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GLOBAL PLATFORM
& INFRASTRUCTURE

Pulsar

Realtime Analytics At Scale

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Big Data Trends

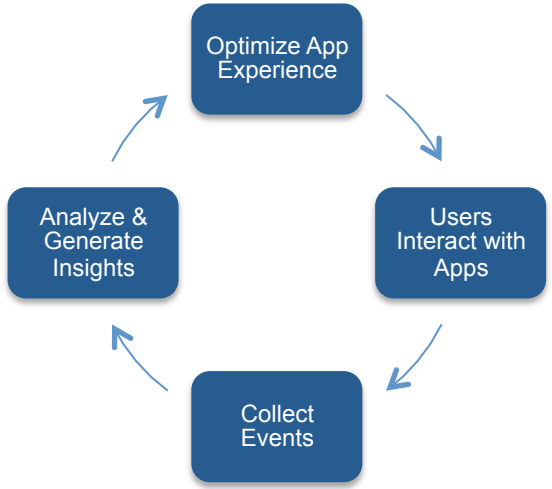
- Bigger data volumes
- More data sources
  - DBs, logs, behavioral & business event streams, sensors …
- Faster analysis
  - Next day to hours to minutes to seconds
- Newer processing models
  - MR, in-memory, stream processing, Lambda …

What is Pulsar

Open-source real-time analytics platform and stream processing framework

Business Needs for Real-time Analytics

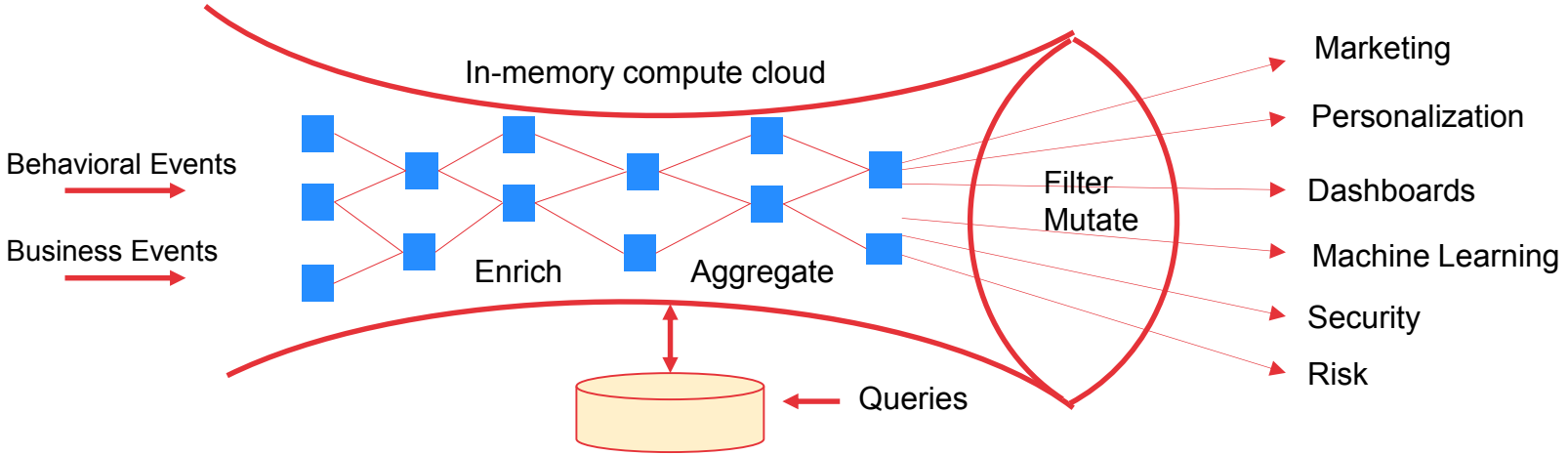
- Near real-time insights
- React to user activities or events within seconds
- Examples:
  - Real-time reporting and dashboards
  - Business activity monitoring
  - Personalization
  - Marketing and advertising
  - Fraud and bot detection



Systemic Quality Requirements

- **Scalability**
  - Scale to millions of events / sec
- **Latency**
  - <1 sec delivery of events
- **Availability**
  - No downtime during upgrades
  - Disaster recovery support across data centers
- **Flexibility**
  - User driven complex processing rules
  - Declarative definition of pipeline topology and event routing
- **Data Accuracy**
  - Should deal with missing data
  - 99.9% delivery guarantee

Pulsar Real-time Analytics



- **Complex Event Processing (CEP)**: SQL on stream data
- **Custom sub-stream creation:** Filtering and Mutation
- **In Memory Aggregation:** Multi Dimensional counting

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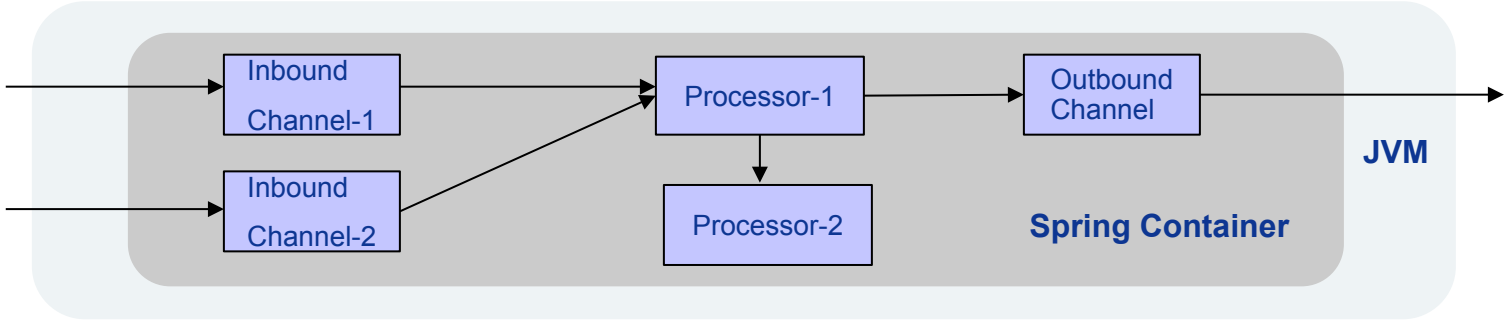
Pulsar Framework Building Block (CEP Cell)

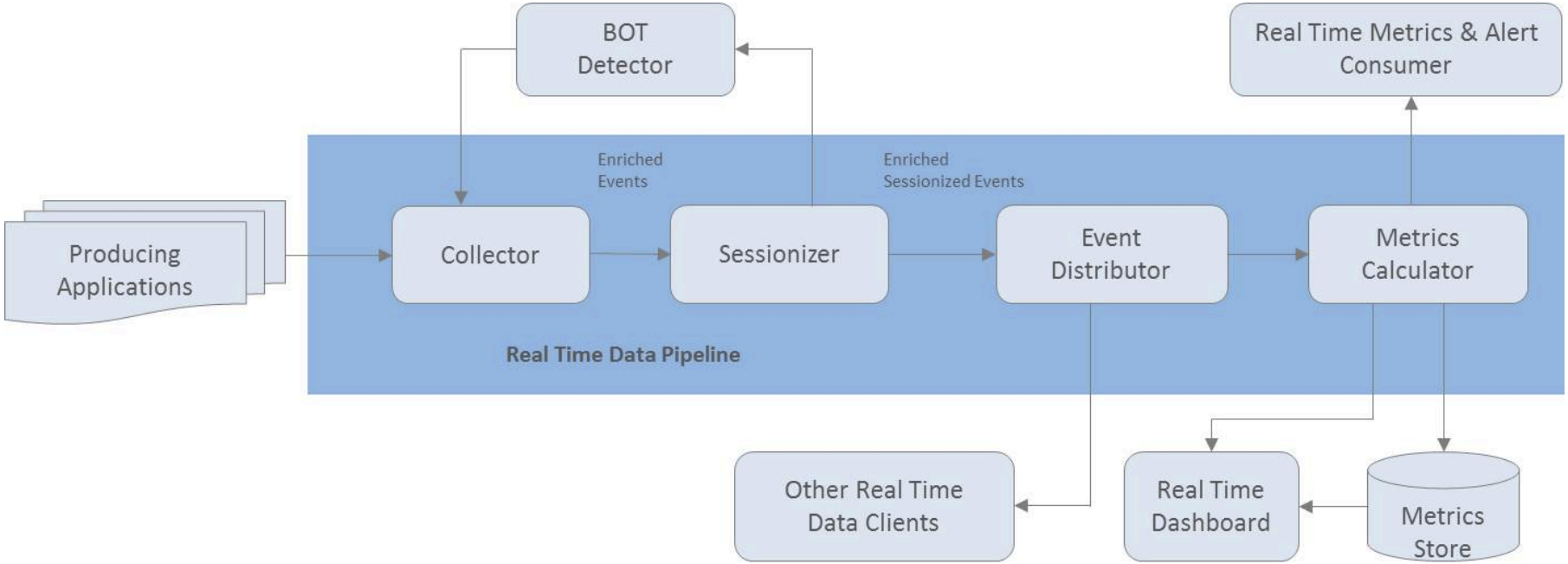


- Event = Tuples (K,V) – Mutable
- Channels: Message, File, REST, Kafka, Custom
- Event Processor: Esper, RateLimiter, RoundRobinLB, PartitionedLB, Custom

Pulsar Framework Flexibility

- Stream Processing Pipeline
  - Consist of loosely coupled stages (cluster of CEP cells)
  - CEP cells (channels and processors) configured as Spring beans
  - Declarative wiring of CEP cells to define pipeline
  - Each stage can adopt its own release and deployment cycles
  - Support topology changes without pipeline restart
- Stream Processing Logic
  - Two approaches: Java or SQL-like syntax through Esper integration
  - SQL statements can be hot deployed without restarting applications

Pulsar Real-time Analytics Pipeline



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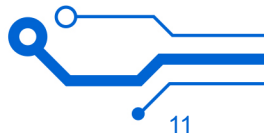
Complex Event Processing in Real-time Analytics Pipeline

- Enrichment
- Filtering and mutation
- Analysis over windows of time (rolling vs. tumbling)
  - Aggregation
  - Grouping and ordering
- Stateful processing
- Integration with other systems

Event Filtering and Routing Example

```
insert into SUBSTREAM select D1, D2, D3, D4
from RAWSTREAM where D1 = 2045573 or D2 = 2047936 or D3 = 2051457 or D4 = 2053742; // f
iltering
@PublishOn(topics="TOPIC1")   // publish sub stream at TOPIC1
@OutputTo("OutboundMessageChannel")
@ClusterAffinityTag(column = D1);    // partition key based on column D1
select * FROM SUBSTREAM;
```



Aggregate Computation Example

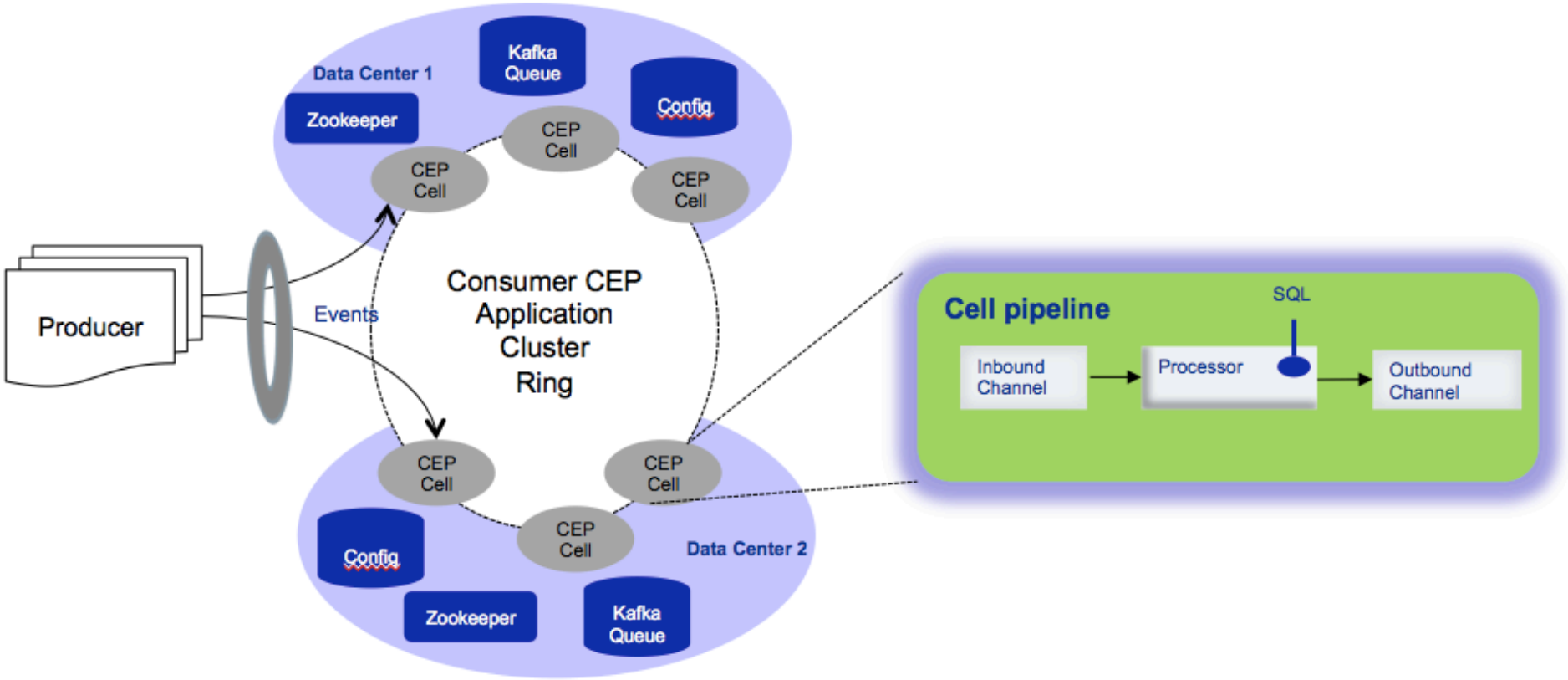
```
// create 10-second time window context
create context MCContext start @now end pattern [timer:interval(10)];
// aggregate event count along dimension D1 and D2 within specified time window
context MCContext insert into AGGREGATE select count(*) as METRIC1, D1, D2 FROM RAWSTRE
AM group by D1,D2 output snapshot when terminated;
select * from AGGREGATE;
```

TopN Computation Example

```
// create 60-second time window context
create context MCContext start @now end pattern [timer:interval(60)];
// sort to find top 10 event counts along dimensions D1, D2, and D3
// within specified time window
context MCContext insert into TOPITEMS select count(*) as totalCount, D1, D2, D3 from R
awEventStream group by D1, D2, D3 order by count(*) limit 10;
select * from TOPITEMS;
```

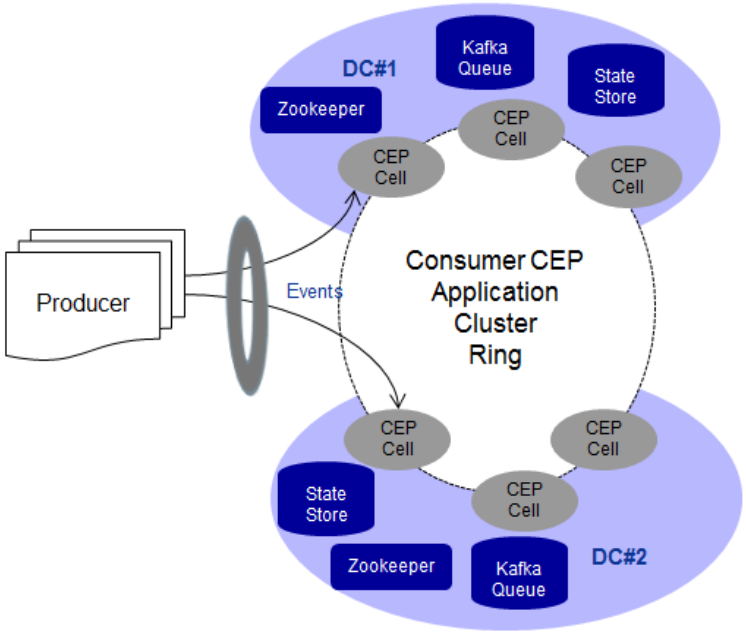
- TopN computation can be expensive with high cardinality dimensions
- Consider approximate algorithms
- Implemented as aggregate functions e.g. select ApproxTopN(10, D1, D2, D3)

Pulsar Deployment Architecture



Availability And Scalability

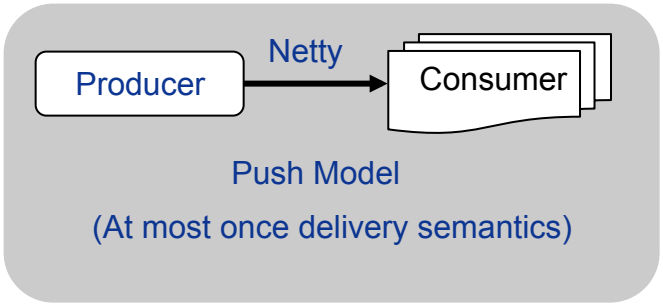
- Self Healing
- Datacenter failovers
- State management
- Shutdown Orchestration
- Dynamic Partitioning
- Elastic Clusters
- Dynamic Flow Routing
- Dynamic Topology Changes

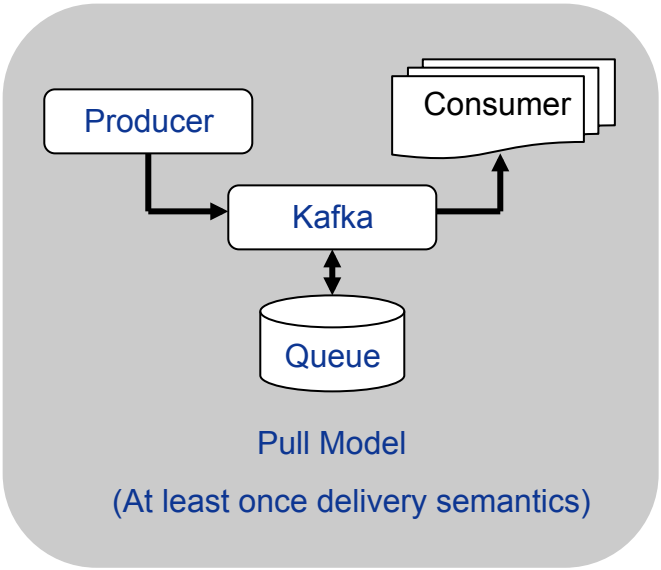


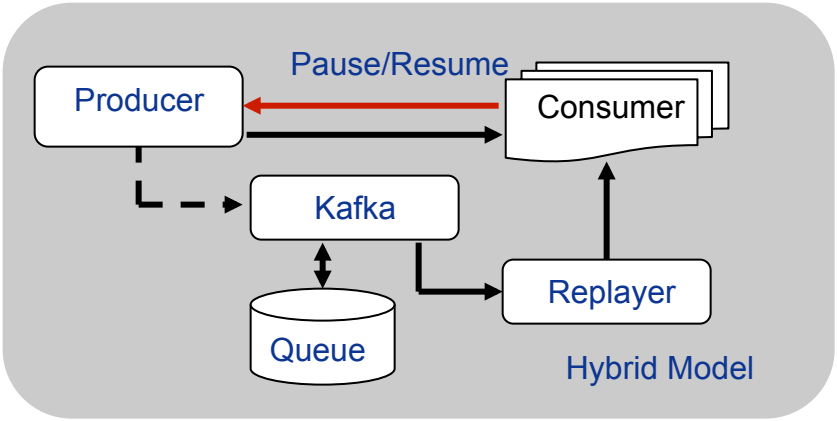
Pulsar Integration with Kafka

- Kafka
  - Persistent messaging queue
  - High availability, scalability and throughput
- Pulsar leveraging Kafka
  - Supports pull and hybrid messaging model
  - Loading of data from real-time pipeline into Hadoop and other metric stores

Messaging Models







Pulsar Integration with Kylin

- Apache Kylin
  - Distributed analytics engine
  - Provide SQL interface and multi-dimensional analysis (OLAP) on Hadoop
  - Support extremely large datasets
- Pulsar leveraging Kylin
  - Build multi-dimensional OLAP cube over long time period
  - Aggregate/drill-down on dimensions such as browser, OS, device, geo location
  - Capture metrics such as session length, page views, event counts

Pulsar Integration with Druid

- Druid
  - Real-time ROLAP engine for aggregation, drill-down and slice-n-dice
- Pulsar leveraging Druid
  - Real-time analytics dashboard
  - Near real-time metrics like number of visitors in the last 5 minutes, refreshing every 10 seconds
  - Aggregate/drill-down on dimensions such as browser, OS, device, geo location

Key Takeaways

- Creating pipelines declaratively
- SQL driven processing logic with hot deployment of SQL
- Framework for custom SQL extensions
- Dynamic partitioning and flow control
- < 100 millisecond pipeline latency
- 99.99% Availability
- < 0.01% steady state data loss
- Cloud deployable

Future Development and Open Source

- Real-time reporting API and dashboard
- Integration with Druid and other metrics stores
- Session store scaling to 1 million insert/update per sec
- Rolling window aggregation over long time windows (hours or days)
- Dynamic Joins with graphs and RDBMS tables
- Hot deployment of Java source code

More Information

- **GitHub:** http://github.com/pulsarIO
  - repos: pipeline, framework, docker files
- **Website:** http://gopulsar.io
  - Technical whitepaper
  - Getting started
  - Documentation
- **Google group:** http://groups.google.com/d/forum/pulsar

Appendix

Twitter Storm/Spark Streaming vs Pulsar – Key Differences

Requirement	Pulsar	Storm/Trident	Spark Streaming
Declarative Pipeline Wiring	Yes	No	No
Pipeline stitching	Run time	Build time	Build time
Topology change requires reboot	No	Yes	Yes
SQL support	Yes	No	Yes*
Hot deployment of processing rules	Yes	No	No
Guaranteed Message Processing	Yes (batching)	Yes	Yes
Pipeline Flow Control	Yes	?	?
Stateful Processing	Yes	Yes	Yes