

Component Based Software Development with Java

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A Strange World

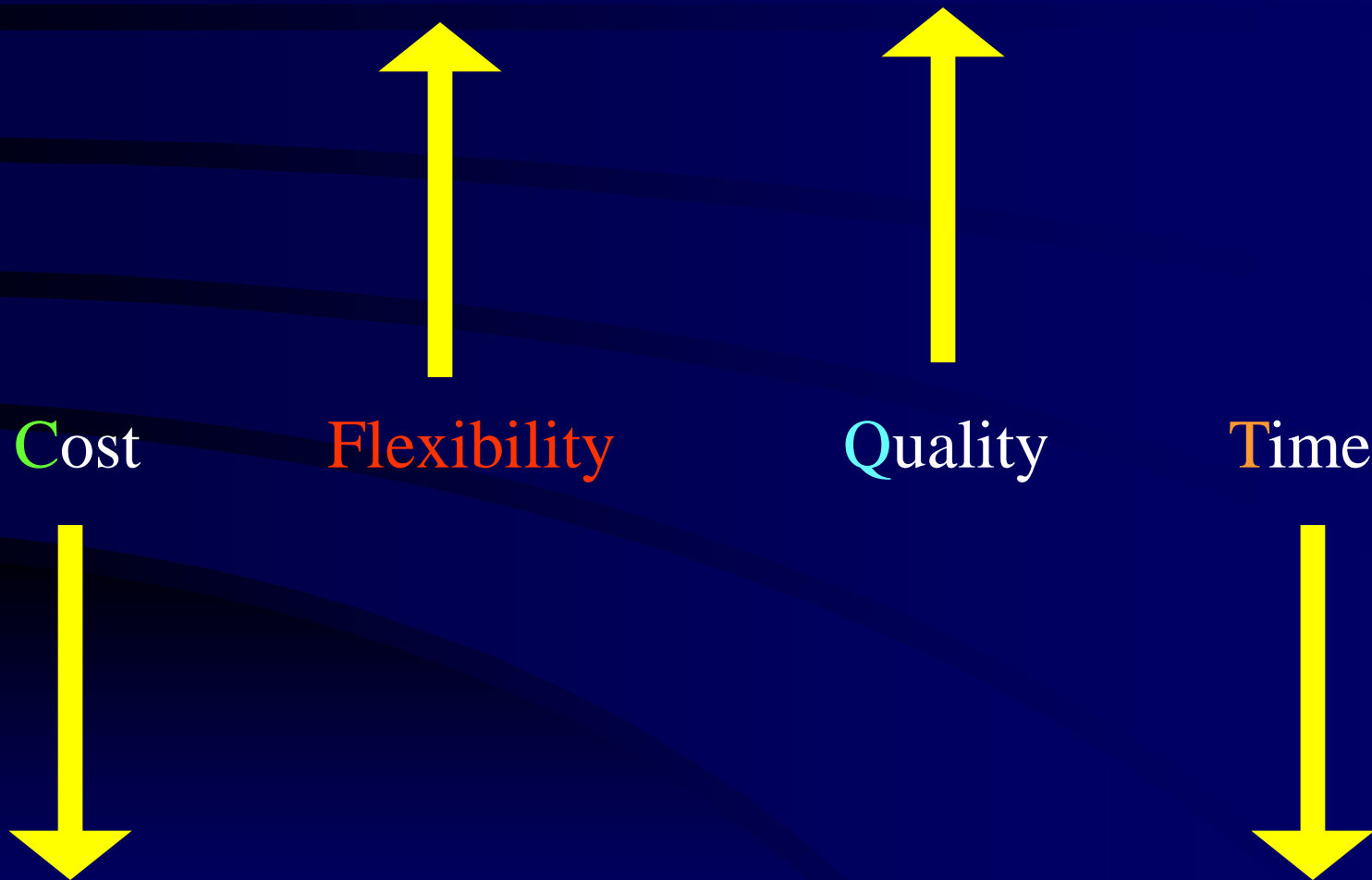


OS



Mouse

Crisis in Software Industry



A Perennial Problem?

Software engineering

- formal methods, verification, testing, programming language

- **reuse**, frameworks and libraries

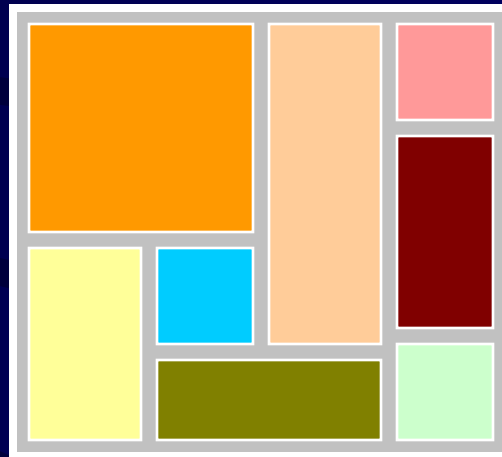
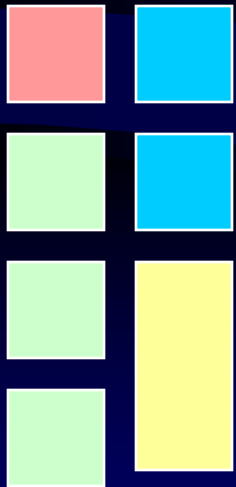
Component Based Software

- old wine in new bottle.
- breaking a system into **reusable** modules, components, sub-systems...
- facilitating system integration, reuse of design, testing and product evolution.



Benefits

*Pre-fabricated
Components*



A Software System

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In the Real World

The software industry has readily embraced CBSD.



Flashline (www.flashline.com)

Javabeans/COM/ActiveX

Vbxtras (www.vbxtras.com)

Visual Basic

Component Source (www.componentsource.com)

Java/COM/C++/Delphi/VisualStudio

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The Industry Says ...

“... companies can spend \$1000 on a software component instead of \$100000 on development resources.”

Sam Patterson (CEO ComponentSource)

“... These less skilled developers can 'assemble' components that were built by higher skilled developers ... It is a solution to the skills shortage.”

Tom Dwyer (Research Directory EJB Aberdeen G)

The Academic Says ...

“Working programmers are well aware of this last revolution ... Academic researchers are doing little or nothing ... The revolution has already happened, and in the academic community, nobody came.”

Peter Maurer (USF) 2000 in IEEE Computer

What contributed to the Buzz?

According to Meyer and Mingins (IEEE Computer 1999)
The current excitement about CBSD results from ...

| | |
|---------------------------------|---------------|
| Scientific | Industrial |
| Political | OO Technology |
| Monolithic Systems (Stovepipes) | |

Clashes of Views

Main Concern

Interconnecting technology for components.

Component

An abstract business process.

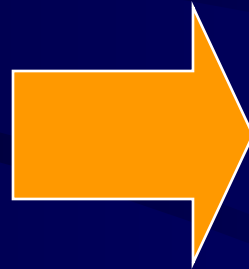
Output

Architectures, frameworks, standards, reference implementations

Political Bodies

Standard/Technology Custodians

Industry
Component Providers



Main Concern

Creation and sale of components of various base technologies

Component

An unit of reuse for a business domain

Output

Identifying specific business process -> components.

Component Definitions

So what is a component after all?

1. A unit of independent deployment;
2. A unit of third party composition;
3. Has no persistent state."

C Szyperski

Component is the next thing after
objects...

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Component Definitions

“ ... prepackaged generic elements”
B. Meyer & C. Mingins

It is absurd ... (that) CBD is the next thing
beyond object.

OO ... provides the only serious
technical basis ...

A Holistic View of CBSD

Application Integration Environment

Composition/Integration Tools

Component Repository

Component Contract/Metadata

Component

Language

Platform

Interface

Granularity

Domain

Runtime Environment

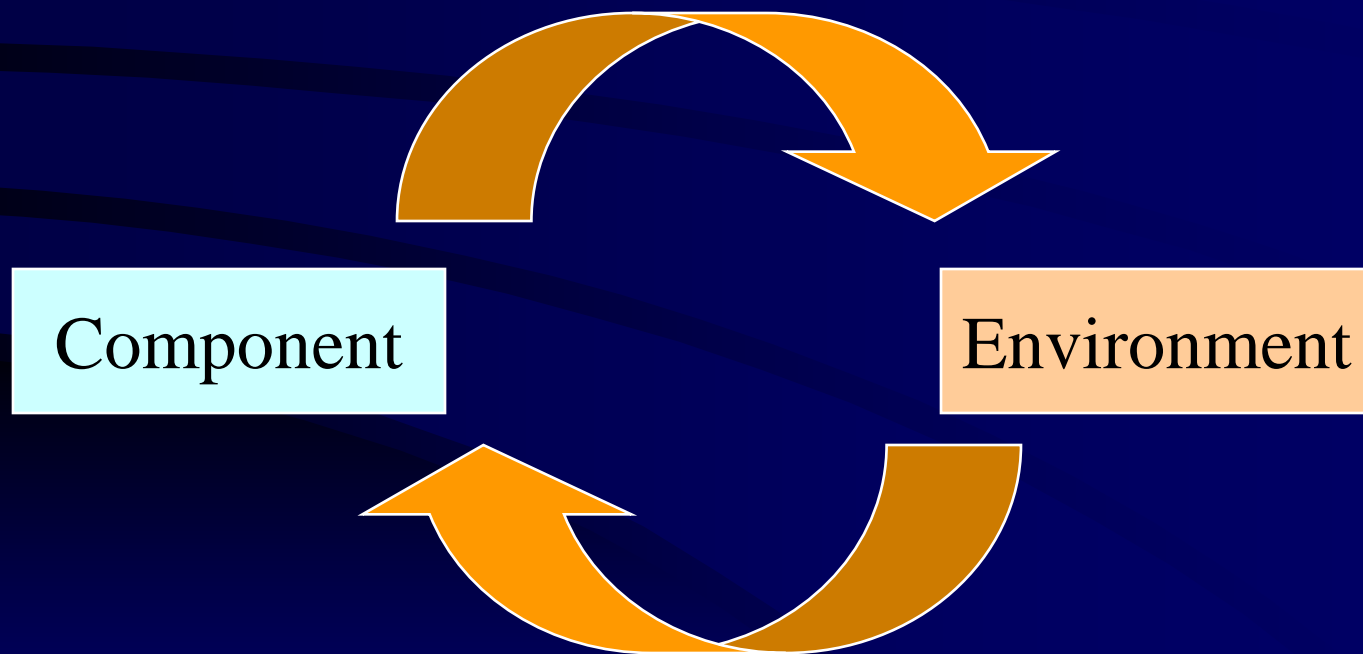
Interconnecting Technology

Resource Management

Component

Component Environment

A component is tightly coupled to its native environment.



CBSD Process

Application Integration Environment

Component  interface, contract, instantiation

Runtime Environment

Component

Component

Component

May I Join the Club?

- Yes, and there is no application fees.
- Consider whether CBSD can benefit your work/project.
- Paying a higher upfront cost for higher reusability and extensibility.

Java as a CBSD Environment

JavaBean - Toolable components.

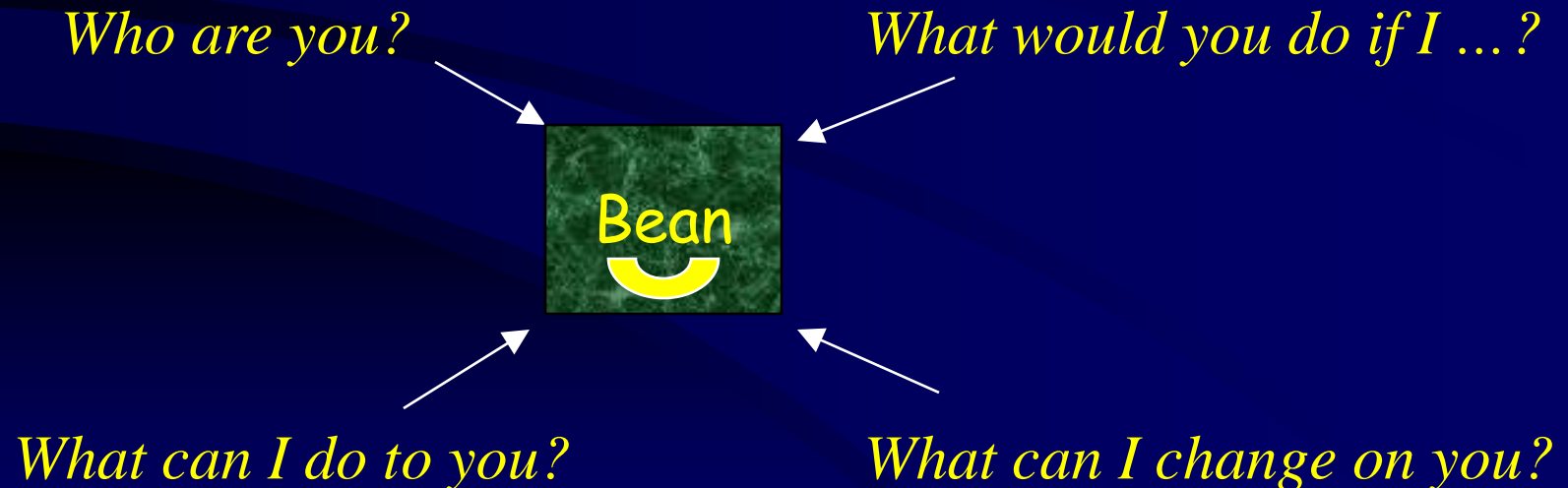
RMI/CORBA - Distributed components.

Jini/Serialization - Mobile components.

Messaging Middleware - Loosely-coupled
components.

JavaBeans

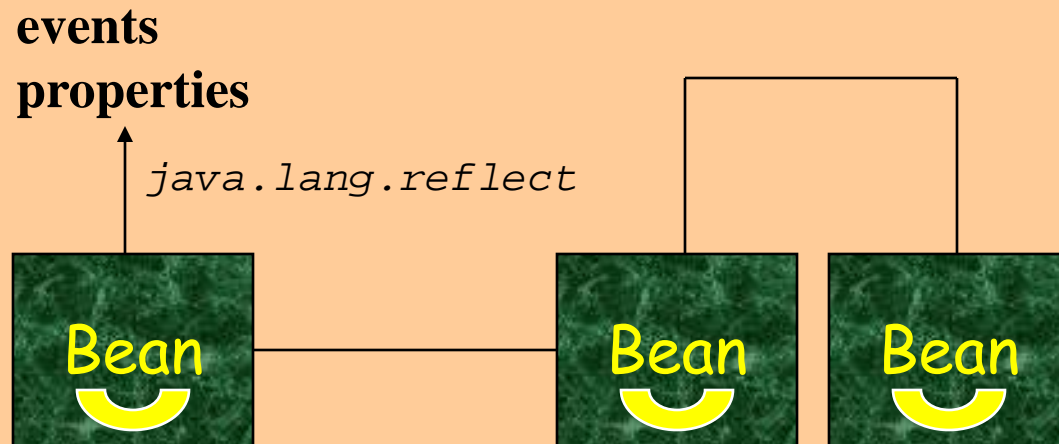
- Introspection distinguishes JavaBeans from ordinary Java classes.



Toolable JavaBeans

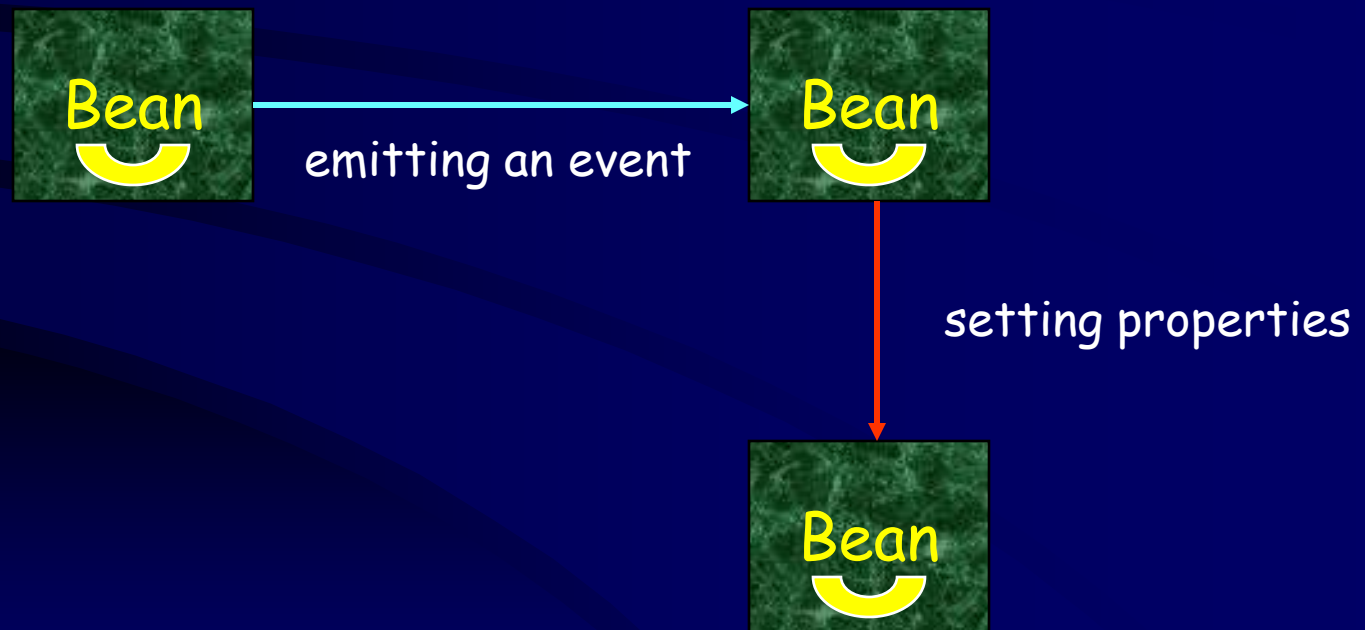
Container

java.beans
java.awt.events

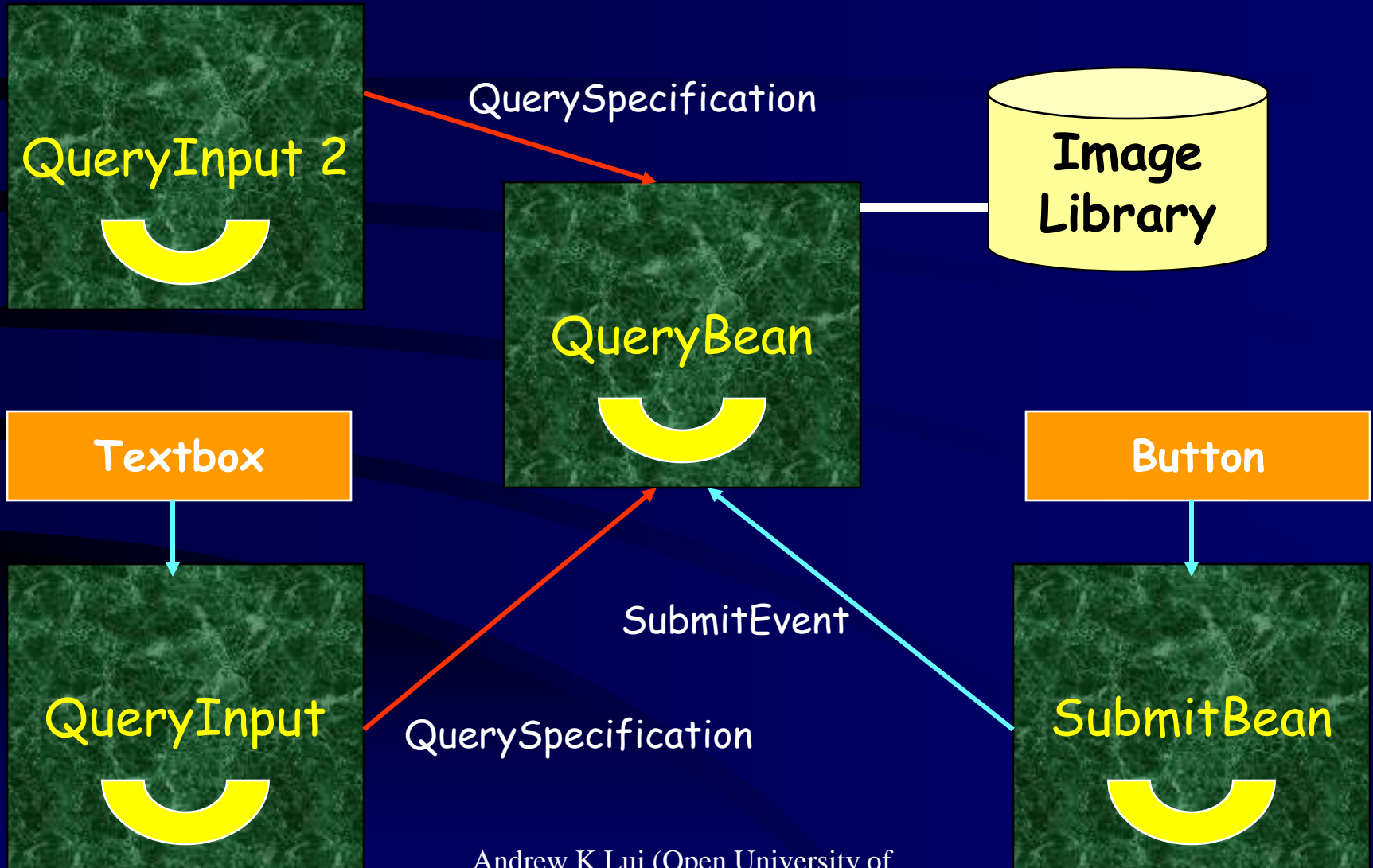


Connecting JavaBeans

Javabeans are connected by hooking properties and event handling.



Example - Image library client



Visual Appearance

The screenshot shows the 'IMAD Query Client' window with the title 'IMAD Image Query'. The interface is divided into three main sections, each highlighted with a cyan border:

- Geolocation:** Contains checkboxes for 'Rectangle' (checked) and 'Circle'. Below are input fields for 'Latitude' (DDMMSS) and 'Longitude' (DDDMMSS). The 'TL' row has '100000' S and '1000000' E. The 'BR' row has '800000' S and '1700000' E. A 'Rad' field is empty with 'km' next to it.
- Date Range:** Contains two rows of date inputs. The first row is '01' d '01' m '1996' y. The second row is '31' d '12' m '1998' y, with 'to' centered between the two rows.
- Sensor Type and Sensor Platform:** Two columns of checkboxes. 'Sensor Type' includes 'Visible' (checked), 'InfraRed', 'SAR', and 'MultiSpectral'. 'Sensor Platform' includes 'Satellite' (checked), 'Aircraft' (checked), and 'UAV'.

At the bottom, a red border highlights three buttons: 'Submit Query', 'Query Properties', and 'Quit'.

query
input

submit

JavaBean Tools

- Inprise (Borland) Jbuilder
- IBM VisualAge
- Symantec Visual Cafe

JavaBean Component Model

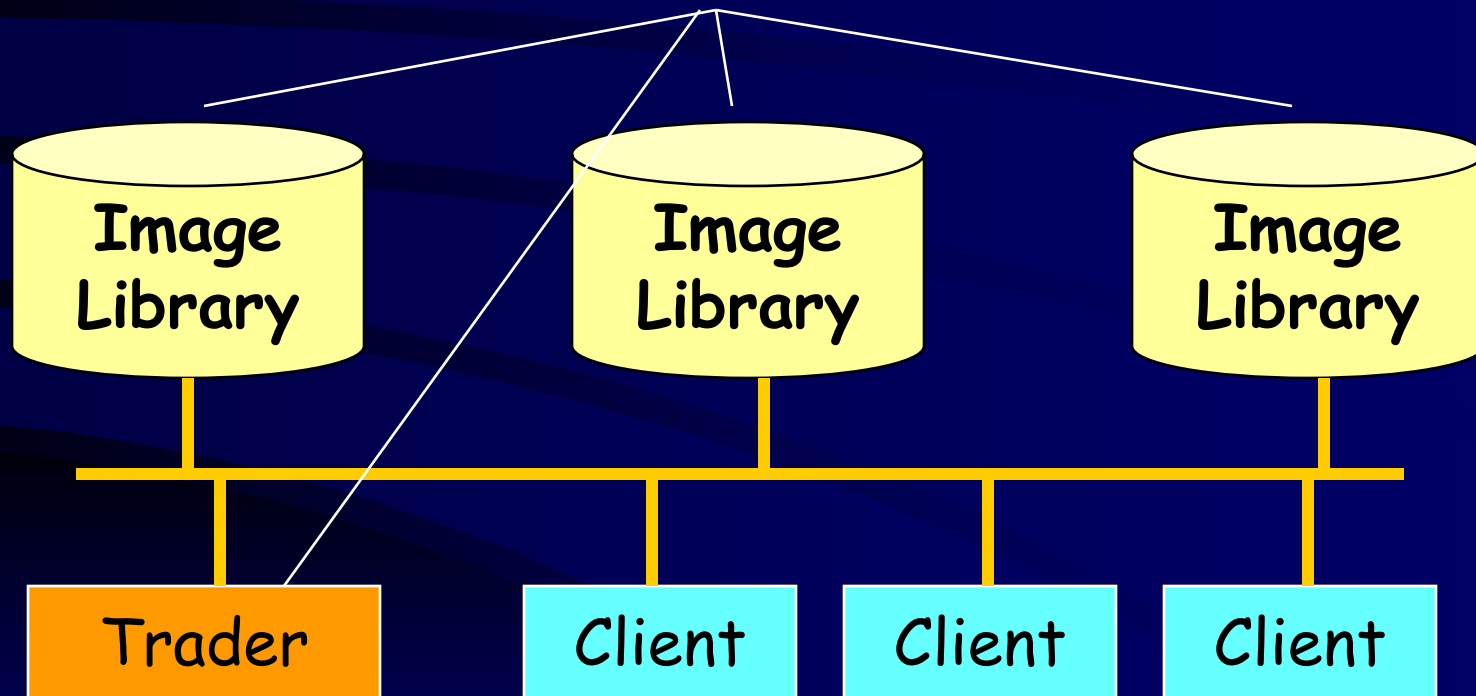
- Visual oriented.
- Stateful.
- Introspectual.
- Event driven.
- Design Pattern Defined.
 - Method naming.
 - Event naming.
 - BeanInfo class.

Distributed Components

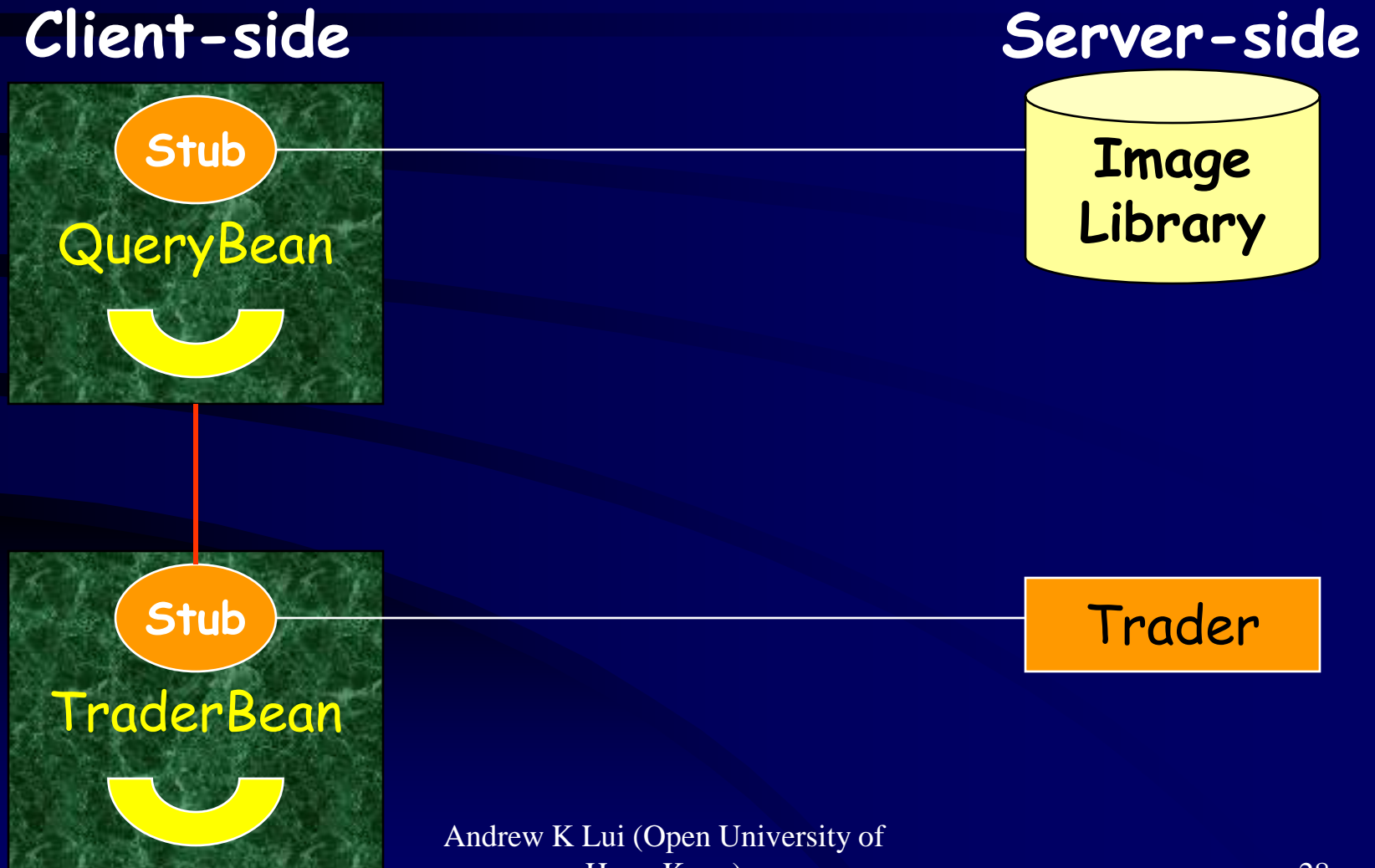
- JavaBean integration technique is local.
- Java supports distributed computing in RMI/CORBA
- How to extend JavaBean model to work with distributed computing.

Distributed Image Library

CORBA Services



JavaBeans as Stubs



Rapid Application Dev (DSTO)

The screenshot displays the Active Container Development Environment (ACDE) interface. The main window, titled "Application", contains a GIS application with the following components:

- Map:** A world map showing a grid and a red line across the equator.
- Query Engine:** A panel for defining queries, currently showing "GIS Location" with latitude and longitude coordinates.
- Available Components:** A list of components including Repository, Result, Query Engine, and Query, with "LocationBean" selected.
- Component Description:** A text box explaining that "LocationBean" places a minimum and maximum on latitude-longitude points in a query.

The interface includes a menu bar (File, Edit, Options, Repository, Help) and a status bar at the bottom indicating "Connected to Repository".

GIS Location

| | Latitude | Longitude |
|----|------------|-----------|
| TL | 38.274467 | -9.313153 |
| BR | -67.486786 | -82.13779 |

Jini

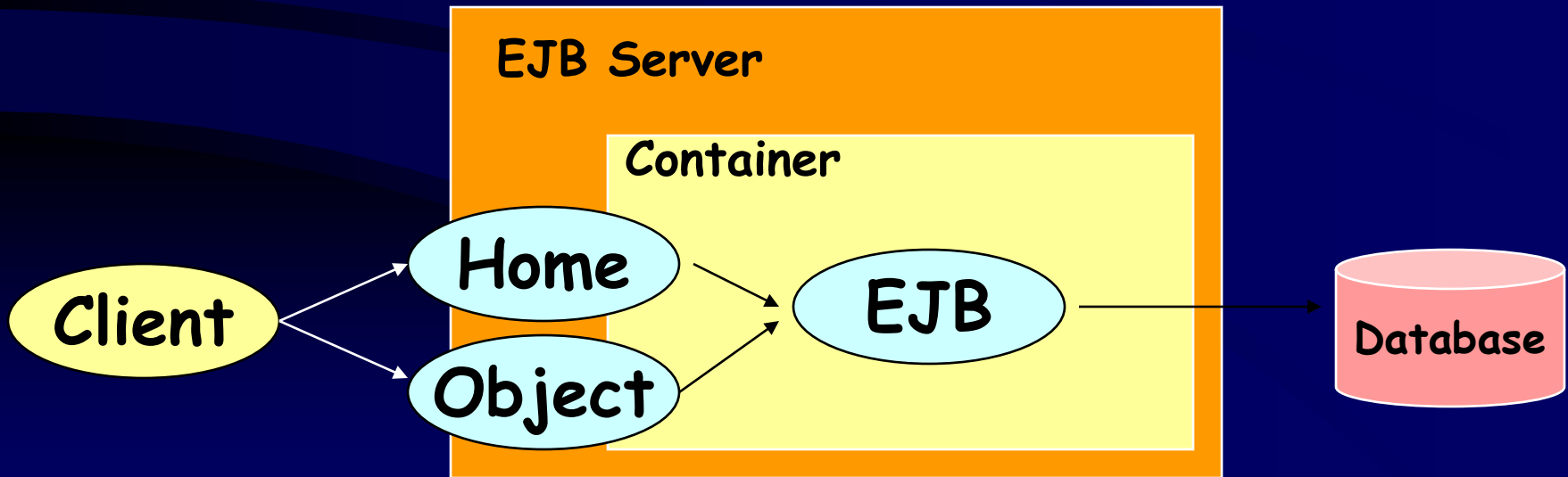
Stubs themselves can be downloaded from services - encapsulating the protocol.



Server Components?

Enterprise JavaBeans (EJB)

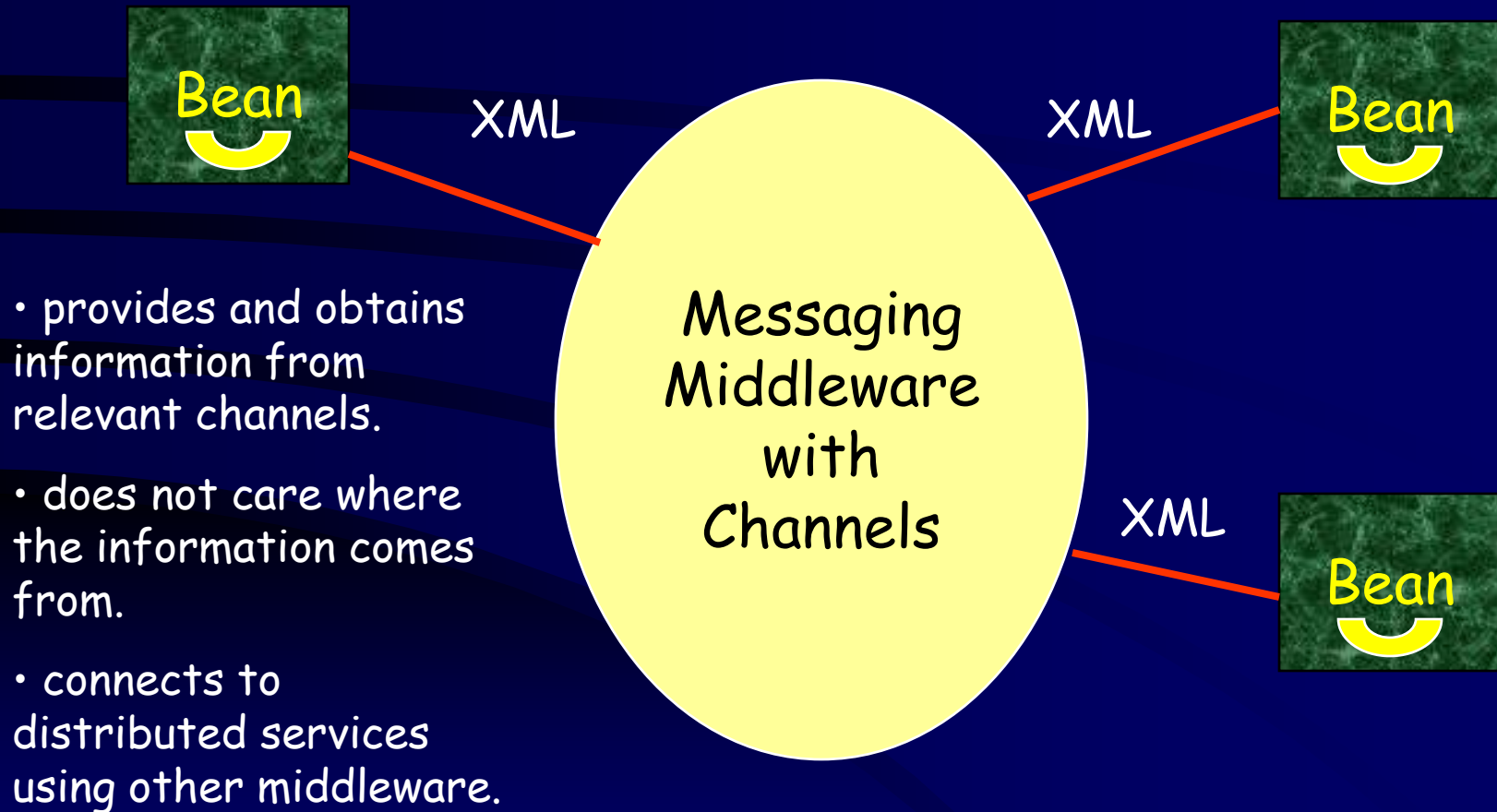
Distributed transaction management, concurrency management, middleware support, ...



Other CSBD Environments

- JavaBean connection is tightly coupled - one bean *knows* other beans.
- Distributed bean component has already made bean location independent.
- Use of messaging middleware can even encapsulate the existence of other beans.

CSBD with messaging middleware



Summary

- Very popular in industry but only at a beginning stage in academic.
- Lots of experience gained, but with thin theoretical support.
- Java is a good platform for CBSD.

The Future

- Loosely-coupled component model.
- Component Contracts.
- Microsoft Dot Net