Open Source Cloud Computing Management with OpenNebula

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dsa-research.org | OpenNebula.org
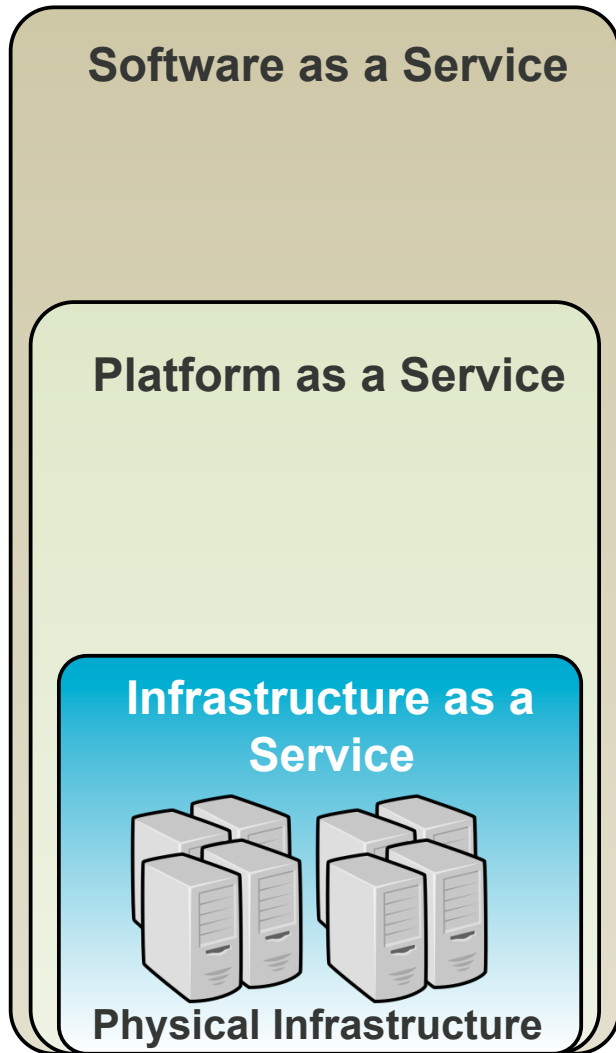
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Cloud Computing Disciplines

An Introduction to Cloud Computing

	What	Who
Software as a Service	On-demand access to any application	**End-user** (does not care about hw or sw)
Platform as a Service	Platform for building and delivering web applications	**Developer** (no managing of the underlying hw & swlayers)
Infrastructure as a Service / **Physical Infrastructure**	Delivery of a *raw* computer infrastructure	**System Administrator** (complete management of the computer infrastructure)

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Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

Public Cloud

- Simple Web Interface

- Raw *Infrastructure* Resources

- Pay-as-you-go (On-demand access)

- Elastic & *"infinite"* Capacity

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Infrastructure as a Service (IaaS)

An Introduction to Cloud Computing

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amazon webservices™

Private Cloud

A *"Public Cloud behind the firewall"*

• Simplify internal operations

• Dynamic allocation of resources

• Higher utilization & operational savings

• Security concerns

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Hybrid Cloud

- Supplement the capacity of the Private Cloud

- Utility Computing dream made a reality!

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amazon
web services

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Challenges of an IaaS Cloud

I'm using virtualization/cloud, and plan a private Cloud (BUT's)

Where do/did I put my web server VM?
Monitoring & Scheduling

How do I provision a new VM?
Image Management & Context

Who have access to cloud (and What)?
User & Role Management

How do I create a new disk?
Storage

How do I set up networking for a multitier service?
Network & VLANs

How can I manage the distributed infrastructure?
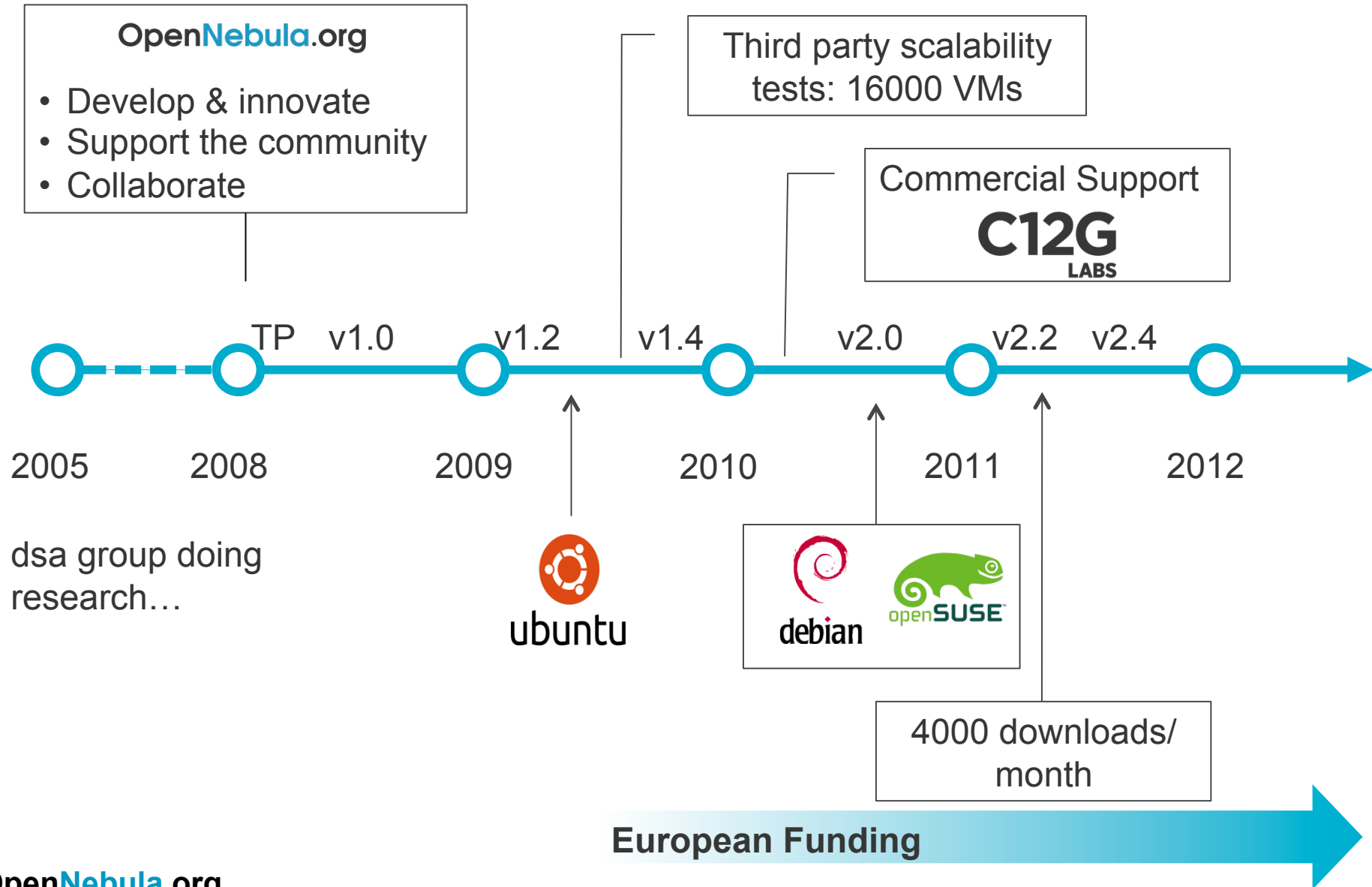**Interfaces & APIs**

Can I use hypervisor X?
Virtualization

Uniform management layer that orchestrates multiple technologies

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History of OpenNebula.org

An Introduction to Cloud Computing

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- Develop & innovate
- Support the community
- Collaborate

Third party scalability tests: 16000 VMs

Commercial Support
C12G LABS

TP   v1.0   v1.2   v1.4   v2.0   v2.2   v2.4

2005   2008   2009   2010   2011   2012

dsa group doing research…

ubuntu

debian   openSUSE

4000 downloads/ month

European Funding

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History of OpenNebula.org: Sample Users

An Introduction to Cloud Computing

Organizations Building Clouds for Development, Testing and Production

Projects Building an Open Cloud Ecosystem Around OpenNebula
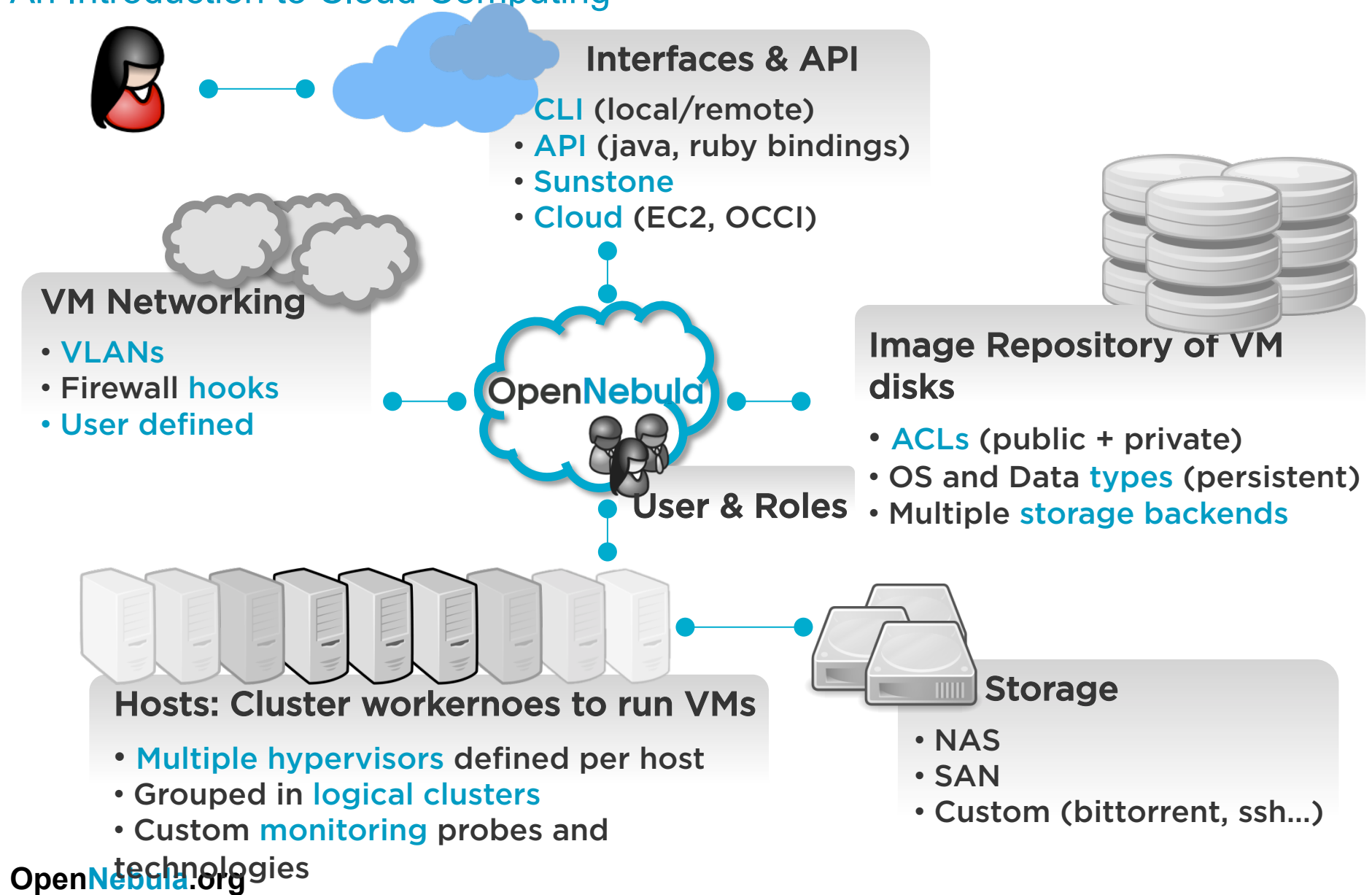
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Technical Overview of OpenNebula: Vision & Design Philosophy

An Introduction to Cloud Computing

- **One solution can not fit all** data-center, requirements and constraints

- **Open, flexible and extensible** architecture that allows multiple components to be orchestrated

- **Ready for production**

- **Massively scalable** deployments

- **Open Source** – Apache License v2.0

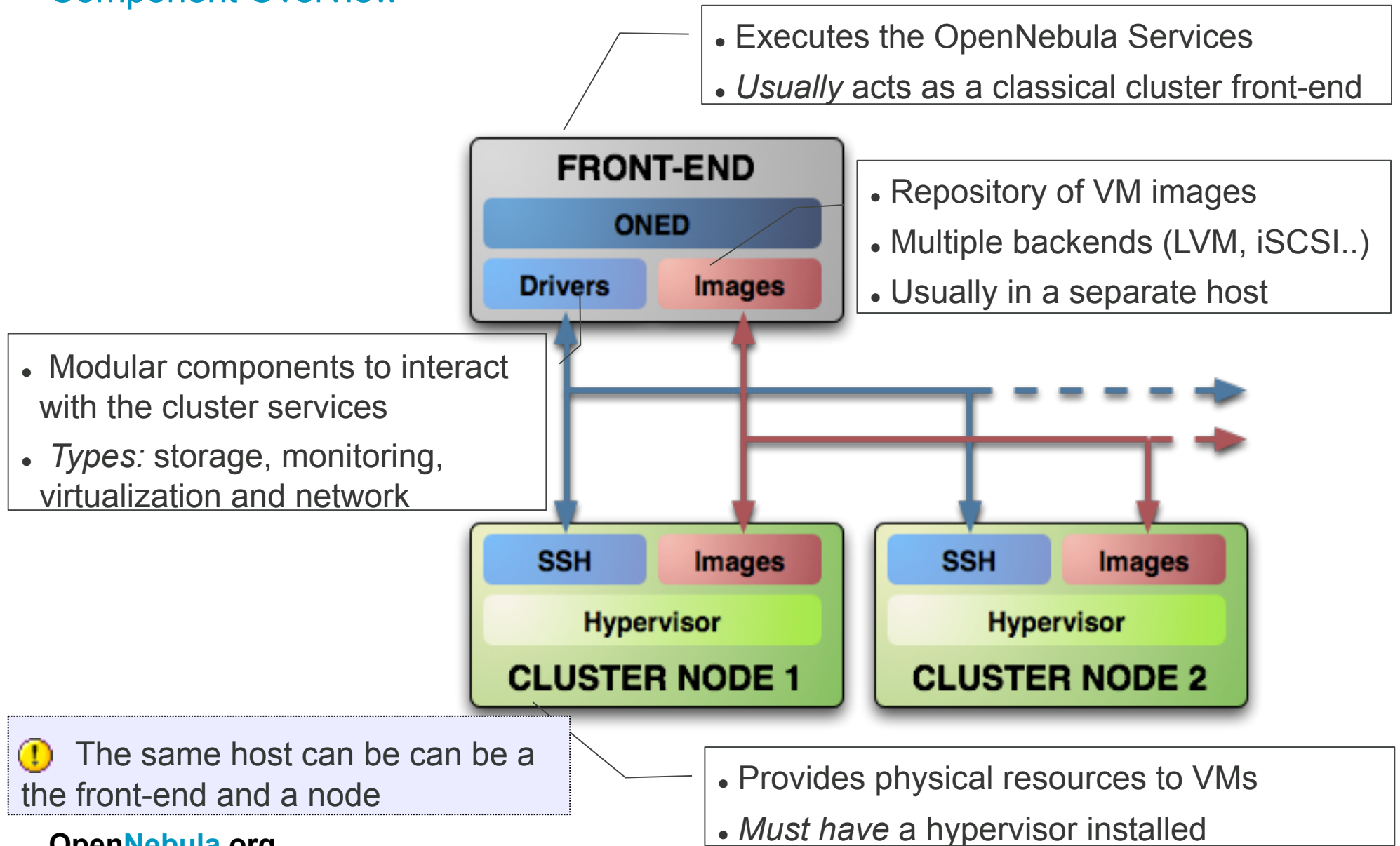- Provide basic components, but allow them to be **easily replaceable**

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Technical Overview of OpenNebula: Key Components

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Interfaces & API

CLI (local/remote)
- **API** (java, ruby bindings)
- **Sunstone**
- **Cloud** (EC2, OCCI)

VM Networking

- **VLANs**
- Firewall **hooks**
- **User defined**

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User & Roles

Image Repository of VM disks

- **ACLs** (public + private)
- OS and Data **types** (persistent)
- Multiple **storage backends**

Hosts: Cluster workernoes to run VMs

- **Multiple hypervisors** defined per host
- Grouped in **logical clusters**
- Custom **monitoring** probes and technologies

Storage

- NAS
- SAN
- Custom (bittorrent, ssh...)

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Component Overview

- Executes the OpenNebula Services
- *Usually* acts as a classical cluster front-end

FRONT-END

ONED

Drivers   Images

- Repository of VM images
- Multiple backends (LVM, iSCSI..)
- Usually in a separate host

- Modular components to interact with the cluster services
- *Types:* storage, monitoring, virtualization and network

SSH   Images

Hypervisor

CLUSTER NODE 1

SSH   Images

Hypervisor

CLUSTER NODE 2

⚠ The same host can be can be a the front-end and a node

- Provides physical resources to VMs
- *Must have* a hypervisor installed

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Component Overview

Processes

Storage for the Private Cloud

- **Image Repository:** Any storage medium for the VM images (usually a high performing SAN).

- **Cluster Storage**

  - OpenNebula supports multiple back-ends (e.g. LVM for fast cloning)

- **VM Directory:** The home of the VM in the cluster node

  - Stores checkpoints, description files and VM disks

  - Actual operations over the VM directory depends on the storage medium

  - Should be shared for live-migrations

  - You can go on without a shared FS and use the SSH back-end

  - Defaults to `$ONE_LOCATION/var/$VM_ID`

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# Storage for the Private Cloud

Example, a shared FS architecture
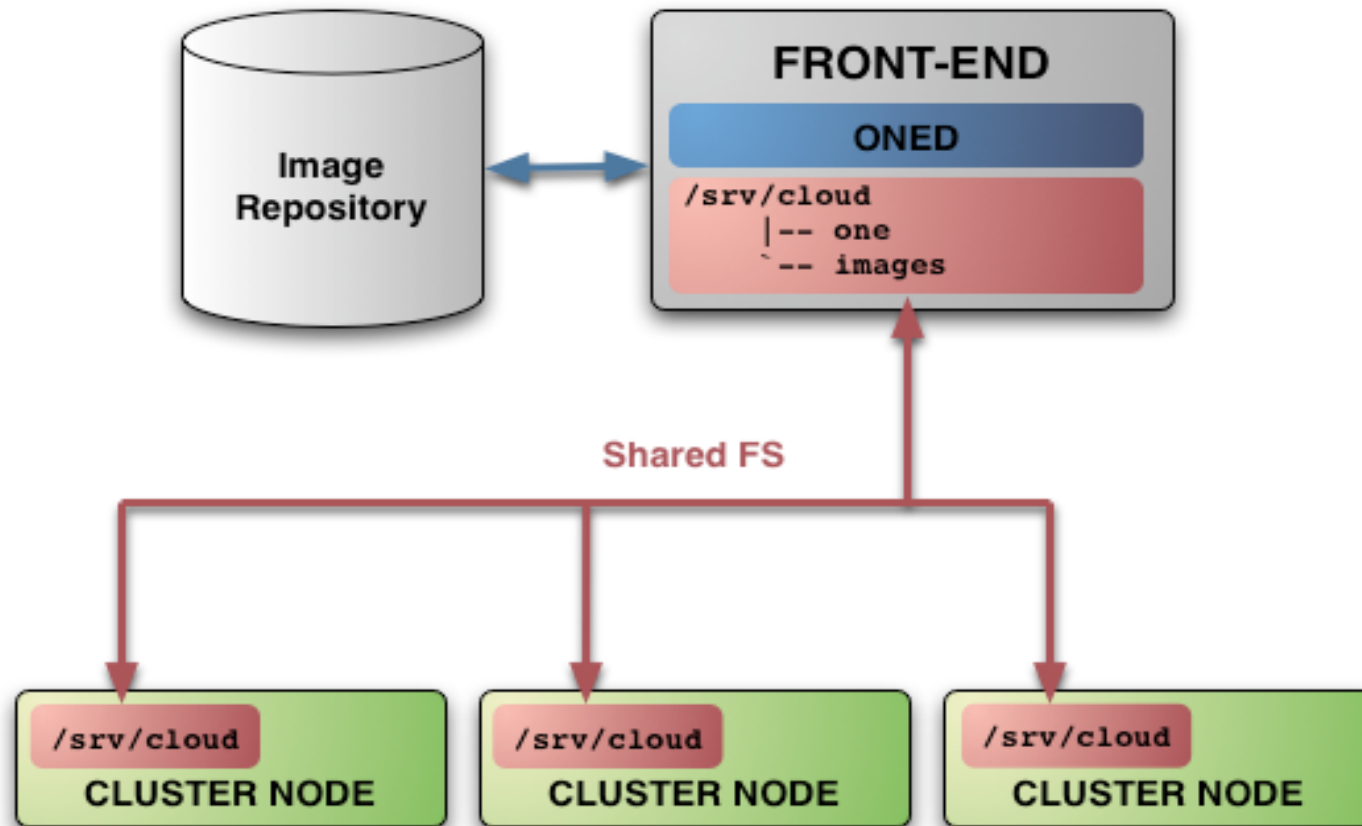
Networking for the Private Cloud

Component Overview

- OpenNebula management operations uses a ssh connections, it does not require a performing NIC

- **Image traffic,** may require the movement of heavy files (VM images, checkpoints). Dedicated storage links may be a good idea

- **VM demands,** consider the typical requirements of your VMs. Several NICs to support the VM traffic may be a good idea

- OpenNebula relies on bridge networking for the VMs
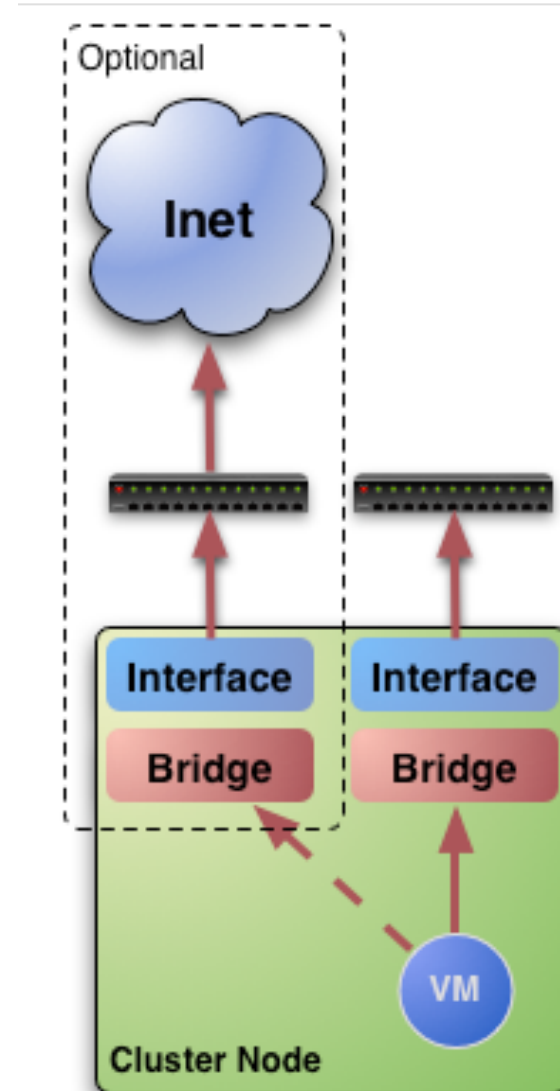
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Virtual Networks

- A **Virtual Network (vnet)** in OpenNebula
    - Defines a separated MAC/IP address space to be used by VMs
    - A vnet is associated with a physical network through a bridge
    - Virtual Networks can be isolated (at layer 2 level)
- Virtual Network **definition**
    - **Name,** of the network
    - **Type**
        - **Fixed**, a set of IP/MAC leases
        - **Ranged,** defines a network range
    - **Bridge**, name of the physical bridge in the physical host where the VM should connect its network interface.
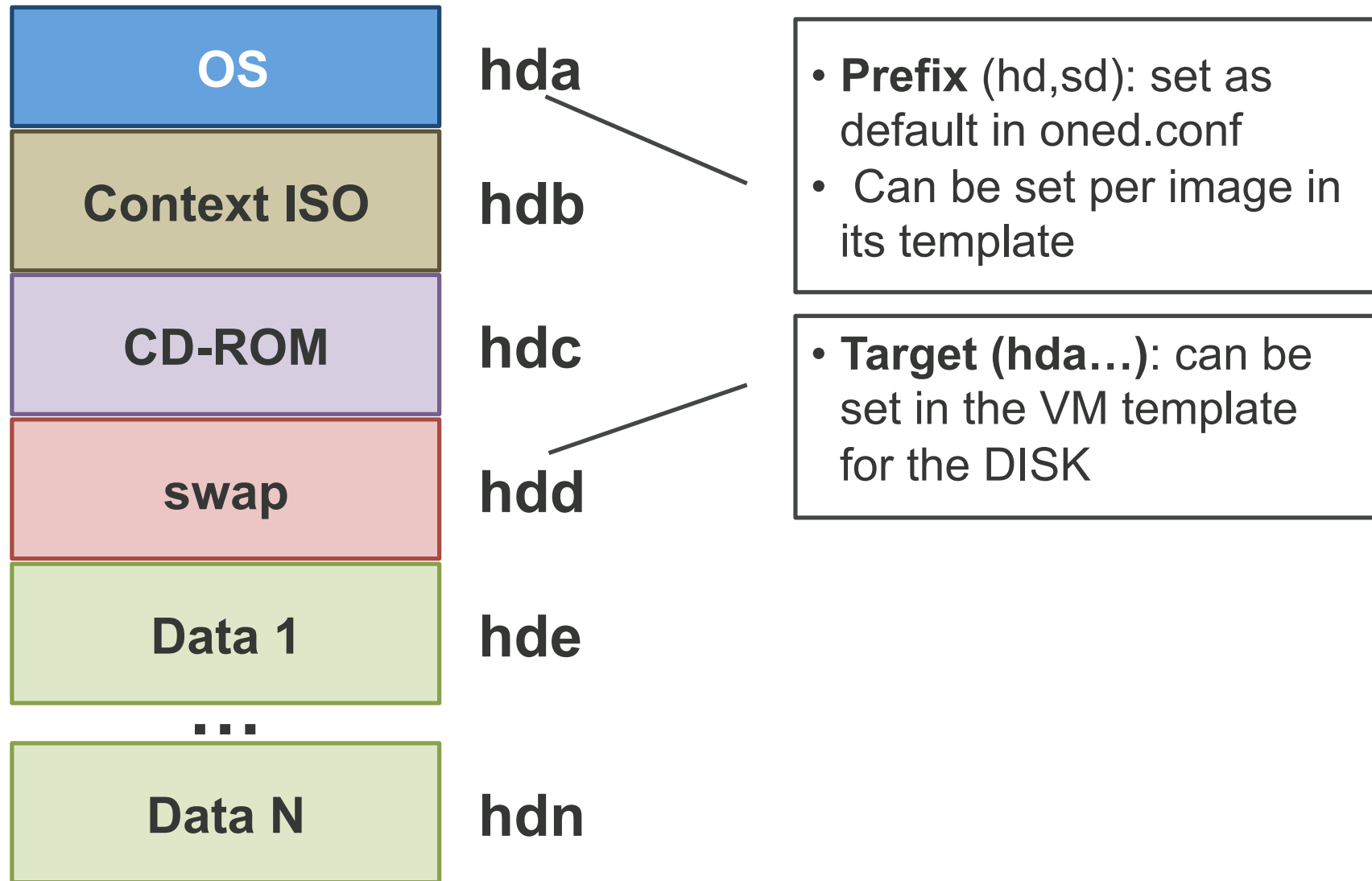- Virtual Networks are managed with the `onevnet` utility

OpenNebula**.org**

Images

- An **Image** in OpenNebula's repository

    - A virtual machine disk to be used as OS or DATA device.

    - Images can be **persistent** and/or **public**

    - Images modifications can be saved as another image

- **Image Types**:

    - **OS**: contains a working operative system

    - **CDROM**: readonly data

    - **DATABLOCK**: A storage for data. Can be created either from previous existing data, or as an empty drive.

- Images are *stored* in the repository

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Images

Automatic Disk Layout for Images

OS	**hda**
Context ISO	**hdb**
CD-ROM	**hdc**
swap	**hdd**
Data 1	**hde**
. . .	
Data N	**hdn**

- **Prefix** (hd,sd): set as default in oned.conf
- Can be set per image in its template

- **Target (hda…)**: can be set in the VM template for the DISK

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Virtual Machines

- A **Virtual Machine** in OpenNebula

    - A **capacity** in terms memory and CPU

    - A set of **NICs** attached to one or more virtual networks

    - A set of **disk images,** to be "*transfered*" to/from the execution host.

    - A **state file** (optional) or recovery file, with the memory image of a running VM plus some hypervisor specific information.

- Virtual Machines are defined in a **VM template**

- Each VM has an unique ID in OpenNebula the VMID

- All the files (logs, images, state files...) are stored in **$ONE_LOCATION/var/<VMID>**

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Hybrid Cloud Computing

Overview

- VMs can be local or remote
- VM connectivity has to be configured, usually VPNs

Virtual Infrastructure

Virtual Network

OpenNebula

Local Physical Infrastructure

Cloud Provider
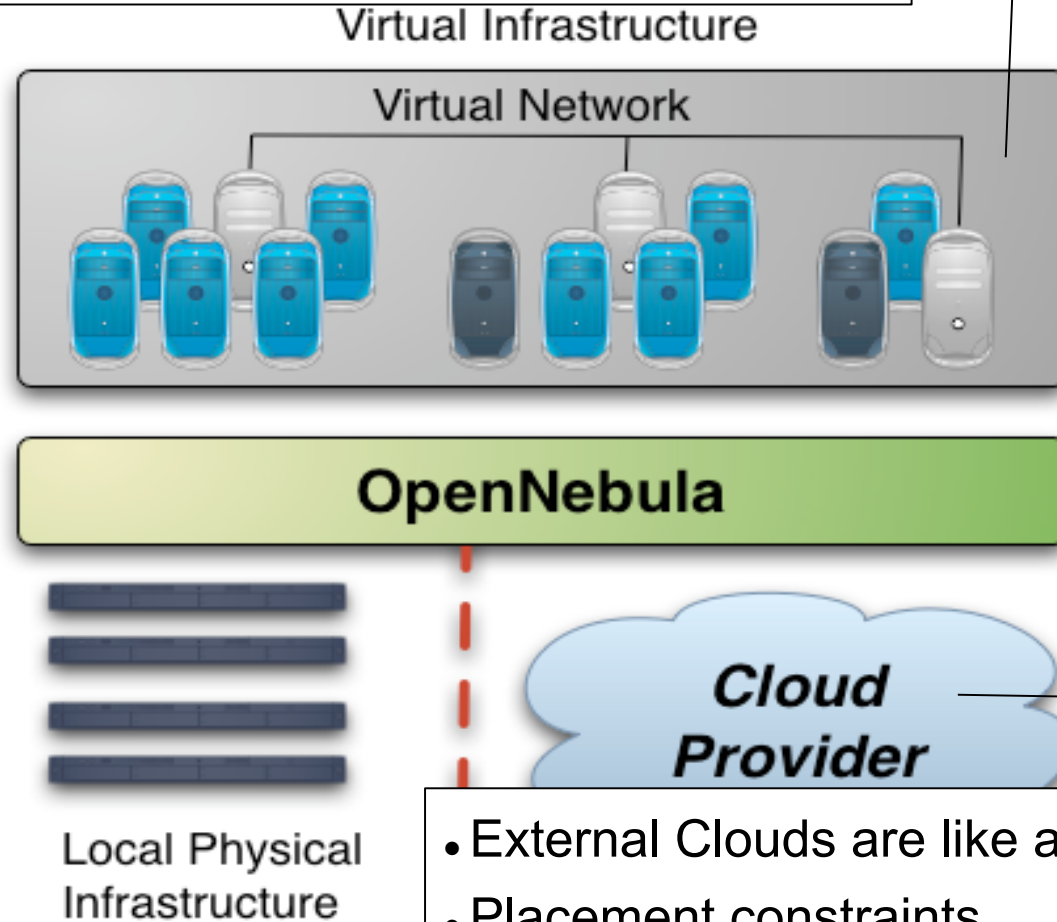
- External Clouds are like any other host
- Placement constraints
- OpenNebula distribution includes EC2 drivers

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Public Cloud Computing with OpenNebula

Overview
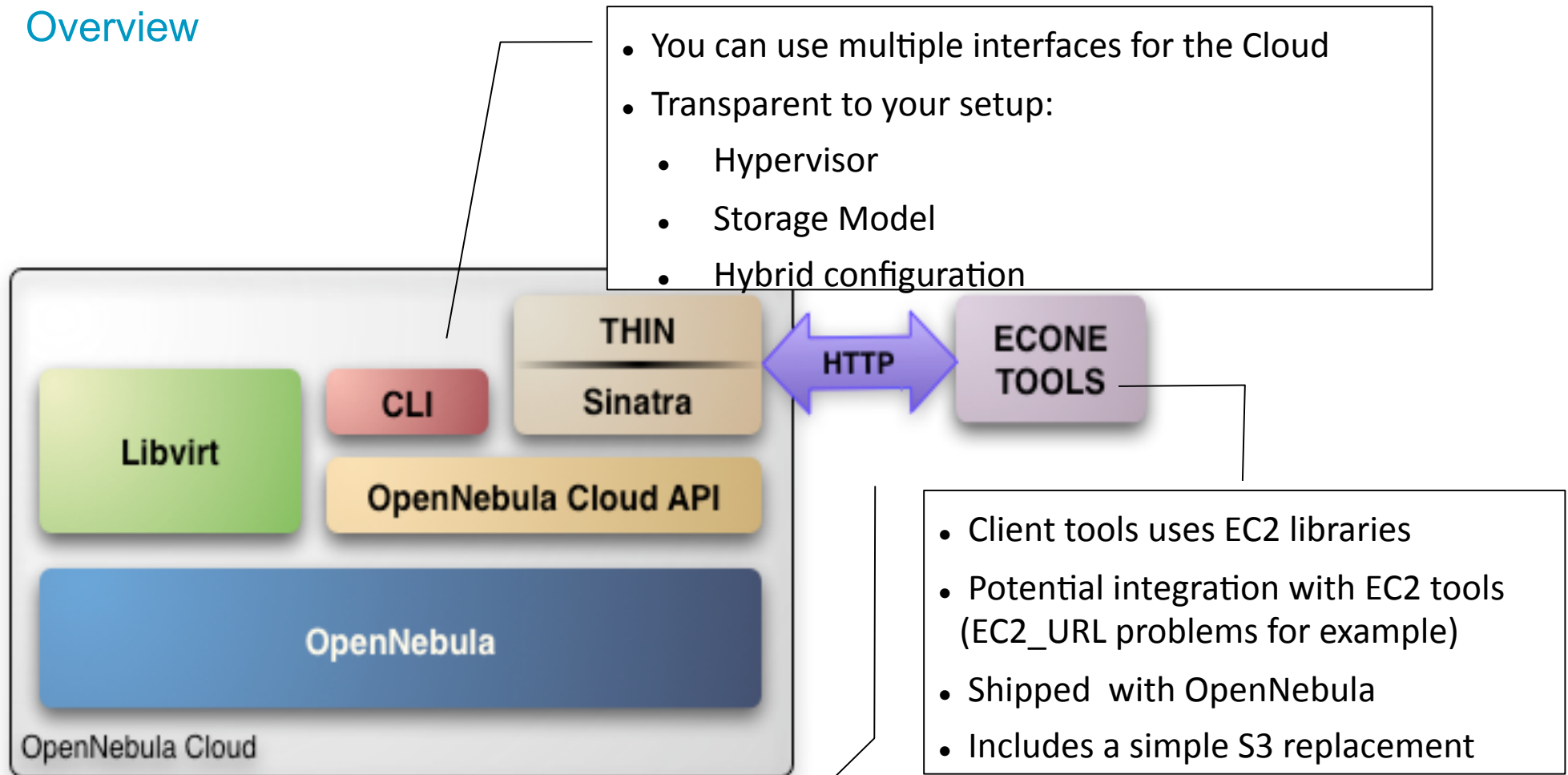
- You can use multiple interfaces for the Cloud
- Transparent to your setup:
  - Hypervisor
  - Storage Model
  - Hybrid configuration

- Client tools uses EC2 libraries
- Potential integration with EC2 tools (EC2_URL problems for example)
- Shipped with OpenNebula
- Includes a simple S3 replacement

- Supports HTTP and HTTPS protocols
- *EC2 authentication* based on OpenNebula credentials
- Public Cloud users need an OpenNebula account

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StratusLab Project

- MarketPlace with pregenerated Grid images
- Claudia service manager
- User friendly CLI to manage VMs and create new images
- Prepackaged software for common Linux distributions
- Quattor recipes to easily install and configure the software in a cluster
- X509/Grid credentials support
- VM management based on OpenNebula 2.2

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StratusLab Project

Grid aware cloud stack

The version 0.4 of the software is available at http://stratuslab.eu

Version 1.0 is coming soon with utilities to upgrade previous installed versions.

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