

Cloud computing

An overview (Part 1)

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Why Cloud Computing?

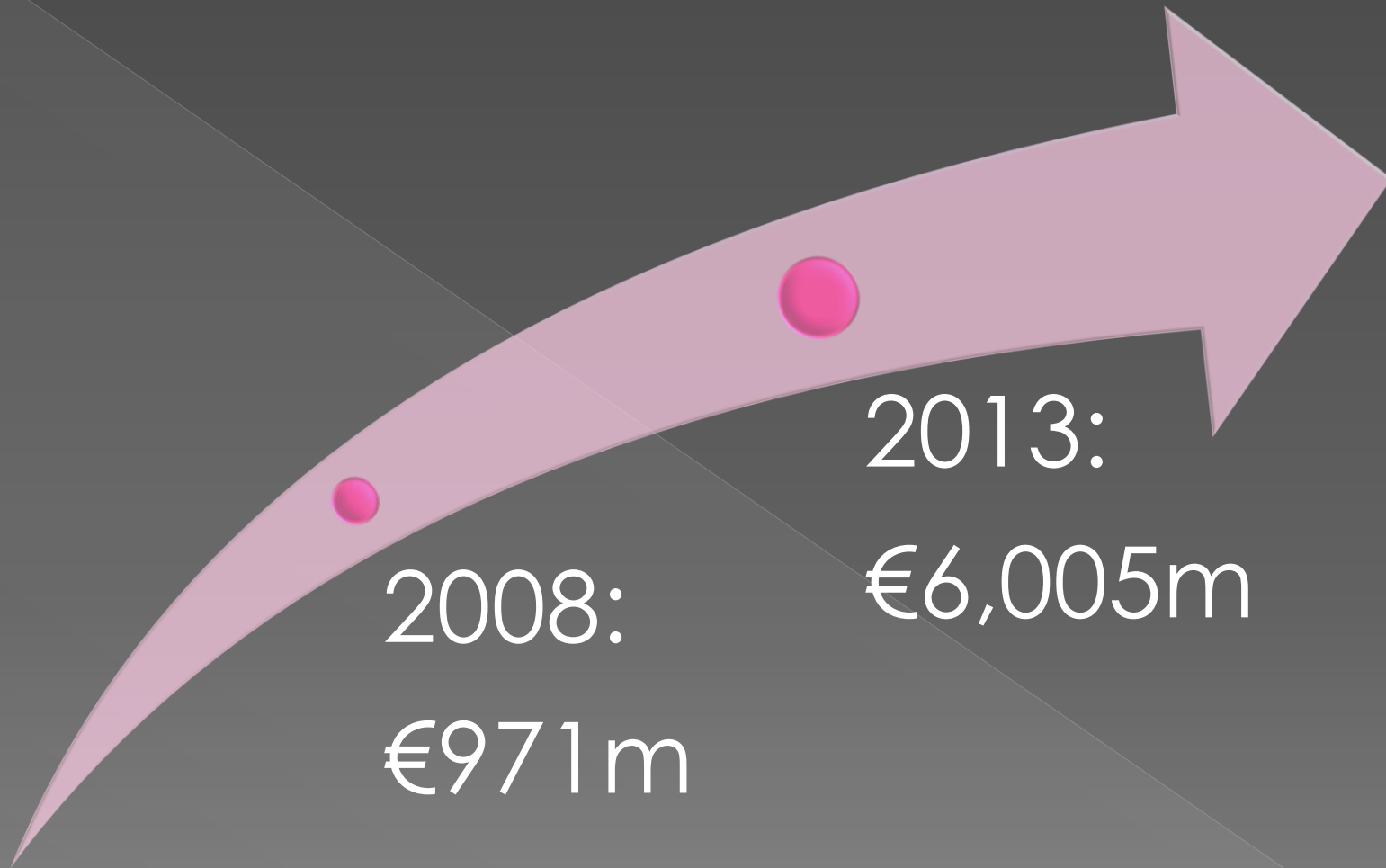
economies of scale for all the resources involved with computing services

optimal resource use = computing resources abstracted from underlying hardware

Computing, content storage and processing are massively distributed

content is delivered and received as close to customers as possible = global distribution and redundancy = resources managed in bulk, both physically and logically

Cloud Computing trend



IDC's European market for cloud services forecast as cited in "Cloud Computing Benefits, risks and recommendations for information security" by ENISA

What Cloud Computing is?

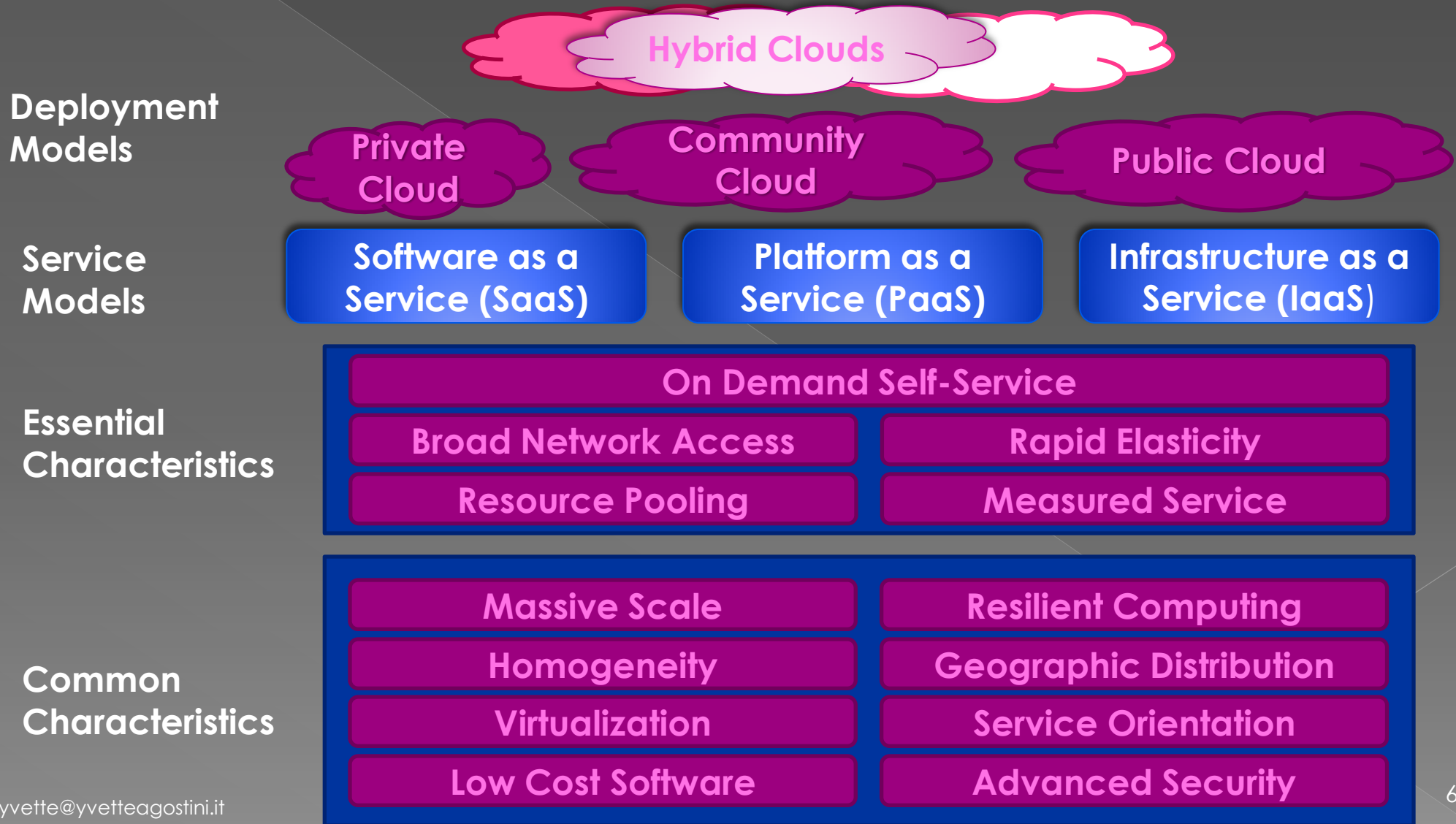
on-demand **service model for IT provision**, often based on virtualization and distributed computing technologies

a new way of delivering computing resources

Computing services (from data storage and processing to software) available **instantly, commitment-free and on-demand.**

not a new technology

The NIST Cloud Definition Framework



On-demand self-service

- A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service's provider

Broad network access

- Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, laptops, and PDAs)

Resource pooling

- The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be able to specify location at a higher level of abstraction (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, network bandwidth, and virtual machines

Rapid elasticity

- Capabilities can be rapidly and elastically provisioned, in some cases automatically, to quickly scale out and rapidly released to quickly scale in. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time

Measured service

- Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth, and active user accounts). Resource usage can be monitored, controlled, and reported providing transparency for both the provider and consumer of the utilized service

3 different service models

- ◉ Application/Software as a Service (**SaaS**)
- ◉ Platform as a Service (**PaaS**)
- ◉ Infrastructure as a Service (**IaaS**)

Security note:

Risks and benefits associated with each model are different

The same is true for key considerations in contracting for this type of service

Cloud Software as a Service (SaaS)

ENISA definition

- is software offered by a third party provider, available on demand, usually via the Internet configurable remotely. Examples include online word processing and spreadsheet tools, CRM services and web content delivery services (Salesforce CRM, Google Docs, etc).

NIST definition

- The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through a thin client interface such as a web browser (e.g., web-based email). The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings

Cloud Platform as a Service (PaaS)

ENISA definition

- allows customers to develop new applications using APIs deployed and configurable remotely. The platforms offered include development tools, configuration management, and deployment platforms. Examples are Microsoft Azure, Force and Google App engine.

NIST definition

- The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages 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 application hosting environment configurations.

Cloud Infrastructure as a Service (IaaS)

ENISA definition

- provides virtual machines and other abstracted hardware and operating systems which may be controlled through a service API. Examples include Amazon EC2 and S3, Terremark Enterprise Cloud, Windows Live Skydrive and Rackspace Cloud

NIST definition

- The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, deployed applications, and possibly limited control of select networking components (e.g., host firewalls)

Cloud Computing: deployment models

Private cloud

- The cloud infrastructure is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise.

Community cloud

- The cloud infrastructure is shared by several organizations and supports a specific community that has shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be managed by the organizations or a third party and may exist on premise or off premise.

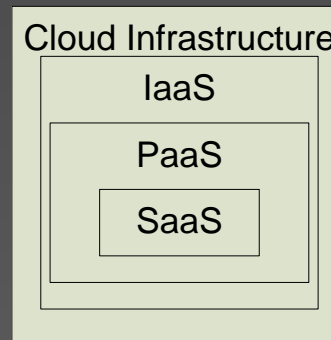
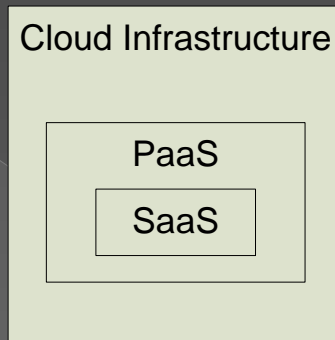
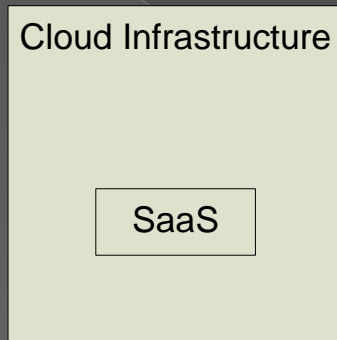
Public cloud

- The cloud infrastructure is made available to the general public or a large industry group and is owned by an organization selling cloud services.

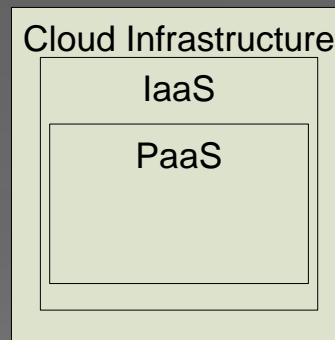
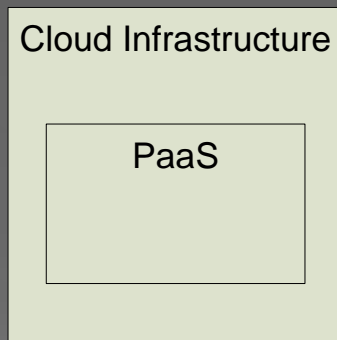
Hybrid cloud

- The cloud infrastructure is a composition of two or more clouds (private, community, or public) that remain unique entities but are bound together by standardized or proprietary technology that enables data and application portability (e.g., cloud bursting for load-balancing between clouds).

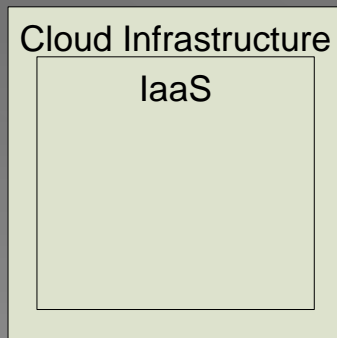
Cloud Computing Architecture



Software as a Service
(SaaS)
Architectures



Platform as a Service (PaaS)
Architectures



Infrastructure as a Service (IaaS)
Architectures

Cloud Computing: BENEFITS and RISKS

Benefits

- SCALE
- MARKET DIFFERENTIATOR
- STANDARDIZED INTERFACES FOR MANAGED SECURITY SERVICES
- RAPID, SMART SCALING OF RESOURCES
- AUDIT AND EVIDENCE-GATHERING
- MORE TIMELY AND EFFECTIVE AND EFFICIENT UPDATES AND DEFAULTS
- BETTER RISK MANAGEMENT
- RESOURCE CONCENTRATION

Risks

- LOSS OF GOVERNANCE
- LOCK-IN
- ISOLATION FAILURE
- COMPLIANCE RISKS
- MANAGEMENT INTERFACE COMPROMISE
- DATA PROTECTION
- INSECURE OR INCOMPLETE DATA DELETION
- MALICIOUS INSIDER

Sources

- Cloud Computing Benefits, risks and recommendations for information security
[http://ww.enisa.europa.eu/act/rm/files/deliverables/cloud-computing-risk-assessment/at_download/fullReport]
- The NIST Definition of Cloud Computing
[<http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-def-v15.doc>]
- Effectively and Securely Using the Cloud Computing Paradigm [<http://csrc.nist.gov/groups/SNS/cloud-computing/cloud-computing-v26.ppt>]