Mulilateral Privacy in Clouds: Requirements for Use in Industry

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Cloud Services

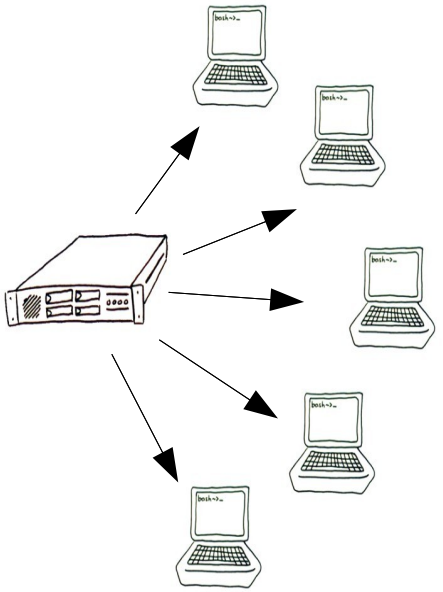
Introduction

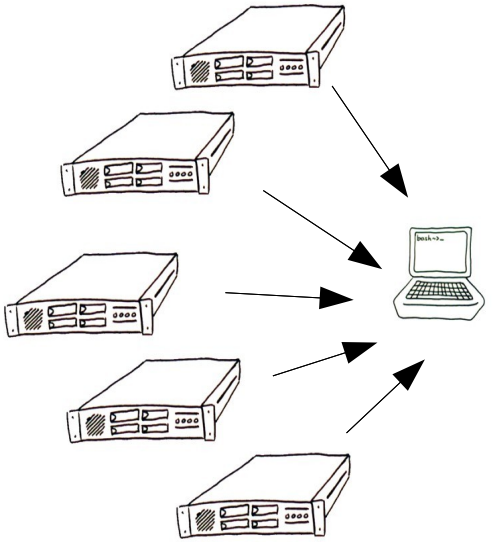
- Interacting Partners
- Types of Cloud Services
- Types of Clouds
- Graph Representation
- Reasons and Risks
- Multilateral Privacy

Requirements

Methods

- Dynamically utilisable, scalable IT services
- Use of **virtualisation** and **scalability**





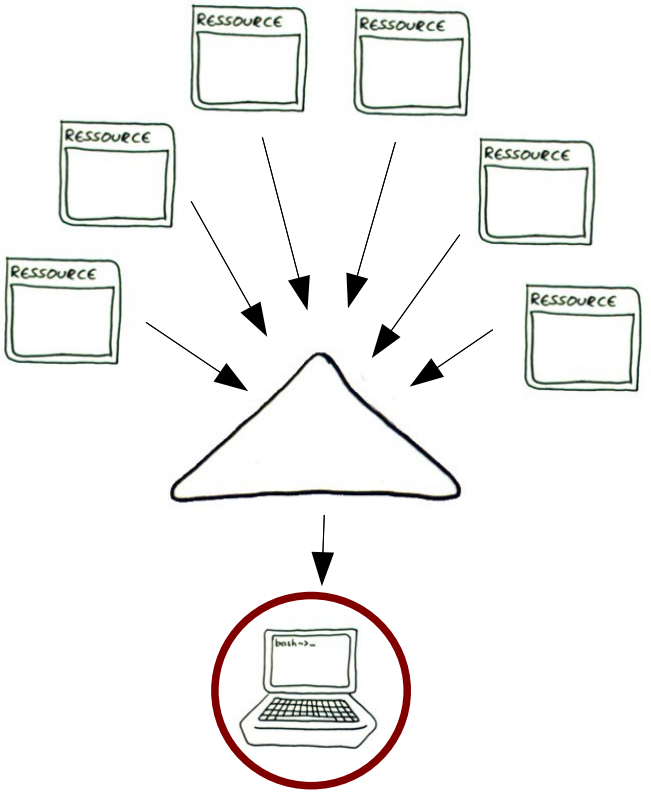
Interacting Partners

The different **interacting partners** in a cloud environment are

- Cloud Users
- Cloud Providers
- Resource Owners

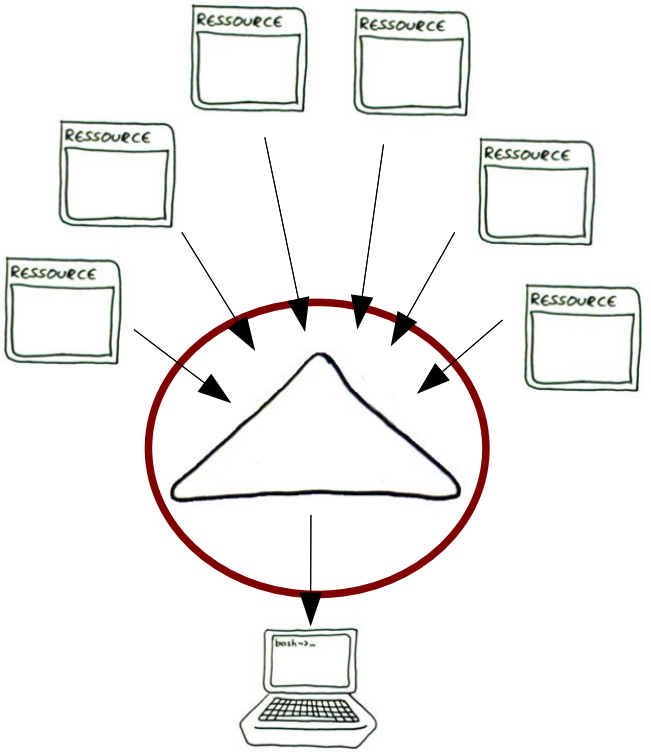
Cloud User

- Uses a cloud service
- A company is e.g. a cloud user



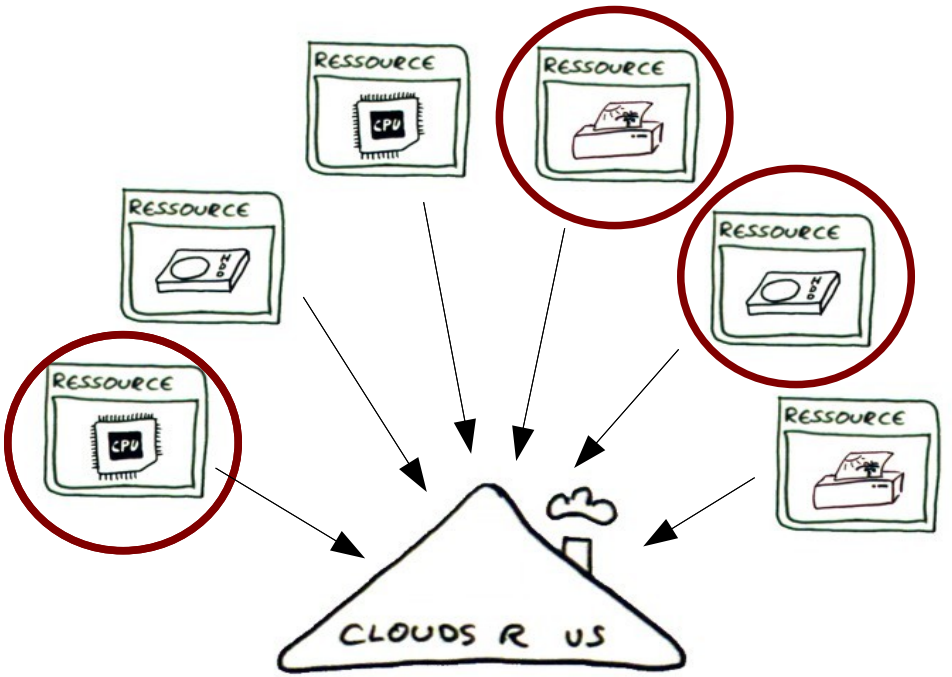
Cloud Provider

- Cloud services are offered by cloud providers



Resource Owner

- Resource Owner is an interacting party who owns resources



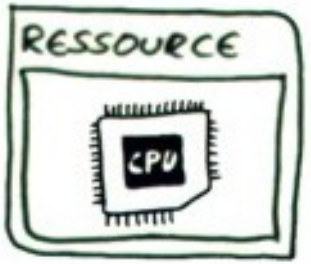
Types of Cloud Services

Cloud services are distinguished concerning the complexity of the technology stack they deliver.

- Types of cloud services are:
- **IaaS** - Infrastructure as a Service
- **PaaS** - Platform as a Service
- **SaaS** - Software as a Service

Infrastructure as a Service

- storage
- compute
- printing services



Platform as a Service

- Resources and infrastructure software as web servers, data bases, etc. (e.g. LAMP-Stack)

Software as a Service

- Software for complex processes e.g.
  - Email,
  - ERP (Enterprise Resource Planning),
  - CRM (Customer Relationship Management)
  - ECM (Enterprise Content Management)

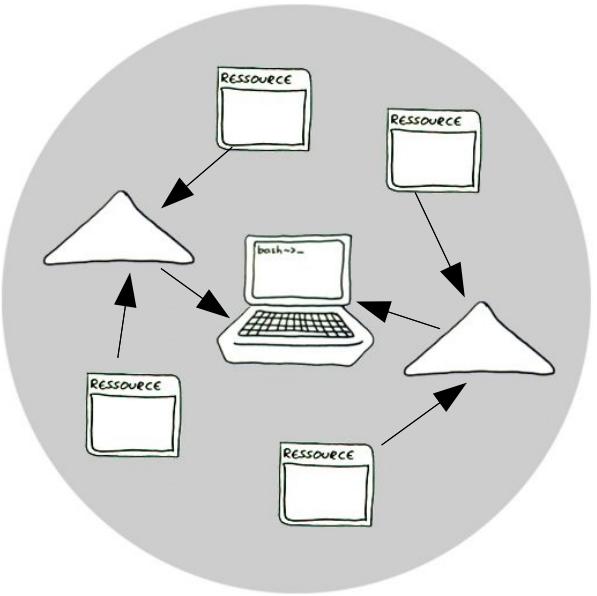
Types of Clouds

Cloud services are also distinguished concerning where the cloud service is situated:

- Internal clouds
- External clouds
- Hybrid clouds

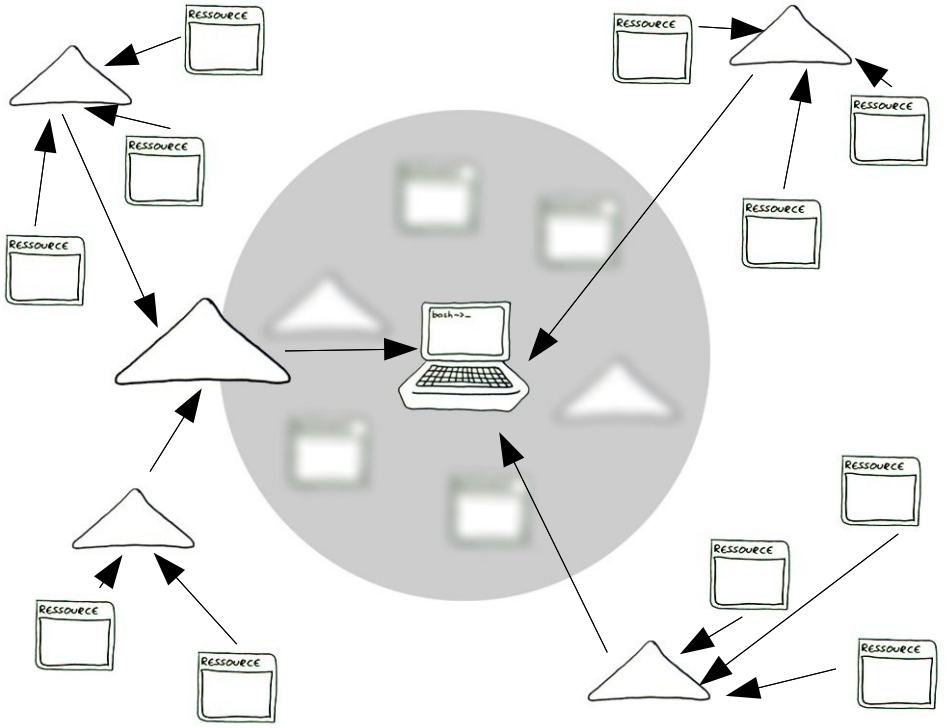
Internal Clouds

- Cloud user, cloud provider and resource owner are the same instance



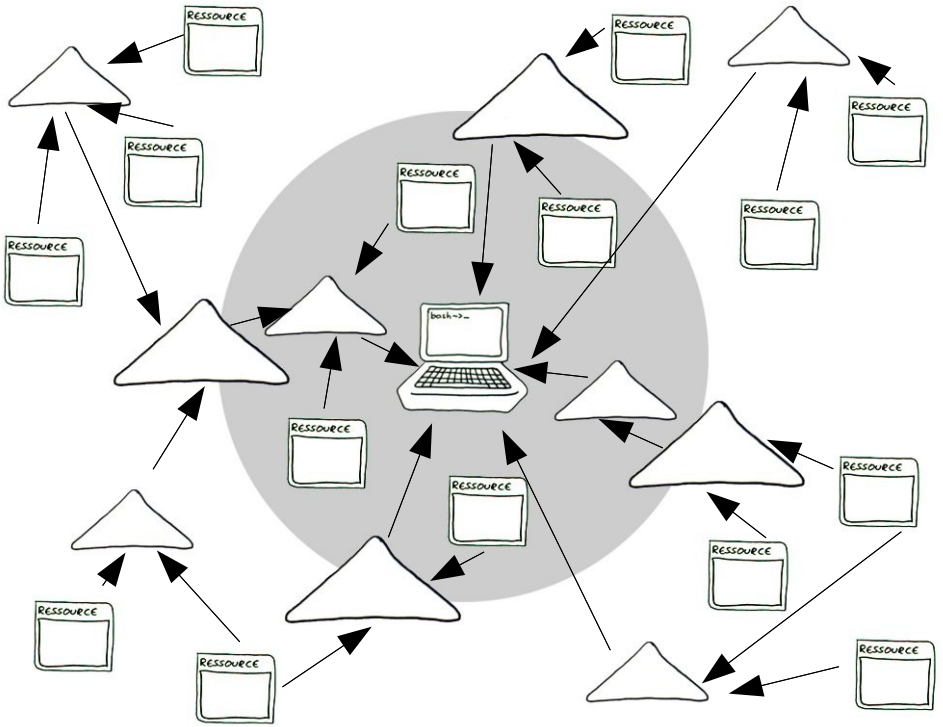
External Clouds

- Cloud services offered by an external supplier
- **All physical resources are out of reach of the cloud user**



Hybrid Clouds

- Mixture of internal and external cloud providers



Cloud Network

Interacting partners in a cloud can be visualized as a

finite, directed, cycle-free graph:

- **Vertices** - Interacting partners
- **Edges**
  - From cloud provider to cloud user
  - From resource owner resp. cloud provider to another cloud provider

Cloud Network

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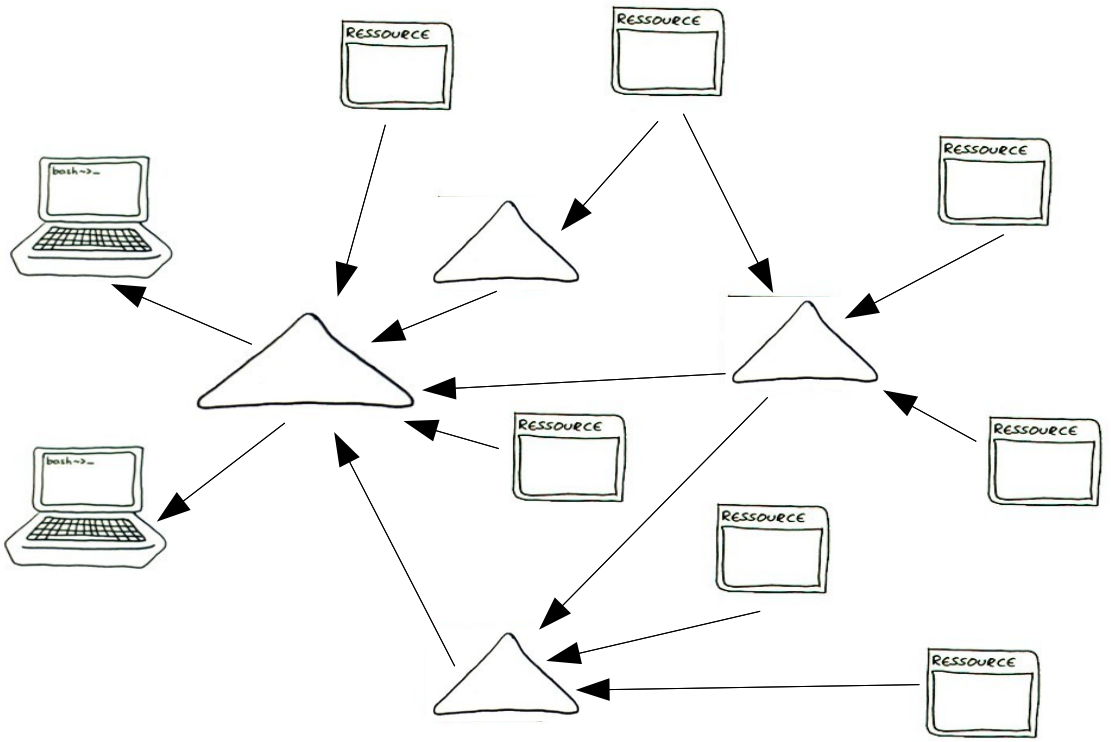

Cloud Network - Special Nodes

Cloud user:

- Vertex without successor

Resource owner:

- Vertex without predecessor

Cloud Subnet

For each **cloud user** at a certain **point in time** the **cloud subnet** is the sub-graph induced by the

- the cloud user,
- all cloud providers and
- all resource owners

that are utilized to provide the cloud service to the specified cloud user.

Cloud Subnet

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- **Graph Representation**
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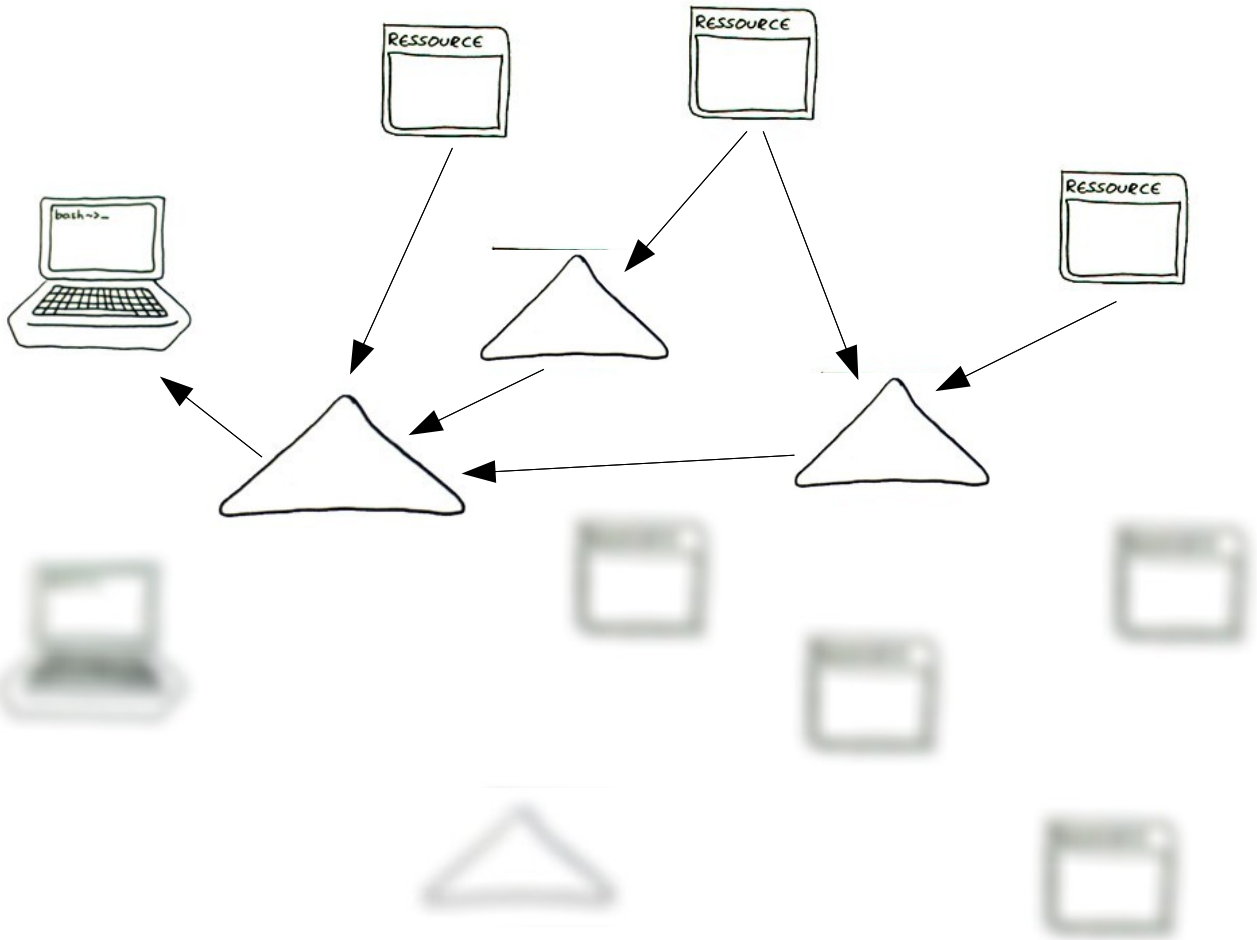
Requirements

Methods



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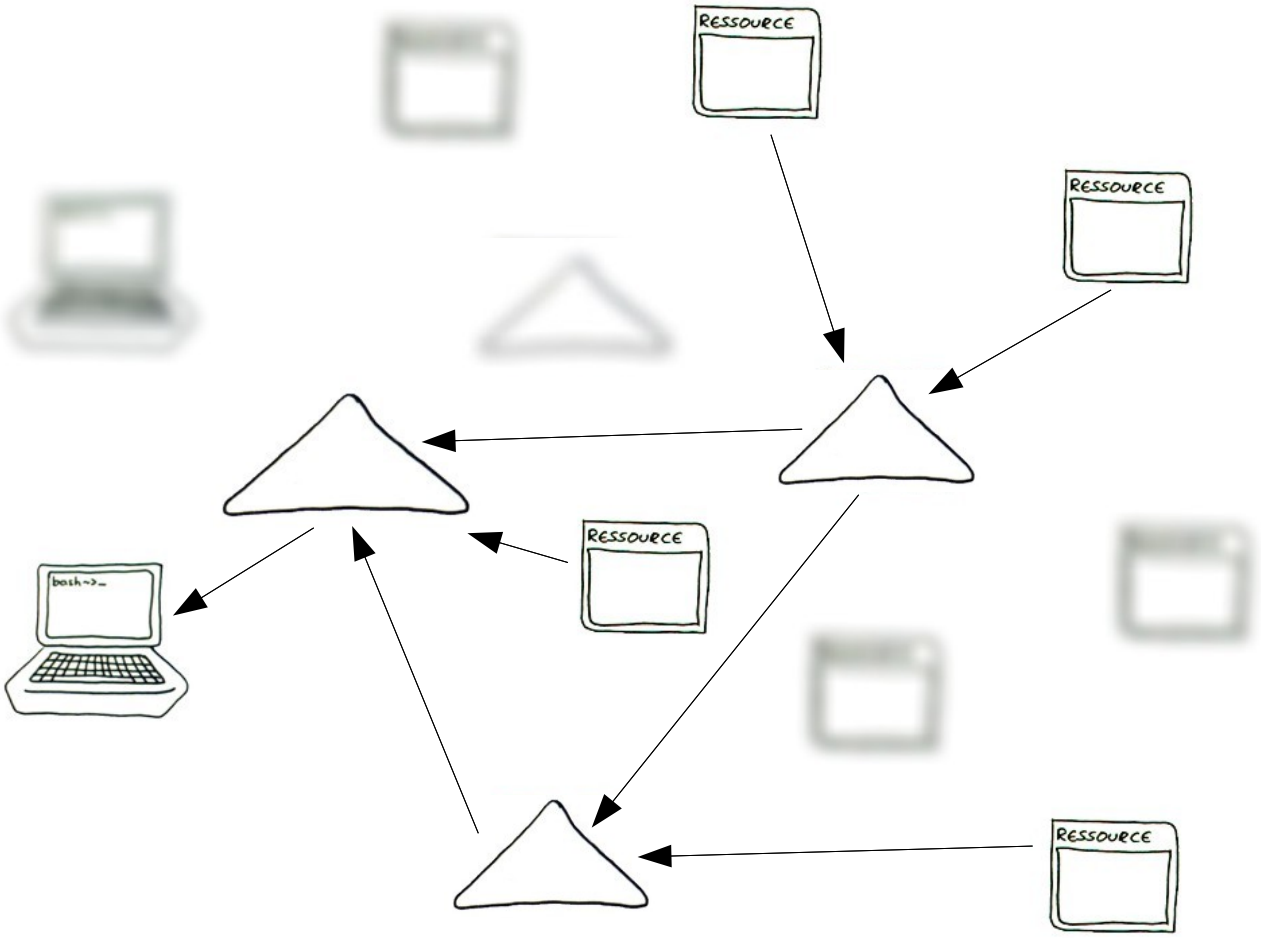


Why to use cloud services?

Reasons for cloud users:

- limited IT know-how
- limited IT investment
- interesting service levels difficult to realise
  - mirroring over different physical sites
  - off-site backup
  - high availability of the computing platform

Why to use cloud services?

Reasons for cloud users:

- realisation of complex processes
  - Email
  - CRM - Customer Relationship Management
  - ECM - Enterprise Content Management
  - ERP - Enterprise Resource Planning

Risks of cloud services?

Cloud User needs legal warranties concerning

- security
- data privacy

since person-related data are operated not only from the cloud provider but

from the whole cloud subnet at any point in time.

Multilateral Security

Allows all parties of an interaction

- **to express their security objectives**
- recognizing conflicting objectives
- negotiating compromises
- enforcing objectives within the scope of the compromise
- with no party taking precedence over another.

Mechanisms of effective control are needed.

Multilateral Privacy

Allows all parties of an interaction

- **to express their privacy objectives**
- with no party taking precedence over another.

Mechanisms of effective control are needed.

Cloud Requirements

What sort of requirements?

- Functional Requirements
- Non-Functional Requirements

Whose requirements?

- Cloud user
- Cloud provider / resource owner

Functional Requirements

IaaS

- Type and clock rate of the CPU
- Amount of memory, disk space

SaaS

- E.g. collaborative work on documents
- Search options for data stored

Non-Functional Requirements

Operational Requirements

- Start, stop, configure the service
- Automatic provisioning

Service Level Agreements (SLA)

- Availability, reliability, scalability
- **Data integrity, privacy, access control**
- **Legal regulations**

Legal Regulations

- **Data Protection Directive**
- **E-Privacy Directive**
- **EuroSOX**

Data Protection Directive

Any person-related data has to be processed

- fairly and lawfully, **for limited purpose**
- adequate, relevant, not excessive, **accurate**
- **not be kept longer than necessary**
- processed in accordance with the subjects rights
- **secure**

E-Privacy Directive

In cloud environments important:

- transfer of personal information to countries outside the EU providing an adequate level of privacy protection
- Transfer of data to the USA: Safe Harbour Agreement

SOX, EuroSOX

SOX (Sarbanes-Oxley Act): reaction to accounting scandals e.g. Enron, Worldcom

- Demands e.g. an internal control system for corporations in the US and all subsidiaries

EuroSOX: similar requirements have evolved in the EU

- Resulting e.g. in the german law BilMoG (Bilanzmodernisierungsgesetz)

Requirements for SOX, EuroSOX

Central prerequisites for compliance with these regulations are the following

- Transparent and documented business processes
- Transparent and documented IT environment
- Identity Management
- Based on the above control objectives can be formulated and checked by an internal control system

Requirements of Cloud Providers

All the requirements named above are mainly requirements of the cloud users

Cloud providers, resource owners have also requirements they need to impose

- **Operational requirements**: monitoring, measuring, reporting and billing for services
- **Comply with legal regulations**, e.g. export control regulations

Methods

What are the measures and means to realize the requirements of all interacting partners in the cloud?

- **Federated Identity Managemen**t as a basis to realise access control and reporting.
- **Cloud Interfaces** as a cloud service should be started dynamically in an automated way.
- **Certification and Control** to check that the requirements are fulfilled

Cloud Interfaces

Introduction

Requirements

Methods

- Federated Identity Management
- **Cloud Interfaces**
- Certification and Control

Interfaces for cloud services are differentiated according to types of cloud services

- **SaaS:** Often a web interface (Salesforce, Gmail) or a special user client is used
- **Iaas, Paas:** provider specific API, examples for provider APIs are:
  - Amazon EC2 API,
  - Sun Cloud API
  - ...

Cloud Interfaces

Notation for the APIs based on

- **XML**
- **JSON** (JavaScript Object Notation)

Type of information

- **Functional requirements** (mainly)

Risks of Present Cloud APIs

Non-functional requirements:

- compliance
- availability
- scalability
- privacy
- data security

Vendor lock-in:

- Dynamic change of cloud provider implies change of API in application

Standardisation Initiatives

Standardization initiatives start based on the cloud APIs in industry for IaaS:

OCCI-WG (Open Cloud Computing Interface Working Group)

- Start of API for IaaS based on cloud APIs in industry
- Non-functional requirements based on use cases
- Relies on RESERVOIR architecture

Requirements in APIs

- **Format for data interchange** as e.g. XML, JSON
- **Categories of requirements:**
  - Low, medium, high availability instead of 93.5%
- **Categories defined in the documentation**
- **Automated check**

Automated Check of Requirements

There are 3 scenarios:

1. **Cloud user** requests a service
2. **Standard Requirements**
   Cloud provider provides a cloud service where a typical requirements is met
3. **Cloud provider, resource owner** is added to the cloud network

1. Cloud User Requests a Service

- Cloud User requests a requirement from the cloud provider
- Cloud provider requests if all direct predecessors in the cloud network support the requirement
- Inductively repeat that step until resource owners are reached
- Resource Owners could at least answer to the request

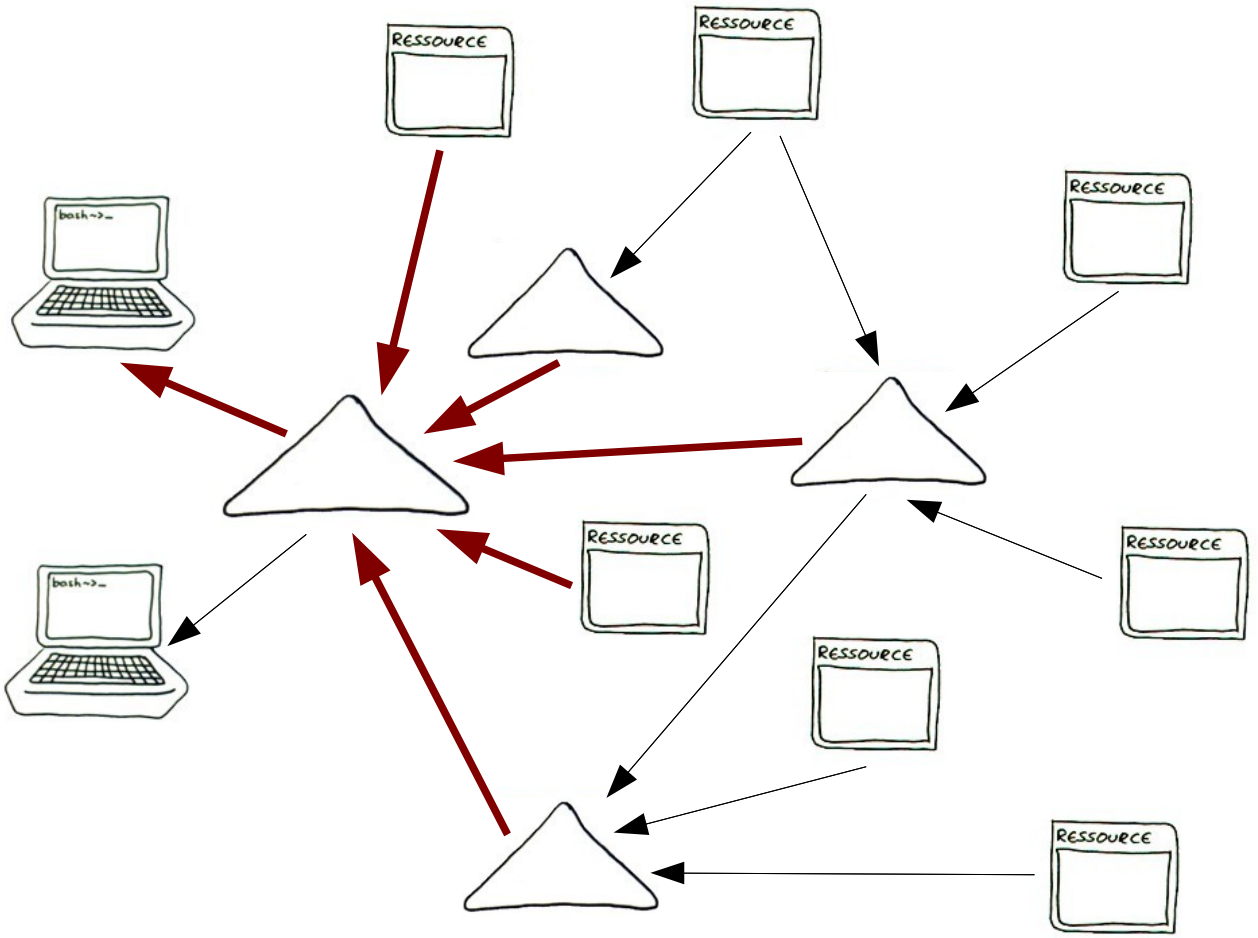
1. Cloud User Requests a Service

Introduction

Requirements

Methods

- Federated Identity Management
- **Cloud Interfaces**
- Certification and Control



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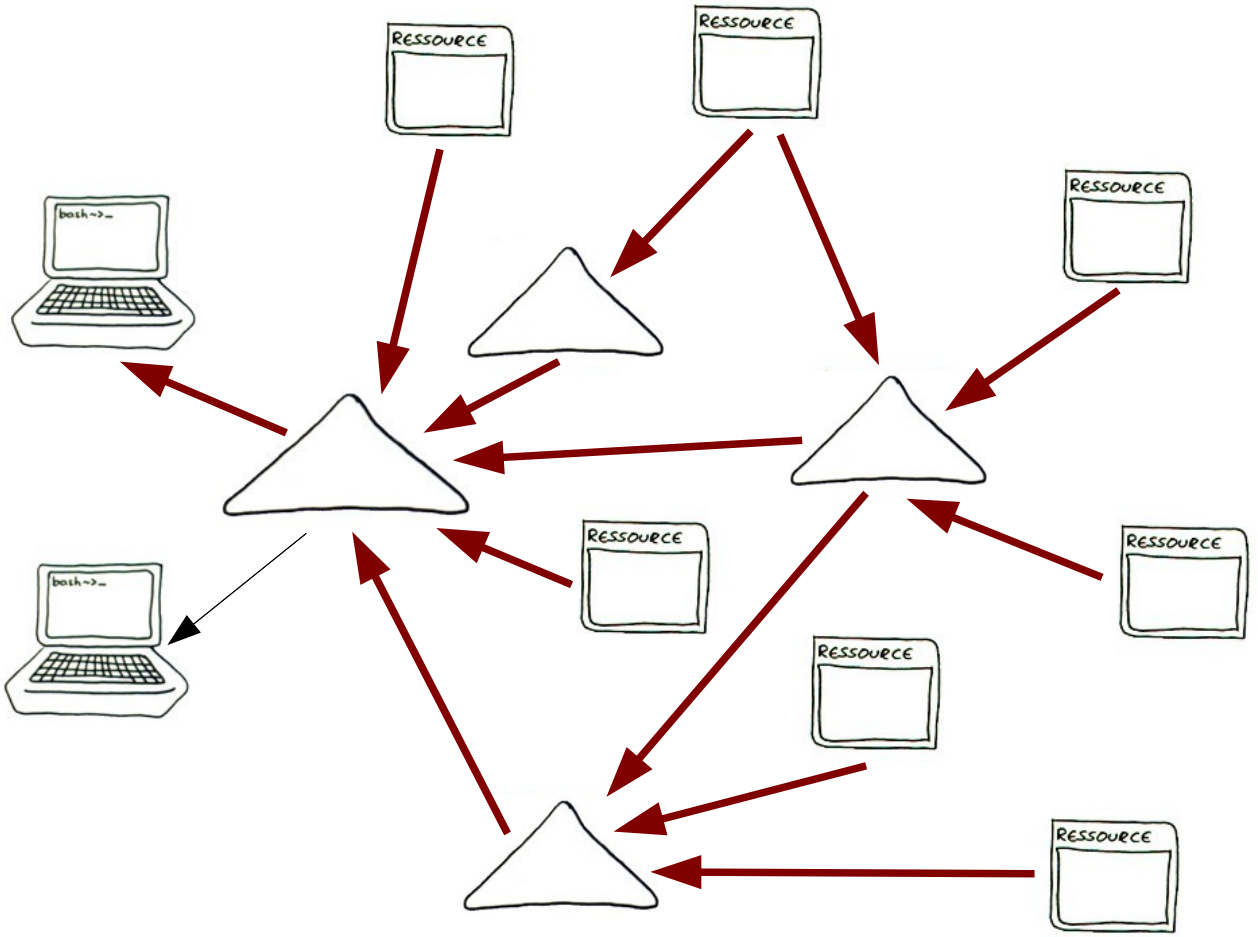

1. Cloud User Requests a Service (2)

- Answers are acknowledge, non-acknowledge
- Cloud Providers derive their answer from the answers of all direct predecessors
- Cloud user receives an acknowledge or non-acknowledge message

1. Cloud User Requests a Service (2)

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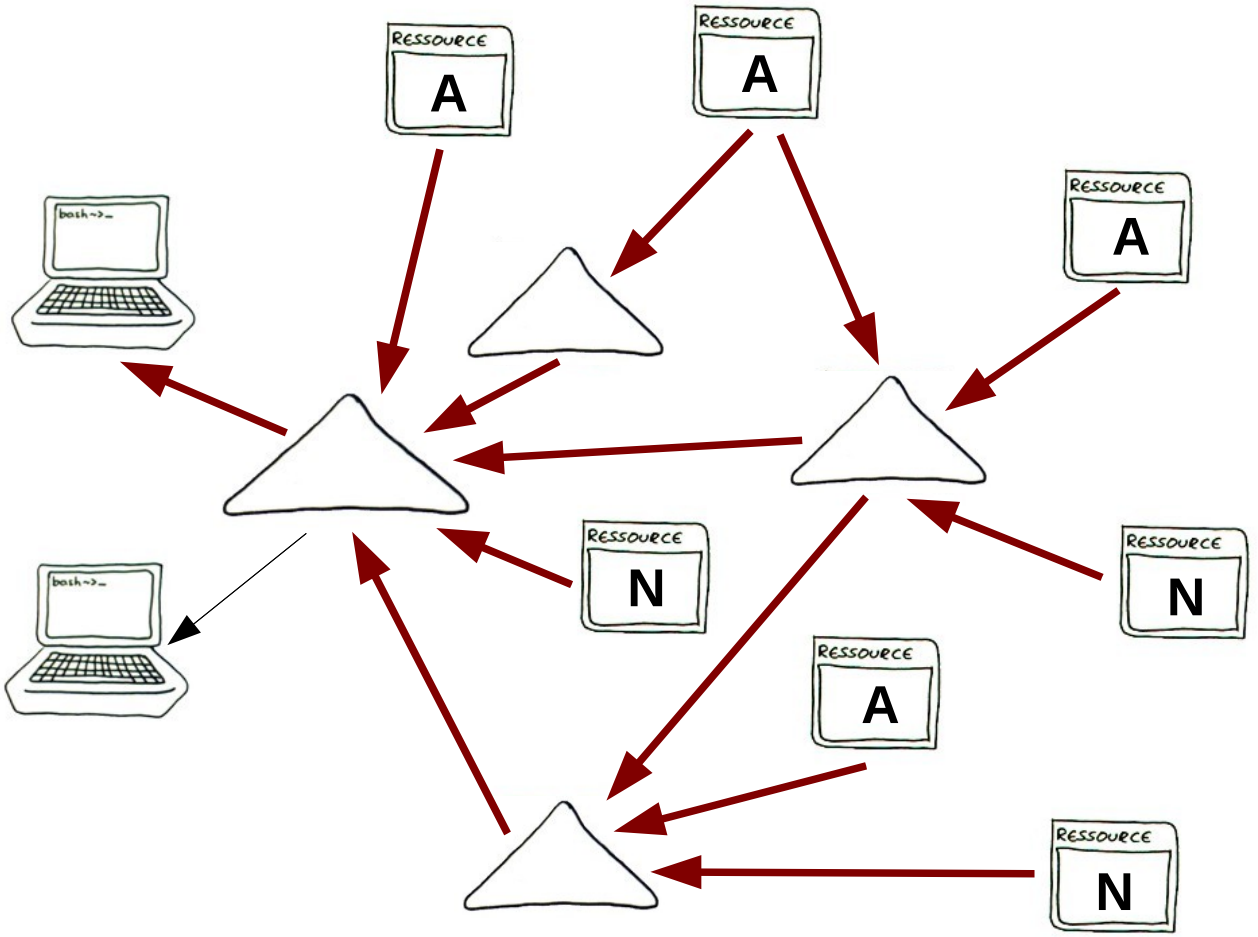

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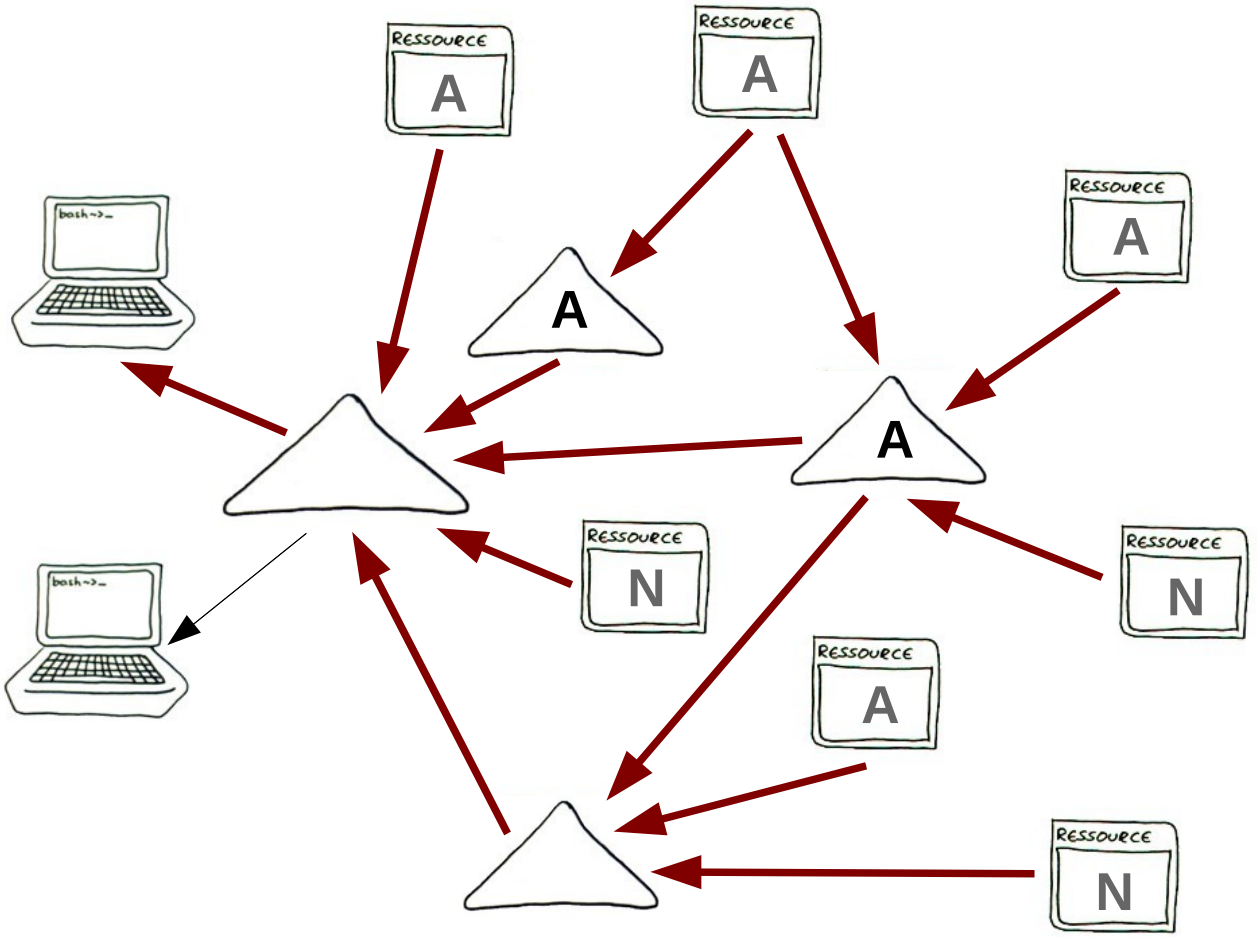

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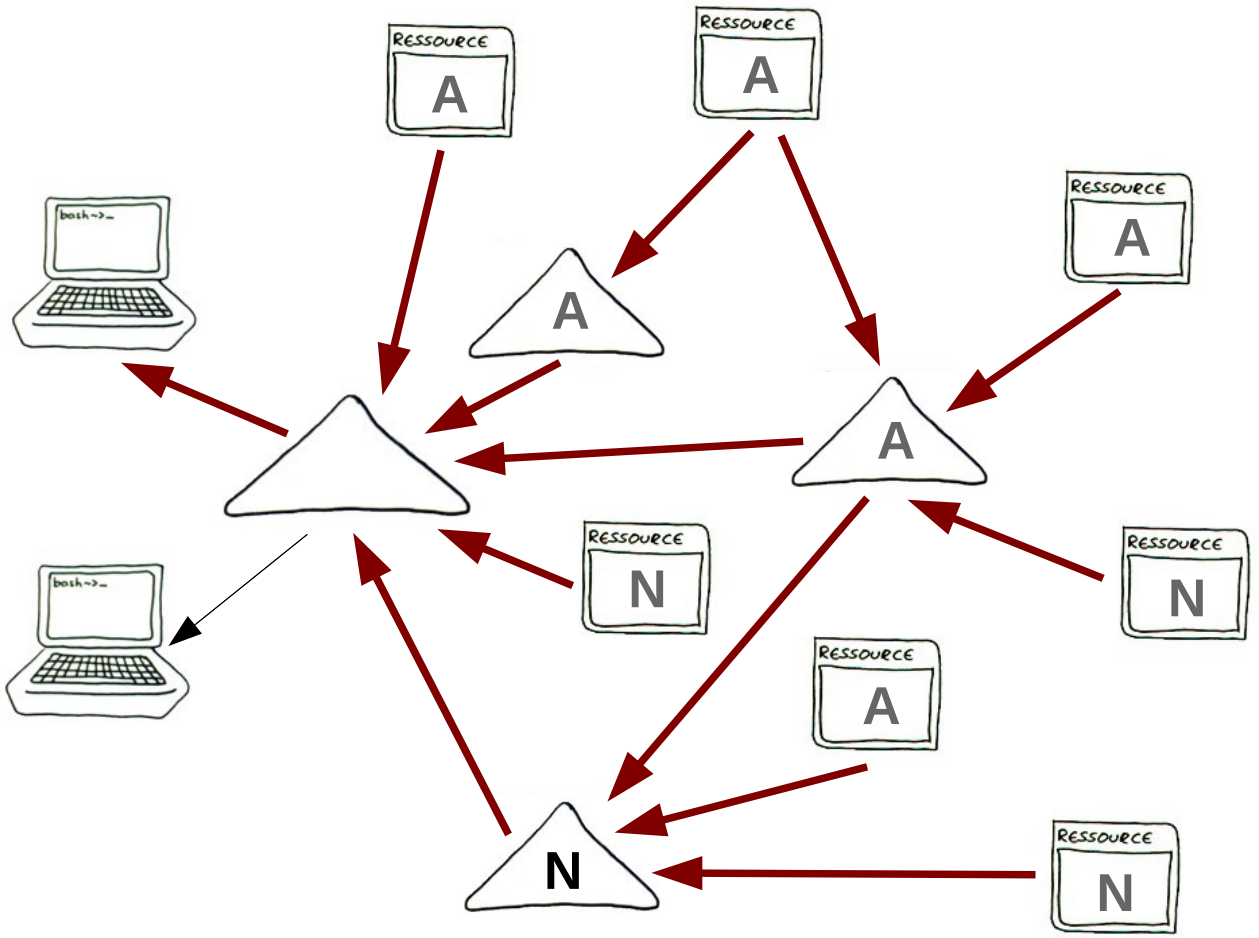

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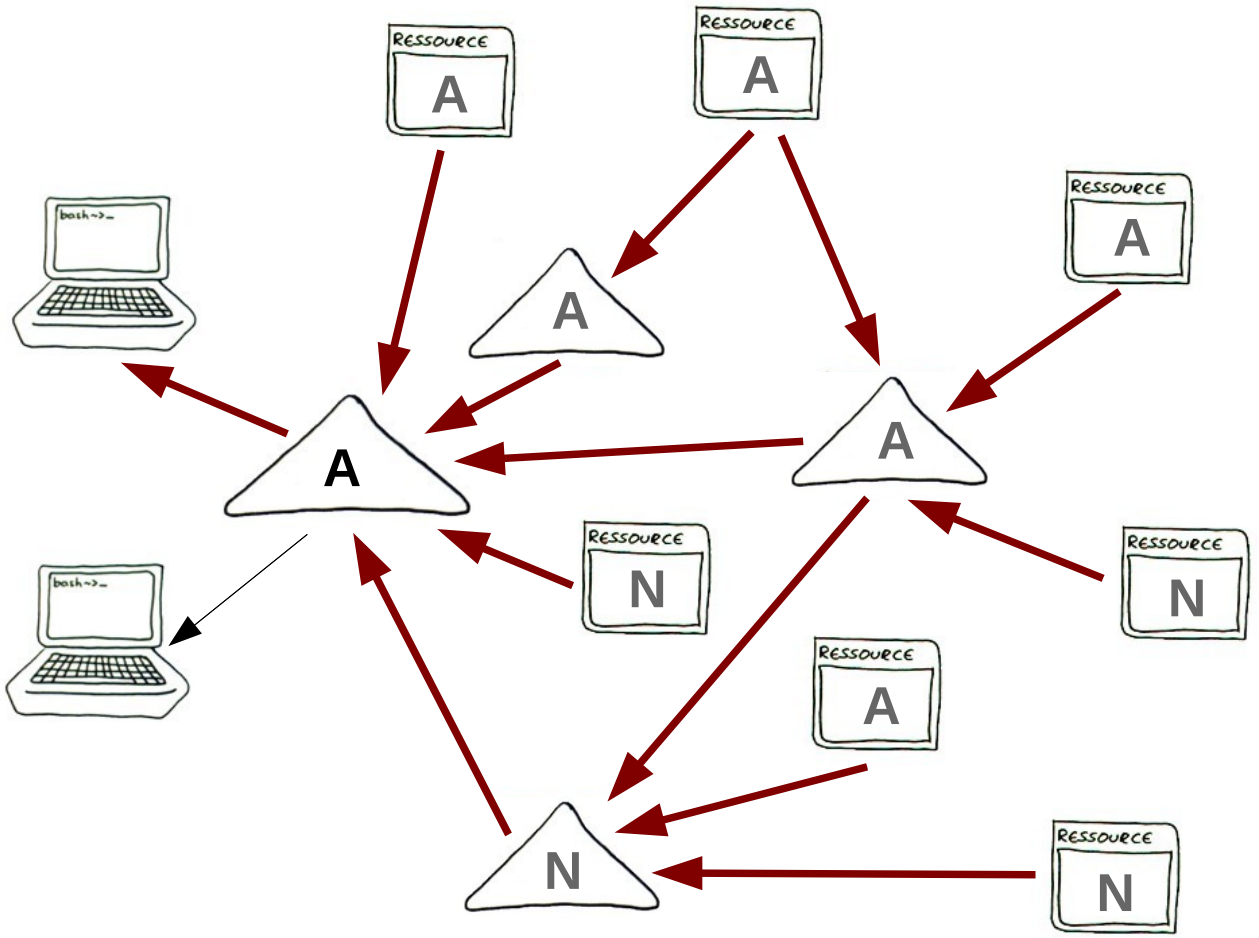

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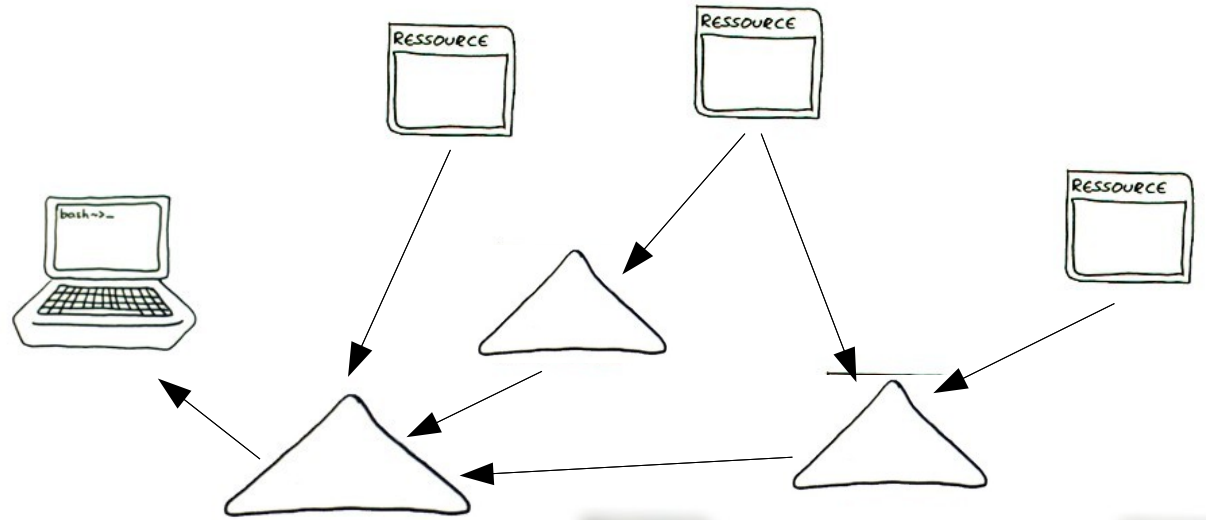

2. Standard Requirements

- For standard requirements e.g.
  - Data is only stored and processed in the EU
  - High availability
- Cloud Providers can offer special cloud services where this requirement is already met

3. Cloud Provider, Resource Owner is Added

Introduction

Requirements

Methods

- Federated Identity Management
- **Cloud Interfaces**
- Certification and Control

- Cloud provider, resource owner express the requirements they have when added to a cloud network
- These requirements are propagated through the cloud network as is done with user requirements before answering the request of the cloud user

Certification and Control

- Every interacting partner pretends to fulfil security and privacy requirements.
- **But how can cloud users be sure?**

Certification and Control

Traditional Approach:

- Have a contract where requirements are stated (SLA)
- Control in a regular manner

Not feasible in a dynamic cloud environment

Alternative: Certifications

- Common Criteria
- ICPP Privacy Seal

Certificates

Introduction

Requirements

Methods

- Federated Identity Management
- Cloud Interfaces
- **Certification and Control**

- Certificates can be handed through from resource owner and cloud provider to the cloud user
- **Rely on trusted third parties instead of direct control**

Open question: Can certification frameworks cope with dynamically interacting systems

Conclusion

Cloud services can be used for processing

- **person-related and**
- **business-critical data**

when appropriate

- **Cloud APIs**
- **Certification mechanisms**

are used.

Thank you for your attention