qaware.de

# Cloud Computing Introduction

Franz Wimmer & Lukas Buchner

# Survey:
# Do you have experience with the cloud?

What experience do you have?

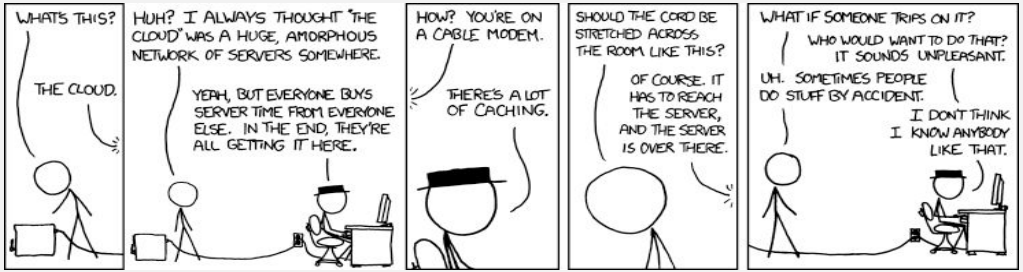
Who here has already developed software for the cloud?

Who here has already used software that runs in the cloud?

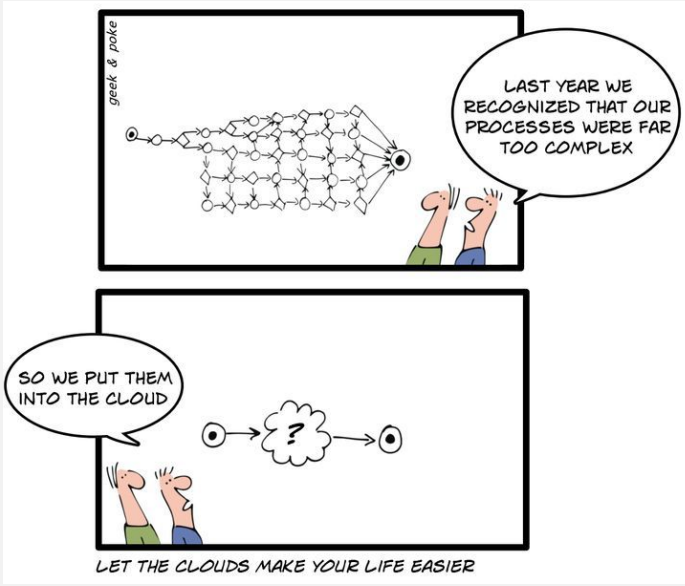
Who here has ever used Azure, AWS, Google Cloud, etc.?

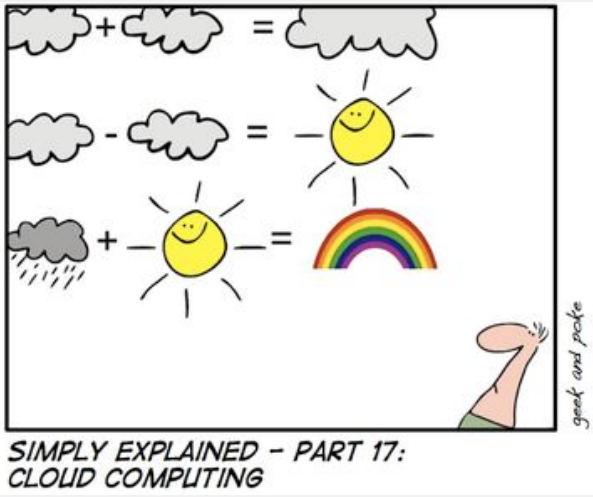
# What is Cloud Computing?

# What is Cloud Computing?



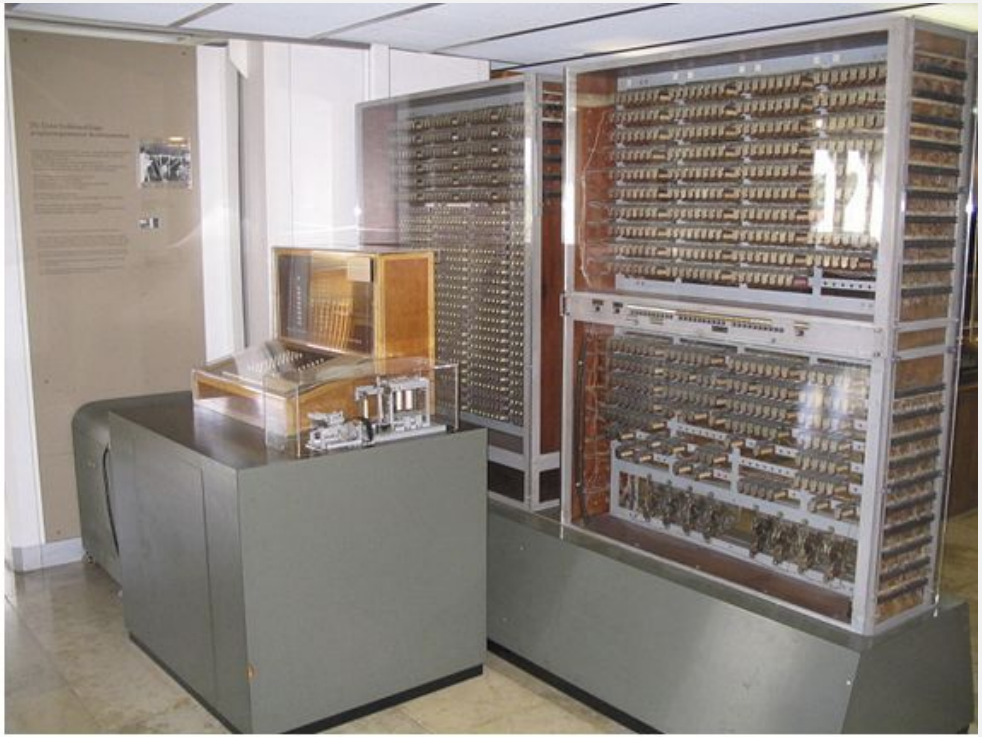

There's planned downtime every night when we turn on the Roomba and it runs over the cord.



# Generation 0: The first computers

Quelle: wikipedia.de



**Zuse Z3**
Rechenleistung: 2 FLOPS
Preis: unbekannt

# Generation 1: Mainframes

Quelle: wikipedia.de

**IBM AS/400**
Rechenleistung: 4,5 bis 250 Mega-FLOPS
Preis: 6.000-9.000 $/Monat

**Cray 1**
Rechenleistung: 80 bis 133 Mega-FLOPS
Preis: 5-8 Mio. $

# Generation 2: Supercomputers and Data Centers

Quelle: strato.de

**Strato Rechenzentrum:**
Rechenleistung: ca. 2,6 Peta-FLOPS
**K-Computer** (Supercomputer):
Rechenleistung: 10,5 Peta-FLOPS

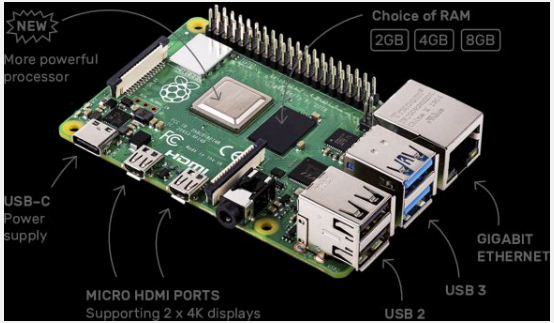
**Computer performance**

| Name | FLOPS |
|---|---|
| yottaFLOPS | $10^{24}$ |
| zettaFLOPS | $10^{21}$ |
| exaFLOPS | $10^{18}$ |
| petaFLOPS | $10^{15}$ |
| teraFLOPS | $10^{12}$ |
| gigaFLOPS | $10^{9}$ |
| megaFLOPS | $10^{6}$ |
| kiloFLOPS | $10^{3}$ |

# Generation 3: Ubiquitous Computing or „The commoditization of computing power“

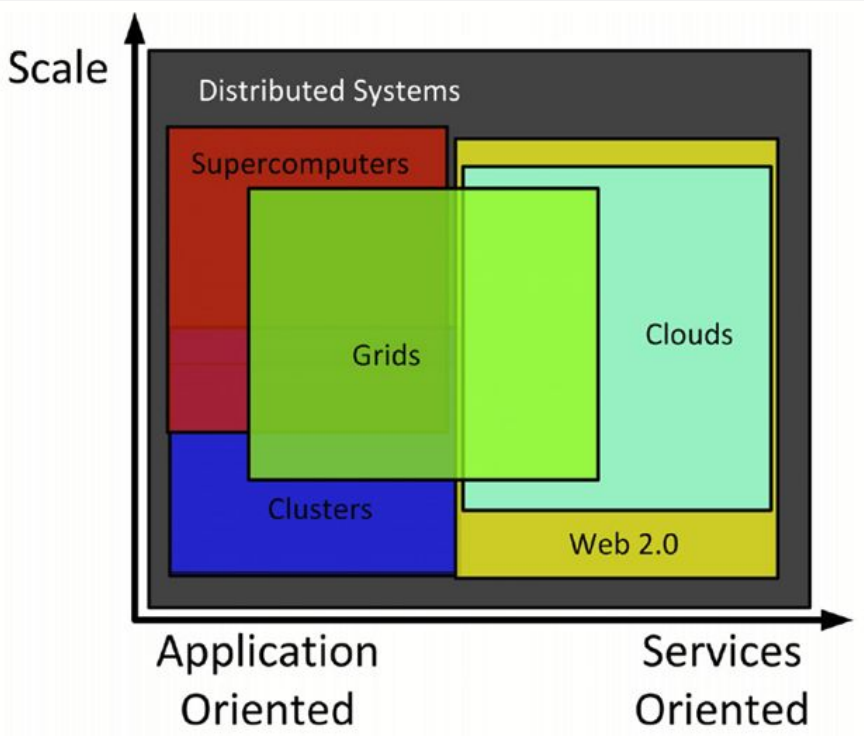
**Apple A13 (iPhone 11 Pro)**
ca. 155 GFlops
Price: ~1000 €

**Nvidia RTX 3090**
ca. 36 TFlops
Price: 1.500 €




**Raspberry Pi 4**
ca. 13,5 GFlops
Price: 30 €

# Classification of cloud computing in relation to other approaches for distributed systems.




Ian Foster et al., Cloud Computing and Grid Computing 360-Degree Compared

# Cloud computing is the result of the commoditization of computing power, computing capacity and the internet.

*noun - digital technology*: internet-based computing in which large groups of remote servers are networked so as to allow sharing of data-processing tasks, centralized data storage, and online access to computer services or resources.
http://dictionary.reference.com

“Cloud computing is the **access to computers and their functionality via the Internet** or a local area network. Users of a cloud request this access from a set of web services that manage **a pool of computing resources** (i.e., machines, network, storage, operating systems, application development environments, application programs). When granted, **a fraction of the resources in the pool is dedicated** to the requesting user until he or she releases them.”

http://open.eucalyptus.com/learn

“A large-scale **distributed computing paradigm** that is driven by **economies of scale**, in which a **pool of abstracted, virtualized, dynamically-scalable, managed computing power, storage, platforms, and services** are **delivered on demand** to external customers **over the Internet**.”

Ian Foster et al., Cloud Computing and Grid Computing 360-Degree Compared

# The NIST definition of Cloud Computing

*Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.*

https://www.nist.gov/publications/nist-definition-cloud-computing

Essential properties of cloud computing:

- **On-demand** self-service
  *No interaction between people!*
- Broad **network access**
  *Internet-based administration*
- Resource **pooling**
  *Multiple customers are using the same resources*
- Rapid **elasticity**
  *Rapid scaling with seemingly unlimited resources*
- **Measured** service
  *Resource utilization measurement (e.g. for billing)*

**Resources are, for example:**

- **Storage**
- **Compute**
- **Memory**
- **Network**
- **…**

# High number of IT resources

# Commodity hardware

# High degree of distribution

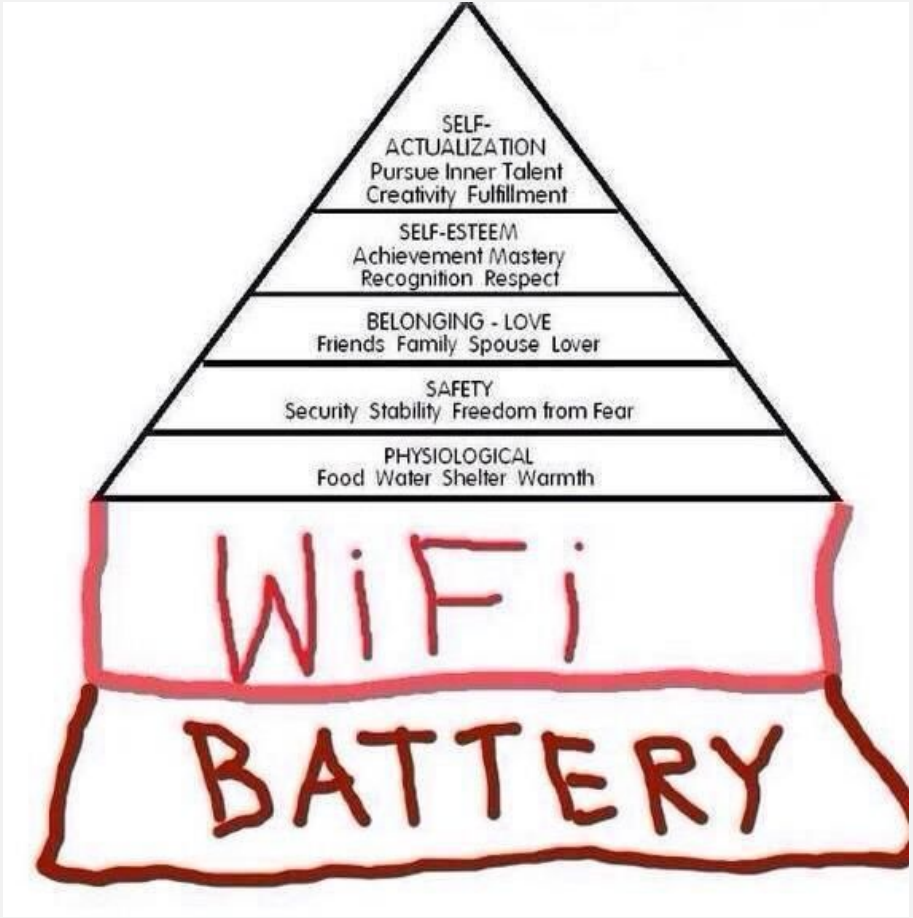
**Summit**
200 Petaflops

**Folding @ home**
2,43 Exaflops

Quelle: https://en.wikipedia.org/wiki/Summit_(supercomputer)

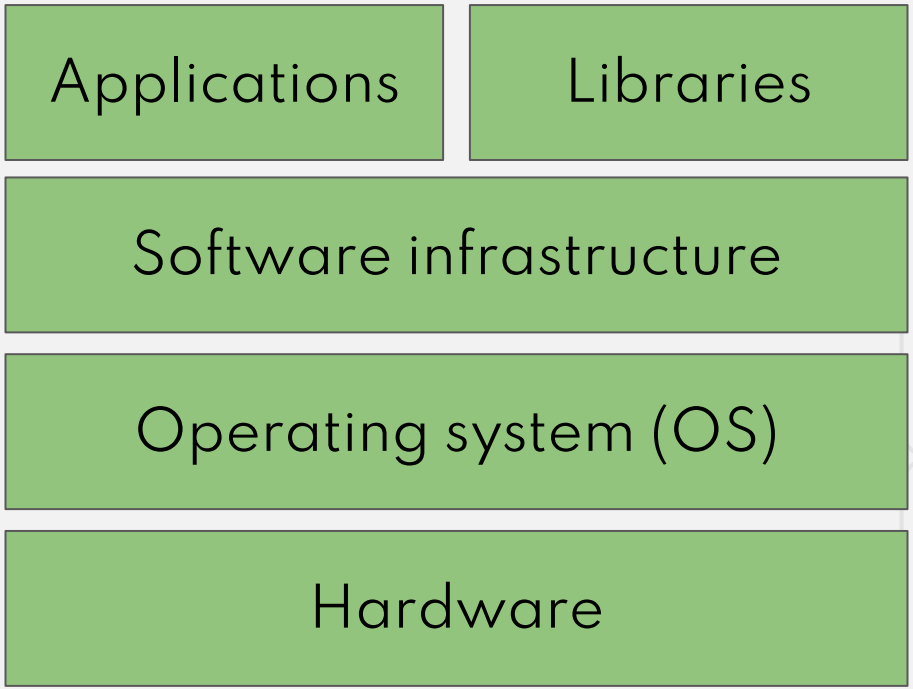
Quelle: https://en.wikipedia.org/wiki/Folding@home

# The commoditization of the internet.



# So what is Cloud Computing?

**At its core, cloud computing is about a shallower level of integration in system development and operation.**

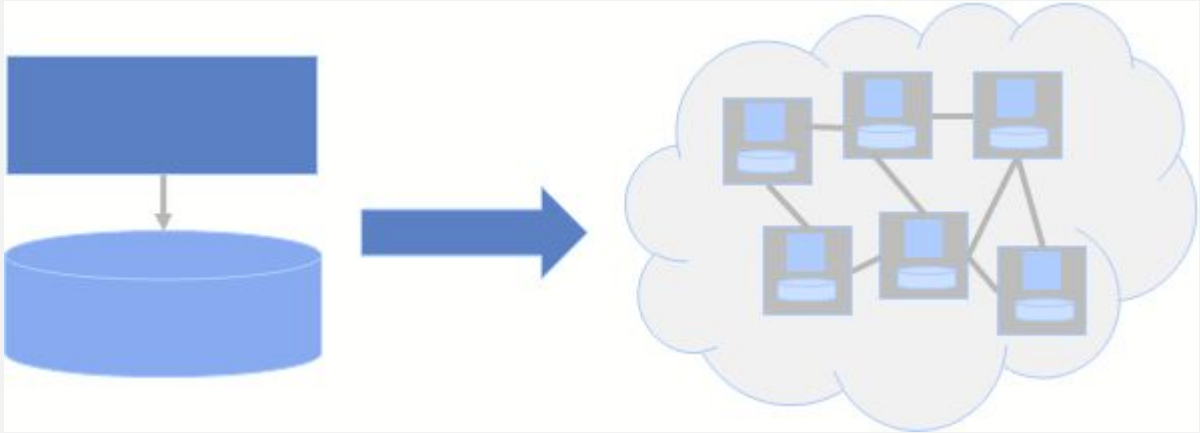



IT resources from the cloud that can be consumed on demand.

“computation may someday be organized as a public utility”, John McCarthy, 1961

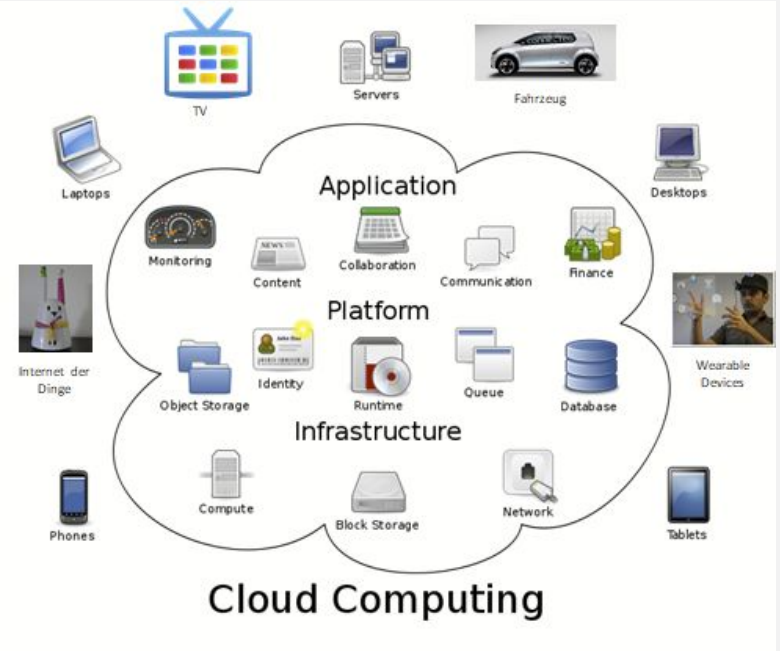
# Probably the most important technical influence on how we will build software systems in the future.

QA|WARE



- Distributed data
- Distributed logic
- Distributed consistency
- Diagnosability
- Elasticity
- Provisioning
- Orchestration
- Scheduling
- Service Discovery

# The cloud is dynamic, elastic and omnipresent.




Die wichtigsten Eigenschaften von Cloud Computing:

- **X as a Service**: On-demand character; provision of computing capacity, platform services and applications on request and in real time.
- **Resource pools**: Availability of seemingly unlimited resources that process requests in a distributed manner.
- **Elasticity**: Dynamic allocation of additional resources as needed (self-adaptation). No more capacity planning necessary from the user's point of view.
- **Pay as you go model**:  Economy of Scale. The costs scale with the benefits.
- **Omnipresence:** Access to the cloud via the internet and from a wide range of end devices (via standard protocols).

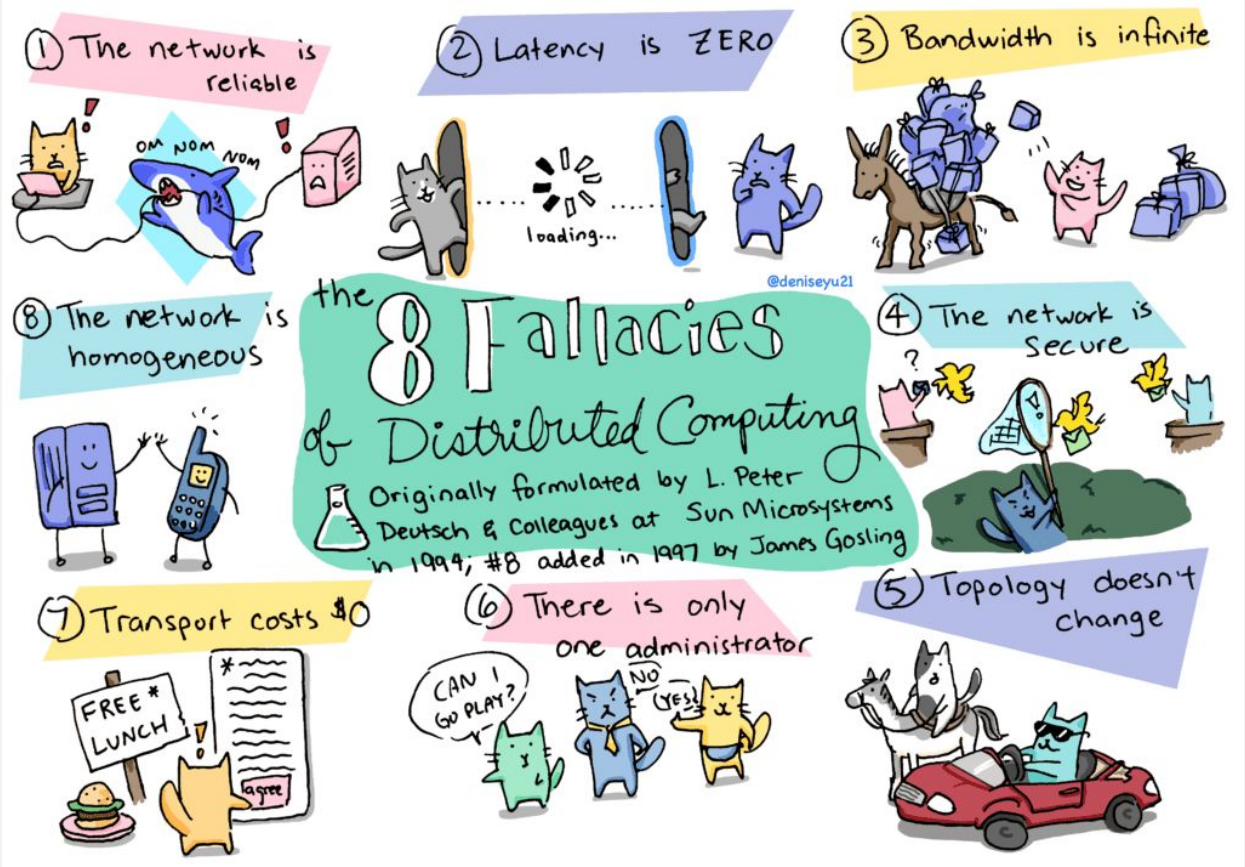
# The 5 Commandments of the Cloud

- Everything fails all the time
- Focus on MTTR, not on MTTF
- Respect the eight fallacies of distributed computing
- Scale out, not up
- Treat resources as cattle, not as pets

Quelle: https://de.wikipedia.org/wiki/Zehn_Gebote

# Eight fallacies of distributed computing

# Eight fallacies of distributed computing



# Cloud benefits

**Temporary servers**

- Project servers
- Test servers
- Prototype servers

**Easy deployment**

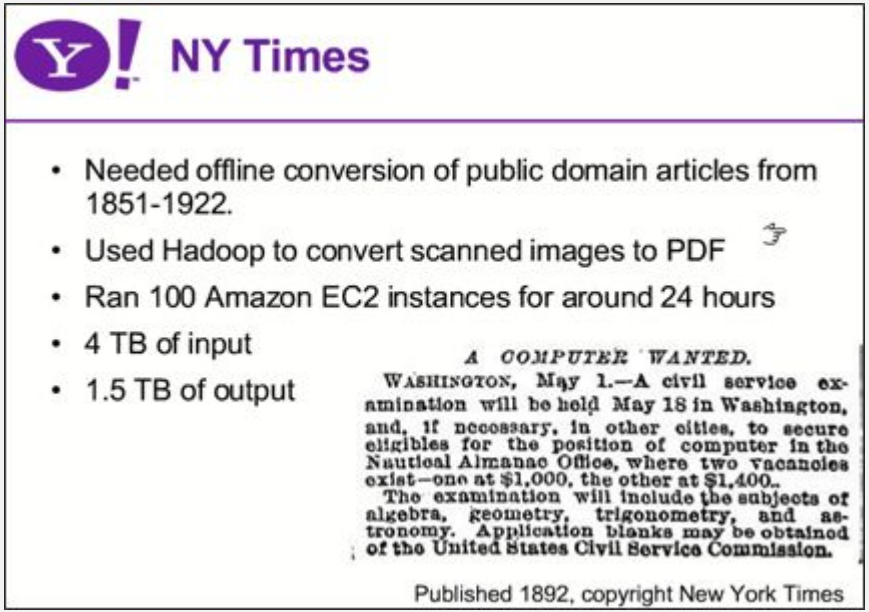
- Automatic application deployment
- Automatic creation of various deployment variants

**Scalable applications**

- Dynamic scaling, depending on the request load

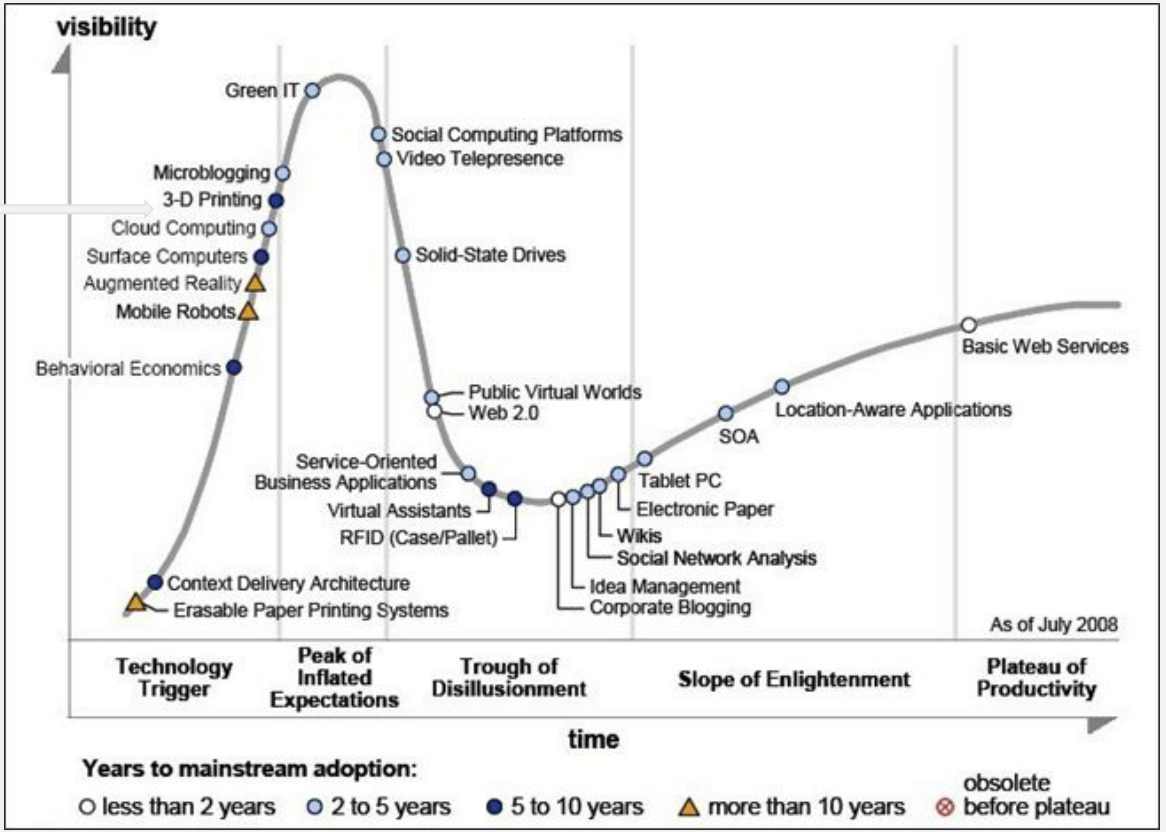
**Comprehensive calculations**

- Transaction analysis
- Data aggregation
- Data warehousing




http://www.slideshare.net/acarlos1000/hadoop-basics-presentation

# Cloud computing is one of the biggest IT trends of recent years. (2008)




Gartner Emerging Technologies Hype Cycle, 2008

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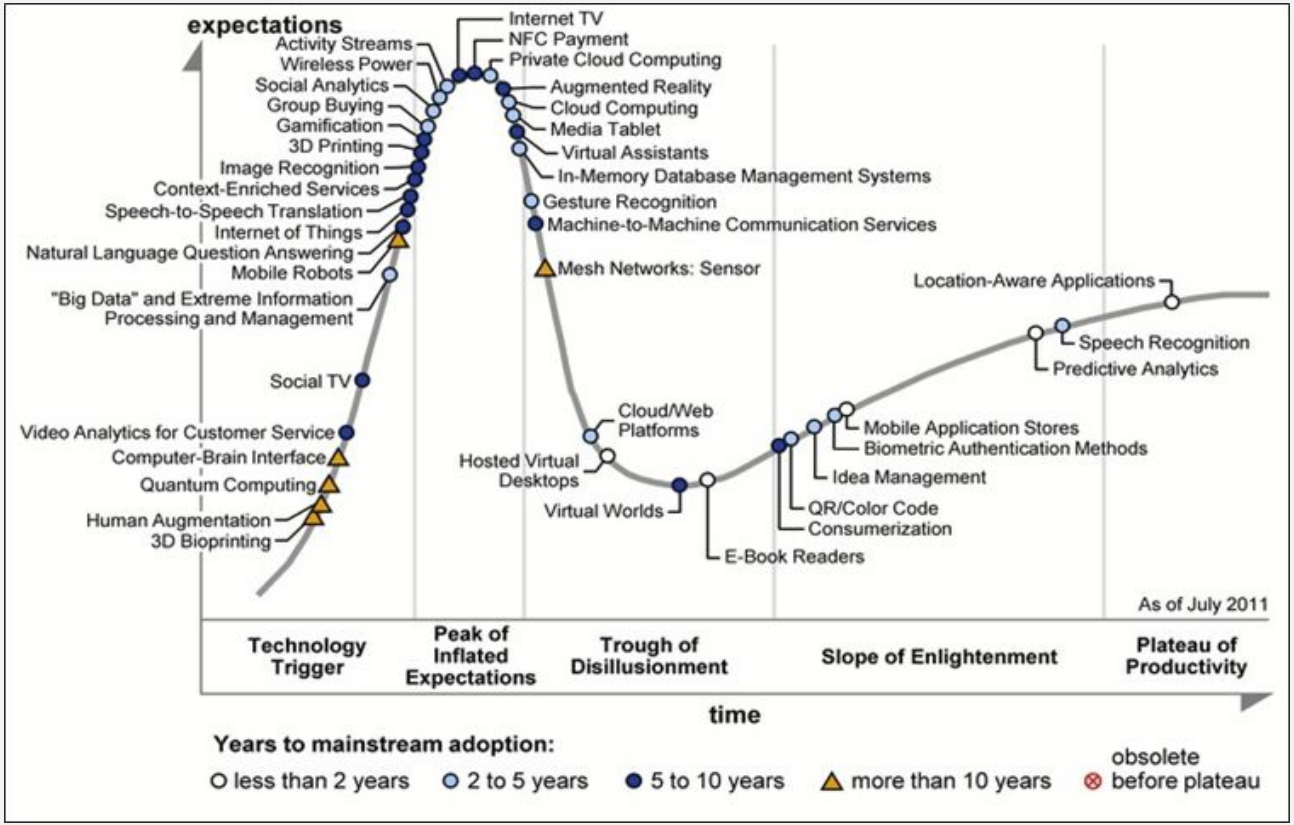
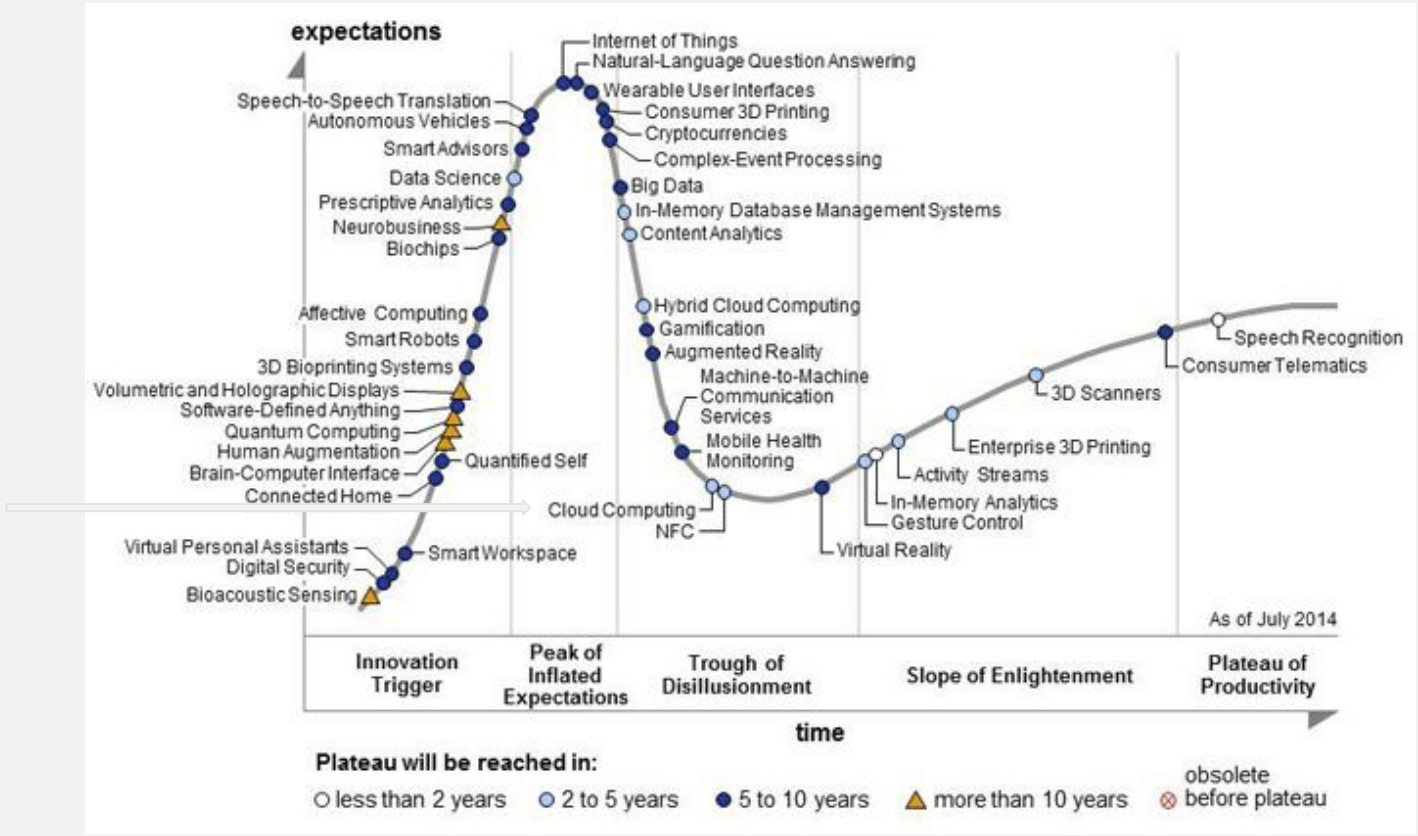


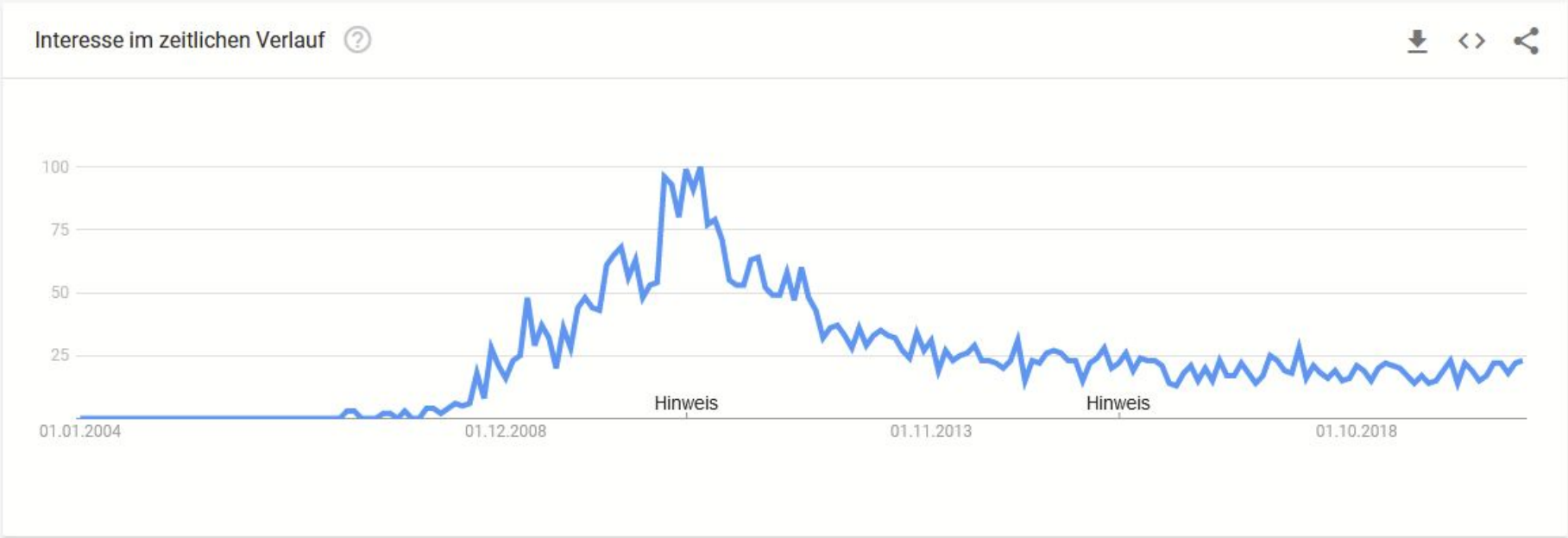

Gartner Emerging Technologies Hype Cycle, 2011

# But it returns to the facts.



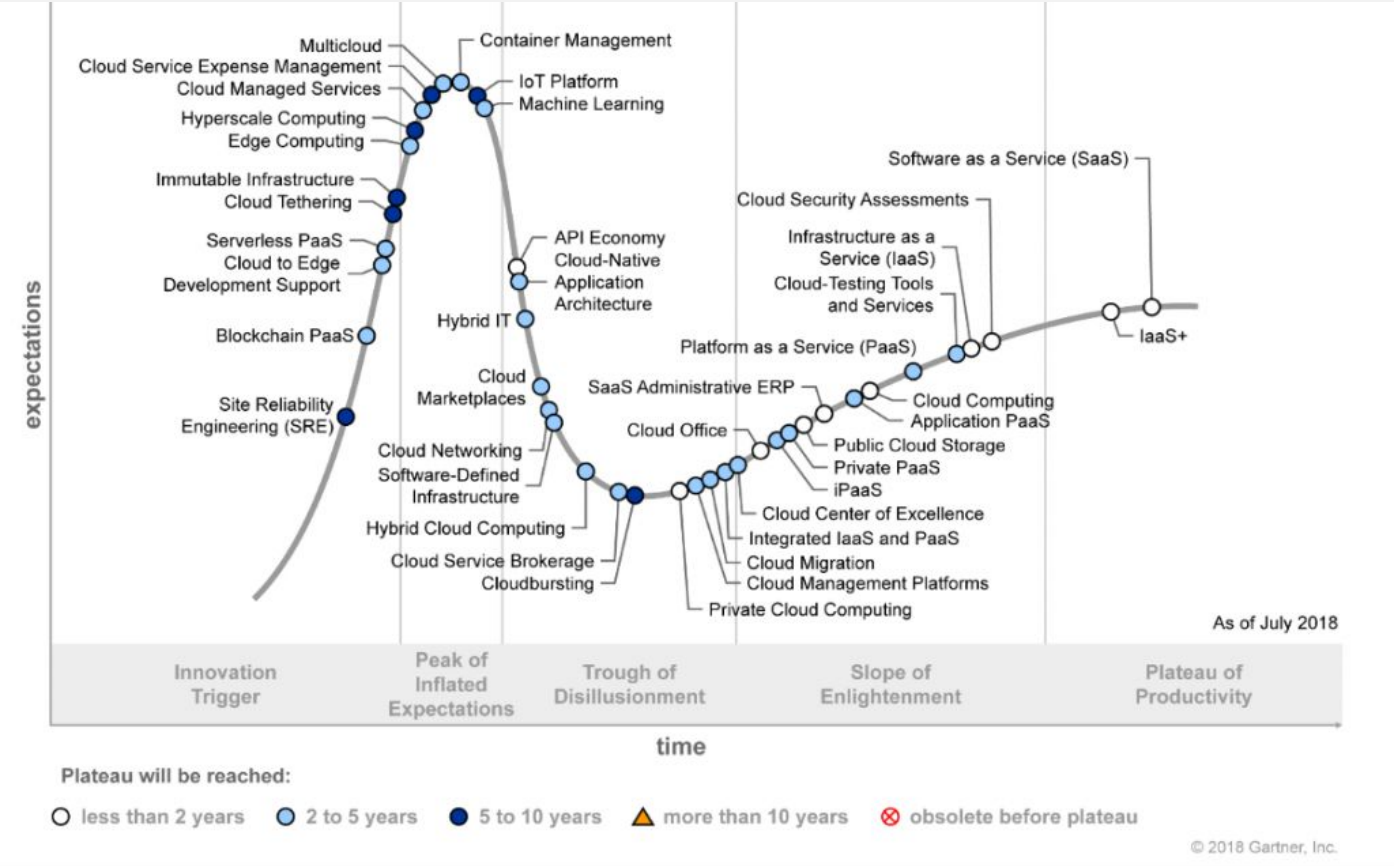

Gartner Emerging Technologies Hype Cycle, 2014

# But it returns to the facts

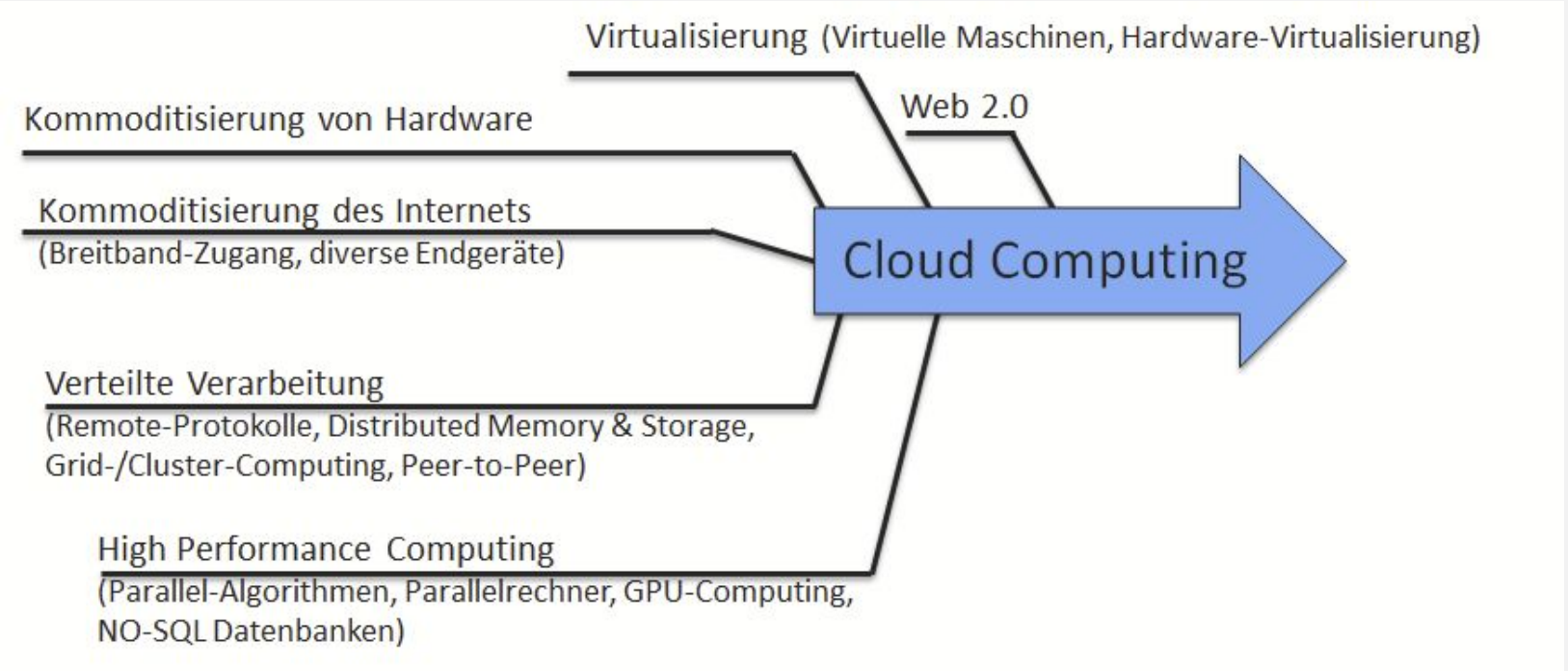



https://trends.google.de/trends/explore?date=all&geo=DE&q=cloud%20computing

# Ten years later (2018): cloud computing is a commodity.



# Cloud computing is not a surprise, but has been created on the shoulders of giants.

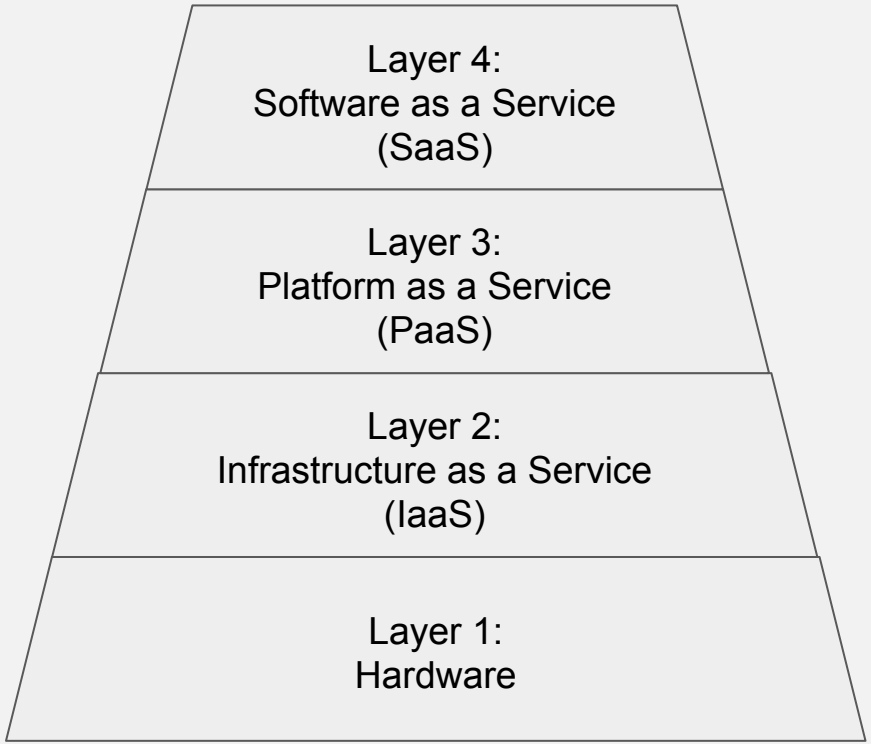


# Cloud computing is not a surprise, but has been created on the shoulders of giants.

QA|WARE

- **Virtualization** (Virtual machines, hardware virtualization)
- **Commoditization of hardware**
- **Commoditization of the internet** (broadband access, various end devices)
- **Distributed processing** (remote protocols, distributed memory and storage, grid/cluster computing, peer-to-peer)
- **High performance computing** (Parallel algorithms, parallel computers, GPU computing, NoSQL databases)

# The layered model of cloud computing: From metal to application.




**Target Group: Users**

- Customizable software services
- CaaS: Component as a service (e.g. Google Charts)
- BaaS: Backend as a Service
- Transparent Updates

**Target group: Developers**

- Platform services
- Application programming interfaces (APIs)
- Abstraction of technical infrastructure

**Target group: Operations**

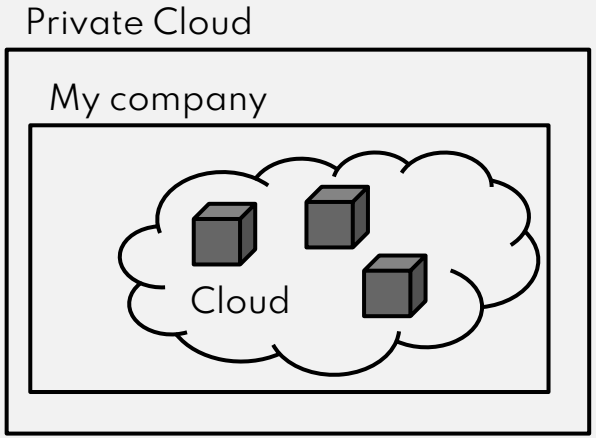
- Elasticity
- Virtual resourcepools
- Technical infrastructure: Machines, Servers (DNS, DHCP, LB, NAS, …)

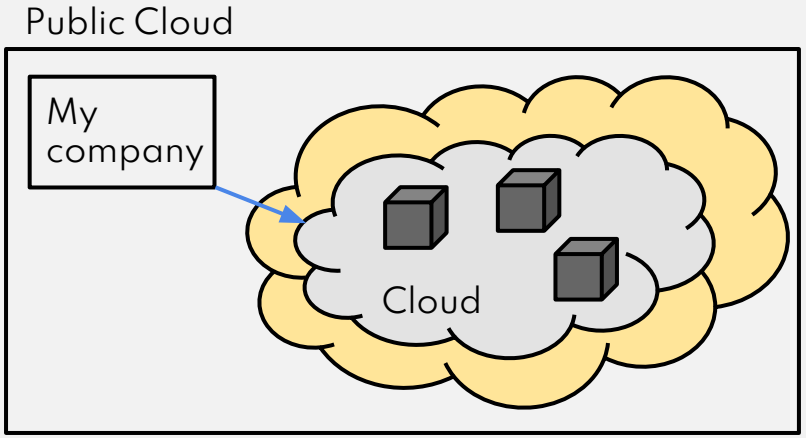
- Computers
- Network
- Storage

https://www.youtube.com/watch?v=M988_fsOSWo

# Types of Clouds

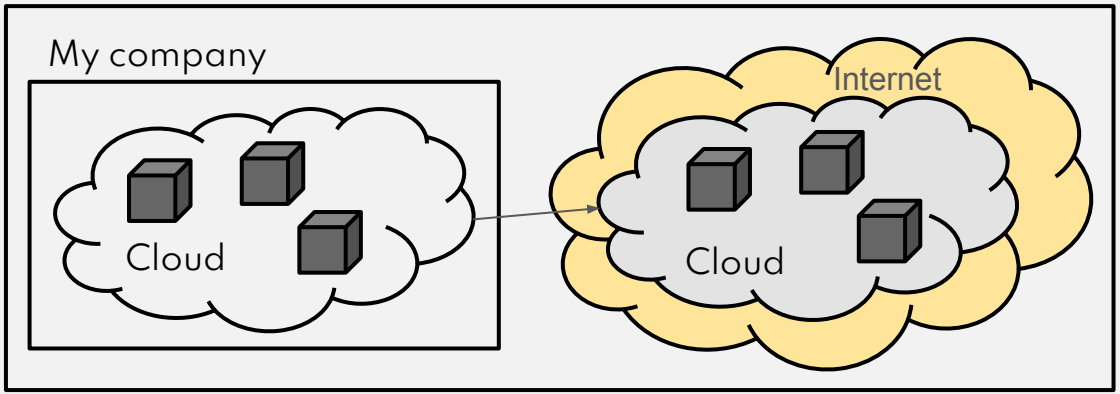
# Public and private clouds.



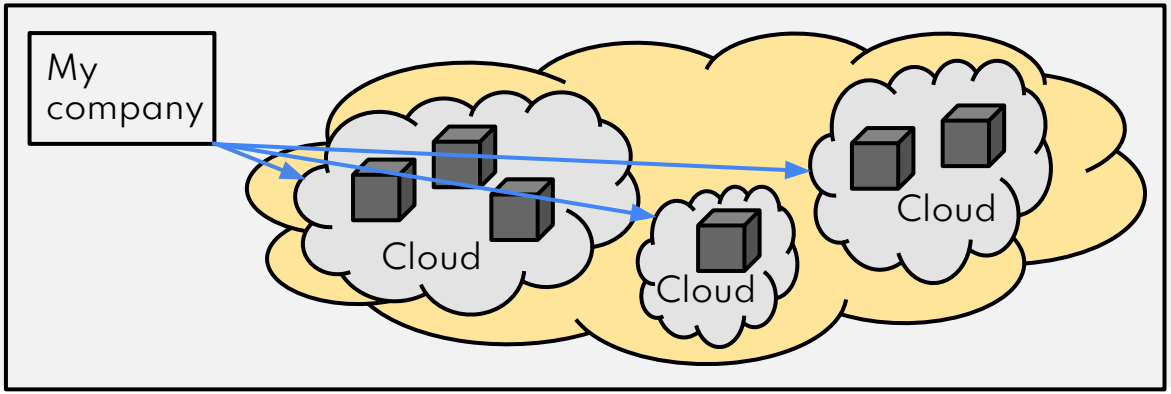



# Hybrid and multi Clouds.

Hybrid Cloud




Multi Cloud



# Cloud Computing and security.

- Cloud computing currently has a security problem in the public eye and thus a problem with acceptance.
- Legal requirements and certifications for data protection and IT security:
  - BDSG / EU-DSGVO: Bundesdatenschutzgesetz, EU Data Protection
  - TKG: Telekommunikationsgesetz
  - TMG: Telemediengesetz
  - BSI: Bundesamt für Sicherheit in der Informationstechnologie (BSI Grundschutz)
  - ISO 27001: Information security management
  - ISO 18028: IT-Sicherheitsverfahren
- Additional sources:
  - Legal requirements for cloud computing, IT summit http://www.eurocloud.de/wp-content/blogs.dir/5/files/anford_recht_beicloudcomputing_v1.pdf
- Cloud Security Alliance: https://cloudsecurityalliance.org

20.07.2009

E-Reader Kindle

SPIEGEL ONLINE

**Amazon löscht digitale Exemplare von "1984"**

**Amazon löscht Eigentum seiner Kunden: Ausgerechnet die Orwell-Bücher "1984" und "Farm der Tiere" verschwanden aus dem Speicher von Kindle-Lesegeräten, obwohl deren Besitzer sie gekauft und bezahlt hatten. Ein Lehrstück über Macht und Rechte im Zeitalter totaler Vernetzung.**

FINANCIAL TIMES
DEUTSCHLAND

Cloud-Computing

**Die Wolke des Grauens**

**Sie soll der IT-Branche Milliardenerlöse bescheren. Doch viele Kunden schlagen sich mit Sicherheitsbedenken herum und zögern mit dem Umzug in die Datenwolke. Der Aufbau von Vertrauen dauert - und internationale Gütesiegel fehlen.** *von Annika Graf, Hamburg*

5.3.2012, http://www.ftd.de/it-medien/medien-internet/:cloud-computing-die-wolke-des-grauens/70003428.html

# Cloud Computing and security.

Example: Storing videos in AWS (Amazon Web Services)

- Access by government authorities to data stored in clouds of domestic companies abroad has long been a controversial issue.
- CLOUD Act (Clarifying Lawful Overseas Use of Data Act)
- Foreign authorities should also have access to US servers under the same conditions.
- Who owns the data and who has access to it?

- In this case, the data is stored in encrypted form on AWS.

IT Mobiles Entertainment Wissen Netzpolitik Wirtschaft Journal

TOPTHEMEN: ARTIKEL 13 ELEKTROAUTO DSGVO WINDOWS 10 ANDROID KI

heise online › News › 03/2019 › Bundespolizei speichert Bodycam-Aufnahmen in Amazons AWS-Cloud

03.03.2019 13:07 Uhr

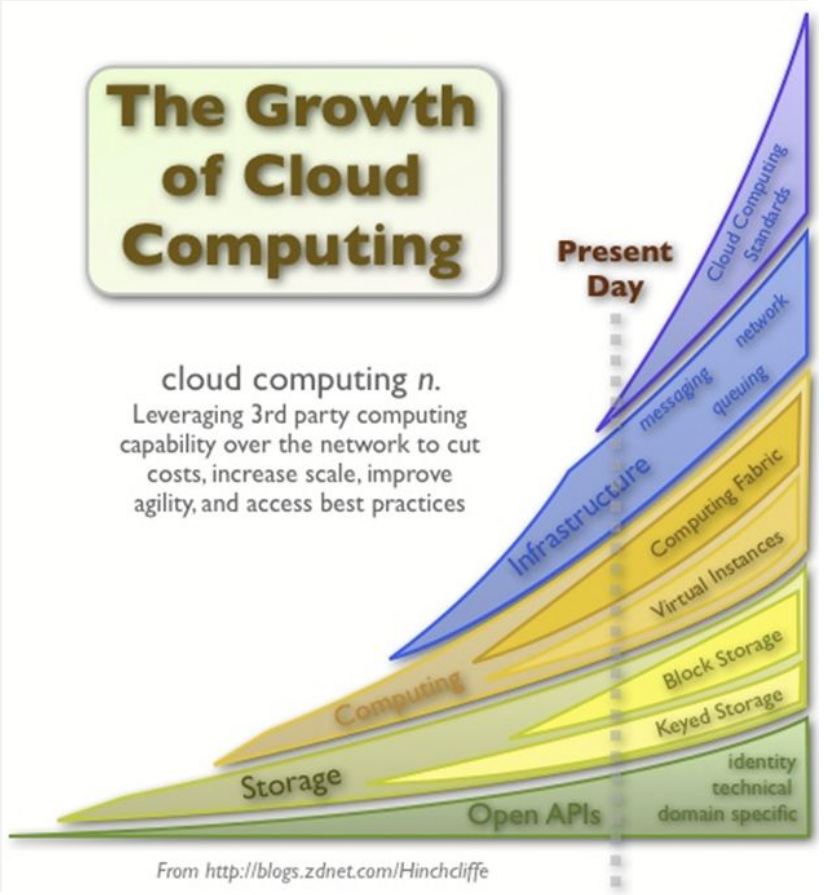
**Bundespolizei speichert Bodycam-Aufnahmen in Amazons AWS-Cloud**

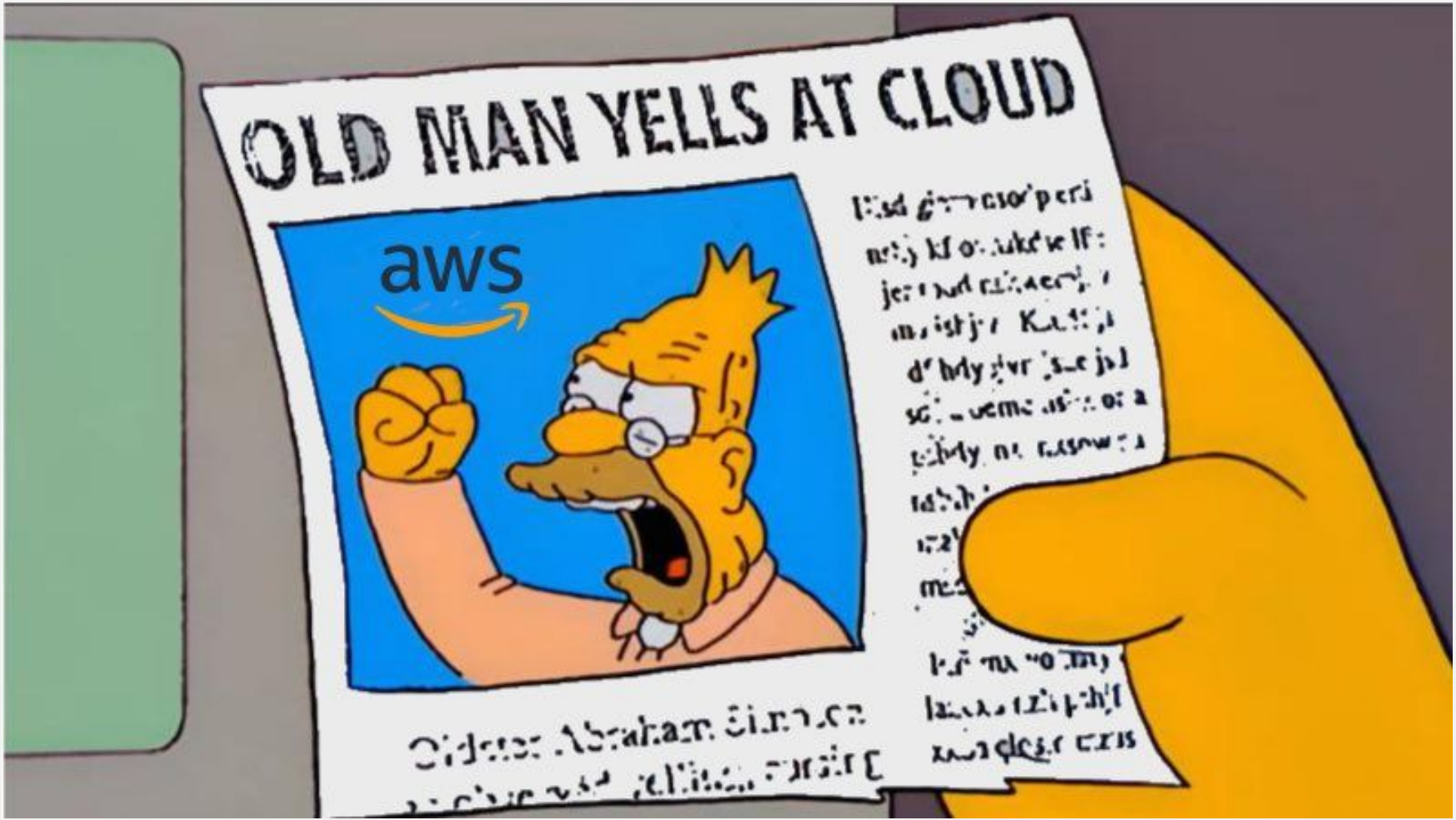
**Eine FDP-Anfrage ergab, dass die Bundespolizei Aufnahmen auf Amazon-Servern in Deutschland speichert. Einen anderen zertifizierten Anbieter gebe es nicht.**

Von Tilman Wittenhorst 256

# What can we expect?

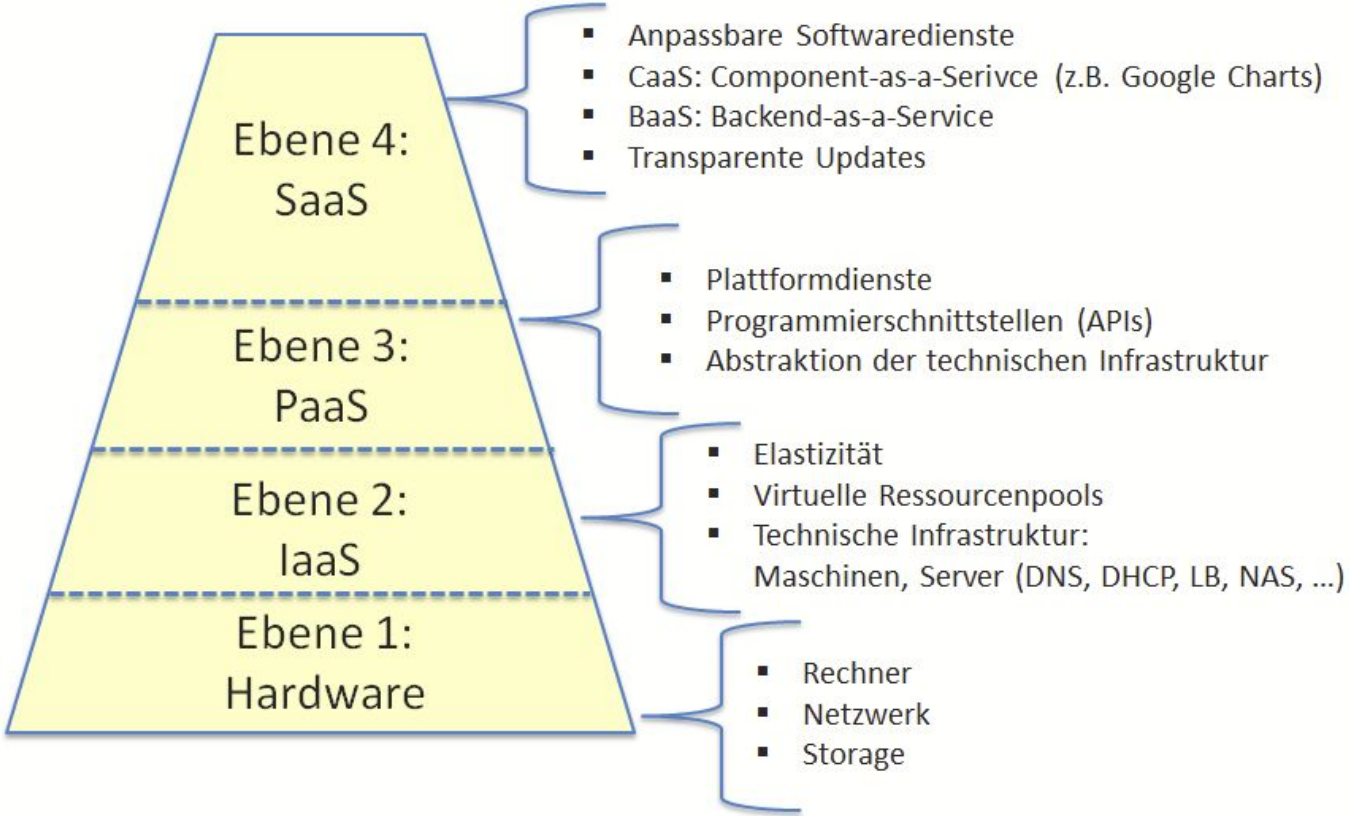
- Sharply falling prices for cloud computing.
- Standardization and open interfaces.
- Commodification of the cloud
- Technological expansion
    - Infrastructure capacities
    - Platform services
    - Processing patterns




OLD MAN YELLS AT CLOUD
aws

# ?aaS-Quiz!

# Das Schichtenmodell des Cloud Computing: Vom Blech zur Anwendung.



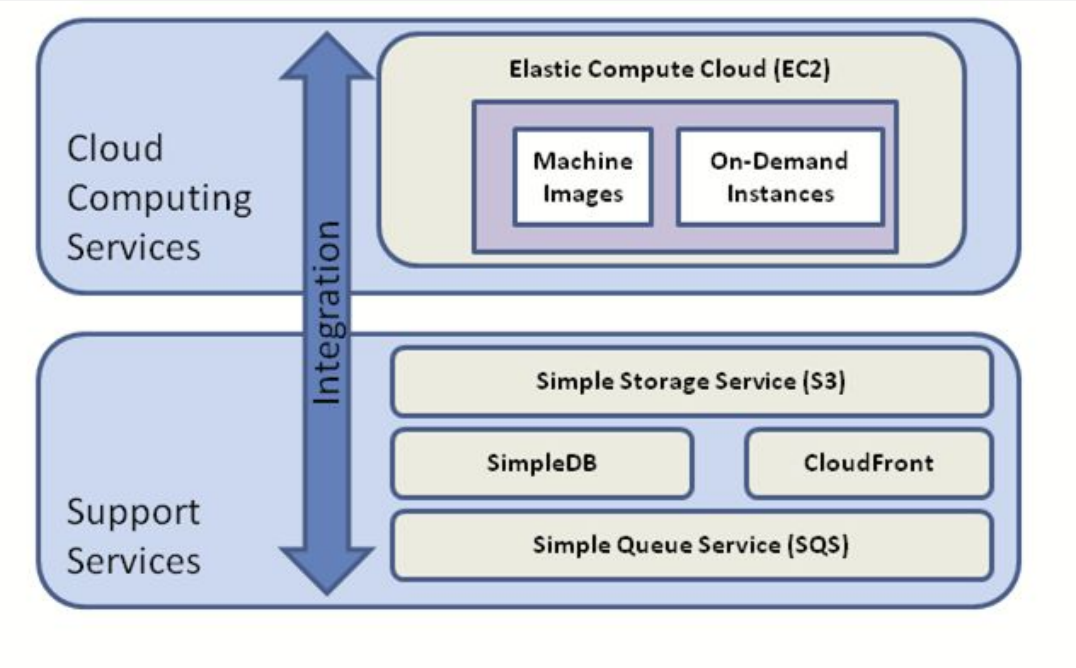

**Zielgruppe: User**

**Zielgruppe: Entwickler**

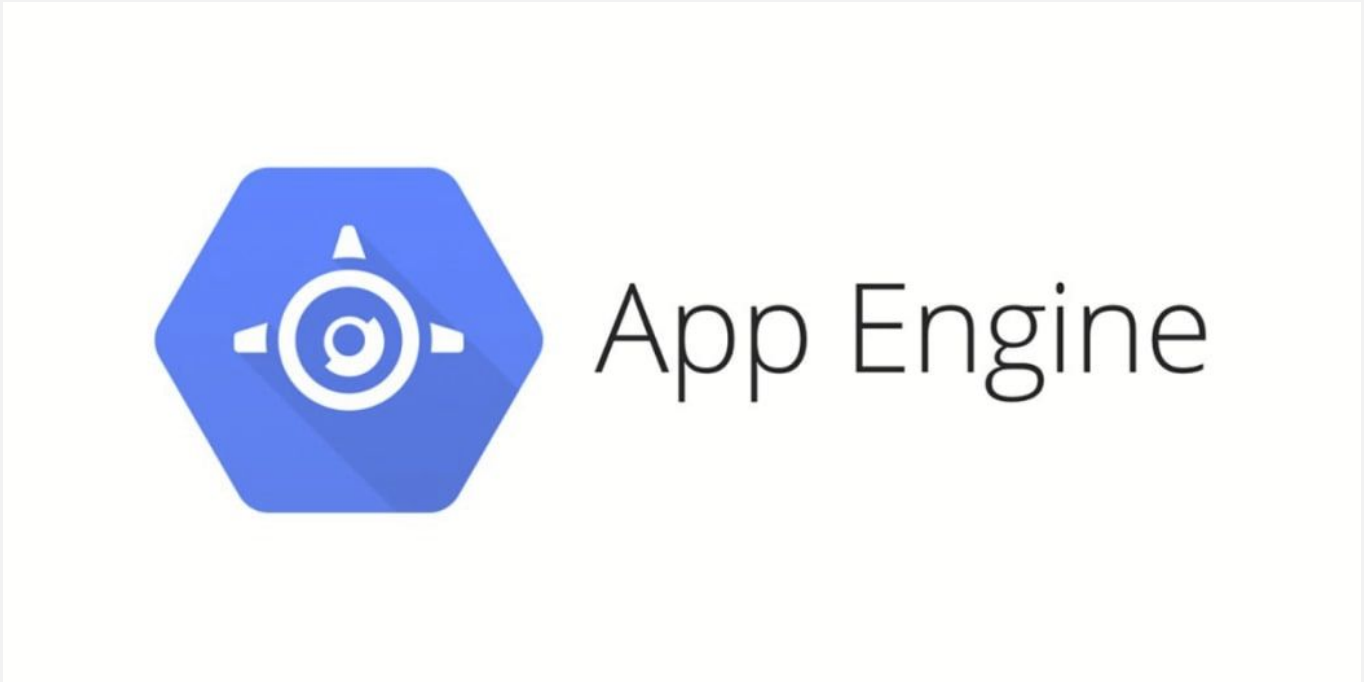
**Zielgruppe: Betrieb**

# Amazon Kindle

# Amazon EC2


Cloud
Computing
Services
Elastic Compute Cloud (EC2)
Machine
Images
On-Demand
Instances
Integration
Support
Services
Simple Storage Service (S3)
SimpleDB
CloudFront
Simple Queue Service (SQS)

# Google App Engine



# Dropbox

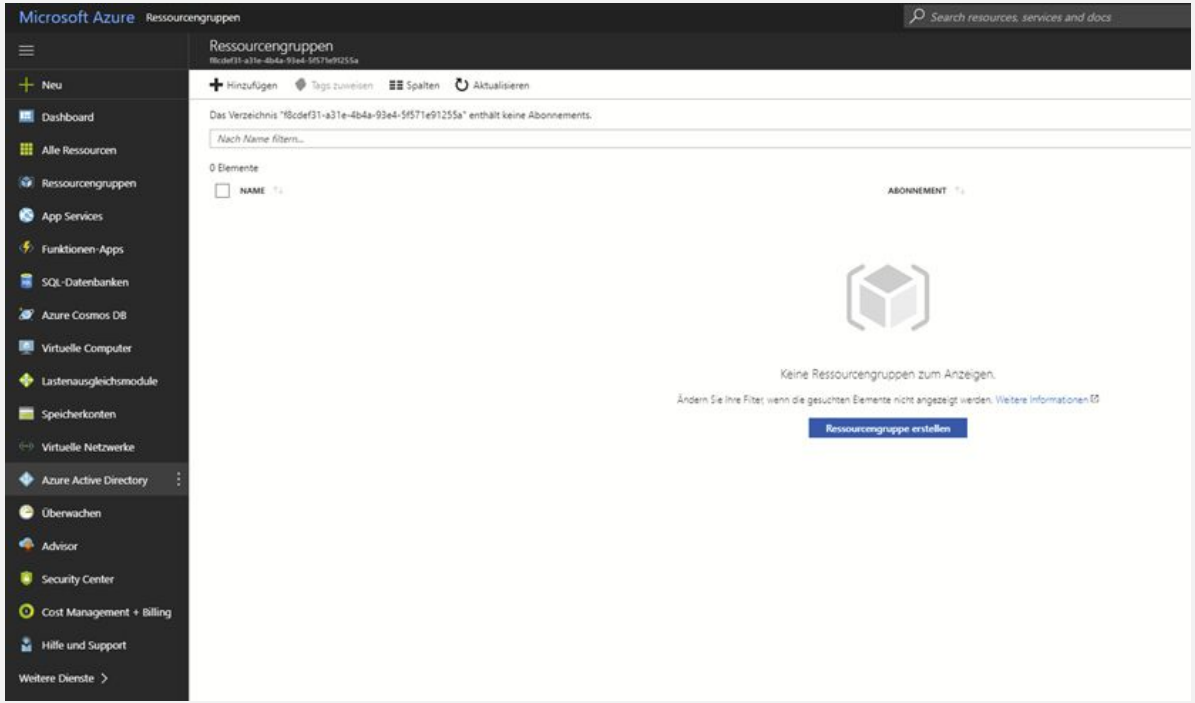
## Was ist Dropbox?

*"Deine Projekte, immer und überall."*

Dropbox ist ein kostenloser Service, mit dem du deine Fotos, Dokumente und Videos immer zur Hand hast. Das bedeutet, dass jede Datei in deiner Dropbox automatisch auf all deinen Computern, Telefonen und sogar der Dropbox-Website gespeichert wird.

Auch die Freigabe von Dateien ist mit Dropbox ein Kinderspiel - für Studenten, Eltern, Großeltern oder im Büro. Und falls du einmal versehentlich deinen Kaffee über deinen Laptop schüttest: nur keine Panik! Dropbox ist dein Retter in der Not und sorgt dafür, dass deine Dateien niemals verloren gehen.

# Microsoft Azure.



# Spotify

Search
Sara Chin
MAIN
Browse
Activity
Radio
YOUR MUSIC
Songs
Albums
PLAYLIST
Discover Weekly
Your weekly mix of discoveries and deep cuts, picked just for you. Updated every Monday, so save your favourites!
Created by: Spotify • 30 songs, 2 hr 04 min
PLAY
FOLLOWING
FOLLOWERS
Filter
SONG
ARTIST
ALBUM
All My Friends
Dylan Kelly
All My Friends
Brandon Flowers
Can't Deny My Love
Ben Khan
1000
Abrasive
That's Love - Single
Spotify®
Discover Weekly
FOLLOWING
BY SPOTIFY
SHUFFLE PLAY
Available Offline
All My Friends
Dylan Kelly • All My Friends
Can't Deny My Love
Brandon Flowers • Can't Deny My Love
1000
Ben Khan • 1000
What You Want

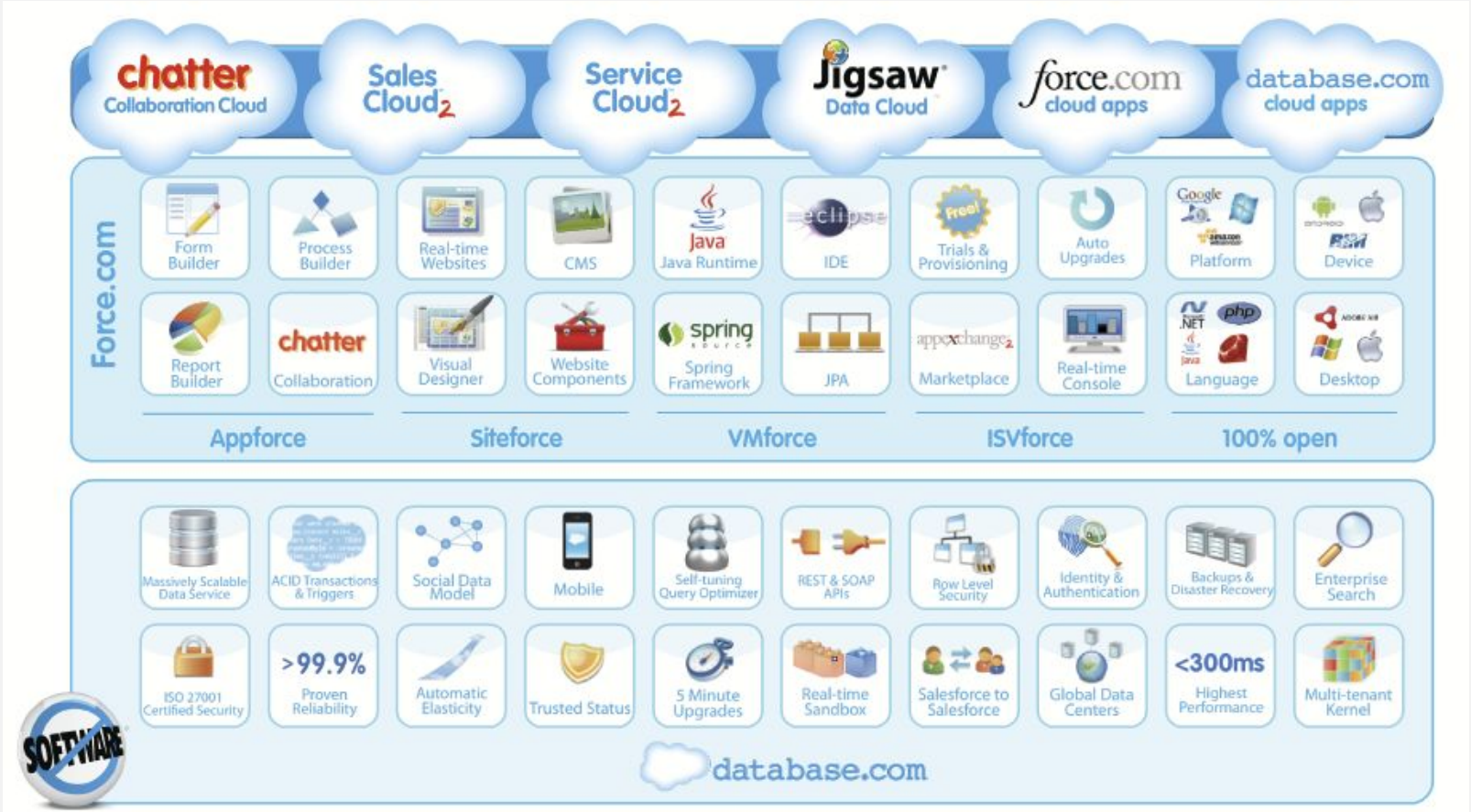
# Cloud Testing.

BlazeMeter™
THE JMETER CLOUD

WHAT IS BLAZEMETER?

BlazeMeter is a 100% JMeter-compatible, self-service load testing cloud. Instantly generate massive stress tests with comprehensive reporting and analysis tools.

# Salesforce


chatter
Collaboration Cloud
Sales Cloud 2
Service Cloud 2
Jigsaw
Data Cloud
force.com
cloud apps
database.com
cloud apps
Force.com
Form Builder
Process Builder
Real-time Websites
CMS
Java
Java Runtime
eclipse
IDE
Free!
Trials & Provisioning
Auto Upgrades
Google
Platform
Device
Report Builder
chatter
Collaboration
Visual Designer
Website Components
spring
Spring Framework
JPA
appexchange
Marketplace
Real-time Console
.NET
php
Language
Desktop
Appforce
Siteforce
VMforce
ISVforce
100% open
Massively Scalable Data Service
ACID Transactions & Triggers
Social Data Model
Mobile
Self-tuning Query Optimizer
REST & SOAP APIs
Row Level Security
Identity & Authentication
Backups & Disaster Recovery
Enterprise Search
ISO 27001 Certified Security
>99.9%
Proven Reliability
Automatic Elasticity
Trusted Status
5 Minute Upgrades
Real-time Sandbox
Salesforce to Salesforce
Global Data Centers
<300ms
Highest Performance
Multi-tenant Kernel
database.com
SOFTWARE

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