# Towards a Reference Model for Implementing the Fractal Specifications for Java and the .NET Platform

## Fractal Workshop
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L. Seinturier – N. Pessemier
INRIA & Univ. of Lille, France

C. Escoffier – D. Donsez
LSR & Univ. of Grenoble, France

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# Plan

- Introduction
- Platform architecture
- Implementations
- Conclusion and future directions

Assumption: basic knowledge of the Fractal component model

# 1. Introduction

- Several existing implementation of the Fractal Specifications
  - Java (Julia, ProActive), C (Think), SmallTalk (FracTalk), C++ (Plasma)
- These platforms share the Fractal API
  - provide a compile-time compatibility of application components
- Extending these platforms (e.g. with new controllers)
  - so far a matter of understanding the internals of the platform
- Goal: provide a common ground for platform developers
- Experiment: a Java and .NET implementation of the Specifications



# 2. Platform Architecture

The role of a platform
- provide an implementation for the Fractal API
- provide a way of implementing control membranes

- membranes are implemented as a set of controllers

Controllers perform
- code injection ⇨ adding functionalities to components
- code interception ⇨ modifying the behavior of existing functionalities

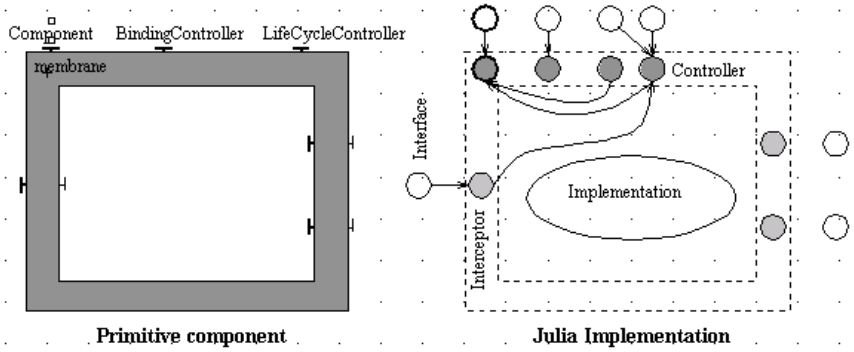
⇨ The membrane acts as a container for components

Issue for platform implementors
- how to engineer these containers

# 2. Platform Architecture

Example: Julia

- mixin
- bytecode engineering (ASM)






# 2. Platform Architecture

Back to the basics

Controllers perform

- code injection ⇨ adding functionalities to components
- code interception ⇨ modifying the behavior of existing functionalities

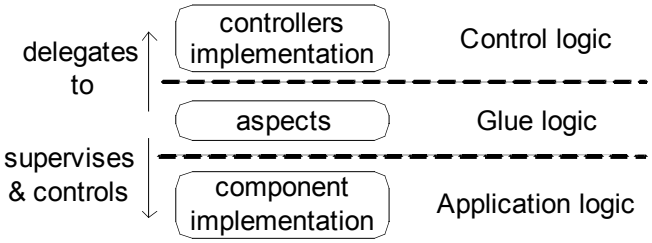
Candidate technologies

- generation and transformation
  - code or bytecode
  - compile-time or load-time or run-time
- MOP
- AOP

# 2. Platform Architecture

Aspect-Oriented Programming [Kiczales 97]

Our proposal
- 3 level architecture
- 1 aspect per controller





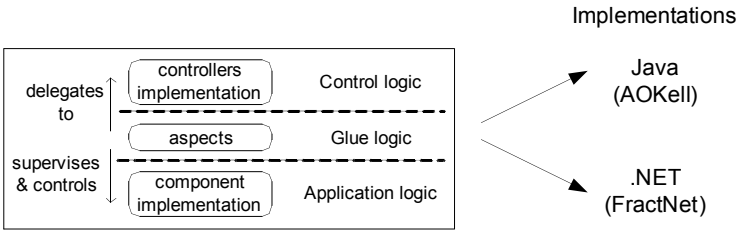

# 2. Platform Architecture

Example: AspectJ
- inter-type declaration
- pointcut and advice

```
public aspect ALifeCycleController {

  private LifeCycleController LCType._lc;

public String LCType.getFcState() { return _lc.getFcState(); }
public void LCType.startFc() throws IllegalLifeCycleException { _lc.startFc(); }
public void LCType.stopFc() throws IllegalLifeCycleException { _lc.stopFc(); }

pointcut methodsUnderLifecycleControl( LCType adviced ):
   execution( * LCType+.*(..) ) && target(adviced) &&
   ! controllerMethodsExecution() && ! jlObjectMethodsExecution();

before(LCType adviced) : methodsUnderLifecycleControl(adviced) {

 if( adviced.getFcState().equals(LifeCycleController.STOPPED) ) {
   throw new RuntimeException("Components must be started before
                                    accepting method calls");
```

# 3. Implementations

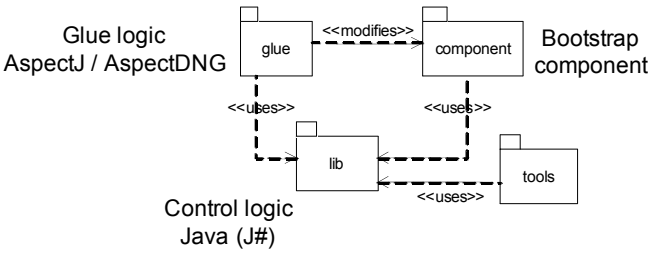
Instantiating the 3-layer architecture






# 3. Implementations

Code structure

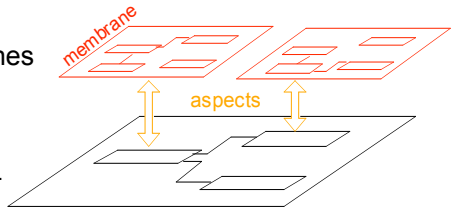



| | AOKell | FractNet | % (lines of source code) |
|---|---|---|---|
| glue | AspectJ or Spoon | AspectDNG | 12% |
| component | Java | | 1% |
| lib | | | 82% |
| tools | | | 5% |

# 3. Implementations

Control logic
- written in Java
- javac or J# compiler

2 versions
- pure OO controllers
- componentized membranes
  - control components
  - control membranes
  - Fractal API and ADL






# 3. Implementations

Glue logic

- J2SE: written with AspectJ

- .NET: written with AspectDNG
  - input: MSIL assembly (outputed by any .NET language compiler)
  - output: a woven MSIL assembly

# 4. Conclusion

A common ground for 2 versions of the Fractal platform

- Java: AOKell http://fractal.objectweb.org
  - solution comparable (perf., code size) to Julia
  - fully compatible (JUnit tests passed)
  - able to run existing applications (comanche, GoTM, Fractal Explorer, …)
  - can be compiled for ≠ targets: J2SE, J2ME CDC, J2ME CLDC
- .NET: FractNet http://www-adele.imag.fr/fractnet/
  - a first step towards the .NET world
  - pending work
    - Fractal ADL, unit testing



# 4. Future directions

Evolution of the glue logic

- moving from AspectJ to Spoon http://spoon.gforge.inria.fr
  - Java source-to-source transformer
- rationale
  - performance (weaving and weaved code)
  - towards a CT convergence of AOKell & Julia
    - reusing Julia controller with AOKell
    - a Spoon version of the Julia mixin algorithm

# 4. Future directions

Issue: Julia-AOKell interoperability

- controller interoperability
- component interoperability

- controller interoperability
  - both Julia and AOKell define their own Controller interface
  - ⇨ candidate for the Fractal API v3? for a new API (so-called SPI)?



# 4. Future directions

Issue: Julia-AOKell interoperability

- component interoperability
  - e.g. an heterogeneous assembly with Julia and AOKell components
  - issue: « internal » API extending the Fractal API
    - LifeCycleCoordinator extends LifeCycleController
    - SuperControllerNotifier extends SuperController
    - Template extends Factory
    - ComponentInterface extends Interface
    - ContentBindingController (new interface)
  - ⇨ stick to this API to provide Fractal component interoperability

  - ⇨ candidate for the Fractal API v3? for a new API (so-called SPI)?