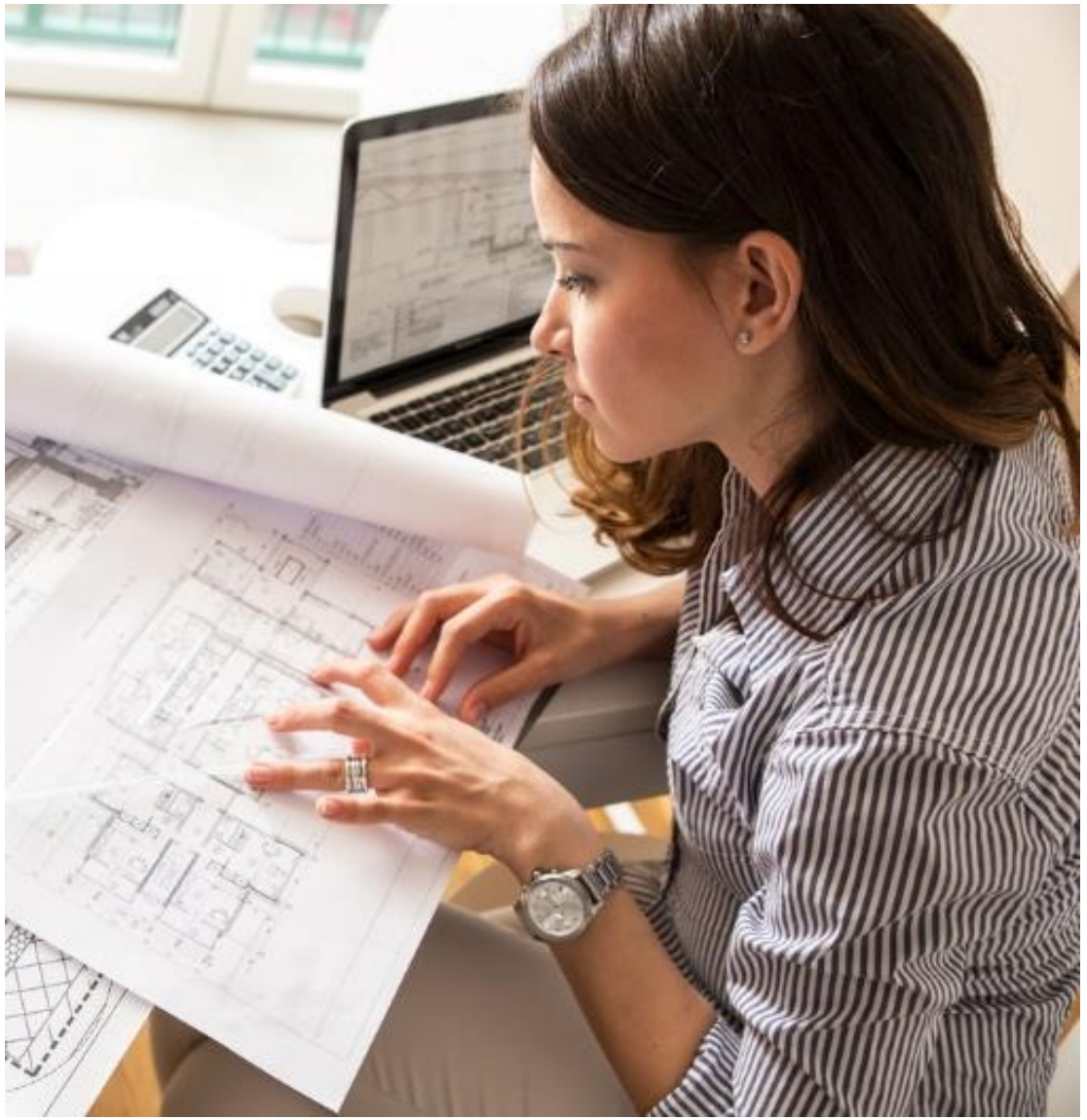
Clean Architecture

Patterns, Practices, and Principles

@matthewrenze

#devup



About Me

Independent consultant

Education

- B.S. in Computer Science (ISU)
- B.A. in Philosophy (ISU)

Community

- Public Speaker
- Pluralsight Author
- Microsoft MVP
- ASPInsider
- Open-Source Software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SWANK MOTION PICTURES, INC. Tim Swank, Chairman
Microsoft
redgate
SILVER
LogicNP Software The power of Components

Overview

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

Focus

Enterprise Architecture

Line-of-Business Applications

Modern equivalent of 3-Layer

Focus

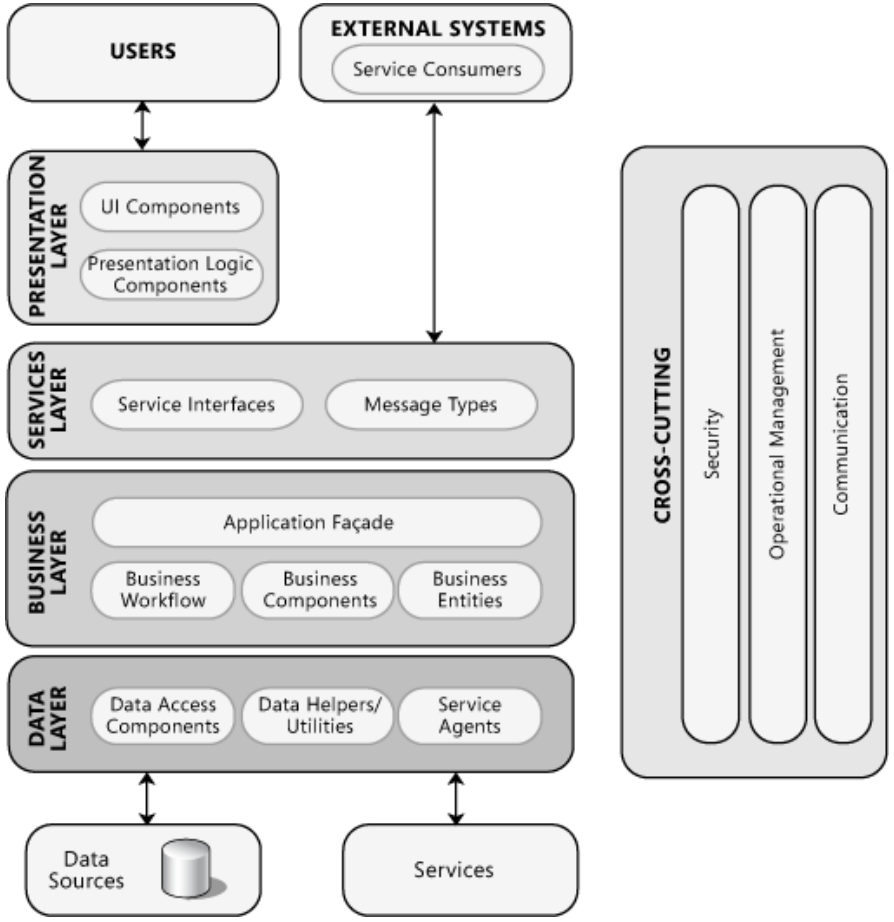
Generally applicable

6 Key Points

Q & A

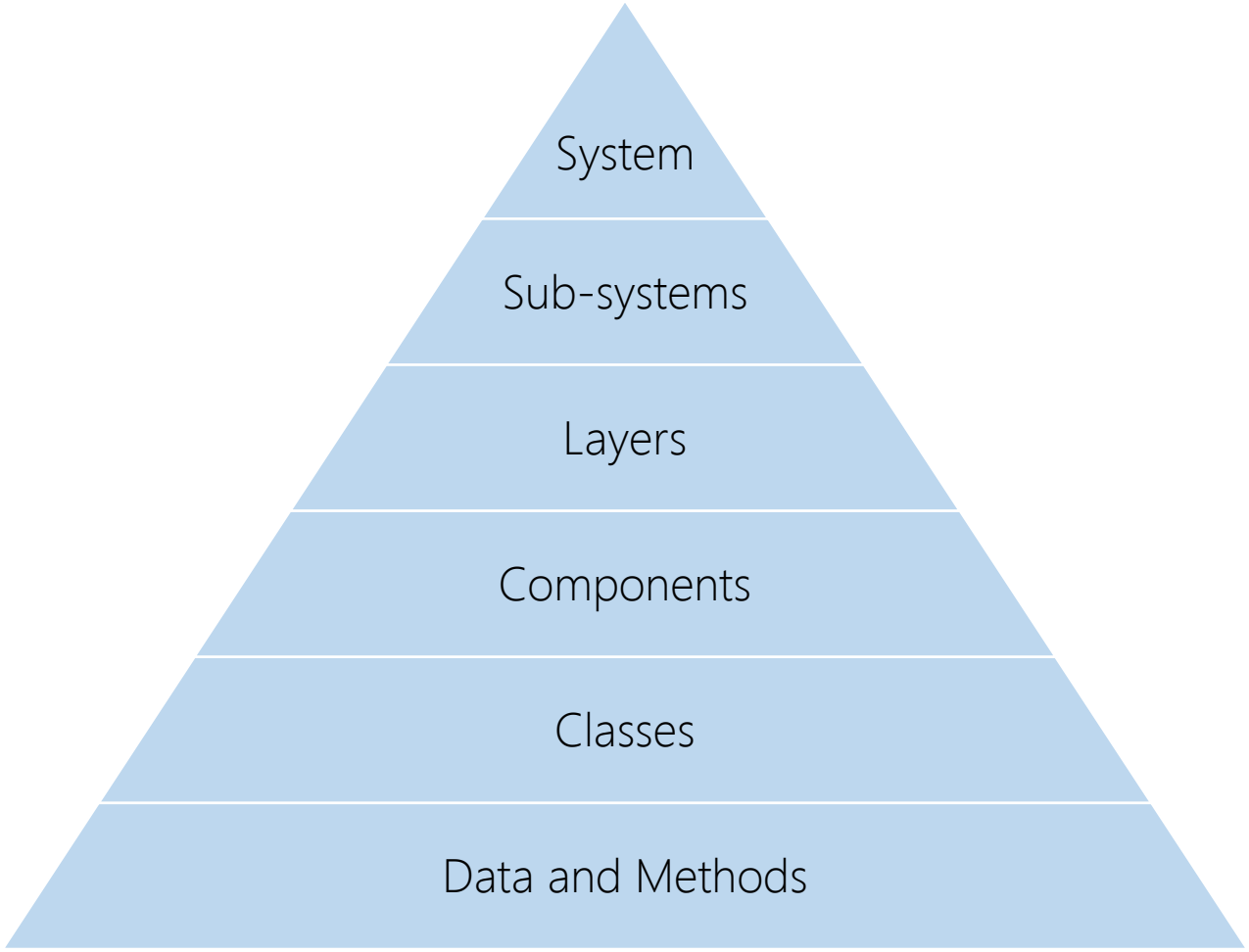
What is Software Architecture?

High-level
Structure
Layers
Components
Relationships

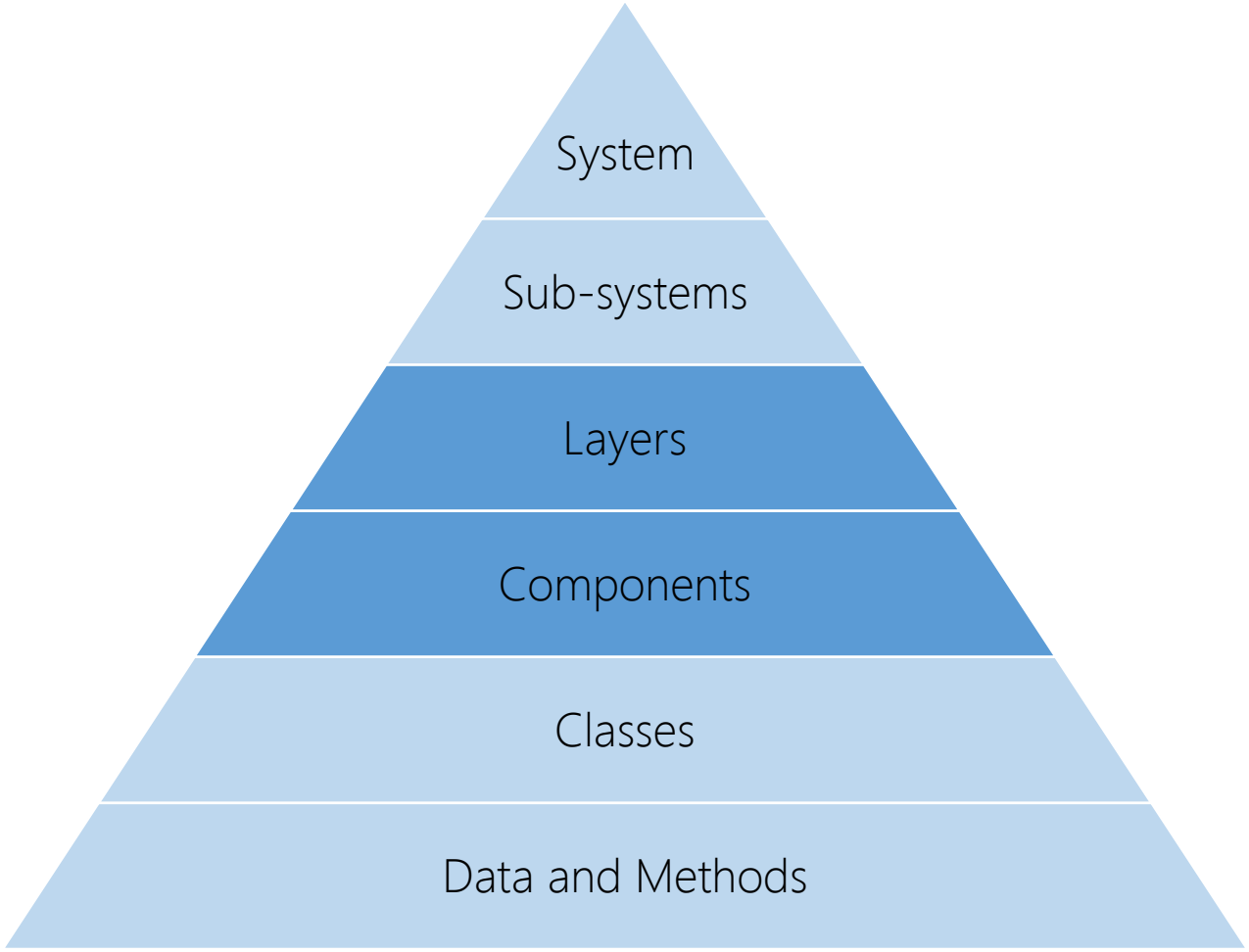


Source: http://msdn.microsoft.com/en-us/library/ff650706.aspx

Levels of Architectural Abstraction



Levels of Architectural Abstraction



Messy vs Clean Architecture

Messy vs Clean Architecture

Messy vs Clean Architecture

What Is Bad Architecture?

Complex
Inconsistent
Incoherent
Ridged
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

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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Architecture that is designed for the inhabitants of the architecture…
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Architecture that is designed for the inhabitants of the architecture…
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Why Is Clean Architecture Important?

Cost/benefit

Minimize cost to maintain

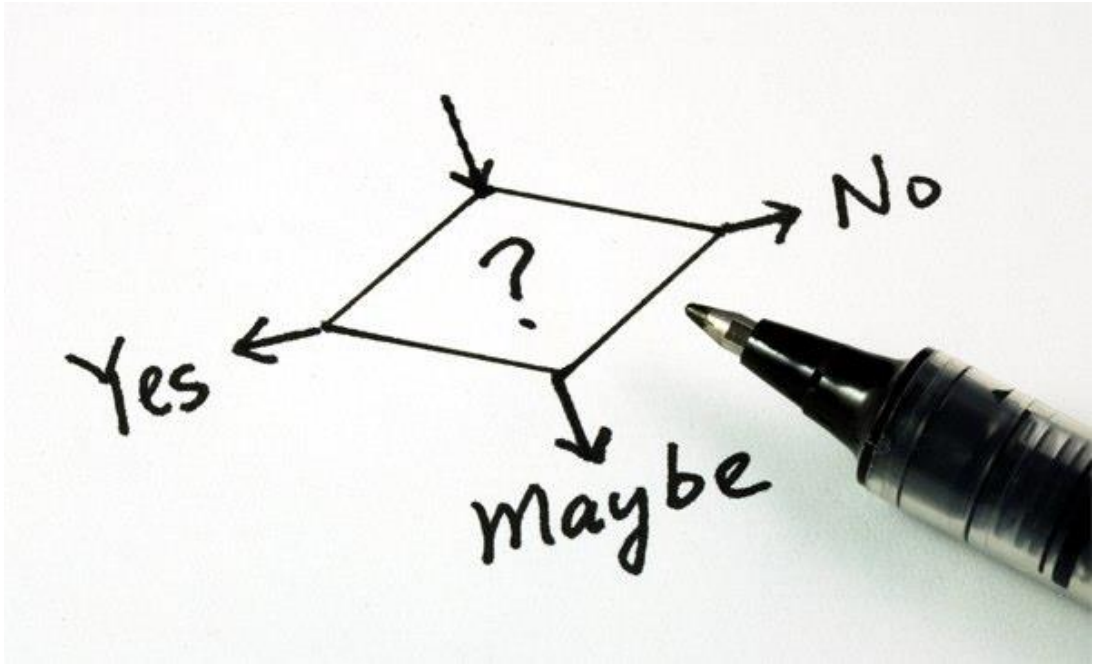
Maximize business value

Decisions, Decisions, Decisions…

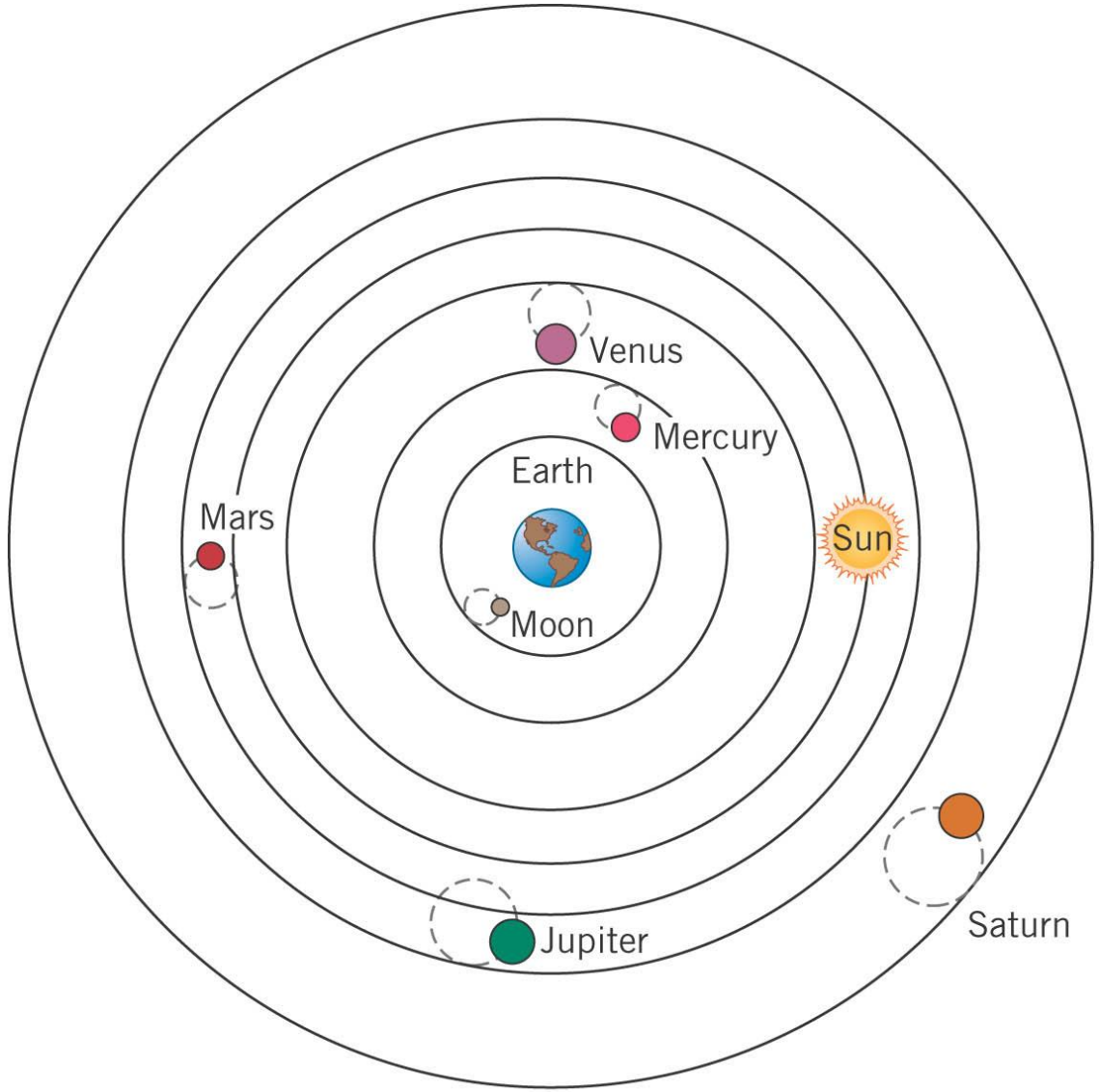
Context is king

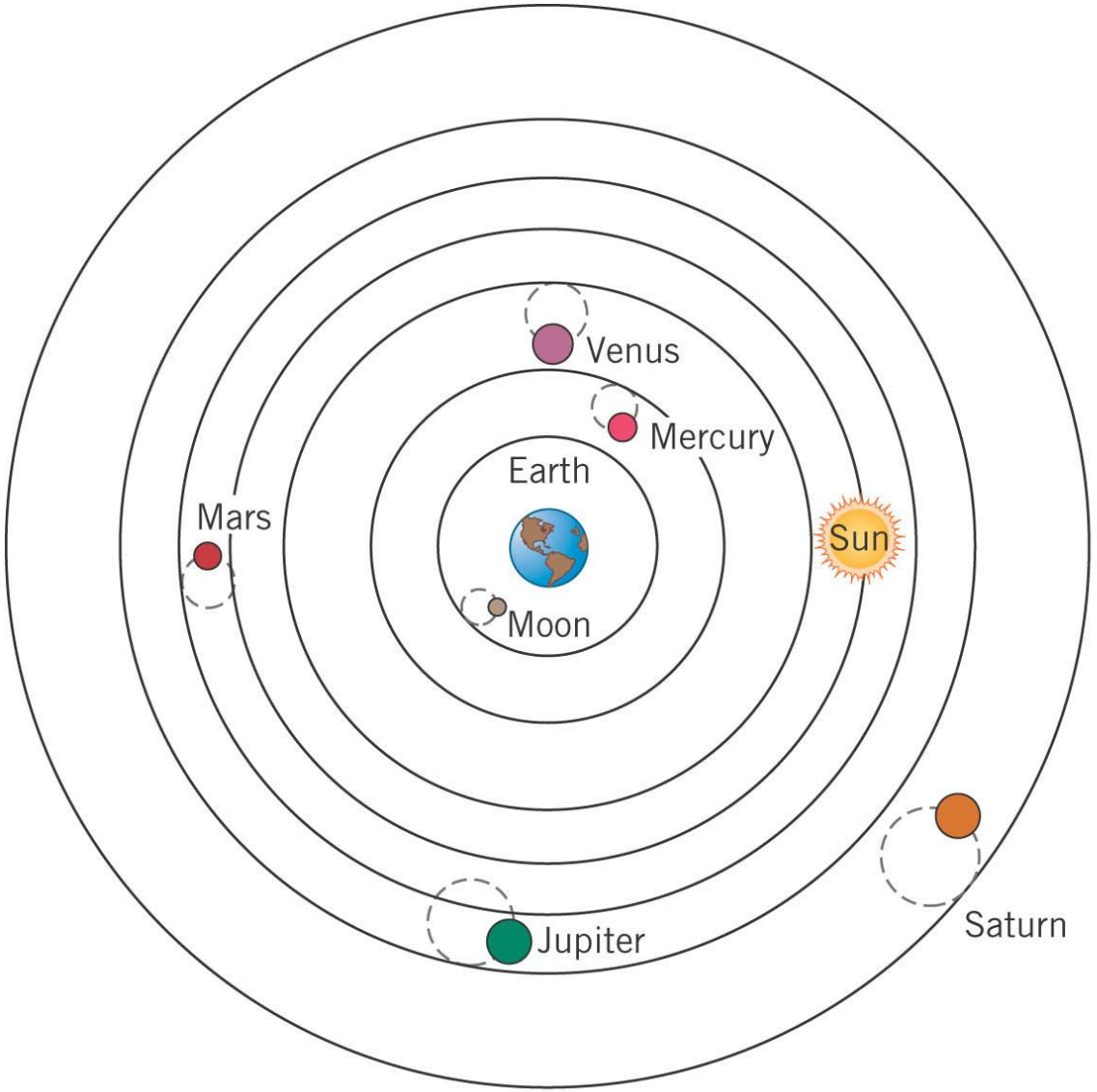
All decisions are a tradeoff

Use your best judgement

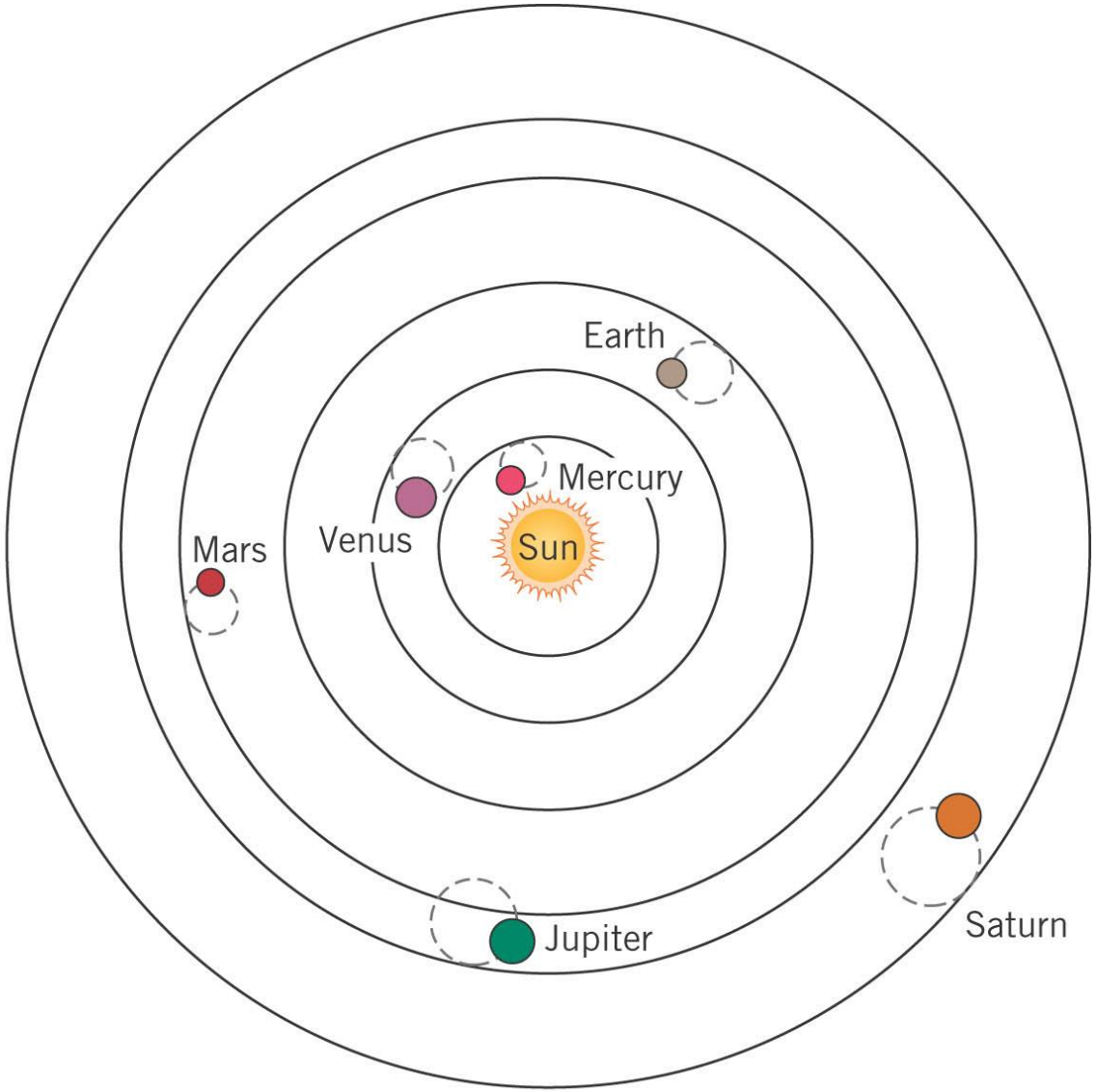


Domain-Centric Architecture


Venus
Mercury
Earth
Mars
Sun
Moon
Jupiter
Saturn

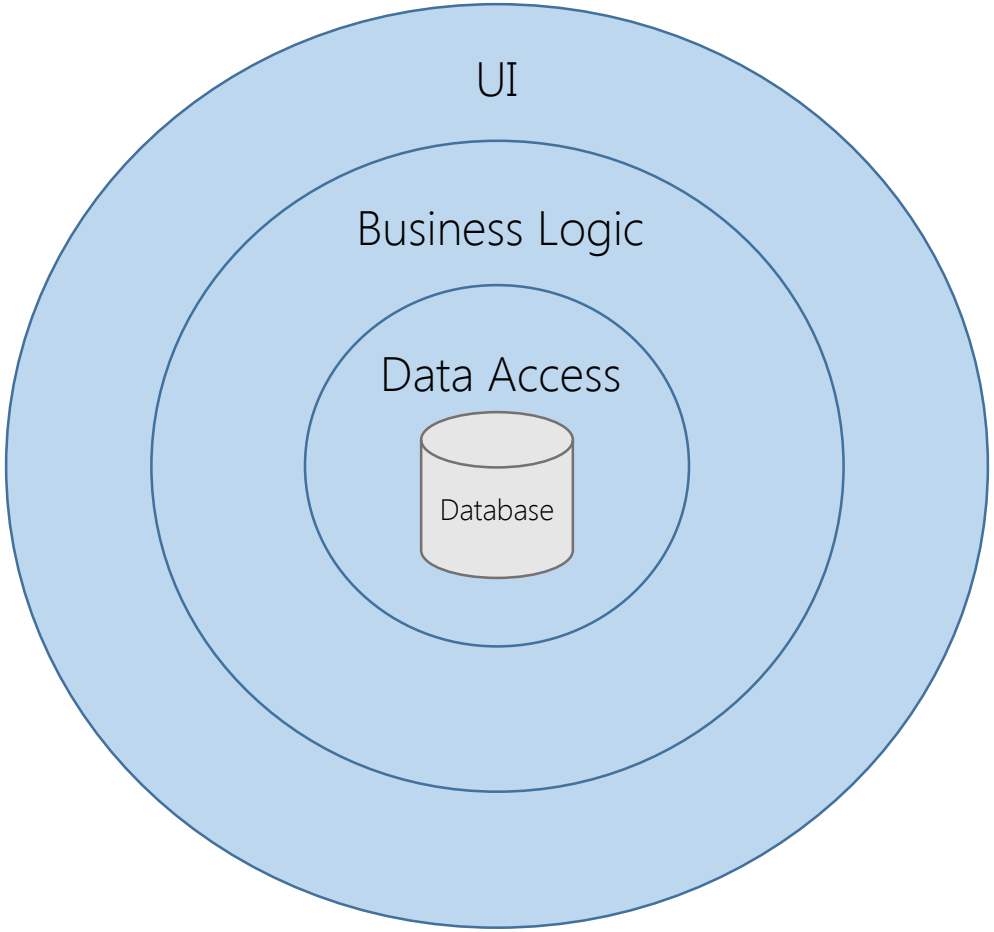


Geocentric Model

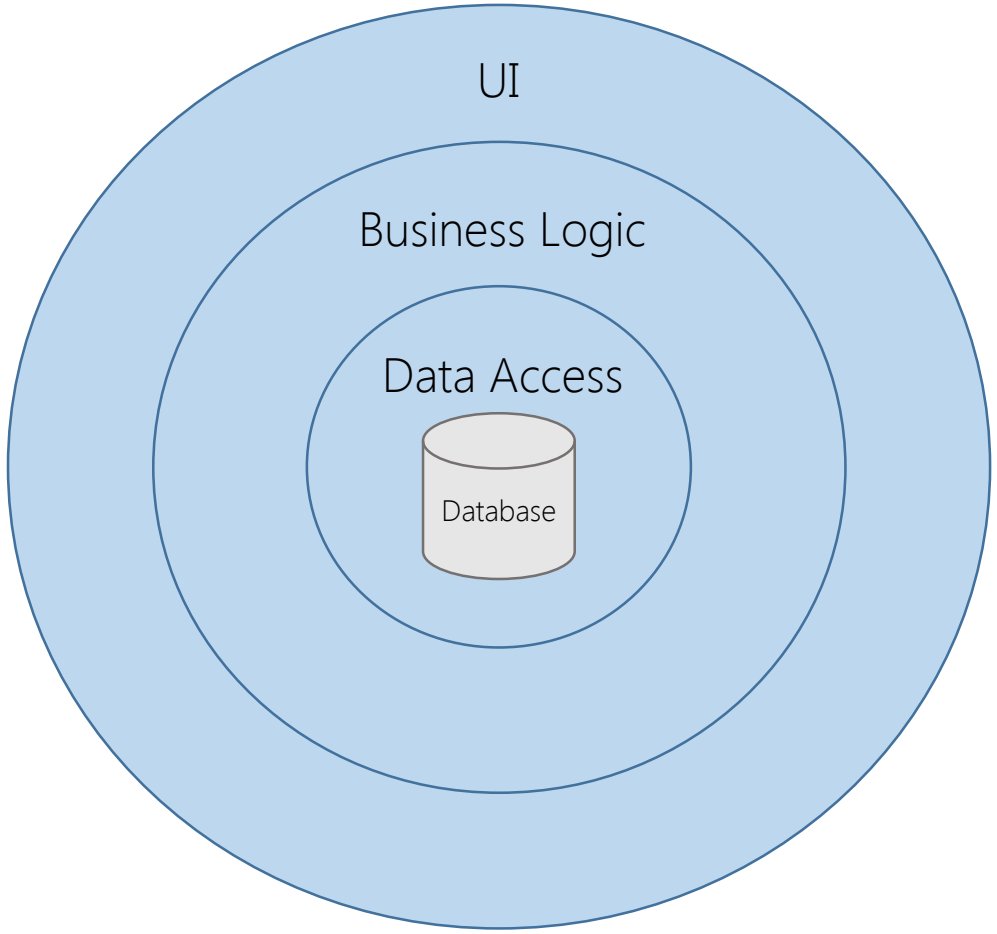


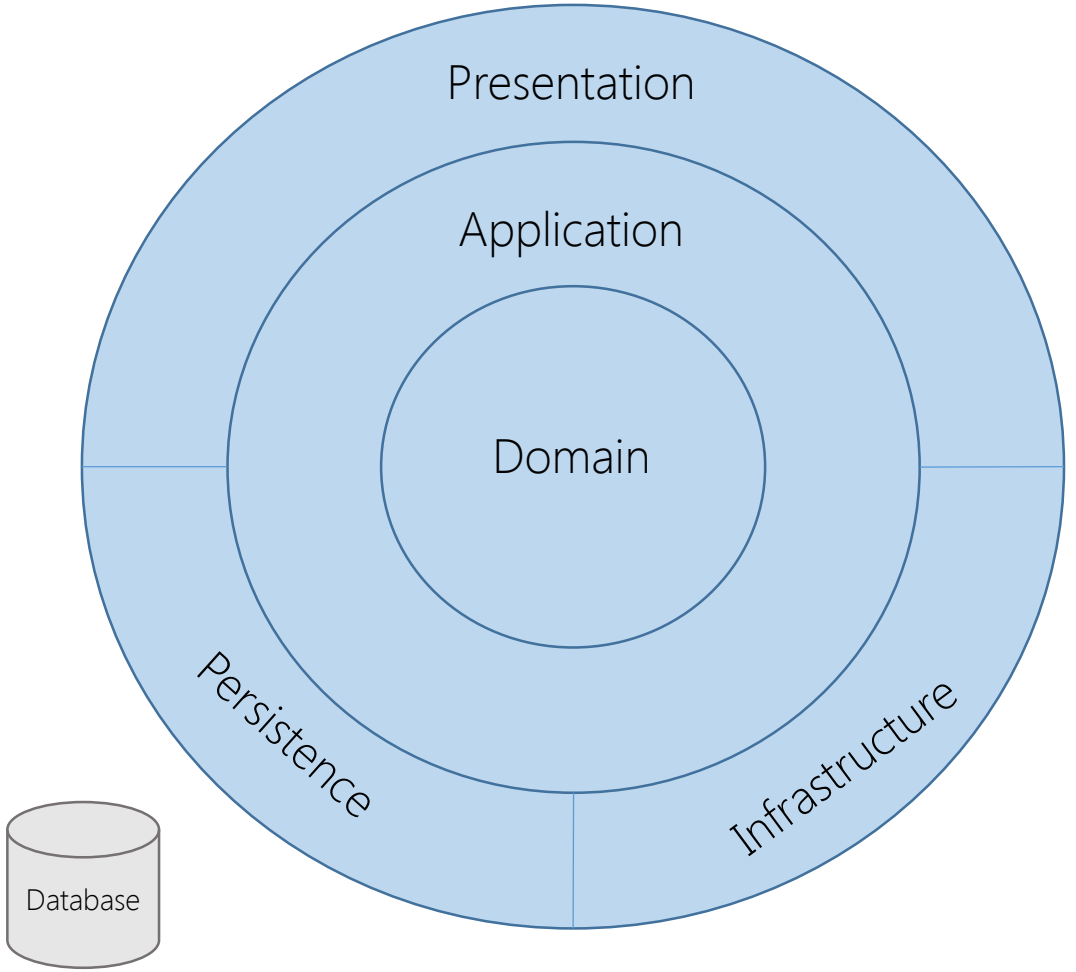
Heliocentric Model

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

Space is essential

Usability is essential

Building material is a detail

Ornamentation is a detail

Source: http://www.whitegadget.com/attachments/pc-wallpapers/85254d1320380902-house-house-wallpaper.jpg

Essential vs. Detail

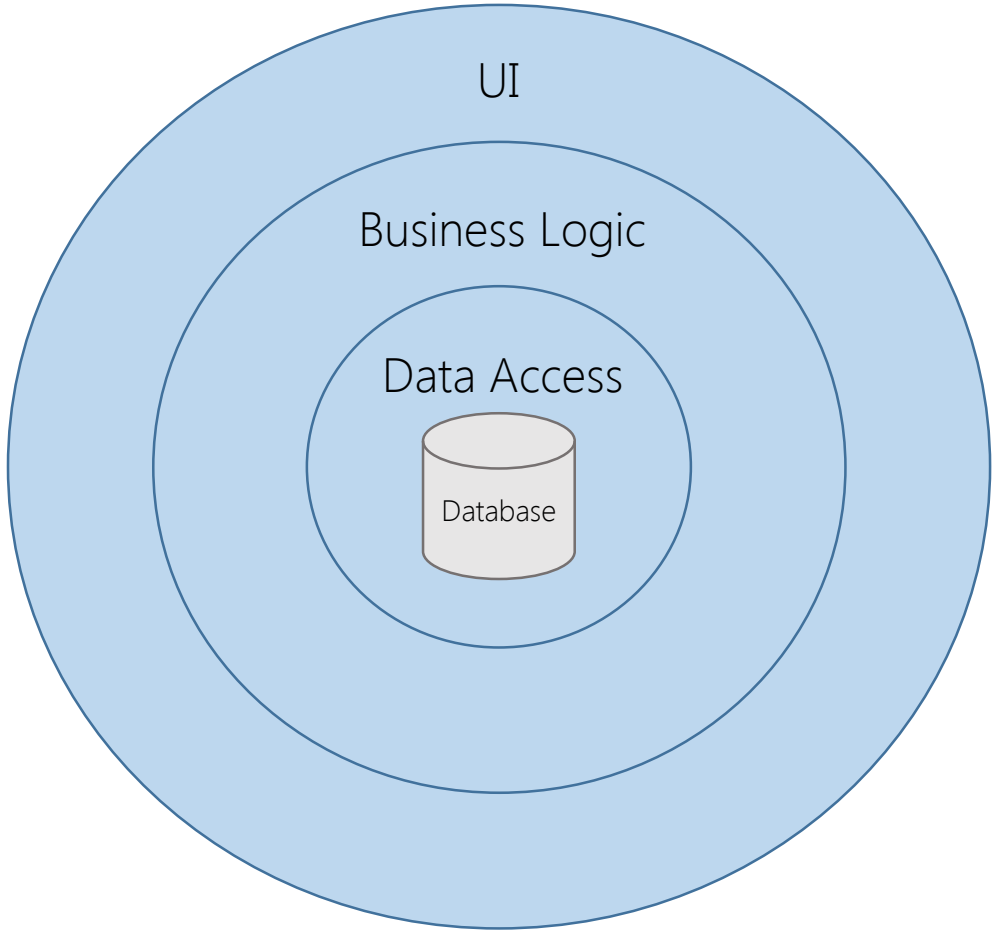
Domain is essential

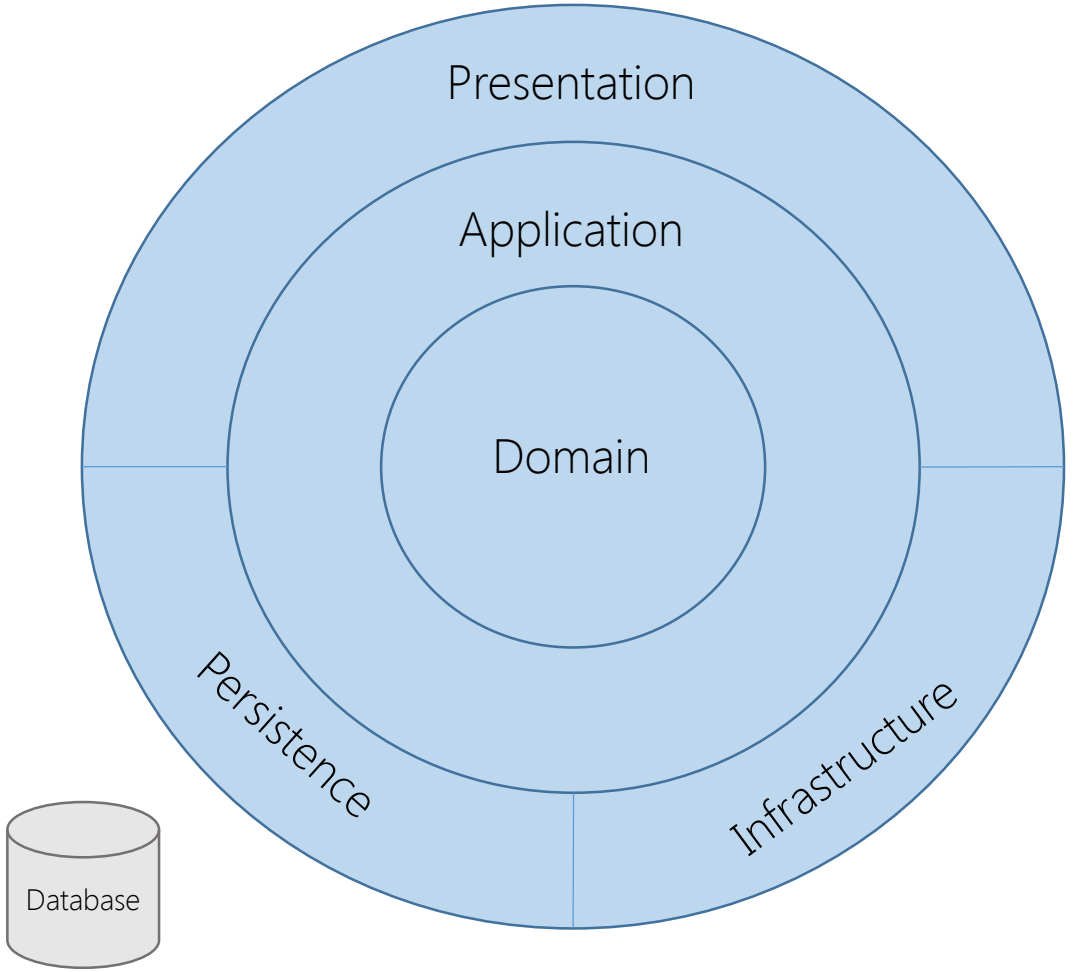
Use cases are essential

Presentation is a detail

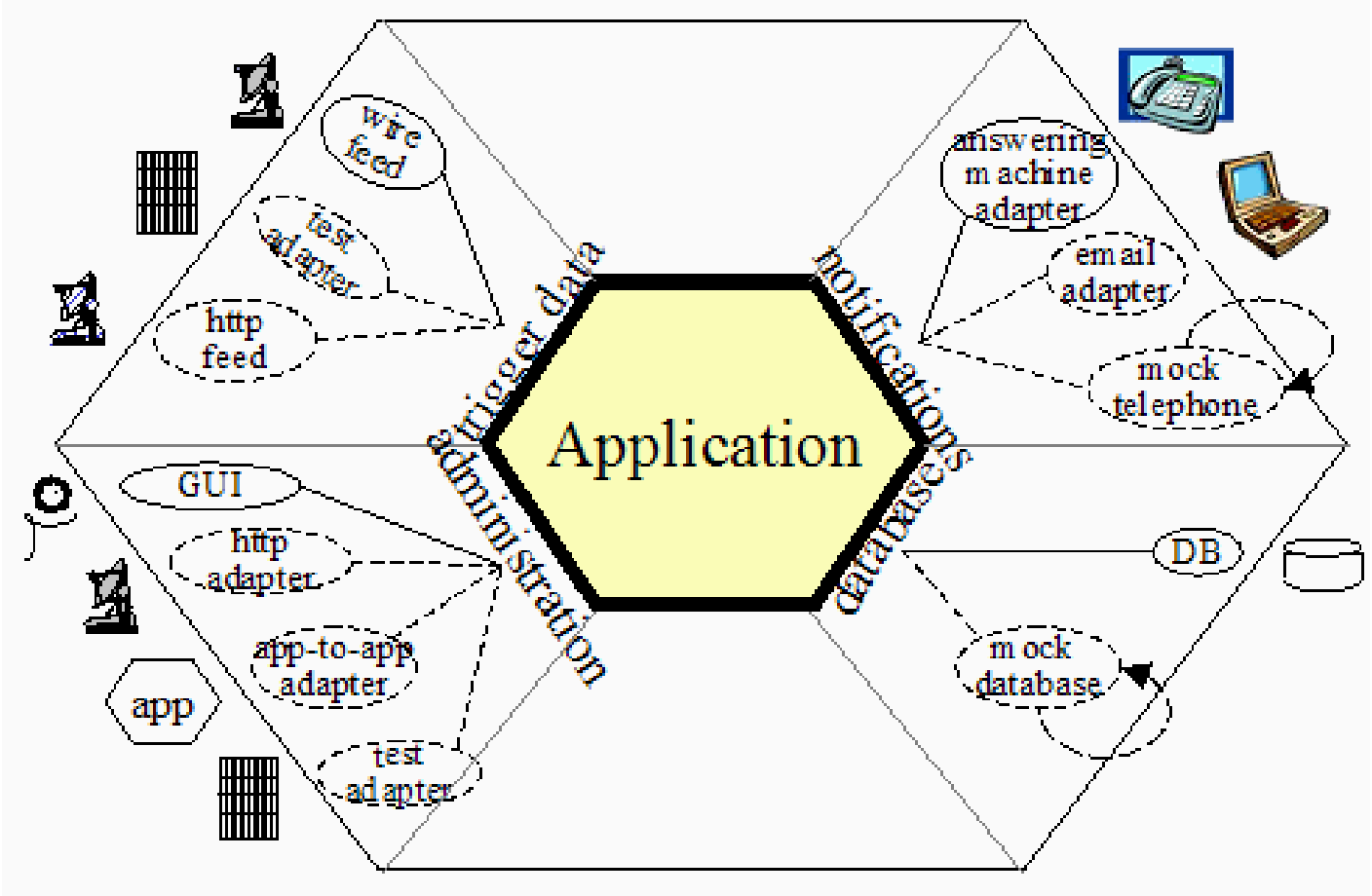
Persistence is a detail

Database- vs. Domain-centric Architecture

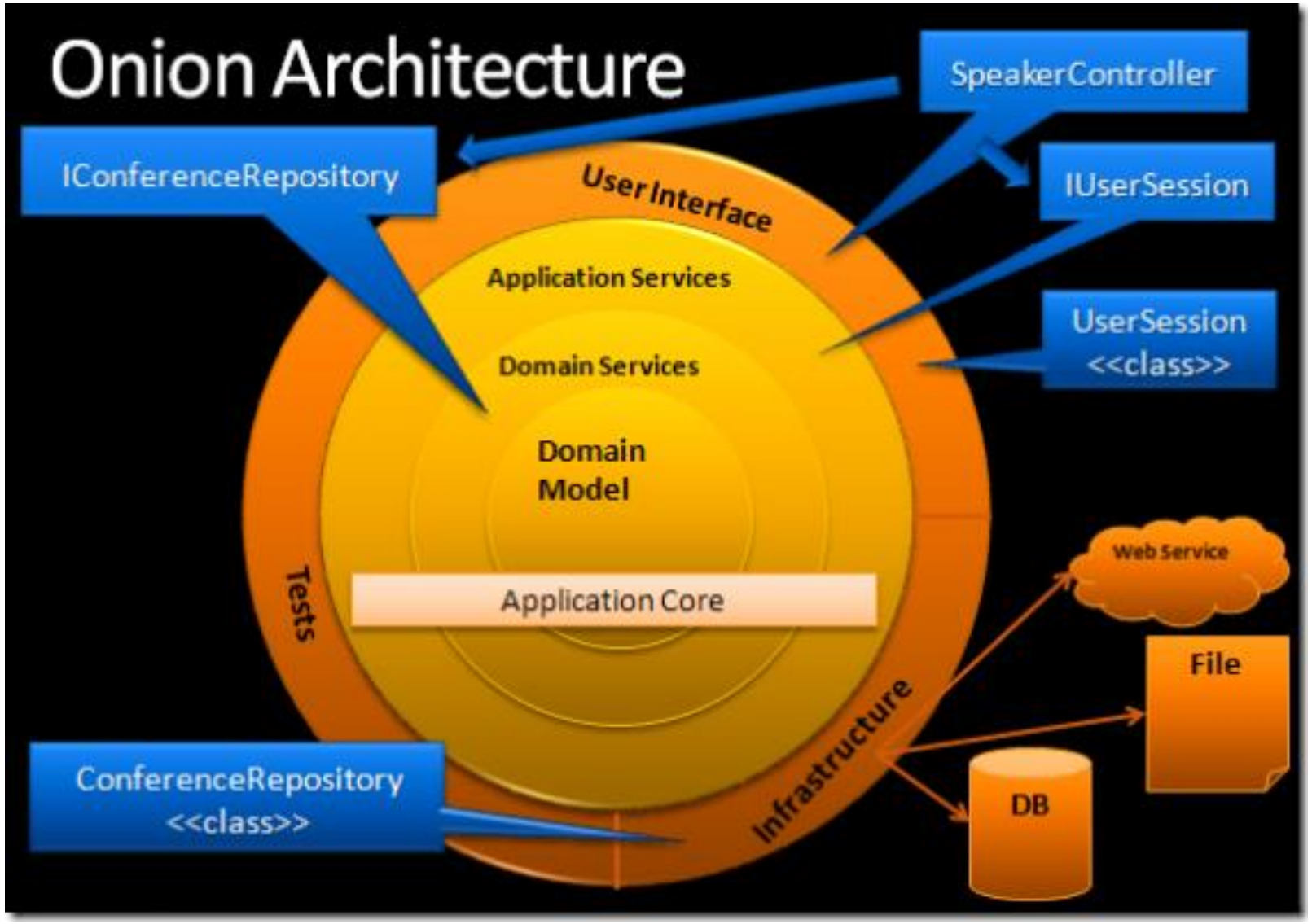




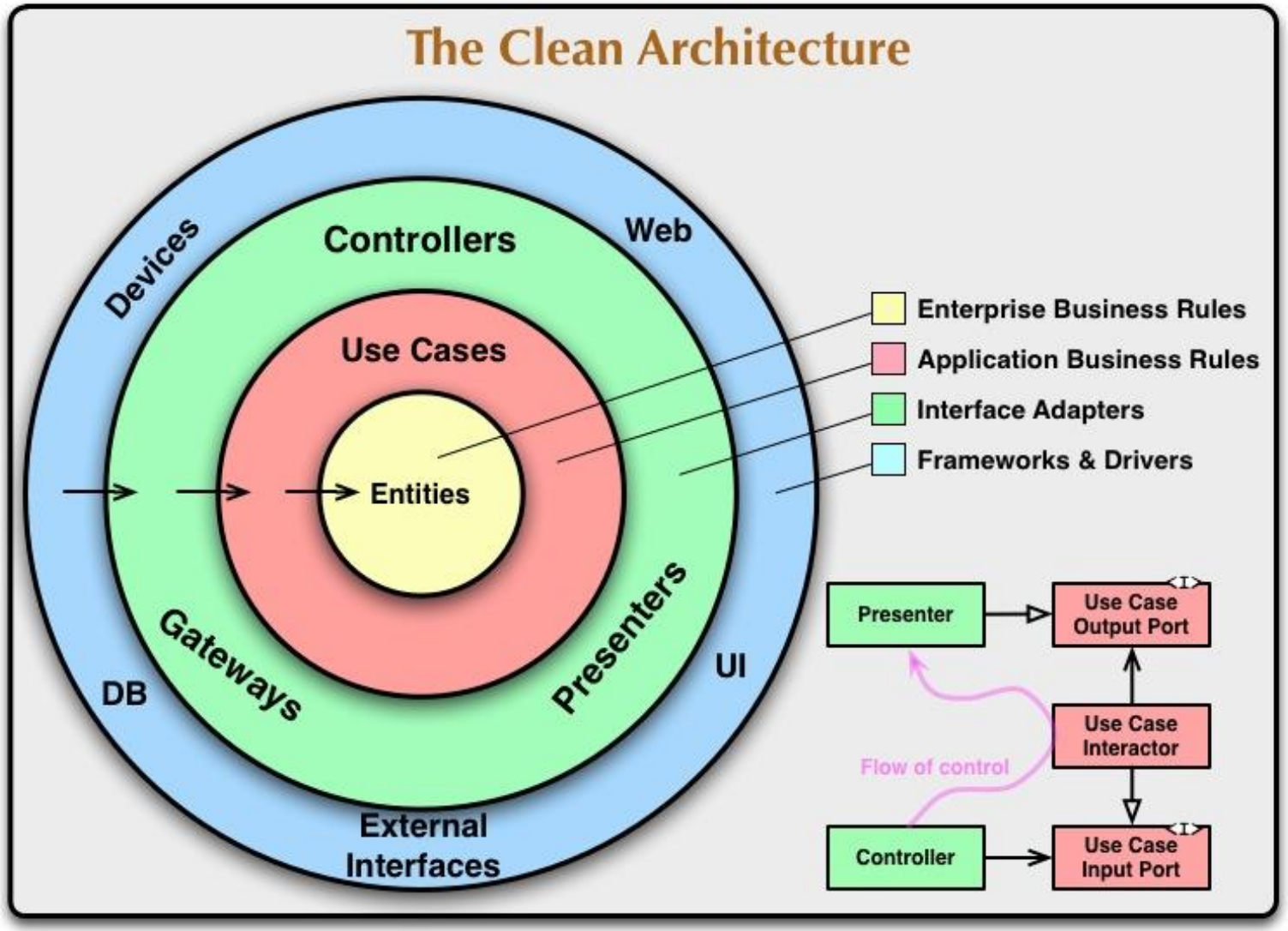
Hexagonal Architecture



Source: http://alistair.cockburn.us/Hexagonal+architecture

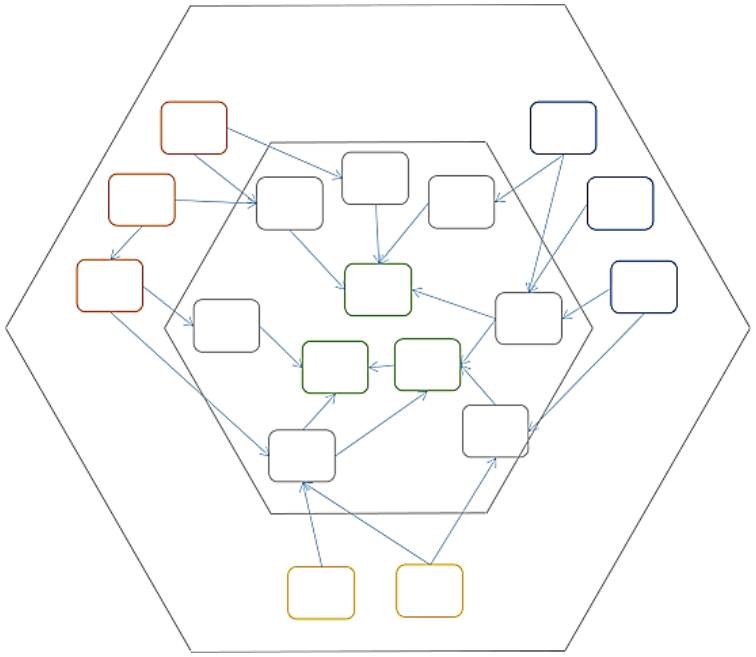


Source: http://jeffreypalermo.com/blog/the-onion-architecture-part-2/

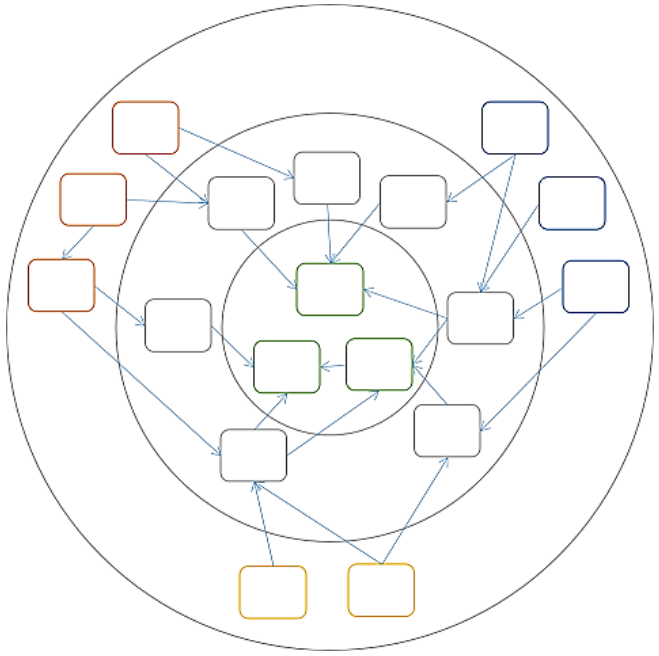


Source: http://blog.8thlight.com/uncle-bob/2012/08/13/the-clean-architecture.html

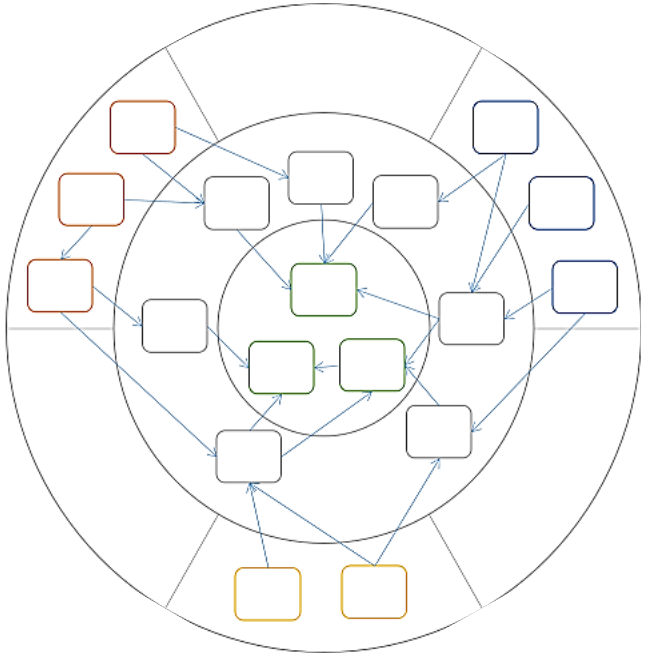
It's All the Same Thing



Hexagonal



Onion



Clean

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

Why Use Domain-Centric Architecture?

Pros

Focus on essential

Less coupling to details

Necessary for DDD

Why Use Domain-Centric Architecture?

Pros

Focus on essential

Less coupling to details

Necessary for DDD

Cons

Change is difficult

Requires extra thought

Initial higher cost

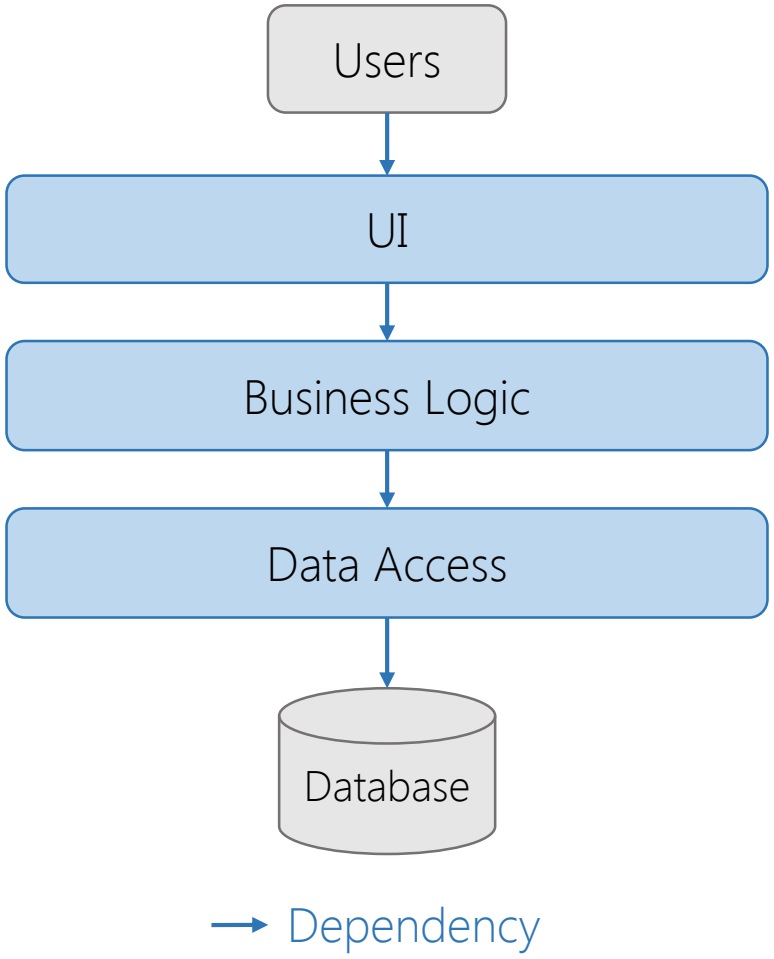
Application Layer

What Are Layers?

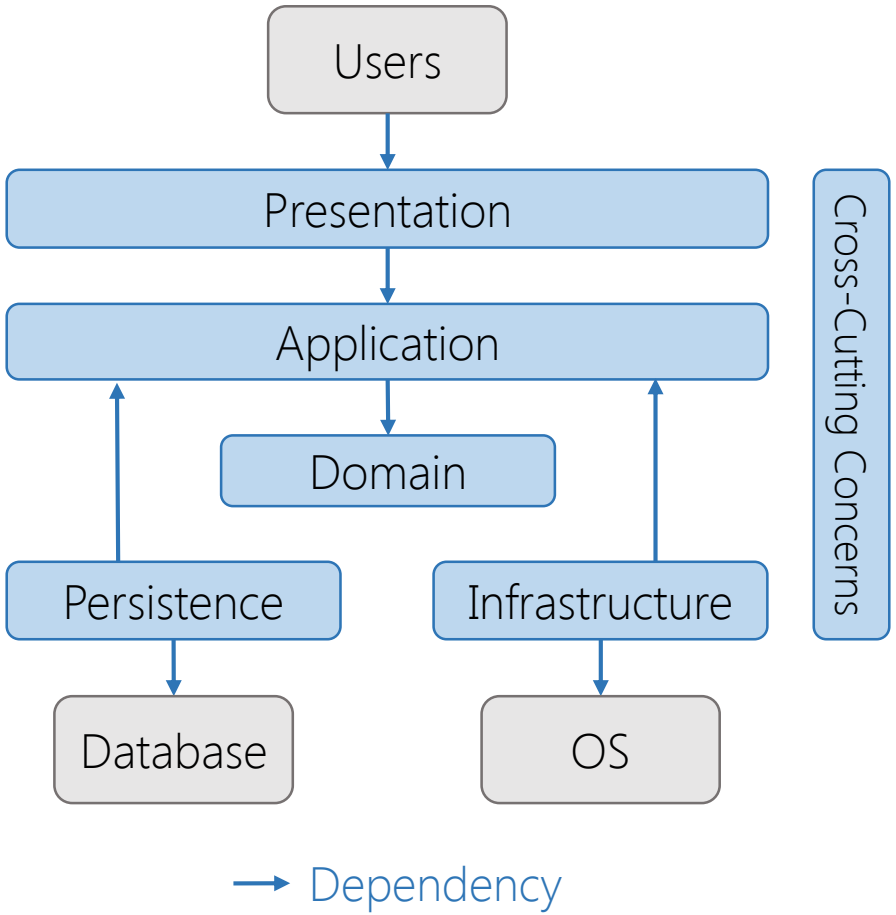
Levels of abstraction
Single-Responsibility Principle
Developer roles / skills
Multiple implementations
Varying rates of change

Source: http://www.followmefoodie.com/wp-content/uploads/2012/03/Spumone-Layered-Cake.jpg

Classic 3-Layer Architecture



Modern 4-Layer Architecture



Application Layer

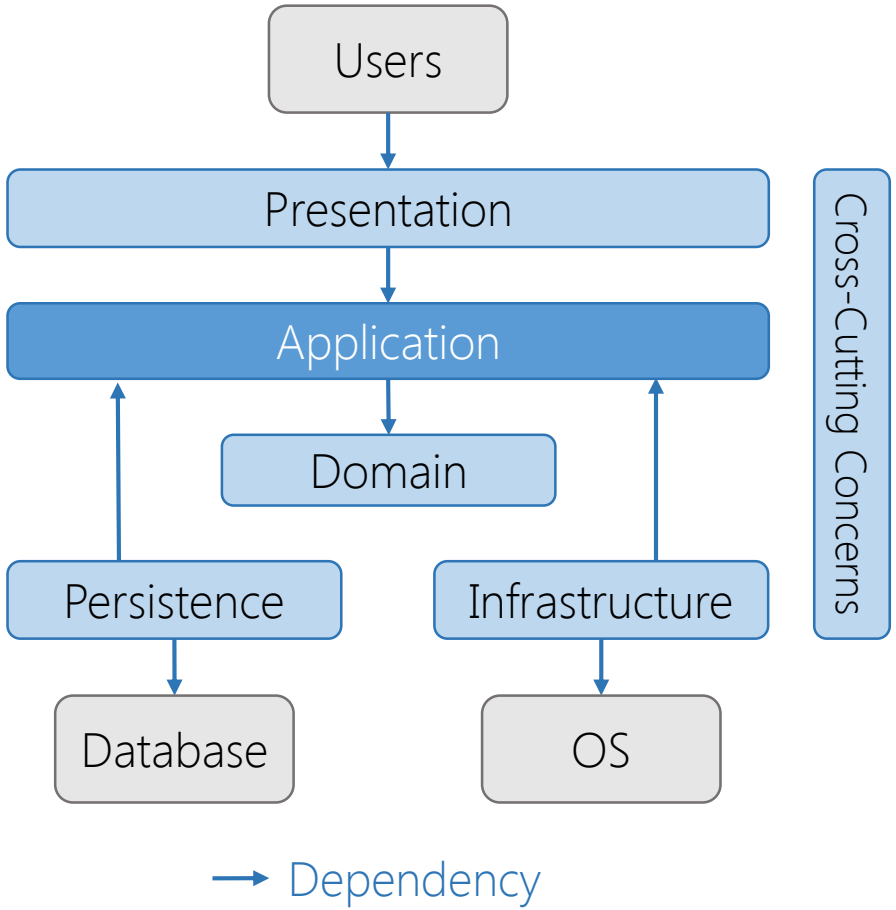
Implements use cases

High-level application logic

Knows about domain

No knowledge of other layers

Contains interfaces for details



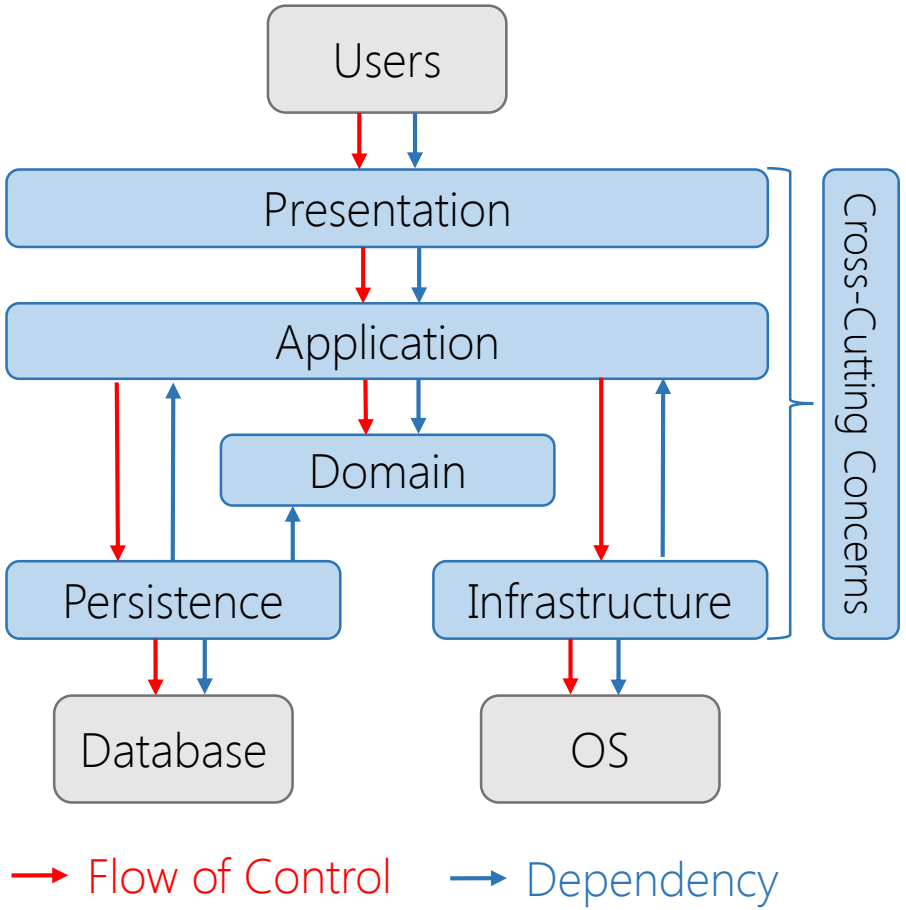
Layer Dependencies

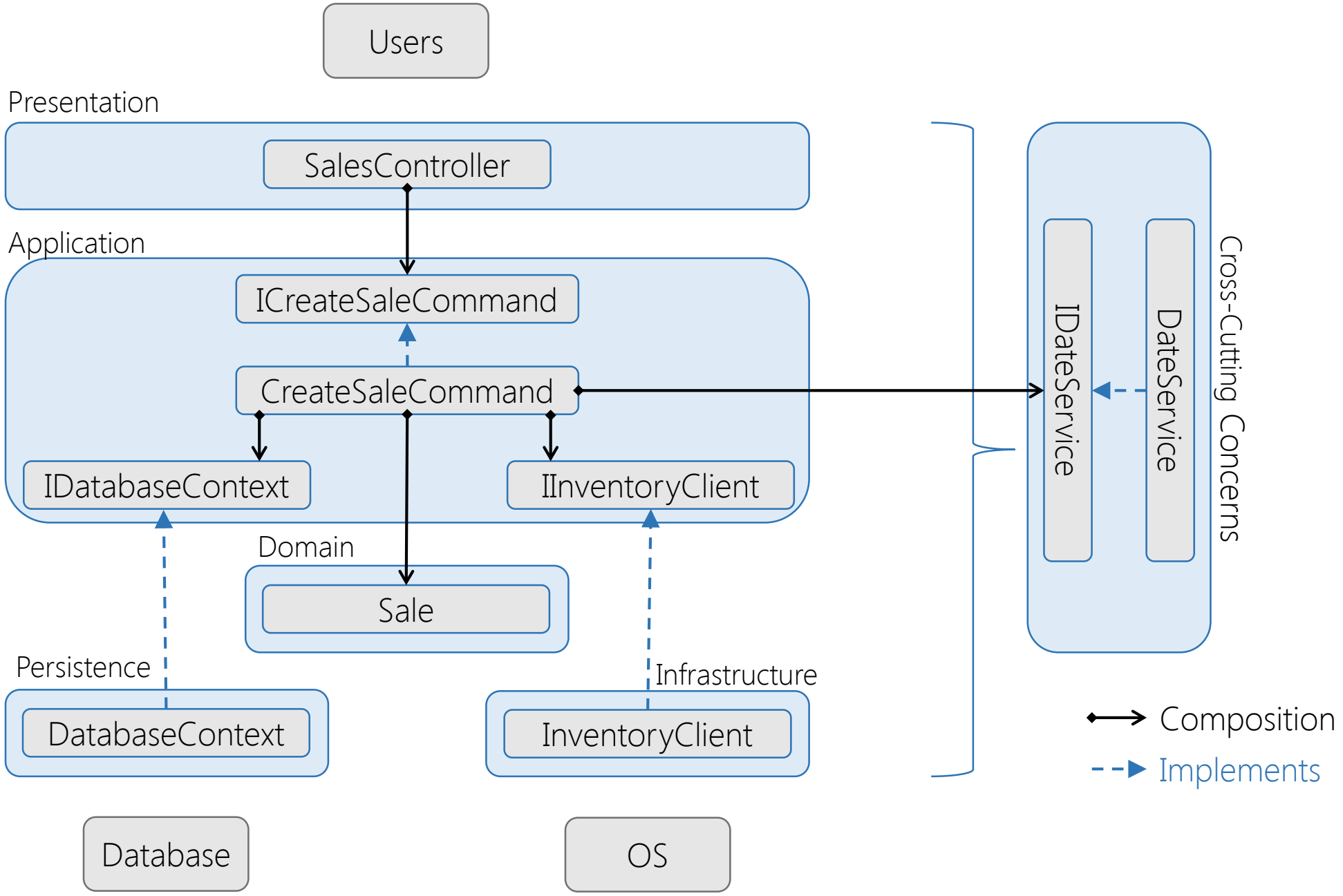
Dependency inversion

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

Easy to understand

Follows DIP

Why Use an Application Layer?

Pros

Focus is on use cases

Easy to understand

Follows DIP

Cons

Additional cost

Requires extra thought

IoC is counter-intuitive

Commands and Queries

Command-Query Separation

Command

Does something

Modifies state

Should not return a value

Command-Query Separation

Command

Does something

Modifies state

Should not return a value

Query

Answers a question

Does not modify state

Always returns a value

Command-Query Separation

Command

Does something

Modifies state

Should not return a value *(ideally)*

Query

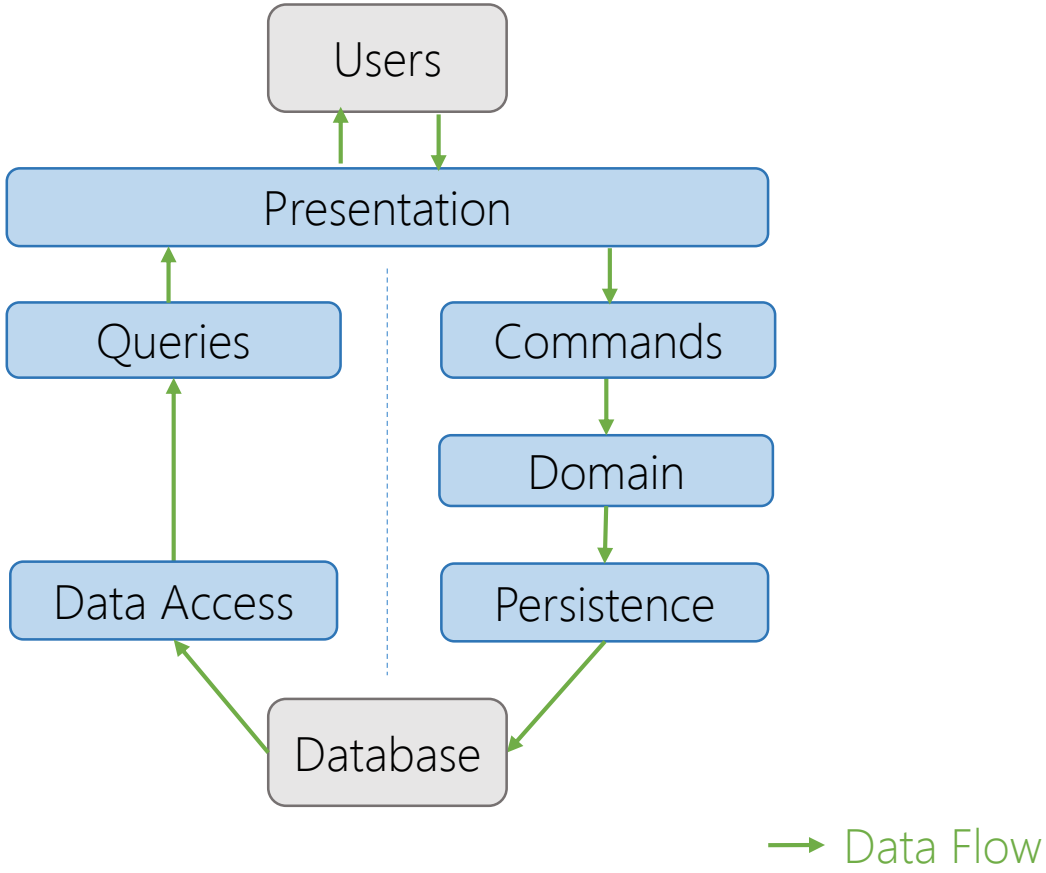
Answers a question

Does not modify state

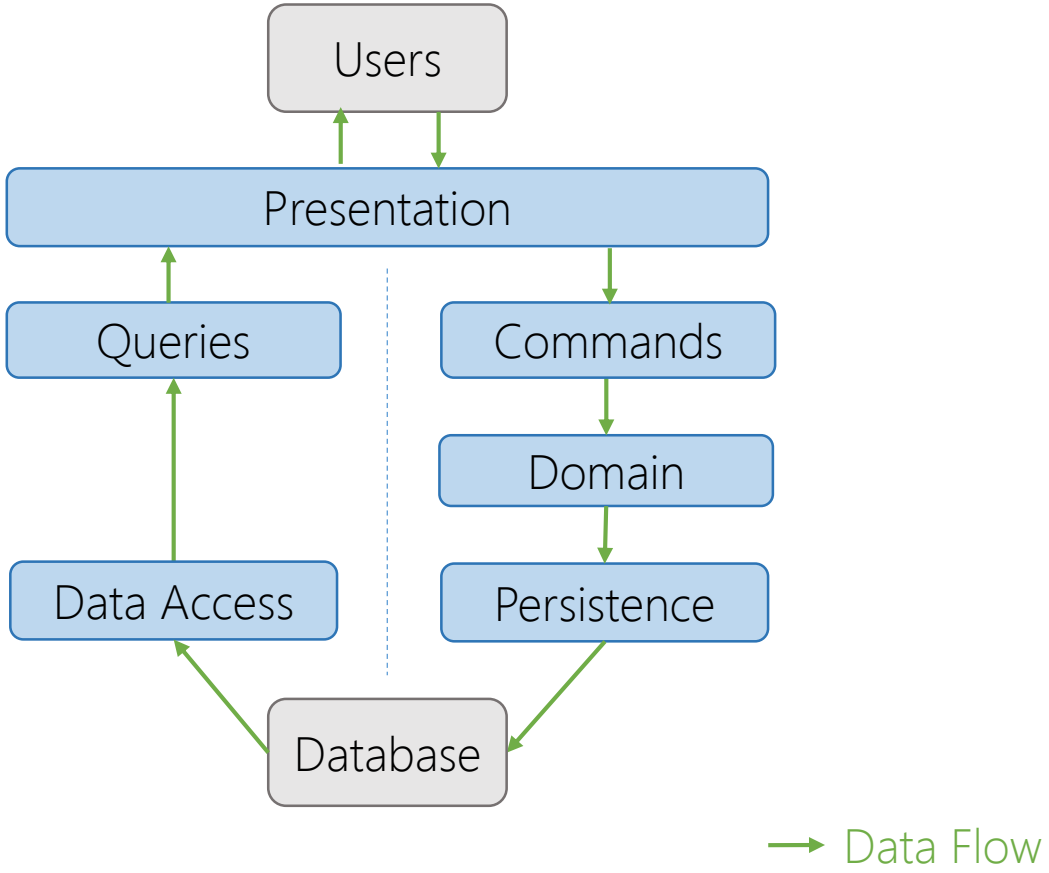
Always returns a value

Avoid mixing the two!

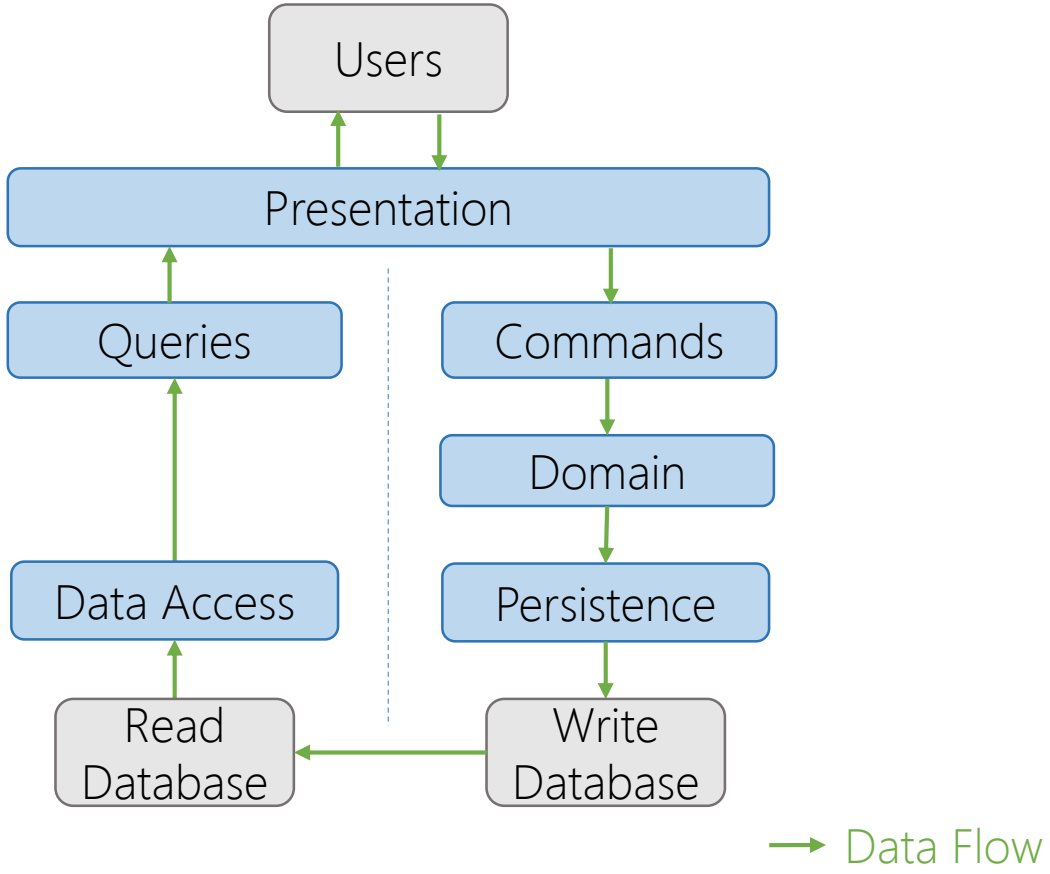
CQRS Architectures



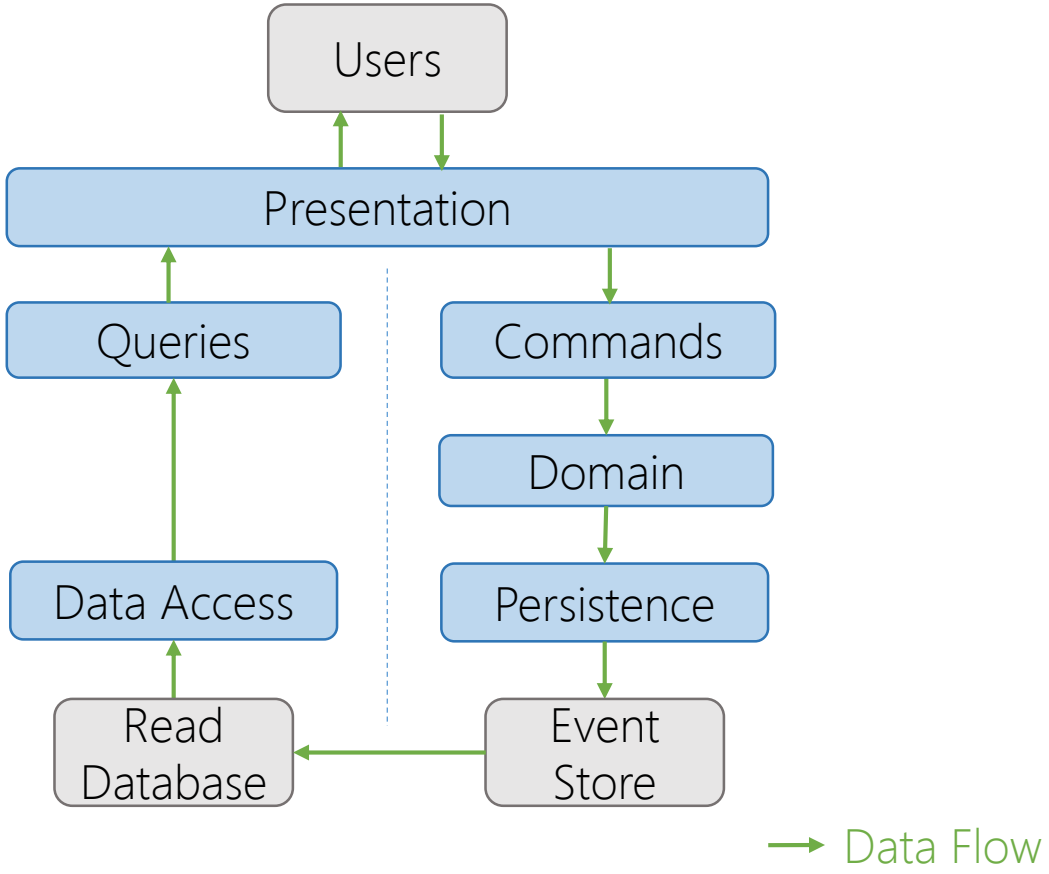
CQRS Type 1 – Single Database



CQRS Type 2 – Read/Write Databases



CQRS Type 3 – Event Sourcing



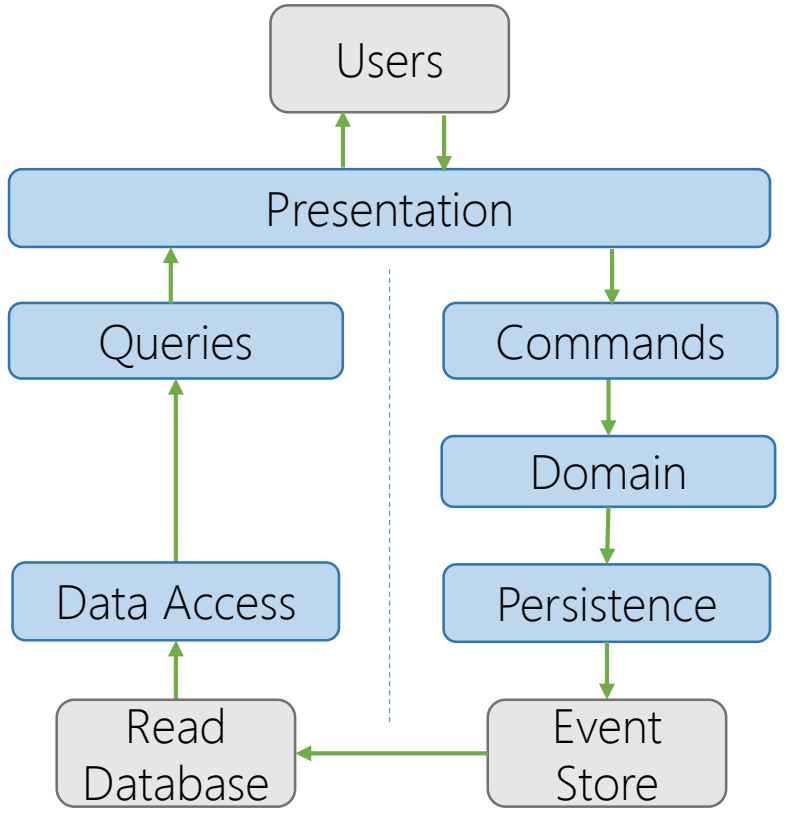
CQRS Type 3 – Event Sourcing

Complete audit trail

Point-in-time reconstruction

Replay events

Rebuild production database



Why Use CQRS?

Pros

More efficient design

Simpler within each stack

Optimized performance

Why Use CQRS?

Pros

More efficient design

Simpler within each stack

Optimized performance

Cons

Inconsistent across stacks

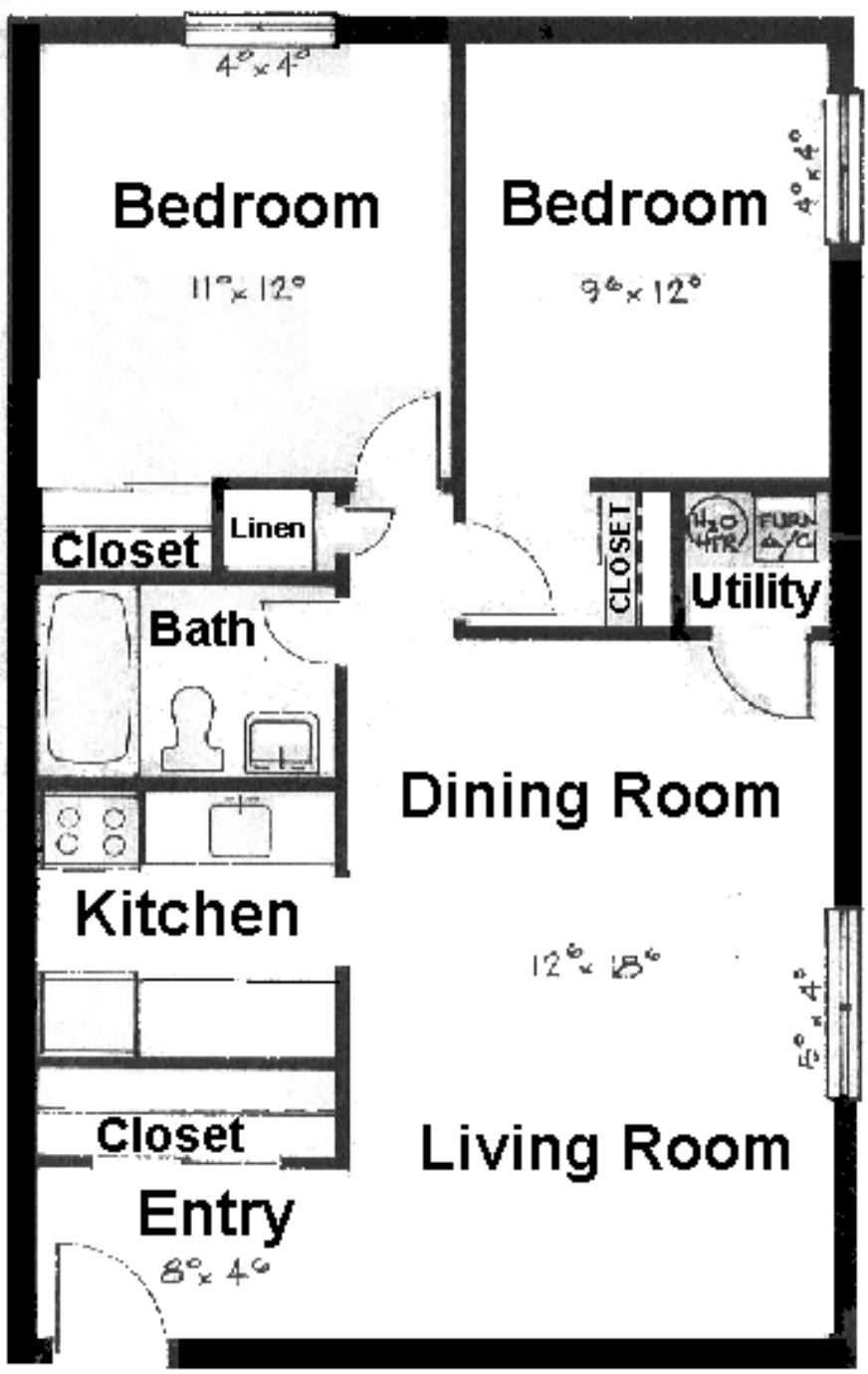
Type 2 is more complex

Type 3 might be overkill

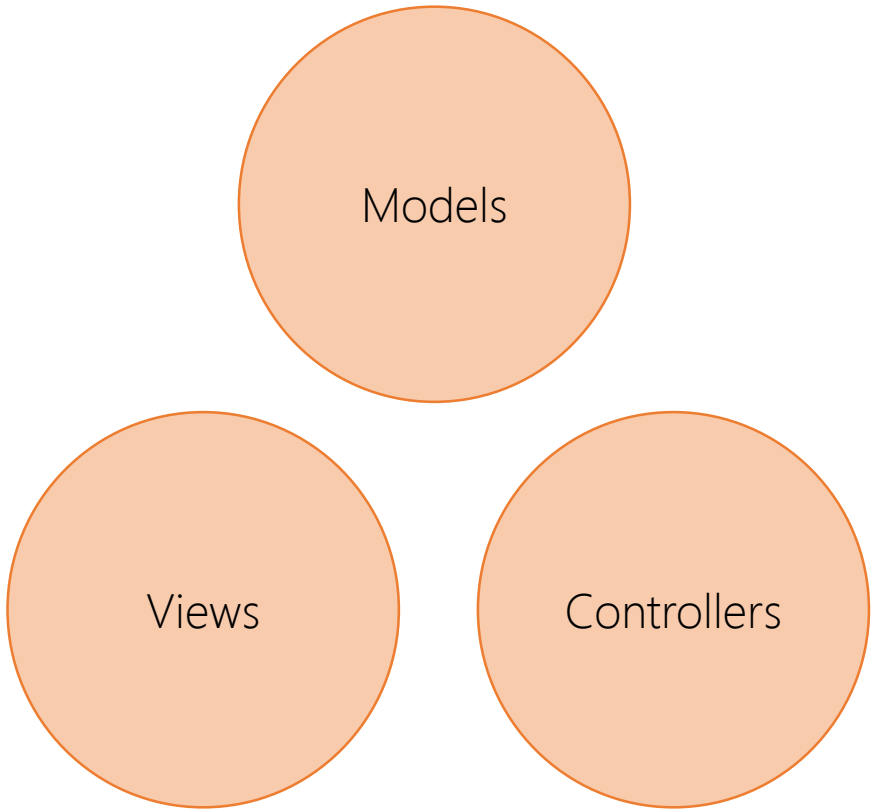
Functional Organization

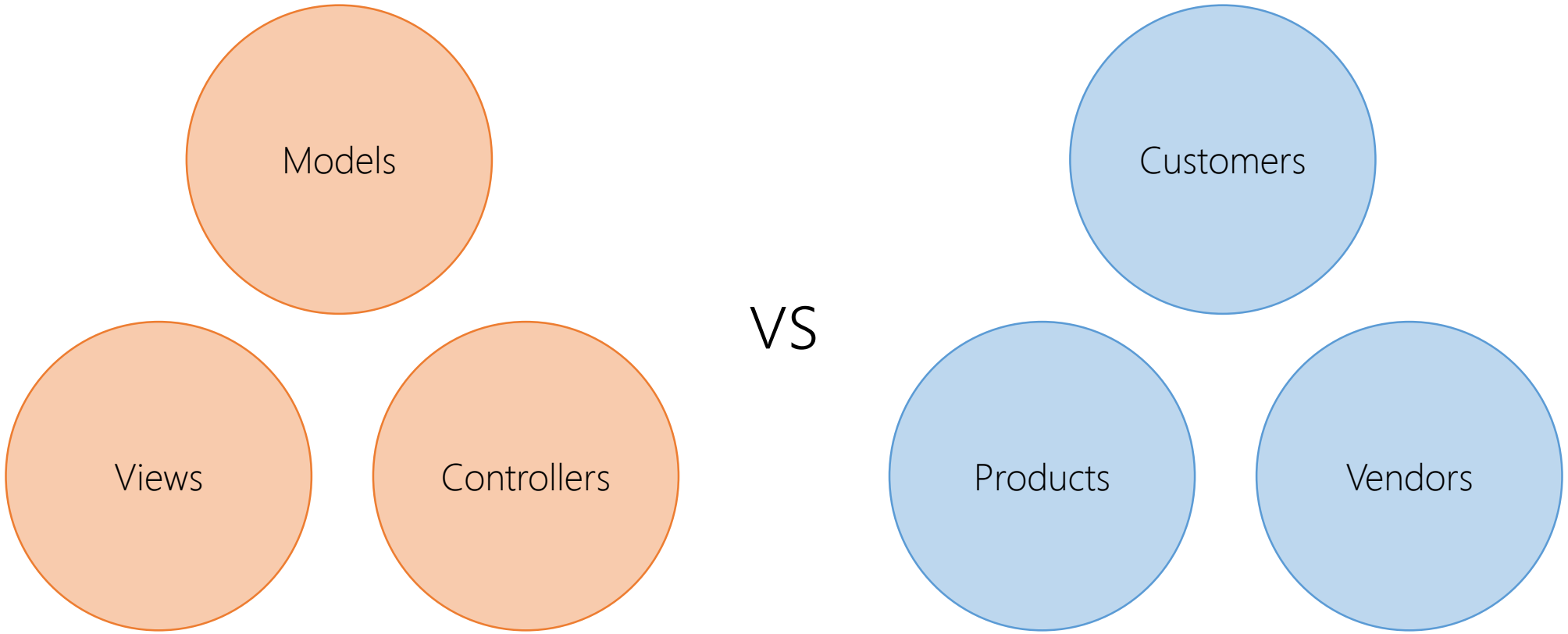
"The architecture should scream
the intent of the system!"

– Uncle Bob


4' x 4'
Bedroom
11' x 12'
Bedroom
9'6 x 12'
4' x 4'
Linen
Closet
Bath
CLOSET
H2O HTR
FURN A/C
Utility
Dining Room
Kitchen
12'6 x 15'
5' x 4'
Closet
Living Room
Entry
8' x 4'

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

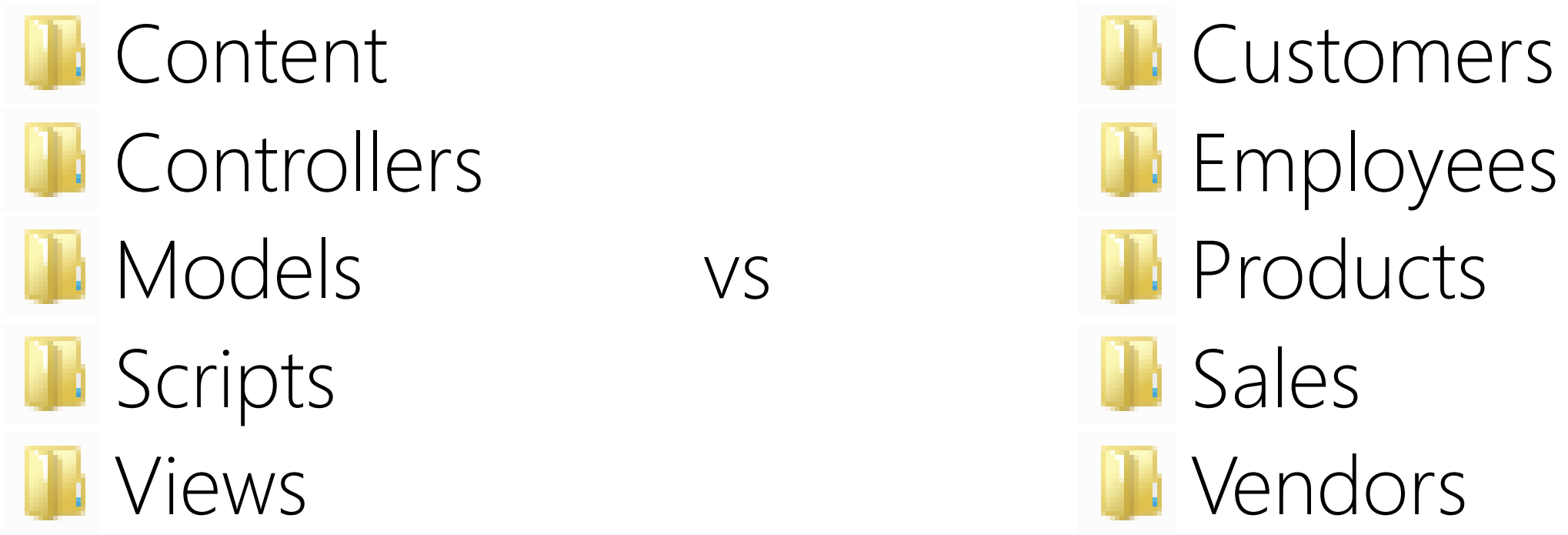
Content

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

Easy to navigate

Avoid vendor lock-in

Why Use Functional Organization

Pros

Spatial locality

Easy to navigate

Avoid vendor lock-in

Cons

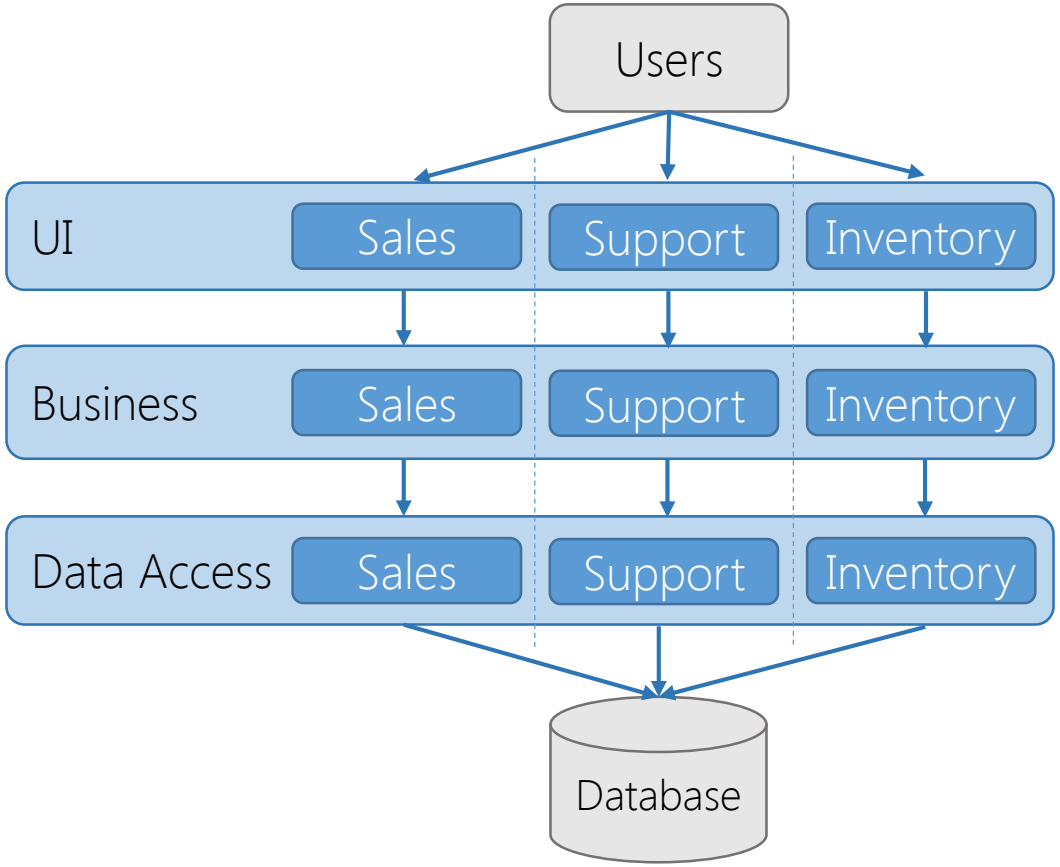
Lose framework conventions

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

Problem Domain

Sales

Sales Opportunity

Contact

Sales Person

Product

Sales Territory

Support

Support Ticket

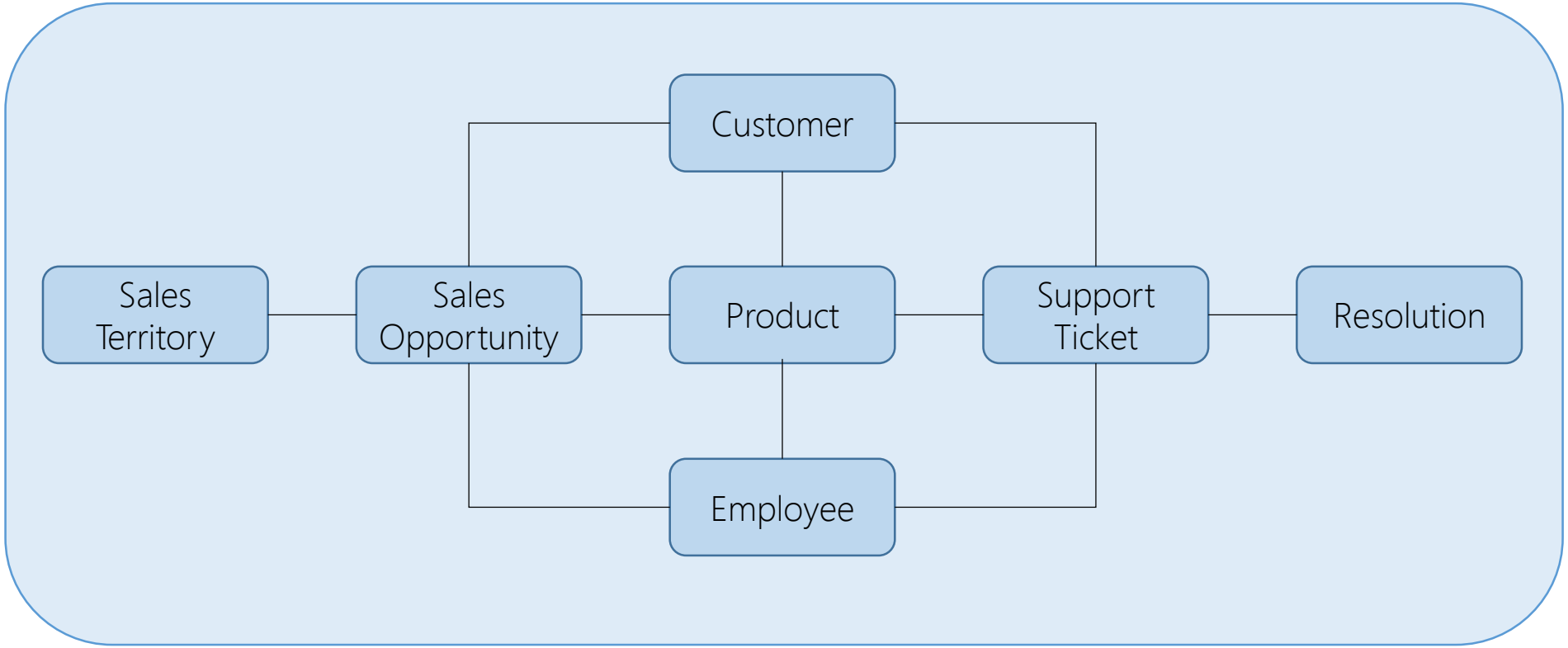
Customer

Support Person

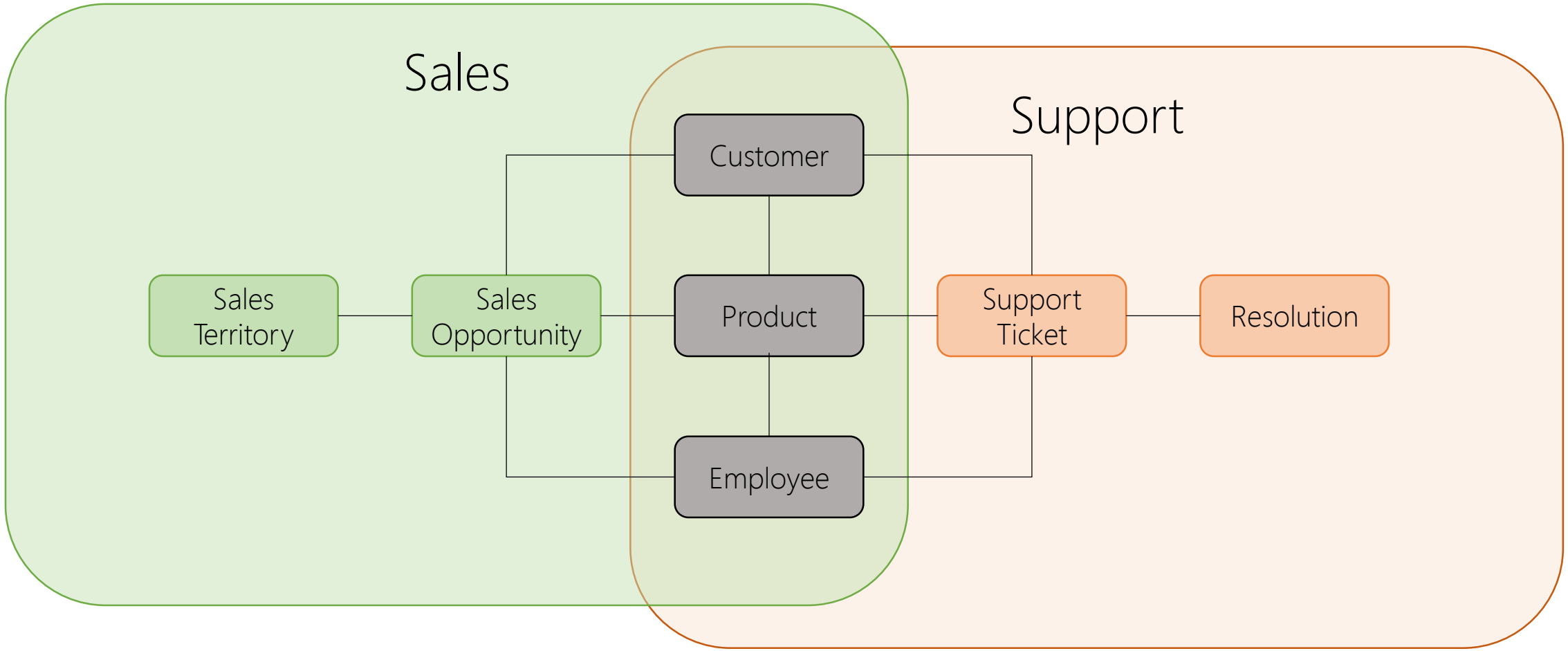
Product

Resolution

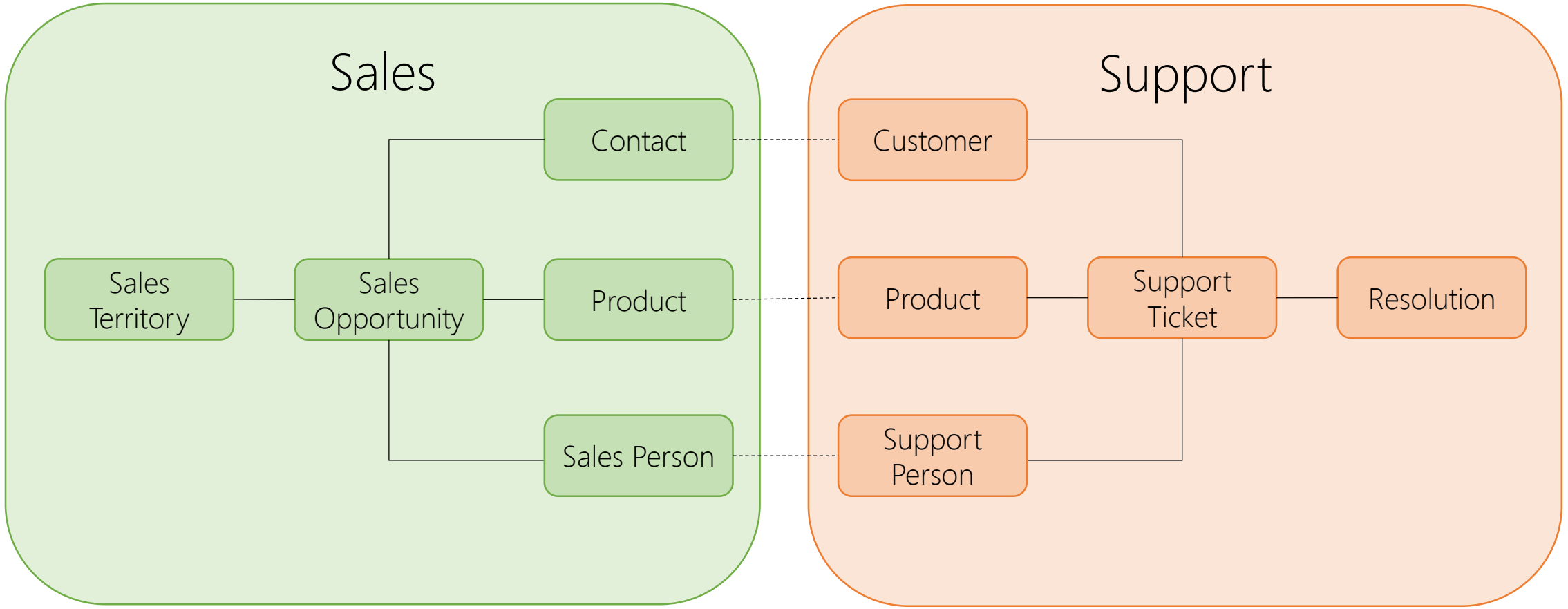
Single Domain Model



Bounded Contexts



Bounded Contexts

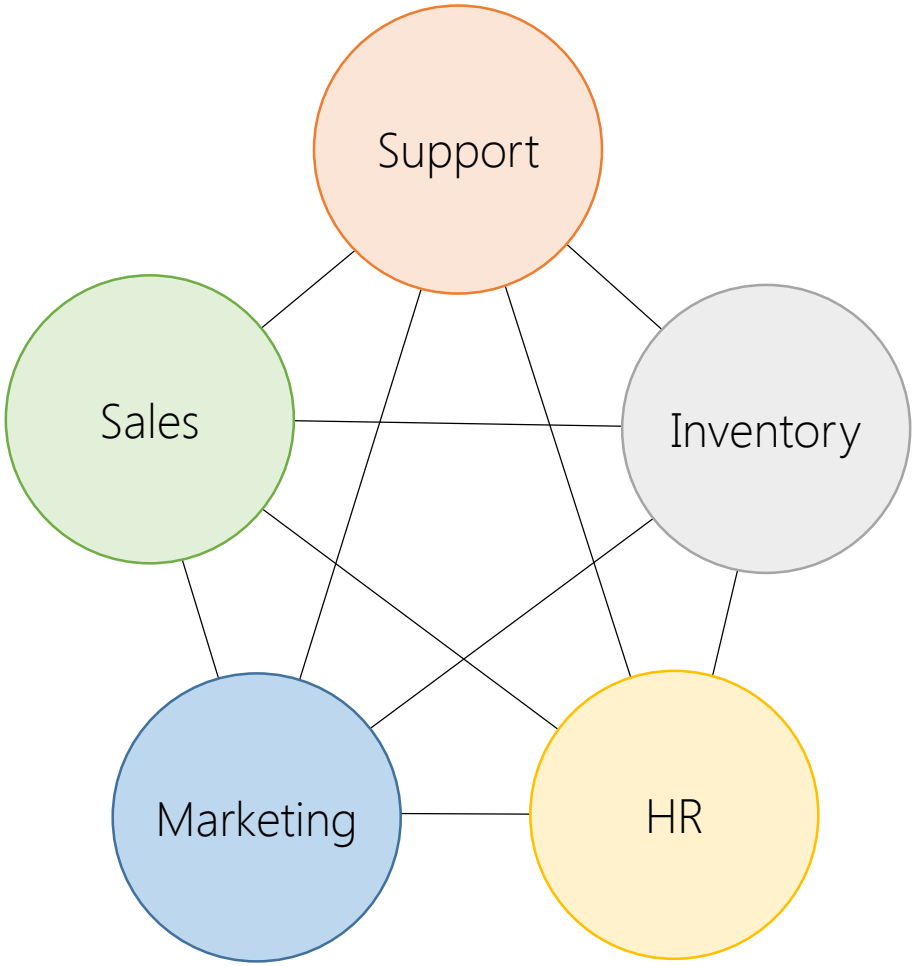


Microservice Architectures

Subdivide system

Bounded contexts

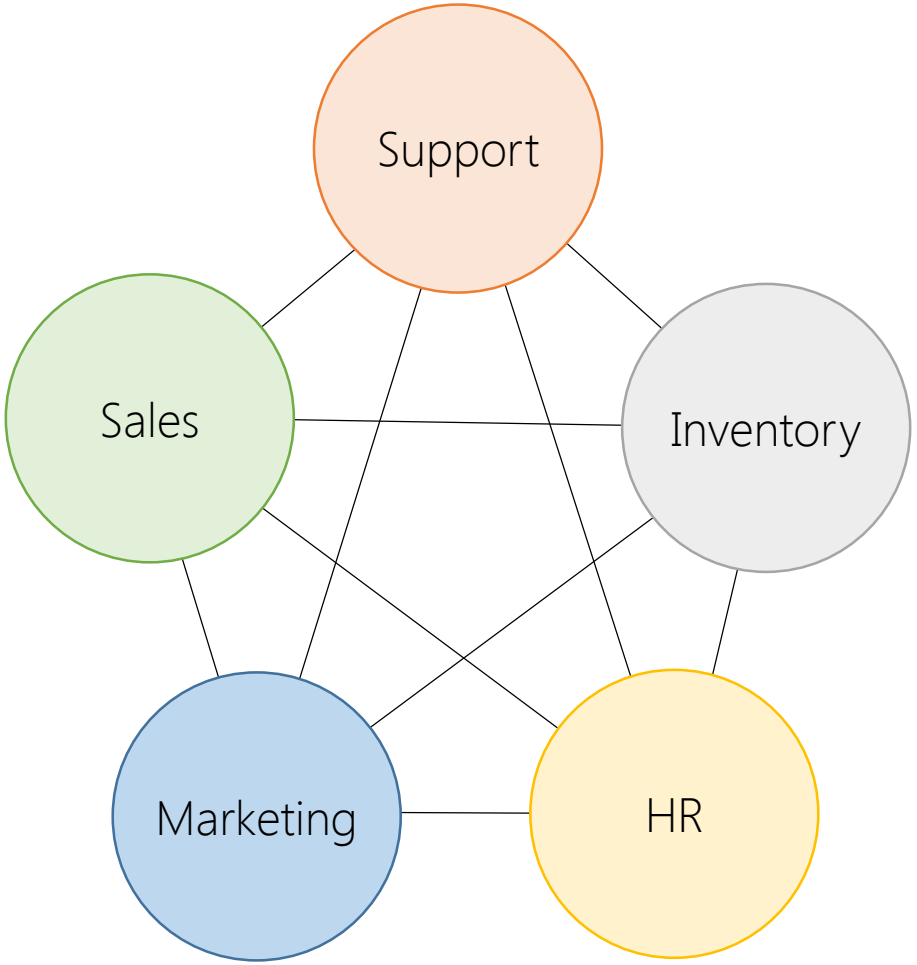
Small teams



Microservice Architectures

Independent

Similar to SOA



Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

Independence

Why Use Microservices?

Pros

Less cost for large domains

Smaller teams

Independence

Cons

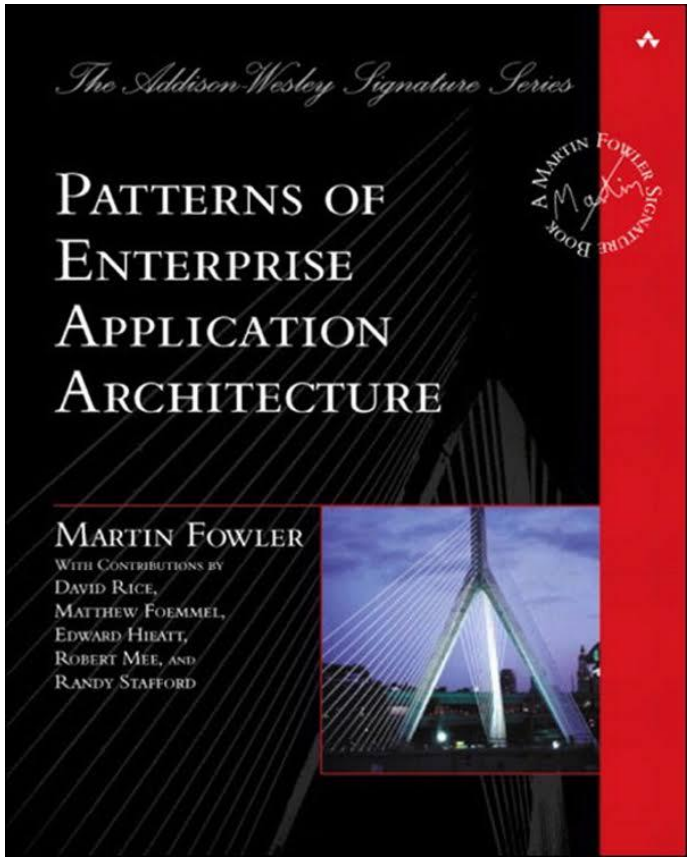
Only for large domains

Higher up-front cost

Distributed system costs

Code Demo

Where to Go Next?



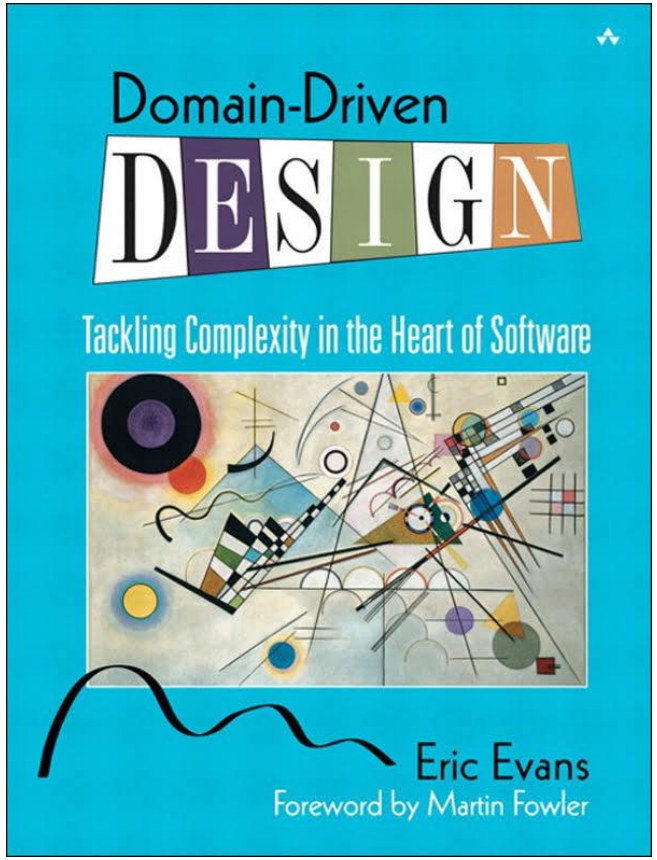
Martin Fowler

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?

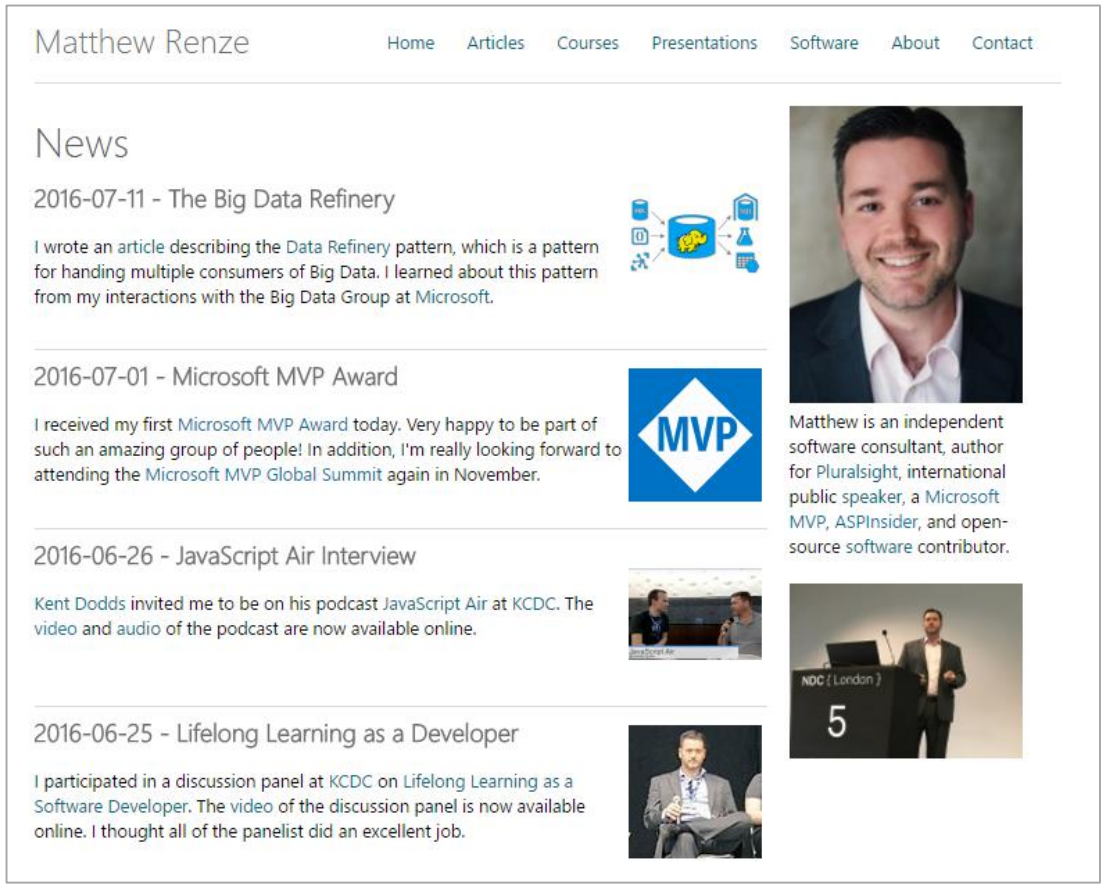
Articles

Courses

Presentations

Source Code

Videos



www.matthewrenze.com

Conclusion

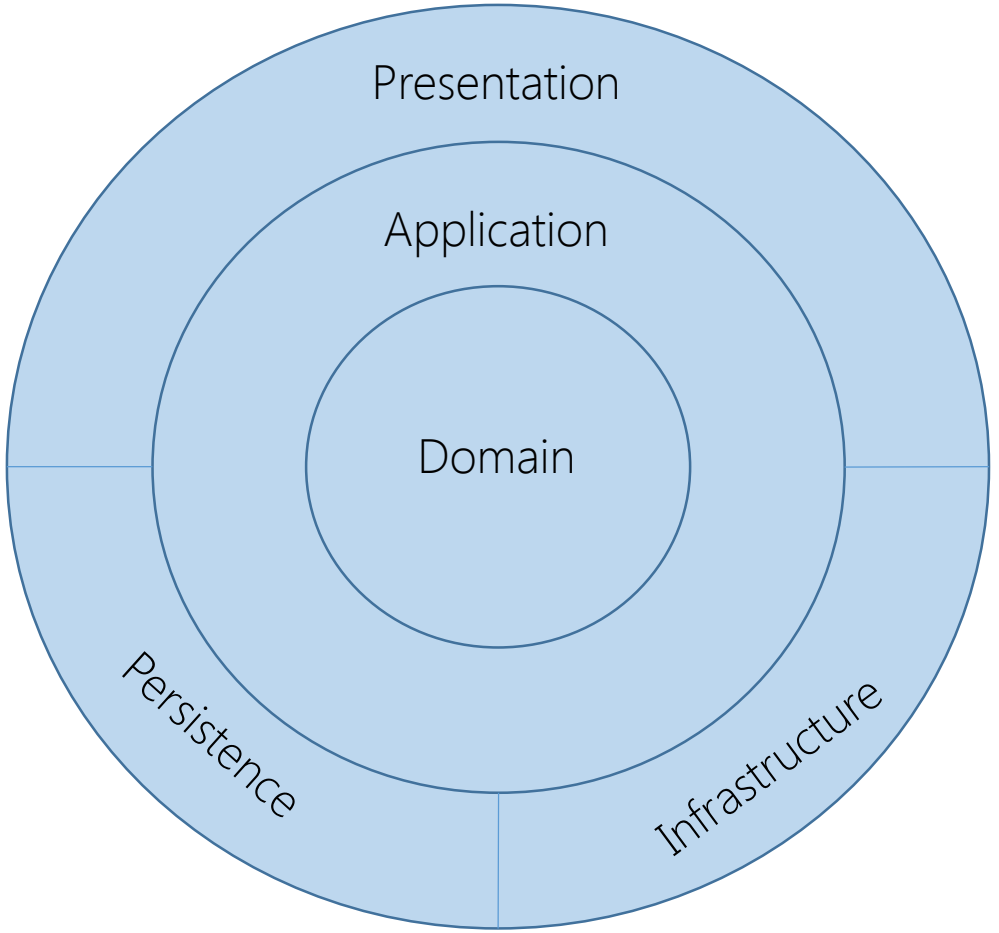
Summary

Focus on the inhabitants

Summary

Focus on the inhabitants

Domain-centric Architecture

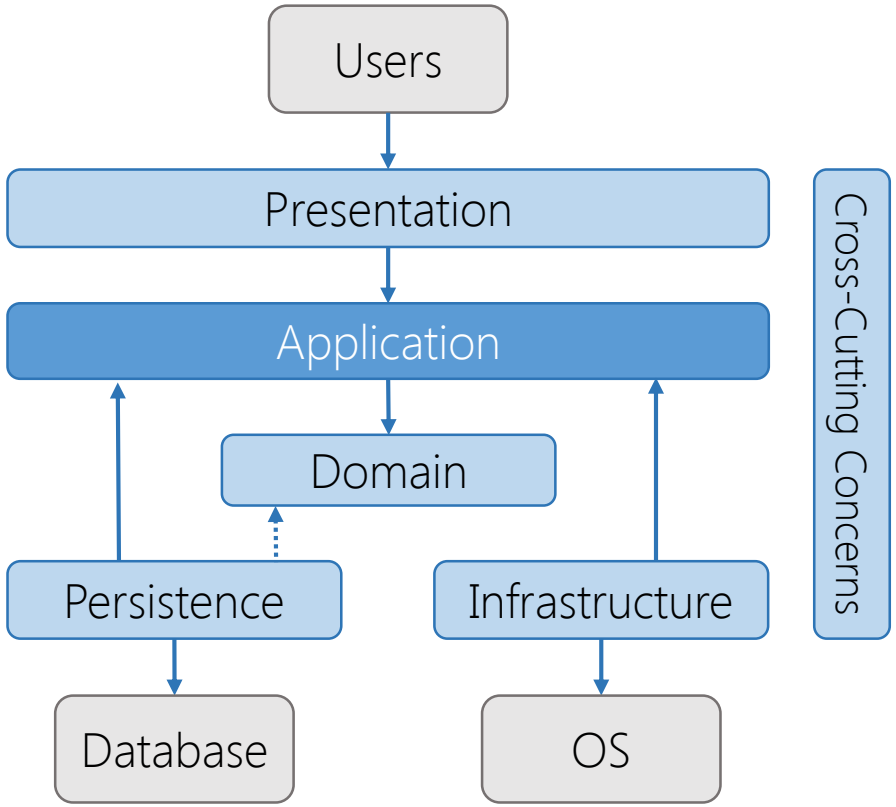


Summary

Focus on the inhabitants

Domain-centric Architecture

Application Layer



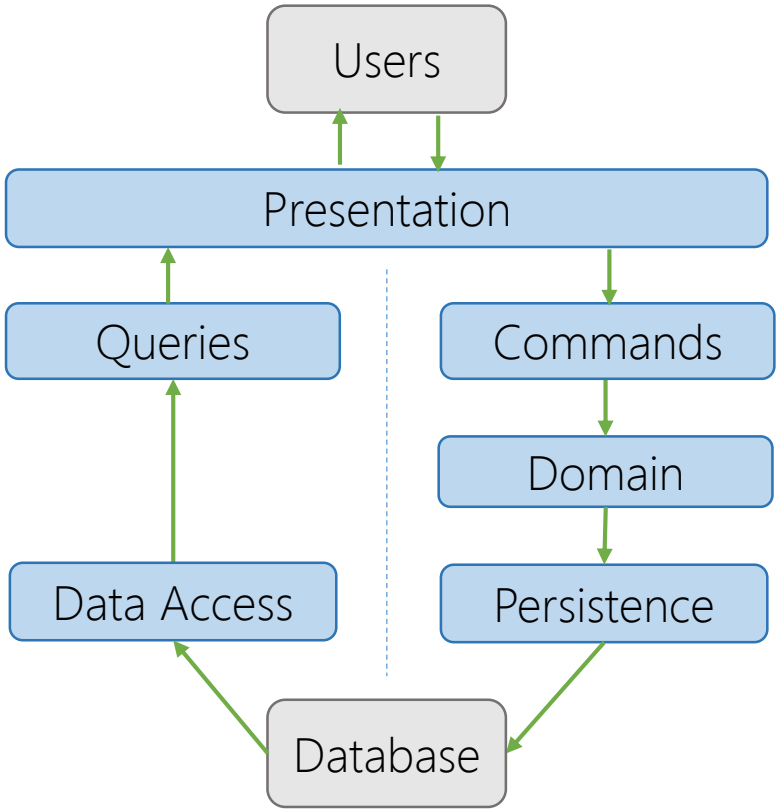
Summary

Focus on the inhabitants

Domain-centric Architecture

Application Layer

Commands and Queries



Summary

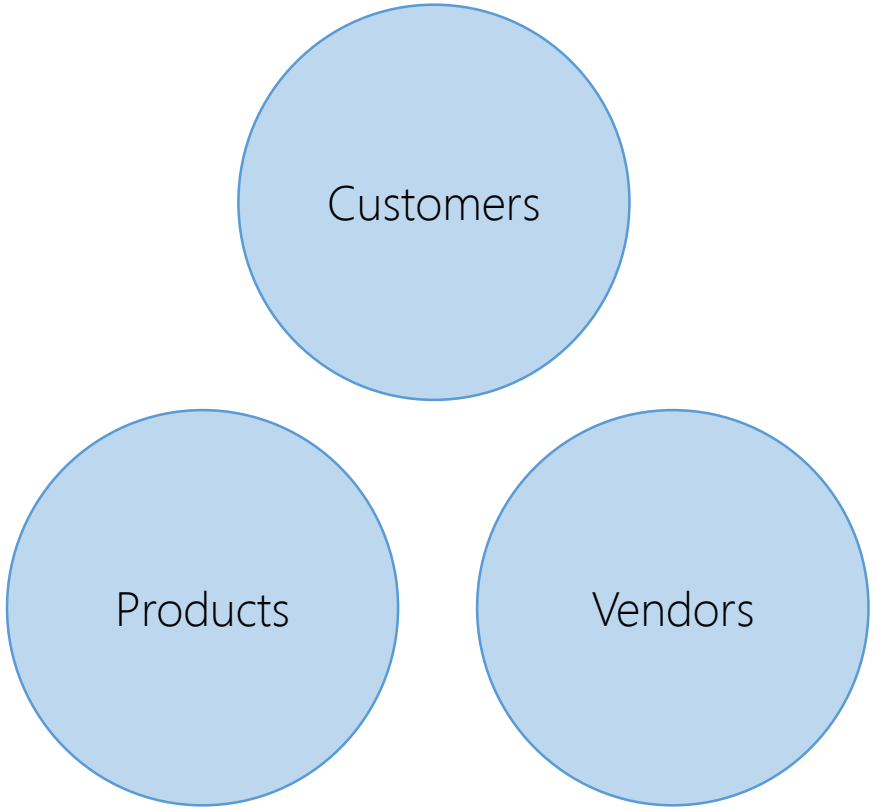
Focus on the inhabitants

Domain-centric Architecture

Application Layer

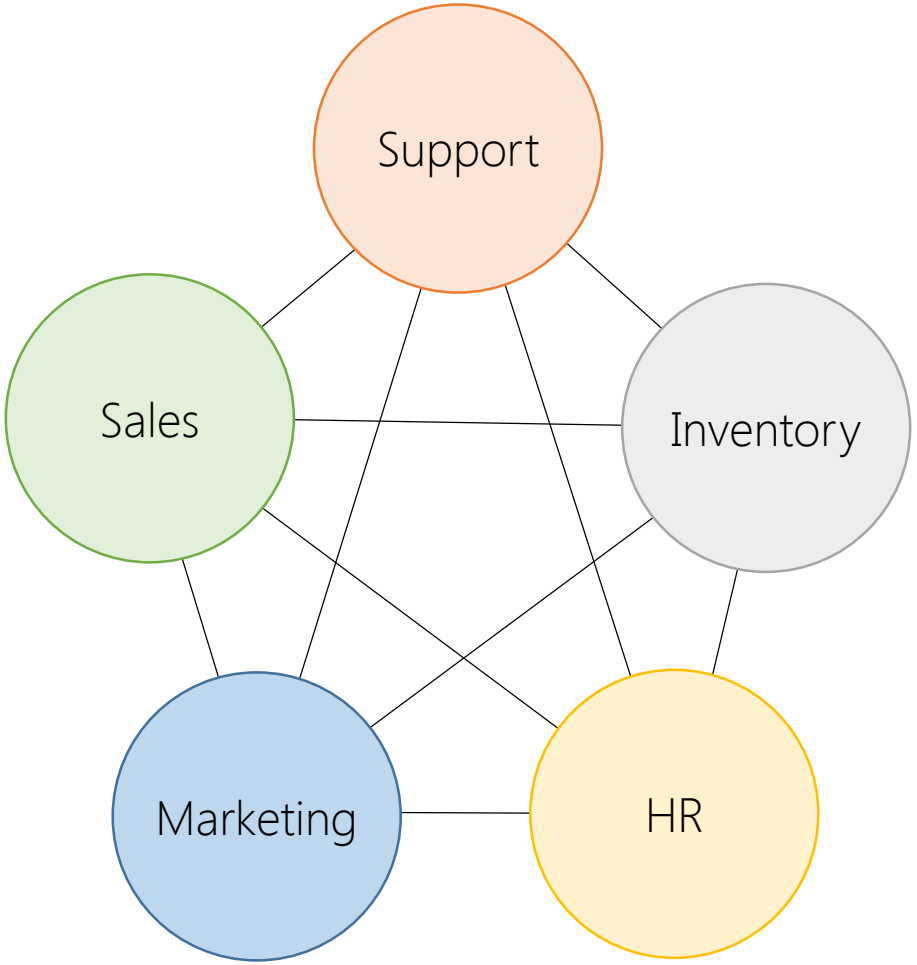
Commands and Queries

Functional Cohesion



Summary

Focus on the inhabitants
Domain-centric Architecture
Application Layer
Commands and Queries
Functional Cohesion
Bounded Contexts



dev up Conference 2016 Attendee Party

Ryse Nightclub

October 21st Friday 5:15 – 10:15

Food, Drinks, Games, and Fun!

Feedback

Feedback is very important to me!

One thing you liked?

One thing I could improve?

Contact Info

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Thank You! :)