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New resource provision paradigms for Grid Infrastructures: Virtualization and Cloud

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Objectives

- Brief review of some limitations of current Grids
- Use of virtual machines in Grids and its use for the dynamic provisioning of virtual clusters
- Grids & Clouds: Scale-out a Grid sites
- Demo!

Brief Review of Grid Infrastructures

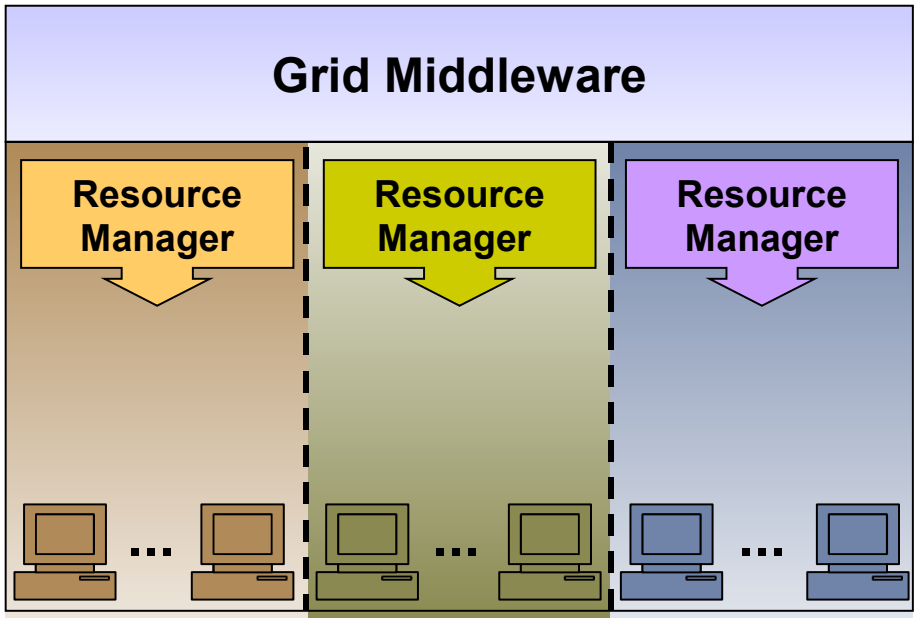
New provision models for Grids: Virtualization and Clouds

"*Any problem in computer science can be solved with another layer of indirection… But that usually will create another problem.*"

David Wheeler

A Grid… a new abstraction layer

"A (*computational*) Grid is an abstraction layer (*middleware*) to integrate disparate administration domains (*platforms and policies*)"



Common Interface for Each Type of Resources: User can access a wide set of resources.

Types of Resources: Computational, storage and network.

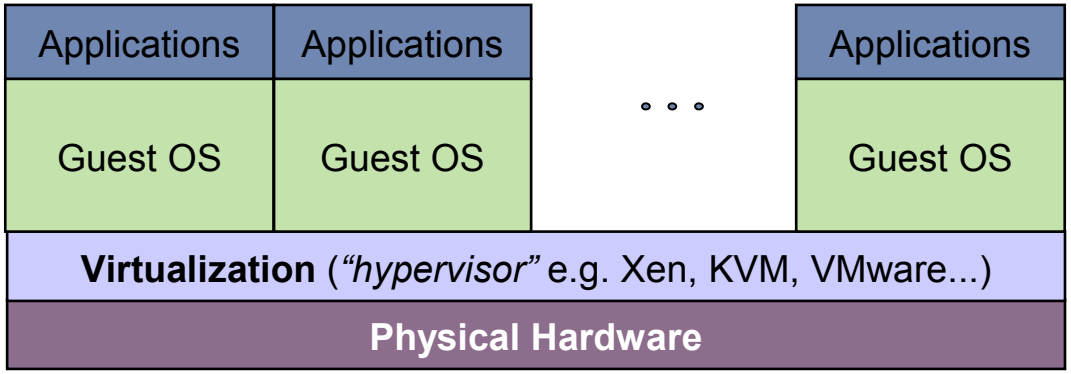
Some Limitations of Current Grids

- High degree of heterogeneity (software & hardware)
- High operational costs
- Isolate and partition resources contributed to the Grid
- Specific environment requirements for different VOs

Grids are difficult to maintain, operate and use

Virtual Machines

- A VM is an isolated runtime environment (guest OS and apps)
- Hypervisors: Full Virtualized, para-virtualization, HW Virtualization

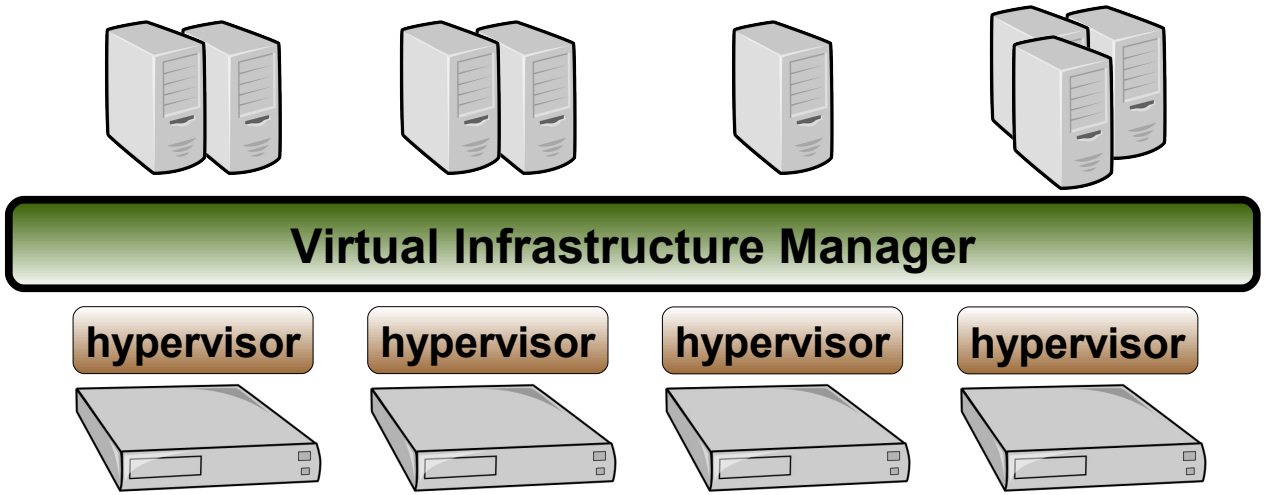


Benefits of Virtualization Platforms

- Natural way to deal with the *heterogeneity* of the infrastructure
- Allow partitioning and isolating of physical resources
- Execution of legacy applications

Virtual Infrastructure Manager (VIM)

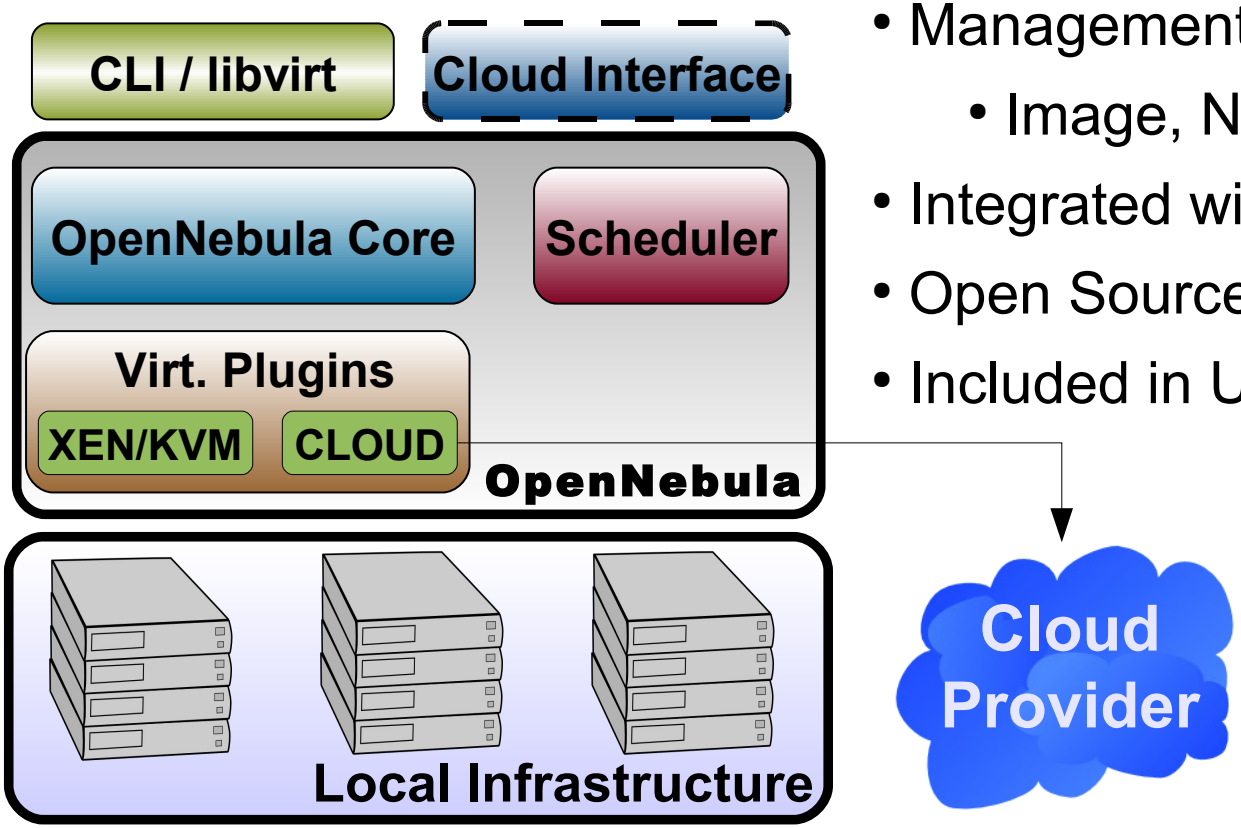
- ...but something more is needed
  - Where did/do I put my VM? (***scheduling & monitoring***)
  - How do I provision a new cluster node? (***clone & context***)
  - What MAC addresses are available? (***networking***)
- Provides a ***uniform view*** of the resource pool
- ***Life-cycle management*** and monitoring of VM
- The VIM ***integrates*** Image, Network and Virtualization



The OpenNebula Virtual Infrastructure Manager

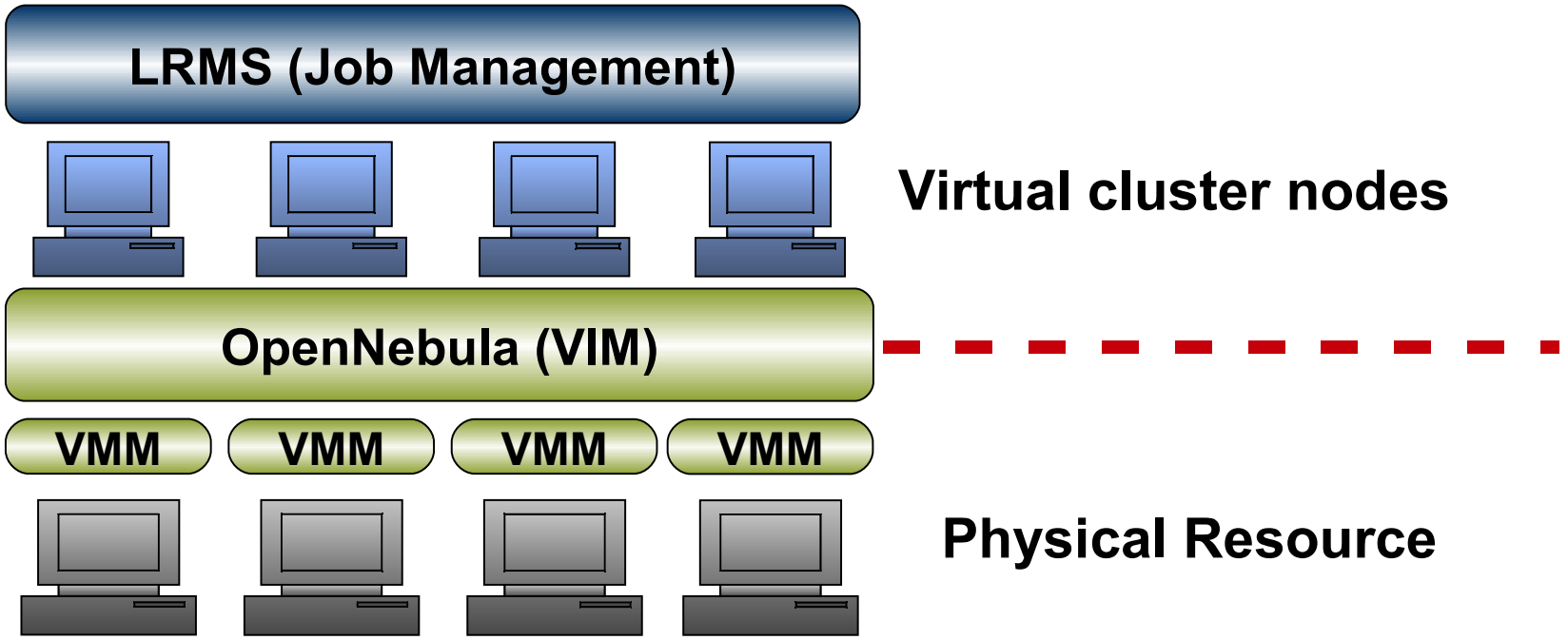
www.OpenNebula.org

- Flexible & Open Design
  - Third-party components
  - Easily adapted & extended
- Management of *Virtual Services*
  - Image, Network & Context
- Integrated with cloud providers
- Open Source – Apache2
- Included in Ubuntu 9.04 (server)



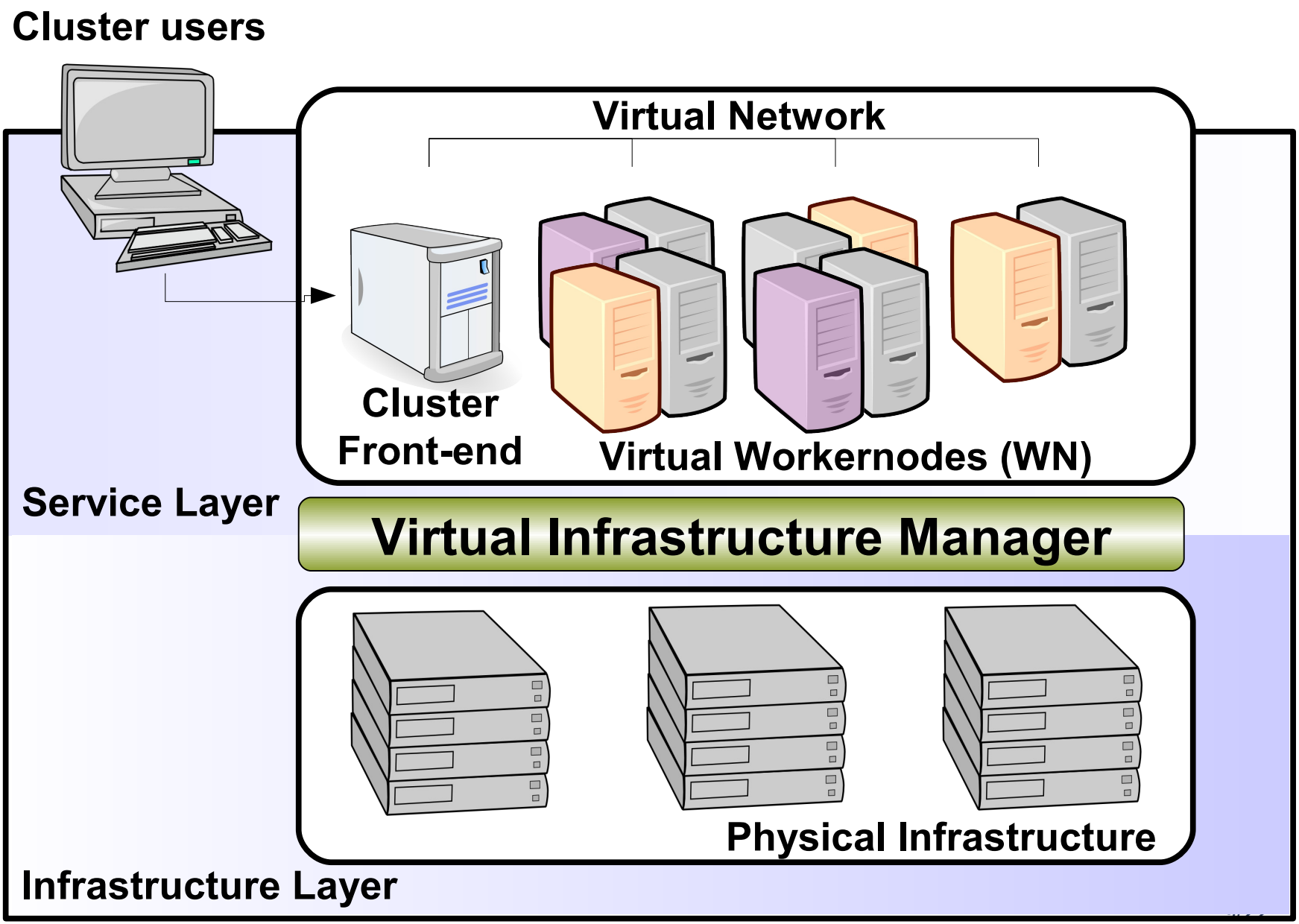
A New Infrastructure Layer for Grids...

- Separation of Resource Provisioning from Job Management
- Seamless integration with the existing middleware stacks.
- Completely transparent to the computing service and end users



Grids & Virtual Machines

New provision models for Grids: Virtualization and Clouds



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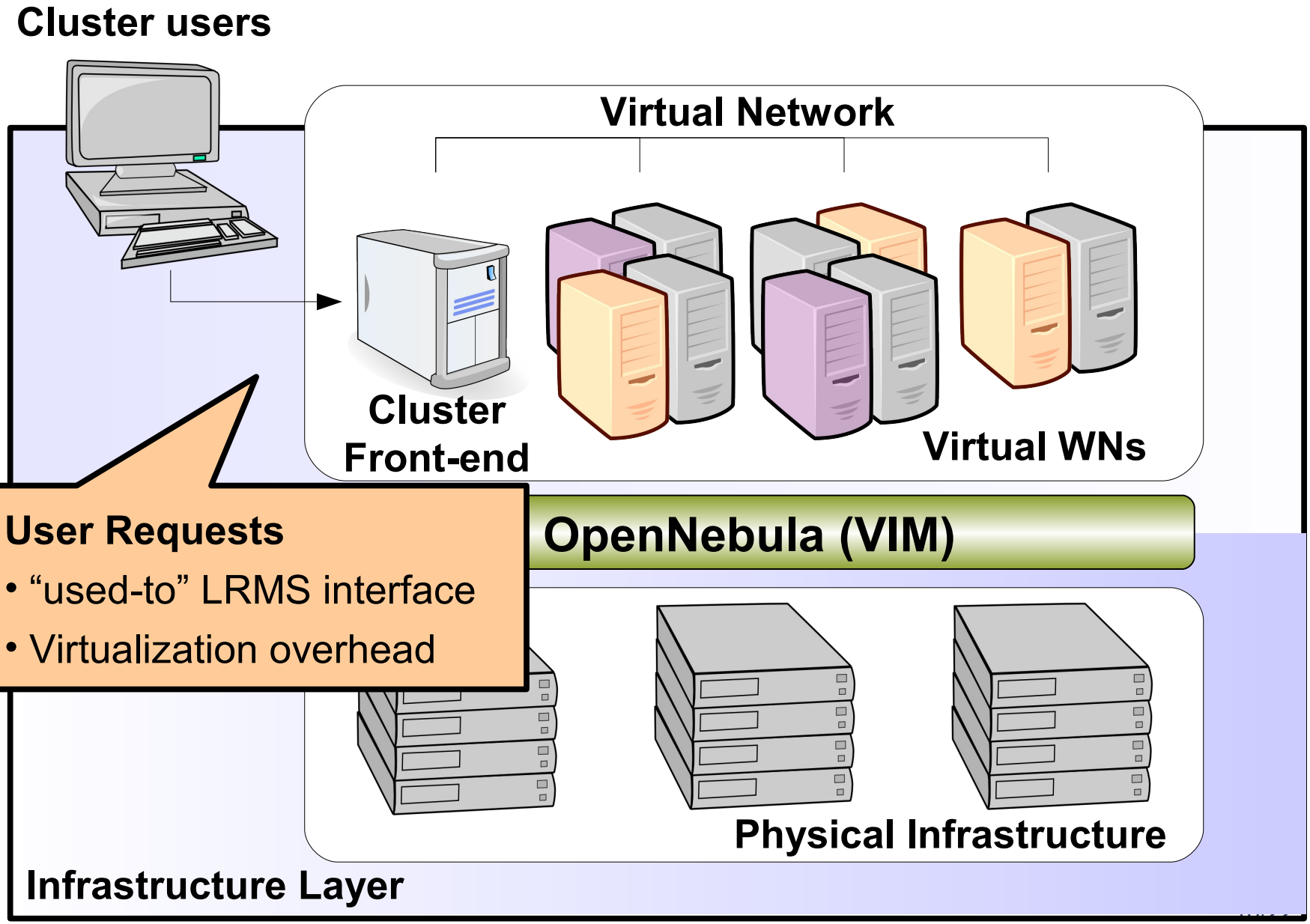

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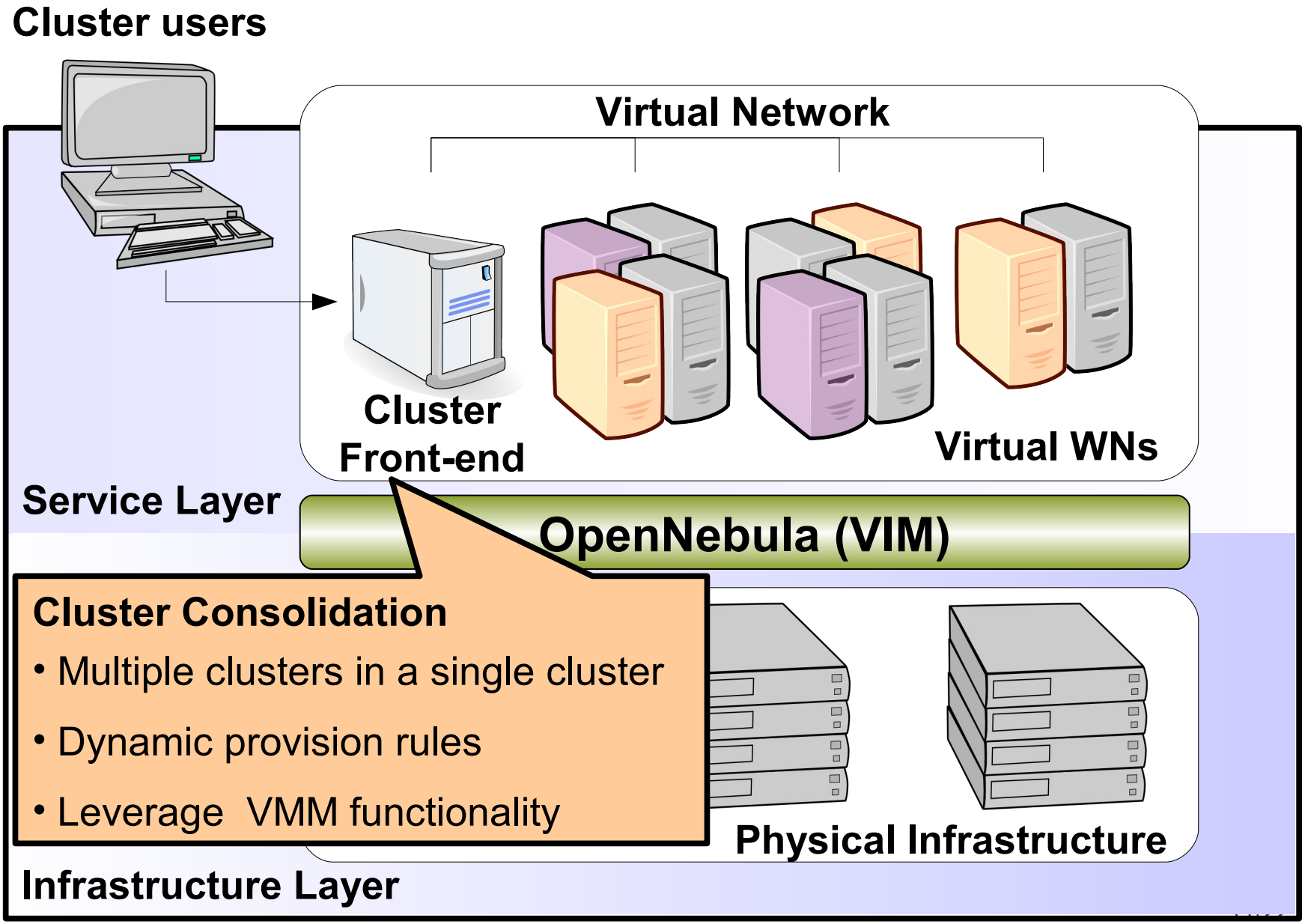

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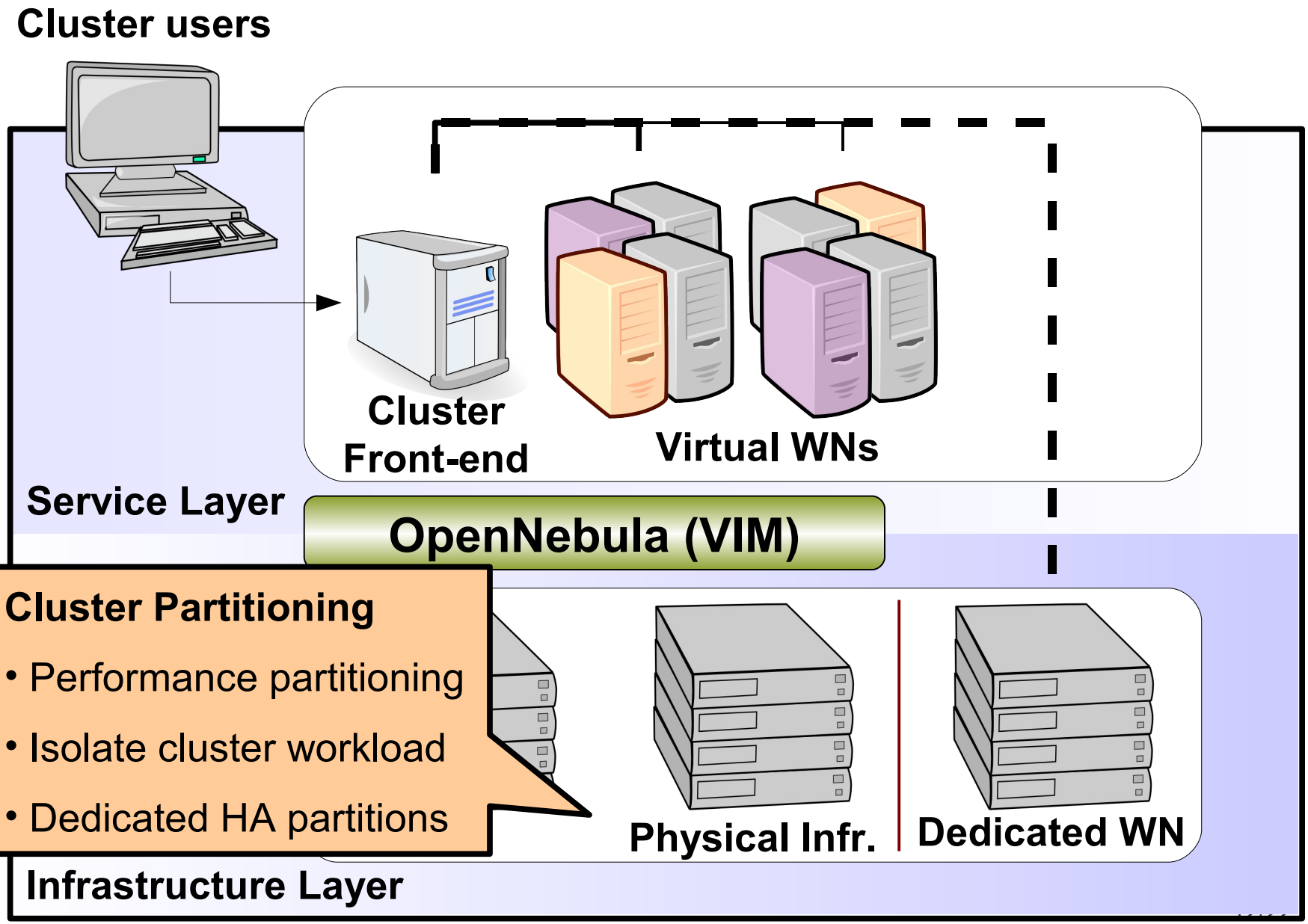

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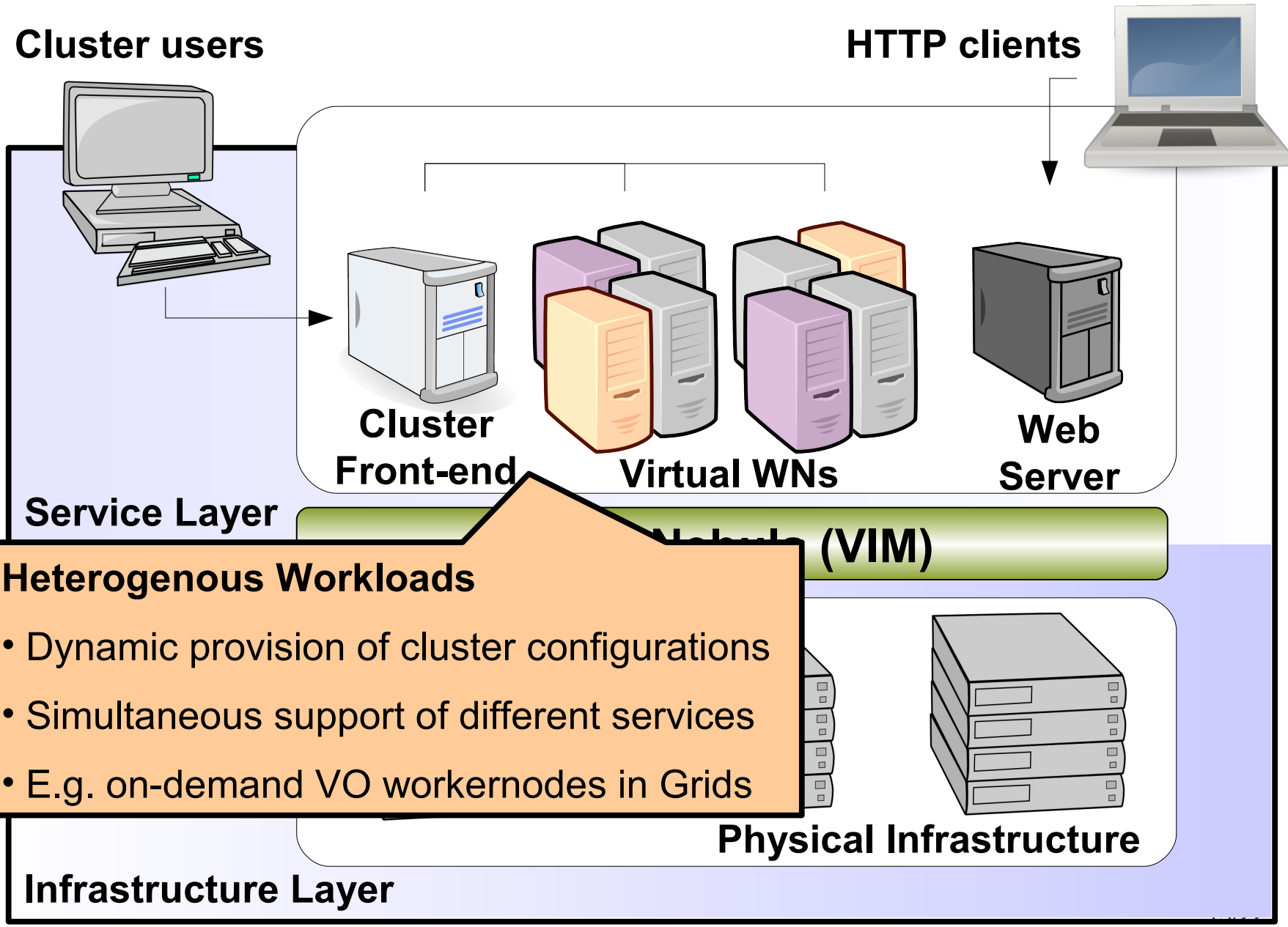
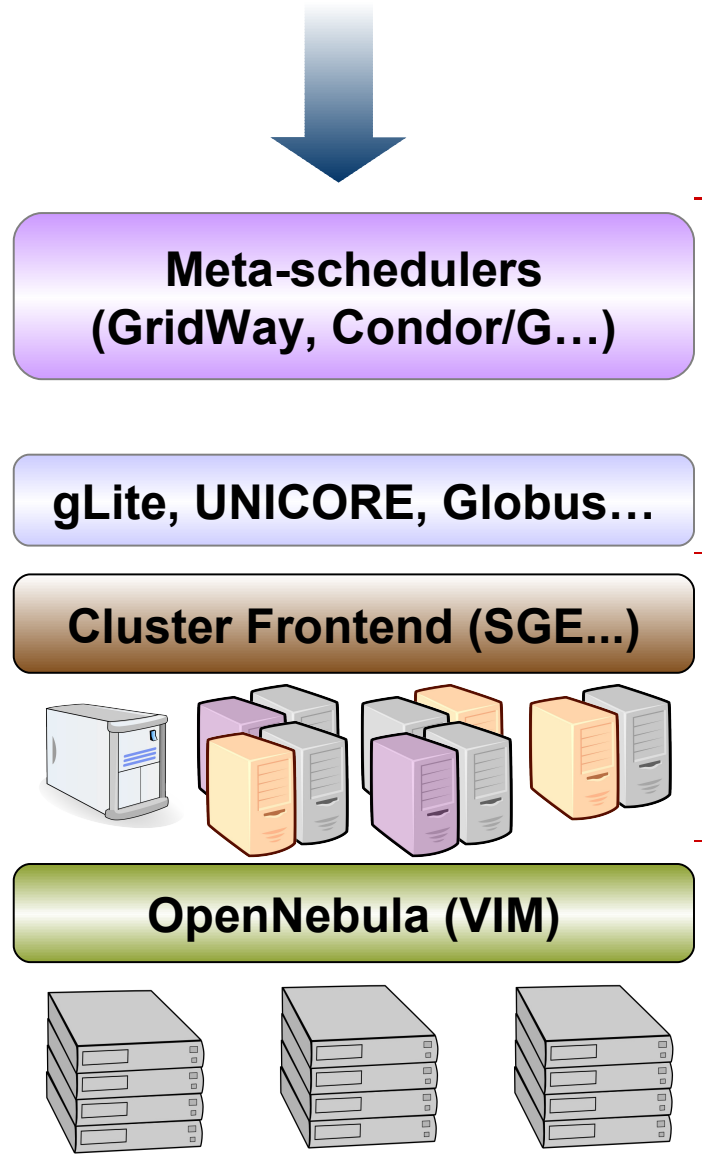


Heterogenous Workloads

- Dynamic provision of cluster configurations
- Simultaneous support of different services
- E.g. on-demand VO workernodes in Grids

A Complete Grid Middleware Stack

New provision models for Grids: Virtualization and Clouds



- Unmodified Applications (Grid or local)
- Interfaces preserved (qsub, DRMAA..)

Applications

- Virtual resources are exposed by GM
- Dynamic scheduling
- Fault detection & recovery

Grid Middleware Layer

- WNs register to different queues
- Multiple VO-specific clusters

Computing Service Layer

- Infrastructure consolidation
- Infrastructure partitioning
- Infrastructure adaptation

Infrastructure Layer

A Complete Grid Middleware Stack

New provision models for Grids: Virtualization and Clouds

- Unmodified Applications (Grid or local)
- Interfaces preserved (qsub, DRMAA..)

Applications

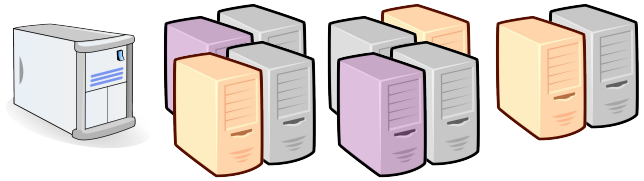
Meta-schedulers (GridWay, Condor/G…)

- Virtual resources are exposed by GT
- Dynamic scheduling
- Fault detection & recovery

gLite, UNICORE, Globus…

Grid Middleware Layer

Cluster Frontend (SGE...)



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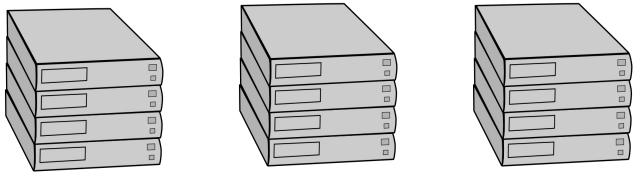
Computing Service Layer

Distributed VM Manager



- Infrastructure consolidation
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Infrastructure Layer

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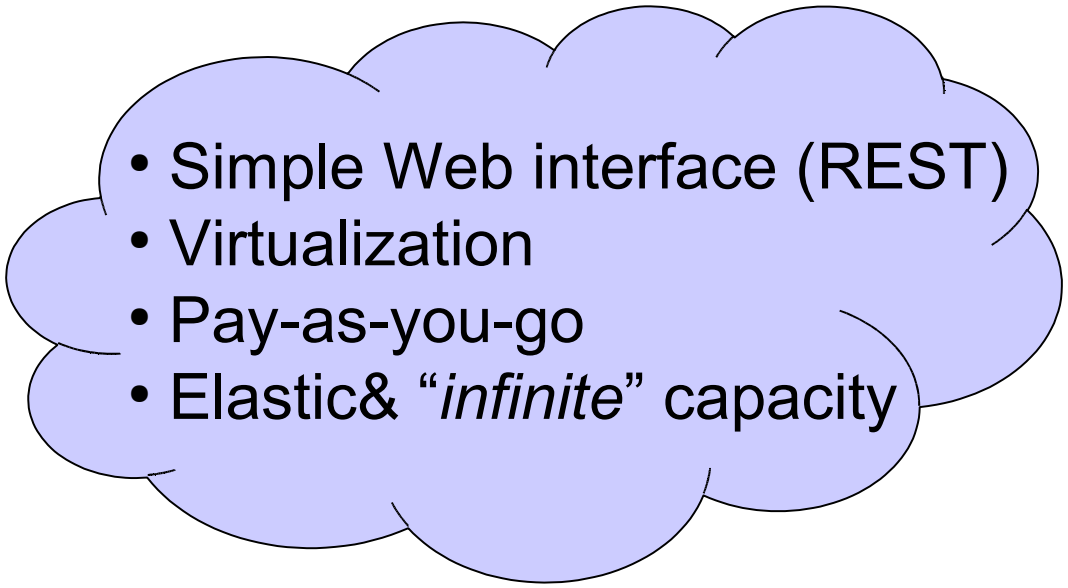
Cloud Computing, An Infrastructure View

New provision models for Grids: Virtualization and Clouds

A Service to Provide Hardware on Demand (IaaS)

- Cloud systems provide **virtualized resources as a service**
- Provide remote **on-demand access to infrastructure** (through VMs)



Infrastructure Cloud Services

- Commercial Cloud Providers: Amazon EC2, GoGrid, Elastic Hosts…
- Open Source Cloud: Nimbus, Eucalyptus

Cloud Computing, An Infrastructure View

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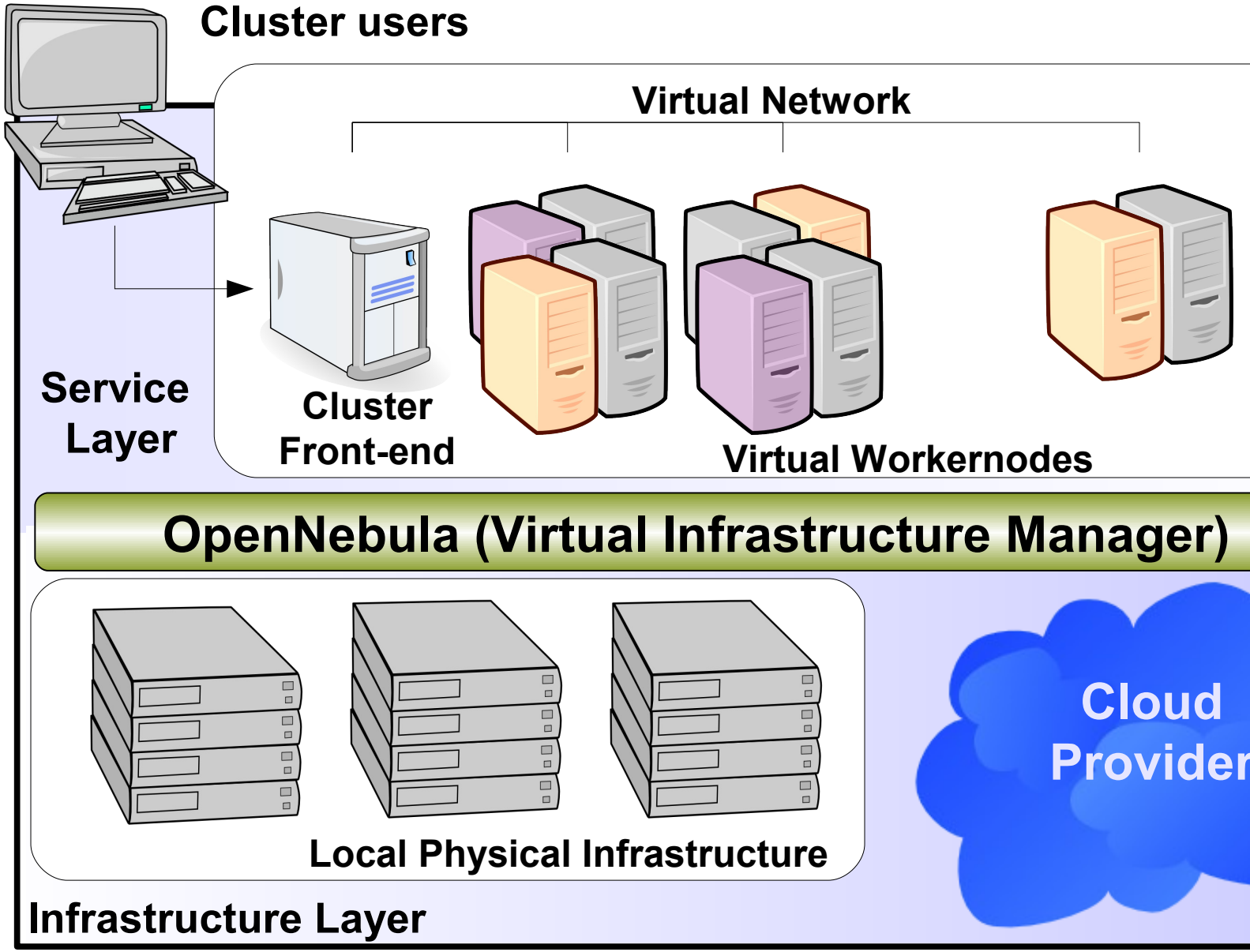

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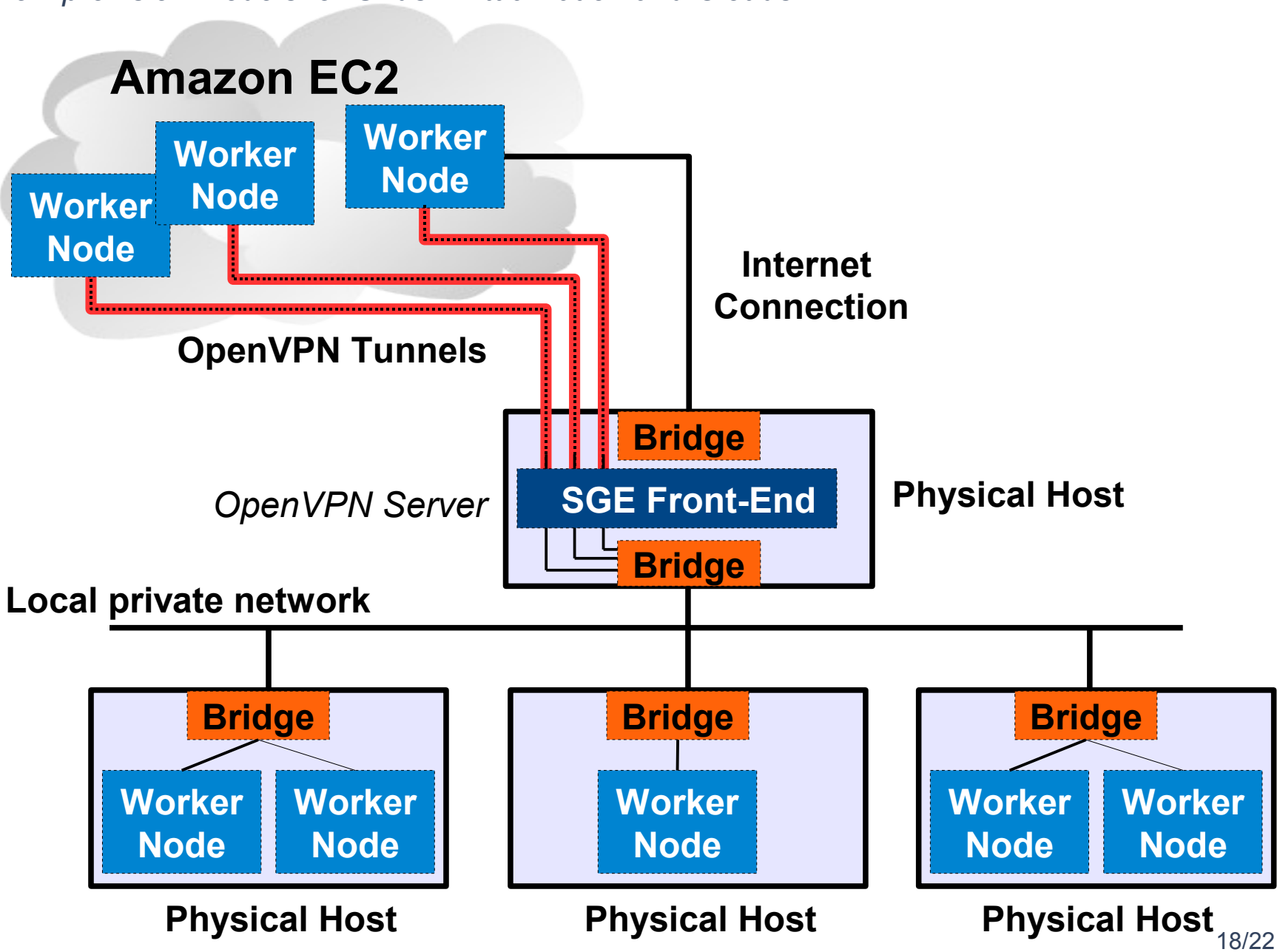
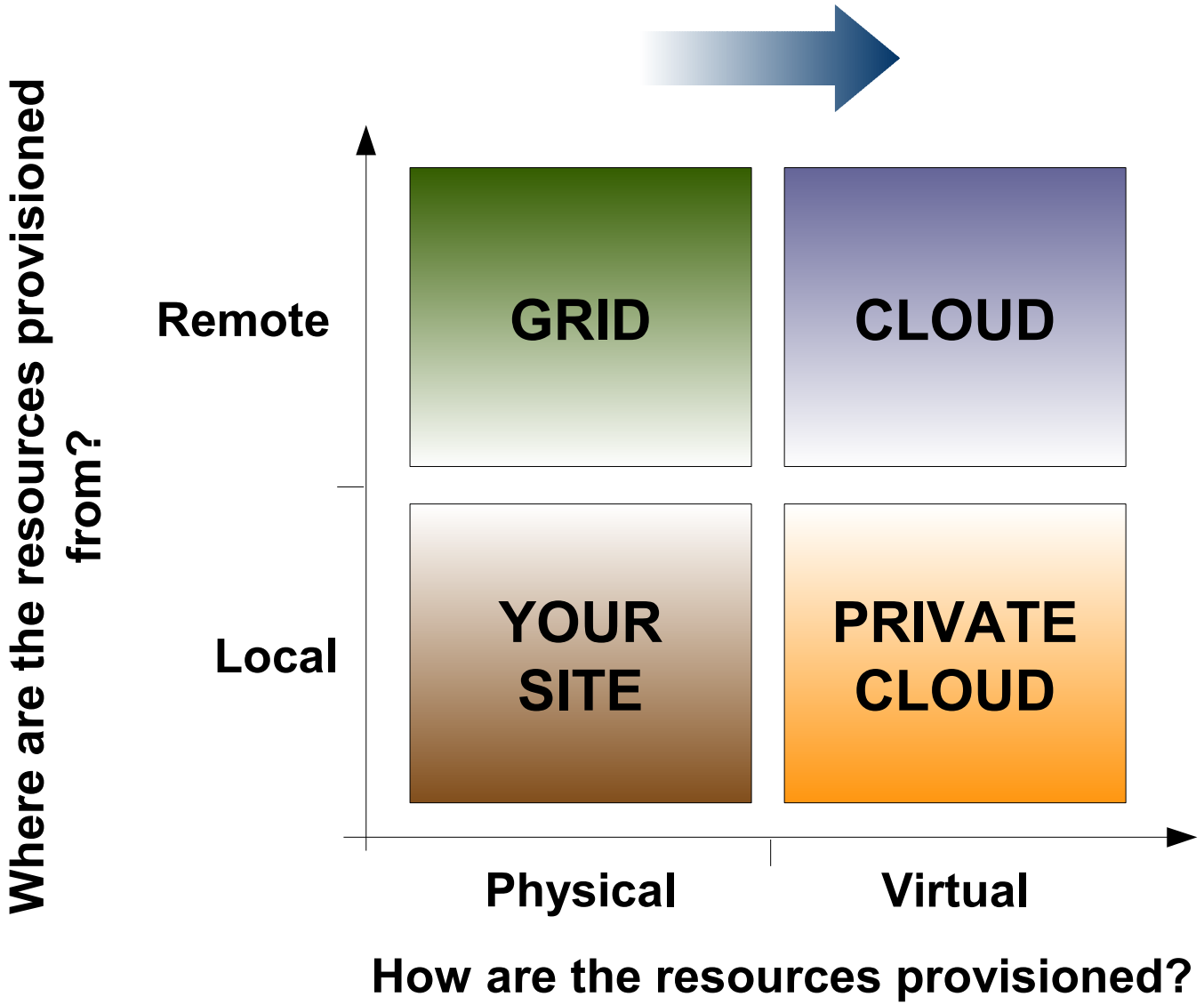


The Infrastructure Quadrant



About the Coexistence of Grid and Clouds

- Virtualization, cloud, and grid are complementary technologies and will coexist and cooperate at different levels of abstraction
- Virtualization can solve many obstacles for Grid adoption
- Virtualization and cloud do NOT require any modification within service layers from both the administrator and the end-user perspectives
- Separation between service and infrastructure layers will allow the application of the utility model to Grid/cluster/HPC computing

Thanks and More Info

More info, downloads, mailing lists at www.OpenNebula.org

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RESERVOIR
www.reservoir-fp7.eu/

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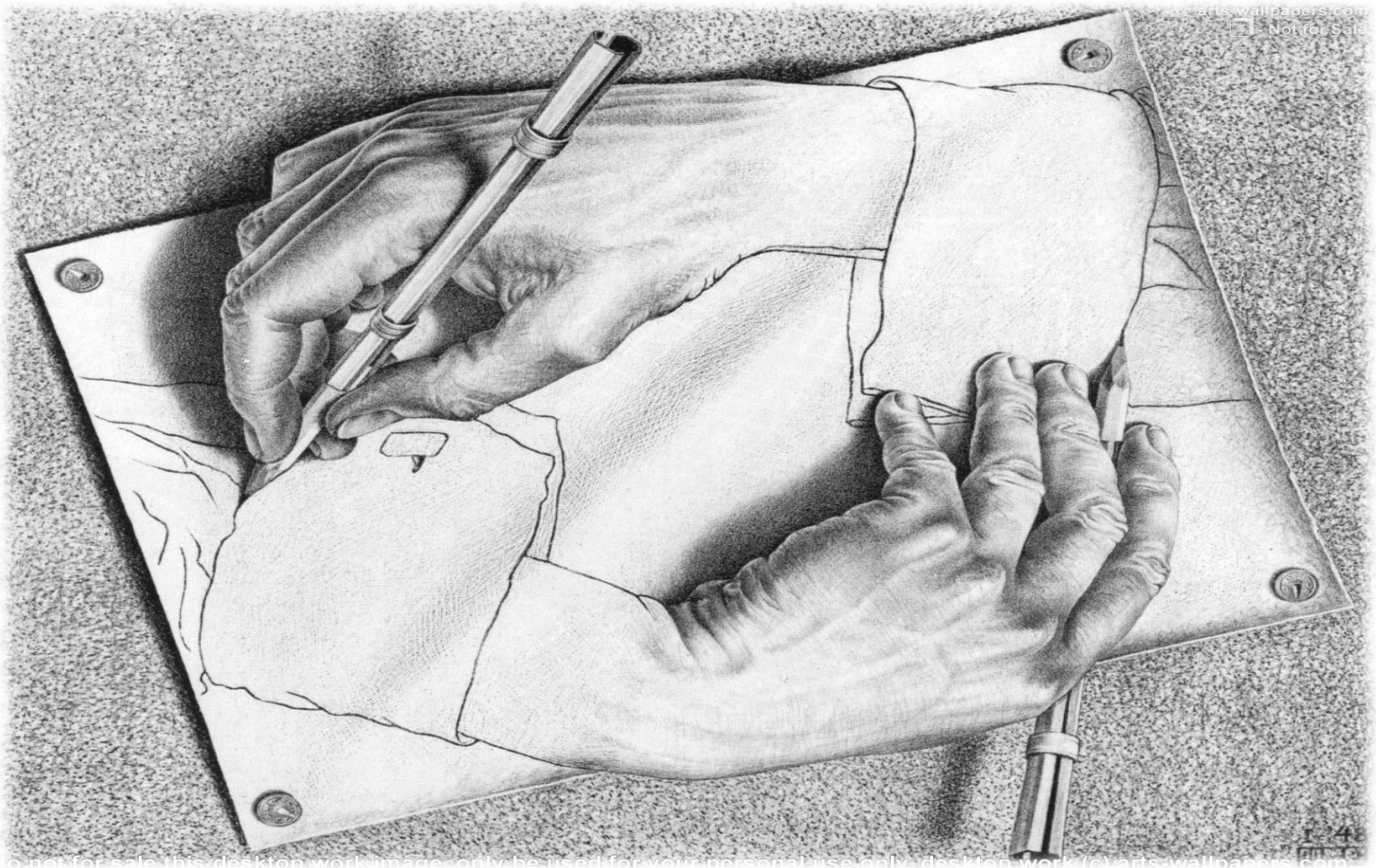
THANK YOU FOR YOUR ATTENTION



QUESTIONS?