

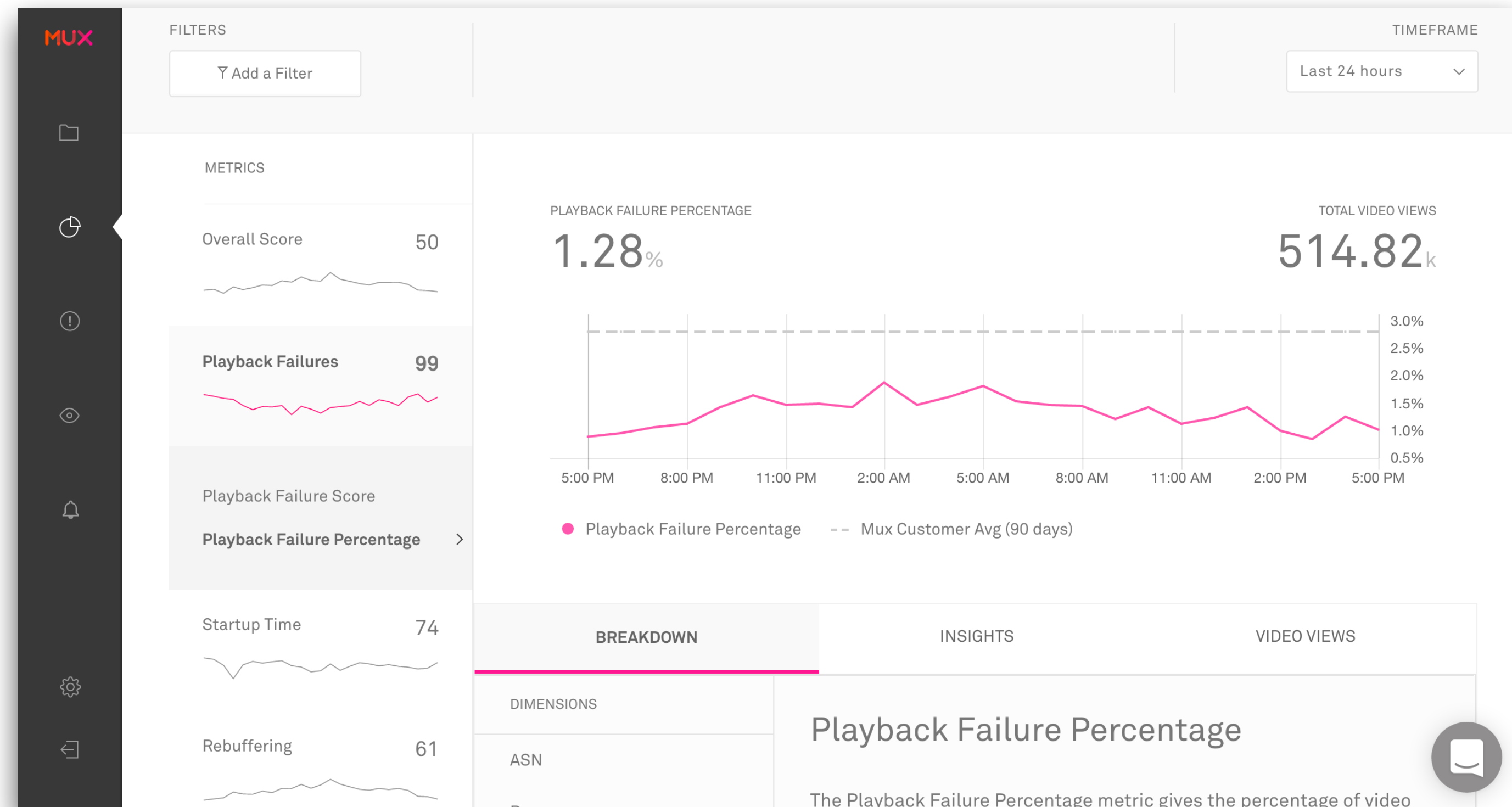


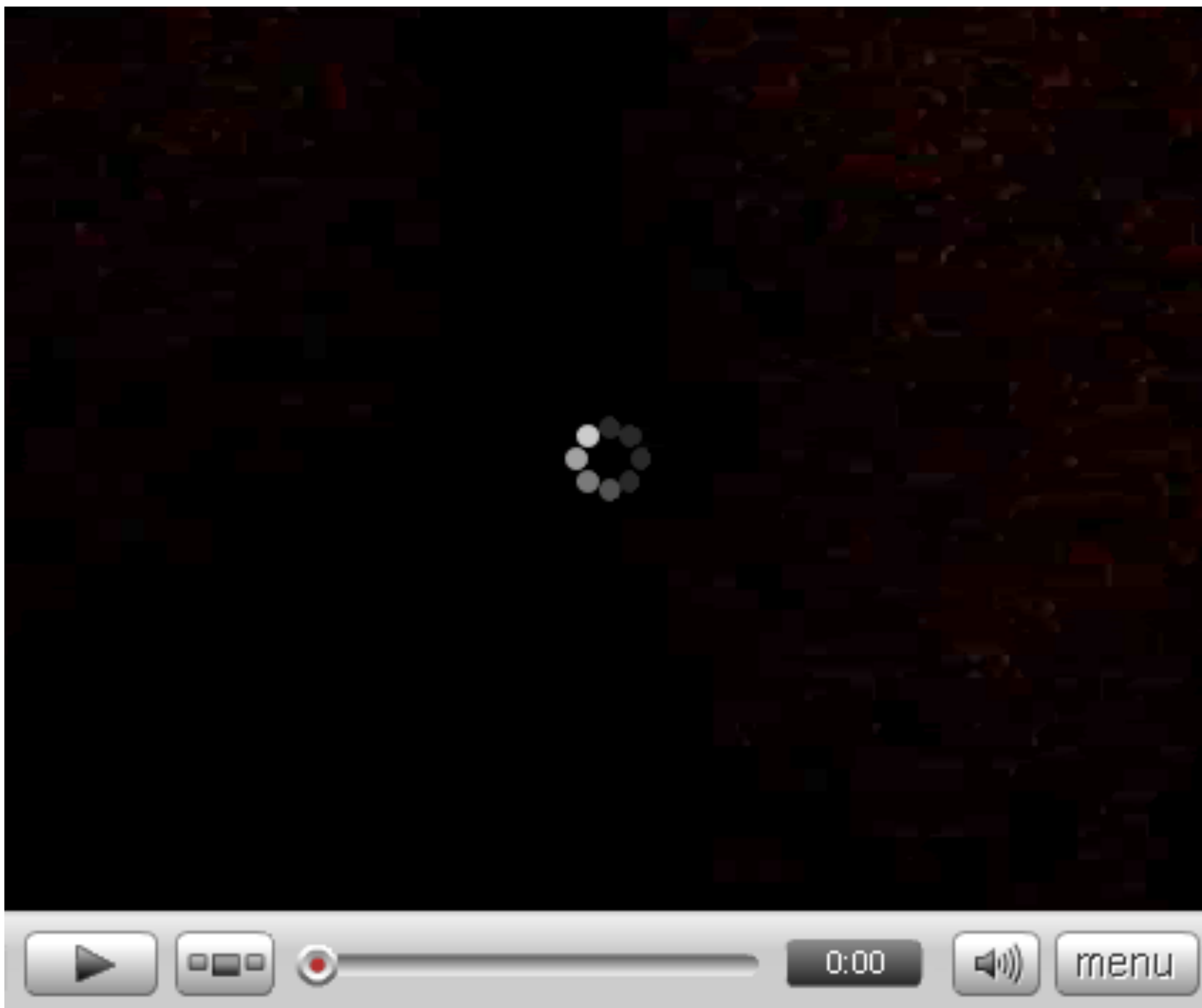
# Building a Real-Time Anomaly-Detection System with Flink @ Mux

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# What is Mux?

- Real-time analytics for video
- Customers include PBS, Funny or Die, IGN, Wistia
- Track playback failures, start-up time, rebuffering, and more
- Process millions of video views per day





**“All production flows have a basic characteristic: the material becomes more valuable as it moves through the process.”  
— Andy Grove, High Output Management**

# What processing adds the most value?

# Making Video-Delivery a Monitored Service

- Susan Fowler’s book “Production-Ready Microservices” lists components of a well-monitored microservice:
  1. Logging
  2. Dashboards
  3. Alerting
  4. On-call Rotation
- Mux supported the first two in the form of video-event ingestion and a pretty web dashboard, but lacked alerting and an on-call rotation





# Types of Error-Rate Alerts

- **Property Alerts**
  - Problems affecting an entire customer property
  - **Example:** CDN publishing for HTTP Live Streaming is broken, resulting in widespread live-streaming failures.
- **Video-Title Alerts**
  - Problems affecting specific video-titles within a customer property
  - **Example:** Poorly encoded/mislabeled video is published to catalog





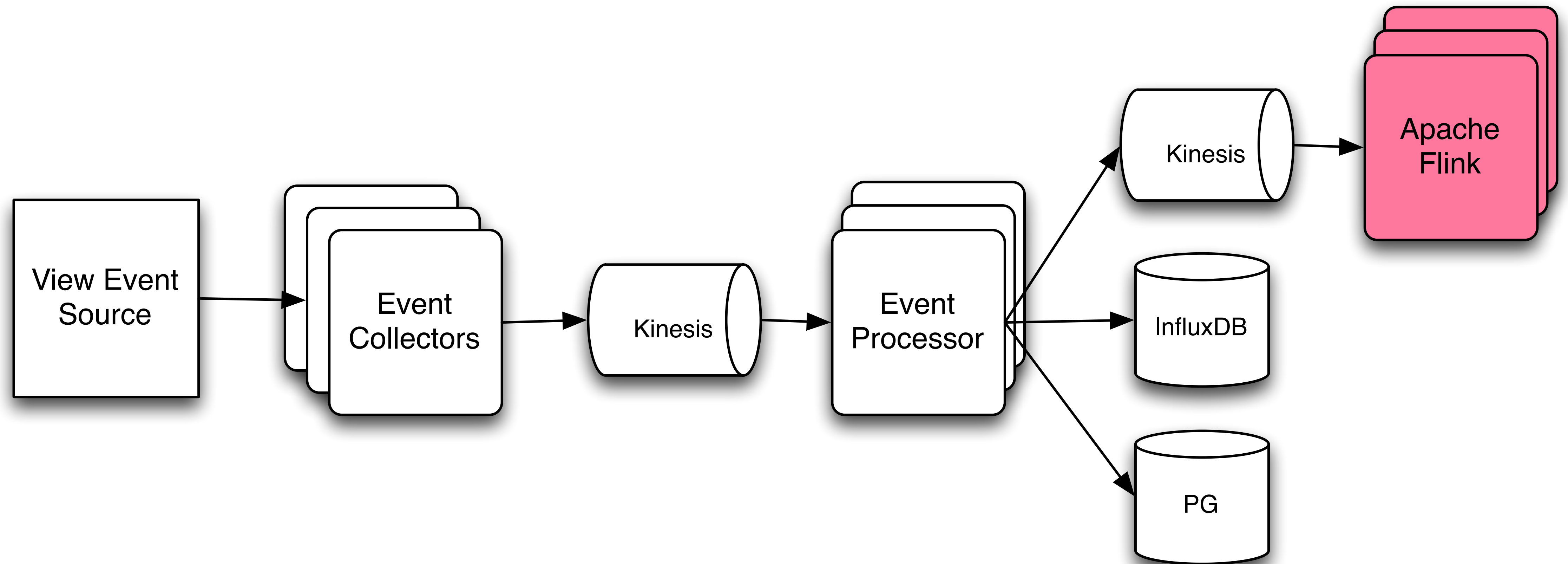
# Alerting Technical Requirements

- Needed a system to detect error-rate anomalies in video-views across a customer property and for every video title
- Very low latency, high-availability
- Horizontally-scalable on AWS commodity hardware, preferably running in a Docker container
- Easy to use at every stage: prototyping, development, production
- Read from AWS Kinesis streams, but preferably support Kafka too

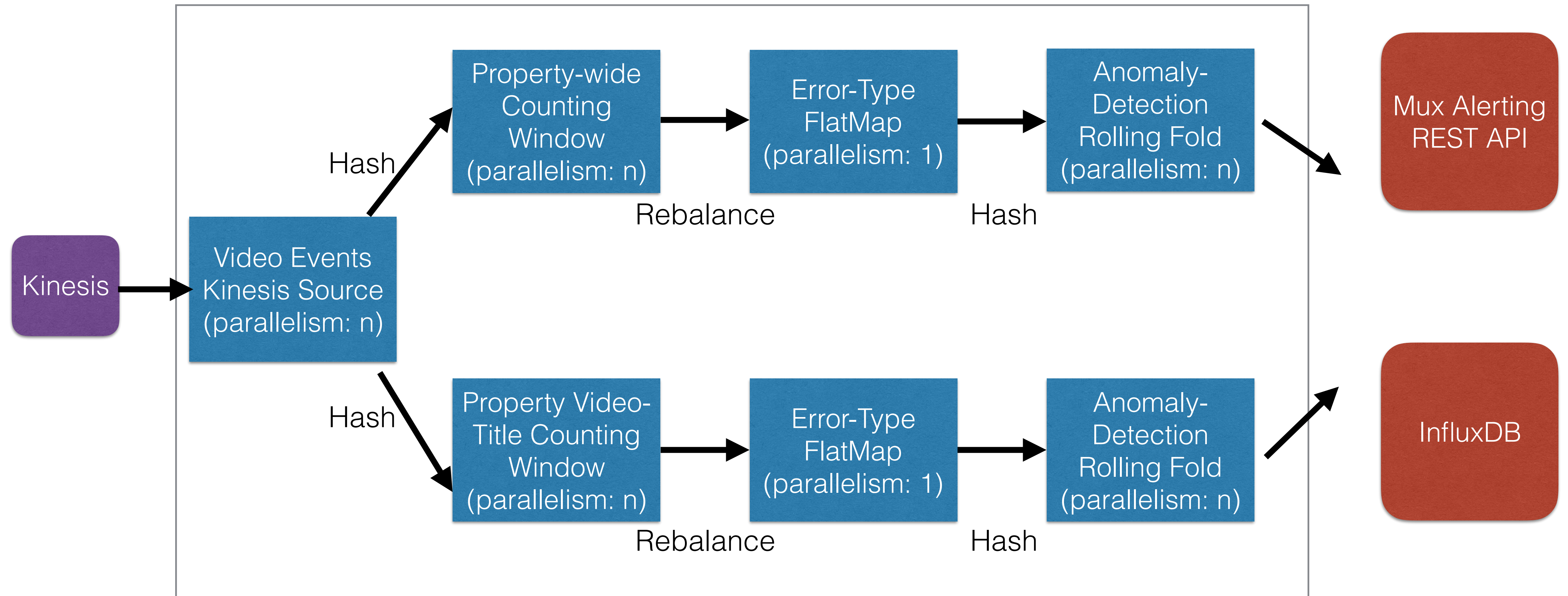



# Application Design

# Event Ingestion Architecture



# Flink Execution Plan



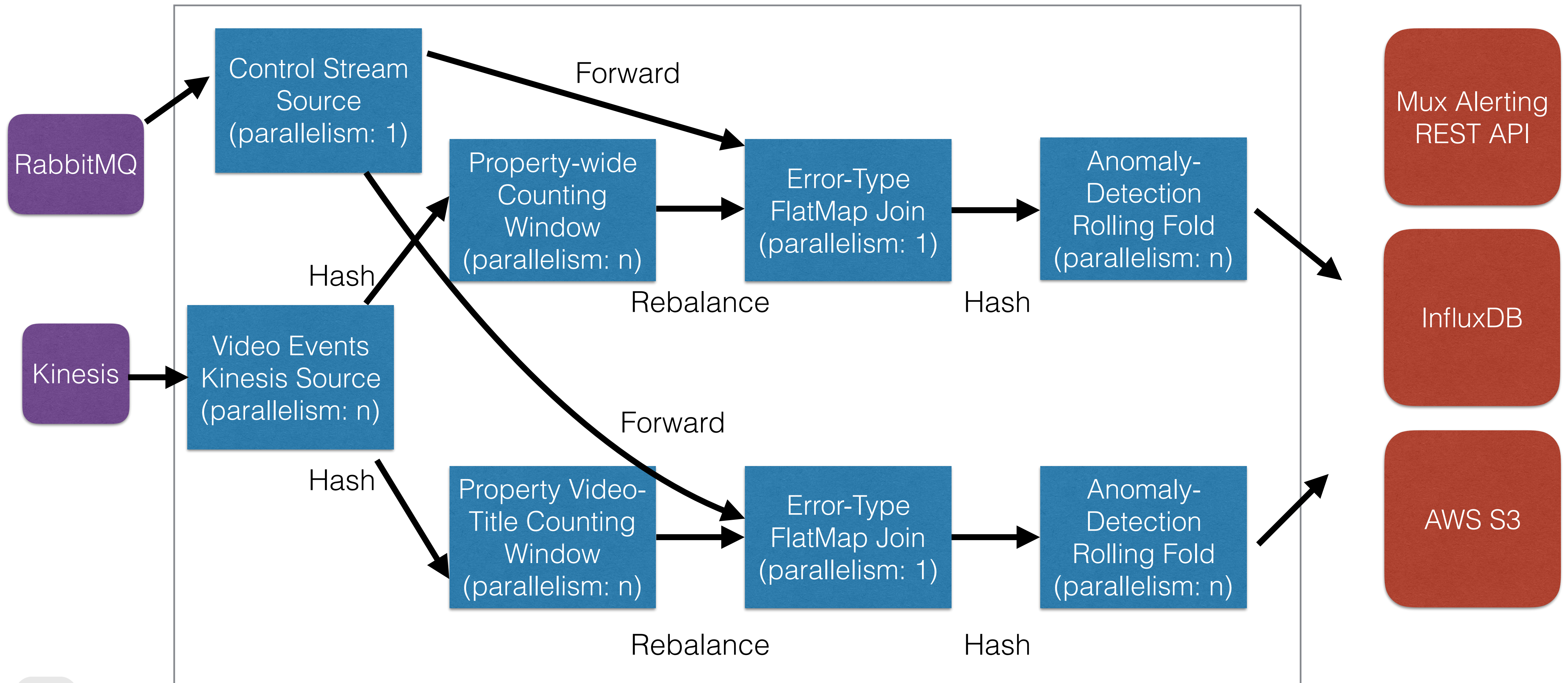


# Introducing a Control Stream

- Data pipeline worked great, but needed ability to interact with running application without a restart
- Added a simple RabbitMQ stream source that accepts control messages
- Control messages feed into the FlatMap operator
- Control operations include:
  - Dump error-rates to S3 for each property/error-type permutation
  - Dump active alert-incident state to S3



# Flink Execution Plan with Control Stream



# Deployment and Operations



# Docker

- All services at Mux are deployed in Docker containers
- Created a custom Docker image of Flink built from source
- Use BuildKite to build Docker image and push to Docker Hub
- Same image for Flink Job Manager & Task Manager
- Configure Flink using environment-variables
- Used with Alpine & Debian-Jessie base-images successfully
- Deploy Flink Standalone Cluster with Rancher



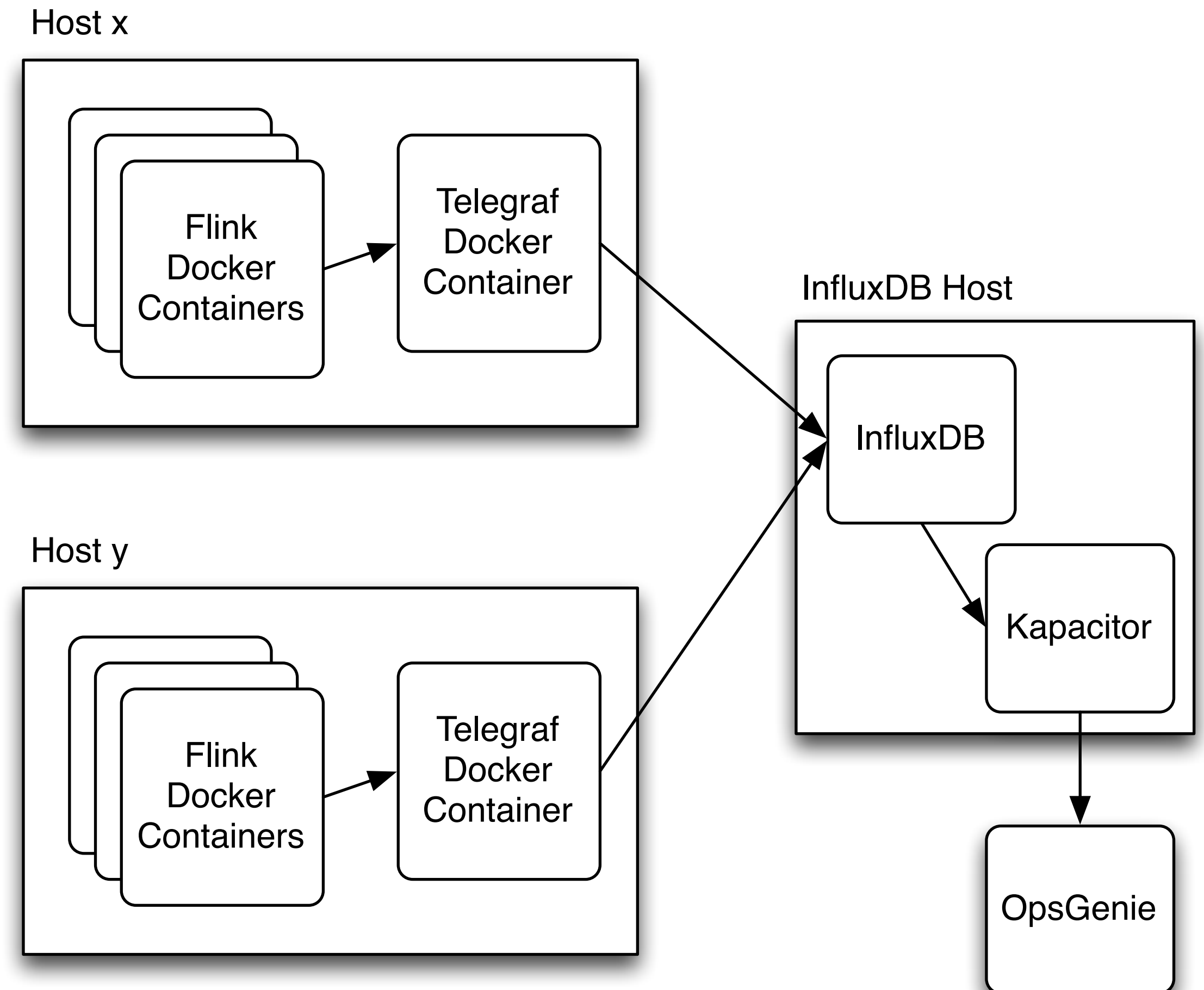


# Builds & Behavioral Testing

- Use BuildKite to build our Flink application JAR
- BuildKite build runs in a Docker container on AWS EC2 instances
- Behavioral tests written in Cucumber (Ruby)
- Cucumber tests run against a set of Docker containers brought up using Docker-Compose: Flink, Kinesalite (Kinesis clone), Minio (S3 clone), RabbitMQ, InfluxDB
- Docker-managed networking to connect services

# Internal Monitoring






- Use Statsd to emit Flink Metrics about Flink cluster
- Telegraf Docker container consumes Statsd metrics and writes to InfluxDB
- Kapacitor monitors InfluxDB writes
- Kapacitor scripts can trigger alerts (OpsGenie, PagerDuty, etc)



# Mux Alerting UI

# Listing of Alert Incidents

MUX



Alerts

See all incidents that have been alerted on

Notification Settings

OPEN INCIDENTS

ALL INCIDENTS

ID	DETAILS	OPEN FOR	VIEWS IMPACTED	VIEWS IMPACTED / HR
13331	Video Title <b>Grupo Formula 104.1</b> is failing at a significant rate (86.0%) due to an error of <b>networkError</b>	6 minutes	184	2660
13332	Overall error-rate is significantly high (22.4%) due to an error of <b>networkError</b>	8 minutes	300	3121
13323	Video Title <b>Enlace</b> is failing at a significant rate (86.0%) due to an error of <b>networkError</b>	an hour	97	532
13320	Video Title <b>Bank of Montreal Rings the NYSE Opening Bell</b> is failing at a significant rate (88.0%) due to an error of <b>networkError</b>	an hour	44	1022

# Slack Notifications for Alerts



[Open: Incident #13331](#)

## Video Title

Grupo Formula 104.1

## Error

networkError

## Error Percentage

86.0%

## Rate

11908 / hour



<https://dashboard.mux.com/properties/177/incidents/13331>



[Open: Incident #13332](#)

## Error

networkError

## Error Percentage

22.4%

## Rate

5486 / hour



<https://dashboard.mux.com/properties/177/incidents/13332>

# Alert Incident Details

MUX



ERROR  
**networkError**

INITIAL ERROR PERCENTAGE  
**22.4%**

INITIAL RATE  
**5486 / hour**

## INCIDENT TRIGGER

Opened At	03/07/2017 7:25 AM
Error Percentage	22.4%
Alert Threshold	14.7%
Minimum Window	1000 views

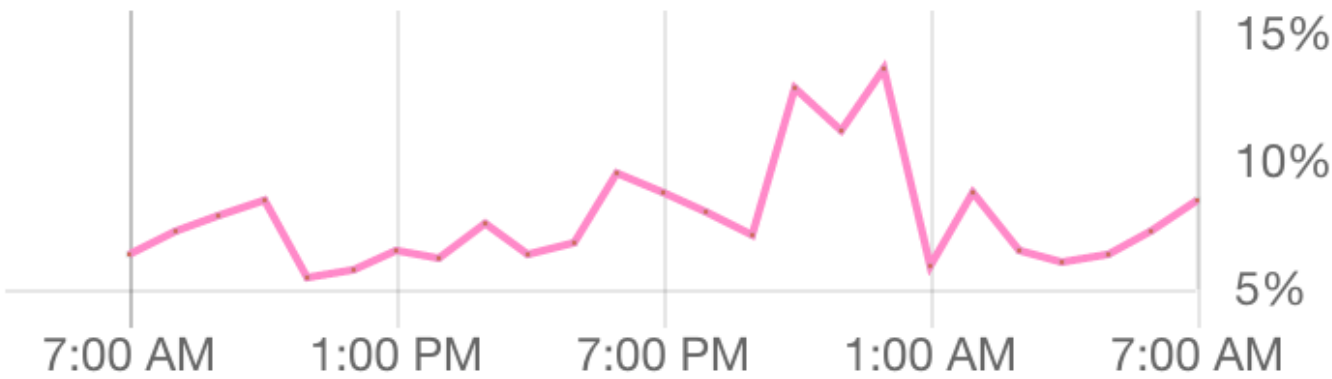
## CURRENT STATUS

Open For	<b>12 minutes</b>
Views Impacted	670 views
Impact/hr	3792 views

NOTIFICATIONS: **ON**

Silence Alert Notifications

## INCIDENT TIMELINE [\(View in metrics\)](#)



## OTHER OCCURENCES

an hour ago	Duration: <b>23 minutes</b>	>
2 hours ago	Duration: <b>24 minutes</b>	>
5 hours ago	Duration: <b>an hour</b>	>
8 hours ago	Duration: <b>2 hours</b>	>
10 hours ago	Duration: <b>an hour</b>	>

# Thank You!