Real-time Streaming Data on AWS

Deep Dive & Best Practices Using Amazon Kinesis, Spark Streaming, AWS Lambda, and Amazon EMR

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Agenda

Real-time streaming overview

Use cases and design patterns

Amazon Kinesis deep dive

Streaming data ingestion & Stream processing

Sizmek Case Study

Q&A

It’s All About the Pace

Batch Processing	Stream Processing
Hourly server logs	Real-time metrics
Weekly or monthly bills	Real-time spending alerts/caps
Daily web-site clickstream	Real-time clickstream analysis
Daily fraud reports	Real-time detection

Streaming Data Scenarios Across Verticals

Scenarios/ Verticals	Accelerated Ingest-Transform-Load	Continuous Metrics Generation	Responsive Data Analysis
Digital Ad Tech/Marketing	Publisher, bidder data aggregation	Advertising metrics like coverage, yield, and conversion	User engagement with ads, optimized bid/buy engines
IoT	Sensor, device telemetry data ingestion	Operational metrics and dashboards	Device operational intelligence and alerts
Gaming	Online data aggregation, e.g., top 10 players	Massively multiplayer online game (MMOG) live dashboard	Leader board generation, player-skill match
Consumer Online	Clickstream analytics	Metrics like impressions and page views	Recommendation engines, proactive care

Customer Use Cases

SONOS

Sonos runs near real-time streaming analytics on device data logs from their connected hi-fi audio equipment.

Glu Mobile collects billions of gaming events data points from millions of user devices in real-time every single day.

REDFIN

One of the biggest online brokerages for real estate in US. Built Hot Homes feature.

NORDSTROM

Nordstorm recommendation team built online stylist using Amazon Kinesis Streams and AWS Lambda.

Streaming Data Challenges: Variety & Velocity

- Streaming data comes in different types and formats
  - Metering records, logs and sensor data
  - JSON, CSV, TSV
- Can vary in size from a few bytes to kilobytes or megabytes
- High velocity and continuous processing

```
{
  "payerId": "Joe",
  "productCode": "AmazonS3",
  "clientProductCode": "AmazonS3",
  "usageType": "Bandwidth",
  "operation": "PUT",
  "value": "22490",
  "timestamp": "1216674828"
}
```

Metering Record

```
{
  127.0.0.1 user-
  identifier frank
  [10/Oct/2000:13:5
  5:36 -0700] "GET
  /apache_pb.gif
  HTTP/1.0" 200
  2326
}
```

Common Log Entry

```
{
  <165>1 2003-10-11T22:14:15.003Z
  mymachine.example.com evntslog -
  ID47 [exampleSDID@32473 iut="3"
  eventSource="Application"
  eventID="1011"][examplePriority@
  32473 class="high"]
}
```

Syslog Entry

```
{
   "SeattlePublicWa
   ter/Kinesis/123/
   Realtime" -
   412309129140
}
```

MQTT Record

Two Main Processing Patterns

Stream processing (real time)

- Real-time response to events in data streams

Examples:

- Proactively detect hardware errors in device logs
- Notify when inventory drops below a threshold
- Fraud detection

Micro-batching (near real time)

- Near real-time operations on small batches of events in data streams

Examples:

- Aggregate and archive events
- Monitor performance SLAs

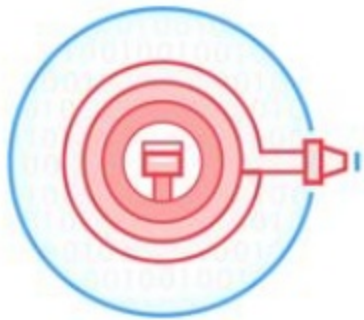
Amazon Kinesis Deep Dive

Amazon Kinesis: Streaming Data Made Easy

Services make it easy to capture, deliver and process streams on AWS

Amazon Kinesis Streams

- For Technical Developers
- Build your own custom applications that process or analyze streaming data



Amazon Kinesis Firehose

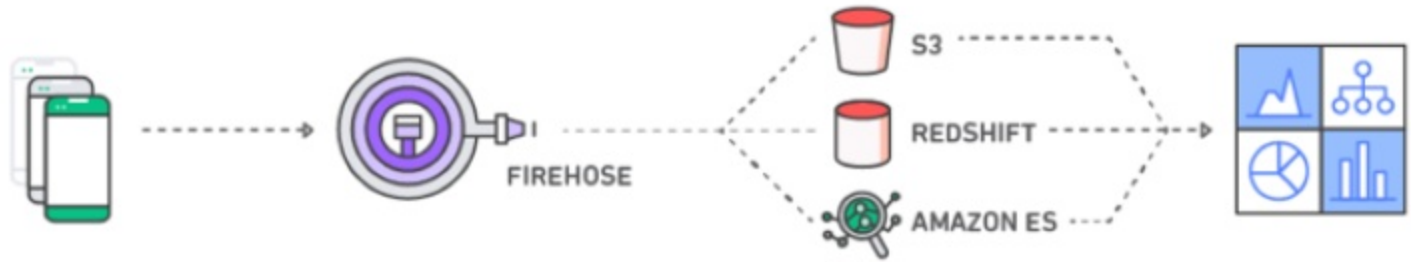
- For all developers, data scientists
- Easily load massive volumes of streaming data into S3, Amazon Redshift and Amazon Elasticsearch

Amazon Kinesis Analytics

- For all developers, data scientists
- Easily analyze data streams using standard SQL queries
- **Preview**

Amazon Kinesis Firehose

Load massive volumes of streaming data into Amazon S3, Amazon Redshift and Amazon Elasticsearch



Capture and submit streaming data to Firehose

Firehose loads streaming data continuously into S3, Amazon Redshift and Amazon Elasticsearch

Analyze streaming data using your favorite BI tools

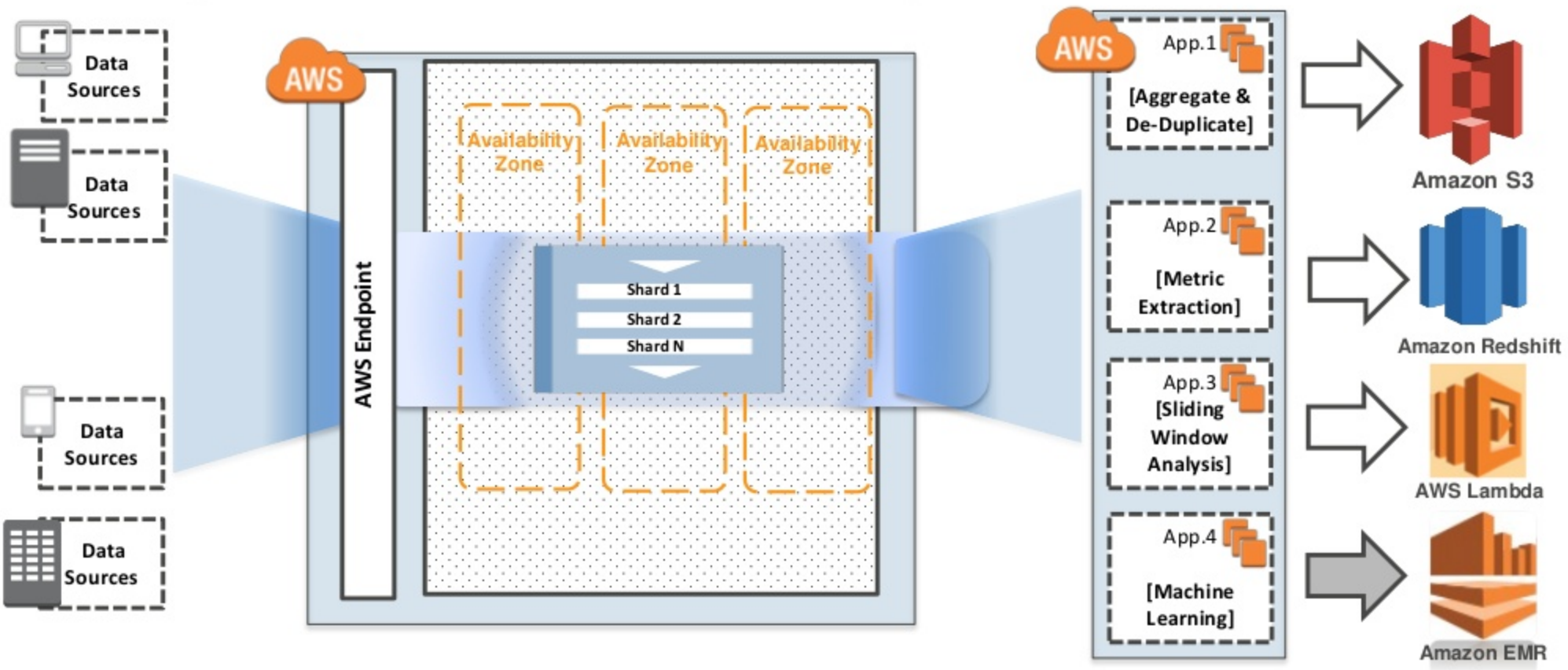
Zero administration: Capture and deliver streaming data into Amazon S3, Amazon Redshift and Amazon Elasticsearch **without writing an application or managing infrastructure.**

Direct-to-data store integration: **Batch, compress**, and **encrypt** streaming data for delivery into data destinations **in as little as 60 secs** using simple configurations.

Seamless elasticity: Seamlessly scales to match data throughput w/o intervention

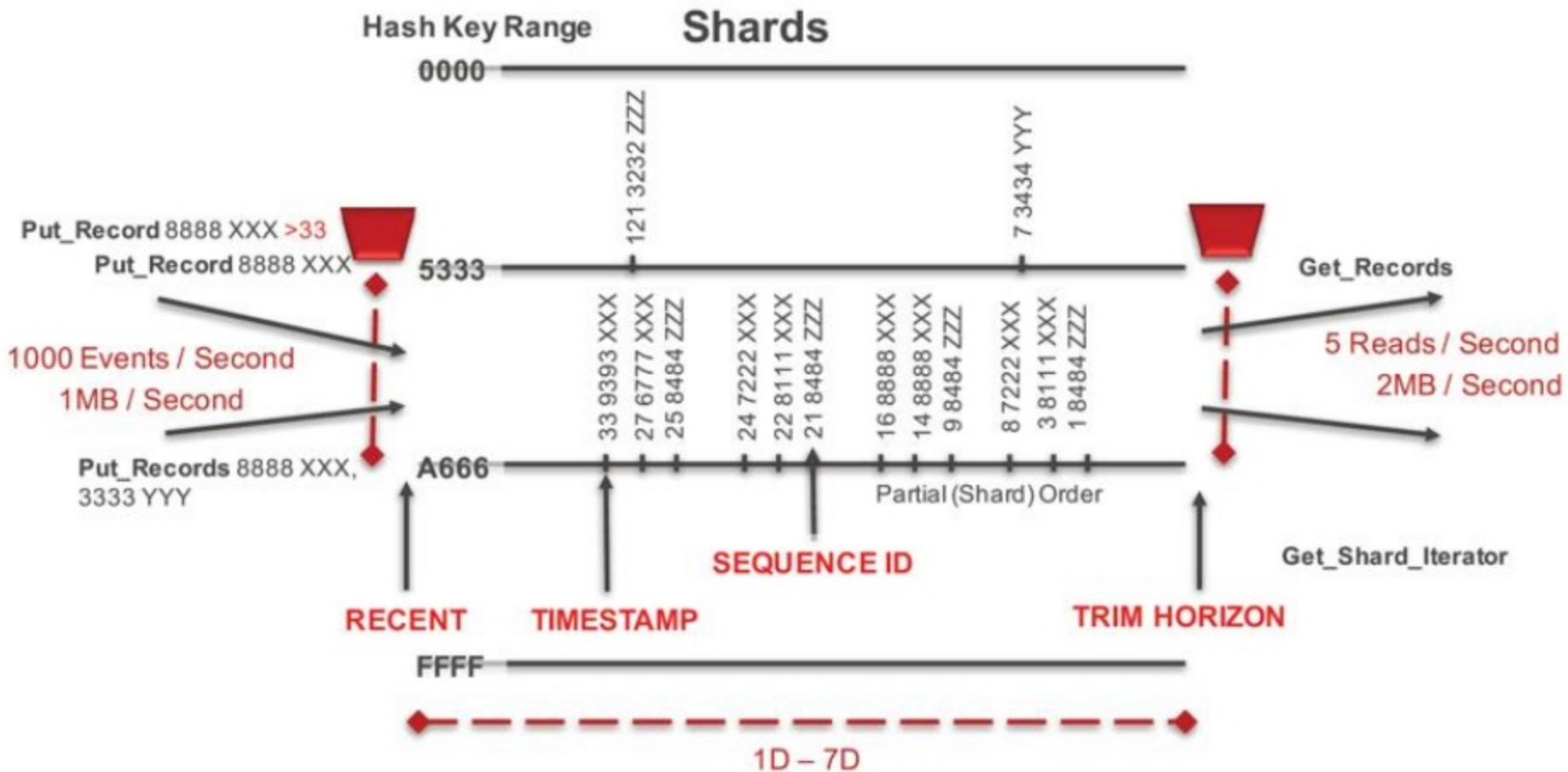
Amazon Kinesis Streams

Managed service for real-time streaming



Amazon Kinesis Streams

Managed ability to capture and store data



Amazon Kinesis Streams

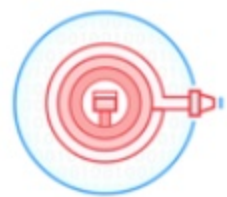
Managed ability to capture and store data

- Streams are made of **shards**
- Each shard ingests up to 1MB/sec, and 1000 records/sec
- Each shard emits up to 2 MB/sec
- All data is **stored for 24 hours by default**; storage can **be extended for up to 7 days**
- **Scale** Kinesis streams using scaling util
- **Replay** data

Amazon Kinesis Firehose vs. Amazon Kinesis Streams

Amazon Kinesis Streams

Amazon Kinesis Streams is for use cases that require **custom processing**, per incoming record, with sub-1 second processing latency, and a choice of stream processing frameworks.



Amazon Kinesis Firehose

Amazon Kinesis Firehose is for use cases that require zero administration, ability to **use existing analytics tools based on Amazon S3, Amazon Redshift and Amazon Elasticsearch**, and a data latency of 60 seconds or higher.

Streaming Data Ingestion and Stream Processing

Putting Data into Amazon Kinesis Streams

Determine your partition key strategy

- Managed buffer or streaming MapReduce job
- Ensure high cardinality for your shards

Provision adequate shards

- For ingress needs
- Egress needs for all consuming applications: if more than two simultaneous applications
- Include headroom for catching up with data in stream

Putting Data into Amazon Kinesis

Amazon Kinesis Agent – (supports pre-processing)

- http://docs.aws.amazon.com/firehose/latest/dev/writing-with-agents.html

Pre-batch before Puts for better efficiency

- Consider Flume, Fluentd as collectors/agents
- See https://github.com/awslabs/aws-fluent-plugin-kinesis

Make a tweak to your existing logging

- log4j appender option
- See https://github.com/awslabs/kinesis-log4j-appender

Amazon Kinesis Producer Library

- Writes to one or more Amazon Kinesis streams with automatic, configurable retry mechanism
- Collects records and uses PutRecords to write multiple records to multiple shards per request
- Aggregates user records to increase payload size and improve throughput
- Integrates seamlessly with KCL to de-aggregate batched records
- Use Amazon Kinesis Producer Library with AWS Lambda (**New!**)
- Submits Amazon CloudWatch metrics on your behalf to provide visibility into producer performance

Record Order and Multiple Shards

Unordered processing

- Randomize partition key to distribute events over many shards and use multiple workers

Exact order processing

- Control partition key to ensure events are grouped into the same shard and read by the same worker

Need both? Use global sequence number

Sample Code for Scaling Shards

```
java -cp
KinesisScalingUtils.jar-complete.jar
-Dstream-name=MyStream
-Dscaling-action=scaleUp
-Dcount=10
-Dregion=eu-west-1 ScalingClient
```

Options:

- **stream-name - The name of the stream to be scaled**
- **scaling-action - The action to be taken to scale. Must be one of "scaleUp", "scaleDown" or "resize"**
- **count - Number of shards by which to absolutely scale up or down, or resize**

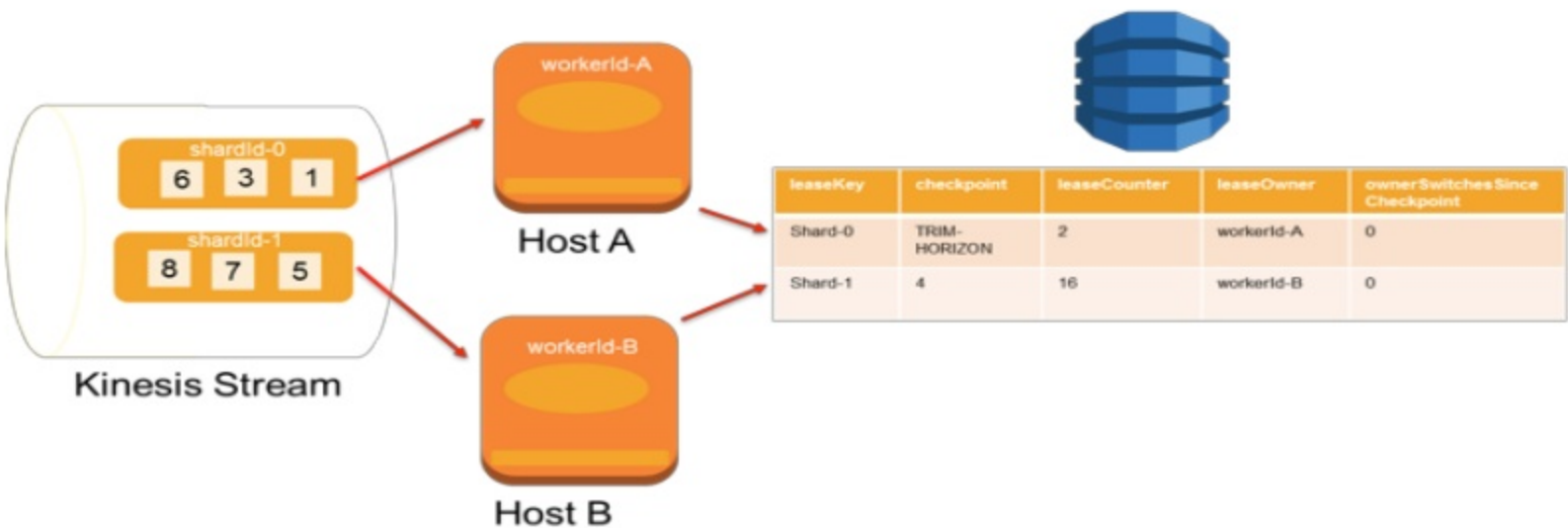
See https://github.com/awslabs/amazon-kinesis-scaling-utils

Amazon Kinesis Client Library

- Build Kinesis Applications with Kinesis Client Library (KCL)
- Open source client library available for Java, Ruby, Python, Node.JS dev
- Deploy on your EC2 instances
- KCL Application includes three components:
  1. **Record Processor Factory** – Creates the record processor
  2. **Record Processor** – Processor unit that processes data from a shard in Amazon Kinesis Streams
  3. **Worker** – Processing unit that maps to each application instance

State Management with Kinesis Client Library

- One record processor maps to one shard and processes data records from that shard
- One worker maps to one or more record processors
- Balances shard-worker associations when worker / instance counts change
- Balances shard-worker associations when shards split or merge



Other Options

- Third-party connectors(for example, Apache Storm, Splunk and more)
- AWS IoT platform
- **Amazon EMR with Apache Spark, Pig or Hive**
- **AWS Lambda**

Apache Spark and Amazon Kinesis Streams

Apache Spark is an **in-memory analytics** cluster using RDD for fast processing

Spark Streaming can read **directly** from an Amazon Kinesis stream

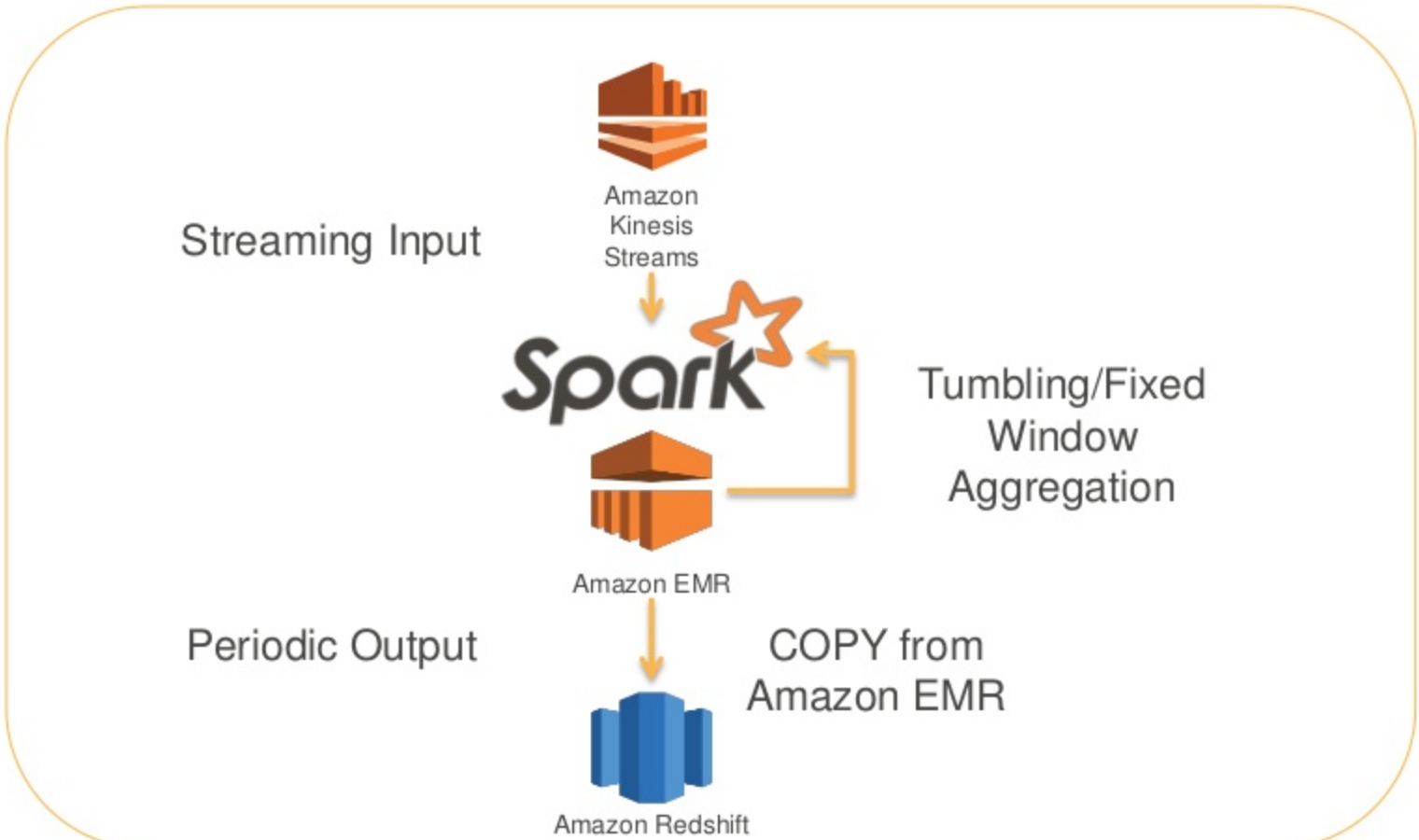
Amazon software license linking – Add ASL dependency to SBT/MAVEN project, `artifactId = spark-streaming-kinesis-asl_2.10`

Example: Counting tweets on a sliding window

```
KinesisUtils.createStream('twitter-stream')
    .filter(_.getText.contains("Open-Source"))
    .countByWindow(Seconds(5))
```

Common Integration Pattern with Amazon EMR

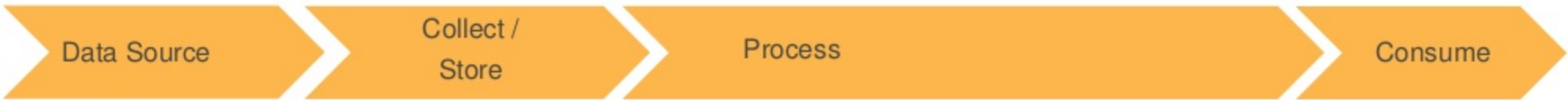
Tumbling Window Reporting



Using Spark Streaming with Amazon Kinesis Streams

1. **Use Spark 1.6+ with EMRFS consistent view option** – if you use Amazon S3 as storage for Spark checkpoint
2. **Amazon DynamoDB table name** – make sure there is only one instance of the application running with Spark Streaming
3. **Enable Spark-based checkpoints**
4. Number of Amazon Kinesis receivers is multiple of executors so they are load-balanced
5. Total processing time is less than the batch interval
6. Number of executors is the same as number of cores per executor
7. Spark Streaming uses default of 1 sec with KCL

Demo



Sensors

- Simulated using EC2
- 20K events/sec

Amazon Kinesis Streams

- Scalable
- Managed
- Millisecond latency
- Highly available

Spark Streaming

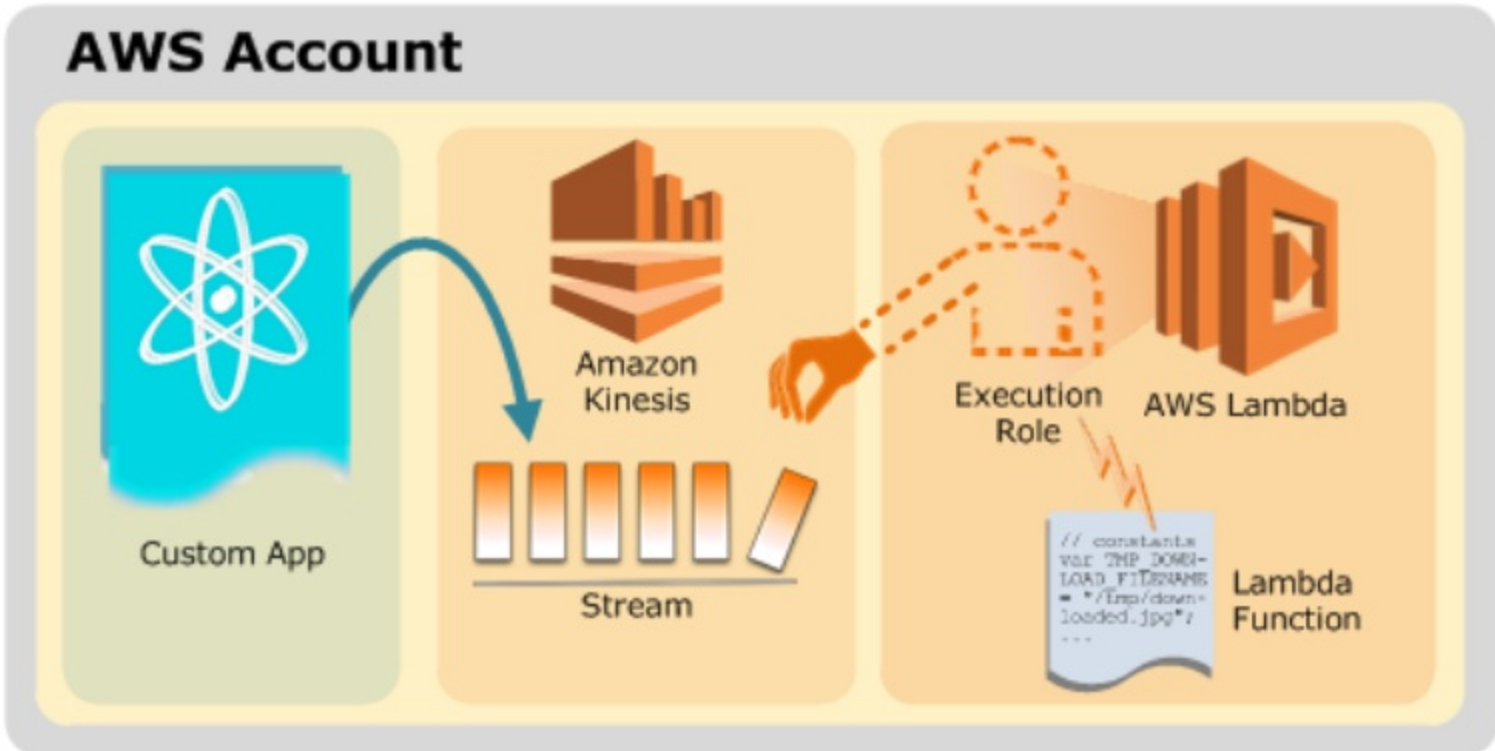
- Scalable
- Managed
- Micro-batch
- Checkpoint in DynamoDB

Apache Zeppelin

Amazon DynamoDB

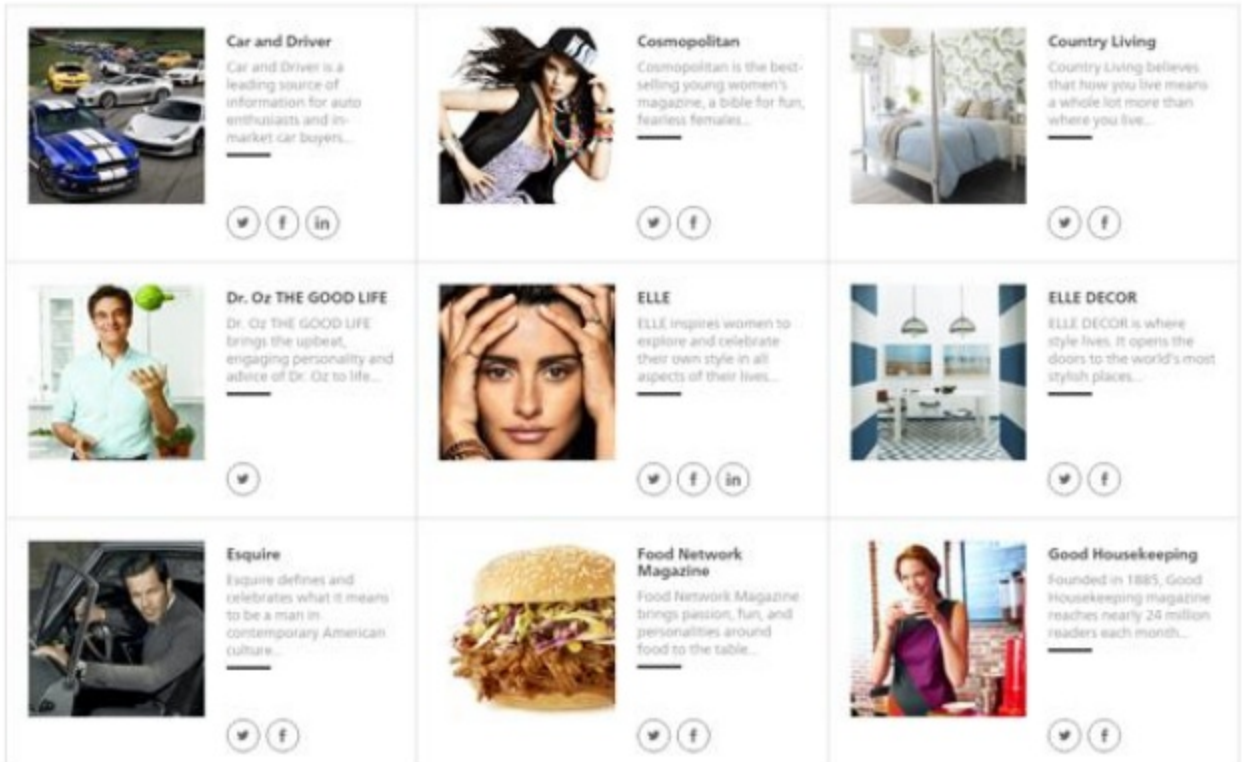
Device_Id, temperature, timestamp
1,65,2016-03-25 01:01:20
2,68,2016-03-25 01:01:20
3,67,2016-03-25 01:01:20
4,85,2016-03-25 01:01:20

Amazon Kinesis Streams with AWS Lambda



Hearst's wonderful world of streaming data

- Digital Media
- Publication brands
- Mobile Apps
- Re-targeting platforms



HEARST

Buzzing@Hearst Demo

The Business Value of Buzzing@Hearst

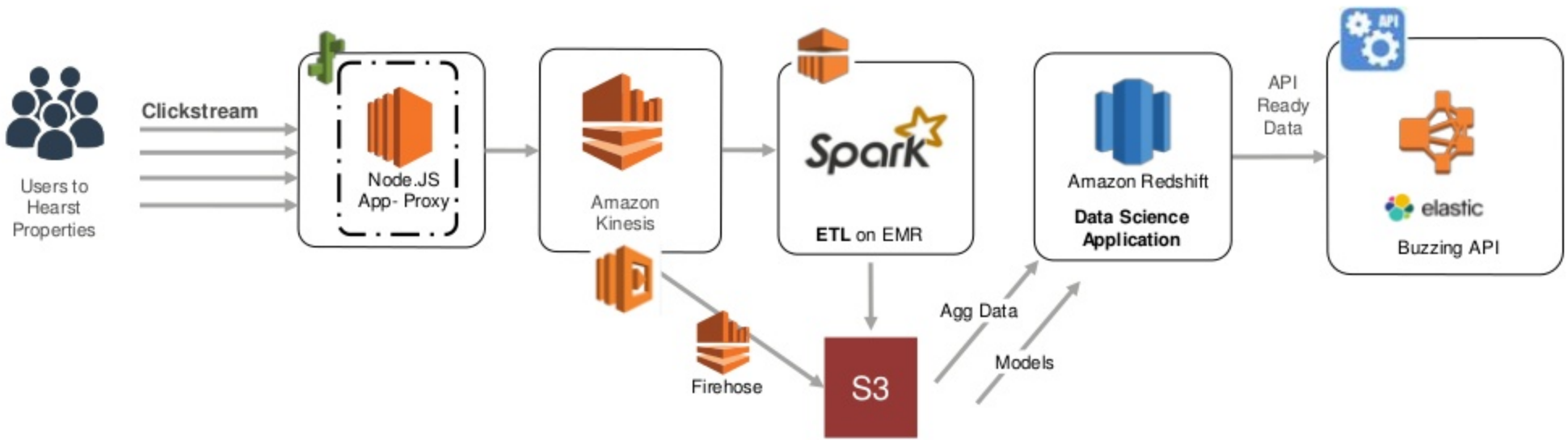
Real-Time Reactions
Instant feedback on articles from our audiences

Promoting Popular Content Cross-Channel
Incremental re-syndication of popular articles across properties (e.g. trending newspaper articles can be adopted by magazines)

Authentic Influence
Inform Hearst editors to write articles that are more relevant to our audiences

Understanding Engagement
Inform both editors what channels are our audiences leveraging to read Hearst articles

Final Hearst Data Pipeline



LATENCY	Milliseconds	30 Seconds	100 Seconds	5 Seconds
THROUGHPUT	100GB/Day	5GB/Day	1GB/Day	1GB/Day

Real-time streaming @sizmek

Orit Alul – R&D Director

Sizmek OPEN AD MANAGEMENT

Sizmek – Who? What? How?

- **Who are we?**
  - **2nd** Largest Ad management company in the world operating globally in **50+** countr
  - Open Ad Management Platform

Sizmek
OPEN AD MANAGEMENT

- **Who are our customers?**
  - Advertising agencies and advertisers

- **What is our value?**
  - We enable our clients to manage their cross-channel campaigns, and find their relevant audience seamlessly
  - We built a fast, high throughput infrastructure that enables real time analytics and decision making.

Sizmek – Our customers

Over 13,000 brands use our platform

Over 5,000 media agencies use our platform

groupm
dentsu
HAVAS
IPG
Omnicom
WPP

Data processing at Sizmek

- 15B events per day
- 4 TB data per day
- 150K events per second
- Volatile data traffic load
  - During the day /week/year
  - During the special event(e.g. Black Friday)
- Increase demand for Realtime insights

NXT generation of Analytics at Sizmek

Flexible

Faster

Simple

Sizmek Data Platform on AWS

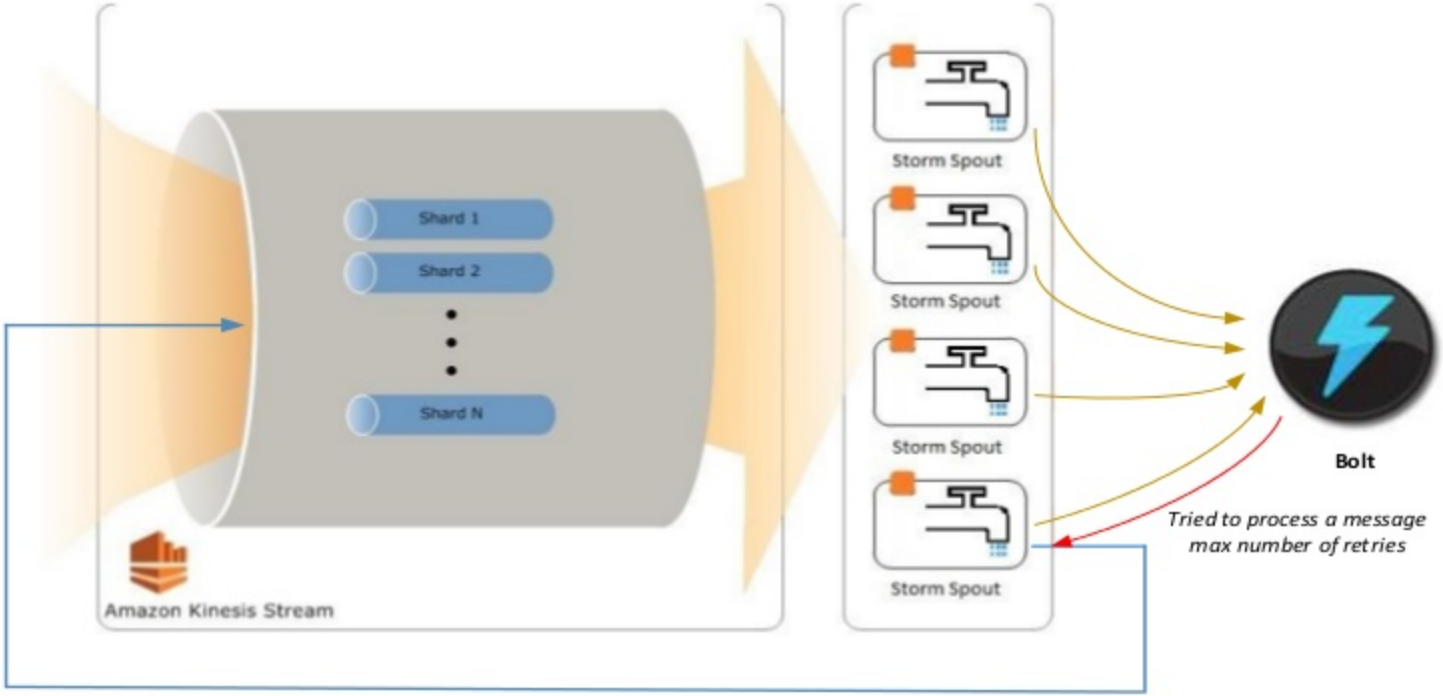
Our Kinesis Journey

Sizmek OPEN AD MANAGEMENT

Why Amazon Kinesis?

- Apache Kafka -> Amazon Kinesis = Managed Service = no Ops effort
- Integration with Apache Storm and AWS Lambda
- Integration with Amazon S3, Amazon Redshift and other AWS services
- Meets our throughput needs

Tip 1: Amazon Kinesis Apache Storm connector



Tip 2: putRecord = more shards!

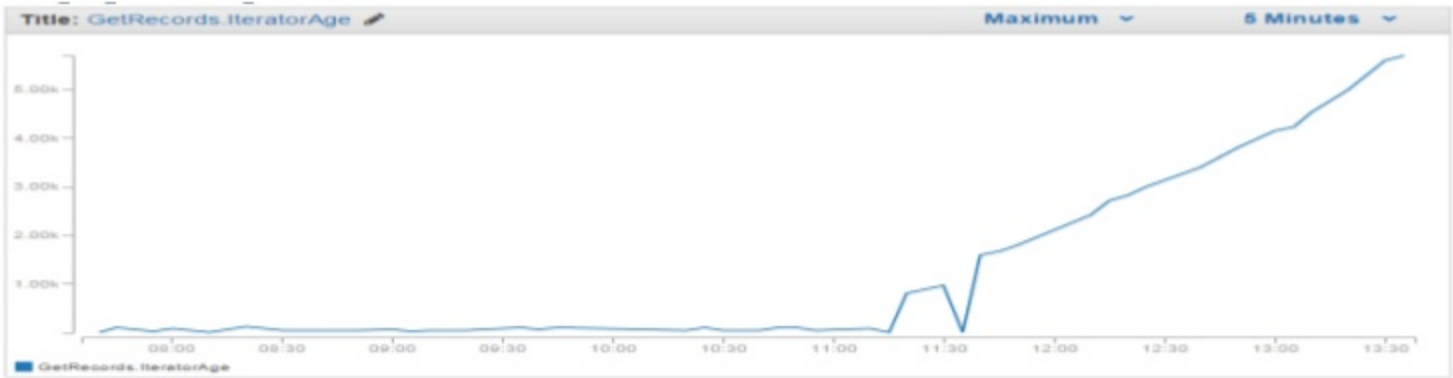
- **Requirements**:
  - Apache Storm requires processing event by event
  - Average event size is 1KB
  - We must use putRecord API
- **Testing results:**
  - 75% of Amazon Kinesis maximum TP limit
  - 300 - 500 shards
- **Conclusion**
  - Provision more shards (25%)
  - Always test your workload

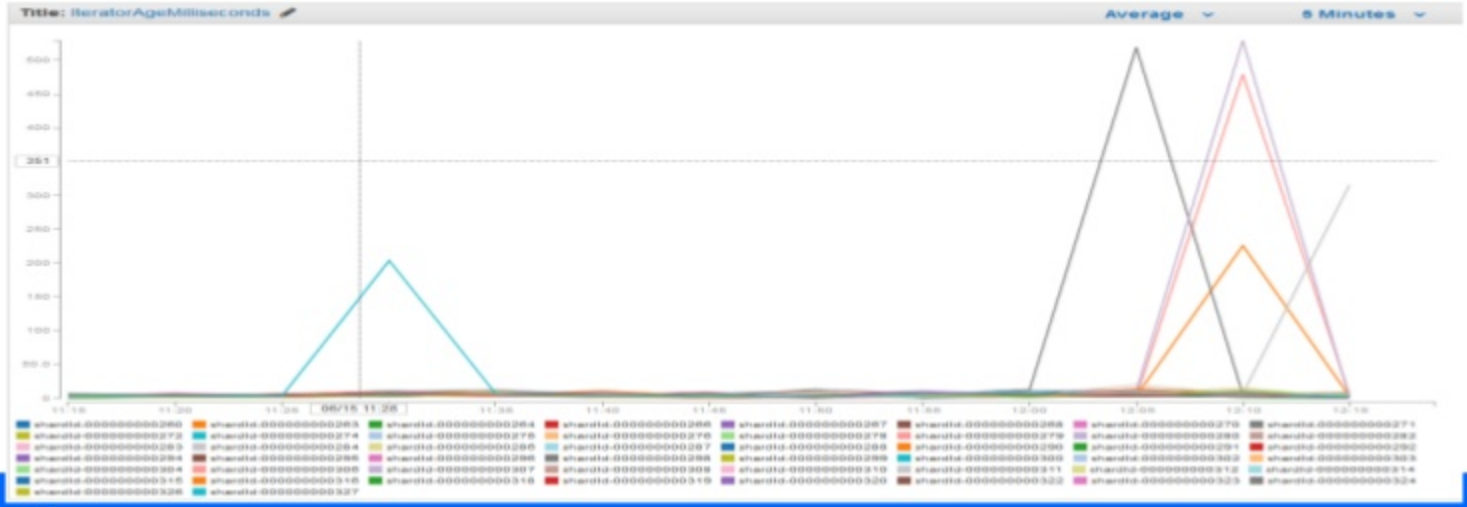
Tip 3: Error handling on record level

Kinesis putRecords (bulk insert) response

```
Date: <Date>
{
    "FailedRecordCount": 2,
    "Records": [
        {
            "SequenceNumber":
"49543463076548007577105092703039560359975228518395012686",
            "ShardId": "shardId-000000000000"
        },
        {
            "ErrorCode": "ProvisionedThroughputExceededException",
            "ErrorMessage": "Rate exceeded for shard shardId-000000000001 in
stream <StreamName> under account 111111111111."
        },
        {
            "ErrorCode": "InternalFailure",
            "ErrorMessage": "Internal service failure."
        }
    ]
}
```

Tip 4: Shard level metrics is your





Thank You!

& Yes we're hiring ☺

Sizmek OPEN AD MANAGEMENT

Conclusion

- Amazon Kinesis offers: managed service to build applications, streaming data ingestion, and continuous processing
- Ingest aggregate data using Amazon Producer Library
- Process data using Amazon Connector Library and open source connectors
- Determine your partition key strategy
- Try out Amazon Kinesis at http://aws.amazon.com/kinesis/

Reference

- **Technical documentations**
  - Amazon Kinesis Agent
  - Amazon Kinesis Streams and Spark Streaming
  - Amazon Kinesis Producer Library Best Practice
  - Amazon Kinesis Firehose and AWS Lambda
  - Building Near Real-Time Discovery Platform with Amazon Kinesis
- **Public case studies**
  - Glu mobile – Real-Time Analytics
  - Hearst Publishing – Clickstream Analytics
  - How Sonos Leverages Amazon Kinesis
  - Nordstorm Online Stylist

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