Introduction to Cloud Computing and Trends

Seminario de Investigación
Máster Ciencias y Tecnologías de la Computación
Curso 205/16

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  - (-ilities)
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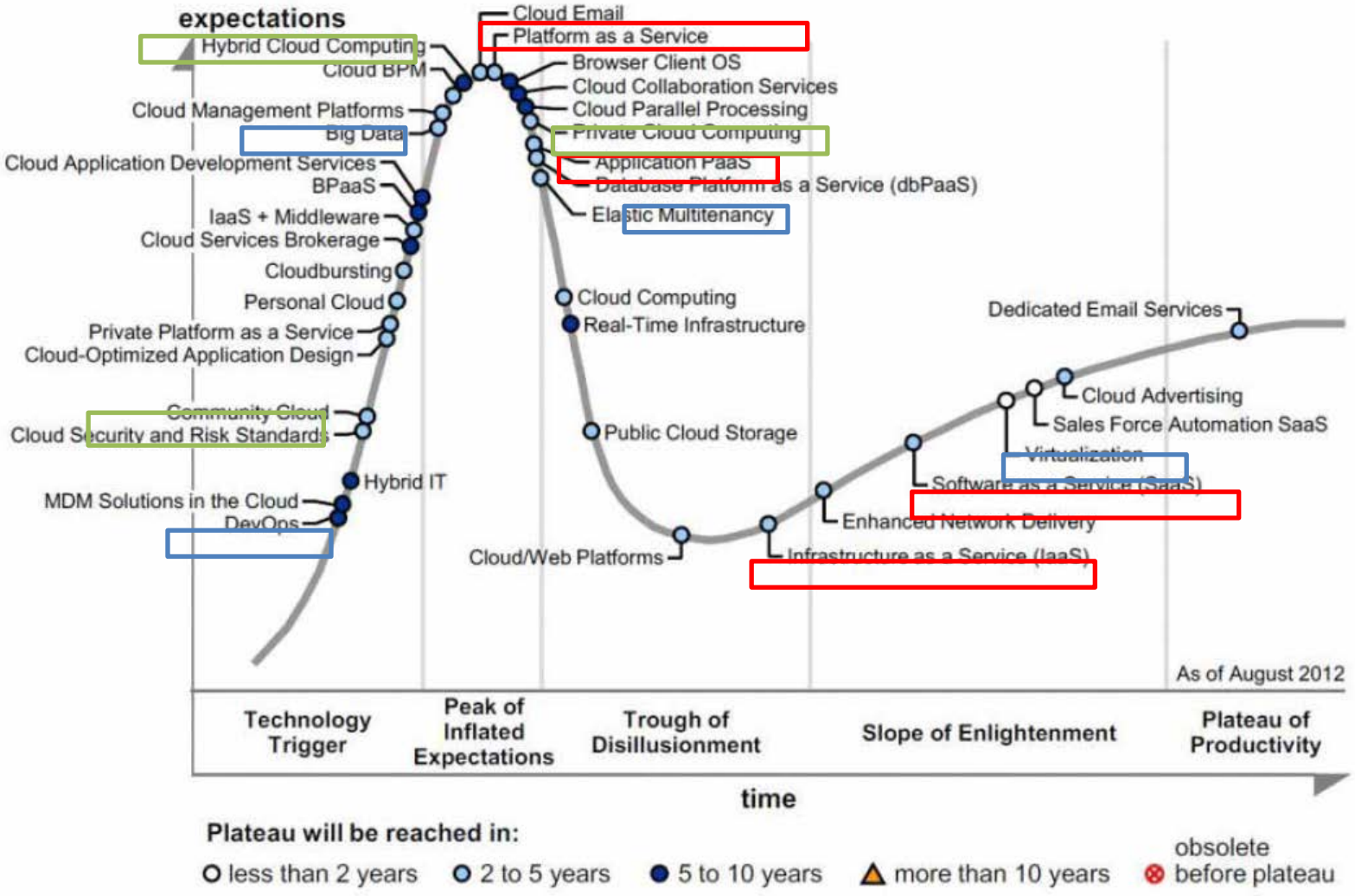
Emerging Technologies: Cloud Computing

Source Garner (July 2015)

Emerging Technologies: Cloud Computing

Figure 1. Hype Cycle for Cloud Computing, 2012



Source: Gartner (August 2012)

A paradigm shift: from on-premises to off-premises software

*"It is envisioned that by 2020 most people will access software applications **online** and **share** and access information through the use of **remote server networks**, rather than depending primarily on tools and information housed on their individual, personal computers"*

*"71% of the survey takers believed that by 2020, most people won't do their work with software running on a general-purpose PC. Instead, they will work in **Internet-based applications** such as Google Docs, and in applications run from smart phones" [PEW INTERNET & AMERICAN LIFE PROJECT]*

[Cloud Computing: Methodology, Systems, and Applications]

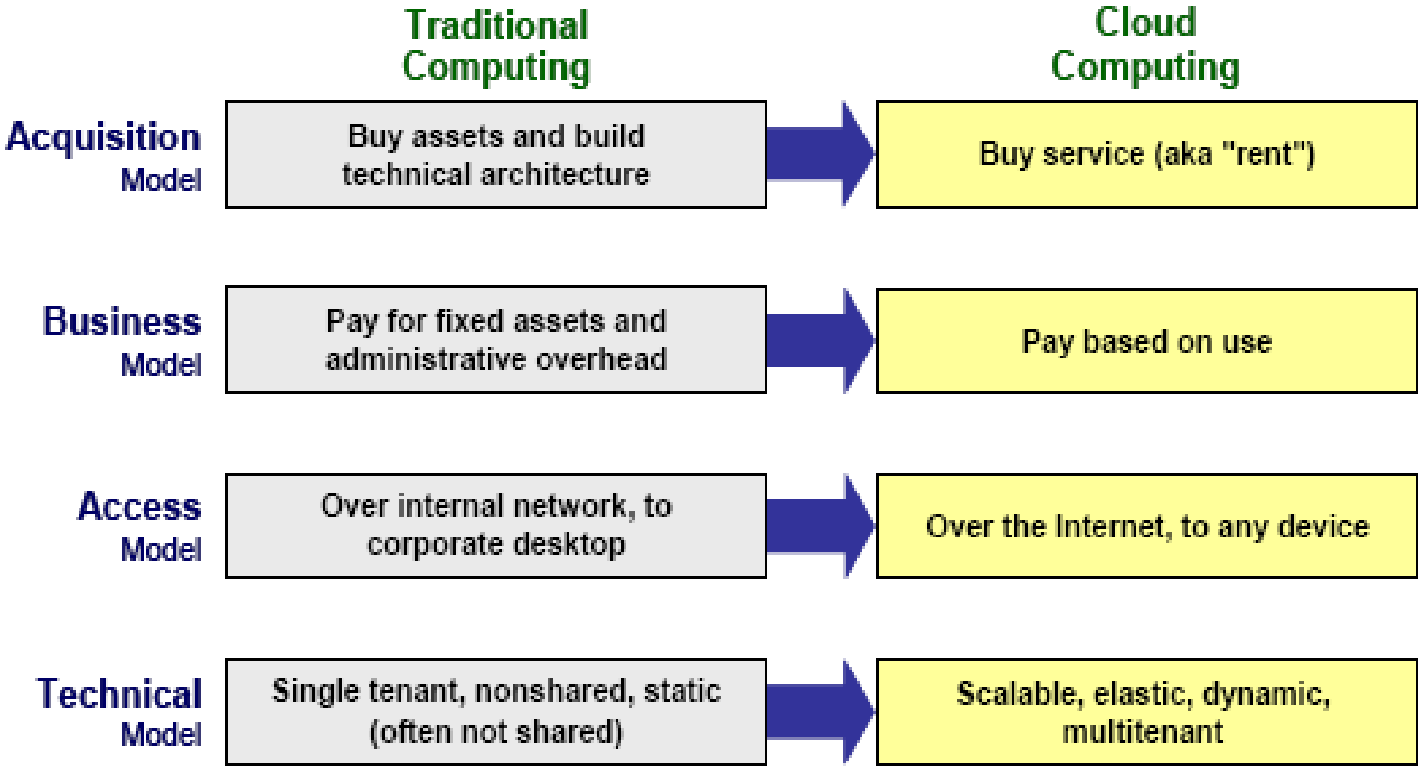
A paradigm shift: from on-premises to off-premises software

- **On-premises software** is installed and runs on computers on the premises of the person or organization using the software (i.e. the software is installed and operated from a customer's in-house server and computing infrastructure), rather than at a remote facility, such as at a server farm or cloud - somewhere on the Internet.

- On-premises software is more expensive than **off-premises** or **cloud software** (on-demand) (software as a service) because it requires in-house server hardware, capital investment in software licenses, in-house IT support staff and longer integration periods. However, on-premises software is considered more secure, as the entire instance of software remains on the organization’s premises.

A paradigm shift: from on-premises to off-premises software

Cloud computing implica un cambio en el modelo de IT, ya que el proveedor cloud es responsable de un conjunto de actividades IT: Instalación de software, actualización, mantenimiento, copias de seguridad (backups), almacenamiento de datos y seguridad.



Source: Gartner (September 2008)

Cloud Computing - Definition

- A model for enabling convenient, **ON-DEMAND** network access to **a shared pool of configurable computing resources** (e.g., networks, servers, storage, applications, platforms, and services) that can be **rapidly PROVISIONED** and released with minimal management effort or service provider interaction [National Institute of Standards and Technology]

[Cloud Computing: Methodology, Systems, and Applications]

- Cloud computing is a term for **computing resources and services** such as server and network infrastructure, web servers, and databases, hosted by cloud service **vendors**, rented by **tenants**, and delivered via the **Internet**.

[Learning Microsoft Azure]

Cloud computing companies such as Microsoft and Google offer a variety of computing services built on top of their own infrastructure, which are managed in dedicated globally distributed data centers that offer high **availability**, **resilience**, and **scalability**.

Cloud Computing - Definitions

- **Capacidad computacional y almacenamiento virtualizada** expuesta mediante infraestructura agnóstica a la plataforma y accedida por Internet

[**Diego Lz. de Ipiña , To Cloud or not Cloud, That is the Question!**]

- Cloud Computing is based on two main techniques
  - **Virtualization** → Cloud brings the resources to the users through virtualization. *Consiste en la creación, a través de software, de una versión virtual de algún recurso tecnológico.

  - **Service Oriented Architecture (SOA)** → Cloud computing perceives of all tasks accomplished as a "Service" rendered to users. *SOA provides loosely-coupled suite of services to be discovered, composed, and executed, that can be used within multiple business domains.

[Cloud Computing: Methodology, Systems, and Applications]

Cloud Service Models

- "**Everything as a Service**" abbreviated as XaaS

  - Infrastructure as a Service (**IaaS**): offers server, storage, and networking infrastructure, which users can build their own systems on.
  - Platform as a Service (**PaaS**): allows users to create and deploy applications without having to worry about the infrastructure that's hosting it using services and tools designed to streamline the development and deployment processes.
  - Software as a Service (**SaaS**): offers on-demand software products, which remove the infrastructure and software installation and setup overhead.

[Learning Microsoft Azure]

Cloud Service Models

- "**Everything as a Service**" abbreviated as XaaS

Computer/host

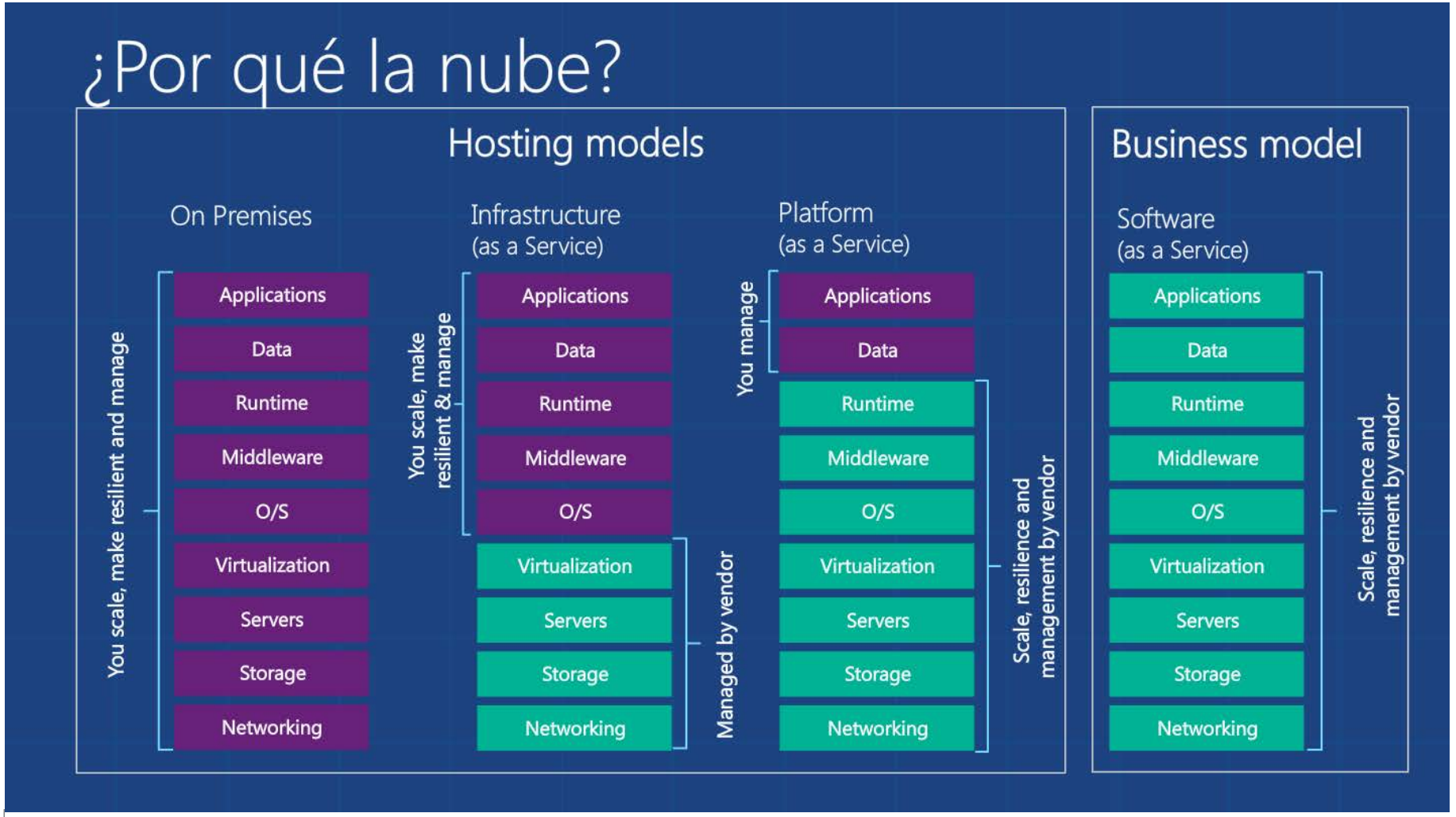
App/framework

Functionality

[**Windows Azure Platform: Cloud Development Jump Start**]

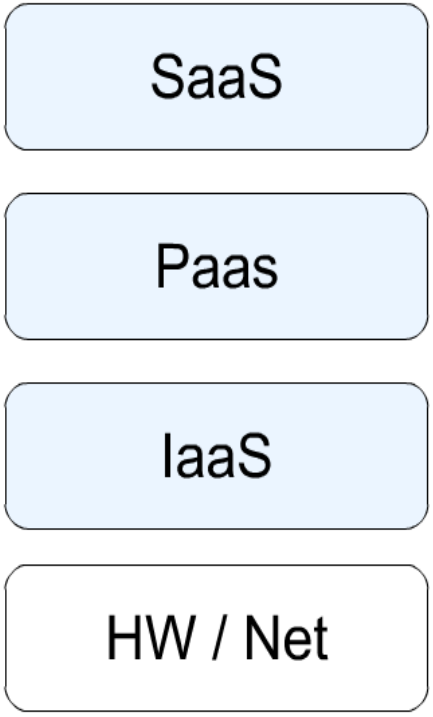
Cloud Service Models

Data Visualization of Vendor Management Responsibility of Services



[Introducción a Azure, Yalda Pourian]

Cloud Service Models



Software as a Service

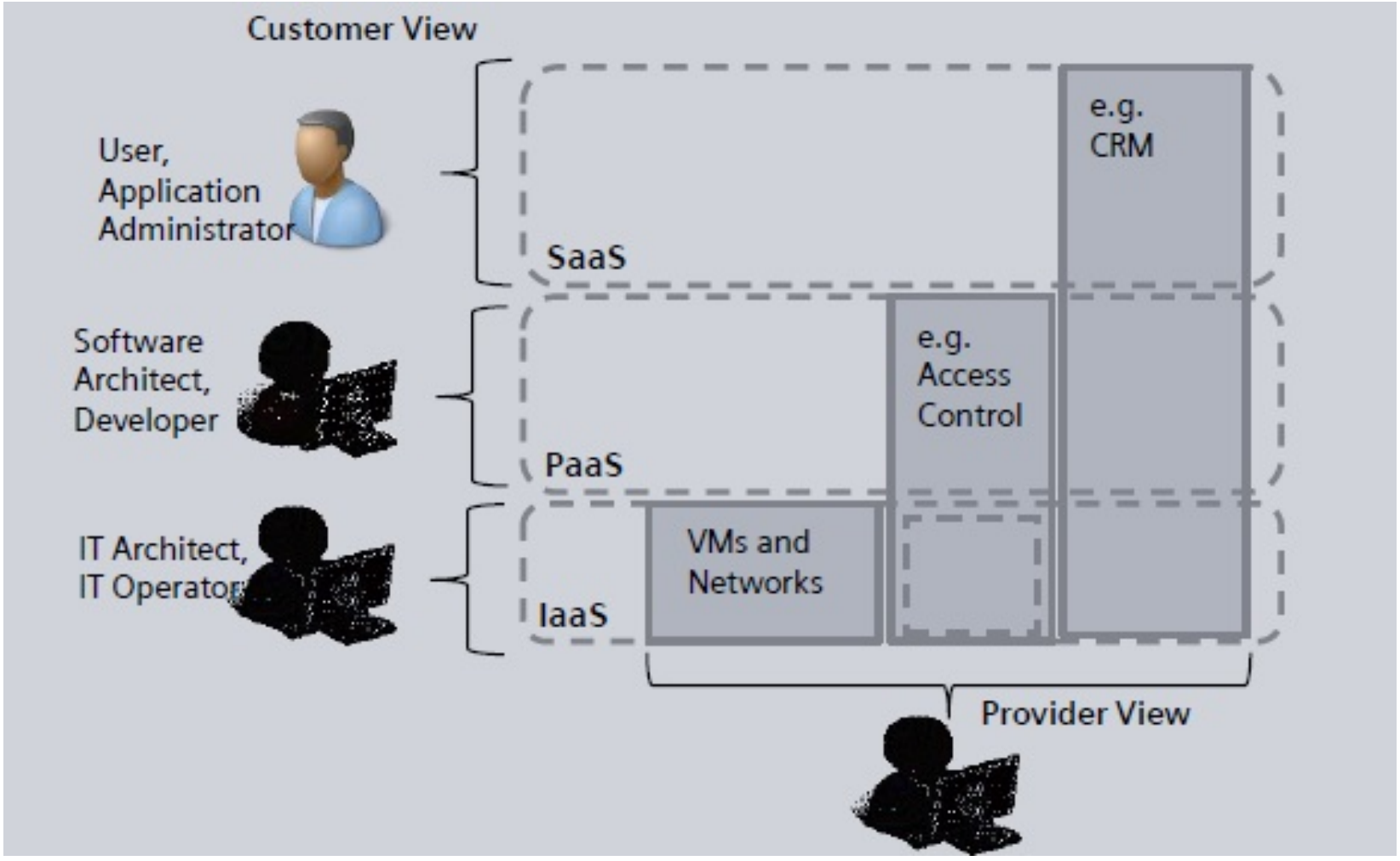
Platform as a Service

Infrastructure as a Service

Amazon EC2
Amazon S3

Cloud Service Models

Cloud architecture - Stakeholders view



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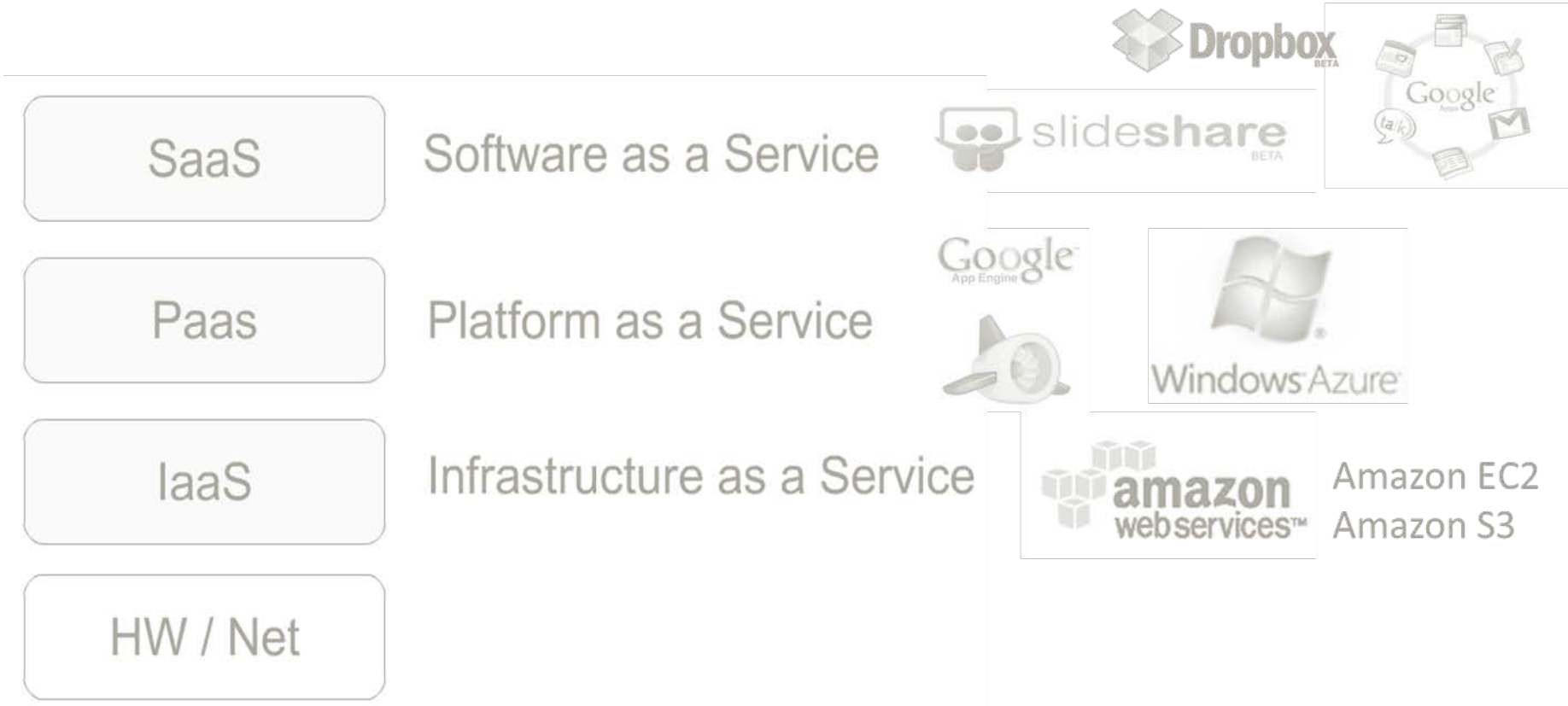
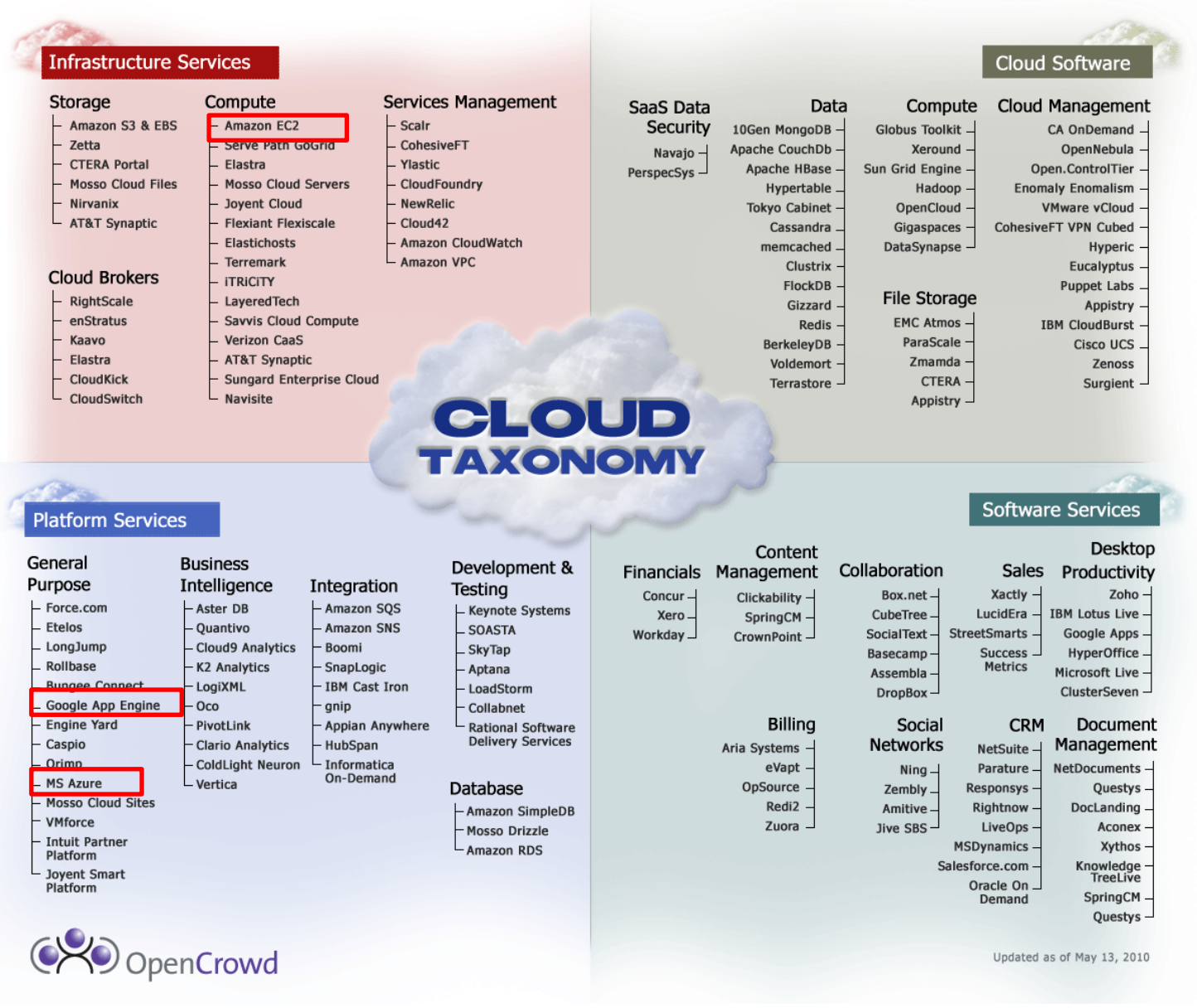
Cloud Service Models

Enterprise Application PaaS (aka. Application development PaaS)

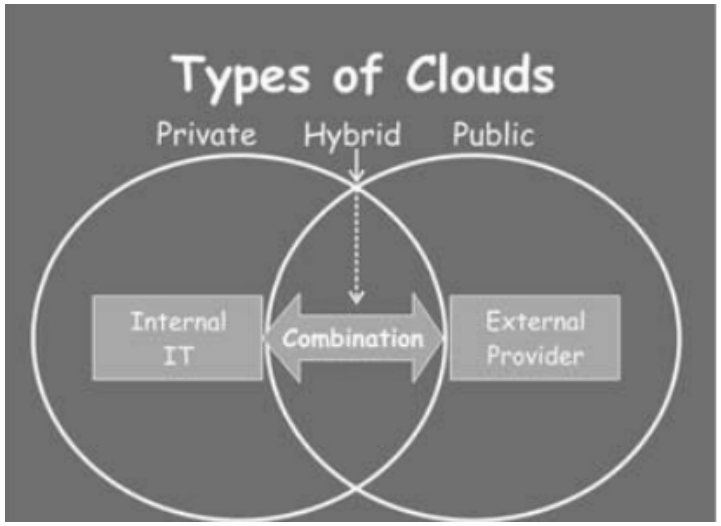


Cloud Service Models



Cloud Deployment Models

- The manner in which a Cloud is designed to provide its services.
  - Public cloud: resources are dynamically provisioned by third party providers who share them with the users and bill the users (pay-as-you-go model)
  - Private cloud: the computing infrastructure is solely dedicated to a particular organization or business.
  - Hybrid cloud
  - Community cloud

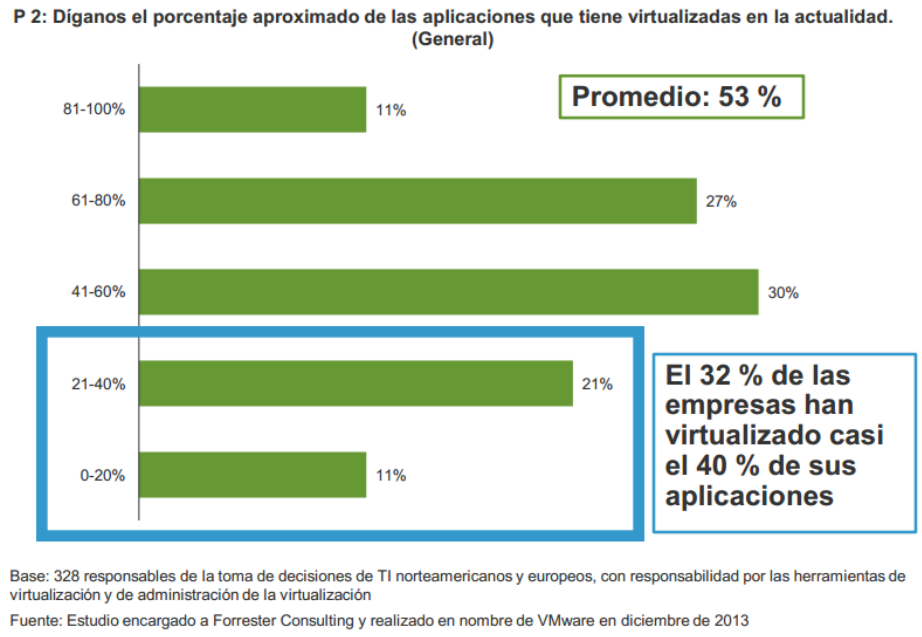


[Cloud Computing: Methodology, Systems, and Applications]

Cloud Computing - Trends

- In case you have a web application that you are planning to sell in the market, (*multi-tenant*) Software as a Service (SaaS) on a cloud infrastructure is essential

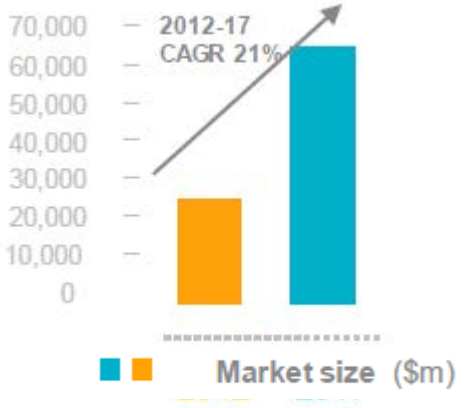
Porcentaje actual de aplicaciones virtualizadas



Base: 328 responsables de la toma de decisiones de TI norteamericanos y europeos, con responsabilidad por las herramientas de virtualización y de administración de la virtualización

Fuente: Estudio encargado a Forrester Consulting y realizado en nombre de VMware en diciembre de 2013

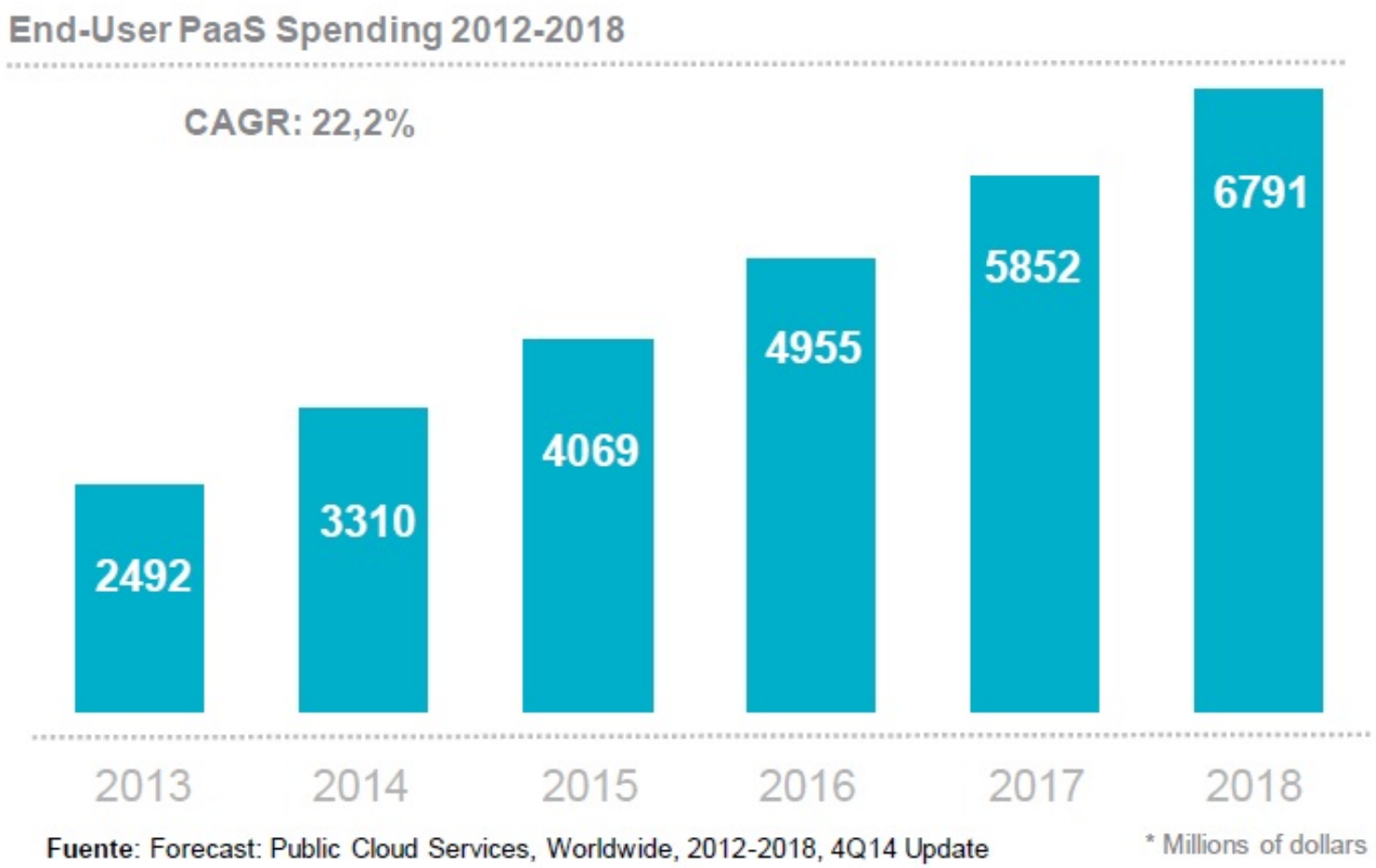
Crecimiento estimado en soluciones de SaaS hasta 2017



Mientras que la oferta tradicional de servicios TI a nivel mundial crece a un dígito bajo –entre +0% y +4%-

Cloud Computing - Trends

VOLUMEN DE NEGOCIO PAAS



Cloud Computing - Key features

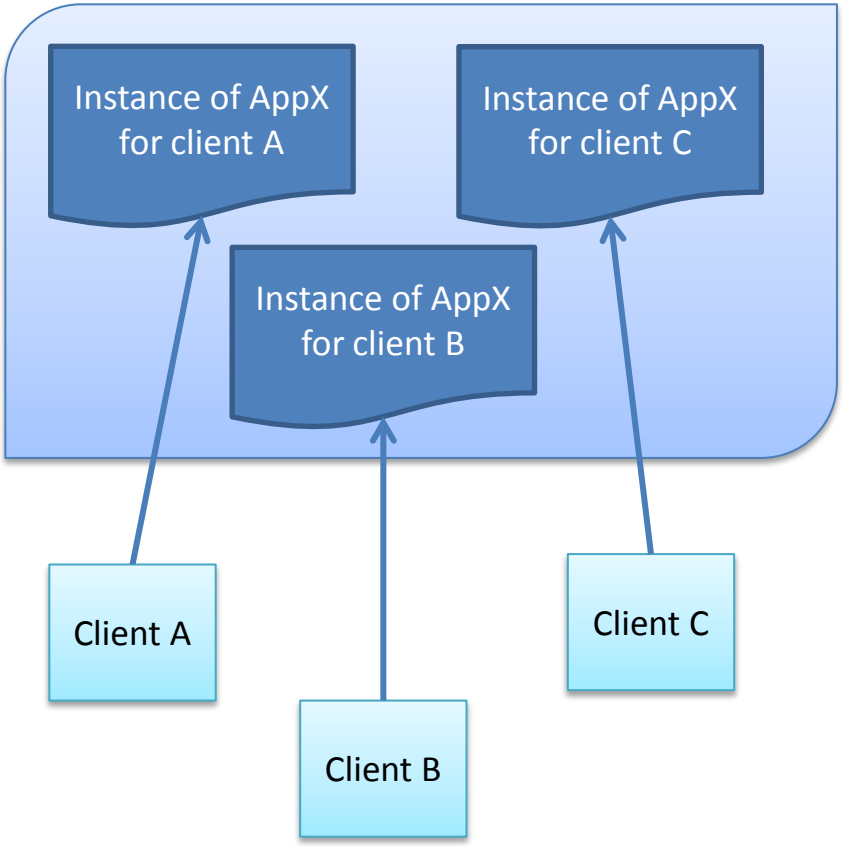
- **Agility** – helps in rapid and inexpensive re-provisioning of resources.
- **Scalability** – dynamic provisioning of data helps in avoiding various bottleneck scenarios.
- **Reliability** – dependable accessibility of resources and computation.
- **Availability** - Probability that a system is ready to respond a request in a given time
- **Location Independence** – resources can be accessed from anywhere and everywhere.
- **Multi-Tenancy** – resources are shared amongst a large pool of users.
- **Maintenance** – users have less work in terms of resource upgrades and management (handled by service providers of Cloud Computing)
- **Cost reduction in IT**
  - ✓ No inhome data centers → Pay per use
  - ✓ The same datacenter is used by multiple companies
- **Self-provisioning:** Feature among many cloud service providers which allows their end users to provision resources by themselves.

[Cloud Computing: Methodology, Systems, and Applications]

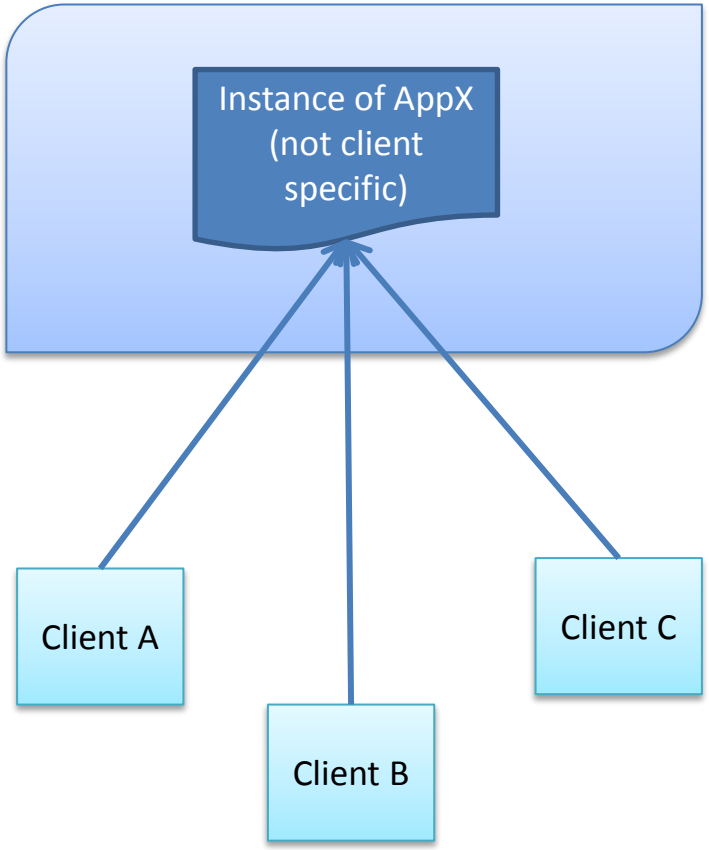
Cloud Computing - Key features

Single-tenant vs Multi-tenant

Multi-instance, single-tenant



Single-instance, multi-tenant

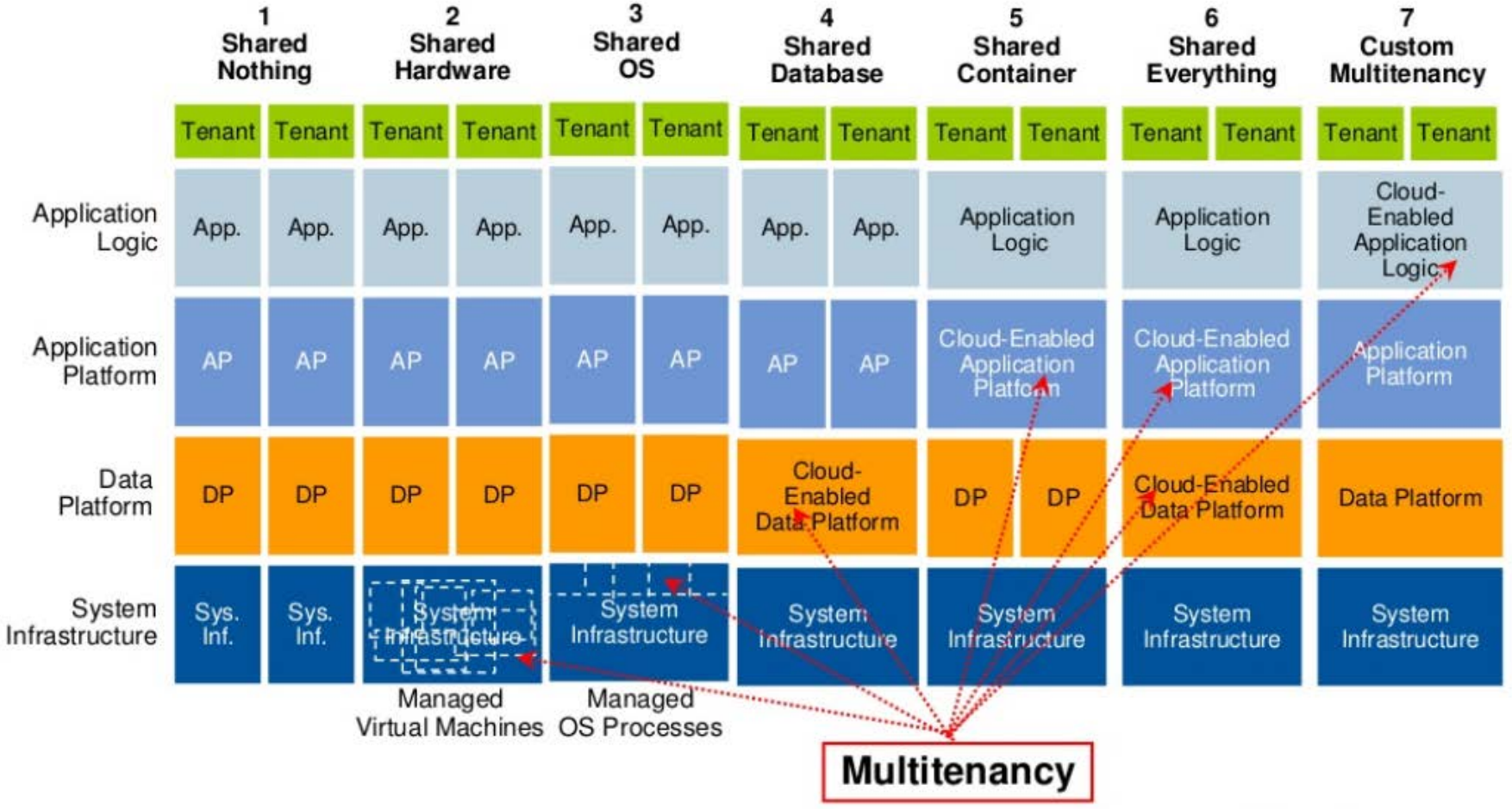


*A tenant is a group of users who share a common access with specific privileges to the software instance

[Based on https://msdn.microsoft.com/en-us/library/hh534478.aspx]

Cloud Computing - Key features

Multi-tenancy models



From "Gartner Reference Architecture for Multi-tenancy" G00205983

Gartner

Cloud Computing - Key features

Multi-tenancy models

Isolation → Tenants want the application to appear as though they have exclusive use of it (use and data)

Availability → Tenants want the application to be constantly available

Scalability → Tenants want the presence and actions of other tenants should not affect the performance of the application

Costs → Tenants expect that the costs will be lower than running a dedicated, single-tenant application because multi-tenancy enables the sharing of resources

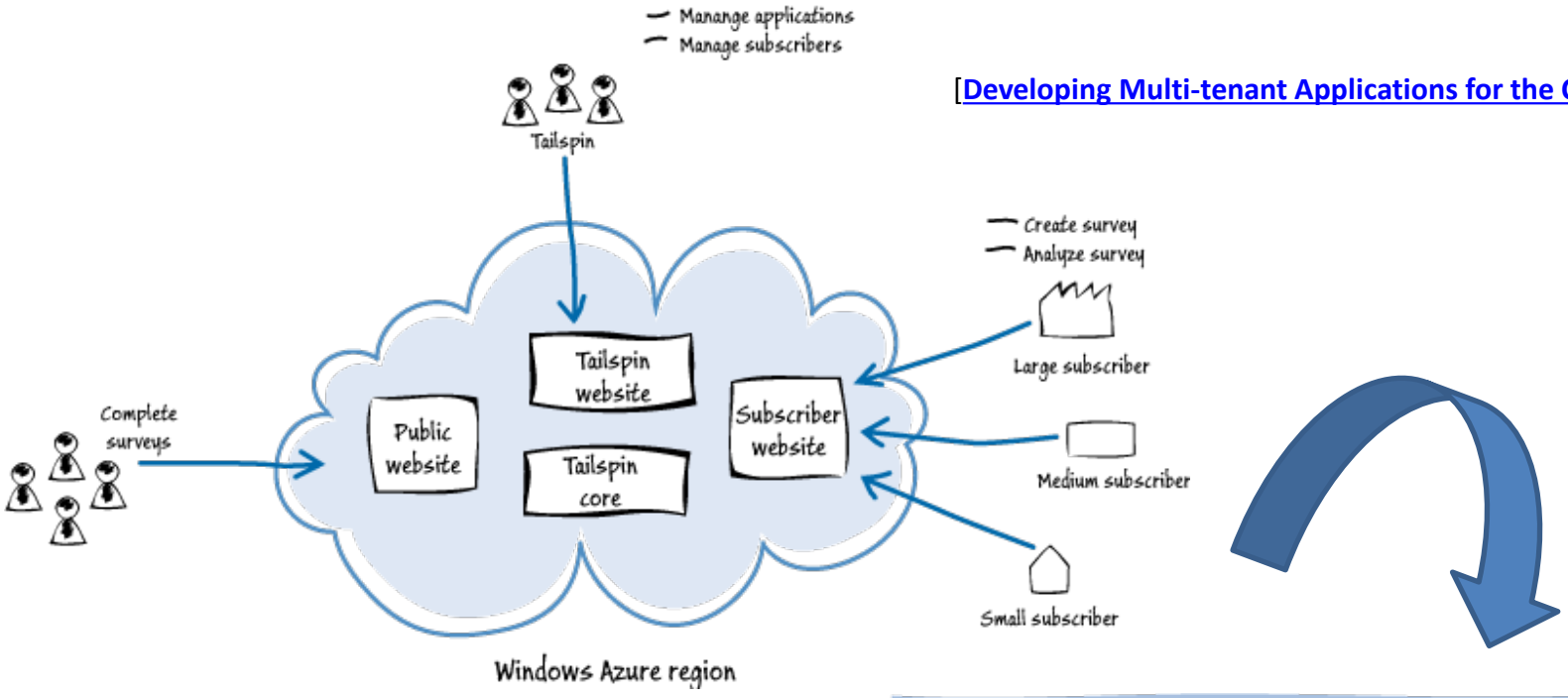
Customizability → Tenants may require the ability to customize the application: adding or removing features, changing colors and logos, or even adding their own code or script

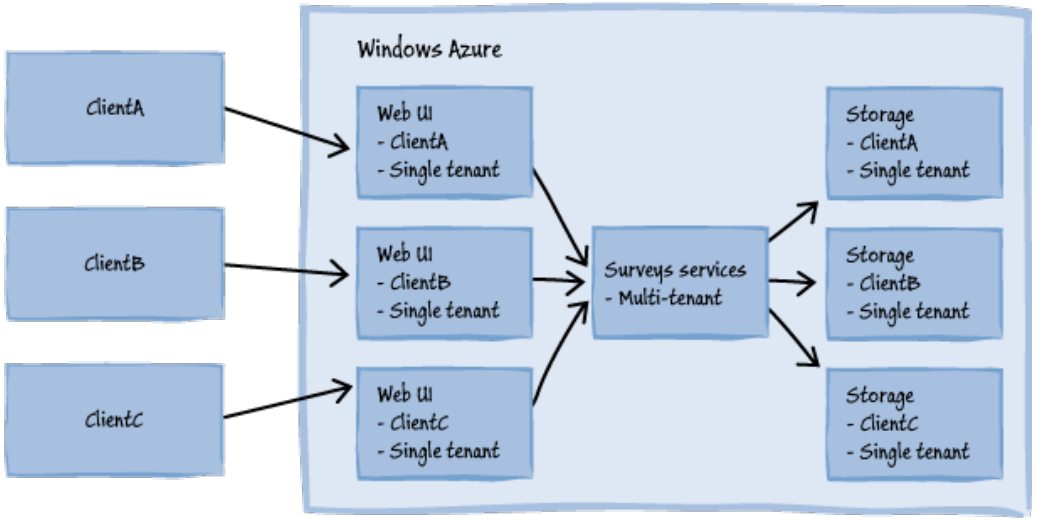
Regulatory Compliance → Tenants may need to ensure that the application complies with specific industry or regulatory laws and limitations

From "Gartner Reference Architecture for Multi-tenancy" G00205983

Multi-tenancy - example

[Developing Multi-tenant Applications for the Cloud, 3rd Edition]





Note:

Other possible designs:

- Multi-Tenant Data Architecture
- Partitioning caches and queues

Multi-tenancy – pros & cons

- **Maintaining the Code Base:** A multi-tenant system with a single, logical instance guarantees a single code base for the application.
- **Handling Application Updates:** A multi-tenant application that has a single code base makes it easy to roll out application updates to all your subscribers at the same time.

- **Application Stability:** A multi-tenant application is more vulnerable to instance failure than a single-tenant application. If a single-tenant instance fails, only the user of that instance is affected. If the multi-tenant instance fails, all users are affected.
- **Resource Limitations and Throttling:** Individual elements of your application architecture will have specific limitations, such as the maximum throughput of the message queuing element, or the maximum number of transactions per second supported by the data storage system used in your application. These resource limitations may place constraints on the number of tenants who can share a particular instance. You must understand the resource limitations and quotas in relation to the likely usage patterns of your tenants so that these resource limitations do not affect overall performance of the application.

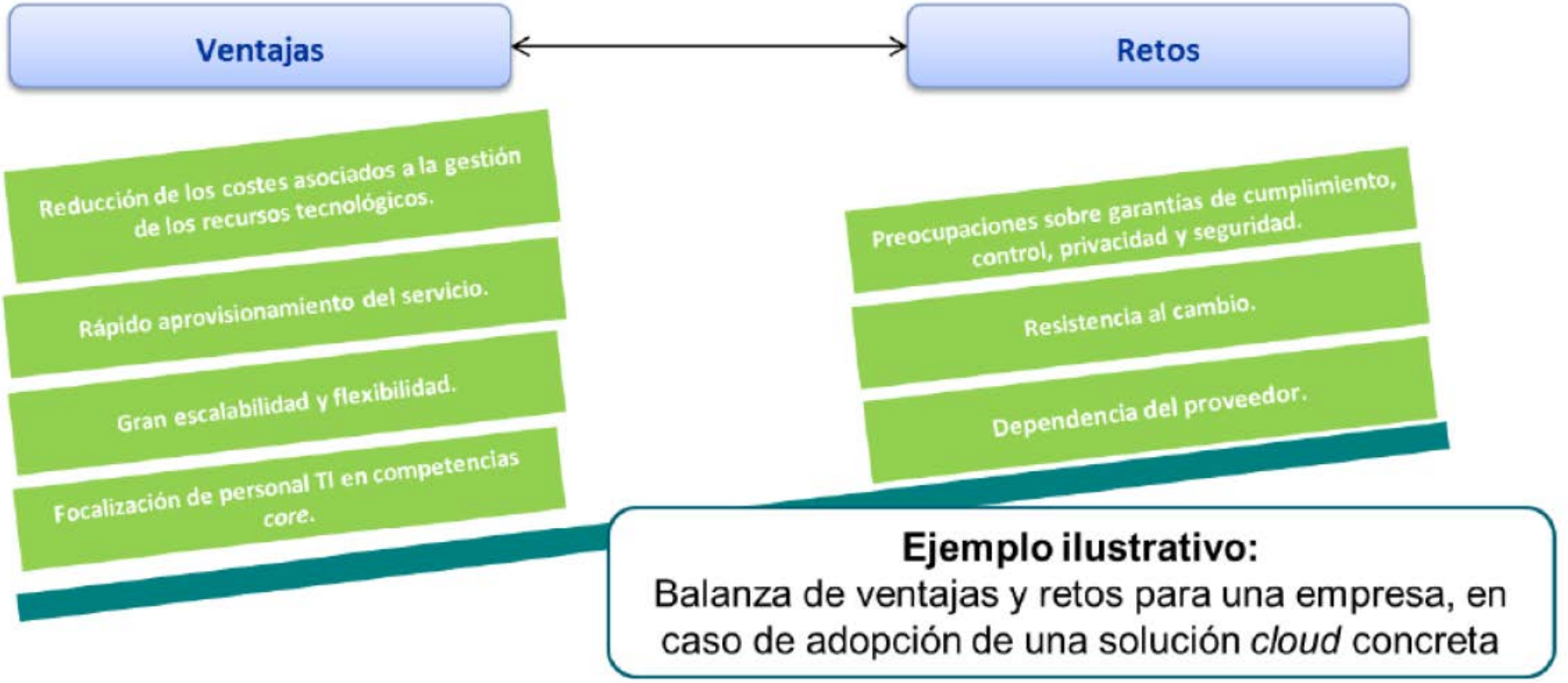
[Developing Multi-tenant Applications for the Cloud, 3rd Edition]

Issues with Cloud Computing

- Security issues
  - Cloud Computing can be vaguely defined as outsourcing of services, which in turn causes users to lose significant control over their data.
  - Cloud networks stand the potential threat of both Indirect Denial of Service attacks and Distributed Denial of Service attacks.
- Legal and compliance issues
  - Physical location of the data
  - Responsibilities of the data
  - Intellectual property rights
- Performance and QoS related issues
- Data management issues
  - Scalability of data, storage of data, data migration from one Cloud to another
- Interoperability issues
  - Companies such as Microsoft, Amazon, IBM, and Google all own their independent Clouds but they lack interoperability amongst them.

[Cloud Computing: Methodology, Systems, and Applications]

Conclusions



[**Cloud Computing: una perspectiva tecnológica, Dr. Diego López-de-Ipiña**]