The Cloud, the Software-defined Enterprise and OpenStack

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DELL

Workshop della Commissione Calcolo e Reti dell'INFN

28.05.2014 | Catania, Italy

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

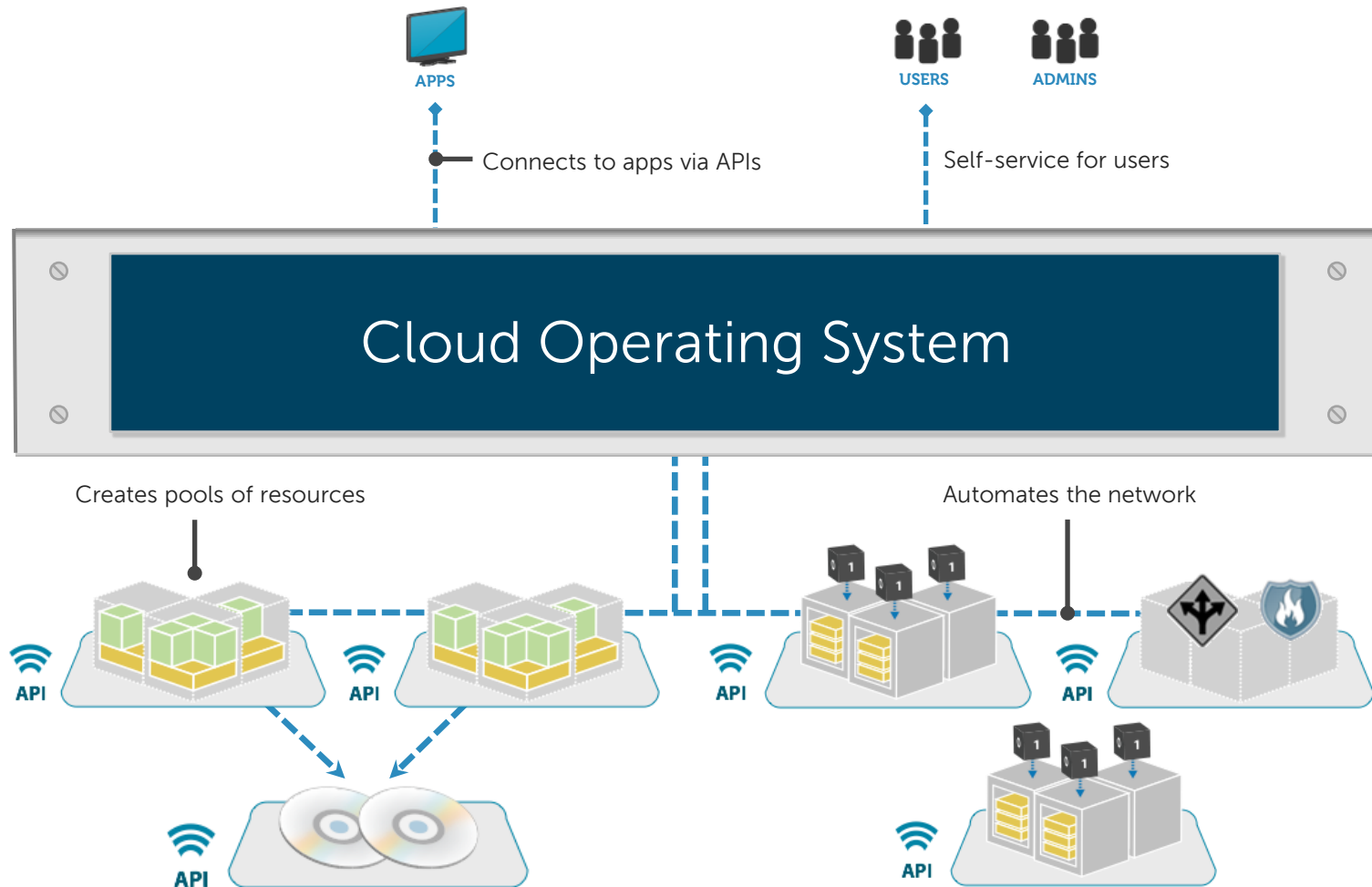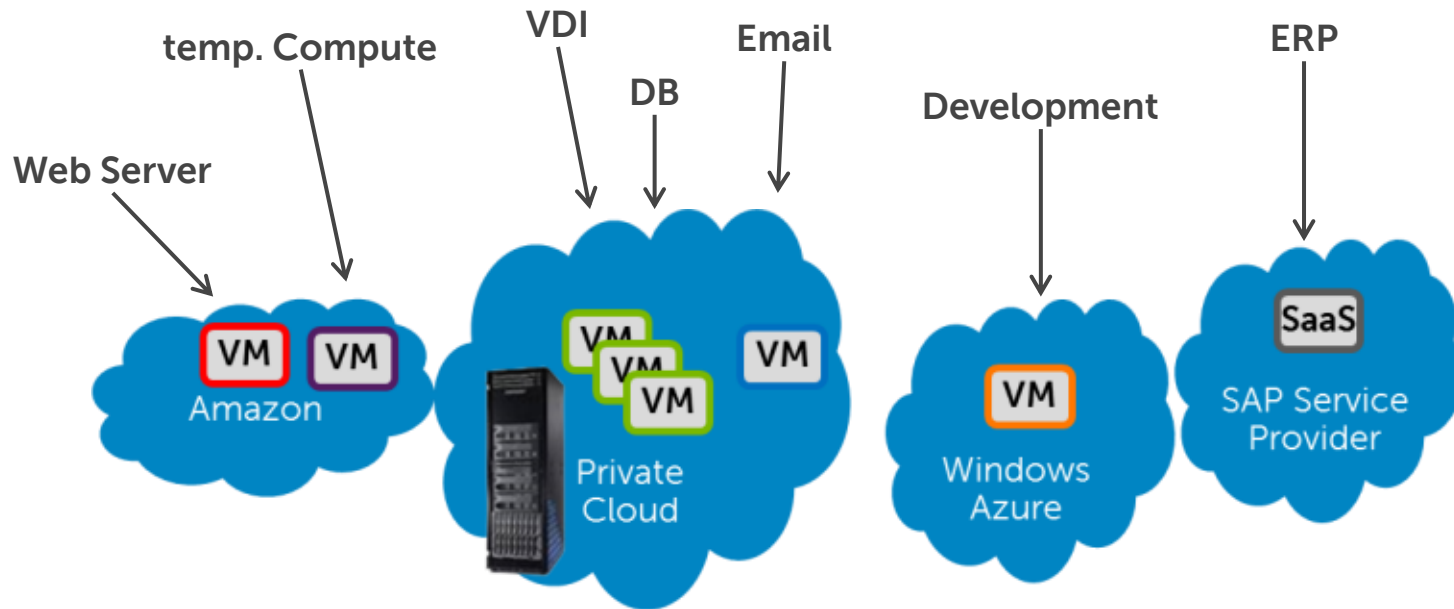| SaaS	**Software as a Service**	**Target: End users** – Collaborative, Engineering & Manufacturing Apps
PaaS	**Platform as a Service**	**Target: Developers** – database, middleware & infrastructure software
IaaS	**Infrastructure as a Service**	**Target: Traditional IT** – Server, Storage, Network, OS,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

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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

Cloud Federation:
Making the Best of On- and Off-Premise

temp. Compute

VDI

Email

ERP

DB

Development
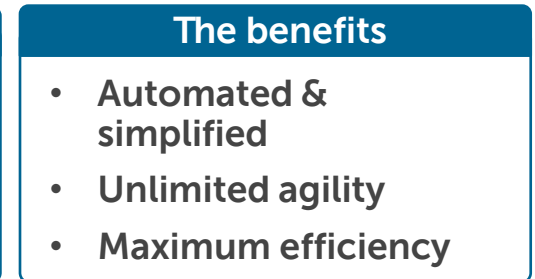
Web Server

VM VM
Amazon

VM
VM
VM

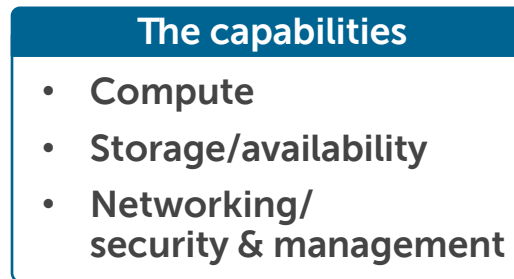VM
Private
Cloud

VM
Windows
Azure

SaaS
SAP Service
Provider

SDDC / SDE

Software-Defined DC

Software-Defined Enterprise

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

Internet

Remote Data Centers

L4-L7 (Policy)

SDC

Servers

Oracle | Microsoft

SAP | VDI

VMware | Hadoop

Openstack | HPC

VM

Storage Network

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 →
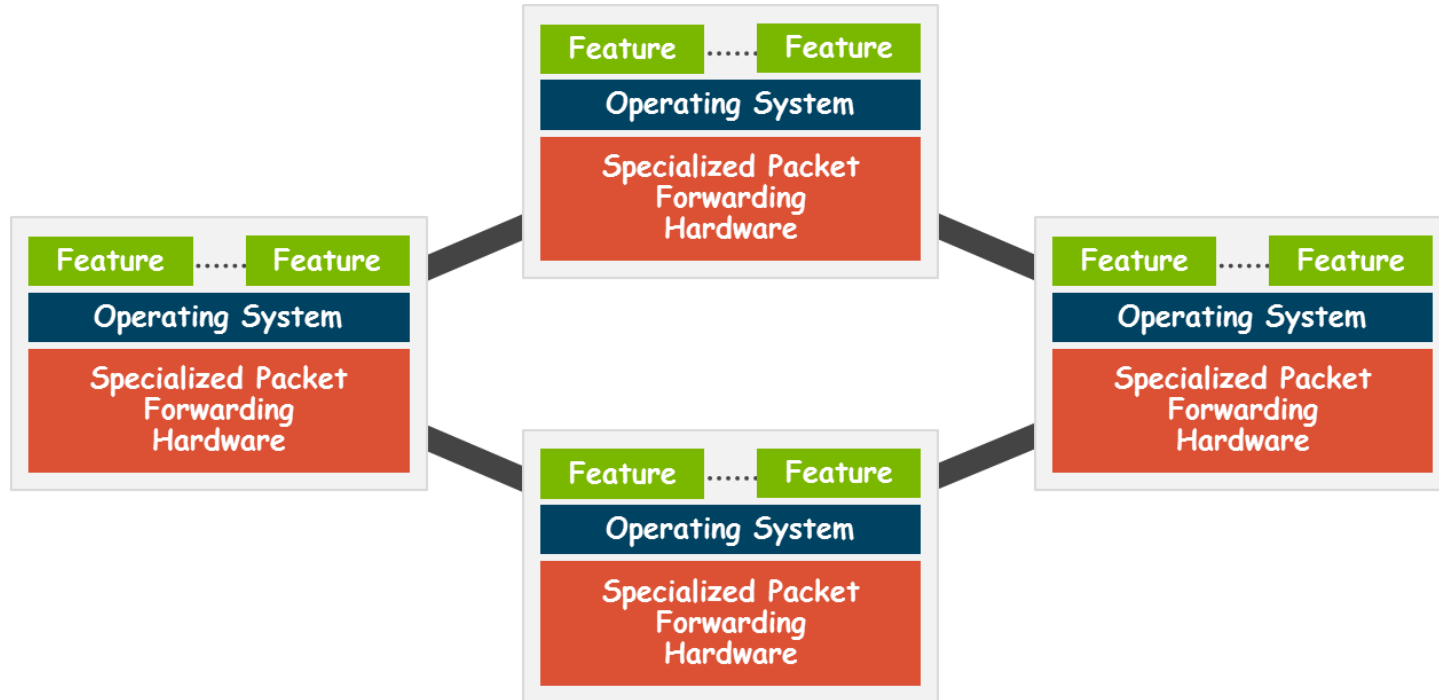
Hypervisor
(VMWare ESX, Citrix XEN Server, KVM, etc.)
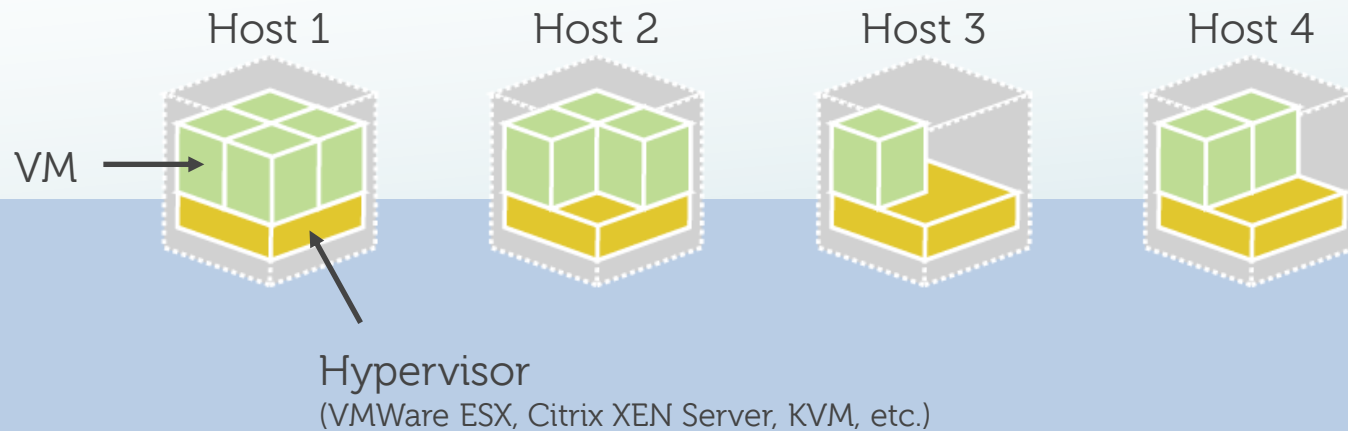
☑ Hardware abstraction for each server

☑ Better resource utilization for each server

SDN

Software-Defined Networking
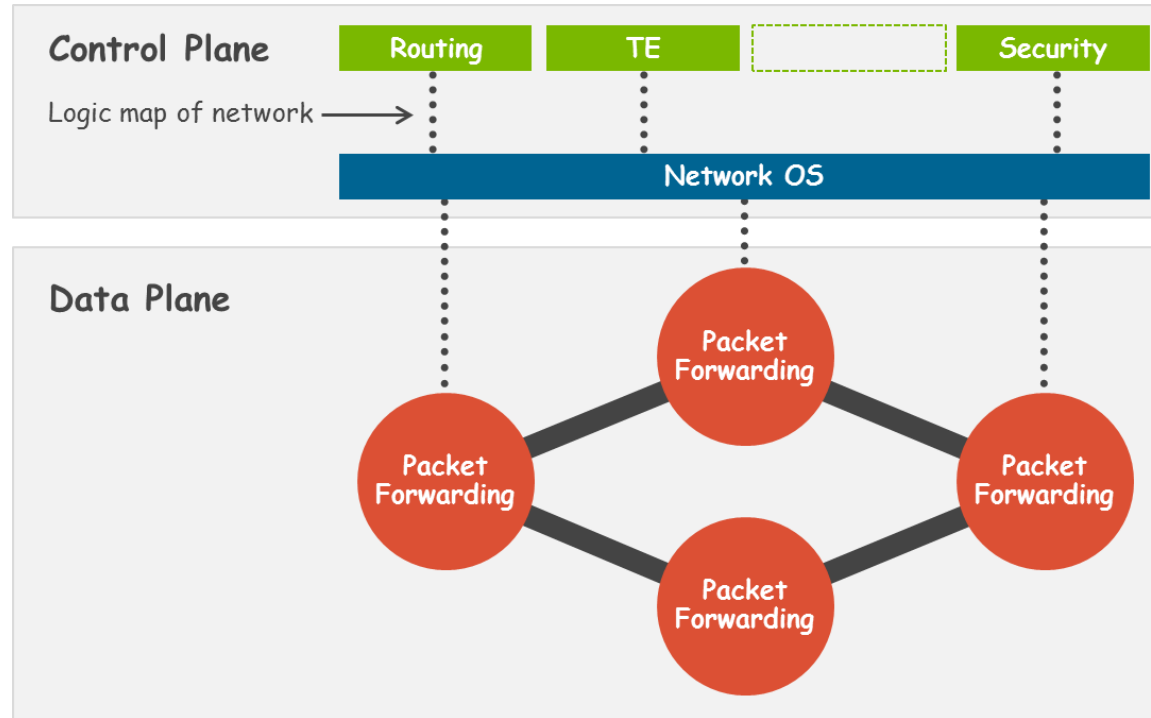
So what is SDN really?

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.**

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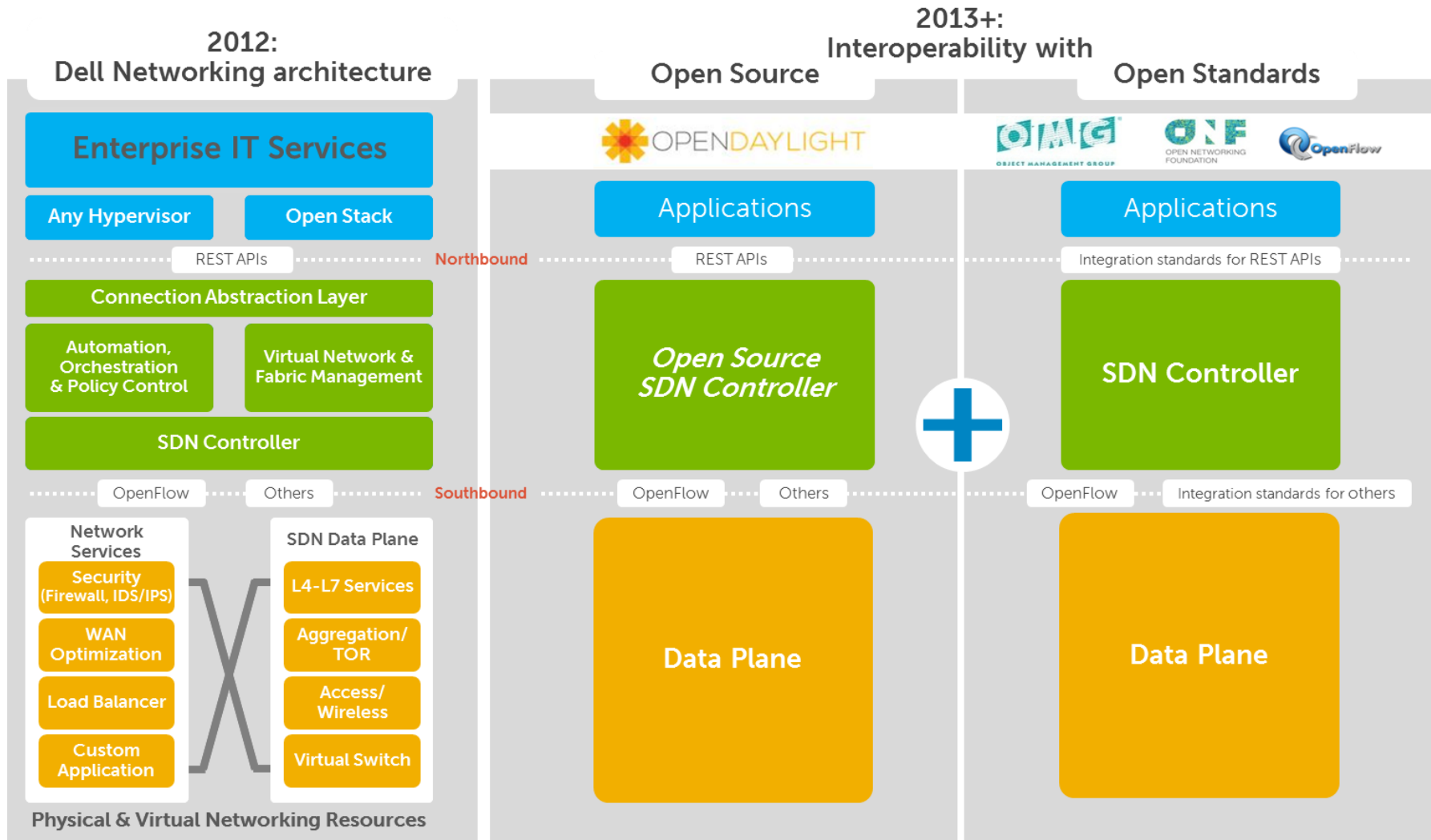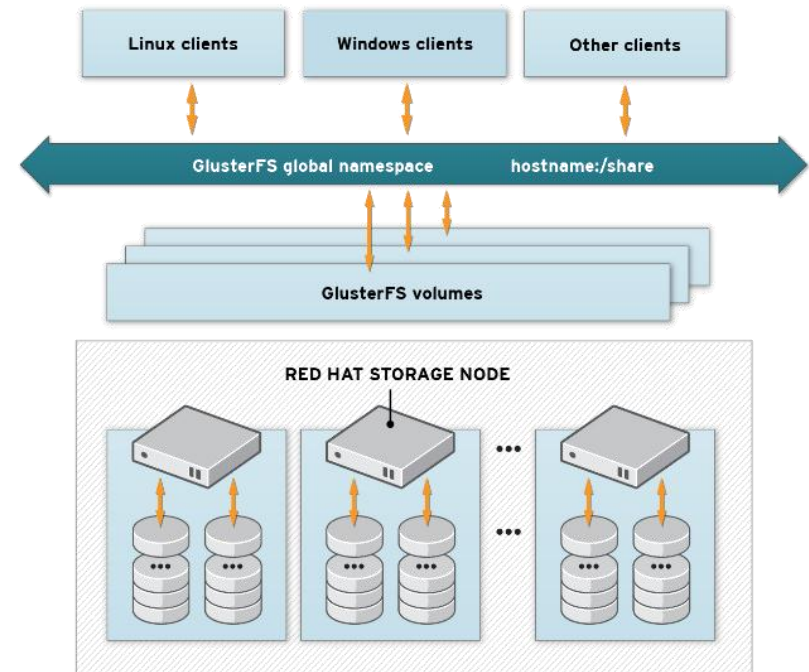
SDN – driven by Open Source & Open Standards

SDS

Software-Defined Storage
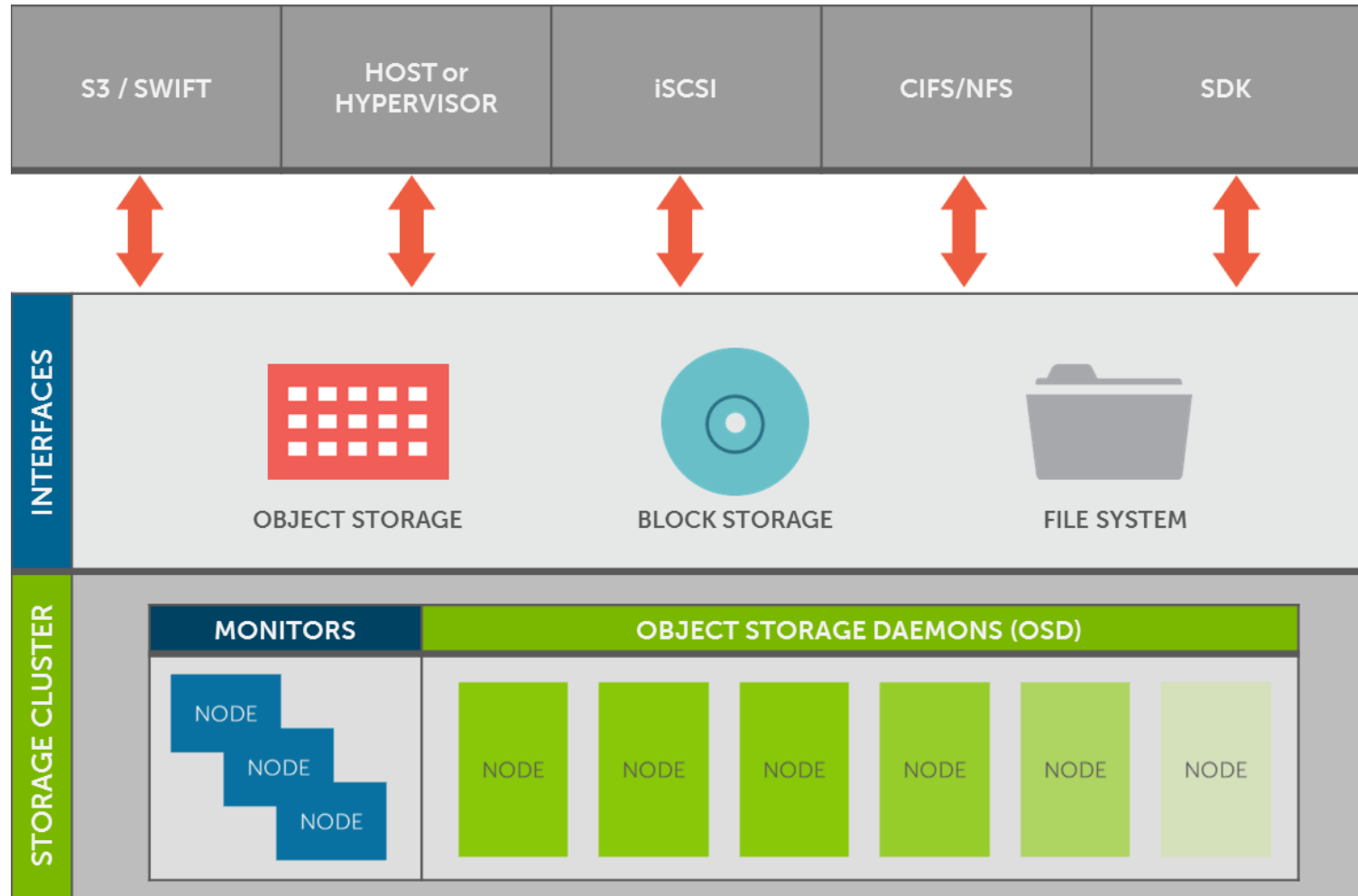
Software-Defined Storage (SDS)
New Horizons

- From modern **local** file systems...
  - ZFS, btrfs, XFS,...

- ...via **distributed** file systems...
  - Lustre, GlusterFS, HDFS,...

- ...to **object** storage sytems
  - OpenStack Swift, Scality, Ceph,...

- Infrastructure
  - **Commodity** servers & storage modules
  - **Commodity** network (1GbE, 10GbE)

Picture courtesy of Red Hat

Ceph – a Distributed Storage Platform
Development/support by inktank (now Red Hat)

S3 / SWIFT	HOST or HYPERVISOR	iSCSI	CIFS/NFS	SDK

INTERFACES

OBJECT STORAGE   BLOCK STORAGE   FILE SYSTEM

STORAGE CLUSTER

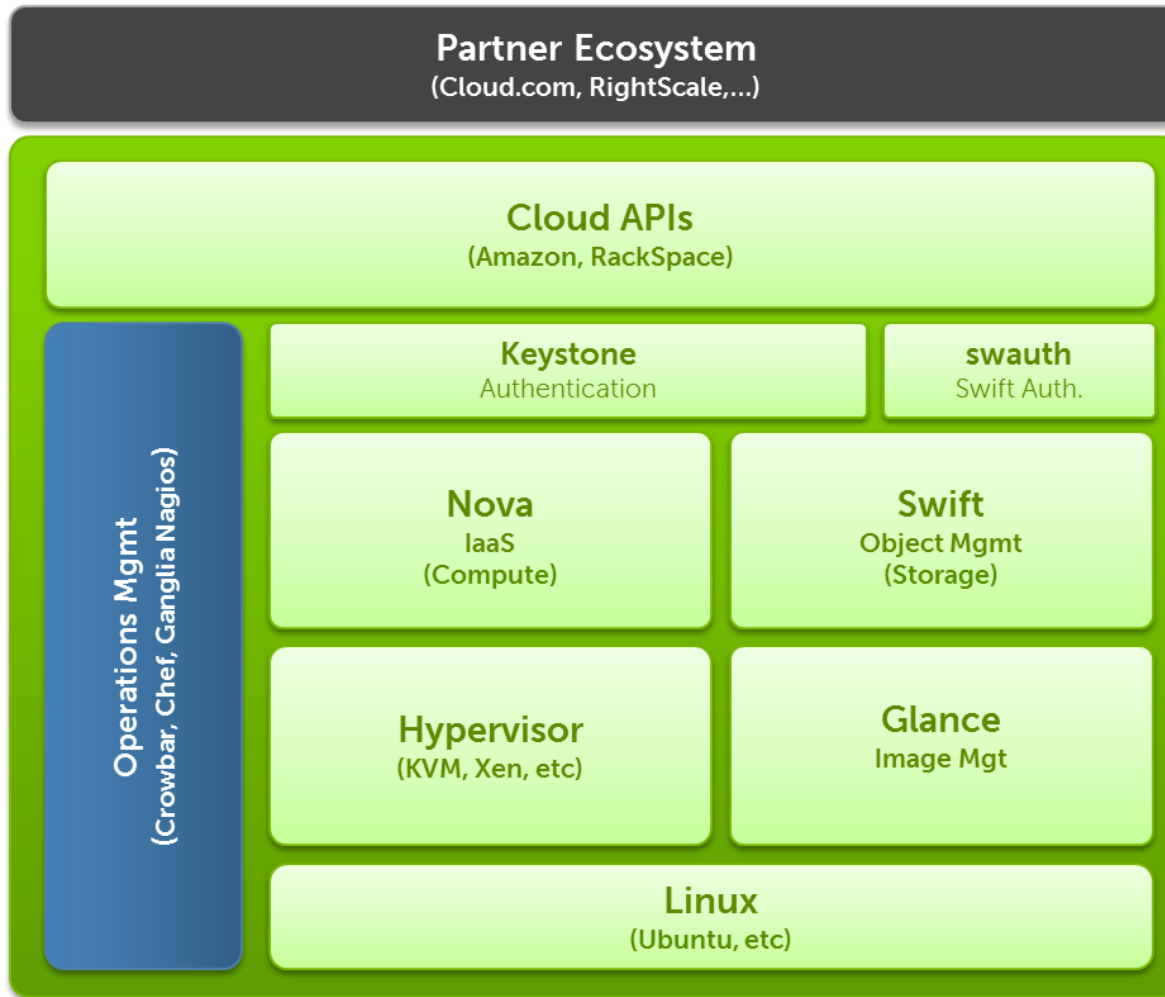| MONITORS	OBJECT STORAGE DAEMONS (OSD)
NODE NODE NODE	NODE NODE NODE NODE NODE NODE

OpenStack

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**."
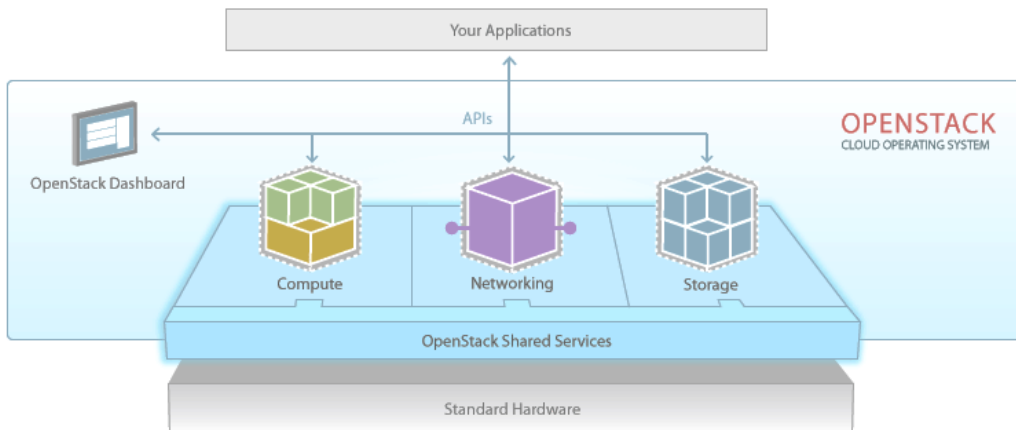
OpenStack Technology Overview

Partner Ecosystem
(Cloud.com, RightScale,...)

Cloud APIs
(Amazon, RackSpace)

Operations Mgmt
(Crowbar, Chef, Ganglia Nagios)

Keystone
Authentication

swauth
Swift Auth.

Nova
IaaS
(Compute)

Swift
Object Mgmt
(Storage)

Hypervisor
(KVM, Xen, etc)

Glance
Image Mgt

Linux
(Ubuntu, etc)

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

"Dell's commitment to OpenStack and their team with deep expertise in Data Center Solutions is the **foundation for a great partnership.**"

Ben Cherian, General Manager of Emerging Technologies, DreamHost

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 | Red Hat Enterprise Cloud
Powered by OpenStack

Make
OpenStack
the defacto
OPEN
Cloud Solution
in the
Enterprise

- Address **the gaps for OpenStack** in the **Enterprise** via a jointly engineered solution

- **Deliver enterprise-grade**, **certified**, highly–scalable, secure, and **fully supported** cloud infrastructure solutions

- **Provide a fulfillment, deployment, and support experience** like commercial software

- Support **specific enterprise use cases** for cloud applications, software defined storage, development and test

Dell | Red Hat Enterprise Cloud
Powered by OpenStack

All benefits of community **OpenStack ...plus**:

- Enterprise **hardened** and **integrated** with Red Hat Enterprise Linux
- Provides **enterprise software lifecycle**
- World-class **global support**
- Worlds **largest OpenStack partner ecosystem**
- OpenStack **training** and **certification**
- Integrated with trusted Red Hat stack
  - Red Hat **CloudForms** (Hybrid cloud management)
  - Red Hat **OpenShift** (PaaS)
  - Red Hat Enterprise Virtualization
    - › **Docker** (containers vs. VMs)
  - Red Hat Storage: **Gluster & Ceph**

- Additional integration
  - ASM, Dell Cloud Manager, EQL, CML, SonicWall, Quest, Secureworks, OpenDaylight,...

Big Data & HPC in the Cloud

Scale-Out Use Cases
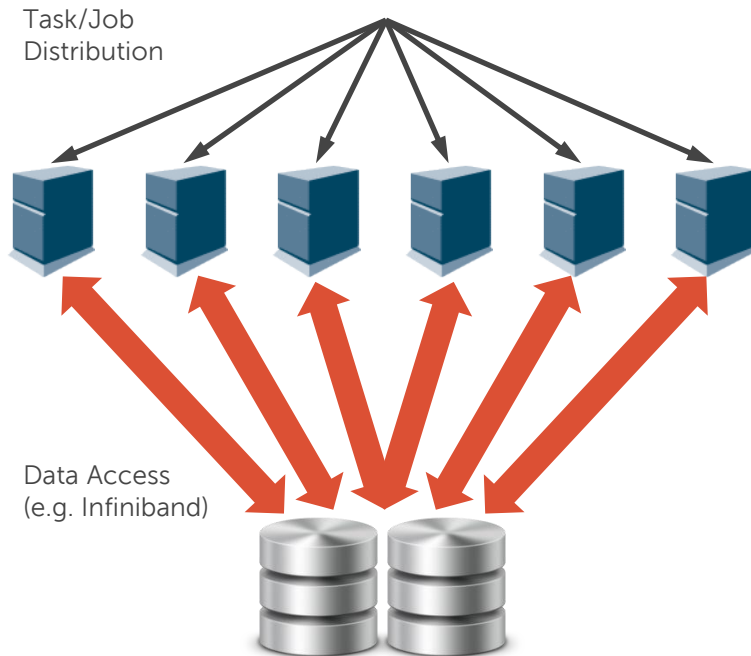
HPC/BigData in the Cloud – Why?

- Share Resources
  - protect investment
  - increase utilisation

- Multi-Tenancy
  - offer services for multiple customers/departments

- Agility / Flexibility
  - dynamically setup/expand/shrink a cluster – quickly & easily

- Multi-Purpose/Workload
  - use one platform for multiple use cases / workloads
    › HPC (3D rendering, CFD,…)
    › Big Data (Hadoop, noSQL,…)
    › IaaS, PaaS,…

- Automation is Key!

# 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**

Task/Job
Distribution

Data Access
(e.g. Infiniband)

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

Task/Job
Distribution

Data Access
(local!)
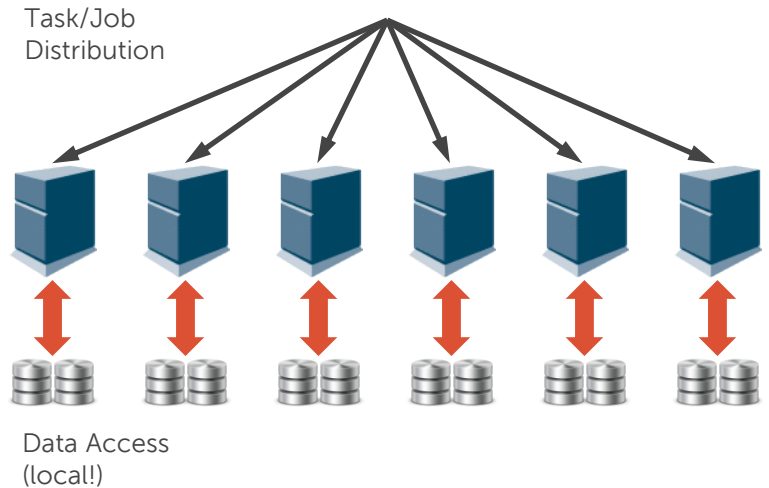
Big Data in the Cloud – e.g. Hadoop

- Pros
  - no hardware dedicated to Hadoop
    - › very flexible usage of resources
    - › potential use of hybrid clouds
  - **good if** the analytic workload is **just temporary**
    - › typical data node: 2x 6-core CPU, 32-64GB RAM

- Cons
  - Hadoop is designed for local disks (JBOD)
    - › Shared local disks
      - – potential performance loss
      - – **large data can't be moved easily** (e.g. vMotion)
    - › SAN / NAS / Object Store / Parallel FS
      - – **network IO will increase** a lot
        (no local processing anymore)
  - Hadoop is rack-aware
    - › availablity concept (replication, node failure,...)
      needs to be reflected in cloud
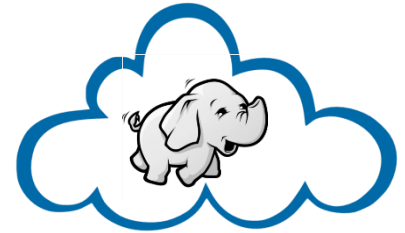
HPC in the Cloud

- Network / Latency
  - std. clouds usually have 1/10 GbE
  - low-latency might be necessary
    - › Infiniband, RDMA over Converged Ethernet (RoCE)

- 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...

The Dell | Cambridge HPC Solution Centre

- Established in 2010
- Proof-of-Concepts
- Services
  - Implemetation, Support,…
- Best Practices

HPC at University of Cambridge
- One of the largest HPC sites in EMEA
- HPC cloud for both Internal and external users
- First NVIDIA CUDA centre of excellence in the UK (2009)
- Strong growth in both academic and commercial programmes

- OpenStack to come this year!

Backup Slides

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

IaaS, PaaS & SaaS

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

managed by Client

managed by Client

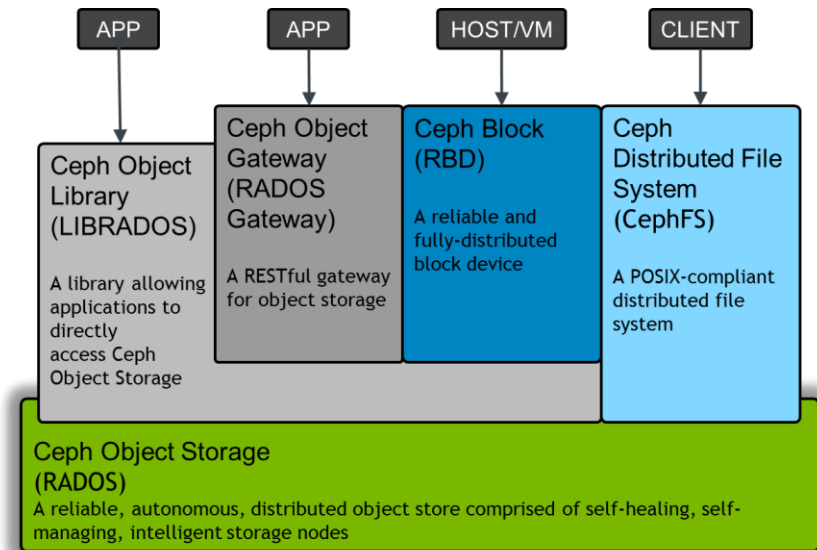managed by Provider

managed by Provider

managed by Provider

Ceph – a Distributed Storage Platform

Development/support by inktank (now redhat!)

- Object Storage
  - S3 & Swift APIs
- Block Devices
  - vLUNs
- File System
  - Global namespace
  - Metadata server cluster
  - Linux client

- Redundant shared-nothing cluster architecture
  - no SPOF

- Data distribution with **CRUSH**
  - **C**ontrolled **R**eplication **U**nder **S**calable **H**ashing
  - object location can be calculated
  - storage nodes can be grouped in failure domains
  - replication for data protection

APP   APP   HOST/VM   CLIENT

Ceph Object Library (LIBRADOS)
A library allowing applications to directly access Ceph Object Storage

Ceph Object Gateway (RADOS Gateway)
A RESTful gateway for object storage

Ceph Block (RBD)
A reliable and fully-distributed block device

Ceph Distributed File System (CephFS)
A POSIX-compliant distributed file system

Ceph Object Storage (RADOS)
A reliable, autonomous, distributed object store comprised of self-healing, self-managing, intelligent storage nodes

- Roadmap
  - Erasure Coding   v1.2 (May 2014)
  - Cache Tiering
  - CephFS   v2.0 (Sep 2014)
  - Hyper-V support
  - VMware support   later (2015)
  - DeDup

Dell Cloud Manager
Once know as Enstratius

User

Chef

puppet labs

Directory services

Service tools

Operations tools

Other

UI

Dell Cloud Manager API

Dell Cloud Manager

SaaS or On-Premises

Deploy & manage enterprise applications
across private, public & hybrid clouds
with Agility, Governance and Choice

Dasein Cloud Abstraction Layer

amazon web services   Windows Azure   Google   HP Cloud Services
dimension data   ScaleMatrix   bluelock   at&t   CloudSigma
rackspace HOSTING   terremark   Joyent   cloudcentral scale your data center in the cloud

Off-Premises Public Clouds

cloudscaling   vmware
EMC² where information lives   DELL   Joyent   openstack
cloudstack   EUCALYPTUS

On-Premises Private Clouds

Applications in the Cloud
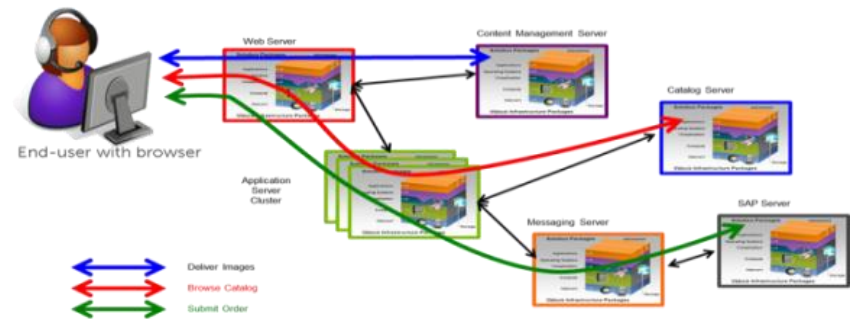
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Composite Applications

Multi-Cloud   +   Composite Applications

Our customers have workloads running in many locations.
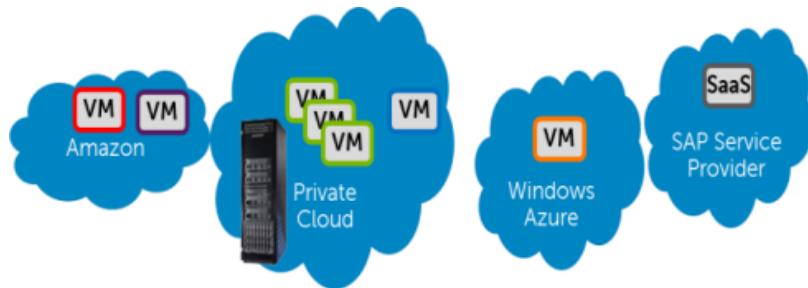
Applications are becoming complex combinations of interconnected software components.

Composite Applications

Multi-Cloud   +   Composite Applications

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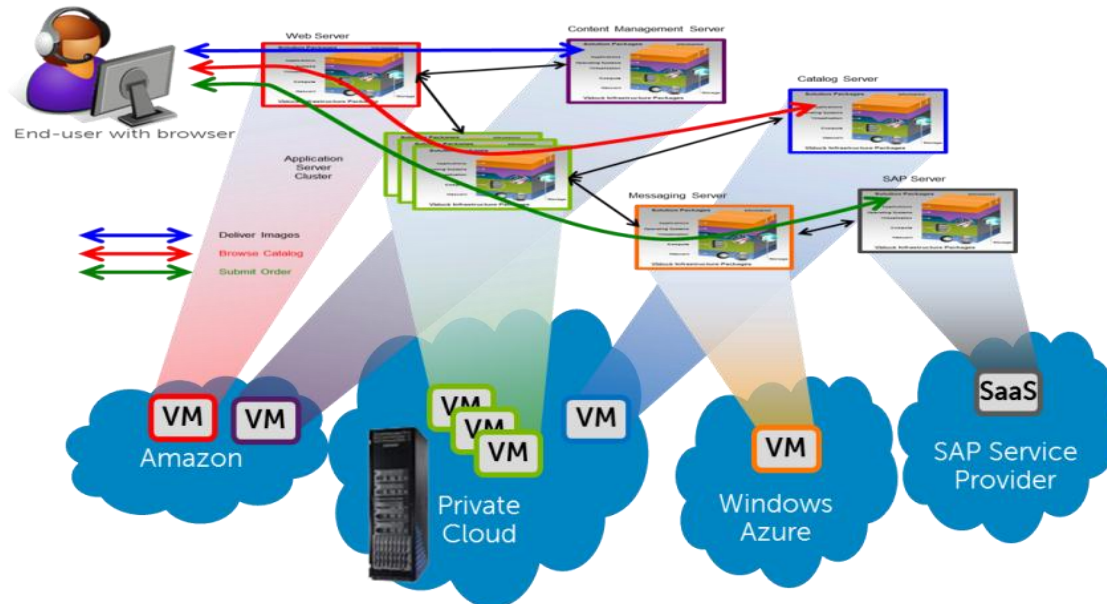
= a **Composite Application** running **across Multiple Clouds**

What are the right workloads for the Cloud?

- Identify applications that benefit from cloud characteristics
  - horizontal scalability / cloud bursting
  - very dynamic / on-demand
    - batch, fluctuating traffic,…
    - projects, launches, temporary needs,…
  - Disaster Recovery (DR) – depends on details(!)…

- What migth be less suitable?
  - high performance requirements
    - esp. storage
  - high availability requirements
  - applications that just scale vertically
  - applications that work with confidential data
  - applications with large data capacities
  - applications that are hardware-dependent/-optimized
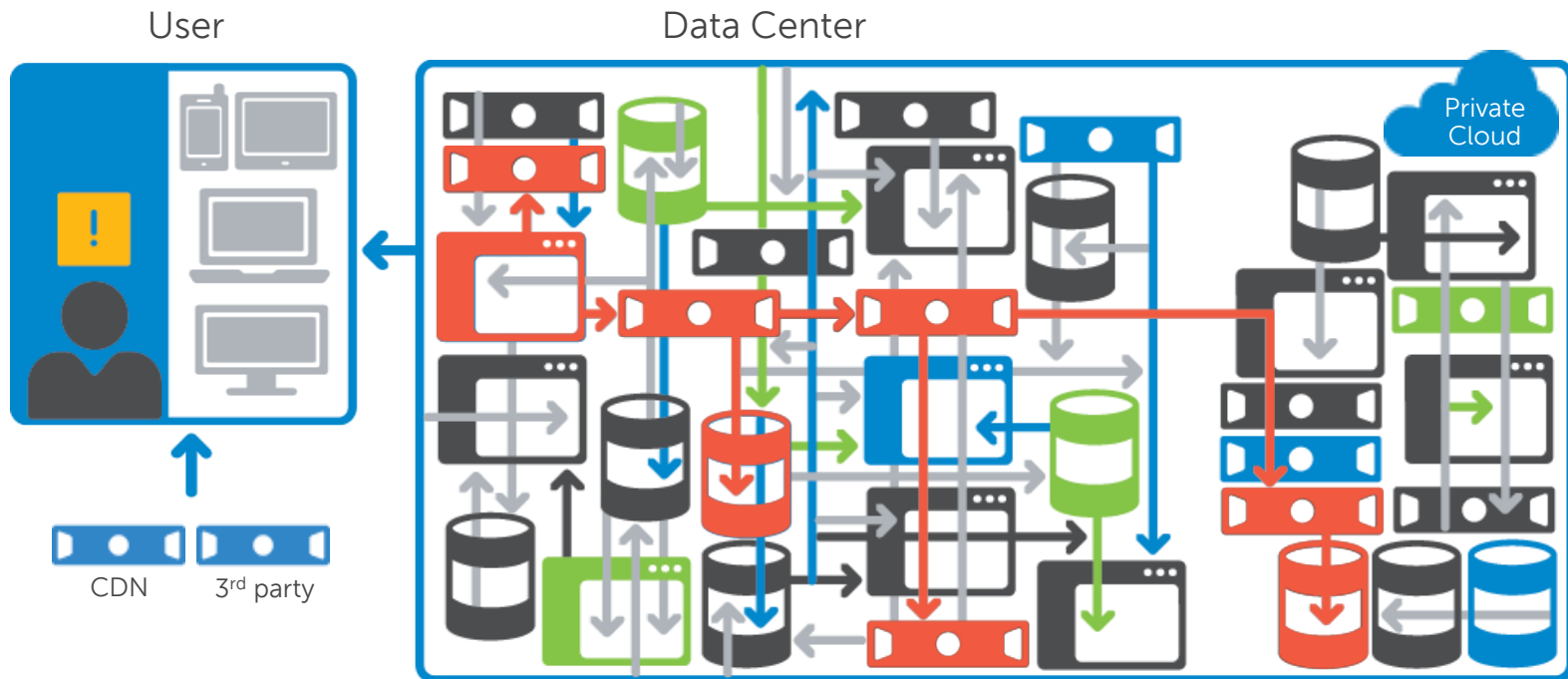
needs further investigation

Modern Environments Can Be Complex

Latency?

User Experience?

Performance Bottlenecks?

User

Data Center

CDN   3rd party

Private Cloud
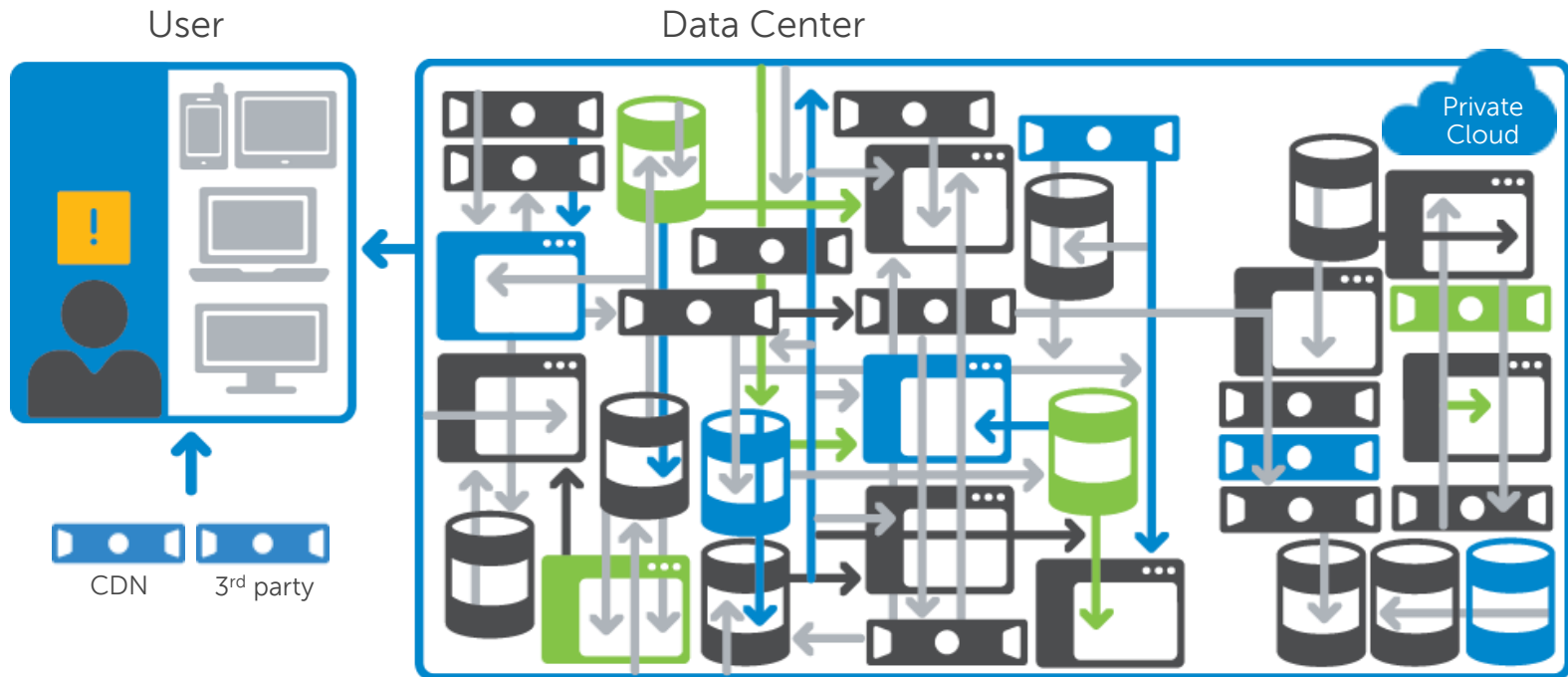
Dell Foglight APM
Application Performance Management

- User Experience Monitoring, TransactionDNA Technology, Analytics,…

Dell Foglight Performance Monitoring
End-to-End View

Application-Centric Enterprise Performance Monitoring

Maximize team collaboration based on a common platform and single version of the truth

Application Performance Monitoring
Most integrated customer and transaction-centric APM

Database Performance Monitoring
Deepest DB monitor and workload analysis for multiple platforms

Infrastructure Performance Monitoring

Virtualization
Enterprise virtualization management with analytics, advice and intelligent automation

Storage
Deepest storage monitor with analytics for virtual and physical environments