

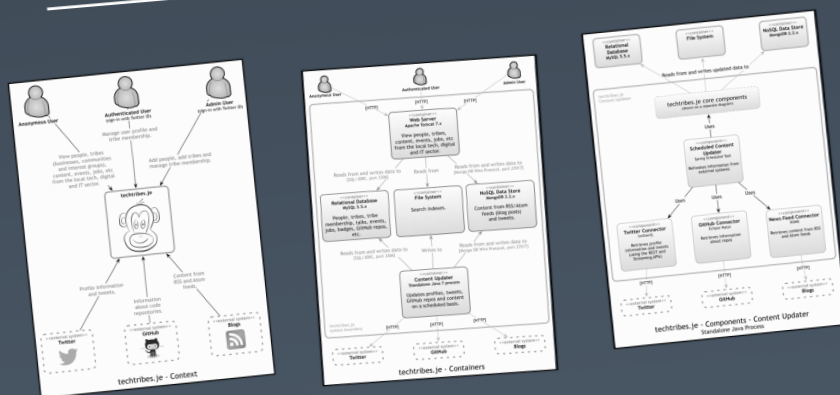
Software Architecture vs Code



Simon Brown
@simonbrown

coding
(the)
architecture

Software Architecture *for Developers*



Technical leadership by **coding**, coaching,
collaboration, *architecture sketching*
and just enough up front design

Simon Brown

A developer-friendly
guide to software
architecture,
technical leadership
and the balance
with agility

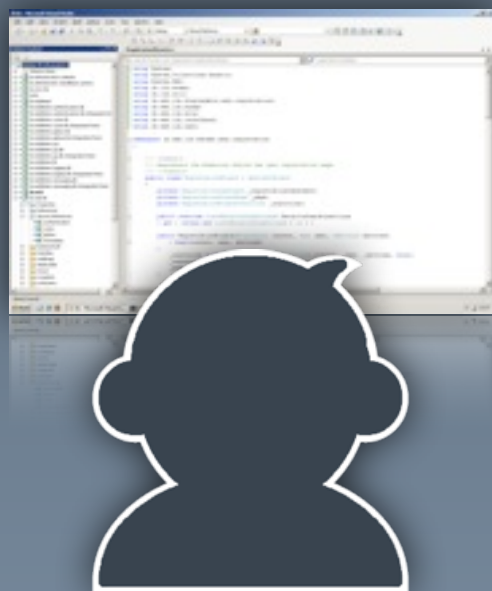
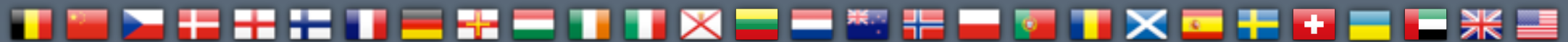
Leanpub

10 out of 10
“Highly recommended reading”

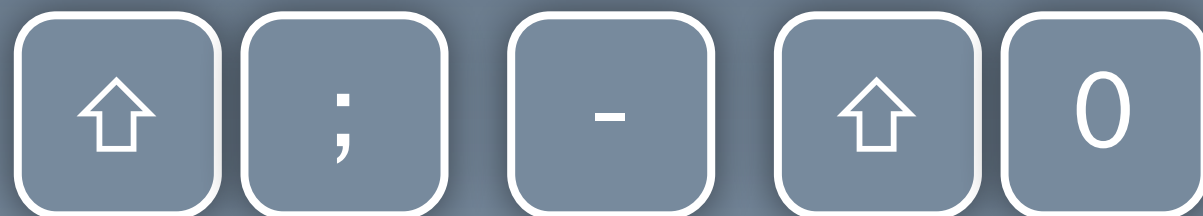
Junilu Lacar, JavaRanch

<http://leanpub.com/software-architecture-for-developers>

I help software teams understand
software architecture,
technical leadership and
the balance with agility



I code too



The intersection between

software architecture and code



Jersey


**JERSEY
FINANCE**
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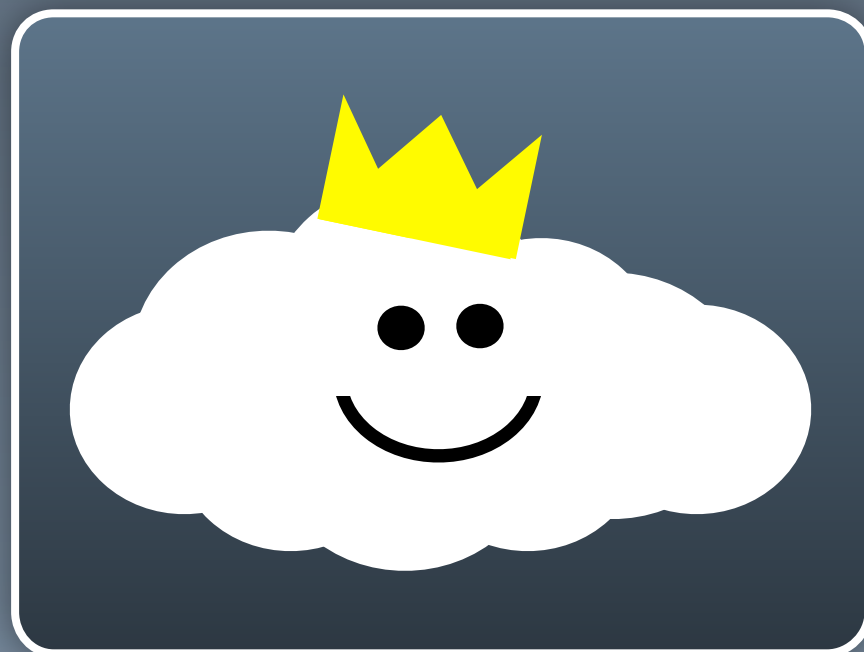

DIGITAL JERSEY

Locate
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Software architecture

There's a common misconception
that software architecture should be
conceptual
and
exclude technology



Structure

Vision

How do we
communicate
software architecture?

Who here uses **UML**
on a **regular basis?**



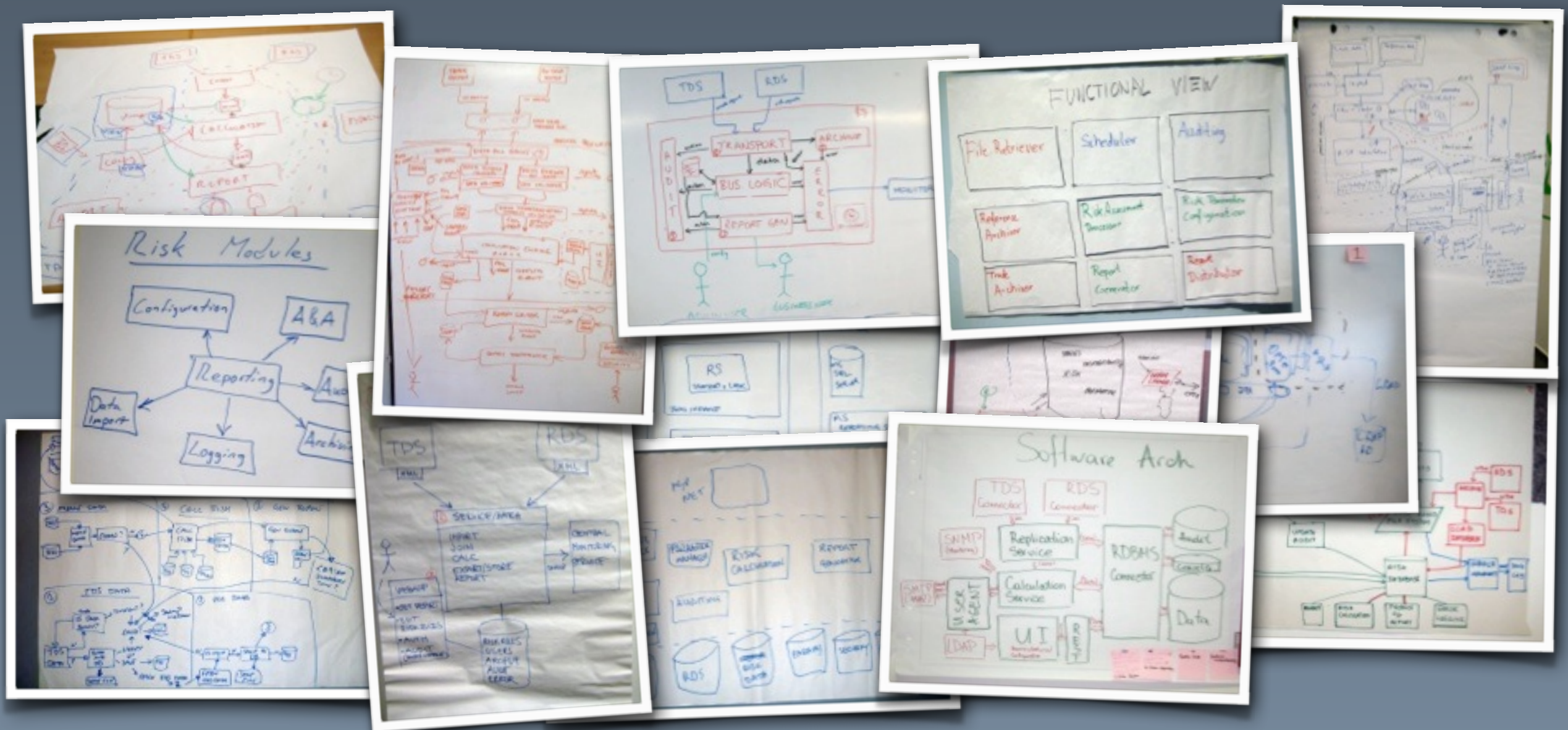


9 out of 10 people
don't use UML

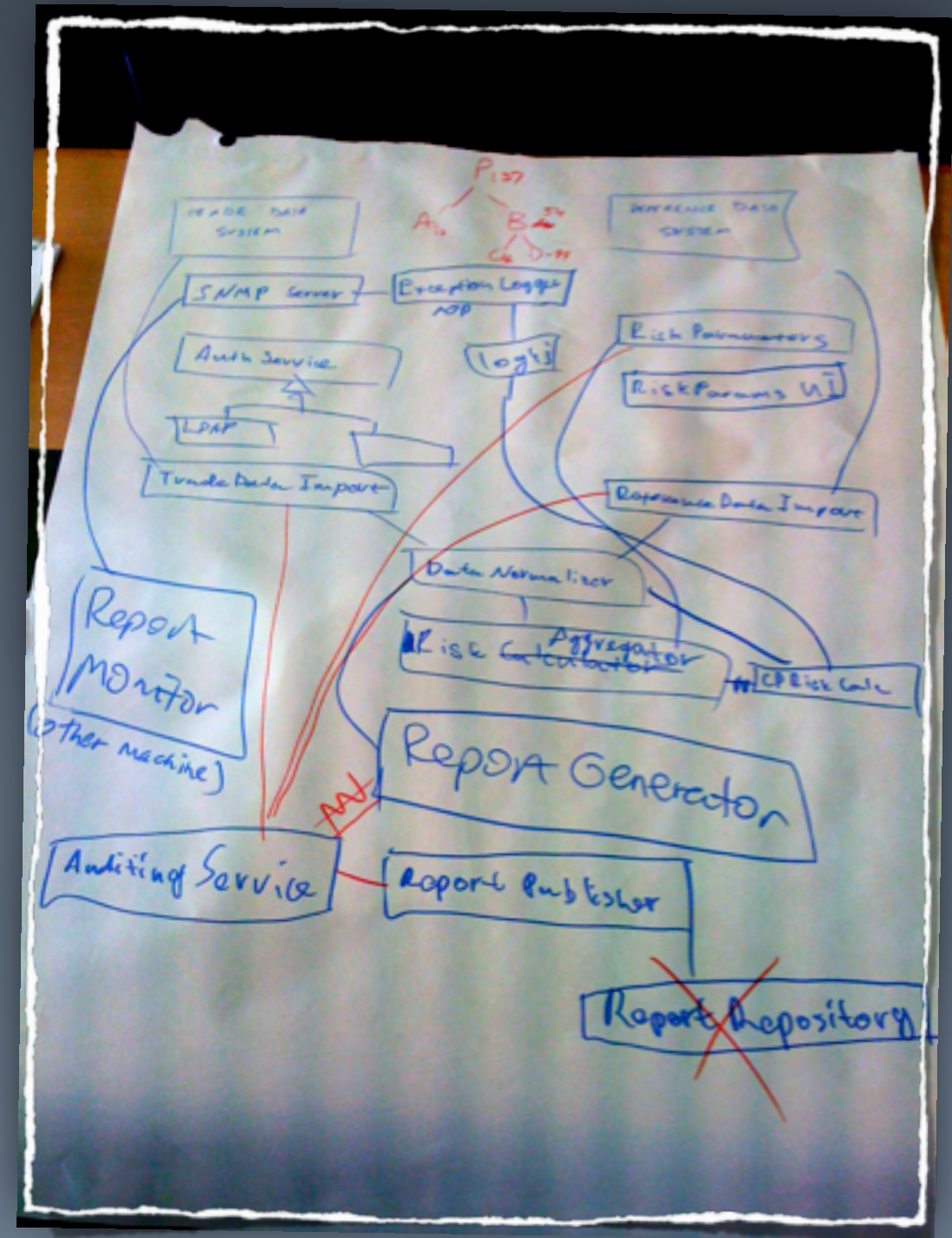
(in my experience)

NOUML

diagrams?

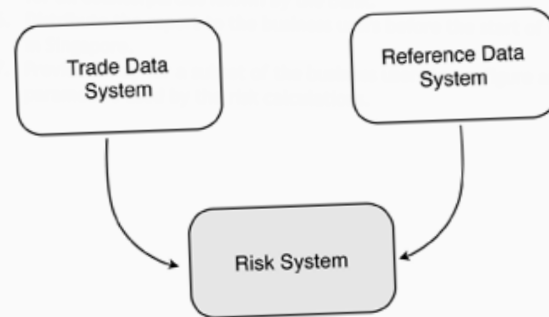


In my experience,
software teams
aren't able to
effectively
visualise the
software
architecture
of their systems



1. Context

A global investment bank based in London, New York and Singapore trades (buys and sells) financial products with other banks (counterparties). When share prices on the stock markets move up or down, the bank either makes money or loses it. At the end of the working day, the bank needs to gain a view of how much risk they are exposed to (e.g. of losing money) by running some calculations on the data held about their trades. The bank has an existing Trade Data System (TDS) and Reference Data System (RDS) but need a new Risk System.



1.1. Trade Data System

The Trade Data System maintains a store of all trades made by the bank. It is already configured to generate a file-based XML export of trade data at the close of business (5pm) in New York. The export includes the following information for every trade made by the bank:

- Trade ID
- Date
- Current trade value in US dollars
- Counterparty ID

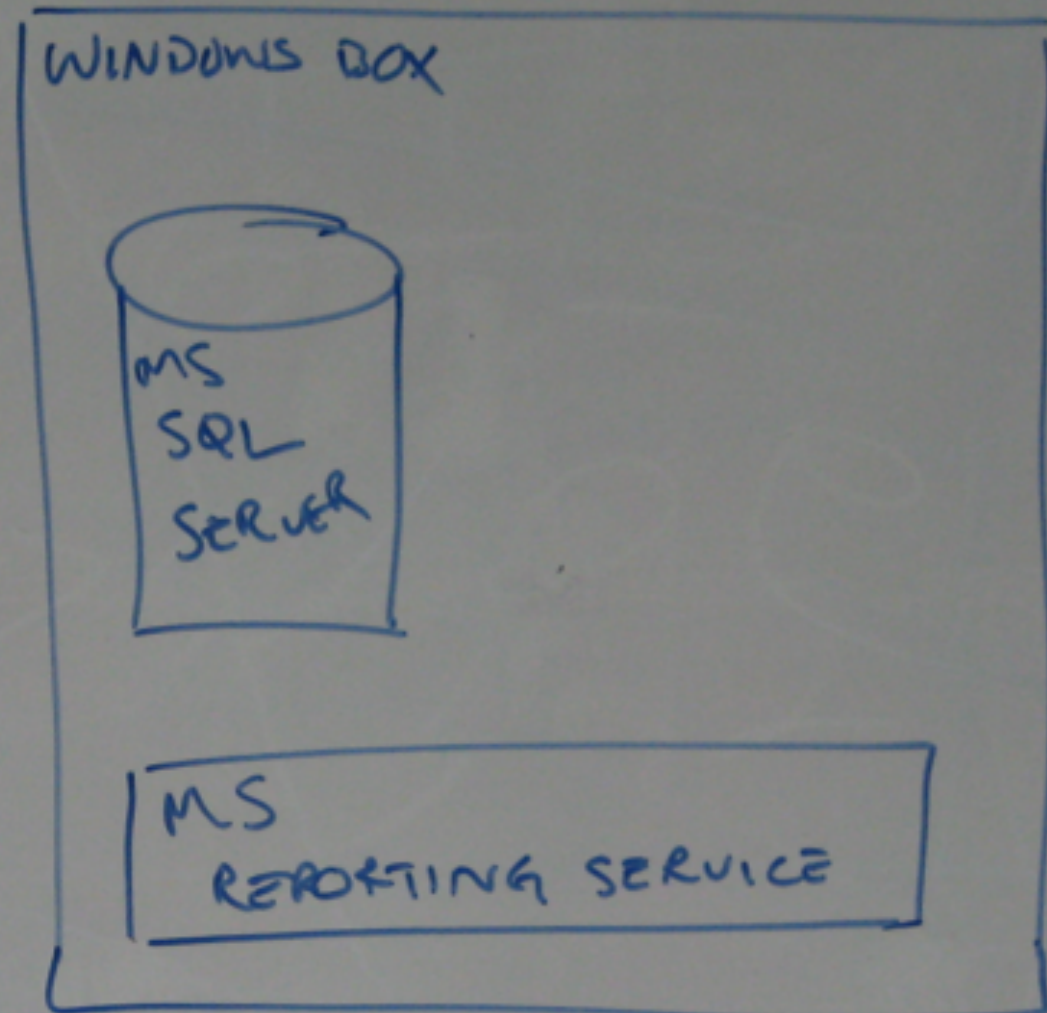
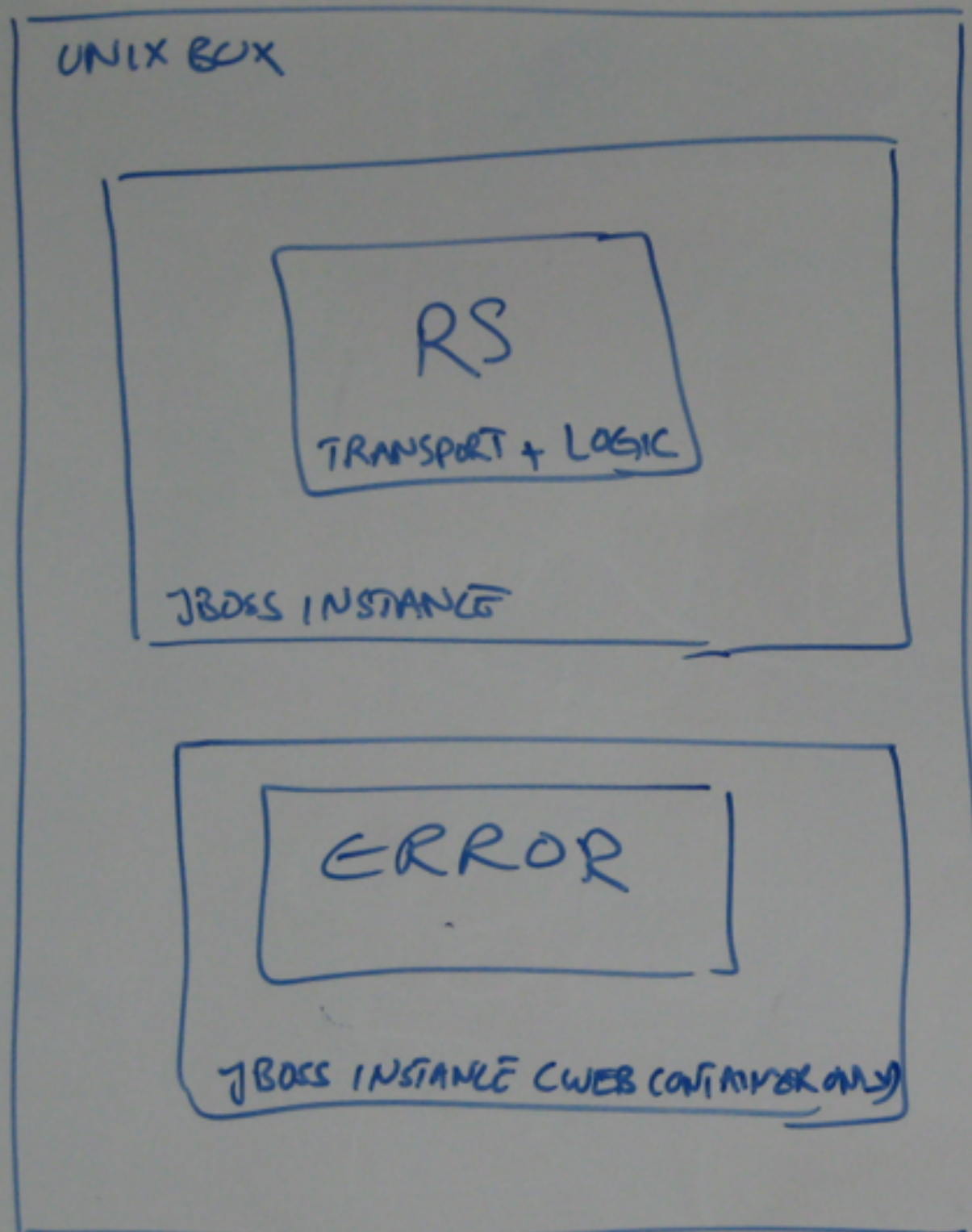
1.2. Reference Data System

The Reference Data System maintains all of the reference data needed by the bank. This includes information about counterparties; each of which represents an individual, a bank, etc. A file-based XML export is also available and includes basic information about each counterparty. A new organisation-wide reference data system is due for completion in the next 3 months, with the current system eventually being decommissioned.

Financial risk system

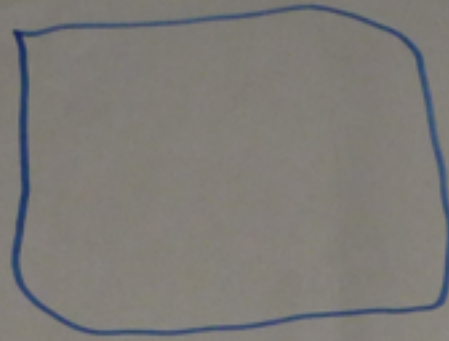
1. Import data from a Trade Data System (TDS).
2. Import data from a Reference Data System (RDS).
3. Merge the data feeds, perform some risk calculations and generate a Microsoft Excel file of the risk report.
4. Allow a subset of users to modify some parameters used during the calculation process.

<http://bit.ly/sa4d-risksystem>



The Shopping List

ASP
NET



LOGGING
SERVICE

PARAMETER
MANAGER

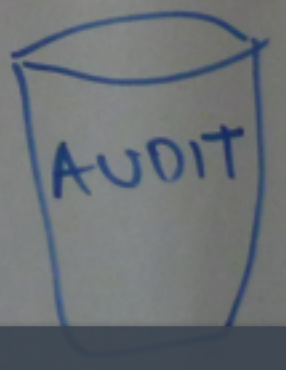
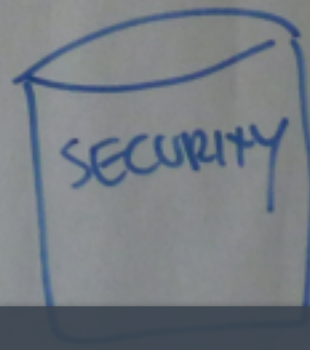
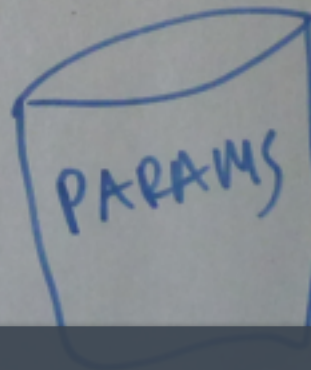
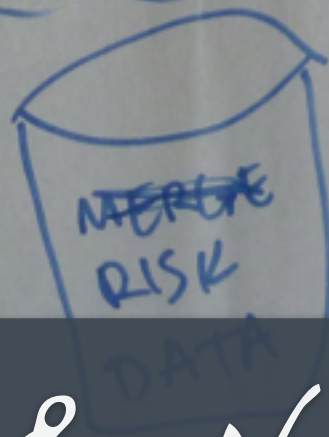
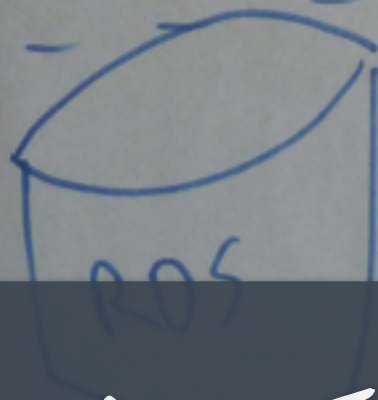
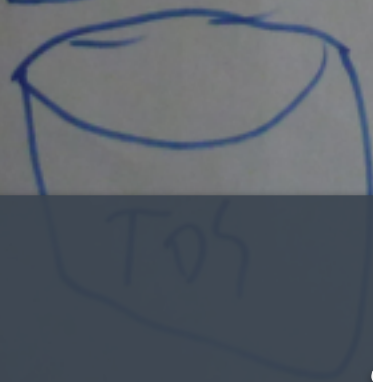
RISK
CALCULATION

REPORT
GENERATOR

DATA
IMPORT

AUDITING

VALIDATION



Boxes & No Lines

FUNCTIONAL VIEW

File Retriever

Scheduler

Auditing

Reference
Archiver

Risk Assessment
Processor

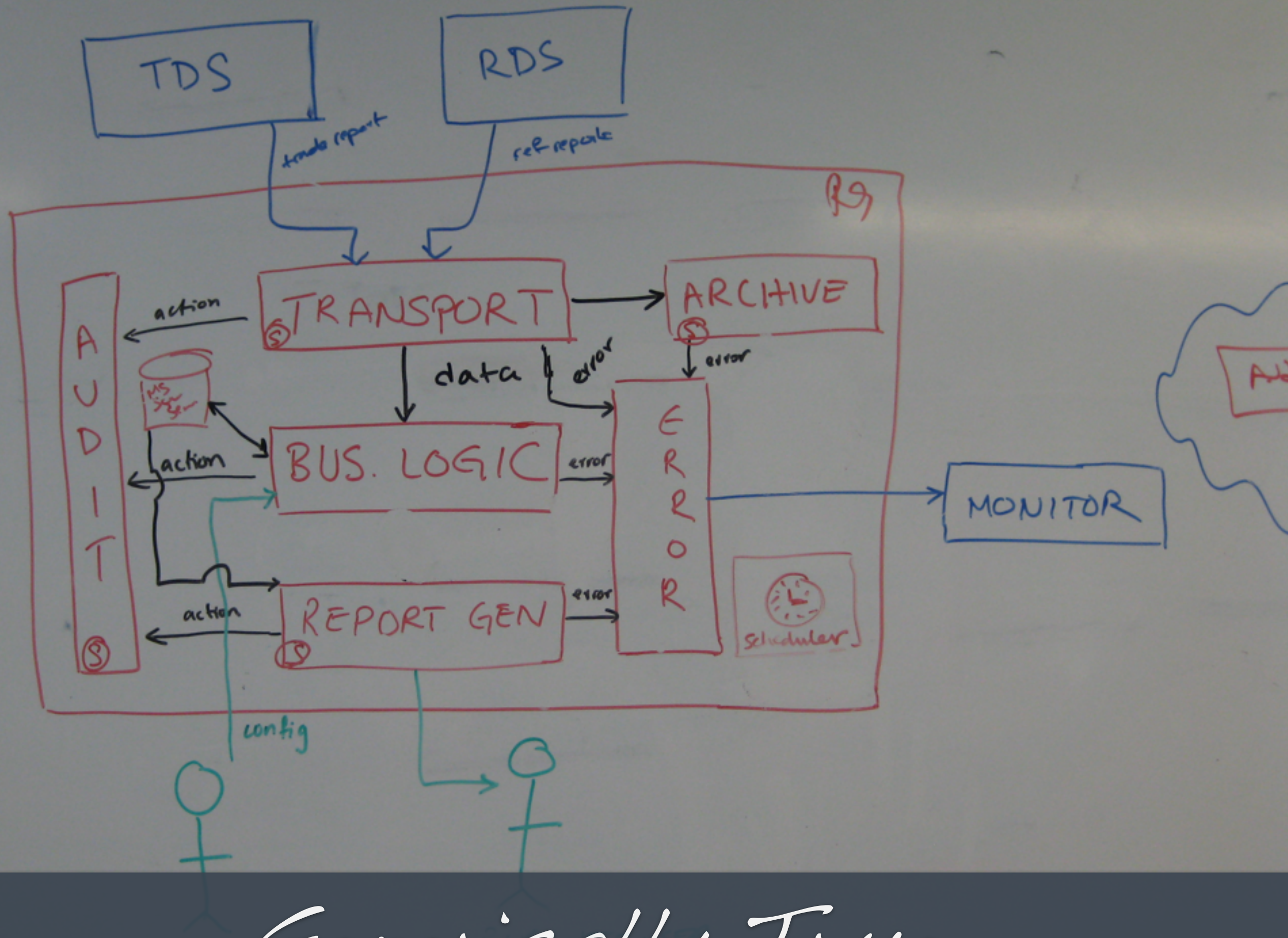
Risk Parameter
Configuration

Trade
Archiver

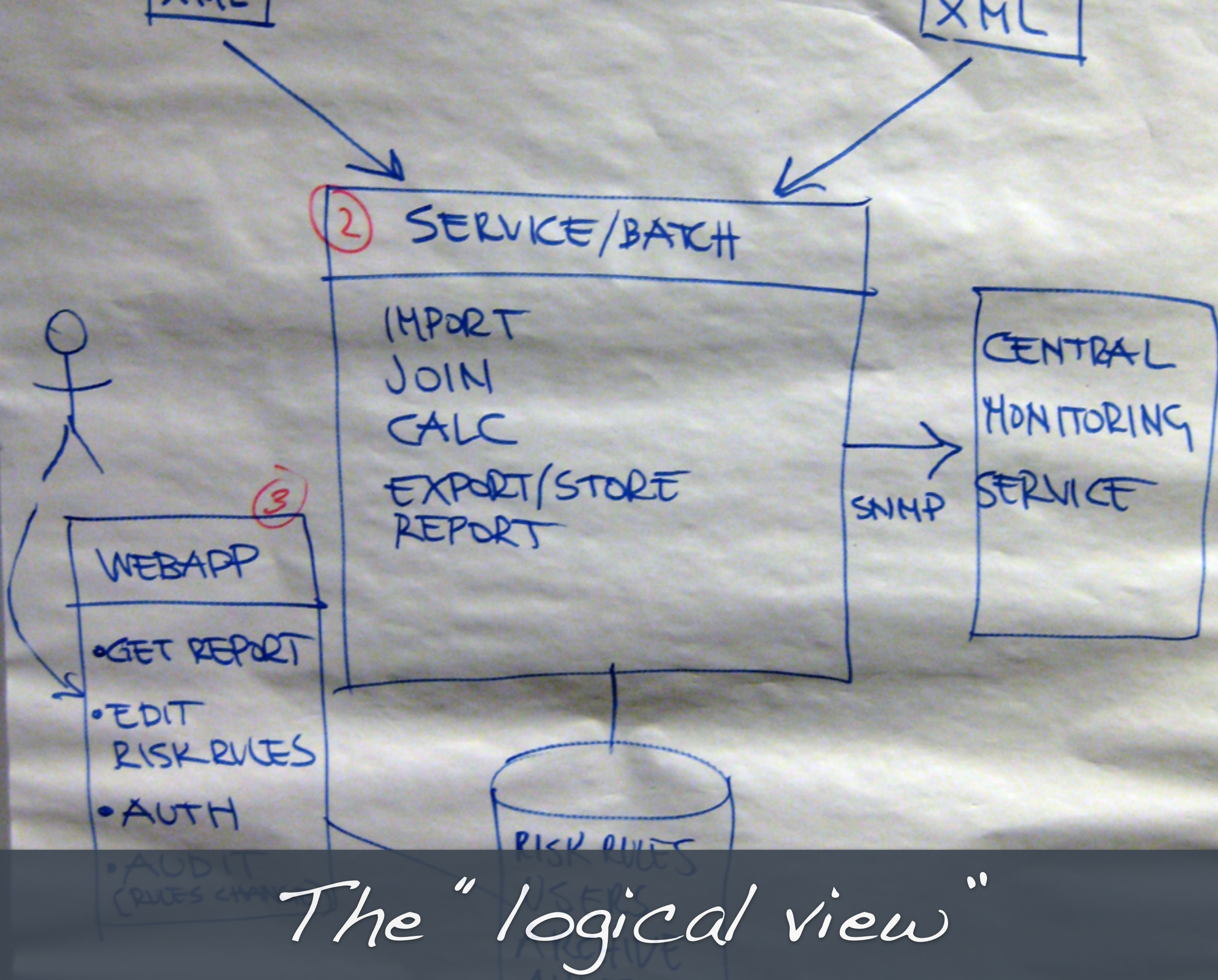
Report
Generator

Report
Distributor

The "functional view



Generically True



The "logical view"

Challenging?

Level of detail

↳ where to stop

Who is the audience - different backgrounds

Implementation

- easy to get bogged down in detail

Type of diagrams

Notation

Documenting assumptions

⑦ Challenging

Needed to ask questions / make assumptions

Temptation to focus on detail

↳ when do we stop?

How much detail?

Talked about more than the diagrams

What notation? - boxes
- arrows

⑩ Challenging?

Verifying our own assumptions

Expressing the solution

- communicating it in a clear way

- use of notation

- easy to mix levels of abstraction

- how much detail?

What's been
challenging about
the exercise?



Why has UML fallen
out of fashion?

UML

is too complex,
is too low-level,
nobody knows it

Oh, plus we're

agile

and/or do

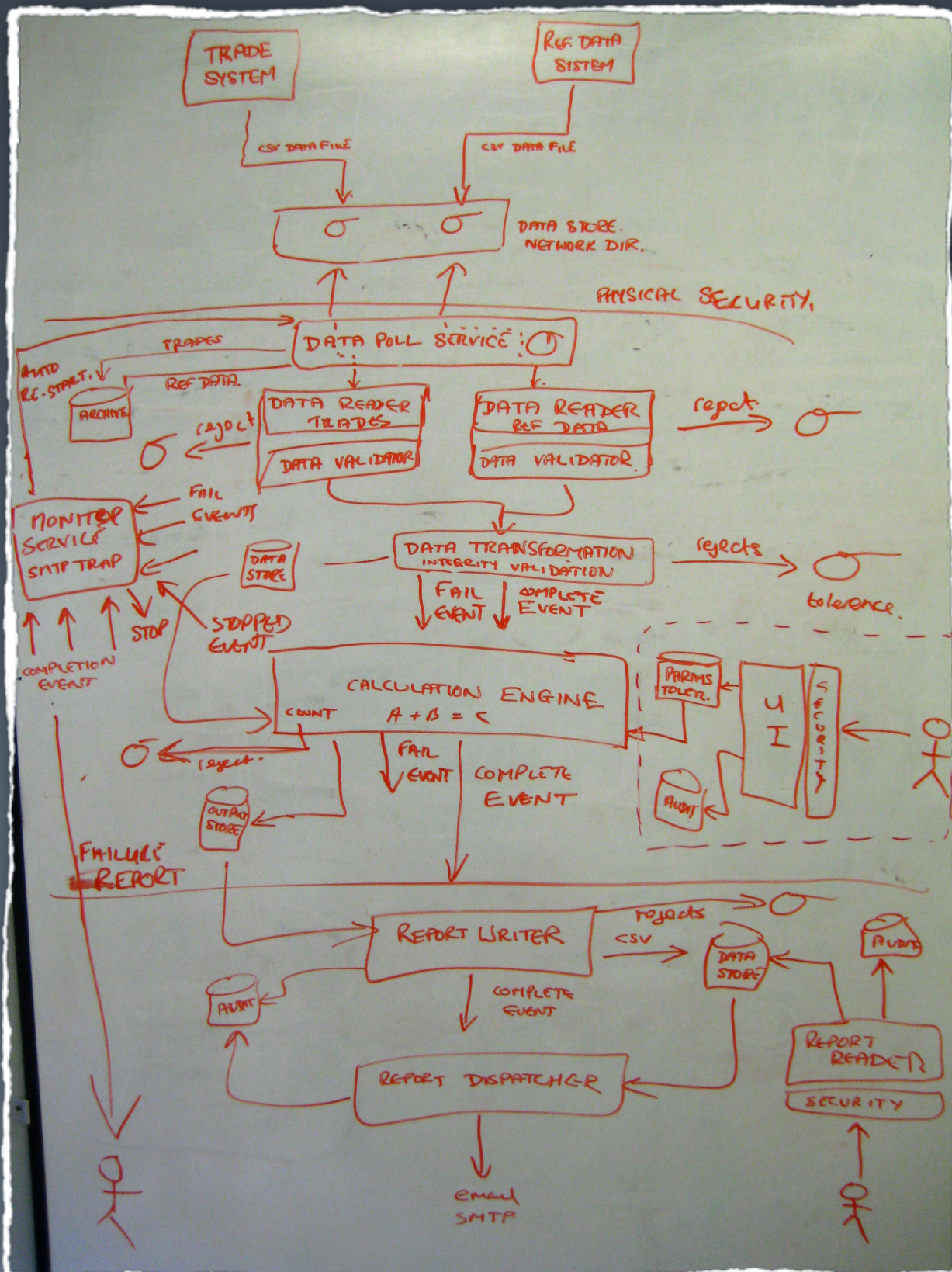
TDD

Software architecture
provides

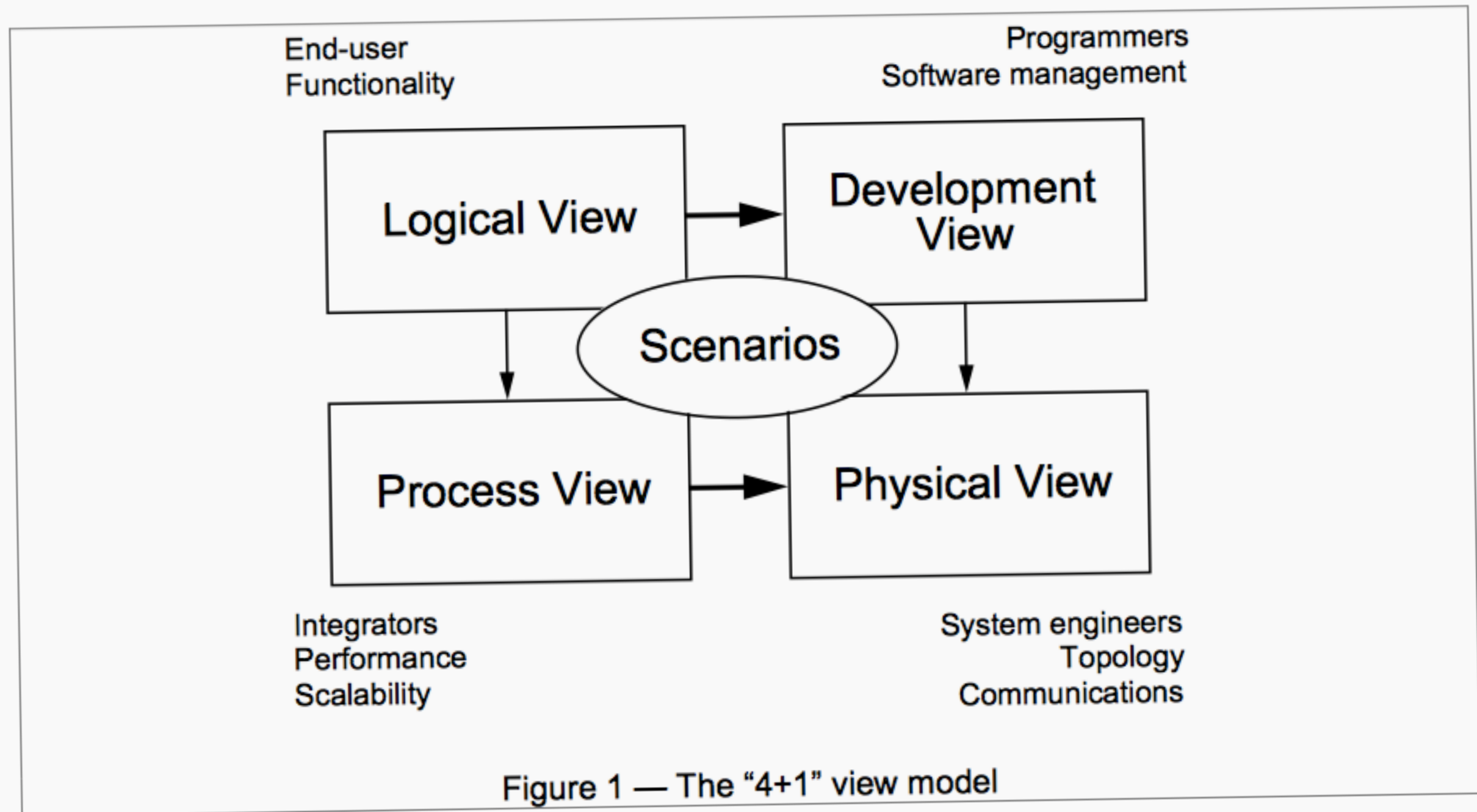
boundaries
for TDD

It's usually difficult to show the entire design on a **single** diagram

Different **views** of the design can be used to manage complexity and highlight different aspects of the solution



The description of an architecture—the decisions made—can be organized around these four views, and then illustrated by a few selected *use cases*, or *scenarios* which become a fifth view. The architecture is in fact partially evolved from these scenarios as we will see later.



We apply Perry & Wolf's equation independently on each view, i.e., for each view we define the set of elements to use (components, containers, and connectors), we capture the forms and patterns that work, and we capture the rationale and constraints, connecting the architecture to some of the requirements.

Do the **names**
of those views make sense?

Conceptual vs Logical

Process vs Functional

Development vs Physical

Development vs Implementation

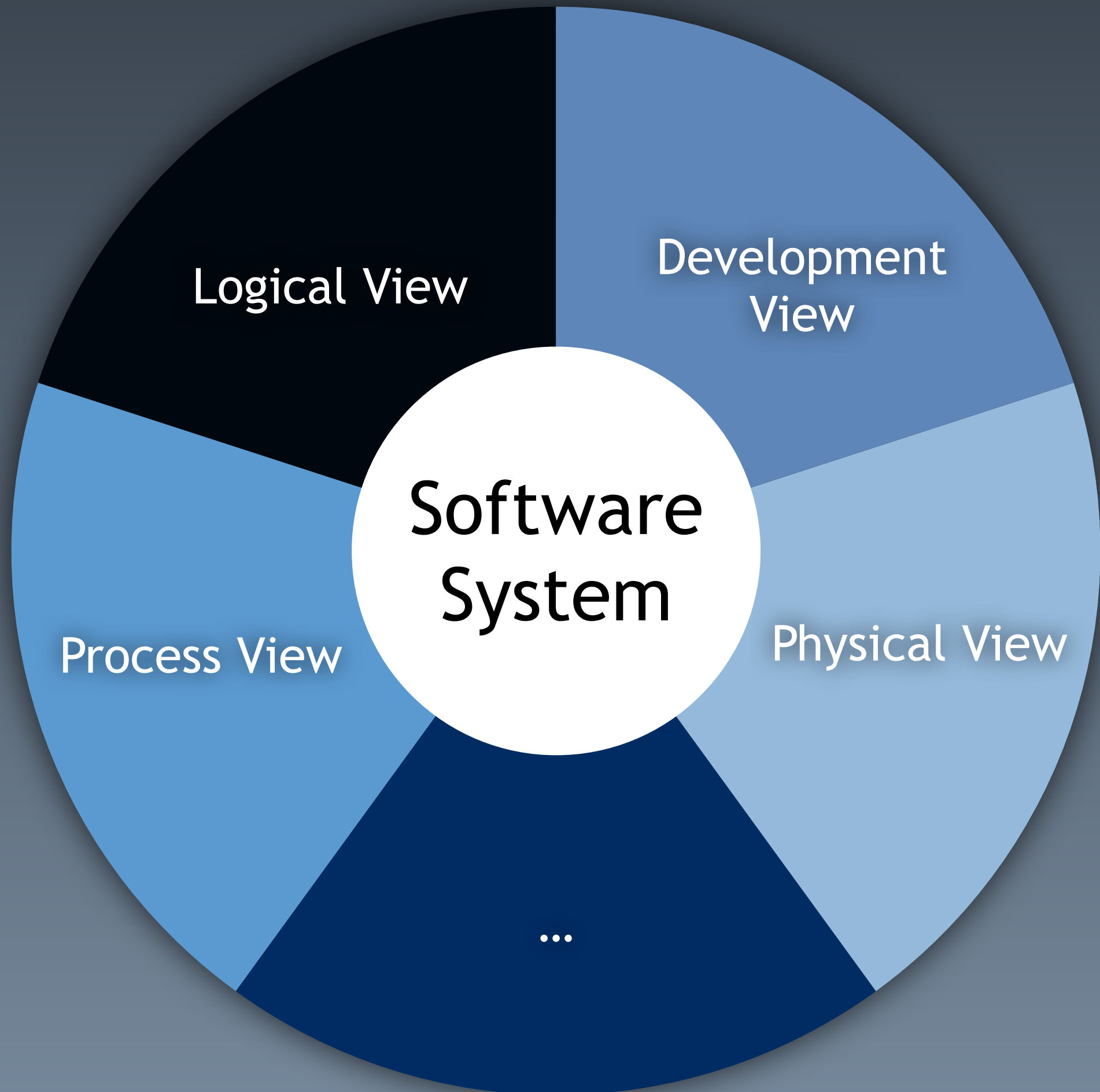
Physical vs Implementation

Physical vs Deployment

Logical and
development

views are often

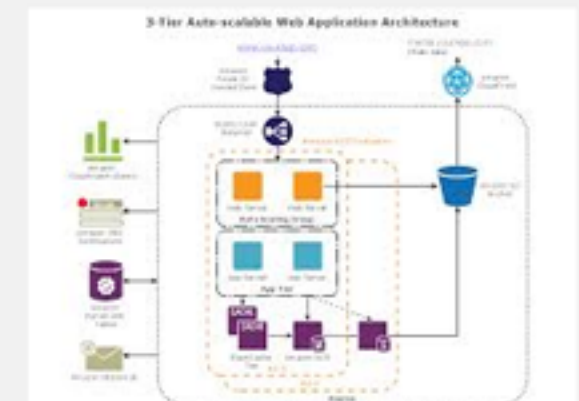
separated

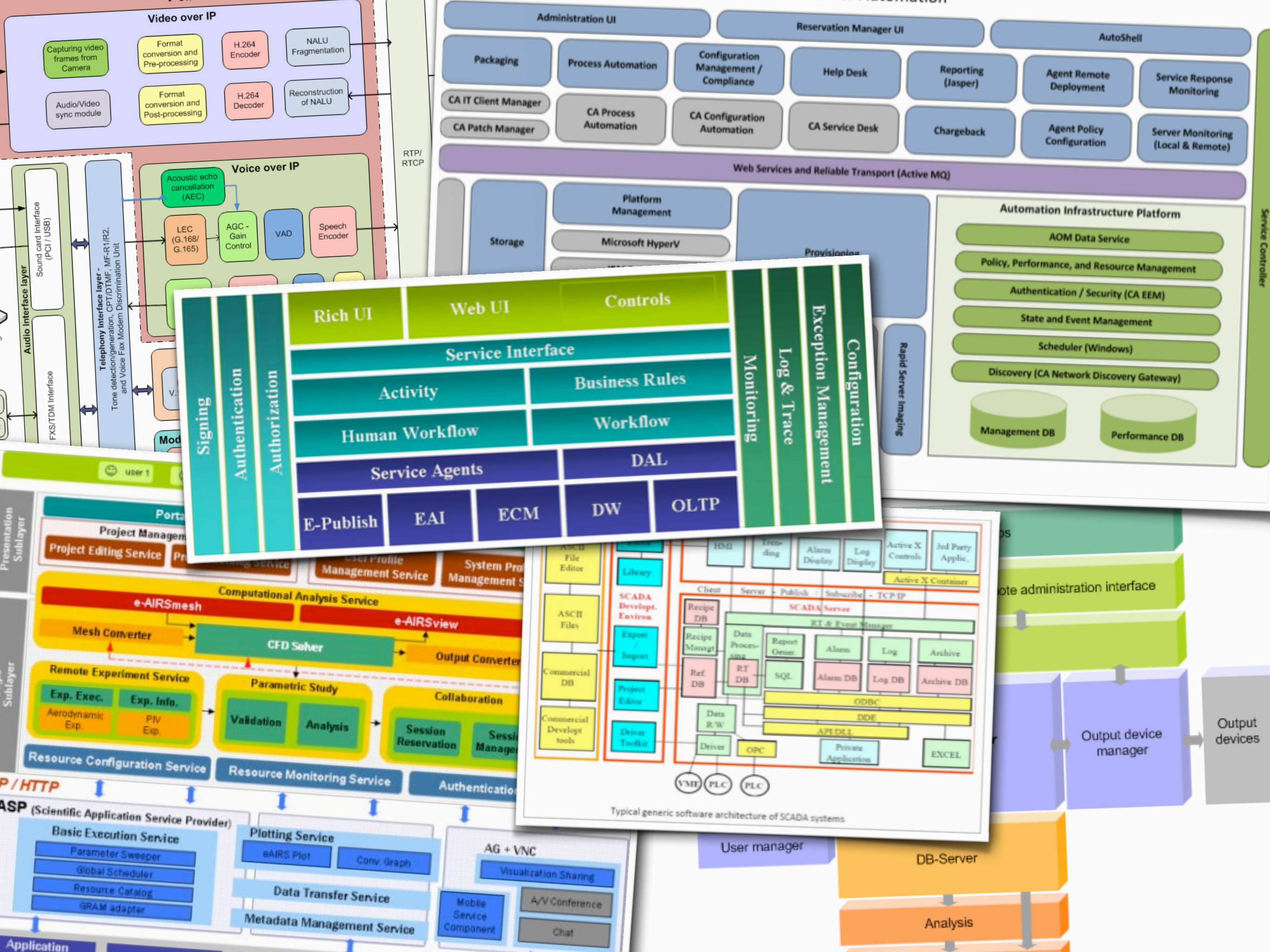


BRAIN

FREEZE!

Got it





I bought a boat



Code

Would we

code

it that way?

Did we

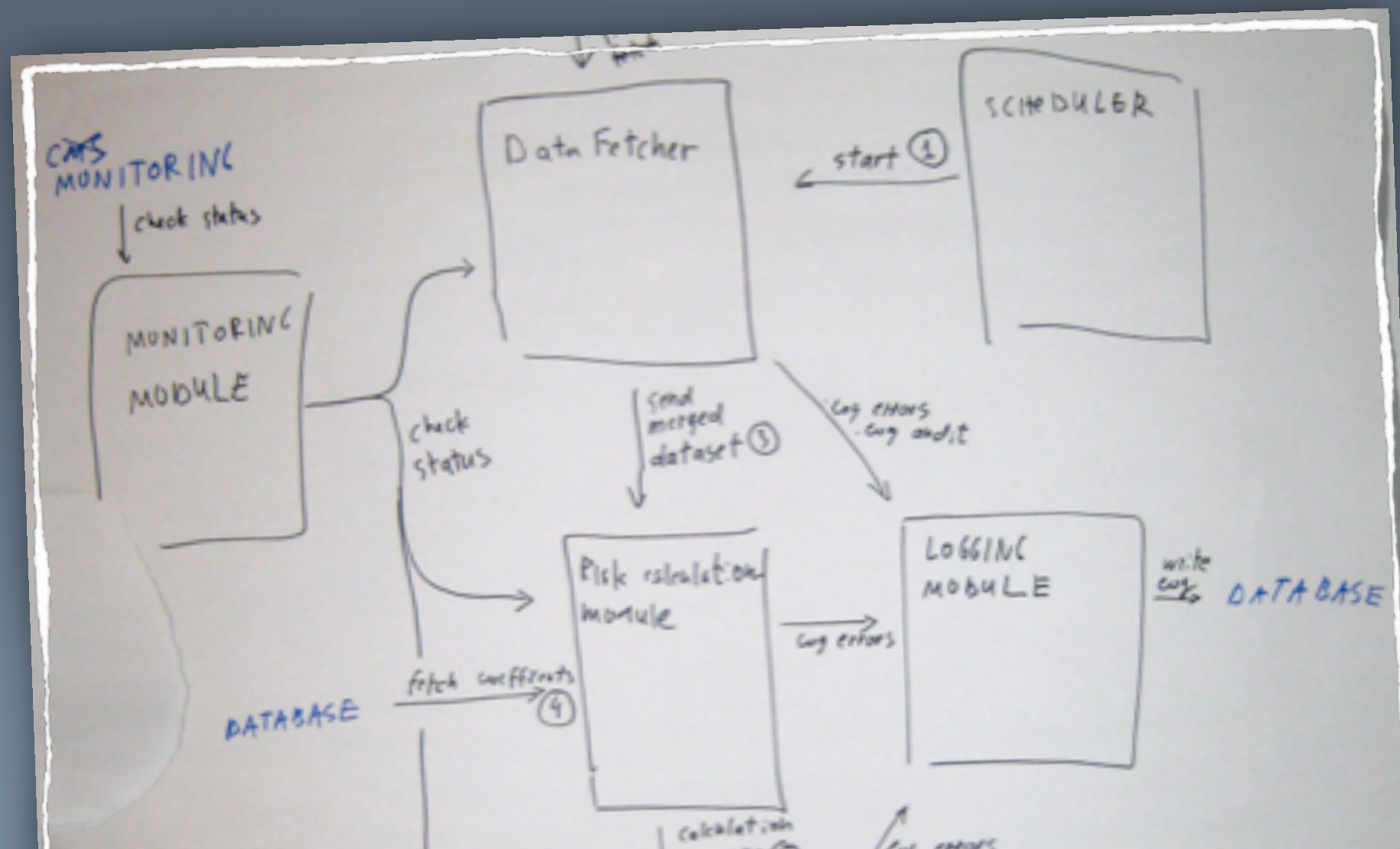
code

it that way?

The code is the
embodiment
of the architecture

Abstraction

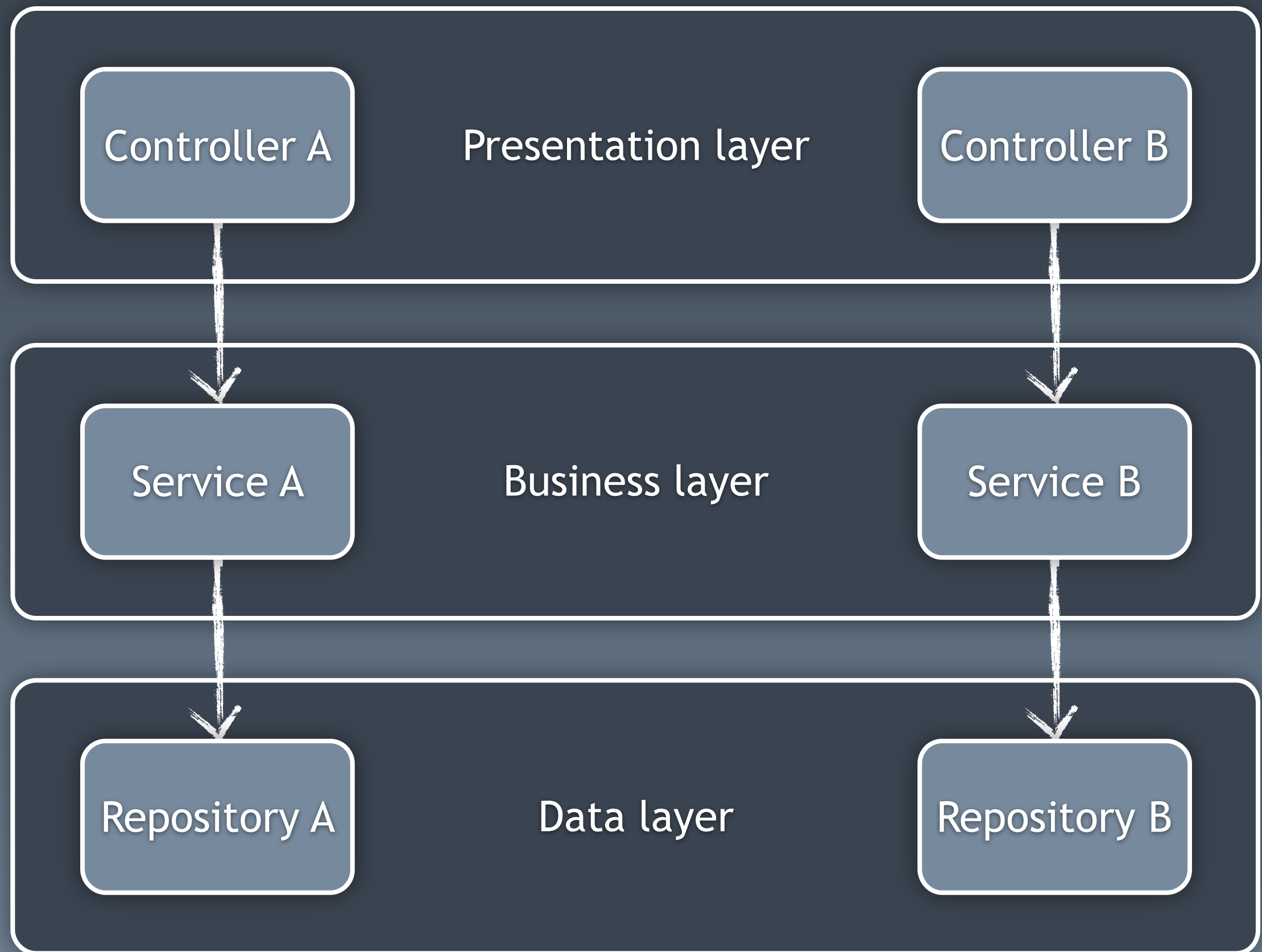
is about reducing detail
rather than creating a different representation



Abstractions help us
reason about
a big and/or complex
software system

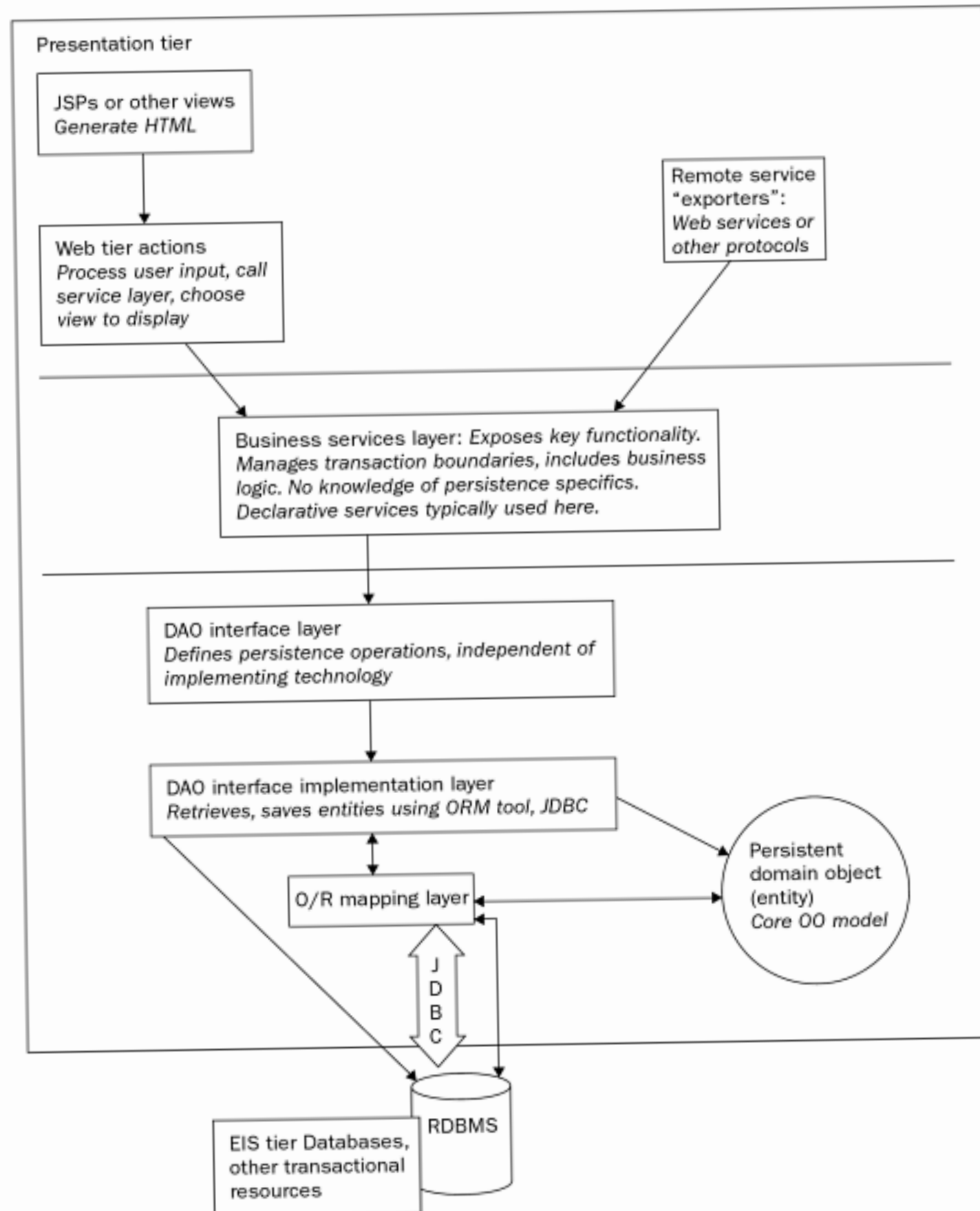
Does your code reflect the
abstractions
that you think about?

We often think
in components
but write classes
(usually in layers)



A layered architecture

Chapter 1



Let's summarize each layer and its responsibilities, beginning closest to the database or other enterprise resources:

- ❑ **Presentation layer:** This is most likely to be a web tier. This layer should be as thin as possible. It should be possible to have alternative presentation layers — such as a web tier or remote web services facade — on a single, well-designed middle tier.
- ❑ **Business services layer:** This is responsible for transactional boundaries and providing an entry point for operations on the system as a whole. This layer should have no knowledge of presentation concerns, and should be reusable.
- ❑ **DAO interface layer:** This is a layer of interfaces *independent of any data access technology* that is used to find and persist persistent objects. This layer effectively consists of *Strategy* interfaces for the Business services layer. This layer should not contain business logic. Implementations of these interfaces will normally use an O/R mapping technology or Spring's JDBC abstraction.
- ❑ **Persistent domain objects:** These model real objects or concepts such as a bank account.
- ❑ **Databases and legacy systems:** By far the most common case is a single RDBMS. However, there may be multiple databases, or a mix of databases and other transactional or non-transactional legacy systems or other enterprise resources. The same fundamental architecture is applicable in either case. This is often referred to as the *EIS (Enterprise Information System)* tier.

In a J2EE application, all layers except the EIS tier will run in the application server or web container. Domain objects will typically be passed up to the presentation layer, which will display data they contain, *but not modify them*, which will occur only within the transactional boundaries defined by the business services layer. Thus there is no need for distinct Transfer Objects, as used in traditional J2EE architecture.

In the following sections we'll discuss each of these layers in turn, beginning closest to the database.

Spring aims to decouple architectural layers, so that each layer can be modified as

Spring aims to decouple architectural layers, so that each layer can be modified as far as possible without impacting other layers. No layer is aware of the concerns of the layer above; as far as possible, dependency is purely on the layer immediately below. Dependency between layers is normally in the form of interfaces, ensuring that coupling is as loose as possible.



Package Explorer

JUnit

- ▼ springapp
 - ▼ src
 - ▼ springapp.domain
 - ▶ Product.java
 - ▼ springapp.repository
 - ▶ JdbcProductDao.java
 - ▶ ProductDao.java
 - ▼ springapp.service
 - ▶ PriceIncrease.java
 - ▶ PriceIncreaseValidator.java
 - ▶ ProductManager.java
 - ▶ SimpleProductManager.java
 - ▶ springapp.web
 - ▶ test
 - ▶ JRE System Library [JVM 1.5.0 (MacOS X Default)]
 - ▶ Referenced Libraries
 - ▶ db
 - ▼ war
 - ▼ WEB-INF
 - ▼ classes
 - ▶ springapp
 - ▶ jdbc.properties
 - ▶ messages.properties
 - ▼ jsp
 - ▶ hello.jsp
 - ▶ include.jsp

1 Answer

active

oldest

votes

8

If you are using maven, it's best to follow the standard maven project layout. You can get maven to generate this structure for you by doing,

```
mvn archetype:generate
```

and select spring-mvc-jpa-archetype from the list of choices

This will give you a package structure like,

```
pom.xml
src
├── main
│   ├── java
│   │   ├── mygroup
│   │   │   ├── controller
│   │   │   │   ├── HomeController.java
│   │   │   │   └── PersonController.java
│   │   │   ├── dao
│   │   │   │   └── PersonDao.java
│   │   │   └── model
│   │   │       └── Person.java
│   ├── resources
│   │   ├── db.properties
│   │   ├── log4j.xml
│   │   ├── META-INF
│   │   │   └── persistence.xml
│   └── webapp
│       ├── index.html
│       ├── META-INF
│       │   ├── context.xml
│       │   └── MANIFEST.MF
│       ├── resources
│       │   └── css
│       │       └── screen.css
│       ├── WEB-INF
│       │   ├── spring
│       │   │   ├── app
│       │   │   │   ├── controllers.xml
│       │   │   │   └── servlet-context.xml
│       │   │   ├── db.xml
│       │   │   └── root-context.xml
│       └── views
```

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Devops, Cloud Systems and AWS
Voyanta

London, United Kingdom

Linux Service Engineers
Shazam

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3 x Senior Engineer (Ruby) 3
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Related

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- 0 Is there a sample web project of integrating Spring-MVC and Spring-Data-JPA?
- 1 Reusing DAOs in another web application
- 0 Java Web Application Warming
- 3 Is a parallel Spring-MVC application possible with a non-spring web app?
- 2 Adding a web interface (Spring MVC) to existing Java application
- 0 package strucutre for Spring MVC project with multiple sub projects using maven
- 0 How to add a setup



HomeController.cs

MvcMovie.Controllers.HomeCont

Index()

```
using System;
using System.Collections.Generic;
using System.Linq;
using System.Web;
using System.Web.Mvc;

namespace MvcMovie.Controllers
{
    public class HomeController : Controller
    {
        public ActionResult Index()
        {
            ViewBag.Message = "Modify this template to create your app's home page."

            return View();
        }

        public ActionResult About()
        {
            ViewBag.Message = "Your app description page."

            return View();
        }
    }
}
```

Solution Explorer



Search Solution Explorer (Ctrl+;)

Solution 'MvcMovie' (1 project)

MvcMovie

- Properties
- References
- App_Data
- App_Start
- Content
- Controllers
- Filters
- Images
- Models
- Scripts
- Views
- favicon.ico
- Global.asax
- packages.config
- Web.config

100 %

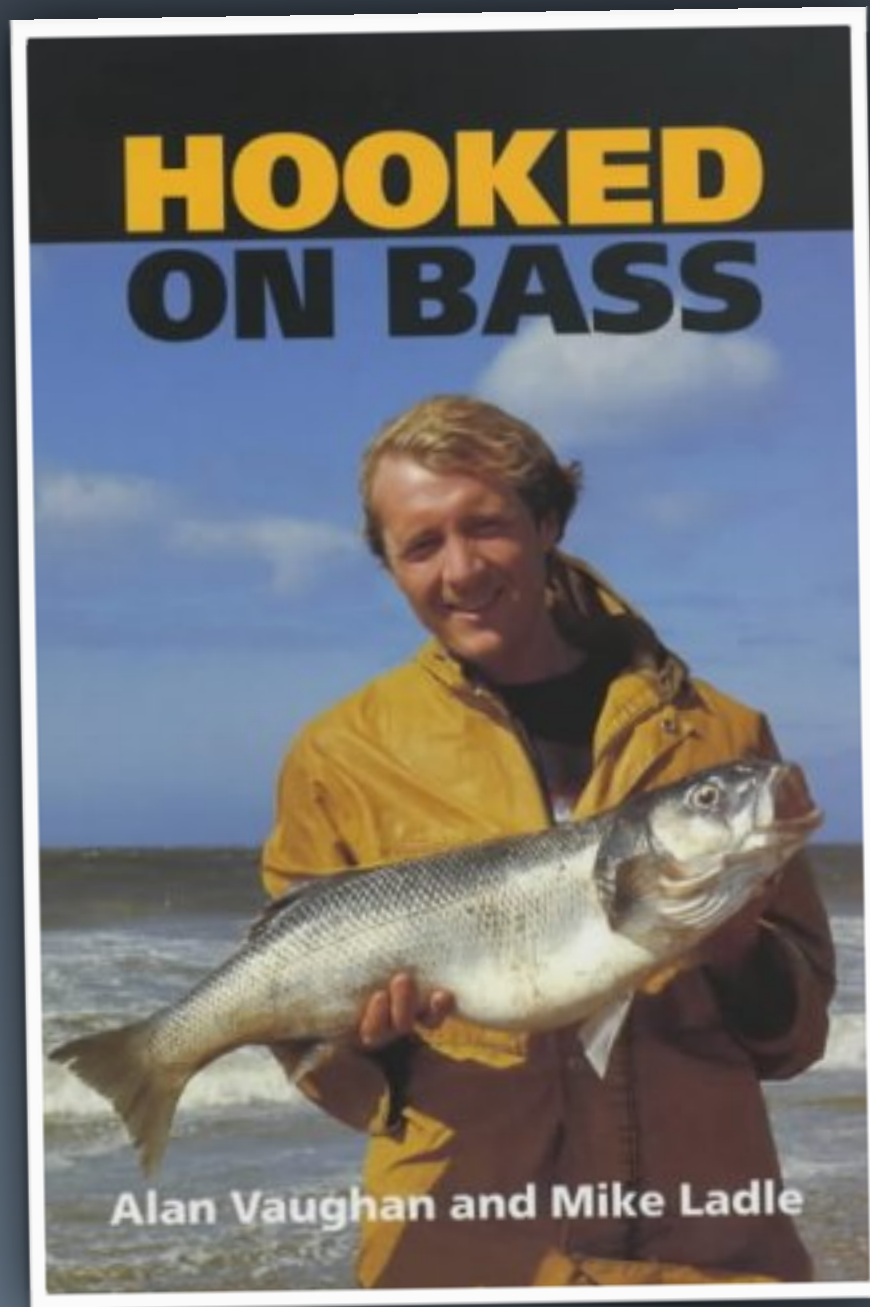
Ready

Ln 1

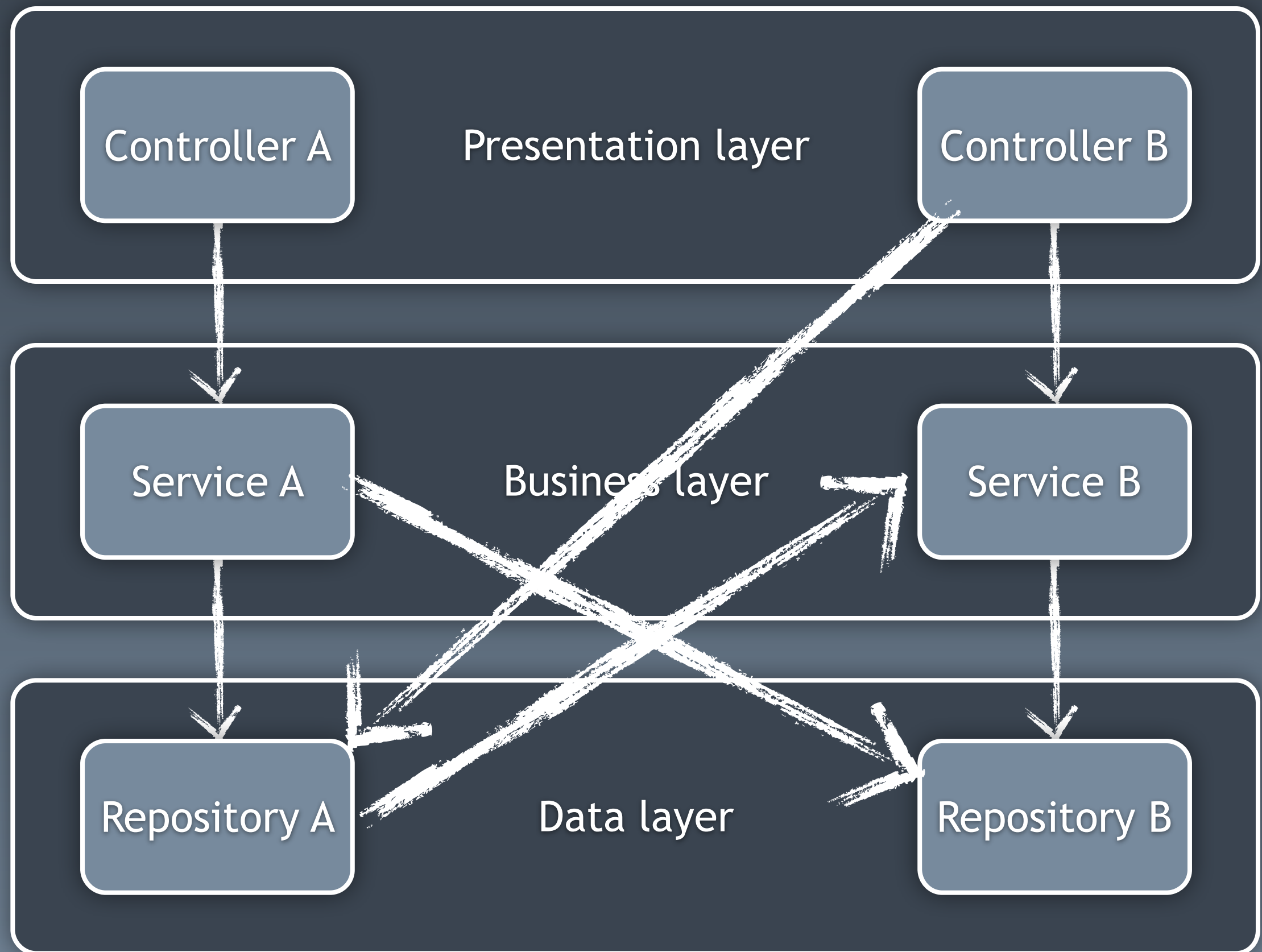
Col 1

Ch 1

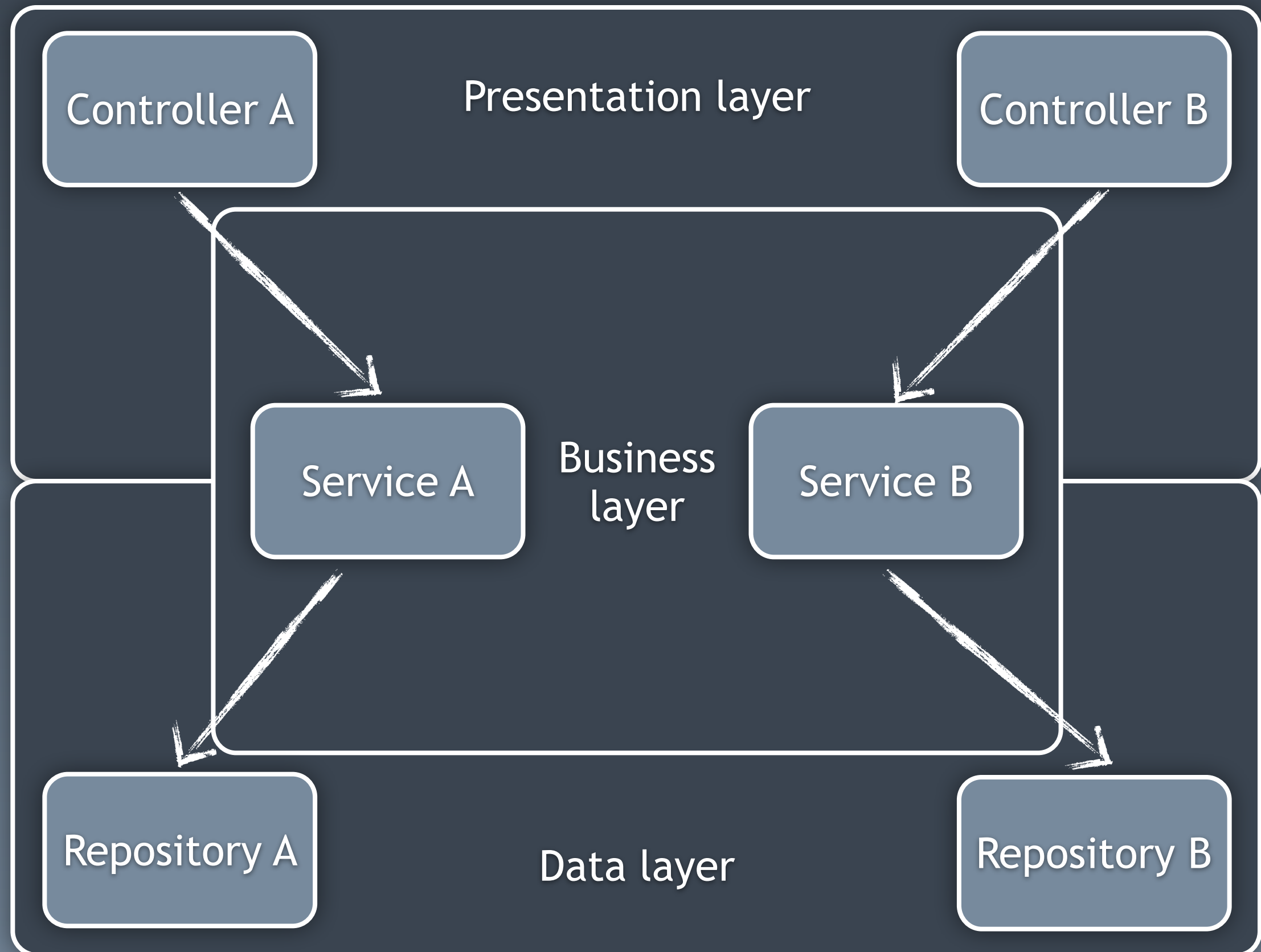
INS



Find the fish and
catch the fish you will



A typical layered architecture :-)



This is still a layered architecture

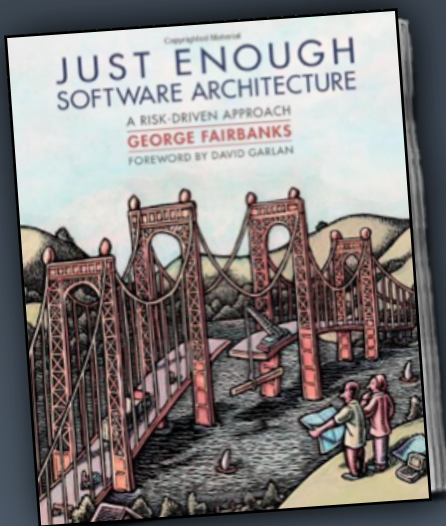
Should layers be
considered
harmful?

Are layers significant

structural
elements

or just an

implementation
detail?



“the model-code gap”

Model-code gap. Your architecture models and your source code will not show the same things. The difference between them is the *model-code gap*. Your architecture models include some abstract concepts, like components, that your programming language does not, but could. Beyond that, architecture models include intensional elements, like design decisions and constraints, that cannot be expressed in procedural source code at all.

Consequently, the relationship between the architecture model and source code is complicated. It is mostly a refinement relationship, where the extensional elements in the architecture model are refined into extensional elements in source code. This is shown in Figure 10.3. However, intensional elements are not refined into corresponding elements in source code.

Upon learning about the model-code gap, your first instinct may be to avoid it. But reflecting on the origins of the gap gives little hope of a general solution in the short term: architecture models help you reason about complexity and scale because they are abstract and intensional; source code executes on machines because it is concrete and extensional.

Organisation

of code

vs

the architectural views

Software architecture vs code

122

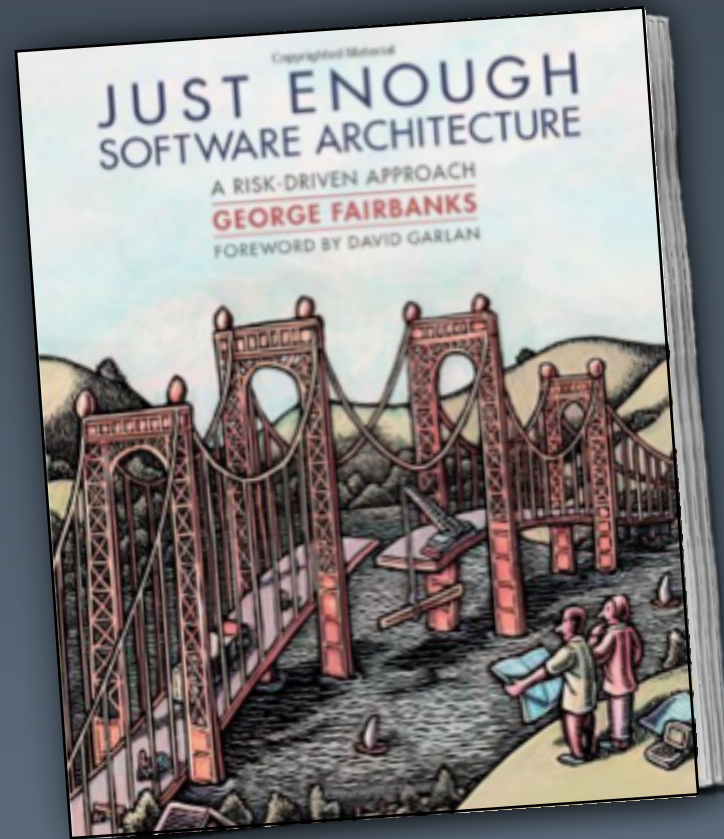
CHAPTER 7. CONCEPTUAL MODEL OF SOFTWARE ARCHITECTURE

	Business Model	Domain Model	Design Model		Code Model
			Boundary Model	Internals Model	
Bosch			System context	Component design	Code
Cheesman & Daniels		Business concept	Type specs	Component architecture	Code
D'Souza (MAp)	Business architecture	Domain	Blackbox	Whitebox	Code
Software Engineering Institute (SEI)			Requirements	Architecture	Code
Jackson		Domain	Domain + machine	Machine	
RUP	Business modeling	Business modeling	Requirements	Analysis & design	Code
		Essential	Specification	Implementation	Code

Merge

the code and the model

(not model-driven architecture!)



“architecturally-evident coding style”

(subclassing, naming conventions, module dependencies, package structure, ...)

It's 2014, why can't we
auto-generate
a useful set of software
architecture diagrams
from code?!

Diagramming tools see
packages
and classes
rather than components

Architecture

Diagrams & rules

Define your desired architecture with Structure101's semantically rich, intuitive, layered block architecture diagrams, present it to your developers through our IDE plugin and enforce it by integrating into your build.

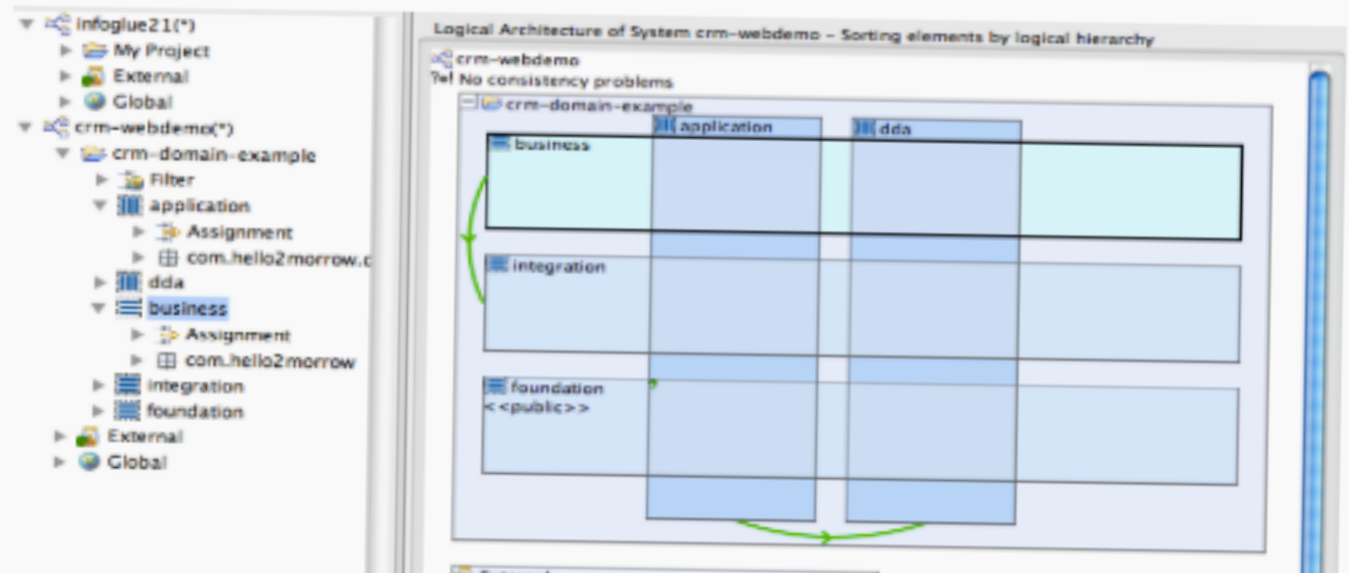


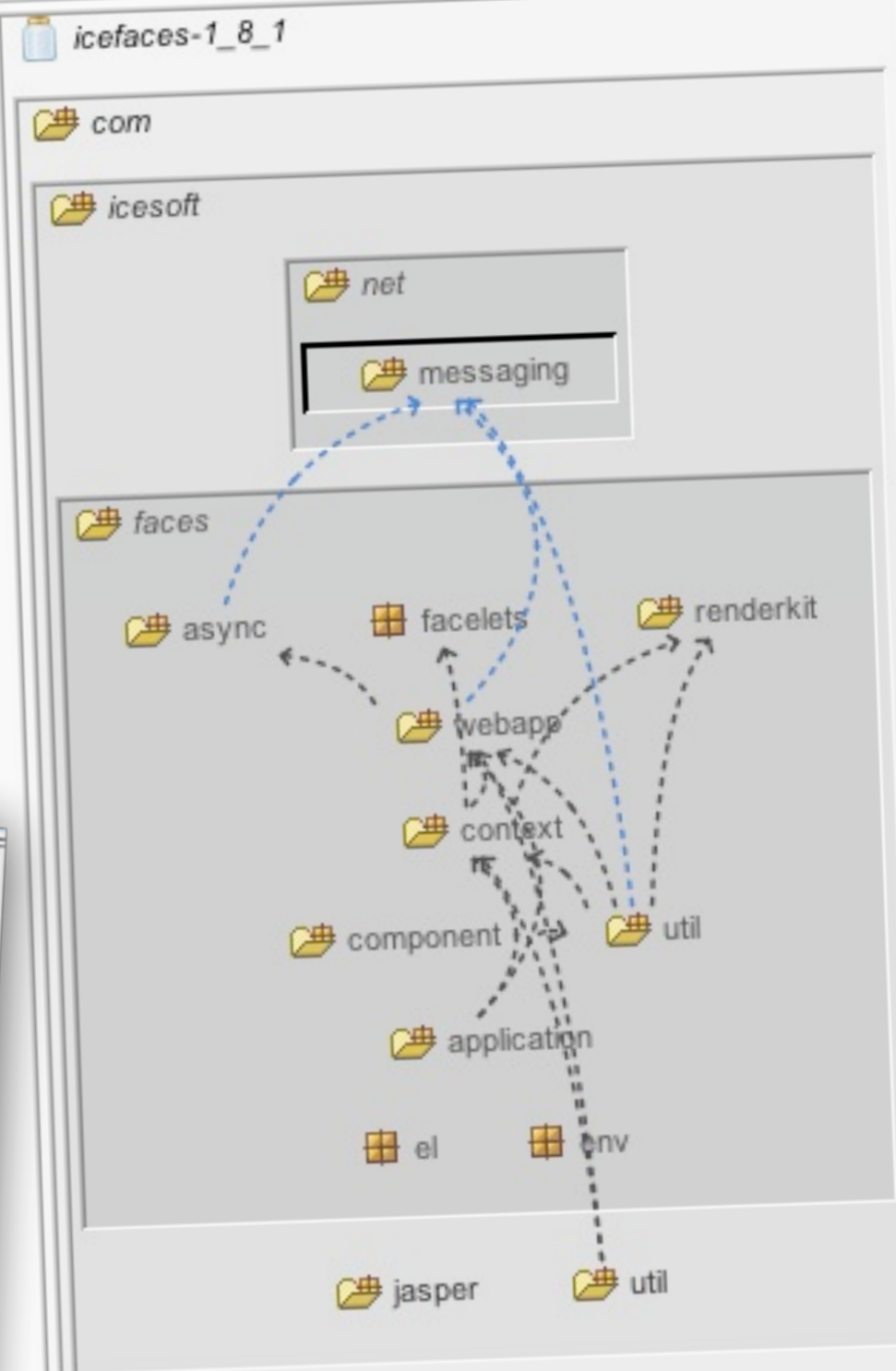
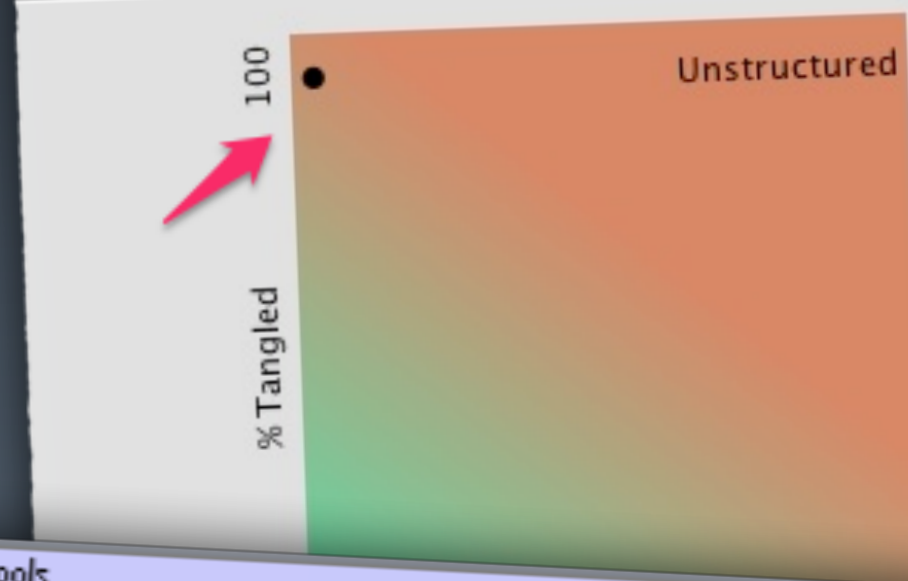
Design

Define and Enforce Architecture

Sonargraph-Architect is designed to simplify software architecture and dependency management. You begin by defining the intended logical architecture of your system and map it to your code. A logical architecture is a set of rules designating allowed and forbidden dependencies in your code. Typical rules would be "the UI layer is not allowed to directly access the DAO layer" or "the UI layer cannot use JDBC directly".

Once defined, our IDE plugins (for Eclipse or IntelliJ IDEA) check every code change for rule compliance. Violating code lines will be marked with error markers so that developers are able to fix rule violations even before they commit their changes to the version control system. If you are not using Eclipse or IntelliJ, you can always use Sonargraph-Architect standalone for immediate rule checking. Moreover Sonargraph-Architect integrates with ANT and Maven so that architecture rules can also be enforced in your build process.



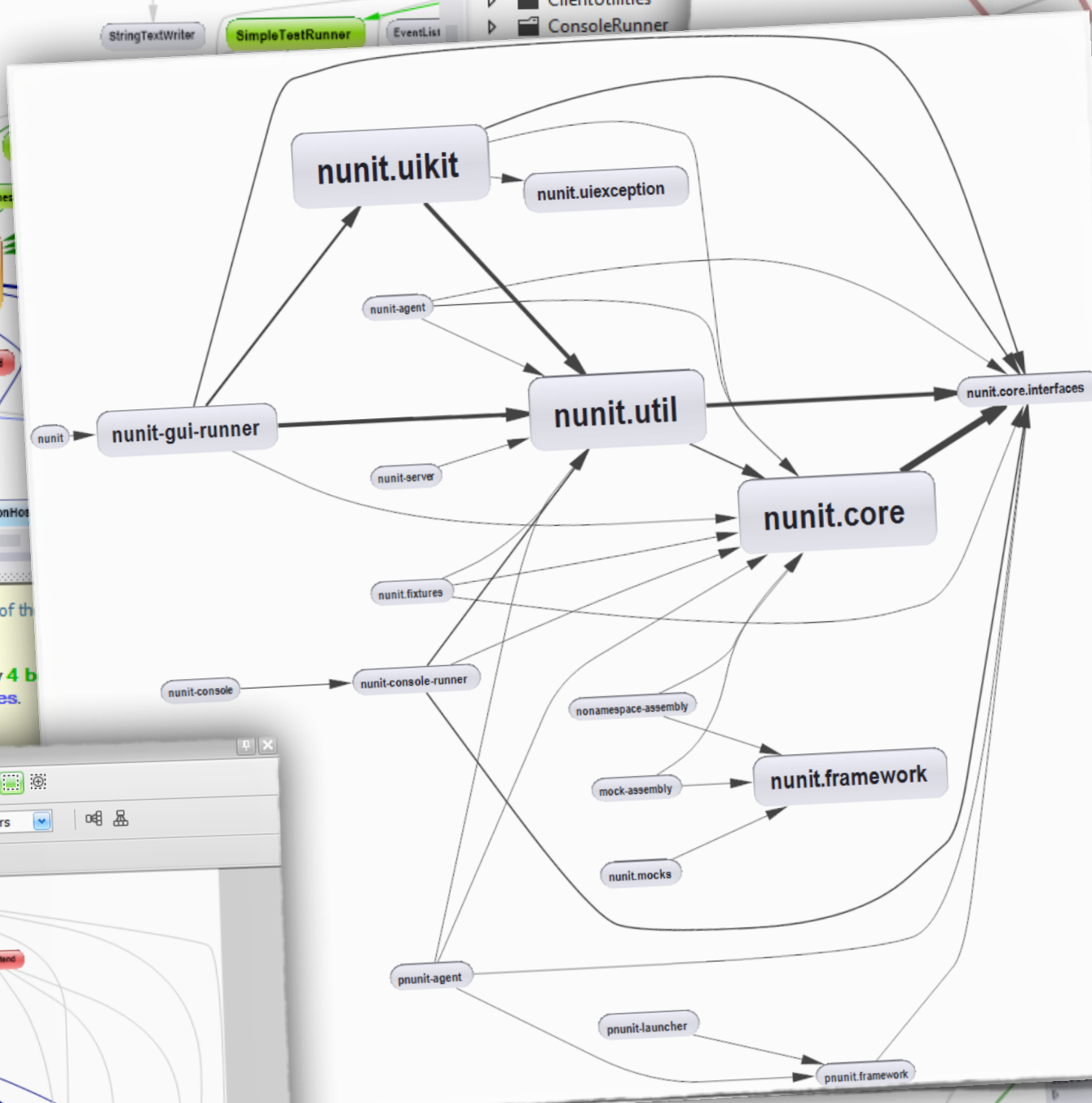
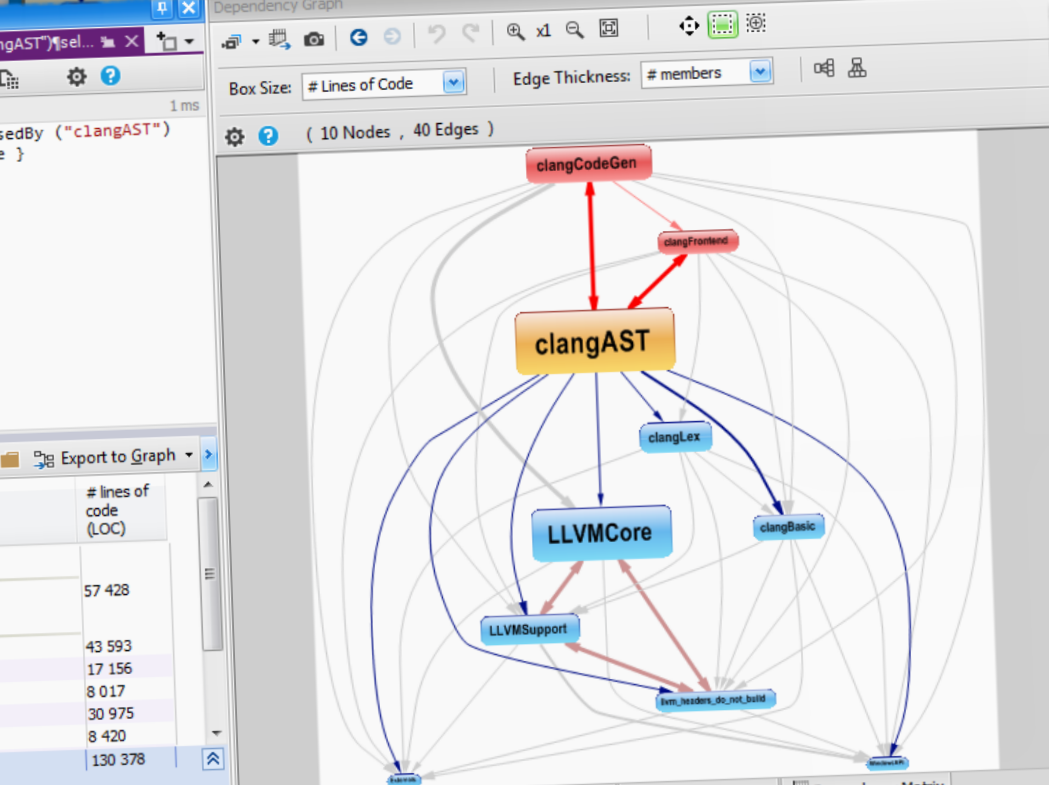


The screenshot shows the 'root' window of the 'Ant' IDE. The left sidebar contains a project tree with the following structure:

- root
 - ant.taskdef...
 - cvslib 1
 - compilers 2
 - rmic 3
 - condition 4
 - email 5
 - * 6
 - ant
 - loader 7
 - listener 8
 - helper 9
 - input 10
 - filters 11
 - util 12
 - types 13
 - * 14
 - UTILITIES 15

The main area displays a 15x15 grid with numbers and colored cells (blue, orange, yellow). The grid is as follows:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	-														
2		-				4									
3			-			10									
4				-		47									
5					-	3						6	1	2	
6	50	61	41	6		-			23						
7							-		9						33
8								-							
9									-						
10						4				-				1	2
11						7					-				10
12						25						-		16	48
13	3	13	5	3	1	284	3	2	18	2	33		52	64	
14	5	297	67	4	8	1378					88	95		49	
15	66	79	59	69	75	2800	5	18	300	18	60	175	585		



Do OO programming languages provide the wrong abstractions for building modern software systems?

The intersection of software architecture and code

Abstractions

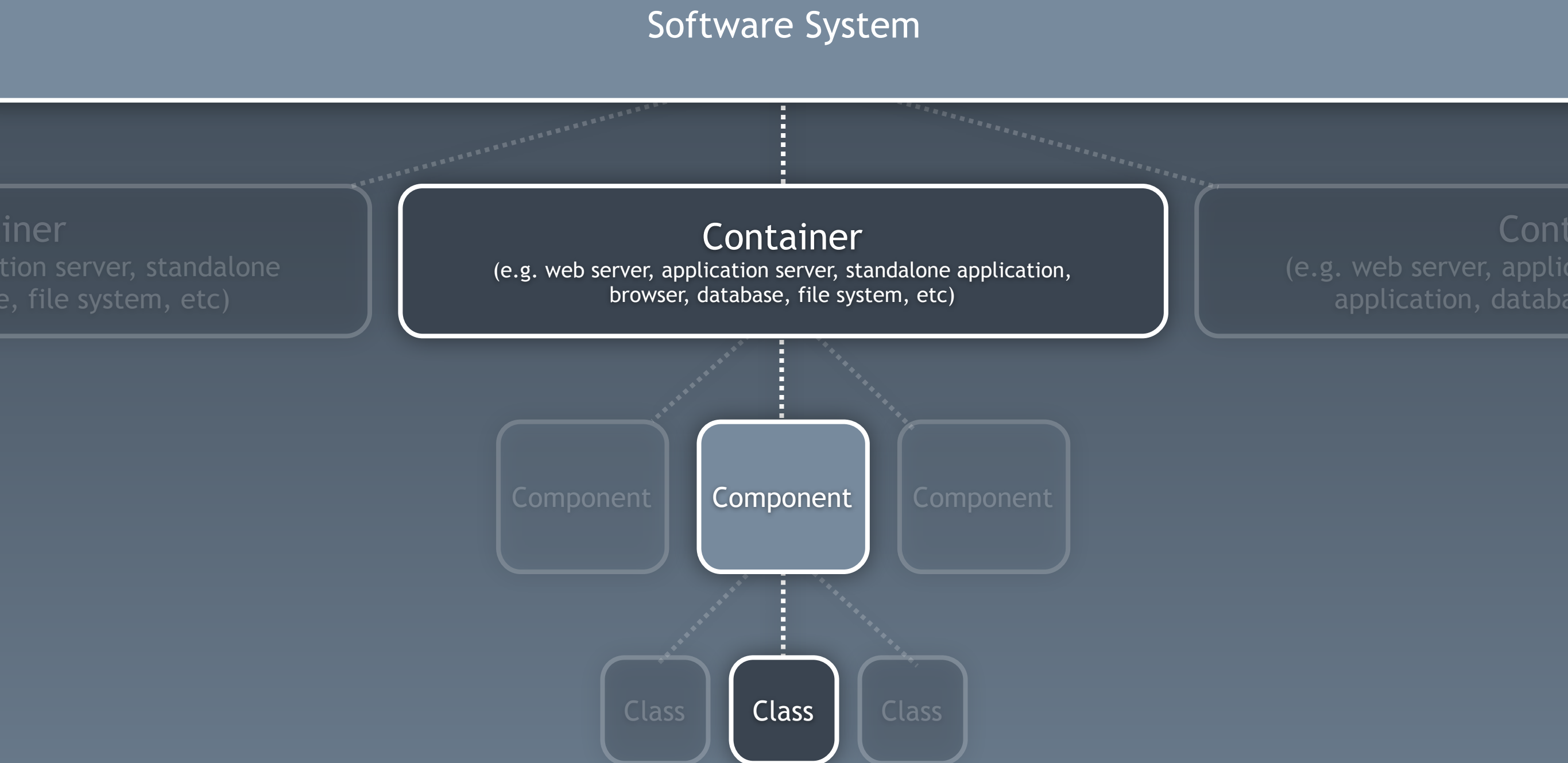
on diagrams

should reflect the

code

A common set of
abstractions

is more important than
a common notation



Agree on a simple set of **abstractions**
that the whole team can use to communicate

The C4 model

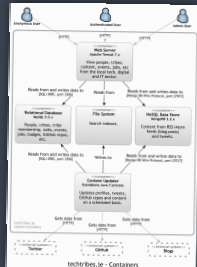
System Context

The system plus users and system dependencies



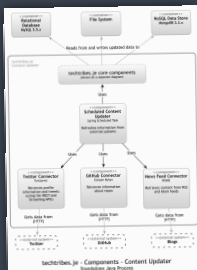
Containers

The overall shape of the architecture and technology choices



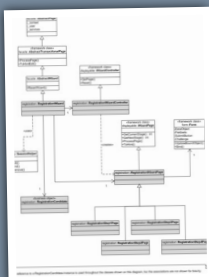
Components

Logical components and their interactions within a container



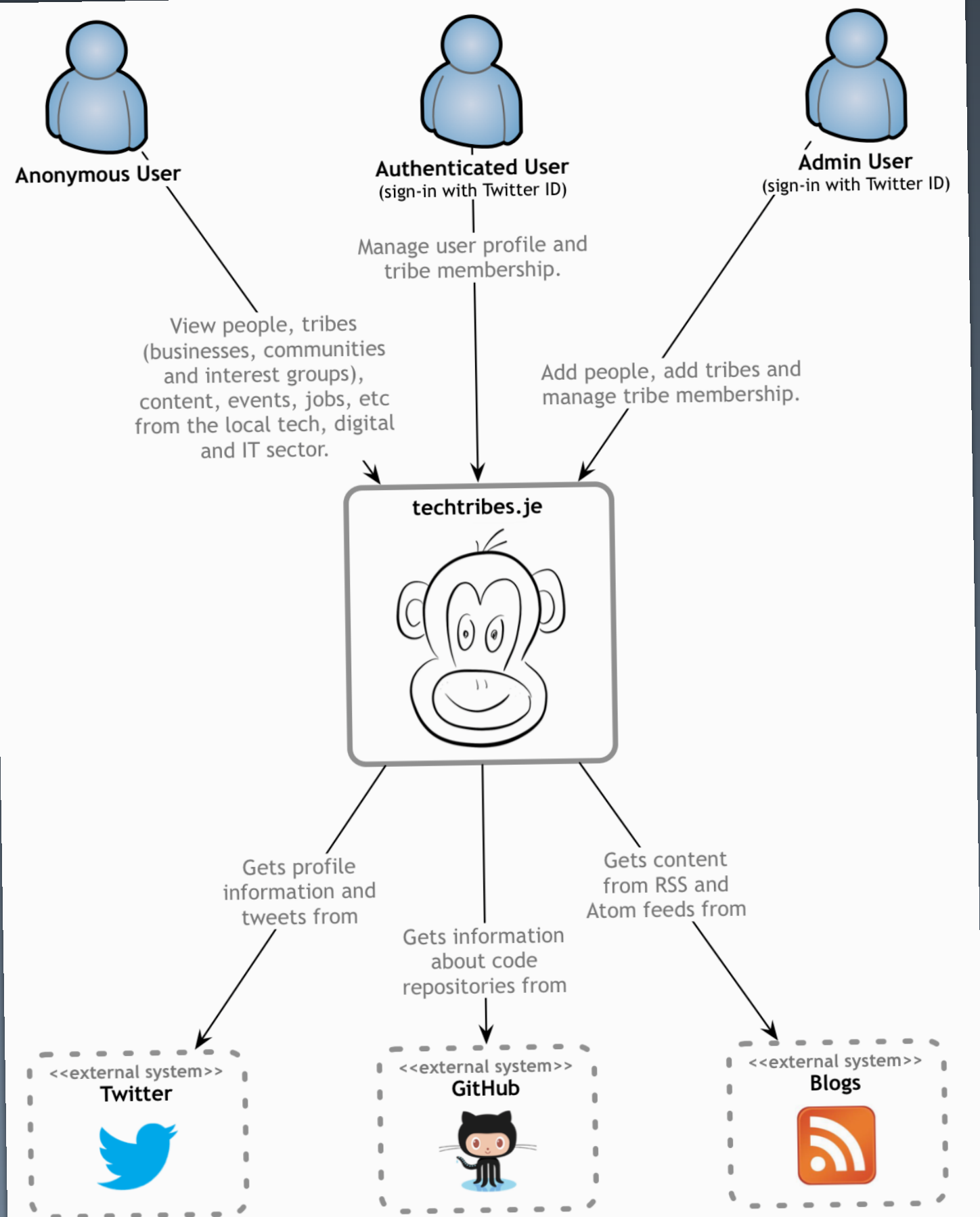
Classes

Component or pattern implementation details



Context

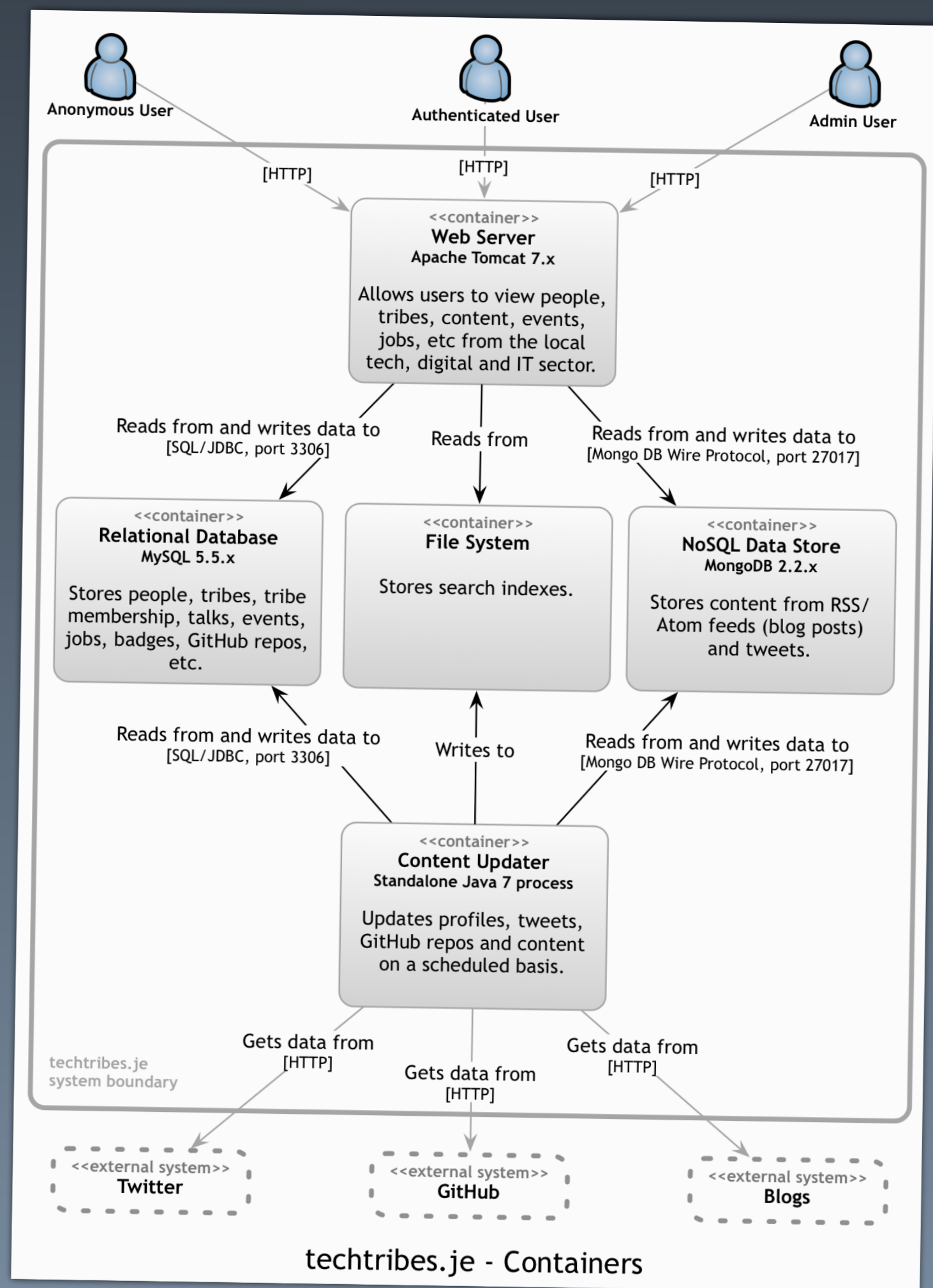
- What are we building?
- Who is using it?
(users, actors, roles, personas, etc)
- How does it fit into the existing IT environment?
(systems, services, etc)



techtribes.je - Context

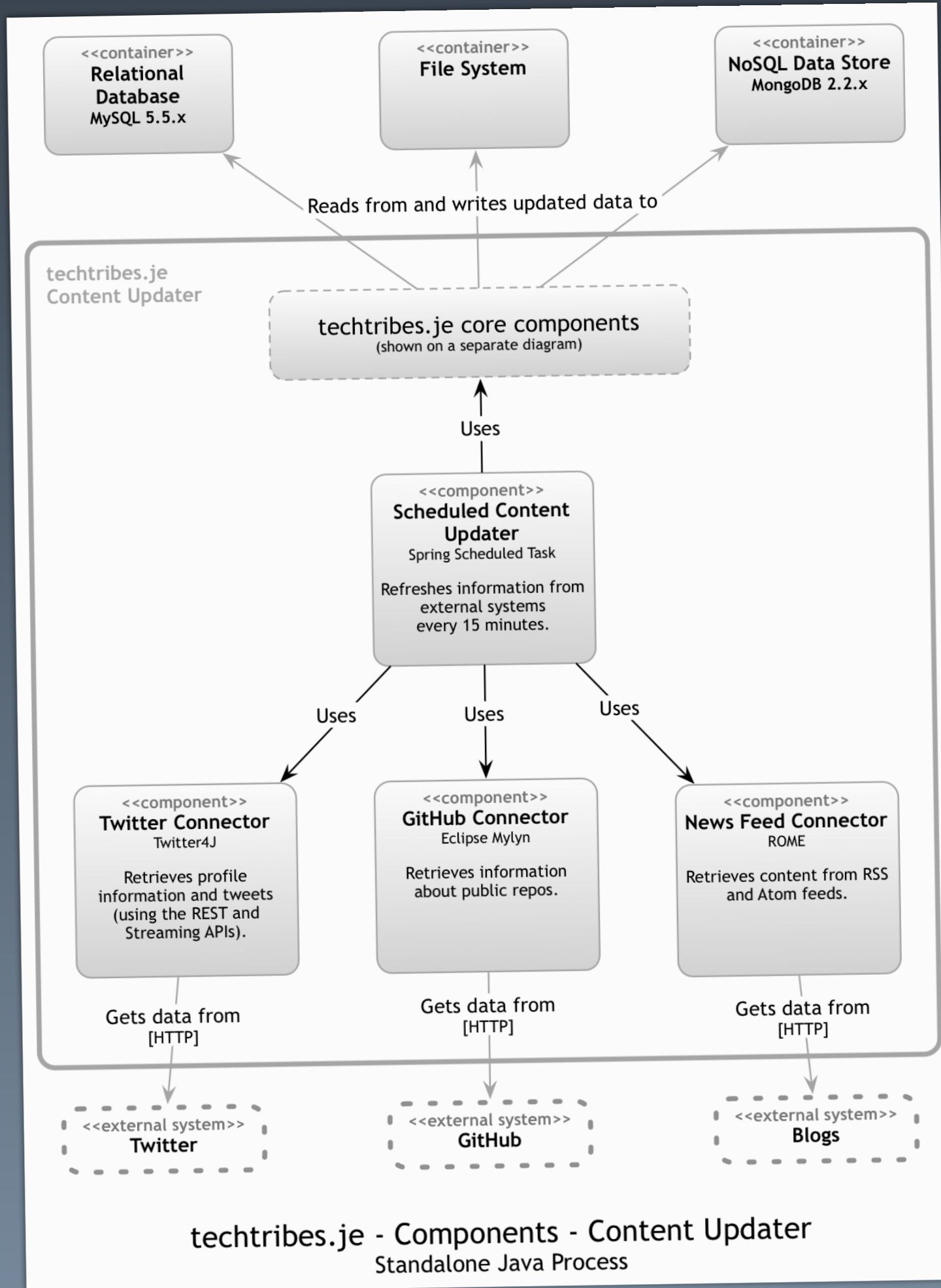
Containers

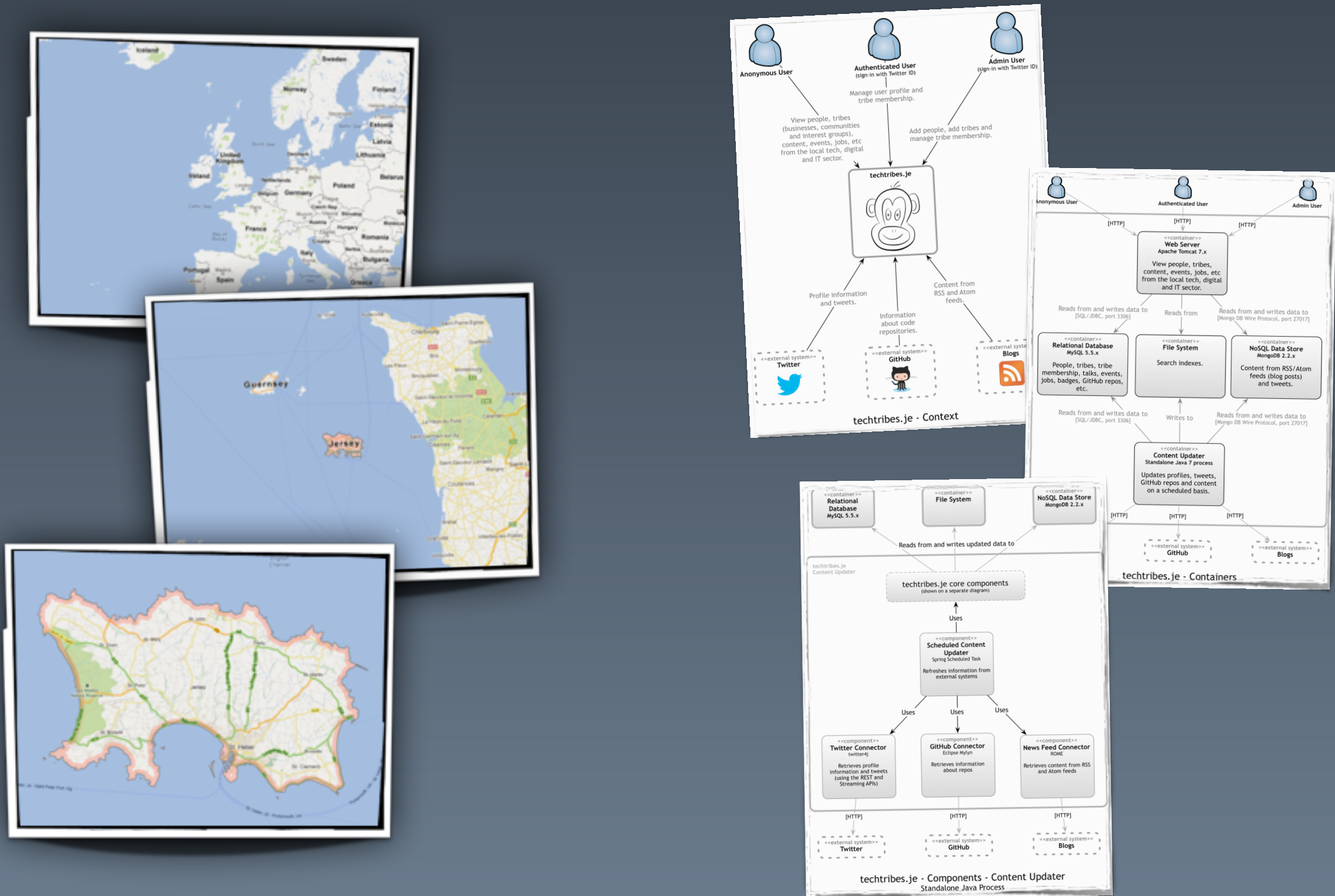
- What are the high-level technology decisions? (including responsibilities)
- How do containers communicate with one another?
- As a developer, where do I need to write code?



Components

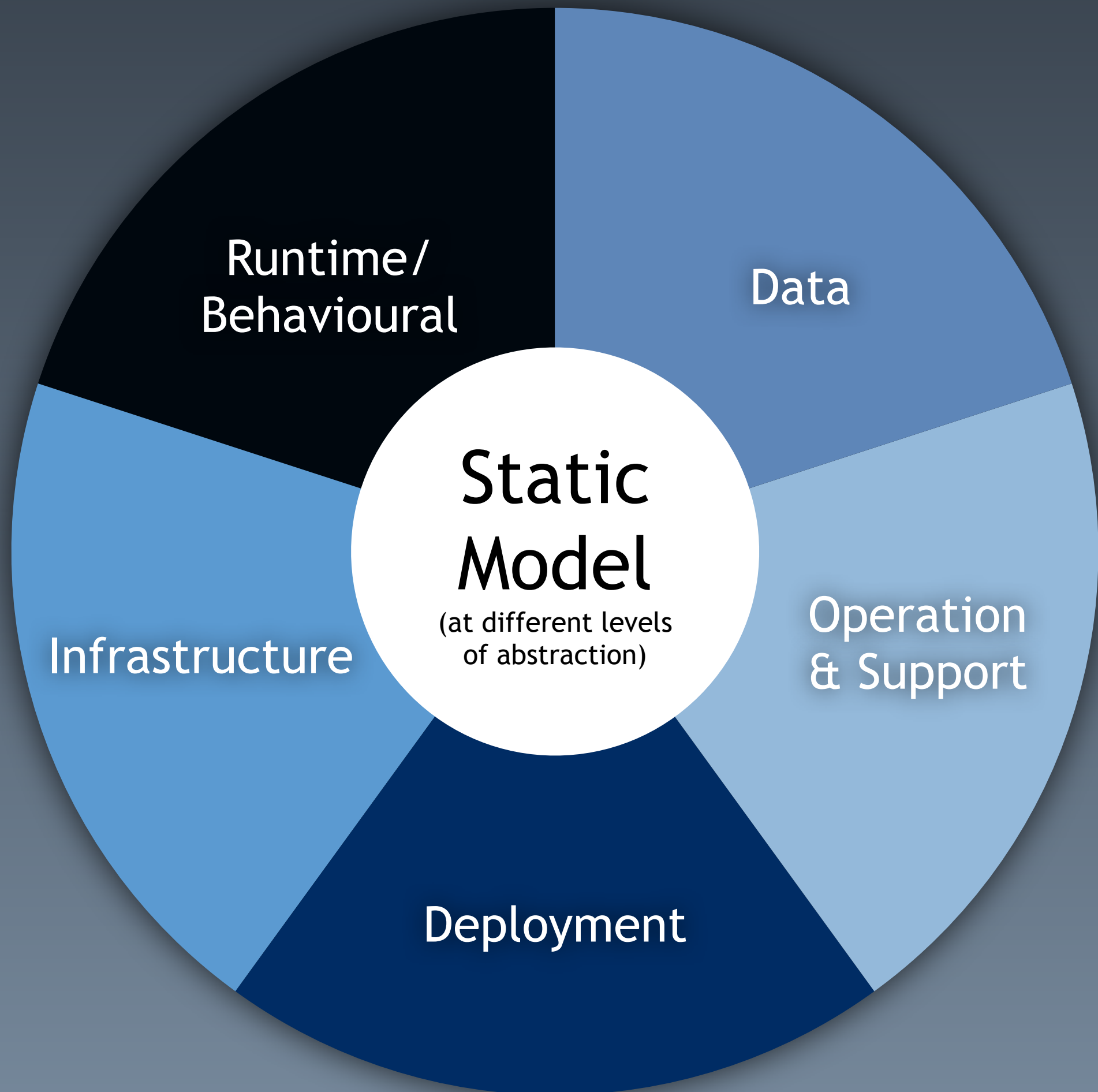
- What components/ services is the container made up of?
- Are the technology choices and responsibilities clear?





Sketches are maps
that help a team navigate a complex codebase

This isn't about
creating a standard

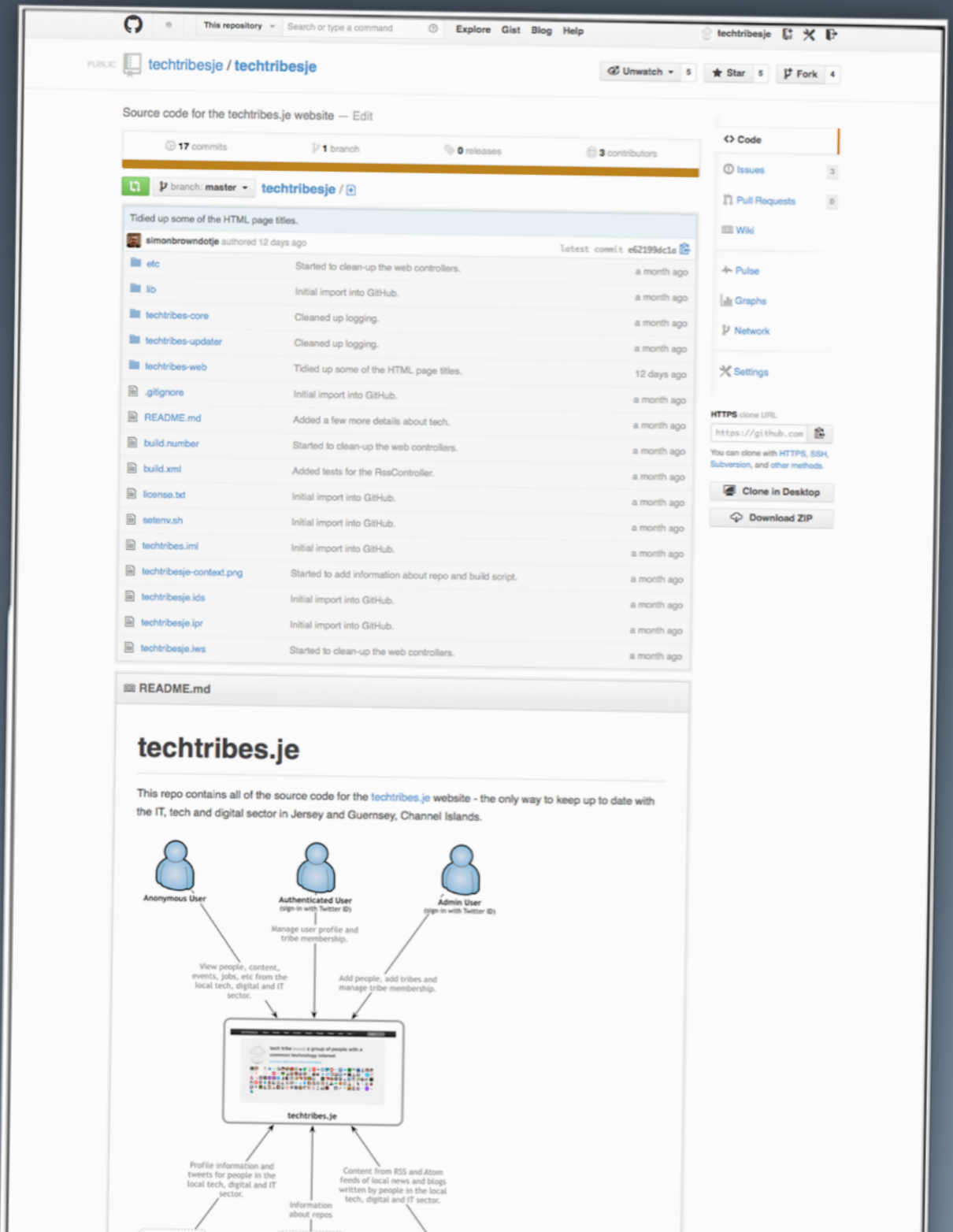
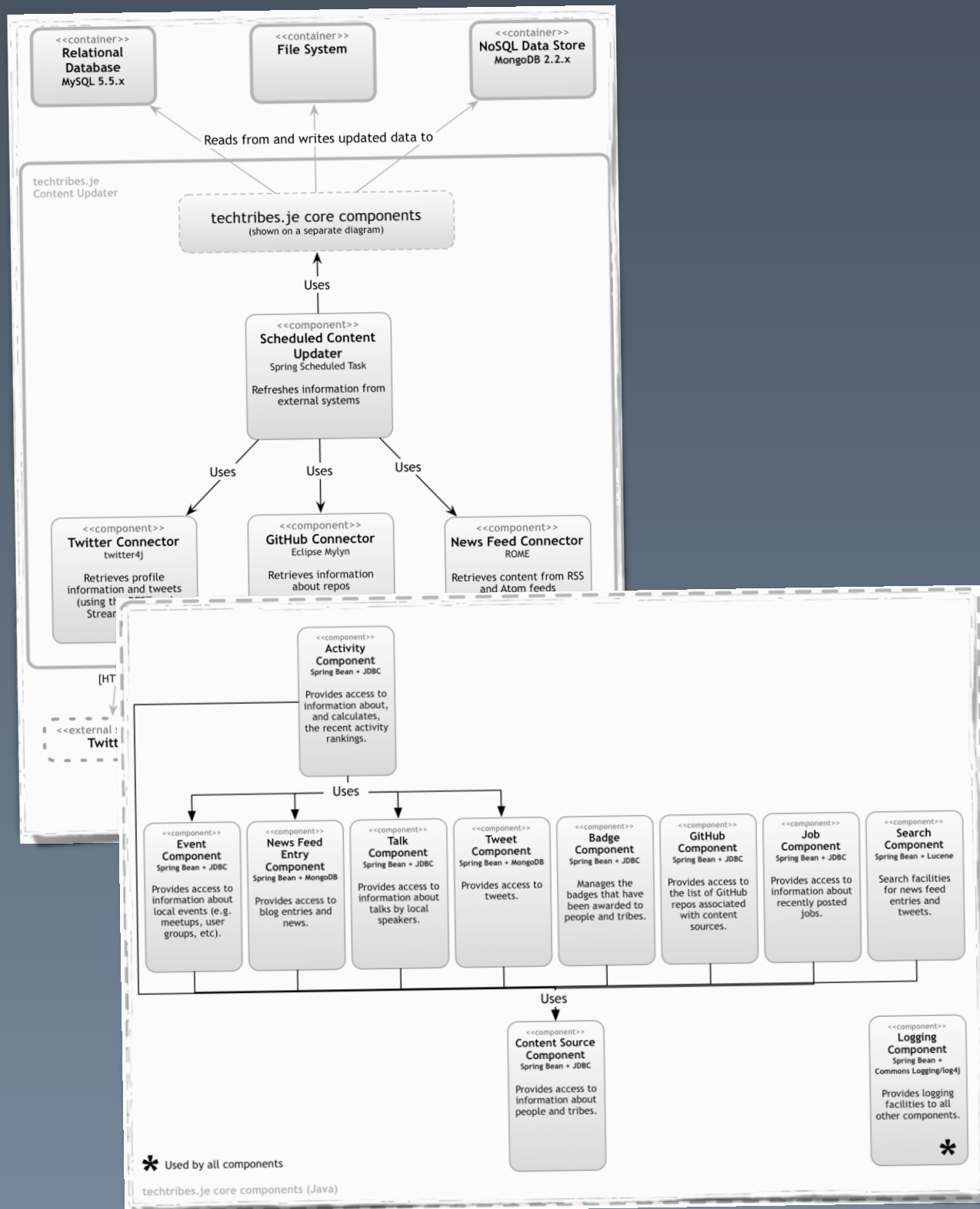


Software developers are
the most important
stakeholders
of software architecture



C4 is about the static
structure of software,
which is ultimately
about code

Does your code reflect the abstractions that appear on your software architecture diagrams?



If the answer is
“no” ... are the
diagrams actually
useful?

Does the code for
techtribes.je
reflect the abstractions
on the software
architecture diagrams?

https://github.com/techtribesje/techtribesje



GitHub repository page for **techtribesje / techtribesje**. The repository is public and has 5 stars, 4 forks, and 17 commits. The current branch is **master**.

Source code for the techtribesje website — Edit

17 commits | 1 branch | 0 releases | 3 contributors

branch: master | techtribesje /

Tidied up some of the HTML page titles.

simonbrowndotje authored 12 days ago | latest commit e62199dc1a

File	Description	Time
etc	Started to clean-up the web controllers.	a month ago
lib	Initial import into GitHub.	a month ago
techtribes-core	Cleaned up logging.	a month ago
techtribes-updater	Cleaned up logging.	a month ago
techtribes-web	Tidied up some of the HTML page titles.	12 days ago
.gitignore	Initial import into GitHub.	a month ago
README.md	Added a few more details about tech.	a month ago
build.number	Started to clean-up the web controllers.	a month ago
build.xml	Added tests for the RssController.	a month ago
license.txt	Initial import into GitHub.	a month ago
setenv.sh	Initial import into GitHub.	a month ago
techtribes.iml	Initial import into GitHub.	a month ago
techtribesje-context.png	Started to add information about repo and build script.	a month ago
techtribesje.ids	Initial import into GitHub.	a month ago
techtribesje.ipr	Initial import into GitHub.	a month ago
techtribesje.iws	Started to clean-up the web controllers.	a month ago

README.md

Code | Issues (3) | Pull Requests (0) | Wiki | Pulse | Graphs | Network | Settings

HTTPS clone URL: <https://github.com/techtribesje/techtribesje>

You can clone with HTTPS, SSH, Subversion, and other methods.

Clone in Desktop | Download ZIP

Project

techtribesje [techtribes] (~/Documents/sandbox/techtribesje)

docs

lib

techtribes-core

sql

src

je.techtribes

component

activity

badge

contentsource

event

github

job

log

newsfeedentry

search

talk

tweet

component.xml

MongoDbTweetDao

TweetComponent

TweetComponentImpl

TweetException

domain

util

config.xml

test

techtribes-core.iml

techtribes-updater

techtribes-web

.gitignore

build.number

build.xml

license.txt

README.md

setenv.sh

software-architecture-for-developers.png

techtribes.iml

TweetComponent.java

TweetComponentImpl.java

MongoDbTweetDao.java

```
package je.techtribes.component.tweet;

import ...

@Component(responsibility = "Provides access to tweets.")
@Collaboration(target = ContentSourceComponent.class, responsibility = "Enriches with")
public interface TweetComponent {

    /**
     * Gets the most recent tweets by page number.
     */
    List<Tweet> getRecentTweets(int page, int pageSize);
}
```

<<component>>

Activity Component

Spring Bean + JDBC

Provides access to information about, and calculates, the recent activity rankings.

Uses

<<component>>

Event Component

Spring Bean + JDBC

Provides access to information about local events (e.g. meetups, user groups, etc).

<<component>>

News Feed Entry Component

Spring Bean + MongoDB

Provides access to blog entries and news.

<<component>>

Talk Component

Spring Bean + JDBC

Provides access to information about talks by local speakers.

<<component>>

Tweet Component

Spring Bean + MongoDB

Provides access to tweets.

<<component>>

Badge Component

Spring Bean + JDBC

Manages the badges that have been awarded to people and tribes.

<<component>>

GitHub Component

Spring Bean + JDBC

Provides access to the list of GitHub repos associated with content sources.

<<component>>

Job Component

Spring Bean + JDBC

Provides access to information about recently posted jobs.

Uses

<<component>>

Content Source Component

Spring Bean + JDBC

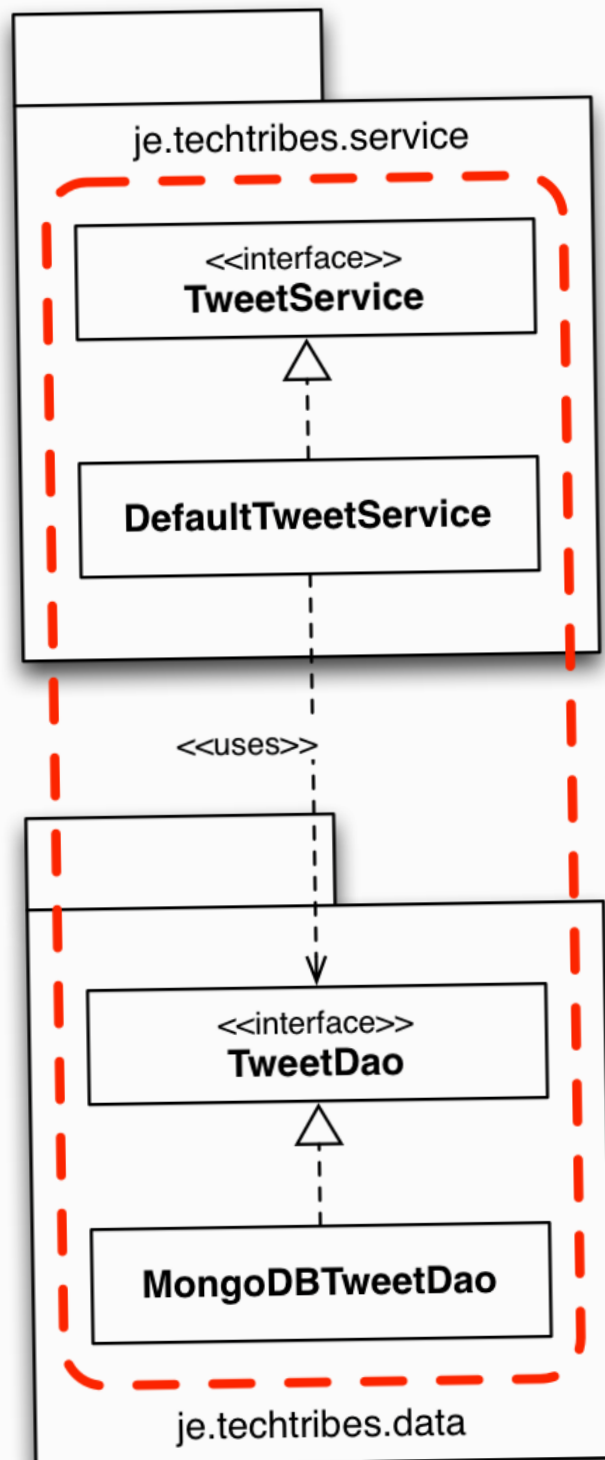
Provides access to information about people and tribes.

6: TODO

9: Changes

Application Servers

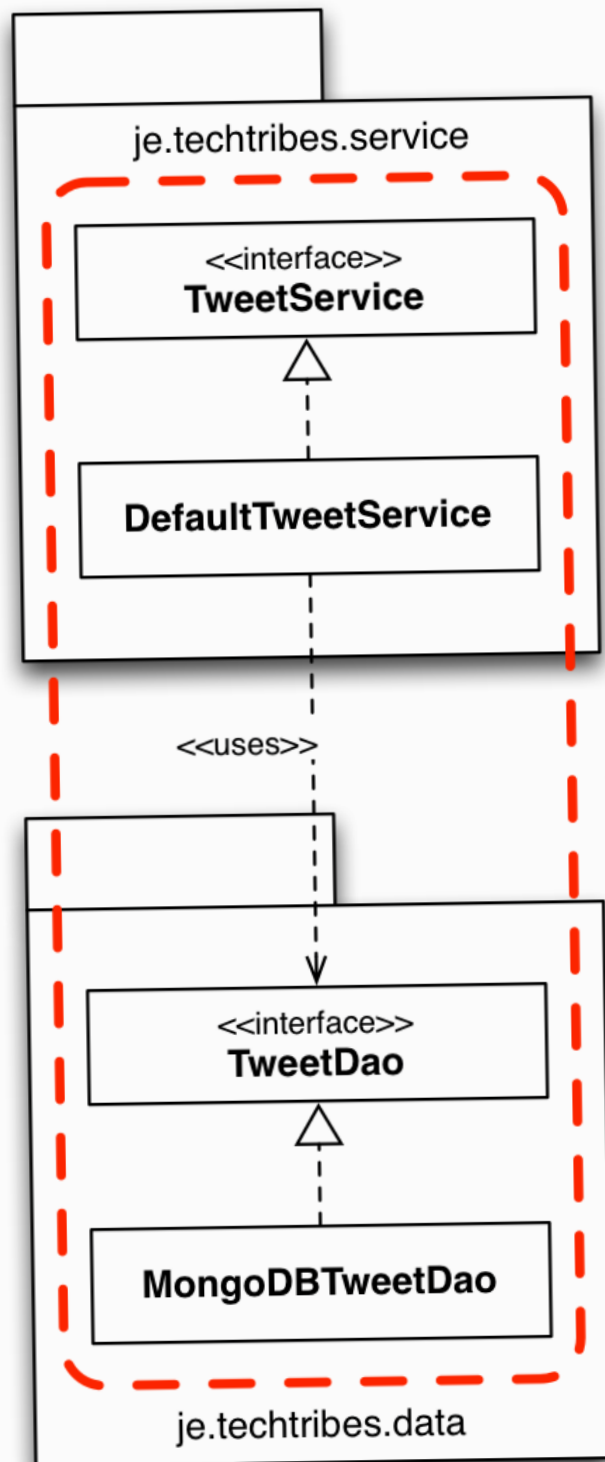
Did it start
out that
way?



A component is often a combination of a number of classes in different layers.

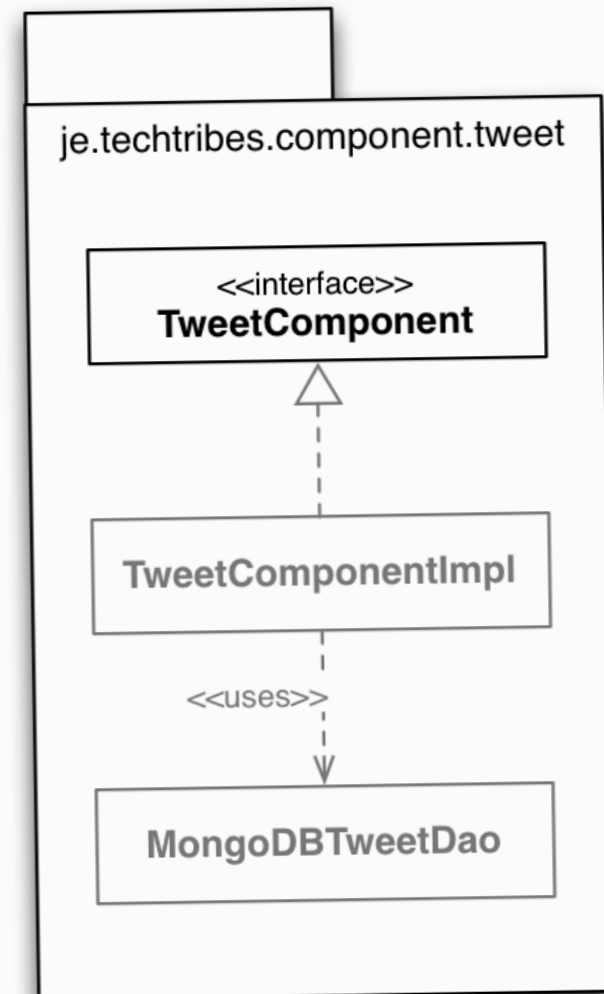
Package by layer

What's a “component”?



Package by layer

A component is often a combination of a number of classes in different layers.



Package by component

What's a "component"?

Don't do
unit testing!

“In the early days of computing when computers were slow, unit tests gave the developer more immediate feedback about whether a change broke the code instead of waiting for system tests to run. Today, with cheaper and more powerful computers, that argument is less persuasive.”



Why Most Unit Testing is Waste

By James O Coplien

1.1 Into Modern Times

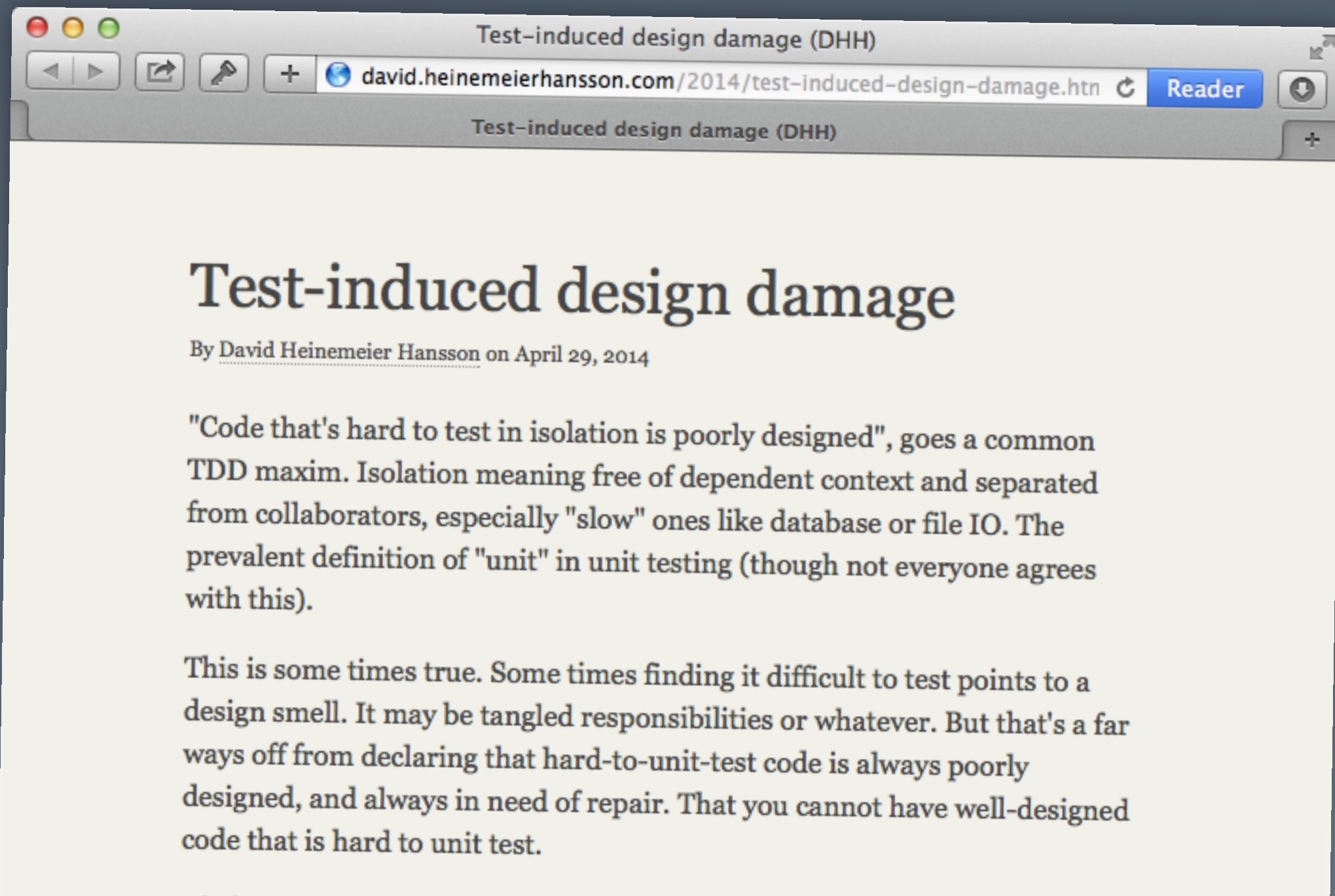
Unit testing was a staple of the FORTRAN days, when a function was a function and was sometimes worthy of functional testing. Computers computed, and functions and procedures represented units of computation. In those days the dominant

“If your coders have more lines of unit tests than of code,
it probably means one of several things.

... Or the problem may be at the other end:

developers don't have
adequately refined
design skills, or the
process doesn't encourage
architectural thinking and
conscientious design.”

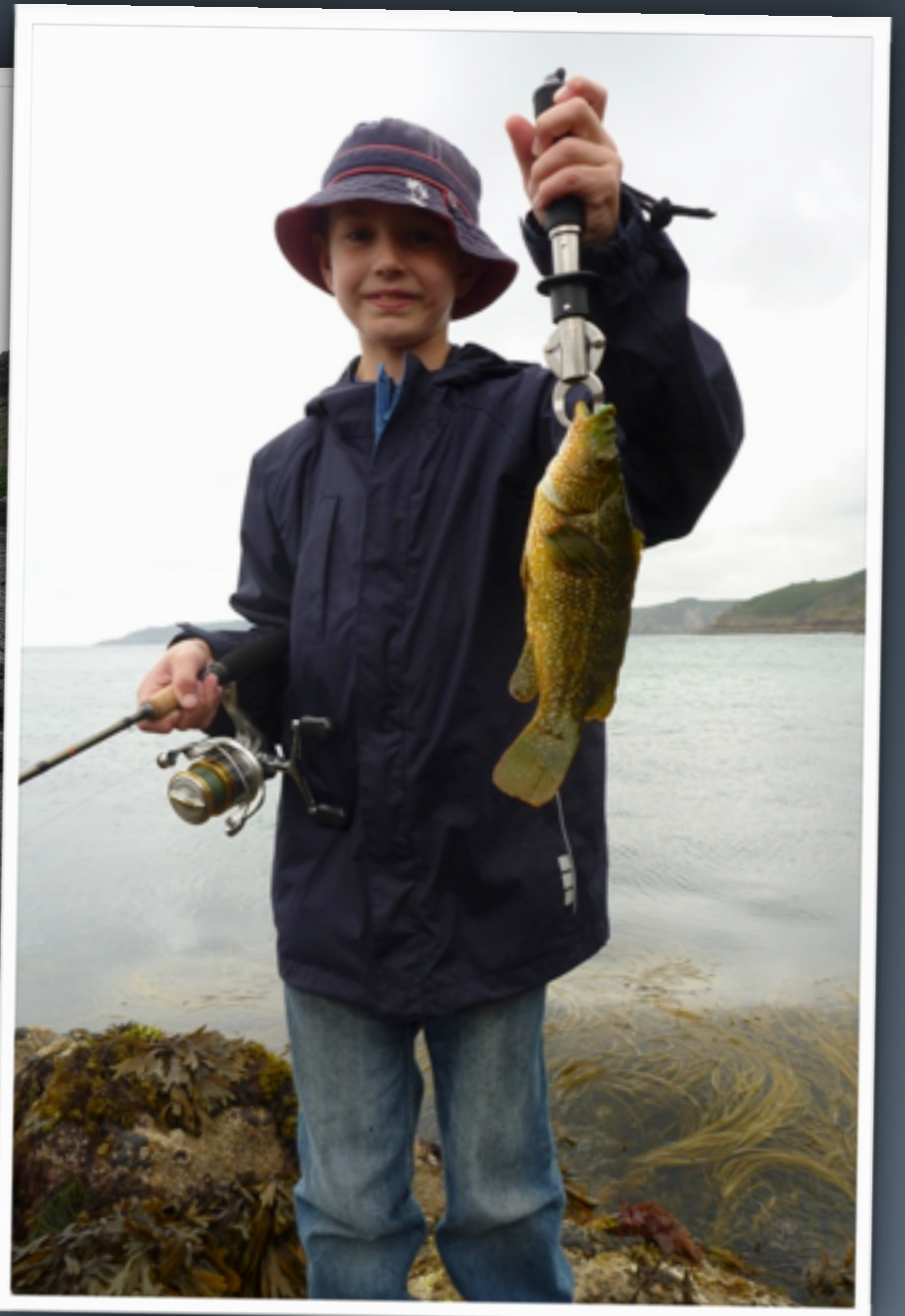
“do not let your tests drive your design”



Instead of unit testing everything, what about testing your significant structural elements as black boxes?



Don't blindly copy
what everybody else
seems to be doing



To teach something,
you need to understand it

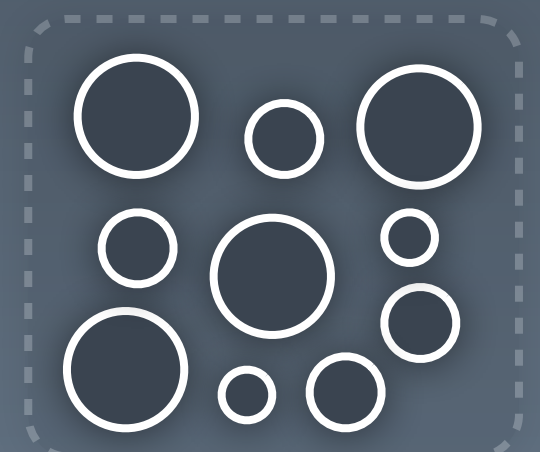
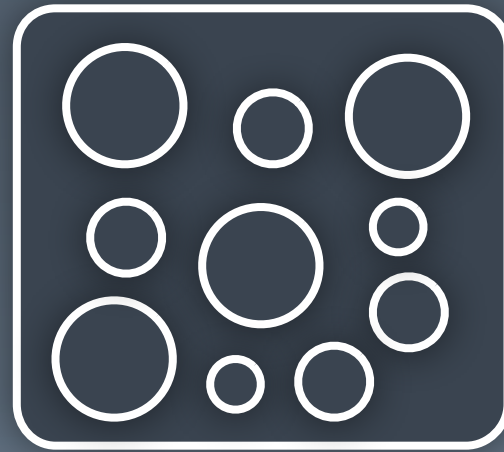
The point of this?

A good
architecture
enables

agility

*Monolithic
architecture*

*Service-based
architecture*
(SOA, micro-services, etc)



Something in between
(components)

The structure of your
software and the
decomposition
strategy
you use to get there
are important

Inspect

and

Adapt

Think about how to align the
software
architecture
and the
code

A simple
and explicit
mapping assists
on many levels

Until we find the one
true solution that works
in all contexts,

you'll need
to think

If your software system is
hard to work with,

change it!



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@simonbrown on Twitter