Elastic APM

Adam Quan
Principal Solutions Architect, Elastic
July 11, 2019

Agenda

- Elastic APM Overview
- Distributed Tracing with Elastic APM
- Elastic APM Java Agent
- Browser Instrumentation with the RUM Agent
- **Demo**
- Performance
- Alerting & Machine Learning Integration with APM
- Q&A

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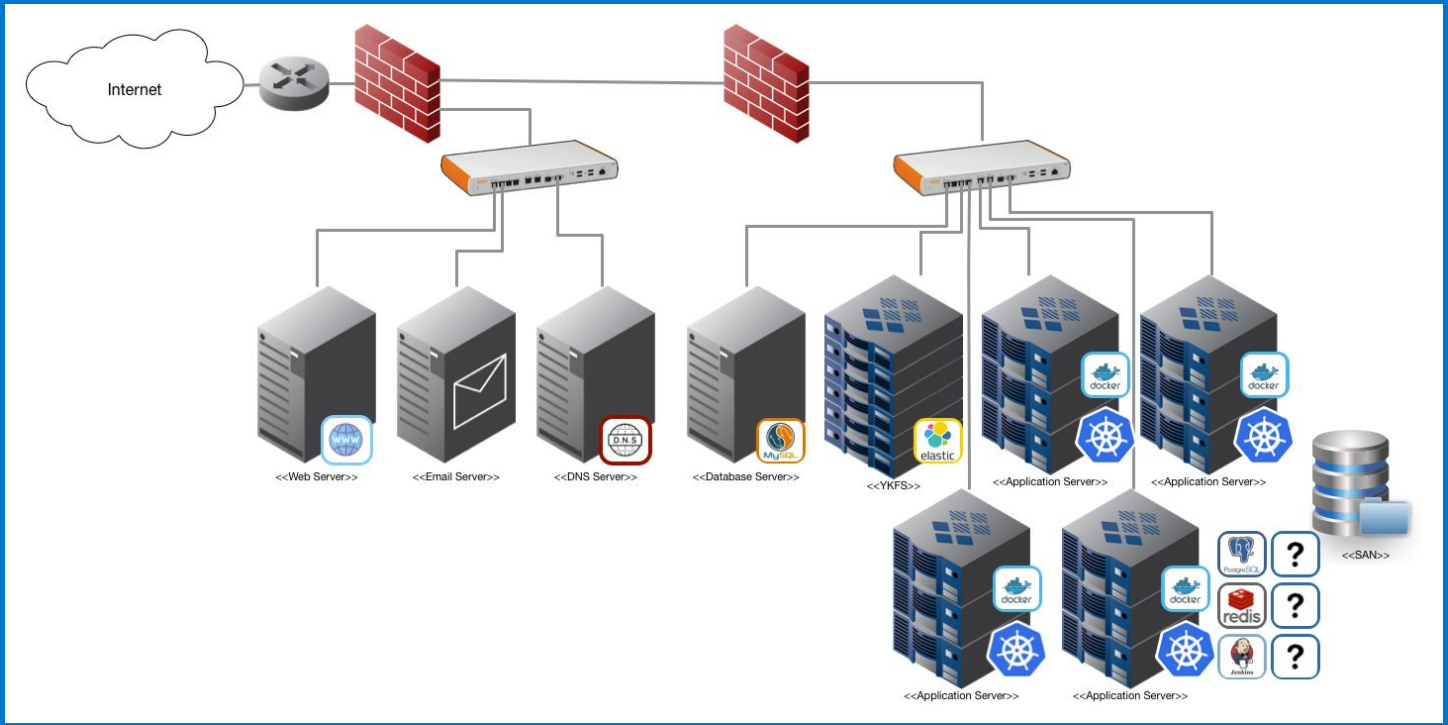
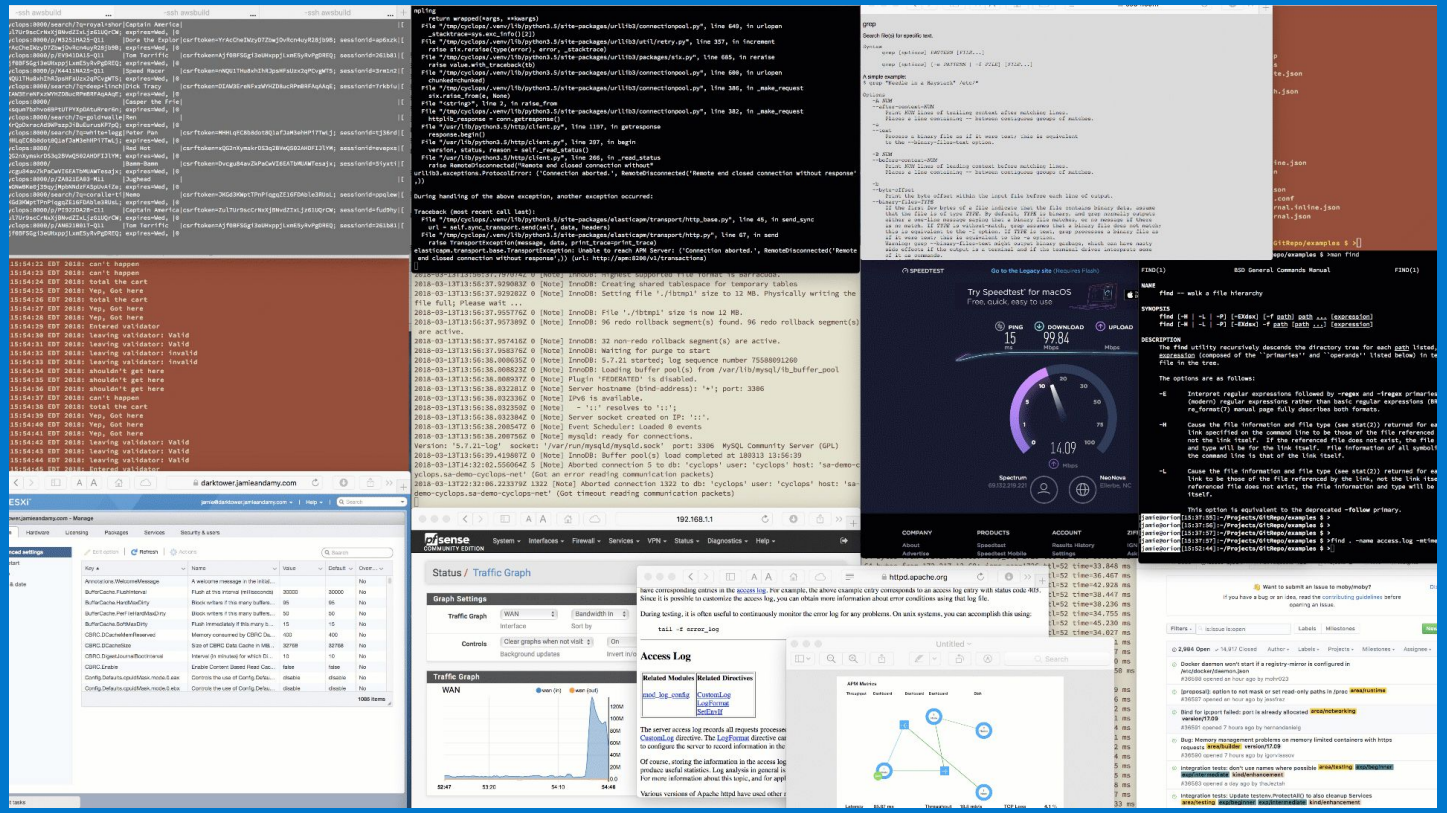
Elastic **APM** Overview

You have this …



.. and when this happens...

you open these...



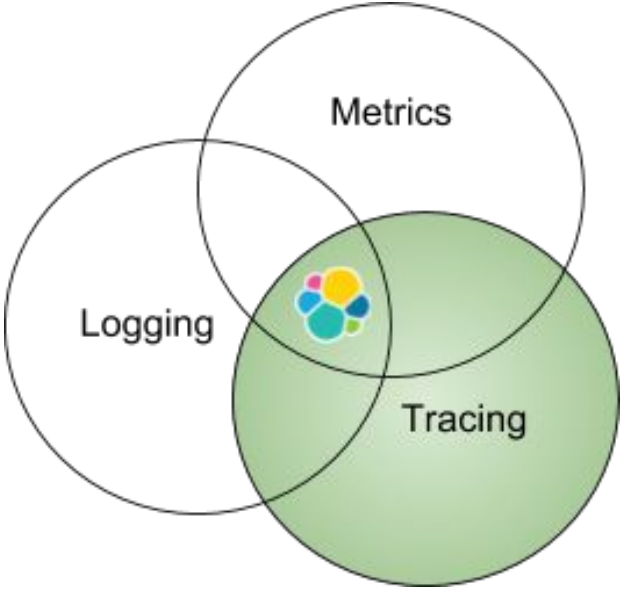
12 hours (and 14 pizzas) later...

SOLVED!

Now where's that Visine?

Bring Logs + Metrics + APM together

The 3rd Pillar of Observability



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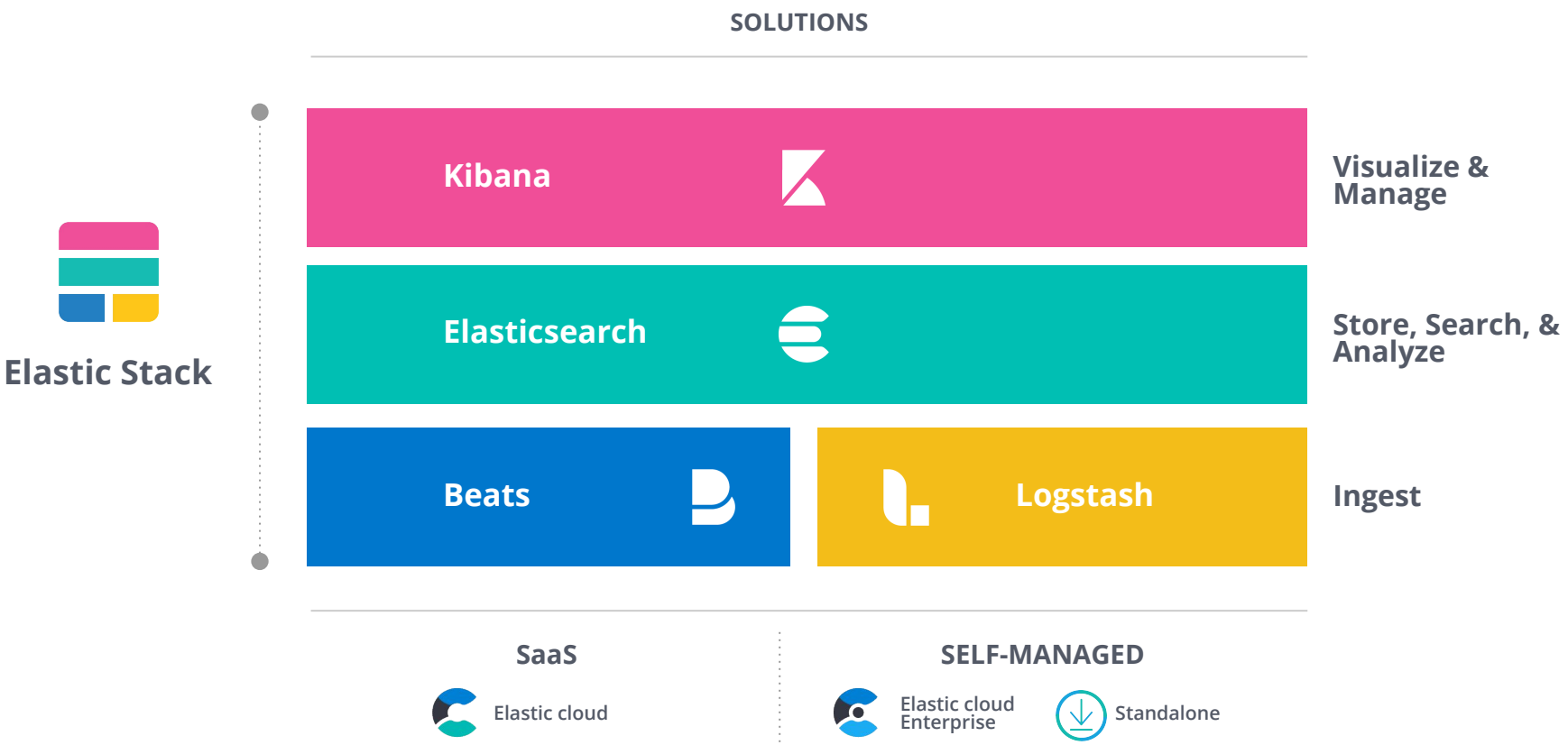
Elastic **Stack**



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Solutions

Logging	Metrics	APM	Uptime	Security Analytics	FUTURE
App Search	Site Search	Enterprise Search	Maps	Business Analytics	

Elastic Stack

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

SaaS

SELF-MANAGED

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Technology **differentiation**

SCALE

Distributed by design

SPEED

Find matches in milliseconds

RELEVANCE

Get highly relevant results

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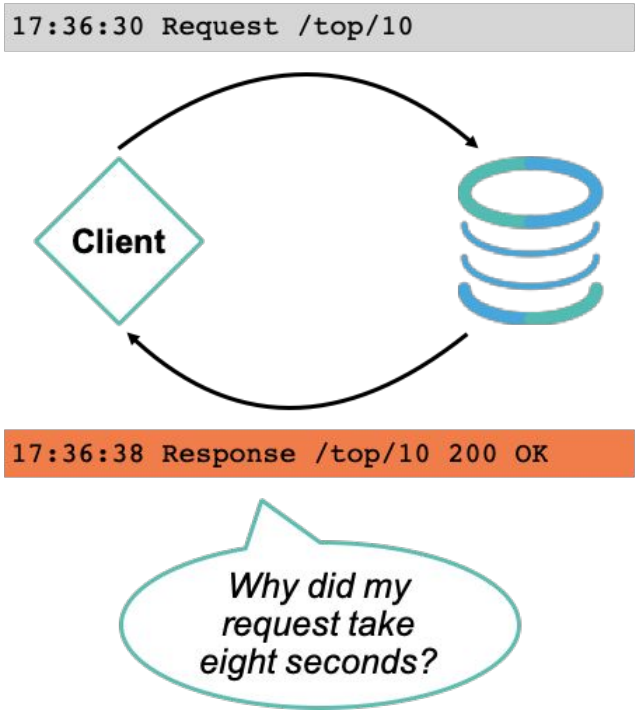
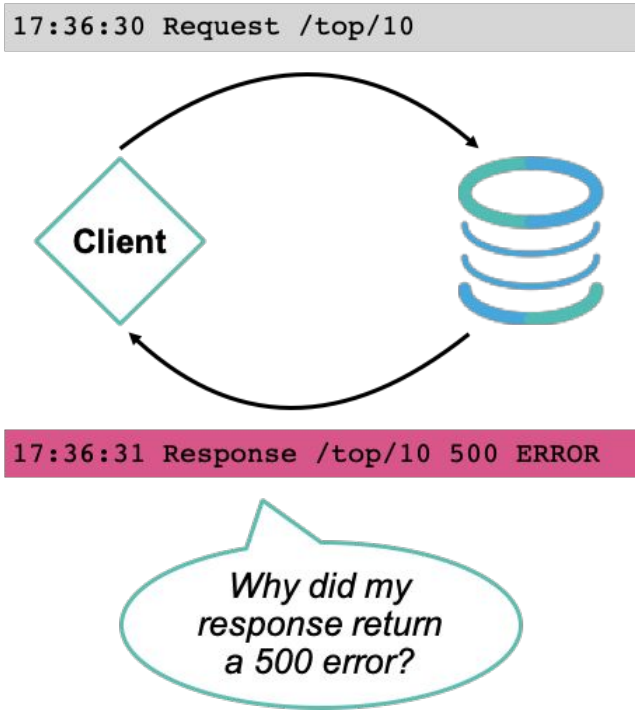
What is APM?

Application Performance Monitoring





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Why APM?

- APM records traces for database queries, external HTTP requests, and other slow operations that happen during requests to your application
  - easier to see where your application is spending time
- It collects not handled errors and exceptions
  - easier to debug errors
- Find performance bottlenecks and errors before your customers face them
- Increase the productivity of your development team

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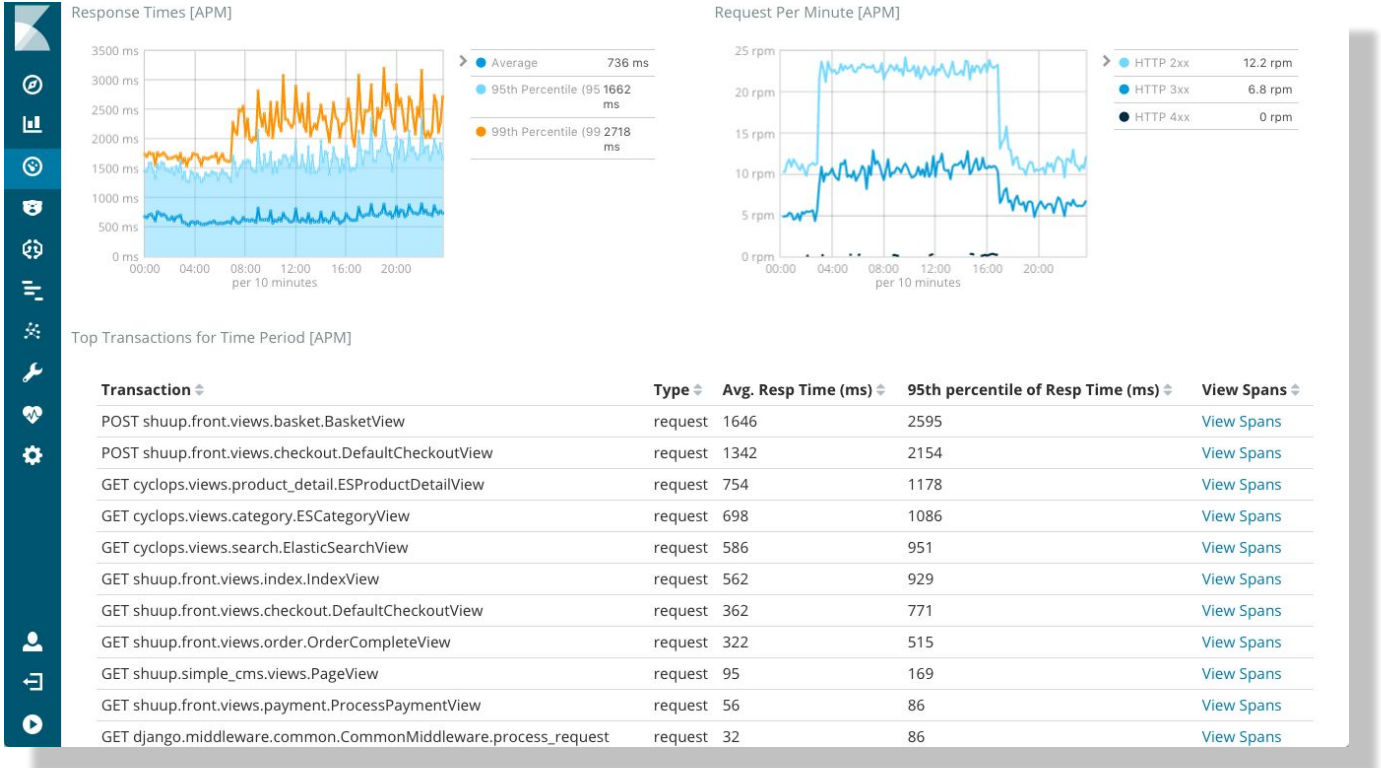
First Major Open Source APM Solution

Agents, Server, Dashboards



Transaction	Type	Avg. Resp Time (ms)	95th percentile of Resp Time (ms)	View Spans
POST shuup.front.views.basket.BasketView	request	1646	2595	View Spans
POST shuup.front.views.checkout.DefaultCheckoutView	request	1342	2154	View Spans
GET cyclops.views.product_detail.ESProductDetailView	request	754	1178	View Spans
GET cyclops.views.category.ESCategoryView	request	698	1086	View Spans
GET cyclops.views.search.ElasticSearchView	request	586	951	View Spans
GET shuup.front.views.index.IndexView	request	562	929	View Spans
GET shuup.front.views.checkout.DefaultCheckoutView	request	362	771	View Spans
GET shuup.front.views.order.OrderCompleteView	request	322	515	View Spans
GET shuup.simple_cms.views.PageView	request	95	169	View Spans
GET shuup.front.views.payment.ProcessPaymentView	request	56	86	View Spans
GET django.middleware.common.CommonMiddleware.process_request	request	32	86	View Spans

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Full stack monitoring in a single place

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

APM	Real User Monitoring (RUM)
APM	Application-level monitoring
Beats	Server-level monitoring
Beats, Logstash	Logging

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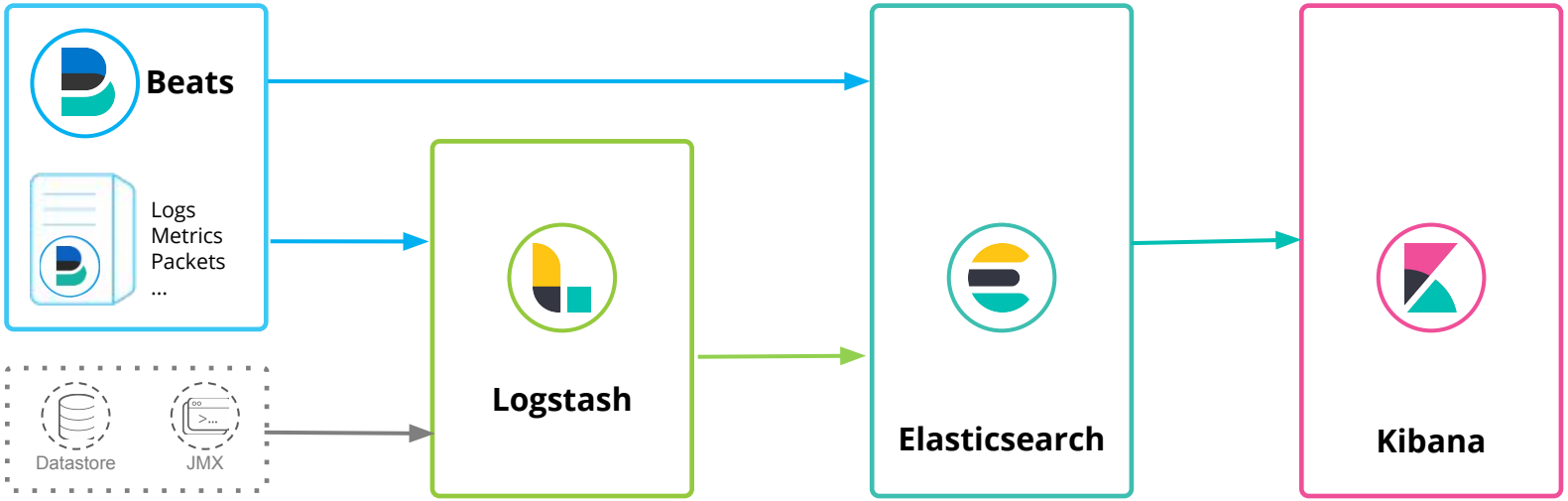
Where APM fits in the Elastic Stack



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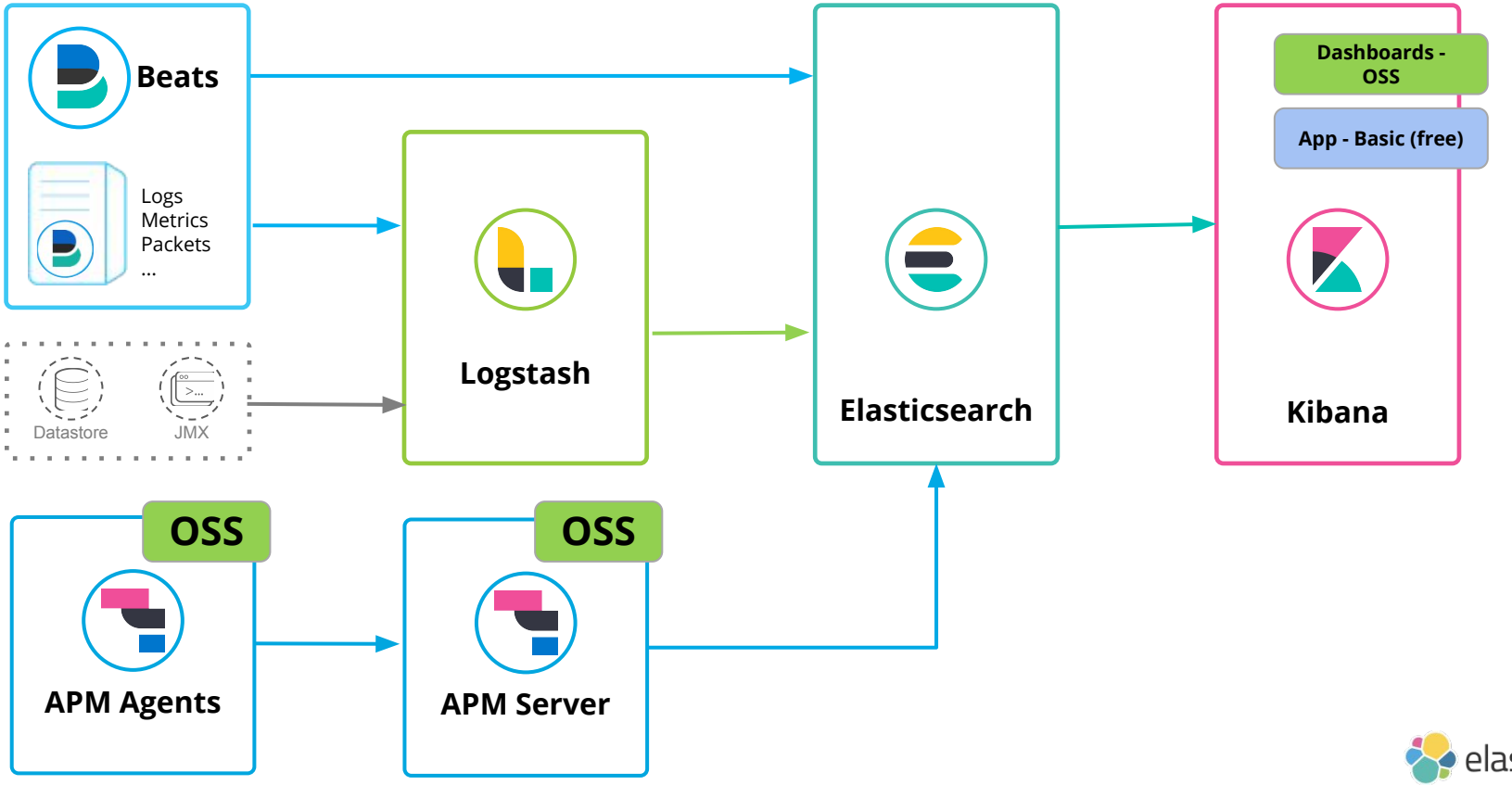
Where APM fits in the Elastic Stack



Track key application metrics

- Response time for requests
- Unhandled errors & exceptions
- Visualize call hierarchy (waterfall chart)
- Identify code bottlenecks
- Drill down to the code level

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Supported Languages & Frameworks

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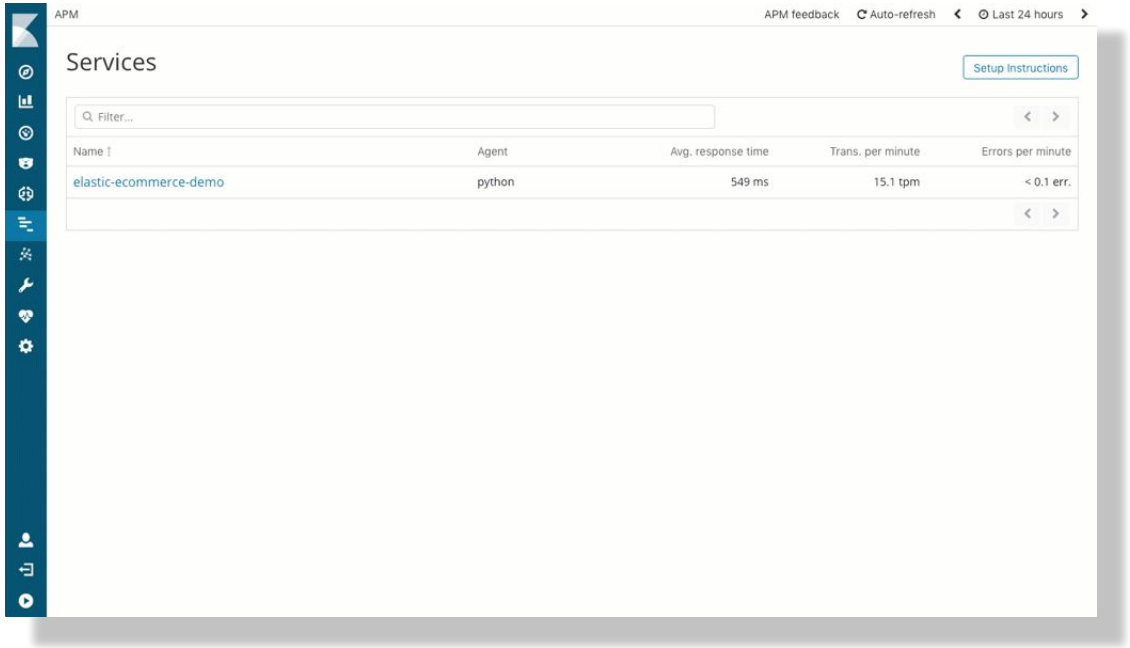
APM App (UI)

- Tailored for APM
- Made for developers
- Free (Basic license)
- Integrated Search Bar



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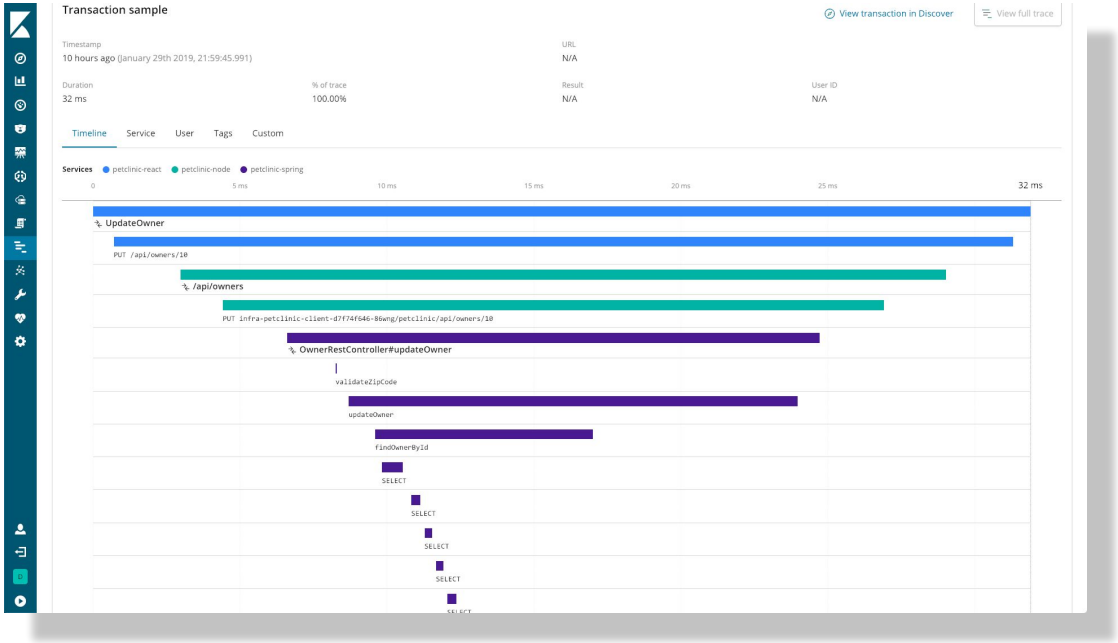
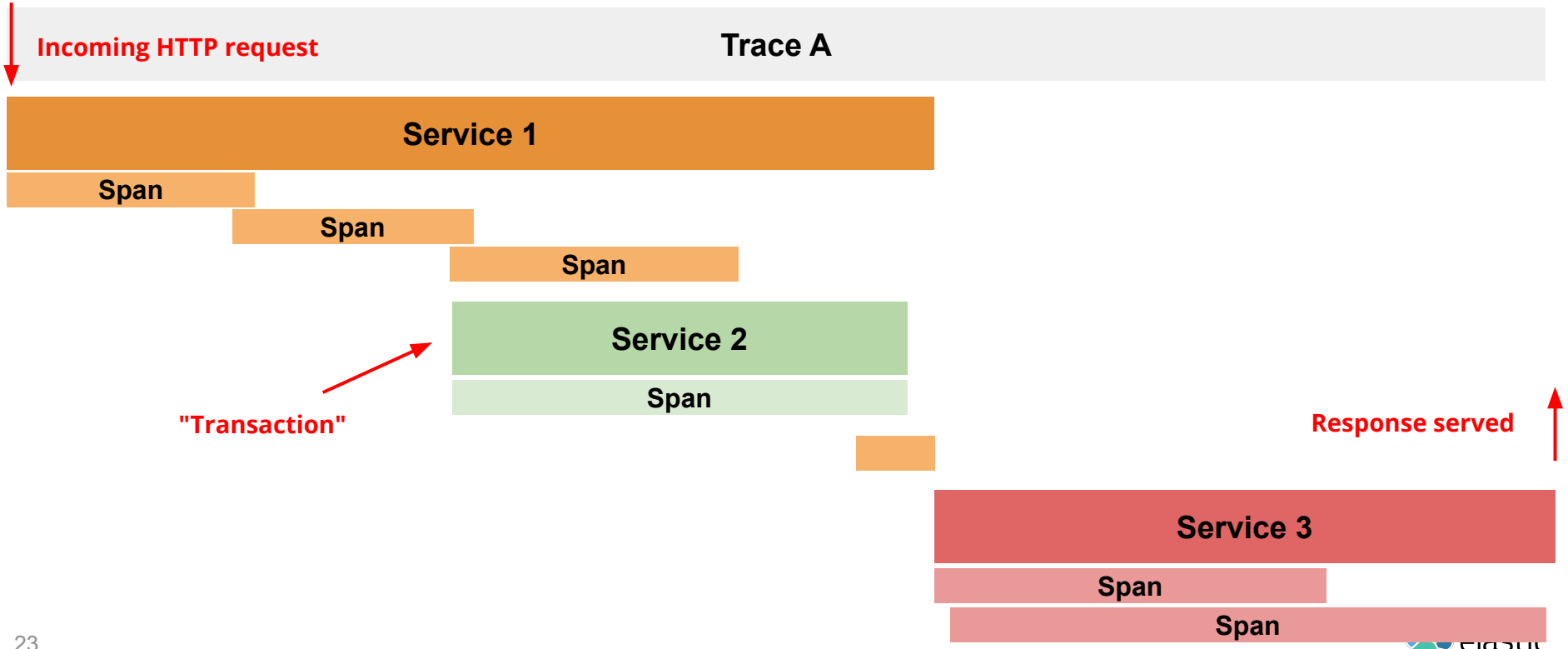


Distributed Tracing

- Instrumented Services, interleaved
- See how services interact
- See External calls with details

How does distributed tracing work?

End-to-end visibility



How does distributed tracing work?

Propagating HTTP headers

- APM agents creates and propagates unique *trace ids* via HTTP headers
- W3C Trace Context working group is standardizing the HTTP header format for distributed tracing

```
traceparent:
00-                                     // version
0af7651916cd43dd8448eb211c80319c-       // trace id
b7ad6b7169203331-                       // parent span id
01                                      // flags (sampling)
```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Mix APM with other data & features

- APM data is **just another Elasticsearch index**
- Customize dashboards with other visuals to show what YOU want
- Mix with other Elastic Stack features, such as machine learning, alerting…
- Built-in integration with ML & Alerting

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Dashboard / Elastic{ON} 2018 - Infrastructure Analysis

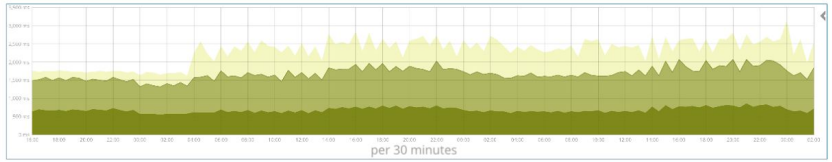
Full screen Share Clone Edit Reporting Auto-refresh January 19th 2018, 16:00:00.000 to January 22nd 2018, 02:59:59.000

*

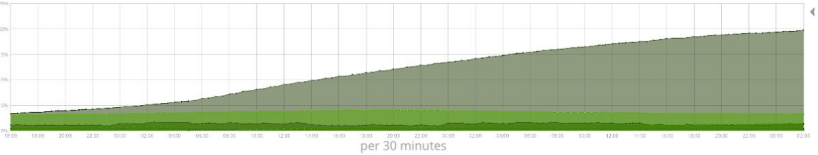
Uses lucene query syntax

Add a filter +

Elastic{ON} 2018 - Site Response Times [APM]

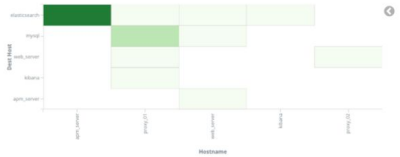


Elastic{ON} 2018 - Memory Usage per Host [Metricbeat]



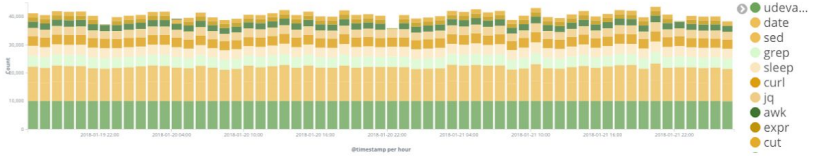
Elastic{ON} 2018 - Unusual Processes [Auditbeat]

Elastic{ON} 2018 - Traffic Between Hosts [Packetbeat]

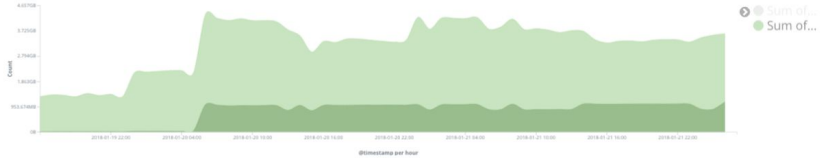


Elastic{ON} 2018 - CPU usage by Host [Metricbeat]

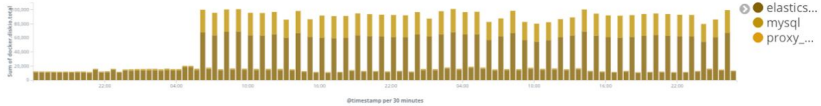
Elastic{ON} 2018 - Unusual Processes by Time [Auditbeat]



Elastic{ON} 2018 - Data Throughput [Packetbeat]



Elastic{ON} 2018 - Total Disk IO on Hosts [Metricbeat]

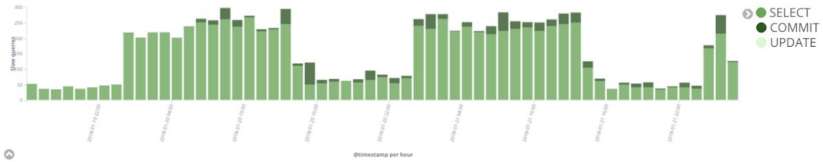


Elastic{ON} 2018 - Process Executions [Auditbeat]

1–50 of 9,935,707

Time	beat.hostname	audit.kernel.action	audit.kernel.category	audit.kernel.how
January 22nd 2018, 02:59:57.628	web_server	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	proxy_01	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	mysql	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	kibana	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	proxy_01	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	apm_server	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.628	proxy_02	executed	audit-rule	/usr/bin/docker-runc
January 22nd 2018, 02:59:57.620	proxy_02	executed	audit-rule	/usr/bin/docker-runc

Elastic{ON} 2018 - MySQL Slow queries over time [Filebeat]



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Get started in minutes

- Drop a few lines of code into your app
- Point APM server to Elasticsearch
- Open APM app

Install and set up APM agent

Node.js | Django | Flask

1 Install the APM agent

Install the APM agent for Python as a dependency to your application. Copy snippet

```
$ pip install elastic-apm
```

2 Configure the agent

Agents are libraries that run inside of your application process. APM apps are created programmatically based on the `APP_NAME`. Copy snippet

```
# Add the agent to the installed apps
INSTALLED_APPS = (
  # ...
  'elasticapm.contrib.django',
)

# Choose an app name and optionally a secret token
ELASTIC_APM = {
  'APP_NAME': '<APP-NAME>',
  'SECRET_TOKEN': '<SECRET-TOKEN>',
}

# To send performance metrics, add our tracing middleware:
MIDDLEWARES = (
   'elasticapm.contrib.django.middleware.TracingMiddleware',
   #...
)
```

See the documentation for advanced usage.

APM agent status

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Java Agent Overview

Elastic APM for Java

No code changes required

- **Java**
  Oracle JDK 7-11
  Open JDK 7-11

- **Frameworks**
  Servlet API, Spring Web MVC, Spring Boot, JAX-RS

- **Application server**
  Tomcat, WildFly, Jetty, Websphere Liberty, WebLogic

- **Data store**
  JDBC (SQL), Elasticsearch

Start your application with the javaagent flag

Add the `-javaagent` flag and configure the agent with system properties.

- Set required service name (allowed characters: a-z, A-Z, 0-9, -, _ and space)
- Set custom APM Server URL (default: http://localhost:8200)
- Set the base package of your application

```
java -javaagent:/path/to/elastic-apm-agent-<version>.jar \
     -Delastic.apm.service_name=my-application \
     -Delastic.apm.server_url=http://localhost:8200 \
     -Delastic.apm.application_packages=org.example \
     -jar my-application.jar
```

Java agent auto-instrumentation

Auto-instrumentation

- Instrument incoming HTTP requests to your applications
- Automatically instrument database calls, cache calls, templating, external requests, if using any of the supported frameworks.
- Auto-instrumentation also supports JDBC calls - and Elasticsearch

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Java agent API

- The Java agent is OpenTracing compatible.
- Use the Agent API package for custom instrumentation: elastic.co/guide/en/apm/agent/java/current/public-api.html
- Annotate methods with `@CaptureTransaction` to automatically create and report corresponding transaction and spans - including uncaught exceptions.

What if I can not stop my JVM?

Dynamic agent attachment

- `apm-agent-attach.jar` attacher
  - Start as standalone application on the command line
  - Include in your application to programmatically attach
- Attaches the Java agent to a specific JVM or to all JVMs of the host
- No need to alter the configuration of your application server
- Only support HotSpot-based JVMs like the OpenJDK and Oracle JDK
- Requires the JDK, a JRE is not sufficient
- Example:

```
java -jar apm-agent-attach.jar --pid 42 --args \
'service_name=my-service;server_urls=http://localhost:8200'
```


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JavaScript Agent Overview

Elastic APM for RUM

Understand actual end-user experience

- Start tracing at the client level (browser)
- Annotates key DOM events
- Monitor geo latency, asset bundle sizes, browser parsing times, etc.
- Install as dependency via `npm` or load via `<script>` tag

```
import { init as initApm } from 'elastic-apm-js-base'
var apm = initApm({
  serviceName: '',
  serverUrl: 'http://localhost:8200',
  serviceVersion: ''
})
```

```
<script src="elastic-apm-js-base.min.js"></script>
<script>
  elasticApm.init({
    serviceName: '',
    serverUrl: 'http://localhost:8200',
  })
</script>
```


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Browser Instrumentation with RUM

Benefits & use cases

- Discover how site performance issues affects your visitors' experience
  - identify current bottlenecks
- Identify most used browsers, devices, and platforms
  - make informed optimizations
- Understand worldwide regional performance of your website
- Comply to service level agreements

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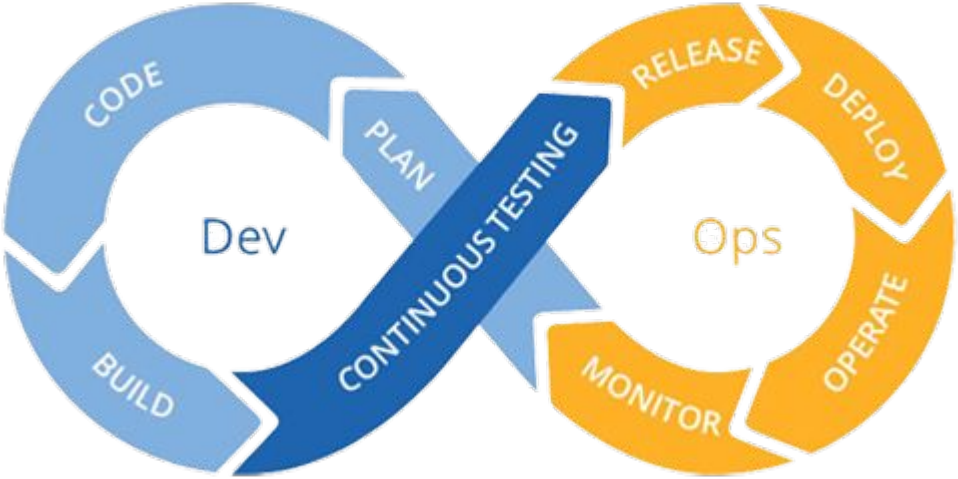
Continuous Monitoring with Elastic APM

DevOps Style

- Continuous integration
- Continuous testing
- Continuous delivery
- **Continuous monitoring**



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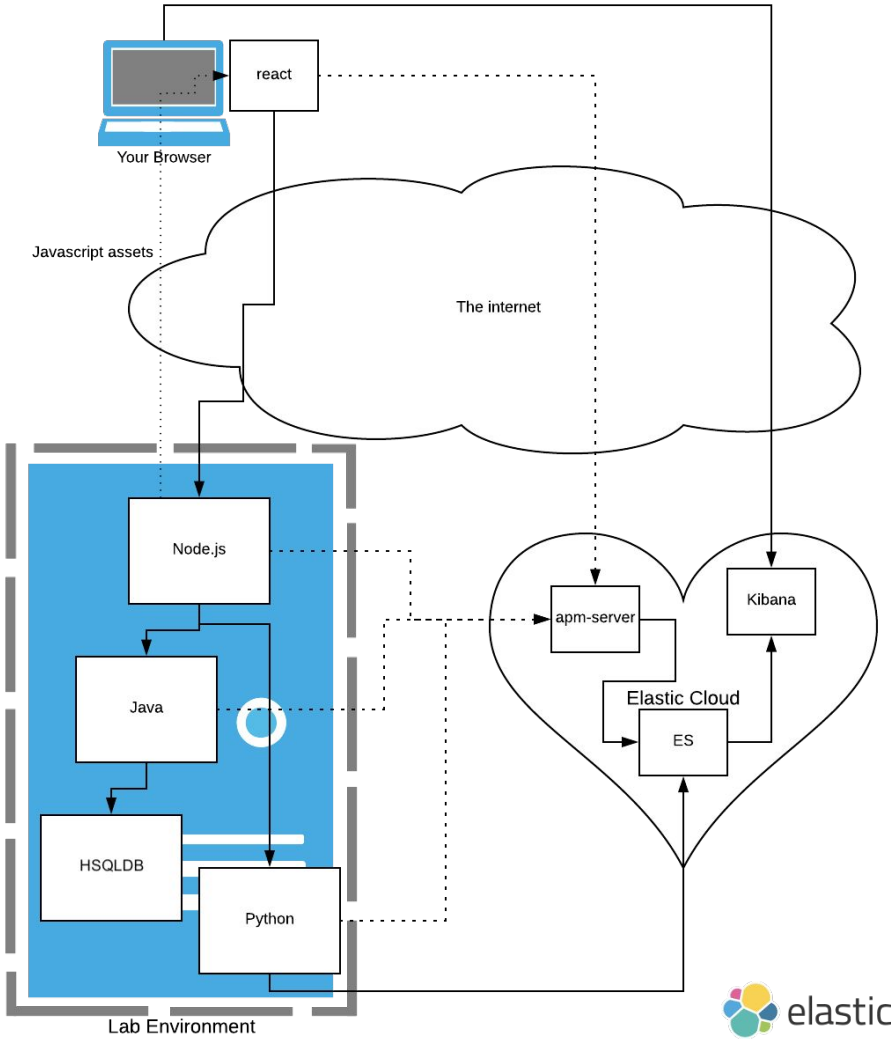
Demo

Application Architecture

- Javascript frontend (React)
- Node.js proxy (Express)
- Java petclinic app (Spring Boot)
  - Relational database (HSQLDB)
- Python address lookup app (Flask)
  - Elasticsearch as data store
- Hosted on Elastic Cloud
  - Elasticsearch
  - Kibana
  - APM



Instrumentation with the Java Agent

- Auto-instrumentation
- Custom instrumentation with `@CaptureSpan`
- Custom instrumentation with API
- `elastic.apm.trace_methods`
- Capture errors with `captureException`

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Performance

Overhead

- 1 operation = recording one HTTP request and one JDBC query
- Response Time Overhead
  - < 1 µs on average (0.000001s)
  - ~ 3.5 µs for the 99.9th percentile
- Allocation Overhead
  - ~ 75 bytes per operation
  - It takes ~14 000 operations to allocate 1 MB
- Benchmarks are Open Source

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Techniques we use to minimize the overhead

- Asynchronous reporting
- Avoid GC pauses
  - GC causes latency spikes
  - Slower response times for higher percentiles
  - Predictable overhead
- Don't allocate Objects
  - new operator is the enemy

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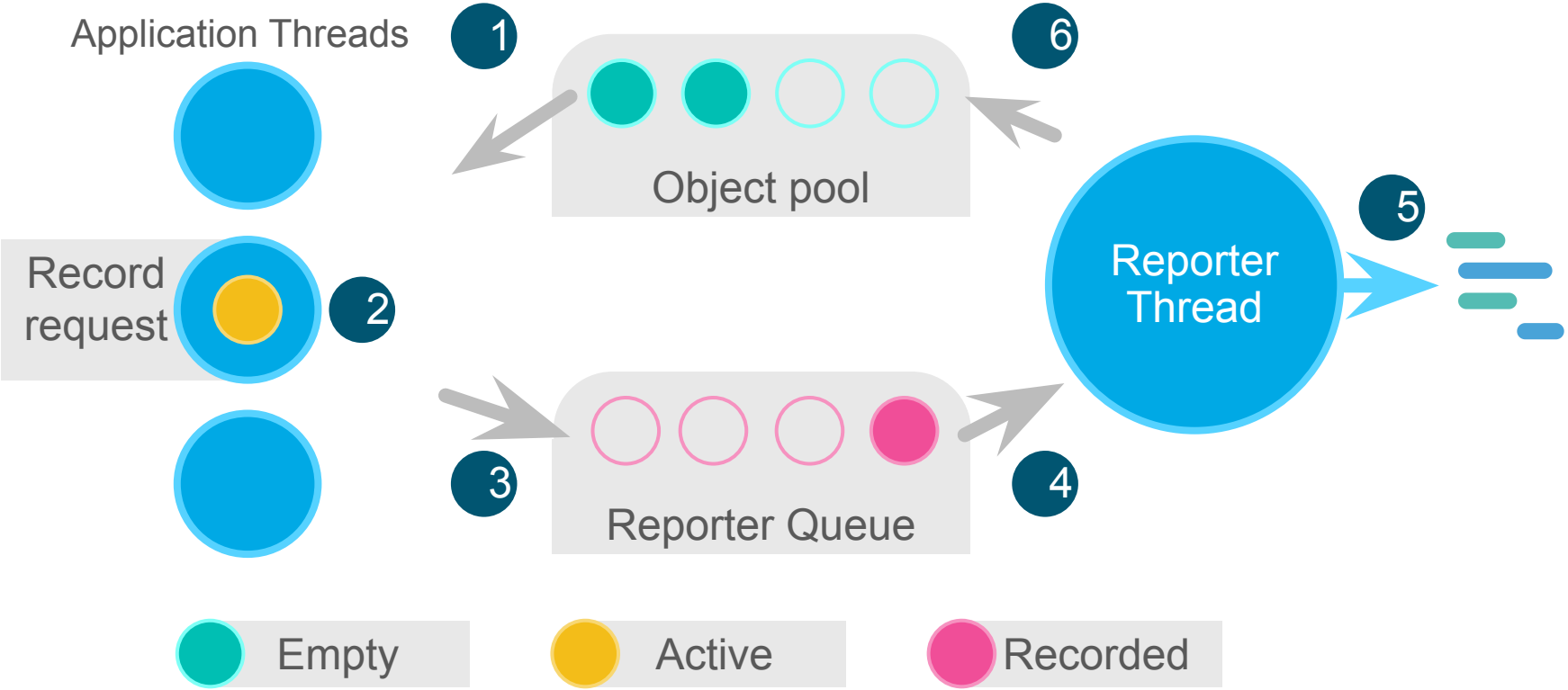
Transaction Object Lifecycle



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APM Server sizing

Performance will vary depending settings and application

- CPU bound. With right settings, the APM Server will scale fairly linearly with the scaling of CPU
- A few examples. Both have a 2x64gb ES cluster as output.

593 events/sec
512mb, 1 CPU
25% CPU, 300MB RAM

```
queue.mem.events=32
queue.mem.flush.min_events=10
queue.mem.flush.timeout=1s
output.elasticsearch.worker=10
output.elasticsearch.max_bulk_size=10
setup.template.settings.index.number_of_shards=2
```

8,649 events/sec
16gb, 4 CPU
380% CPU, 1.3GB RAM

```
queue.mem.events=32000
queue.mem.flush.min_events=1000
queue.mem.flush.timeout=1s
output.elasticsearch.worker=32
setup.template.settings.index.number_of_shards=2
```


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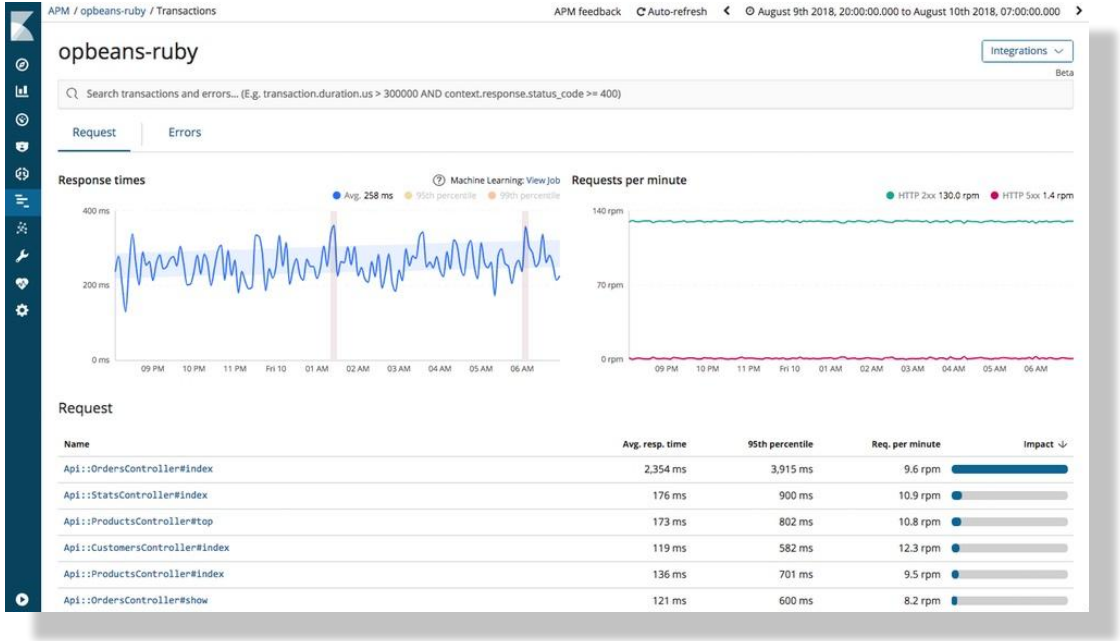
Integration

Metrics, Logging, Alerting, Machine Learning

ML Integration

- Calculate anomaly scores on high response times
- Graph annotations when score is over 75
- Same License as ML



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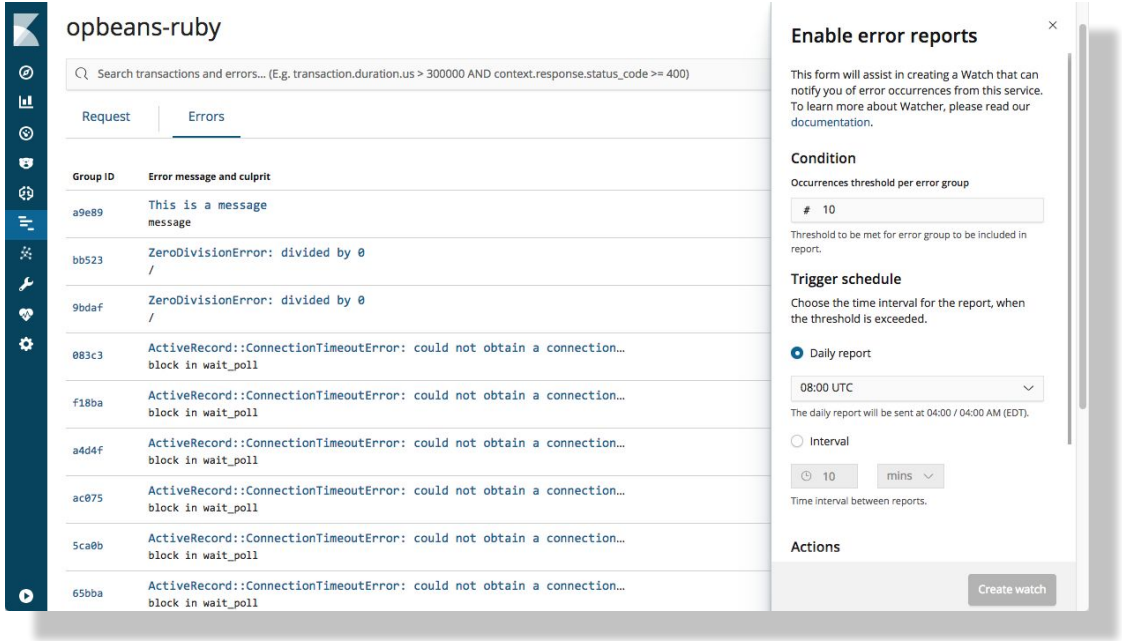

Alerting Integration

- Daily or Interval based
- Configurable Threshold
- Slack or email notification
- Same License as alerting

Elastic APM Summary

- Track your application performance metrics and errors
- APM data is **just another Elasticsearch index**
- Get started in minutes
- Integration with key Features
- Continuous monitoring the DevOps style
- Full Observability with Elastic Stack

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Thank you

Resources

- Java agent GitHub repo
  https://github.com/elastic/apm-agent-java
- APM discuss forum
  https://discuss.elastic.co/c/apm
- APM docs
  https://www.elastic.co/guide/en/apm/get-started/current/index.html
- APM Java docs
  https://www.elastic.co/guide/en/apm/agent/java/current/index.html
- **Blog**: A sip of Elastic RUM
  https://www.elastic.co/blog/performing-real-user-monitoring-rum-with-elastic-apm
- **Blog**: Distributed Tracing, OpenTracing and Elastic APM
  https://www.elastic.co/blog/distributed-tracing-opentracing-and-elastic-apm
- **APM Workshop**

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