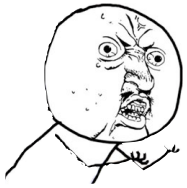
Making most of Scala

Akka, Scala, Spray, Specs2; all in 50 minutes!

Jan Machacek 

- Chief whip at Cake Solutions
- Author of Pro Spring, Pro Spring 2.5 and other books & articles
- Contributor to Akka Patterns, Specs2 Spring, Scalad, Spring Extensions, Spock Spring Integration
- Editor of the Open Source Journal

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Brings all together

- Object oriented language
  Everything is an object: even 1, `true`, ...; mixin composition (multiple implementation inheritance with terms & conditions)
- Functional programming constructs
  Even a function is object that can be bound to a variable, passed as argument
- Static typing and pattern matching
  Compiler infers & enforces type safety;
- Compiles to Java bytecode
  Adopt Scala slowly, don't throw away your existing Java code

Heavy lifting to DSLs

- Use Scala to implement the most complex code
  Java of the future: everything in Java, functions, traits, pattern matching; rich type inference
- Use Scala to implement the ordinary code
  Typical programming tasks can be done with much less syntactical noise
- Use Scala for DSLs
  It is easy to design & implement *statically typed* DSLs

Let's build something

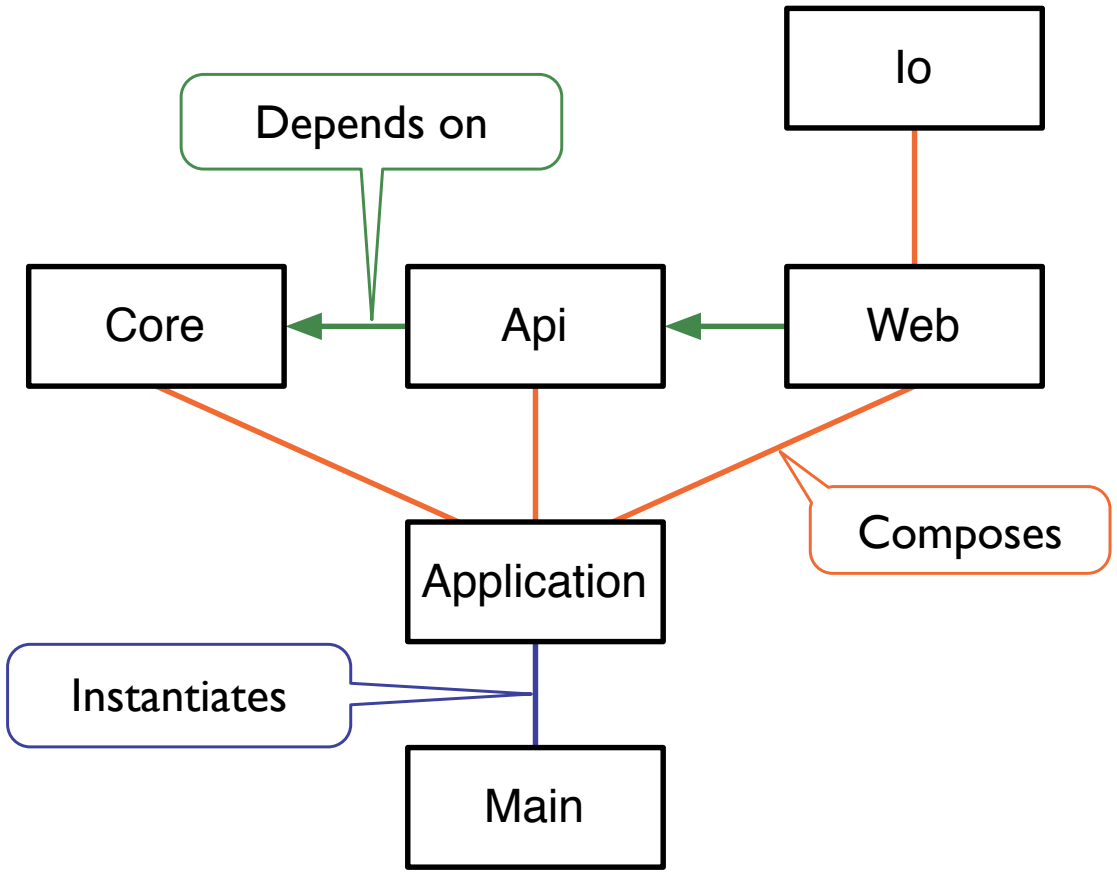
- A *proper* e-commerce app, where you must create an account when you want to buy a widget for £10, giving your date of birth, a letter from the hospital in which your mother was born, ...; then receive text message with an activation code.

Only to find out that they don't deliver to your work address

Let's build something

- We'll do a HTTP POST with a JSON document that can be mapped onto the User instance
  - Unmarshal the JSON document
  - Register the user and send the activation code
  - Marshal the instance of the reply (succeeded, failed) into a JSON document

Let's build something



The components

```
trait ServerCore {
  implicit def actorSystem: ActorSystem

  implicit val timeout = Timeout(30000)

  val core = actorSystem.actorOf(
    Props[ApplicationActor], "application")

  Await.ready(core ? Start(), timeout.duration)
}
```

The components

```
trait HttpIO {
  implicit def actorSystem: ActorSystem

  lazy val ioBridge = IOExtension(actorSystem).ioBridge

  private lazy val httpClient: ActorRef =
    actorSystem.actorOf(Props(new HttpClient(ioBridge)))

  def makeConduit(host: String): ActorRef =
    actorSystem.actorOf(Props(new HttpConduit(
      httpClient, host, port = 443, sslEnabled = true)))

}
```

The components

```
trait HttpIO {
  implicit def actorSystem: ActorSystem

  lazy val ioBridge = IOExtension(actorSystem).ioBridge

  private lazy val httpClient: ActorRef =
    actorSystem.actorOf(Props(new HttpClient(ioBridge)))

  def makeConduit(host: String): ActorRef =
    actorSystem.actorOf(Props(new HttpConduit(
      httpClient, host, port = 443, sslEnabled = true)))

}


trait ActorHttpIO extends HttpIO {
  this: Actor =>

  final implicit def actorSystem = context.system
}
```

The components

```
trait Api extends RouteConcatenation {
  this: ServerCore =>

  val routes =
    new HomeService().route ~
    new UserService().route

  val rootService = actorSystem.actorOf(Props(
    new RoutedHttpService(routes)))

}
```

The components

```
trait Web extends HttpIO {
  this: Api with ServerCore =>

  val httpServer = actorSystem.actorOf(Props(
    new HttpServer(ioBridge,
                   SingletonHandler(rootService))),
    name = "http-server"
  )

  httpServer ! HttpServer.Bind("localhost", 8080)

}
```

The components

```
trait Web {
  this: Api with ServerCore =>
  ...
}
```

```
trait Api {
  this: ServerCore =>
  ...
}
```

```
trait ServerCore {
  implicit def actorSystem: ActorSystem
  ...
}
```

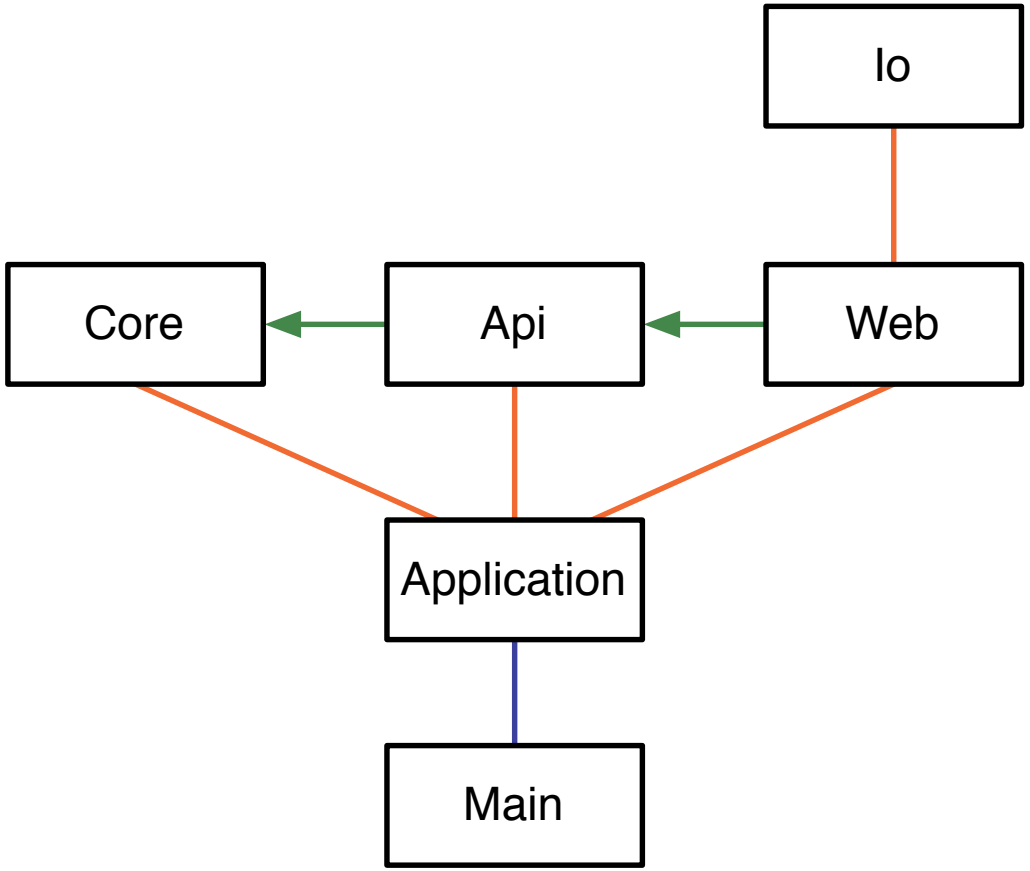
```
class Application(val actorSystem: ActorSystem) extends Api
class Application(val actorSystem: ActorSystem) extends Web
class Application(val actorSystem: ActorSystem) extends Api with Web

class Application(val actorSystem: ActorSystem)
  extends ServerCore with Api with Web
```

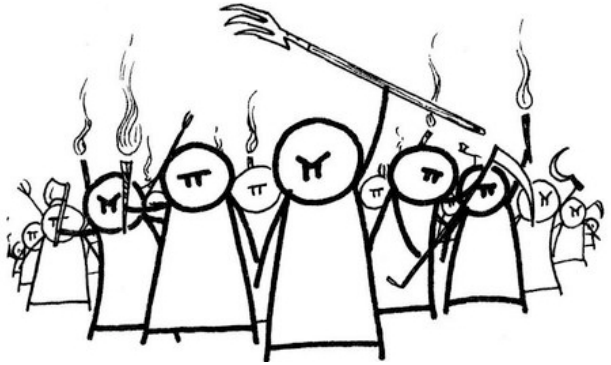
The components

```
object Main extends App {
  val system = ActorSystem("AkkaPatterns")

  class Application(val actorSystem: ActorSystem) extends

    ServerCore with
    Api with
    Web

  new Application(system)
}
```

```
trait ServerCore {
  implicit def actorSystem: ActorSystem
  ...
}
```

Let's build something





Let's build something

```
Application {

  POST /users (ru: RegisterUser) →
    422: Failure
    200: RegistedUser

  GET /users/{UserReference} →
    404: None
    200: Some(User)

}
```

The components

```
trait Api extends RouteConcatenation {
  this: ServerCore =>

  val routes =
    new HomeService().route ~
    new UserService().route
```

```
val route =
  path("users") {
    post {
      handleWith { ru: RegisterUser =>
        (userRegistrationActor ? ru).mapTo[
          Either[ApplicationFailure, RegisteredUser]]
      }
    }
  }
```

A message!

```
class UserService(implicit val actorSystem: ActorSystem)
  extends Directives with UserServiceMarshallers
  with DefaultTimeout {

  def userRegistrationActor =
    actorSystem.actorFor("/user/application/registration")

  val route =
    path("users") {
      post {
        handleWith { ru: RegisterUser =>
          (userActor ? ru).mapTo[
            Either[ApplicationFailure, RegisteredUser]]
        }
      }
    }

}
```

A message!

```
case class RegisterUser(
                  username: String,
                  password: String,
                  email:    String,
                  mobile:   String)
```

A message!

```
case class RegisterUser(
                  username: String,
                  password: String,
                  email:    EmailAddress,
                  mobile:   MobileNumber)

sealed trait Address

case class EmailAddress(address: String) extends Address

case class MobileNumber(number: String) extends Address
```

A message!

```
case class RegisterUser(
                username: String,
                password: String,
                email:    EmailAddress,
                mobile:   MobileNumber)

sealed trait Address

case class EmailAddress(address: String) extends Address

case class MobileNumber(number: String) extends Address

case class RegisteredUser(user: User)

trait ApplicationFailure

case class ValidationFailed(…) extends ApplicationFailure
case object UsernameTaken extends ApplicationFailure
```

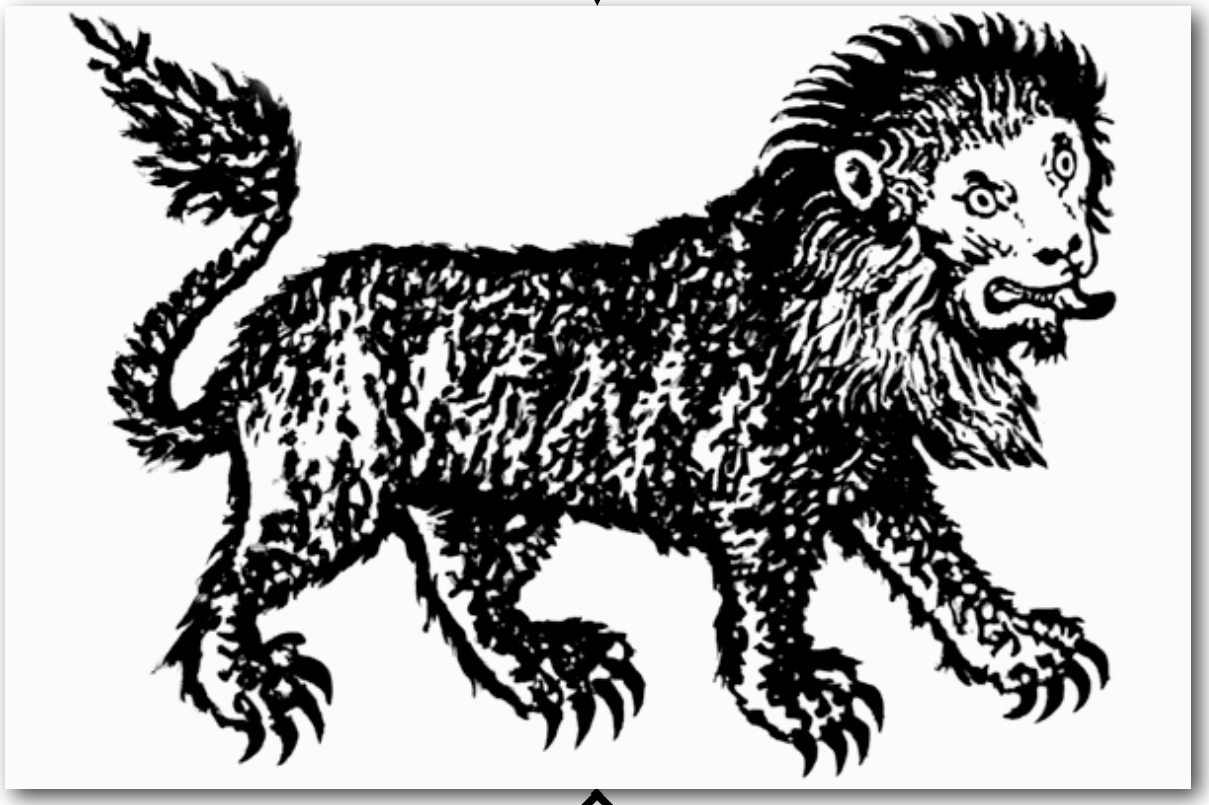
A message!

```
case class User(id: UserReference,
                username: String, hashedPassword: String,
                activationCode: Option[String],
                email:  EmailAddress,
                mobile: MobileNumber)

package object domain {
  type UserReference = UUID
}
```

A message!

```
class UserService(implicit val actorSystem: ActorSystem)
  extends Directives with UserServiceMarshallers
  with DefaultTimeout {

  def userRegistrationActor =
    actorSystem.actorFor("/user/application/registration")

  val route =
    path("users") {
      post {
        handleWith { ru: RegisterUser =>
          (userRegistrationActor ? ru).mapTo[
            Either[ApplicationFailure, RegisteredUser]]
        }
      }
    }

}
```

RegisterUser



ApplicationFailure

RegisteredUser

RegisterUser

ApplicationFailure

RegisteredUser

Hierarchies

http://en.wikipedia.org/wiki/Class_sketch

The user actor structure

- `UserActor` creates and supervises the
  - `MessageDeliveryActor`, which sends e-mails and text messages
  - `UserRegistrationActor`, which takes care of the registration (and sends the activation code using the `MessageDeliveryActor`)
  - `UserManagementActor`, which provides the boring "management" operations

The user actor structure

```
class UserActor extends Actor {
  val messageDelivery =
    context.actorOf(Props[MessageDeliveryActor])
  val registration =
    context.actorOf(
      Props(new UserRegistrationActor(messageDelivery)),
      "registration")
  val management =
    context.actorOf(
      Props(new UserManagementActor(messageDelivery)),
      "management")
  ...
}

class MessageDeliveryActor                  extends Actor
class UserRegistrationActor(md: ActorRef) extends Actor
class UserManagementActor(md: ActorRef)   extends Actor
```

The user actor structure

```
class UserRegistrationActor(messageDelivery: ActorRef)
  extends Actor {

  def receive = {
    case RegisterUser(username, password, email, mobile) =>
      val user = ...  // prepare the User instance
      messageDelivery ! DeliverActivationCode(
                            mobile, user.activationCode.get)
      sender ! Right(RegisteredUser(user))
  }
}
```

The user actor structure

```
class MessageDeliveryActor extends Actor {


  def receive = {
    case DeliverActivationCode(MobileNumber(number), code) =>
      deliverTextMessage(number, "Your code is " + code)
  }
}
```

The user actor structure

```
class MessageDeliveryActor extends Actor {
  this: TextMessageDelivery =>

  def receive = {
    case DeliverActivationCode(MobileNumber(number), code) =>
      deliverTextMessage(number, "Your code is " + code)
  }
}
```

The user actor structure

```
class MessageDeliveryActor extends Actor {
  this: TextMessageDelivery =>

  def receive = {
    case DeliverActivationCode(MobileNumber(number), code) =>
      deliverTextMessage(number, "Your code is " + code)
  }
}
trait TextMessageDelivery {
  def deliverTextMessage(number: String, message: String)
}
```

The user actor structure

```
class MessageDeliveryActor extends Actor {
  this: TextMessageDelivery =>

  def receive = {
    case DeliverActivationCode(MobileNumber(number), code) =>
      deliverTextMessage(number, "Your code is " + code)
  }
}
trait TextMessageDelivery {
  def deliverTextMessage(number: String, message: String)
}
trait NexmoTextMessageDelivery extends TextMessageDelivery {
  this: HttpIO =>
  private lazy val pipeline =
    HttpConduit.sendReceive(makeConduit("rest.nexmo.com"))

  def deliverTextMessage(number: String, message: String) {
    val request = HttpRequest(POST, "https://...")
    pipeline(request) onSuccess { ... }
  }
}
```

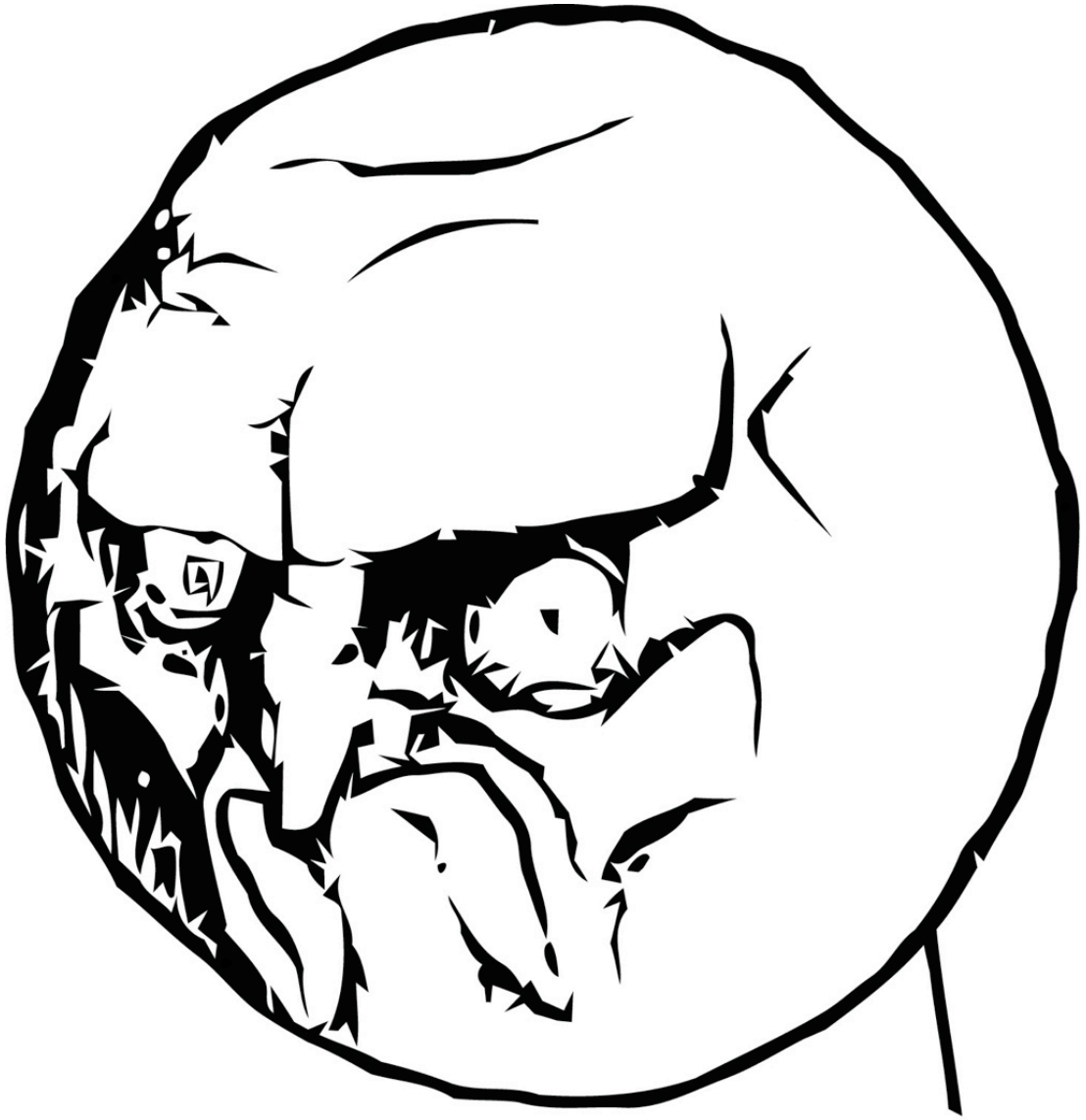
The user actor structure

```
class UserActor extends Actor {
  val messageDelivery =
    context.actorOf(Props[MessageDeliveryActor])



  val registration =
    context.actorOf(
      Props(new UserRegistrationActor(messageDelivery)),
      "registration")
  val management =
    context.actorOf(
      Props(new UserManagementActor(messageDelivery)),
      "management")
  ...
}
```

The user actor structure

```
class UserActor extends Actor {
  val messageDelivery =
    context.actorOf(Props(
      new MessageDeliveryActor
        with MexmoTextMessageDelivery
        with ActorHttpIO))
  val registration =
    context.actorOf(
      Props(new UserRegistrationActor(messageDelivery)),
      "registration")
  val management =
    context.actorOf(
      Props(new UserManagementActor(messageDelivery)),
      "management")
  ...
}
```

Testing



Observe the messages

```
class UserRegistrationActorSpec extends
  TestKit(ActorSystem()) with Specification with
  ImplicitSender {

  val actor = TestActorRef(
    new UserRegistrationActor(testActor))

  "register the user and send the code" in {
    actor ! RegisterUser("janm", "*********", ...)
    val code = expectMsgType[DeliverActivationCode]
    val user = expectMsgType[Either[
                  ApplicationFailure, RegisteredUser]]
    user.activationCode must beEqualSome(code)
```

```
case RegisterUser(username, password, email, mobile) =>
  val user = ...  // prepare the User instance
  messageDelivery ! DeliverActivationCode(
                       mobile, user.activationCode.get)
  sender ! Right(RegisteredUser(user))
```

Observe the messages

```
class UserRegistrationActorIntegrationSpec extends
  TestKit(ActorSystem()) with Specification with
  ImplicitSender with CoreSystem {

  val actor = system.actorFor(
                "/user/application/user/registration")

  "register the user and send the code" in {
    actor ! RegisterUser("janm", "*********", ...)

    val user = expectMsgType[Either[
                 ApplicationFailure, RegisteredUser]]
    ...
  }
}
```

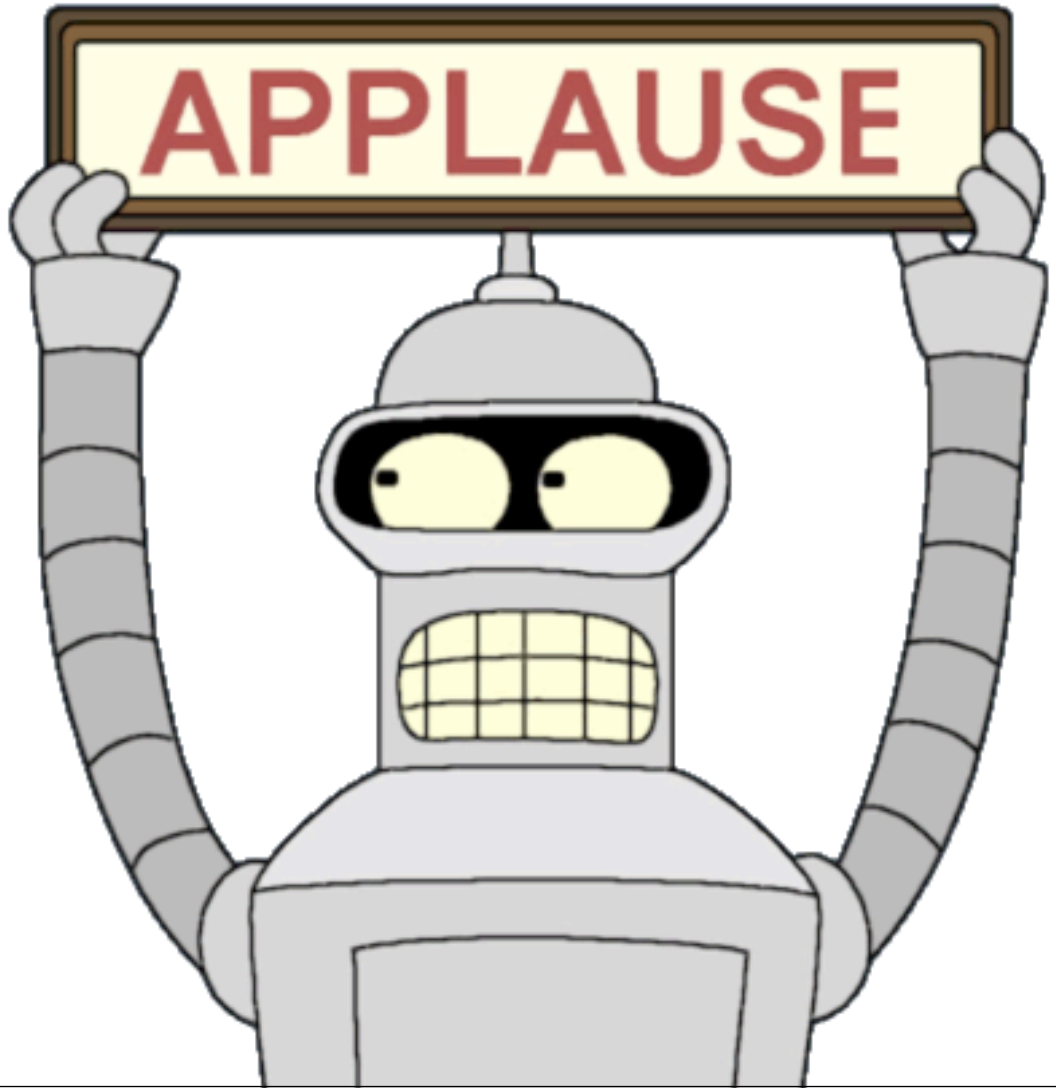
Observe the messages

```
class UserServiceSpec extends TestKit(ActorSystem())
  with TestKitRouteTest with Specification
  with ImplicitSender with CoreSystem with Api {




  "register the user and send the code" in {
    val username = "janm"
    Post(login, RegisterUser(username, "****", ...)) ~>
      routes ~> check {
      val resp = entityAs[RegisteredUser]
      resp.user.username mus\Equal username
    }
  }
}
```

```
case class RegisteredUser(user: User)
```

Scala, Akka, Spray, ...

- *Akka* brings asynchronous & non–blocking behaviour (`!`, `?`) and ability to dynamically change the structure of your application at runtime
- *Spray* wraps it in REST API
- *Specs2* simplifies very expressive tests
- *Scala* gives type safety and expressiveness, functions as first-class citizens (directives in the `route`), very flexible way to "inject" dependencies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