PRODUCTION READY MICROSERVICES AT SCALE

RAJEEV N B
GO-JEK

RAJEEV N BHARSHETTY

- Product Engineer at GO-JEK
- Distributed Systems | Security | Data
- Building reliable and scalable systems
- **@rbharshetty -** Twitter
- **@rshetty -** Github

TRANSPORT, LOGISTICS, HYPERLOCAL DELIVERY AND PAYMENTS

- 18+ products
- 1Million+ Drivers
- 500+ Microservices
- 15k+ Cores
- 2 Cloud Providers
- 6 Data centres
- 100Million+ bookings a month

GO-JEK expands to 4 new markets - Thailand, Vietnam, Singapore & Phillippines

AGENDA

- What are **Production Ready** Microservices ?
- Why do we need them ?
- How do we build them ?
- Future work
- Conclusion

LONG TIME AGO ..

STAN MARSH (MONOLITH)

MICROSERVICES

SMALL, AUTONOMOUS SERVICES THAT WORK TOGETHER

Sam Newman
(Building Microservices)

PRODUCTION READY

WHAT DOES PRODUCTION READY MEAN ?

- Stable
- Reliable
- Scalable
- Performant
- Fault tolerant
- Monitored
- Prepared for Catastrophe
- Secure

BUILDING TRUST

WHY ?

Goal is to be **Available** to serve our users

HOW ?

PRODUCTION READINESS

CHECKLIST

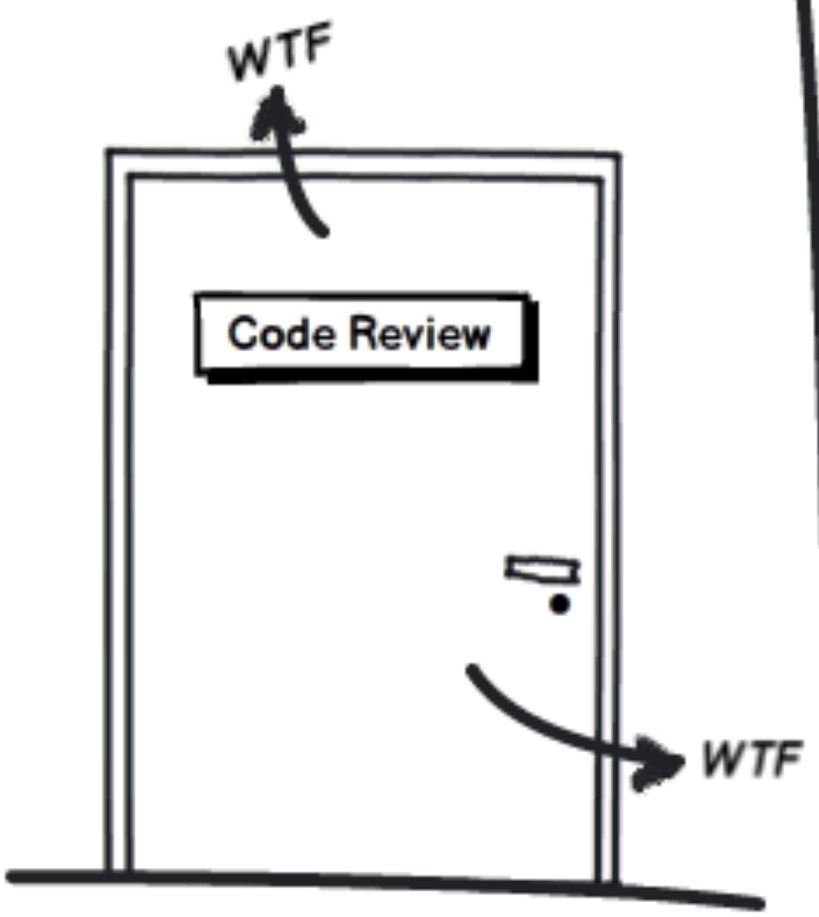
WHY CHECKLIST ?

- **Organisation** Sprawl
- **Technical** Sprawl
- Increased **Development Velocity**
- Building **Trust** and **confidence**

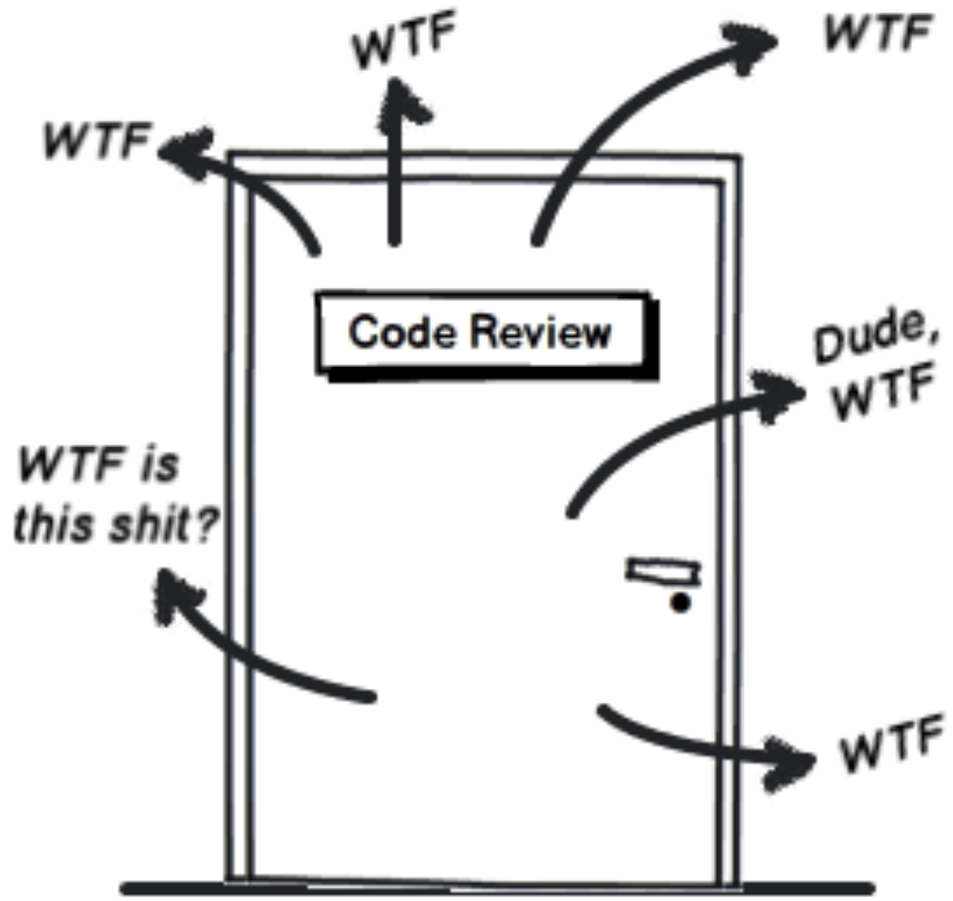
LETS BEGIN . . .

#1:
CODE QUALITY

Code Quality Measurement: WTFs/Minute



Good Code



Bad Code

http://commadot.com

LINTING/FORMATTING

- Statically analyse code for lint and format errors
- Helps write **Idiomatic Go** code
- Helps Improve readability of the code
- Makes code **easier to change**
- Tools used: ***"go fmt", "golint", "go vet"***

CODE SMELLS

- Statically analyse code for *Cyclomatic Complexity, DeadCode, Duplicated Code, ErrCheck etc*
- Keeps **code quality** in check (**Maintainability**)
- Helps maintain **Sanity** of the codebase (also of the people reading it)
- Tools: "***gometalinter***"
- **Meta Linter** (https://github.com/alecthomas/gometalinter)

```
hystrix/hystrix_client_test.go:513:12:warning: ineffectual assignment to err (ineffassign)
hystrix/hystrix_client.go:168::warning: declaration of "err" shadows declaration at hystrix/hystrix_client.go:
163 (vetshadow)
hystrix/hystrix_client.go:178:23:warning: error return value not checked (response.Body.Close()) (errcheck)
hystrix/hystrix_client.go:178::warning: Errors unhandled.,LOW,HIGH (gosec)
hystrix/hystrix_client.go:186::warning: Errors unhandled.,LOW,HIGH (gosec)
hystrix/hystrix_client_test.go:513:12:warning: this value of err is never used (SA4006) (megacheck)
➜  heimdall git:(master) ✗ /
```

SECURE CODING

- Inspect source code for **Security** problems
- Find vulnerabilities like **SQL Injection**, **Hardcoded credentials** etc
- Help write secure code
- Tools: “**gosec**” (https://github.com/securego/gosec)
- Detects problems with various confidence levels

Available rules

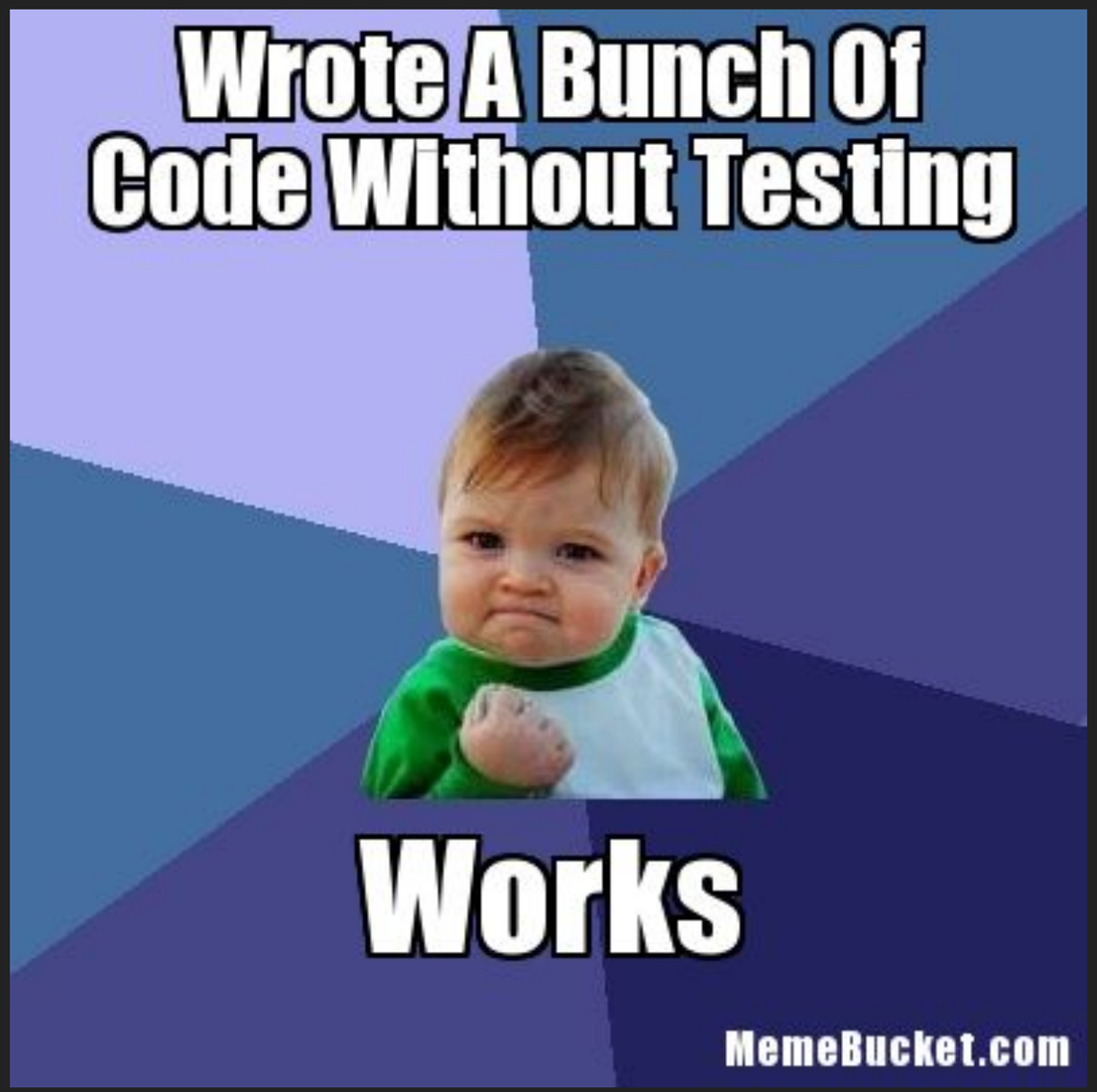
- G101: Look for hard coded credentials
- G102: Bind to all interfaces
- G103: Audit the use of unsafe block
- G104: Audit errors not checked
- G105: Audit the use of math/big.Int.Exp
- G106: Audit the use of ssh.InsecureIgnoreHostKey
- G107: Url provided to HTTP request as taint input
- G201: SQL query construction using format string
- G202: SQL query construction using string concatenation
- G203: Use of unescaped data in HTML templates
- G204: Audit use of command execution
- G301: Poor file permissions used when creating a directory
- G302: Poor file permissions used with chmod
- G303: Creating tempfile using a predictable path
- G304: File path provided as taint input
- G305: File traversal when extracting zip archive
- G401: Detect the usage of DES, RC4, MD5 or SHA1
- G402: Look for bad TLS connection settings
- G403: Ensure minimum RSA key length of 2048 bits
- G404: Insecure random number source (rand)
- G501: Import blacklist: crypto/md5
- G502: Import blacklist: crypto/des
- G503: Import blacklist: crypto/rc4
- G504: Import blacklist: net/http/cgi
- G505: Import blacklist: crypto/sha1

```
[/Users/admin/work/go/src/github.com/gojektech/heimdall/httpclient/client.go:137] - G104: Errors unhandled. (Confidence: HIGH, Severity: LOW)
  > response.Body.Close()


[/Users/admin/work/go/src/github.com/gojektech/heimdall/httpclient/client.go:145] - G104: Errors unhandled. (Confidence: HIGH, Severity: LOW)
  > _, _ = bodyReader.Seek(0, 0)


[/Users/admin/work/go/src/github.com/gojektech/heimdall/hystrix/hystrix_client.go:178] - G104: Errors unhandled. (Confidence: HIGH, Severity: LOW)
  > response.Body.Close()


[/Users/admin/work/go/src/github.com/gojektech/heimdall/hystrix/hystrix_client.go:186] - G104: Errors unhandled. (Confidence: HIGH, Severity: LOW)
  > _, _ = bodyReader.Seek(0, 0)


Summary:
   Files: 8
   Lines: 787
   Nosec: 0
  Issues: 4
```

CLOSING COMMENTS ...

- Make it part of your development process (Makefile)
- Sample Project (https://github.com/gojektech/heimdall)
- Make it part of your **build pipeline** (**CI/CD**)
- Changes to the codebase becomes easier
- Helps maintain **Stability** and **Reliability** of a microservice

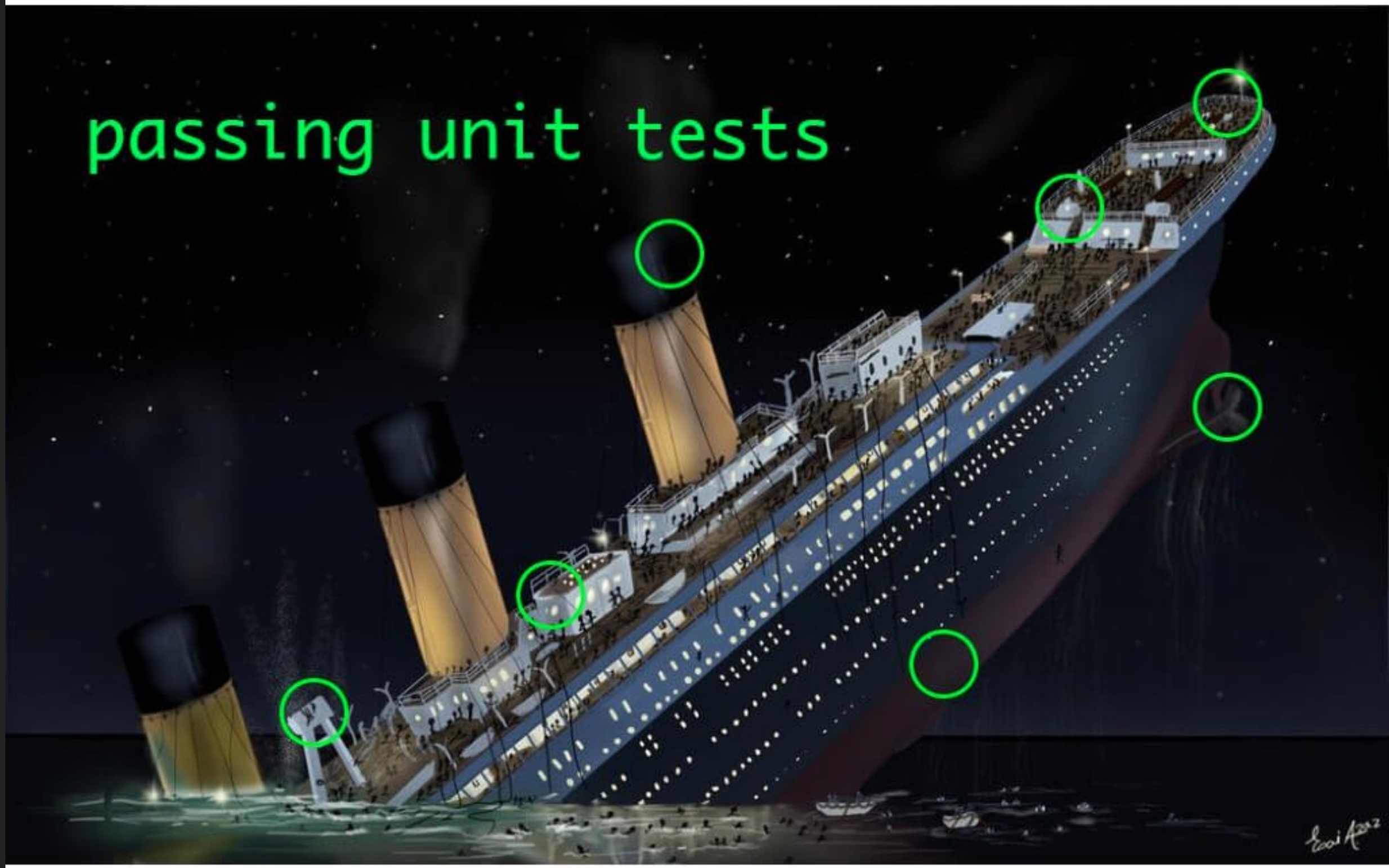
#2:
TESTING


Wrote A Bunch Of
Code Without Testing
Works
MemeBucket.com

UNIT TESTING

- Unit tests test a unit/function (Individual component)
- These are run very often during development
- Are very large in number (# of unit tests)
- Other practices include **TDD (Test Driven Development)**
- Tools: “in-built **Go testing framework**”
- Assertion library (https://github.com/stretchr/testify)

UNIT TESTS SUFFICIENT ?


passing unit tests

Guillaume Malette @gmalette 1h

Replying to @iamdevloper

Running integration tests:

- Ship still afloat after four watertight compartments flooded: PASS

- Band still plays after collision with iceberg: PASS

1 1

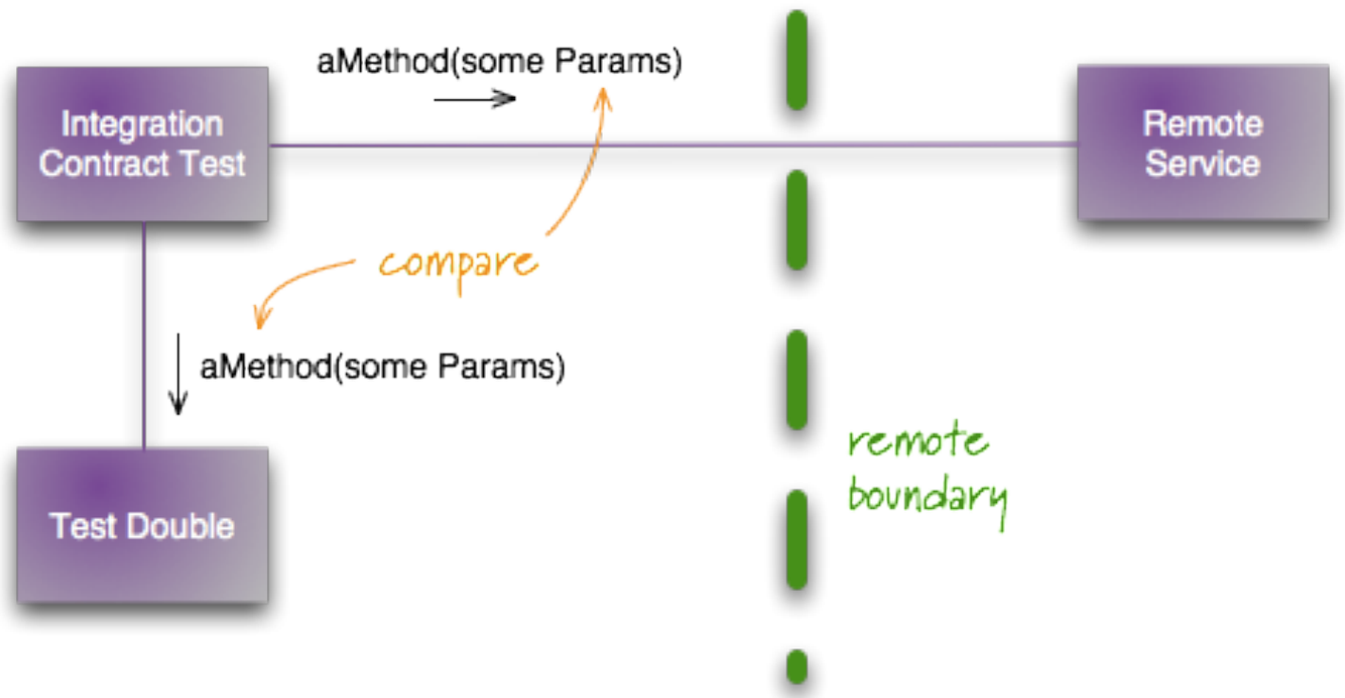
INTEGRATION TESTING

- Integration tests help in testing multiple components working together
- Cover **End to end** flows
- Lesser in number than unit tests
- Helps in finding regressions in the codebase effectively
- Tools: "***godog***" (BDD)
- Link: (https://github.com/DATA-DOG/godog)

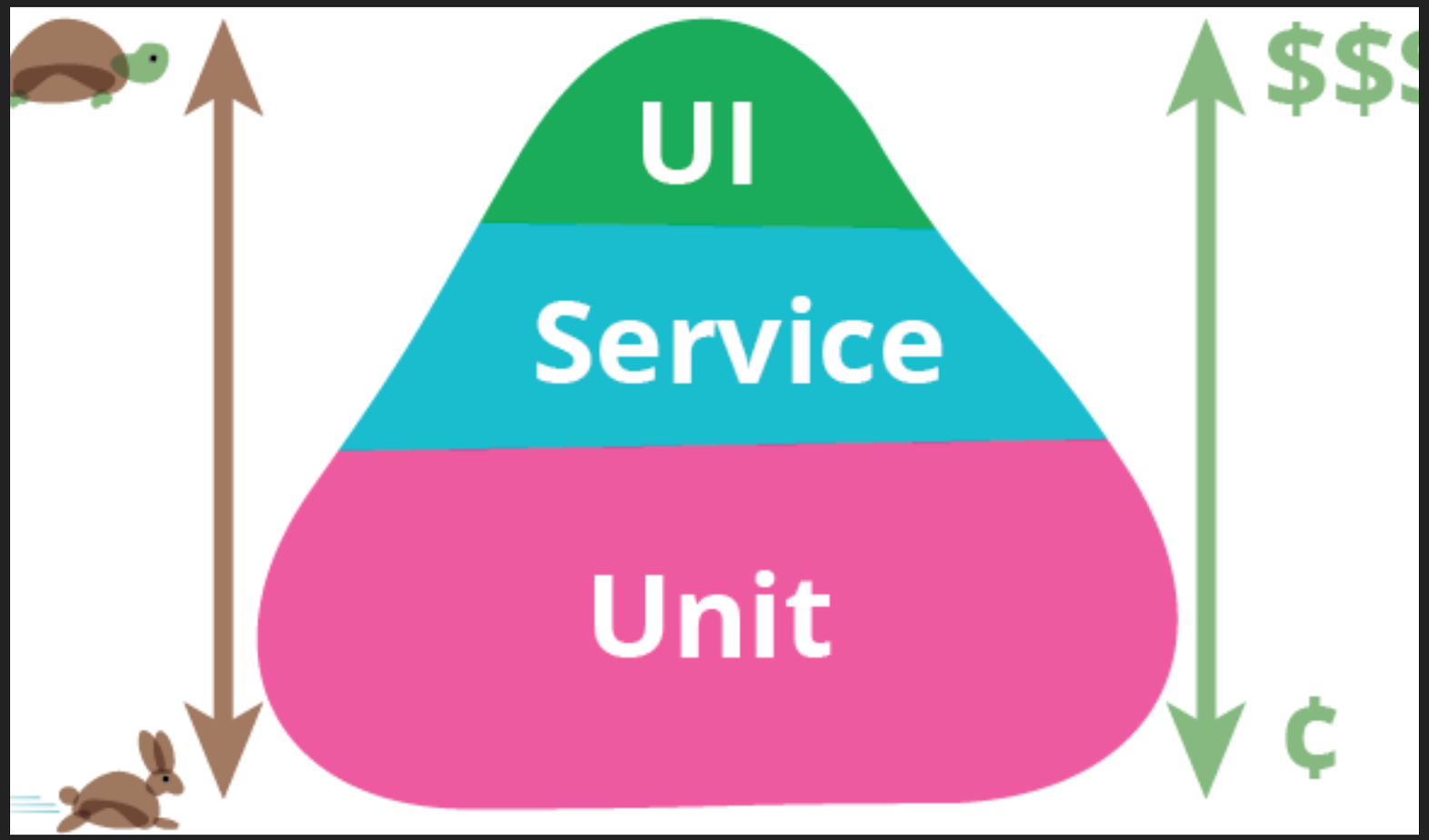
```
Feature: customer legacy login
    In order to access application resources
    As a Customer
    I need to login with my credentials

    Scenario: Successful login
        Given correct credentials for login
        When customer logs in
        Then the login response code should be 201
        And the login response should have valid details
```

CONTRACT TESTING

- Test API contract between a Client(Consumer) and an API(Provider)
- Helps protect against any change in contracts of the provider
- Low frequency runs (Once a day)
- **Consumer Driven Contract Tests**
- Tools: “**pact-go**”


aMethod(some Params)
Integration Contract Test
Remote Service
compare
aMethod(some Params)
Test Double
remote boundary

TEST PYRAMID



LOAD AND PERFORMANCE TESTING

- Test behaviour of app under various loads
- Helps find performance bottlenecks
- Also Memory Leaks
- Helps with **Capacity Planning** and finding **SLA**
- Sizing: **Step Load, Linear Load, Spiky load, Soak test**
- Tools: ***"Gatling"***
- In go: ***"Vegeta"*** *(*https://github.com/tsenart/vegeta*)*

```
50 rps, 1 min, latency on both services
Requests      [total, rate]            3000, 50.01
Duration      [total, attack, wait]    1m0.217022968s, 59.983753s, 233.269968ms
Latencies     [mean, 50, 95, 99, max]  190.12369ms, 186.887664ms, 257.013489ms, 269.958324ms, 348.796101
Bytes In      [total, mean]            527506, 175.84
Bytes Out     [total, mean]            348000, 116.00
Success       [ratio]                  99.57%
Status Codes  [code:count]             201:2987  500:13
```

CHAOS TESTING

- Break systems to understand service behaviour
- It is ***controlled failure injection***
- Helps in determining **Unknown Unknowns**
- It is a kind of **resiliency testing**
- Manual at GO-JEK
- Automated - **Netflix Simian Army**
- **Chaos Monkey, Janitor Monkey, Conformity Monkey**

CLOSING COMMENTS ...

- Integral part of **Development** process
- Integral part of your **CI/CD pipeline**
- Helps build **confidence** in microservice and the codebase
- Helps move faster (Increases Developer velocity)
- Helps with **Scalability, Performance, Stability and Reliability**

#3:

RESILIENCE PATTERNS

TIMEOUTS

- Stop waiting for an answer after some time
- **DefaultHTTPClient** has infinite timeout (Not suitable for production)
- Helps prevent/recover from failures when dependences fail/slow down
- Required at ***Integration points***
- Philosophy of "***Fail Fast***"

HEIMDALL - TIMEOUTS

```
timeout := 100 * time.Millisecond
client := httpclient.NewClient(httpclient.WithHTTPTimeout(timeout))

 _, err := client.Get("https://gojek.com/drivers", http.Header{})
```

RETRIES

- Retry request on failure
- ***Eventually succeed***
- Could lead to bad experience for users (Latencies)
- Will help to recover from temporary network glitches
- **Idempotency is important** when retrying

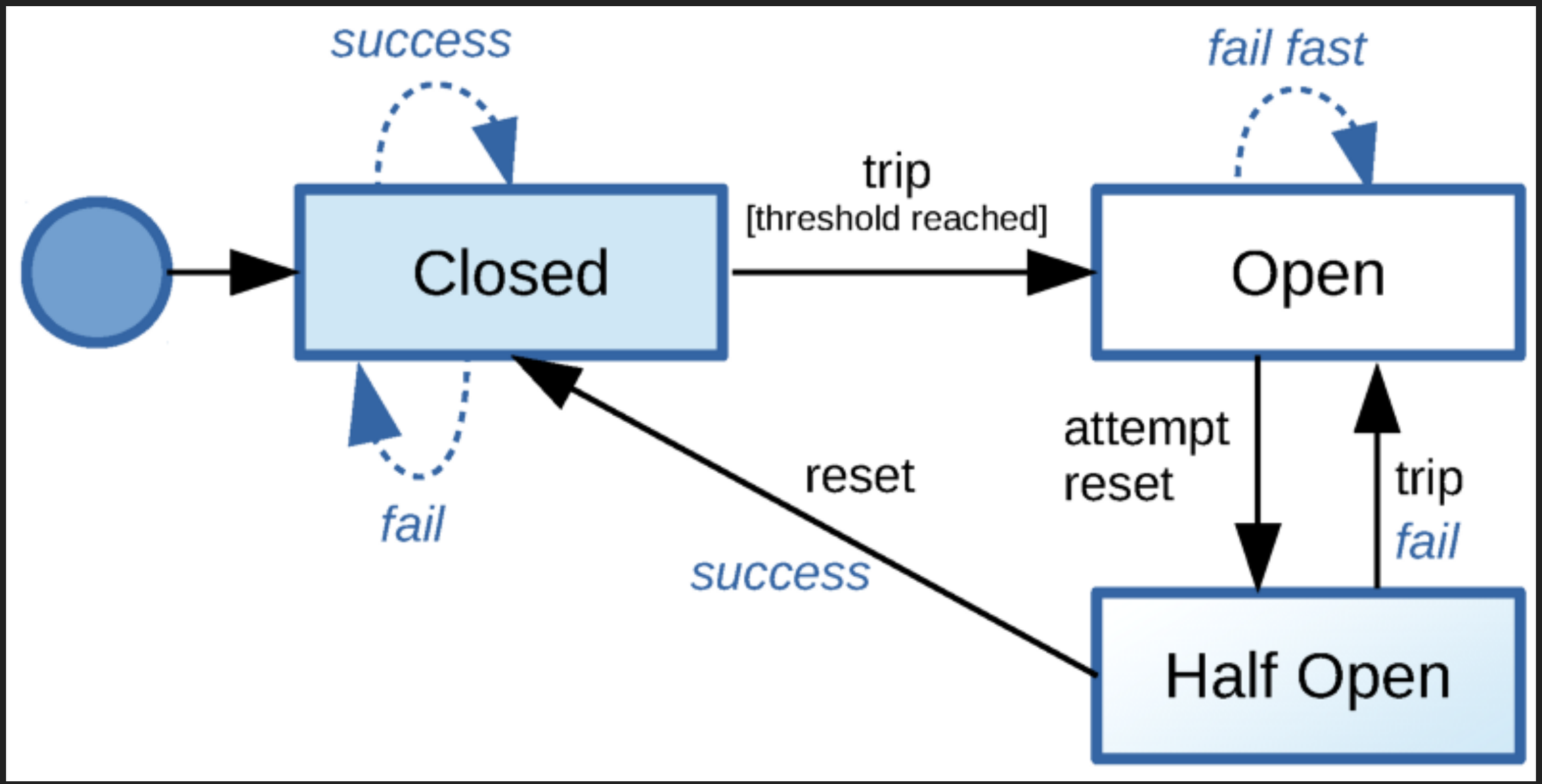
HEIMDALL - RETRIES

```
backoffInterval := 2 * time.Millisecond
maximumJitterInterval := 5 * time.Millisecond

backoff := heimdall.NewConstantBackoff(backoffInterval,
maximumJitterInterval)
retrier := heimdall.NewRetrier(backoff)

timeout := 1000 * time.Millisecond
```

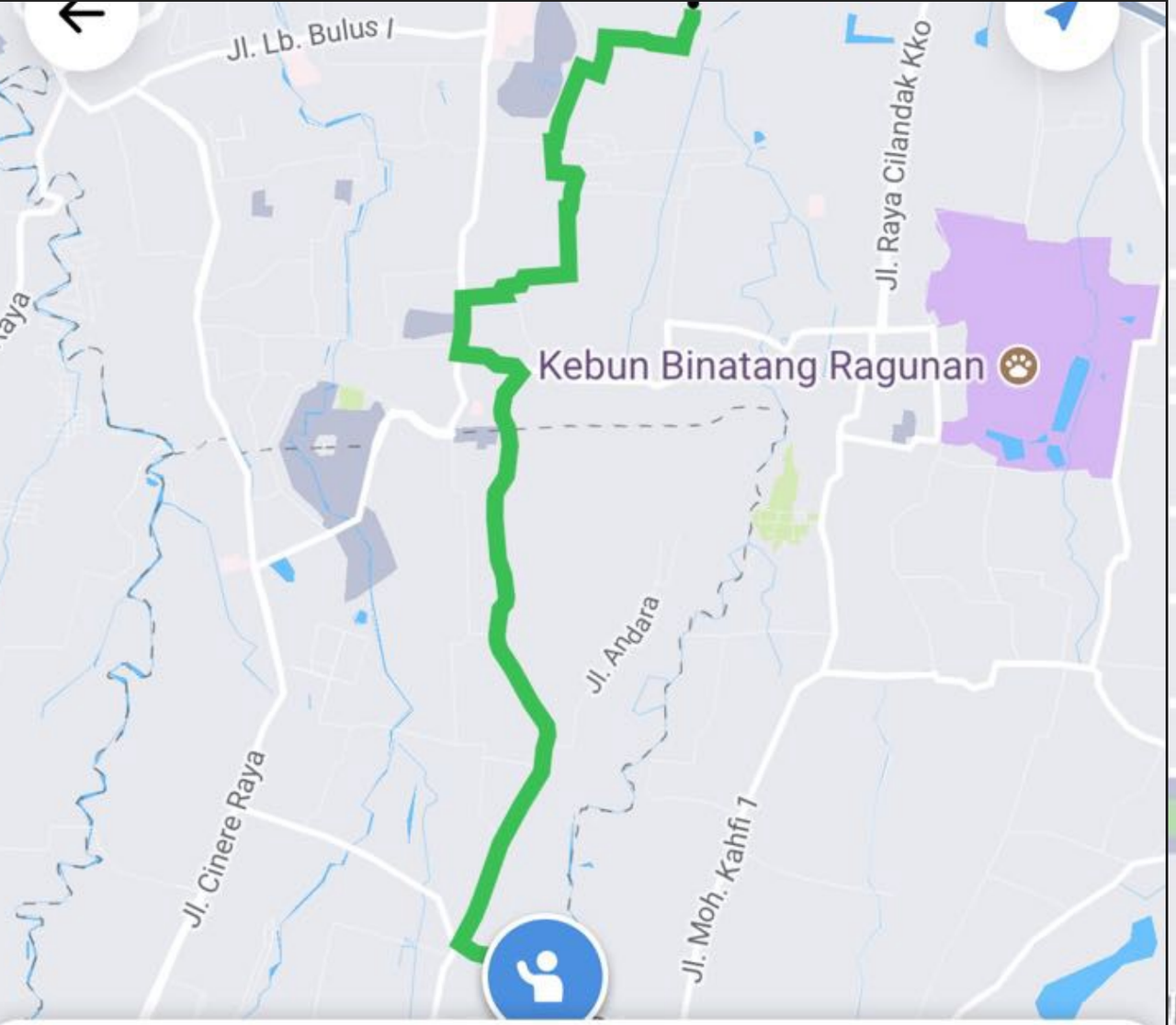
```
client := httpclient.NewClient(
   httpclient.WithHTTPTimeout(timeout),
   httpclient.WithRetrier(retrier),
   httpclient.WithRetryCount(4),
)

client.Get("https://gojek.com/drivers", http.Header{})
```

CIRCUIT BREAKER

- Circumvent calls when calls to dependency on failure
- Once circumvented, fallback to fallback response
- ***Fail fast*** to protect dependent services
- ***Hystrix*** is a well known implementation
- ***Recovers back*** on healthy system behaviour


success
fail fast
trip
[threshold reached]
Closed
Open
attempt
reset
trip
fail
reset
success
fail
Half Open

```
fallbackFn := func(err error) error {
    _, err := http.Post("post_to_channel_two")
    return err
}

timeout := 10 * time.Millisecond

client := hystrix.NewClient(
  hystrix.WithHTTPTimeout(timeout),
  hystrix.WithCommandName("MyCommand"),
  hystrix.WithMaxConcurrentRequests(100),
  hystrix.WithErrorPercentThreshold(20),
  hystrix.WithSleepWindow(10),
  hystrixWithRequestVolumeThreshold(10),
  hystrix.WithFallbackFunc(fallbackFn),
})
 _, err := httpClient.Get("https://gojek.com/drivers", http.Header{}
```

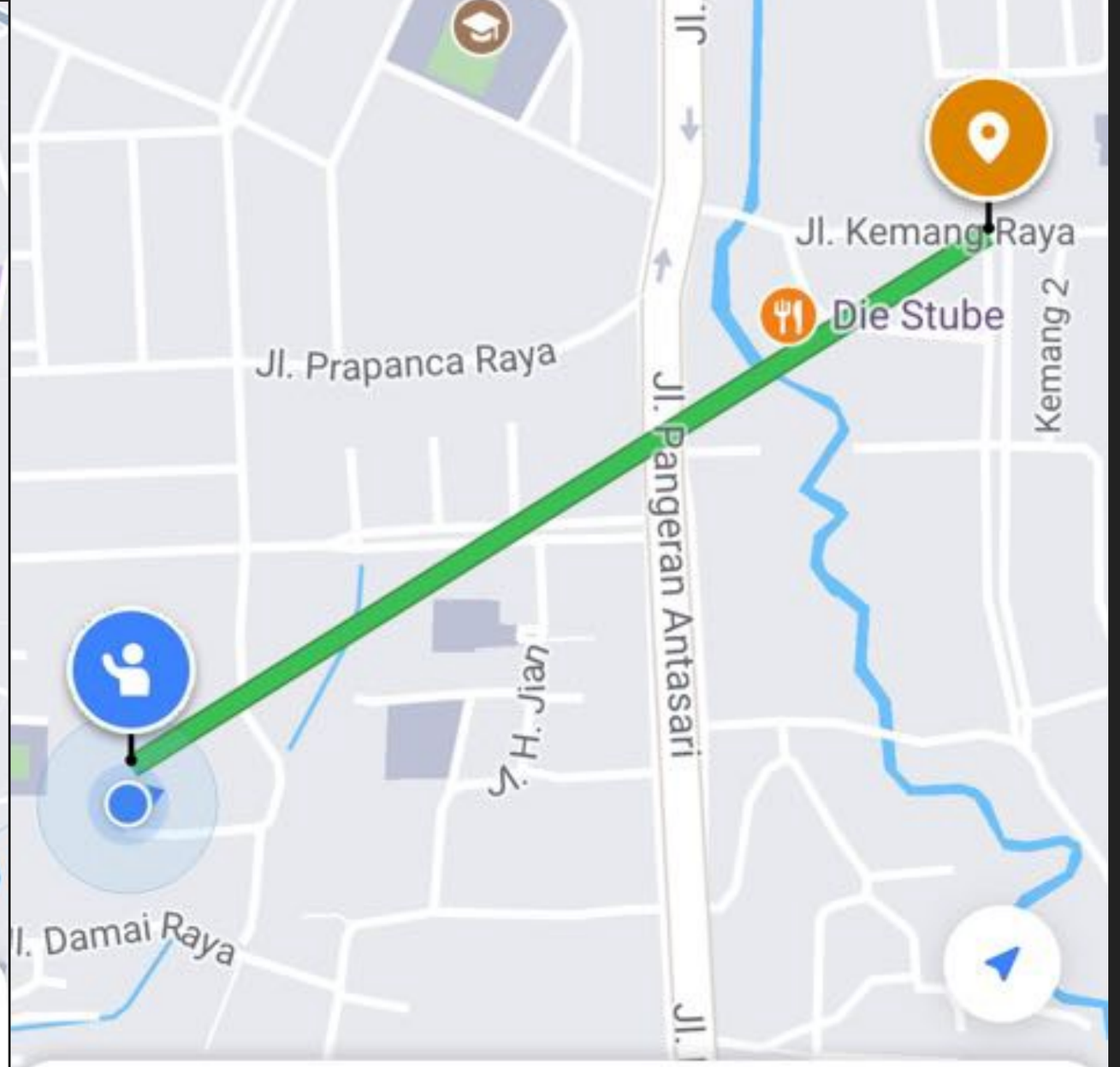


GO-CAR 1-4 PEOPLE

PICKUP LOCATION
Jl. Sawo No.36

DESTINATION • 8.1 km
Jl. Lap. Tembak No.25

GO-PAY Rp39.000



GO-RIDE 1 PERSON

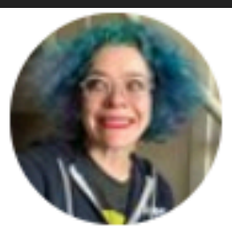
PICKUP LOCATION
Essence Darmawangsa Apartment

DESTINATION • 0.7KM
grandkemang Jakarta

CLOSING COMMENTS ...

- Protects systems and also its dependencies from failure
- **FailFast** to protect systems
- Needed at the integration points of your system
- **Think of Fallbacks** at your integration points (Graceful degradation)
- Helps with **Scalability, Stability and Reliability**

#4:
OBSERVABILITY



Charity Majors
@mipsytipsy

Follow

Replying to @mipsytipsy @mattklein123

Observability, otoh, is about being able to understand the inner workings of your software and systems by asking questions and observing the answers on the outside. Any question — no particular bias toward actionable alerts or problems.

OBSERVABILITY BROADLY INCLUDES:

MONITORING
LOGGING
~~DISTRIBUTED TRACING~~

MONITORING

Monitoring is the act of checking the behaviour and outputs of a system and its components

MONITORING

- It is all about looking out for **presence/absence of patterns**
- Is used to report **overall health** of the system
- Includes **Key Business and System Level Metrics**
- Think **USE (**Utilisation, Saturation and Errors)
- Think **RED** (Response times, errors, duration)

KEY METRICS

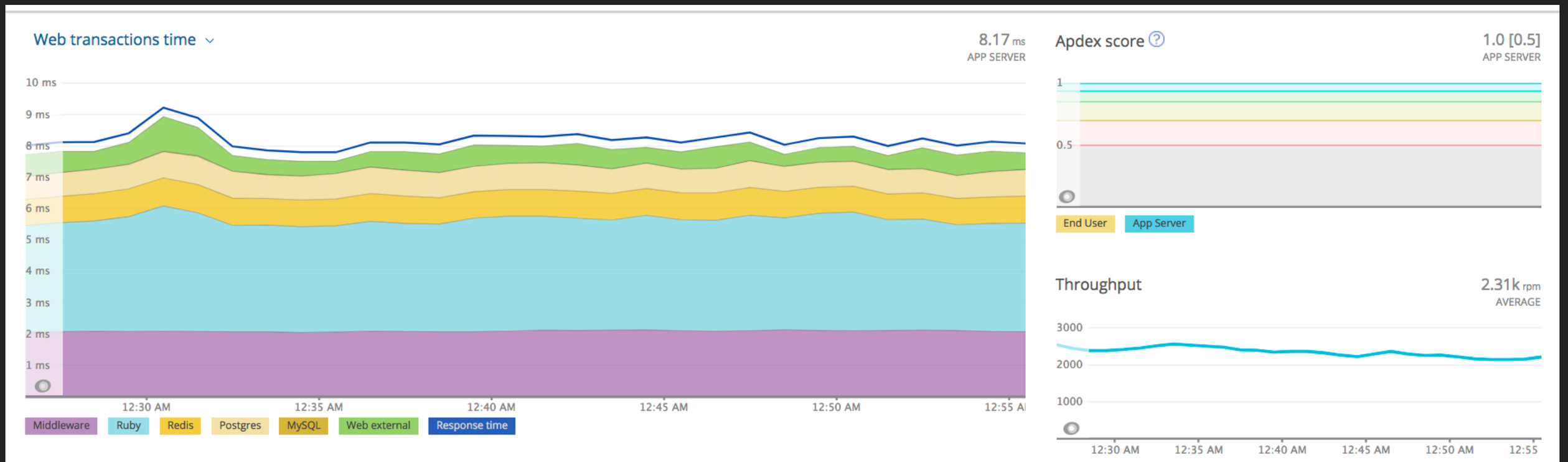
- Host and Infrastructure metrics
  - CPU
  - RAM
  - Threads
  - File Descriptors
  - Database connections

KEY METRICS

- Microservice Key Metrics
  - Availability
  - SLA
  - Latency
  - Success
  - Errors

DASHBOARD

- Reflect the state and **health of your system**
- Should capture key metrics
- **BusinessMetrics, UptimeMetrics, SystemMetrics**
- Grafana/NewRelic at GO-JEK



APM (APPLICATION PERFORMANCE MONITORING)

SYSTEM LEVEL METRICS (GRAFANA) – TICK STACK

Day

99.97%

▼ 0.02%

Week

99.94%

▼ 0.02%

Month

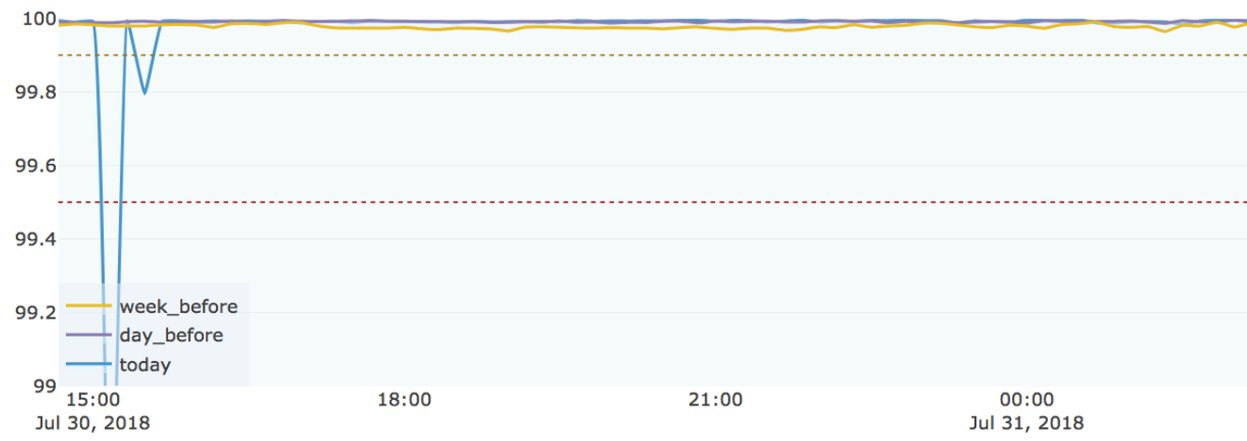
99.95%

▲ 0.07%

Quarter

99.94%

▲ 99.94%



Go-Food

99.94%

▼ 0.01%

Driver Platform

99.95%

▼ 0.03%

Transport

99.99%

—

Allocations

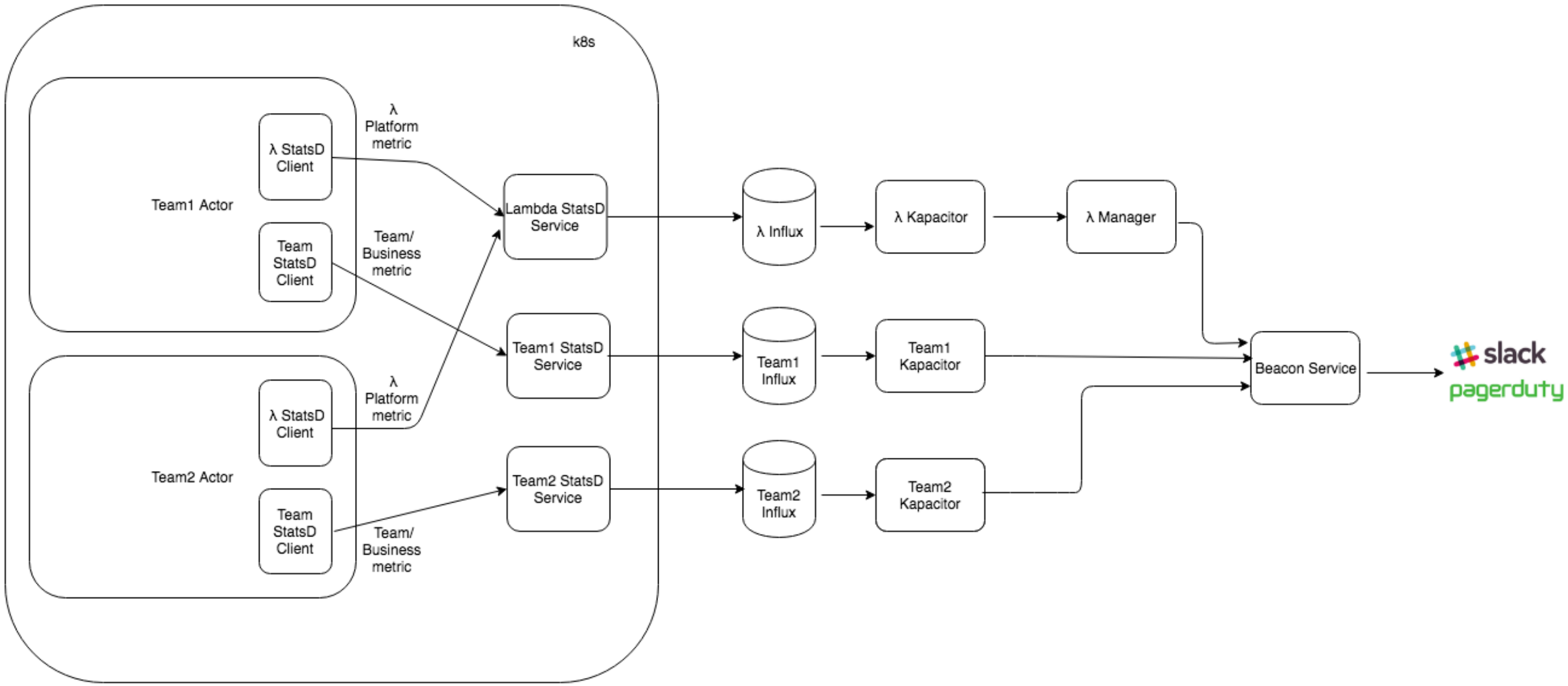
99.99%

—

UPTIME MONITORING - INHOUSE

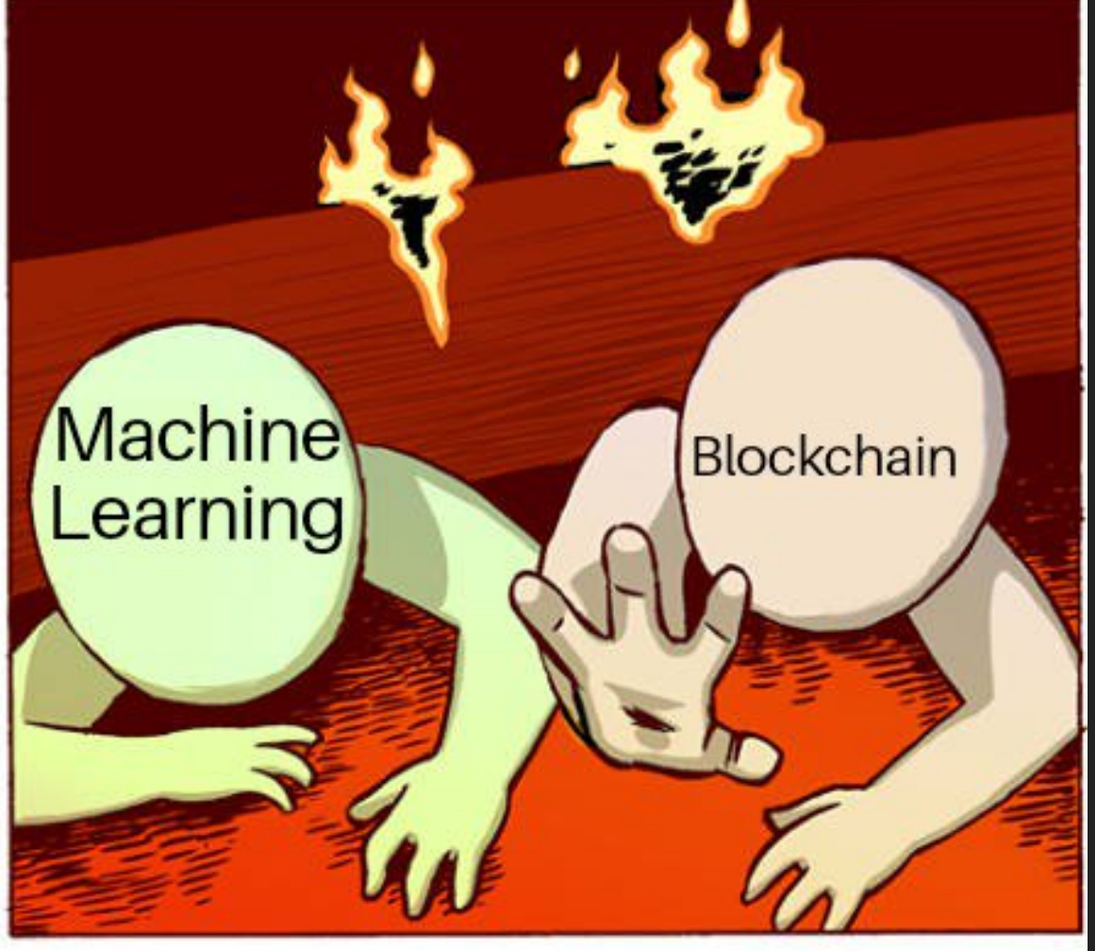
ALERTING

- Notifying team when an anomaly in key metrics is detected
- **Thresholds for various key metrics** is set for alerting
- Alerts should be **actionable**
- Help in alerting teams and recovering before a catastrophe
- **TICK** stack (Telegraf, Influx, Chronograph, Kapacitor)



StatsD Instrumentation of λ actors in k8s

LOGGING


Machine Learning
Blockchain


Event Logs
Roxy

LOGGING

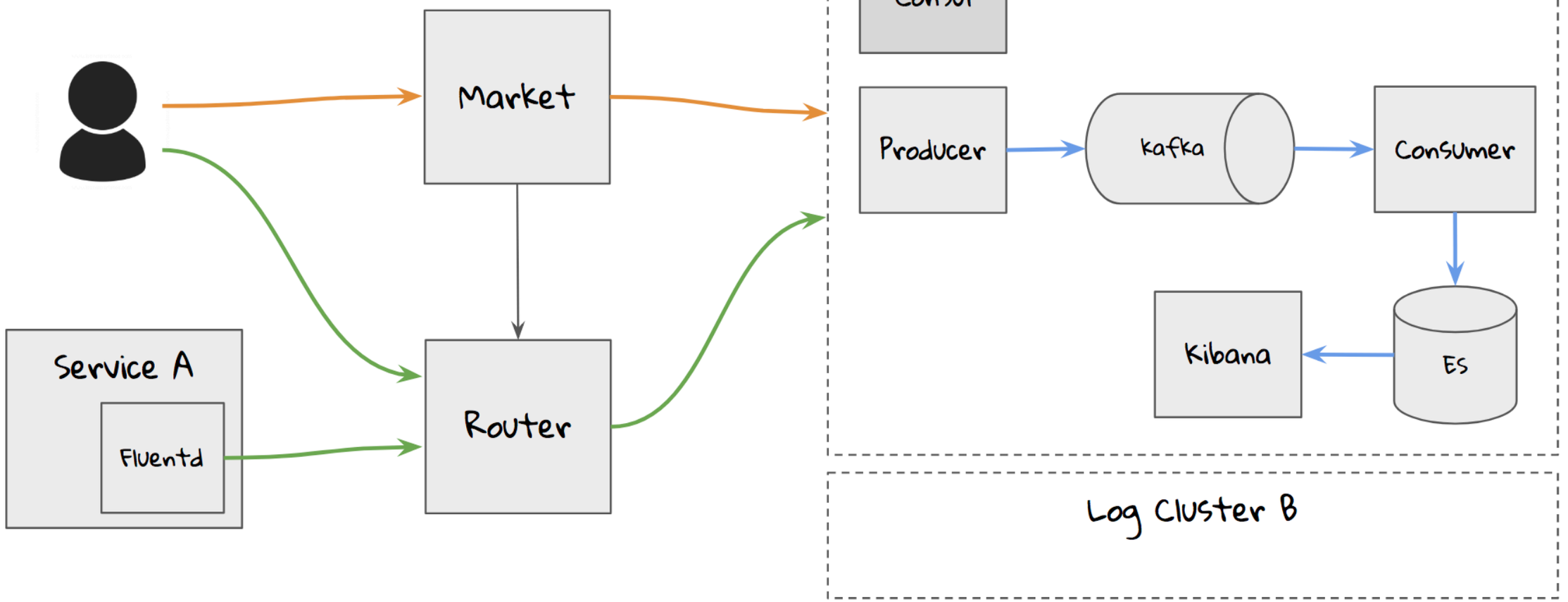
- Logging helps ***describe system state*** at any point in time
- Helps in debugging problems with the system
- Structured logging
- **Log centralisation, aggregation and analysis** is the key
- ***Barito-Log (github.com/BaritoLog)***

Barito Overview

Provisioning

Service Discovery

Log Forwarding



INSTRUMENTATION OF CODE

- Ability to measure various aspects of system behaviour
- Code needs to be written to monitor specific components
- It includes **Structured logging**, **StatsD metrics** (Counters, Gauges, Histograms) and **Error/Exception tracking (Sentry)**
- Should also be able to capture **Application key performance metrics (NewRelic)**

OBSERVABILITY - STATSD

```
type StatsD struct {
   client *statsd.Client
}

func (reporter *StatsD) Incr(key string, tags []string) {
   if reporter.client != nil {
      reporter.client.Incr(key, tags, 1)
   }
}
```

```
reporter.Incr("customers.login.count", []string{"login"})
```

CLOSING COMMENTS ...

- Insights into **Service Health** and **Behaviour**
- Insights into **Service Performance**
- Helps providing **Debuggability in Production**
- Help bring visibility into system
- Knowing when things go wrong
- Helps with **Stability** of the system

#5:
DOCUMENTATION

API DOCS

- Document **API contracts** of the service
- Includes **Request, Response and Header** contracts
- Should provide enough information for integrating with your API
- Specified using **OpenAPI/Swagger** specification
- Tools: "**swagger**"

SWAGGER SPECIFICATION

Schemes

HTTPS

default

POST /login/request Acquire new OTP for login purpose

POST /token Acquire new access token either from otp or from refresh token

DELETE /token Logout

ARCHITECTURAL DECISION RECORDS (ADR)

- Document to capture important architectural ***decisions and design***
- Should be **versioned**
- It also captures **Context** and **Assumptions**
- Helps in understanding why some **key architectural decisions** were made
- Helps **alignment** across teams

SAMPLE ADR

1. Record architecture decisions

Date: 2018-03-06

Status

Accepted

Context

We need to record the architectural decisions made on this project.

Decision

We will use Architecture Decision Records, as described by Michael Nygard in this article: http://thinkrelevance.com/blog/2011/11/15/documenting-architecture-decisions

Consequences

See Michael Nygard's article, linked above. For a lightweight ADR toolset, see Nat Pryce's *adr-tools* at https://github.com/npryce/adr-tools.

RUNBOOKS

- Help **on-call developer** to have **step-by-step instruction** to **find, resolve and mitigate** the root cause of an alert
- **Host level** and **Infrastructure** alerts (General to org)
- **On-Call** Runbooks (Microservice specific)
- Helps in **reliability** of a service
- Helps in preventing **Catastrophe**

SAMPLE RUNBOOK

- **Booking History service** is down
  - Check the process status for the service (Dashboard)
  - Check the **throughput** on the APM dashboard
  - If no requests, log in to boxes and **restart the process**

CLOSING COMMENTS ...

- Brings **Clarity in Thought**
- Helps in **Incidence Response** during outages
- Helps in **alignment** of various stakeholders and the team
- Helps with **Catastrophe Preparedness, Stability and Reliability**

OTHERS

- Security
- Canarying (Test in production)
- CI/CD (Stable deployment process)
- Dependency checks
- HA on components (Postgres, Redis etc)

WRAPPING UP

- Code quality
- Testing
- Resilience Patterns
- Observability
- Documentation

TAKE AWAYS

- Code Health Metrics dashboard
- **Observability** driven Development
- Test Pyramid
- **Document** Everything (Trust me, it helps!)
- Think of **failures** always and protect against them

IN CONCLUSION...

STANDARDISING QUALITY IS THE GOAL

AVAILABILITY
IS THE GOAL

WHAT NEXT ?

- **Automating** the process of production readiness
- Defining a **production readiness score**
- Assigning every microservice a **readiness score**
- Help teams improve quality of microservices in Production
- **Measure** the impact and **improve**

REFERENCES

- Production Ready Microservices - Susan Fowler
- Google SRE Book
- Microservices Standardisation
- Resiliency in Distributed Systems
- TICK stack
- SLA

THANKS FOR
LISTENING

QUESTIONS?