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How to build leakproof stream processing pipelines with Apache Kafka and Apache Spark

Introduction

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  - Previously software engineer building operational data systems on CDH

Agenda

- Intro
- Overview of Spark Streaming from Kafka
  - Workflow of the DStream and RDD
  - Spark Streaming Kafka consumer types
- Offset management
  - Motivation
  - Storing offsets in external data stores
- Q & A

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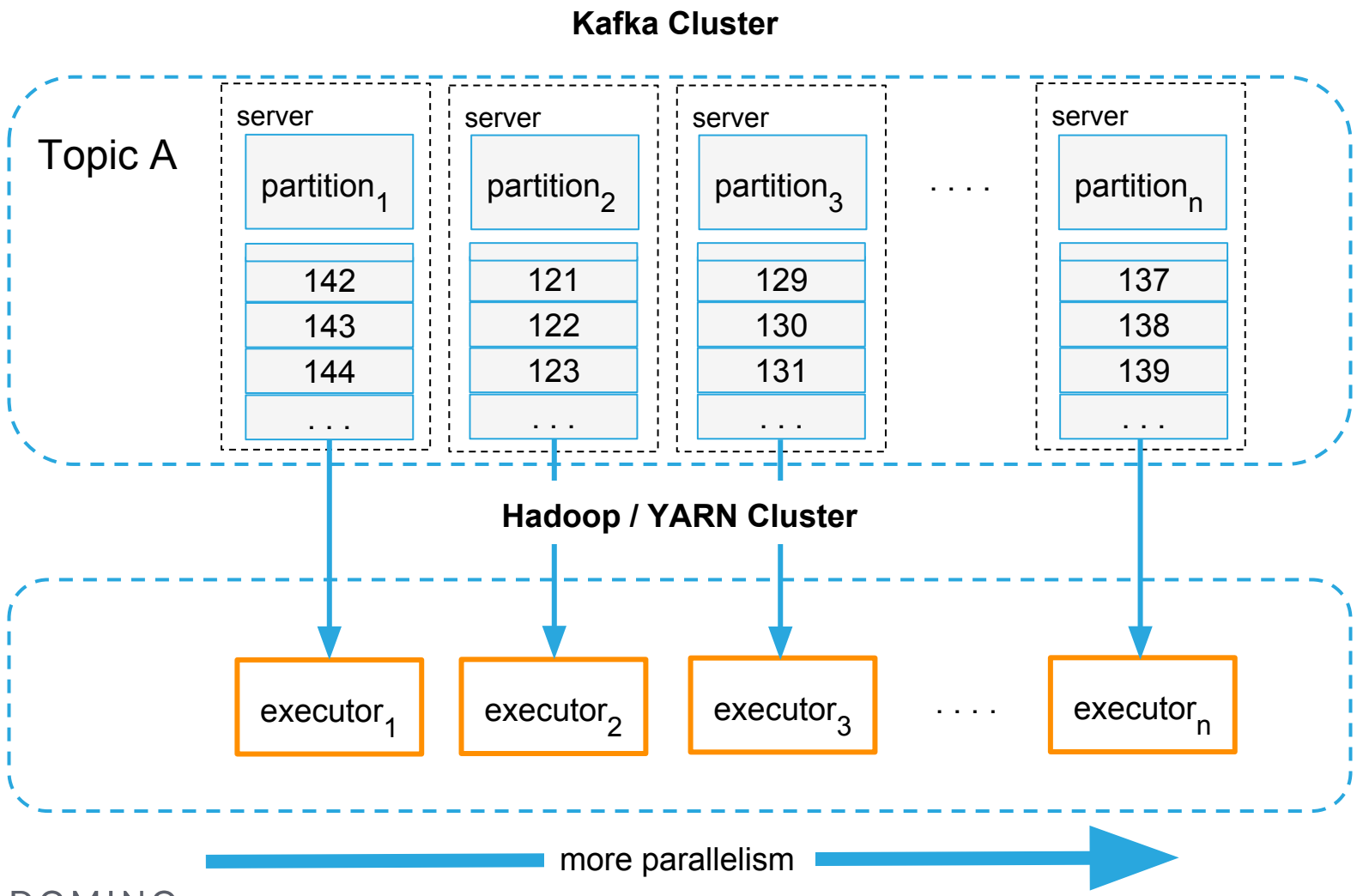
Overview



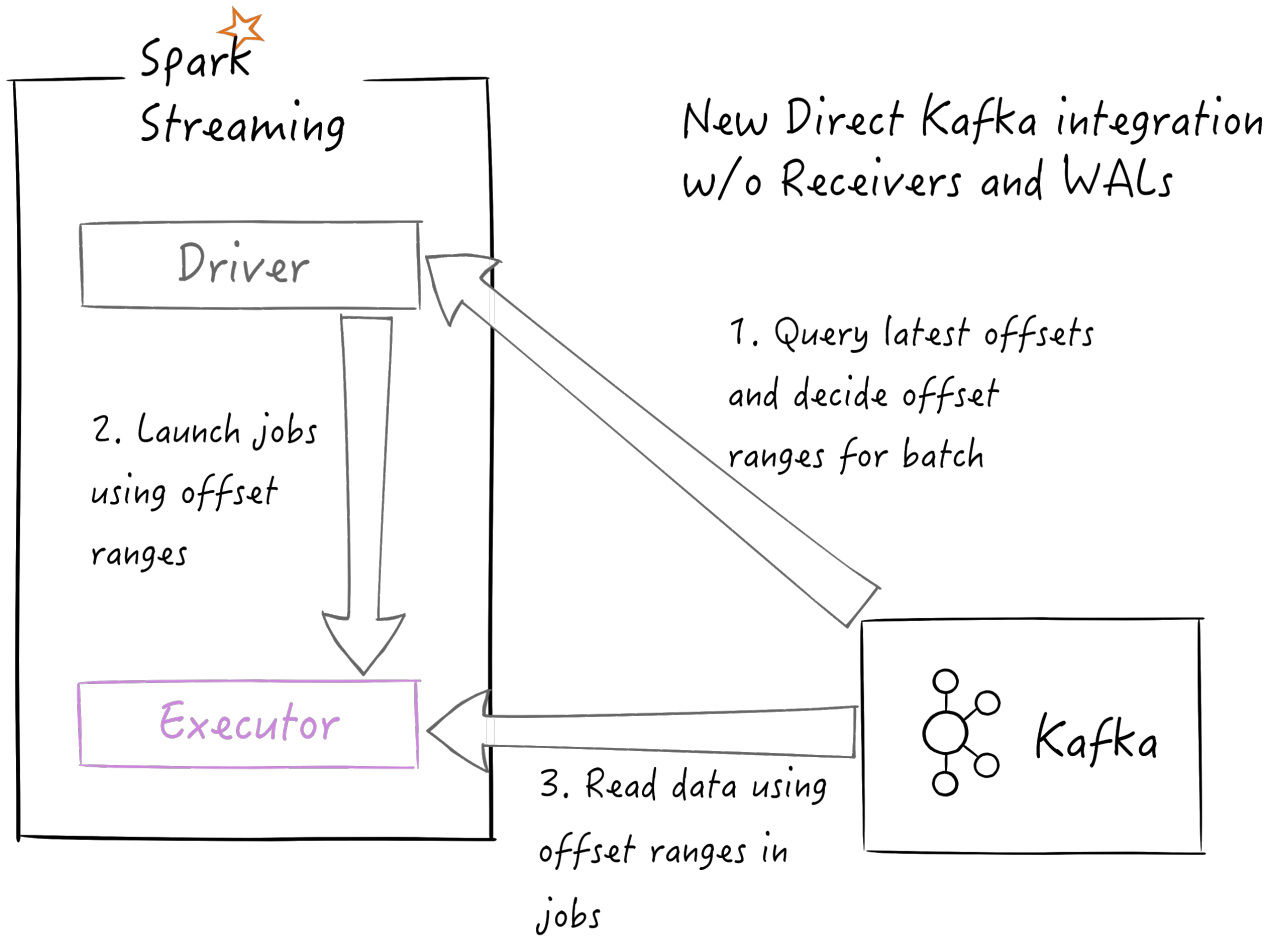
Overview Spark Streaming from Kafka

- DStream - sequence of RDDs

- Two approaches in KafkaUtils
  - Receiver based
  - Direct approach (recommended & the method we talk about)

- Spark streaming embeds a kafka client
  - Spark 1.6 uses the 0.9.0-kafka-2.0.0 client (SimpleConsumer)
  - Spark 2.x kafka 0-8-0 uses the 0.9.0-kafka-2.0.2 client (SimpleConsumer)
  - Spark 2.x kafka 0-10-0 uses the 0.10.0-kafka-2.1.0 client (KafkaConsumer)

DStream and RDD Workflow



- Spark Streaming
  - batchIntervalInSeconds
  - stopGracefullyOnShutdown
- Kafka
  - bootstrap.servers
  - auto.offset.reset
  - group.id
  - key.deserializer
  - value.deserializer

Spark Streaming Kafka Consumer # 1

- spark-streaming-kafka-0-8 / 0.9.0-kafka-2.0.2
- DStream
  - Gets range of each topic/partition - throttle maxRatePerPartition
  - auto.offset.reset (smallest|largest)
  - refresh.leader.backoff.ms - lost leader
- KafkaRDD for set of topic, partition, offsets
  - User can now get offset ranges from RDD
    - topic, partition, fromOffset (inclusive), untilOffset (exclusive)
- KafkaRDDPartition iterator
  - SimpleConsumer initialized and batches of events fetched
  - refresh.leader.backoff.ms - lost leader

Spark Streaming Kafka Consumer # 2

- **Supported** - spark-streaming-kafka-0-10 / 0.10.0-kafka-2.1.0
- Internal Kafka client uses new Java KafkaConsumer
- ConsumerStrategies
  - subscribe, assign, subscribe pattern
- LocationStrategies
  - executor distribution strategy (consistent, fixed, brokers)
- DStream
  - Gets range of each topic/partition - throttle maxRatePerPartition
  - auto.offset.reset (earliest|latest)
  - Be careful - enable.auto.commit (default true)
  - heartbeat & session timeouts

Spark Streaming Kafka Consumer # 2

- DStream
  - Consumer poll for group coordination & discovery
  - Identify new partitions, from offsets
  - Pause consumer
  - seekToEnd to get untilOffsets
- KafkaRDD
  - Fixed [enable.auto.commit = false, auto.offset.reset = none, spark-executor-${group.id}]
  - Attempts to assign offset range consistently for optimal consumer caching
- KafkaRDDPartition iterator
  - Initialize/lookup CachedKafkaConsumer with executor group
    - consumer assigned per single topic, partition with internal buffer
    - on cache miss, seek and poll

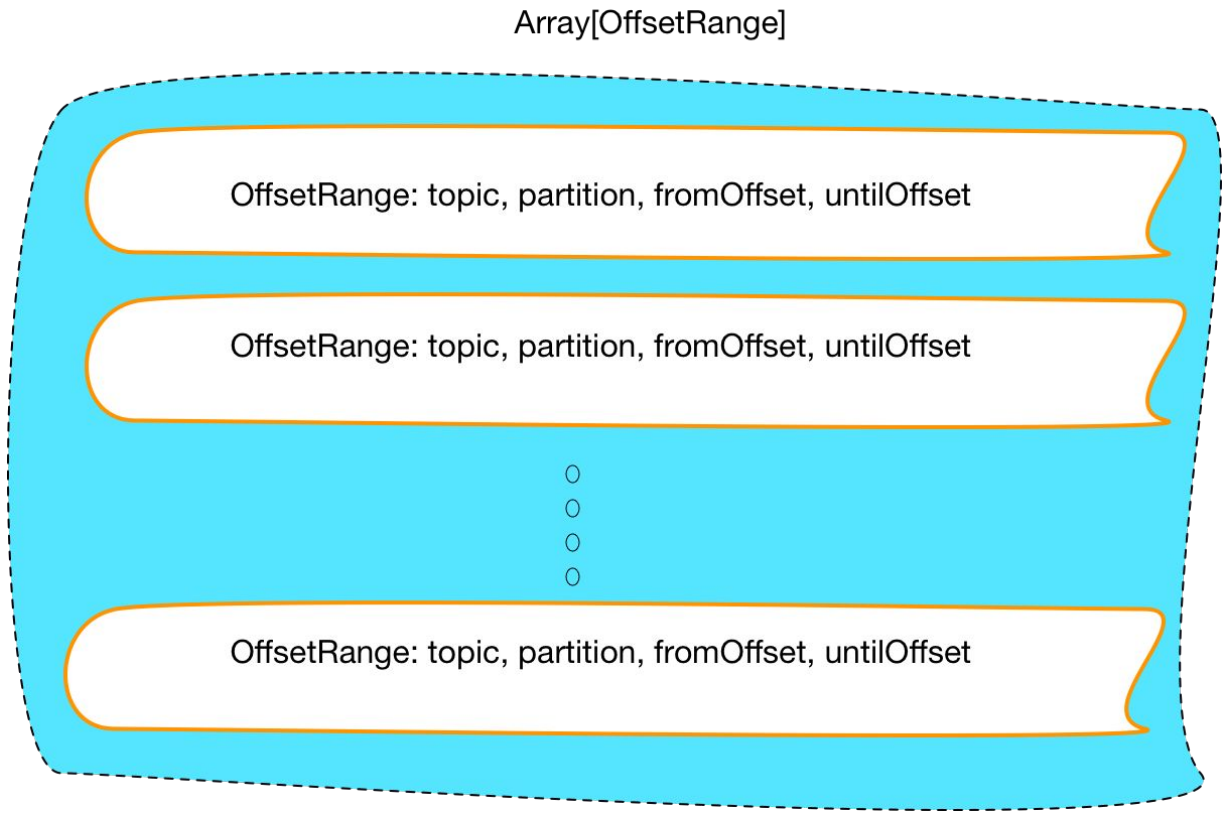
Keeping Track

Motivation for Tracking Offsets

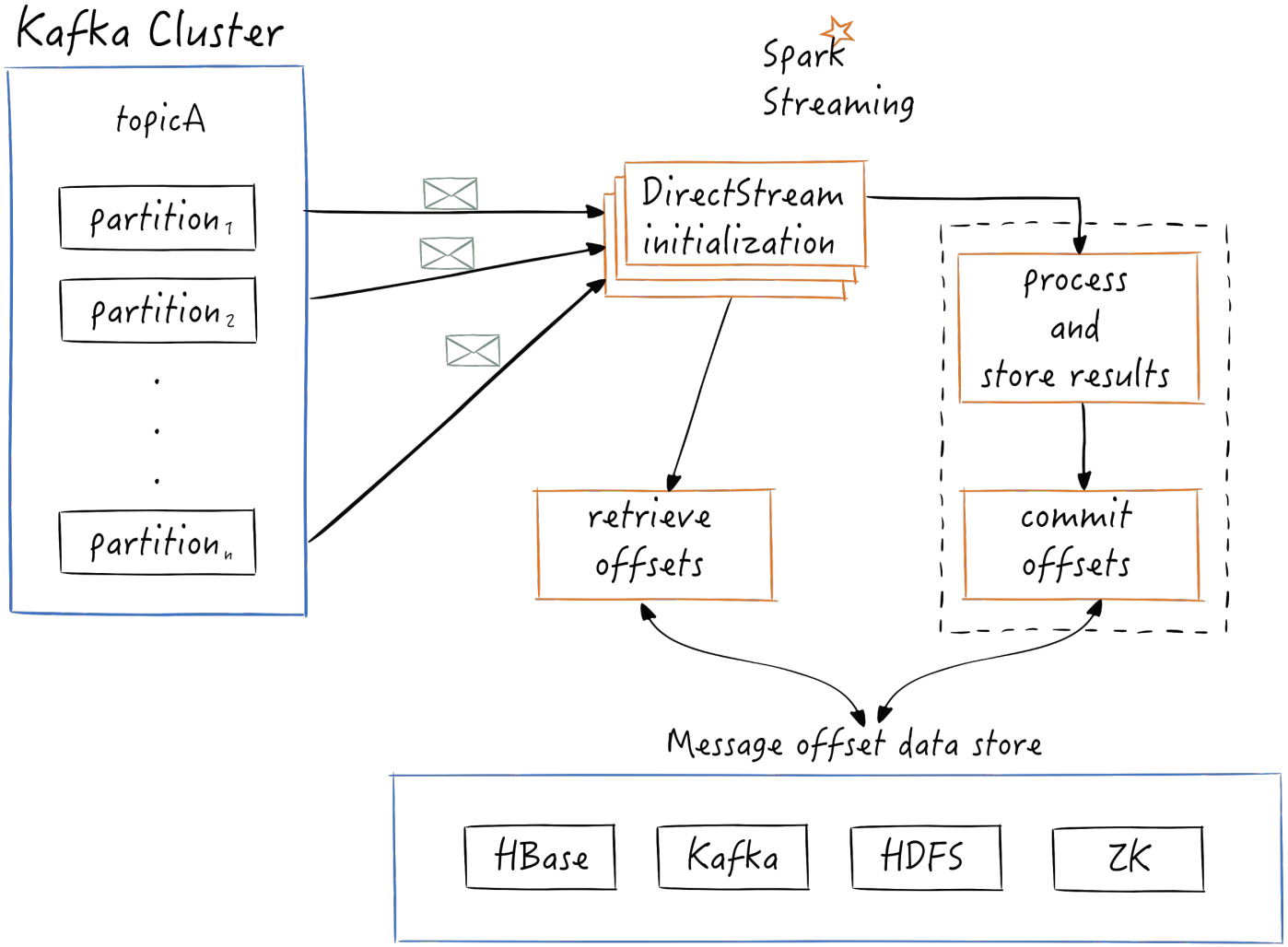
- Planned Maintenance
  - Upgrades
  - Bug-fixes
- Unplanned Maintenance
  - Failures
- Application Processing Errors
  - Wrong calculations
  - Updated algorithm over known streaming data
- More control over messages
  - Just earliest and latest are insufficient

Obtaining Offsets

- Cast RDD to HasOffsetRanges
- DStream's first transformation



Offset management Workflow



- Limited options prior to spark-streaming-kafka-0-10
- Store offsets in external datastore
  - Checkpoints (Not recommended)
  - ZooKeeper
  - Kafka
  - HBase
- Do not have to manage offsets

Offset Management in ZooKeeper

- ZooKeeper
  - znode - /consumers/[groupId]/offsets/[topic]/[partitionId] -> long (offset)
  - Only retains latest committed offsets
  - Can easily be managed by external tools
  - Leverage existing monitoring for Lag, no historical insight

Offset Management in Kafka

- Kafka
  - CanCommitOffsets provides async commit to internal kafka topic
  - More difficult to manage internal kafka topic manually
  - Leverage existing monitoring for Lag, no historical insight

Offset Management in HBase

- HBase
  - Unique entry per consumer group, batch

schema:

row:	<TOPIC_NAME>:<GROUP_ID>:<EPOCH_BATCHTIME_MS>
column family:	offsets
qualifier:	<PARTITION_ID>
value:	<OFFSET_ID>

- Fine-grained monitoring over time
- HBase shell for easy management
- Get latest entry -
  - scan 'prod_stream',
  - STARTROW =>'device_alerts:csi_group',
  - REVERSED =>TRUE,
  - LIMIT =>1

```
hbase(main):001:0> scan 'stream_kafka_offsets', {REVERSED => true}
ROW                                                  COLUMN+CELL
 kafkablog2:groupid-1:1497628830000                  column=offsets:0, timestamp=1497628832448, value=285
 kafkablog2:groupid-1:1497628830000                  column=offsets:1, timestamp=1497628832448, value=285
 kafkablog2:groupid-1:1497628830000                  column=offsets:2, timestamp=1497628832448, value=285
 kafkablog2:groupid-1:1497628770000                  column=offsets:0, timestamp=1497628773773, value=225
 kafkablog2:groupid-1:1497628770000                  column=offsets:1, timestamp=1497628773773, value=225
 kafkablog2:groupid-1:1497628770000                  column=offsets:2, timestamp=1497628773773, value=225
 kafkablog1:groupid-2:1497628650000                  column=offsets:0, timestamp=1497628653451, value=165
 kafkablog1:groupid-2:1497628650000                  column=offsets:1, timestamp=1497628653451, value=165
 kafkablog1:groupid-2:1497628650000                  column=offsets:2, timestamp=1497628653451, value=165
 kafkablog1:groupid-1:1497628530000                  column=offsets:0, timestamp=1497628533108, value=120
 kafkablog1:groupid-1:1497628530000                  column=offsets:1, timestamp=1497628533108, value=120
 kafkablog1:groupid-1:1497628530000                  column=offsets:2, timestamp=1497628533108, value=120
4 row(s) in 0.5030 seconds

hbase(main):002:0>
```

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Starting Streaming Jobs with Known Offsets

- Spark Streaming job started for the first time
- No changes in Kafka partitions
- Increase in number of Kafka partitions

http://blog.cloudera.com/blog/2017/06/offset-management-for-apache-kafka-with-apache-spark-streaming/

Questions?

Thank you

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