

# Základy clouдовých technológií

Úvod

# Organizácia predmetu

- Minimálne 5 1,5 hodinových prednášok
- Možné prednášky z firiem
- Garant - prof. Ing. Iveta Zolotová, CSc.
- Prednášajúci - Ing. Ladislav Pomšár
- Cvičiaci - Ing. Ľubomír Urblík
- Zápočet - 40 bodov, 2 zadania - 10 a 30 bodov
- Skúška - 60 bodov

Cloud computing is the on-demand delivery of IT resources over the Internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider like Amazon Web Services (AWS).

- Amazon

Simply put, cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet (“the cloud”) to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use, helping lower your operating costs, run your infrastructure more efficiently and scale as your business needs change.

- Microsoft

*In cloud computing, the capital investment in building and maintaining data centers is replaced by consuming IT resources as an elastic, utility-like service from a cloud “provider” (including storage, computing, networking, data processing and analytics, application development, machine learning, and even fully managed services).*

- Google

# 5 charakterík cloutu

- On-demand self-service
- Broad network access
- Resource pooling
- Rapid elasticity
- Measured service

# On-demand self-service

- Zákazníci získavajú prístup k ďalším zdrojom na požiadanie
- Prístup k zdrojom by mal byť okamžitý, resp. veľmi rýchly
- Zákazník sa rozhoduje kolko zdrojov potrebuje
- Príklad – na portáli providera cloudu si vypýtam ďalšiu virtuálnu mašinu, ktorú aktuálne potrebujem a ta je mi okamžite pridelená. Po ukončení výpočtov mašinu odstránim

# Broad network access

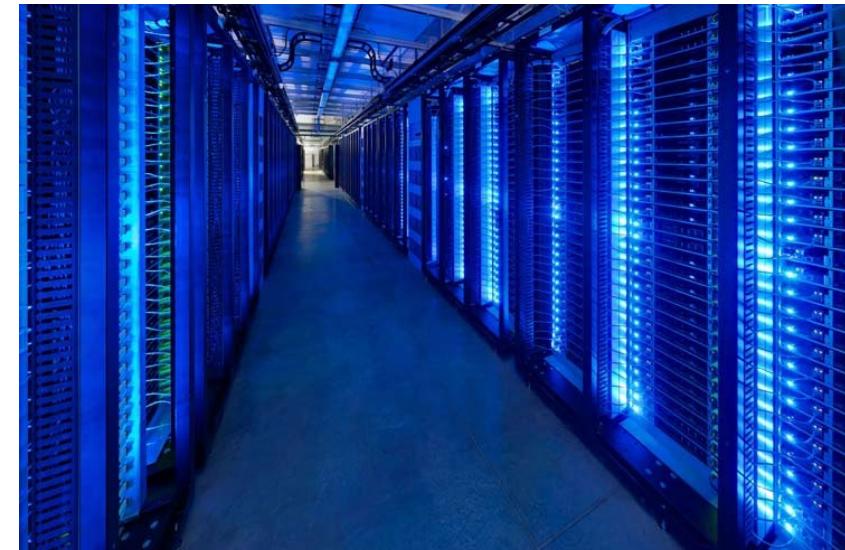
- Zdroje sú dostupné po sieti
- Zdroje sú prístupné pomocou štandardných mechanizmov/protokolov a je možné ich používať z rôznych platform (Windows, iOS, Android...)
- Príklad – mám server na prevádzke v KE a potrebujem naň prístup z USA. V takomto prípade musím riešiť veľkú množinu problémov. Povolenie prístupu k serveru na cloude je triviálne

# Resource pooling

- Poskytovateľ clouдовých služieb má pool (množinu) zdrojov, ktoré dynamicky poskytuje rôznym zákazníkom podľa potreby
- Na lokalite týchto zdrojov nezáleží a zákazník často ich presnú polohu nepozná
- Facebook, Prineville, Oregon, cca 300 000 m<sup>2</sup>



[Zdroj](#)



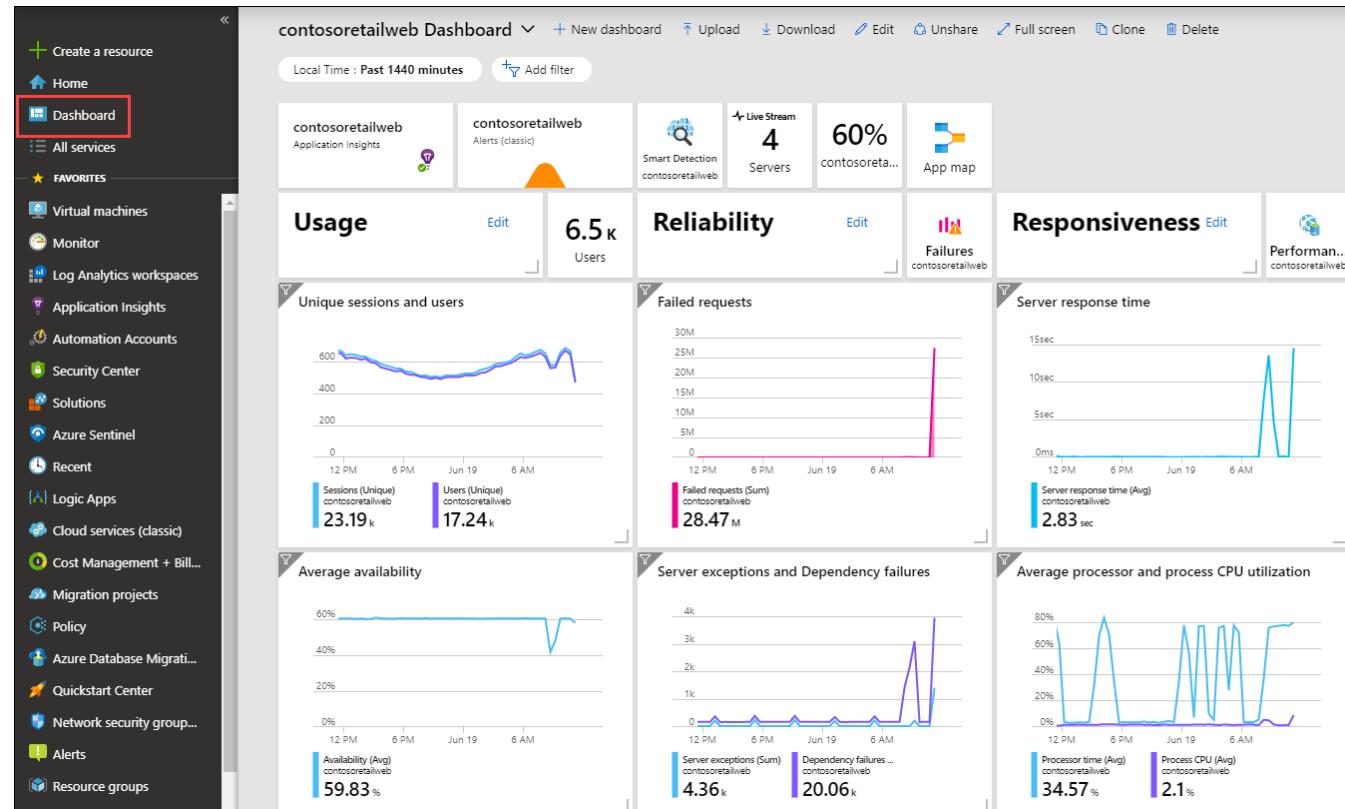
[Zdroj](#)

# Rapid elasticity

- Schopnosť pridávať alebo odoberať zdroje (škálovať), keď to je potrebné, niekedy automaticky
- Zákazníkovi sa zdá, že zdroje sú nekonečné a môže si vypýtať ľubovoľné množstvo v ľubovoľný čas
- Elasticita == škálovateľnosť
- Vertikálna a horizontálna škálovateľnosť, microservices

# Measured service

- Používanie cludových zdrojov je sledované/monitorované
- Zdroje sú ovládané a optimalizované
- Pay as you go – platíme za to, čo použijeme



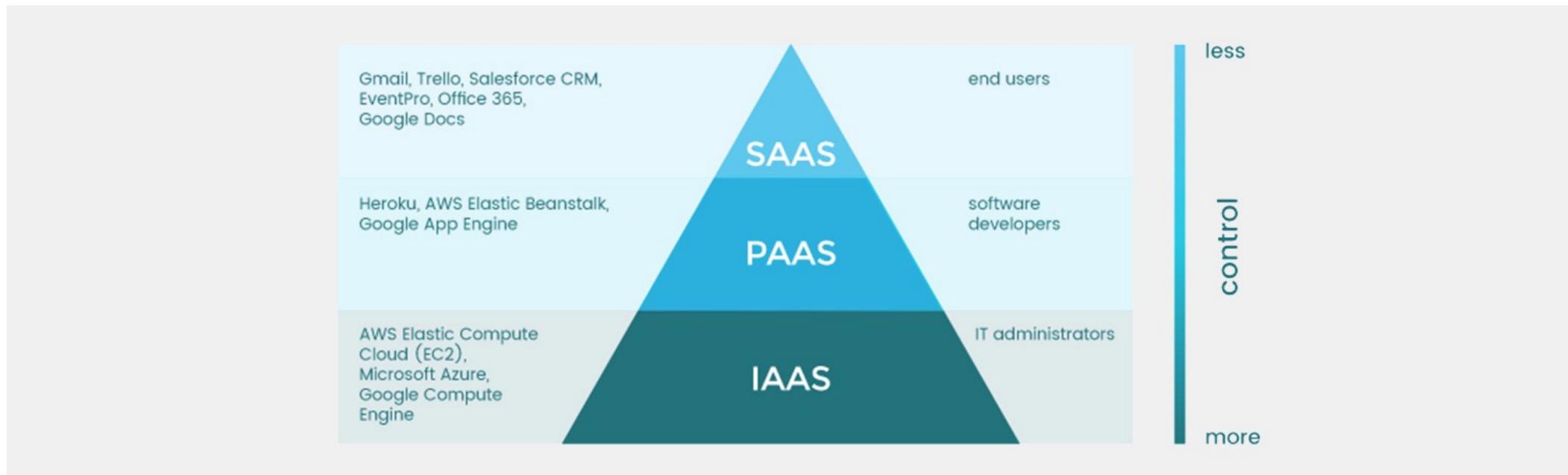
[Zdroj](#)

# Evolution of cloud computing

- DARPA challenge – 1963 - “computer to be used by two or more people, simultaneously”
- Utility computing – model poskytovania služby, pri ktorom poskytovateľ ponúka zákazníkom výpočtové zdroje a správu výpočtovej infraštruktúry. Zákazníci platia len za používané zdroje (nie paušálny poplatok)
- Grid computing – distribuovaný systém výpočtových zdrojov, ktoré sa snažia o dosiahnutie spoločného cieľa

# Modely clouдовých služieb

- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Infrastructure as a Service (IaaS)



# Software as a Service

- Užívateľ je schopný používať aplikáciu poskytovateľa na cloude
- Aplikácia je prístupná rôznym klientom pomocou tenkých klientov či programového rozhrania
- Zákazník nemá prístup k sieti, serverom, úložisku... , ktoré aplikácia používa
- Office 365, Gmail, Google Docs, OneDrive

# Platform as a Service

- Užívateľ dokáže nahrať aplikáciu na cloud
- Užívateľ opäť nedokáže spravovať siet, servery..., no má kontrolu nad aplikáciou, nastaveniami, ktoré s ňou súvisia a dátami
- Deploy WordPressu či Drupal-u
- Heroku, Google App Engine, MS Azure

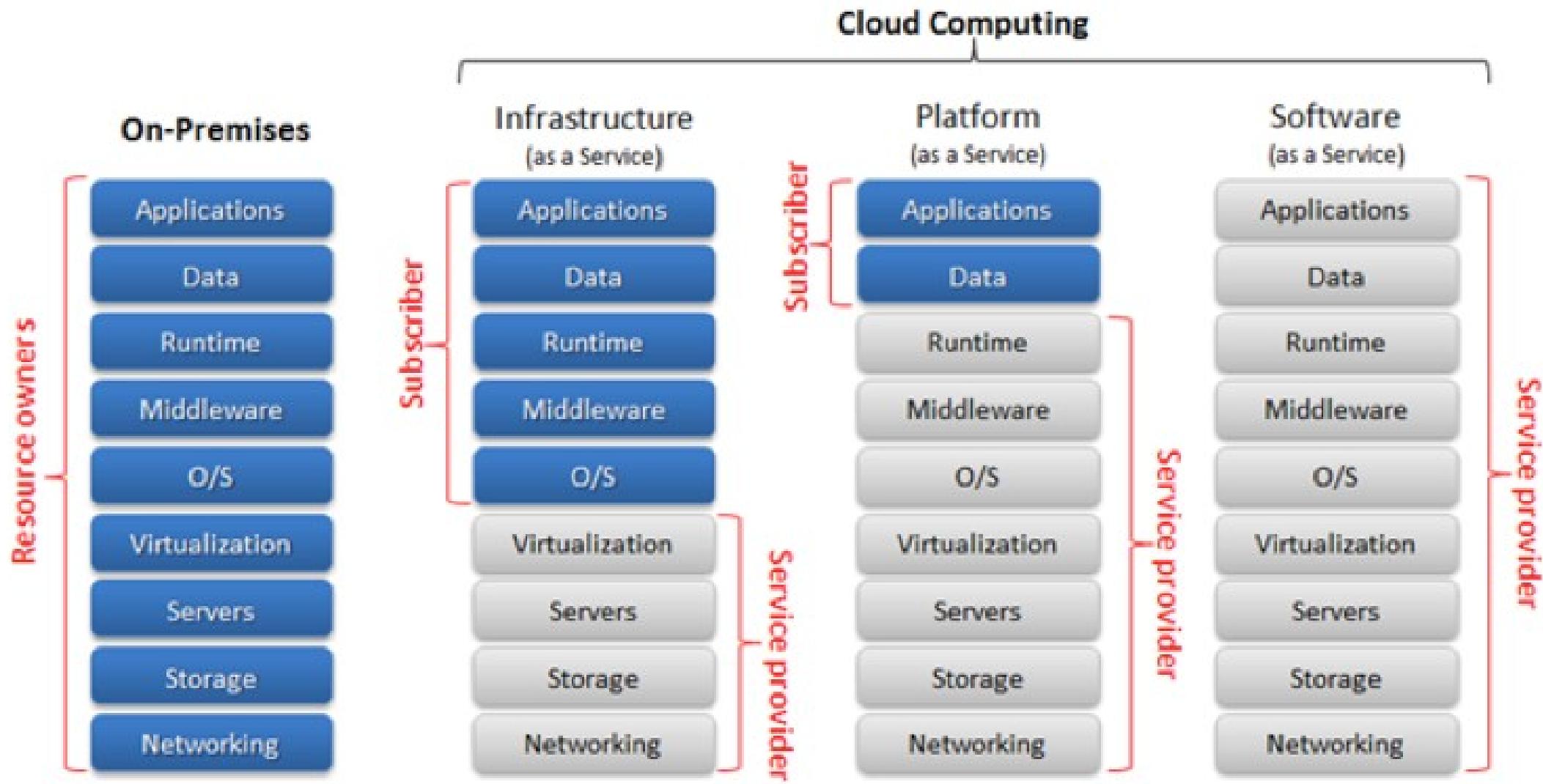
# Infrastructure as a Service

- Užívateľ dokáže spravovať operačný systém, dátá, deploynuté aplikácie a čiastočne sietové nastavenia (firewall)
- Virtuálny stroj
- Google Compute Engine, Microsoft Azure, EC2

# Anything as a Service

- XaaS
- Čím d'alej, tým viac vecí je poskytovaných na cloude -> myšlienka, že tam vieme poskytnúť čokoľvek
- Rôzne služby si používajú príponu „aaS“, no často nedodržujú princípy cloudov
- Príklad - Games as a service

# Separation of Responsibilities



# Cloud deployment models

- Private cloud - používaný jednou organizáciou, môže, no nemusí, ďou byť aj vlastnený a spravovaný
- Community cloud – používaný nejakou komunitou, ktorá ma spoločné záujmy, môže ho spravovať komunita, tretia strana alebo kombinácia
- Public cloud – používať ho môže široká verejnosť, správu môžu zastrešovať rôzne organizácie ako firmy, univerzity či vláda
- Hybrid cloud – pozostáva z 2 a viac rôznych clouдовých infraštruktúr, ktoré sú prepojené propietárhou/štandardnou technológiou umožňujúcou prenos dát a aplikácií

# Predpoved' vs realita

**Table 1. Worldwide Public Cloud Service Revenue Forecast (Billions of U.S. Dollars)**

	2018	2019	2020	2021	2022
Cloud Business Process Services (BPaaS)	45.8	49.3	53.1	57.0	61.1
Cloud Application Infrastructure Services (PaaS)	15.6	19.0	23.0	27.5	31.8
Cloud Application Services (SaaS)	80.0	94.8	110.5	126.7	143.7
Cloud Management and Security Services	10.5	12.2	14.1	16.0	17.9
Cloud System Infrastructure Services (IaaS)	30.5	38.9	49.1	61.9	76.6
<b>Total Market</b>	<b>182.4</b>	<b>214.3</b>	<b>249.8</b>	<b>289.1</b>	<b>331.2</b>

BPaaS = business process as a service; IaaS = infrastructure as a service; PaaS = platform as a service; SaaS = software as a service

Note: Totals may not add up due to rounding.

Source: Gartner (April 2019)

**Table 1. Worldwide Public Cloud Services End-User Spending Forecast (Millions of U.S. Dollars)**

	2022	2023	2024
Cloud Application Infrastructure Services (PaaS)	119,579	145,320	176,493
Cloud Application Services (SaaS)	174,416	205,221	243,991
Cloud Business Process Services (BPaaS)	61,557	66,339	72,923
Cloud Desktop-as-a-Service (DaaS)	2,430	2,784	3,161
Cloud System Infrastructure Services (IaaS)	120,333	143,927	182,222
<b>Total Market</b>	<b>478,315</b>	<b>563,592</b>	<b>678,790</b>

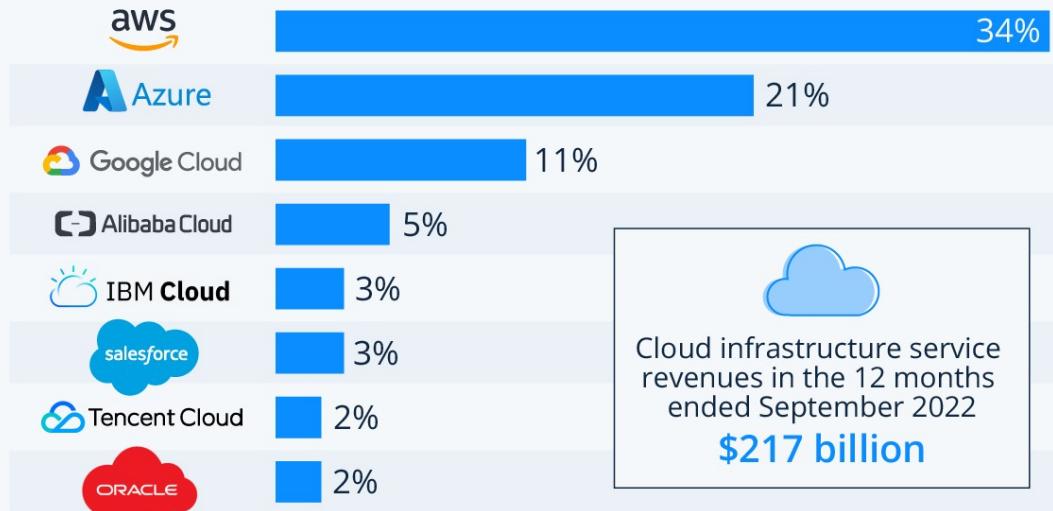
BPaaS = business process as a service; IaaS = infrastructure as a service; PaaS = platform as a service; SaaS = software as a service

Note: Totals may not add up due to rounding.

Source: Gartner (November 2023)

# Amazon, Microsoft & Google Dominate Cloud Market

Worldwide market share of leading cloud infrastructure service providers in Q3 2022\*



Cloud infrastructure service revenues in the 12 months ended September 2022  
\$217 billion

\* includes platform as a service (PaaS) and infrastructure as a service (IaaS) as well as hosted private cloud services

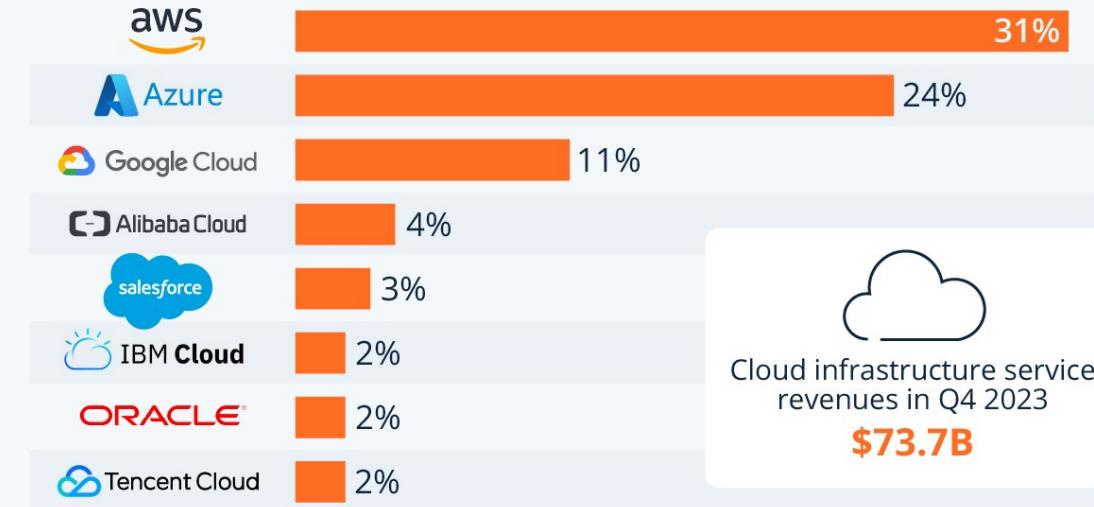
Source: Synergy Research Group



statista

# Amazon Maintains Cloud Lead as Microsoft Edges Closer

Worldwide market share of leading cloud infrastructure service providers in Q4 2023\*



Cloud infrastructure service revenues in Q4 2023  
\$73.7B

\* Includes platform as a service (PaaS) and infrastructure as a service (IaaS) as well as hosted private cloud services

Source: Synergy Research Group

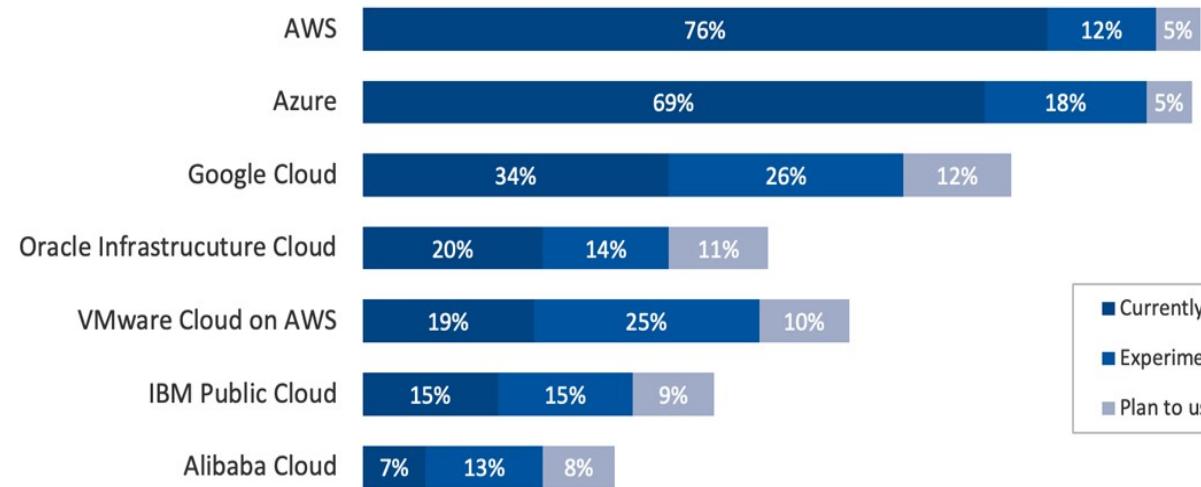


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## Public Cloud Adoption for Enterprises

% of enterprise respondents

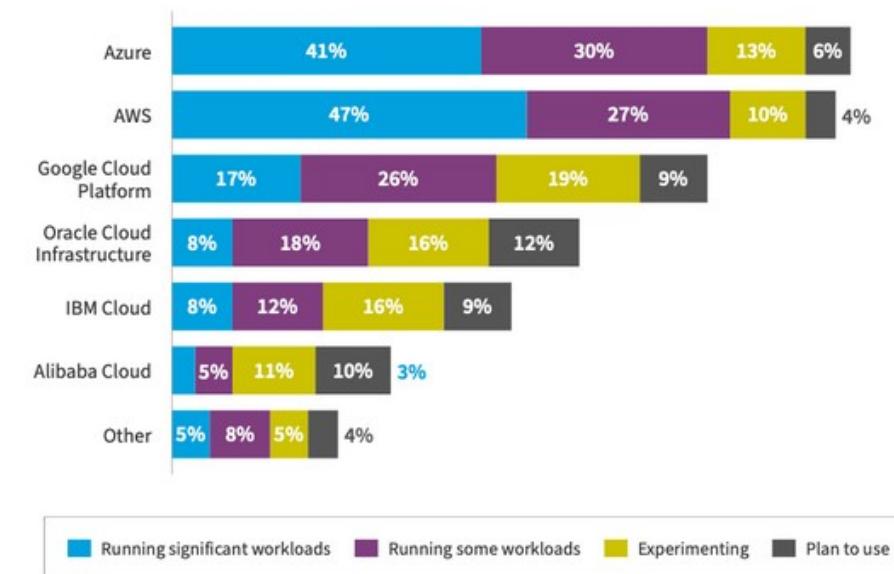


- Currently use
- Experimenting
- Plan to use

N=554

Source: Flexera 2020 State of the Cloud Report

## What public cloud providers does your organization use?



N=750

Source: Flexera 2023 State of the Cloud Report

**flexera**

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# Výhody cloudu pre firmy

- Menšie náklady na infraštruktúru
- Bezpečnosť
- Škálovateľnosť
- Univerzálny prístup
- Ochrana pred stratou dát
- Automatické aktualizácie

# Virtualizácia

- “Virtualization uses software to create an abstraction layer over computer hardware that allows the hardware elements of a single computer—processors, memory, storage and more—to be divided into multiple virtual computers, commonly called virtual machines (VMs). Each VM runs its own operating system (OS) and behaves like an independent computer, even though it is running on just a portion of the actual underlying computer hardware.” - IBM
- “A methodology for emulation or abstraction of hardware resources that enables complete execution stacks including software applications to run on it.” - NIST
- „Virtualization is technology that lets you create useful IT services using resources that are traditionally bound to hardware. It allows you to use a physical machine’s full capacity by distributing its capabilities among many users or environments.“ – Red Hat
- “Virtualisation creates a simulated, or virtual, computing environment as opposed to a physical environment. Virtualisation often includes computer-generated versions of hardware, operating systems, storage devices and more. This allows organisations to partition a single physical computer or server into several virtual machines. Each virtual machine can then interact independently and run different operating systems or applications while sharing the resources of a single host machine.” - Microsoft

# Virtualizácia (2)

- Umožňuje nám delenie zdrojov jedného stroja medzi viac užívateľov
- Umožňuje poskytovať užívateľom vyžadovanú úroveň abstrakcie
- Vďaka abstrakcií umožňuje používať požadované aplikácie na rôznom HW
- Virtuálny stroj je virtuálna reprezentácia/emulácia fyzického počítača, ktorý má svoj OS a zdroje

# Hypervisor

- Známy aj ako virtual machine monitor (VMM)
- Software-ová vrstva, ktorá vytvára a spravuje virtuálne stroje
- Alokuje zdroje HW pre jednotlivé virtuálne stroje
- Oddeluje virtuálne stroje od HW a seba navzájom
- Bare metal hypervisor – beží priamo na HW – Microsoft Hyper-V
  - výkonnejší a bezpečnejší
- Hosted hypervisor – beží na úrovni OS – Oracle Virtual Box
  - jednoduchší na setup

# Hypervisor or Virtual Machine Monitor (VMM)

## Type 1

Native (bare metal)



Hardware



Hypervisor



Guest  
OS



Guest  
OS



Guest  
OS

## Type 2

Hosted



Hardware



Host  
OS



Hypervisor



Guest  
OS



Guest  
OS



Guest  
OS

[Zdroj](#)

# Druhy virtualizácie

- Full/native
- Para-virtualizácia
- Hardware assisted
- OS-level

# Full/native virtualizácia

- Virtuálny stroj simuluje dostatok HW na to, aby v ňom mohol izolované bežať zvolený operačný systém
- Operačný systém musí podporovať inštrukčnú sadu procesora (emulácia vs virtualizácia)
- Oracle VM VirtualBox, Vmware Workstation, XenCenter

# Para-virtualizácia

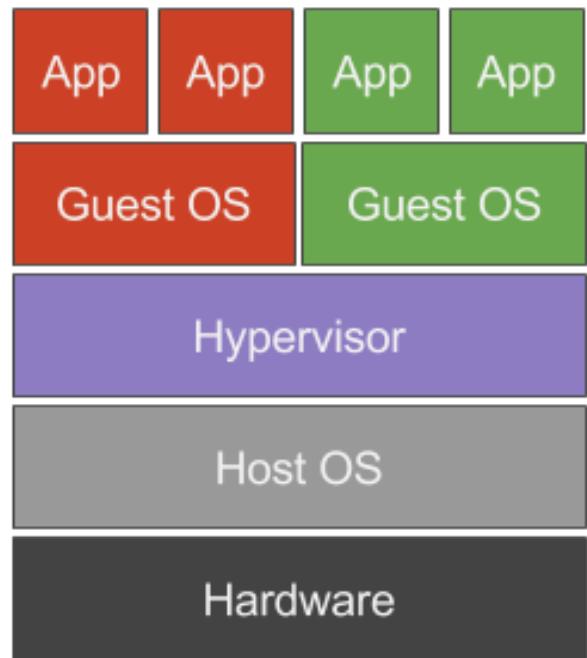
- Plná síce umožňuje používať požadovaný OS bez zmien, no za cenu straty výkonu
- Tento problém rieši para-virtualizácia úpravou jadra OS a poskytnutím API na prácu s HW
- Virtuálna mašina nemusí simulovala HW
- Hostovský OS si je vedomý, že je virtualizovaný
- VMWare VMI

# Hardware assisted

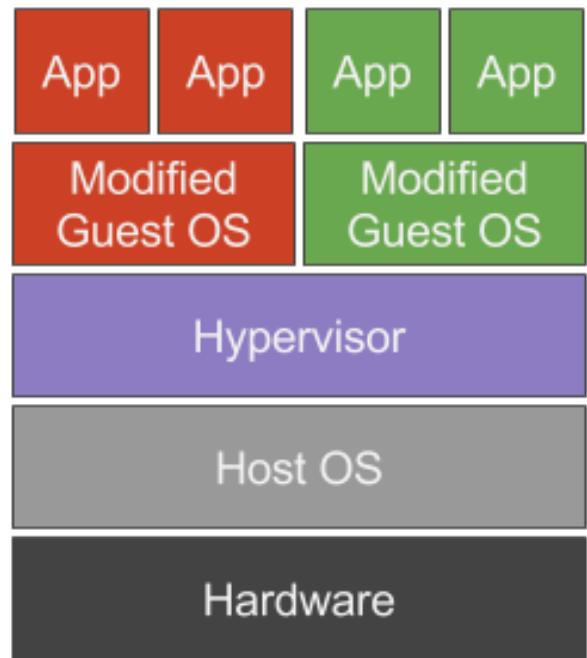
- AMD-V, Intel VT (IVT)
- Virtualizačný software používa vstavané schopnosti CPU, aby dosiahol plnú full virtualizáciu
- Najbližšie k native výkonu

# OS Level

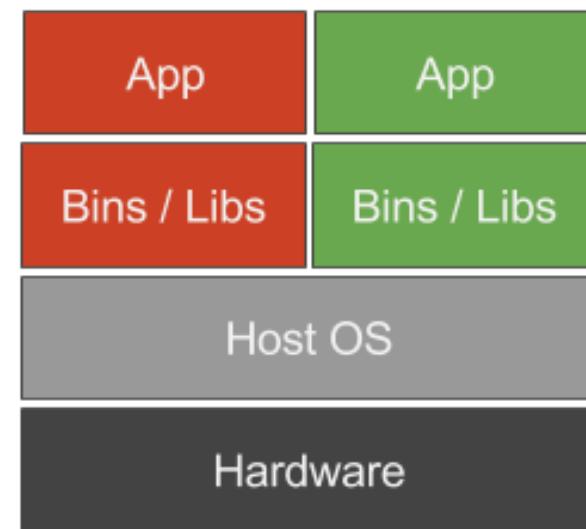
- Umožňuje beh niekoľkých izolovaných virtuálnych strojov na spoločnom operačnom systéme. Každý z týchto strojov ma prístup k funkcionality spoločného OS
- Nesimuluje HW, tým pádom je strata výkonu nižšia ako pri full či paravirtualizácii
- Spoločný operačný systém a systémy vo virtuálnych strojoch musia byť rovnaké/mať spoločný kernel
- Docker, Solaris



Full Virtualization

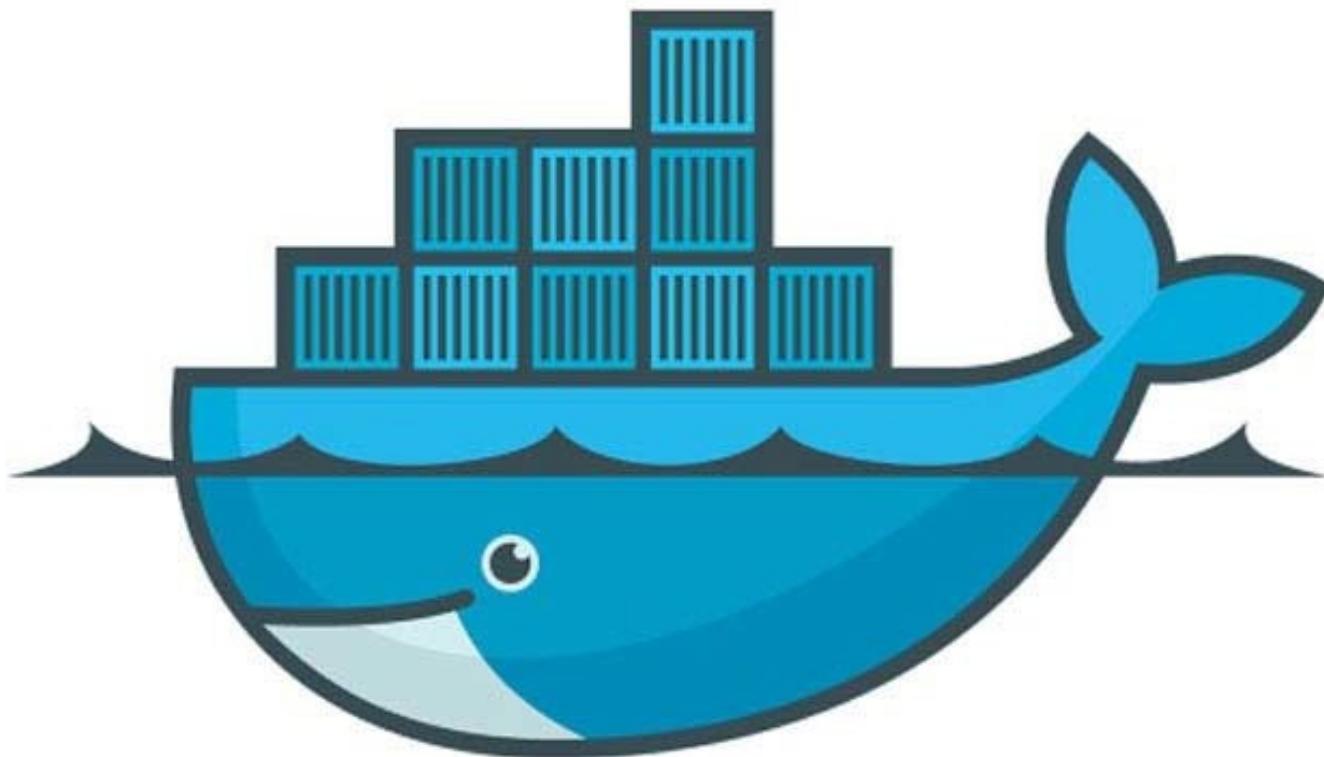


Paravirtualization



OS Level virtualization

# Nabudúce



Otázky?

Ďakujem za pozornosť.

# Aplikačný kontajner

Autori: Daniel Hládek, Ladislav Pomšár

# Recap

- Čo je to cloud
- Aké charakteristiky ma cloud
- Modely clouдовých služieb
- Cloud deployment models
- Virtualizácia a hypervisor

## Cloud a open-source

- Mnoho clouдовých technológií je open-source
- CNCF - Cloud native computing foundation
- Súčasť Linux Foundation
- 182 projektov, 766 členov, viac ako 75k community členov
- Business sa od 0. rokov zmenil - Vendor Lock-Ins, Openness, Innovation, Transparency, Compatibility, Control...
- <https://www.cncf.io/projects/>

<https://landscape.cncf.io/>

# OCI

- Open container initiative
- Štandardy sú v IT mimoriadne dôležité
- Runtime specification, Image specification, Distribution specification
- Pôvodne dohoda Docker-u, CoreOS a iných industry leadov

## Príklady OCI-compliant container engines

- Podman
- CRI-O
- runc
- crun
- containerd
- Docker
- Štandardy fungujú

## Prečo vlastne Docker?

- Jednoduchosť a user-experience
- Základy a vysoko-úrovňové koncepty by mali byť veľmi podobné resp. rovnaké s ostatnými (OCI), implementačné detaily sa môžu myliť
- Vytvorené kontajnery budú aj tak pustiteľné aj v iných engines
- Chaos po oznámení o konci supportu Docker v Kubernetes

# Docker

# Docker

Virtualizačná vrstva medzi aplikáciou a operačným systémom.

Aplikácia využíva jadro hostiteľského OS.

Napísaný v Go.

Používa niekoľko vlastností linux kernel-u - namespaces, control groups, container

## Docker

Umožňuje rýchlo spúšťať aplikáciu na ľubovoľnom HW bez toho aby ste museli riešiť inštaláciu a závislosti.

# Docker Komponenty

- docker client
- docker daemon
- image registry

# Docker Komponenty

```
+-----+
| registry | Docker Hub
+-----+
|| (image)
+-----+
| daemon | Host machine
+-----+
|| (REST API)
+-----+
| client | Host machine
+-----+
```

# Docker client

- príkaz 'docker' v príkazovom riadku
- beží na ľubovoľnom OS
- pomocou REST API komunikuje s docker daemonom

# Docker Daemon

- (väčšinou) beží na Linux OS alebo na Docker Machine
- manaže iné Docker objekty ako images, containers, networks či volumes
- má svoje vlastnosti vďaka komunikácií s container runtimes - containerd a runc
- nazývaný aj Docker Engine
- môže komunikovať s ďalšími daemon-mi

# Docker registry

- Docker registre ukladajú docker image
- Docker defaultne používa Docker Hub
- Docker hub - public register  
možnosť private registrov
- použitím docker pull získam image z registry, push ho naopak nahrá do registry

# Docker objects

- objekty, ktoré docker potrebuje na zabezpečovanie svojej funkcionality
- rôzne druhy - images, containers, networks, volumes, plugins ...

# Image

- read-only vzor pre spustenie kontajnera
- proces jeho tvorby je definovaný pomocou dockerfile-u
- pozostáva z vrstiev - príkaz v dockerfile == vrstva
- dovoľujú odvodzovanie jedného obrazu od druhého (niečo pridám)

# Príklad Dockerfile-u

```
# Define a base stage that uses the official python runtime base image
FROM python:3.11-slim AS base

# Add curl for healthcheck
RUN apt-get update && \
    apt-get install -y --no-install-recommends curl && \
    rm -rf /var/lib/apt/lists/*

# Set the application directory
WORKDIR /usr/local/app

# Install our requirements.txt
COPY requirements.txt ./requirements.txt
RUN pip install --no-cache-dir -r requirements.txt

# Define a stage specifically for development, where it'll watch for
# filesystem changes
FROM base AS dev
RUN pip install watchdog
ENV FLASK_ENV=development
CMD ["python", "app.py"]

# Define the final stage that will bundle the application for production
FROM base AS final

# Copy our code from the current folder to the working directory inside the container
COPY . .

# Make port 80 available for links and/or publish
EXPOSE 80

# Define our command to be run when launching the container
CMD ["gunicorn", "app:app", "-b", "0.0.0.0:80", "--log-file", "-", "--access-logfile", "-", "--workers", "4", "--keep-alive", "0"]
```

# Kontajner

- bežiaca inštancia image-u
- definovaný pomocou image-u a jeho konfigurácie
- rozdiel medzi kontajnerom a image-om predstavuje najvrchnejšia vrstva, ktorá slúži na zápis a zmenu dát. Zmazaním kontajneru, táto vrstva zaniká, image sa nemení  
kontajner môže byť pripojený k rôznym sietiam či úložiskám
- dokážeme kontrolovať ako veľmi sú pripojené prostriedky izolované od ostatných kontajnerov

## Spustenie Docker kontajnera

```
docker run nginx
```

## Interaktívne spustenie

```
docker run -it --rm nginx
```

# Čo sa deje po spustení?

1. Ak image nginx nemáme už stiahnutý, je stiahnutý z registry
2. Docker vytvorí kontajner
3. Docker kontajneru alokuje súborový systém
4. Docker vytvorí sietový interface pre pripojenie kontajneru k defaultnej sieti
5. Docker zapne interaktívne kontajner (môžeme mu poskytnúť vstup z klávesnice) - --it
6. Po opustení kontajnera (exit), je tento odstránený - --rm

## Virtuálna siet'

- Kontajner vidí "svoju" siet'.
- Docker podporuje "software defined networking".
- Docker ponuká niekoľko druhov driverov, napríklad:
  - bridge - dovoľuje komunikovať kontajnerom napojeným na rovnakú bridge siet', izoluje ostatné; defaultná siet'
  - host - odstraňuje sietovú izoláciu medzi hostiteľským pc a kontajnerom
  - none - kontajner nemá prístup k žiadnej sieti

## Virtuálny súborový systém

- Kontajner vidí svoj vlastný súborový systém
- Ak súbor existuje v nižšej vrstve a potrebujeme ho čítať, je použitý existujúci súbor.
- Ak je súbor upravovaný nejakou vrstvou, je do nej skopírovaný. (Copy-on-write)
- Docker ps -s hovorí o mieste zaberanom kontajnermi
  - size - hovorí o množstve dát na najvrchnejšej vrstve kontajnera
  - virtual size - dáta potrebné na vytvorenie kontajneru z image-u + size. Tieto dáta môžu byť kontajnermi zdieľané

## Oddelenie dát od aplikácie

- Aplikácia je defaultne stateless - nemá žiadne permanentne uložené dáta, ktoré môže použiť pri ďalšom zapnutí
- Dáta môžu byť uložené kdekoľvek

## Data volumes

- Na uloženie dát z kontajnera (stateful)
- Priamo pripojený do kontajnera
- Lokálne súbory, no vďaka driverom aj rôzne cloudové úložiská
- Native performance
- Alternatívou sú menej flexibilné bind mounts

## Spustenie s mapovaním siete a zväzkov

```
docker run -p 80:80 -v /var/www:/var/www nginx
```

- Mapovanie medzi reálnym a virtuálnym adresárom.

# Docker Swarm

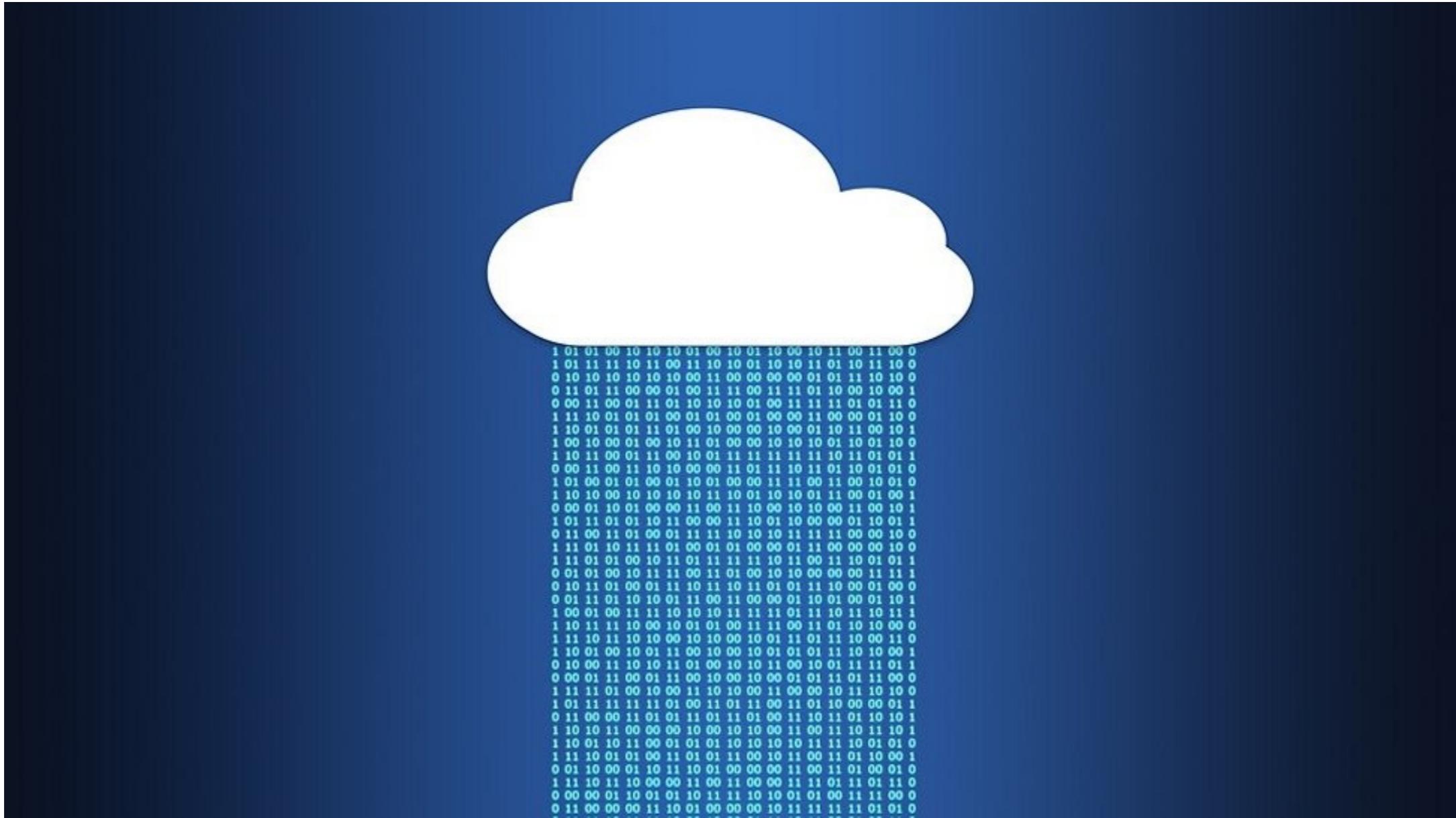
- platforma na manažment clustrov a orchestráciu
- node - inštancia docker engine-u
- manager - orchestruje a manažuje worker-ov, rozdeľuje im úlohy, zabezpečuje load balancing
- worker - vykonáva úlohy
- service definuje úlohy, ktoré má node vykonať a image na ktorom ich vykonať.
- replicated service - špecifikujeme na koľkých node-och vykonať tú istú úlohu naraz
- global - tasky sú distribuované na všetky možné node-y

## Možné problémy

- Závislosť na Docker Hub
- Časté využívanie neoverených obrazov
- docker daemon beží ako 'root'

## Docker

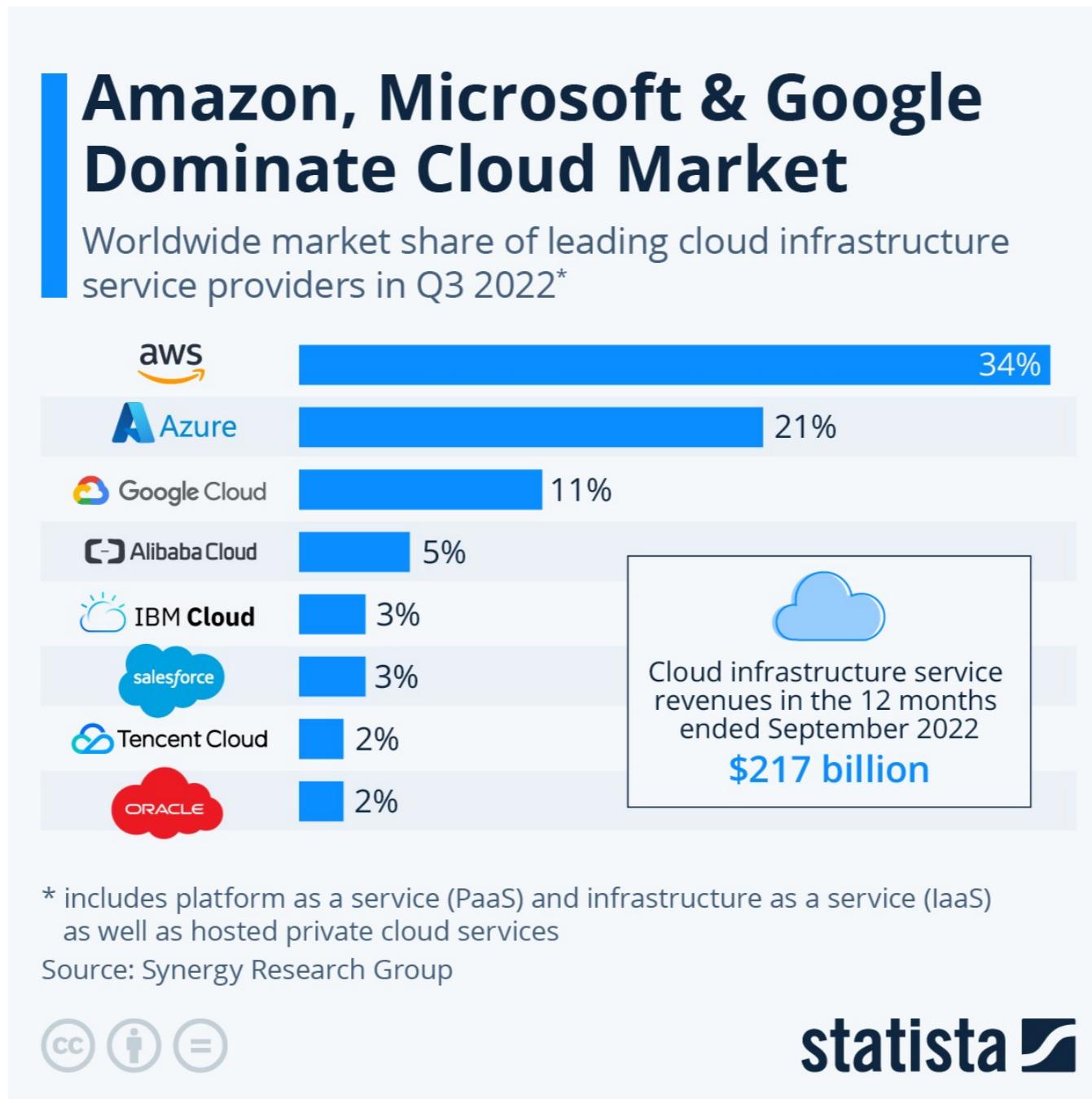
- je virtualizačná vrstva medzi jadrom a aplikáciou
- umožňuje ľahko spustiť aplikáciu v cloude
- zjednodušuje inštaláciu



# NAJVÄČŠÍ DODÁVATELIA CLOUDOVÝCH SLUŽIEB

Ing. Ladislav Pomšár  
prof. Ing. Iveta Zolotová, CSc.

# Najväčší dodávateľia clouдовých služieb



[Source](#)

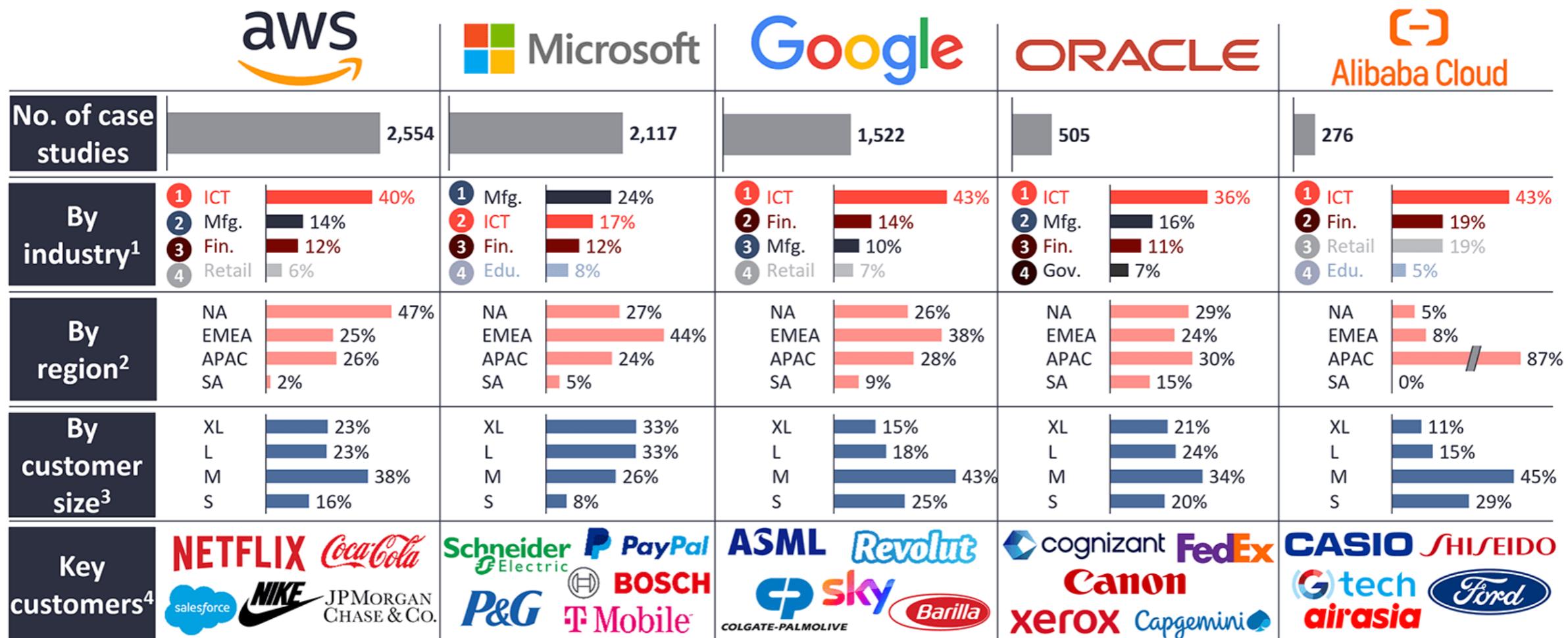
# Najväčší dodávateľia clouдовých služieb



June 2023

## Mapping the world's cloud projects

Data based on 7,000 public customer case studies on respective cloud vendor websites



Note: N = 6,974; Data based on public customer case studies on respective cloud vendor websites (as of May 2023). Includes all cloud IaaS and PaaS customer case studies, does not include case studies that solely include specific cloud applications from the respective vendor (e.g., MS Teams, Microsoft 365, Google Docs) 1: Share of case studies of each vendor in each of the top four industries. 2: Share of case studies of each vendor in the respective region. 3: Share of case studies of each vendor that highlight customer with each size [Small (1–49 employees), Medium (Med.) (50–999 employees), Large (1,000–9,999 employees), Extra large (XL) (10,000+ employees)]. 4: Selection of well-known companies with significant commercial relationship

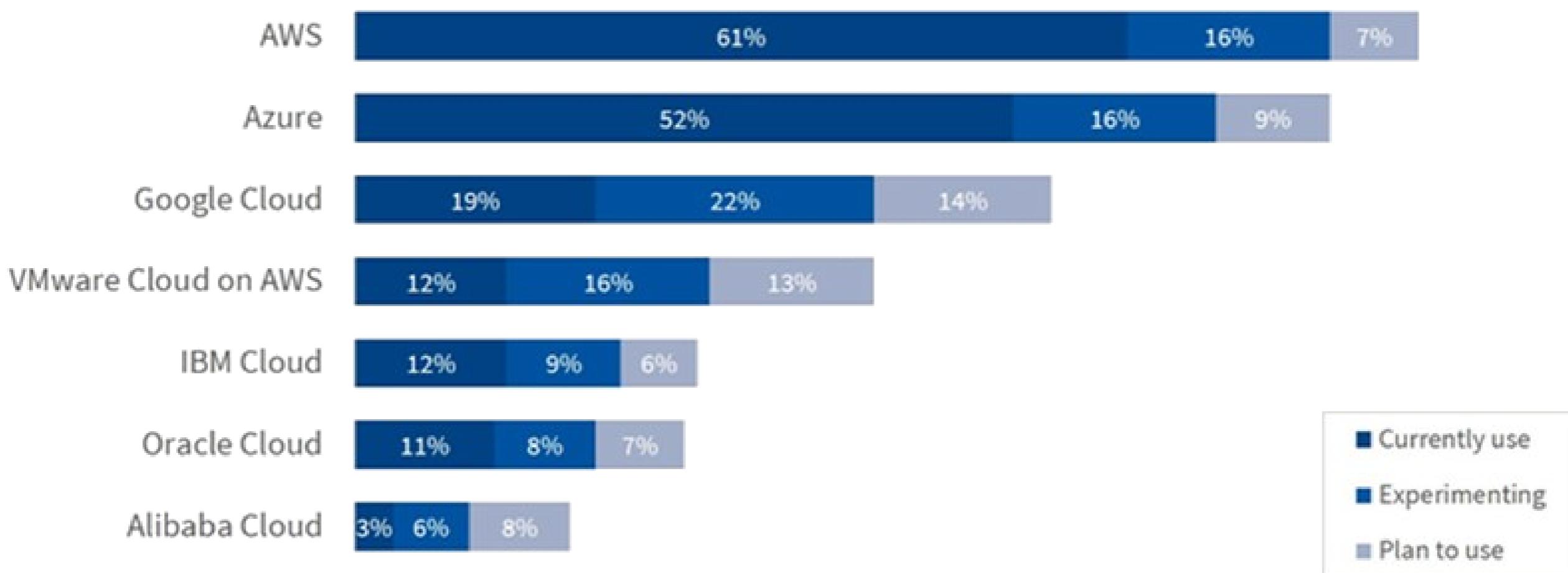
Source: IoT Analytics Research 2023 – Global Cloud Projects Report 2023. We welcome republishing of images but ask for source citation with a link to the original post or company website.

[Source](#)

# Najväčší dodávateľia clouдовých služieb

## Public Cloud Adoption

% of All Respondents



Source: RightScale 2019 State of the Cloud Report from Flexera

[Source](#)

# Úvod

- Všetci veľkí provider-i dnes ponúkajú širokú škálu služieb (dostupnosť môže záležať od regiónu), do určitej mieri podobnú
- Jedná sa jednak o všeobecné služby, súvisiace so zabezpečením behu aplikácie a infraštruktúry
- Existujú aj špecializované služby, ktoré umožňujú firmám využívať cloud na rozširovanie funkcionality služieb
- Podľa analytikov sú najväčší a najsilnejší Amazon, Microsoft a Google
- Ostatok provider-ov ich viac menej dobieha

# Všeobecné služby

- Virtuálne stroje
- Networking
- Aplikácie
- Databázy
- Storage
- Developer Tools
- Integration
- Identity
- Management and Governance
- Security
- DevOps

## Špecializované služby

- AI + Machine Learning
- Data Analytics
- Blockchain
- Internet of Things
- Media
- Mixed Reality
- Mobile
- Web

# Prehľad služieb

<http://comparecloud.in/>



Amazon Web Services



[Source 1](#)

[Source 2](#)

# Amazon

- Najväčší internetový obchod a najväčší poskytovateľ cludových služieb na svete,
- Založenie: 1994 (hned' po zavedení HTTP □),
- 750 tisíc zamestnancov k roku 2019



# Amazon Web Services

- Známe aj ako AWS
- Založenie: 2006
- Najväčší poskytovatelia clouдовých služieb
- IaaS - AWS Elastic Compute Service 2 (EC2)
- PaaS – napr. AWS Elastic Beanstalk

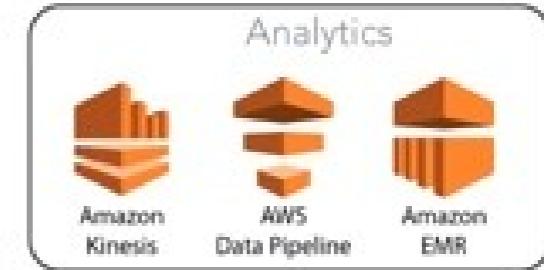


# AWS Services

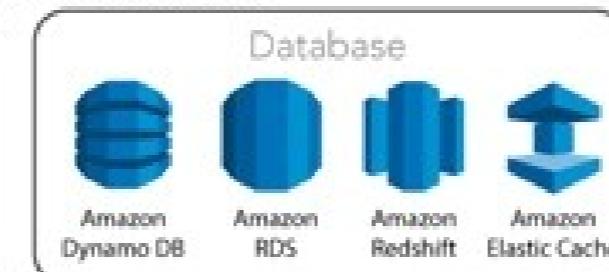
## Deployment & Management



## Application Services



## Foundation Services



[Source](#)

# Kto sú zákazníci a prečo?

- Najširšia ponuka služieb
- Dobrá dokumentácia a mnoho existujúcich expertov
- Ľahké a rýchle školenie nových ľudí – množstvo kurzov...
- Dynamicky inovujúca platforma, aj za cenu horšie fungujúcich služieb
- Amazon, podobne ako pri e-shope, počúva primárne zákazníka, má top podporu
- Produkty tretích strán majú najlepšiu integráciu s AWS

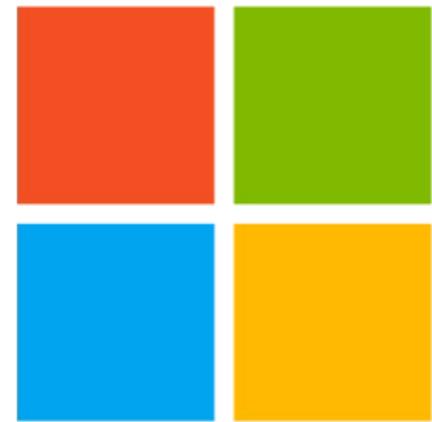
# Dostupnosť AWS

- 105 zón v 33 lokalitách (80 v 25 minulý rok)



# Demo AWS

- Pre študentov
  - AWS educate starter account
- AWS free tier



Microsoft  
Azure

Microsoft Azure



Microsoft

[Source 1](#)

[Source 2](#)

# Microsoft

- Dcérské firmy ma v súčasnosti v 121 krajinách, aj na Slovensku (134 tisíc zamestnancov - 2018),
- Založená 4. apríl 1975,
- Hlavné produkty: OS, kancelársky softvér, cloudová platforma

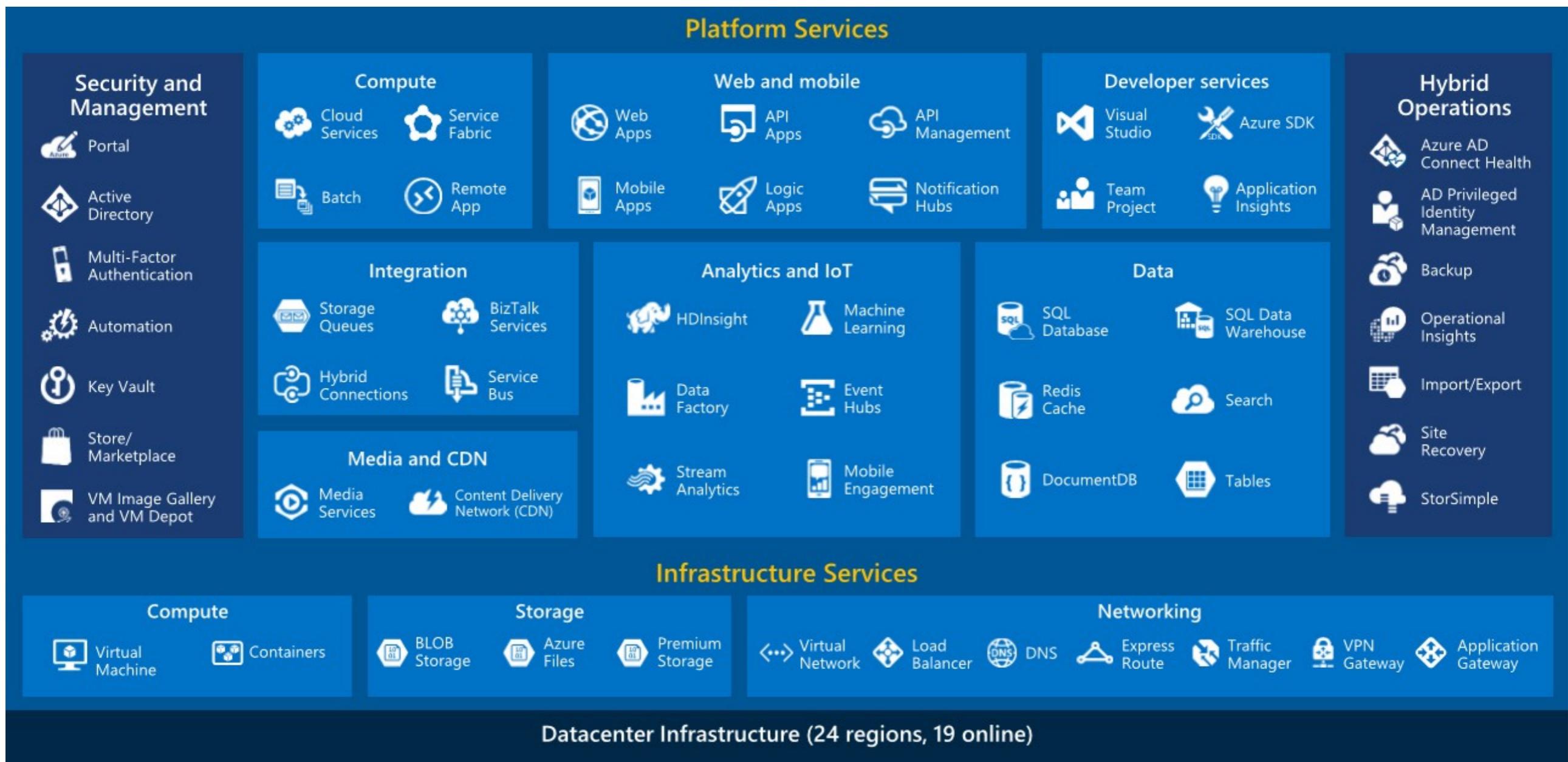


# Microsoft Azure

- Predstavenie produktu: 2008,
- Uvoľnenie produktu: 2010 pod názvom Windows Azure Platform
- Premenovanie produktu: 2014 – Microsoft Azure
- Zmena loga a manifestu – 2017
- IaaS – Azure Virtual Machine
- PaaS – Azure Web Apps / Azure Cloud Services



Microsoft  
Azure



[Source](#)

# Kto sú zákazníci a prečo?

- Microsoft má kopy enterprise zákazníkov – enterprise oriented
- Optimalizácie a preferencia Windows platformy a .NET
- => Microsoft sa snaží ponúknuť ich zákazníkom čo najlepšie možnosti hybrid cloud-u
- Ľahko vyklikateľný portal
- ?Problém? - Reputácia MS - éra Steve-a Ballmer-a

# Dostupnosť MS Azure

- Viac ako 43 regiónov a nie len na zemi (Azure Space a Orbital)
- Európa – 16 regiónov

<https://datacenters.microsoft.com/globe/explore>

# Demo MS Azure

- MS Azure for students
  - 100 dolárov kredit ročne
  - Viac ako 55 free služieb
  - Viac info - <https://azure.microsoft.com/en-us/free/students>



# Google Cloud

Google Cloud Platform

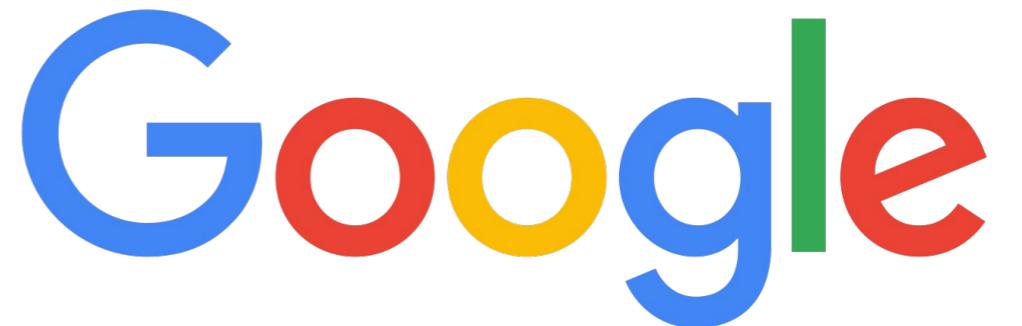
Google

[Source 1](#)

[Source 2](#)

# Google

- hlavné produkty: Web search, Earth, Maps, Chrome, ...
- založenie: 4. september 1998,
- 100 tisíc zamestnancov k roku 2018.



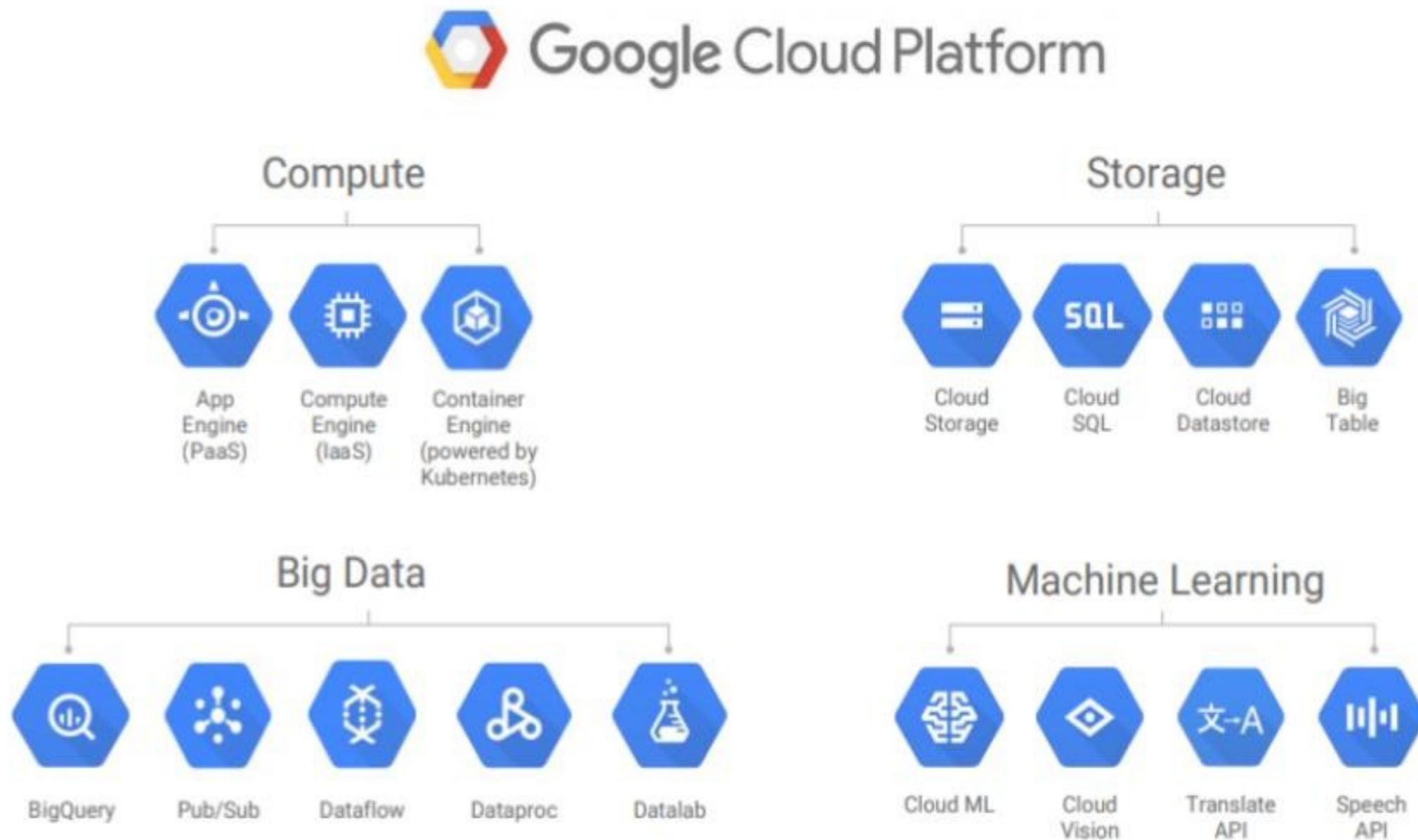
# Google Cloud Platform

- Súčasť Google Cloud
- Google App Engine: 2008,
- Google Cloud Storage: 2010,
- Google Cloud Platform: 2011.
- IaaS – Compute Engine
- PaaS – Google App Engine



Google Cloud

# Google Cloud Platform



[Source](#)

# Kto sú zákazníci a prečo?

- Migrácia bežiaceho virtuálneho stroja medzi hostujúcimi strojmi
- Google Kubernetes Engine - najlepšia implementácia Kubernetes-u na cloude
- AI - GPU a TPU na trénovanie, BigQuery
- Mobile - Firebase
- Problém - Google môže ukončiť vývoj a podporu služby
- Google ma víziu, zákazník je „druhoradý“

# Kubernetes



- Pôvodne projekt Google-u, dnes open source
- Nástroj na správu kontajnerov, pracuje na úrovni kontajnerov, nie HW
- Funkcie
  - Load balancing
  - Správa úložiska
  - Automatizácia spúšťania a vypínanie kontajnerov
  - Automatické rozmiestňovanie kontajnerov na node-y
  - Reštartuje/nahradzuje/vypína chybné kontajnery
  - Manažuje heslá či SSH kľúče
- Kubernetes nie je obyčajný nástroj na orchestráciu. Orchestrácia sa snaží vykonať nejaký postup - najprv A, potom B, nakoniec C. Kubernetes má A a chce dosiahnuť C pomocou nezávislých kontrolných procesov.
- Umožňuje zvládať kontajnery na rôznych cloudoch

[Source](#)



[Source](#)



Alibaba Cloud



# Alibaba

- 1999
- Alibaba je najväčšia maloobchodná siet' a najväčšia e-commerce spoločnosť na svete
- V roku 2018 svojím dňom nezadaných prelomili všetky rekordy, keď za 24 hodín predali tovar za 30 miliárd dolárov
- AliExpress, AliPay

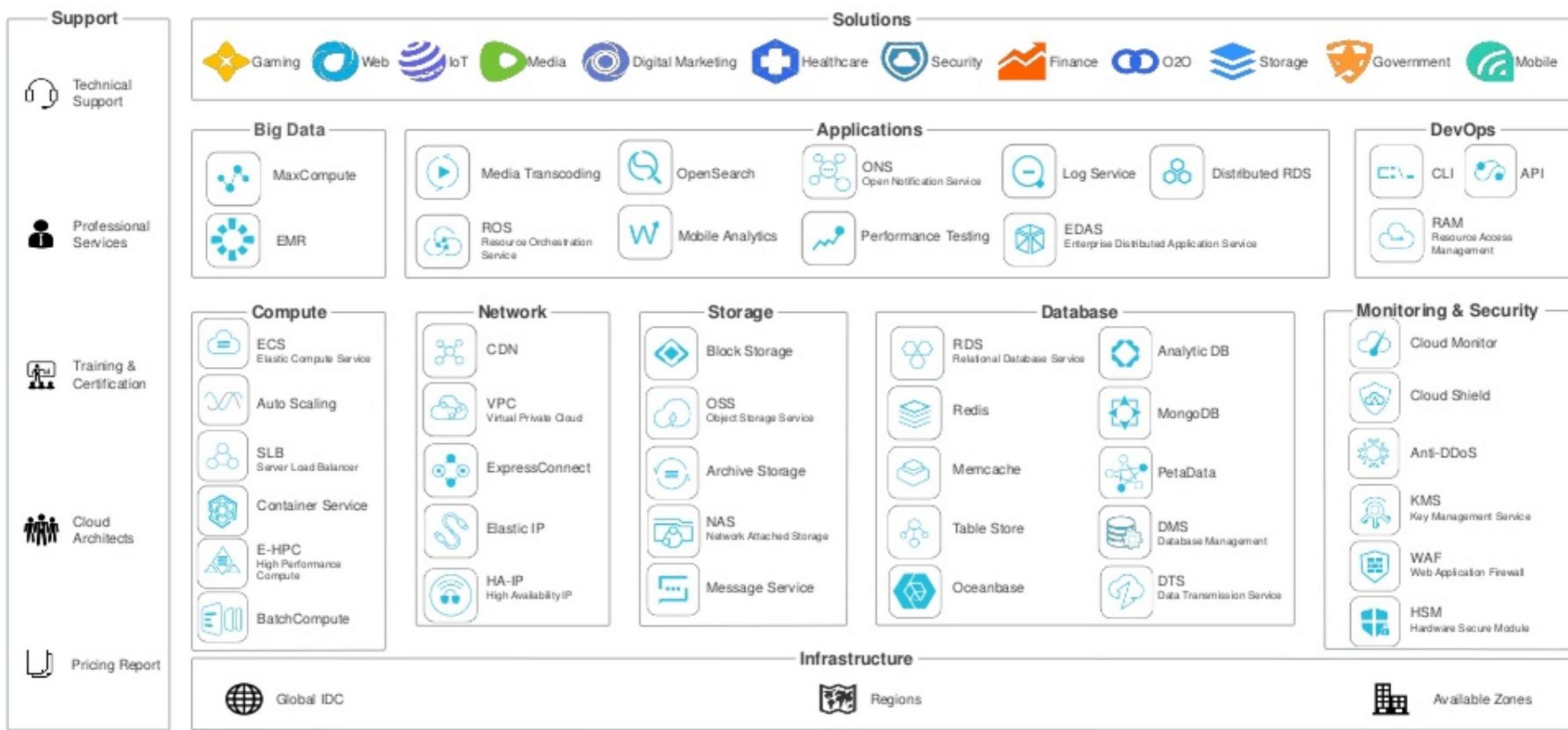


# Alibaba Cloud

- Nazývaný aj Aliyun
- Súčasť čínskej spoločnosti Alibaba group, registrovaná v Singapure
- Alibaba group ma cca 102 tisíc zamestnancov
- ISO27001 – prvá Čínska cloudová spoločnosť s touto certifikáciou zaobrajúcou sa bezpečnosťou informačných systémov
- IaaS – Alibaba Elastic Compute Service
- PaaS - Enterprise Distributed Application Service



# Alibaba Cloud Services Portfolio



# Kto sú zákazníci a prečo?

- Orientácia na Čínu a Áziu
- Sieť s vyše 1 000 uzlov content delivery network v Číne
- Integrácia s Alibaba produktmi
- Great firewall of China

# Dostupnosť Alibaba Cloud

- 89 zón, 30 regiónov (14 v Číne) (pred rokom 69 zón, 23 regiónov)
- Primárne pokrýva Ázijsky trh



[Source](#)

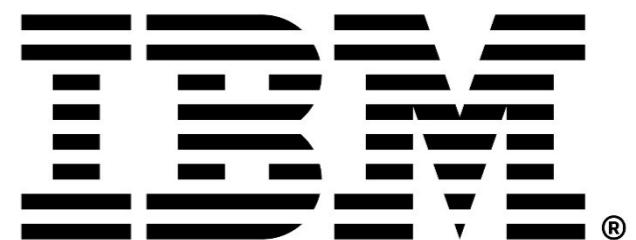
# Alibaba Cloud for Students

<https://www.alibabacloud.com/developer/students>



IBM Cloud

IBM Cloud

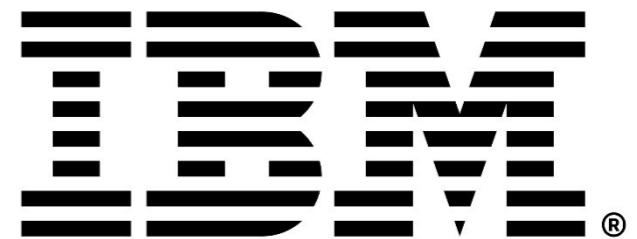


[Source 1](#)

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# IBM

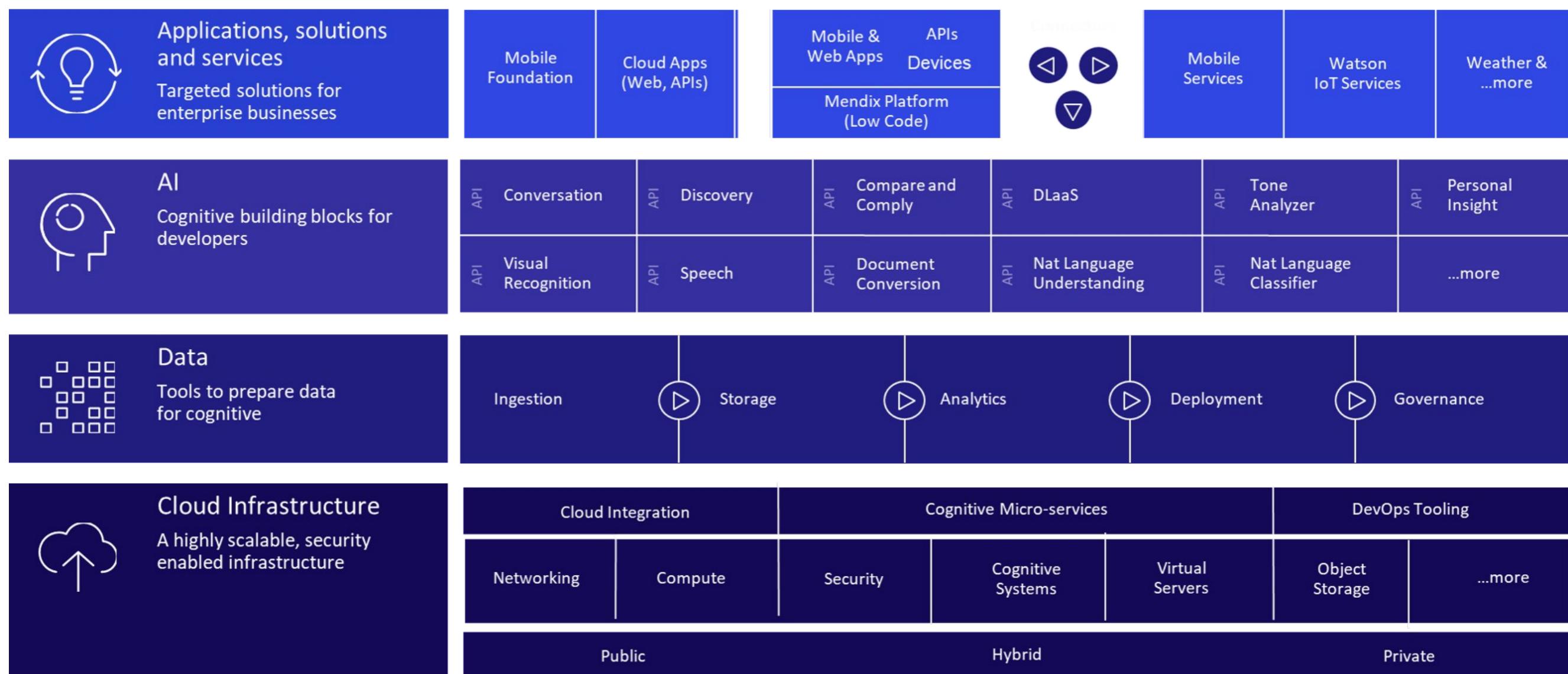
- International Business Machines
- jedna z najväčších IT spoločností sveta (350 tisíc zamestnancov), s pobočkami aj na Slovensku (177 krajín)
- Založená 16. júna 1911, prvý predchodca už v roku 1889
- Autor mnohých významných technológií: prvý pevný disk, vývoj mainframu System360 (počítač pre kritické aplikácie, ktoré spracovali veľké množstvo dát), vynález čiarového kódu



# IBM Cloud

- IBM Bluemix na trhu od 2014
- koncom roka 2017 premenovaný na IBM Cloud:
  - najmä PaaS služba (Platform as a Service), ale aj IaaS
  - pomáha programátorom tvoriť, dodávať, manažovať a spravovať clouдовé aplikácie.
- Na pozadí používa open source platformu CloudFoundry
- IaaS - Classic Virtual Server
- PaaS - Cloud Foundry Apps





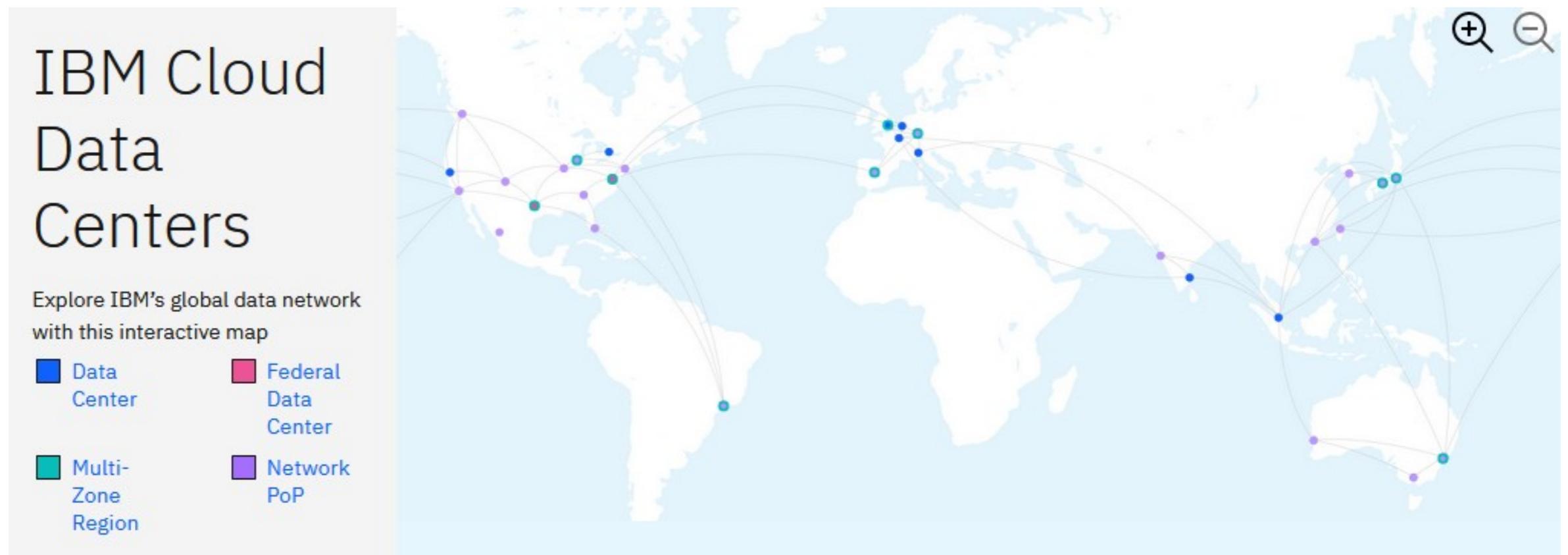
[source](#)

# Kto sú zákazníci a prečo?

- Dlhoroční IBM zákazníci
- IBM Watson – AI platforma pre biznis
- IBM Cognos – BI platforma pre analytiku
- Akvizícia Red Hat
  - OpenShift – Kubernetes s dodatočnými cloud technológiami
  - OpenStack
  - Ansible
- Slabšia integrácia služieb

# Dostupnosť IBM cloud

- Cez 60 data centier, 6 regiónov, 18 zón



[Source](#)

# Demo IBM Cloud

- Trial
  - Bez zadania kreditky je možné používať niektoré služby
    - 5000 predikcií Watson Machine Learning, 500 zariadení IoT platform, 2 Visual Recognition modely, cluster s 1 node zadarmo
    - Po zadaní kreditky je možné využívať free tieru niektorých služieb
- IBM Academic Initiative

# Firmy ponúkajúce PaaS hostované u providerov

- Siemens – Mindsphere
  - „Operačný systém“ pre IoT
  - AWS
- GE Predix
  - Prvá IoT industriálna clouдовá platforma
  - Azure
- Heroku
  - Dovoľuje developerom buildovať, nasadzovať, škálovať a manažovať aplikácie
  - AWS, napriek tomu, že vlastníkom je Salesforce
- Workday
  - Manažment ľudských zdrojov, financie, plánovanie
  - Mali už SaaS, PaaS dovoľuje používať ich API, zlepšovať funkciaľitu a pracovať nad dátami zo SaaS

# Selfhosting

- Hostovanie cludových aplikácií na vlastnej infraštrukúre
- Alternatíva v prípade vlastných výpočtových zdrojov
- Vyžaduje software na selfhosting
- Napr. Jira
- <https://github.com/awesome-selfhosted/awesome-selfhosted>

# Ovládanie clouдов

- V princípe 4 rôzne rozhrania
  - CLI
  - REST API
  - Portál
  - SDK
- Každý provider má iné príkazy, argumenty...
- Potreba existencie
  - Dostatočnej dokumentácie
  - Ideálne aj príkladov použitia
  - Podpory
    - Často rôzne úrovne
    - Free vs Paid, team vs enterprise...
    - Napr. Azure má podľa závažnosti problému a úrovne zákaznika maximálnu dobu reakcie (nie vyriešenia!) od 15 min do 8 hodín (v rámci pracovnej doby), viac [tu](#)

# REST API

- representational state transfer API/RESTful API
- Nie je to ani standard (ako napr. SOAP), ani protokol, len nejaký štýl SW architektúry/odporúčané postupy pre ich implementáciu
- Používa sa na integráciu aplikácií či mikroslužieb
- Výhodami sú flexibilita, škálovateľnosť či efektivita
- Používa sa zväčša nad HTTP – POST, GET, PUT, DELETE
- Môže teoreticky používať hocakú štruktúru na reprezentáciu stavu zdroja, zmien, ktoré chceme vykonať a pod.
  - V realite najčastejšie používany JavaScript Object Notation (JSON)

# CLI a SDK

- CLI
- Skrýva komplexitu REST API pred používateľom => prekladá požadované príkazy a argumenty
- Zväčša rovnako schopné ako REST API, niekedy má ešte viac funkcionality
- Väčšinou pre všetky operačné systémy
- Vhodné skôr pre opakované manipulácie userov/automatizačných skriptov
- SDK
- Skrýva komplexitu REST API pred používateľom => prekladá požadované príkazy a argumenty
- Zväčša má nejaké obmedzenia
- Väčšinou len pre niektoré jazyky (univerzálne pre Python)
- Ľahšia integrácia priamo do aplikácie => Ak mam web, ktorý ma niečo vykonať, nechcem ešte nejak vykonávať nejaký ďalší skript v skriptovacom jazyku...

# Webový portál

- Najjednoduchší formát pre používateľa
- Vhodný na vizualizáciu výsledkov či informácií (napr. AI či dátové služby)
- Často obmedzený v niektorých druhoch funkcionality
- Podlieha častejším zmenám ako ostatné spôsoby
- Najjednoduchší spôsob ako sa ozvať podpore

Otázky?

Ďakujem za pozornosť

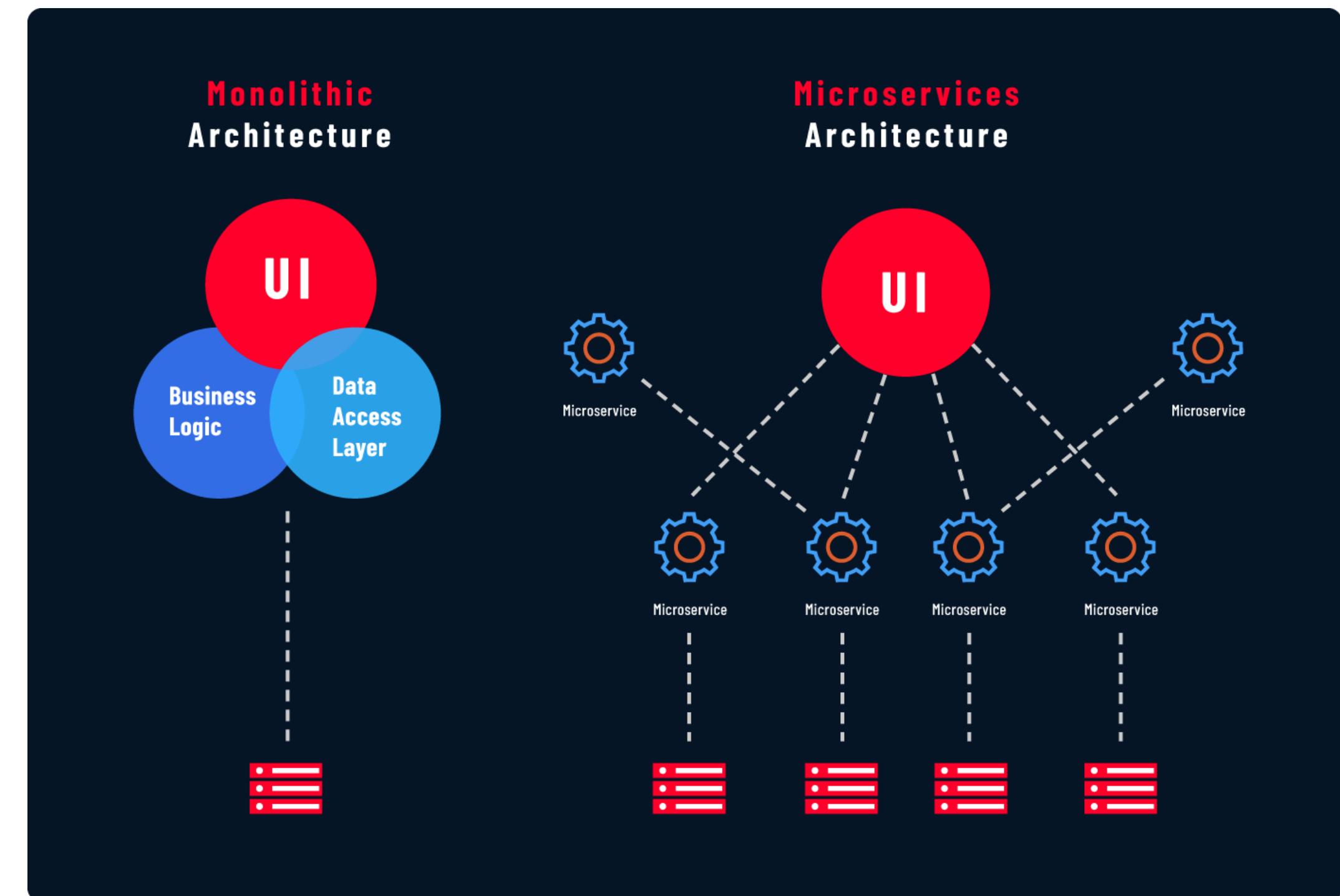
# Tvorba cloud riešenia

Ing. Ladislav Pomšár, prof. Ing. Iveta Zolotová, CSc.

2023/24

# Microservices

- Monolitické architektúry -> Service-oriented architecture -> Microservices
- Dnes sú aplikácie kolekciou microservices
- Menšie prvky, ľahší vývoj, menej refactoringu, izolácia



[Zdroj](#)

# Vlastnosti Microservices

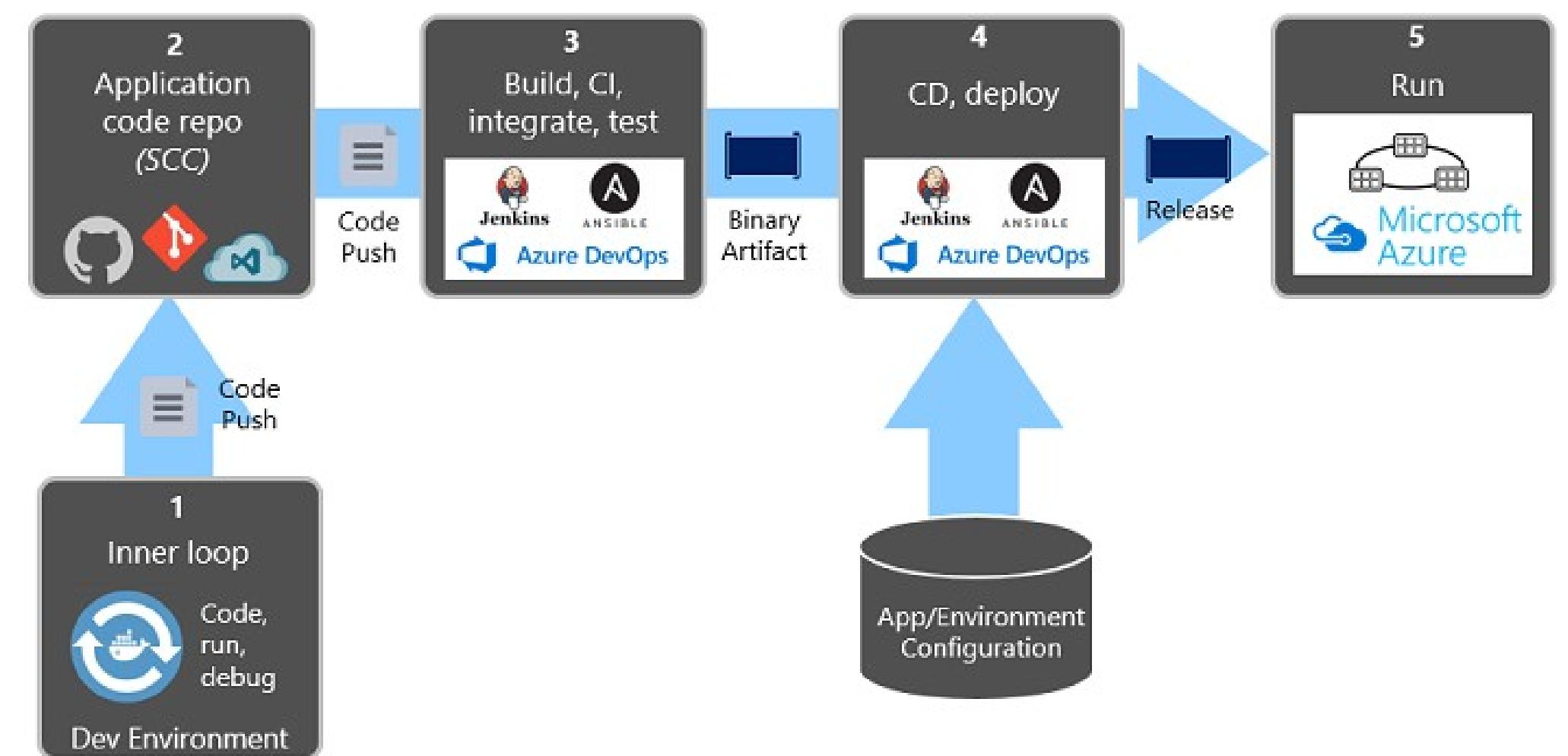
- Každá implementuje špecifickú vlastnosť
  - Viete vyvíjať jednu mikroservice pre viac aplikácií
- Je vyvýjaná samostatne a nasadzovaná nezávislo
- Obsahuje svoje úložiská, závislosti a pod
- Má svoj vlastný proces, s ostatnými komunikuje a kooperuje
- Spolu tvoria aplikácie

# Výzvy pri tvorbe Microservices

- Komunikácia
  - Kto, kde, ako, s kým?
- Odolnosť
  - Čo ak komunikuje viac služieb a jedna neodpovedá? Mohla „zomrieť“ alebo len sa updateuje
- Distribuované dátam
  - Služba má svoje dátam, no čo s dátami, ktoré zdielá a upravuje viac služieb
- Tajomstvá
  - Ako bude služba ukladať heslá, konfiguráciu... ?

# CI/CD

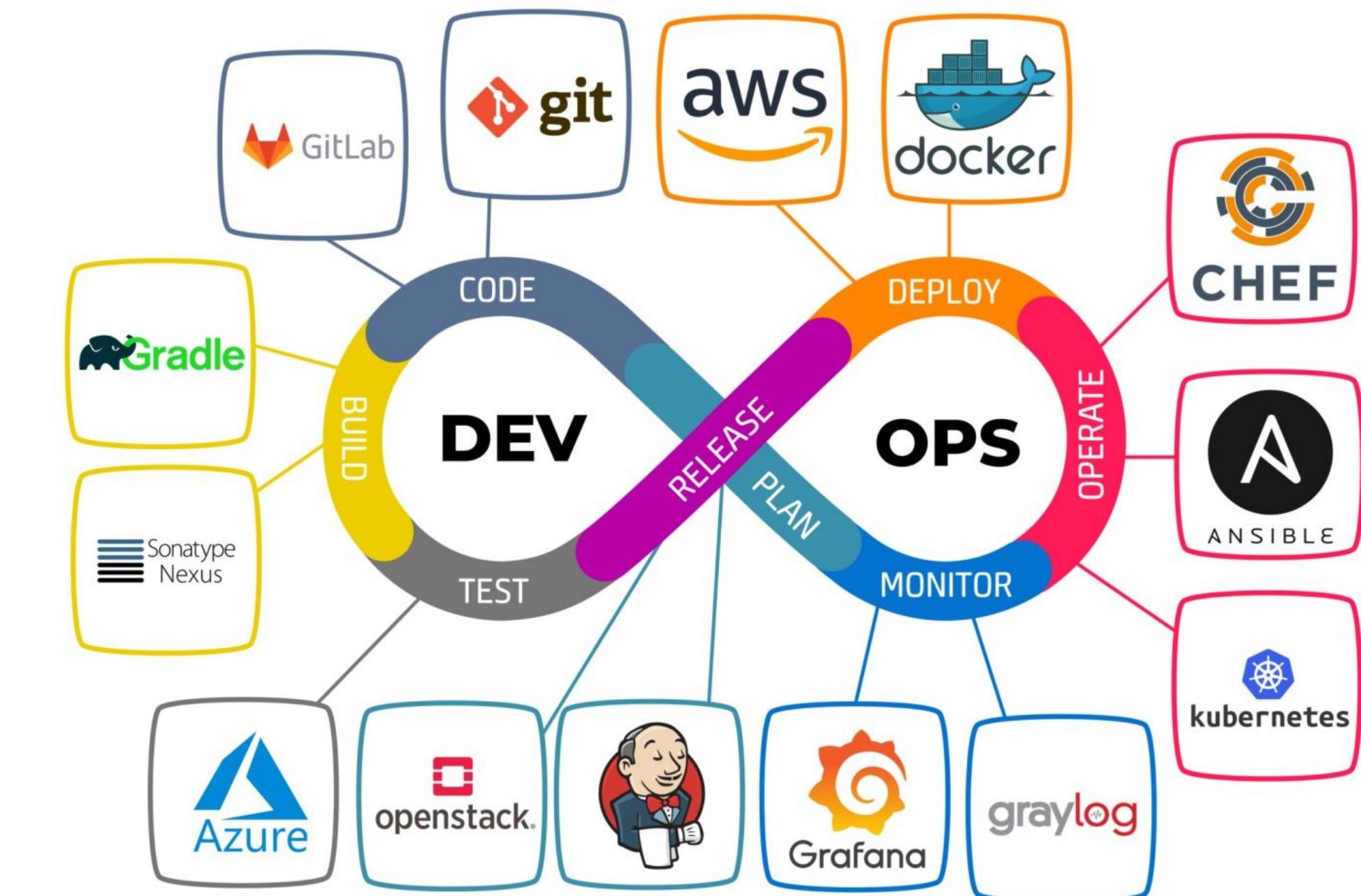
- „**Continuous integration** is a DevOps software development practice where developers regularly merge their code changes into a central repository, after which automated builds and tests are run.“
- „**Continuous delivery** is a software development practice where code changes are automatically built, tested, and prepared for a release to production.“
- Infrastructure as a code – umožňuje definovať infraštruktúru pomocou kódu



[Source](#)

# DevOps

- Software development (Dev) + Operations (Ops)
- Dodám kód a neriešim? Eh... Nie
- Set praktík, pre automatizáciu a optimalizáciu dodávania SW, snažíme sa optimalizovať kvalitu a čas dodania
- Coding, Building, Testing, Packaging, Releasing, Configuring, Monitoring



[Zdroj](#)

# Cloud aplikácie

- Cloud-native – design je od začiatku navrhnutý pre cloud
- Cloud-based – používa niektoré schopnosti cloutu, napr. škálovateľnosť
- Cloud-enabled – zväčša klasická aplikácia premigrovaná do cloutu

# Cloud Native

*“Cloud-native technologies empower organizations to build and run scalable applications in modern, dynamic environments such as public, private, and hybrid clouds. Containers, service meshes, microservices, immutable infrastructure, and declarative APIs exemplify this approach. These techniques enable loosely coupled systems that are resilient, manageable, and observable. Combined with robust automation, they allow engineers to make high-impact changes frequently and predictably with minimal toil.”*

- CNCF

# Cloud Native – it works!

Company	Experience
<a href="#">Netflix</a>	Has 600+ services in production. Deploys 100 times per day.
<a href="#">Uber</a>	Has 1,000+ services in production. Deploys several thousand times each week.
<a href="#">WeChat</a>	Has 3,000+ services in production. Deploys 1,000 times a day.

## Benefity

- Efektívnejšie
- Lacnejšie
- Rýchlejšie na trhu
- Dostupnejšie
- Ľahšia správa
- Škálovateľnejšie a flexibilnejšie

[Source](#)

# Pillars of cloud native – by MS

- Cloud
  - PaaS
  - Pets vs Cattle princip
- Modern design
  - 12 factor application
- Microservices
- Containers
- Backing services
  - Data stores, message brokers, monitoring, identity...
- Automation
  - Infrastruktúry - IaC
  - Deploymentov - CI/CD

[Source](#)

# Principles for cloud-native architecture

## by Google

- Design for automation
  - Infraštruktúra, CI/CD, Scale up/down, Monitoring and recovery
- Be smart with state
  - Najťažšie je skladovať stav aplikácie (dáta používateľov, dáta aplikácie...)
- Favor managed services
  - Používanie manažovaných služieb rieši problémy a šetrí peniaze
- Practice defense in depth
  - Minimalizácia dôvery medzi komponentmi, autentifikácia
- Always be architecting
  - Cloud native systém sa stále mení

[Source](#)

# Cloud native architektúra - AWS

- Immutable infrastructure
- Mikroservices
- API
- Service Mesh
  - Vrstva, kde mikroservices medzi sebou komunikujú
- Containers

# Cloud native vývoj - AWS

- Continuous integration
- Continuous delivery
- DevOps
- Serverless
  - Infraštruktúra je plne manažovaná poskytovateľom
  - Chcem aby vykonal nejaký výpočet
  - Infraštruktúra automaticky preberá výpočty, škáluje a dealokuje

# Krátky prehľad zjednodušeného cloud stack-u

<https://assets.dynatrace.com/global/images/most-popular-cloud-technologies-2017.png>

# Virtual infrastructure

- IaaS
- Kolekcia softwareovo definovaných komponentov
- Virtualizované výpočty, úložisko, networking či security

# Operating system

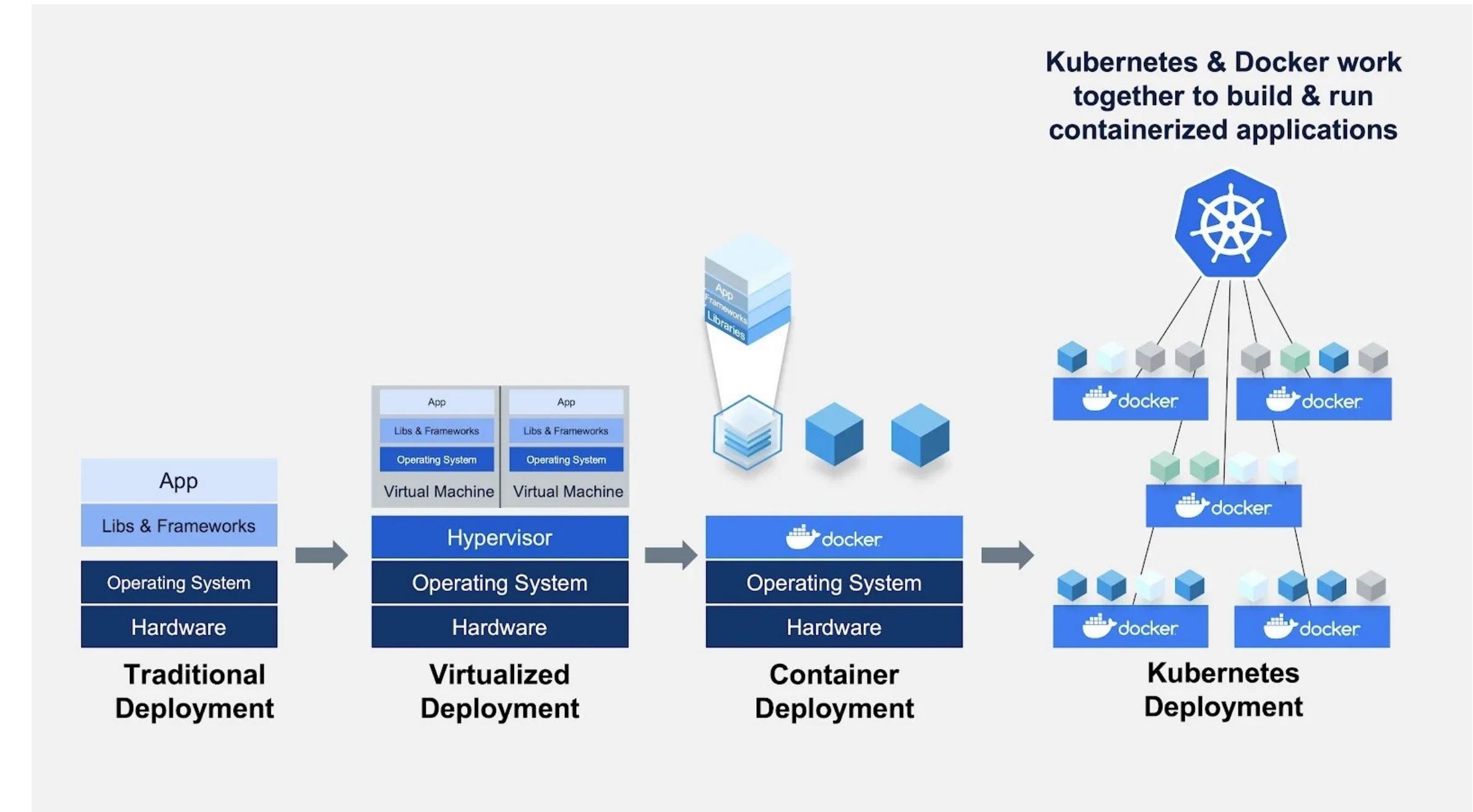
- Podľa druhu kontajnerov
- Podľa konkrétnie používaných technológií
  - Windows vs Linux
- Licenčná politika a podpora
- Existencia špecializovaných OS – Fedora CoreOS, k3OS

# Container engine

- Existujú aj iné technológie ako docker, napr. rkt či LXC
- OS-level virtualisation
- Predchádzajúce prednášky
- Úroveň – samostatný kontajner

# Container orchestration

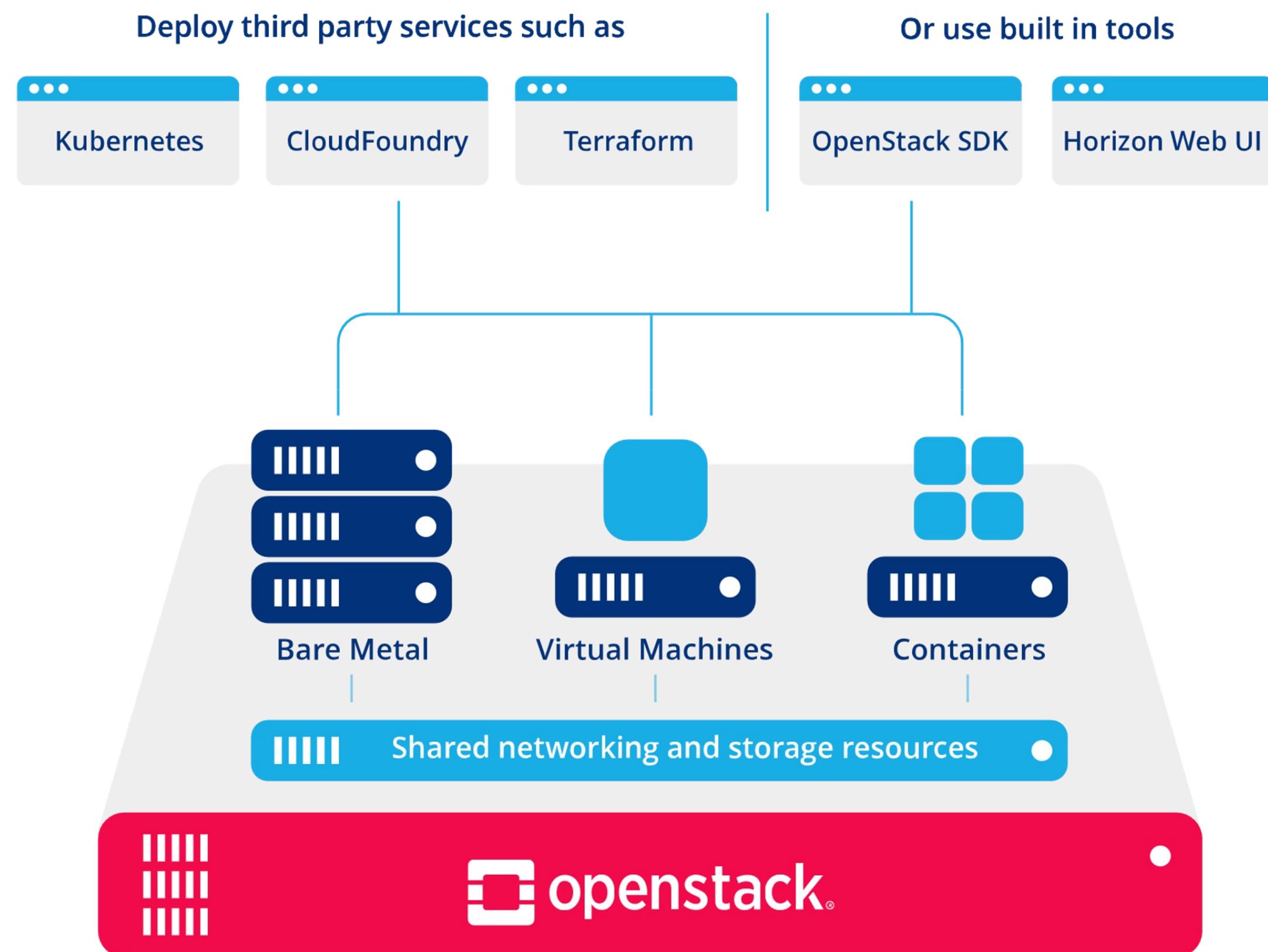
- „automates the deployment, management, scaling and networking of containers.“
- Automatizácia IT processov bežiacich nad aplikáciou hostovanou v clustri
- DevOps
- Úroveň – správa clustra



[Zdroj](#)

# Cloud management platforms

- „main focus is monitoring and managing of infrastructure resources such as virtual machines, storage, networks.“
- Úroveň – Správa infraštruktúry



[Zdroj](#)

# Applications

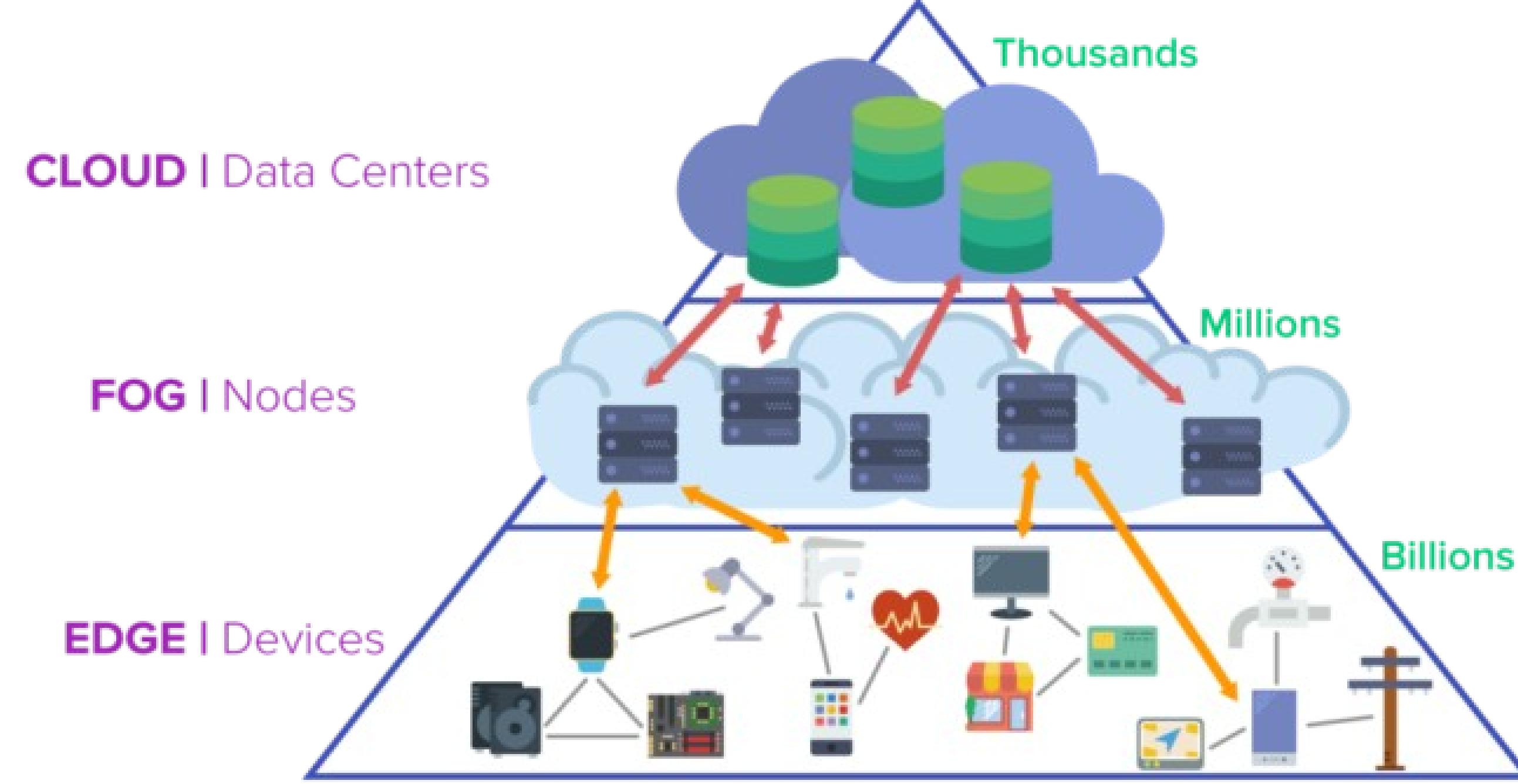
- Neexistujú lepšie a horšie programovacie jazyky
- Kladivo nie je univerzálny nástroj
- Tradeoff medzi komplexitou, výkonom a cenou

# Databases

- SQL/NoSQL
- Rôzne licenčné politiky

# Bottom line

- Cloud je výborný nástroj na dosiahnutie istej množiny cielov
- Nie je to ale všetko
- Rýchlosť a množstvo dát, obmedzenia fyzickej internetovej siete
- Nové koncepty distribúcie výpočtov



[Zdroj](#)

Ak Vás cloudy zaujali, CNCF CZ a SK organizujú konferenciu, virtuálne lístky sú do konca marca zadarmo

<https://community.cncf.io/events/details/cncf-kcd-czech-slovak-presents-kcd-czech-slovak-2024/>

Ďakujem za pozornosť



# The EPIC Cloud Analytics Platform for Energy Markets

# Who am I?

Martin Miskuf  
Head of Analytics



[linkedin.com/in/martin-miskuf](https://linkedin.com/in/martin-miskuf)

## Experience

### Head of Analytics and Model Development London Branch

EP Commodities, a.s. · Full-time  
Apr 2022 - Present · 1 yr 11 mos  
London, England, United Kingdom

EP Commodities specializes in the trading of energy commodities, transit and storage capacities. We deal with transactions in natural gas, power, emissions allowances, coal and structural products like spreads acr...see more

### Developer

Gazprom Marketing & Trading  
Aug 2018 - Mar 2022 · 3 yrs 8 mos  
London, United Kingdom

Developer, Data & Analytics, Gazprom Marketing & Trading, London, United Kingdom  
Main responsibilities...  
...see more



### Ph.D. Student

The Technical University of Košice  
Sep 2014 - Jun 2018 · 3 yrs 10 mos  
Košice, Slovakia

The team of Intelligent Cybernetics Systems, Department of Cybernetics and Artificial Intelligence, Faculty of electrical engineering and informatics...  
...see more



Department of Cybernetics and Artificial Intelligence  
stránka Katedry Kybernetiky a Umelej Inteligencie na TU Košice

+



- Developers: Levente, Gellert, Zoltan
- Focus:
  - Python Analytics Platform
    - Cloud – Microsoft Azure
    - Python standards
    - Core model logic
  - Building Python & Excel models
  - Helping Traders & Quants

Front-Office  
Development

Fundamentals  
Analytics

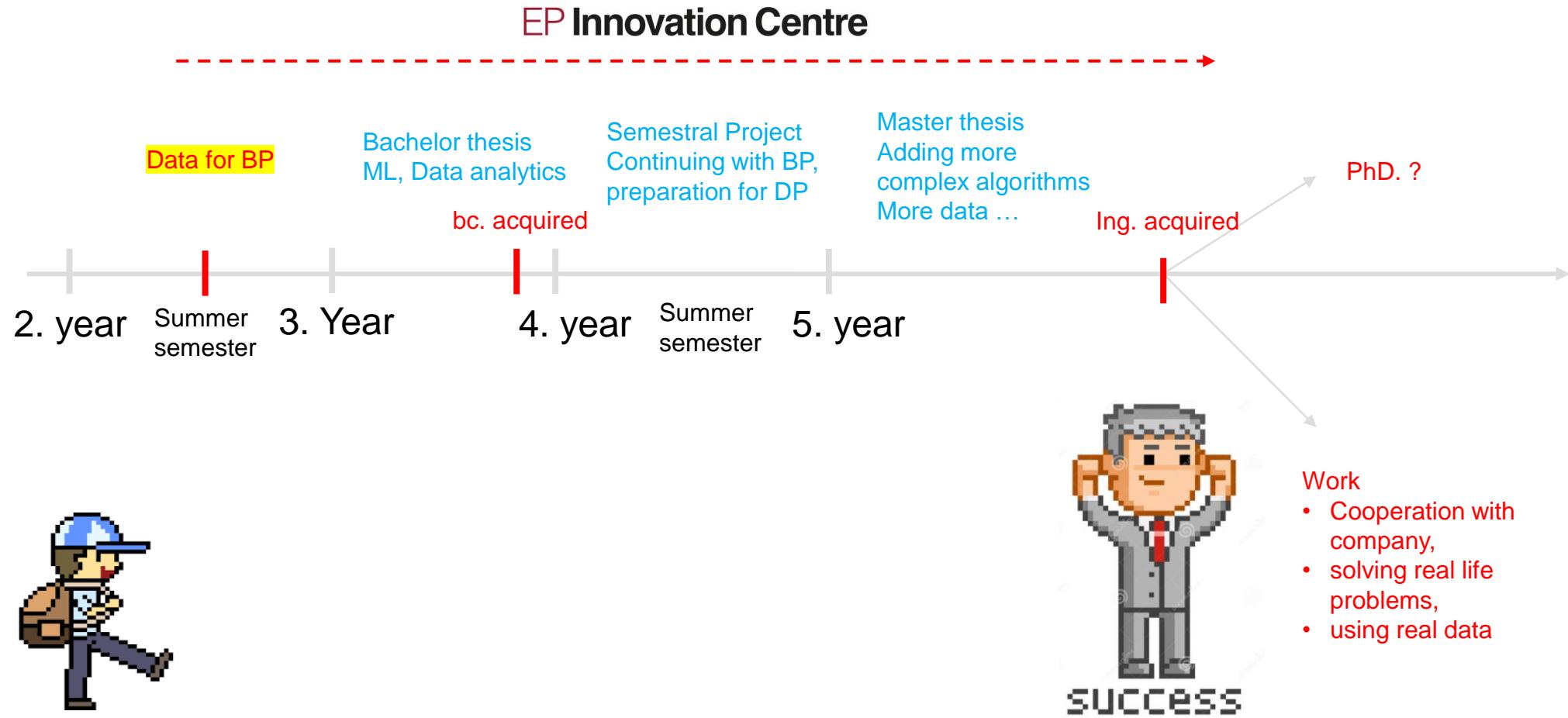
Gas  
Analytics

Power  
Analytics

Metrology

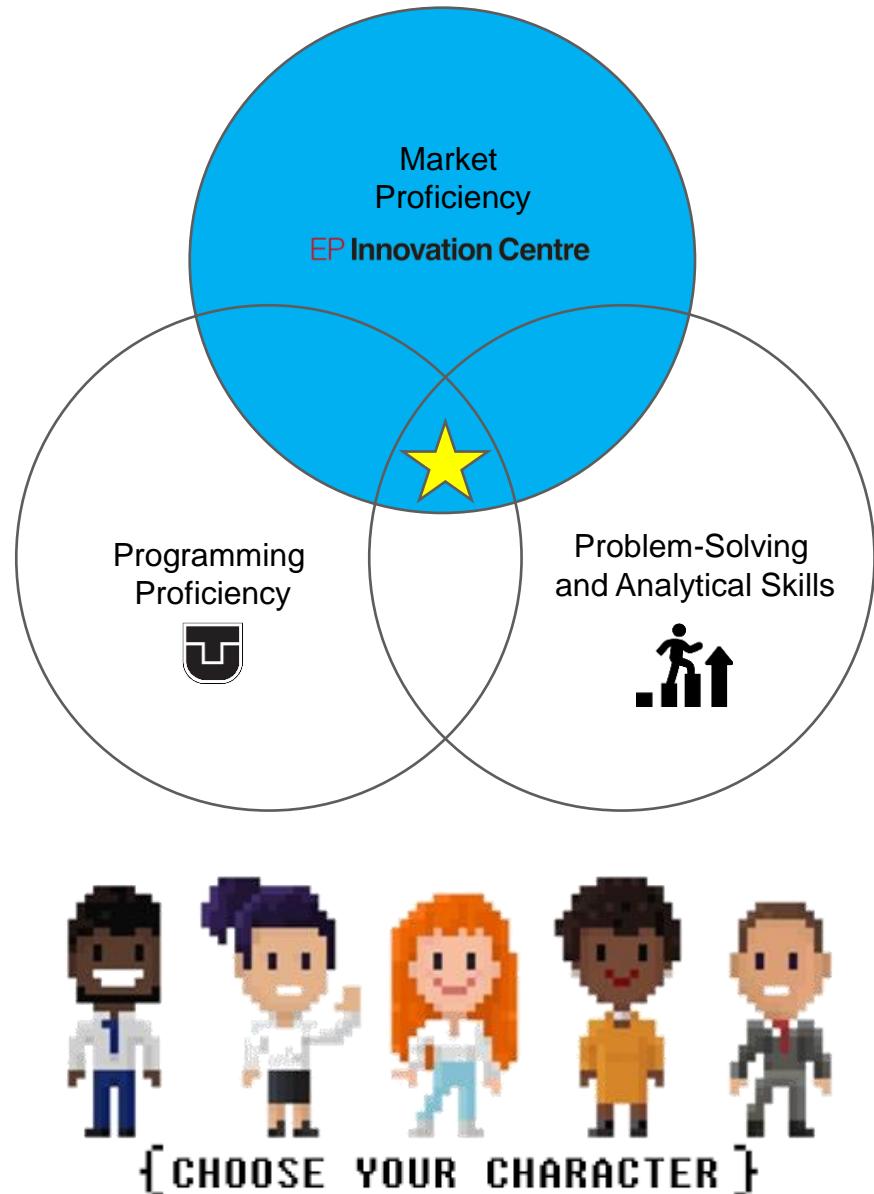


If I were you ...



# Agenda

- ❑ EPH/EPC - Who we are, EP Innovation Centre
- ❑ Quick intro about energy markets, analytics & trading
- ❑ From “tactical” to production ready solutions
  - Excel models
  - Python – Excel models
  - Cloud based analytics platform
- ❑ Aspiring to Become an **EPIC** Quantitative Developer
- ❑ Q&A Session



## Who we are

EPH



## Gas & Power Distribution

Key strategic gas infrastructure operator & relevant power distributor in Slovakia and the Czech Republic

[Read more](#)



## Gas Storage

A major operator of natural gas storage capacity in the region of Slovakia, Czech Republic and Austria.

[Read more](#)



## Power Generation

One of Europe's leading producers of energy from traditional sources

[Read more](#)



## Gas Transmission

Operator of the biggest pipeline in Europe and critical gas infrastructure for Western, Central and Southern Europe

[Read more](#)



Heat Infra

A leading supplier of heat in the Czech Republic, serving hundreds of thousands of households and commercial customers

[Read more](#)



Renewables

Production of oxygen from a balanced mixture of renewable energy sources

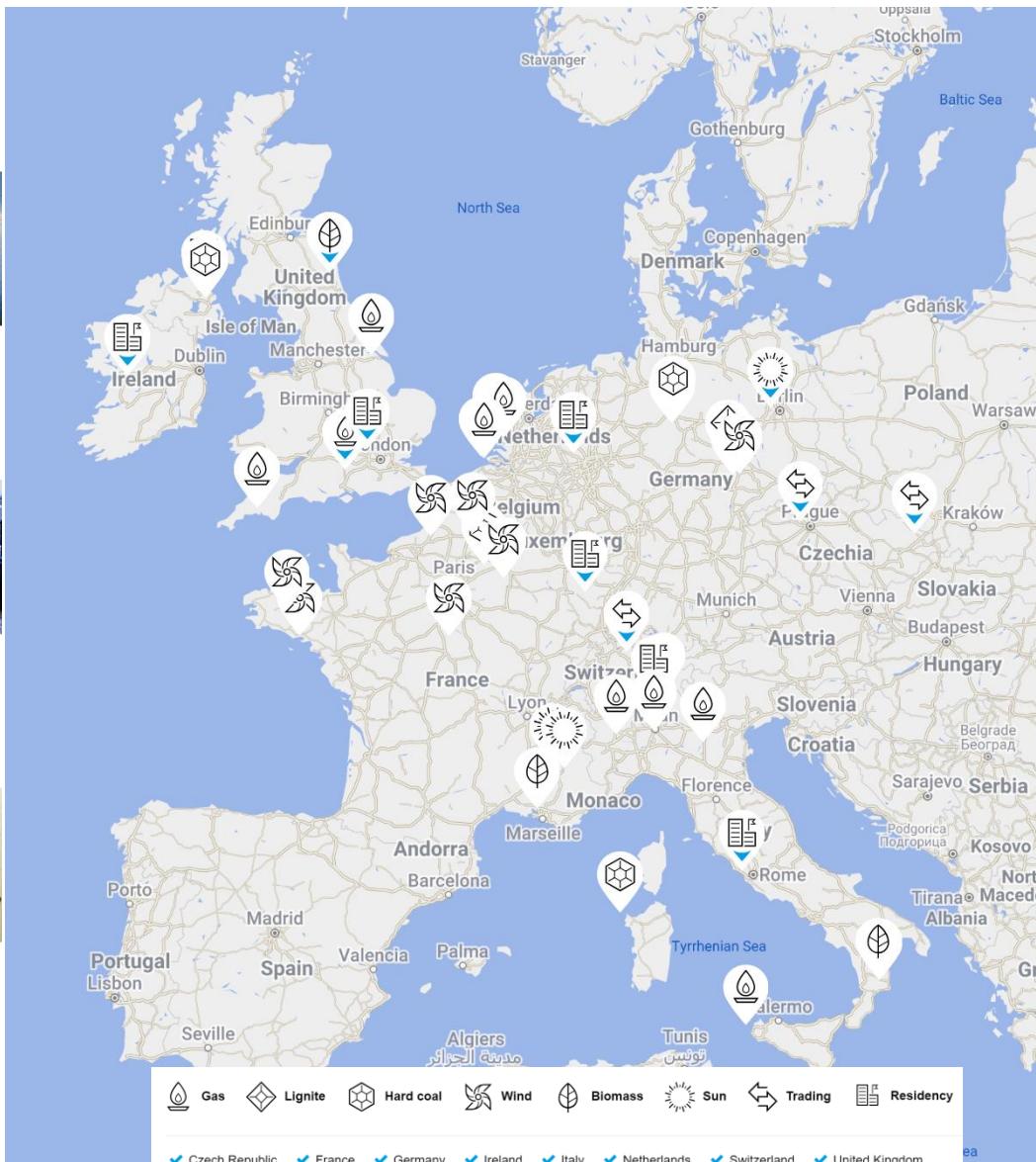
Read more



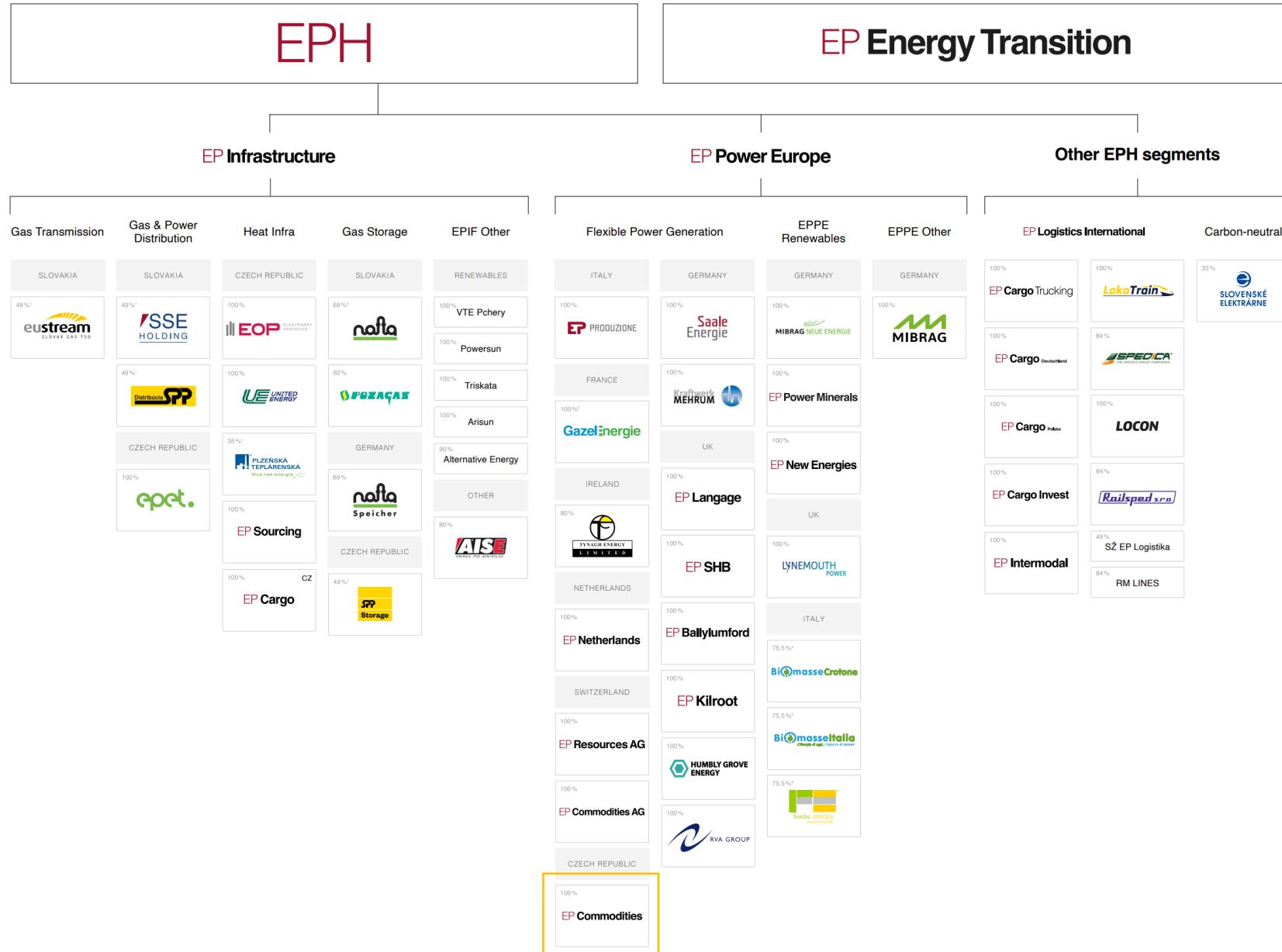
Mining

2000

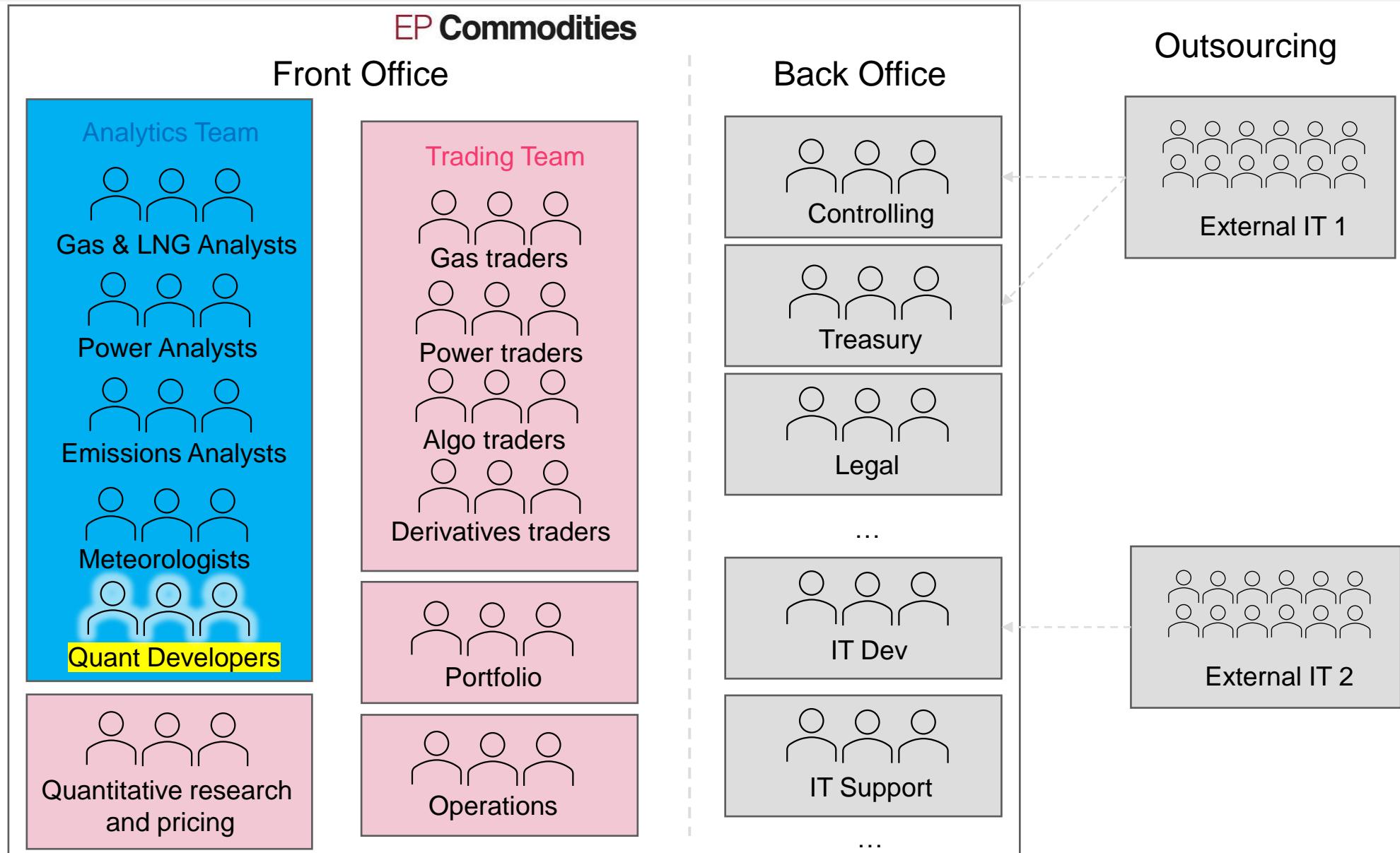
EP Power Europe



# Company Structure



# The most important slide – Quant dev vs. Delivery center dev



# Quick introduction to the energy commodity analytics & trading



There are three ways to make a living in this business: **be first; be smarter; or cheat.**  
Now, I don't cheat. And although I like to think we have some pretty smart people in this building,  
it sure is a hell of a lot easier to just be first.

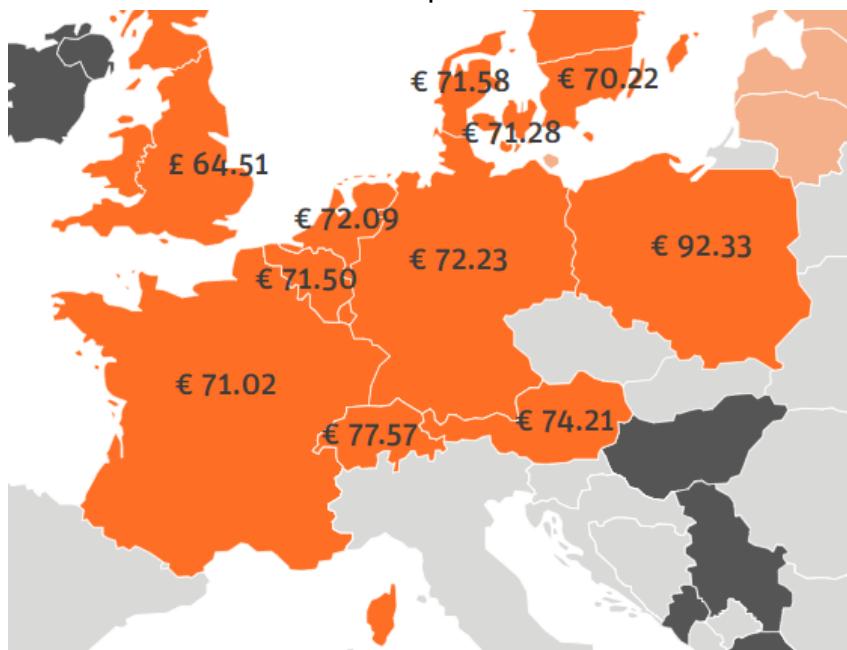
# Fundamental analytics of energy markets

Power example

	UK	NL	FR	DE
Residual Load (GWh/d)	15	-30	-5	30
Price (EUR/MWh)	70	55	60	90

Demand – (Wind + Solar) = Residual Load  
 Demand – (Wind + Solar + Nuclear + Hydro) = Adjusted Residual Load

Location spreads



Market fundamentals

Gas example

Date	Supply	Demand	Storage	Imbalance
Winter	840	-1060	146	-74
Summer	793	-551	-144	98

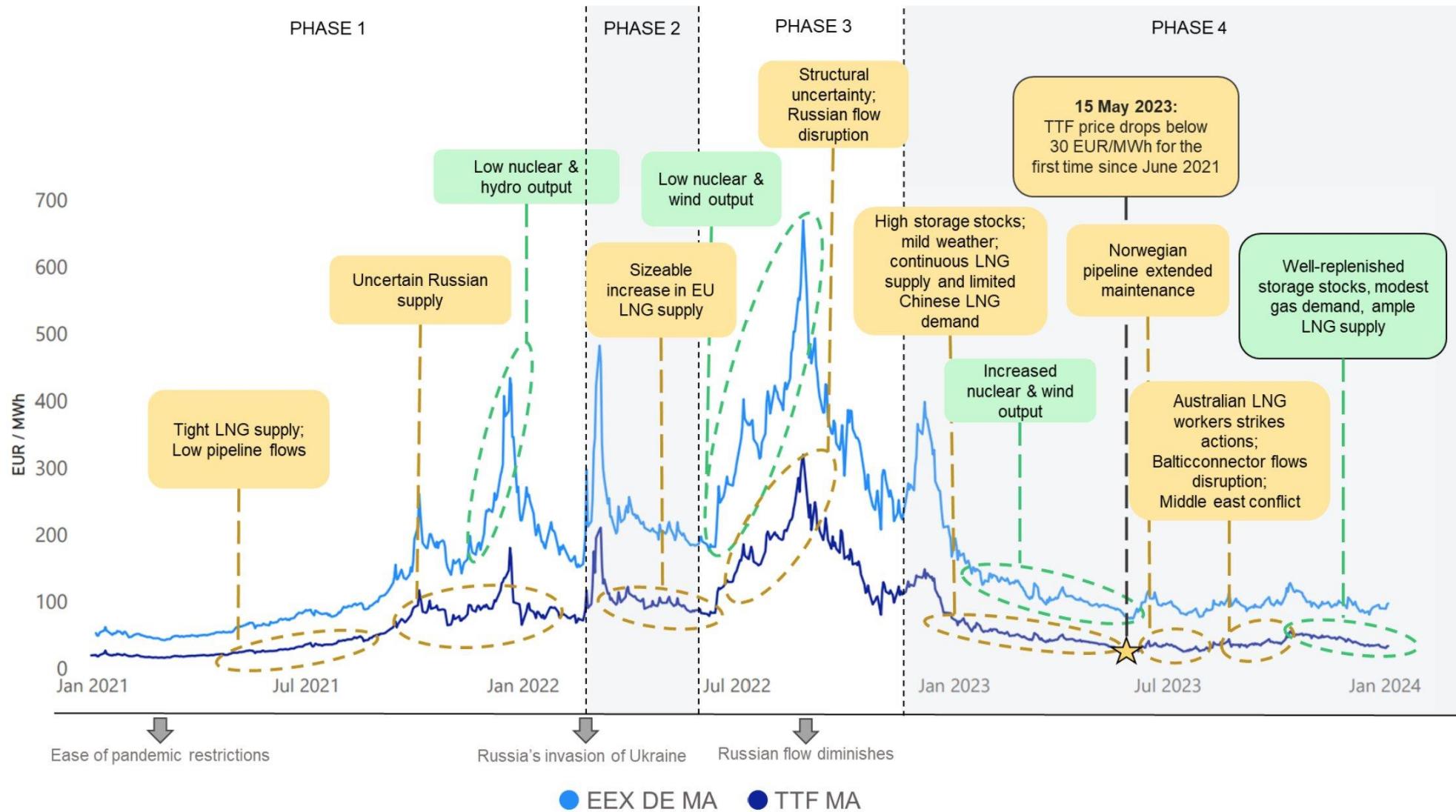
Demand + Production + Border Flows + LNG + Storage = Balance  
 Storage + Balance = IMBALANCE STORAGE

Time spreads



How do we decide: Combination of: **Fundamental Analysis**, Technical Analysis, Open Interest, Commitments of Traders, Option Analysis, ...

# EU Gas & Power market



# How to make money on the energy market

Asymmetrical reaction of market – bad vs good news



"Buy low, sell high" remains a timeless strategy.

Additionally:

"Buy high, sell even higher" suggests capitalizing on momentum.

"Sell low, buy even lower" hints at attempting to catch falling prices, often a risky endeavour.

"Buy the rumour, sell the news" advises capitalizing on market expectations before and after significant events.

"Cut your losses short, let your profits run" emphasizes the importance of minimizing losses quickly while allowing profitable trades to continue.

"The trend is your friend" suggests following the direction of market trends for successful trading.

"Don't try to catch a falling knife" warns against attempting to buy assets that are rapidly declining in value without clear indicators of a reversal.

# Let's trade



NL Gas (TTF): <https://www.tradingview.com/chart/?symbol=NYMEX%3ATTF1%21>

DE Power (DEB): <https://www.tradingview.com/chart/YvghlZYz/?symbol=NYMEX%3ADEB1%21>

# The EPIC life of a quantitative developer



What my mom thinks I do



What my co-workers think I do



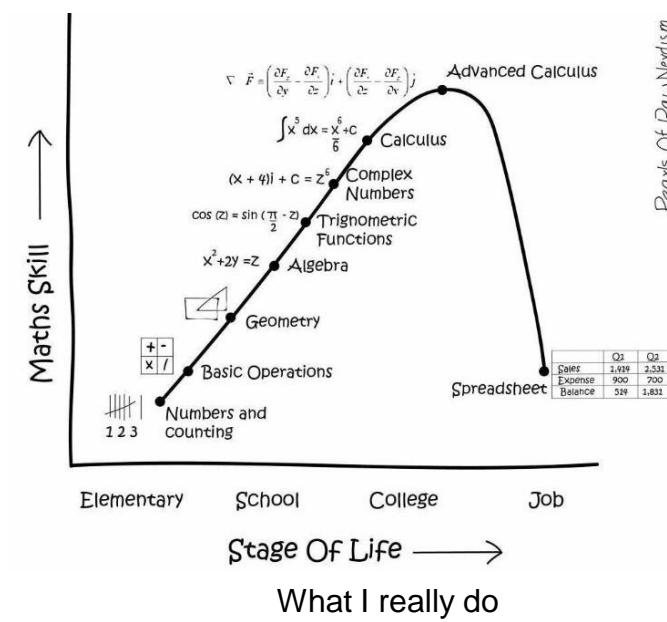
What my friends think I do



What my family thinks I do

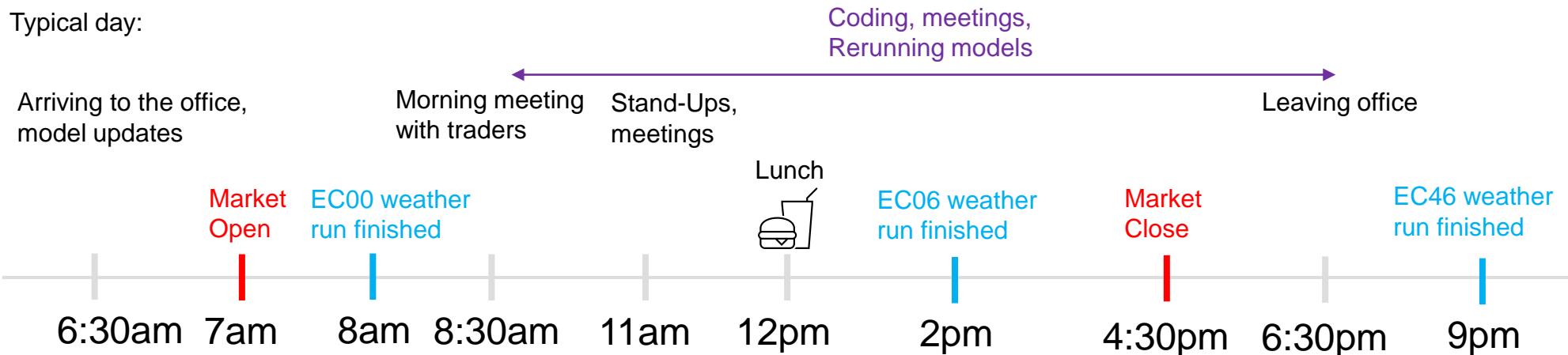


What I think I do



# Life in the Front Office

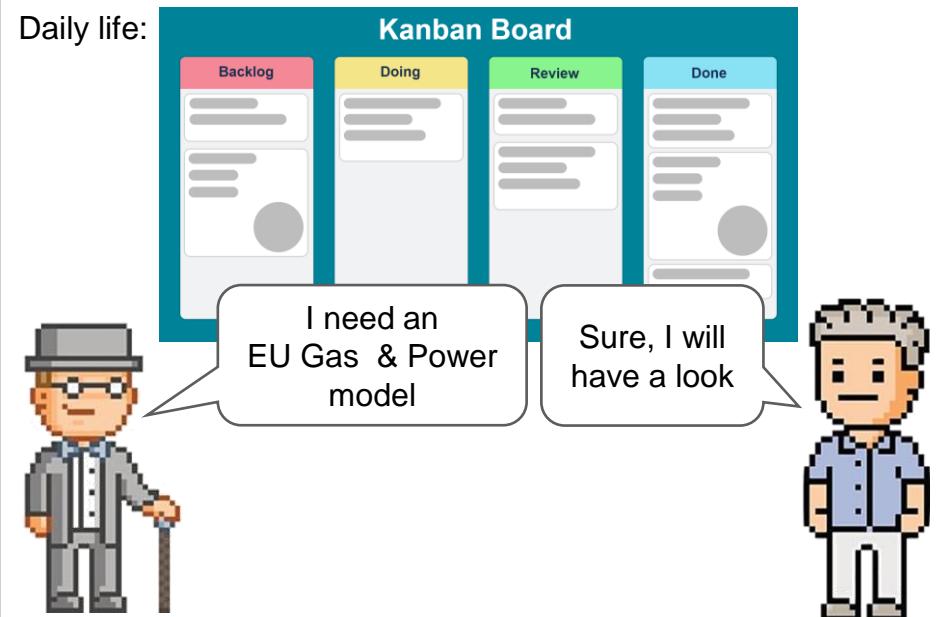
Typical day:



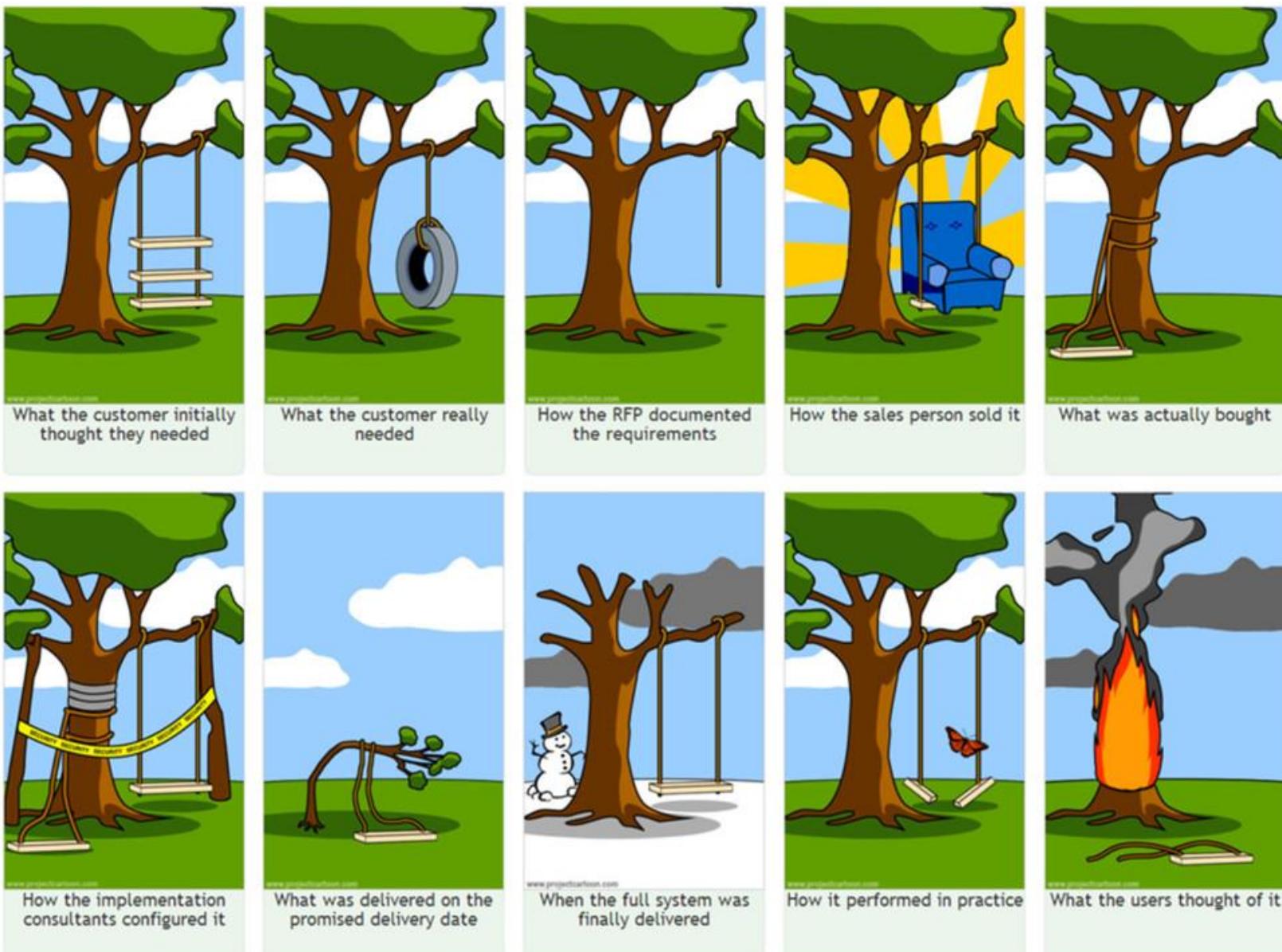
Yearly life:

- January – Peak winter, **Ski trip**
- February – High wind
- March – End of winter season, **Bonus, Company Ski trip**
- April – Start of summer season, first storage injections
- May – Summer heatwave warnings, **Holiday no 1.**
- Jun – Holding meetings
- July – Maintenance season starts, **Holiday no 2.**
- August – Peak summer, high solar – negative power prices
- September – FR strikes season
- October – Start of Gas year, start of winter season
- November – Seasonal weather forecasts, first cold spells, storage withdrawals
- December – Christmas/New Year low demand period, **Holiday no 3.**

Daily life:



## From “Tactical” to Production solutions



# On premise vs Cloud

	Cloud	On-Premises
Maintenance cost	Is included in the implementation fee.	Requires in-house resources and consulting.
Implementation cost	Cheaper in the short-run. In the long run, paying monthly fees might become more expensive than owning resources.	Typically more expensive as the team needs to invest in hardware, as well as talent needed to maintain the infrastructure.
Software requirements	No specific requirements – the team can access the storage using a device connected to the Internet.	High server capacity, software, and hardware needed to maintain the storage, high bandwidth, backup infrastructure.
Data ownership	Data ownership is negotiable – some vendors want to co-own stored data while others hand ownership off completely.	Data is typically owned by the company itself.
Data security	Cloud storage has a wide user base which calls for robust security infrastructure. On the other hand, third-party platforms are more vulnerable to outside attacks.	Depends on the dedication of the team. Typically, there's less risk of data breaches but a higher number of human-error-related threats.
Staffing needs	No immediate need for internal staffing.	Internal staff is needed to manage the on-premises infrastructure.
Customisation	Limited and depends on the vendor.	Fully controlled by the company that hosts the storage.
Mobile access	Included in most cloud storage platforms.	Designing a mobile interface is up to the company.
Offline access	No or limited.	Depending on the needs of the company, there may be full offline availability.



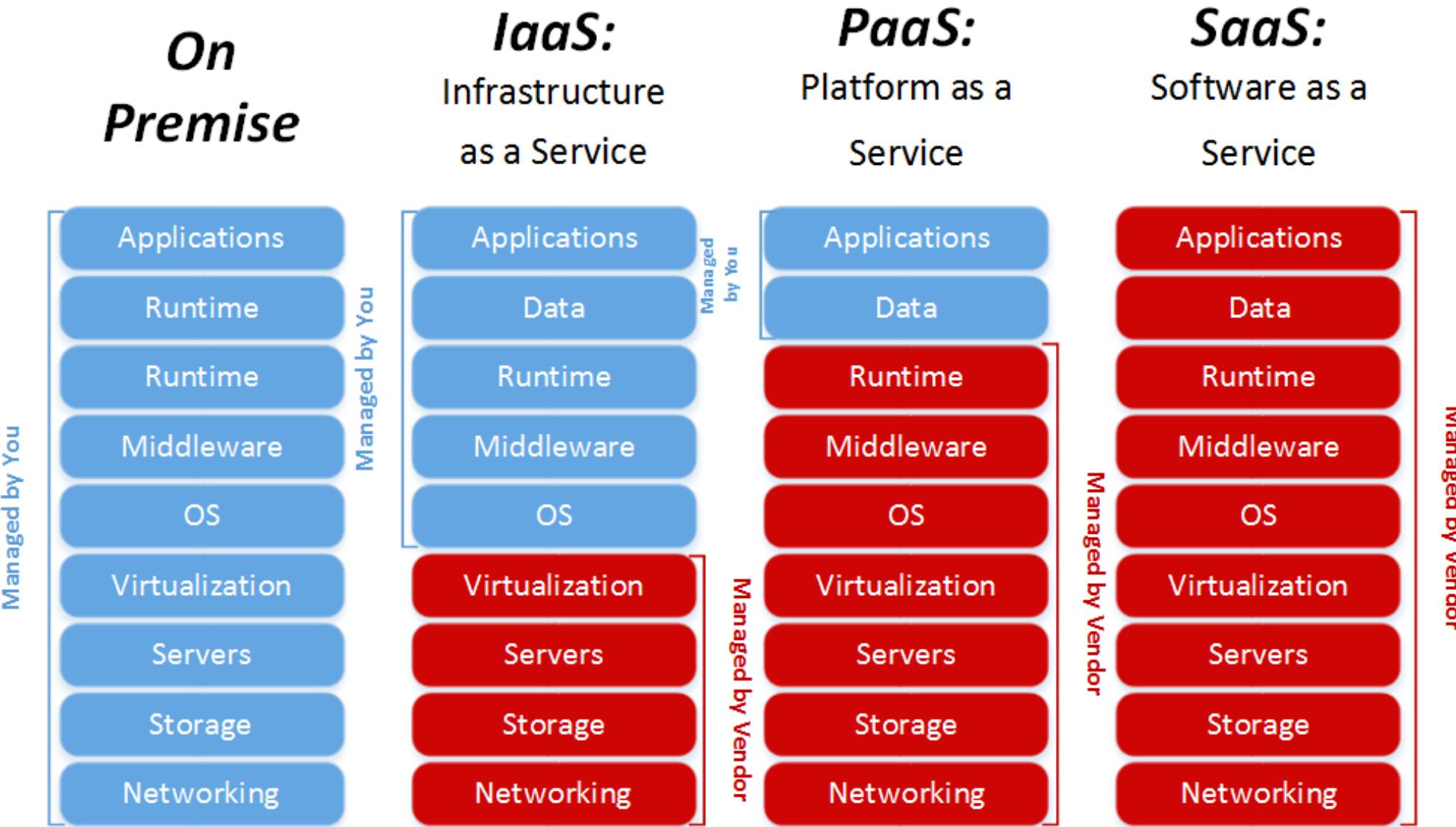
## You should choose on-premises if:

- You want to have full ownership of stored data.
- Security is a major concern—you want to set up advanced data protection systems and cloud vendors don't meet your needs.
- It's important for your team to have offline accessibility of the storage.
- You want to be able to customise the storage, add and remove features freely.
- You have enough resources to build, maintain, and scale on-premises storage.

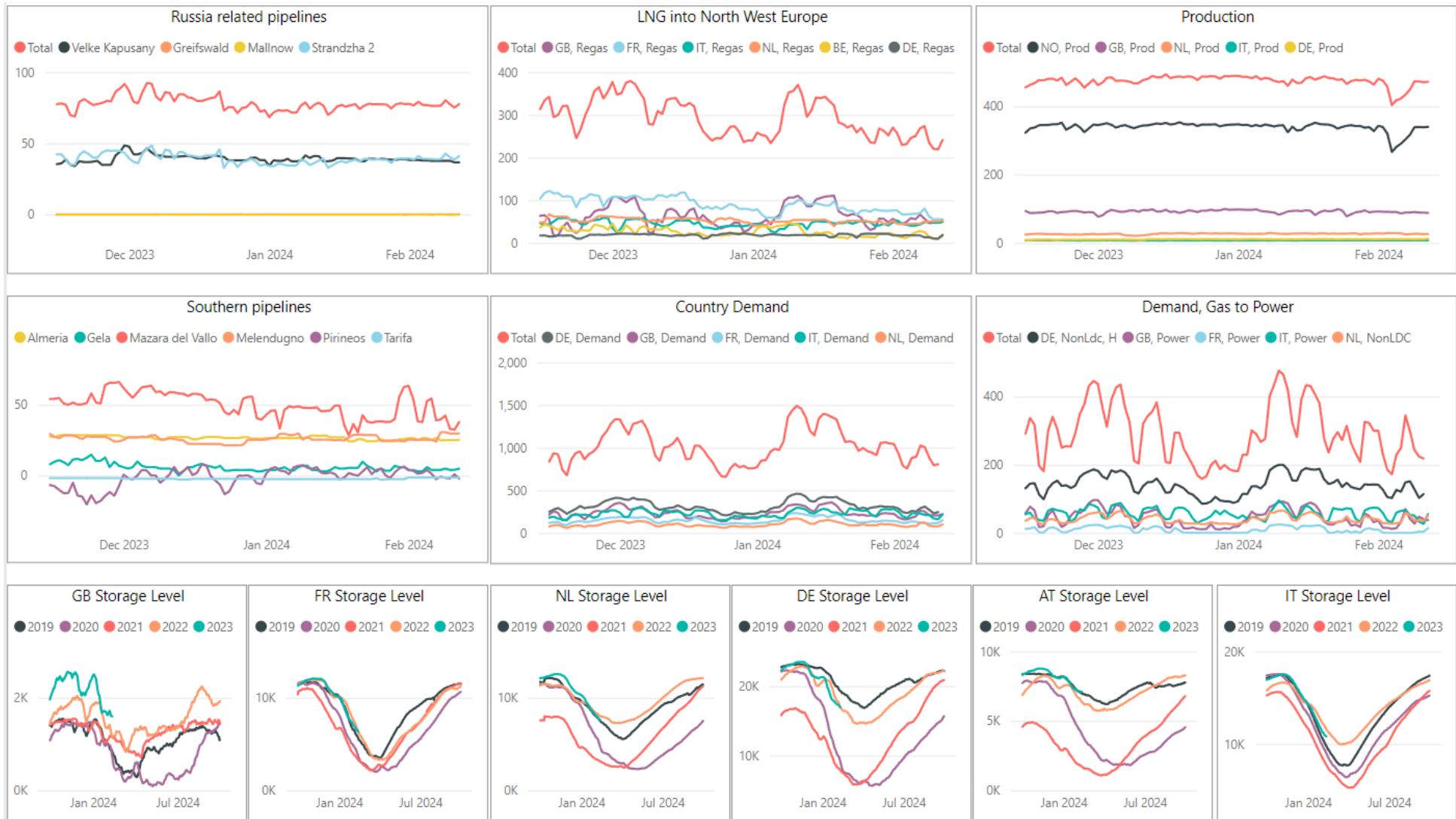
## You should choose cloud if:

- Accessibility is crucial. Since the cloud has no attachment to a particular location, it's a powerful solution for fully remote teams.
- You don't have enough resources or time to build a storage infrastructure from scratch.
- Your product and team are constantly changing and you want to quickly get on-demand resources as soon as you need them.

# On premise vs Cloud



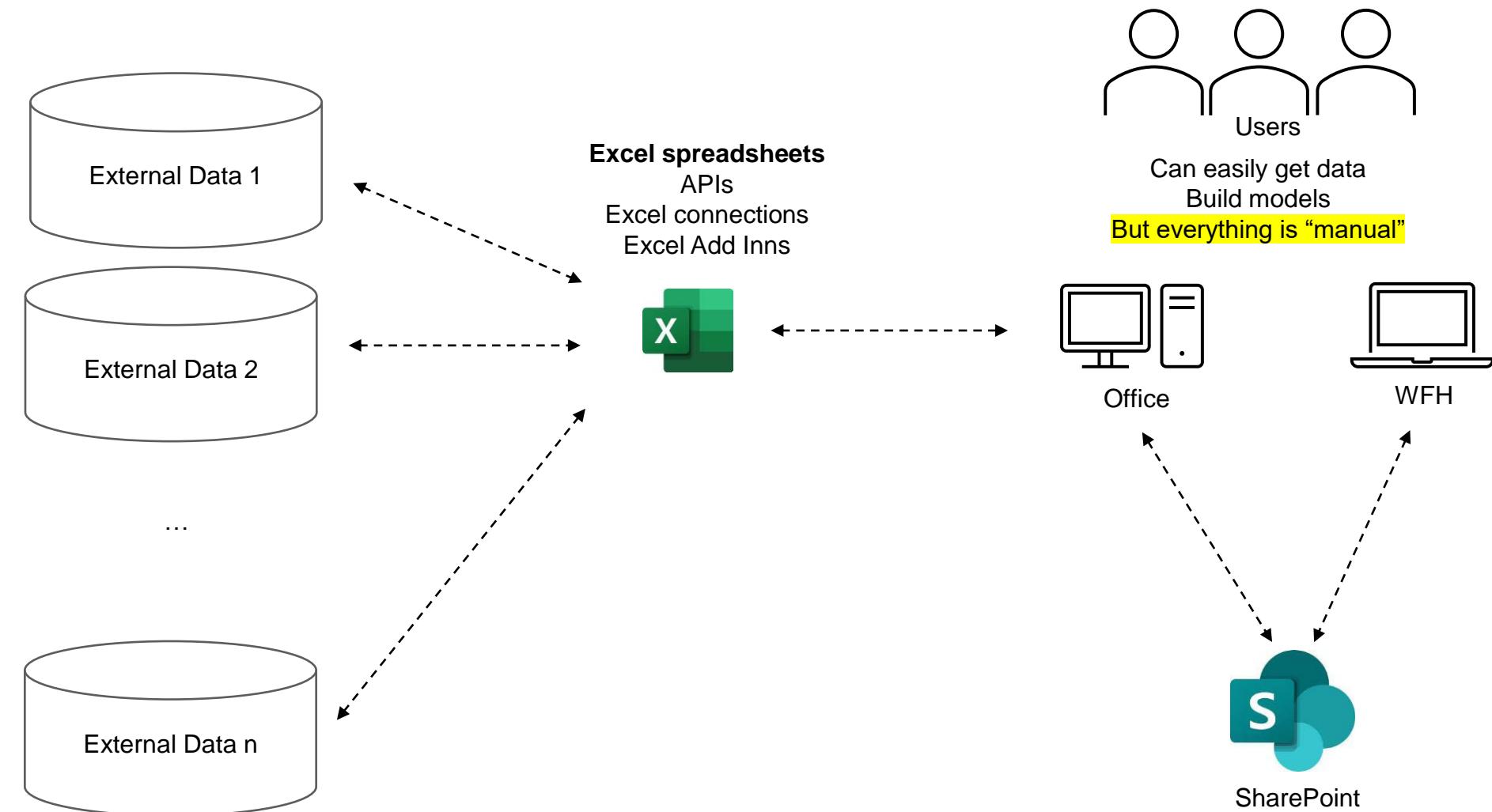
# Use case 1: Building Gas S&D (Supply and Demand) model – SaaS



<https://gasdashboard.entsog.eu/>  
<https://gas.kyos.com/gas>  
<https://commodityessentials.com/>

# Use case 1: Building Gas S&D (Supply and Demand) model – SaaS

“Tactical solution” / There are three ways to make a living in this business: **be first; be smarter; or cheat.**



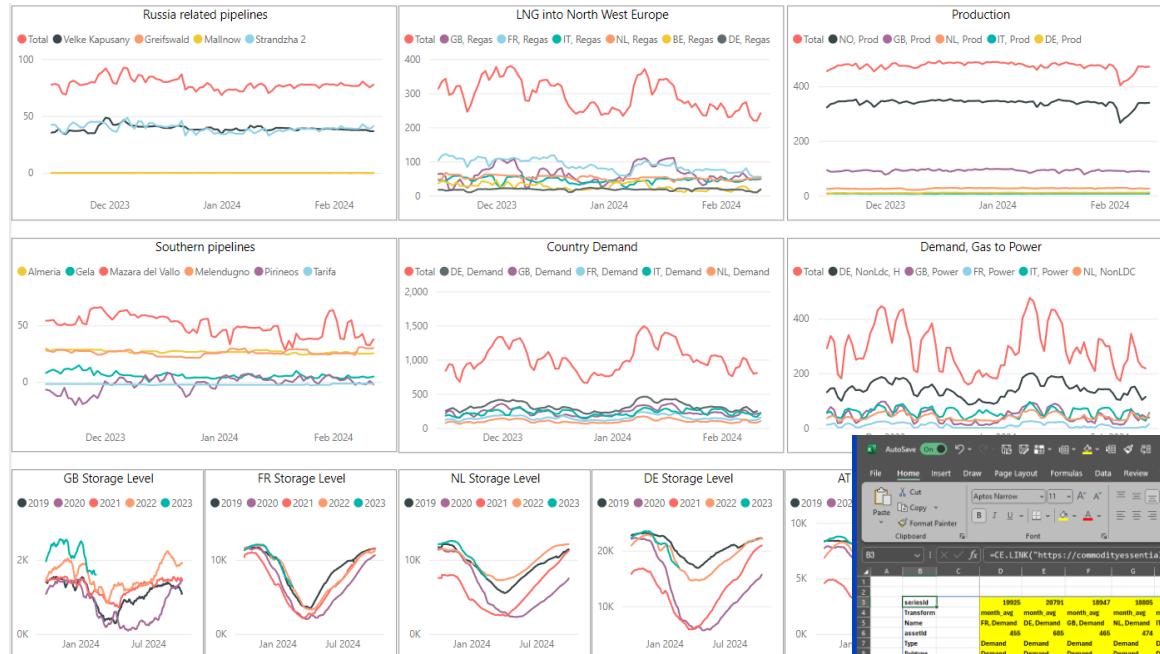
Costs are almost nothing, not great reliability, great for prototyping

# Use case 1: Building Gas S&D (Supply and Demand) model – SaaS

<https://commodityessentials.com/>

Provide API & Excel Add-In

We managed to get university license for EPIC



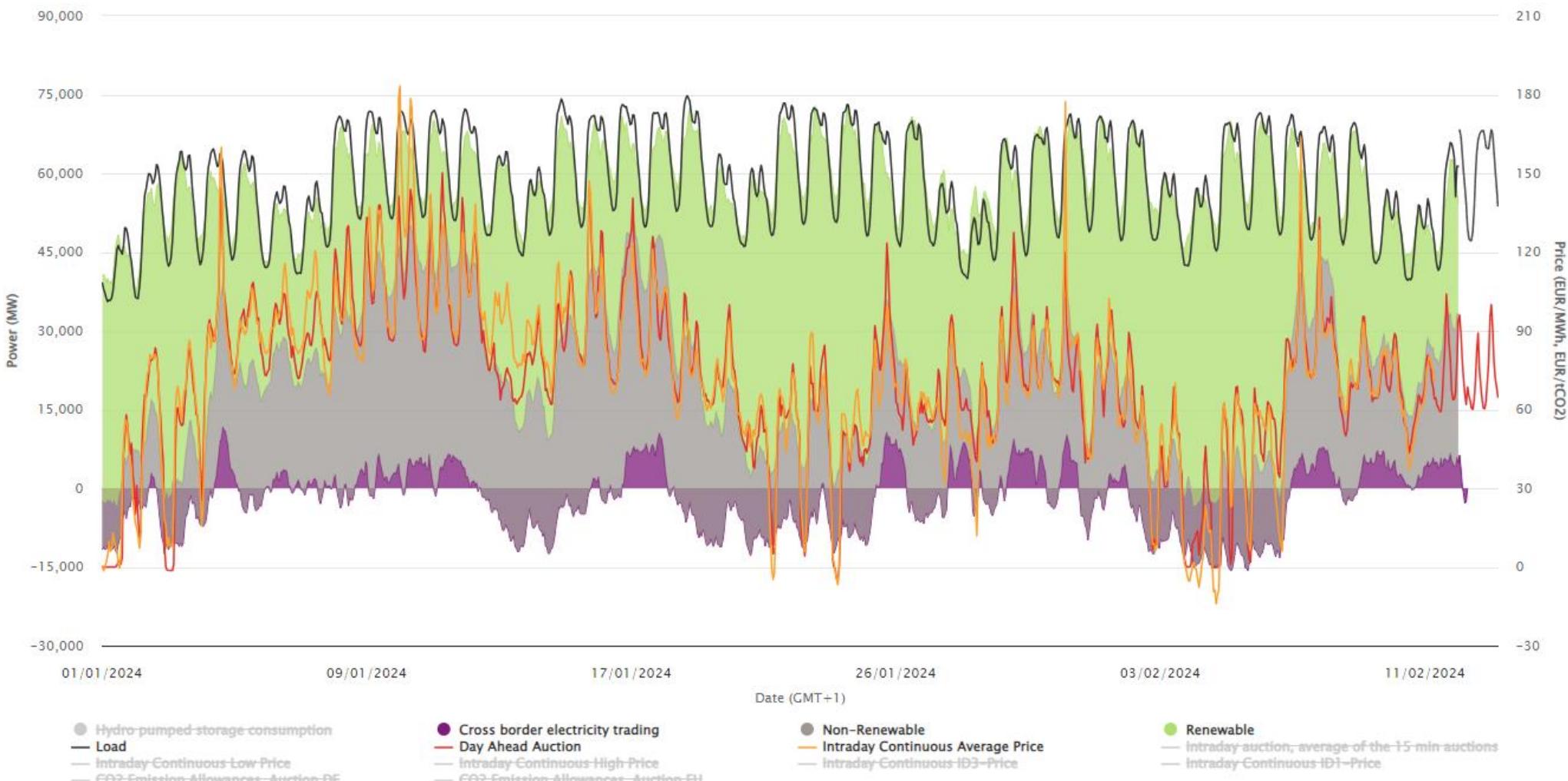
Excel spreadsheets  
using externally built Excel functionality  
Formulas with API links ...

The screenshot shows an Excel spreadsheet with the following details:

- File Name:** Gas - CE data.xlsx
- Cells:** A1: Gas - CE data.xlsx, I1: 1990s, J1: 2000s, K1: 1800s, L1: 1800s, M1: 1800s, N1: 1800s, O1: 1800s, P1: 1800s, Q1: 1800s, R1: 1800s, S1: 1800s, T1: 1800s, U1: 1800s, V1: 1800s, W1: 1800s, X1: 1800s, Y1: 1800s, Z1: 1800s.
- Formulas:** C1 contains the formula =CELINK("https://commodityessentials.com/api/eugasserseries?ld=19925,20791,18947,18805,25331,1990,57746,18884,18946&t=transform-month\_avg&dateFrom=1-Jan-2020")
- Chart:** A line chart in the bottom right corner shows 'Storage Level' over time (Jan 2020 to Dec 2023) with multiple data series representing different years (2019, 2023, 2024).

## Use case 2: Building Power S&D model – PaaS

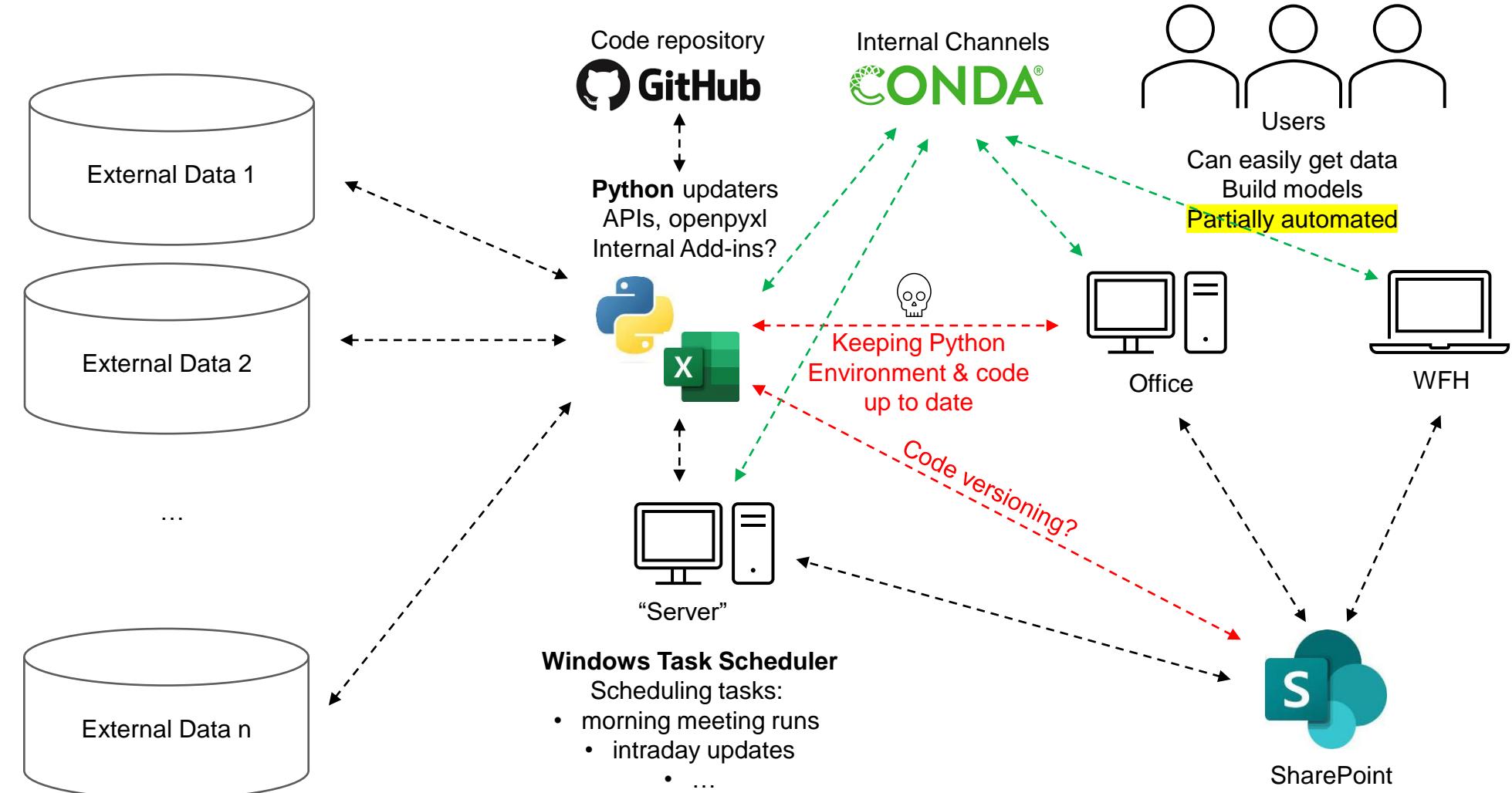
Electricity production and spot prices in Germany in 2024



[https://energy-charts.info/charts/price\\_spot\\_market/chart.htm?l=en&c=DE&interval=year&year=2023&legendItems=011111110000000](https://energy-charts.info/charts/price_spot_market/chart.htm?l=en&c=DE&interval=year&year=2023&legendItems=011111110000000)

## Use case 2: Building Power S&D model – PaaS

“Tactical solution” / There are three ways to make a living in this business: **be first; be smarter; or cheat.**



Getting more complicated, better reliability, costs are going up

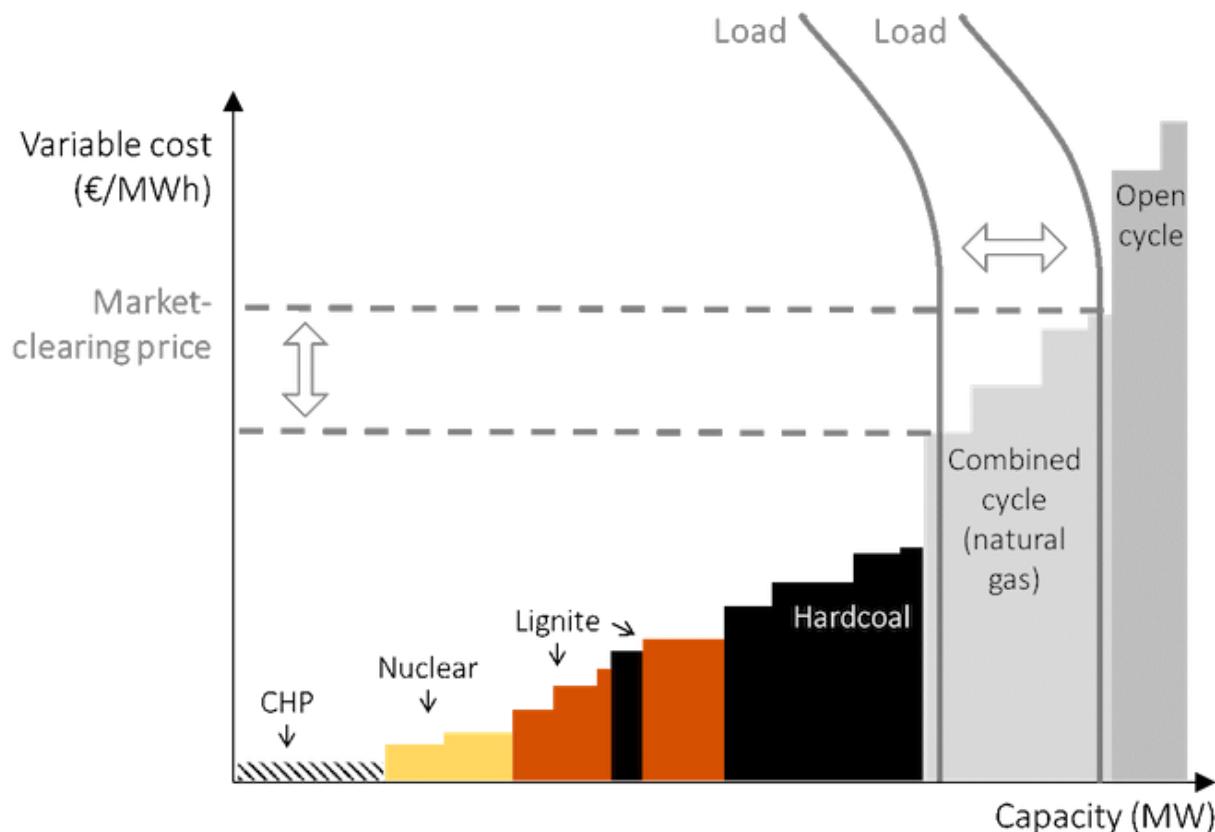
## Use case 2: Building Power S&D model – PaaS

Excel spreadsheets updated by  
Python script using [OpenPyXL](#) package

```
2141 03/05/2024 04:03:40 [INFO] C:\Windows\system32\cmd.exe
2142 04/03 [INFO] PowerSD updat...
2143 05/03 [INFO] Python-Excel>python "openpyxl power_PC-test.py"
2144 06/03 [INFO] 2024/02/29 11:12:19.507 [INFO] [PowerSD updat...: Starting
2145 07/03 [INFO] 2024/02/29 11:12:19.507 [INFO] [PowerSD updat...: Opening workbook PowerSD-test.xlsx
2146 07/03 [INFO] 2024/02/29 11:12:22.617 [INFO] [PowerSD updat...: Total execution time for the function open_workbook was 3094 ms
2147 07/03 [INFO] 2024/02/29 11:12:22.617 [INFO] [PowerSD updat...: Updating DE-D
2148 07/03 [INFO] 2024/02/29 11:12:33.535 [INFO] [PowerSD updat...: Downloaded curve tt de hydro °c cet min15 af size:3168 tzinfo:CET
2149 07/03 [INFO] 2024/02/29 11:12:35.932 [INFO] [PowerSD updat...: Downloaded curve pro de wnd offshore mwh/h cet min15 af size:3957 tzin...
2150 : CET
2151 07/03 [INFO] 2024/02/29 11:12:36.768 [INFO] [PowerSD updat...: Downloaded curve pro de wnd onshore mwh/h cet min15 af size:3957 tzin...
2152 : CET
2153 07/03 [INFO] 2024/02/29 11:12:37.758 [INFO] [PowerSD updat...: Downloaded curve tt de con °c cet min15 af size:3957 tzinfo:CET
2154 07/03 [INFO] 2024/02/29 11:12:39.791 [INFO] [PowerSD updat...: Downloaded curve res de hydro sgw gwht cet h af size:3168 tzinfo:CET
2155 07/03 [INFO] 2024/02/29 11:12:40.521 [INFO] [PowerSD updat...: Downloaded curve res de hydro wtr gwht cet h af size:2861 tzinfo:CET
2156 07/03 [INFO] 2024/02/29 11:12:42.118 [INFO] [PowerSD updat...: Downloaded curve con de mwh/h cet min15 af size:3957 tzinfo:CET
2157 07/03 [INFO] 2024/02/29 11:12:42.852 [INFO] [PowerSD updat...: Downloaded curve res de hydro bal gwht cet h af size:3168 tzinfo:CET
2158 07/03 [INFO] 2024/02/29 11:12:42.889 [INFO] [PowerSD updat...: Downloaded curve pro de wnd mwh/h cet min15 af size:3957 tzinfo:CET
2159 07/03 [INFO] 2024/02/29 11:12:43.099 [INFO] [PowerSD updat...: Downloaded curve res de hydro tot gwht cet h af size:2861 tzinfo:CET
2160 07/03 [INFO] 2024/02/29 11:12:44.523 [INFO] [PowerSD updat...: Downloaded curve inf de hydro gwht cet h af size:3168 tzinfo:CET
2161 07/03 [INFO] 2024/02/29 11:12:46.195 [INFO] [PowerSD updat...: Downloaded curve inf de hydro gross gwht cet h af size:3168 tzinfo:CET
```

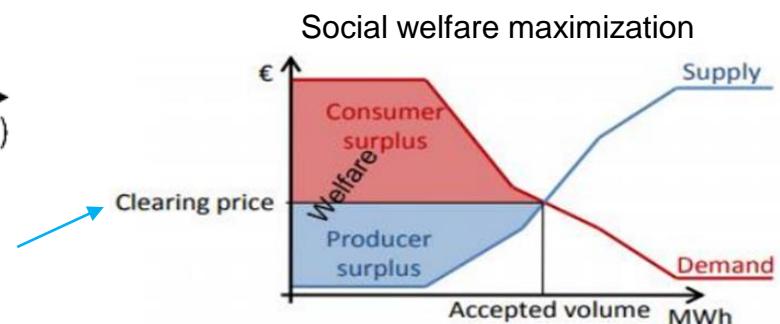
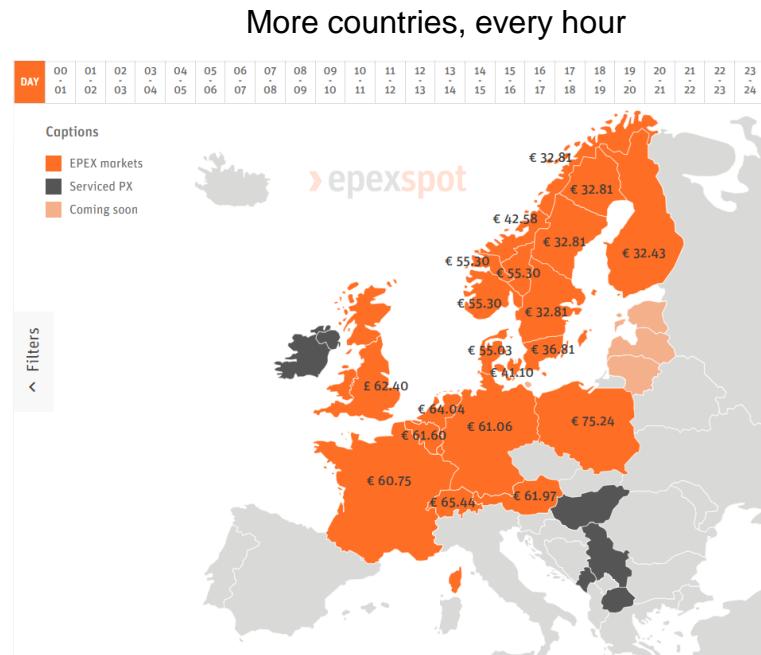
## Excel spreadsheets using an internal Excel Add-in JavaScript

# Use case 3: Building Power DA model – IaaS



Optimisation problem – Mixed integer problem

Is it cheaper to produce or import – Optimal solution for every country, every hour  
Run with every weather run – 50+ runs \* 4+ weather runs/day

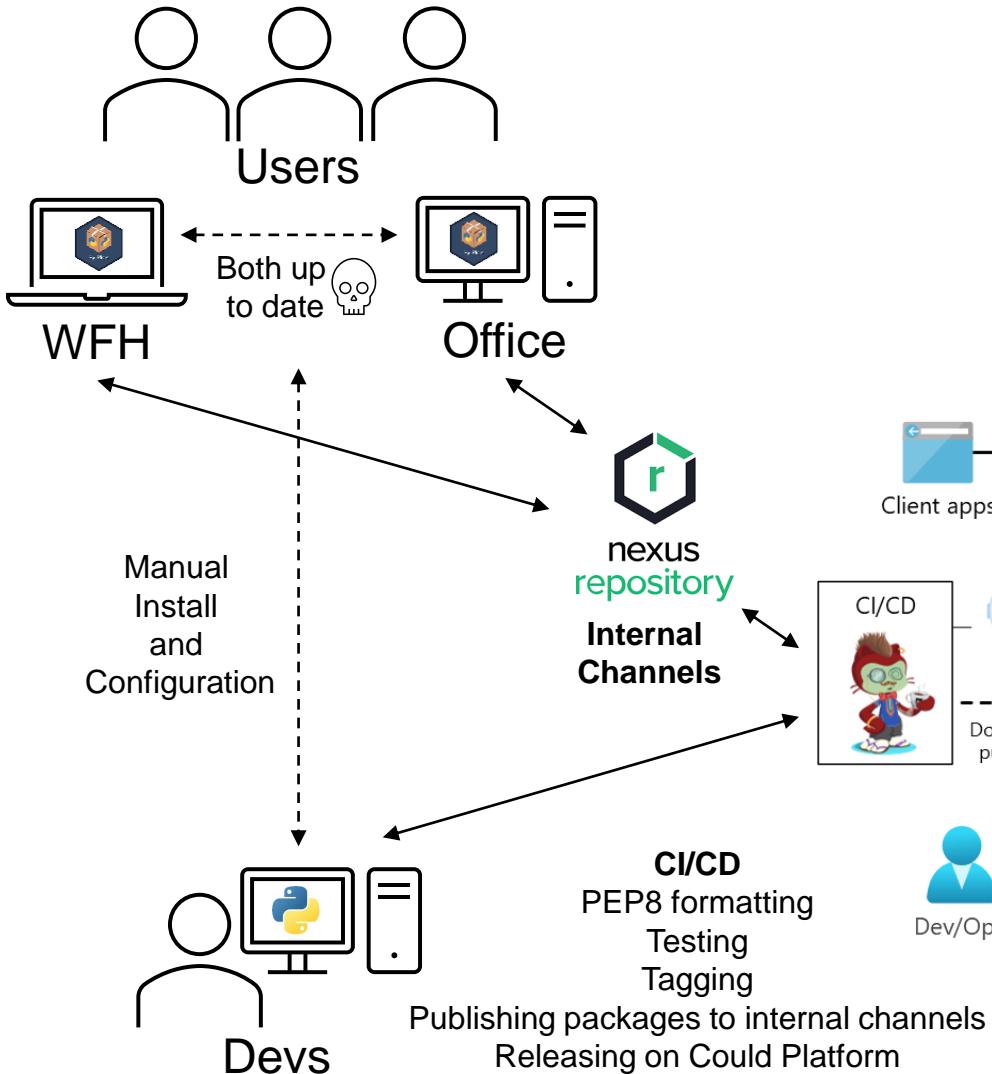


Merit – order model: <http://open-electricity-economics.org/book/text/04.html>

EUPHEMIA Public Description: [https://www.epexspot.com/sites/default/files/2020-02/Euphemia\\_Public%20Description\\_Single%20Price%20Coupling%20Algorithm\\_190410.pdf](https://www.epexspot.com/sites/default/files/2020-02/Euphemia_Public%20Description_Single%20Price%20Coupling%20Algorithm_190410.pdf)

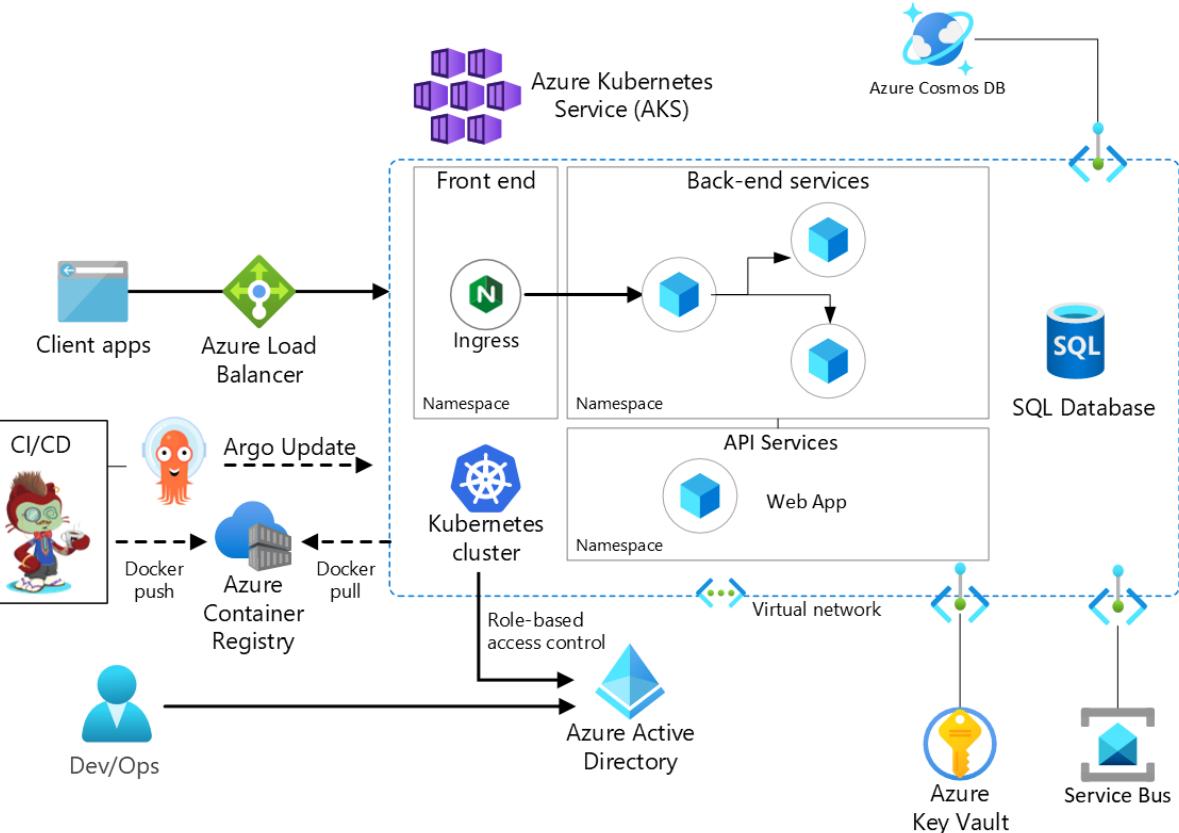
Aggregated curves: <https://www.epexspot.com/en/market-data>

# Stack for the IaaS - Cloud Based Python Analytics Platform



## Cloud Analytics Platform

Running analytics, controlling, trading & algo-trading models



# Aspiring to Become an EPIC Quantitative Developer



Decision fatigue

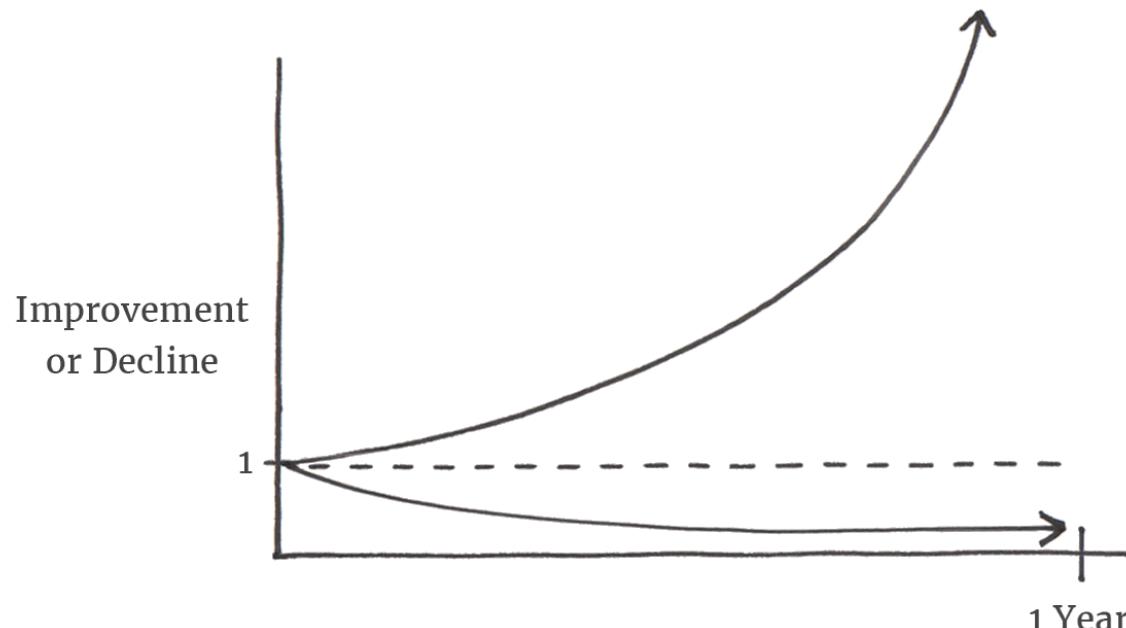
# The Power of Tiny Gains

1% better every day

$$1.01^{365} = 31.18$$

1% worse every day

$$0.99^{365} = 0.03$$



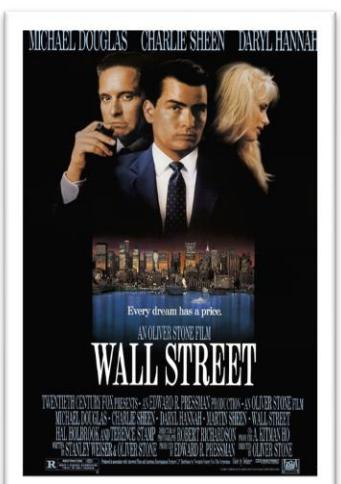
# Homework – there is a lot online!



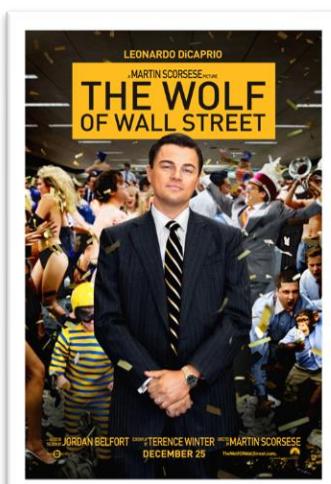
Margin call  
Risk analyst



Shorting market  
Derivatives - Options



Greed and excessive  
risk-taking



Risk Management  
Penny stock scene

An infographic titled 'The Trillion Dollar Equation' from Veritasium. It features a dark background with blurred images of people in a trading floor and skyscrapers. Text on the right includes 'EXCHANGE TRADED OPTIONS', 'OVER-THE-COUNTER DERIVATIVE SECURITIES', 'SECURITIZED DEBT', and 'CREDIT DEFAULT SWAPS'. In the center, there is a mathematical equation:  $\frac{\partial V}{\partial t} + rS \frac{\partial V}{\partial S} + \frac{1}{2} \sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} - rV = 0$ . At the bottom, it says 'and transformed everyone's approach to risk.' The Veritasium logo is in the bottom right corner.

Veritasium: <https://youtu.be/A5w-dEgIU1M?si=ICV4kdx05yKLixe0>

Online lectures:

MIT OpenCourseWare: <https://www.youtube.com/@mitocw>

Finance theory - Futures and pricing:

[https://www.youtube.com/watch?v=i\\_pLF9J3QPE&ab\\_channel=MITOpenCourseWare](https://www.youtube.com/watch?v=i_pLF9J3QPE&ab_channel=MITOpenCourseWare)

Geopolitics:

Johnny Harris: <https://www.youtube.com/@johnnyharris>

RealLifeLore: <https://www.youtube.com/@RealLifeLore>

Vox: <https://www.youtube.com/@Vox>

The Infographics Show: <https://www.youtube.com/@TheInfoGraphicsShow>

Economics Explained: <https://www.youtube.com/@EconomicsExplained>

# EP Innovation Centre – “*Every journey starts with the first step*”

- **Enhancing Education and Research Quality:** Collaboration aims to elevate the quality of education and research at TUKE through innovative initiatives.
- **Skill Development in Commodity Market:** Provides a unique opportunity for students to acquire valuable skills in commodity market analysis and trading, fostering practical knowledge alongside academic learning.
- **Centre of Excellence - TECHNICOM Office:** TUKE hosts a Centre of Excellence where talented students can access the TECHNICOM office, equipped with excellent hardware and resources for hands-on learning.
- **Opportunities for Exposure:** Students have the chance to visit trading offices in Europe and the UK, gaining exposure to real-world trading environments and networking opportunities.
- **Empowering Talent:** The collaboration empowers talented students to excel by providing them with resources, mentorship, and opportunities to thrive in the field of commodities trading and analytics.
- **Interested? Contact us for more information.**

- [erik.kajati@tuke.sk](mailto:erik.kajati@tuke.sk)
- [iveta.zolotova@tuke.sk](mailto:iveta.zolotova@tuke.sk)
- [martin.miskuf@epcommodities.cz](mailto:martin.miskuf@epcommodities.cz)

In May 2023, the research and innovation center EPIC was inaugurated within the TECHNICOM facility



Captivating snapshots of university students exploring our London office in September 2023.



# Q&A and some useful links

## ❑ LinkedIn

- Lion Hirth (Prof. energy study programme in DE): <https://www.linkedin.com/in/lionhirth/>
- Gabriele Martinelli (Reuters power): <https://www.linkedin.com/in/gabriele-martinelli-10bb1819/>
- Joachim Gessner (Bloomberg News): <https://www.linkedin.com/in/joachimgessner/>
- Tom Marzec-Manser (ICIS Gas): <https://www.linkedin.com/in/tom-marzec-manser/>
- Matthew Jones (ICIS Power): <https://www.linkedin.com/in/matthew-jones-5a25862a/>
- Jonathan Howells (Market reports): <https://www.linkedin.com/in/jhhowells/>
- Marcello Kolax (Tech Analysis): <https://www.linkedin.com/in/marcello-kolax/>
- Stefan Feuchtinger (Emissions): <https://www.linkedin.com/in/steffeuchtinger/>

## ❑ EMBER: <https://ember-climate.org/insights/>

- European Electricity Review 2024: <https://ember-climate.org/insights/research/european-electricity-review-2024/>

## ❑ BRUEGEL: <https://www.bruegel.org/keyword/energy>

- European natural gas imports: <https://www.bruegel.org/dataset/european-natural-gas-imports>
- Europe's under-the-radar industrial policy: <https://www.bruegel.org/policy-brief/europees-under-radar-industrial-policy-intervention-electricity-pricing>

## ❑ IEA reports <https://www.iea.org/analysis?type=report>

- Electricity 2024: <https://www.iea.org/reports/electricity-2024>
- Gas Market Report, Q1-2024 : <https://www.iea.org/reports/gas-market-report-q1-2024>

## ❑ Oxford Institute for Energy Studies: <https://www.oxfordenergy.org/publication-topic/energy-insight/#>

## ❑ Gas - ENTSOG: <https://gasdashboard.entsog.eu/>

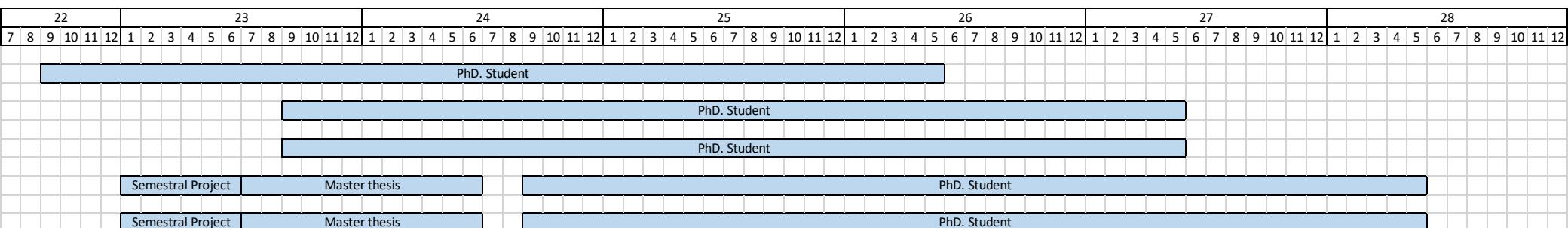
## ❑ Power / Electricity - ENTSOE: <https://transparency.entsoe.eu/>

# EP Innovation Centre – collaboration bc., Ing., PhD. Theses & Projects

□ UK Analytics, Quant and Trading department will specify some projects which will be consulted with university.

□ We can categorize tasks into 2 groups:

- Research projects (bc., Ing., PhD. dissertations)
  - Modelling energy markets using Composite AI
  - Energy security of Europe / Industry 5.0
  - Game-theoretic modelling of energy markets
  - Algorithmic trading
  - Neuro-Dynamic Programming
  - Structured convex quadratic programming models
  - Statistics of Extremes
  - Statistical Methods for Trend Detection
  - Numerical Solutions for Stochastic Differential Equations
- Engineering projects (Commercial projects)
  - Back testing & model tuning - Time expensive verification of models build by UK Quant and Analytics team
  - Building of POC (Proof of Concepts) for new technologies
  - Other MIMO (Most Ignored but Most Obvious) business challenges
  - Euphemia and SciPy vs Mosek – mixed integer problem

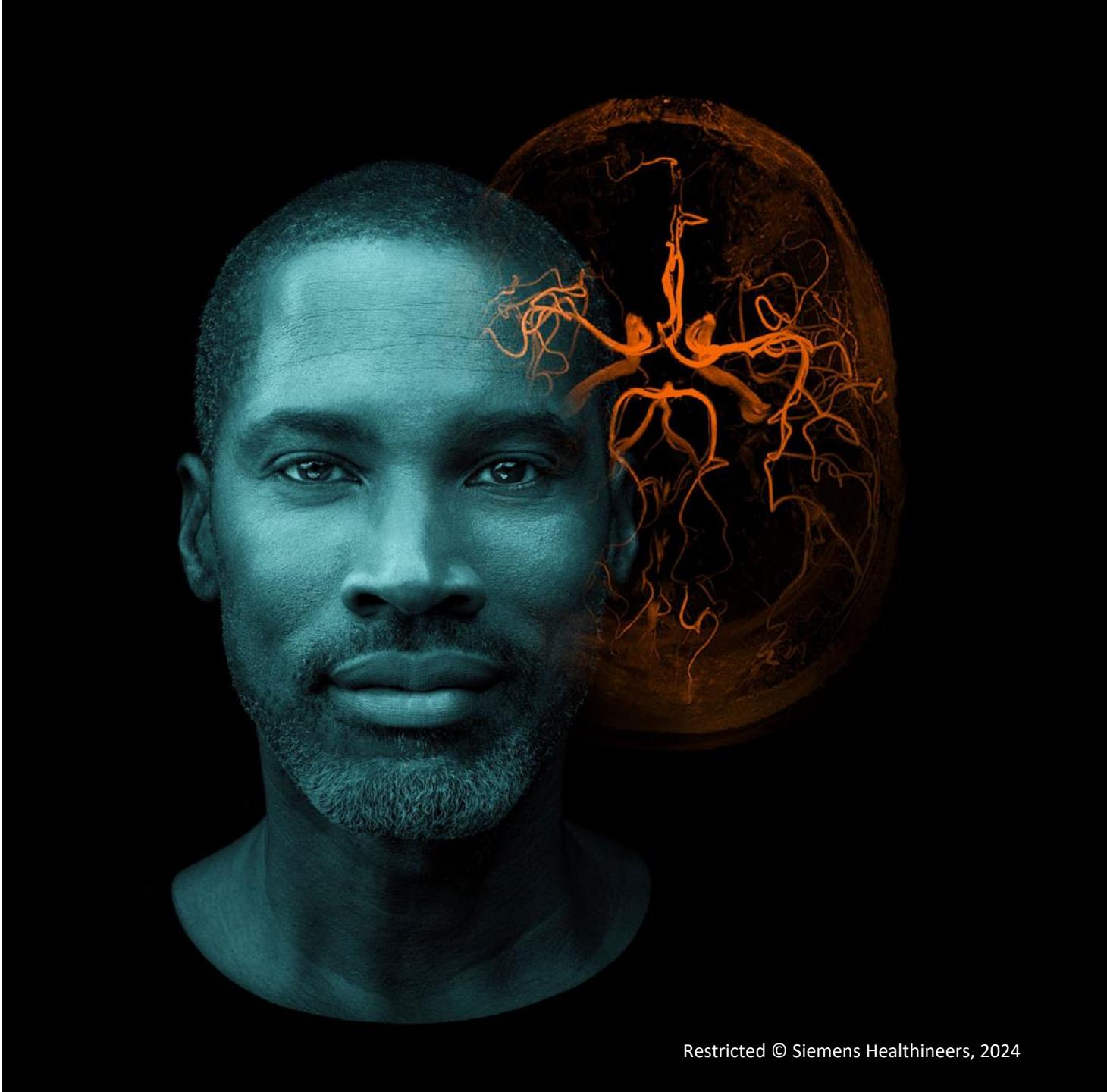


# teamplay Fleet & eCommerce

Real-world cloud development



Ing. Vladimir Nemergut  
English, March 2024



Hi!

---

**Ing. Vladimír Nemergut**

*Software Architect*

[vladimir.nemergut@siemens-healthineers.com](mailto:vladimir.nemergut@siemens-healthineers.com)

- Software architecture
  - System architecture
  - Full stack development
  - Cloud technologies
  - DevOps
- 



# Using cloud technologies



- Prefer using common services (no vendor lock-in)
- Infrastructure as a code
- Start small, expand
- Pay for the real usage only

**Equipment fleet management**  
**teamplay Fleet**

SIEMENS Healthineers LifeNet

Only my equipment 3 🔔 ? 📧 🌐 🔎 Eduard Karpel

My Dashboard Equipment Service Tickets Planned Activities Contracts Vulnerability Assessments Security Advisories System Updates more + Create new ticket

### Equipment Status

33

### Planned Activity Status

3

### Site Status

Map Satellite

?

Need Help?

Insights from teamplay

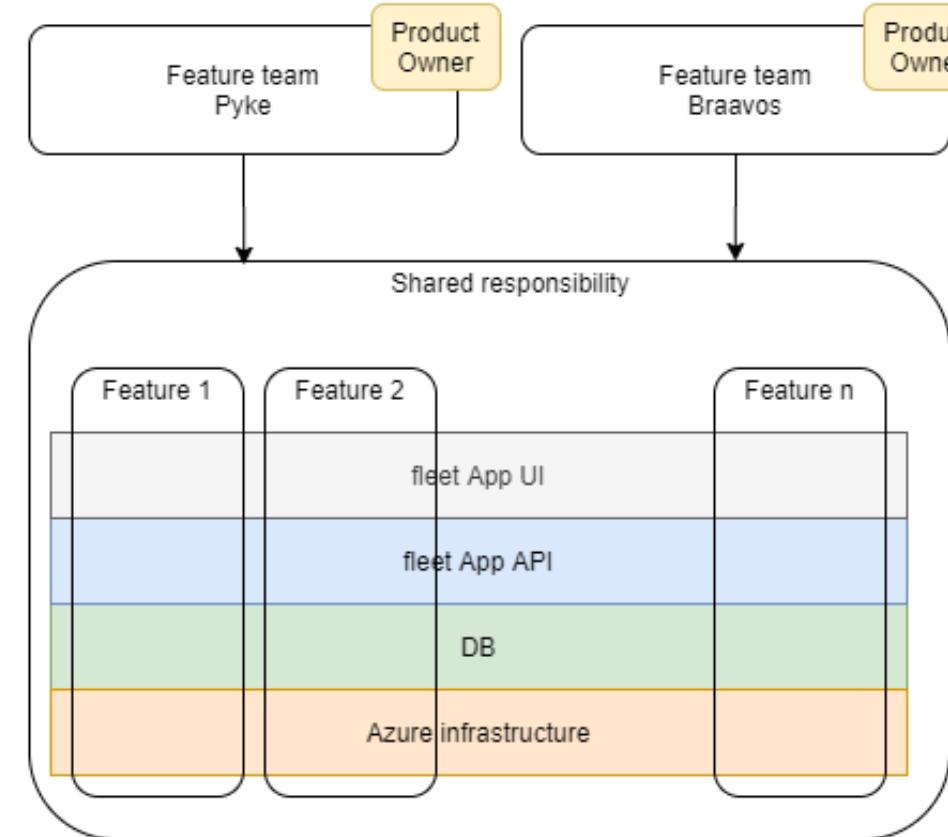
● Computed Tomography ● Andere ● Magnetic Resonance ● Ultrasound

Avg. Number of Exams p.m.

Avg. Exam Duration (min)

1,500 T

# Two teams, one goal





kubernetes









sonarqube



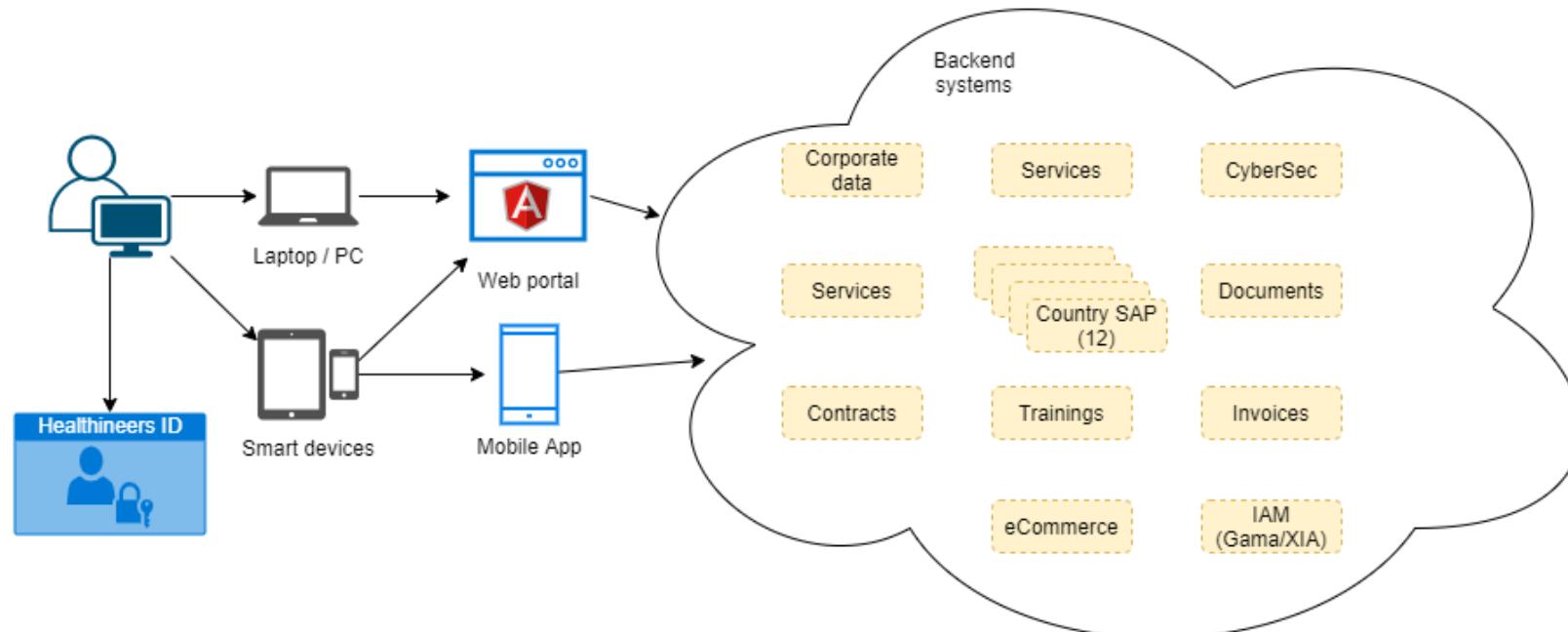
nerdctl

Azure  
DevOps

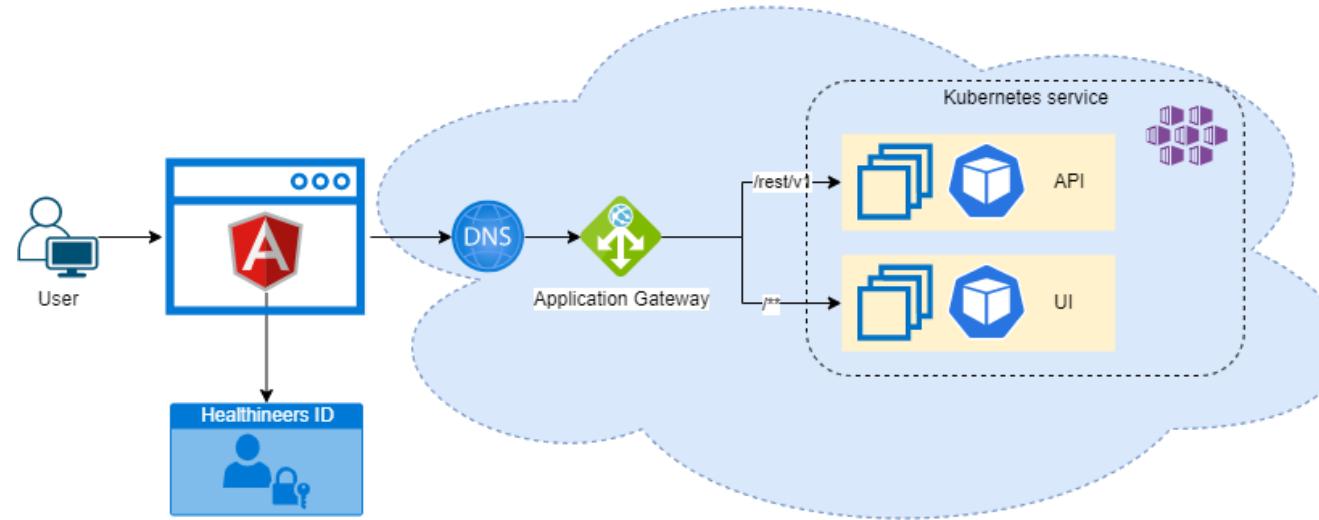


dynatrace

# High Level Overview

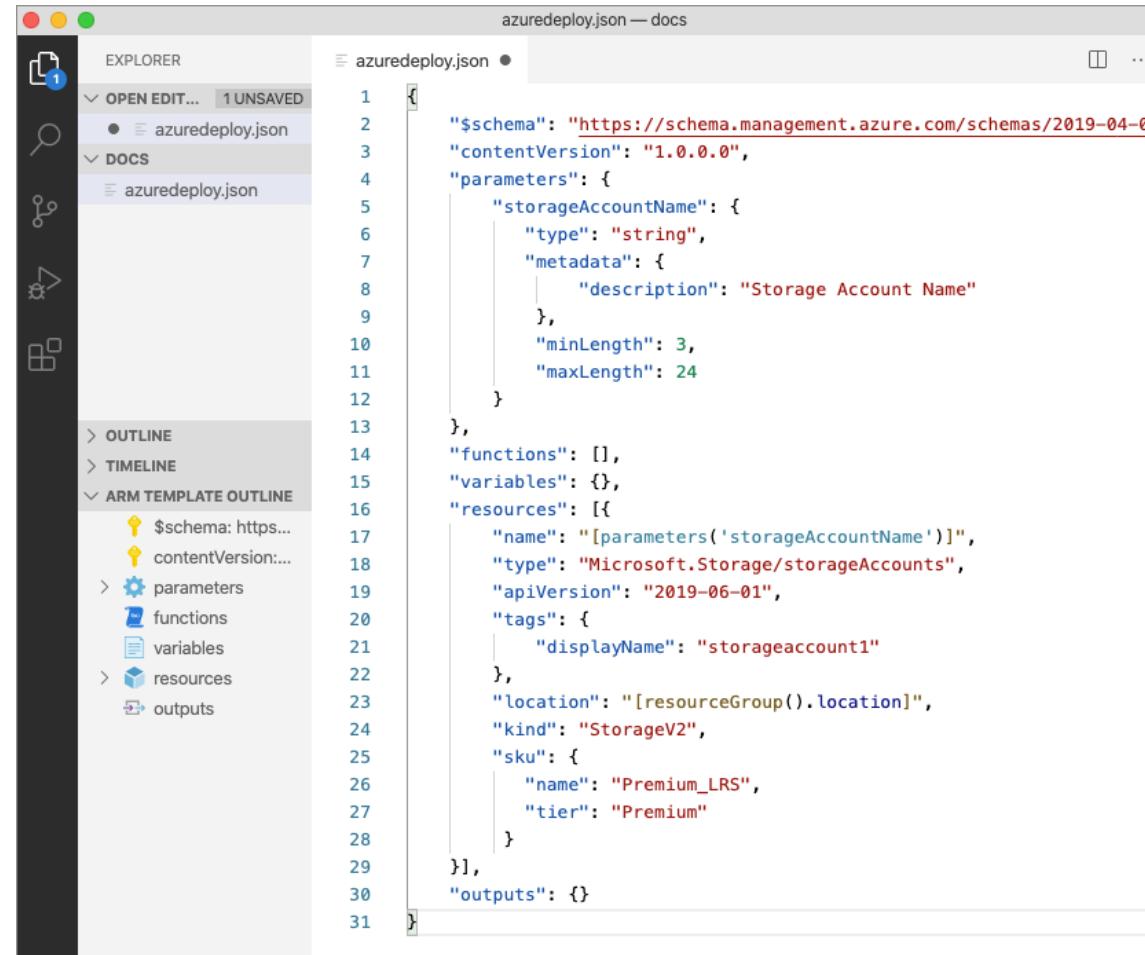


# Client-server architecture



# Doing it ourselves

- ARM templates (infrastructure as code)
- Azure DevOps build & release pipelines
- Fully automated deployment



The screenshot shows the Microsoft Visual Studio Code editor with the following details:

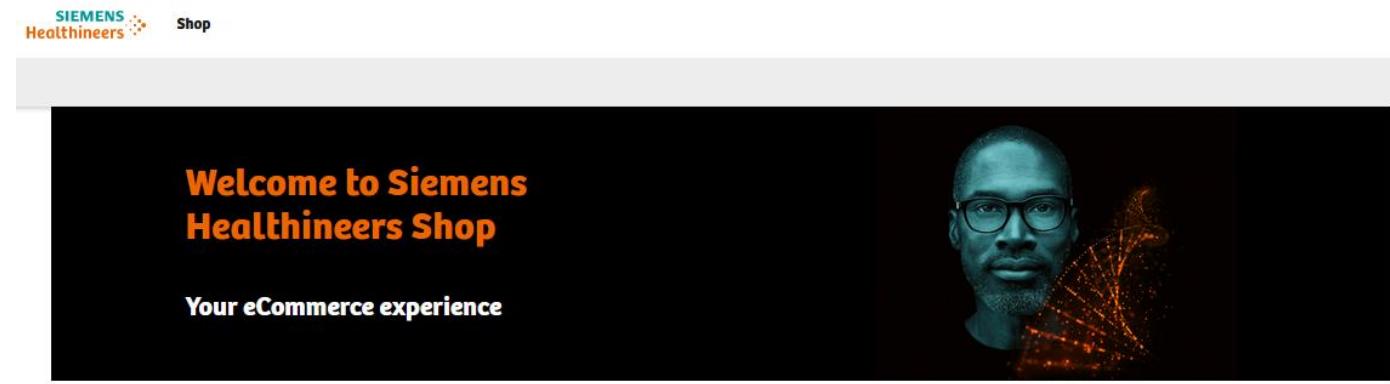
- Explorer View:** Shows two files: "azuredelay.json" (1 UNSAVED) and "DOCS/azuredelay.json".
- Outline View:** Shows the structure of the ARM template, including sections for parameters, functions, variables, resources, and outputs.
- Code Editor:** Displays the content of the "azuredelay.json" file, which defines a storage account resource.

```
1  "$schema": "https://schema.management.azure.com/schemas/2019-04-01
2  "contentVersion": "1.0.0.0",
3  "parameters": {
4      "storageAccountName": {
5          "type": "string",
6          "metadata": {
7              "description": "Storage Account Name"
8          },
9          "minLength": 3,
10         "maxLength": 24
11     }
12 },
13 "functions": [],
14 "variables": {},
15 "resources": [
16     {
17         "name": "[parameters('storageAccountName')]",
18         "type": "Microsoft.Storage/storageAccounts",
19         "apiVersion": "2019-06-01",
20         "tags": {
21             "displayName": "storageaccount1"
22         },
23         "location": "[resourceGroup().location]",
24         "kind": "StorageV2",
25         "sku": {
26             "name": "Premium_LRS",
27             "tier": "Premium"
28         }
29     },
30     {
31         "outputs": {}
32     }
33 ]
```

# Keeping machines ready for patients

# eCommerce

# Landing page



Please select your preferred store



# Home page



Shop

Search catalogue (i.e. Product, number, serial)



maros.kovac@siemens-healthineers.com  
maros.kovac@siemens-healthineers.com

Your Installed base

Browse entire catalogue

## Welcome to Siemens Healthineers Shop

Your eCommerce experience



### Your installed base

MRI US CT ANGIO MAMMO IT X-RAY MI ONCO



MAGNETOM Trio, A  
Tim System



Magnetom Skyra



MAGNETOM Amira  
(CN)



MAGNETOM Sola



MAGNETOM  
Avanto

### Featured products



External hand switch

Add to cart



Foot cushion

Add to cart



Set of Straps for Baby mattress

Add to cart



• • •

# Product catalogue

SIEMENS Healthineers [Shop](#)

Search catalogue (i.e. Product, number, serial) 

Your installed base [Browse entire catalogue](#)

Home > Product List > Parts

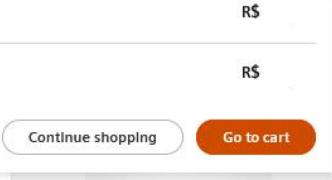
## Parts

Parts

- Accessories (495)
  - 3rd Party (1)
  - Belts & straps (53)
  - Cables (46)
  - Clips & clamps (8)
  - Computer aids (7)
  - Consumables (15)
  - Cushions & pads (178)
  - Gels (4)
  - Holders (46)
  - Mattresses (4)
  - Mirrors (7)
  - Others (25)
  - Phantoms & Brackets (15)
  - Positioning aids (51)
  - Switches (8)
  - Vials & Caps (6)
- System Area
- Clinical Field
- Anatomic Area

Head rest  R\$ [Add to cart](#)

Filling cushion  R\$ [Add to cart](#)

Set patient table pads  R\$ [Add to cart](#)

Skull support for ARTIS  R\$ [Add to cart](#)

MECH Air filter kit  R\$ [Add to cart](#)

Insert Endo Probe Holder, blue  R\$ [Add to cart](#)

**Added to cart**  
'Head rest' was successfully added to your cart.

Head rest	1	R\$
Total		R\$

[Continue shopping](#) [Go to cart](#)

# Shopping cart

SIEMENS Healthineers  Shop

Search catalogue (i.e. Product, number, serial) 

Your installed base [Browse entire catalogue](#)

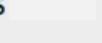
**Your cart**

	Quantity	Price
	<b>Head rest</b> Currently in stock Estimated arrival: Up to 12 days	1  R\$
		<a href="#">Remove item </a>

**Proceed to Delivery Details**

[Export shopping cart](#)

[Continue shopping](#)

Total Price   
(including taxes) in Reais  
Free Shipping

# Order details

SIEMENS Healthineers [Shop](#)

Search catalogue (i.e. Product, number, serial) 

Your installed base [Browse entire catalogue](#)

   Maros Kovac maros.kovac@siemens-healthineers.com

## Order Details

### Status of your order BR-61

[Back to hospital orders](#)



Your order BR-61 is being prepared.

[Cancel order](#)

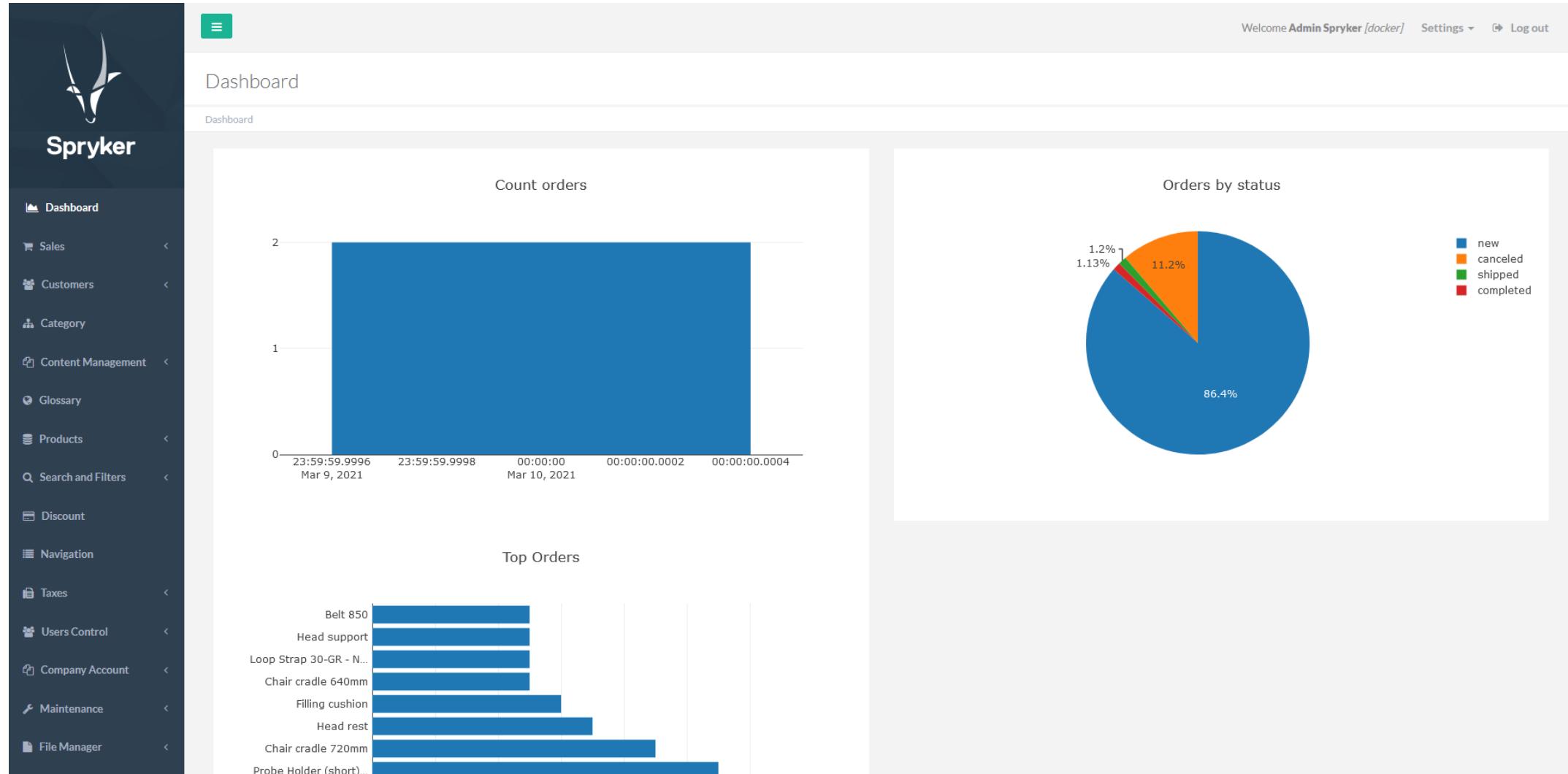
Your order was approved.

The estimated time is 12 days after approval.



## Your ordered items

Order	Ordered on	Total quantity	Order Total	Total sum
BR-61	03.03.2021	2 Items	R\$	
	<b>Filling cushion</b> R\$ Currently in stock Estimated arrival within 12 days	1	Delivery address Street 2 BR	
	<b>Set patient table pads</b> R\$ Currently in stock Estimated arrival within 12 days	1		







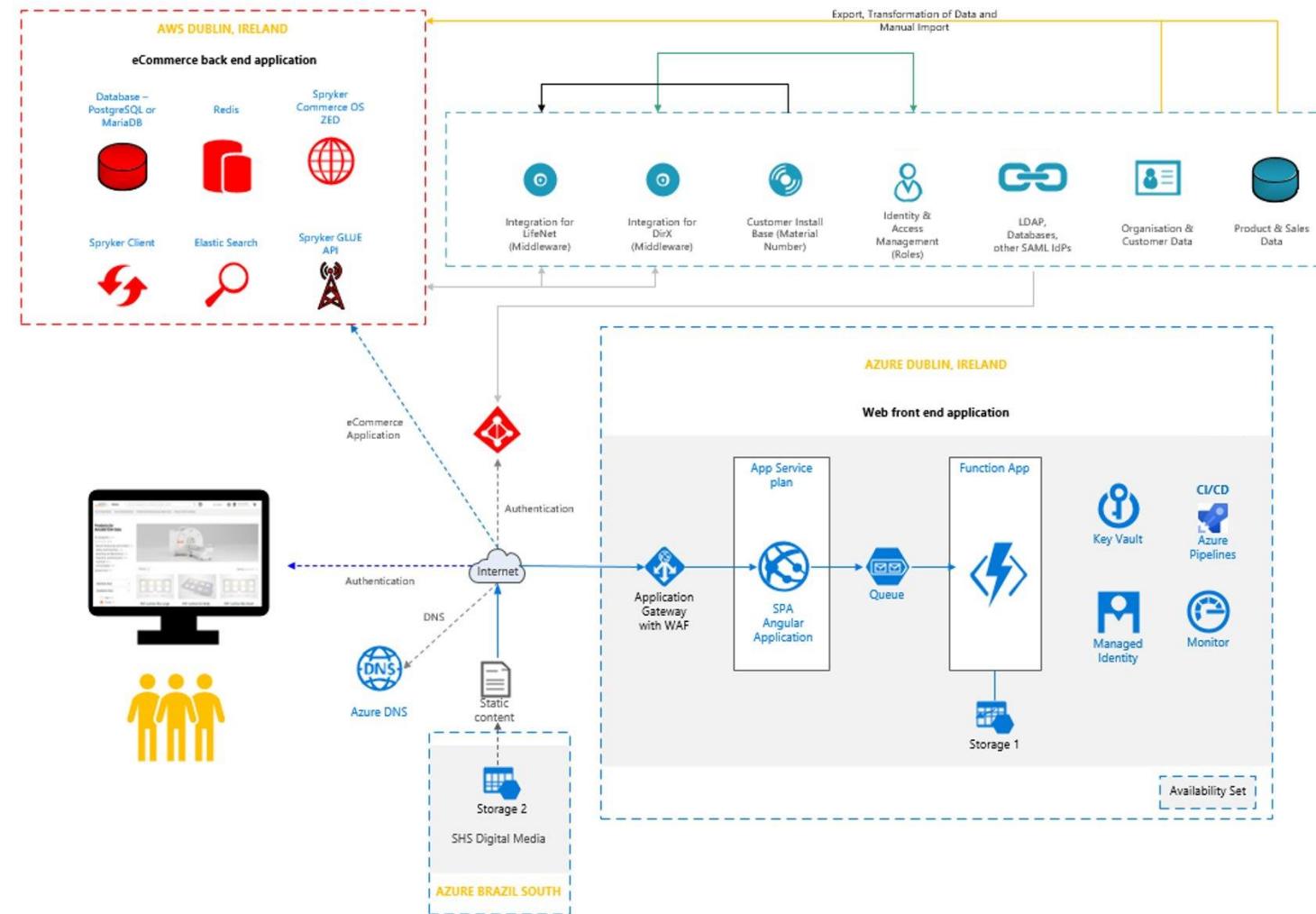




new relic.<sup>®</sup>



# High Level Overview



Decentralized training and federated learning

# Federated Learning



**kubernetes**



**Microsoft Azure**



**Red Hat**  
Enterprise Linux



**vmware**  
**ESXi**



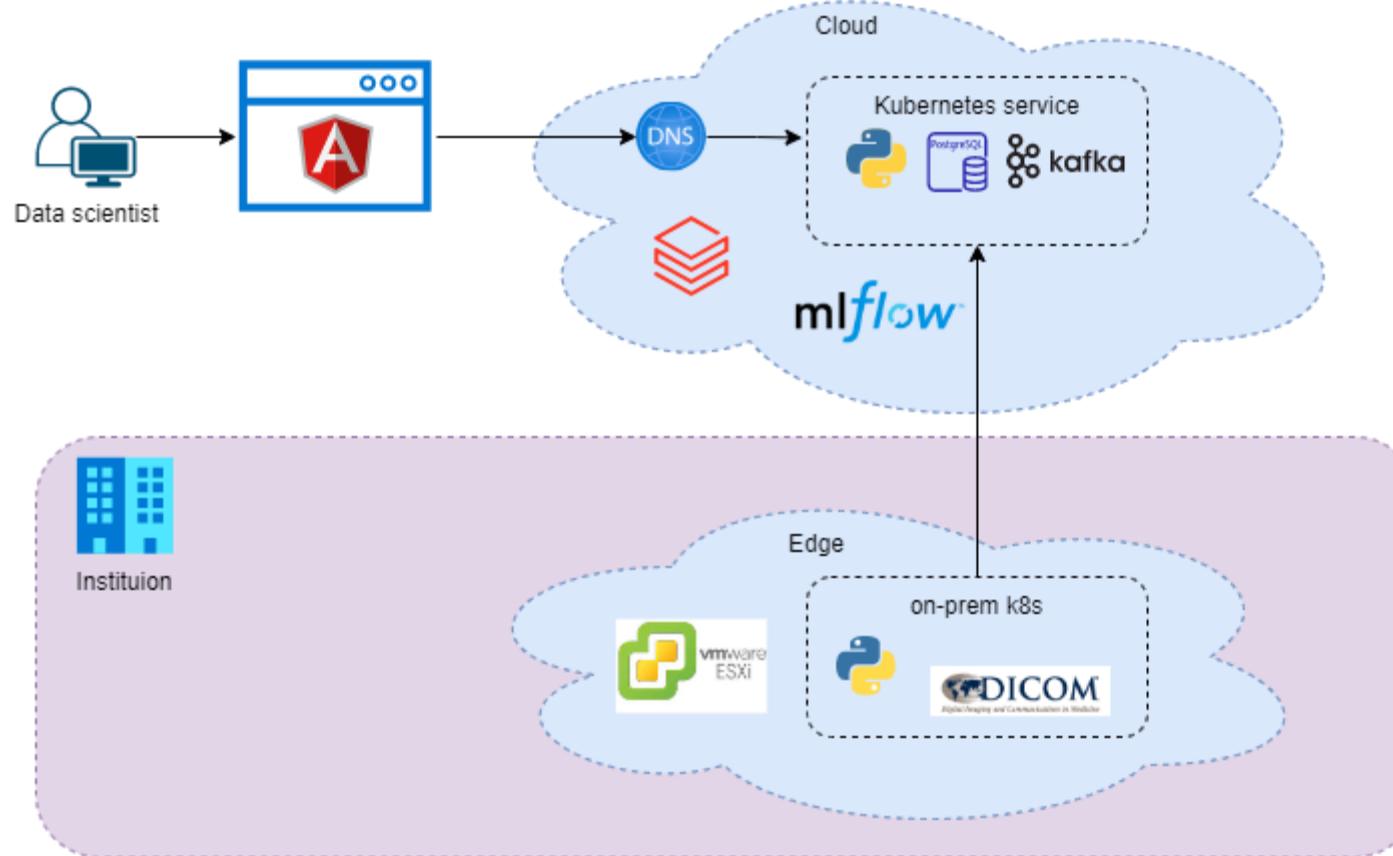


*Digital Imaging and Communications in Medicine*

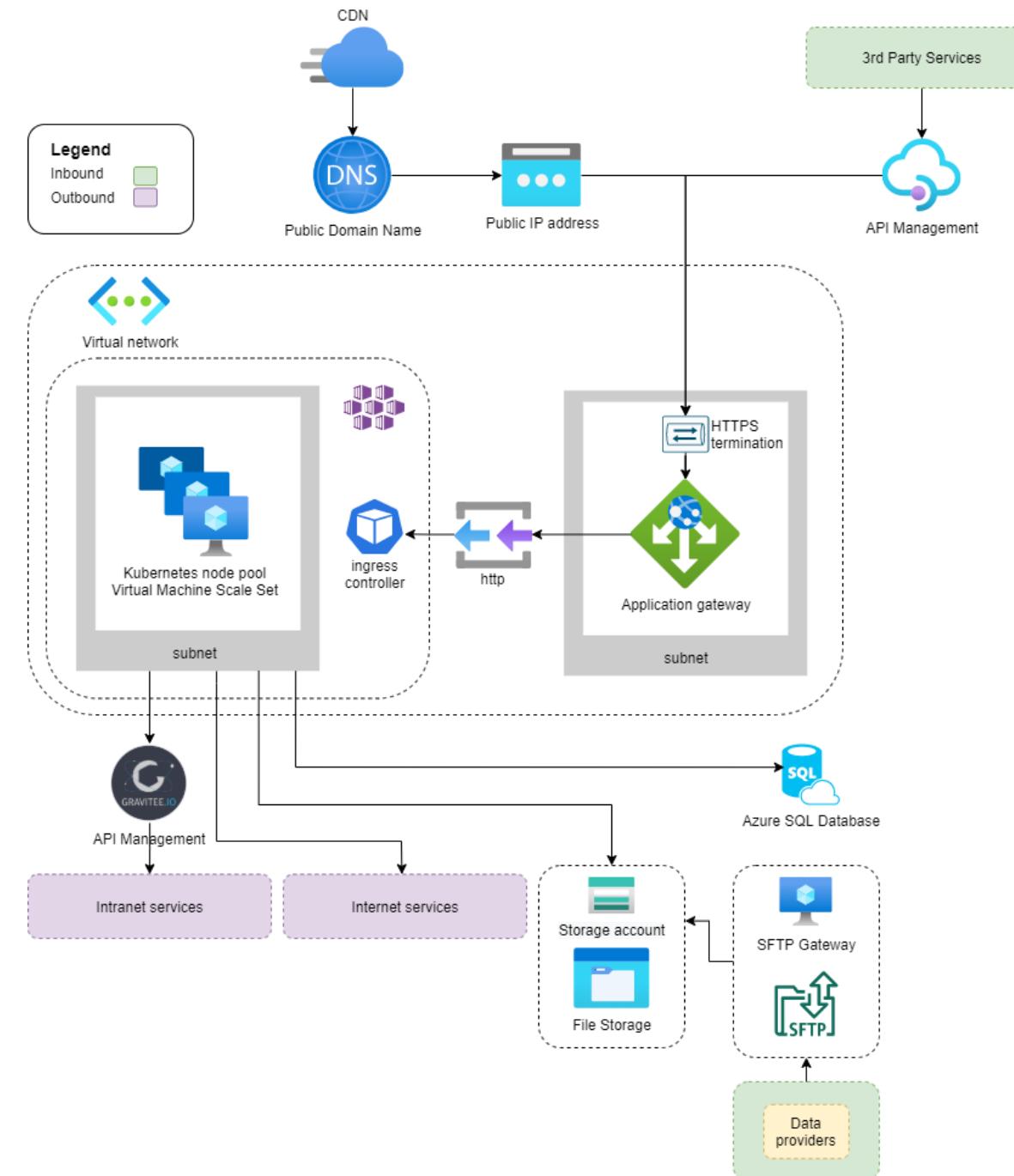


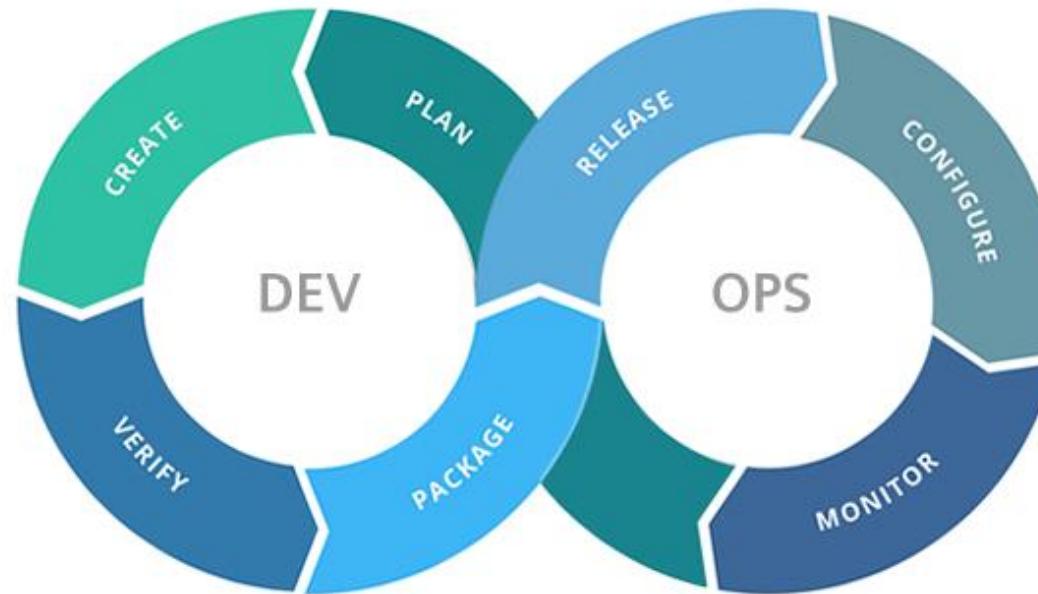






# Demo time





# Thank you!

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*Software Architect*

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