Monitoring Reactive Microservices

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2/24/2017

ABOUT ME


Texas Instruments
TI-99/4A
computer
Speech Synthesizer
DEL INS ERASE CLEAR BEGIN PROC'D AID REDO BACK QUIT
ENTER
SHIFT
SHIFT
ALPHA LOCK
CTRL
FCTN
Solid State Software


Lightbend


Scala


akka


play


lagom

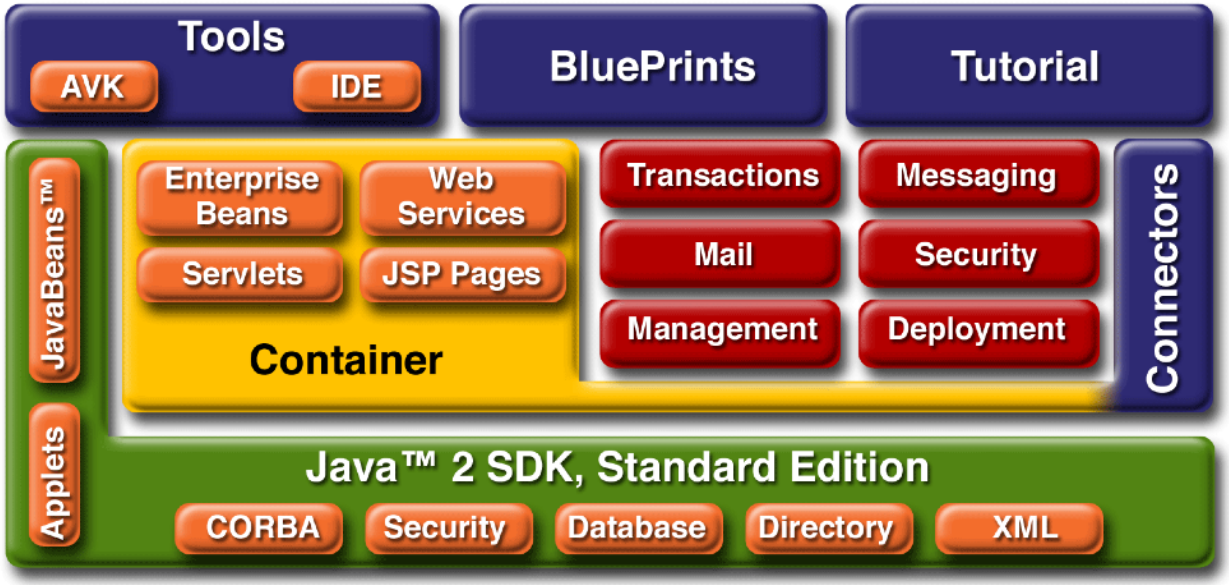
AGENDA

- “TRADITIONAL” AND REACTIVE APPLICATIONS
- MICROSERVICES
- MONITORING (DIFFERENT TYPES OF) APPLICATIONS
- CHALLENGES IN MONITORING AND MITIGATIONS
- PEEKING INTO FUTURE<THE>
- FAST DATA AND PRODUCTION MONITORING
- LIGHTBEND MONITORING

“TRADITIONAL” AND REACTIVE APPLICATIONS

WHEN I STARTED

GOOD OL' J2EE


Tools
AVK
IDE
BluePrints
Tutorial
JavaBeans™
Applets
Enterprise Beans
Web Services
Servlets
JSP Pages
Container
Transactions
Messaging
Mail
Security
Management
Deployment
Connectors
Java™ 2 SDK, Standard Edition
CORBA
Security
Database
Directory
XML

⏩ COUPLE OF YEARS

BEING SYNCHRONOUS

- \+ : Simple, well known, easier to reason about
- \- : Underutilizing hardware. harder to scale, brittle

Walmart

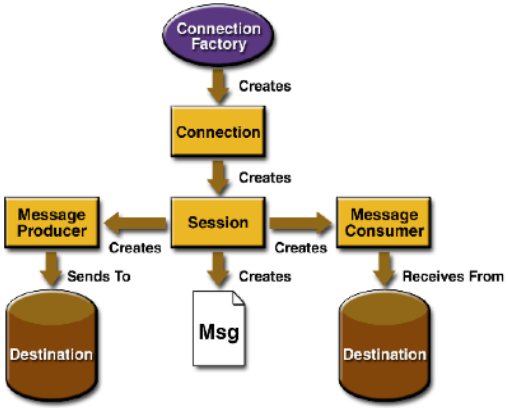
IT IS 2017 AND WE STILL USE

- Synchronous local/remote calls
- Single machine apps - scaling is an afterthought
- Non resilient approaches

Result: brittle, non-scaling applications

WHAT CAN WE DO ABOUT IT?

Use message driven/asynchronous programming

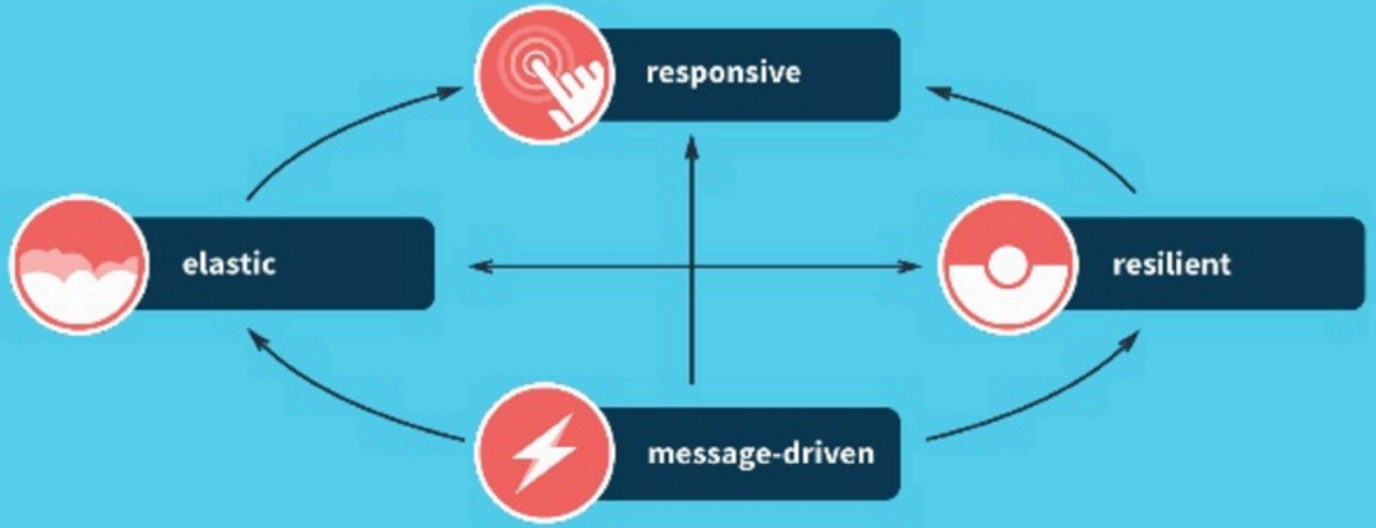


PROBLEM SOLVED!?

REACTIVE MANIFESTO

- Created in September 2014, +16k signatures
- Consists of four traits
  - *Responsive*
  - *Resilient*
  - *Elastic*
  - *Message Driven*

Reactive applications share four traits



RESPONSIVE

A responsive application is quick to react to all users

- under blue and grey skies
- regardless of load of system, time of day, day of year
- ensures a consistently positive user experience

RESILIENT

Things can and will go wrong!

- A resilient application applies proper design and architecture principles
- Resiliency tends to be the weakest links in applications
- Your application should be resilient on all levels

ELASTIC

Your app should be able to scale UP and OUT

- UP: Utilize all hardware on the machine
- OUT: Spread over multiple nodes

Elasticity and resiliency of hand in hand when creating consistently responsive applications.

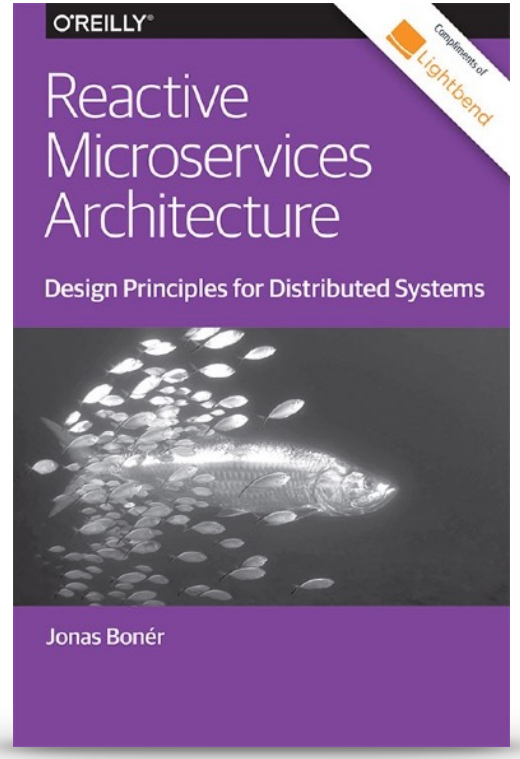
MESSAGE DRIVEN

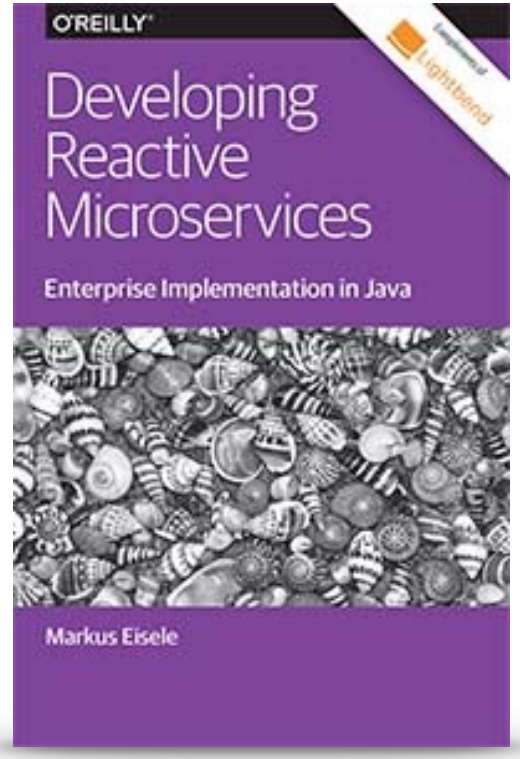
- A message-driven architecture is the foundation of a reactive application.
- Using this approach, correctly, will enable your application to be both asynchronous and distributed.

MICROSERVICES

RECIPES FOR MICROSERVICES

- Isolate everything
- Act autonomously
- Do one thing and do it well
- Own your state
- Embrace asynchronous message passing





http://www.lightbend.com/resources/e-books

MONITORING TRADITIONAL APPLICATIONS

SYNCHRONOUS APPS

- Metrics based on entry/exit points
- Context packed stack traces are available
- Logs are (more) descriptive
- Thread locals can be used to transfer contexts

MONITORING ASYNCHRONOUS APPLICATIONS

ASYNCH STACK TRACE

```
[info]      at cinnamon.sample.failure.B$$anonfun$receive$2.applyOrElse(FailureDemo.scala:102)
[info]      at akka.actor.Actor$class.aroundReceive(Actor.scala:467)
[info]      at cinnamon.sample.failure.B.aroundReceive(FailureDemo.scala:86)
[info]      at akka.actor.ActorCell.receiveMessage(ActorCell.scala:516)
[info]      at akka.actor.ActorCell.invoke(ActorCell.scala)
[info]      at akka.dispatch.Mailbox.processMailbox(Mailbox.scala:238)
[info]      at akka.dispatch.Mailbox.run$$original(Mailbox.scala:220)
[info]      at akka.dispatch.Mailbox.run(Mailbox.scala:29)
[info]      at akka.dispatch.ForkJoinExecutorConfigurator$AkkaForkJoinTask.exec(AbstractDispatcher.scala:397)
[info]      at scala.concurrent.forkjoin.ForkJoinTask.doExec(ForkJoinTask.java:260)
[info]      at scala.concurrent.forkjoin.ForkJoinPool$WorkQueue.runTask(ForkJoinPool.java:1339)
[info]      at scala.concurrent.forkjoin.ForkJoinPool.runWorker(ForkJoinPool.java:1979)
[info]      at scala.concurrent.forkjoin.ForkJoinWorkerThread.run(ForkJoinWorkerThread.java:107)
```

JUMP ASYNCH BOUNDARIES

EXAMPLE SPI

```
abstract class ActorInstrumentation {
  def systemStarted(system: ActorSystem): Unit
  def systemShutdown(system: ActorSystem): Unit
  def actorStarted(actorRef: ActorRef): Unit
  def actorStopped(actorRef: ActorRef): Unit
  def actorTold(actorRef: ActorRef, message: Any, sender: ActorRef): AnyRef
  def actorReceived(actorRef: ActorRef, message: Any, sender: ActorRef, context: AnyRef):
Unit
  def actorCompleted(actorRef: ActorRef, message: Any, sender: ActorRef, context: AnyRef):
Unit
  // …
}
```

INSIDE THE SAUSAGE FACTORY

```
// ActorCell.scala
final def invoke(messageHandle: Envelope): Unit = try {
  //…
  systemImpl.instrumentation.actorReceived(
     self, messageHandle.message, messageHandle.sender, context)
  messageHandle.message match {  // … }
  systemImpl.instrumentation.actorCompleted(
     self, messageHandle.message, messageHandle.sender, context)
} catch handleNonFatalOrInterruptedException { e ⇒ handleInvokeFailure(Nil, e)

// …
```

MONITORING DISTRIBUTED APPLICATIONS

DISTRIBUTED TRACING

In a nutshell:

- Create event for each “occurrence”
- Persist these events
- Deduct information based on the events
- Transfer contexts at remote boundaries

PAPER NOTE EXPERIMENT

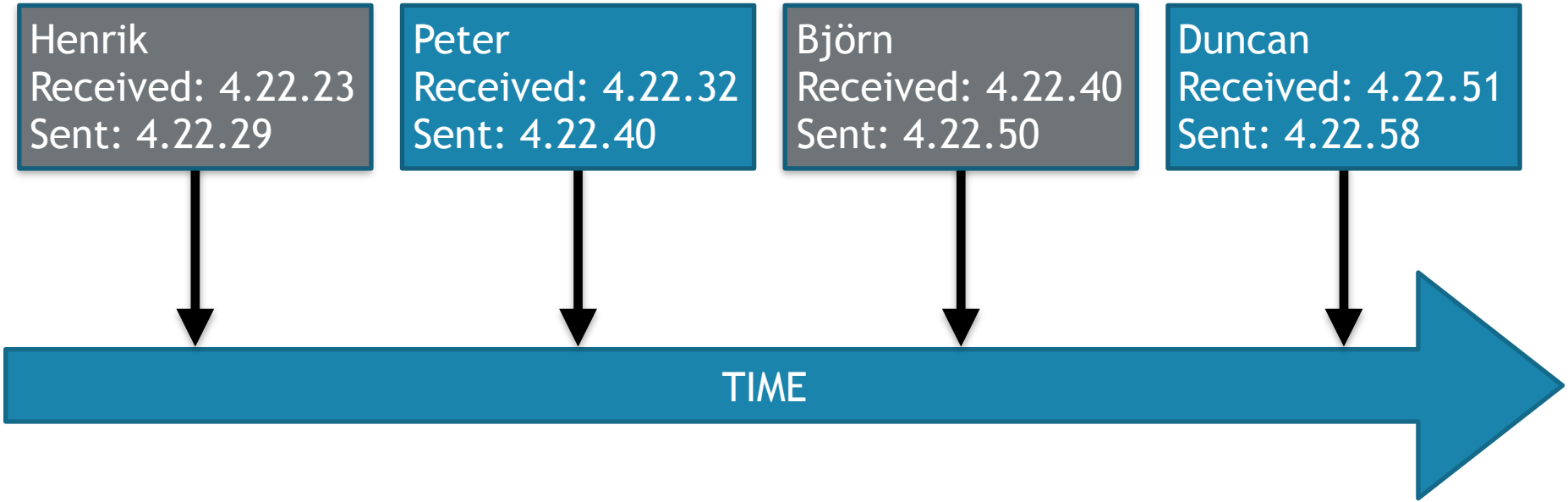
Henrik
Received: 4.22.23
Sent: 4.22.29

Björn
Received: 4.22.40
Sent: 4.22.50

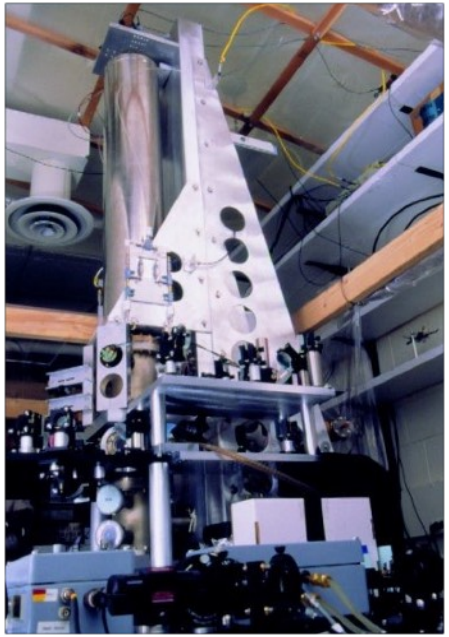
Peter
Received: 4.22.32
Sent: 4.22.40

Duncan
Received: 4.22.51
Sent: 4.22.58

WHAT IS WRONG WITH THIS?



APPROACH TO ACHIEVING ORDER



PAPER NOTE EXPERIMENT

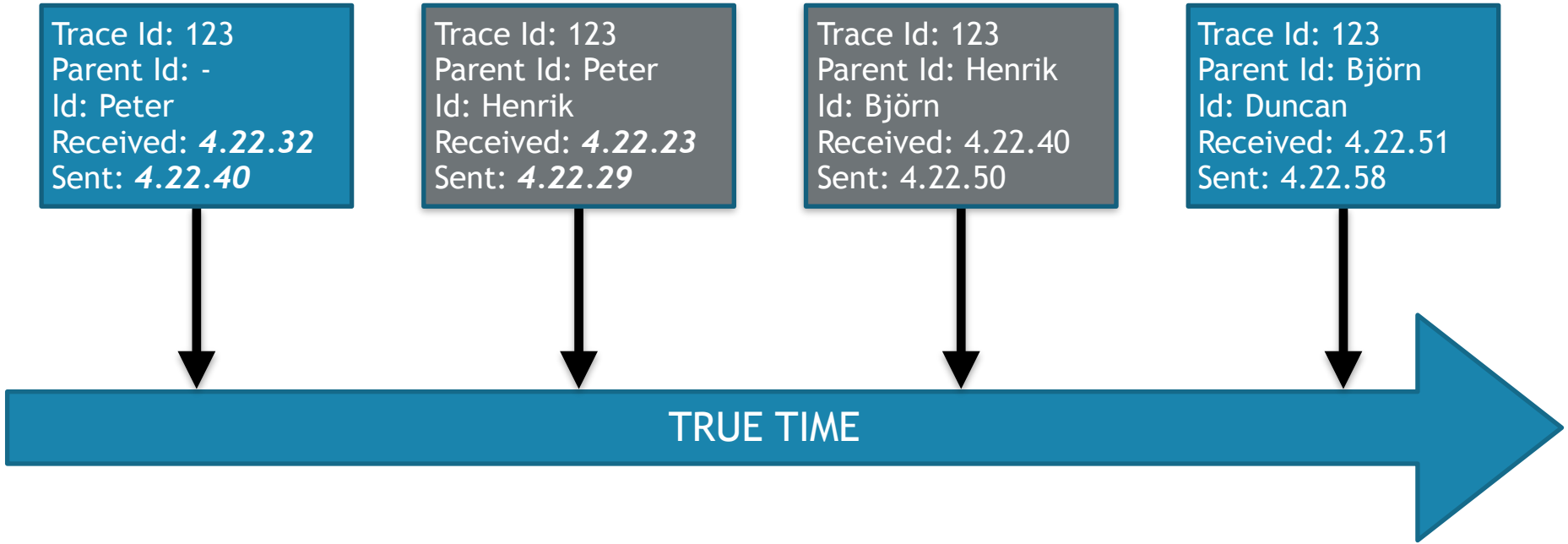
Trace Id: 123
Parent Id: Peter
Id: Henrik
Received: 4.22.23
Sent: 4.22.29

Trace Id: 123
Parent Id: Henrik
Id: Björn
Received: 4.22.40
Sent: 4.22.50

Trace Id: 123
Parent Id: -
Id: Peter
Received: 4.22.32
Sent: 4.22.40

Trace Id: 123
Parent Id: Björn
Id: Duncan
Received: 4.22.51
Sent: 4.22.58

CORRECT ORDER



VISIBILITY

How do we get full visibility then? Log everything?

- No, it could/would be too costly.
- We have to come up with clever ways of doing good enough - see challenges and mitigations in the following slides for inspiration.

CHALLENGES IN MONITORING AND MITIGATIONS

HANDLING SCALE

If we create event for everything it will be like drinking from a firehose!

Mitigation:

- Dynamic configuration
- Sampling (adaptive), rate limiting
- Gather information closer to the source
- Use delta approach

EPHEMERALITY

Things come and go in an asynchronous, distributed system.

Mitigation:

- Create metrics of “patterns” instead of individual instances
- Group information together based on classes or grouped classes to get to a higher level

STAYING COST EFFECTIVE

Monitoring introduces cost in terms of time (performance overhead) and money (running and storing data).

Mitigation:

- Only monitor “valid” parts of your application, or at least use class or group level monitoring for short lived, ephemeral things
- Use dynamic configuration that can be used to zoom in when anomalies are detected

CORRELATION

When monitoring your system you have to use data from multiple sources in order to make sense of the data.

Mitigation:

- Combine sources together to understand what is going on
- E.g. low level metrics combined with JVM info, OS info, Orchestration Tool info, Data Center info, etc.

VARIETY

Just like snowflakes, no two monitored application are the same. This makes it hard to create a generic monitoring system that can handle all sorts of applications.

Mitigation:

- Use configurable monitoring to instruct how you want to monitor to be performed
- ML in combination with runtime config is very interesting!

HIGHER AVAILABILITY

What good is your monitoring system if it cannot stay up when the monitored application is having trouble?

Mitigation:

- Use inspiration from the Reactive Manifesto when you build or buy your monitoring system

PEEKING INTO FUTURE<THE>

EXAMINING DEPLOYMENT TRENDS

- 1970s: Mainframes
- 1980s: Minicomputers
- 1990s: Unix servers
- 2000s: Windows on x86, *Linux on x86*
- 2010s: *Cloud computing, Serverless/FaaS*

FaaS/Serverless/NoOps

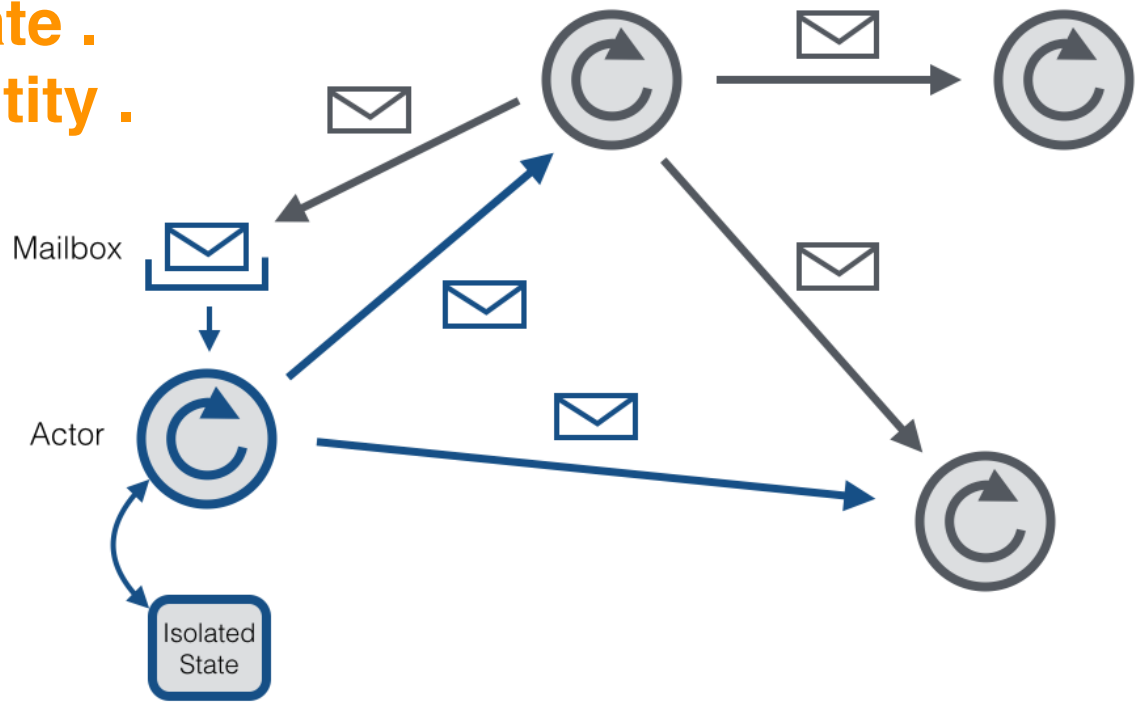
AWS Lambda:

- Short lived functions
- Triggered by events
- Stateless
- Auto scaling
- Pay per 100ms of invocation

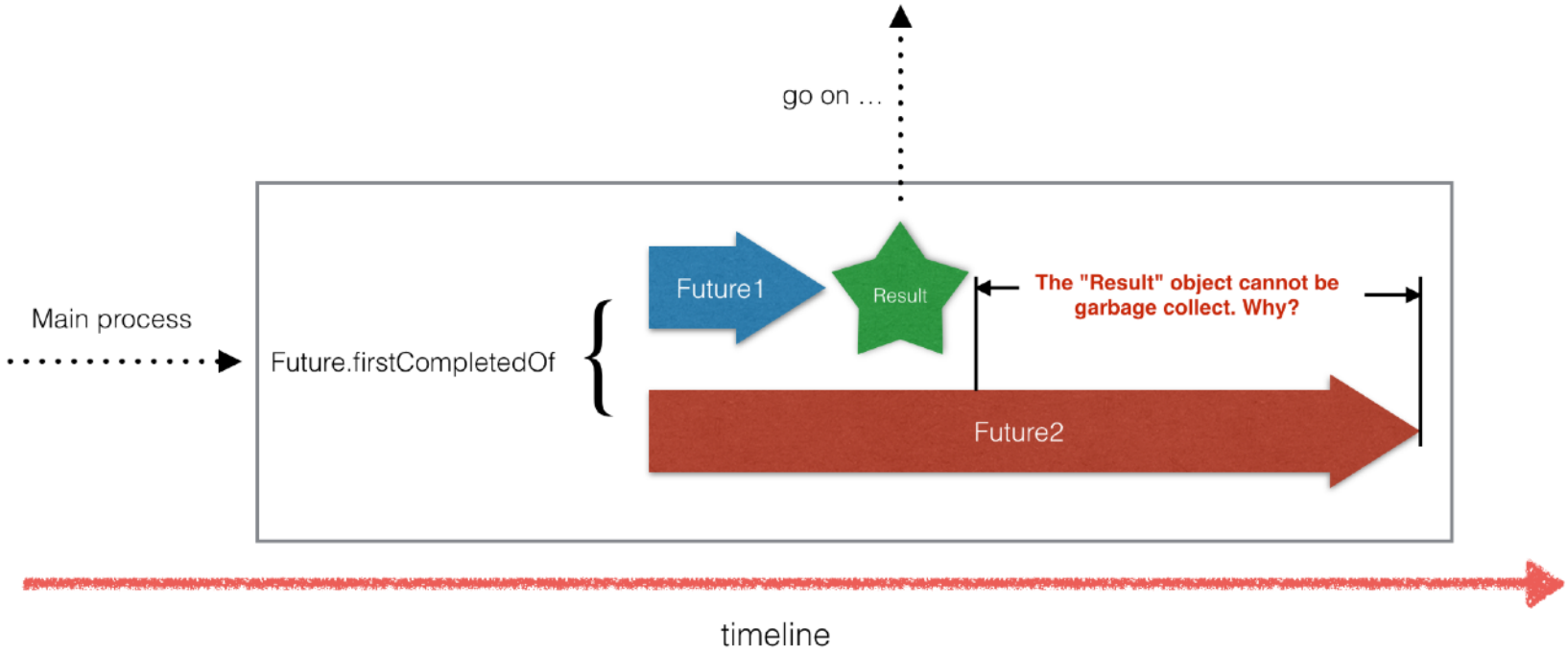
ACTORS

.Distributed State .

.Distributed Identity .



FUTURES


go on …
Main process
Future.firstCompletedOf
Future1
Result
The "Result" object cannot be garbage collect. Why?
Future2
timeline

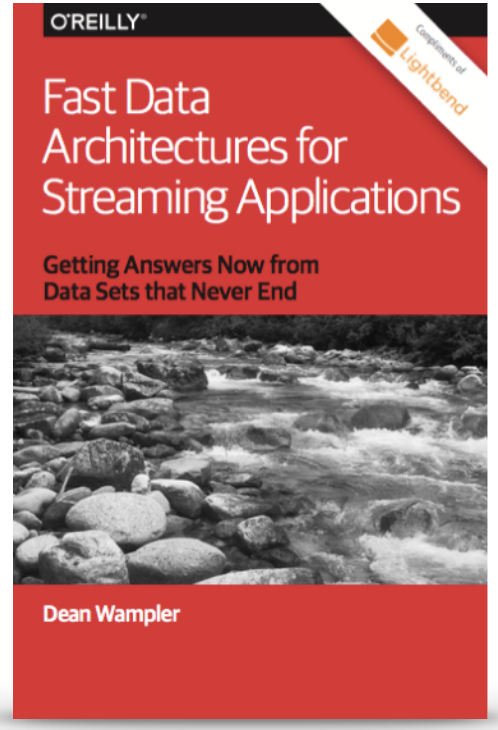
SO, IT'S NOT REALLY NEW!

Actors are location transparent

Futures are anonymous blocks of code executed some time

Serverless/FaaS just highlights a monitoring need that already exists!

FAST DATA AND PRODUCTION MONITORING



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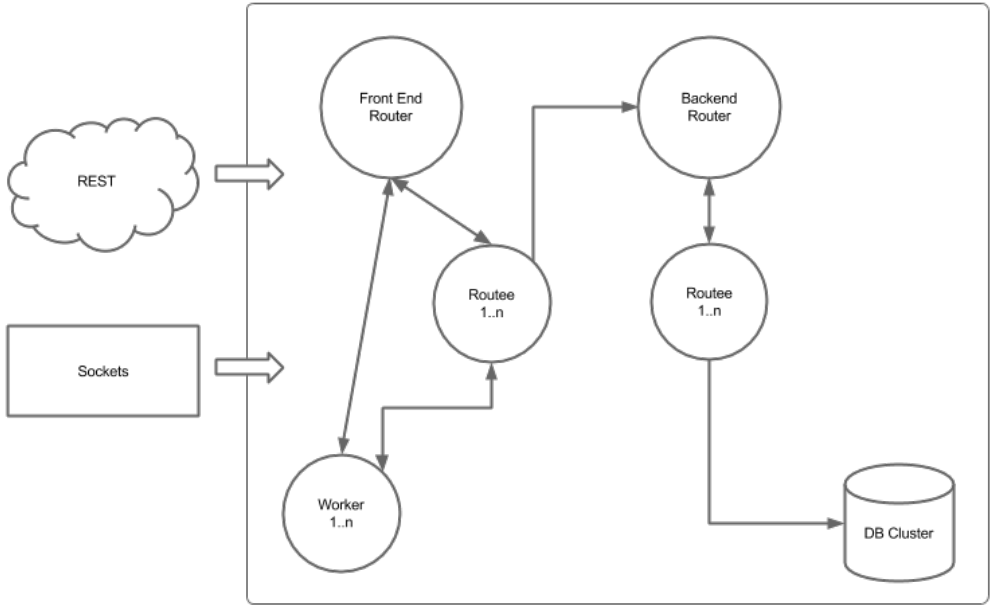
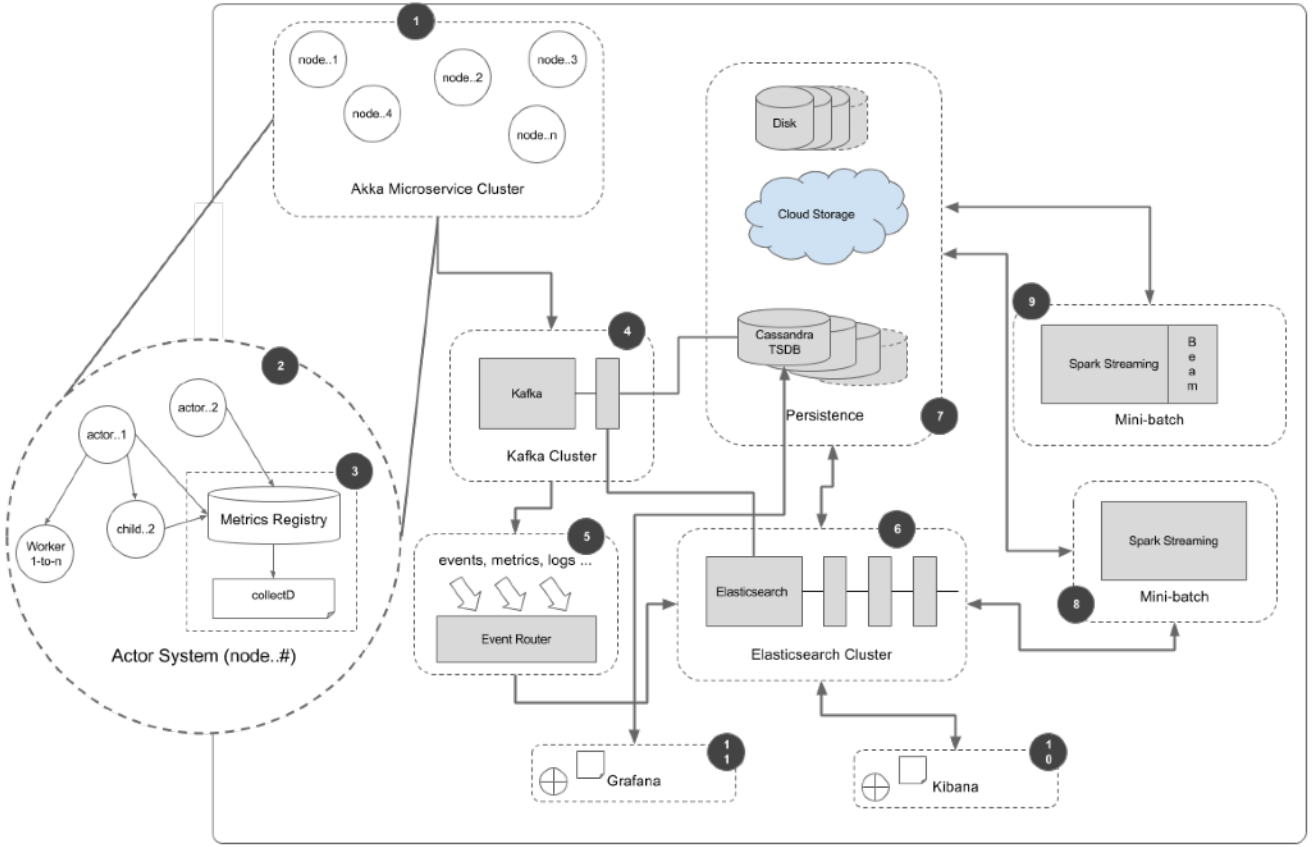
MONITORING AT SCALE

http://dev.lightbend.com/guides/monitoring-at-scale/home.html

MONITORING AT SCALE

Our use case will focus on an Akka-based system that includes a front-end service which routes requests to a backend that persists information to a database. The front-end service will implement the router pattern to handle multiple requests as will the backend for persistence. The application will also contain a logic module that will spin up 1-to-n number of short-lived worker actors which do some calculation required to validate the request before persisting. Following is a diagram of our use case:




1
node..1
node..2
node..3
node..4
node..n
Akka Microservice Cluster
Disk
Cloud Storage
Cassandra TSDB
Persistence
7
9
Spark Streaming
Beam
Mini-batch
4
Kafka
Kafka Cluster
2
actor..2
actor..1
3
Metrics Registry
Worker 1-to-n
child..2
collectD
Actor System (node..#)
5
events, metrics, logs ...
Event Router
6
Elasticsearch
Elasticsearch Cluster
Spark Streaming
8
Mini-batch
11
Grafana
10
Kibana

INTERESTING FRAMEWORKS

LIGHTBEND MONITORING

FEATURE LIST (2016-09)

- Targets Lightbend's Reactive Platform
  - Akka Actors
  - Remoting / Clustering
  - Lagom Circuit Breakers
  - Dispatchers/Thread Pools
  - Akka Cluster Information (statistics, events, SBR)
  - Various backend integration (ES, StatsD, …)
  - Sandbox environment (EKG) for easy exploration

UPCOMING FEATURES

- Futures (Java8/Scala)
- Akka Streams
- Akka HTTP and Play
- Expanded Lagom monitoring
- Expanded distributed tracing

HOW TO GET IT

- Free to use during development
- Requires subscription to use in production

  Create, *free*, account to get started:

  https://www.lightbend.com/account/register

  Demo:

  https://demo.lightbend.com

THANKS FOR LISTENING!
Q & A

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