Akka Made Our Day

JFokus 2014

Daniel Deogun & Daniel Sawano
Email: Daniel.deogun@Omegapoint.se, Daniel.Sawano@Omegapoint.se
Twitter: @DanielDeogun, @DanielSawano

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Who We Are

Daniel Deogun

Daniel Sawano

Omegapoint

Stockholm - Gothenburg - Malmoe - Umea - New York

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Agenda

- Akka in a nutshell
- Akka & Java
- Domain influences
- Lessons learned from building real systems with Akka

Akka in a Nutshell

http://akka.io/

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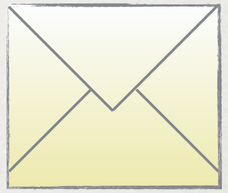
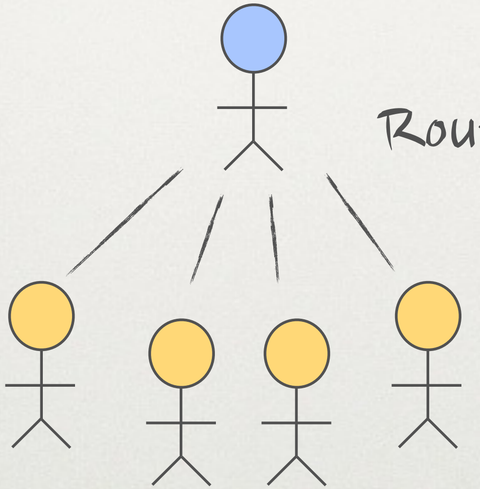
Akka in a Nutshell

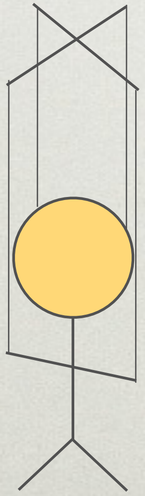
Actors

Messages





Routers



Actor System

Mailbox

[1]

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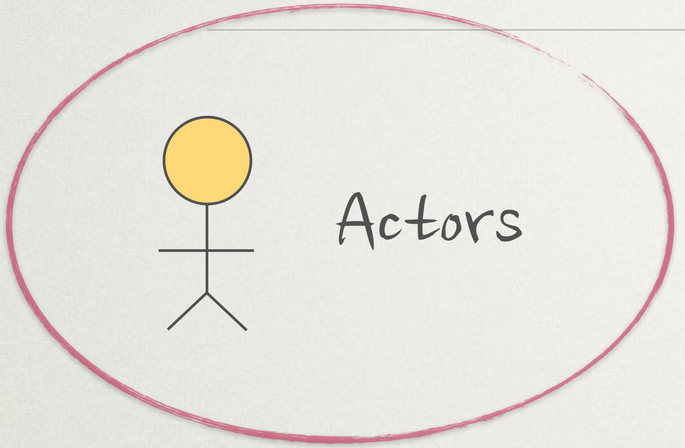
Akka in a Nutshell



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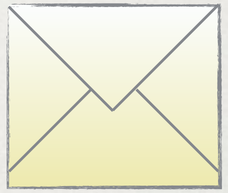

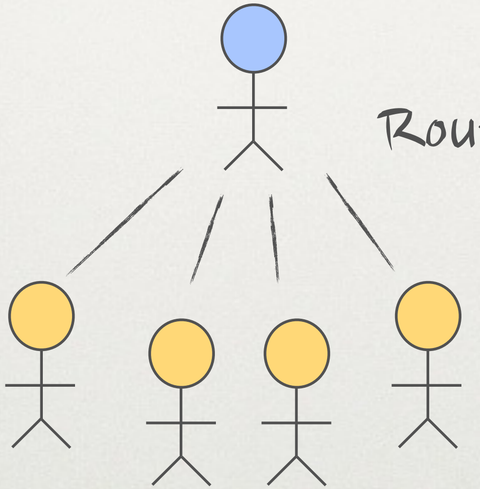

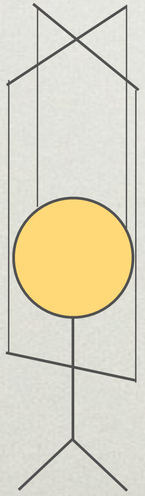

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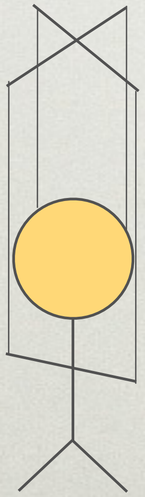

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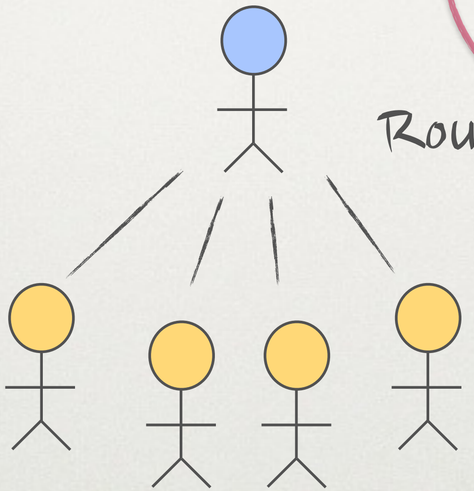

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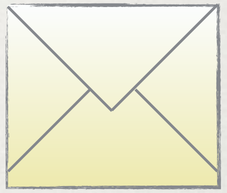
Messages



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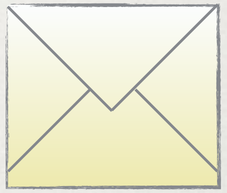

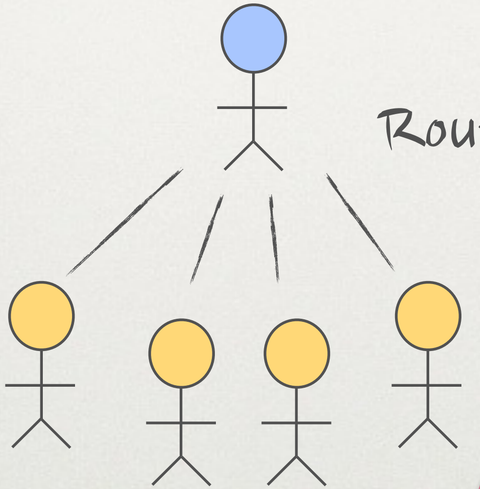

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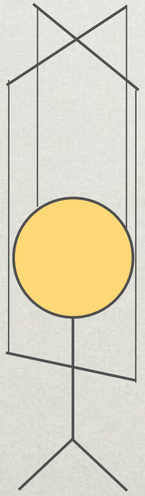

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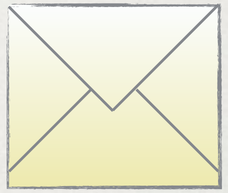

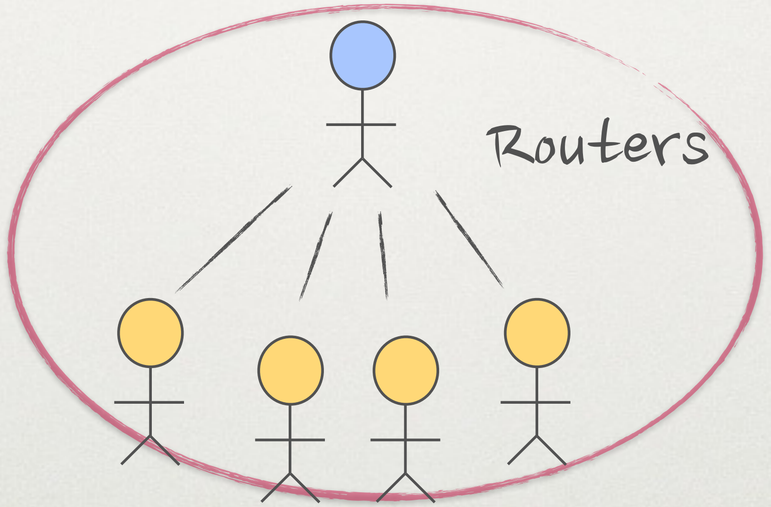

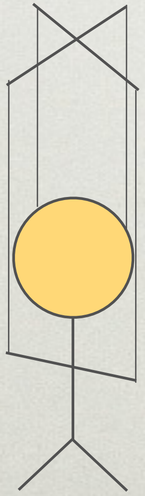

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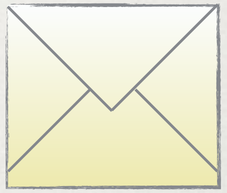

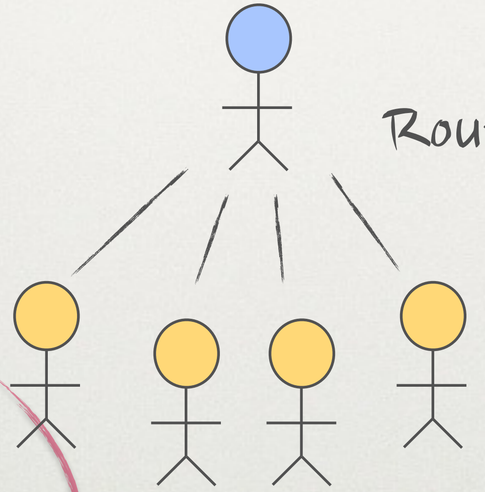

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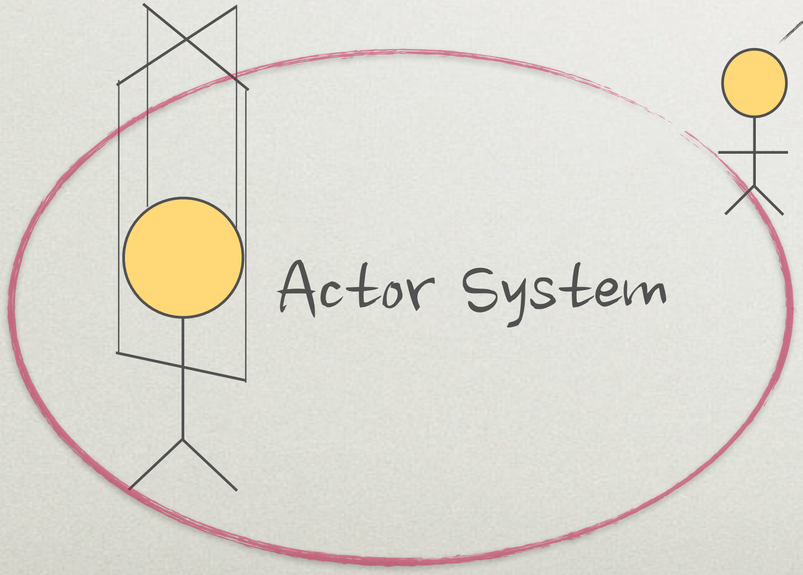

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Our definition of Legacy Code

Legacy \ˈle-gə-sē\

“: something that happened in the past or that comes from someone in the past”

- Merriam-Webster

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Legacy \ˈle-gə-sē\

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Legacy Code \ˈle-gə-sē\ \ˈkōd\

": code that does not satisfy the characteristics of a reactive system"

- Deogun-Sawano

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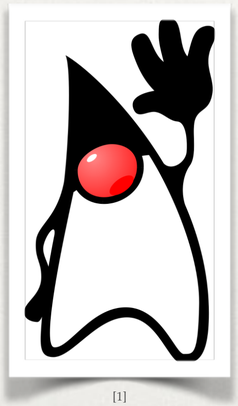
What is Legacy Code?

Characteristics of a reactive system, as defined by the reactive manifesto:

- responsive
- scalable
- resilient
- event-driven

reactivemanifesto.org

Java or Scala



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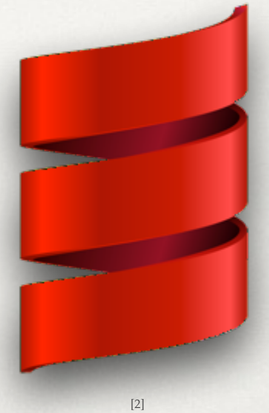

[2]

I want to build an application with Akka, should I use Java or Scala?

Well, it depends...

[1] https://duke.kenai.com/wave/_Midsize/Wave.png.png
[2] http://www.scala-lang.org/

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Java or Scala

Assume we want to build a machine M to solve a problem P where,

- Efficiency is imperative
- Sequential computations shall be independent
- Implementation of M shall be platform independent
- Complexity and boilerplate code shall be reduced
- M's behavior shall be verifiable
- Time to Market is essential and risks minimized

omega point.

Java or Scala
Pros & Cons

Assume we want to build a machine M to solve a problem P where,

- ☐ Efficiency is imperative
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- ☐ Implementation of M shall be platform independent
- ☐ Complexity and boilerplate code shall be reduced
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Scoreboard

Java:

Scala:

omega point.

Java or Scala
Pros & Cons

Assume we want to build a machine M to solve a problem P where,

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Scoreboard

Java: 1

Scala: 1

omega point.

Java or Scala
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Scoreboard

Java: 11

Scala: 11

omega point.

Java or Scala
Pros & Cons

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Scoreboard

Java: III

Scala: III

omega point.

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Scoreboard

Java: III

Scala: IIII

omega point.

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Scoreboard

Java: IIII

Scala: ~~IIII~~

omega point.

Java or Scala
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Java or Scala Conclusion

- Both Java and Scala works well with Akka
- Choose the language that makes most sense
- Don't add unnecessary risk

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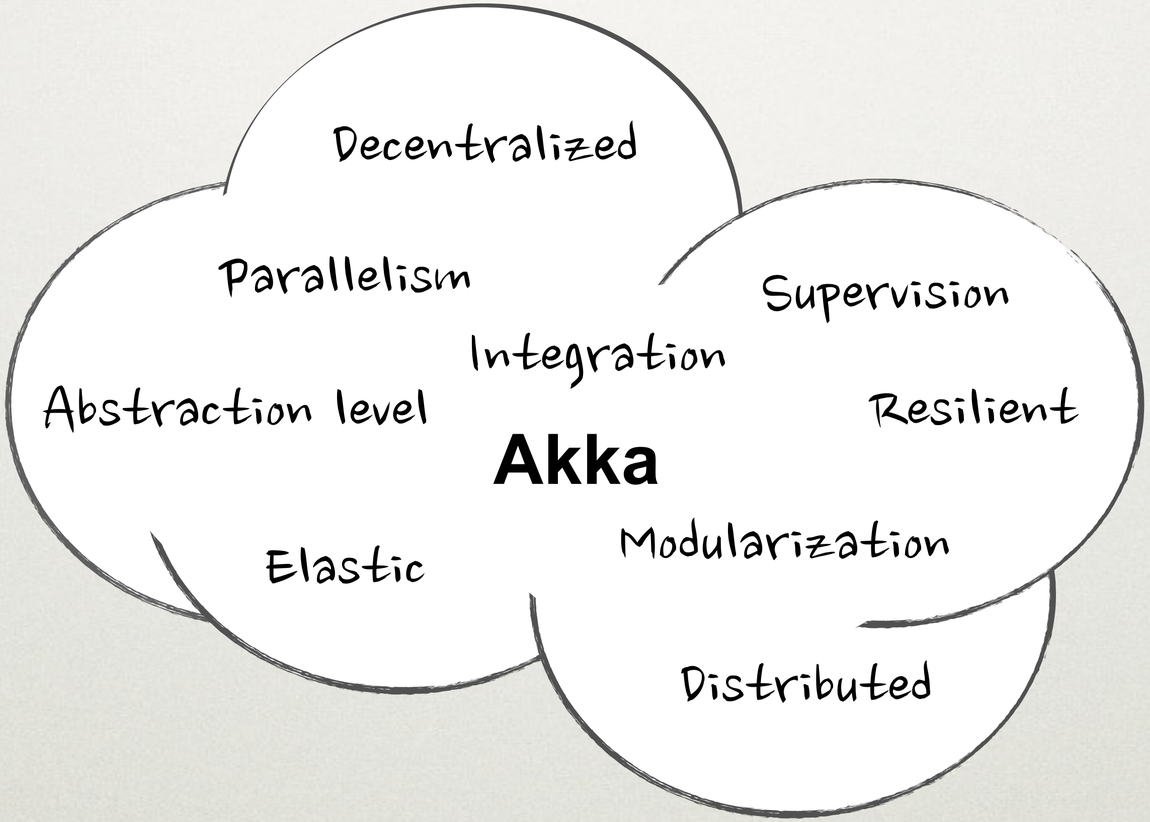
Akka
All or nothing?



omega point.

Akka
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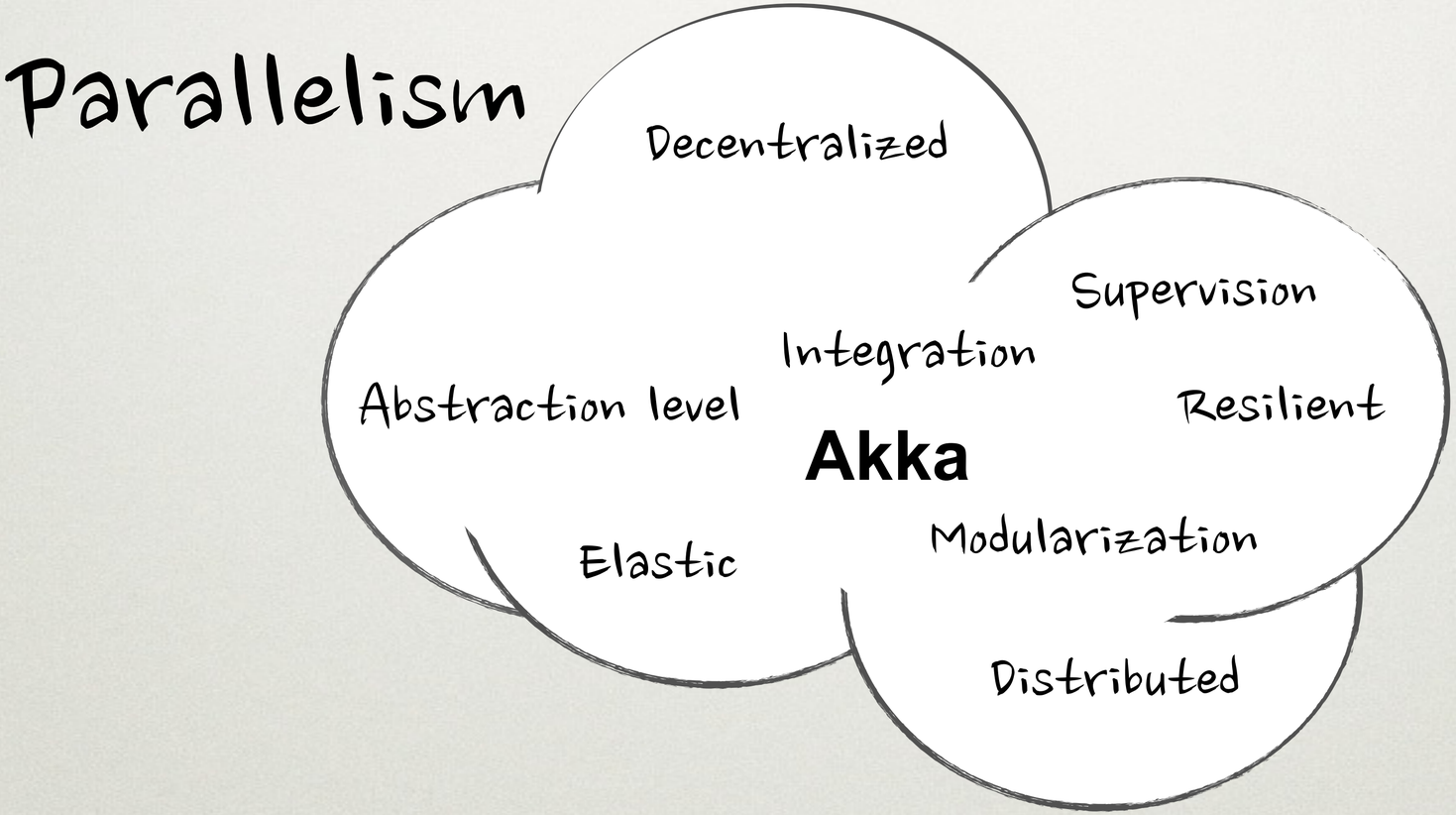

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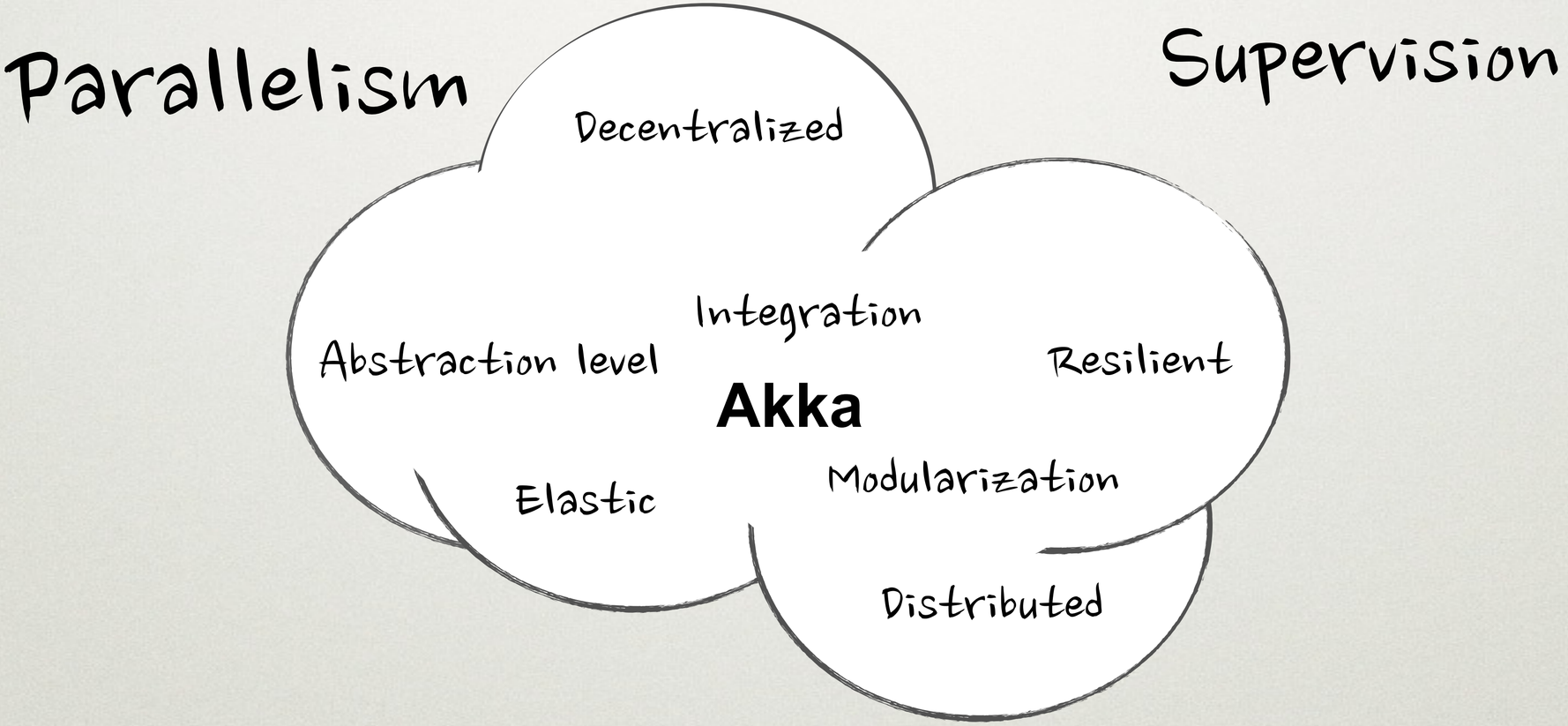

omega point.

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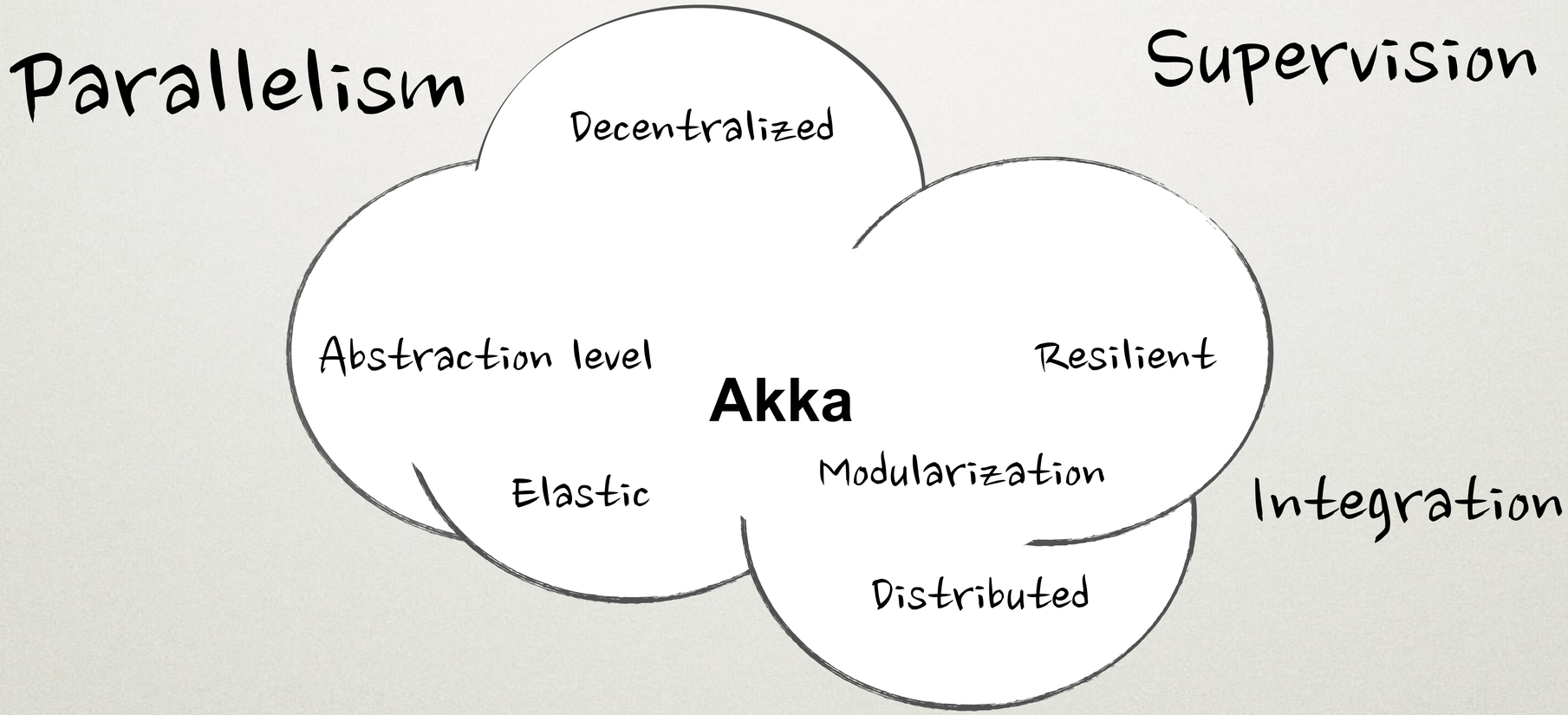

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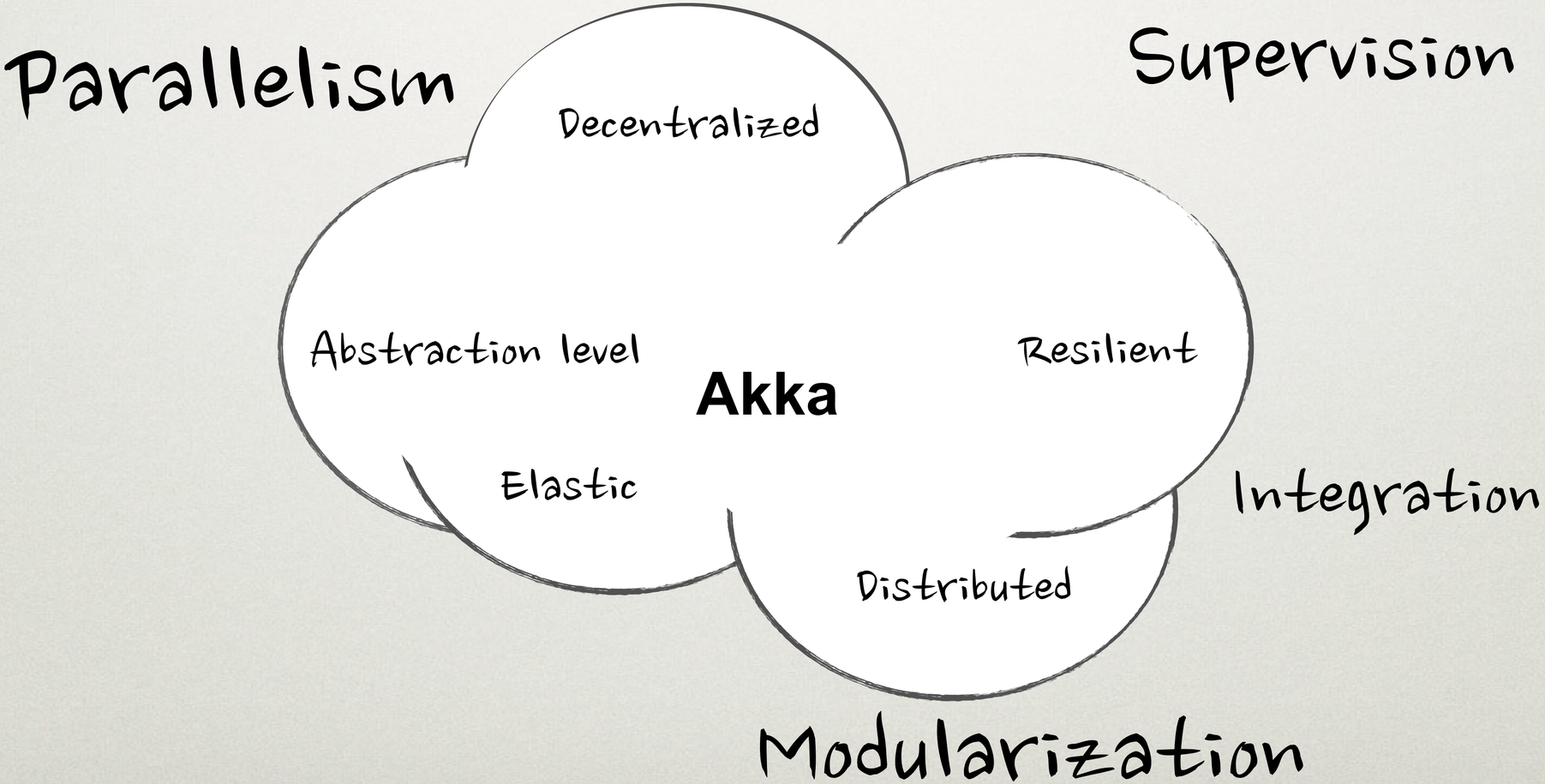

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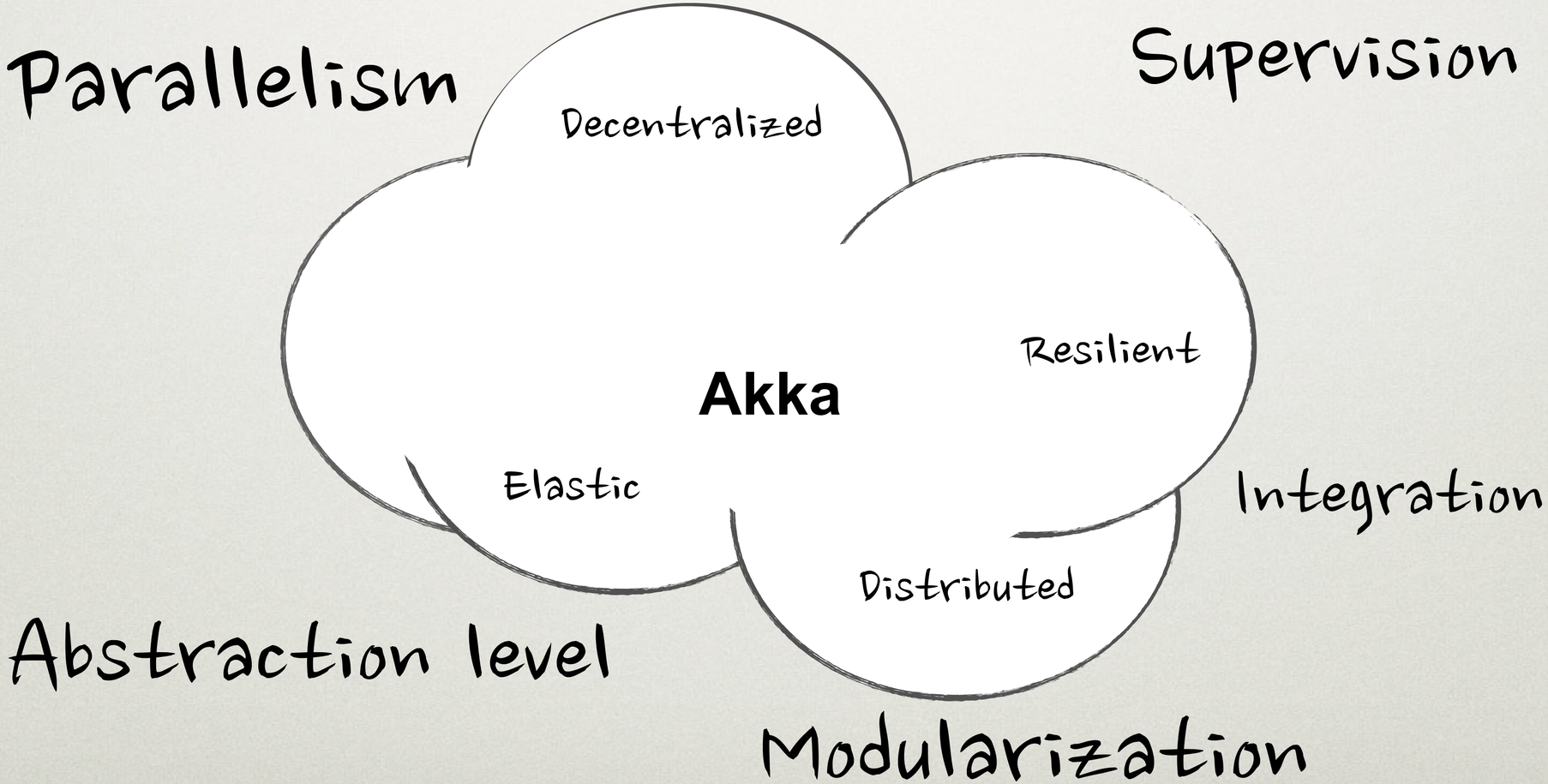

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Domain Specific Requirements

- Akka is more or less a perfect match for all parallelizable domains

- But what about
  - reactive domains with blocking parts?
  - legacy domains with reactive parts?

[1]

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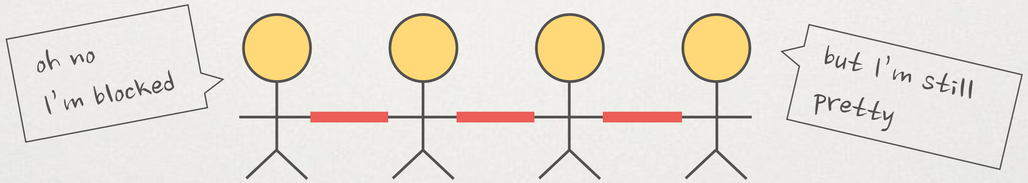
Blocking in a Reactive Environment

- If we choose Akka, we need to block actors, yuck!



- The main advantage is that we can reuse actors from parallelizable parts but are there any downsides?

- The other option is to use legacy design

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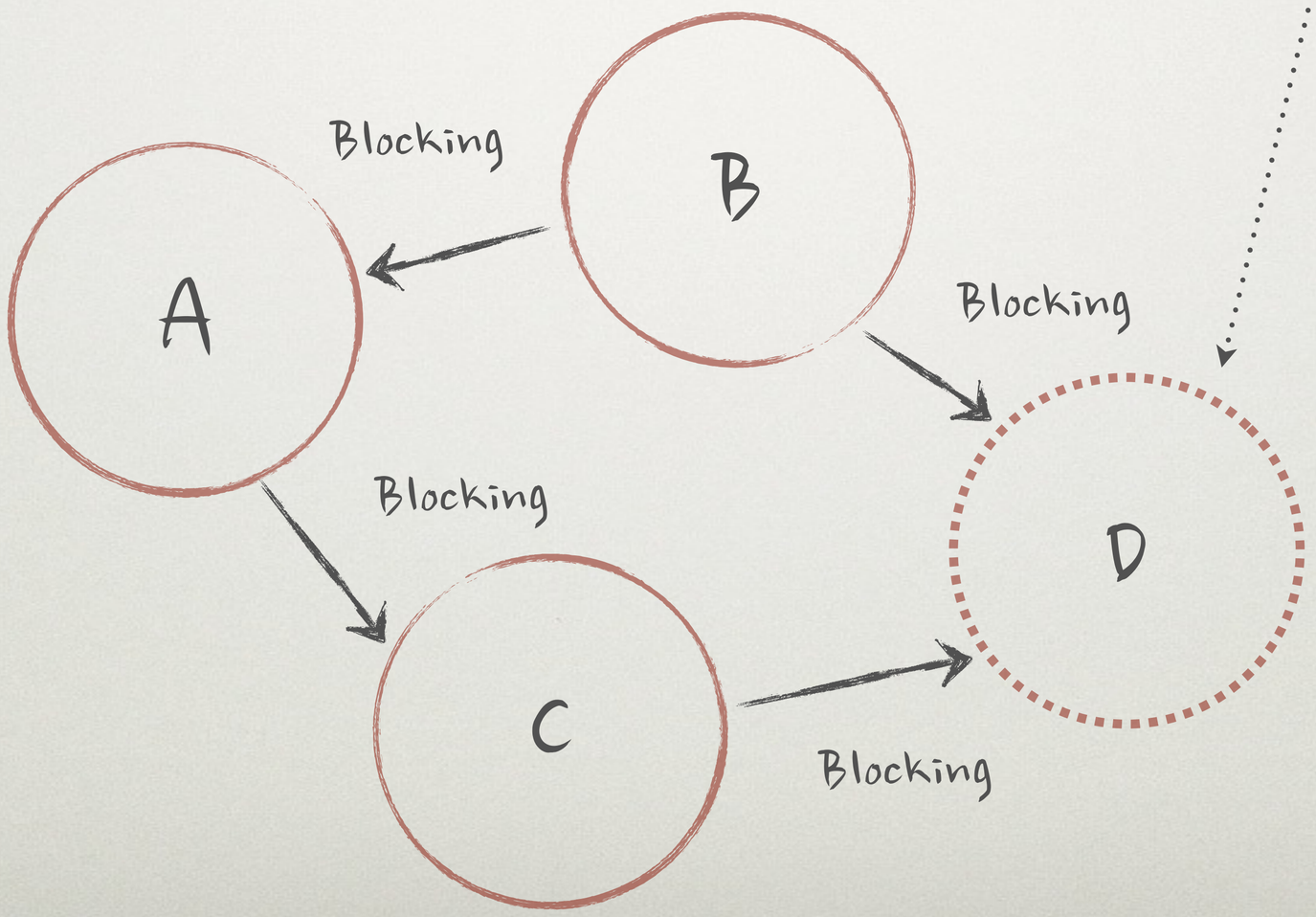
Reactive in a Legacy Environment?

Is it possible to replace D by a component implemented with Akka?



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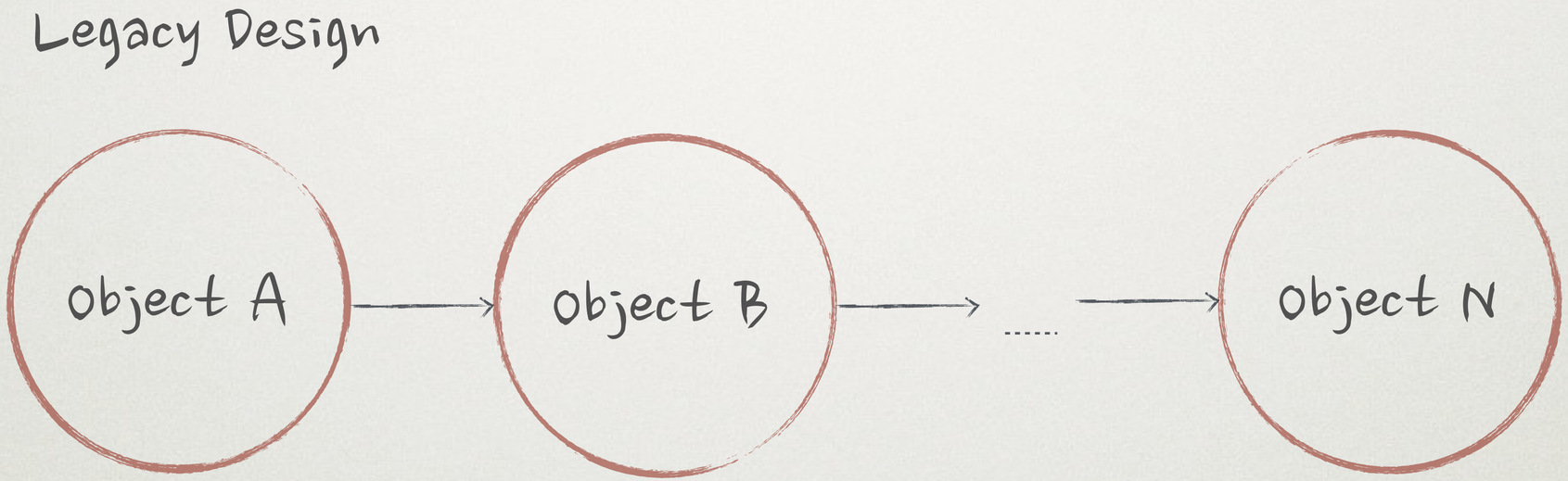
Debugger
Friend or Foe?

We often get the question:

"The asynchrony in Akka makes it very hard to use the debugger, Am I doing it wrong?"

omega point.

Debugger in Legacy Design



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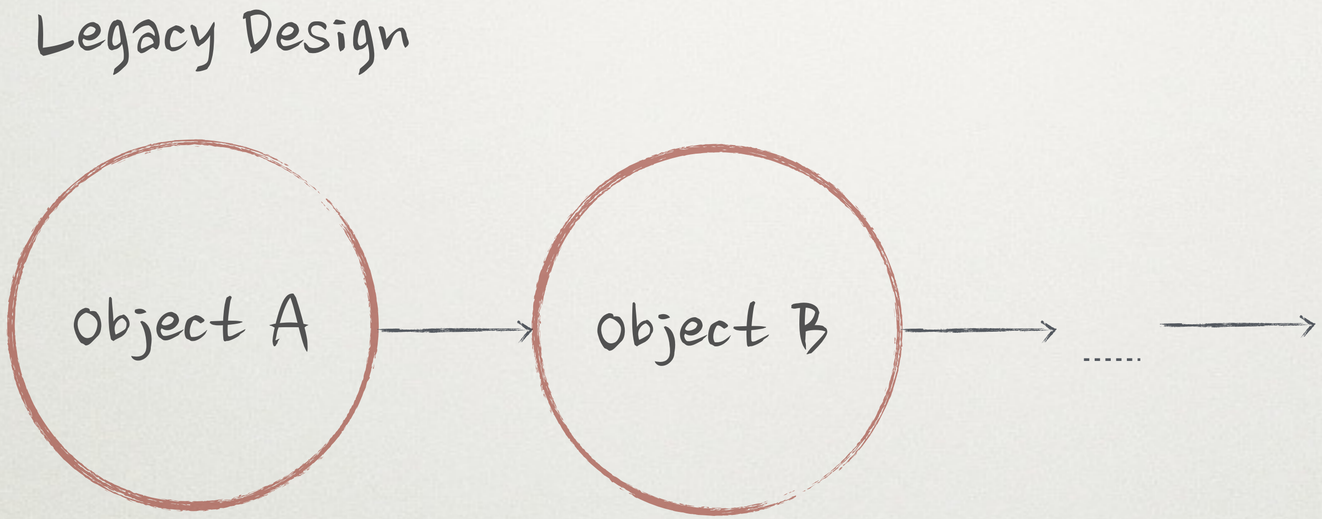
Debugger in Legacy Design



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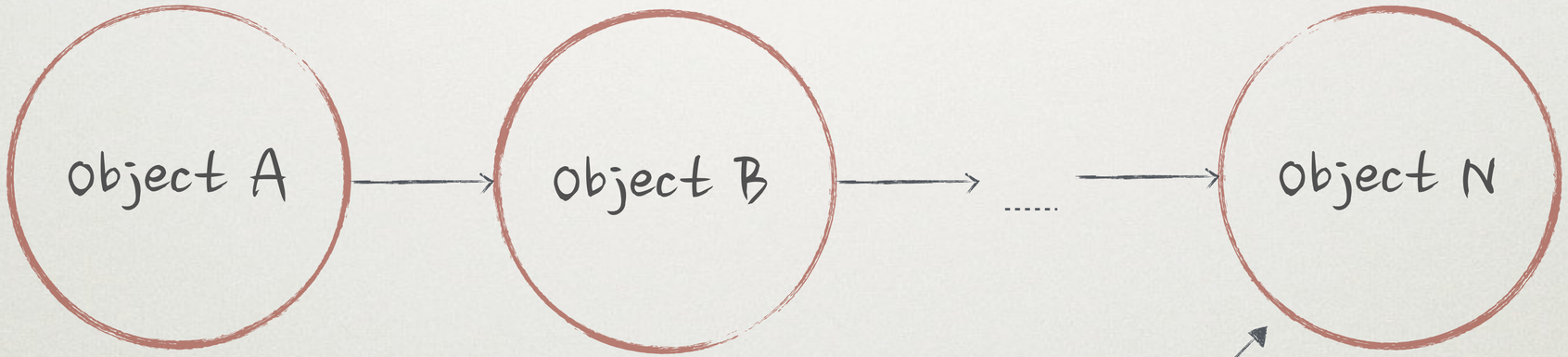
Debugger in Legacy Design

Legacy Design



Place a break point in N to find out

- Which value caused the crash?
- Who created it?

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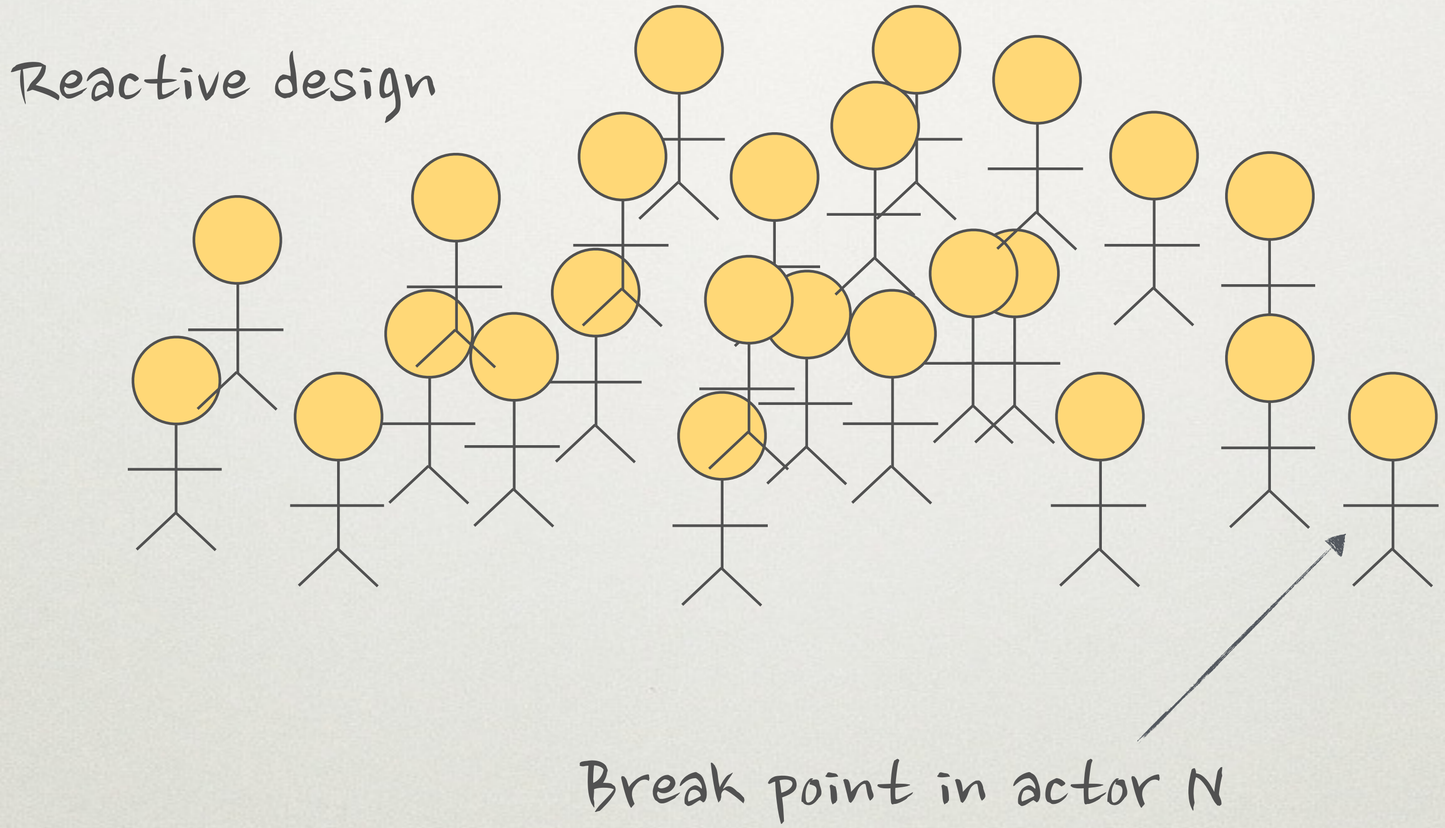
Debugger in Reactive Design



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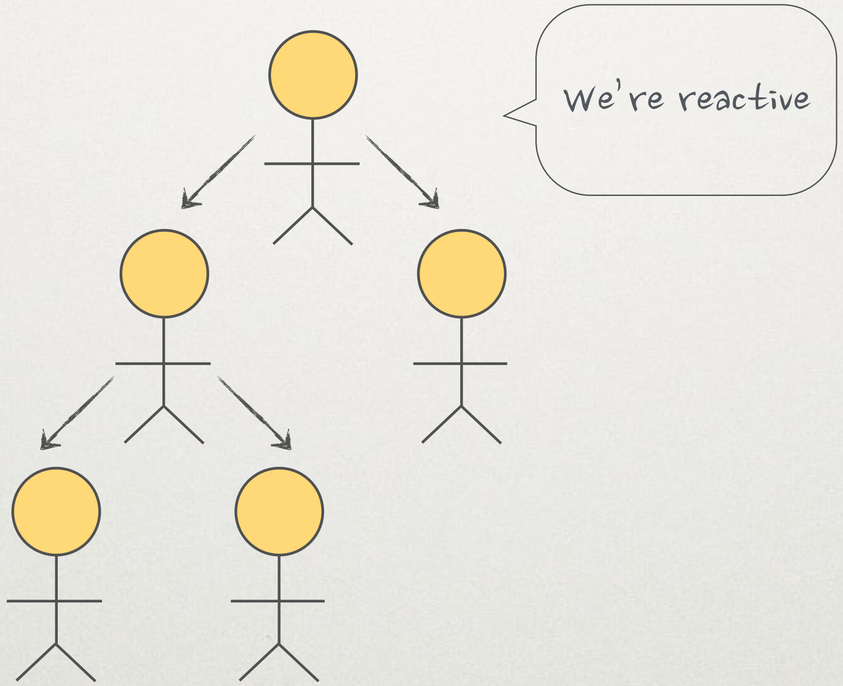
Supervision



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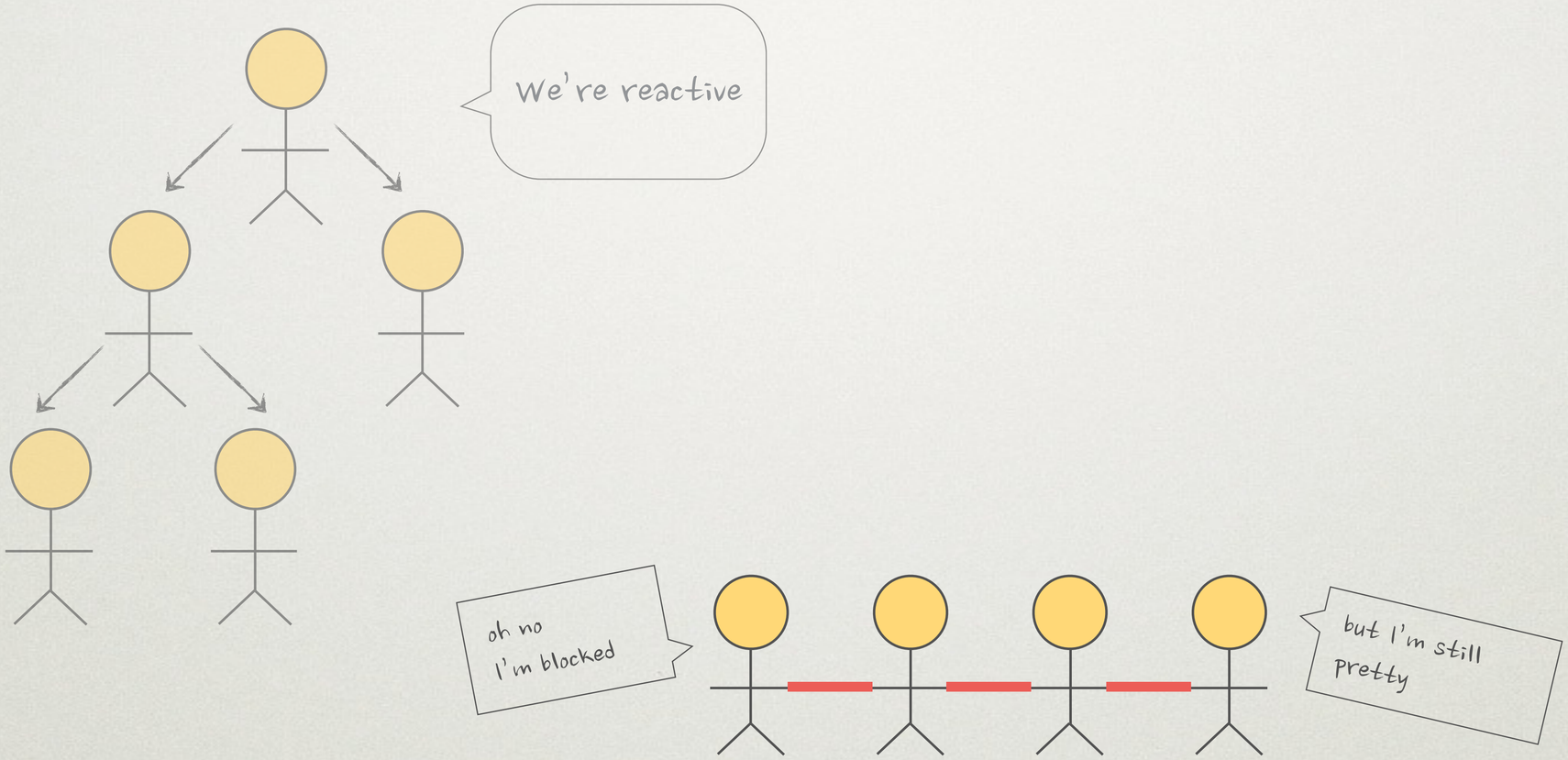

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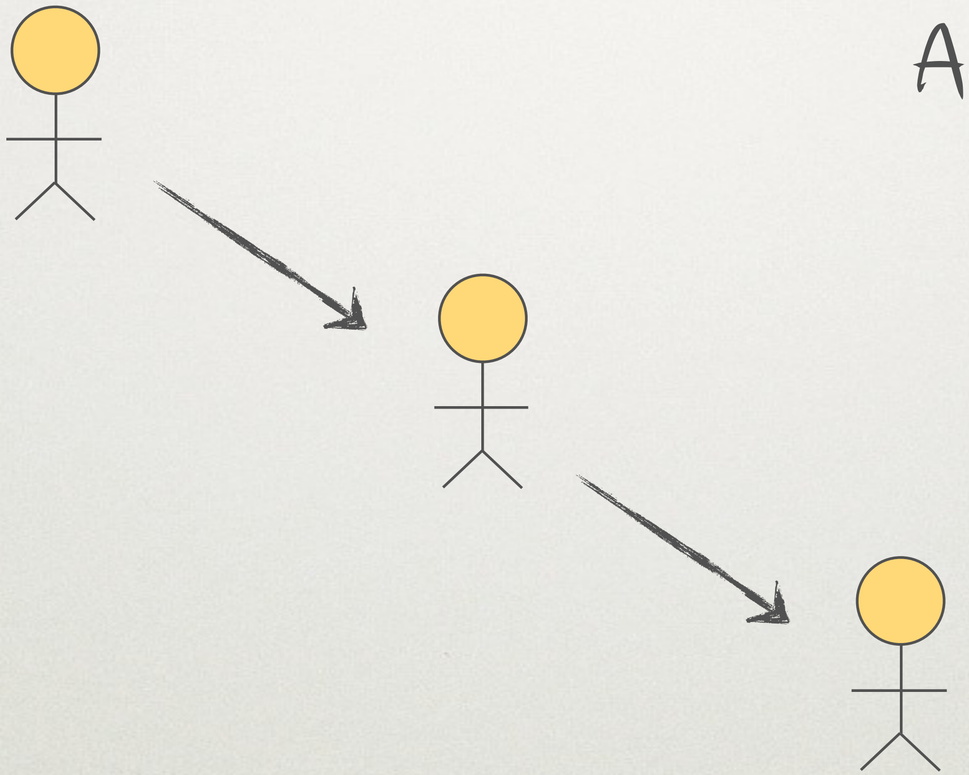

Asynchronous

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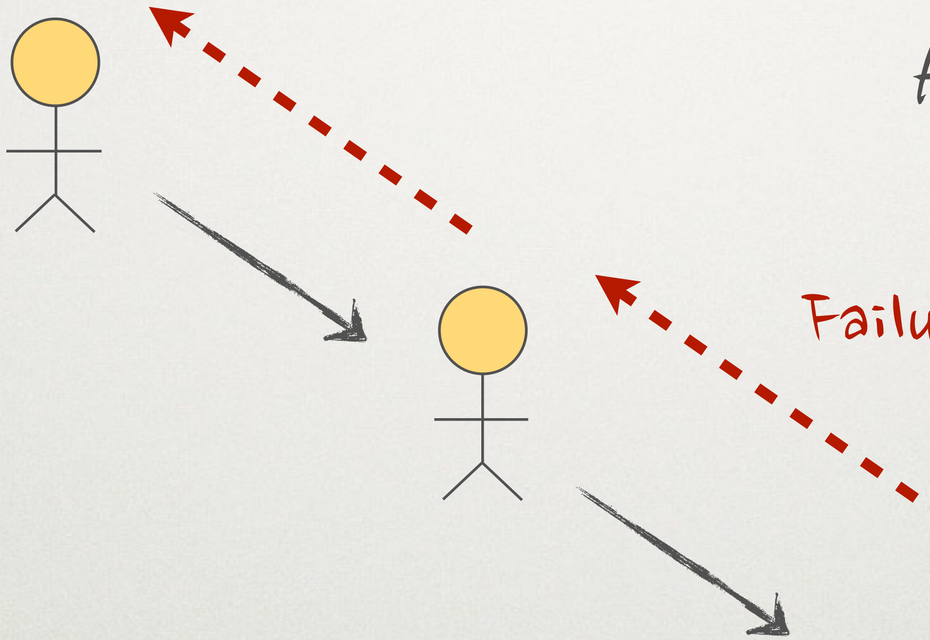
Supervision



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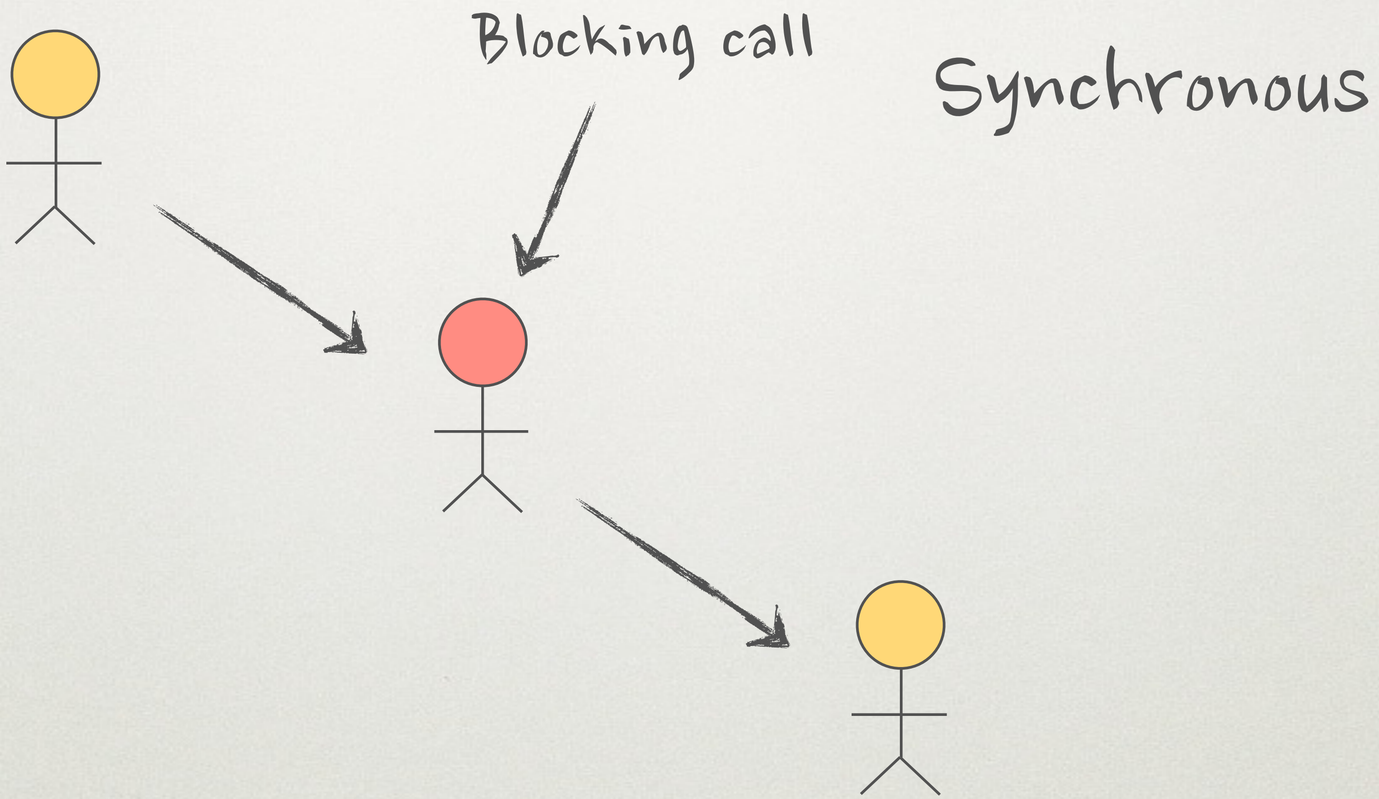

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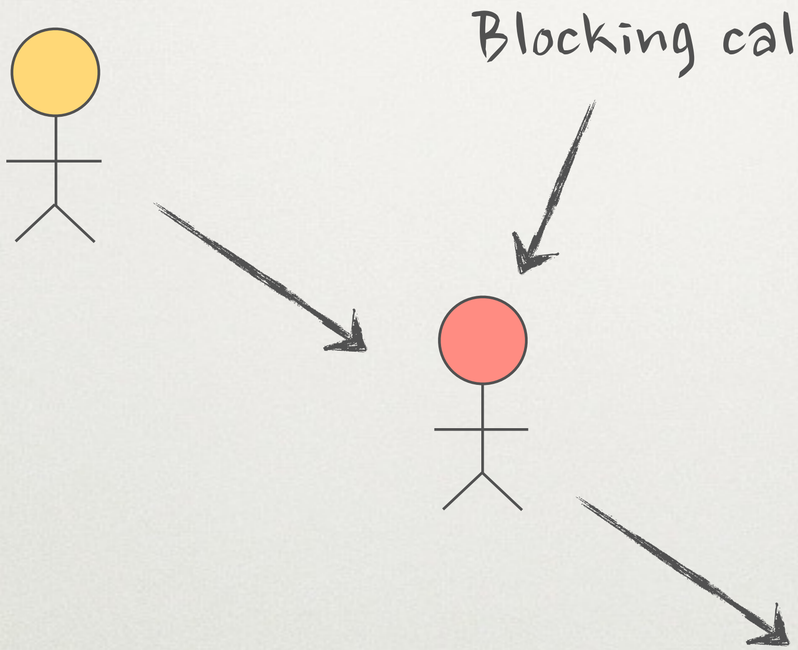

Synchronous

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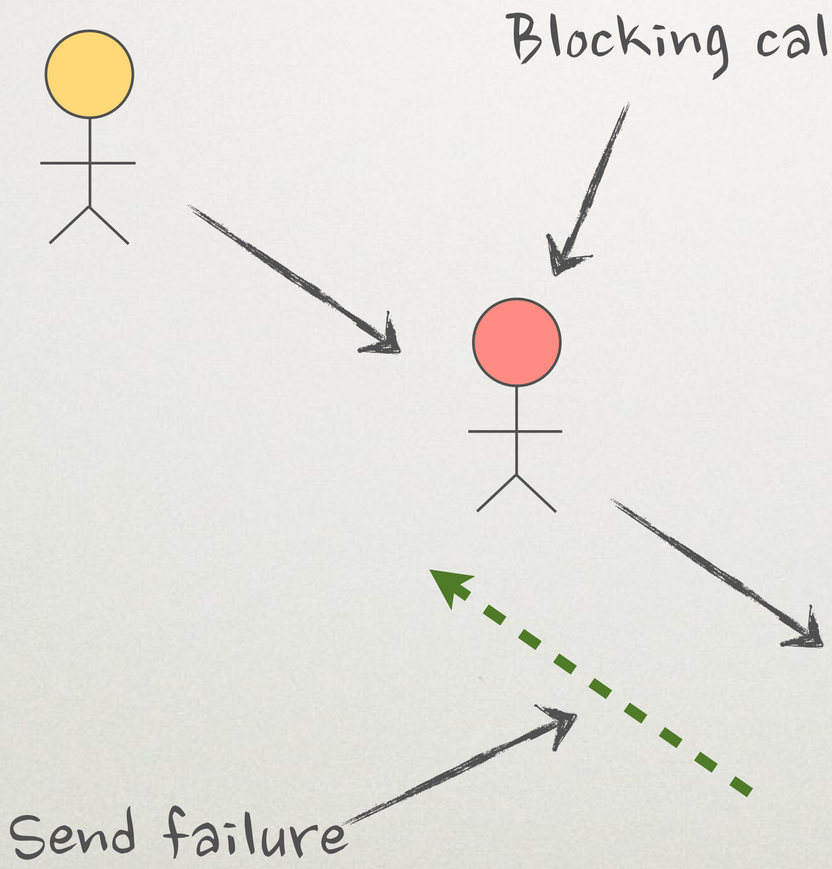

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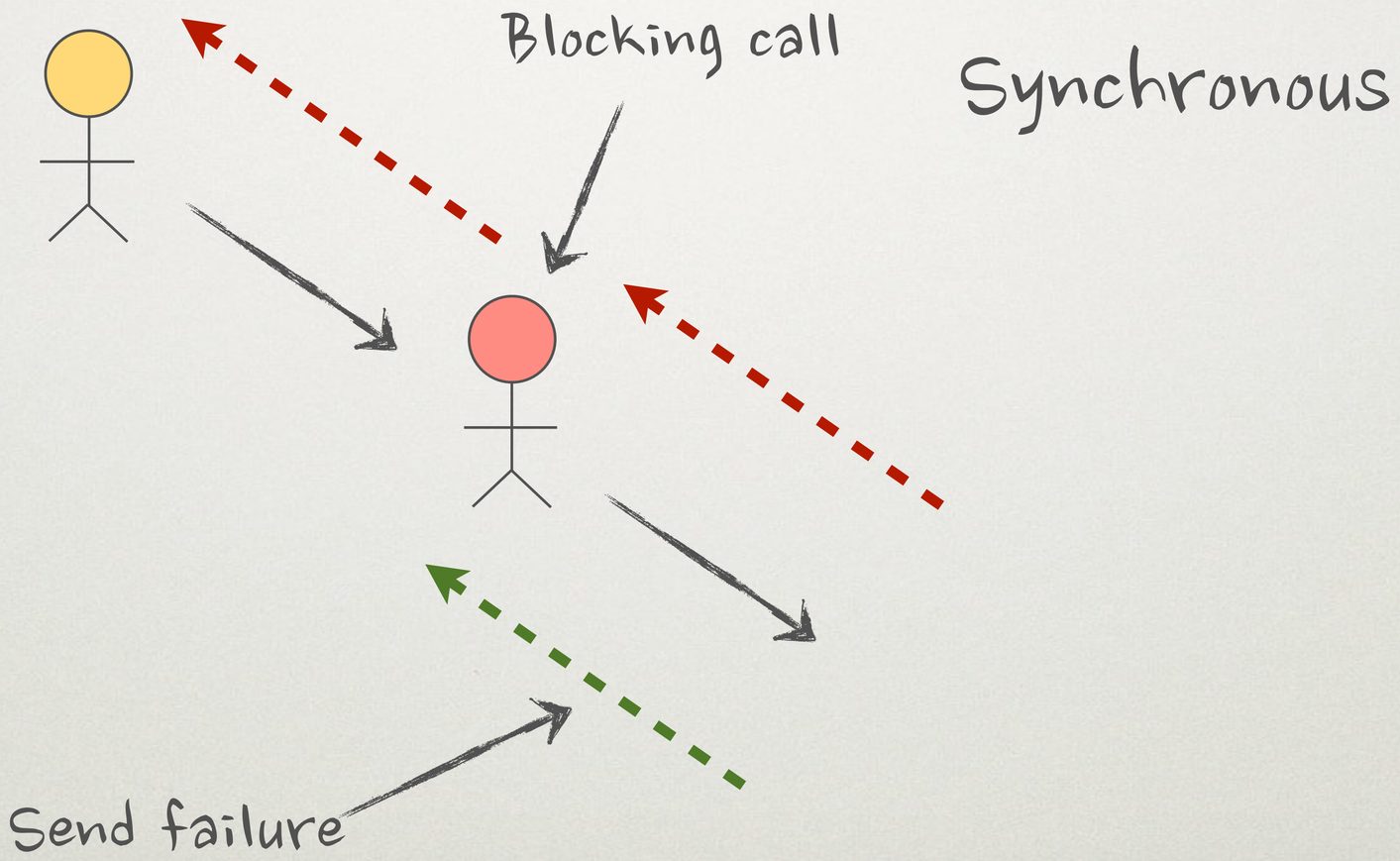

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Supervision

```
    private ActorRef targetActor;
    private ActorRef caller;
    private AskParam askParam;
    private Cancellable timeoutMessage;

    @Override
    public SupervisorStrategy supervisorStrategy() {
        return new OneForOneStrategy(0, Duration.Zero(), new Function<Throwable, SupervisorStrategy.Directive>() {
            public SupervisorStrategy.Directive apply(Throwable cause) {
                caller.tell(new Failure(cause), self());
                return SupervisorStrategy.stop();
            }
        });
    }

    @Override
    public void onReceive(final Object message) throws Exception {
        if (message instanceof AskParam) {
            askParam = (AskParam) message;
            caller = sender();
            targetActor = context().actorOf(askParam.props);
            context().watch(targetActor);
            targetActor.forward(askParam.message, context());
            final Scheduler scheduler = context().system().scheduler();
            timeoutMessage = scheduler.scheduleOnce(askParam.timeout.duration(), self(), new AskTimeout(), context().dispatcher(),
null);
        }
        else if (message instanceof Terminated) {
            sendFailureToCaller(new ActorKilledException("Target actor terminated."));
            timeoutMessage.cancel();
            context().stop(self());
        }
        else if (message instanceof AskTimeout) {
            sendFailureToCaller(new TimeoutException("Target actor timed out after " + askParam.timeout.toString()));
            context().stop(self());
        }
        else {
            unhandled(message);
        }
    }

    private void sendFailureToCaller(final Throwable t) {
        caller.tell(new Failure(t), self());
    }
```

omega point.

Supervision

- Write legacy code
- Use Akka actors

omega point.

Supervision

- Write legacy code
- Use Akka actors

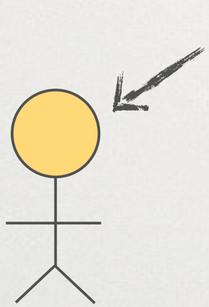
Sequential does not imply synchronicity

The Shared Mutable State Trap

Keeping state between messages in an actor is extremely dangerous because it may cause a shared mutable state

omega point.

The Shared Mutable State Trap



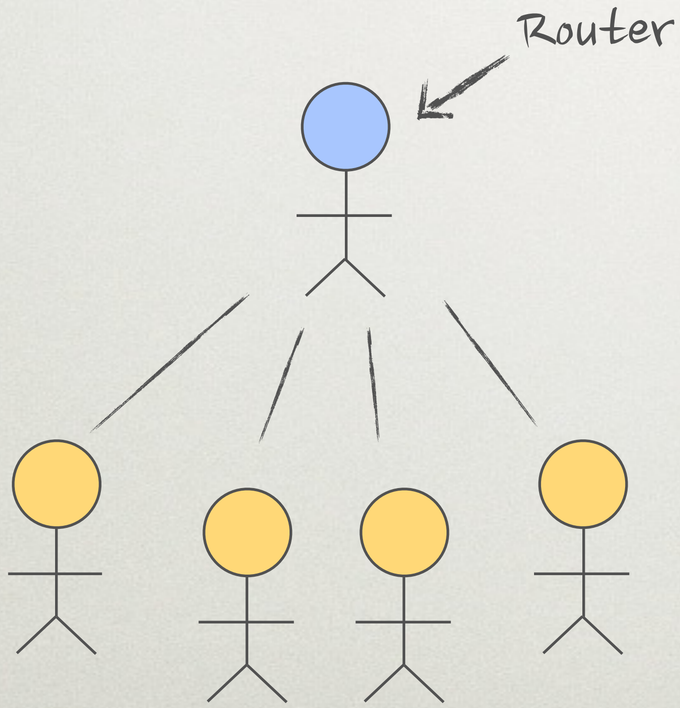
Properties

- One message queue
- Only one message is processed at a time
- Messages are processed in order received
- An actor may choose to divide and conquer a task by calling other actors

omega point.

The Shared Mutable State Trap

Actors may be grouped in a router



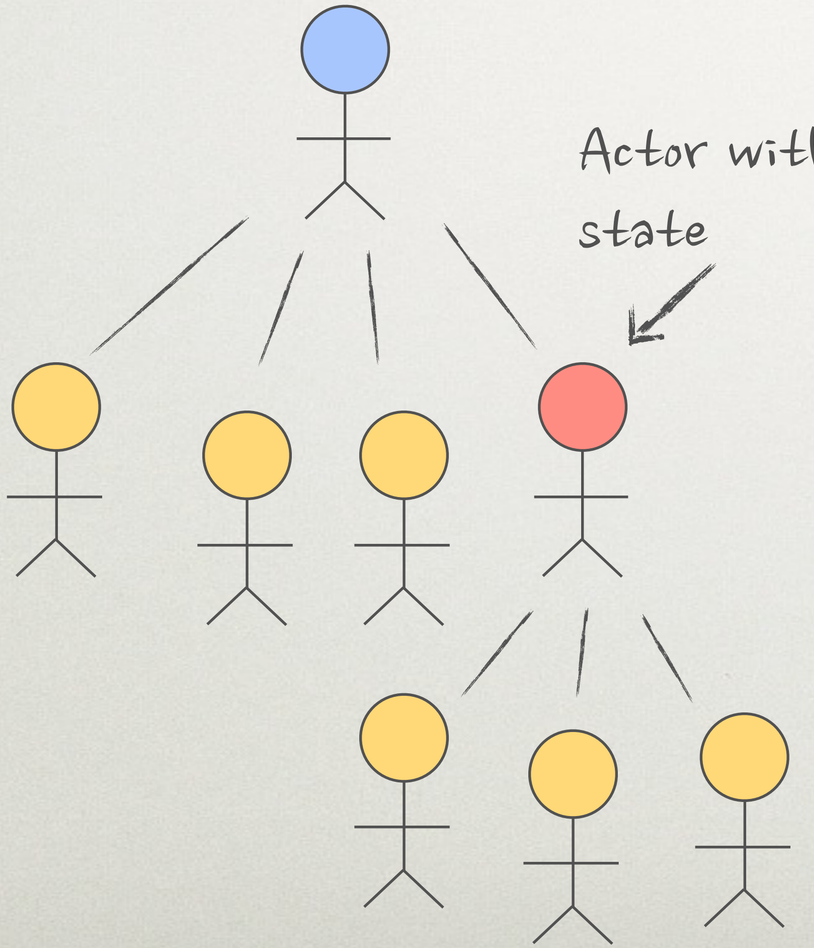
Properties

- Messages are distributed among actors according to some message delivery scheme, eg Round Robin or Smallest Mailbox

- A router may receive a lot of messages

omega point.

The Shared Mutable State Trap



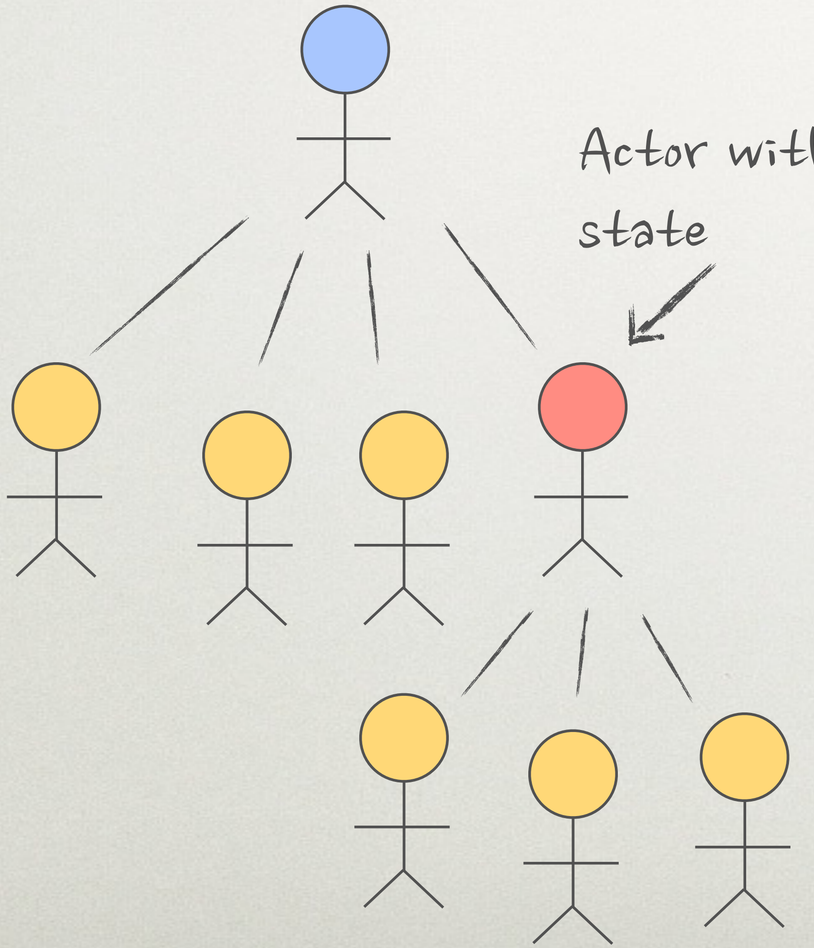
Scenario

- A stateful actor is part of a router

- It uses divide and conquer to solve its task

omega point.

The Shared Mutable State Trap



Scenario

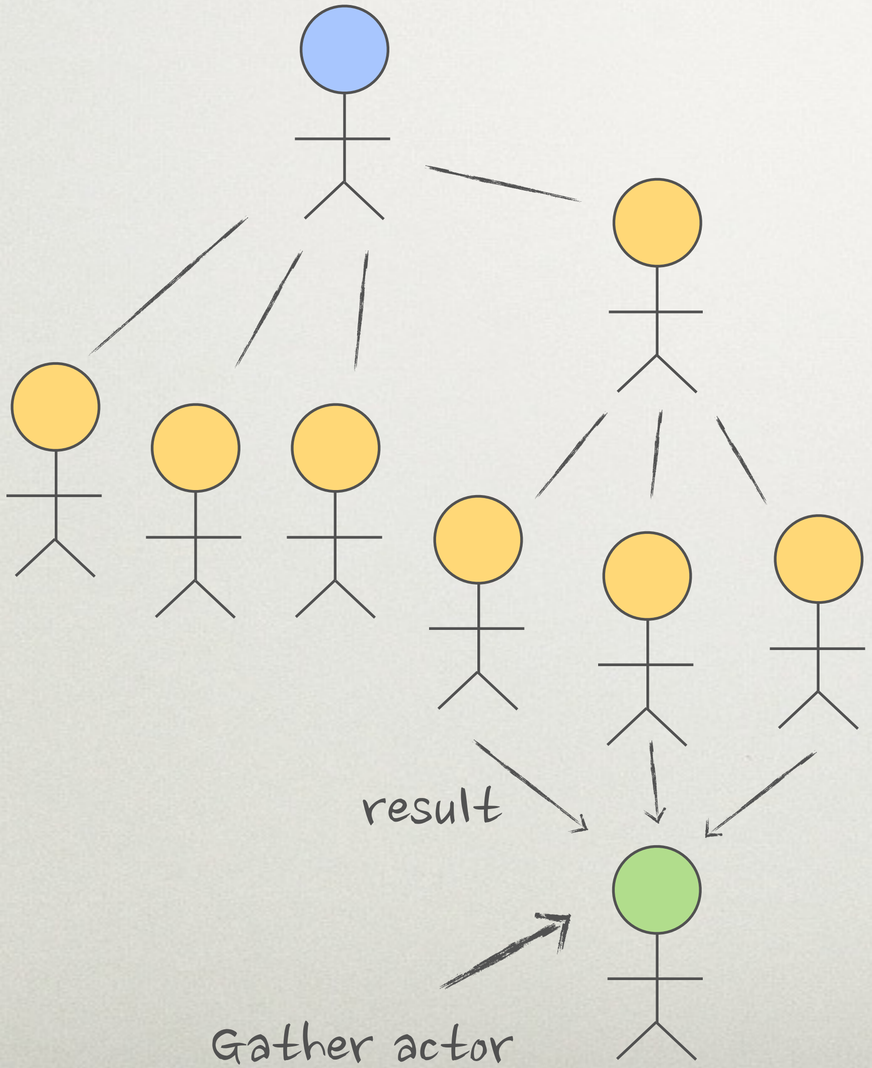
- Each message recived from the router resets the state

- New messages are inter mixed with child responses

- Hence, we have a shared mutable state

omega point.

The Shared Mutable State Trap



Solution

- Each request sent by the router results in a "Gather" actor

- The Gather actor is responsible for collecting the result

- A Gather actor is NEVER reused

omega point.

Key Take-Aways

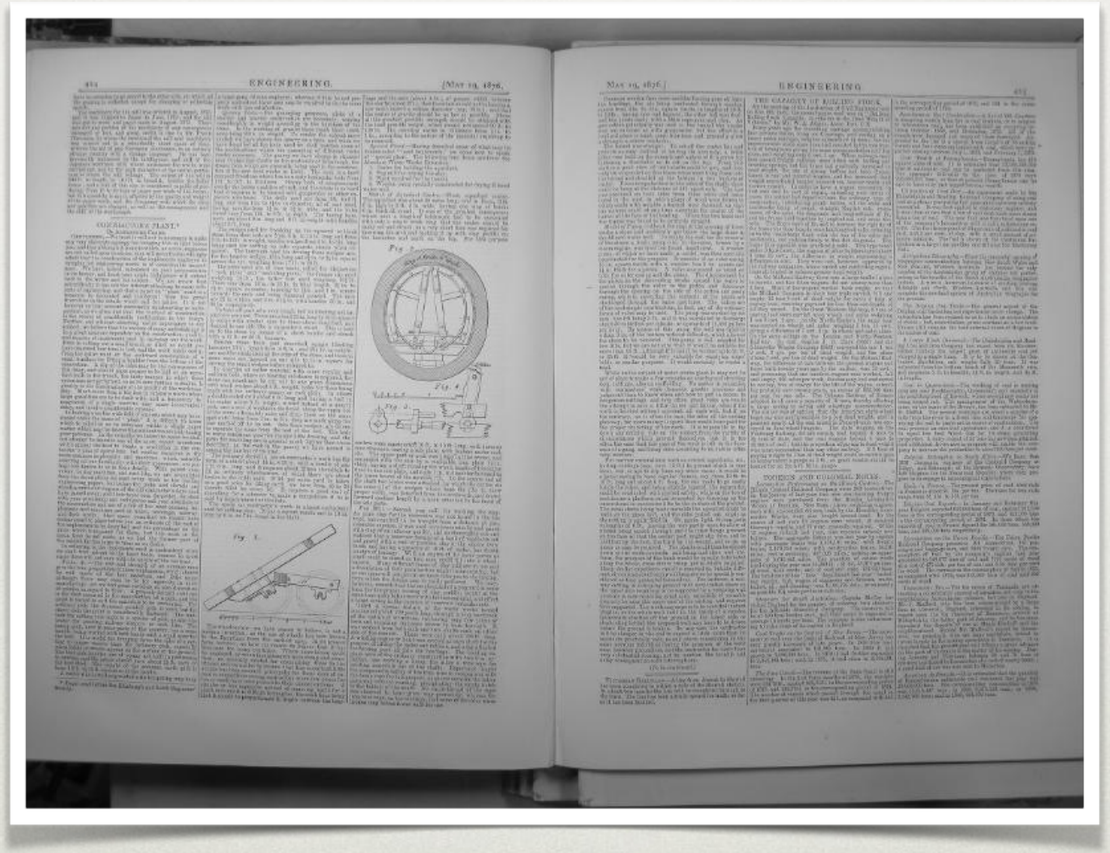
- It's very easy to accidentally fall back to sequential "thinking" with state

- Often one does not realize this until the system is placed under heavy load

- Try to avoid state!

omega point.

Readability



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omega point.

Implications of untyped actors

Akka actors are untyped – by design

```
public void onReceive(Object message)
```

Implications of untyped actors

Akka actors are untyped – by design

```
public void onReceive(Object message)
```

- Readability
- No support from compiler/IDE

omega point.

Message Handling V 1.0

```
@Override
public void onReceive(Object message) {
    if (message instanceof SomeMessage) {
        doStuff();
    }
    else {
        unhandled(message);
    }
}
```

omega point.

V 1.0 - If-else contd.

```
@Override
public void onReceive(Object message) {
    if (message instanceof SomeMessage) {
        doStuff();
    }
    else if (message instanceof SomeOtherMessage) {
        doSomeOtherStuff();
    }
    else {
        unhandled(message);
    }
}
```

omega point.

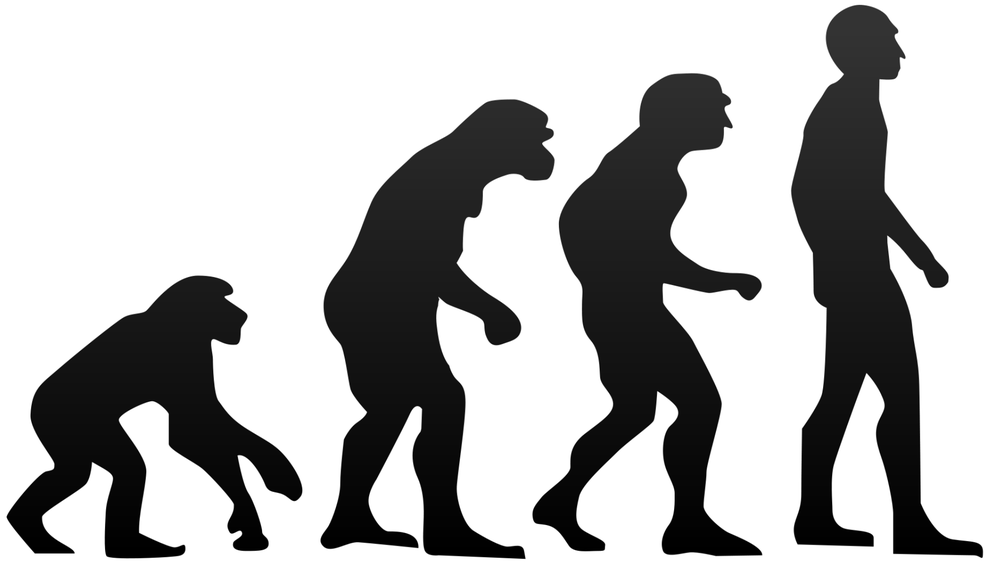
V 1.0 - If-else mess

```
@Override
public void onReceive(Object message) {
    if (message instanceof SomeMessage) {
        doStuff();
    }
    else if (message instanceof SomeOtherMessage) {
        doSomeOtherStuff();
    }
    else if (message instanceof YetAnotherMessage) {
        doEvenMoreStuff();
    }
    else {
        unhandled(message);
    }
}
```

omega point.

Evolution of message handling

```
@Override
public void onReceive(Object message) {
    ...
}
```



http://upload.wikimedia.org/wikipedia/commons/thumb/6/69/Human_evolution.svg/2000px-Human_evolution.svg.png

omega point.

V 2.0 - Overloading

```
public void onMessage(SomeMessage message) {...}

public void onMessage(SomeOtherMessage message) {...}
```

omega point.

V 2.0 - Overloading

```
public void onMessage(SomeMessage message) {...}

public void onMessage(SomeOtherMessage message) {...}
```

```
@Override
public void onReceive(Object message) {
    ...
    methods.get(message.getClass()).invoke(this, message);
    ...
}
```

omega point.

V 2.1 - Annotations

```
class Worker extends BaseActor {

    @Response
    public void onMessage(SomeMessage message) {...}


    public void onMessage(SomeOtherMessage message) {...}
}
```

omega point.

V 3.0 - Contract

```
interface Messages {
    void doSomething(SomeMessage message);
    void doSomethingElse(SomeOtherMessage message);
}
```

omega point.

V 3.0 - Contract

```
interface Messages {
    void doSomething(SomeMessage message);
    void doSomethingElse(SomeOtherMessage message);
}
```

```
SomeActor extends BaseActor implements Messages {...}
```

omega point.

V 3.0 - Contract

```
class Worker extends BaseActor implements Messages {

   public void handleResponse(SomeMessage message) {...}

   public void handleRequest(SomeOtherMessage message) {...}
}
```

omega point.

V 3.0 - Contract

```
BaseActor extends UntypedActor {

    BaseActor() {
        methodDelegate = new MethodDelegate(this);
    }

    @Override
    public void onReceive(Object message) {
        if (methodDelegate.onReceive(message)) {
            return;
        }
        unhandled(message);
    }
}
```

omega point.

Before

```
class Worker extends BaseActor implements Messages {
    @Override
    public void onReceive(Object message) {
        if (message instanceof SomeMessage) {
            doStuff();
        }
        else if (message instanceof SomeOtherMessage) {
            doSomeOtherStuff();
        }
        else if (message instanceof YetAnotherMessage) {
            doEvenMoreStuff();
        }
        else {
            unhandled(message);
        }
```

After

```
class Worker extends BaseActor implements Messages {

   public void handleResponse(SomeMessage message) {
      doStuff();
   }

   public void handleRequest(SomeOtherMessage message) {
      doSomeOtherStuff();
   }

   public void process(YetAnotherMessage message) {
      doEvenMoreStuff();
   }
}
```

omega point.

Conclusions

- Contracts to explicitly define behavior works pretty well
- Can be a useful tool in your toolbox
- Scala can give similar support via traits & match

Testing Akka Code

Interact by sending messages

BDD Scenarios

Integration tests

omega point.

Scenarios

Case A1: Sort any sequence of numbers in increasing order

Given a sequence of numbers in decreasing order

When applying the sort algorithm

Then the resulting sequence of numbers is in increasing order

The Test

```
@Test
public void caseA1() {
    given(sequence(9,8,7,6,5,4,3,2,1,0));

    whenSorting();

    thenResultIs(sequence(0,1,2,3,4,5,6,7,8,9));
}
```

omega point.

Key Take-Aways

- It's possible to use Akka in legacy code
- Akka is Scala & Java compliant
- Akka is a toolkit with a lot of goodies
- Stop writing legacy code

Thank you

@DanielDeogun @DanielSawano

omega point.