Practical Advice For Monitoring Microservices

Adrian McMichael
@trev_boxmonster
adrian.mcmichael@rightmove.co.uk
Introduction

- Adrian McMichael
- Lead Application Architect at Rightmove.
- UK’s Biggest Property Portal
  - Established in 2000.
  - Around 60M requests a day.
  - Around 1.2 Million Properties on Site.
  - 90% of all estate agent listings in the country.
  - Around 7.3 Billion Log messages a day.
What I’ll cover

• A short Rightmove history lesson
• Best Practices
  • Observable Events
• How We Monitor
  • Logging Pipeline
  • Alerting
• Results
A Bit of History
Before Microservices

• Before 2014 if an application failed
  • ssh onto application server
  • cd to the correct directory
  • Hope the logs contain the data you need in the right format
  • Begin the awk/sed wizardry
  • if answer present:
    • Repeat for each application instance affected
  • else
    • Increase logging and wait for reoccurrence

gzcat access_log.h2-api05.20130506 | awk - F'' ' $7 > 3000000 {print $2}' | grep '?q' | sed 's/.* \(/.*\?\).*/\1/g' | sed 's/\(\/api\/.*\)/\(\//api\/\)/\(\//api\/.*\)/\(\//sync\)/\(\//api\/\)/syc/g' | sort | uniq -c | sort

- An ancient incantation for grouping slow pages
Enter Project Odin

• Investigated a new search engine
• Decided to replace our core flow with microservices
  • Gives us more flexibility
  • Improve ownership
  • Improve maintainability
• Given the time it could take to look at issues we needed better tools.
What We Wanted to Achieve

• Take advantage of the wider surface area of microservices to pinpoint issues better.
• Have a self service approach to logging and investigating how services are behaving.
• Support microservice ownership.
• Provide access to data about our systems in a way that is friendlier to non-developers.
Observable Events
Obligatory definition time!

“’Monitoring’ refers to repeatedly checking a system and its outputs to make sure they are within known-good ranges...”

Observability ... is about being able to understand the inner workings of your software and systems by asking questions and observing the answers on the outside…”

- Charity Majors, @mipsytipsy, 2018
Bad Event Logging

• Is an afterthought.
• Is autogenerated or relies purely on 3rd Party agents and plugins.
• Is anaemic and lacks context
• Uses a human readable format which makes ingestion hard
• Uses a message field that contains all the information.
• Describes the system as we expect it to work!
Good Event Logging

- Is a stream of events that can be followed across boundaries to describe how a system behaves.
- Shares a common specification
- Is designed to allow us to ask questions of a system.
- Has messages that help discoverability but are not the source of contextual data.
- Is testable
- Evolves with the system
- Accepts failure!
How we structure logging

• A bit about our event structure
  • Transactions are correlatable across application boundaries
  • Log data is machine readable and in most cases JSON based.
  • Supports thread local dimensional key-values pairs, timing and tags.
  • Supports passing of contextual data across application boundaries to keep APIs clean.

• We use a custom made Log4j2 Java Library
  • See Also:
    • Open Tracing - https://opentracing.io/
    • Open Census - https://opencensus.io/
    • Brave - https://github.com/openzipkin/brave
    • Zipkin - https://zipkin.io/
    • Honeycomb - https://www.honeycomb.io/
Correlation Ids

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3. Application needs data from another service.
   Client filter reads correlation id from thread local storage and applies it to outgoing request.
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4. Request B sent to retrieve Data from 2nd Application with Correlation Id in Headers

5. Correlation Id Http Request Filter

6. Application Code
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3. Application needs data from another service. Client filter reads correlation id from thread local storage and applies it to outgoing request.

4. Request B sent to retrieve Data from 2nd Application with Correlation Id in Headers

5. Filter sees correlation id is present in headers and stores this in local storage
Event Ids

• Identify a discrete event within a transaction
  • Usually a numeric id/enumeration which allows to query across families
  • Are unique per activity not per transaction like correlation ids.
  • Can be used to query across event types when exploring data.
  • Can be technical
    • Like an Application Starting
  • Can be domain driven
    • Adding an item to a basket, saving a property
Common Metadata

- Request parameters
  - Search filters
  - User ids
  - User-agent details
- Application instance details
- Timings
  - Broken down for multiple calls
  - Share a common timing denomination
- Can pass important information for logging purposes via request headers to avoid polluting APIs
  - E.g. Customer Ids, Human readable Search terms, user-agent
Anemic Events vs Fat Events

```json
{
  "level": "INFO",
  "message": "property search",
  "duration": 100
}

{
  "message": "sales property search complete",
  "eventId": 20000,
  "correlationId": "a4229...
  "duration": 100,
  "containerId": "abcd098098",
  "metadata": {
    "locationId": 12345,
    "locationType": "region",
    "minBeds": 2,
    "maxPrice": 1000000,
    "keywords": ["sea view"]
  },
  "containerLabels": {
    "language": "java"
  },
  ...
}
```

What about Aggregated Metrics?

• Aggregated metrics are cheap and quick to store but lack context.
• Indicative of faults.
• Aggregated metrics are good for tracking a fluctuating numeric value.
  • Connection Pool Usage
  • JVM Memory
  • CPU Usage
  • Request rate
  • Error Rate
• Check out micrometer for JVM based metric collection:
  • [https://micrometer.io/](https://micrometer.io/)
  • Supports tags on metrics
  • Spring Boot 2+ library of choice
Events Strategy

• Focus on state changes.
• Consider using spans to break down transactions.
• Start with a sensible coverage then iterate as needed.
• Practice Continuous Delivery.
• Consider thread local metadata storage to make sharing context easy.
• Watch out for edge cases and errors and ensure metadata is present in all cases.
Docker Engine

Deploys

Application Containers

Logs Message

Log Files

Beats

Auto-discovers containers and reads files
Beats and Container Auto-discovery

- A lightweight log shipper written in Go
- Has the ability to Autodiscover Kubernetes/Docker hosts based on listening to docker engine events.
- Augments events with metadata like container names, ids images, Docker Labels and Kubernetes Annotations
filebeat.autodiscover:
  providers:
    - type: docker
  templates:
    - condition:
      contains: docker.container.image: redis
    config:
      - type: docker
        containers.ids:
          - "${data.docker.container.id}"
Logstash as a service

- Logstash commonly used in a sidecar pattern.
- Can also act as a clustered service
- Beats can be configured to communicate to a list of Logstash servers
- Allows centralized enrichment and processing of log messages
  - User-agent normalising
  - Geo IP lookups
- Codify your Logstash setup
  - We use Pebble templates - [https://github.com/PebbleTemplates/pebble](https://github.com/PebbleTemplates/pebble)
Hot-Warm Architectures

• Logstash writes to smaller faster Elasticsearch nodes sized for 24 hours
  • SSDs for fast I/O
• After 24 Hours indices are moved to slower but larger capacity nodes
  • HDDs that are cheaper and much larger
• Need to leave 30-40% capacity to allow for datacenter failure
Elasticsearch Advice

• Indexes all fields so everything is searchable.
• Don’t use dynamic schemas!
  • Use mappings to avoid type clashes and unwanted analysing.
  • Custom fields that are more dynamic can be mapped with dynamic templates to keep types and analysing consistent.
• Analyse free-text.
  • Users will search for partial stack traces and error names and expect this to work.
• Consider data roll-ups to track trends.
• Don’t map 1000s of fields in one index unless you want heap issues.
Pipeline Advice

• Codify your configuration.
• Measure your message latency.
• Set a sensible retention policy for raw data.
• Backup important metrics.
• Make your pipeline continuously deliverable and separate from your application delivery.
• Provide a test environment for developers.
• Log in pre-production!
Alerting Architecture

- 2 Elasticsearch Clusters
  - One for monitoring
  - One for collecting logs
- Custom Web-App for setting up and managing alerts
  - Self-service
  - Covers complexity
  - Uses Kibana where possible instead of reinvention
Watcher/X-Pack Alerting

- Part of Elastic’s X-Pack suite
- Allows us to alert based on our logging data directly
- REST API based setup
- Backed by a configurable data context object
- Uses a groovy-like scripting language called Painless
- A watch consists of:
  - Input – Adds any input data needed to check the alert condition
  - Trigger – How often the alert should run
  - Condition – The condition to check and alert on
  - Actions – What to do when alerting, e.g. send a slack message
  - Transforms – Allows the optional transformation of data for use in actions
<table>
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<th>Status</th>
<th>Alert Name</th>
<th>User</th>
<th>Application</th>
<th>Team</th>
<th>Recipient(s)</th>
<th>Actions</th>
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<td>adrianm</td>
<td>property-web</td>
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<td>@adrianm, <a href="mailto:adrian.mcmichael@rightmove.co.uk">adrian.mcmichael@rightmove.co.uk</a></td>
<td></td>
</tr>
</tbody>
</table>
Set up a query alert

Pick a team to own the alert
- platforms

Name your alert
- test-query-alert

Select an index
- access_log_

Select an application
- static-map-generator

Define your alert query
- response[400 TO *]

Setup alert condition.
Will alert if the percentage of documents that matches the query is above \( \frac{0}{5} \) for 5 minute(s).

Setup alert interval
- Run this alert every 5 minute(s).

Setup your alert actions
- Alert using email
- Alert using slack
  @adrianm

Throttle actions after an alert for 15 minute(s).
Alerting Advice

• Try to focus on what matters!
  • Traffic
  • Error Rate
  • Duration of important types of requests
  • Important KPIs

• Give teams power to configure themselves but be prepared to offer guidance.

• Health is a sliding scale!
  • Understand what healthy looks like for your system.

• Fix issues as they arise!

• Building a system isn’t enough!
The Results
Cultural Change

• Developers naturally reach out to the tooling when issues occur.
• Workshops have helped spread the knowledge amongst teams.
• Other areas of the business are looking to Kibana dashboard for support processes.
• Queuing events has led to exploration of other Data Processing use-cases
• Made a difference when starting new projects.
Final Advice!

• Sounds like a lot of work!
  • It is but that’s okay
  • Think of this like your testing
  • Make time for it - its easy to show the benefits to management

• Treat it with respect and care
  • Crappy logging and alerting helps no-one and erodes trust

• Share with Others
  • Show them how you figured out problems
  • Discuss KPIs and health
  • Hold Reviews!

• Keep trying!
Big Shout Out to…

• Matthew Skelton
  • https://twitter.com/matthewpskelton

• Charity Majors
  • https://twitter.com/mipsytipsy

• Cindy Sridharan
  • https://twitter.com/copyconstruct

• O11ycast
  • https://www.heavybit.com/library/podcasts/o11ycast/

• My team at Rightmove
  • Especially Alex Palmer who helped with the Lego photography
The End

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