Big Data Primer For IT Professional

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Abstract

- Big Data Primer For IT Professionals
  - This session will highlight some Big Data technologies that an aspiring Big Data developers should learn.
    This talk will appeal to developers / engineers who want to learn Big Data technologies.

A look at Big data eco system

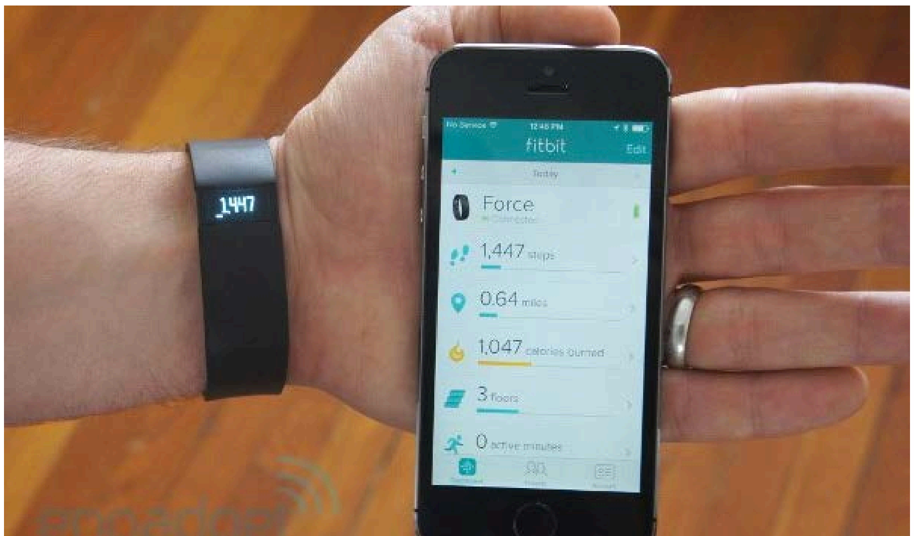
SNIA Global Education

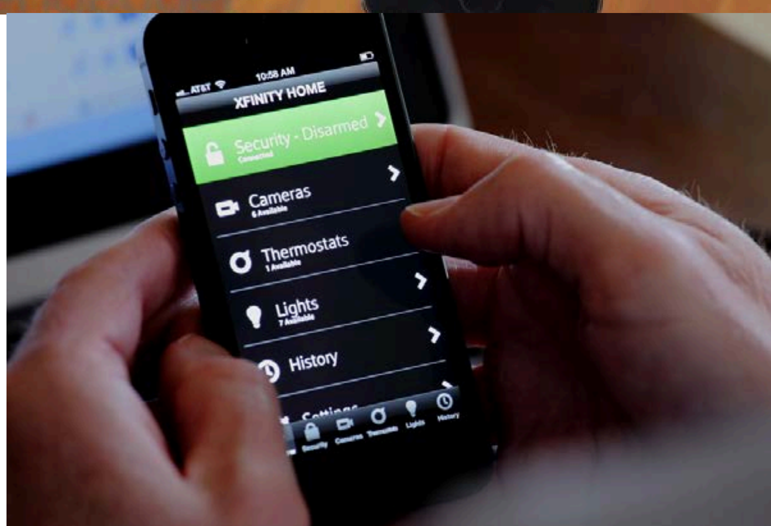
Source : datafloq.com

Which One ?

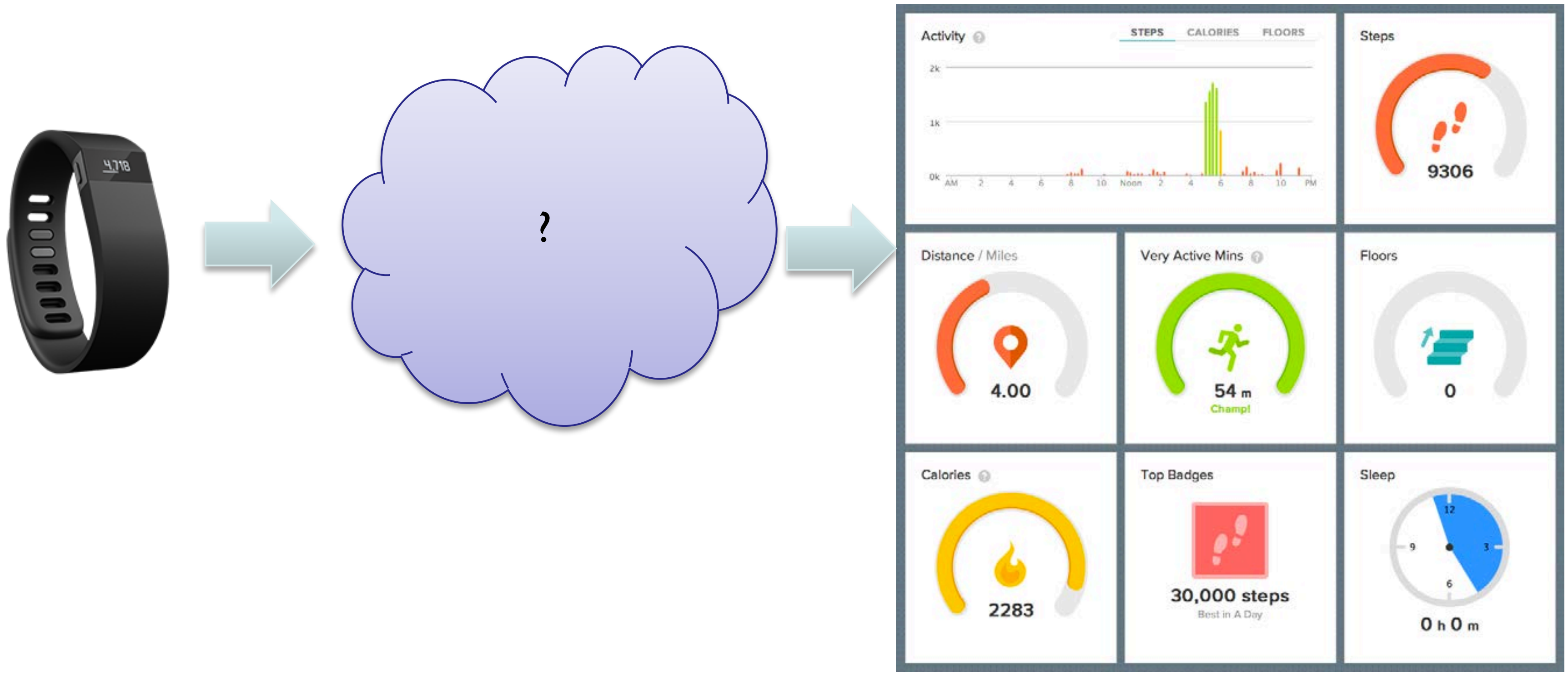
- Let’s take ‘design driven approach’

Internet of Things – A reality





Data infrastructure



Data Volume ?
A Napkin calculation

- Say we have
- Million sensors
- Each sensor reports every minute
- data size 1KB

- This will result in :
- 1.44 Billions events / day !
- 1.44 TB / day !!

Sensor Data : Texas utilities smart meter data

Texas Smart Meter Projections

variables	**description**				
sensors	10 million customers	1.00E+07	10 million		
signal frequency	every 15 mins	900	secs		
event size	1.4 K	1400	bytes		
events per day per sensor		**96**			
total events per day		**9.60E+08**	**960**	**millions**	0.96 billion
total events / sec		**1.11E+04**			11,111.11
total data size per day		**1.34E+12**	**1344**	GB	1.344 TB

Data Velocity

- Say we have
- Million sensors
- Each sensor reports every minute
- data size 1KB

- →
- Millions events / minute
- ~ 17,000 events / sec

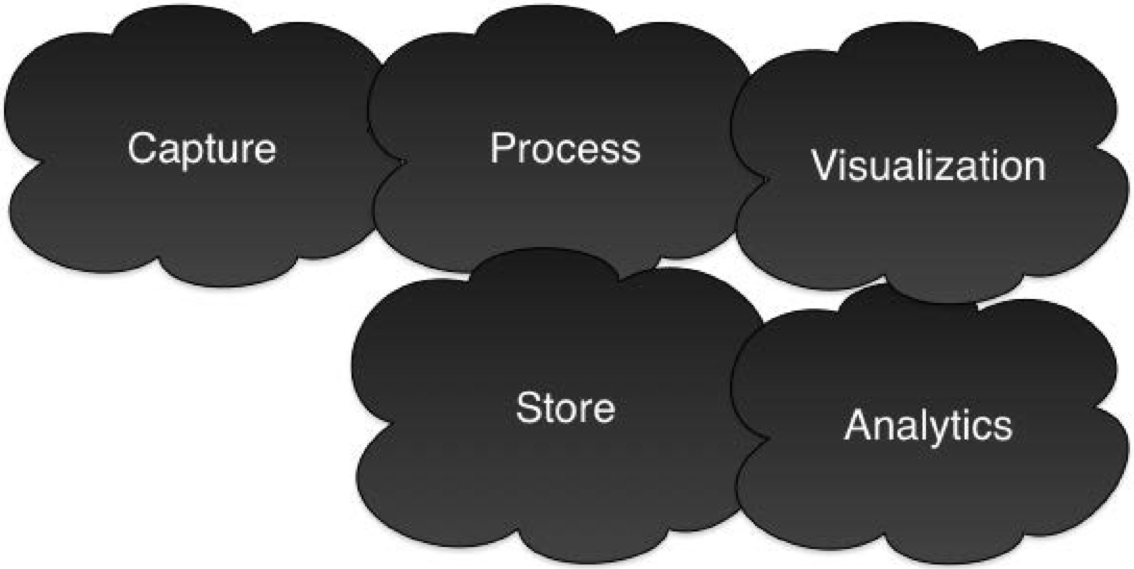
Data processing speed

- Need (near) real time processing most of the time
  - E.g. Need to alert if temperature suddenly spikes

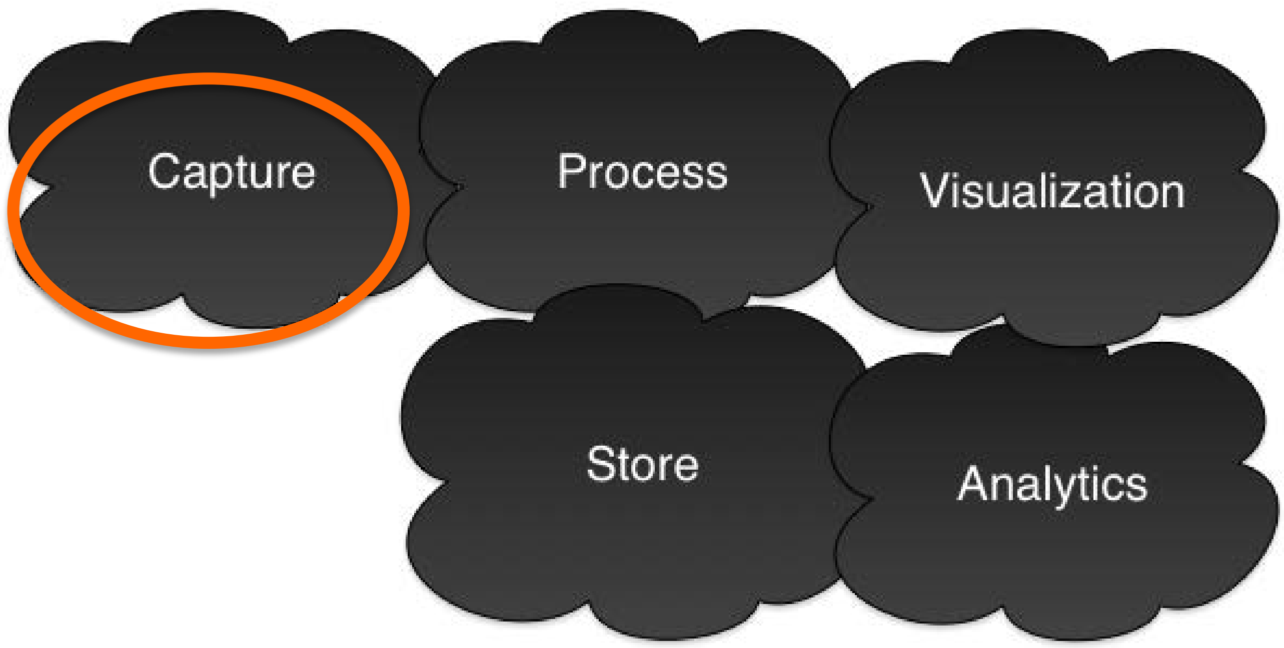
Challenge = big data + real time

- Don’t loose events !
  - Any event could be important
  - Most events are mundane (e.g. temperature stays between 68’F – 72’ F)
- Process them in near real time
- Store the events for a long time
  - Audit
  - Diagnose
- Support various queries
  - Real time (what is the latest temperature for sensor id 123?)
  - Aggregate (what is the avg. temp in zipcode 12345)

High Level Architecture



Capture



(1) Capture
Requirements

- Requirements:
- Capture events coming at high speed
  - Tens of thousands events / sec (some times millions / sec)
- Don't loose events
  - Tolerate hardware / software failure
  - Tolerate intermittent connectivity issues
- Scale 'easily'

(1) Capture
Choices

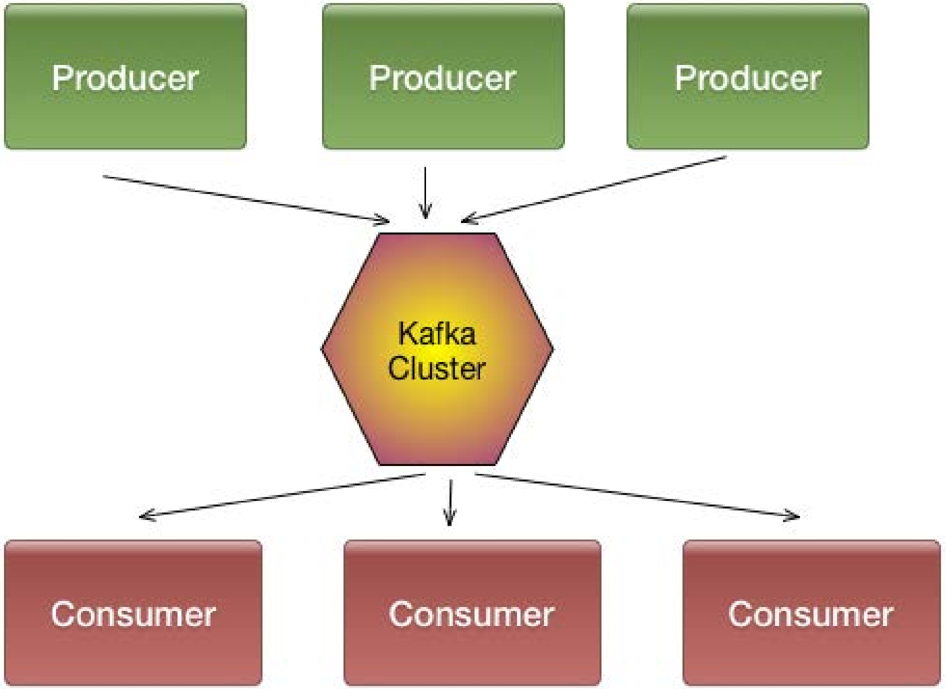
- MQ (RabbitMQ ..etc)
  - Good adoption in enterprises / durable
- FluentD
  - Data collector for various sources
- Flume
  - Part of Hadoop eco system
  - Good for collecting logs from many sources
- AWS Kinesis
  - Queue system in Amazon Cloud
- Kafka
  - Distributed queue

(1) Capture
Meet kafka

- Apache Kafka is a distributed messaging system
- Came out of LinkedIn… open sourced in 2011
- Built to tolerate hardware / software / network failures
- Built for high throughput and scale
  - LinkedIn : 220 Billion messages / day
  - At peak : 3+ million messages / sec

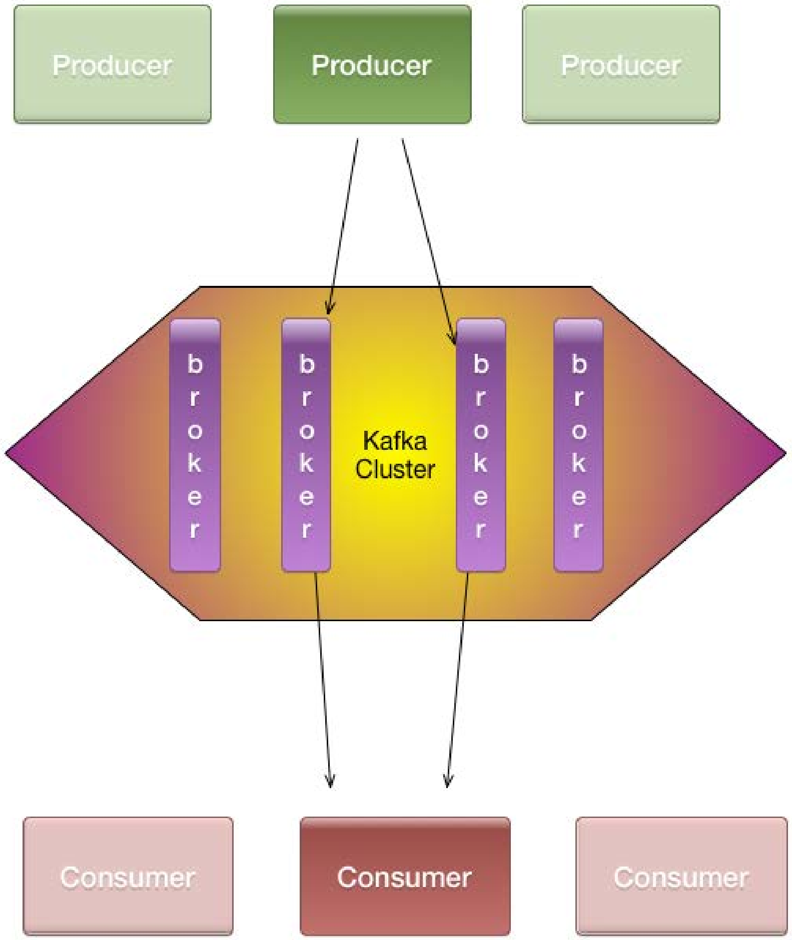
(1) Capture
Kafka architecture

- Publisher - subscriber / producer – consumer model

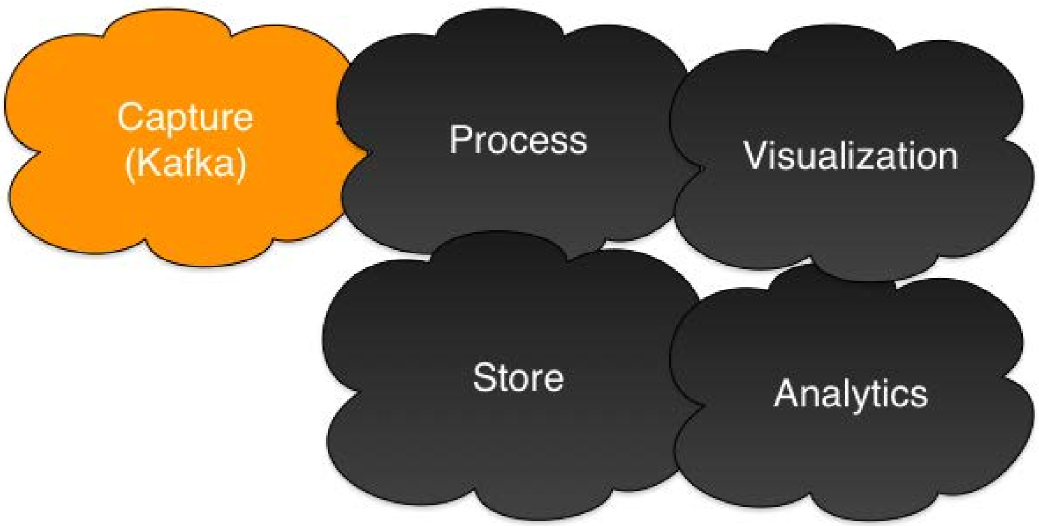


(1) Capture
Kafka architecture

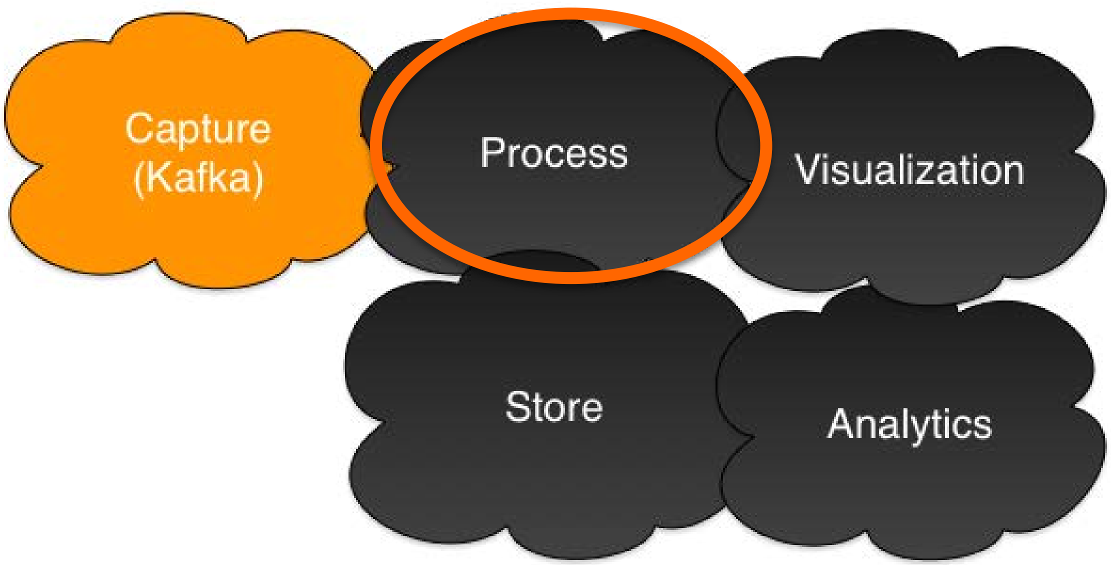
- Producers write data to brokers
- Consumers read data from brokers
- All of this is distributed / parallel
- Failure tolerant
- Data is stored as topics
  - “sensor_data”
  - “alerts”
  - “emails”



Capture



Next : (2) Processing



(2) Processing requirements

- Process events in real time or near real time
- High velocity
  - Tens of thousands → millions of events / sec
- Guaranteed processing
  - Process an event at-least-once
  - Exactly-once (harder to achieve)
- Failure tolerant
- Scale 'easily'

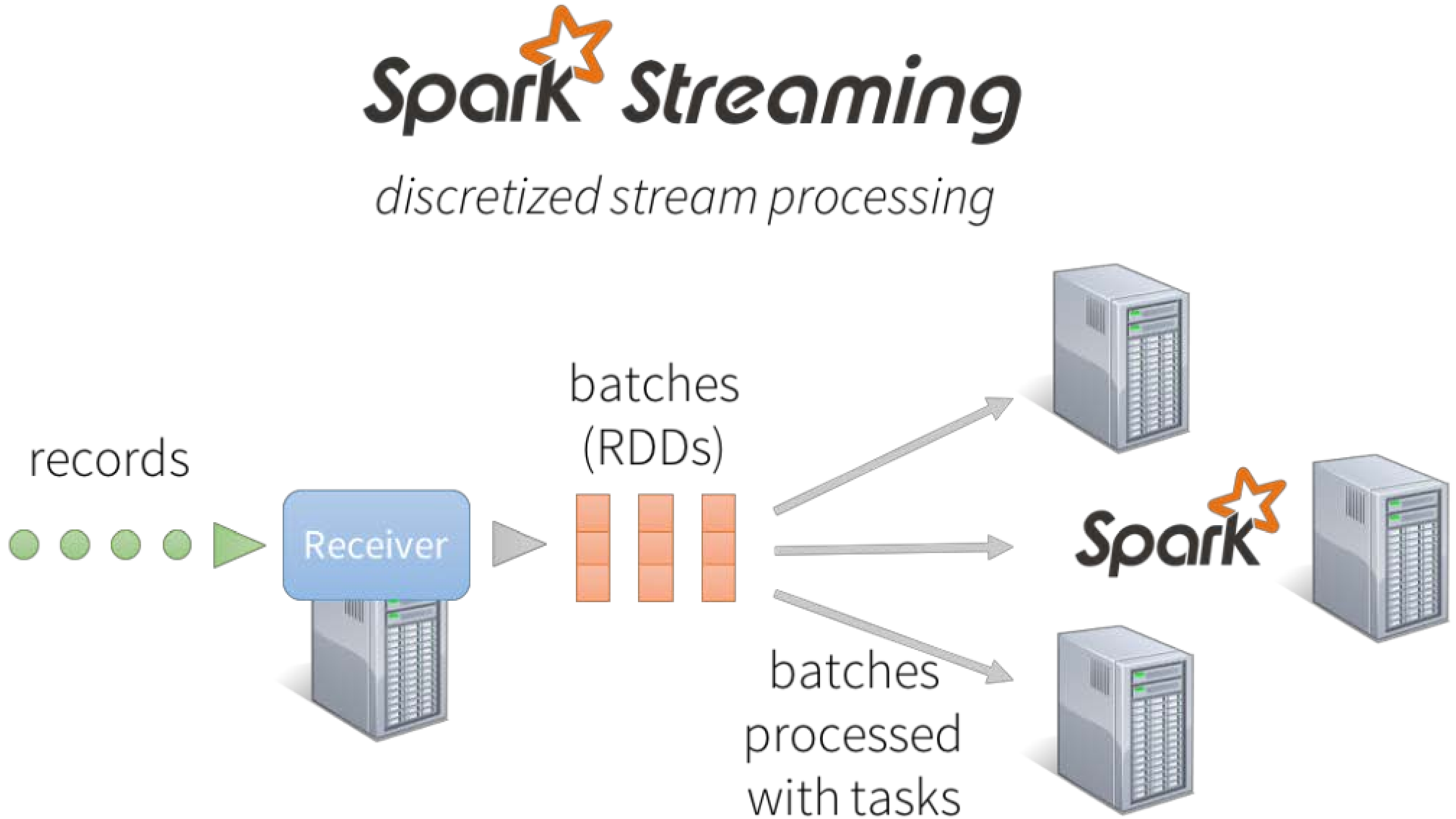
(2) Processing
Choices

- Storm
  - ’Original’ stream processing
- Apache Samza
  - Stream processing framework based on Kafka + Hadoop YARN
- Apache NiFi
  - Data flow
- Flink
  - New framework
- Spark Streaming
  - Cool framework

Streaming Systems Feature Comparison

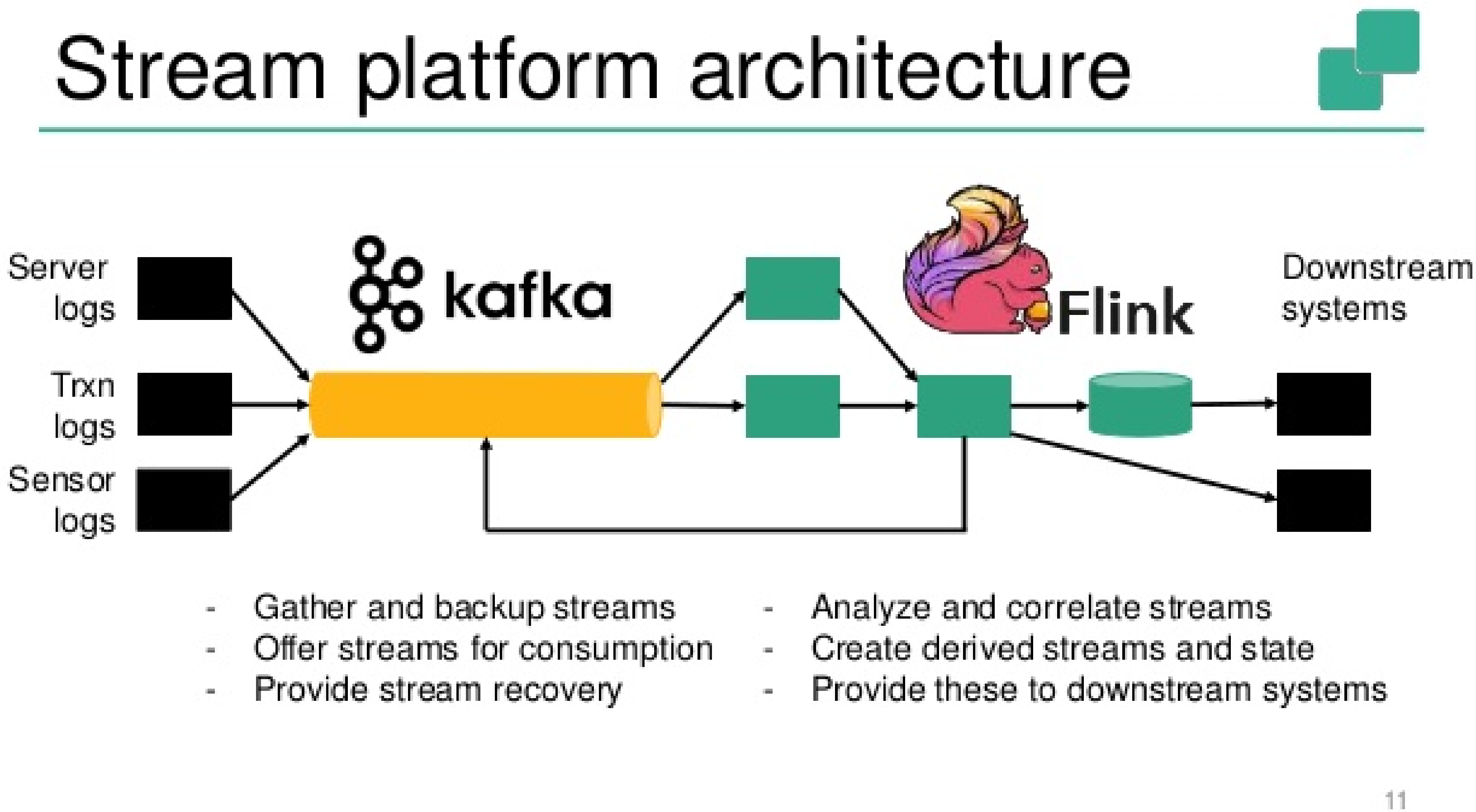
Feature	Storm	Spark Streaming	Flink	NiFi
Processing Model	Event based by default (micro batch using Trident)	Micro Batch	Event based + Micro Batch based	Event Based (?)
Windowing operations	Supported by Trident	Yes	Yes	?
Latency	Milliseconds	Seconds	Milliseconds	Milliseconds
At-least-once	YES	YES	YES	YES
At-most-once	YES	NO	YES	?
Exactly-once	YES with Trident	YES	YES	?

Spark Streaming Architecture

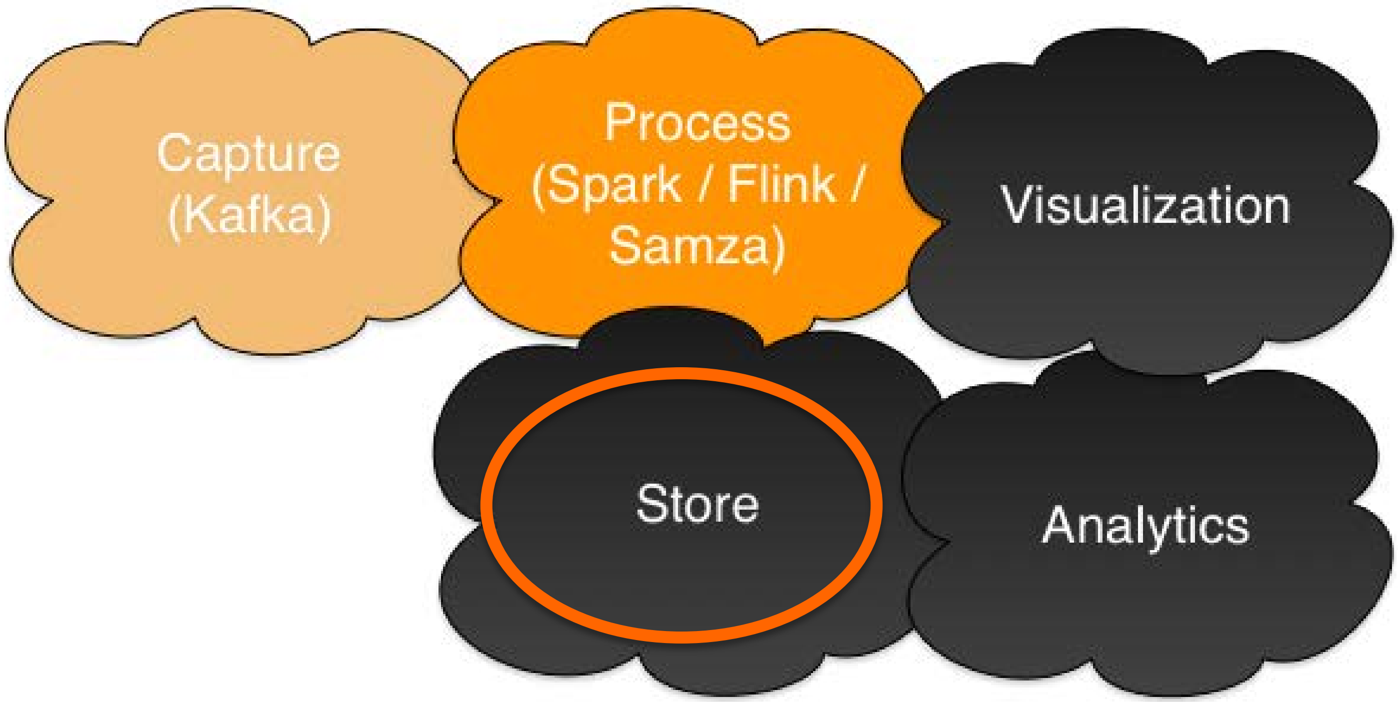


records processed in batches with short tasks
each batch is a RDD (partitioned dataset)

Flink Streaming Architecture



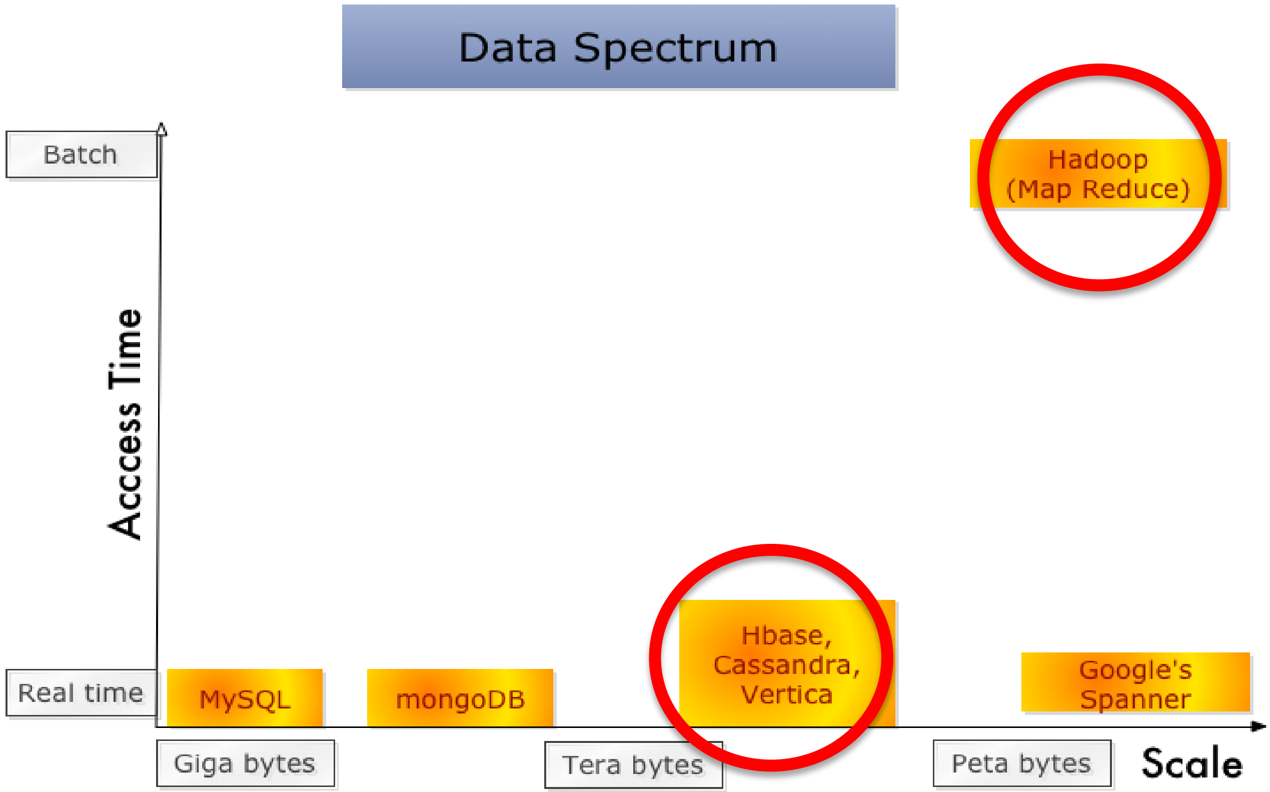
Stream Processing



(3) storage
Requirements

- Handle ‘Big Data’ (1 TB / day !)
- Traditional storages are not effective (or too expensive)
- Need two types of storage
  1. ‘forever’ storage
     - Store multi terabytes of data for a long periods
     - Support Batch queries
  2. ‘fast / real-time lookup’ storage
     - Query in real time (milliseconds)
       “what is the latest reading for sensor-123 ?”
     - Store latest / new data (e.g. last 3 months)
     - Flexible schema for semi-structured data
- Both need to scale

(3) Storage Requirements



adapted from : http://www.slideshare.net/medriscoll/driscoll-strata-buildingdatastartups25may2011clean

(3) storage
Choices

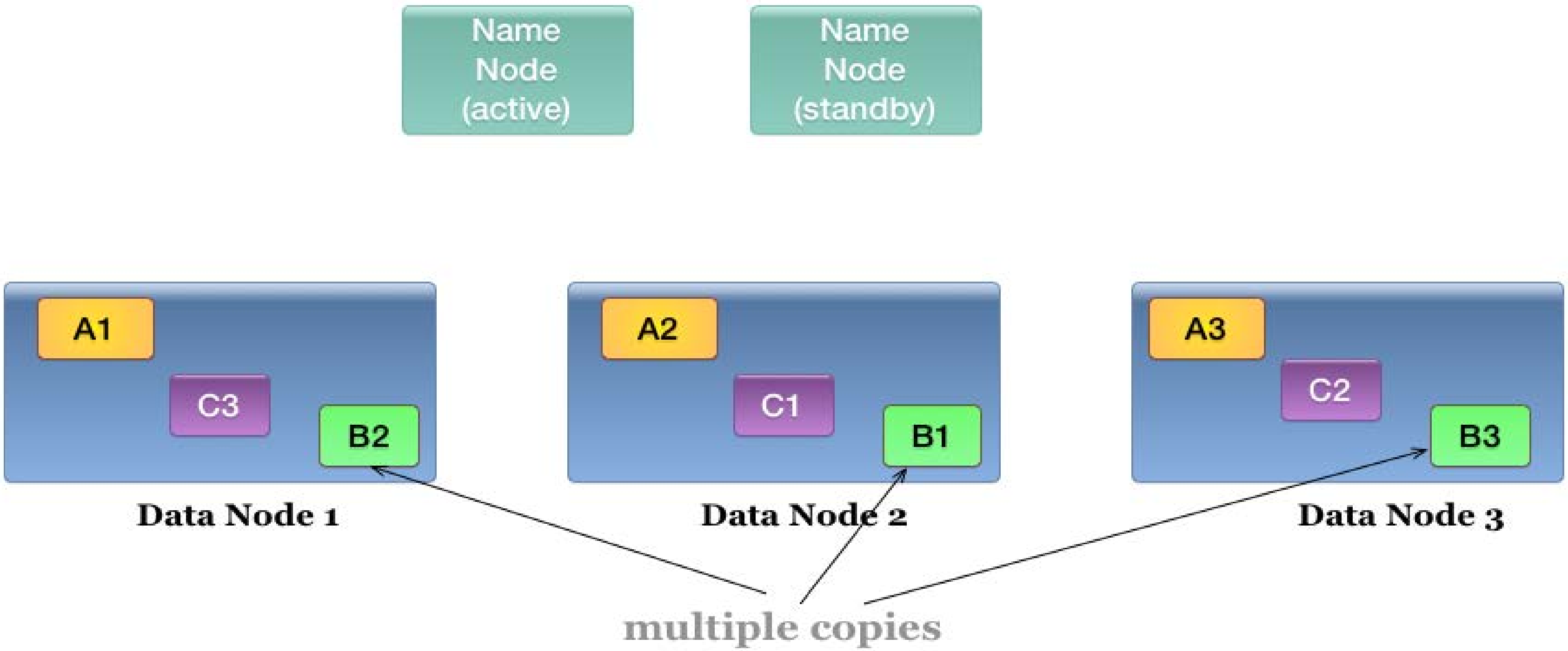
- ‘forever’ storage
  - Scalable distributed file systems
  - Hadoop ! (HDFS actually)

- ‘real time store’
  - Traditional RDBMS won’t work
    - Don’t scale well (or too expensive)
    - Rigid schema layout
  - NoSQL !

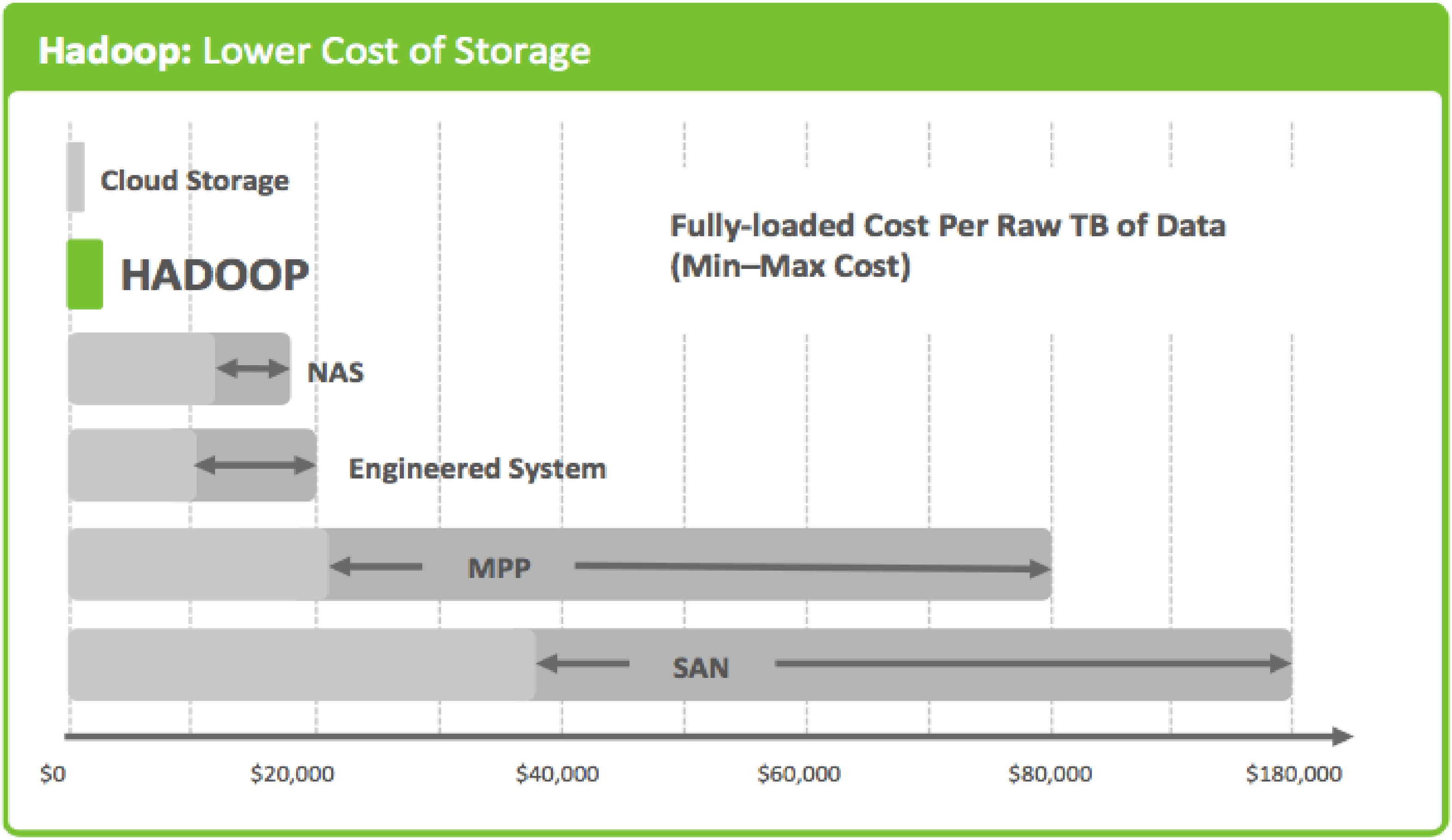
(3) Storage
HDFS (in 20 secs)

- Distributed file system
- Runs on commodity servers
  - → high ROI
- Can keep ticking even when nodes go down
  - → fault tolerant
- Replicates data to prevent data loss in case of node failures
  - → built in backup ☺
- Scales to Peta bytes (horizontal scalability)
- Proven in the field

(3) Storage
HDFS Architecture



(3) Storage
Cost of Big data



Source : hortonworks

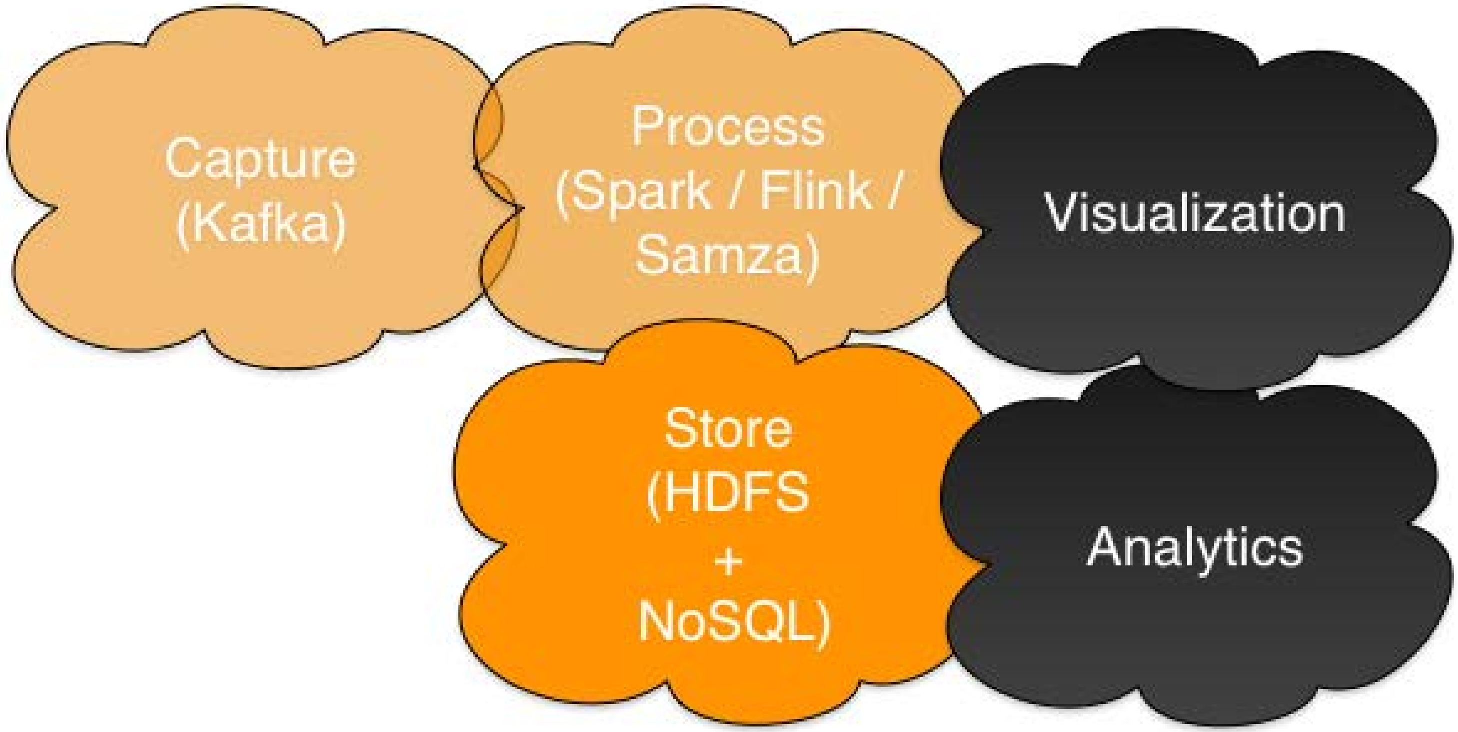
(3) Storage
HDFS

- Can handle big data
- Scales easily
- Cost effective
- “Source of Truth”
  - Files are immutable within HDFS (new data is ‘appended’)
  - Audit friendly

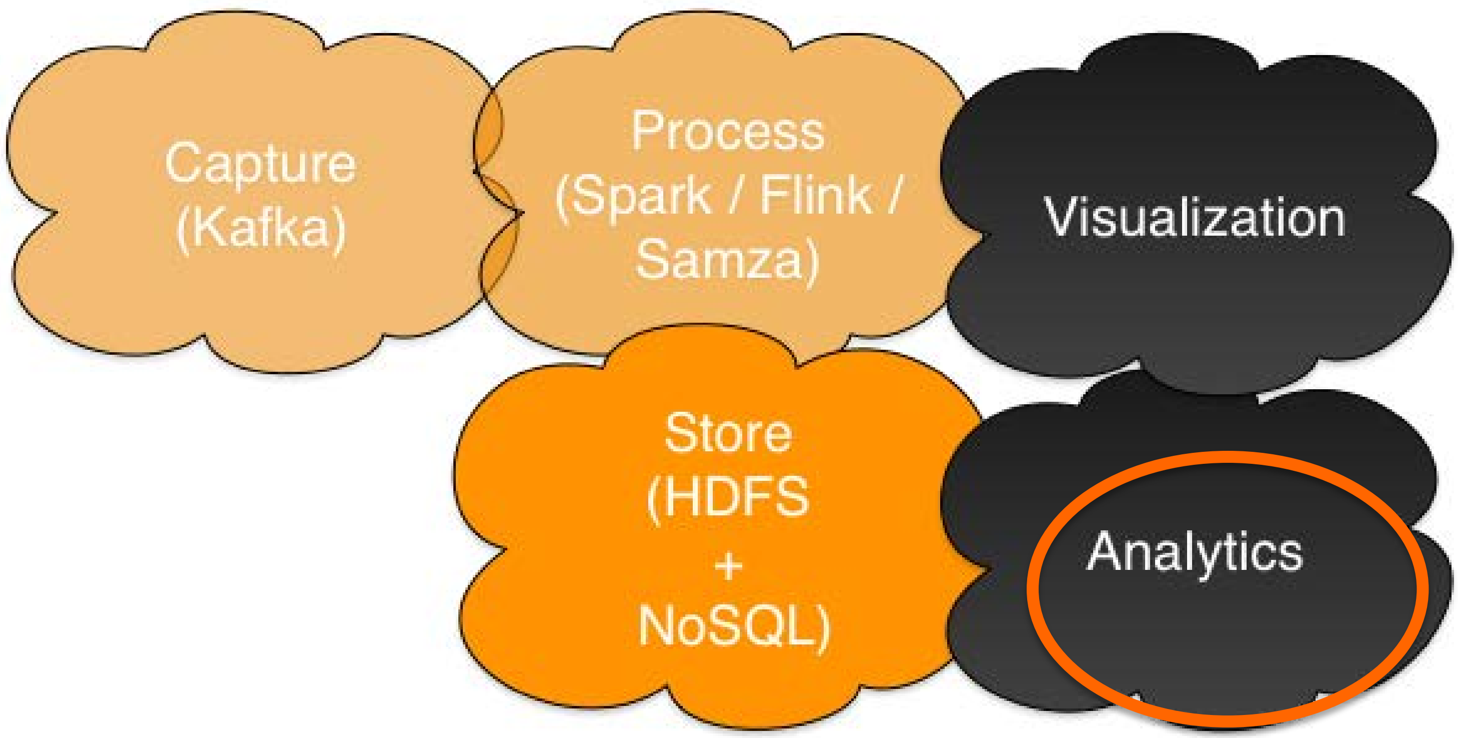
(3) Storage (real time)
Choices for NOSQL

- Too many ! ☺
- HBase
  - Part of Hadoop eco system
  - Uses HDFS for storage
  - Provides consistent view of data
- Cassandra
  - Popular NoSQL store
  - No Single Point of Failure (SPOF) – ring architecture
  - No dependency on Hadoop
- Druid
  - Sub second OLAP queries / fast aggregations

Storage


Capture
(Kafka)
Process
(Spark / Flink /
Samza)
Visualization
Store
(HDFS
+
NoSQL)
Analytics

Next : Analytics



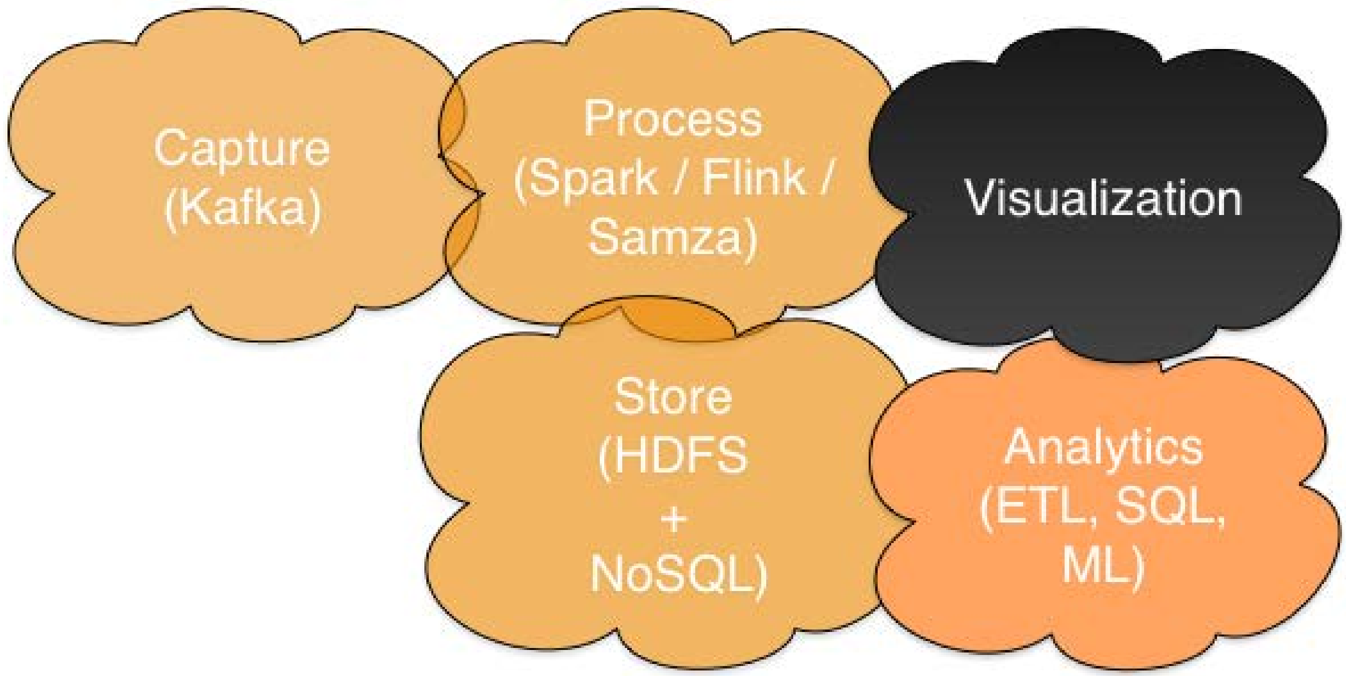
Next : Analytics

- Must scale to peta bytes of data size
- Large queries
  - Popular #hashtags in 2015
- ETL
  - Shape / clean data
- Data warehousing
  - Batch queries
- Machine Learning
  - Model building (credit scoring ..etc)

Analytics Tools

- ETL
  - Pig
  - Spark
  - Flink
- SQL queries
  - Hive / Impala
  - Drill
  - Spark SQL
  - Flink SQL
- Machine Learning
  - Spark ML
  - Flink ML

Analytics



Capture
(Kafka)
Process
(Spark / Flink /
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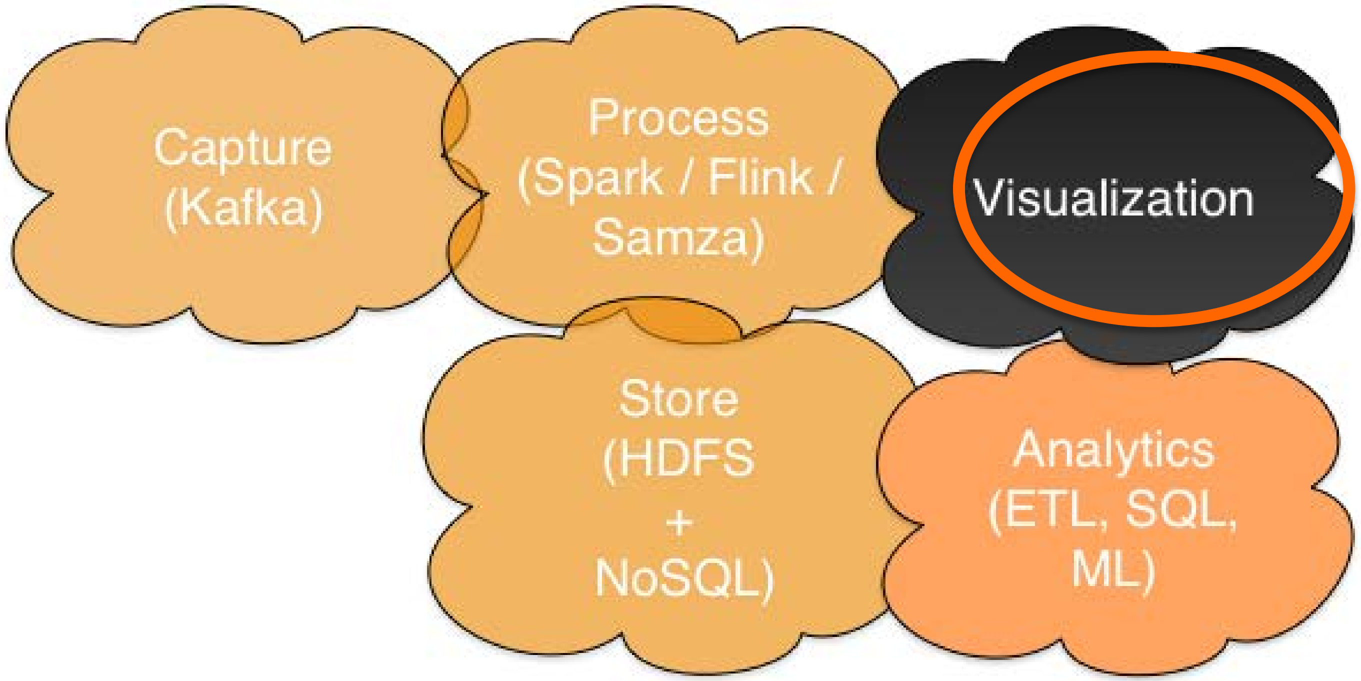
Visualization
Store
(HDFS
+
NoSQL)
Analytics
(ETL, SQL,
ML)

Next : Visualization



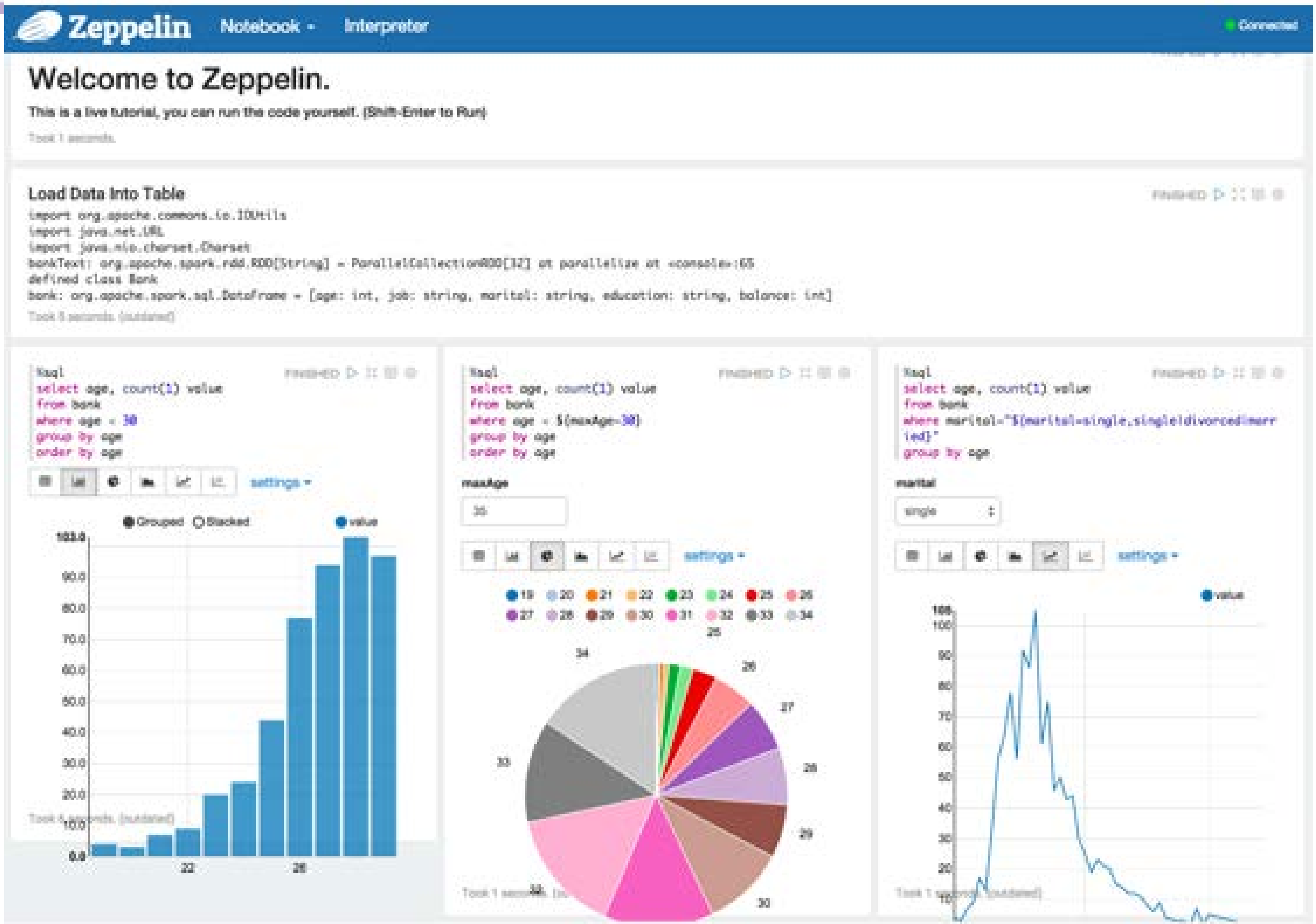
Visualization Tools

- Ready made for enterprises
  - Tableau
  - SiSense
  - Pentaho
- Roll your own
  - Notebooks
  - D3.js
  - R
- And don't forget…
  - Excel !!

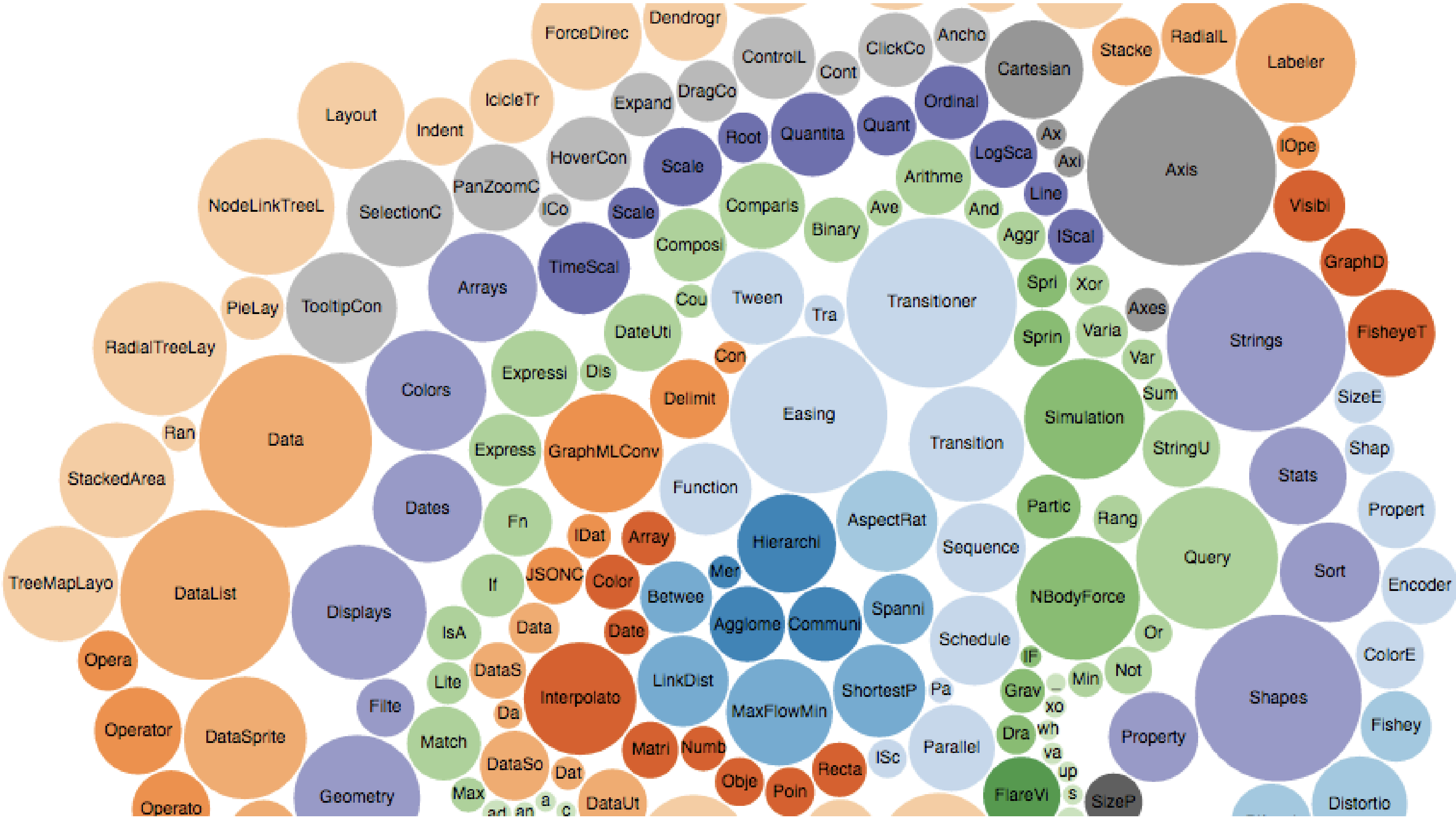
Notebooks

- Zeppelin
- Spark Notebook
- iPython

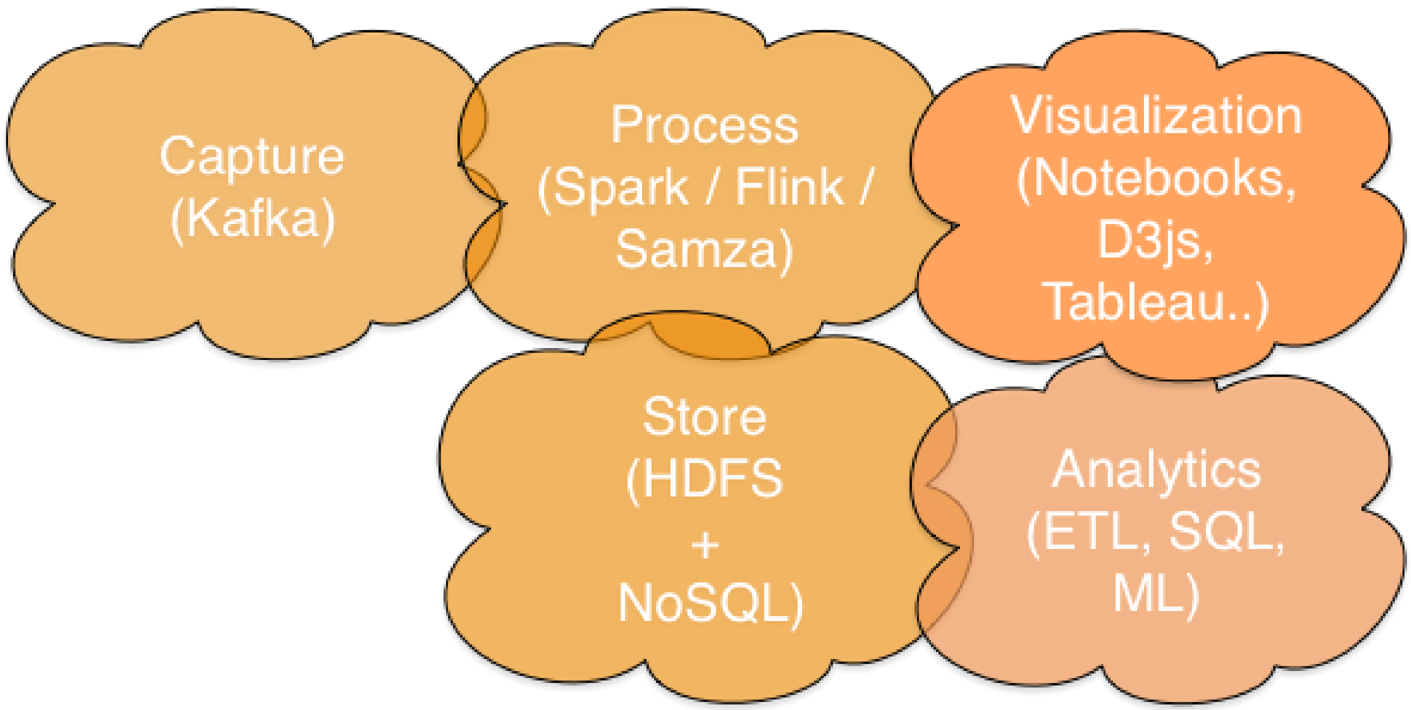
Notebook Example



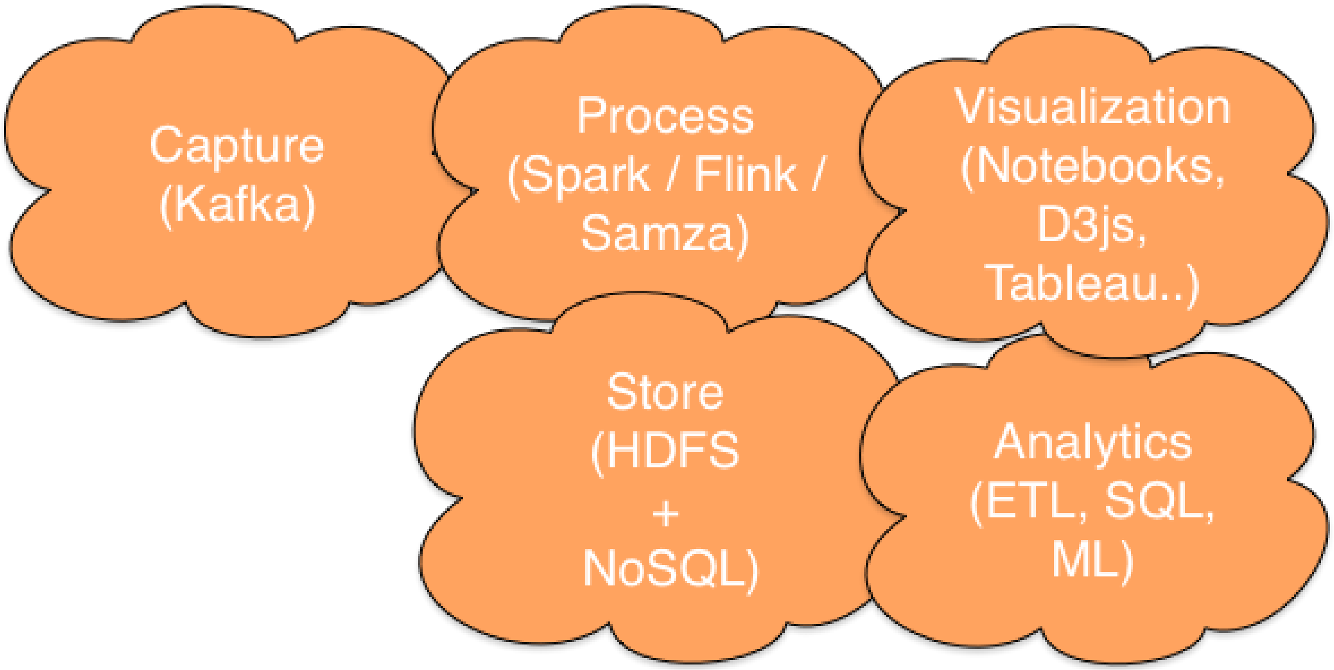
D3.js Example



Visualization



Final Stack


Capture
(Kafka)
Process
(Spark / Flink /
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Visualization
(Notebooks,
D3js,
Tableau..)
Store
(HDFS
+
NoSQL)
Analytics
(ETL, SQL,
ML)

Final Words

- No one can know every thing !
  - At least get a basic understanding
- Levels of knowledge
  - I haven't heard of it
  - I have heard of it
  - I have played around with it on my laptop
  - I have working knowledge
  - I am an expert / I wrote the damn thing !

Also keep in mind…

≠

At scale nothing works as advertised !

Attribution & Feedback

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Authorship History

Sujee Maniyam - May 2016

Additional Contributors

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