Machine Learning on Streaming Data

with Apache Kafka, Apache Beam, & TensorFlow

About Us

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Big Thanks to:

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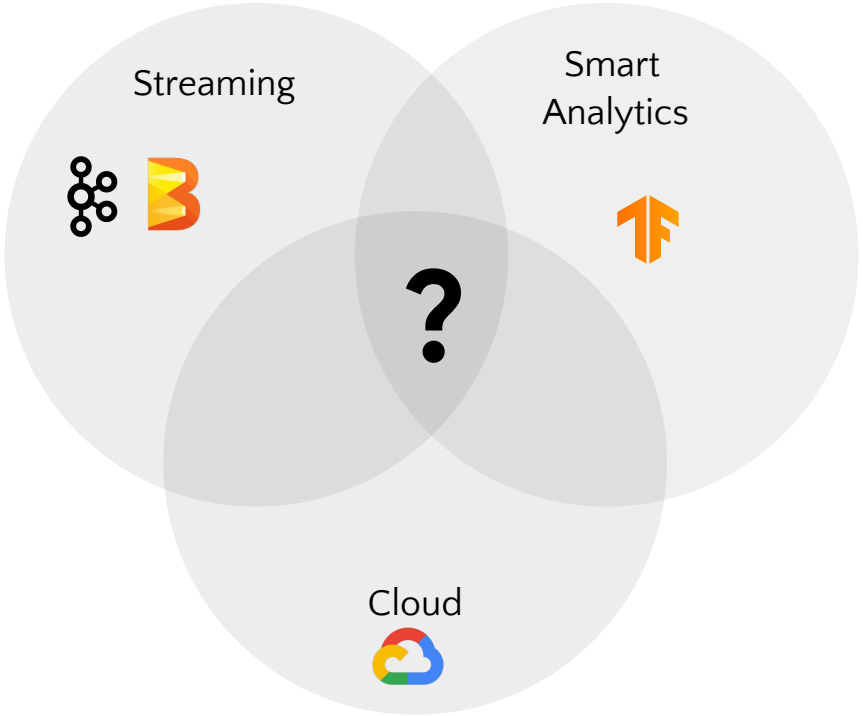
Kai Waehner
Technology Evangelist, Confluent

Agenda

1. Motivation
2. Architecture
3. **Use Case Walk-Through w/ Demo**
4. Summary

1 Motivation

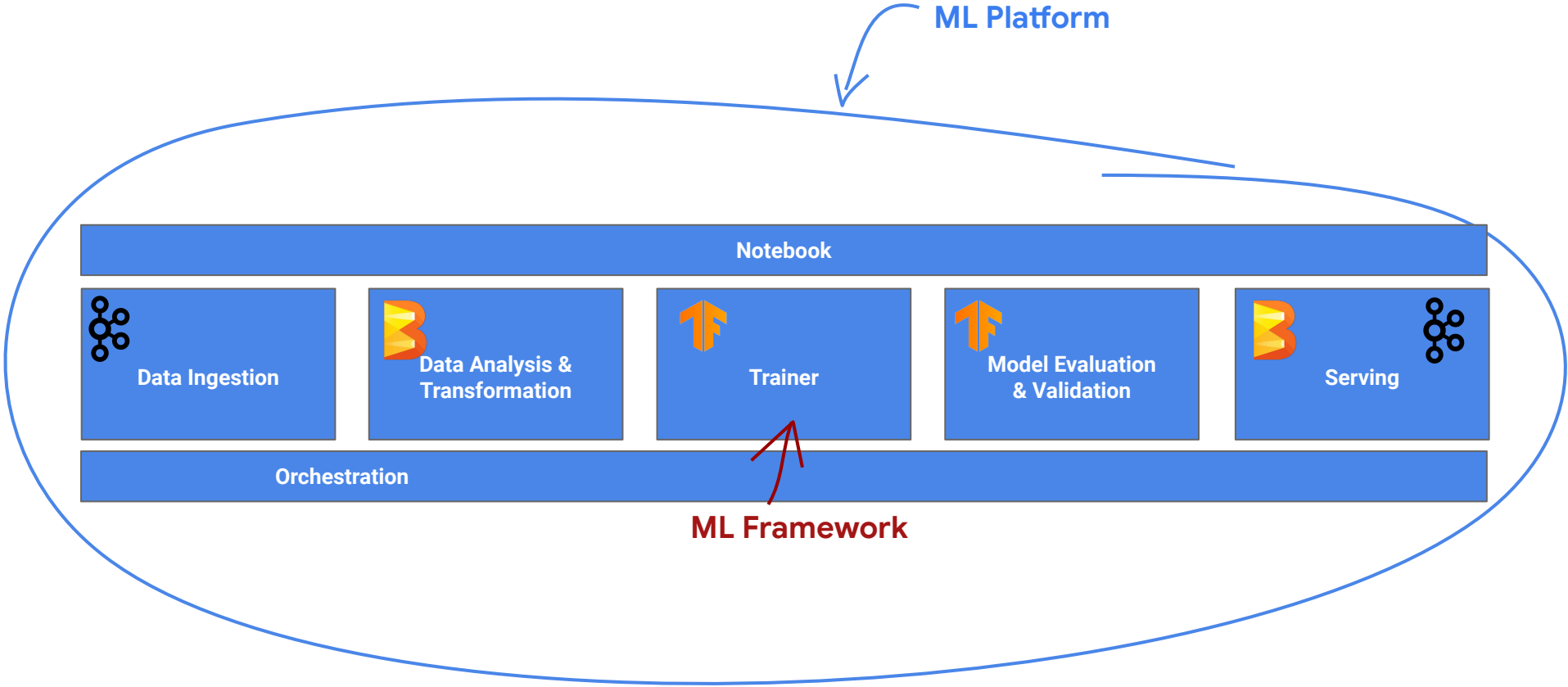
Technology Landscape



InfoWorld's 2019 Technology of the Year Award Winners:

- **Apache Beam**
- **Apache Kafka**
- Elastic Stack
- DataStax Enterprise
- Firebase
- Horovod
- H2O Driverless AI
- Keras
- Kubernetes
- LLVM
- .Net Core
- PyTorch
- Redis
- **TensorFlow**
- Visual Studio Code
- XGBoost

https://www.globenewswire.com/news-release/2019/01/30/1707685/0/en/InfoWorld-Announces-2019-Technology-of-the-Year-Award-Winners.html

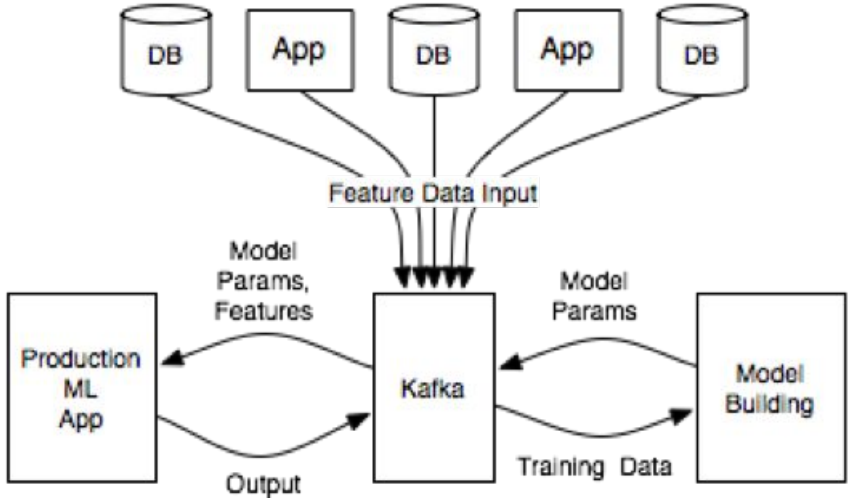

ML Platform
Notebook
Data Ingestion
Data Analysis & Transformation
Trainer
Model Evaluation & Validation
Serving
Orchestration
ML Framework

OSS	Managed Service
Apache Kafka Event streaming platform 	**Confluent Cloud** Monitoring, Replication, Data Balancing
Apache Beam Data processing pipelines Unified batch & streaming 	**Dataflow** Automated resource management of workers 
TensorFlow Robust foundation for machine and deep learning 	**Cloud Machine Learning Engine** • Training: Distributed training infrastructure that supports CPUs, GPUs, and TPUs • Serving: Host models for batch & online prediction 

2 Architecture

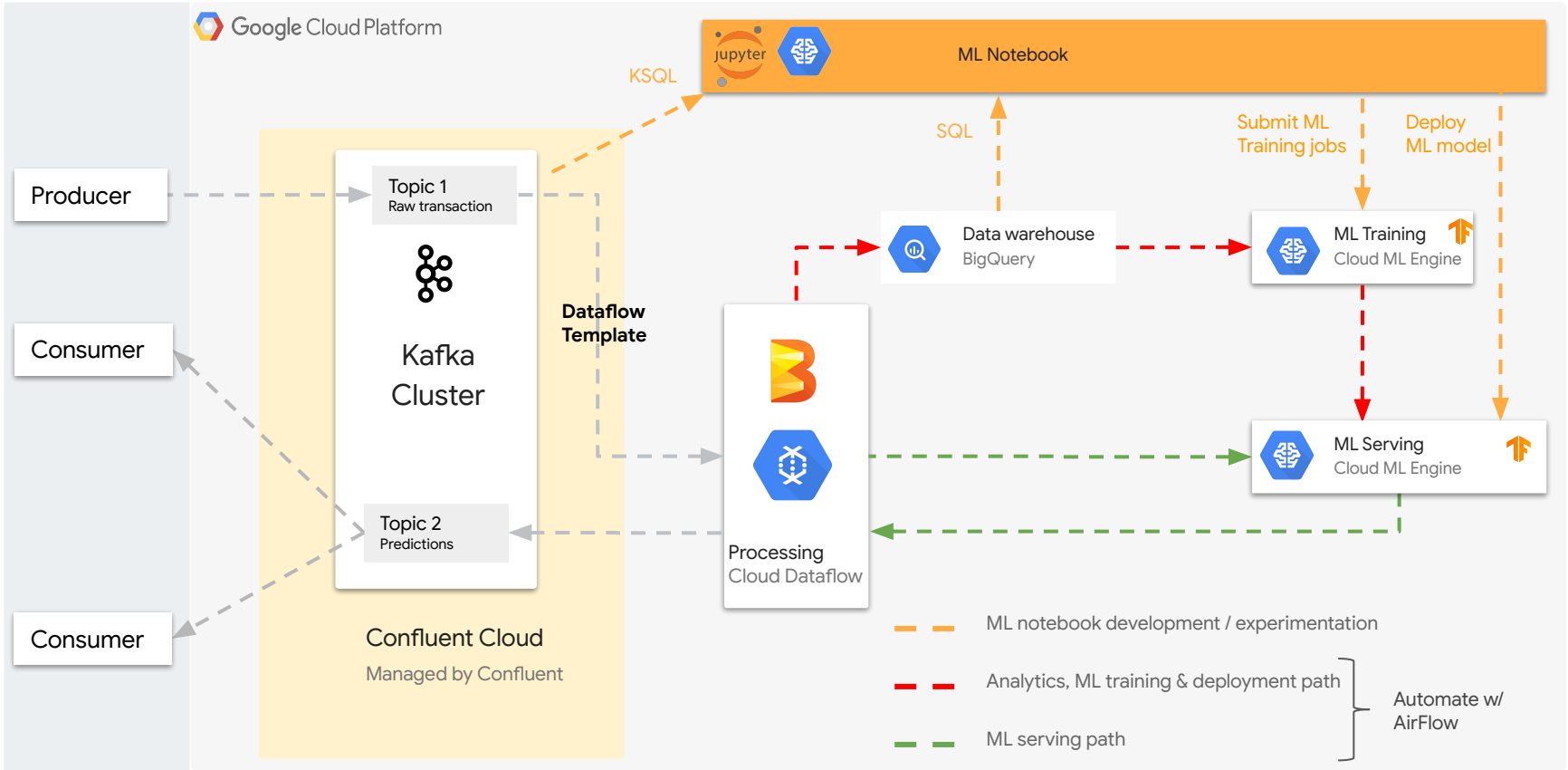
Reference Kafka ML Architecture

- Data pipelines are simplified
- Building analytic modules is decoupled from servicing them
- Usage of real time or batch as needed
- Analytic models can be deployed in a performant, scalable and mission-critical environment



Kai Waehner
Technology Evangelist, Confluent
https://www.confluent.io/blog/build-deploy-scalable-machine-learning-production-apache-kafka/

Leverage managed services to simplify & focus on code not infrastructure



3 Use Case Walk-Through

Kaggle Case Study
Fraud Detection of Credit Card Transactions

284,807

transactions

492

Fraud (0.172%)

- Collect transaction data
- Analyze historical data
- Train model on historic sample
- Evaluate model based on precision & recall
- Predict fraud on new streaming data

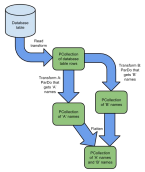
- Andrea Dal Pozzolo, Olivier Caelen, Reid A. Johnson and Gianluca Bontempi. Calibrating Probability with Undersampling for Unbalanced Classification. In Symposium on Computational Intelligence and Data Mining (CIDM), IEEE, 2015
- Dal Pozzolo, Andrea; Caelen, Olivier; Le Borgne, Yann-Ael; Waterschoot, Serge; Bontempi, Gianluca. Learned lessons in credit card fraud detection from a practitioner perspective. Expert systems with applications,41,10,4915-4928,2014, Pergamon
- Dal Pozzolo, Andrea; Boracchi, Giacomo; Caelen, Olivier; Alippi, Cesare; Bontempi, Gianluca. Credit card fraud detection: a realistic modeling and a novel learning strategy. IEEE transactions on neural networks and learning systems,29,8,3784-3797,2018,IEEE
    - Dal Pozzolo, Andrea Adaptive Machine learning for credit card fraud detection ULB MLG PhD thesis (supervised by G. Bontempi)
- Carcillo, Fabrizio; Dal Pozzolo, Andrea; Le Borgne, Yann-Aël; Caelen, Olivier; Mazzer, Yannis; Bontempi, Gianluca. Scarff: a scalable framework for streaming credit card fraud detection with Spark. Information fusion,41, 182-194,2018,Elsevier
- Carcillo, Fabrizio; Le Borgne, Yann-Aël; Caelen, Olivier; Bontempi, Gianluca. Streaming active learning strategies for real-life credit card fraud detection: assessment and visualization. International Journal of Data Science and Analytics, 5,4,285-300,2018,Springer International Publishing

DEMO 1 - **5 min**

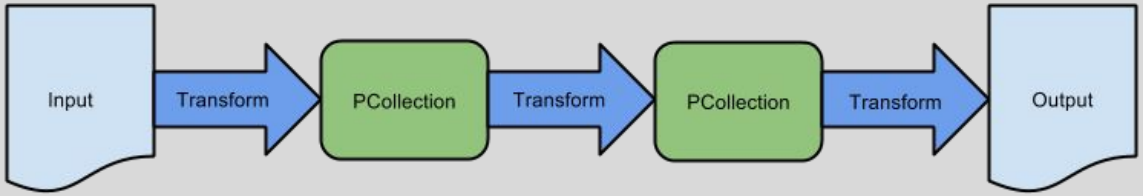
Sending our credit card data

Confluent Cloud, Creating a Topic, Python Script, Security

Kafka to BigQuery



Java Code

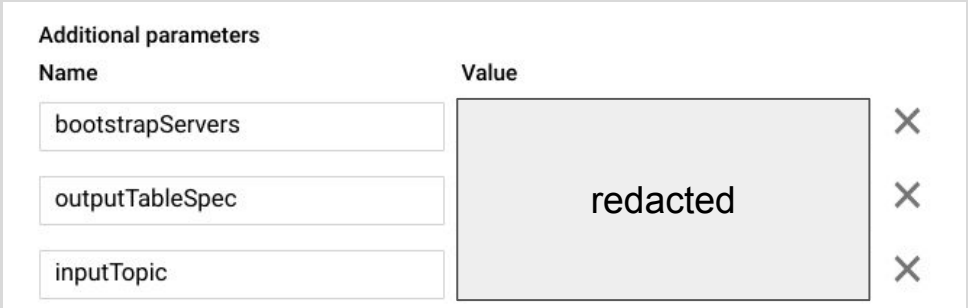



```
KafkaIO.<String, String>read()
```

```
BigQueryIO.writeTableRows()
```

Create a template for easy re-usability by an analyst

Dataflow Template



Images from https://beam.apache.org/documentation/pipelines/design-your-pipeline/

Explore data & train ML model

Query directly from topic

```
from ksql import KSQLAPI

redacted
```

Query petabytes of data

```
%%bigquery

redacted
```

Submit ML training job

```
gcloud ml-engine jobs
submit training

redacted
```

DEMO 2 - **5 min**

Dataflow template & job

Jupyter: KSQL, BQML, TensorFlow CMLE job

Send Predictions back to Kafka

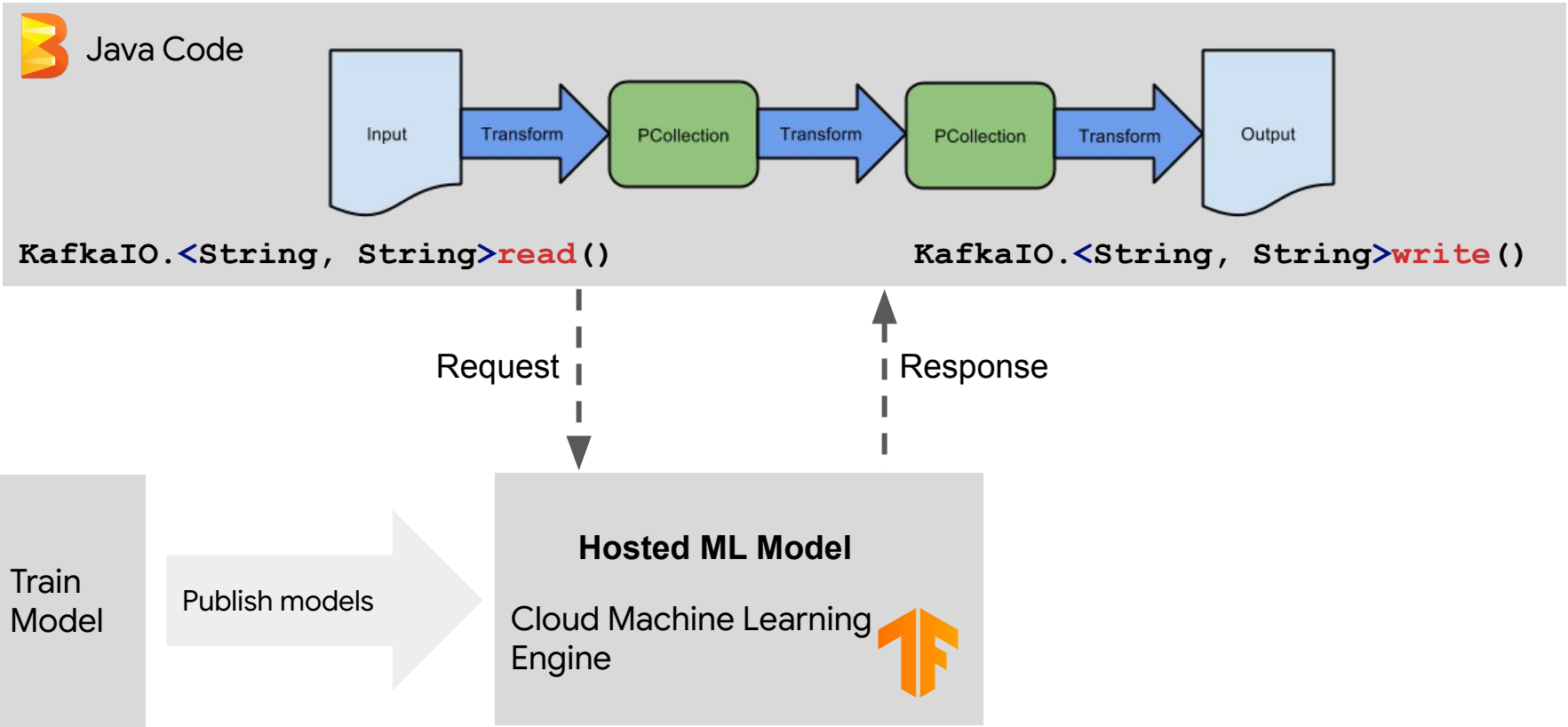


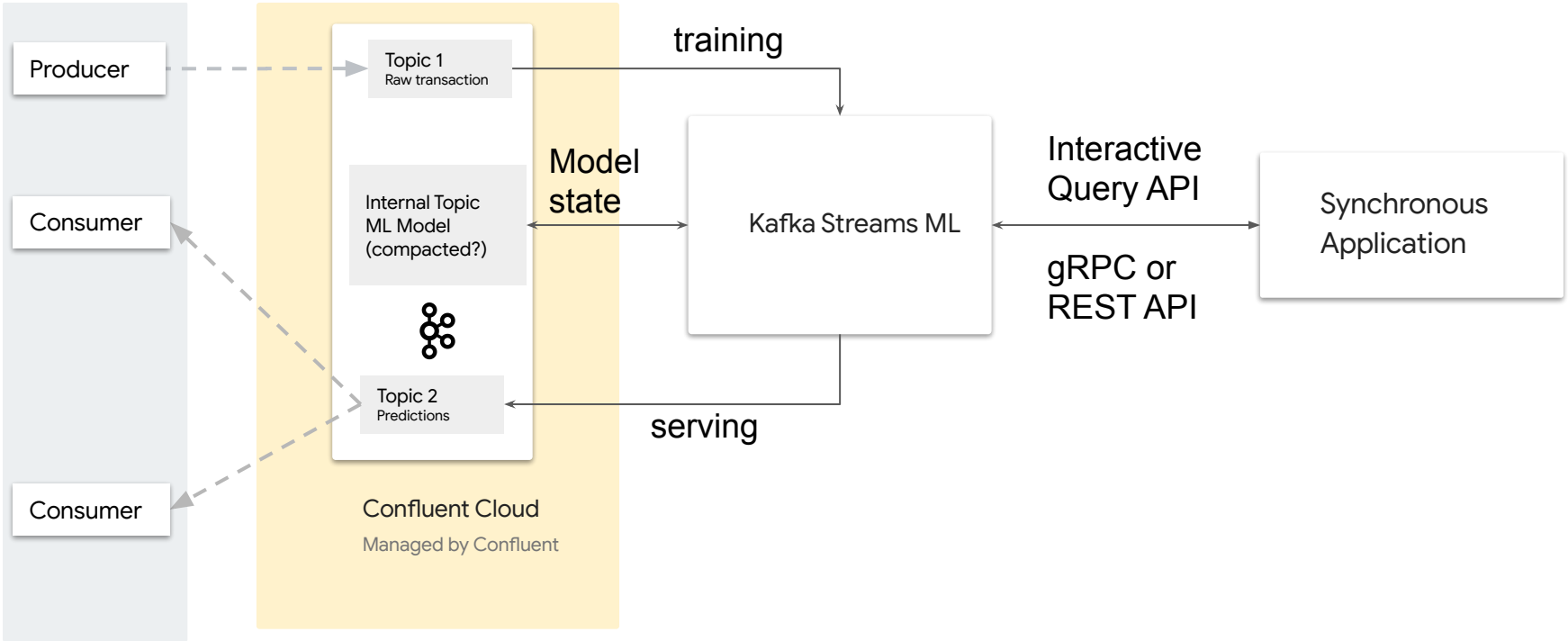
Image from https://beam.apache.org/documentation/pipelines/design-your-pipeline/

DEMO 3 - **5 min**

(1) Deploy model as an end point
(2) Prediction sent to Kafka topic to be consumed
(3) Track models & monitor predictions in CMLE UI

Futuristic Architecture: Pure Kafka-based ML

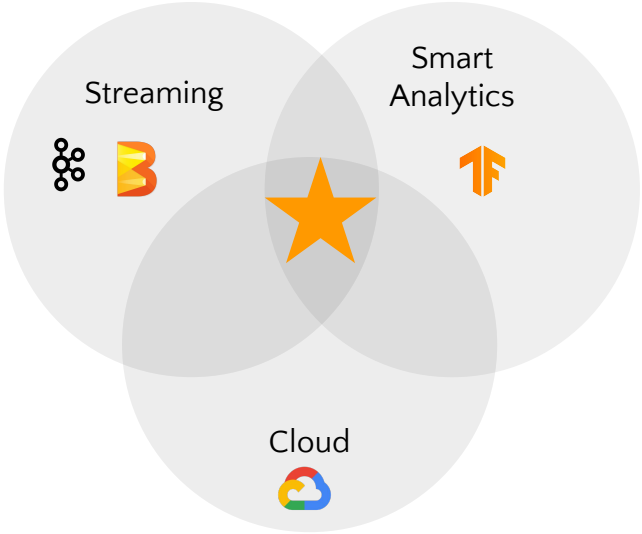
Resilient, highly available, sync & async



4 Summary

Summary

- Kafka + Beam + TensorFlow = Great foundation for future
  - Batch today ⟶ streaming tomorrow
  - Small data ⟶ big data tomorrow
  - Shallow learning today ⟶ deep learning tomorrow
- Make data & ML easier for yourself by using managed services
- Build for many other use cases:
  - Predictive maintenance
  - Logistics routing
  - Image search & recommendations in e-commerce



Talk to Google Cloud

K1

Booth

Learn More

Blog: Enabling connected transformation with Apache Kafka and TensorFlow on Google Cloud Platform
bit.ly/2CHERoI

KafkaIO on Beam
bit.ly/2YwL3Jc

KafkaToBigQuery Dataflow Template Example
bit.ly/2HQqVN0

Contact us

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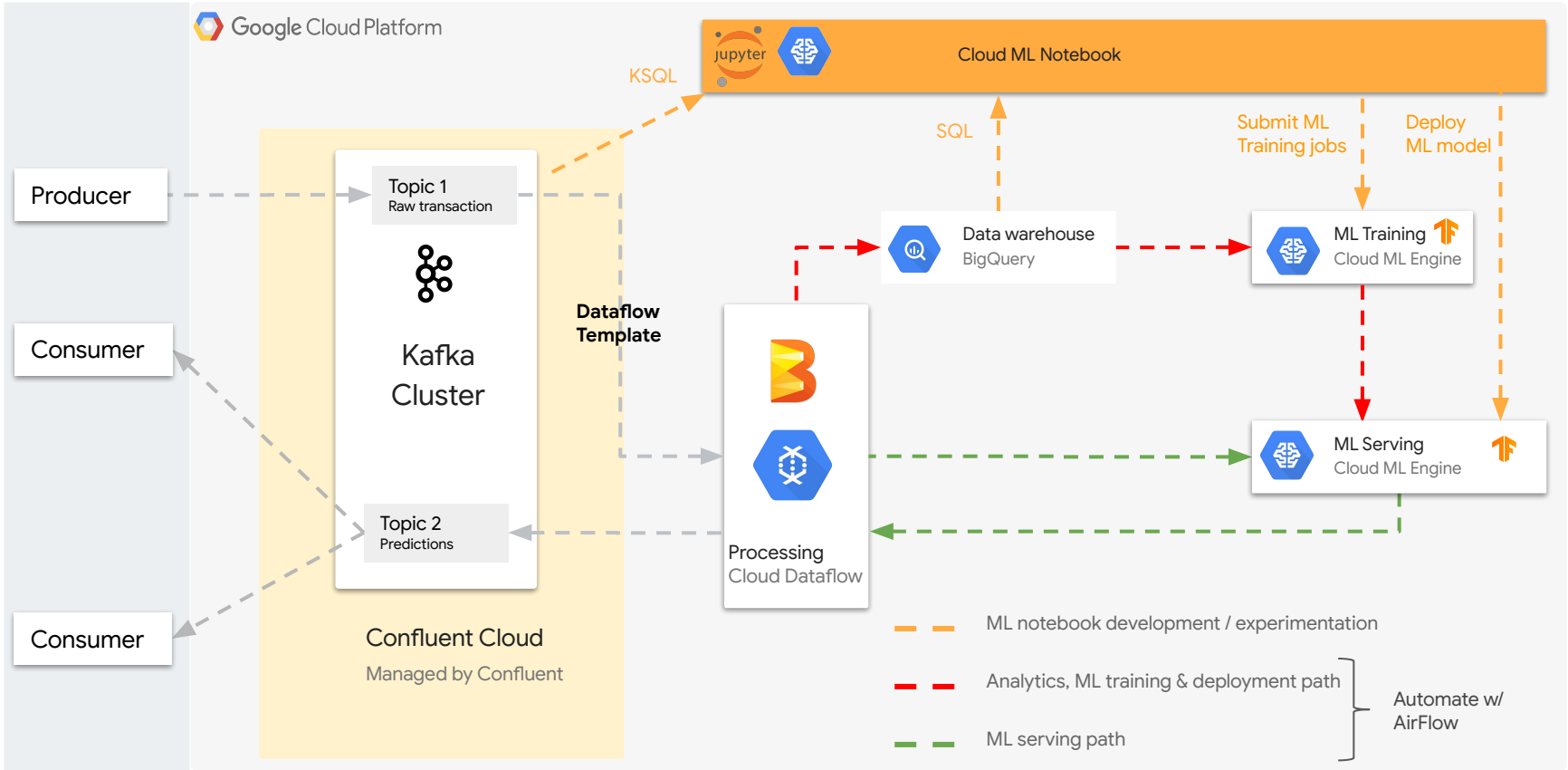
Questions


Google Cloud Platform
jupyter
Cloud ML Notebook
KSQL
SQL
Submit ML Training jobs
Deploy ML model
Producer
Consumer
Consumer
Topic 1
Raw transaction
Kafka Cluster
Topic 2
Predictions
Confluent Cloud
Managed by Confluent
Dataflow Template
Data warehouse
BigQuery
ML Training
Cloud ML Engine
ML Serving
Cloud ML Engine
Processing
Cloud Dataflow
ML notebook development / experimentation
Analytics, ML training & deployment path
ML serving path
Automate w/ AirFlow