Distributed Tracing, OpenTracing & Elastic APM

Adam Quan | Solutions Architect

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Adam Quan

Solutions Architect, Elastic Certified Engineer

Elastic

Housekeeping & Logistics

- **Recording** will be available following the webinar
- Chat via IRC #elastic-webinar
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  - Click "Join the Chat" link, create an IRC account
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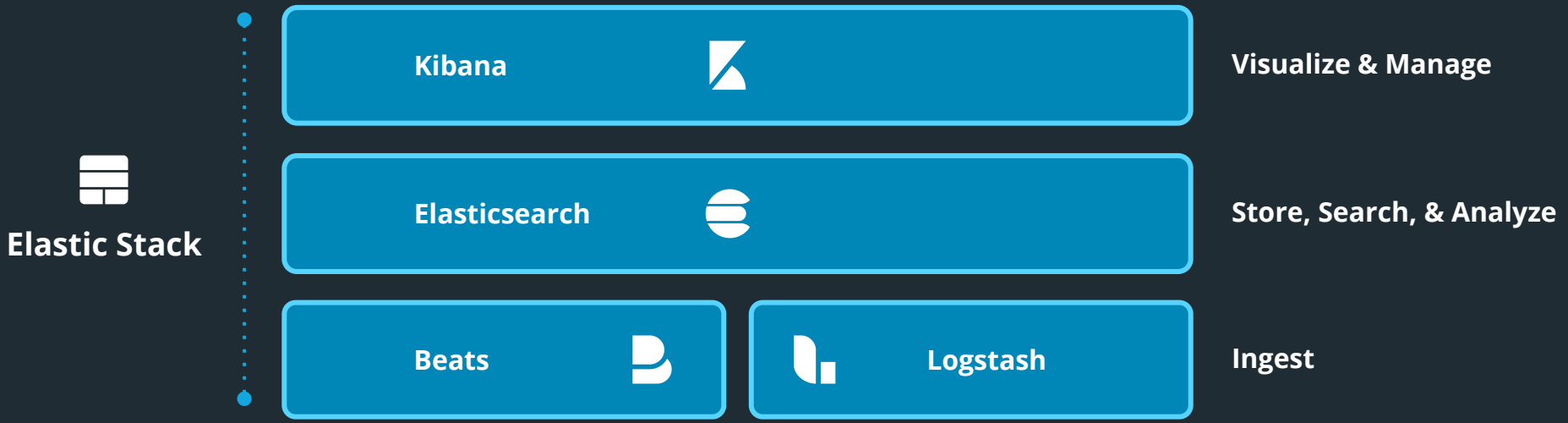

Elastic Stack
Kibana
Visualize & Manage
Elasticsearch
Store, Search, & Analyze
Beats
Logstash
Ingest

Technology **differentiation**

SCALE

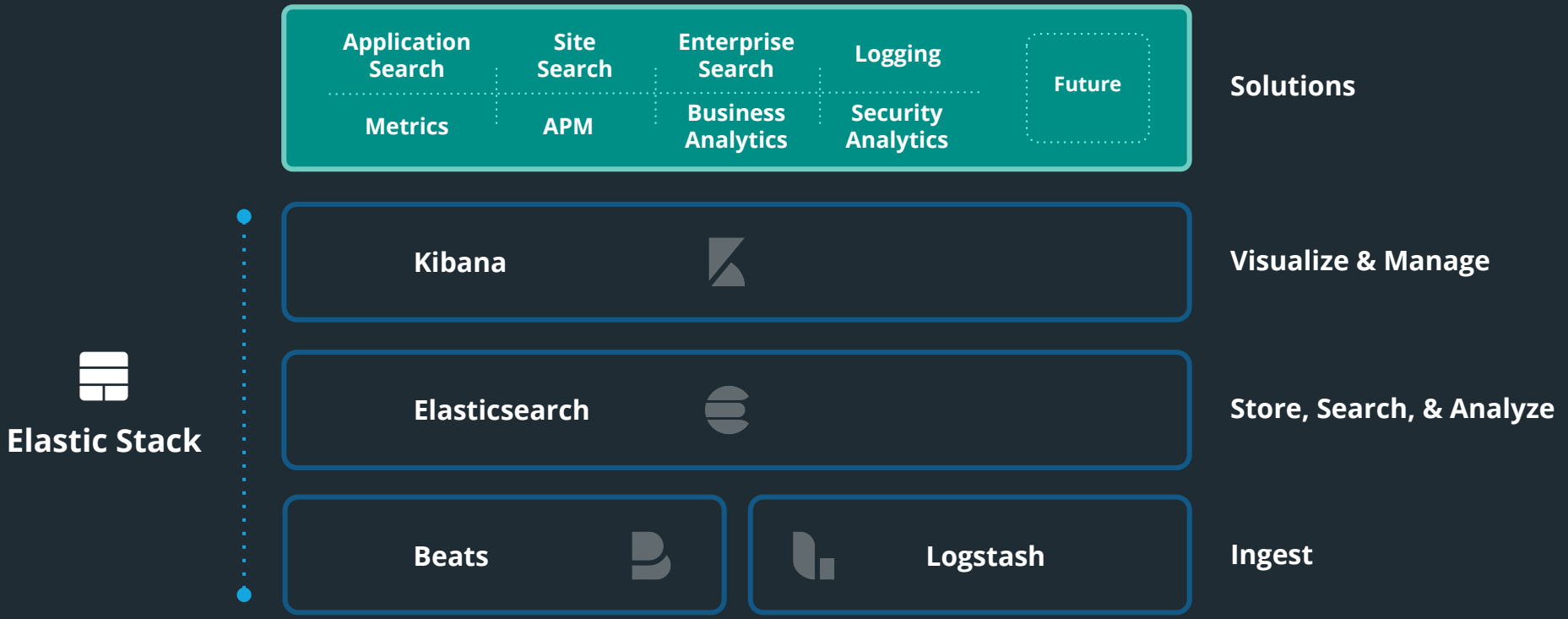
Distributed by design

SPEED

Find matches in milliseconds

RELEVANCE

Get highly relevant results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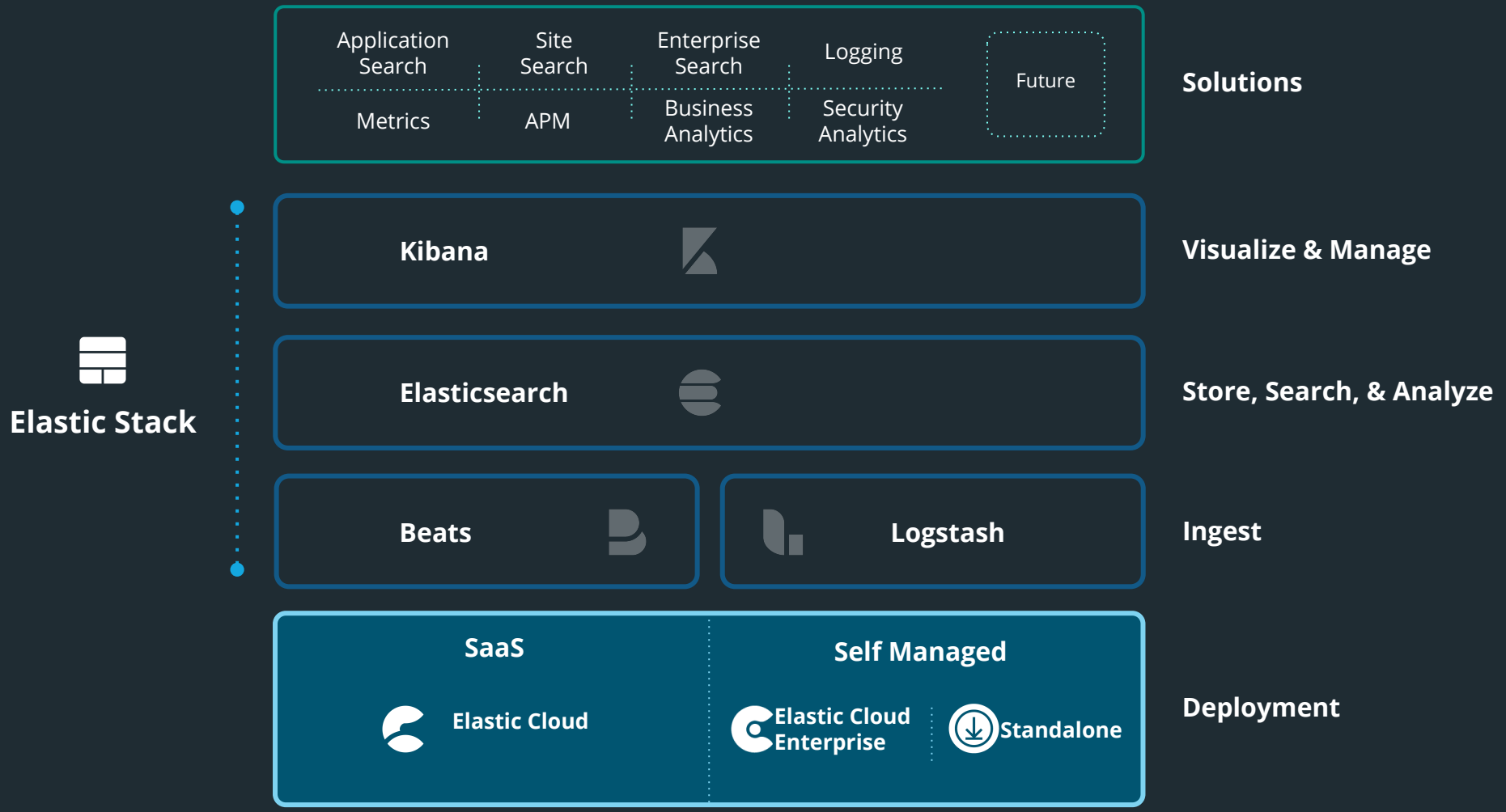
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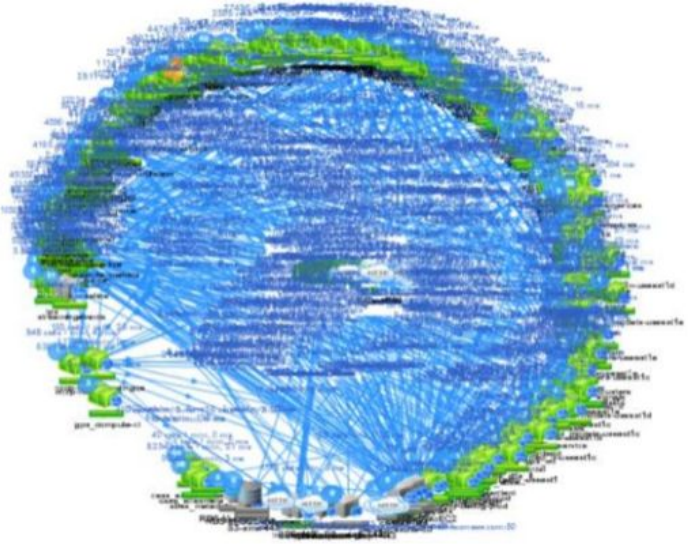
Logstash
Ingest
SaaS
Elastic Cloud
Self Managed
Elastic Cloud Enterprise
Standalone
Deployment

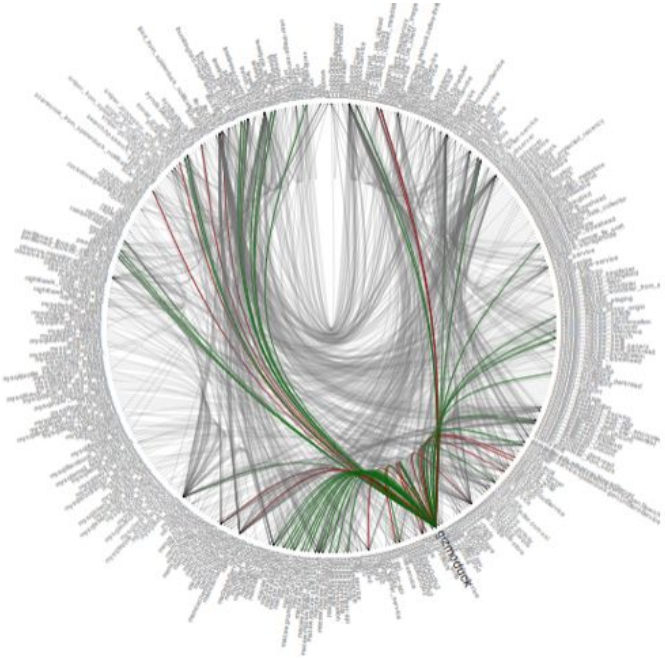
Agenda

- Microservices
- Distributed Tracing
- OpenTracing
- Elastic APM & Distributed Tracing
- Demo
- Q&A

Microservices Can Be Very Complex



Netflix



Twitter

Why Distributed Tracing?

Distributed tracing provides a solution for describing and analyzing the cross-process transactions.

- Latency tracking
  - Where & why things are slow?
  - Slow code, slow network?
- Root cause analysis
  - Where & why did it fail?
  - Bad code?
  - Network failure?

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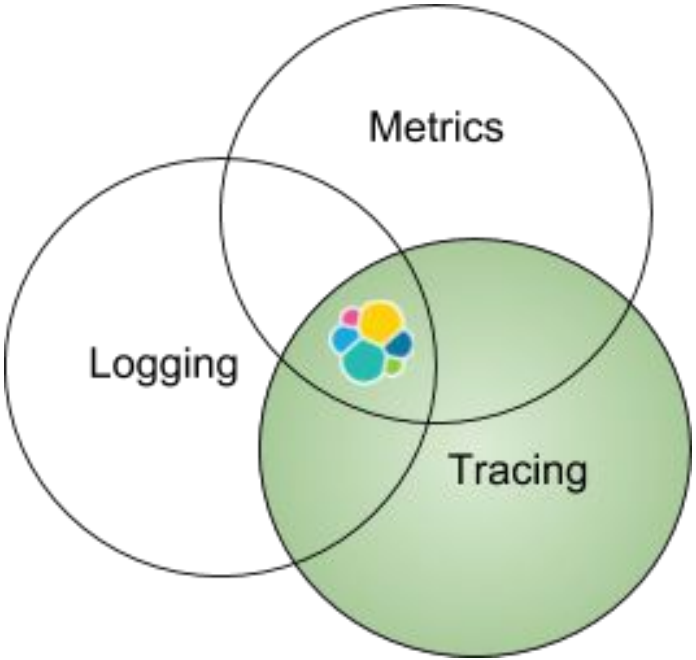
The 3rd Pillar of Observability



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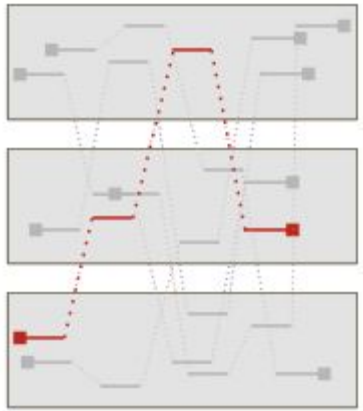
Distributed Tracers

A fast growing ecosystem

- **Dapper** (Google) - 2010.
  - Google's production distributed systems tracing infrastructure
  - A self-contained tracing tool evolved into a monitoring platform
- **Zipkin** (Twitter)
  - Developed by **Twitter** based on the Google Dapper paper
  - Written in **Java**
  - Uses Cassandra or **Elasticsearch** as a scalable backend, MySQL too
- **Jaeger** (Uber)
  - Newer project from **Uber**, CNCF adopted as an Incubating project
  - Written in **Golang**
  - Supports Cassandra and **Elasticsearch** as scalable storage backends
- **Appdash**
- Others ...



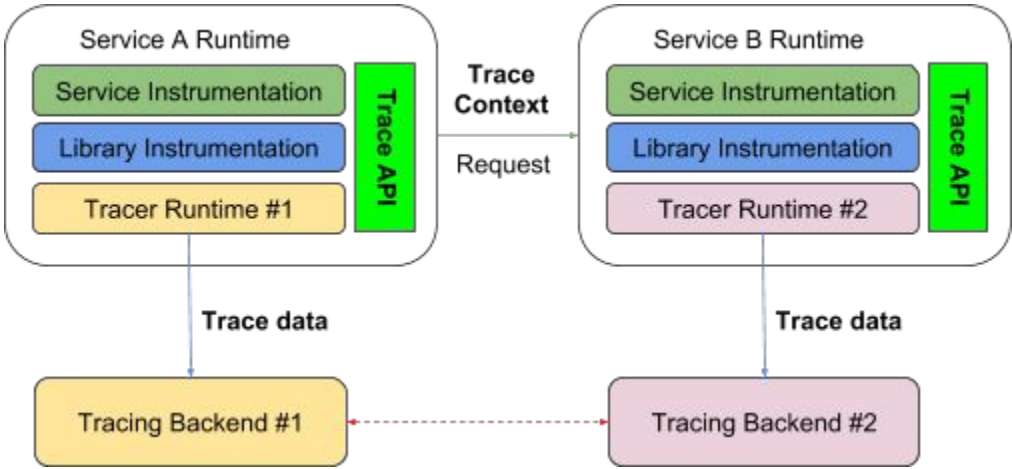
Challenges for Application Developers

- Add the tracer in the application code
- Which one to use?
- What if I need to change my tracer?
- No, I don’t want to change my entire source code
- What do I do with shared libraries?
- What if my third party services use a different tracer?

We Need Distributed Tracing Standardization

Four Components

- **Tracing API**
  - The OpenTracing API
- **Wire Protocol**
  - What gets sent alongside application data in RPC requests
  - Distributed Context Propagation
  - Eg. The trace-context HTTP headers, AMQP message headers
- **Data Definition & Format**
  - What gets sent asynchronously to the analysis system
- **Analysis System**
  - A service for extracting insights from trace data



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Enter OpenTracing

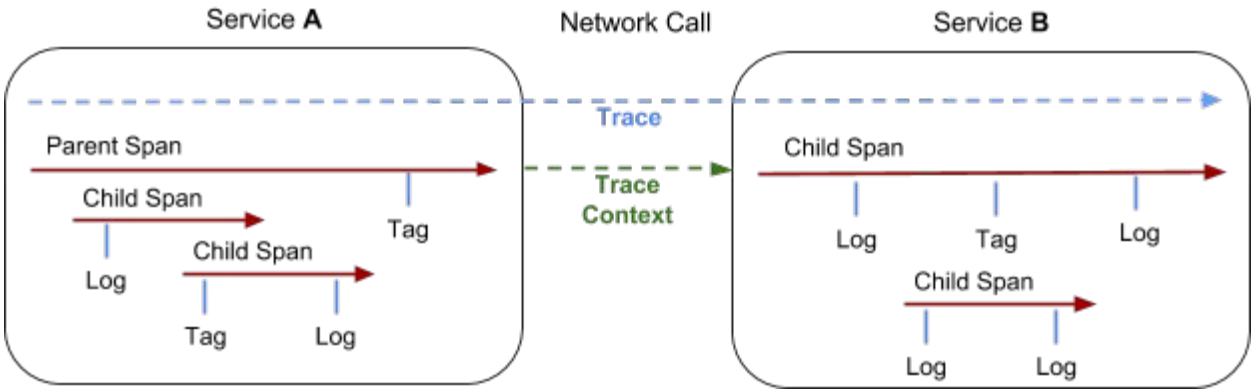
Emerging Industry Standard for Distributed Tracing

- Abstraction from different tracers
- Vendor-neutral APIs and instrumentation
- Switching between tracers
- OpenTracing and OpenCensus are merging
  - Make observability a built-in feature in every modern application
  - Not just “tracing” - merged project includes data sources beyond distributed transaction traces, like metrics, traces and logs

OpenTracing

A Mental Model

- Distributed Tracing is a process of collecting end-to-end transaction graphs in near real time
- A **trace** represents the entire journey of a request
- A **span** represents single operation call
- As a request is flowing from one microservice to another, tracers add logic to create unique trace Id, span Id



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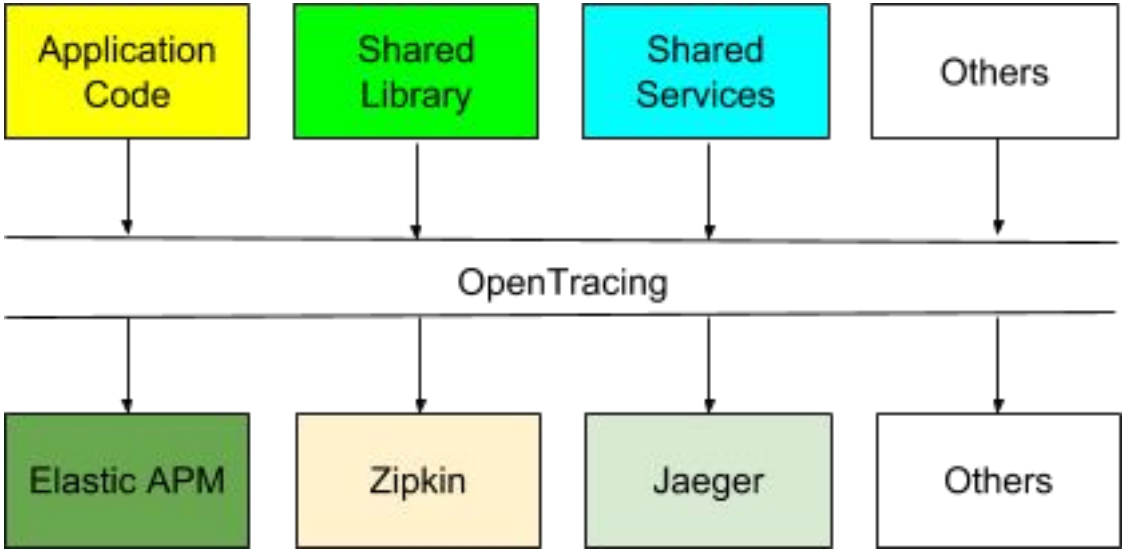
How Does It All Fit In?



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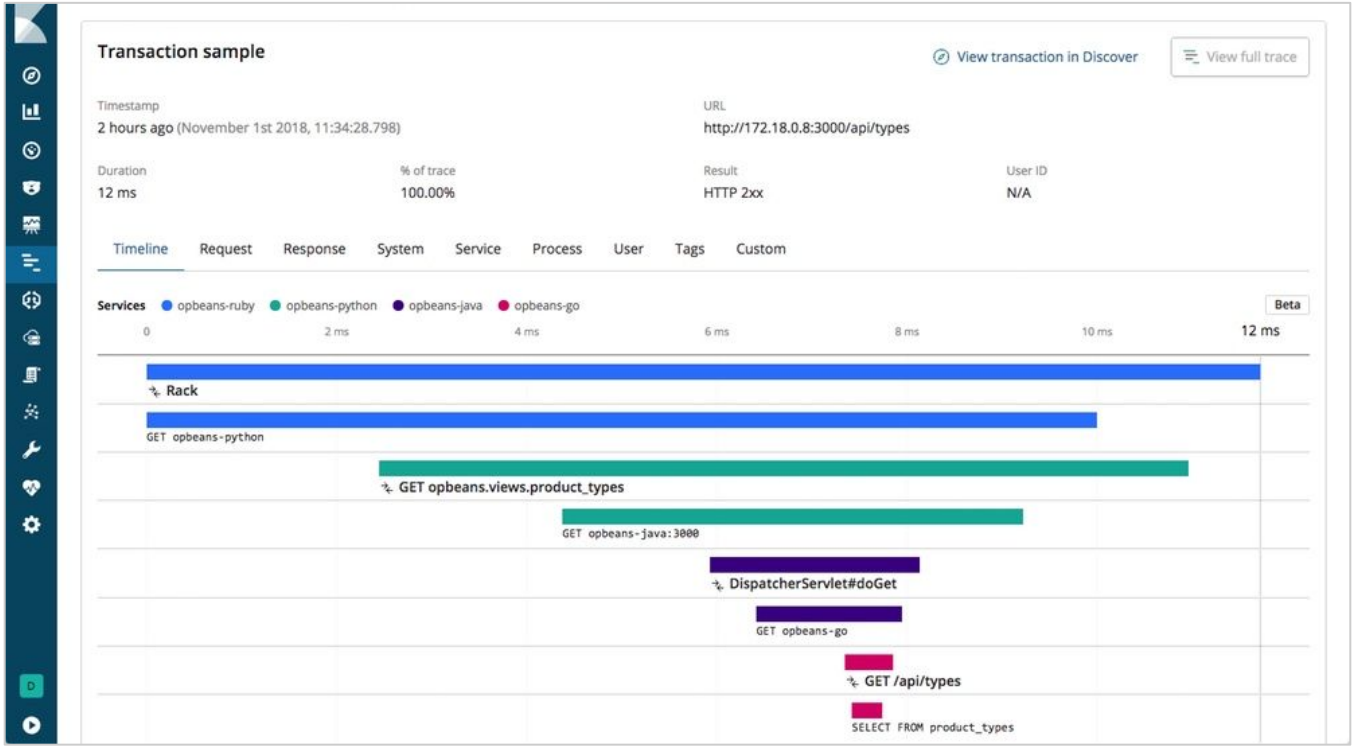
The Unfortunate Facts - Today

No Runtime Compatibility among Tracers, but there is hope

- The only thing standardized by OpenTracing is the programmatic **Tracing API**
  - `io.opentracing.Span, io.opentracing.Tracer`
- **Wire Protocol** is not standardized yet.
  - For example, HTTP headers for context propagation:
    - Jaeger: **uber-trace-id**: 118c6c15301b9b3b3:56e66177e6e55a91:18c6c15301b9b3b3:1
    - Elastic: **elastic-apm-traceparent**: 00-f109f092a7d869fb4615784bacefcfd7-5bf936f4fcde3af0-01
  - HTTP header name is different & ID format is different
  - Trace-Context is a W3C working group for standardizing the HTTP headers for distributed tracing https://github.com/w3c/distributed-tracing
  - OpenTracing will most likely adopt and require Trace-Context for distributed tracing HTTP headers as part of its specification
- **Data Protocol** is not standardized
  - Zipkin, Jaeger and Elastic APM use different data format for Span data and others

Elastic & Distributed Tracing

Elastic APM is OpenTracing Compliant and Supports Distributed Tracing



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Elastic OpenTracing Bridge

Reuse Existing Instrumentations

```
<dependency>
    <groupId>co.elastic.apm</groupId>
    <artifactId>apm-opentracing</artifactId>
    <version>${elastic-apm.version}</version>
</dependency>
```

```
import co.elastic.apm.opentracing.ElasticApmTracer;
import io.opentracing.Tracer

Tracer tracer = new ElasticApmTracer();
```

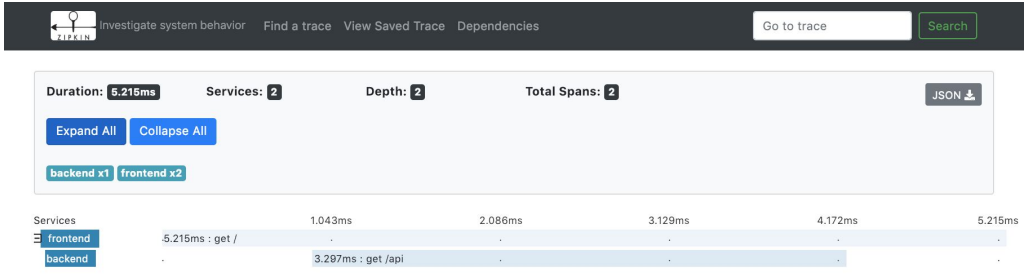
Allows you to replace other OpenTracing-compliant tracers like Jaeger without having to change the rest of the tracing code.

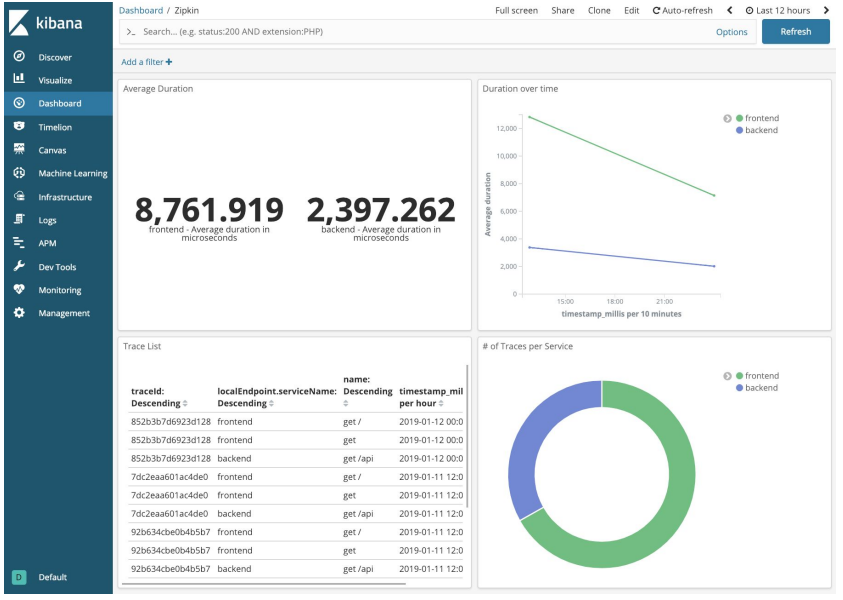
See: https://www.elastic.co/guide/en/apm/agent/java/current/opentracing-bridge.html

Elastic & Distributed Tracing

Integrating Zipkin, Jaeger with Elastic

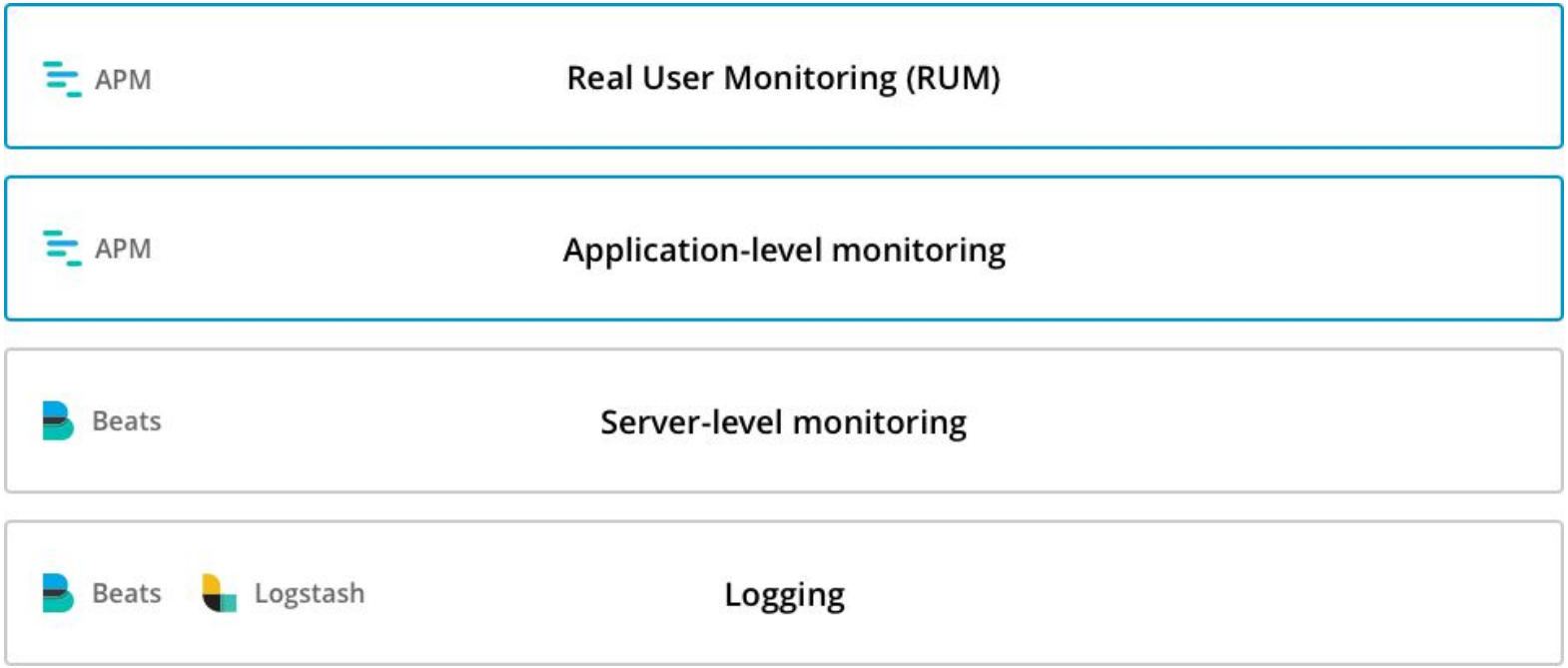
- Zipkin & Jaeger
  - Basic tracing information
  - Dependency diagram
  - Out-of-the-box integration with Elasticsearch
- Elasticsearch
  - Rich trace analysis
  - Long-term trace data storage
  - Correlation with logs & metrics





Full stack monitoring in a single place

Adding end-user experience and application-level monitoring to the Elastic Stack



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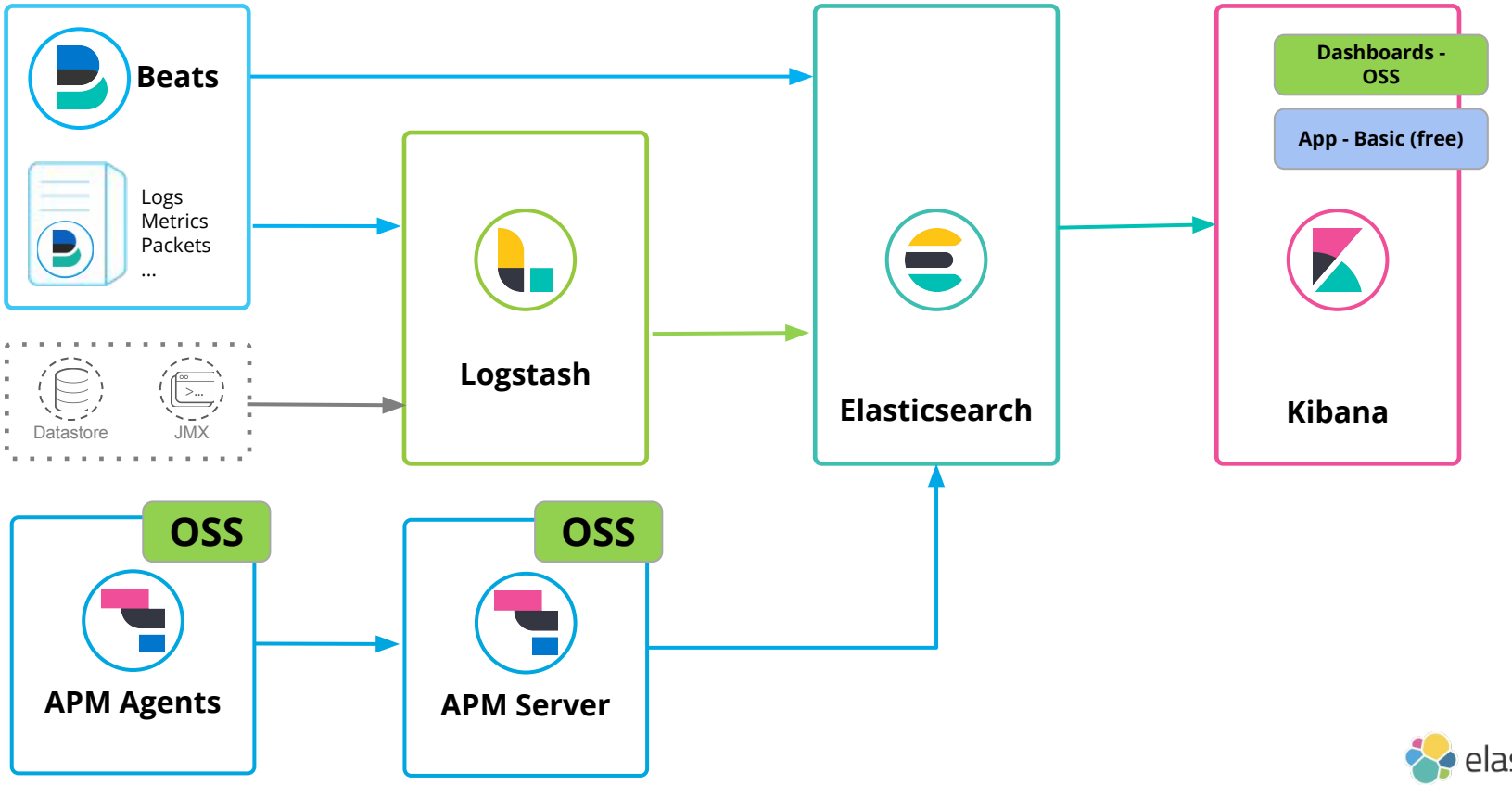
Where APM fits in the Elastic Stack



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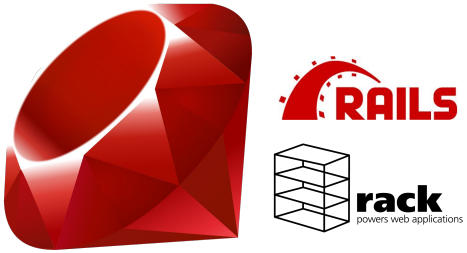
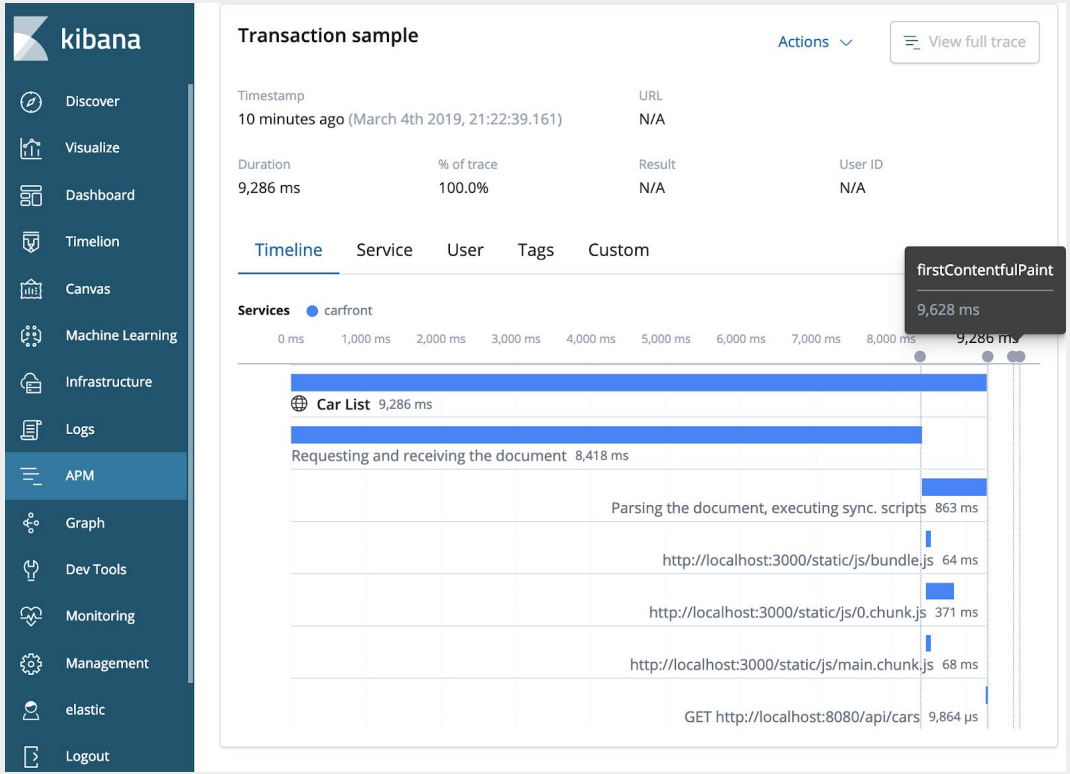
Supported Languages & Frameworks

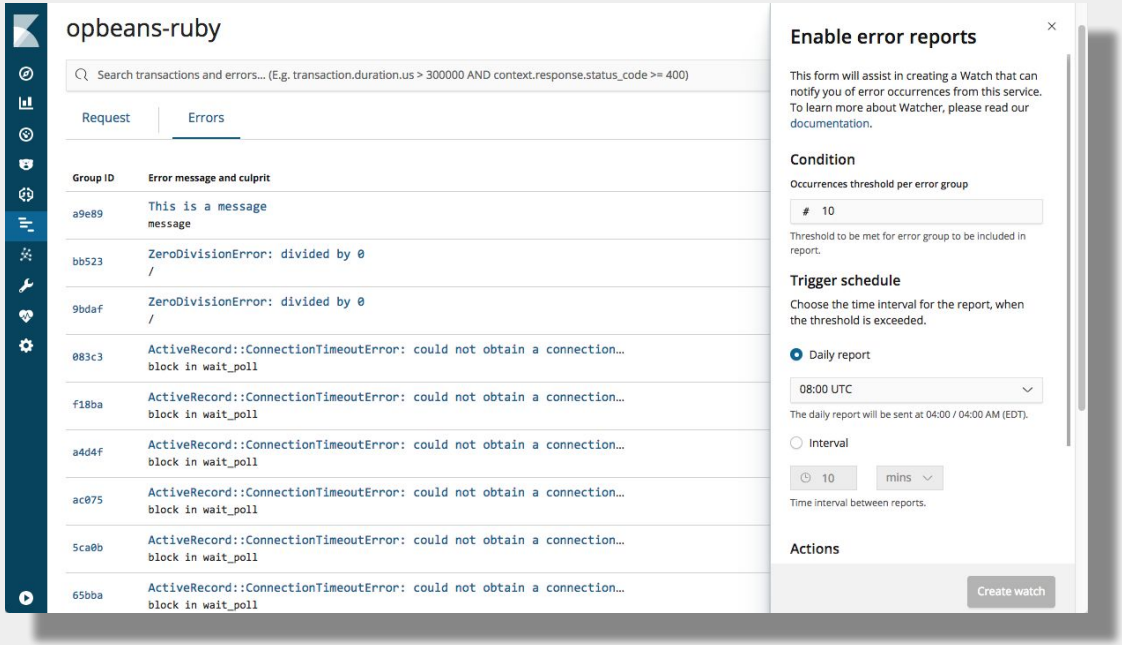


RUM

- Measures actual end-user experience
- See where the browser spends its time
- Similar waterfall view
- Annotations at key DOM events



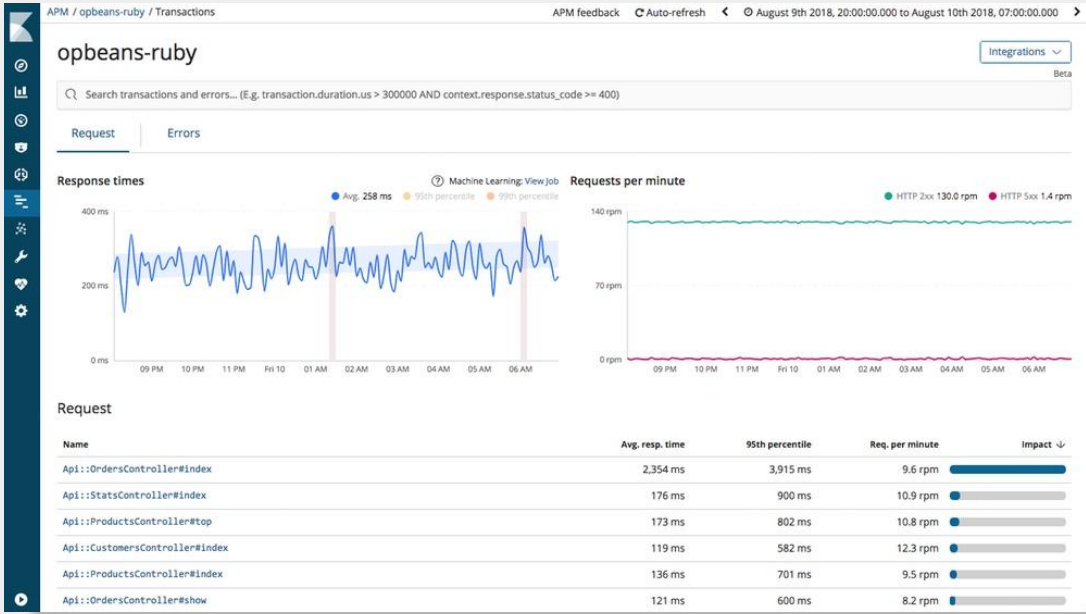
Alerting Integration



- Daily or Interval based
- Configurable Threshold
- Slack or email notification

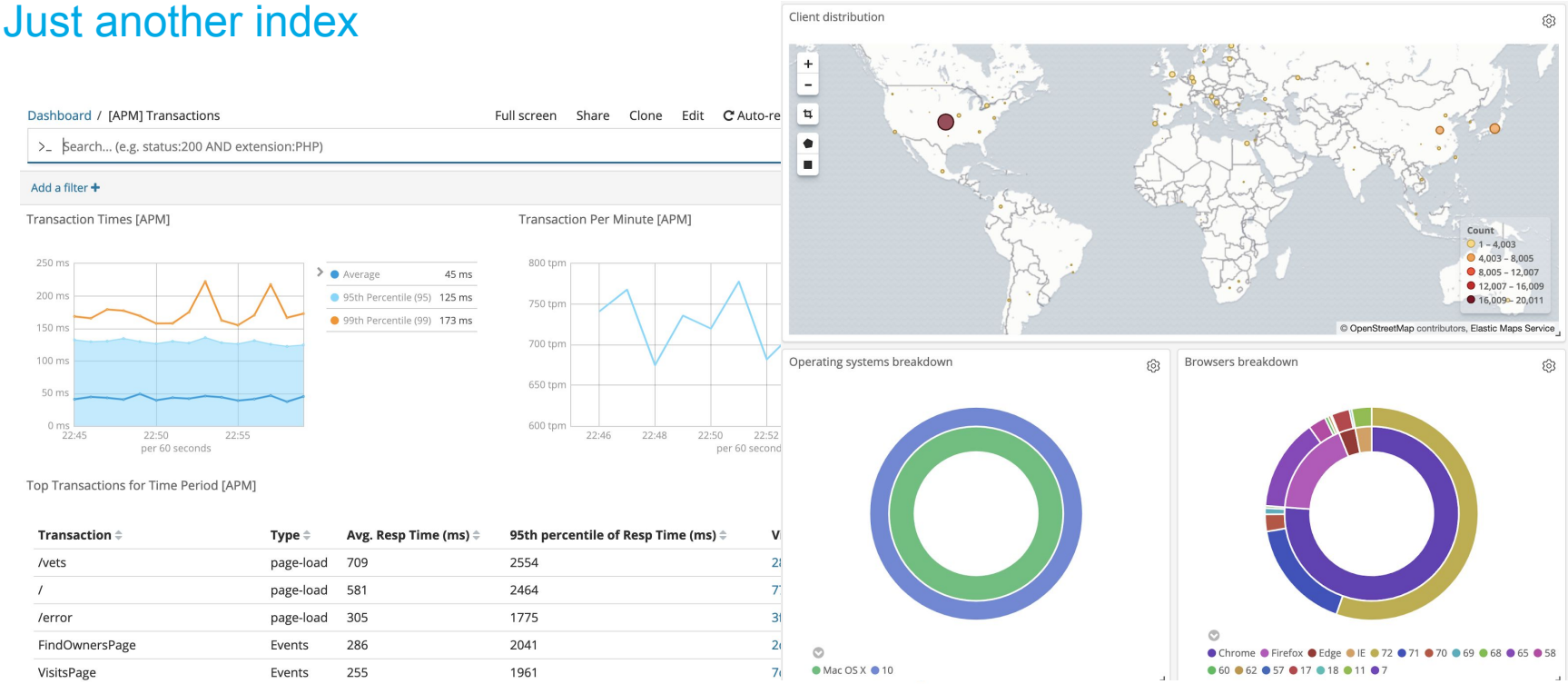
ML Integration

- Calculate anomaly scores on high response times
- Graph annotations when score is over 75



Import Dashboards or Make Custom Visualizations

Just another index



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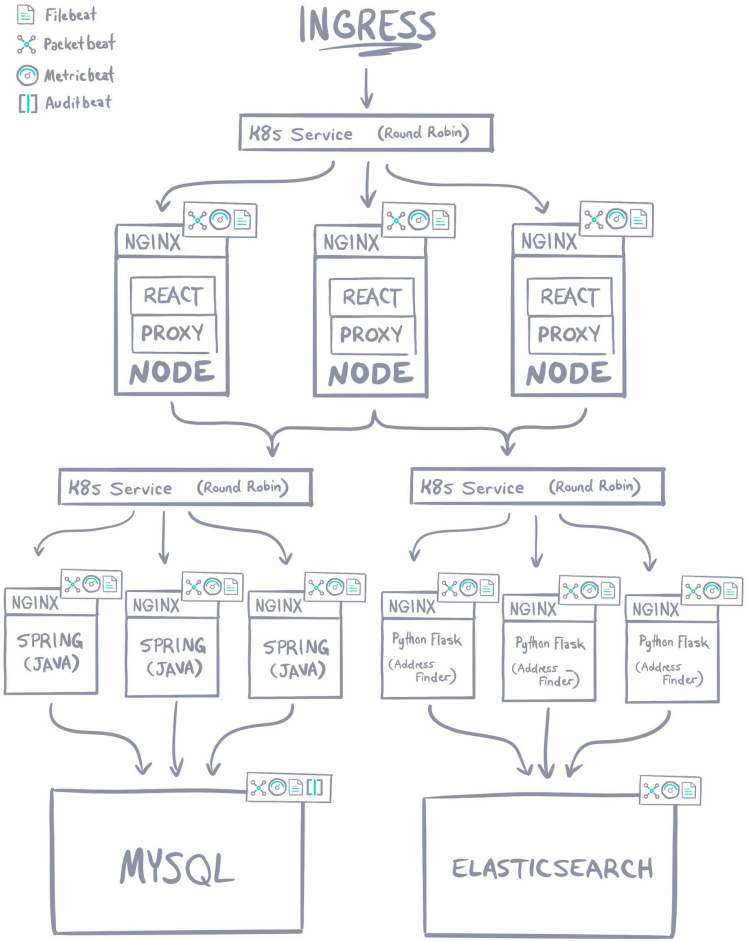
Demo Time

Application Architecture

- React frontend
- Node.js Express proxy
- Java backend
- MySQL data store
- Python for address lookup
- Elasticsearch backend
- Elastic Cloud:
  - ES
  - Kibana
  - APM



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Key Takeaways

Why Elastic APM?

- Elastic APM is **OpenTracing compliant**
- Elastic OpenTracing bridge allows **instrumentation reuse**
- Elastic Stack is a great **scalable long-term storage** for other tracers
- Elastic provides **rich analytics** for tracing data Elastic or not
- Elastic is a great platform for all **three pillars of observability** - logging, metrics & tracing

Resources

Elastic APM: https://www.elastic.co/solutions/apm

Blog: Distributed Tracing, OpenTracing & Elastic APM

Blog: A Sip of Elastic RUM (Real User Monitoring)

APM Forum: https://discuss.elastic.co/c/apm

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Questions?