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Petabyte scale logging with Fluentd and Fluent Bit: A use case from Intuit

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Who are we?

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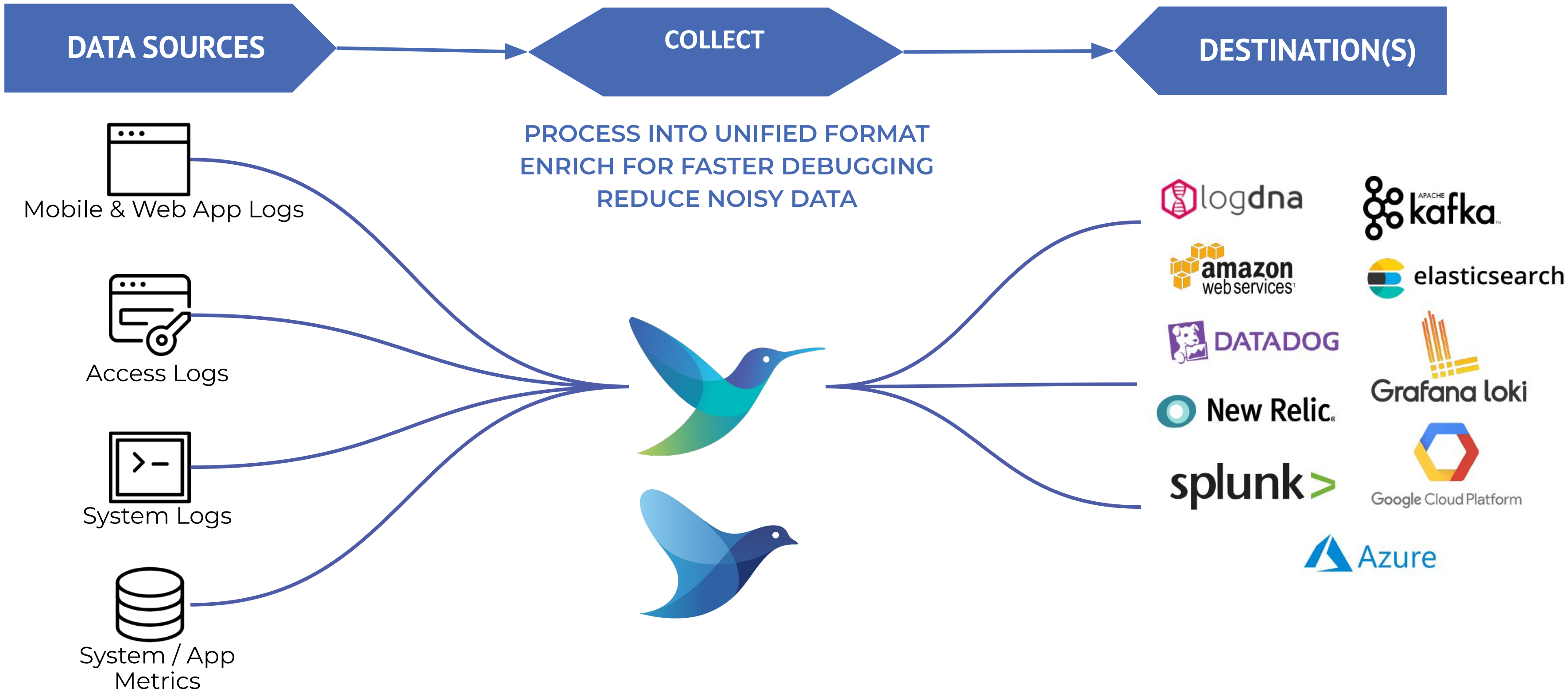
What are Fluentd / Fluent Bit?



DATA SOURCES

COLLECT

DESTINATION(S)

PROCESS INTO UNIFIED FORMAT
ENRICH FOR FASTER DEBUGGING
REDUCE NOISY DATA

Mobile & Web App Logs

Access Logs

System Logs

System / App Metrics

Challenges for logs @ scale

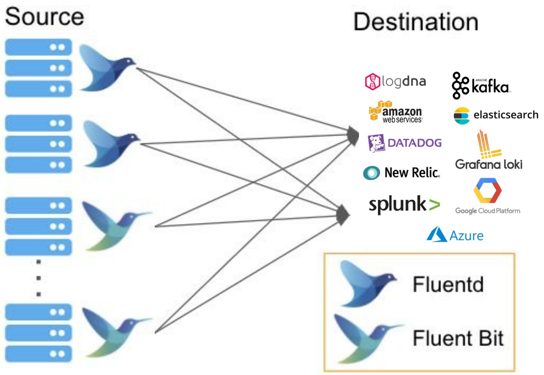
- **High Scale can equal high costs!!**
- **Reliability and buffering**
- **Networking**
- **Event Throughput**
- **Security**
  - Securing sensitive information.
  - Securing the data transition.
- **Operationality**
  - Minimizing log collector operations in data source.

Challenges for logs @ scale

- **High Scale can equal high costs!!** - Filtering, Parsing, compression
- **Reliability and buffering** - Filesystem and Memory buffers
- **Networking** - Configurable retry mechanisms, Backpressure handling
- **Event Throughput** - Multi-worker configuration
- **Security** - TLS in transit
  - Securing sensitive information.
  - Securing the data transition.
- **Operationality** - Forwarder / Aggregator architecture
  - Minimizing log collector operations in data source.

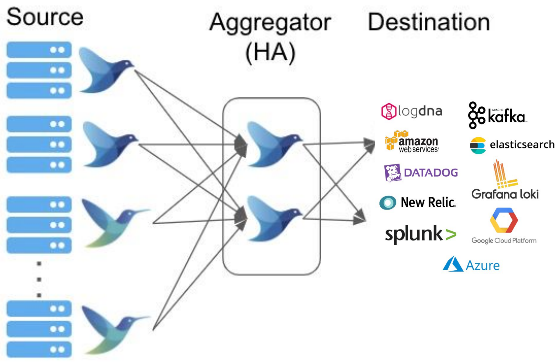
Common Architecture

Forwarder only



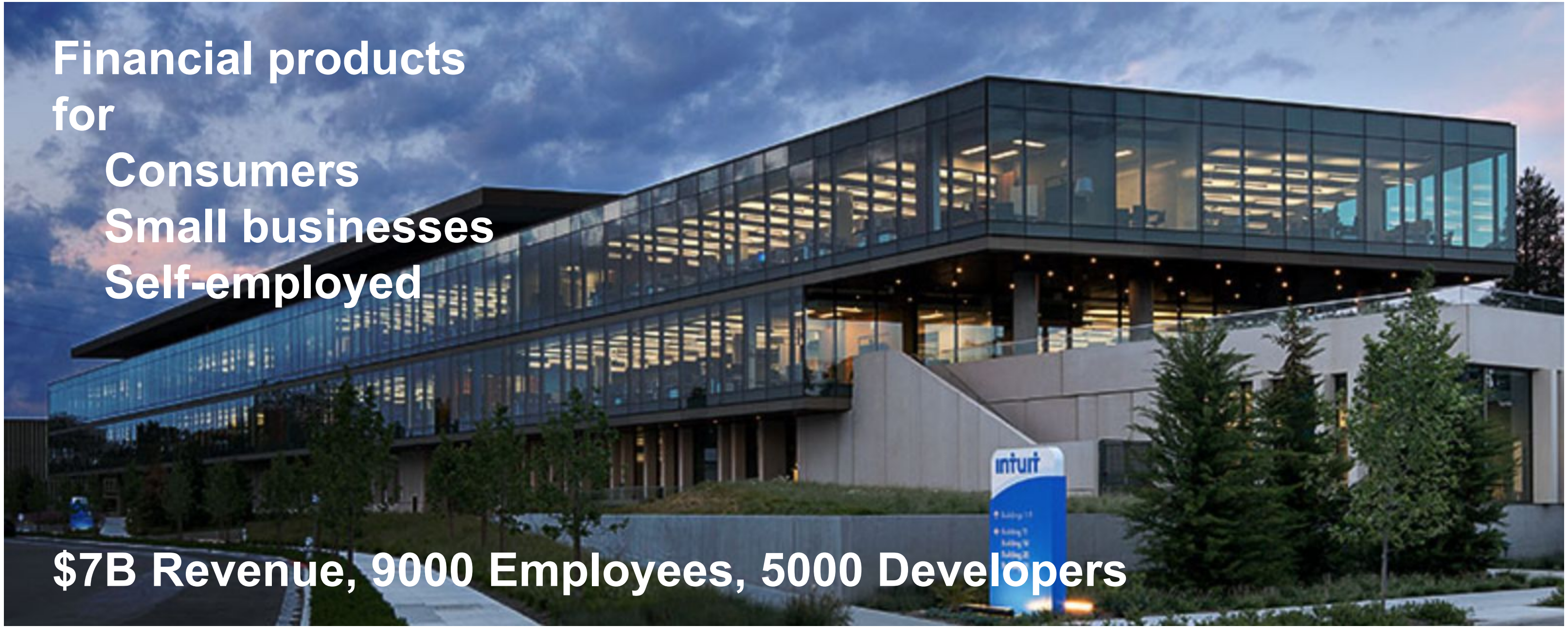
- **Advantages**
  - No aggregator is needed; each forwarder handles backpressure.
- **Disadvantages**
  - Hard to change configuration across a fleet of forwarder (E.g., adding another backend or processing)
  - Hard to add more end destinations if needed

Forwarders with aggregators



- **Advantages**
  - Less resource utilization on the edge devices
  - Allow processing to scale independently on the aggregator tier.
  - Easy to add more backends (configuration change in aggregator vs. all forwarders)
- **Disadvantages**
  - Dedicated resources required for an aggregation instance

intuit

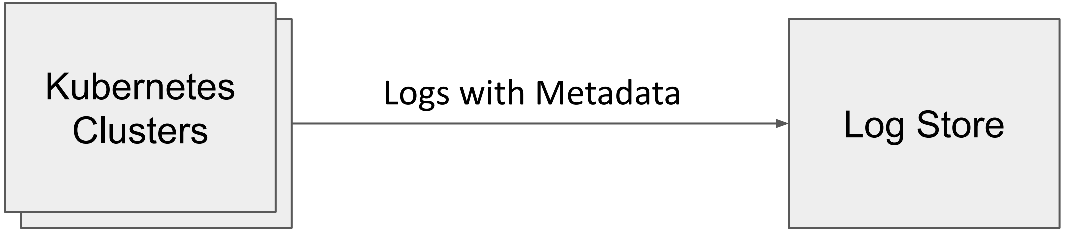


Financial products for
- Consumers
- Small businesses
- Self-employed

$7B Revenue, 9000 Employees, 5000 Developers

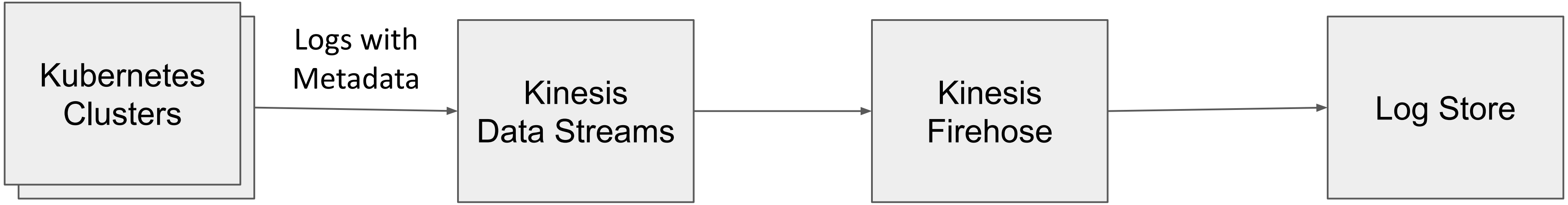
turbotax. quickbooks. mint.

Logging for Kubernetes



- At Intuit, log analytics is a core capability that is offered by a centrally hosted log store.
- Among others, containers running on Kubernetes are a major log sources. There are 100+ Kubernetes clusters hosting 2000+ services.
- Fluentd processes running as daemonsets are used to collect and forward the logs to the store.
- Log events are enriched with metadata to generate insightful correlations and improve search experience.
- High throughput & Low latency pipeline is desirable.

Streaming Pipeline



- Highly distributed log sources that are spread across 100+ VPCs. Transfer data between Kubernetes VPCs and log store VPC.
- Durable, fault tolerant, and scalable log data pipeline is required.
- Ability to fan out the data to multiple stores to solve for additional requirements like security, compliance etc.

Better Logging Pipeline

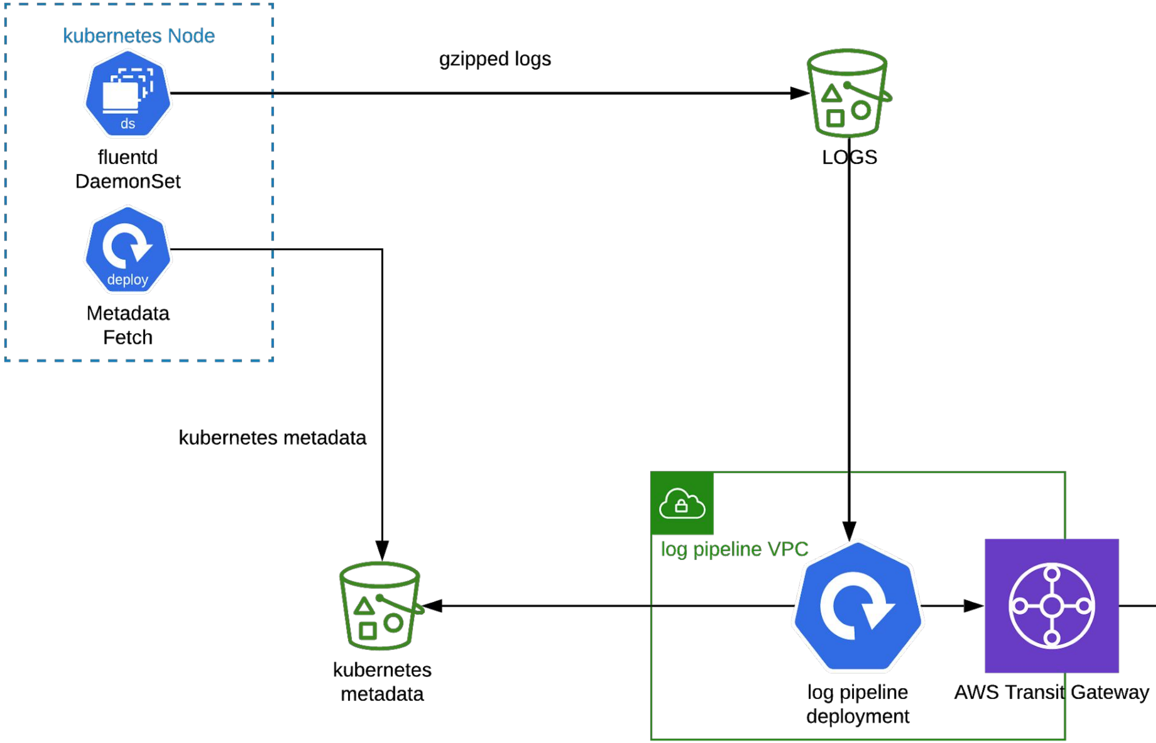
Challenges faced with streaming transport

- Multiline events need to be identified and packaged as a single record at the source. This added to the work that fluentd process has to do at the collection time. This severely limited the collection throughput.
- Metadata enrichment at the source added to the fluentd workload.
- Dequeuing from the stream required additional hop adding to latency as well as cost.

Problems to be solved

- Increase collection throughput with minimal overhead.
- Low end-to-end latency to transport between source and target.
- Reduce the cost to maintain the pipeline.

S3 Pipeline: Architecture



S3 Pipeline: Improvements

Target: Increase Throughput

- Minimize the work done by fluentd.
- Avoid multi-line detection
  - Eliminate the need for CPU intensive timestamp parsing.
  - Maintain the chronology of events and offload multiline detection task to the log store.
- Avoid Metadata Enrichment
  - Export kubernetes metadata from each cluster and enrich log events in transit.

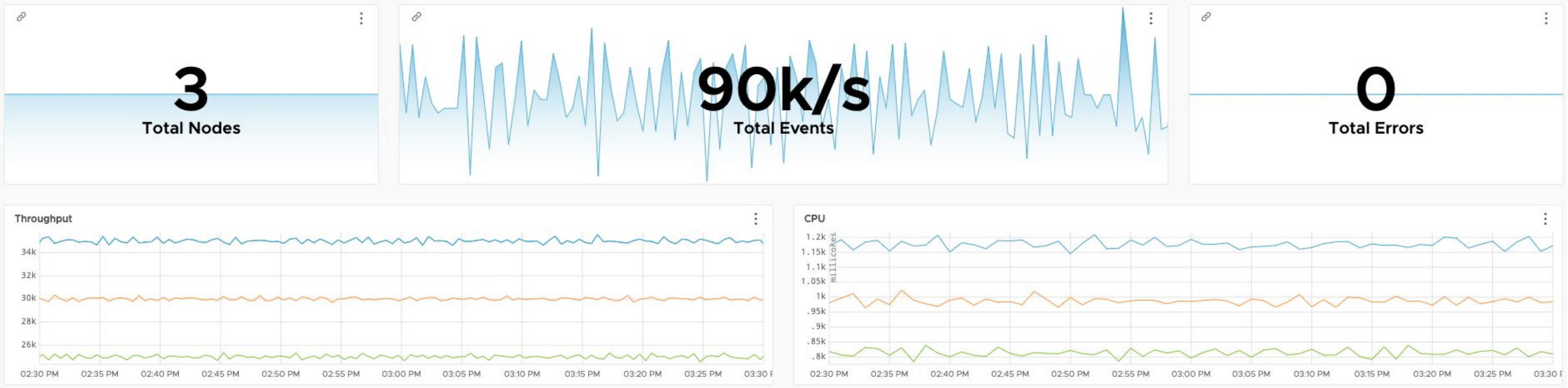
S3 Pipeline: Improvements

Target: Minimize Latency & Reduce Cost

- Network transfer cost is the highest component. So, reducing the data transferred will reduce both cost and latency.
- Fluentd writes compressed data to s3 (~10X compression) and it’s written to Log Store as is. So, the data is always compressed in transit and decompression happens at the log store.
- Metadata is applied in batch and need not be added to each log event.
- AWS Transit Gateway to transfer data between Log Pipeline VPC and Log Store VPC.

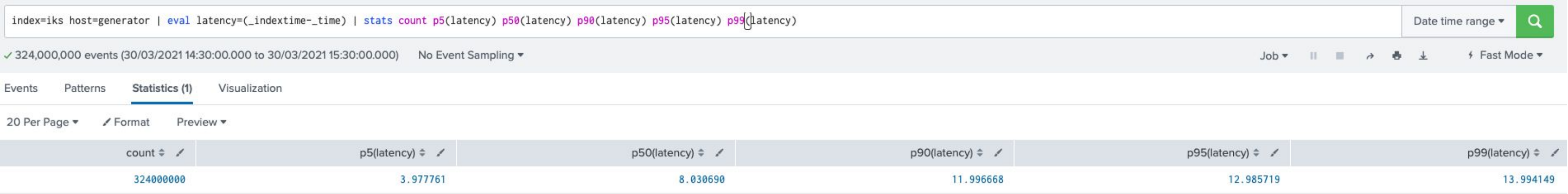
S3 Pipeline: Demo

Throughput



S3 Pipeline: Demo

End-to-end Latency



```
index=iks host=generator | eval latency=(_indextime-_time) | stats count p5(latency) p50(latency) p90(latency) p95(latency) p99(latency)
```

✓ 324,000,000 events (30/03/2021 14:30:00.000 to 30/03/2021 15:30:00.000) No Event Sampling ▾

count	p5(latency)	p50(latency)	p90(latency)	p95(latency)	p99(latency)
324000000	3.977761	8.030690	11.996668	12.985719	13.994149

- Total Events: 324 Million (90,000 events/s over 1 hour)
- Latency
  - 5th Percentile: < 4 seconds
  - Median / 50th Percentile: ~ 8 seconds
  - 90th Percentile: < 12 seconds
  - 95th Percentile: < 13 seconds
  - 99th Percentile: < 14 seconds

S3 Pipeline: Results

Throughput

6x

- Supports **6-times** throughput, compared to the streaming pipeline, at **30,000 events per seconds per node** while consuming just 1.2 core CPU.
- Supporting more than **1 GB/s** of log data across the pipeline for a single cluster.

Latency

⅓

- Median End-to-end latency cut down to less than **one-third** from 30 seconds to just 8 seconds.
- For **99th Percentile**, the latency is cut down by more than **75%**.

Cost

92%

- More than **92%** cost saved when compared to streaming pipeline.
- More than **$50,000** saved for every PB transported.