Die Lambda Architektur als Grundmuster für Big Data Projekte

Lambda Architecture: A blueprint for Big Data Applications

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http://www.ferari-project.eu

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Big Data Projects – Big Data Components

"Big Data"-topic is the cause to

- understand, select, apply and experience analytic algorithms
- learn the features and the impacts of new technology
- start pilot projects for proof of concept

Select

- Requirements, Ideas, Tasks
- Data
- Tools
- Big Data Components

Understand Big Data Technology

Setup a justifiable, useful application architecture

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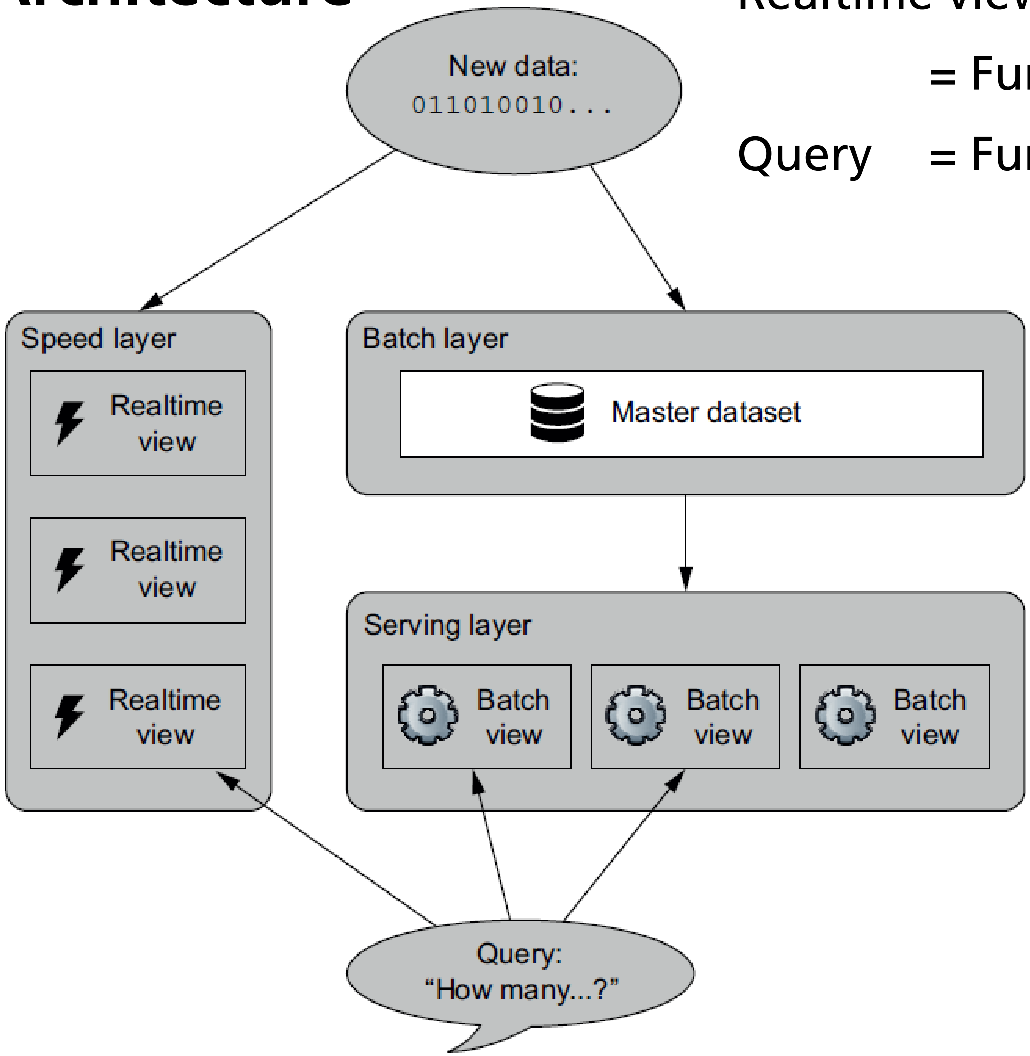
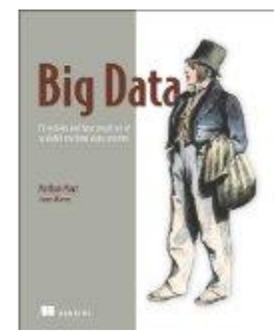
Lambda Architecture

Batch view
= Function(All Data)

Realtime view
= Function(Realtime view, New data)

Query = Function(Batch view, Realtime view)





Nathan Marz with James Warren
Big Data: Principles and best practices of scalable real-time data systems
Manning 2015

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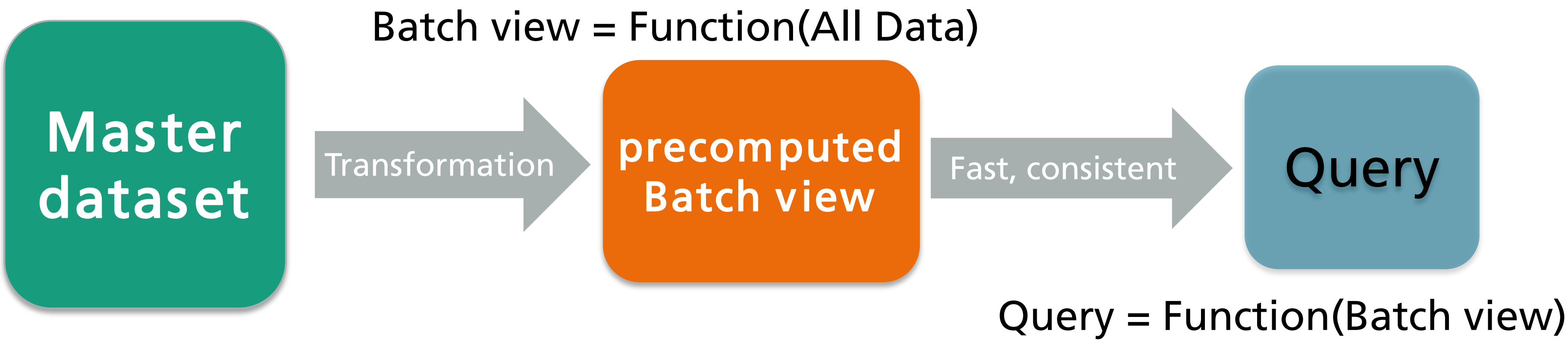
Answer queries consistently and fast by using precomputed views



Information: General collection of knowledge relevant for the Big Data System.

Data: Information that can't be derived from anything else.

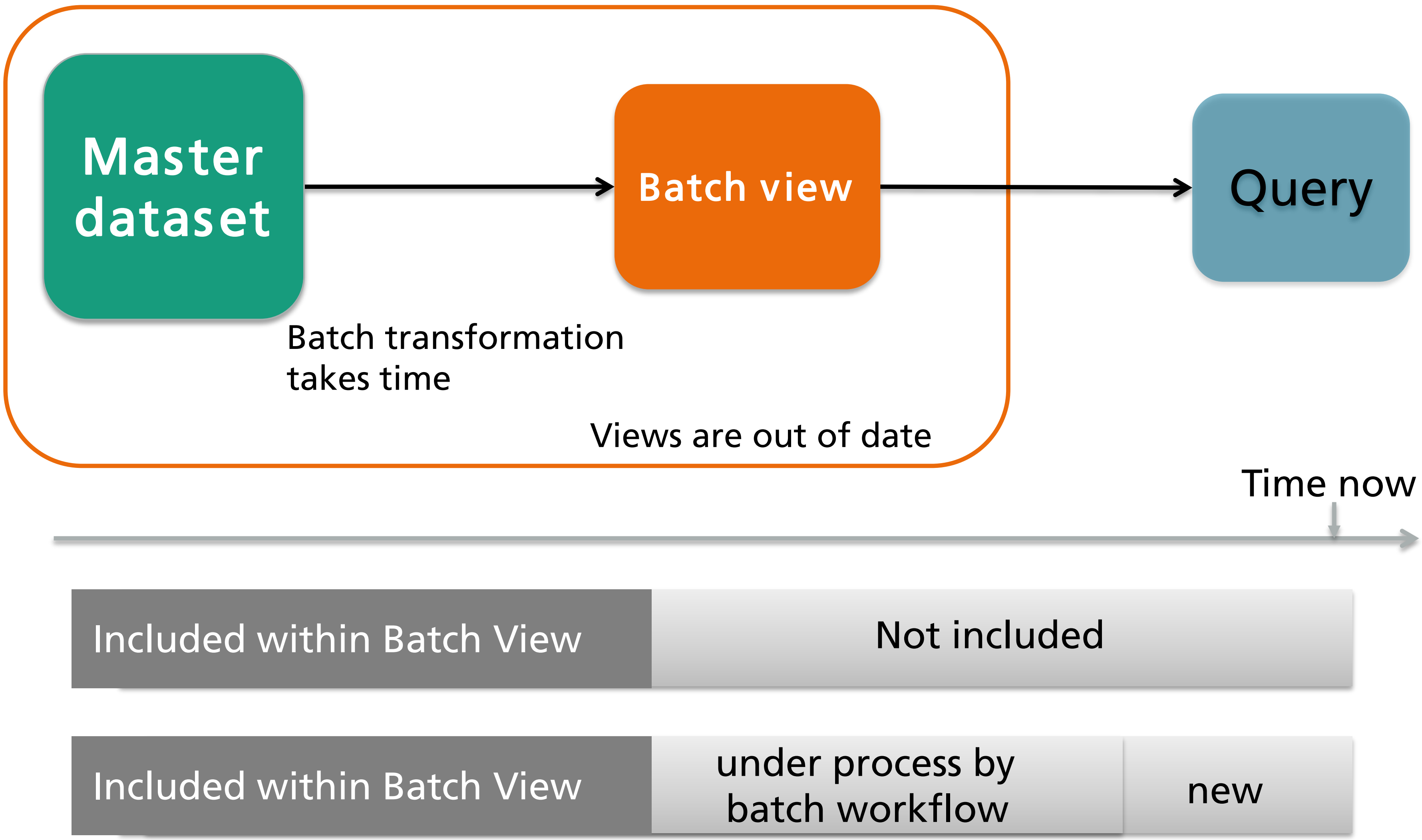
Query: Questions that are asked about the data.

Views: Information that has been derived from the base data.
Views help to **answer questions fast and consistently**

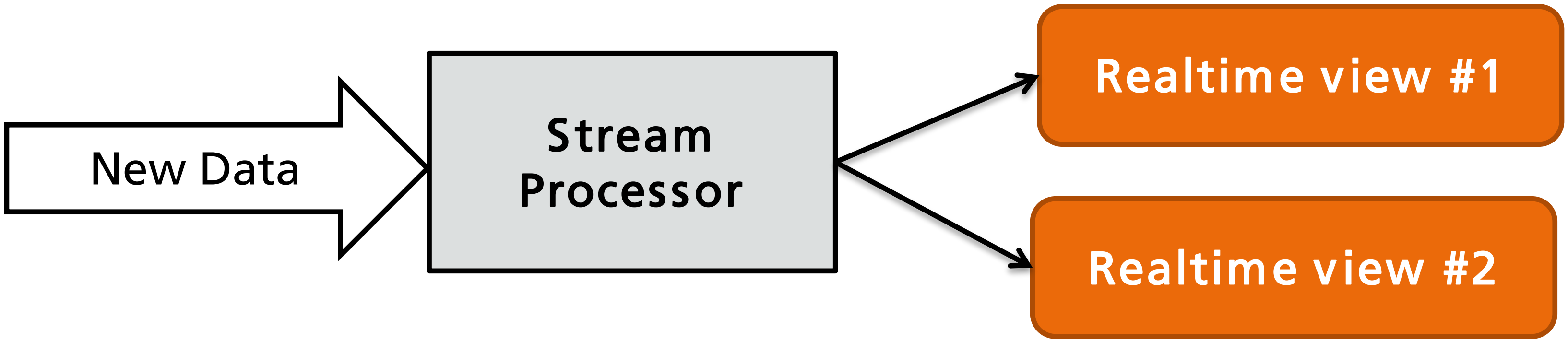
The master dataset holds base data-records that are:

- **raw**
- **immutable**
- **timestamped** and **eternally true**

Information available for queries has high latency



Bridge the latency gap of batch processing by immediate processing of incoming data.



Information that become available in Batch view may be removed from Realtime view.

Stream processing may compute an approximation of exact values, that are computed in batch runs.

"Eventual Accuracy"

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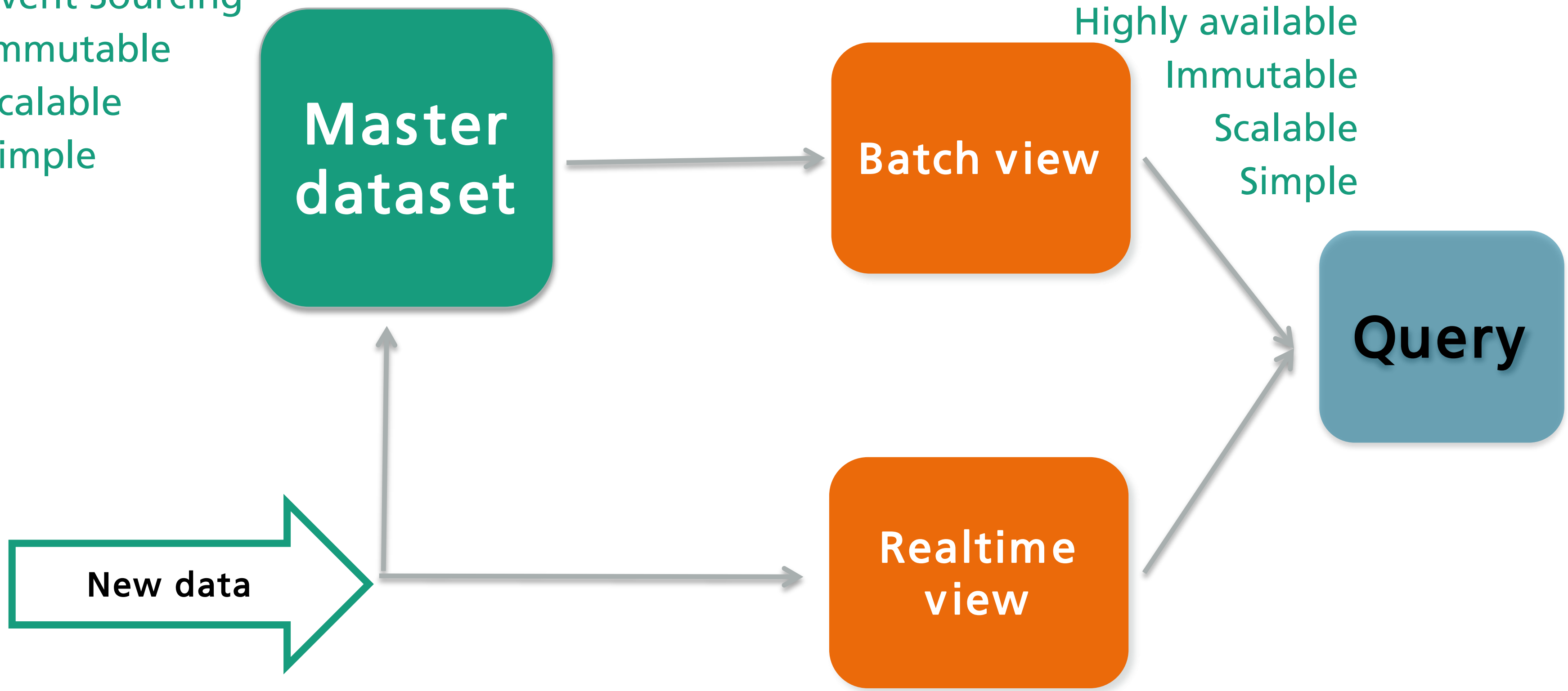
Avoid complexity in core components
"Complexity Isolation" into the Real-time view

Create / Read - append only
Event Sourcing
Immutable
Scalable
Simple

no update
fast random read
Highly available
Immutable
Scalable
Simple



Random write/update/read access
is very complex for scalable data stores.
(eventually consistent – vector clocks …)

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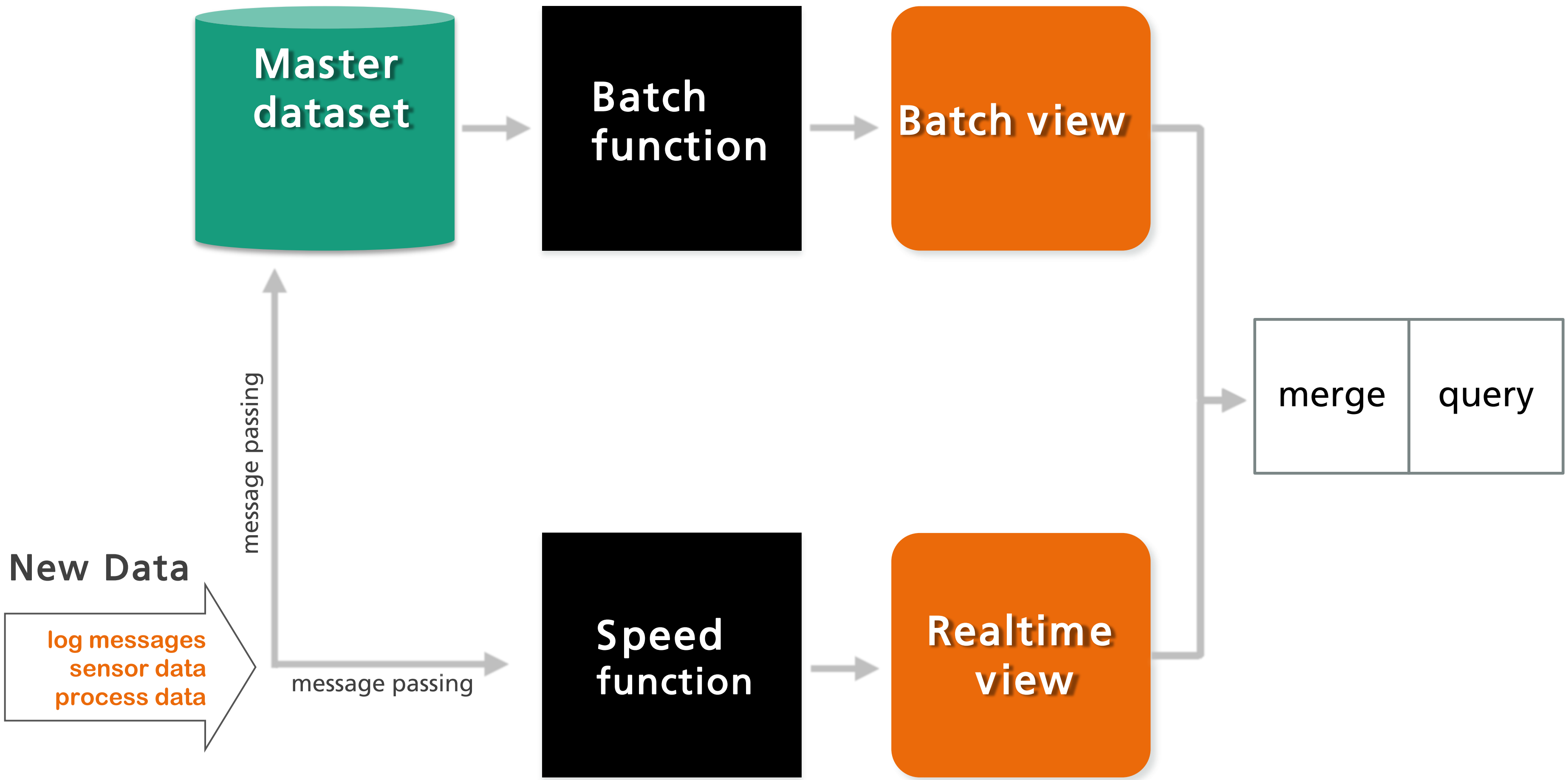
Components in a Big Data "Lambda" Architecture



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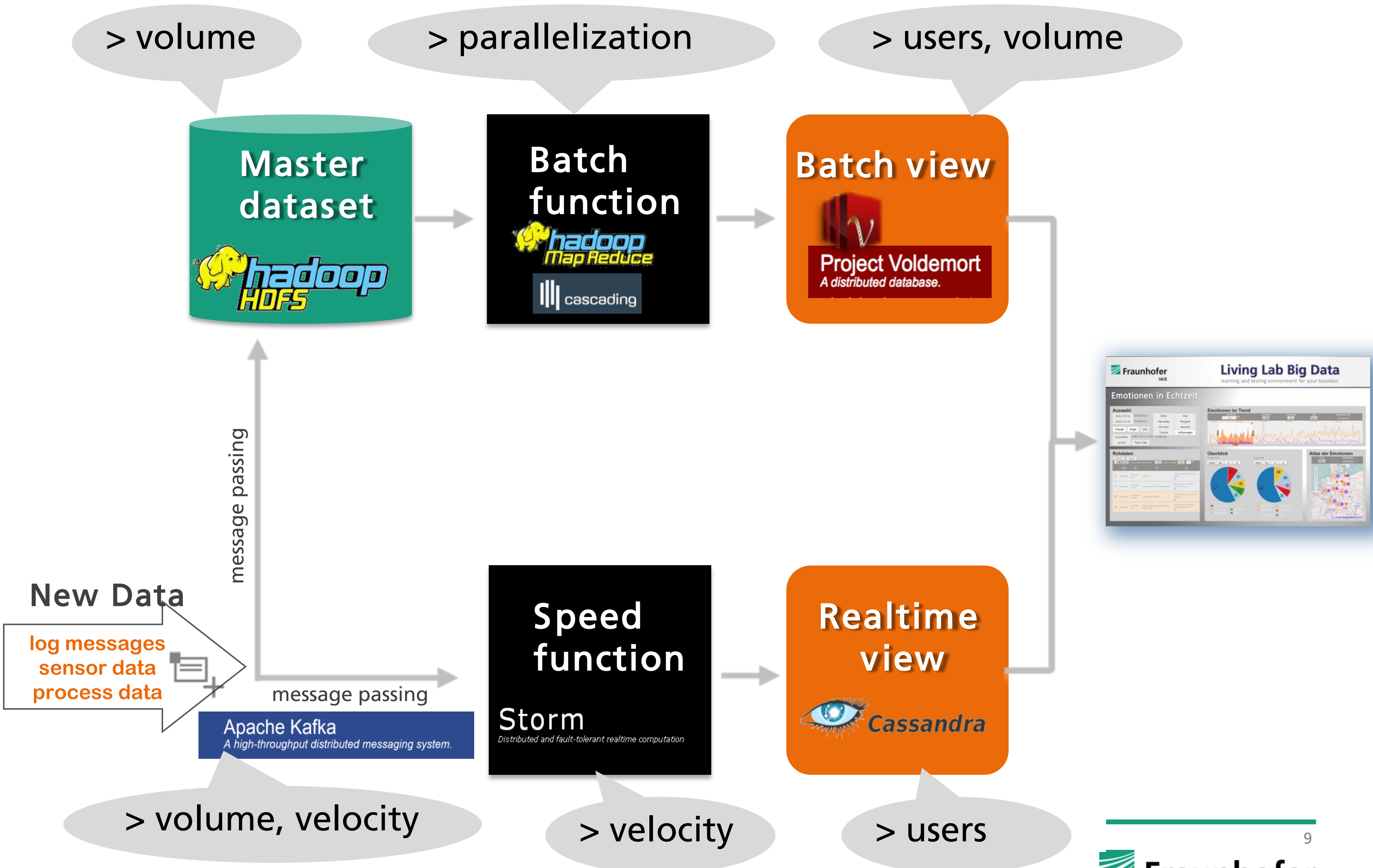
Component Selection / Horizontal Scalability



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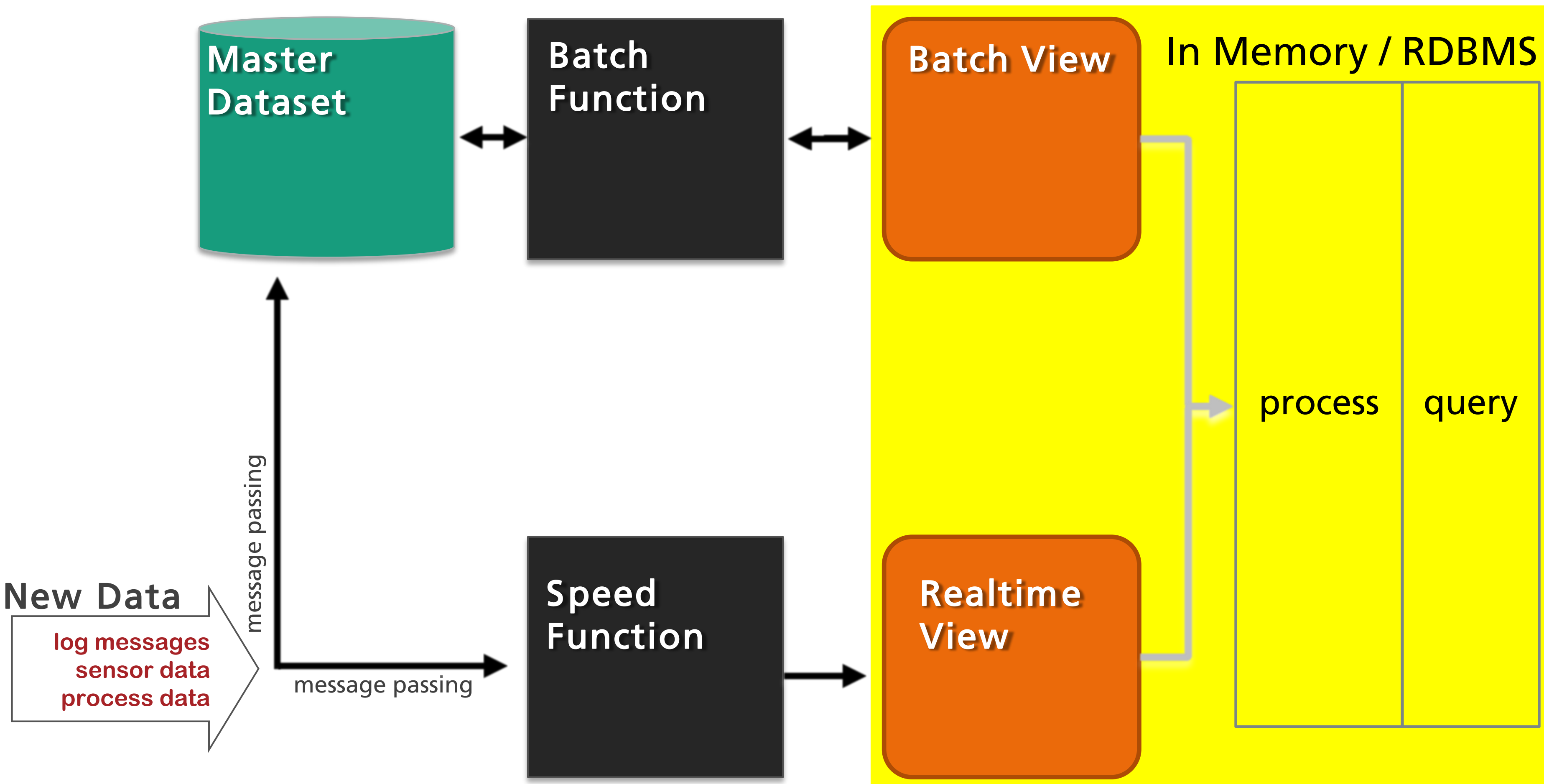
ETL Extract-Transform-Load + flexible Analysis



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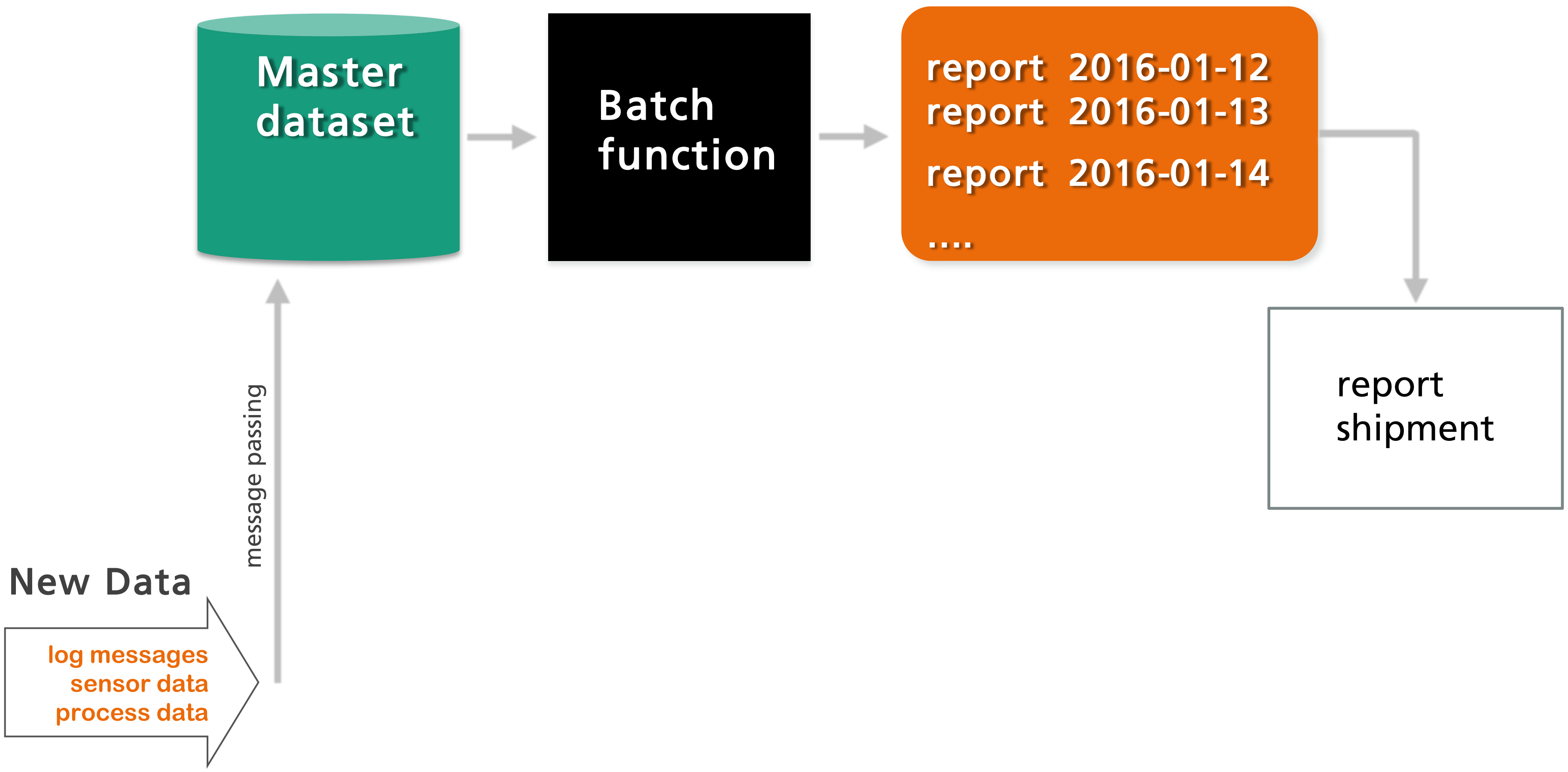
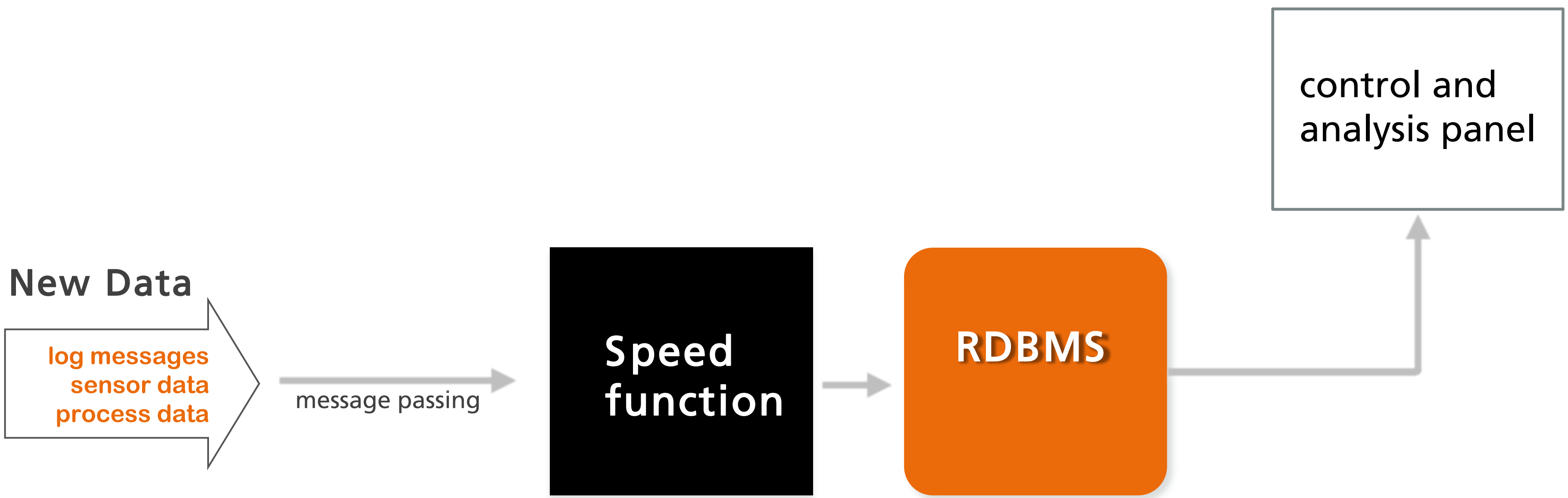
Reporting



Master dataset
Batch function
report 2016-01-12
report 2016-01-13
report 2016-01-14
....
report shipment
message passing
New Data
log messages
sensor data
process data

Monitoring



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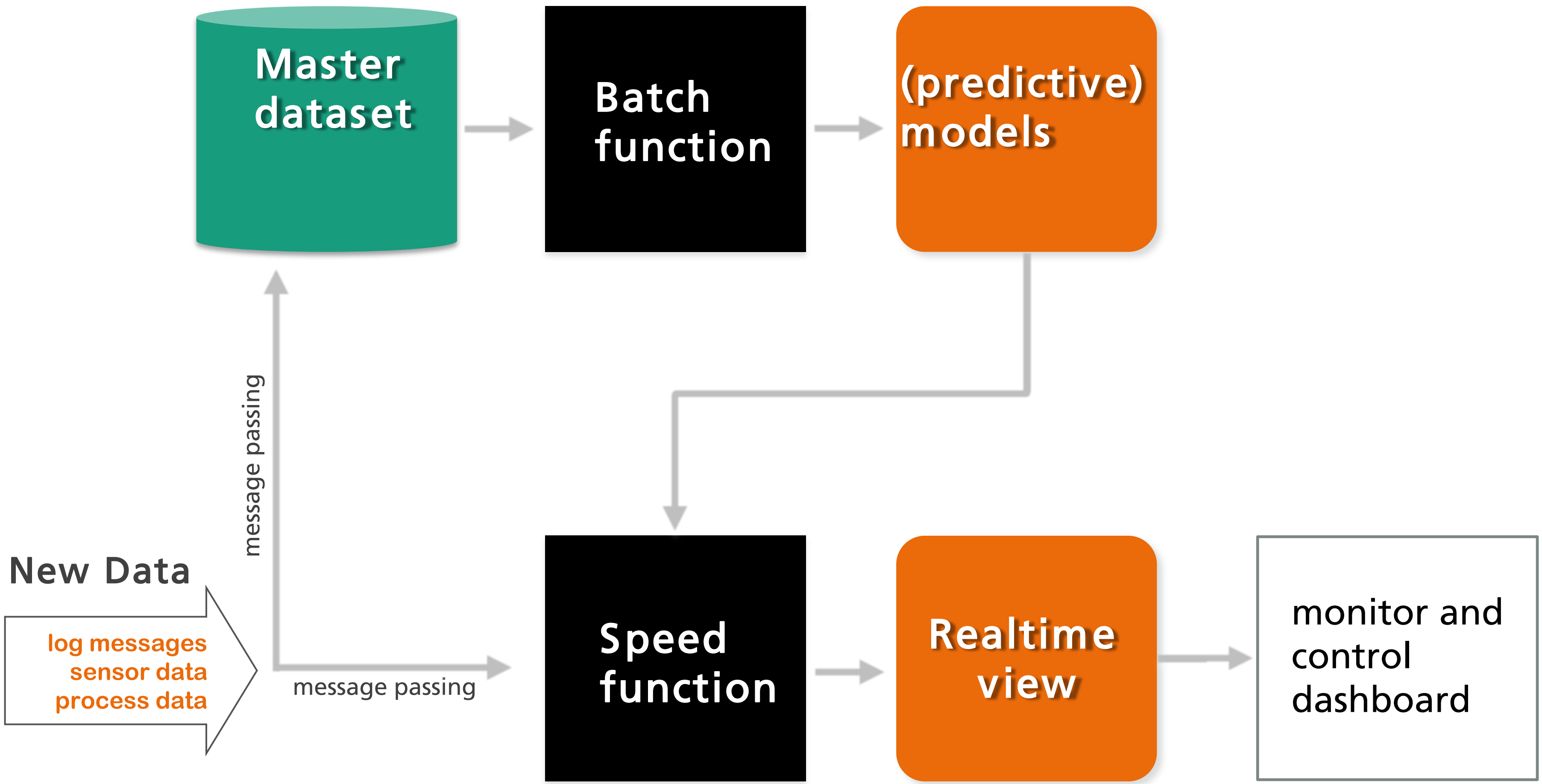
Model learning and realtime model-application



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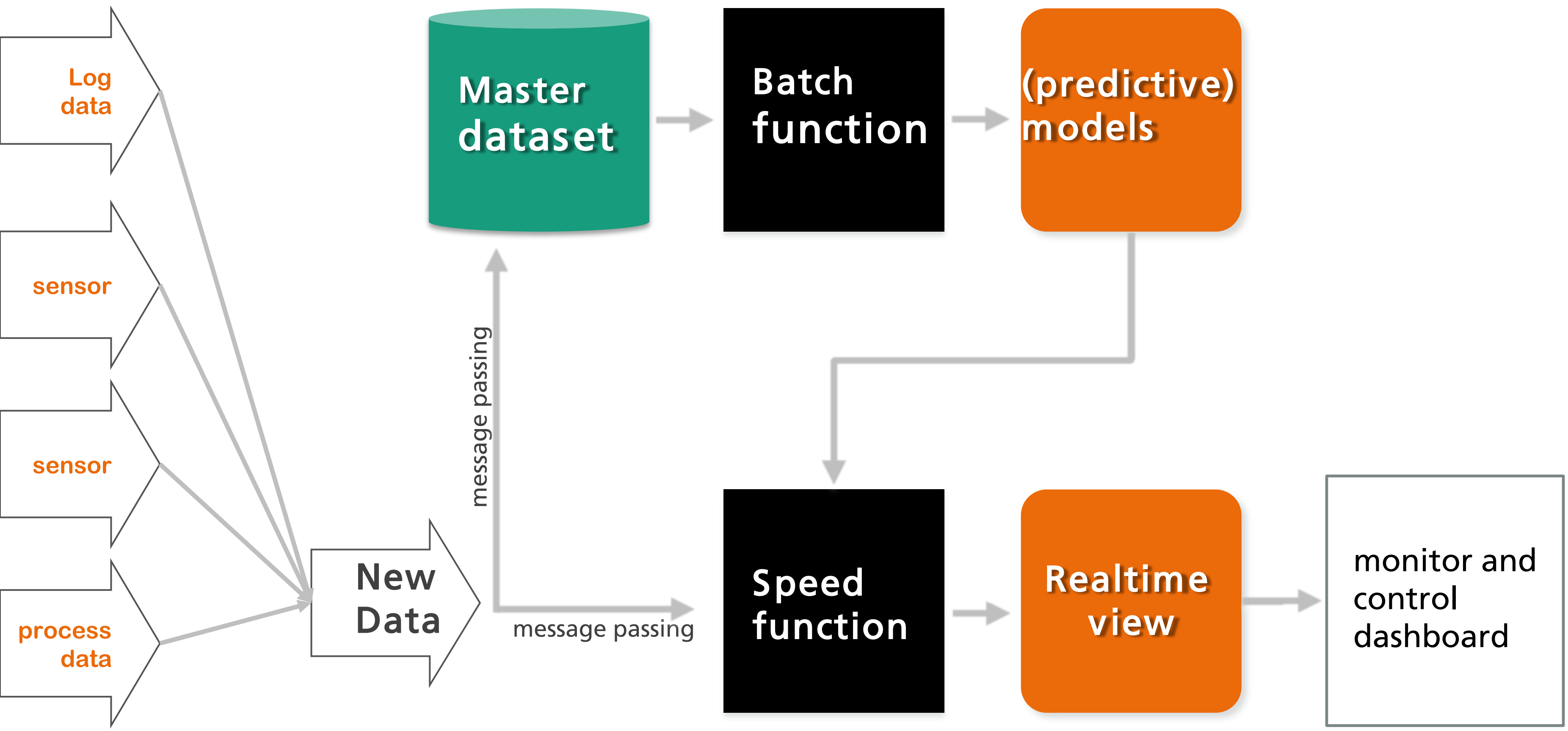
New Data acquisition, filtering, cleaning … and ingestion is stream processing



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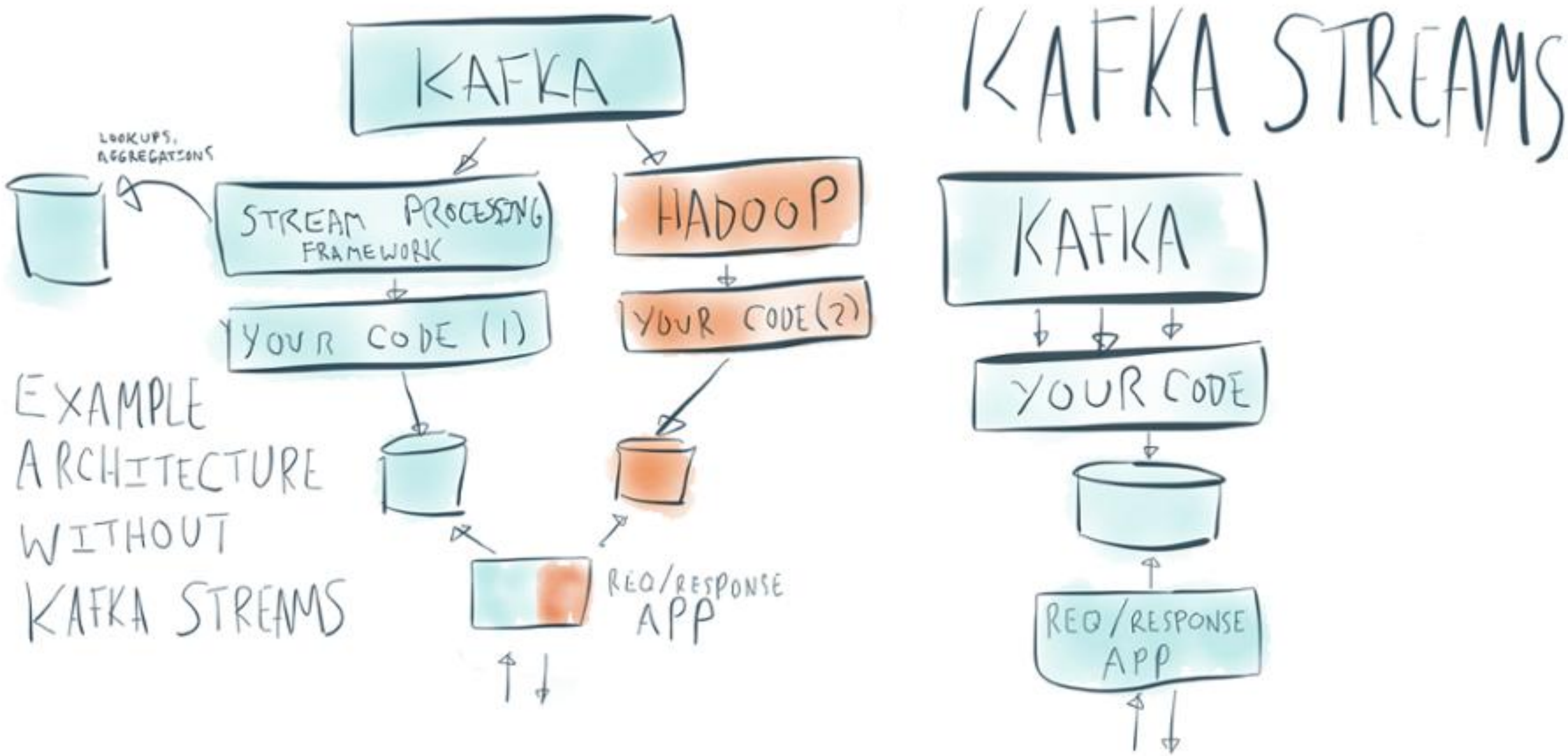
Lambda Architecture or Stream Processing



http://www.confluent.io/blog/introducing-kafka-streams-stream-processing-made-simple

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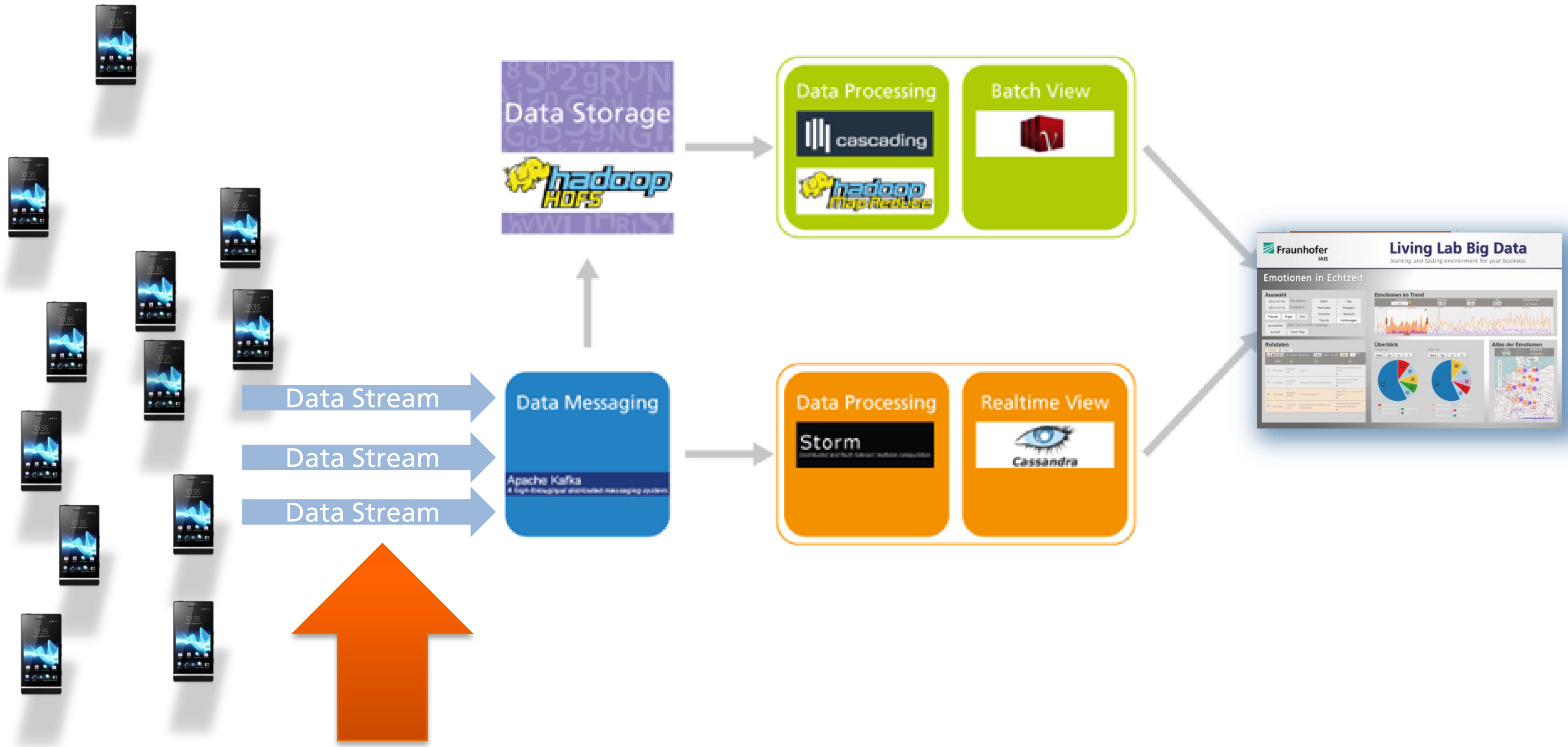
Massive Data Streams Create Bottlenecks



Bottlenecks

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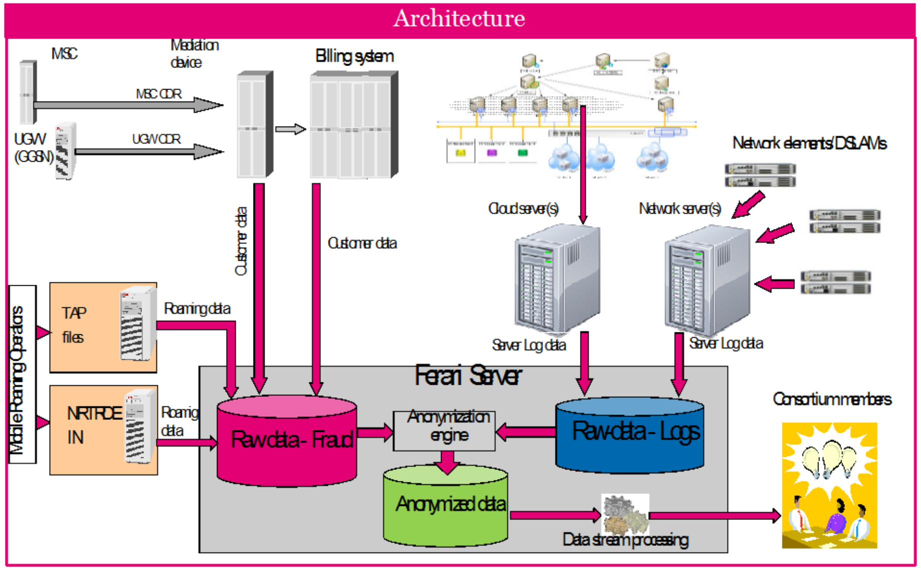
Use Case: Fraud Detection on CDR Data

- Anonymized CDR Data from HT (Croatia Telekom)
- Fraud Rules provided by HT
- Standard Approach: CDR data is imported into separate database where fraud rules are applied
- => import delays analysis
- Challenge: Apply Rules to Data Streams
- => faster detection of fraud
- => Express fraud rules with Complex Event Patterns !



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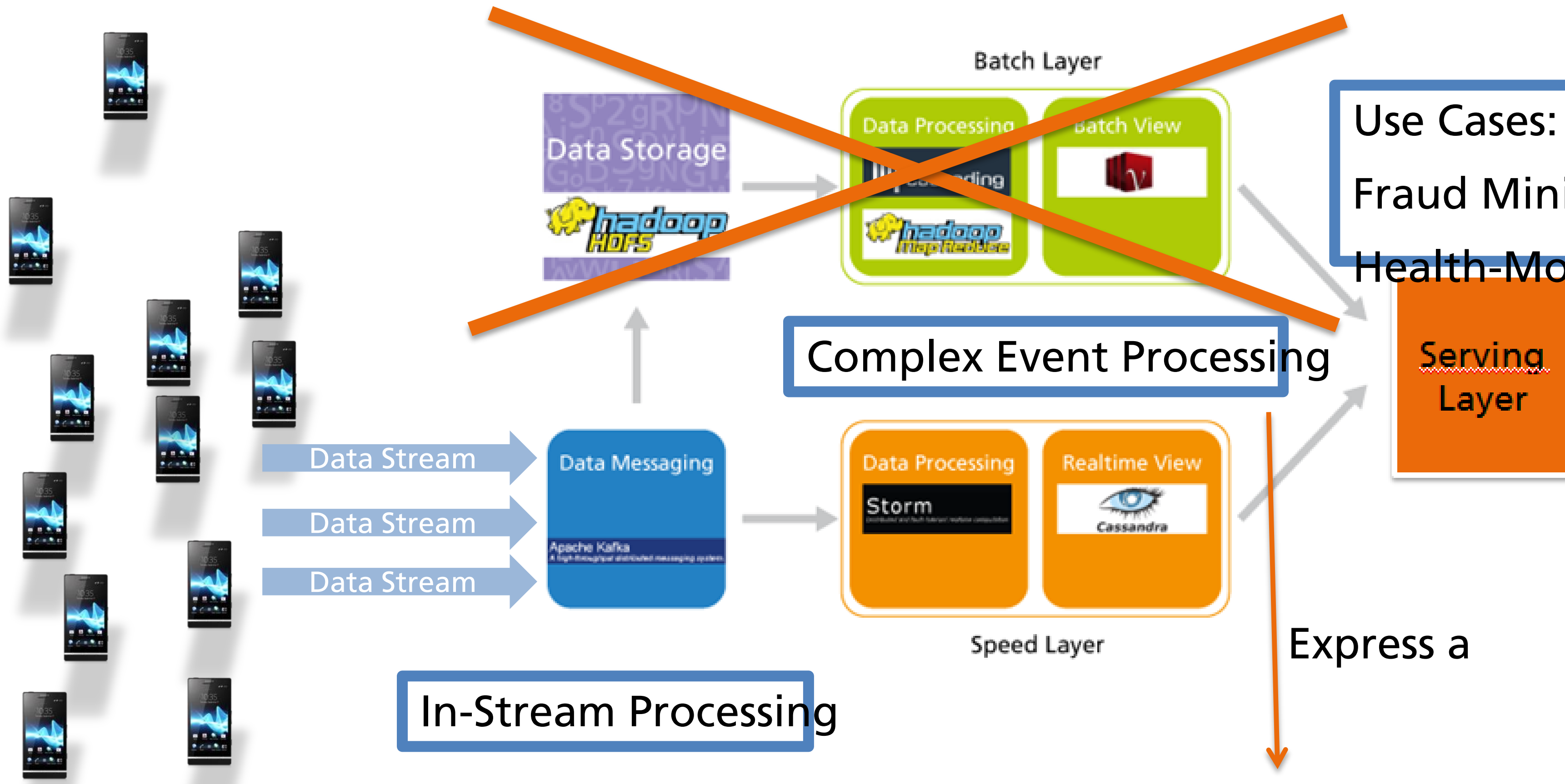
In-Situ and In-Stream Processing



Use Cases:

Fraud Mining

Health-Monitorin

Complex Event Processing

In-Stream Processing

In-Situ Processing

Express a "global condition" but monitor by local conditions

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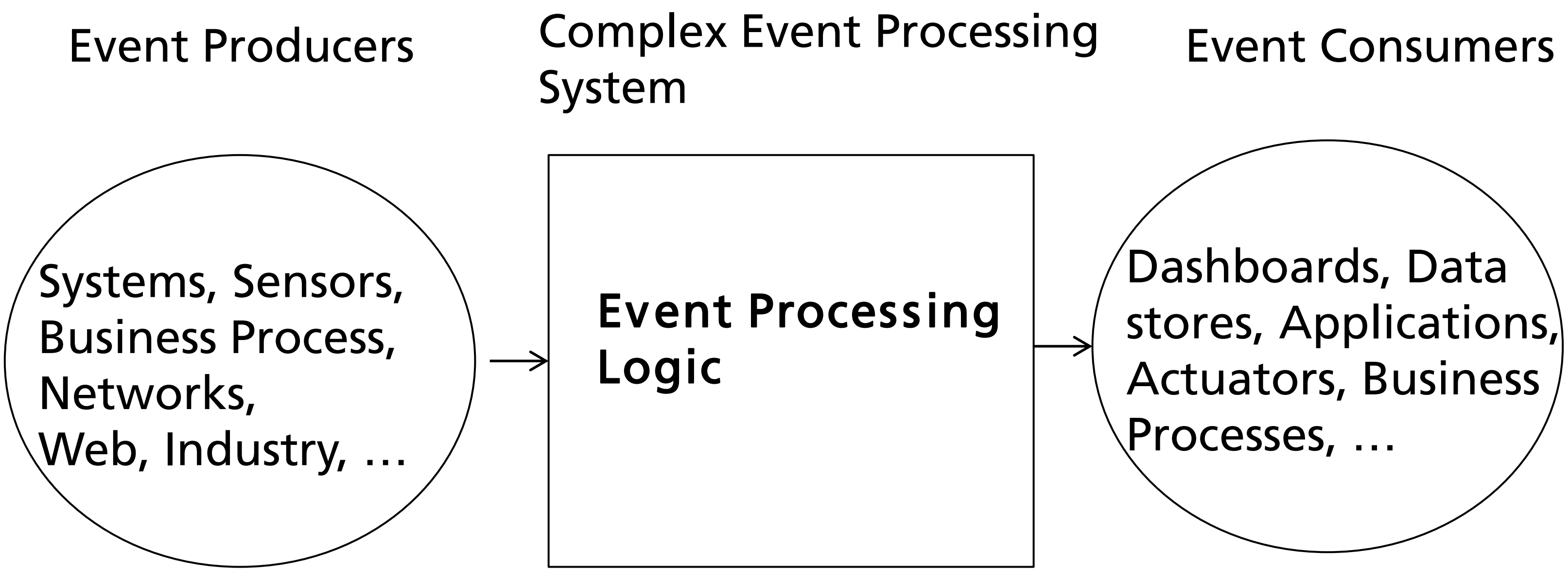
Complex Event Processing

streaming with higher level abstractions



Event Processing in Action, O. Etzion and P. Niblett, Manning 2010

Complex Event Processing Principles

Input (simple) Events

- Timestamp
- Event Source
- Attributes

Event Processing Logic

Set of patterns that define conditions on one or multiple events. If events occur that match a pattern, a new event is generated (derived event).

Output (complex, derived) Events

- Timestamp
- (Event Sources)
- Attributes

Input Events and Example Complex Event for Fraud

- Input Event: **CDR** (call detail record) data
  - subscriber number, called number,
    timestamp, duration,
    start cell, end cell, …
- Complex Event 1: ***LongCallAtNight***
  A long call to premium distance is made during night hours.
- Complex Event 2: ***FrequentLongCallsAtNight***
  At least three of these
  LongCallAtNight-events per calling number
- …

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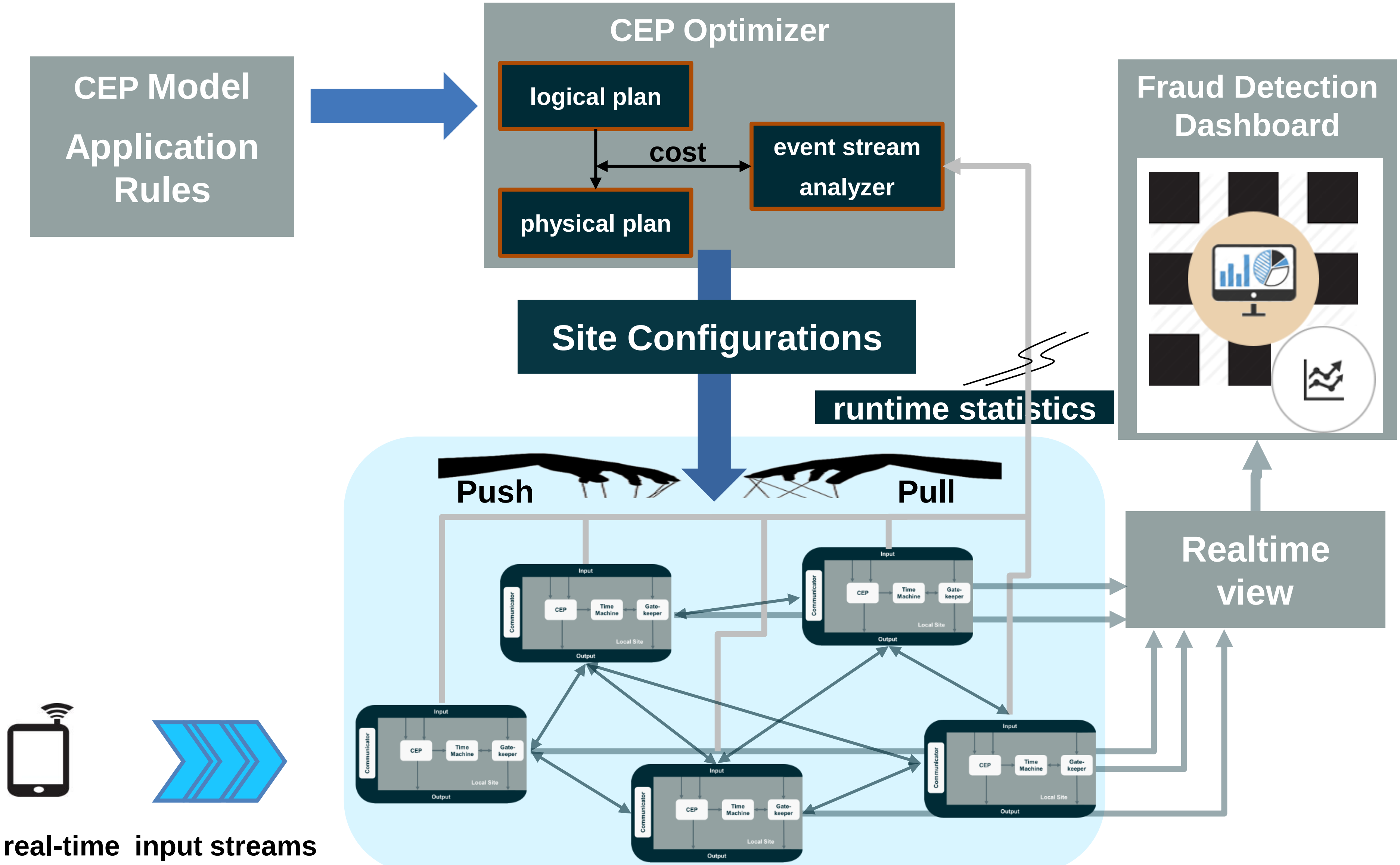
FERARI: towards In-Situ Complex Event Processing



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Proton on Storm

- Proton - IBM Proactive Technology Online
  - research asset developed by IBM Research Haifa https://github.com/ishkin/Proton
  - Used in many EU Projects (FIWARE, Fispace, Psymbiosis, SPEEDD)
  - Patterns defined **by Event Processing Networks (EPN)**
- Proton on Storm
  - Developed by IBM in the FERARI EU Project Grant No 619491
  - http://www.ferari-project.eu
  - Distributed, scalable CEP on Storm
  - Use case example: fraud mining on telekom data
  - https://bitbucket.org/sbothe-iais/ferari

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Selected FERARI References

http://www.ferari-project.eu

Open Source Repository

https://bitbucket.org/sbothe-iais/ferari

I. Flouris, V. Manikaki, N. Giatrakos, A. Deligiannakis, M. Garofalakis, M. Mock, S, Bothe, I. Skarbovsky, F. Fournier, M.Stajcer, T. Krizan, J. Yom-Tov T. Curin :**FERARI: A Prototype for Complex Event Processing over Streaming Multi-cloud Platforms**, ACM SIGMOD 2016, Demo

I. Flouris, V. Manikaki, N. Giatrakos, A. Deligiannakis, M. Garofalakis, M. Mock, S, Bothe, I. Skarbovsky, F. Fournier, M.Stajcer, T. Krizan, J. Yom-Tov M. Volarevic : **Complex Event Processing over Streaming Multi-cloud Platforms - The FERARI Approach**, ACM DEBS 2016, Demo

N. Giatrakos, A.Deligiannakis, M.Garofalakis: **Scalable Approximate Query Tracking over Highly Distributed Data Stream**, ACM SIGMOD'2016

O. Etzion, F. Fournier, I. Skarbosky: **A Model Driven Approach for Event Processing Applications**, ACM DEBS 2016

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wrap up

- Big Data - Proof of concept - Experimental applications
- The Lambda Architecture
  - Principles of data processing
  - Architecture template to recognize Big Data issues
  - Guide to Component Selection
- Examples of Architecture instantiations
- Streaming and the Internet of things - Industrie 4.0
  - Big Data processing becomes Stream Processing
- In-Situ complex event processing

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