

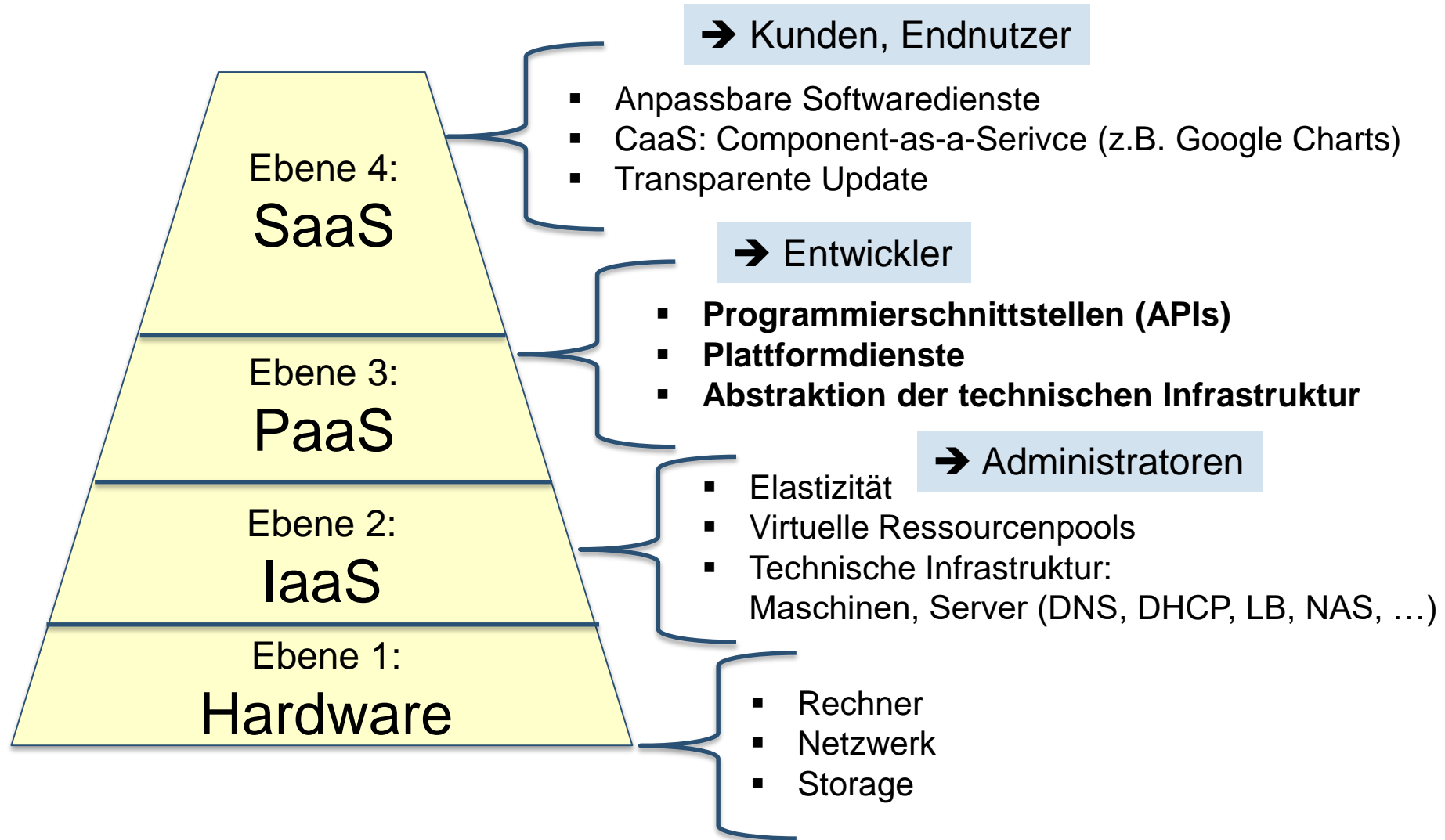
# Cloud Computing

## Kapitel 10: Platform-as-a-Service

Dr. Josef Adersberger

# Grundlagen zu einer PaaS Cloud

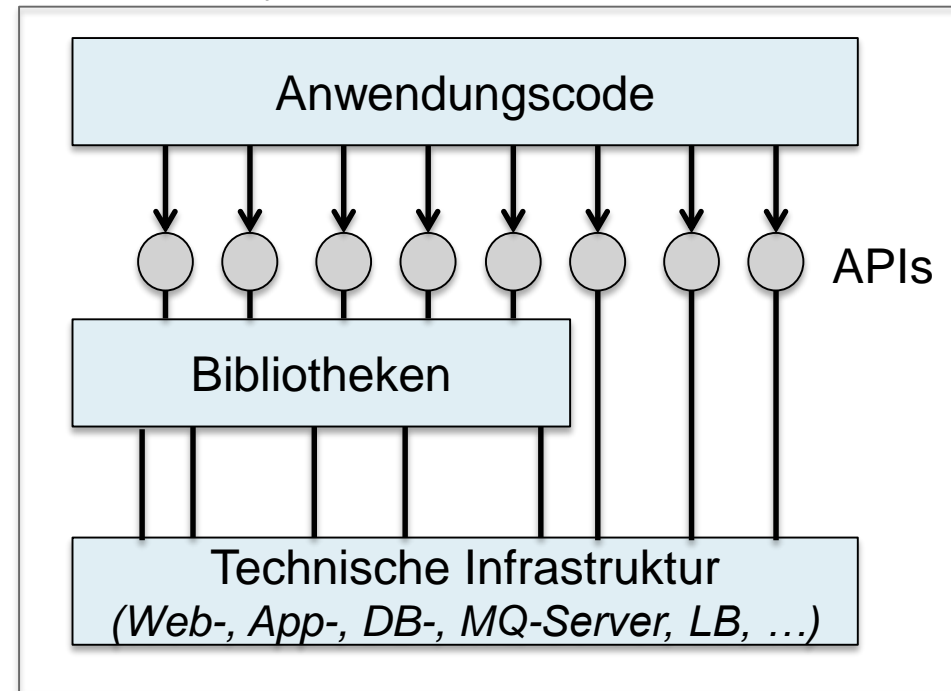
# Das Schichtenmodell des Cloud Computing: Vom Blech zur Anwendung.



# Das Problem: Stovepipe Architecture. Anwendungen aufwändig von Hand verdrahten.

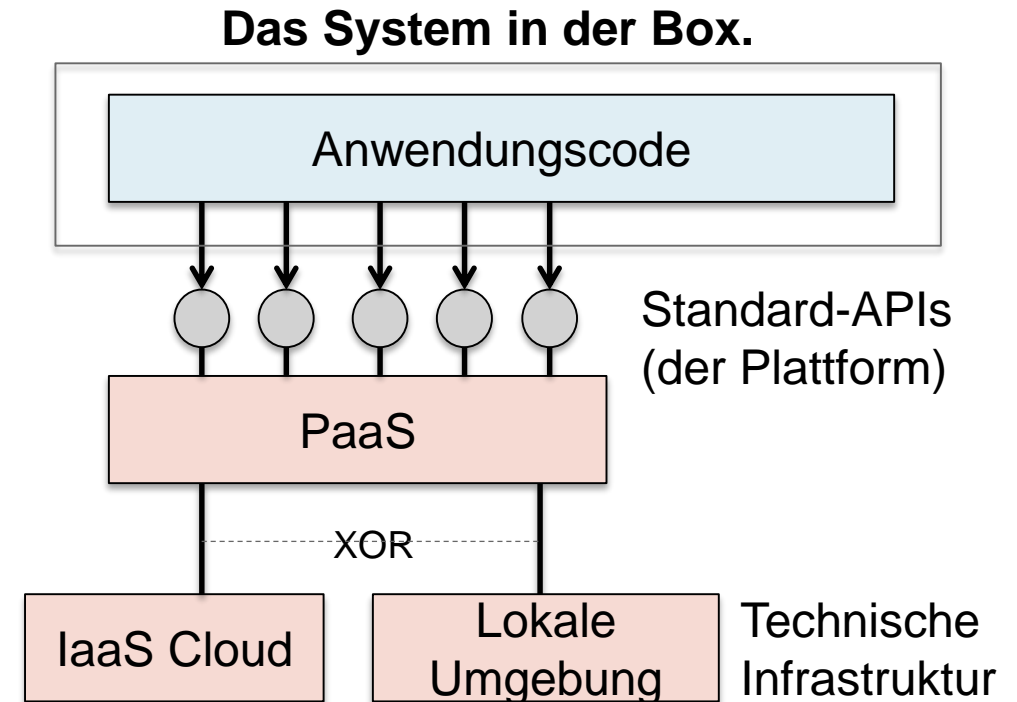


Das System: Mühevoll verdrahtet.



# Die Lösung: Plattform-as-a-Service bietet eine ad-hoc Entwicklungs- und Betriebsplattform.

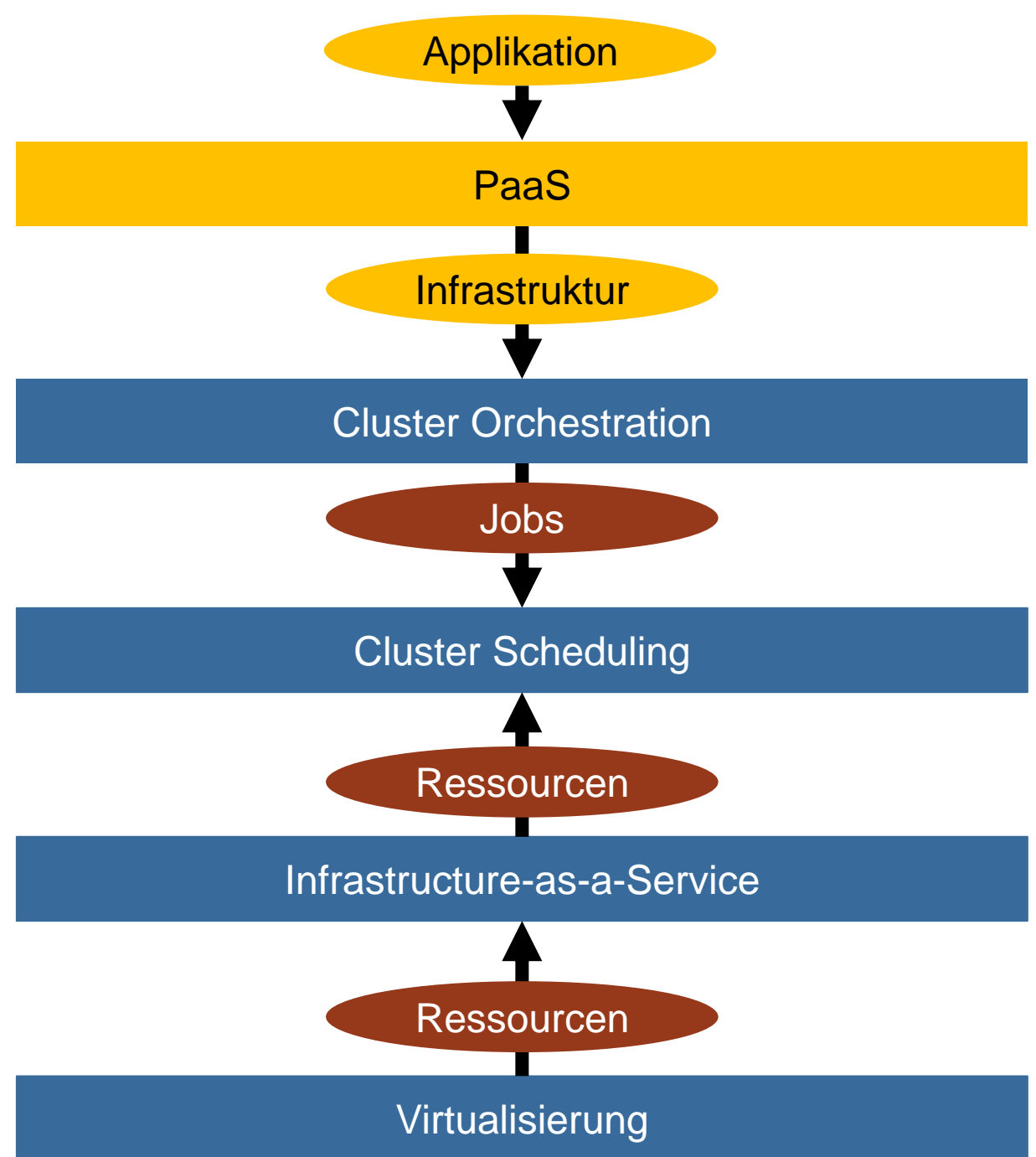
- Die Anwendung wird per Applikationspaket oder als Quellcode deployed. Es ist kein Image mit Technischer Infrastruktur notwendig.
- Die Anwendung sieht nur Programmier- oder Zugriffsschnittstellen seiner Laufzeitumgebung. „Engine and Operating System should not matter....“.
- Es erfolgt eine automatische Skalierung der Anwendung.
- Entwicklungswerkzeuge (insb. Plugins für IDEs und Buildsysteme sowie eine lokale Testumgebung) stehen zur Verfügung: „deploy to cloud“.
- Die Plattform bietet eine Schnittstelle zur Administration und zum Monitoring der Anwendungen.



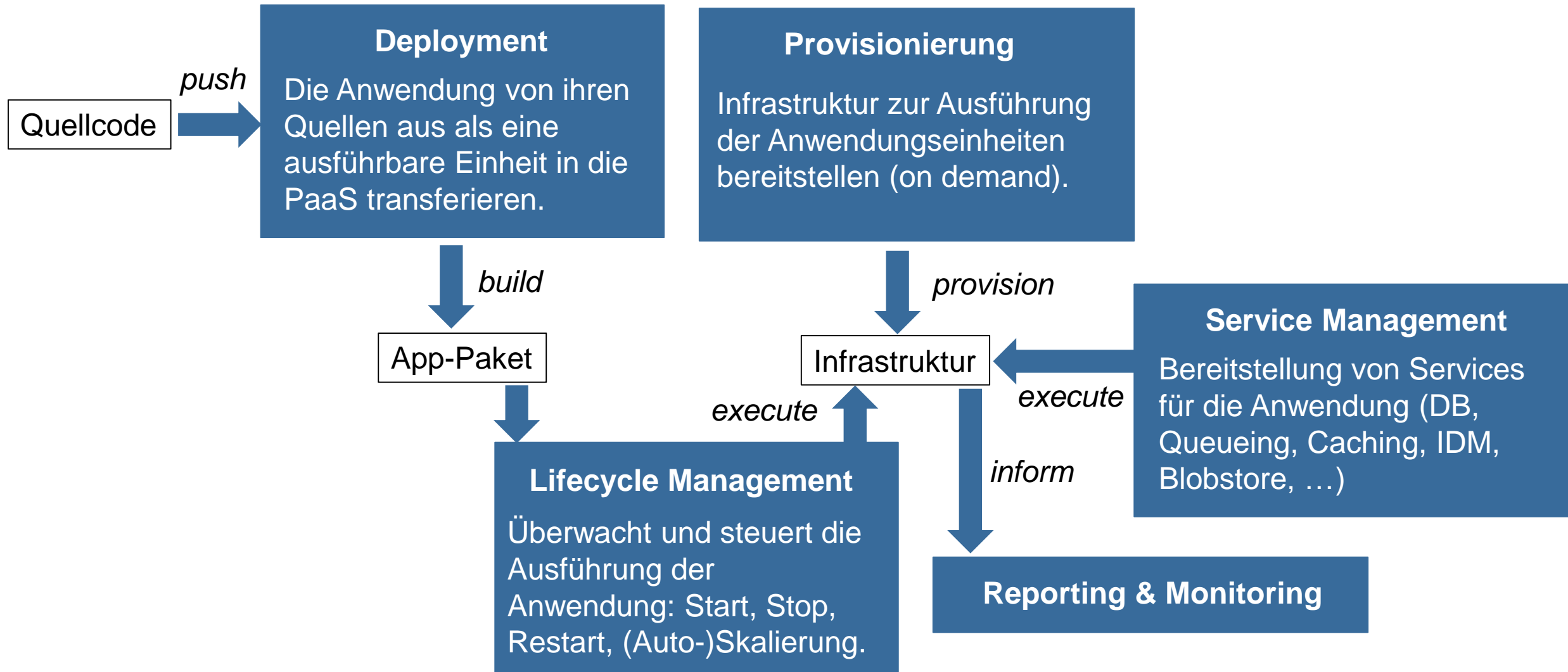
# PaaS: Definitionen

- NIST: The capability provided to the consumer is to **deploy onto the cloud infrastructure** consumer-created or acquired applications created **using programming languages, libraries, services, and tools supported by the provider**. **The consumer does not manage or control the underlying cloud infrastructure** including network, servers, operating systems, or storage, **but has control over the deployed applications** and possibly configuration settings for the application-hosting environment.
- Forrester: A complete **application platform** for multitenant cloud environments that **includes development tools, runtime, and administration** and management tools and services. PaaS combines an **application platform with managed cloud infrastructure** services.

# Das Big Picture



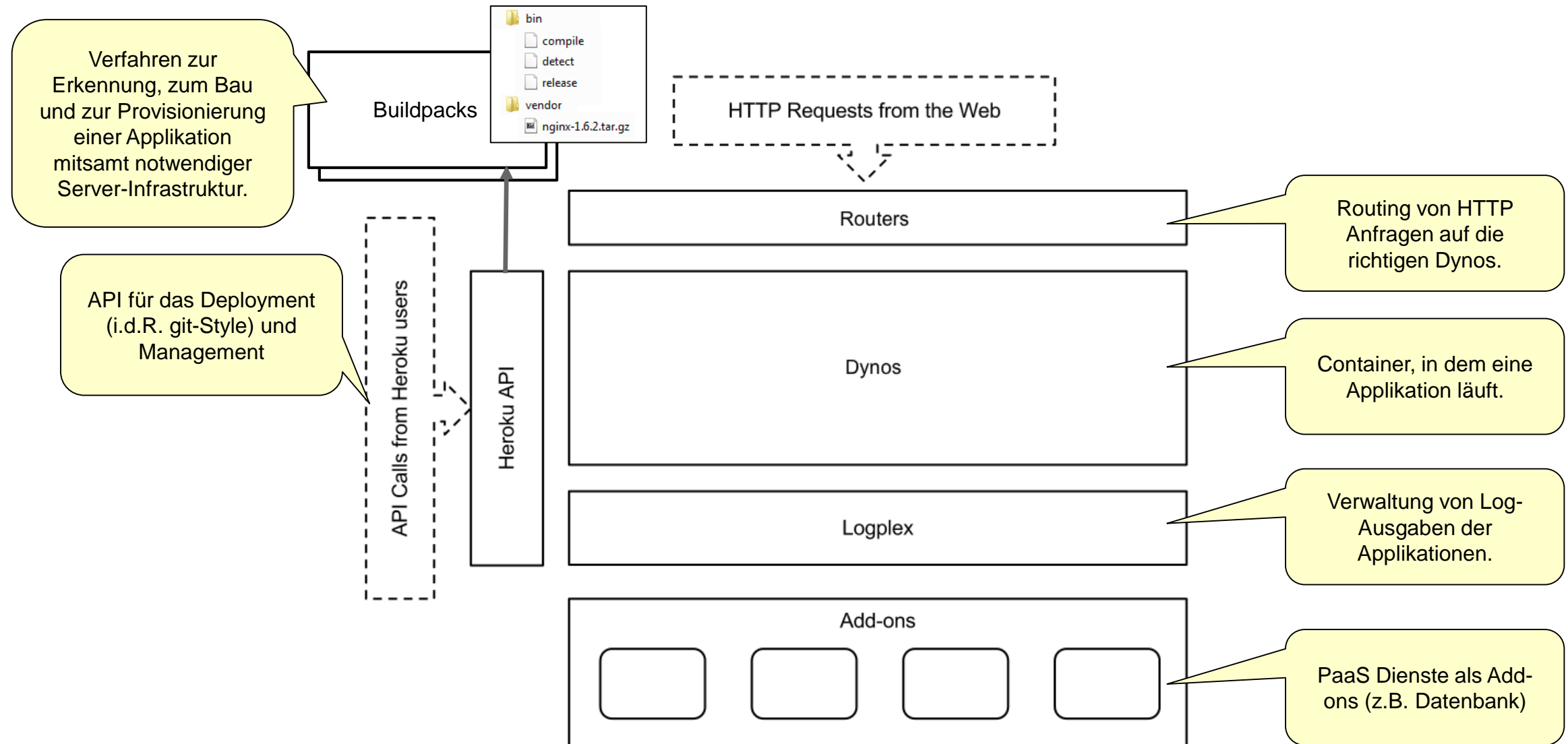
# Die funktionalen Building Blocks einer PaaS Cloud.



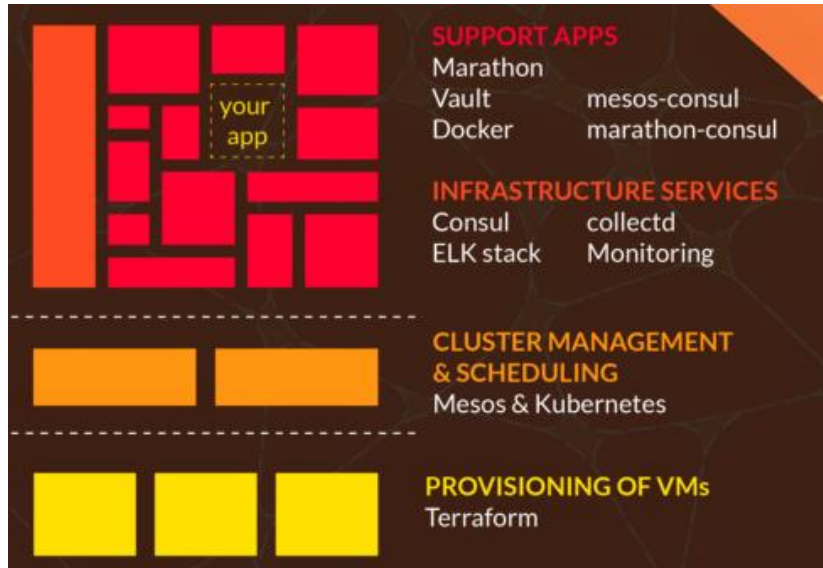
← = Datenfluss



# High-Level Architektur einer PaaS am Beispiel Heroku.



# Die technischen Building-Blocks von PaaS-Lösungen: Sehen sie die Gemeinsamkeiten?



Quelle: <https://mantl.io>

Quelle: <https://github.com/yelp/paasta>

*Note:* PaaS is an opinionated platform that uses a few un-opinionated tools. It requires a non-trivial amount of infrastructure to be in place before it works completely:

- [Docker](#) for code delivery and containment
- [Mesos](#) for code execution and scheduling (runs Docker containers)
- [Marathon](#) for managing long-running services
- [Chronos](#) for running things on a timer (nightly batches)
- [SmartStack](#) for service registration and discovery
- [Sensu](#) for monitoring/alerting
- [Jenkins](#) (optionally) for continuous deployment



Apollo is built on top of the following components:

- [Packer](#) for automating the build of the base images
- [Terraform](#) for provisioning the infrastructure
- [Apache Mesos](#) for cluster management, scheduling and resource isolation
- [Consul](#) for service discovery, DNS
- [Docker](#) for application container runtimes
- [Weave](#) for networking of docker containers
- [HAProxy](#) for application container load balancing

Quelle: <https://github.com/Capgemini/Apollo>

Cloud-fähige Softwarearchitektur

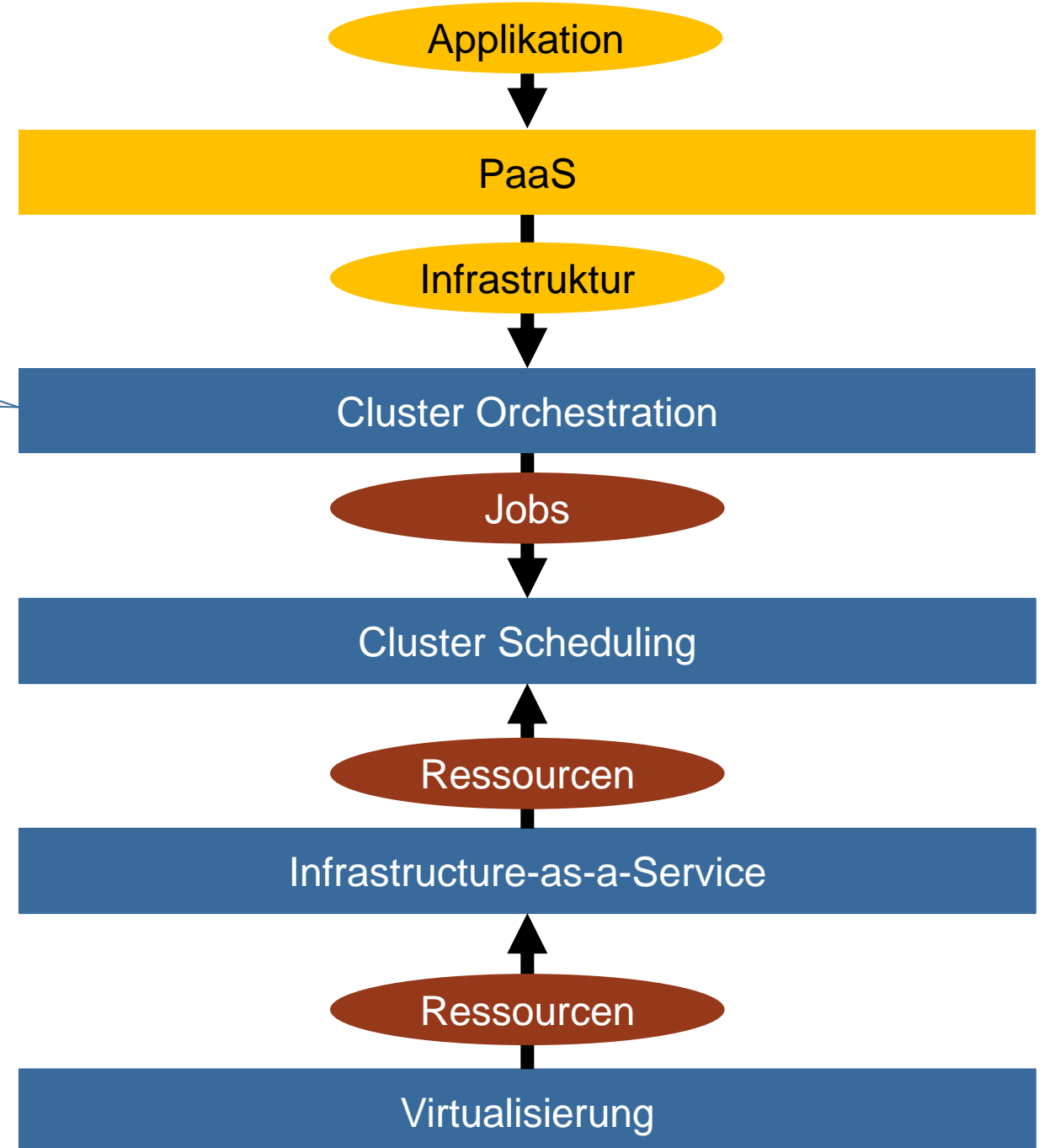
Cluster Orchestration

Cluster Scheduling

# Das Big Picture

Hier ist man bereits bei 80% einer PaaS. Was noch fehlt:

- Wiederverwendung von Infrastruktur / APIs
- Komfort-Dienste für Entwickler



# Private PaaS Clouds am Beispiel Flynn

# Flynn

## ■ Private PaaS auf Basis Docker

## ■ Open-Source-Projekt unter einer BSD Lizenz

In a Nutshell, Flynn.io...

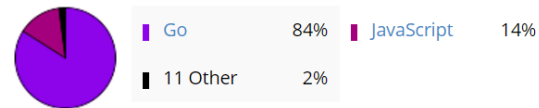
... has had **6,154 commits** made by **104 contributors** representing **409,138 lines of code**

... is **mostly written in Go** with an average number of source code comments

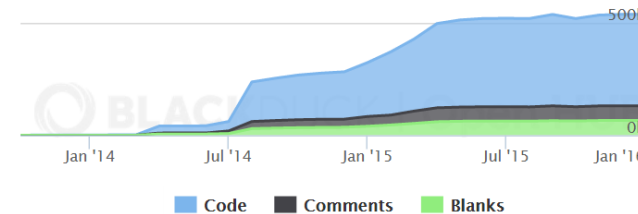
... has a young, but established codebase maintained by a **very large development team** with **stable Y-O-Y commits**

... took an estimated **111 years of effort** (COCOMO model) starting with its **first commit in October, 2013** ending with its **most recent commit 2 days ago**

Languages



Lines of Code



## Activity

### 30 Day Summary

Dec 10 2015 — Jan 9 2016

**139 Commits**

**6 Contributors**

including **1 new contributor**

### 12 Month Summary

Jan 9 2015 — Jan 9 2016

**2473 Commits**

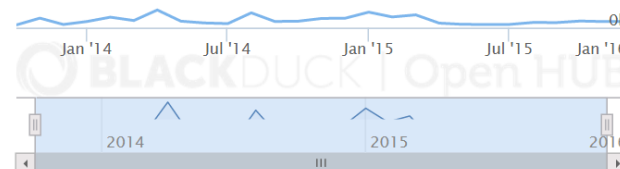
Down **-603 (19%)** from previous 12 months

**35 Contributors**

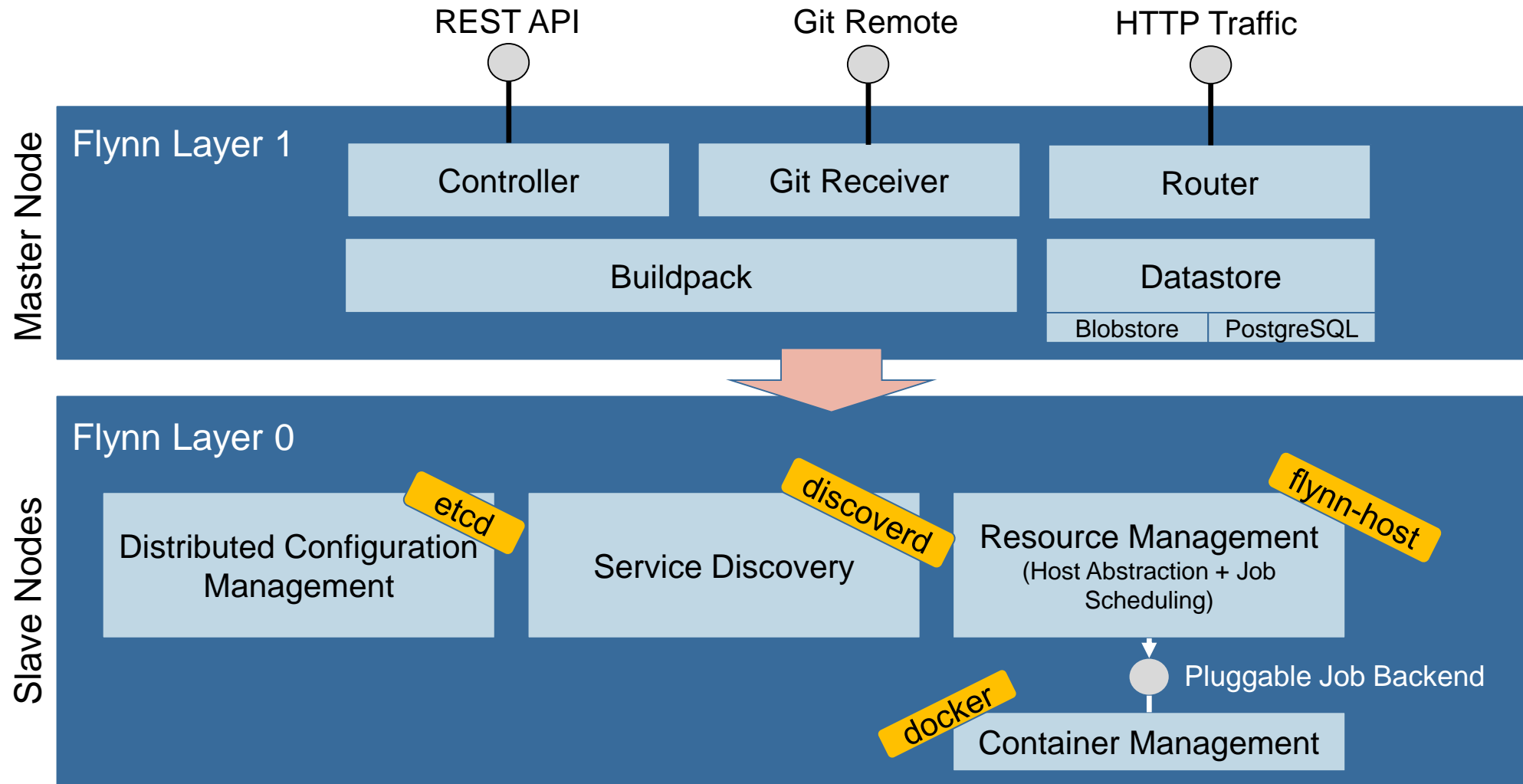
Down **-30 (46%)** from previous 12 months

Commits per Month

Zoom 1yr All



# Die Architektur von Flynn



# Alternative Private PaaS Clouds

- DEIS (<http://deis.io>, zu Flynn vergleichbarer Ansatz auf Basis von Docker)
- OpenShift (<https://www.openshift.com>, PaaS mit Schwerpunkt JEE von Red Hat)
- CloudFoundry (<http://www.cloudfoundry.org>, produktionserprobte PaaS von Pivotal mit breiter Unterstützung aus der Industrie)
- Stackato (<http://www.activestate.com/stackato>). Private PaaS von ActiveState (kommerziell).
- PaaSSTA (<https://github.com/yelp/paasta>). Open-Source private PaaS auf Basis von Mesos und Marathon.
- VAMP (<http://vamp.io>). Leichtgewichtige Open-Source private PaaS ausgelegt auf Microservices. Läuft auf Basis Mesos oder Kubernetes.
- Apollo (<https://github.com/Capgemini/Apollo>). Open-Source private PaaS auf Basis Mesos von Capgemini.
- Mantl (<http://mantl.io>). Open-Source private PaaS auf Basis von Mesos von Cisco.

# Public PaaS Clouds am Beispiel Google App Engine



# Ein PaaS-Vergleich über die angebotenen APIs und Services.

	GAE-J	AWS
<b>Datenspeicher</b>	App Engine Datastore (Key/Value mit JDO und JPA API) Cloud Storage (Objekte) Blobstore (Dateien), Cloud SQL (relational)	DynamoDB (Key/Value), S3 (Objekte und Dateien), RDS (relational)
<b>Messaging</b>	Mail (mit javax.mail API), XMPP, Channel (Push-API)	SES (E-Mails), SNS (Notifications), SQS (Message Queuing)
<b>Engine</b>	Servlet Engine, Capabilities, LogService	Elastic Beanstalk (Servlet Engine)
<b>Integration</b>	URLFetch, App Identity, OAuth	
<b>Parallele Verarbeitung</b>	Task Queue	Elastic MapReduce
<b>Volltextsuche</b>	Search, Prospective Search	CloudSearch
<b>Cache</b>	Memcache mit JCache-API	ElastiCache
<b>User-Authentifizierung</b>	Google Accounts, OpenID	IAM
<b>SaaS-APIs</b>	Google Data API, Images, Conversion	SWF (Workflows)
<b>Mandantenfähigkeit</b>	Multitenancy (Namespaces API)	

# Die Google App Engine

- Die Google App Engine (GAE) ist das PaaS-Angebot von Google.
- Anwendungen laufen innerhalb der Google Infrastruktur.
- Der Betrieb der Anwendungen ist innerhalb bestimmter Quoten kostenfrei. Danach fallen Kosten u.A. auf Basis von Service-Aufrufen, Storage-Volumen und real genutzten CPU-Sekunden an.
- Unterstützte Sprachen:
  - Python (seit 2008)
  - Java (seit 2009)
  - Go - „Python meets C++“ (seit 2011)
  - PHP (seit 2013)
- Integrationen in alle gängigen IDEs stehen zur Verfügung (Eclipse, IntelliJ, Netbeans).




# Einschränkungen der Google App Engine.

Eine GAE-Applikation läuft in einer Sandbox, die das Verhalten der Applikation einschränkt. Dies geschieht mit dem Ziel, die Verarbeitung effizient zu halten und die Infrastruktur im Auto-Scaling zu schützen.




- Es dürfen nicht alle Klassen der Standardbibliothek genutzt werden
  - Keine eigenen Threads öffnen
  - Kein Zugriff auf die Laufzeitumgebung und z.B. ihre Classloader
  - <http://code.google.com/p/googleappengine/wiki/WillItPlayInJava>
- Kommunikation mit anderen Web-Anwendungen oder Servern nur über URL Fetch, XMPP oder Email
  - Anfragen und Antworten dürfen maximal 1MB groß sein
  - Web-Hooks als allgemeines Architekturmittel für eingehende Kommunikation. Angestoßen bei Ereignissen (Warmup), Messages oder Cron-gesteuert.
- Alle Requests an eine GAE-Anwendung werden nach 60 Sekunden beendet
- Diverse Einschränkungen zu Datenvolumina und Anzahl von Service-Aufrufen

# Funktionen der Admin-UI: Die Applikationsübersicht.

 adersberger@googlemail.com | [My Account](#) | [Help](#) | [Sign out](#)

## My Applications

« Prev 20 **1-3 of 3** Next 20 »

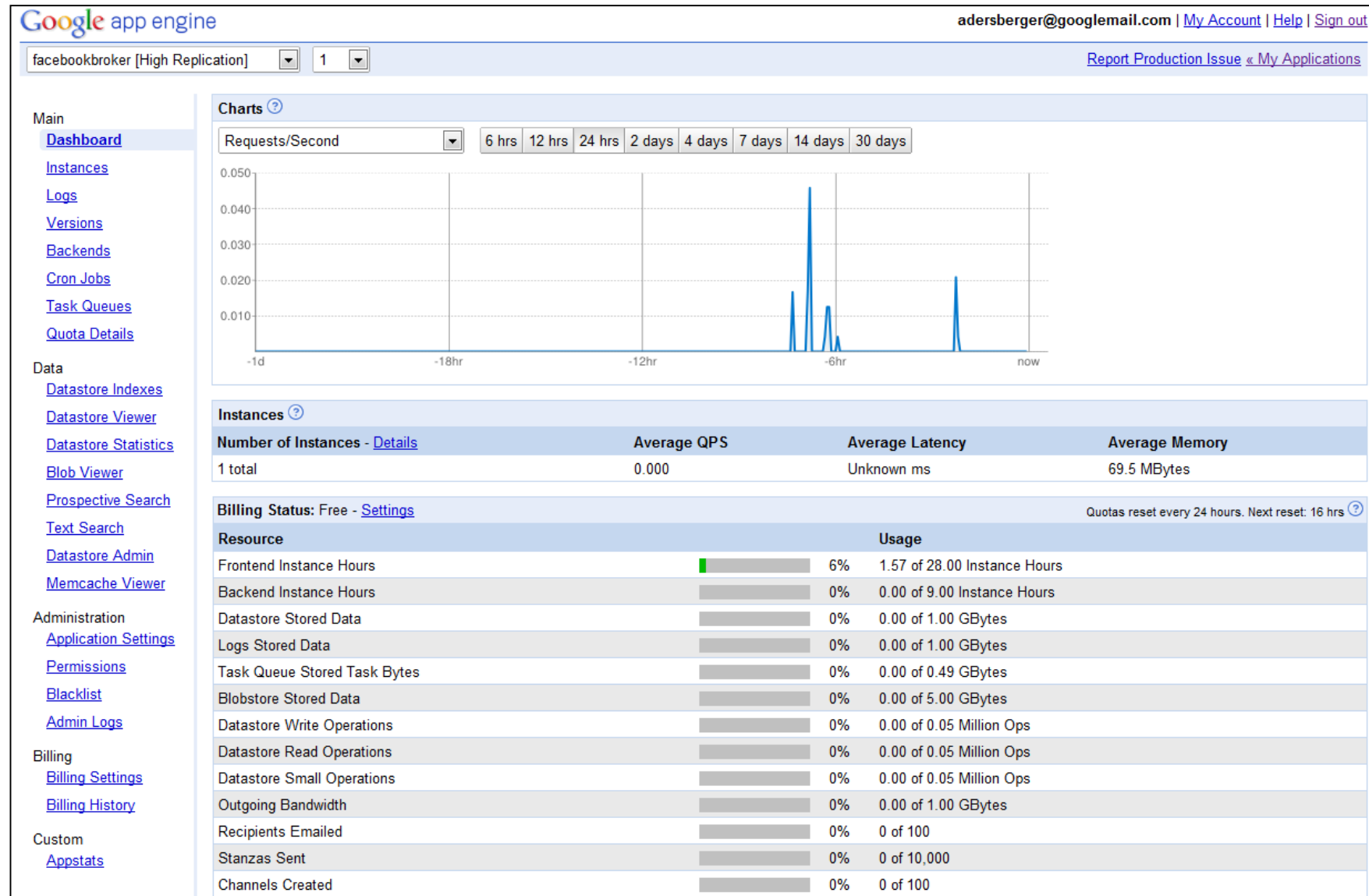
Application	Title	Billing Administrator	Storage Scheme	Current Version
<a href="#">cczwitscher</a>	Zwitscher 4 Cloud Computing		High Replication	1 
<a href="#">facebookbroker</a>	Facebook Broker		High Replication	2 
<a href="#">qaware-cc-sandbox</a>	QAware Cloud Computing Sandbox		High Replication	1 

Create Application

« Prev 20 **1-3 of 3** Next 20 »

You have 7 applications remaining.

# Funktionen der Admin-UI: Das Applikations-Dashboard.



# Funktionen der Admin-UI: Zugriff und Analyse der Log-Einträge.

**Total Logs Storage:** 47 KBytes spanning 1 day, 3 hours (0% of the Retention limit) **Total Logs Storage for Version:** 47 KBytes (99% of Logs Storage) [Change Settings](#)

Show: ☒ All requests ☐ Logs with minimum severity: Error ▼

Timezone: (GMT-7:00) US/Pacific ▼

[+ Options](#)

Tip: Click a log line to show or hide its details. [+ Expand logs](#)

[◀ Prev 20](#) **21-40** [Next 20 ▶](#) (Top: 6:55:44 ago)

Last record searched: 06-17 05:27AM 53.952. Use Next link to search older records.

<a href="#">+</a>	2012-06-18 01:30:41.354	/appstats/static/appstats_js.js	200	81ms	44kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:30:41.351	/appstats/static/app_engine_logo_sm.gif	200	69ms	3kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:30:41.348	/appstats/static/appstats_css.css	200	78ms	15kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:30:41.118	/appstats/stats	200	523ms	7kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:30:40.423	/appstats	302	37ms	0kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:30:39.452	/appstats	302	25ms	0kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:29:49.458	/resources/facebook/Java	200	5407ms	3kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">+</a>	2012-06-18 01:29:43.453	/resources/facebook/Java	303	19915ms	0kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">I</a>	2012-06-18 01:29:43.450	This request caused a new process to be started for your application, and thus caused your application code to be loaded for the first time. This requ				
<a href="#">+</a>	2012-06-18 01:29:20.878	/	200	7ms	0kb	
<a href="#">+</a>	2012-06-18 01:00:25.876	/resources/facebook/Java	200	18993ms	83kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">I</a>	2012-06-18 01:00:25.866	This request caused a new process to be started for your application, and thus caused your application code to be loaded for the first time. This requ				
<a href="#">+</a>	2012-06-18 01:00:05.132	/	304	7ms	0kb	
<a href="#">+</a>	2012-06-18 01:00:01.921	/	304	10ms	0kb	
<a href="#">+</a>	2012-06-18 00:59:55.130	/	200	116ms	0kb	
<a href="#">+</a>	2012-06-17 06:19:25.565	/resources/facebook/Java	200	16954ms	2kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">I</a>	2012-06-17 06:19:25.565	This request caused a new process to be started for your application, and thus caused your application code to be loaded for the first time. This requ				
<a href="#">+</a>	2012-06-17 06:15:31.450	/resources/facebook/Java	200	12685ms	4kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">I</a>	2012-06-17 06:15:31.450	This request caused a new process to be started for your application, and thus caused your application code to be loaded for the first time. This requ				
<a href="#">+</a>	2012-06-17 06:07:16.650	/resources/facebook/Java	500	17468ms	0kb	Mozilla/5.0 (Windows NT 6.1; WOW64) AppleWebKit/536.5 (KHTML, like Gecko) Chrome/19.0.1084.56 Safari/536.5
<a href="#">E</a>	2012-06-17 06:07:16.589	com.sun.jersey.spi.container.ContainerResponse mapMappableContainerException: The RuntimeException could not be mapped to a response, re-throwing to t				
<a href="#">W</a>	2012-06-17 06:07:16.643	/resources/facebook/Java java.lang.NullPointerException at edu.hm.cc.fbbroker.gae.FacebookBroker.getOutputStream(FacebookBroker.java:55) at sun.reflect.Na				
<a href="#">C</a>	2012-06-17 06:07:16.648	Uncaught exception from servlet.java.lang.NullPointerException at edu.hm.cc.fbbroker.gae.FacebookBroker.getOutputStream(FacebookBroker.java:55) at sun.ref				
<a href="#">I</a>	2012-06-17 06:07:16.650	This request caused a new process to be started for your application, and thus caused your application code to be loaded for the first time. This requ				

# Funktionen der Admin-UI: Mehrere Versionen einer Applikation gleichzeitig betreiben.

<a href="#">Version</a>	Default	<a href="#">Deployed</a>	Delete
<input type="radio"/> <a href="#">1</a> <a href="#">instances</a>   java   api_version: 1.0	No	6:48:31 ago by adersberger@googlemail.com	<button>Delete</button>
<input checked="" type="radio"/> <a href="#">2</a> <a href="#">instances</a>   java   api_version: 1.0	Yes	2:19:52 ago by adersberger@googlemail.com	<button>Delete</button>

Make Default

**[Traffic Splitting](#)**

Traffic Splitting is useful for activities such as anonymously testing new features of your application or different versions of your application with a percentage of users. For more information, be sure to checkout [Getting Started with App Engine Traffic Splitting](#).

**Running Traffic Splits**

Version	Traffic %	Delete
1	<input type="text" value="90"/>	<button>Delete</button>

Add Traffic Split...

Split traffic by: ☒ IP Address ☐ Cookie

# Funktionen der Admin-UI: Verwaltung der Plattform-Dienste (z.B. Datastore).

Query

Create

By kind:

KeywordHistoryItem

kinds as of 0:00:08 ago

Options

☐ By GQL:

SELECT \* FROM KeywordHistoryItem

Learn more about [GQL syntax](#).

Run Query

KeywordHistoryItem Entities

« Prev 20 1-3 Next 20 »

<input type="checkbox"/> ID/Name	keyword	timestamp	user
<input type="checkbox"/> <a href="#">id=1</a>	Java	2012-06-18 13:09:08.967000	adersberger@googlemail.com
<input type="checkbox"/> <a href="#">id=1001</a>	München	2012-06-18 13:09:24.550000	adersberger@googlemail.com
<input type="checkbox"/> <a href="#">id=2001</a>	Rosenheim	2012-06-18 13:09:38.647000	adersberger@googlemail.com

Delete

« Prev 20 1-3 Next 20 »