Karlsruhe Institute of Technology

Cloud Computing: Demand-driven Utilities and Business Opportunities in the Hands of Many

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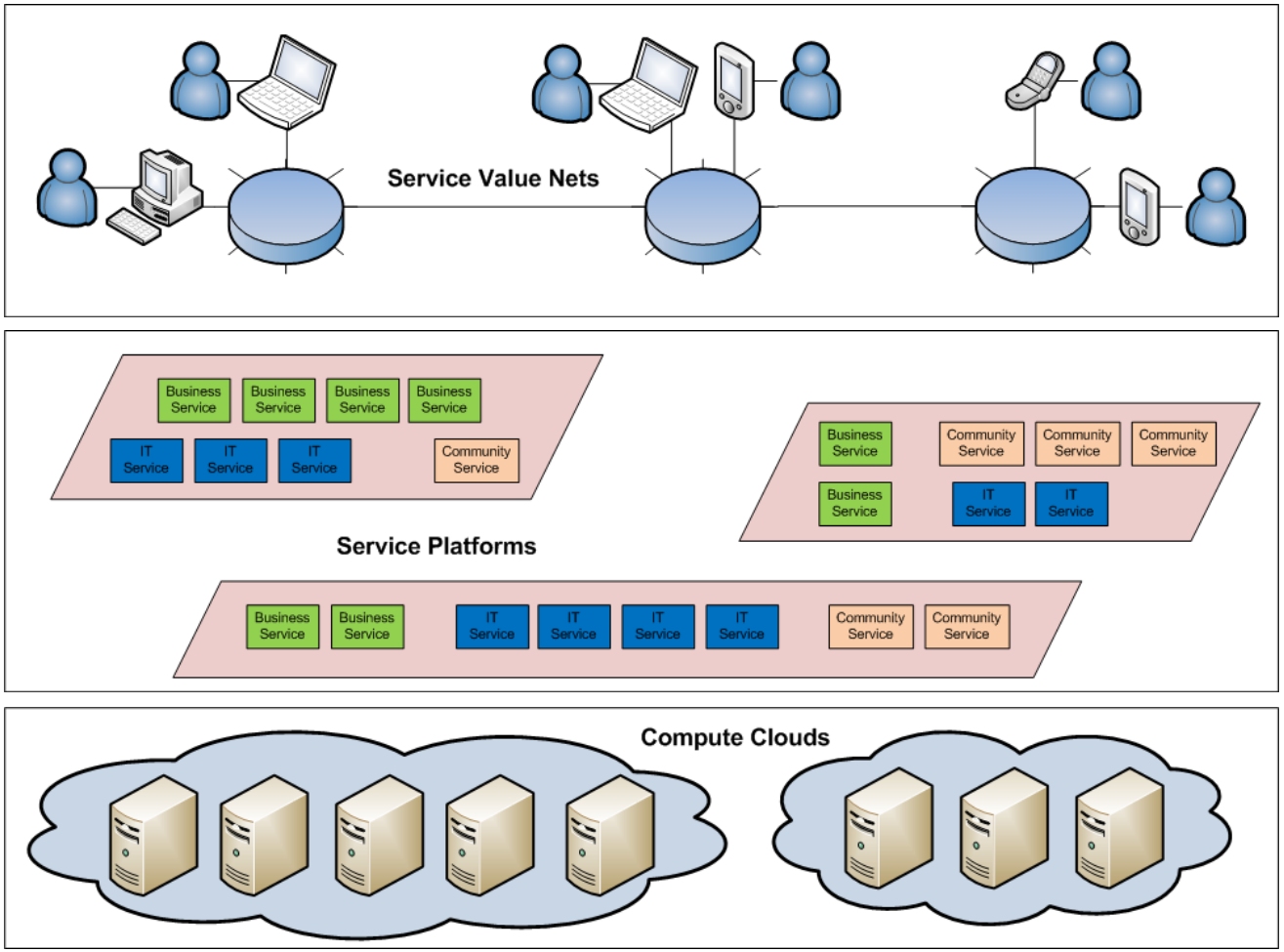
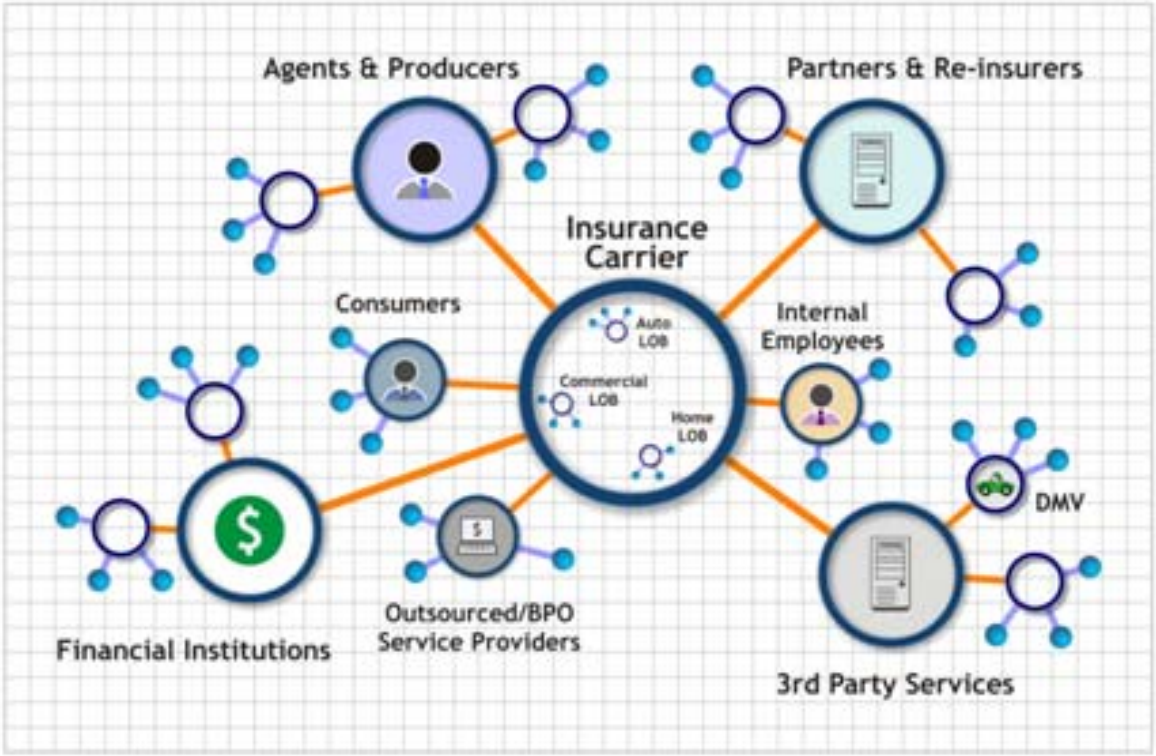
Research University · founded 1825

eOrganization Research



Service Systems are configurations of people, technology and information – connected via value propositions



Insurance Business Services Ecosystem

An Inter-disciplinary Perspective

Business view:
Services := Deliverable (vs. Product)

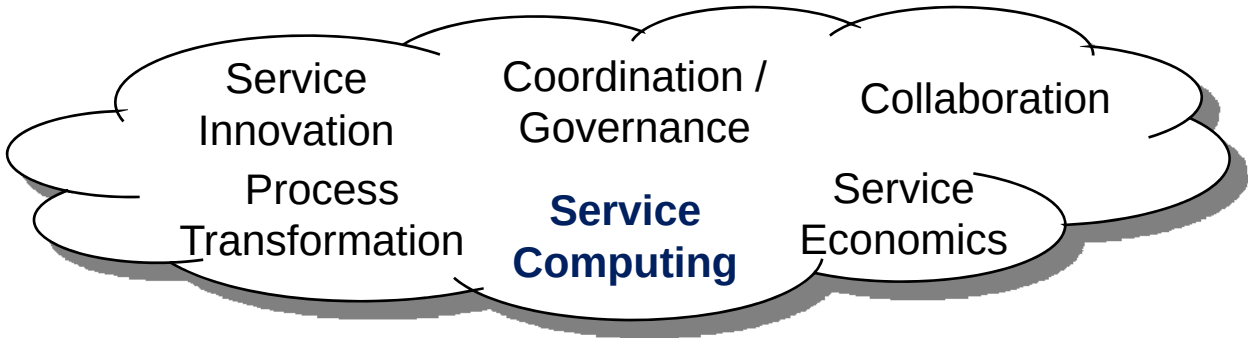
ICT view:
Service := Software construct

means to „transport“ value

SOA,
customer-provider interaction via Internet

Comprehensive view:
Service := activity to co-create value

Joint value creation



ICT enabled

Agenda

1. **Introduction: Cloud Computing**

2. **Understanding the Cloud Ecosystem; understanding business and technical (architectural) challenges**

3. **Understanding when (and when not) Clouds „compute“ (TCO – Total Cost of Ownership)**

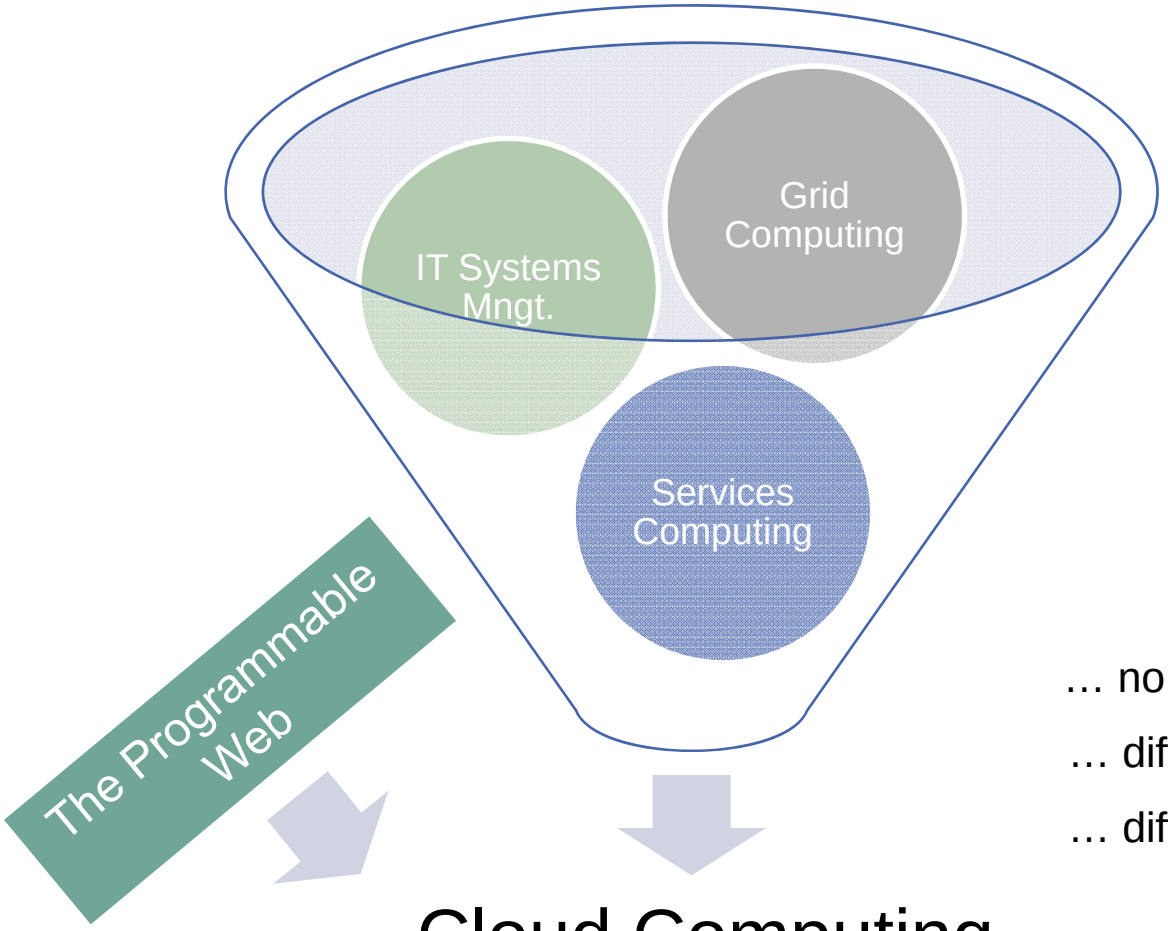
Why Cloud Computing?

- The classical problem
  - Under-utilized server resources waste computing power (and energy)
  - Over-utilized servers cause interruption or degradation of service levels
- The emerging problem
  - Highly dynamic scalability demands
  - Time to market
  - Affordable pricing
- Leveraging the modern Web
  - Sophisticated infrastructure is available as Services
  - Sufficient bandwidth makes Services a feasible option
  - New mass market for computing utilities

The Economist, October 23 Issue

- Cloud Computing lowers market barriers, thus enforcing competition and specialisation…
- The next wave of business process outsourcing is yet to come…
- Hardware is going to be a winner (with declining margins over time), business application vendors will lose, unless they manage to change their business model …
- Netbooks, smartphones and other electronic devices with built-in Internet access are going to be even more successful, allowing users to tap into the cloud wherever they are…
- *Headlines*:
  - The long nimbus
  - Clouds and judgment
  - Computers without borders
  - Highs and lows
  - On the periphery
  - Creating the cumulus
  - Where the cloud meets the ground
  - Let it rise

What is Cloud Computing?



… no single scientific community

… different research foci

… different business implications

A Definition

- **Building on compute and storage virtualization, and leveraging the modern Web, cloud computing provides scalable and affordable compute utilities as on-demand services with variable pricing schemes, enabling a new consumer mass market**

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Cloud Computing Players

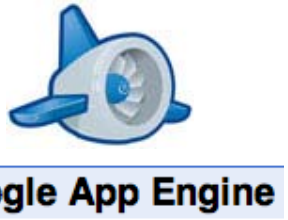
- Cloud **providers** – raw cloud resources; IaaS (infrastructure-as-a-service)
- Cloud **platform providers** – resources + frameworks; PaaS (platform-as-a-service)
- Cloud **brokers** – help broker some aspect of raw resources and frameworks, e.g.,
  - server managers
  - application assemblers
  -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

Players: Providers

- Programmatic access via Web Services and/or Web APIs
- "Pure" virtualized resources
  - CPU, memory, storage, and bandwidth
  - Data store

OR

- Virtualized resources plus application framework (e.g., RoR, Python, .NET)
  - Imposes an application and data architecture
  - Constrains how application is built



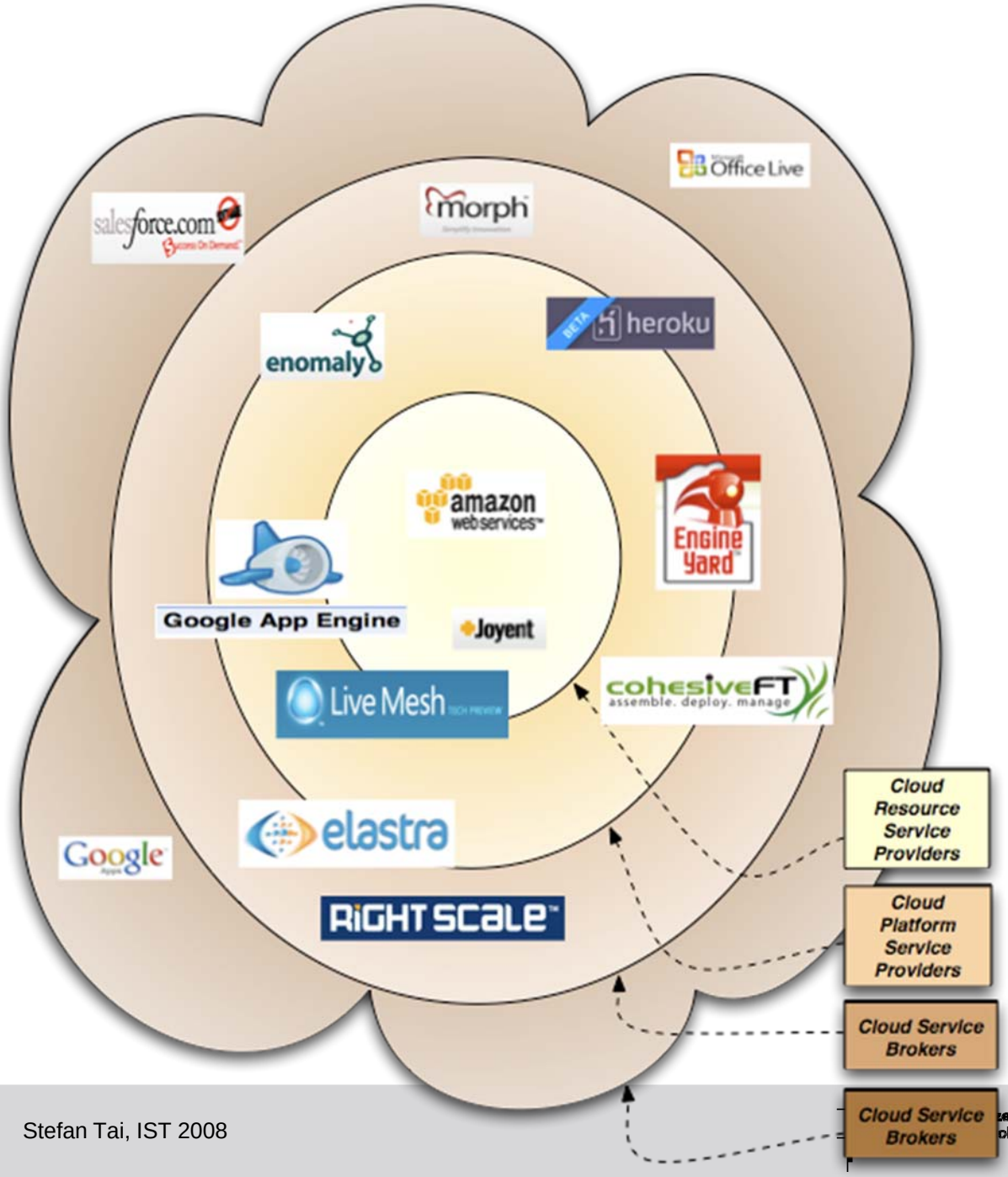
Players: Cloud Brokers

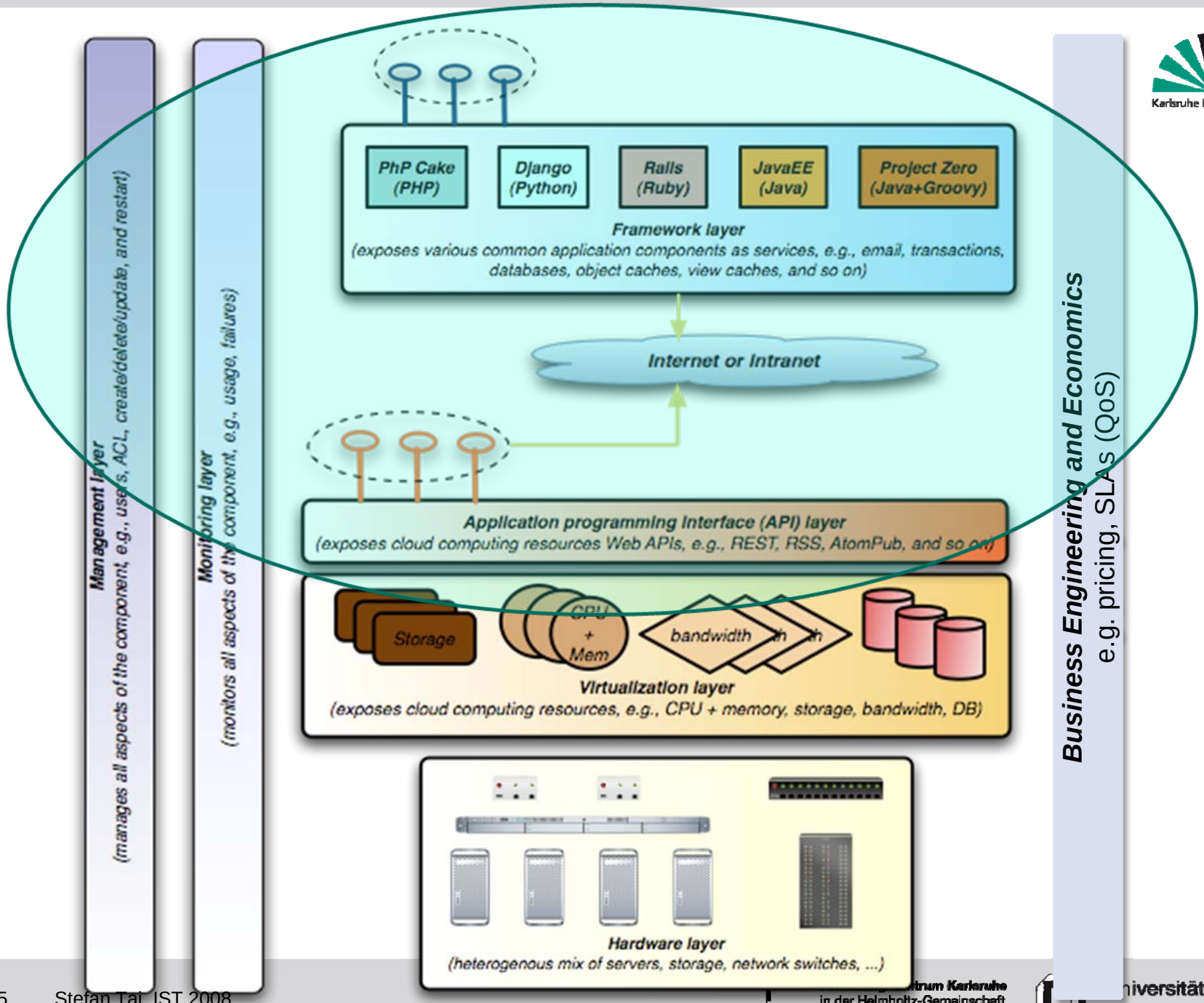
- Resells (aspects of) raw cloud resources, with added value propositions
  - Packaging resources as bundles
  - Facilitating cloud resource management, e.g., setup, updates, backup, load balancing, etc.
  - Providing tools and dashboards
- Enabler of a cloud ecosystem

Players: Application Providers

- **Software as a Service (SaaS): Applications provided and consumed over the Web**
- **Cloud usage (mostly) hidden**

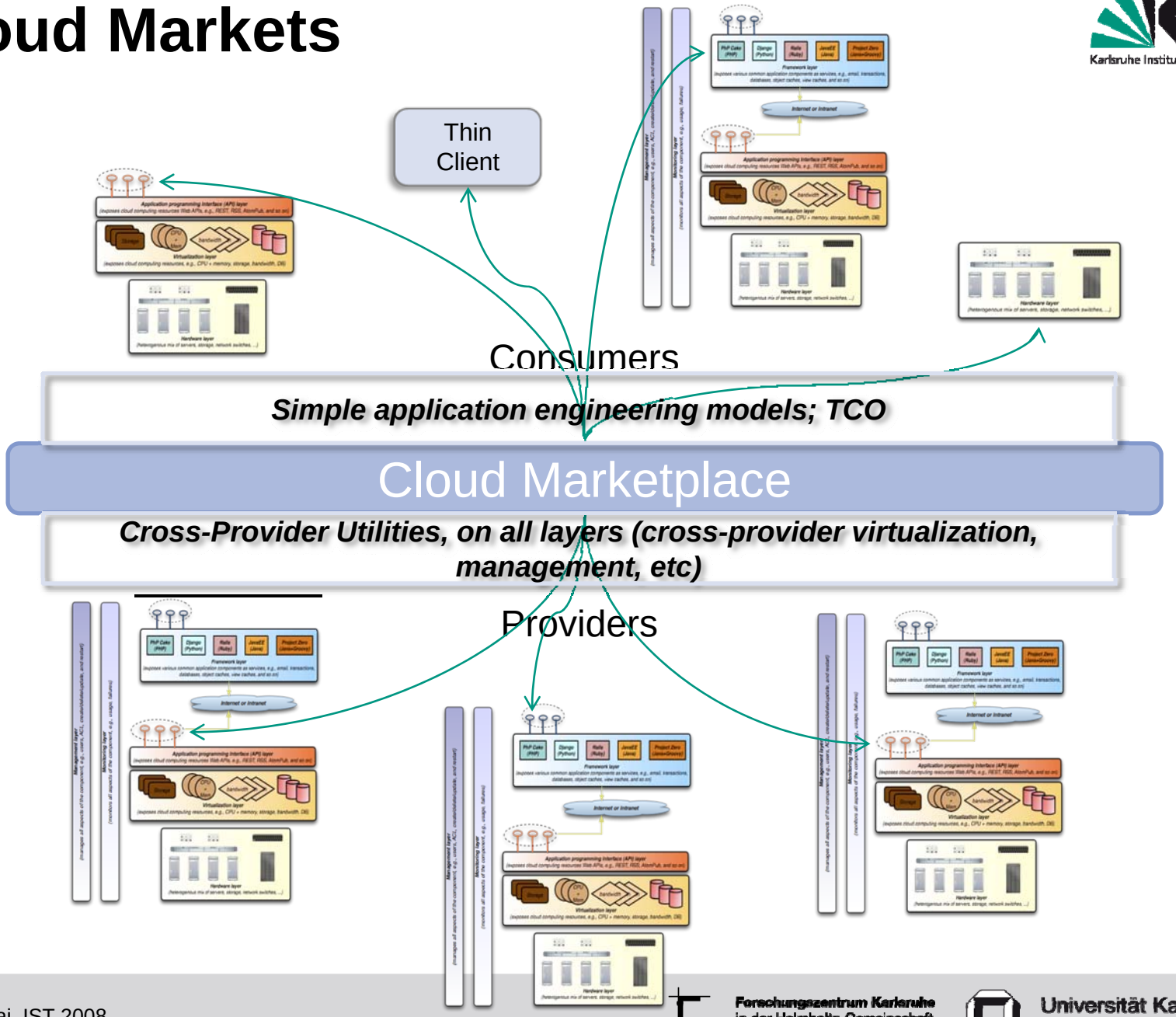
Evolving Cloud Ecosystem





Adapted from E. Michael Maximilien, IBM

Cloud Markets



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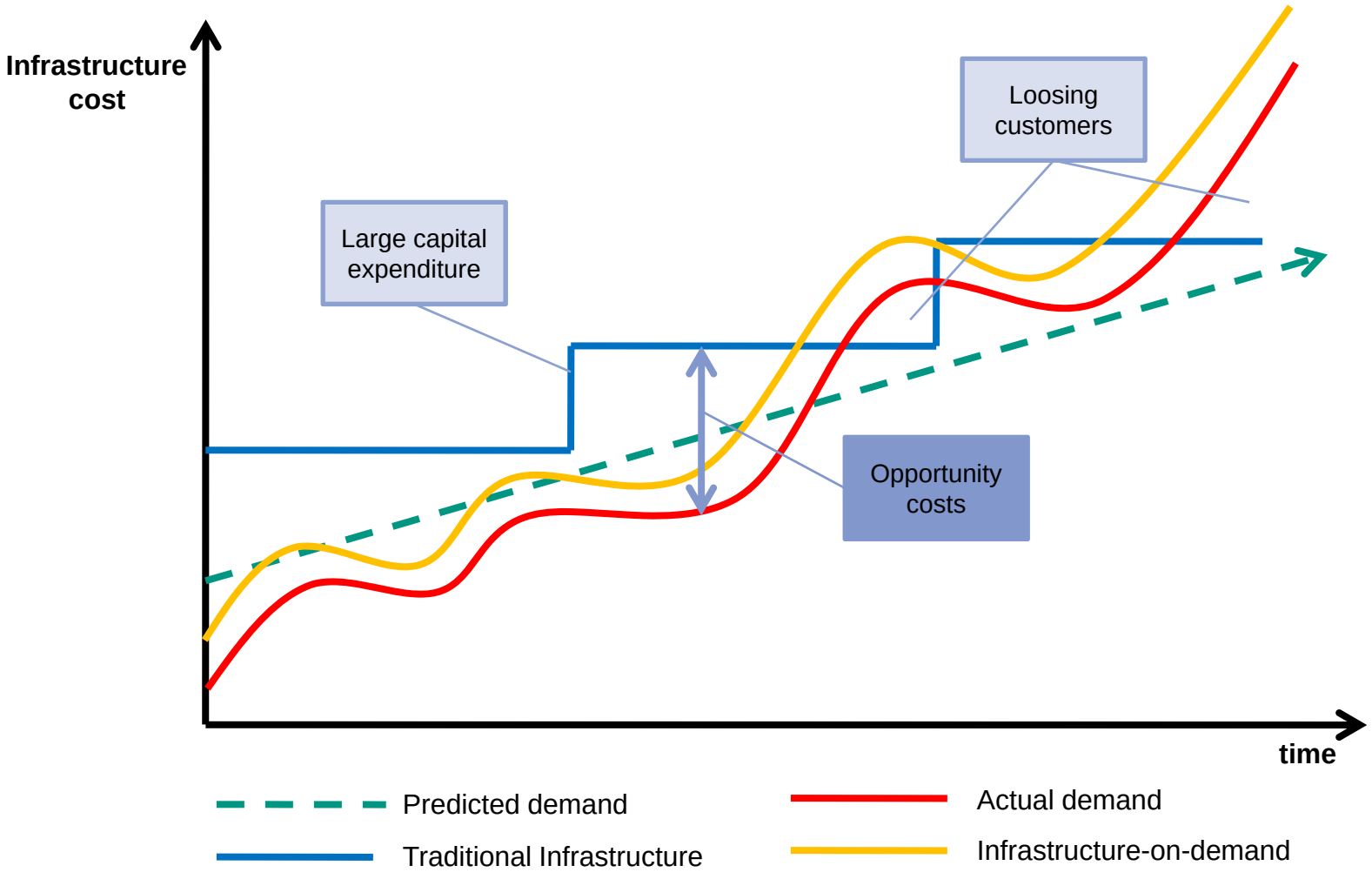
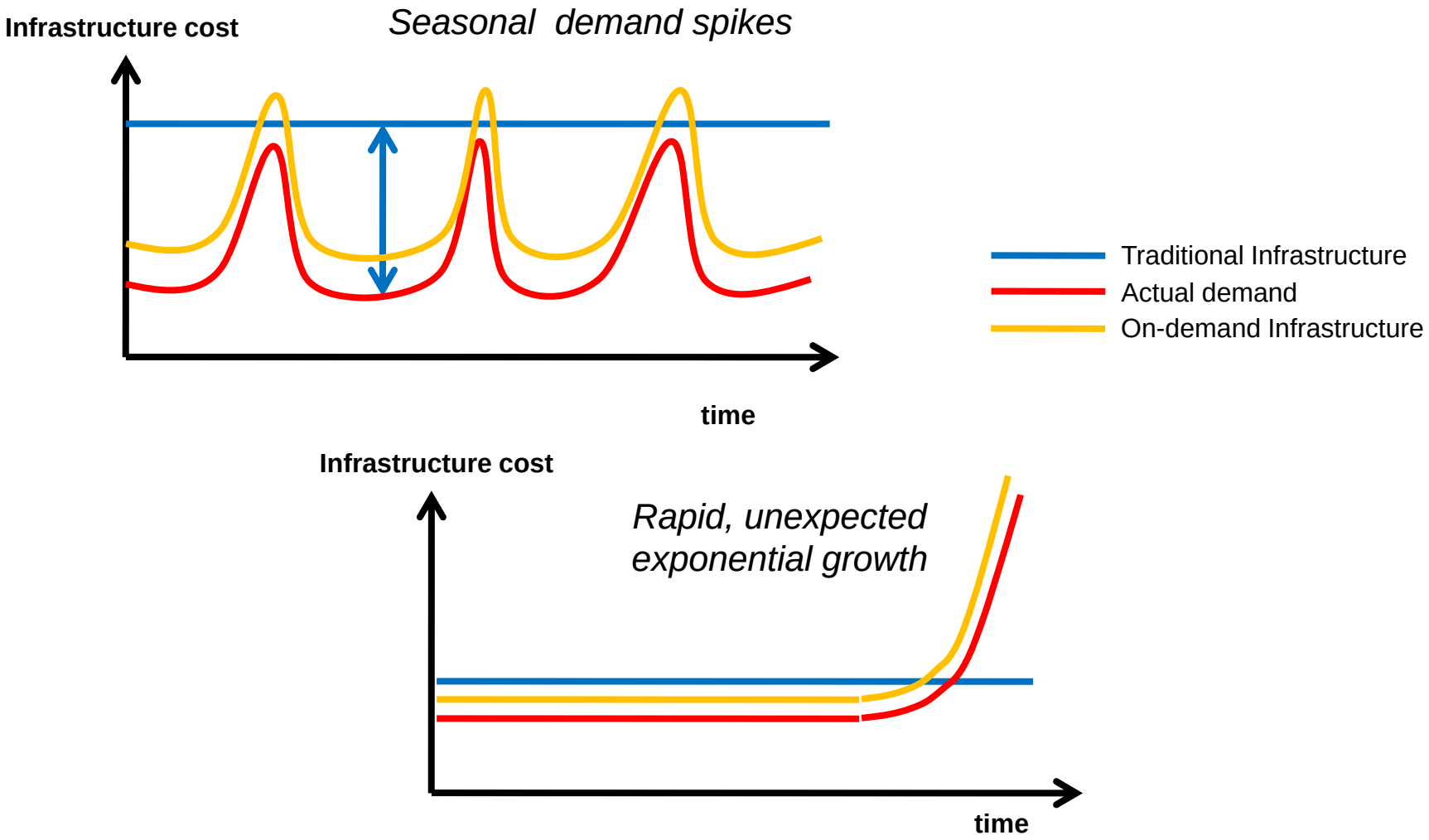
Demand predictions cost money



Adapted from Mike Culver, amazon.com

Diverse demand patterns exist



Cloud Computing TCO

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

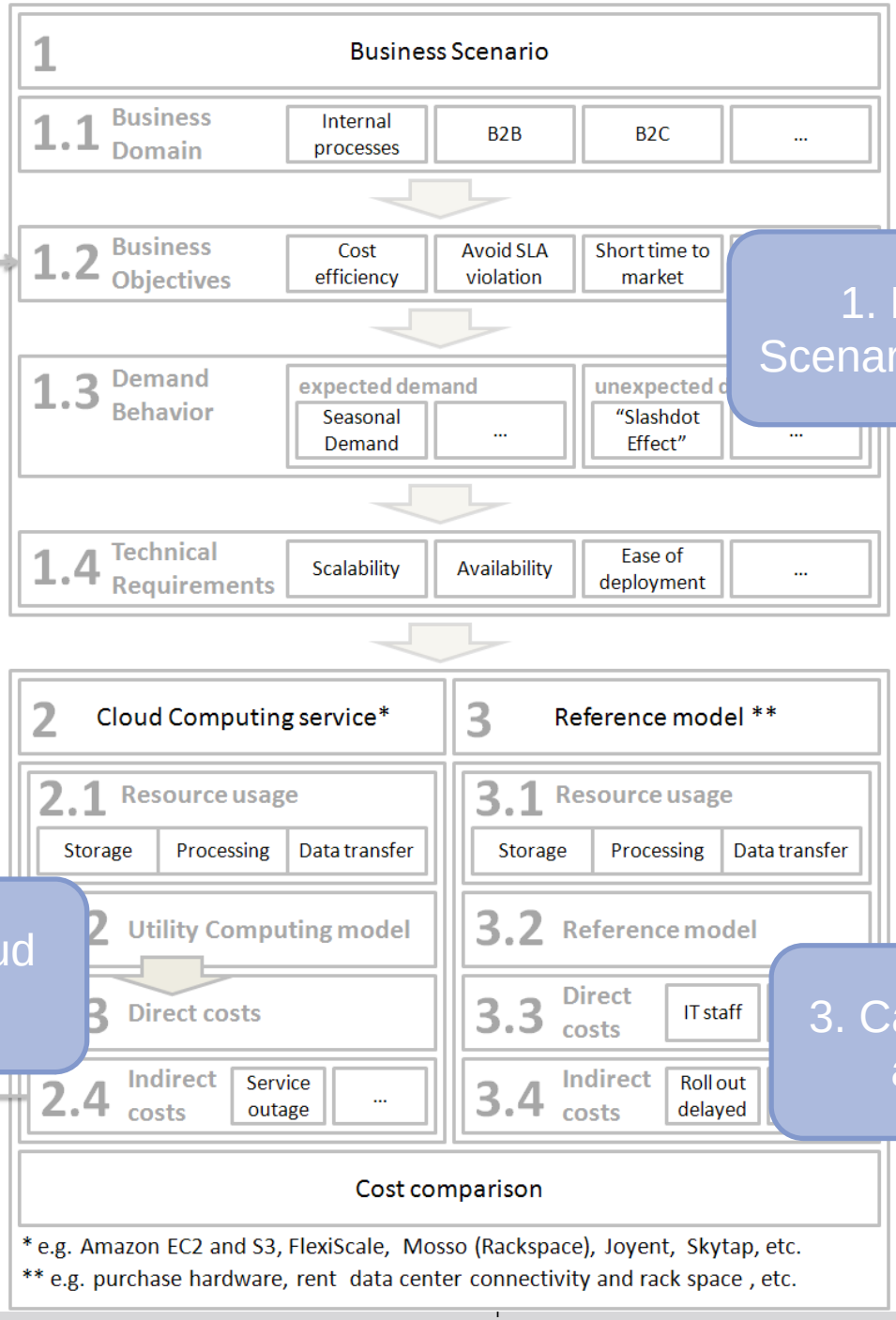
IT requirements
- scalability
- reliable and stable platform
- high availability

Understand and valuate benefits from cloud computing

Strategic evaluation
- understanding the cloud ecosystem
- **discovering new markets**
- **project-specific decision support**
- **provider lock-in problems**
- **SLAs, policies, and compliance**

Cost estimation & comparison
- TCO comparison
- utility computing modeling
- application of valuation tools

TCO Framework



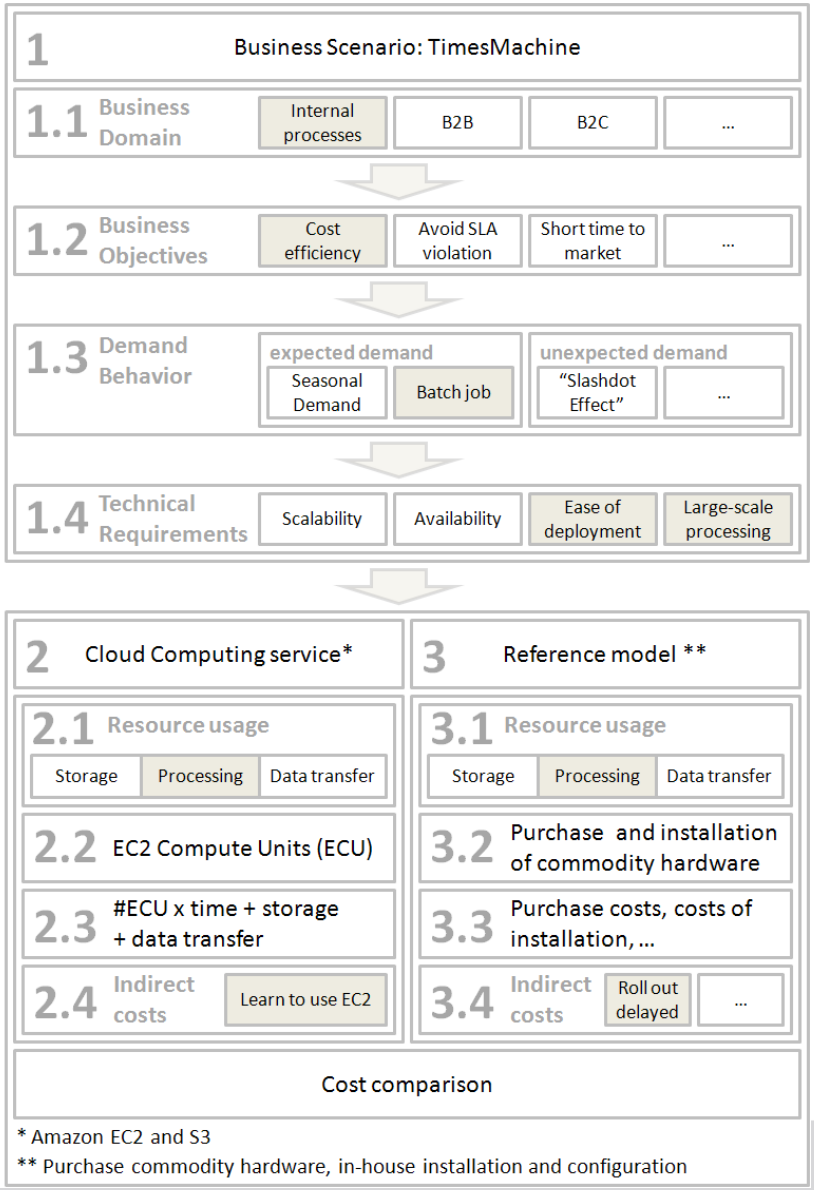
1. Model the Scenario/Application

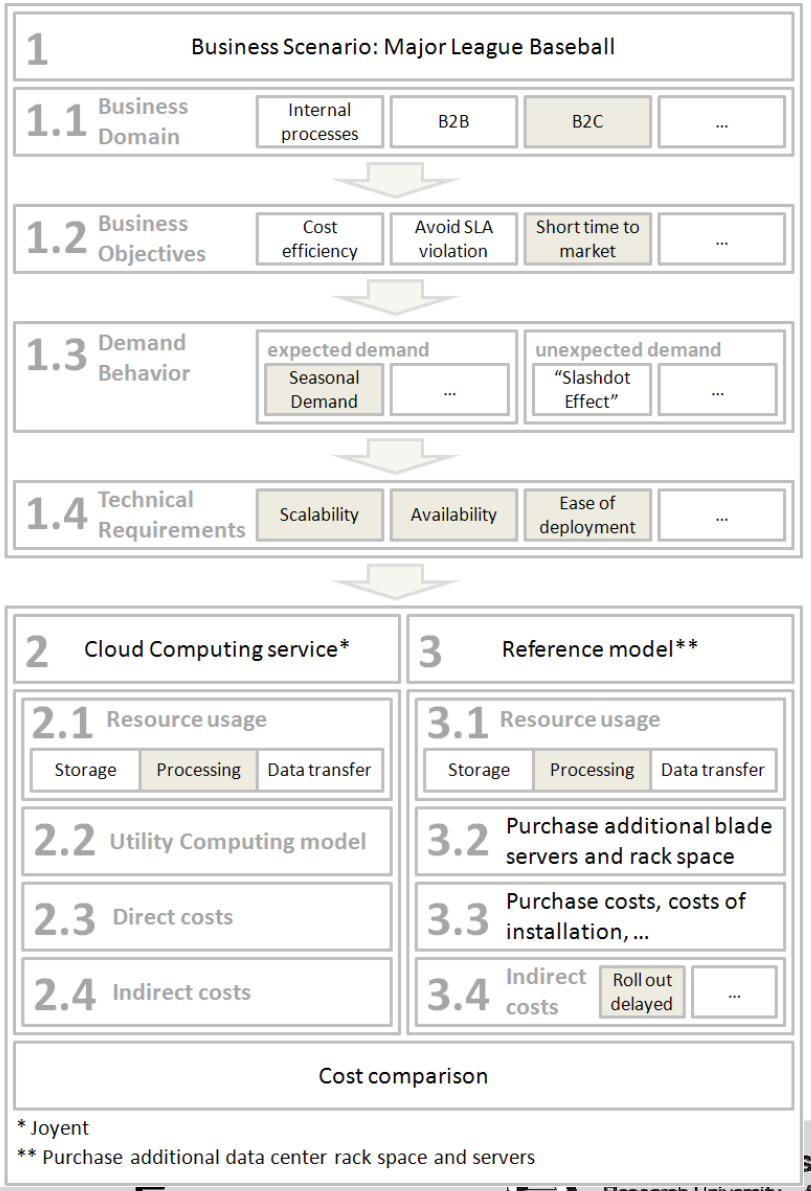
2. Calculate Cloud TCO

3. Calculate TCO of alternatives

Source:
M. Klems, J. Nimis, S. Tai:
„Do Clouds Compute?“, 2008

Sample Applications



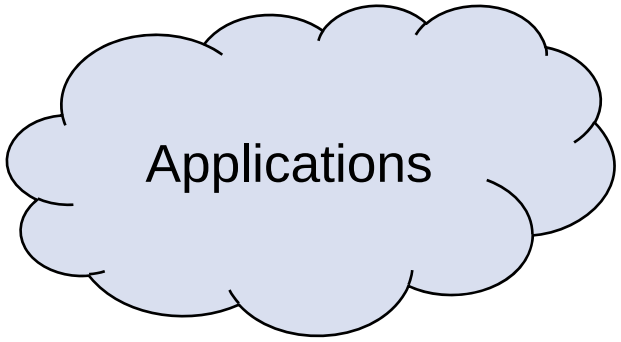


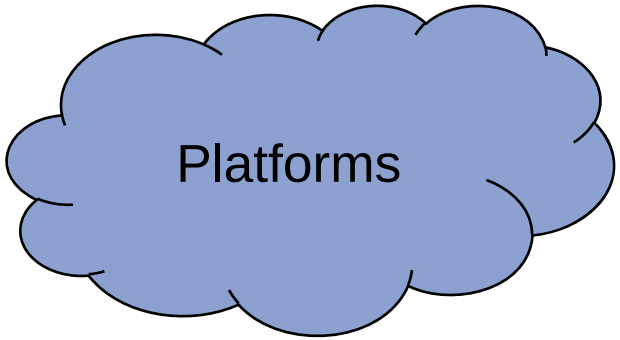
Summary: There are many Clouds…

Enterprise applications
(e.g., salesforce.com)

Consumer applications
(e.g., Google desktop apps)

Social networking applications



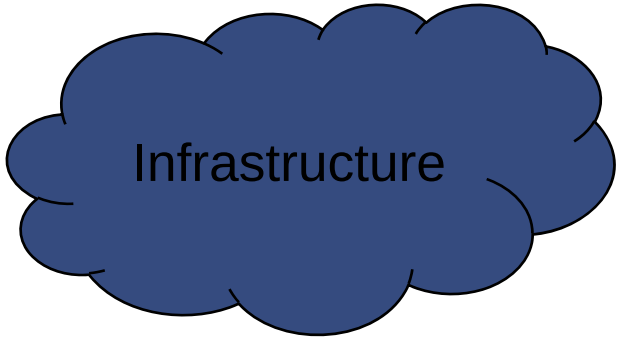


Frameworks and runtimes
(e.g., Google App Engine)

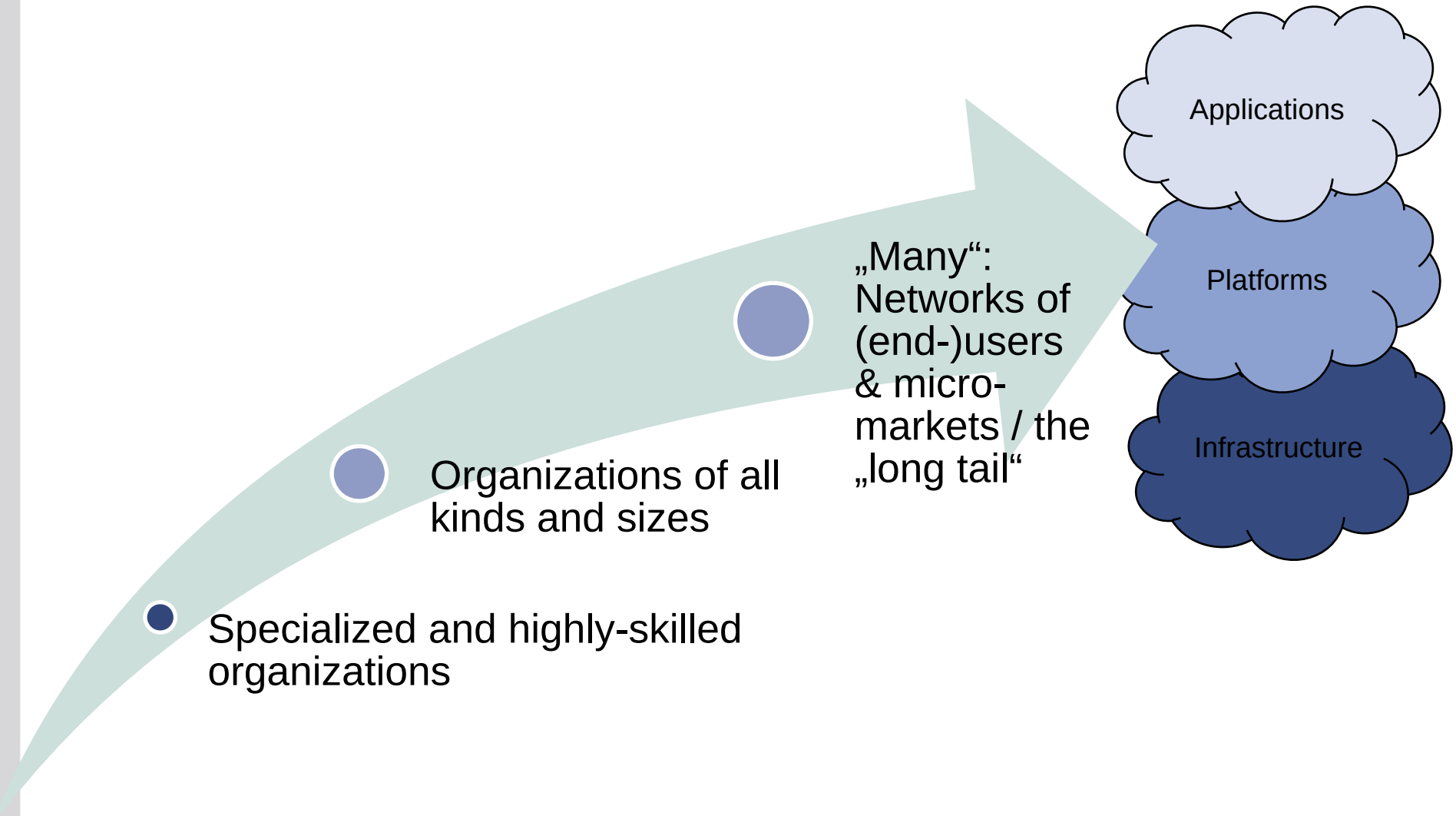
Workforce services
(e.g., Amazon‘s Mechanical Turk)

Compute power
(e.g., Amazon‘s EC2)

Storage
(e.g., Amazon‘s S3)



Opportunities in the hands of many

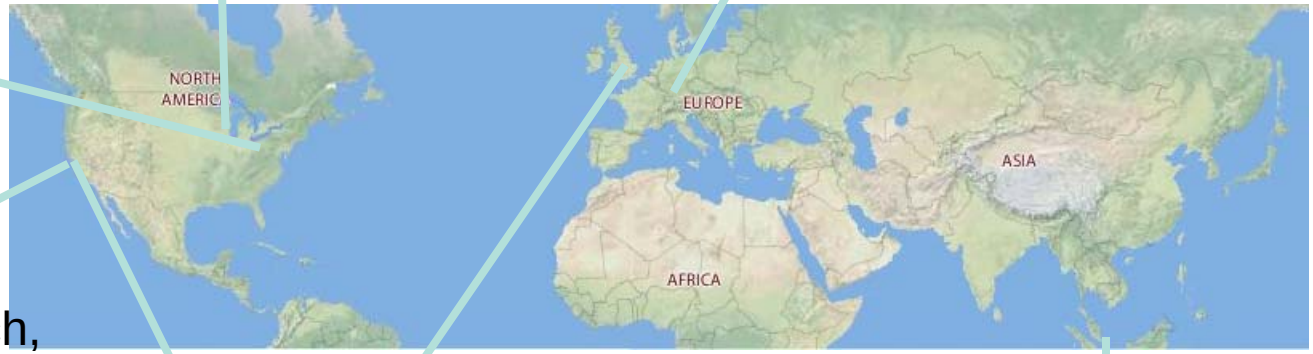


…and in Karlsruhe

University of Illinois,
Urbana Champaign

KIT, Karlsruhe,
Germany

Intel Research,
Pittsburgh



Yahoo! Research,
Sunnyvale

HP Labs,
Palo Alto, Bristol

Infocomm Development
Authority, Singapore

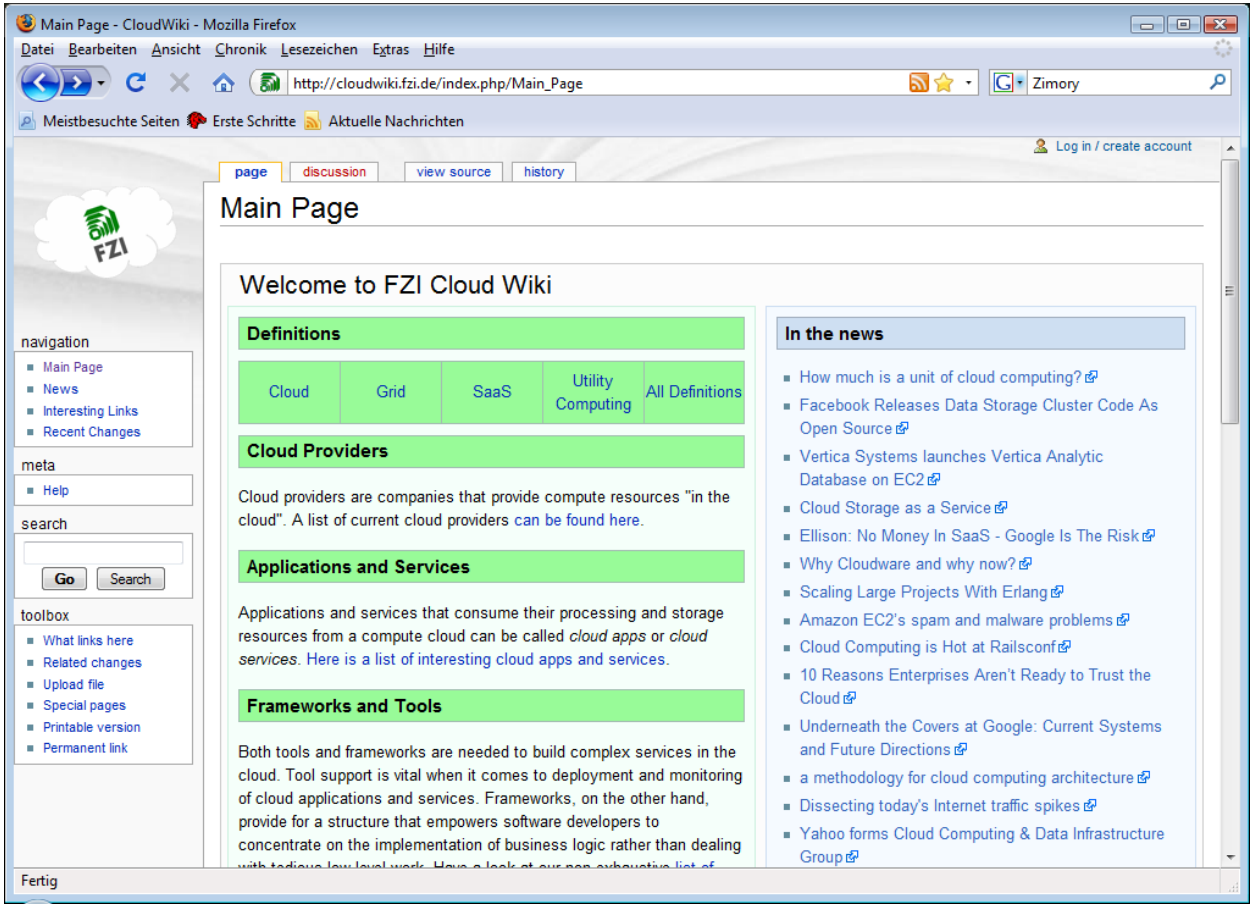
http://cloudtestbed.org

- Promote
  - collaborative cloud computing research among industry, academia and government on
  - cloud computing software,
  - data-center management infrastructure and hardware at an
  - Internet scale
- Availability by end of 2008

- Technical Benefits
  - Allow federated cluster experiments/benchmarks
  - Allow innovation at all levels of the cloud computing infrastructure stack
  - Commitment to openness in sharing software, tools, best practices
  - Collection of usage statistics
- Diversity of research areas

Cloud Computing Resources

http://cloudwiki.fzi.de



www.eOrganization.de

Thank You!

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- Christian Zirpins, KIT eOrganization

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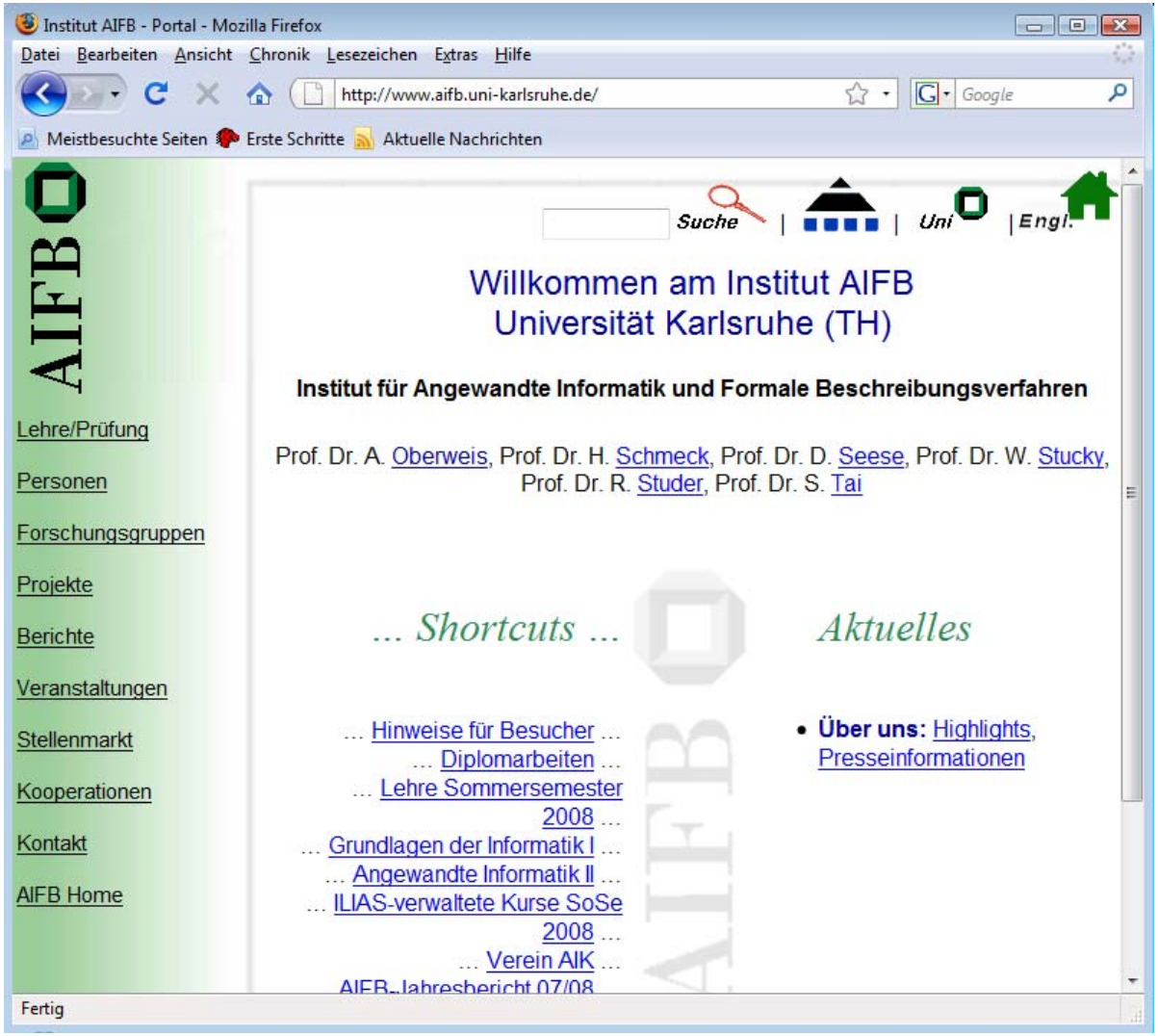

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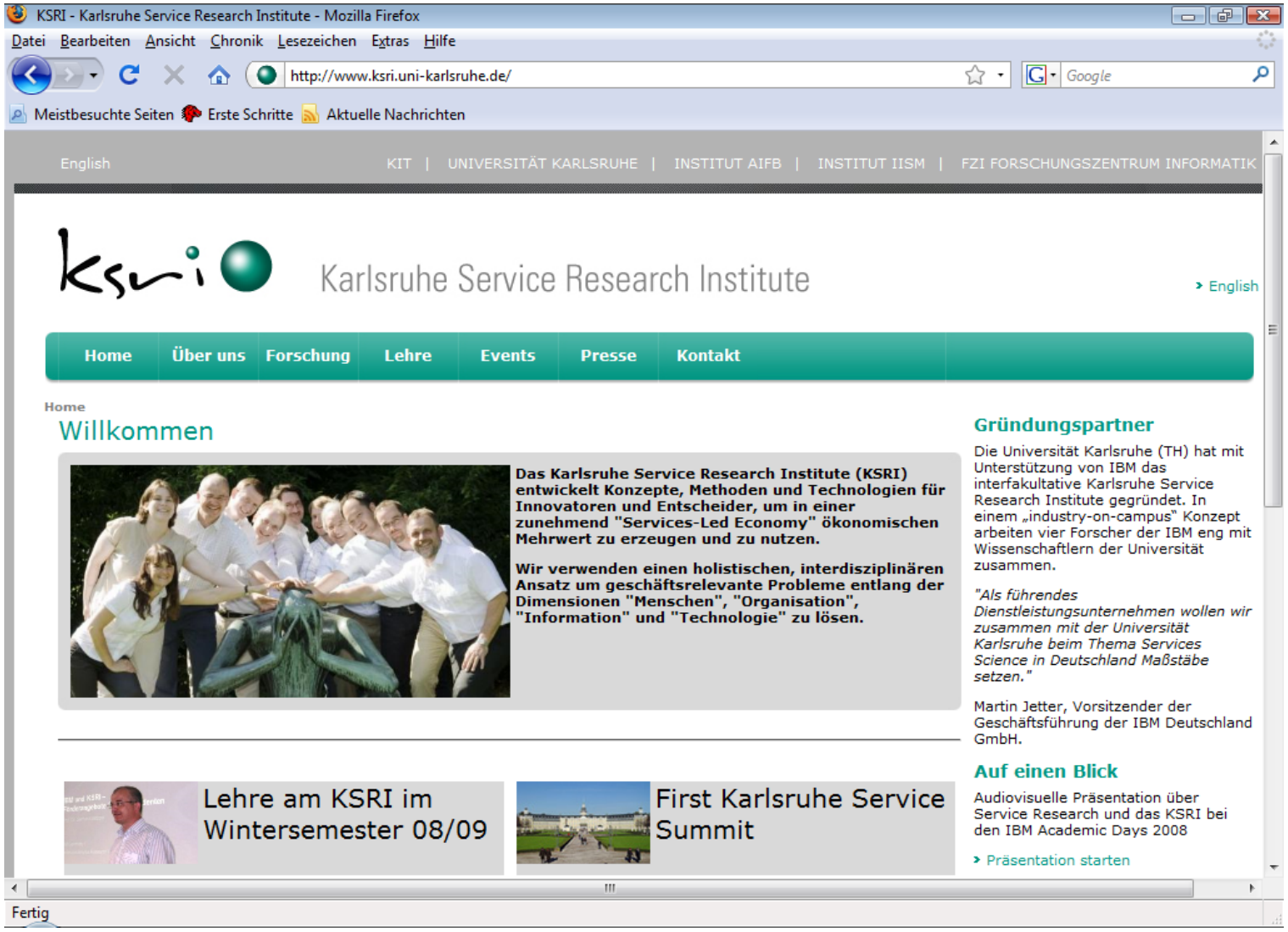

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