

# Cloud Service Engineering

Dr. Jens Nimis

24. AIK-Symposium  
23. Oktober 2009, Karlsruhe

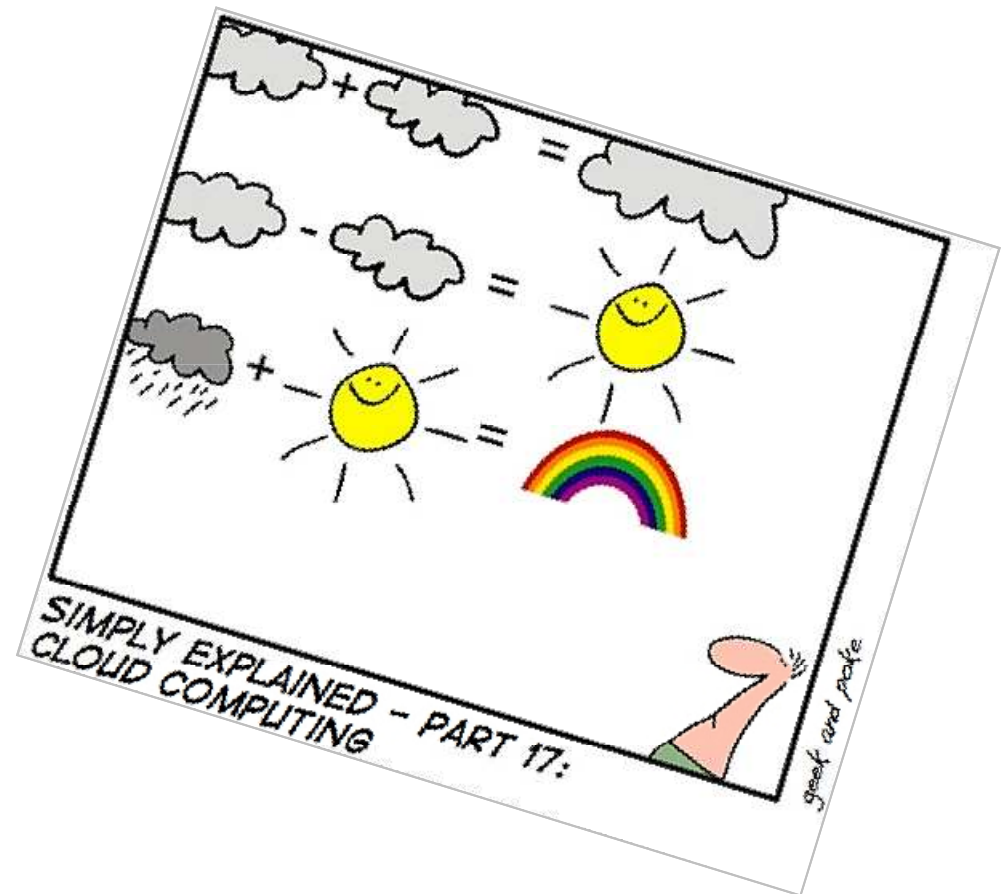
# Agenda – Part 1



- Part 1: What is Cloud Computing?
  - Definition(s)
  - Opportunities
- Part 2: The Cloud Ecosystem
- Part 3: Cloud Computing Research

# Some Remarks on Cloud Definitions

- „[...] unfortunately the marketing guys got hold of the term before the technicians had known what Cloud Computing is [...]“  
(Anonymous)
- A lot of semi-serious definitions:
  - Cloud = Grid made right  
Cloud = Grid made easy
  - Grid: from Science for Science  
Cloud: from Business for Business
- Let's be serious...



partly [MKCB]

# Some Serious Definition Attempts

- **UCBerkeley RADLabs:** “Cloud computing has the following characteristics: (1) The illusion of infinite computing resources... (2) The *elimination of an up-front commitment* by Cloud users... (3). The ability to *pay for use*...as needed...”  
→ **business perspective**
- **Wikipedia:** “.. a style of computing in which dynamically scalable and often virtualized resources are provided as *a service over the Internet*”  
→ **technical perspective**
- **McKinsey:** “Clouds are hardware-based services *offering compute, network and storage* capacity where: Hardware management is highly abstracted from the buyer, Buyers incur infrastructure costs as variable OPEX, and Infrastructure capacity is highly elastic”  
→ **only one kind of Cloud**

[JB]

# Our Understanding and Definition



**“Building on compute and storage virtualization, *cloud computing* provides scalable, network-centric, abstracted IT infrastructure, platforms, and applications as on-demand services that are billed by consumption.”**

## Common ground:

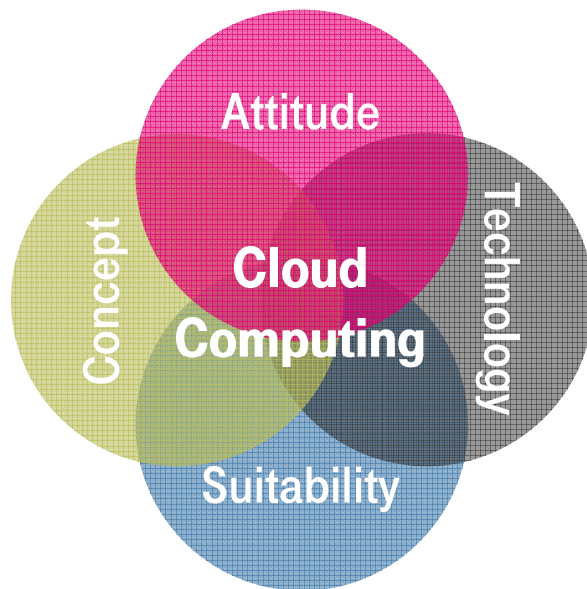
- Virtualisation/abstraction
- Scalability
- XaaS
- Web technologies
- Pay per use

## How strict?

- Clouds are fuzzy things...
- What about monthly rents?

# More Fundamental View: CC as a Disruptive Transformation in IT

- Simon Wardley: „Cloud Computing- Why IT Matters“, OSCON 09  
[http://www.youtube.com/watch\\_popup?v=okqLxzWS5R4#t=347](http://www.youtube.com/watch_popup?v=okqLxzWS5R4#t=347)
- Compares CC to the (undefineable) industrial revolution:



- His definition:  
Cloud Computing is a generic term used to describe the disruptive transformation in IT towards a service based economy driven by a set of economic, cultural and technological conditions

# Cloud Computing Opportunities



## Creation of new businesses

- Faster time-to-market, and cost-effective innovation processes
- Dynamic (trans-)formation of open service and business networks
- Leveraging the participation Web and mass programming



## Internet-scale service computing

- Provide and consume sophisticated infrastructure, platforms and business applications as modular (Web) services
- Disrupt traditional industries and offer rich, highly dynamic experiences



## Classical enterprise-grade systems management

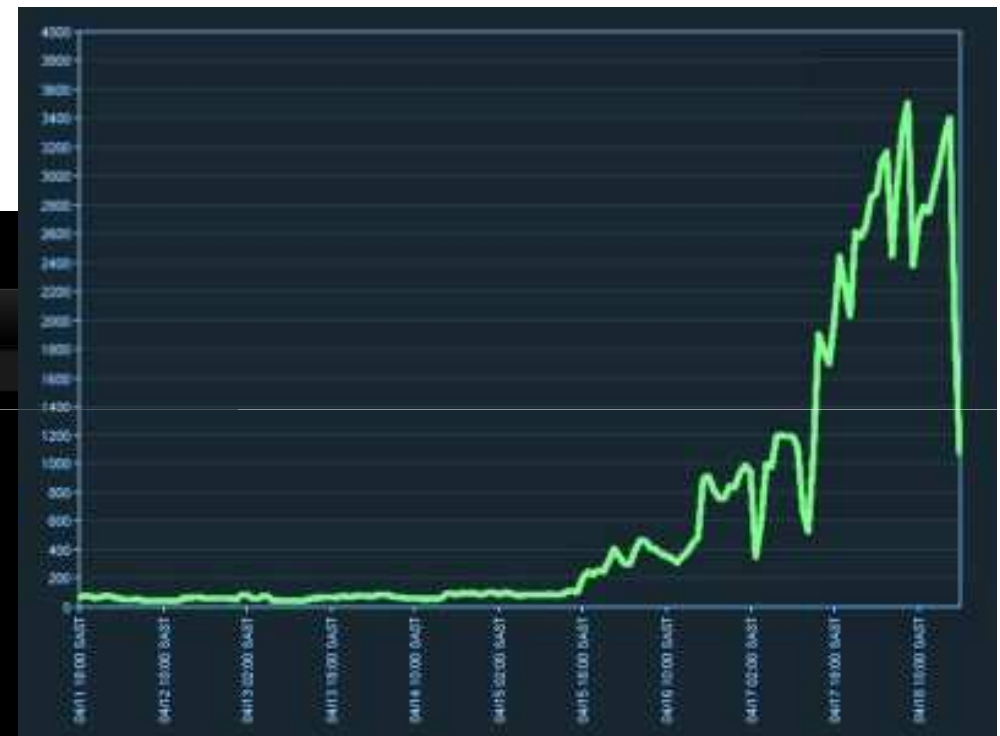
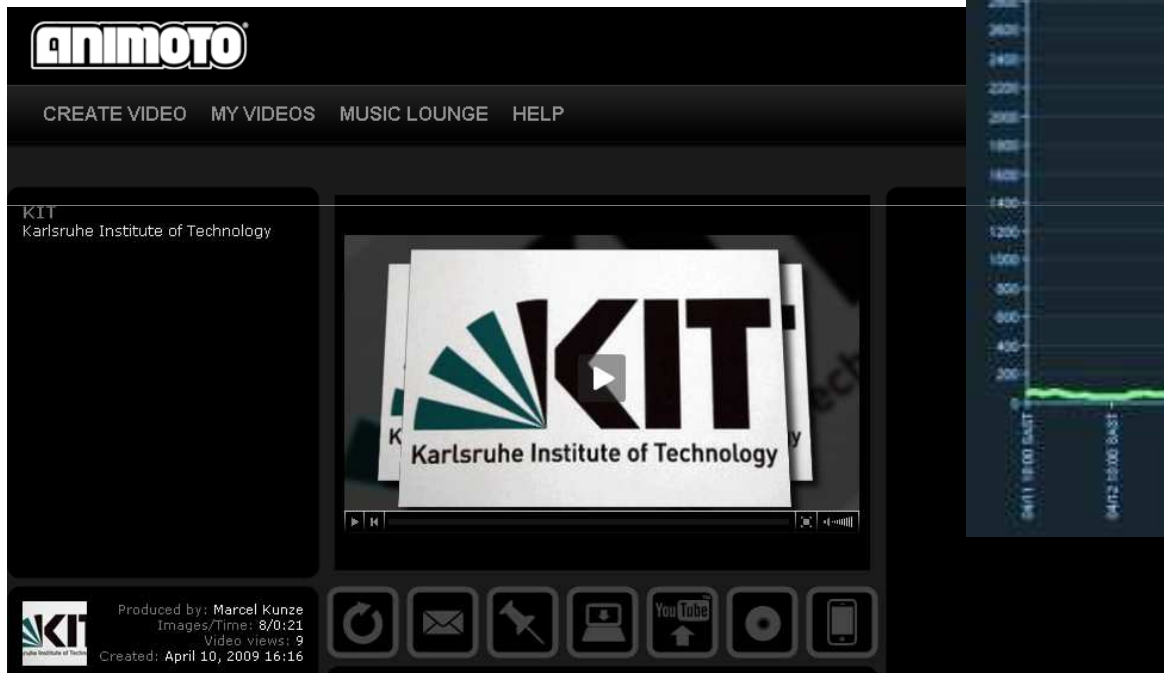
- Under-utilized server resources waste computing power and energy
- Over-utilized servers cause interruption or degradation of service levels



# Well-known Examples: NYT, animoto,...

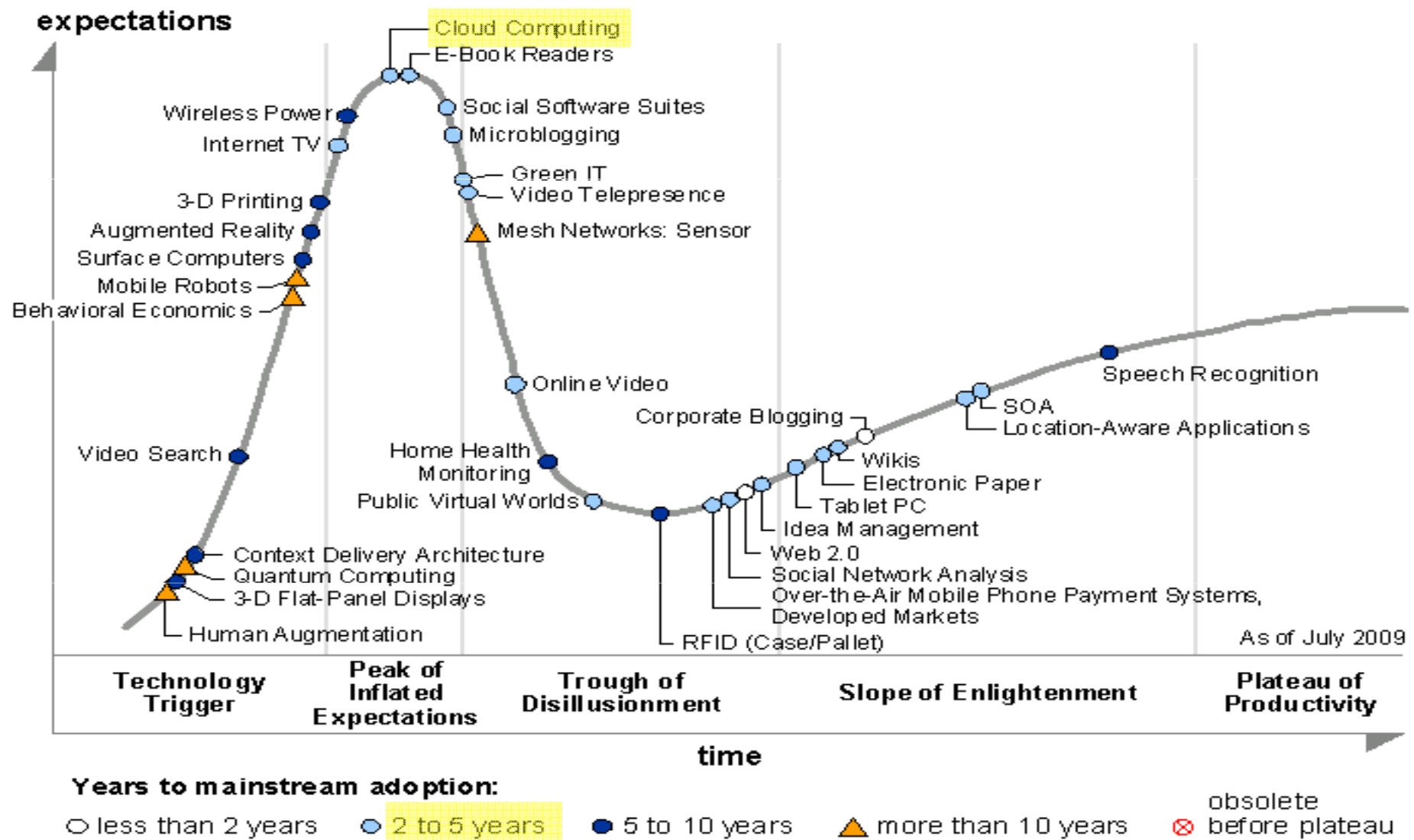


- New York Times:
  - Bulk PDF production of scanned articles
- Animoto
  - does not own any IT-infrastructure
  - Scalability (elasticity) through Cloud services





# Cloud Computing in the Technology Crystal Ball

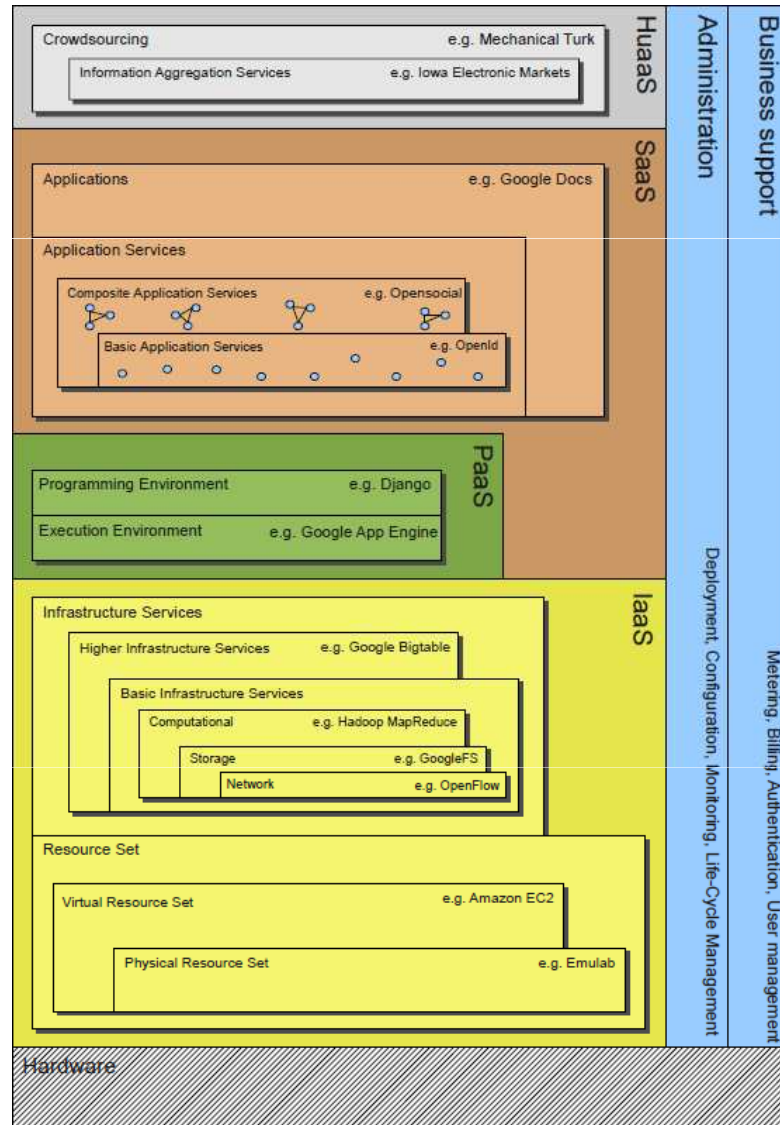


[Gartner, July 2009]

Cloud Computing is on the top of Gartner's "Peak of Inflated Expectations".

- Part 1: What is Cloud Computing?
- Part 2: The Cloud Ecosystem
  - Cloud Architecture
  - Cloud Players
- Part 3: Cloud Computing Research

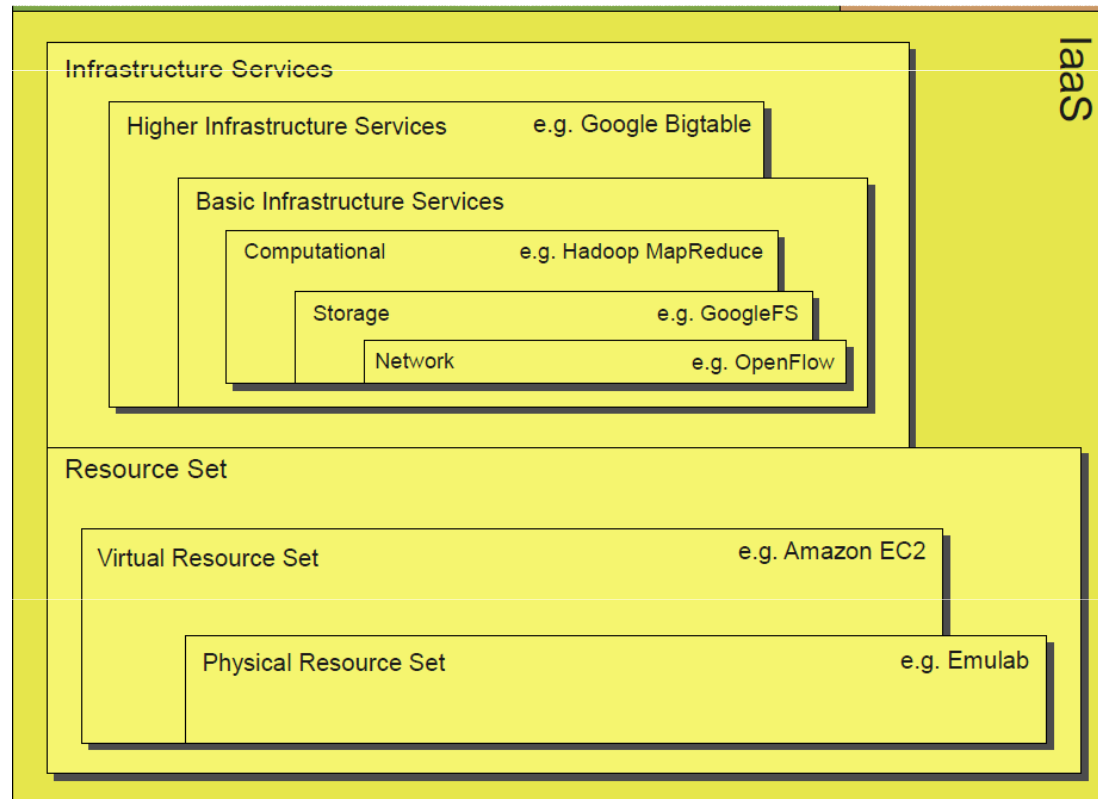
# Technical Cloud Architecture: Cloud Computing Stack



- Generic Approach
- Layered architecture
- Everything as a Service concept
  - Standard layers
    - Infrastructure as a Service
    - Platform as a Service
    - Software as a Service
  - Extra Layers
    - Human as a Service
    - Administration/Business Support

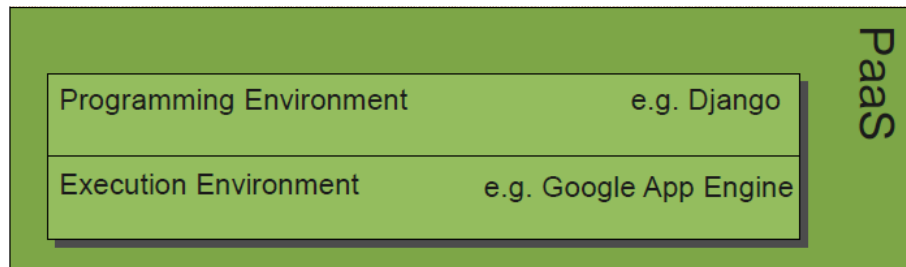
*„What's Inside the Cloud? An Architectural Map of the Cloud Landscape“,  
A. Lenk, T. Sandholm, M. Klems, J. Nimis, S. Tai (ICSE Cloud 09 Workshop, 25.05.2009)*

# Infrastructure as a Service



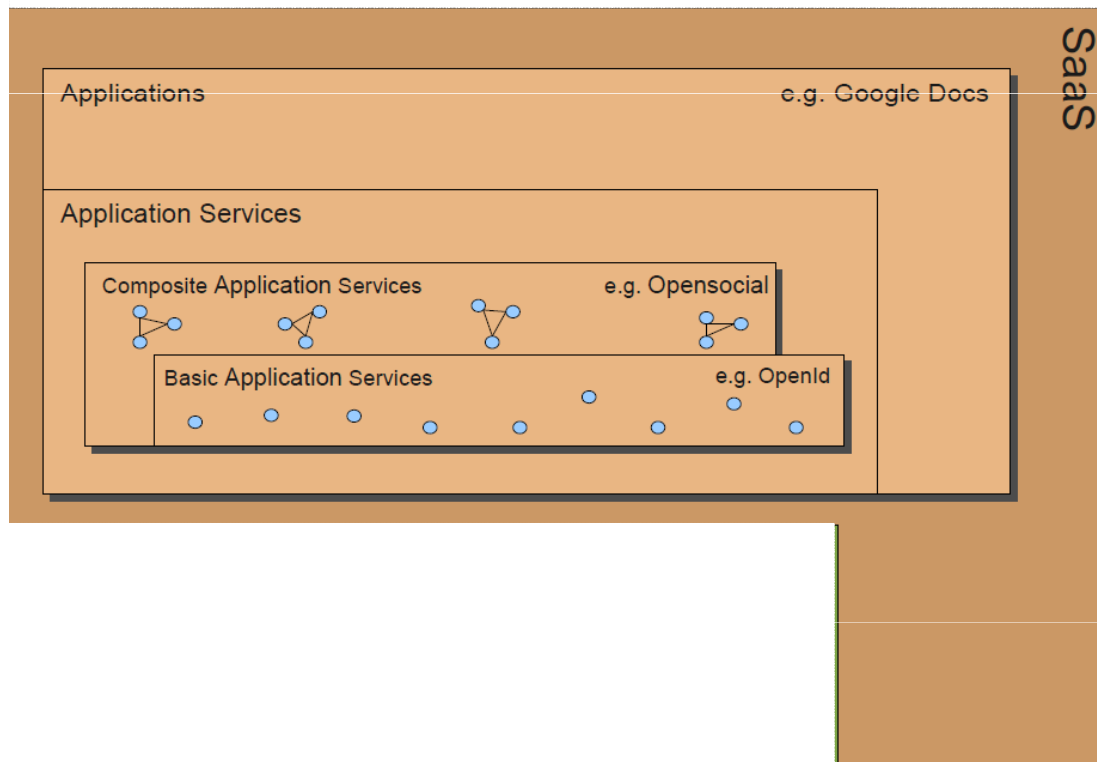
- **Infrastructure Services**
  - Storage
  - Computational
  - Network
  - Database
  - e.g. Google Bigtable, GoogleFS, Hadoop MapReduce, HadoopFS
  
- **Resource Set**
  - Machine Images
  - e.g. EC2, Eucalyptus

# Platform as a Service



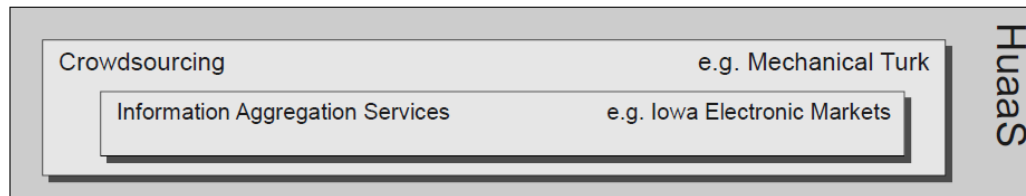
- Programming Environment
  - Programming Language, Libraries
  - e.g. Django, Java
- Execution Environment
  - Runtime Environment
  - e.g. Google App Engine, Java Virtual Machine

# Software as a Service



- Applications
  - User Interface
  - Frontend Application
  - e.g. Google Docs, Yahoo Email
- Application Services
  - Webservices Interface
  - Basic or Composite
  - e.g. Opensocial, Google Maps

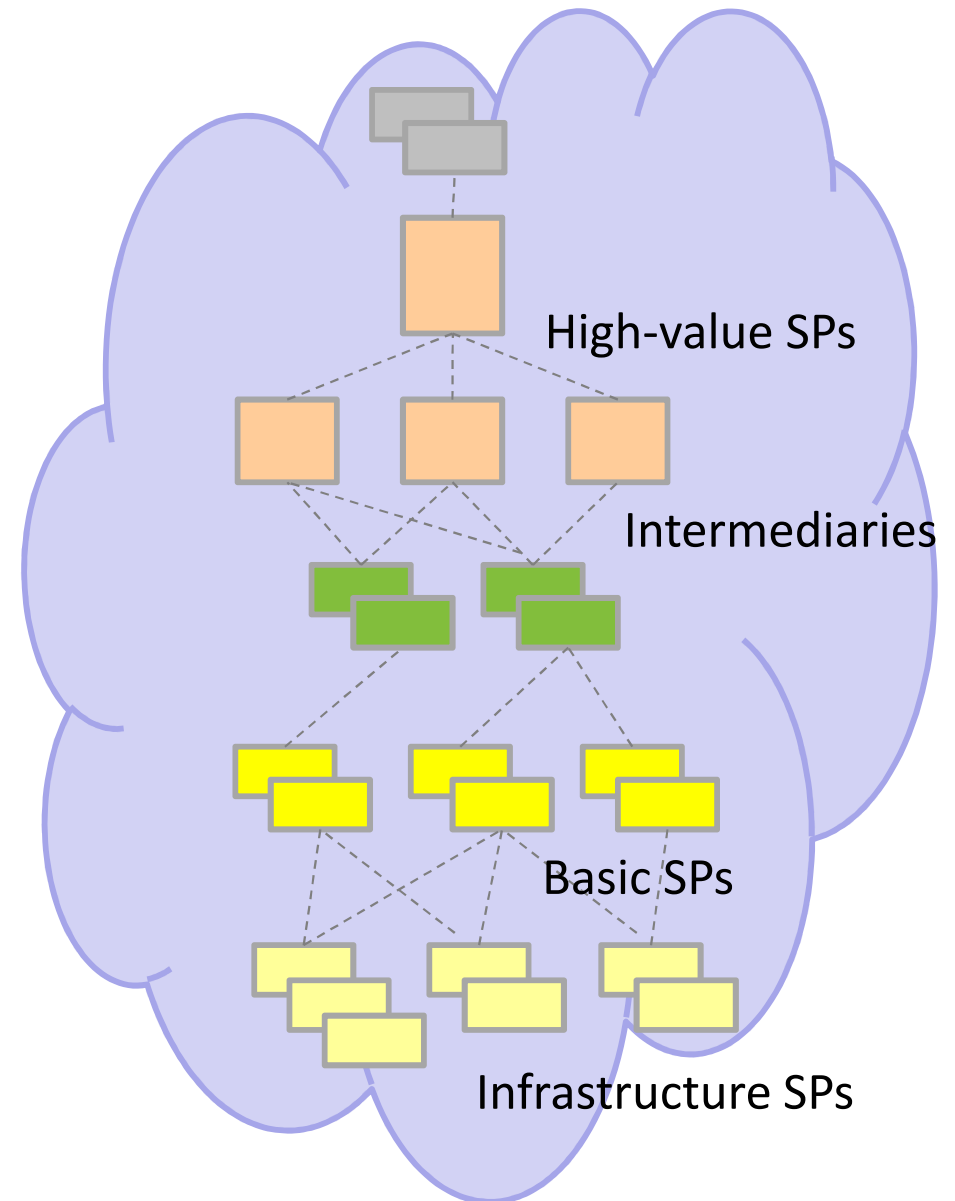
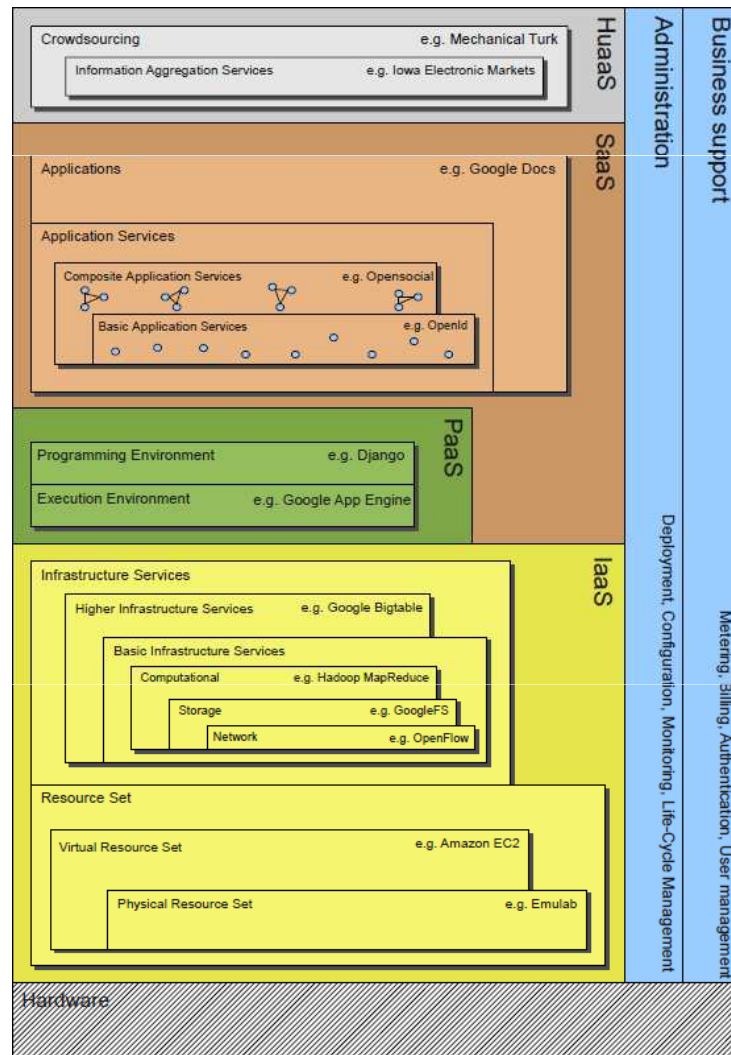
# Human as a Service



- Crowdsourcing
  - Enabling Collective Intelligence
  - e.g. Mechanical Turk
- Information Markets
  - Prediction of events
  - e.g. Iowa Electronic Markets

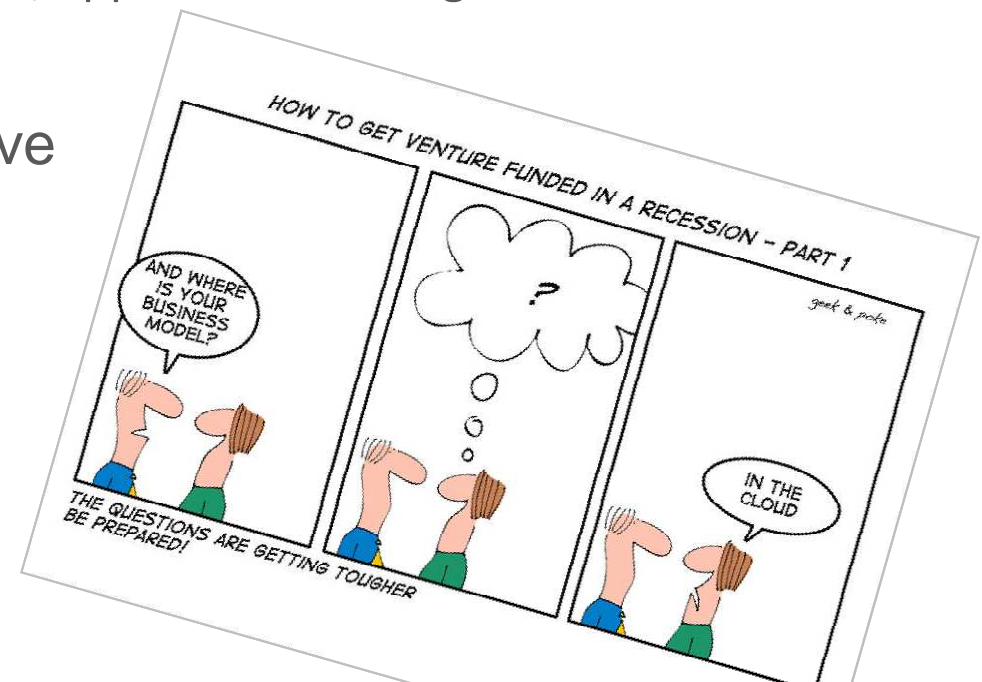


# Cloud Architecture → Cloud Players



# Categorization of Cloud Players

- Cloud **infrastructure service providers** – raw cloud resources  
IaaS (infrastructure-as-a-service)
- Cloud **platform providers** – resources + frameworks; PaaS (platform-as-a-service)
- Cloud **intermediaries** – help broker some aspect of raw resources and frameworks, e.g.,
  - server managers, application assemblers, application hosting
- Cloud **application providers** (SaaS)
- Cloud **consumers** – users of the above



[MM, MKCB]

# Agenda – Part 3

- Part 1: What is Cloud Computing?
- Part 2: The Cloud Ecosystem
- Part 3: Cloud Computing Research
  - In general
  - At eOrganization

# Top 10 Obstacles to Cloud Computing

Table 1: Quick Preview of Top 10 Obstacles to and Opportunities for Growth of Cloud Computing.

	Obstacle	Opportunity
1	Availability of Service	Use Multiple Cloud Providers; Use Elasticity to Prevent DDOS
2	Data Lock-In	Standardize APIs; Compatible SW to enable Surge Computing
3	Data Confidentiality and Auditability	Deploy Encryption, VLANs, Firewalls; Geographical Data Storage
4	Data Transfer Bottlenecks	FedExing Disks; Data Backup/Archival; Higher BW Switches
5	Performance Unpredictability	Improved VM Support; Flash Memory; Gang Schedule VMs
6	Scalable Storage	Invent Scalable Store
7	Bugs in Large Distributed Systems	Invent Debugger that relies on Distributed VMs
8	Scaling Quickly	Invent Auto-Scaler that relies on ML; Snapshots for Conservation
9	Reputation Fate Sharing	Offer reputation-guarding services like those for email
10	Software Licensing	Pay-for-use licenses; Bulk use sales

*Above the Clouds: A Berkeley View of Cloud Computing.* Armbrust M, Fox A, Griffith R, Joseph A, Katz R, Konwinski A, Lee G, Patterson D, Rabkin A, Stoica I und Zaharia M.  
 Technical Report No. UCB/EECS-2009-28. Electrical Engineering and Computer Sciences.  
 University of California at Berkeley. USA. 2009

# On a more Generic Level Obstacles become Research Questions



- Network Constraints / Reliability / Scalability
  - Unorthodox ideas already adress some issues (e.g. AWS Import/Export)
  - VPN aaS with guarantees
  - Smart system architectures will outperform traditional systems
- Portability / Lock-In
  - Open Source clones
  - Standardization
- Security
  - Security specialists care at provider sites and channels can be secured
  - Secure parallelization algorithms
  - Could become an organizational or trust issue
- And many more:
  - End-to-End SLAs
  - Licenses
  - Regulations

And many more activities like:

- Cloud Computing Lecture w. SCC
- Strategic alliance w. U. Stgt & IBM BB
- ...

# CC @ [www.eOrganization.de](http://www.eOrganization.de)

## Some select activities



Business Cases  
& Perspectives

### Business Cases and Cloud TCO

- E.g. CC business cases for T-Com (w. T-Labs)
- Cloud Computing Adoption
  - CC maturity model incl. online tool (w. IBM D,...)

Cloud  
Ecosystem

- Cloud Value Creation
  - Cloud offering value creation for intermediaries (EU)
- Architecture of „the Cloud“ (see above)

„The Cloud“

Cloud  
Engineering

- Cloud Engineering
  - Dev. support for Cloud-patterns (w. T-Labs)
  - Business continuity services (IBM Watson)
- Cloud Application Development
  - „Cloudification“ of existing apps (OpenCirrus/HP)
- Cloud Platforms and Testbeds for Service Networks
  - EU projects (w. T-Systems, SAP, IBM,...)

Cloud Management  
& Provisioning

- SAP Landscape Provisioning and Demos
  - Mgmt and Reliability of VPDC (w. fluidOps)
  - SLA mgmt for complex systems (w. SAP Research)

# Cloud TCO Framework – the General Approach

Framework for estimating value and determine benefits from Cloud Computing as an alternative to conventional IT infrastructure.

**Collect real-world  
use cases and  
identify typical  
scenarios**



**Examine key  
aspects from  
business and IT  
perspective**

**business objectives**

- foster innovation
- rapid prototyping
- leverage Web as platform

**demand behavior**

- seasonal
- temporary spikes
- unpredictable

**IT requirements**

- scalability
- reliable and stable platform
- high availability

**Understand and  
value benefits  
from cloud  
computing**

**estimate costs**

- variable costs
- fixed costs
- time to market

**estimate value**

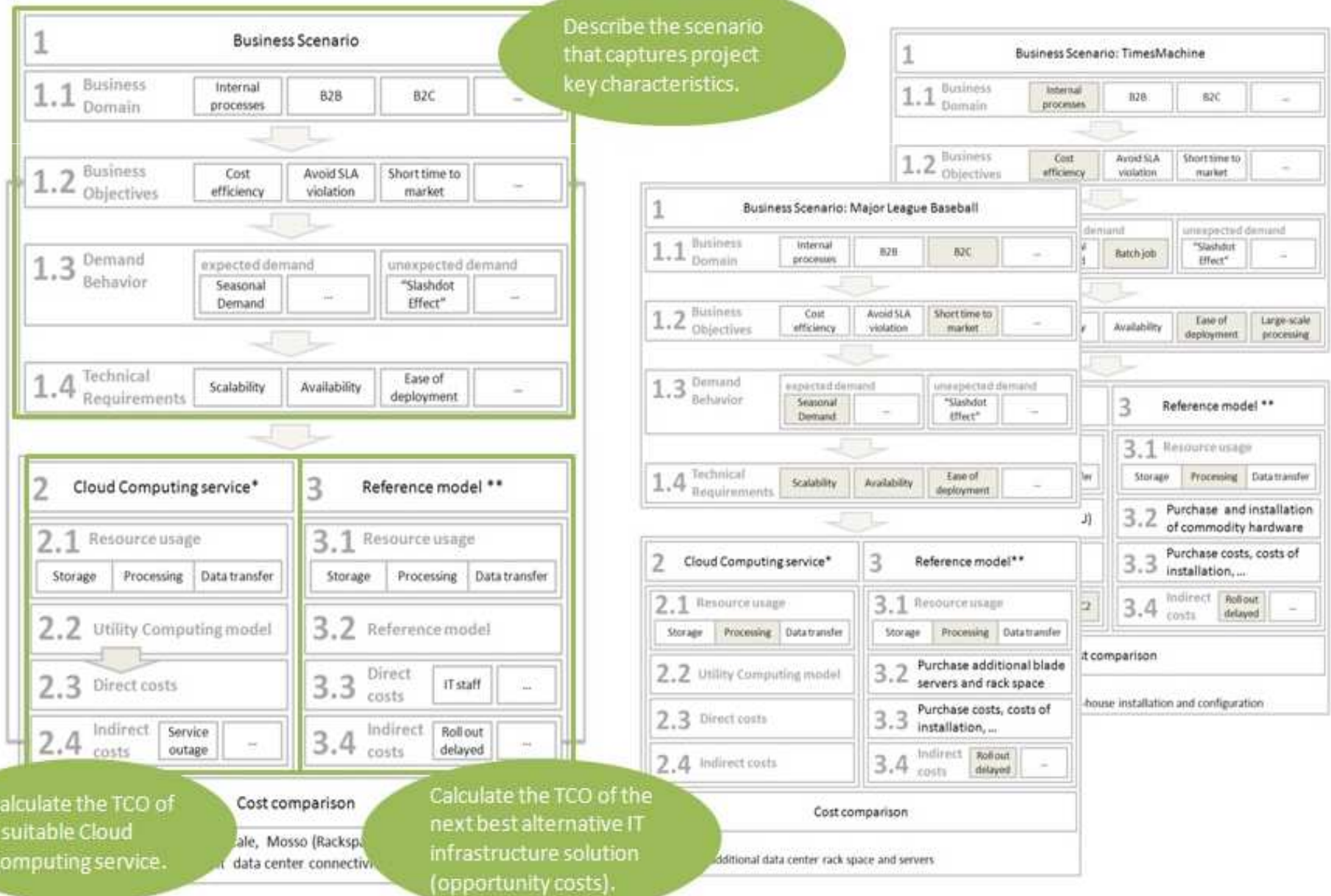
- Business value
- Economic value

**derive strategies**

- Decision processes
- Recommendations
- Business transformation



# Cloud TCO Framework – Systematization



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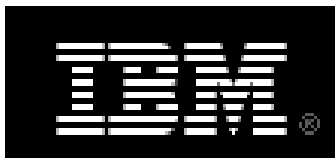
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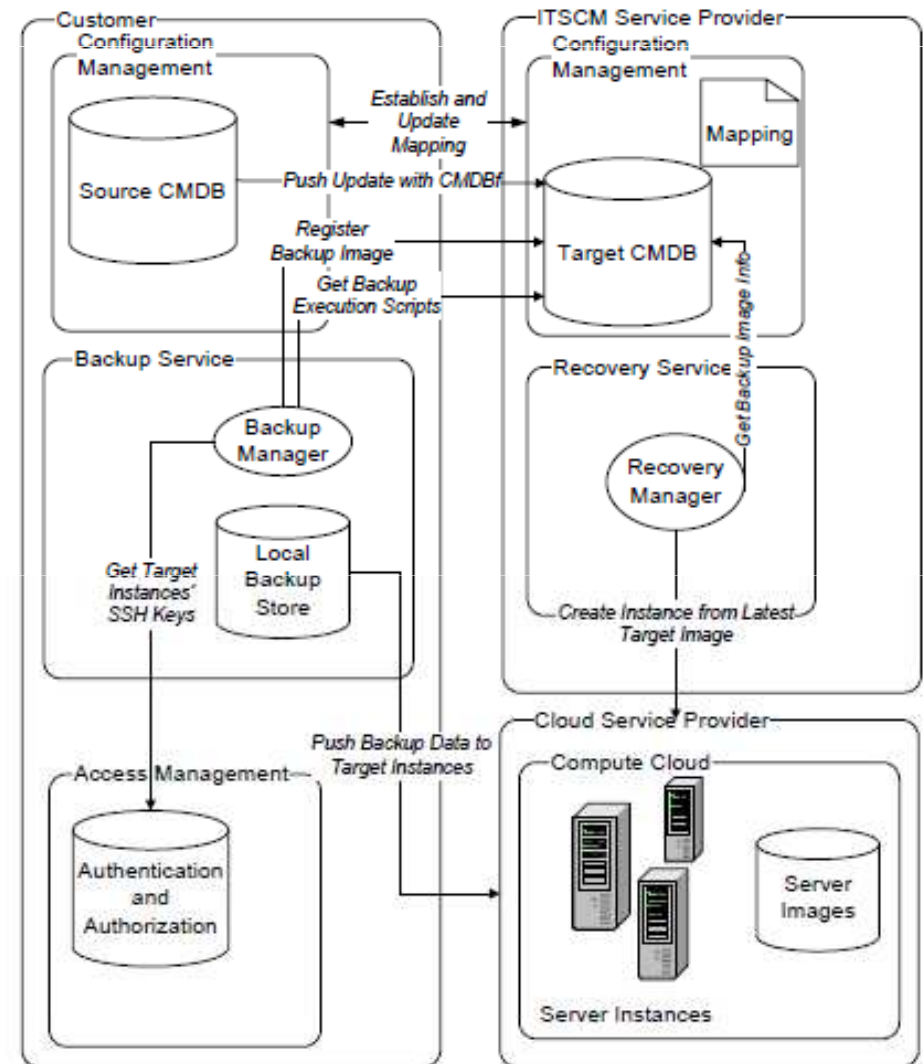


# IT-Service Continuity Management

## Top-down approach for Cloud-based recovery.



- Novel approach to deliver ITSCM through orchestrating
  - cloud services,
  - supporting services and
  - people services
- Based on the separation of an IT-service into
  - Business Service Configuration Item (replicated on a VM image at cloud service provider)
  - Service Business Data (using file system or database backup and recovery mechanisms)
- Currently ongoing:
  - estimation of over-all cost of end to end ITSCM Invocation & Recovery and On-Going Operations processes



And many more activities like:

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## Some select activities



Business Cases  
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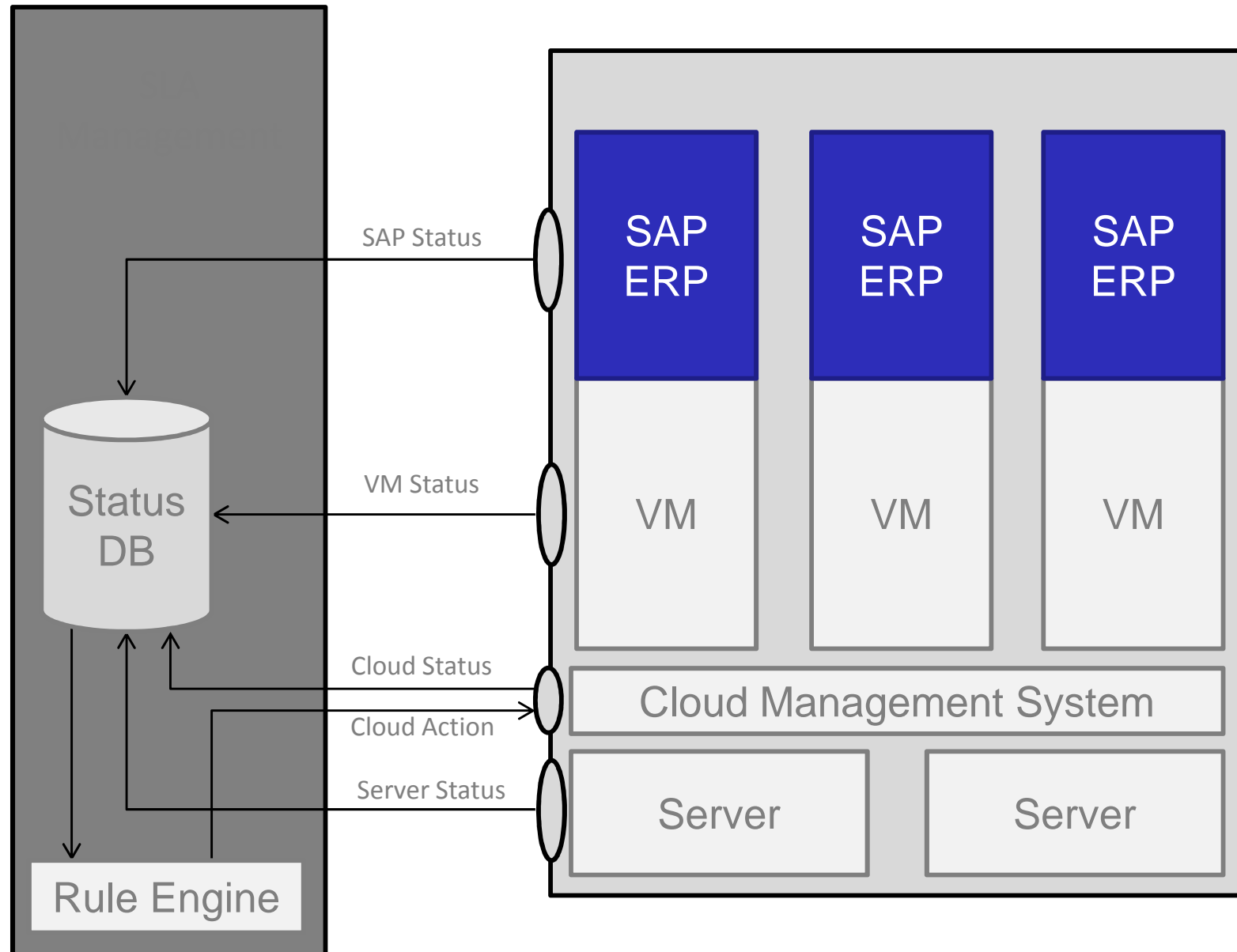
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# SAP on Cloud Demo

## Simple experimentation environment w. SAP CEC.



And many more activities like:

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Cloud  
Ecosystem

„The Cloud“

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More information:  
<http://cloudwiki.fzi.de>



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## Main Page

Welcome to FZI Cloud Wiki

### Introduction to Cloud Computing

"Building on compute and storage virtualization, and leveraging the modern Web, cloud computing provides scalable, network-centric, abstracted IT infrastructure as on-demand services that are billed by consumption."

Overview | Learning material | Hot Trends in Cloud Computing | CloudyTimes Blog

### Cloud Computing Research Focus: Business Engineering

Cloud computing is widely perceived as a disruptive technology that is about to change the fundamentals of ICT business. Within the scope of our research activities we want to understand the cloud ecosystem and its players, evaluate the benefit that this emerging technology provides and discuss the strategic implications. Doing so, we are going to present a structured framework on how to approach a TCO calculation in order to compare cloud computing services to alternative ICT solutions.

Cloud TCO calculation and comparison | Key players and the cloud ecosystem | Cloud computing use cases and typical scenarios

### Cloud Computing Research Focus: Service Technology

Cloud computing is an exciting technology that offers new ways to design and program ICT services. Our research activities concentrate on cloud programming models, frameworks and middleware as well as engineering cloud applications.

#### In the news

- Hypertable
- Opera Unite
- I.B.M. to Help Clients Fight Cost and Complexity
- The Dawn of Maneuver Warfare in IT Security
- New York Times: Data Center Overload
- Google Wave Federation Protocol
- Annelidous ? Virtual Infrastructure Management Framework
- Drizzle ? A Lightweight SQL Database for Cloud and Web
- McKinsey Report: Clearing the Air on Cloud Computing
- Amazon's BI-on-the-fly using MapReduce-as-a-service brings huge cloud data crunching to the masses
- Amazon Elastic Map Reduce
- Envisioning the Cloud (marketspace)
- AppScale Overlay for Eucalyptus
- AWS Toolkit for Eclipse available
- Google App Engine Lets Your Web
- Berkeley Releases Cloud Computing
- Processor Value Unit [PVU] licensing
- IBM partners with AWS
- Cloud Computing: Forscher haben
- iPhone Console for EC2
- Small Web Hosts Turning to Mini Cl
- Combining Clouds: Appirio's Referm
- Facebook To Salesforce
- Cloud Computing Ontology
- Bringing IT to Underserved Markets
- A maturity model for cloud computi

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## Cloudy Times

Random Thoughts of Markus Klems

### Opera Unite

June 18, 2009 by Markus Klems

Opera 10 introduces a technology called *Opera Unite*, that extends your browser to become a Web server. The idea is to enable non-technical people to serve and share content and services from their local computer, such as file sharing, chat rooms, Web hosting, remote access to music files, etc.

In a way, Opera Unite is an opposite trend to Cloud Computing where content is distributed and services are provided from large-scale data centers under the administrative domain of single providers, such as Amazon or Google. Instead, Opera Unite is a technology that borrows from ideas known in P2P and Grid Computing where hybrid user/provider models are common.

I have been a big Opera fan ever since due to the browser's incredible speed (much faster and less resource-hungry than Firefox, at least on my system). Opera Unite could be the game changer that Opera needs to compete with IE and Firefox.

#### Pages

- About
- Cloud Classification
- CloudDebug
- Internal Cloud

#### Top Posts

- Cloud Classification
- Cloud vs. Grid
- Merrill in the Cloud
- Zotero plus JungleDisk helps you manage your research sources
- OpenSocial Applications in the Cloud
- Google Datastore API

#### Blogroll

- Giles Bowkett
- Ian Foster
- Kent Langley
- Kevin L. Jackson
- Patrick Chanezon
- Rails Envy
- Randy Bias
- Refresh the Net
- Tom White
- Werner Vogels

search this site

See also <http://markusklems.wordpress.com/>



Questions?  
Thank you!



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- Thanks to:
  - [JB] Dr. James Broberg, U. Melbourne, CC-Tutorial at CCGrid 2009  
<http://www.slideshare.net/jamesbroberg/introduction-to-cloud-computing-ccgrid-2009>
  - [MM] Michael Maximilien, IBM
  - [MKCB] Dr. Marcel Kunze und Christian Baun, KIT SCC
  - Stefan Tai, Alex Lenk, Markus Klems, Sebastian Schmidt ,...