Reduce energy consumption and costs through workload consolidation in data centers: the case of Telecom Italia

Telecom Italia Information Technology

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From theory…. to the real case of Telecom Italia

from theory.. to case studies

After discussing the theoretical principles and the practical applications of innovative approaches for consolidation, let's analyze the **case study of Telecom Italia**

energy saving in Telecom Italia

Workload consolidation is one of the approaches through which Telecom Italia faces the problem of energy saving in data centers.

focus on workload consolidation

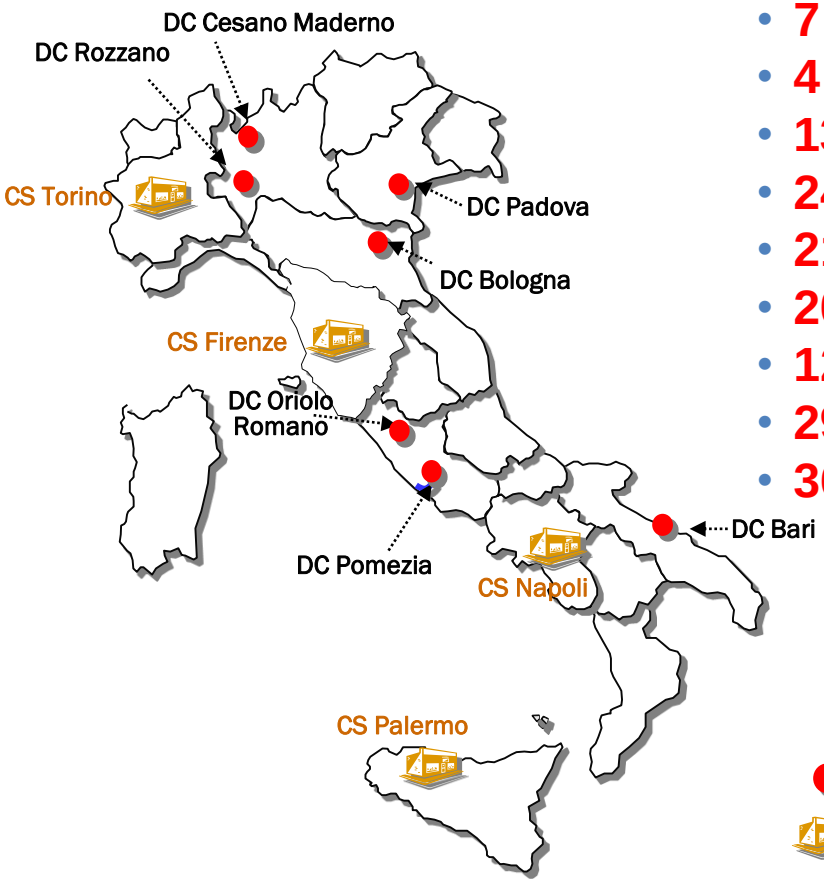
We will focus on the **technological and architectural benefits** deriving from the use of **workload consolidation** solutions in Telecom Italia data centers.

– **energy-consumptive DCs** require strategies for energy saving

– smart workload consolidation: macro level

– smart workload consolidation: micro level

Data Centers in Telecom Italia

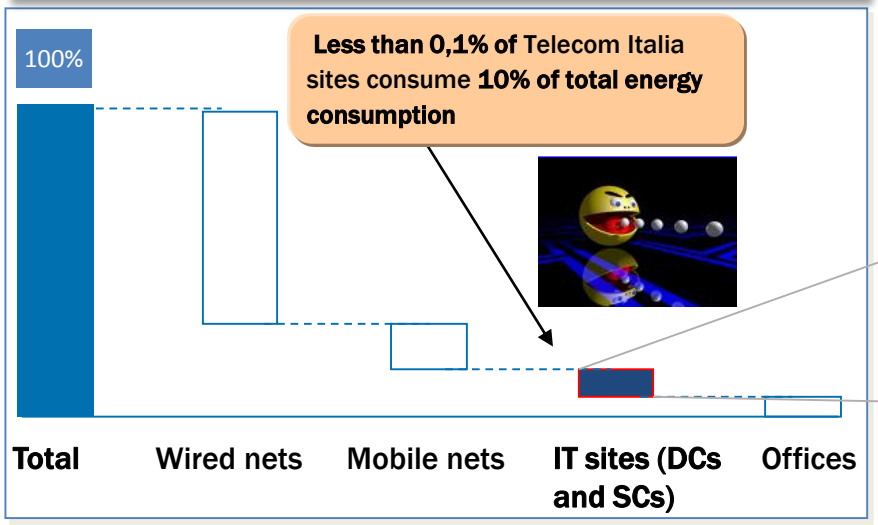


- **7** National Data Centers
- **4** Regional Service Centers
- **135** System Rooms
- **24.000** Servers
- **21.000 TB** Storage
- **20.000 TB** Backup
- **12.000 TB** Backup transmitted/month
- **29 MW** Available Power
- **36.000 m^2** Available Floor Area

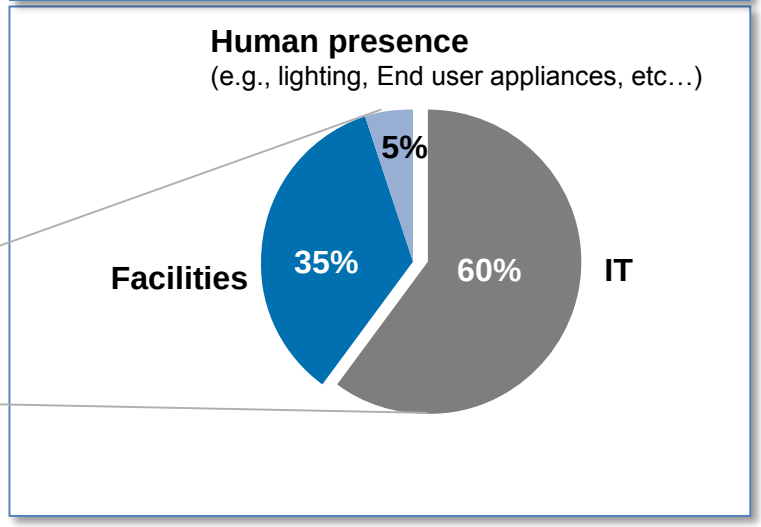
Data Centers: energy-consumptive sites

- For many years now **Telecom Italia** has undertaken **energy efficiency initiatives,** as Data Centers are energy-consumptive sites
- As an example, a medium-size data center (2500 m^2) consumes 25 GWh/year, which at current electricity prices corresponds to about € 4M

2013: energy partitioned per user categories

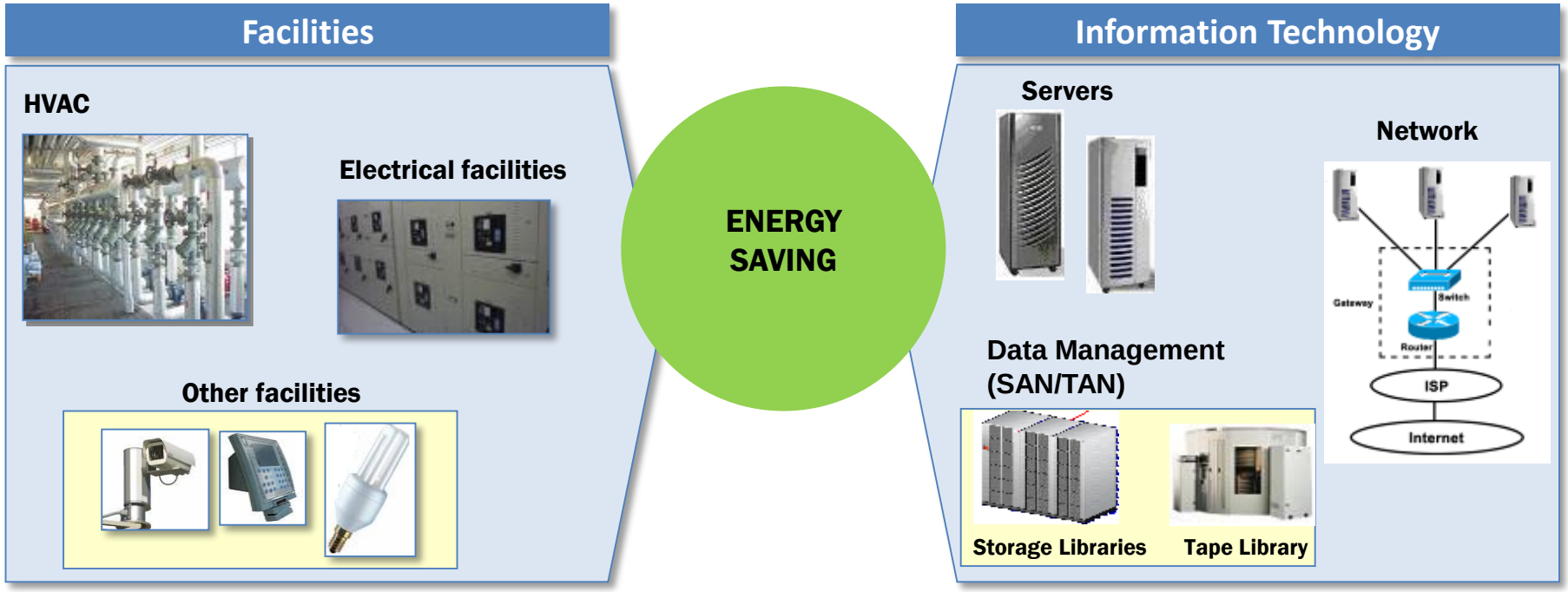


Use of energy in IT sites



PUE index may be misleading and may bring to overlook the fact that most of the energy consumption in data centers is caused by **IT infrastructures**

Energy saving: combined effect of actions on facilities and on IT



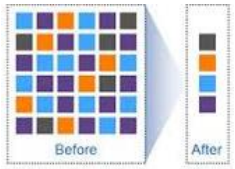
- Telecom Italia operates along the two directions:
  1. Improve technological solutions adopted in Facilities to increase the energy efficiency (reducing the PUE)
  2. Introduce hardware and software solutions to optimize the IT workload to reduce power consumption

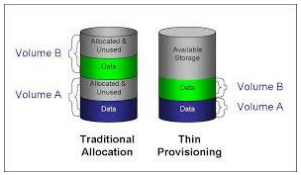
IT initiatives: smart workload consolidation

- Old **IT appliances** (primarily *servers* and *storage*) **consume** more energy than more recent systems. By replacing obsolete hardware we reduce power consumption.
- Telecom Italia has also established two different approaches for workload consolidation, obtaining not only power consumption reduction but also significant **technological** and **architectural benefits**

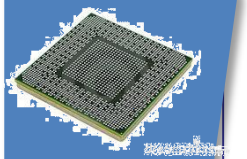
Macro Level

- Actions that aim to **consolidate the systems** or **reduce** the need for storage space:
  - **Workload consolidation** by applying **P2V** (Physical-To-Virtual) conversions on old servers to be decommissioned
  - **Storage efficiency** (e.g., thin provisioning and deduplication)





Micro Level



- Actions that aim at an efficient use of CPU and HW resources in general:
  - **Intelligent Workload Management** (*DCM, Eco4Cloud, DRS/DPM, …*)

intel DCM

e4c

vmware

Smart Workload Management: virtualized sites

- Products used for the optimization of computational resources are generally installed as **virtual appliances** integrated with the virtualization platform APIs. The appliance “advises” the manager of virtual resources on how to **consolidate VMs** on fewer physical hosts so as to unload and hibernate the unneeded servers
- **Consolidation** is performed while continuously **monitoring specific system counters** like **Ready Time** and **Ballooned memory**, in order to prevent overload events

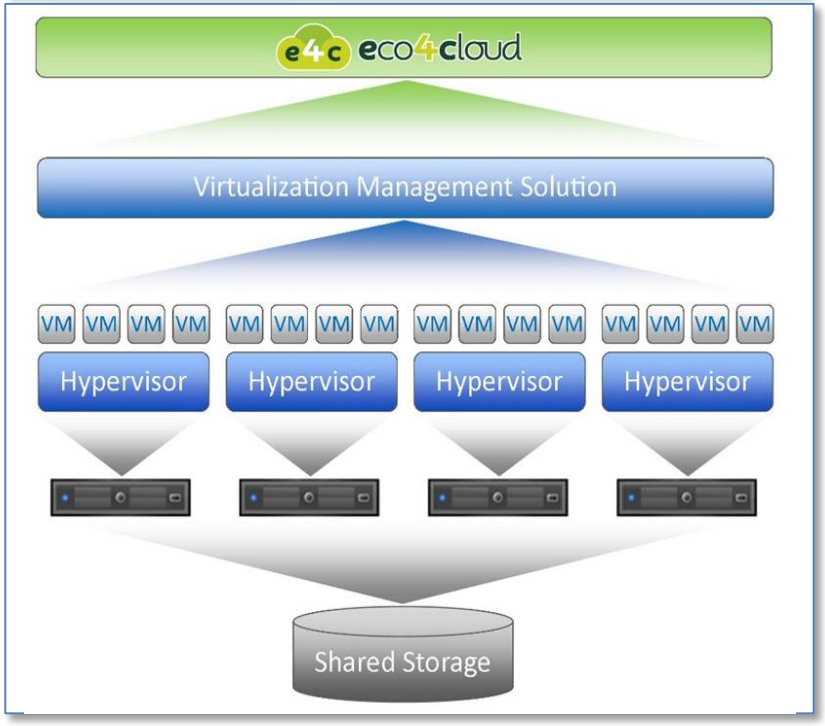
Macro-functionalities

multi-platform portal integrated with Microsoft Hyper-V and VMware vSphere (KVM is in the roadmap)

automatic consolidation of VMs on the minimum number of servers, which allows to save energy while preventing overload events

integrated with the underlying hypervisor manager (*e.g.. vCenter*) through the APIs offered by the specific vendor.

Architecture



Smart workload management in Telecom Italia: lab experiments

In July 2012, Telecom Italia started **laboratory experiments** aimed to test the Eco4Cloud software in a **Pilot Data Center**

Preliminary activities (*July-Dec 2012*)

- Tests started on **32 servers** of the **Test & Dev data center in Bari**
- 11 servers were soon declared unmanageable because too old
- The first version didn't consider memory overbooking and the fact that the clusters were separate and isolated
- During this time, several new versions were tested including many improvements, with some suggestions coming from Telecom Italia staff

Final tests (*January-July2013*)

- In January 2013 a final release was installed
- A feature called "**smart ballooning**" was implemented to achieve efficient memory management
- Power sensors were installed to **measure** and certify the **obtained savings**. The sensors have been installed and included on the **TI-Green** system so as to extract data from the related portal.
- June 2013: we ran successful **stress tests** to verify the adaptive product reaction in case of human interference (*vMotion, Maintenance Mode, etc.*).
- June-July 2013: campaigns to measure weekly consumption:
  - With Eco4Cloud disabled
  - With Eco4Cloud but without the "smart balooning" feature
  - With Eco4Cloud enriched with the "smart balooning" feature

Smart workload management in Telecom Italia: extensions in progress

The deployment started in Jan 2014 and has progressively extend to all VMware data centers (*about 500 ESX servers*) with the objective of minimizing the number of active servers, **reducing energy consumption** and improving the **overall efficiency**.

Issues

- Due to the complexity of the environment, **monitoring features** were developed on all data centers.
- To solve configuration problems it's important to gain full **commitment** of people in charge of operations.
- **Some obsolete servers** had to be taken out of the perimeter and planned for decommissioning. Their workloads were moved to servers that had been turned off.

Deployment solution

- The software is installed as a ***virtual appliance*** integrated with VMware vCenter
- The appliance suggests vCenter how to **dynamically and optimally consolidate VMs** on physical hosts

FARM	Total hosts	# Hosts w/E4C Active	# Host in permanent stand-by	% Host in permanent stand-by
Bari Consolidation (Production)	20	8	4	50,0%
Bari Consolidation (Test & Dev)	29	24	7	29,2%
Bari NGDC (Test & Dev)	58	22	13	59,1%
Bari vCloud (Test & Dev)	9	9	1	11,1%
Bologna NGDC (Production)	41	28	4	14,3%
Pomezia Consolidation (Production)	28	26	6	23,1%
Pomezia NGDC (Production)	48	48	8	16,7%
Pomezia NGDC (Test & Dev)	31	31	2	6,5%
Rozzano NGDC (Production)	13	13	1	7,7%
Padova Consolidation (Production)	13	6	1	16,7%
Padova NGDC (Production)	25	25	2	8,0%
Oriolo Consolidation (Production)	43	30	1	3,3%
Oriolo NGDC (Production)	17	17	2	11,8%

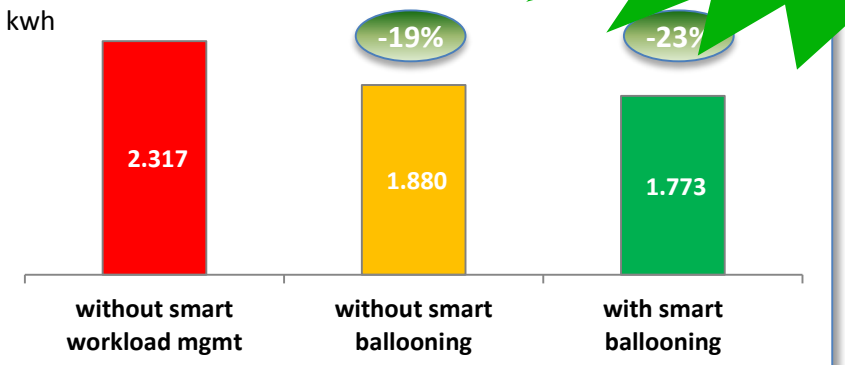
Energy savings may **fluctuate,** depending on **the dynamic workload**

Smart workload management in Telecom Italia: results

- So far, the VM consolidation solution has been applied on the physical servers of on-premises Telecom Italia data centers (*about 500 servers*)
- As the utilization of CPU and RAM is variable, the overall number of servers that can be switched off (and possibly [illegible] workload) is estimated to be around **20%** of the overall [illegible]

Annual savings:
~440 MWh

Energy consumption [illegible] **benefits**



Overall number of servers	500 ESX
No. of servers that can be hibernated	100 (20% tot)
Energy saving/hour for each hibernated server	450 Wh

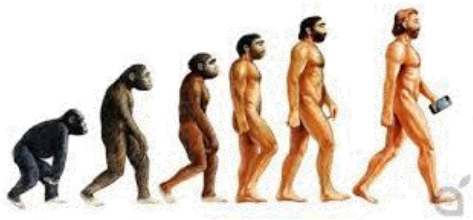
Based on the tests from Jun-Jul 2013 on the 21 Server farm

Smart workload management in Telecom Italia: strategies for further enhancement

- Telecom Italia intends to introduces **new features** for **«live» simulation** and **Capacity Planning**

New Features

- **Troubleshooting -** continuous monitoring of virtualization options and immediate warning in case of wrong/suboptimal configuration (compliance check)
- **Enhanced Smart Ballooning -** for optimal memory management
- **«Live» Simulator -** analysis of alternative consolidation scenarios through a dashboard, and choice of the best configuration depending on the objectives
- **Capacity Planning –** software that helps to predict hardware requirements depending on:
  - the additional **workload** that can be supported by servers
  - **what-if scenarios** for acquisition/removal of HW resources



Conclusions

"IT systems consume a lot of energy but it is possible to obtain large savings with a combined macro - micro approach"

"Are you worried for excessive workload on servers? Use a smart approach to Workload Management !!!"

"DIY Project Manager?"

No! Expertise and skills are required

THANK YOU!

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