Executive Briefing: What You Need to Know about Fast Data

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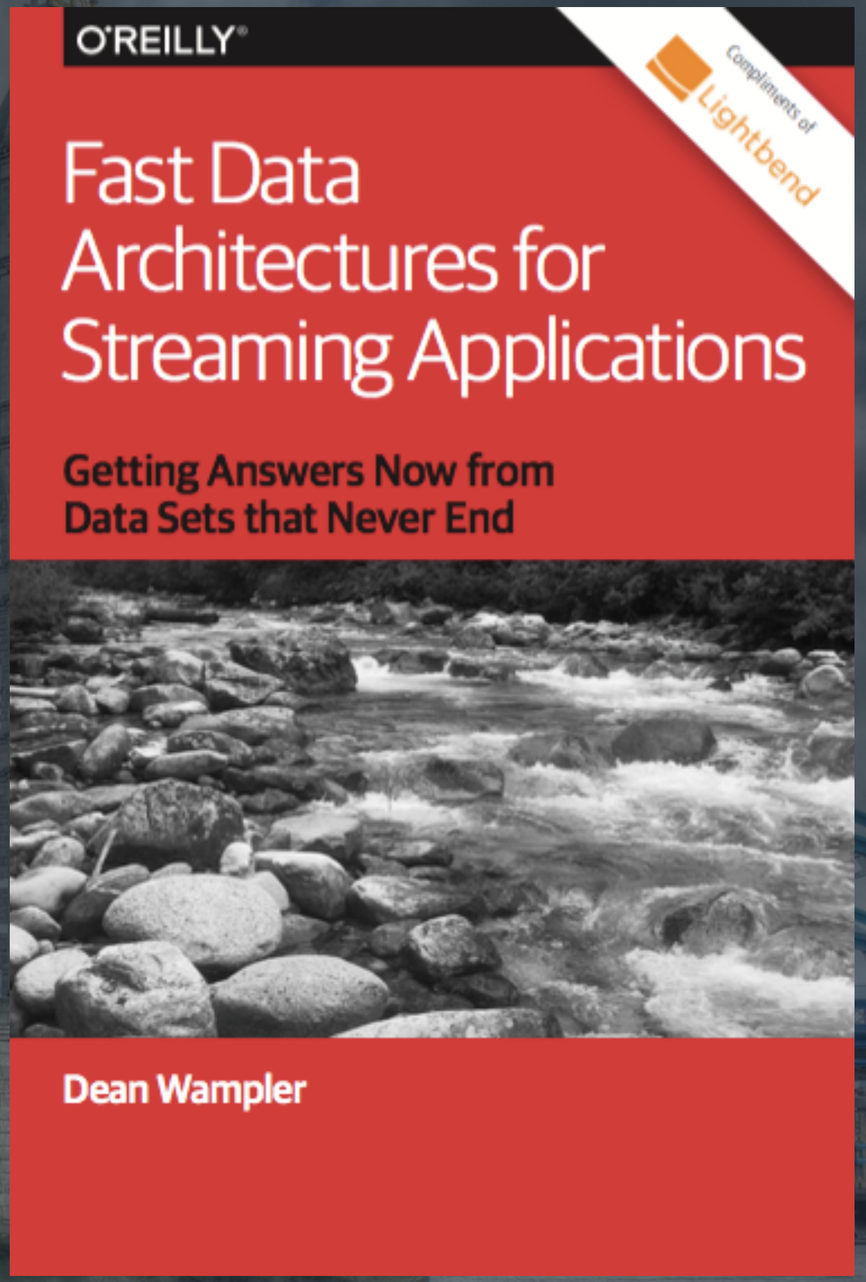
Based on this report

lightbend.com/fast-data-platform



What We'll Discuss

- Why streaming? Why now?
- How should I choose technologies?
- How will this impact the rest of my organization?

What We'll Discuss

Why Streaming?

- New opportunities that require streaming
- Upgrading batch applications for competitive advantage

Why Streaming?

Fast Data Use Cases

Predictive Analytics	IoT	Real-time Personalization	Real-time Financial Processes	Legacy Modernization
Apply ML models to large volumes of device data to pre-empt failures / outages	Real-time consumer and industrial Device and Supply Chain management at scale	Real-time marketing based on behavior, location, inventory levels, product promotions, etc.	Drive better business outcomes through real-time risk, fraud detection, compliance, audit, governance, etc.	Accelerate decision making processes and optimize infrastructure costs by moving from batch to streaming
Hewlett Packard Enterprise	STARBUCKS COFFEE	RoyalCaribbean INTERNATIONAL	CapitalOne	IQVIA

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Fast Data Use Cases

Similar IoT Architectures

Predictive Analytics	IoT	Real-time Personalization	Real-time Financial Processes	Legacy Modernization
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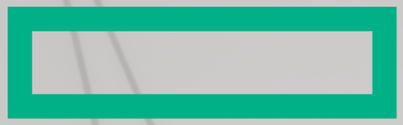


Predictive Analytics

Hewlett Packard
Enterprise

- ML models applied to device telemetry to detect anomalies
- Preemptive maintenance prevents potential failures that would impact users

Core Idea

Handle anomaly: move activity off component, schedule maintenance window to replace it.

Anomaly Handler

Probable Anomalies

Train models to look for anomalies… and score incoming telemetry.

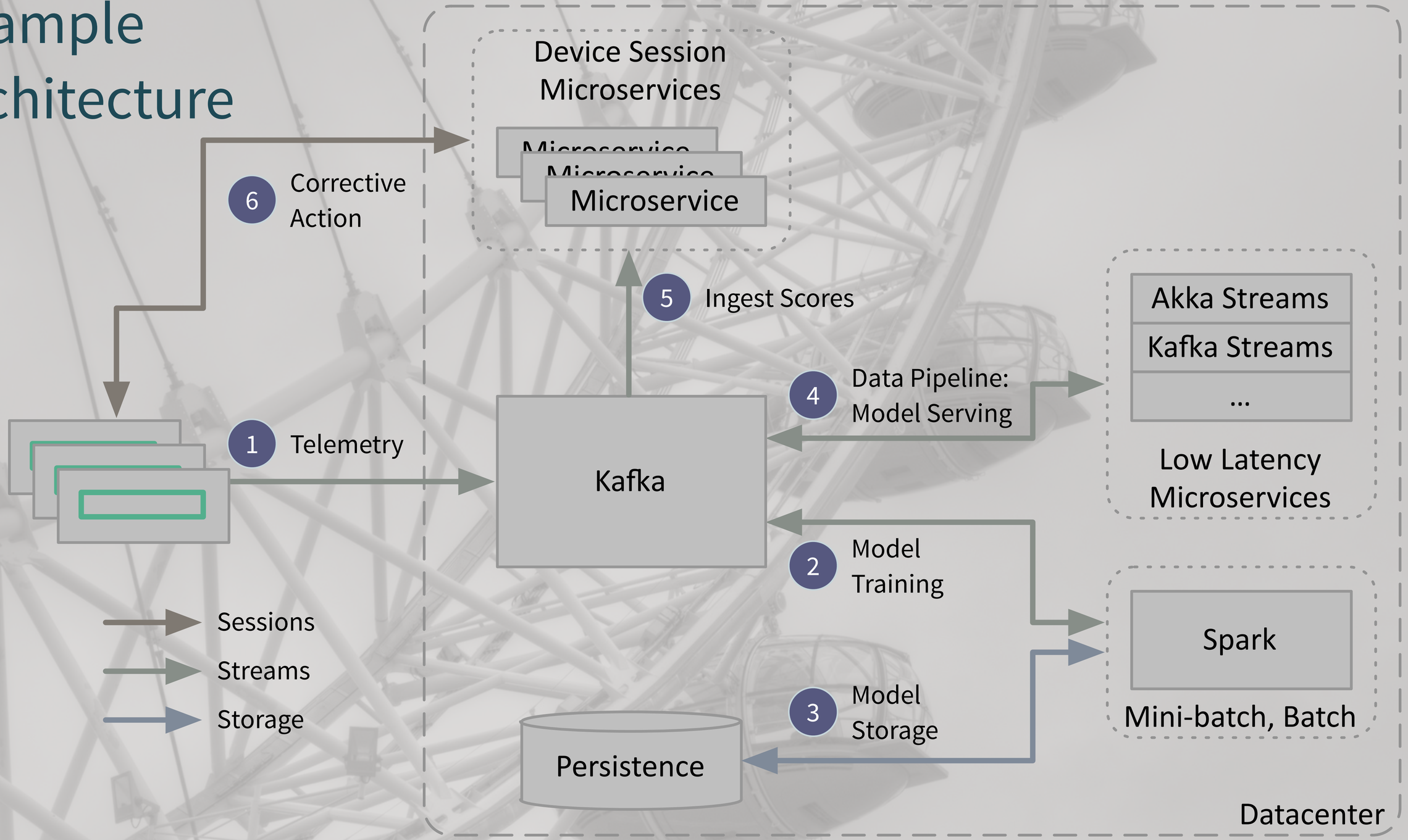
Anomaly Detection: Model

Corrective Actions

Telemetry Records

Ingest telemetry from edge devices.

Example Architecture



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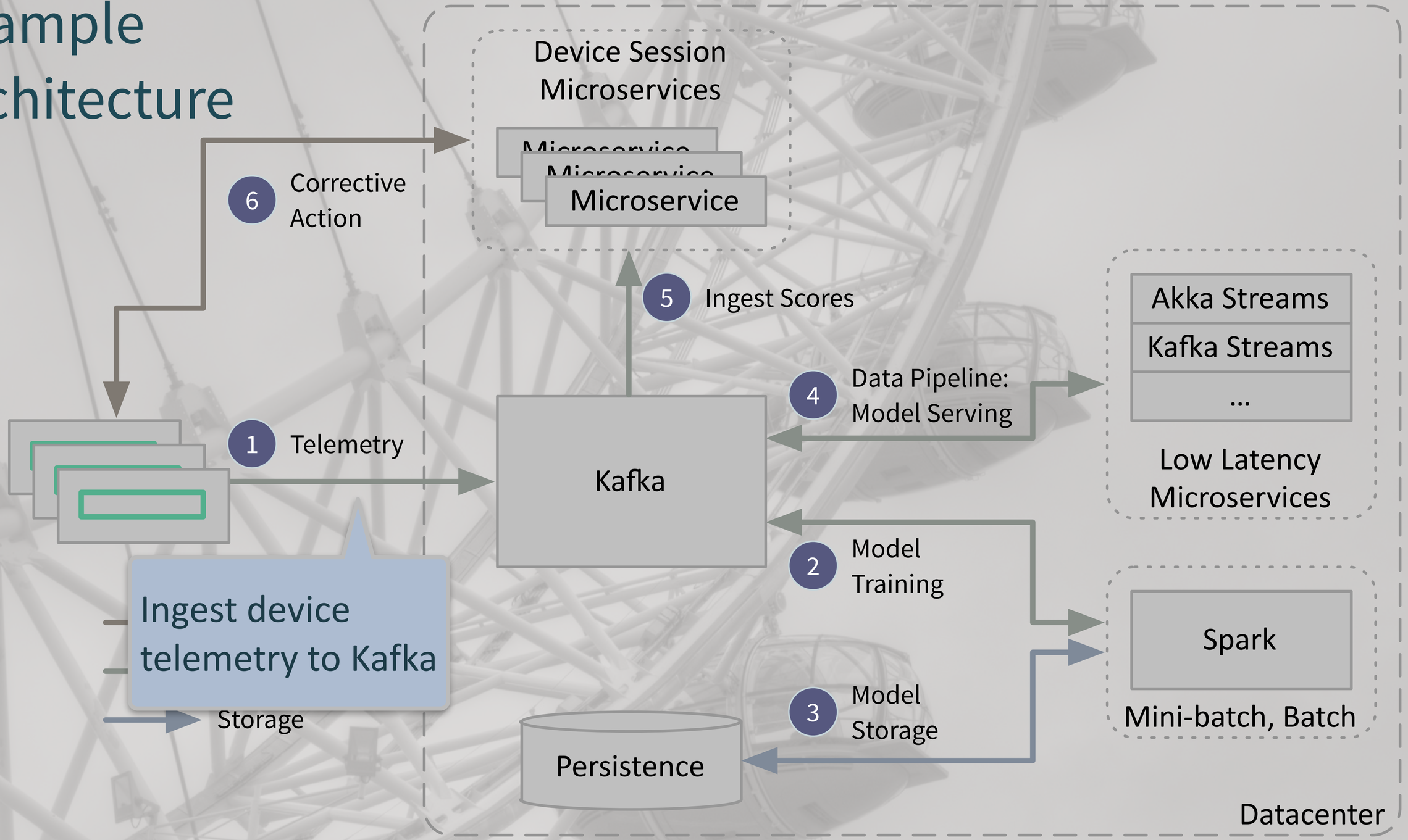

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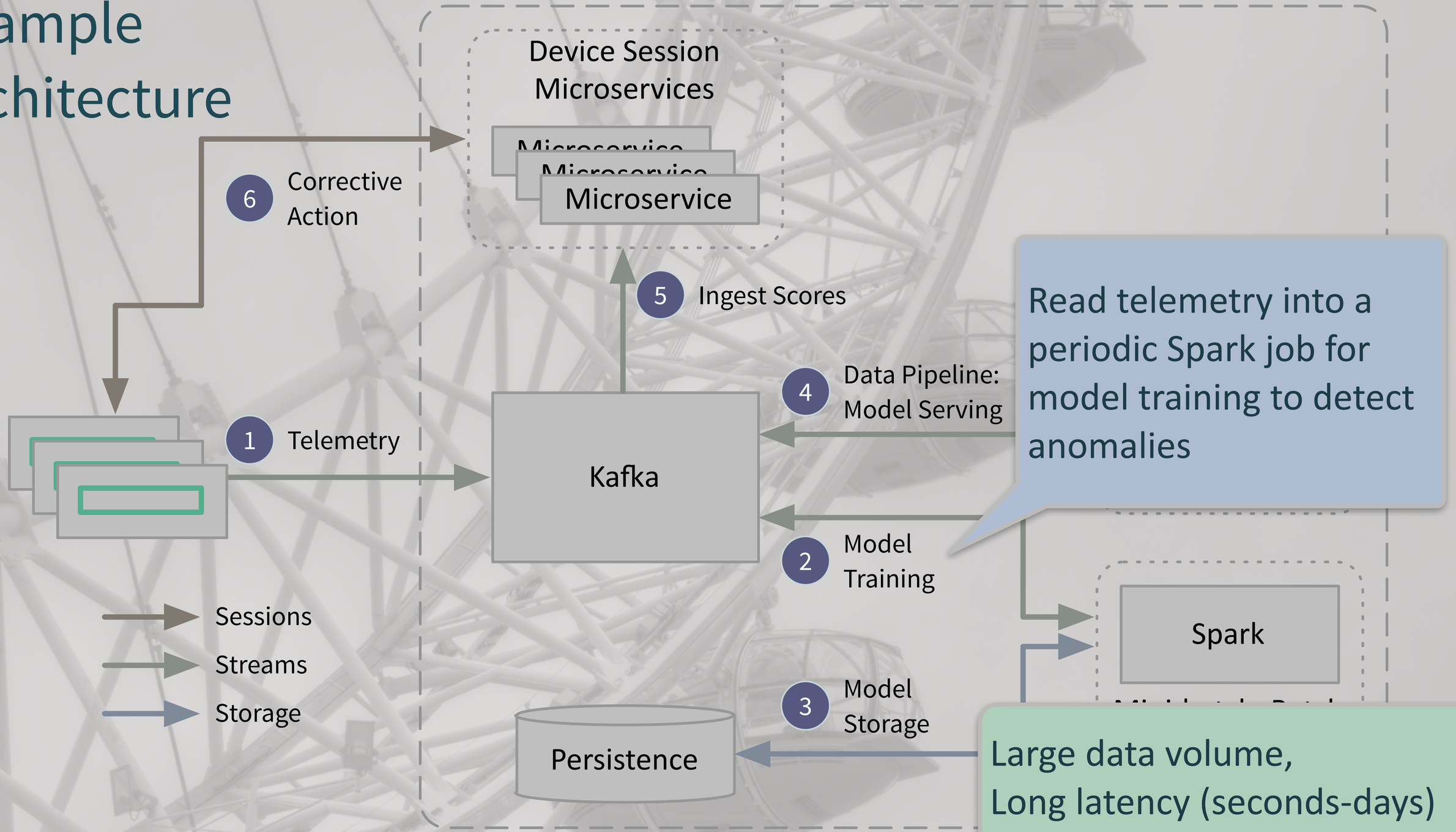

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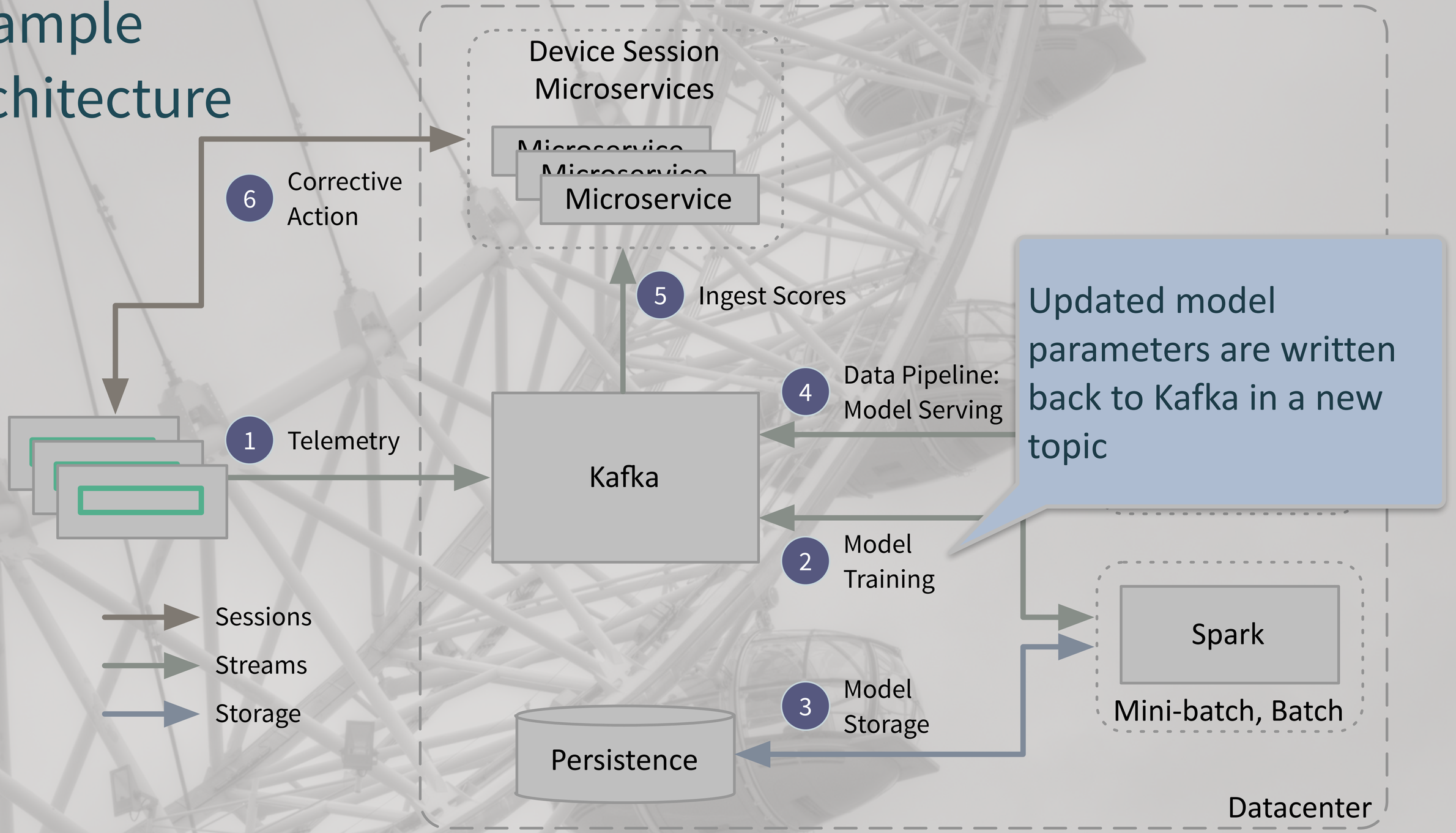

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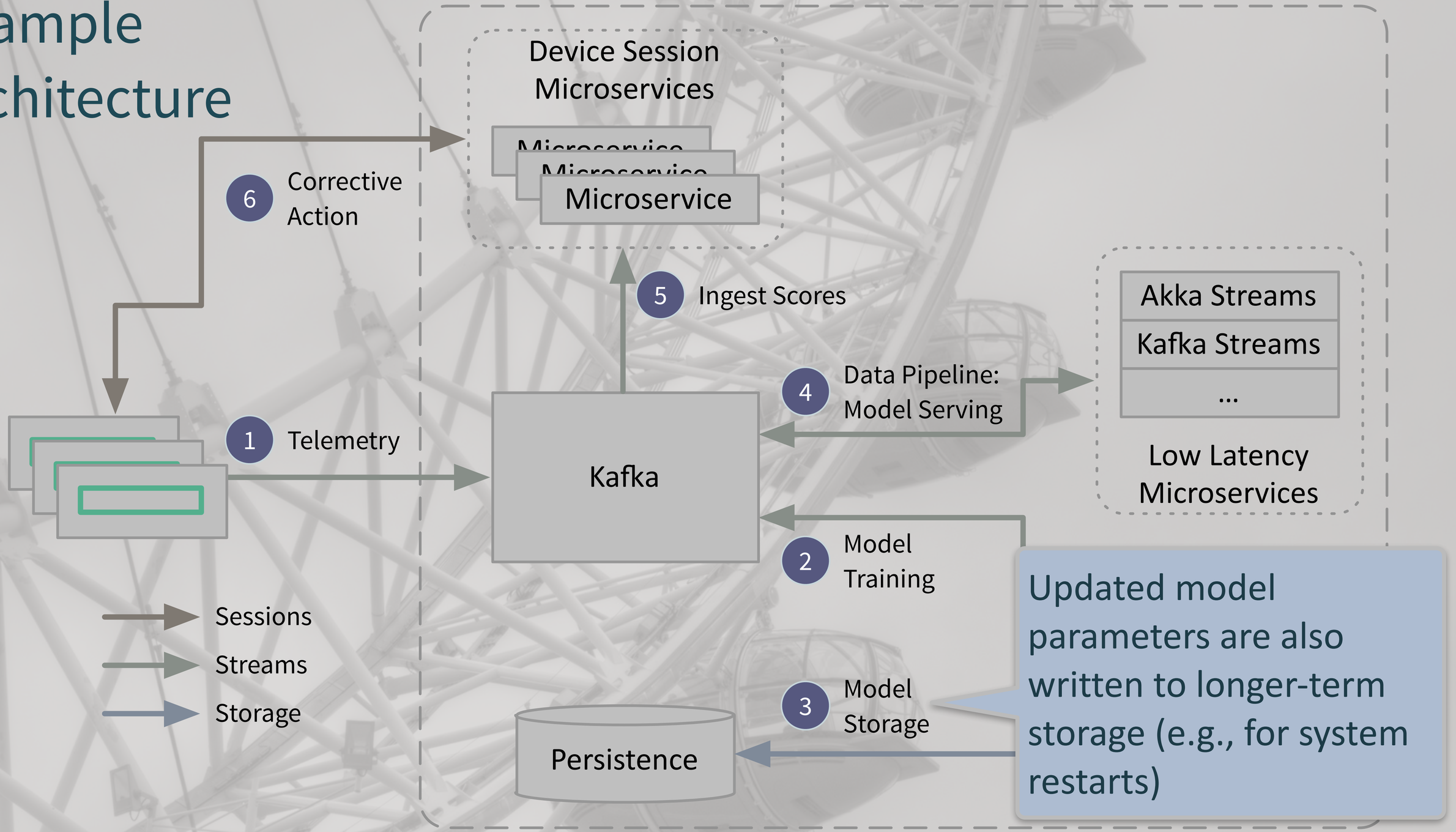

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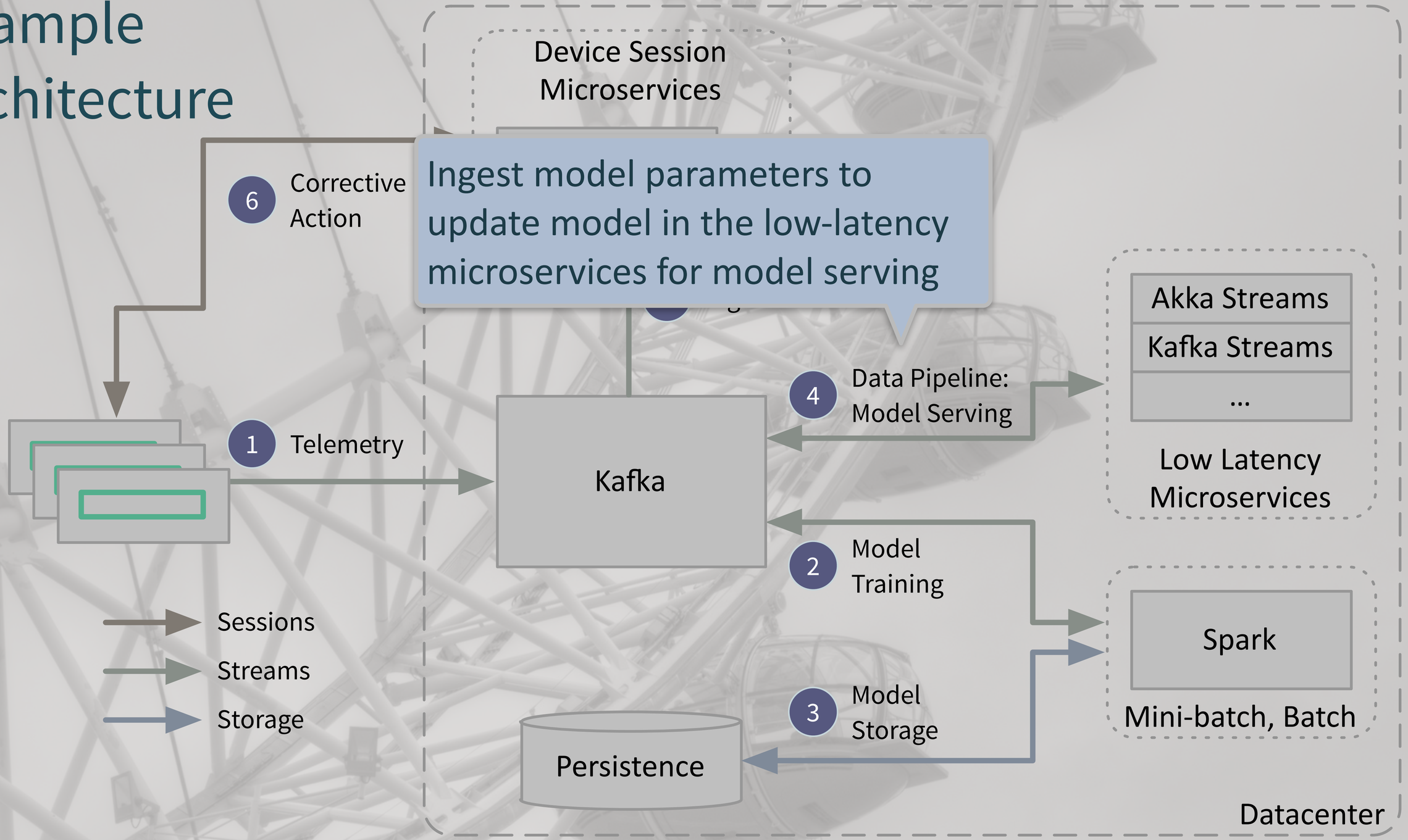

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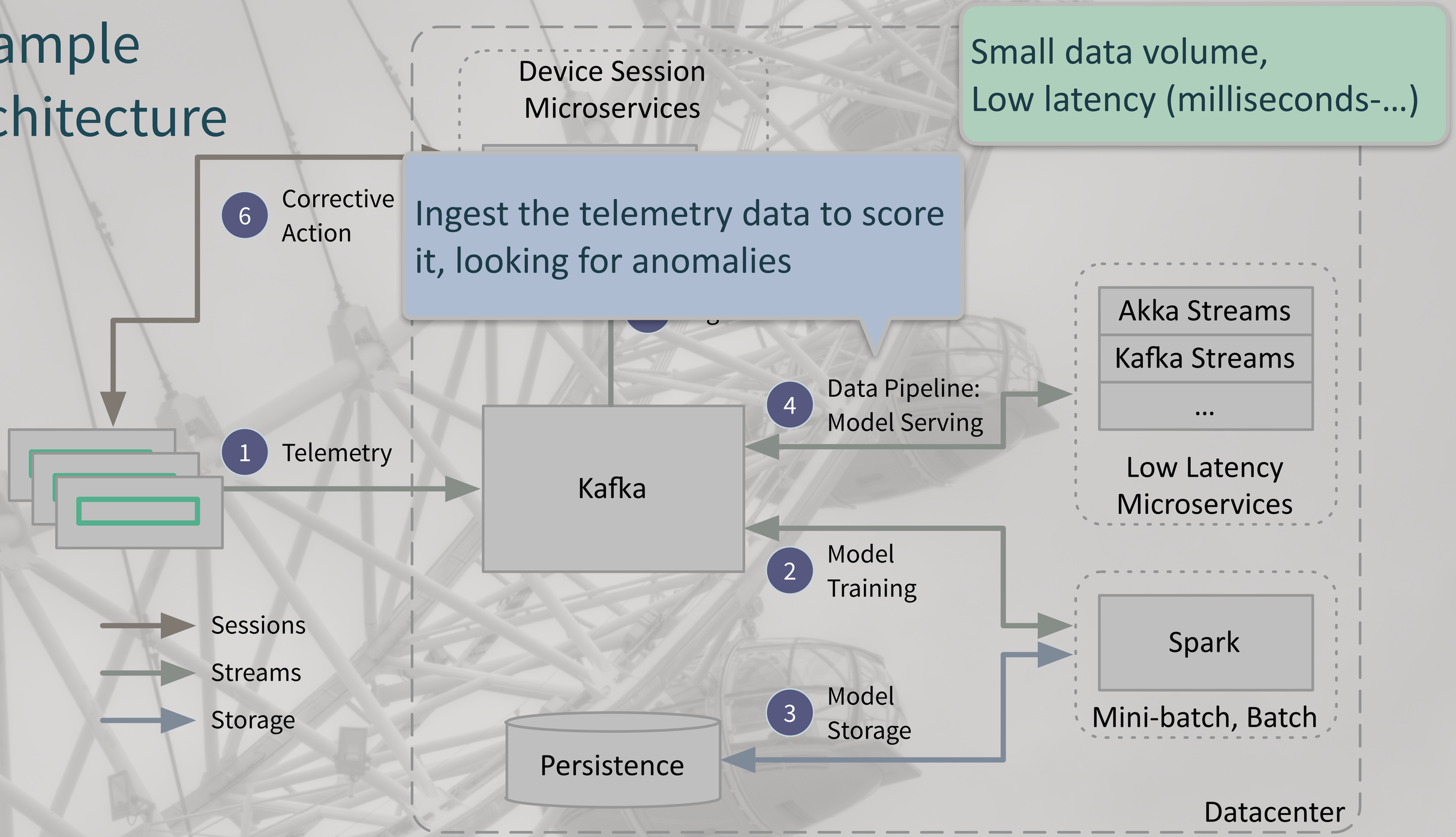

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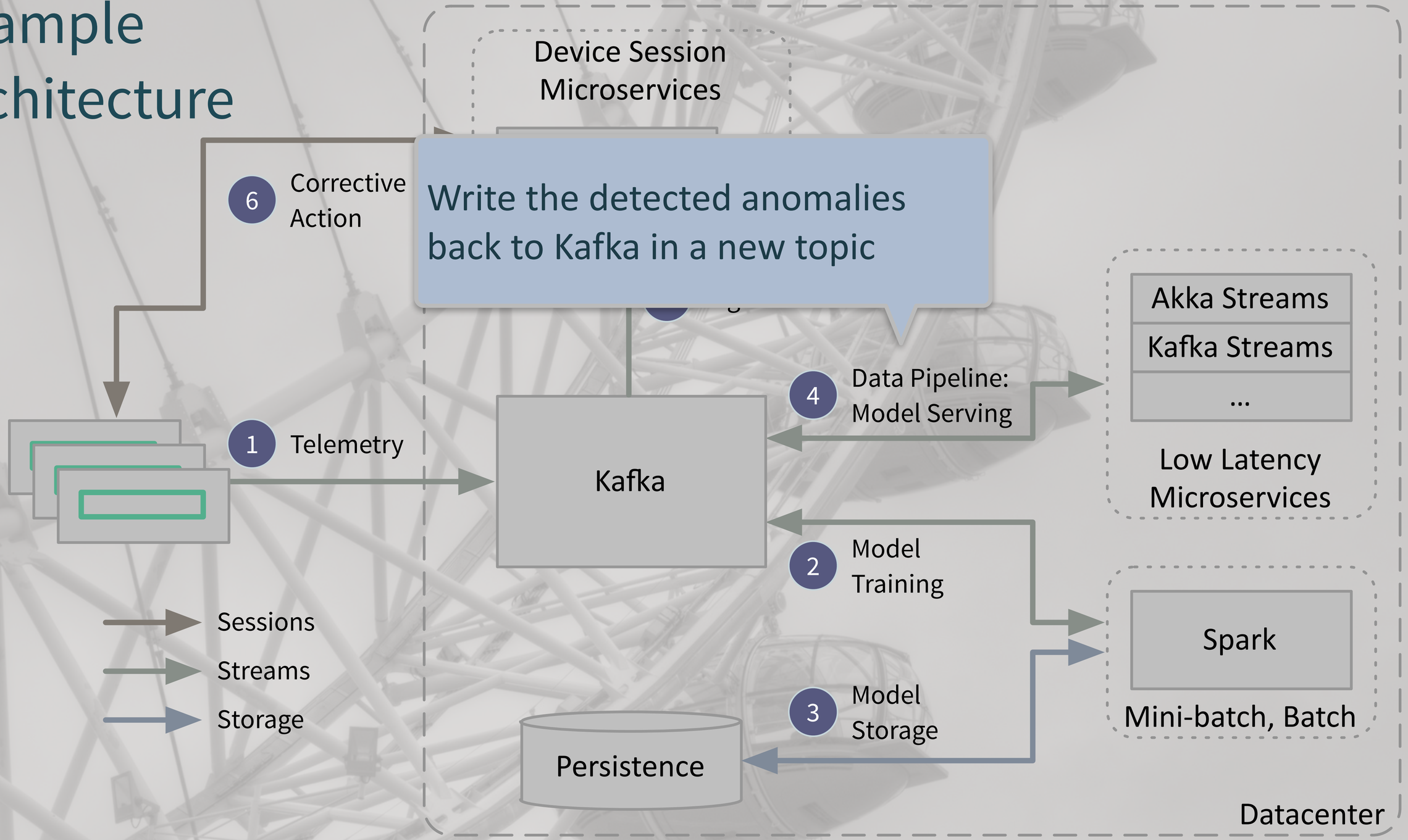

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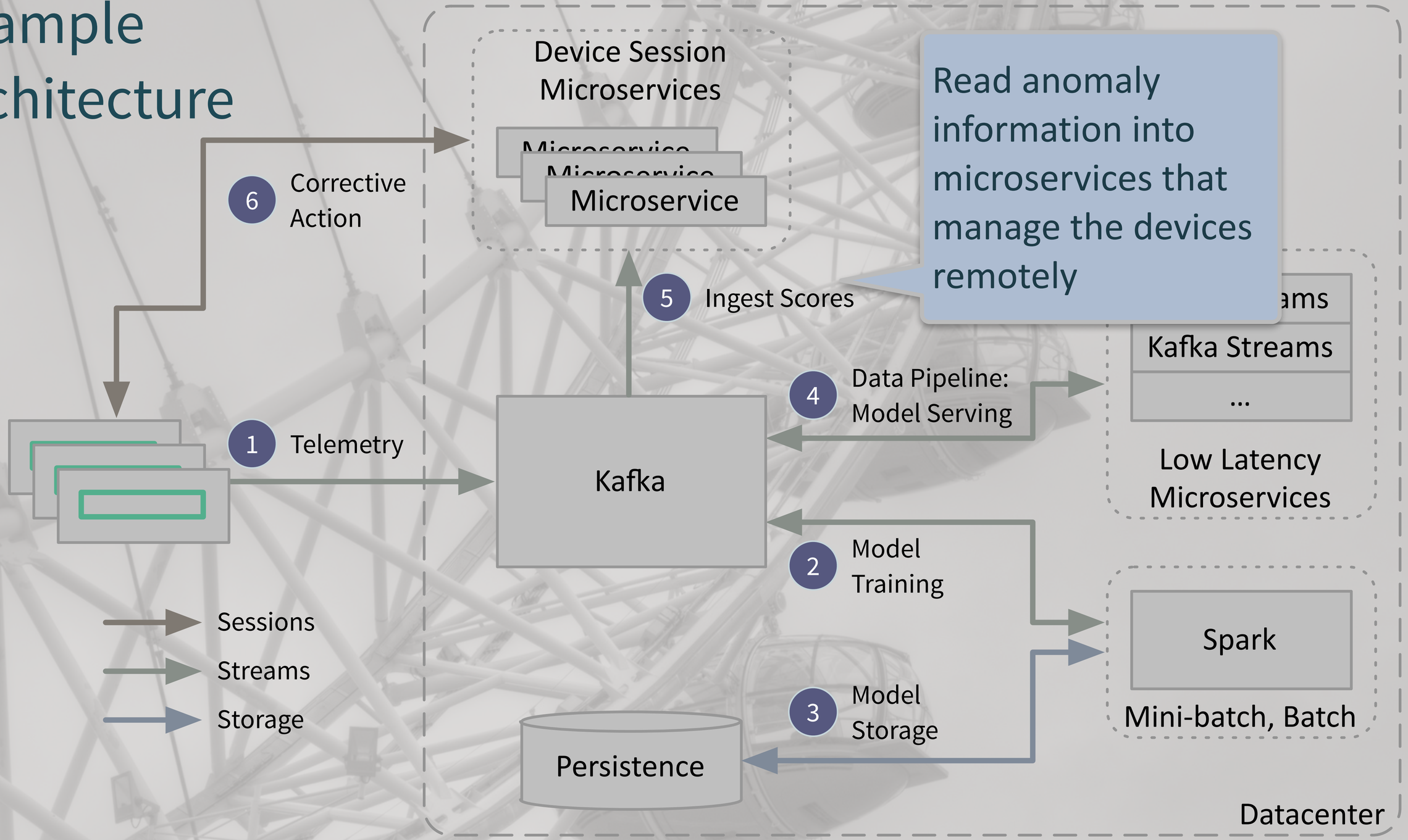

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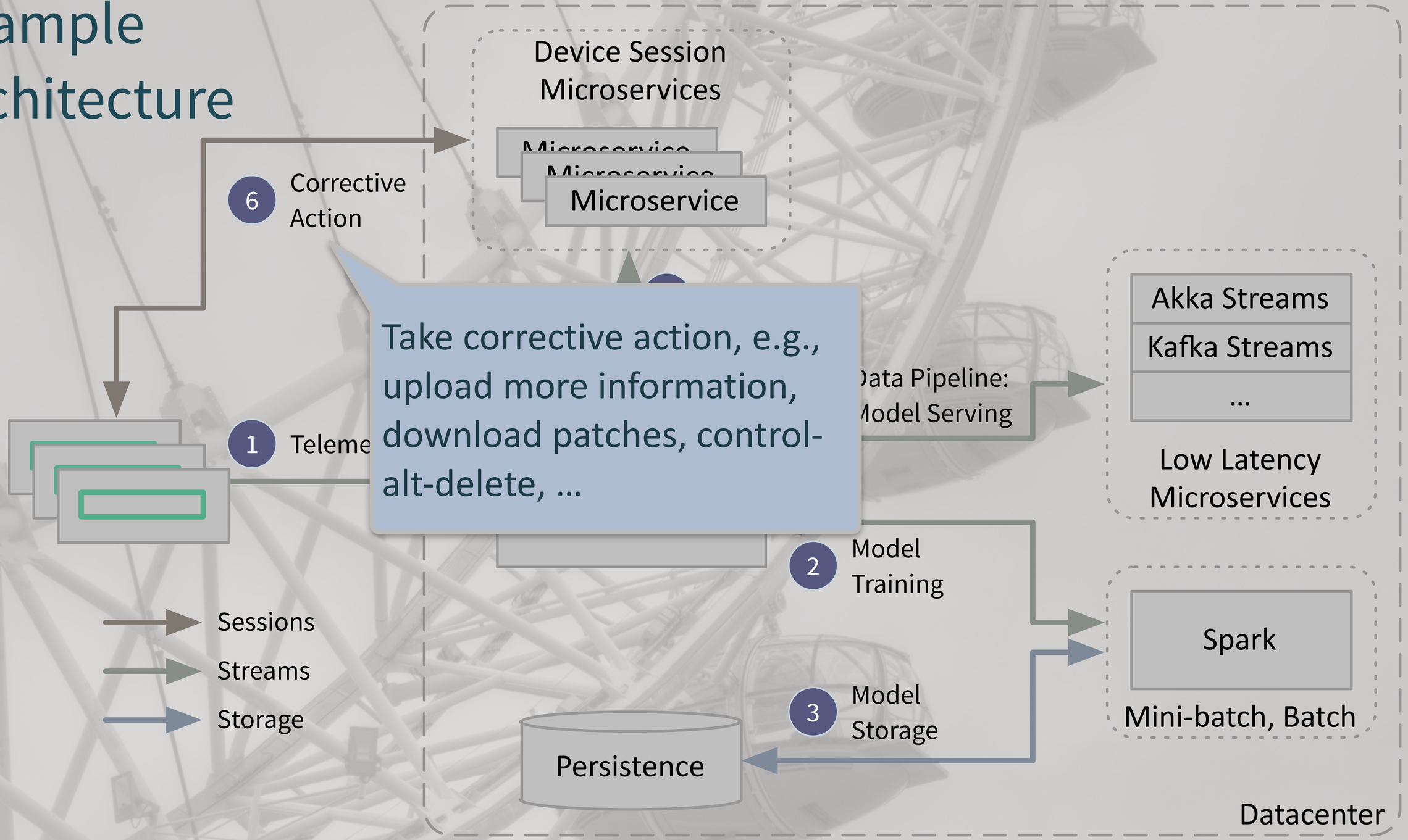
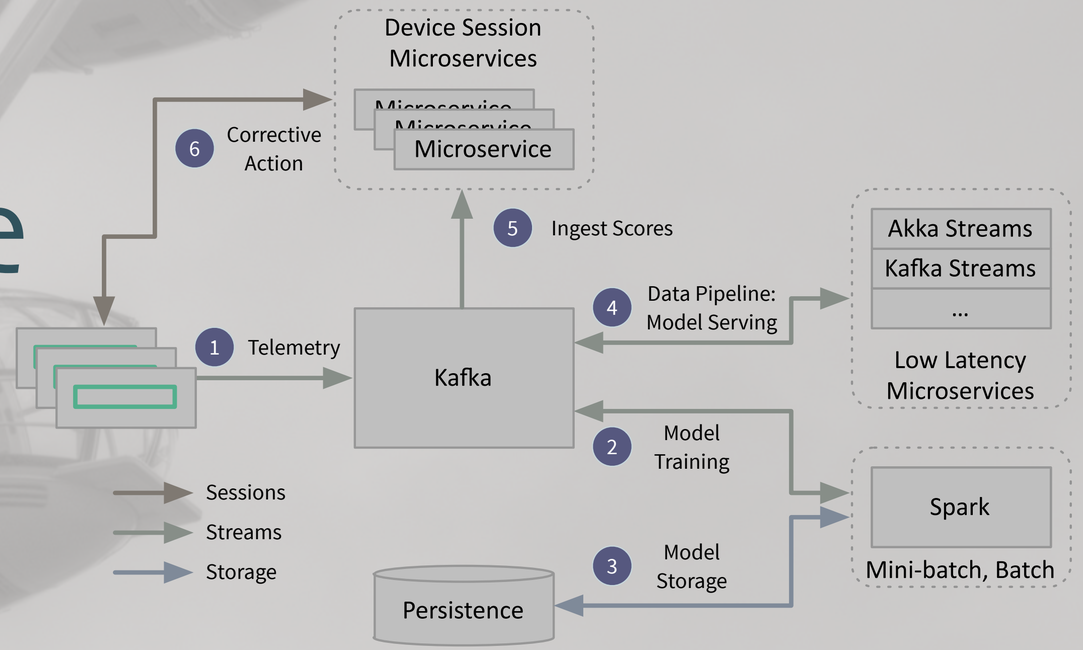


Challenges

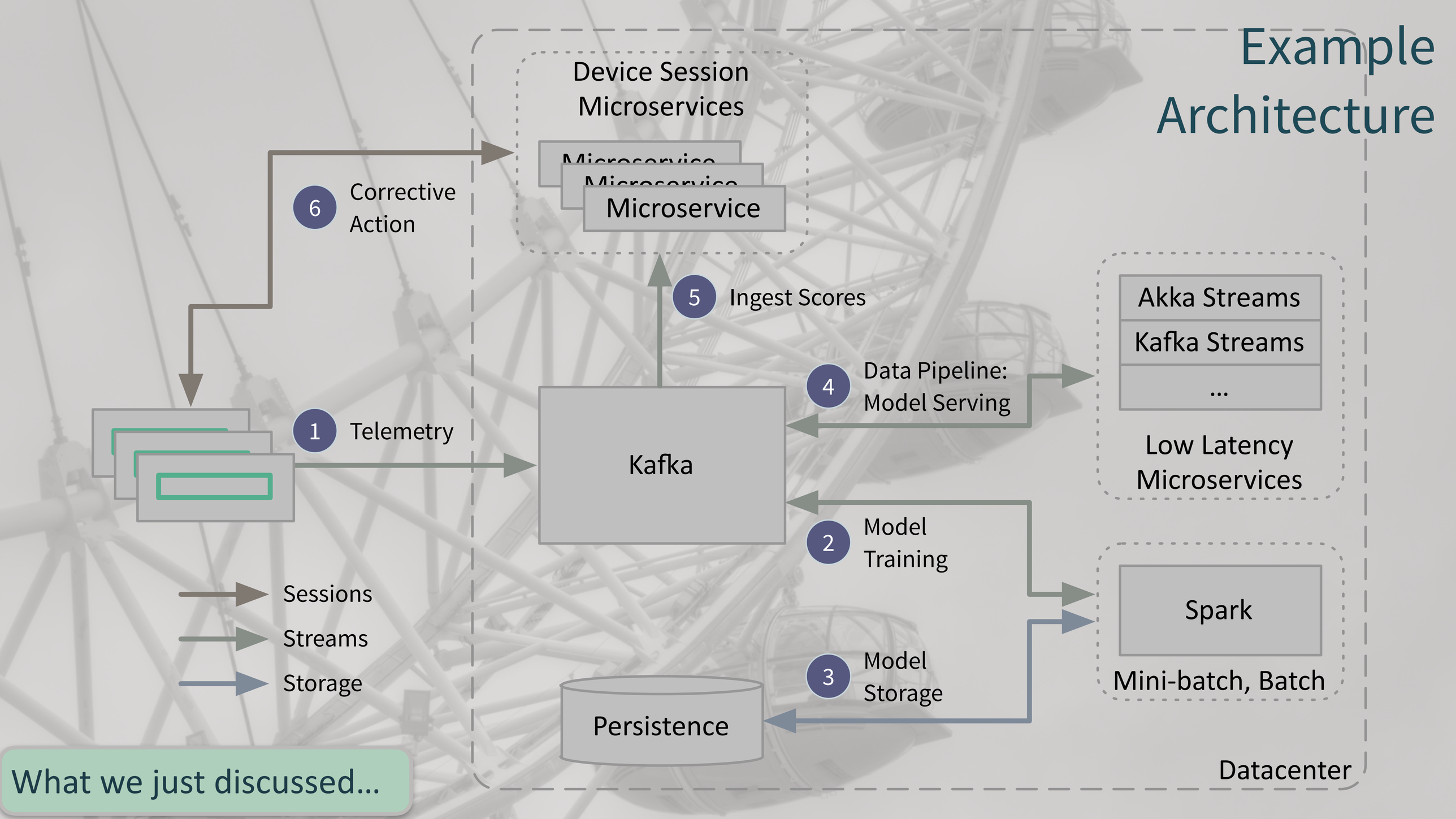
- Network overhead for telemetry ingestion too high?
- Model serving latency too long?
- Idea: Serve model on the device!



Internet of Things

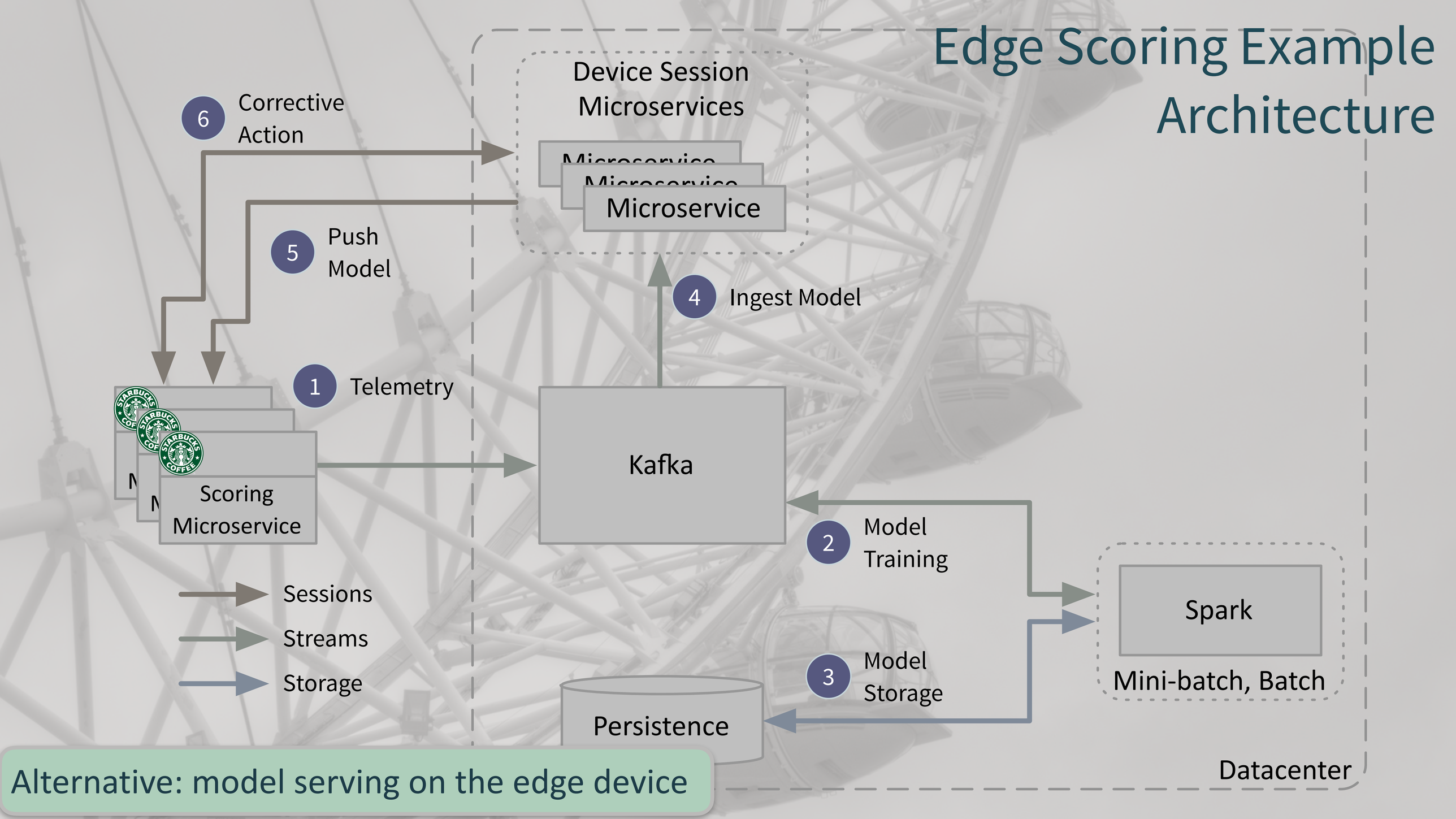
- Real-time consumer and industrial device and supply chain management at scale

Example Architecture



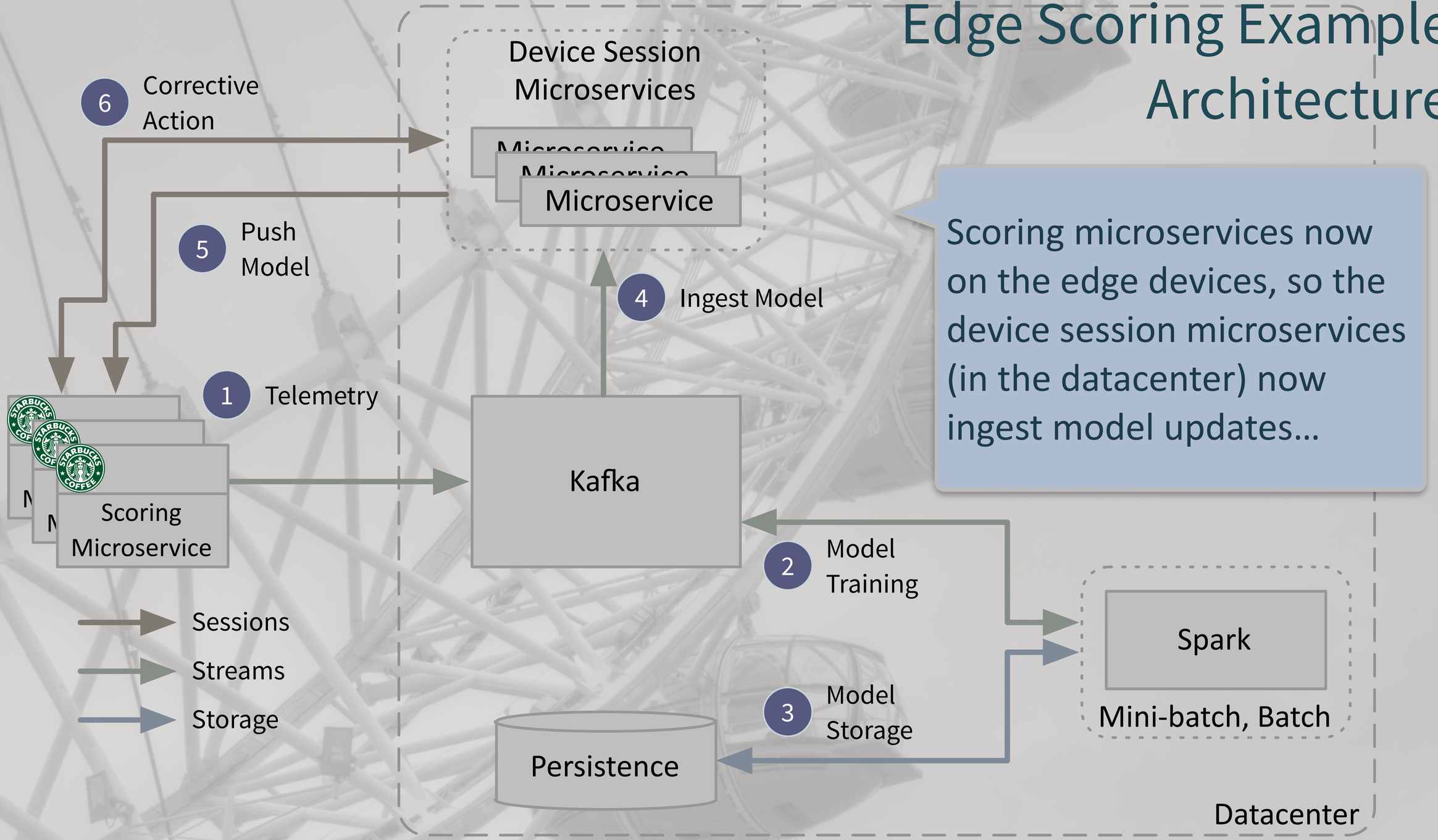
What we just discussed...

Edge Scoring Example Architecture



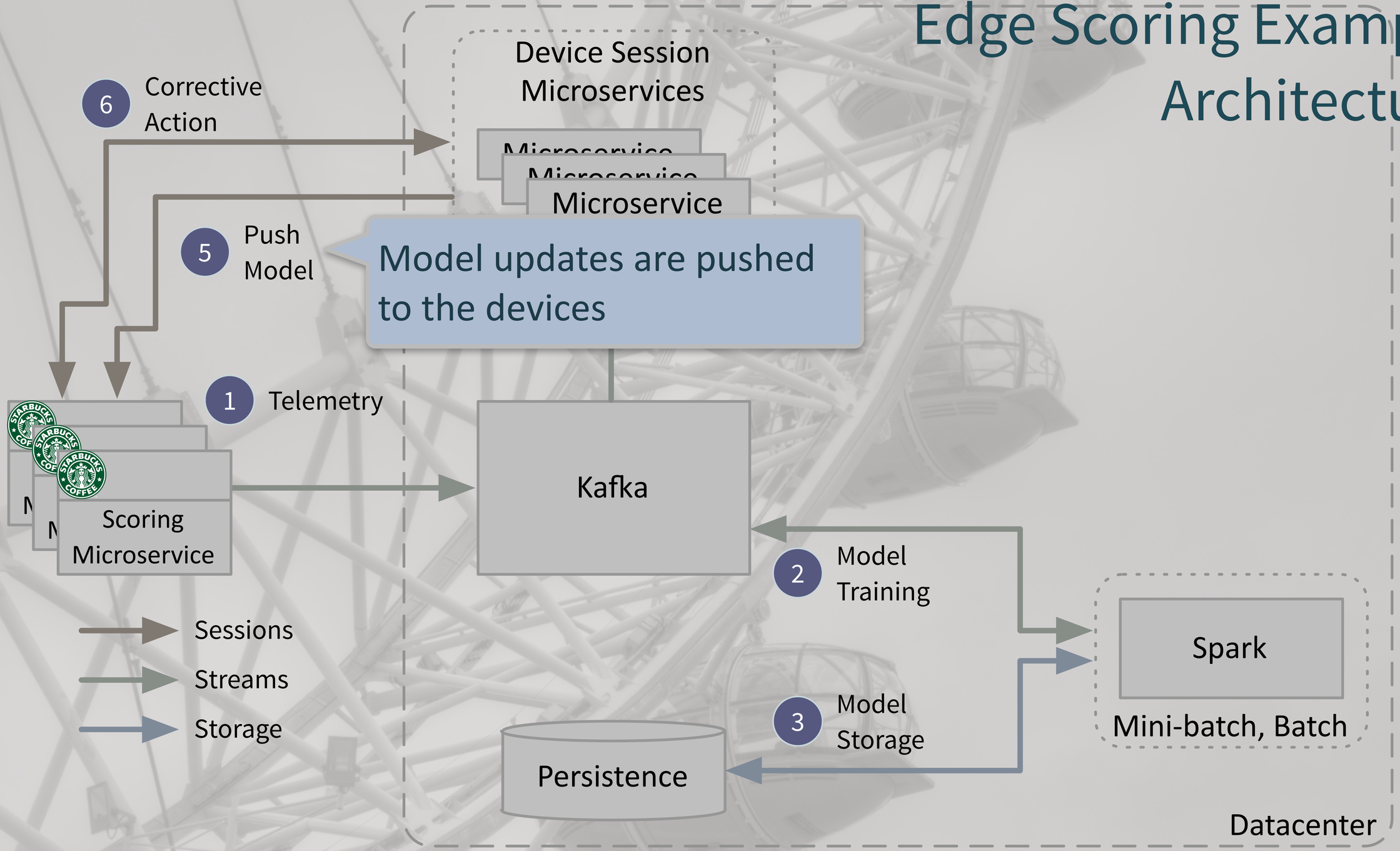
Alternative: model serving on the edge device

Edge Scoring Example Architecture



Scoring microservices now on the edge devices, so the device session microservices (in the datacenter) now ingest model updates…

Edge Scoring Example Architecture



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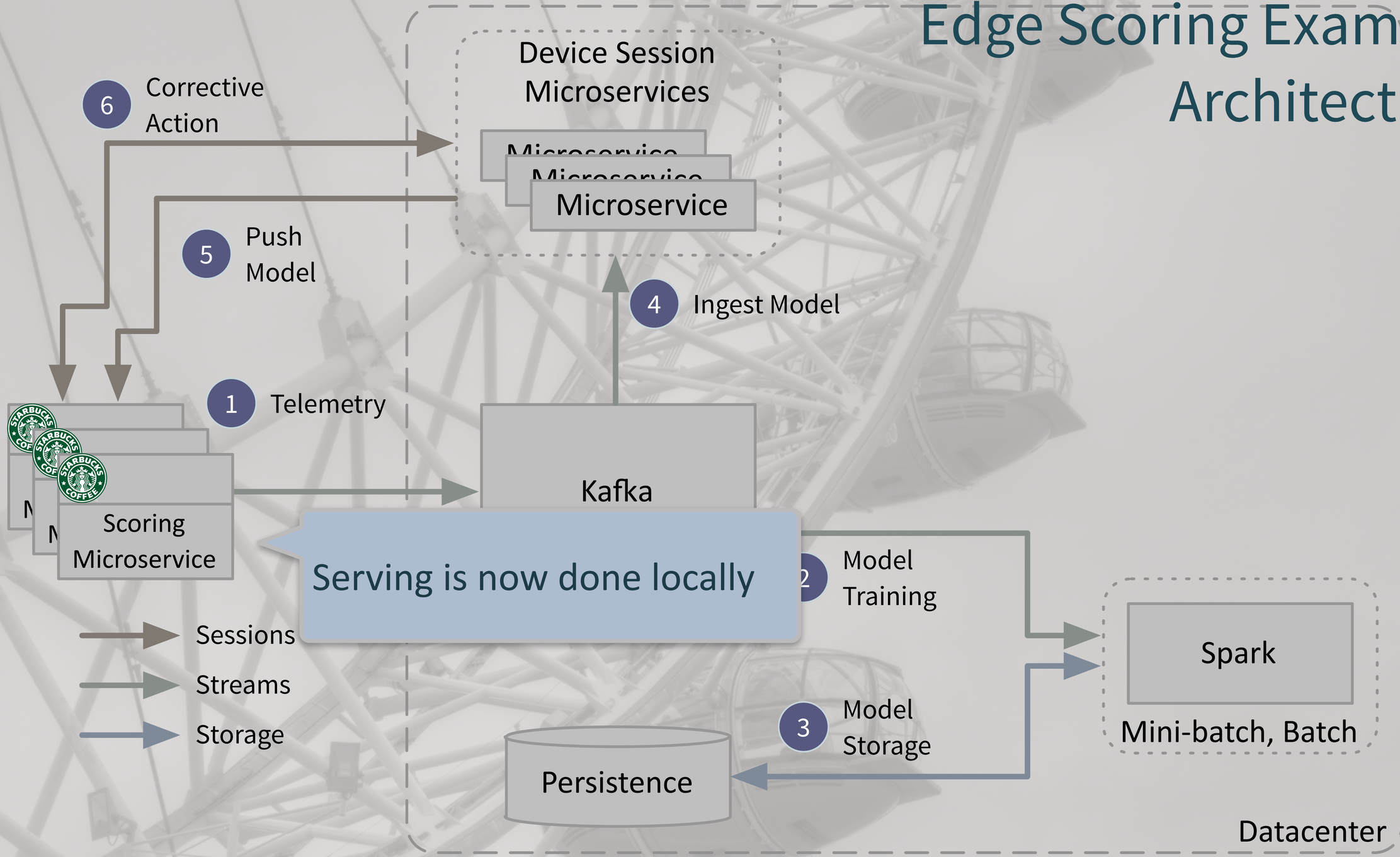
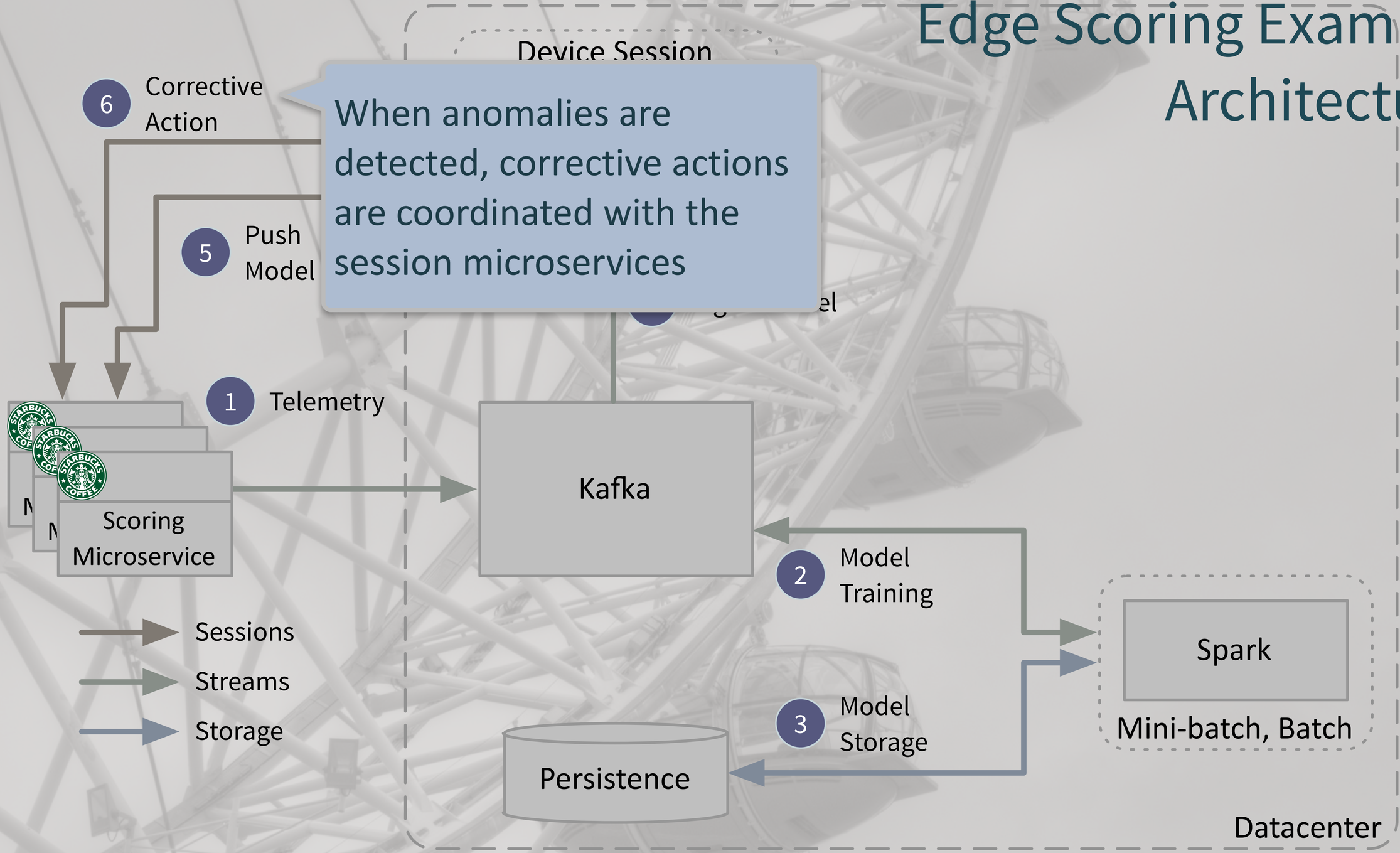


Edge Scoring Example Architecture



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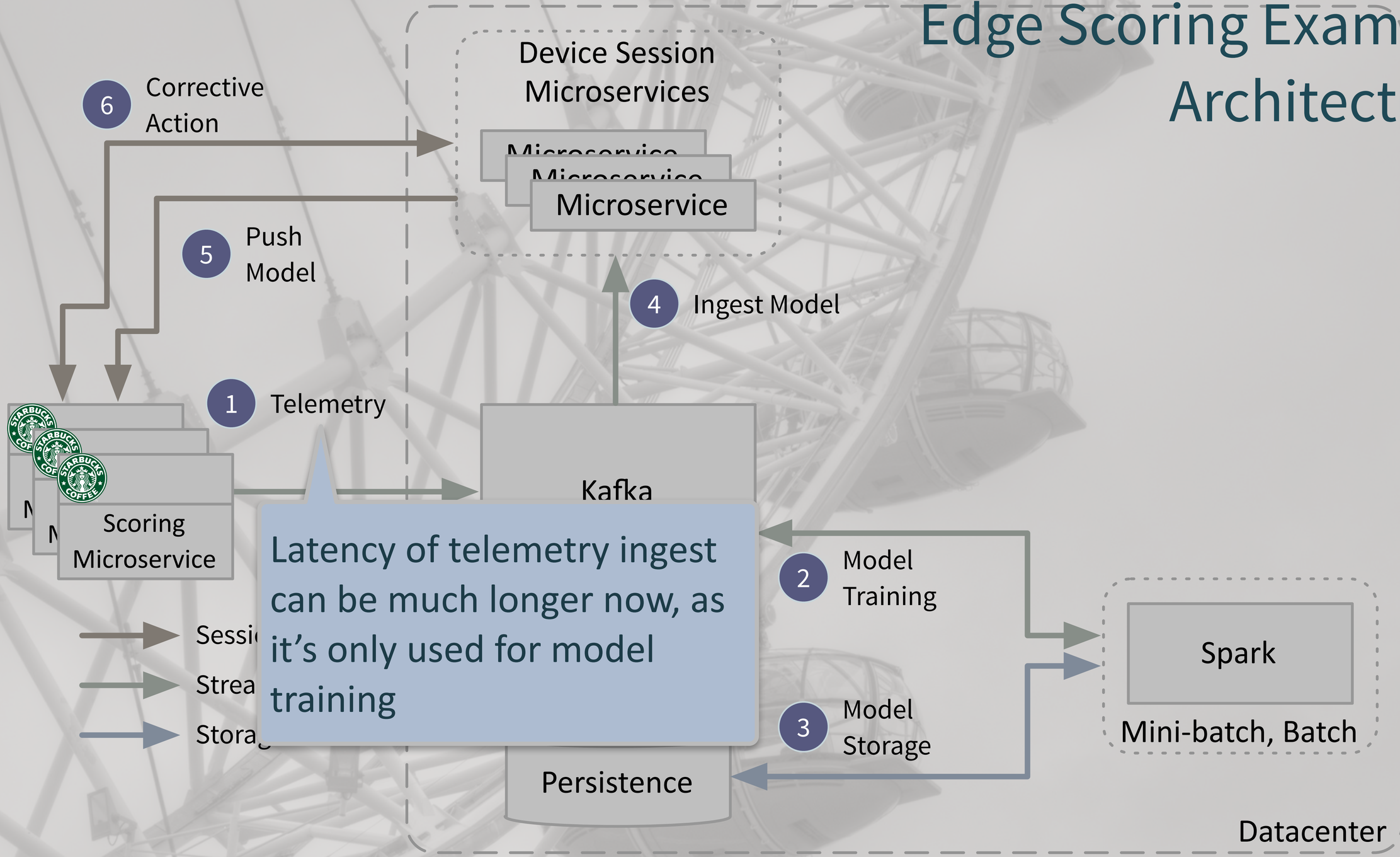

Fas e Cases

Batch -> streaming for competitive advantage

Predictive Analytics	IoT	Real-time Personalization	Real-time Financial Processes	Legacy Modernization
Apply ML models to large volumes of device data to pre-empt failures / outages	Real-time consumer and industrial Device and Supply Chain management at scale	Real-time marketing based on behavior, location, inventory levels, product promotions, etc.	Drive better business outcomes through real-time risk, fraud detection, compliance, audit, governance, etc.	Accelerate decision making processes and optimize infrastructure costs by moving from batch to streaming
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Real-time Personalization

- Model users to provide real-time marketing based on behavior, location, inventory levels, product promotions, etc.

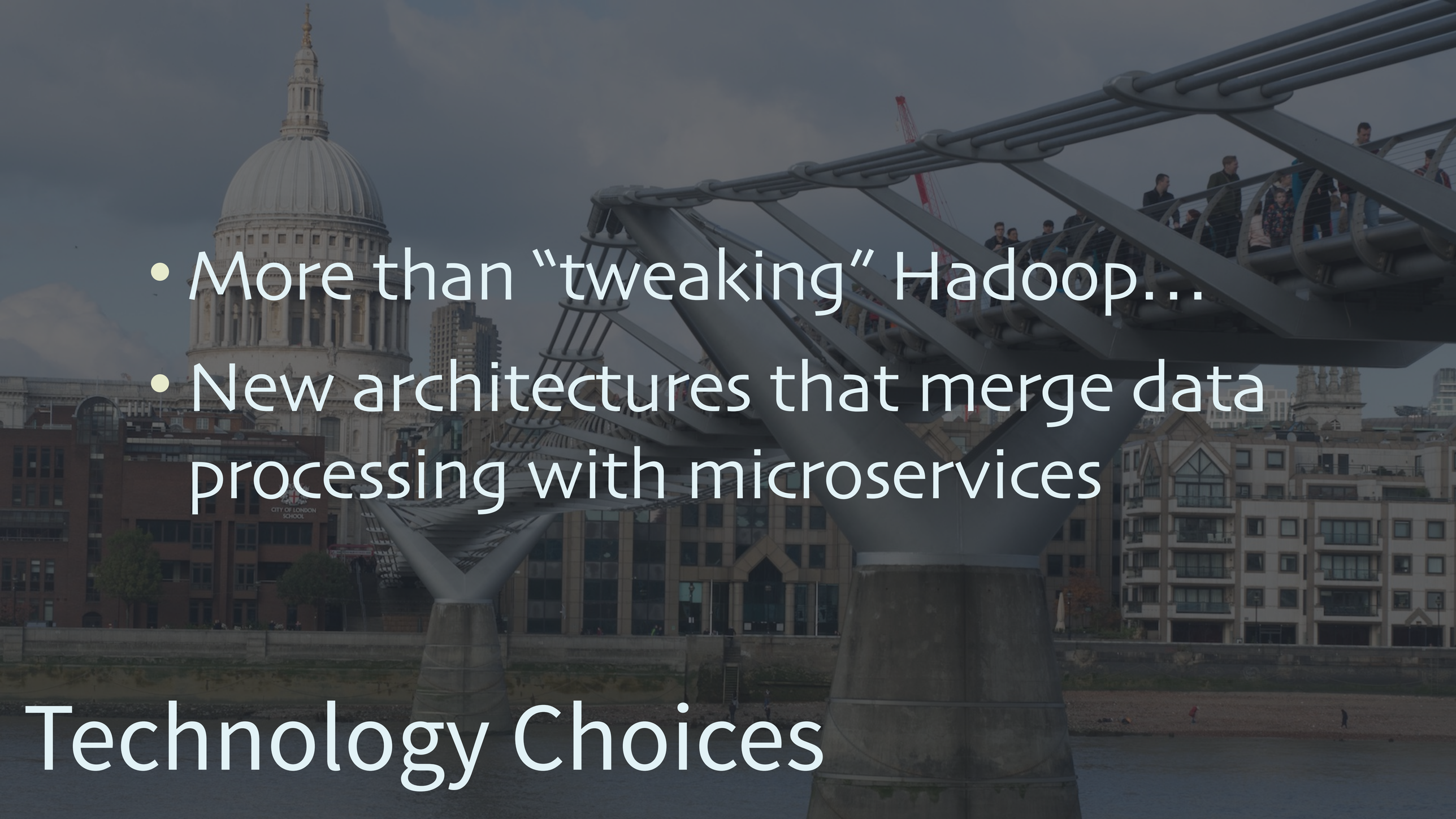
Real-time Financial

- Drive better business outcomes through real-time risk, fraud detection, compliance, audit, governance, etc.

Legacy Modernization

- Accelerate decision making processes and optimize infrastructure costs by moving from batch to streaming
- Hadoop replacement

Technology Choices

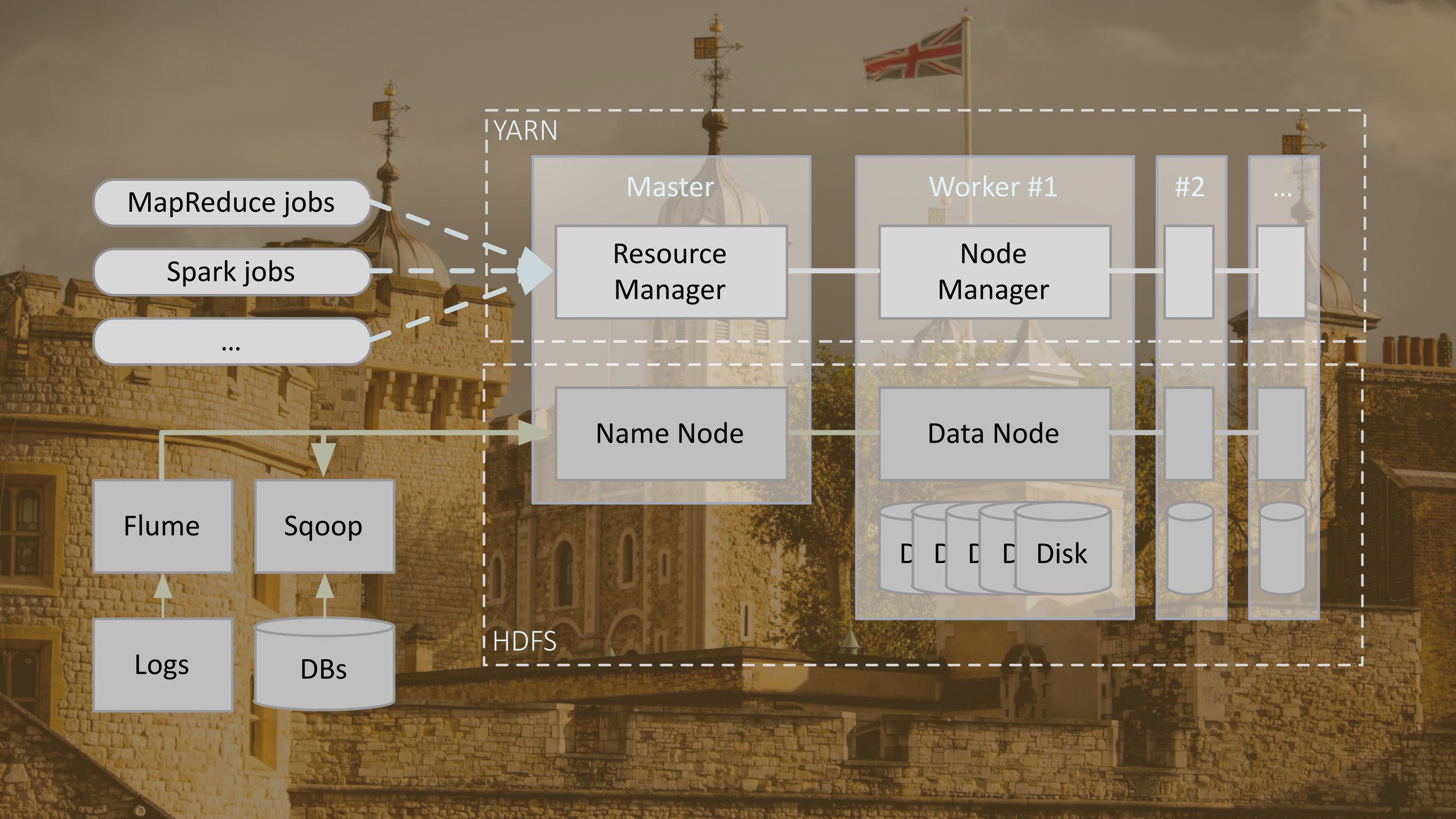


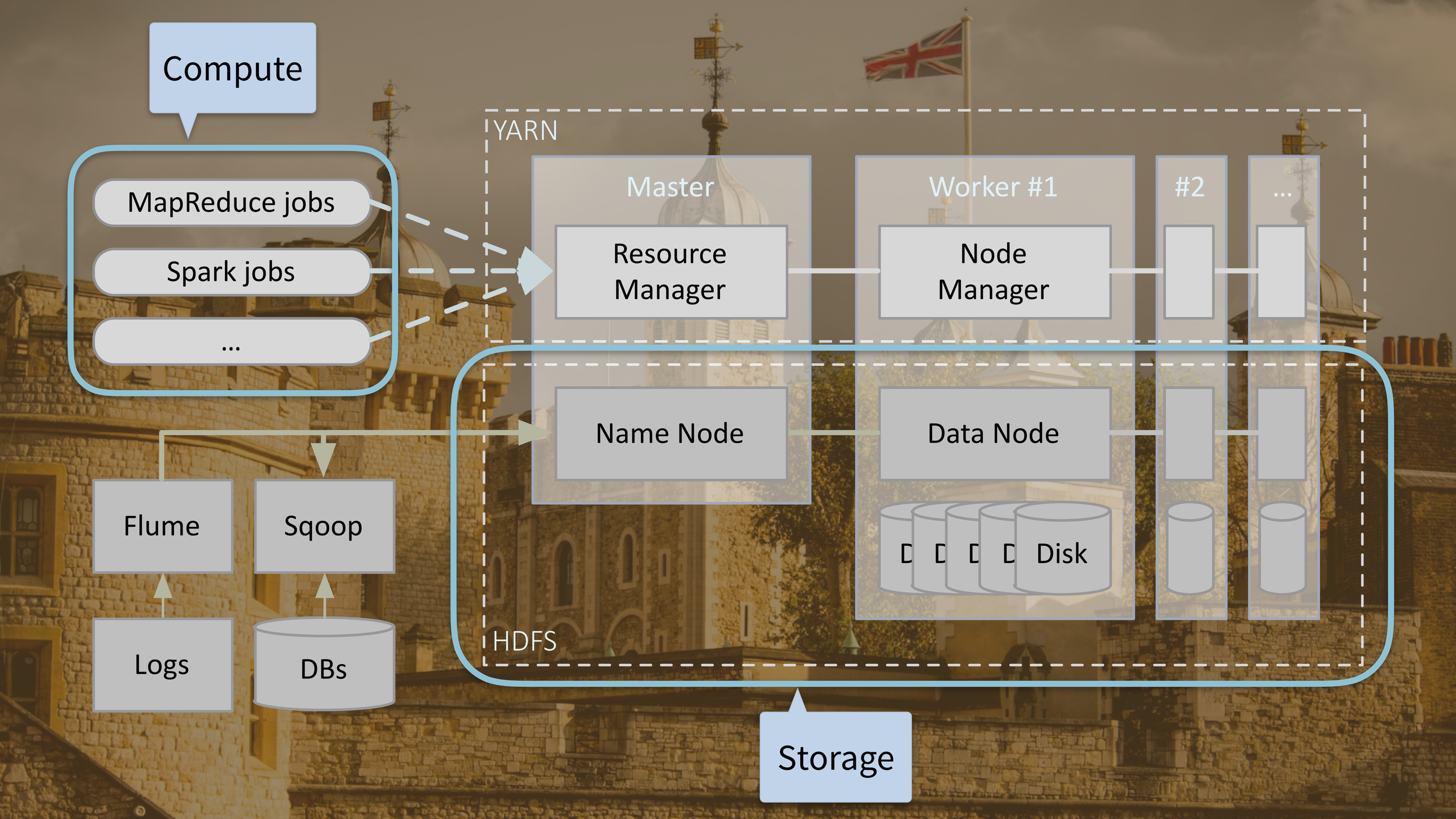
- More than "tweaking" Hadoop…
- New architectures that merge data processing with microservices

Technology Choices

Recall Hadoop…

- Data warehouse replacement
- Historical analysis
- Interactive exploration
- Offline training of machine learning models
- …


YARN
Master
Worker #1
#2
...
MapReduce jobs
Spark jobs
...
Resource Manager
Node Manager
Name Node
Data Node
Disk
Flume
Sqoop
Logs
DBs
HDFS


Compute
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Node Manager
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...
Name Node
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HDFS
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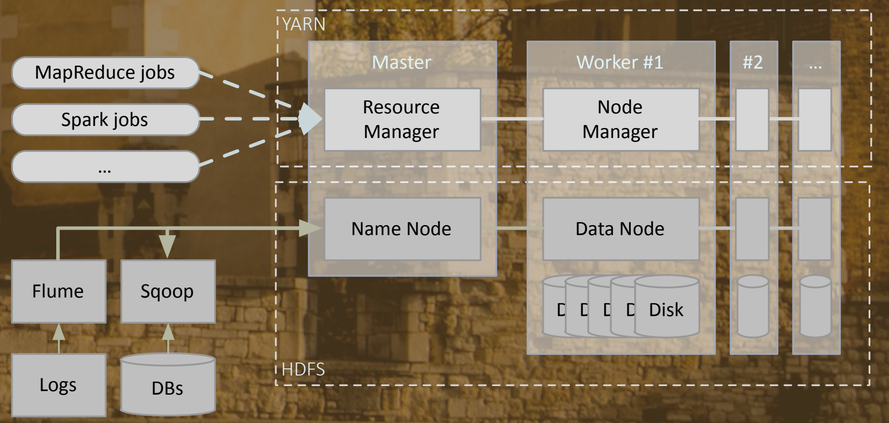
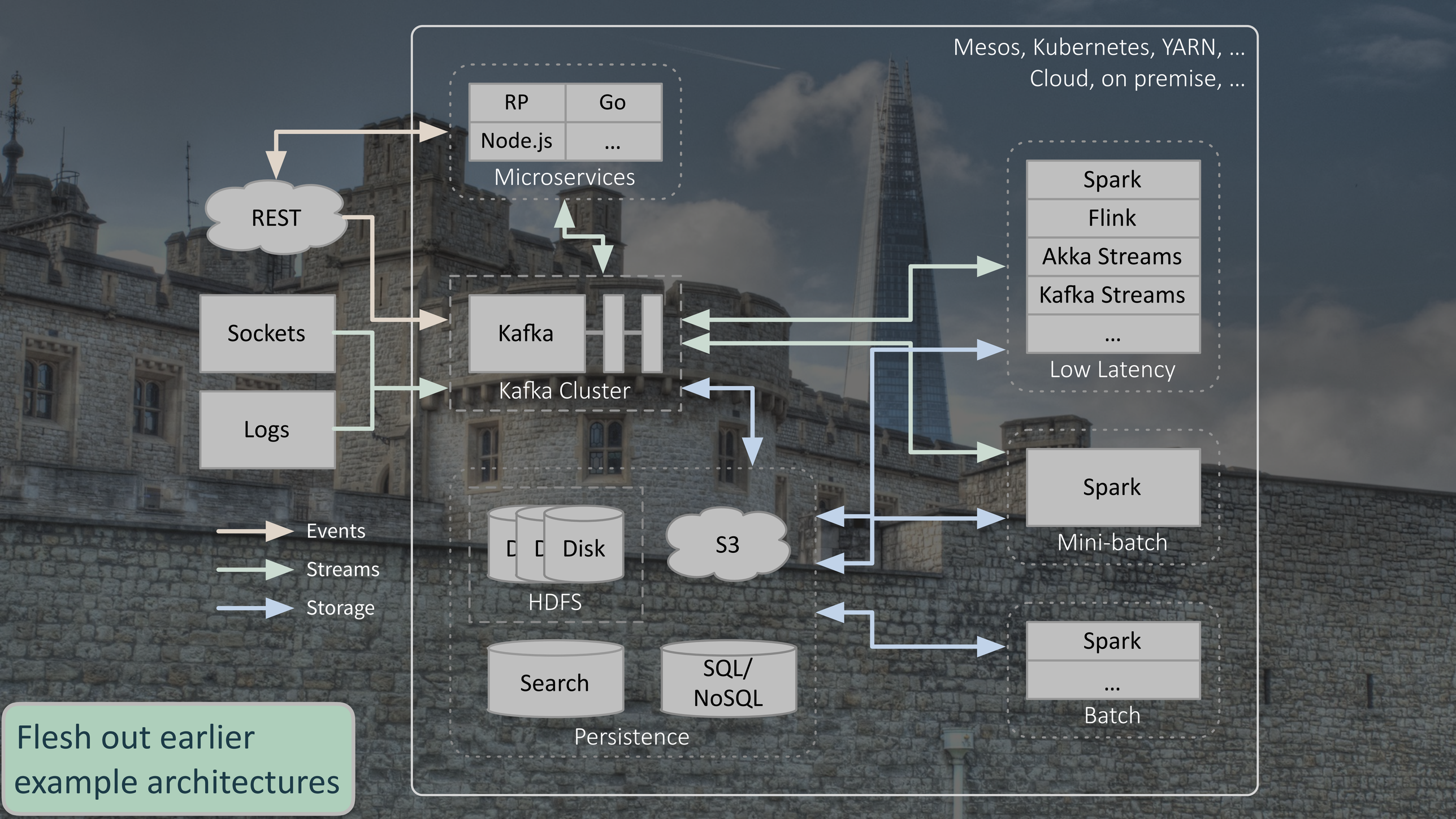
Logs
DBs
Storage

- Hadoop is ideal for batch and interactive apps
- … but also constrained by that model



New Fast Data Architecture


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Go
Node.js
…
Microservices
REST
Sockets
Logs
Kafka
Kafka Cluster
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Spark
…
Batch
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Persistence
Events
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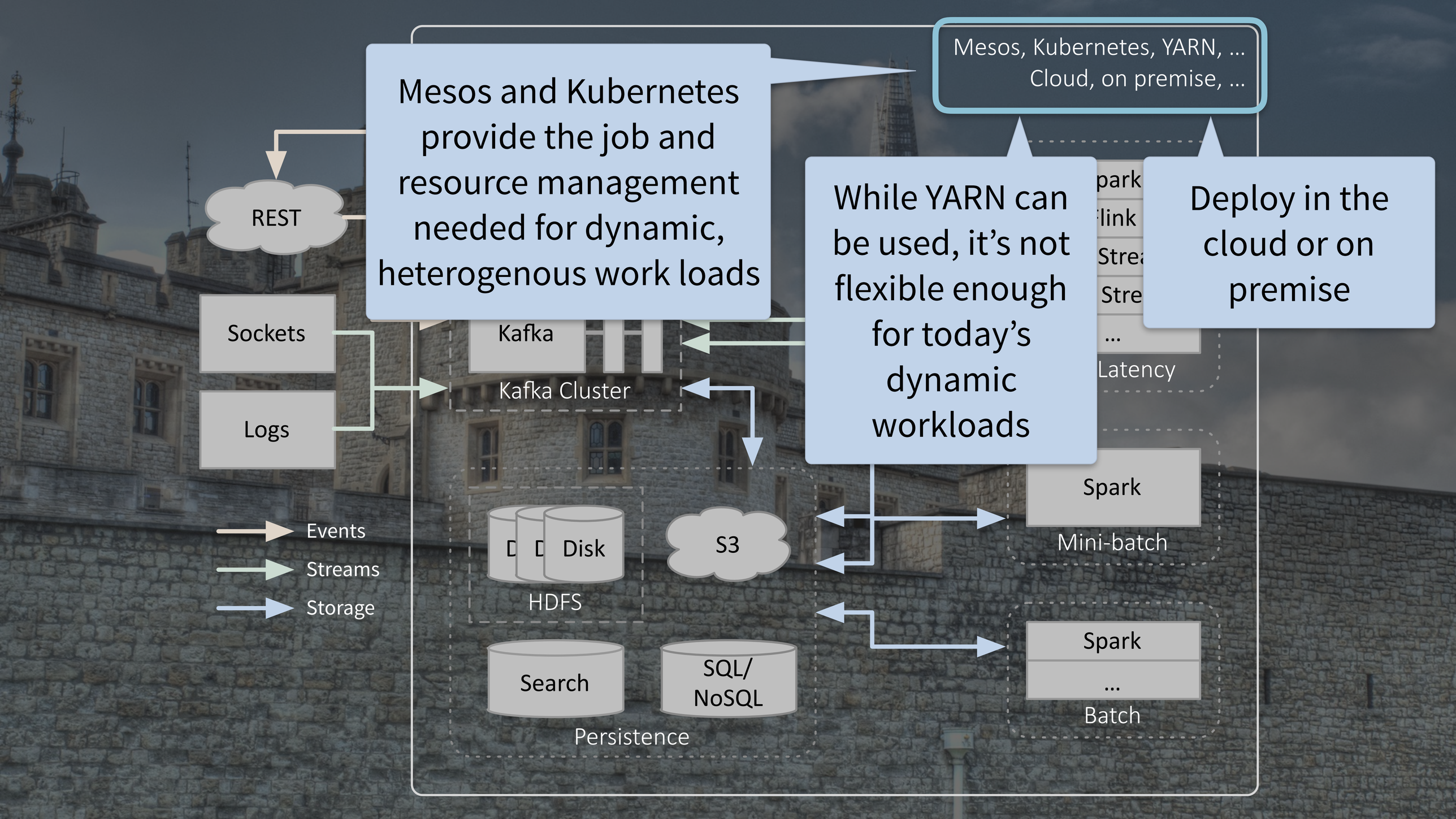
Storage
Flesh out earlier
example architectures


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
Mesos and Kubernetes provide the job and resource management needed for dynamic, heterogenous work loads
While YARN can be used, it's not flexible enough for today's dynamic workloads
Deploy in the cloud or on premise
REST
Sockets
Logs
Kafka
Kafka Cluster
park
link
Strea
Stre
…
Latency
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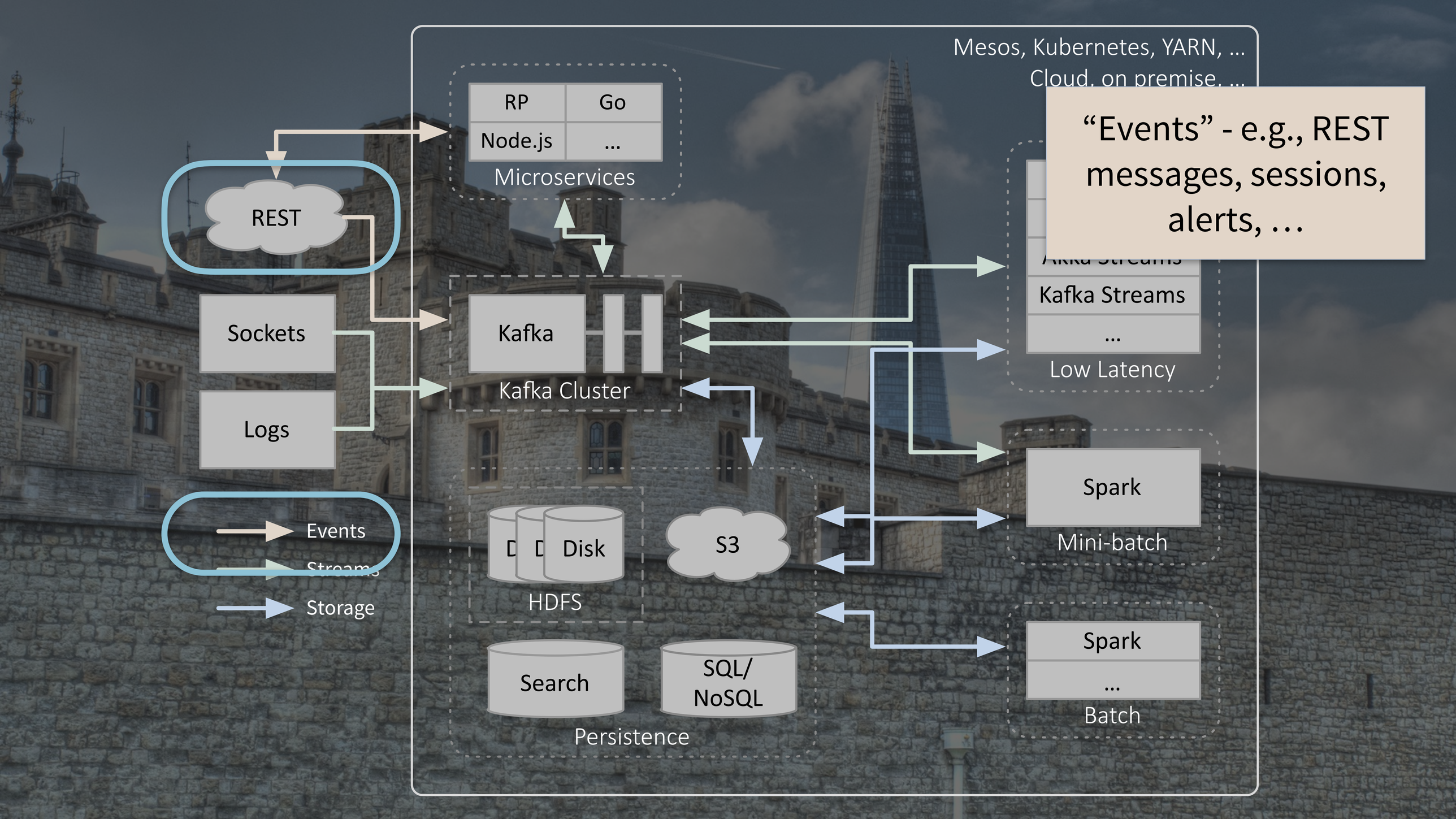
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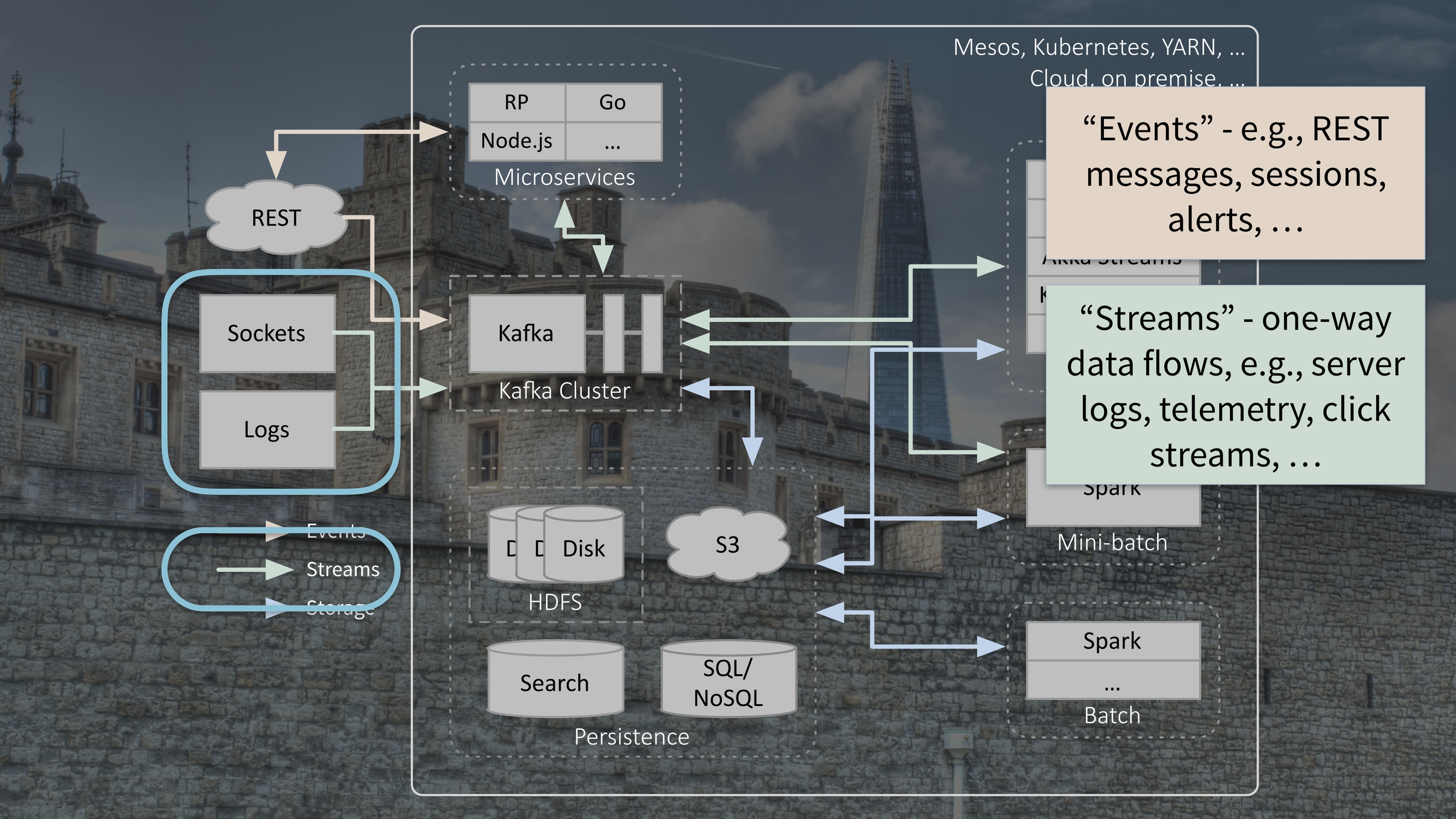
“Events” - e.g., REST messages, sessions, alerts, …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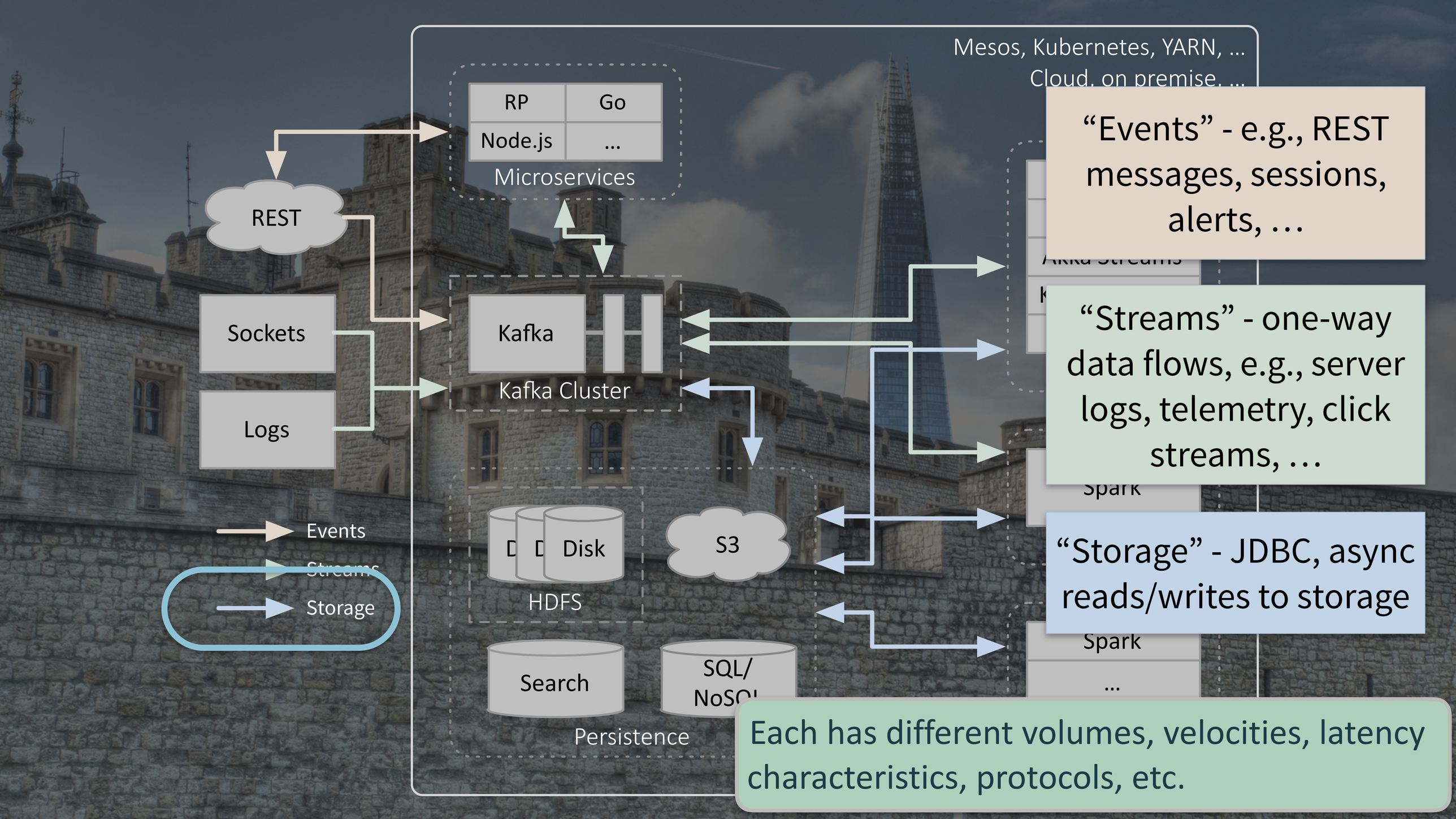
“Streams” - one-way data flows, e.g., server logs, telemetry, click streams, …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Events
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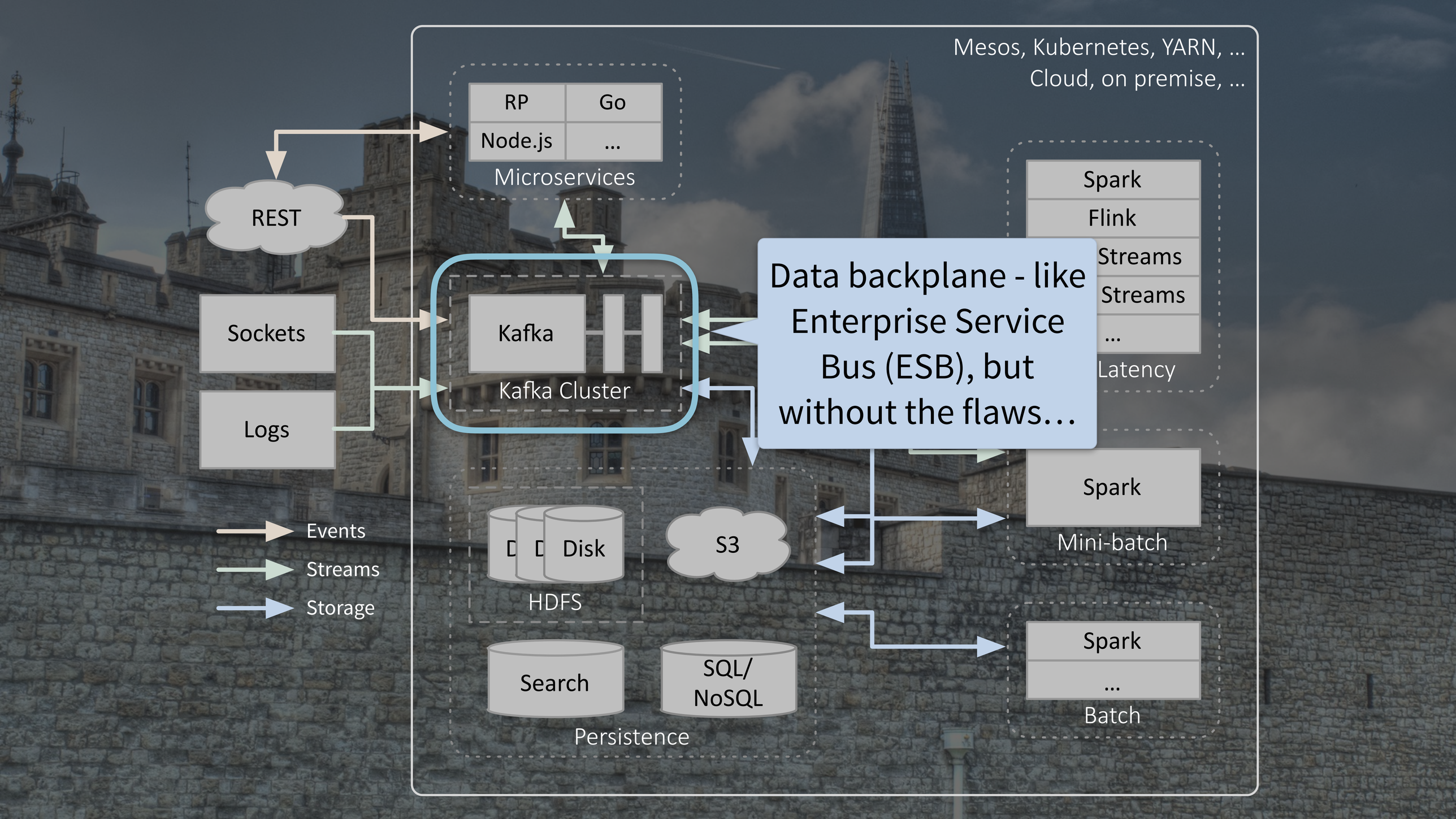
“Events” - e.g., REST messages, sessions, alerts, …
“Streams” - one-way data flows, e.g., server logs, telemetry, click streams, …
“Storage” - JDBC, async reads/writes to storage
Each has different volumes, velocities, latency characteristics, protocols, etc.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Data backplane - like Enterprise Service Bus (ESB), but without the flaws…
Spark
Flink
Streams
Streams
…
Latency
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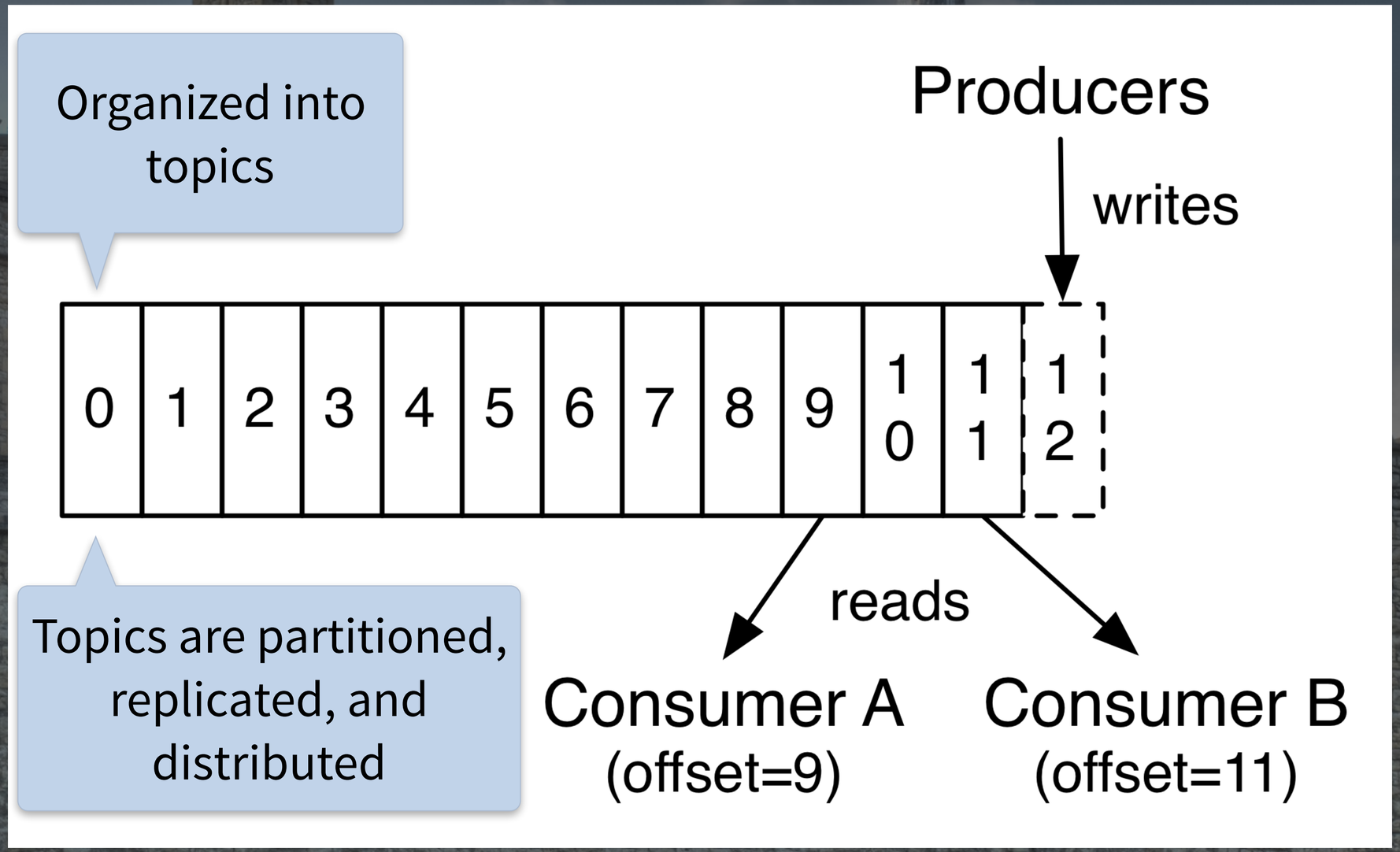
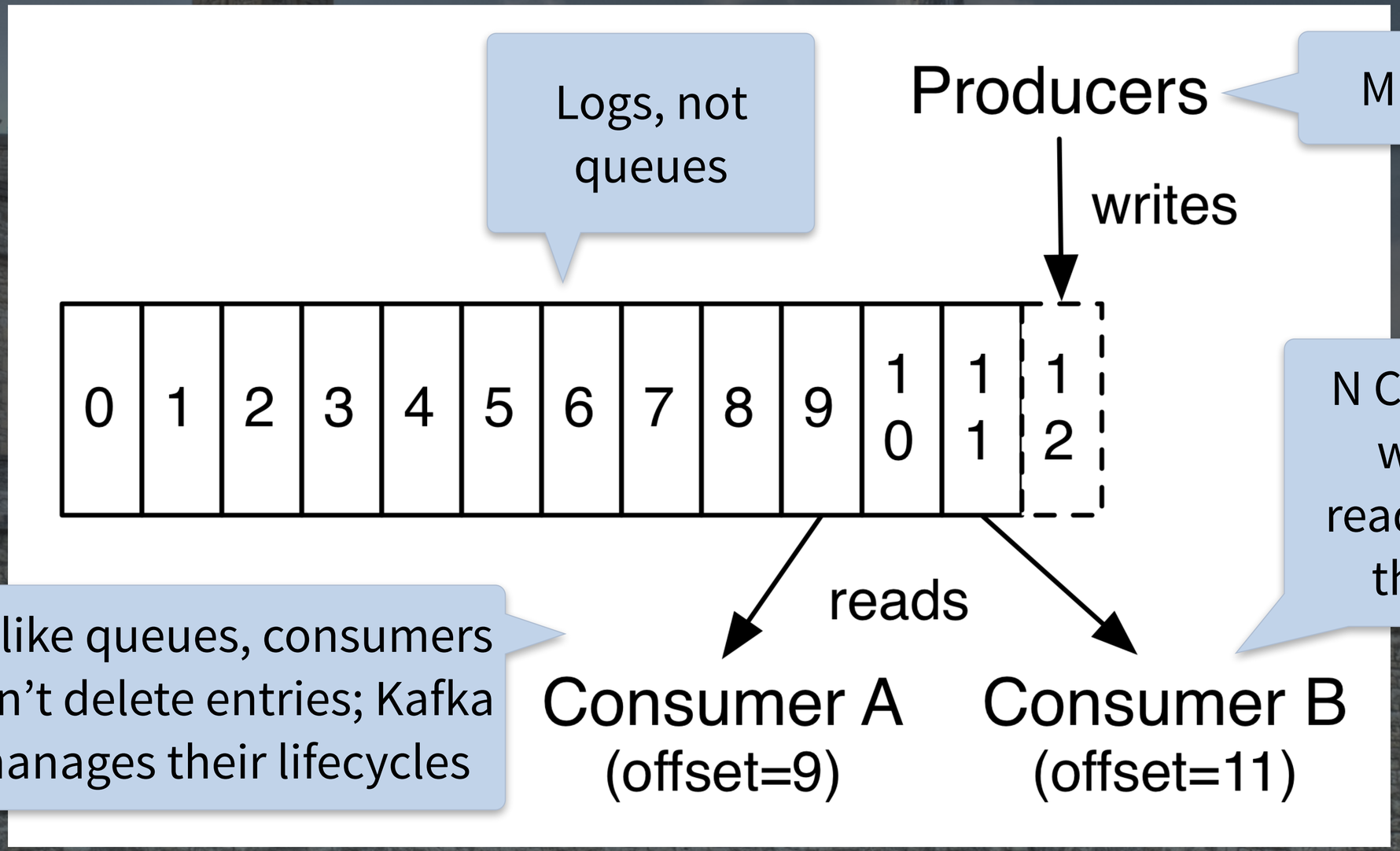
Storage

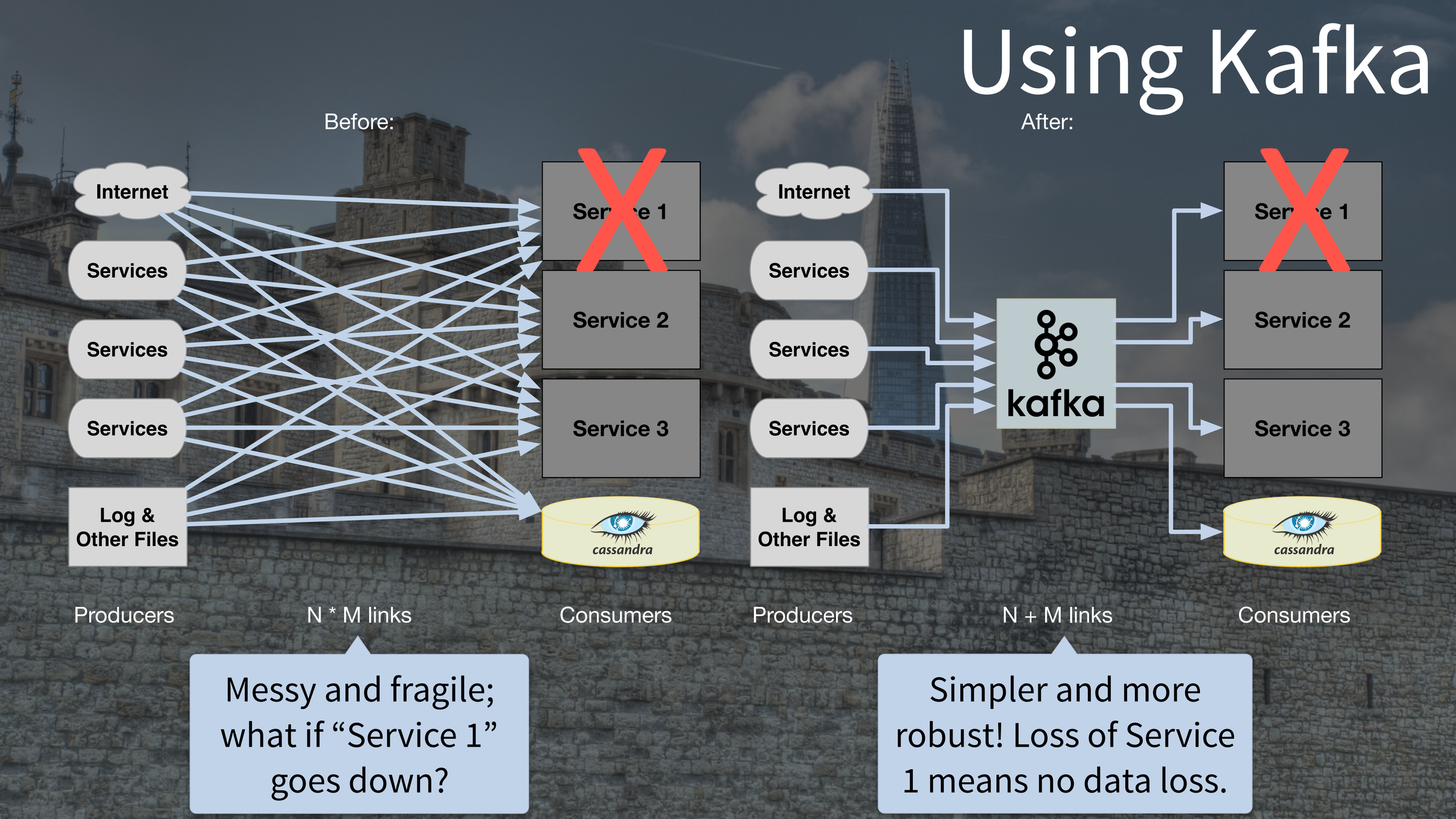
Why Kafka?


Organized into topics
Producers
writes
0
1
2
3
4
5
6
7
8
9
10
11
12
reads
Consumer A
(offset=9)
Consumer B
(offset=11)
Topics are partitioned, replicated, and distributed

Why Kafka?

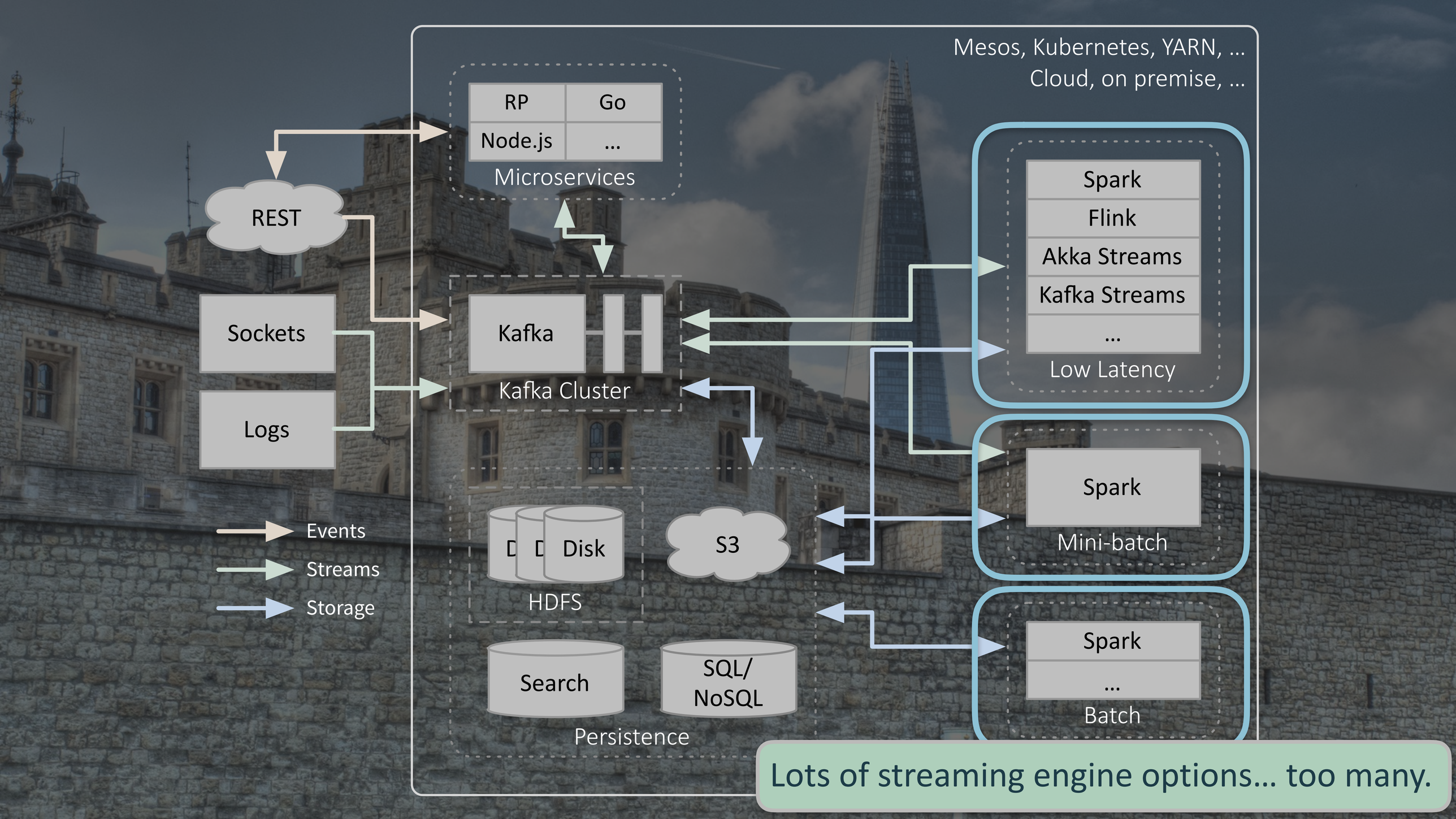

Logs, not queues
Producers
M Producers
writes
0
1
2
3
4
5
6
7
8
9
10
11
12
N Consumers, who start reading where they want
reads
Unlike queues, consumers don’t delete entries; Kafka manages their lifecycles
Consumer A
(offset=9)
Consumer B
(offset=11)

Using Kafka



Messy and fragile; what if “Service 1” goes down?

Simpler and more robust! Loss of Service 1 means no data loss.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Streams
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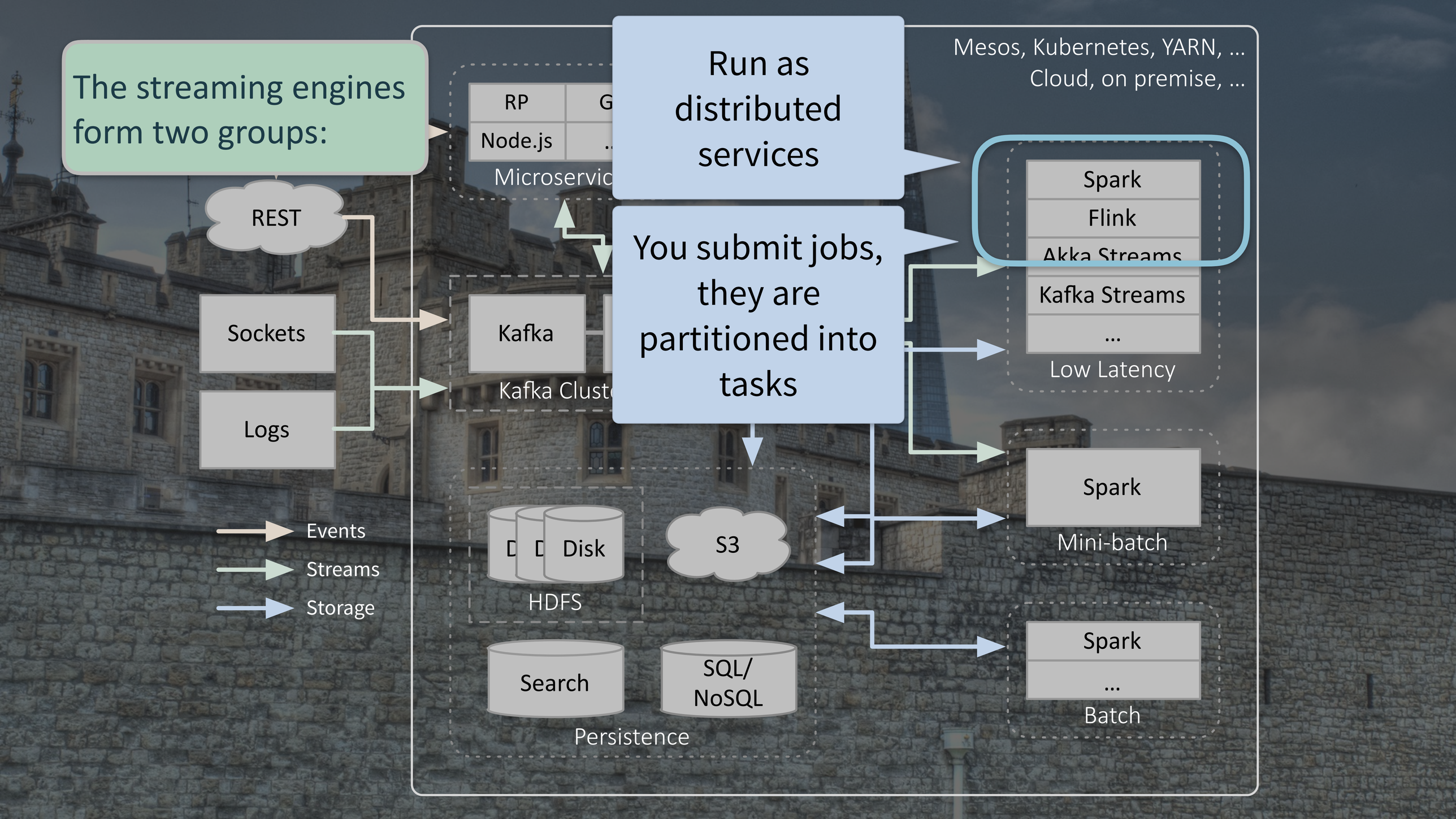
Lots of streaming engine options… too many.

How do you choose?

- Latency? How low?
- Volume: How high?
- Which kinds of data processing?
- How do you want to build, deploy, and manage these services?


The streaming engines form two groups:
Run as distributed services
You submit jobs, they are partitioned into tasks
Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Node.js
Microservic
REST
Sockets
Logs
Kafka
Kafka Clust
Spark
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Akka Streams
Kafka Streams
…
Low Latency
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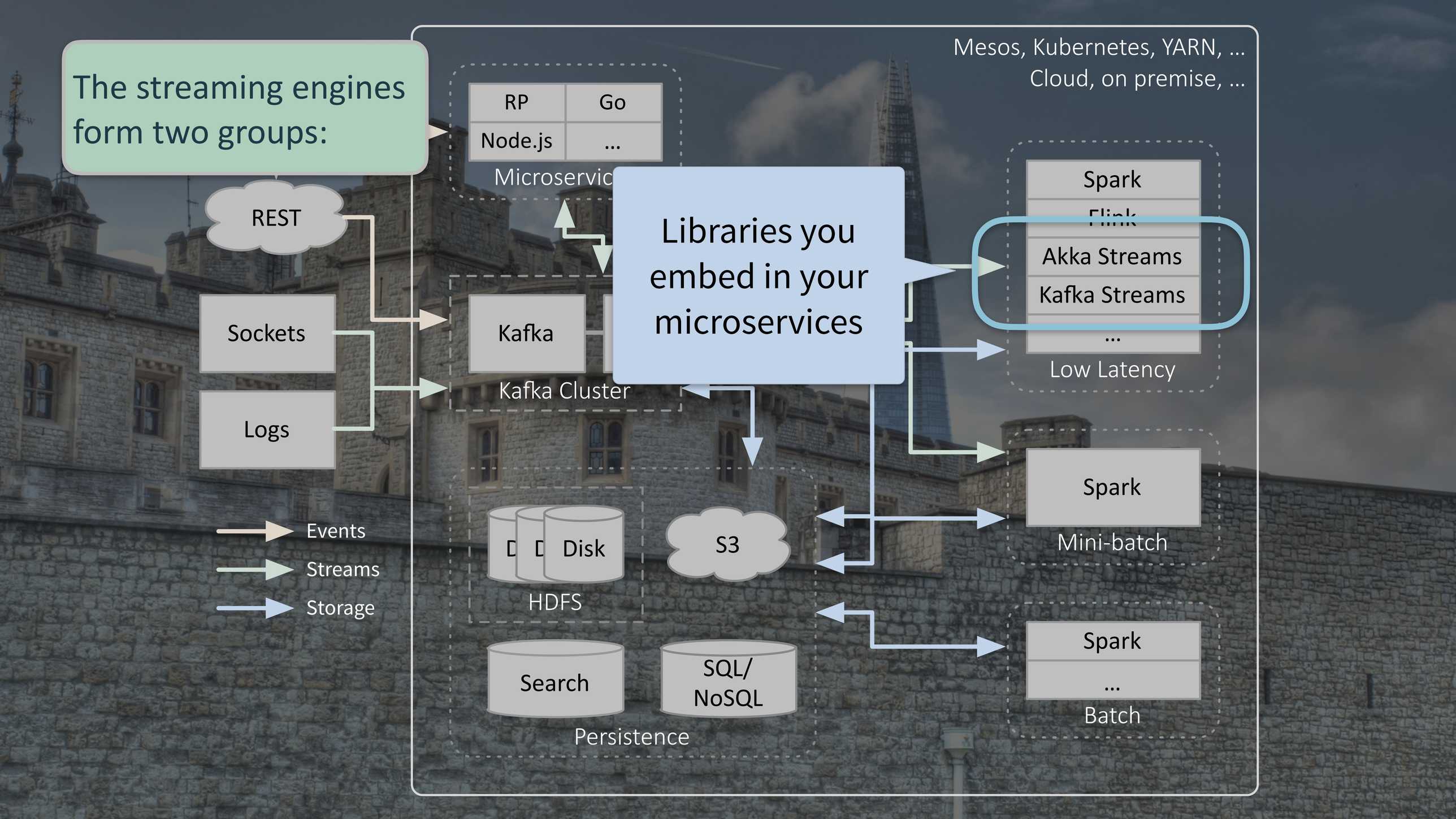
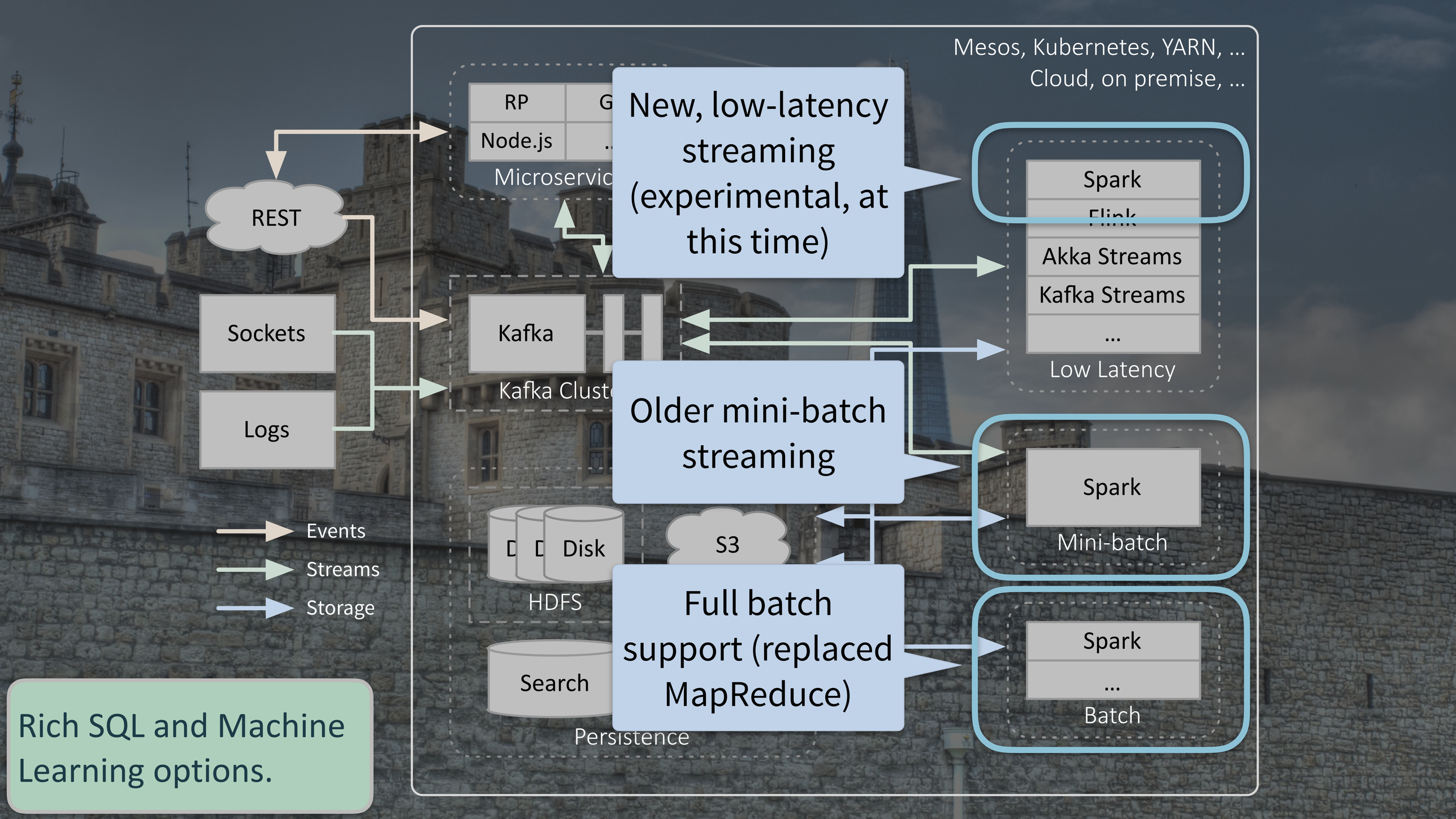
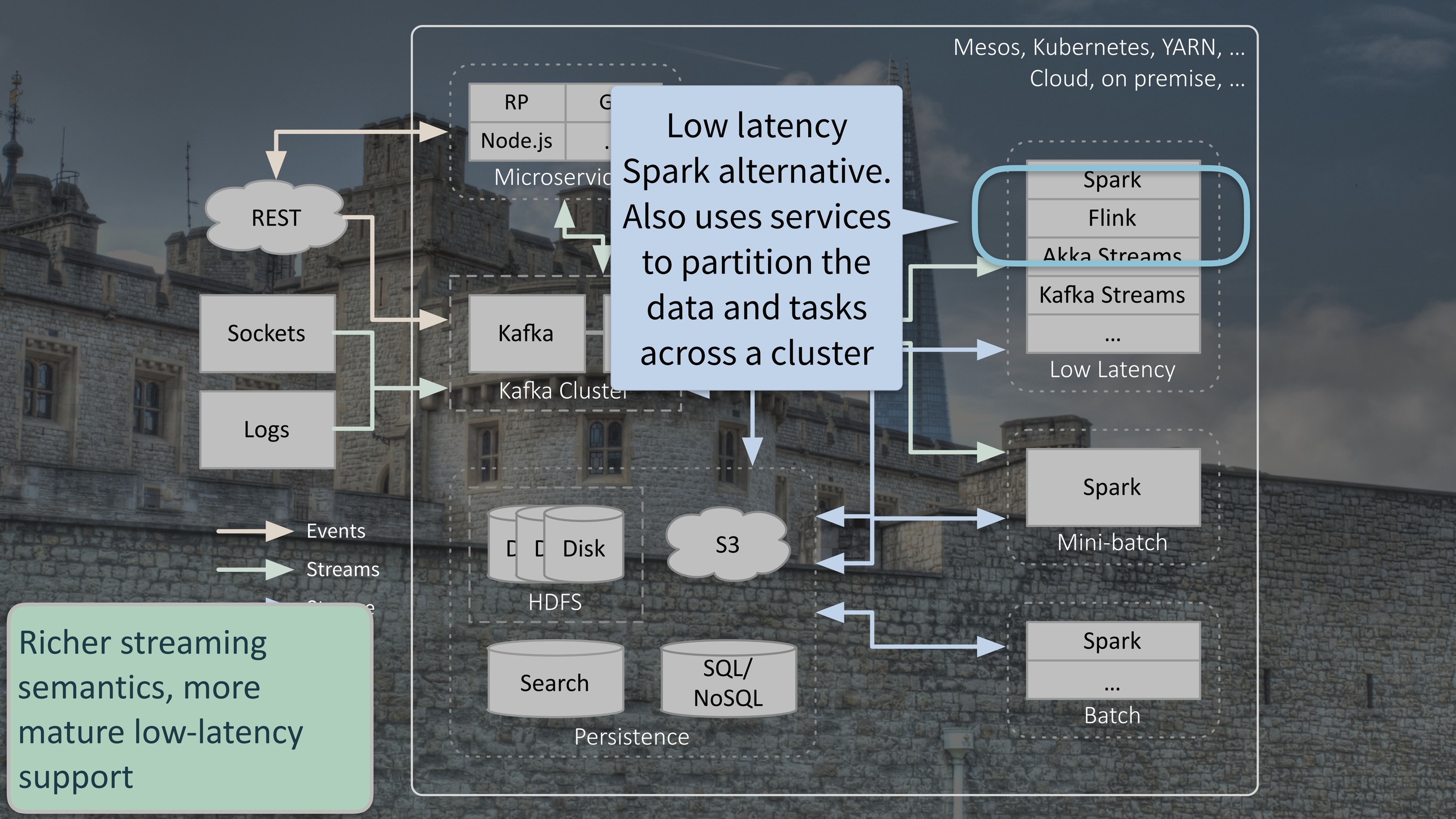
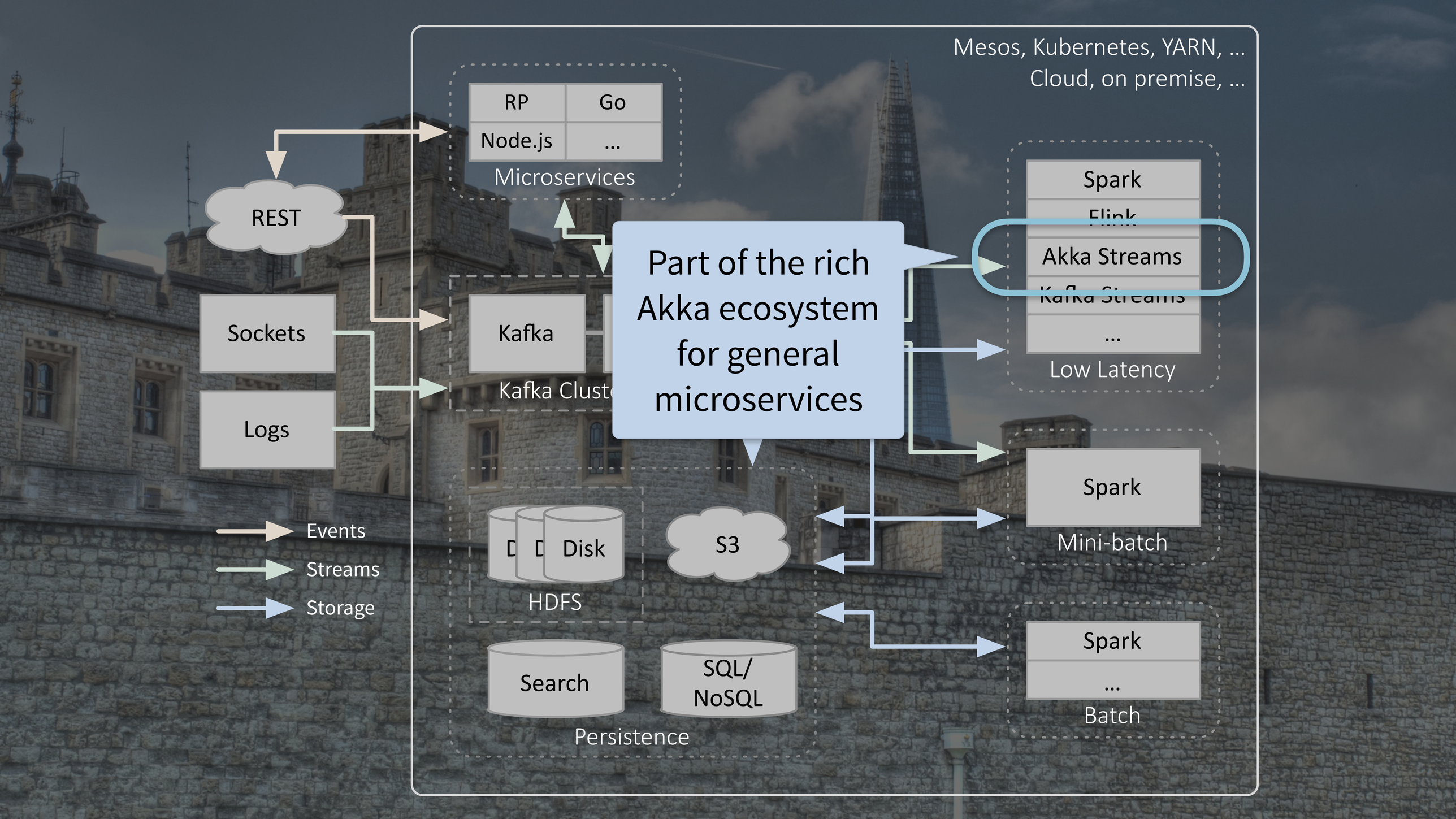
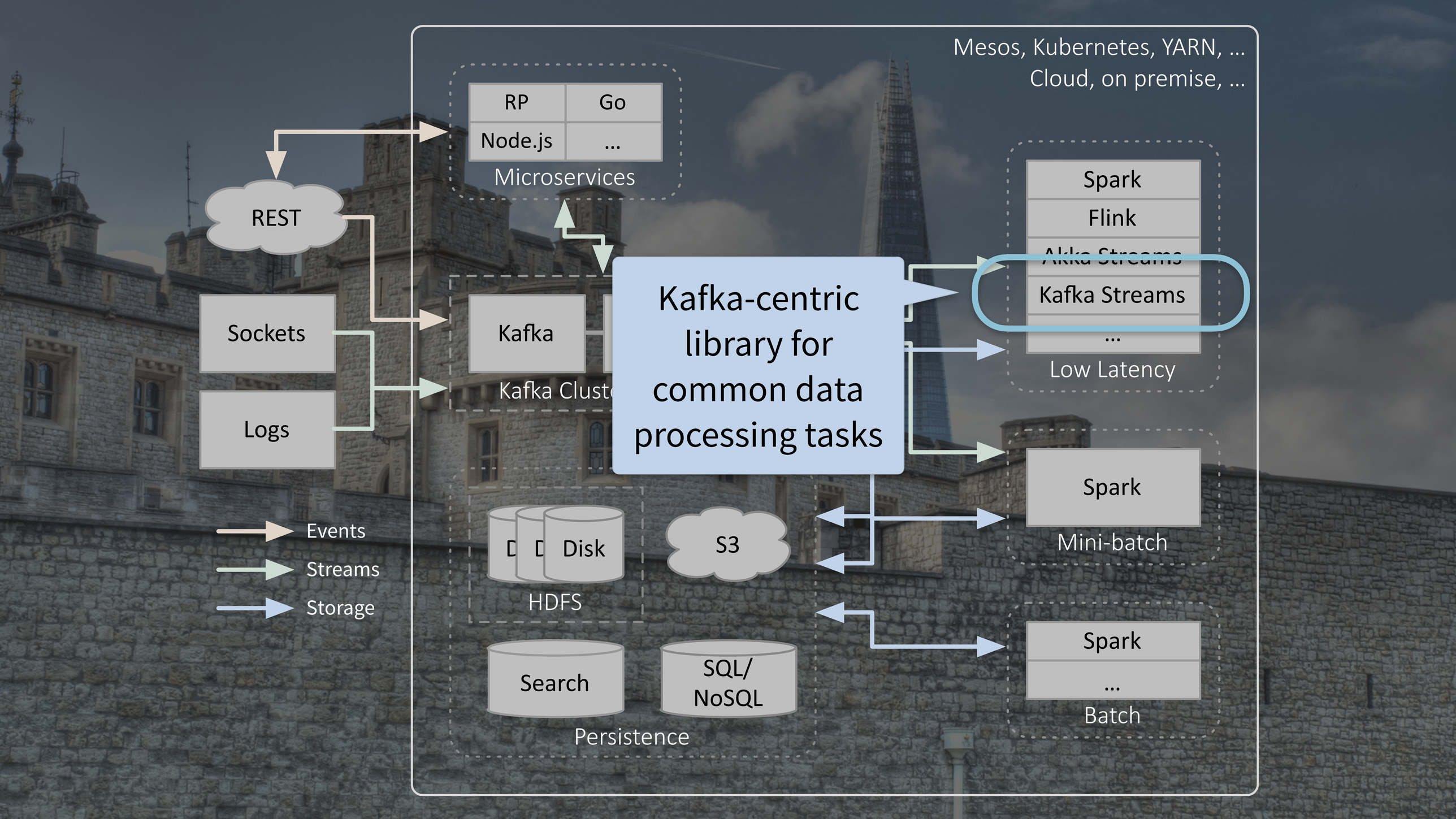
Streams
Storage

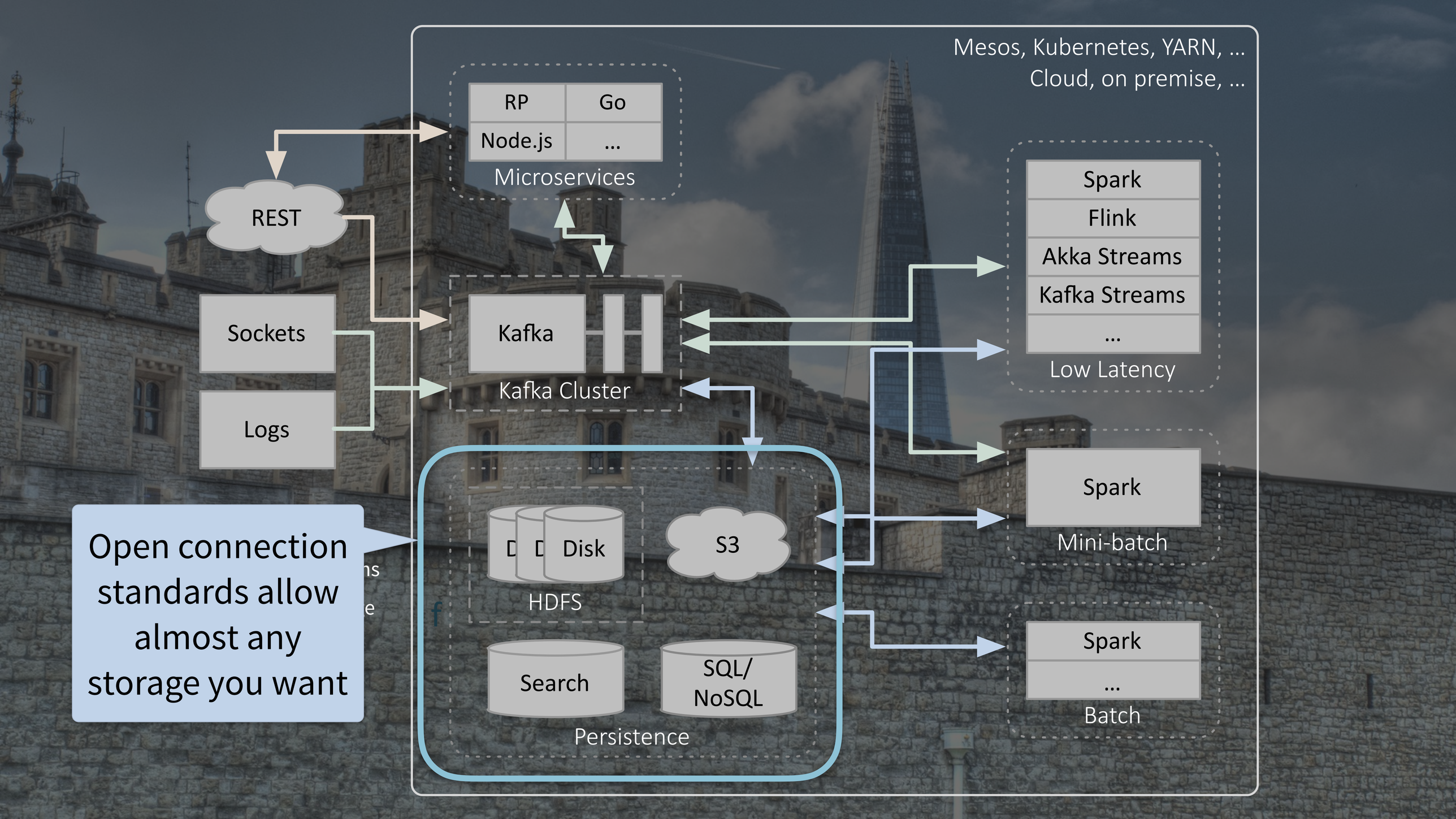

The streaming engines form two groups:
Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Go
Node.js
…
Microservic
REST
Sockets
Logs
Kafka
Kafka Cluster
Libraries you embed in your microservices
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Disk
HDFS
S3
Search
SQL/ NoSQL
Persistence
Spark
…
Batch
Events
Streams
Storage


Mesos, Kubernetes, YARN, ...
Cloud, on premise, ...
RP
Node.js
Microservic
REST
Sockets
Logs
Kafka
Kafka Clust
New, low-latency streaming (experimental, at this time)
Spark
Flink
Akka Streams
Kafka Streams
...
Low Latency
Older mini-batch streaming
Spark
Mini-batch
Disk
S3
HDFS
Search
Persistence
Full batch support (replaced MapReduce)
Spark
...
Batch
Events
Streams
Storage
Rich SQL and Machine Learning options.


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Node.js
Microservic
REST
Sockets
Logs
Kafka
Kafka Cluster
Low latency Spark alternative. Also uses services to partition the data and tasks across a cluster
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Disk
HDFS
S3
Search
SQL/ NoSQL
Persistence
Spark
…
Batch
Events
Streams
Richer streaming semantics, more mature low-latency support


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Go
Node.js
…
Microservices
REST
Sockets
Logs
Kafka
Kafka Clust
Part of the rich Akka ecosystem for general microservices
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Disk
HDFS
S3
Search
SQL/ NoSQL
Persistence
Spark
…
Batch
Events
Streams
Storage


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Go
Node.js
…
Microservices
REST
Sockets
Logs
Kafka
Kafka Clust
Kafka-centric library for common data processing tasks
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Disk
HDFS
S3
Search
SQL/ NoSQL
Persistence
Spark
…
Batch
Events
Streams
Storage


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
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Node.js
…
Microservices
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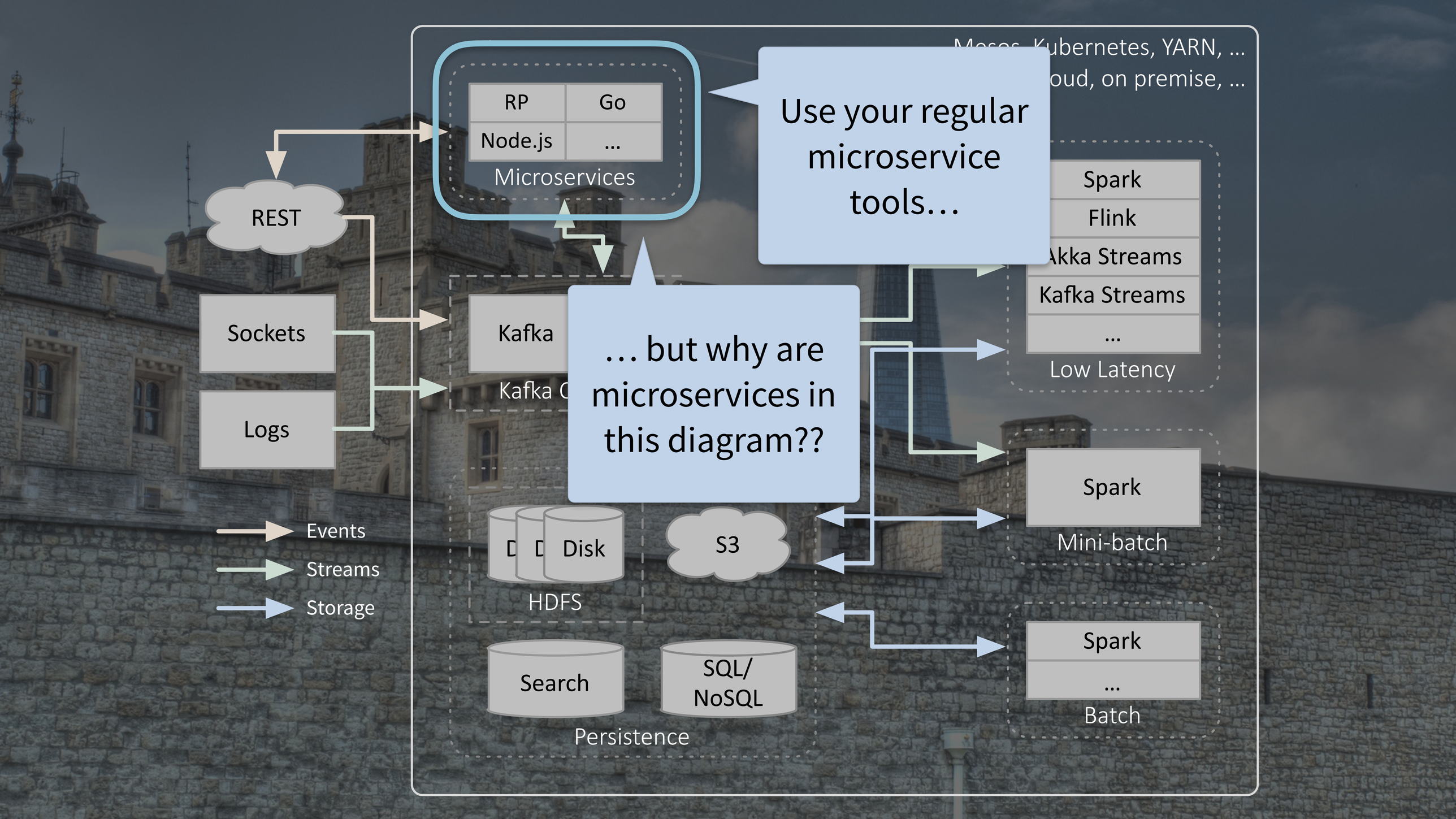
Sockets
Logs
Kafka
Kafka Cluster
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Spark
…
Batch
Disk
HDFS
S3
Search
SQL/
NoSQL
Persistence
Open connection standards allow almost any storage you want


Mesos, Kubernetes, YARN, …
Cloud, on premise, …
RP
Go
Node.js
…
Microservices
Use your regular microservice tools…
REST
Sockets
Logs
Kafka
Kafka C
… but why are microservices in this diagram??
Spark
Flink
Akka Streams
Kafka Streams
…
Low Latency
Spark
Mini-batch
Disk
HDFS
S3
Search
SQL/
NoSQL
Persistence
Spark
…
Batch
Events
Streams
Storage

Why Microservices in Fast Data?

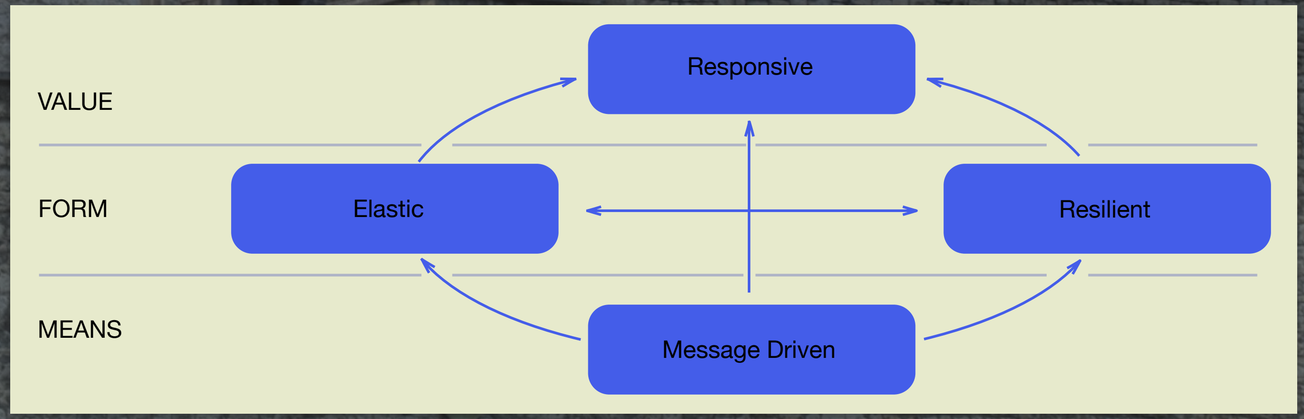
1. The trend is to run everything in big clusters using Kubernetes or Mesos
   - In the cloud or on-premise

Why Microservices in Fast Data?

2. If streaming gives you information faster…
   - … you'll want quick access to it in your other services!

Why Microservices in Fast Data?

3. Streaming raises the bar on data services
   - Compared to batch services, long-running streaming services must be more:
     - Scalable
     - Resilient
     - Flexible



https://www.reactivemanifesto.org/

Why Microservices in Fast Data?

4. This leads to our last major point…

Organizational Impact

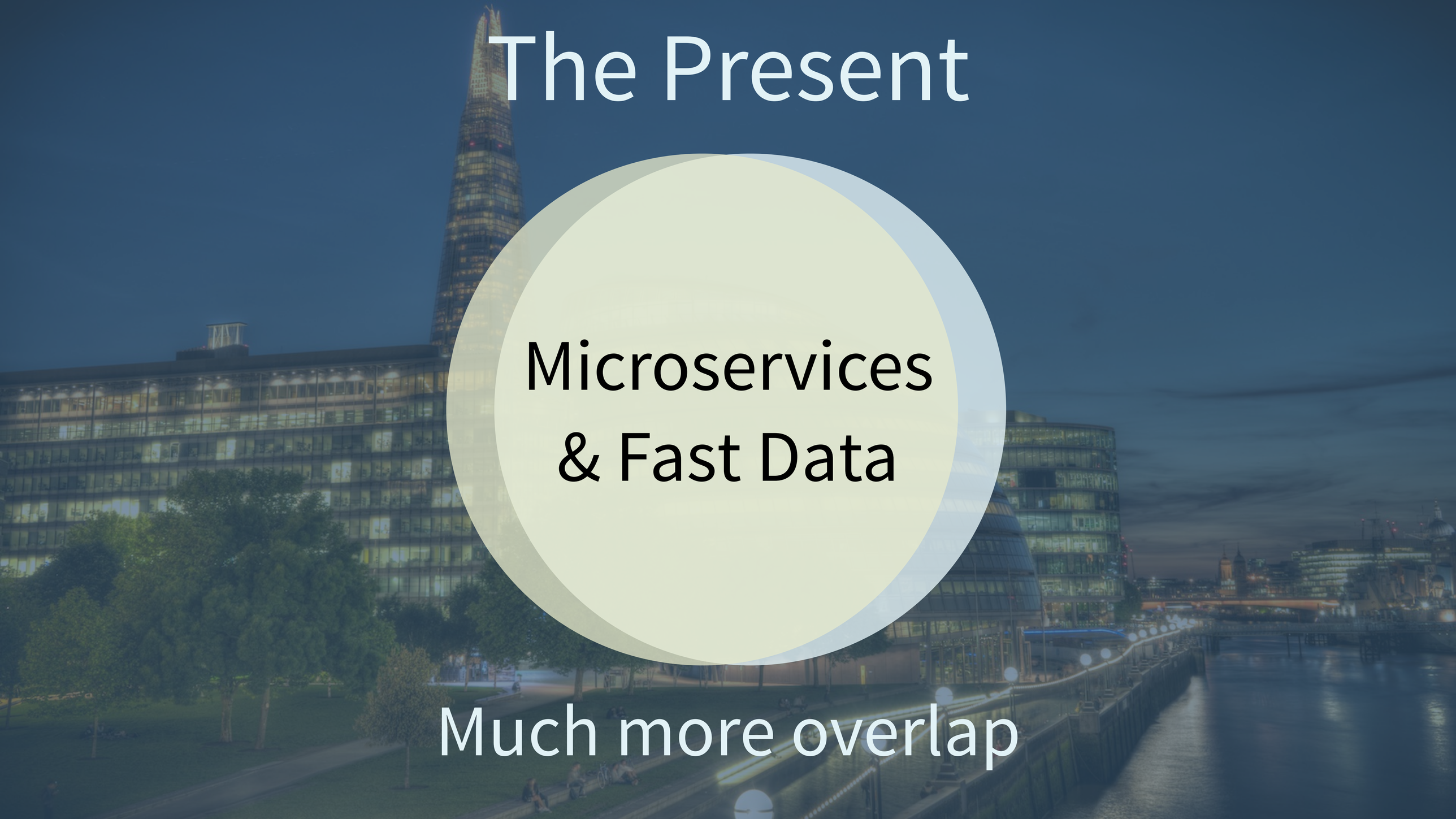
Organizational Impact

- Data scientists have to understand deployment
- Data engineers have to become good at highly-available microservices
- Microservice engineers have to become good at data

The Past

Some overlap in concerns, architecture

The Present



Much more overlap

The Future?

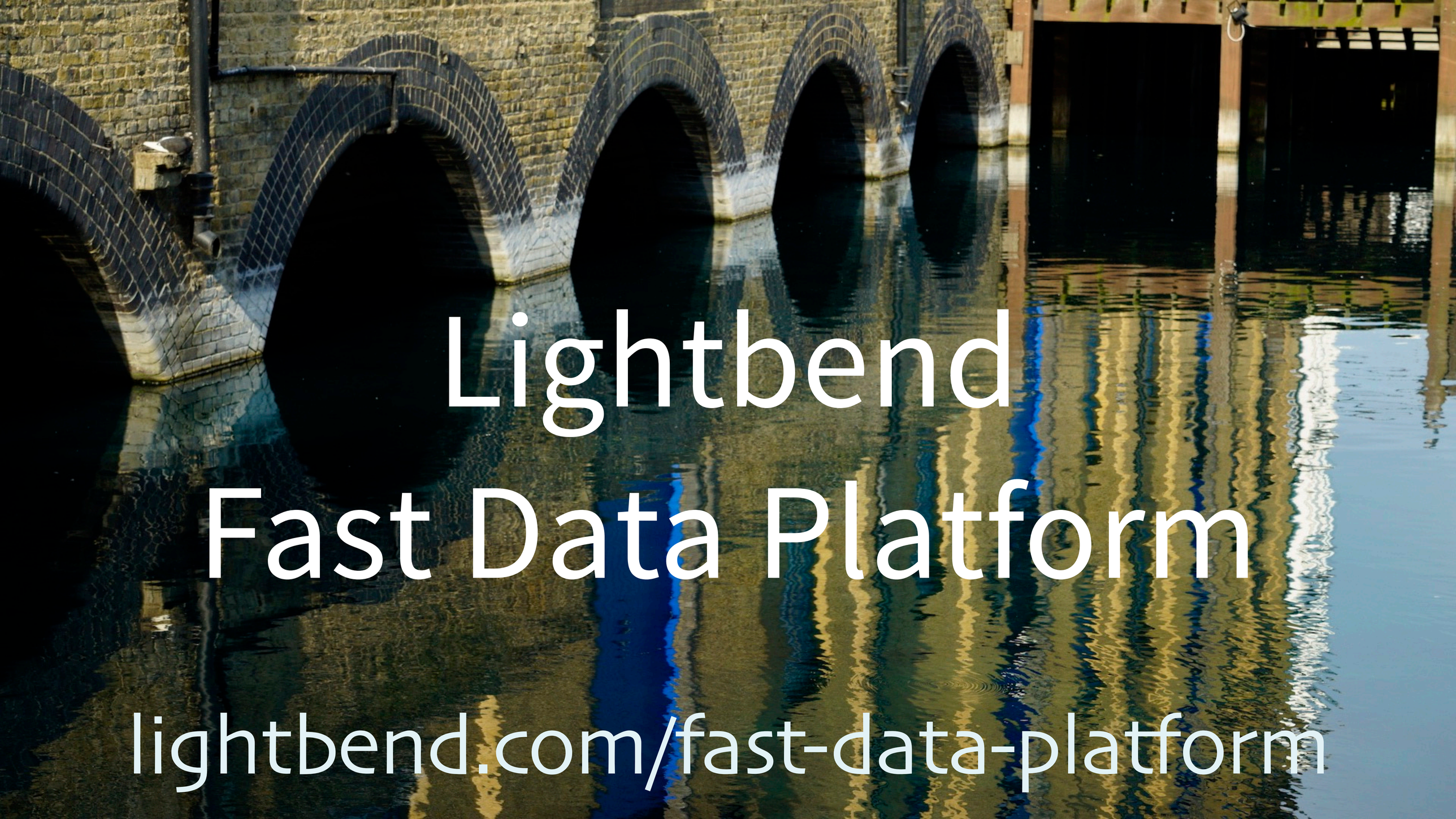
Why? Since streams process data incrementally, there is less need for large-scale tools like Spark, Flink

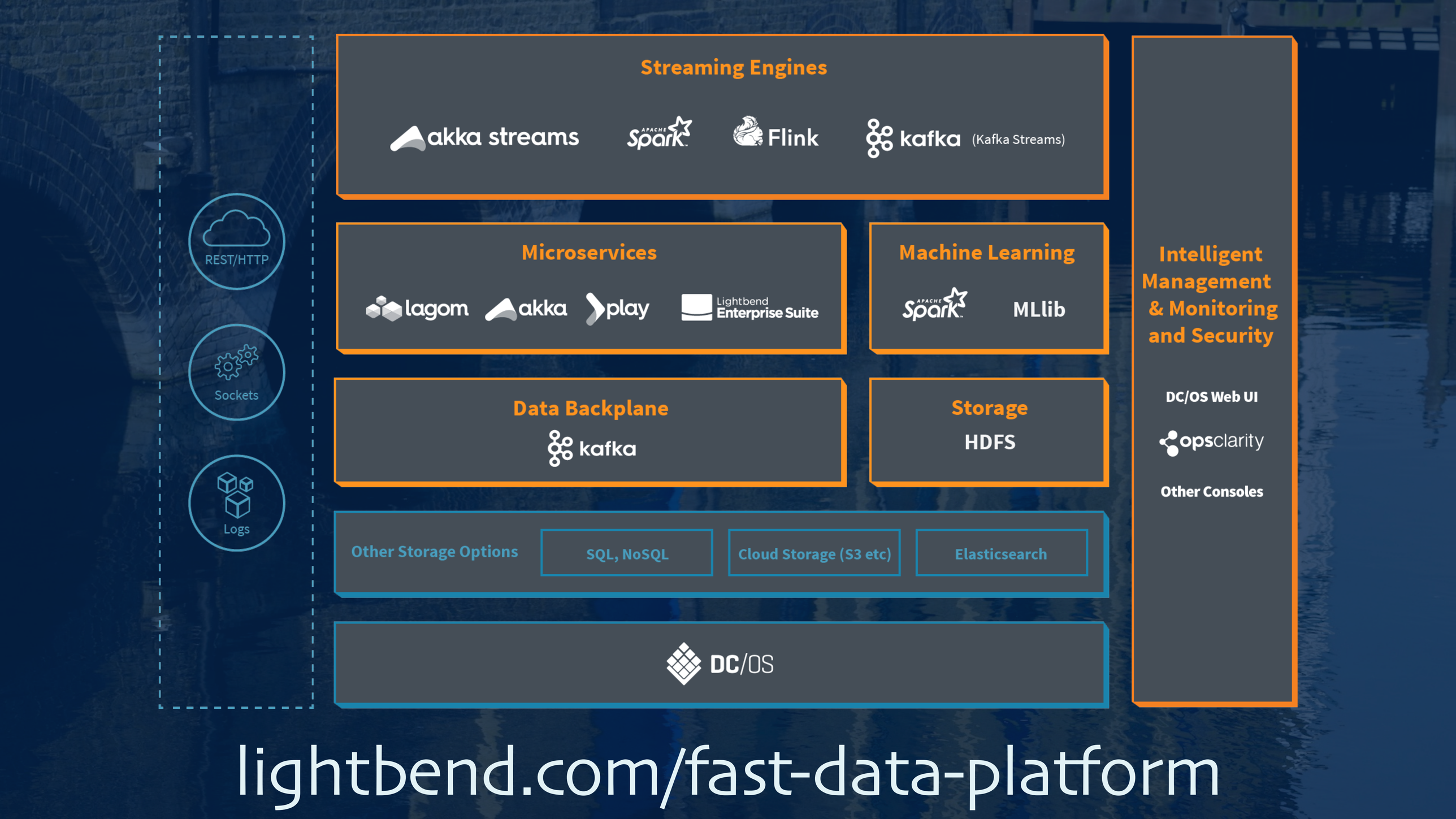
… and using microservices for everything simplifies development and operations

Microservices *for* Fast Data

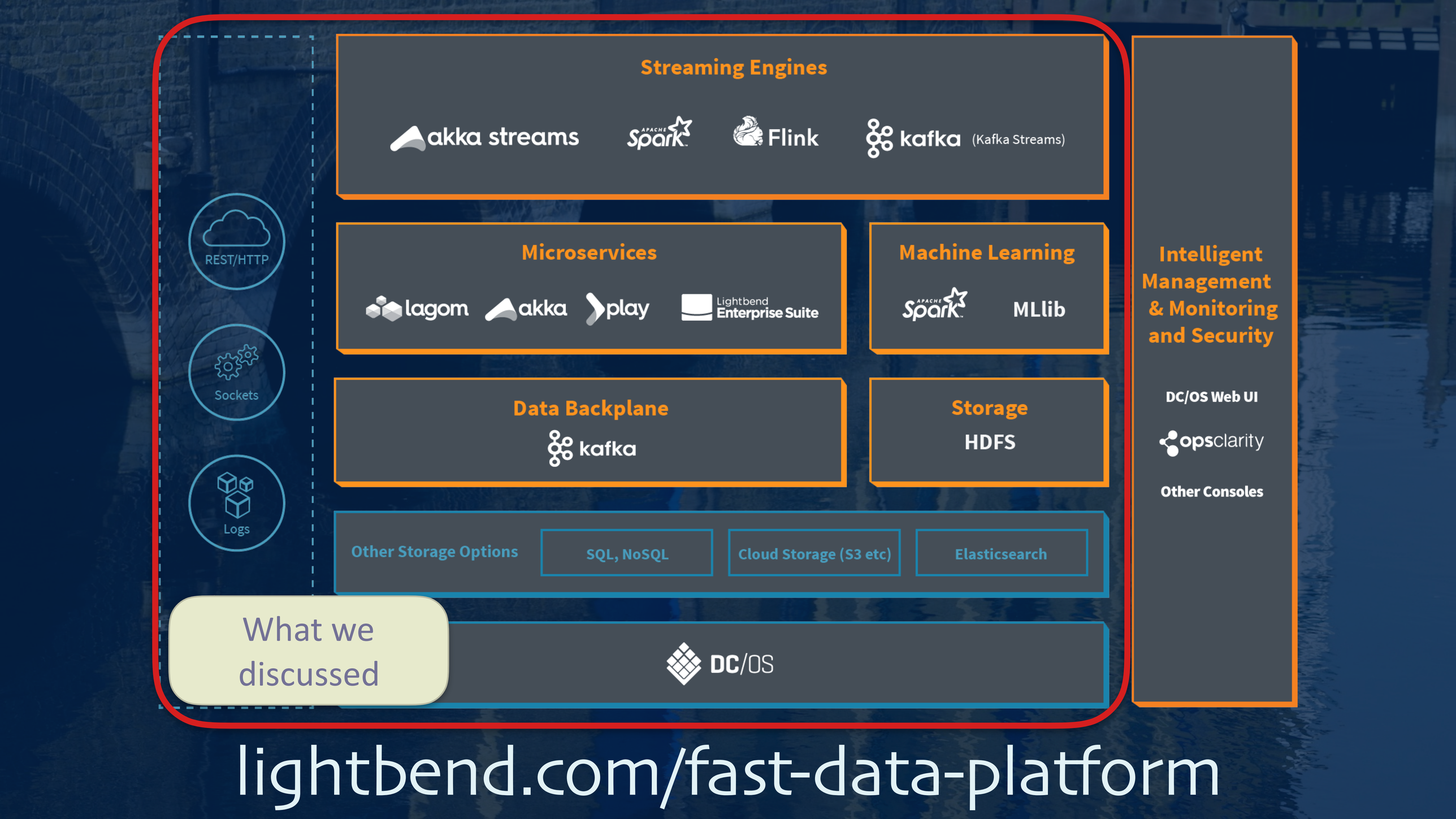
Whatever tool choices we make, they have to integrate with the data science workflows we love.

Much more microservice focused?


Lightbend
Fast Data Platform
lightbend.com/fast-data-platform



lightbend.com/fast-data-platform



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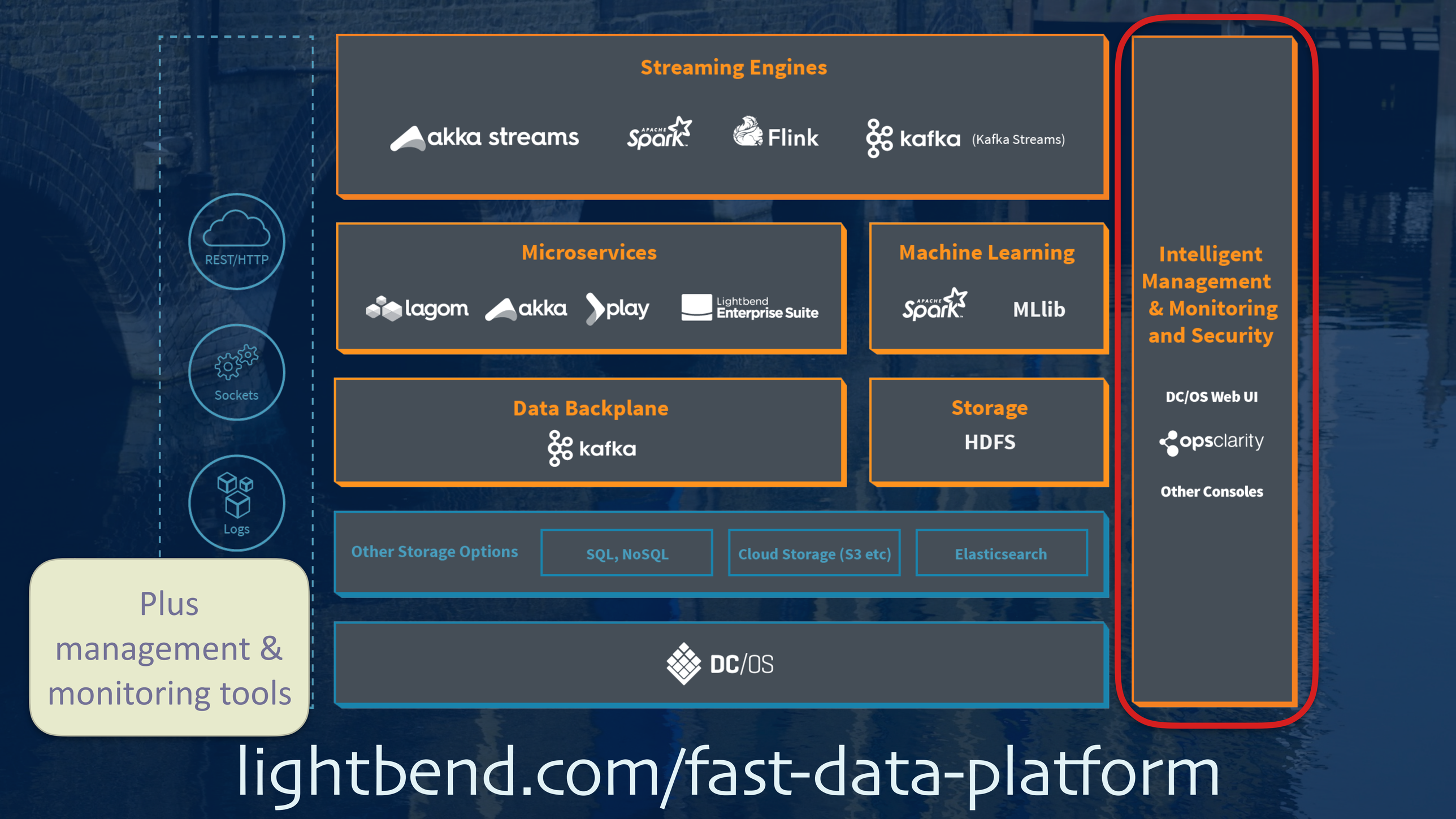
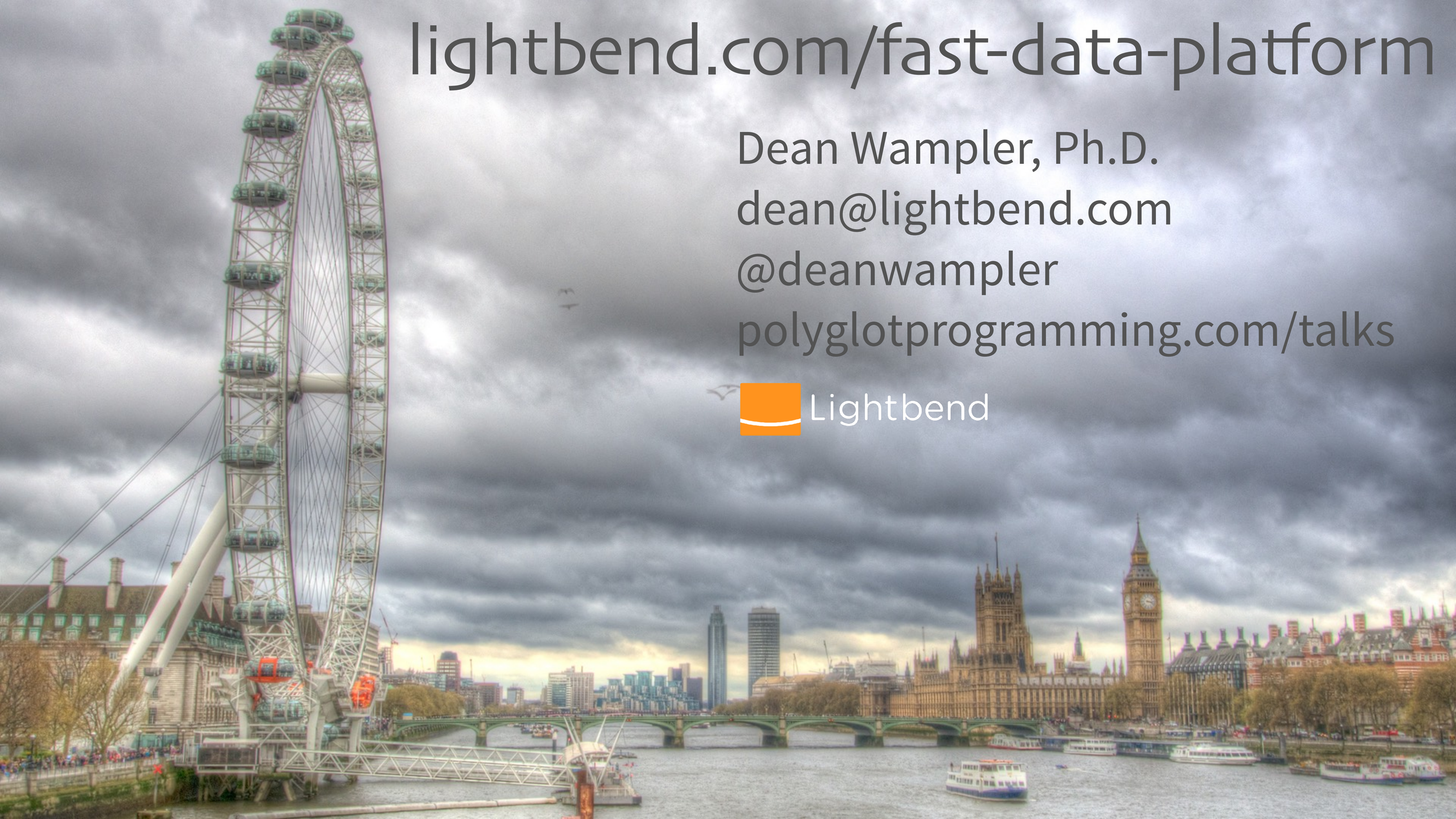

REST/HTTP
Sockets
Logs
Plus management & monitoring tools
Streaming Engines
akka streams
Spark
Flink
kafka (Kafka Streams)
Microservices
lagom
akka
play
Lightbend Enterprise Suite
Machine Learning
Spark
MLlib
Data Backplane
kafka
Storage
HDFS
Other Storage Options
SQL, NoSQL
Cloud Storage (S3 etc)
Elasticsearch
DC/OS
Intelligent Management & Monitoring and Security
DC/OS Web UI
opsclarity
Other Consoles
lightbend.com/fast-data-platform



lightbend.com/fast-data-platform

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dean@lightbend.com
@deanwampler
polyglotprogramming.com/talks

Lightbend