# Introduction to Reactive

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# Slides and code is

# available at:

https://github.com/dhinojosa/intro_to_reactive

# What is reactive?

Streamlining
Synergy
Win-Win
Paradigm
Best of Breed
Turnkey
Touch Base
Best Practices
Service Oriented Architecture
Mission Critical
ROI
Holistic Approach
Eating our own
Push the Envelope

# Reactive?

# What is reactive?

# What is reactive programming?

functional

# What is reactive programming?

# According to…


**Functional reactive programming** (**FRP**) is a programming paradigm for reactive programming (asynchronous dataflow programming) using the building blocks of functional programming (e.g. map, reduce, filter). FRP has been used for programming graphical user interfaces (GUIs), robotics, and music, aiming to simplify these problems by explicitly modeling time.

# According to…


In computing, **reactive programming** is a programming paradigm oriented around data flows and the propagation of change. This means that it should be possible to express static or dynamic data flows with ease in the programming languages used, and that the underlying execution model will automatically propagate changes through the data flow.


Mark
08

## In the year, 2051, anthropologists discovered...

```
var a = 10;
var b = a + 1;
a = 11;
b = a + 1;
```

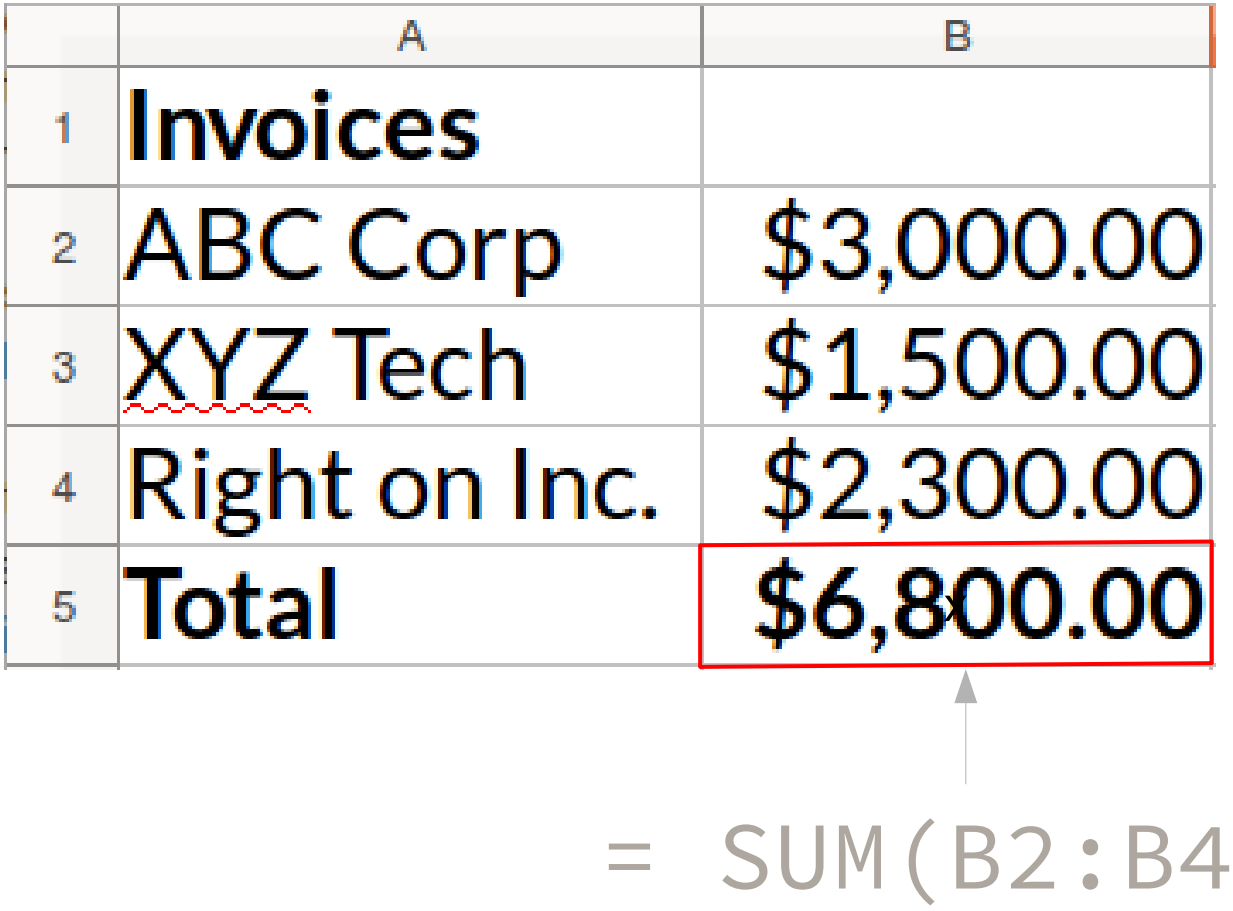
http://paulstovell.com/blog/reactive-programming

## Example of P#

```
var a = 10;
var b <= a + 1; // <= Destiny Operator
a = 20;
Assert.AreEqual(21, b);
```

http://paulstovell.com/blog/reactive-programming

| | A | B |
|---|---|---|
| 1 | **Invoices** | |
| 2 | ABC Corp | $3,000.00 |
| 3 | XYZ Tech | $1,500.00 |
| 4 | Right on Inc. | $2,300.00 |
| 5 | **Total** | **$6,800.00** |


A
B
1
Invoices
2
ABC Corp
$3,000.00
3
XYZ Tech
$1,500.00
4
Right on Inc.
$2,300.00
5
Total
$6,800.00
= SUM(B2:B4)

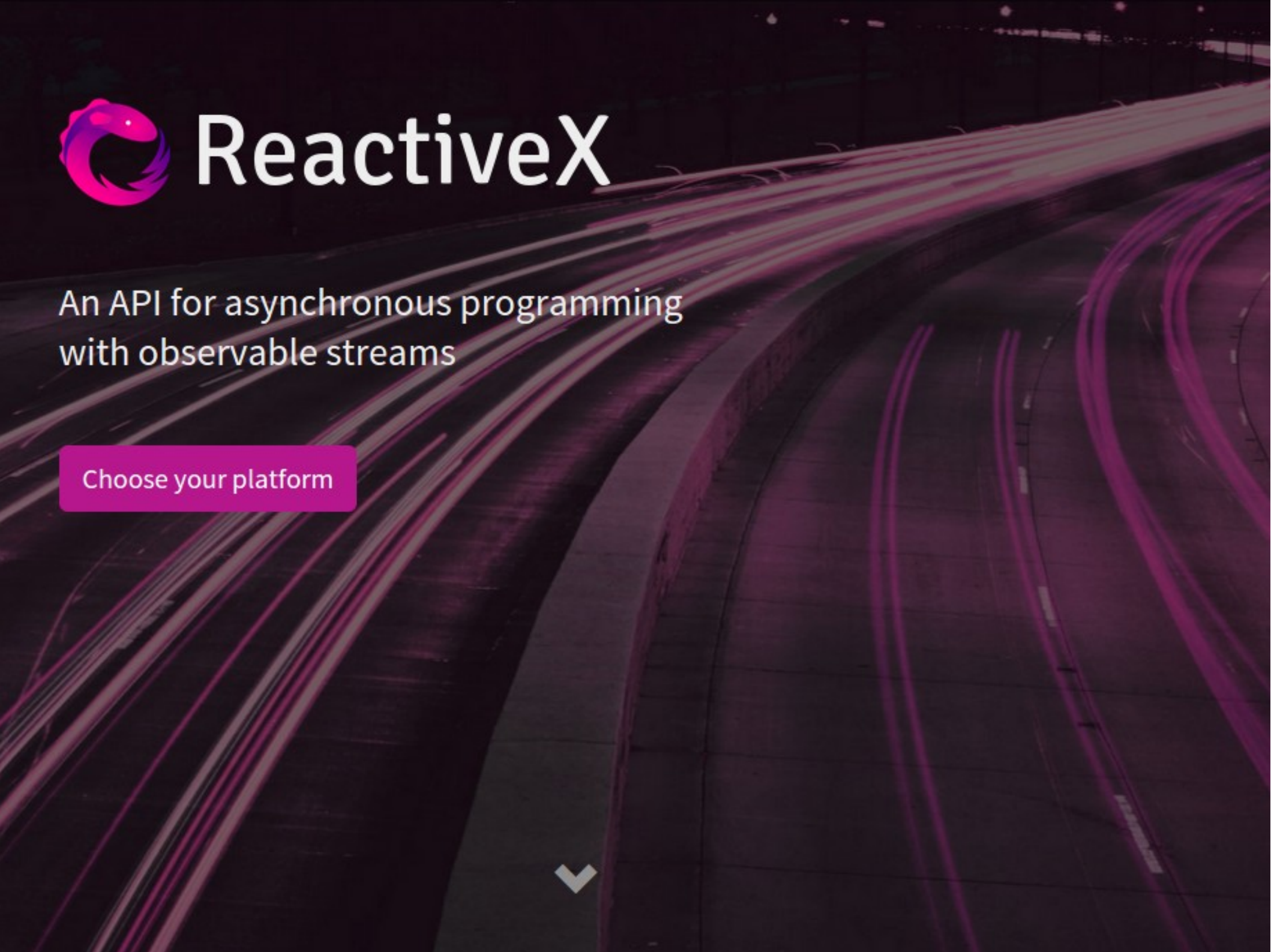
Is there a language like P#, today?

Can we do this FRP

on the JVM... easily?


Not in a natural
way....

# What technologies can we use on the JVM... for "Reactive"?


ReactiveX
An API for asynchronous programming
with observable streams
Choose your platform


# Actors and Resiliency


akka
Streams

# Reactive Extensions for Async Programming

# RX
# for Async Programming

**RX is FRP on the JVM**


RX is FRP
the JVM

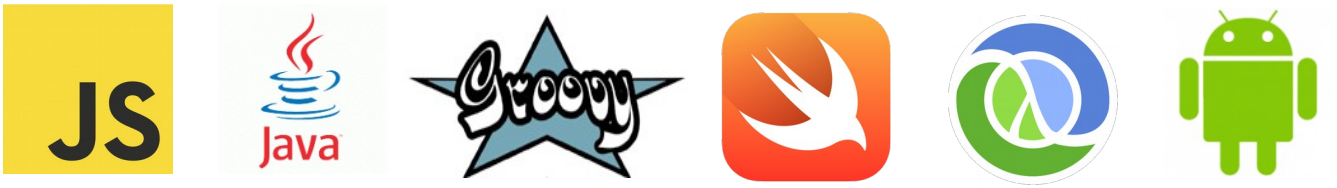
**"There's a whole lot debate to what we should be calling this. We started using Functional Reactive to name it before any of us had any clue about the academia behind it...if anyone can give me a better name for what we are doing...I'd like to hear it"**

- Ben Christensen @ Goto Conference

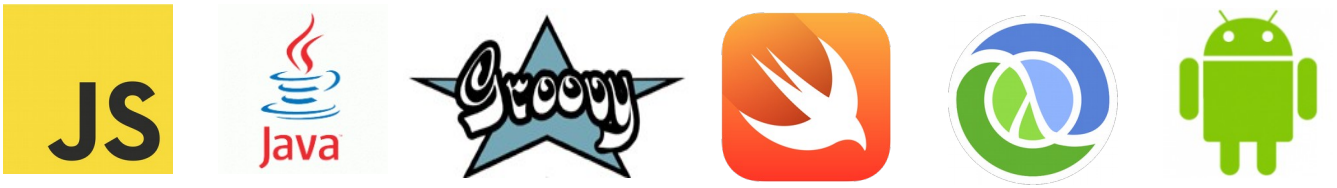
**https://youtu.be/_t06LRX0DV0?t=46**


Reactive Streams

# Reactive Extensions for Async Programming



# RX
# for Async Programming



formerly of....

Microsoft

**“Mouse is a database”**


PUSH

# Observer Iterator

# What pains does Rx alleviate?

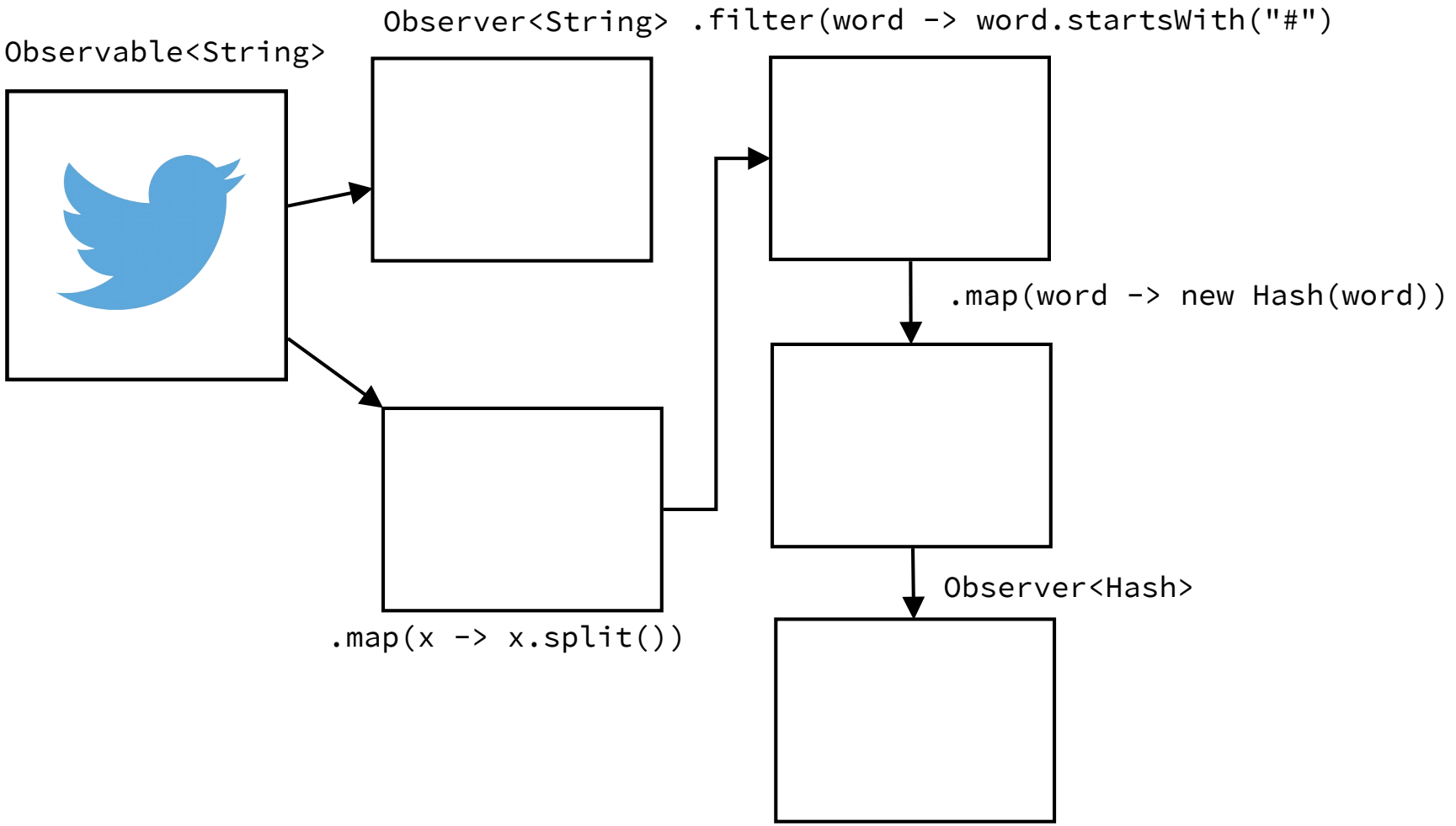
# Callback Hell

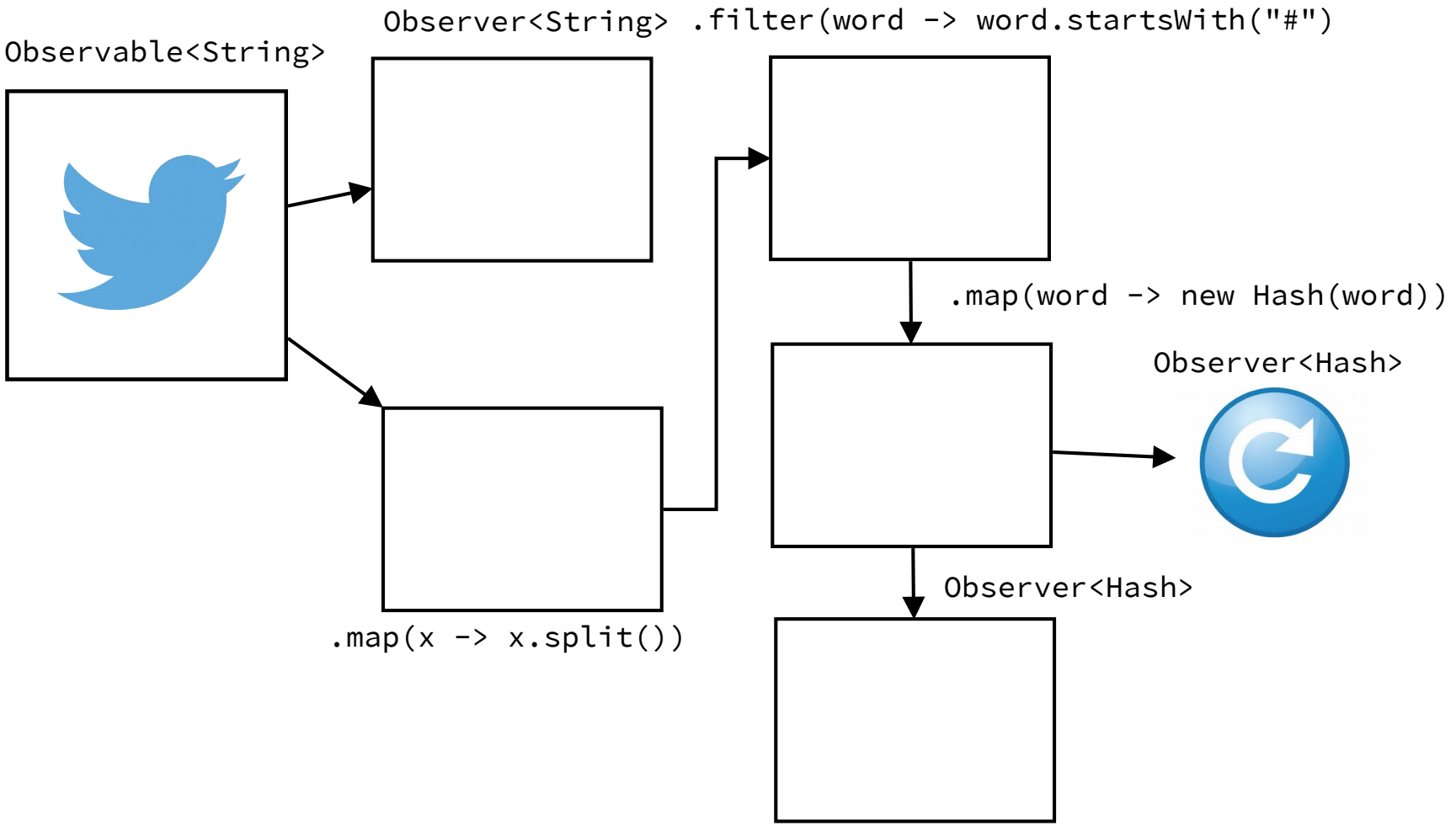
# Retaining a Source

# Backpressure Remedies

| | One | Many |
|---|---|---|
| **Sync** | `T` | `Iterator<T>` |
| **Async** | `Future<T>` | `Observable<T>` |

# Future Demo


Observable<String>
Observer<String>
.filter(word -> word.startsWith("#")
.map(word -> new Hash(word))
.map(x -> x.split())
Observer<Hash>

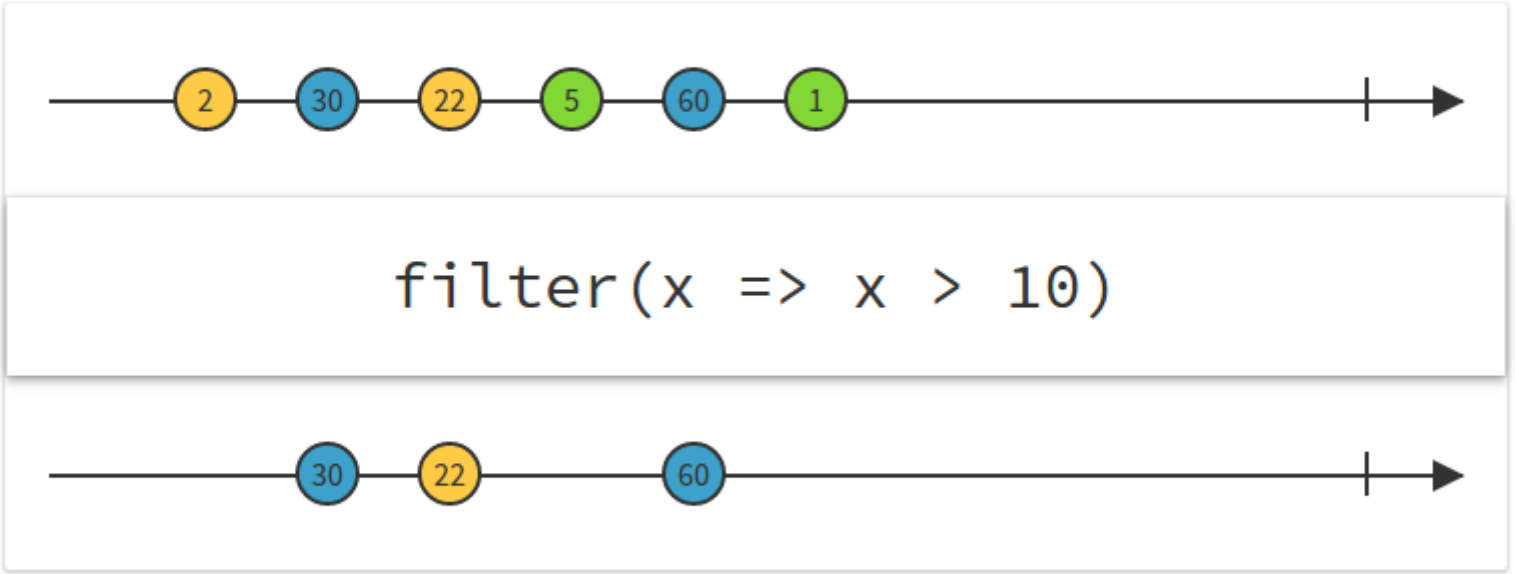

Observable<String>
Observer<String>
.filter(word -> word.startsWith("#")
.map(word -> new Hash(word))
Observer<Hash>
.map(x -> x.split())
Observer<Hash>


# Thinking of `Observable`s as Pipes

# Marble Diagrams

## Filter

emit only those items from an Observable that pass a predicate test




The `Filter` operator filters an Observable by only allowing items through that pass a test that you specify in the form of a predicate function.

# Find all your favorite operators at:

http://reactivex.io/documentation/operators


# RXJava Observable Demo


Hot vs. Cold Observable


# PSY- Gangnam Style (Official Music Video)

DanceGangnamStyle

Subscribe 46,824

44,983,176

Add to Share More

88,792 23,430


# Southwest Florida Eagle Cam

Southwest Florida Eagle Cam

Subscribe 6,394

2592 watching now

Add to Share More

4,599 392


# RXJava Hot/Cold Demo


UNDER BACKPRESSURE

Backpressure *def*:

Back pressure refers to pressure opposed to the desired flow of a fluid in a confined place such as a pipe. It is often caused by obstructions or tight bends in the confinement vessel along which it is moving, such as piping or air vents.

## Backpressure *def*:

Back pressure is when an `Observable` is emitting items more rapidly than an operator or subscriber can consume them. This presents the problem of what to do with such a growing backlog of unconsumed items.

# RXJava Backpressure Demo


# Streams?

# Reusing Streams

31

2

I'd like to duplicate a Java 8 stream so that I can deal with it twice. I can `collect` as a list and get new streams from that;

```
// doSomething() returns a stream
List<A> thing = doSomething().collect(toList());
thing.stream()... // do stuff
thing.stream()... // do other stuff
```

but I kind of think there should be a more efficient/elegant way. **Is there a way to copy the stream without turning it into a collection?**

# Reusing Streams

38

I think your assumption about efficiency is kind of backwards. You get this huge efficiency payback if you're only going to use the data once, because you don't have to store it, and streams give you powerful "loop fusion" optimizations that let you flow the whole data efficiently through the pipeline.

If you want to re-use the same data, then by definition you either have to generate it twice (deterministically) or store it. If it already happens to be in a collection, great; then iterating it twice is cheap.

We did experiment in the design with "forked streams". What we found was that supporting this had real costs; it burdened the common case (use once) at the expense of the uncommon case. The big problem was dealing with "what happens when the two pipelines don't consume data at the same rate." Now you're back to buffering anyway. This was a feature that clearly didn't carry its weight.

If you want to operate on the same data repeatedly, either store it, or structure your operations as Consumers and do the following:

```
stream()...stuff....forEach(e -> { consumerA(e); consumerB(e); });
```

You might also look into the RxJava library, as its processing model lends itself better to this kind of "stream forking".

share edit flag

edited May 26 '14 at 4:44

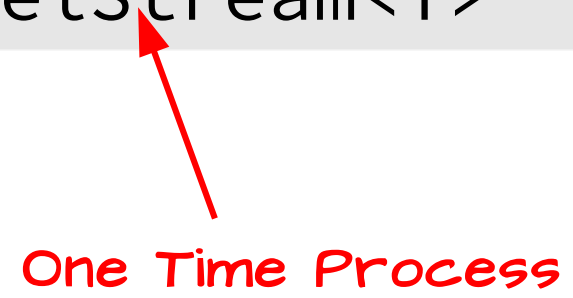
answered May 26 '14 at 0:00

Brian Goetz

**25.5k** ● 7 ● 53 ● 71

| | One | Many |
|---|---|---|
| **Sync** | `T` | `Iterator<T>` |
| **Async** | `Future<T>` | `Observable<T>` |

| | One | Many |
|---|---|---|
| **Sync** | `T` | `Iterator<T>`<br>`Stream<T>` |
| **Async** | `Future<T>` | `Observable<T>`<br>`ParallelStream<T>` |



| | One | Many |
|---|---|---|
| **Sync** | `T` | `Iterator<T>`<br>`Stream<T>` |
| **Async** | `Future<T>` | `Observable<T>`<br>`ParallelStream<T>` |

Multiuse Process

One Time Process

| | One | Many |
|---|---|---|
| **Sync** | T | `Iterator<T>`<br>`Stream<T>` |
| **Async** | `Future<T>`<br>`CompletableFuture<T>` | `Observable<T>`<br>`ParallelStream<T>` |


# More messy overloaded "Reactive" Terms

# The Reactive Manifesto

*Published on September 16 2014. (v2.0)*

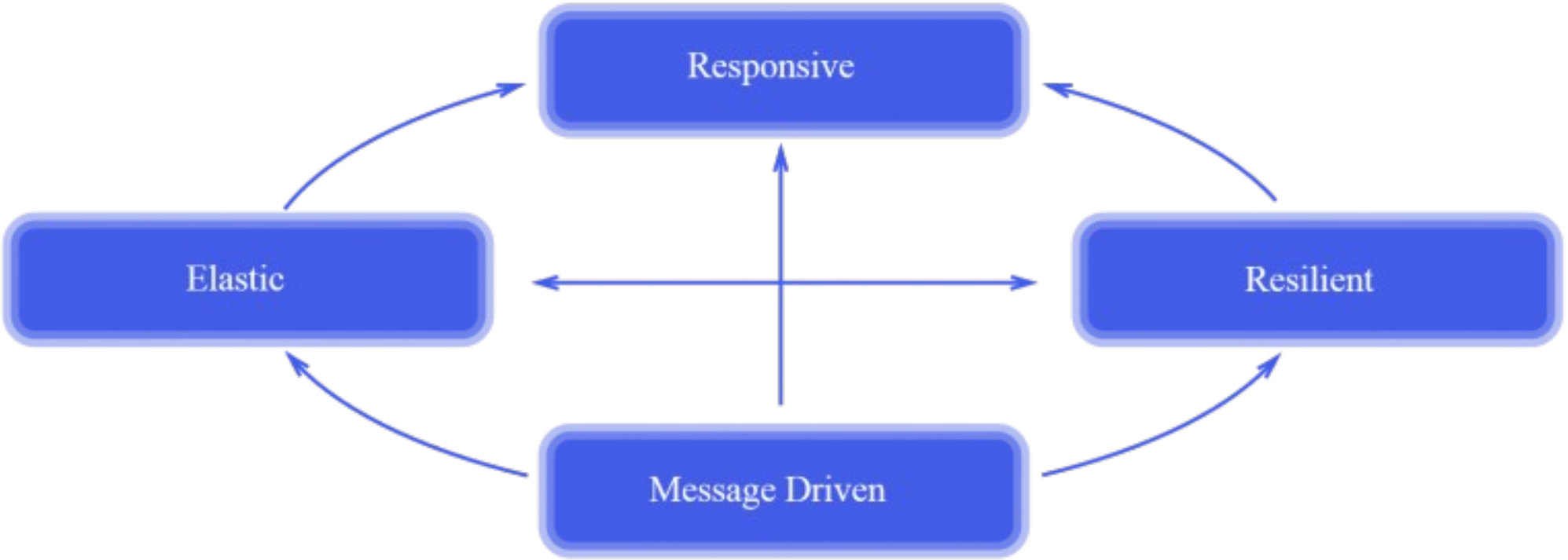
Organisations working in disparate domains are independently discovering patterns for building software that look the same. These systems are more robust, more resilient, more flexible and better positioned to meet modern demands.

These changes are happening because application requirements have changed dramatically in recent years. Only a few years ago a large application had tens of servers, seconds of response time, hours of offline maintenance and gigabytes of data. Today applications are deployed on everything from mobile devices to cloud-based clusters running thousands of multi-core processors. Users expect millisecond response times and 100% uptime. Data is measured in Petabytes. Today's demands are simply not met by yesterday's software architectures.

We believe that a coherent approach to systems architecture is needed, and we believe that all necessary aspects are already recognised individually: we want systems that are Responsive, Resilient, Elastic and Message Driven. We call these Reactive Systems.

Systems built as Reactive Systems are more flexible, loosely-coupled and scalable. This makes them easier to develop and amenable to change. They are significantly more tolerant of failure and when failure does occur they meet it with elegance rather than disaster. Reactive Systems are highly responsive, giving users effective interactive feedback.

http://www.reactivemanifesto.org/


Responsive
Elastic
Resilient
Message Driven


akka


Typesafe

"Swedified" from Áhkká

# http://akka.io

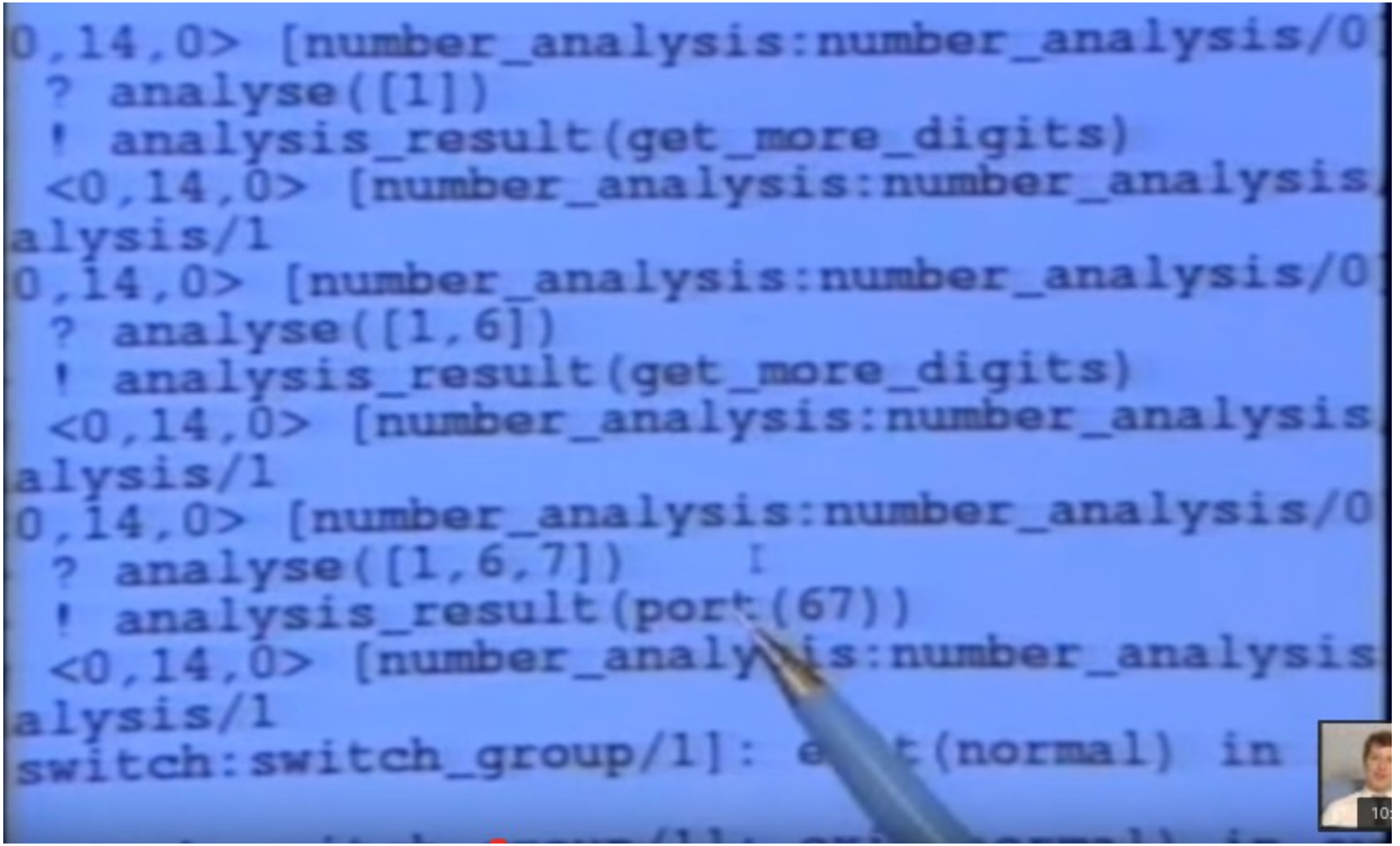
Actors, Location Transparency, Finite State Machines, Persistence, Clustering, Agents

# Failure Tolerance

# Scaling up and out

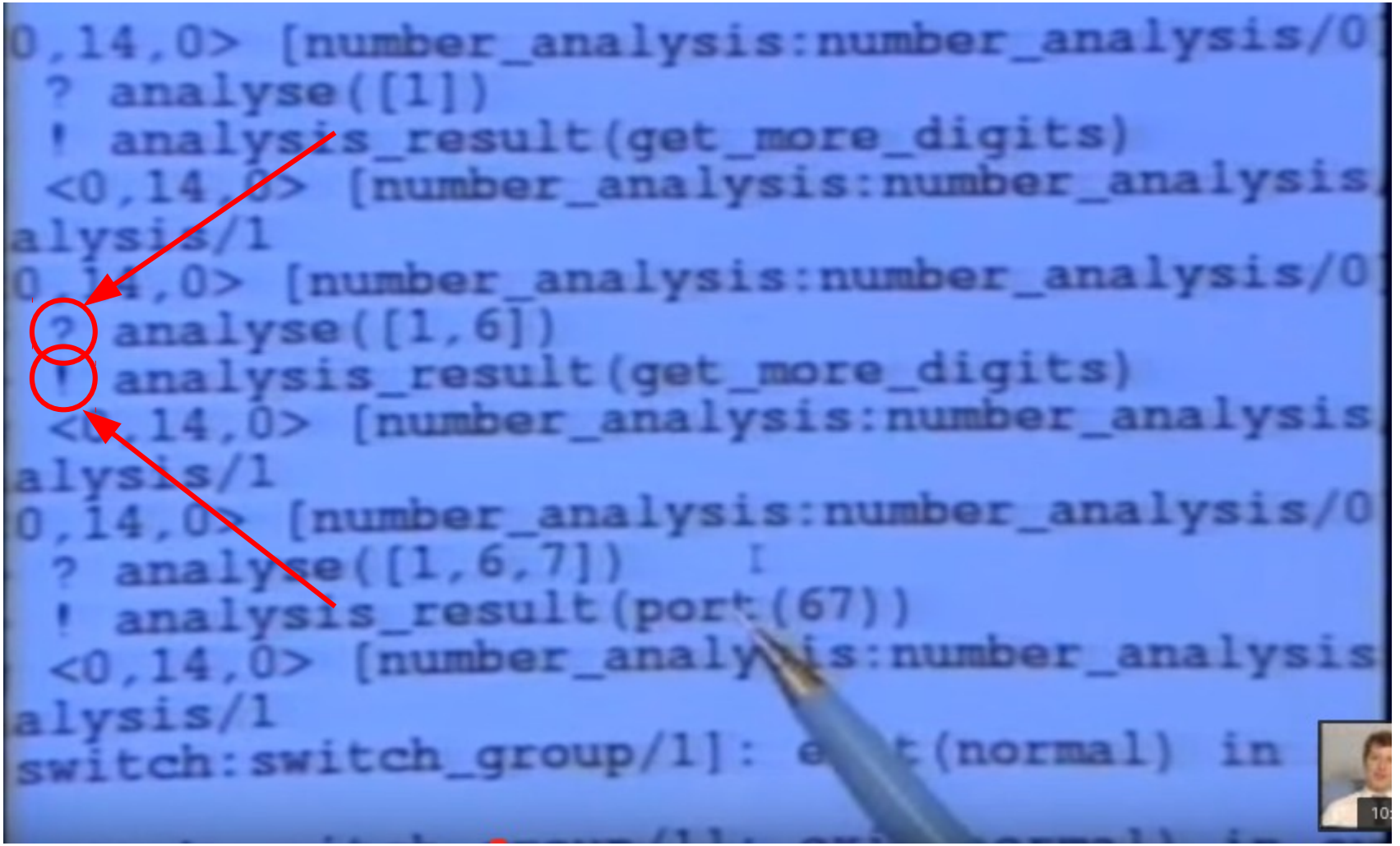
# About Actors


ERLANG




# Erlang the Movie!

https://www.youtube.com/watch?v=xrIjfIjssLE

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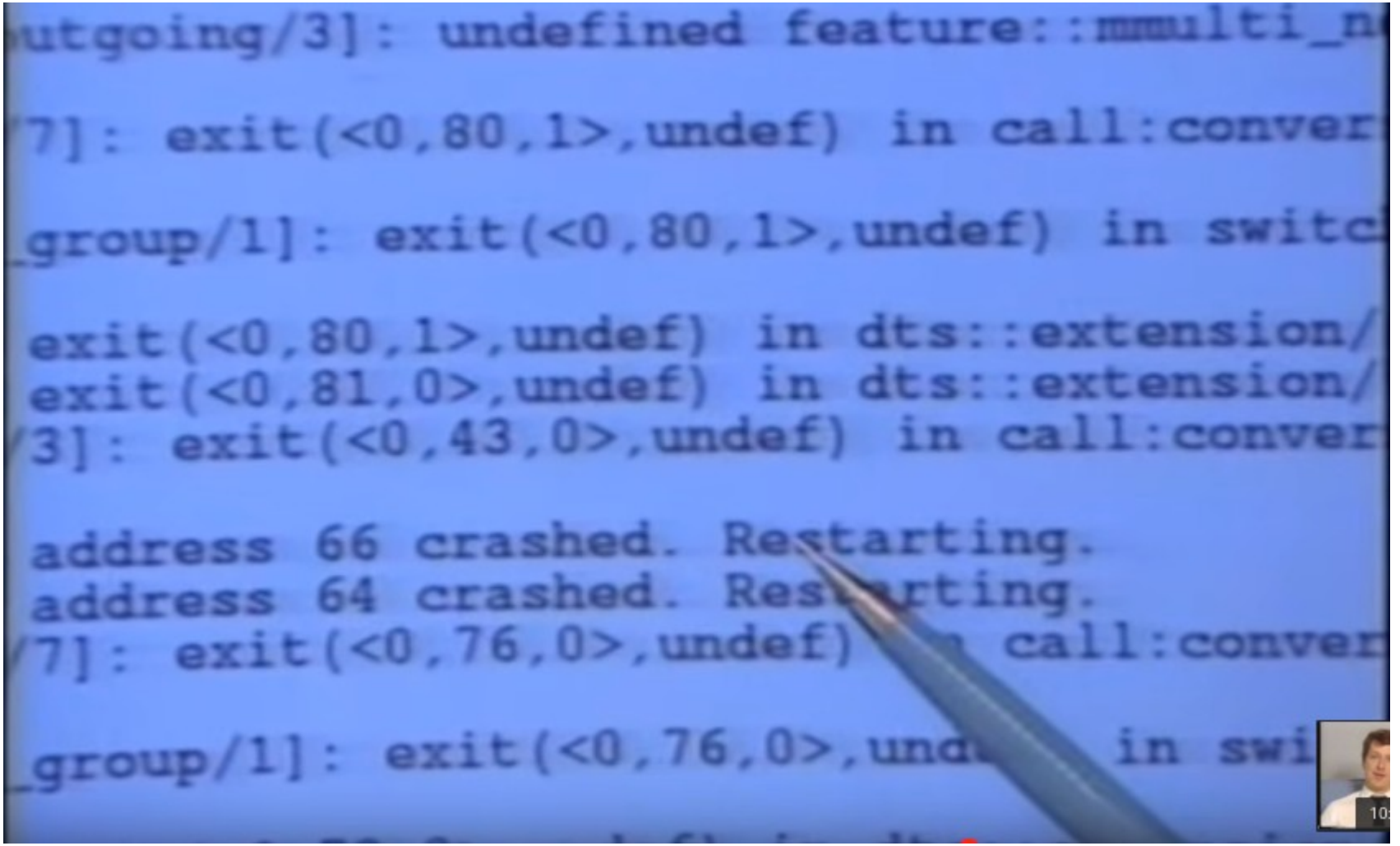


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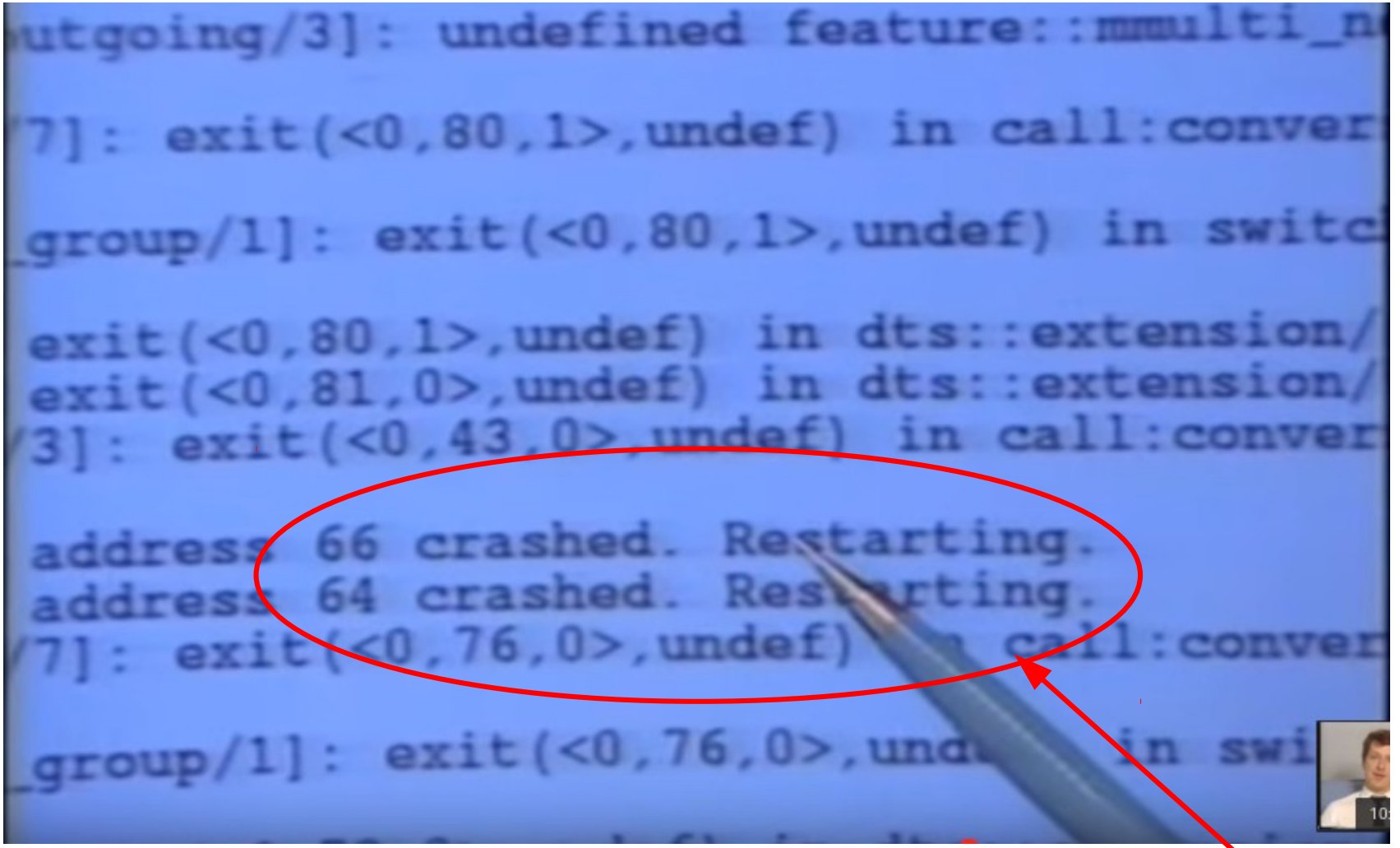


# Erlang the Movie!

https://www.youtube.com/watch?v=xrIjfIjssLE

**Encapsulate** state **and** behavior

Concurrent processors that exchange messages!

# Inside the Actors studio!

TO: MATT


TO: MATT


TO: MATT

Flooding Matt Damon with messages!

TO: MATT


TO: MATT

TO: MATT

TO: MATT

To: Matt

To: Matt

To: Matt

To: Matt

To: Matt

To: Matt

To: Matt

To: Matt

To: Matt

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TO: MATT


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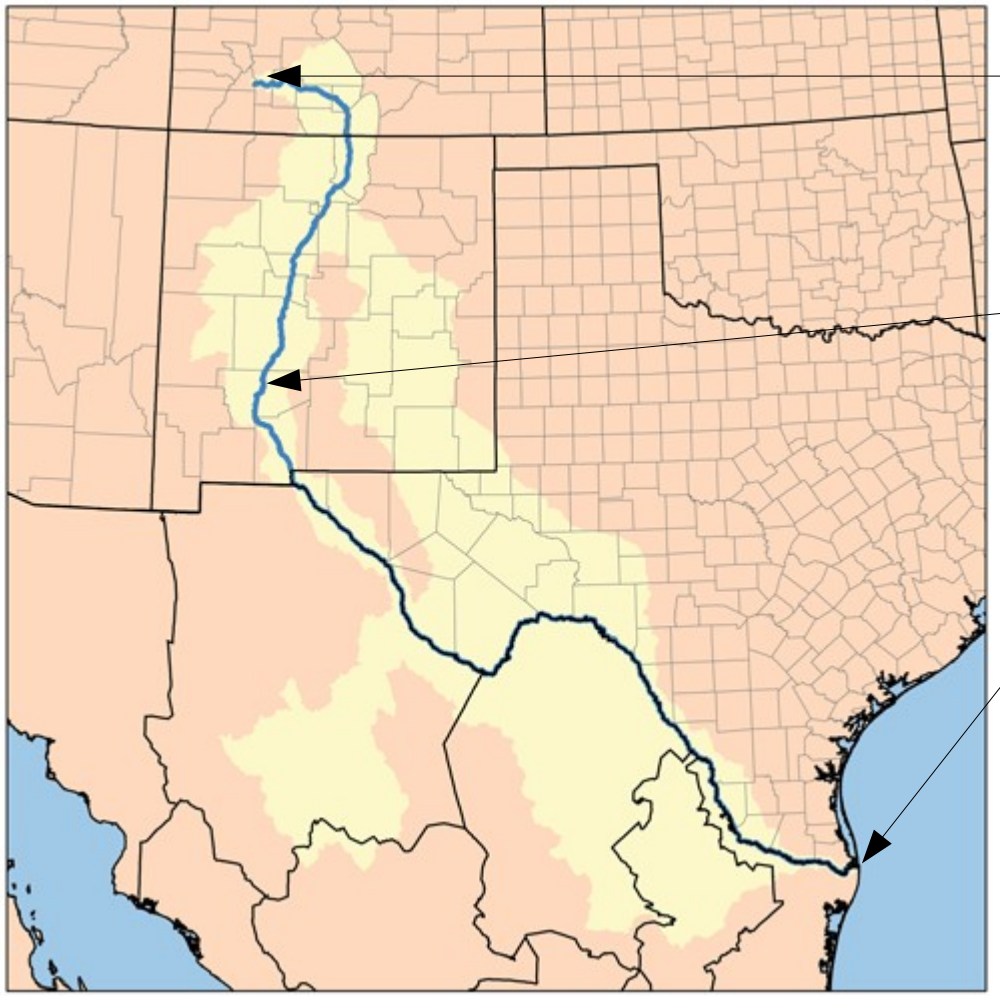
To: Matt


# Actor Demo


akka
Reactive Streams

akka
Streams



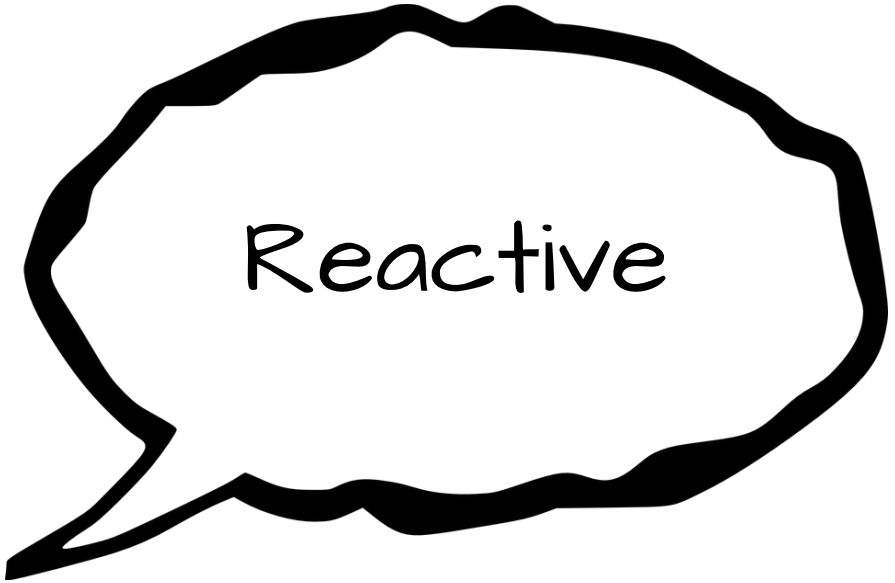
**Source** – One Output, Emits Data Elements

**Flow** – One Input and One Output, Connects up and down streams transforming data.

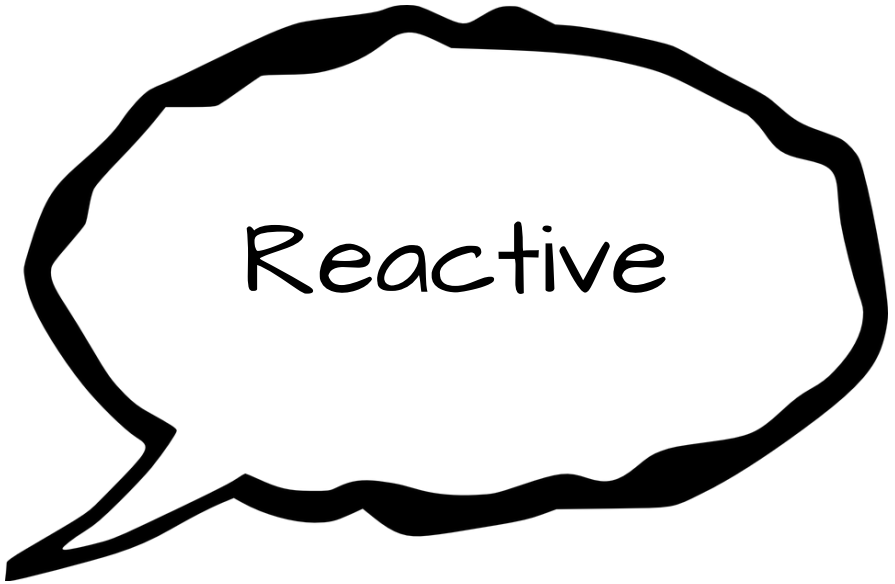
**Sink** – One Output, requesting and accepting data elements possibly slowing down the upstream producer of elements


# Reactive Streams Demo

# What does it mean when something is Reactive?

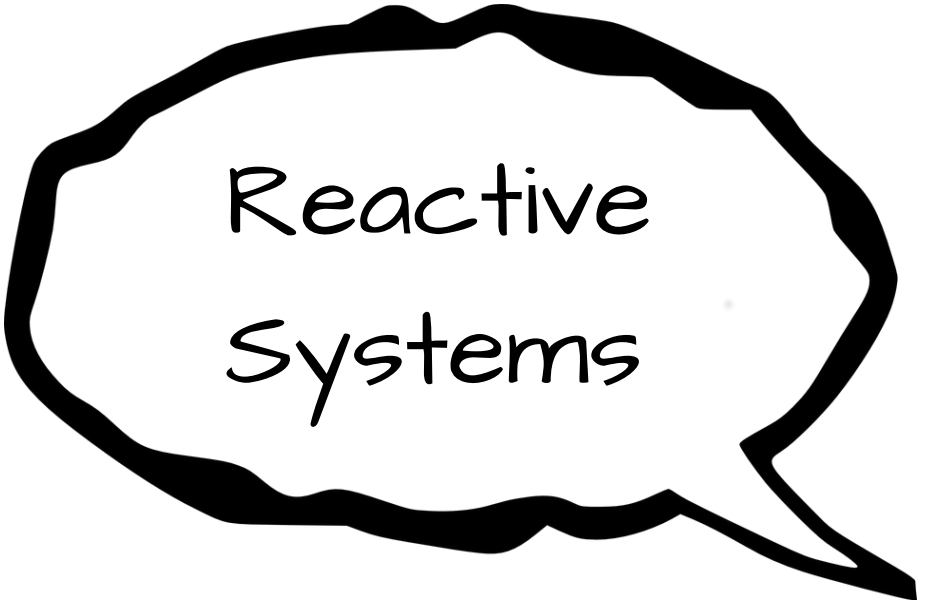

Reactive


FRP


Reactive


FRP


Reactive
Streams


Reactive
Systems

Reactive

FRP

Reactive Streams

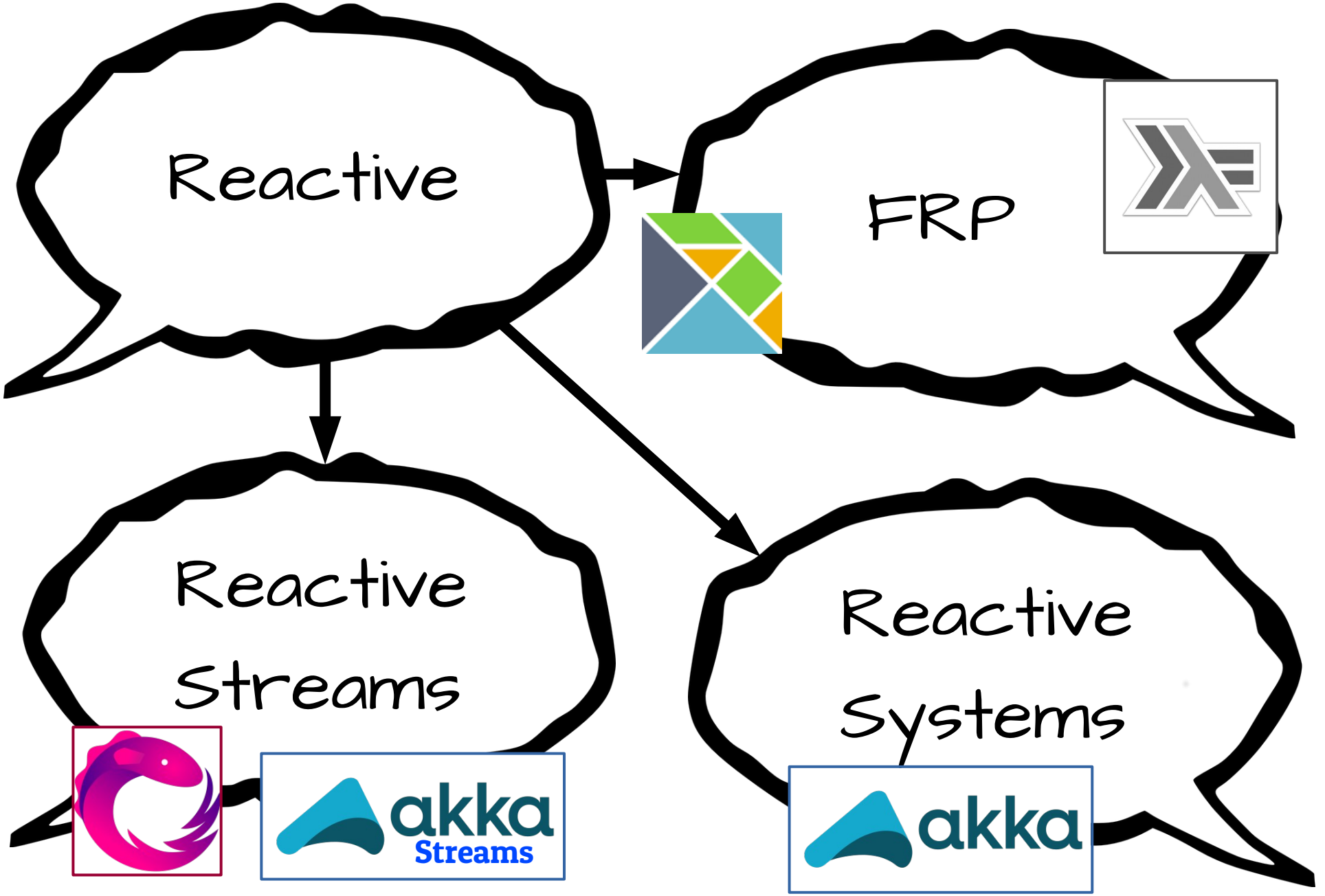

Reactive Systems

Reactive

FRP

Reactive Streams


Reactive Systems


Reactive
FRP
Reactive
Streams
akka
Streams
Reactive
Systems
akka

About knowing the
Differences between...

# Reactive Streams *and* Reactive Systems

# Thank You!