Models, Sketches and Everything In-Between

Simon Brown Coding the Architecture
Eoin Woods Artechra

Software Architect 2014
October 2014, London

Welcome

- It’s hello from me
  - Simon Brown, Coding the Architecture

- And hello from him
  - Eoin Woods, Artechra

Our Agenda

- Simon Says …
- Eoin Says …
- Questions and Queries:

  Q1. Modelling - Why Bother?

  Q2. Models and Agility

  Q3. How to Do It?

  Q4. UML - Worth the Hassle?

  Q5. Modelling in the Large vs the Small
- Summary and Conclusions

Background

- We've been talking about software modelling for ages
  - We both think its a good idea (in moderation)
  - Simon likes boxes and lines, Eoin likes UML (sort of)
  - Simon has C4, Eoin has V&P (with Nick Rozanski)
  - We've both inflicted a book on the world …

Software Architecture for Developers

Simon Brown

Software Systems Architecture

Second Edition

NICK ROZANSKI • EOIN WOODS

- We'd like to work out what the real answer is today
  - We've got questions, but yours are probably better

The Point of Modelling

- Simon:
  - How do you understand what you’re building?
  - How do you explain it to the rest of the team?
  - The trick is not getting stuck in analysis paralysis.
- Eoin:
  - Main problem with not modelling is lack of intellectual control
  - Main problem with modelling is believing that modelling is an end in itself

Some Opinions

Simon Says …

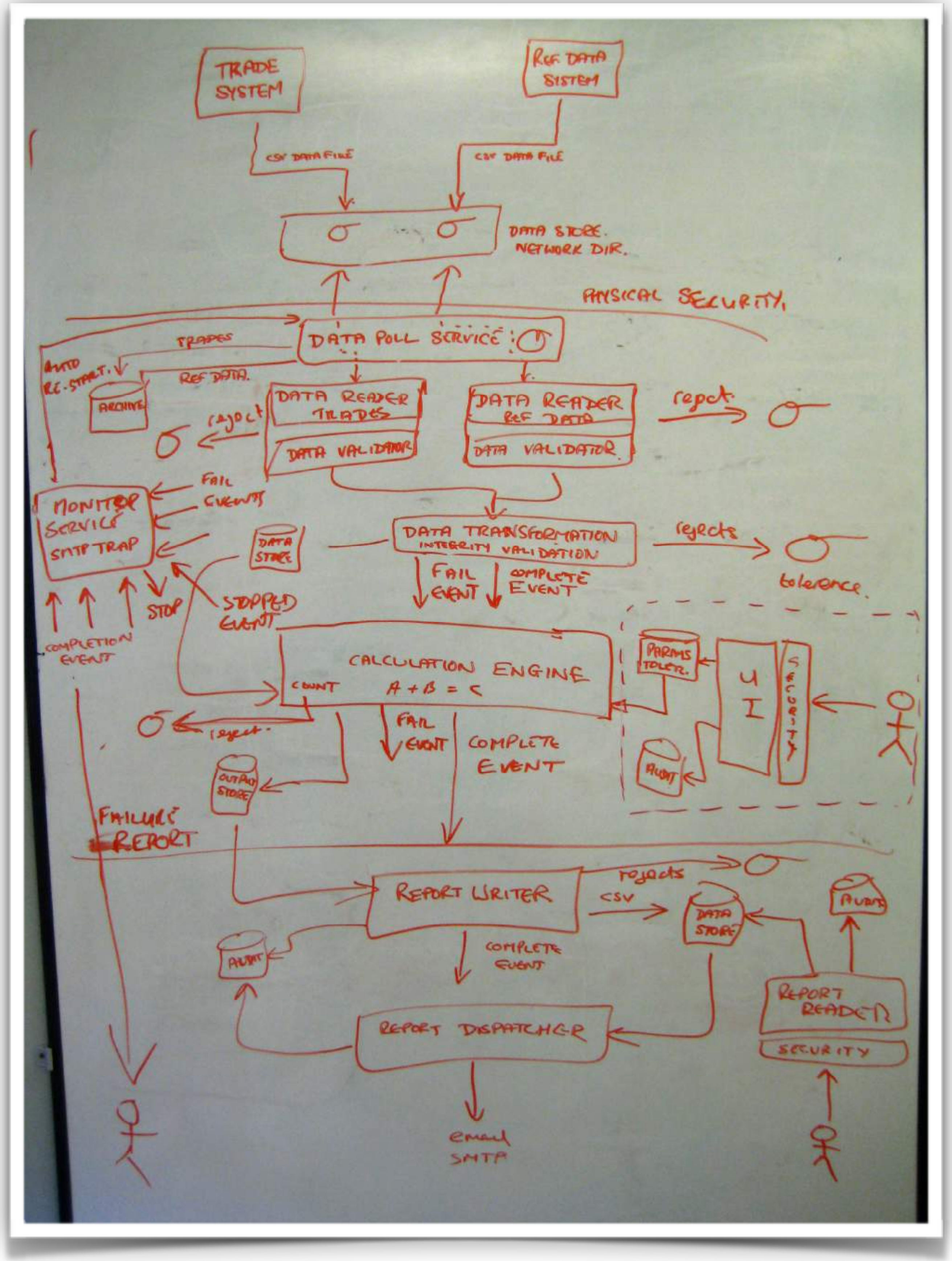
How do we

communicate

software architecture?

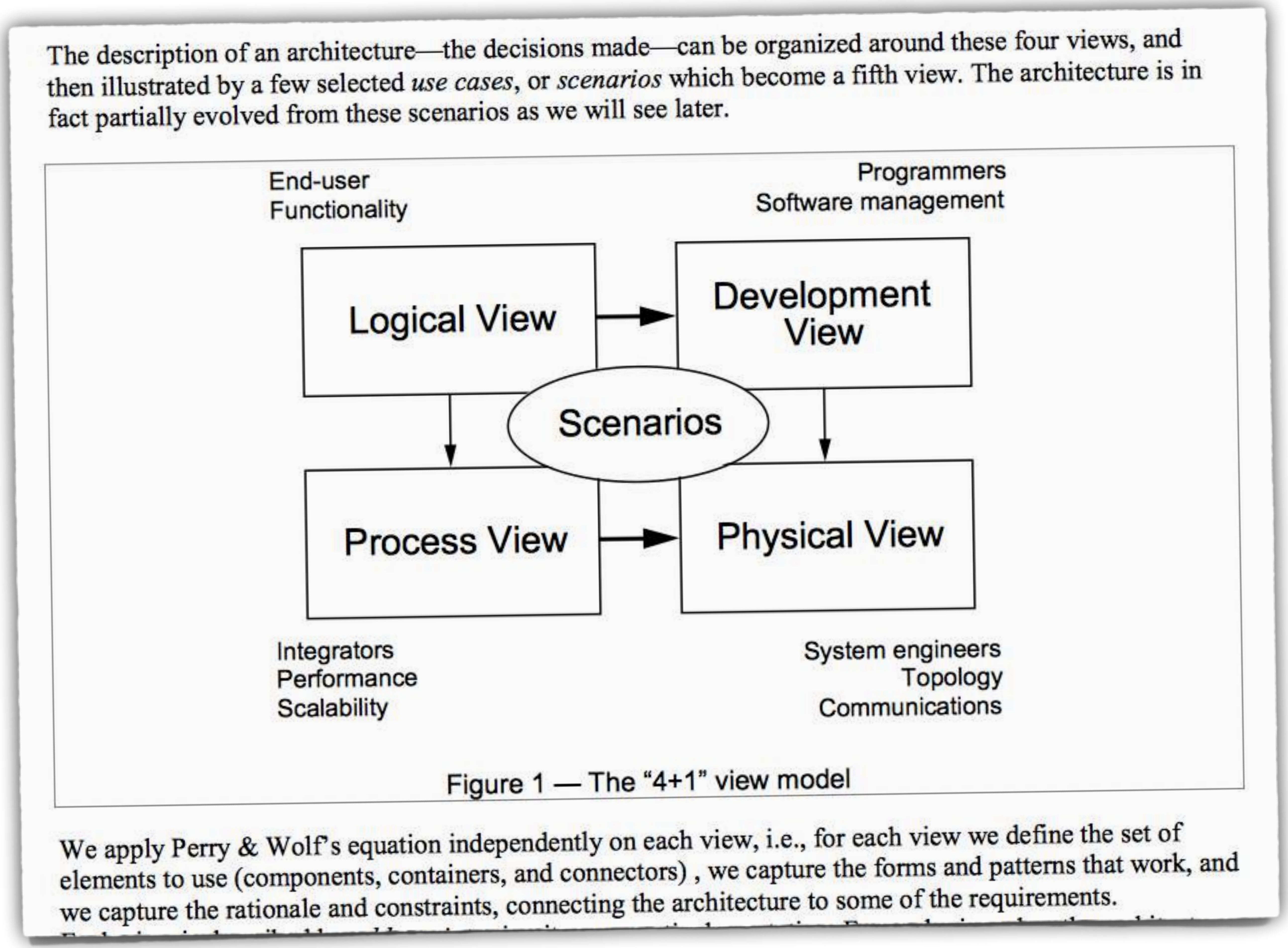
9 out of 10 people
don’t use UML

(in my experience)



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.

End-user
Functionality
Programmers
Software management
Logical View
Development View
Scenarios
Process View
Physical View
Integrators
Performance
Scalability
System engineers
Topology
Communications

Figure 1 — The “4+1” view model

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

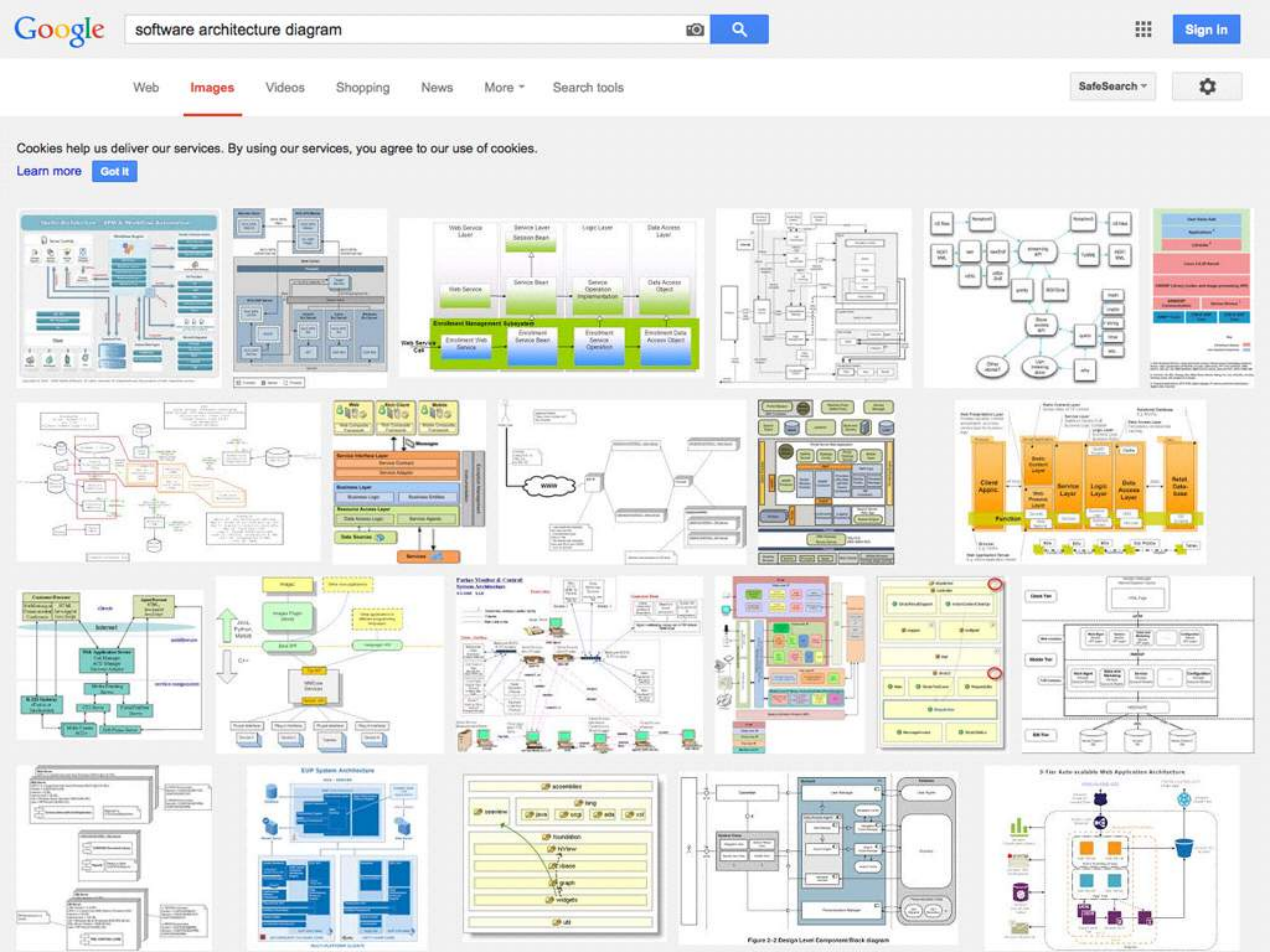
Physical vs Deployment

Logical and

development

views are often

separated



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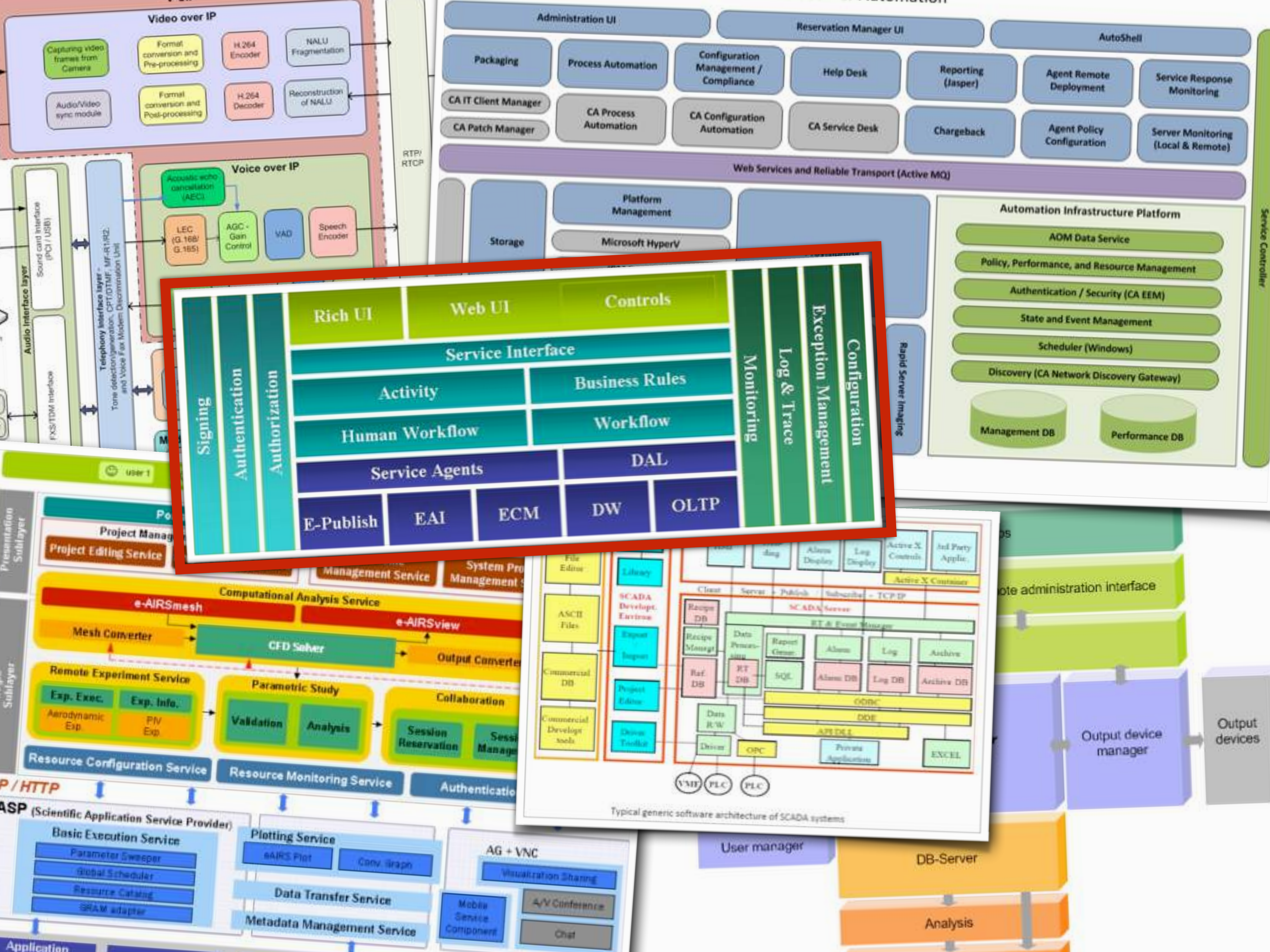
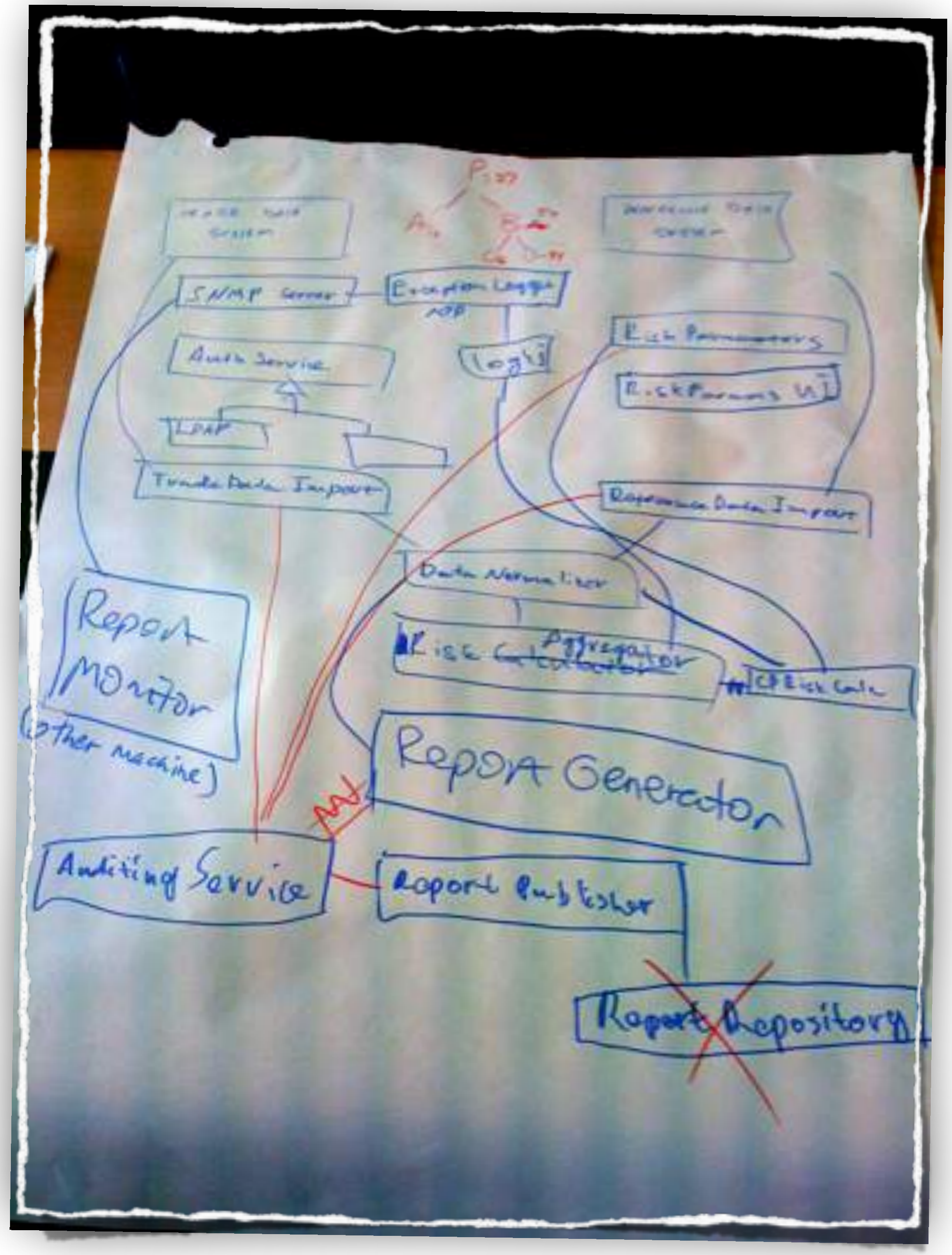

Signing
Authentication
Authorization
Rich UI
Web UI
Controls
Service Interface
Activity
Business Rules
Human Workflow
Workflow
Service Agents
DAL
E-Publish
EAI
ECM
DW
OLTP
Monitoring
Log & Trace
Exception Management
Configuration
Video over IP
Capturing video frames from Camera
Format conversion and Pre-processing
H.264 Encoder
NALU Fragmentation
Audio/Video sync module
Format conversion and Post-processing
H.264 Decoder
Reconstruction of NALU
Voice over IP
Acoustic echo cancellation (AEC)
LEC (G.168/ G.165)
AGC - Gain Control
VAD
Speech Encoder
RTP/ RTCP
Audio interface layer
Sound card interface (PCI / USB)
FXS/TDM interface
Telephony interface layer - Tone detection/generation, CPT/DTMF, MF-R1/R2, and Voice Fax Modem Decrimination Unit
Administration UI
Reservation Manager UI
AutoShell
Packaging
Process Automation
Configuration Management / Compliance
Help Desk
Reporting (Jasper)
Agent Remote Deployment
Service Response Monitoring
CA IT Client Manager
CA Patch Manager
CA Process Automation
CA Configuration Automation
CA Service Desk
Chargeback
Agent Policy Configuration
Server Monitoring (Local & Remote)
Web Services and Reliable Transport (Active MQ)
Storage
Platform Management
Microsoft HyperV
Rapid Server Imaging
Automation Infrastructure Platform
AOM Data Service
Policy, Performance, and Resource Management
Authentication / Security (CA EEM)
State and Event Management
Scheduler (Windows)
Discovery (CA Network Discovery Gateway)
Management DB
Performance DB
Service Controller
user 1
Presentation Sublayer
Project Manag
Project Editing Service
Management Service
System Pro Management
Computational Analysis Service
e-AIRSmesh
e-AIRSview
Mesh Converter
CFD Solver
Output Converter
Remote Experiment Service
Exp. Exec.
Exp. Info.
Aerodynamic Exp.
PIV Exp.
Parametric Study
Validation
Analysis
Collaboration
Session Reservation
Sessi Manage
Resource Configuration Service
Resource Monitoring Service
Authenticatio
P / HTTP
ASP (Scientific Application Service Provider)
Basic Execution Service
Parameter Sweeper
Global Scheduler
Resource Catalog
GRAM adapter
Plotting Service
eAIRS Plot
Conv. Graph
Data Transfer Service
Metadata Management Service
AG + VNC
Visualization Sharing
A/V Conference
Chat
Mobile Service Component
Application
File Editor
ASCII Files
Commercial DB
Commercial Develop tools
Library
SCADA Develop. Environ
Export Import
Project Editor
Driver Toolkit
Alarm Display
Log Display
Active X Controls
3rd Party Applic.
Active X Container
Client
Server
Publish
Subscribe
TCP/IP
SCADA Server
Recipe DB
Recipe Managt
RT & Event Manager
Data Processing
Report Gener.
Alarm
Log
Archive
Ref. DB
RT DB
SQL
Alarm DB
Log DB
Archive DB
ODBC
DDE
API DLL
Data R/W
Driver
OPC
Private Application
EXCEL
VME
PLC
PLC
Typical generic software architecture of SCADA systems
ote administration interface
Output device manager
Output devices
User manager
DB-Server
Analysis

In my experience,

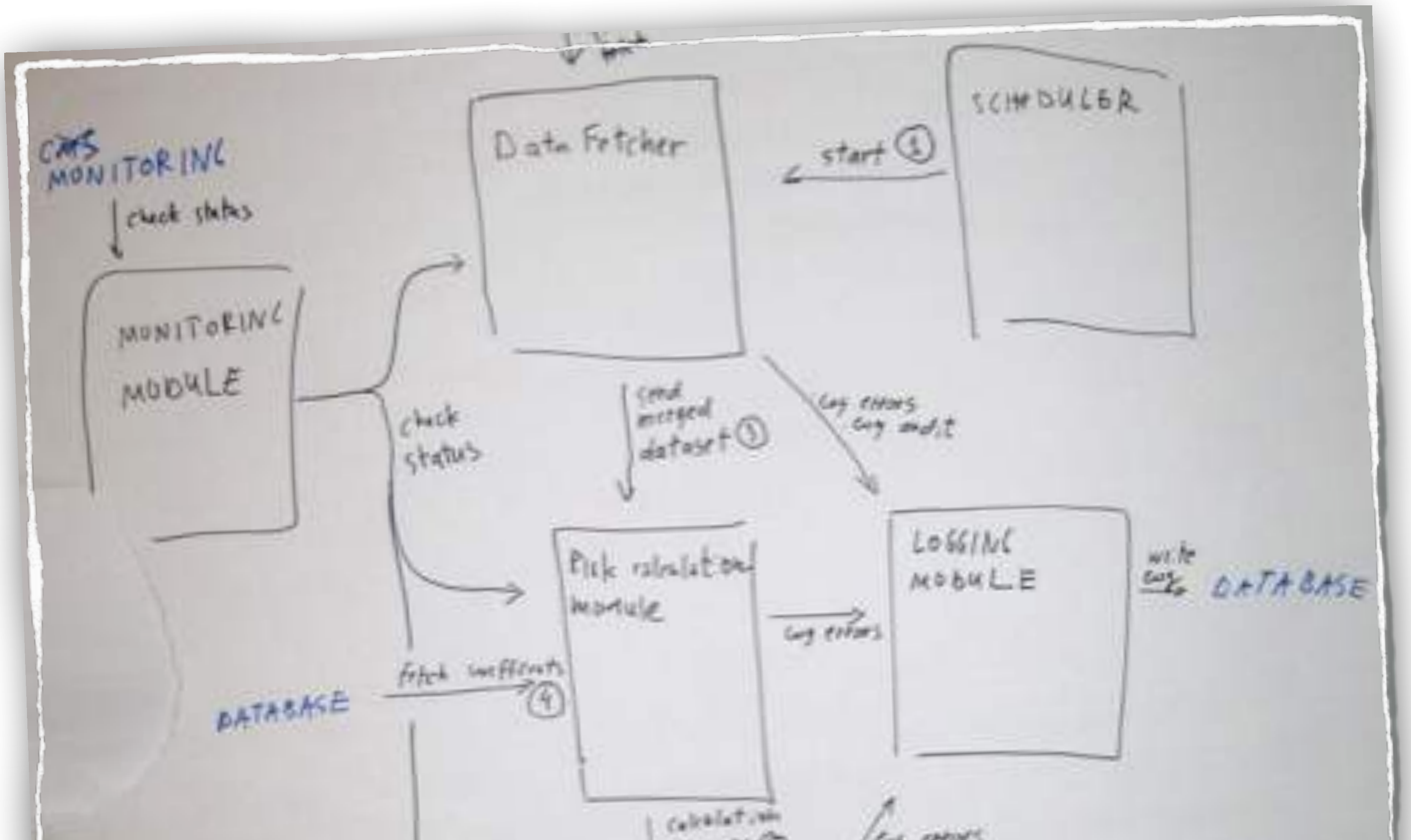
software teams aren’t able to effectively communicate the software architecture of their systems



Abstraction

is about reducing detail

rather than creating a different representation



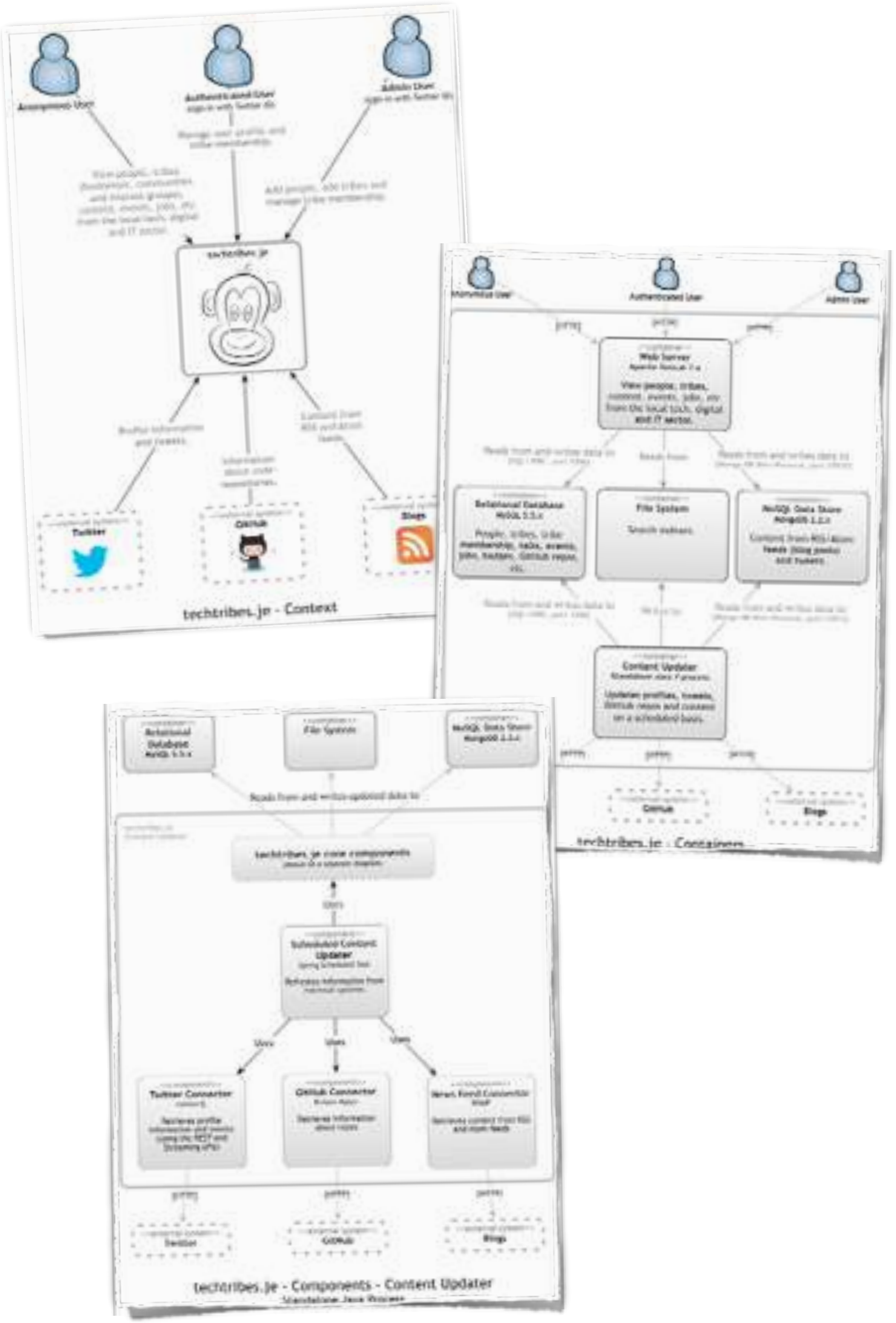
Abstractions help us

reason about

a big and/or complex software system

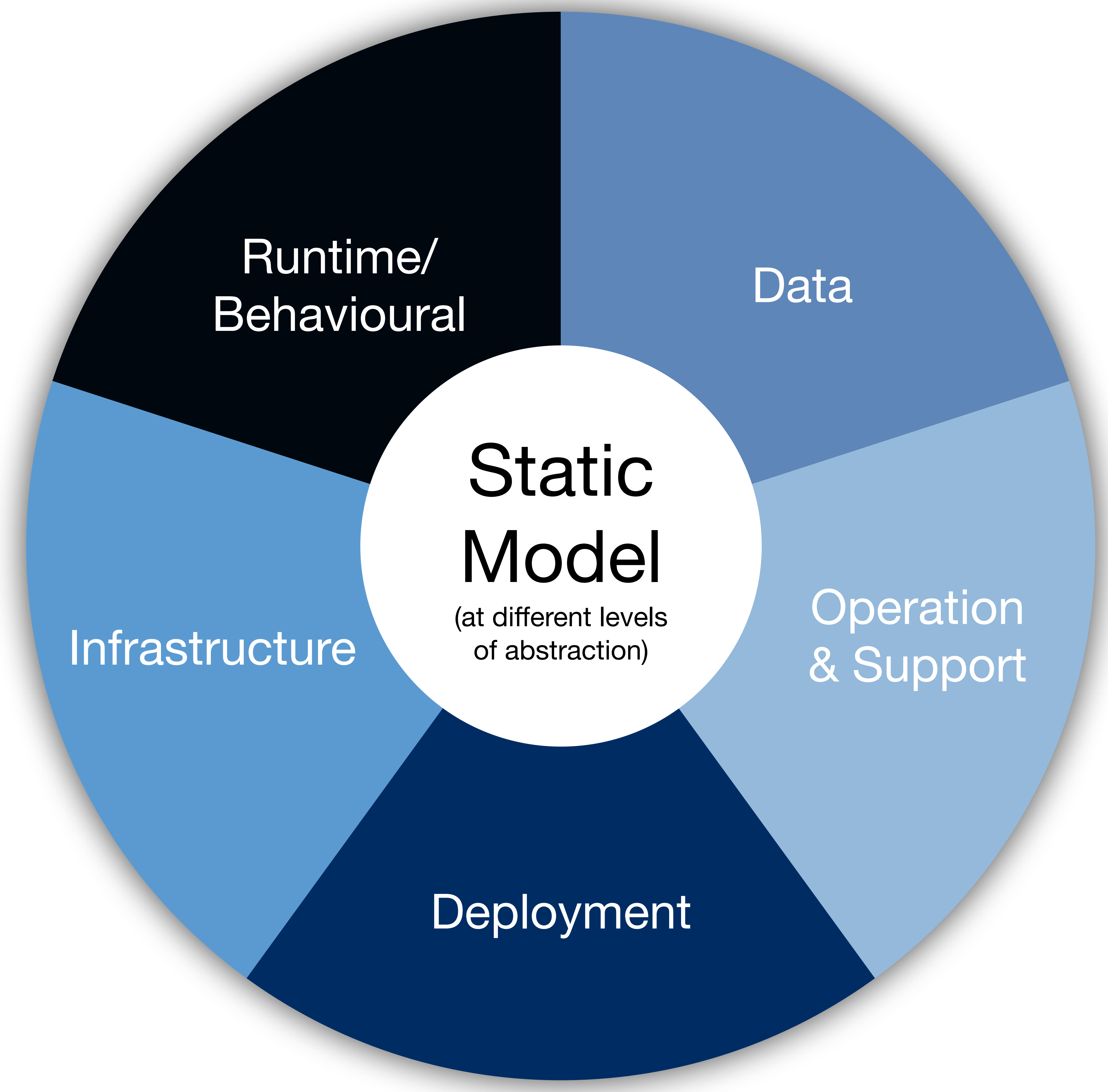
A common set of abstractions

is more important than
a common notation



Sketches are maps

that help a team navigate a complex codebase


Runtime/
Behavioural
Data
Static
Model
(at different levels
of abstraction)
Operation
& Support
Infrastructure
Deployment

Does your code reflect the

abstractions

that you think about?

My focus is primarily on the

static structure

of software, which is ultimately about

code

Software developers are the most important

stakeholders

of software architecture

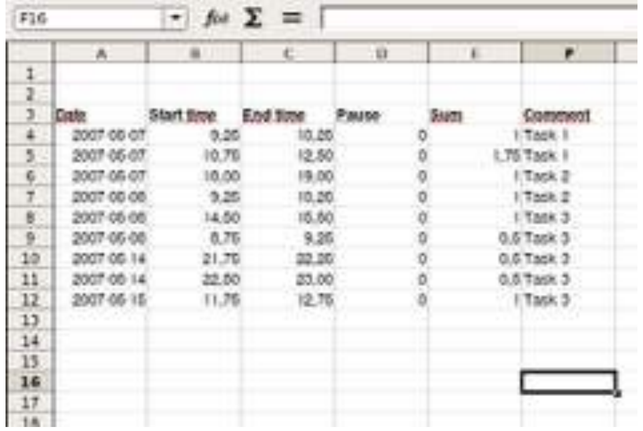
Eoin Says …

The point is that …

- Some models worth creating are worth preserving
- Models capture things that code can’t
- Sketches the place to start … but limited
- Models communicate, so ground rules are useful - UML is a good *base* to work from

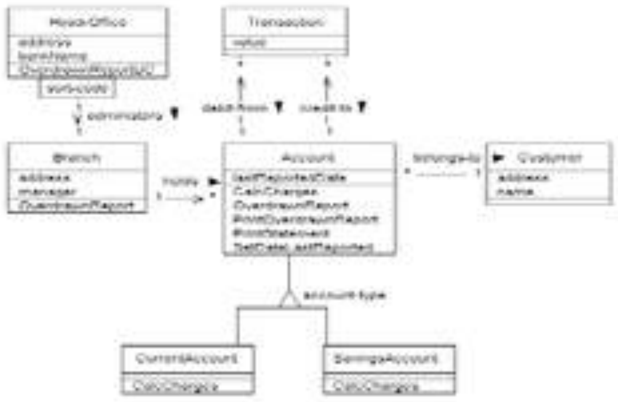
What is modelling?

- A model is any simplified representation of reality
  - a spreadsheet of data
  - a Java domain model
  - a UML model
- Modelling represents concepts to allow some aspect of them to be understood



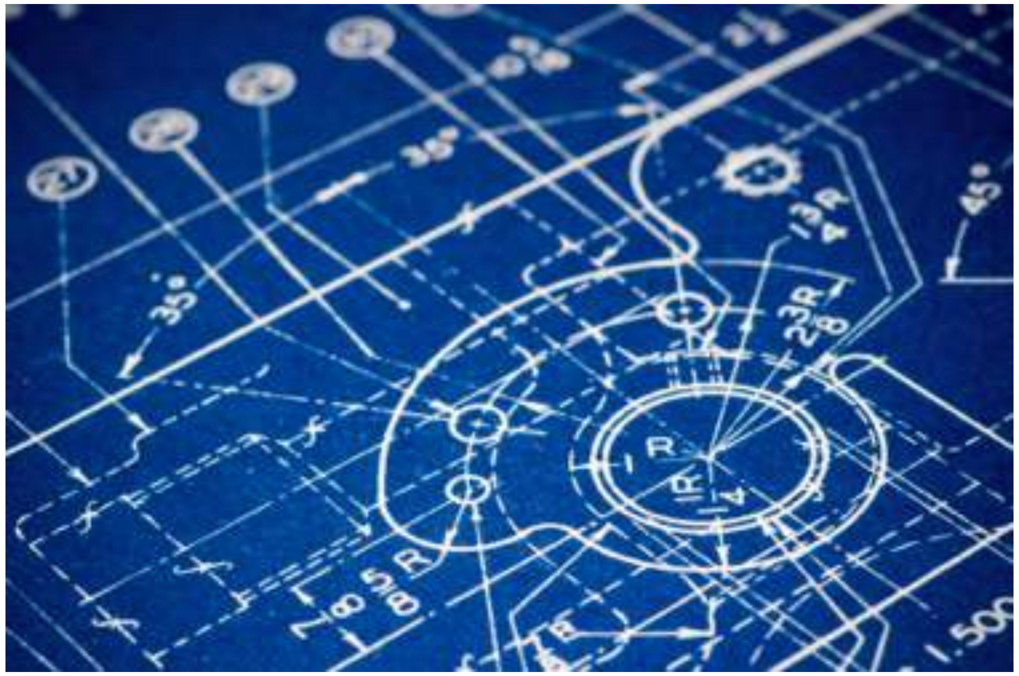
	A	B	C	D	E	F
1						
2						
3	Date	Start time	End time	Pause	Sum	Comment
4	2007-06-07	9,25	10,25	0	1	Task 1
5	2007-06-07	10,75	12,50	0	1,75	Task 1
6	2007-06-07	18,00	19,00	0	1	Task 2
7	2007-06-08	9,25	10,25	0	1	Task 2
8	2007-06-08	14,50	15,50	0	1	Task 3
9	2007-06-08	8,75	9,25	0	0,5	Task 3
10	2007-06-14	21,75	22,25	0	0,5	Task 3
11	2007-06-14	22,50	23,00	0	0,5	Task 3
12	2007-06-15	11,75	12,75	0	1	Task 3
13						
14						
15						
16						
17						
18						

```
public class TcpClientSample
{
    public static void Main()
    {
        byte[] data = new byte[1024]; string input, stringData;
        TcpClient server;
        try{
            server = new TcpClient(" . . . . ", port);
        }catch (SocketException){
            Console.WriteLine("Unable to connect to server");
            return;
        }
        NetworkStream ns = server.GetStream();
        int recv = ns.Read(data, 0, data.Length);
        stringData  = Encoding.
            ASCII.GetString(data, 0, recv);
        Console.WriteLine(stringData);
        while(true){
            input = Console.ReadLine();
            if (input == "exit") break;
                newchild.Properties["ou"].Add
                ("Auditing Department");
                newchild.CommitChanges();
                newchild.Close();
```



Why create models?

Communicate

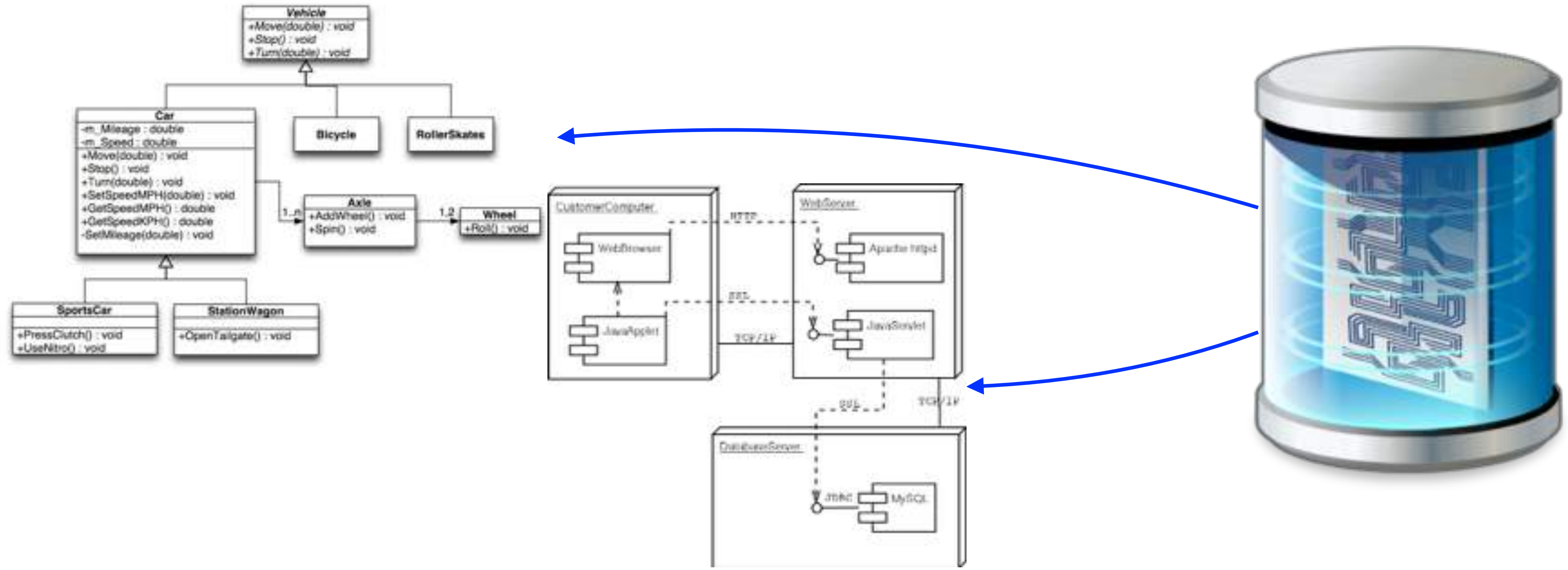


Record

Understand

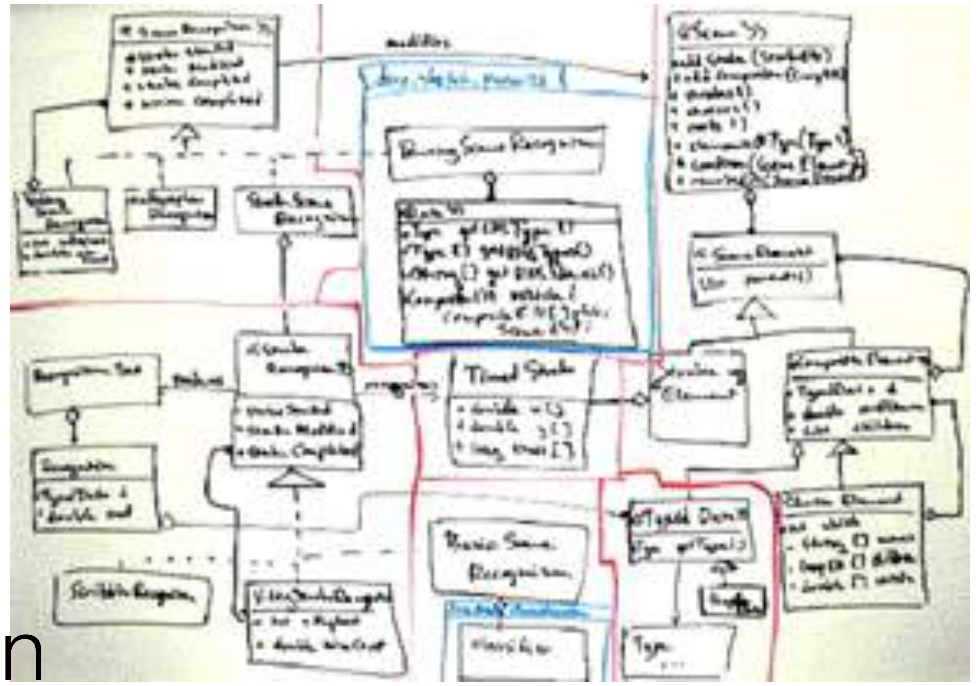
Models vs diagrams

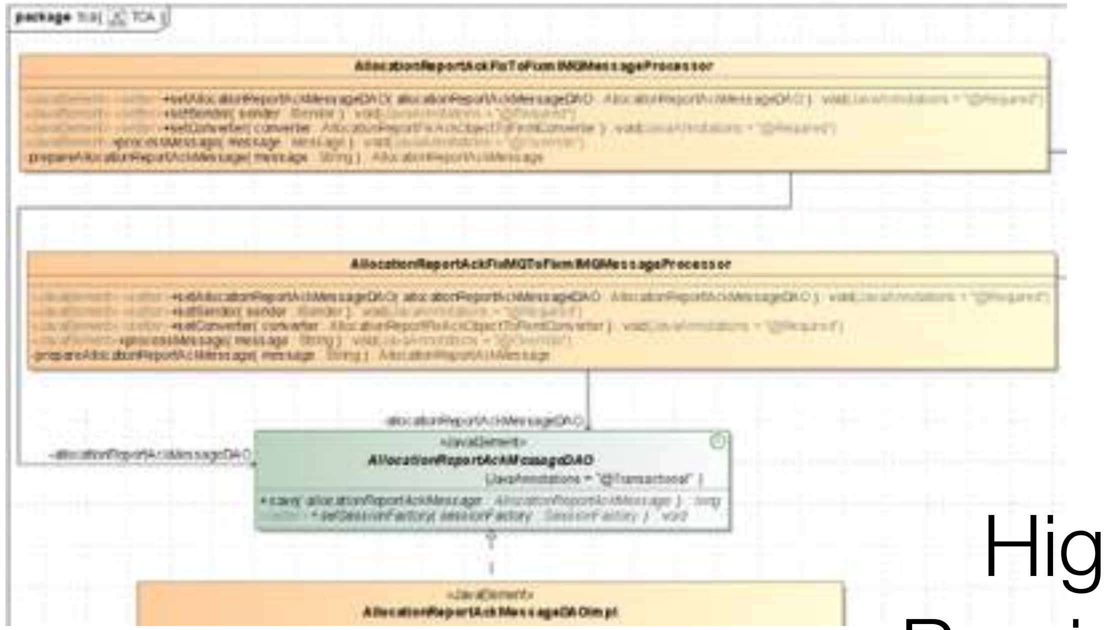
- A diagram is a purely visual representation
- A model contains definitions (and possibly a diagram)
  - In UML terms diagrams provide views of a model



Types of Model

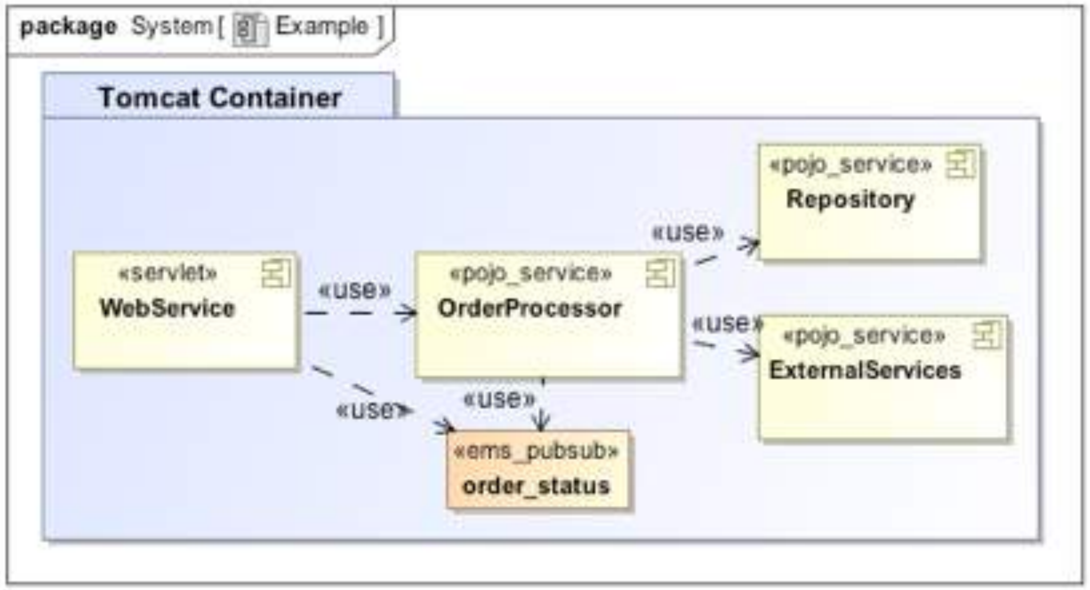
High Detail





Low Precision

High Precision



Low Detail

Uses for models

- Consistency
  - change once, its changed everywhere
- Reporting
  - ask your model a question
  - “what is connected to the Flange Modulator Service?”
- Checking and Validation
  - do I have a deployment node for every piece of the system?
  - how complicated is the system going to be?
- Sharing information
  - generate many views of a single model
  - Powerpoint, wiki, tables, ...

An Analogy

- Would you use JSON to represent your shopping list?
  - I personally use a PostIt™ note
- Would you hold system configuration in free text?
  - I personally would rather XML or JSON
- Long lived models are valuable … store them as data
  - UML is a practical option for machine readable models

Some Questions and Answers

Q1. Modelling - Why Bother?

- Simon:
  - A model makes it easy to step back and see the big picture.
  - A model aids communication, inside and outside of the team.
  - Modelling provides a ubiquitous language with which to describe software.
- Eoin:
  - Modelling helps you understand what you have and need
  - You can’t understand all of the detail anyway
  - Code is in fact a model, we just don’t think of it as such

Q2. Modelling and Agility

- Simon:
  - Good communication helps you move fast.
  - A model provides long-lived documentation.
  - A model provides the basis for structure, vision and risks.
- Eoin:
  - No fundamental conflict - “*model with a purpose*” (Daniels)
  - Working software *over* <u>comprehensive</u> documentation
  - Agility should be for the long haul, not this sprint
  - Can you know all the feed dependencies from your system?

Q3. How to Do It?

- Simon:
  - Start with the big picture, and work into the detail.
  - Stop when you get to a “sufficient” level of detail.
  - Include technology choices!
- Eoin:
  - Start small, start with a definite purpose
  - Start with a whiteboard or a napkin or an A4 sheet
  - Skip Visio and Omnigraffle … get a tool, get a model

Q4. UML - Is It Worth the Hassle?

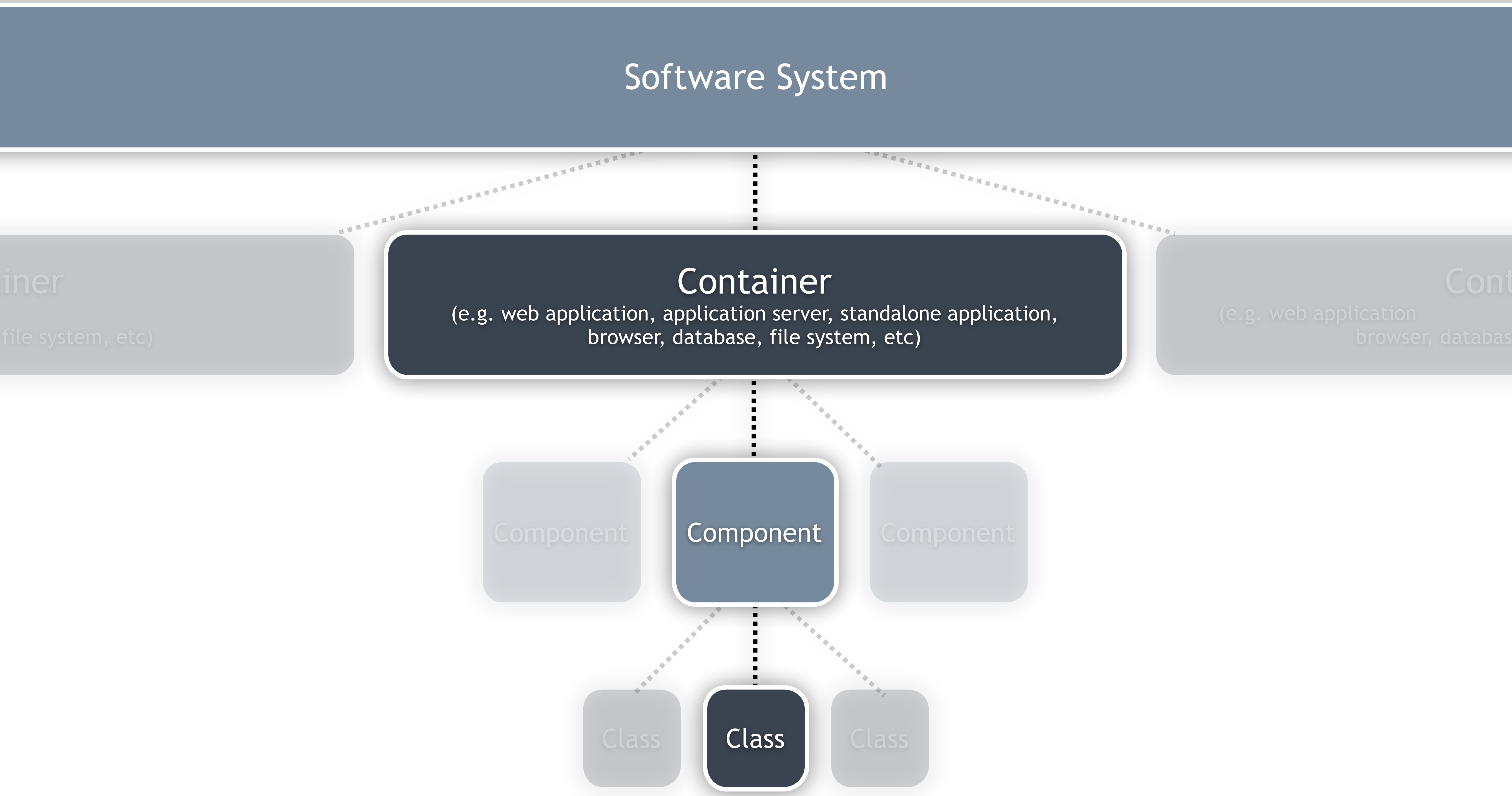
- Simon:
  - No.
- Eoin:
  - Maybe … depends what you need
  - Would you write a shopping list in JSON? Would you store configuration settings in a free text file?
  - If you have long lived models and want to use the data then yes, *highly tailored* UML is worth the effort

Q5. Modelling in the Large vs the Small

- Simon:
  - Sketches will quickly become out of date.
  - Reverse-engineering tends to lead to cluttered diagrams.
  - Many small diagrams are better than one uber-diagram.
- Eoin:
  - A large system means you need help from a computer to understand it
  - However large your model, the code is still “the truth”
  - Modelling languages scale like programming languages

How We Do It

Simon



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

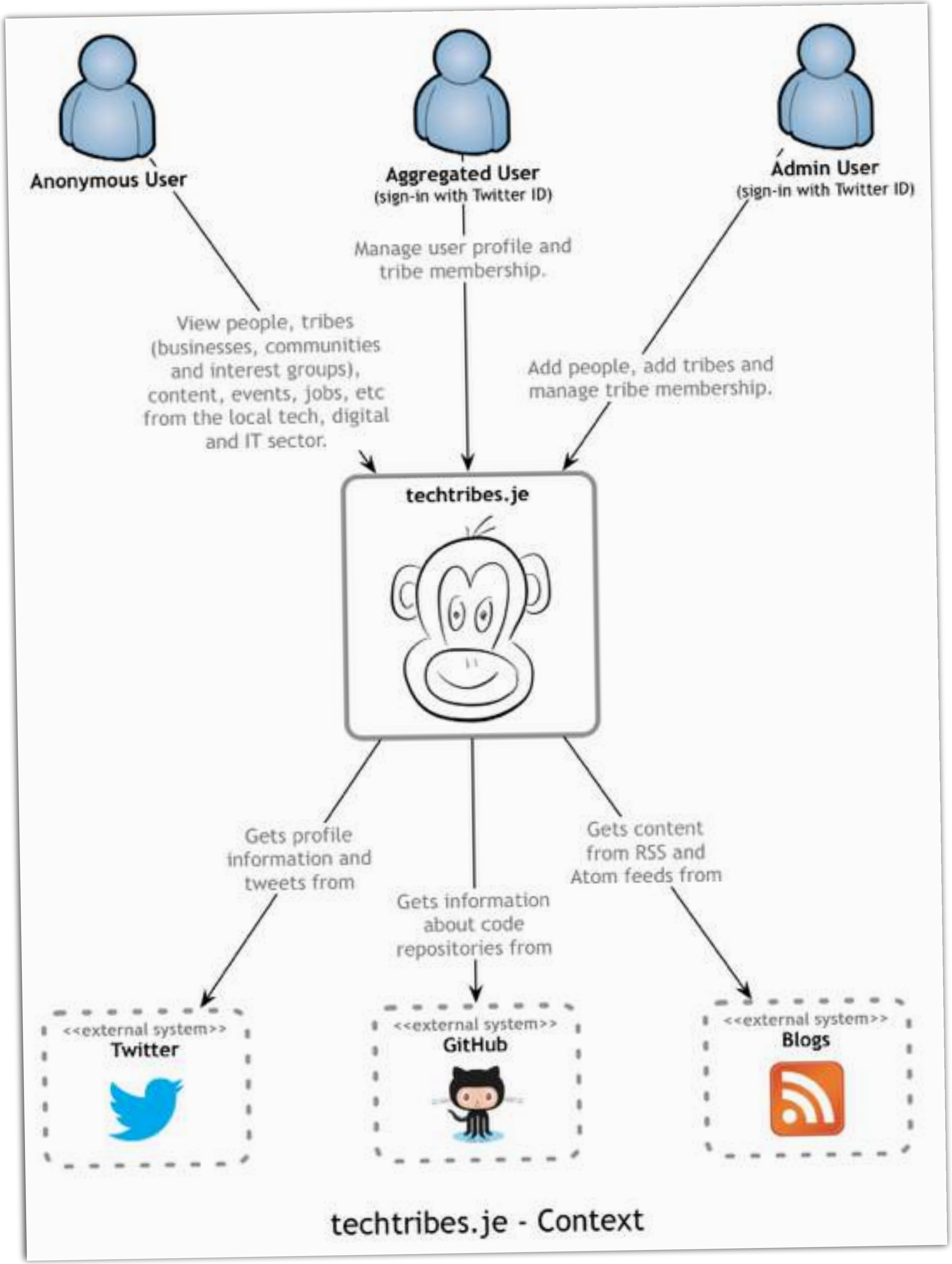
Logical components and their interactions within a container

Classes

Component or pattern implementation details

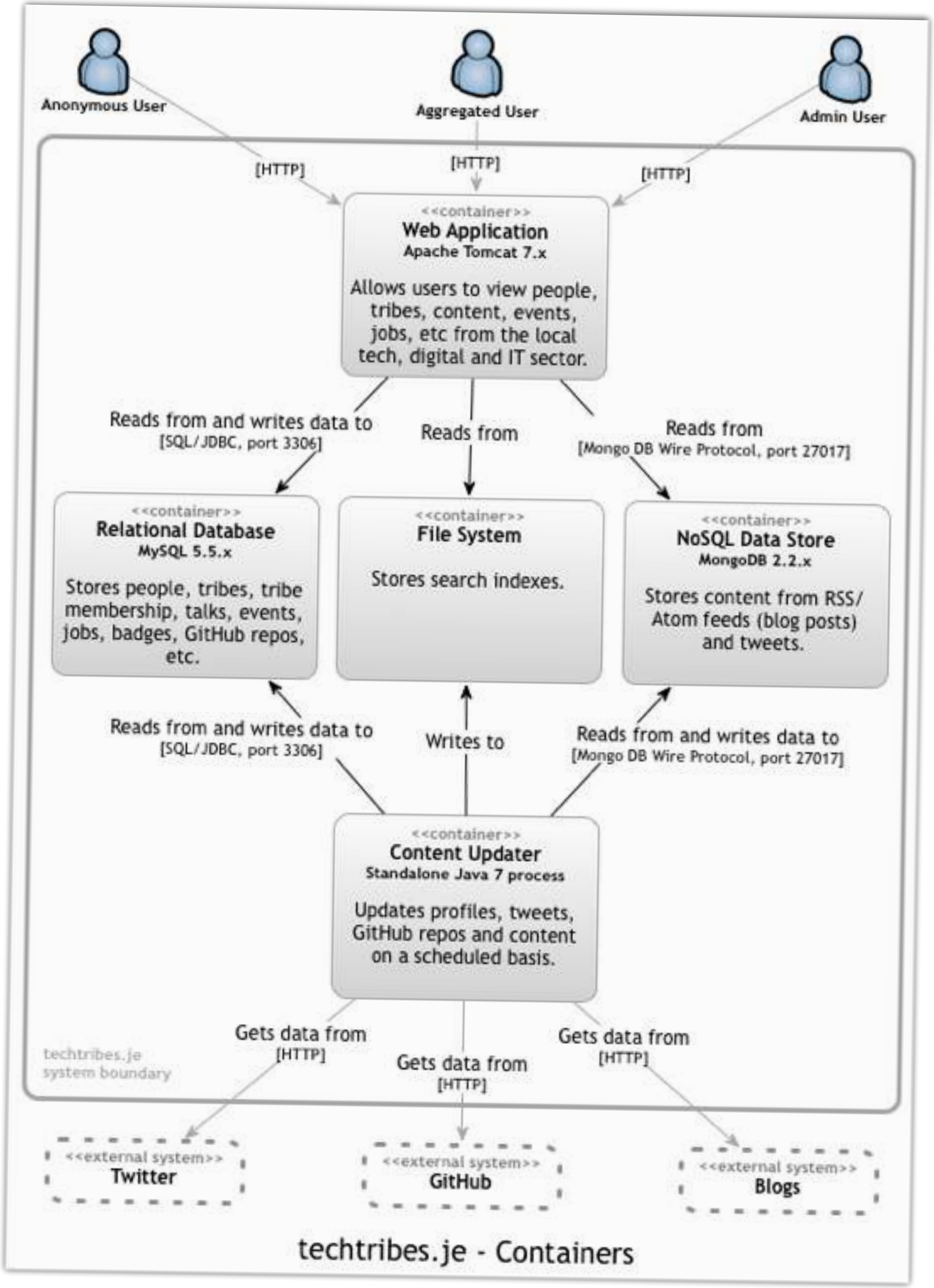
Context

- 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)


Anonymous User
Aggregated User
(sign-in with Twitter ID)
Admin User
(sign-in with Twitter ID)
Manage user profile and tribe membership.
View people, tribes (businesses, communities and interest groups), content, events, jobs, etc from the local tech, digital and IT sector.
Add people, add tribes and manage tribe membership.
techtribes.je
Gets profile information and tweets from
Gets information about code repositories from
Gets content from RSS and Atom feeds from
<<external system>>
Twitter
<<external system>>
GitHub
<<external system>>
Blogs
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?



Anonymous User

Aggregated User

Admin User

[HTTP]

[HTTP]

[HTTP]

<<container>>
Web Application
Apache Tomcat 7.x

Allows users to view people, tribes, content, events, jobs, etc from the local tech, digital and IT sector.

Reads from and writes data to
[SQL/JDBC, port 3306]

Reads from

Reads from
[Mongo DB Wire Protocol, port 27017]

<<container>>
Relational Database
MySQL 5.5.x

Stores people, tribes, tribe membership, talks, events, jobs, badges, GitHub repos, etc.

<<container>>
File System

Stores search indexes.

<<container>>
NoSQL Data Store
MongoDB 2.2.x

Stores content from RSS/ Atom feeds (blog posts) and tweets.

Reads from and writes data to
[SQL/JDBC, port 3306]

Writes to

Reads from and writes data to
[Mongo DB Wire Protocol, port 27017]

<<container>>
Content Updater
Standalone Java 7 process

Updates profiles, tweets, GitHub repos and content on a scheduled basis.

Gets data from
[HTTP]

Gets data from
[HTTP]

Gets data from
[HTTP]

techtribes.je
system boundary

<<external system>>
Twitter

<<external system>>
GitHub

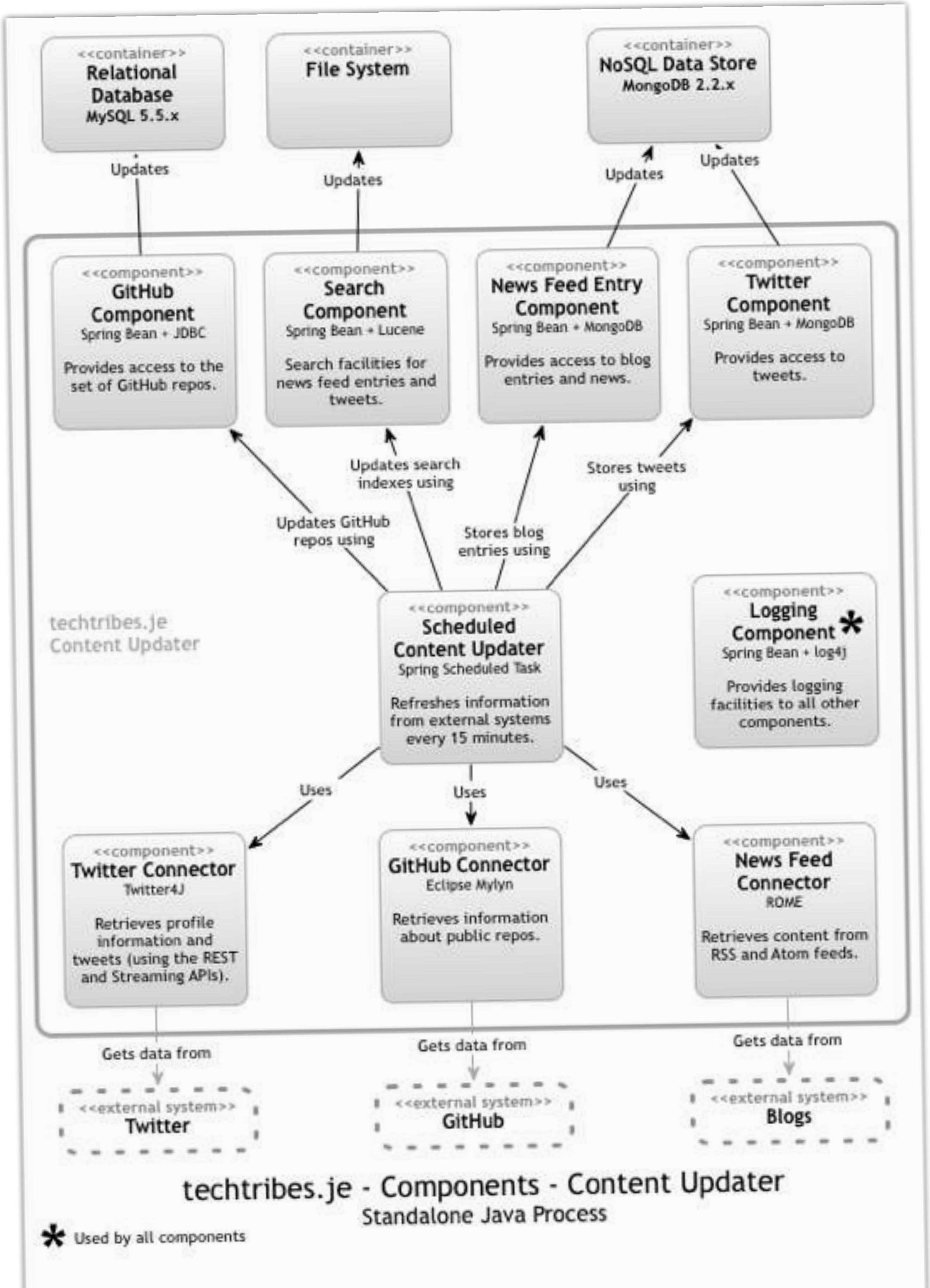
<<external system>>
Blogs

techtribes.je - Containers

Components

- What components/ services is the container made up of?

- Are the technology choices and responsibilities clear?



<<container>> Relational Database MySQL 5.5.x

<<container>> File System

<<container>> NoSQL Data Store MongoDB 2.2.x

Updates

Updates

Updates

Updates

<<component>> GitHub Component Spring Bean + JDBC
Provides access to the set of GitHub repos.

<<component>> Search Component Spring Bean + Lucene
Search facilities for news feed entries and tweets.

<<component>> News Feed Entry Component Spring Bean + MongoDB
Provides access to blog entries and news.

<<component>> Twitter Component Spring Bean + MongoDB
Provides access to tweets.

Updates search indexes using

Stores tweets using

Updates GitHub repos using

Stores blog entries using

techtribes.je Content Updater

<<component>> Scheduled Content Updater Spring Scheduled Task
Refreshes information from external systems every 15 minutes.

<<component>> Logging Component * Spring Bean + log4j
Provides logging facilities to all other components.

Uses

Uses

Uses

<<component>> Twitter Connector Twitter4J
Retrieves profile information and tweets (using the REST and Streaming APIs).

<<component>> GitHub Connector Eclipse Mylyn
Retrieves information about public repos.

<<component>> News Feed Connector ROME
Retrieves content from RSS and Atom feeds.

Gets data from

Gets data from

Gets data from

<<external system>> Twitter

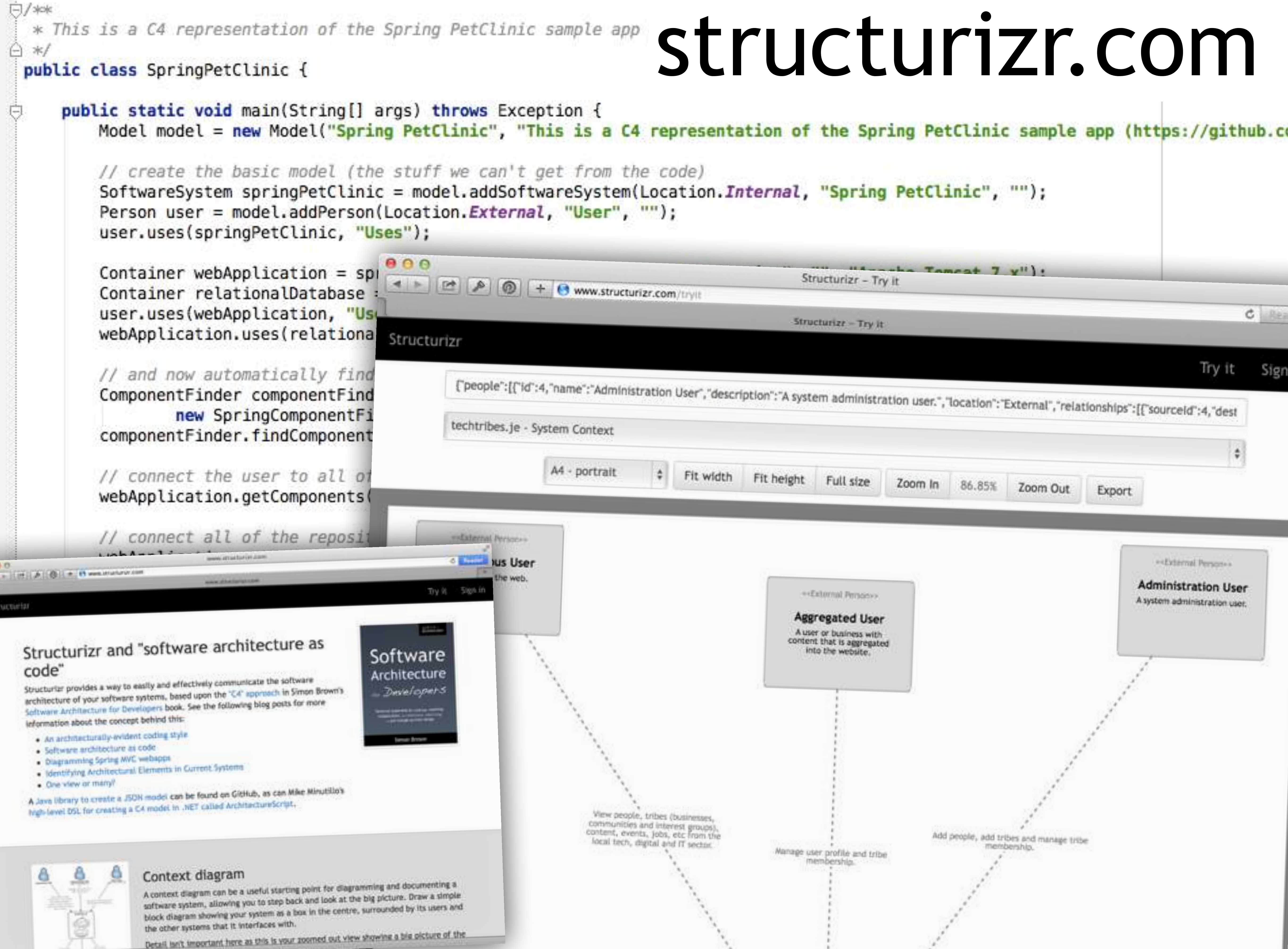
<<external system>> GitHub

<<external system>> Blogs

techtribes.je - Components - Content Updater
Standalone Java Process

* Used by all components

structurizr.com



```
/**
 * This is a C4 representation of the Spring PetClinic sample app
 */
public class SpringPetClinic {

    public static void main(String[] args) throws Exception {
        Model model = new Model("Spring PetClinic", "This is a C4 representation of the Spring PetClinic sample app (https://github.co

        // create the basic model (the stuff we can't get from the code)
        SoftwareSystem springPetClinic = model.addSoftwareSystem(Location.Internal, "Spring PetClinic", "");
        Person user = model.addPerson(Location.External, "User", "");
        user.uses(springPetClinic, "Uses");

        Container webApplication = spr
        Container relationalDatabase =
        user.uses(webApplication, "Us
        webApplication.uses(relationa

        // and now automatically find
        ComponentFinder componentFind
                new SpringComponentFi
        componentFinder.findComponent

        // connect the user to all o
        webApplication.getComponents(

        // connect all of the reposit
```

{"people":[{"id":4,"name":"Administration User","description":"A system administration user.","location":"External","relationships":[{"sourceId":4,"dest

techtribes.je - System Context

A4 - portrait
Fit width
Fit height
Full size
Zoom In
86.85%
Zoom Out
Export
<<External Person>>
us User
the web.
<<External Person>>
Aggregated User
A user or business with content that is aggregated into the website.
<<External Person>>
Administration User
A system administration user.
View people, tribes (businesses, communities and interest groups), content, events, jobs, etc from the local tech, digital and IT sector.
Manage user profile and tribe membership.
Add people, add tribes and manage tribe membership.
www.structurizr.com
Try it
Sign in
ucturizr
Software Architecture for Developers
Simon Brown

Structurizr and "software architecture as code"

Structurizr provides a way to easily and effectively communicate the software architecture of your software systems, based upon the "C4" approach in Simon Brown's Software Architecture for Developers book. See the following blog posts for more information about the concept behind this:

- An architecturally-evident coding style
- Software architecture as code
- Diagramming Spring MVC webapps
- Identifying Architectural Elements in Current Systems
- One view or many?

A Java library to create a JSON model can be found on GitHub, as can Mike Minutillo's high-level DSL for creating a C4 model in .NET called ArchitectureScript.

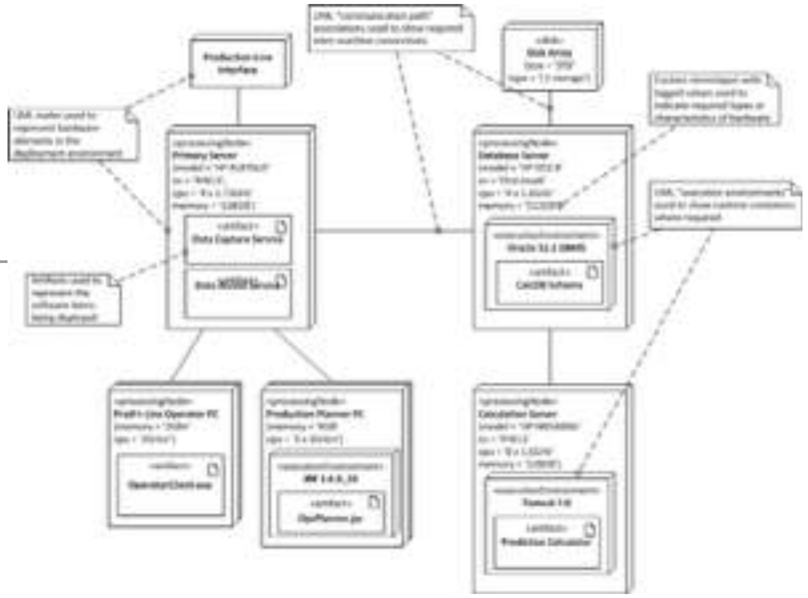
Context diagram

A context diagram can be a useful starting point for diagramming and documenting a software system, allowing you to step back and look at the big picture. Draw a simple block diagram showing your system as a box in the centre, surrounded by its users and the other systems that it interfaces with.

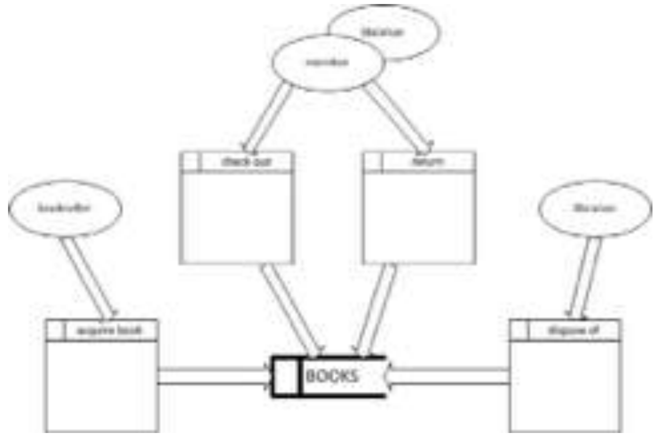
Detail isn't important here as this is your zoomed out view showing a big picture of the

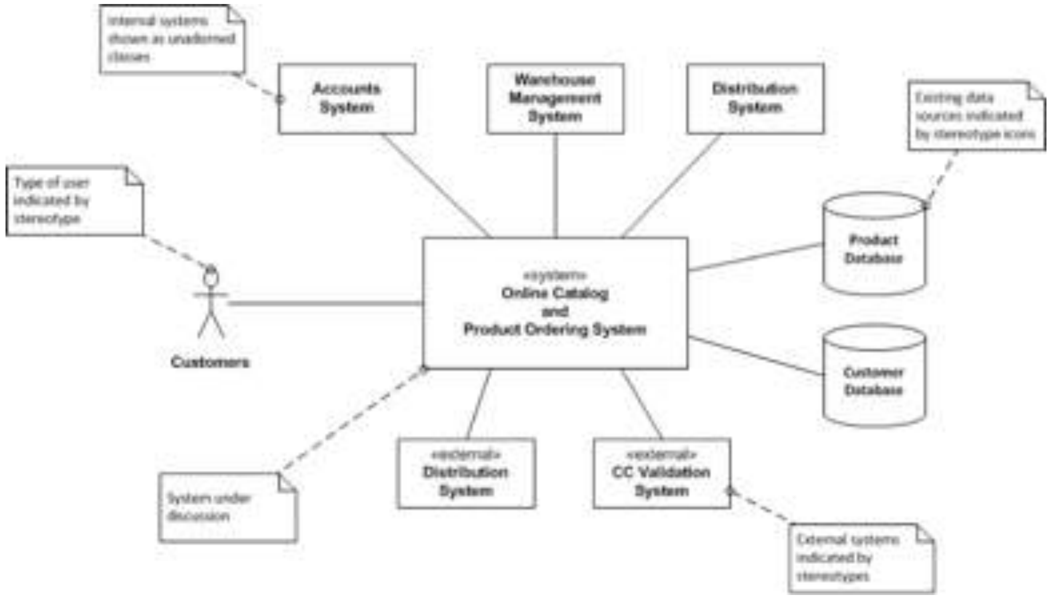
Eoin

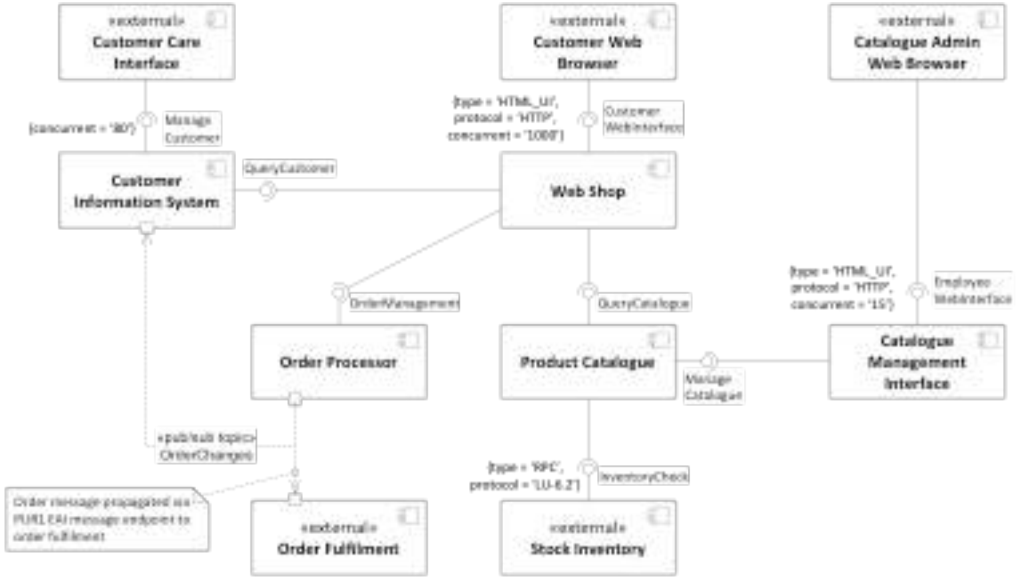
Common Types of Models



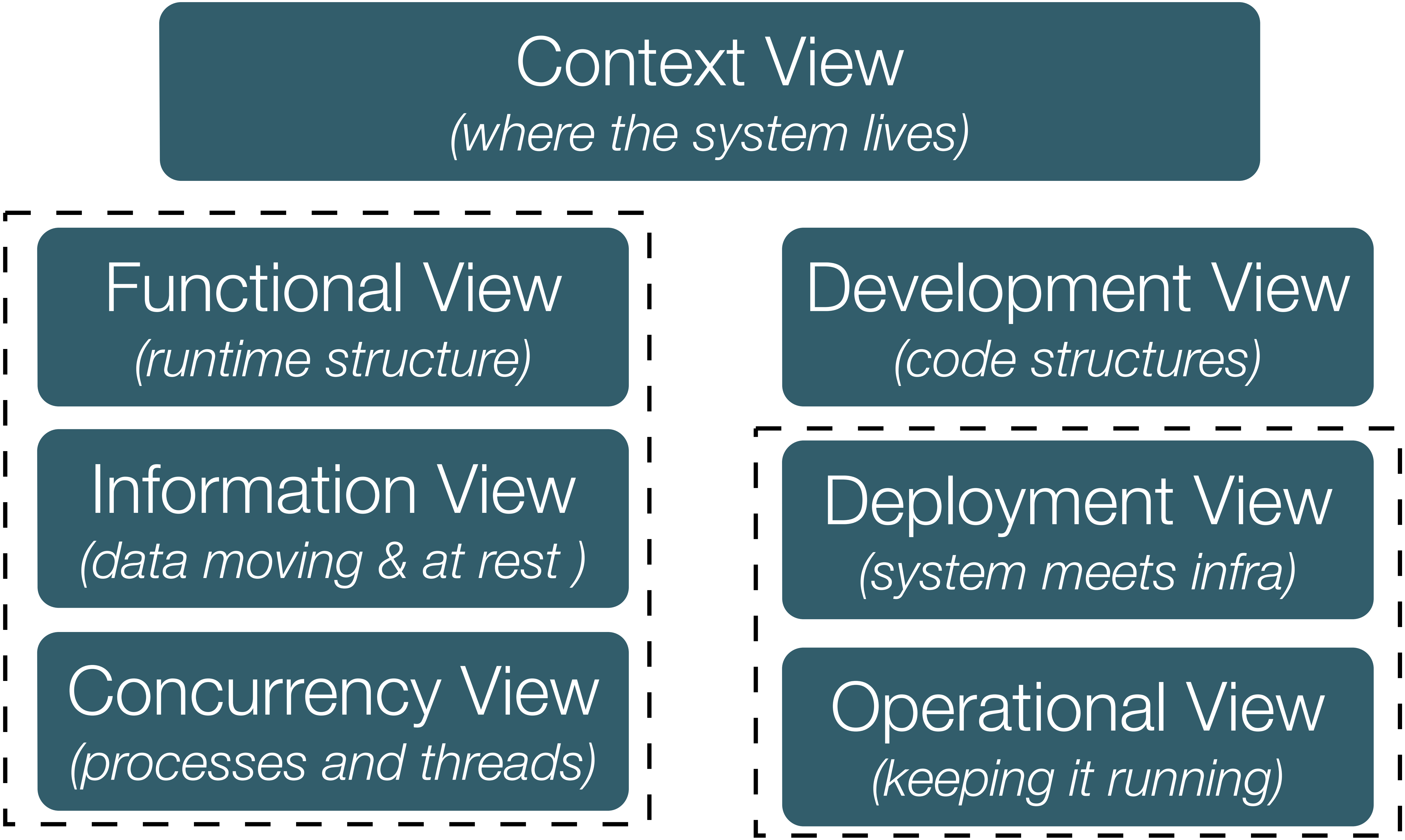
- System Environment - context view
- Run Time Structure - functional view
- Software meets Infrastructure - deployment view
- Stored and In-Transit Data - information view




Internal systems shown as unadorned classes
Accounts System
Warehouse Management System
Distribution System
Existing data sources indicated by stereotype icons
Type of user indicated by stereotype
Product Database
«system» Online Catalog and Product Ordering System
Customers
Customer Database
System under discussion
«external» Distribution System
«external» CC Validation System
External systems indicated by stereotypes


«external» Customer Care Interface
«external» Customer Web Browser
«external» Catalogue Admin Web Browser
{concurrent = '80'}
Manage Customer
{type = 'HTML_UI', protocol = 'HTTP', concurrent = '1000'}
Customer WebInterface
Customer Information System
QueryCustomer
Web Shop
OrderManagement
QueryCatalogue
{type = 'HTML_UI', protocol = 'HTTP', concurrent = '15'}
Employee WebInterface
Order Processor
Product Catalogue
Manage Catalogue
Catalogue Management Interface
«pub/sub topic» OrderChanges
{type = 'RPC', protocol = 'LU-6.2'}
InventoryCheck
Order message propagated via PUR1 EAI message endpoint to order fulfilment
«external» Order Fulfilment
«external» Stock Inventory

The Viewpoints and Perspectives model



Context View
(where the system lives)

Functional View
(runtime structure)

Information View
(data moving & at rest)

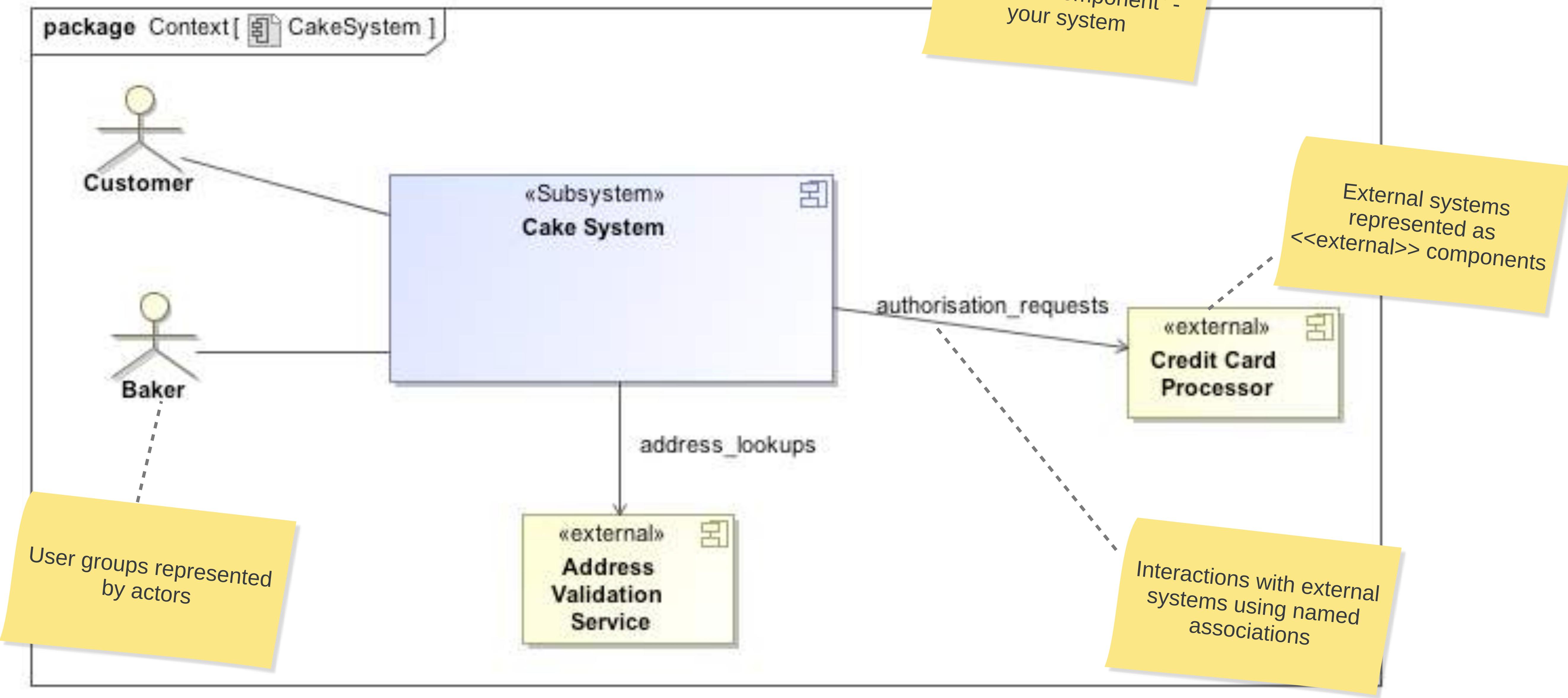
Concurrency View
(processes and threads)

Development View
(code structures)

Deployment View
(system meets infra)

Operational View
(keeping it running)

Context View



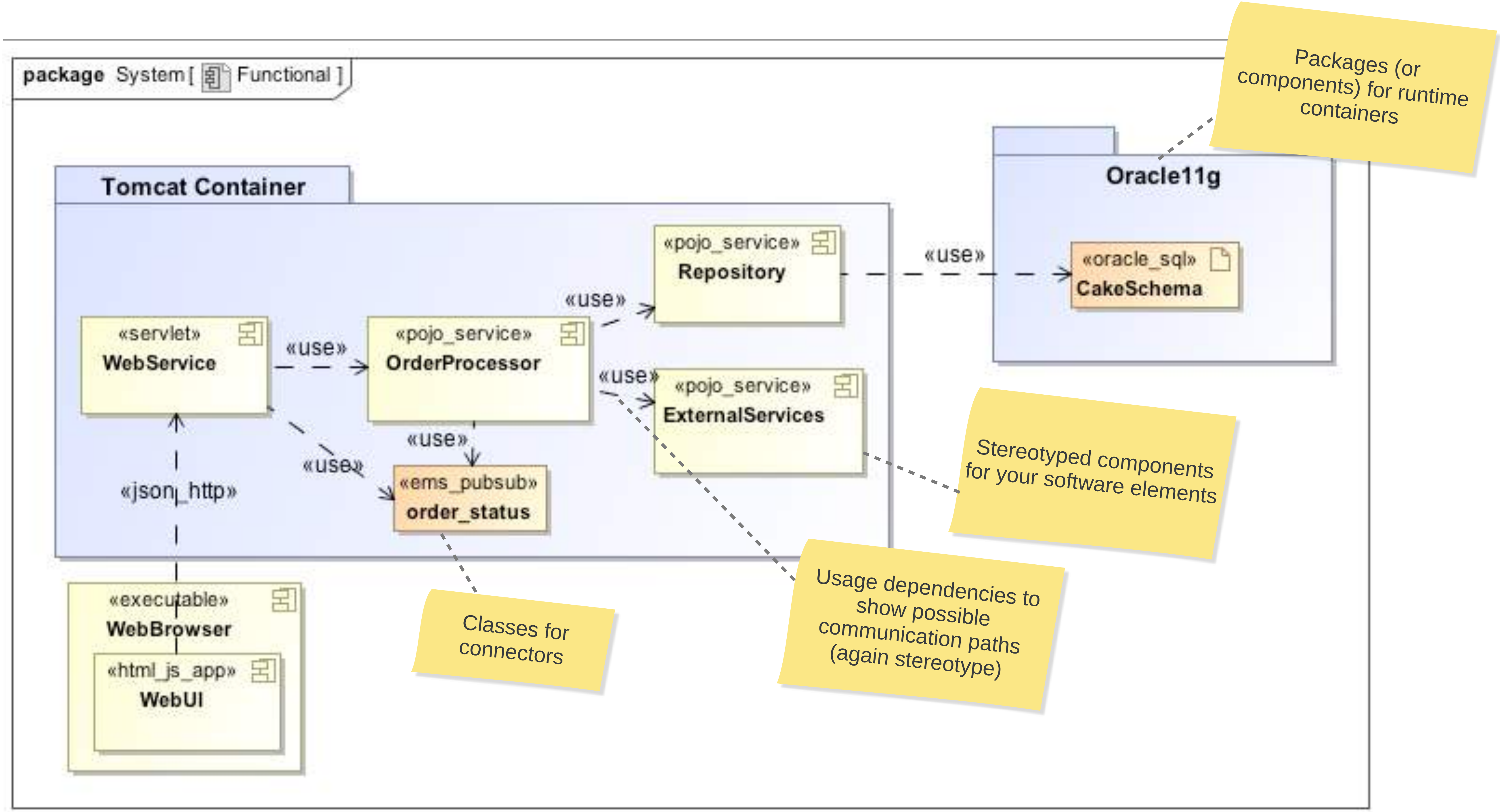
Component diagram with a single “component” - your system

External systems represented as <<external>> components

User groups represented by actors

Interactions with external systems using named associations

Functional View



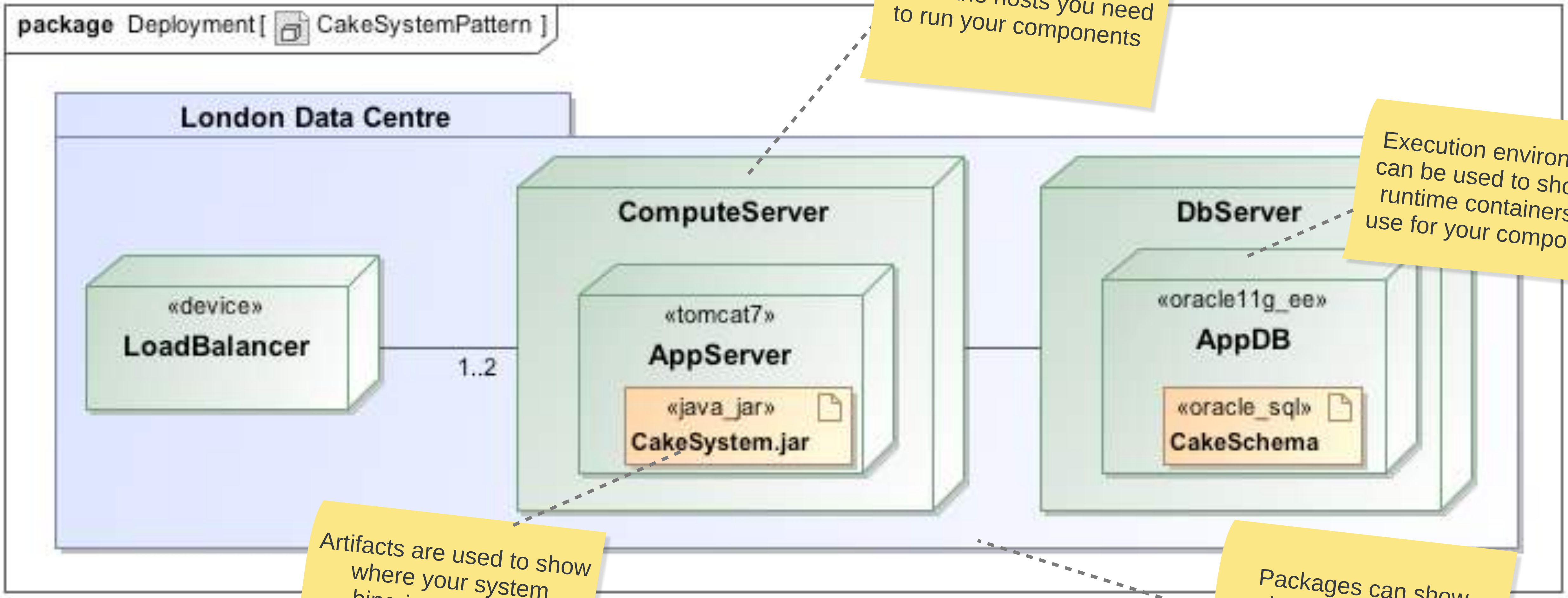
Packages (or components) for runtime containers

Stereotyped components for your software elements

Usage dependencies to show possible communication paths (again stereotype)

Classes for connectors

Deployment View



Show the hosts you need to run your components

Execution environments can be used to show the runtime containers you use for your components

Artifacts are used to show where your system binaries reside for execution

Packages can show locations or other groupings of hosts

Summary and Conclusions

What We Have Talked About

- Modelling is terrifically useful
  - communication
  - clarity
  - analysis
- Many ways of doing it
  - napkins to UML tools
- The key point is to get value from what you do
  - don’t get stuck in “analysis paralysis”

Questions?

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