Keeping on top of Hybrid-Cloud usage with Apache Pulsar

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Who are we?

Shivji Kumar Jha

Staff Engineer at Nutanix,
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- Leading “Cloud data Platforms” Team
- Loves Distributed Systems & Open-Source fanatic
- Data geek(data stores, stream, analytics etc.)
- Pulsar & MySQL Contributor

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Tarun Annapareddy

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- Loves Distributed Streaming Frameworks
- Writes articles on software technologies
- Apache Pulsar Enthusiast

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What do we do?

NUTANIX

- Nutanix unifies public cloud simplicity with private cloud performance and security
- Whether on-premises or hybrid, we'll ensure business continuity through centralized management, one-click operations
- More than 20,000 leading companies trust Nutanix

Supported Clouds

https://www.nutanix.com/

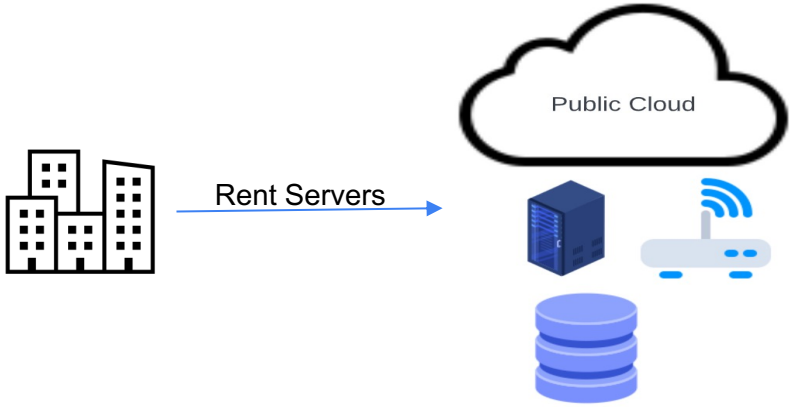
Agenda

- Need for Hybrid-Cloud and Multi-Cloud
- Challenges with Multi-Cloud and Need for Single plane of view
- Architecture overview
- Apache Flink-Pulsar Connector
- Key Features of Apache Pulsar
- Challenges we faced in the production

On-Premises Infrastructure

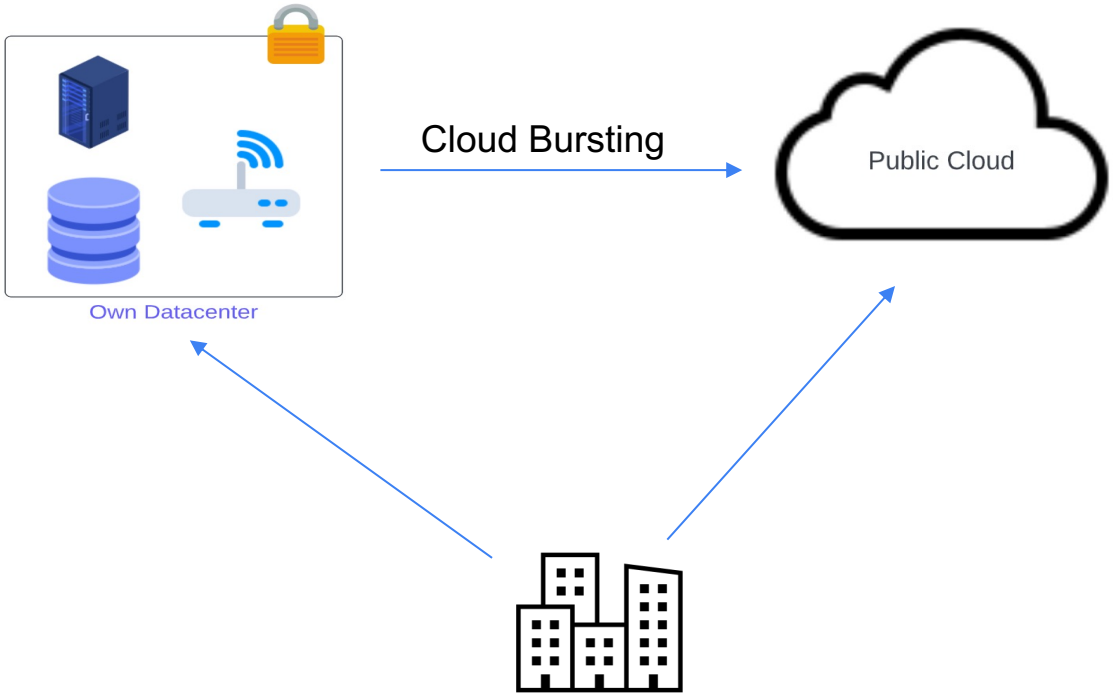
- More control over the resources
- Predictable Server usage
- Reduced costs
- Data Security

Public Cloud

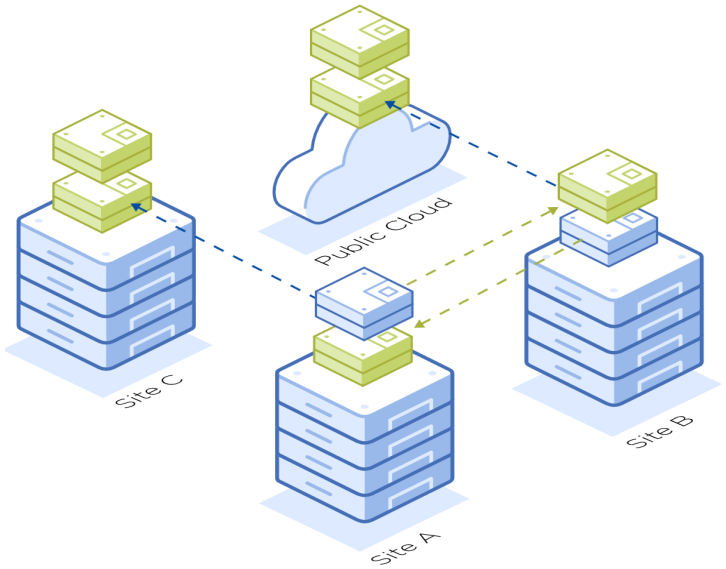


- Fast and easy Infrastructure setup
- Pay-As-You-Go Model

Hybrid Cloud : Cloud Bursting



Hybrid Cloud : Nutanix Disaster Recovery

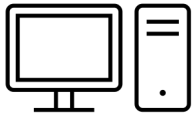


- More distributed means more available in the event of a disaster
- Make Replication and Disaster Recovery Effortless Across Multiple Sites
- Single click Failover
- Automated recovery plans

https://www.nutanix.com/products/nutanix-cloud-infrastructure/disaster-recovery

Multi-Cloud : Choose the best features

Best for Web Applications



Best for big data analytics

Best for Microsoft Products

https://bit.ly/2W9UEq6

Need for a Single plane of view

Lack of Unified Visibility Across Cloud Boundaries

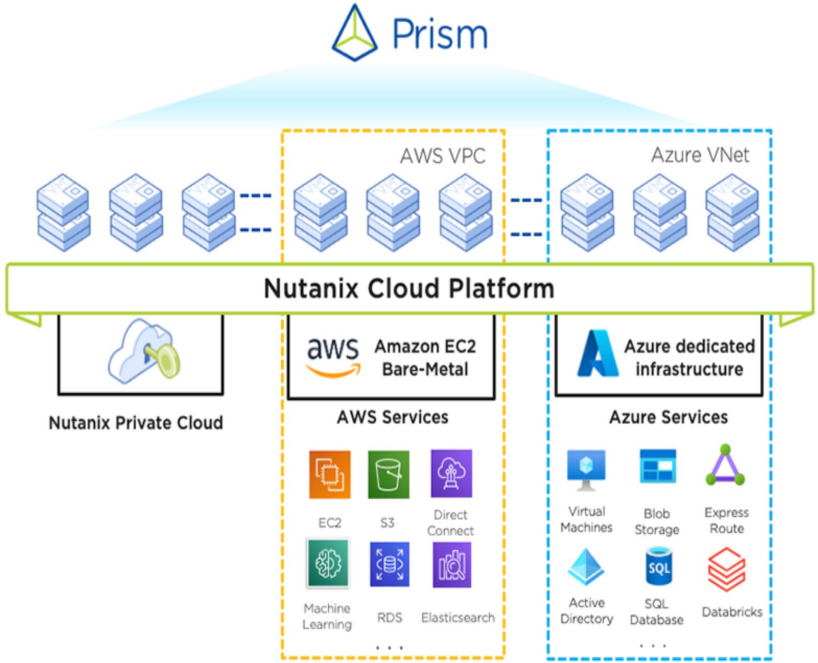
Infrastructure Complexity

Complicated Compliance Auditing

Skill Gap

https://portal.nutanix.com/page/documents/solutions/list

Nutanix Cloud Clusters



- All your Clusters, On-Premises and Public can be operated as a single cloud
- Seamless Application movement without any code changes
- OnDemand capacity bursting
- Disaster recovery

https://www.nutanix.com/products/nutanix-cloud-clusters

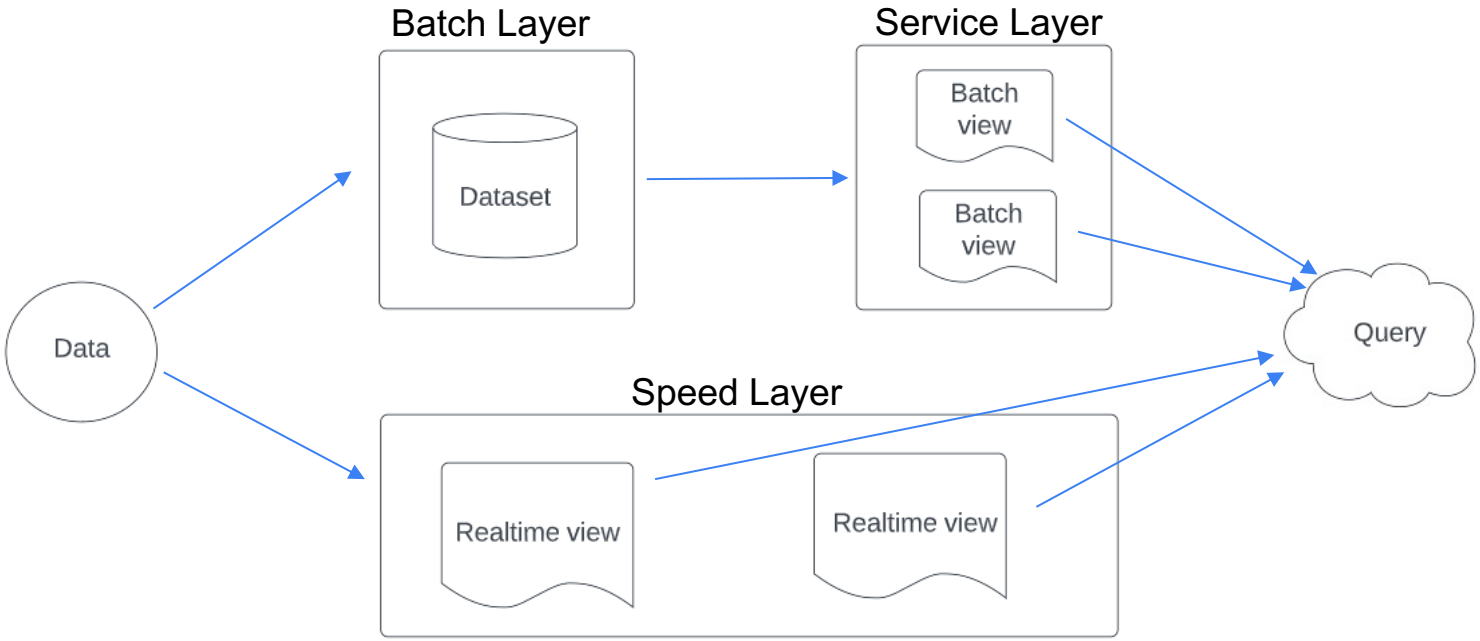
Proposed Architecture

Lambda Architecture

- Unites the benefits of the batch and stream processing techniques.
- Serve a wide range of use cases and withstands faults well with
  - **Batch Layer**
    - ✓ High Precision (involved algorithms?)
    - ✓ Latency not a concern
    - ✓ Think Hadoop!
  - **Speed Layer**
    - ✓ Trades precision for low latency and high availability
    - ✓ Think (Pulsar / Kafka) + (Flink / Spark)

https://www.researchgate.net/publication/338375917_Lambda_Architecture_-_Realtime_Data_Processing

Lambda Architecture



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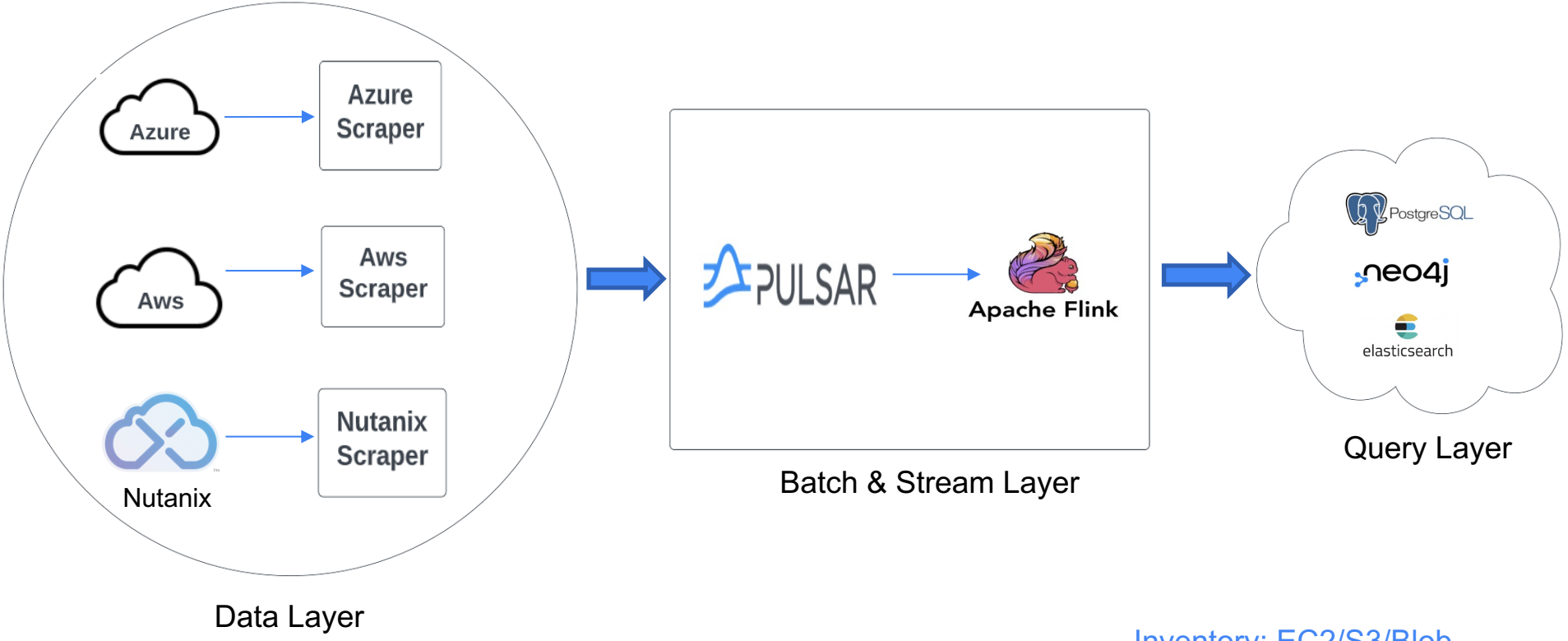
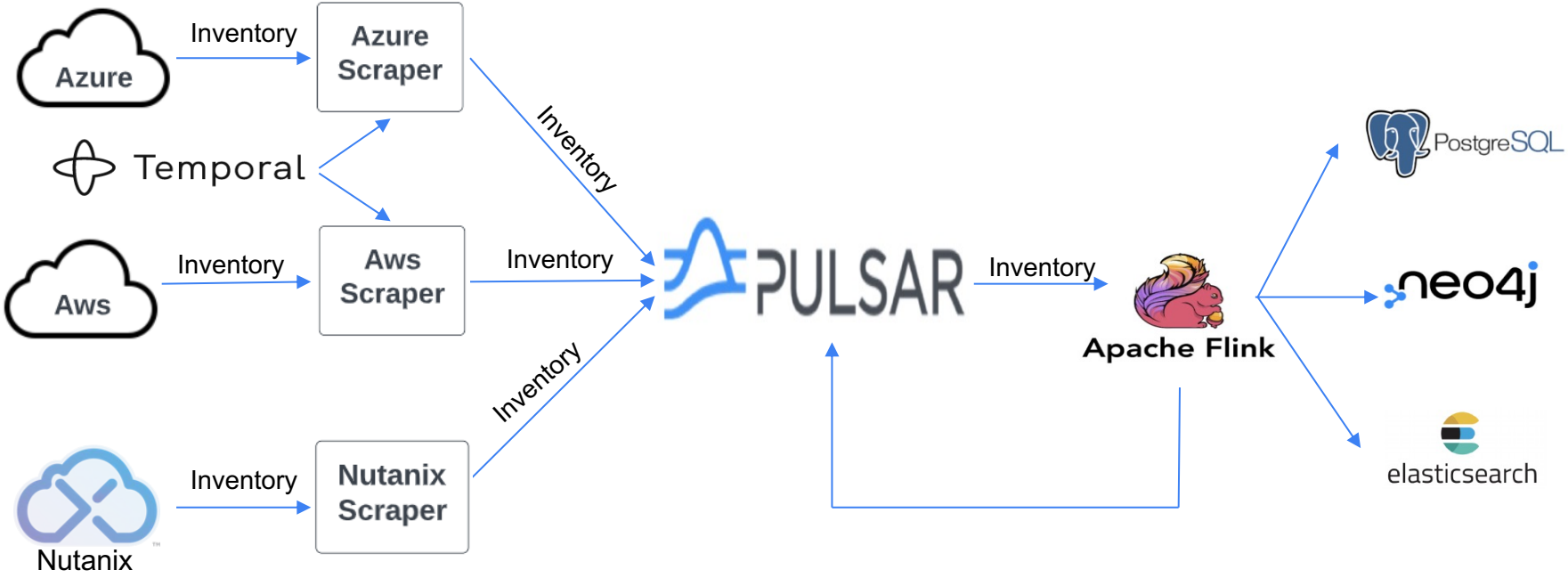
Batch+ Stream Processing



Inventory: EC2/S3/Blob

Batch+ Stream Processing



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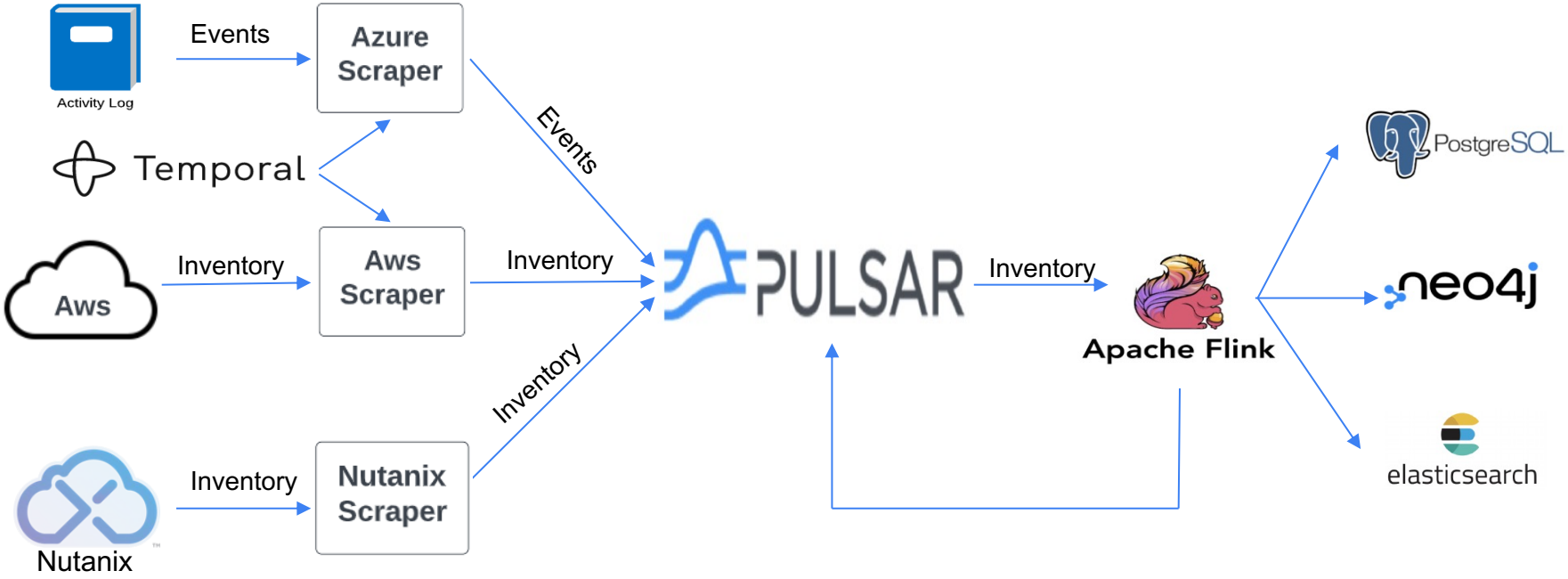
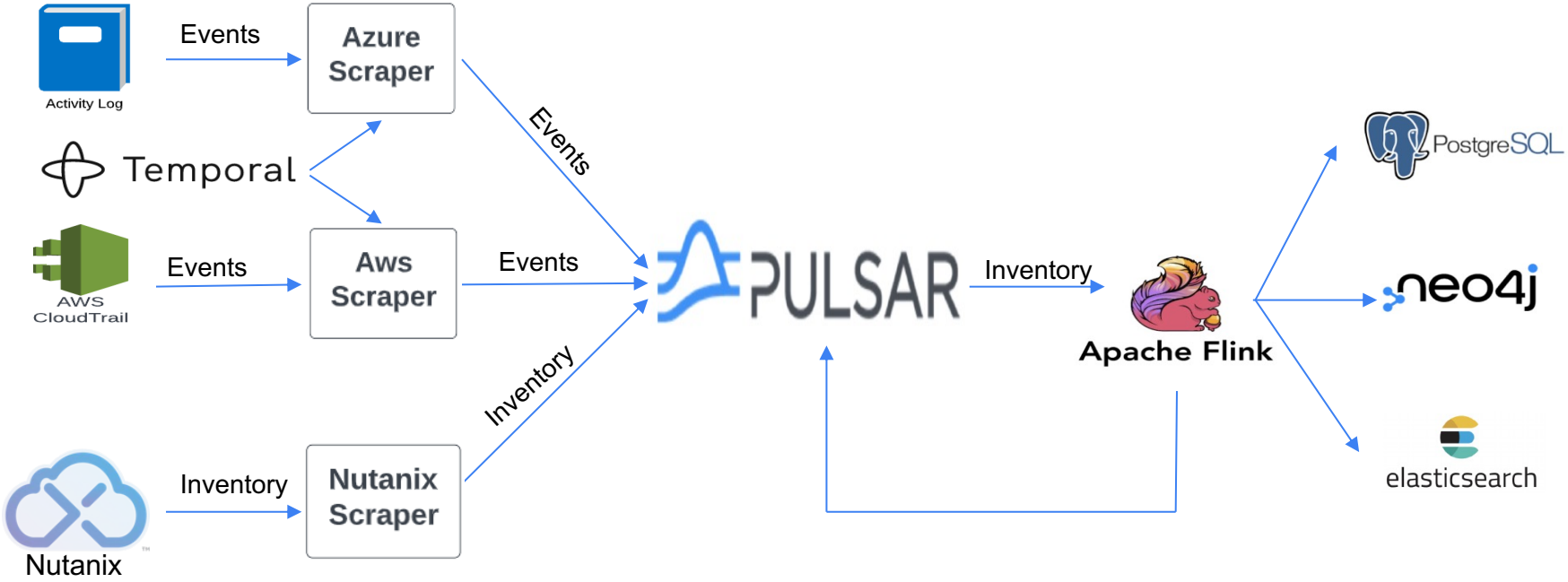
Batch+ Stream Processing



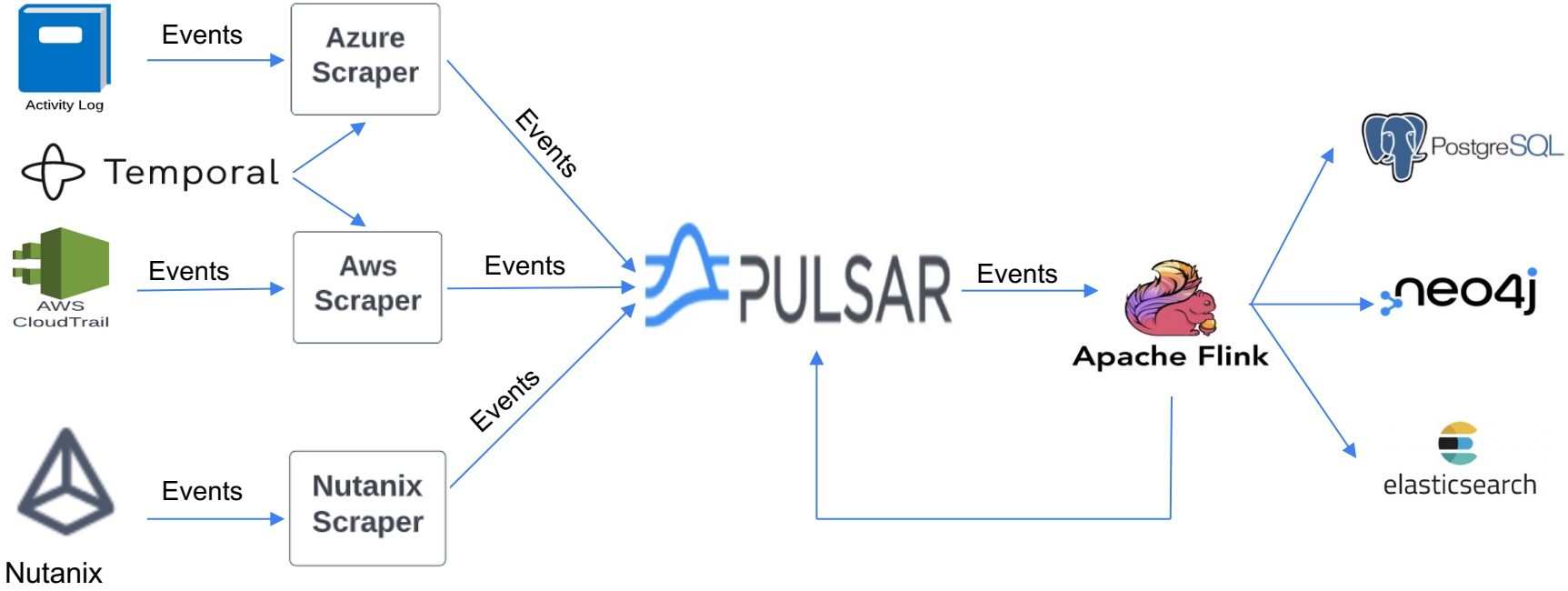
Inventory: EC2/S3/Blob

Batch+ Stream Processing



Inventory: EC2/S3/Blob

Batch+ Stream Processing

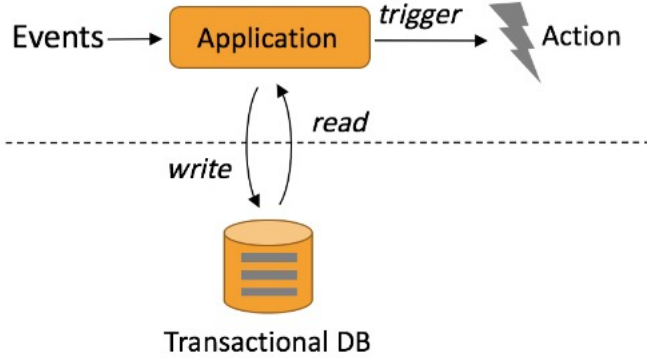


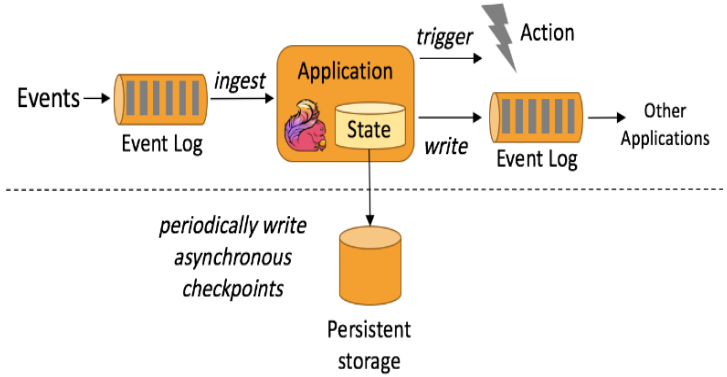
Inventory: EC2/S3/Blob

Apache Pulsar + Flink: The path to Unified batch and stream processing

Stream Processing - Apache Flink

- Stream-based distributed processing framework
- Optimized In-Memory state access for event-driven applications
- Very Suitable for Extract-Transform-Load(ETL) applications



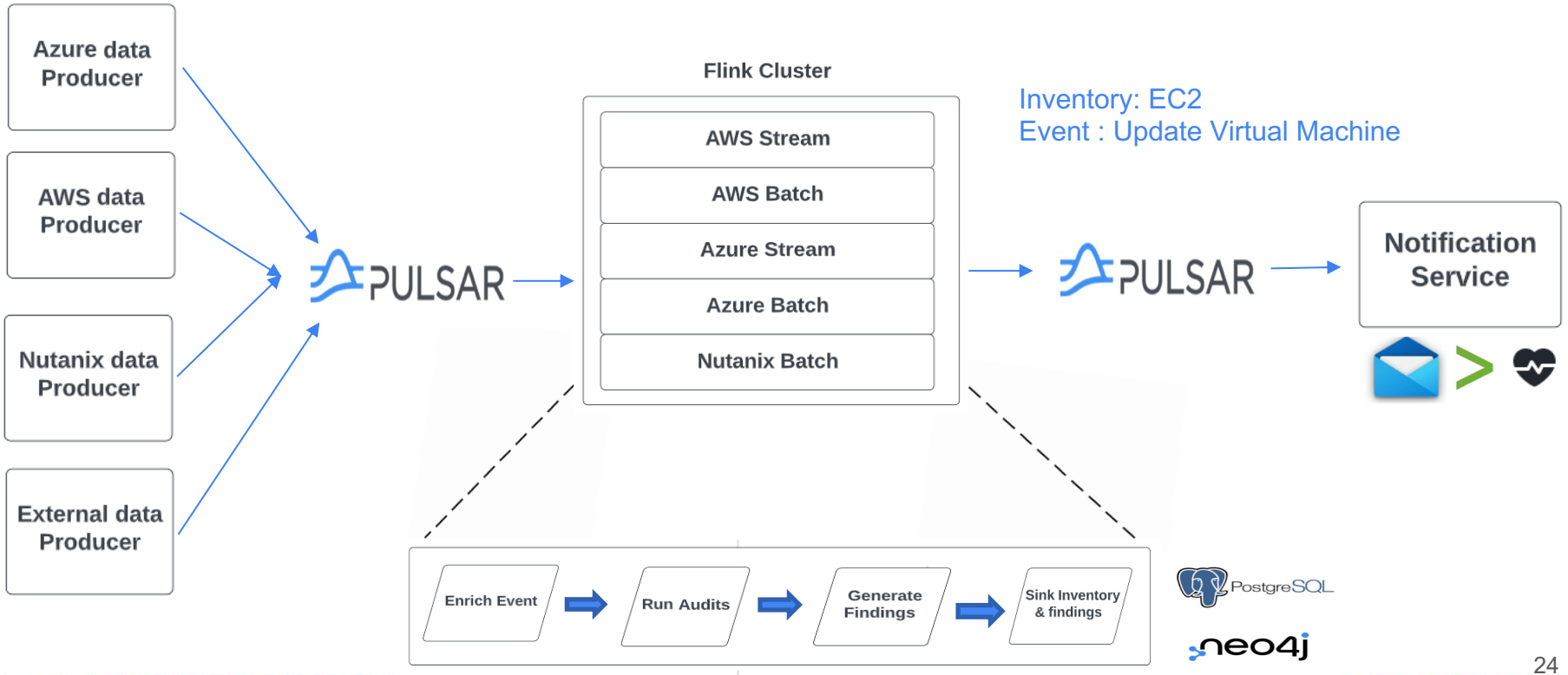


https://nightlies.apache.org/flink/flink-docs-master/docs/concepts/stateful-stream-processing/

Flink-Pulsar Connector

```
PulsarSource<String> source = PulsarSource.builder()
                                          .setServiceUrl(serviceUrl)
                                          .setStartCursor(StartCursor.earliest())
                                          .setTopics("my-topic")
                                          .setSubscriptionName("my-subscription")
                                          .setSubscriptionType(SubscriptionType.Exclusive)
                                          .build();

// topics “my-topic-1”, “my-topic-2”
PulsarSource.builder().setTopics("my-topic-1", "my-topic-2");

// Partition 0 and 2 of topic “my-topic”
PulsarSource.builder().setTopics("my-topic-partition-1", "my-topic-partition-2");

// all partitions of  topic “my-topic”
PulsarSource.builder().setTopicPattern("my-topic-*");

// Struct types (JSON, Protobuf, Avro, etc.)
PulsarDeserializationSchema.pulsarSchema(Schema, Class);
```

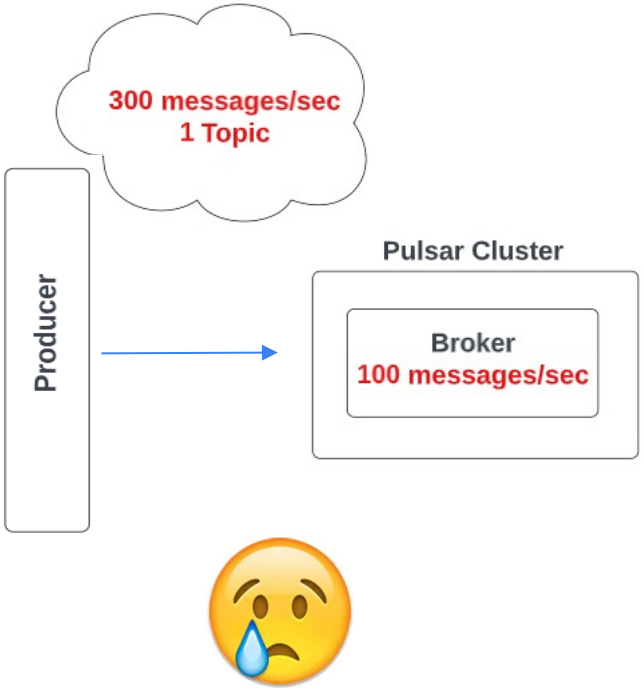
Flink-Pulsar view of Architecture

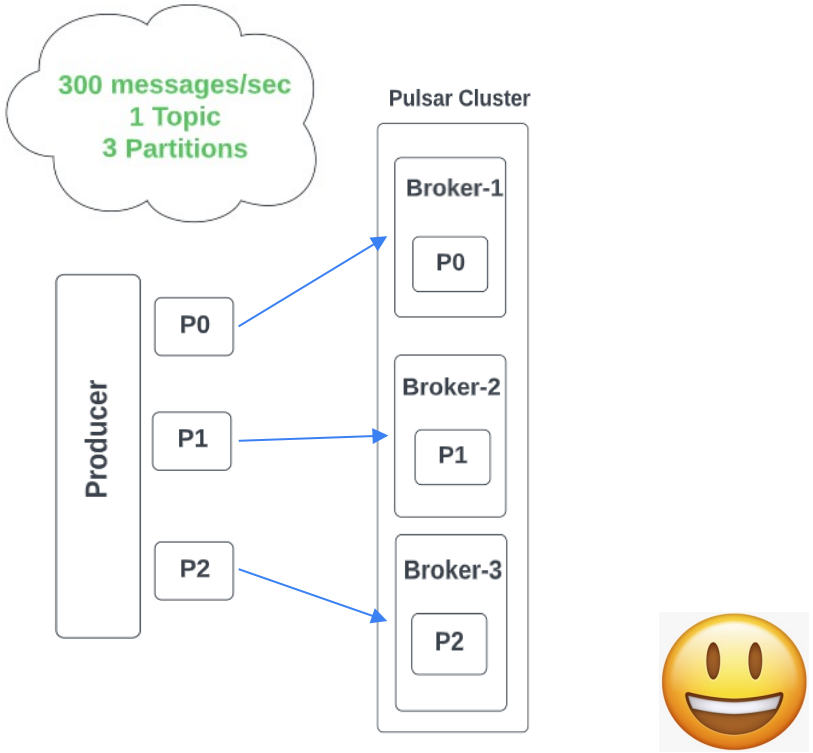


Key Features of Apache Pulsar

- Partitioned Topics : Scale beyond single broker
- Unified Messaging Model : Streaming and Queuing
- Pulsar Schema : Built-in Schema Management
- Multi Tenancy: Isolation, Policies
- Features of Flink-Pulsar connector

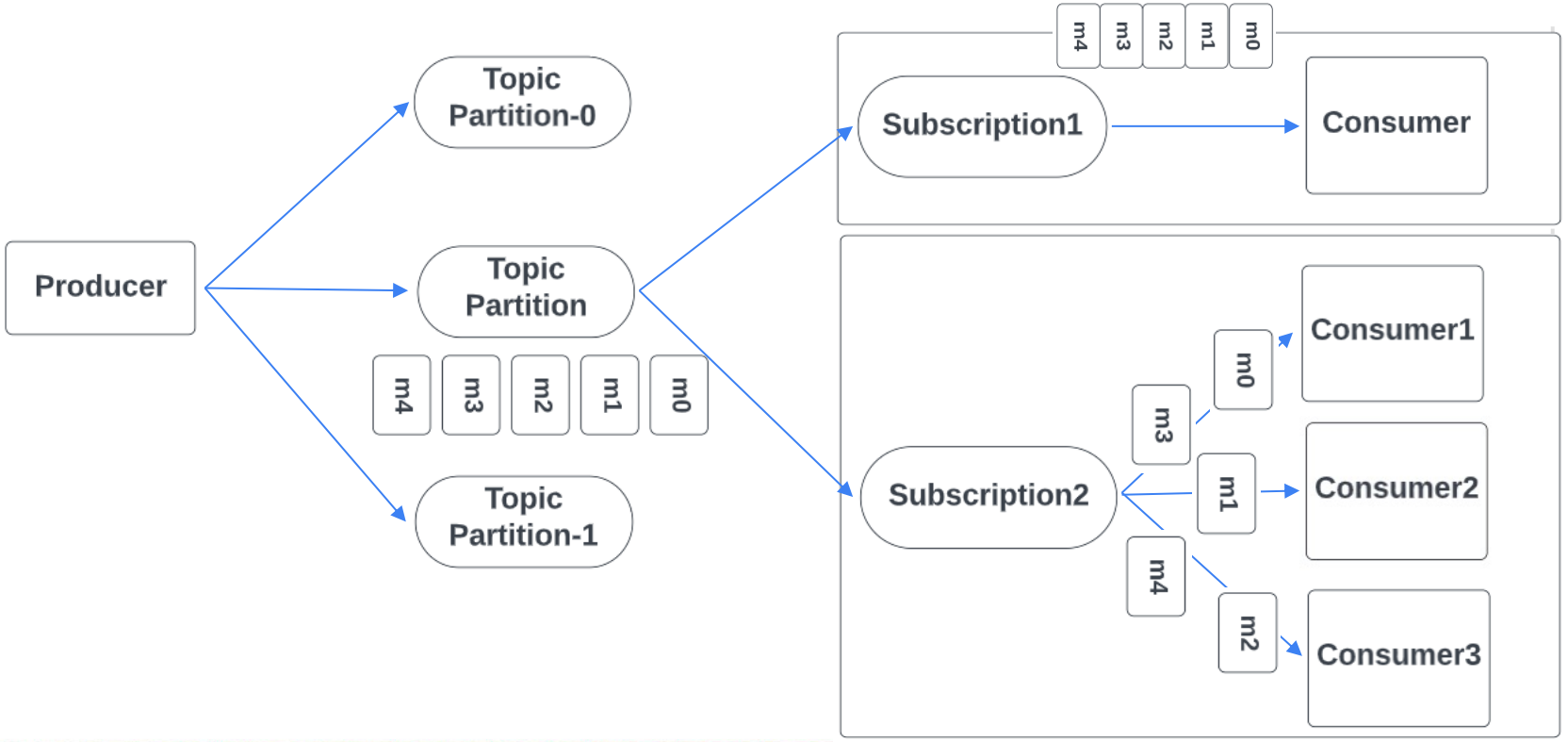
Partitioned Topics





Ordering?

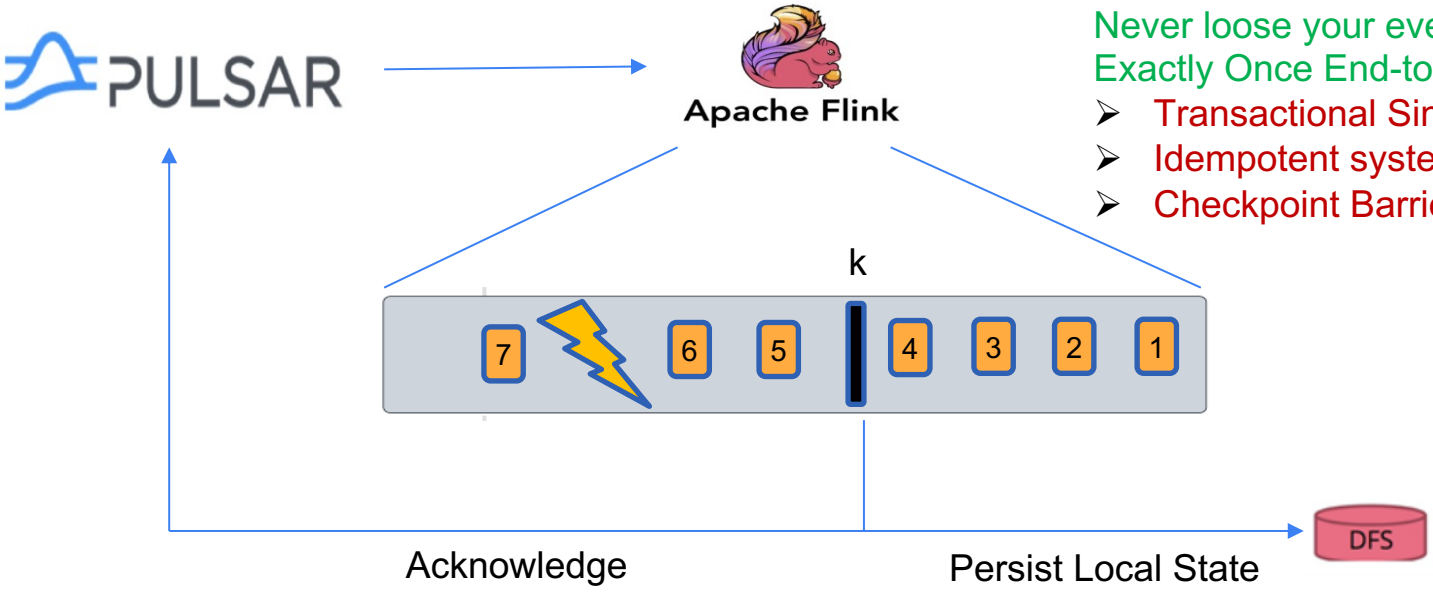
Unified Streaming and Queuing model



Challenges we faced in Production

- Exactly-Once Processing with Flink-Pulsar Connector
- Acknowledgement strategy with Flink-Pulsar Connector
- Open-source contributions to add security to Flink-Pulsar connector
- Open-source contributions to Pulsar Server to run with schemas

Exactly-Once Processing



Never loose your events with Checkpoints
Exactly Once End-to-End Processing??

- Transactional Sinks
- Idempotent system
- Checkpoint Barrier Alignment

Improved Flink-Pulsar Connector

Flink 1.8 + Pulsar-Flink Connector 2.6.1

- Acknowledge Async

```
ArrayDeque<Tuple2<checkPointId, Set<MessageId>>> pendingCheckpoints;
// end of kth checkPoint
Tuple2<k,Set<1,2,3,4>> checkpoint
 for (MessageId id : checkpoint.f1) {
      consumer.acknowledgeAsync(id);
 }
```

Flink 1.15 + flink-connector-pulsar 1.16.0

- Cumulative Acknowledgement

```
SortedMap<checkPointId, Map<TopicPartition, MessageId>> cursorsToCommit;
Map<TopicPartition, MessageId> cursors = cursorsToCommit.get(checkpointId);
// end of kth checkPoint
 <partitionId, 4> cursor
 cursors.forEach((partition, messageId) ->
                                pulsarConsumer.acknowledgeCumulative(messageId));
```

PULSAR SUMMIT | Thanks

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