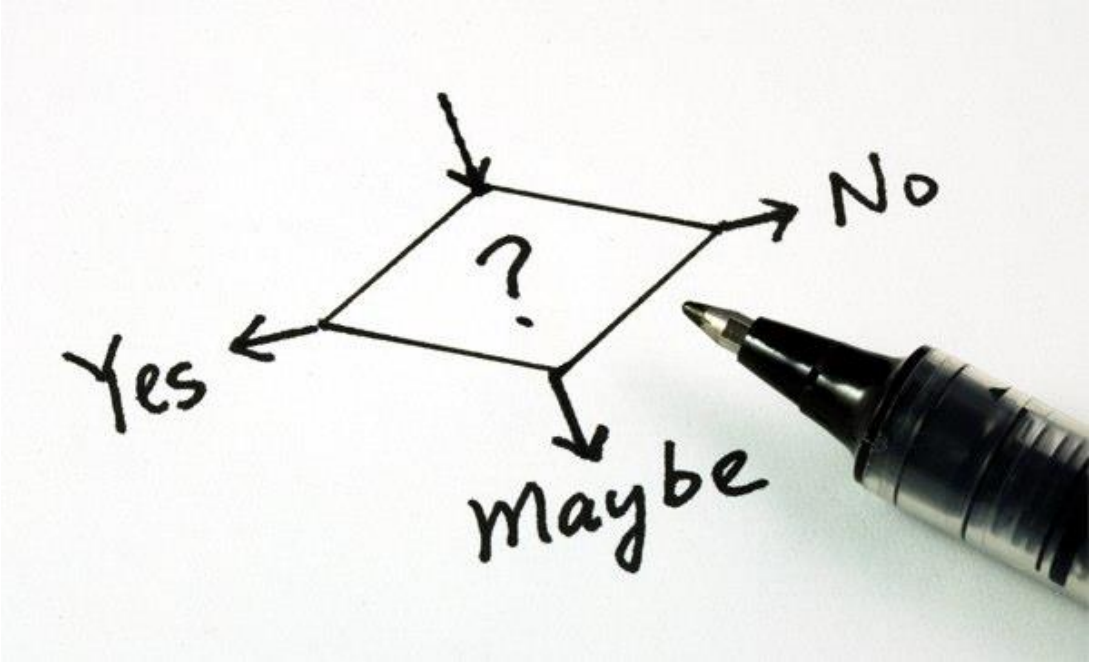
Context is king

All decisions are a tradeoff

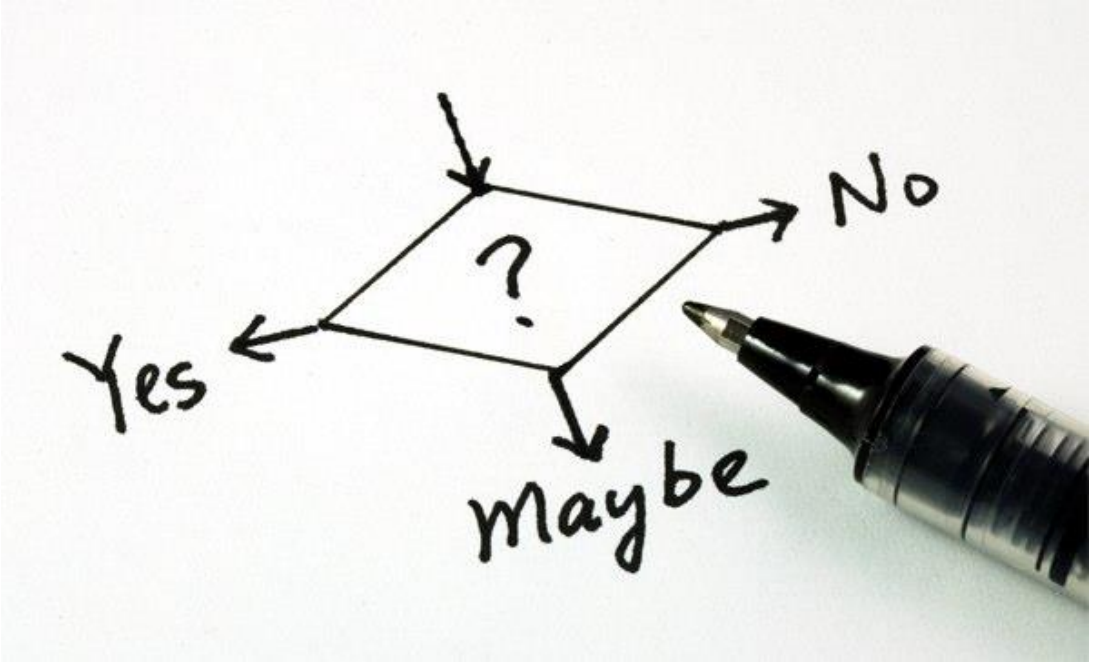


Decisions, Decisions, Decisions…

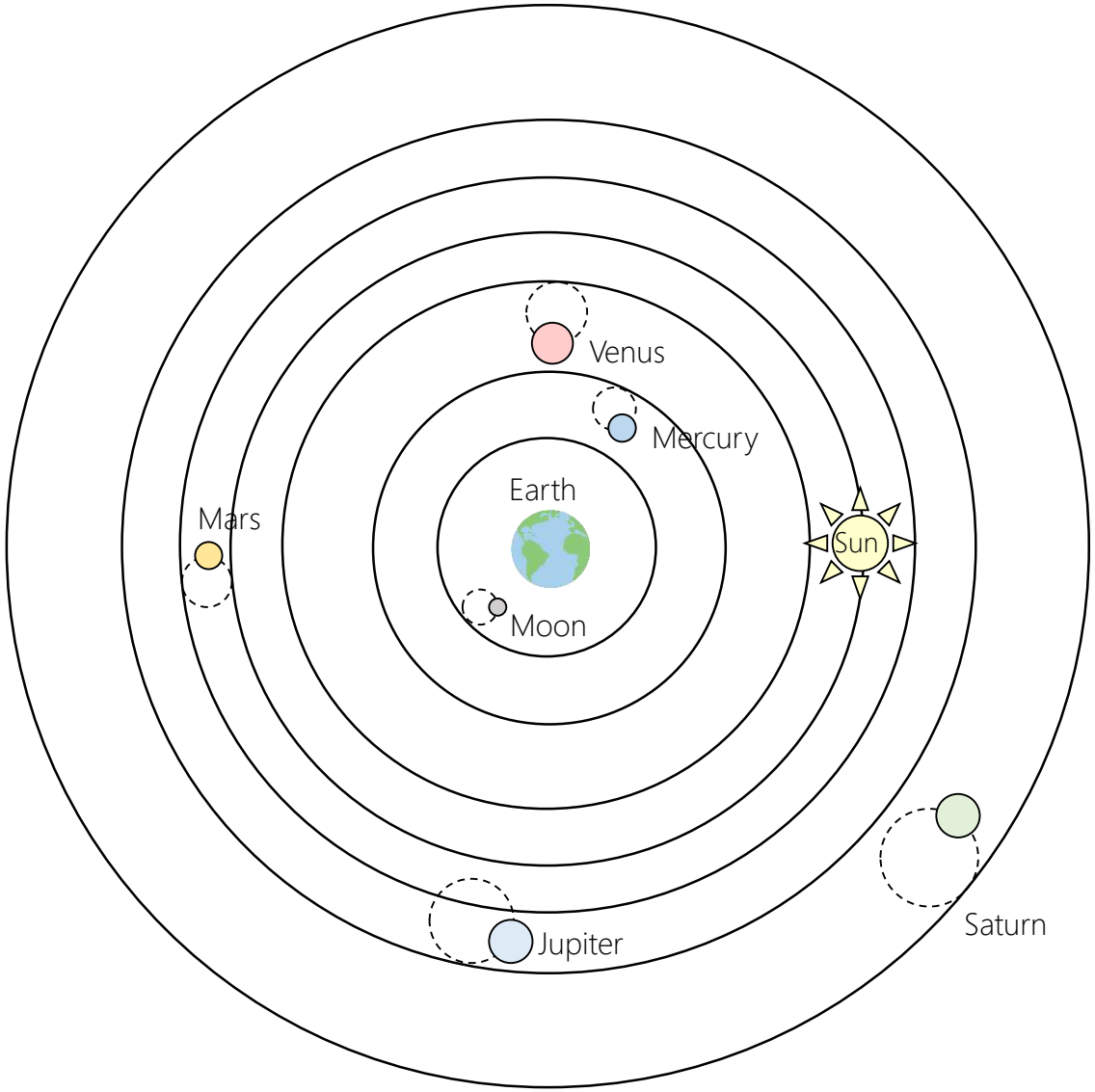
Context is king

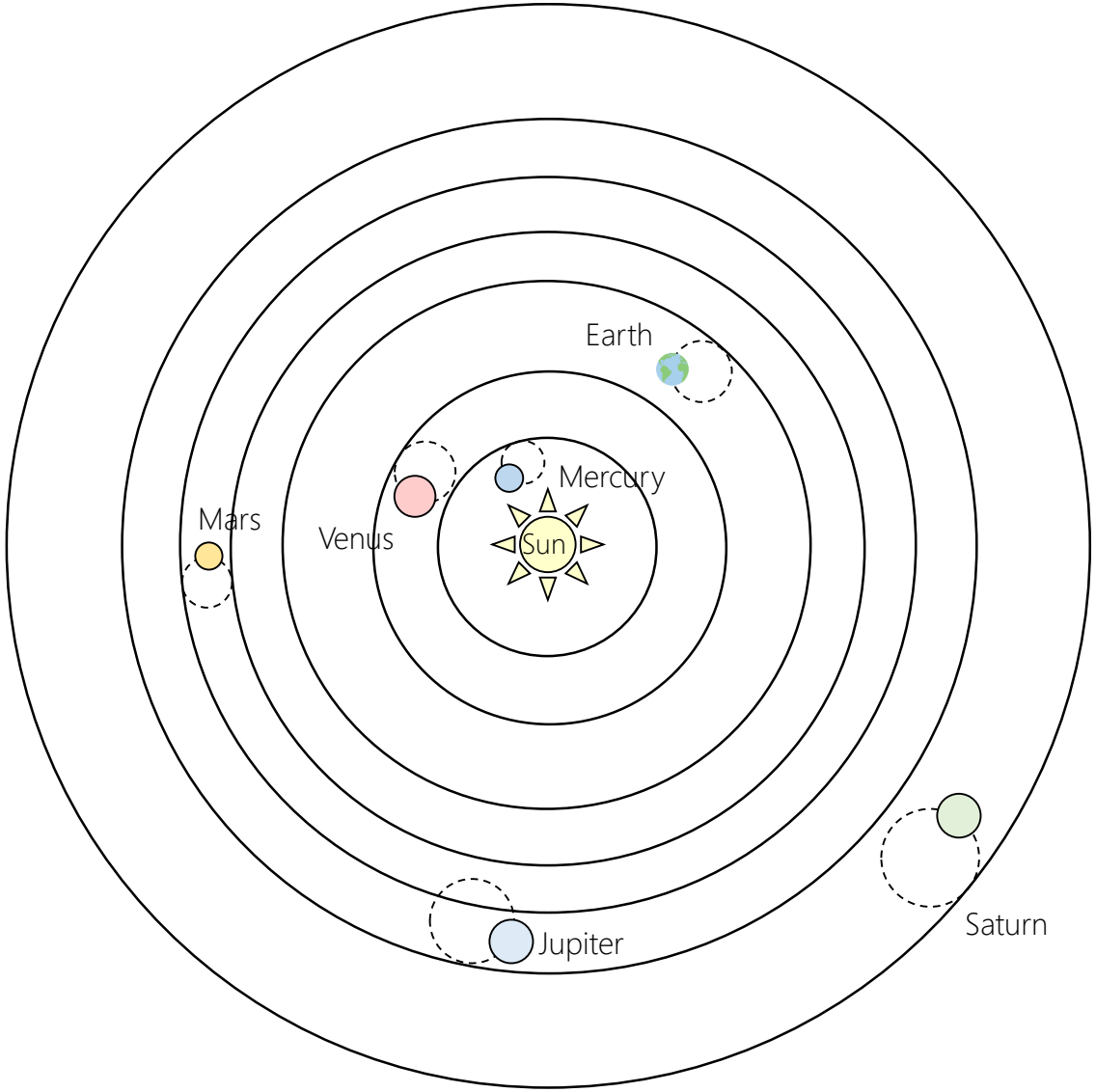
All decisions are a tradeoff

Use your best judgement



Domain-Centric Architecture


Venus
Mercury
Earth
Mars
Sun
Moon
Saturn
Jupiter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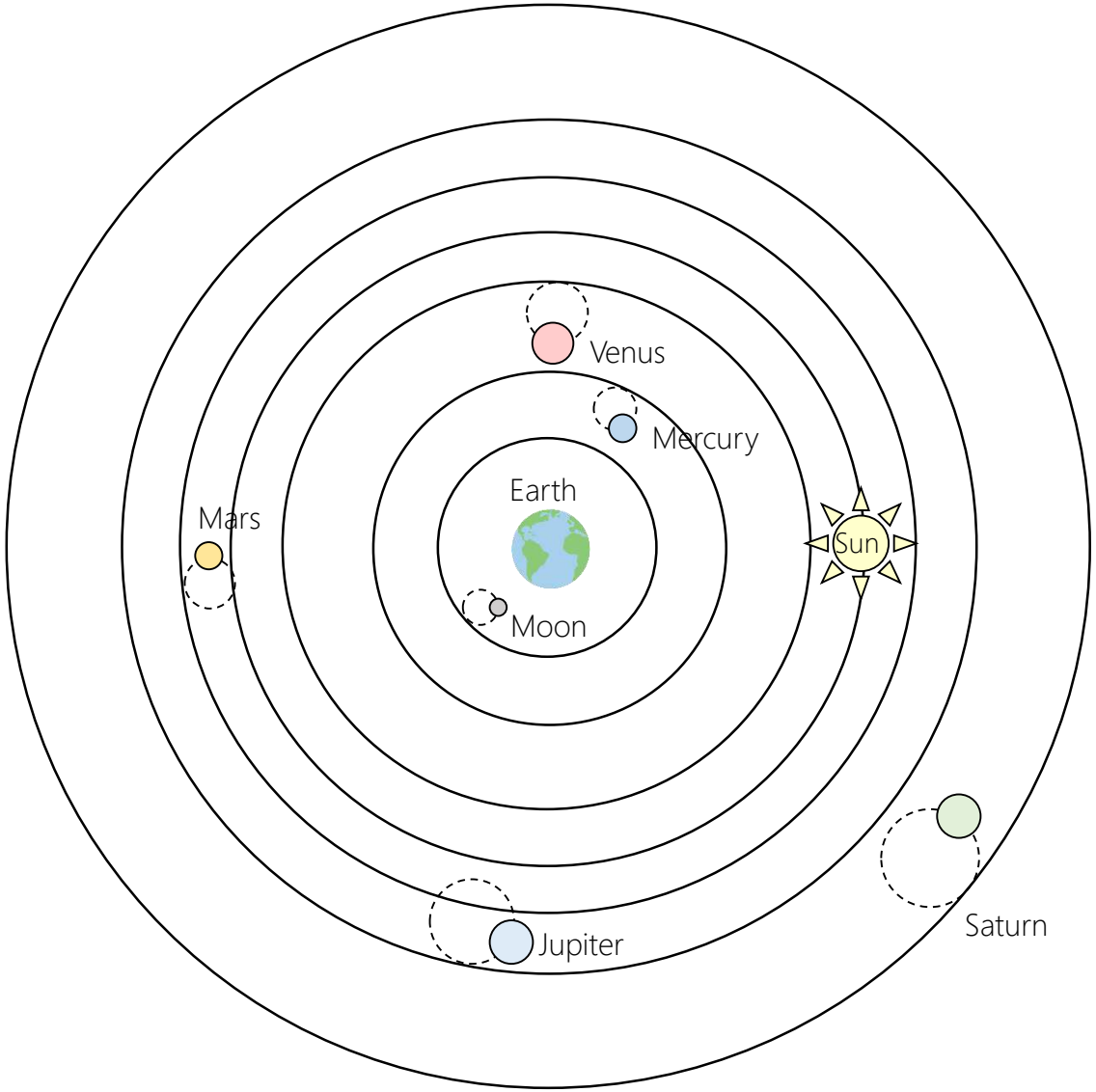
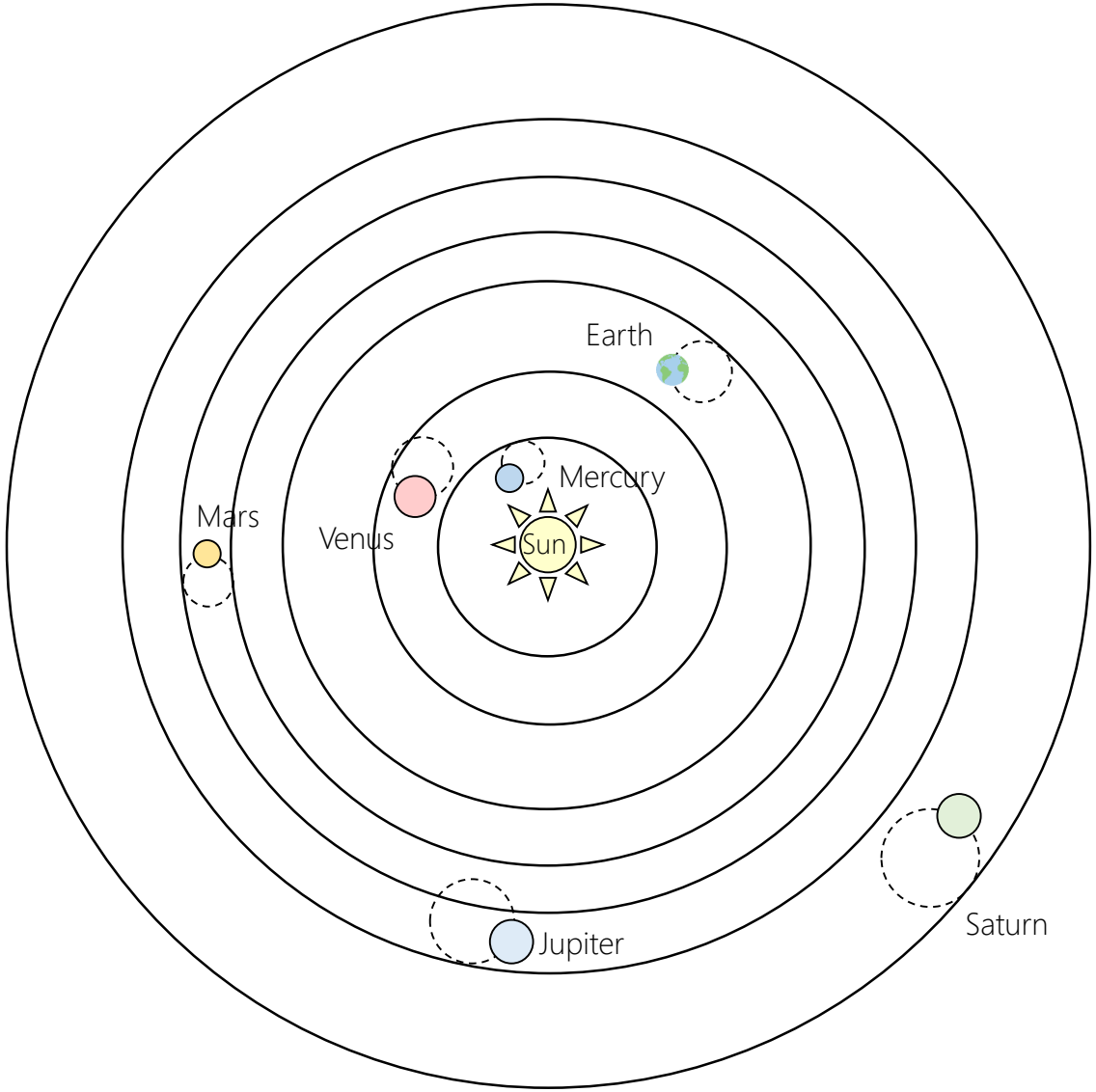
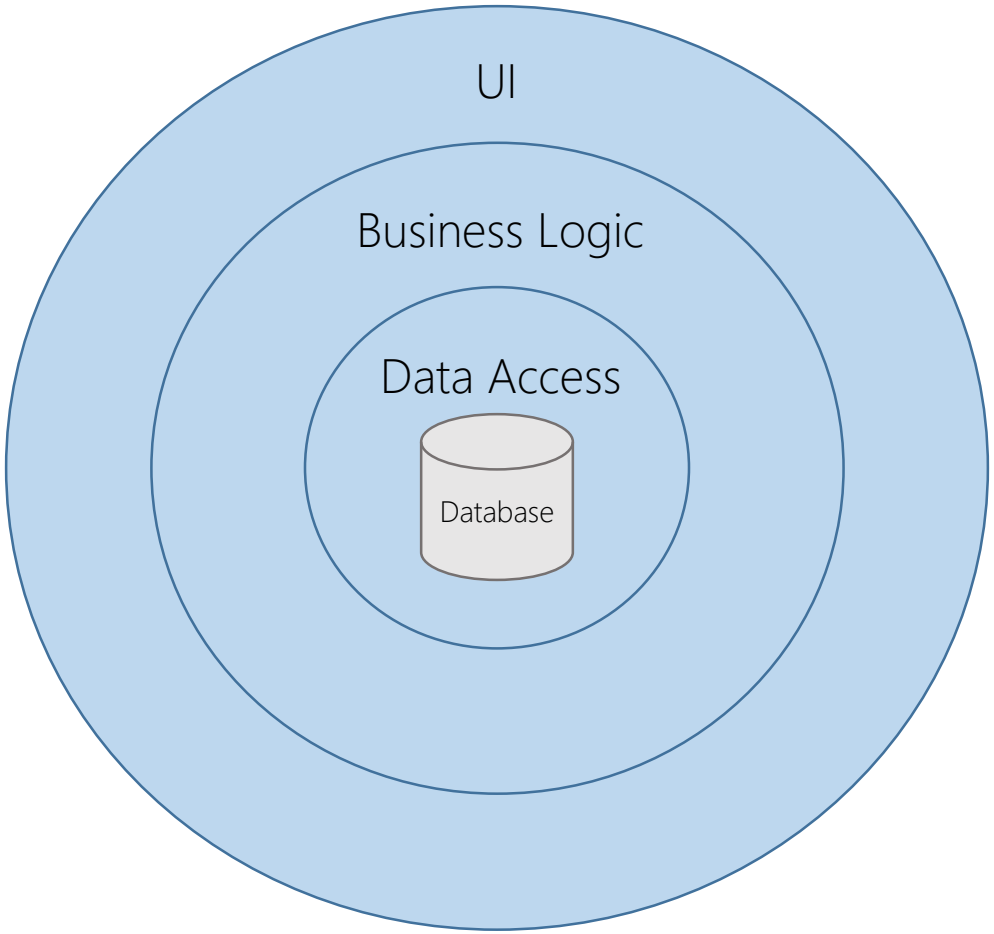


Geocentric Model

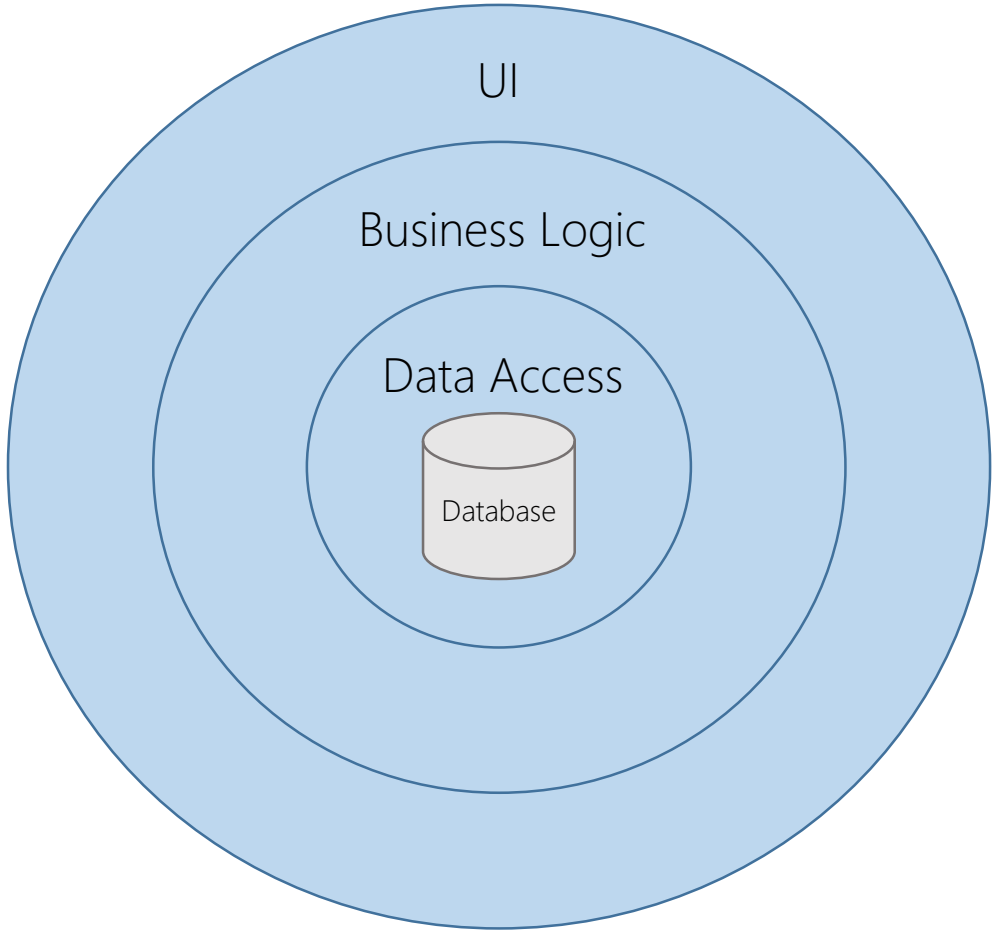


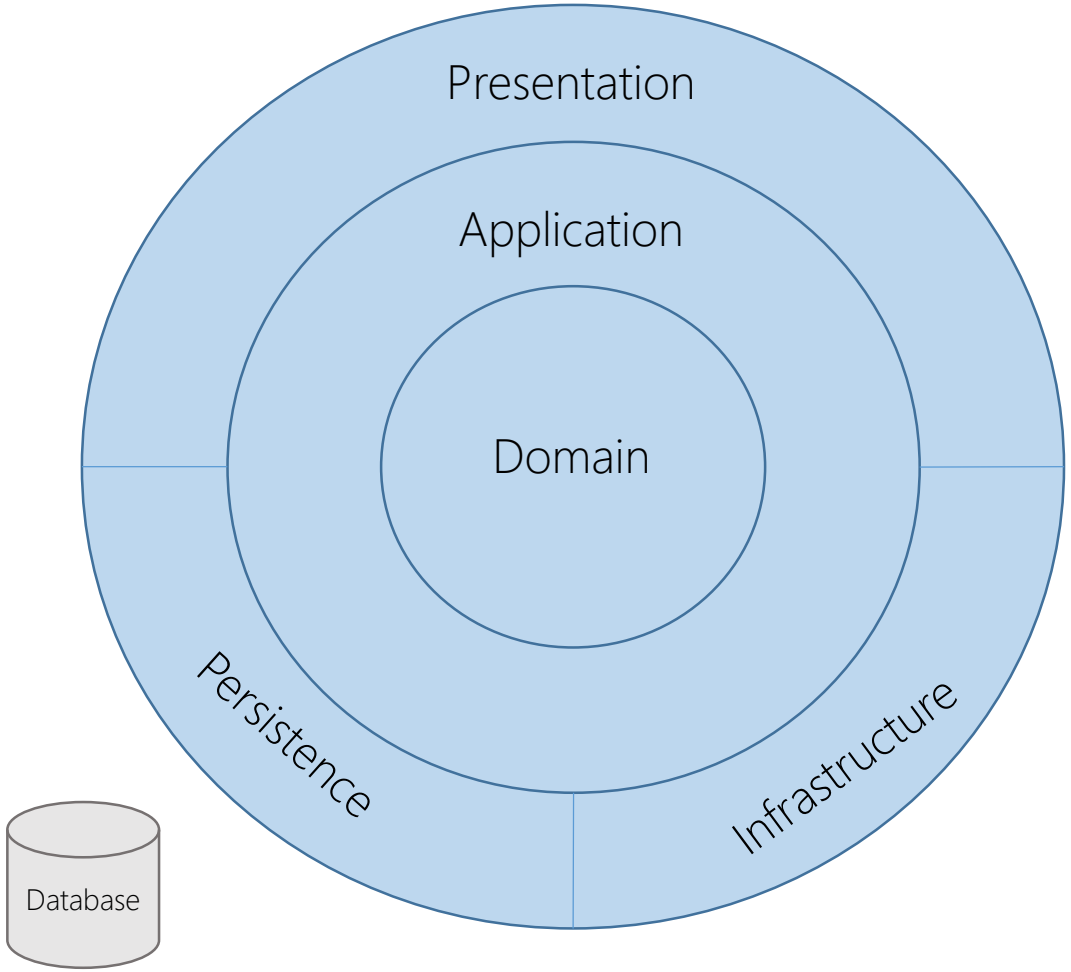
Heliocentric Model

Classic 3-layer Database-centric Architecture



Database- vs. Domain-centric Architecture





"The first concern of the architect is to make sure that the house is usable, it is not to ensure that the house is made of brick."

– Uncle Bob

Essential vs. Detail

Essential vs. Detail

Space is essential

Essential vs. Detail

Space is essential

Usability is essential

Essential vs. Detail

Building material is a detail

Essential vs. Detail

Building material is a detail

Ornamentation is a detail

Essential vs. Detail

Essential vs. Detail

Domain is essential

Essential vs. Detail

Domain is essential

Use cases are essential

Essential vs. Detail

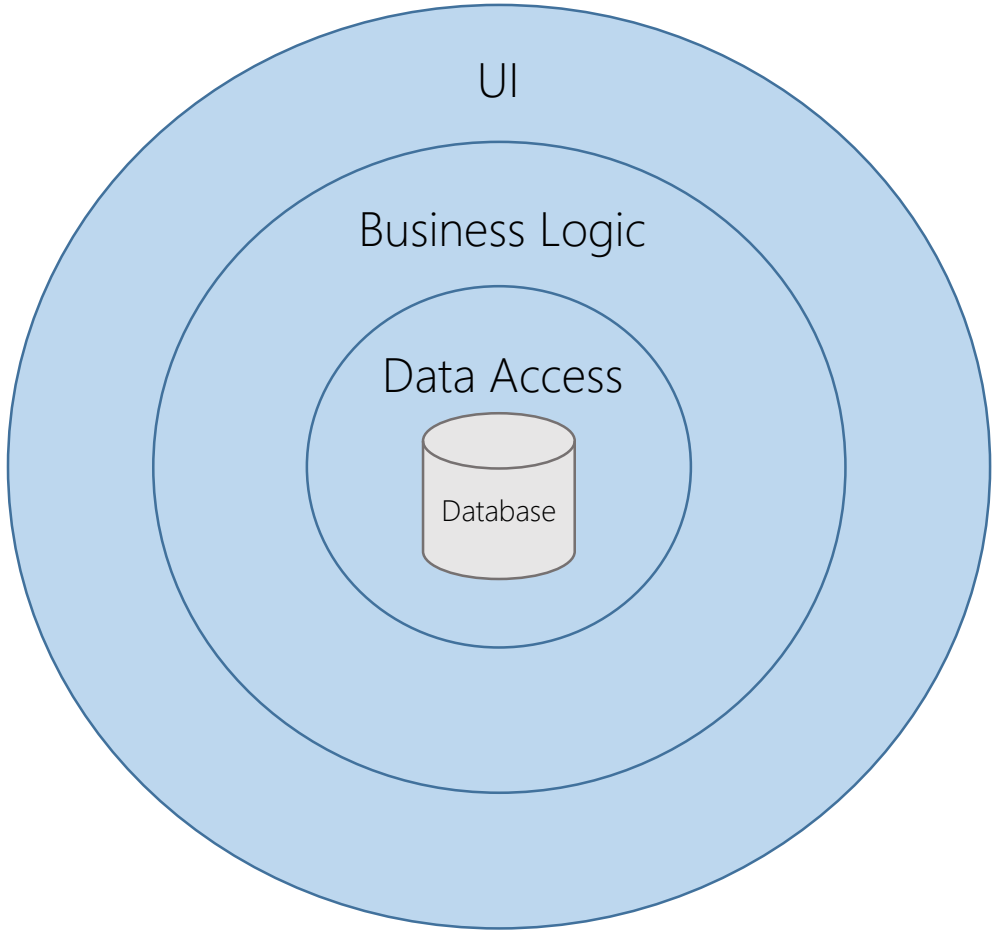
Presentation is a detail

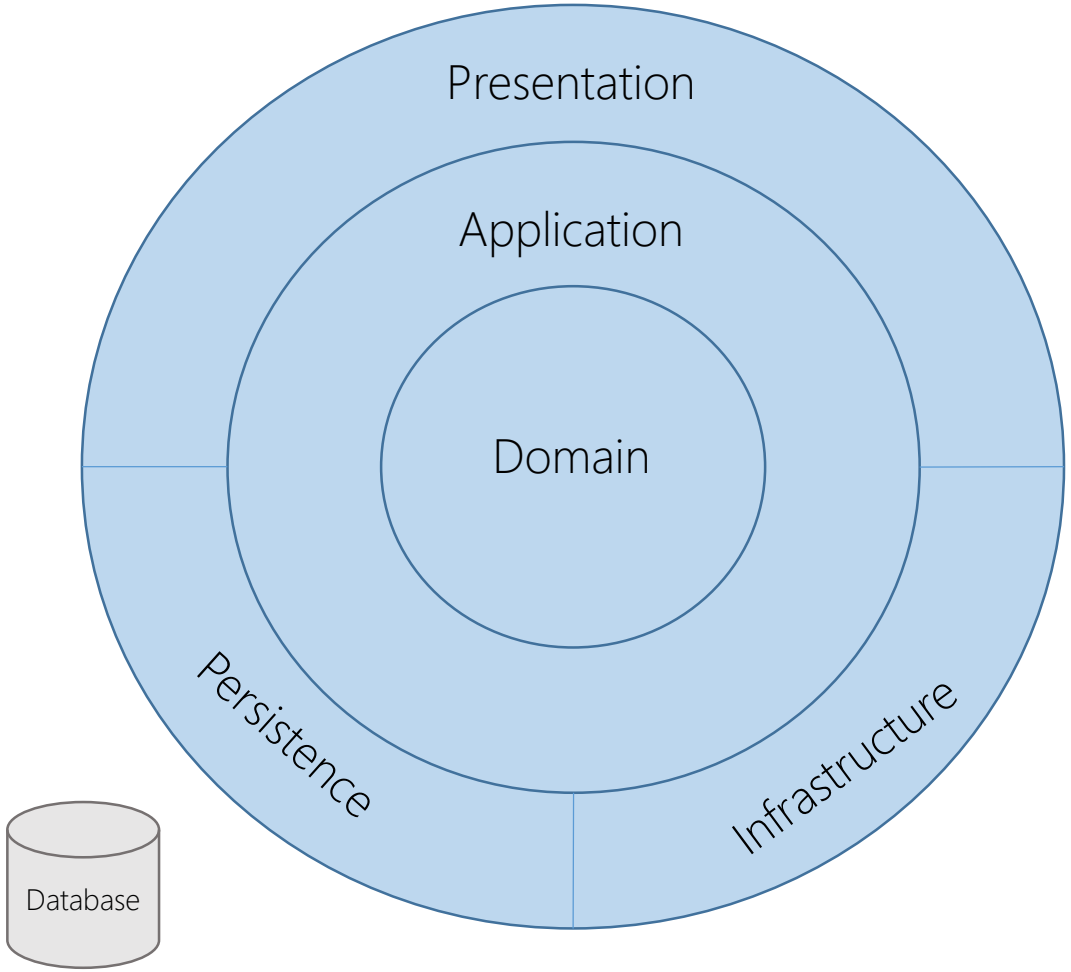
Essential vs. Detail

Presentation is a detail

Persistence is a detail

Database- vs. Domain-centric Architecture





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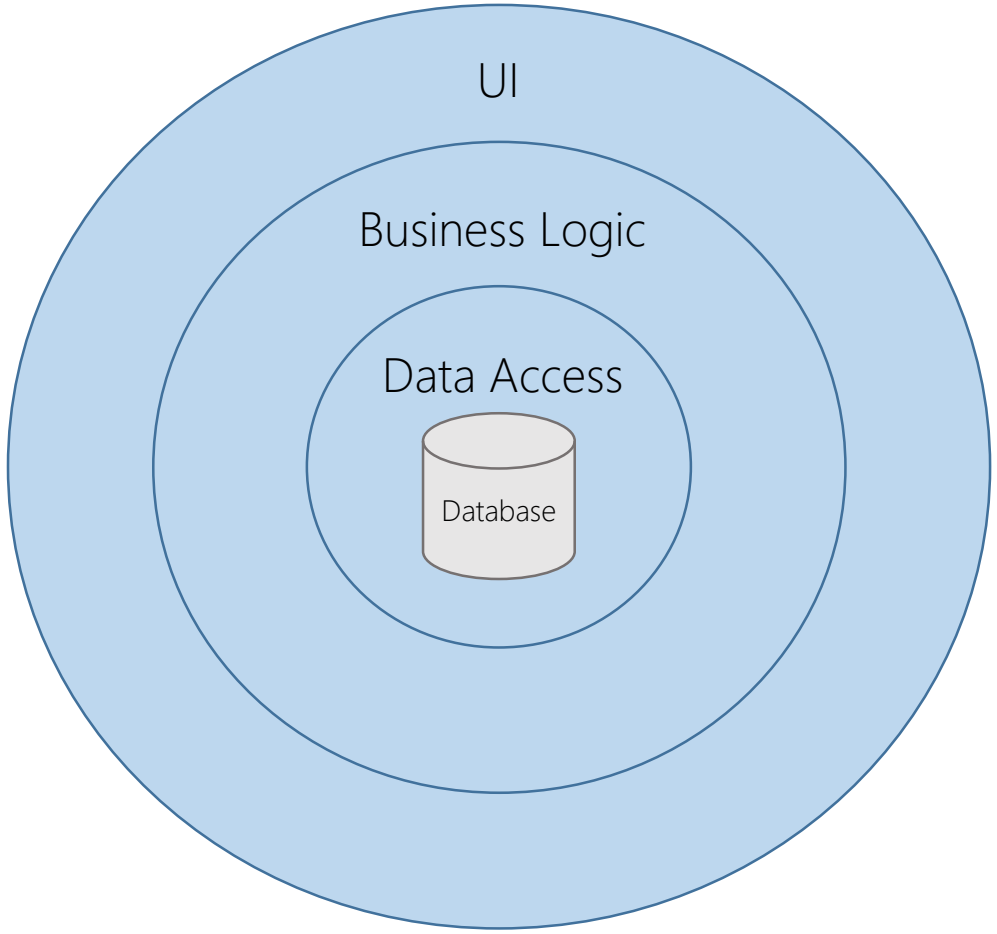

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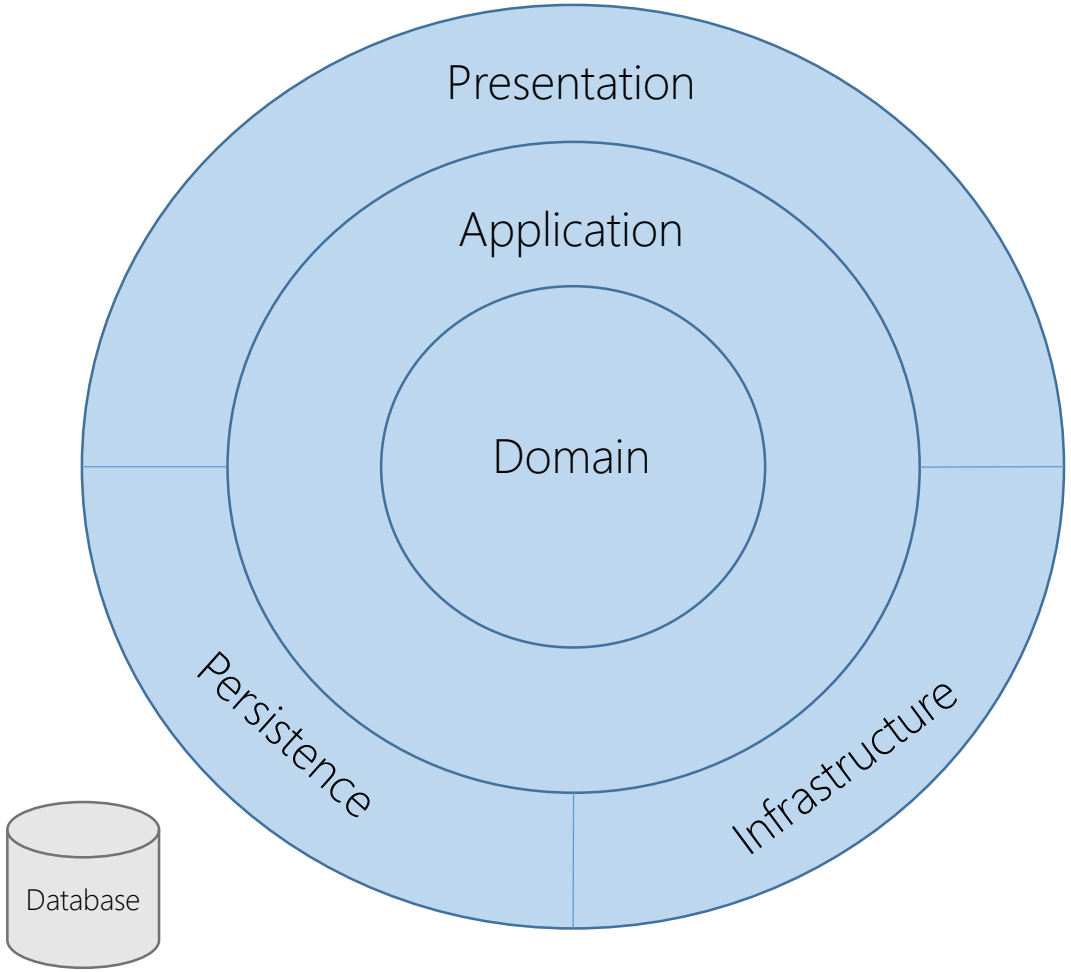
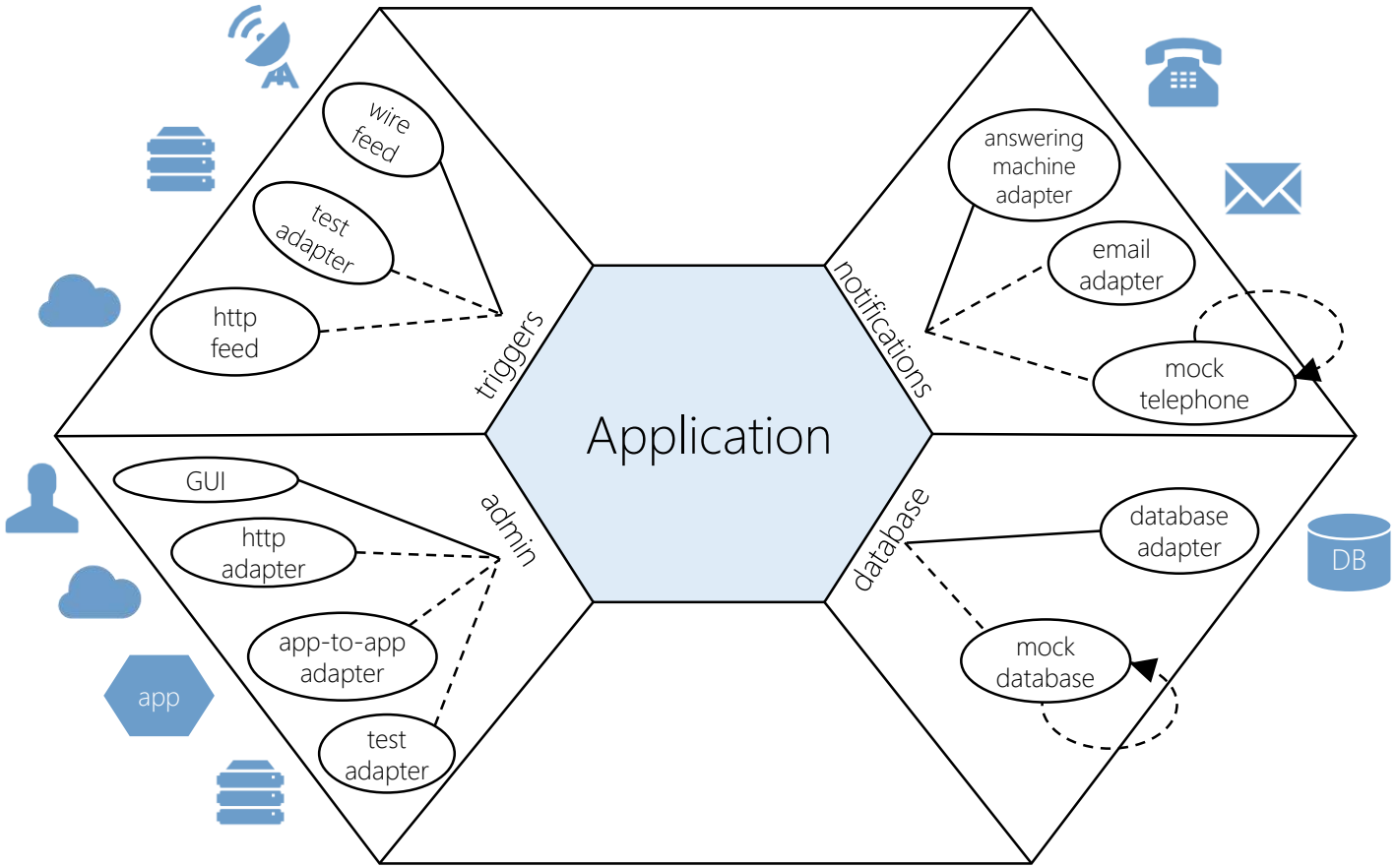
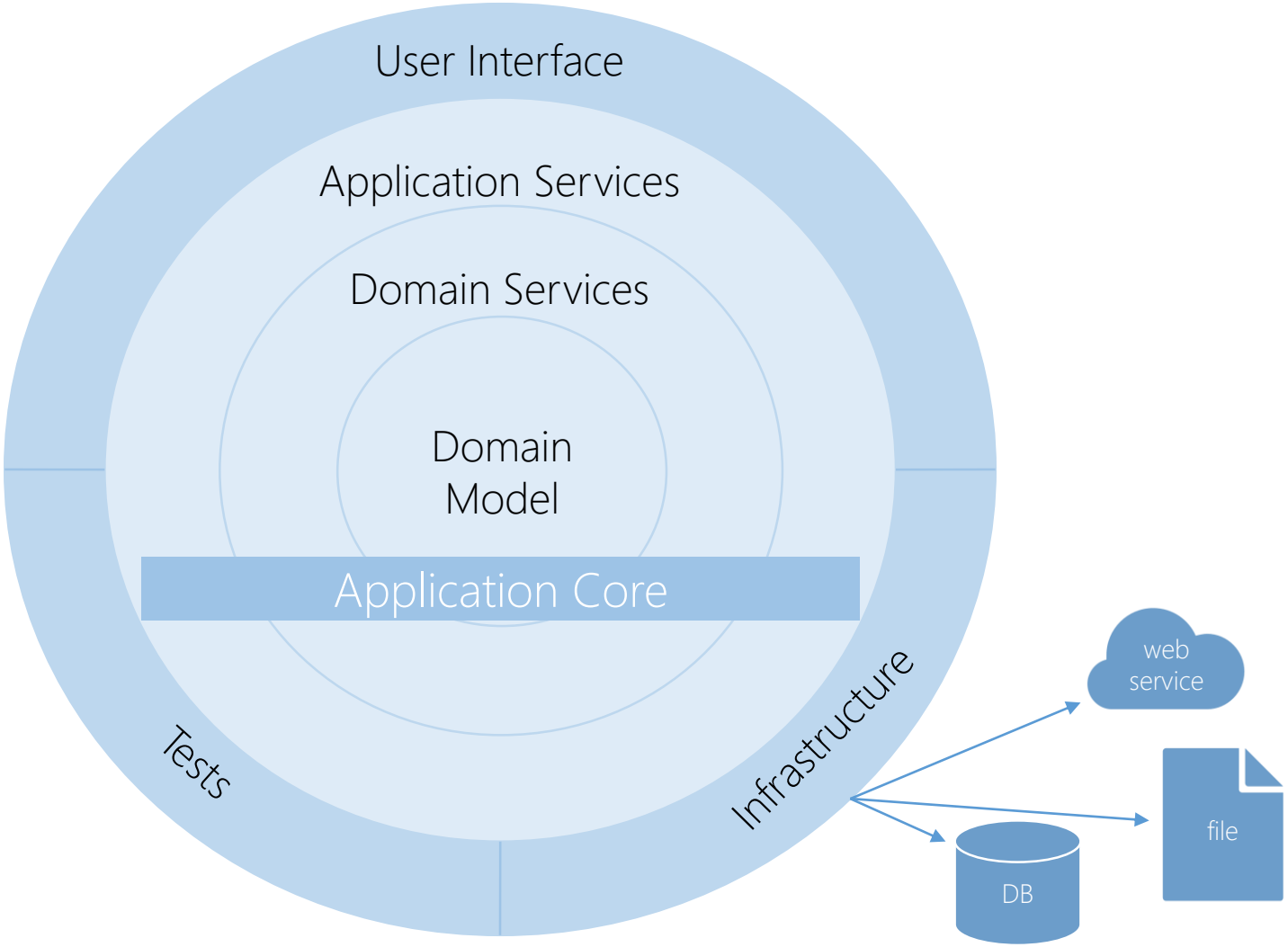


Hexagonal Architecture



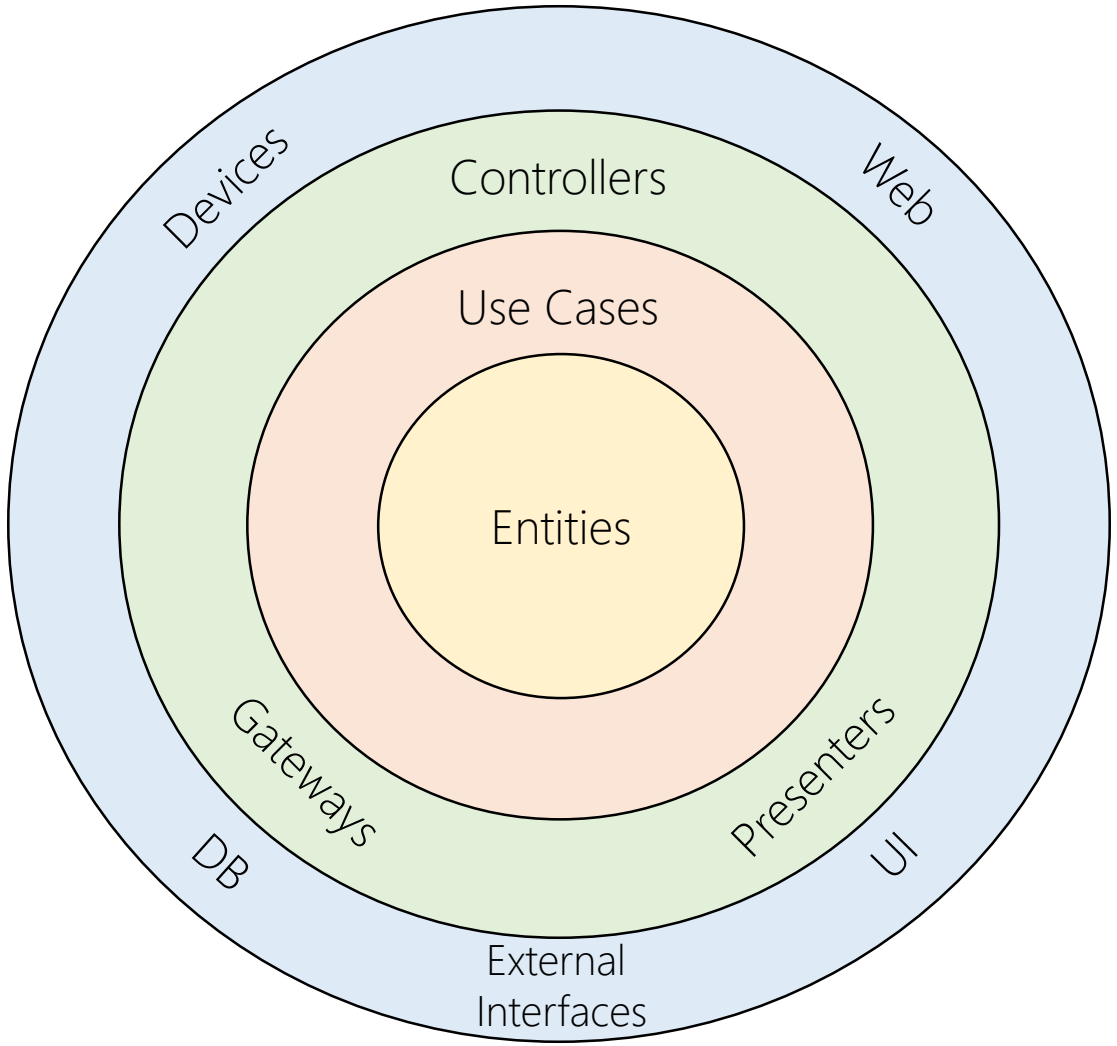
Original source: http://alistair.cockburn.us/Hexagonal+architecture

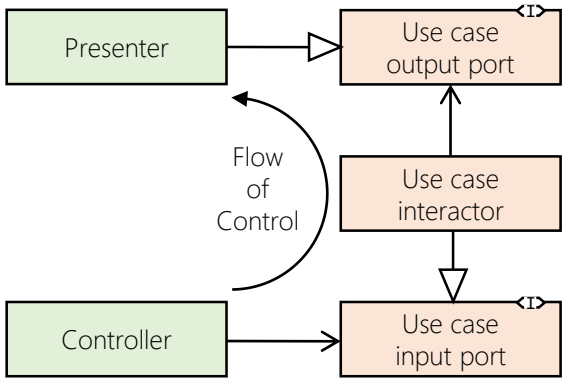
Onion Architecture



Original source: http://jeffreypalermo.com/blog/the-onion-architecture-part-2/

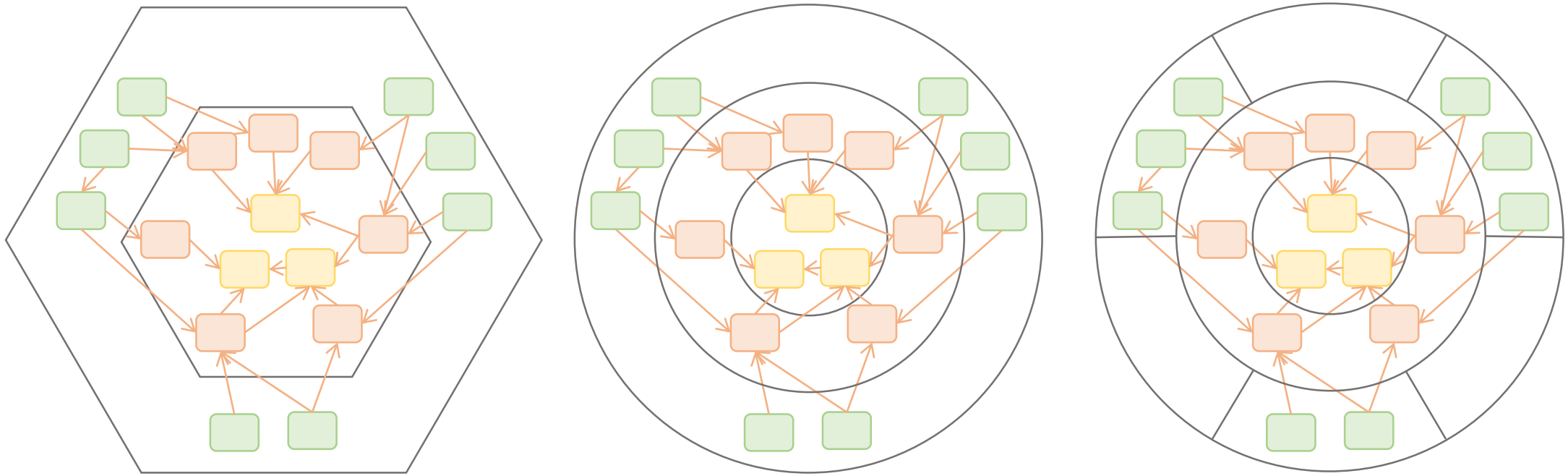
Clean Architecture





Original source: http://blog.8thlight.com/uncle-bob/2012/08/13/the-clean-architecture.html

It's All the Same Thing



Hexagonal Onion Clean

Original Source: http://blog.ploeh.dk/2013/12/03/layers-onions-ports-adapters-its-all-the-same/

Why Use Domain-Centric Architecture?

Pros

Focus on essential

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Less coupling to details

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Necessary for DDD

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Requires extra thought

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Pros

Focus on essential

Less coupling to details

Necessary for DDD

Cons

Change is difficult

Requires extra thought

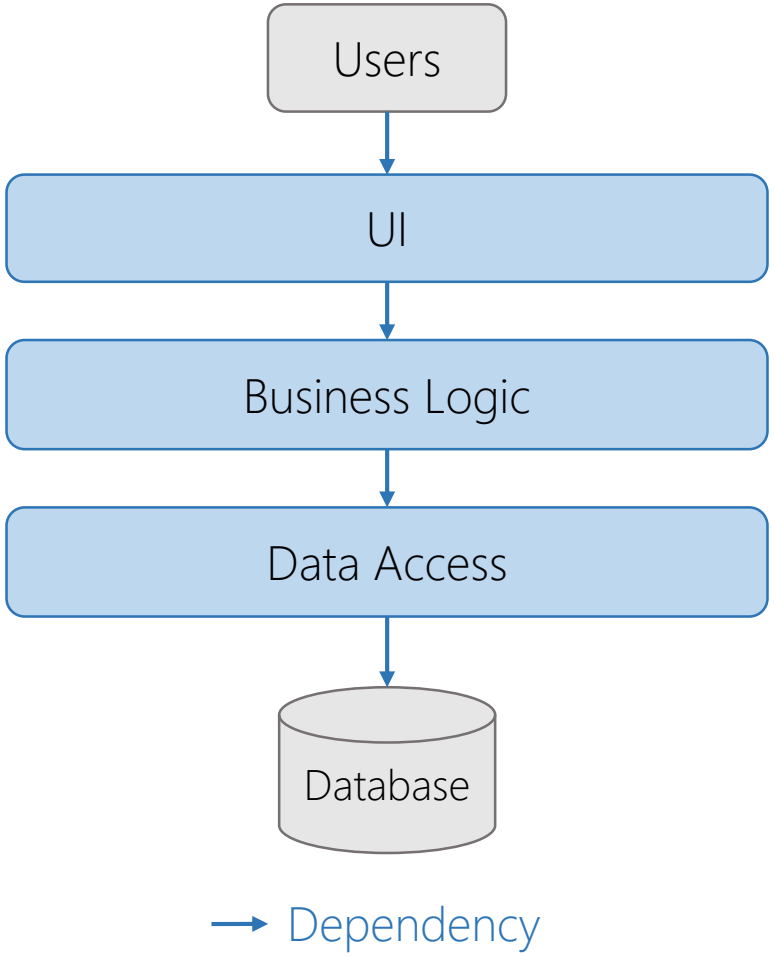
Initial higher cost

Application Layer

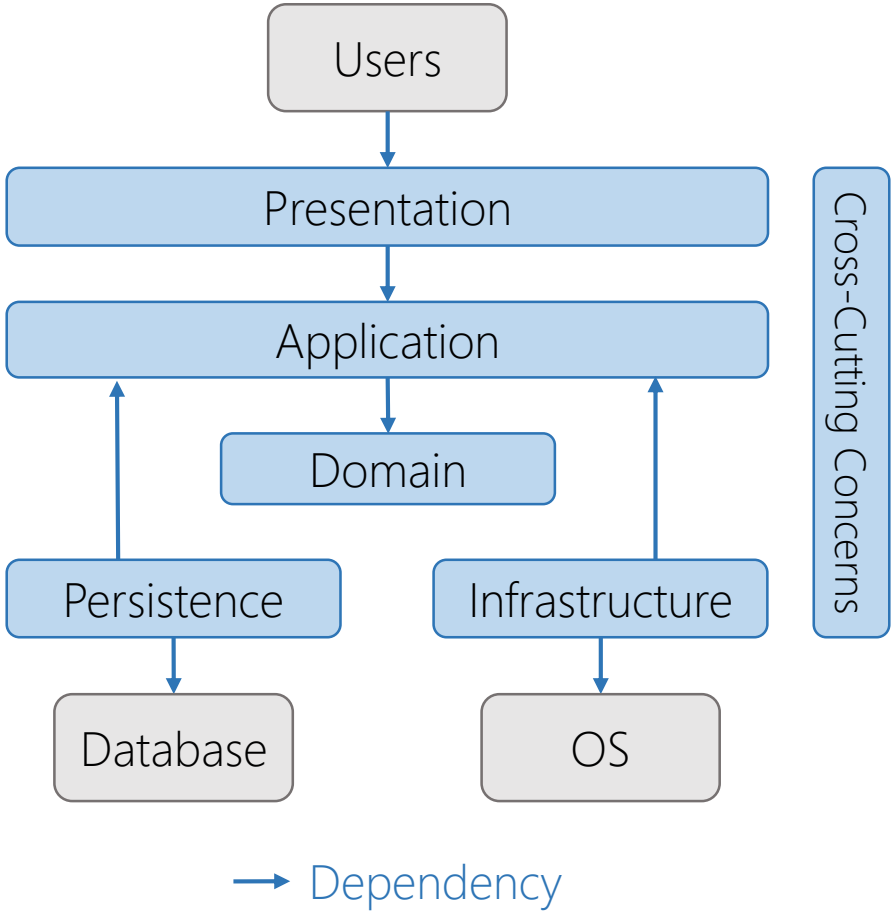
What Are Layers?

Levels of abstraction
Single-Responsibility Principle
Developer roles / skills
Multiple implementations
Varying rates of change

Classic 3-Layer Architecture

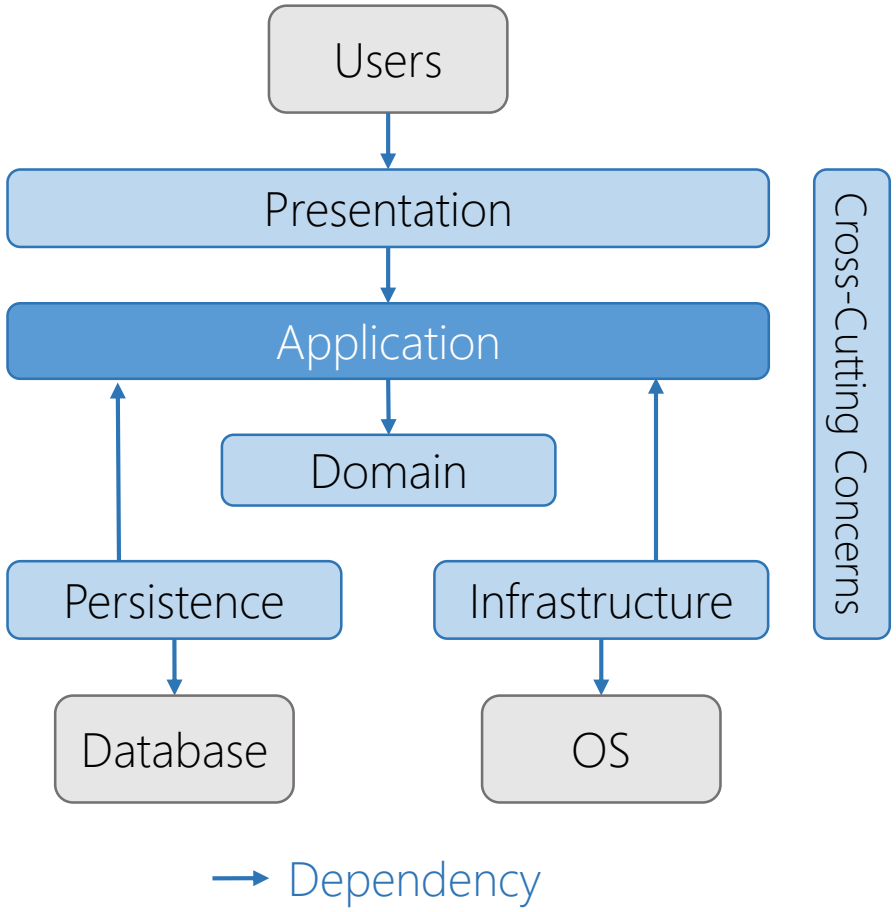


Modern 4-Layer Architecture



Application Layer

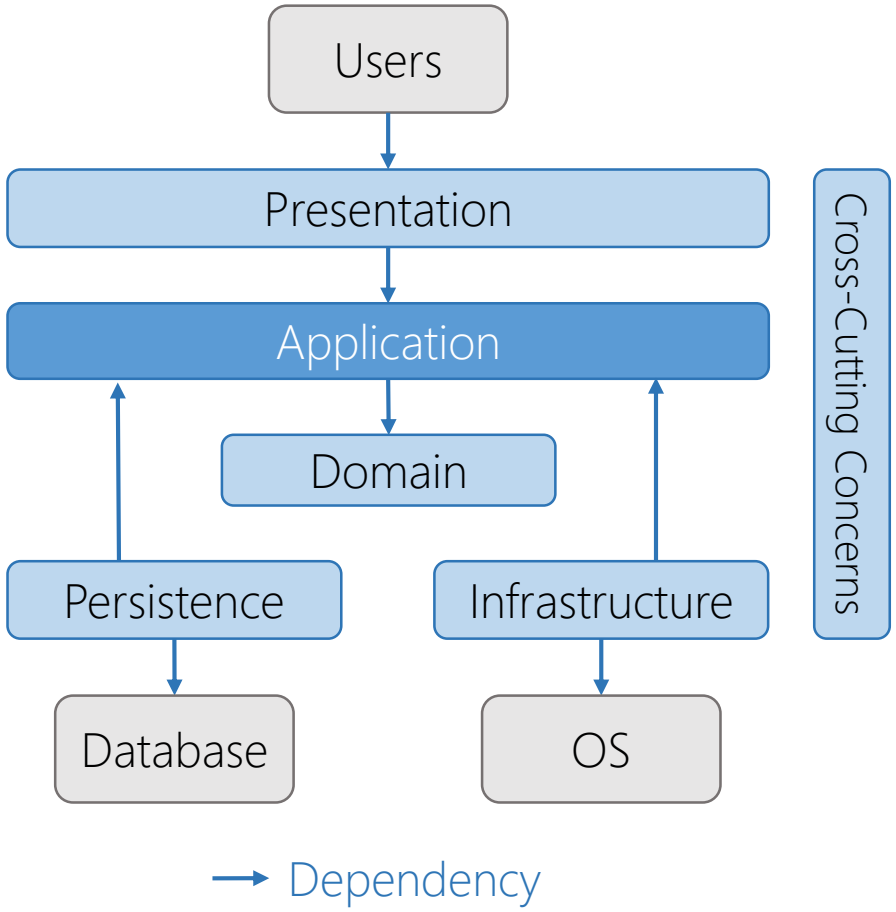
Implements use cases



Application Layer

Implements use cases

High-level application logic

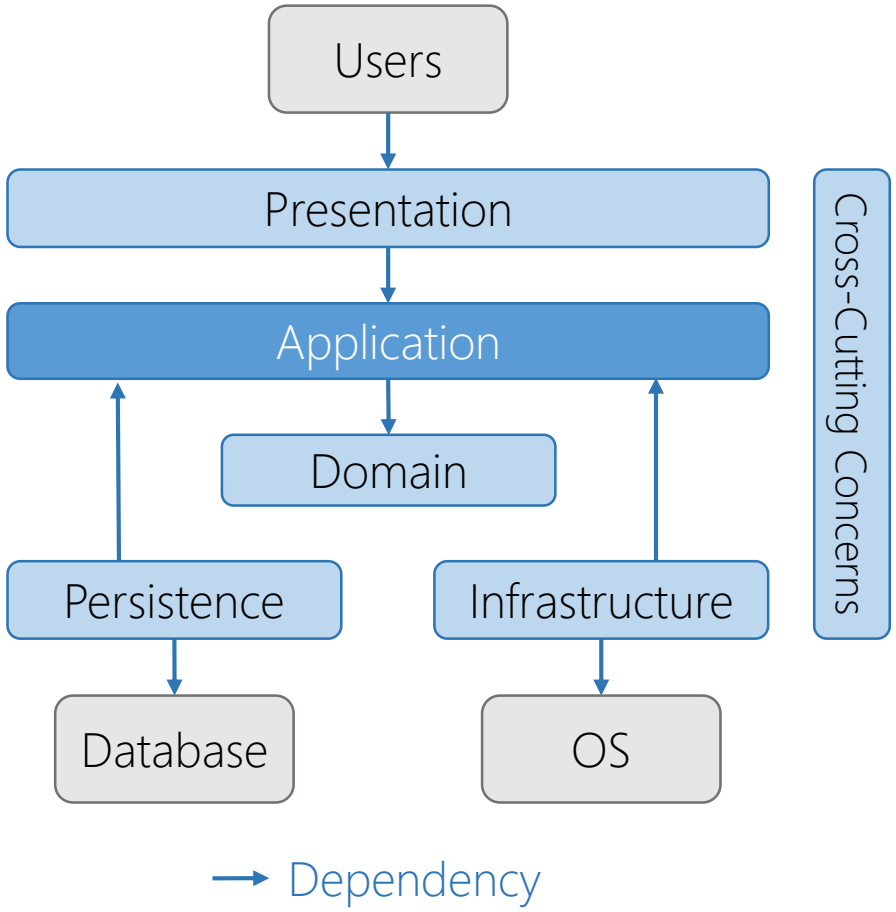


Application Layer

Implements use cases

High-level application logic

Knows about domain



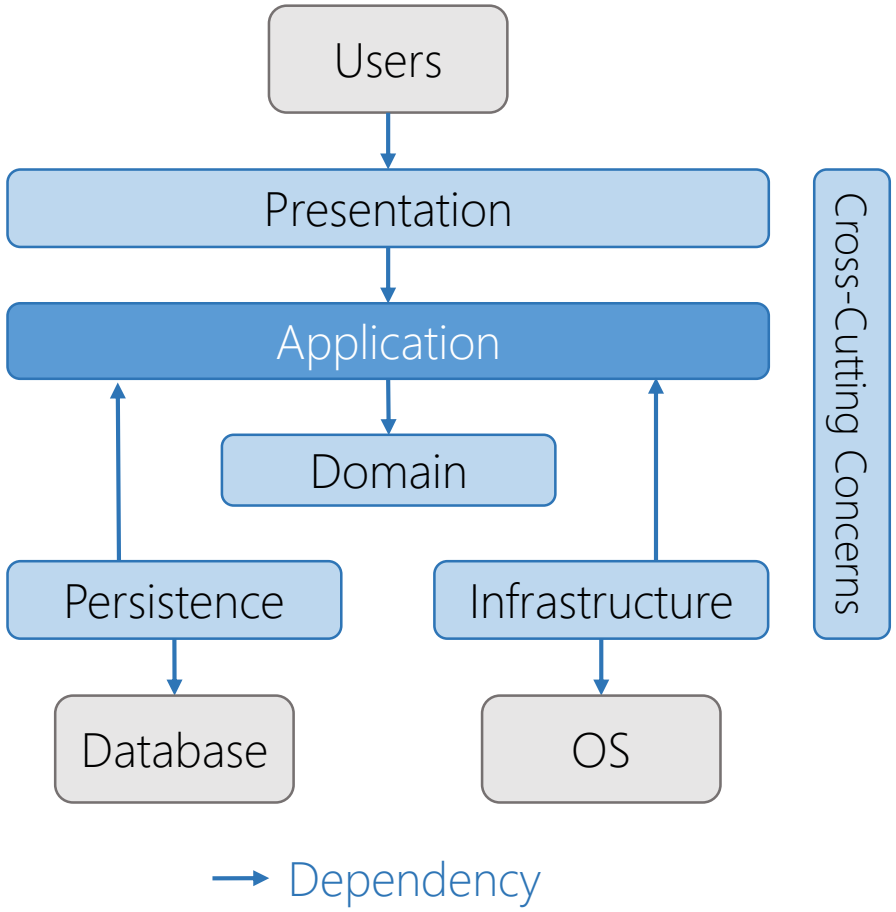
Application Layer

Implements use cases

High-level application logic

Knows about domain

No knowledge of other layers



Application Layer

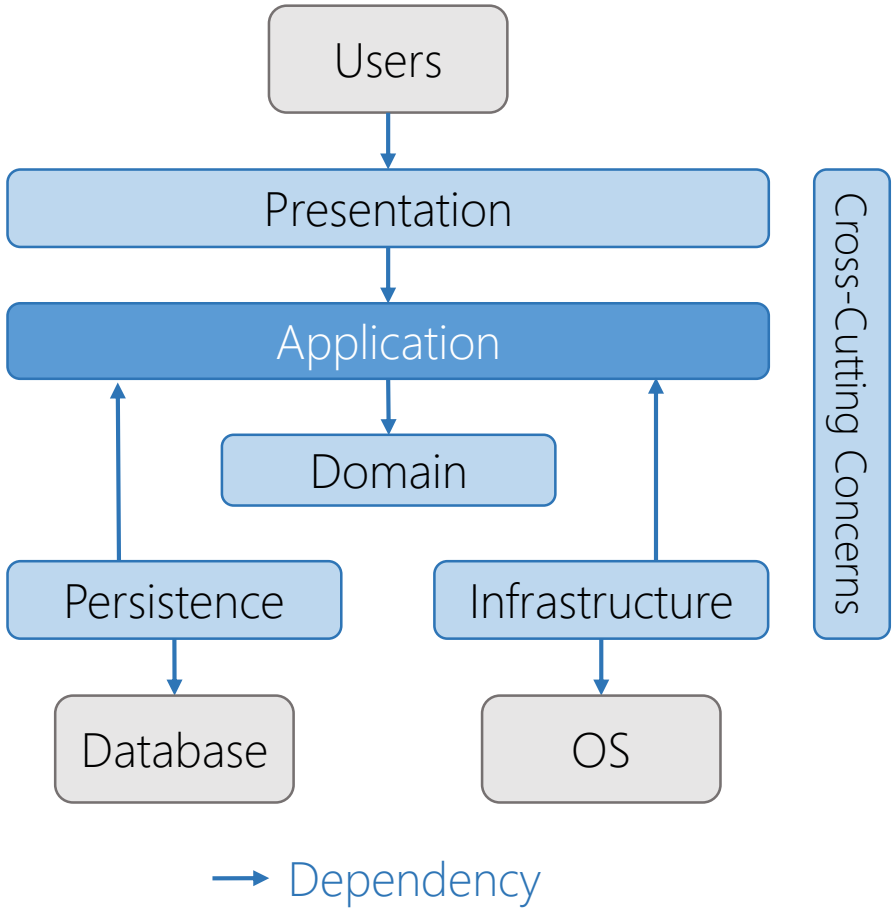
Implements use cases

High-level application logic

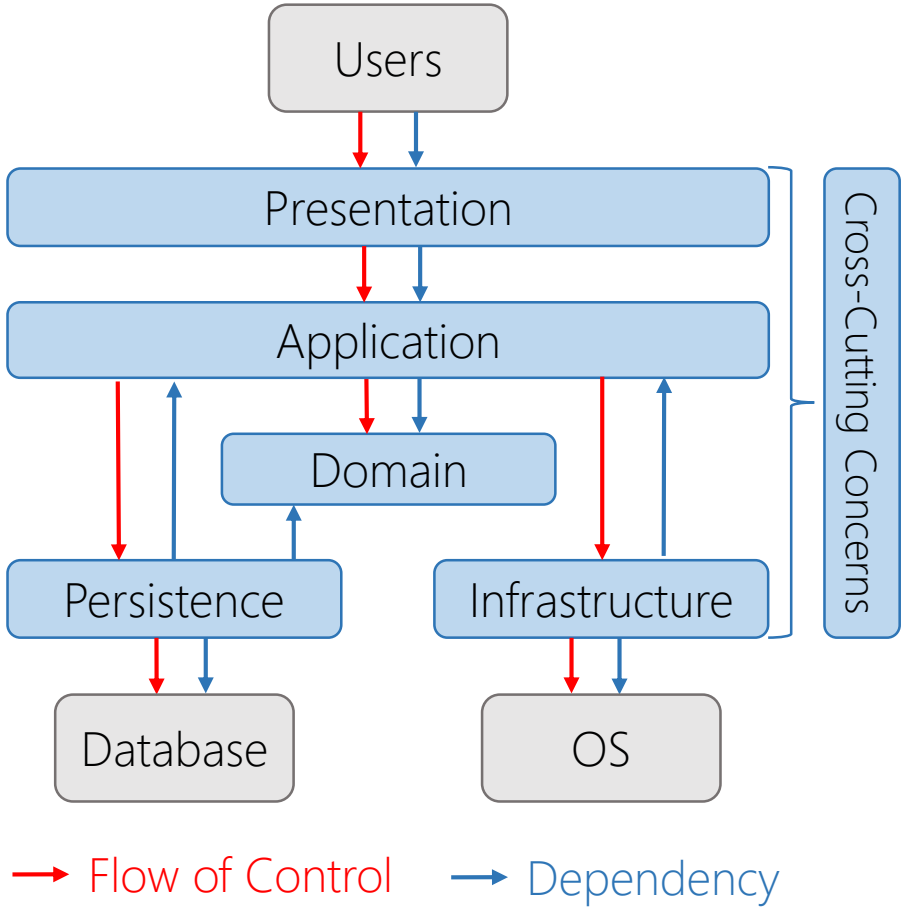
Knows about domain

No knowledge of other layers

Contains interfaces for details

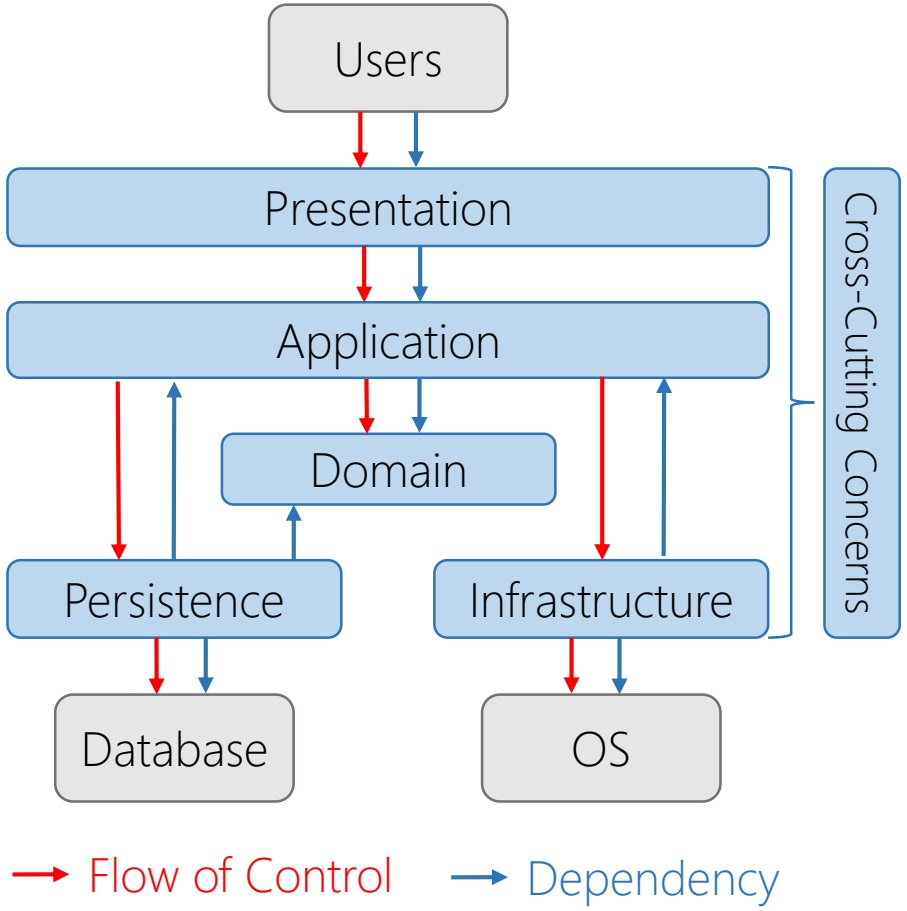


Layer Dependencies



Layer Dependencies

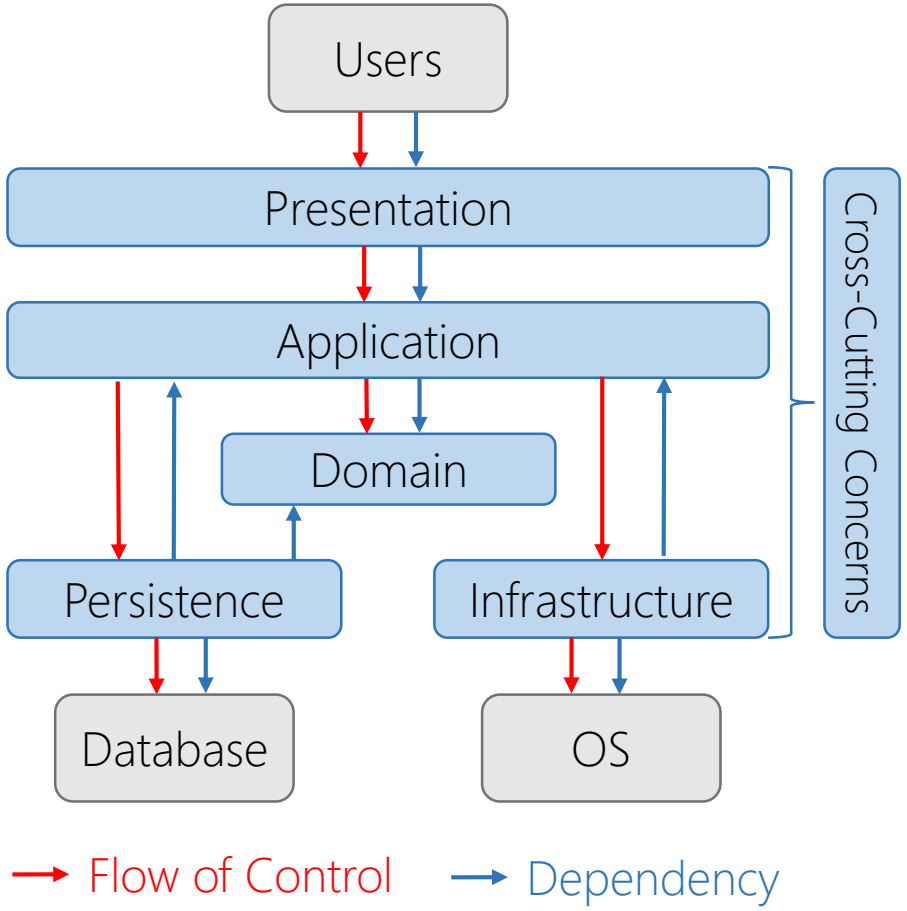
Dependency inversion



Layer Dependencies

Dependency inversion

Inversion of control

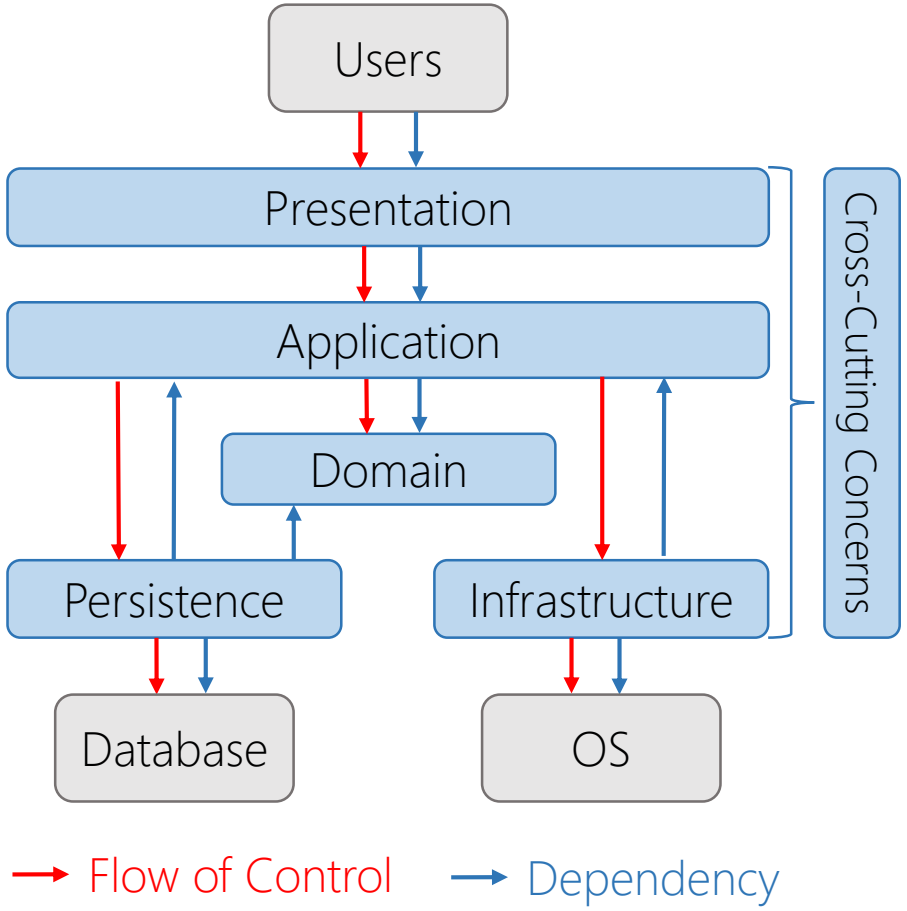


Layer Dependencies

Dependency inversion

Inversion of control

Independent deployability



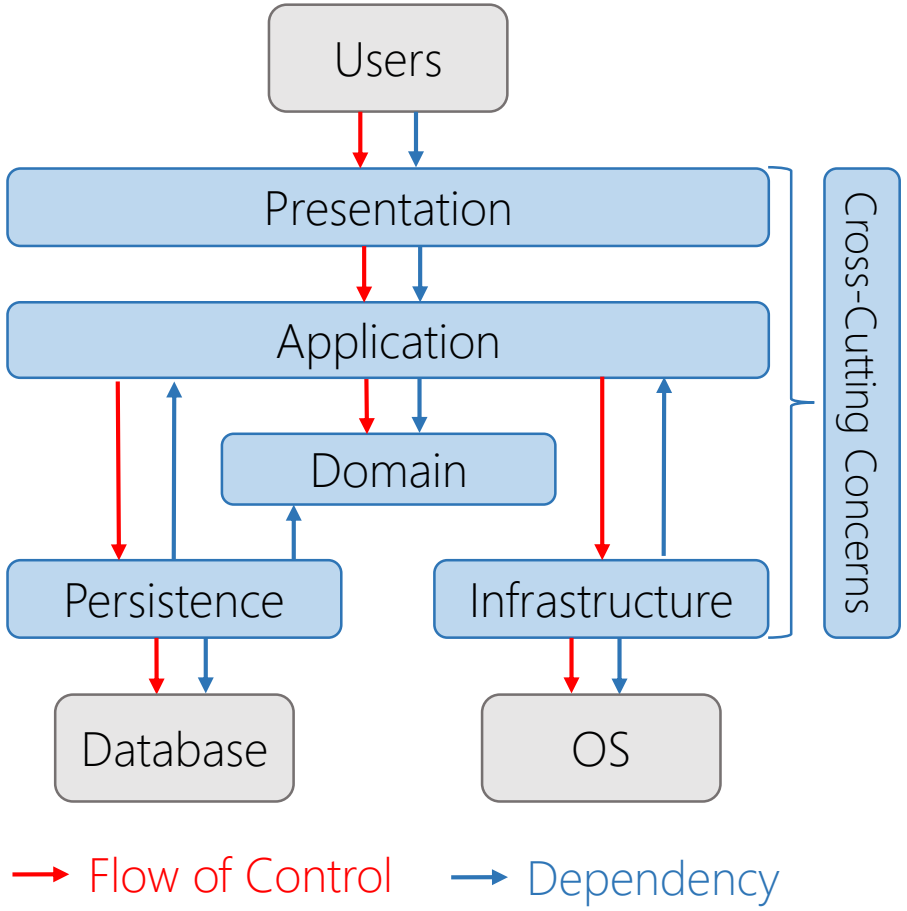
Layer Dependencies

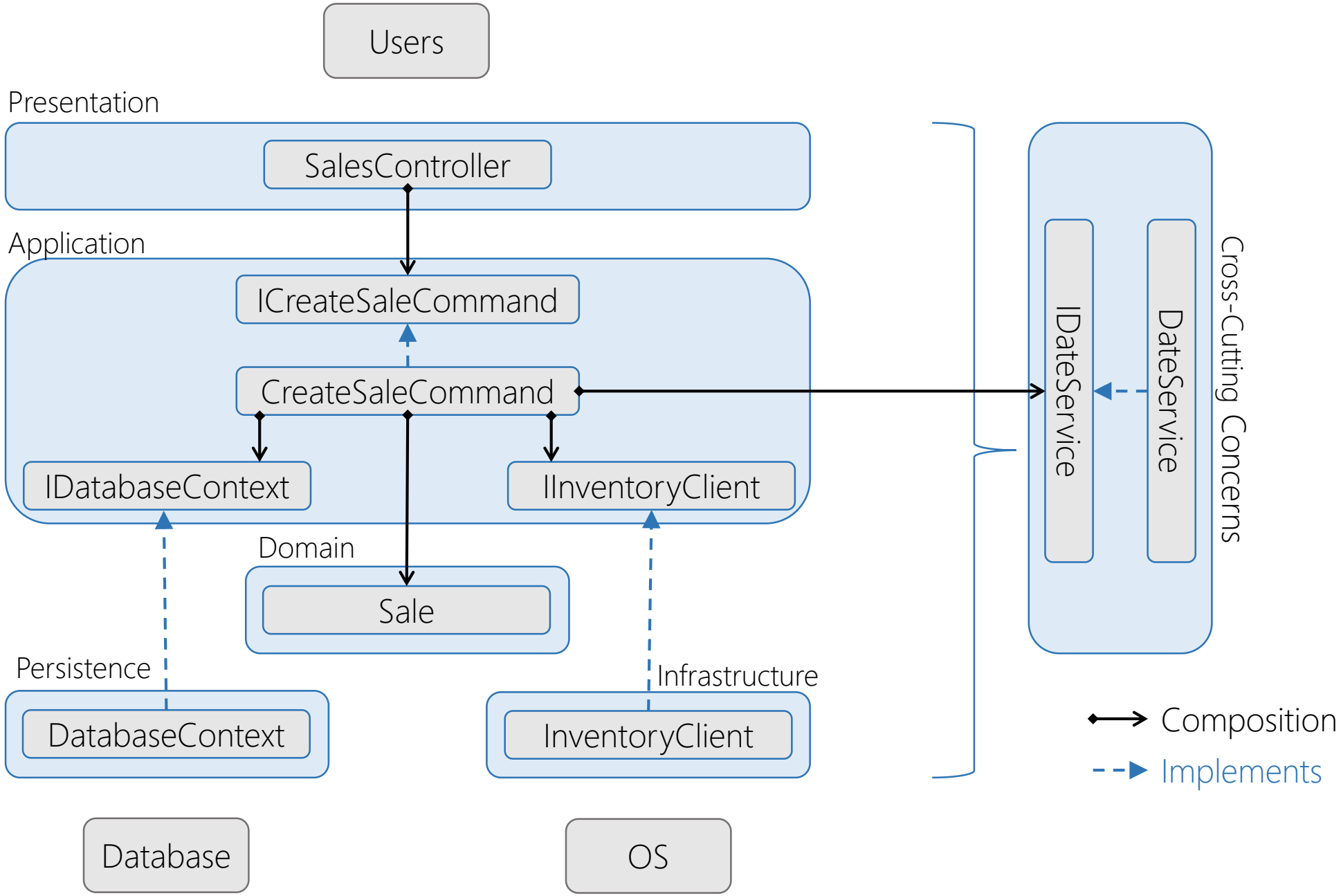
Dependency inversion

Inversion of control

Independent deployability

Flexibility and maintainability




Users
Presentation
SalesController
Application
ICreateSaleCommand
CreateSaleCommand
IDatabaseContext
IInventoryClient
Domain
Sale
Persistence
DatabaseContext
Infrastructure
InventoryClient
Database
OS
IDateService
DateService
Cross-Cutting Concerns
Composition
Implements

Why Use an Application Layer?

Pros

Focus is on use cases

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Easy to understand

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Additional cost

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Additional cost

Requires extra thought

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Pros

Focus is on use cases

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Follows DIP

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Requires extra thought

IoC is counter-intuitive

Commands and Queries

Command-Query Separation

Command

Does something

Should modify state

Should not return a value

Command-Query Separation

Command

Does something

Should modify state

Should not return a value

Query

Answers a question

Should not modify state

Always returns a value

Command-Query Separation

Command

Does something

Should modify state

Should not return a value *(ideally)*

Query

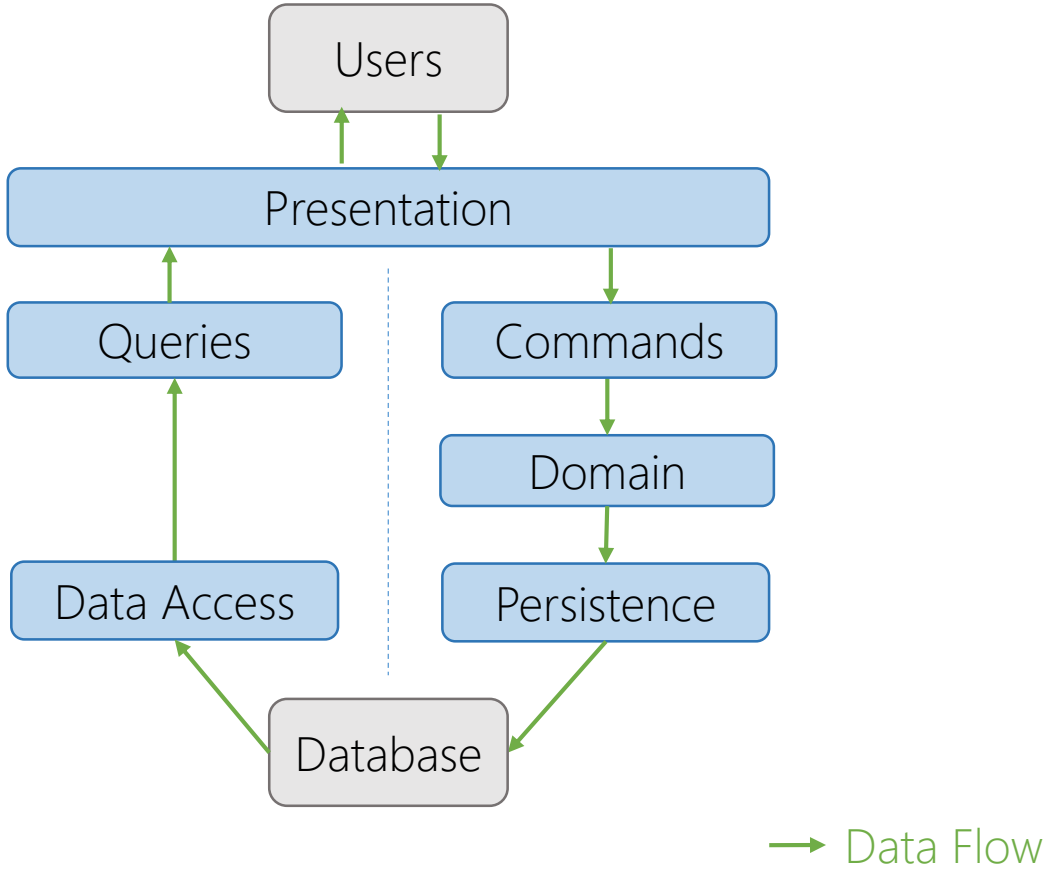
Answers a question

Should not modify state

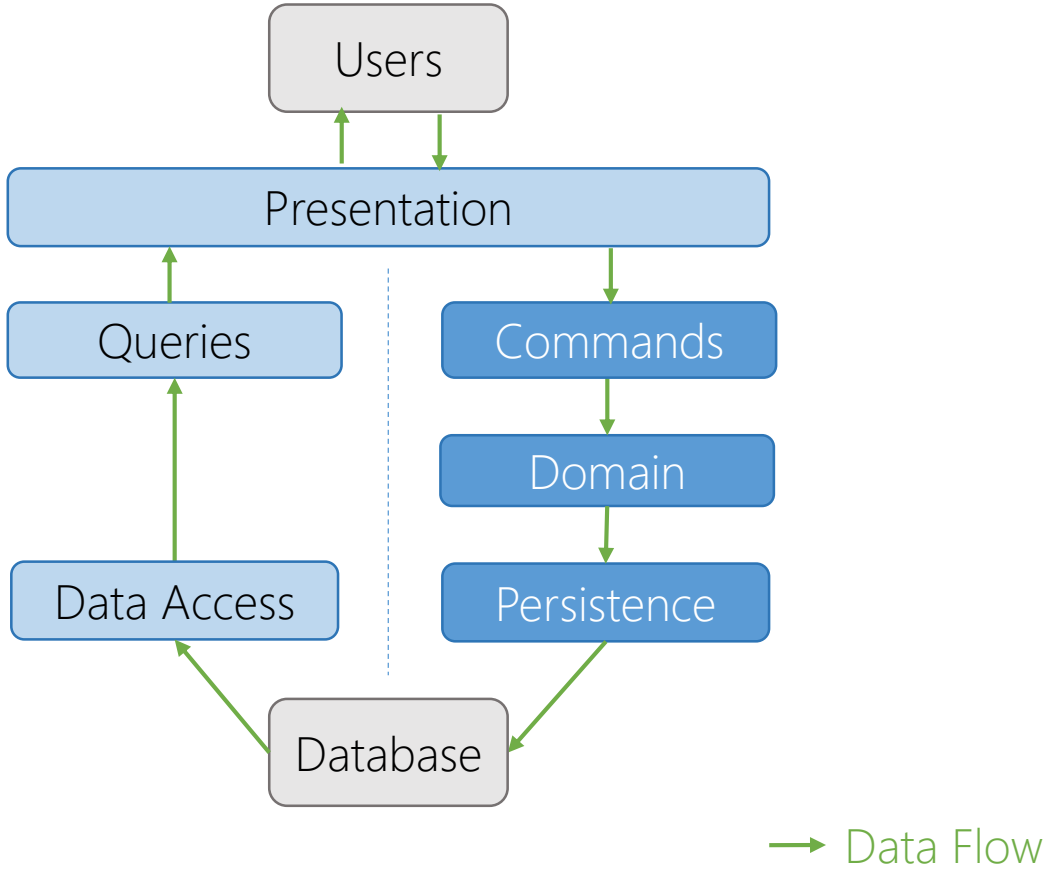
Always returns a value

Avoid mixing the two!

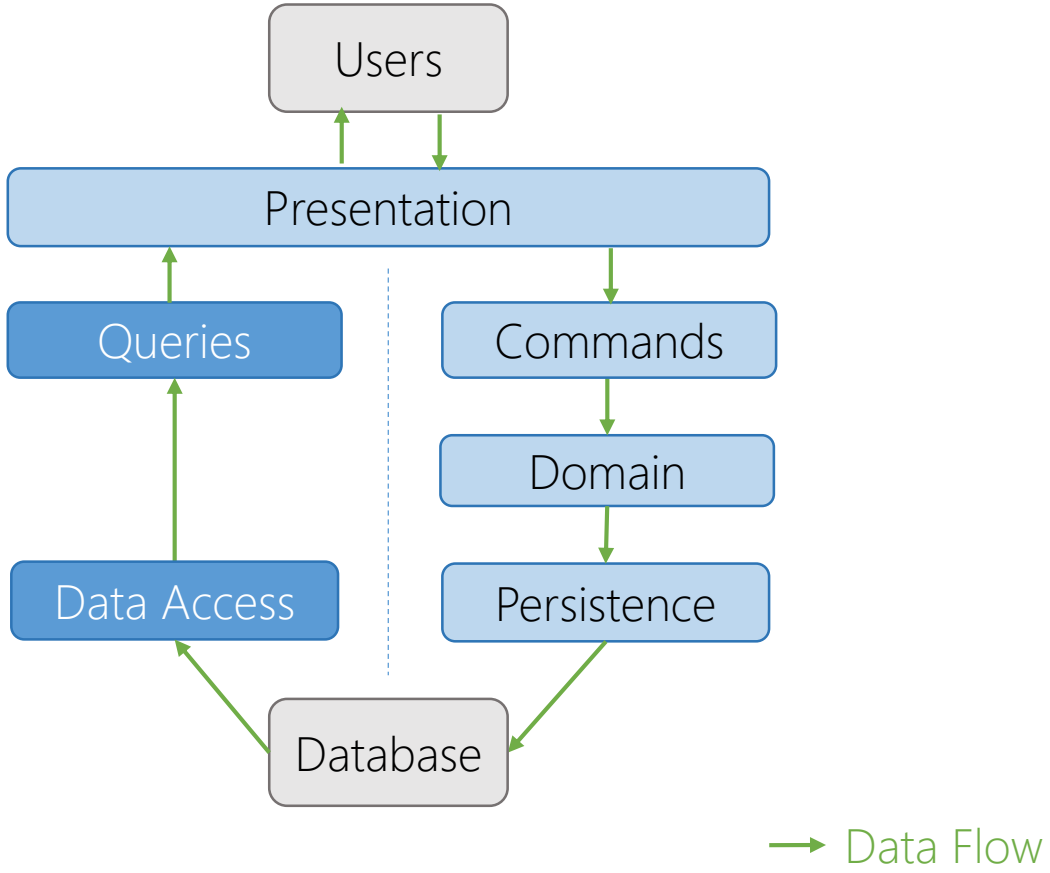
CQRS Architectures



CQRS Architectures



CQRS Architectures



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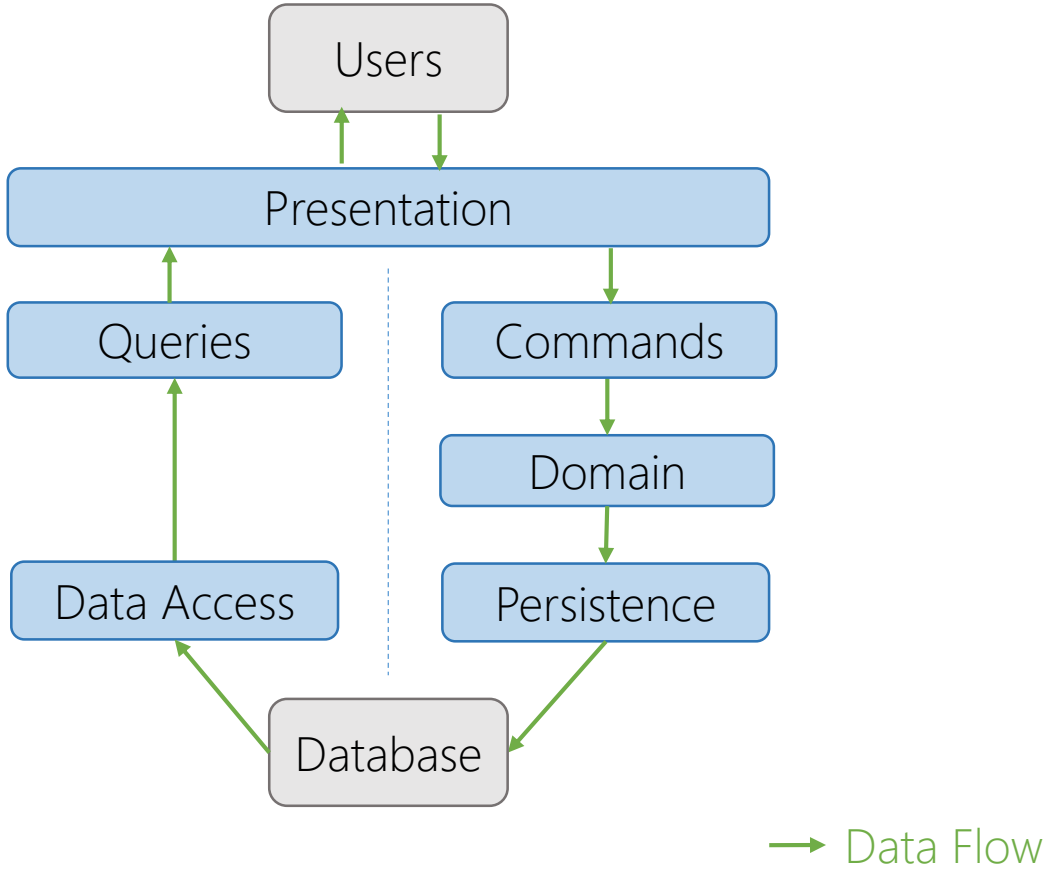
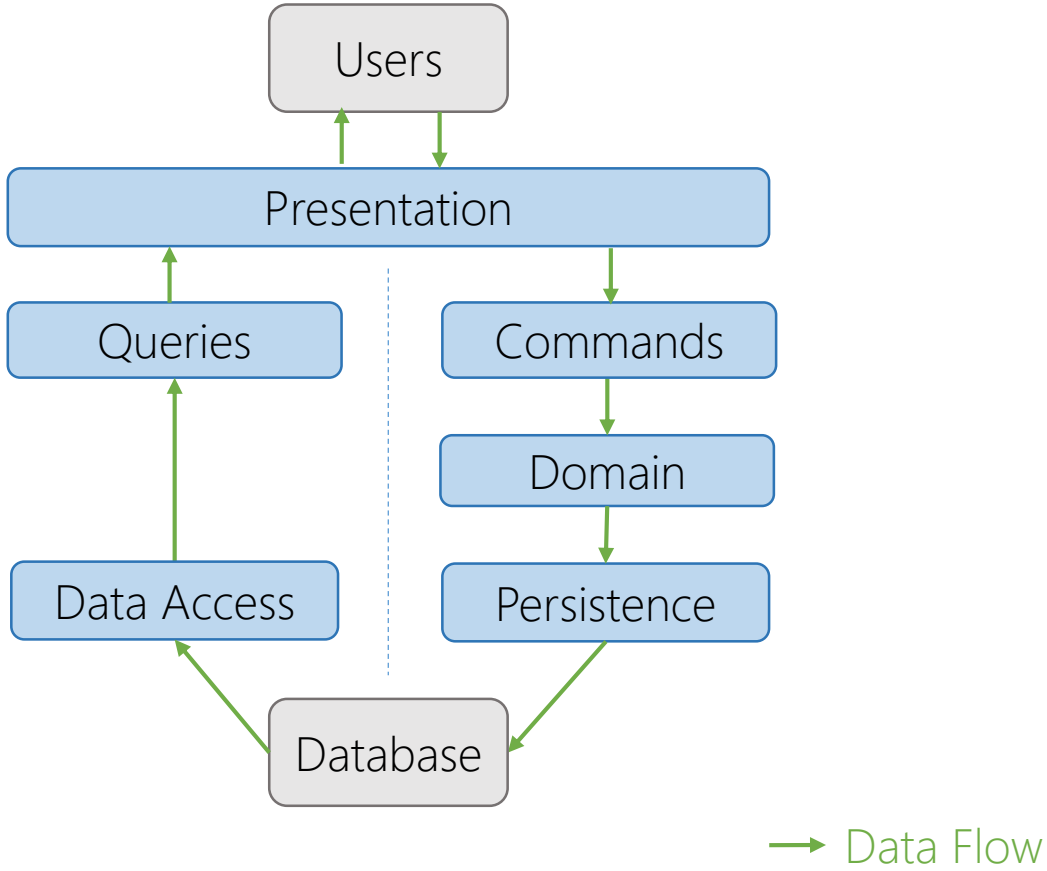


CQRS Type 1 – Single Database



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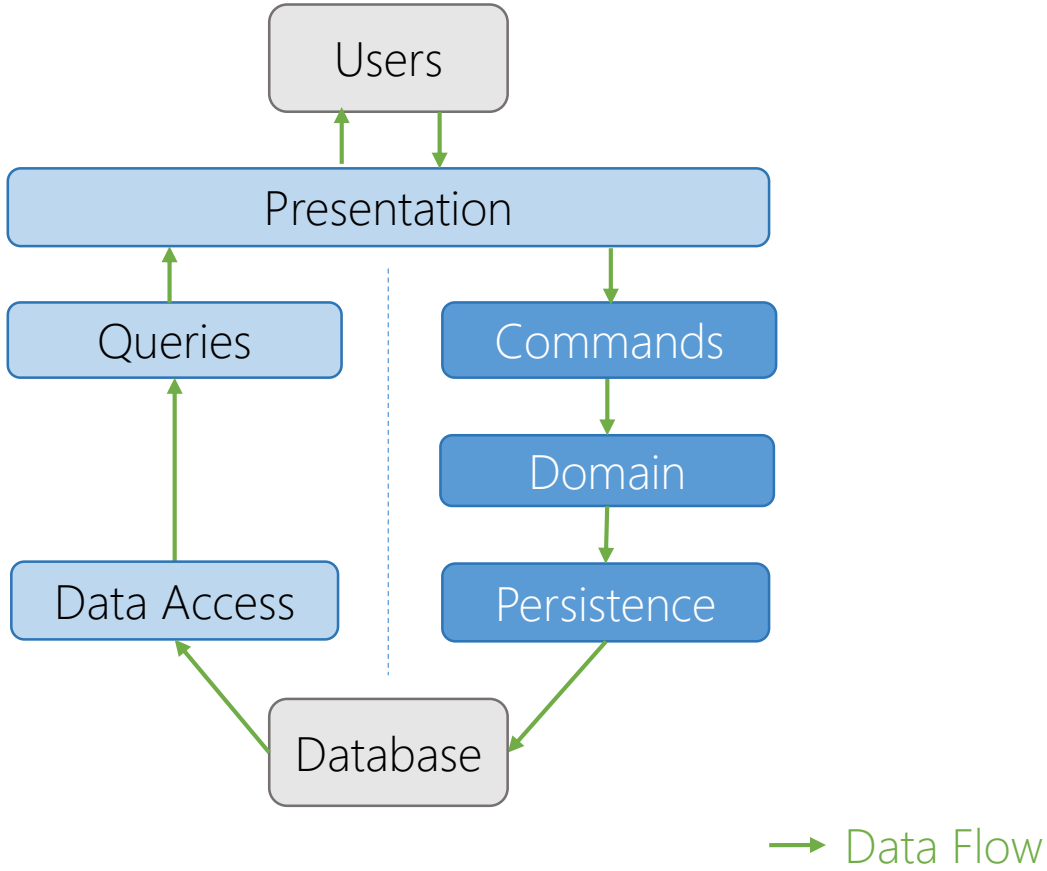

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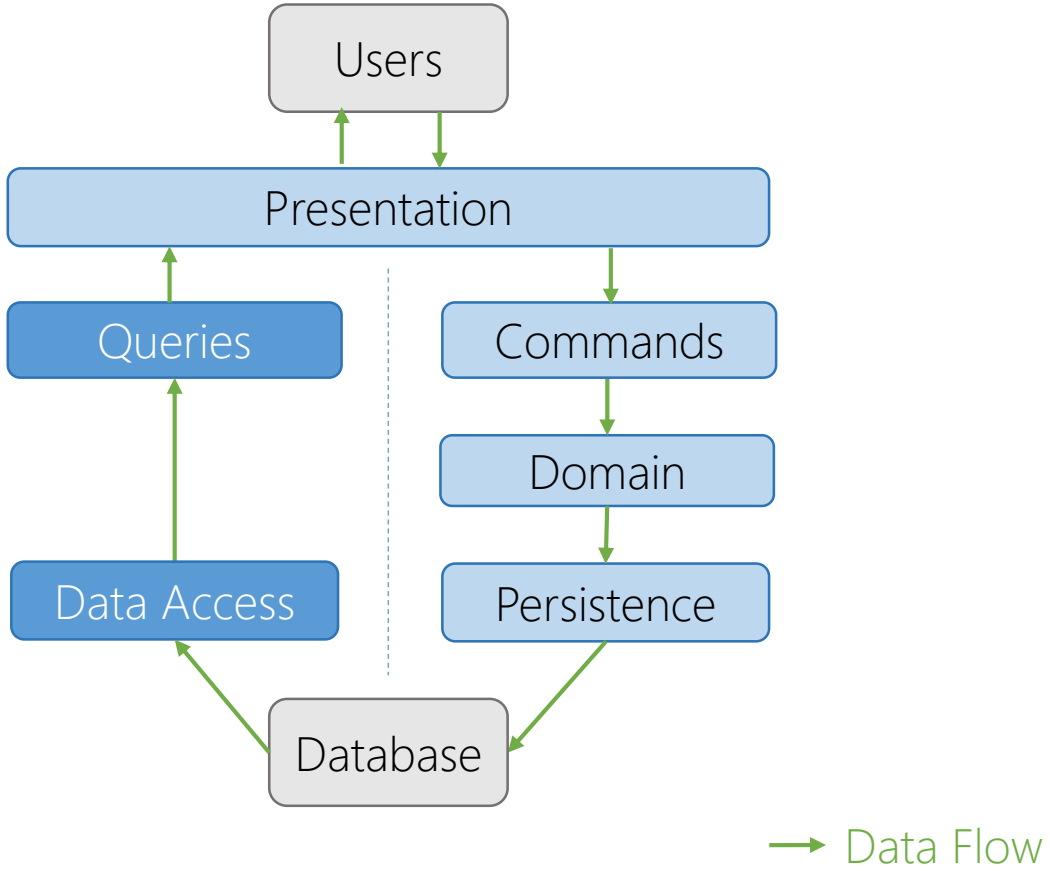
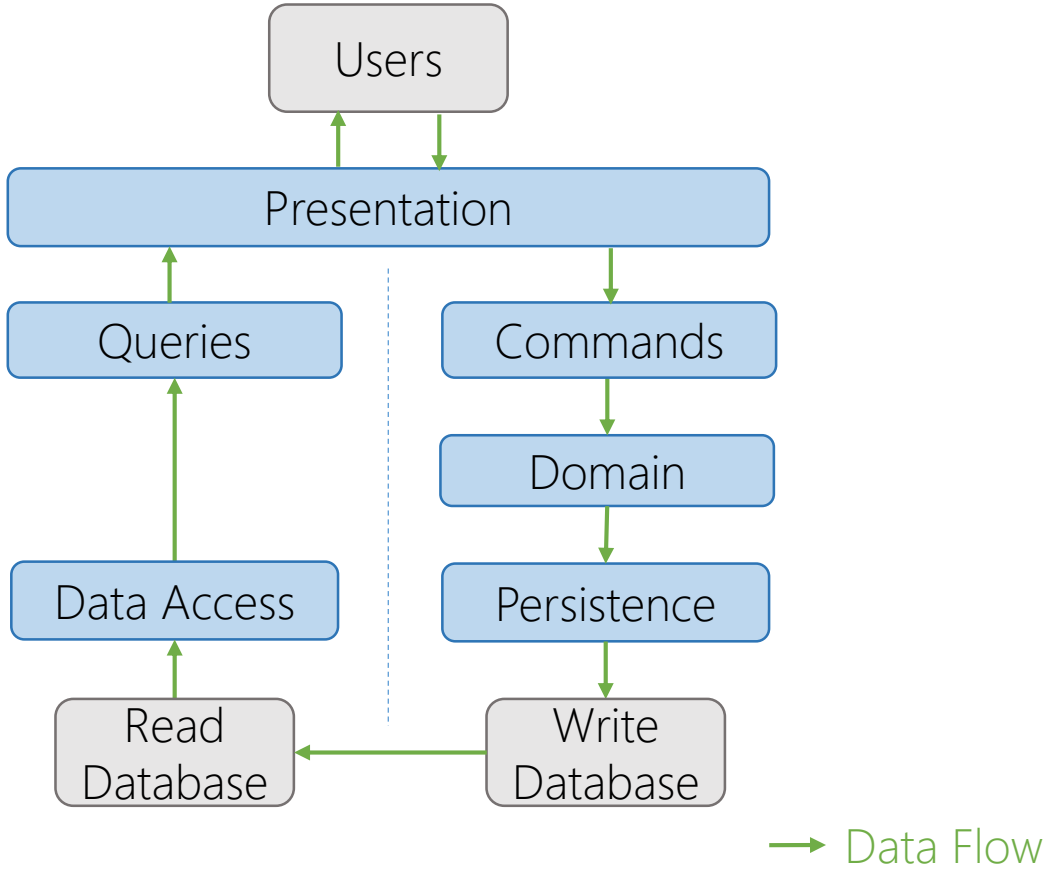


CQRS Type 2 – Read/Write Databases



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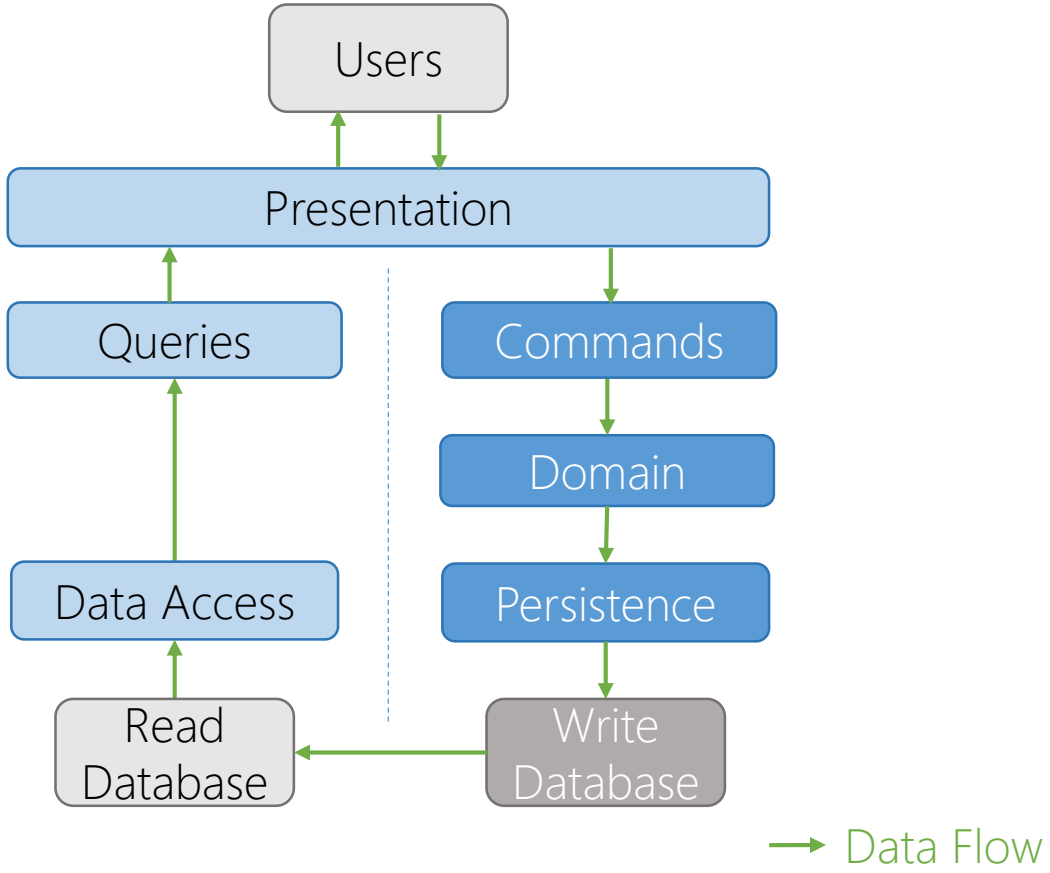

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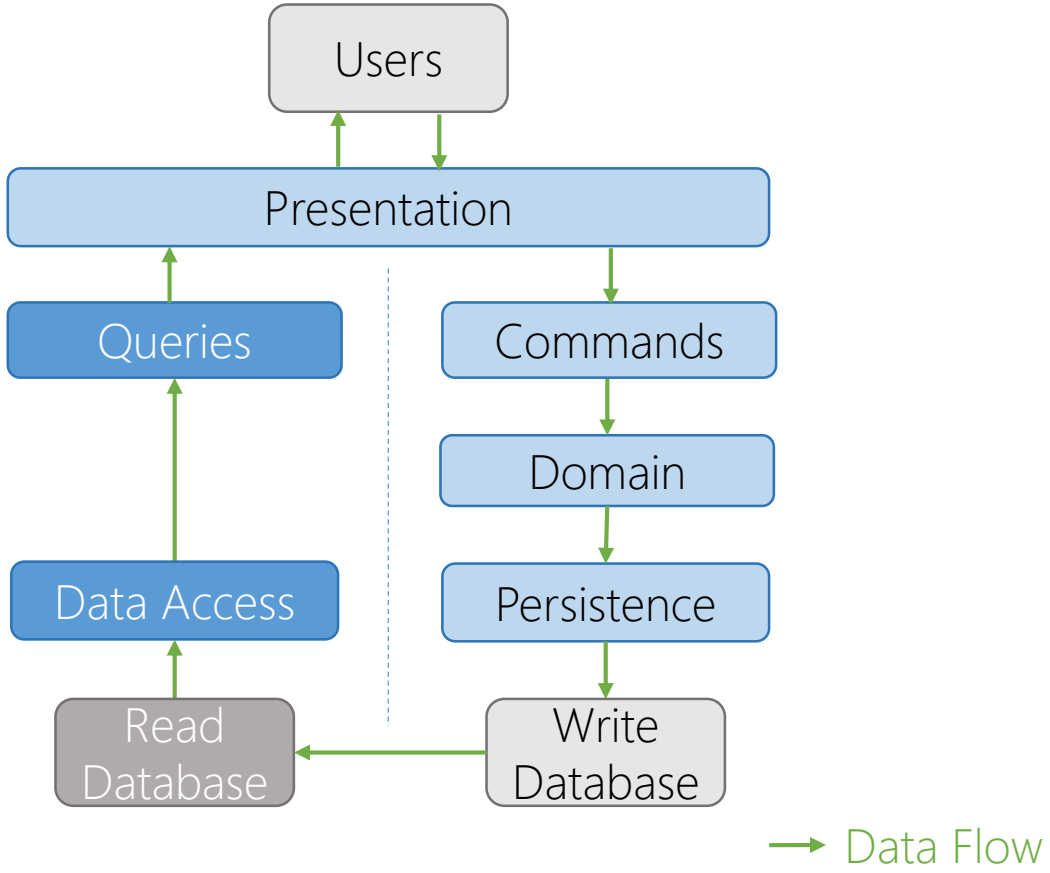
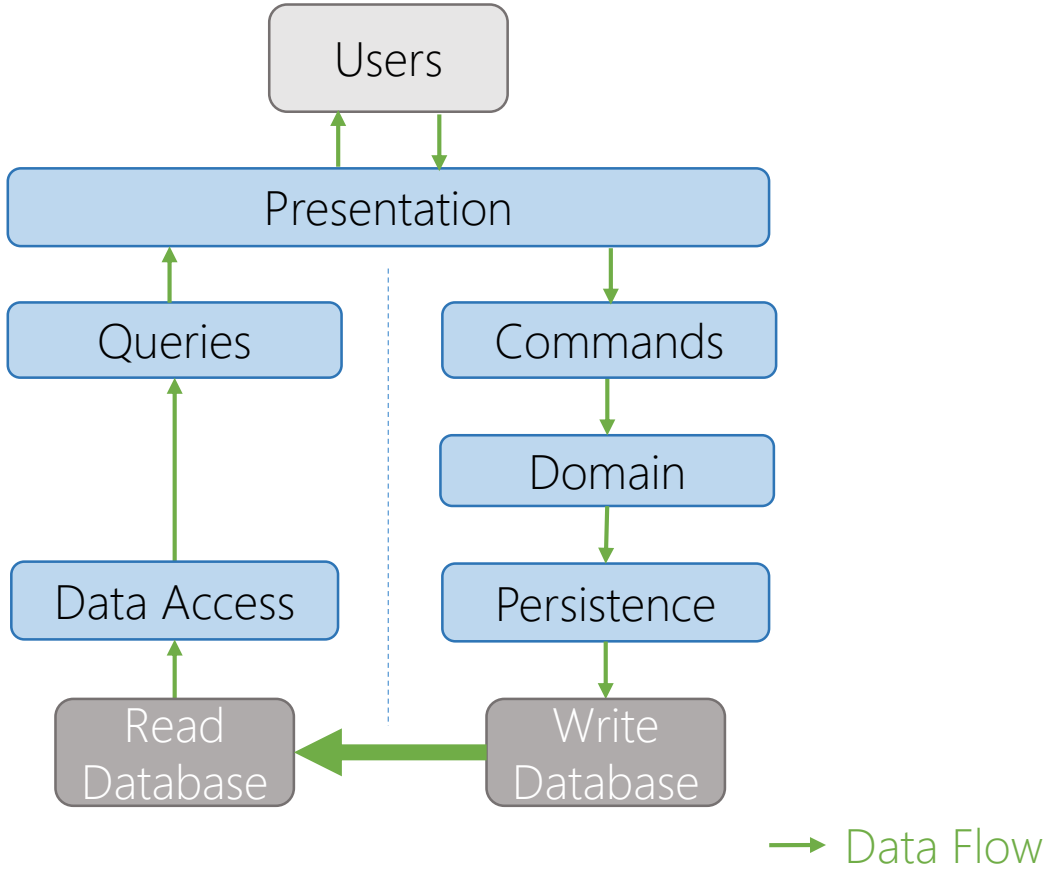


CQRS Type 2 – Read/Write Databases



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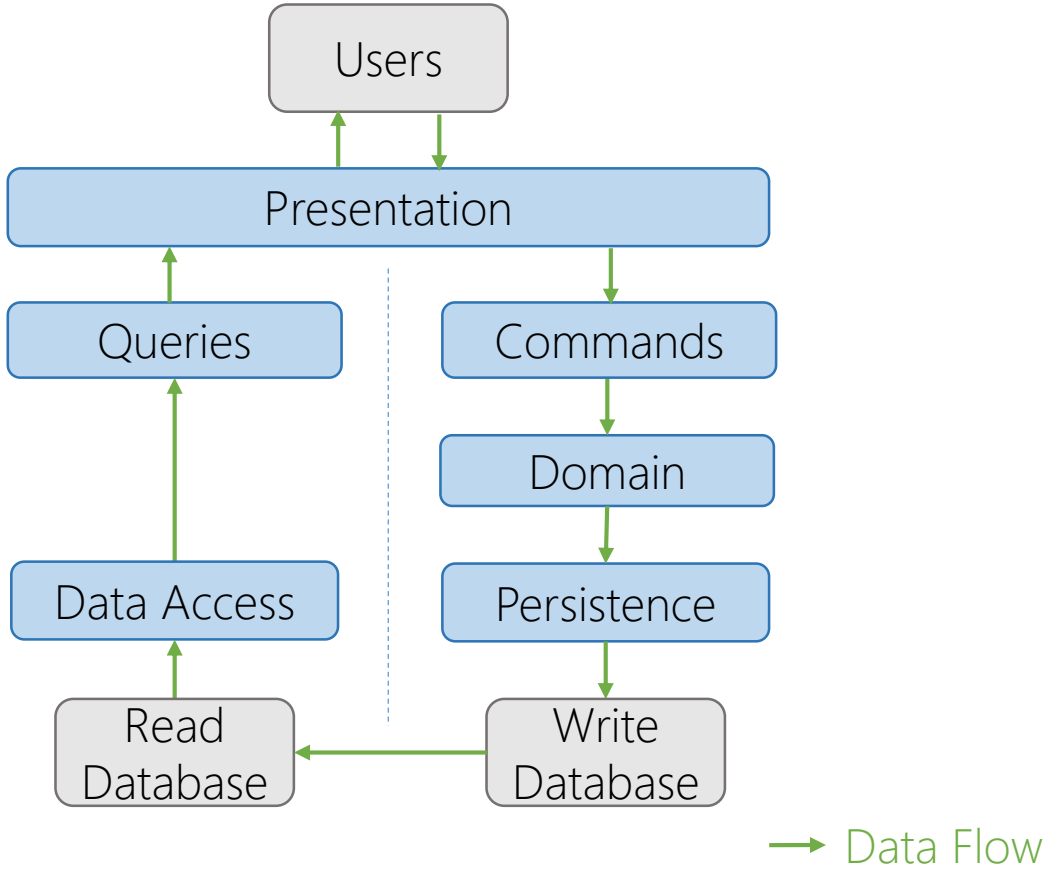
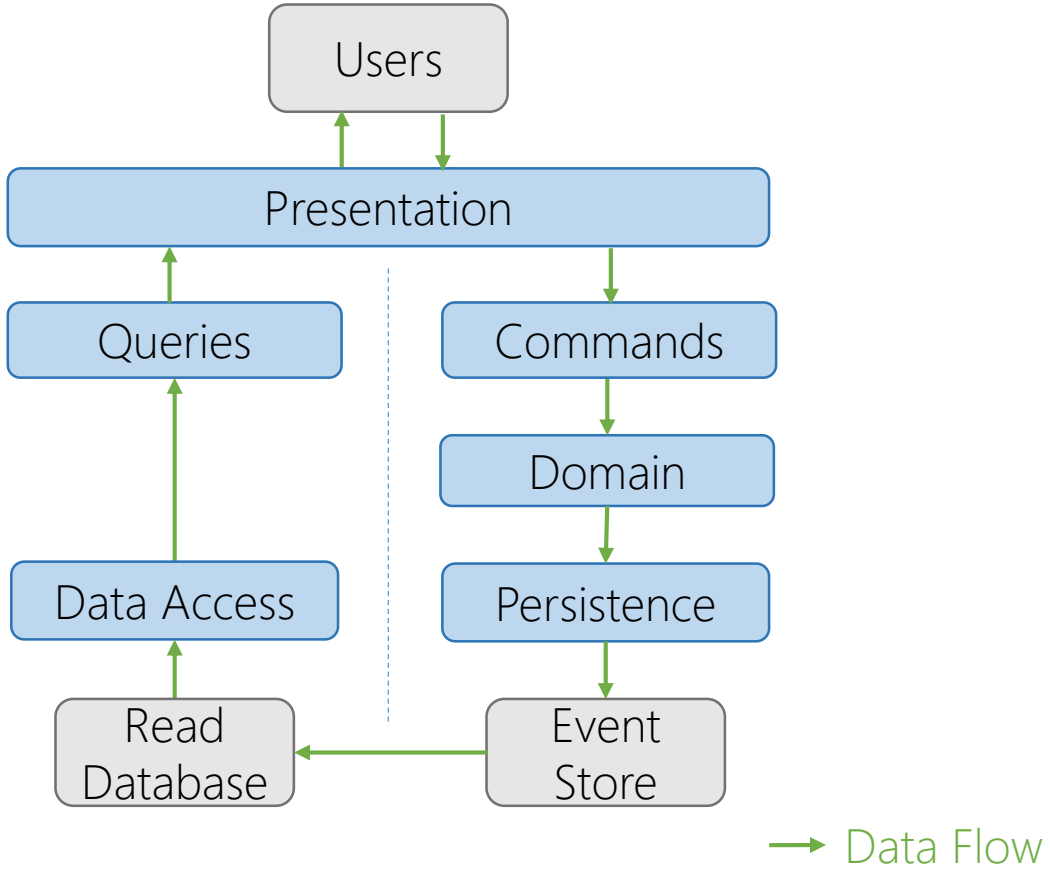
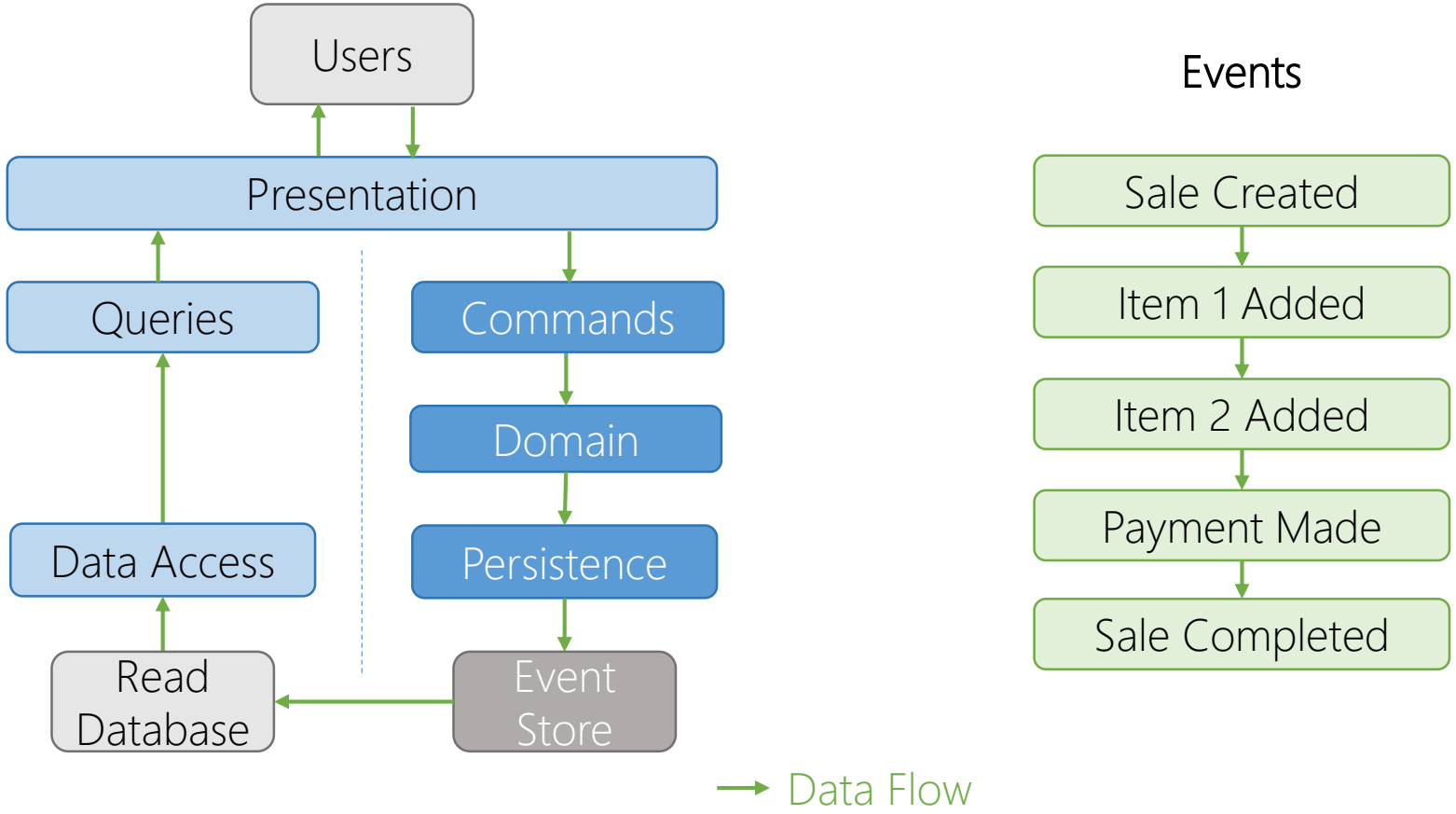


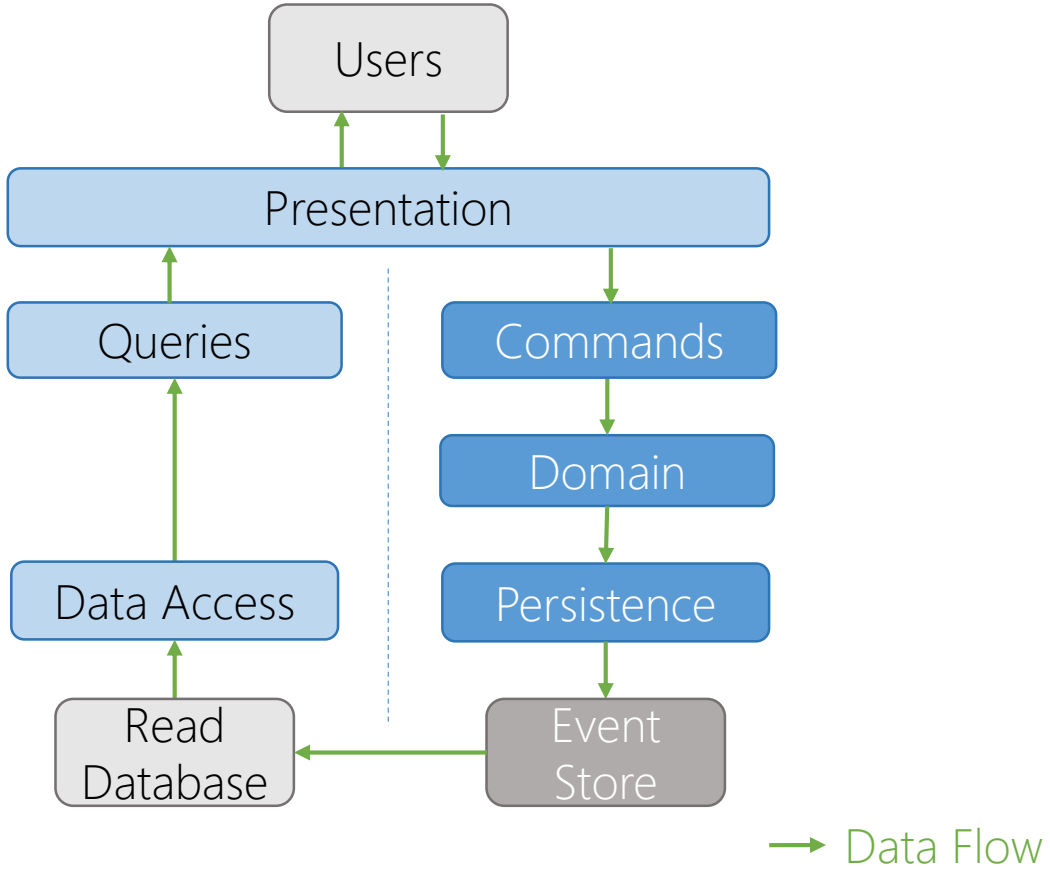
CQRS Type 3 – Event Sourcing



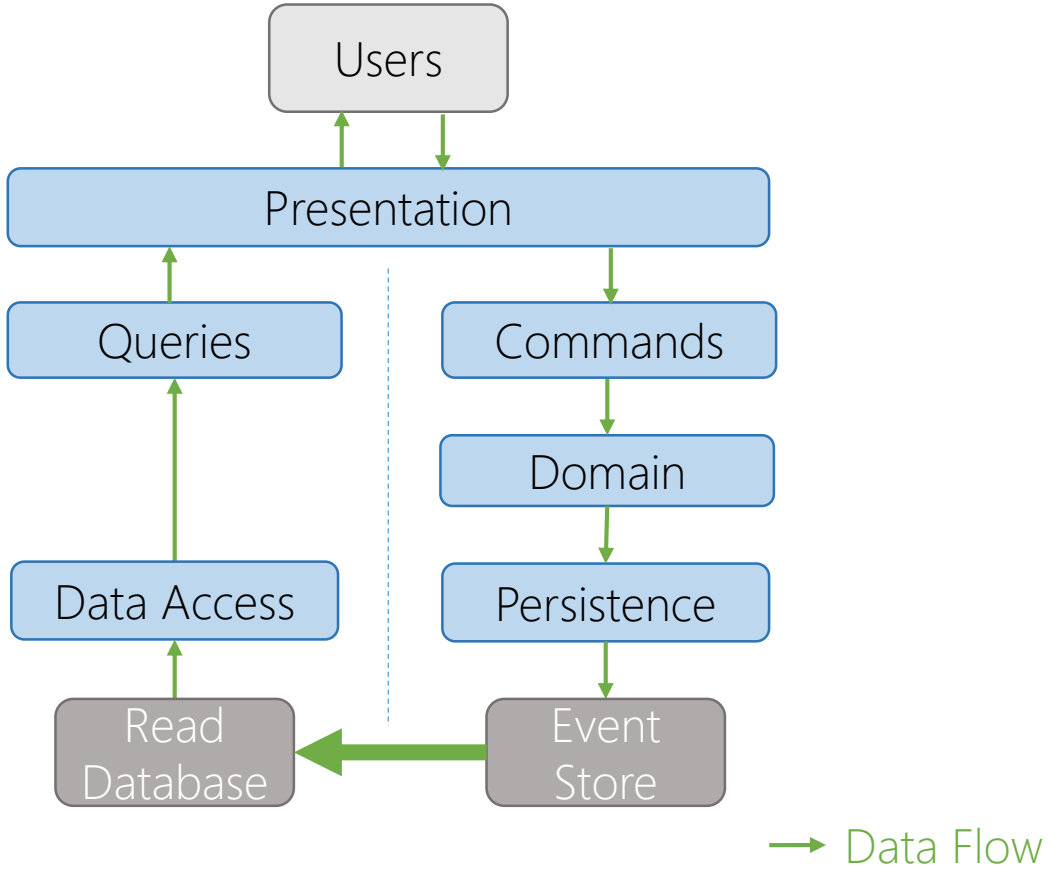
CQRS Type 3 – Event Sourcing



CQRS Type 3 – Event Sourcing



CQRS Type 3 – Event Sourcing



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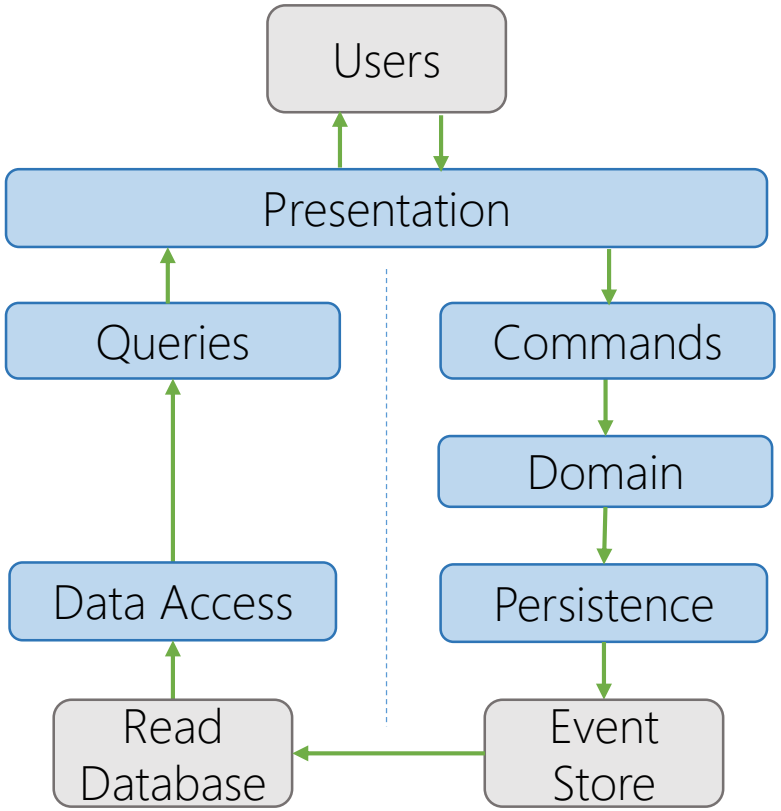
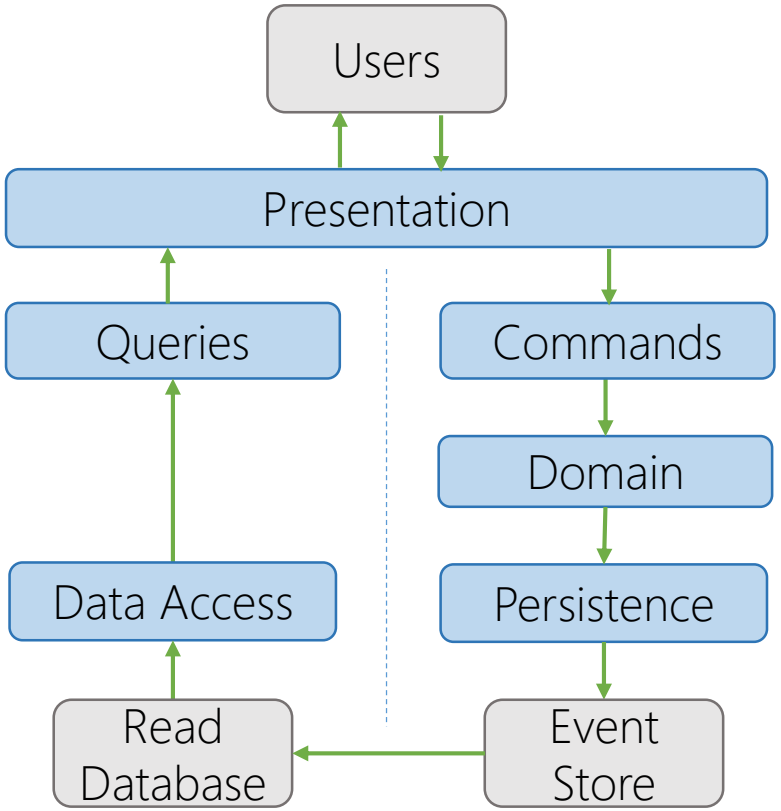


CQRS Type 3 – Event Sourcing

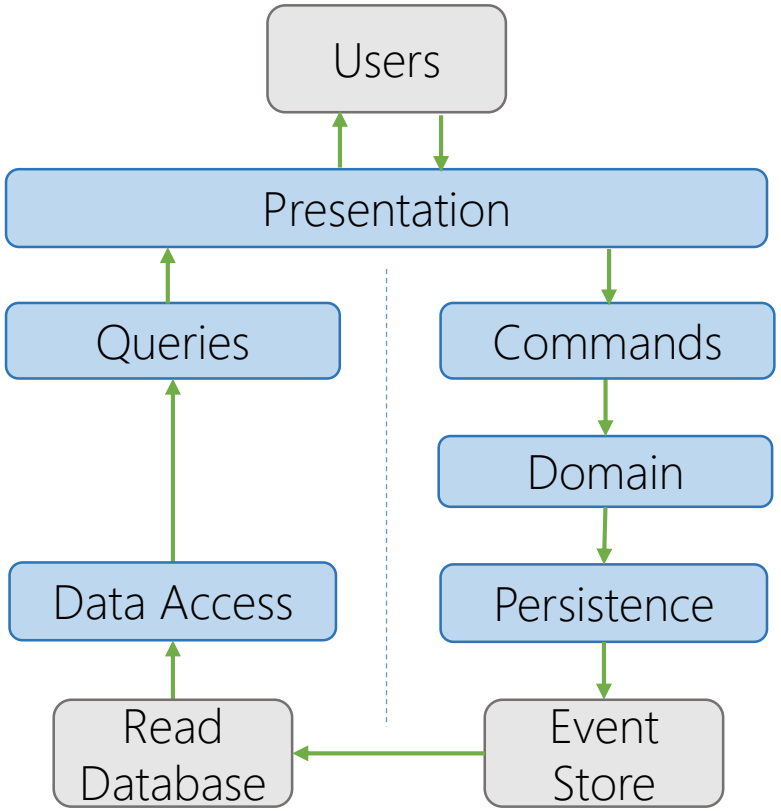
Complete audit trail



CQRS Type 3 – Event Sourcing

Complete audit trail

Point-in-time reconstruction

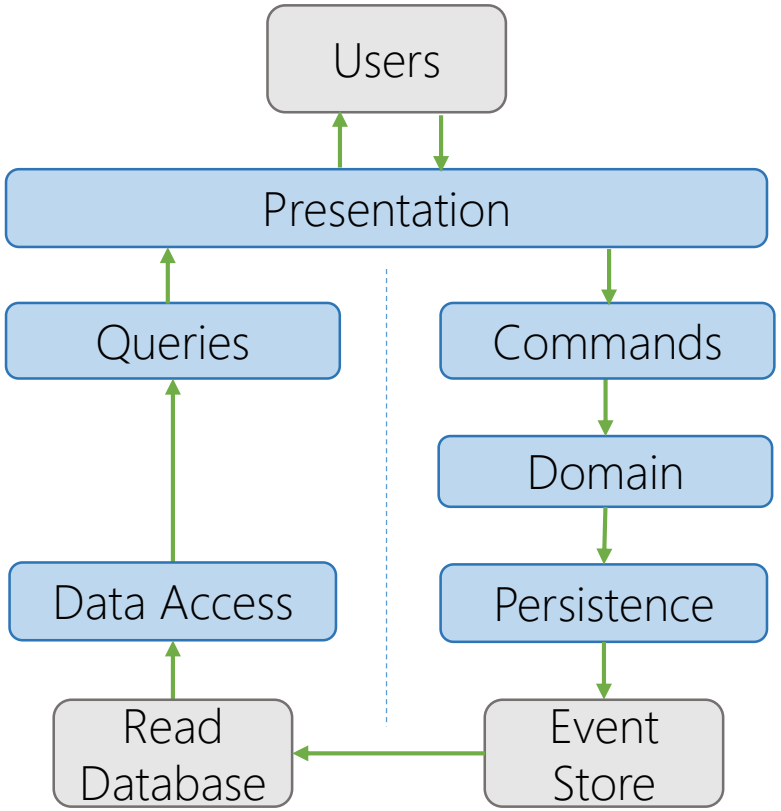


CQRS Type 3 – Event Sourcing

Complete audit trail

Point-in-time reconstruction

Replay events



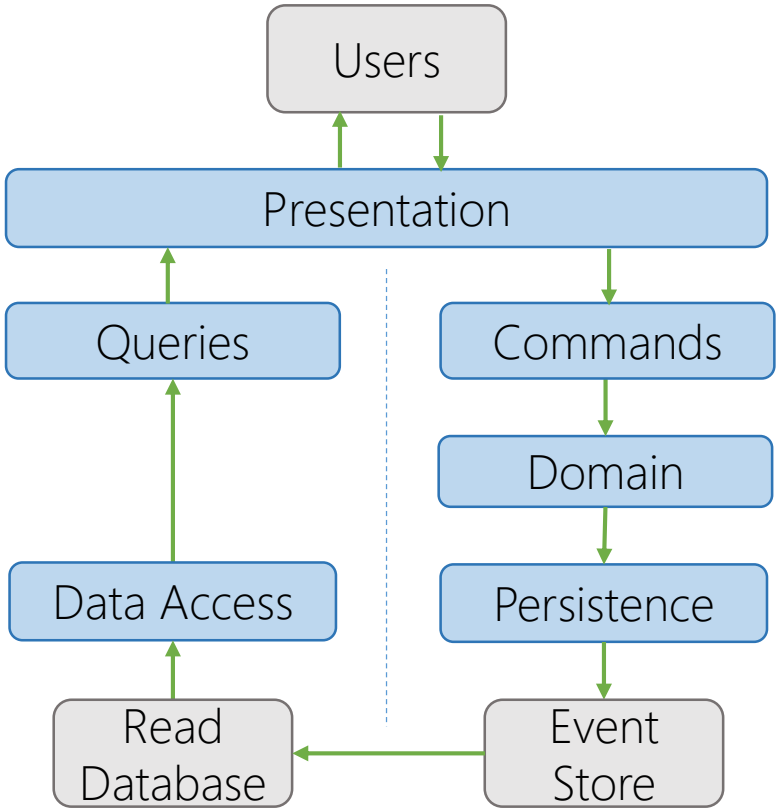
CQRS Type 3 – Event Sourcing

Complete audit trail

Point-in-time reconstruction

Replay events

Rebuild production database



Why Use CQRS?

Pros

More efficient design

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Pros

More efficient design

Simpler within each stack

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Simpler within each stack

Optimized performance

Why Use CQRS?

Pros

More efficient design

Simpler within each stack

Optimized performance

Cons

Inconsistent across stacks

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Simpler within each stack

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Inconsistent across stacks

Type 2 is more complex

Why Use CQRS?

Pros

More efficient design

Simpler within each stack

Optimized performance

Cons

Inconsistent across stacks

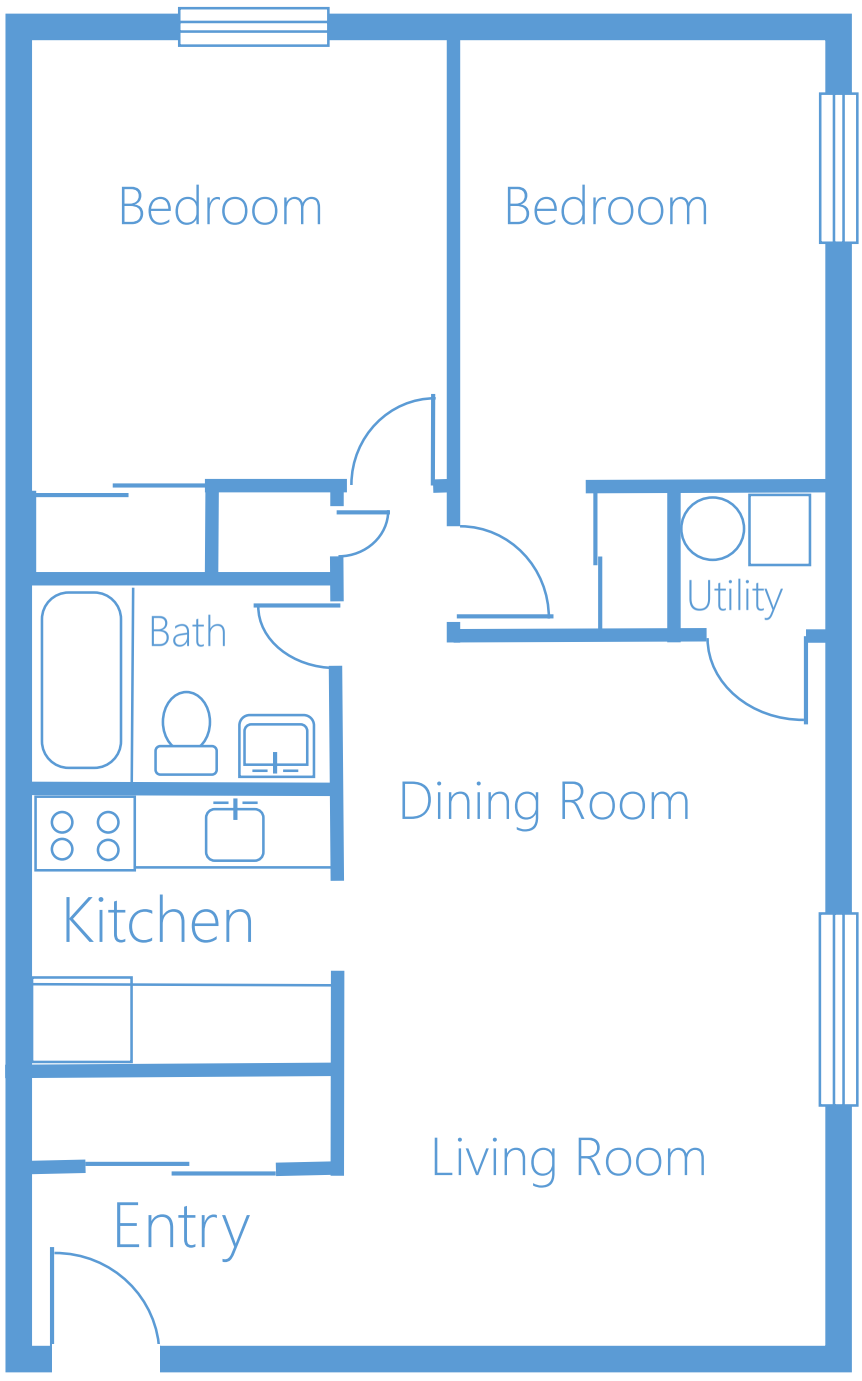
Type 2 is more complex

Type 3 might be overkill

Functional Organization

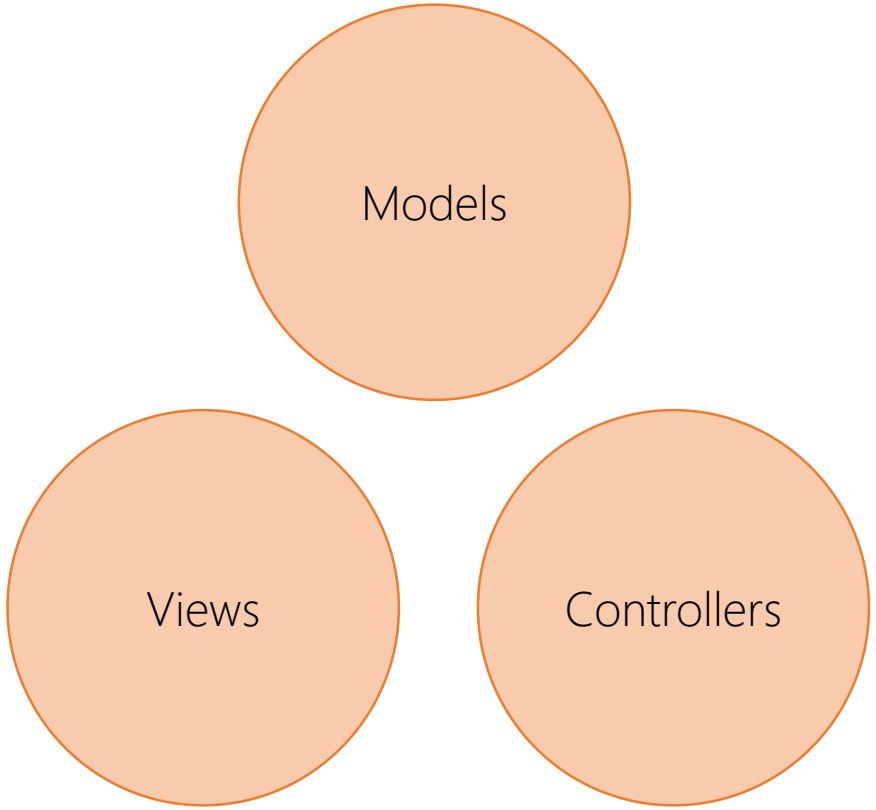
"The architecture should scream the intent of the system!"

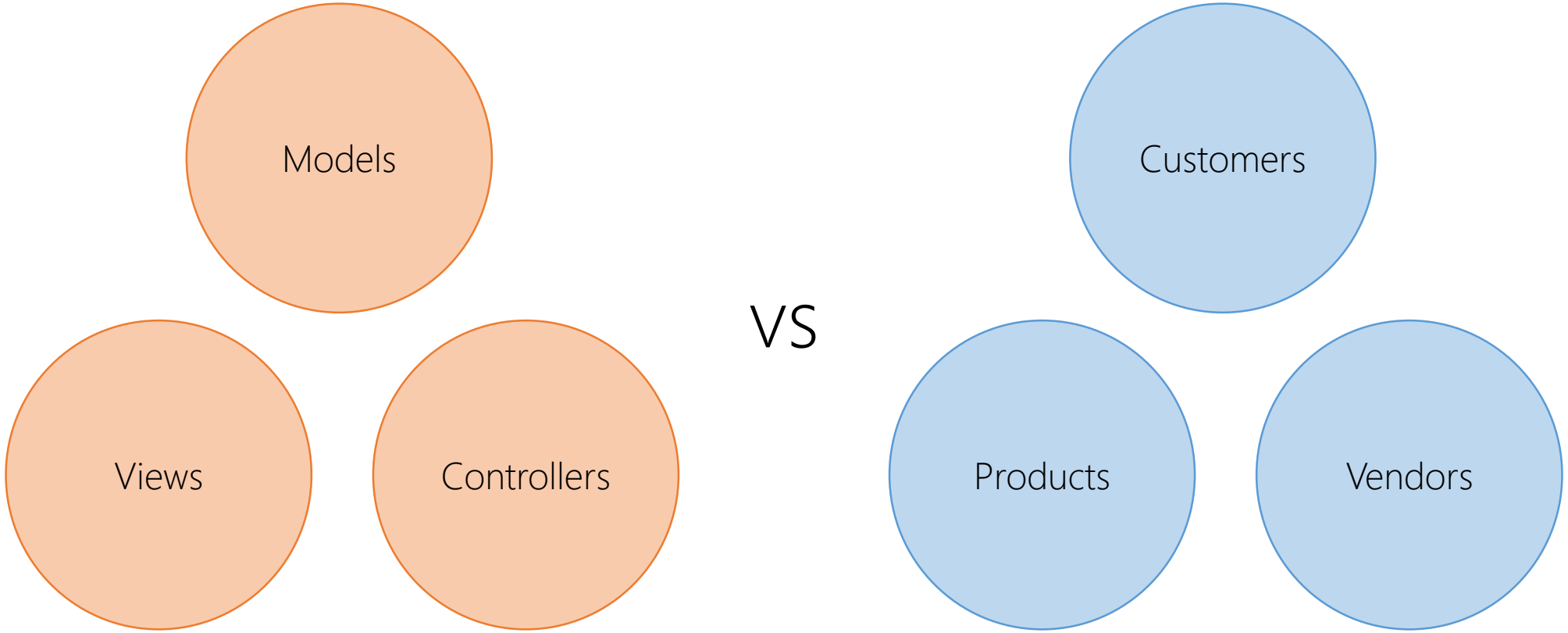
– Uncle Bob


Bedroom
Bedroom
Utility
Bath
Dining Room
Kitchen
Living Room
Entry

Utility
Bath

Material	Quantity	Cost
Appliances	5	$5,000
Cabinets	10	$2,500
Doors	15	$750
Fixtures	12	$2,400
Floors	9	$4,000
Walls	20	$10,000
Windows	8	$2,500


Models
Views
Controllers


Models
Views
Controllers
VS
Customers
Products
Vendors

- Content
- Controllers
- Models
- Scripts
- Views

Content
Controllers
Models
Scripts
Views

vs

Customers
Employees
Products
Sales
Vendors

So what?

512

VS

Why Use Functional Organization

Pros

Spatial locality

Why Use Functional Organization

Pros

Spatial locality

Easy to navigate

Why Use Functional Organization

Pros

Spatial locality

Easy to navigate

Avoid vendor lock-in

Why Use Functional Organization

Pros

Spatial locality

Easy to navigate

Avoid vendor lock-in

Cons

Lose framework conventions

Why Use Functional Organization

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Lose framework conventions

Lose automatic scaffolding

Why Use Functional Organization

Pros

Spatial locality

Easy to navigate

Avoid vendor lock-in

Cons

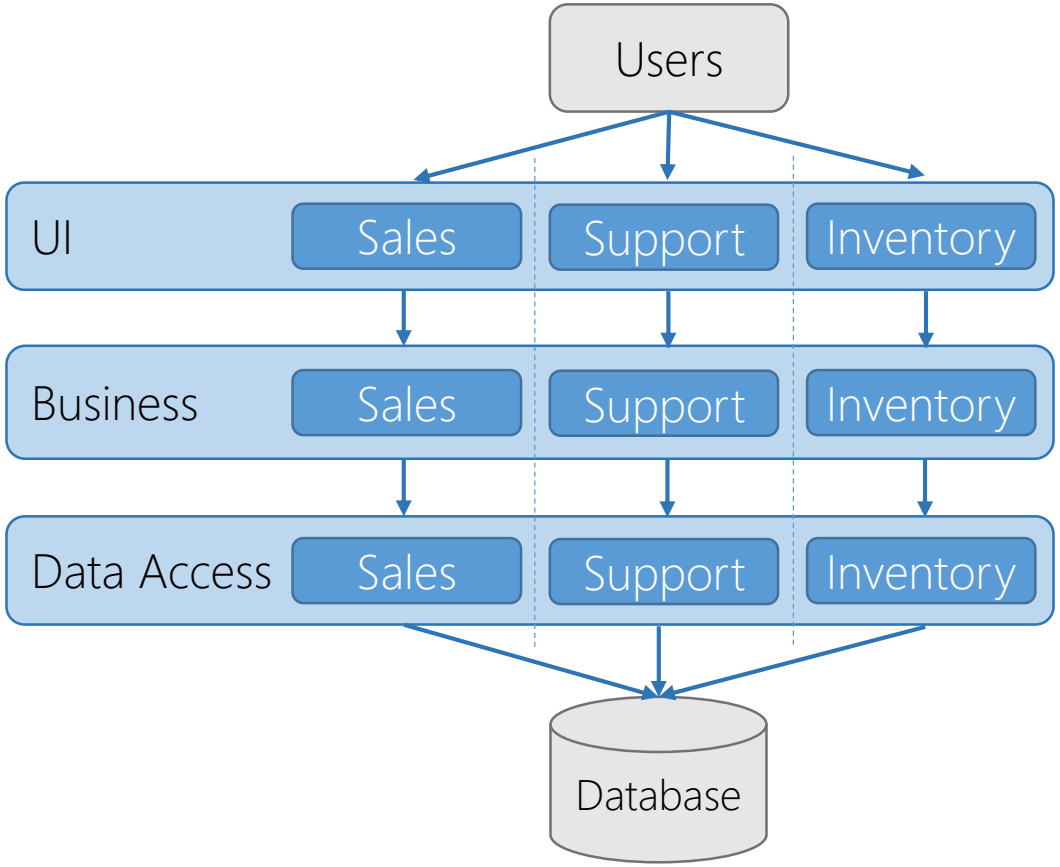
Lose framework conventions

Lose automatic scaffolding

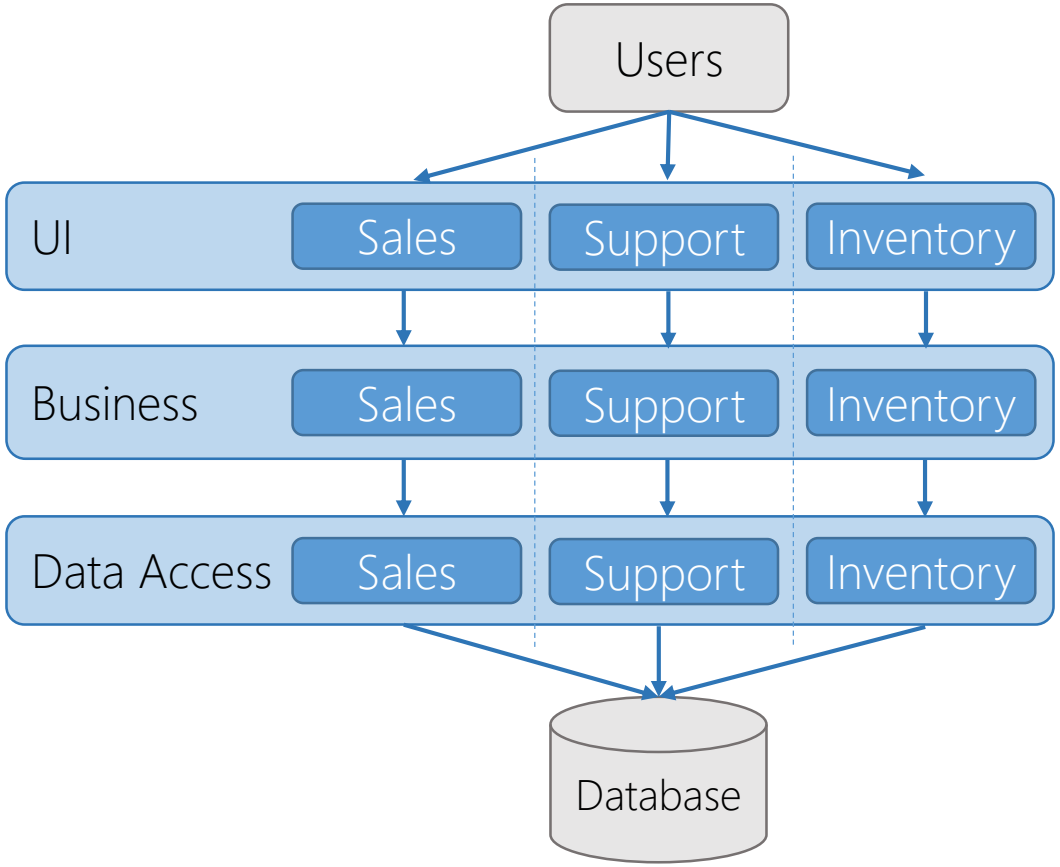
Categorical is easier at first

Microservices

Components


Users
UI
Sales
Support
Inventory
Business
Sales
Support
Inventory
Data Access
Sales
Support
Inventory
Database

Components


Users
UI
Sales
Support
Inventory
Business
Sales
Support
Inventory
Data Access
Sales
Support
Inventory
Database

Problem Domain

Sales

Sales Opportunity

Contact

Sales Person

Product

Sales Territory

Support

Support Ticket

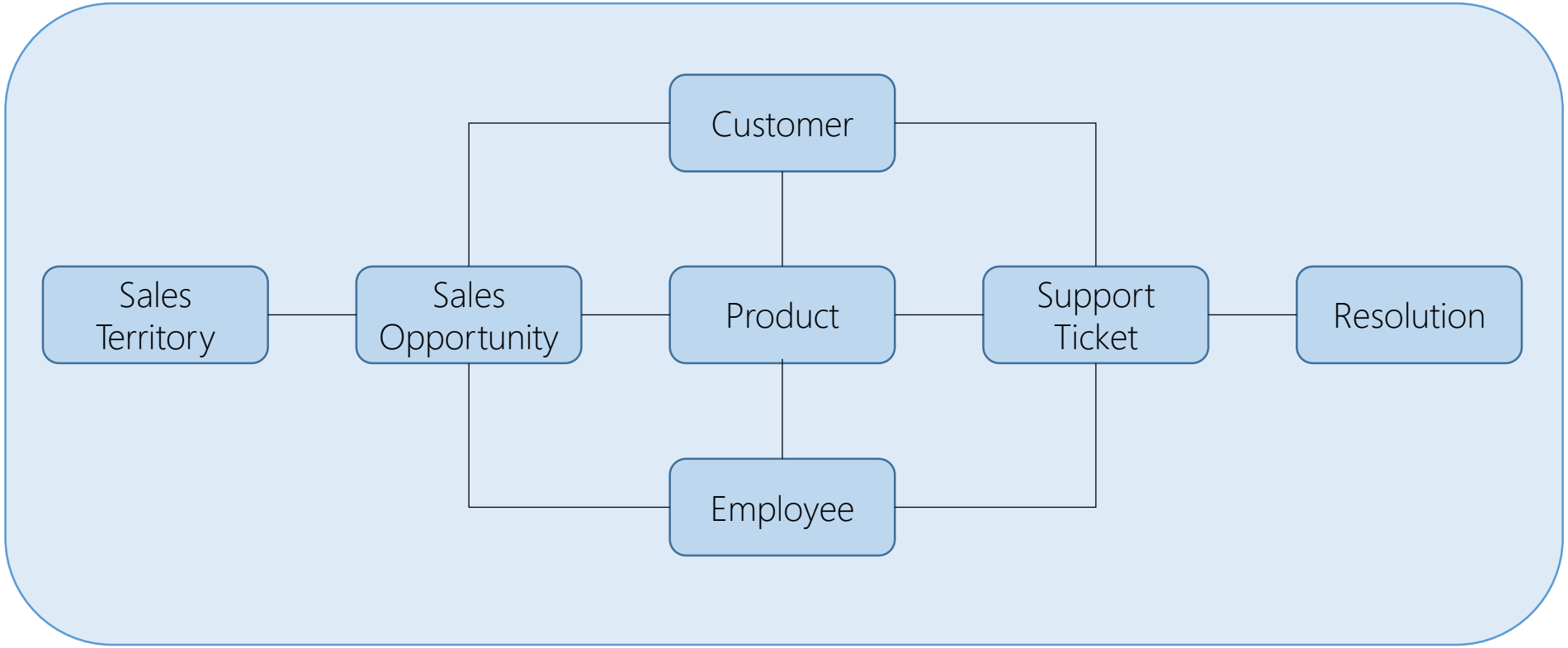
Customer

Support Person

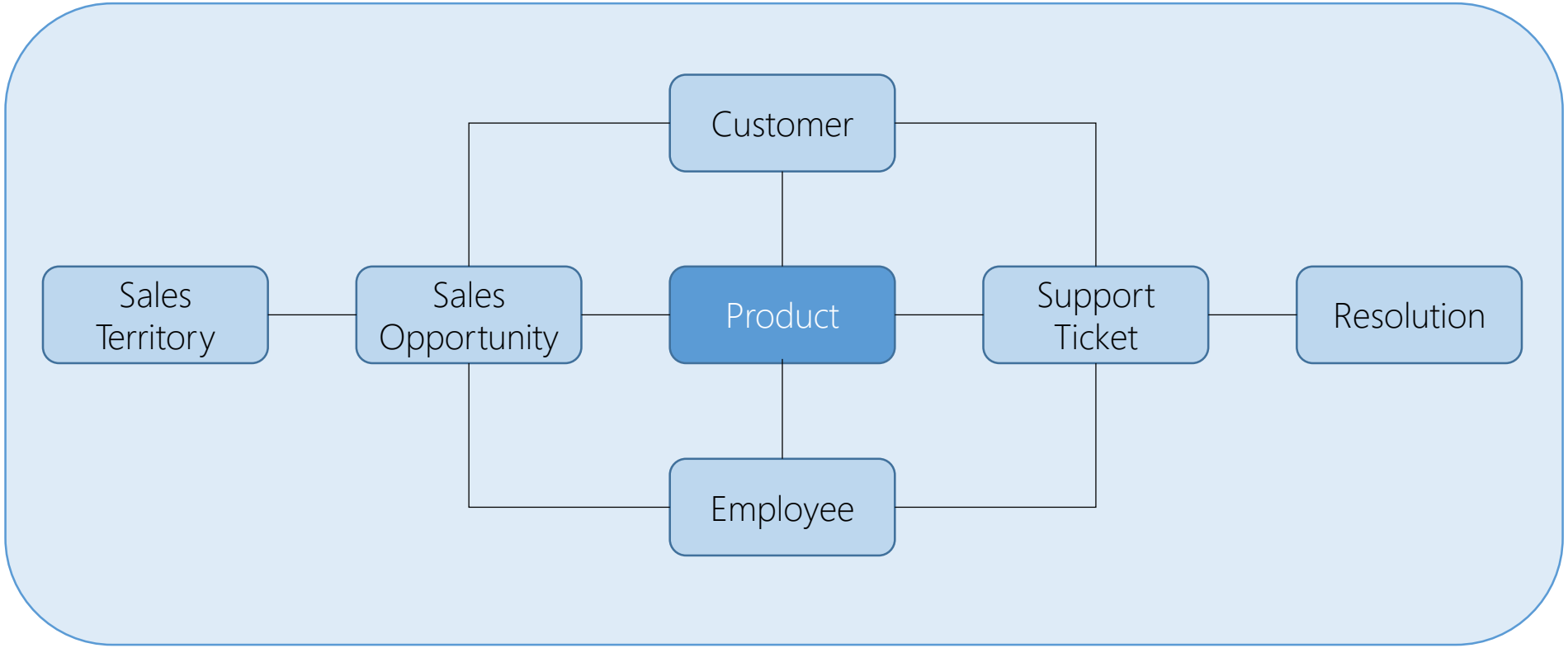
Product

Resolution

Single Domain Model



Single Domain Model



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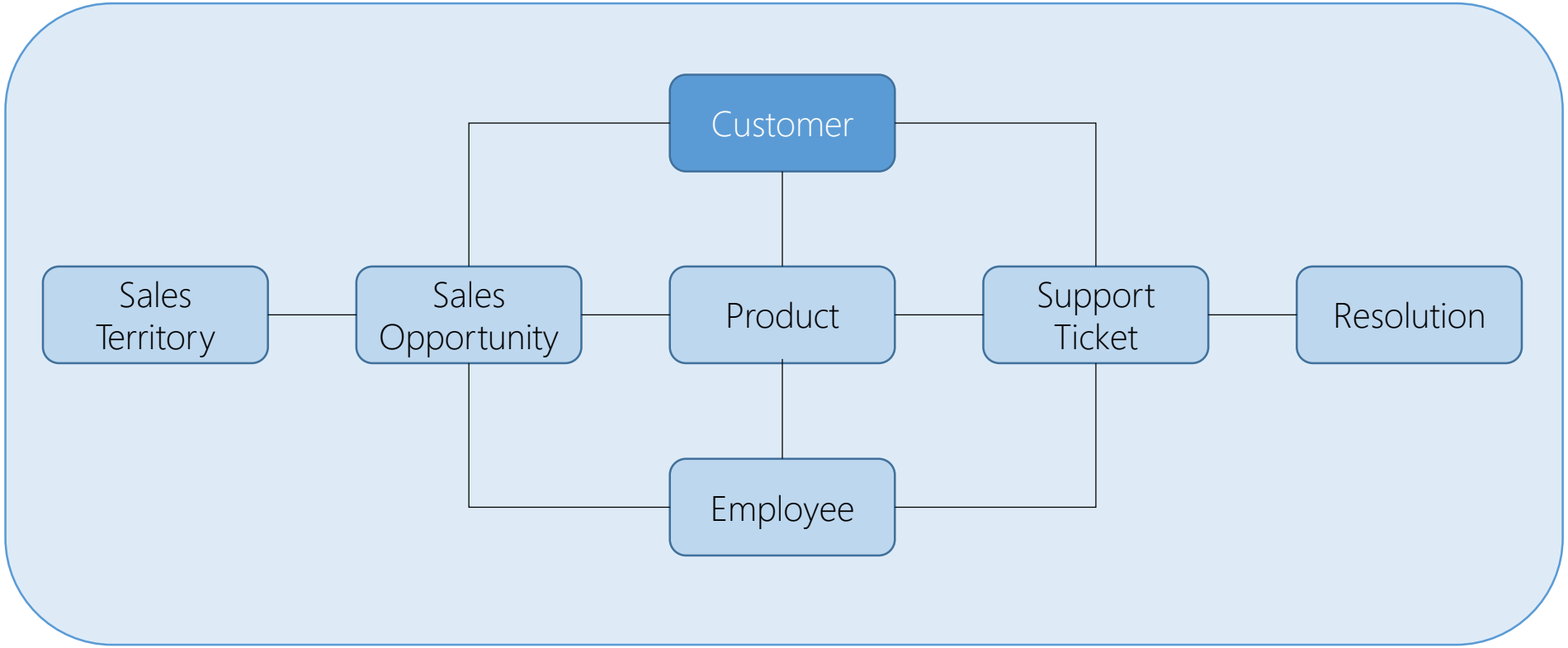

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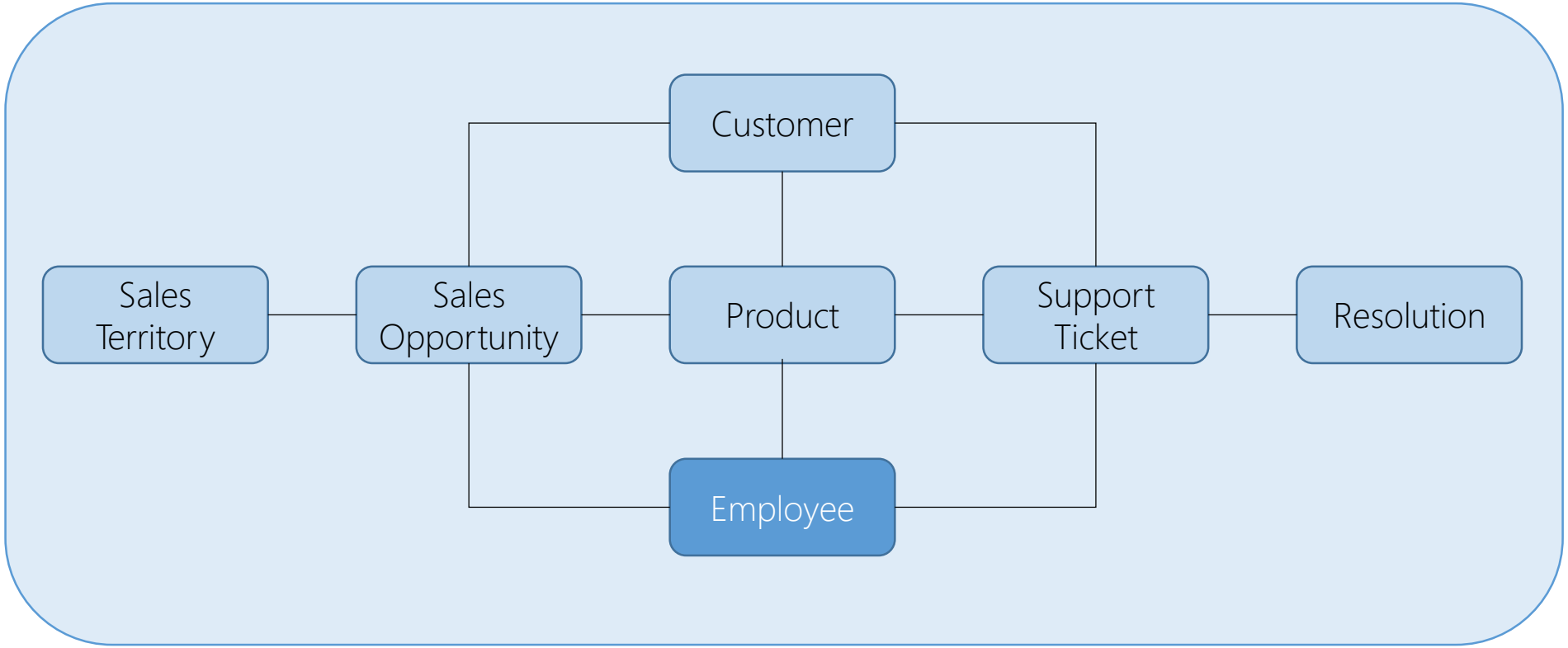
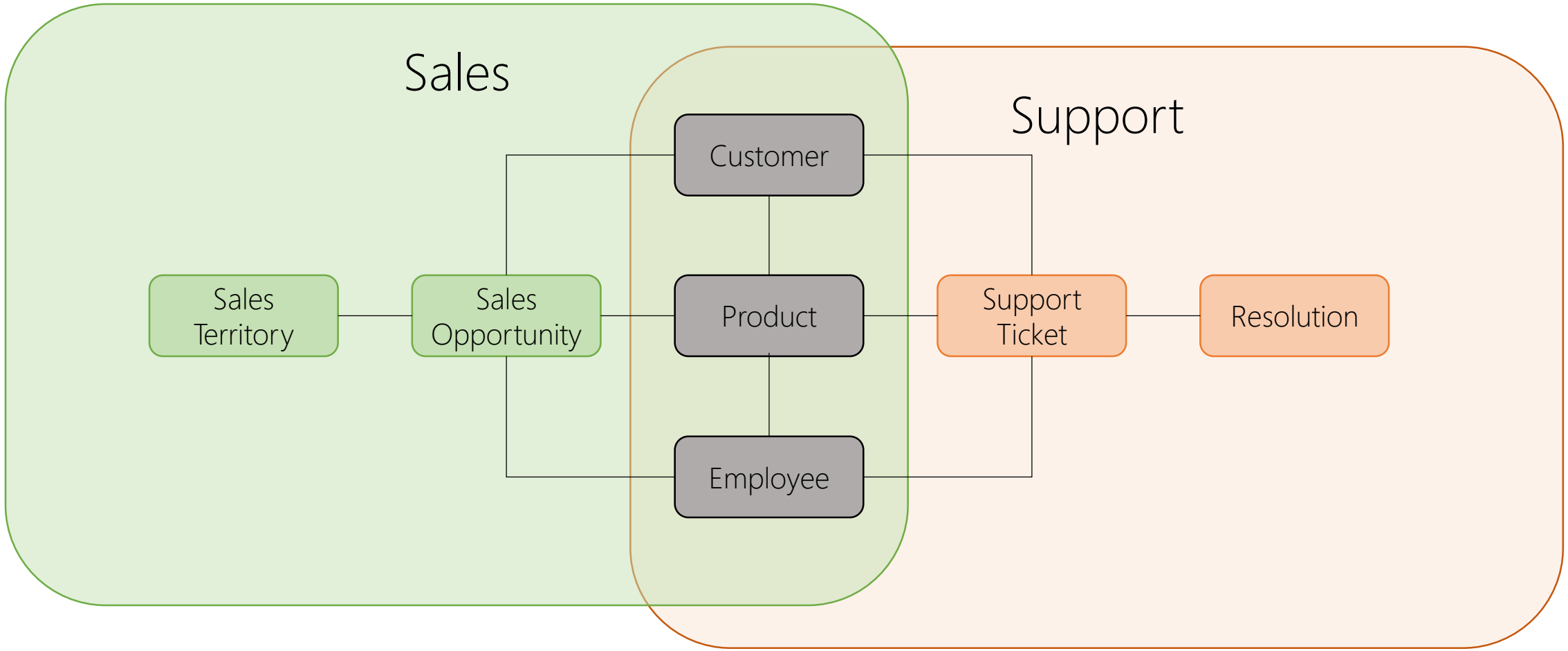
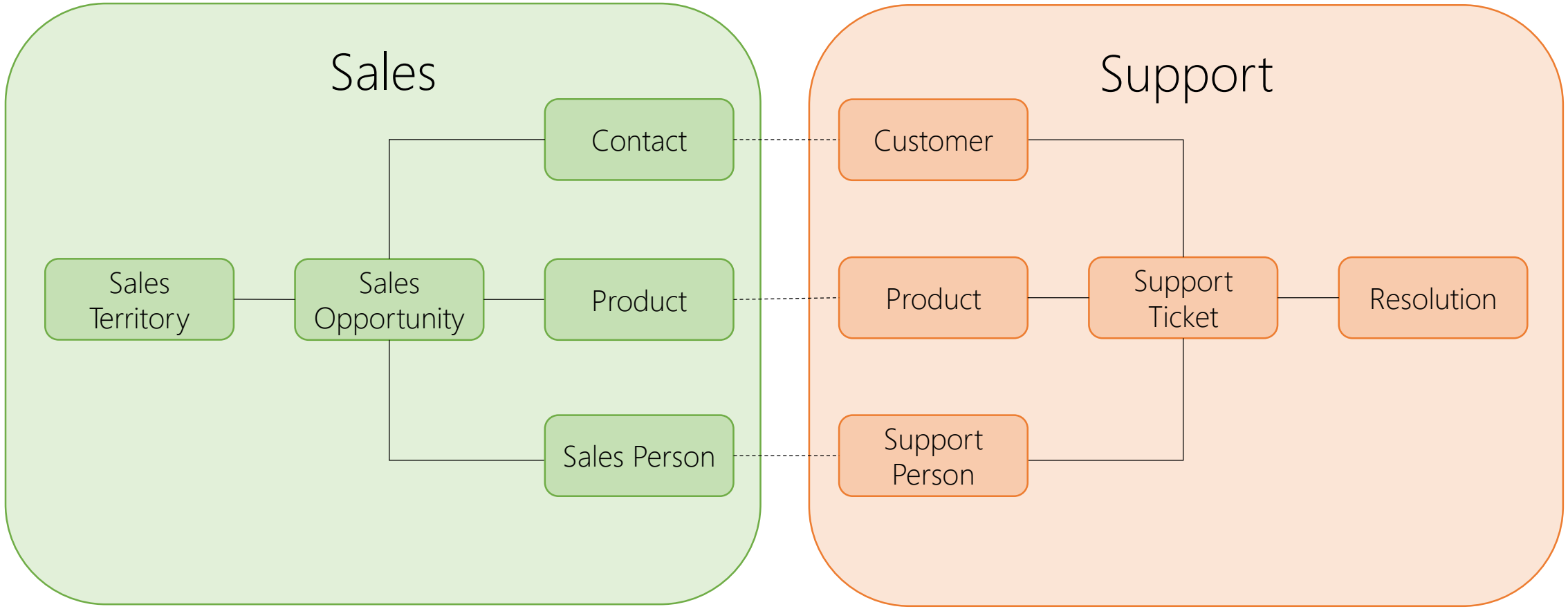


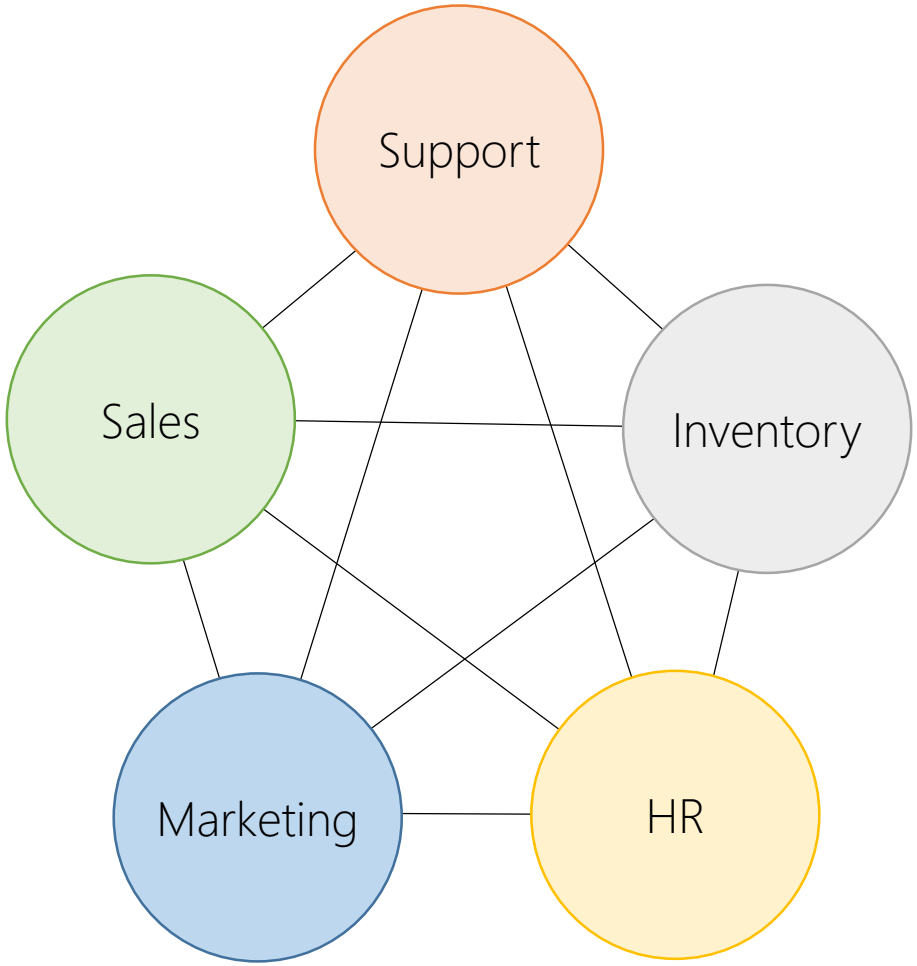
Overlapping Contexts



Bounded Contexts

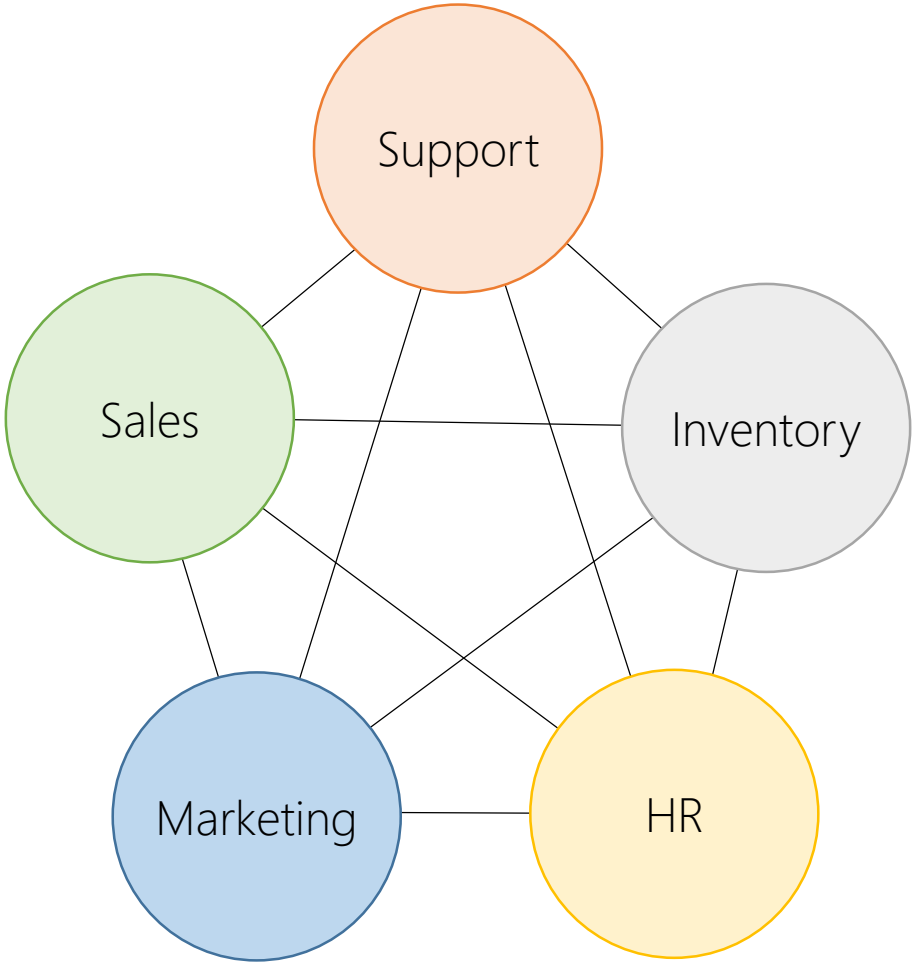


Microservice Architectures



Microservice Architectures

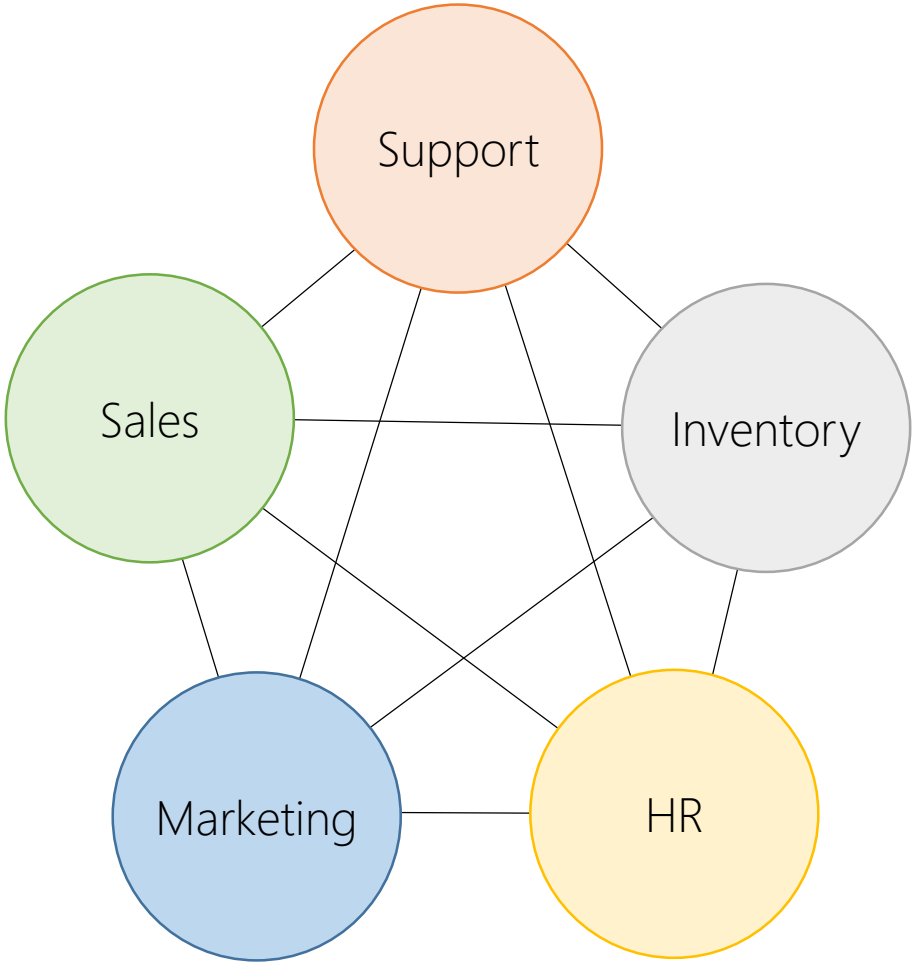
Subdivide system



Microservice Architectures

Subdivide system

Light-weight APIs

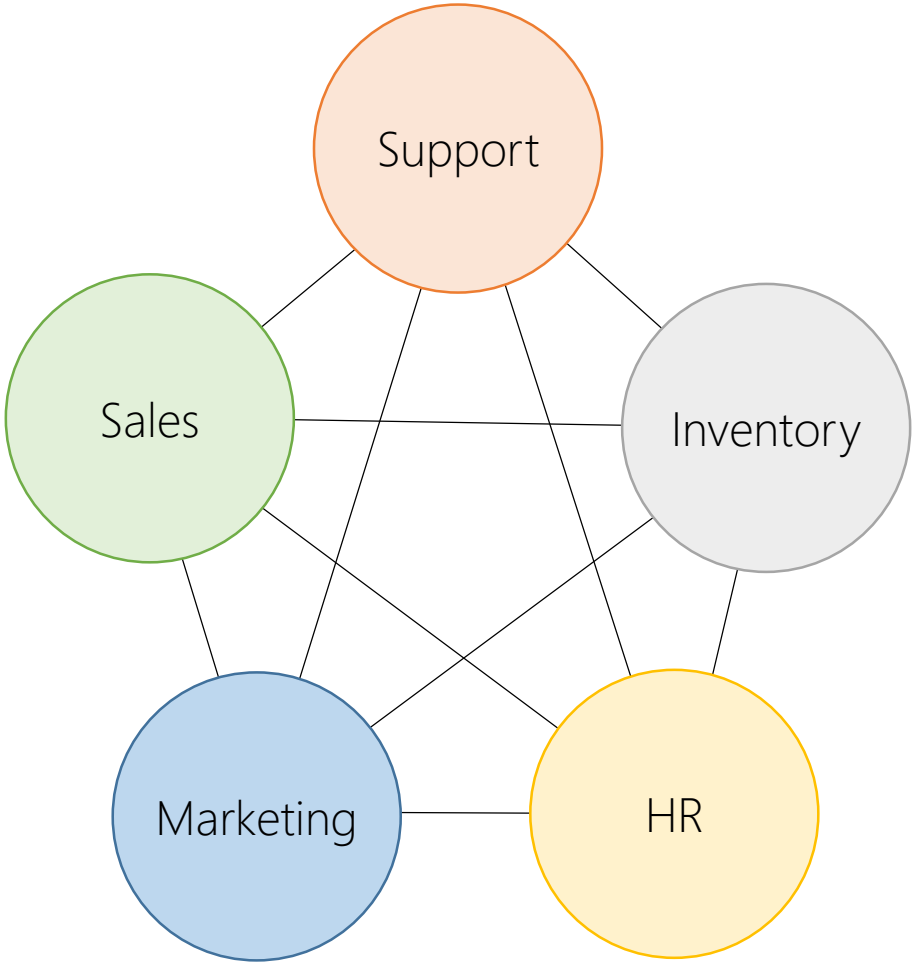


Microservice Architectures

Subdivide system

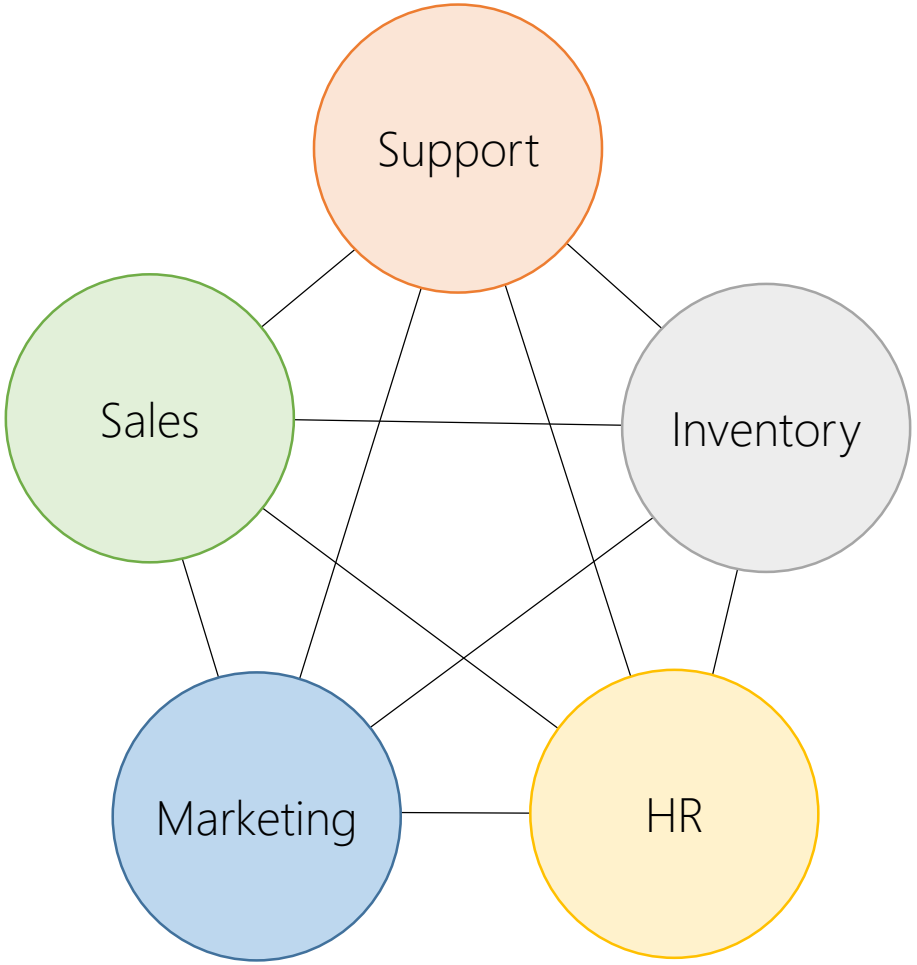
Light-weight APIs

Small teams



Microservice Architectures

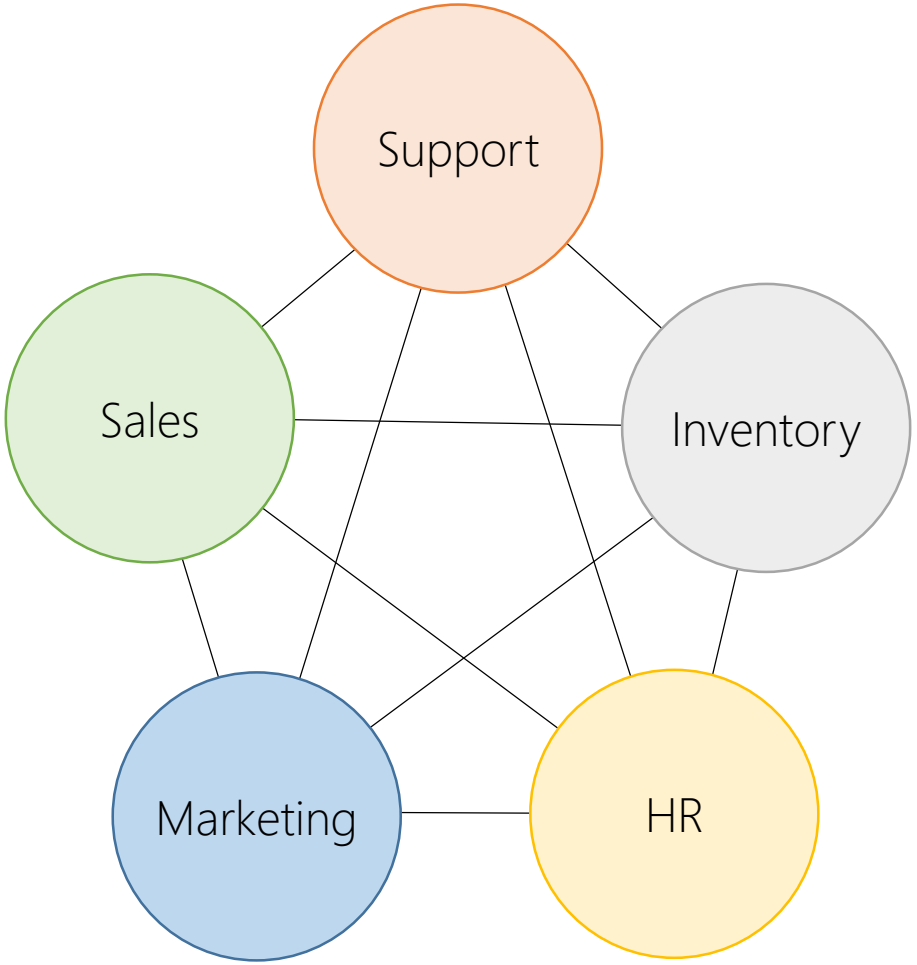
Independent



Microservice Architectures

Independent

Similar to SOA

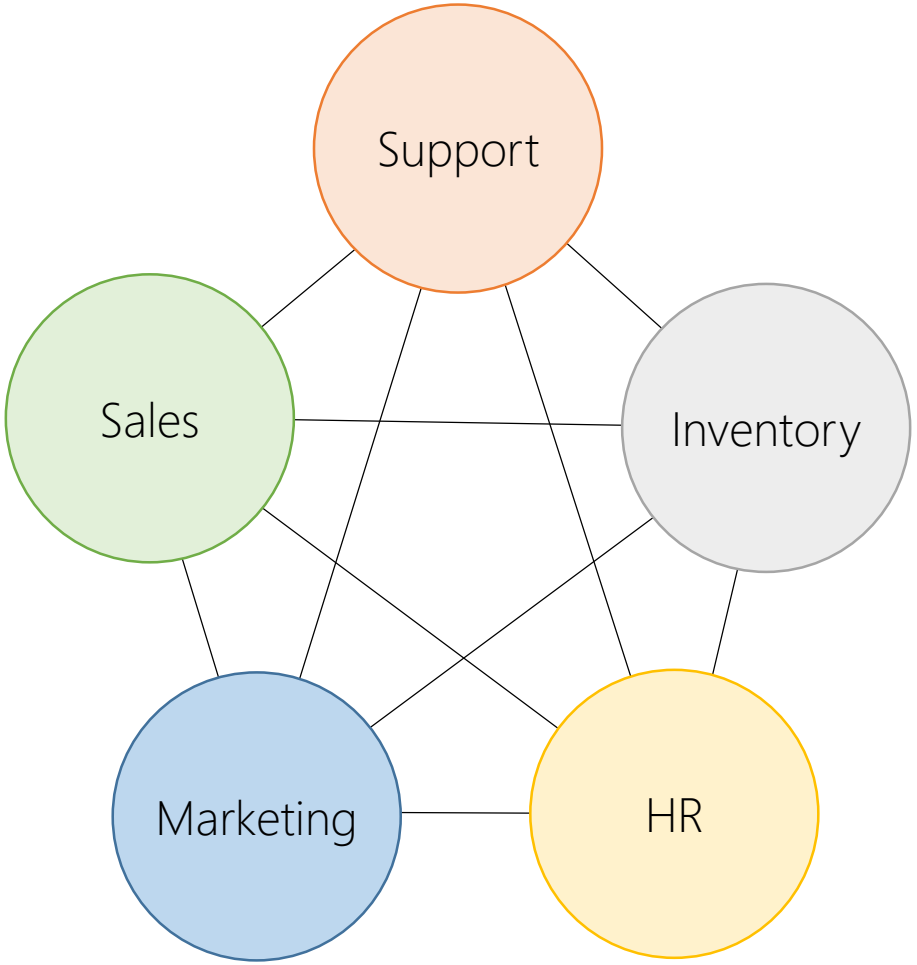


Microservice Architectures

Independent

Similar to SOA

Size matters



Why Use Microservices?

Pros

Less cost for large domains

Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

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Smaller teams

Independence

Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

Independence

Cons

Only for large domains

Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

Independence

Cons

Only for large domains

Higher up-front cost

Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

Independence

Cons

Only for large domains

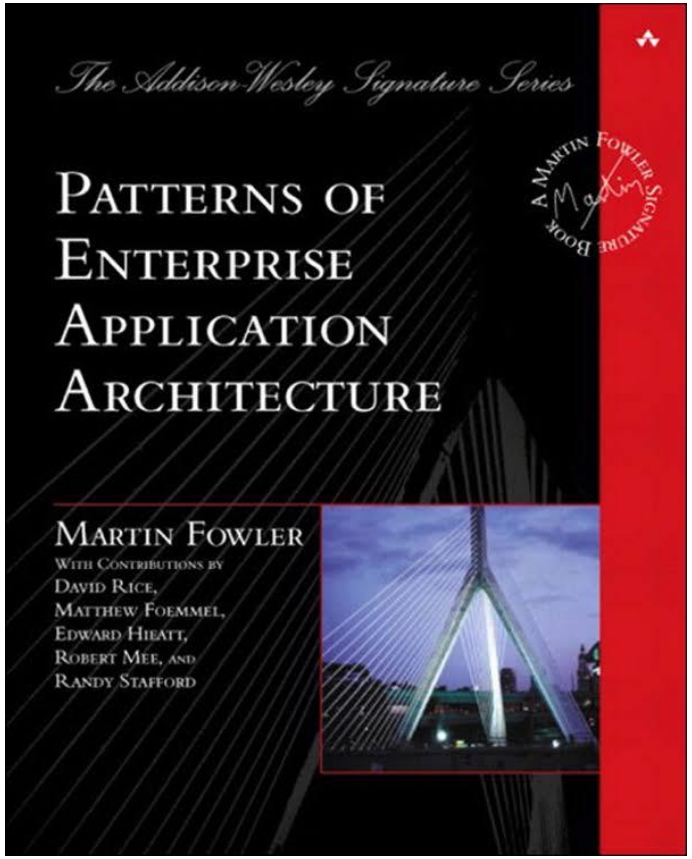
Higher up-front cost

Distributed system costs

Code Demo

Where to Go Next?

Where to Go Next?



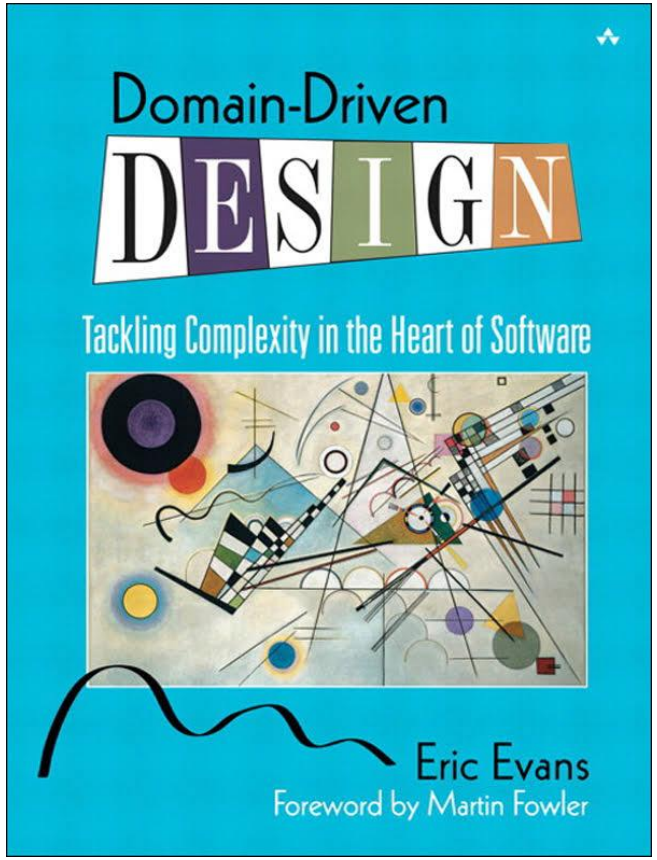
Martin Fowler

Where to Go Next?

http://cleancoders.com/

Robert C. Martin

Where to Go Next?



Eric Evans

Where to Go Next?

Greg Young

Udi Dahan

Where to Go Next?

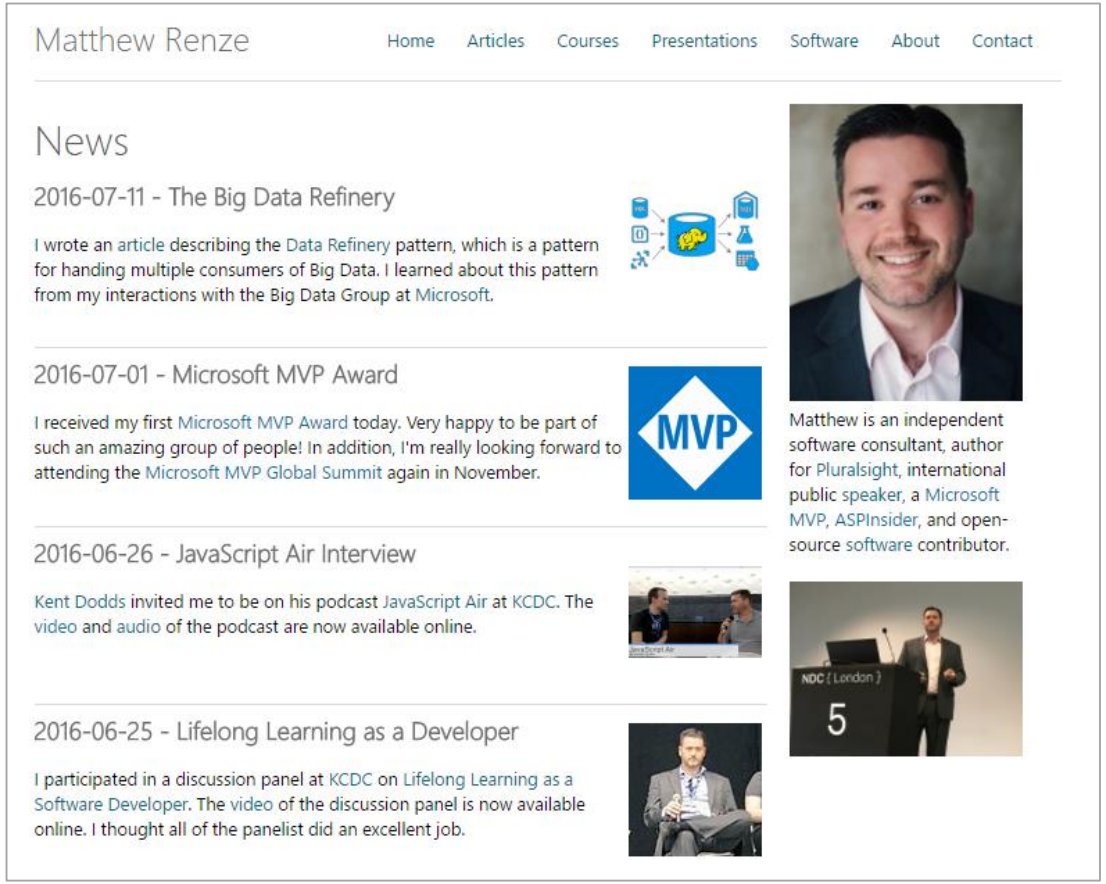
Articles

Courses

Presentations

Source Code

Videos



www.matthewrenze.com

Clean Architecture: Patterns, Practices, and Principles

INTRODUCTION

Matthew Renze
SOFTWARE CONSULTANT

@matthewrenze www.matthewrenze.com

www.pluralsight.com/authors/matthew-renze

Conclusion

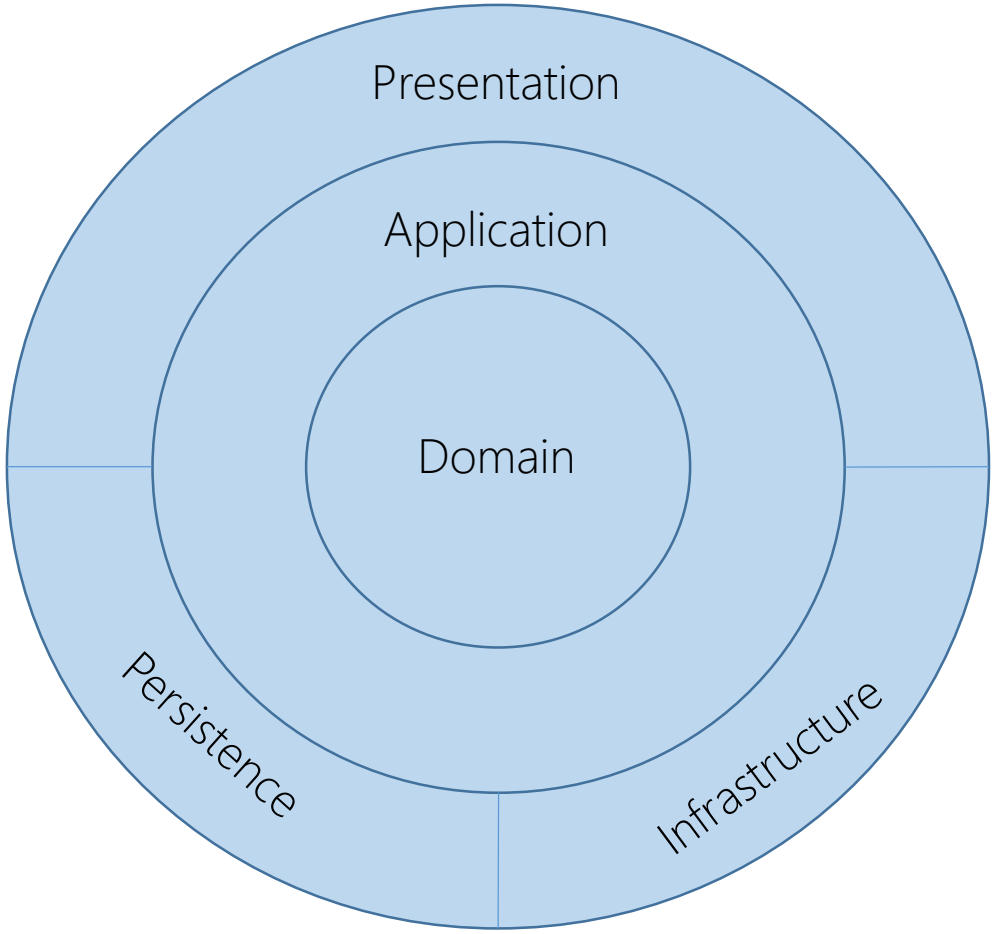
Summary

Focus on the inhabitants

Summary

Focus on the inhabitants

Domain-centric Architecture

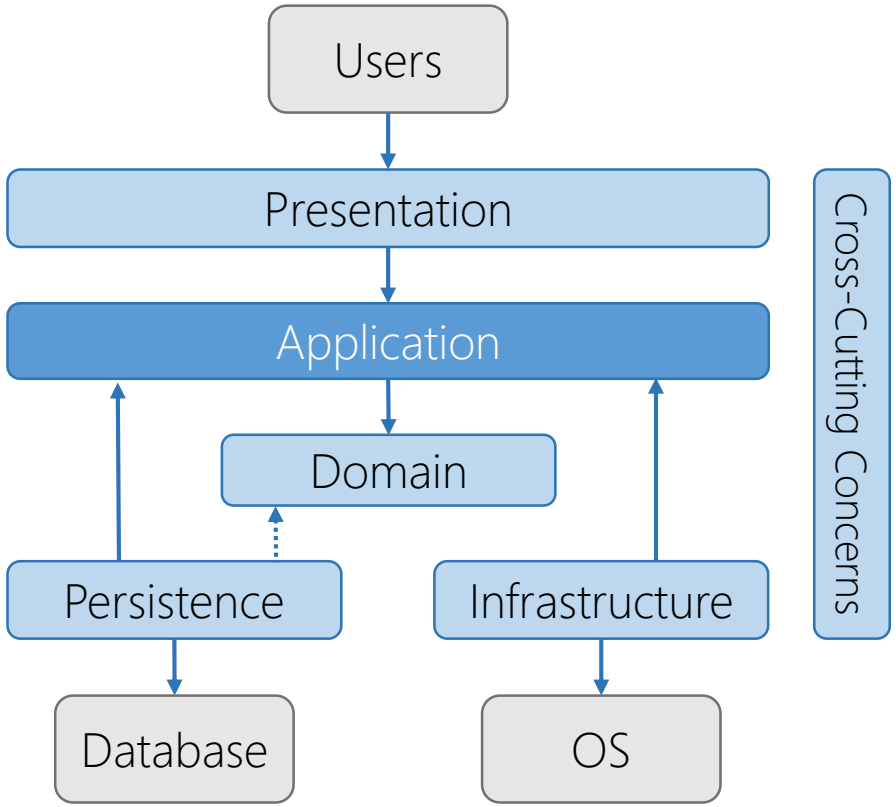


Summary

Focus on the inhabitants

Domain-centric Architecture

Application Layer



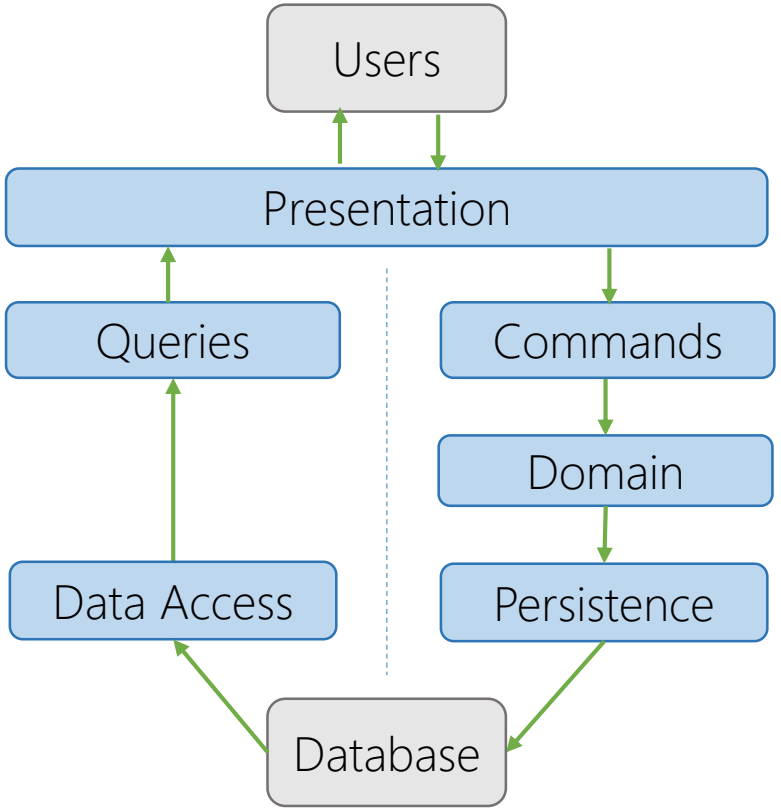
Summary

Focus on the inhabitants

Domain-centric Architecture

Application Layer

Commands and Queries



Summary

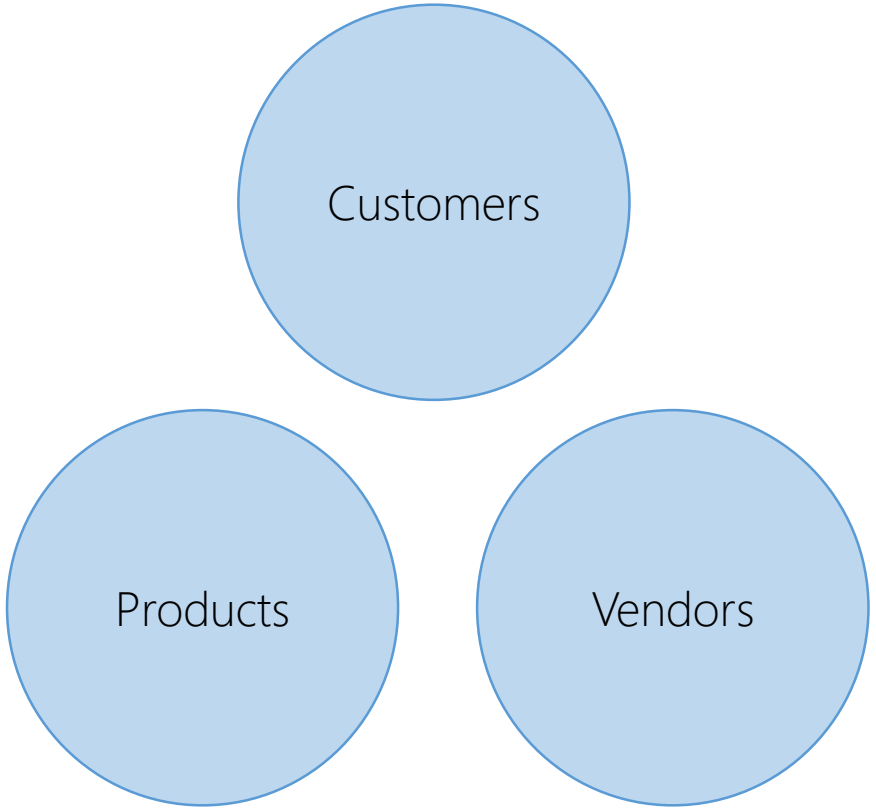
Focus on the inhabitants

Domain-centric Architecture

Application Layer

Commands and Queries

Functional Cohesion



Summary

Focus on the inhabitants

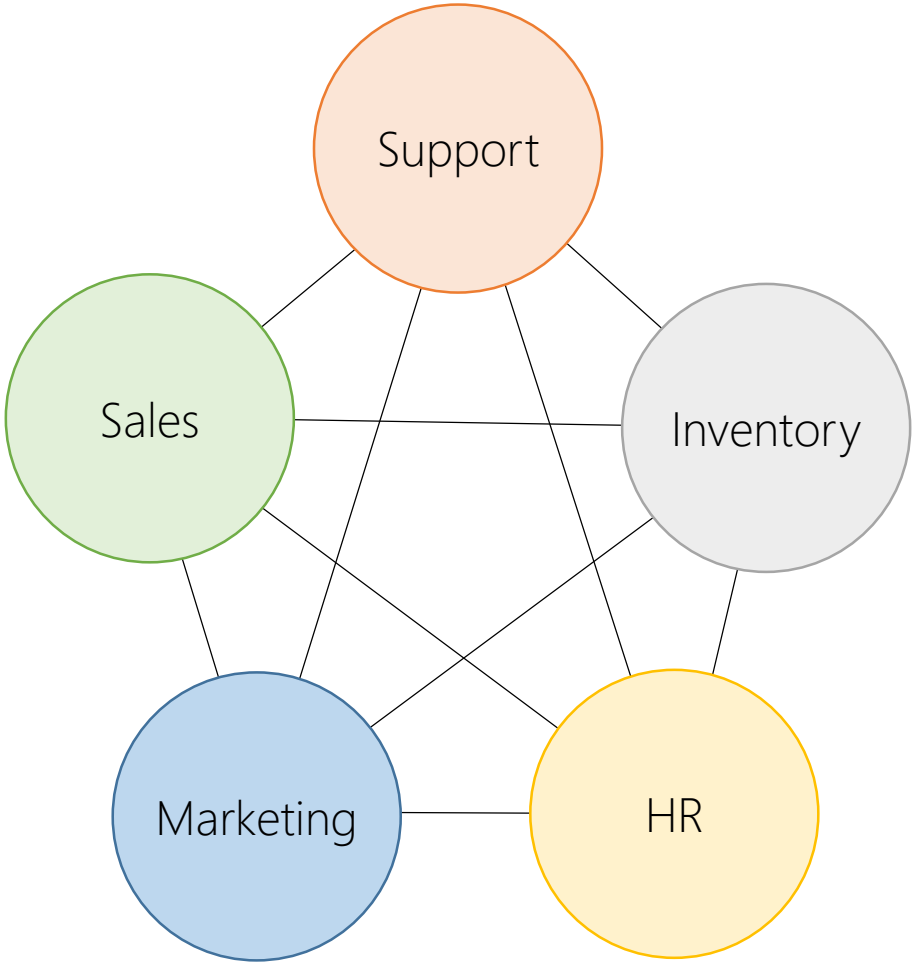
Domain-centric Architecture

Application Layer

Commands and Queries

Functional Cohesion

Bounded Contexts



Feedback

Very important to me!

One thing you liked?

One thing I could improve?

Contact Info

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Thank You! :)