Impact of Cloud on Networking Architectures
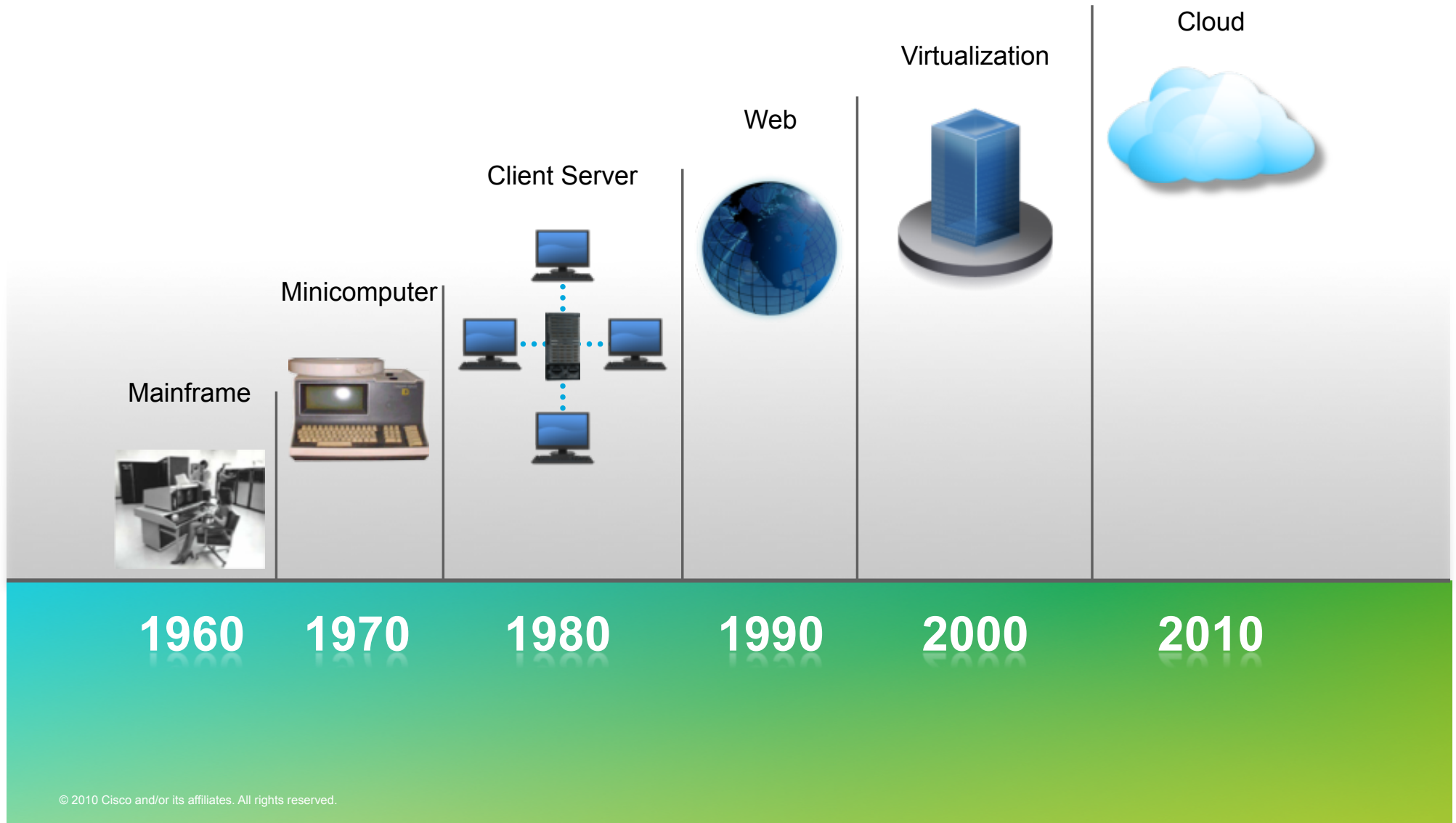
Enrico Mercadante

*Sales Business Development
Managed and Cloud Services*
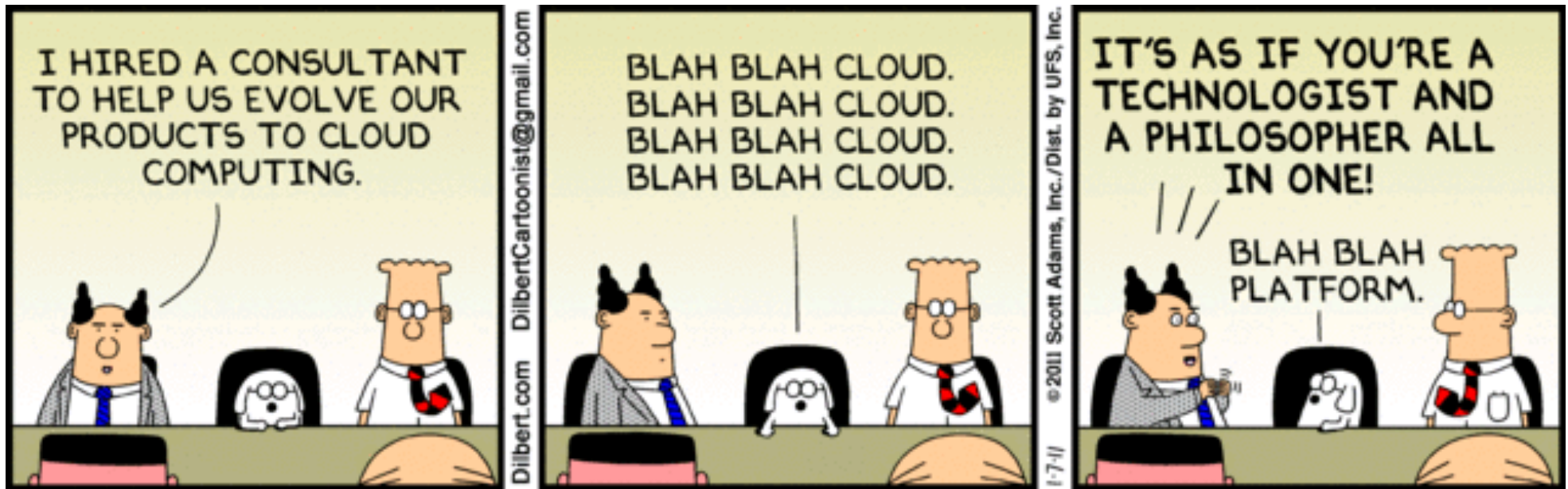
Agenda for Today

Roma Universita' Tor Vergata

- Cloud Computing – what is happening

- Use of Cloud Services

- Impact on the Network

Cloud Computing Is the Next Big Step in the Evolution of Computing and the Internet.

Mainframe

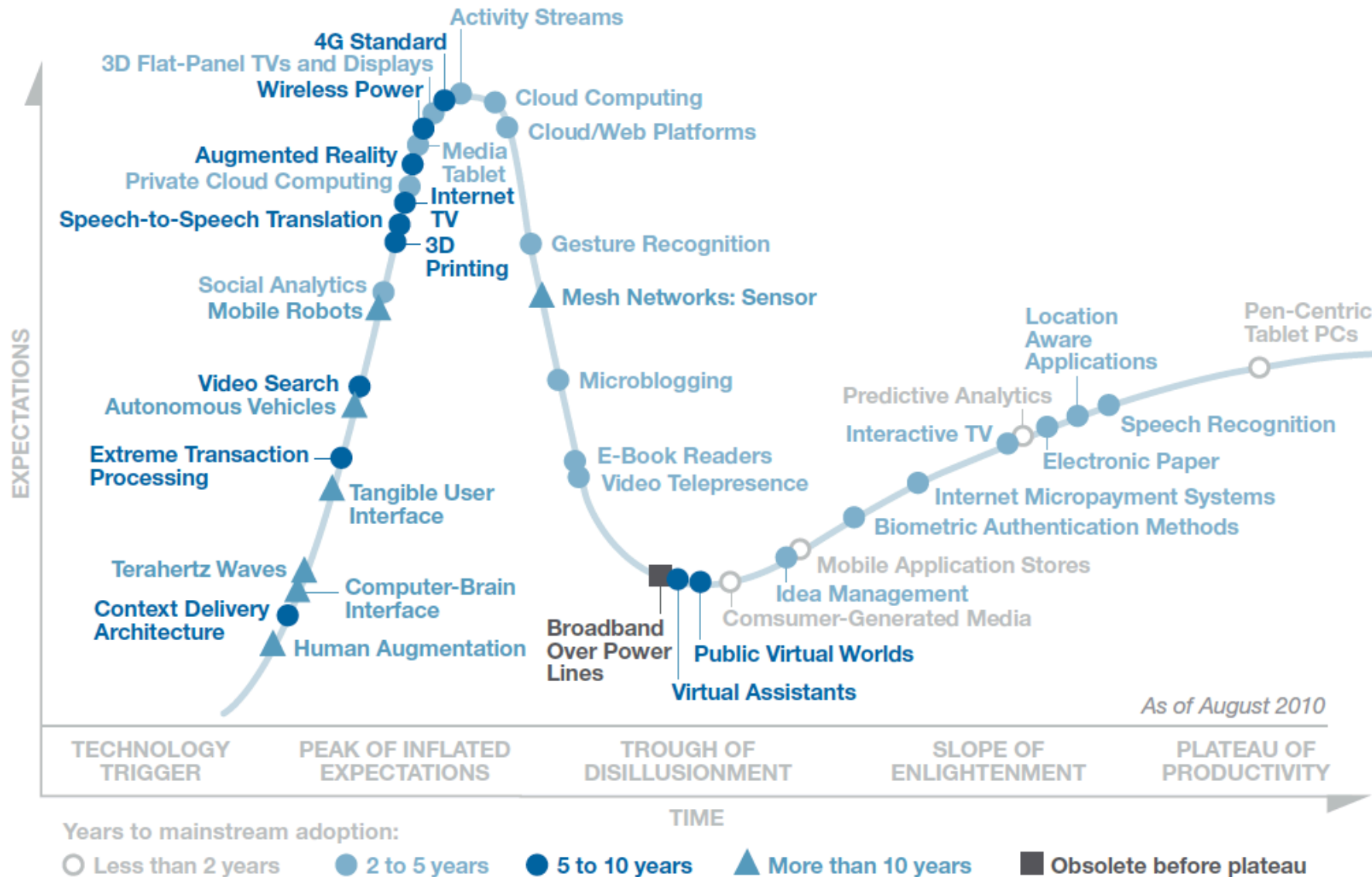Minicomputer

Client Server

Web

Virtualization

Cloud

1960   1970   1980   1990   2000   2010

Cloud cloud Cloud…

IT is
a fashion
industry, and
cloud computing
is the new black.
(Ovum)

Hype Cycle

Hype Cycle for Emerging Technologies, 2010

EXPECTATIONS

Activity Streams
4G Standard
3D Flat-Panel TVs and Displays
Wireless Power
Cloud Computing
Cloud/Web Platforms
Augmented Reality
Media Tablet
Private Cloud Computing
Internet TV
Speech-to-Speech Translation
3D Printing
Gesture Recognition
Social Analytics
Mobile Robots
Mesh Networks: Sensor
Location Aware Applications
Pen-Centric Tablet PCs
Video Search
Microblogging
Predictive Analytics
Autonomous Vehicles
Speech Recognition
Interactive TV
Extreme Transaction Processing
E-Book Readers
Video Telepresence
Electronic Paper
Tangible User Interface
Internet Micropayment Systems
Biometric Authentication Methods
Terahertz Waves
Mobile Application Stores
Computer-Brain Interface
Context Delivery Architecture
Idea Management
Comsumer-Generated Media
Human Augmentation
Broadband Over Power Lines
Public Virtual Worlds
Virtual Assistants

As of August 2010

| TECHNOLOGY TRIGGER | PEAK OF INFLATED EXPECTATIONS | TROUGH OF DISILLUSIONMENT | SLOPE OF ENLIGHTENMENT | PLATEAU OF PRODUCTIVITY |

TIME

Years to mainstream adoption:
○ Less than 2 years   ● 2 to 5 years   ● 5 to 10 years   ▲ More than 10 years   ■ Obsolete before plateau
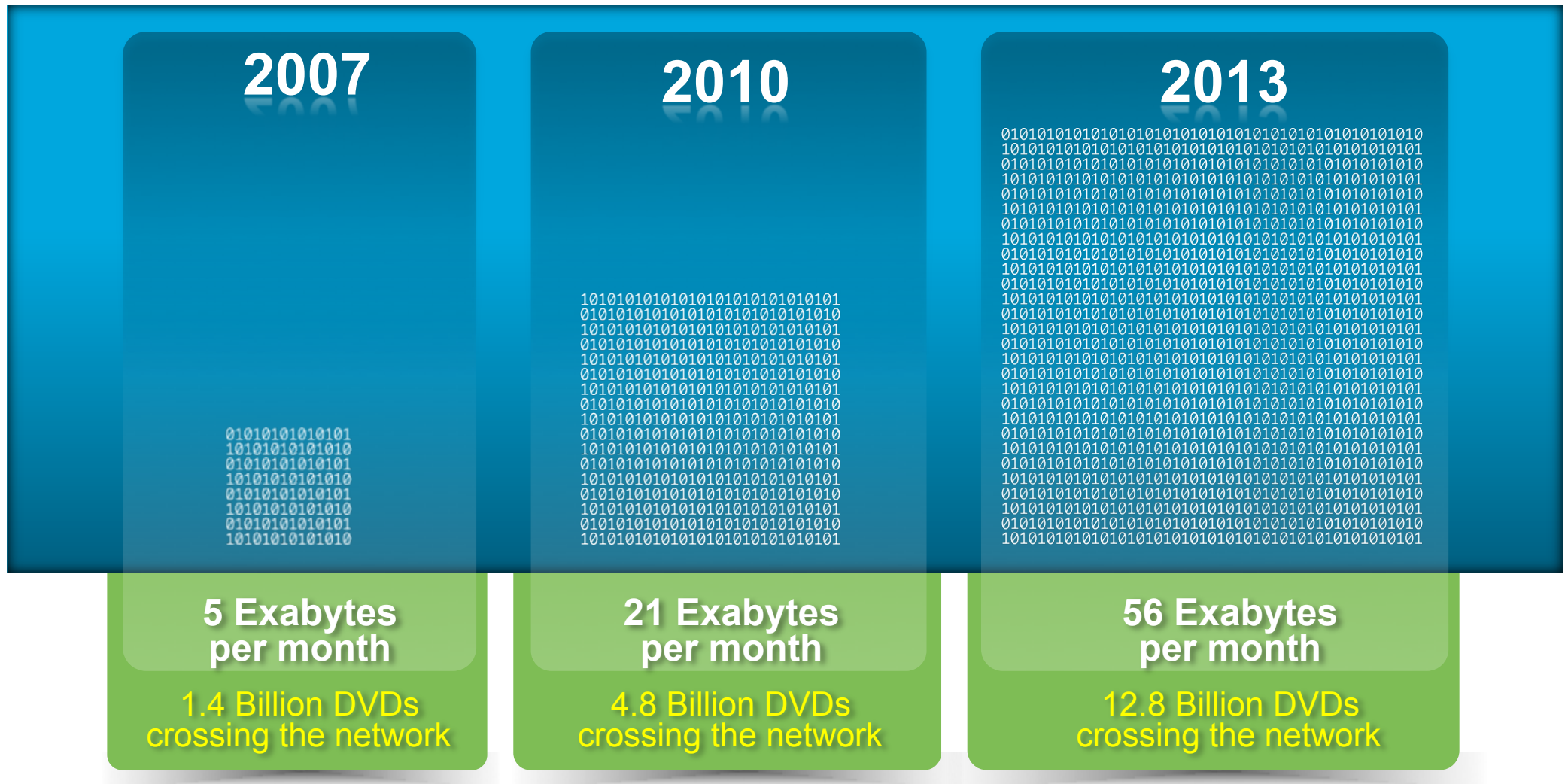
Gartner 2010

Cloud definition

IT resources and services that are abstracted from the underlying infrastructure and provided "On-Demand" and "At Scale" in a multi-tenant environment

- IT, from infrastructure to applications, is delivered and **consumed as a service over the network**

- Services operate **consistently**, regardless of the underlying systems

- Capacity and performance **scale** to meet demand and are invoiced by use

- Services are shared across **multiple organizations**, allowing the same underlying systems and applications to meet the demands of a variety of interests, simultaneously and securely

- Applications, services, and data can be accessed through a **wide range of connected devices** (e.g., smart phones, laptops, and other mobile internet devices)
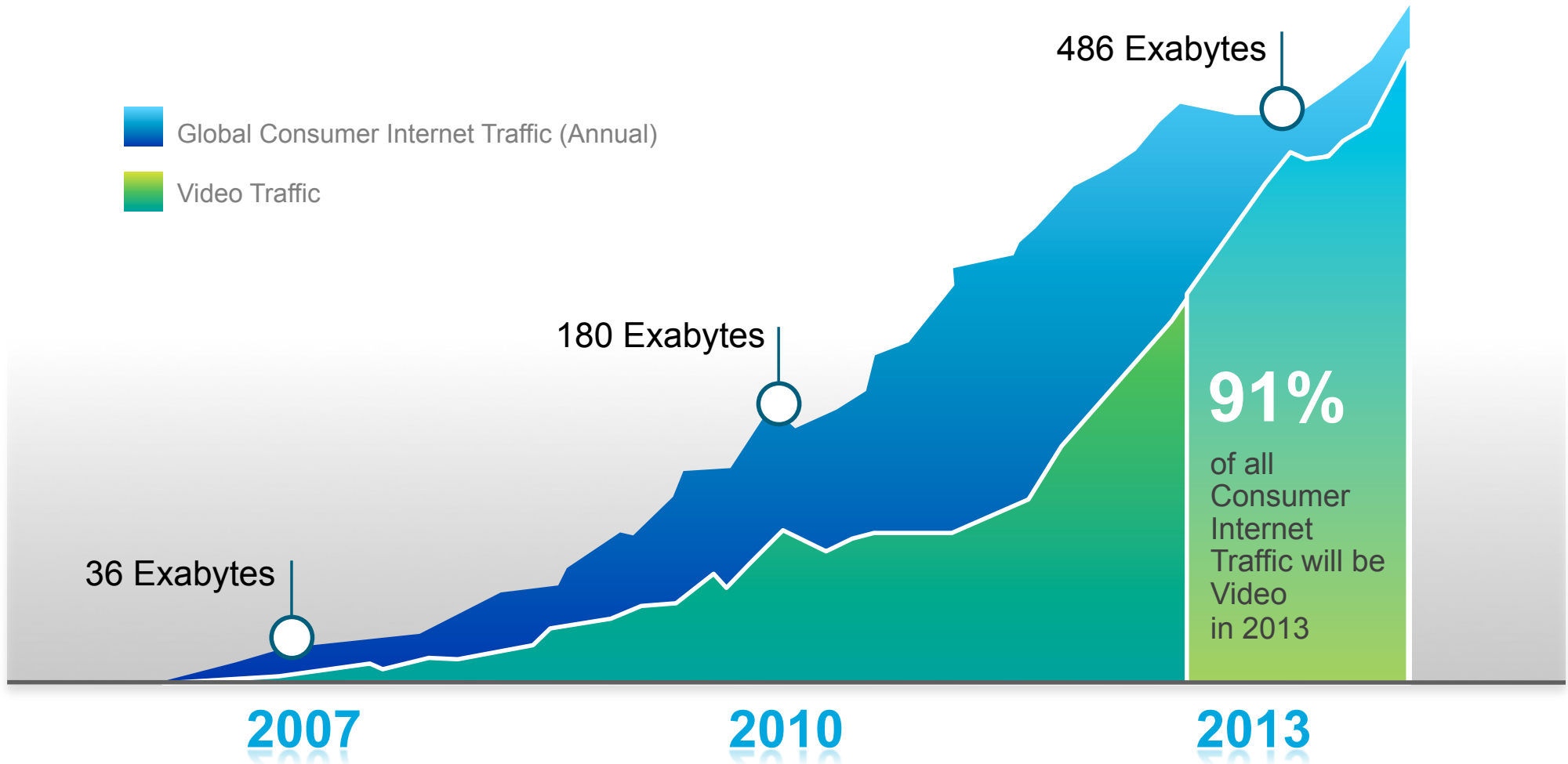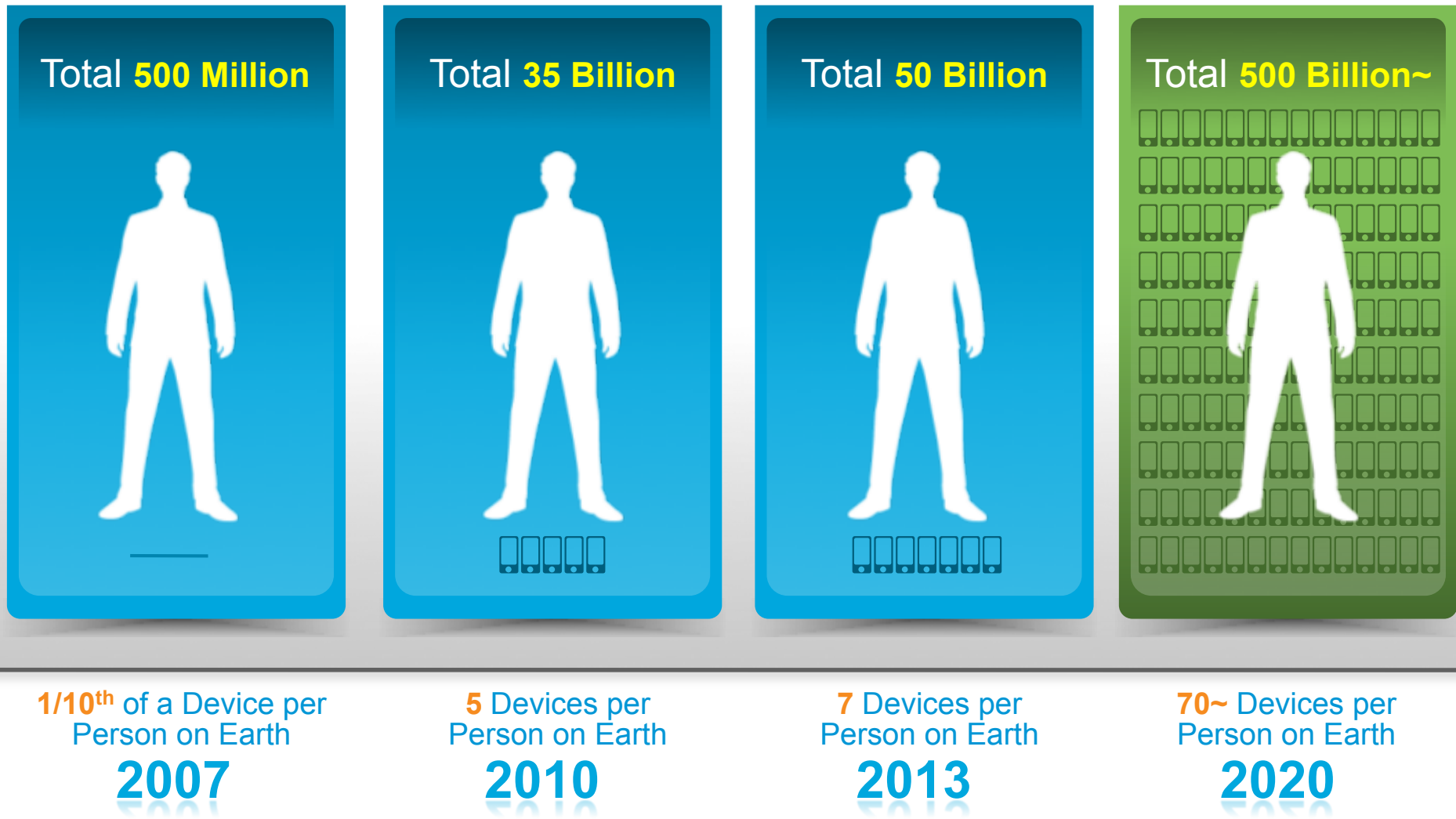
Explosion in the Amount of Information

2007

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2010

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2013

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5 Exabytes per month

1.4 Billion DVDs crossing the network

21 Exabytes per month

4.8 Billion DVDs crossing the network

56 Exabytes per month

12.8 Billion DVDs crossing the network

Source: Cisco Visual Networking Index

Video Will Dominate the Information Flow

486 Exabytes

■ Global Consumer Internet Traffic (Annual)

■ Video Traffic

180 Exabytes

91%

of all
Consumer
Internet
Traffic will be
Video
in 2013

36 Exabytes

2007   **2010**   **2013**

Source: Cisco Visual Networking Index

Growth of Connected Devices

Total **500 Million**	Total **35 Billion**	Total **50 Billion**	Total **500 Billion~**

1/10th of a Device per Person on Earth
2007

5 Devices per Person on Earth
2010

7 Devices per Person on Earth
2013

70~ Devices per Person on Earth
2020

Source: Forrester Research, Cisco IBSG

Cloud Computing Arriving Just in Time

Age of "Warehouse Scale" Machines

Google's data center on the Columbia river, Oregon

Own or Consume

Emergence of New 'Classic' Business Model from Amazon

Capacity Versus Utilization
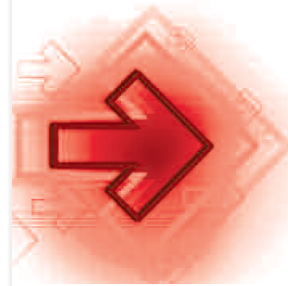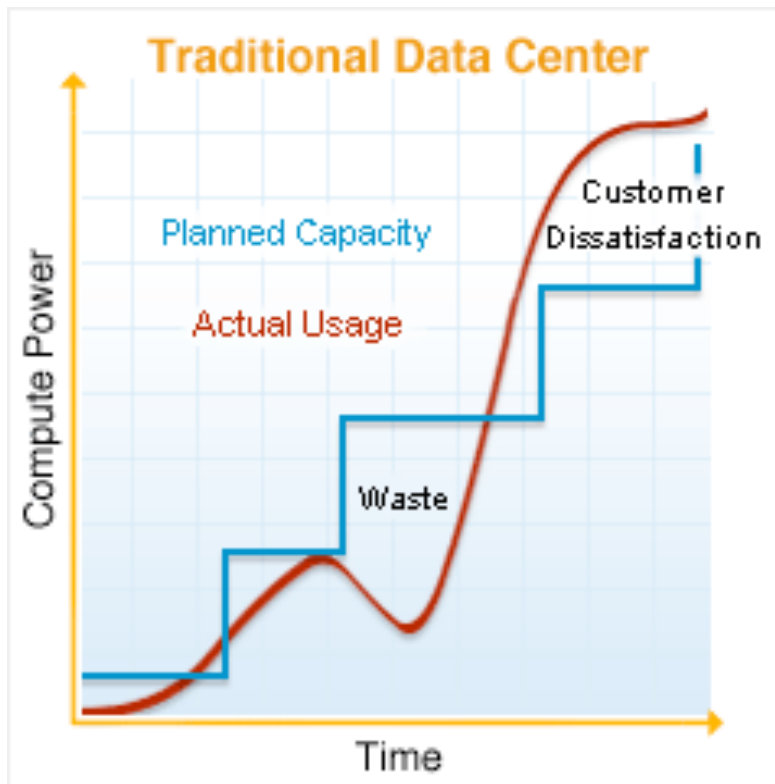
Cloud Service Provider to Businesses

Source: AWS Economics Center http://aws.amazon.com/economics

Conceptual Model for Cloud Services
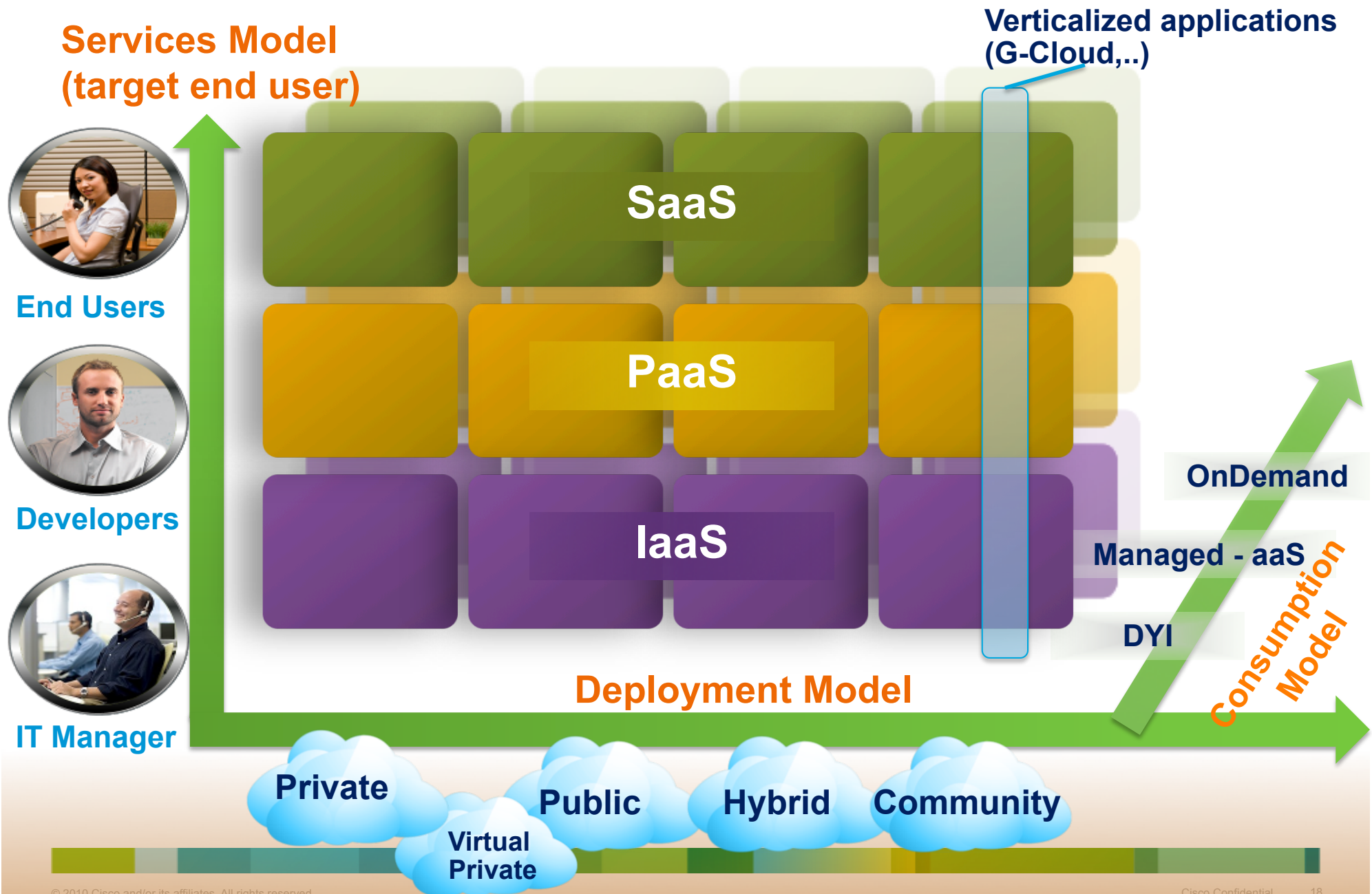
Evolution of Data Centers and Clouds

Consolidation   **Virtualization**   **Automation = Utility/Cloud model**

Phase 1	Phase 2	Phase 3	Phase 4
	Private Cloud	Private Cloud	Open Cloud (Federations)

Inter-Cloud

Virtual Private Cloud

Stand-Alone Data Centers

Public Cloud   Public Cloud   Public Cloud 1   Public Cloud 2

Present

Future Deployment
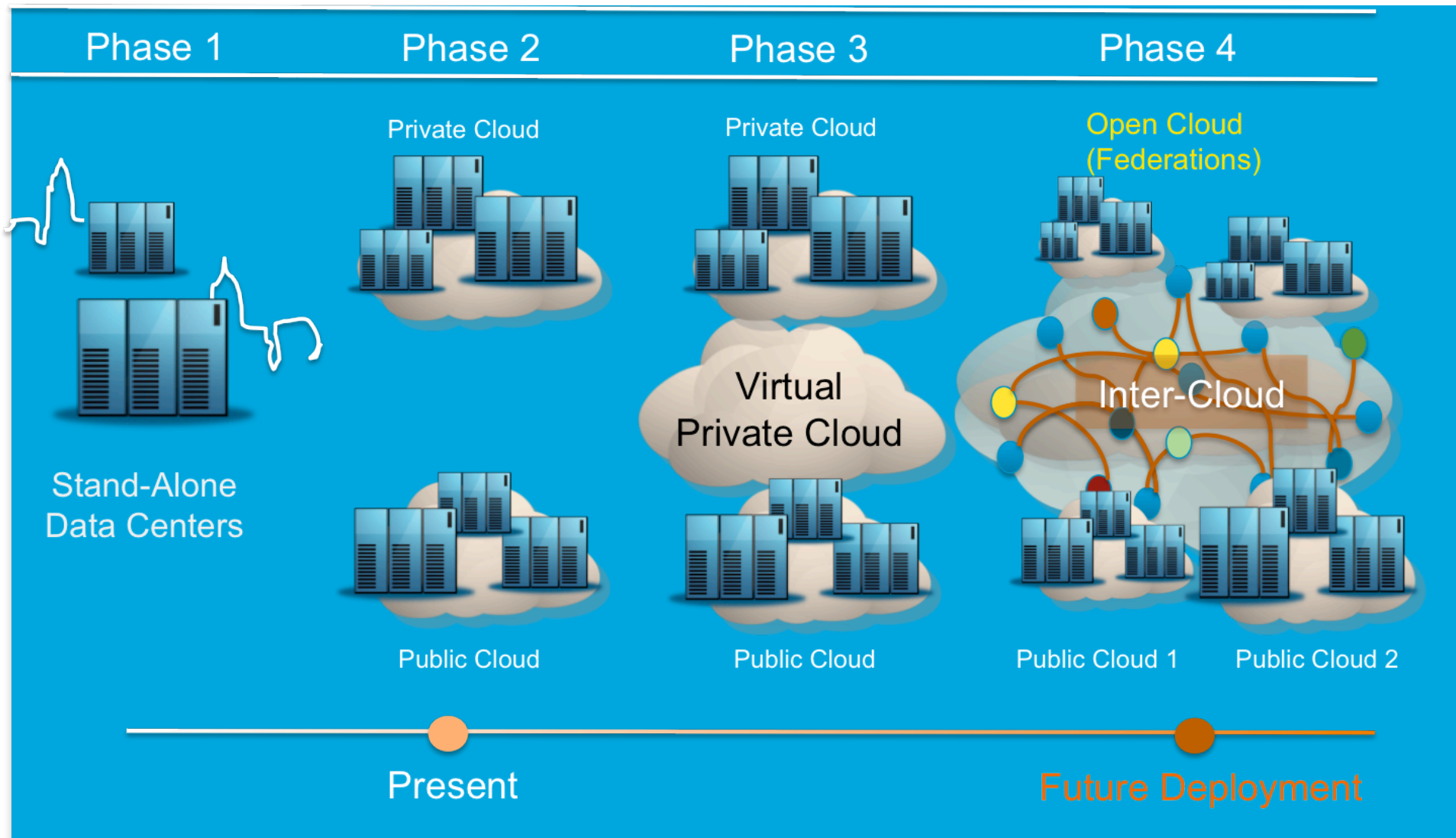
Open Cloud Computing

Why Cloud

- Scalability on Demand
- Streamlining Datacenter
- Improving Business Processes
- Minimizing Startup Works

Challenges

- Security
- Interoperability
- Portability
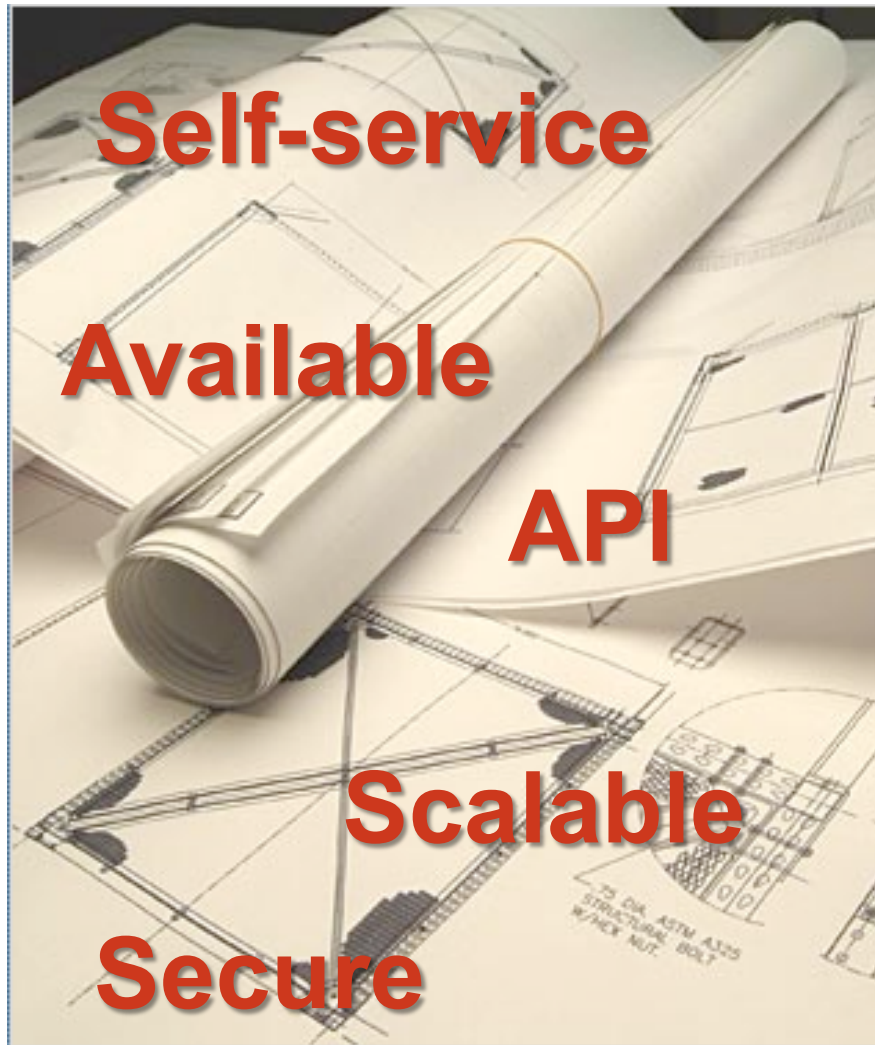- Governance / Management
- Metering/ Monitoring

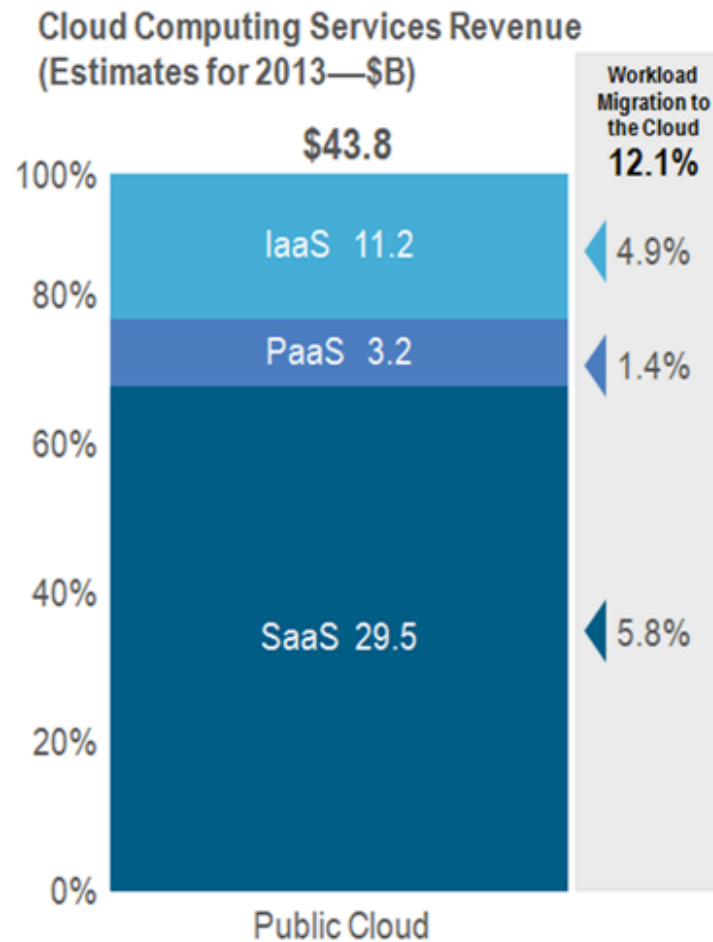## Open Cloud

- Choice
- Flexibility
- Speed/Agility
- Skills

open cloud manifesto

Dedicated to the belief that the cloud should be open
www.opencloudmanifesto.org

Cloud for me is…

Self-service

Available

API

Scalable

Secure

Standardization

Automation

Cost

Scale

Utilization

Self-Service

The Cloud services market is over $44B by 2013

Cloud Computing Services Revenue
(Estimates for 2013—$B)

$43.8

	Workload Migration to the Cloud **12.1%**
IaaS 11.2	◄ 4.9%
PaaS 3.2	◄ 1.4%
SaaS 29.5	◄ 5.8%

Public Cloud

100% / 80% / 60% / 40% / 20% / 0%

Source: Cisco IBSG, 2010

- Cloud is **on the enterprise agenda**: decision made at application level

- *Decision:* **Internal** versus **Public Cloud**

SaaS/PaaS Example

salesforce

CRM and collaboration

Sales Cloud
The world's #1 sales application.
Close more deals—faster.
Learn more | View demo | Pricing

Service Cloud
The future of customer service. Get higher
customer satisfaction—at a lower cost.
Learn more | View demo | Pricing

Chatter
Your own private and secure social network.
Collaborate with your team in real time.
Learn more | View demo | Pricing

Jigsaw
The world's largest contact database in the
cloud. Turbo-charge your pipeline.
Learn more | View demo | Pricing

IT and development

Force.com
The leading cloud platform for business apps.
Build apps and Web sites faster than ever.
Learn more | View demo | Pricing

Heroku
The frictionless, rock-solid Ruby platform.
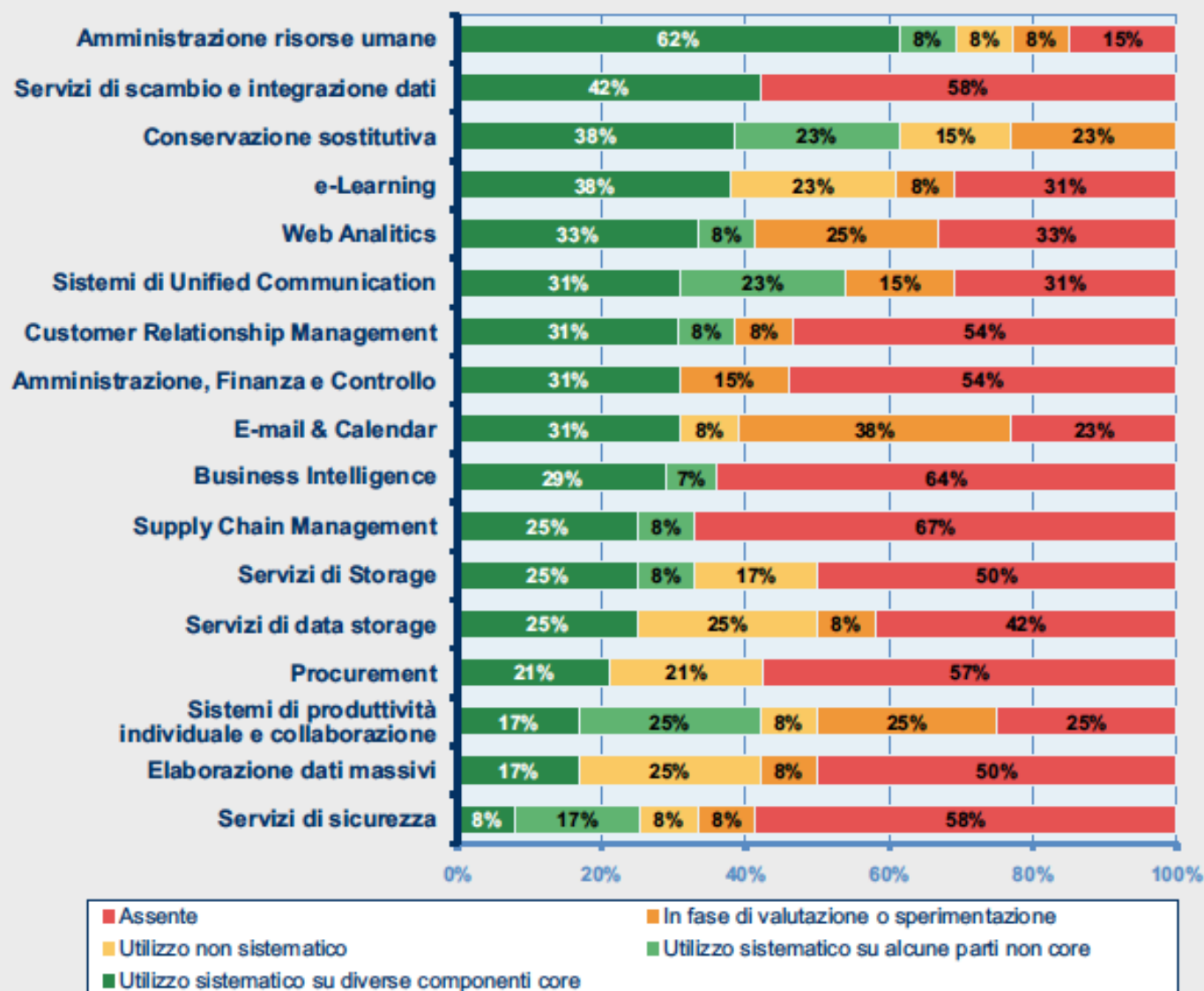Deploy and scale with speed and confidence.
Learn more

Database.com
The enterprise cloud database.
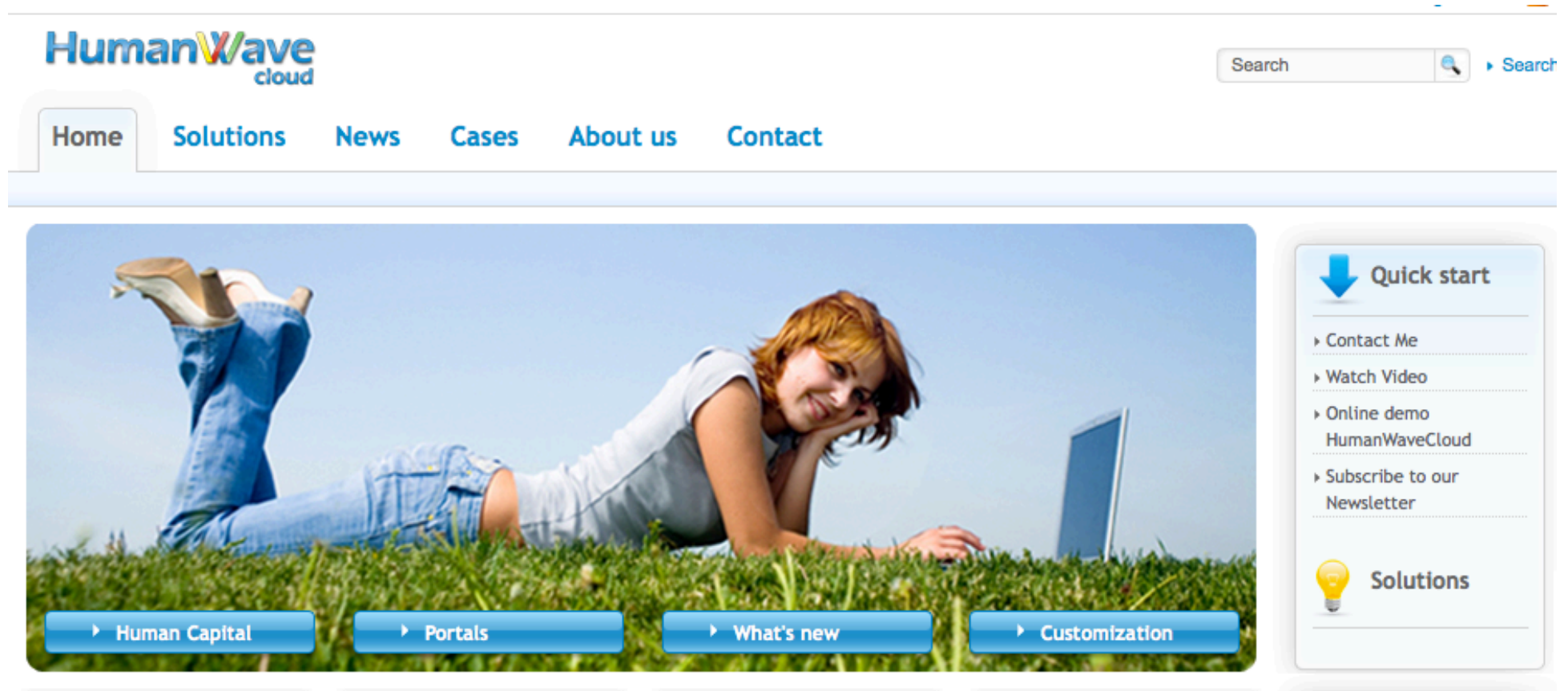Secure, proven, and trusted for business.
Learn more | View demo

Remedyforce
The easiest way to manage your IT help desk.
Deliver faster IT assistance for substantially less.
Learn more

Italy Poll

Figura 2.3 – Gli ambiti soggetti all'adozione di servizi ICT secondo nuovi modelli di offerta as a Service (dati Workshop)

Ambito	Utilizzo sistematico su diverse componenti core	Utilizzo sistematico su alcune parti non core	Utilizzo non sistematico	In fase di valutazione o sperimentazione	Assente
Amministrazione risorse umane	62%		8%	8%	8% / 15%
Servizi di scambio e integrazione dati	42%				58%
Conservazione sostitutiva	38%	23%	15%	23%	
e-Learning	38%		23%	8%	31%
Web Analitics	33%	8%		25%	33%
Sistemi di Unified Communication	31%	23%		15%	31%
Customer Relationship Management	31%	8%	8%		54%
Amministrazione, Finanza e Controllo	31%			15%	54%
E-mail & Calendar	31%	8%		38%	23%
Business Intelligence	29%	7%			64%
Supply Chain Management	25%	8%			67%
Servizi di Storage	25%	8%	17%		50%
Servizi di data storage	25%	25%	8%		42%
Procurement	21%		21%		57%
Sistemi di produttività individuale e collaborazione	17%	25%	8%	25%	25%
Elaborazione dati massivi	17%		25%	8%	50%
Servizi di sicurezza	8%	17%	8%	8%	58%

Legend:
- Assente
- In fase di valutazione o sperimentazione
- Utilizzo non sistematico
- Utilizzo sistematico su alcune parti non core
- Utilizzo sistematico su diverse componenti core

SaaS Example

SaaS Examples
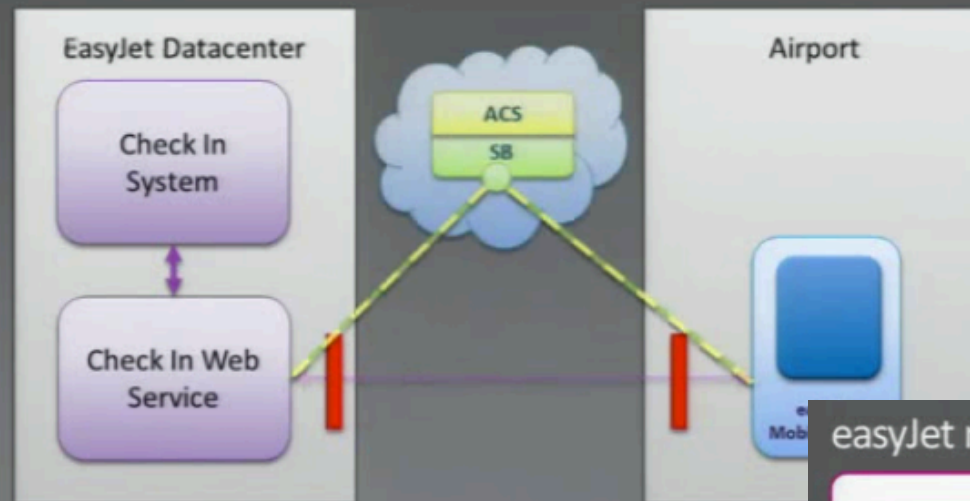
PaaS Example
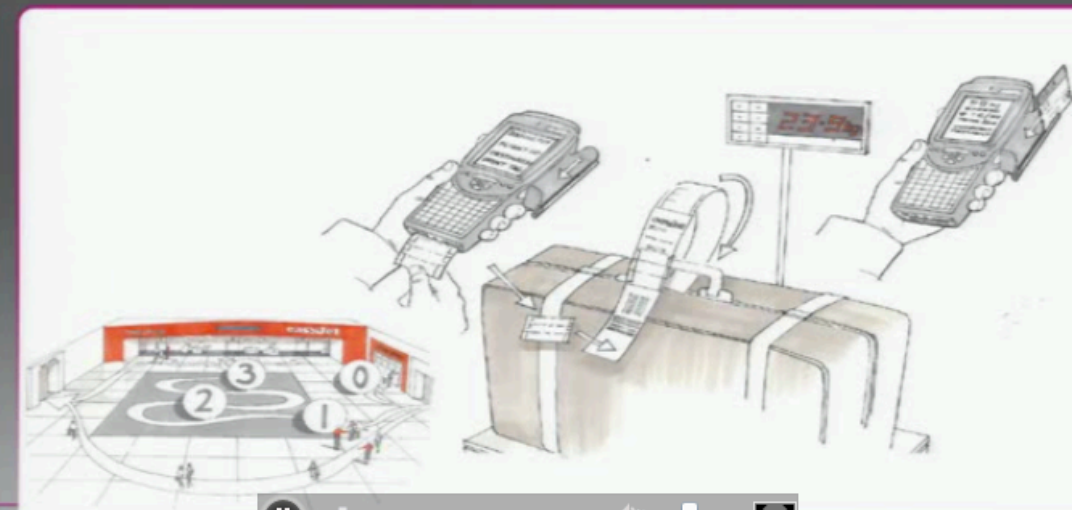
IaaS: VDI Choices
Where is computation happening?

OS Desktop

Virtual Desktop Streaming

Apps

WinXP

Synchronized Desktop

APP OS
APP OS
APP OS
APP OS
APP OS
APP OS

VMware

Hosted Virtual Desktop

VMware

Display Protocol

Application

Application Streaming

WinXP

Application

Operating System

Hosted Virtual Application

THINAPP

THINAPP OS
THINAPP OS
THINAPP OS

VMware

THINAPP

Client-Based Computing

Server-Based Computing

Used VMware Hypervisor as an example. Could use any flavor of Hypervisor

Snapshot of a VDI Cloud

Android
iPad
Windows Phone

Employee Owned
PC / Mac:
Browser / Client

Mobile Users:
Client for
Smartphones &
Tablets

Thin Client
Integration

Corporate Office:
PC and MAC
Browser / Client

Android
Client

Laptop – PC / MAC
Disconnected User

Internet

LAN / WAN

Offline

AD / LDAP Authentication

DaaS Platform

Connection Broker	Multi-tenancy
Management Interface	Role Separation

Apps

Data
Stores

AD

Enterprise
Data Center

Compute / Store

IP Networking

VM   o o o   VM

Hypervisor

x86 Server

NAS

IP Networking

Hypervisor:
- ESX, KVM, Xen, Hyper-V

Server:
- Power, Density, Cost,

Functionality at NAS Level
- Dedupe
- Rapid Manufacturing

App-V   XenApp
Google docs
Office
Windows 7
ubuntu

Image Running in VM

Feature:
- Profile Management
- User Shares
- Printers

Desktop Type:
Dynamic or Static

Traditional Data Center Approach
Complexity Grows With Number of Apps

Corp

App
OS

Physical Server

DB

Mktg

App
OS

Physical Server

DB

Finance

App	App
OS	OS

Physical Server | Physical Server

DB | DB

Engineering

App
OS

Physical Server

Storage

HR

App	App
OS	OS

Physical Server | Physical Server

DB | DB
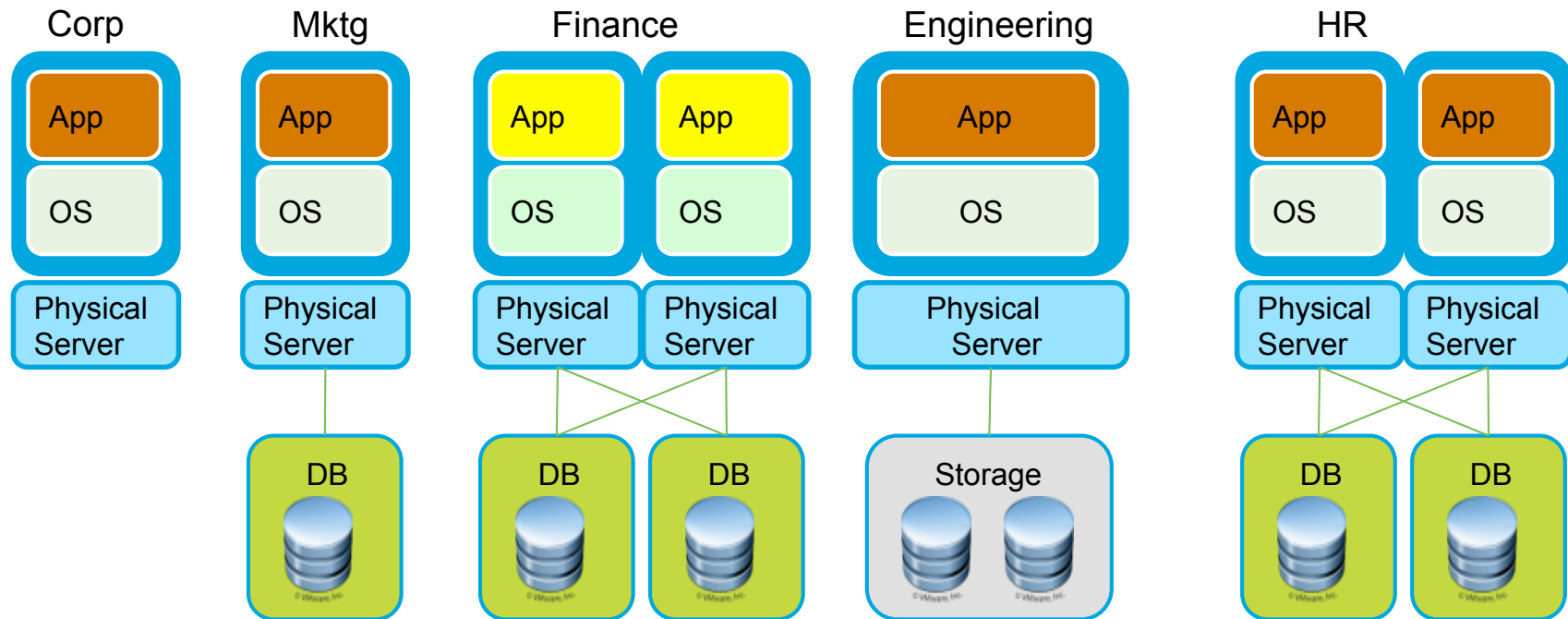
Poor Utilization

Inflexible Infrastructure

What is Driving and Enabling Server Consolidation?

Multi-core Architecture

Blade Servers

Application **Application**
Operating System **Operating System**
ESX Server
Hardware
CPU Memory NIC Disk

Server Virtualization
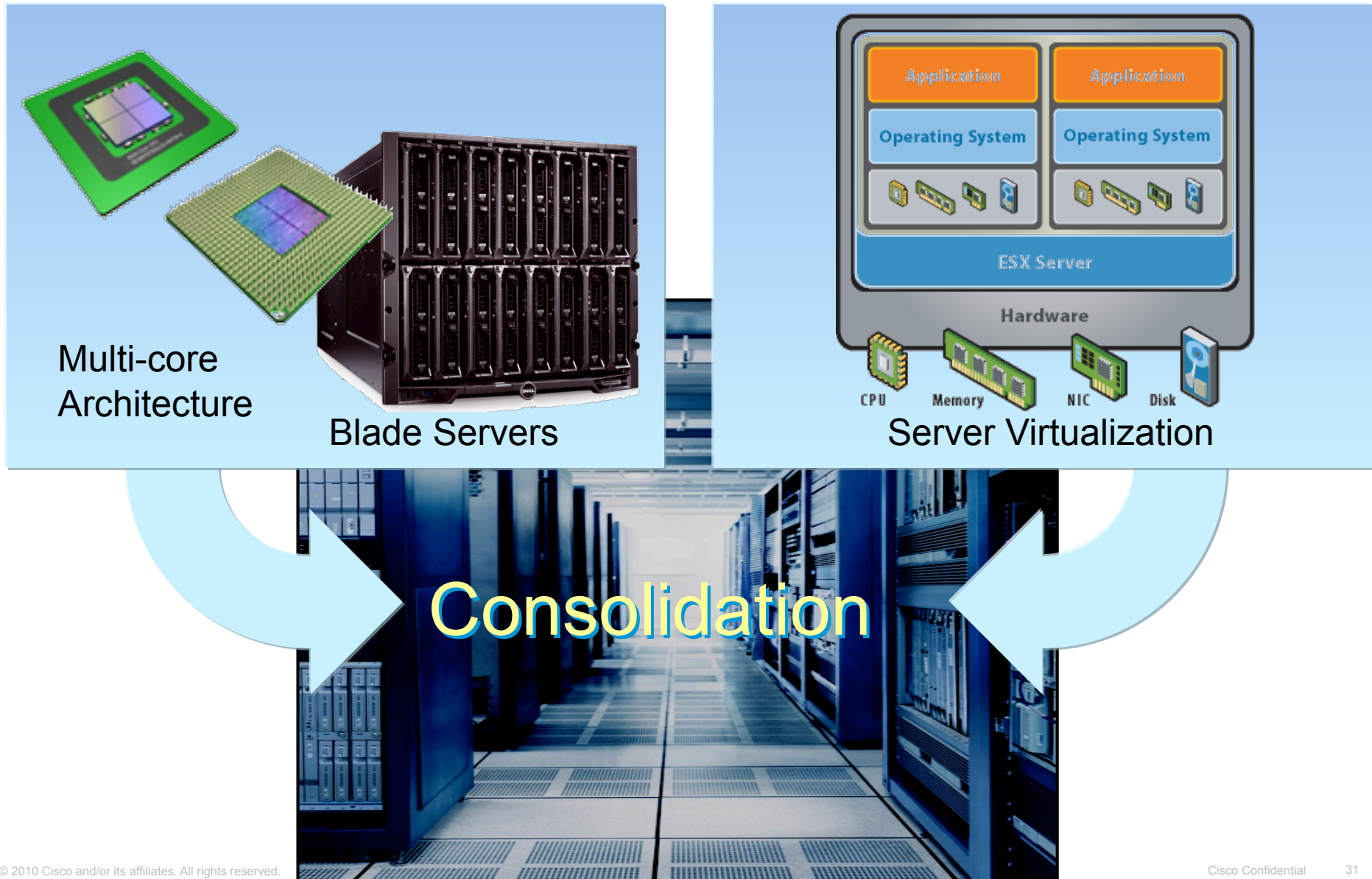
Consolidation

Simplifying the Data Center

From ad hoc and inconsistent…
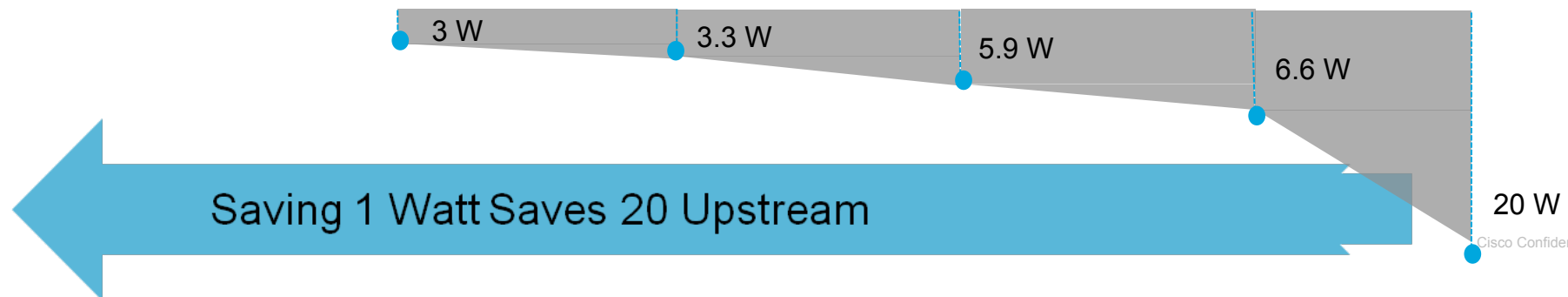
…to structured, but siloed, complicated and costly…
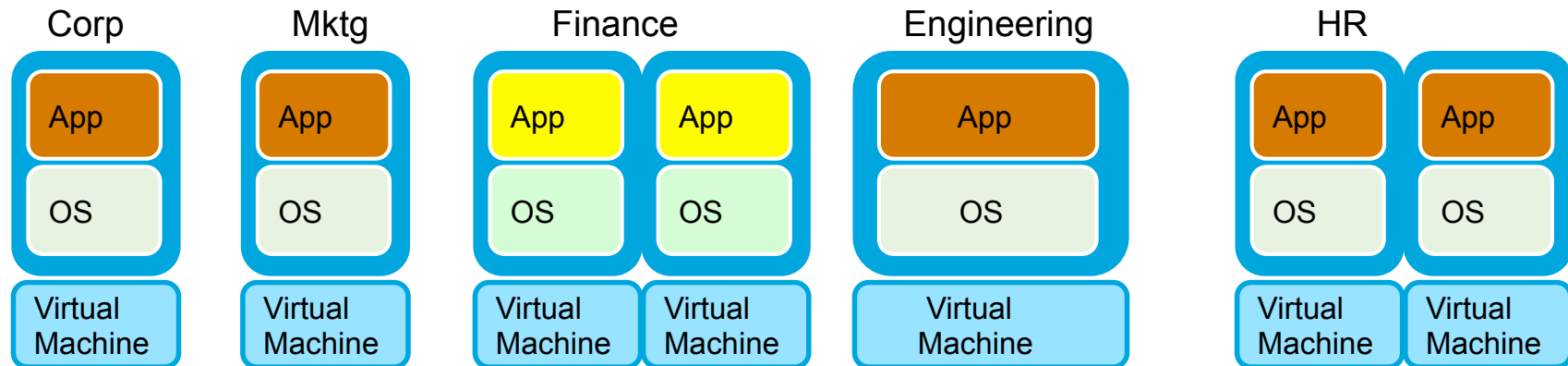
…to simple, optimized and automated

Virtualization and Consolidation impact

Conversion Losses

Distribution Losses

Facility Overhead

Fans & PSU Losses

Wasted Cycles *

* Wasted power versus running at 50% utilization

67 W

3 W

13 W

2 W

10 W

100 W

33 W

30 W

17 W

15 W

5 W

Coal

Power Generation

Transmission

Datacenter

IT equipment

Components

Computation

Efficiency	33%	90%	59%	88%	30%	
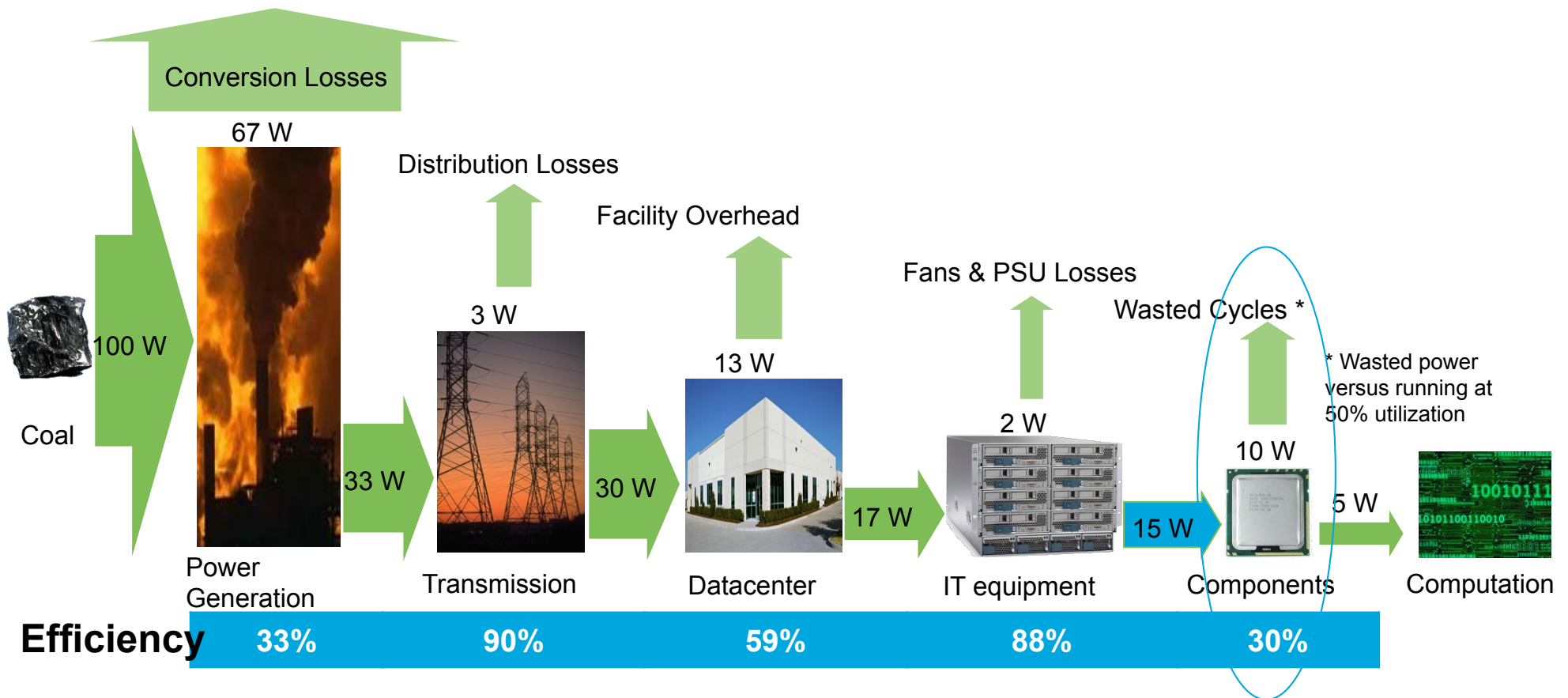
Watts Coal To Deliver a Watt at Each Stage

3 W

3.3 W

5.9 W

6.6 W

20 W

Saving 1 Watt Saves 20 Upstream

Infrastructure Becomes Scalable & Efficient

Corp
| App |
| OS |
| Virtual Machine |

Mktg
| App |
| OS |
| Virtual Machine |

Finance
App	App
OS	OS
Virtual Machine	Virtual Machine

Engineering
| App |
| OS |
| Virtual Machine |

HR
App	App
OS	OS
Virtual Machine	Virtual Machine

API-driven services   **Self-service portal**   **Selective application mgmt**

Cloud Infrastructure Service

Pool of shared resources

Physical Server

Physical Server

Storage

Physical Server

Storage

DB Service

Physical Server

Queue
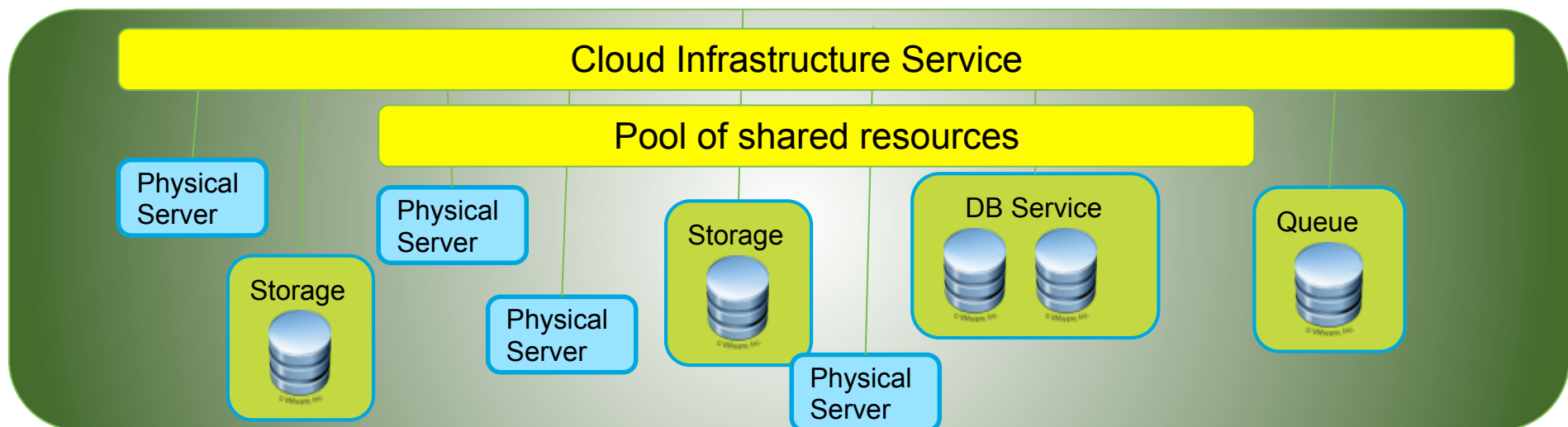
Taxonomy of Cloud Computing
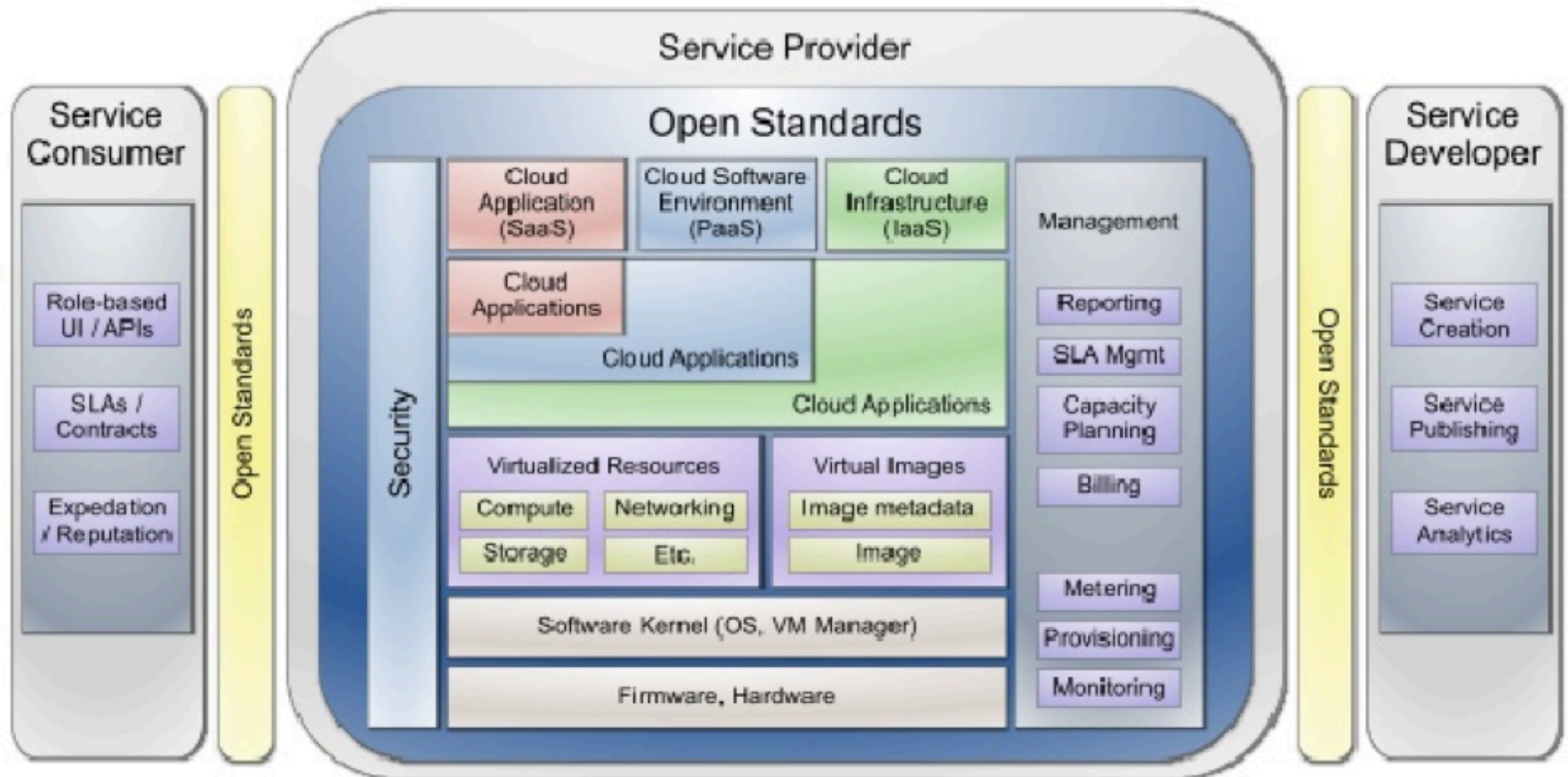
Cloud Computing Use Cases White Paper,
http://groups.google.com/group/cloud-computing-use-cases

Proofing the Value of IaaS
Progressing the Private Cloud
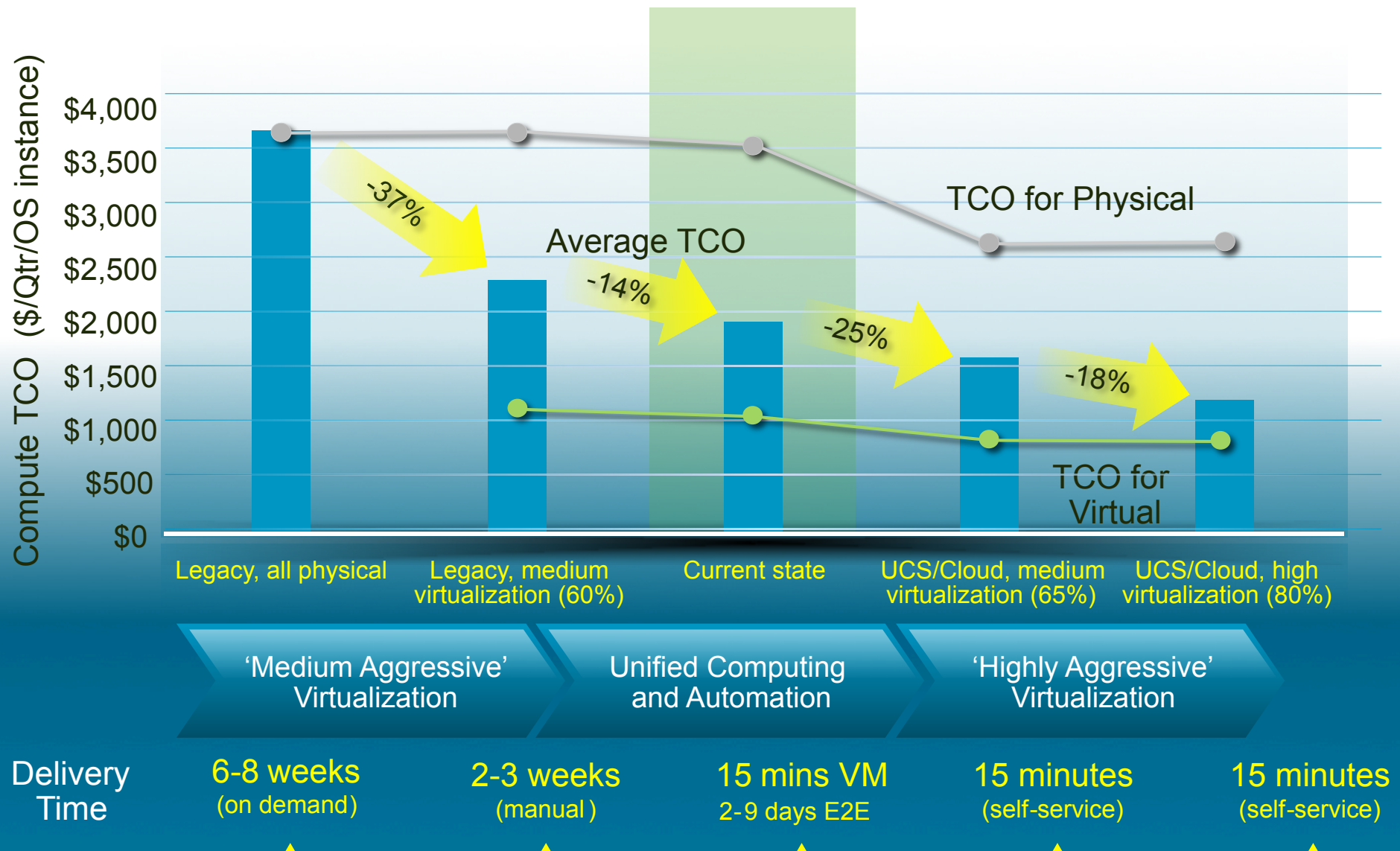
Compute TCO ($/Qtr/OS instance)

$4,000
$3,500
$3,000
$2,500
$2,000
$1,500
$1,000
$500
$0

-37%

-14%

Average TCO

-25%

-18%

TCO for Physical

TCO for Virtual

Legacy, all physical	Legacy, medium virtualization (60%)	Current state	UCS/Cloud, medium virtualization (65%)	UCS/Cloud, high virtualization (80%)

'Medium Aggressive' Virtualization	Unified Computing and Automation	'Highly Aggressive' Virtualization

Delivery Time	6-8 weeks (on demand)	2-3 weeks (manual)	15 mins VM 2-9 days E2E	15 minutes (self-service)	15 minutes (self-service)

Scaling as never before

Virtual
Servers

Animoto.com case study

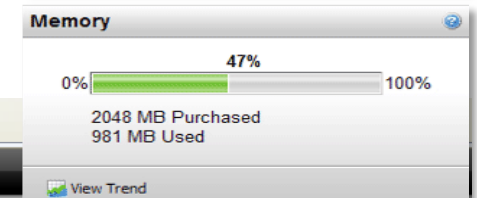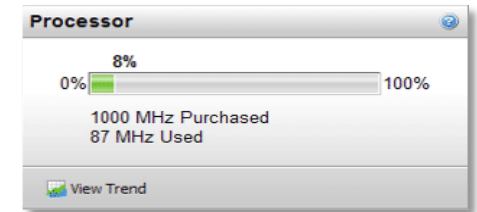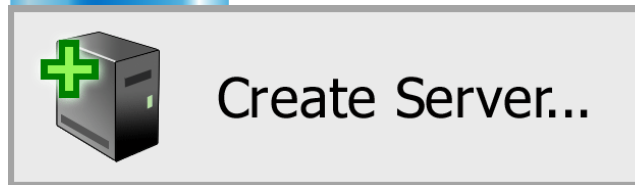4/12   4/13   4/13   4/14   **4/15**   4/16   4/17   4/17   **4/18**

IaaS Example: Terremark
The Enterprise Cloud™
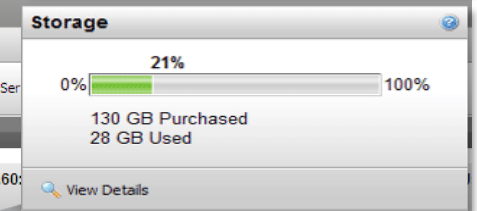
- Virtual private cloud

- Dedicated Resource Pool

- Physical device integration

- Secure connectivity to private networks

- Reconfigurable VM+Bursting

- Role-based security & full audit capability

Italian IaaS example

L'infrastruttura è "**servita**"
... con HyperCED.

Infrastructure becomes the enabler for services

Connectivity on demand	Storage on demand	Power computing on demand

AS

x86   RISC

Technology base

New Intel CPU family "Nehalem"	Unified I/O FCoE with CNA	Cell model for horizontal scalability	Unified computing
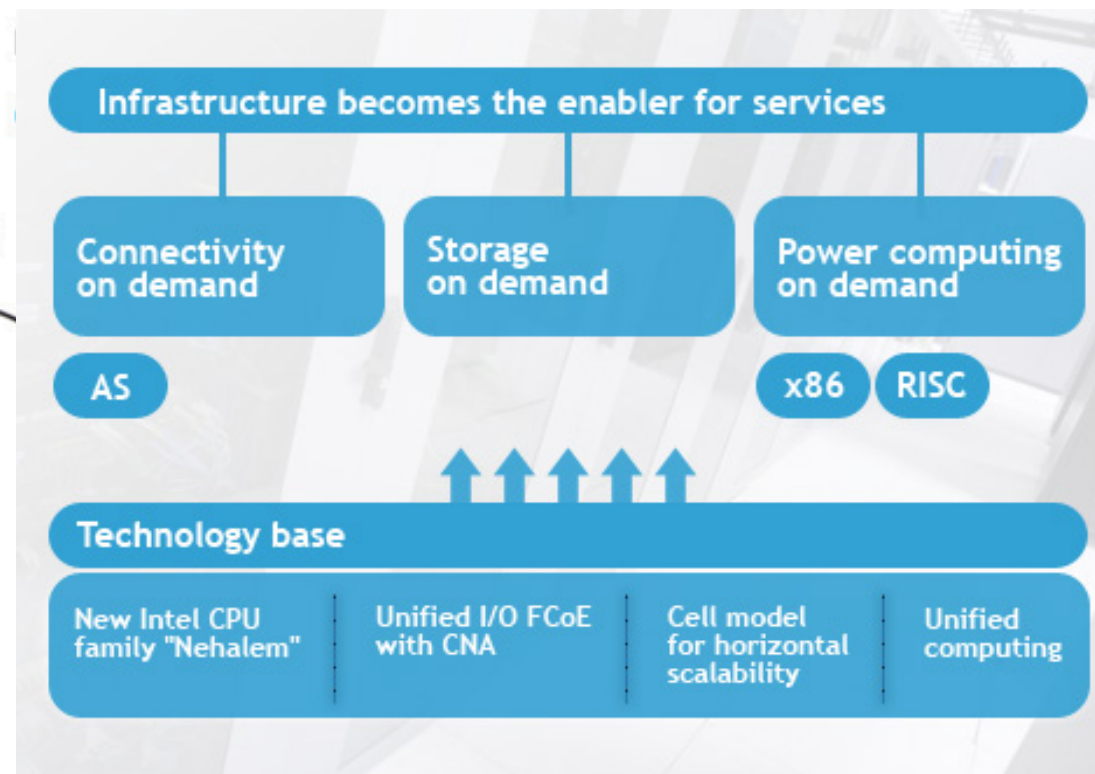
Italy poll

Figura 2.1 – Gli ambiti di utilizzo del Cloud Computing (dati Workshop – lato domanda)

Ambienti di staging e testing per pre-produzione: Non utilizzato 17%, Utilizzato internamente 42%, Utilizzato esternamente 33%, Utilizzato internamente-esternamente 8%

Consolidamento infrastrutturale: Non utilizzato 33%, Utilizzato internamente 33%, Utilizzato esternamente 25%, Utilizzato internamente-esternamente 8%

Backup/continuità del servizio/disaster recovery: Non utilizzato 50%, Utilizzato internamente 17%, Utilizzato esternamente 33%

Gestione dei picchi di carico: Non utilizzato 75%, Utilizzato internamente 17%, Utilizzato esternamente 8%

■ Non utilizzato ■ Utilizzato internamente ■ Utilizzato esternamente ■ Utilizzato internamente-esternamente

US Government Cloud Vision

In September 2009, we announced the Federal Government's Cloud Computing Initiative. Cloud computing has the potential to greatly reduce waste, increase data center efficiency and utilization rates, and lower operating costs.

Cloud Sourcing Models

Outsourced ←——————————————————→ *Government*

High

Trust (Security and Data Privacy)

Low

Private Cloud Commercially Hosted:
Publically available Cloud Computing services offered through commercial sources that are dedicated and separate from the Public both physically and logically and must to remain within the U.S. borders to support heighted data security and privacy requirements. Access to these services are provided through a dedicated Government Intranet and is not accessible from the Public Internet.

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.

Private Government 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 premises or off premises.

Private Commercially Hosted Cloud

Government Dedicated Intranet

Private Government Cloud

25%-50% Savings in IT Infrastructure, licences and operations

Public Cloud

Public Internet

Cloud

Hybrid Government Cloud

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 premises or off premises.

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).

Apps.Gov

USA Goverment Cloud Data

- US Army SFDC (500k investment >54k per year)

- Defense Information System (IaaS for App testing; provisioning time 6 wks to 24 hrs)

- Dept of Energy 5k Google Federal Emails

- Health and Human Services SFDC for Electronic Health Records

- USA.gov on Terremark (2.3$M/year > 650k)

- …many more

http://www.cio.gov/pages.cfm/page/STate-of-Public-Sector-Cloud-Computing

DOWNLOAD
A BOOK IN
60
seconds

The stunning third and final nove
internationally best-selling trilog
heart of Larsson's two previous

Digital List Price: $27.95
Print List Price: $27.95
Kindle Price: $9.99*
You Save: $17.96 (

*Includes free wireless delive
via Amazon Whispernet

320 Customer Reviews :

Sales Rank: #2 in Kindle Sto
Text-to-Speech: Not enable
Available on these devices
Print Length: 576 pages
Published: May 19, 2010

End-to-End Network Intelligence

Broadcasters

Advertisers

Content Aggregators

Application Developers

Retailers

Cloud Services

Network

Client Devices

Open Standards

IETF, IEEE, GSMA and Others

HTML, XML, IMS, XMPP, etc.

Service Providers

WRAP - CARD
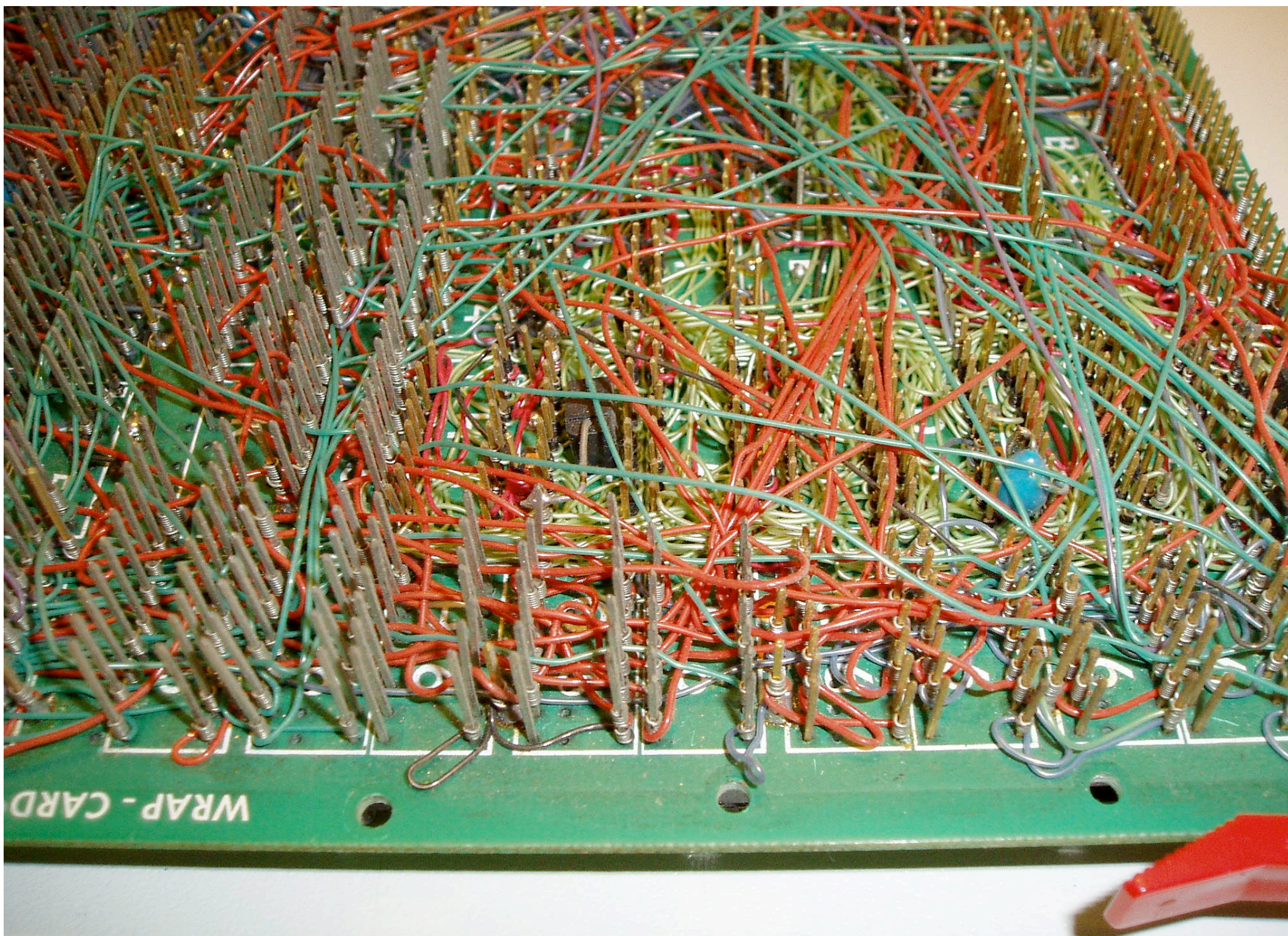
SLA's for Assurance Over the Network

"By 2010 most global providers will offer application-oriented performance as part of a standard [managed] service" – Gartner, June 2008

Business process SLA based on business KPIs

Application-centric SLA based on application metrics

Application-oriented SLA based on network metrics

Network-centric SLA based on network metrics

Application User

Application Server

WOC

LAN

CE Router

PE Router

MPLS

PE Router

CE Router

WOC

LAN

Application Server

Application User

Cisco IP SLA

MSP SLA

MSP SLA
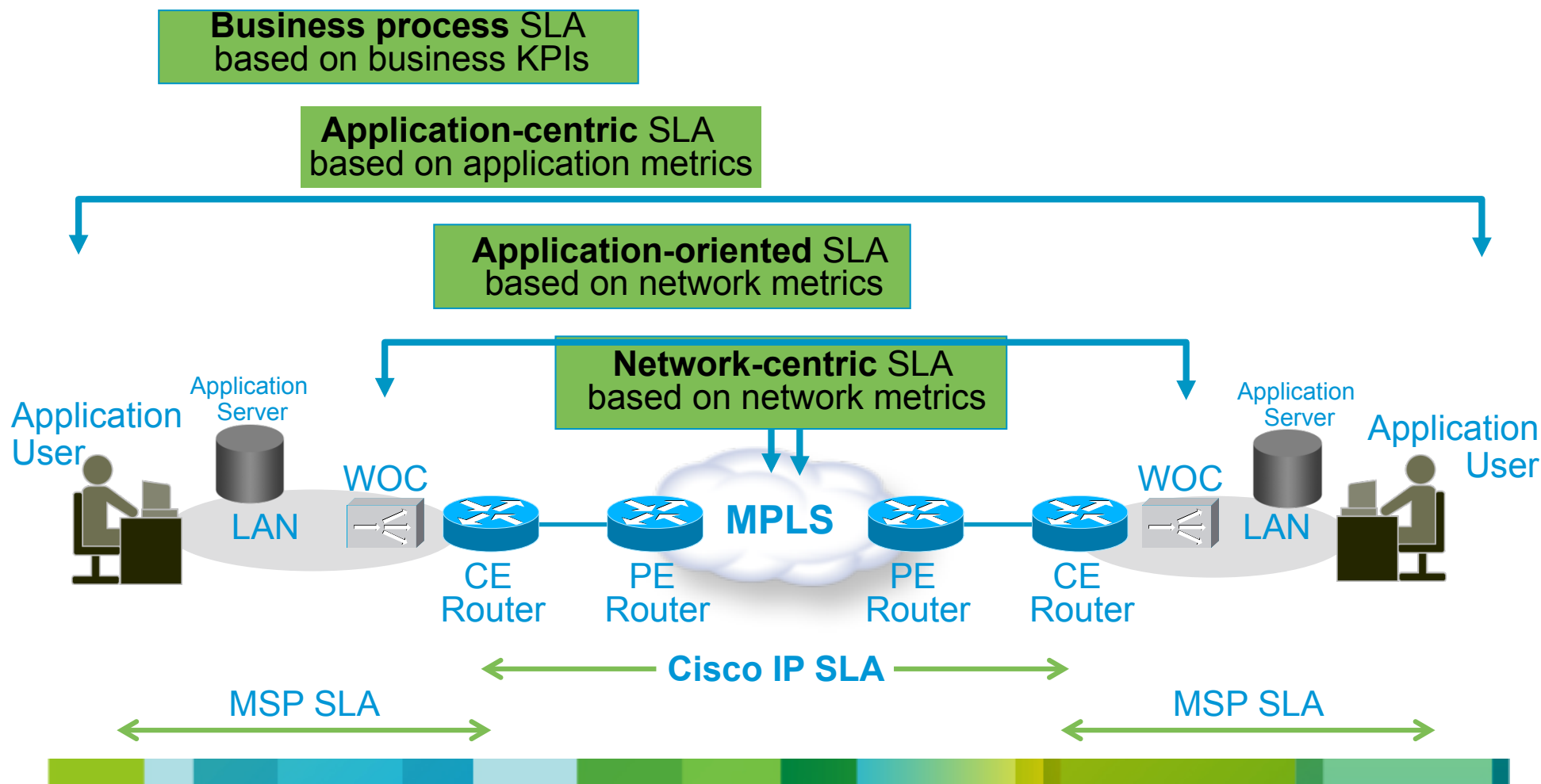
Source: Adapted from Gartner, June 2008

End-2-End SLA Example: TSystems
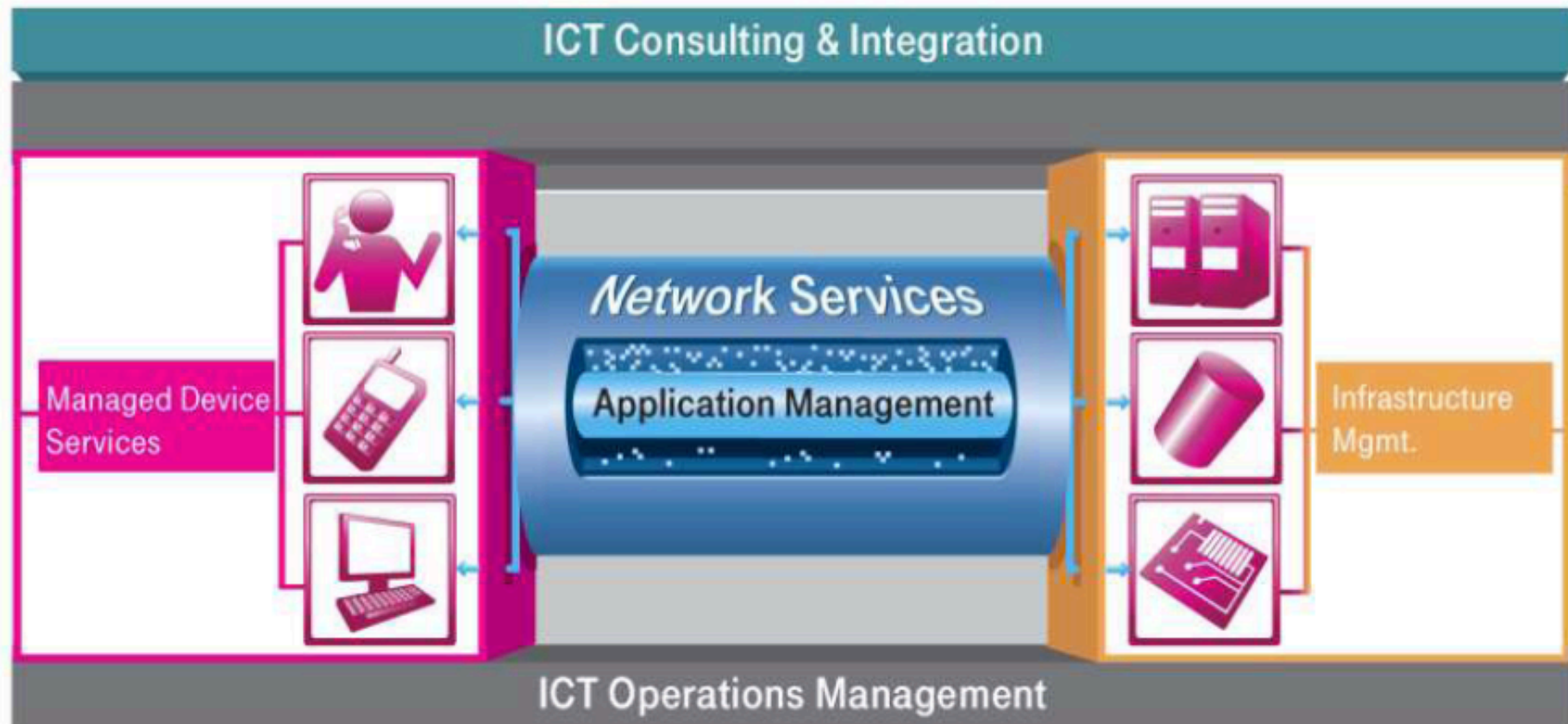
Orange Business Services

Orange leverages its VPN heritage to guarantee scalability, security and end-to-end SLA's

security as a service

real-time applications as a service

security

infrastructure as a service

lifecycle support

collaboration as a service

end-to-end SLAs

cloud-ready networking

standardization of user classes « SaaS »

Enterprise Application	
Application	Criticality
SAP	Top
IP Telephony	Top
Business Services	High
CRM over Citrix	High
salesforce.com	Medium
Office over Citrix	Medium
SharePoint	Medium
Google	Medium
Skype	Low
YouTube	Low

Convergence Across IT & Network Will Simplify End to End Services

NW and IT Decision Making (Sample = 20)

- Separate 20%
- Converging 15%
- Converged 65%

"From an infrastructure standpoint, it is all converged: one group would do buying across DC and WAN."
—CTO, Health Provider
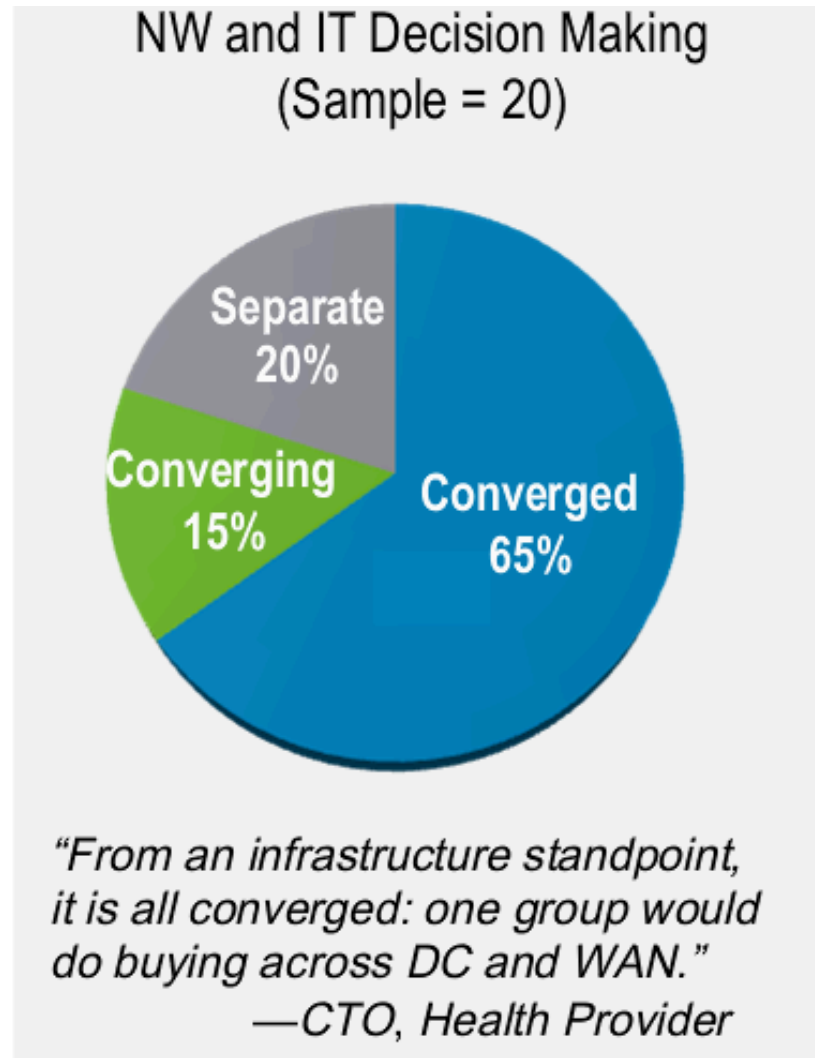
- Converged network & IT already well underway

Source: Cisco IBSG, 2010

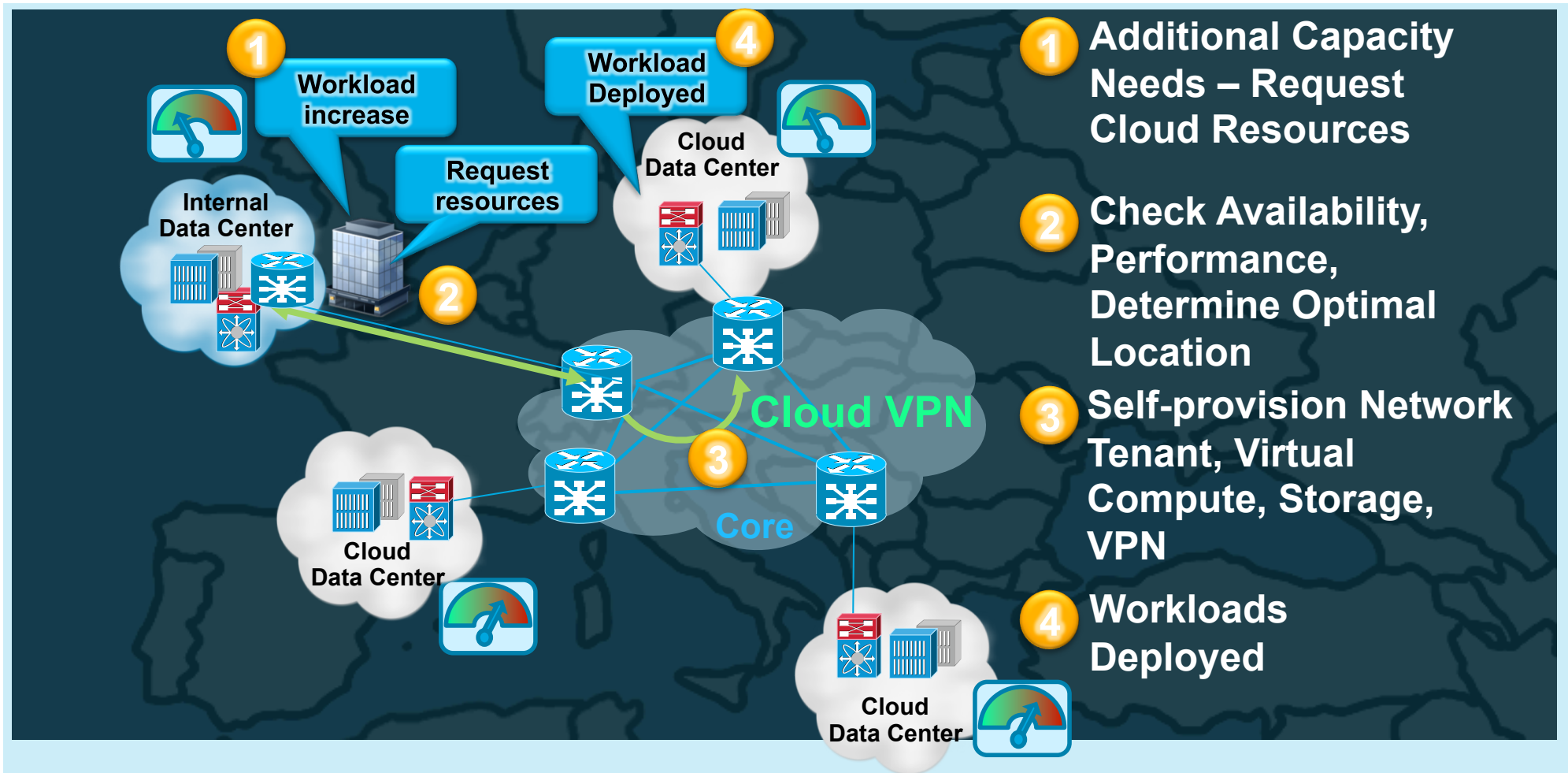# Cloud-Centric Networking
A Provisioning Scenario

1 Workload increase

Request resources

4 Workload Deployed

Internal Data Center

Cloud Data Center

2

3 Cloud VPN

Core

Cloud Data Center

Cloud Data Center

1 Additional Capacity Needs – Request Cloud Resources

2 Check Availability, Performance, Determine Optimal Location

3 Self-provision Network Tenant, Virtual Compute, Storage, VPN
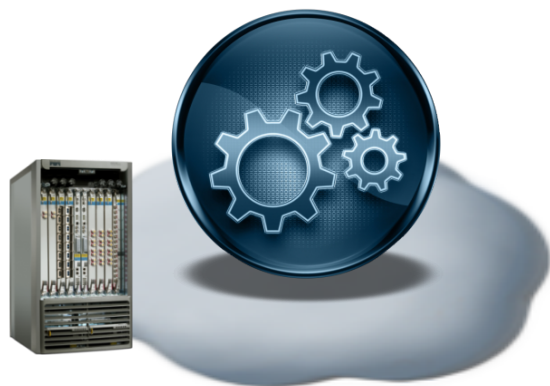
4 Workloads Deployed

'Pay-as-you-go' for compute, storage, network

Needing new functions in the Network

Network Positioning System (NPS)

L3-L7 info for best path to content
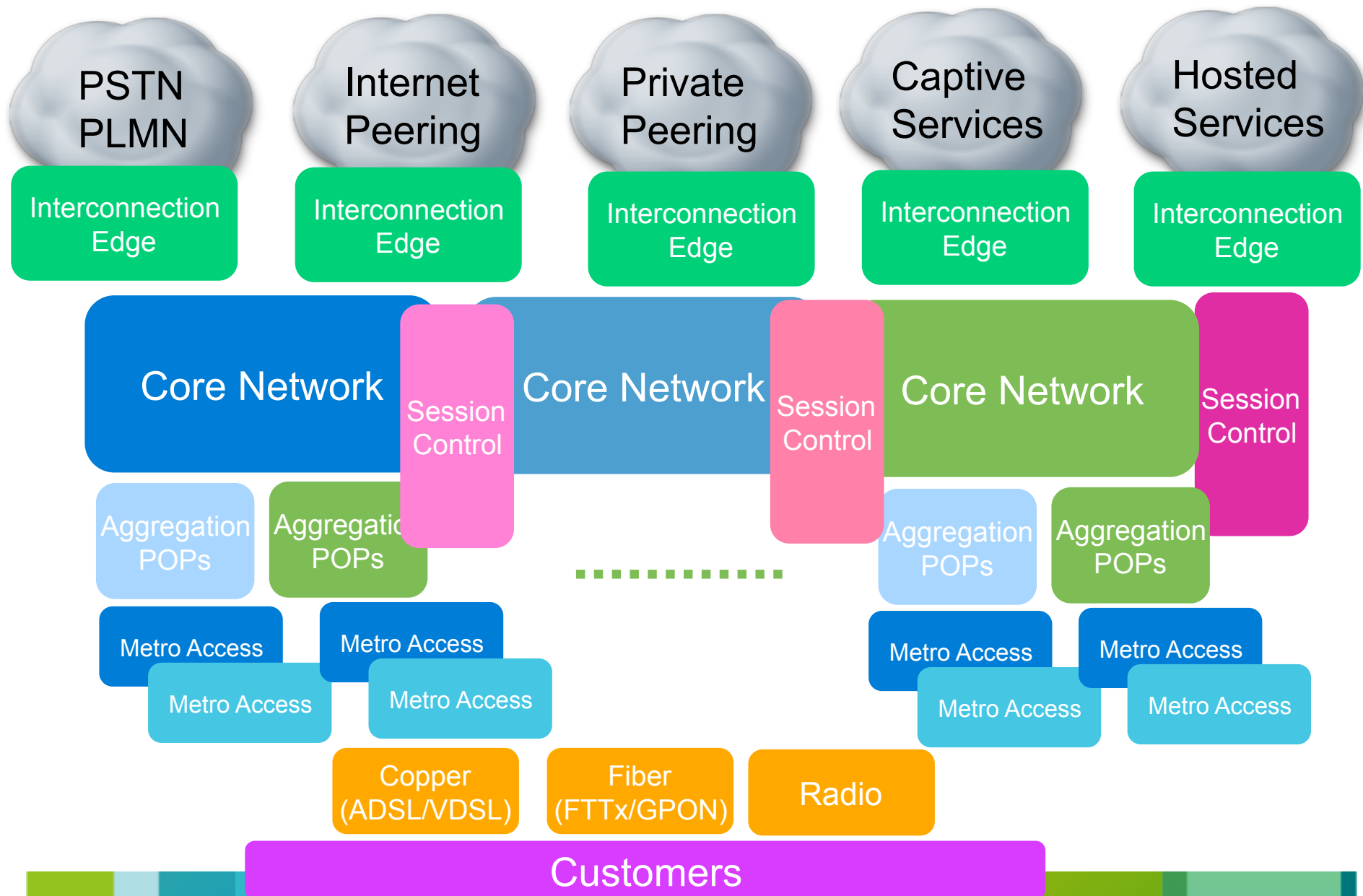Improves Experiences, reduces costs

VPNs for IaaS

Network and DC automate Inter-DC connections for
'Pay-as-you-go' for compute, storage, network

Tight Linkages Between DC/Cloud and Core

Carrier Networks, siloed architecture

PSTN PLMN — Interconnection Edge

Internet Peering — Interconnection Edge

Private Peering — Interconnection Edge

Captive Services — Interconnection Edge

Hosted Services — Interconnection Edge

Core Network | Session Control | Core Network | Session Control | Core Network | Session Control

Aggregation POPs | Aggregation POPs | Aggregation POPs | Aggregation POPs

Metro Access | Metro Access | Metro Access | Metro Access
Metro Access | Metro Access | Metro Access | Metro Access

Copper (ADSL/VDSL) | Fiber (FTTx/GPON) | Radio

Customers

Carrier Networks, NGN architecture

PSTN PLMN

Internet Peering

Private Peering

Captive Services

Hosted Services

| Interconnection Edge | Interconnection Edge | Interconnection Edge | Interconnection Edge | Interconnection Edge |

Core Network

Session Control

Aggregation POPs

Aggregation POPs

....

Aggregation POPs

| Metro Access | Metro Access | Metro Access | Metro Access |

Copper (ADSL/VDSL)

Fiber (FTTx/GPON)

Radio

Customers

Carrier Networks, NGN architecture… and Datacenters

PSTN PLMN

Internet Peering

Private Peering

DC Services APIs

Interconnection Edge

Interconnection Edge

Interconnection Edge

Captive Services

Hosted Services

Network Services APIs

Core Network

Interconnection Edge

Interconnection Edge

Session Control

Aggregation POPs

Aggregation POPs

Aggregation POPs

Metro Access

Metro Access

Metro Access

Metro Access

Copper (ADSL/VDSL)

Fiber (FTTx/GPON)

Radio

Customers

Network Role in Cloud: Summary

- Application Aware Behavior (acceleration, quality)

- Ubiquity, Mobility

- DC Awareness, Resiliency, Restoration

- Interoperability

- Realtime Media Delivery Transcoding,Transrating

- Billing/Metering

- Assurance/Monitoring

- Security and Privacy

- Single Sign On

- Cloud VPN

We Are Rapidly Approaching…

1 Trillion
Connected Devices

1 Million
Applications

1 Zettabyte
1B Terabytes of Content

Where is Italy

BQS2010, Application Readiness

Ready for tomorrow	Comfortably enjoying Today's applications	Meeting needs of Today's applications	Below Today's Application Threshold	Basic Apps
Korea Lithuania Japan Netherlands Latvia Hong Kong Sweden Germany Bulgaria Portugal Finland Denmark Romania Iceland United Kingdom Greece Ukraine Canada	Switzerland United States Czech Republic Hungary Belgium France Slovakia Norway Estonia Luxembourg Austria Singapore Poland Slovenia Russian Federation	Taiwan Spain Australia Ireland Malta New Zealand Italy Turkey Chile Israel Ghana Thailand Saudi Arabia Cyprus Brazil	United Arab Emirates Qatar China Argentina Bahrain Mexico Tunisia Costa Rica South Africa Malaysia Pakistan India Morocco Colombia Philippines Indonesia Jordan Egypt Vietnam	Algeria Peru Nigeria Kenya Angola

14 countries already prepared for the Internet "applications of tomorrow" compared to only 1 country in 2008

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Thank you.