Serverless architecture: Functions as a Service

#LvivJS2017

Dzmitry Varabei

EPAM, Chief Software Engineer

#rollingscopes
#rsschool

#rsconf


C
BLOCK
Я ВЧИВ БІЛОРУСІВ
JAVASCRIPT
C
BLOCK
БІЛОРУСІВ, КАРЛ

Часть #1. Предисловие


– Кем вы видите себя в нашей компании через 5 лет?
– Никем.


CEO?
Manager?
Team Lead?
Senior?
3.
2.
1.

Кто-нибудь хочет быть Архитектором?

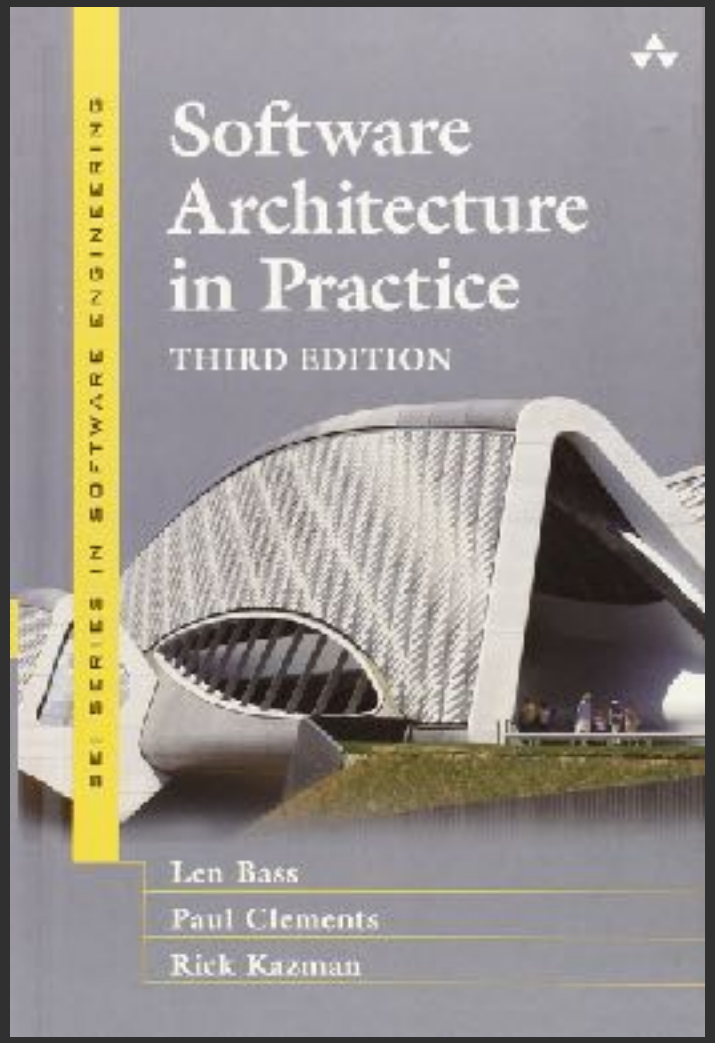
Точнее Software Architect

Часть #2.

Исследование на тему
“Кто такой Software/Solution Architect”

Поговорил с архитекторами

Почитал книгу



Сходил на курсы

SOLUTION ARCHITECTURE
SCHOOL

eit Digital
PROFESSIONAL SCHOOL

coursera

Software Architecture for the Internet of Things

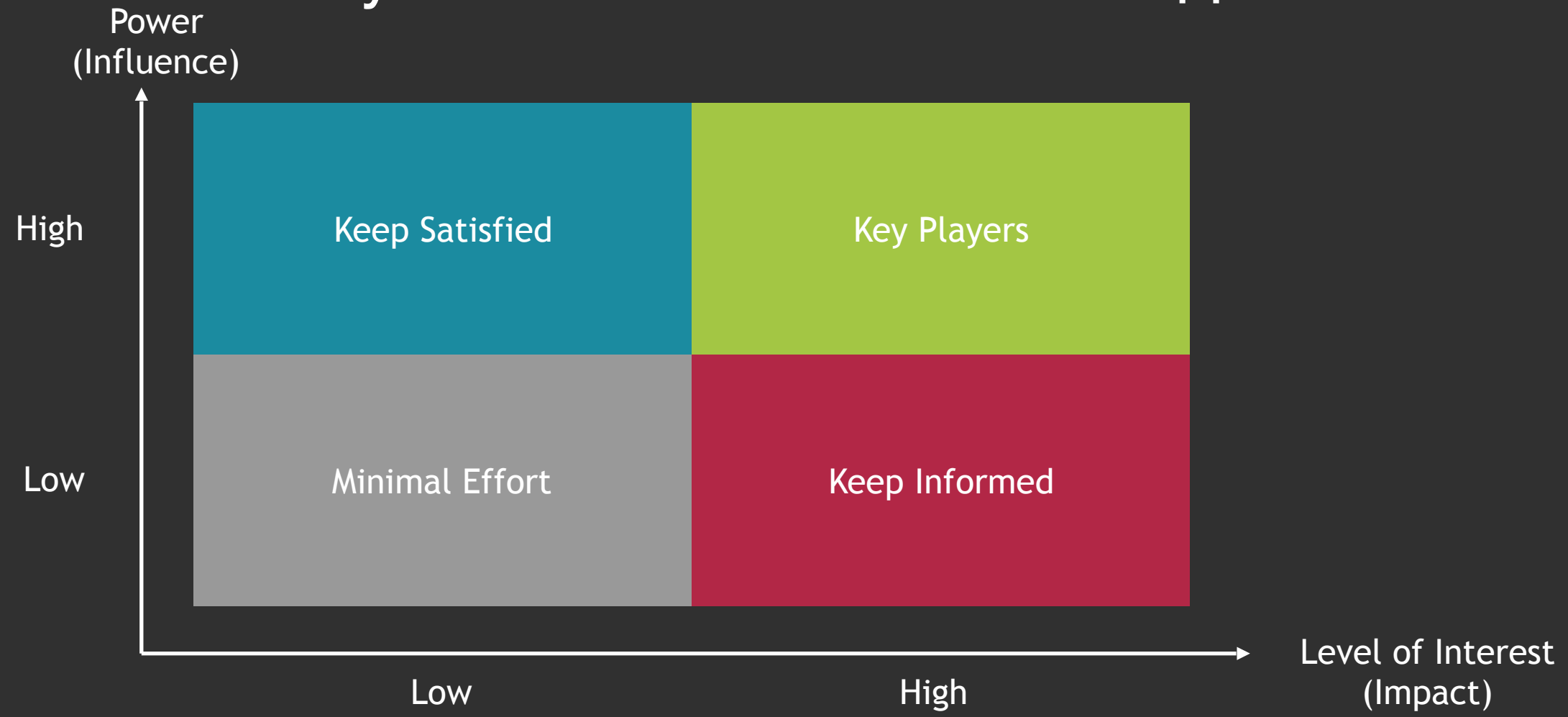
Аналогия №1

Аналогия №2

TDD & Test First

- Много командировок (до 25% рабочего времени)
- Много общения с заказчиком
- Много общения с заказчиками заказчиков
- Много общения с sales отделом
- Много общения с разработчиками
- Много эстимирования, прогнозирования и т.д.
- Много подготовки различной документации
- Много рисования диаграмм
- ГДЕ КРАСИВЫЙ КОД??????
- ГДЕ ХОТЬ КАКОЙ-НИБУДЬ КОД??????

Классификация и приоритизация заказчиков или кого слушать и что же всё-таки делать



- Попытаться понять реальные бизнес цели
- Понять требования (иногда противоречивые)
- Определить основные не функциональные требования (ASR)

Байка №1

0.6 sec

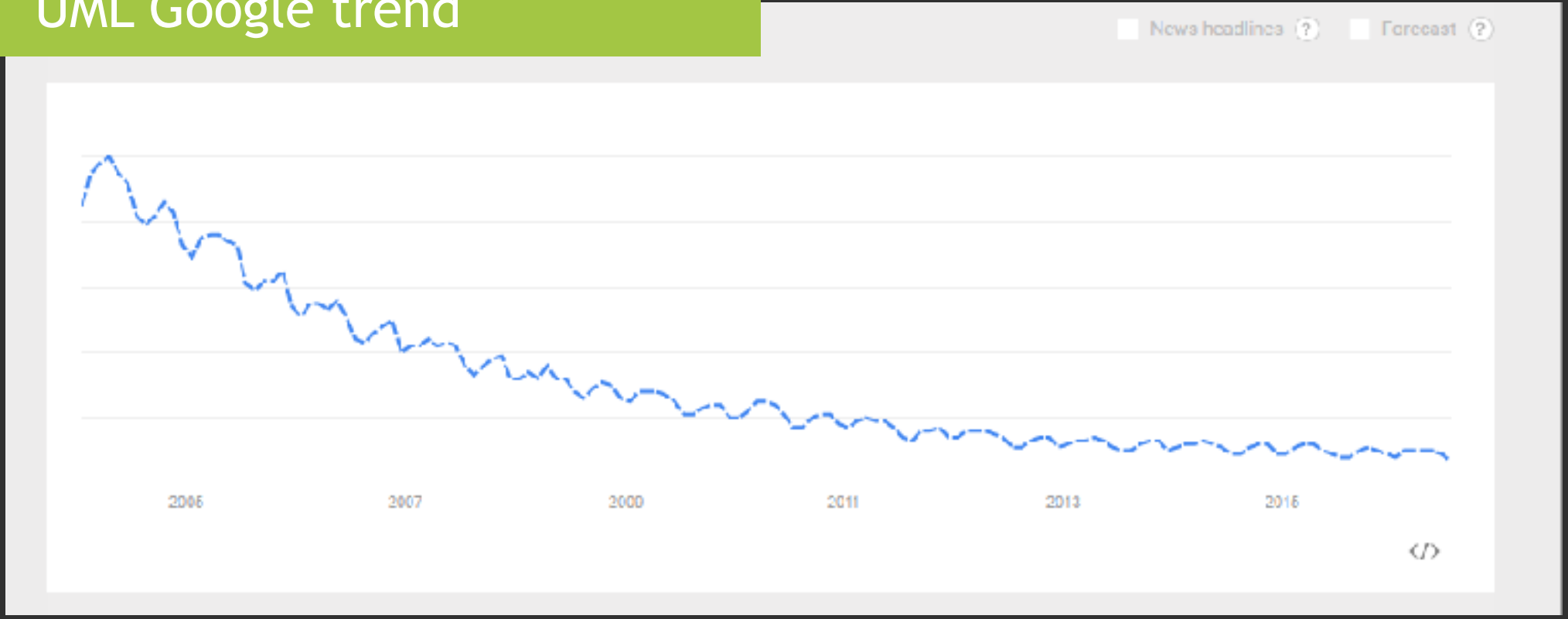
- Work breakdown structure
- Estimations
- Resource plan
- Release schedule

Вас когда-нибудь просили подготовить документацию?

Нарисовать пару диаграмм?

Хорошие новости

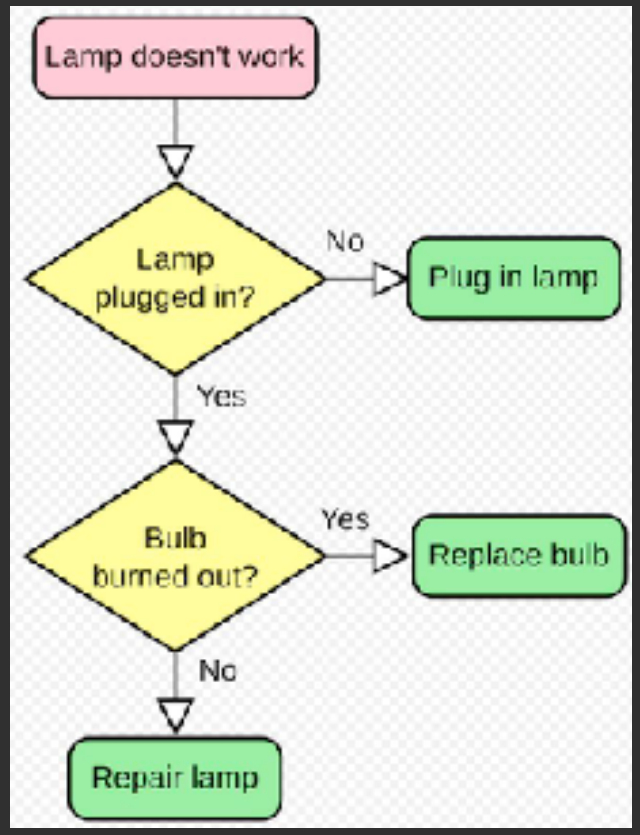
UML Google trend



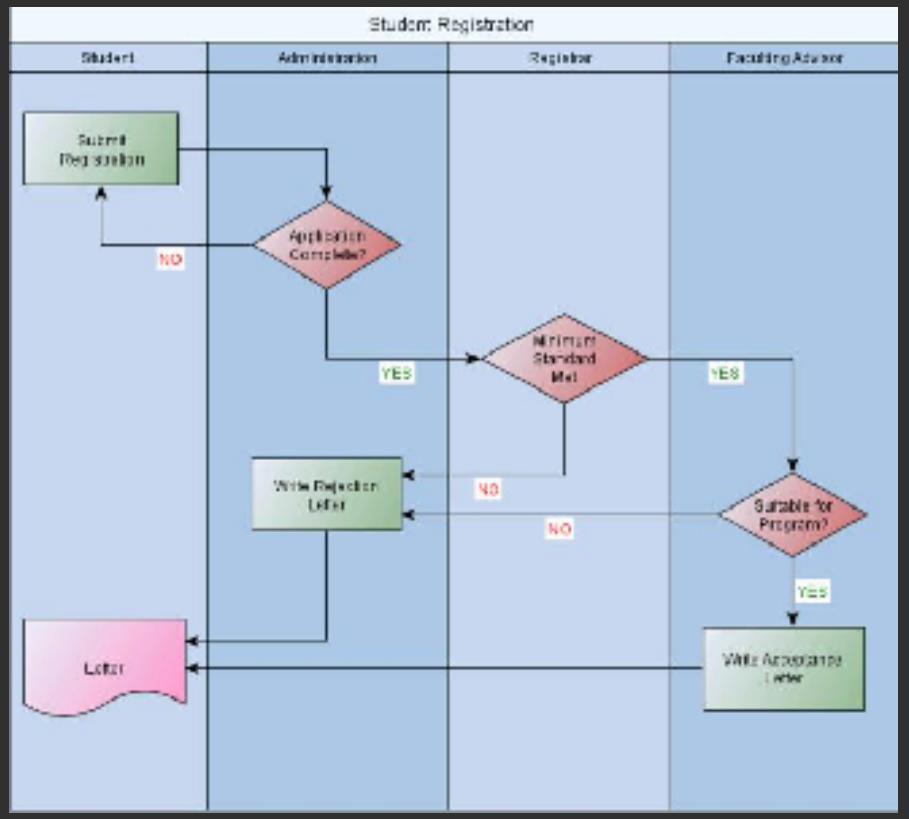
В природе 150+ классифицированных видов диаграмм

Например

Flowchart

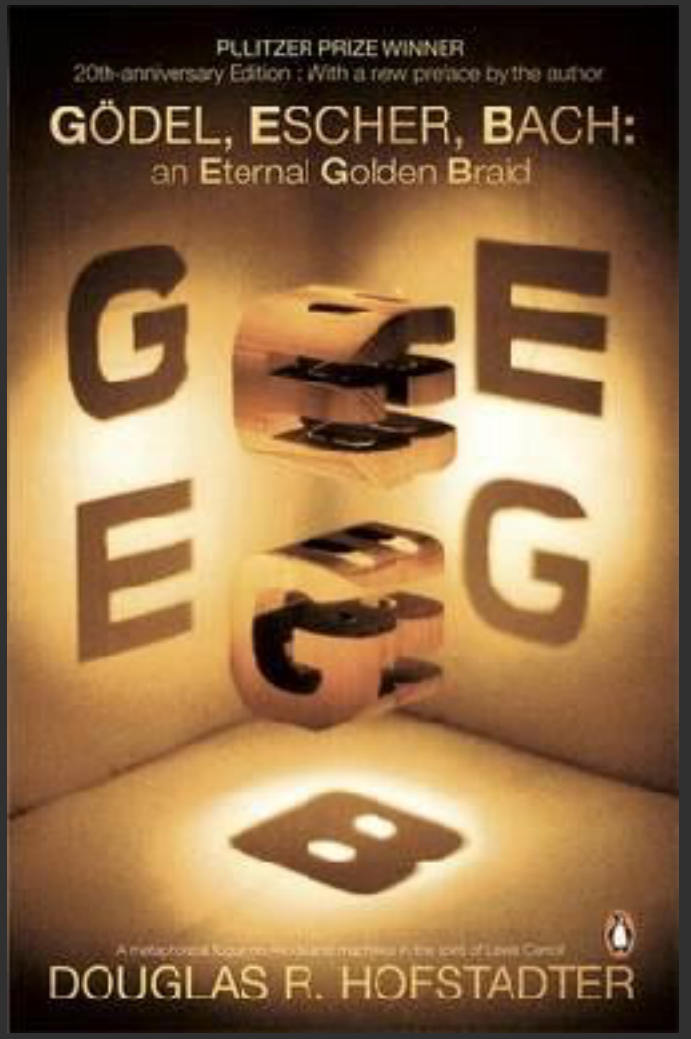


Swimlane



В это время на реальном проекте:

“линии и блоки
в powerpoint” без легенды
и текстового описания



Architecture views

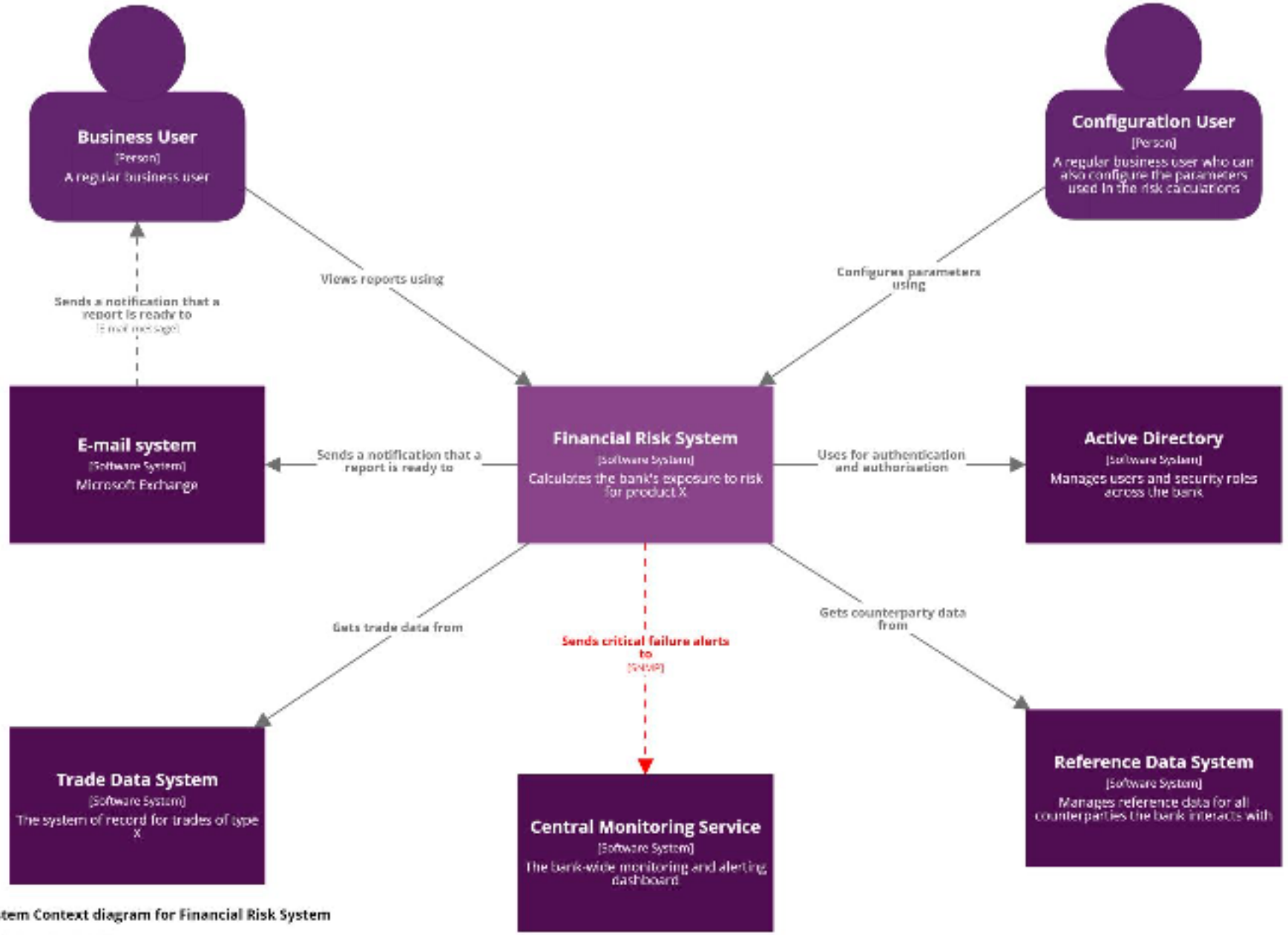
- 4 + 1 View Model
- Siemens architecture view
- Zachman framework
- TOGAF
- C4 (From developers to developers)

C4 MODEL

C4 Model

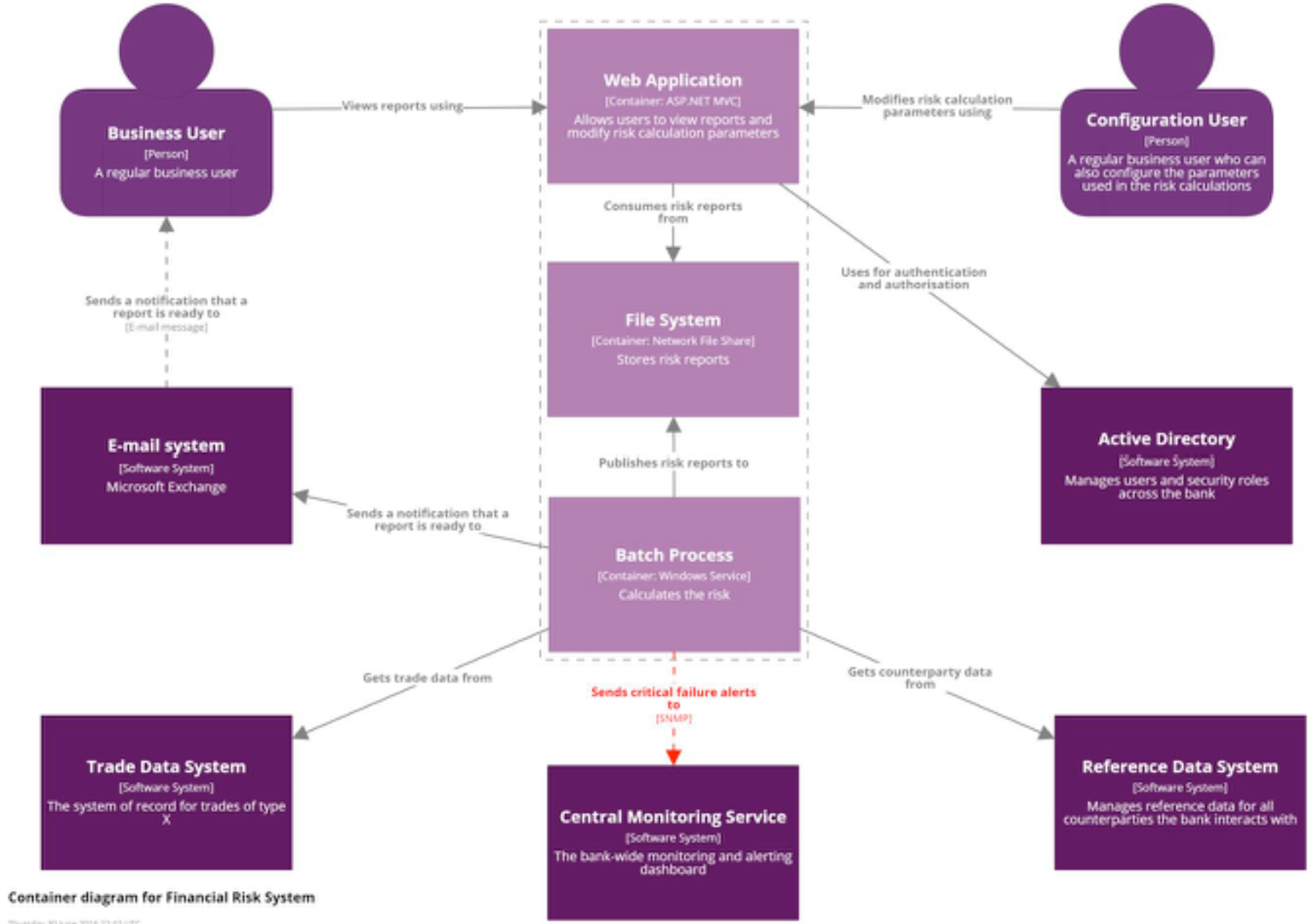
SYSTEM CONTEXT DIAGRAM	Starting point for diagramming and documenting, allows to look at the big picture. Draw a simple block diagram showing your system as a box in the centre, surrounded by its users and the other systems that it interfaces with.
CONTAINER DIAGRAM	Next step can be to illustrate the high-level technology choices with a containers diagram. By "container" I mean something like a web application, desktop application, mobile app, database, file system, etc.
COMPONENT DIAGRAM(S)	Zoom in and decompose each container further. However you decompose your system is up to you, but I tend to identify the major logical components and their interactions.
CLASS DIAGRAM(S)	This is optional, but I sometimes draw one or more UML class diagrams if I want to illustrate specific component

SYSTEM CONTEXT DIAGRAM



System Context diagram for Financial Risk System

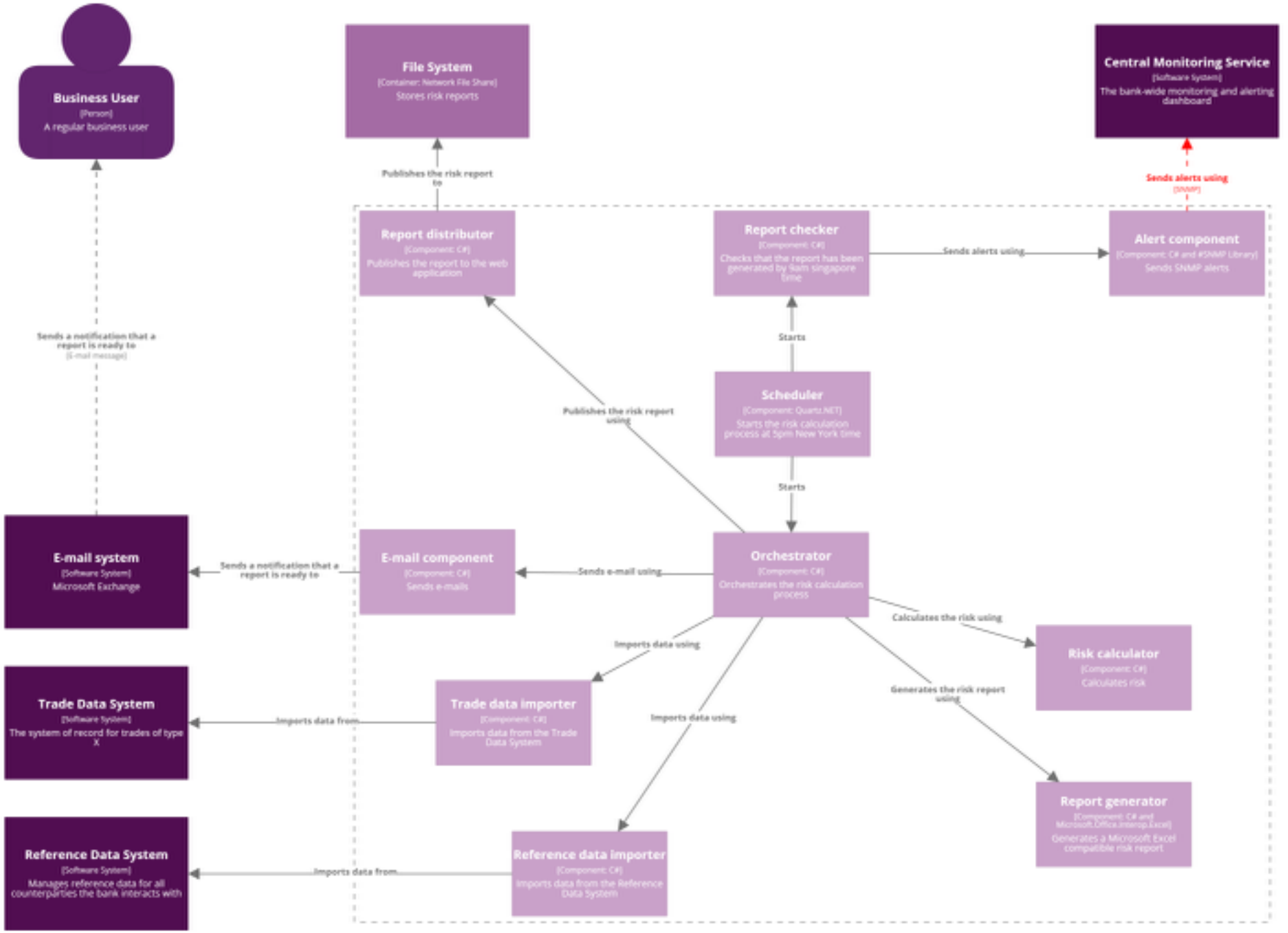
CONTAINER DIAGRAM



Container diagram for Financial Risk System

Thursday 30 June 2016 22:42 UTC

COMPONENT DIAGRAM

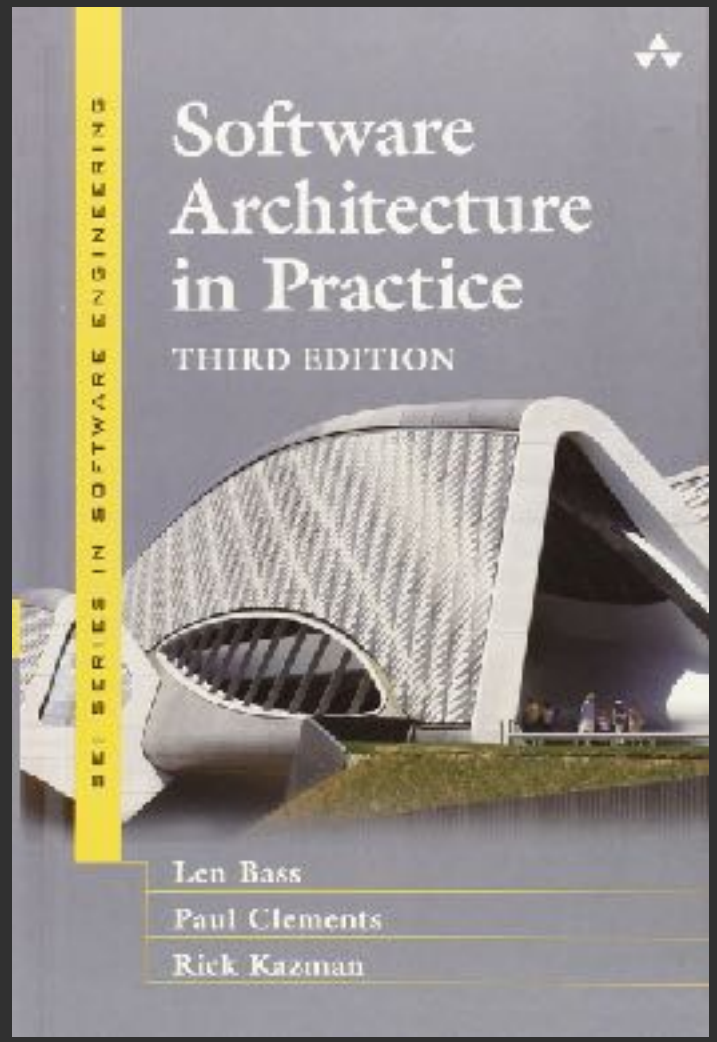


Component diagram for Financial Risk System - Batch Process

Thursday 30 June 2016 22:42 UTC

Основные атрибуты качества

Availability
Interoperability
Modifiability
Performance
Security
Testability
Usability



Availability

Availability refers to a property of software that it is there and ready to carry out its task when you need it to be. It is linked with:

- Security : if hacked it won't be available
- Performance : available but response time is 2 days???
- Fault-tolerance : can a system recover from failures

A common way to express availability is in terms of a number of nines:

Number of nines	Percentage	Minutes of downtime (year)
Three 9s	99.9%	525.6
Four 9s	99.99%	52.56
Five 9s	99.999%	5.256
Six 9s	99.9999%	0.5256


THE VERGE
TECH
SCIENCE
CULTURE
CARS
MORE
WEB
TECH
AMAZON
40
How a typo took down S3, the backbone of the internet
Hello, operator
by Casey Newton | @CaseyNewton | Mar 2, 2017, 1:24pm EST
SHARE
TWEET
LINKEDIN

In 2013, Gmail was available
99.978 percent of the time
(~2 hours per year)

И еще много интересных паттернов

Pattern: Leaky Bucket Counter

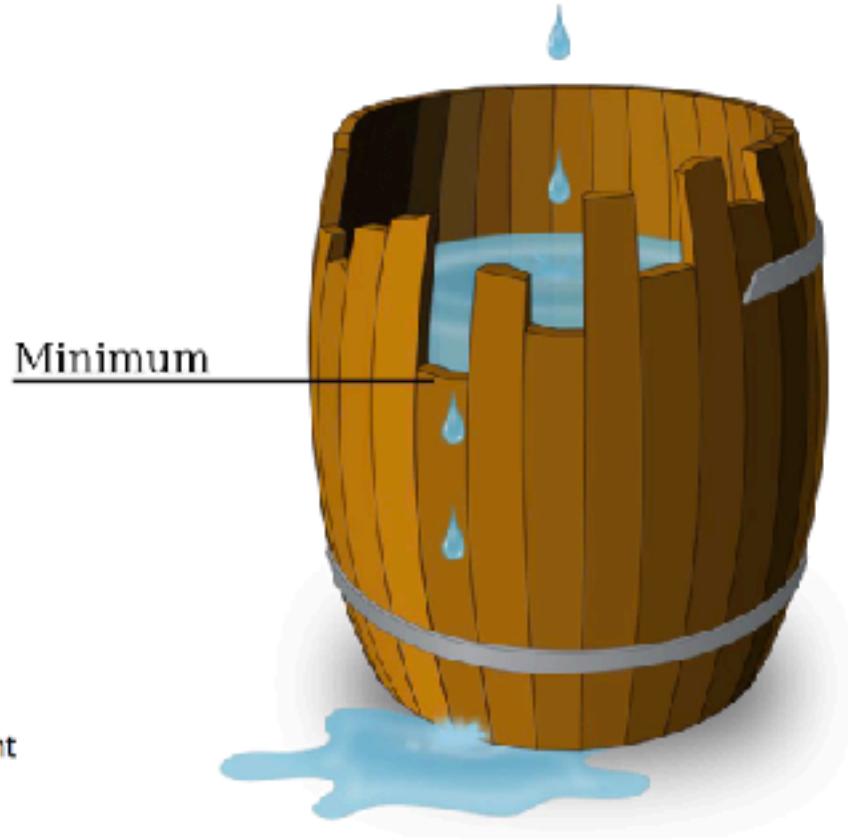
Level: Detection

Context/Risk
You system is intended to recognize and correct errors automatically. Not all errors are so critical that the first occurrence of them stimulates error processing.

Intention
You need to know if an error is transient or intermittent.

Solution:
Define your leaky bucket counter

- Initial value at the system start-up
- Incrementing when specified issue occurs
- Decrementing over specified period but never less than initial value
- If exceeding a predetermined upper threshold, handle the error as permanent



И еще много интересных паттернов

HYSTRIX

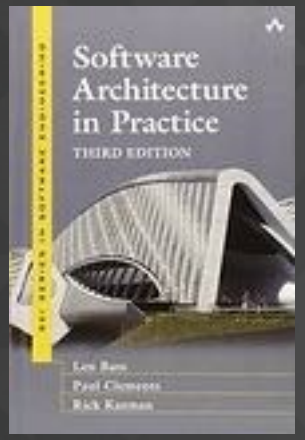
DEFEND YOUR APP

Hystrix: Latency and Fault Tolerance for Distributed Systems

OSS Lifecycle inaccessible | build failing | maven central 1.5.12 | License Apache 2

Hystrix is a latency and fault tolerance library designed to isolate points of access to remote systems, services and 3rd party libraries, stop cascading failure and enable resilience in complex distributed systems where failure is inevitable.

BOOKS



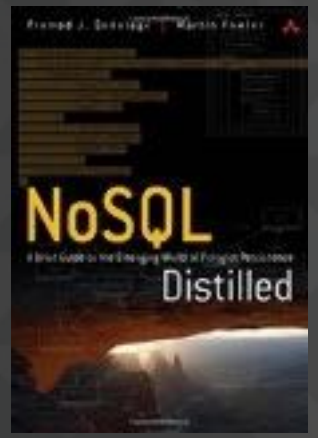
Software Architecture in Practice (3rd Edition)

Documenting Software Architectures: Views and Beyond (2nd Edition)

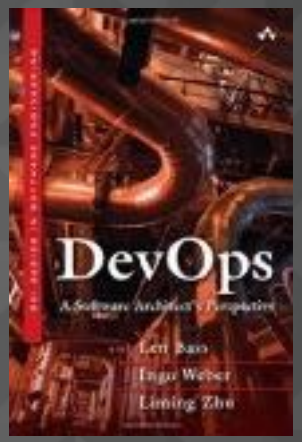
Release It! Design and Deploy Production-Ready Software

Software Systems Architecture: Working With Stakeholders Using Viewpoints and Perspectives (2nd Edition)

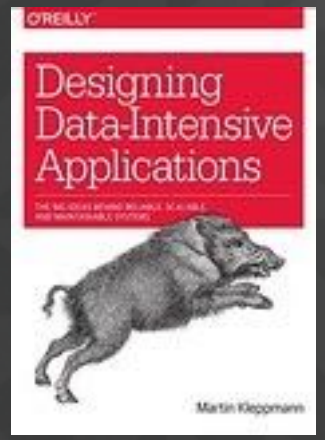
BOOKS



NoSQL Distilled: A Brief Guide to the Emerging World of Polyglot Persistence



DevOps: A Software Architect's Perspective (SEI Series in Software Engineering)



Designing Data-Intensive Applications

Continuous Delivery: Reliable Software Releases through Build, Test, and Deployment Automation

Что осталось за кадром?

Architecture styles

SOLUTION LEVEL

- MONOLITH
- SERVICE-ORIENTED
- MICROSERVICES
- EVENT-DRIVEN

COMPONENT LEVEL

- LAYERED
- MODULE-BASED
- REST

Techical Domains

SQL

Web

Cloud

Mobile

Data Streaming

BigData

Cache

NoSQL

Search

Message oriented middleware

Machine Learning

и на десерт…

Infrastructure Provisioning & Deployment

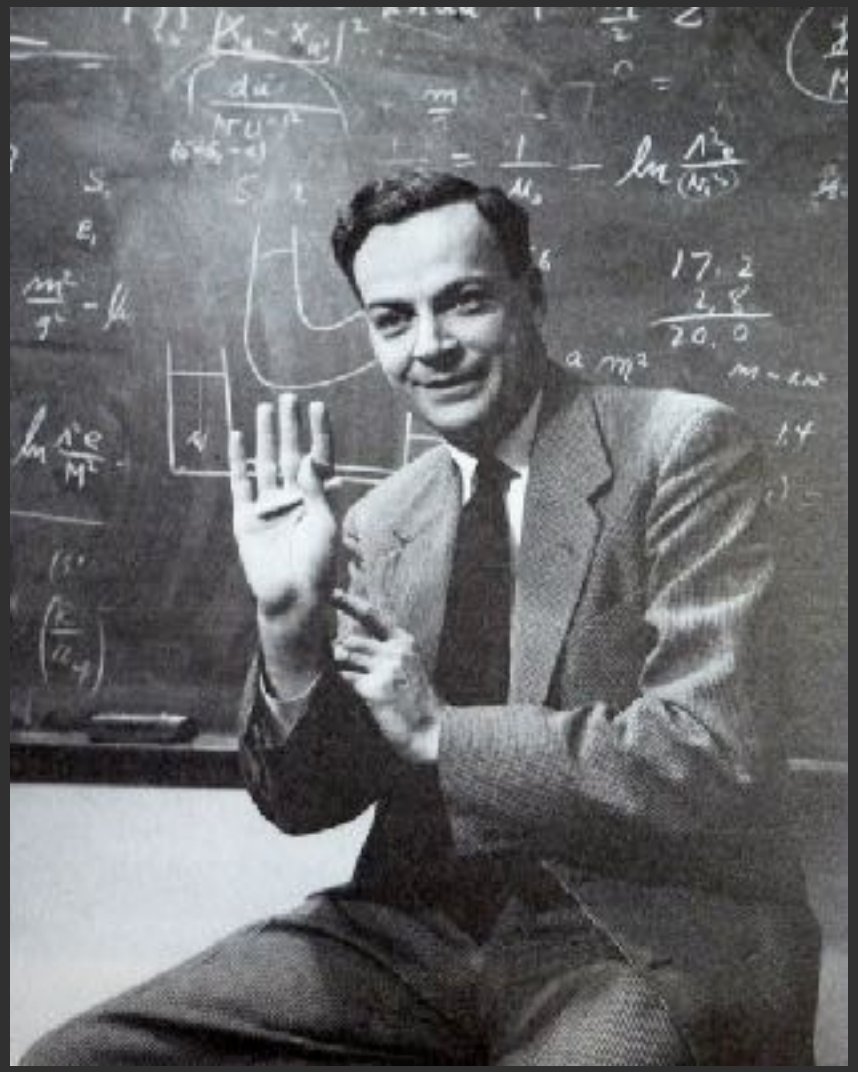
Вывод:

Читайте книги, ходите на митапы и т.д.
Не забывайте про закон Парето.

fs.writeFileSync()
fs.fsync()
fs.fsyncSync()

Скучно?

Скучно



НОБЕЛЕВСКИЙ ЛАУРЕАТ О ВРЕМЕНИ, НАУКЕ И О СЕБЕ

ВЫ, КОНЕЧНО, ШУТИТЕ, МИСТЕР ФЕЙНМАН!

Это произведение – лучшее доказательство того, что гении могут заставить вас одновременно смеяться и задумываться на весьма серьезные темы.

«New York Times»

РИЧАРД ФЕЙНМАН

Serverless architecture: Functions as a Service

#LvivJS2017

ThoughtWorks®

TECHNOLOGY RADAR *APRIL '16*

Our thoughts on the technology and trends that are shaping the future

Chapter I:
The hardest problem

The hardest problem in computer science

- …is, of course, **naming**.

Serverless architecture!

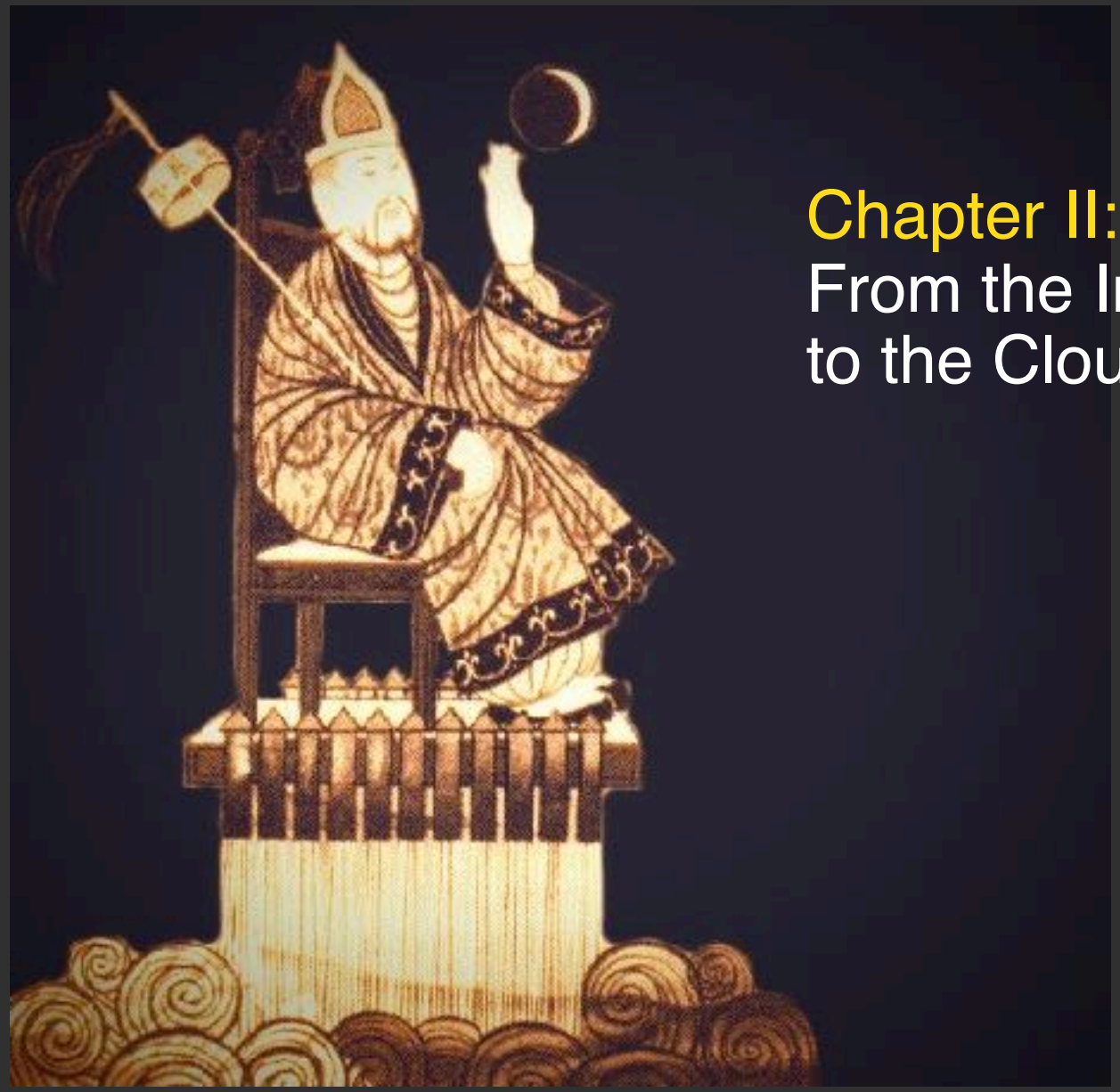
Just right for front-end devs?


02 WINS
60
Angular.js developer
CAGE
Front-end WINS
FATALITY
???
DevOps ?
Java dev?

NO
NO
NO

Fashionable Naming

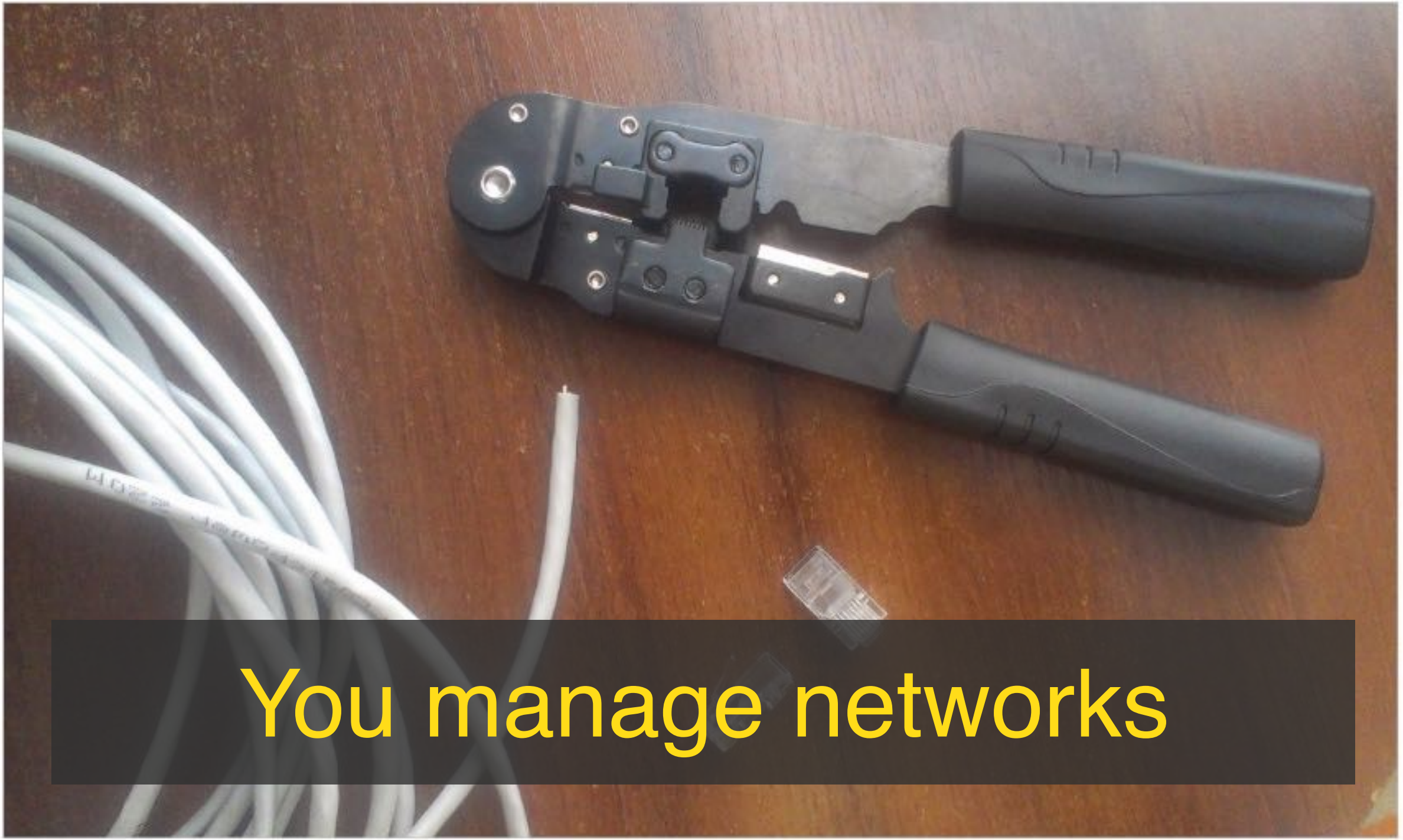
Cloud Computing
Infrastructure as a service (IaaS)
Platform as a service (PaaS)
Function as a service (FaaS)
Serverless architecture
AWS Lambda, Phoenix Environments, API Gateway,
……..



Chapter II:
From the Iron Age to the Cloud Age

Self-hosting
(aka On-premise)

You buy and install hardware

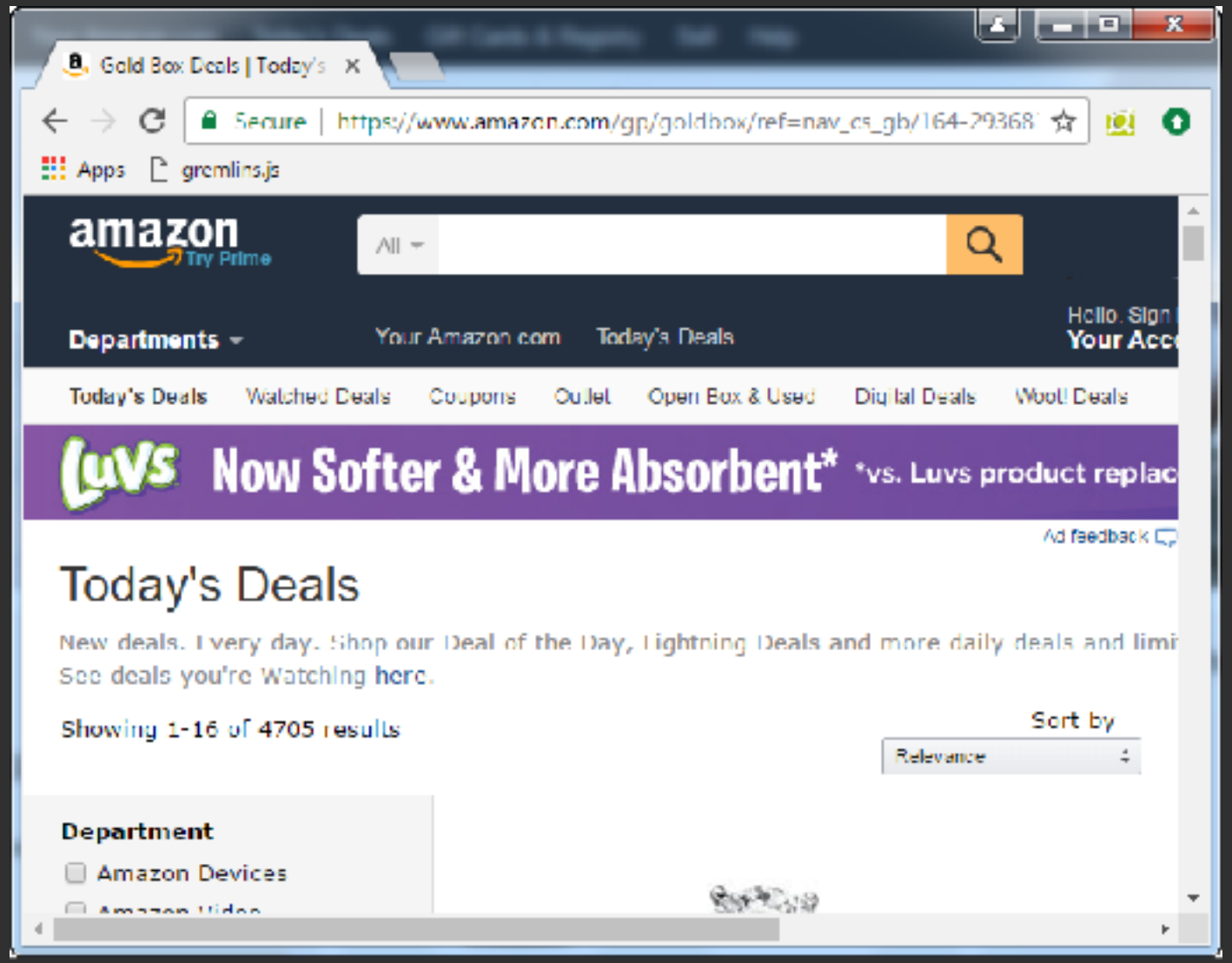

You manage networks

You scale

[Silicon Valley](http://www.imdb.com/title/tt2575988/)

You maintain

In Amazon we trust



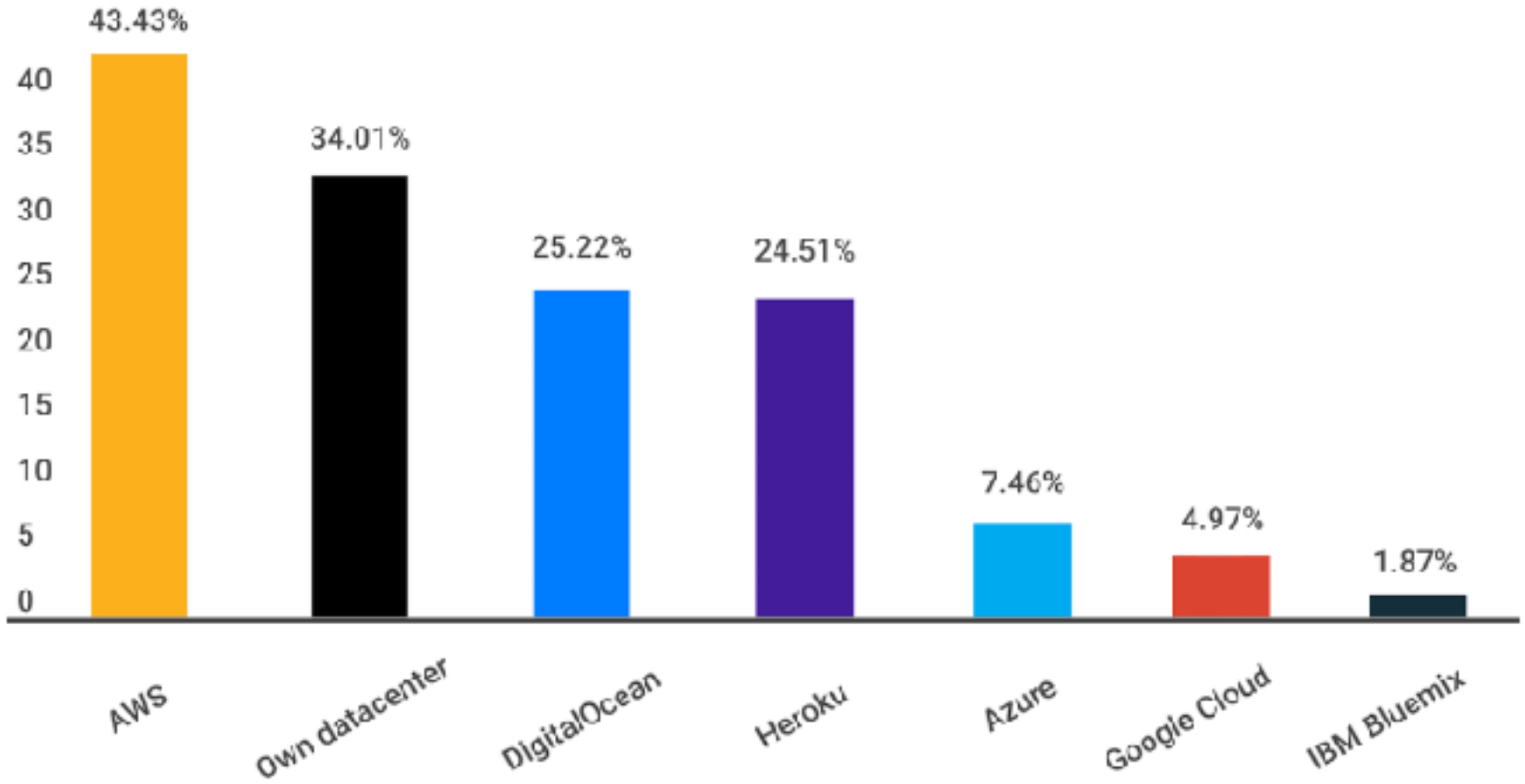
Survey

“How Developers use Node.js”
1126 Respondents

https://blog.risingstack.com/node-js-developer-survey-results-2016/

Where do you run your Node.js apps?

1126 respondents - multiple choice answers



https://blog.risingstack.com/node-js-developer-survey-results-2016/


Three DevOps Survey

Results: 80-90% AWS/Hubrid/ Private cloud

Private cloud

PayPal OpenStack Private Cloud

Physical servers: 8000+
Total cores: 400 000+
Number of VMs: 82000+
Storage: 2 petabytes
Processed $228 billion in payments last year

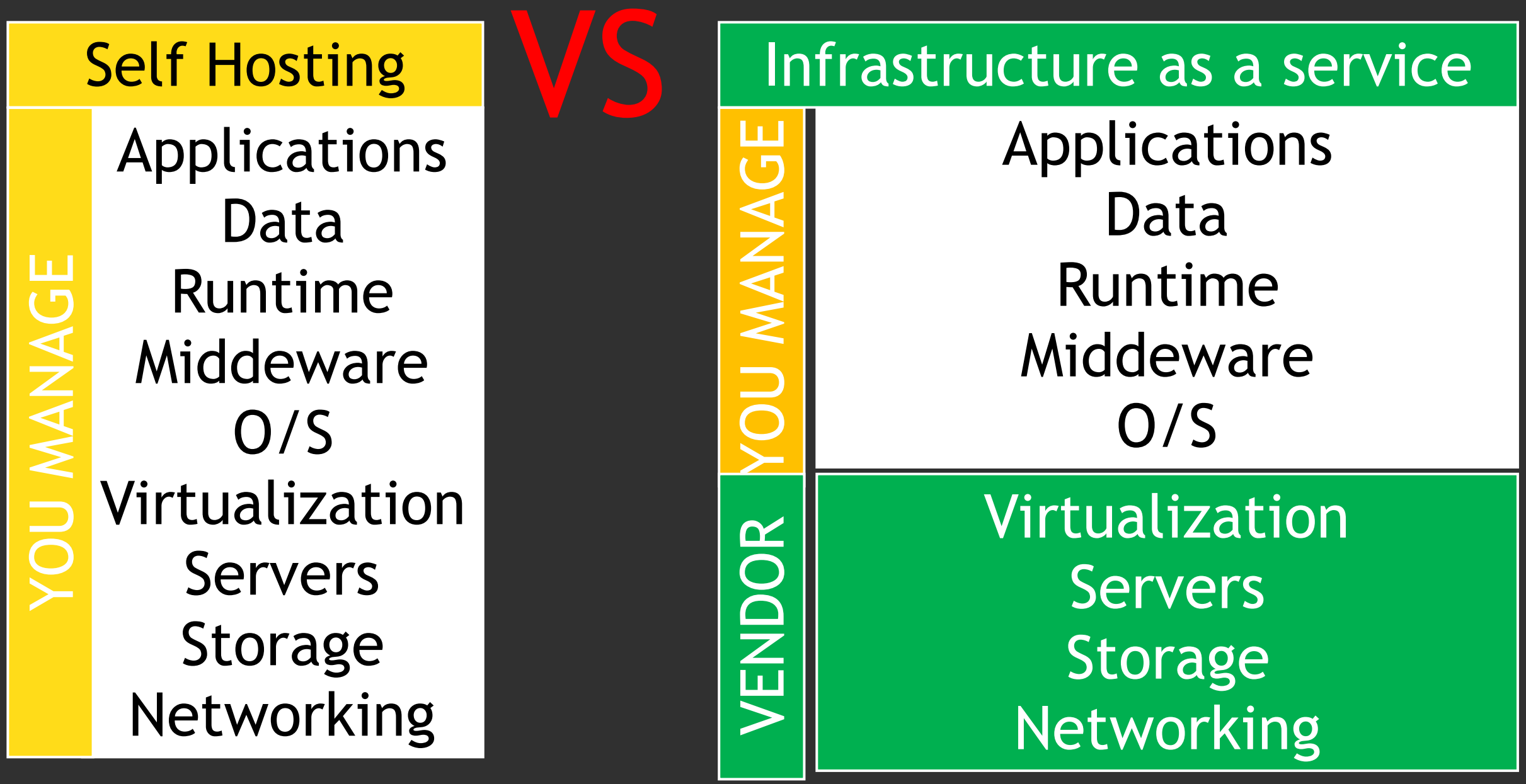
https://www.openstack.org/summit/tokyo-2015/videos/presentation/architectures-for-successful-openstack-cloud-deployment

Hybrid cloud

Chapter III:
Cloud computing services

Infrastructure as a service (IaaS)

is a form of cloud computing that provides virtualized computing resources over the Internet.


Self Hosting
YOU MANAGE
Applications
Data
Runtime
Middeware
O/S
Virtualization
Servers
Storage
Networking
VS
Infrastructure as a service
YOU MANAGE
Applications
Data
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Middeware
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VENDOR
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VS

Infrastructure as a service

YOU MANAGE

Applications
Data
Runtime
Middeware
O/S

VENDOR

Virtualization
Servers
Storage
Networking

40 servers to 5000 in 3 days

EC2 scaled to peak of 5000 instances

"Techcrunched"

ch of Facebook modification

Steady state of ~40 instances

Number

4/12/2008 4/13/2008 4/14/2008 4/15/2008 4/16/2008 4/17/2008 4/18/2008 4/19/2008 4/20/2008

Case Study

IAAS benefits

- Infrastructure in minutes
- Reduced operational cost
- Pay as you go
- Worldwide
- Scalability and flexibility
- Anytime, Anywhere, Access

“add dev/prod env, env in japan, add 1000 servers or remove 1000 servers - by clicking a button”

Inappropriate Usage Examples

- Where regulatory compliance makes the offshoring or outsourcing of data storage and processing difficult
- Where the highest levels of performance are required, and on-premise or dedicated hosted infrastructure has the capacity to meet the organization’s needs

Compute
EC2
EC2 Container Service
Lightsail
Elastic Beanstalk
Lambda
Batch

Storage
S3
EFS
Glacier
Storage Gateway

Database
RDS
DynamoDB
ElastiCache
Redshift

Networking & Content Delivery
VPC
CloudFront
Direct Connect
Route 53

Migration
Application Discovery Service
DMS
Server Migration
Snowball

Developer Tools
CodeStar
CodeCommit
CodeBuild
CodeDeploy
CodePipeline
X-Ray

Management Tools
CloudWatch
CloudFormation
CloudTrail
Config
OpsWorks
Service Catalog
Trusted Advisor
Managed Services

Security, Identity & Compliance
IAM
Inspector
Certificate Manager
Directory Service
WAF & Shield
Compliance Reports

Analytics
Athena
EMR
CloudSearch
Elasticsearch Service
Kinesis
Data Pipeline
QuickSight

Artificial Intelligence
Lex
Polly
Rekognition
Machine Learning

Internet Of Things
AWS IoT
AWS Greengrass

Contact Center
Amazon Connect

Game Development
Amazon GameLift

Mobile Services
Mobile Hub
Cognito
Device Farm
Mobile Analytics
Pinpoint

Application Services
Step Functions
SWF
API Gateway
Elastic Transcoder

Messaging
Simple Queue Service
Simple Notification Service
SES

Business Productivity
WorkDocs
WorkMail
Amazon Chime

Desktop & App Streaming
WorkSpaces
AppStream 2.0


Наша
свадьба

AWS Spot Market

“At the time of writing this (October 2016), an On-Demand r3.2xlarge instance (with 8 vCPUs and 61 GB RAM) costs $0.665 per hour in the US East region. However, the current Spot price for that instance is only $0.10… a cost savings of over 80%!”

https://databricks.com/blog/2016/10/25/running-apache-spark-clusters-with-spot-instances-in-databricks.html

AWS Spot Market

“Foursquare has started using the service, performing analytics across more than three million daily checkins and has reduced analytics costs by more than 50%. They have decreased processing time for urgent data-analysis, all without requiring additional application development or adding risk to the company’s analytics.”

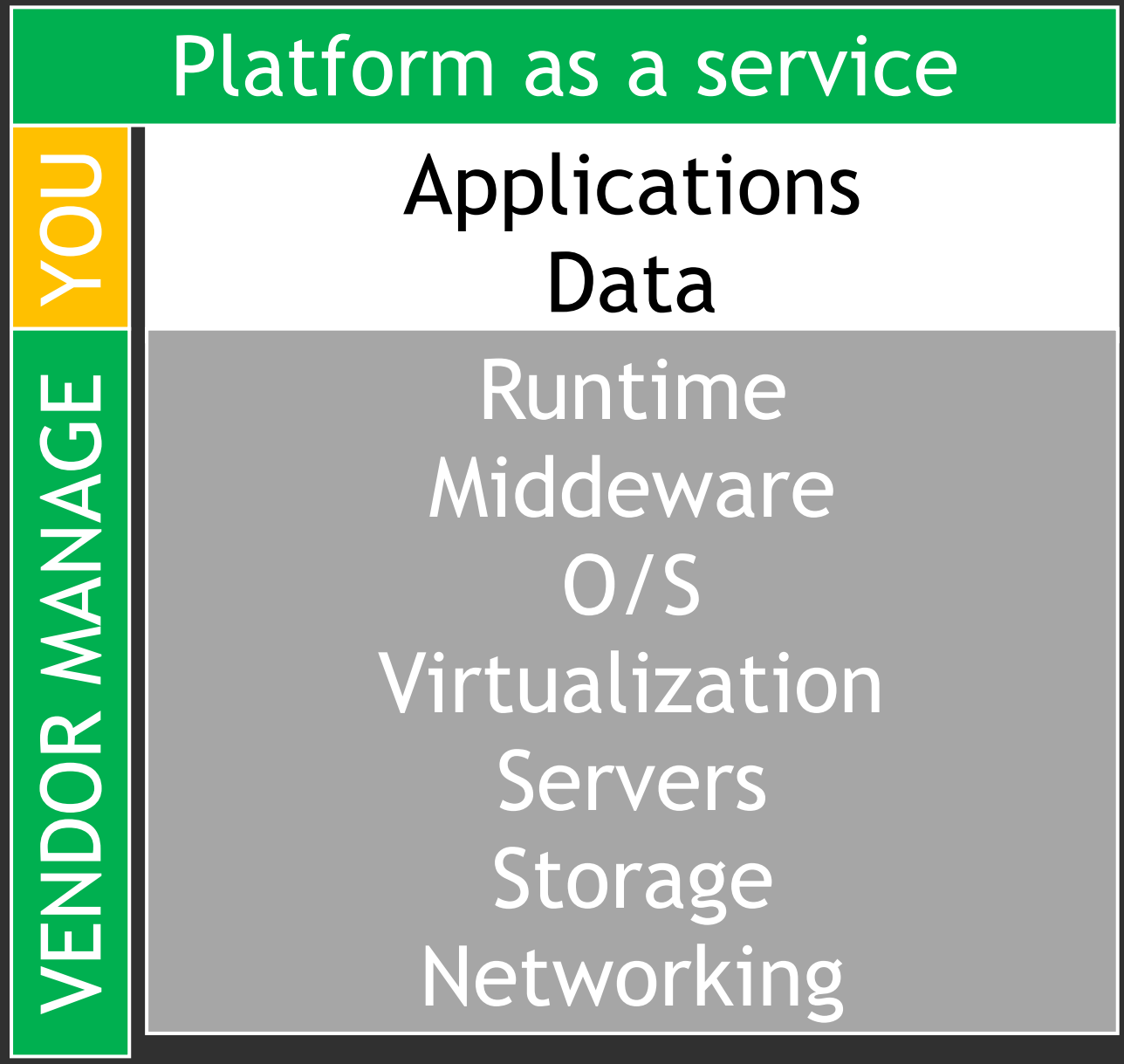
https://siliconangle.com/blog/2011/08/18/amazon-web-services-offers-spot-market-capabilities-for-managing-hadoop-clusters/

Используя облачные сервисы, можно собирать очень крутые прототипы БЫСТРО.

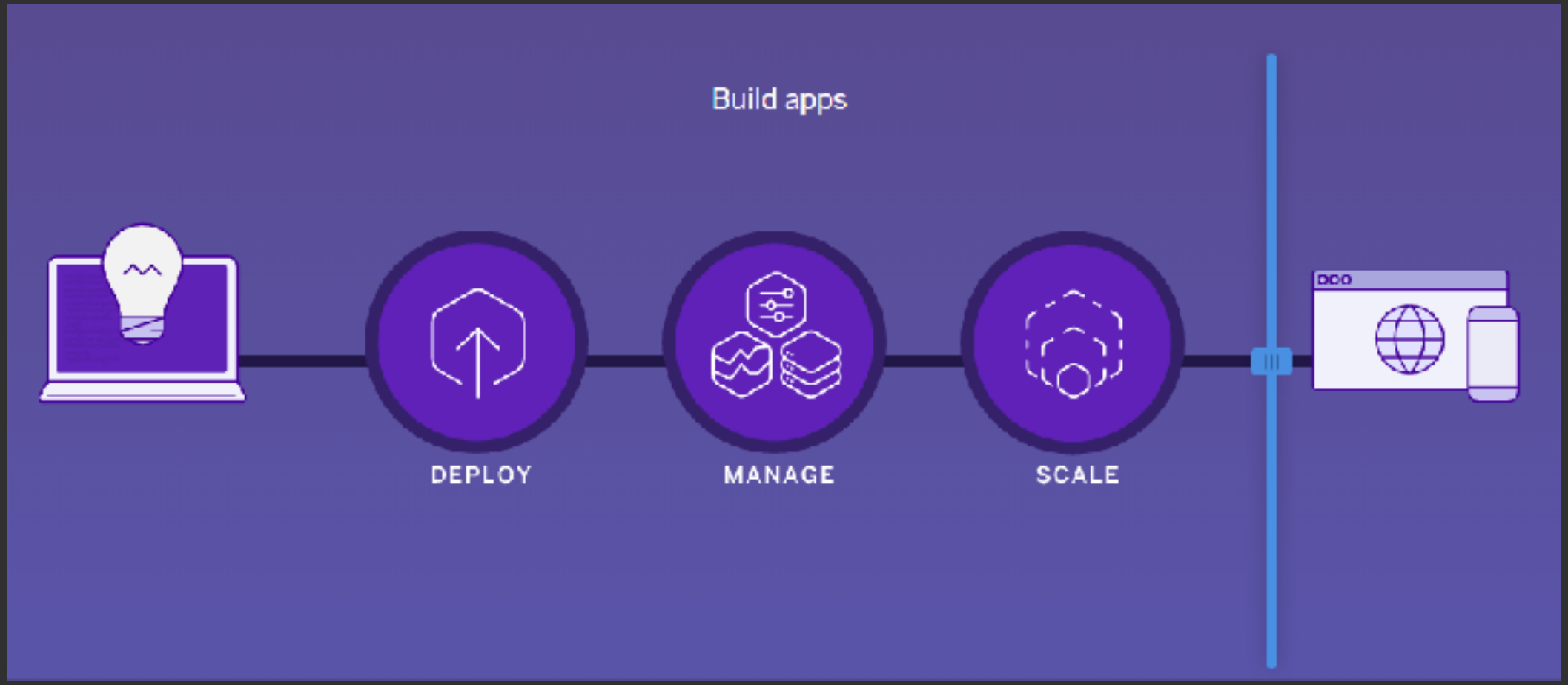
Примеры:

- госпиталь будущего
- кофеварки будущего

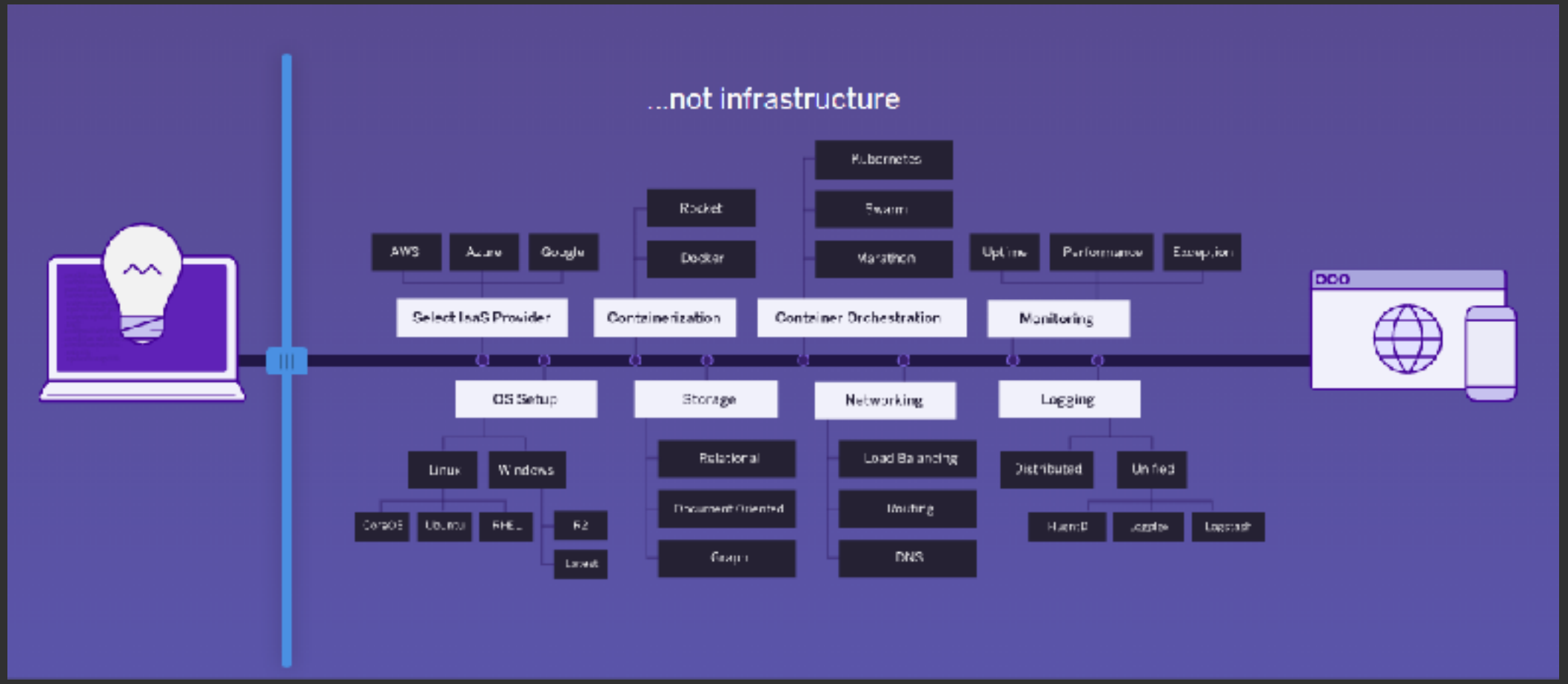
Platform as a service


Platform as a service
YOU
VENDOR MANAGE
Applications
Data
Runtime
Middeware
O/S
Virtualization
Servers
Storage
Networking

Heroku: “Build apps…

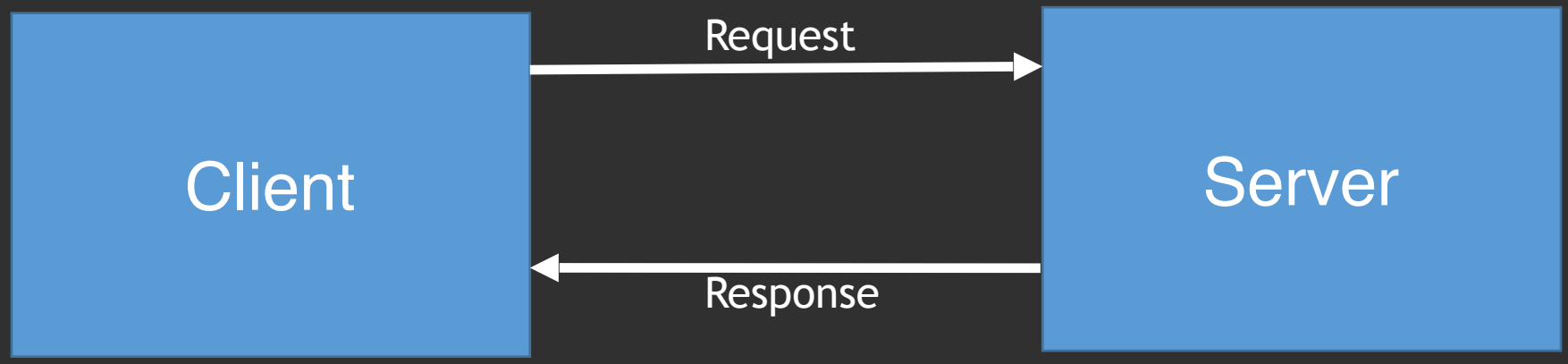


Heroku: “… not infrastructure”



Chapter III:
Scalability and cost basics

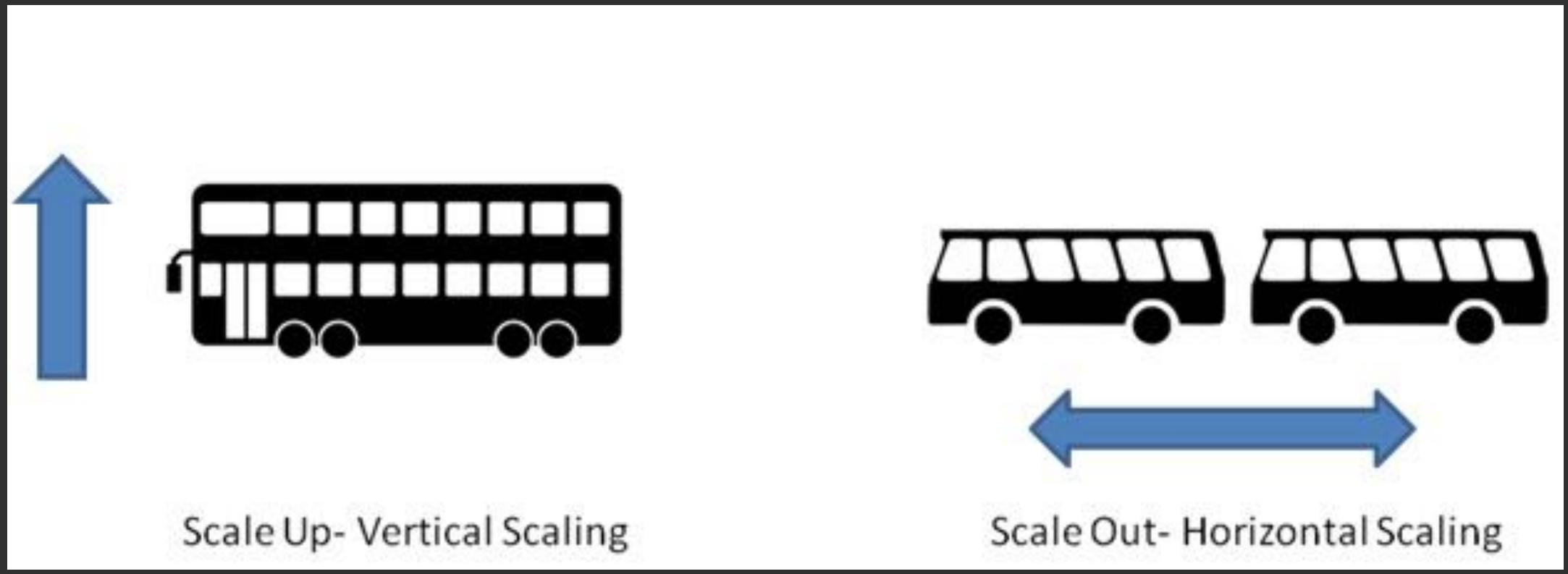
Classic Client-Server Architecture



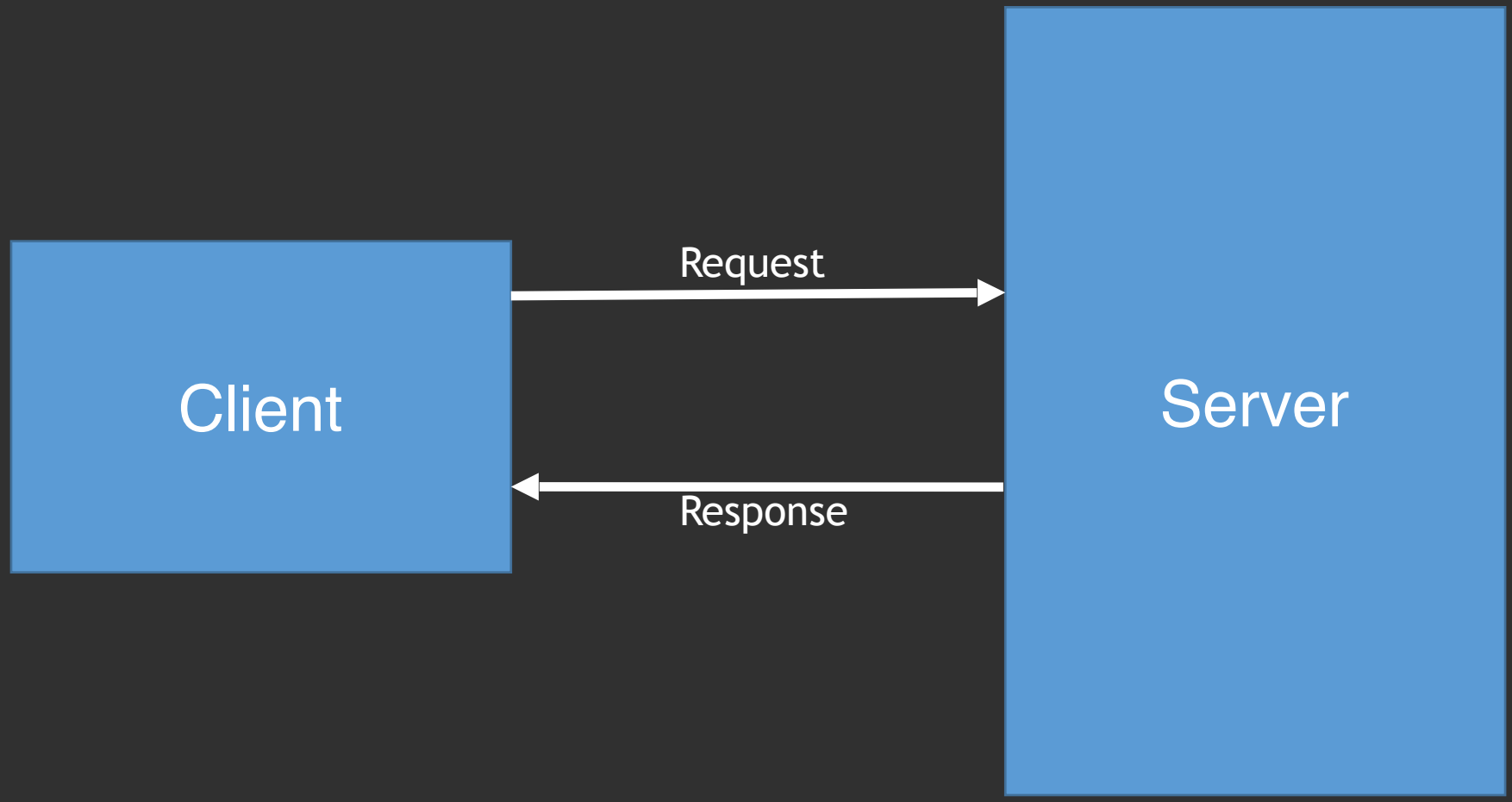
What about scaling?

10 users -> 10000+ users

Vertical scaling

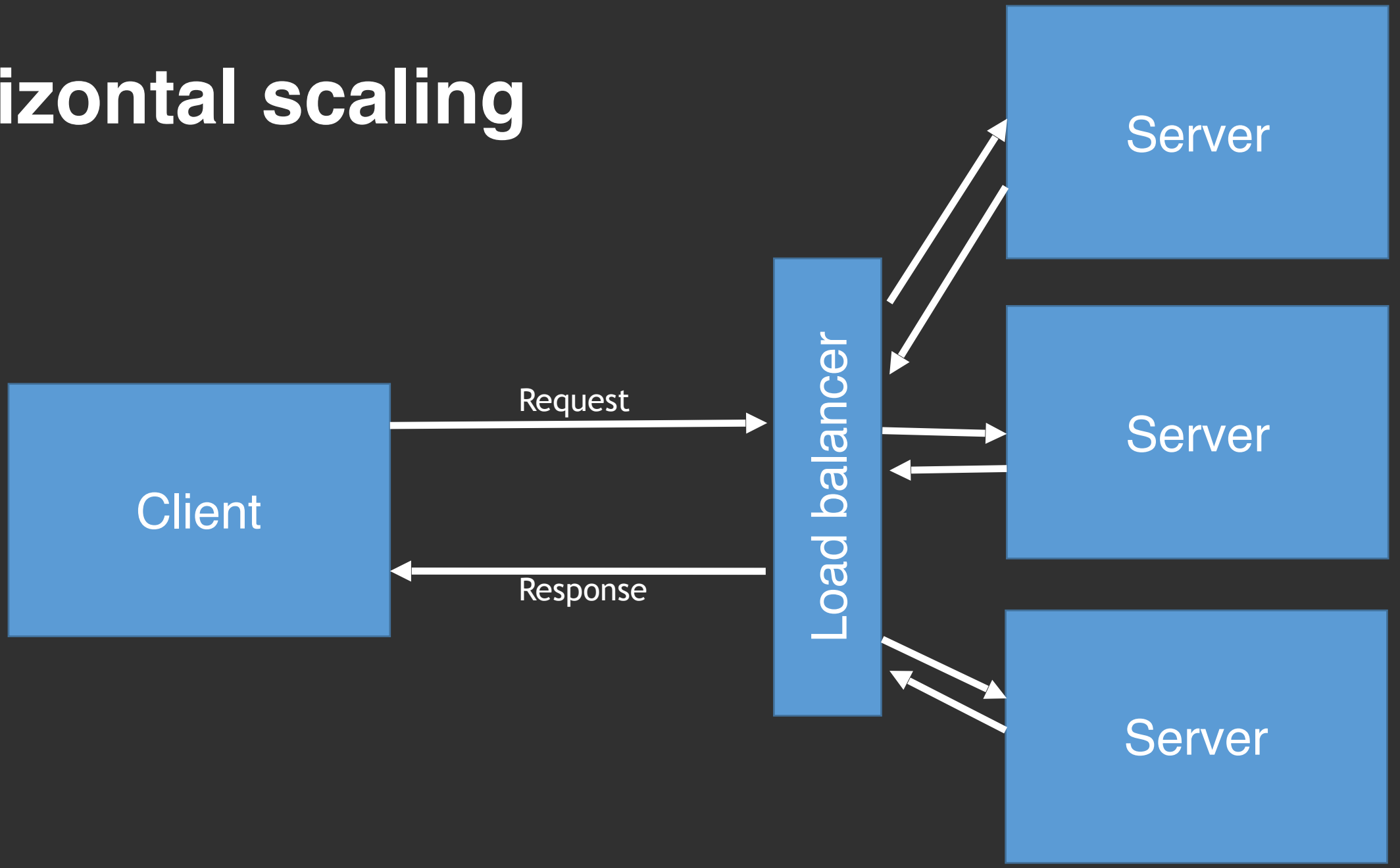


Vertical scaling



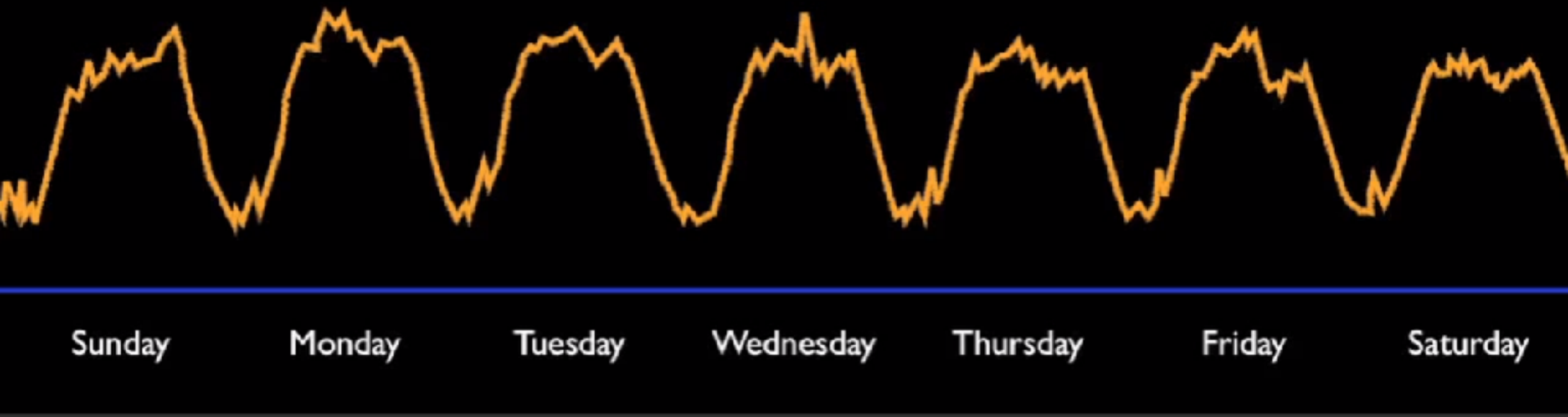
That’s enough for 90 percent of projects

Horizontal scaling



Traffic story

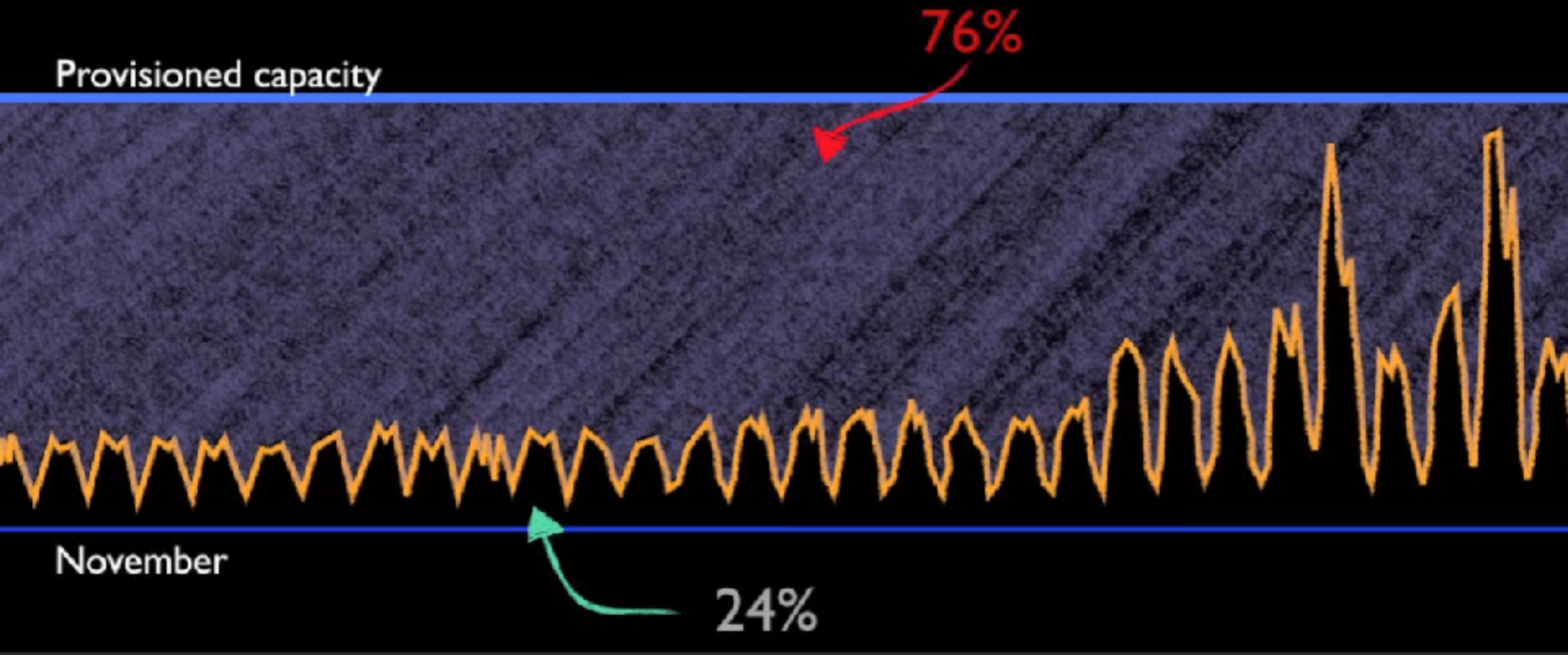
Typical weekly traffic to Amazon.com



https://www.youtube.com/watch?v=DERzYnthq1s

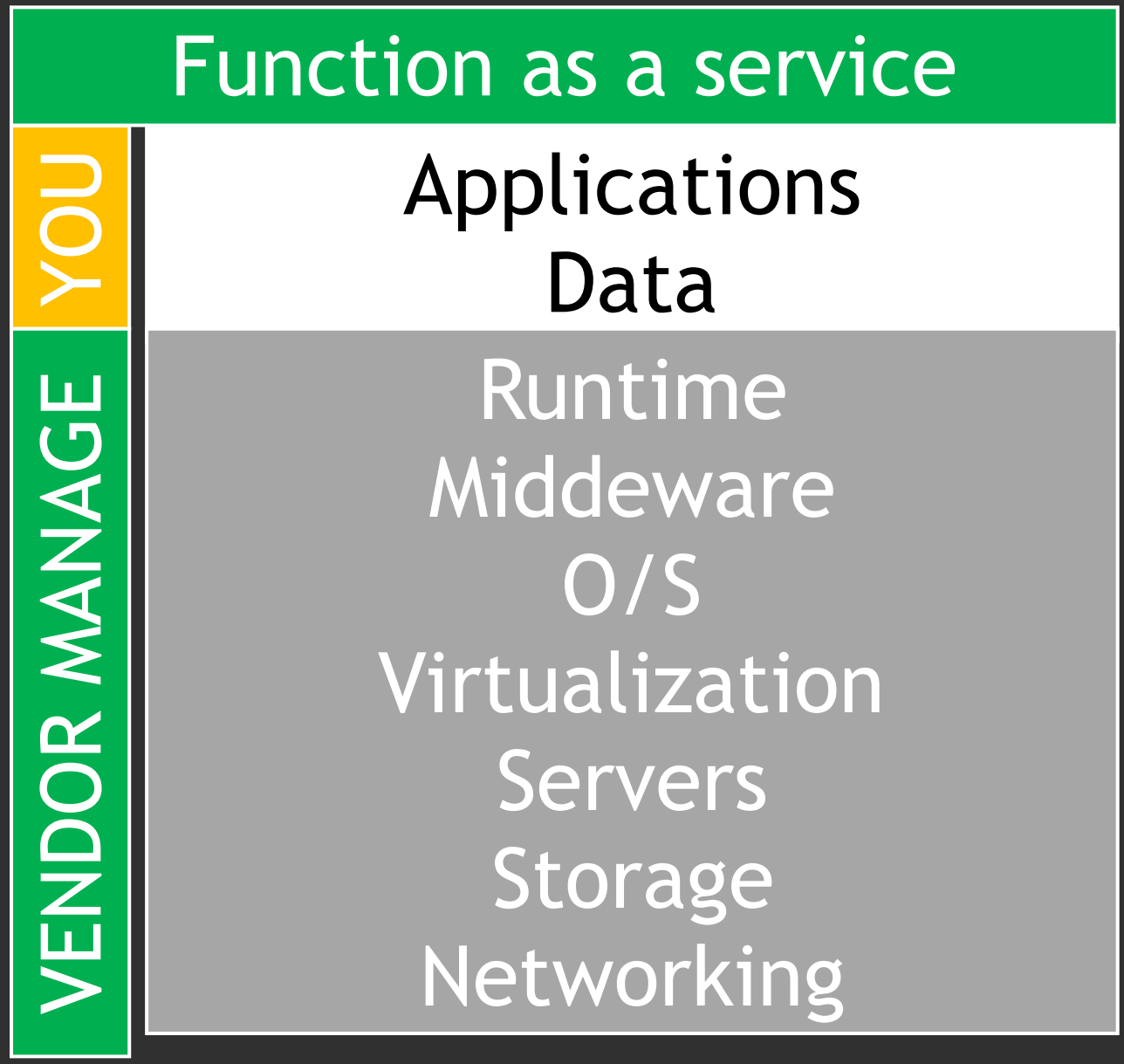
Black Friday

November traffic to Amazon.com



https://www.youtube.com/watch?v=DERzYnthq1s

Chapter IV:
Function as a service


Function as a service
YOU
VENDOR MANAGE
Applications
Data
Runtime
Middeware
O/S
Virtualization
Servers
Storage
Networking

Function as a Service

“[illegible]puter power that comes into existence on request and dissapears immediatly after use”

(c) ThoughtWorks Radar

В отличии от PaaS, FaaS оперирует понятием функции вместо приложения.

Serverless architecture

1. Infinite scaling
2. Only pay for the compute that you need
3. No servers to manage

Doug McIlroy distilled the Unix Philosophy down to

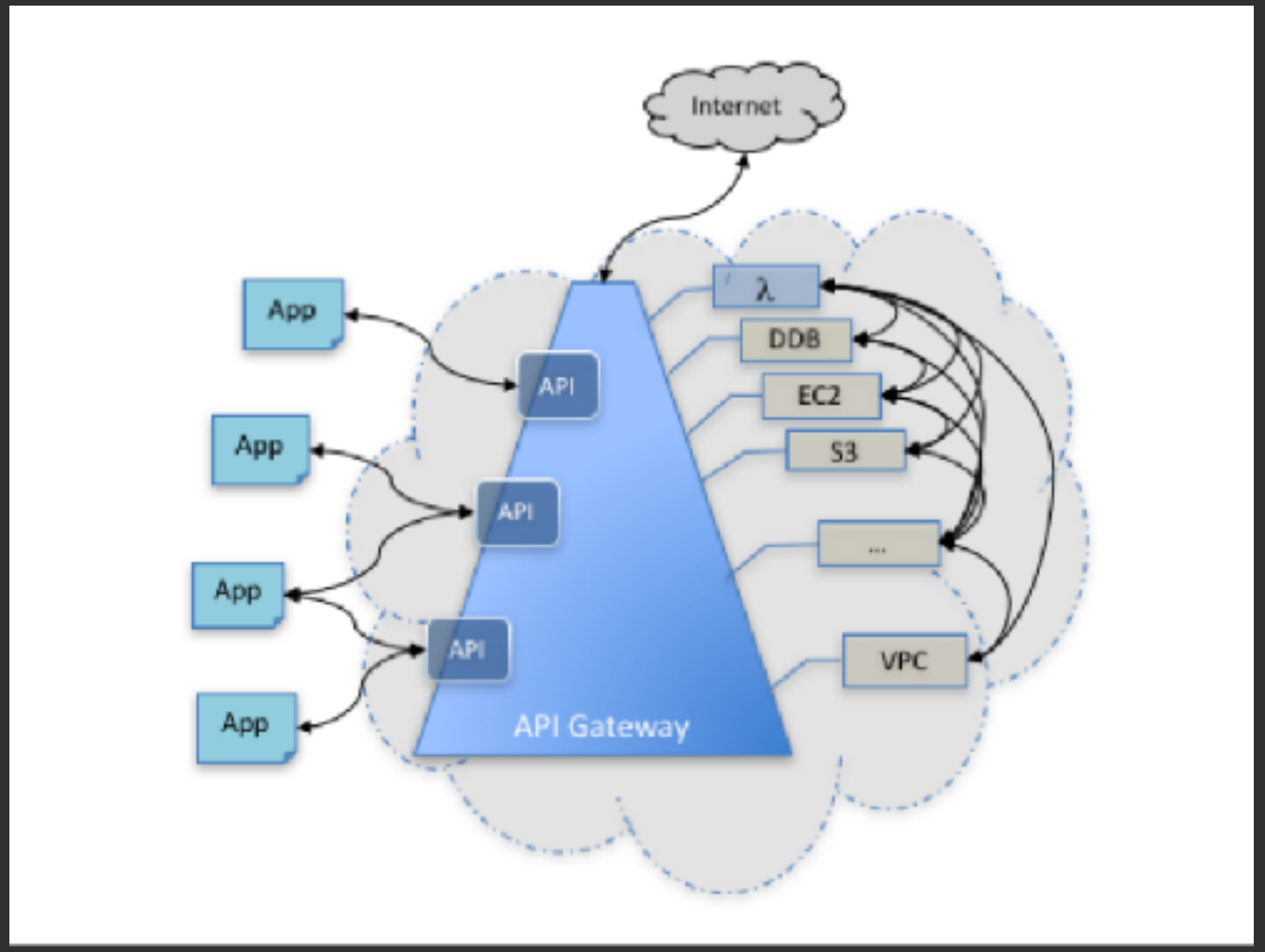
“Write programs that do one thing and do it well.
Write programs to work together.
Write programs to handle text streams, because that is a universal interface.”

Adapting the Unix Philosophy for the serverless world is simply a matter of changing the interface.

“Write programs that do one thing and do it well.
Write programs to work together.
Write programs to handle https, because that is a universal interface”.

Function as a Service

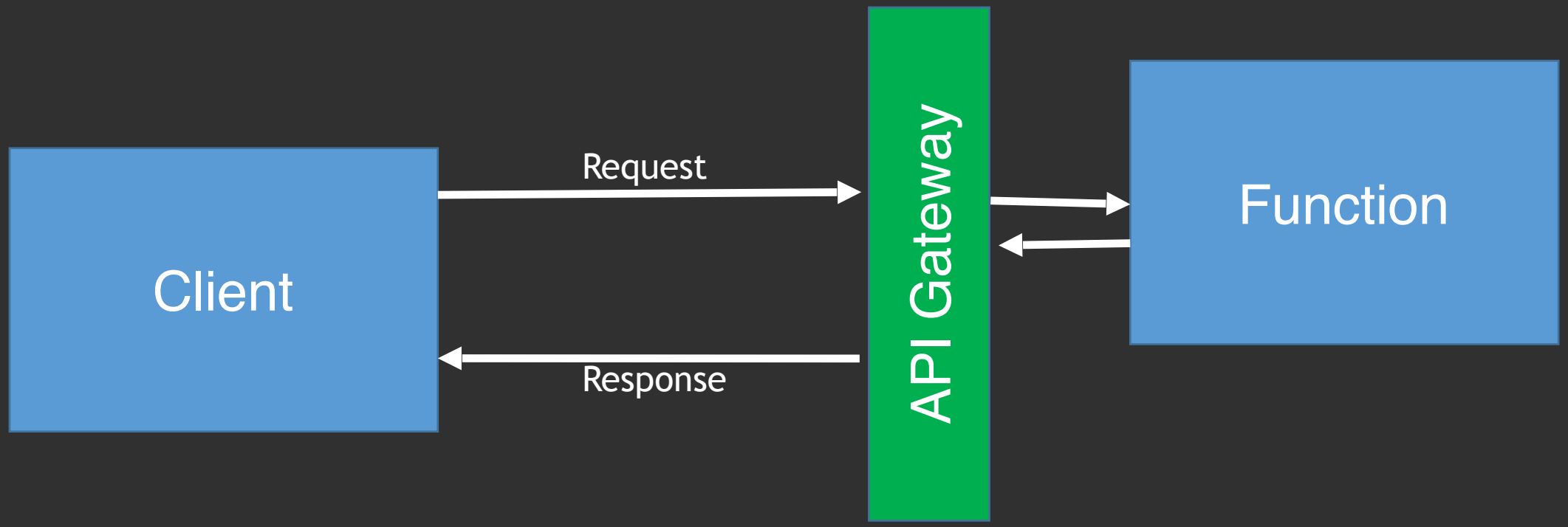
Amazon API Gateway



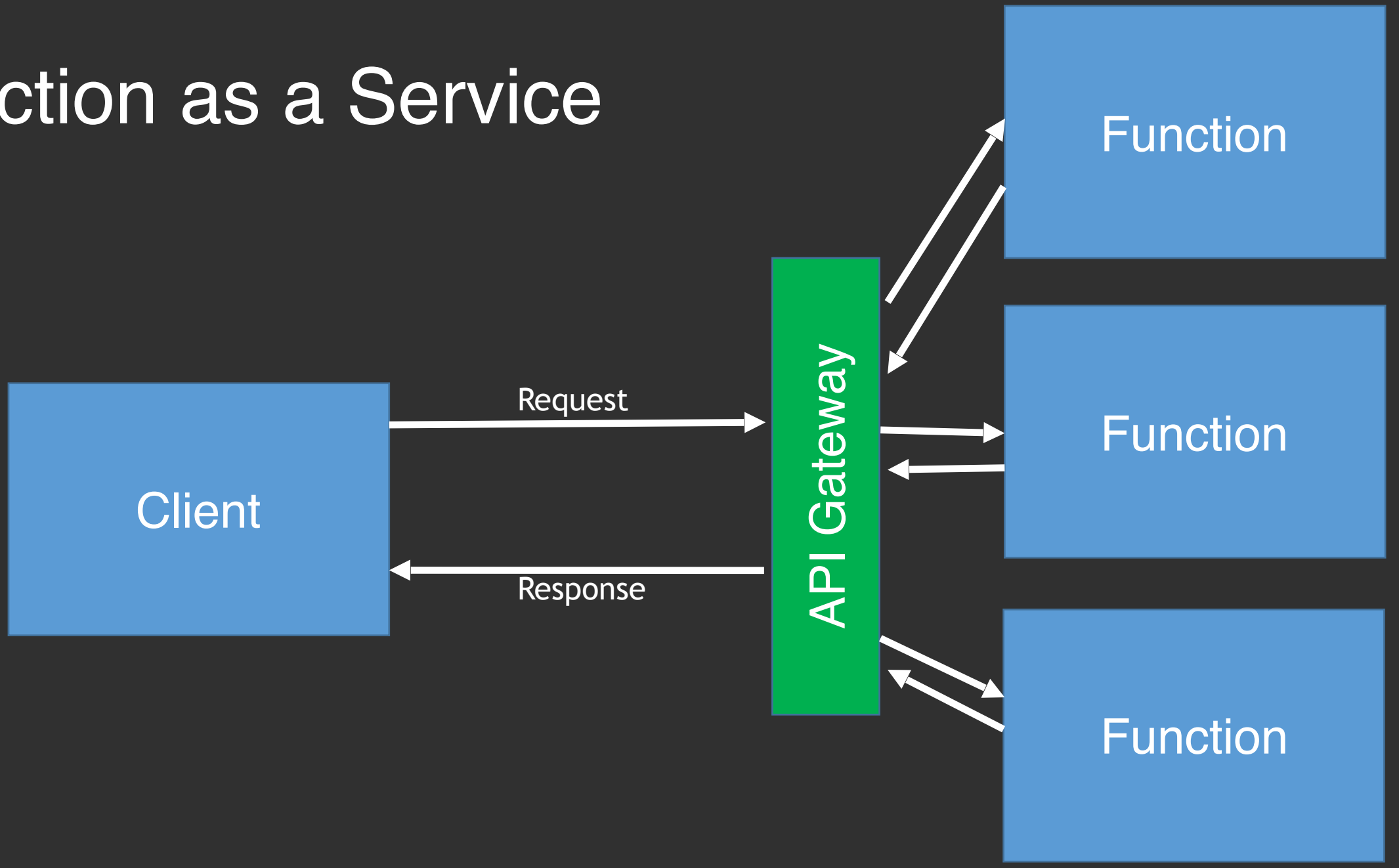
- Fully managed and scalable **RESTful** API gateway service
- Powered by Amazon **content delivery network** via 59 global edge locations

Amazon API Gateway is an AWS service that enables developers to create, publish, maintain, monitor, and secure APIs at any scale. You can create APIs that access AWS or other web services, as well as data stored in the AWS Cloud.

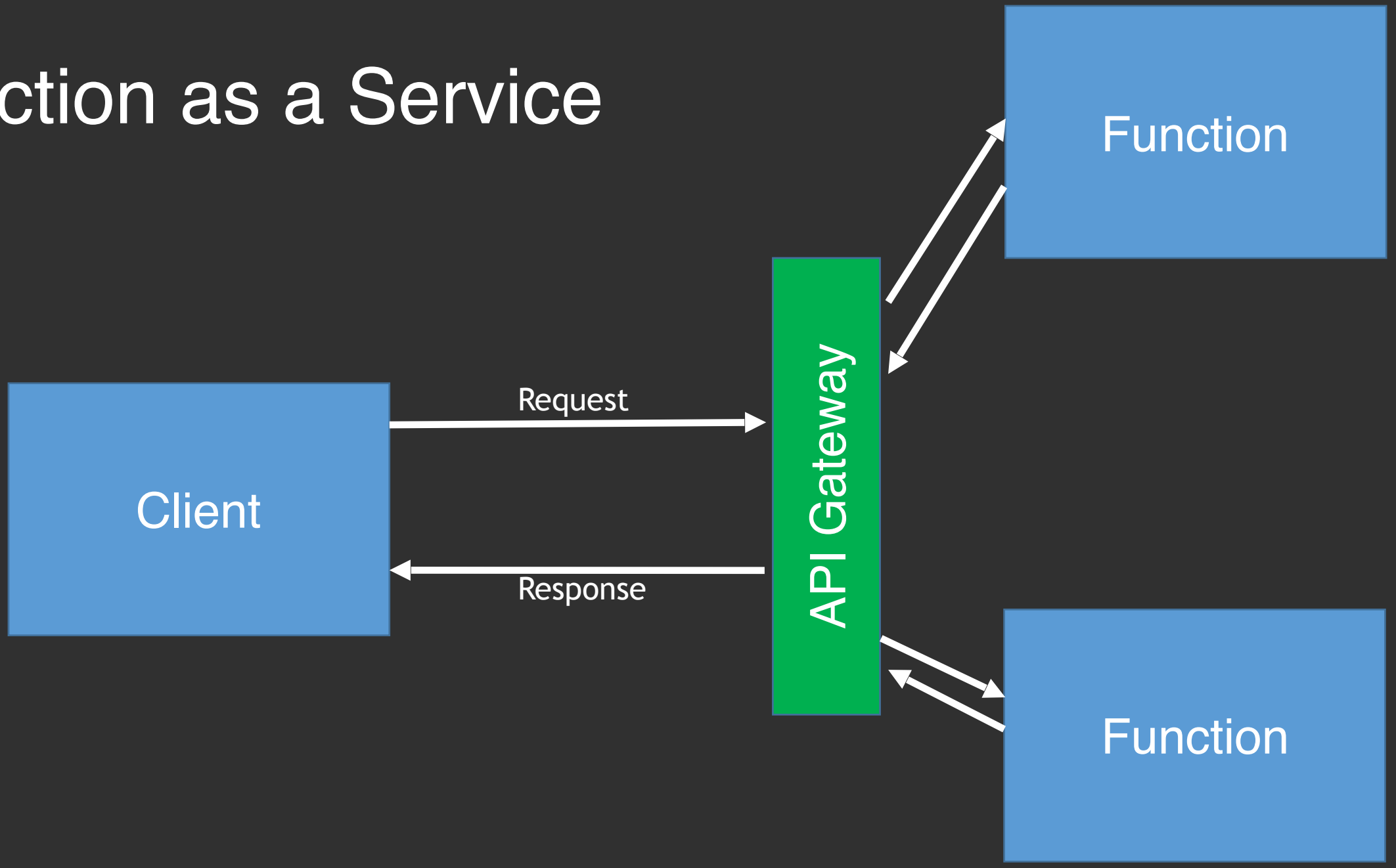
Function as a Service



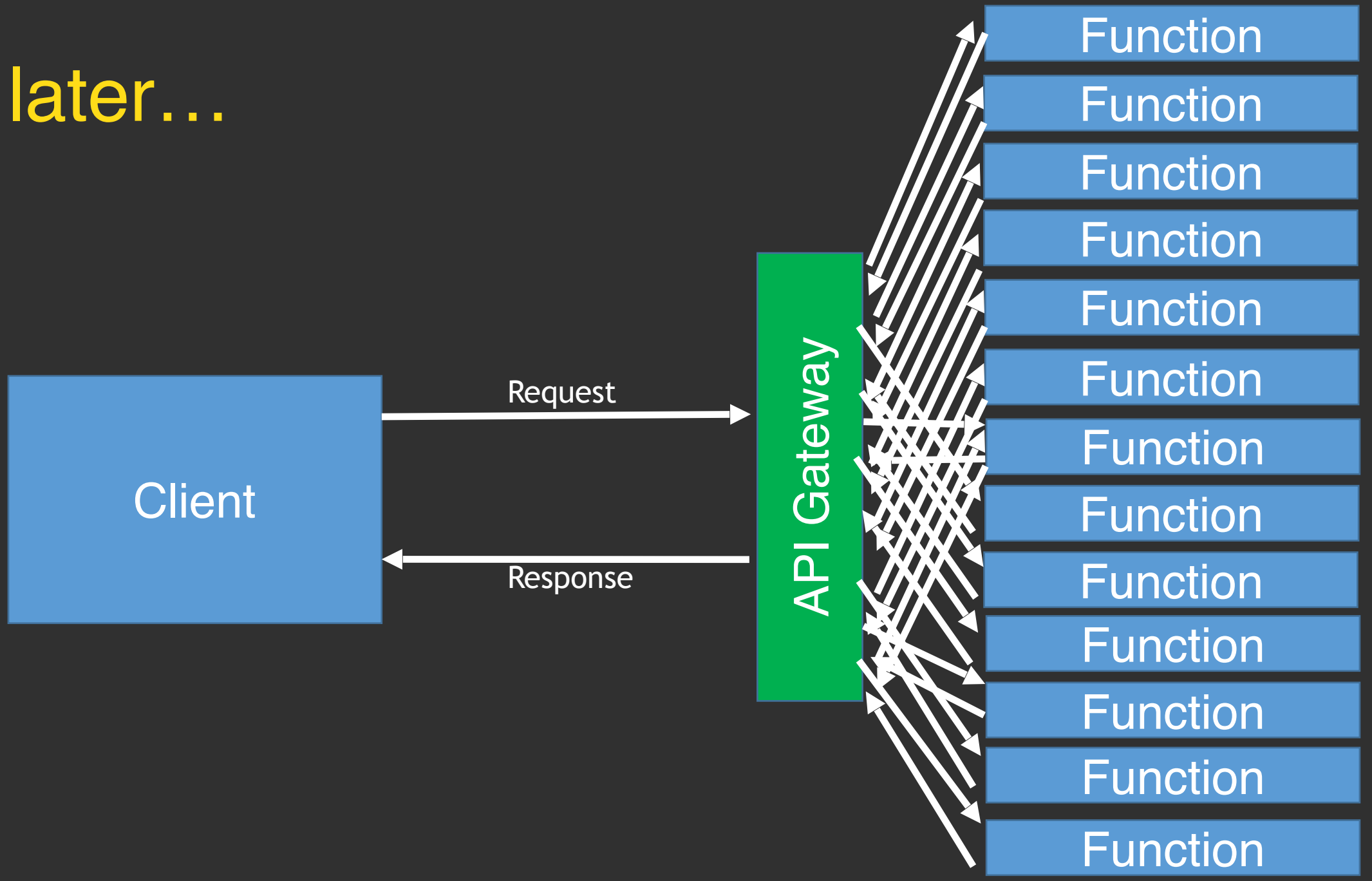
Function as a Service



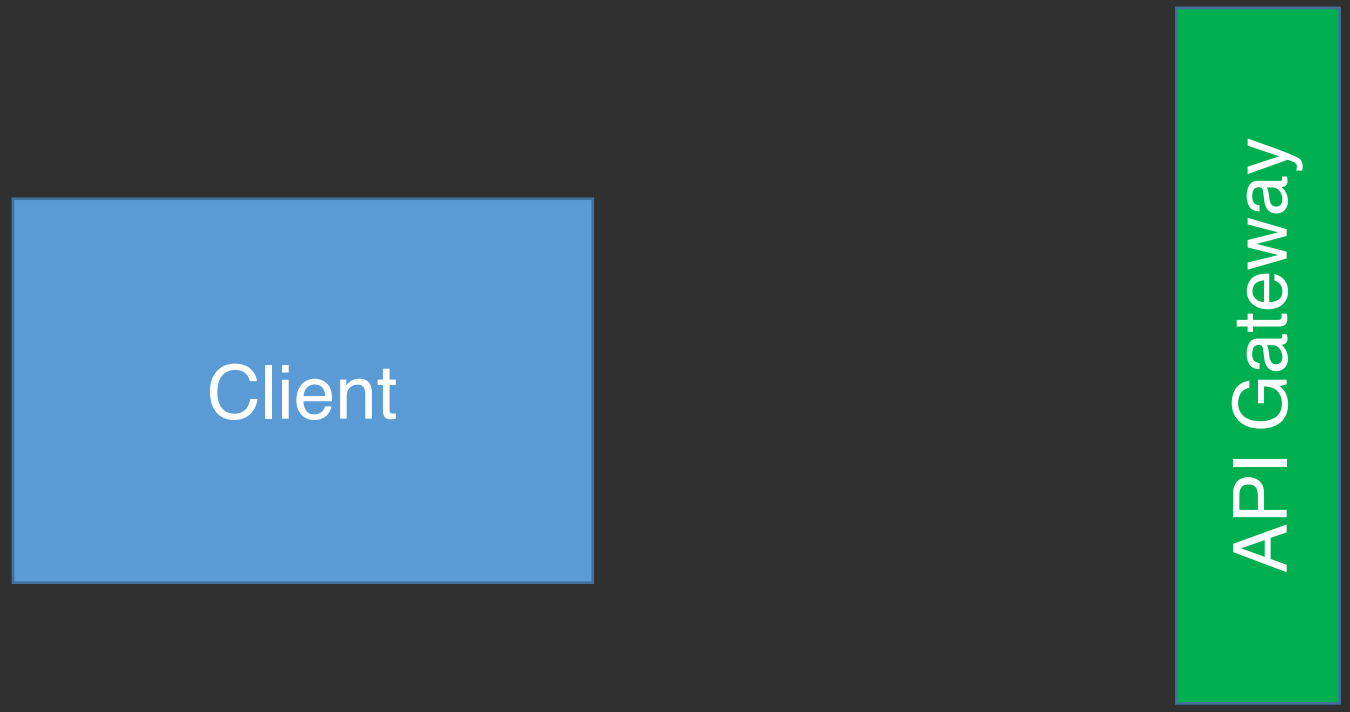
Function as a Service



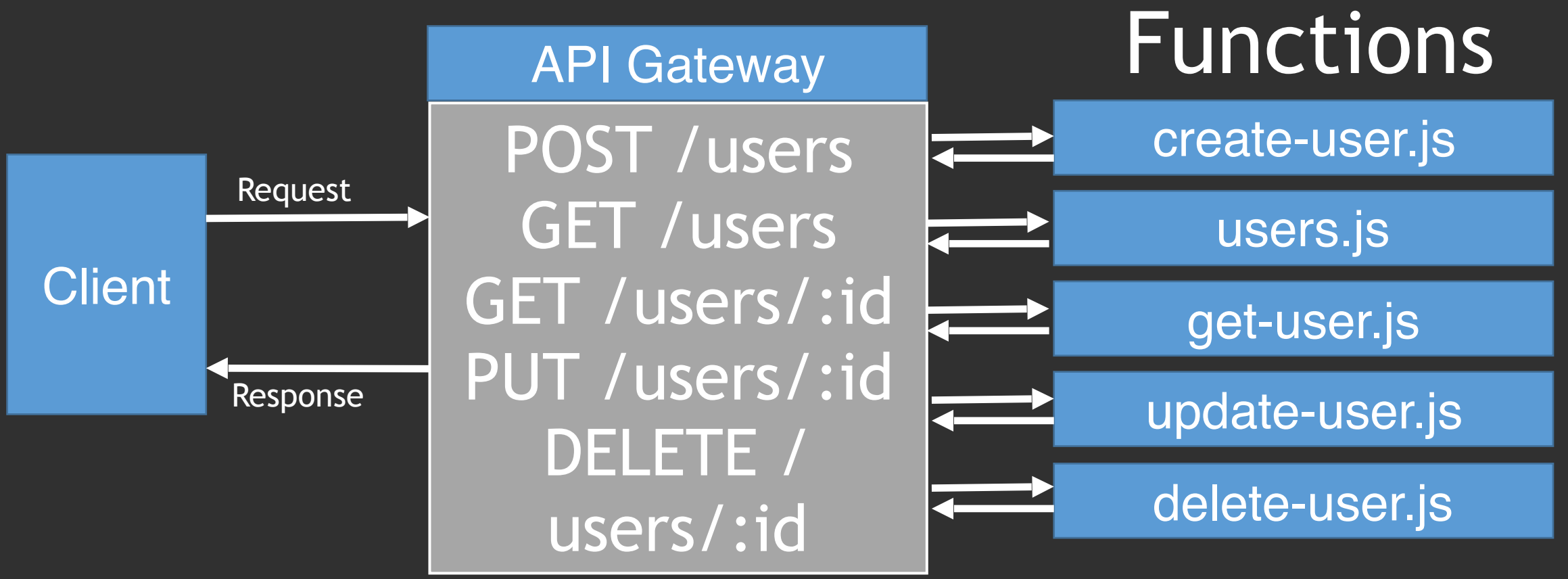
30s later…


Client
Request
Response
API Gateway
Function
Function
Function
Function
Function
Function
Function
Function
Function
Function
Function
Function
Function
Function

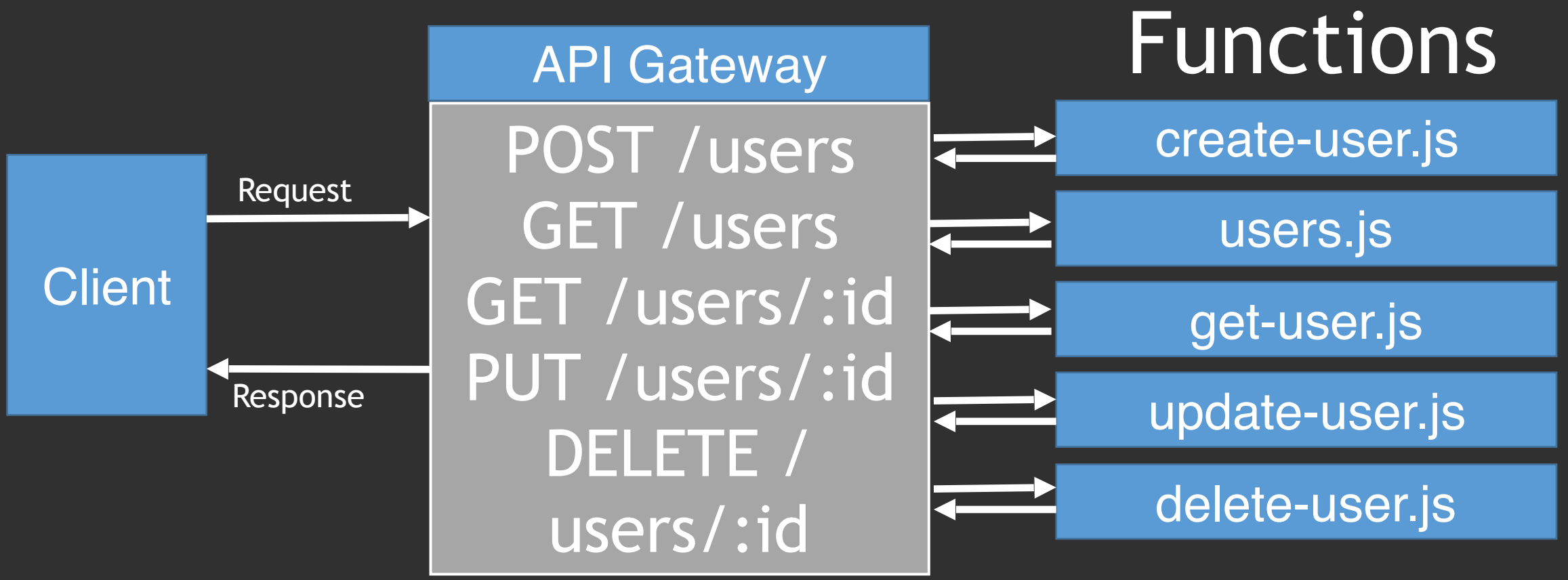
60s later…



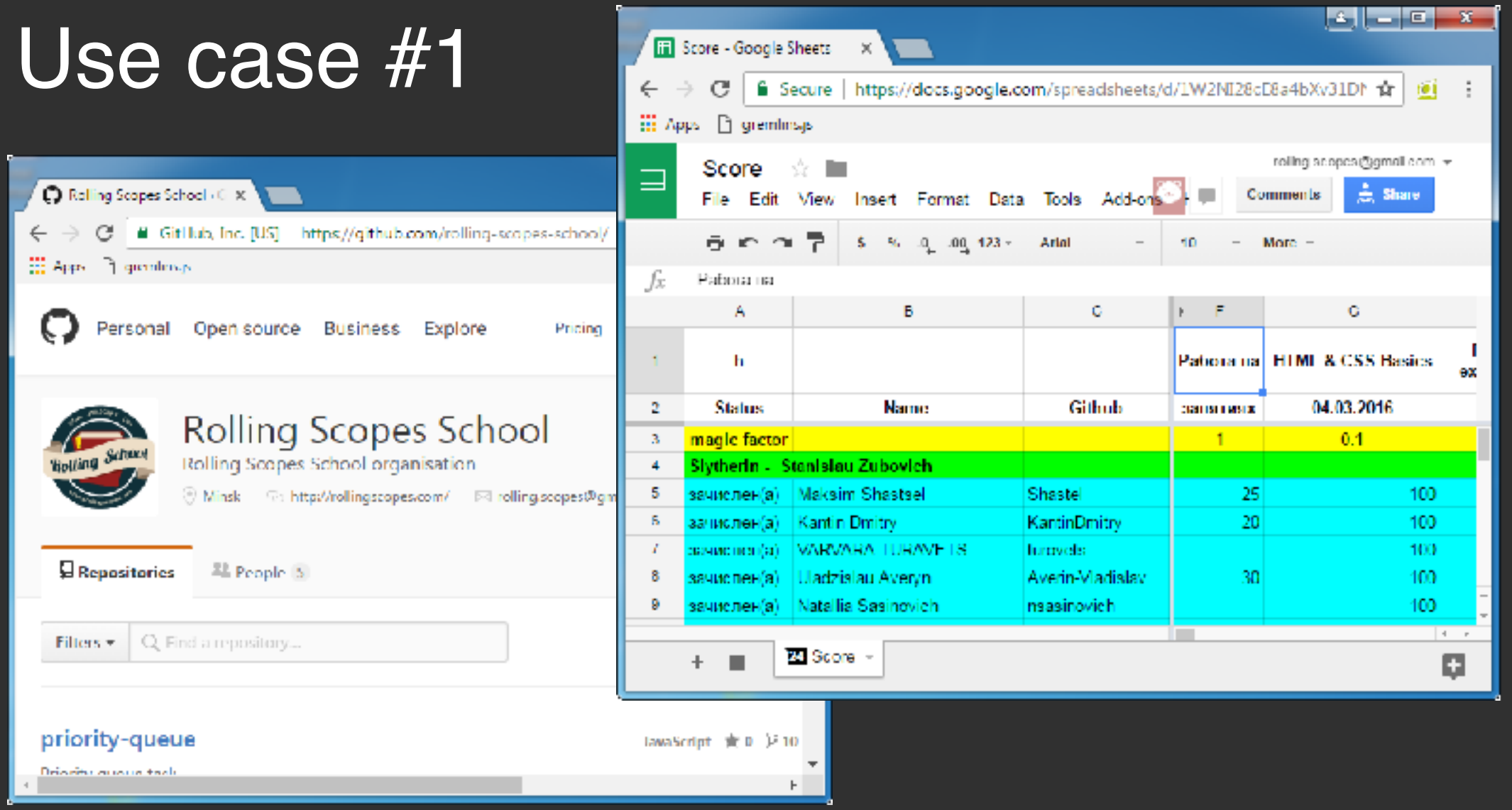
Nanoservices

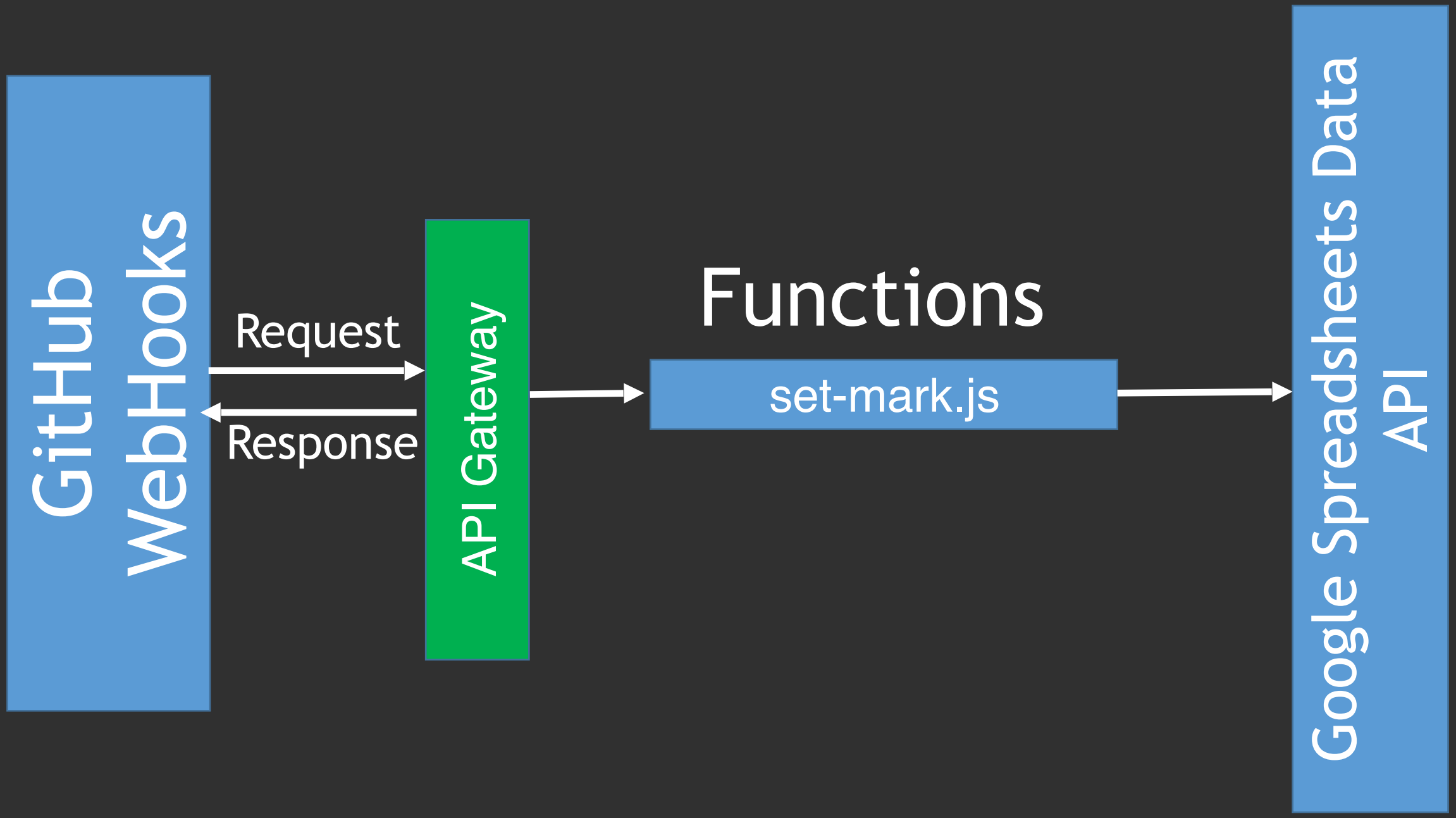


Granular Deploy, Update, Scale, Reliability, etc.



Use case #1


Rolling Scopes School
Personal
Open source
Business
Explore
Rolling Scopes School
Rolling Scopes School organisation
Repositories
People
priority-queue
Score - Google Sheets
Score
File
Edit
View
Insert
Format
Data
Tools
Comments
Share
Status
Name
Github
magic factor
Slytherin - Stanislau Zubovich
HTML & CSS Basics
04.03.2016


GitHub WebHooks
Request
Response
API Gateway
Functions
set-mark.js
Google Spreadsheets Data API

Function as a Service

Functions are the unit of deployment and scaling

No machines, VMs or containers visible in the programming model

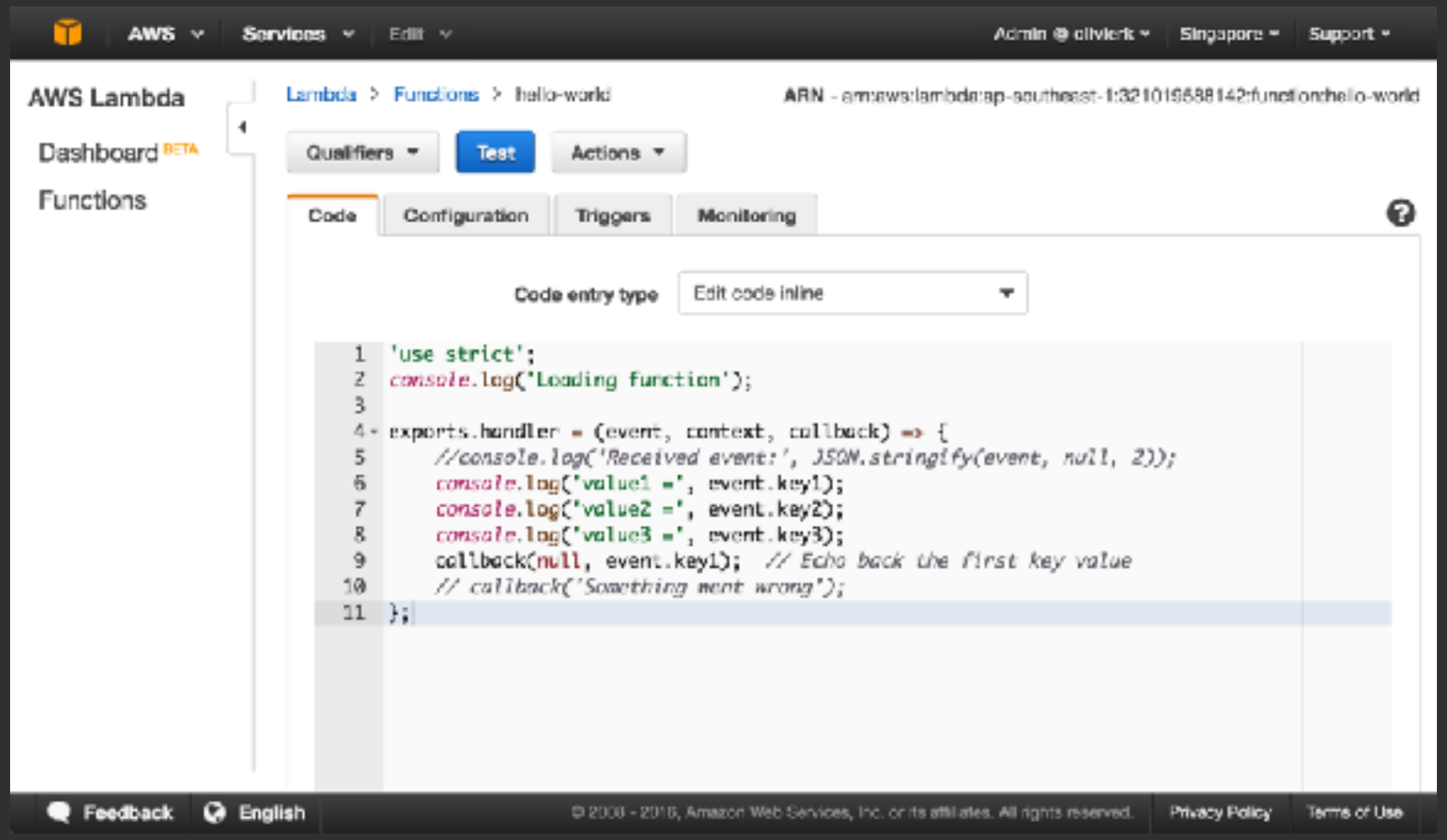
Scales per request, Users cannot over- or under-provision capacity

Major functins-as-a-service providers:

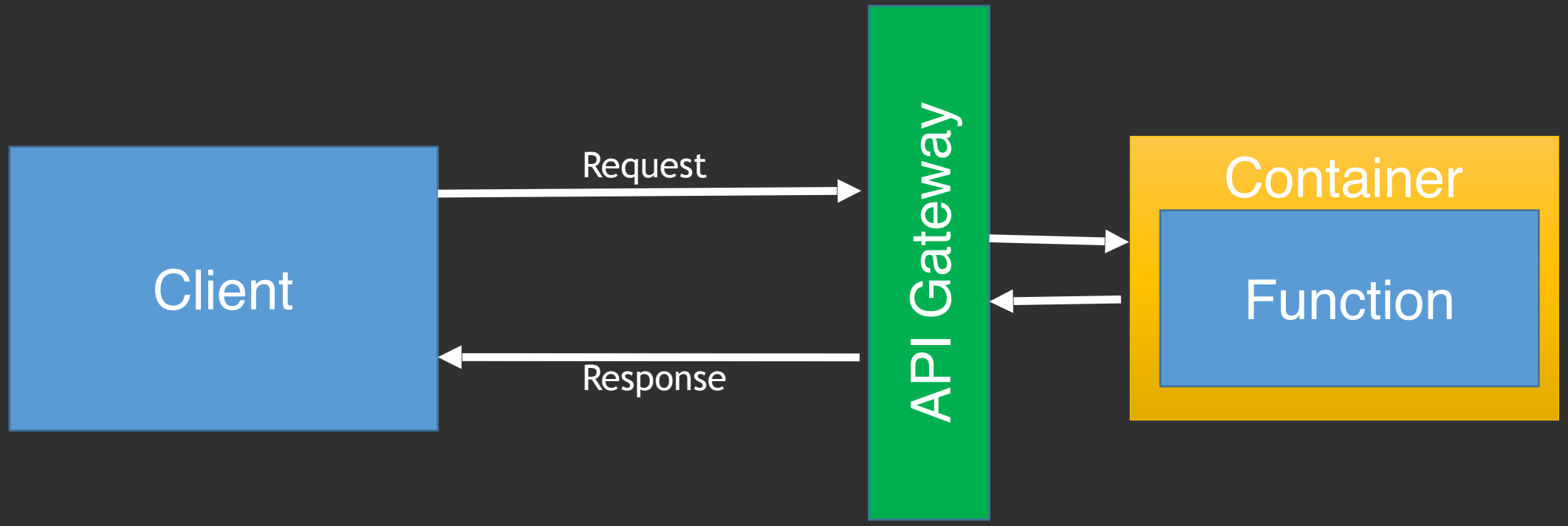
- AWS Lambda (since 2014)
- Microsoft Azure Functions (MAR-2016 C#, F#, Node.js)
- Google Cloud Functions (FEB-2016 / Node.js only)
- IBM OpenWhisk

AWS Lambda

Supports
JavaScript,
Java
Python



Lambda container



Start-up latency

Node 10-100 ms

Java ??? ms

Cold start / Hot start / Container reuse

If start time is crucial, create a scheduled function to keep the Lambda function “warm” **(c) AWS**

What is Lambda container?

Resource	Default Limit
Ephemeral disk capacity	512 MB
Invoke request body payload size (RequestResponse)	6 MB
Invoke response body payload size (RequestResponse)	6 MB

http://docs.aws.amazon.com/lambda/latest/dg/limits.html

Maximum execution duration per request:
5 min

AWS Lambda Deployment Limits

MAX 50Mb (zip) per Function

Default concurrent executions limits Per Region Per Account

1000

NoOps?

Serverless != DevOpsLess

AWS CloudFormation

Phoenix Environments

Using automation, we can create whole environments - including network configuration, load balancing and firewall ports - for example by using CloudFormation in AWS. We can then prove that the process works by tearing the environments down and recreating them from scratch on a regular basis.

(c) ThoughtWorks Radar

Fine-Grained Pricing

Free Tier

1M requests and 400,000 GBs of compute.

Every month, every customer.

- Compute time in 100ms increments
- Low request charge
- No hourly, daily or monthly minimums
- No per-device fees

- **Never pay for idle!**

Gigabytes per second (GBps)

Price =

function's RAM size X execution time (sec)

Example: 1GB RAM X 5 min = 0.005001$

ROLLINGSCOPES.COM ☺️

Billing: $11.43/month

Instance utilization: 4%/month ☹️

Fond of performance optimization?

Direct relationship between cost and performance ☺️

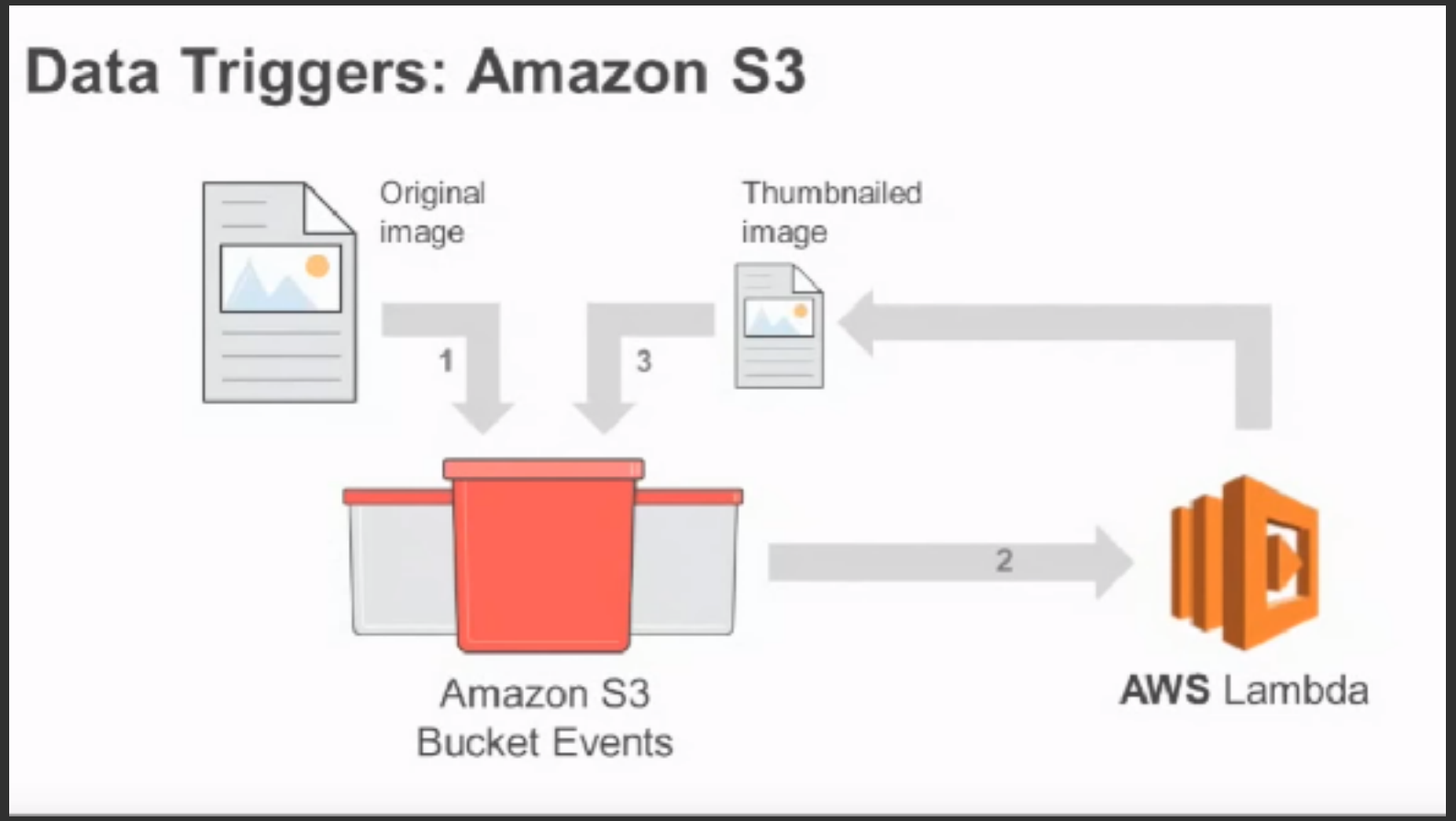
Serverless architecture

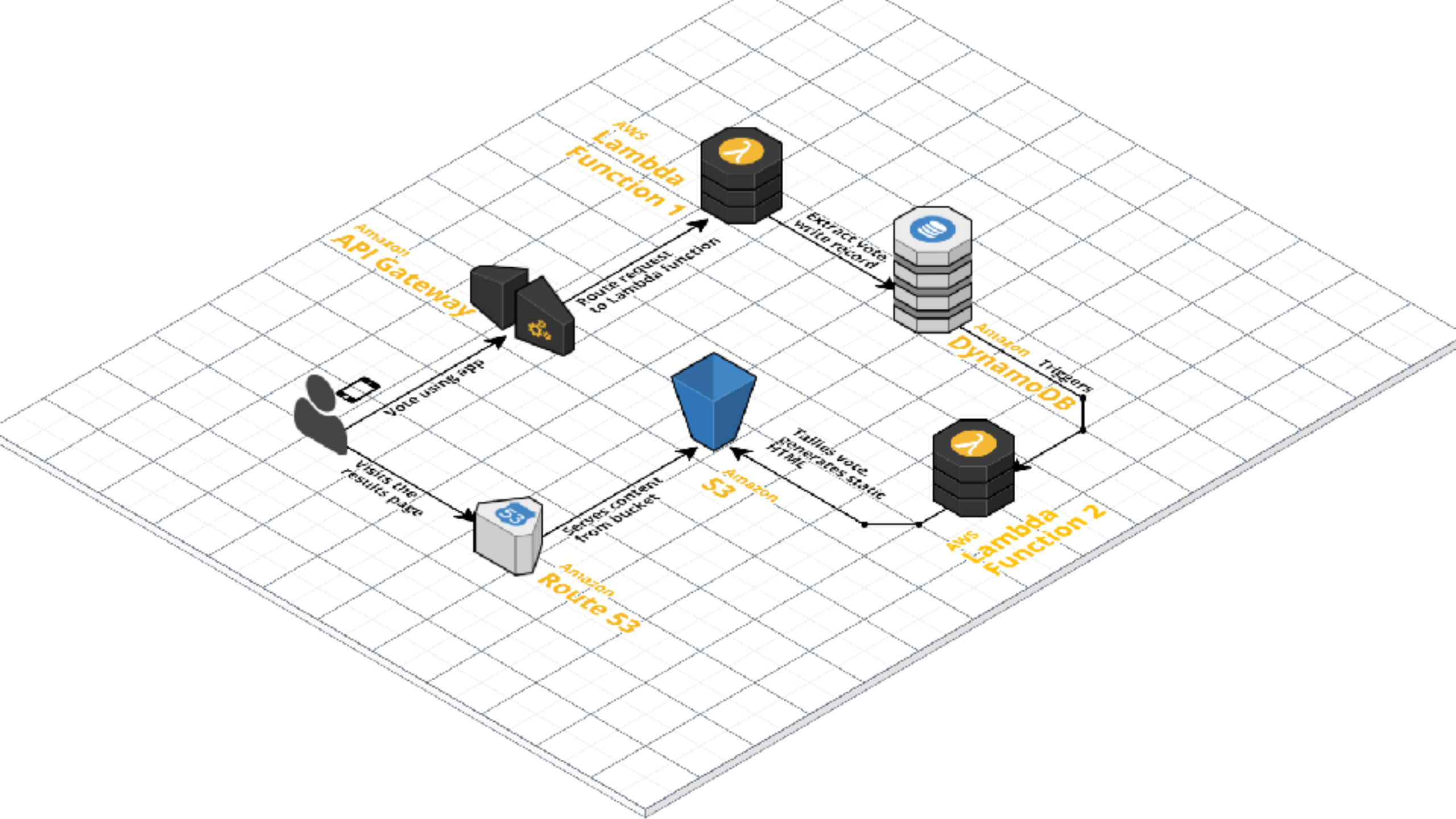
Serverless was first used to describe applications that significantly or fully depend on 3rd party applications / services (‘in the cloud’) to manage server-side logic and state.

http://martinfowler.com/articles/serverless.html

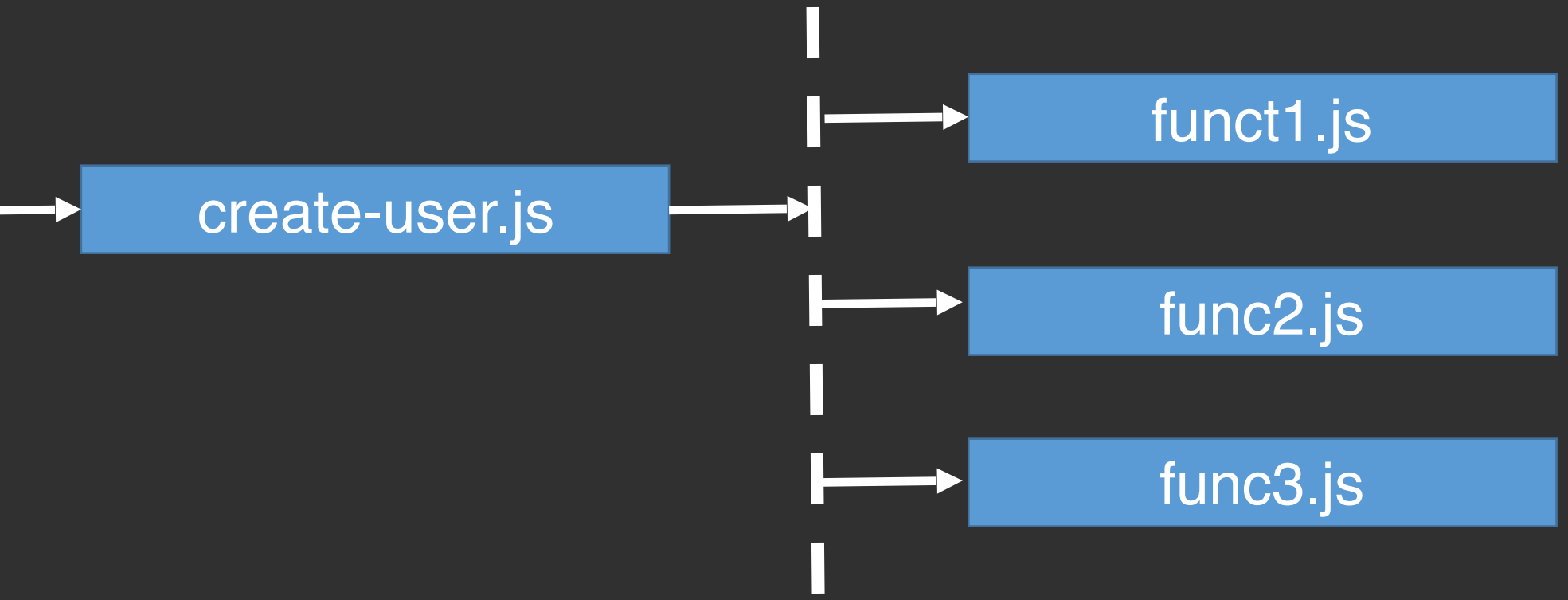
Usual scenario (for web)

Event-driven Compute in the Cloud




AWS
Lambda
Function 1
Amazon
API Gateway
Route request
to Lambda function
Extract vote
write record
Amazon
DynamoDB
Triggers
Vote using app
Visits the
results page
Serves content
from bucket
Amazon
S3
Tallies vote.
Regenerates static
HTML
AWS
Lambda
Function 2
Amazon
Route 53

SNS Events



Topic name

Serverless Reference Architectures with AWS Lambda

- Web Applications Serverless Reference Architecture
- Mobile Backend Serverless Reference Architecture
- Real-time File Processing Serverless Reference Architecture
- IoT Backend Serverless Reference Architecture
- Real-time Stream Processing Serverless Reference Architecture

http://www.allthingsdistributed.com/2016/06/aws-lambda-serverless-reference-architectures.html

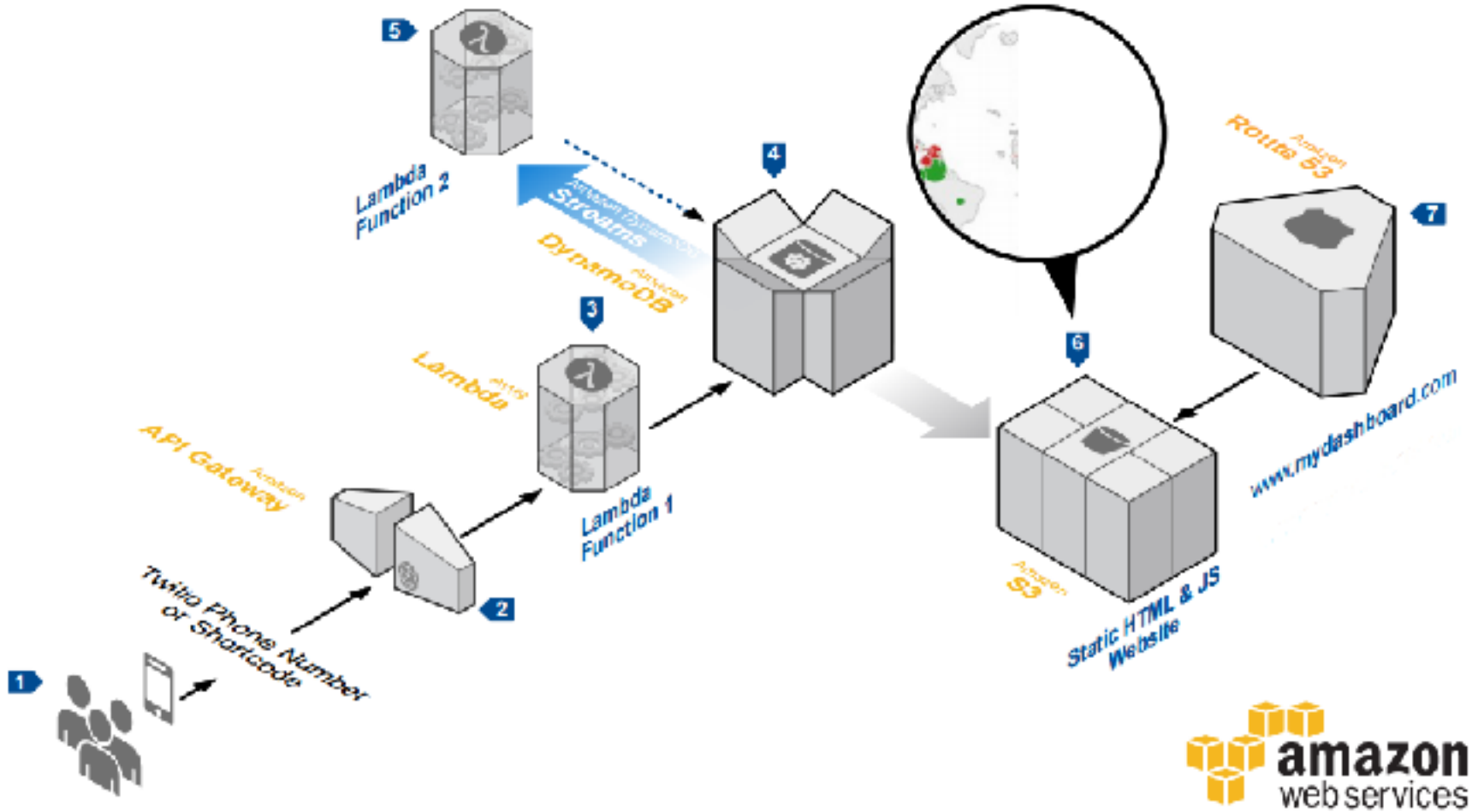
AWS Reference Architectures

Amazon API Gateway
AWS Lambda
Amazon DynamoDB
Amazon S3
Amazon Route 53

AWS LAMBDA: REAL-TIME VOTING APPLICATION

Consider a dynamic web application that receives votes in real-time. Traditionally, architecting such applications meant building out your infrastructure to support both "spiky" and sustained usage over a finite amount of time. In most cases, this required your operations team to overprovision resources, leading to waste outside of high-volume voting periods.

By combining AWS Lambda with other serverless AWS services such as Amazon API Gateway, you can build a powerful, highly available web application that automatically scales up and down to handle large amounts of concurrent votes - all with zero administrative effort required. You can also store and analyze your data in fault-tolerant services like Amazon DynamoDB and Amazon Simple Storage Service.



amazon web services

System

1 Users text a vote to a phone number or shortcode provided by a third party like Twilio.

4 [illegible] into a table in Amazon DynamoDB. This table has DynamoDB Streams enabled, which allows you to track changes to your tables on a rolling basis.

6 A dashboard to display a summary of votes is created using HTML and JavaScript, and hosted as a static [illegible] Storage Service (Amazon S3). [illegible] JavaScript SDK to query the [illegible] and display the voting results in

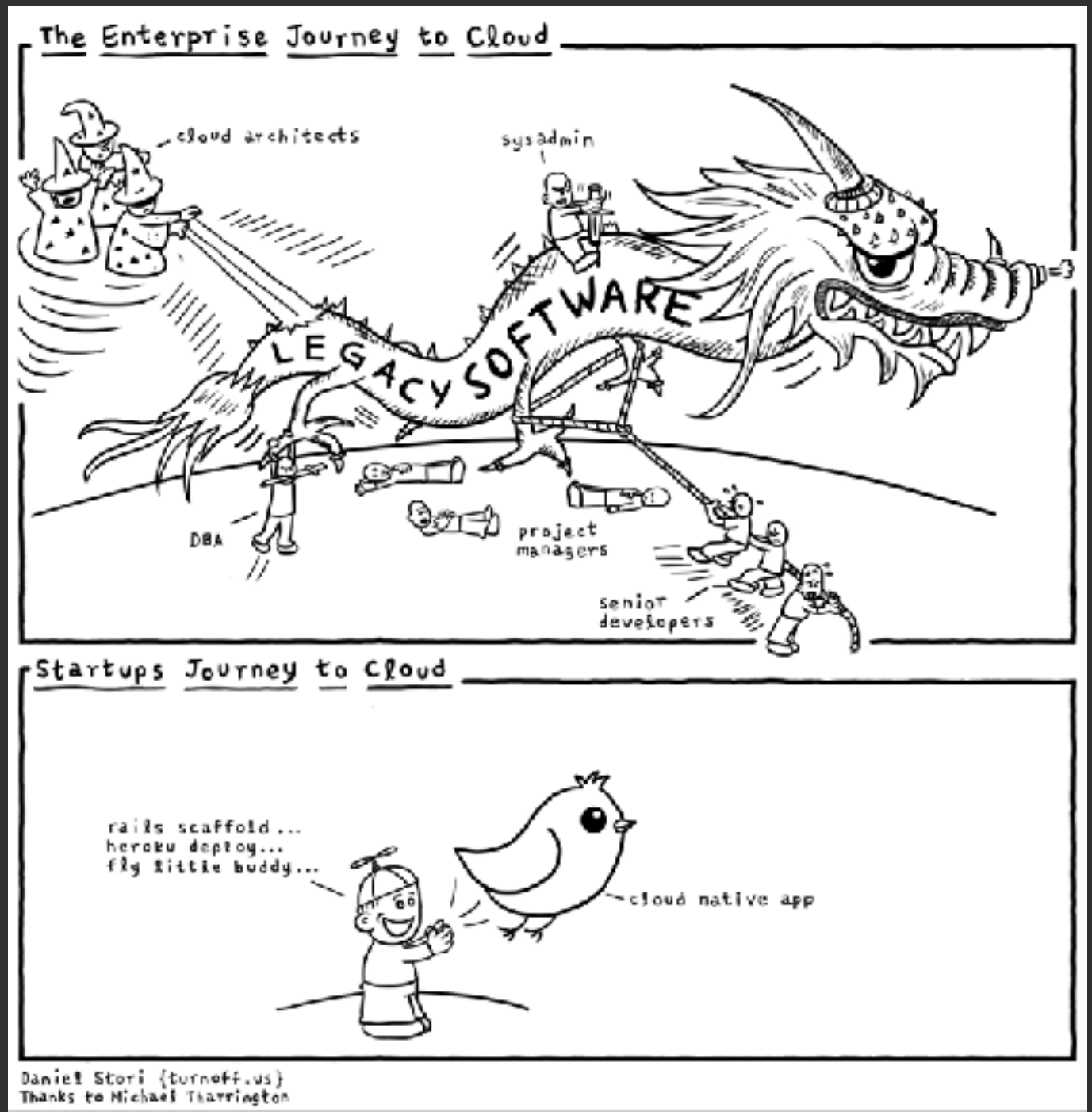
function extracts the vote from the message content and writes the result and any

7 [illegible] Amazon Route 53 is used as a DNS provider to create a hosted zone pointing a custom domain name to the Amazon S3 bucket.

https://github.com/awslabs/lambda-refarch-webapp

Drawbacks

Massive Vendor Lock-In


The Enterprise Journey to Cloud
cloud architects
sysadmin
LEGACY SOFTWARE
DBA
project managers
senior developers
Startups Journey to Cloud
rails scaffold...
heroku deploy...
fly little buddy...
cloud native app
Daniel Stori {turnoff.us}
Thanks to Michael Tharrington

How to debug?

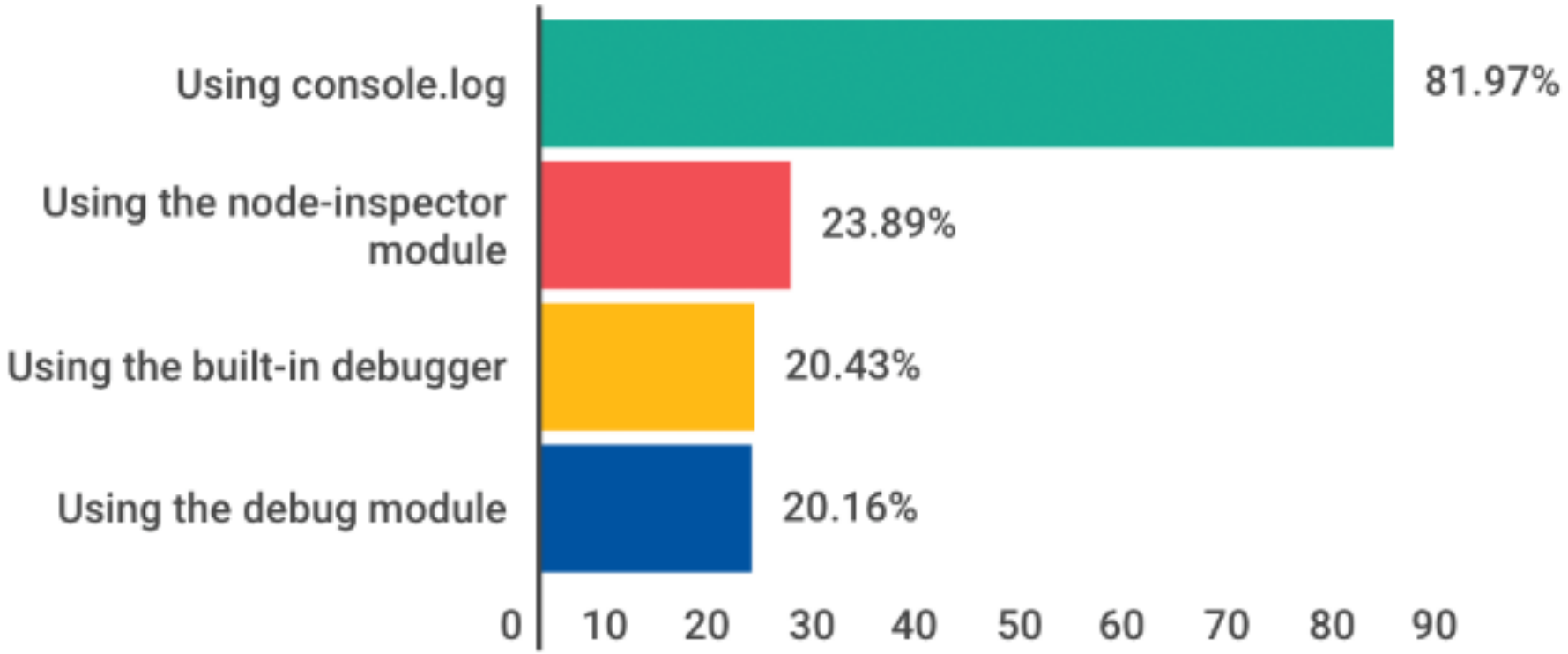
“It is also INCREDIBLY irritating and challenging to debug in a practically infinite number of insanity-inducing ways”

“You cannot ssh into your Lambda.”

“You cannot inspect your program as it’s running. Forget debugging techniques that we’ve accumulated over the years, they don’t apply in this post-Kansas serverless world. Forget dtrace, forget perf, forget flamegraphs. Your debugging arsenal is limited to good old printf debugging. No, scratch that, I should’ve said “good old CloudWatch” debugging, which is a few notches below printf-debugging, because it lags. Hooray!”

How do you debug your applications?

1126 respondents - multiple choice answers



https://blog.risingstack.com/node-js-developer-survey-results-2016/

Serverless === Stateless

No in-proc caching or state

Limited Environments

- No local env
- One account for QA, UAT, PROD
- Integration testing difficulties

- Self DDOS ☺️

Thank you!

https://goo.gl/EhdzY3

Useful links

AWS Free Tier
https://aws.amazon.com/ru/free/

AWS Lambda Developer Guide
http://docs.aws.amazon.com/lambda/latest/dg/lambda-dg.pdf

Serverless Architectures
http://martinfowler.com/articles/serverless.html

Useful links

What is AWS?
https://www.youtube.com/watch?v=DERzYnthq1s

Your First Week on Amazon Web Services
https://www.youtube.com/watch?v=7CiHBcqw6zc

https://github.com/JustServerless/awesome-serverless
https://github.com/donnemartin/awesome-aws

https://acloud.guru/course/serverlessconf-nyc-2016/dashboard

Useful links

AWS May 2016 Webinar Series - Deep Dive on Serverless Web Applications

https://www.youtube.com/watch?v=fXZzVzptkeo

AWS April Webinar Series - AWS Lambda: Event-driven Code for Devices and the Cloud

https://www.youtube.com/watch?v=YEWtQsqIYsk