Linguistic Symbiosis between Actors and Threads

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Overview

- AmbientTalk: OO DSL for mobile ad hoc networks
- Pure event-driven concurrency model (actors [Agha86])
- How to do a *safe* linguistic symbiosis between actors and threads?

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Actors vs. Threads

```
actor: {
  def obj := object: {
    def m() { ... }
  }

  def button := Button.new(“Click Me”);
  button.addActionListener(object: {
    def actionPerformed(actionEvent) {
      obj.m();
    }
  })

  obj.m();
}
```

Actors vs. Threads

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actor: {
  def obj := object: {
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  def button := Button.new("Click Me");
  button.addActionListener(object: {
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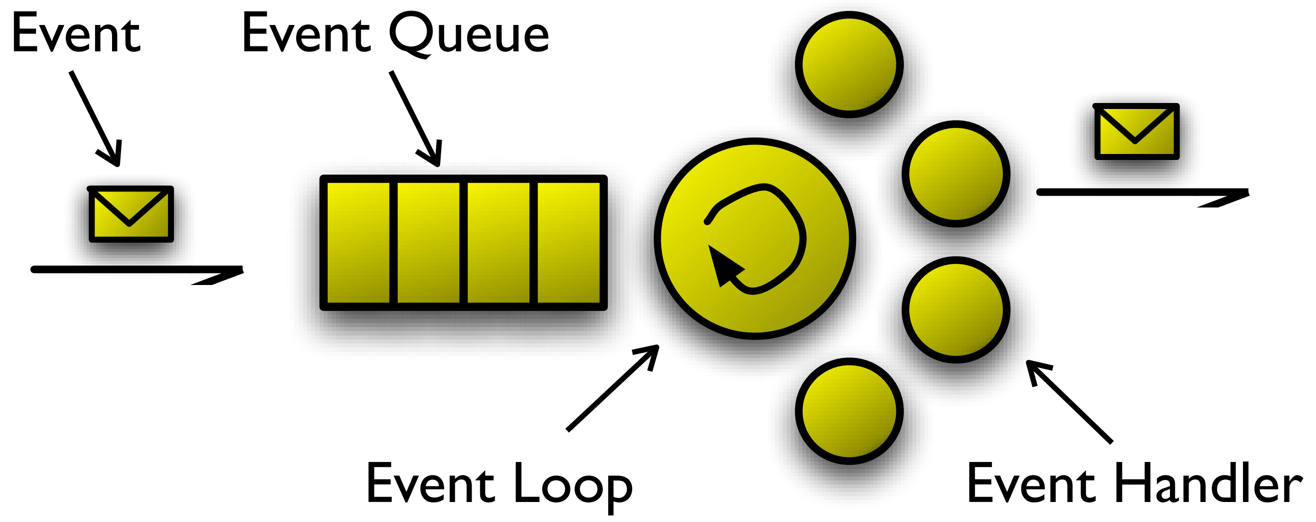
  })

  obj.m();
}
```

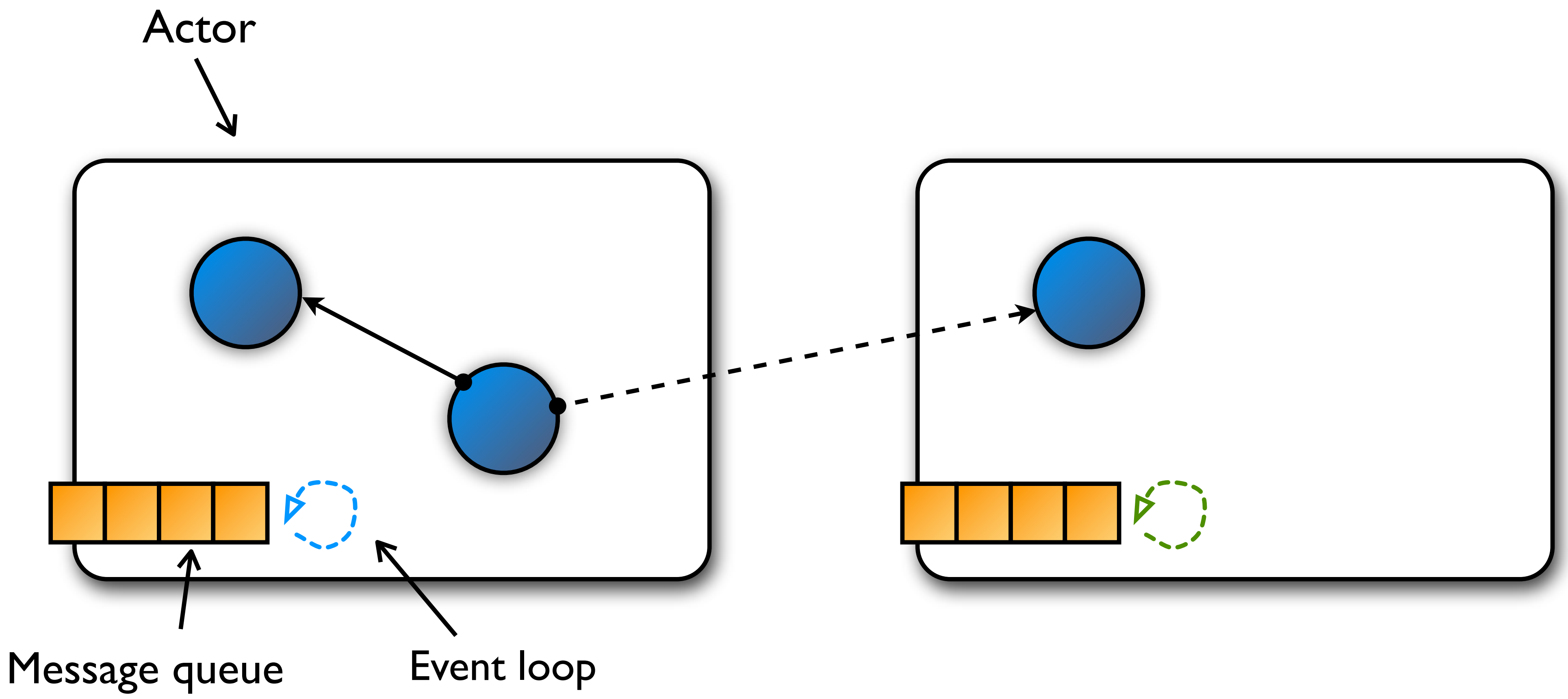
Event Loop Concurrency

- Events are executed serially
- Event notification is strictly asynchronous
- Event loops should have no shared state



Event loop concurrency

Based on E programming language [Miller05]



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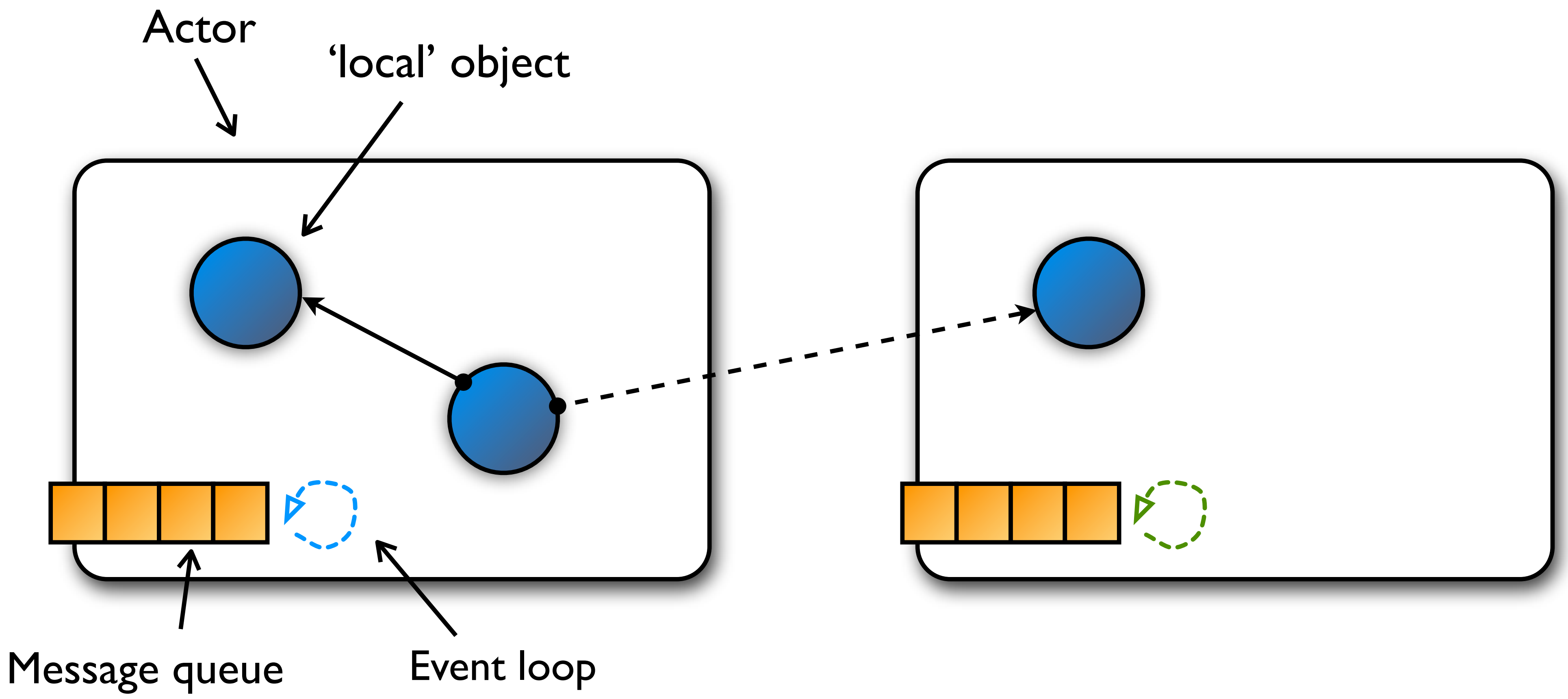

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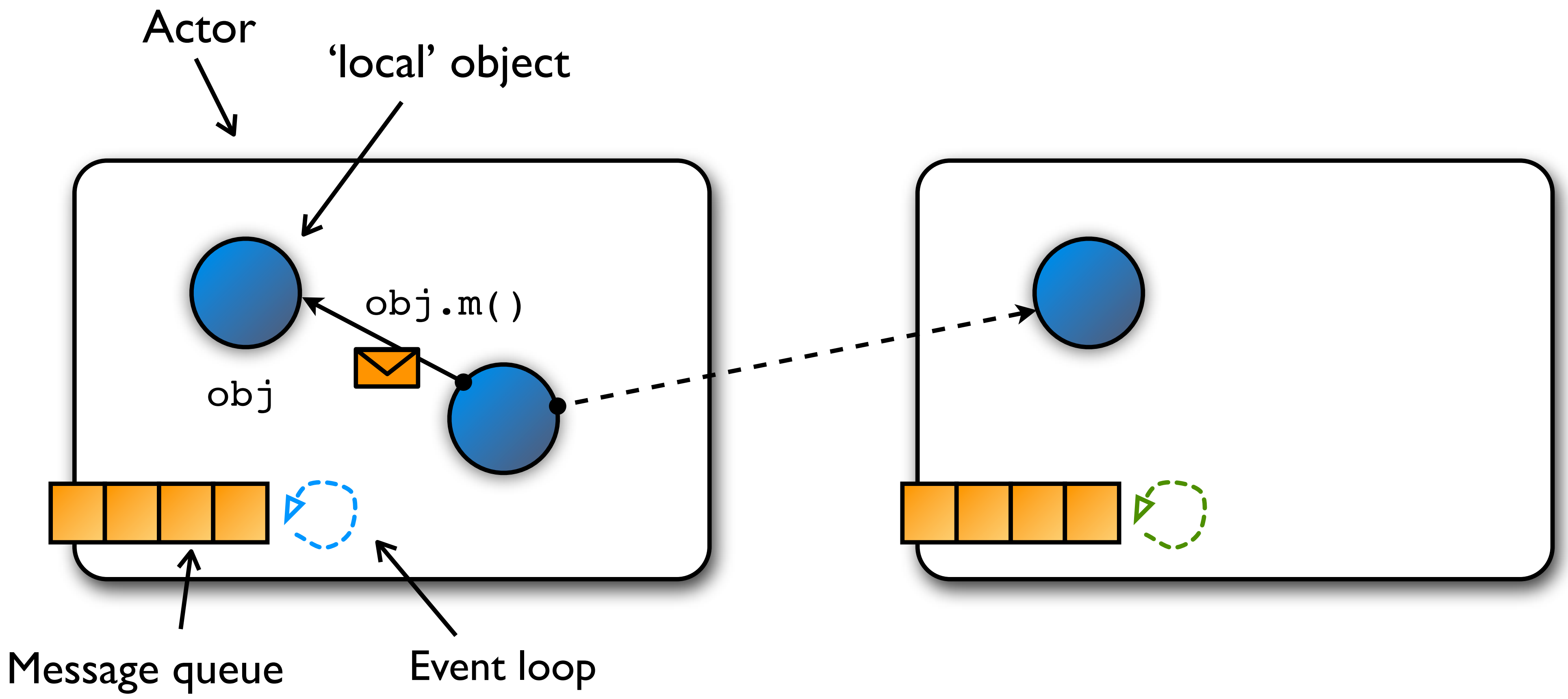

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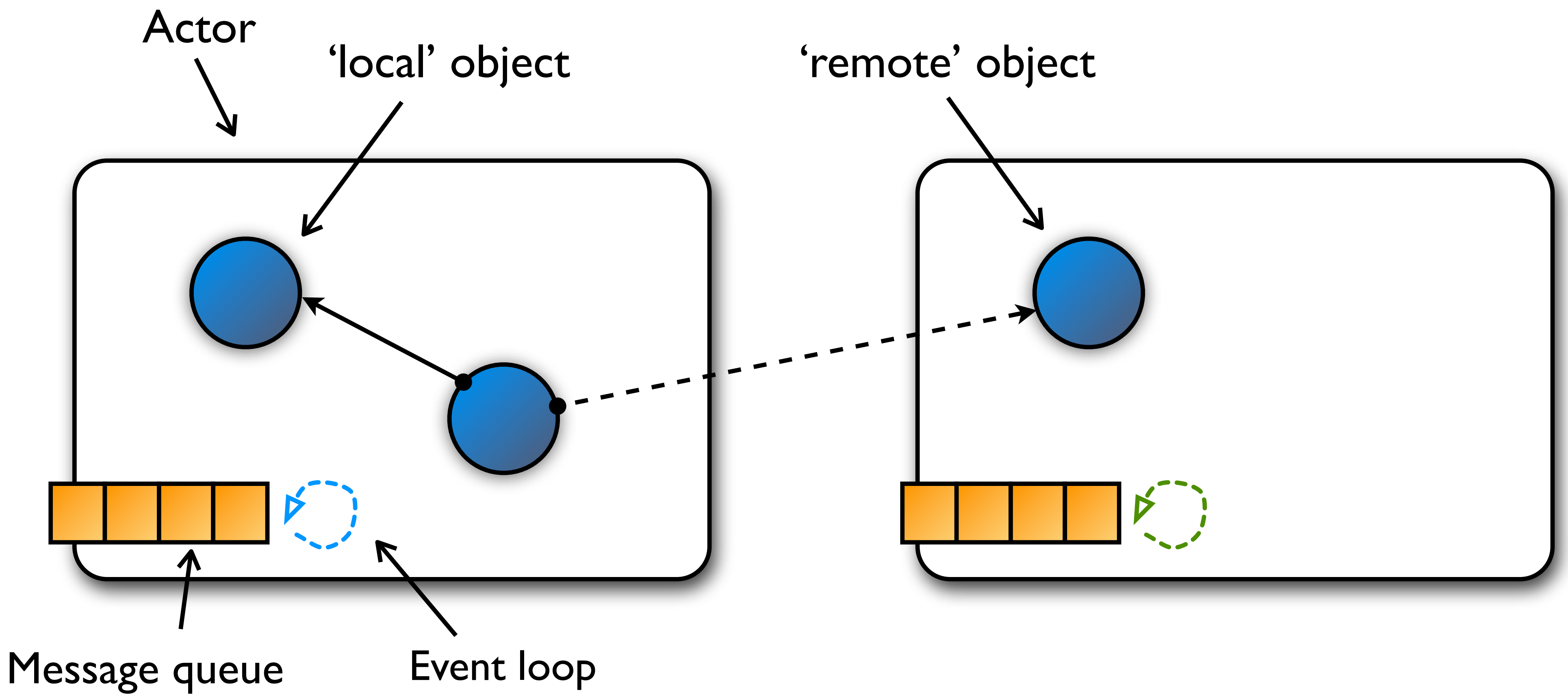

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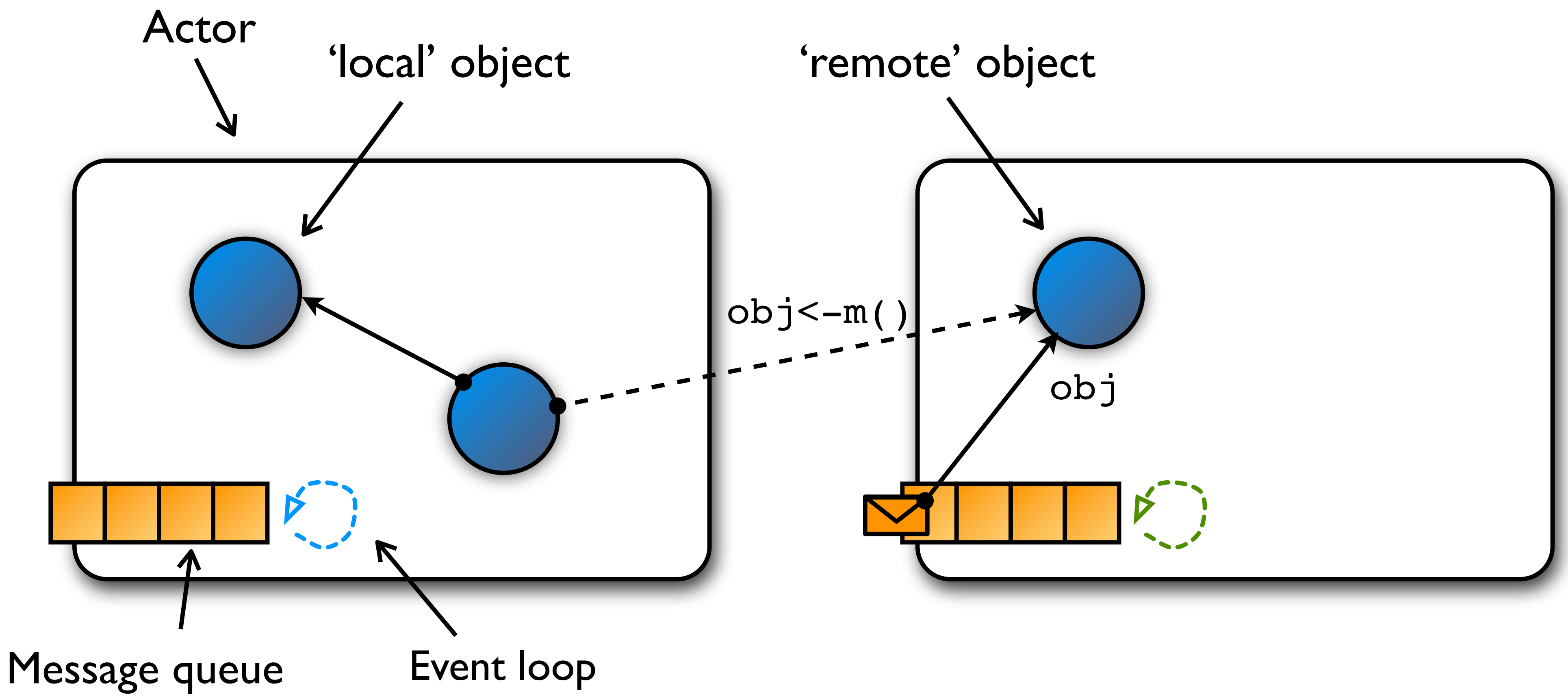

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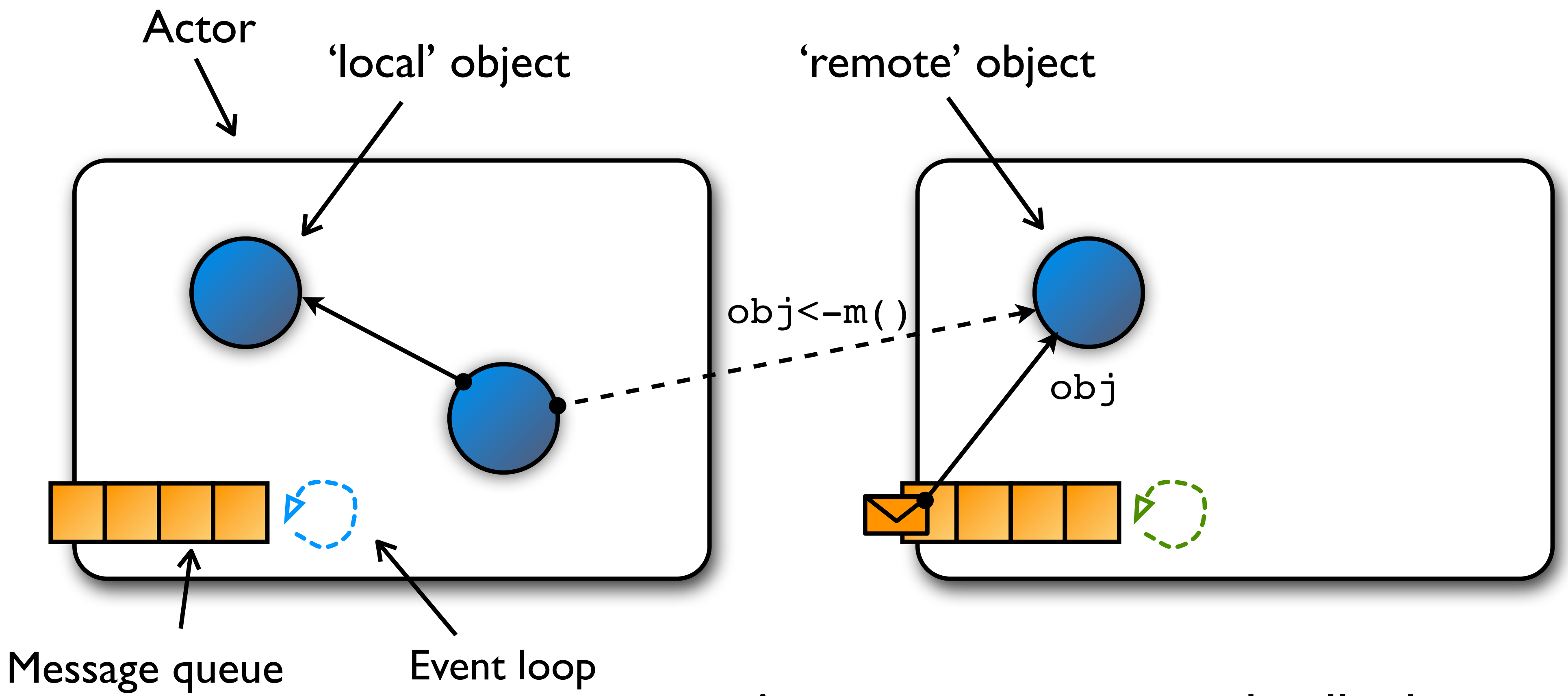

Actors cannot cause deadlock

No race conditions on objects

AmbientTalk/Java

Based on Inter-language Reflection [Gybels et al 05]

- AmbientTalk is implemented in Java
- Data mapping: cfr. JRuby, Jython, JScheme, LuaJava, JPiccola, ...
- Tight integration at the syntactic level

```
def Button := jlobby.java.awt.Button;
def button := Button.new("Click Me");
button.addActionListener(object: {
  def actionPerformed(actionEvent) { ... }
});
button.setVisible(true);
```

Actor/Thread Mapping

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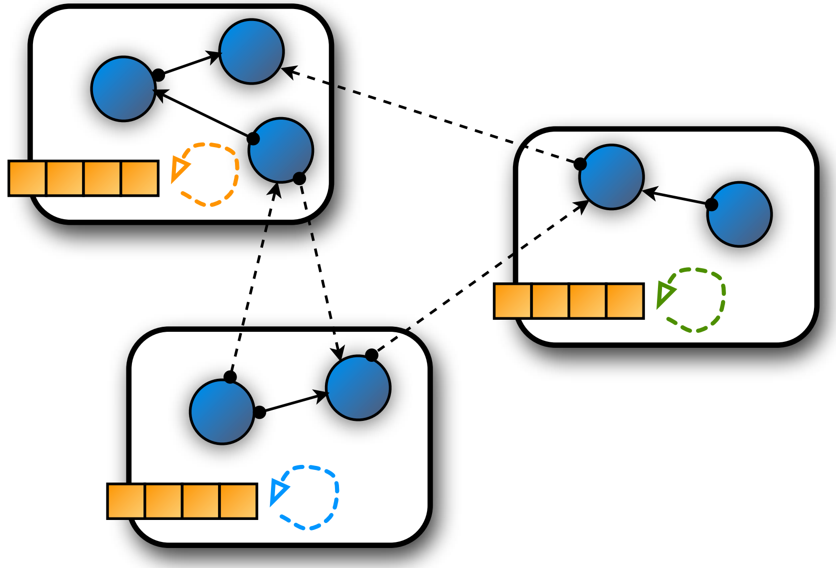
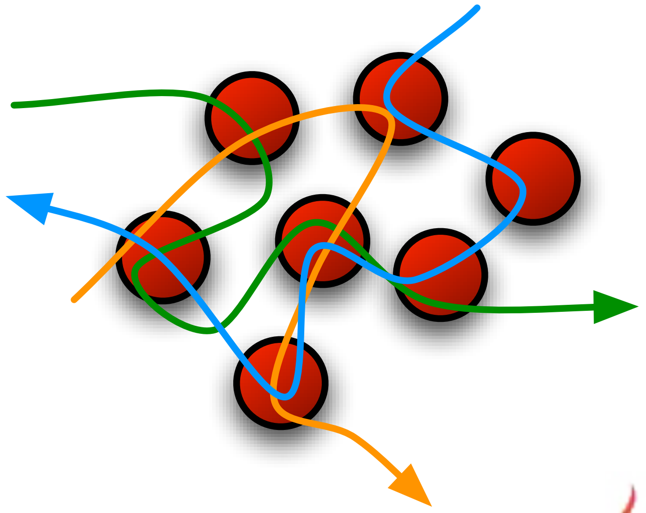
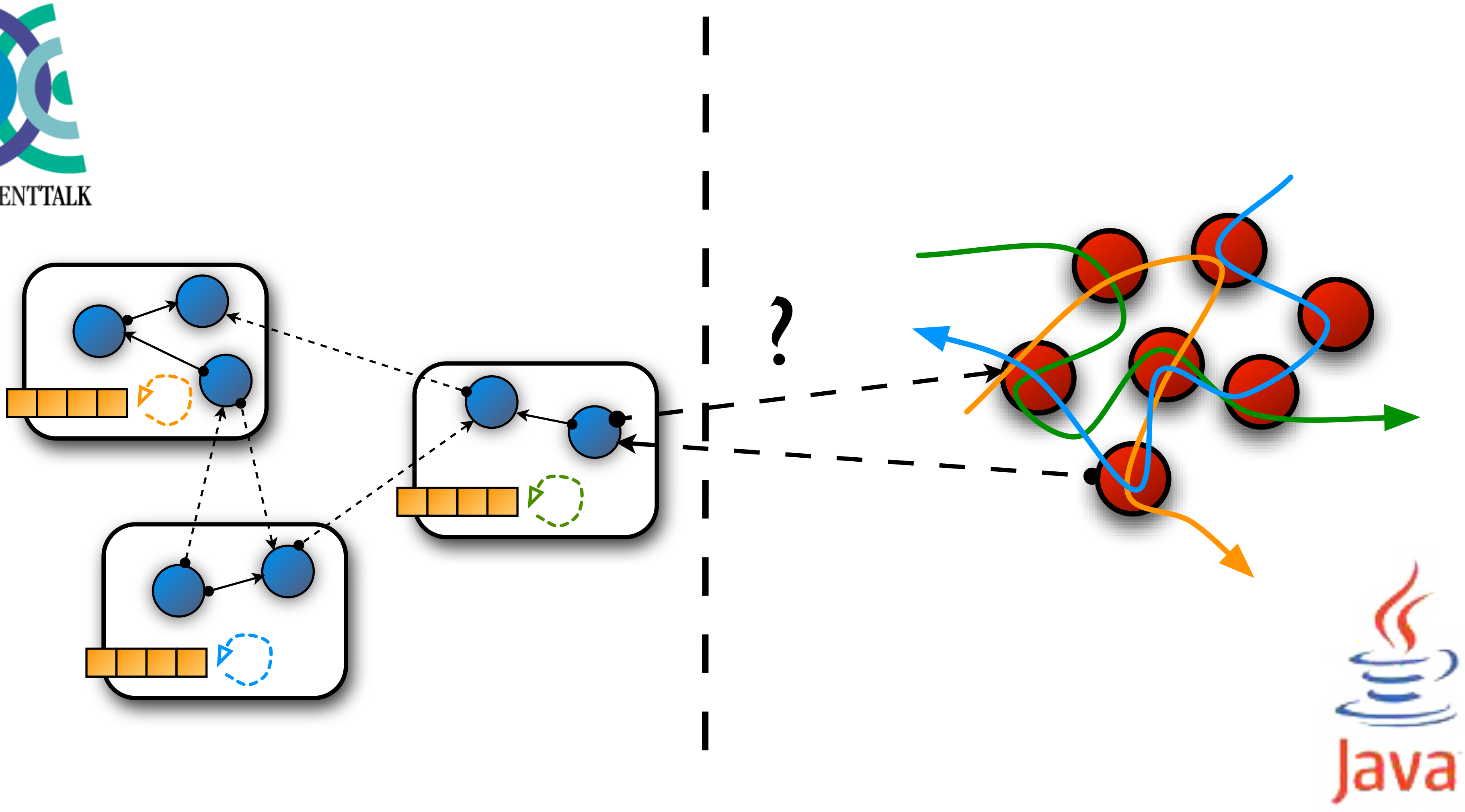




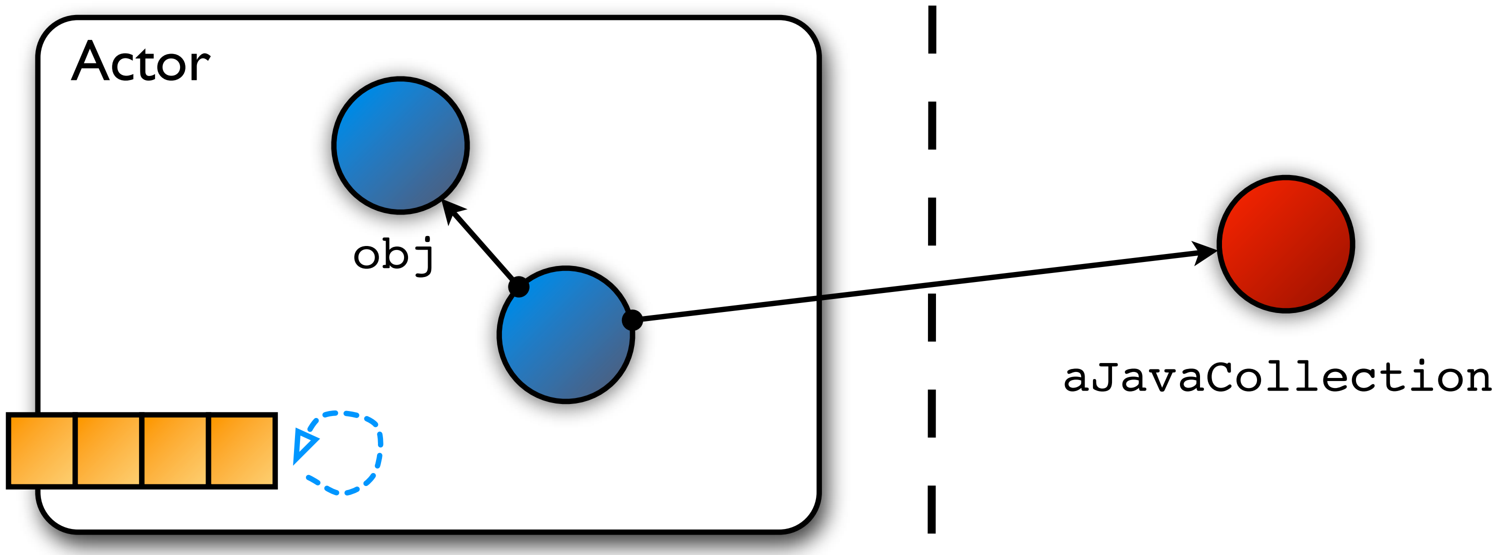
Java

Actor/Thread Mapping



Actors as Threads

```
def obj := object: { ... };
aJavaCollection.add(obj);
```



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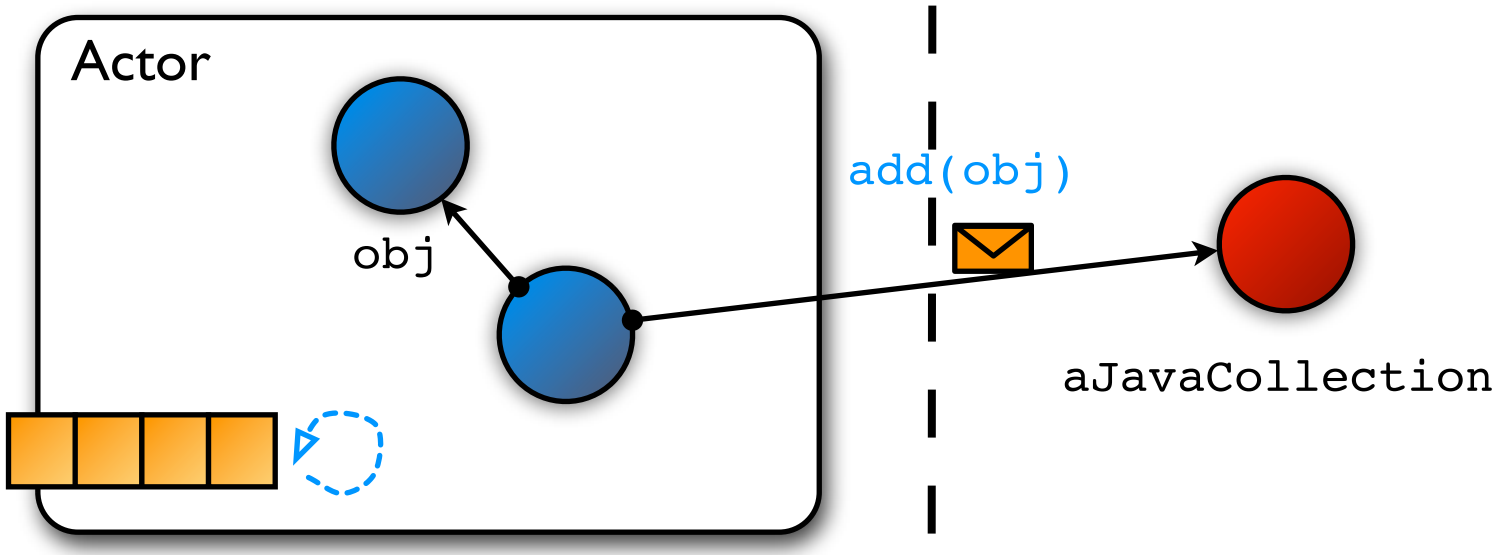

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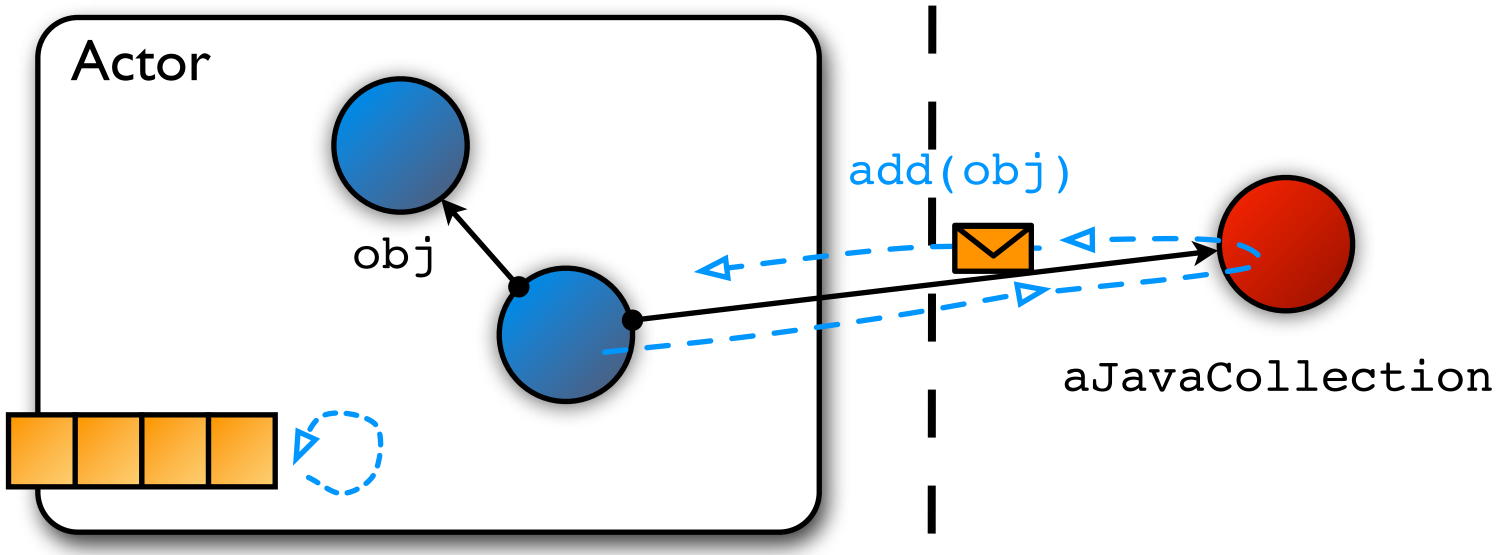

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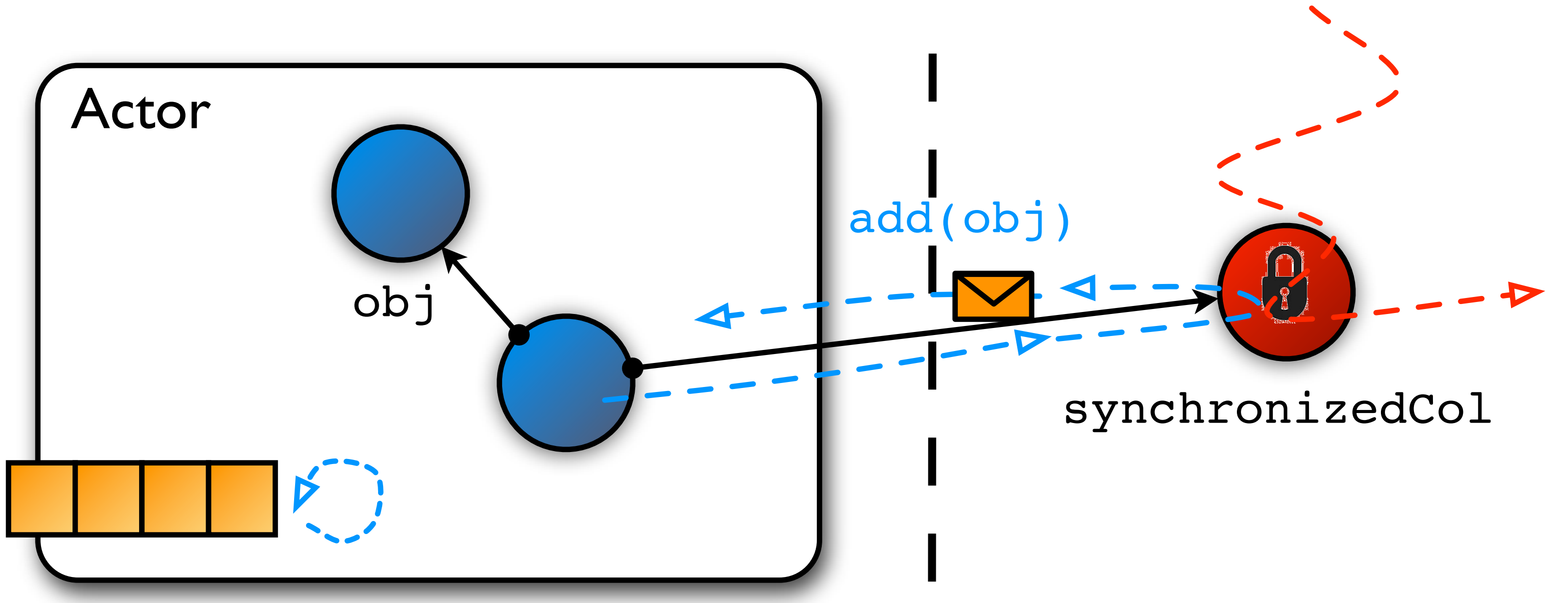

Actors as Threads

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def obj := object: {
  def compareTo(other) { ... }
}

aJavaCollection.add(obj);
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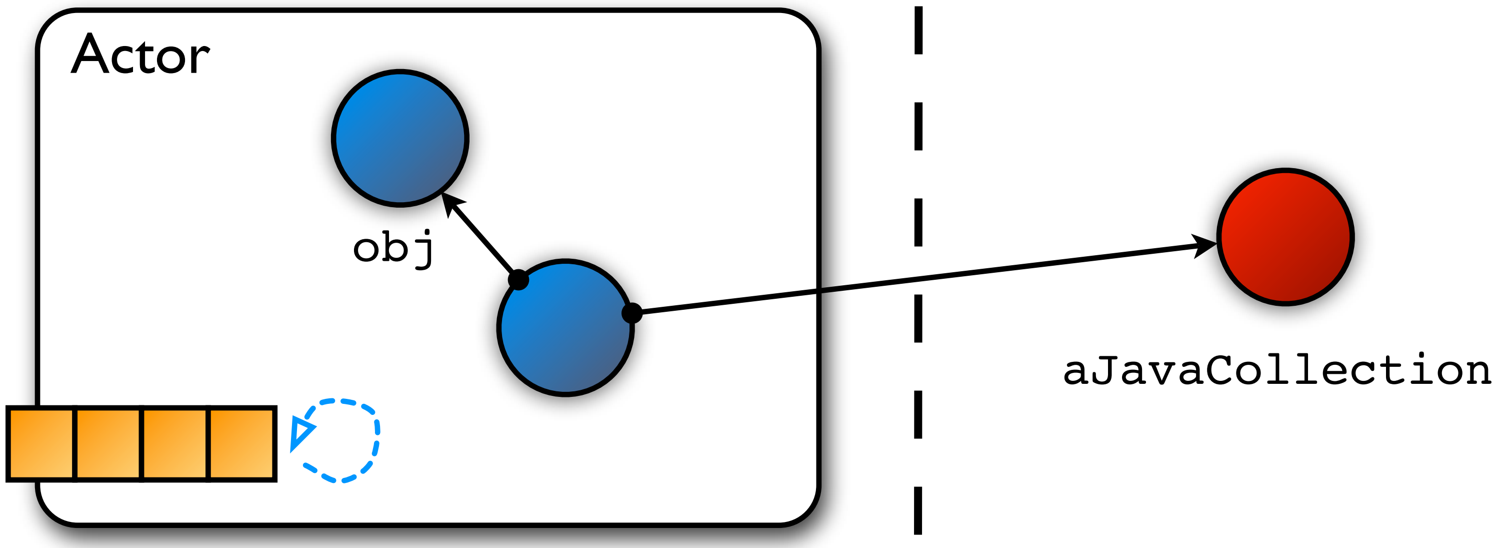

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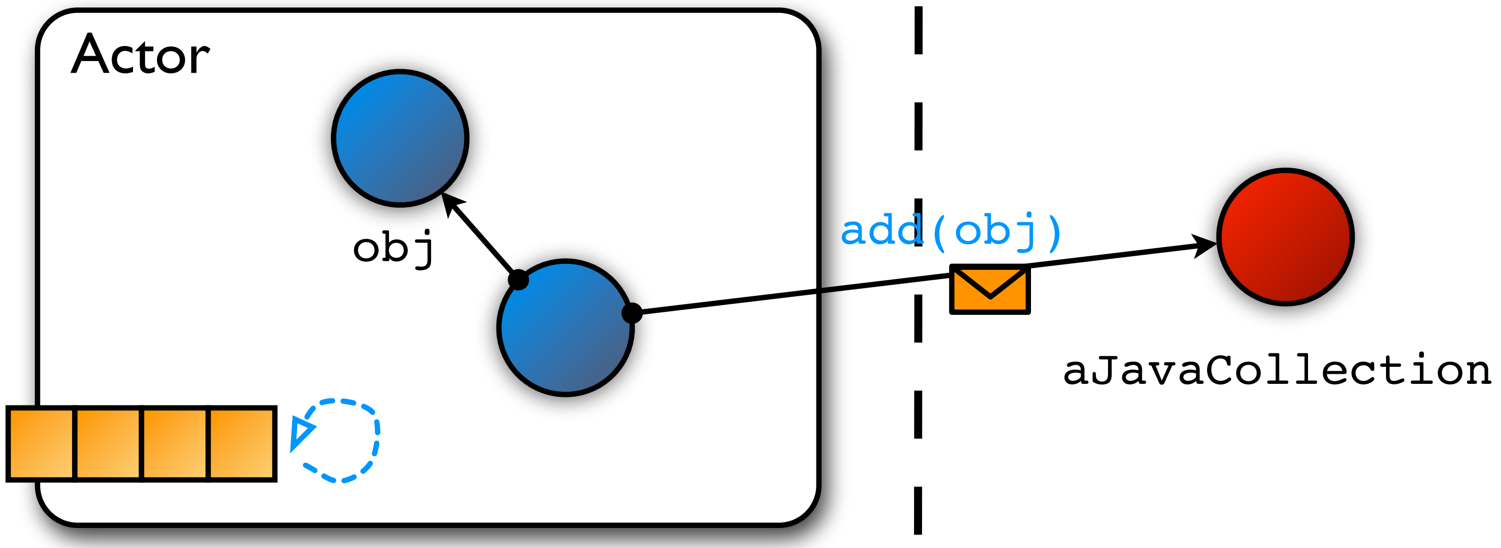

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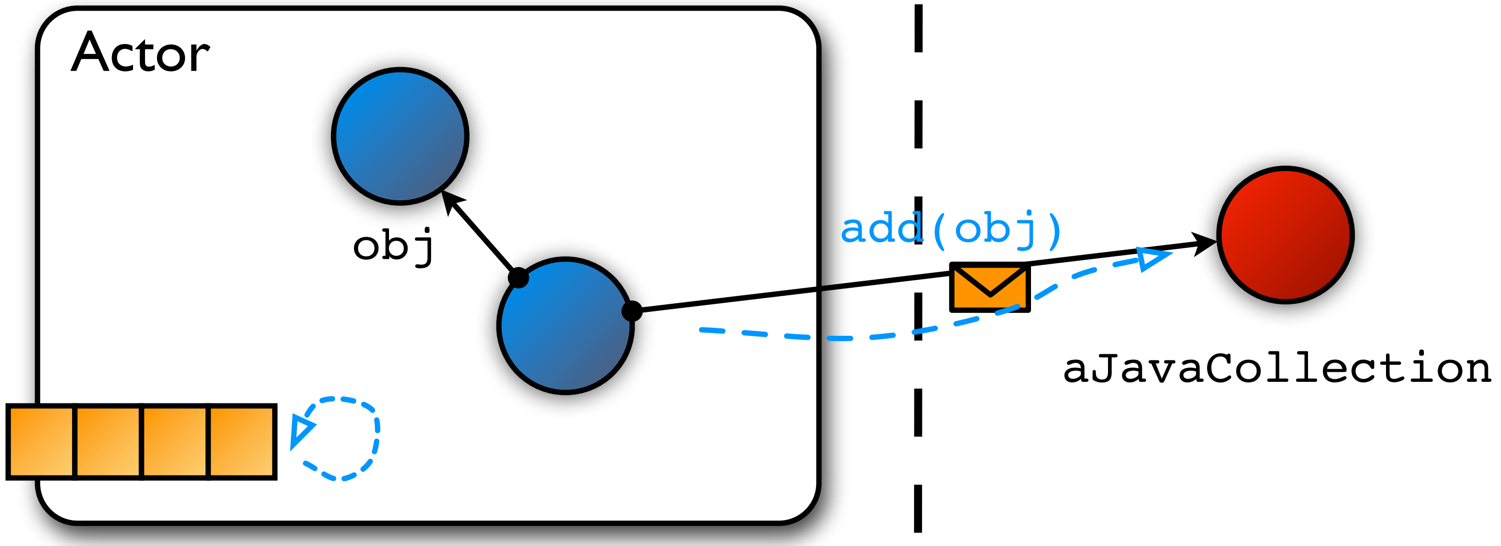

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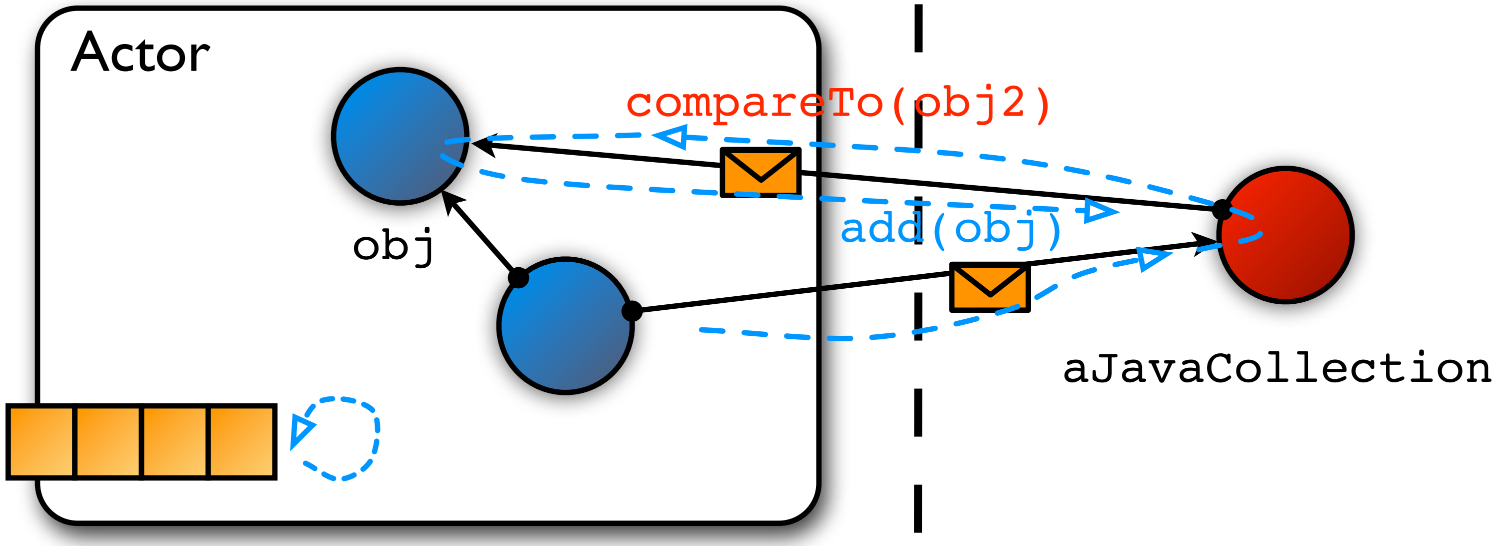

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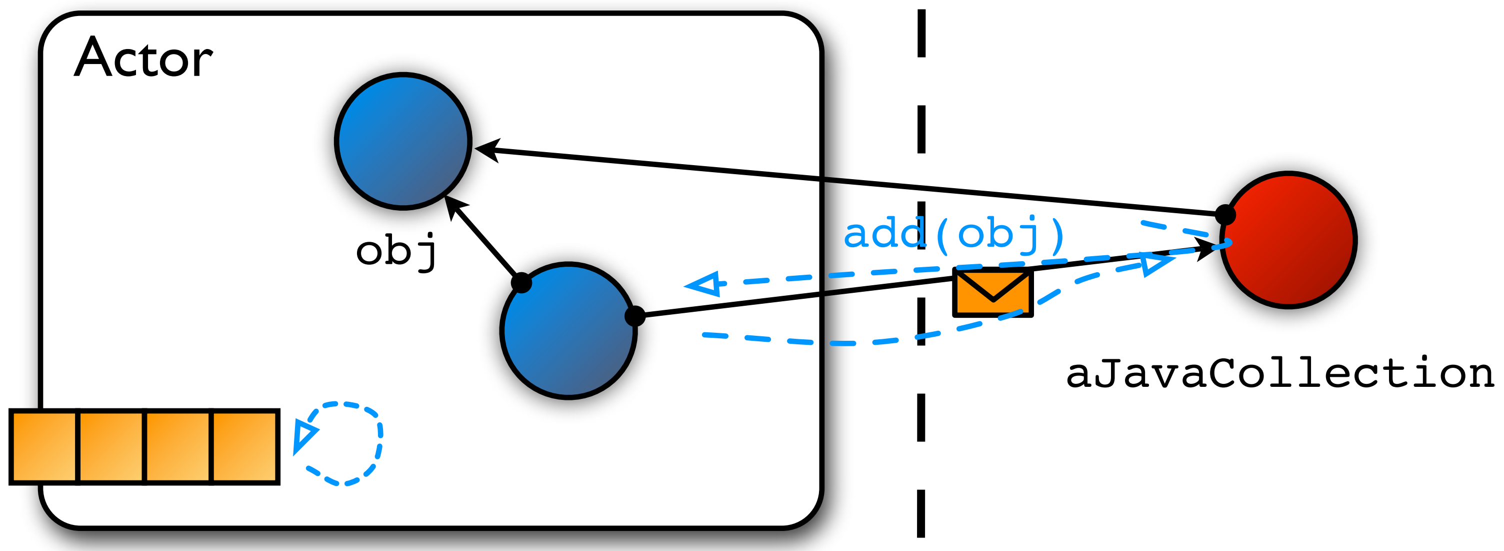

Threads as Actors

```
interface junit.framework.Test {
  public int countTestCases();
  public void run(TestResult r);
}
```

```
def ambientTalkTest := object: {
  def countTestCases() { ... }
  def run(result) { ... }
}
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Threads as Actors

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def ambientTalkTest := object: {
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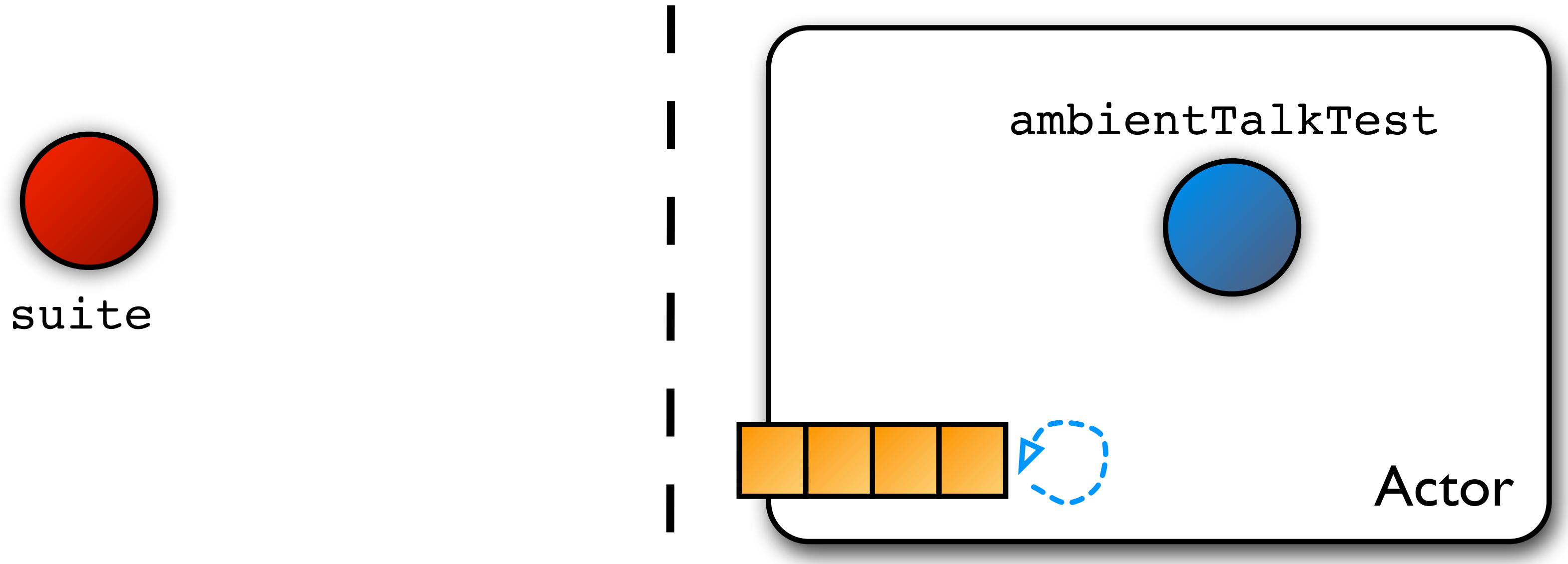
```
TestSuite suite = new TestSuite();
ATObject atUnitTest = /* load ambienttalk test */;
suite.addTest((Test) wrap(atUnitTest, Test.class));
suite.addTest(aJavaUnitTest);
junit.textuit.TestRunner.run(suite);
```

Threads as Actors



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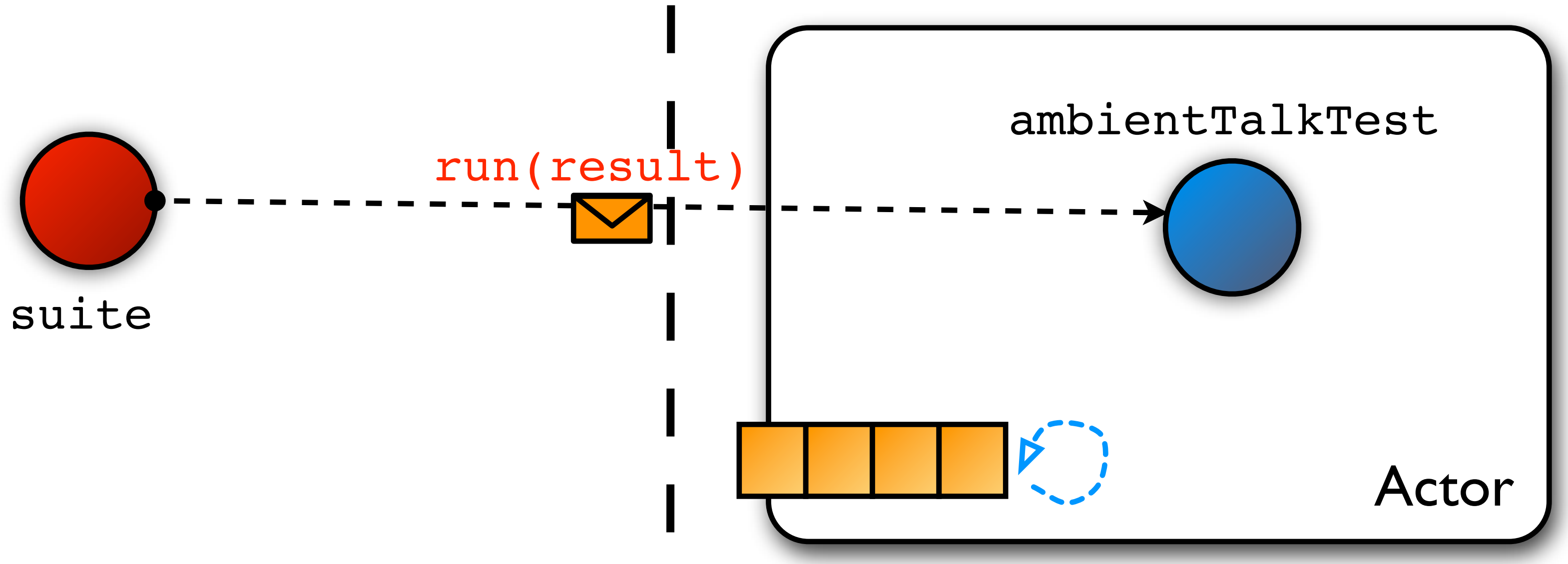

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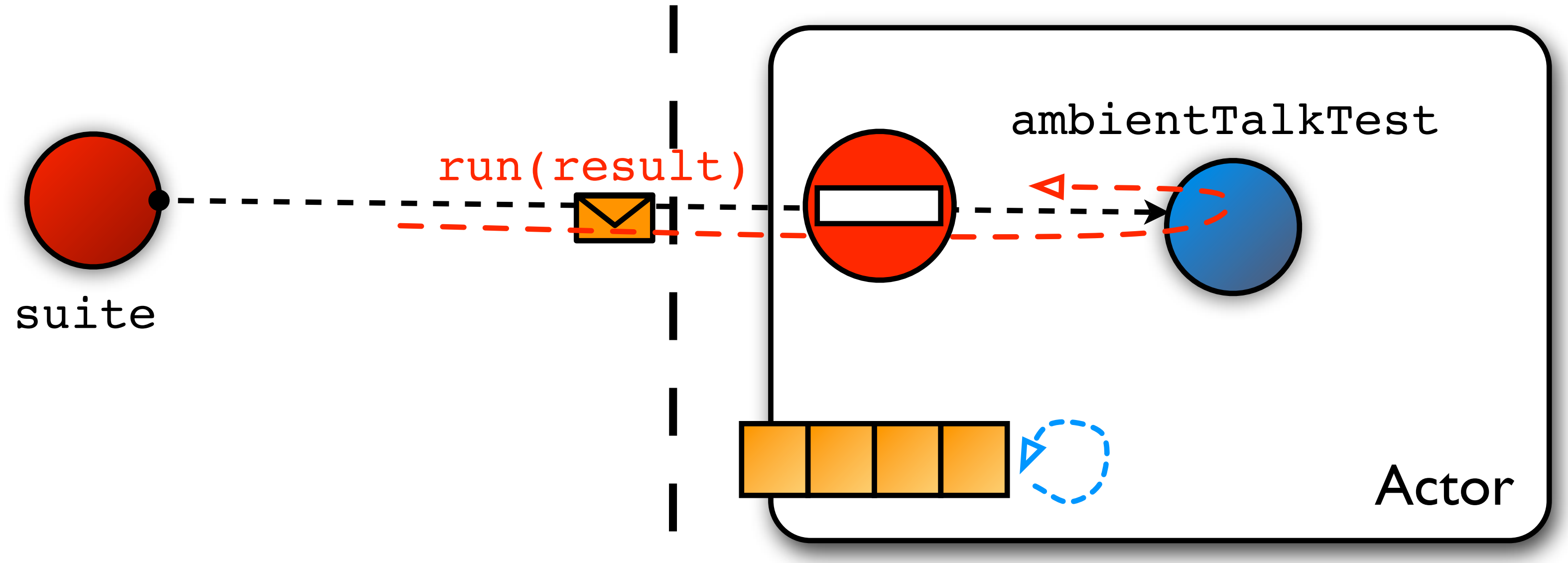

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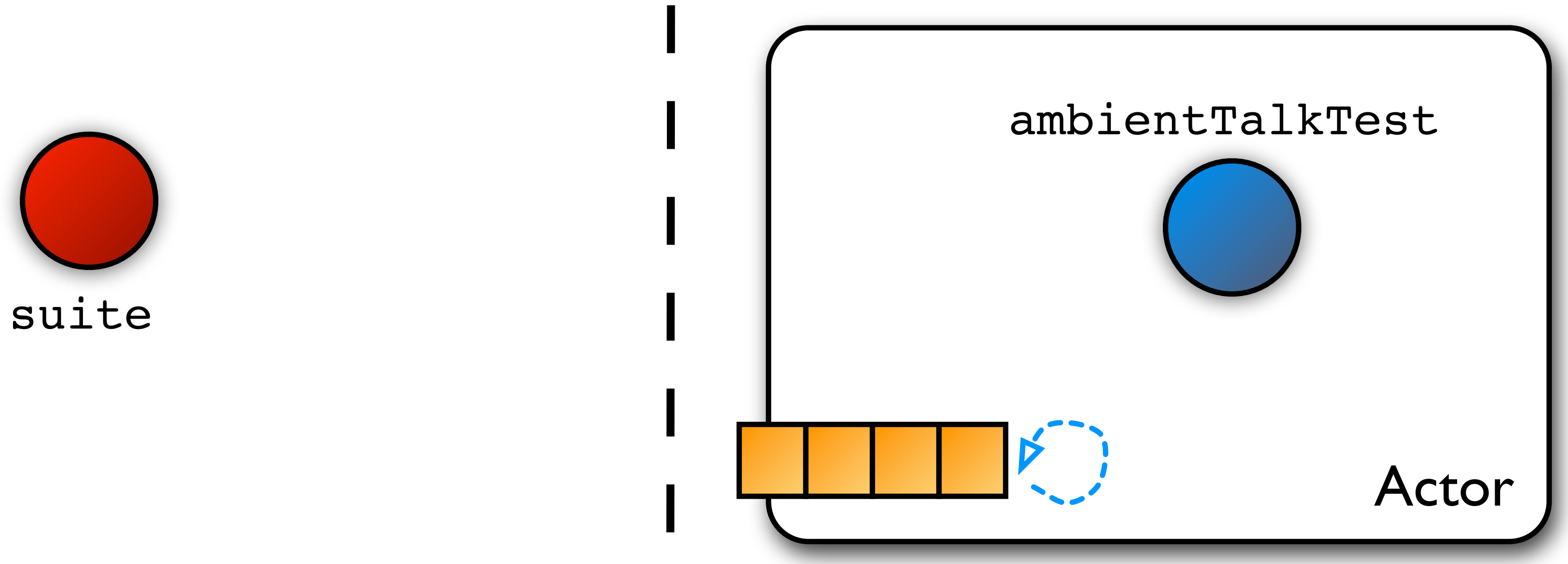

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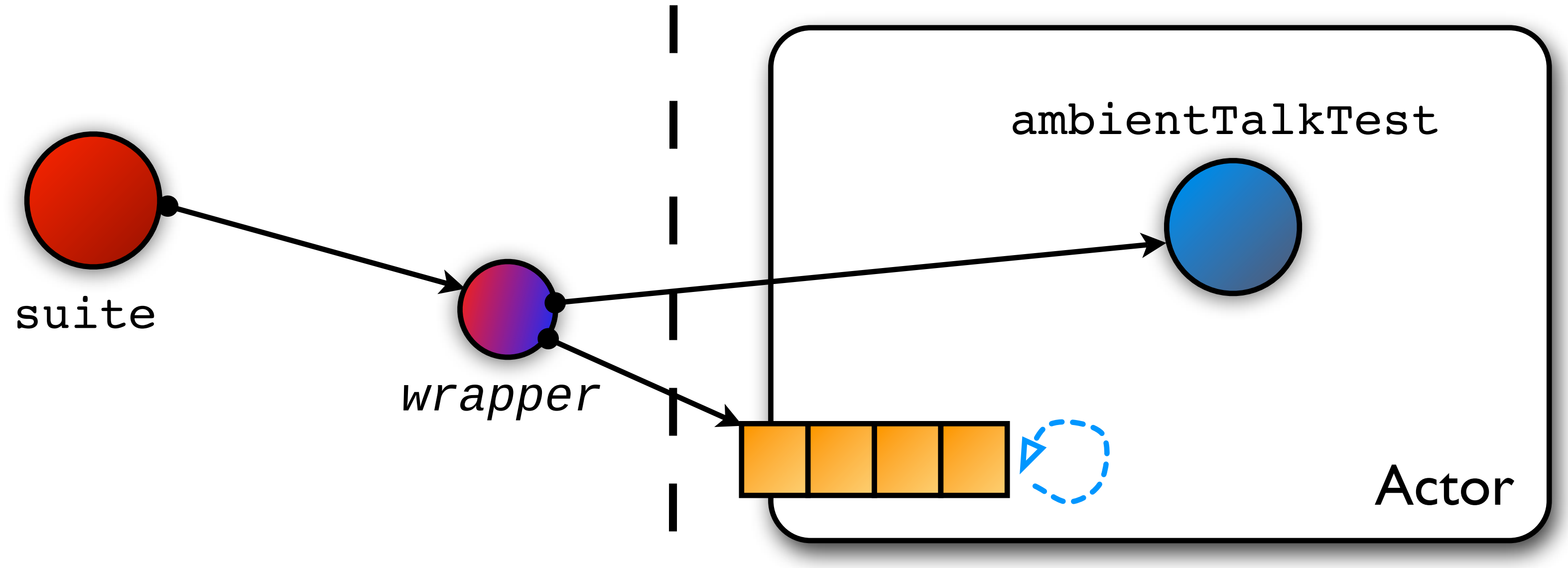

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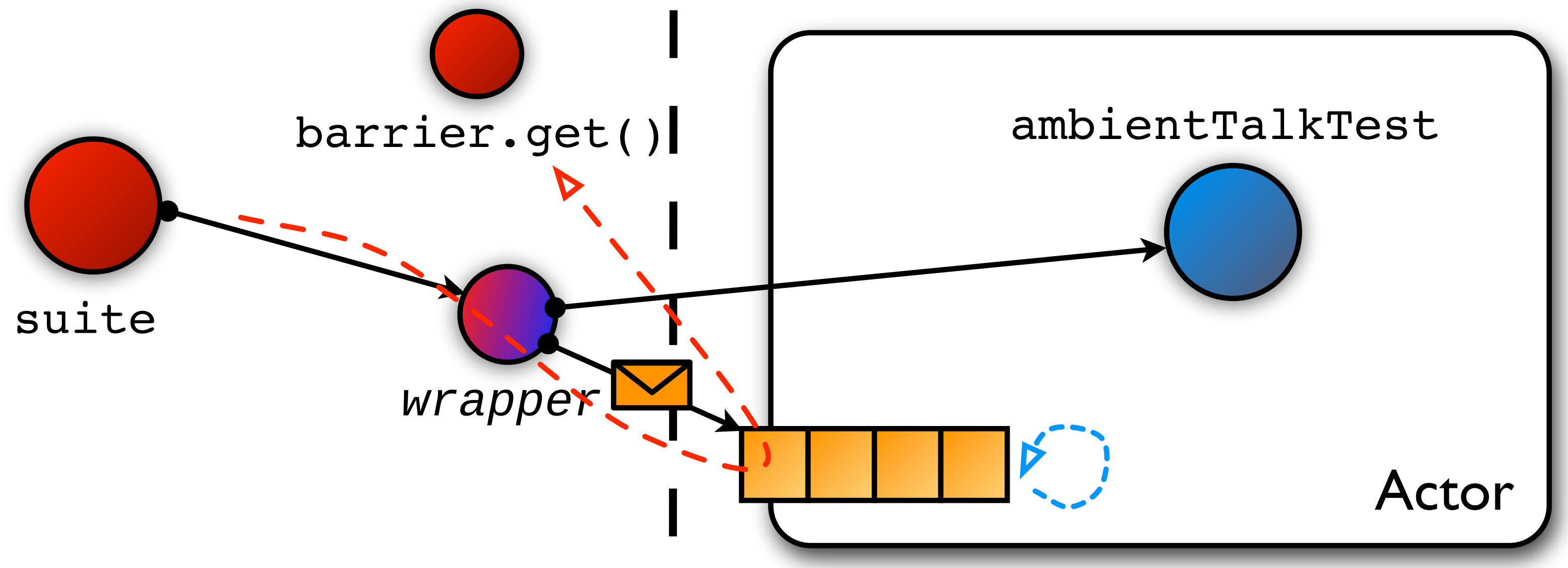

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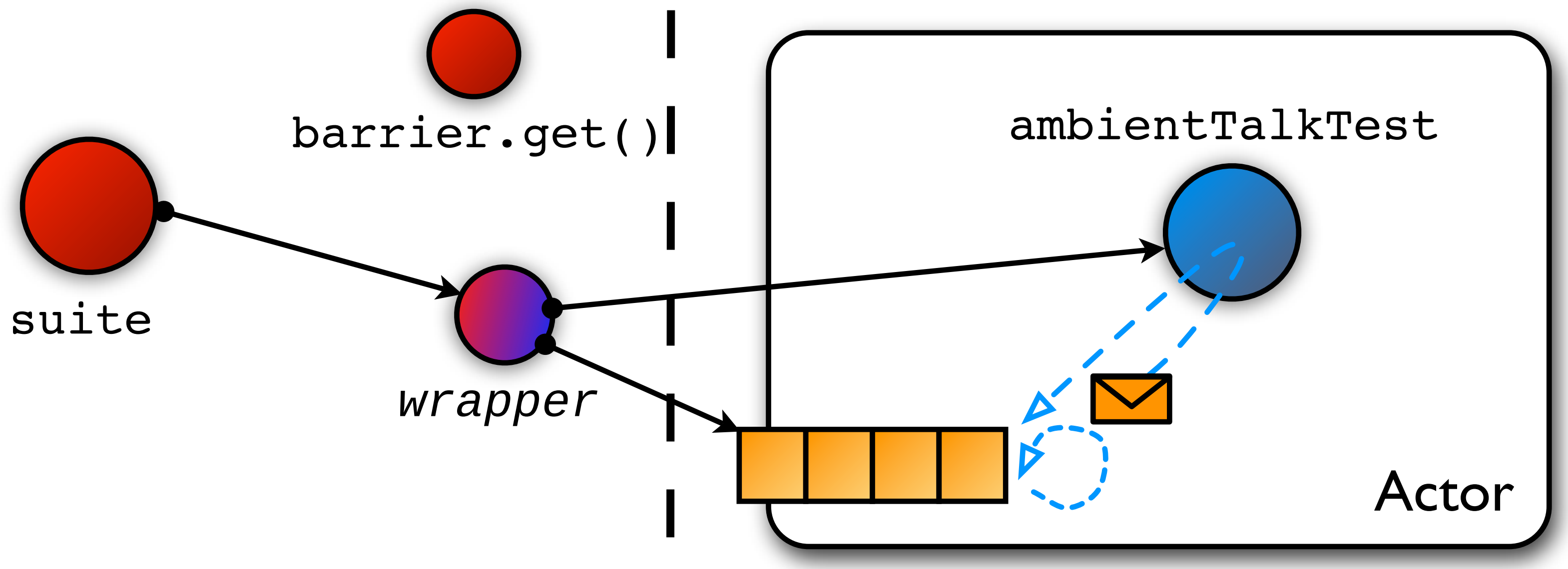

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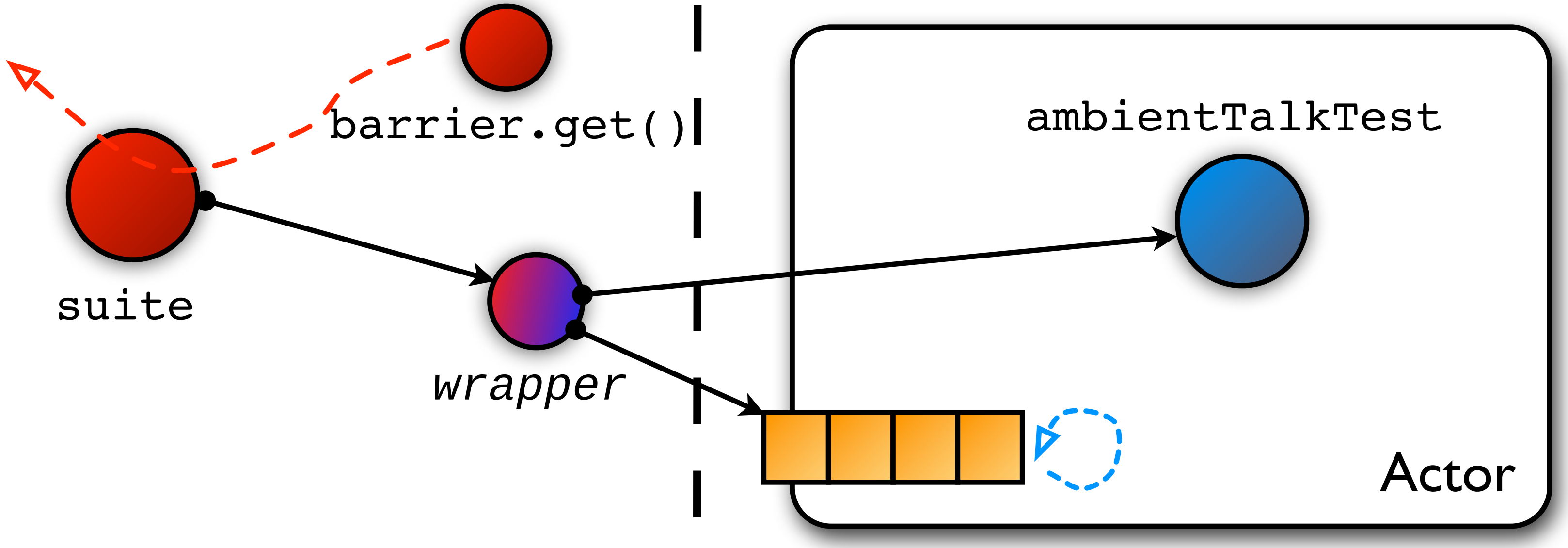

Threads as Actors

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ActionListener l = ...;
l.actionPerformed(actionEvent);
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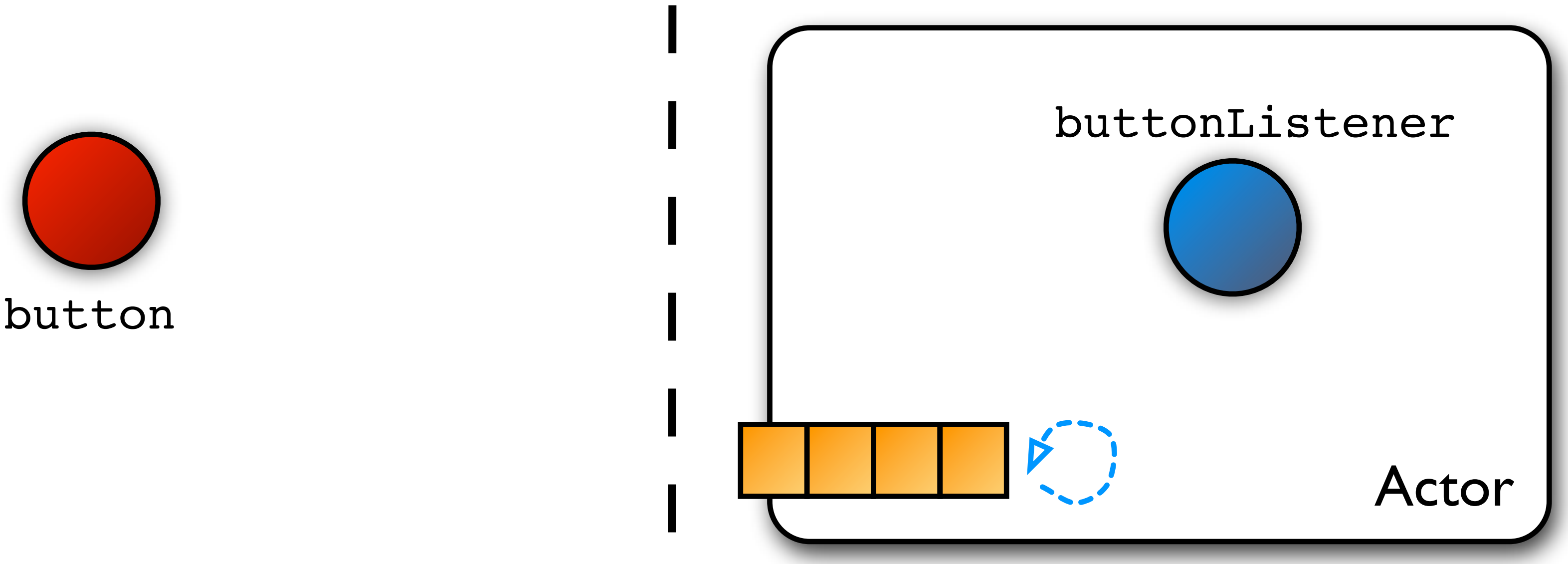

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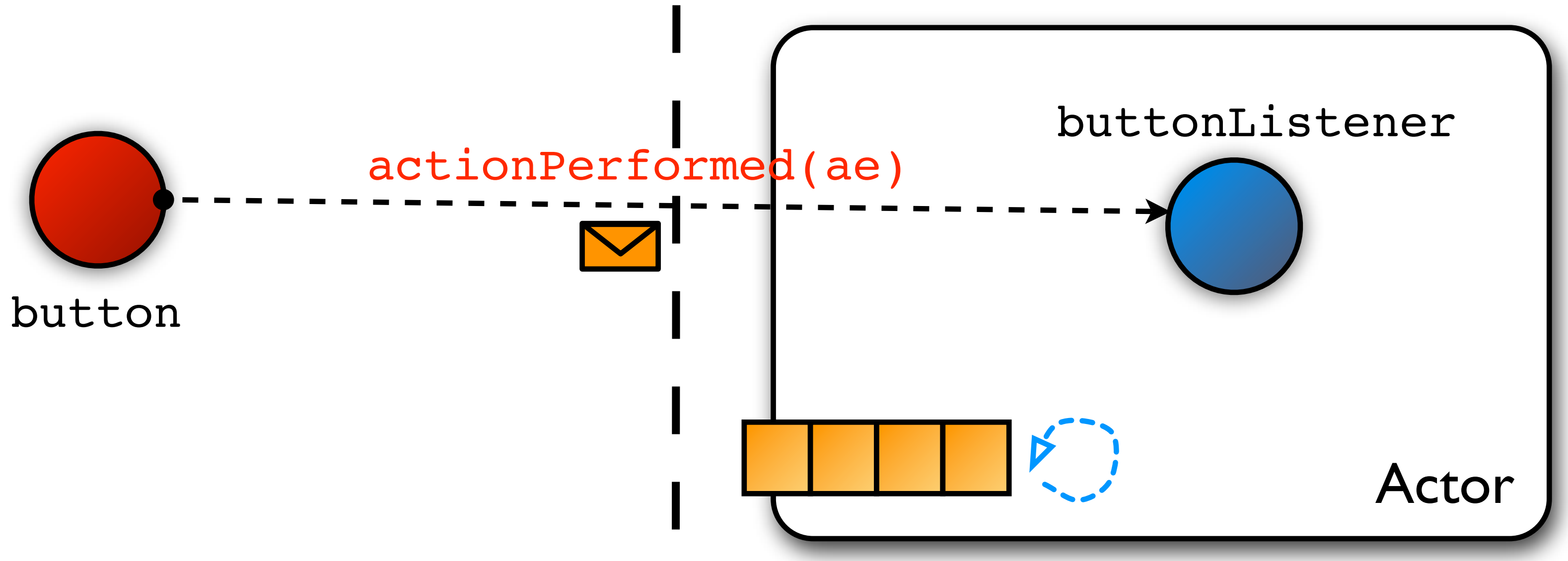

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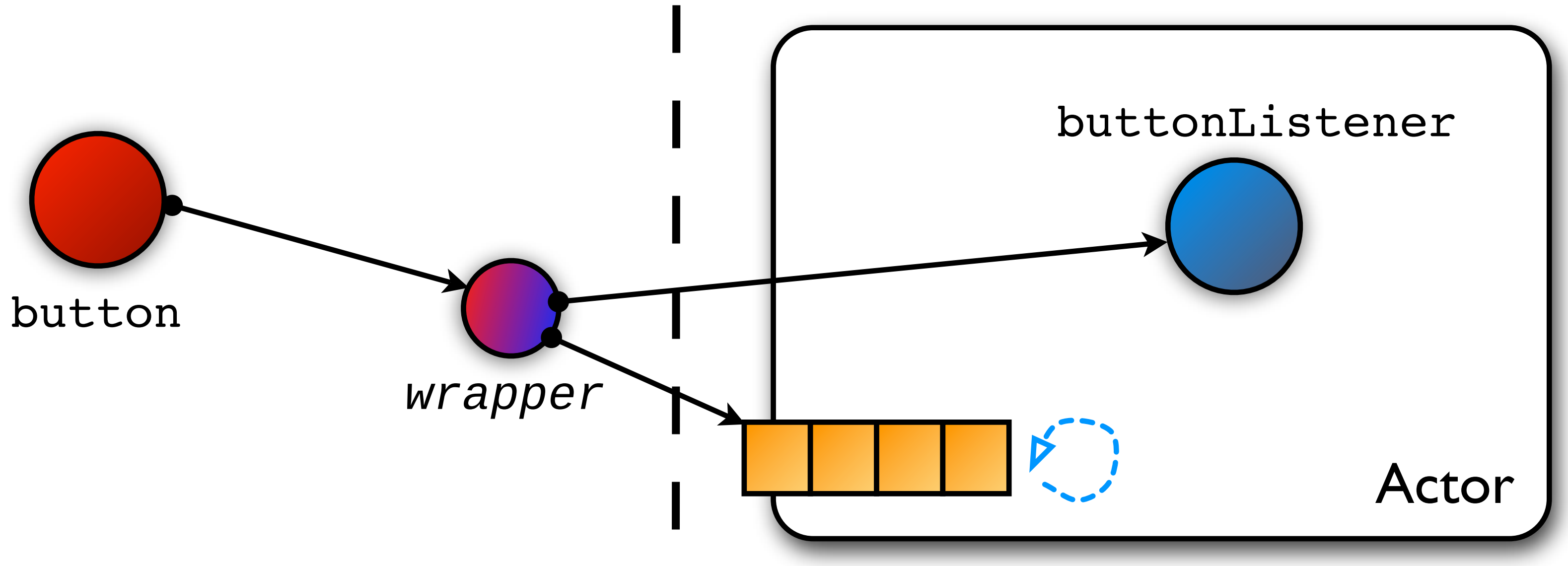

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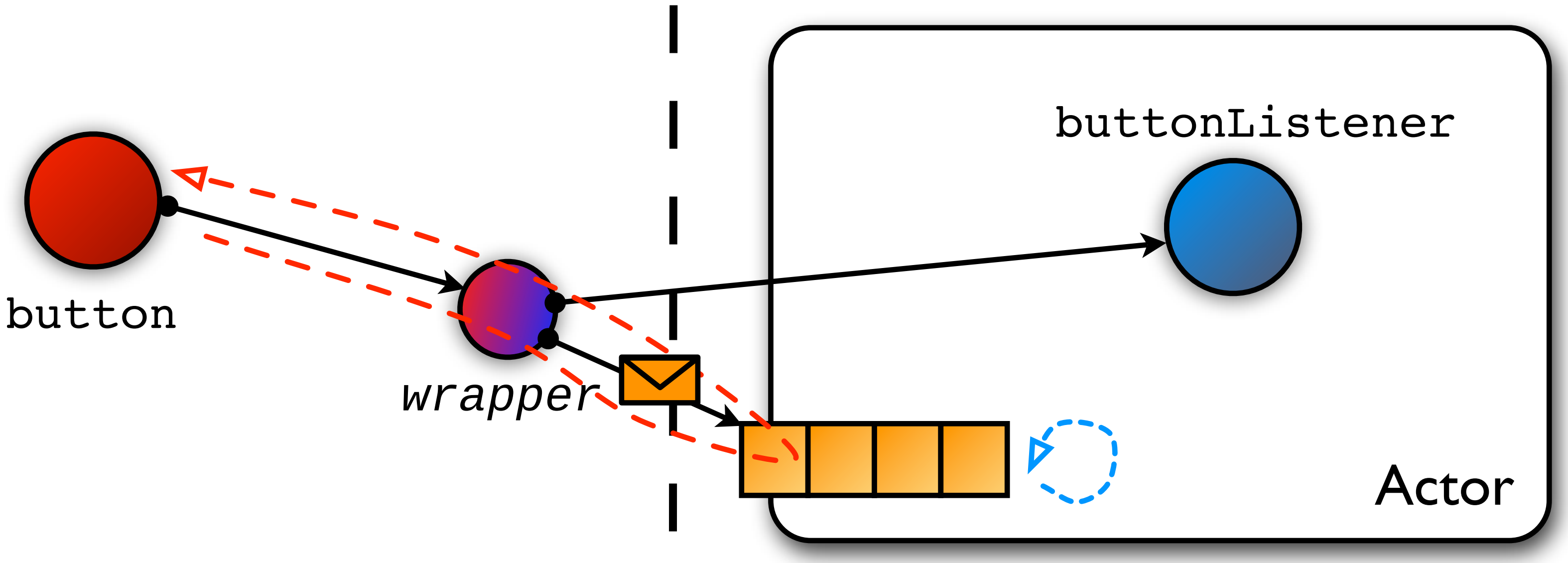

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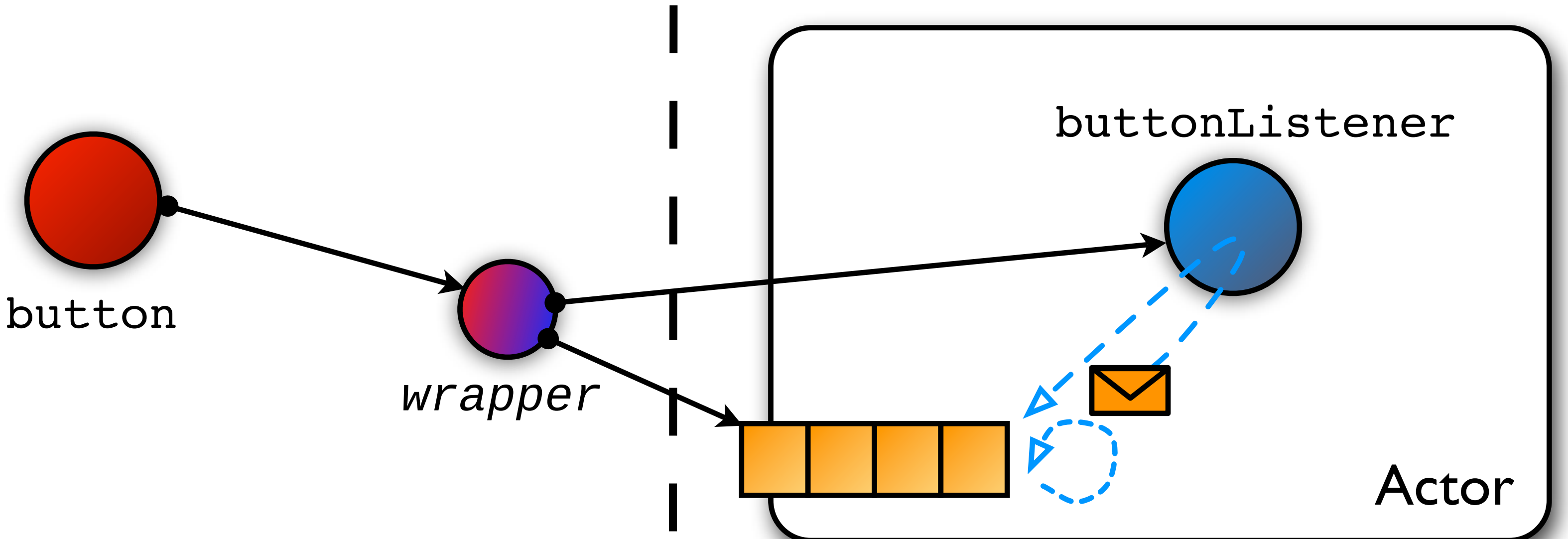

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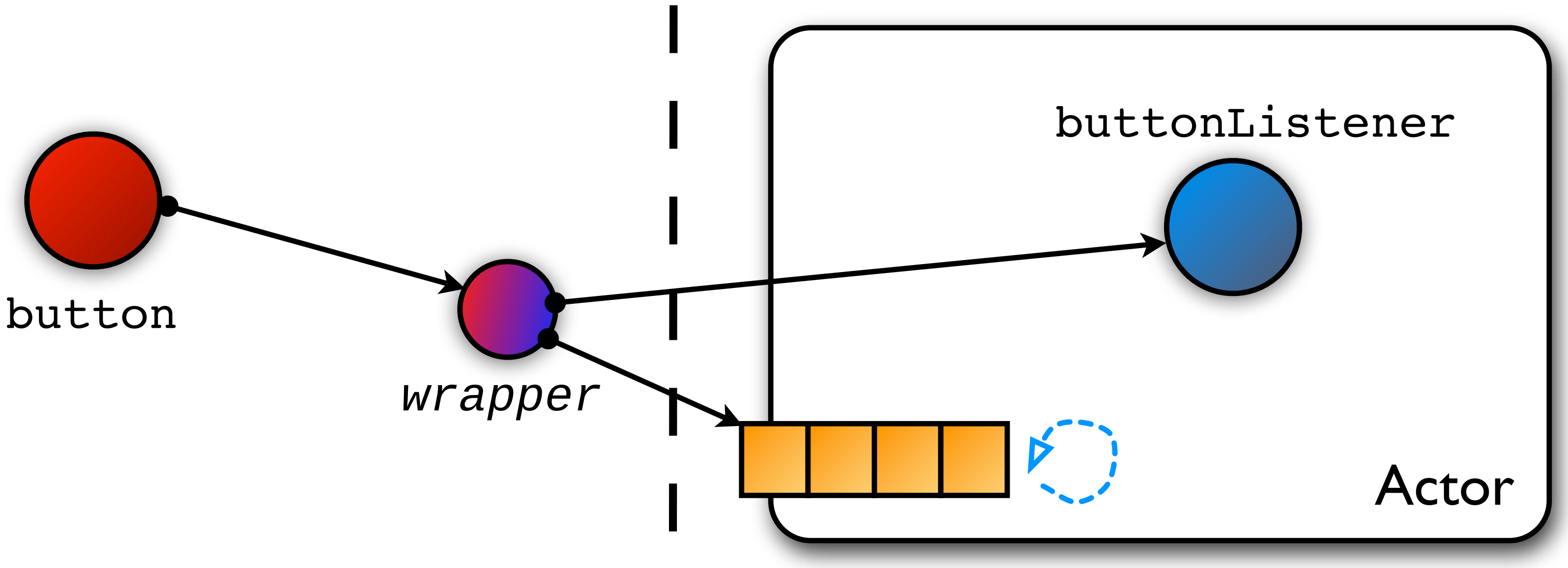
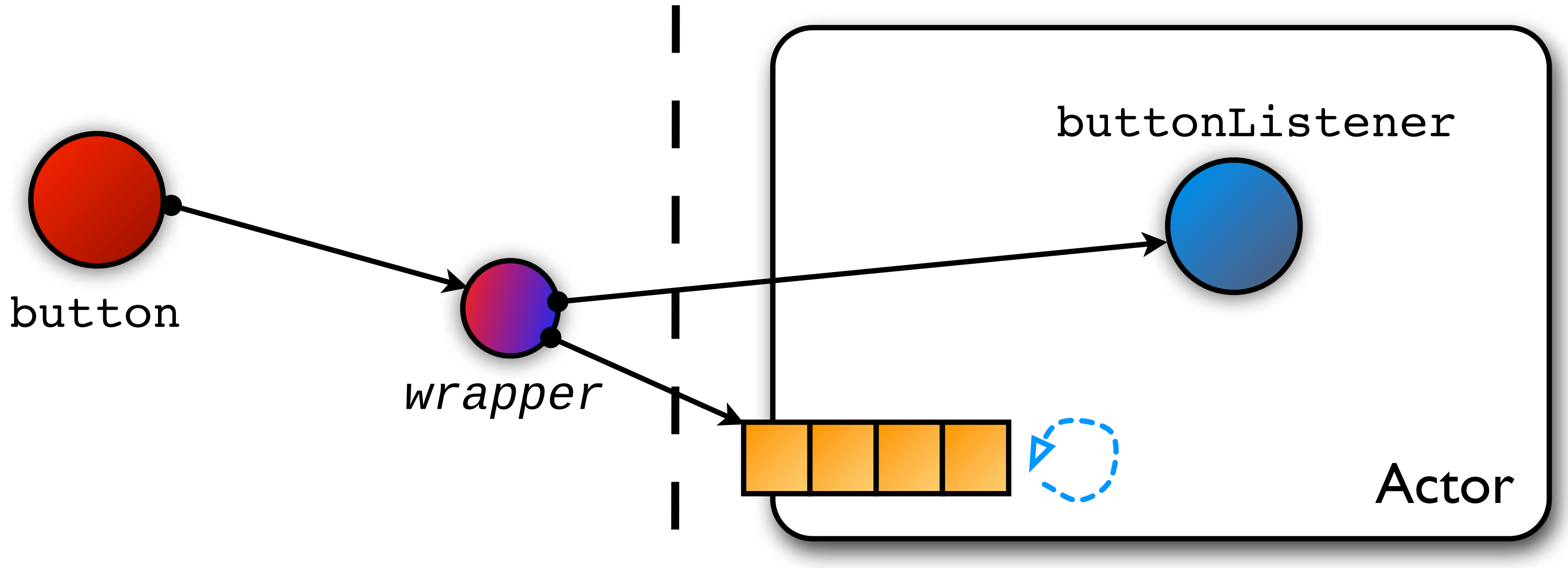
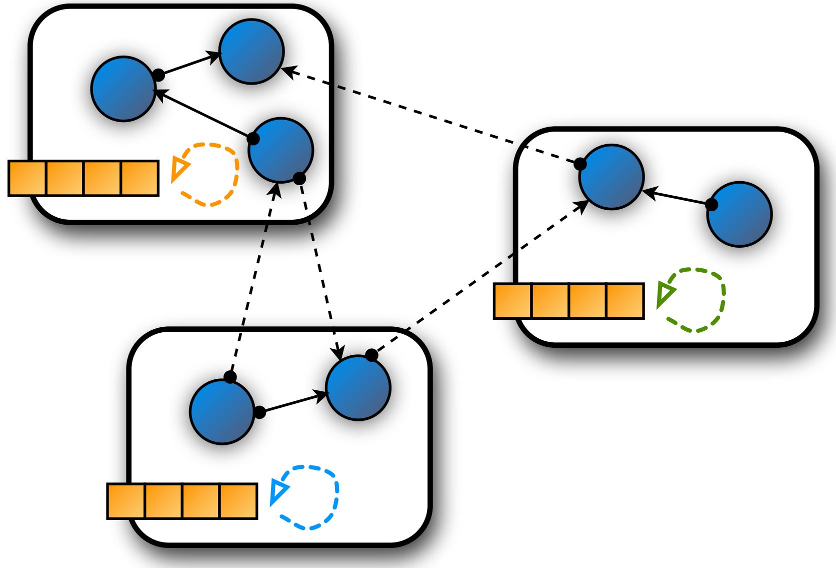


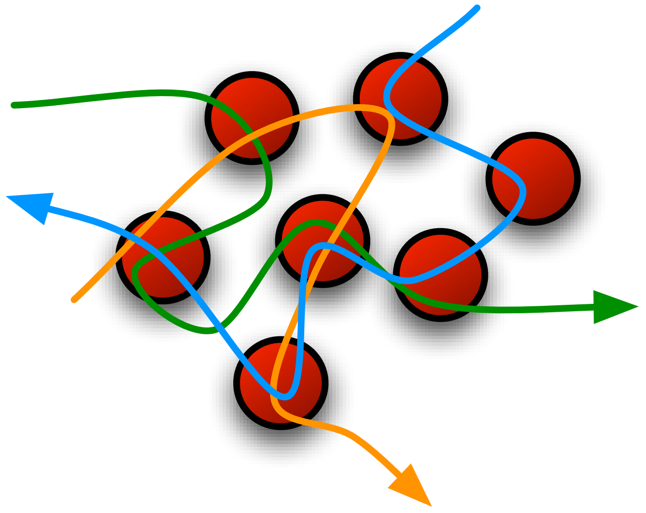
Threads as Actors

```
interface I extends java.util.EventListener {
  public void event(...);
}
```



Summary





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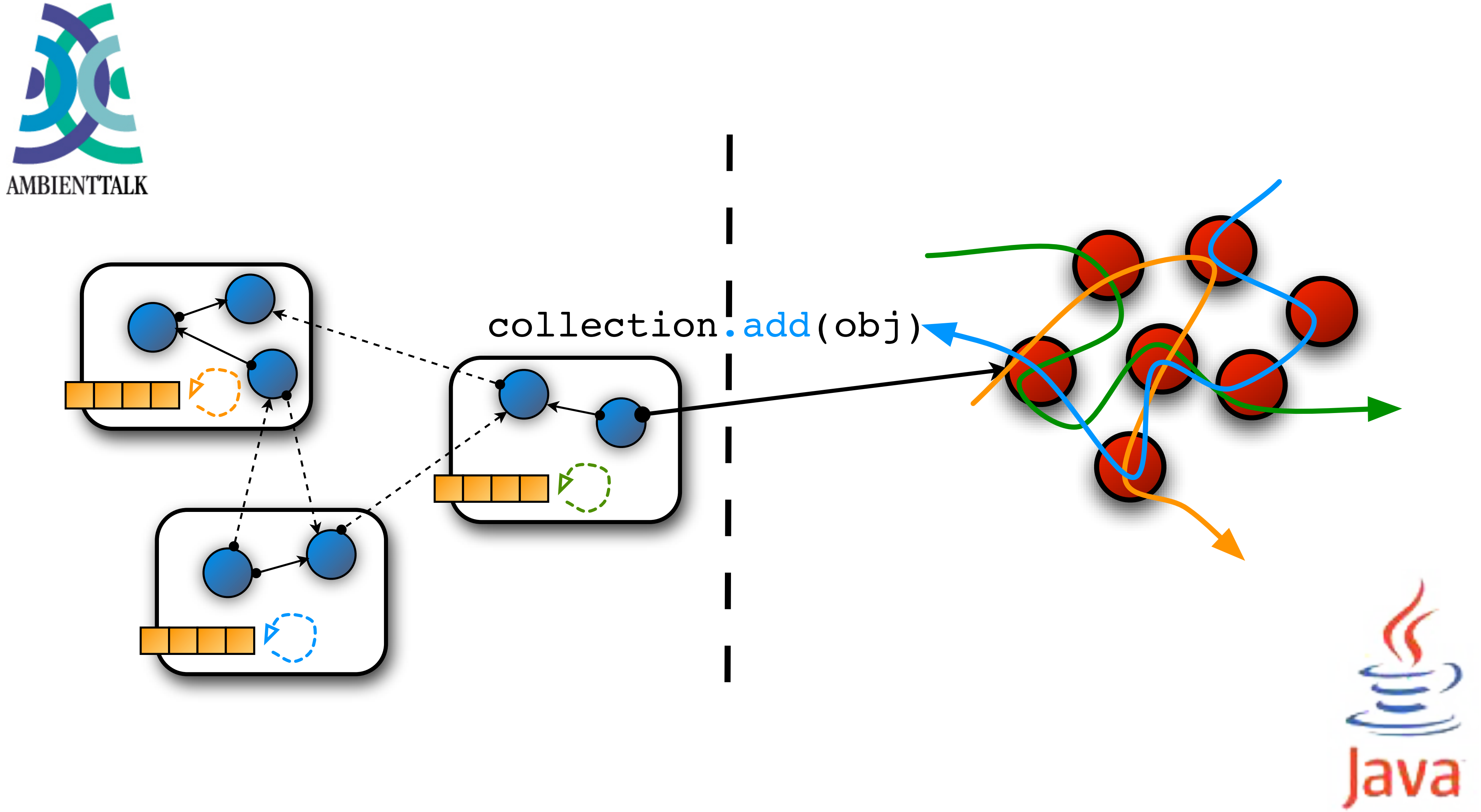

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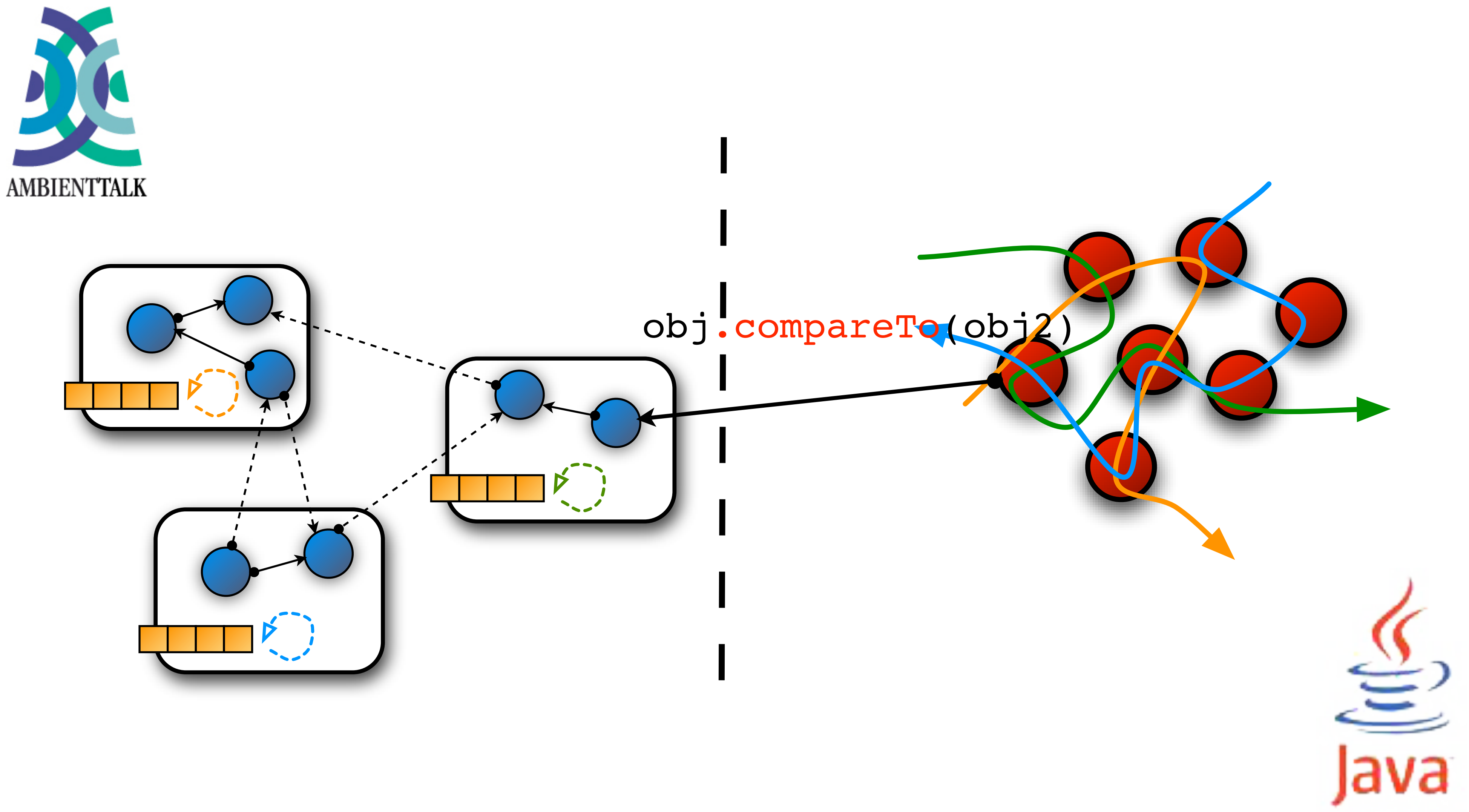

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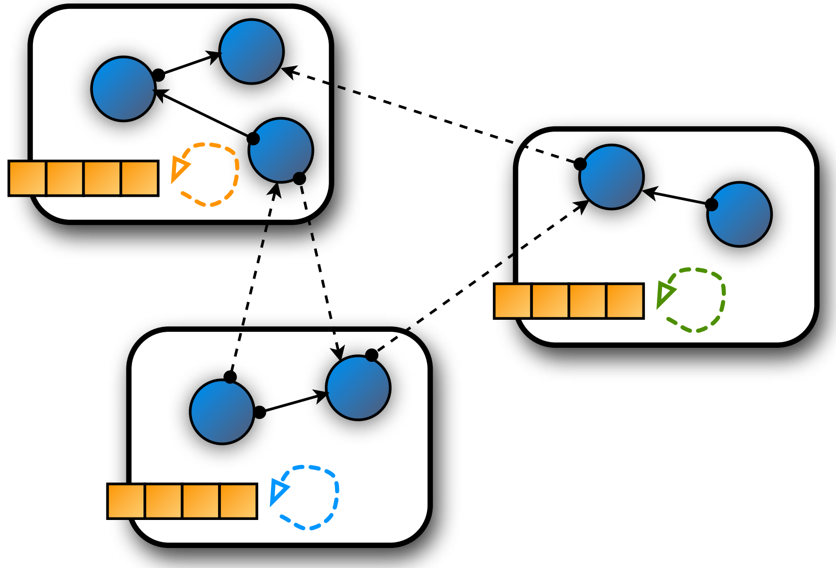

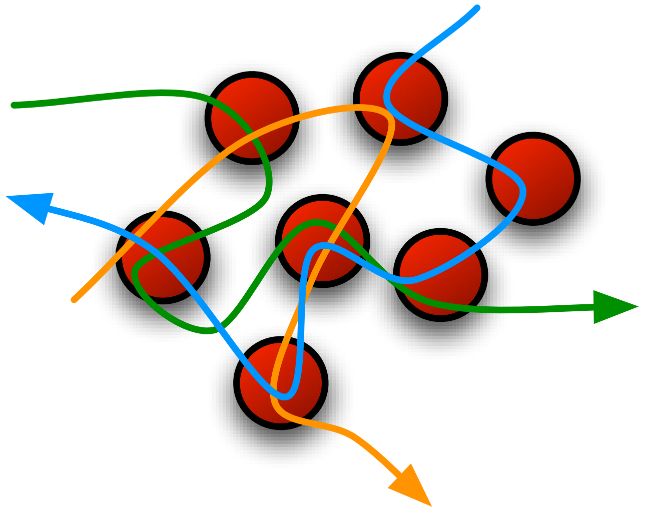

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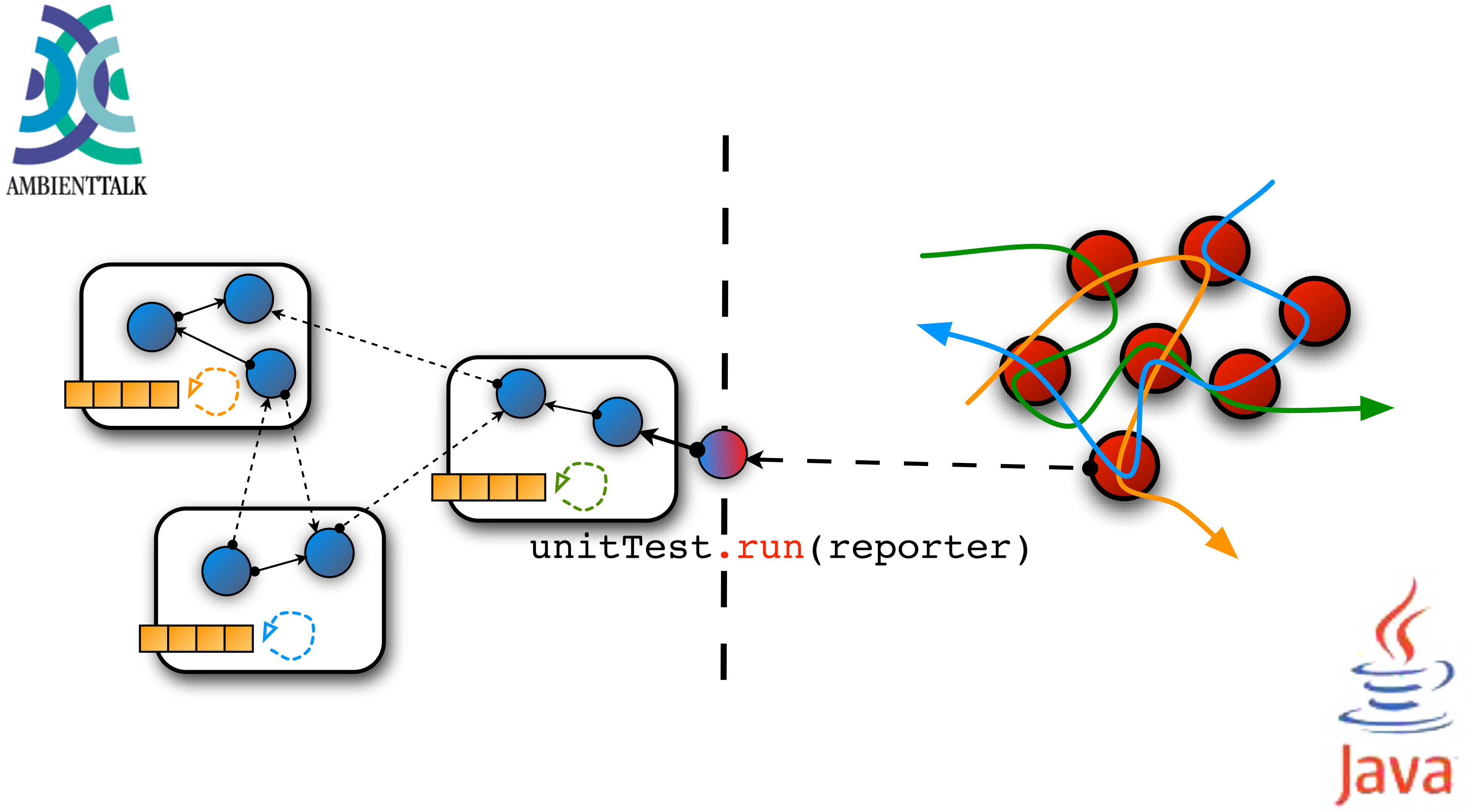

Summary

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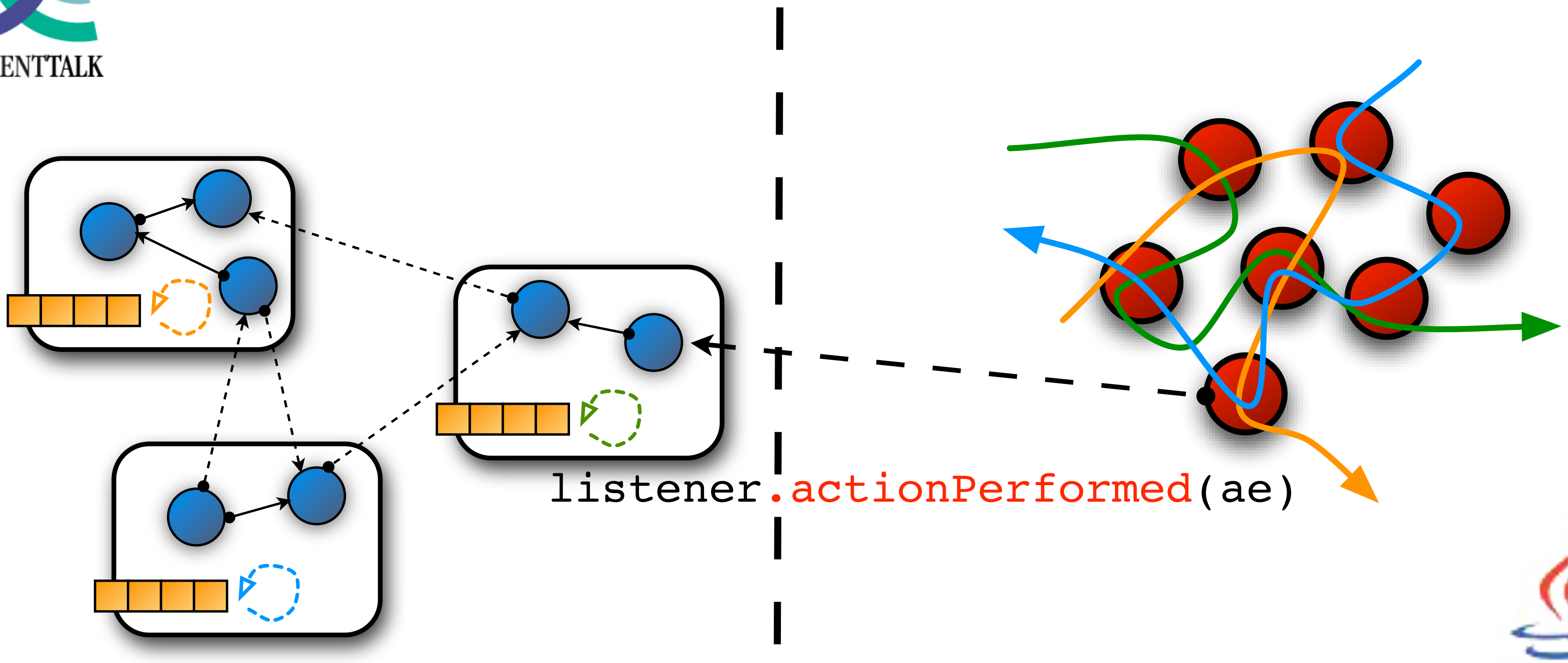

Java

Experience

- AmbientTalk using Java: AWT and Swing for GUI construction
- Java using AmbientTalk: JEdit plugin for collaborative text editing
- Self/Squeak's Morphic UI framework in AmbientTalk

Conclusions

- AmbientTalk: object-oriented (distributed) event-driven programming
- Symbiotic Thread/Actor mapping:
  - AmbientTalk invocations proceed immediately
  - Automatic synchronization of Java invocations
  - Support for Java "event notifications" (listeners)

AMBIENTTALK

http://prog.vub.ac.be/amop