Cloud Computing

Course plan

Learning session 4 (July 29-31)

Pricing

Monitoring and Observability

Pricing

Sometimes you pay not for what you use, but for what you forgot to turn off

There is no Garbage Collection

Pricing

- Snowflake pricing
- Pay-as-you-go vs pre-paid vs spot instances
- Storage pricing
- Traffic pricing
- Cost analysis
- Calculator

Pricing

Pricing story could be completely different for different resources in the same cloud

Pricing

Pay-as-you-go (on-demand) – pay according to consumption

Pricing

Consumption could be calculated:

- Memory/cpu/disk
- Seconds/minutes/hours
- Custom units

Pricing

Pre-paid (reserved) – pay in advance

Sometimes can reduce price by >50%

Pricing

Spot instance – propose your price for resource

Pricing

Spot instances

- Cloud unused capacity
- Best suitable for batch or non-critical workloads
- You cannot know when resources will be available and when cloud takes them away
- Sometimes can reduce prices by 80%

Pricing

In cloud network traffic could be expensive

- Try not to cross a single data-center boundary
- Network traffic between data-centers is (often) billed
- Internet traffic is (often) billed

Pricing

Storage pricing

Cross-zone availability or backups could be included into cloud-managed service

You will pay for it if you implement the same functionality using basic Compute/Storage/Network primitives

Pricing

Regularly use cost analysis tools and set alerts on crossing your budget

Pricing

To estimate spending use Calculator:

- Azure
- AWS
- GCP

Pricing

Demo

Pricing

Tips

- Shut-down unused resources (automation is your friend)
- Consider changing resource size (often it’s easy-peasy, but could be only one direction - up)
- Reserved and spot instances to the rescue
- Autoscaling
- Regularly review your architecture (new services and features may arise)
- Set budget and ALERTS

Pricing

p.s.

Often engineering team salary is >>> cloud bill

Self-managed service price also includes engineering time

Course plan

Learning session 4 (July 29-31)

Pricing

Monitoring and Observability

Monitoring and Observability

- What is Monitoring and Observability
- Logs
- Metrics
- Traces
- Audit
- Alerts
- Available solutions

Monitoring and Observability

Any system eventually starts misbehaving

Monitoring and Observability

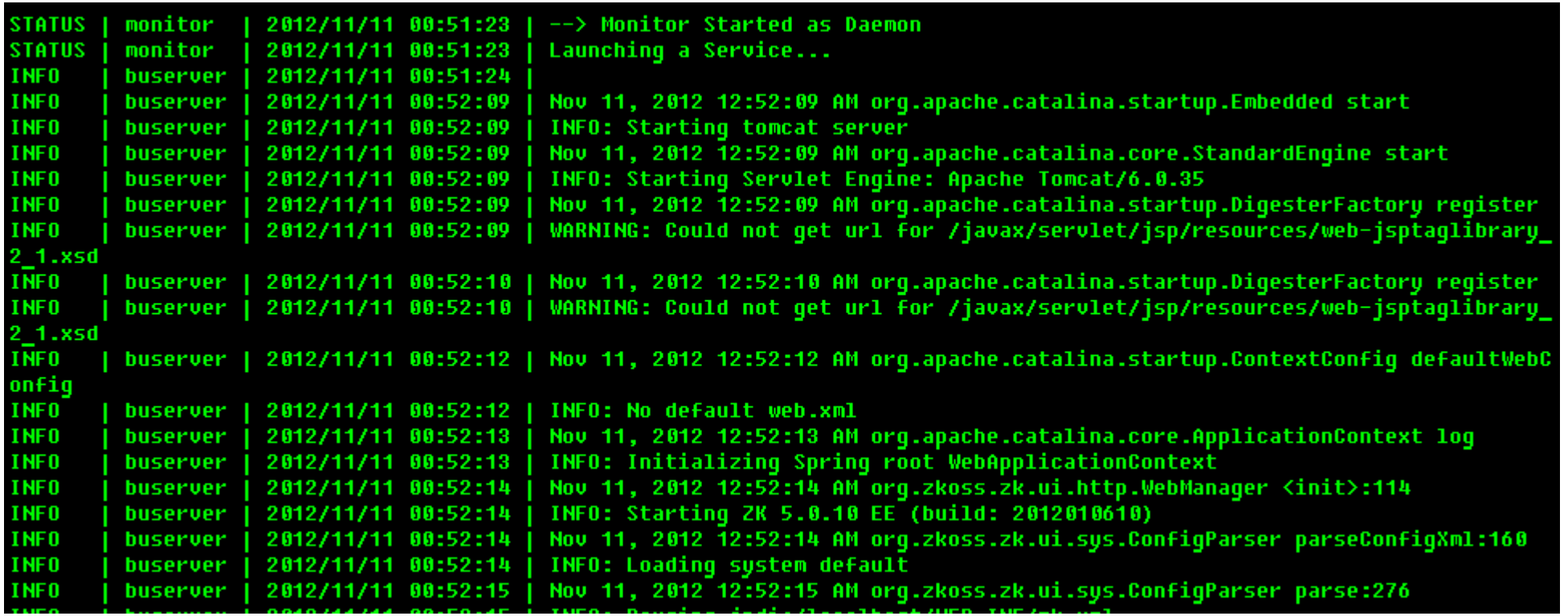
When system misbehaves on *my-machine* – I can debug it

Monitoring and Observability

When system misbehaves in-production – I can …

Monitoring and Observability

Logging – process for collecting, storing, retrieving, processing and visualizing log records/events.



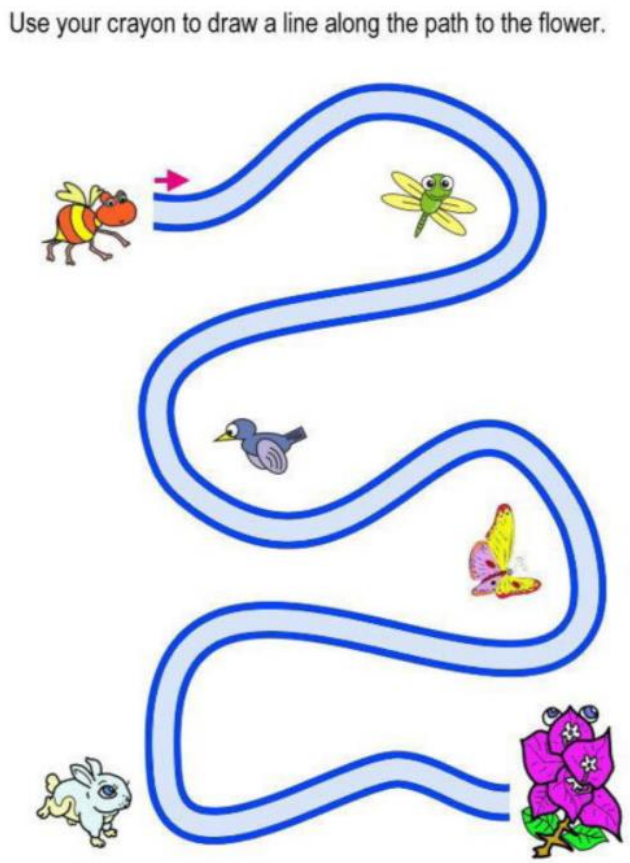
Monitoring and Observability

Monitoring – process for collecting, storing, retrieving, processing and visualizing state data

https://grafana.com/

Monitoring and Observability

Tracing – represents the entire path of a request: which services (or methods) it crosses, how long each step takes



Monitoring and Observability

Observability – a measure of how well internal states of a system can be inferred from knowledge of its external outputs

“Observability is about being able to ask arbitrary questions about your environment **without having to know ahead of time what you wanted to ask**” © Honeycomb

If you want to look fancy, you can write o11y instead of Observability

Monitoring and Observability: Logging

Logs – events written to a file or storage (almost always time-stamped)

Monitoring and Observability: Logging

Plain-text (unstructured) log: just a string

"2010-01-01 12:34:56.0000 Info: Hello, world"

Monitoring and Observability: Logging

Plain-text log pros

+ easy to read by humans

+ easy to implement

+ cheap to store

Monitoring and Observability: Logging

Plain-text log cons

- limited filtering capabilities
- limited analysis options

Monitoring and Observability: Logging

Structured logs: all log-events follow defined structure.


```
{
"time": "2010-01-01 12:34:56.0000",
"level": "Info",
"message": "hello, world",
"user": "test-user",
"env":"prod",
"hostname":"vm-0001"
}
```

Monitoring and Observability: Logging

The most popular format for structured logs is json

Big companies often prefer binary encoding: protobuf or avro

Monitoring and Observability: Logging

Structured logs cons

- hardly readable by humans
- harder to implement
- could be expensive to store
- requires infrastructure to process, aggregate, ingest, index

Monitoring and Observability: Logging

Structured log pros:

+ unlimited filtering capabilities (without master’s degree in regex)

+ unlimited analysis options

+ (could) enforce format

+ (could be) small messages

Monitoring and Observability: Logging

Demo

Monitoring and Observability: Metrics

Metrics – numerical representation of data

Monitoring and Observability: Metrics

Popular metric types:

- Counter/Gauge – a number, which goes up or down
- Histogram – samples observations into buckets

Monitoring and Observability: Metrics

Often metrics are stored in *Time-Series Database (TSDB)*: software optimized to store ordered by time data-points

But could be also stored as structured records in any other storage type

Monitoring and Observability: Metrics

Often time-series record is identified by name + unique set of **dimensions** *<name>{<label_name>=<label value>, ...}*:

- `api_http_requests_total{method="POST", handler="/messages"}`
- `api_http_requests_total{method="GET", handler="/messages"}`

Monitoring and Observability: Metrics

Each unique label generates a new time-series, thus:

- Save one more measurement into **existing time-series** – *cheap*
- Save one more measurement into **new time-series** – *expensive*

Monitoring and Observability: Metrics

- Querying *the same* time-series– *cheap*
- Querying *multiple* time-series – *expensive*

Monitoring and Observability: Metrics

High-cardinality label – label that could have a lot of unique values

When you use TSDB, better not to use high-cardinality labels

Monitoring and Observability: Metrics

Good label:

- HTTP Verb and Status Code
- VM id

Bad label:

- UserId
- RequestId

Monitoring and Observability: Metrics

Service-Level Objective (**SLO**) – target availability: how long system can be unavailable.

Service-Level Agreement (**SLA**) – SLO promised to others (users)

Service-Level Indicator (**SLI**) – units of SLO

sli, sla, slo by Google

Monitoring and Observability: Metrics

Compute AWS Service Level Objective

> *AWS will use commercially reasonable efforts to make the Included Services each available for each AWS region with a Monthly Uptime Percentage of at least 99.99%*

Monitoring and Observability: Metrics

Compute AWS Service Level Agreement

Monthly Uptime Percentage	Service Credit Percentage
Less than 99.99% but equal to or greater than 99.0%	10%
Less than 99.0% but equal to or greater than 95.0%	30%
Less than 95.0%	100%

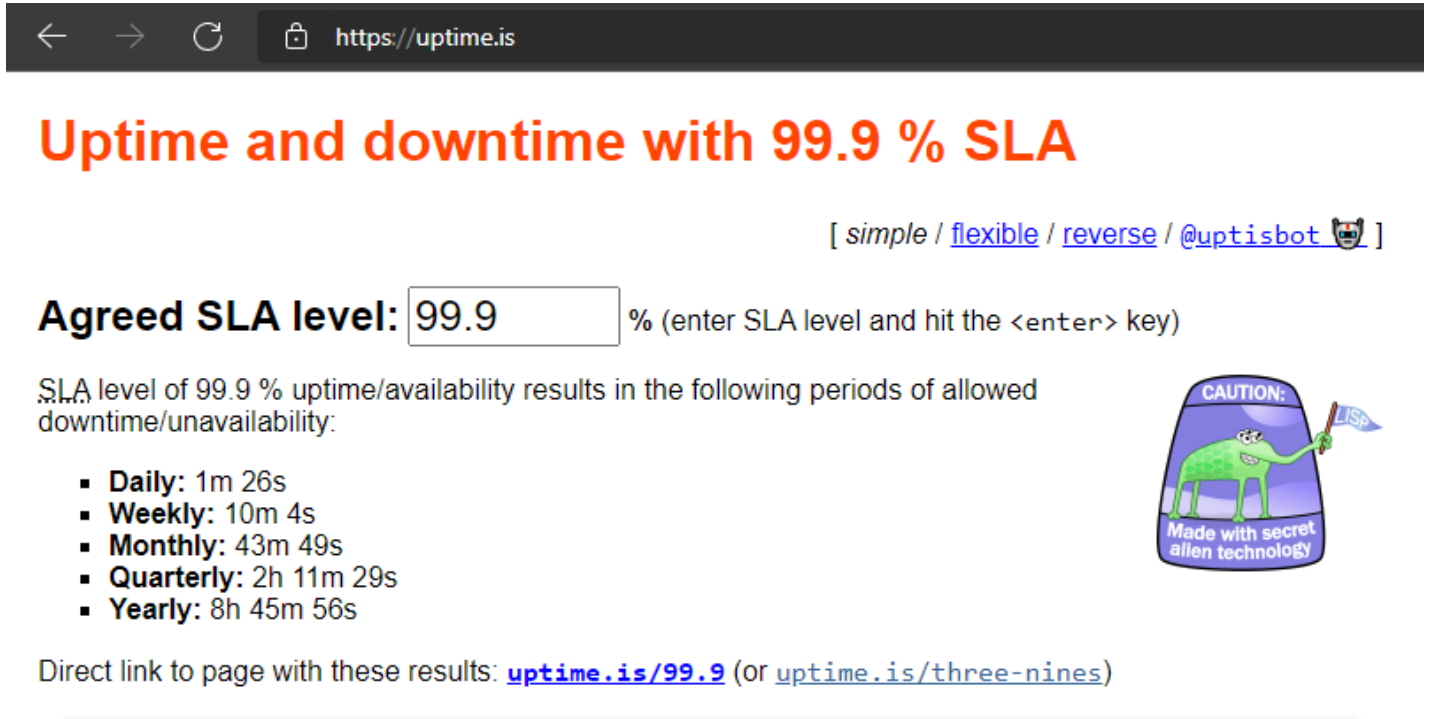
Monitoring and Observability: Metrics

Compute AWS Service Level Indicator

> *"Monthly Uptime Percentage" is calculated by subtracting from 100% the **percentage of minutes** during the month in which … [service] was **in the state of Unavailability***
>
> *"Unavailable" and "Unavailability" mean … for Single EC2 Instances, when your Single EC2 Instance **has no external connectivity**.*

Monitoring and Observability: Metrics

[Uptime calculator]



Monitoring and Observability: Metrics

p.s.

Internal and External SLO often are different

Monitoring and Observability: Metrics

Demo

Monitoring and Observability: Traces

In distributed system finding logs and metrics associated with the same action/request could be tricky.

Monitoring and Observability: Traces

Tracing is an attempt to address this problem

Trace represents the entire journey of a request/action as it moves through all the nodes/modules of a distributed system.

Monitoring and Observability: Traces

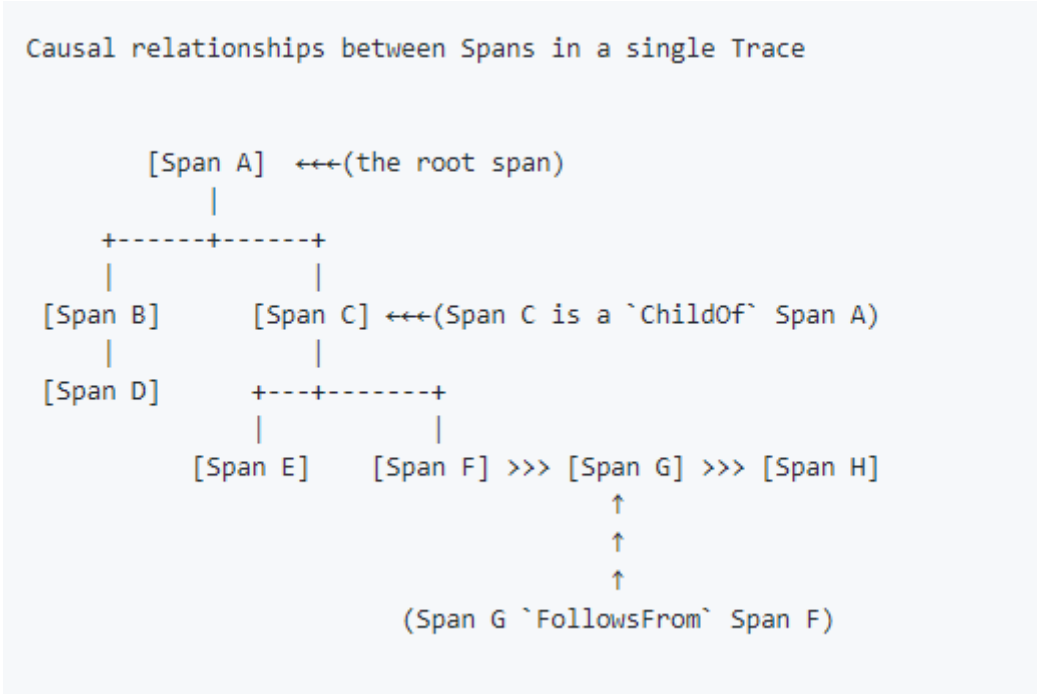
OpenTracing – vendor-neutral specification

Monitoring and Observability: Traces

OpenTracing introduces data model:

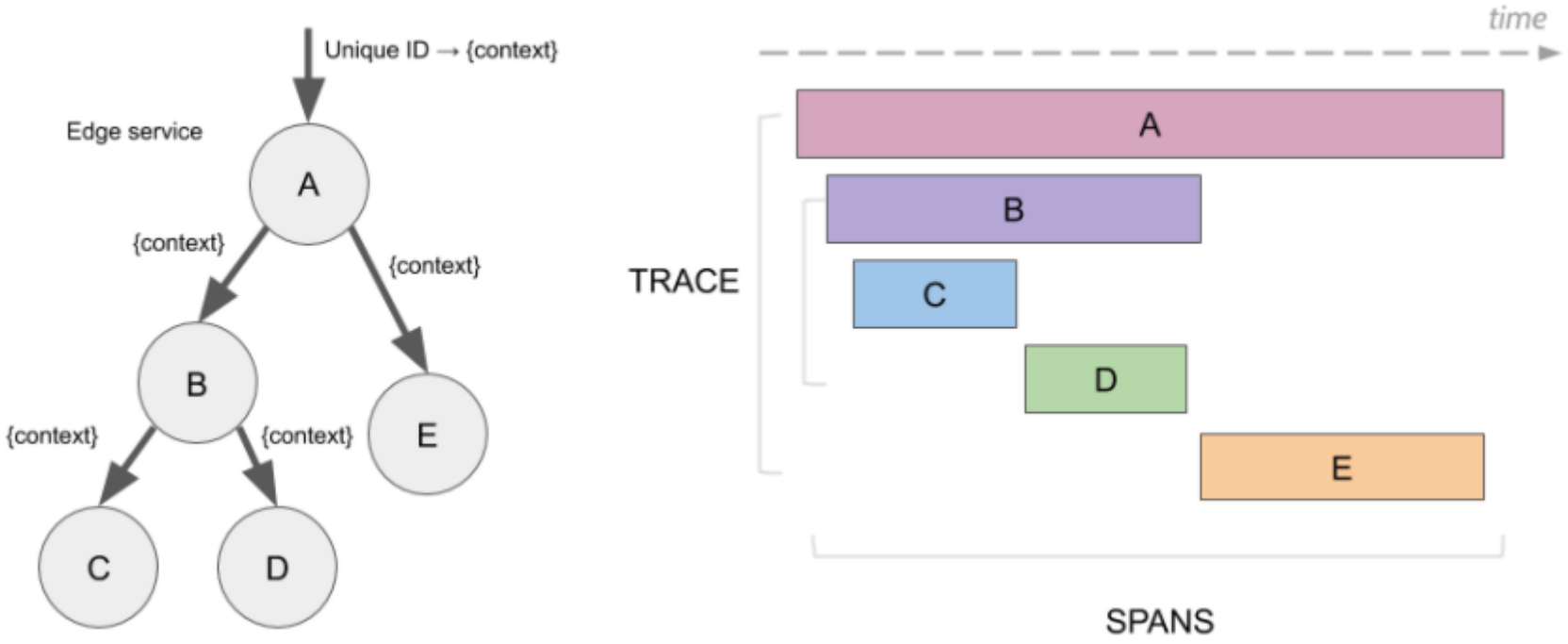
- *Trace* is directed acyclic graph (DAG)
- Each edge of this graph is named *Span*
- *Spans* could have two relation types: *ChildOf* and *FollowsFrom*
- *Spans* can have associated *Logs*, *Tags*, *Context*

Monitoring and Observability: Traces



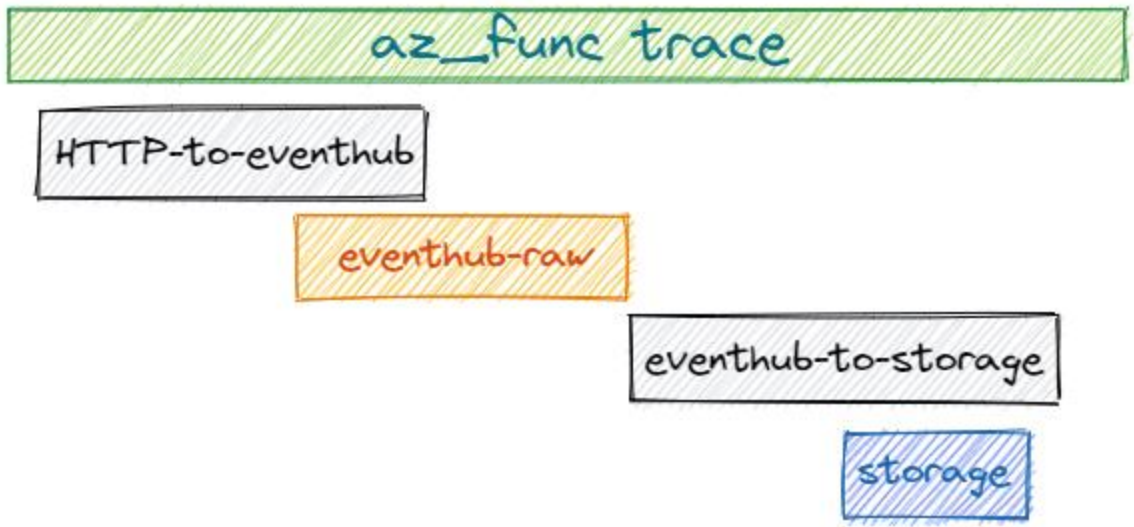
https://github.com/opentracing/specification/blob/master/specification.md#the-opentracing-data-model

Monitoring and Observability: Traces



https://www.jaegertracing.io/docs/1.22/architecture/

Monitoring and Observability: Traces



Monitoring and Observability: Traces

To build a trace:

- Propagate *trace-id* with each request
- Write events with attached *trace-id*
- Aggregate events from all the services into a single storage
- Group all events from the storage that have the same *trace-id*

Monitoring and Observability: Traces

Demo

Monitoring and Observability: Alerts

Alert – action based on a criteria

Monitoring and Observability: Alerts

Alert could be based on

- Logs
- Metrics
- Billing

Monitoring and Observability: Alerts

Alert, often, is a notification: a message sent to a communication channel

Monitoring and Observability: Alerts

But instead of sending a message you can make a request or invoke an API

Monitoring and Observability: Alerts

With alerts you can:

- post a warning to messenger (for example, Slack or email)
- make a phone call or send SMS
- invoke a Lambda function

Monitoring and Observability: Alerts

Demo

- Billing alert
- Metric alert
- Logs alert

Monitoring and Observability

All-in-one solutions:

- Azure Monitor; Amazon CloudWatch; Google Stackdriver
- Datadog, Splunk, Elastic, New Relic, Dynatrace, Honeycomb

Metrics-only: Prometheus, Graphite, Victoria-Metrics

Traces-only: Jaeger, Zipkin

Logs-only: Elasticsearch (ELK), Grafana Loki

…and many-many-many others

Monitoring and Observability: Audit

Audit log – records/events answering the question: *“**who** did **what** and **when**?”*

Monitoring and Observability: Audit

Some audit logs are enabled by default

Some – you must enable explicitly and route to a long-term storage

Monitoring and Observability: Audit

Audit log is crucial in terms of Security

Monitoring and Observability: Audit

Demo

Additional resources

- (articles + java samples) Terse logback: github and webpage
- (article) SRE fundamentals: SLIs, SLAs and SLOs
- (article) Distributed Tracing