BUILDING A CLOUD INFRASTRUCTURE WITH OPEN SOURCE SOFTWARE

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Building a cloud infrastructure

- Hardware
  - Low-cost, commodity hardware
  - Redundent resources to ensure high availability
  - Approach: Use low-cost hardware with software providing redundency and avoid high-end hardware
- Software
  - Role of software is greater than that of hardware
  - A collection or “stack” of software is needed
  - Proprietary software stacks with vendor lock-in
  - Several open source software stacks available

Software stack

- Because of the complexity, software required to run a could is organized as layers of a “stack”
  - Hypervisor: enables the creation of several virtual machines (Vms) on a single physical machine (node)
  - Clustering: use of multiple nodes / storage devices to serve as “clusters” of computing power (compute clusters) and storage capacity (storage culsters) with redundency built in
  - Virtual Networks: need to create virtual networks that connect VMs to each other and then to the outside world
  - Resource Management: management of compute clusters, storage clusters, networks, software images etc.
  - User Management: User privileges, authentication etc.
  - Billing: Based on resource usage

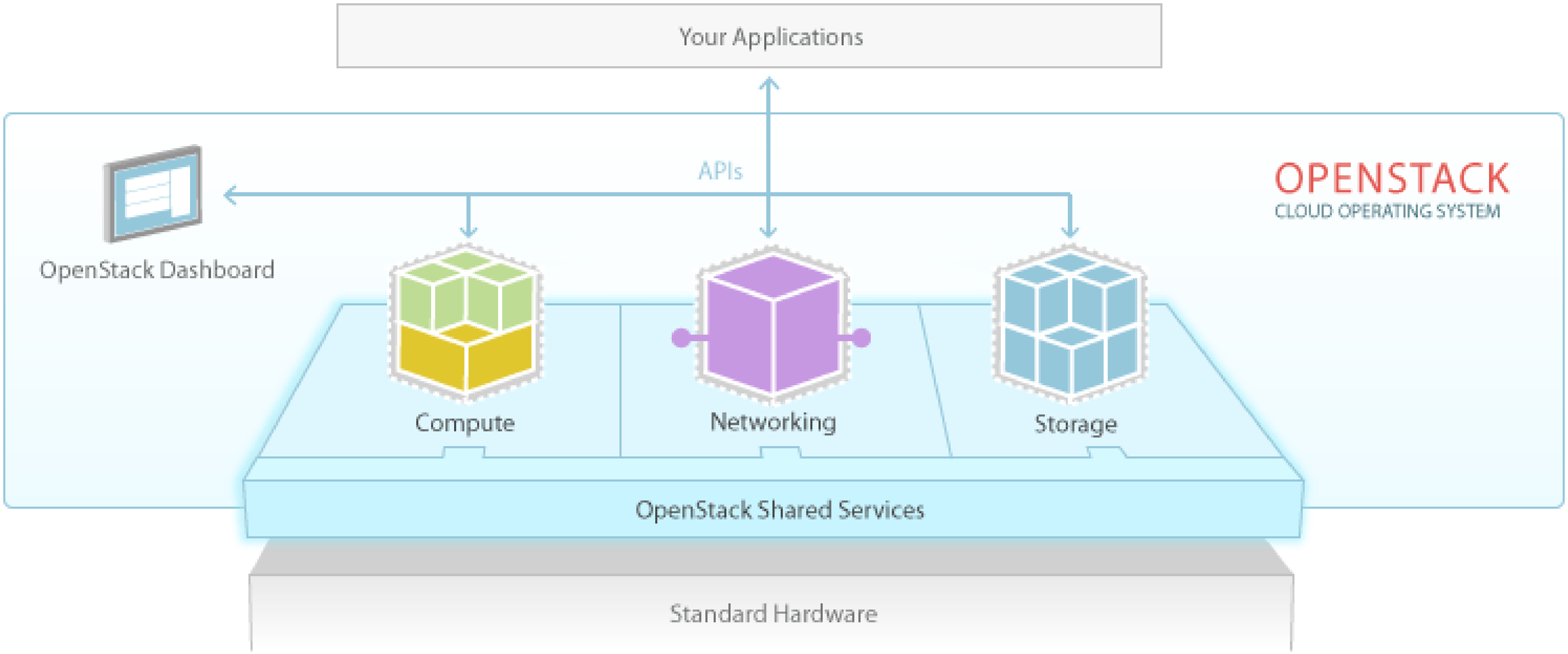
Open Source Cloud software stacks

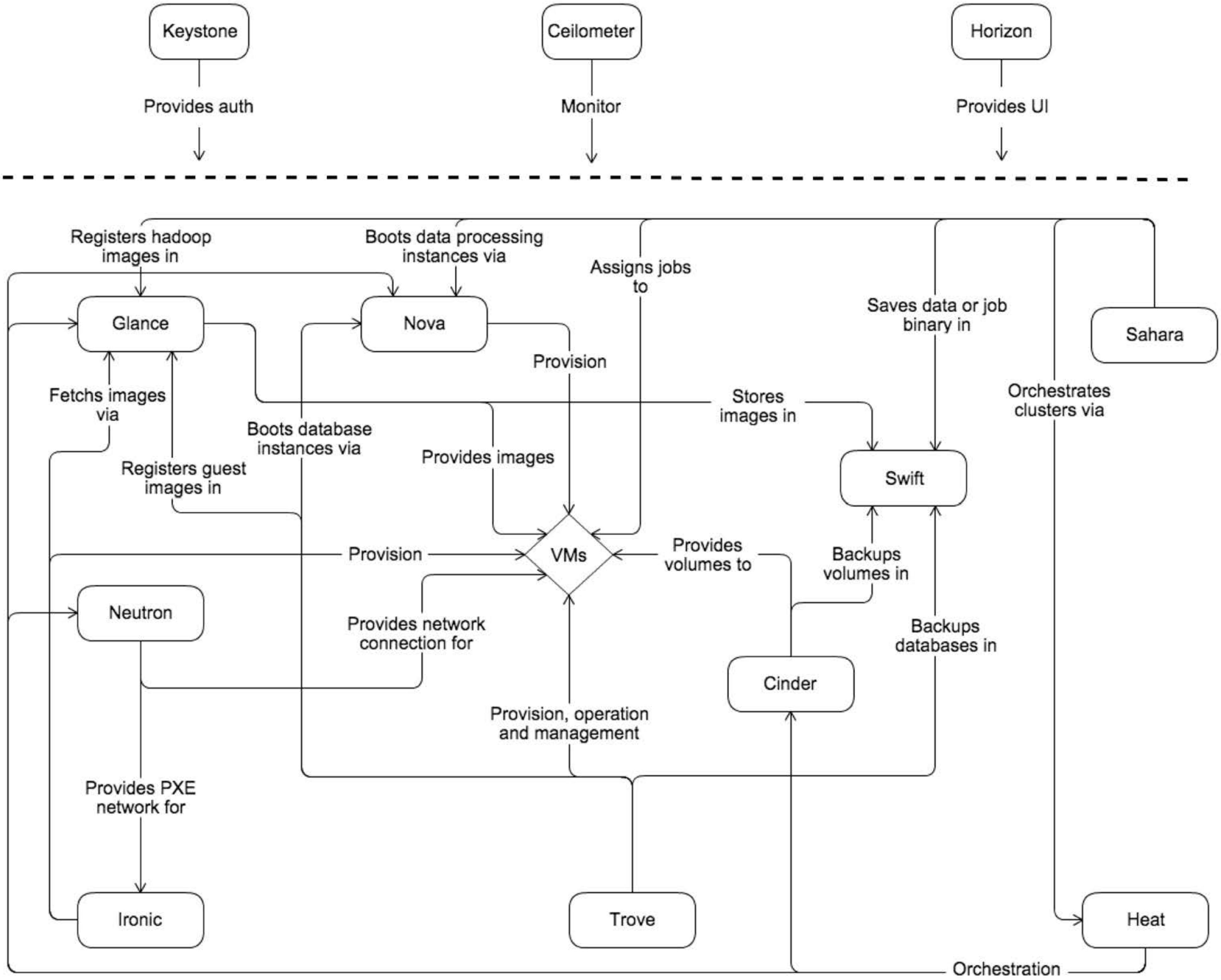
- OpenStack
  - Initiated by Rackspace / NASA
  - Governed by consortium of vendors
- Ganeti + Synnefo
  - Ganeti released to public by Google
  - Synnefo developed by GRNET runs on top of Ganeti
- OpenNebula
  - Focus on the requirements of “users”, not “providers”
  - VoneCloud - Open replacement for VMWare's vCloud
- Others

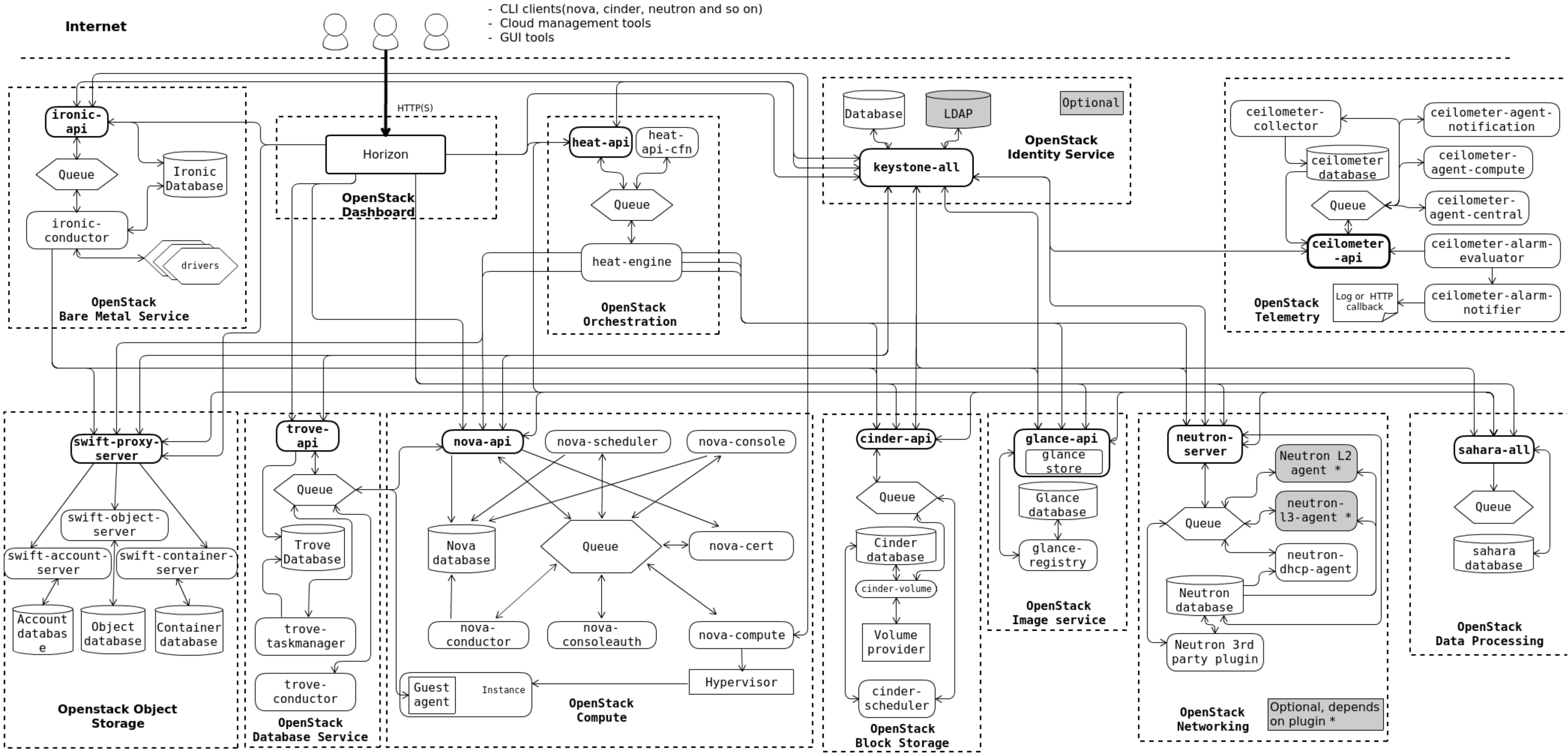
OpenStack

- Development since 2010
- Managed by OpenStack Foundation
  - 500+ members including most cloud giants
- Supports many hypervisors
  - KVM/QEMU, Xen, VMWare vSphere, HyperV
- Current version is “Kilo”
  - Consists of 16 components
  - Installation from scratch is not easy
- Vendors sell “Distributions”
  - Usually not free, except for small scale use

Openstack Architecture

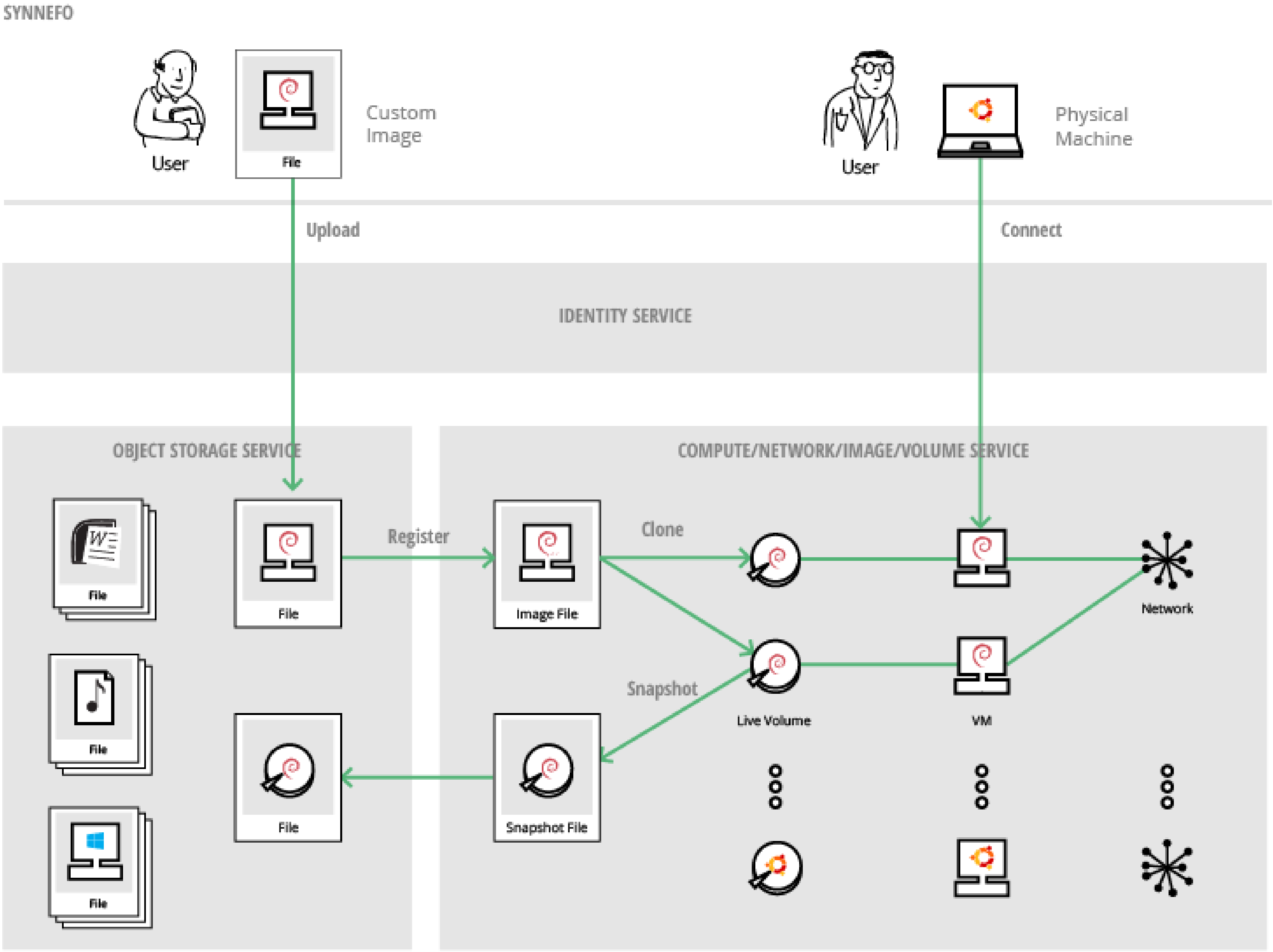


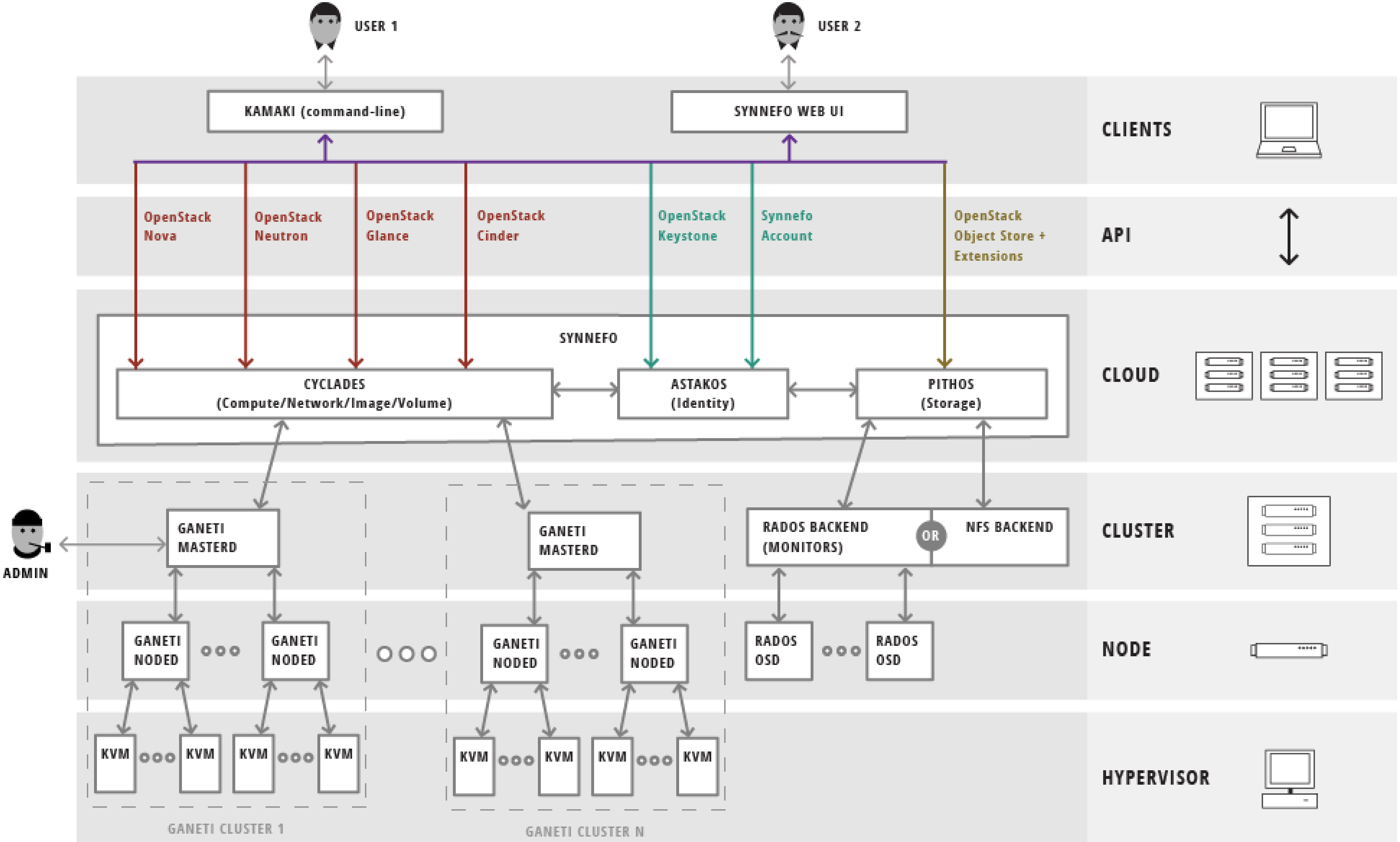

Keystone
Provides auth
Ceilometer
Monitor
Horizon
Provides UI
Registers hadoop images in
Boots data processing instances via
Assigns jobs to
Saves data or job binary in
Sahara
Glance
Nova
Provision
Fetchs images via
Stores images in
Orchestrates clusters via
Boots database instances via
Provides images
Swift
Registers guest images in
Provision
VMs
Provides volumes to
Backups volumes in
Neutron
Provides network connection for
Backups databases in
Cinder
Provision, operation and management
Provides PXE network for
Ironic
Trove
Heat
Orchestration


Internet
- CLI clients(nova, cinder, neutron and so on)
- Cloud management tools
- GUI tools
HTTP(S)
Horizon
OpenStack Dashboard
ironic-api
Queue
Ironic Database
ironic-conductor
drivers
OpenStack Bare Metal Service
heat-api
heat-api-cfn
Queue
heat-engine
OpenStack Orchestration
Database
LDAP
Optional
keystone-all
OpenStack Identity Service
ceilometer-collector
ceilometer database
Queue
ceilometer-api
ceilometer-agent-notification
ceilometer-agent-compute
ceilometer-agent-central
ceilometer-alarm-evaluator
ceilometer-alarm-notifier
Log or HTTP callback
OpenStack Telemetry
swift-proxy-server
swift-object-server
swift-account-server
swift-container-server
Account databas e
Object database
Container database
Openstack Object Storage
trove-api
Queue
Trove Database
trove-taskmanager
trove-conductor
OpenStack Database Service
nova-api
nova-scheduler
nova-console
Nova database
Queue
nova-cert
nova-conductor
nova-consoleauth
nova-compute
Hypervisor
Guest agent
Instance
OpenStack Compute
cinder-api
Queue
Cinder database
cinder-volume
Volume provider
cinder-scheduler
OpenStack Block Storage
glance-api
glance store
Glance database
glance-registry
OpenStack Image service
neutron-server
Neutron L2 agent *
neutron-l3-agent *
Queue
neutron-dhcp-agent
Neutron database
Neutron 3rd party plugin
OpenStack Networking
Optional, depends on plugin *
sahara-all
Queue
sahara database
OpenStack Data Processing

Ganeti + Synnefo

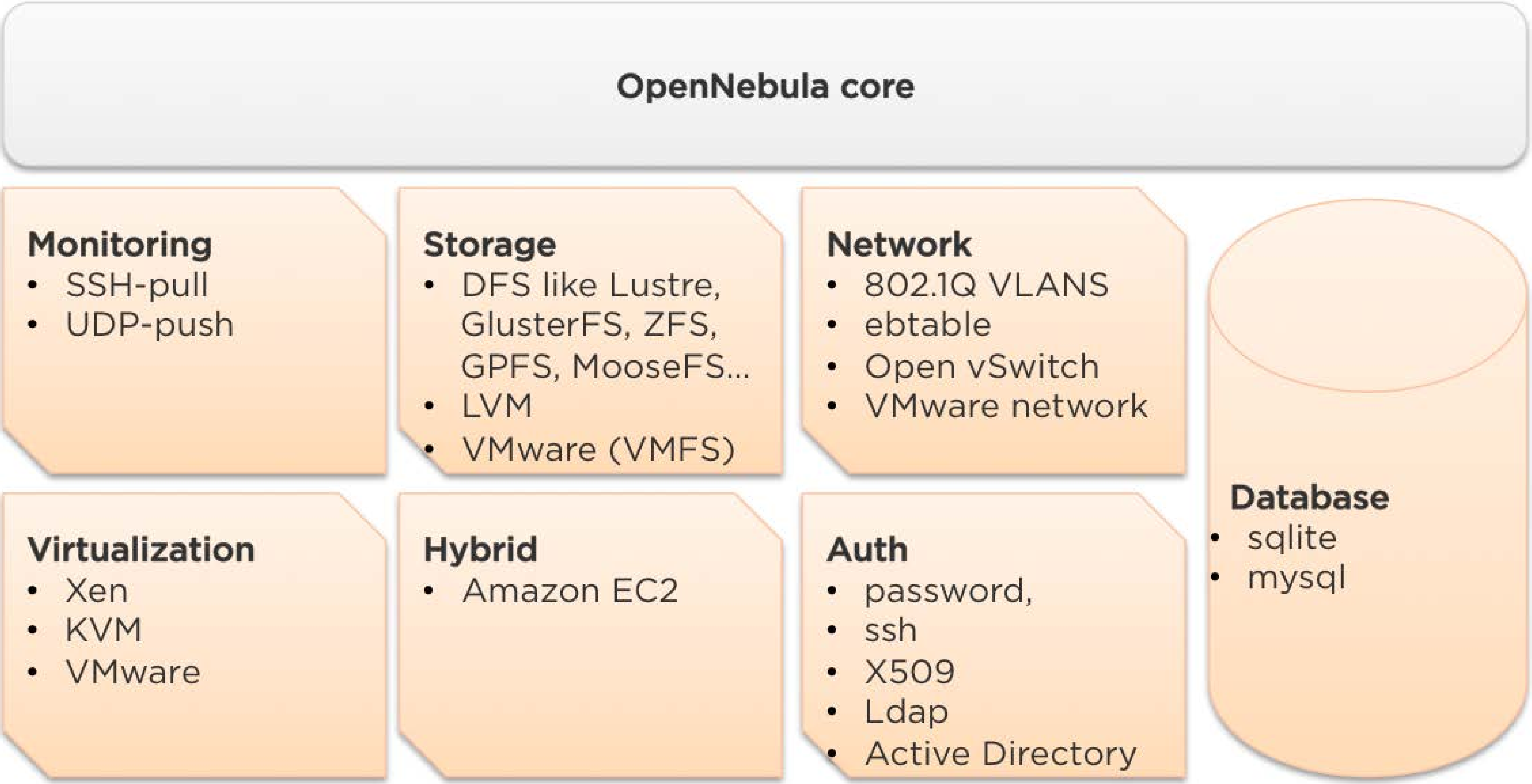
- Ganeti developed by Google, released as open source – mainly provides clustering of KVM nodes
  - Current version 2.14
- Synnefo developed by GRNET – provides a cloud management interface to Ganeti clusters
  - Uses the OpenStack API
  - Current version 0.16
- Fewer components compared to OpenStack
- Installation and maintenance is simpler
- Less dependent on vendors


SYNNEFO
User
File
Custom Image
User
Physical Machine
Upload
Connect
IDENTITY SERVICE
OBJECT STORAGE SERVICE
COMPUTE/NETWORK/IMAGE/VOLUME SERVICE
File
File
File
File
Register
Image File
Clone
Network
Snapshot
Live Volume
VM
File
Snapshot File


USER 1
USER 2
KAMAKI (command-line)
SYNNEFO WEB UI
CLIENTS
OpenStack Nova
OpenStack Neutron
OpenStack Glance
OpenStack Cinder
OpenStack Keystone
Synnefo Account
OpenStack Object Store + Extensions
API
SYNNEFO
CYCLADES (Compute/Network/Image/Volume)
ASTAKOS (Identity)
PITHOS (Storage)
CLOUD
ADMIN
GANETI MASTERD
GANETI MASTERD
RADOS BACKEND (MONITORS)
OR
NFS BACKEND
CLUSTER
GANETI NODED
GANETI NODED
GANETI NODED
GANETI NODED
RADOS OSD
RADOS OSD
NODE
KVM
KVM
KVM
KVM
KVM
KVM
KVM
KVM
HYPERVISOR
GANETI CLUSTER 1
GANETI CLUSTER N

OpenNebula

- Focus on Simplicity, Openness, Reliability and Flexibility
- Originated as a research project in 2005
  - Architecture is different from others
  - Current version is 4.12
- vOneCloud
  - Open replacement for VMWare's vCloud



OpenNebula core

Monitoring

- SSH-pull
- UDP-push

Storage

- DFS like Lustre, GlusterFS, ZFS, GPFS, MooseFS…
- LVM
- VMware (VMFS)

Network

- 802.1Q VLANS
- ebtable
- Open vSwitch
- VMware network

Database

- sqlite
- mysql

Virtualization

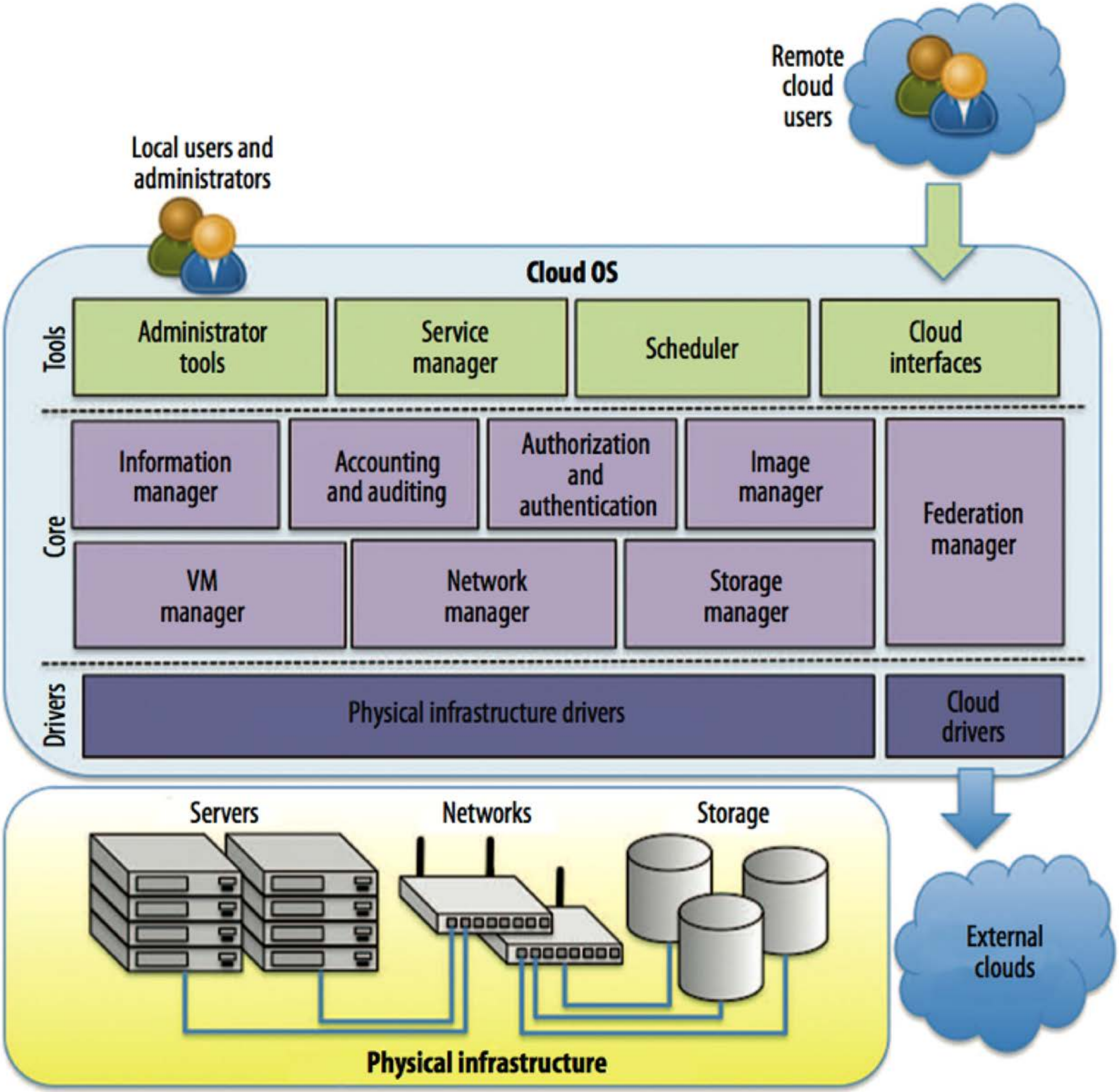
- Xen
- KVM
- VMware

Hybrid

- Amazon EC2

Auth

- password,
- ssh
- X509
- Ldap
- Active Directory


Remote cloud users
Local users and administrators
Cloud OS
Tools
Administrator tools
Service manager
Scheduler
Cloud interfaces
Core
Information manager
Accounting and auditing
Authorization and authentication
Image manager
Federation manager
VM manager
Network manager
Storage manager
Drivers
Physical infrastructure drivers
Cloud drivers
Servers
Networks
Storage
Physical infrastructure
External clouds

Containers

- Use of containers is changing the virtualization and cloud landscape significantly
- In conventional (hypervisor based) virtualization, each virtual machine (guest) runs an operating system on top of the host operating system
  - Inefficient
- Linux kernel features supporting virtualization has matuared to a point where running a guest OS is no longer essential

Containers

- Linux kernel features supporting virtualization
  - Namespaces: provide an isolated instance of a global resource
  - Control Groups (cgroups): allows allocation of resources (CPU time, system memory, network bandwidth, …) among user-defined groups of tasks (processes) running on a system
- Container standards
  - Docker
  - OpenContainer