CONTAINERIZED SPARK ON KUBERNETES

William Benton
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BACKGROUND

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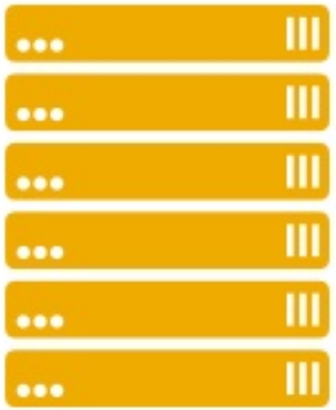

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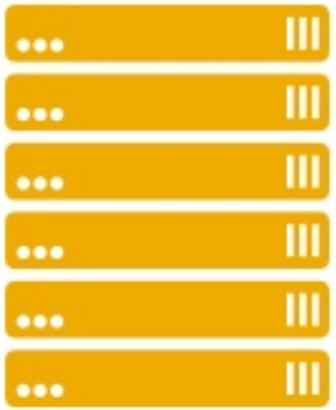

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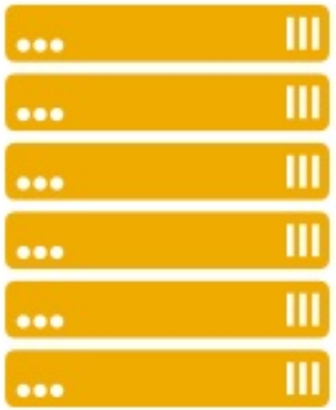

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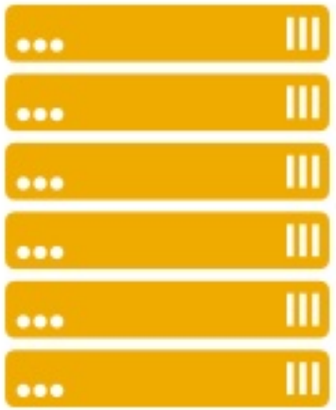

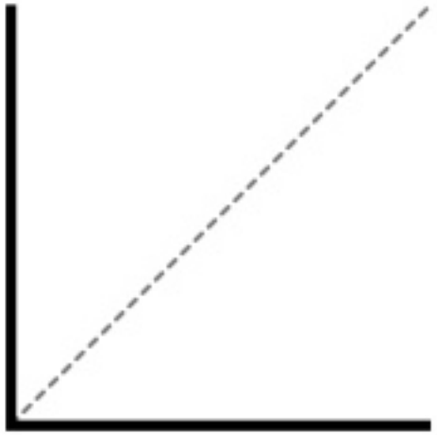

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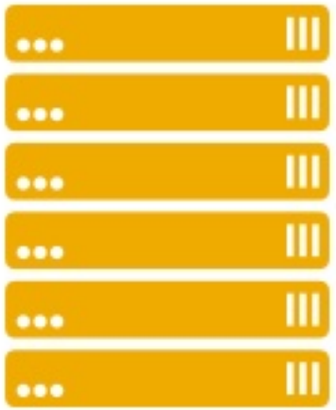

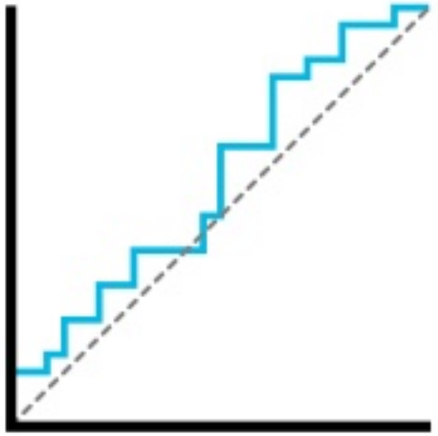

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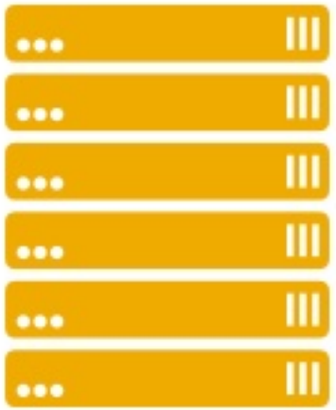

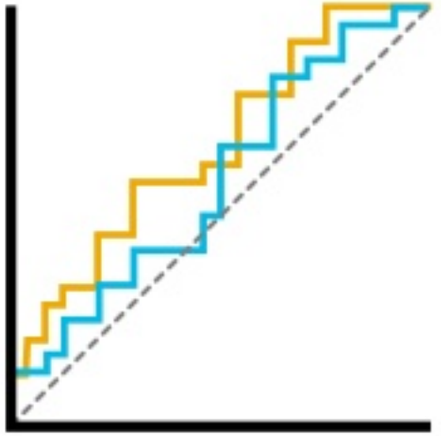

WHAT OUR SPARK CLUSTER LOOKED LIKE IN 2014

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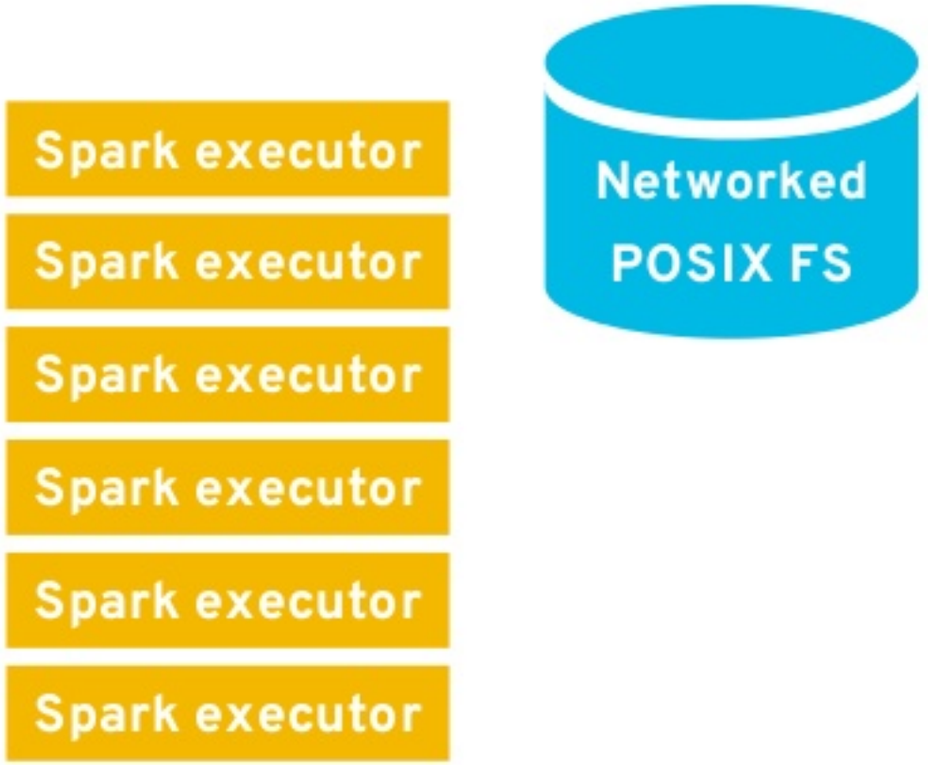

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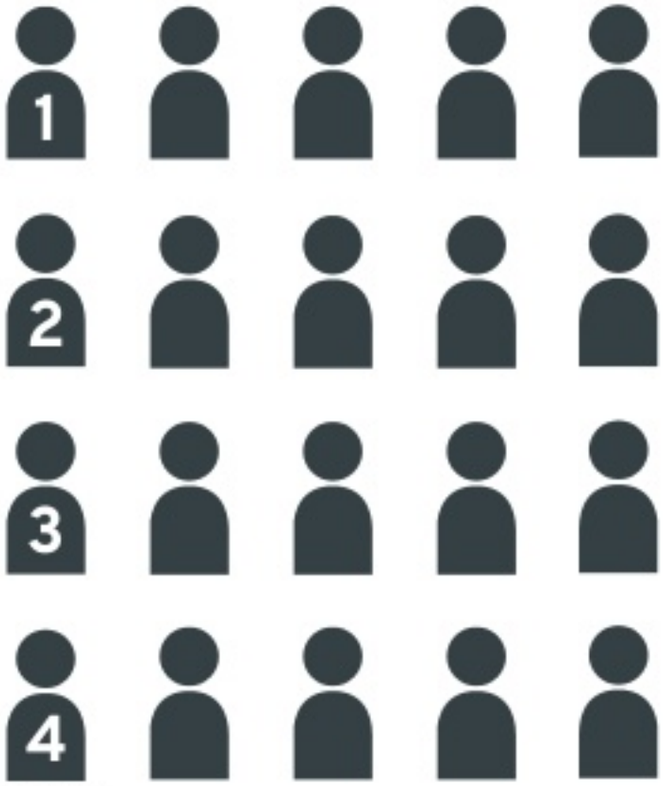

Analytics is no longer a separate workload.

Analytics is an essential component of modern data-driven applications.

OUR GOALS

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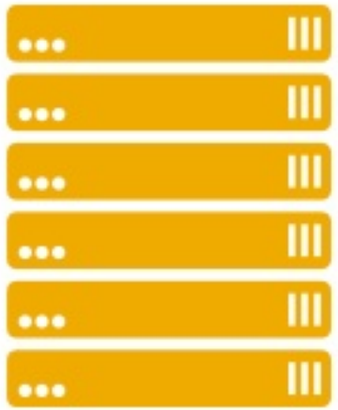

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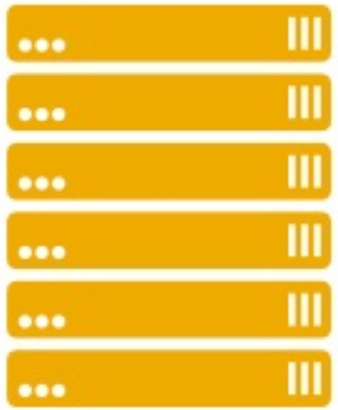

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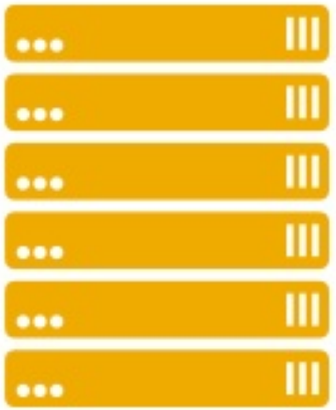

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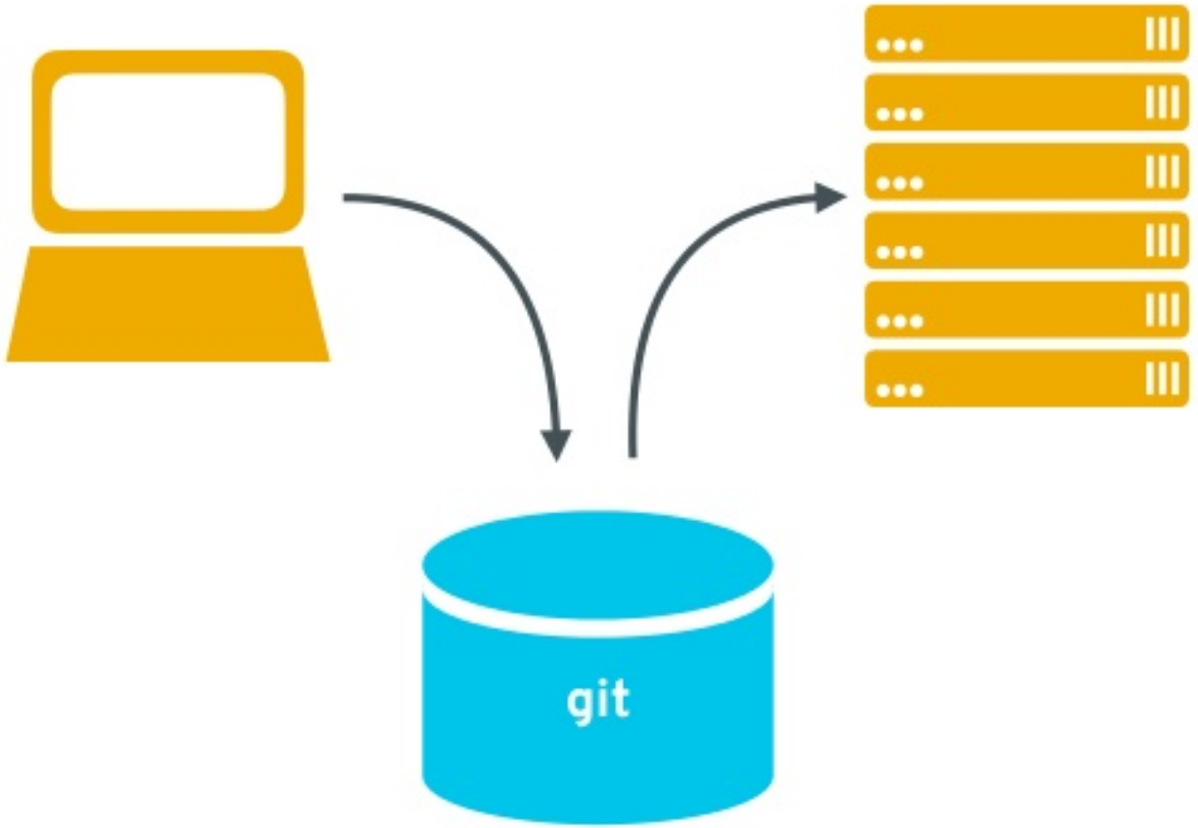

FORECAST

Motivating containerized microservices

Architectures for analytics and applications

Spark clusters in containers: practicalities and pitfalls

Play along at home

Future work

MOTIVATING MICROSERVICES

A **microservice** architecture employs **lightweight**, **modular**, and typically **stateless** components with **well-defined interfaces and contracts.**

BENEFITS OF MICROSERVICE ARCHITECTURES

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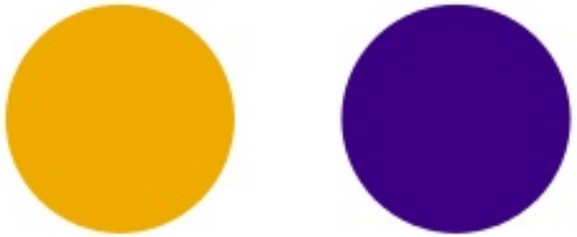

BENEFITS OF MICROSERVICE ARCHITECTURES

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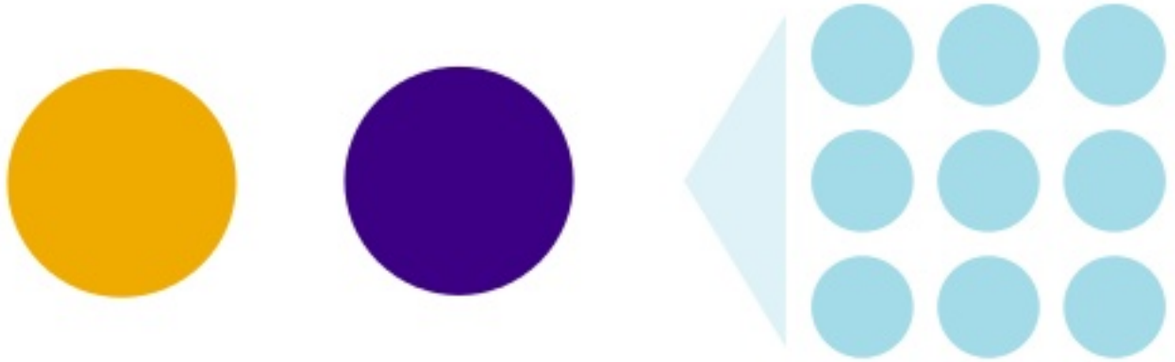

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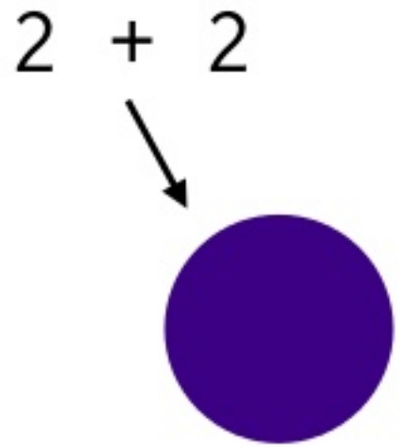

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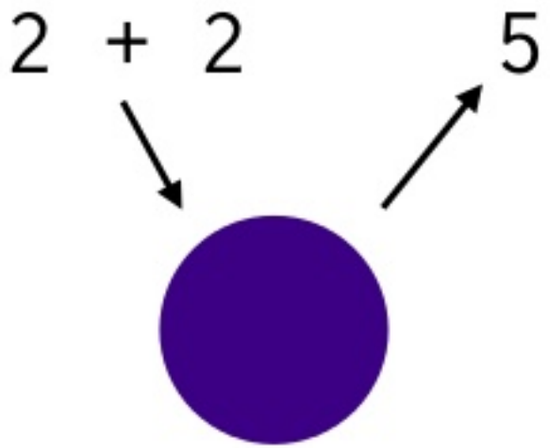

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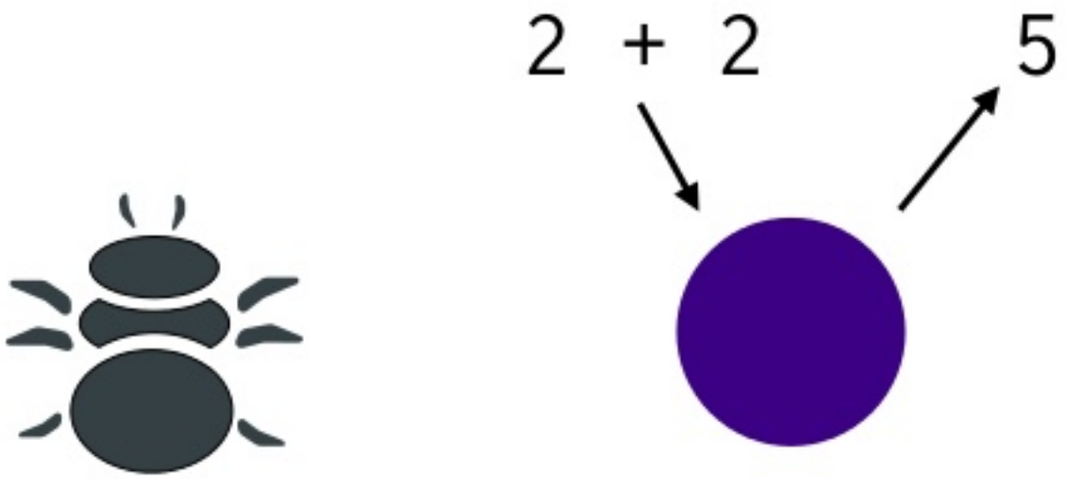

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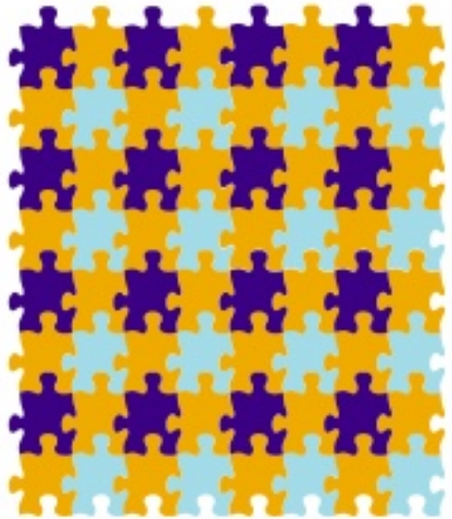

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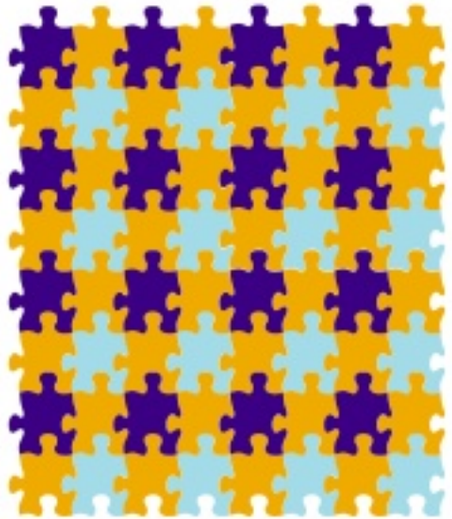

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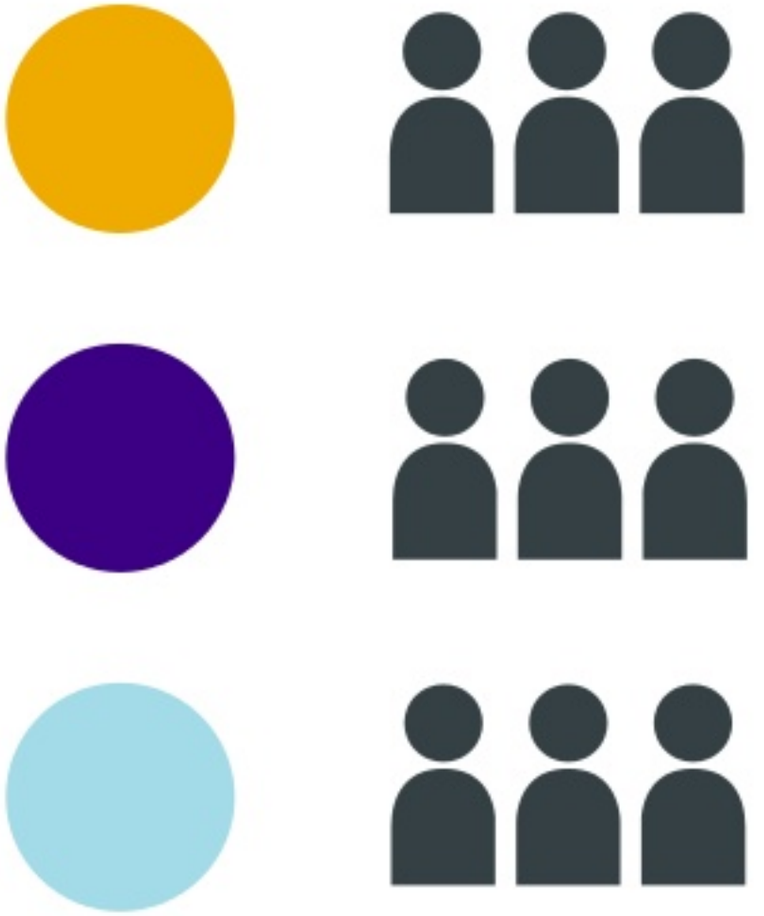
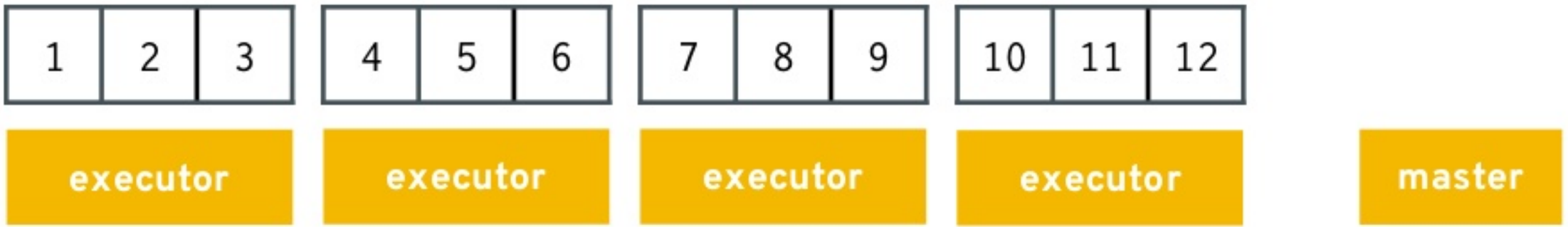


MICROSERVICES AND SPARK



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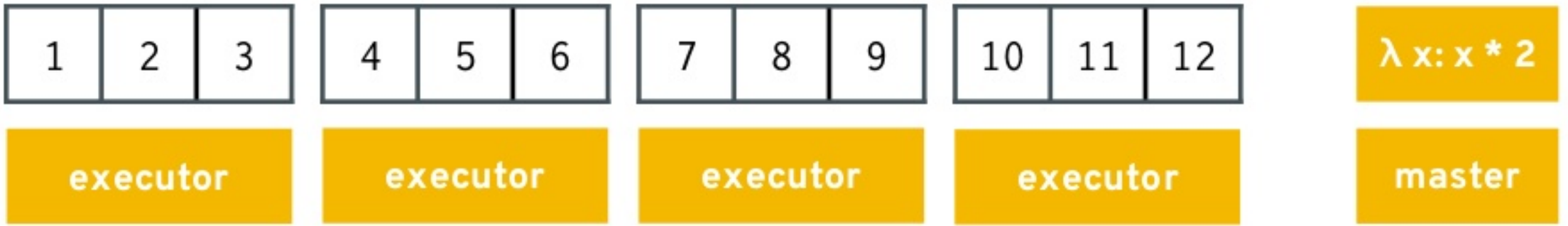

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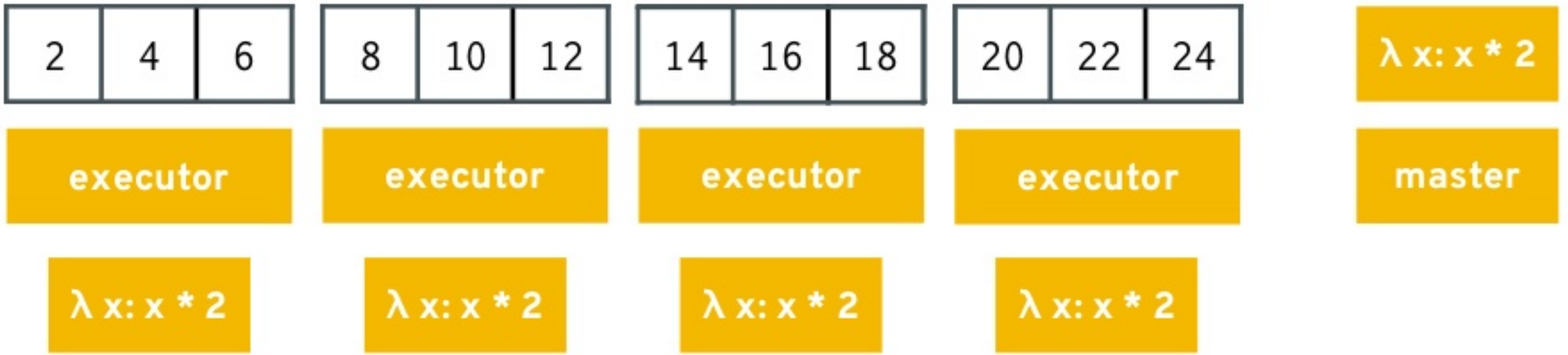

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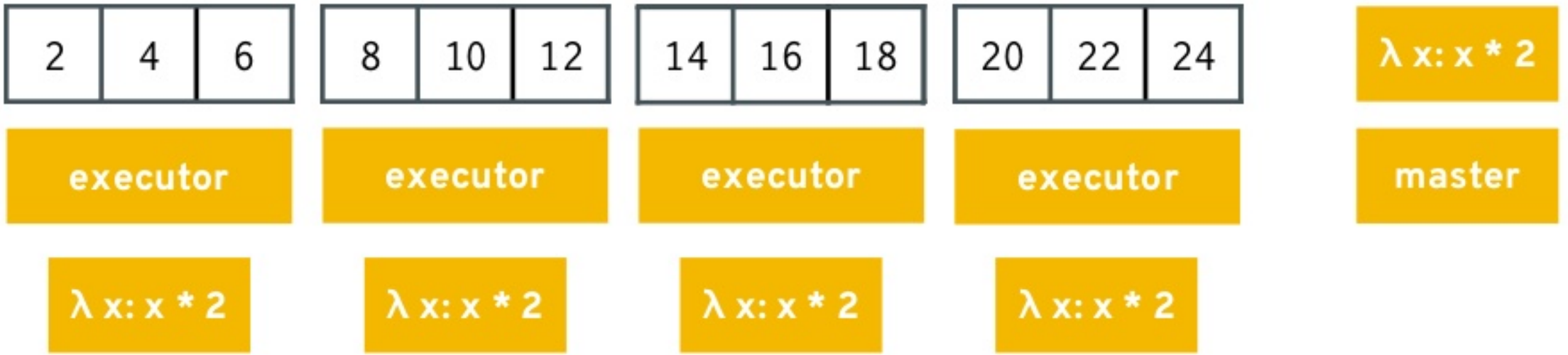

ARCHITECTURES FOR ANALYTICS AND APPLICATIONS

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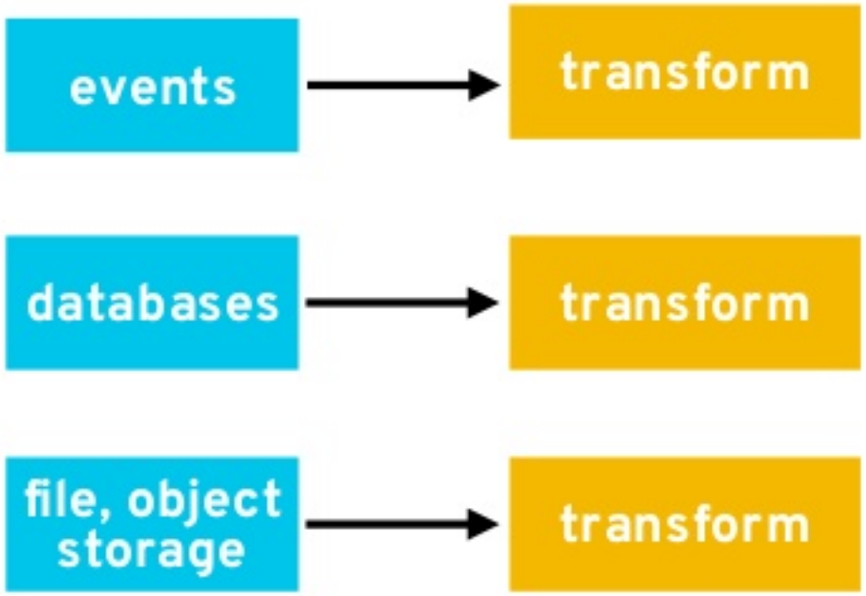

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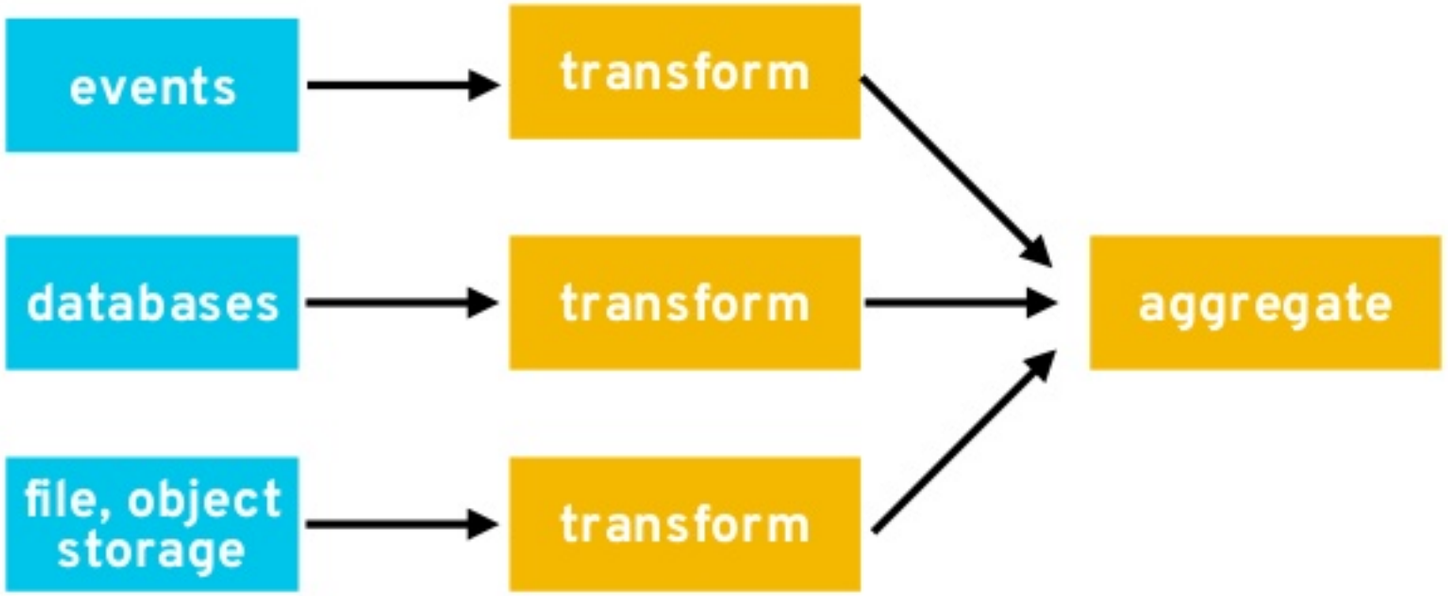

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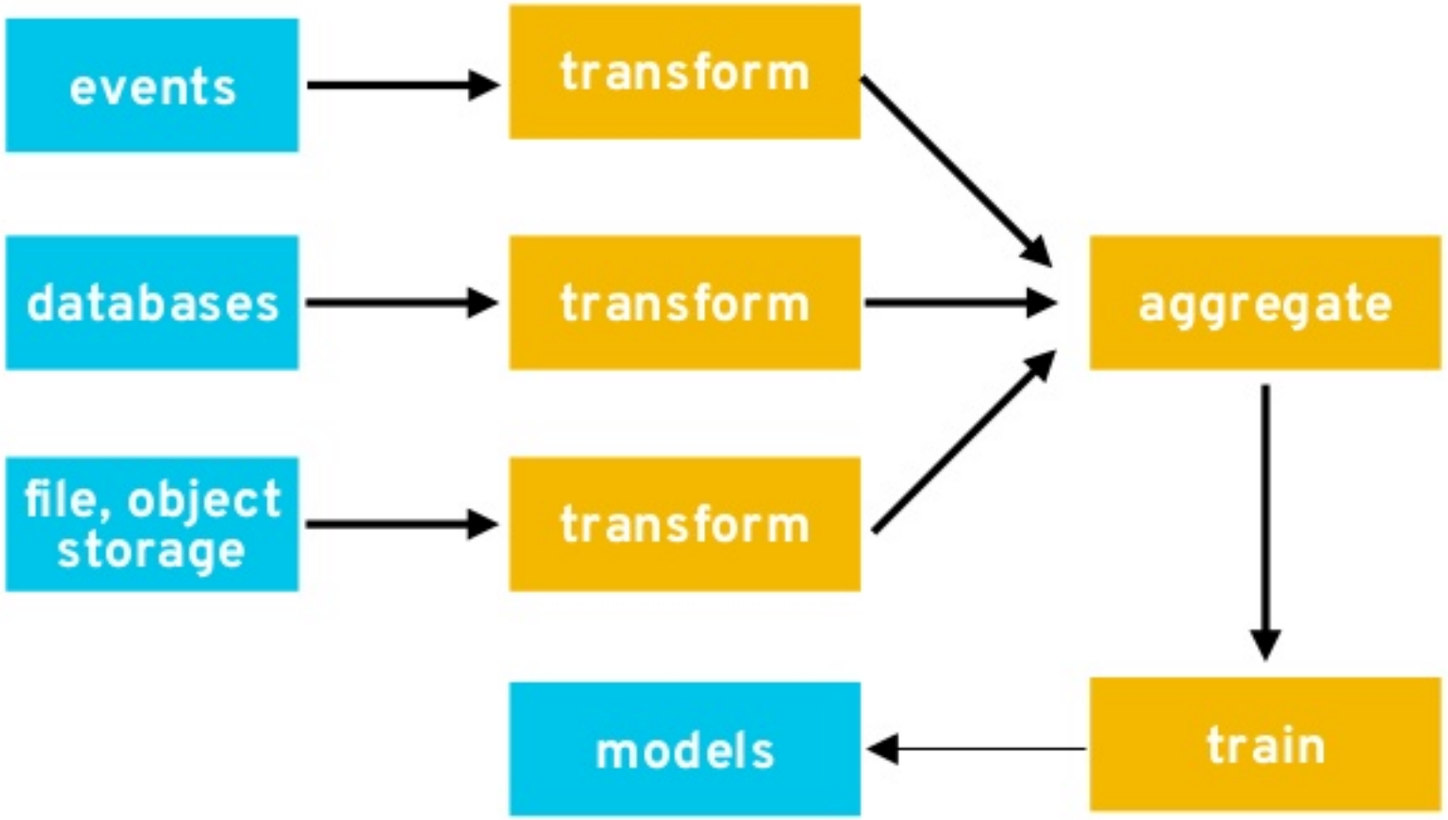

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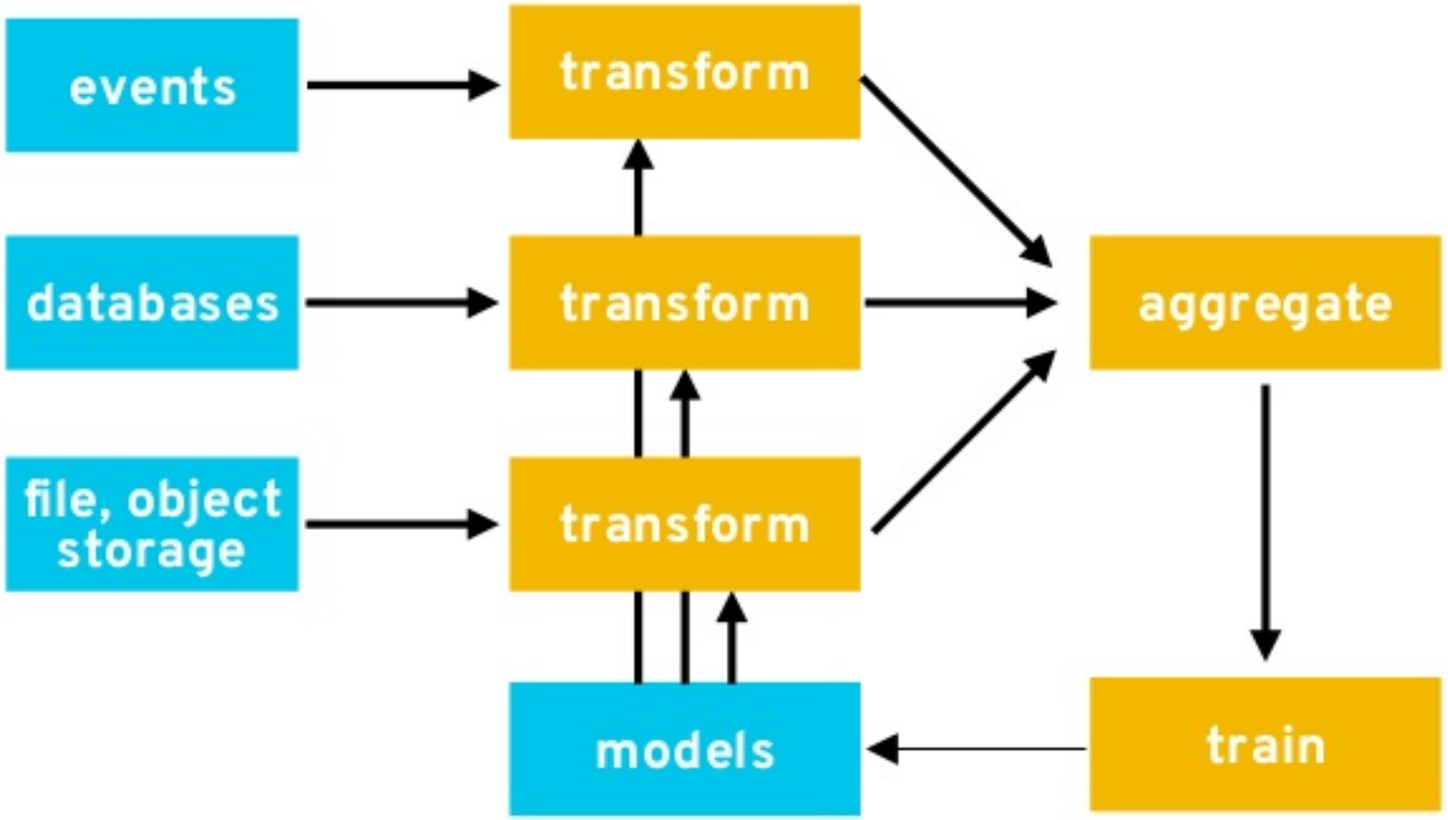

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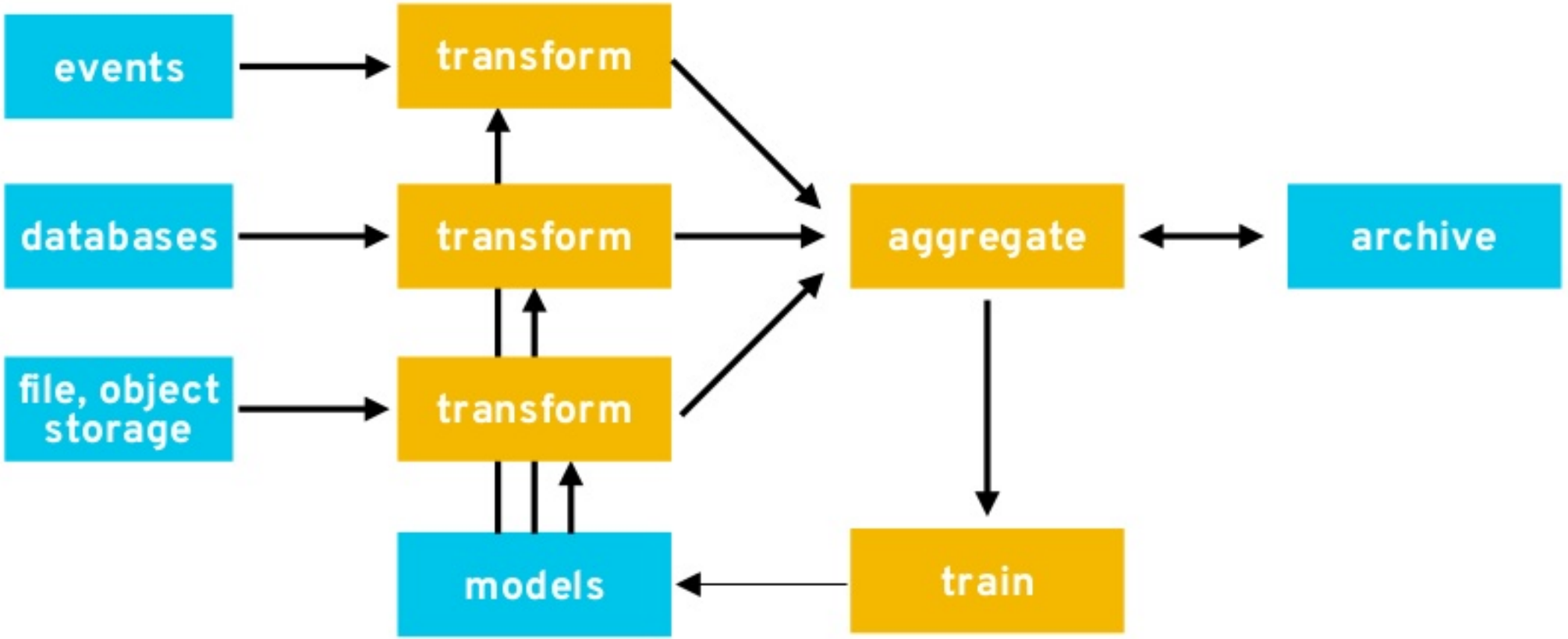

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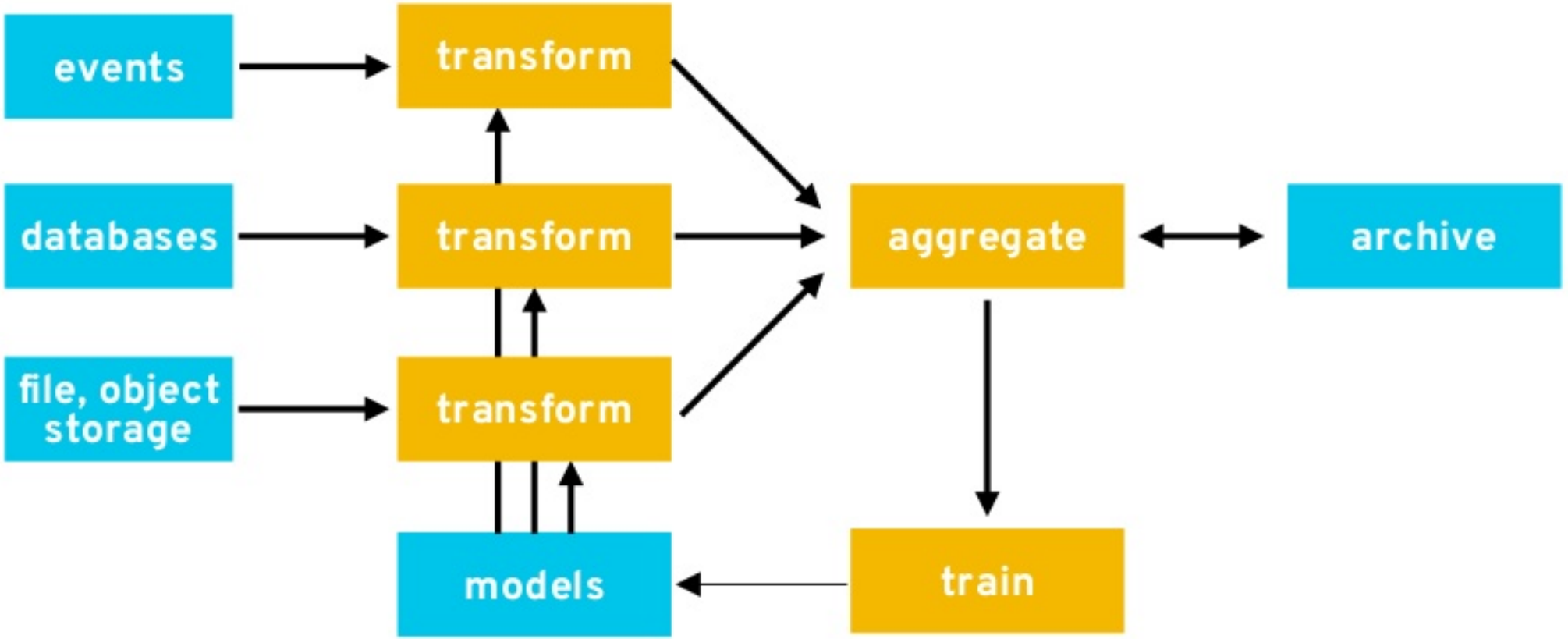

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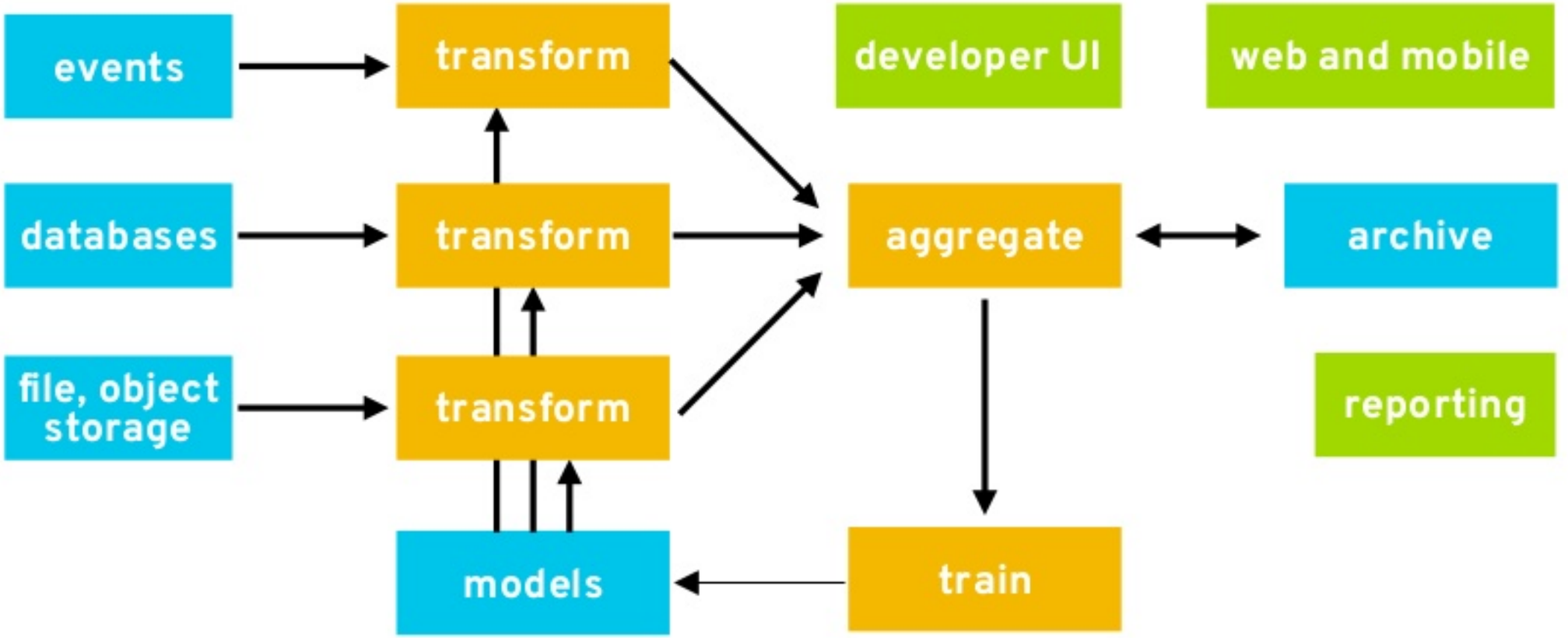

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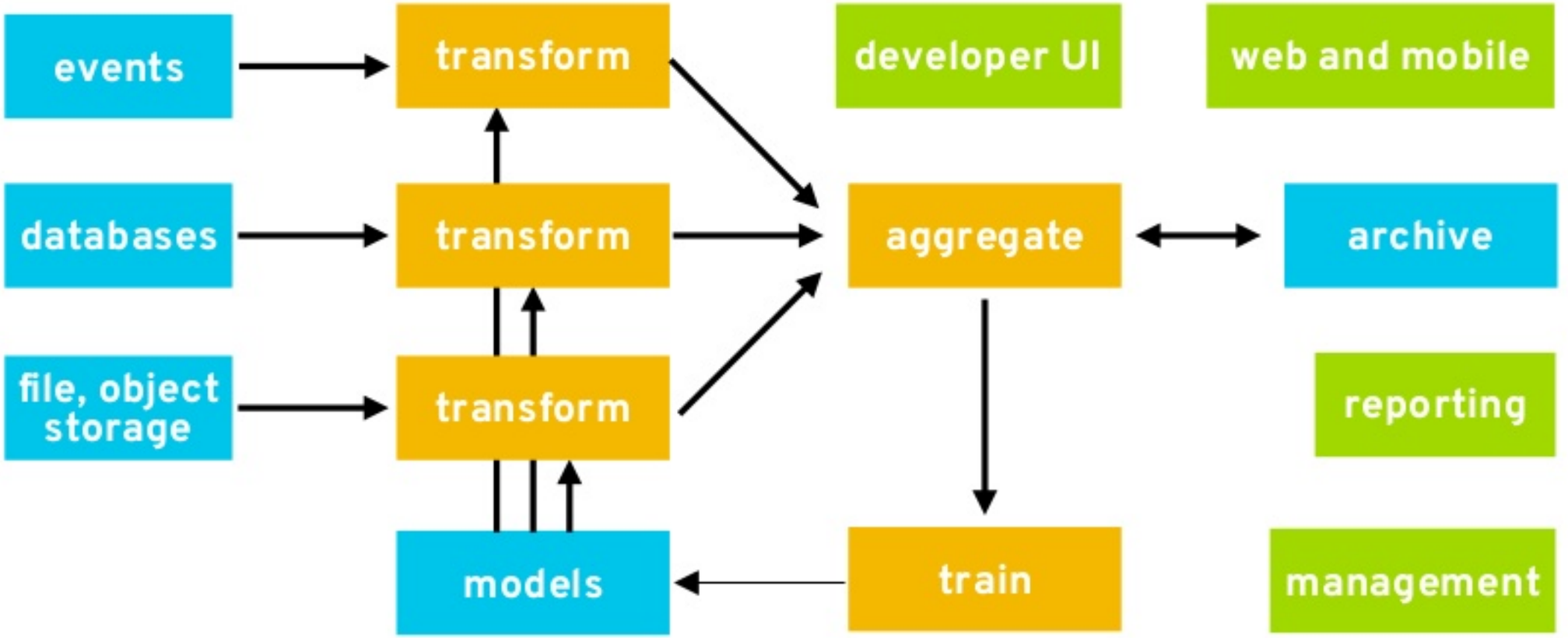

LEGACY ARCHITECTURES

CONVENTIONAL DATA WAREHOUSE

events

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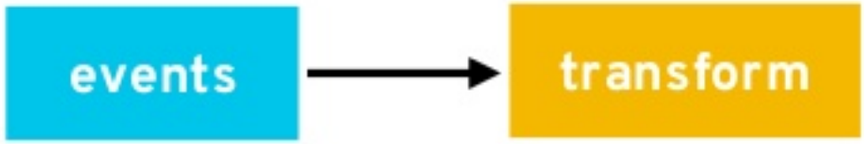

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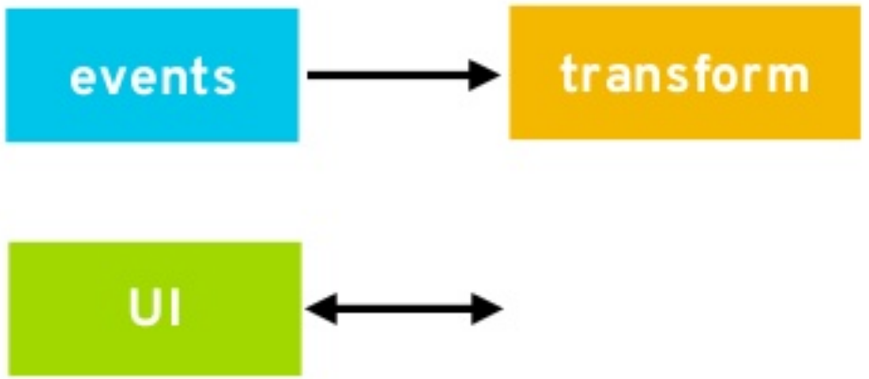

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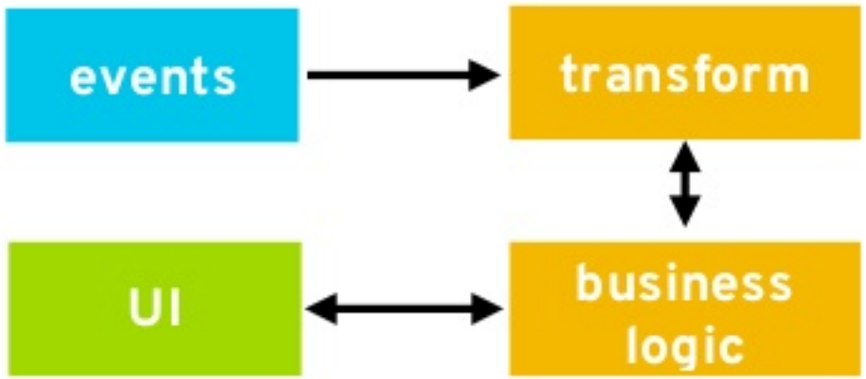

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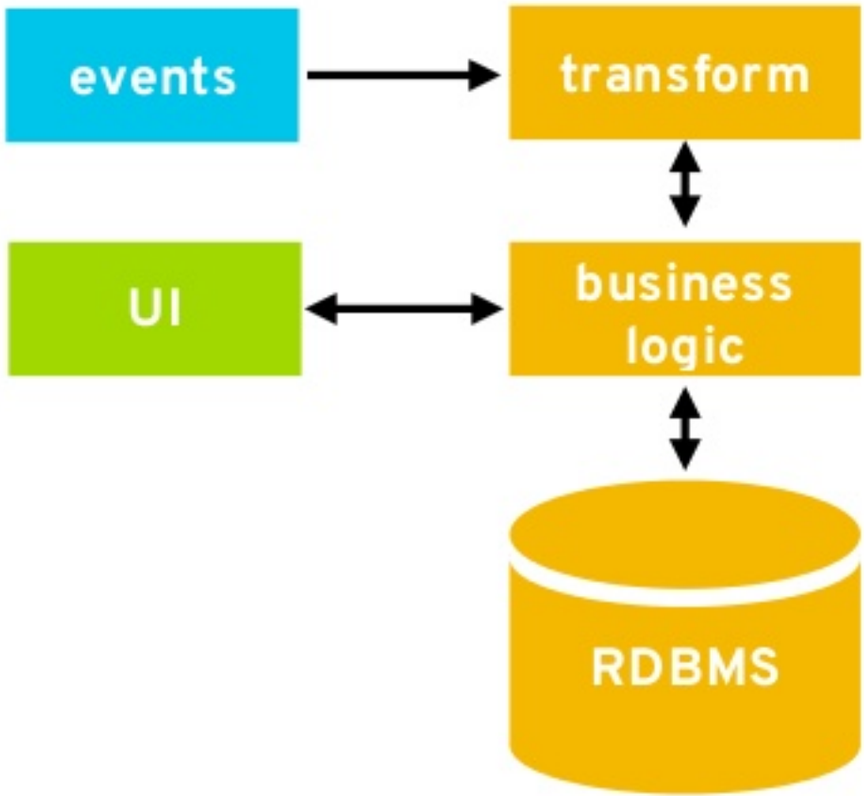

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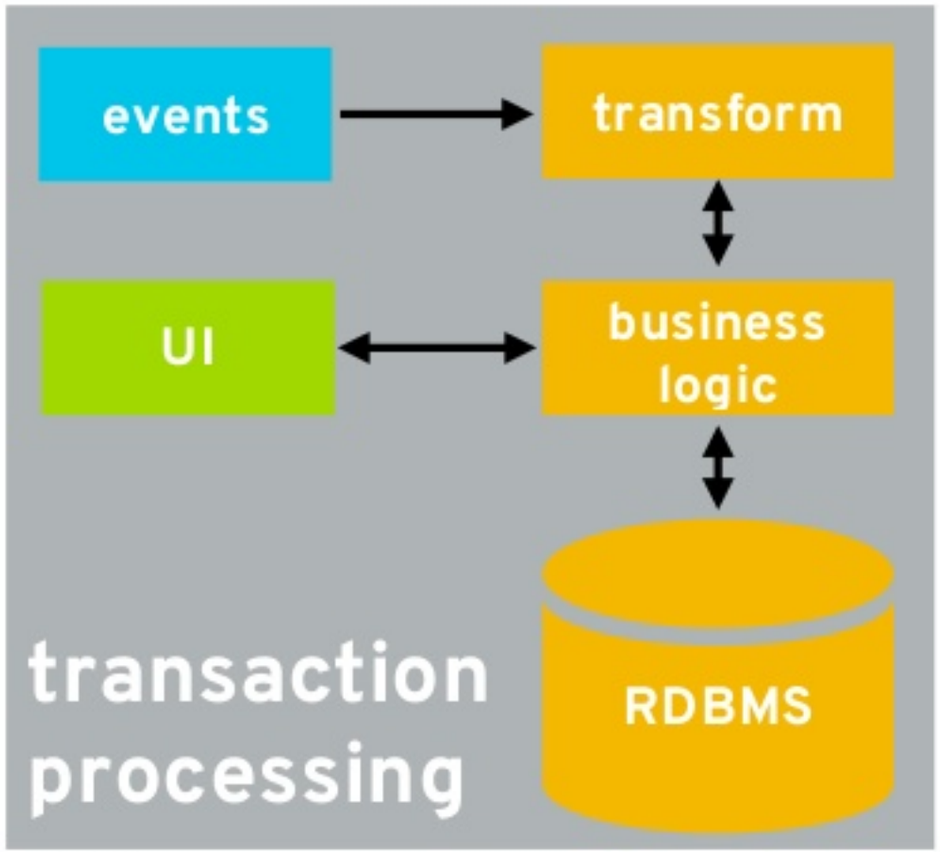

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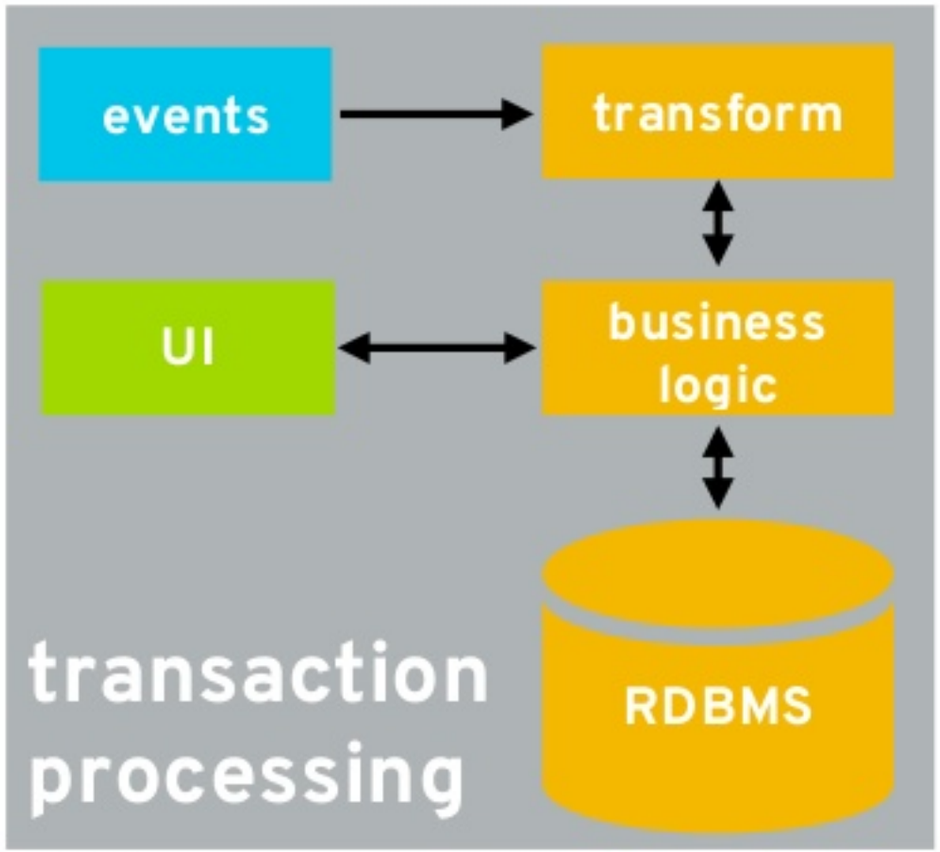

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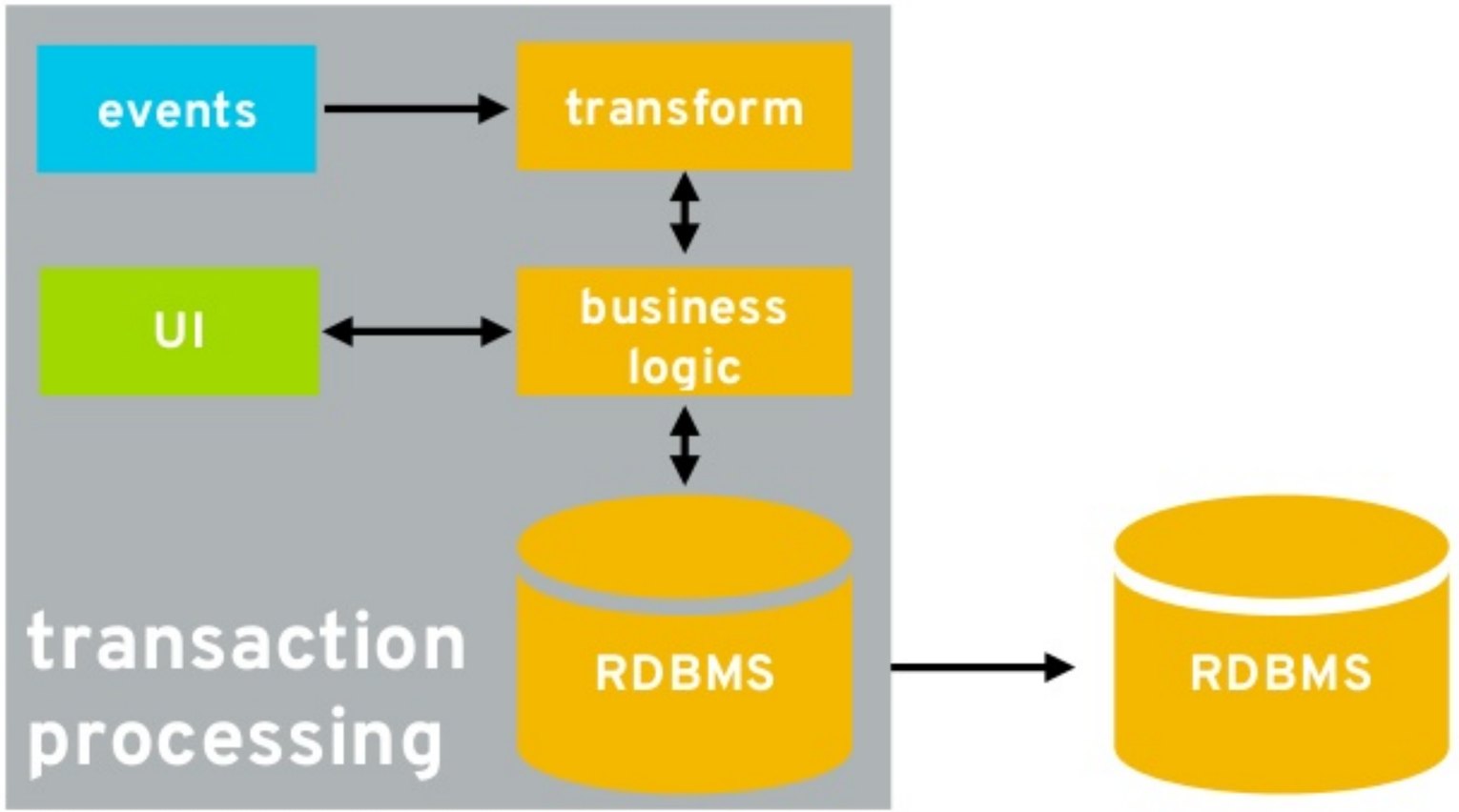

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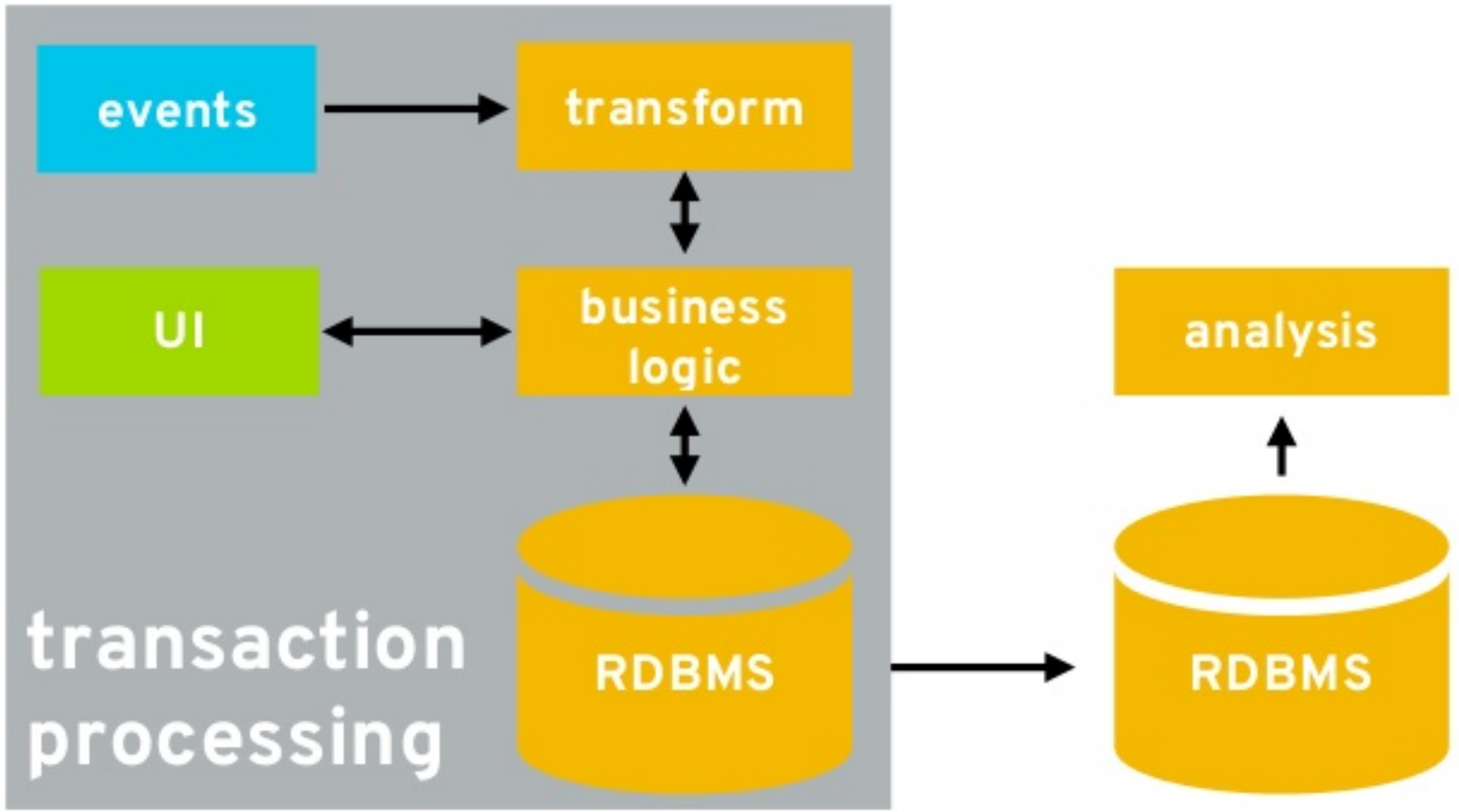

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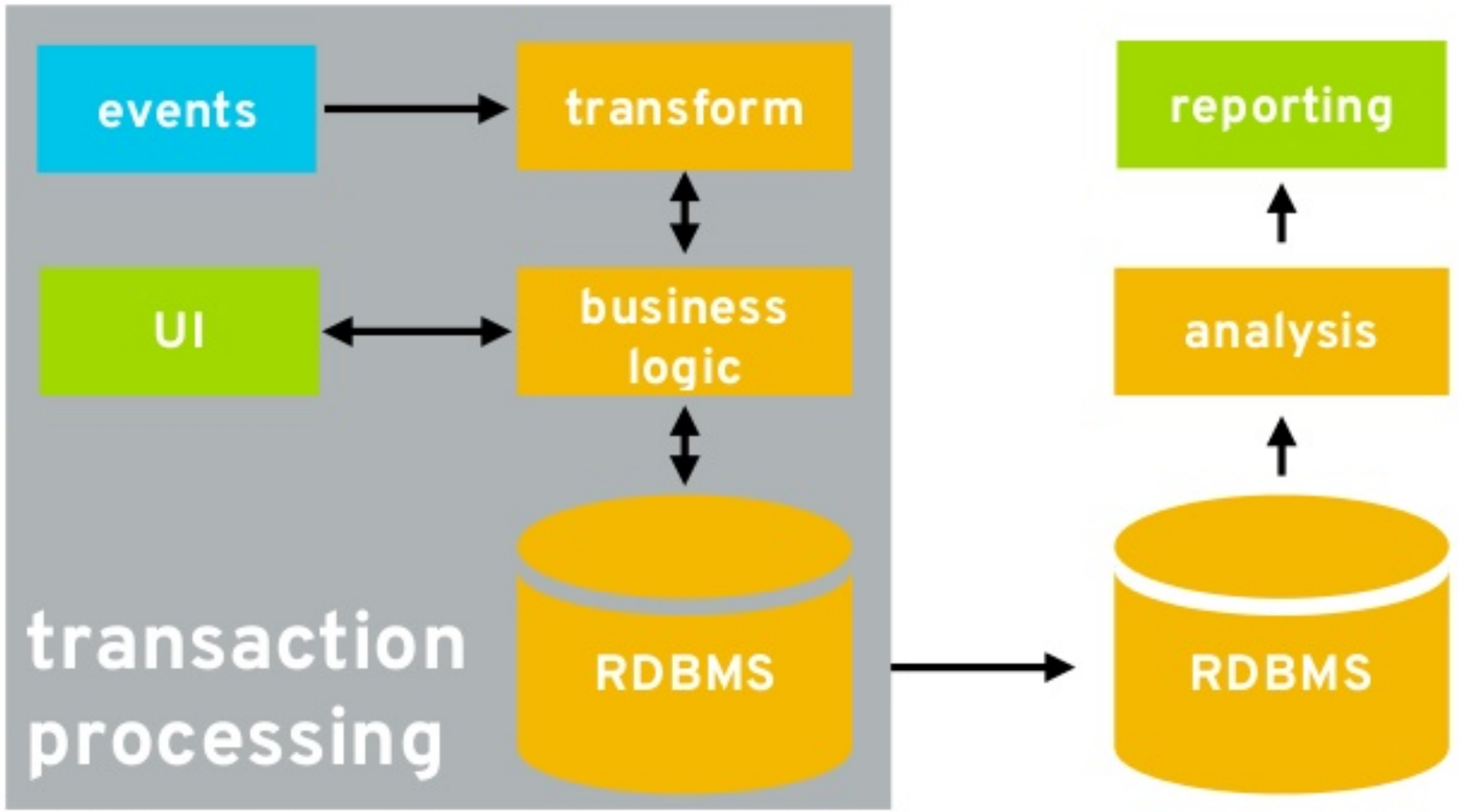

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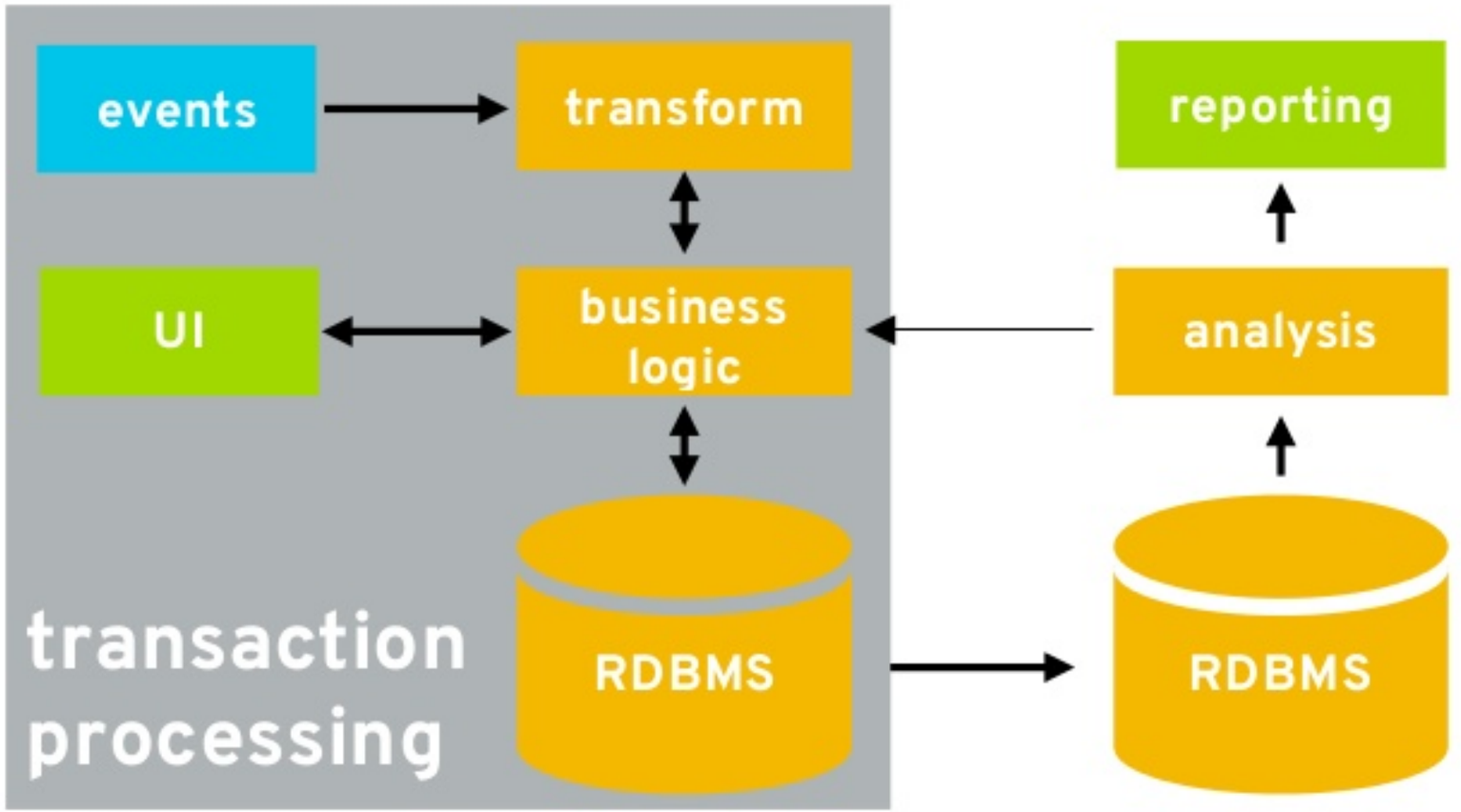

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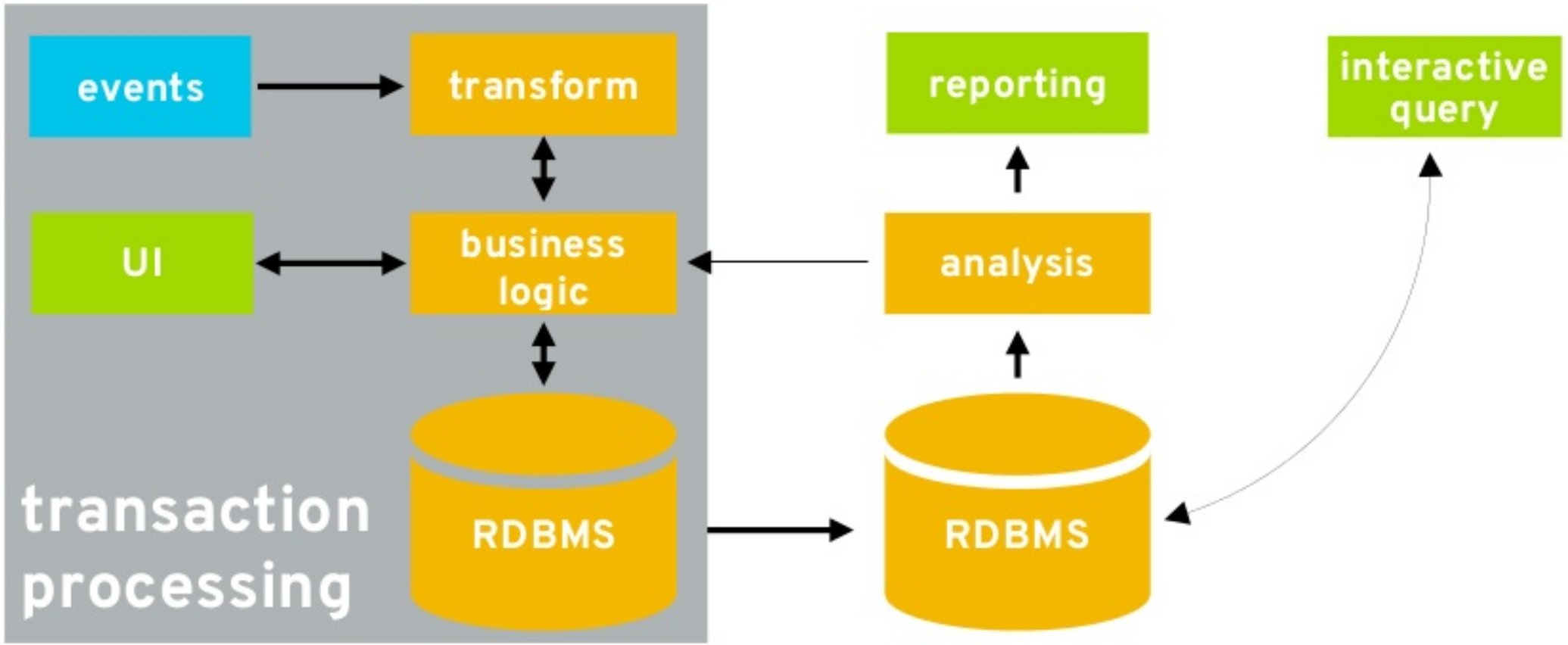

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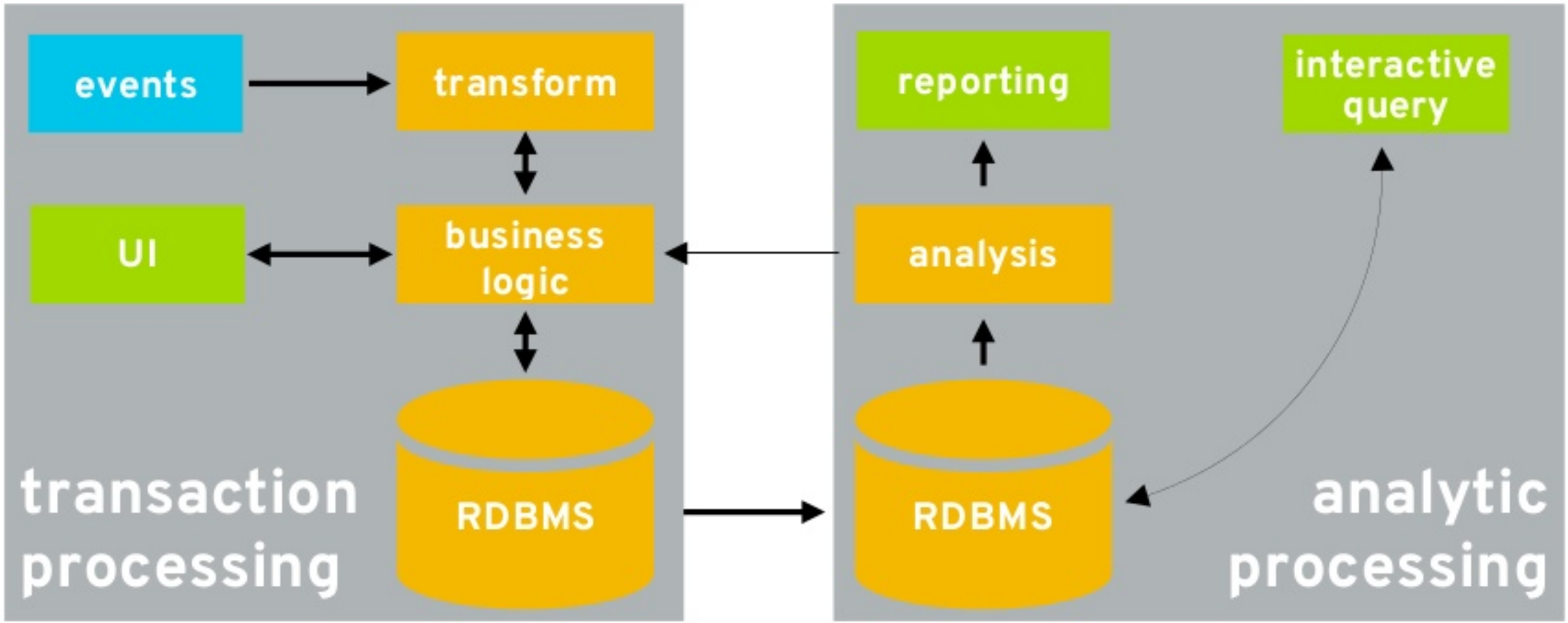

HADOOP-STYLE “DATA LAKE”

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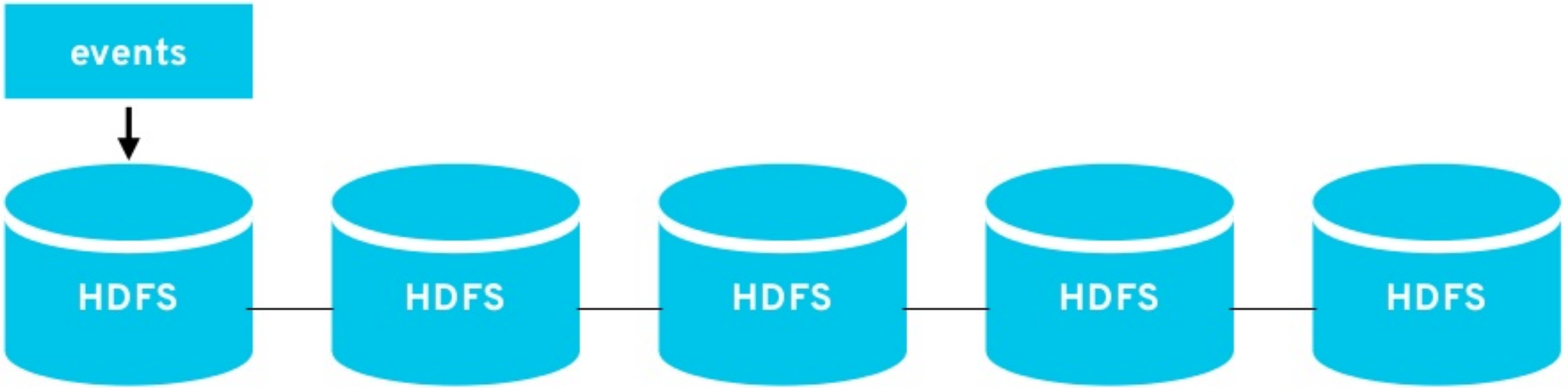

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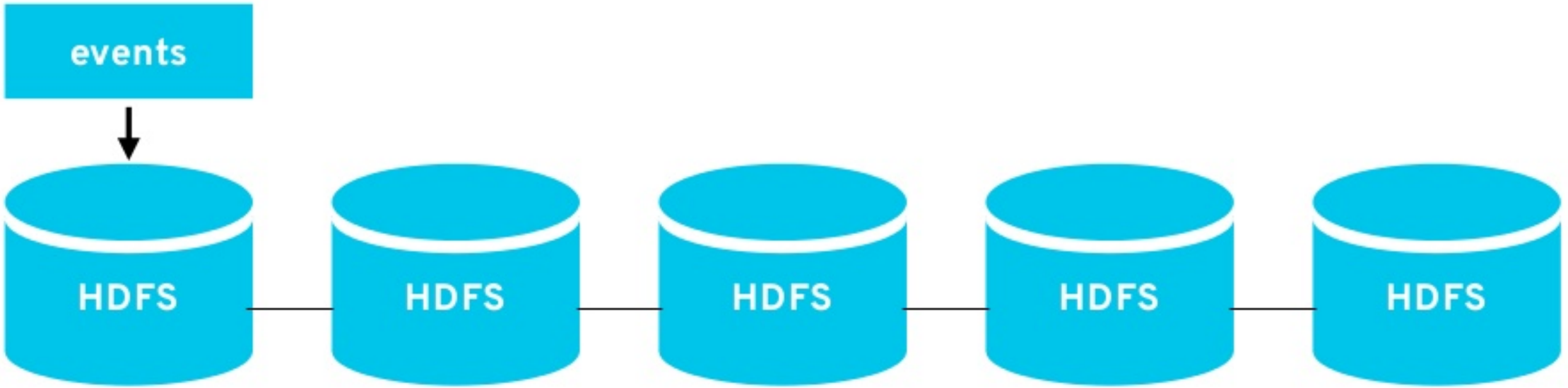

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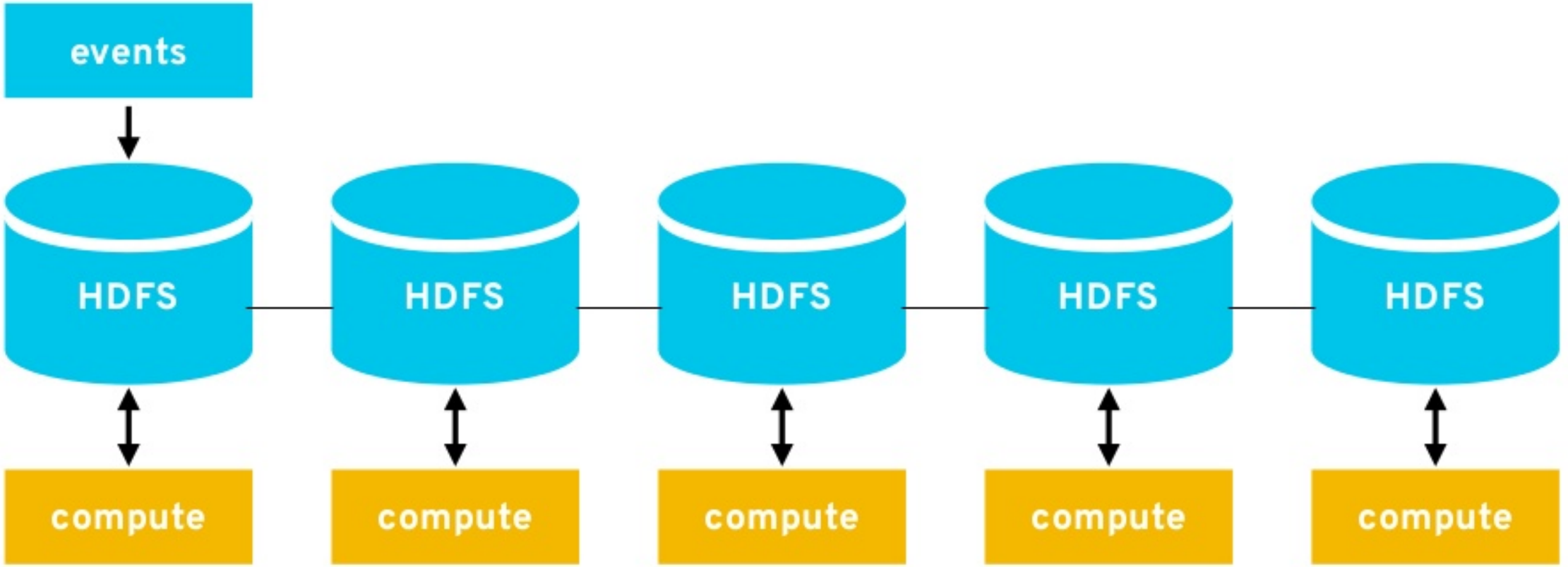
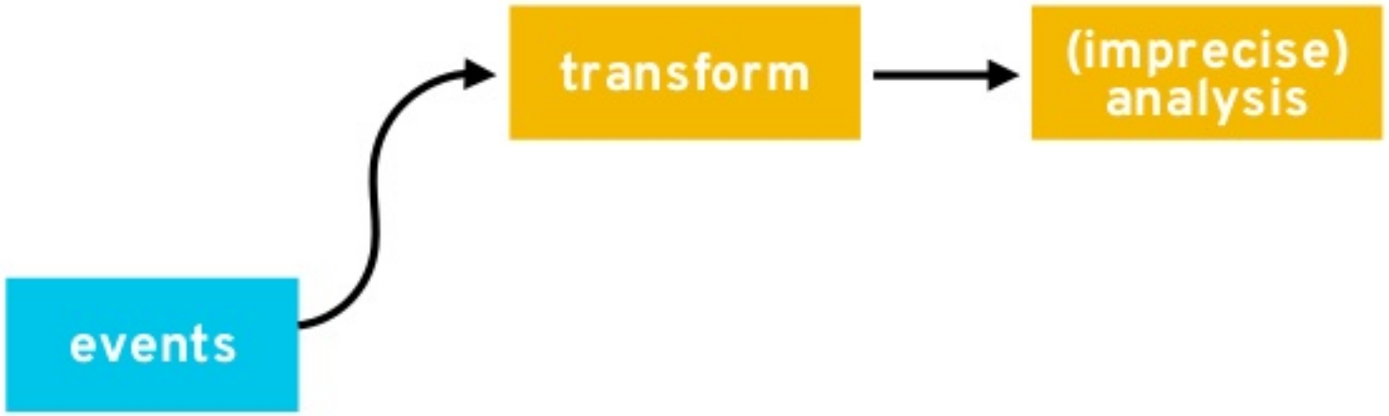


MODERN ARCHITECTURES

THE LAMBDA ARCHITECTURE



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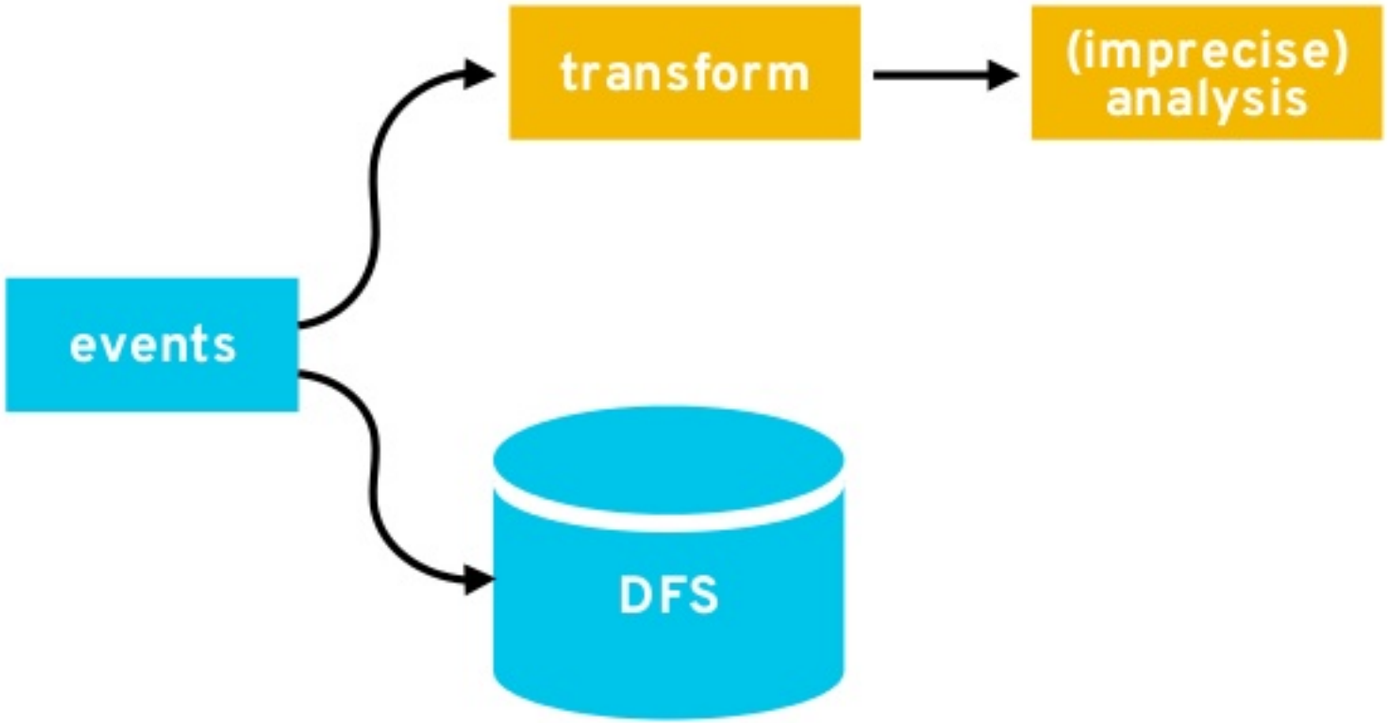

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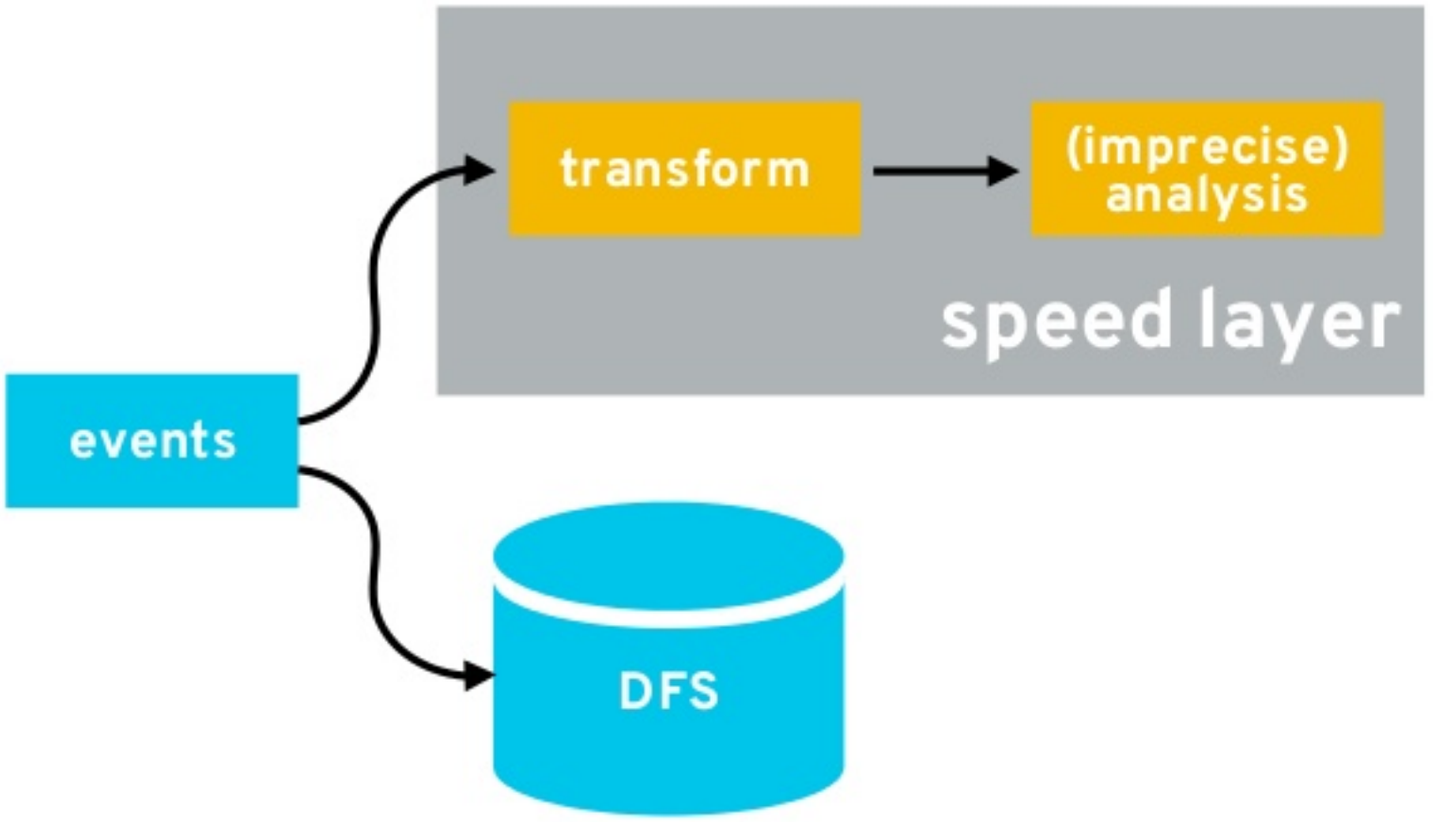

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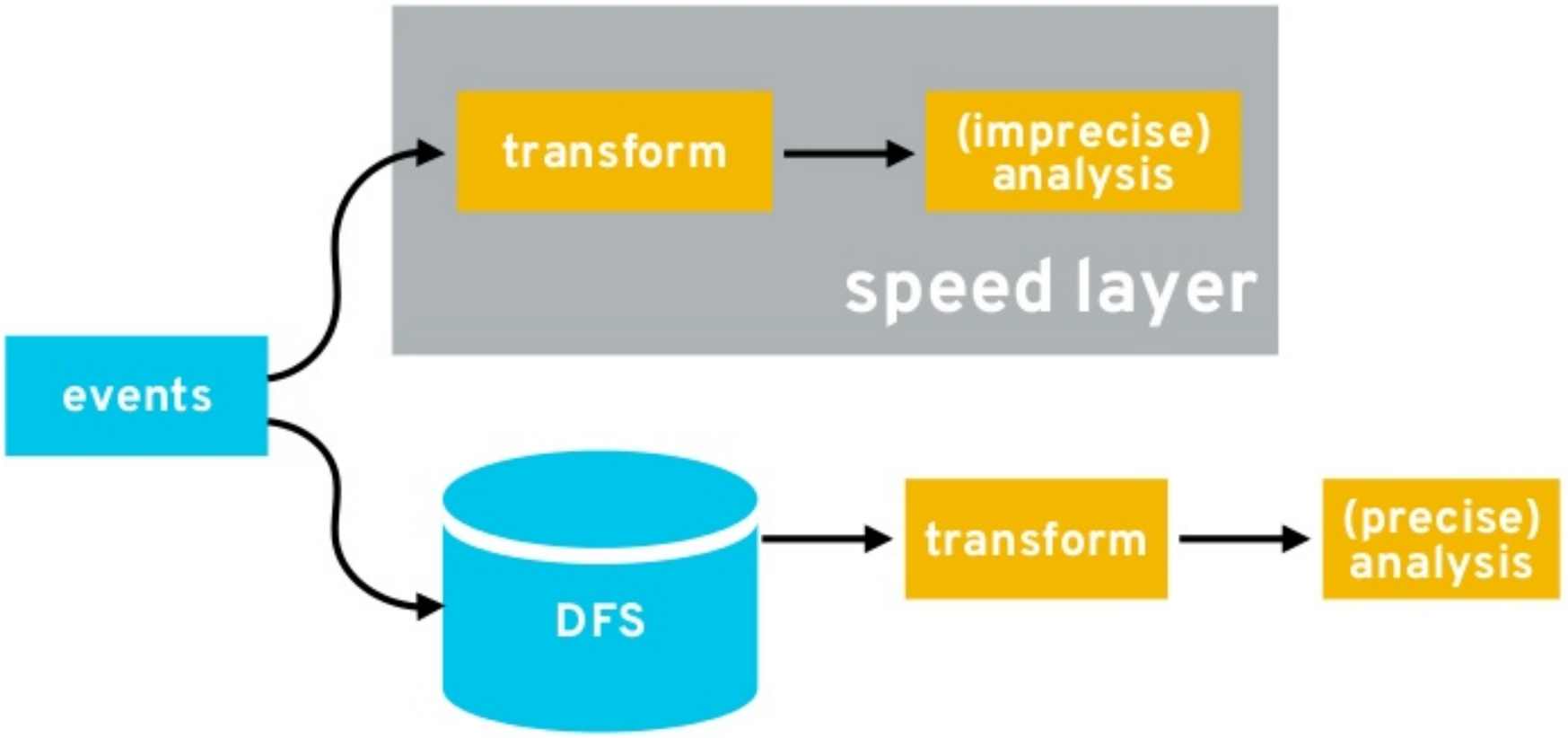

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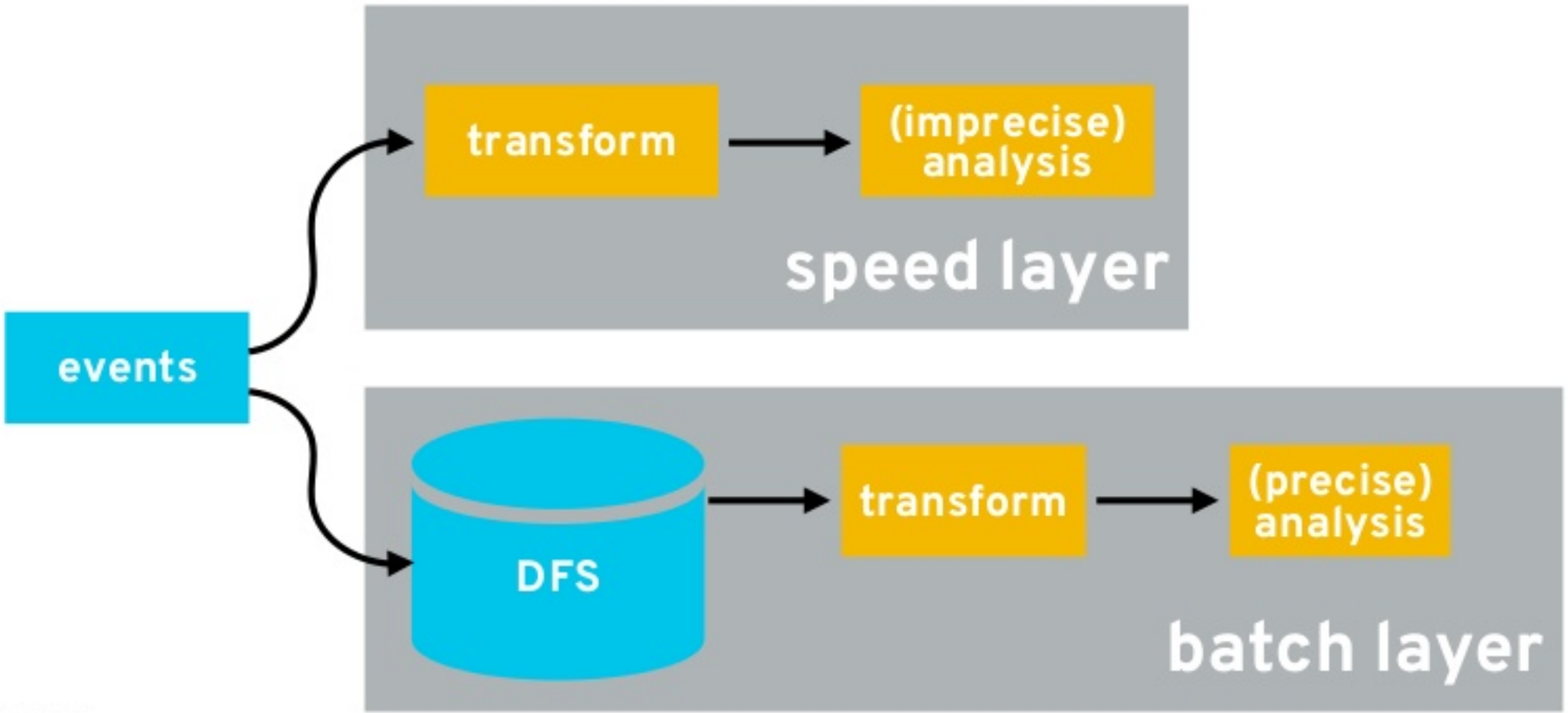
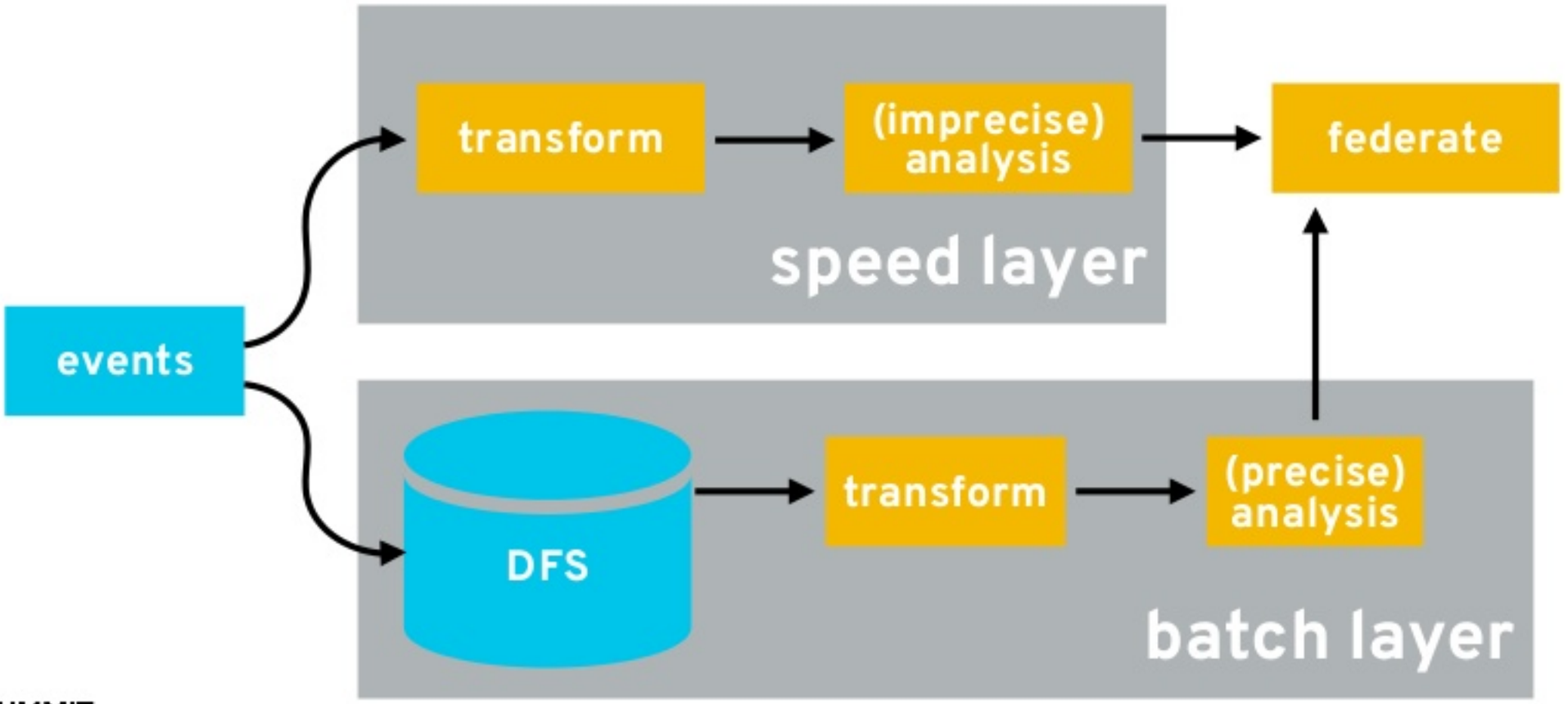
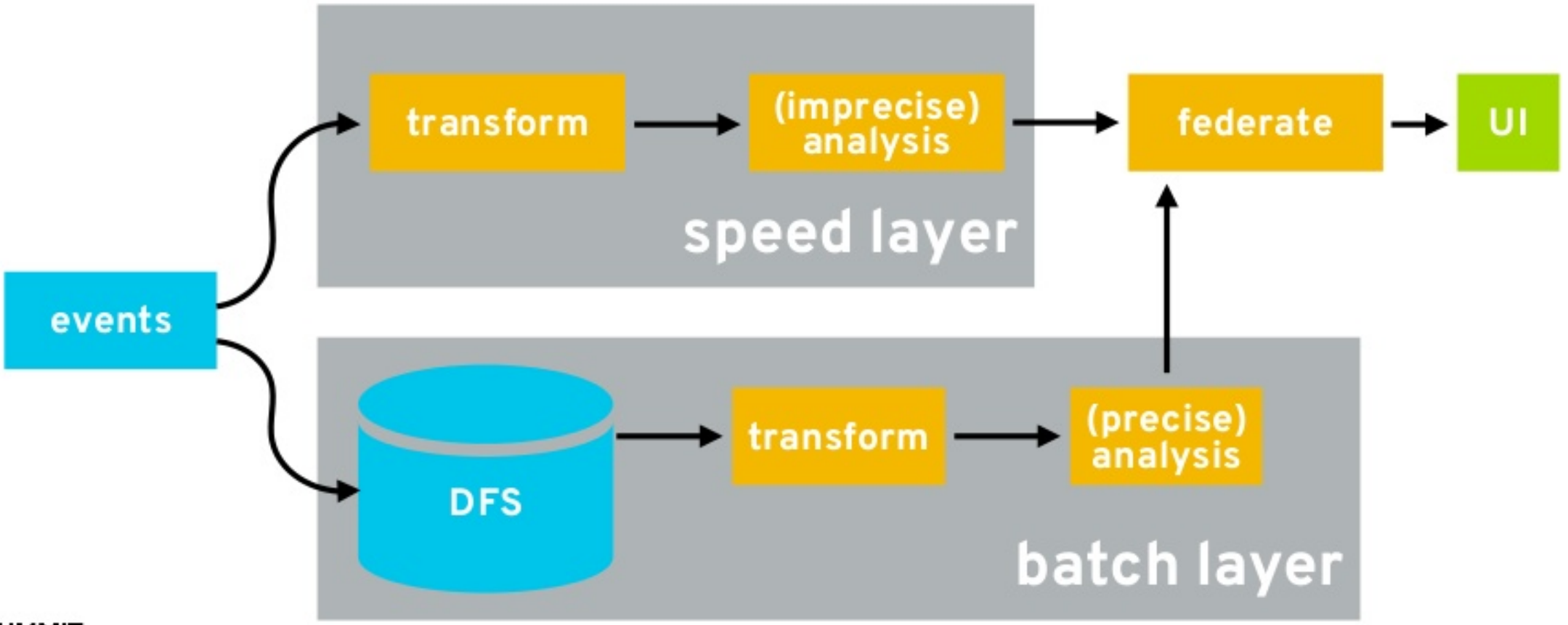


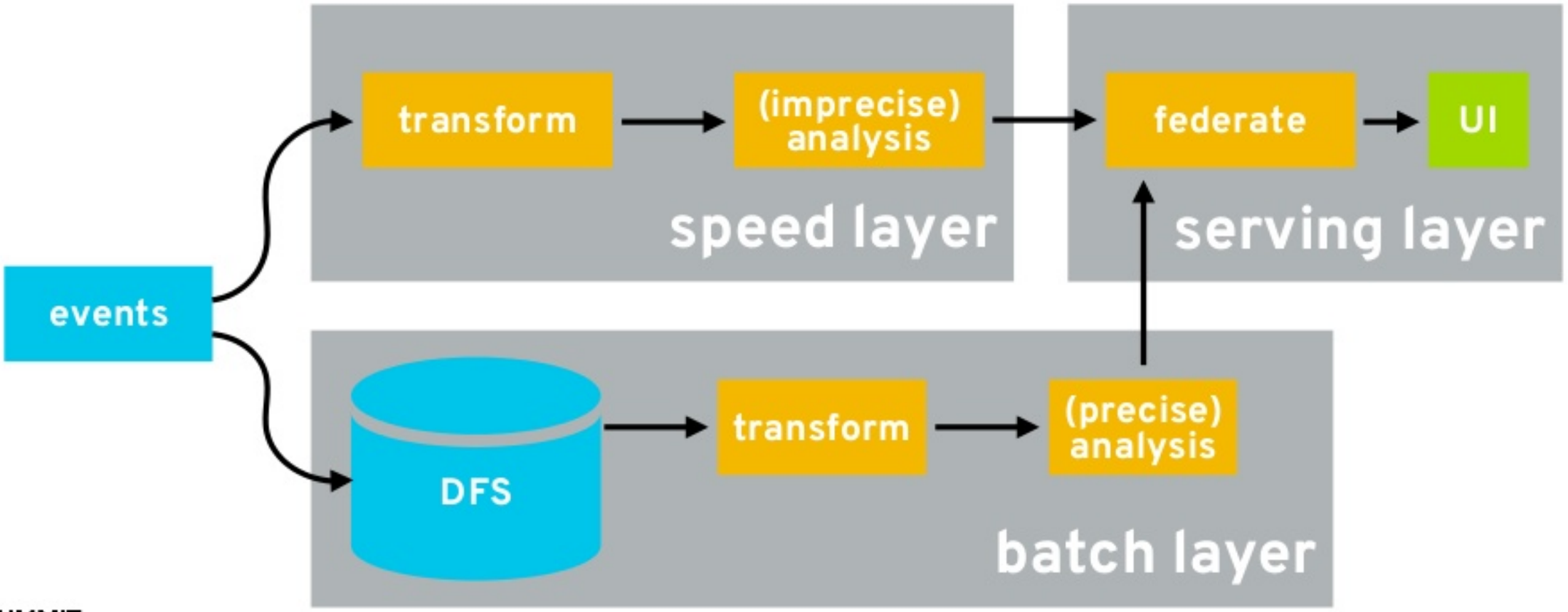
THE LAMBDA ARCHITECTURE



THE LAMBDA ARCHITECTURE



THE LAMBDA ARCHITECTURE



THE KAPPA ARCHITECTURE

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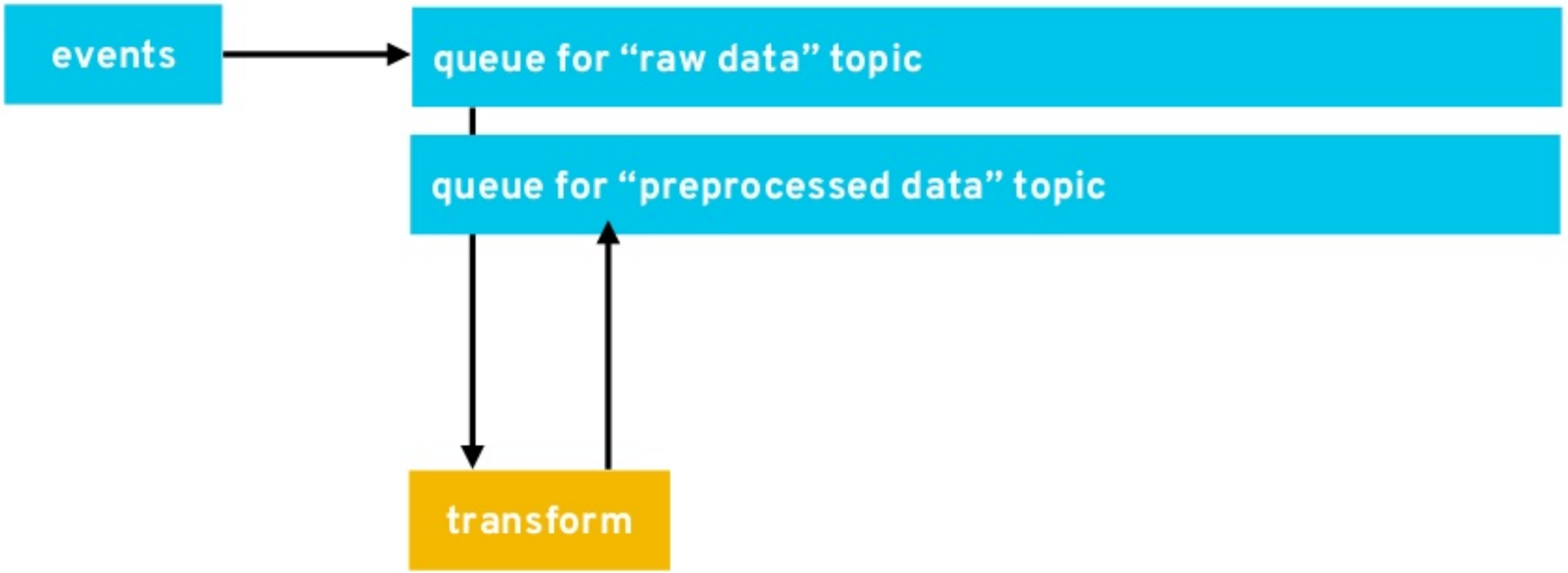

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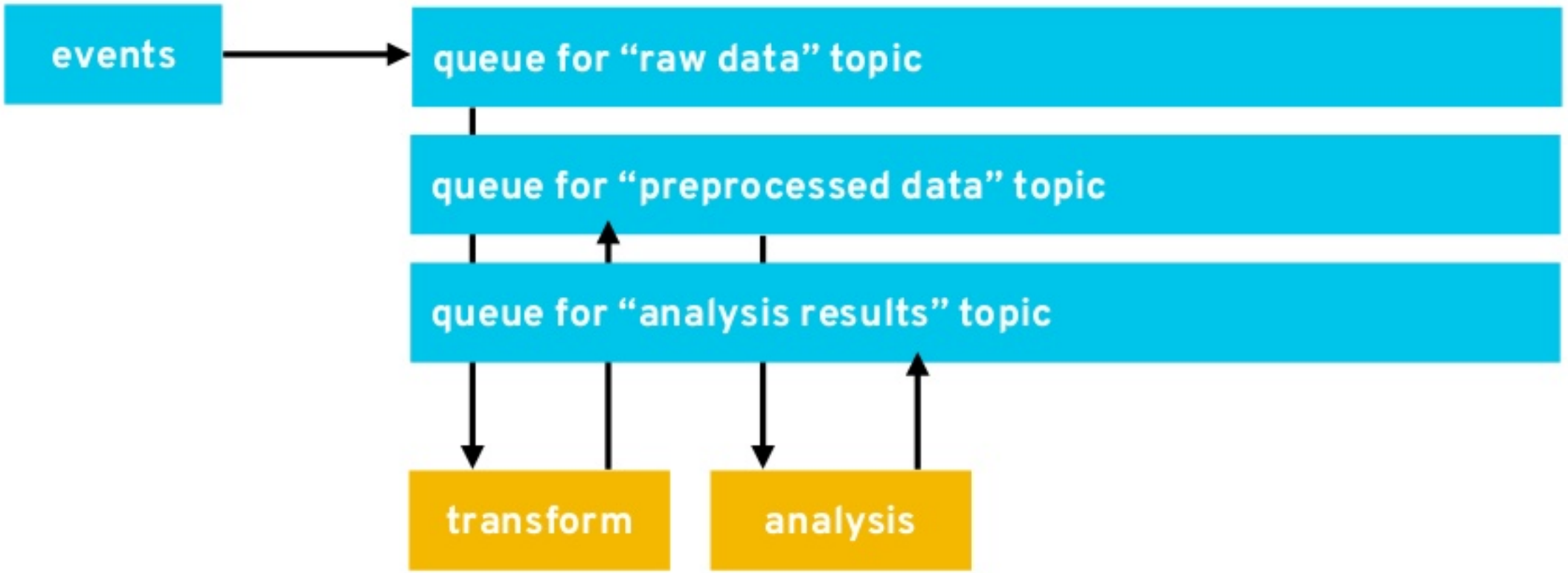
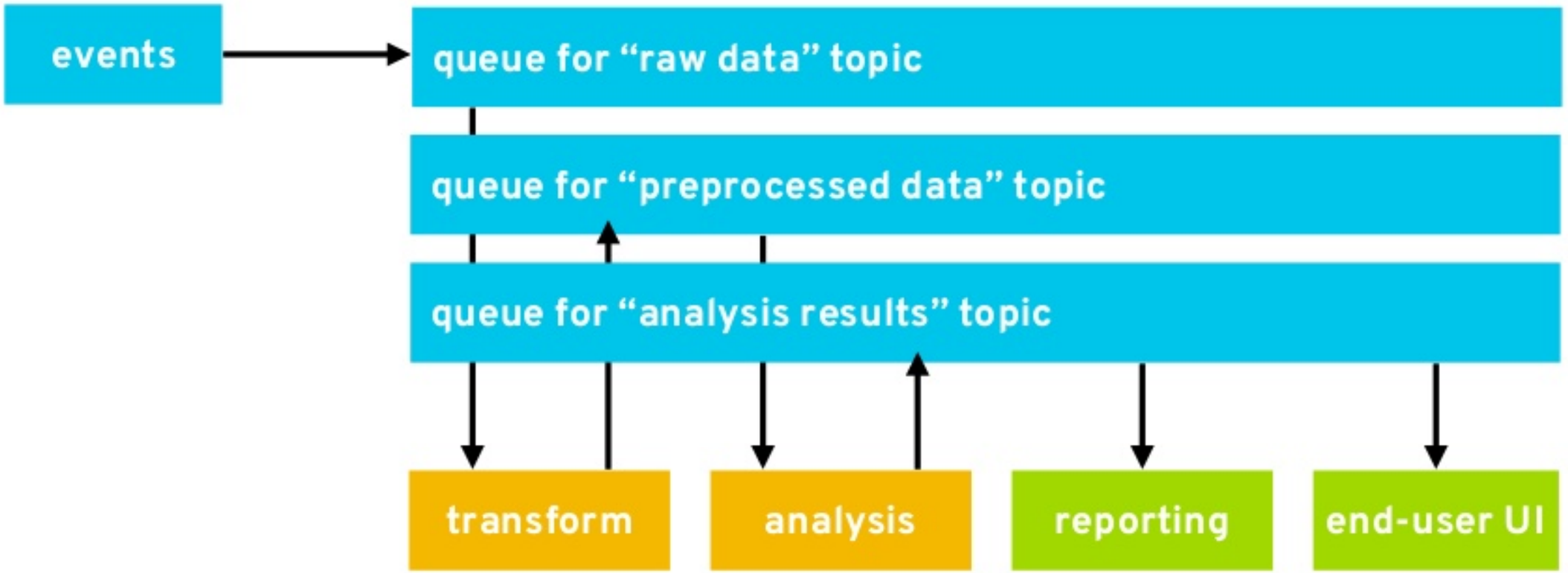
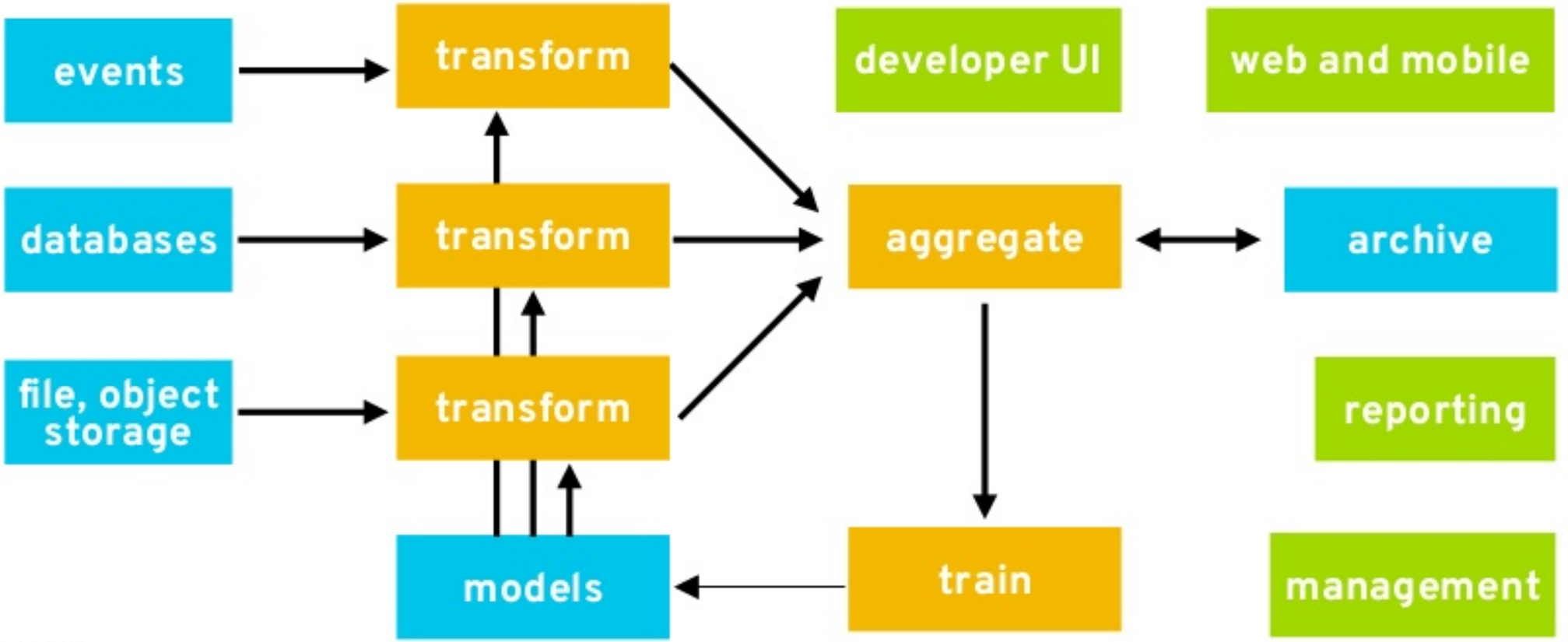


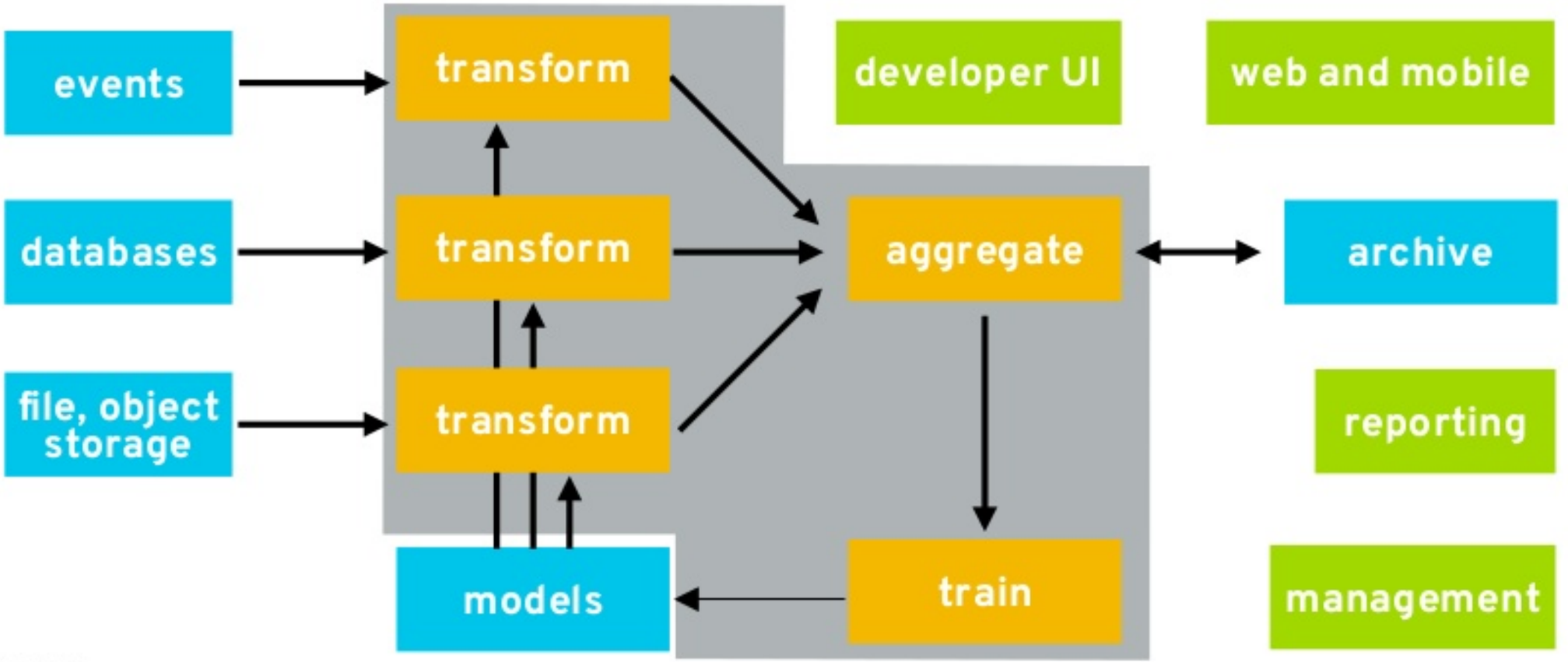
THE KAPPA ARCHITECTURE



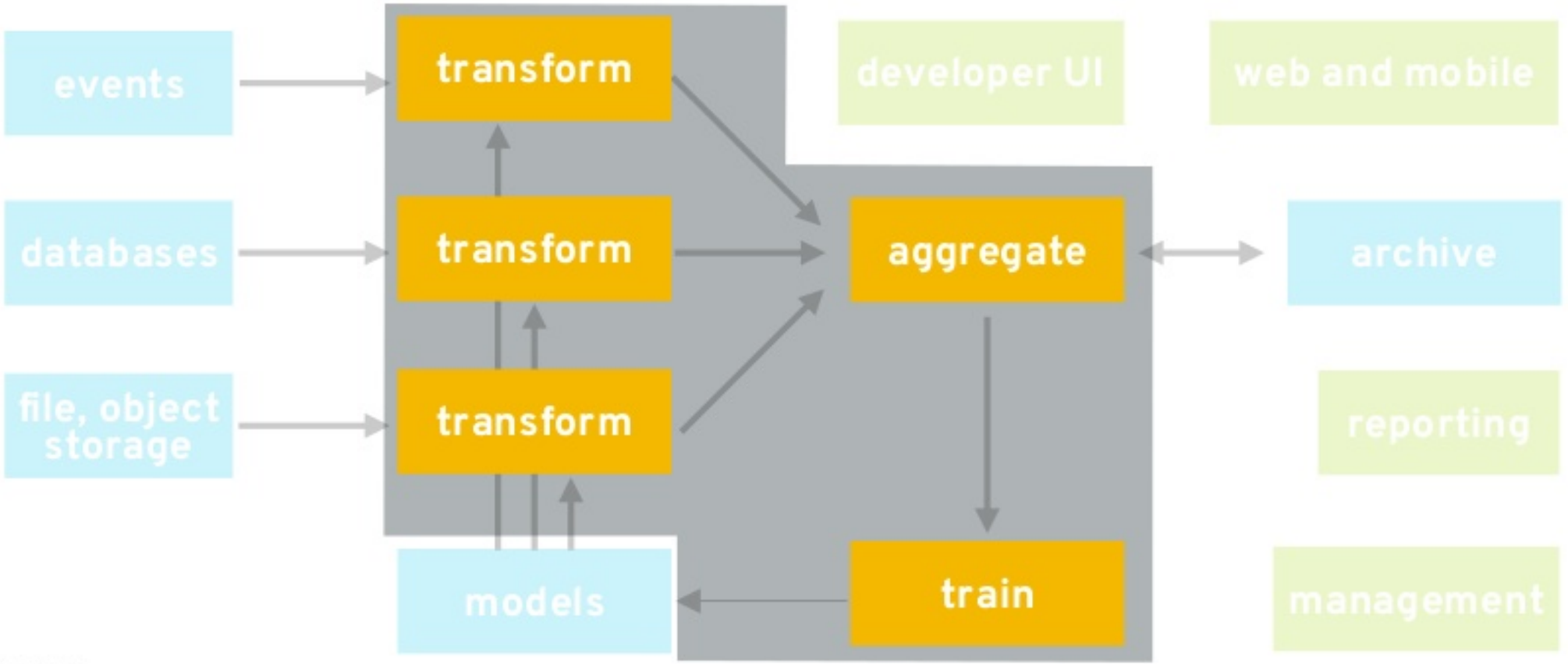
DATA FEDERATION IN THE COMPUTE LAYER



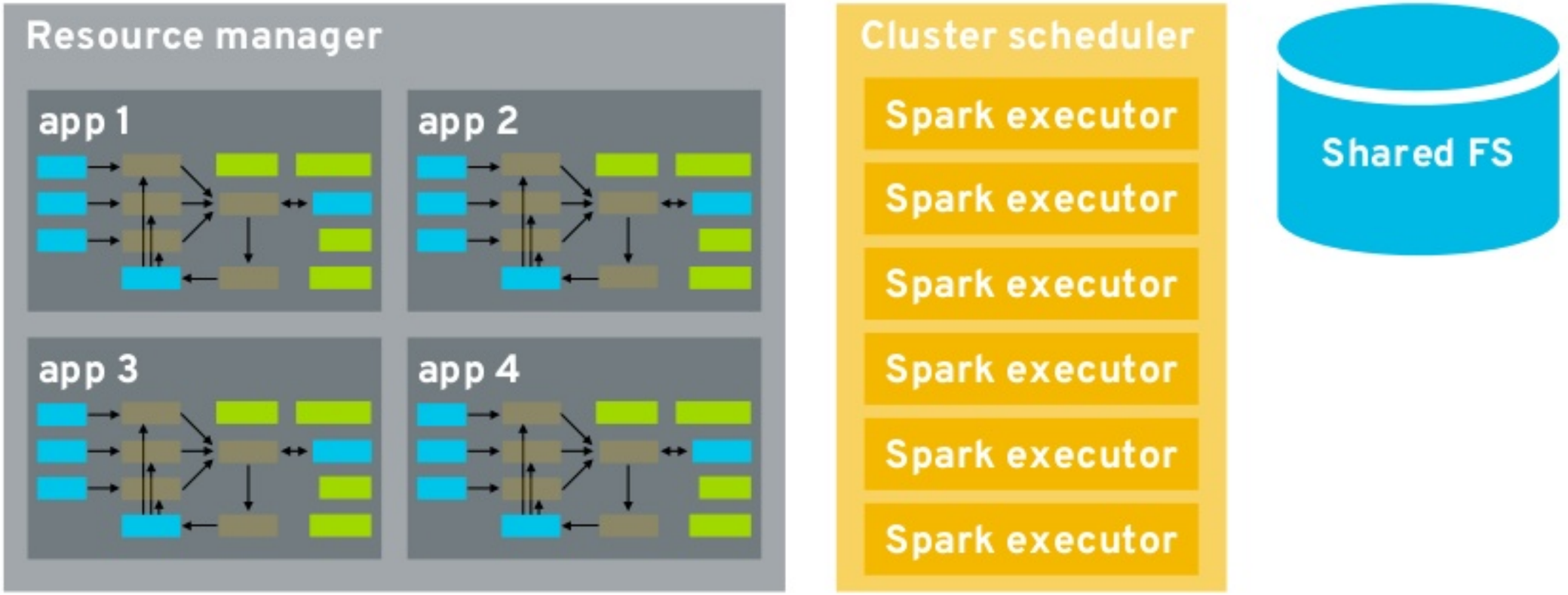
DATA FEDERATION IN THE COMPUTE LAYER



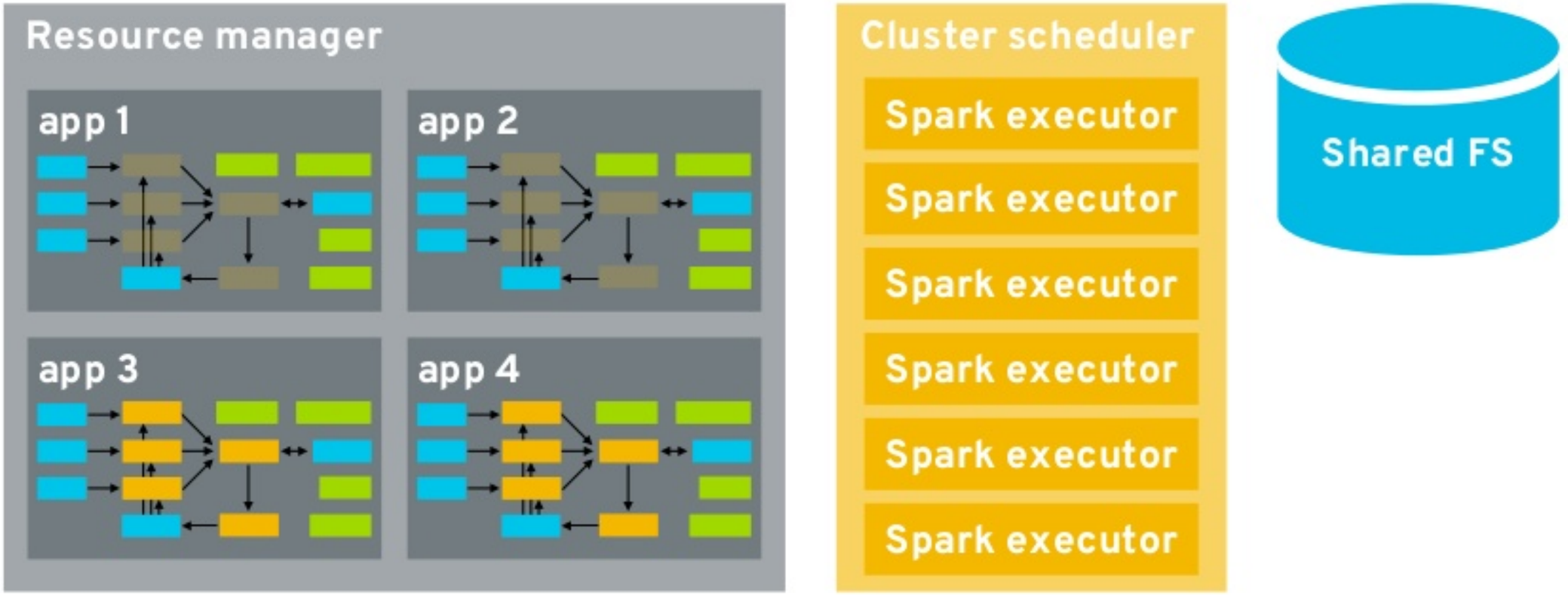
DATA FEDERATION IN THE COMPUTE LAYER



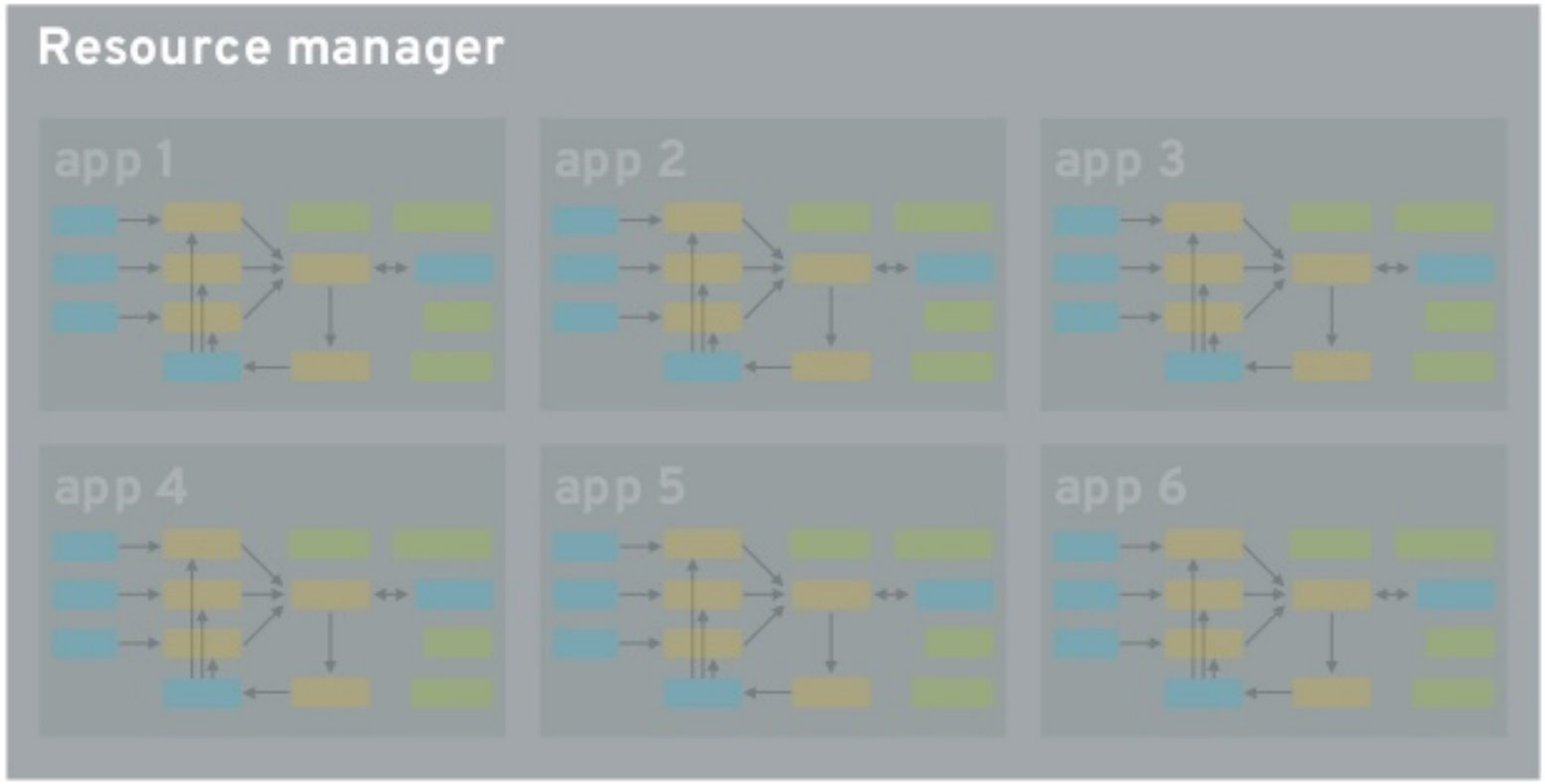
SIDEBAR: THE MONOLITHIC SPARK ANTIPATTERN



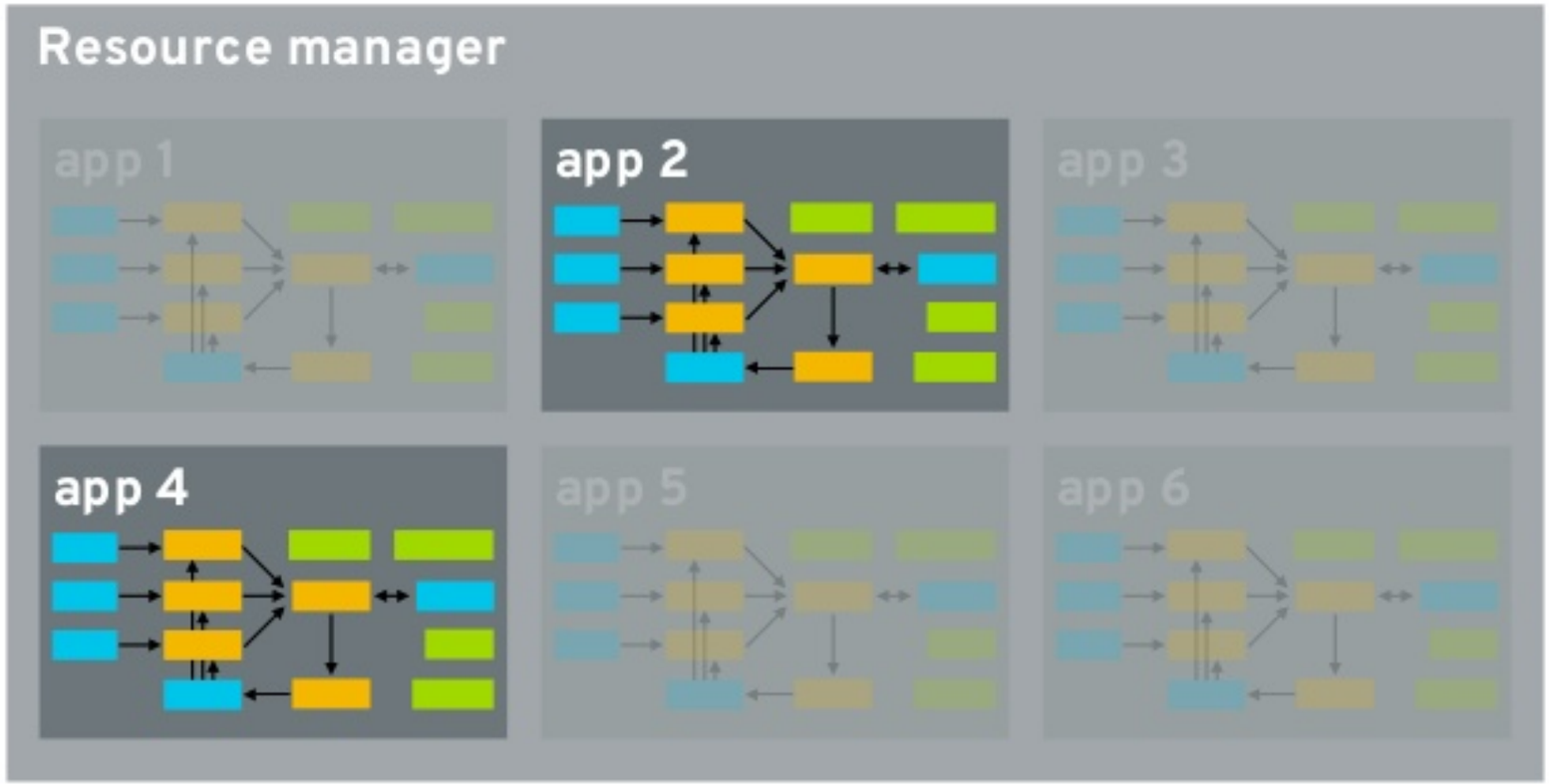
SIDEBAR: THE MONOLITHIC SPARK ANTIPATTERN



ONE CLUSTER PER APPLICATION

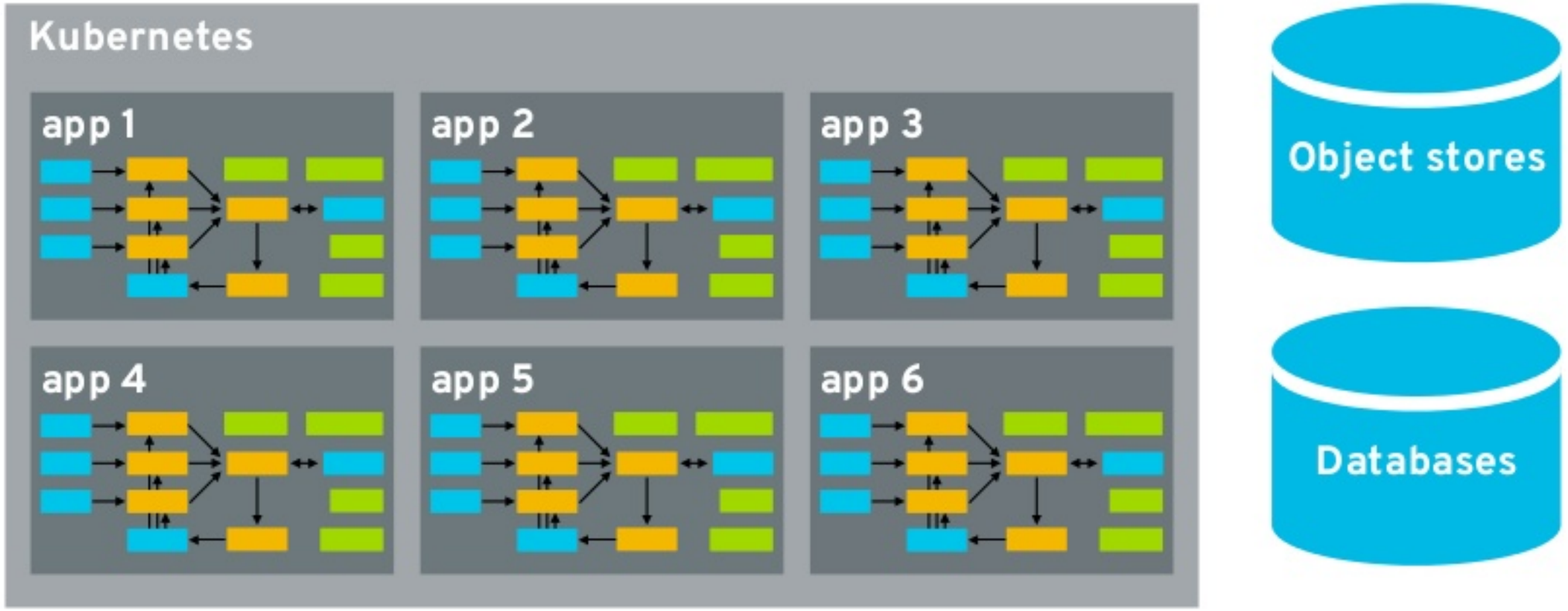


ONE CLUSTER PER APPLICATION

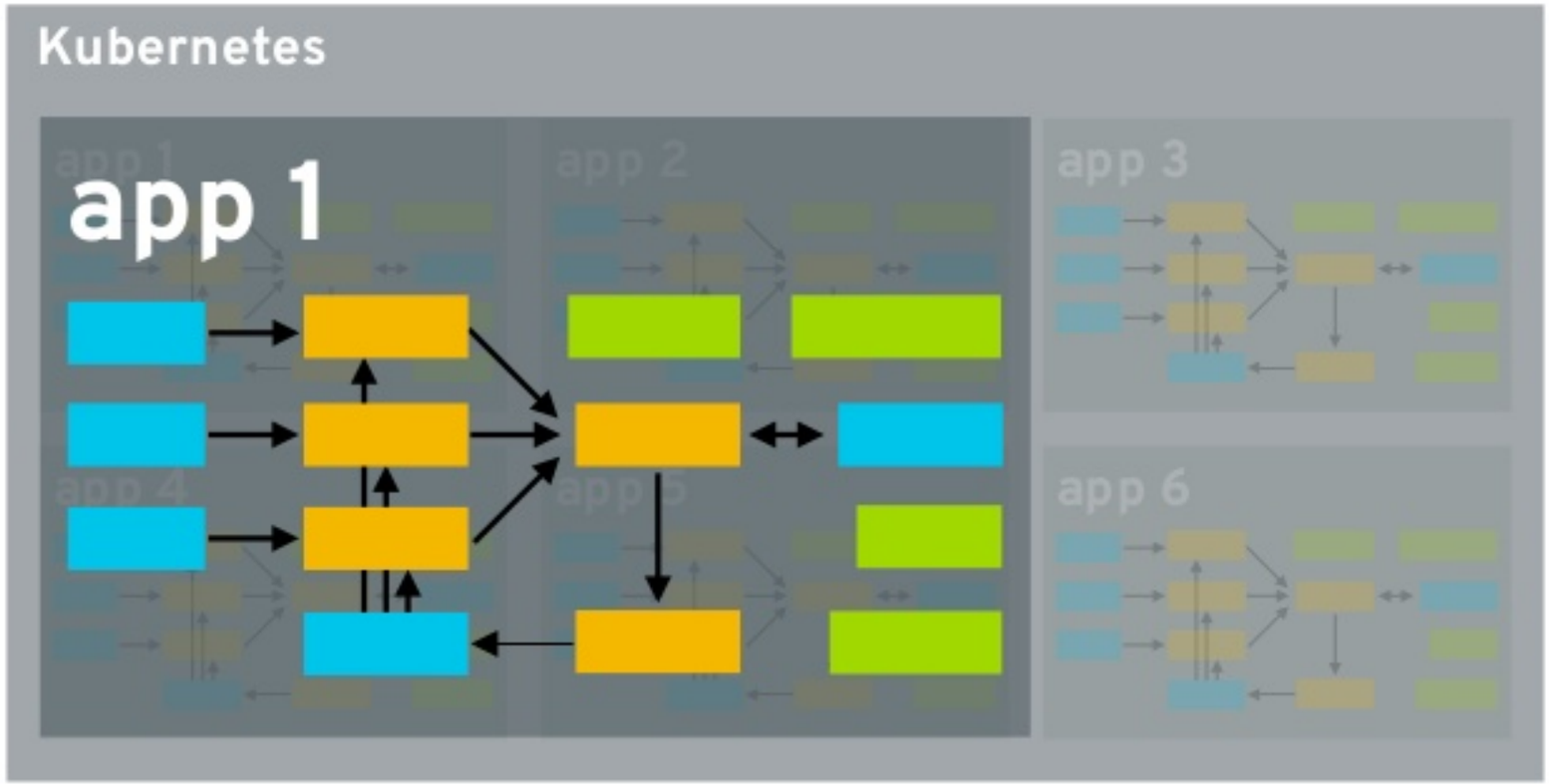


PRACTICALITIES AND POTENTIAL PITFALLS

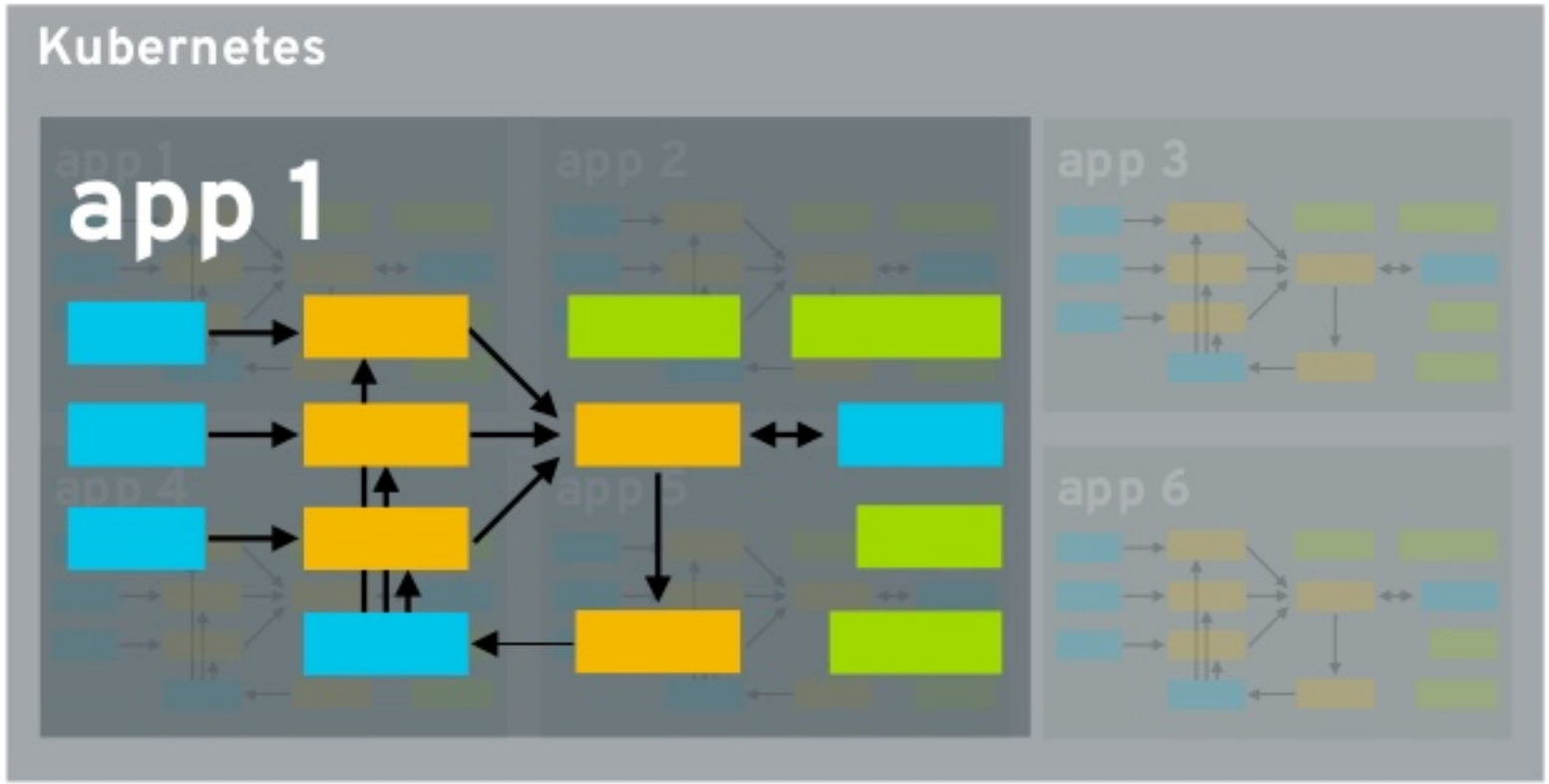
SCHEDULING


Kubernetes
app 1
app 2
app 3
app 4
app 5
app 6
Object stores
Databases

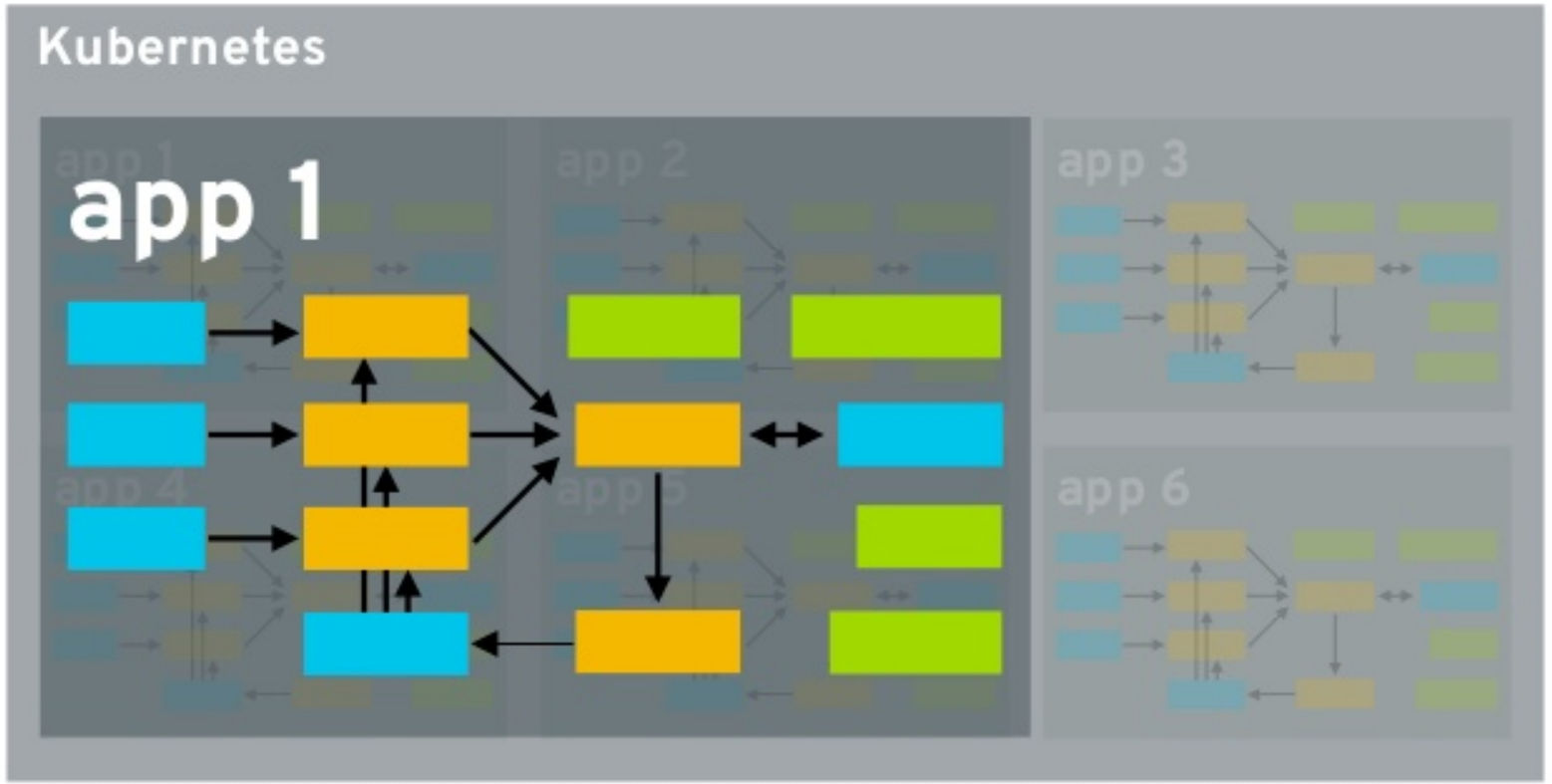
SCHEDULING



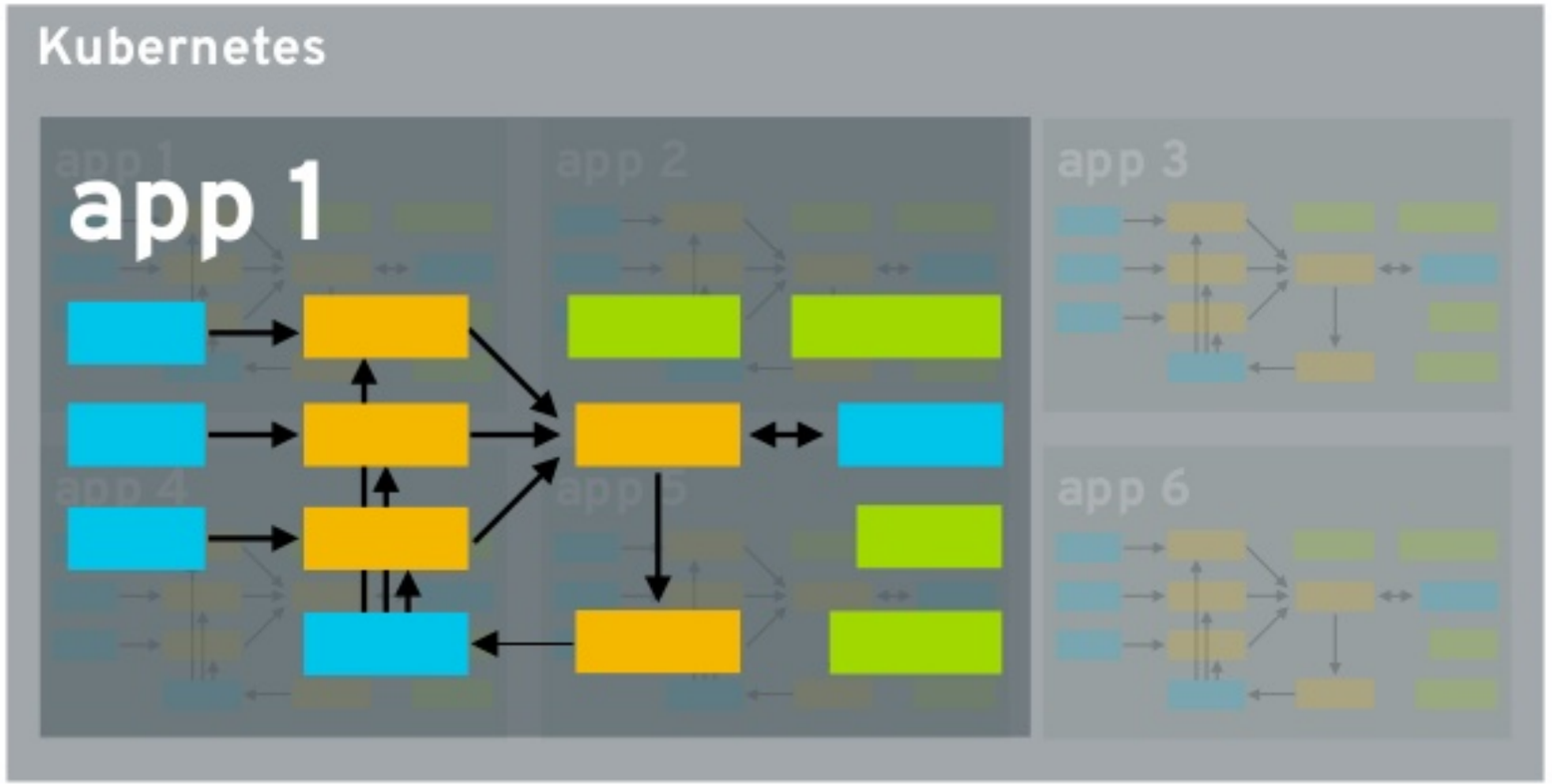
SCHEDULING



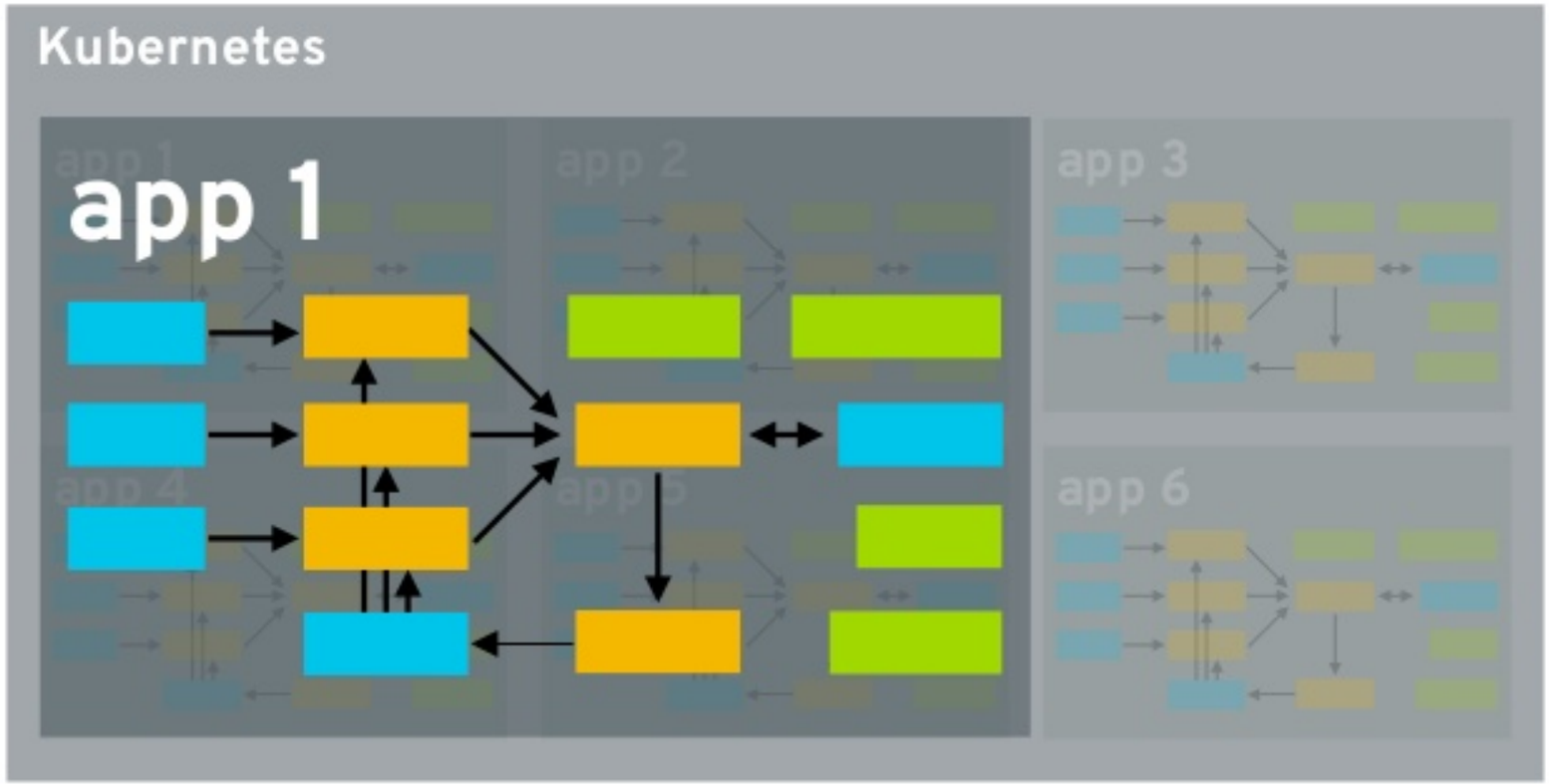
SCHEDULING



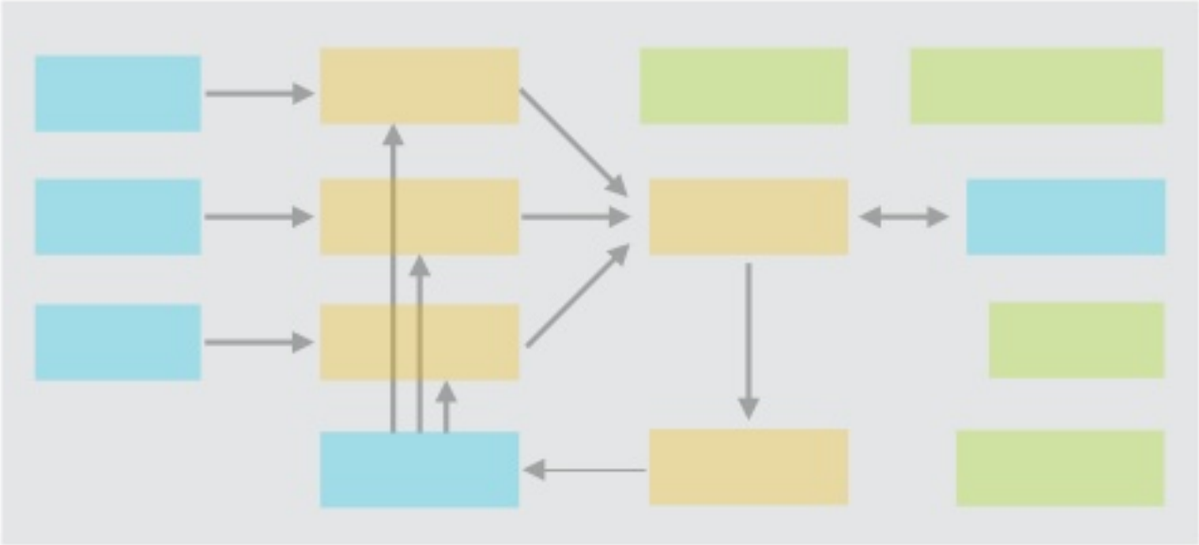
SCHEDULING



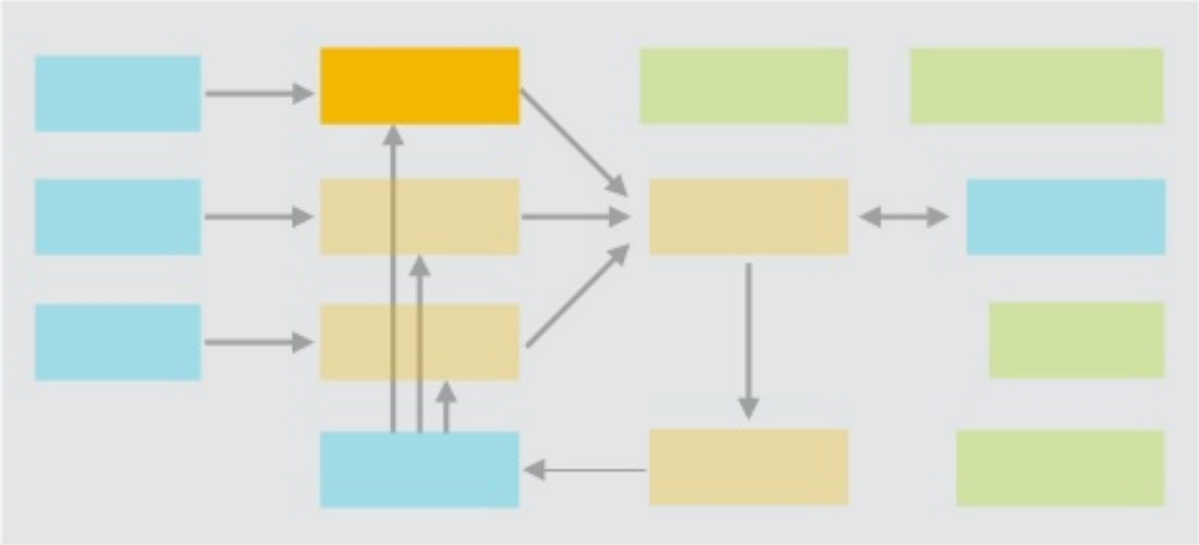
SCHEDULING



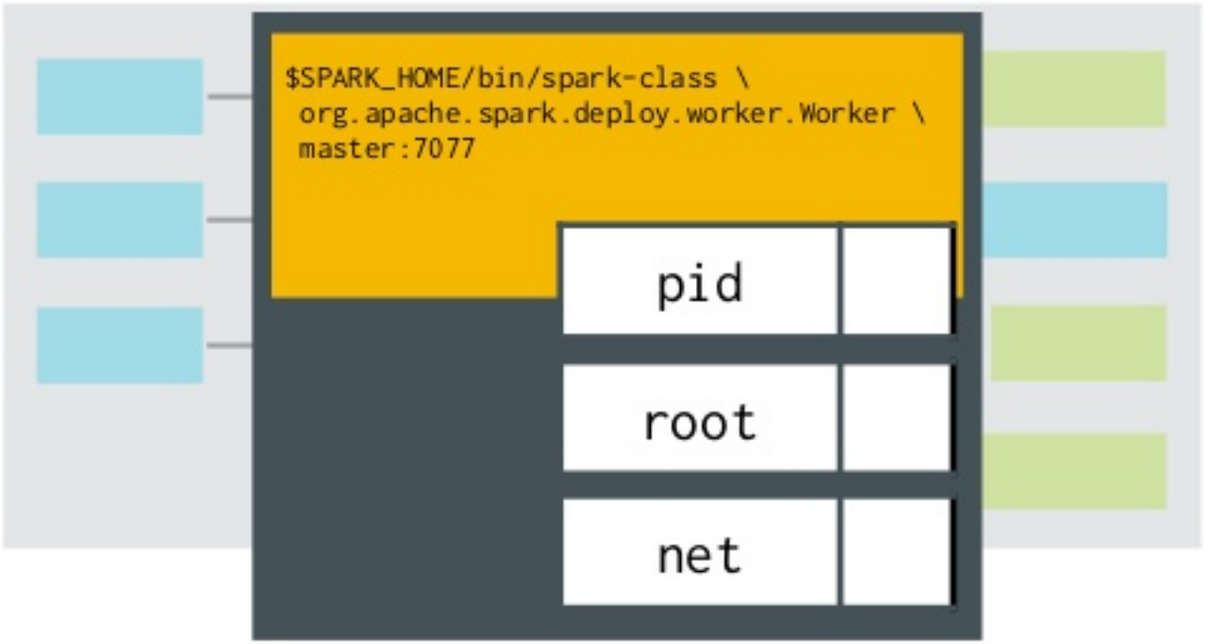
SECURITY



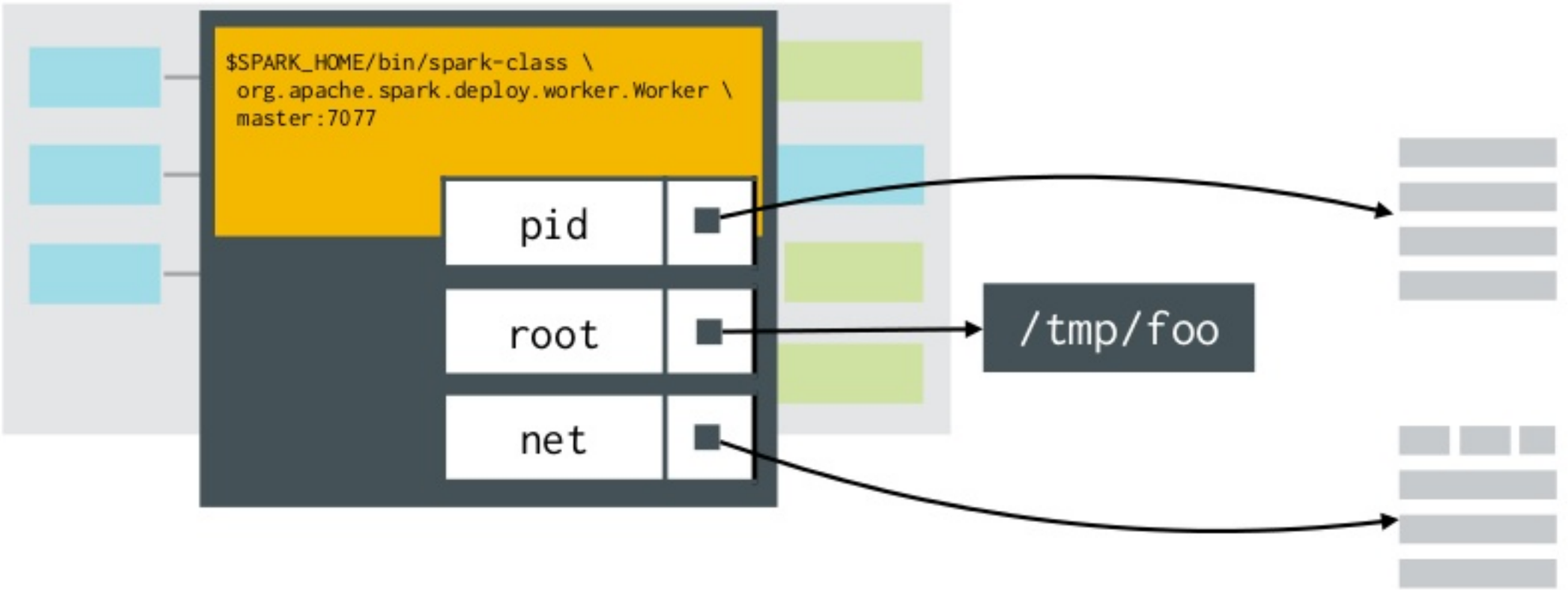
SECURITY



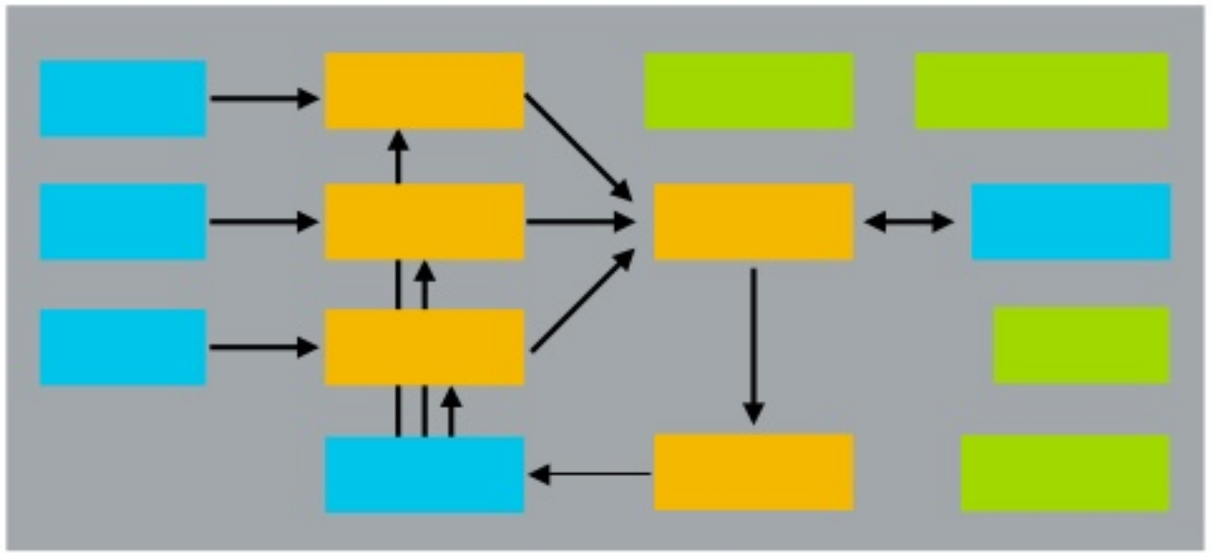
SECURITY


$SPARK_HOME/bin/spark-class \
org.apache.spark.deploy.worker.Worker \
master:7077
pid
root
net

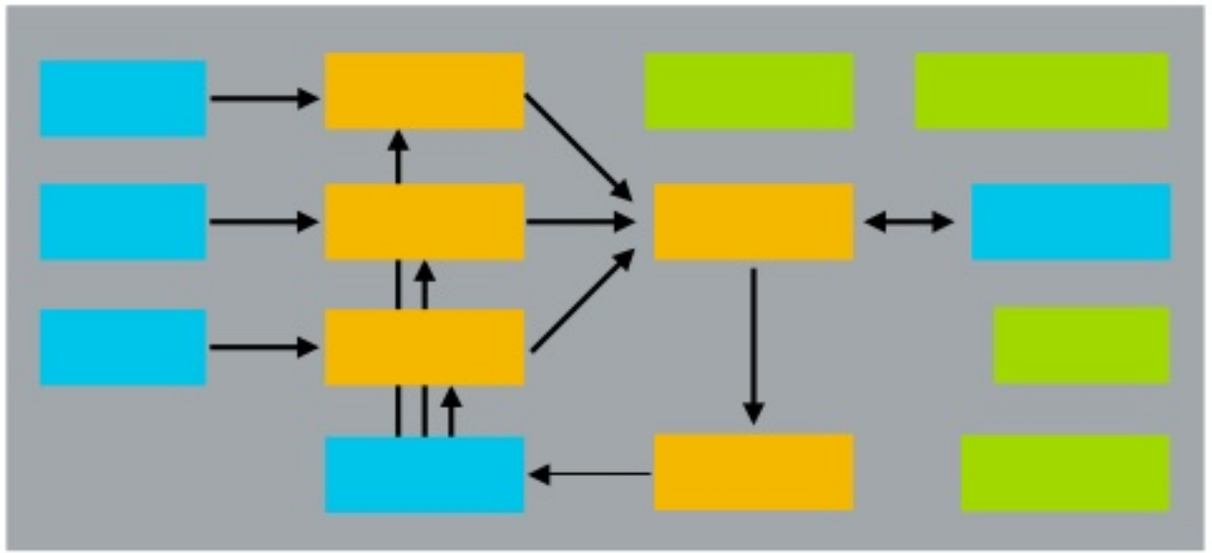
SECURITY


$SPARK_HOME/bin/spark-class \
org.apache.spark.deploy.worker.Worker \
master:7077
pid
root
net
/tmp/foo

SECURITY

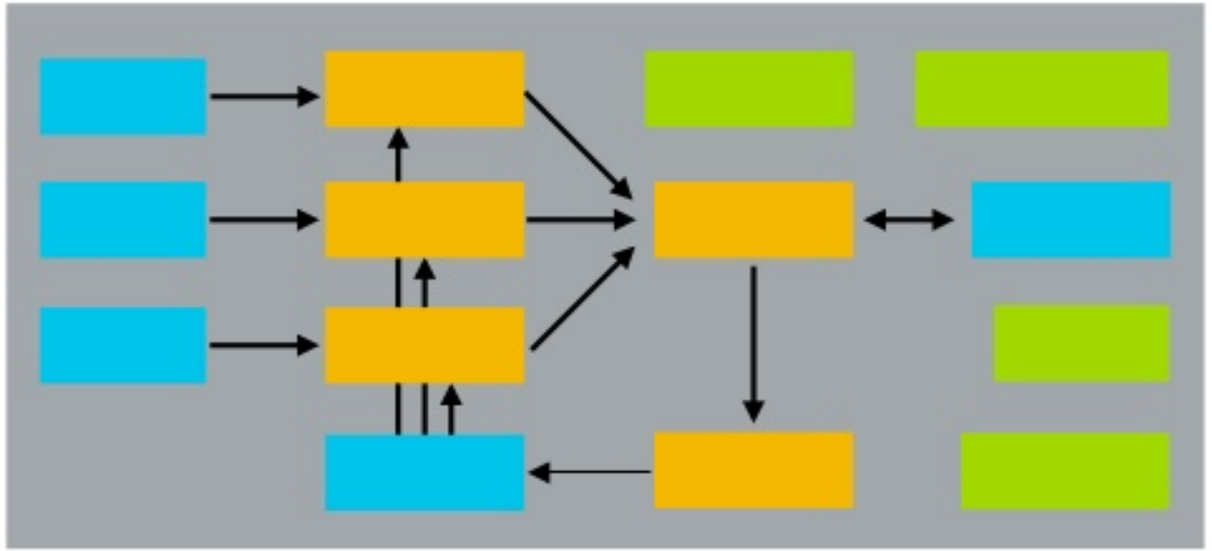


SECURITY



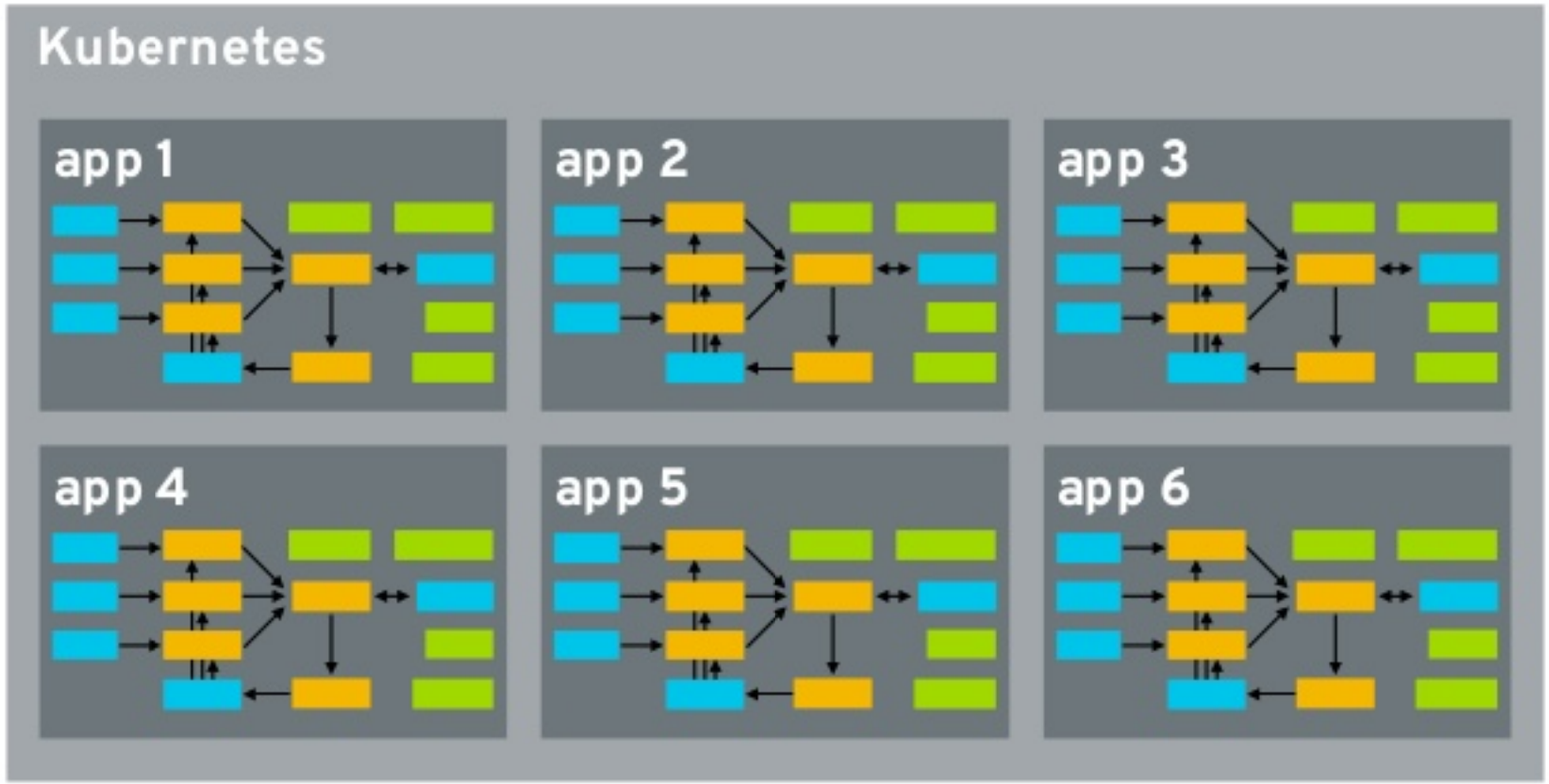
k8s namespace

SECURITY

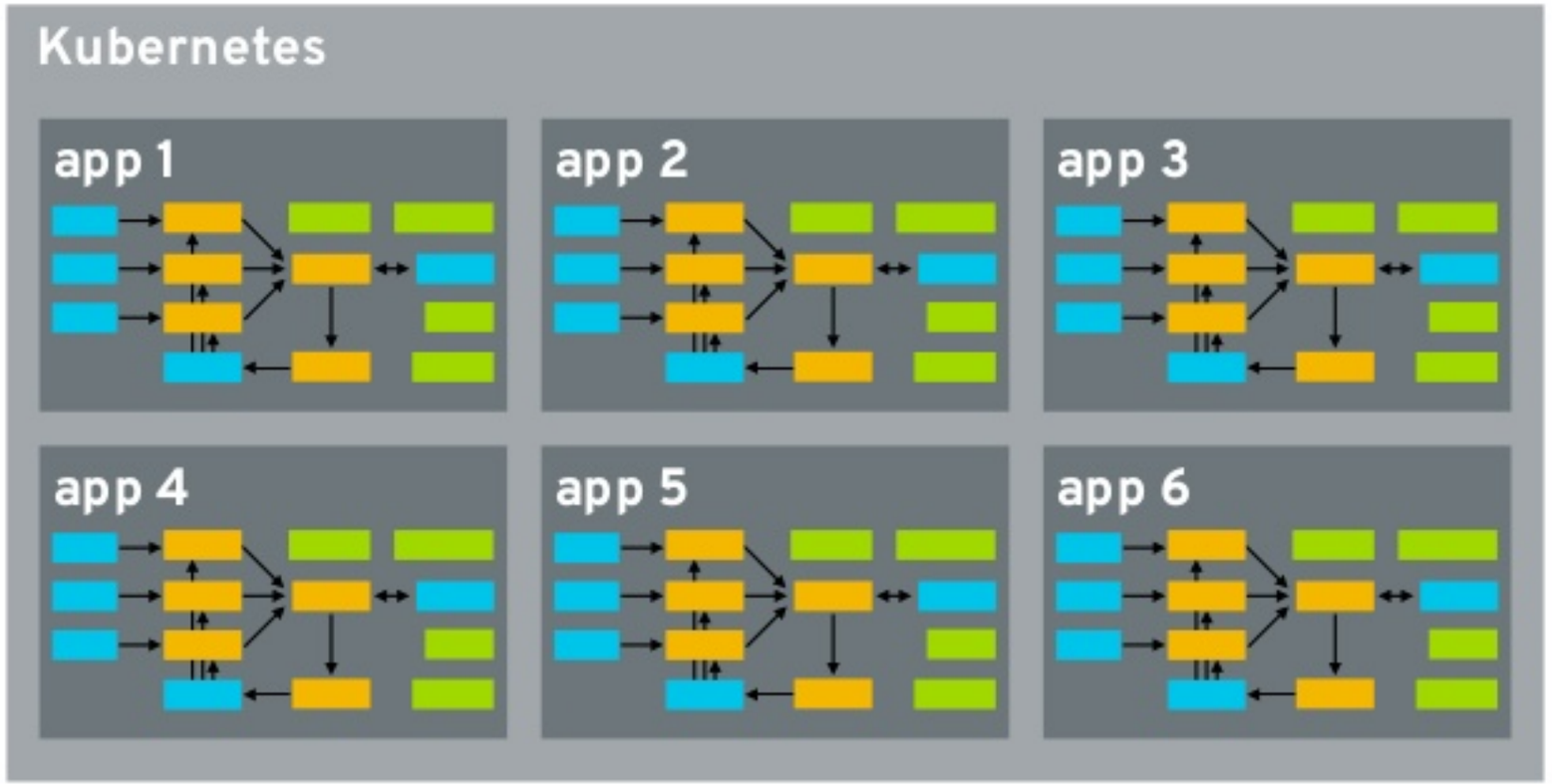


k8s namespace*

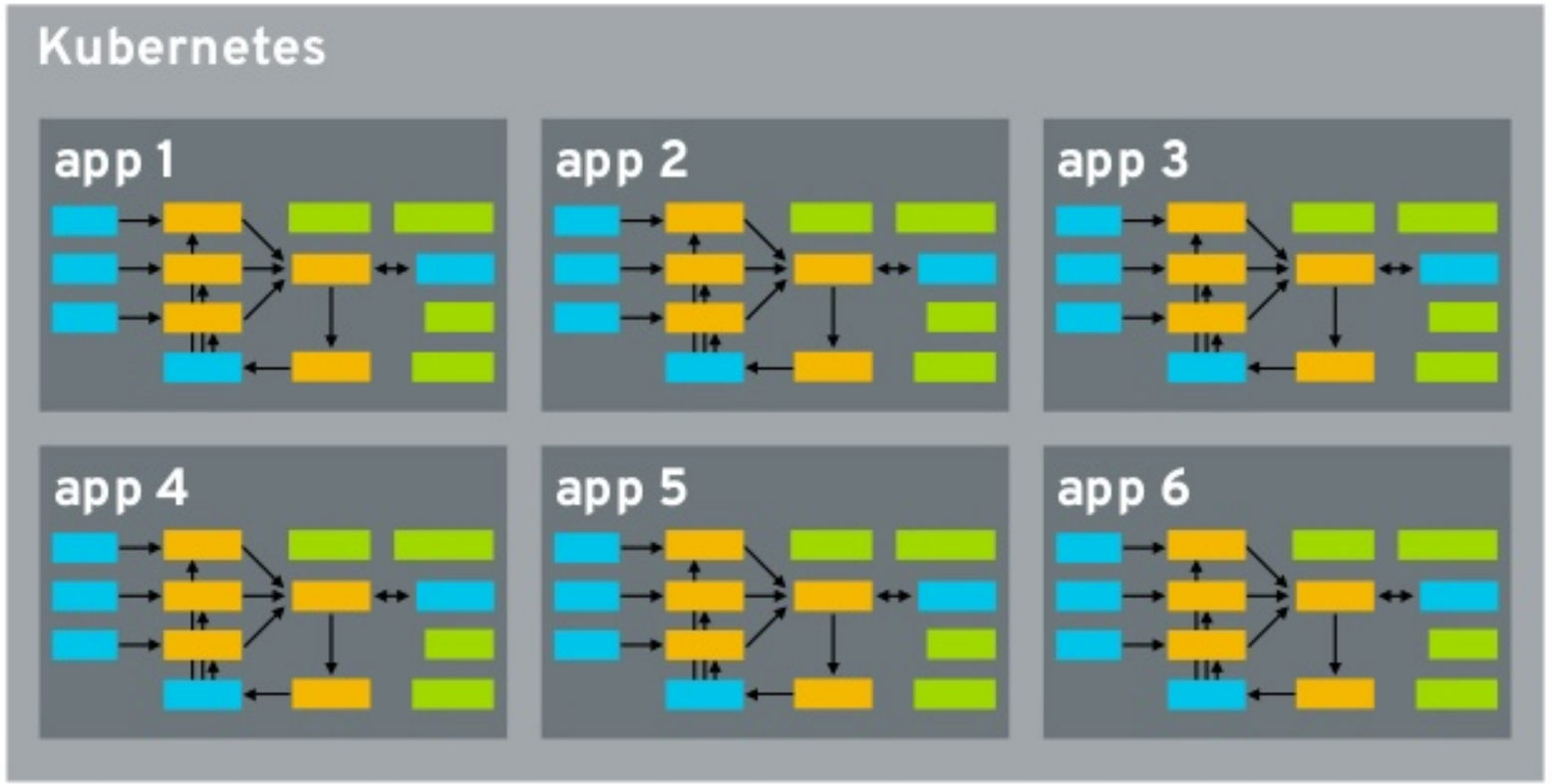
STORAGE



STORAGE

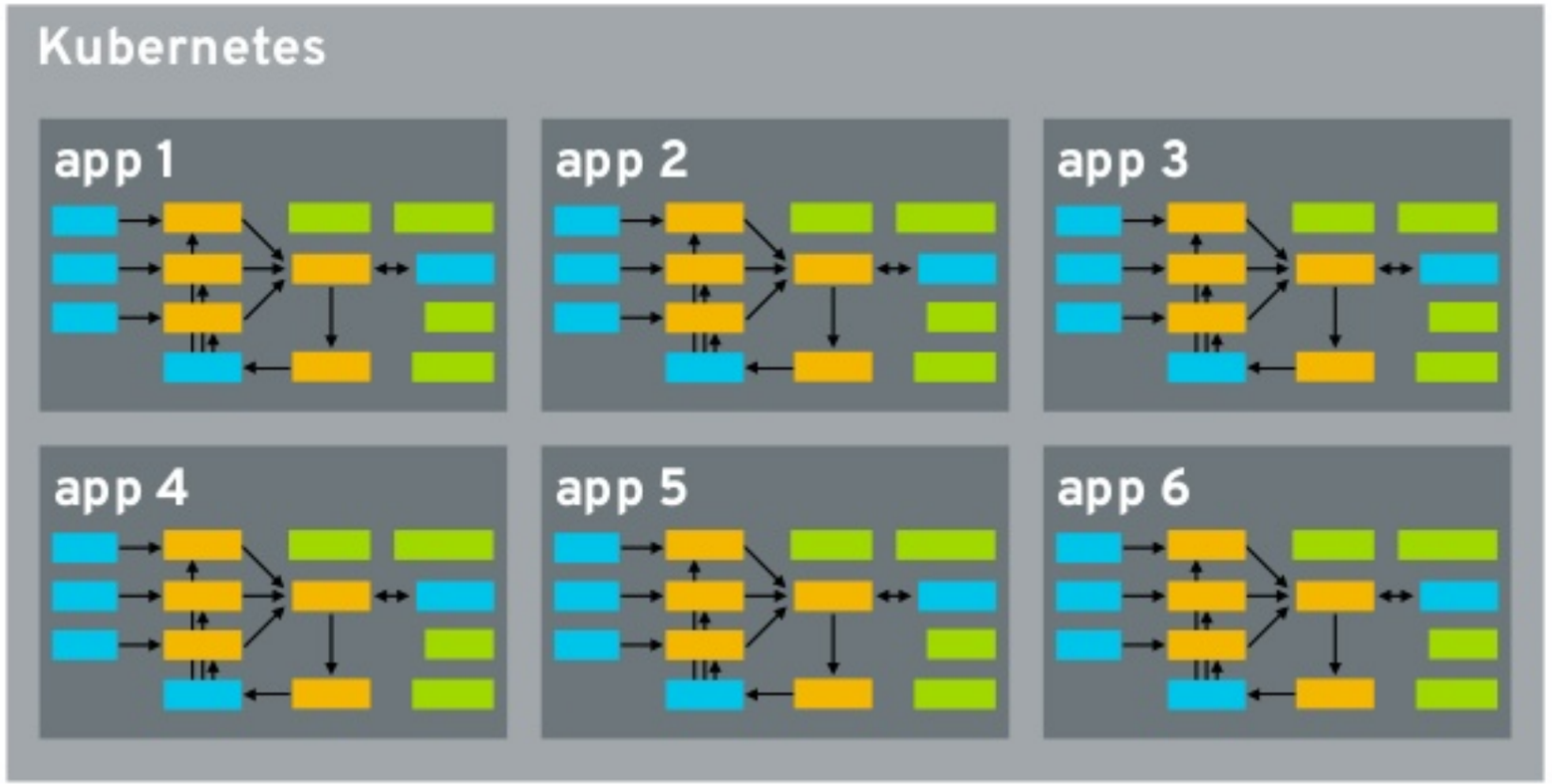


STORAGE



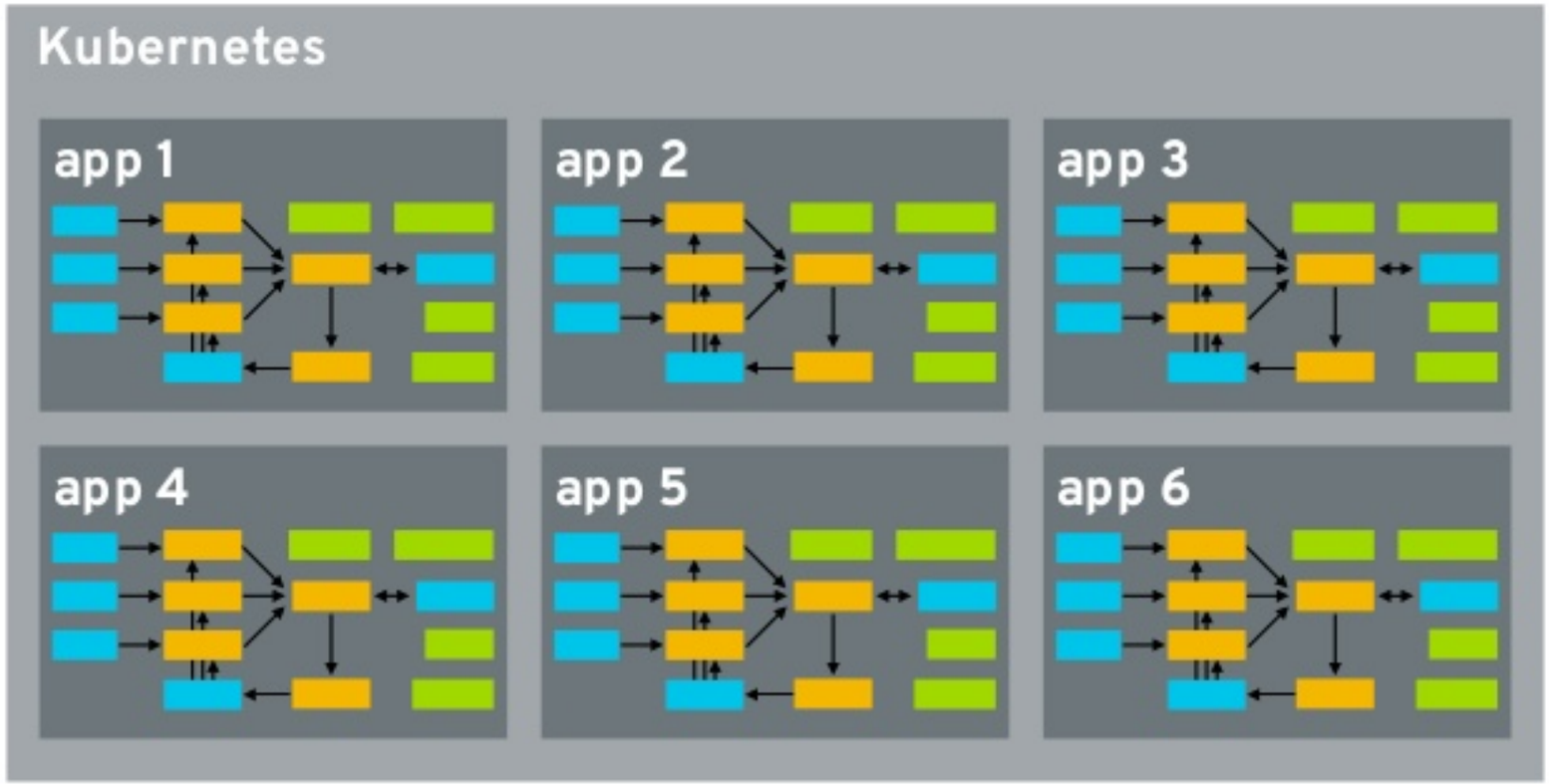
- ✓ familiar interface
- ✓ interoperability with other programs

STORAGE



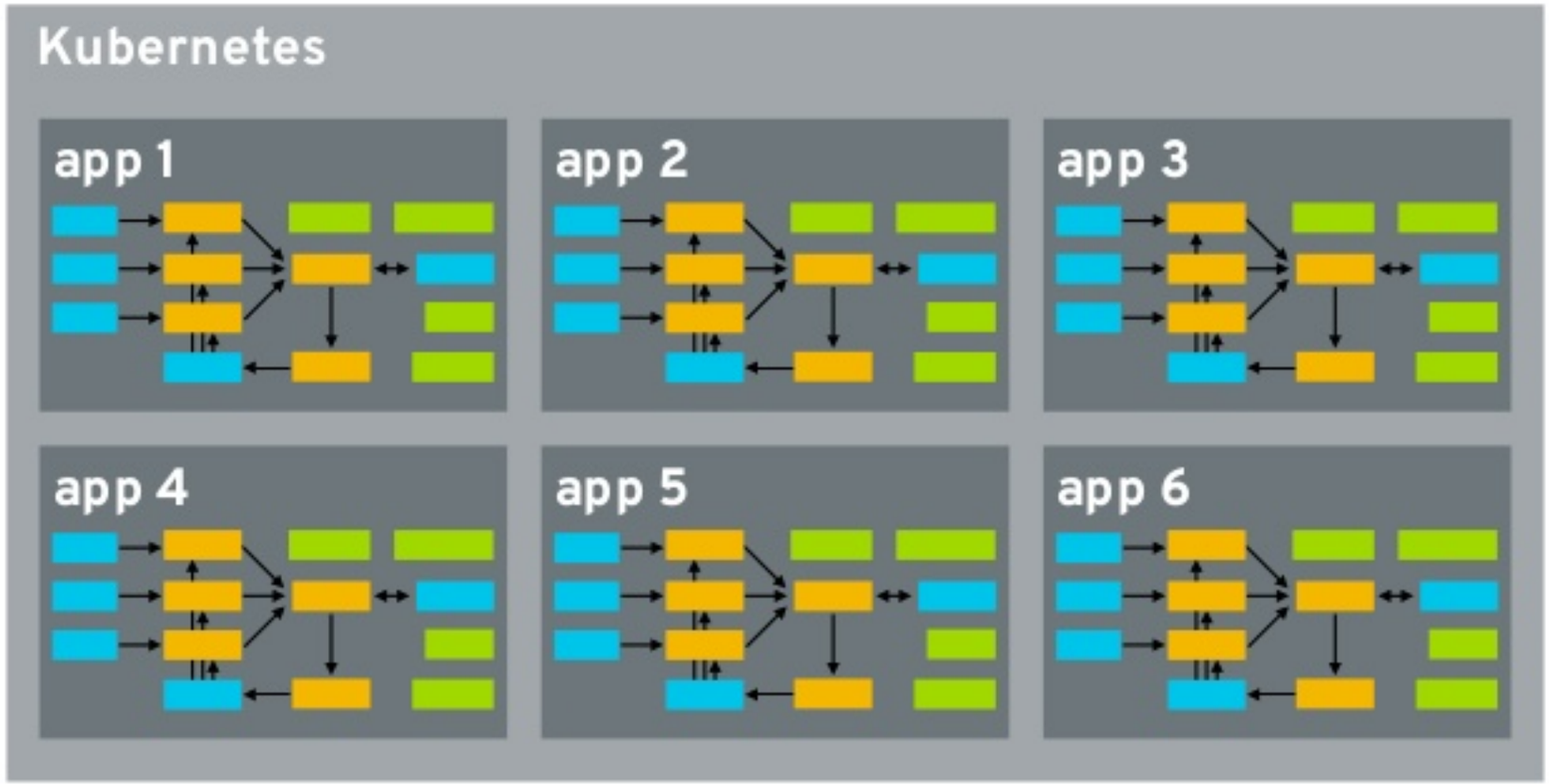
- ✓ familiar interface
- ✓ interoperability with other programs
- ✗ unnecessary semantic guarantees
- ✗ difficult to manage

STORAGE


Kubernetes
app 1
app 2
app 3
app 4
app 5
app 6

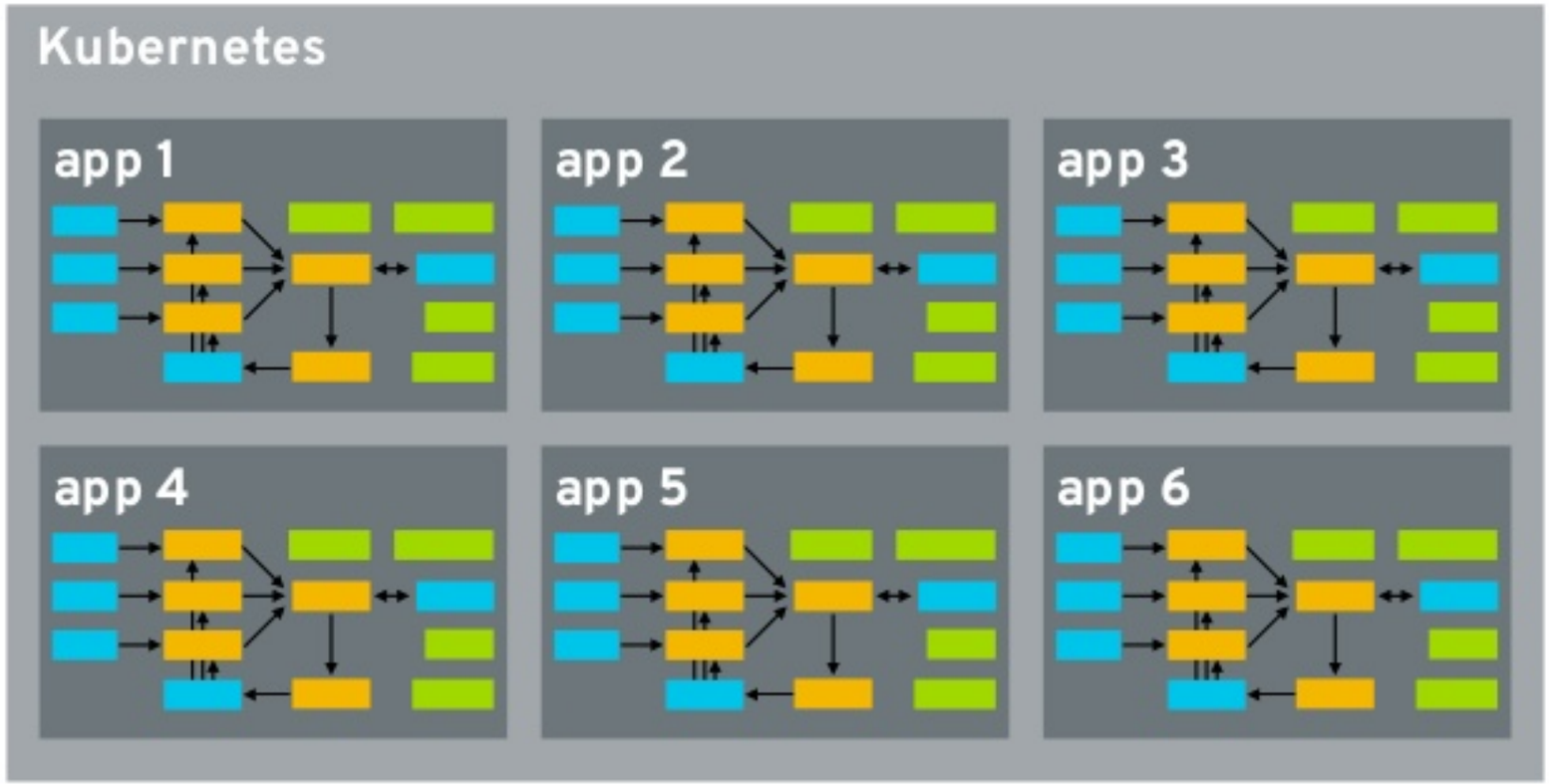

HDFS
HDFS
HDFS
HDFS
HDFS
HDFS

STORAGE



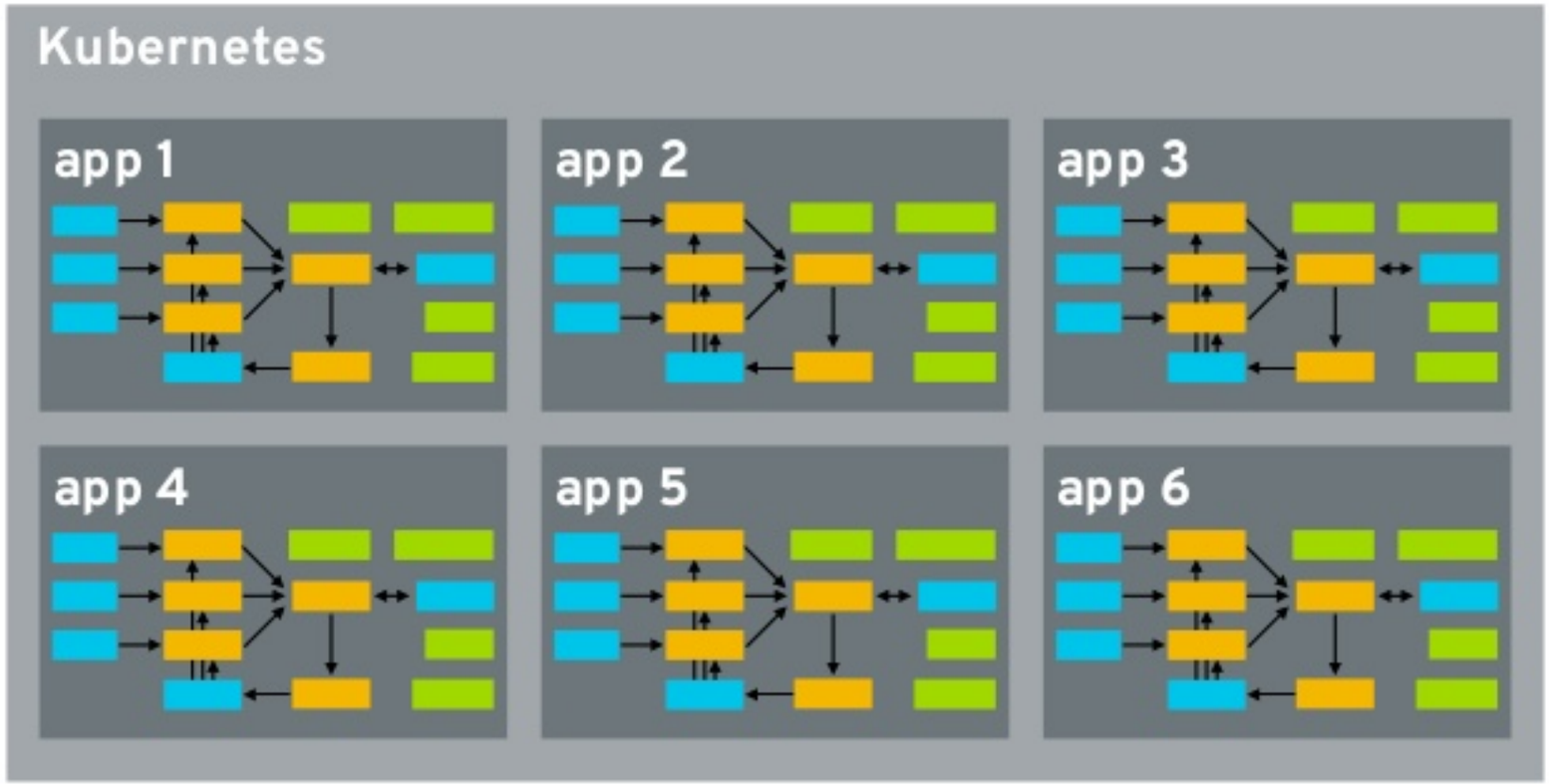
✓ support for legacy Hadoop installations

STORAGE

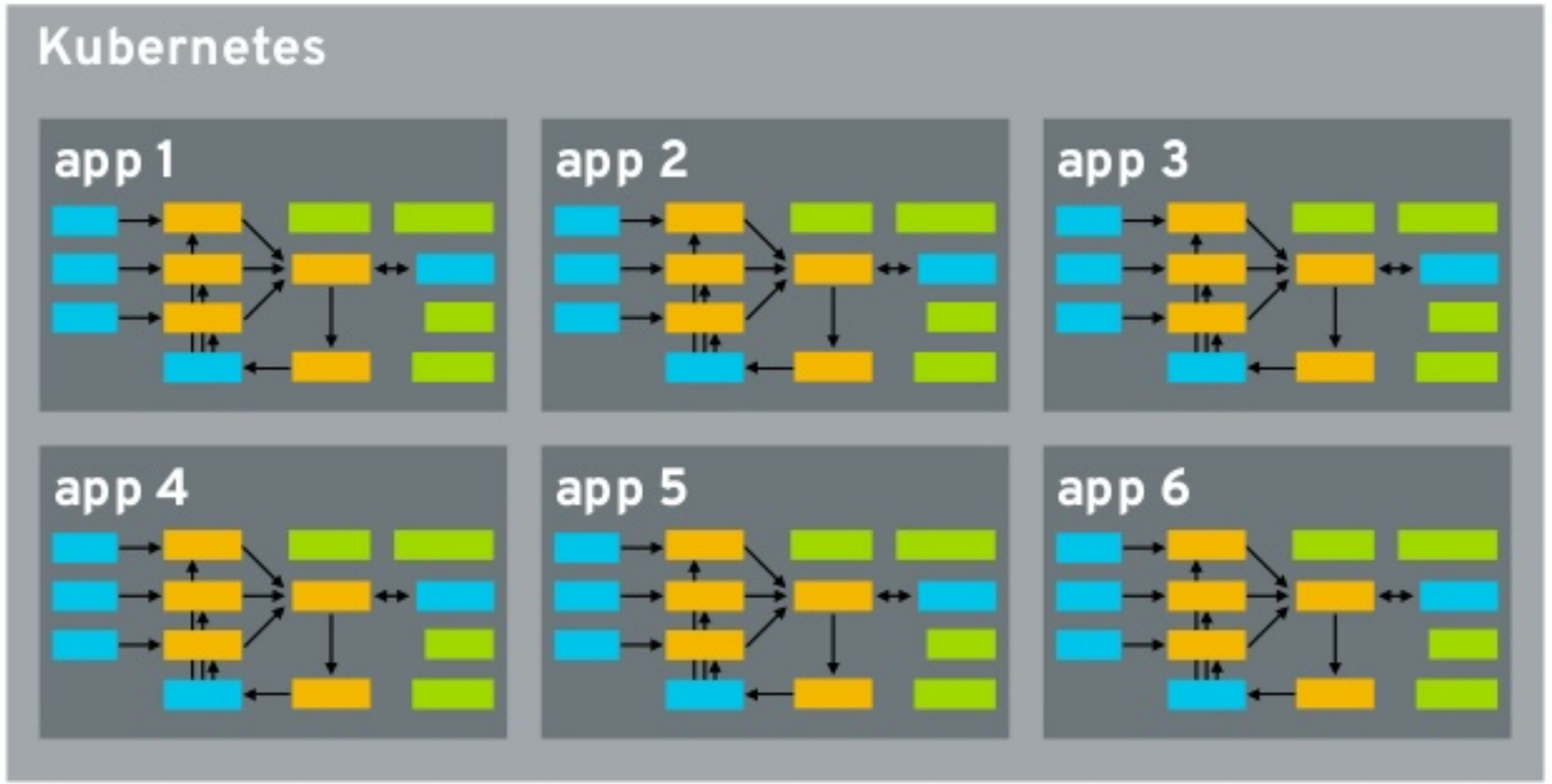


- ✓ support for legacy Hadoop installations
- ✗ inelastic
- ✗ stateful
- ✗ can't collocate compute and data

STORAGE

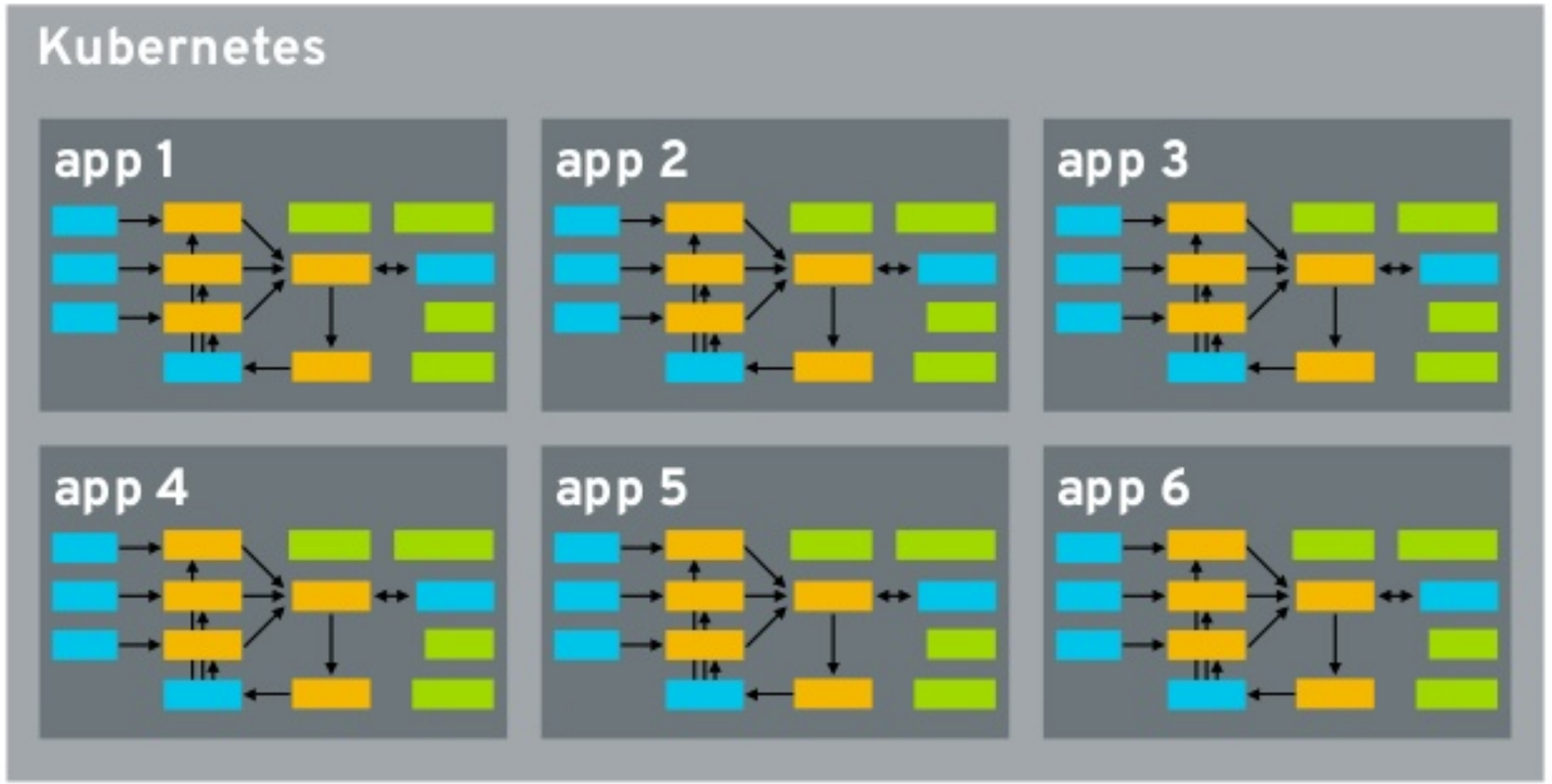


STORAGE



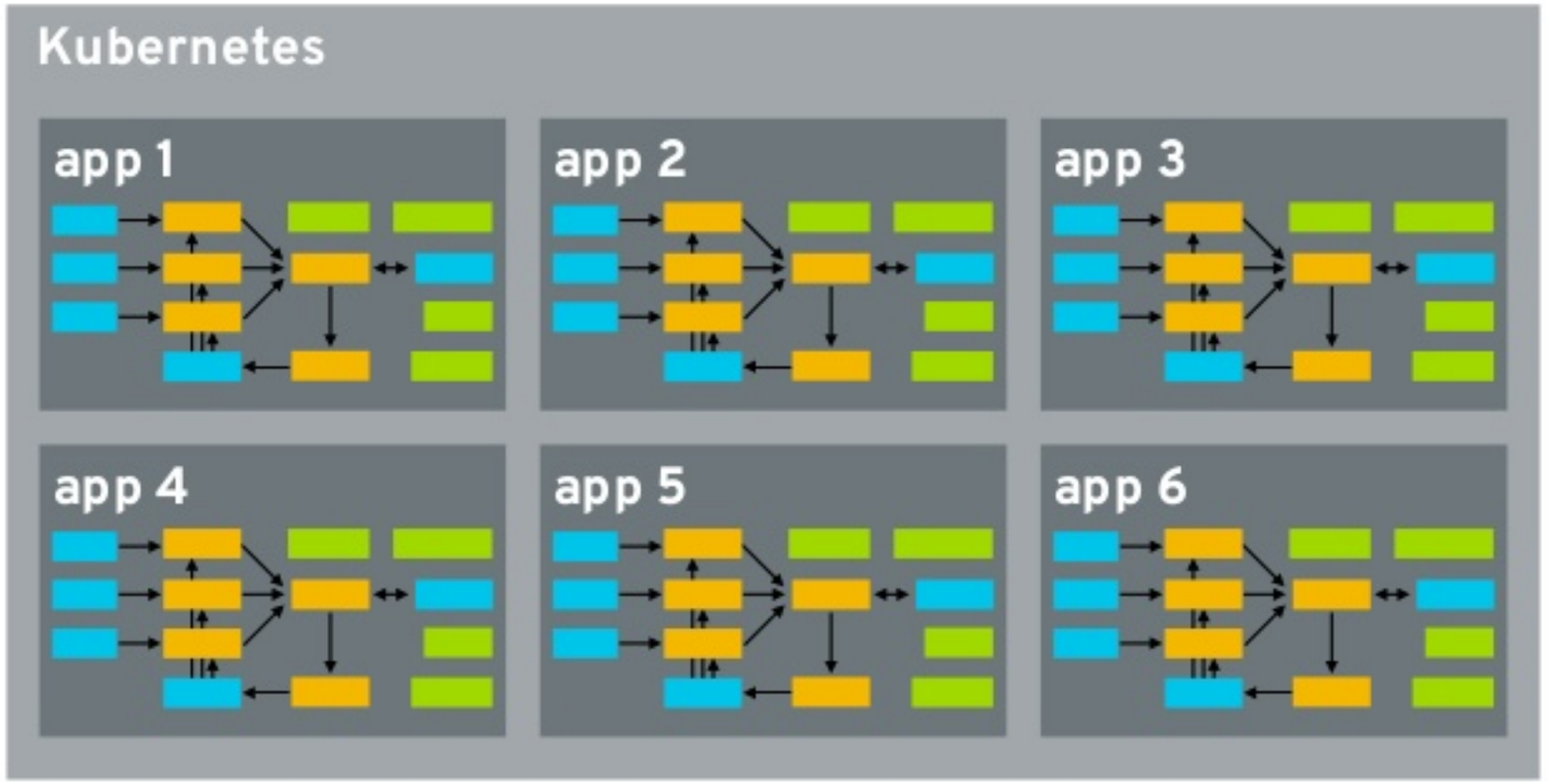
- ✓ interoperability
- ✓ fine-grained AC
- ✓ many implementations

STORAGE



- ✓ interoperability
- ✓ fine-grained AC
- ✓ many implementations
- ✗ consistency model
- ✗ performance (?)

STORAGE

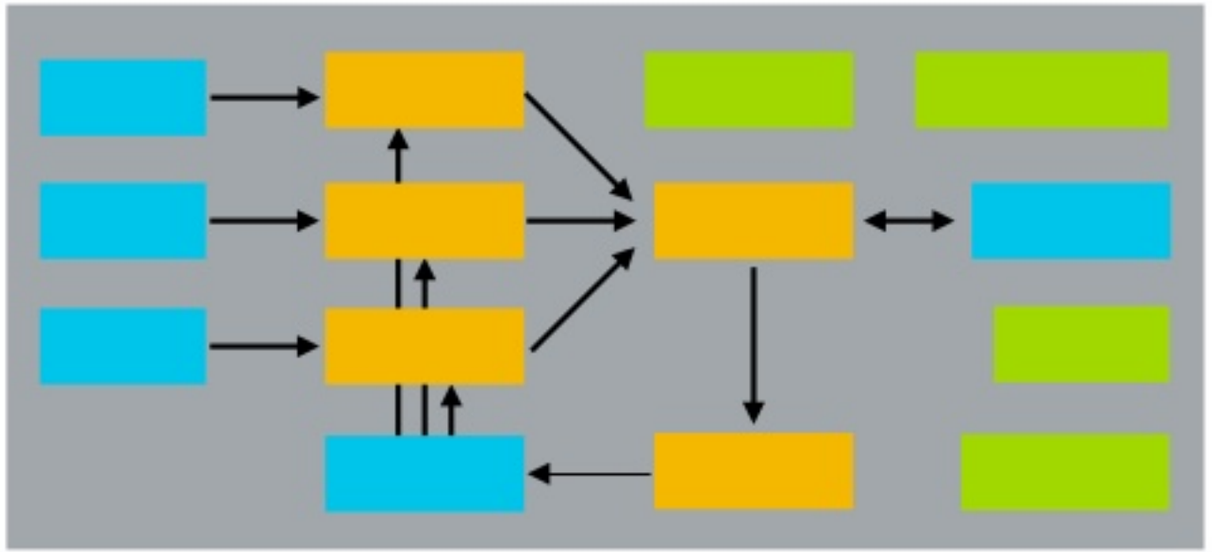


- ✓ interoperability
- ✓ fine-grained AC
- ✓ many implementations
- ✗ consistency model
- ✗ performance

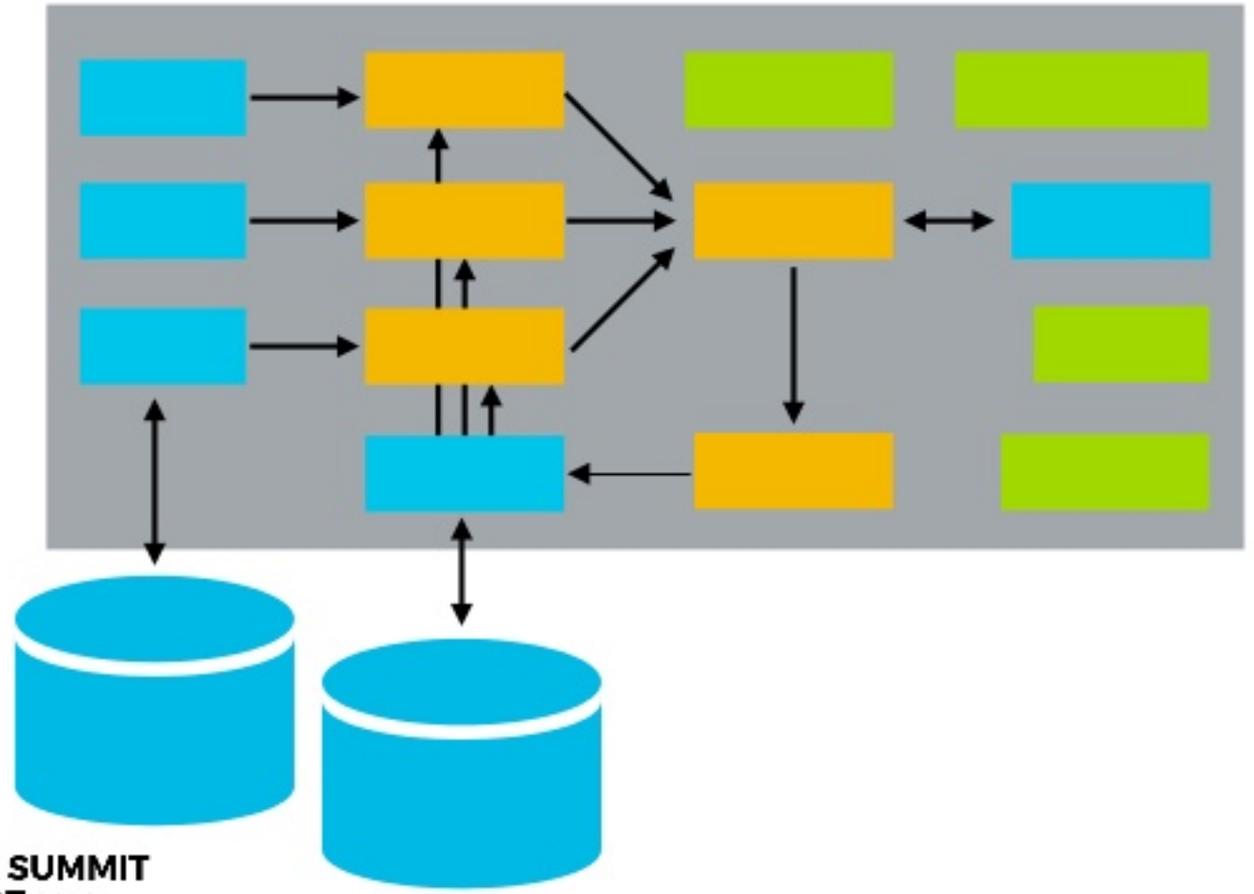
"…in a cloud native architecture, the benefit of HDFS is actually very small and that is why many cloud-first organizations no longer run HDFS, or only run it as a caching layer for S3."

—Reynold Xin on Quora (http://qr.ae/TAF4cN)

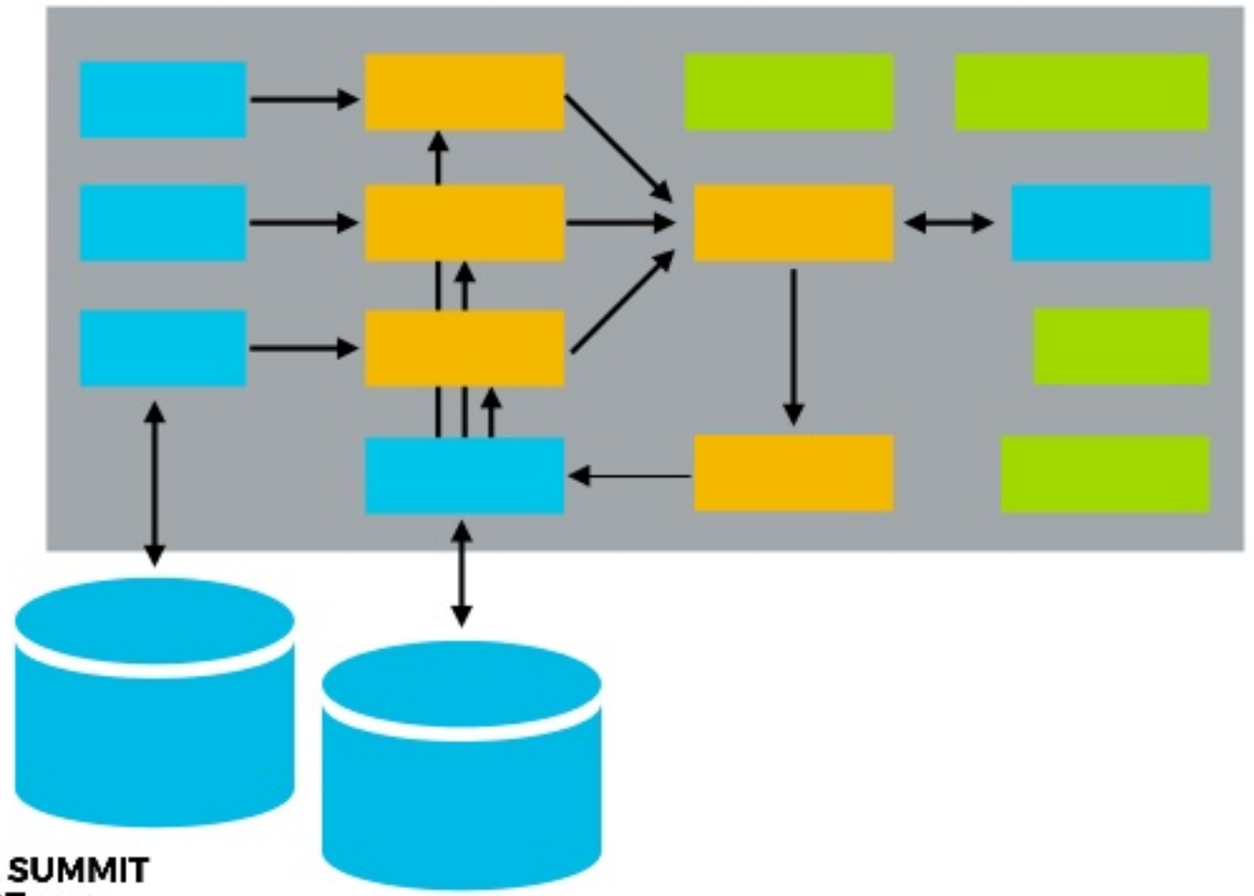
NETWORKING



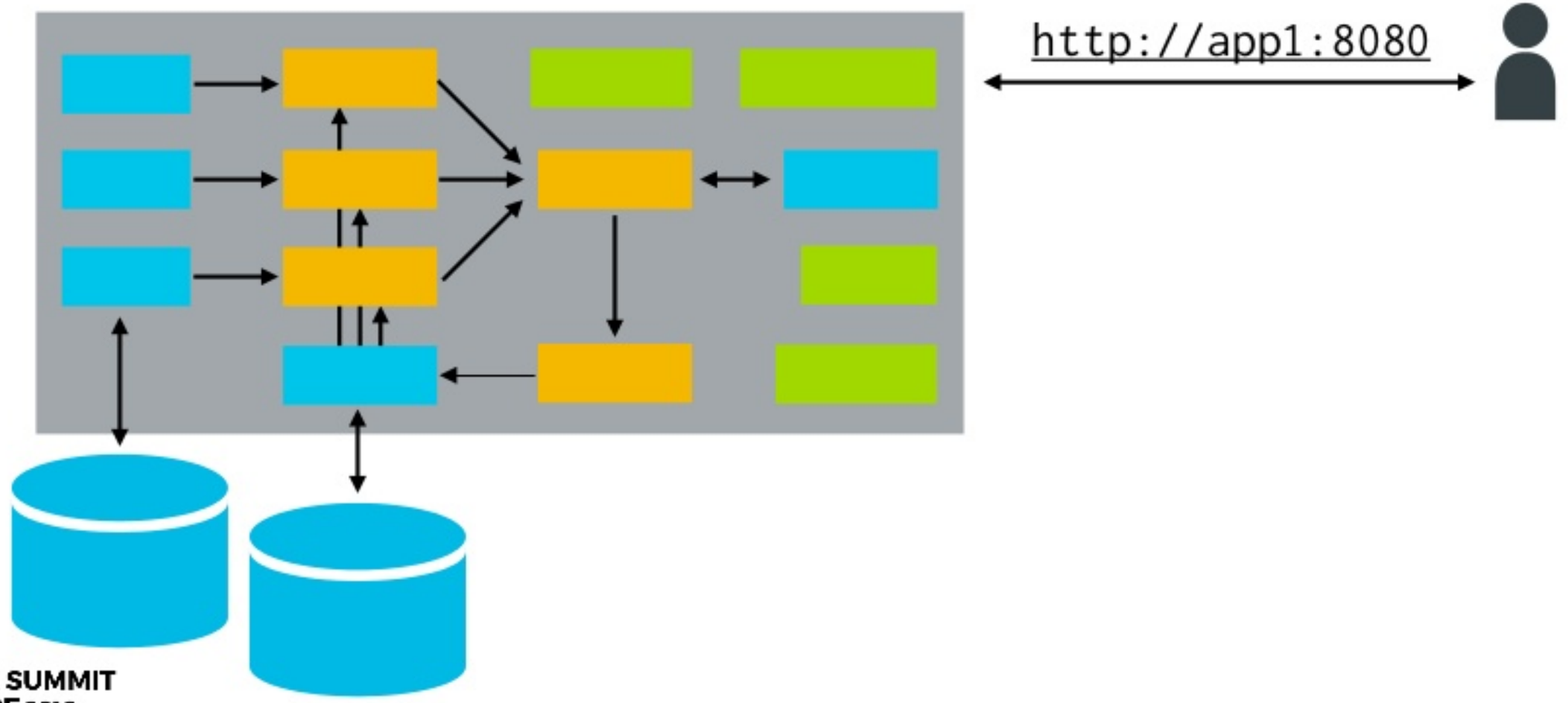
NETWORKING



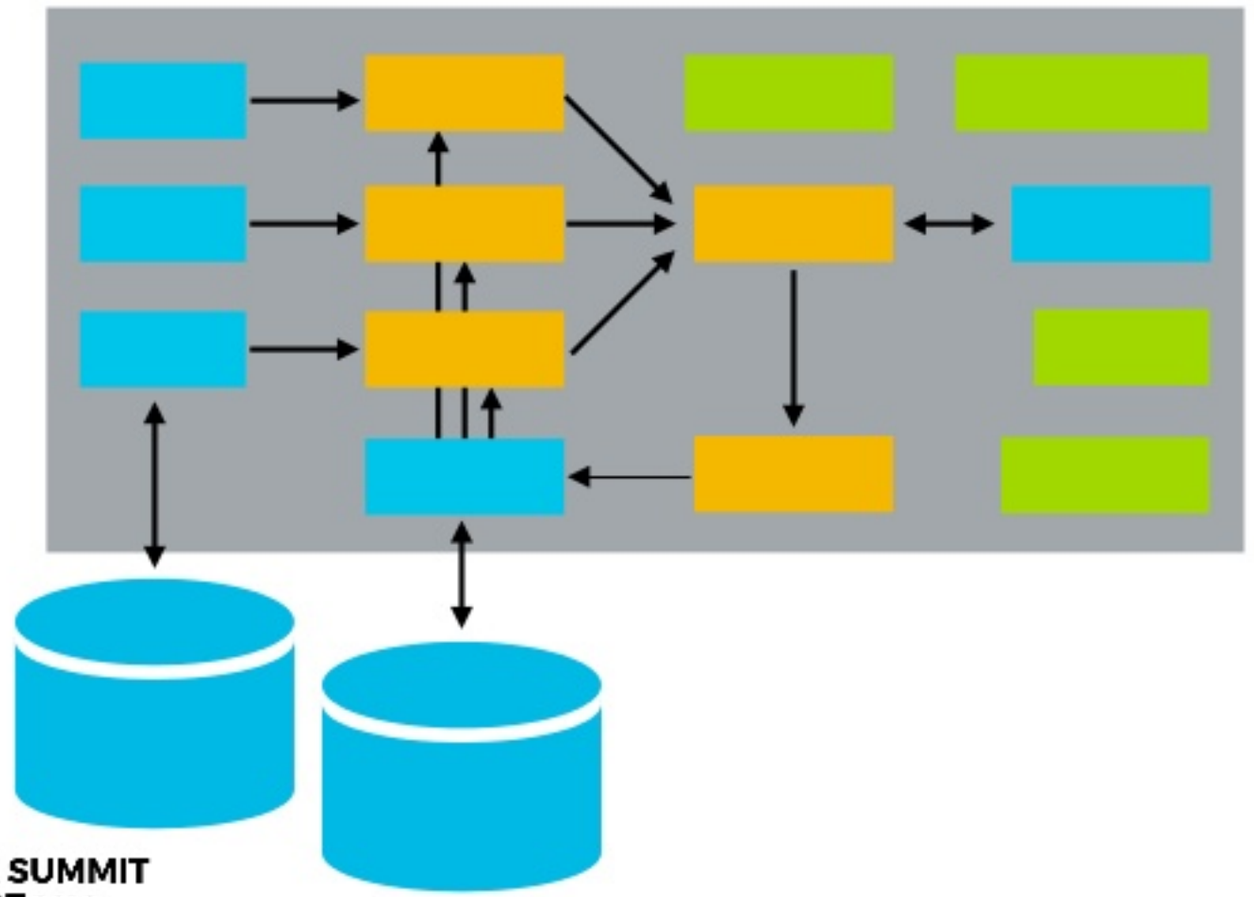
NETWORKING



NETWORKING



NETWORKING

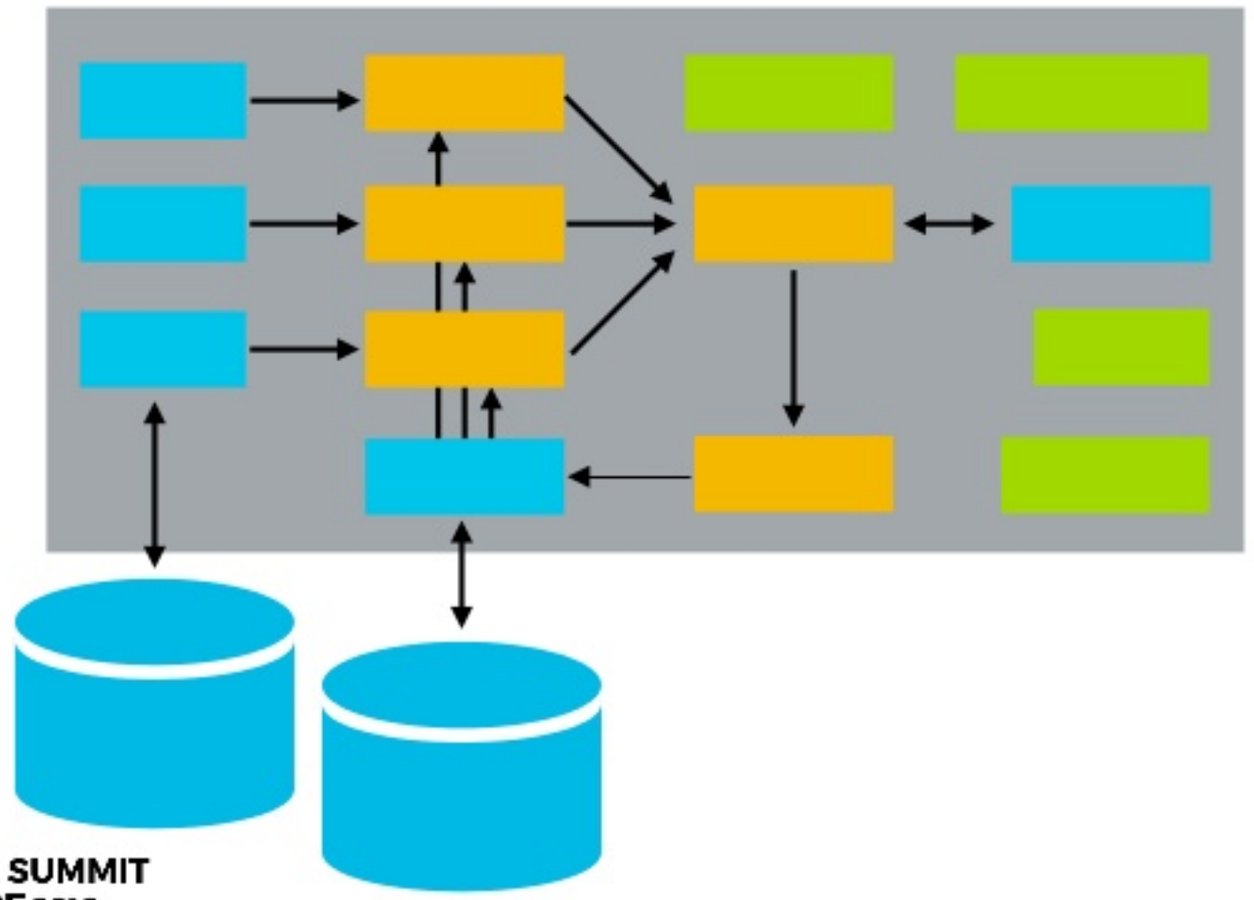


http://app1:8080

✗ can't access worker web UI

(but wait for Spark 2.1!)

NETWORKING



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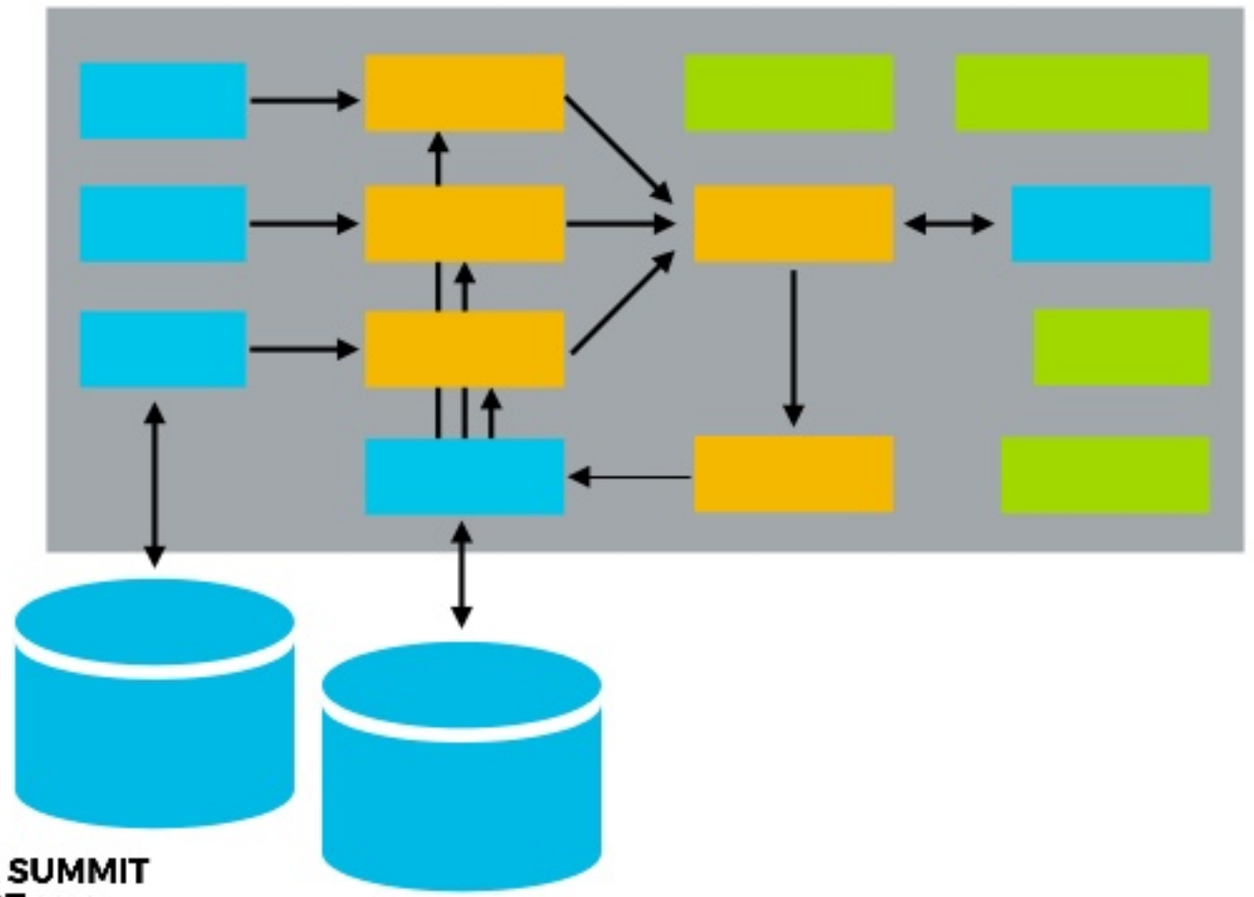
NETWORKING



http://app1:8080

✗ can't access worker web UI

(but wait for Spark 2.1!)

http://app1:80

NEXT STEPS: FUTURE WORK & PLAYING ALONG AT HOME

NEXT STEPS

Further performance evaluation

Better developer experience

Improved scheduling of Spark tasks on Kubernetes

TRY IT OUT YOURSELF

Kubernetes standalone Spark example:
https://github.com/kubernetes/kubernetes/tree/master/examples/spark

Enabling Spark on OpenShift: https://github.com/radanalyticsio

Native Spark on Kubernetes proposal:
https://github.com/kubernetes/kubernetes/issues/34377

THANKS!

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https://chapeau.freevariable.com