

The Future of Cloud Computing: Technical Aspects

report from the
cloud computing expert working group meetings

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Technical Aspects

- State of the Art
- Gaps
- European Focus
- Major Opportunities

Current State of the Art

- Horizontal scale-out elasticity
- Reliable basic data storage
- Resource level QoS
- High availability
- Basic system level virtualization
- Basic security mechanisms
- Basic tenant separation

GAPS

- Manageability and Self-*
- Data Management
- Privacy & Manageable Security
- Federation & Interoperability
- Elasticity (Vertical and Down)
- Programming Models & Resource Control

Manageability and Self-*

- Efficiency & Overhead of management
- Interoperability of management frameworks
- Compensation for insufficient resources
- Boundary criteria (QoS, legal, environmental)

Data Management

- Data size (with new access patterns)
- Lifecycle control (compliance & economic)
- Multi-tenancy
- Flexibility, expressiveness
- Consistency and concurrency models*

*see also programming models

Privacy & Manageable Security

- Multi-tenancy
- Provenance & compliance
- Composable security

Federation & Interoperability

- Proprietary de-facto standards
- Vendor lock-in
- Lack of agreed upon abstractions and interfaces for federation
 - QoS
 - Security
 - Migration

Elasticity

- Rapid release of unused resources
- Scheduling with variable resources
- Vertical elasticity*
- Rapidly changing workloads

*see also programming models

Programming Models & Resource Control

- Vertical scalability
- Intelligent distribution of code & data
- Reliability
- Ease of Use
- Development and operations support

European Focus

- Taking into account SWOT analysis
 - Generic IaaS probably too late to provide much differential impact through additional research
 - Uptake in Europe slower than elsewhere
- Where should Europe focus effort?
 - Concentrate on Ease of Use
 - Find and efficiently fill (large) **new** niches

European Focus

- Internet of Services
 - Leverage technical investments with high profitability and value creation and profitability
 - Leverage well standardized/regulated European strengths (telecommunications, energy, etc.)
- Comprehensive uptake support
 - Easy to use PaaS/SaaS (probably domain specific)
 - Attack vendor-lock-in and security concerns