HSLU Hochschule Luzern

Software Architecture and Techniques

Architectural Trends I

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Truths (1/2)

- Agile architecture is **emergent**
- Agile architecture **evolves**
- Architecture is **technology related**
- Not all architecture aspects are technology related

Truths (2/2)

- SOA is dead – *infrastructure, applications, and application business services coordinated through orchestration, use instead bounded domains -*
- Monolith Solutions must be handled with care
  - Through discipline you can build a **modular monolith solution**
- Applications are now mobile first
- Applications are often browser first – *in general for strange reasons -*
  - Progressive Web Application *PWA* approaches are emerging
- Browser solutions must often be rewritten – *every 18 or 24 months -*

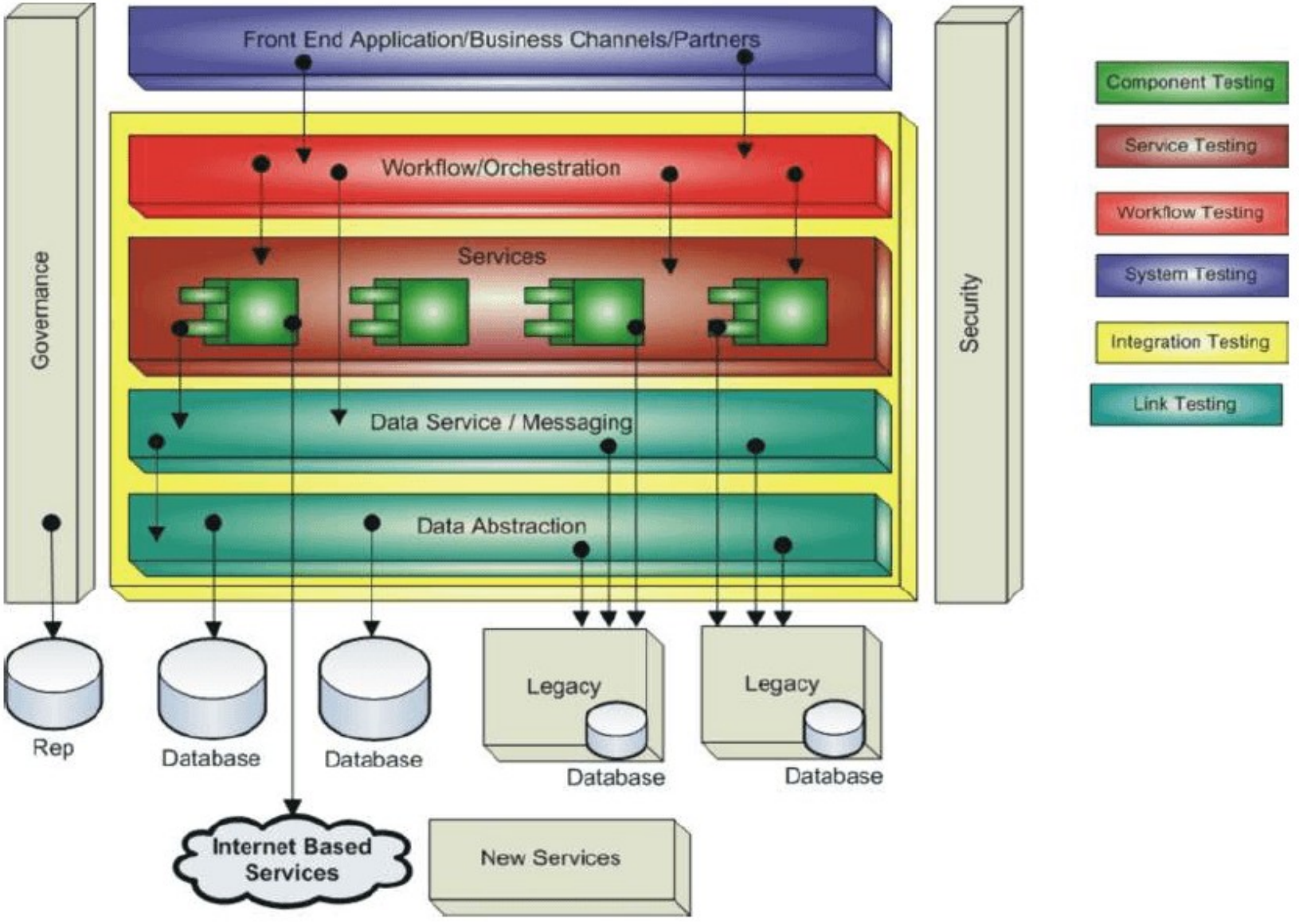
Layered Architecture

- Unorganized source code and modules with no definite roles can become a problem for the application.
- Skipping previous layers to create tight coupling can lead to a logical mess full of complex interdependencies.
- Basic modifications can require a complete redeployment of the application.

Event Driven Architecture

- Testing individual modules can only be done if they are independent, otherwise, they need to be tested in a fully functional system.
- When several modules are handling the same events, error handling becomes challenging to structure.
- Development of a system-wide data structure for events can become arduous if the events have different needs.
- Maintaining a transaction-based mechanism for consistency can become complex with decoupled and independent modules.

SOA Architecture



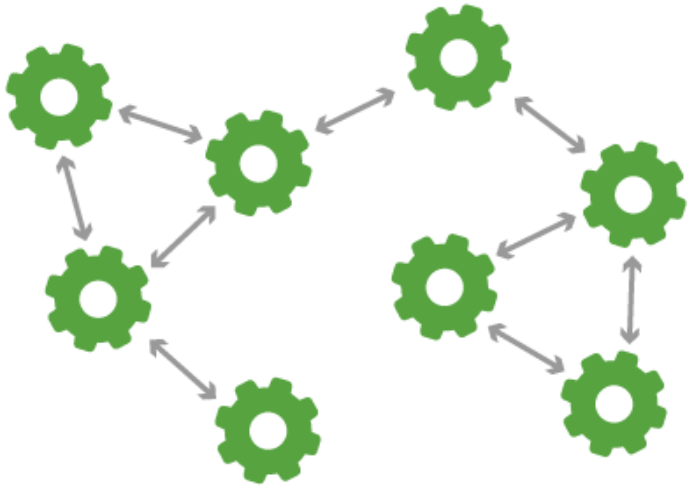
2000's

SERVICE ORIENTED ARCHITECTURE

SOA based applications are compromised of more loosely coupled components that use an Enterprise Services Bus messaging protocol to communicate between themselves.

2010's

MICROSERVICES ARCHITECTURE



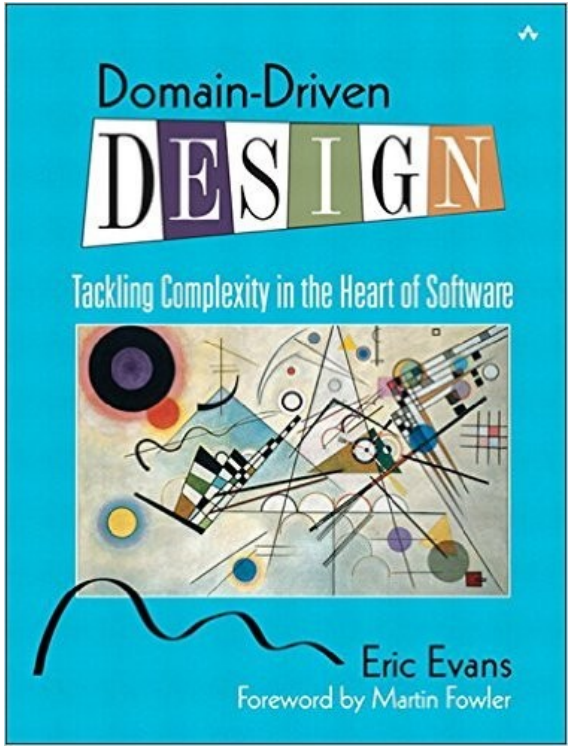
Microservices are a number of independent application services delivering one single functionality in a loosely connected and self-contained fashion, communicating through light-weight messaging protocols such as HTTP, REST or Thrift API.

Micro Kernel Architecture

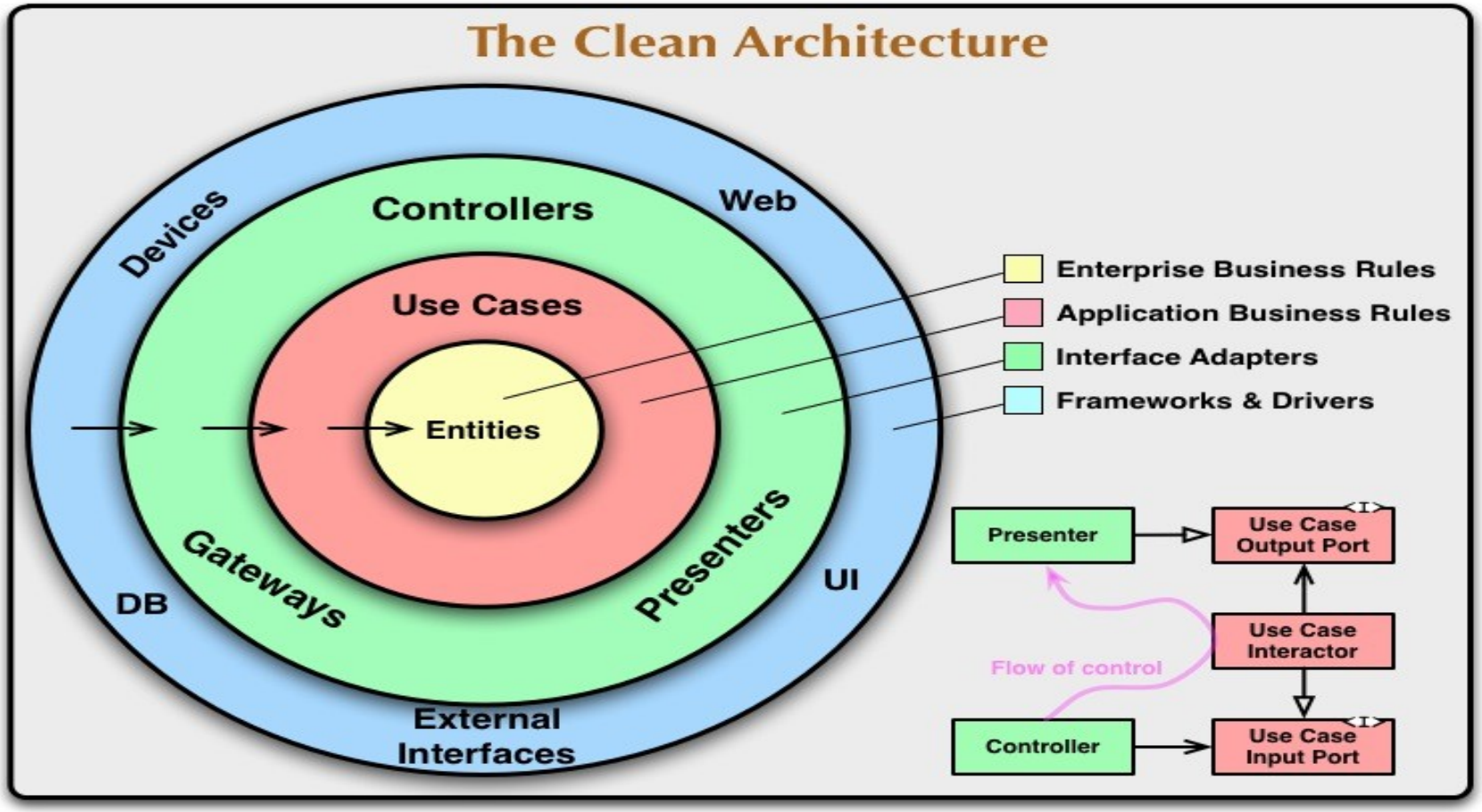
- The plugins must have good handshaking code so that the microkernel is aware of the plugin installation and is ready to work.
- Changing a microkernel is almost impossible if there are multiple plugins dependent on it.
- It is difficult to choose the right granularity for the kernel function in advance and more complex at a later stage.

Domain Driven Design

- Book published in 2003
- Focus on application domain instead of technical world
- Understand user and his language
- Code reflects user model
- Death of big UML models

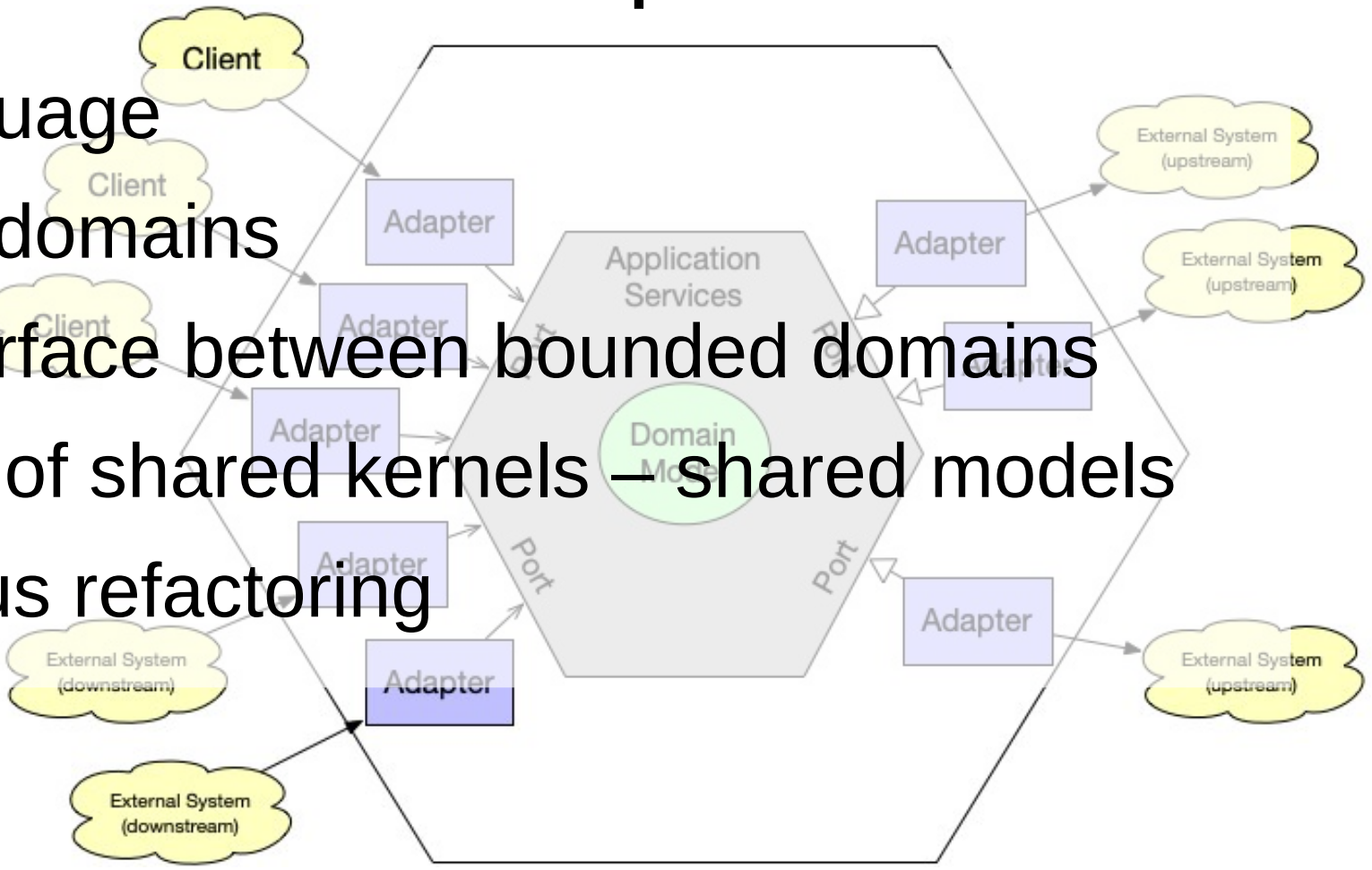


Hexagonal or Onion Architecture



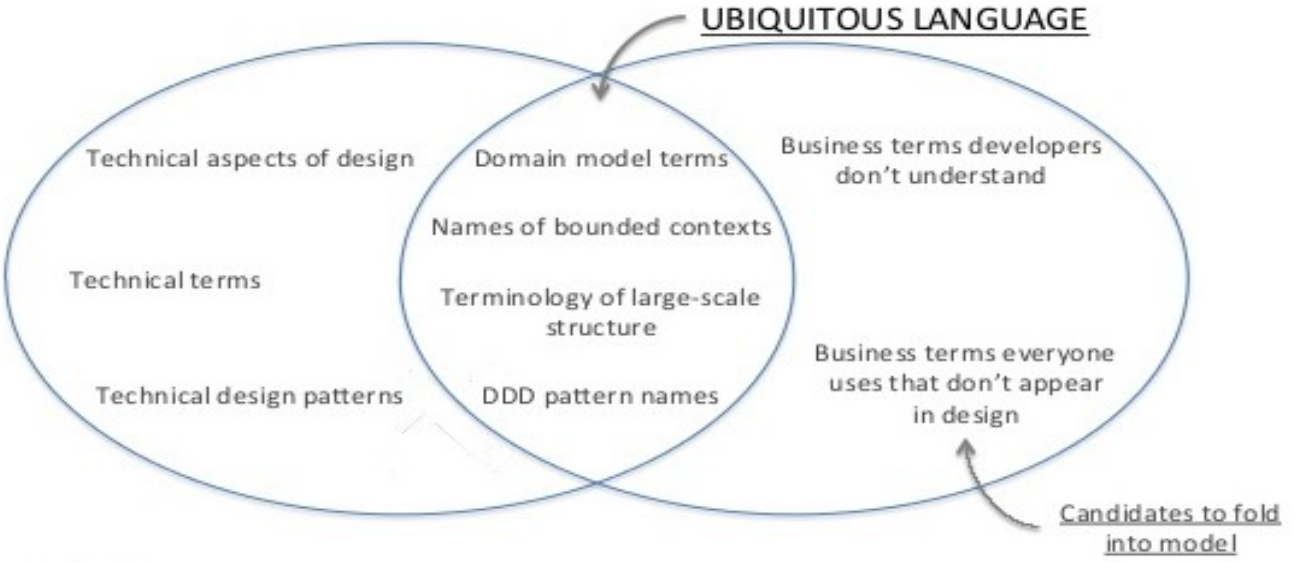
Domain Driven Development

- User language
- Bounded domains
- Clear interface between bounded domains
- Definition of shared kernels – shared models
- Continuous refactoring

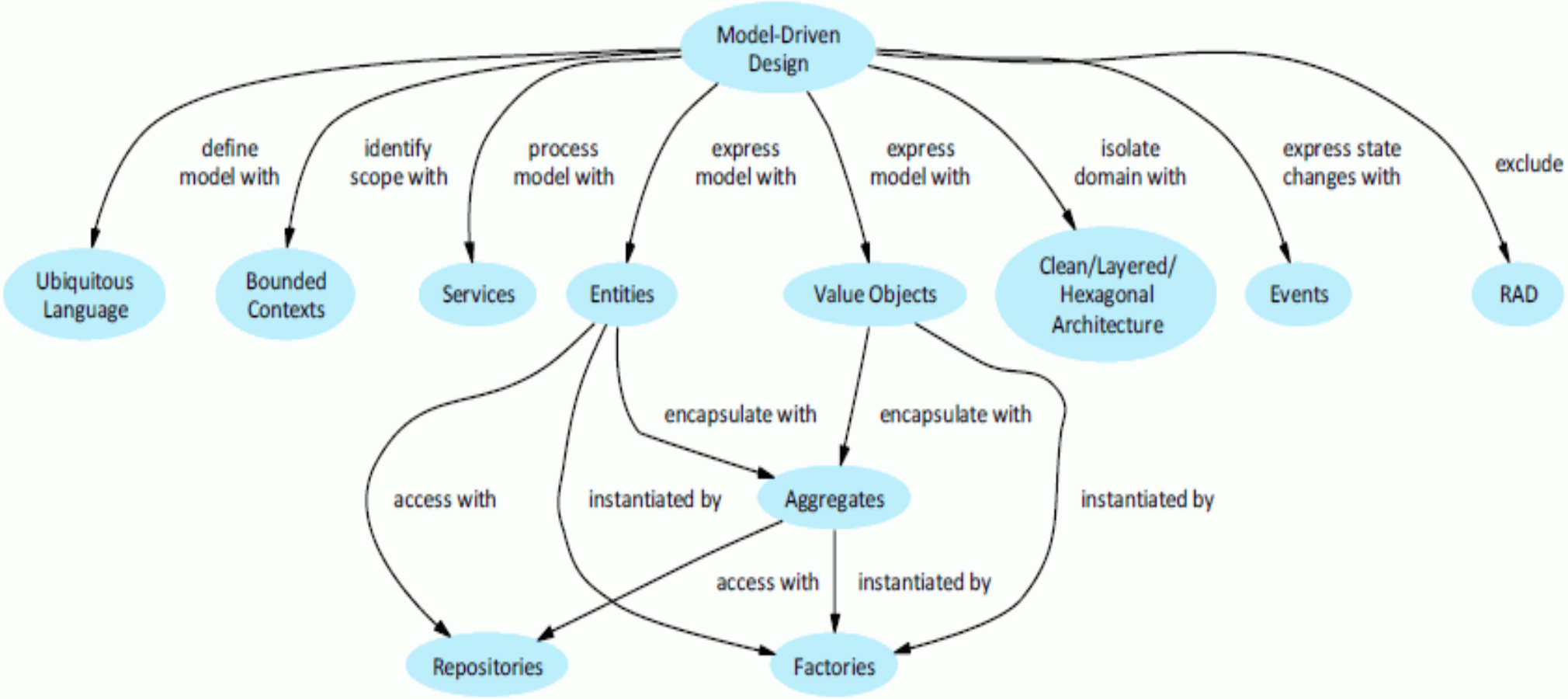


Domain Ubiquitous Language

- Value is generated by and through the customer
- Use his domain language through your design and in the source code



Domain Driven Design

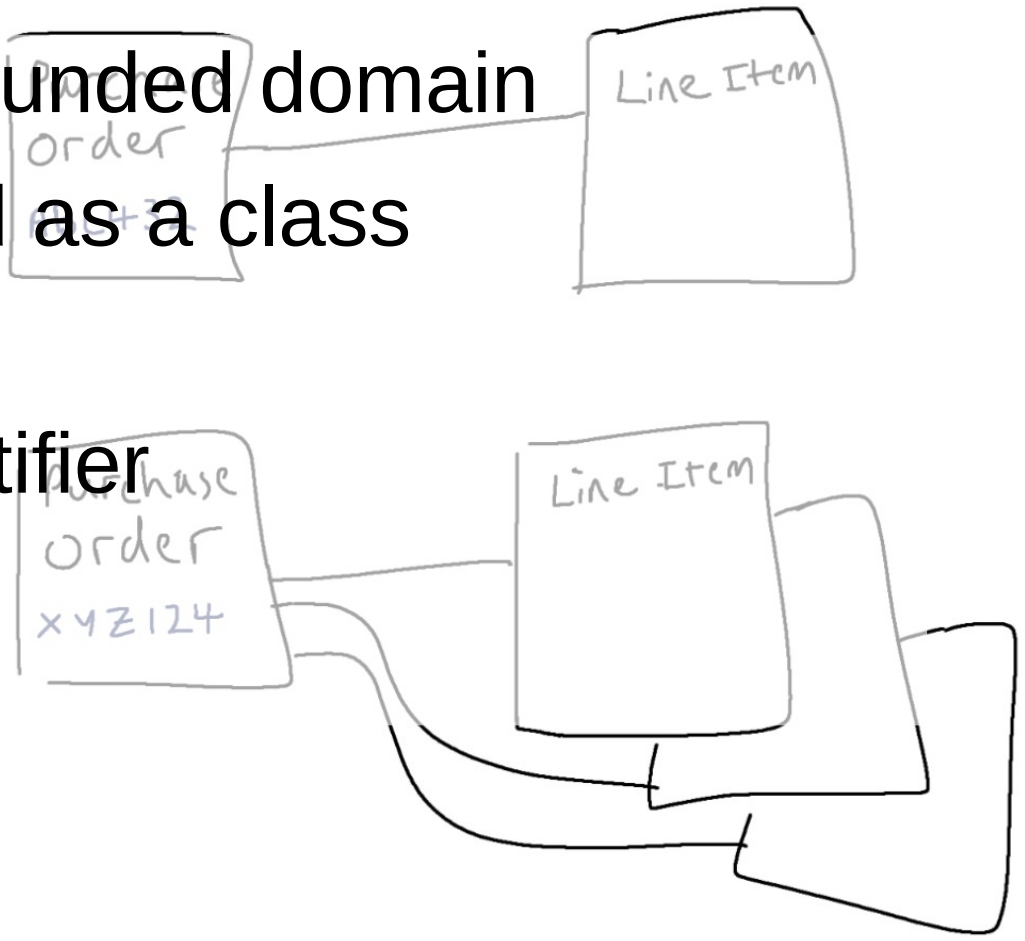


Domain Driven Design

- **Entities** – objects having an identity
  - e.g. Person, Company
- **Value Objects** – have information, no identity
  - e.g. Address, Phone Number
- **Aggregates** – compose entities and value objects
- **Services** – business operations not belonging to objects
- **Repositories** – persist entities and value objects
- **Factories** – creates entities and value objects

Entities

- A key concept of the bounded domain
- An abstraction modeled as a class
  - Identity, state, behavior
- Has unique visible identifier



Value Objects

- Does not have an identity
- Easily created and discarded
- Value objects should be immutable
- Value objects are shareable
- Value objects should often be implemented as *record, sealed types, or enumeration*

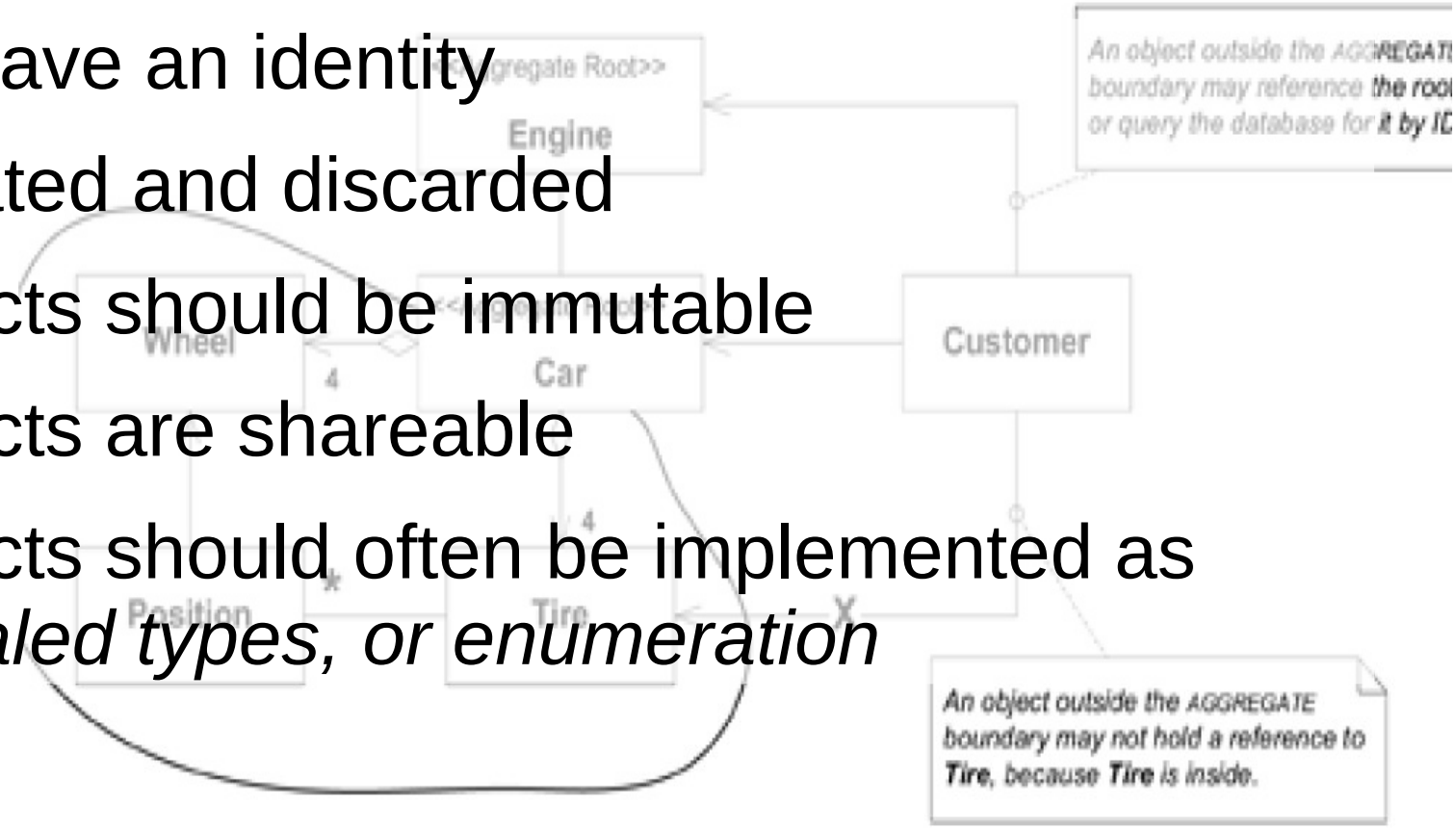
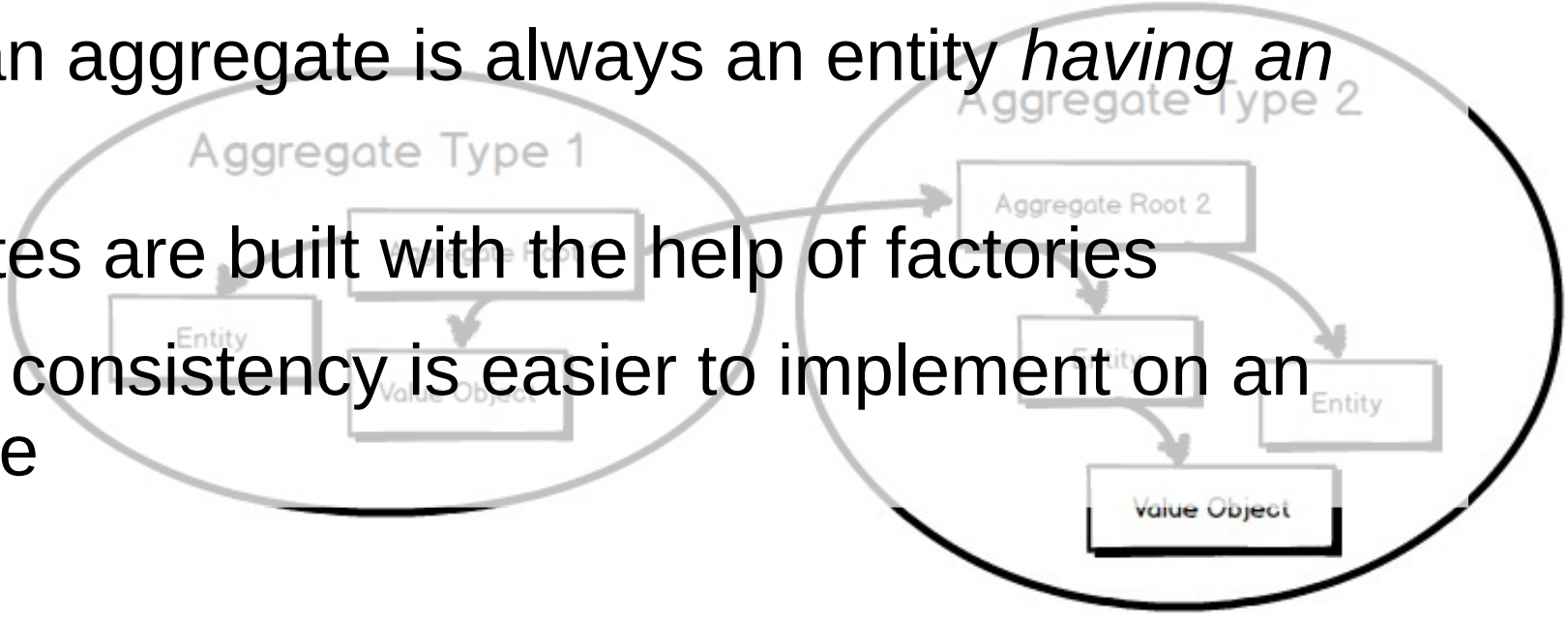


Figure 6.2. Local versus global identity and object references

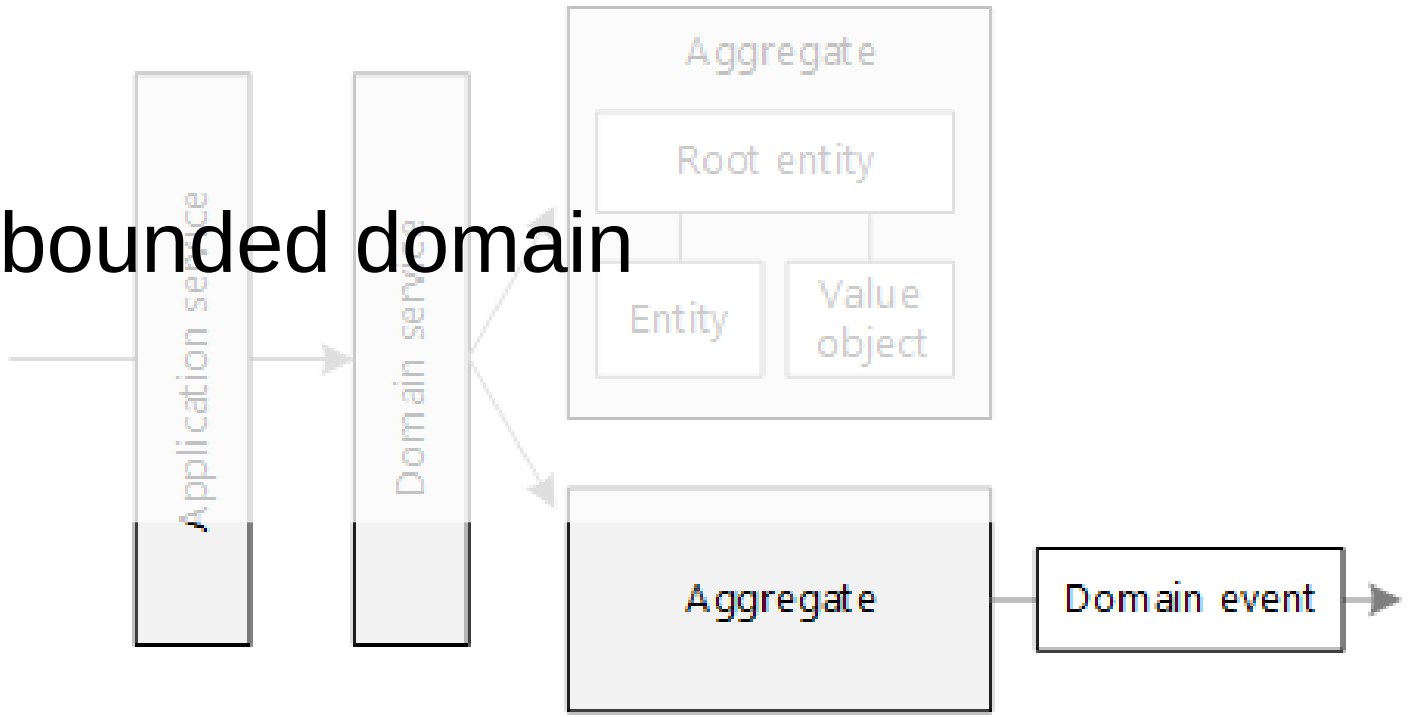
Aggregates

- An Aggregate is a group of associated objects which are considered as one unit with regard to data changes
- Root of an aggregate is always an entity *having an identity*
- Aggregates are built with the help of factories
- Invariant consistency is easier to implement on an aggregate



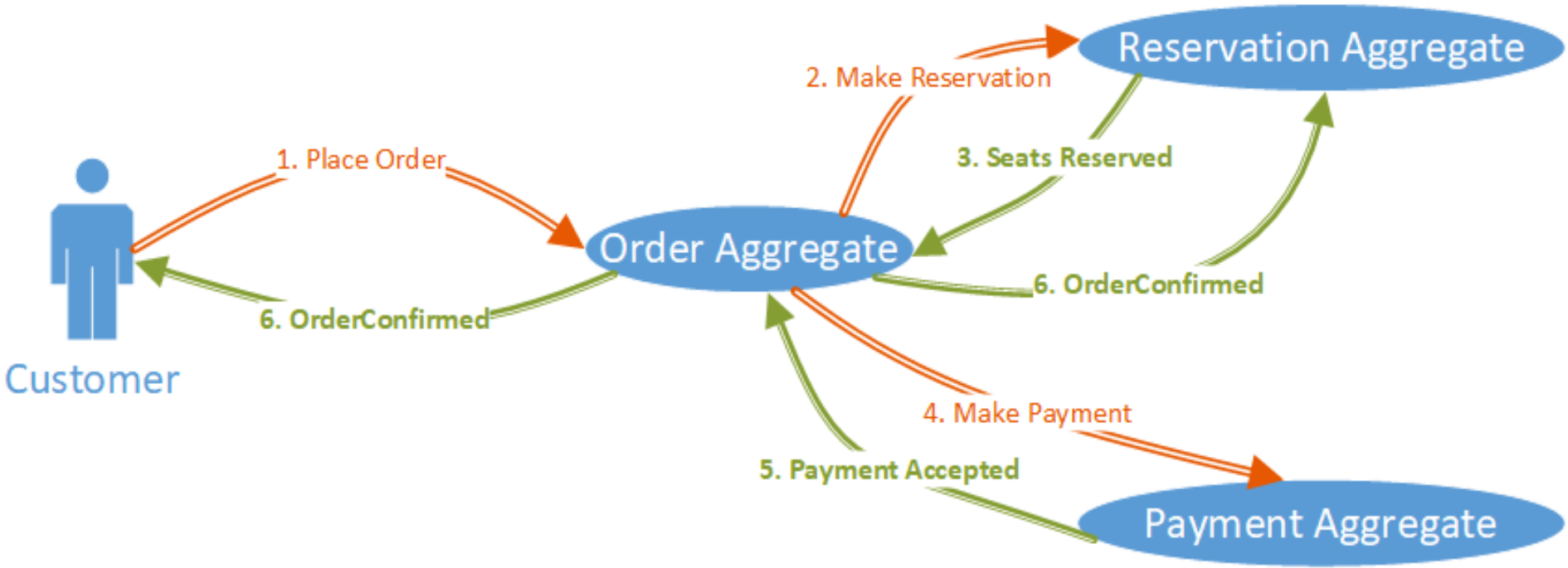
Services

- Logic does not belong to an entity or an aggregate
- Are stateless
- Are part of a bounded domain



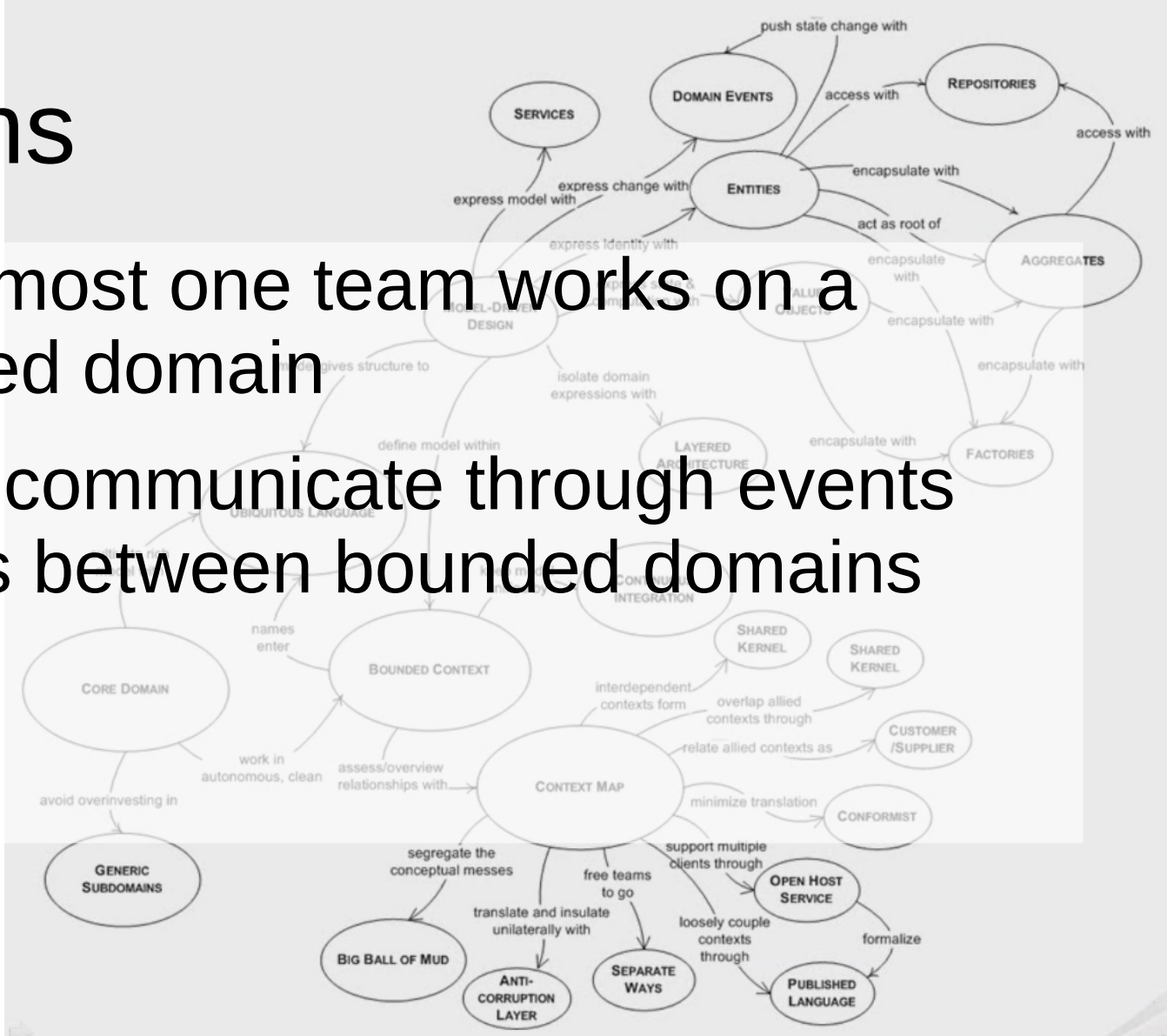
Domain Events

- Event – Something changed in the system
  - Order Placed
-



Multiple teams

- Good Rule: At most one team works on a specific bounded domain
- Multiple teams communicate through events and commands between bounded domains



Immutability and Functional Style

- Entity objects shall have an immutable identity
- Value objects shall be immutable
- Immutable means that all values are set at creation
- You have quite a few immutable classes in the Java standard library

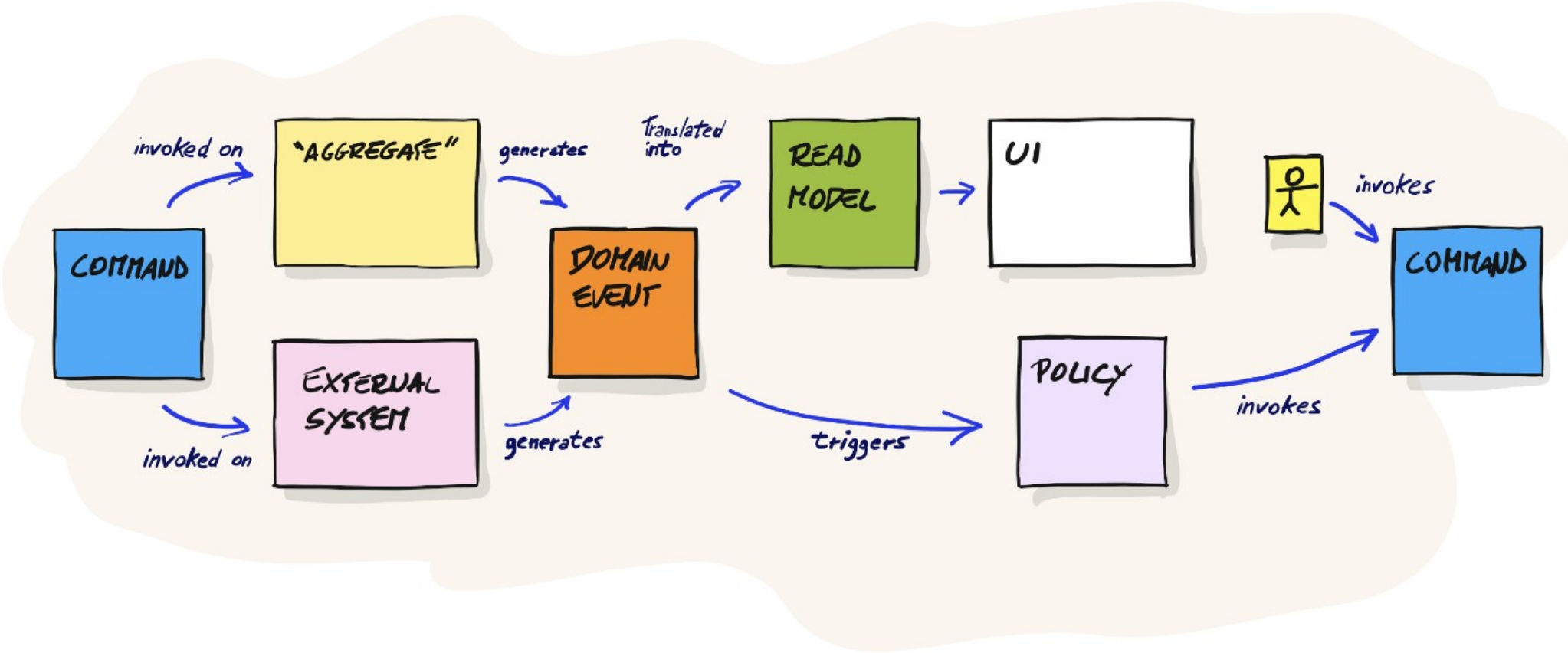
Domain Driven Design Questions

- What is an identity?
- Why should value objects be immutable?
- Why is a bounded context important?
- Why is continuous integration a central activity?
- How can you model bounded domains in Java?
- Reflect about Domain Specific Languages DSL

DDD Anti-Patterns

- Anemic domain objects
- Repetitive DAO's
- Fat Service Layer where service classes will end up having all the business logic.
- Feature Envy: This is one of the classic smells mentioned in Martin Fowler's book on Refactoring where the methods in a class are far too interested in data belonging to other classes.

Event Storming – Ignite Your DDD



Micro Service Architecture

- Designing the right level of granularity for a service component is always a challenge.
- Not all applications do include tasks that can be split into independent units.
- Performance can be affected because of tasks being spread across different microservices.

Micro Services (1/4)

- Mapping bounded domains and micro services
- Exchange of information over JSON
  - Only if needed use a binary format – see protocol buffers -

Micro Services (2/4)

- REST services → openAPI, Swagger
- GraphQL services
- Asynchronous services
- Reactive system
  - Event based
  - Eventual consistency
  - CAP Theorem

Micro Services (3/4)

Beware of the fallacies of distributed computing

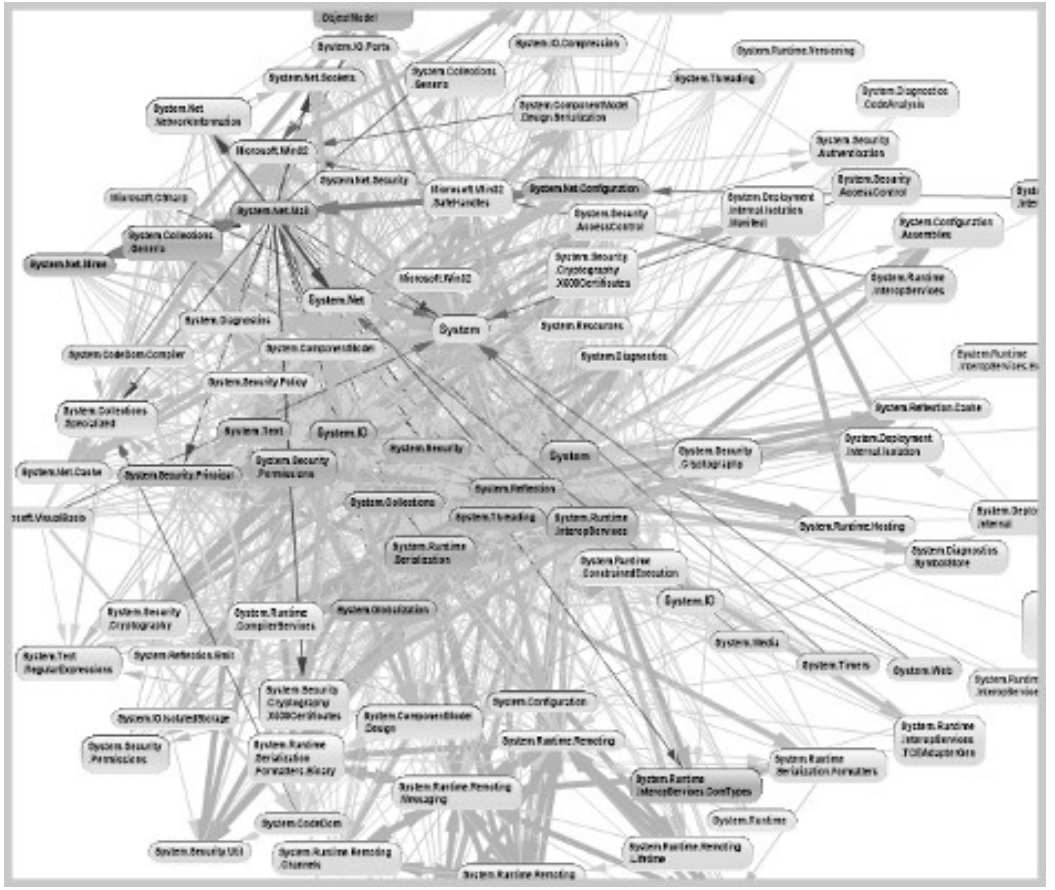
- The network is reliable
- Latency is zero
- Bandwidth is infinite
- The network is secure
- Topology does not change
- There is one administrator
- Transport cost is zero
- The network is homogeneous

Micro Services (4/4)

- User Interfaces are more difficult
  - Micro user interface component approach
  - GraphQL is one approach to solve some aspects
- Logging is more difficult
  - ELK is a possible answer
- Running the system is more difficult
  - Docker, Kubernetes, Helm are approaches

Big Ball of Mud

- You will encounter often this big Anti-Pattern in Europe
- You will not get the money to rewrite the product
- You must destroy this horror



Monolith to Modular

- Extract one big service and all associated classes
  - As a separate application
  - As a separate Java module
- Try to define your bounded domain
  - e.g. Spring has support for modulith
- Persisted data is migrated in their own schema
- Deploy as a separate micro profile service (if using Java)

Refactor Aggressively

- Refactor your extracted big service to have clean code
- Repeat
  - Extract another big service from the ball of mud
  - Split your big service into smaller services

Evolvable Architecture

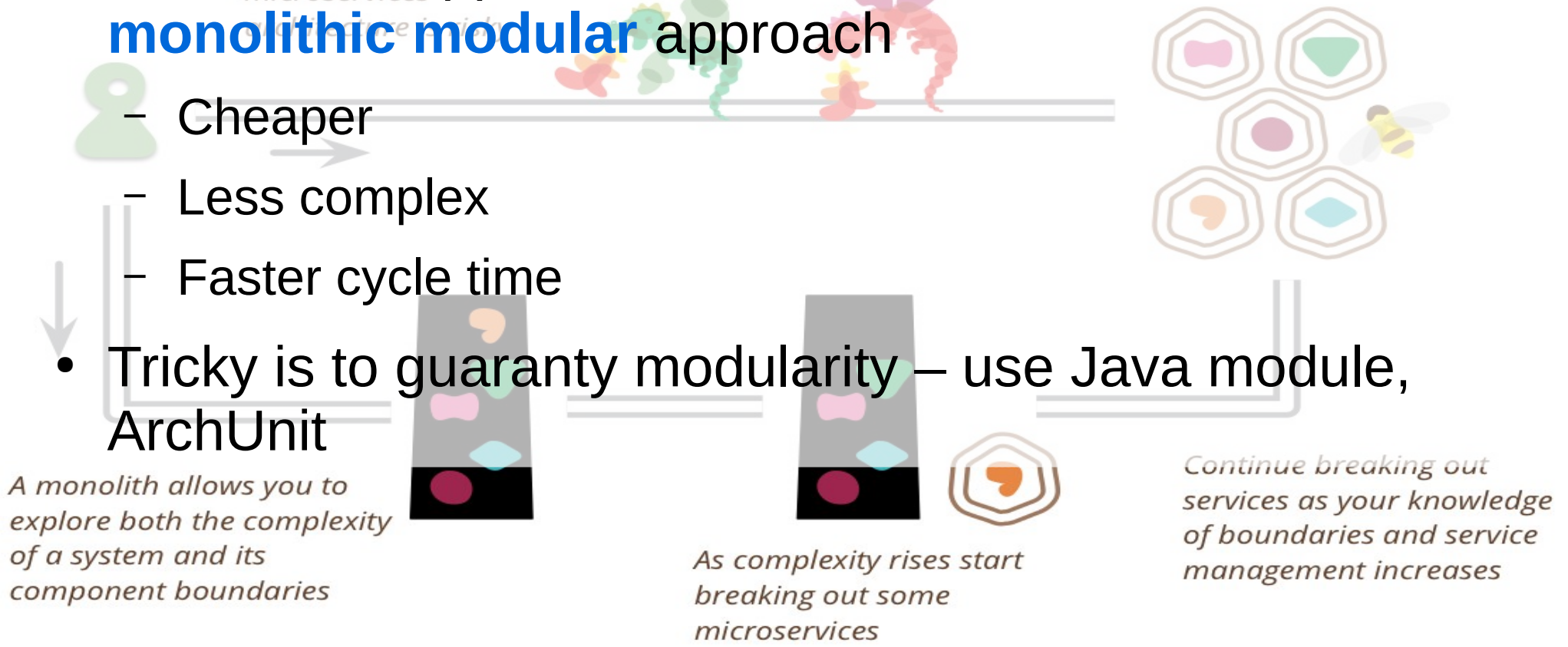
1) Identify Dimensions Affected by Evolution
2) Define Fitness Functions for each Dimension
3) Use Deployment Pipeline to Automate Fitness Functions
4) Start evolving

Wisdom (1/3)

- Understand the **business problem** before choosing your architecture
- The more reusable code is, the less usable it is
- **Prefer** duplication to coupling
- **Avoid COTS** solutions if you want to be agile
- **Avoid frameworks**, use libraries
- Remove needless variability

Wisdom (2/3)

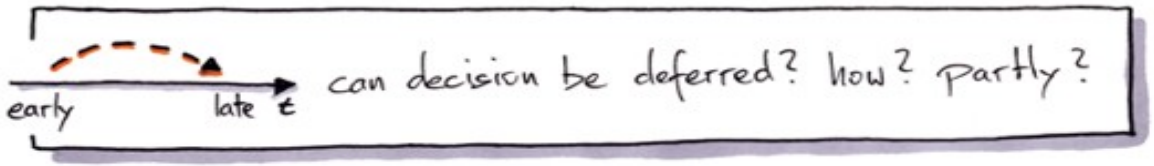
- For smaller applications start with a **monolithic modular** approach
  - Cheaper
  - Less complex
  - Faster cycle time
- Tricky is to guaranty modularity – use Java module, ArchUnit



Wisdom (3/3)

- You must have a modular persistent approach
  - Multiple schemas in the database
  - Multiple databases
- You must have an agile migration approach to persistent data
  - FlyWay, Liquidbase

Reflection



- persist data of your system to survive restart
- how to translate UI and data
- communication between parts of your system
- scaling (run on multiple threads, processes, machines)
- security (how to authenticate, authorize)
- journaling (Activities, data)
- reporting
- data migration / data import
- releasability
- backwards compatibility
- response times
- Archiving data

- Go back to the list of architectural themes
- For your technology have solutions to each theme

Exercises

- Read article “Domain Driven Design Quickly”
- Make some of your Java classes immutable
  - Often implies Builder pattern, evaluate Lombok library,
  - Often implies a functional programming style
- Return only immutable collections
  - And never return null values → use **Optional<T>**
- Replace your loops and conditions with streams and filters
- Use Java modules to declare boundaries and dependencies