LEAN & MEAN - GO MICROSERVICES WITH DOCKER SWARM MODE AND SPRING CLOUD

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2017-11-09 I CALLISTAENTERPRISE.SE

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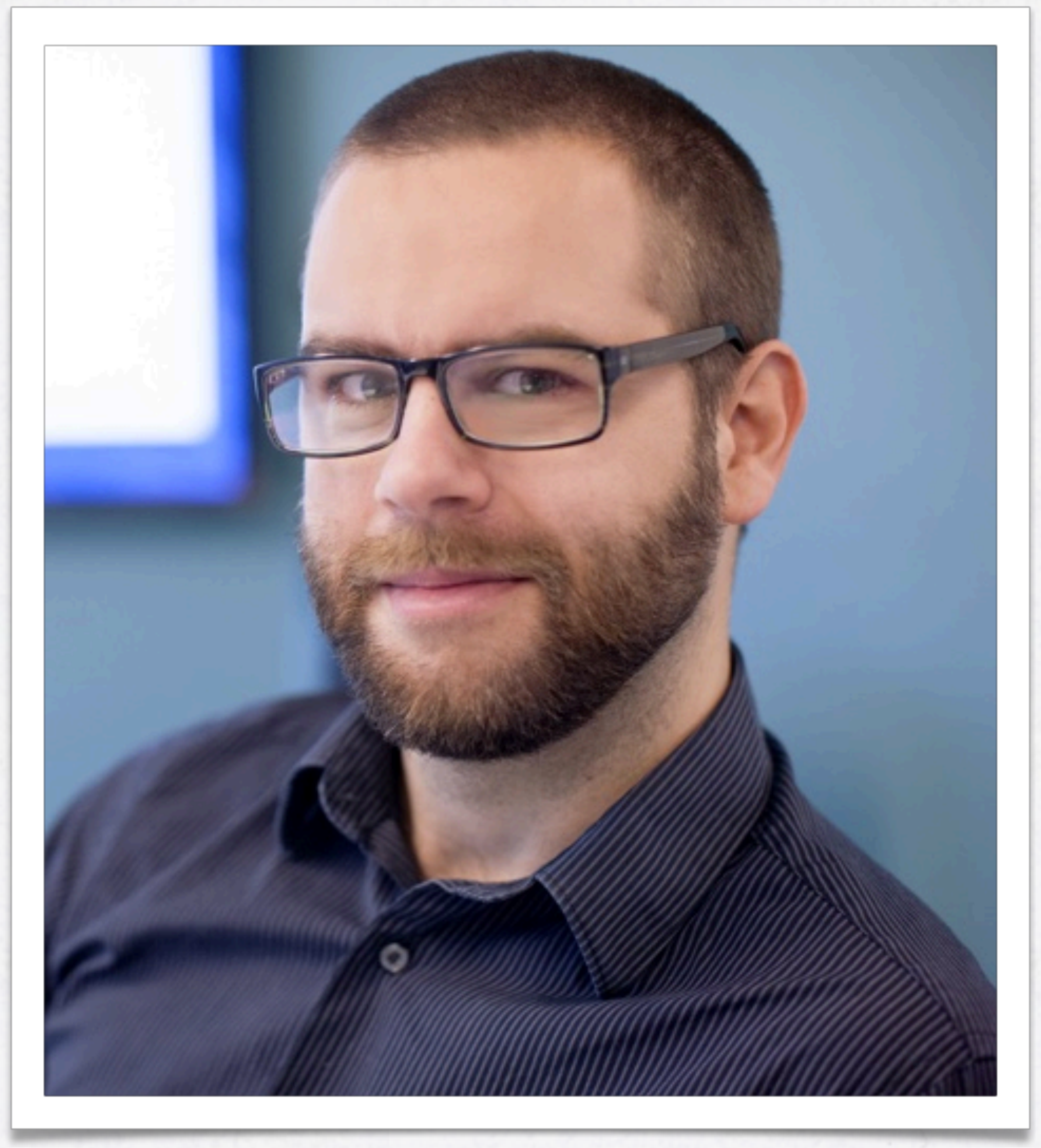
ABOUT ME

- Erik Lupander, consultant at Callista Enterprise.
- Primarily a Java dude.
- ”Discovered” Go about 2 years ago.

Love at first sight!



Go

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ON THE AGENDA…

- Background: The footprint problem.
- The Go programming language.
- Go in the context of:
  - Microservices
  - Spring Cloud/Netflix OSS
  - Docker Swarm mode.
- Demos!

Can Go help us help us reduce the footprint of a microservice?

THE FOOTPRINT PROBLEM

- JVM-based solutions comes with a hefty footprint.
- If you need to run tens or even hundreds of microservice instances, cost is definitely a factor.
  - t2.micro (1GB) —> t2.small (2GB) doubles the cost / h.
- There are obviously many other alternatives for microservice development….
  - Very interesting topic… if we had all day.

The Go Language

THE GO LANGUAGE

It has been stated that the reason the three authors created Go was their…

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THE GO LANGUAGE

”… shared dislike of C++'s complexity as a primary motivation for designing a new language”

THE GO LANGUAGE

Go was designed …

”… to eliminate the slowness and clumsiness of software development at Google”

Go official FAQ

WHAT WAS IMPROVED WITH GO?

- ~50x build time improvement over C++
  - Internal C++ application builds taking 30-75 minutes.
- Better dependency management
- Cross-platform builds
- Language level concurrency
- Readable and maintainable code
  - Even for non superstar developers

THE GO LANGUAGE

- Claims to be
  - efficient, scalable and productive.
- Designed
  - to improve the working environment for its designers and their coworkers.
- Is not
  - a research language.

THE GO LANGUAGE

- Go is
  - compiled, statically typed, concurrent, garbage-collected
- Has
  - structs, pointers, interfaces, closures
- But does not have
  - classes, inheritance, generics, operator overloading, pointer arithmetic

WHY GOLANG - DEVELOPING

What does actual developers think about Go?

”… a disservice to intelligent programmers”

Gary Willoughby - blogger

”… stuck in the 70’s”

Dan Given

”… psuedointellectual arrogance of Rob Pike and everything he stands for”

Keith Wesolowski

But also

”I like a lot of the design decisions they made in the [Go] language. Basically, I like all of them.”

Martin Odersky, creator of Scala

”Never used a language before that empowers you to solve problems as quick as Go does”

Alexander Orlov @ Twitter

”Go isn’t a very good language in theory, but it’s a great language in practice, and practice is all I care about”

anonymous hackernews poster

Some pros and cons

DEVELOPMENT IN GOLANG - PROS

- Easy to learn, readable, productive and pretty powerful.
- The built-in concurrency is awesome.
- Cross-platform.
- Rich standard APIs and vibrant open source community.
- Quick turnaround and decent IDE support (getting better!)
- Nice bundled tools.
  - Built-in unit testing, profiling, coverage, benchmarking, formatting, code quality…
- Strongly opinionated.
  - Code formatting, compile errors on typical warnings.

DEVELOPING IN GOLANG - SOME CONS

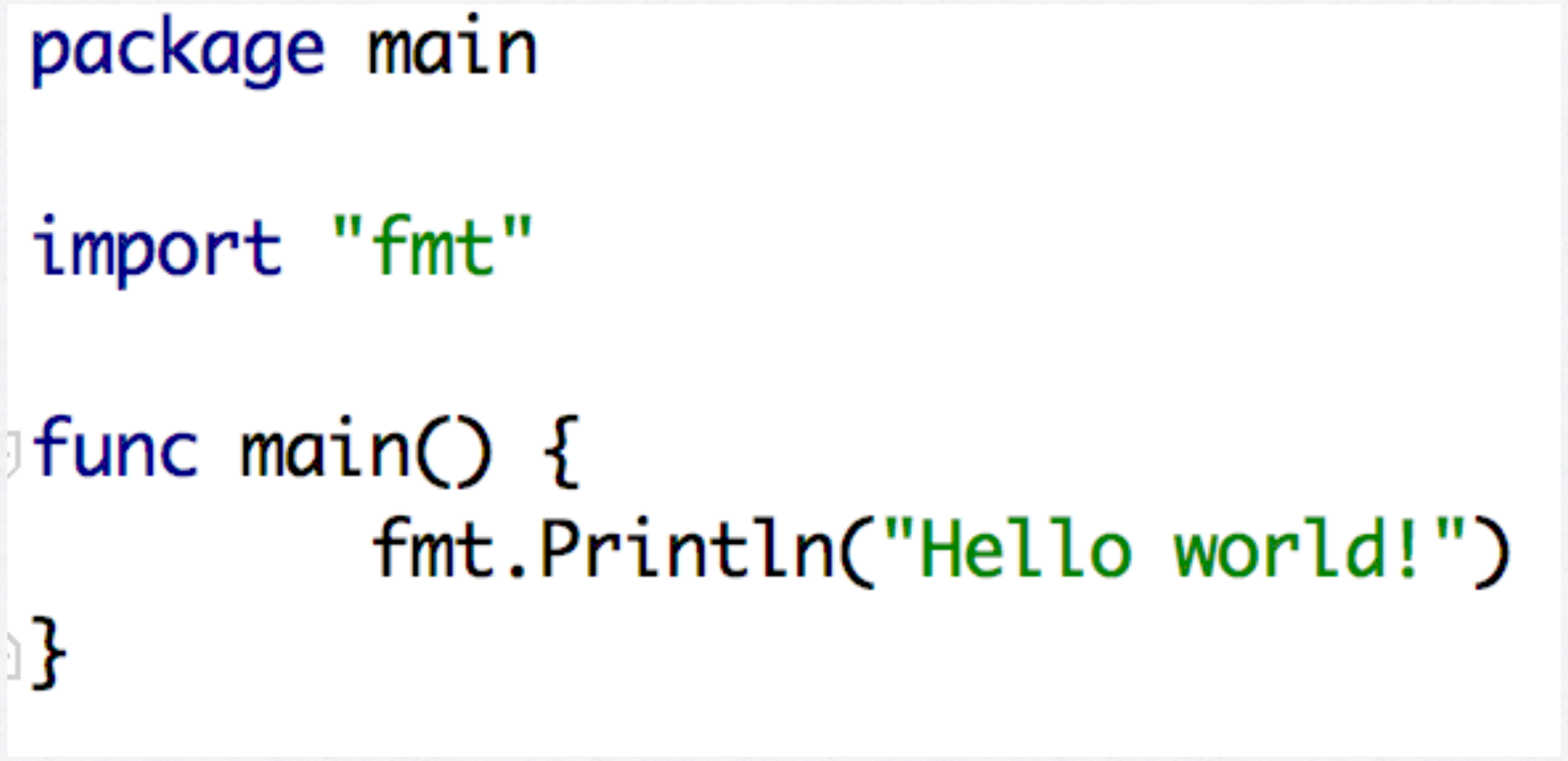
- Missing generics
- Dependency versioning
- Verbose syntax
  - Error checking, no autoboxing of primitive types etc.
- Unit testing and Mocking isn’t very intuitive.

WHO USES GOLANG

- Some well-known software built entirely in golang
  - Docker
  - Kubernetes
  - etcd
  - influxdb (time series database)
  - cockroachdb (spanner-like database)

Two code samples

SAMPLE CODE 1 - HELLO WORLD

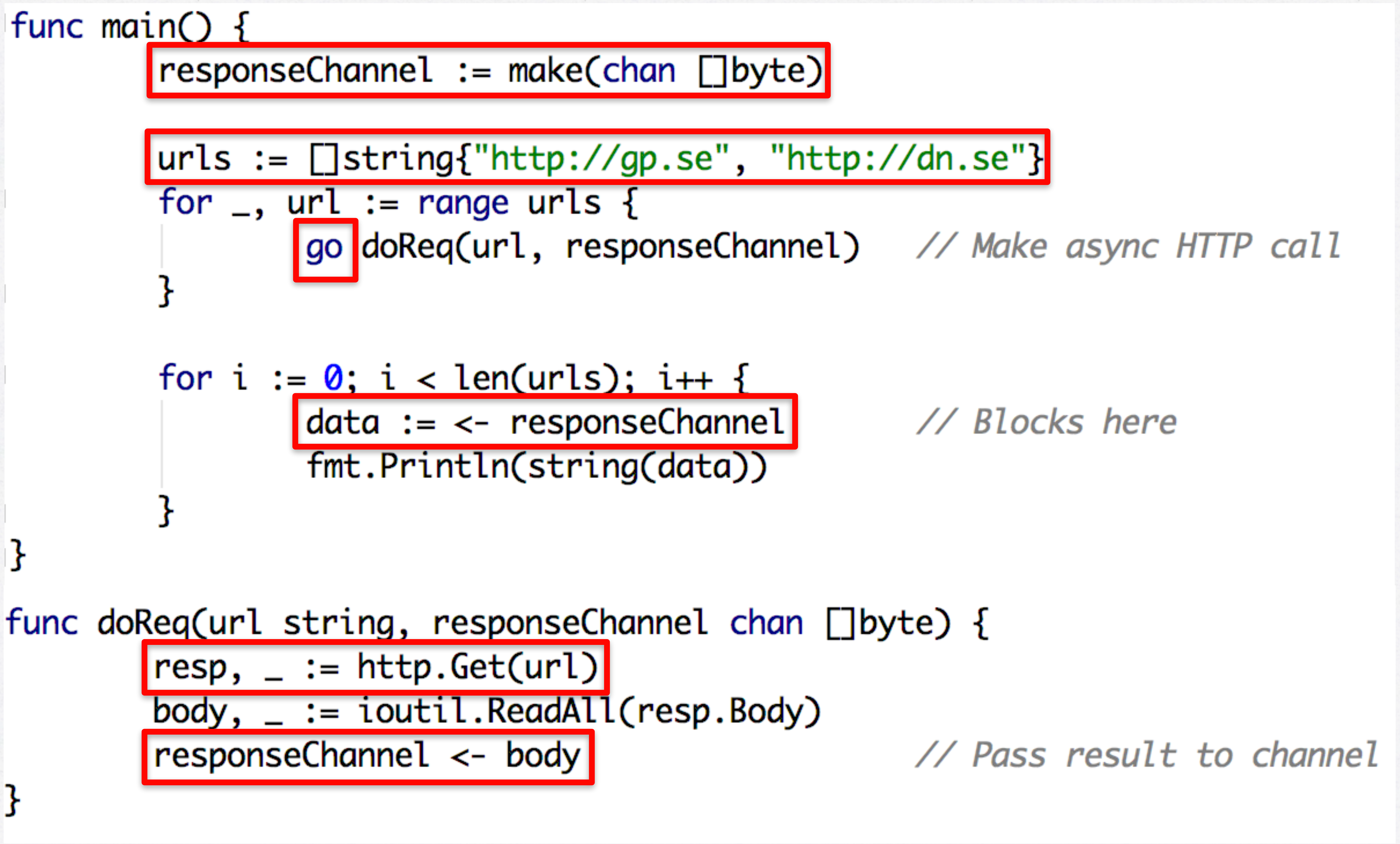


```
package main

import "fmt"

func main() {
	fmt.Println("Hello world!")
}
```

SAMPLE CODE 2 - CONCURRENCY



```go
func main() {
        responseChannel := make(chan []byte)

        urls := []string{"http://gp.se", "http://dn.se"}
        for _, url := range urls {
                go doReq(url, responseChannel)    // Make async HTTP call
        }

        for i := 0; i < len(urls); i++ {
                data := <- responseChannel        // Blocks here
                fmt.Println(string(data))
        }
}

func doReq(url string, responseChannel chan []byte) {
        resp, _ := http.Get(url)
        body, _ := ioutil.ReadAll(resp.Body)
        responseChannel <- body                   // Pass result to channel
}
```

Go microservices

GO MICROSERVICE IMPLEMENTATION - CONSIDERATIONS

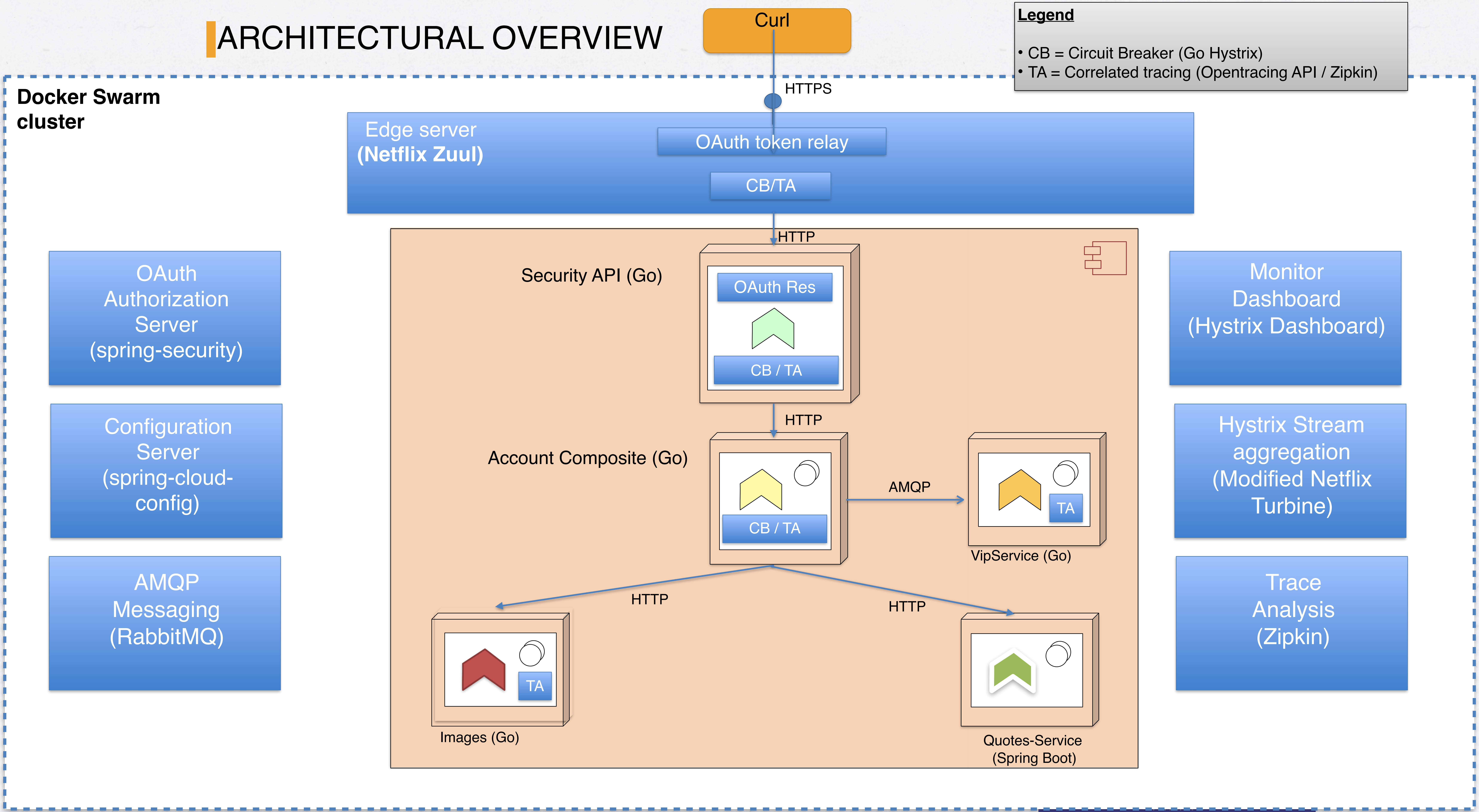
- When implementing microservices, we need working, mature and stable libraries for things such as:
  - HTTP / REST / RPC APIs
  - Data serializers / deserializers (json, xml etc.)
  - Messaging APIs
  - Persistence APIs
  - Logging
  - Testability

The demo application

ARCHITECTURAL OVERVIEW

Legend

- CB = Circuit Breaker (Go Hystrix)
- TA = Correlated tracing (Opentracing API / Zipkin)



Curl
HTTPS
Docker Swarm cluster
Edge server
(Netflix Zuul)
OAuth token relay
CB/TA
HTTP
Security API (Go)
OAuth Res
CB / TA
HTTP
Account Composite (Go)
CB / TA
AMQP
TA
VipService (Go)
HTTP
HTTP
TA
Images (Go)
Quotes-Service (Spring Boot)
OAuth Authorization Server (spring-security)
Configuration Server (spring-cloud-config)
AMQP Messaging (RabbitMQ)
Monitor Dashboard (Hystrix Dashboard)
Hystrix Stream aggregation (Modified Netflix Turbine)
Trace Analysis (Zipkin)

WHY GO - RUNTIME CHARACTERISTICS

- Low memory usage
- Typically executes at least as fast as Java
- Fast startup
- Highly concurrent
- Garbage Collector geared for very short GC pauses

GO MICROSERVICES - STATICALLY LINKED BINARIES

- Statically linked binary produces an executable without external dependencies.
  - No jar- or dll-hell
  - No requirement on the OS having a JRE / CLR / NodeJS or other libraries
    - (except libc)
- Small executable size

DOCKER CONTAINERS & STATICALLY LINKED BINARIES

- In the context of Docker Containers, the statically linked binary allows use of very bare parent images.
- I’m using *iron/base* which is ~6 mb, *alpine* is another popular choice.

```
FROM iron/base

EXPOSE 6868
ADD vipservice-linux-amd64 /
ADD healthcheck-linux-amd64 /

HEALTHCHECK CMD [”./healthcheck-linux-amd64”, ”-port=6868”]

ENTRYPOINT [”./vipservice-linux-amd64", ”-profile=test”]
```

Demo 1
Footprint @ Docker Swarm Mode

”what is hard in Microservices is all the things around them”

Jonas Bonér - author of Akka

Consider:

MICROSERVICE CONSIDERATIONS

- Centralized configuration
- Service Discovery
- Centralized Logging
- Distributed Tracing
- Circuit Breaking
- Load balancing
- Edge server / Reverse proxy
- Monitoring
- Security

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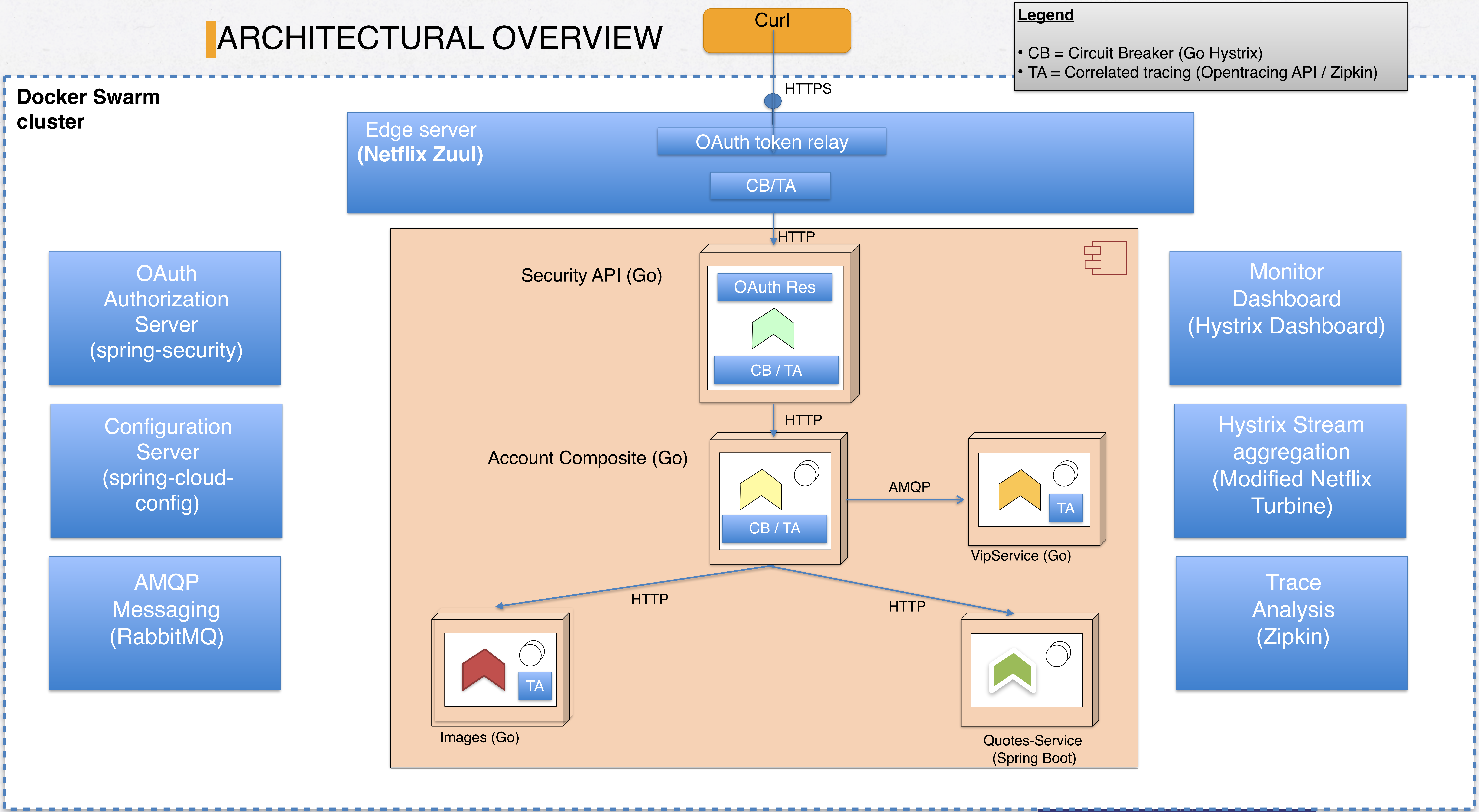

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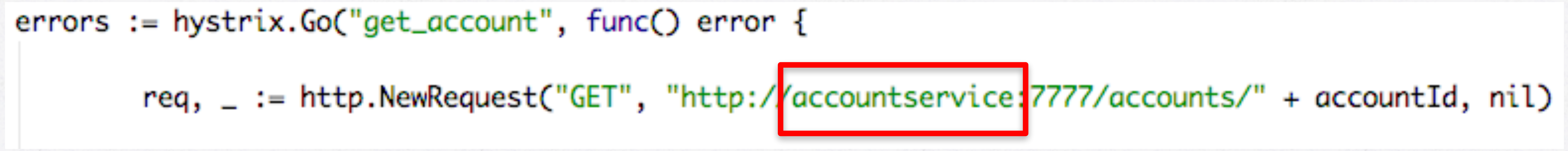
Things not really Go-related…

EDGE SERVER

- Our Go services doesn’t care about the EDGE / reverse-proxy
- Netflix Zuul, Nginx, HAProxy …
- Or use solution provided by container orchestrator
  - Ingress Routing mesh (Docker Swarm mode)
  - Ingress controller (K8S)
  - Routes (OpenShift)
- Must forward HTTP headers.
  - Security

SERVICE DISCOVERY AND LOAD BALANCING

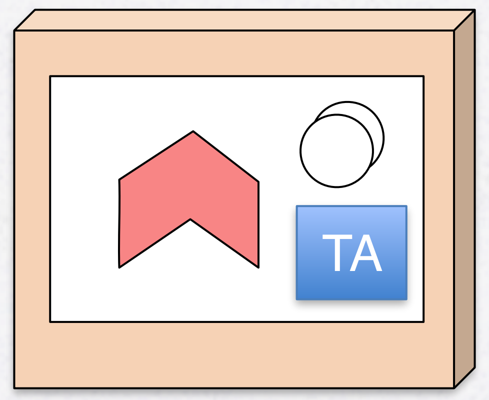
- Load-balancing and Service Discovery is handled by the orchestration engine.
  - E.g. the Docker Swarm or K8S / OpenShift ”service” abstraction.
- Eureka service discovery and Ribbon-like client-based load-balancing can be implemented too.



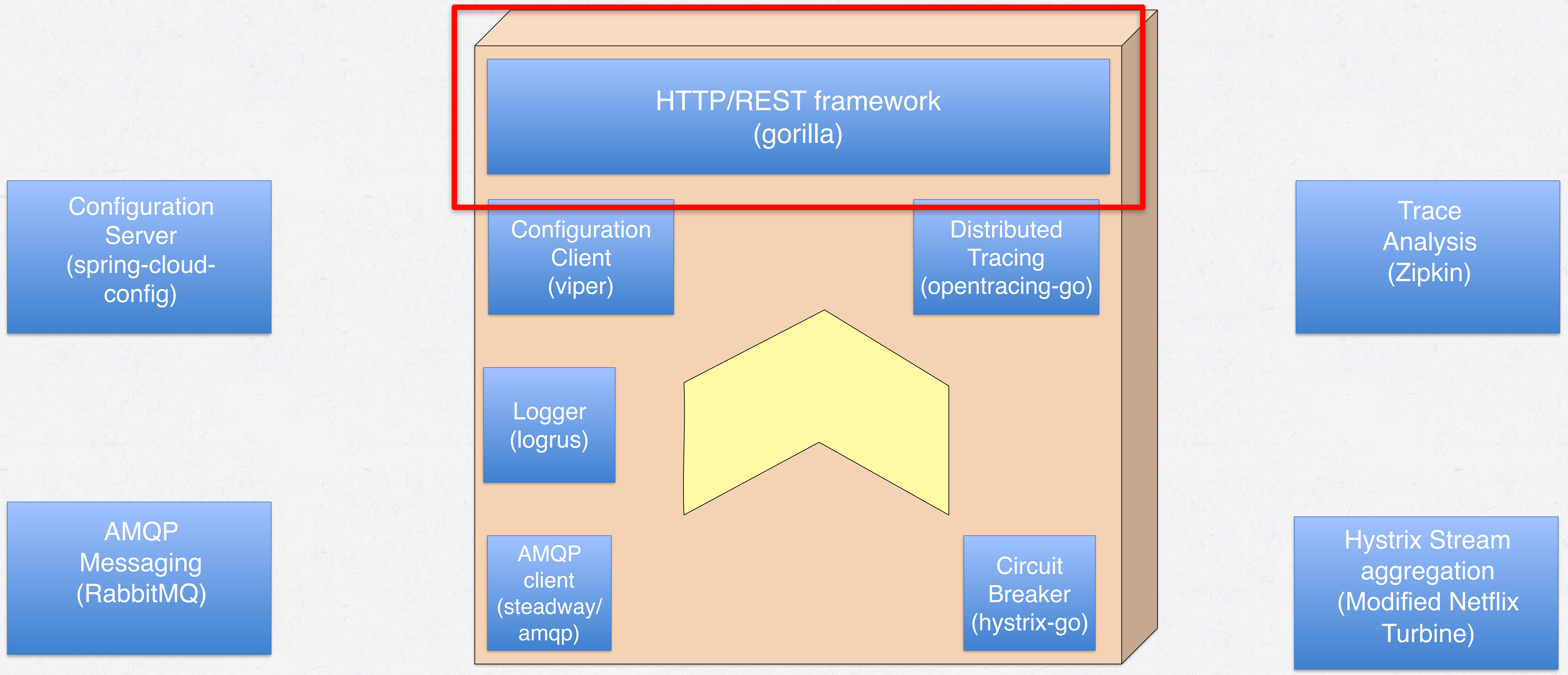
```
errors := hystrix.Go("get_account", func() error {

        req, _ := http.NewRequest("GET", "http://accountservice:7777/accounts/" + accountId, nil)
```

Demo 2 -
Load balancing and fast scaling
@ Docker Swarm

Go Microservice Anatomy



HTTP / REST FRAMEWORK


HTTP/REST framework (gorilla)
Configuration Server (spring-cloud-config)
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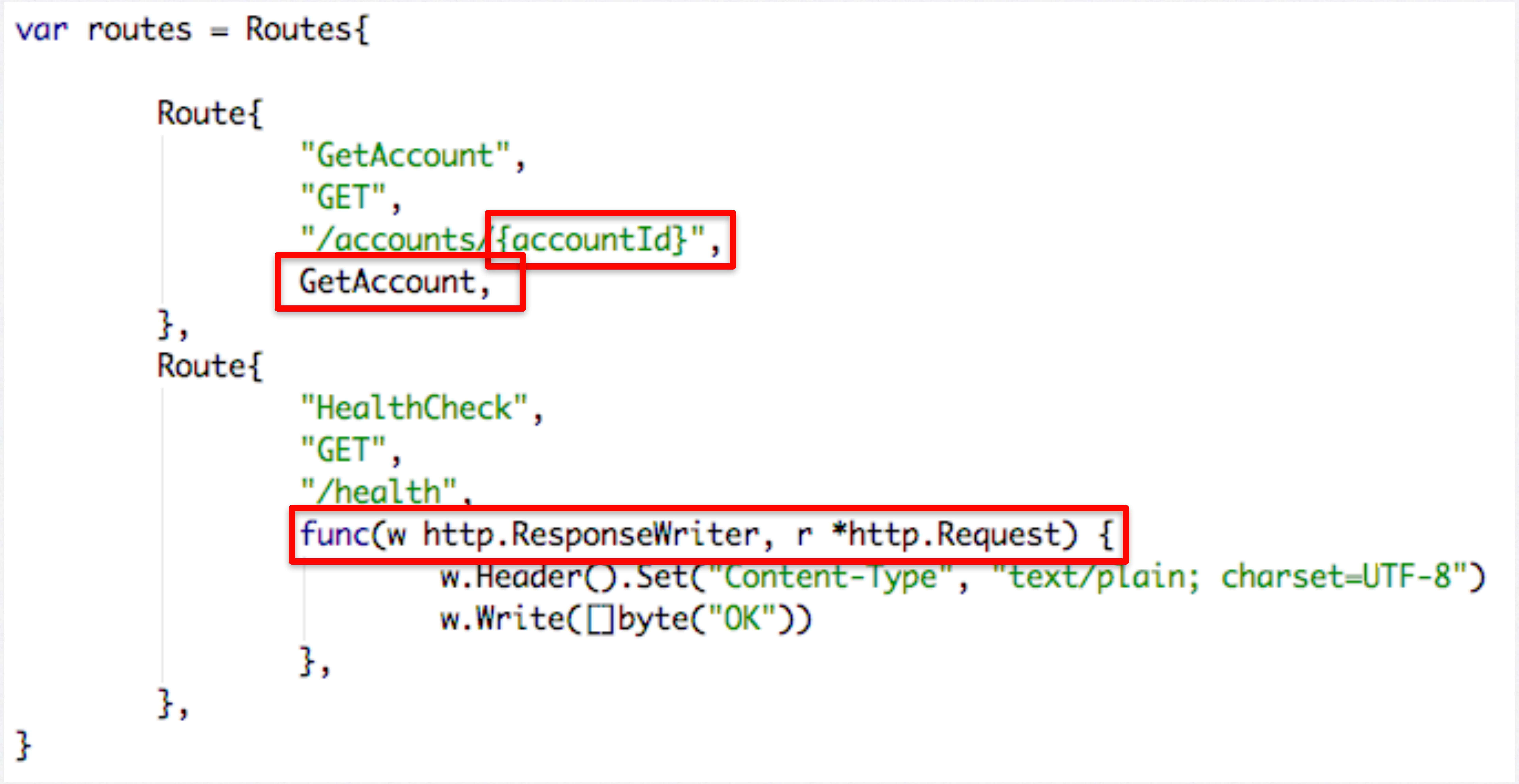
GO WITH OUT WITHOUT WEB FRAMEWORKS?

- Consider using the native http packages + a router package over a full-blown web framework such as gin, echo, beego.

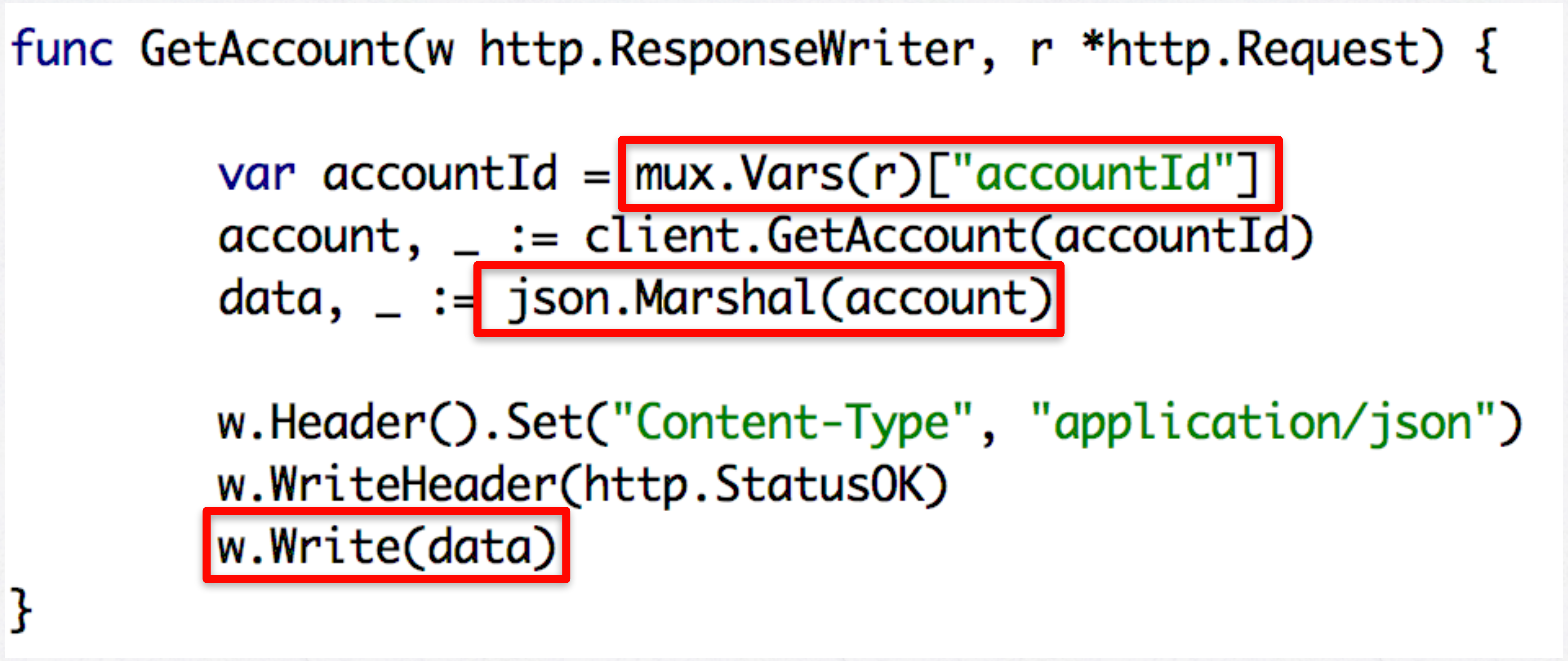
HTTP FRAMEWORK (GORILLA)



```
var routes = Routes{

        Route{
                "GetAccount",
                "GET",
                "/accounts/{accountId}",
                GetAccount,
        },
        Route{
                "HealthCheck",
                "GET",
                "/health",
                func(w http.ResponseWriter, r *http.Request) {
                        w.Header().Set("Content-Type", "text/plain; charset=UTF-8")
                        w.Write([]byte("OK"))
                },
        },
}
```

HTTP FRAMEWORK (GORILLA)

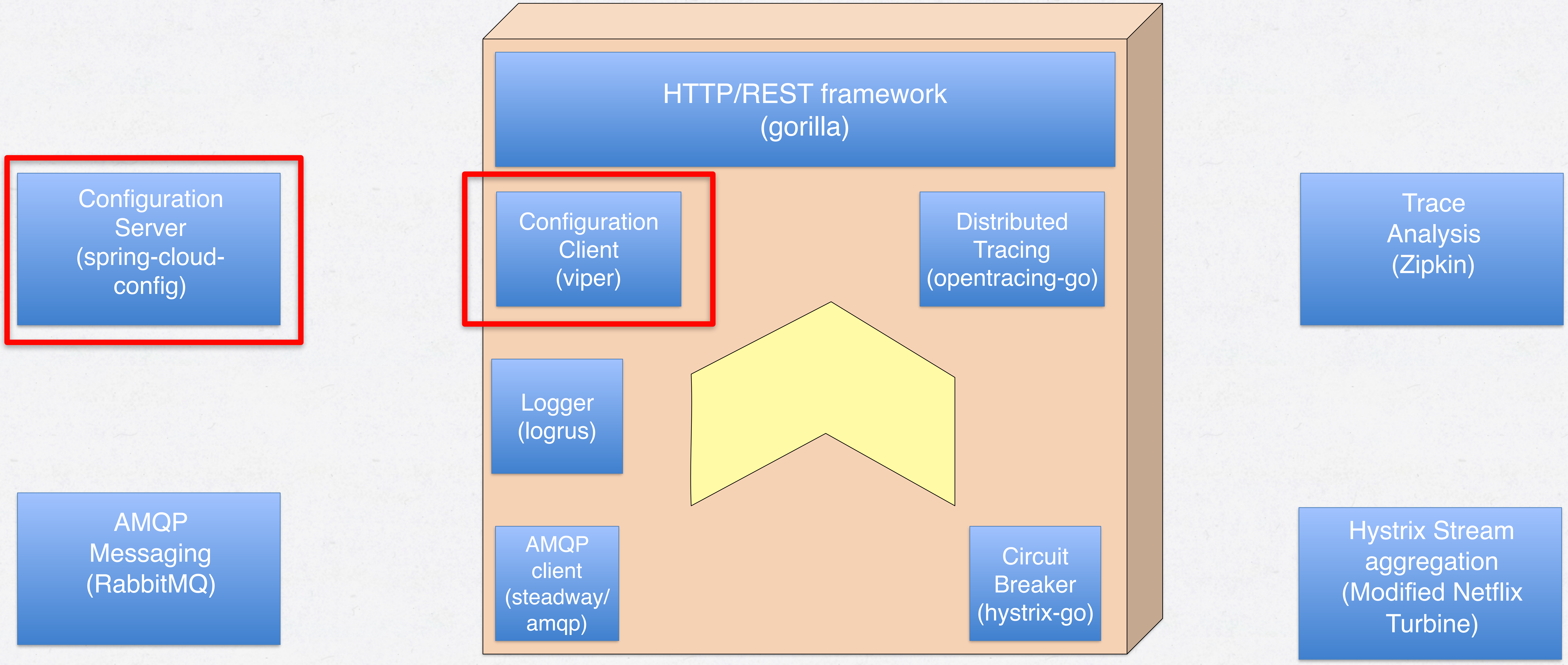


```
func GetAccount(w http.ResponseWriter, r *http.Request) {

        var accountId = mux.Vars(r)["accountId"]
        account, _ := client.GetAccount(accountId)
        data, _ := json.Marshal(account)

        w.Header().Set("Content-Type", "application/json")
        w.WriteHeader(http.StatusOK)
        w.Write(data)
}
```

CENTRALIZED CONFIGURATION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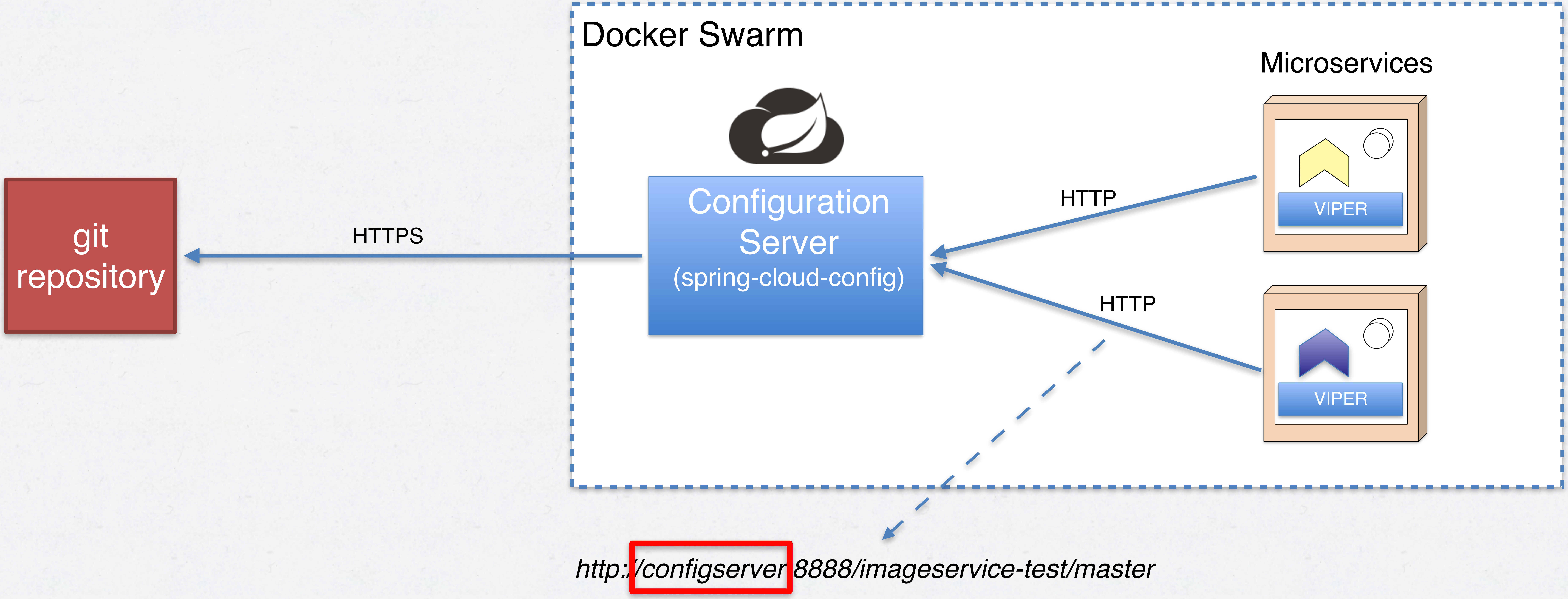
CENTRALIZED CONFIGURATION

- With possibly tens of microservices and hundreds of instances, centralized and externalized configuration is a must.
- Configuration providers:
  - Config servers
    - Spring Cloud Config, etcd …
  - Container orchestrator mechanisms
    - K8S and OpenShift has ”config maps” and ”secrets” in order to mount configuration files, certificates etc. into containers at startup.

CONFIGURATION USING SPRING CLOUD CONFIG AND VIPER


git repository
HTTPS
Docker Swarm
Configuration Server (spring-cloud-config)
HTTP
HTTP
Microservices
VIPER
VIPER
http://configserver:8888/imageservice-test/master

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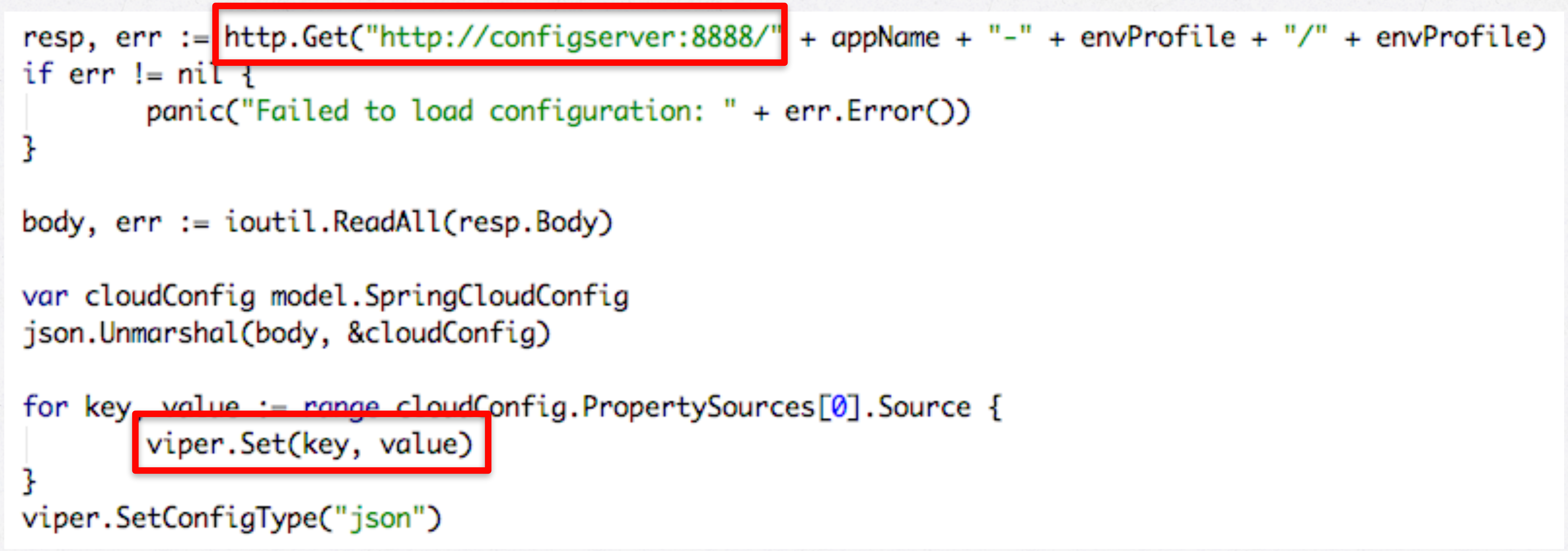
CONFIGURATION - VIPER

- Viper supports YAML, .properties, JSON and Env-vars
- With a few lines of code, we can load and inject config from Spring Cloud Config into Viper



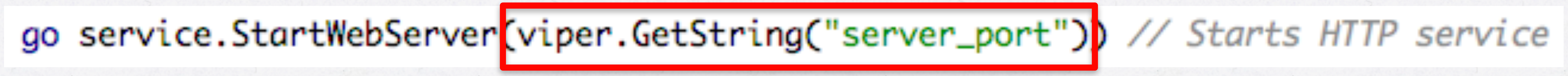
```go
resp, err := http.Get("http://configserver:8888/" + appName + "-" + envProfile + "/" + envProfile)
if err != nil {
        panic("Failed to load configuration: " + err.Error())
}

body, err := ioutil.ReadAll(resp.Body)

var cloudConfig model.SpringCloudConfig
json.Unmarshal(body, &cloudConfig)

for key, value := range cloudConfig.PropertySources[0].Source {
        viper.Set(key, value)
}
viper.SetConfigType("json")
```

CONFIGURATION - VIPER USAGE



```
go service.StartWebServer(viper.GetString("server_port")) // Starts HTTP service
```

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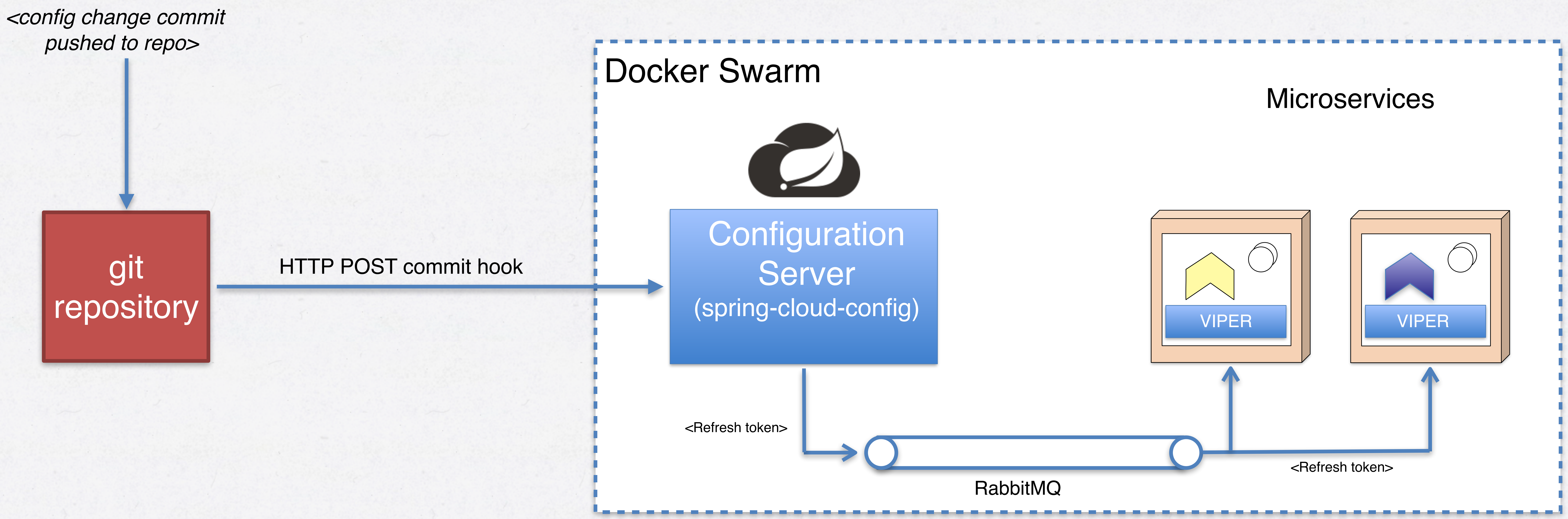
CONFIGURATION PUSH USING SPRING CLOUD CONFIG AND VIPER



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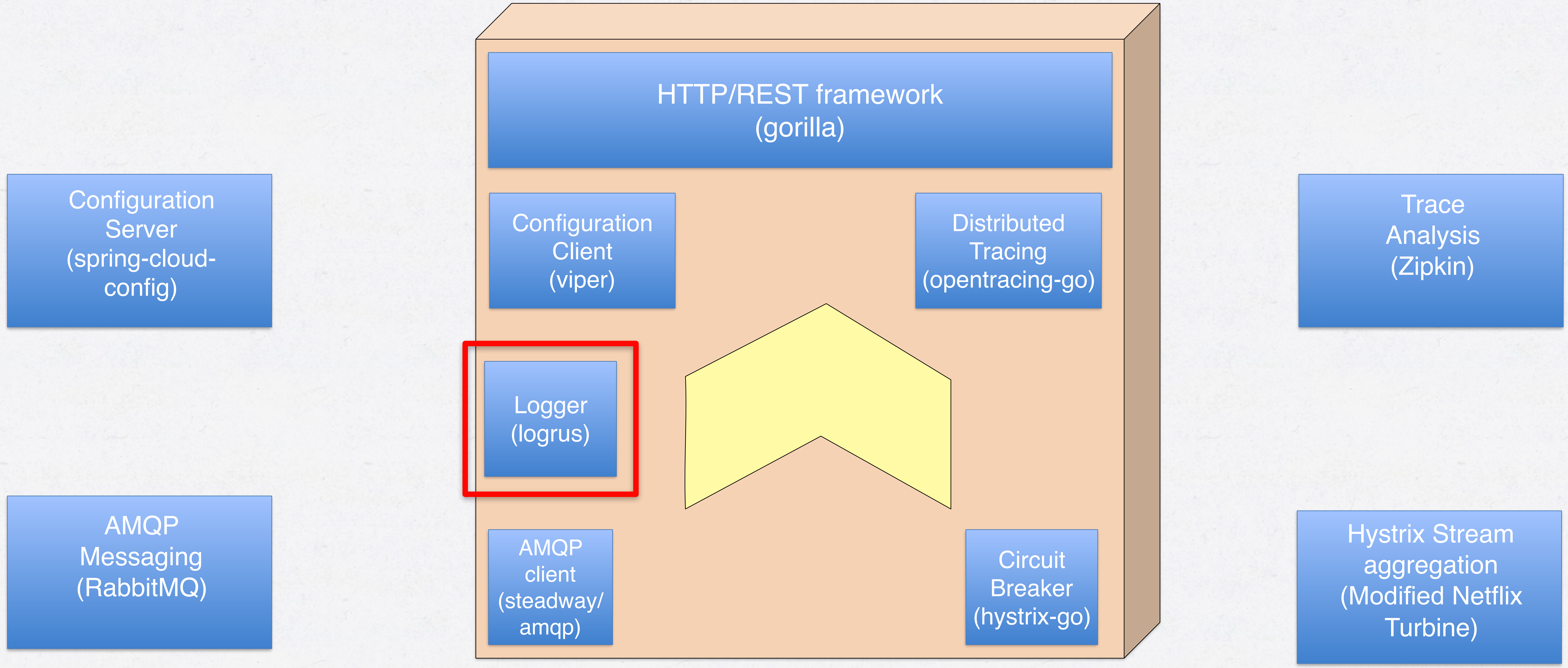
Demo 3 -
Configuration Push

CENTRALIZED LOGGING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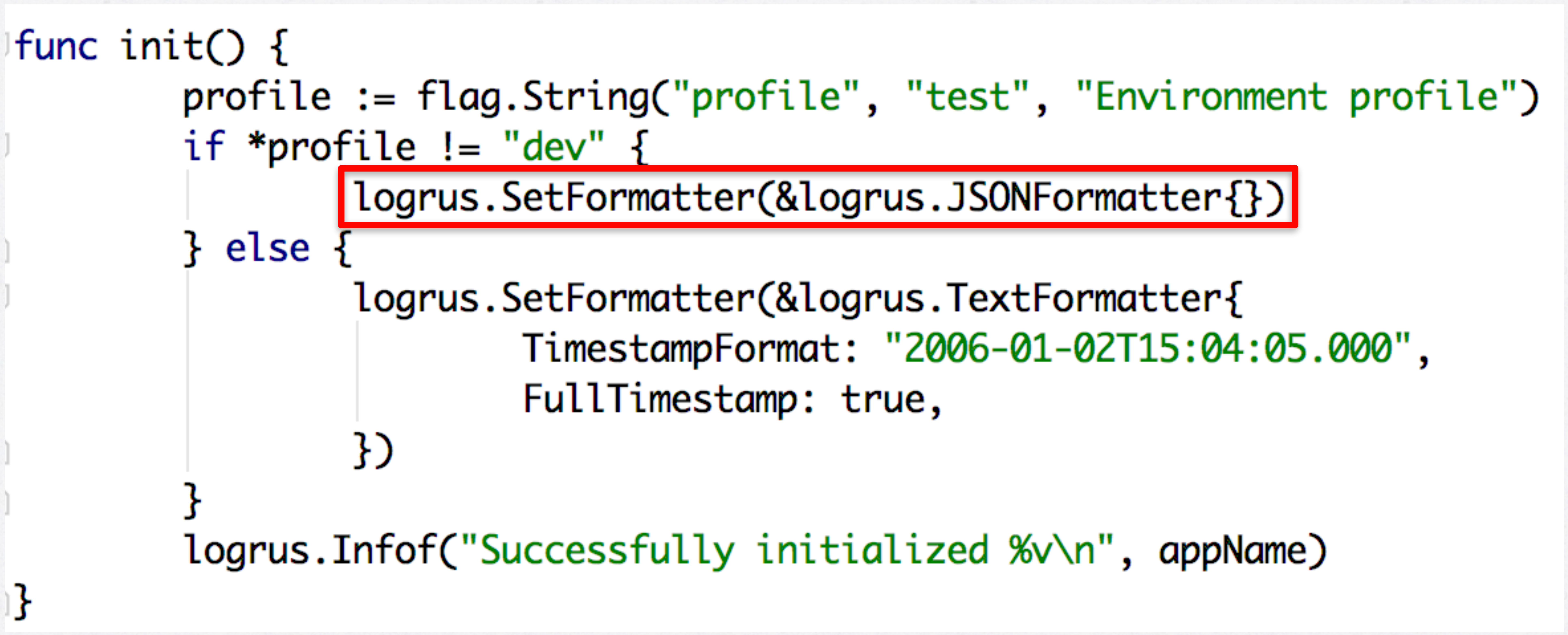
LOGGING - LOGRUS

- Applications needs structured logging
  - slf4j, log4j, logback…
- Logrus is a similar API for Go
- Supports levels, fields, formatters, hooks

LOGRUS



```
func init() {
        profile := flag.String("profile", "test", "Environment profile")
        if *profile != "dev" {
                logrus.SetFormatter(&logrus.JSONFormatter{})
        } else {
                logrus.SetFormatter(&logrus.TextFormatter{
                        TimestampFormat: "2006-01-02T15:04:05.000",
                        FullTimestamp: true,
                })
        }
        logrus.Infof("Successfully initialized %v\n", appName)
}
```

CENTRALIZING LOGS

- In a Docker context, we configure a logging driver when declaring our ”service”.
  - The logging driver adds lots of nice container metadata.
- Logs are sent to an aggregation service (typically something like logstash)
- The log aggregation service may perform some filtering, transforming etc. before storing logs to a storage backend or sending them to a LaaS provider.

LOGGING WITH CONTAINER METADATA (GELF)

```
{
    "version":"1.1",
    "host":"swarm-manager-0",
    "short_message":{
      ”level”:"info",
      "msg":"Successfully initialized service”,
      ”time":"2017-07-17T16:03:35+02:00"
    },
    "timestamp":1.487625824614e+09,
    "level":6,
    "_command":"./vipservice-linux-amd64 -profile=test",
    ”_container_id”:”894edfe2faed131d417eebf77306a0386b430….",
    "_container_name":"vipservice.1.jgaludcy21iriskcu1fx9nx2p",
    "_created":"2017-02-20T21:23:38.877748337Z",
    ”_image_id”:”sha256:1df84e91e0931ec14c6fb4e55…..”,
    "_image_name":"someprefix/vipservice:latest",
    "_tag":"894edfe2faed"
}
```

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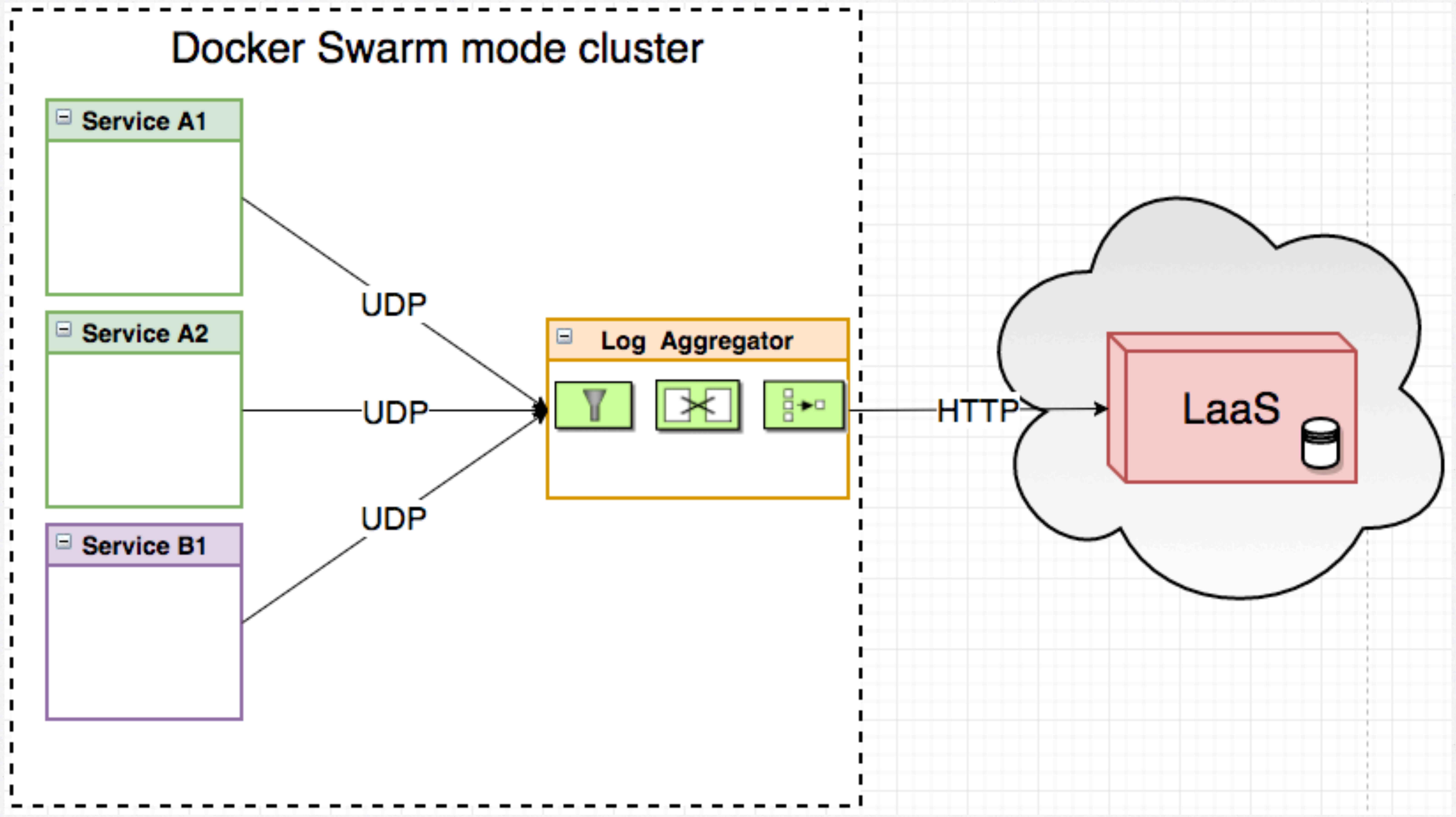
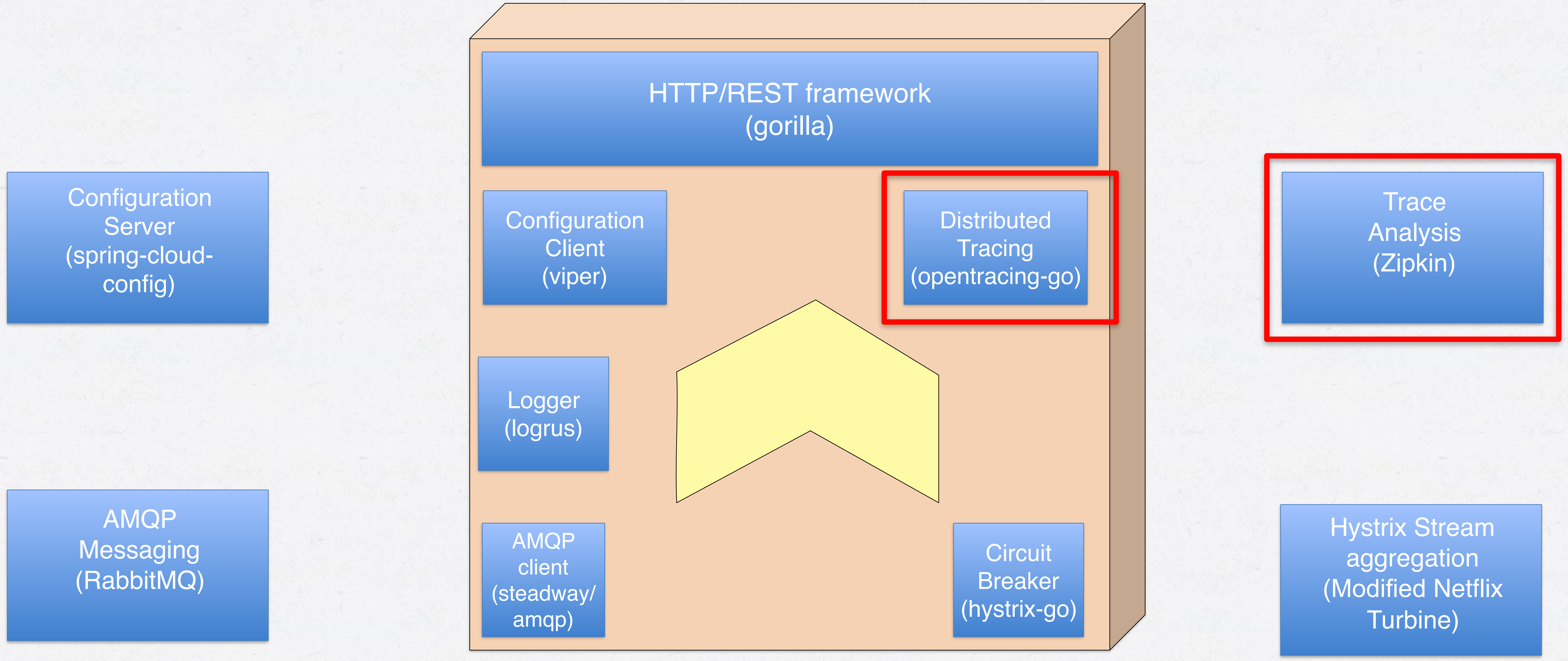

Docker Swarm mode cluster
Service A1
Service A2
Service B1
UDP
UDP
UDP
Log Aggregator
HTTP
LaaS

DISTRIBUTED TRACING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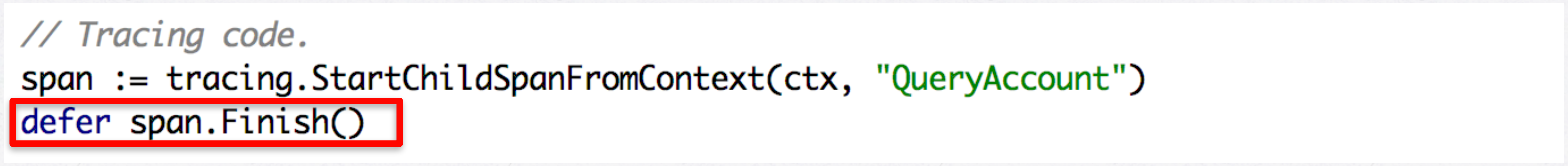
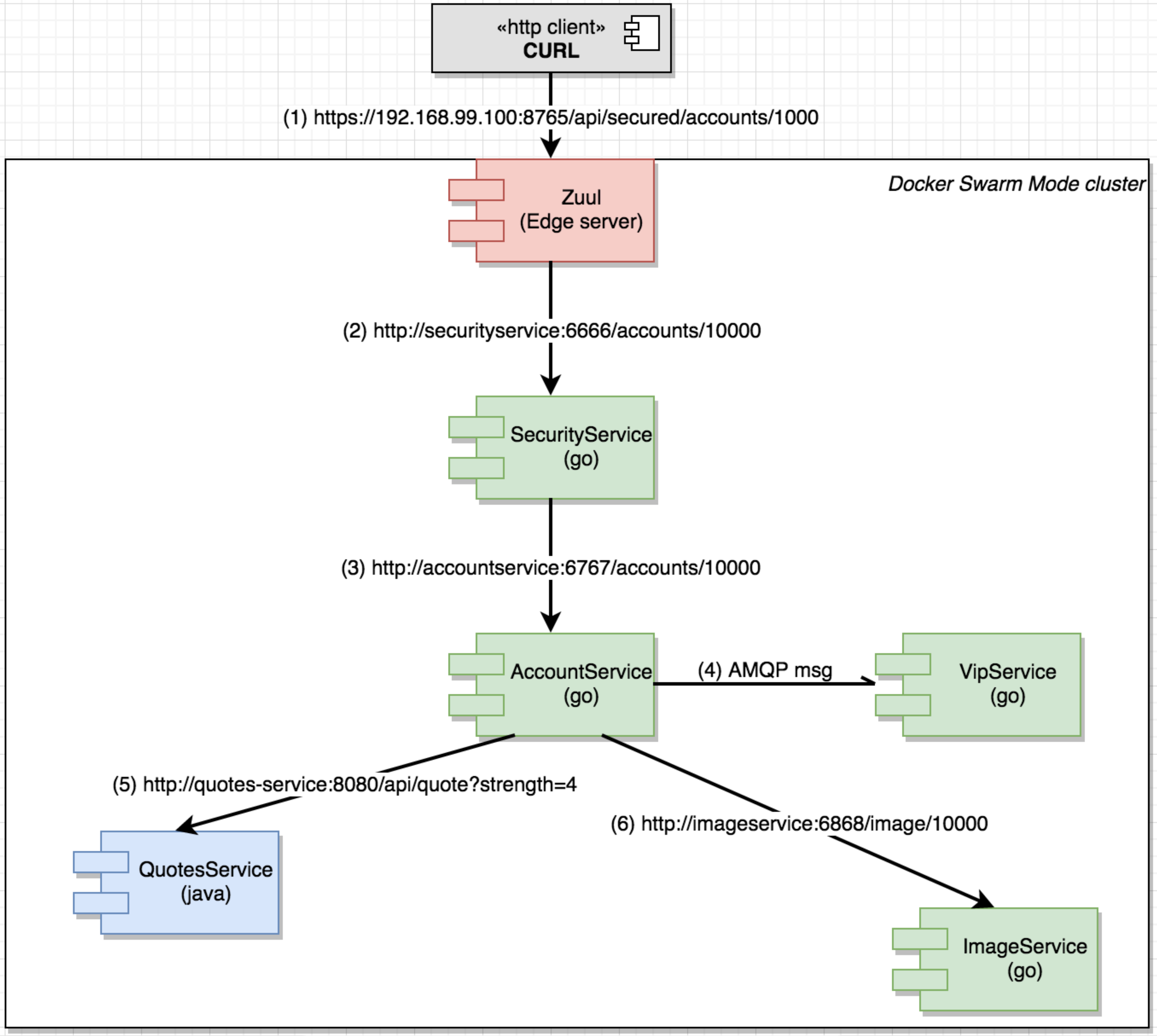
DISTRIBUTED TRACING

- Track a request over multiple microservices
  - Also trace within services and methods
- Invaluable for high-level profiling across the service stack.
- Facilitated by go-opentracing and zipkin

GO-OPENTRACING CODE SAMPLE

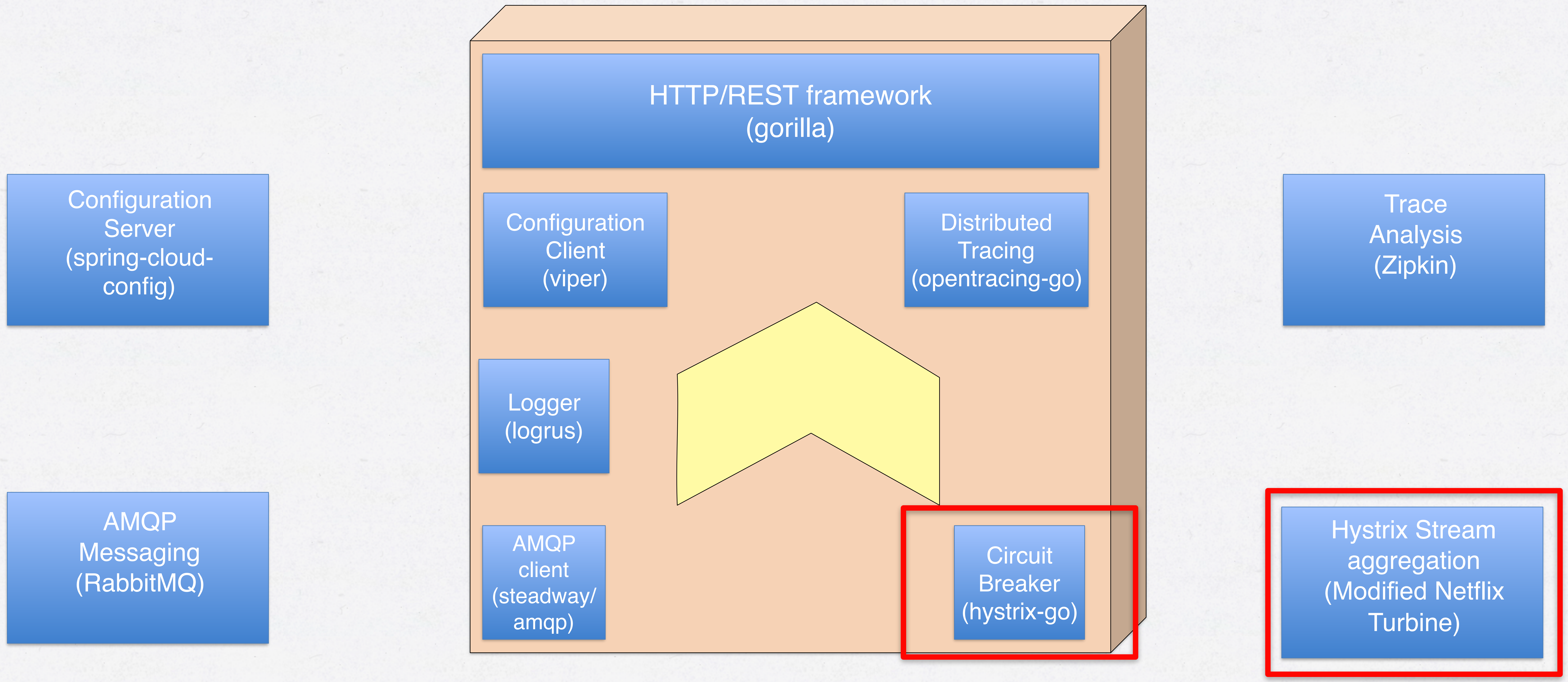


```go
// Tracing code.
span := tracing.StartChildSpanFromContext(ctx, "QueryAccount")
defer span.Finish()
```


«http client»
CURL
(1) https://192.168.99.100:8765/api/secured/accounts/1000
Docker Swarm Mode cluster
Zuul
(Edge server)
(2) http://securityservice:6666/accounts/10000
SecurityService
(go)
(3) http://accountservice:6767/accounts/10000
AccountService
(go)
(4) AMQP msg
VipService
(go)
(5) http://quotes-service:8080/api/quote?strength=4
QuotesService
(java)
(6) http://imageservice:6868/image/10000
ImageService
(go)

Demo 4 -
Distributed Tracing with Zipkin

CIRCUIT BREAKER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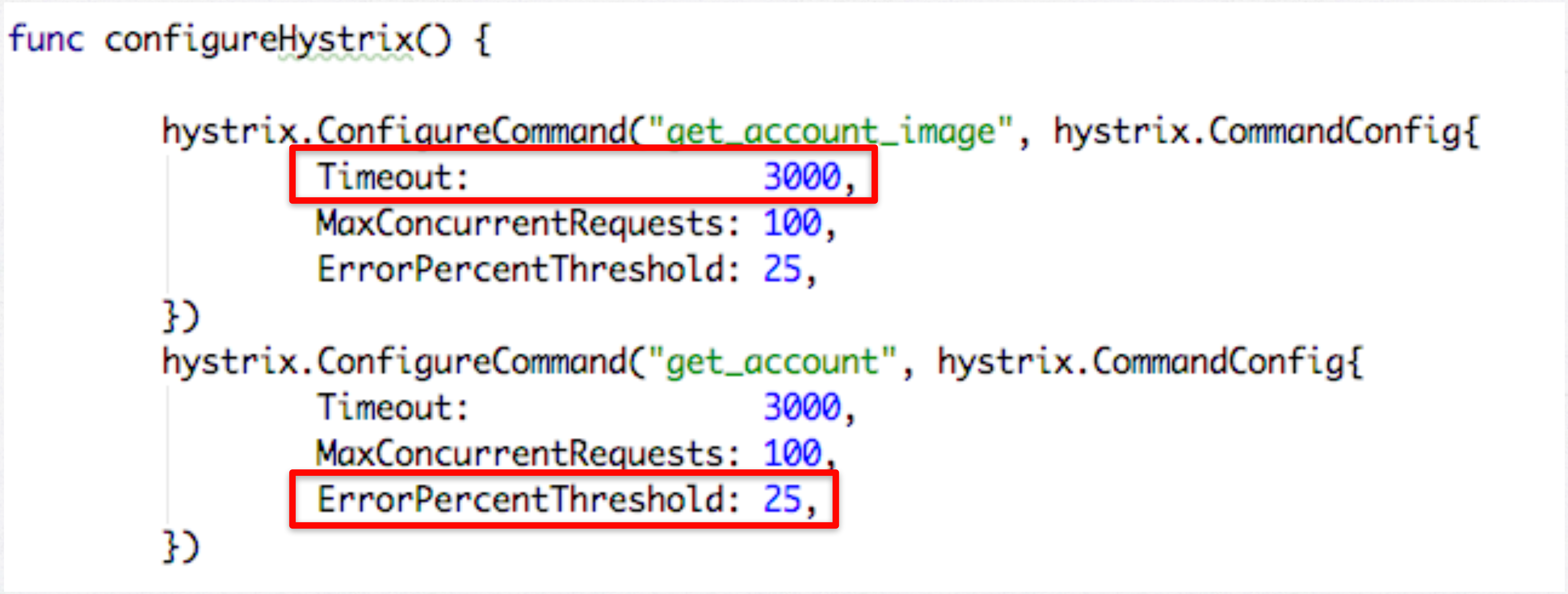
CIRCUIT BREAKING - HYSTRIX

- Mechanism to make sure a single malfunctioning microservice doesn’t halt the entire service or application.
- go-hystrix (circuit breaker)
- Netflix Turbine (aggregation)
- Netflix Hystrix Dashboard (GUI)

CIRCUIT BREAKING

- Programmatic hystrix configuration

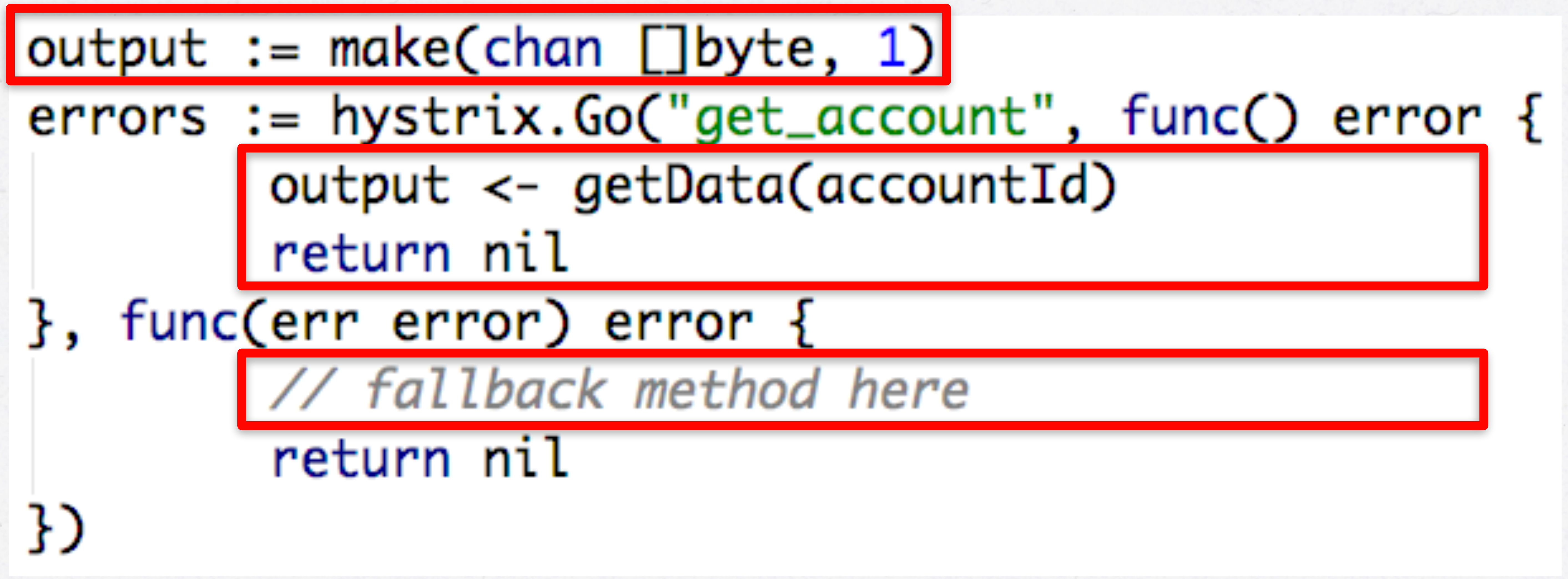


```
func configureHystrix() {

    hystrix.ConfigureCommand("get_account_image", hystrix.CommandConfig{
            Timeout:                3000,
            MaxConcurrentRequests:  100,
            ErrorPercentThreshold:  25,
    })
    hystrix.ConfigureCommand("get_account", hystrix.CommandConfig{
            Timeout:                3000,
            MaxConcurrentRequests:  100,
            ErrorPercentThreshold:  25,
    })
```

CIRCUIT BREAKING

- Example go-hystrix usage, non-blocking.



```
output := make(chan []byte, 1)
errors := hystrix.Go("get_account", func() error {
        output <- getData(accountId)
        return nil
}, func(err error) error {
        // fallback method here
        return nil
})
```

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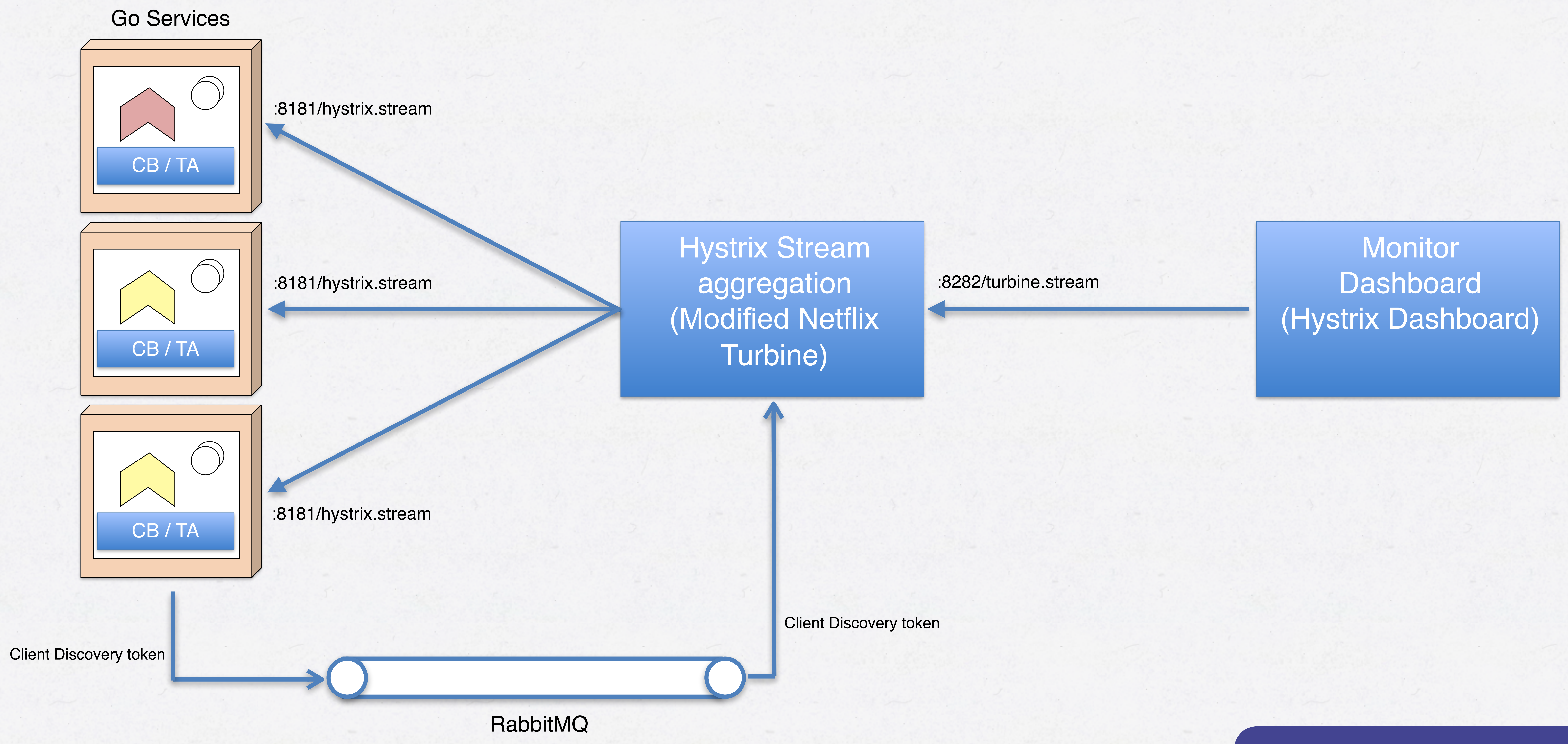
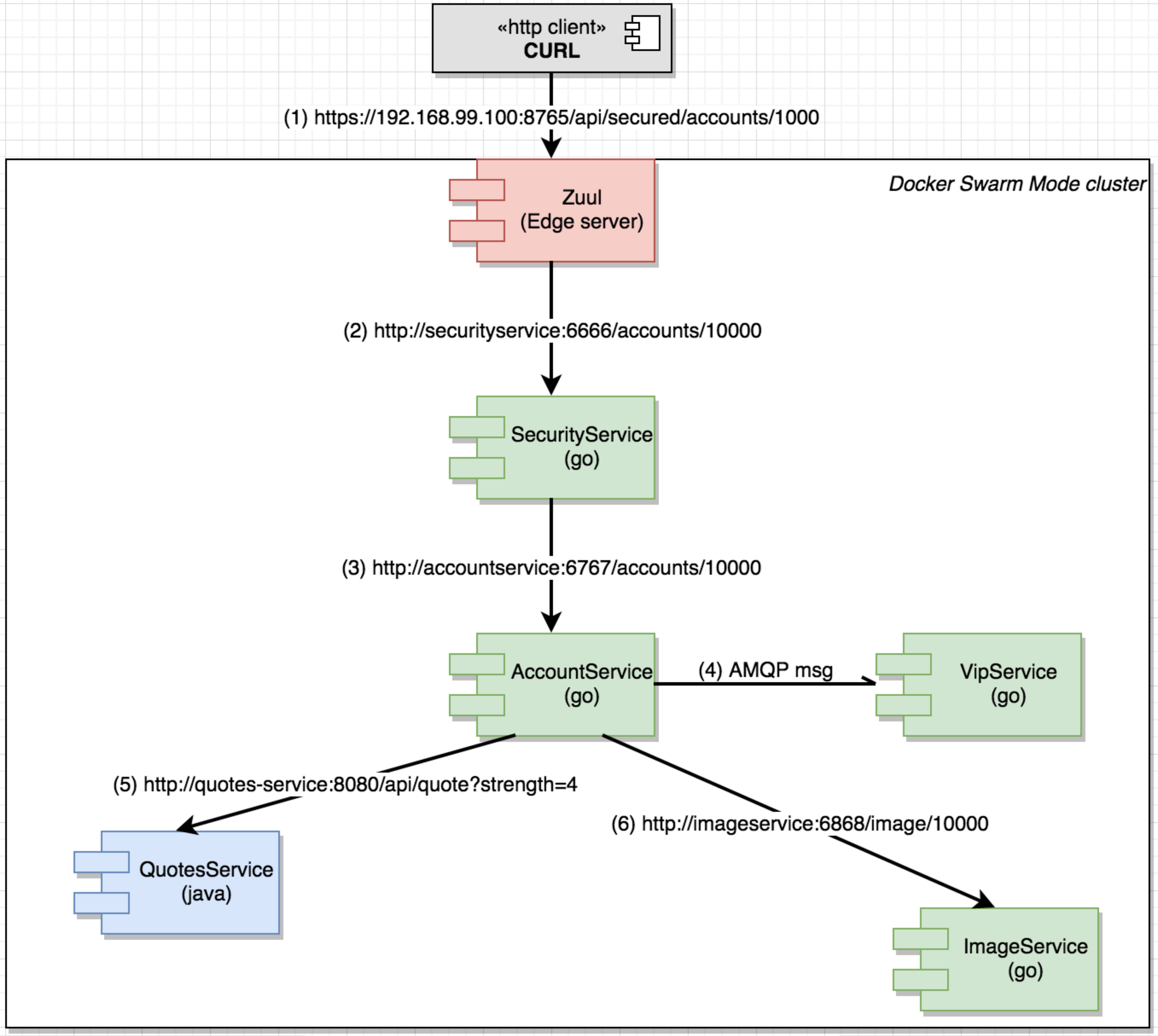
CIRCUIT BREAKING

- Hystrix stream aggregation using customized Netflix Turbine



Demo 5 -
Hystrix Dashboard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Zuul
(Edge server)
(2) http://securityservice:6666/accounts/10000
SecurityService
(go)
(3) http://accountservice:6767/accounts/10000
AccountService
(go)
(4) AMQP msg
VipService
(go)
(5) http://quotes-service:8080/api/quote?strength=4
QuotesService
(java)
(6) http://imageservice:6868/image/10000
ImageService
(go)

SUMMARY

- Go is an interesting option for microservices due to runtime characteristics and rather pleasant developing.
  - Although but not without it’s fair share of quirks especially regarding the lack of traditional OO constructs and missing generics.
- Microservice development in Go requires a bit of work regarding integration with supporting services, but can be mitigated by using integration libraries such as go-kit or our own little toolkit.
  - Don’t be afraid to pick your favorite libraries!

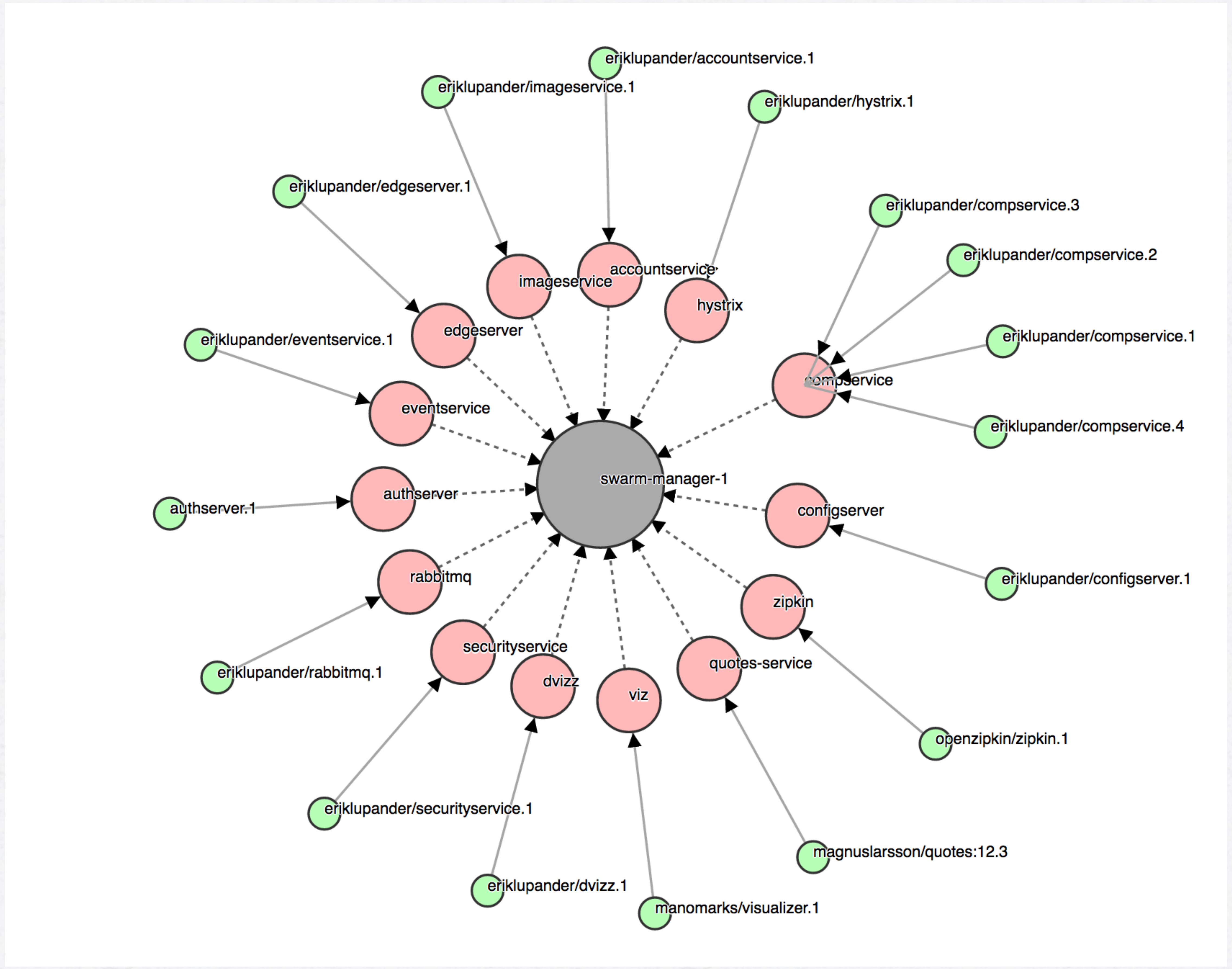
WANT TO LEARN MORE?

- Nic Jackson
- July 2017 from Packt
- Technical reviewers:
  - Magnus Larsson
  - Erik Lupander

Nic Jackson
Building Microservices with Go
Build seamless, time efficient and robust microservices with Go
Packt

DVIZZ - A DOCKER SWARM VISUALIZER

- https://github.com/eriklupander/dvizz
- Pull requests are more than welcome!


eriklupander/accountservice.1
eriklupander/imageservice.1
eriklupander/hystrix.1
eriklupander/edgeserver.1
eriklupander/compservice.3
eriklupander/compservice.2
eriklupander/compservice.1
eriklupander/compservice.4
eriklupander/eventservice.1
imageservice
accountservice
hystrix
edgeserver
compservice
eventservice
swarm-manager-1
authserver.1
authserver
configserver
eriklupander/configserver.1
rabbitmq
zipkin
eriklupander/rabbitmq.1
securityservice
dvizz
viz
quotes-service
openzipkin/zipkin.1
eriklupander/securityservice.1
magnuslarsson/quotes:12.3
eriklupander/dvizz.1
manomarks/visualizer.1

RESOURCES

- My 12-part blog series: http://callistaenterprise.se/blogg/teknik/2017/02/17/go-blog-series-part1/
- Demo landscape source code: https://github.com/callistaenterprise/goblog
  - Branch ”nov2017”
- Spring Cloud Netflix: https://cloud.spring.io/spring-cloud-netflix/
- go-kit: https://github.com/go-kit/kit
- dvizz: https://github.com/eriklupander/dvizz
- packt book: https://www.packtpub.com/application-development/building-microservices-go

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Questions?

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