Delivering IaaS for the Greek Academic and Research Community

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Outline

- ~okeanos ?
- Rationale
- Design – Platform - Features
- Unity - Automation
- Opensource – Upcoming

What is ~okeanos?

What is ~okeanos?

‘okeanos’ is Greek for ‘ocean’.

What is ~okeanos?

‘okeanos’ is Greek for ‘ocean’.

Oceans capture, store and deliver energy, oxygen and life around the planet.

Simplicity

LEGO
Builders of Tomorrow™
LEGOfamilyfun.com
Ages/edades
4+
6177
Building Toy
Jouet de Construction
Juguete para Construir
WARNING: CHOKING HAZARD.
Small parts. Not for children under 3 years.
650
pcs/pzs

Compute

Network

Storage

Security

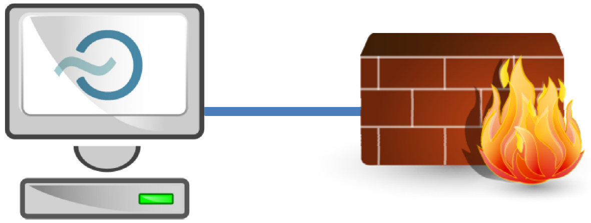
Virtual Machines

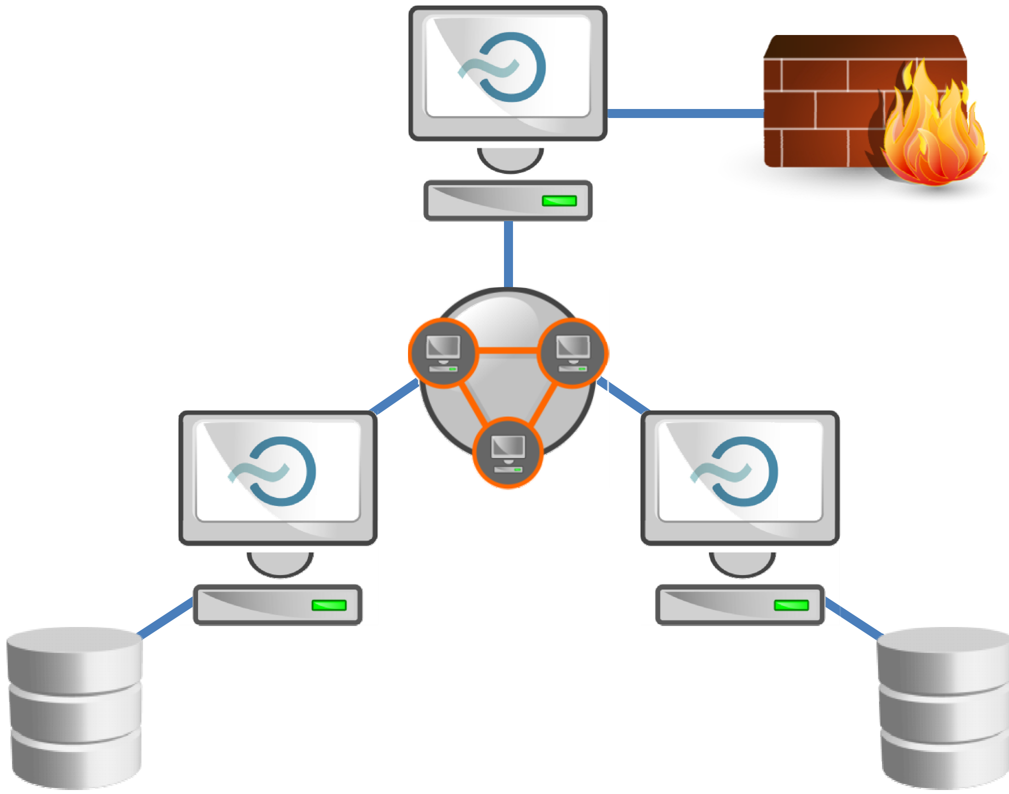
Virtual Ethernets

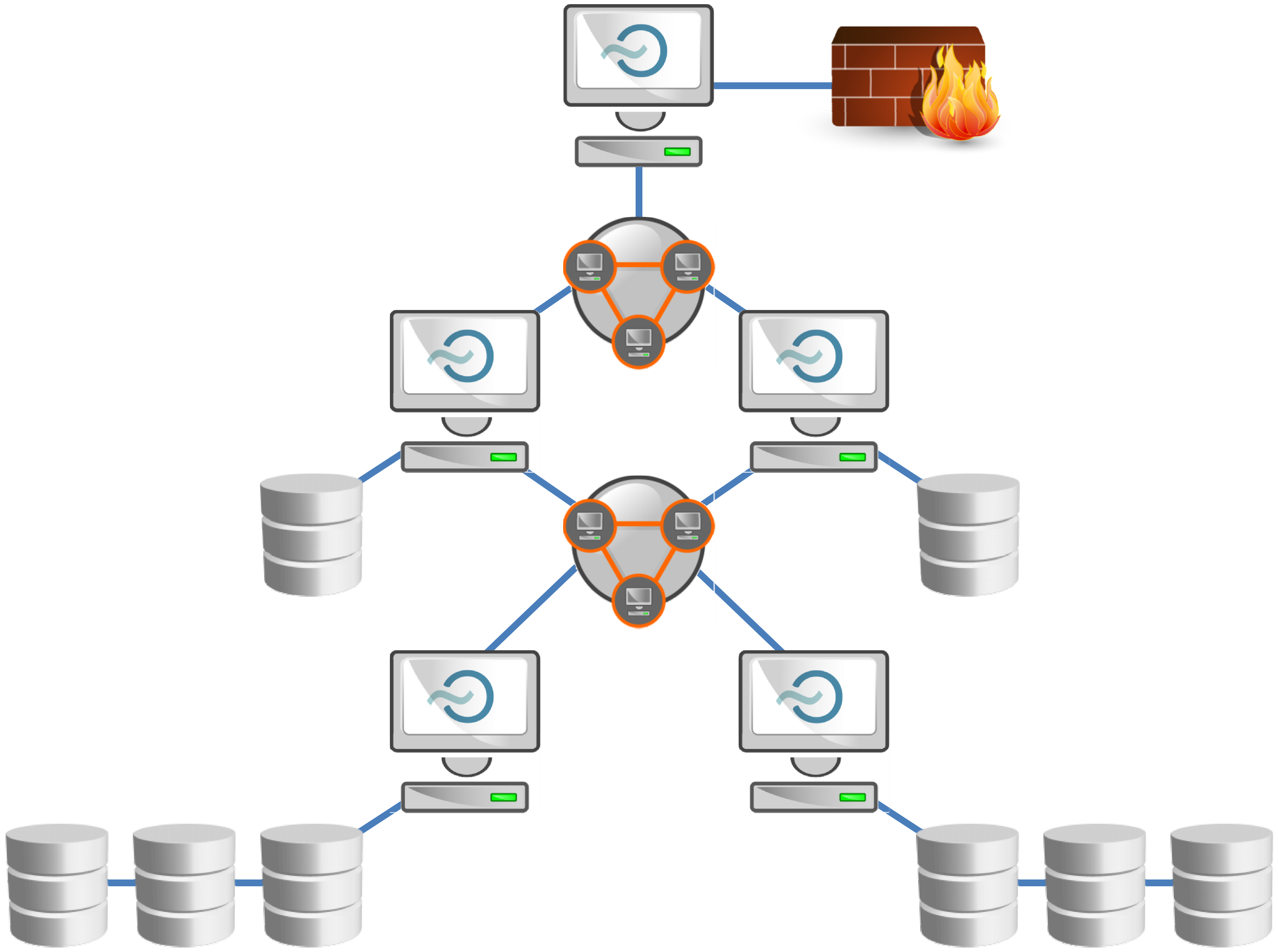
Virtual Disks

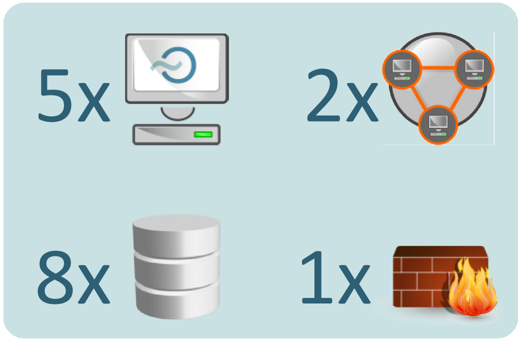
Virtual Firewalls

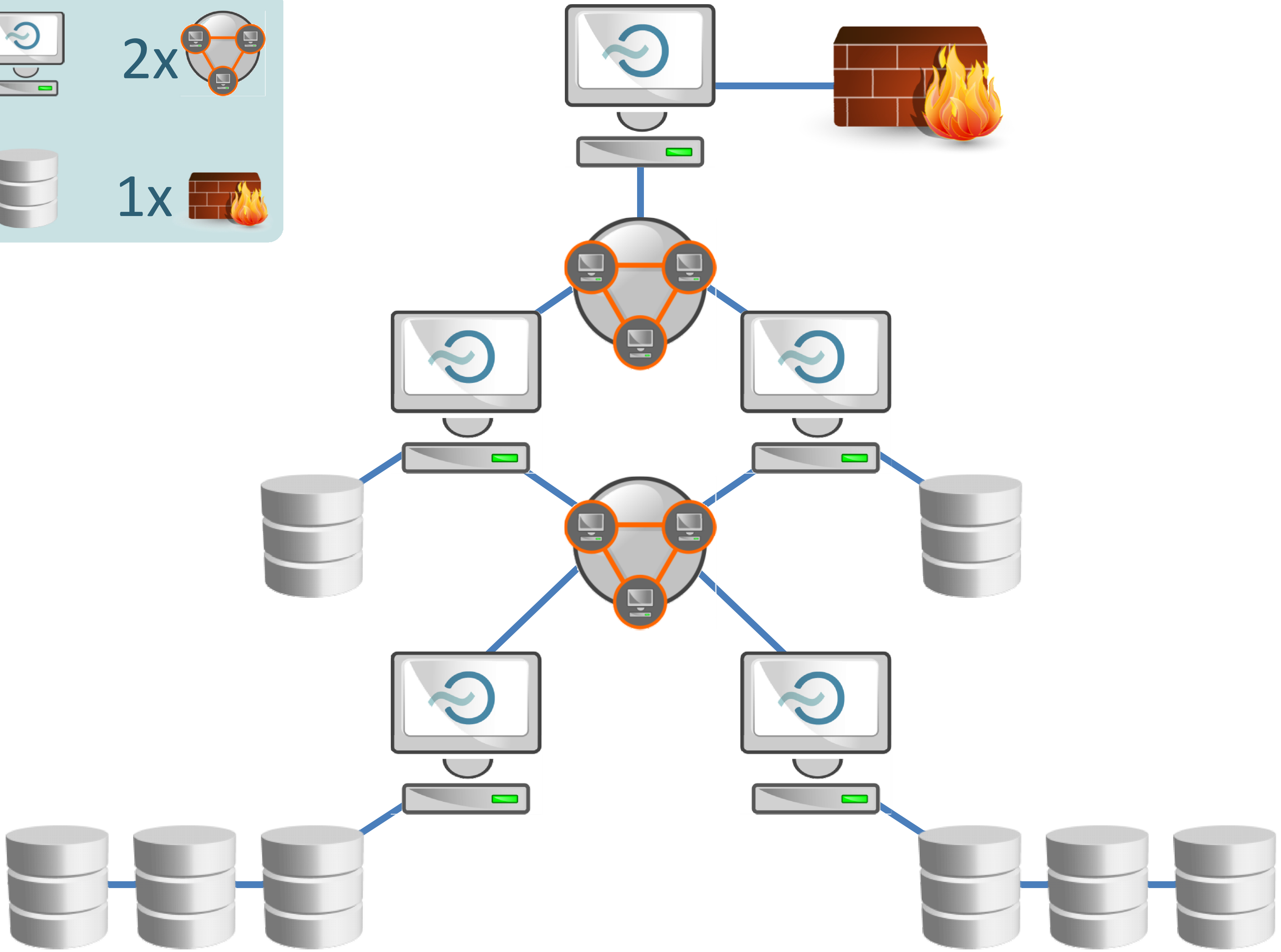
Flexibility








5x
2x
8x
1x



~okeanos service

- Goal: Production-quality IaaS
- Now in Alpha: from July 2011, ~1200 VMs / ~800 users
- Target group: GRNET's customers
  - direct: IT depts of connected institutions
  - indirect: university students, researchers in academia
- Users manage resources over
  - a simple, elegant UI, or
  - a REST API, for full programmatic control

~okeanos service

- **Compute:** Cyclades
- **Files:** Pithos+
- **Images:** Plankton
- **Identity:** Astakos

- **Volumes:** Archipelago
- **Accounting/Billing:** Aquarium

Rationale

How it all started

How it all started

- Need for easy, secure access to GRNET’s datacenters
  - User friendliness, simplicity
- Scalable to the thousands
  - #VMs, TBs, users (Pithos: ~10k)
- running within GRNET’s AAI Federation
- Resell or build your own?
  - IaaS cloud provider, vendor, or own infrastructure?
  - It all depends on your needs

Build on commercial IaaS?

- Commercial IaaS
  - ➡ Amazon EC2 not an end-user service
  - ➡ Need to develop custom UI, AAI layers
  - ➡ Vendor lock-in
  - ➡ Unsuitable for IT depts
    - persistent, long-term servers
    - custom networking requirements
- GRNET has invested heavily in its core network
  - ➡ > 8000km of dark fiber

Bring vendor into datacenter?

- Hypervisor lock-in
- Is a turn-key solution suitable for a public cloud?
- Building public clouds is an ongoing process
  - Manageable by GRNET's operation
  - Integrated into the rest of the infrastructure
  - Scaling to thousands of users
- Build on existing know-how
- Gain know-how, build own IaaS $\rightarrow$ reuse for own services

What about opensource?

- Eucalyptus, OpenNebula, OpenStack
- Need a mature opensource core to *build* around
- Maturity, production-readiness?
  - proven in production environments, predictable
- Extensibility?
- Flexibility?
- Upgradeability, maintainability?

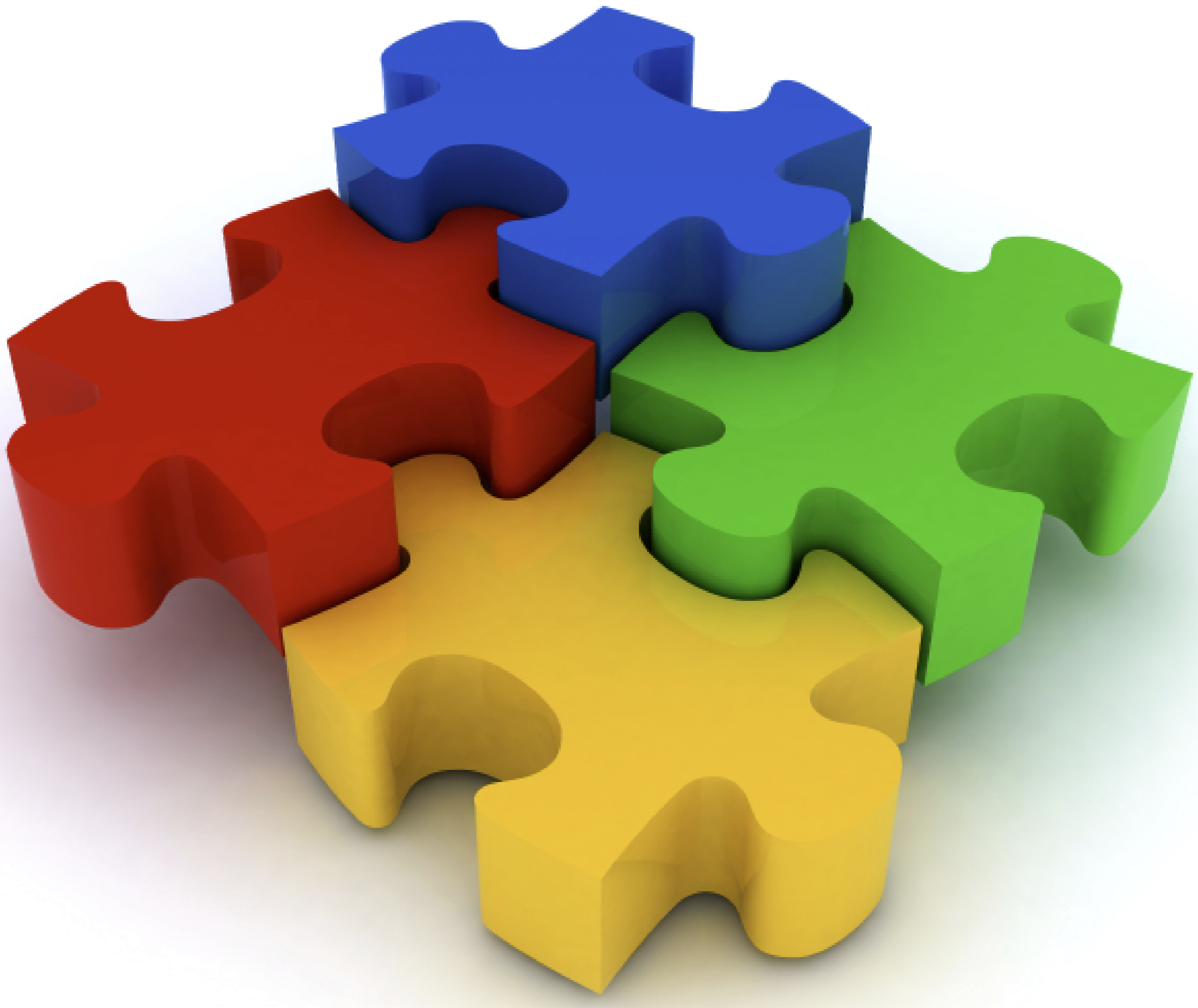
Design

~okeanos design decisions

- Reuse existing components
- Build on Google Ganeti
- target commodity hardware
- release to the community as opensource

~okeanos design principles

- No need to make the world
- No need to support *everything*
  - ➡ Service developed and maintained by ~10-15 people
- Start from the architecture…
  - ➡ …then discover, combine, reuse the right components
- And for everything that's not already available
  - ➡ Do it yourself!



Jigsaw puzzle

- Synnefo
  - ➡ custom cloud management software to power ~okeanos
- Google Ganeti backend
  - ➡ VM cluster management: physical nodes, VMs, migrations
- OpenStack APIs: Compute API v1.1, Object Storage API
  - ➡ with custom extensions whenever necessary
- Then everything comes together
  - ➡ UI, Networking, Images, Storage, Monitoring, Identity management, Accounting, Billing, Clients, Helpdesk

Why Ganeti?

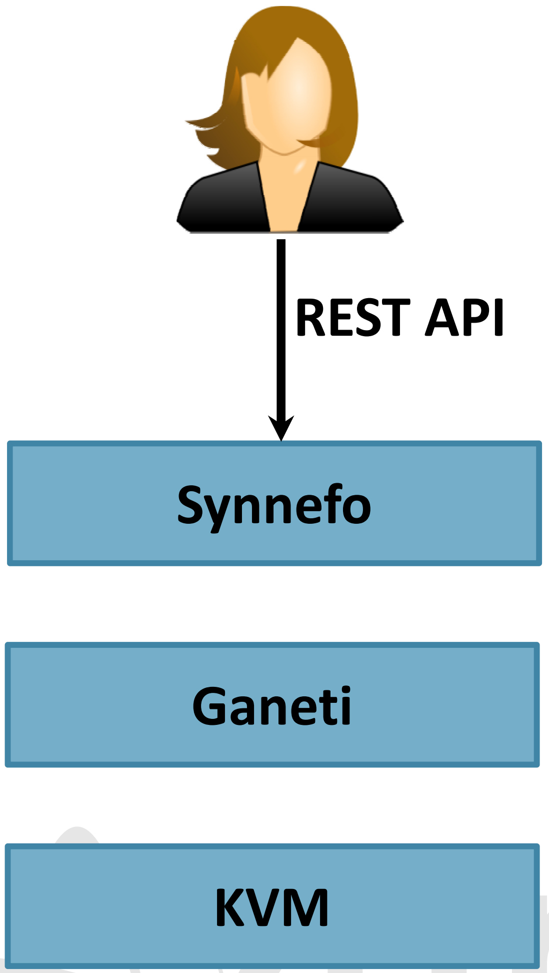
- No need to reinvent the wheel
- Scalable, proven software infrastructure
  - Built with reliability and redundancy in mind
  - Combines open components (KVM, LVM, DRBD)
  - Well-maintained, readable code
- VM cluster management in production is serious business
  - reliable VM control, VM migrations, resource allocation
  - handling node downtime, software upgrades

Why Ganeti?

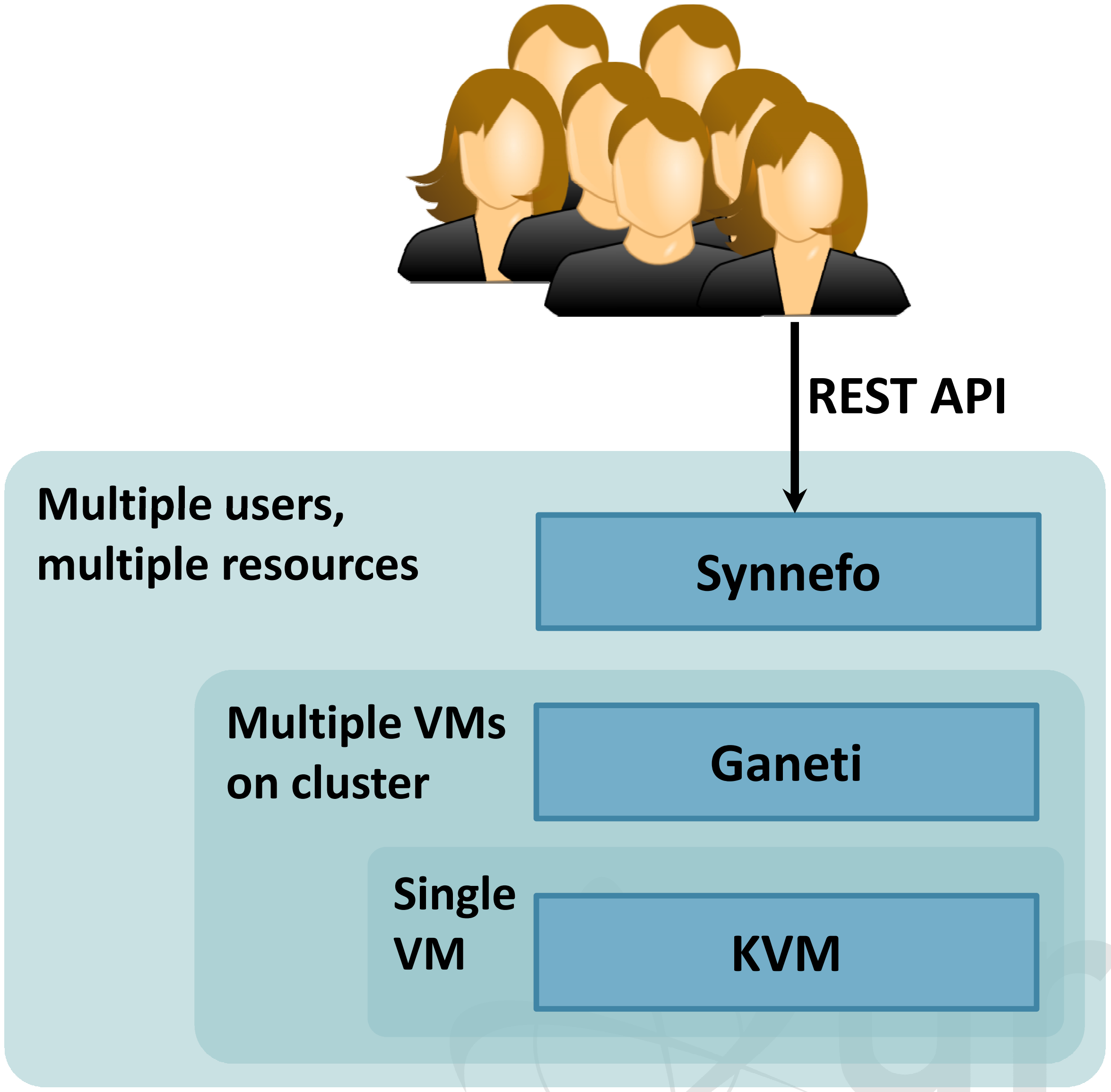
- GRNET already had long experience with Ganeti
  - ➡ provides ~280 VMs to NOCs through the ViMa service
  - ➡ involved in development, contributing patches upstream
- Build on existing know-how for ~okeanos
  - ➡ Common backend, common fixes
  - ➡ reuse of experience and operational procedures
  - ➡ simplified, less error-prone deployment

Platform

Software Stack



Software Stack

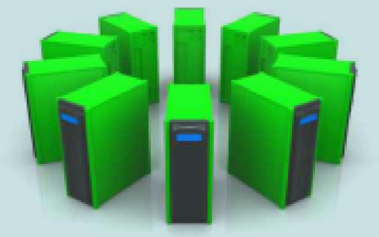


Platform Design

user@home

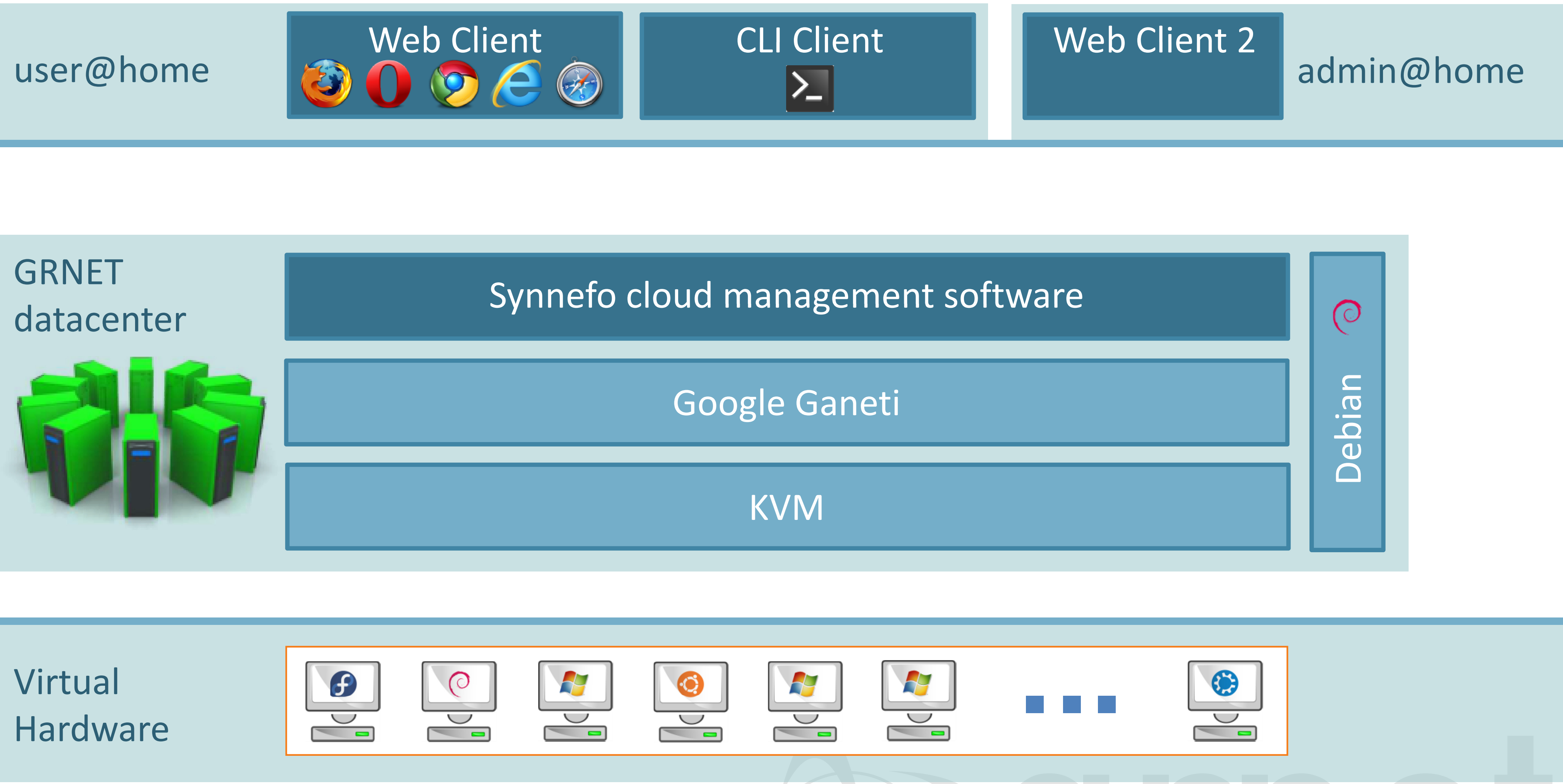
admin@home

GRNET
datacenter



Virtual
Hardware

Platform Design



Platform Design

user@home

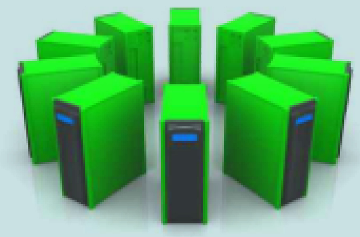
Web Client

CLI Client

Web Client 2

admin@home

GRNET datacenter



Synnefo cloud management software

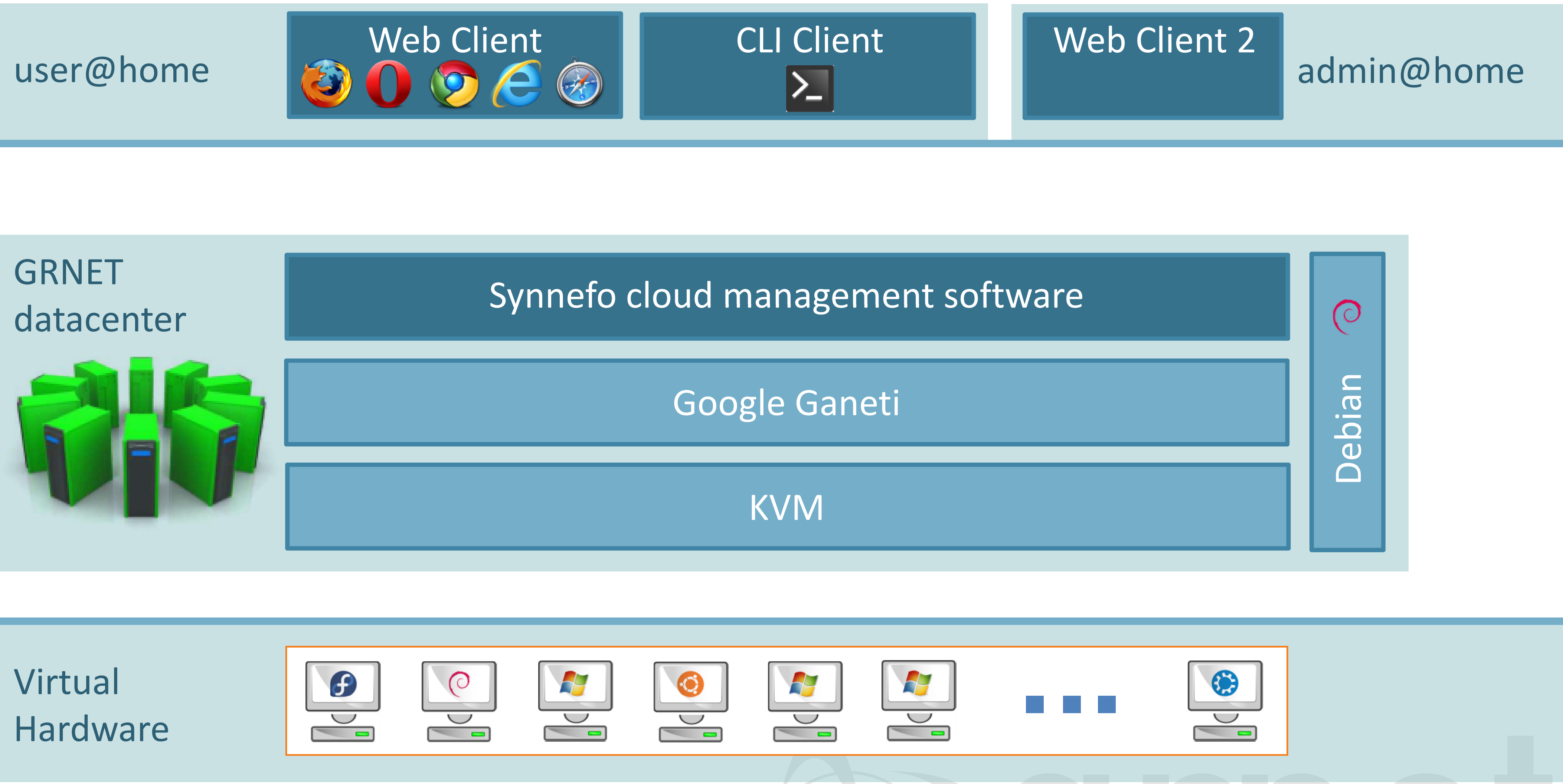
Google Ganeti

KVM

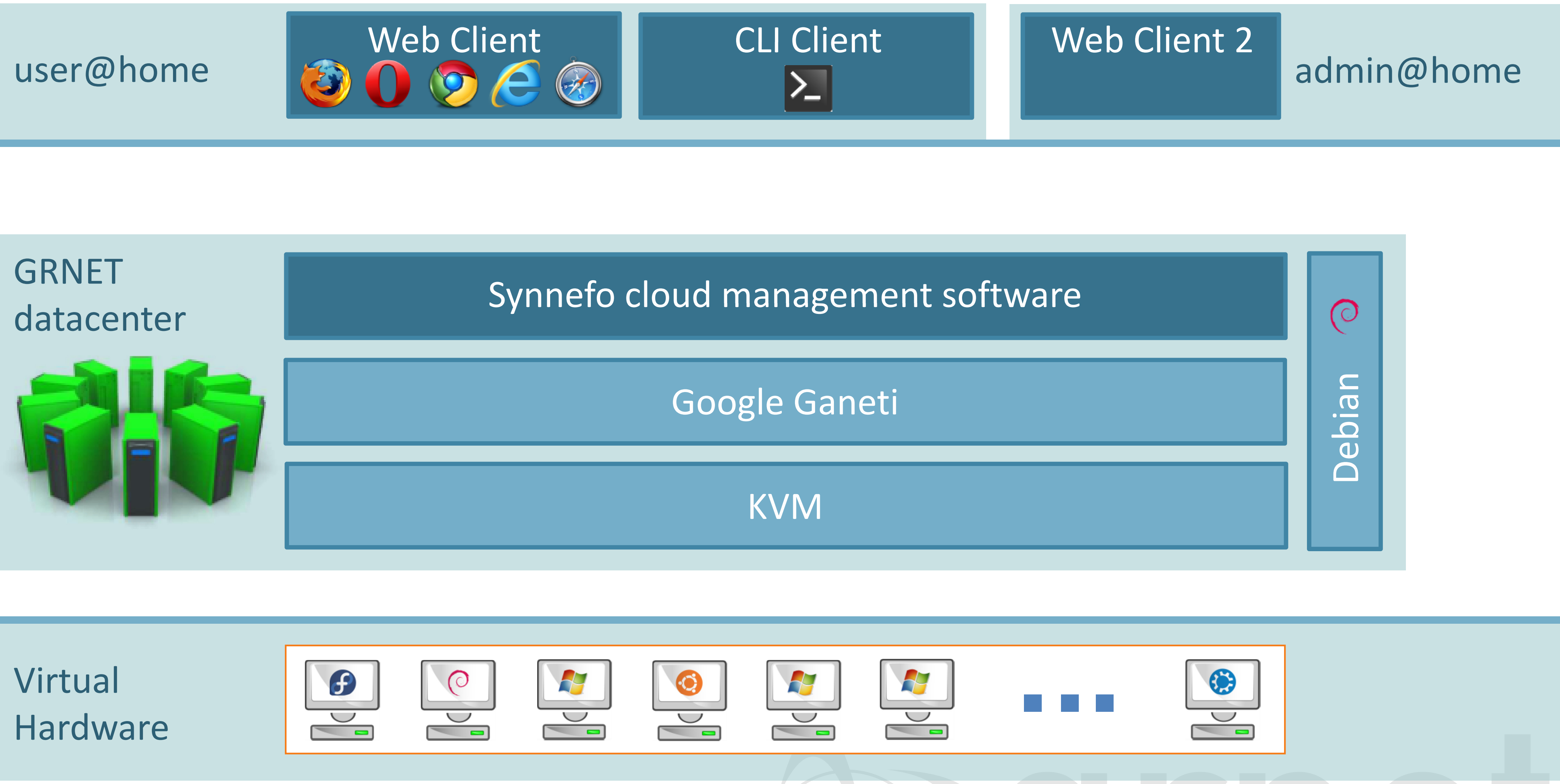
Debian

Virtual Hardware

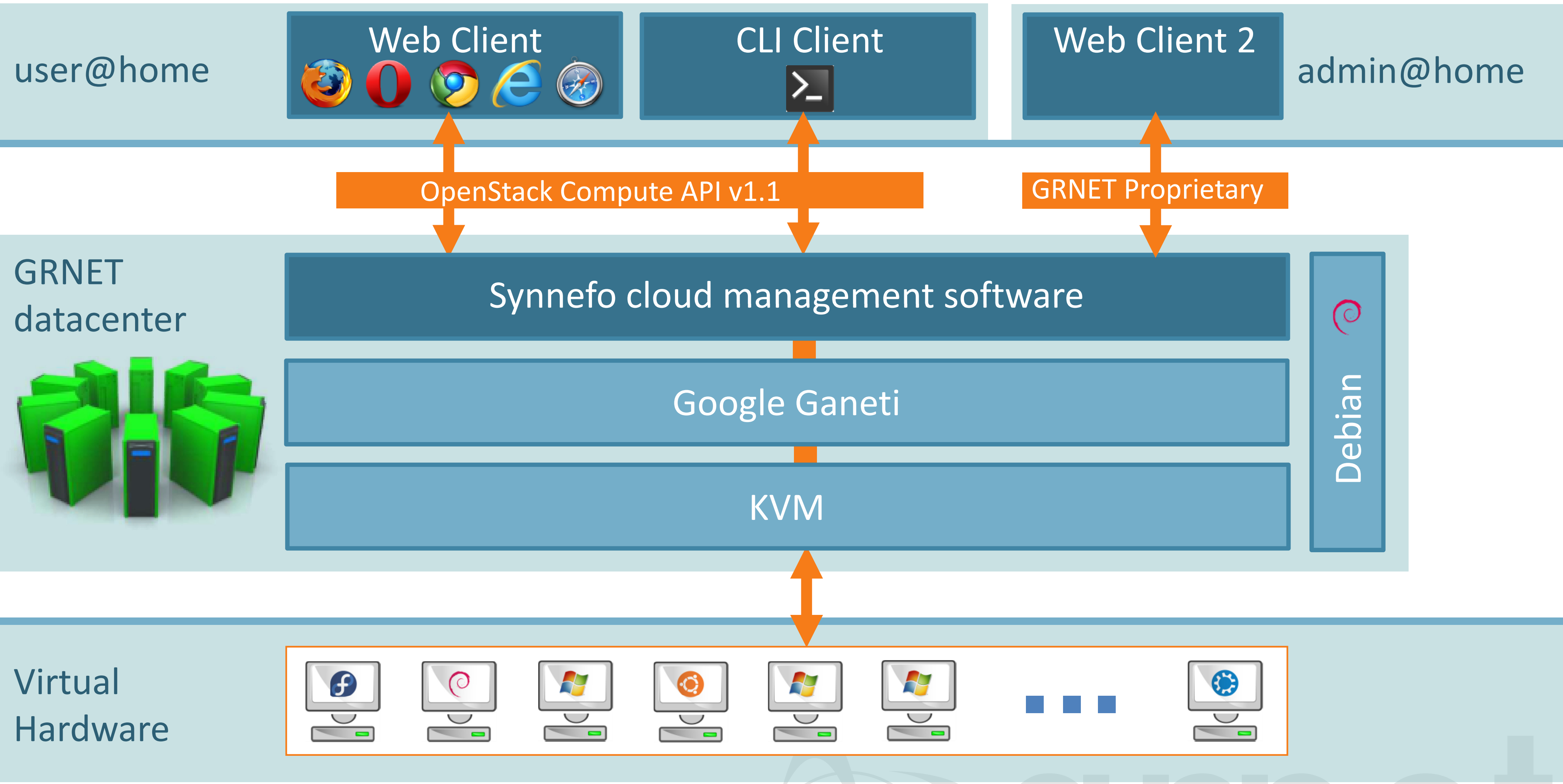
Platform Design



Platform Design



Platform Design



Features

Virtual Machine Actions

My_Windows_desktop

Virtual Machine Actions

My_Windows_desktop

- Start
- Reboot
- Shutdown

Virtual Machine Actions

My_Windows_desktop

Start

Console

Reboot

Shutdown

Destroy

IaaS – Compute (1)

- Virtual Machines
  - powered by KVM
    - Linux and Windows guests, on Debian hosts
  - Google Ganeti for VM cluster management
  - accessible by the end-user over the Web or programmatically (OpenStack Compute v1.1)

IaaS – Compute (2)

- User has full control over own VMs
  - Create
    - Select # CPUs, RAM, System Disk
    - OS selection from pre-defined or ***custom*** Images
    - popular Linux distros (Fedora, Debian, Ubuntu)
    - Windows Server 2008 R2
  - Start, Shutdown, Reboot, Destroy
  - Out-of-Band console over VNC for troubleshooting

IaaS – Compute (3)

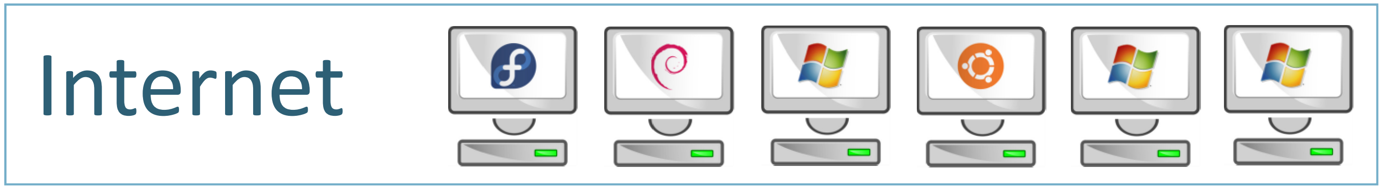
- REST API for VM management
  - OpenStack Compute v1.1 compatible
  - 3rd party tools and client libraries
  - custom extensions for yet-unsupported functionality
  - Python & Django implementation
- Full-featured UI in JS/jQuery
  - UI is just another API client
  - All UI operations happen over the API

IaaS – Network (Virtual Ethernets)

Internet

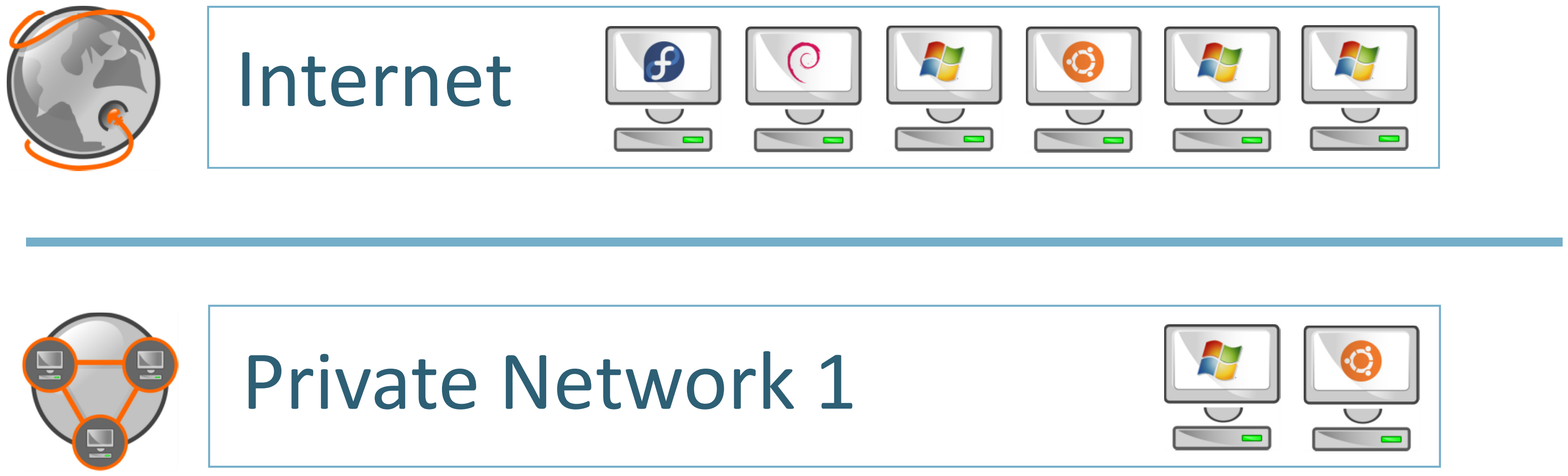
Private Network 1

IaaS – Network (Virtual Ethernets)

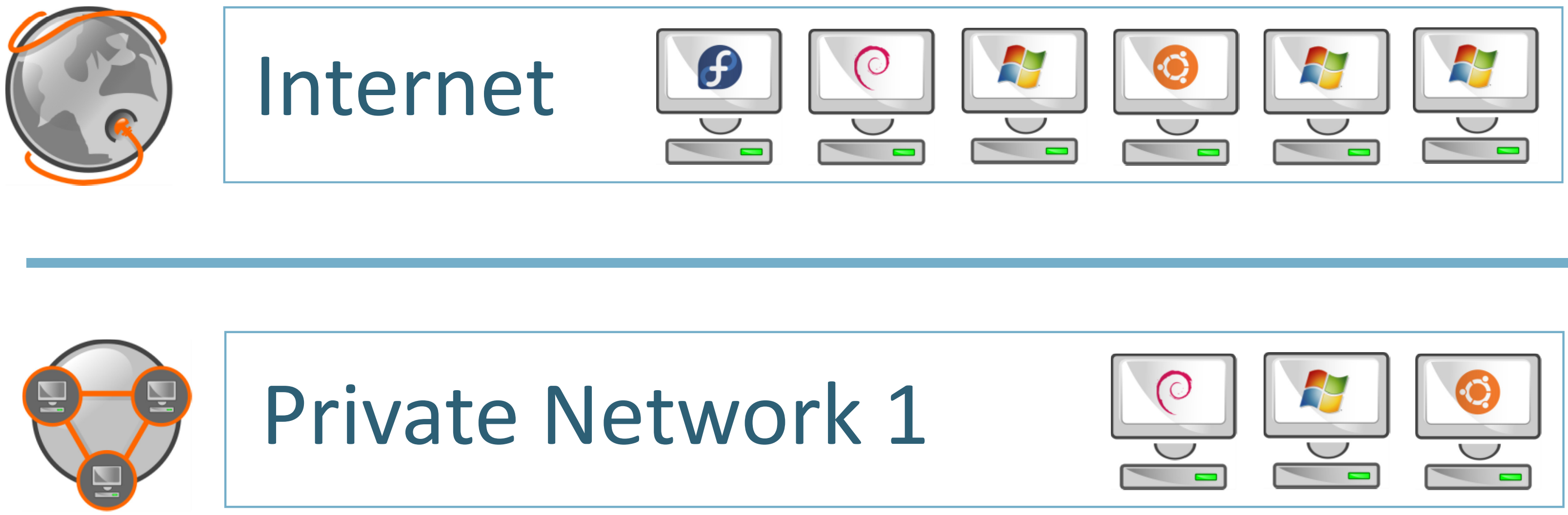


Private Network 1

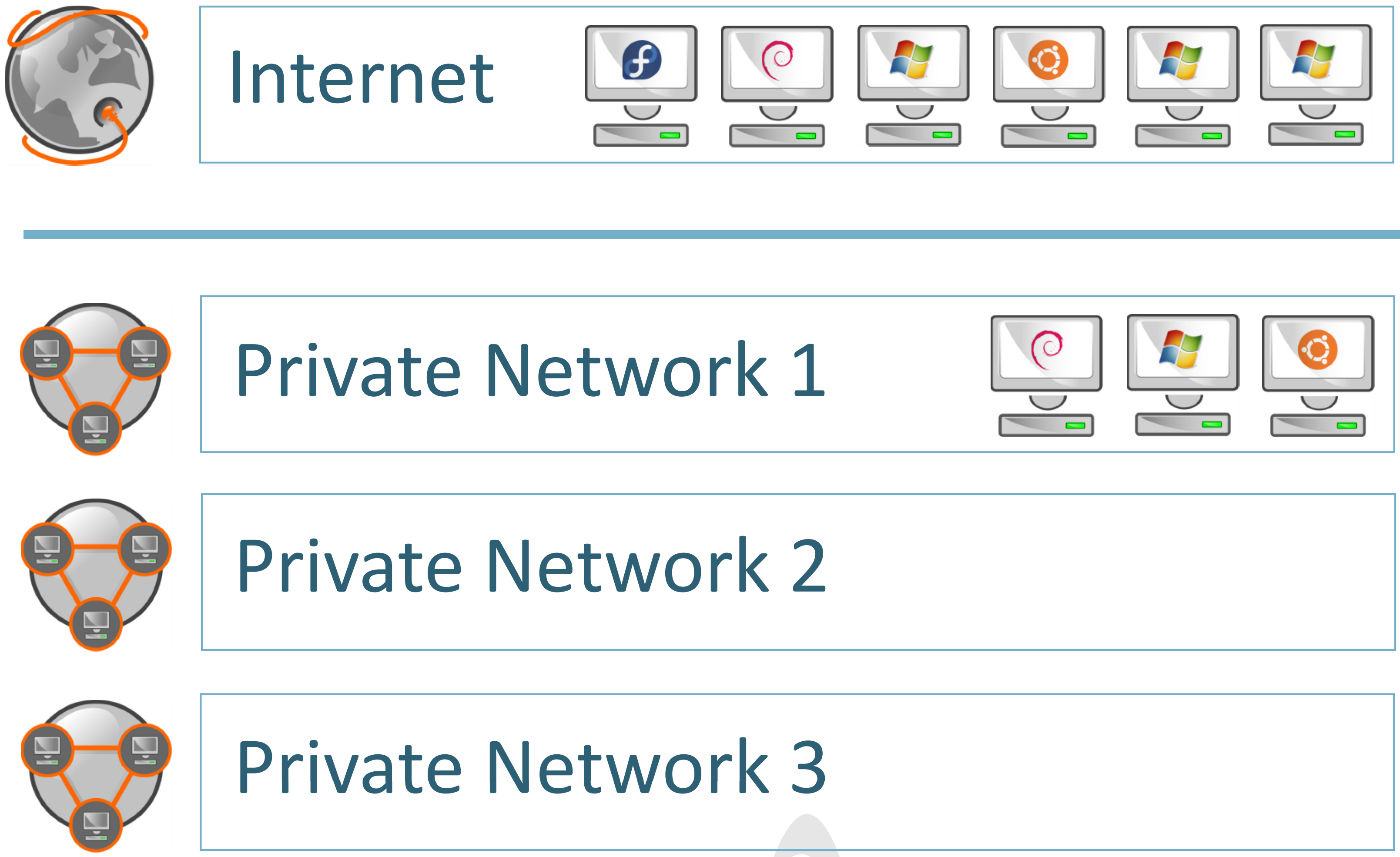
IaaS – Network (Virtual Ethernets)



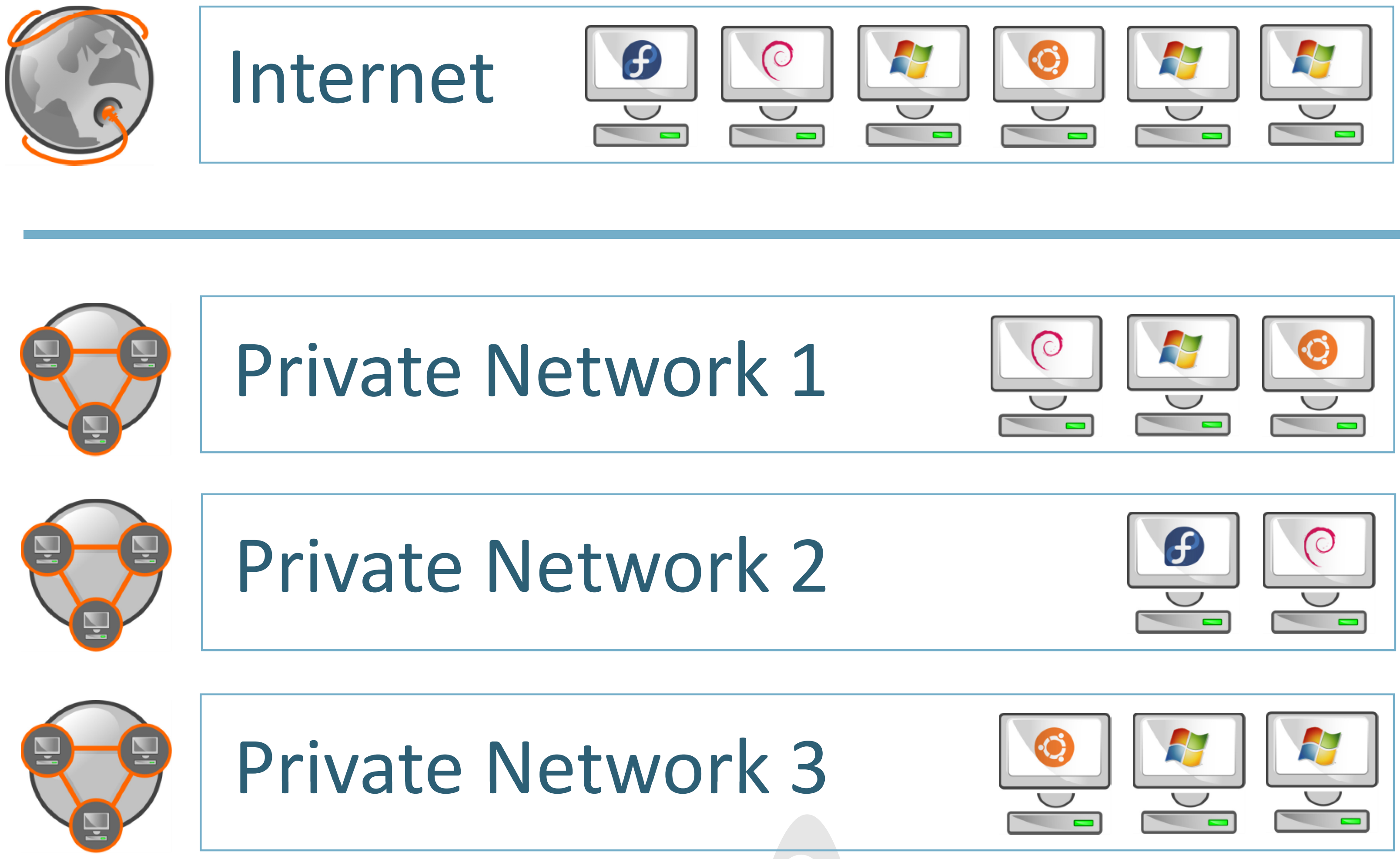
IaaS – Network (Virtual Ethernets)



IaaS – Network (Virtual Ethernets)



IaaS – Network (Virtual Ethernets)



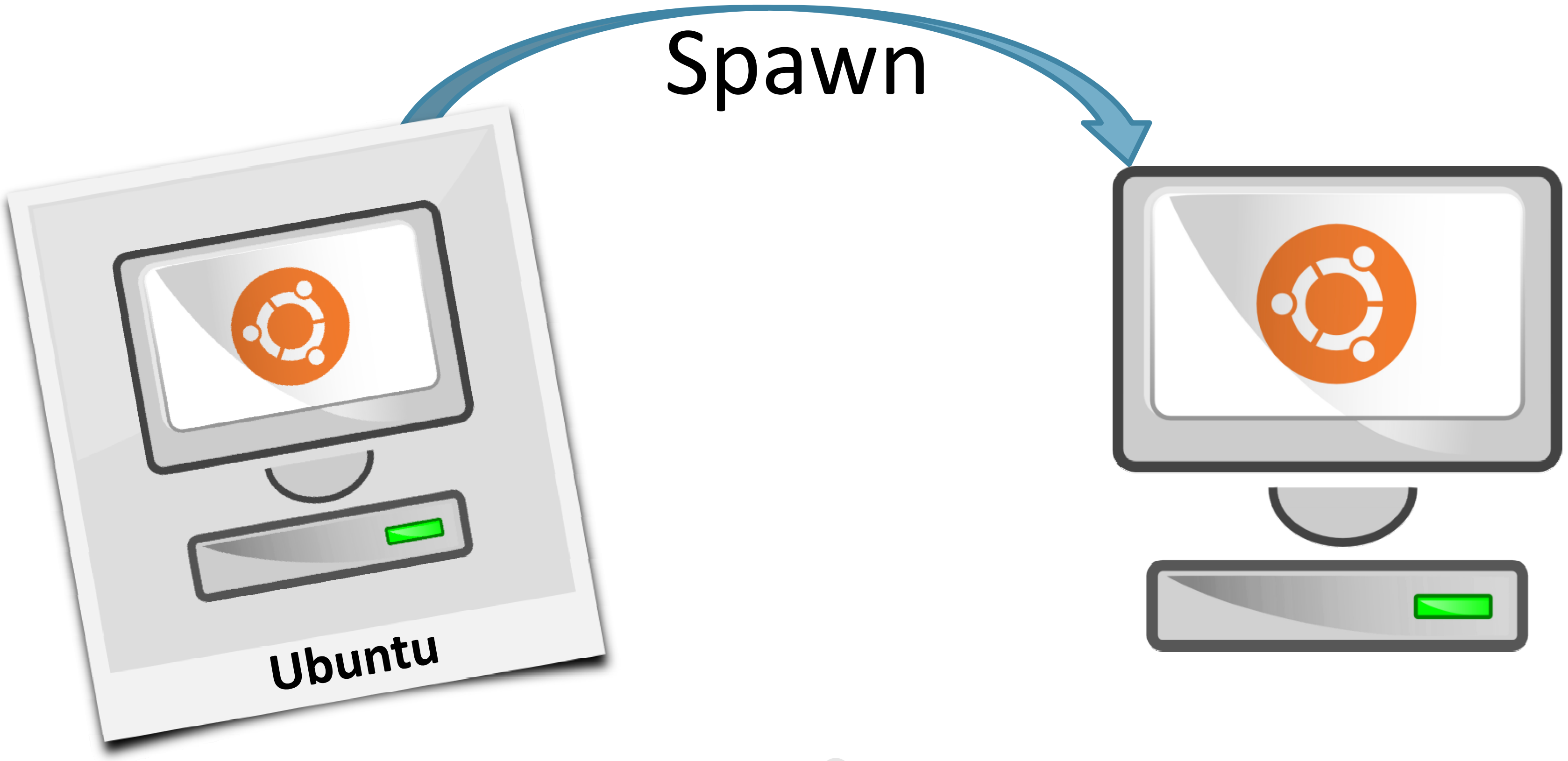
IaaS – Network - Functionality

- Dual IPv4/IPv6 connectivity for each VM
- Easy, platform-provided firewalling
  - Array of pre-configured firewall profiles
  - Or roll-your-own firewall inside VM
- Multiple private, virtual L2 networks
- Construct arbitrary network topologies
  - e.g., deploy VMs in multi-tier configurations
- Exported all the way to the API and the UI

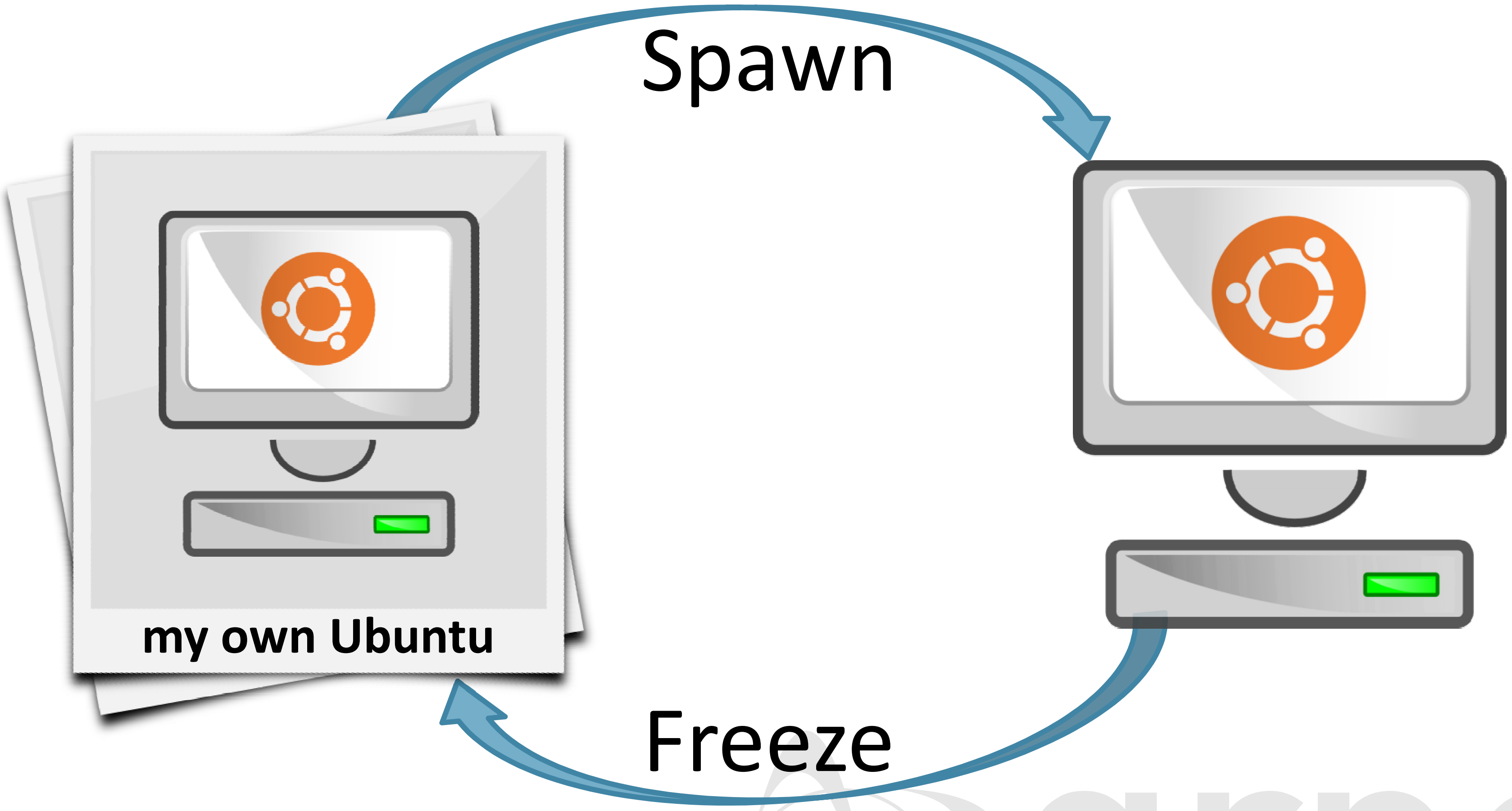
Unity

Images

Images



Images



Custom Images: snf-image

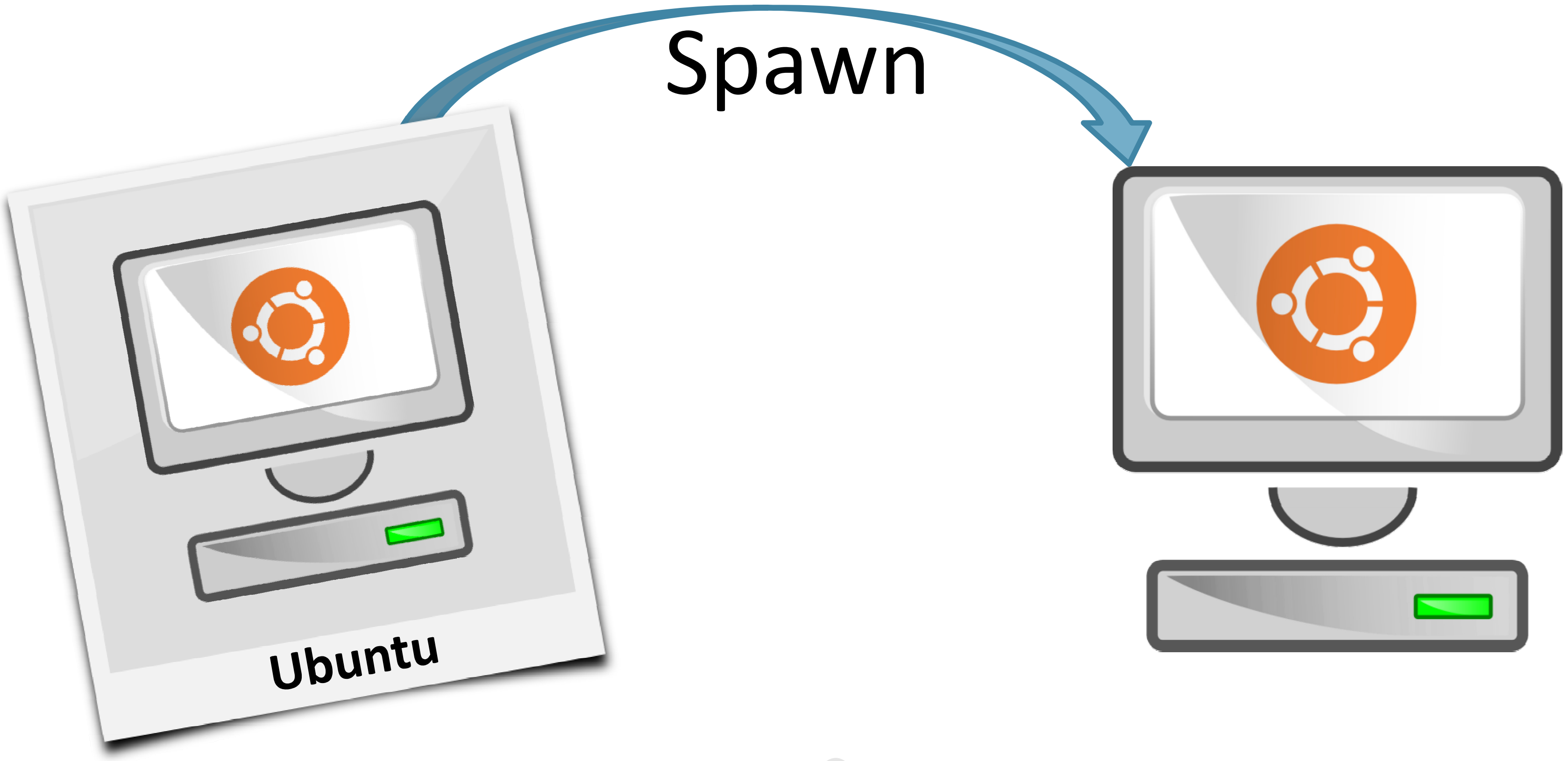
- *Untrusted* images
  - Host cannot touch user-provided data
  - Resize fs, change hostname, change passwords, inject files
- Split design
  - snf-image-host
  - snf-image-helper
- All customization in helper VM

pithos+

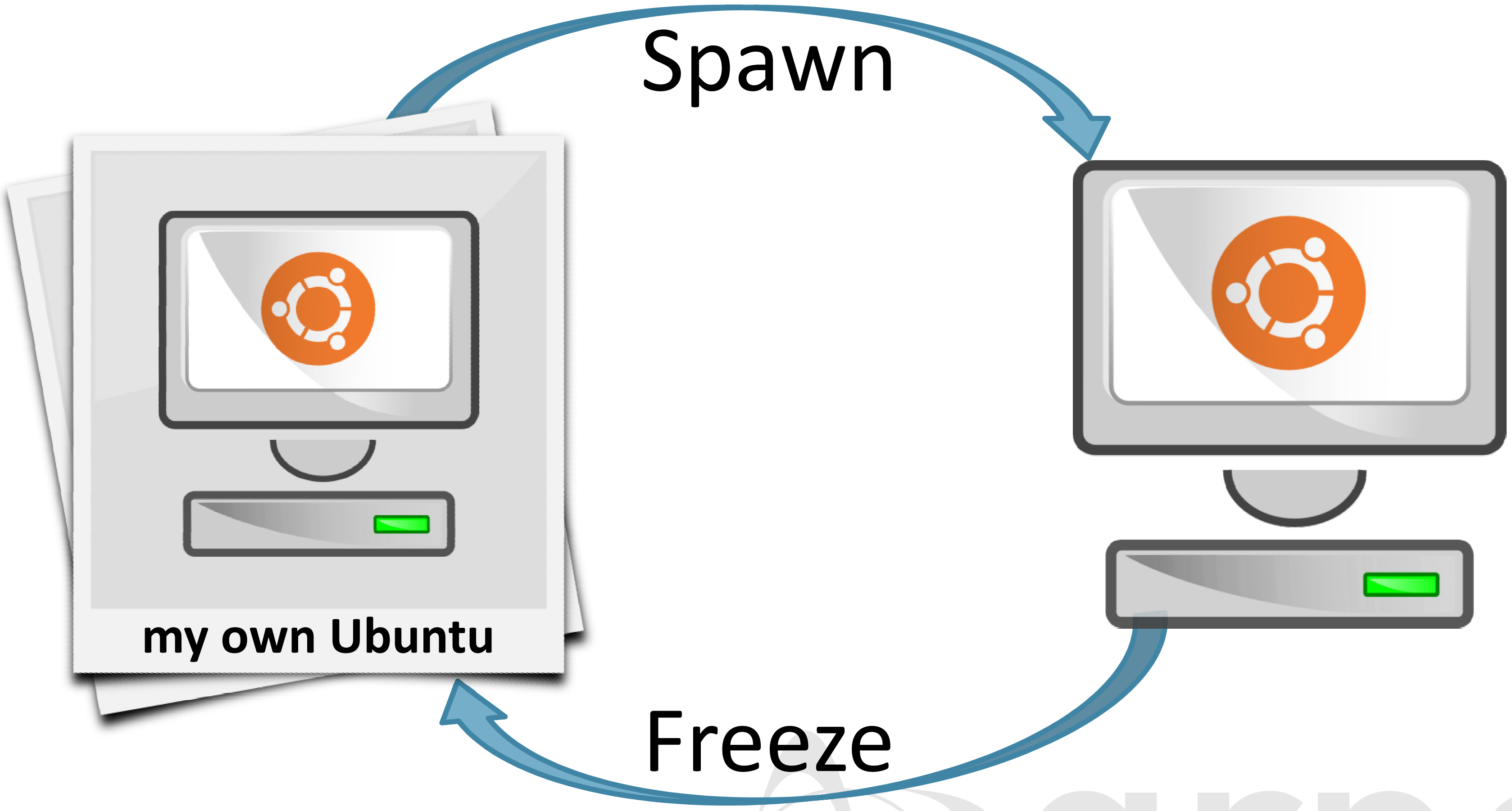
- OpenStack Object Storage API
- Block storage
- Content-based addressing for blocks
- Every file is a collection of blocks
- Web-based, command-line, and native clients
- Synchronization, deduplication
- An integral part of ~okeanos
  - User files, Image registry for VM Images
  - Goal: use common backend with Archipelago

Images

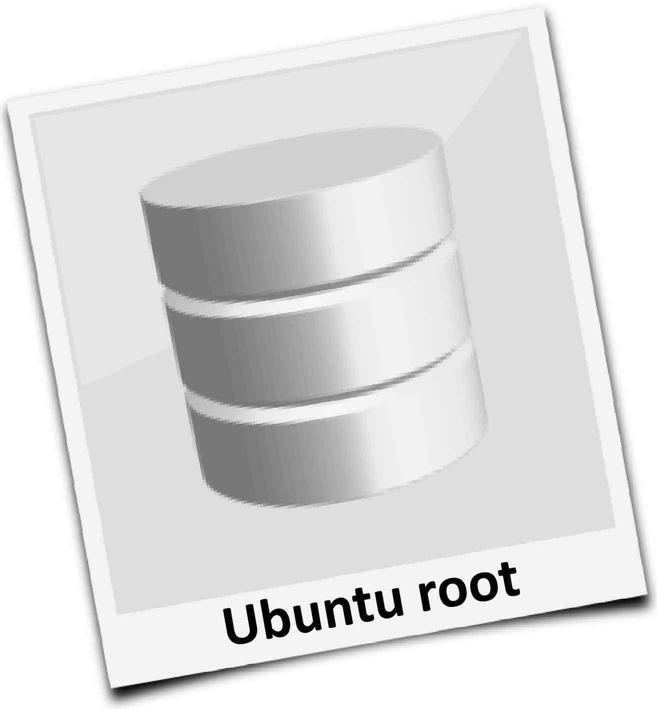
Images



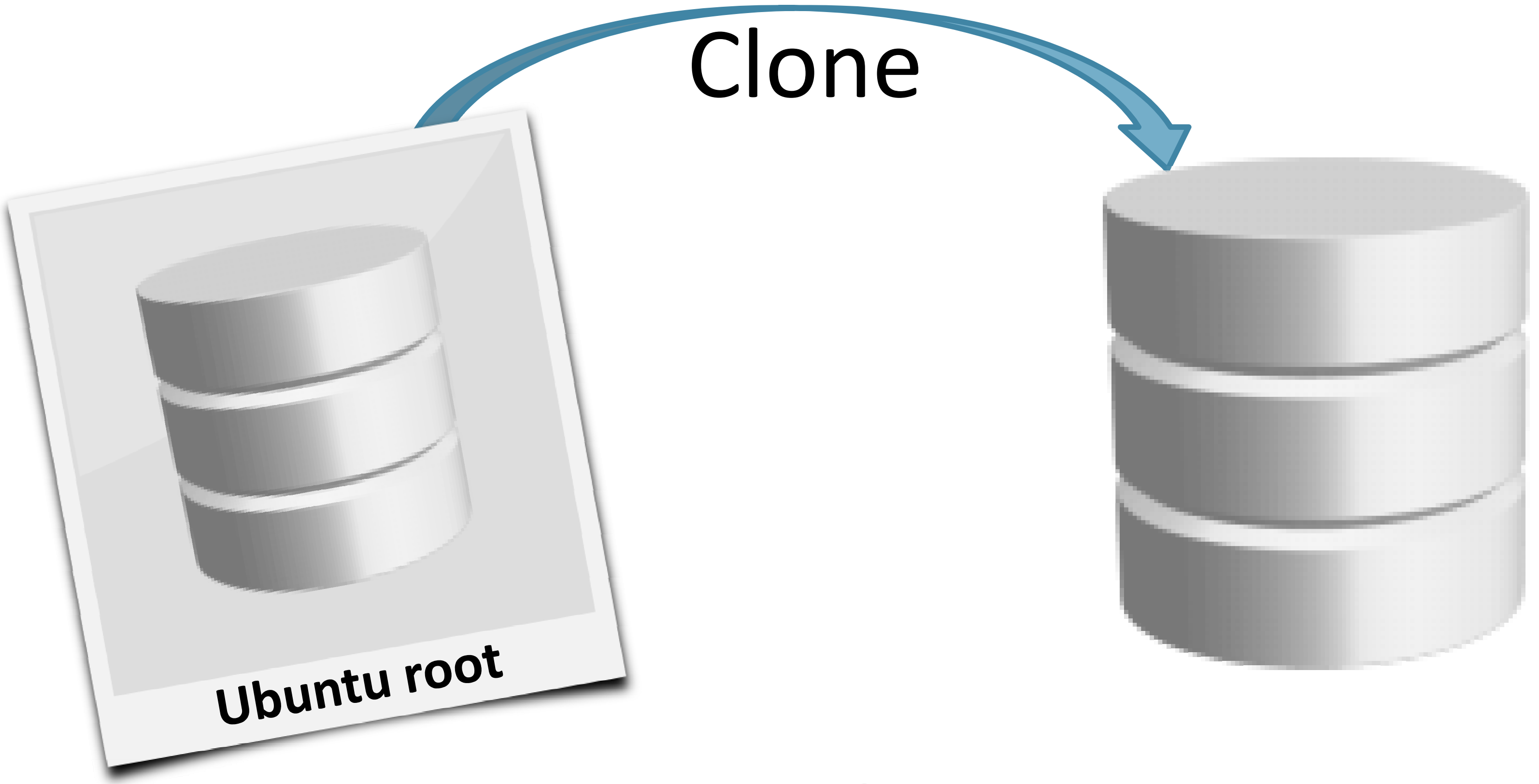
Images



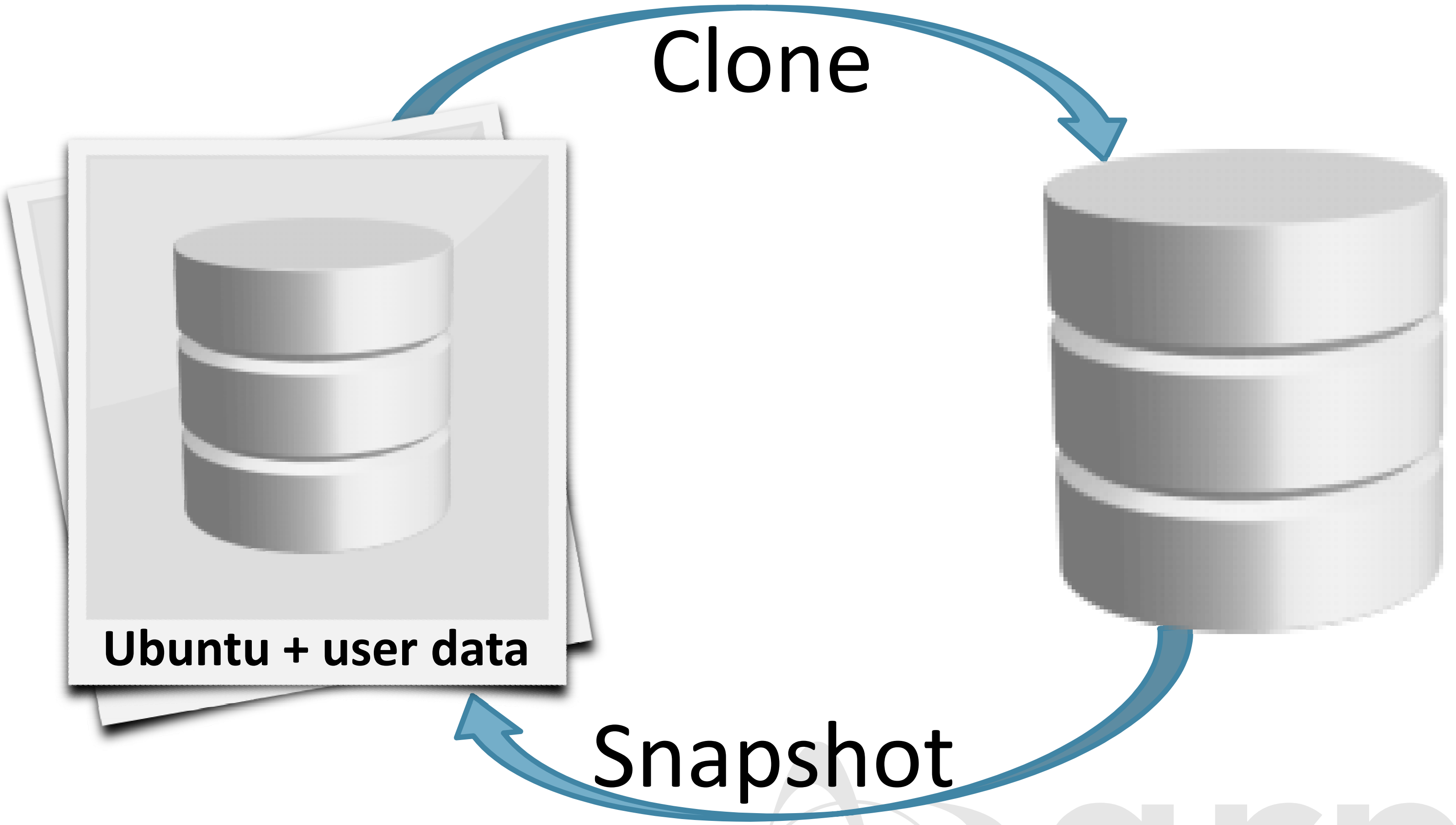
Images ↔ Storage



Images ↔ Storage

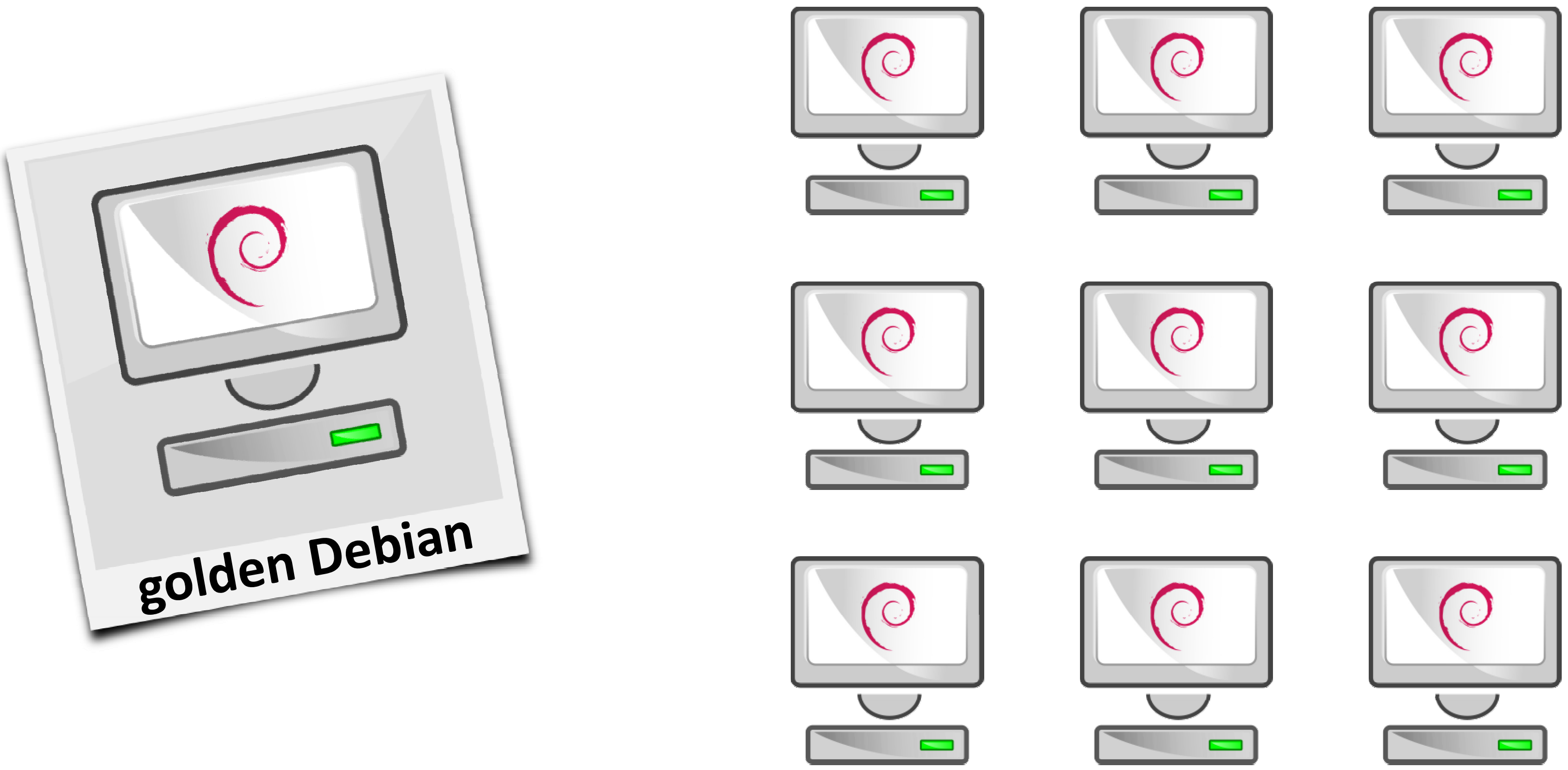


Images ↔ Storage



Images – Golden Image

Images – Golden Image



IaaS – Storage

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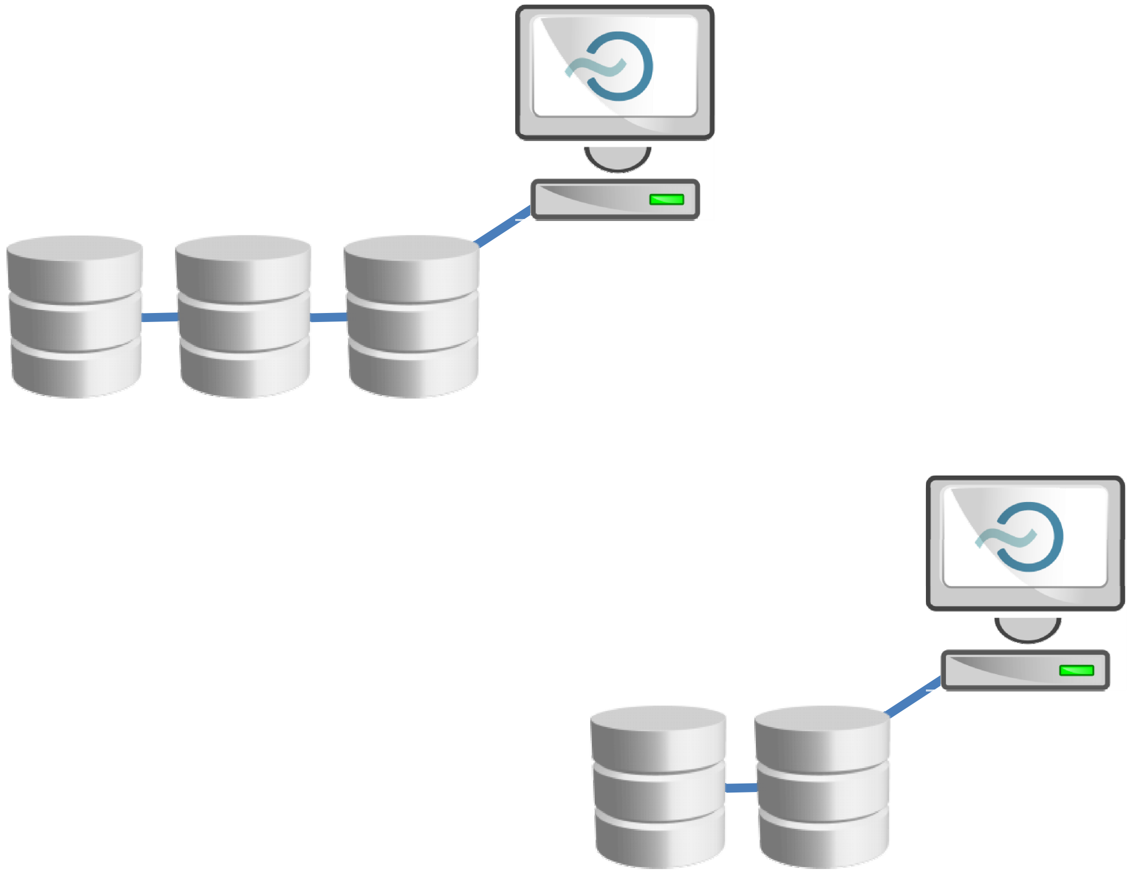

IaaS – Storage

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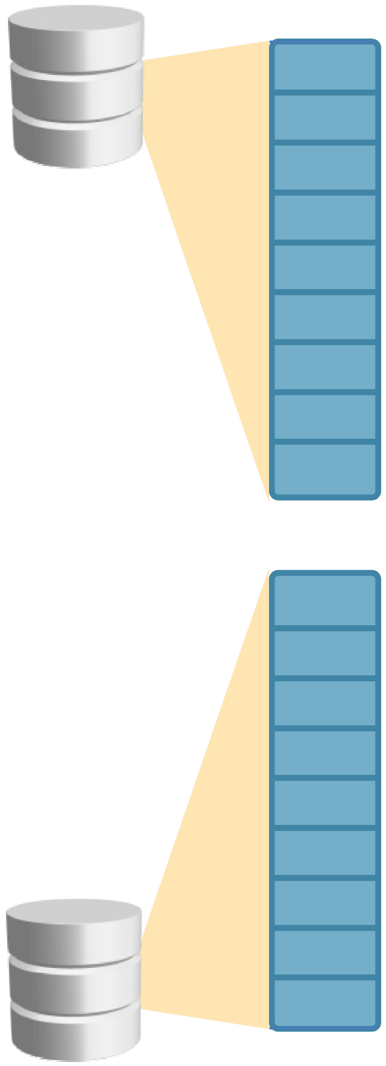

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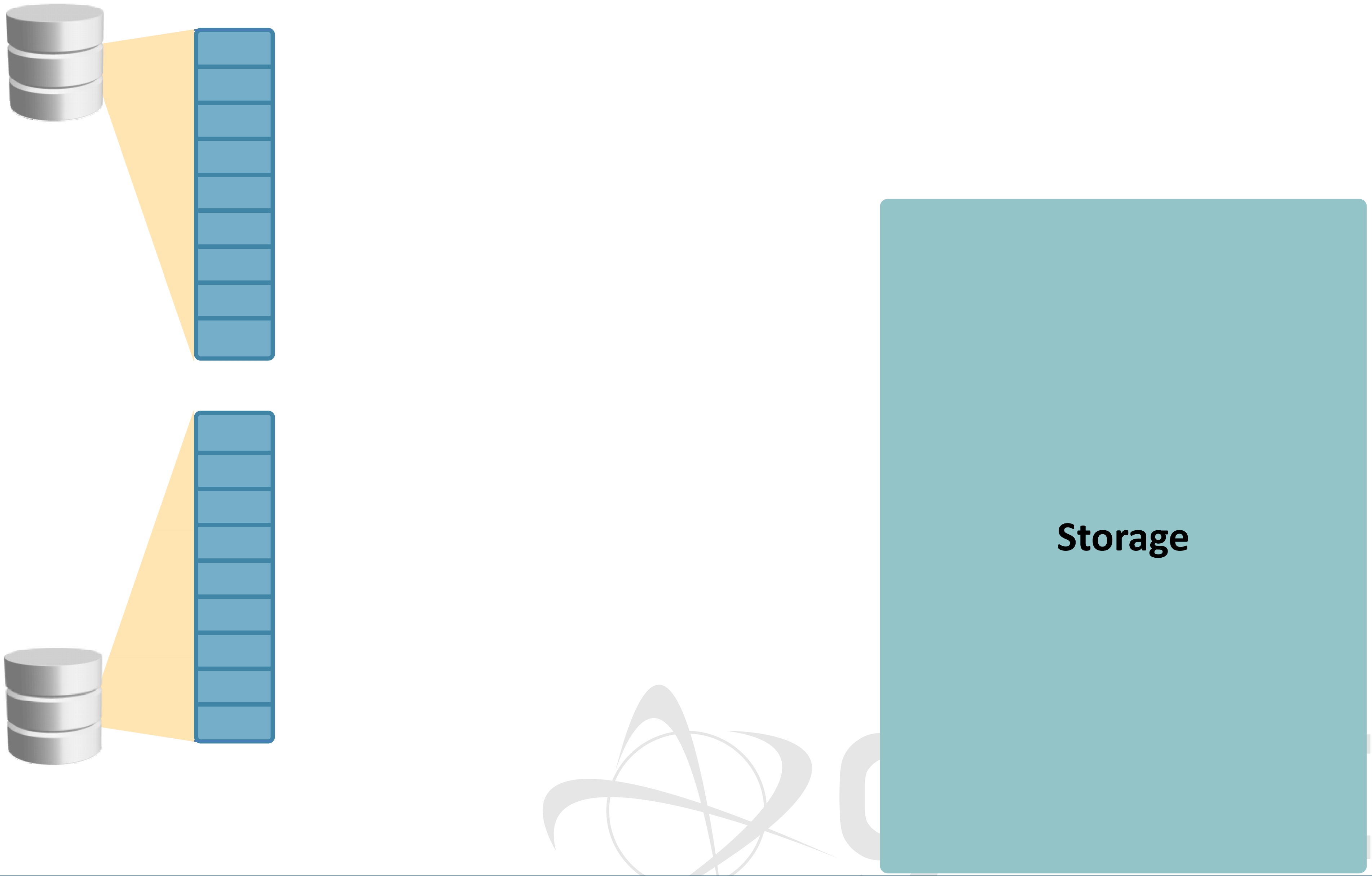

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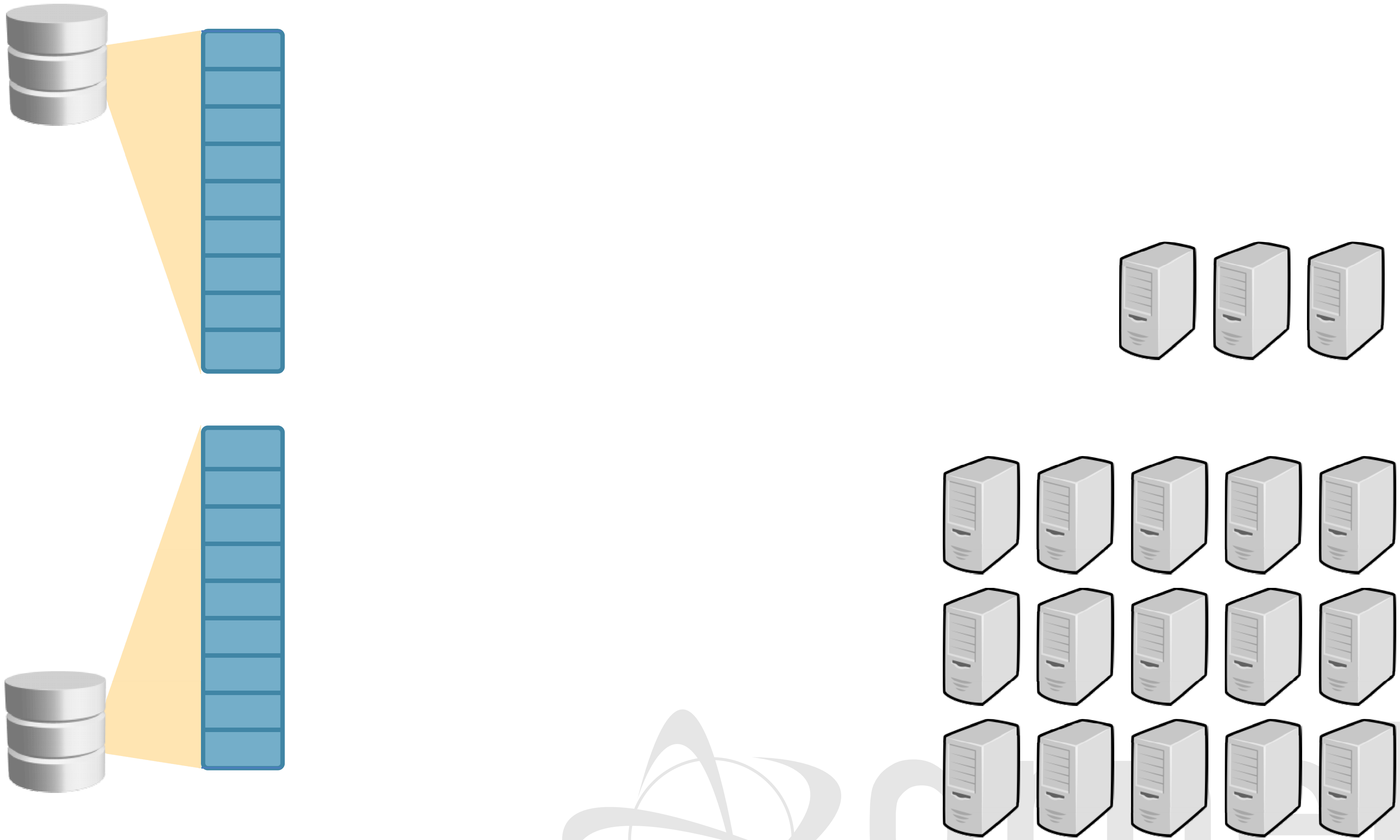

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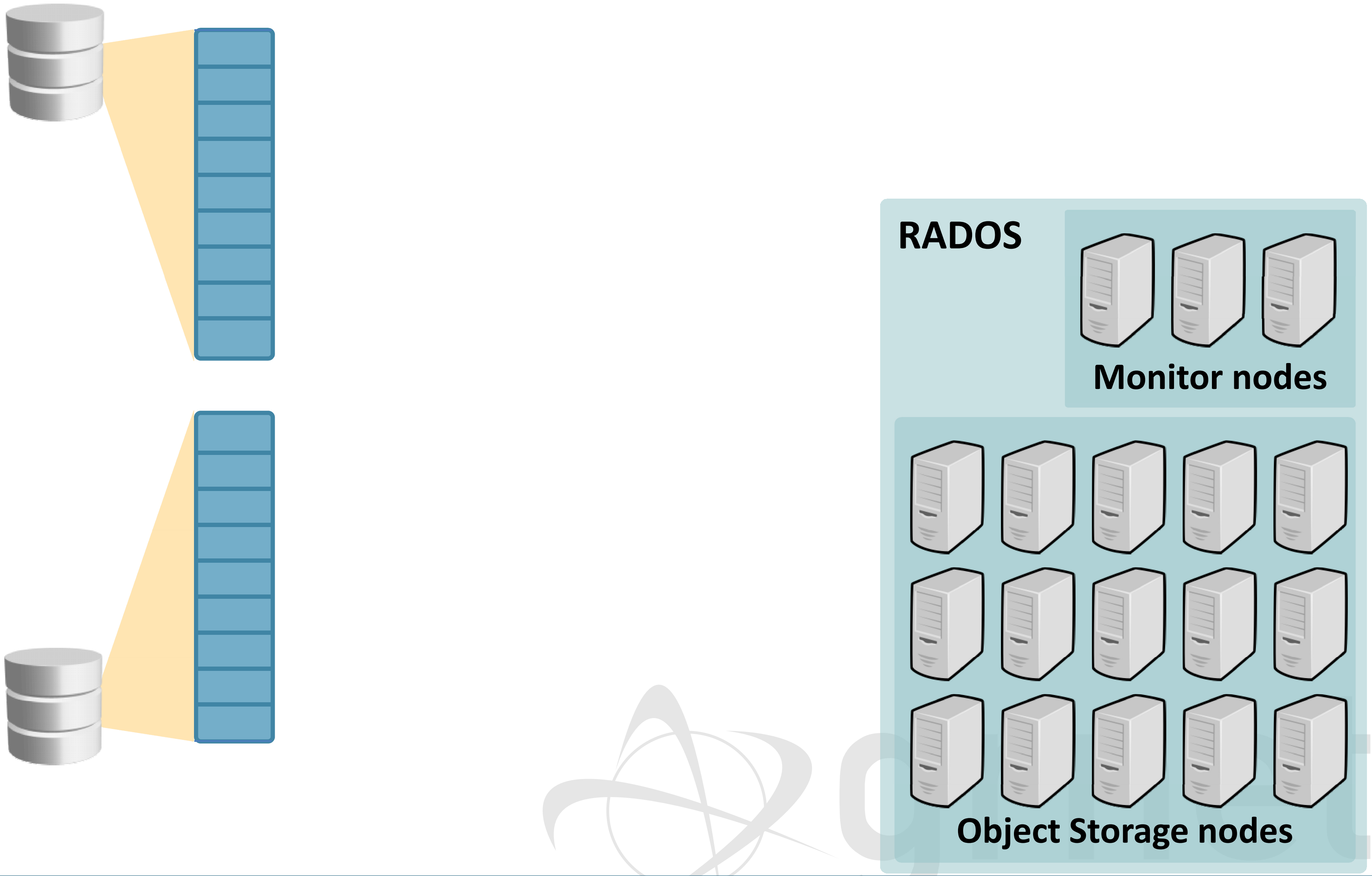

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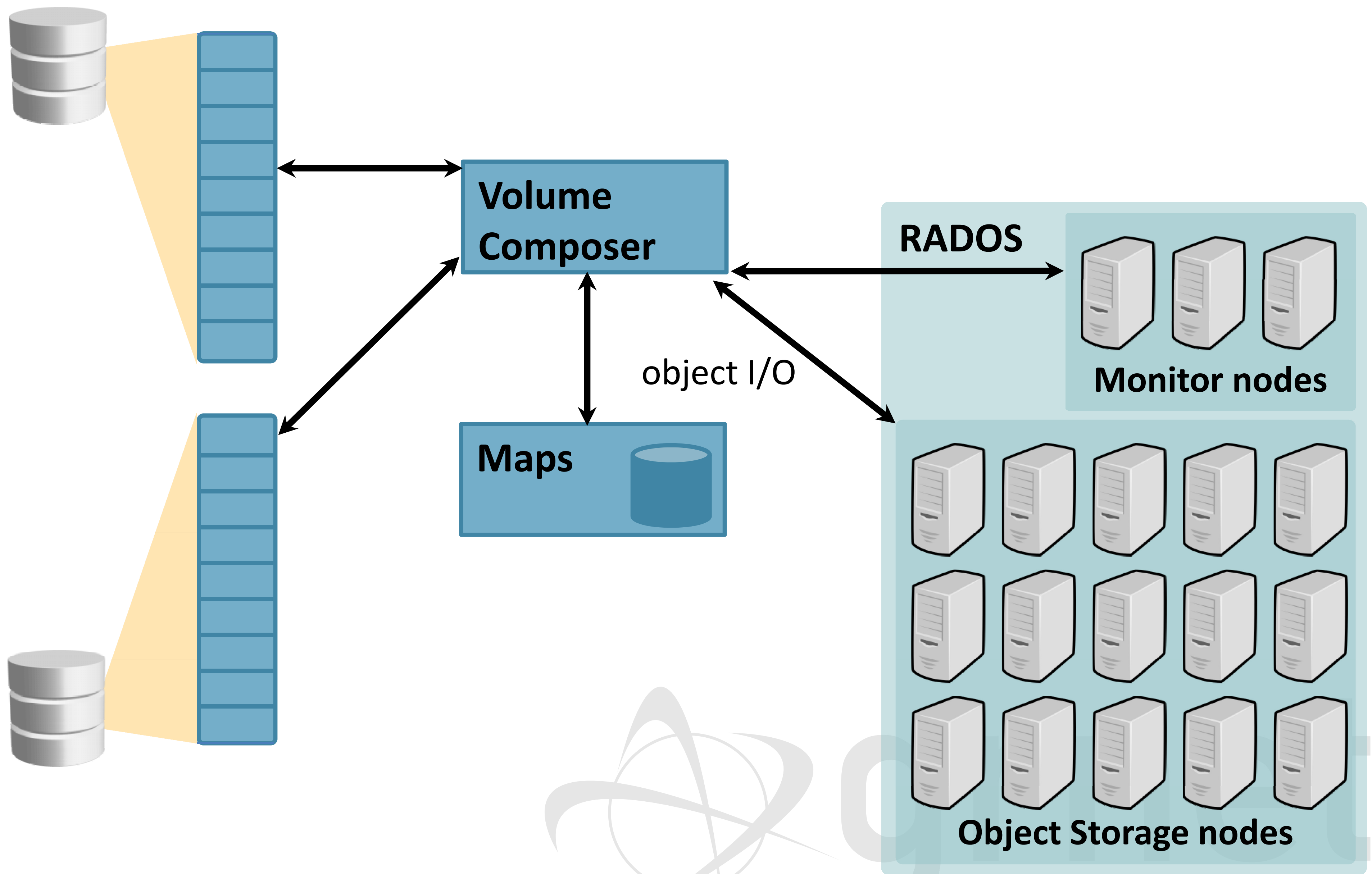

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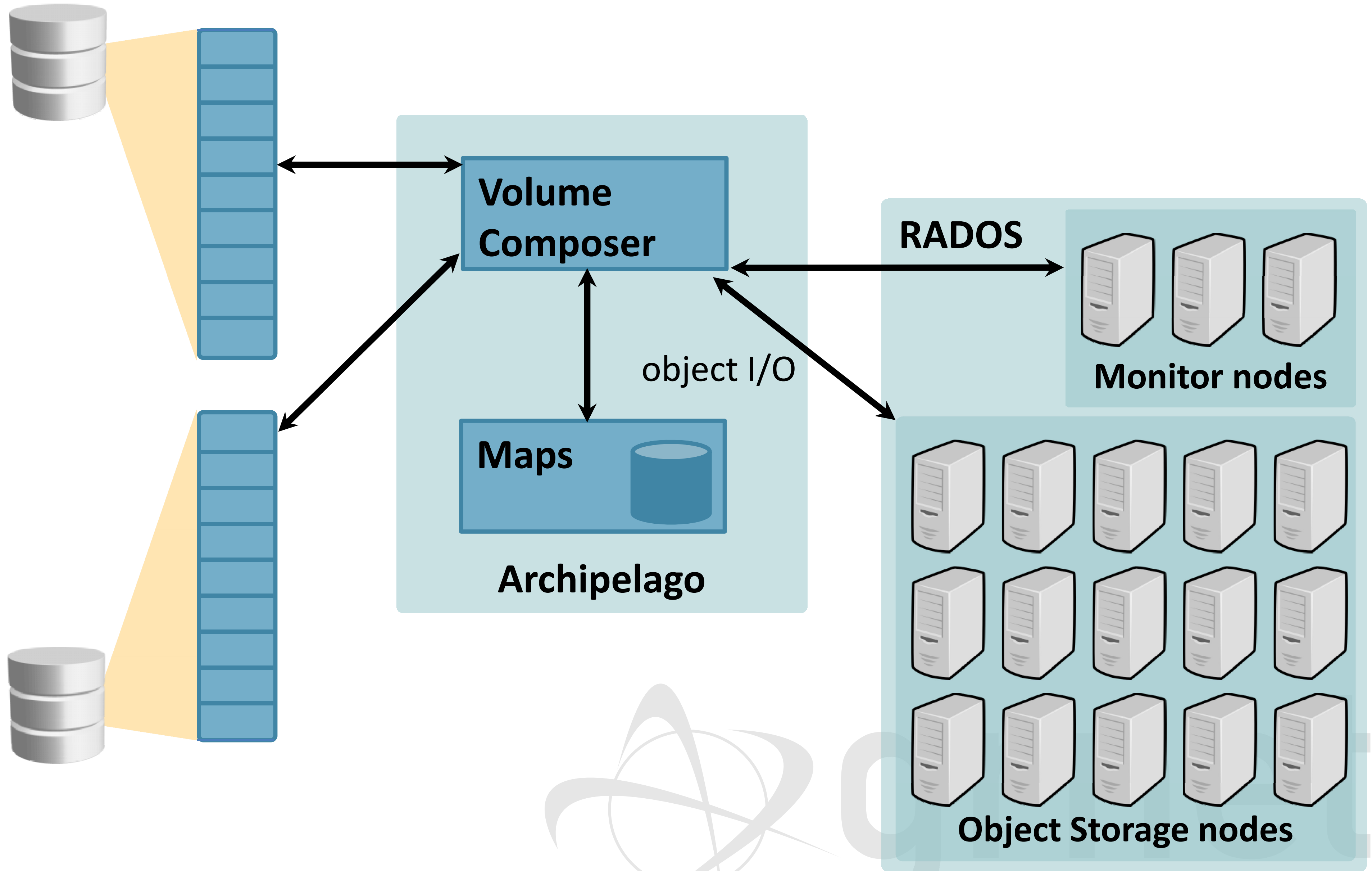

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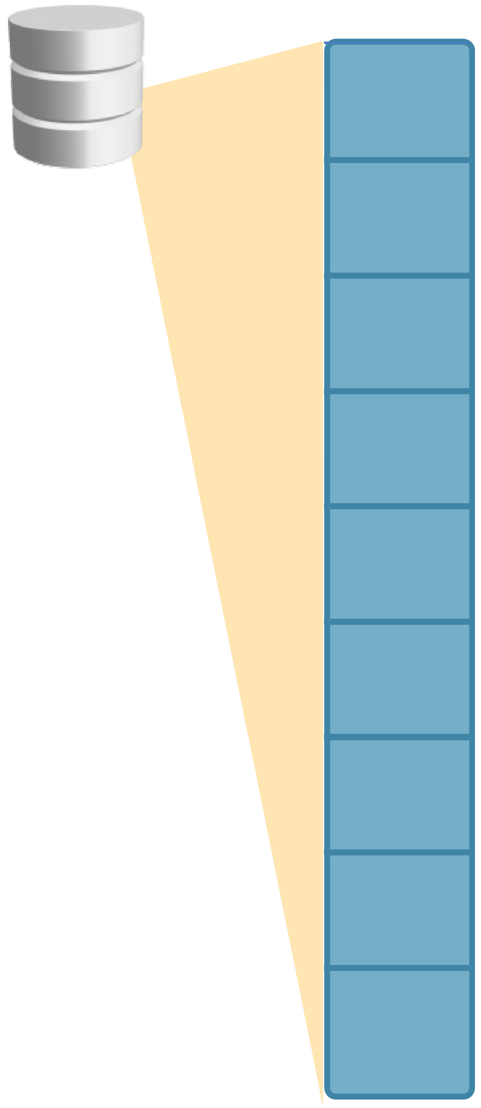

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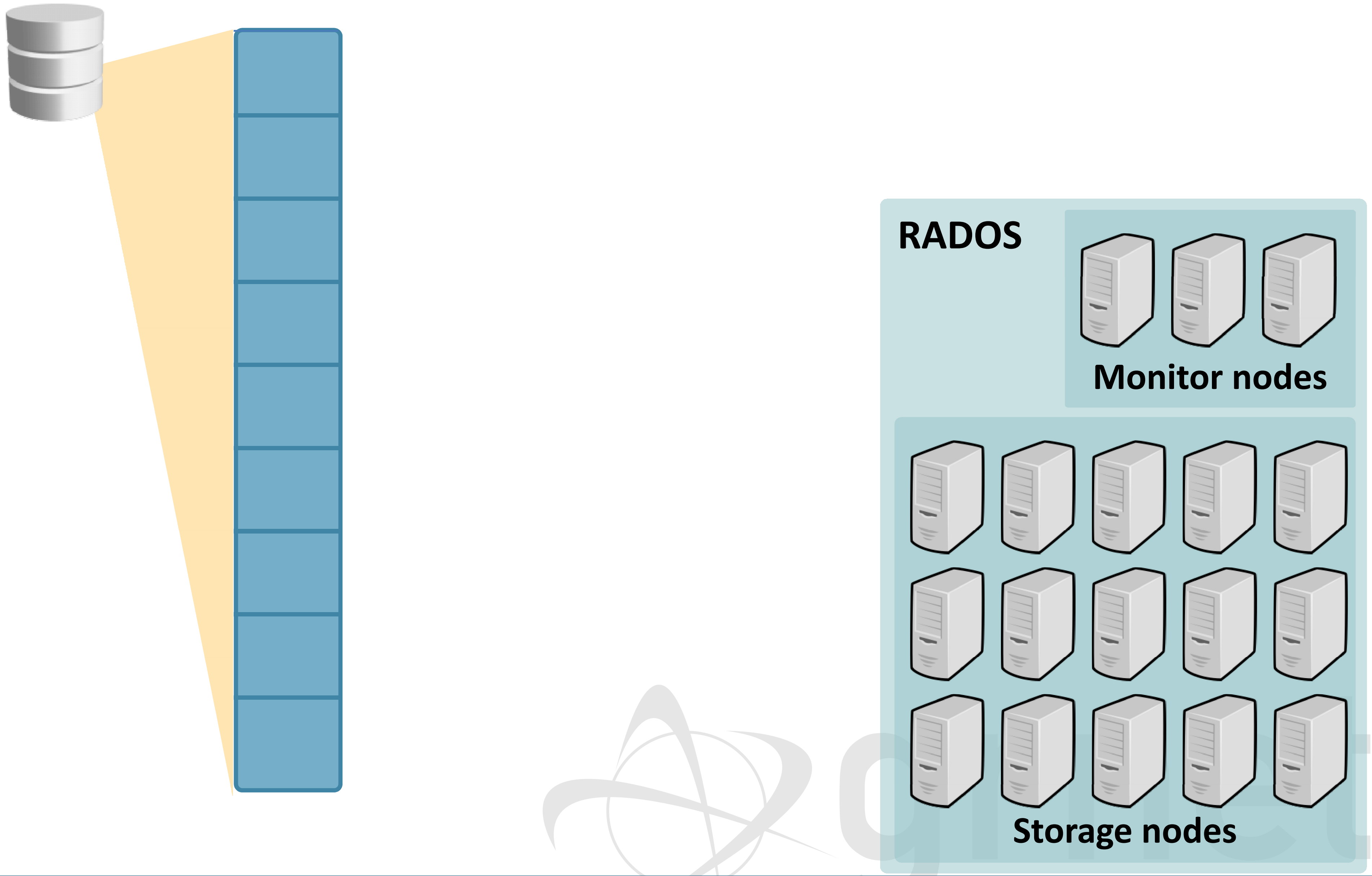

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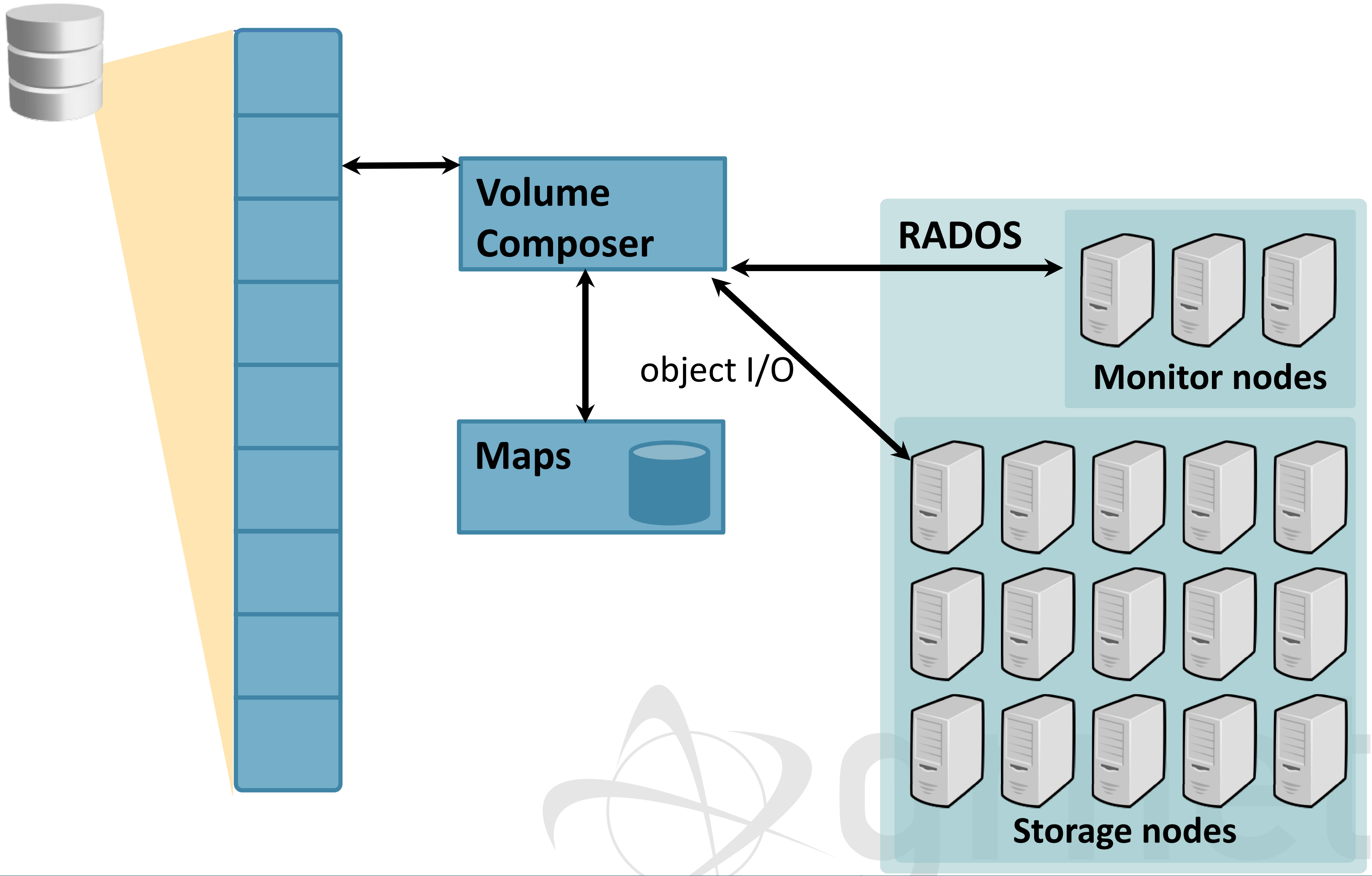


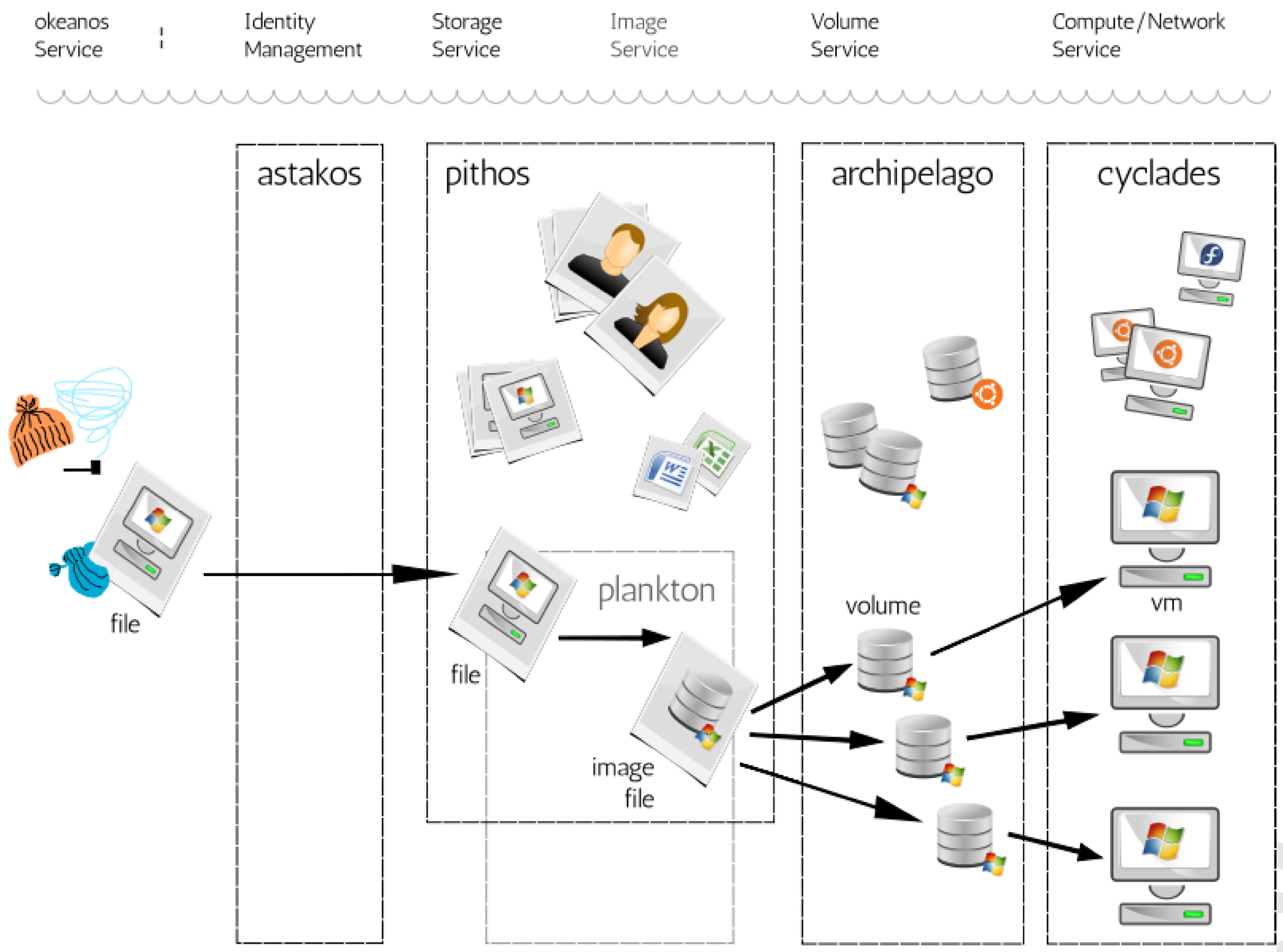
IaaS – Storage (1)

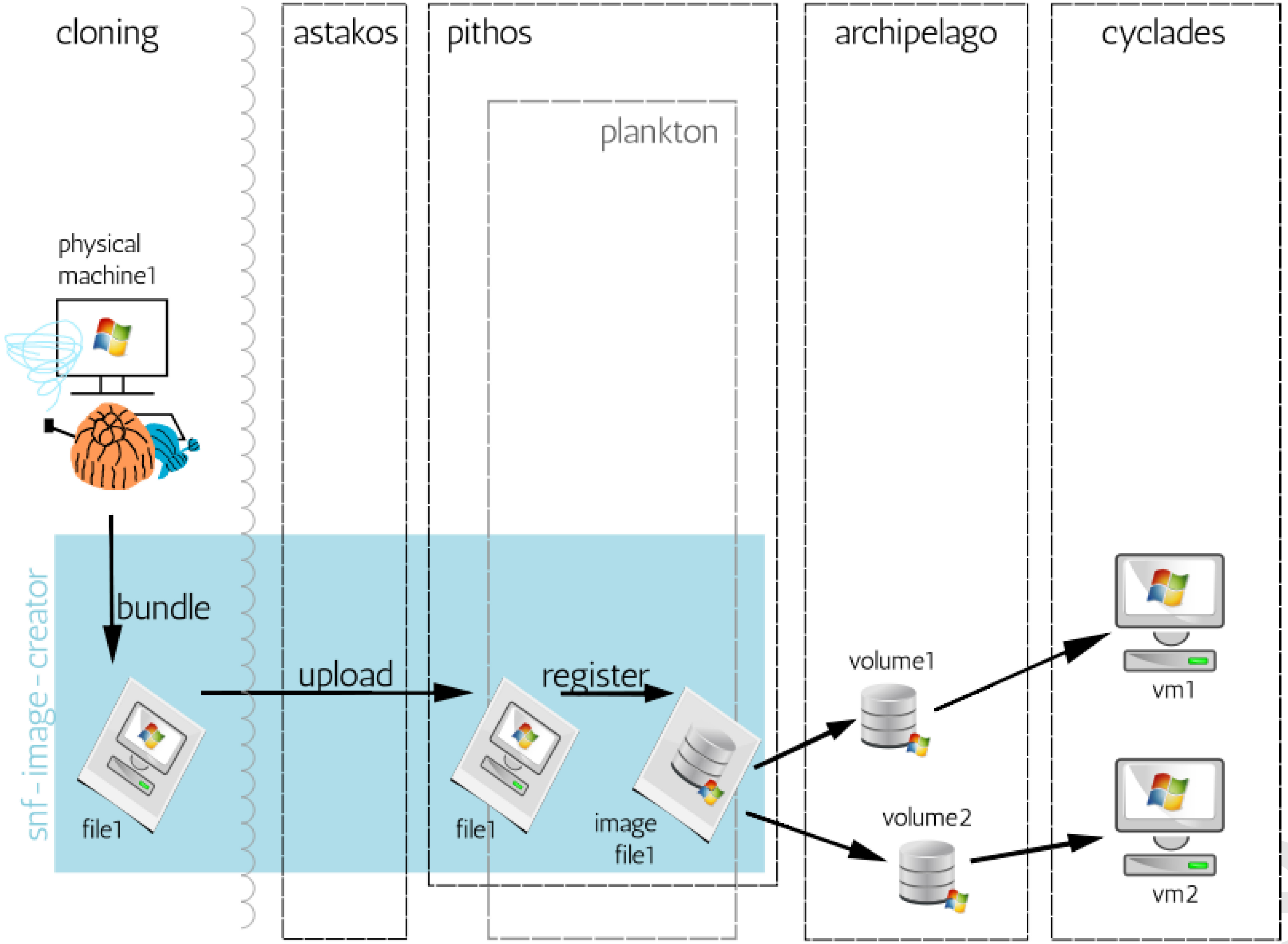
- First-phase deployment
  - System-provided *and* custom user Images
  - Redundant storage based on DRBD
  - VMs survive physical node downtime or failure
- Currently under testing
  - Reliable distributed storage over RADOS
  - Combined with custom software for snapshotting, cloning
  - Dynamic virtual storage volumes

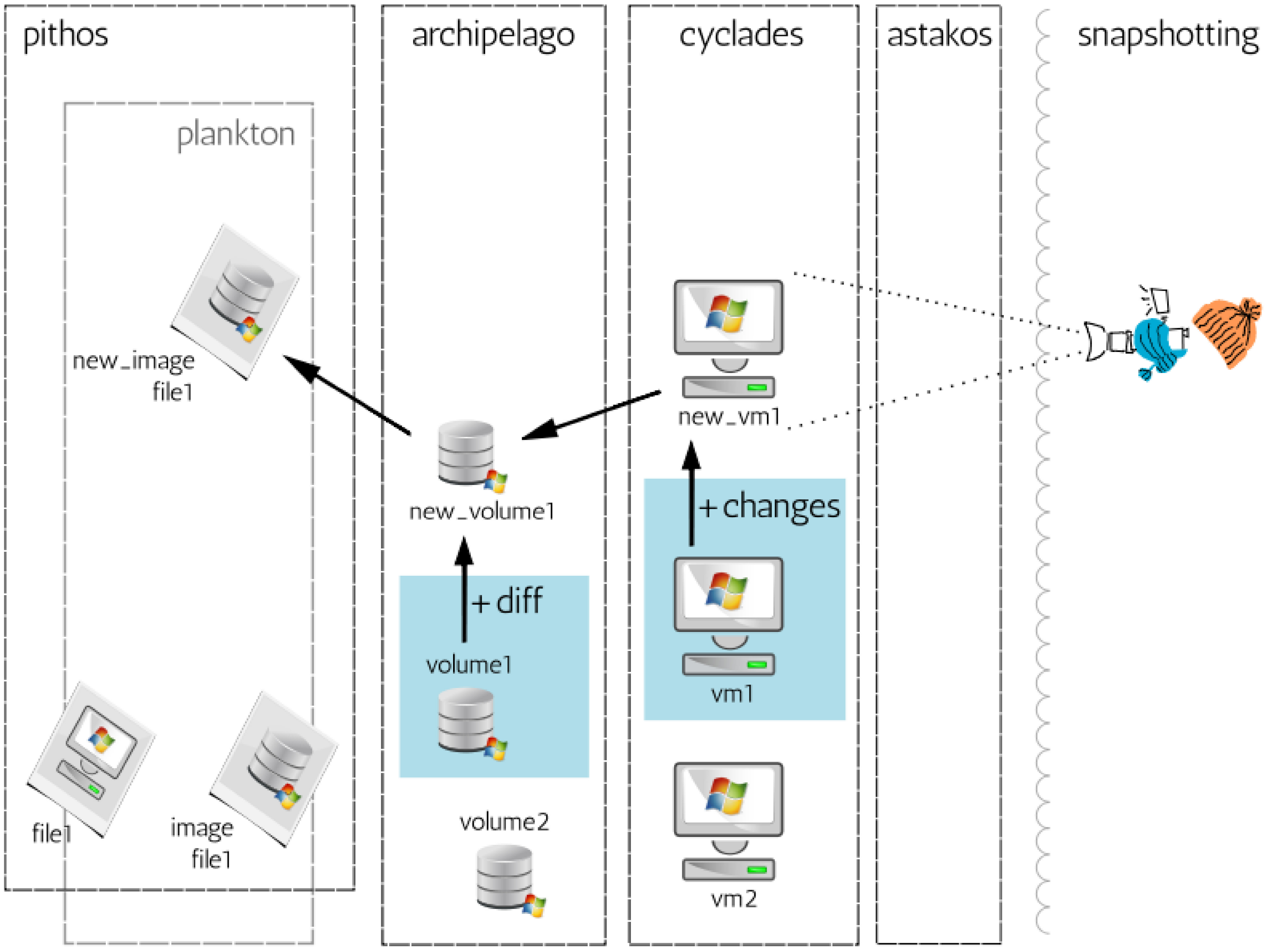
IaaS – Storage (2)

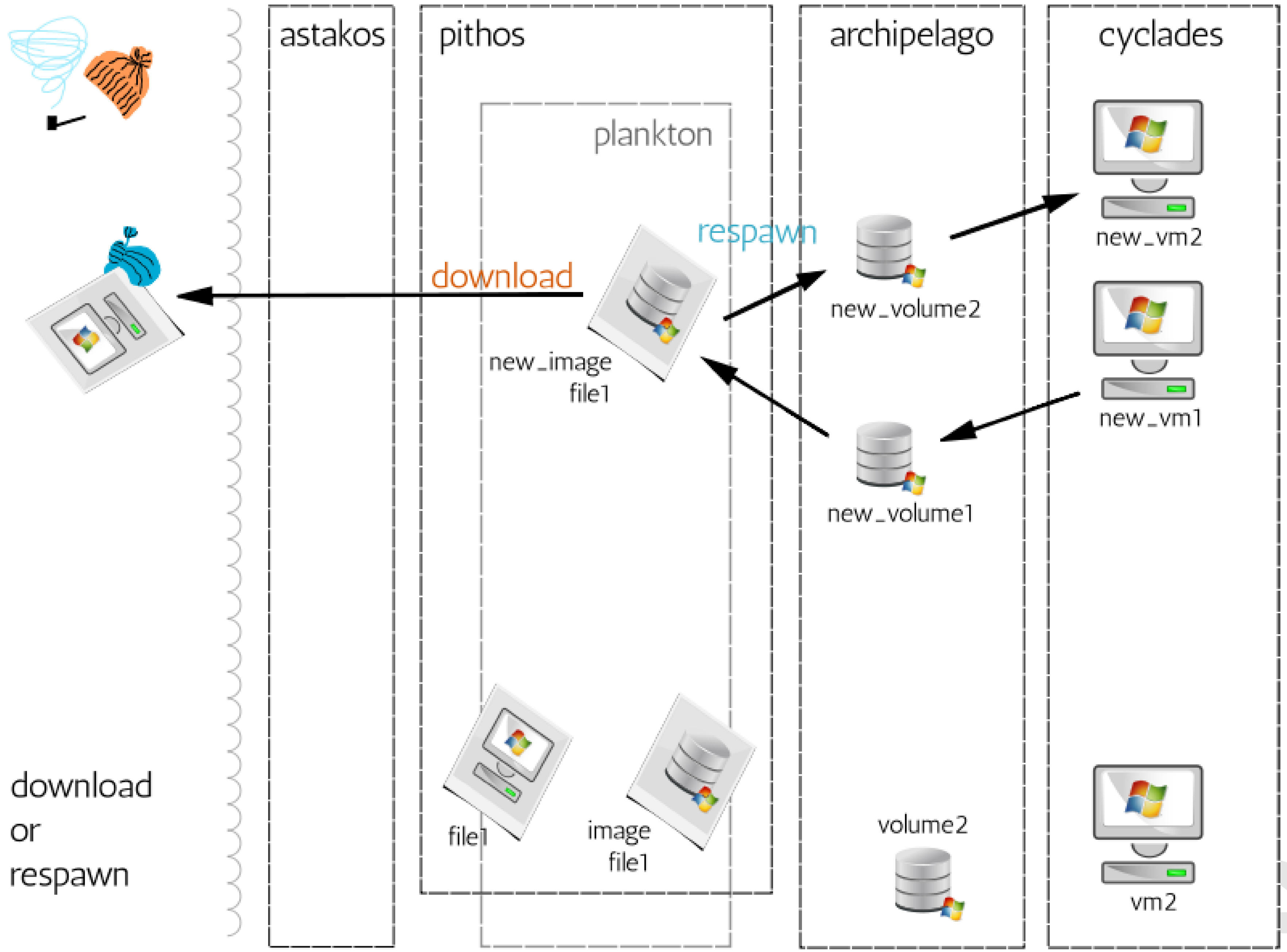
- Multi-tier storage architecture
  - Dedicated Storage Nodes (SSD, SAS, and SATA storage)
  - OSDs, e.g., for RADOS
- Custom storage layer: Archipelago
  - manages snapshots, creates clones over block pools
  - OS Images held as snapshots
- VMs created as clones of snapshots

Integration


okeanos
Service
Identity
Management
Storage
Service
Image
Service
Volume
Service
Compute / Network
Service
astakos
pithos
archipelago
cyclades
file
file
plankton
image
file
volume
vm


cloning
astakos
pithos
plankton
archipelago
cyclades
physical machine1
snf-image-creator
bundle
file1
upload
file1
register
image file1
volume1
volume2
vm1
vm2


pithos
plankton
new_image
file1
file1
image
file1
archipelago
new_volume1
+ diff
volume1
volume2
cyclades
new_vm1
+ changes
vm1
vm2
astakos
snapshotting



download
or
respawn

Support services

- **Identity:** Astakos
  - Provides the user base for ~okeanos
  - Once authenticated, the user retrieves a common auth token for programmatic access

- **Accounting / Billing:** Aquarium
  - Underlying crediting and billing infrastructure

Automation

./kamaki

```
$ ./kamaki
Usage: kamaki <group> <command>  [options]
…
  --api=API      API can be either openstack or synnefo
  --url=URL      API URL
  --token=TOKEN  use token TOKEN
…

Commands:
  flavor info          get flavor details
  flavor list          list flavors
…
  image create         create image
  image delete         delete image

$ ./kamaki server shutdown 101 --url=http://localhost:8000/api/v1.1
--token=1234527db2…
```

./kamaki

```
$ ipython

In [1]: from kamaki.client import Client
In [2]: c = Client('http://localhost:8000/api/v1.1', "1234527db2…")
In [3]: c.list_flavors()
…
In [4]: i = c.list_images()
In [5]: i[5]
{u'created': u'2011-06-09T00:00:00+00:00',
 u'id': 7,
 u'metadata': {u'values': {u'OS': u'windows',
                           u'size': u'11000'}},
 u'name': u'Windows',
 u'progress': 100,
 u'status': u'ACTIVE',
 u'updated': u'2011-09-12T14:47:12+00:00'}
In [6]: c.create_server('mywin1', 3, 5)
```

Sights

Live Demo

Live Demo

- Prepare and upload Image from local template VM
- Spawn compute cluster to run MPI app
- Make local modifications and repeat

- … over Cosmote 3G.
  - Time needed to upload 1GB Image file? ☺
  - Time needed to prepare and spawn virtual nodes?

Live Demo

- Prepare and upload Image from local template VM
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Upcoming

Current and Upcoming features

- Now: Alpha2
  - ➡ Common user base, custom user images on Pithos+
- short-term: Synnefo v0.11, Beta
  - ➡ Ultra-lightweight VMs on Archipelago with RADOS backend
- medium-term
  - ➡ Volumes: clonable / snapshottable / attachable disks
  - ➡ Network and storage hotplugging
- Upcoming beta in fully populated datacenter

Opensource

Opensource

- Synnefo: Cyclades / Pithos+ / Astakos
  - https://code.grnet.gr/projects/synnefo
  - https://code.grnet.gr/projects/pithos
  - https://code.grnet.gr/projects/astakos
- snf-image
  - https://code.grnet.gr/projects/snf-image
- kamaki
  - https://code.grnet.gr/projects/kamaki
- vncauthproxy
  - https://code.grnet.gr/projects/snf-vncauthproxy

Opensource

- Synnefo: Cyclades / Pithos+ / Astakos
  - https://code.grnet.gr/projects/synnefo
  - https://code.grnet.gr/projects/pithos
  - https://code.grnet.gr/projects/astakos
- snf-image
  - https://code.grnet.gr/projects/snf-image
- kamaki
  - https://code.grnet.gr/projects/kamaki
- vncauthproxy
  - https://code.grnet.gr/projects/snf-vncauthproxy

`pip install` or **`apt-get install`** everything!

okeanos

https://okeanos.grnet.gr

Thank You!

Questions?