



# Cloud Native Softwarearchitektur

# Walmart

## Supercentre



Enter

Exit

Low Prices  
\$2



# 2002



QA/WARE

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Search Entire Site for:  [Find](#)

**Roses on Rollback! One Dozen Fresh-Cut, Long-Stem Roses Only \$24.88**

**Home Page**

- Electronics**
  - Computers & Printers
  - Internet Service
  - TV, DVD & Video
  - More...
- Photo**
  - Digital Cameras
  - Camcorders
  - Photo Center
  - More...
- Movies** 12,000 Movies!
- Music** 80,000 CDs!
- Books** 500,000 Titles!
- Video Games**
  - PS2
  - Xbox
  - More...
- Toys**
  - Outdoor Play
  - Rides & Scooters
  - More...
- Baby & Baby Registry**
  - Shop by Age or Stage
- Home**
  - Furniture
  - Appliances
  - Bed & Bath
  - More...
- Garden & Hardware**
  - Patio & Grilling
  - Lawn Equipment
  - Home Improvement
  - More...
- Tires**
- Sporting Goods**
  - Exercise & Hot Tubs
  - Camping & Hiking
  - More...
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**Find 300,000 Textbooks**  
Every Day Low Prices

Find it by [ISBN](#) or [category](#).

- Business
- Education
- Test Prep
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- Engineering
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**Furnish the Dorm**

Find the desk that fits your living space and study habits. [See all desks.](#)

Sleep well with our low prices on bedding. [See all college bedding.](#)

Make dorm life easier with refrigerators, dishwashers and more. [See all small appliances.](#)

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Low prices on [notebook PCs](#) and [printers](#)

Get online for only \$9.94 a month

Call anytime for as low as \$5 a month

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**Video Games Gallery**

[PlayStation 2](#)  
[GameCube](#)  
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[See More](#)

**Back To College**

[Portable Electronics](#)  
[Cameras](#)  
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**K-12**

[Clothing](#)  
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Warenkorb


Registrierung

Kategorien

Artikel


Dienste

# 2008


Walmart  Free Shipping with **site to store**  
Store Finder **Local Ad** Top Products Sign In/New Track Orders



See All Departments Search

Apparel & Jewelry  
Baby  
Books, DVDs & MP3s  
Electronics  
For the Home  
Gifts & Registries  
Grocery  
Health & Beauty  
Outdoor Living  
Pharmacy  
Photo  
Sports & Fitness  
Toys & Video Games  
In Stores Now  
See All Departments

**GREAT VALUE, NEW PRODUCTS**  
Download Flash Player version 7 or later for the ultimate Walmart.com shopping experience.  


**Blu-ray Price Drop**  
★★★★★ Magnavox from \$258  
Sony  
Samsung  
See all:  
[Blu-ray Players](#)

**50% Off Top 50 Books**  
  
The 50 top sellers are 50% off — get great reads for the whole family, from \$4.  
Shop:  
[50% Off Top 50 Books](#)

**Save on Top-Brand Electronics**  
  


INTERNET ARCHIVE  
**WayBack Machine**  
[http://ad.yieldmanager.com/st?ad\\_type](http://ad.yieldmanager.com/st?ad_type)

**Savings Add Up**  
[Clearance](#)  
[Rollbacks](#)  
[\\$4 Prescriptions](#)  
[Video Games Under \\$20](#)  
[Clearance on Baby Items](#)

**What's New**  
[Classifieds](#)  
[Halloween](#)  
[Elevenmoms](#)  
[Better Homes](#)


Zusätzliche  
Dienste



QA|WARE



# 2011

**Walmart**   
Save money. Live better.

Shop for College 2011

New customer? [Sign In](#) | [Help](#)

[Value of the Day](#) | [Local Ad](#) | [Store Finder](#) | [Registry](#) | [Gift Cards](#) | [Track My Orders](#) | [My Account](#) | [My Lists](#)









Search   [My Cart](#) [Choose My Store](#)

### See All Departments

- Electronics & Office >
- Movies, Music & Books >
- Home, Furniture & Outdoor >
- Apparel, Shoes & Jewelry >
- Baby & Kids >
- Toys & Video Games >
- Sports & Fitness >
- Auto & Home Improvement >
- Photo >
- Crafts & Party Supplies >
- Pharmacy, Health & Beauty >
- Grocery & Pets >
- College 2011

### Must-Have College Essentials at Can't-Miss Prices

**COLLEGE 2011**

<b>Bedding</b> from <b>\$35</b> 	<b>Futons &amp; Sofas</b> from <b>\$99</b> 	<b>Storage</b> from <b>\$19</b> 	<b>Desks</b> from <b>\$39</b> 
 <b>Laptops &amp; Netbooks</b> from <b>\$278</b>	 <b>Appliances</b> from <b>\$57</b>	 <b>TVs</b> from <b>\$149</b>	 <b>iPods</b> from <b>\$49</b>

[Shop for College 2011](#)

### Back to School Essentials

From uniforms to supplies, find everything for school at Every Day Low Prices.

[School Supplies](#)  
[Uniforms](#)

### Have Your Fun in the Sun

Enjoy hot summer savings on everything you'll need for some outdoor family fun.

[Pools & Waterslides](#)  
[Swing Sets](#)  
[Trampolines](#)


### Save Big Now


- Amazing Xbox 360 Savings
- Best-Selling Bikes from \$79
- Fragrances from \$5
- Furniture Rollbacks
- Save 10¢ per Gallon on Gas


### What's New


- Captain America Is Here
- HP Dandelion Breeze Laptop
- Summer Fun


### In the Spotlight


**NEW**  **Watch New Releases Instantly**


 **Digital Movies**


 **Watch New Releases Instantly**


 **Digital Movies**


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
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
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
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
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
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
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# Bad News



QA|WARE

## CHALLENGE

Four years ago, the Walmart Global eCommerce system was a monolithic application, deployed once every 2 months. This represented an unsustainable rate of innovation given the competitive climate. Walmart recognized the need to fundamentally transform technology delivery to compete in the Digital Economy.

Walmart auf <http://www.oneops.com>

- "[...] it was unable to scale for 6 million pageviews per minute and was down for most of the day during peak events."
- "This is the multi-million dollar question which the IT Department of Walmart Canada had to address after they were failing to provide to their users on Black Fridays for two years in a row."

<https://blog.risingstack.com/how-enterprises-benefit-from-microservices-architectures>

Lange Zyklen von Dev-to-Prod.

Mangelnde Skalierbarkeit.

Mangelnde Elastizität.

# 2016



QA|WARE

Zusätzliche  
Dienste.

The screenshot displays the Walmart website interface. At the top, the Walmart logo is visible alongside navigation links for Gift Cards, Registering, Links, Weekly Ads, Store Finder, Track Order, Credit Card, and Help. A search bar is positioned next to the logo. Below the navigation bar, there are links for All Departments, Daily Savings Center, My Local Store, Pick it up TODAY, and Tips & Ideas. A prominent banner for 'Rollbacks on iPad Air' offers \$100 off 16GB & 32GB WiFi models, with a 'Shop Now' button. Below this, a banner for the 'Walmart Browser App' encourages users to download it. The 'Featured products' section lists several items with their prices and savings:

- 1799.00 (was 1100.00) Save \$69.00: HP Elite Pad 13.6" 15-172wm Laptop...
- 135.00: Google Chromecast
- 1321.76: LG Black Chromebase XL-in-One
- 1194.24: Lenovo Black 11.6" 1021 Chromebook PC...
- 1276.05 (was 1200.00) Save \$23.55: ASUS Black 15.6" K551M4-4301-413...

Below the featured products, there is a 'Breakfast-hunting SAVINGS' section with a 'Shop Now' button. To the right, a detailed product view for a George Foreman grill is shown, including a price of \$49.99 (was \$59.99), a 'FREE shipping on orders \$35 +', and options for 'Add to Cart', 'Add to Registry', and 'Add to List'. A 'Shipping' section indicates 'FREE pickup' is available. Below the product view, a 'Customers also viewed these products' section lists several other items with their prices and savings.

# Good News



QA|WARE

1000 Deployments pro Tag ...  
... durch die Entwickler

~ 100% Verfügbarkeit

Neue Geschäftsmodelle, Anwendungen  
und Geräte ( IoT, mobile, APIs)

Ressourcen Sparsamkeit

Elastische Skalierbarkeit

## RESULTS

Today the Walmart eCommerce platform is hosted in some of the largest OpenStack clouds and is managed exclusively via OneOps. On a typical day there are now over 1,000 deployments, executed on-demand by development teams, each taking only minutes on average to complete.

Walmart auf <http://www.oneops.com>

"They wanted to prepare for the world by 2020, with 4 billion people connected, 25+ million apps available, and 5.200 GB of data for each person on Earth. Walmart replatformed [...] with the intention of achieving close to 100% availability with reasonable costs."

<https://blog.risingstack.com/how-enterprises-benefit-from-microservices-architectures>

- "In fact, the organization reports that some 3,000 engineers [...] drive 30,000 changes per month to Walmart software."
- "Those new applications, which span everything from mobile devices to the Internet of things (IoT), are crucial weapons in a global e-commerce contest that pits Walmart against the likes of Amazon and Alibaba, as well as a host of other rivals that are emerging as the cost of entry into the online retail sector continues to decline in the age of the API economy."

<http://www.baselinemag.com/enterprise-apps/walmart-embraces-microservices-to-get-more-agile.html>

- "The Walmart [...] servers [...] were able to handle all mobile Black Friday traffic with about 10 CPU cores and 28Gb RAM."
- "On Thanksgiving weekend, Walmart servers processed 1.5 billion requests per day. 70 percent of which were delivered through mobile."

<http://techcrunch.com/2014/12/02/walmart-com-reports-biggest-cyber-monday-in-history-mobile-traffic-at-70-over-the-holidays>

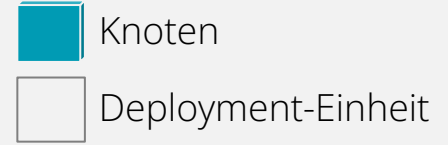




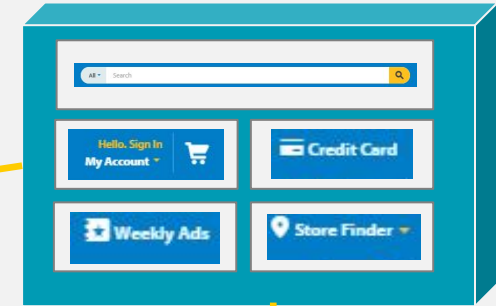
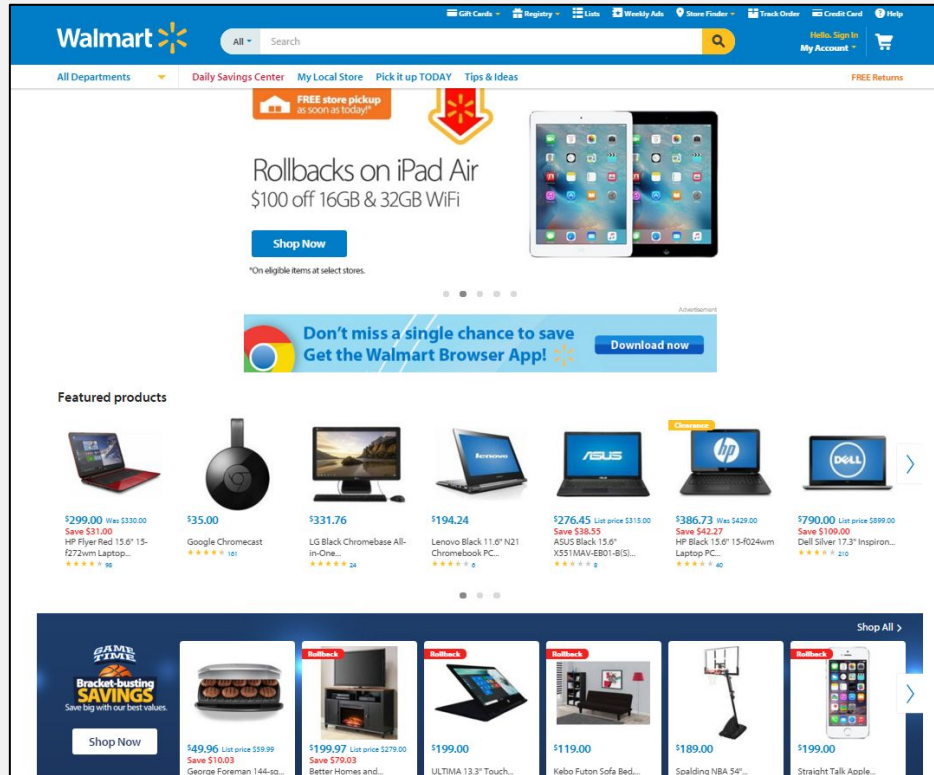
WHAT DID THEY DO?



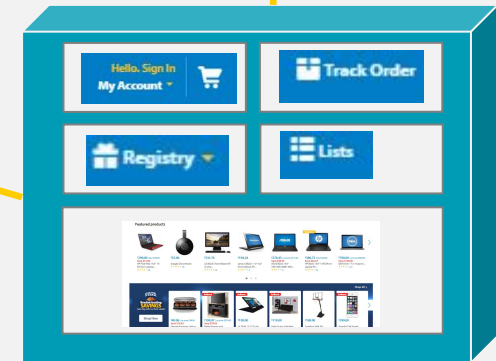
# Von Betriebsmonolithen ...



# ... zu Betriebskomponenten



Skalieren durch  
Verteilung und Klonen



# Cloud Native Application Development: Components All Along the Software Lifecycle



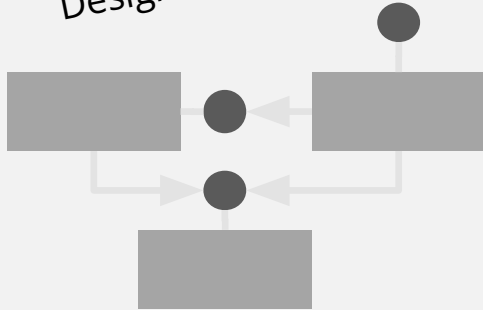
DESIGN

BUILD

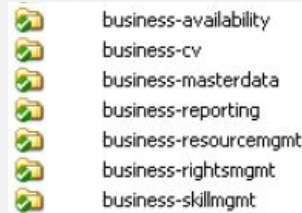
RUN

NEW!

Design Components



Dev Components



Ops Components



1:1

n:1

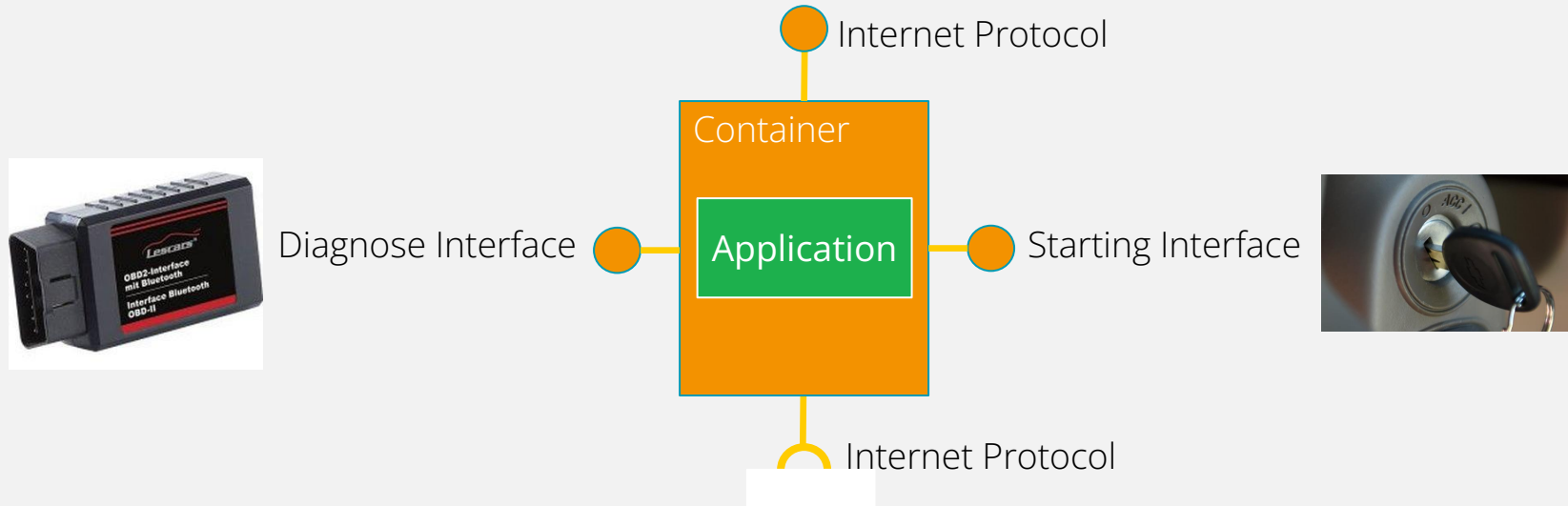
- Complexity unit
- Data integrity unit
- Coherent and cohesive features unit
- Decoupled unit

- Planning unit
- Team assignment unit
- Knowledge unit
- Development unit
- Integration unit

- Release unit
- Deployment unit
- Runtime unit (crash, slow-down, access)
- Scaling unit



# Die Anatomie einer Betriebs-Komponente



# Dev Components

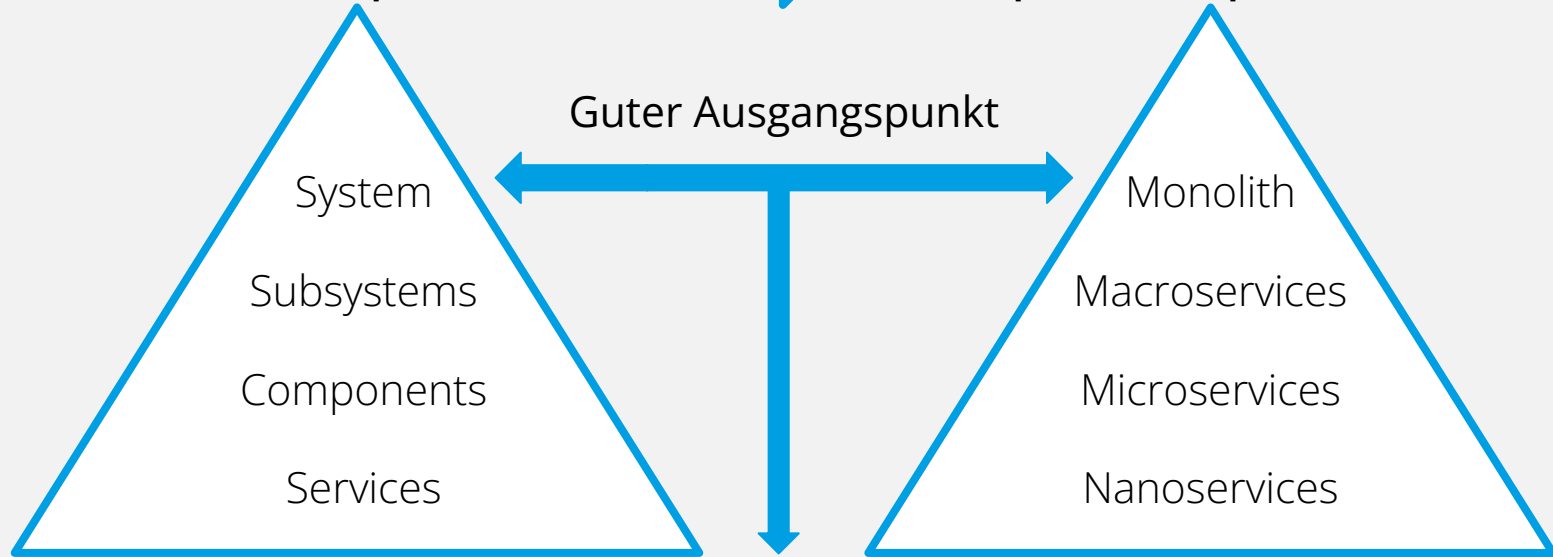


# Ops Components



QA|WARE

Guter Ausgangspunkt



## Decomposition Trade-Offs

- |   |   |
|---|---|
| + More flexible to scale                    | - Distribution debt: Latency            |
| + Runtime isolation (crash, slow-down, ...) | - Increasing infrastructure complexity  |
| + Independent releases, deployments, teams  | - Increasing troubleshooting complexity |
| + Higher utilization possible               | - Increasing integration complexity     |

# Regel #1 für den Betrieb in der Cloud



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*"Everything fails all the time."*

— Werner Vogels, CTO of Amazon



# Regel #2 für den Betrieb in der Cloud

Soll nur der Himmel die Grenze sein, dann funktioniert nur horizontale Skalierung.





# Regel 3 für den Betrieb in der Cloud



QAWARE

Wer in die Cloud will, der sollte Cloud sprechen.

TCP

HTTP

DHCP

DNS

# Die 5 Gebote der 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 cattles, not as pets



Quelle: [https://de.wikipedia.org/wiki/Zehn\\_Gebote](https://de.wikipedia.org/wiki/Zehn_Gebote)

# Eight fallacies of distributed computing



# Cloud-Architektur aus Sicht der Softwarearchitektur: Design for Failure.

- Jede Komponente läuft eigenständig und isoliert Betriebskomponenten
- Die Betriebskomponenten kommunizieren untereinander über Internet-Protokolle □ HTTP, UDP, ...
- Jede Betriebskomponente kann in mehreren Instanzen laufen und bietet damit Redundanz. Es gibt keinen „Common Point of Failure“. Cluster Orchestrator
- Jede Betriebskomponente besitzt Diagnoseschnittstellen um ein fehlerhaftes Verhalten erkennen zu können
- Jeder Microservice kann zu jeder Zeit neu gestartet und auf einem anderen Knoten in Betrieb genommen werden. Er besitzt keinen eigenen Zustand.
- Die Implementierung hinter einem jeden Microservice kann ausgetauscht werden, ohne dass die Nutzer davon etwas bemerken.



# Betriebskomponenten benötigen eine Infrastruktur um sie herum: Eine Micro-Service-Plattform.

## Typische Aufgaben:

- Authentifizierung
- Load Shedding
- Load Balancing
- Failover
- Rate Limiting
- Request Monitoring
- Request Validierung
- Caching
- Logging

## Typische Aufgaben:

- HTTP Handling
- Konfiguration
- Diagnoseschnittstelle
- Lebenszyklus steuern
- APIs bereitstellen

## Typische Aufgaben:

- Metriken sammeln
- Logs sammeln
- Trace sammeln

## Typische Aufgaben:

- Service Discovery
- Load Balancing
- Circuit Breaker
- Request Monitoring

## Typische Aufgaben:

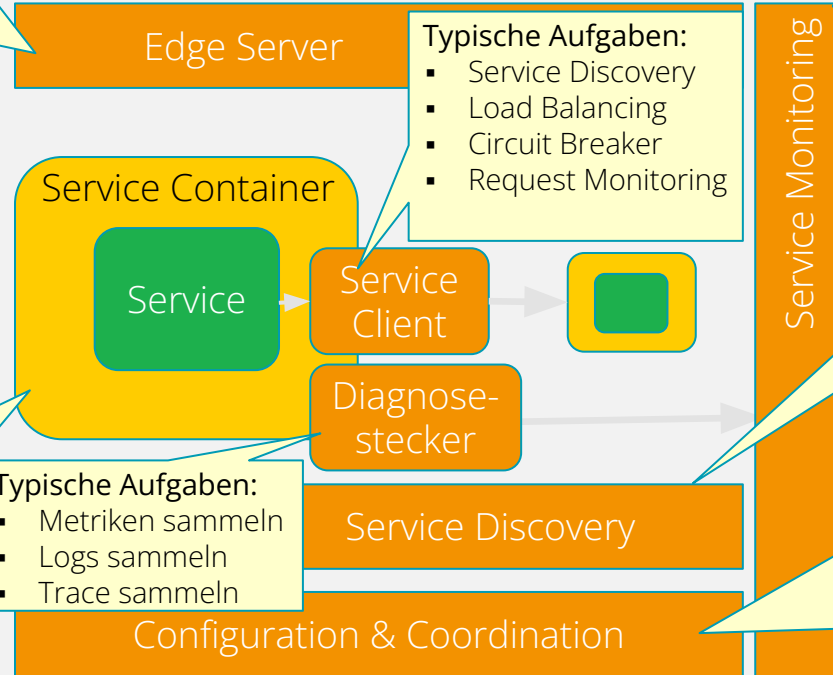
- Aggregation von Metriken
- Sammlung von Logs
- Sammlung von Traces
- Analyse / Visualisierung
- Alerting

## Typische Aufgaben:

- Service Registration
- Service Lookup
- Service Description
- Membership Detection
- Failure Detection

## Typische Aufgaben:

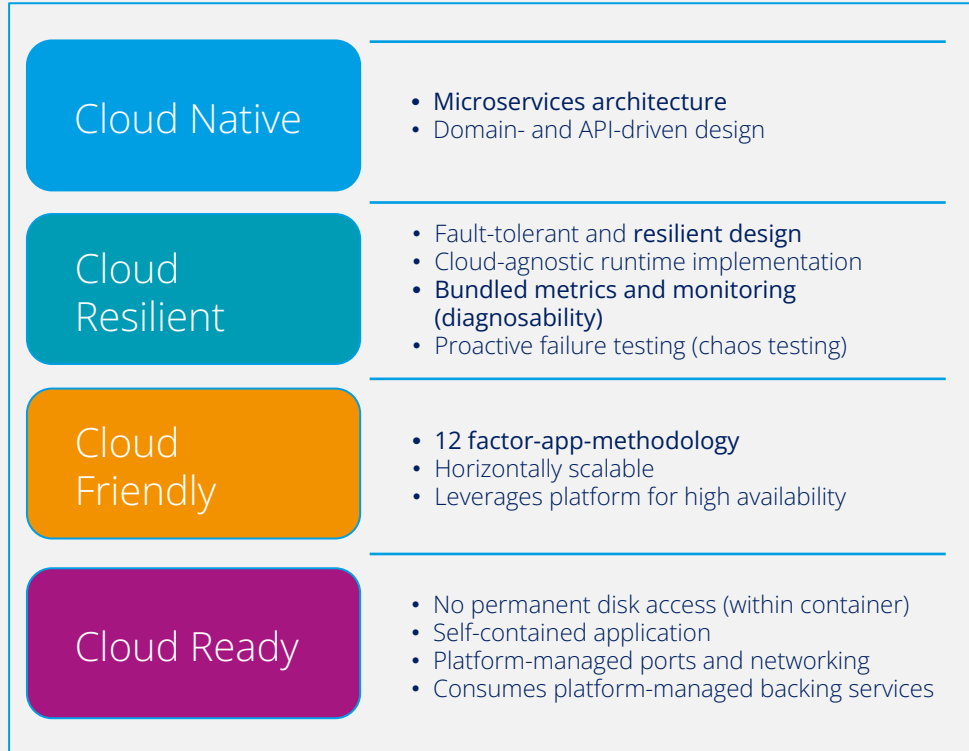
- Key-Value-Store (oft in Baumstruktur. Teilw. mit Ephemeral Nodes)
- Sync von Konfigurationsdateien
- Watches, Notifications, Hooks, Events
- Koordination mit Locks, Leader Election und Messaging
- Konsens im Cluster herstellen



# Das Cloud Native Application Reifegradmodell



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# Übung 1 (20 min): Twelve Factor Apps

# 12 Factor App



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- |  |   |
|--|---|
| <p>1 <b>Codebase</b><br/>One codebase tracked in revision control, many deploys.</p> | <p>7 <b>Port binding</b><br/>Export services via port binding.</p>                                    |
| <p>2 <b>Dependencies</b><br/>Explicitly declare and isolate dependencies.</p>        | <p>8 <b>Concurrency</b><br/>Scale out via the process model.</p>                                      |
| <p>3 <b>Configuration</b><br/>Store config in the environment.</p>                   | <p>9 <b>Disposability</b><br/>Maximize robustness with fast startup and graceful shutdown.</p>        |
| <p>4 <b>Backing Services</b><br/>Treat backing services as attached resources.</p>   | <p>10 <b>Dev/Prod Parity</b><br/>Keep development, staging, and production as similar as possible</p> |
| <p>5 <b>Build, release, run</b><br/>Strictly separate build and run stages.</p>      | <p>11 <b>Logs</b><br/>Treat logs as event streams.</p>  |
| <p>6 <b>Processes</b><br/>Execute the app as one or more stateless processes.</p>    | <p>12 <b>Admin processes</b><br/>Run admin/management tasks as one-off processes.</p>                 |

<https://12factor.net/de/>

<https://www.slideshare.net/Alicanakku1/12-factor-apps>





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# Resilienz

# Resilienz

$$\text{Verfügbarkeit} = \text{MTTF} / (\text{MTTF} + \text{MTTR})$$



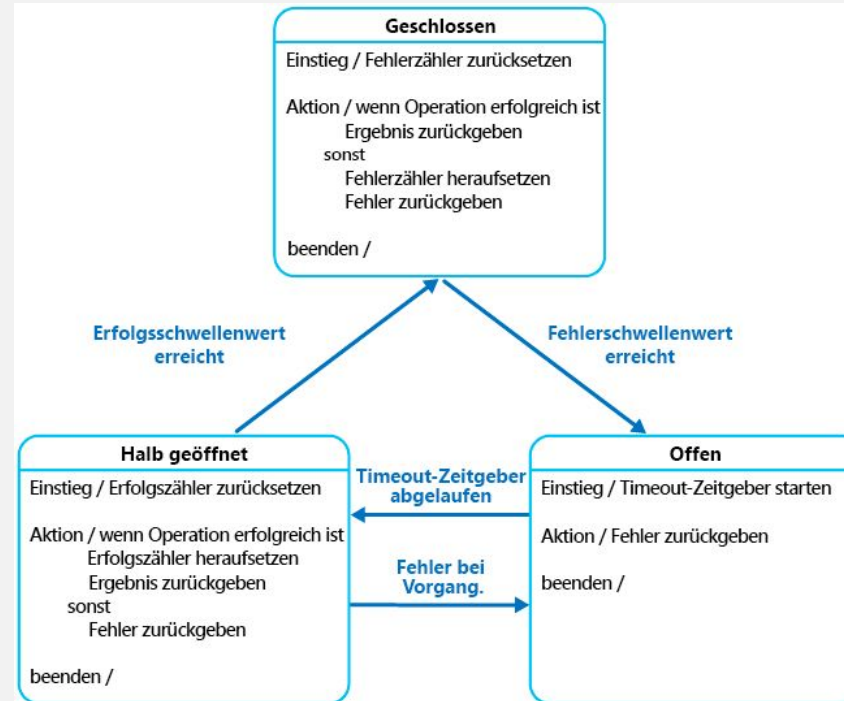
**Resilienz:** Die Fähigkeit eines Systems mit unerwarteten und fehlerhaften Situationen umzugehen

- Ohne dass es der Nutzer merkt (Bestfall)
- Mit ein einer „graceful degradation“ des Services (schlechtester Fall)

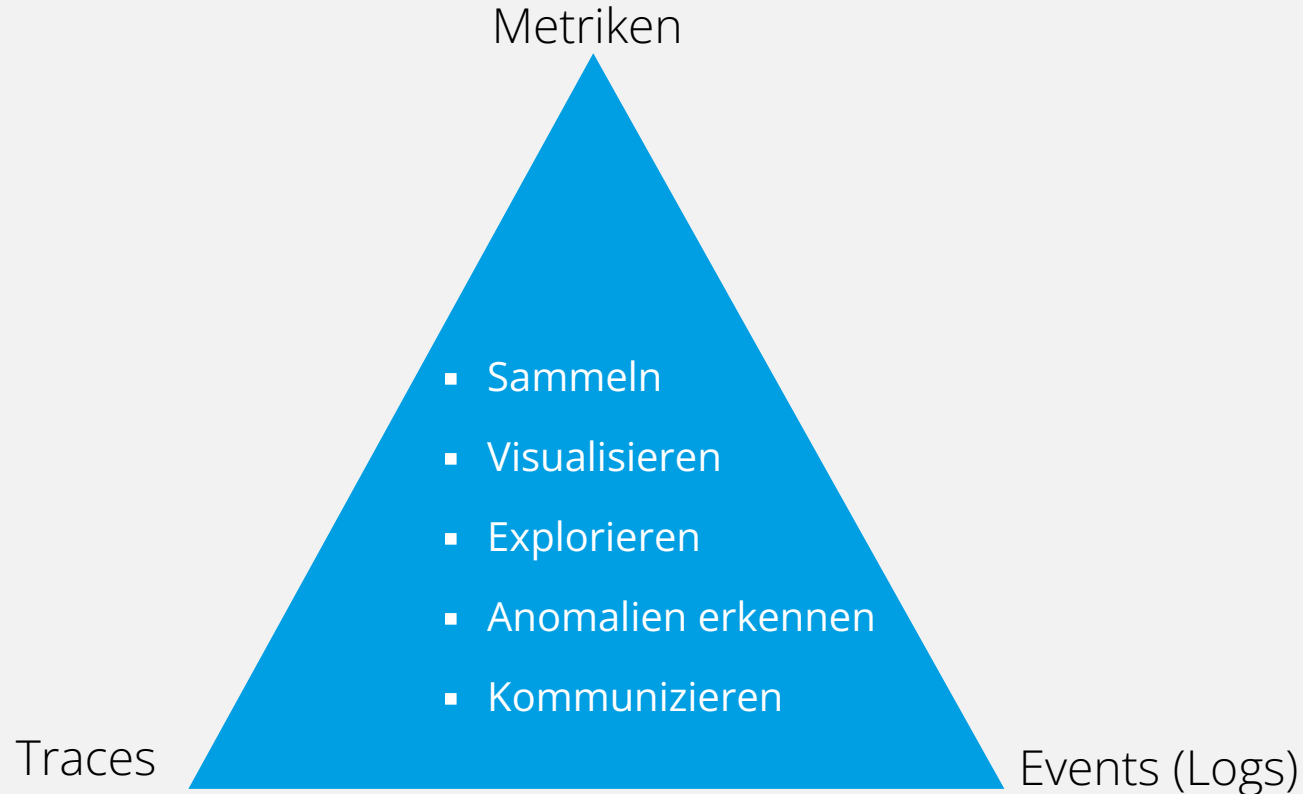
# Resilienz-Pattern: Circuit Breaker



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# Diagnostizierbarkeit

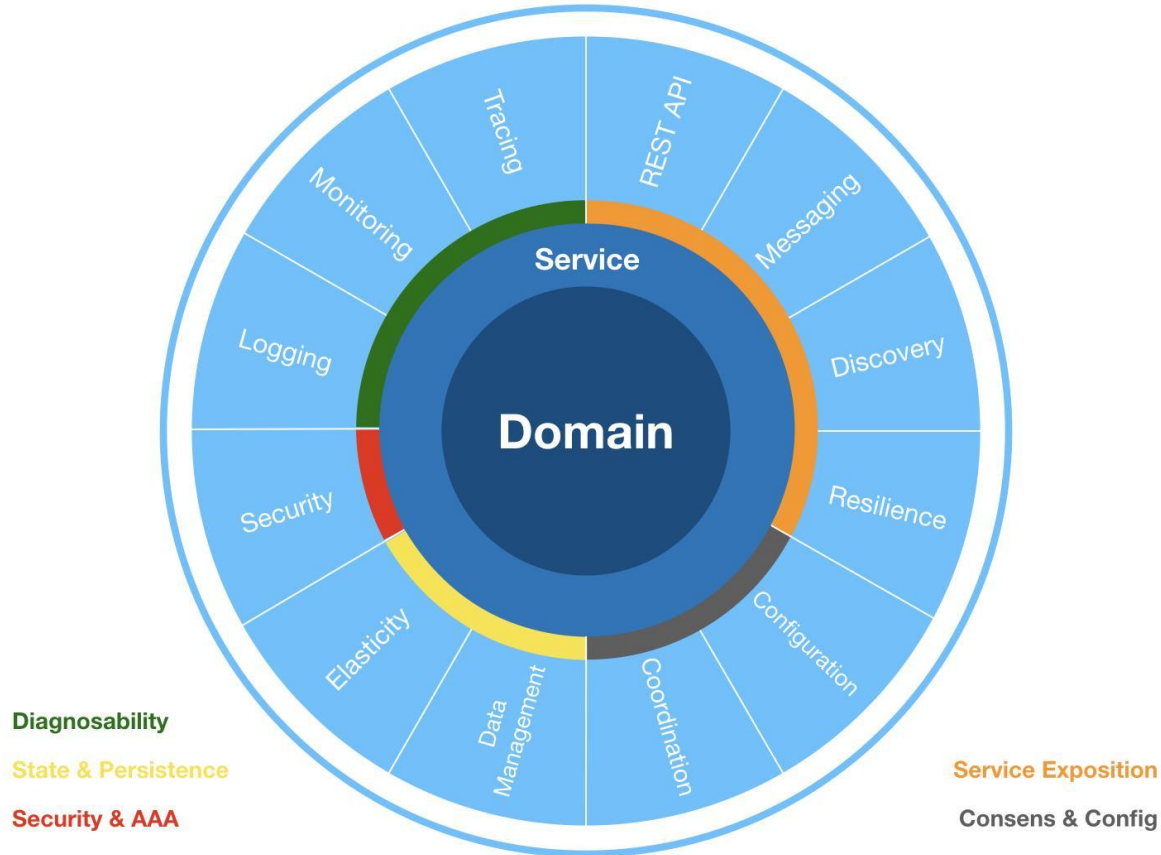




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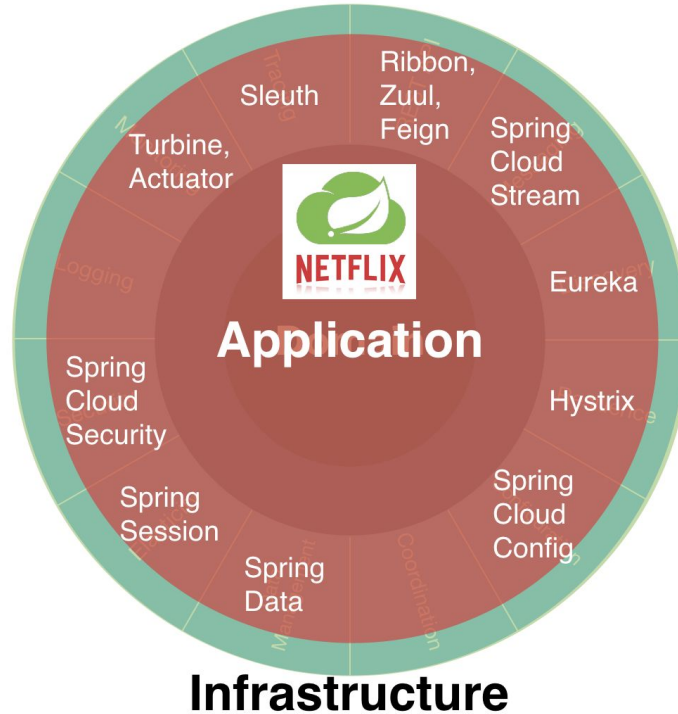
# Technische Aspekte von Microservices

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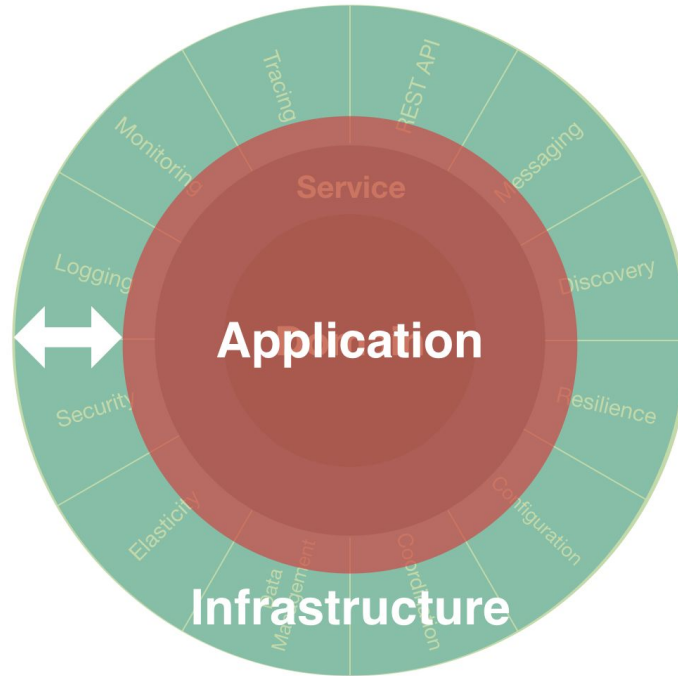




# Technische Aspekte von Microservices: Die Library-Lösung

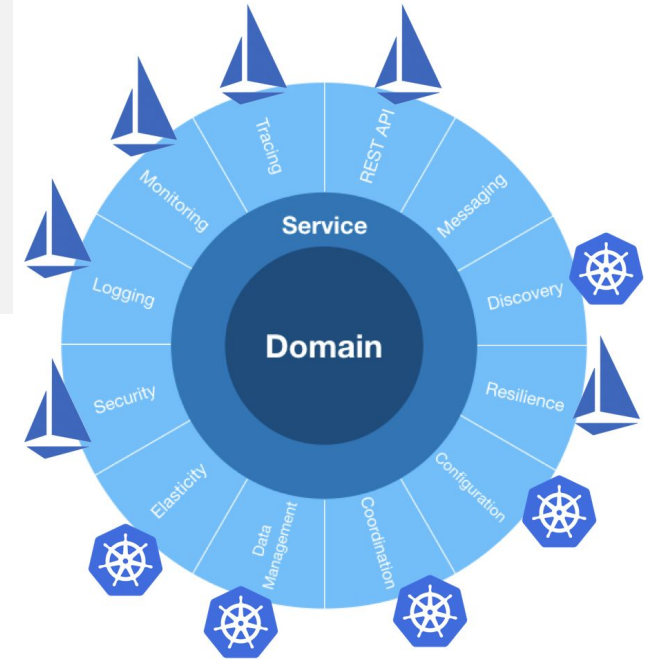
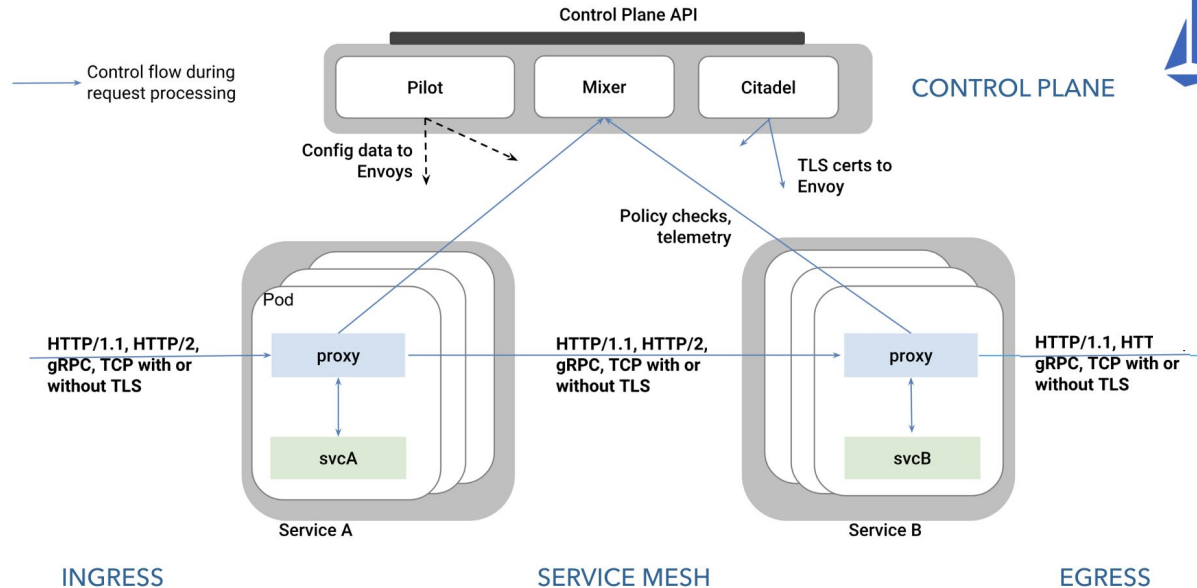


# Technische Aspekte von Microservices: Die Infrastruktur-Lösung



# Istio Service Mesh

- Open-Source-Projekt von Google, IBM, Lyft, RedHat u.A.
- Aufsatz auf Kubernetes, der wichtige technische Aspekte
- auf Infrastruktur-Seite ergänzt



**App Definition and Development**

Database: Veeva, KV, Ceph, Redis, Ignite, Aerospike, BEAR, etc.

Streaming & Messaging: cloudevents, NATS, etc.

Application Definition & Image Build: HELM, etc.

Continuous Integration & Delivery: etc.

**Orchestration & Management**

Scheduling & Orchestration: Kubernetes, etc.

Coordination & Service Discovery: Consul, etcd, etc.

Remote Procedure Call: gRPC, etc.

Service Proxy: Envoy, etc.

API Gateway: etc.

Service Mesh: Linkerd, etc.

**Runtime**

Cloud Native Storage: Rook, etc.

Container Runtime: Docker, etc.

Cloud Native Network: CNI, etc.

**Provisioning**

Automation & Configuration: Ansible, etc.

Container Registry: Harbor, etc.

Security & Compliance: etc.

Key Management: etc.

**Special**

Kubernetes Certified Service Provider: etc.

Kubernetes Training Partner: etc.

**Platform**

Certified Kubernetes - Distribution: etc.

Certified Kubernetes - Hosted: etc.

Certified Kubernetes - Installer: etc.

PaaS/Container Service: etc.

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**Observability and Analysis**

Monitoring: Prometheus, etc.

Logging: fluentd, etc.

Tracing: Jaeger, etc.

Chaos Engineering: etc.

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**Members**

etc.

CLOUD NATIVE Landscape



l.cncf.io

This landscape is intended as a map through the previously uncharted terrain of cloud native technologies. There are many routes to deploying a cloud native application, with CNCF Projects representing a particularly well-traveled path.

CLOUD NATIVE COMMUNITIES FOUNDATION

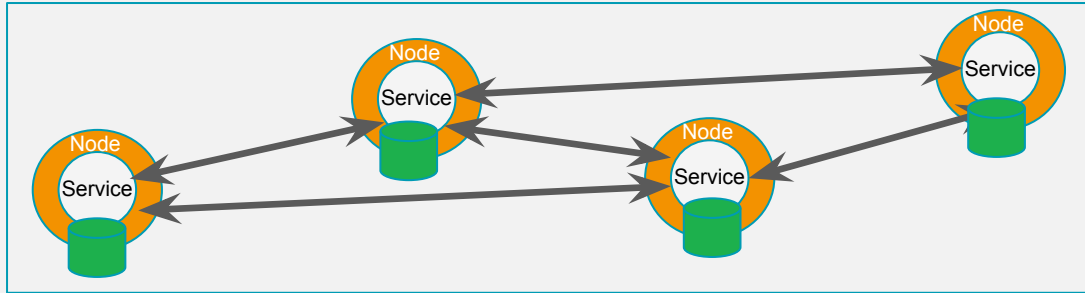
Redpoint Amplify



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# Konfiguration & Koordination: Verteilter Zustand und Konsens

# Ein verteilter Konfigurationsspeicher



Wie wird der Zustand des Konfigurationsspeichers im Cluster synchronisiert?



# Das CAP-Theorem



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Theorem von Brewer für Eigenschaften von zustandsbehafteten verteilten Systemen – mittlerweile auch formal bewiesen. \*

Es gibt drei wesentliche Eigenschaften, von denen ein verteiltes System nur zwei gleichzeitig haben kann:

- Konsistenz (C)
- Verfügbarkeit (A)
- Partitionstoleranz (P)

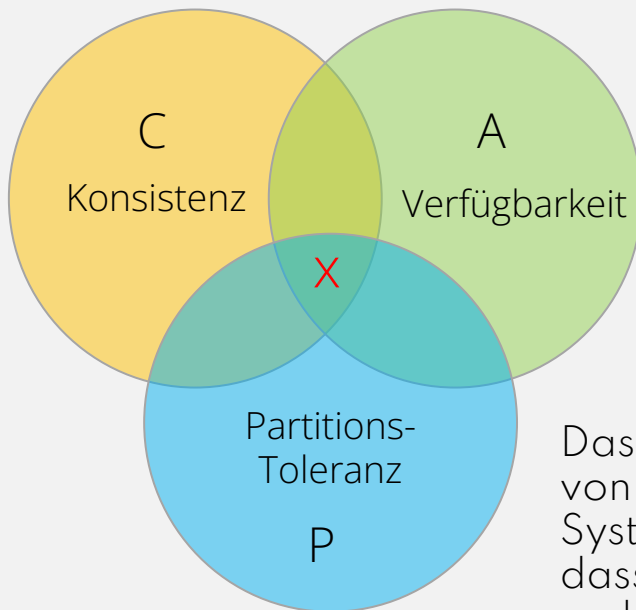
\* Brewer, Eric A. "Towards robust distributed systems." PODC. 2000.

# Das CAP-Theorem



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Alle Knoten sehen dieselben Daten zur selben Zeit. Alle Kopien sind stets gleich.



Das System läuft auch, wenn einzelne Knoten ausfallen. Ausfälle von Knoten und Kanälen halten die überlebenden Knoten nicht von ihrer Funktion ab.

Das System funktioniert auch im Fall von verlorenen Nachrichten. Das System kann dabei damit umgehen, dass sich das Netzwerk an Knoten in mehrere Partitionen aufteilt, die nicht miteinander kommunizieren.

Im Falle einer Netzwerk-Partition muss man sich zwischen Konsistenz und Verfügbarkeit entscheiden, beides geht nicht.

# Gossip-Protokolle für Hoch-Verfügbarkeit

Grundlage: Ein Netzwerk an Agenten mit eigenem Zustand

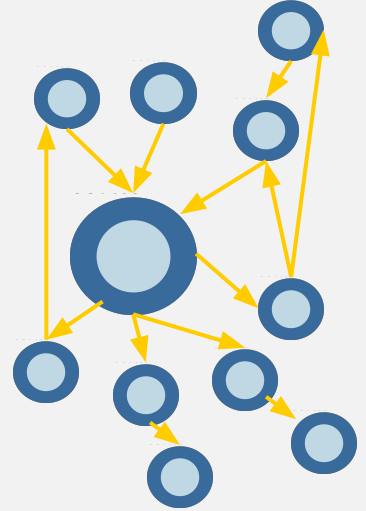
- Agenten verteilen einen Gossip-Strom
- Nachricht: Quelle, Inhalt / Zustand, Zeitstempel
- Nachrichten werden in einem festen Takt periodisch versendet
- an eine bestimmte Anzahl anderer Knoten (Fanout)

Virale Verbreitung des Gossip-Stroms

- Knoten, die mit mir in einer Gruppe sind, bekommen auf jeden Fall eine Nachricht
- Die Top x% an Knoten, die mir Nachrichten schicken bekommen eine Nachricht

Nachrichten, denen vertraut wird, werden in den lokalen Zustand übernommen, wenn

- die gleiche Nachricht von mehreren Seiten gehört wurde
- die Nachricht von Knoten stammt, denen der Agent vertraut
- keine aktuellere Nachricht vorhanden sind



# Gossip-Protokolle für Hoch-Verfügbarkeit

## Vorteile:

- Keine zentralen Einheiten notwendig.
- Fehlerhafte Partitionen im Netzwerk werden umschifft. Die Kommunikation muss nicht verlässlich sein.

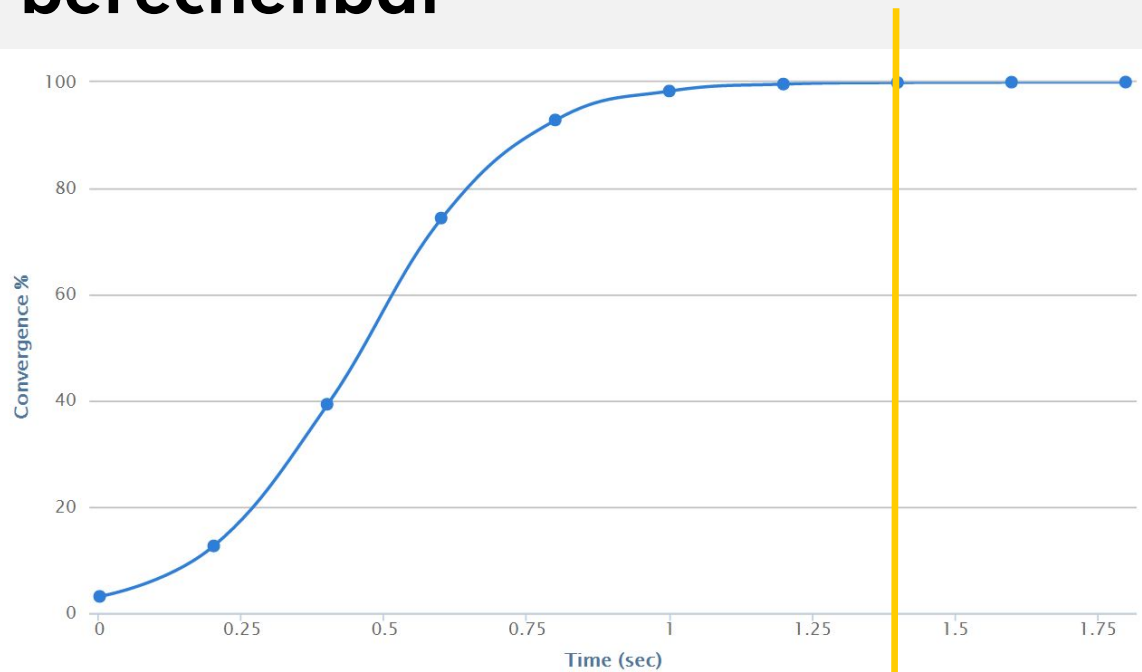
## Nachteile:

- Der Zustand ist potenziell inkonsistent verteilt (konvergiert aber mit der Zeit)
- Overhead durch redundante Nachrichten.

# Die Konvergenz der Daten und damit der Zeitpunkt der vollständigen Konsistenz ist berechenbar



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Vollständige  
Konsistenz

Estimated max bandwidth: 328.1 kbps/node

Gossip Interval

The gossip interval controls how often messages are gossiped to other nodes

seconds

Gossip Fanout

The gossip fanout controls how many nodes we gossip with

nodes

Nodes

This controls how many simulated nodes are in the cluster

Packet Loss

This controls the amount of simulated packet loss [0, 100]

% lost packets

Node failures

This controls what percent of simulated nodes are failed

% failed

<https://www.serf.io/docs/internals/simulator.html>

# Protokolle für verteilten Konsens: im Gegensatz zu Gossip-Protokollen konsistent, aber nicht hoch-verfügbar



Grundlage: Netzwerk an Agenten

Prinzip: Es reicht, wenn der Zustand auf einer einfachen Mehrheit der Knoten konsistent ist und die restlichen Knoten ihre Inkonsistenz erkennen.

Verfahren:

- Das Netzwerk einigt sich per einfacher Mehrheit auf einen Leader-Agenten – initial und falls der Leader-Agent nicht erreichbar ist. Eine Partition in der Minderheit kann keinen Leader-Agenten wählen.
- Alle Änderungen laufen über den Leader-Agenten. Dieser verteilt per Multicast Änderungsnachrichten periodisch im festen Takt an alle weiteren Agenten.
- Quittiert die einfache Mehrheit an Agenten die Änderungsnachricht, so wird die Änderung im Leader und (per Nachricht) auch in den Agenten aktiv, die quittiert haben. Ansonsten wird der Zustand als inkonsistent angenommen.

Konkrete Konsens-Protokolle: Raft, Paxos



# Protokolle für verteilten Konsens: im Gegensatz zu Gossip-Protokollen konsistent, aber nicht hoch-verfügbar



## Vorteile:

- Fehlerhafte Partitionen im Netzwerk werden toleriert und nach Behebung des Fehlers wieder automatisch konsistent.
- Streng konsistente Daten.

## Nachteile:

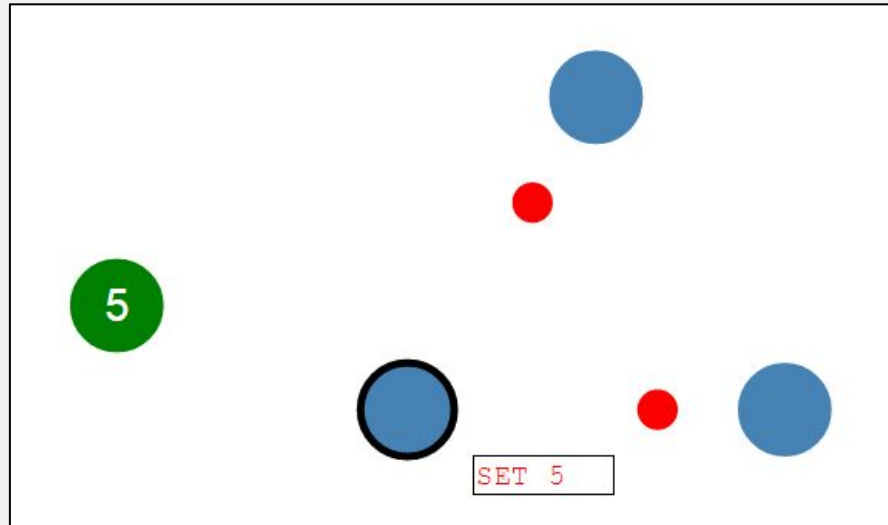
- Der zentrale Leader-Agent limitiert den Durchsatz an Änderungen.
- Nicht hoch-verfügbar: Bei einer Netzwerk-Partition kann die kleinere Partition nicht weiterarbeiten. Ist die Mehrheit in keiner Partition, so kann insgesamt nicht weiter gearbeitet werden.

# Das Raft-Konsens-Protokoll



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Ongaro, Diego; Ousterhout, John (2013).  
"In Search of an Understandable Consensus Algorithm".



<http://thesecretlivesofdata.com/raft>

<https://raft.github.io/>



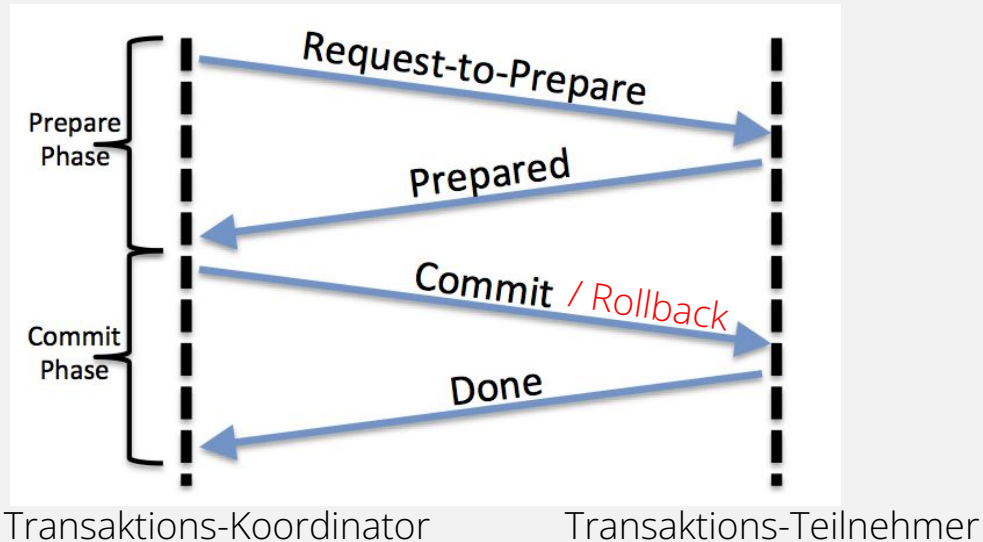
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**Übung 2 & 3 (30 min):**

**Das Raft-Konsens-Protokoll  
etcd**

# Ist strenge Konsistenz über alle Knoten notwendig, so verbleibt das 2-Phase-Commit Protokoll (2PC)

Ein Transaktionskoordinator verteilt die Änderungen und aktiviert diese erst bei Zustimmung aller. Ansonsten werden die Änderungen rückgängig gemacht.



Vorteil:

- Alle Knoten sind konsistent zueinander.

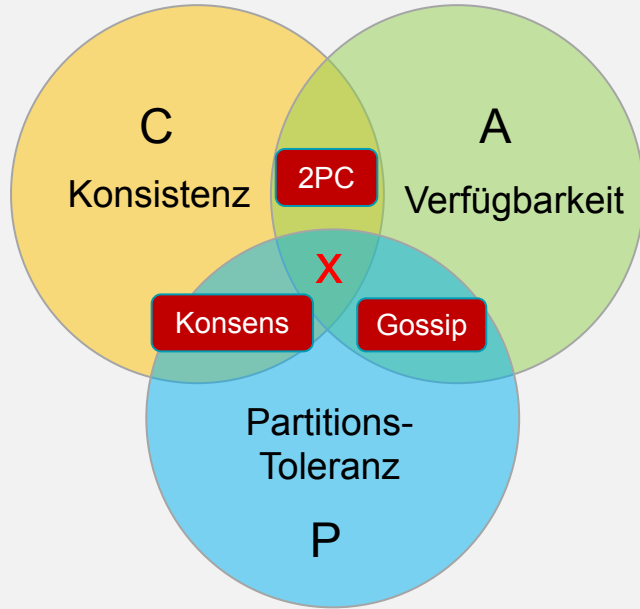
Nachteile:

- Zeitintensiv, da stets alle Knoten zustimmen müssen.
- Das System funktioniert nicht mehr, sobald das Netzwerk partitioniert ist.

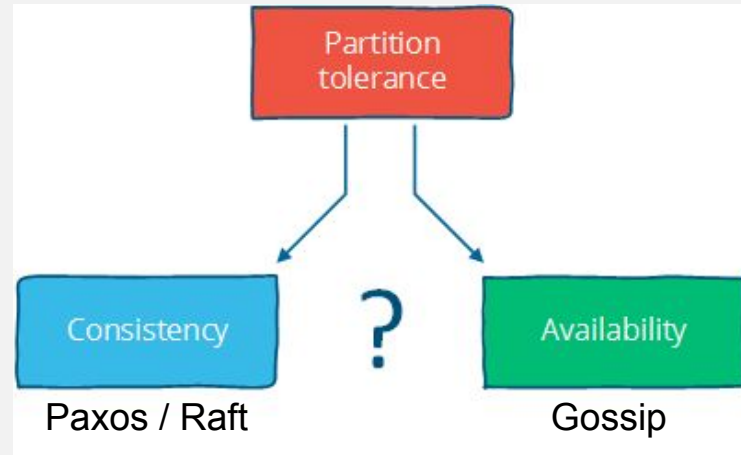
# Die vorgestellten Protokolle und das CAP Theorem



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In der Cloud müssen Partitionen angenommen werden. Damit ist die Entscheidung binär: Zwischen Konsistenz und Verfügbarkeit.





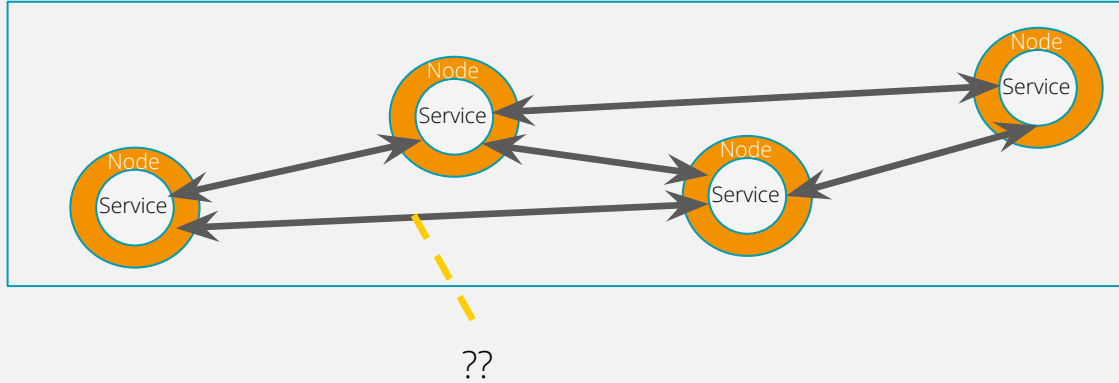
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# Service Discovery



# Die Probleme einer klassischen Verknüpfung von Services in der Cloud



## Probleme:

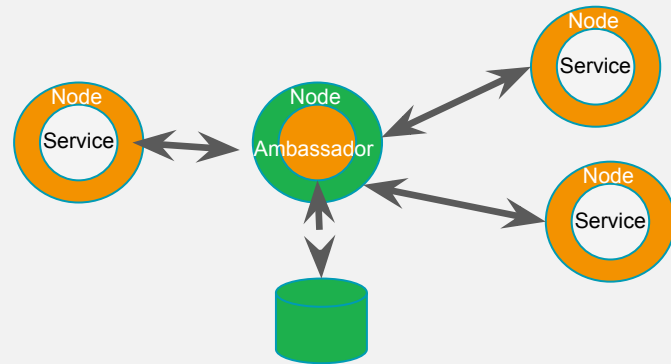
- Mangelnde Redundanz: Jeder Service wird direkt genutzt. Er kann nicht unmittelbar in mehreren Instanzen laufen, die Redundanz schaffen.
- Mangelnde Flexibilität: Die Services können nicht ohne Seiteneffekt neu gestartet oder auf einem anderen Knoten in Betrieb genommen werden – oder sogar durch eine andere Service-Implementierung ausgetauscht werden.

## Lösungen:

- Dynamischer DNS
- Ambassador
- Dynamischer Konfigurationsdateien und Umgebungsvariablen

# Das Ambassador Pattern

Ein Ambassador-Knoten für jede Knoten-Art (z.B. Webserver)



## Service Registration:

- Beobachtet das Cluster und erkennt neue und kranke/tote Knoten in seiner Gruppe.
- Hinterlegt die aktuell aktiven Knoten im Konfigurationsspeicher.

**Service Discovery:** Der Client kommuniziert mit dem Ambassador-Knoten, der die Anfragen aber möglichst effizient an einen Knoten der Gruppe weiterreicht.

Der Ambassador-Knoten kann dabei eine Reihe an Zusatzdienste erweisen bei der Verbindung zum Service (Service Binding):

- Load Balancing inklusive Failover
- Service Monitoring
- Circuit Breaker Pattern
- Throttling



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# Übung 4: Consul & Traefik