REACTIVE STREAMS, linking REACTIVE APPLICATIONS to SPARK STREAMING

Luc Bourlier

Lightbend Inc.

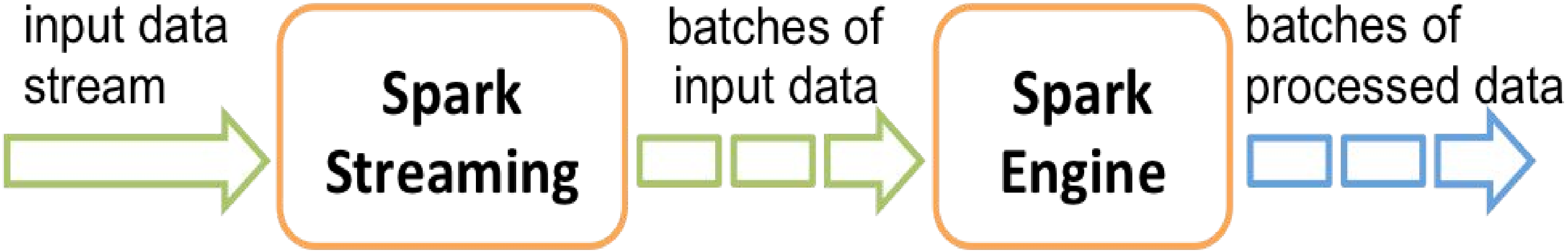
SPARK SUMMIT 2016
DATA SCIENCE AND ENGINEERING AT SCALE
JUNE 6-8. 2016 SAN FRANCISCO

Agenda

- Spark Streaming
- Reactive Application
- Back pressure
- Reactive Streams
- Demo

Spark Streaming

Spark Streaming



input data stream

Spark Streaming

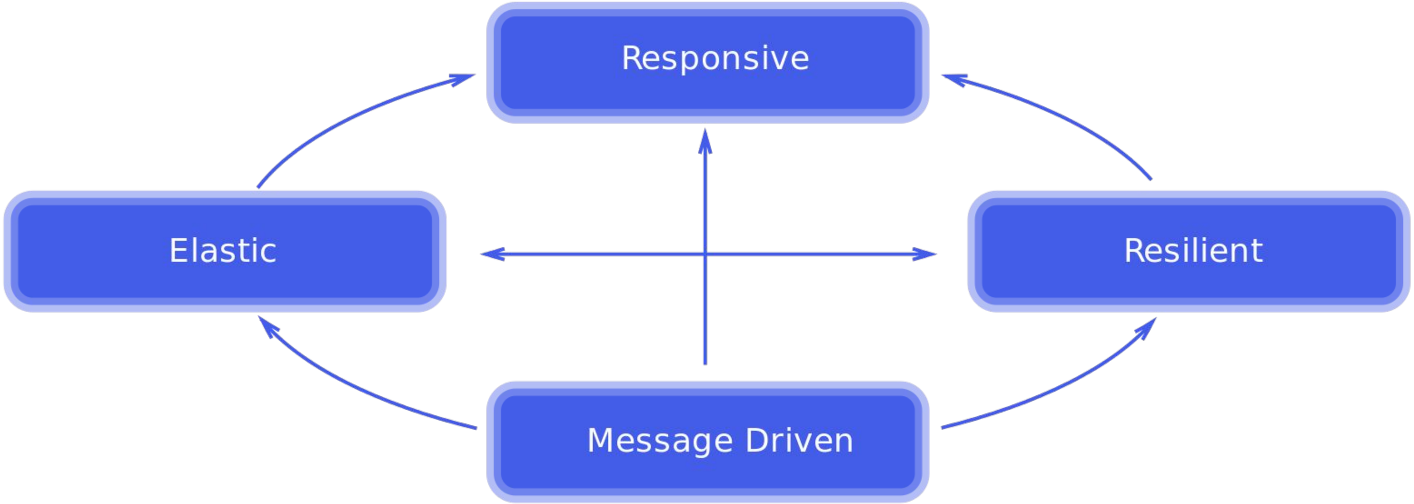
batches of input data

Spark Engine

batches of processed data

Reactive Application

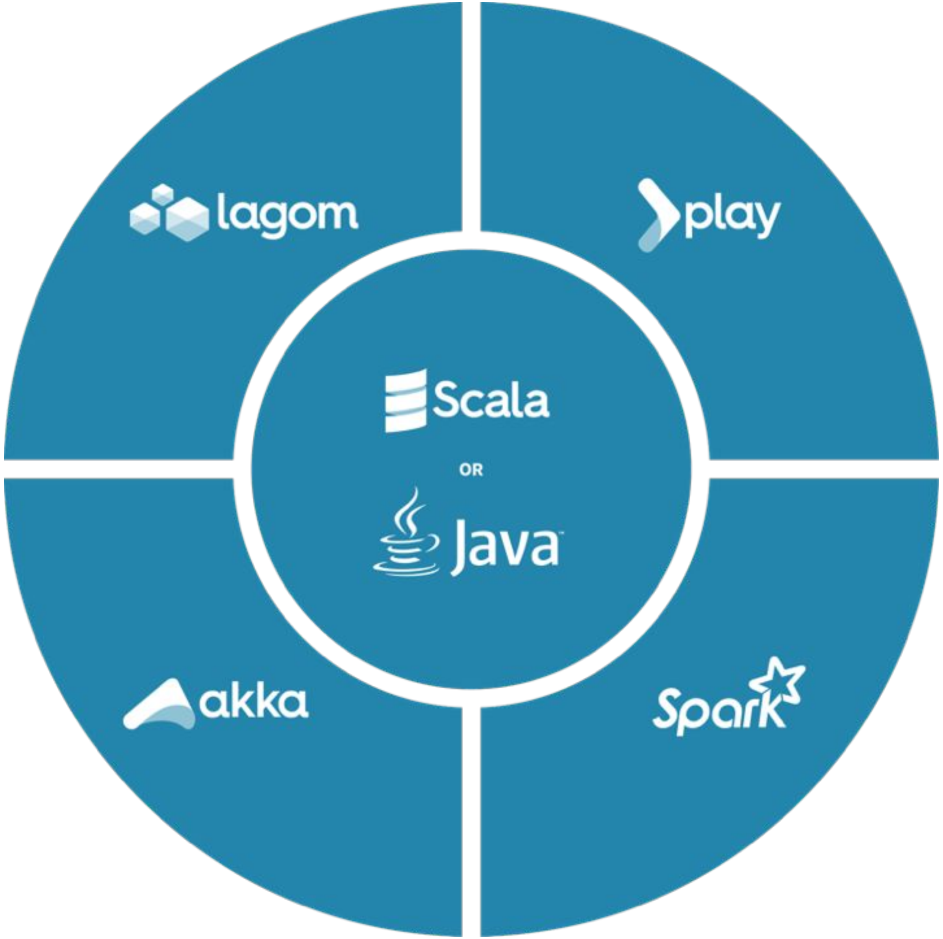
Reactive Application



http://www.reactivemanifesto.org

Reactive Application

Responsive	responds in a timely manner
Resilient	stays responsive in the face of failure
Elastic	stays responsive under varying workload
Message Driven	relies on asynchronous message-passing


lagom
play
Scala
OR
Java
akka
Spark

Resilience in Spark and Spark Streaming

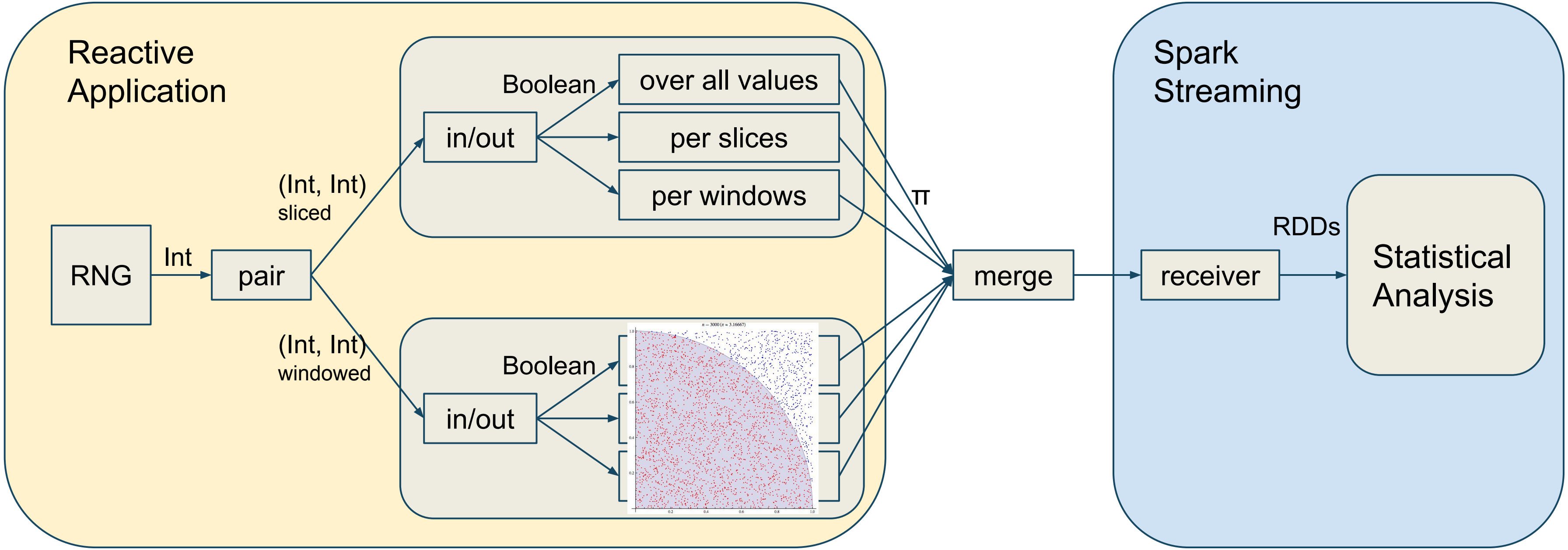
- Support for all kinds of failures
  - Hardware
  - Software
  - Network
- Specific resilience for Spark Streaming
  - Recovery for continuous processing
  - Excess volume of data

Resilience in Spark and Spark Streaming

- Support for all kinds of failures
  - Hardware
  - Software
  - Network
- Specific resilience for Spark Streaming
  - Recovery for continuous processing
  - Excess volume of data ← **the subject of this presentation**

Demo

Demo



Reactive Application

RNG

Int

pair

(Int, Int)
sliced

(Int, Int)
windowed

in/out

Boolean

over all values

per slices

per windows

in/out

Boolean

π

merge

Spark Streaming

receiver

RDDs

Statistical Analysis

Image, Wikipedia. By CaitlinJo - Own work
This mathematical image was created with Mathematica, CC BY 3.0

Back Pressure

Back Pressure

- a slow consumer should slow down the producer
  - the produce applies pressure
  - the consumer applies back pressure
- the classic example: TCP

Back Pressure in Spark Streaming

Spark Streaming

Congestion support in Spark 1.4

Static rate limit

- `spark.streaming.receiver.maxRate`
- conservative
- difficult to find the right limit (depends on cluster size)
- one limit to all streams

Spark Streaming

Back pressure in Spark 1.5

Dynamic rate limit

- rate estimator
  - estimates the number of element that can be safely processed by system during the batch interval
- rate sent to receivers
- rate limiter
  - relies on TCP to slow down producers

Spark Streaming

Rate estimator

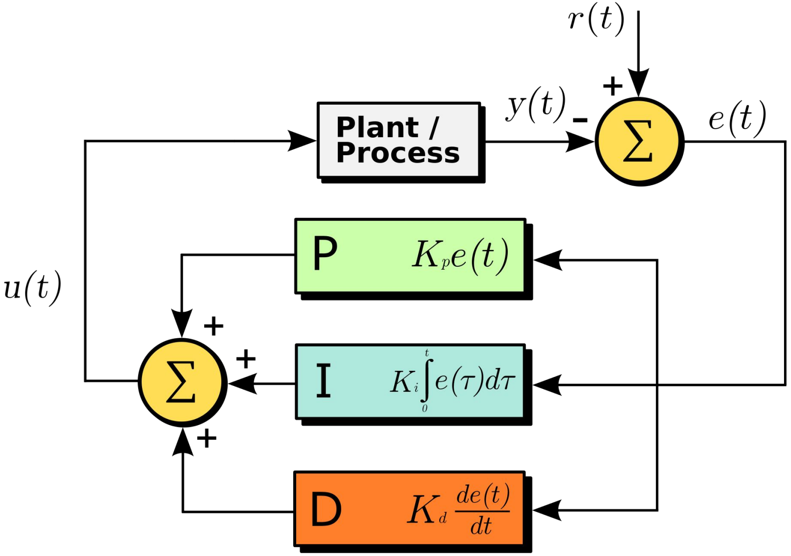
- each BatchCompleted event contains
  - processing delay, scheduling delay
  - number of element in mini-batch
- the rate is (roughly) elements / processingDelay
- but what about accumulated delay?

Spark Streaming

Rate estimator

Proportional-Integral-Derivative

- P, I, D constants change convergence, overshooting and oscillations



https://en.wikipedia.org/wiki/PID_controller

Spark Streaming

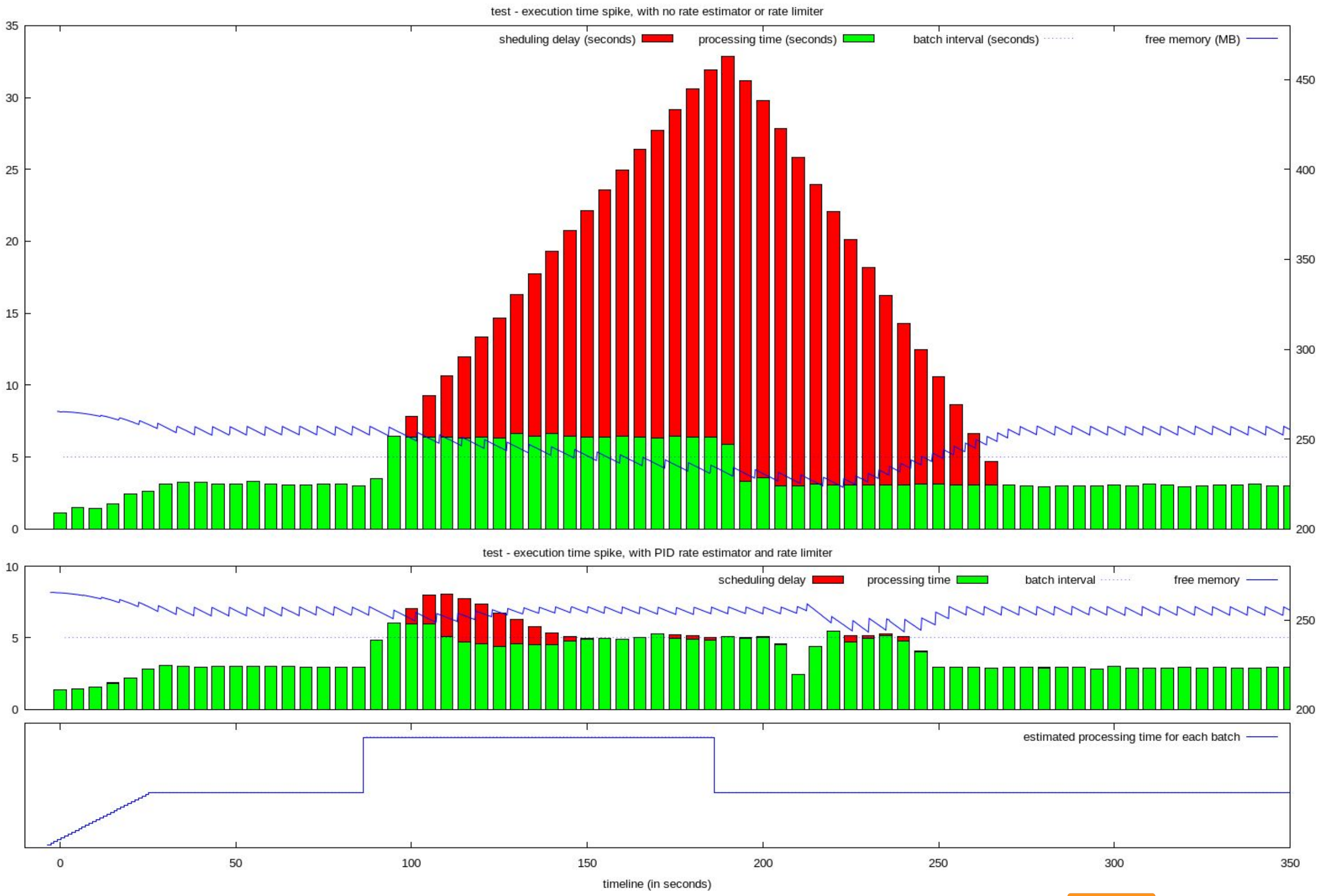
Back pressure in Spark 1.5

- each input has its own estimator
- work with all stream receivers

  including KafkaDirectInputStream

- configuration

```
–   spark.streaming.backpressure.enable     true
–   spark.streaming.backpressure.minRate    R
```


test - execution time spike, with no rate estimator or rate limiter
sheduling delay (seconds)
processing time (seconds)
batch interval (seconds)
free memory (MB)
35
30
25
20
15
10
5
0
450
400
350
300
250
200
test - execution time spike, with PID rate estimator and rate limiter
scheduling delay
processing time
batch interval
free memory
10
5
0
250
200
estimated processing time for each batch
0
50
100
150
200
250
300
350
timeline (in seconds)

Spark Streaming

Limitations

- linearity assumption
- records with similar execution times
- TCP back pressure accumulates in the TCP channel

Reactive Streams

Reactive Streams

- one tool to create reactive applications
- specification for back pressure interface to connect systems supporting back pressure in the JVM
  - small: 3 interfaces, 7 methods total
- subscriber controls rate by requesting elements from producers

http://www.reactive-streams.org

End to end back pressure

End to end back pressure

- Reactive application with reactive streams connector

  ⇒ back pressure enabled

- Spark Streaming 1.5+

  ⇒ back pressure enabled

- Reactive streams Spark Streaming receiver

  ⇒ end to end back pressure

Demo

Spark 2.x ?

- Spark Streaming still available
  - same support
- Structured Streaming
  - experimental, no stable source API
  - different model
  - requires an updated solution

THANK YOU.

luc.bourlier@lightbend.com

SPARK SUMMIT 2016
DATA SCIENCE AND ENGINEERING AT SCALE
JUNE 6-8. 2016 SAN FRANCISCO