Dell, The Cloud, and
the Software-Defined Data Center

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Dell Worldwide

Financial Highlights

- Rev 56,9 B$ (last 4Q)
- Cash and Investments at $15.3B
- Average Inventory days: stable at 3
- 27 Companies acquired FY-09-13
- Nr. 44 in Fortune500

A real Global presence

- 109.000+ employees
- Business in 180 countries
- 42,000+ service professionals
- 8 Factories
- 21 Enteprise Centers
- 10 Solution Centers

Go-to-Market

- Both Direct and Indirect
- Build to Order
- 80%+ revenue with Business Customers

Key facts

- 200.000+ systems shipped daily
- The "Greenest" Computer company, the first "Carbon neutral"
- Ranked # 1 vendor for Customer Satisfation in 29/37 Q according to TBR cust sat survey
- Unparalled In-Factory customization capabilities

Dell Italy Organization

Dell Italia		
North Named Customers	South Named Customers	Small Business

- Sales Engineering (Pre-sales Consultants & Specialists)
- Professional Services (PM, Solution Architects, Technical Consultants, Managed Services)
- Support Services (Tech. Account Manager, Technical Support)
- Channel

Dell Servers
Compute solutions from office scale to hyperscale

#1 in **Americas** in **x86 server** units

#2 in **EMEA** in **x86 server** units
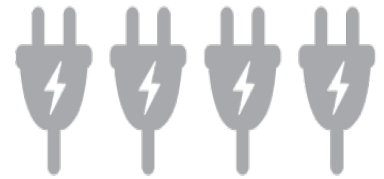
#2 in **APJ** in **x86 server** units[1]

2014 Server of the **Year**[2]

Dell PowerEdge
VRTX

1st integrated solution for **ROBO** & **SMB**

World's **most**
power-efficient
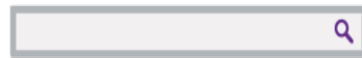**blade server**[3]

2x
density of any other
blade system[4]

1st quarter-height blade for dense computing

4 out of **5** top search engines worldwide

3 out of **4** top social media websites

Powered by **Dell**[5]

Industry firsts[6]

Express Flash PCIe SSD

Comprehensive agent-free management

Titanium power efficiency

Dell Networking—Transforming the Enterprise

CY13: ~3x the market*

WW	Dell	Market*
Data Center	17%	3%
Campus	9%	6%
TOTAL	16%	5%

Market Share Growth*

- **#3** in 40 GbE switching, outgrew market
- **#3** in blade switching (10G), fastest growth in the industry
- **#2** in 10G Base-T switching (Server attach)

Innovation & thought leadership

- **Open Networking & Software Defined -** Only IT vendor to provide a choice of OS & a migration path to SDN

- **Industry leading Platforms for Fabrics & converged racks** Solutions architected for new IT - industry recognition on ALL new data center platforms announced in 2013 & 2014!

- **Mobile Enterprise**—Complete refresh of wired, wireless & chassis switching for the modern campus

24,000
new customers CY13

15+
End-to-End
Solutions
(Pan Dell & Enterprise)

**Market-beating
Growth (3X)**
3M+ 10G Ports shipped
1M+ 10G ports in CY13

* Source: Dell'Oro 2014, Q1 & Q2

The Cloud and The Software-Defined Data Center

Cloud Computing Defined

Cloud computing is a model for enabling ubiquitous, convenient, **on-demand** network access to a shared pool of **configurable computing resources** (e.g., networks, servers, storage, applications, and services) that can be **rapidly provisioned** and released with **minimal management effort or service provider interaction**

US National Institute for Standards and Technology

http://csrc.nist.gov/publications/nistpubs/800-145/SP800-145.pdf

Cloud models & approaches

Deployment

Private
Operated and hosted by an enterprise IT department or external provider
- Exclusive use by the organization
- Host applications and IT services within a single-occupant datacenter

Hybrid
Link disparate clouds together
- Connect multiple clouds
- Move workloads between clouds
- Connect data across Clouds

Public
Open to multiple orgs and individual users on a shared basis
- Minimizes initial capital investment
- Blends agility & efficiency with massive scalability
- Computing resources are owned and operated by a third-party provider

Delivery

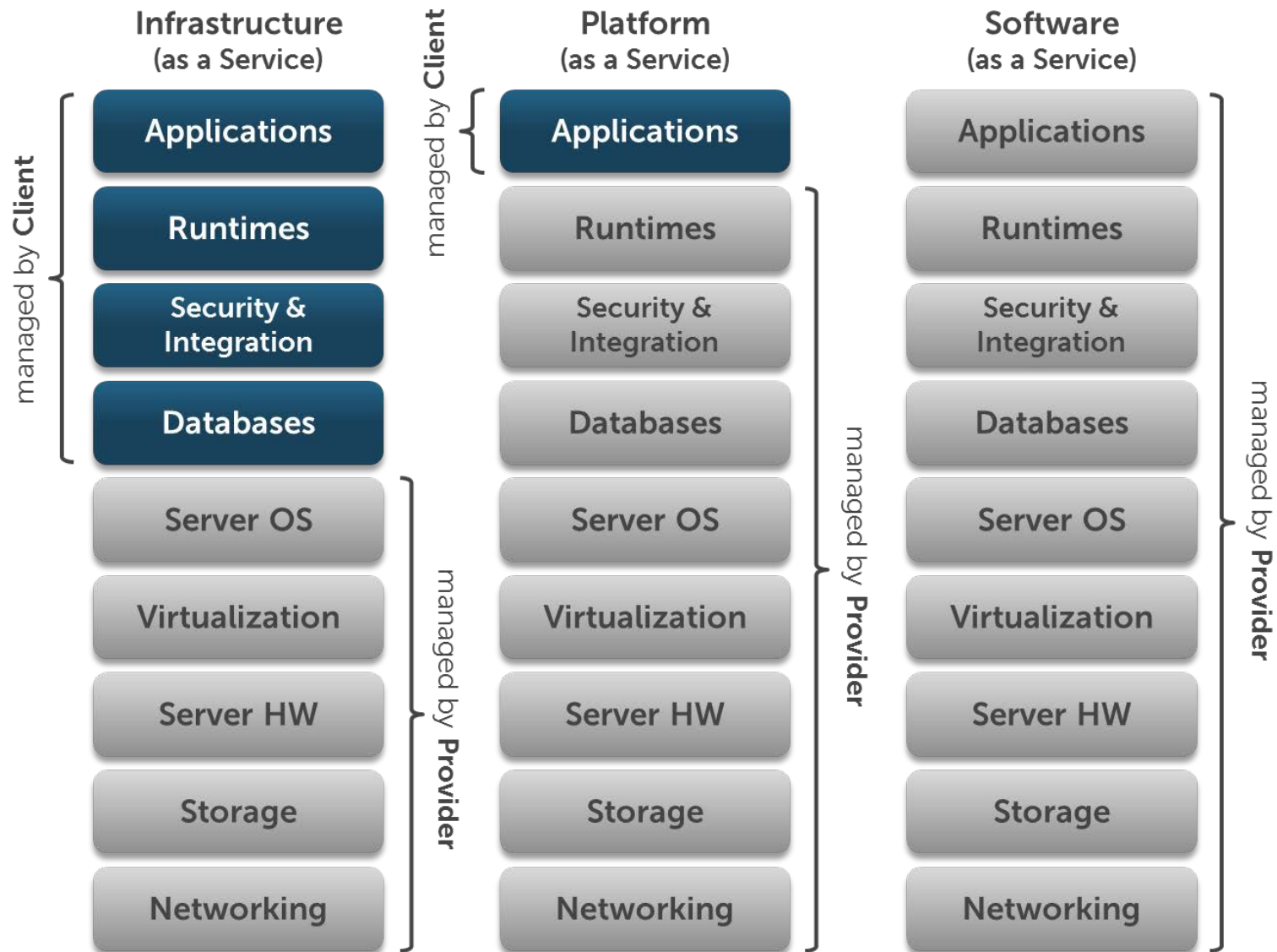|		
SaaS	Software as a Service	**Target: End users** – Collaborative, Engineering & Manufacturing Apps
PaaS	Platform as a Service	**Target: Developers** – database, middleware & infrastructure software
IaaS	Infrastructure as a Service	**Target: Traditional IT** – Server, Storage, Network, OS, Virtualization

IaaS, PaaS & SaaS

Infrastructure (as a Service)

Platform (as a Service)

Software (as a Service)

managed by **Client**

managed by **Client**

managed by **Provider**

managed by **Provider**

managed by **Provider**

| Infrastructure (as a Service)	Platform (as a Service)	Software (as a Service)
Applications	Applications	Applications
Runtimes	Runtimes	Runtimes
Security & Integration	Security & Integration	Security & Integration
Databases	Databases	Databases
Server OS	Server OS	Server OS
Virtualization	Virtualization	Virtualization
Server HW	Server HW	Server HW
Storage	Storage	Storage
Networking	Networking	Networking

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What are the right workloads for the Cloud?

- ## Applications that benefit from cloud characteristics
  - horizontal scalability / cloud bursting
  - very dynamic / on-demand
    - › batch, fluctuating traffic,…
    - › projects, launches, temporary needs,…
  - high availability requirements
  - Disaster Recovery (DR) – depends on details(!)…
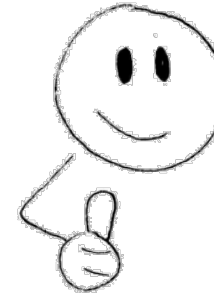
- ## What migth be less suitable?
  - high performance requirements
    - › esp. storage
  - applications that just scale vertically
  - applications that work with confidential data
  - applications with large data capacities
  - applications that are hardware-dependent/-optimized

needs further investigation

HPC in the Cloud

- Network / Latency
  - std. clouds usually have 1/10 GbE
  - High Speed /low-latency might be necessary
    - › 40GbEth, Infiniband, low latency switches

- Compute Efficiency
  - heavily depends on compute model (i.e. workload)!
    - › hardware-specific programming (drivers,..)
    - › parallel programming / userspace communication
      - applications that need to bypass the OS kernel and communicate directly with remote user processes

  - GPGPU Computing
    - › pass-through with Xen HVM hypervisor & NVIDIA GPUs today
      - VMware, KVM, etc.: not yet (or tech previews)
    - › check **white paper** from **Indiana University** and **Information Sciences Institute (ISI), University of Southern California**: Enabling High Performance Computing in Cloud Infrastructure using Virtualized GPUs
      - test using OpenStack is planned

HPC in the Cloud – Storage Considerations

- Parallel file access / high IO bandwidth necessary
  - Lustre, Gluster, pNFS,…
    - › mounted locally in VM
  - fast storage network!
    - › again: IB, RoCE (10/40GbE)
  - potential architectural overhead when block and/or object storage is needed as well

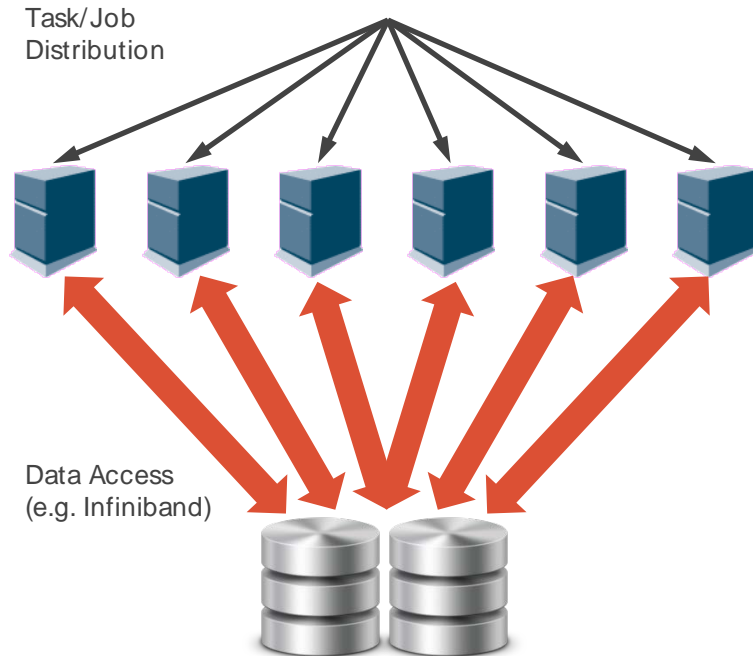- ..so: this HPC cloud will probably look very different from a standard cloud…

Hadoop vs. HPC Clusters
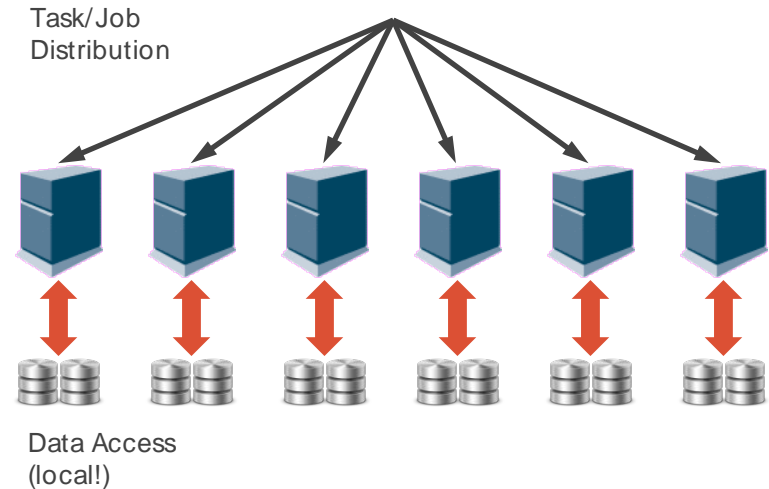## Two Forms of Distributed Computing

HPC Cluster
- Parallel File System
  - High throughput
  - All nodes can access all data
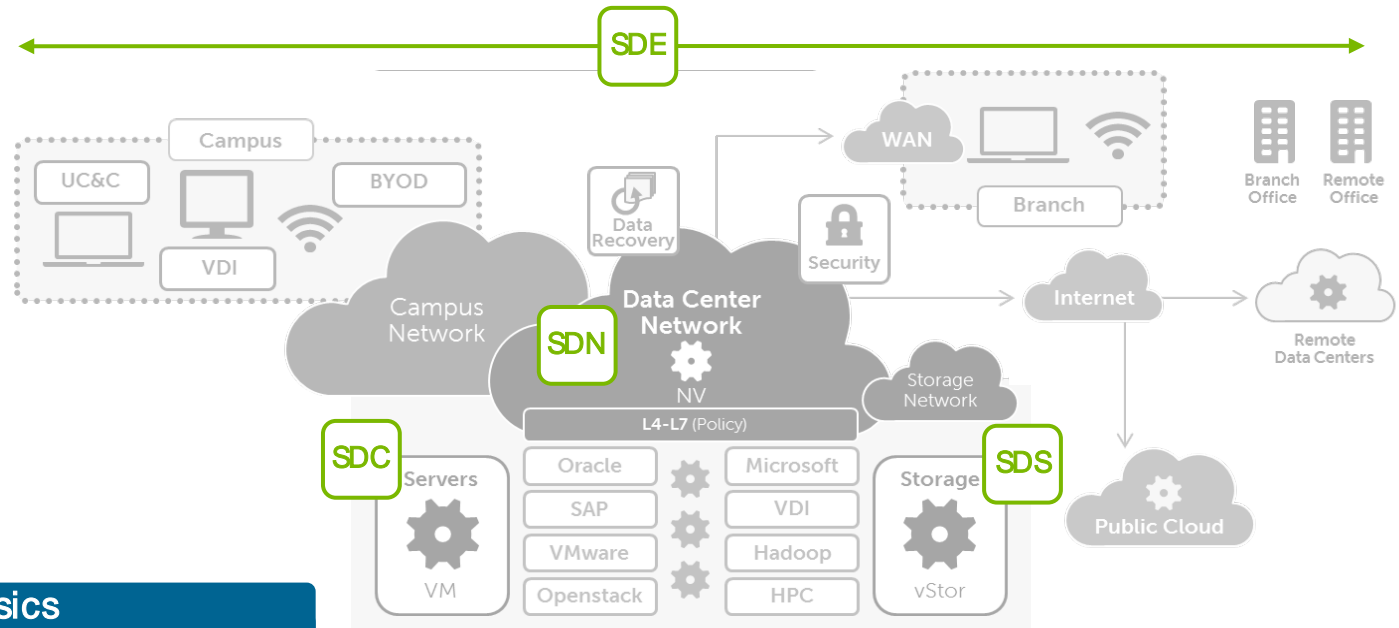 - **Compute-centric workloads**

Hadoop Cluster
- Distributed File System
  - Global namespace (ingest!)
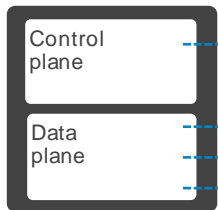 - Nodes just work on local data
  - **Data/IO-centric workloads**

Task/Job
Distribution

Data Access
(e.g. Infiniband)

Task/Job
Distribution

Data Access
(local!)

Defining *"software-defined"*

SDE

Campus
UC&C
BYOD
VDI

Campus Network

Data Recovery

WAN
Branch

Security

Branch Office

Remote Office

Data Center Network

SDN

NV

L4-L7 (Policy)

Internet

Storage Network

Remote Data Centers

SDC

Servers

VM

Oracle	Microsoft
SAP	VDI
VMware	Hadoop
Openstack	HPC

Storage

vStor

SDS

Public Cloud

The basics

Traditional system

Control plane

Data plane

Purpose-built hardware & software

Software-defined

Next-gen compute block

Open standard, e.g., OpenFlow

General-purpose hardware

Purpose-built function virtualized in general-purpose hardware delivered as a service

The capabilities

- Compute
- Storage/availability
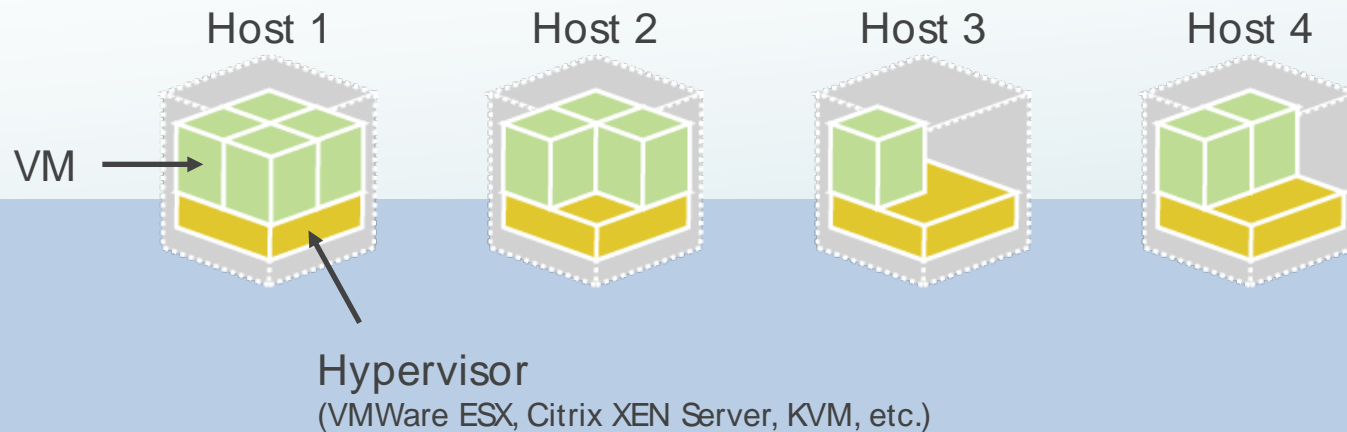- Networking/ security & management

The benefits

- Automated & simplified
- Unlimited agility
- Maximum efficiency
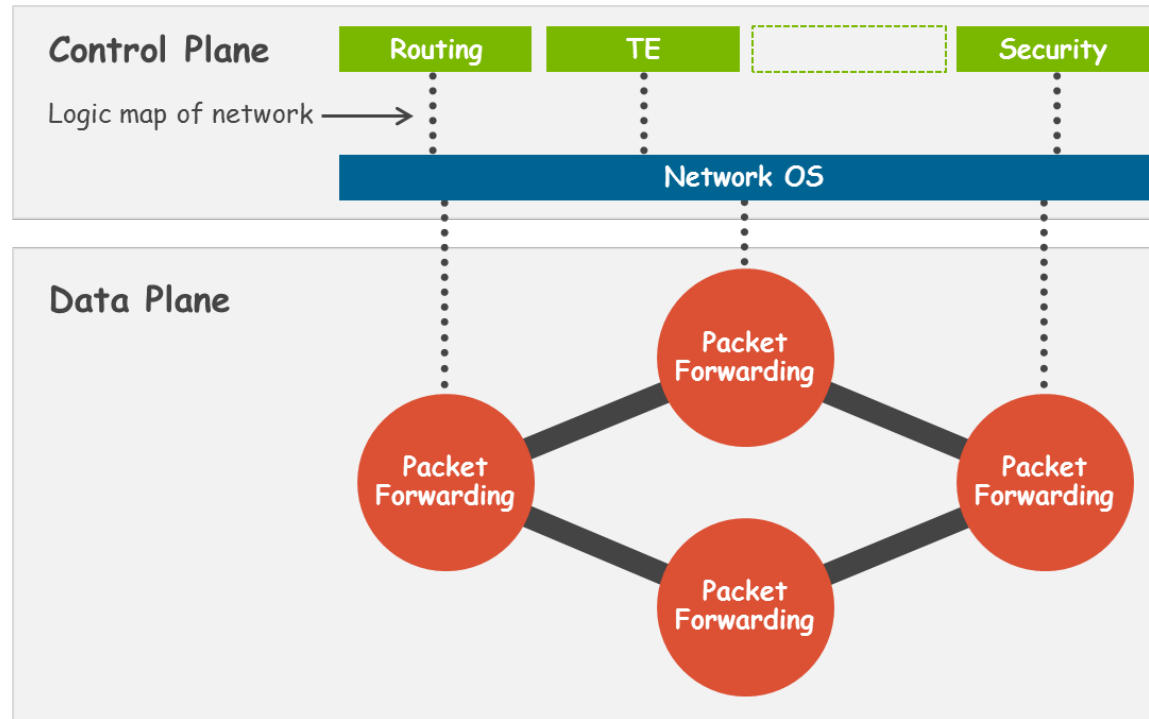
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Software-defined Compute?

Virtual Servers!

Host 1   Host 2   Host 3   Host 4

VM ⟶

Hypervisor
(VMWare ESX, Citrix XEN Server, KVM, etc.)

☑ Hardware abstraction for each server

☑ Better resource utilization for each server

What is SDN really?
SDN according to Open Networking Foundation (ONF)

- SDN is a **new approach** to networking in which **network control is decoupled** from the **data forwarding** function and is **directly programmable**.

- The result is an extremely **dynamic, manageable, cost-effective**, and **adaptable** architecture that gives administrators **unprecedented programmability, automation, and control.**

Software Defined **Networking**

Programmatic solutions	Virtualization/ cloud-oriented	Controller solutions
Enable server-like programmability	Evolve the network from the hypervisor out	Employ open standards for control and application

Dell Open Networking

• Enterprise-class infrastructure

• Global services and support

Software-defined storage is an emerging paradigm

- a technology that decouples the basic elements of a storage system

VMware VSAN, Scale Computing, Hadoop, Nutanix

Current arrays like SC, PS, MD

Customer expectations

- ➢ Data Services - Management, Automation and Orchestration

- ➢ Flexibility

- ➢ Cost

- ➢ Scalability

- ➢ Reliability

Multiple Implementations

HyperConverged/ CompuStorage

Physical Appliance

Software-only

Virtual Appliance

Nexenta, Inktank Ceph, MS Storage Spaces

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Dell value-add
Available now

Dell + Storage Spaces

Dell solution
- End-to-end stack: PowerEdge Servers, HBAs, Drives, and MD1400, MD1420 and MD3060e storage enclosures
- JBOD monitoring
- Collaborative support and services

Target users
- Existing Microsoft customers including hosters, and Test & Dev environments that need cheap and deep storage

Dell + ceph

Dell solution
- PowerEdge R-730XD and Dell Networking to provision and configure the Ceph cluster and integrate with the OpenStack platform
- Solution certified via the Dell Technology Partner Program
- Collaborative support and services

Target users
- Advanced private cloud, public cloud users looking to add scalable storage to their environment

Dell + nexenta

Dell solution
- Simple bundled HA solutions from 44TB to 1.5PB raw capacity
- Six bundle options Collaborative support and services

Target users
- Software based file storage - customers who like the flexibility to choose the hardware
- Customers who want ZFS based storage

Dell Nutanix partnership

Target Markets
- Simple, scalable & high performance for VDI
- Mid-market virtualization for departmental/branch offices
- Multi-hypervisor environments and migrations

Key Benefits
- Designed for virtualization administrators
- Simplicity of sizing, deployment and management
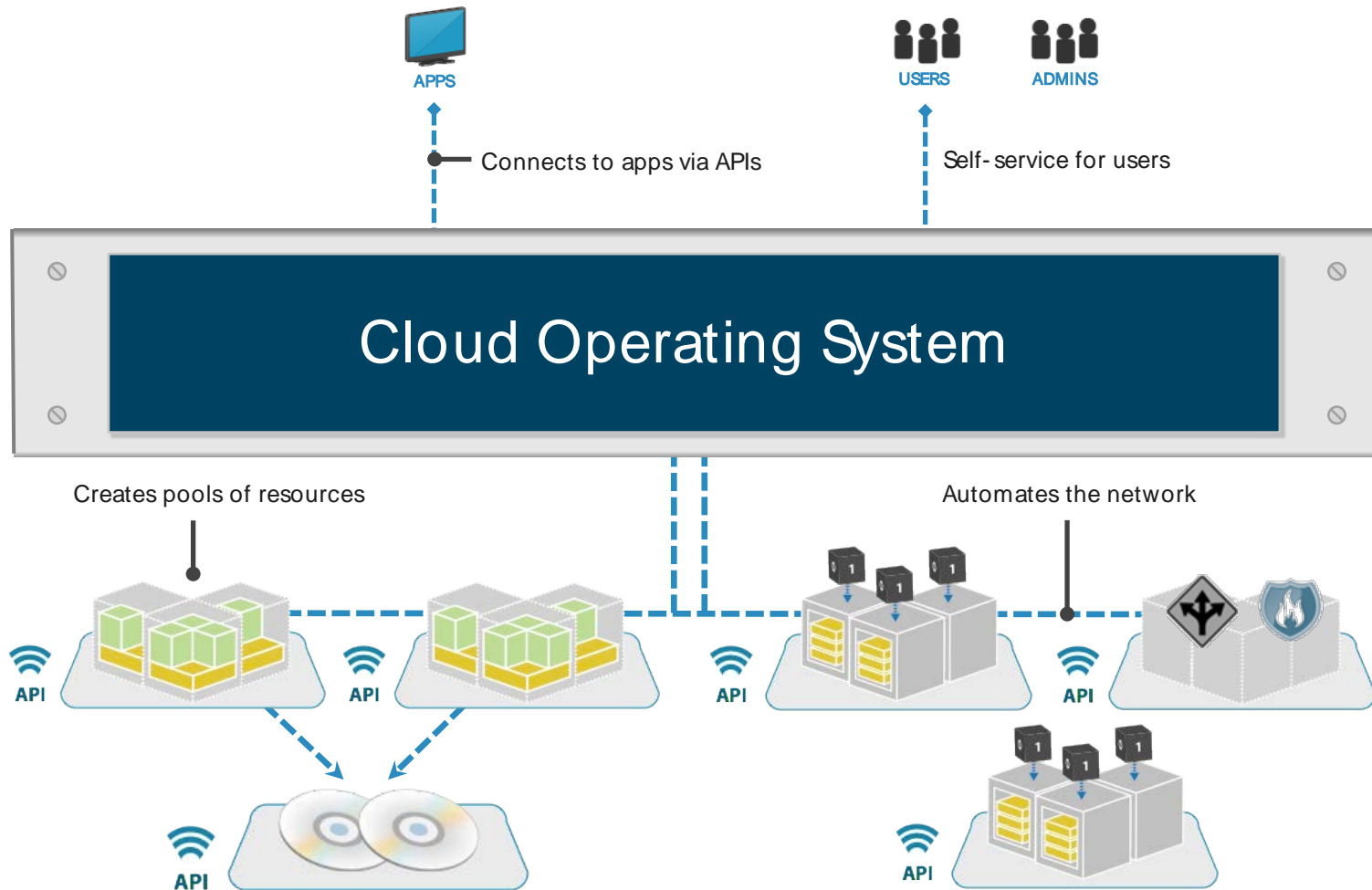- ESXi, Hyper-V, and KVM hypervisor support

Dell Value-add
- Bundles for multiple virtualized workload types
- End-to-End VDI cloud client-computing solution
- Customer satisfaction leader for x86 servers
- Dell Installation & Implementation
- ProSupport w/ Collaborative Nutanix SW Support

The Cloud Operating System
Manage the platform - not the VM…

APPS

USERS

ADMINS

Connects to apps via APIs

Self-service for users

Cloud Operating System

Creates pools of resources

Automates the network

API

API

API

API

API

API

What is in OpenStack?

- A collection of projects developed and maintained collaboratively by a large, active community; e.g.:
  - **Compute** (Nova)
  - **Storage** (Swift & Cinder)
  - **Glance** (Imaging)
  - **Horizon** (Dashboard)
  - **KeyStone** (Authentication)
  - **Quantum/Neutron** (Network service)
  - **Heat** (Orchestration)
  - **Ceilometer** (Metering)

- Basic requirement: "it must be **simple to implement** and **massively scalable**."
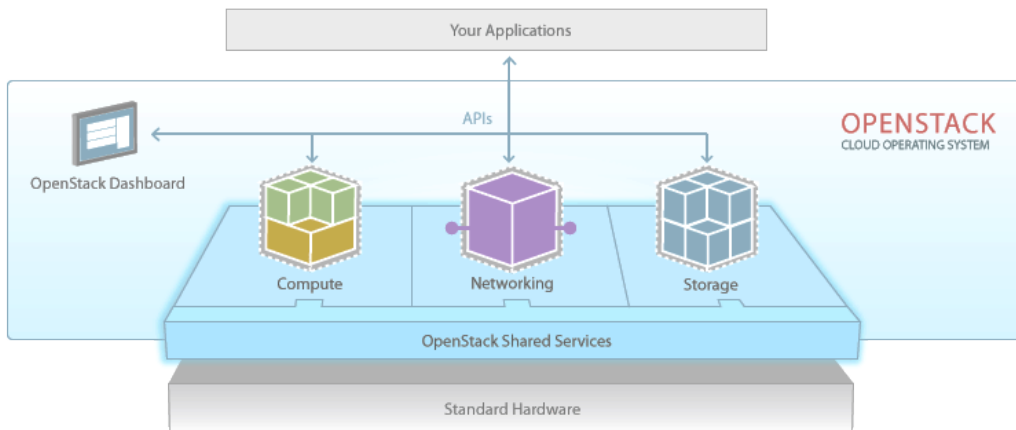
Dell OpenStack-Powered Cloud Solutions

Proven solutions

Elastic , vastly scalable and designed to handle massive data loads

- Tested, validated, and innovative designs in infrastructure, software, and services

- Develop, deploy, and deliver your cloud environment

- Quickly offer new cloud services, lower software licensing costs, and help mitigate the risks of cloud computing

Proven components

OpenStack Cloud operating system

Dell-developed Crowbar Software*

Dell PowerEdge C-Series and R-Series servers

Force10 or PowerConnect Switches

Reference Architecture

Deployment Guide

Dell Service and Support

Dell | Intel | UniPisa | SNS Competence Center

- Launched in may 2013

- HPC & Cloud Competence Center
  - One of the largest iSCSI storage solution in Italy
  - Distributed Datacenter implementation

- Research and Development on new technologies and solutions
- Academic training on Intel Xeon Phi Programming
- Certified Academic Networking Training Center
- **Available for Proof-of-Concepts**
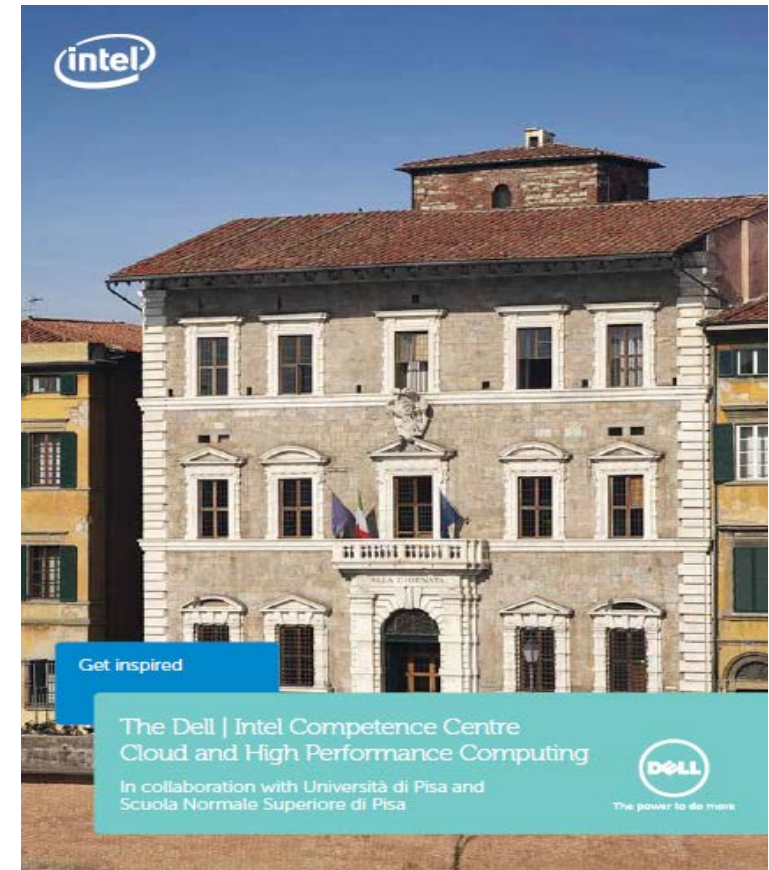
HPC
- Testing with Lustre FS, EQL and PV storage
- DreamsLab
- chemical research

Computing Acceleration
- C8000 servers
- Xeon Phi accelerators

Code Optimization
- HPC
- Xeon Phi programming

Converged Infrastructure
- Full blade solution
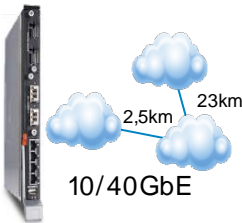- Storage, Compute, Network

Cloud Framework
- IaaS
- OpenStack
- Cloud-scale applications

Software-Defined Data Center
- Dell | Intel Platform
- VMware technology
- Distributed Data Center

Networking
- Distributed solution
- Low-latency Data Center Network

2,5km 23km

10/40GbE

Hybrid Cloud
- Microsoft stack
- Hybrid Cloud deployment
- DR, online back-up DC extension

Cloud Framework
- IaaS
- Crowbar integration
- Virtual Server management and deployment

Virtual Desktop
- VRTX / FX2 back-end solution
- Dell Wyse end-points

Branch Office solutions
- Data Center in-a-box
- Unified management of remote solutions

Storage
- iSCSI storage
- 750TB
- Unified Storage Solution