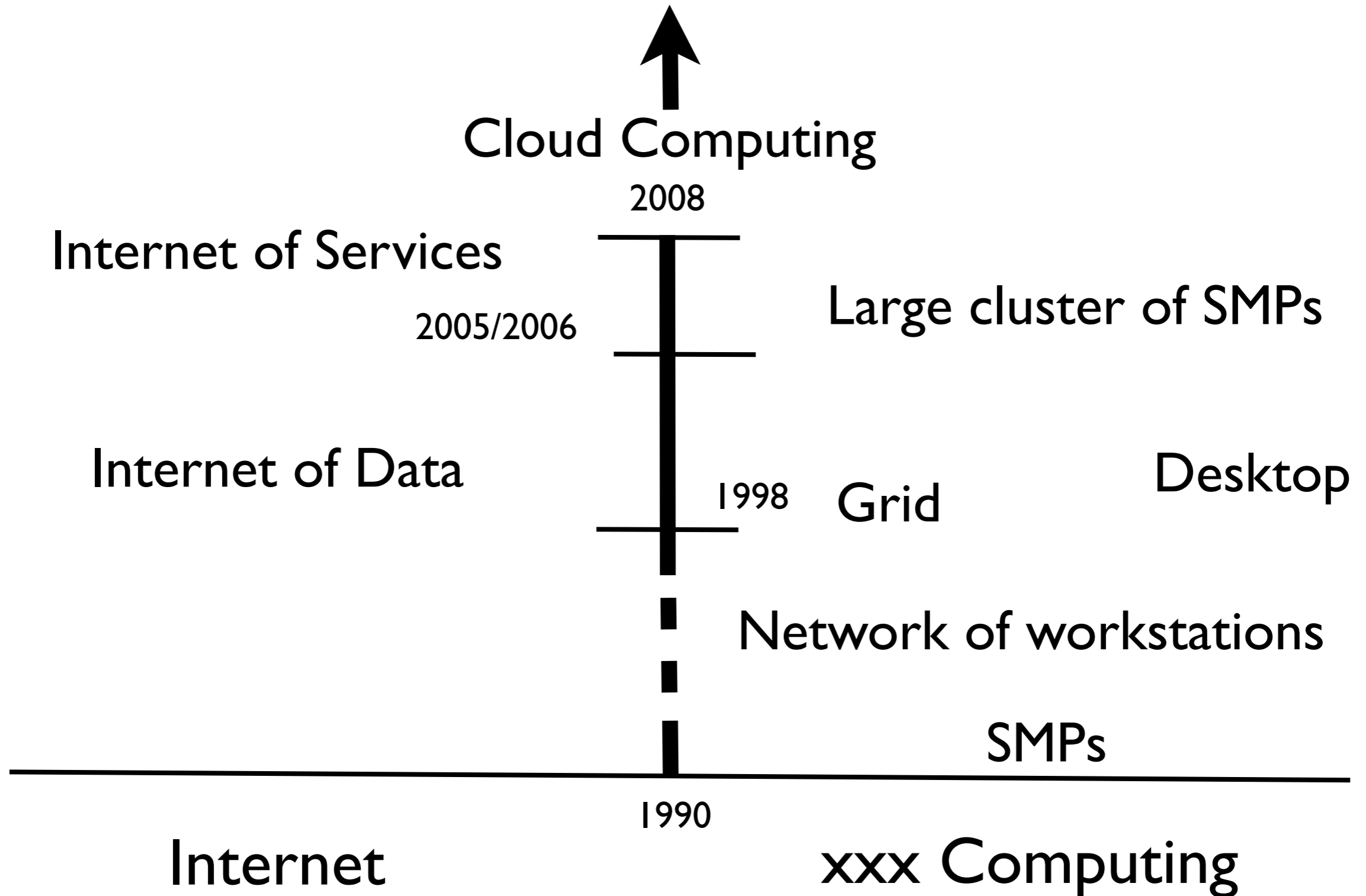# Cloud and Virtualization

Overview

Adrien Lèbre
Ecole des Mines de Nantes

France Grille - Cloud Workshop

Internet + Distributed Computing ?

Cloud Computing

2008

Internet of Services

2005/2006

Large cluster of SMPs

Internet of Data

1998   Grid

Desktop

Network of workstations

SMPs

1990

Internet

xxx Computing

Cloud Computing

- A "merge" between Internet and Distributed Computing

From Internet point of view:
Not only data/services but raw resources

From distributed computing point of view:
a common objective - provide computing resources (both hardware and software) in a flexible, transparent, secure, reliable, ... way
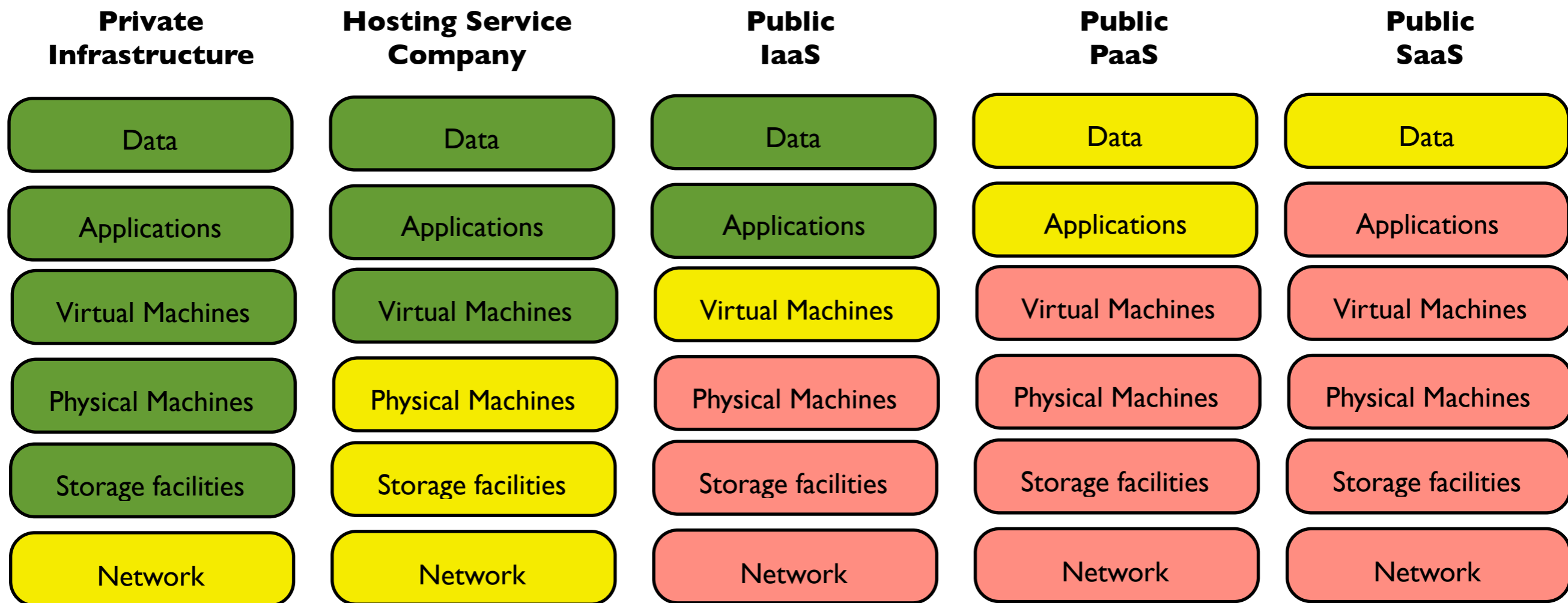
Cloud Computing Organization - X as a Service

Simplicity   Flexibility

Service **aaS**

Platform **aaS**

Infrastructure **aaS**

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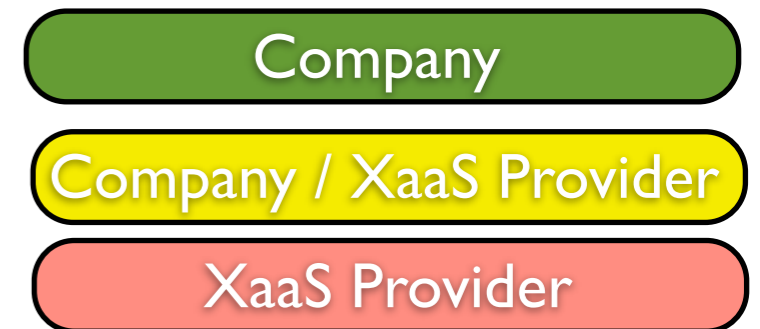
  Cloud Computing Organization - X as a Service

  Simplicity   Flexibility

  Service **aaS**

  DaaS

  Platform **aaS**   ...

  NaaS

  Infrastructure **aaS**

Cloud Computing - Organization

- Who is in charge of ?

| Company |
| Company / XaaS Provider |
| XaaS Provider |

Private Infrastructure	Hosting Service Company	Public IaaS	Public PaaS	Public SaaS
Data	Data	Data	Data	Data
Applications	Applications	Applications	Applications	Applications
Virtual Machines	Virtual Machines	Virtual Machines	Virtual Machines	Virtual Machines
Physical Machines	Physical Machines	Physical Machines	Physical Machines	Physical Machines
Storage facilities	Storage facilities	Storage facilities	Storage facilities	Storage facilities
Network	Network	Network	Network	Network

Credits: P. Saulière - Microsoft

Cloud Computing

- Few examples

Internet of Services
free ⇒ gmail, google maps, google docs, youtube ...

pay as you go ⇒ Microsoft office, SQL server, ...

Service Clouds

Software-as-a-Service

Platform-as-a-Service

Infrastructure-as-a-Service
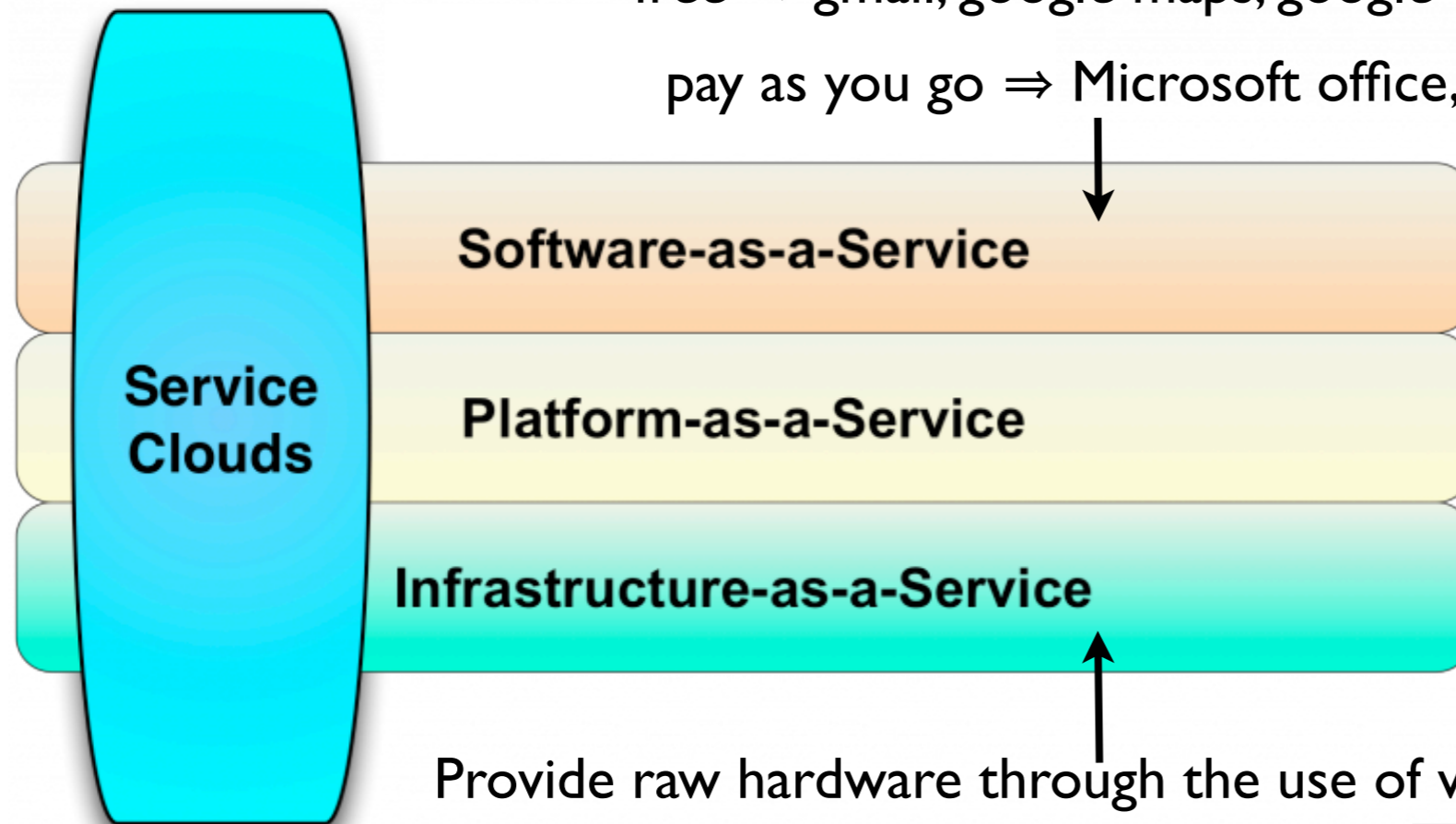
Provide a complete stack (microsoft windows azur, google PAAS, ...)

Windows Azure

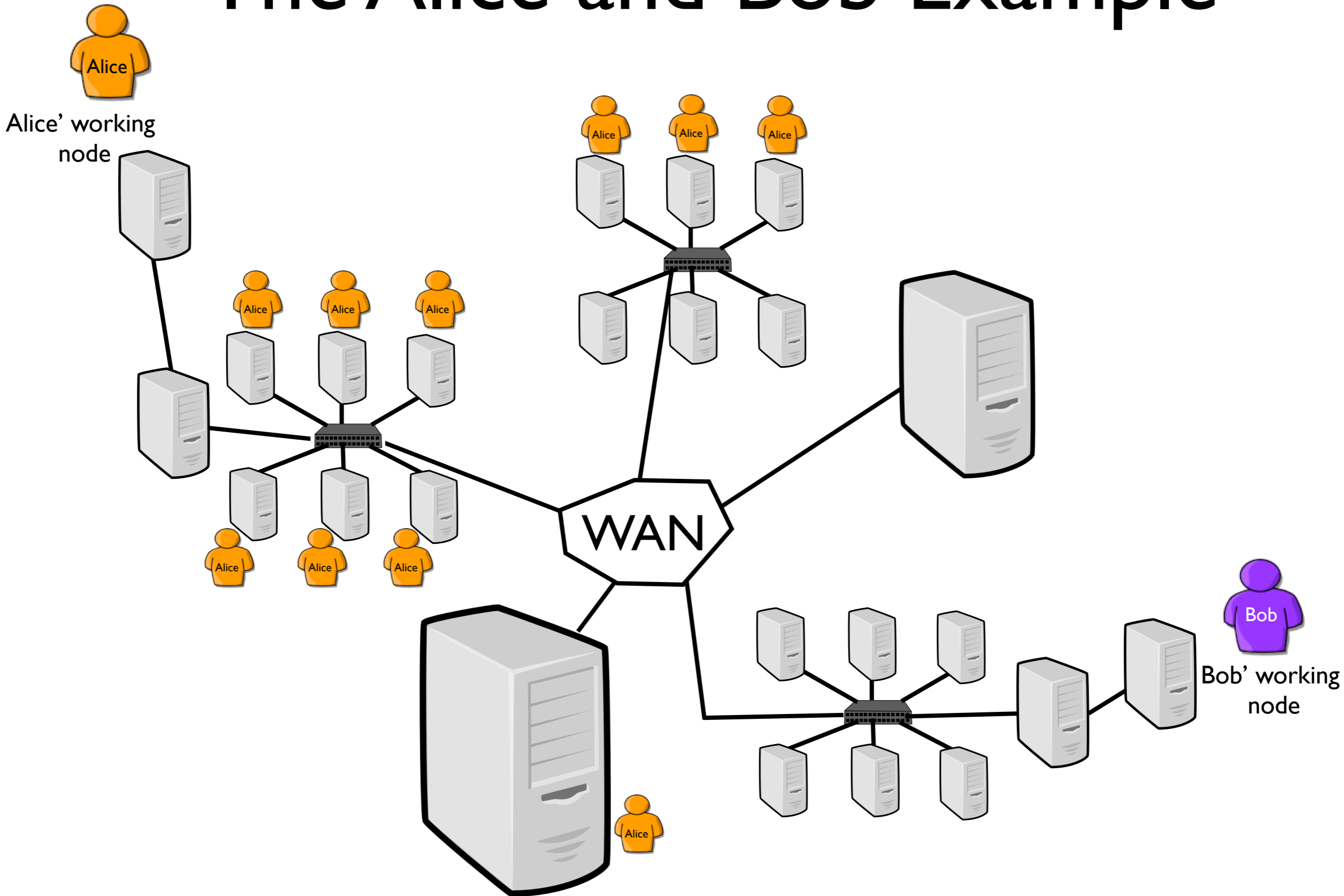Provide raw hardware through the use of virtual machines (Leader: Amazon)

amazon.com
web services

- SaaS upon IaaS: DropBox
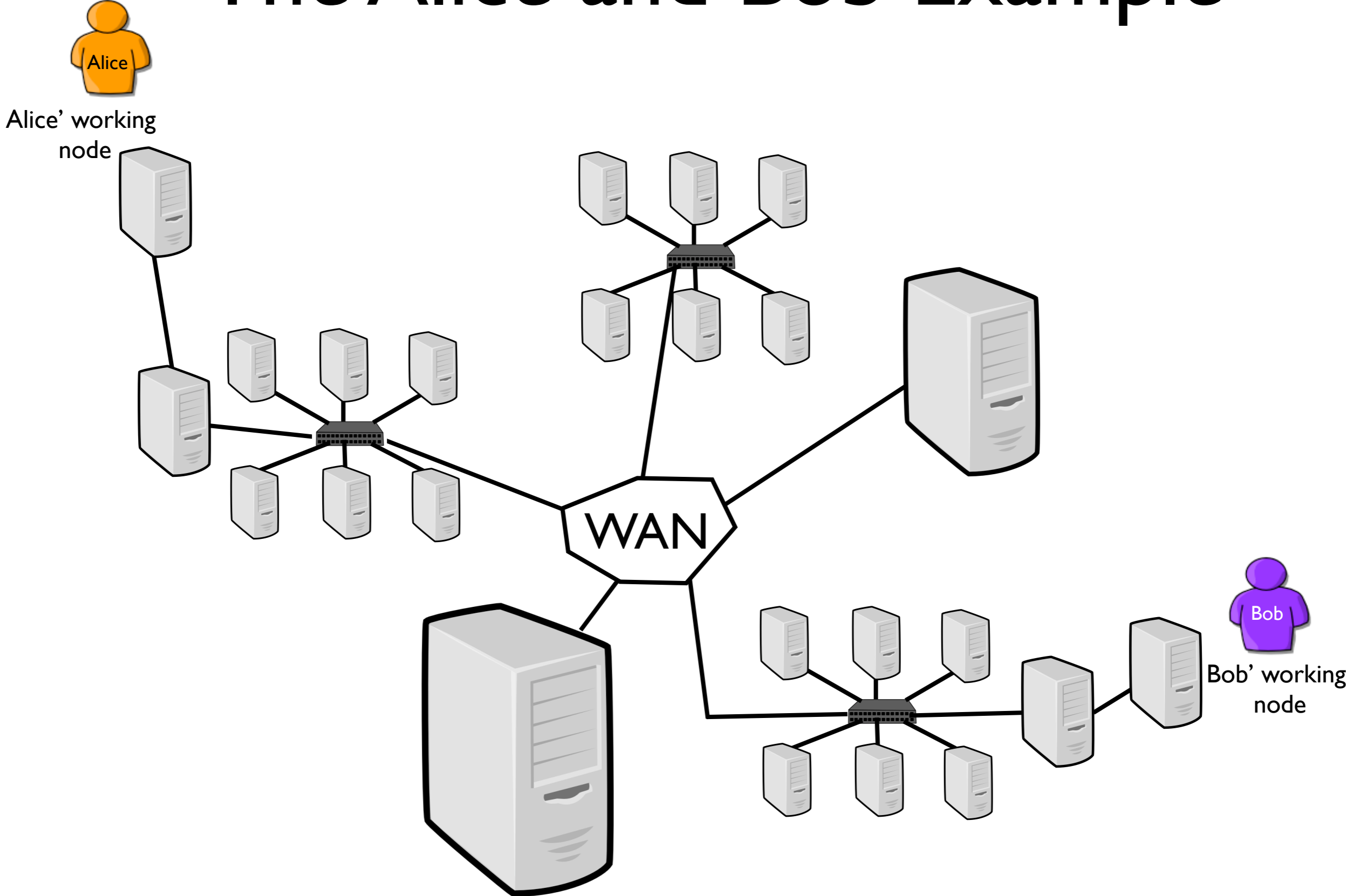
Dropbox
www.getdropbox.com

The Alice and Bob Example

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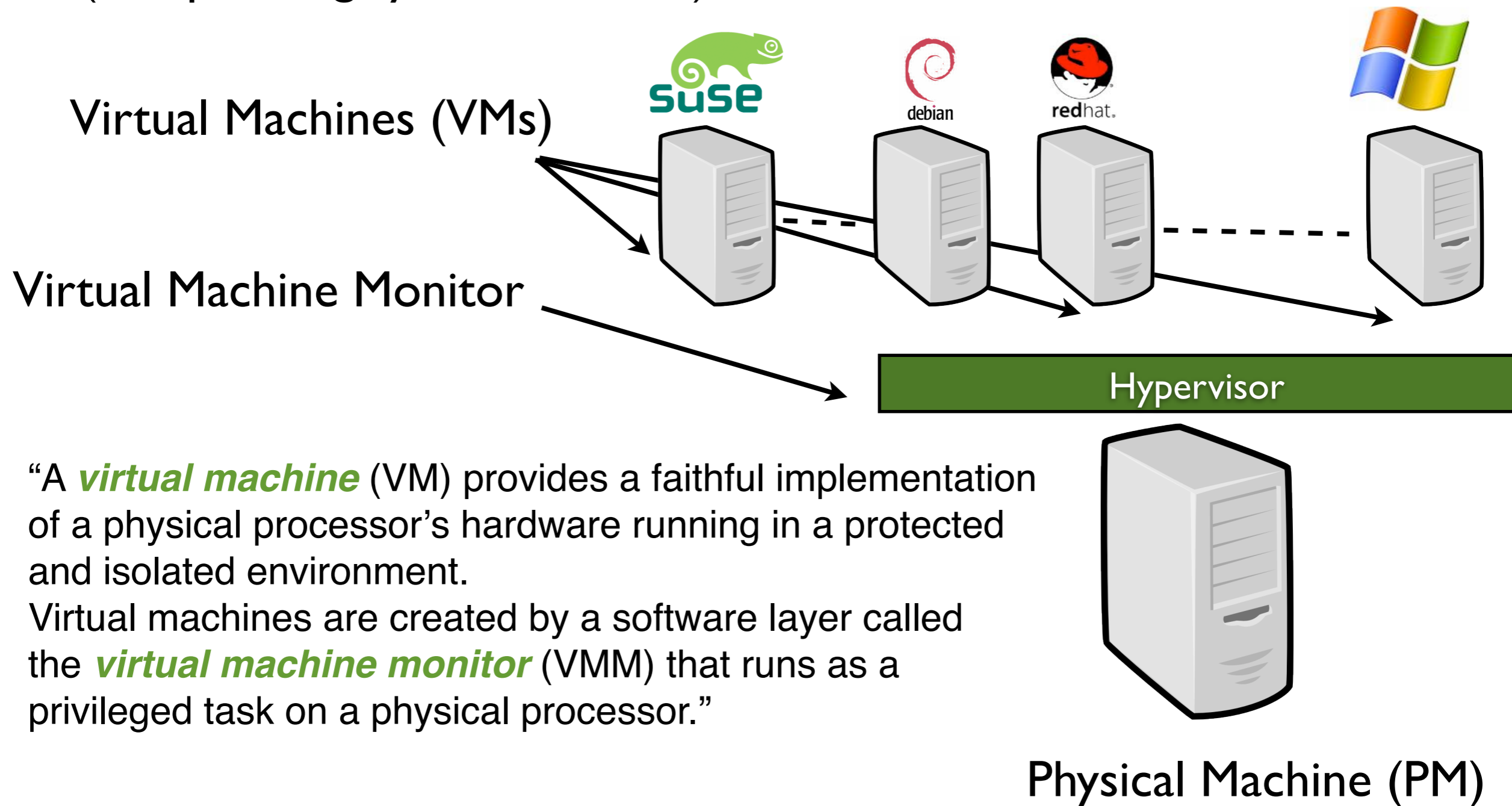# The Alice and Bob Example

Alice' working node
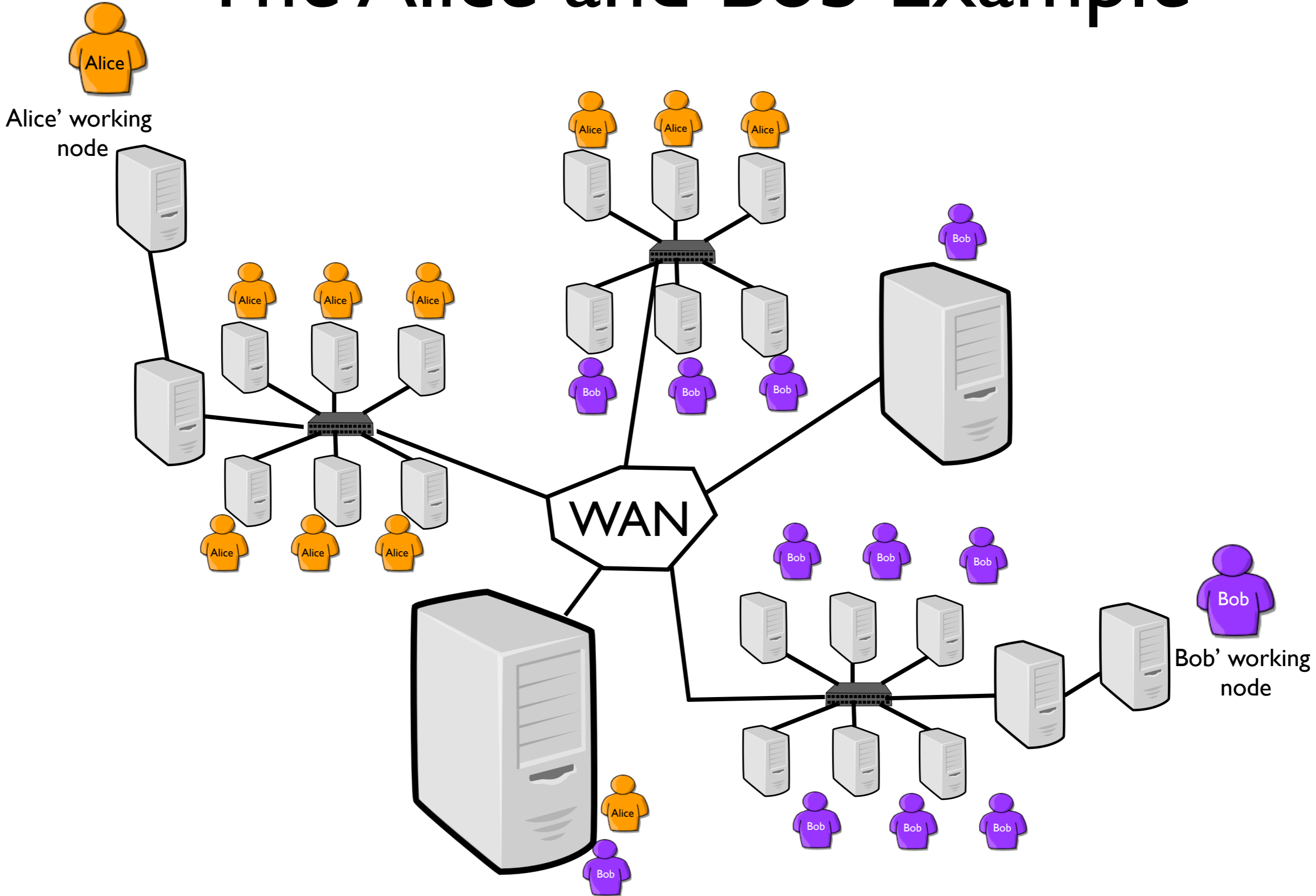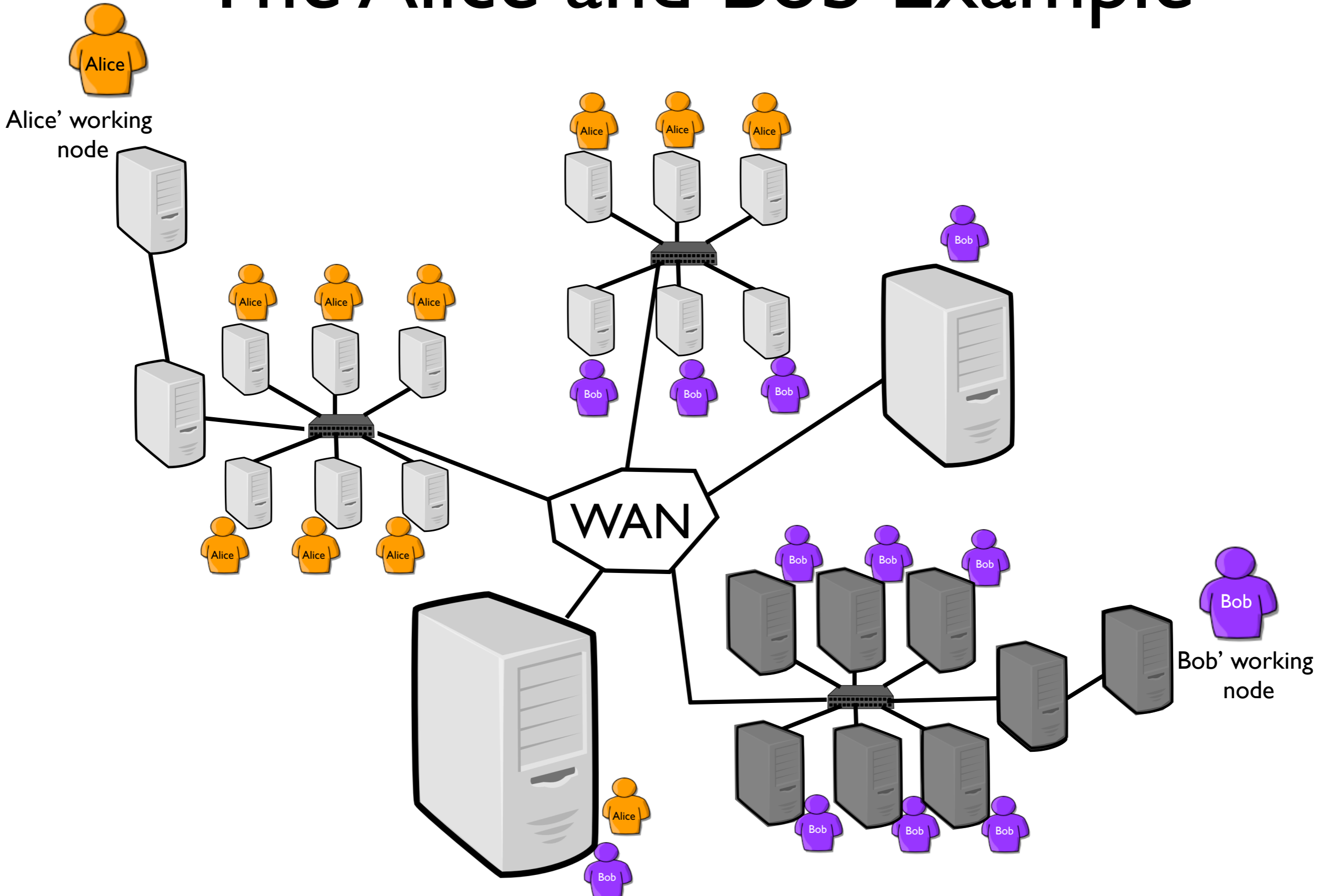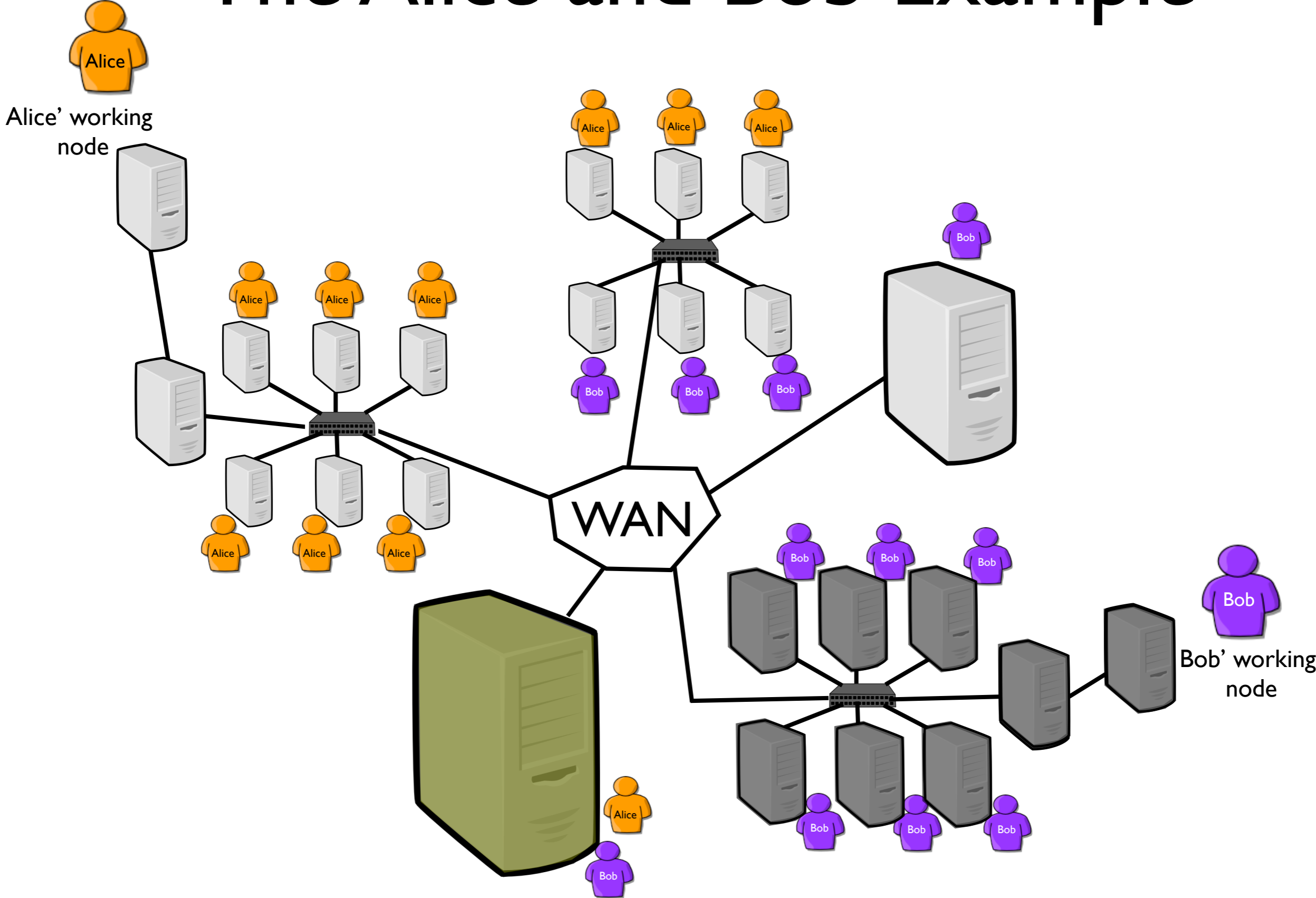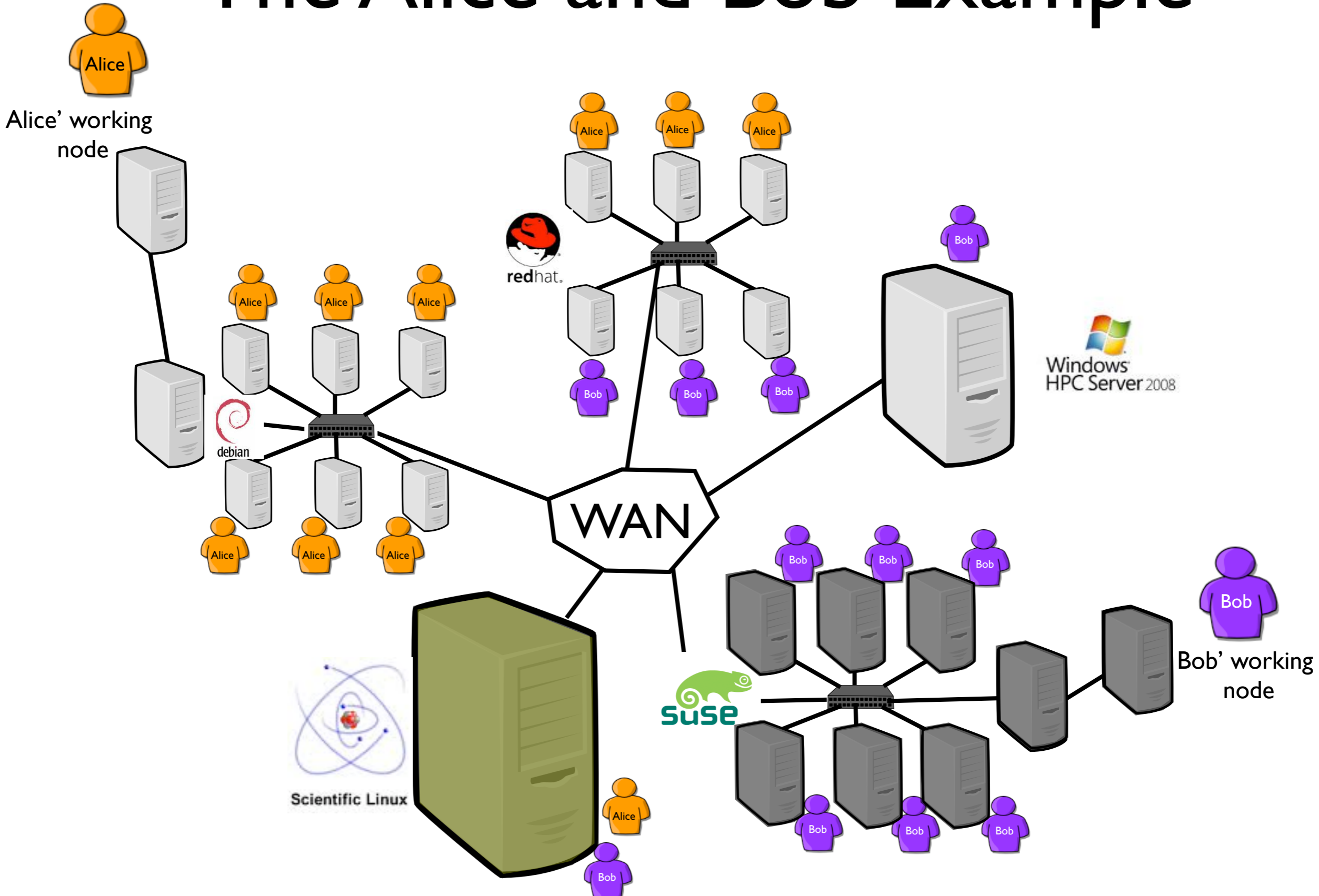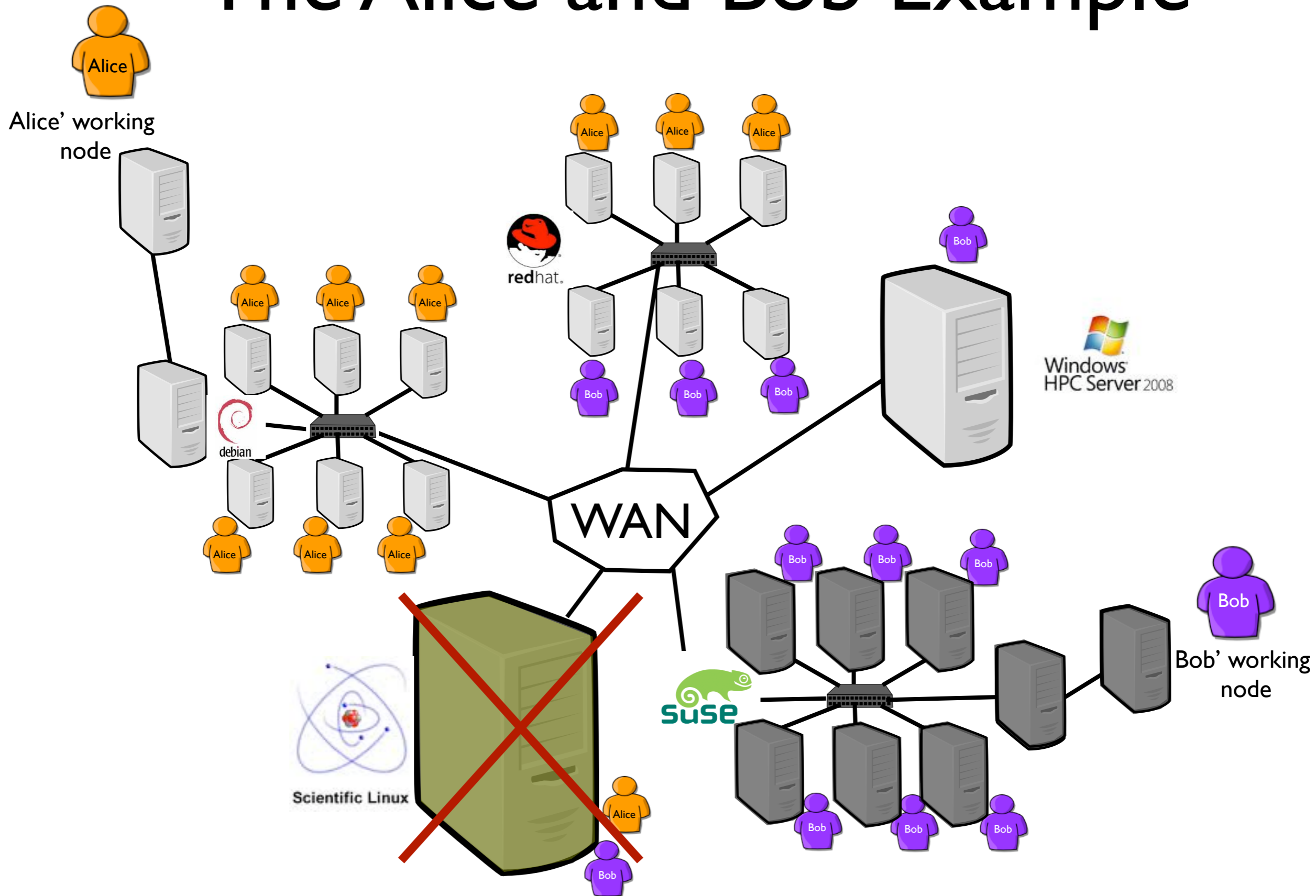
The Alice and Bob Example

Here Comes *System Virtualization*

- One to multiple OSes on a physical node thanks to a hypervisor (an operating system of OSes)
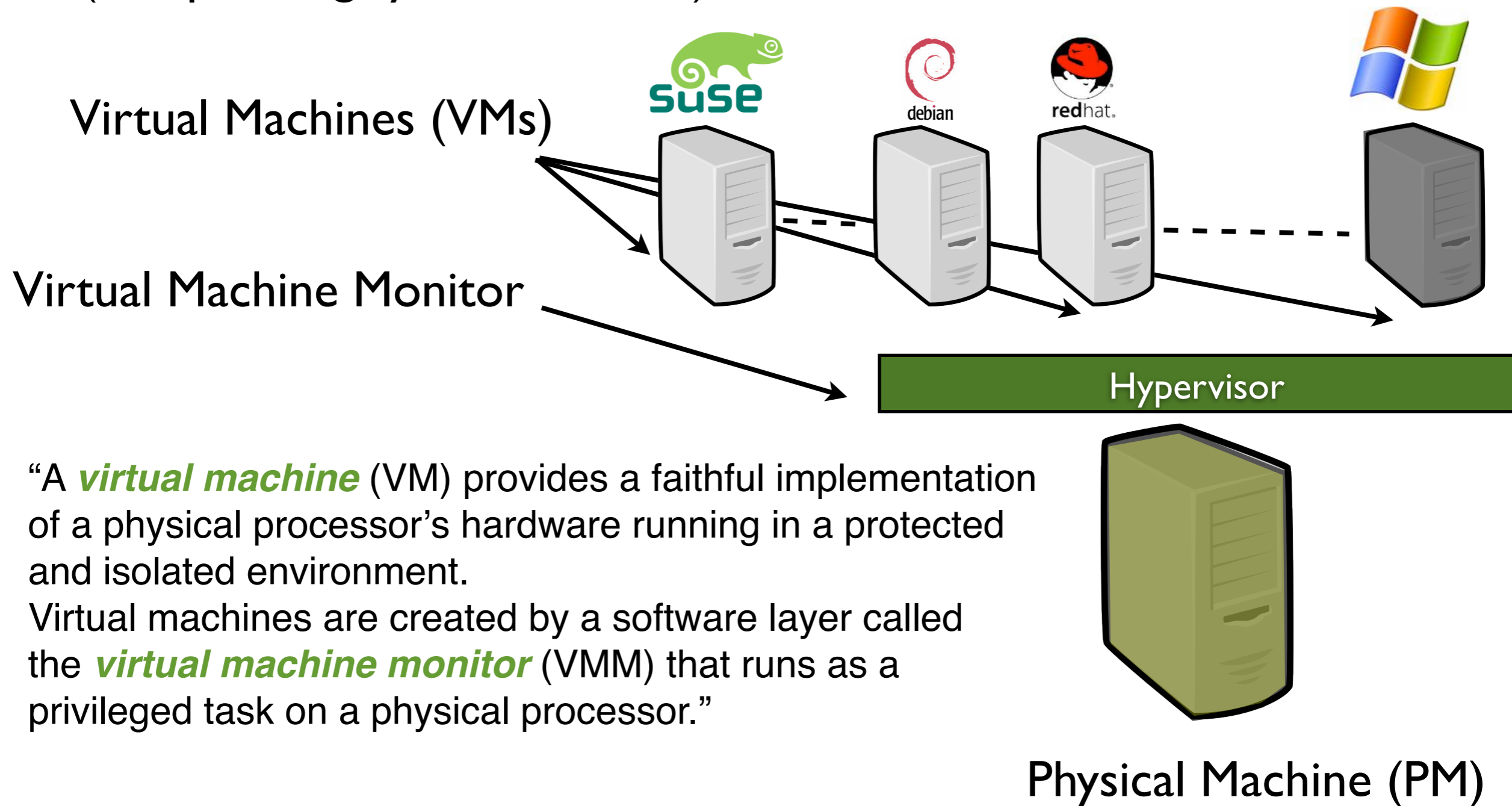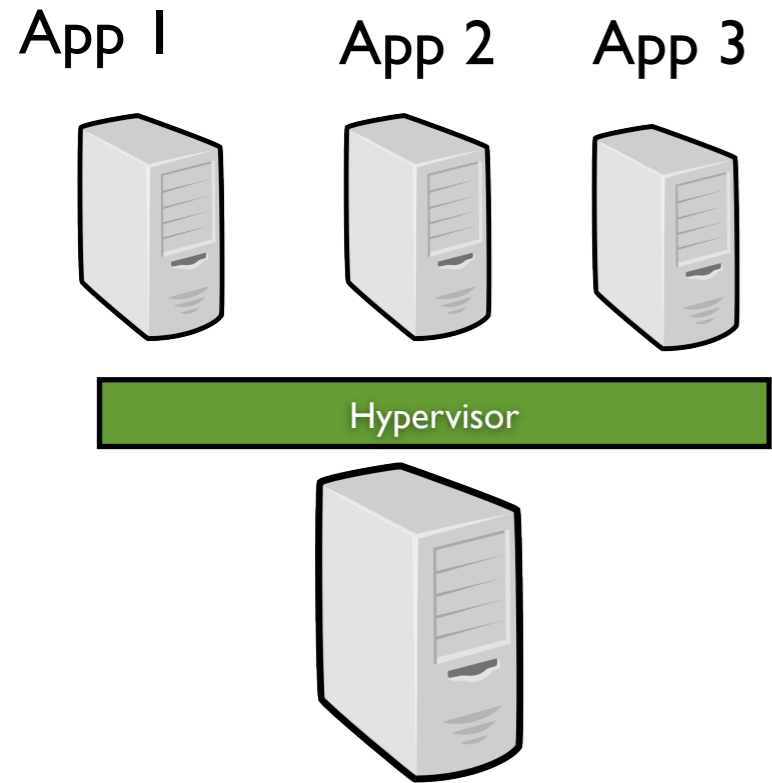
Virtual Machines (VMs)

Virtual Machine Monitor

Hypervisor

"A ***virtual machine*** (VM) provides a faithful implementation of a physical processor's hardware running in a protected and isolated environment.
Virtual machines are created by a software layer called the ***virtual machine monitor*** (VMM) that runs as a privileged task on a physical processor."
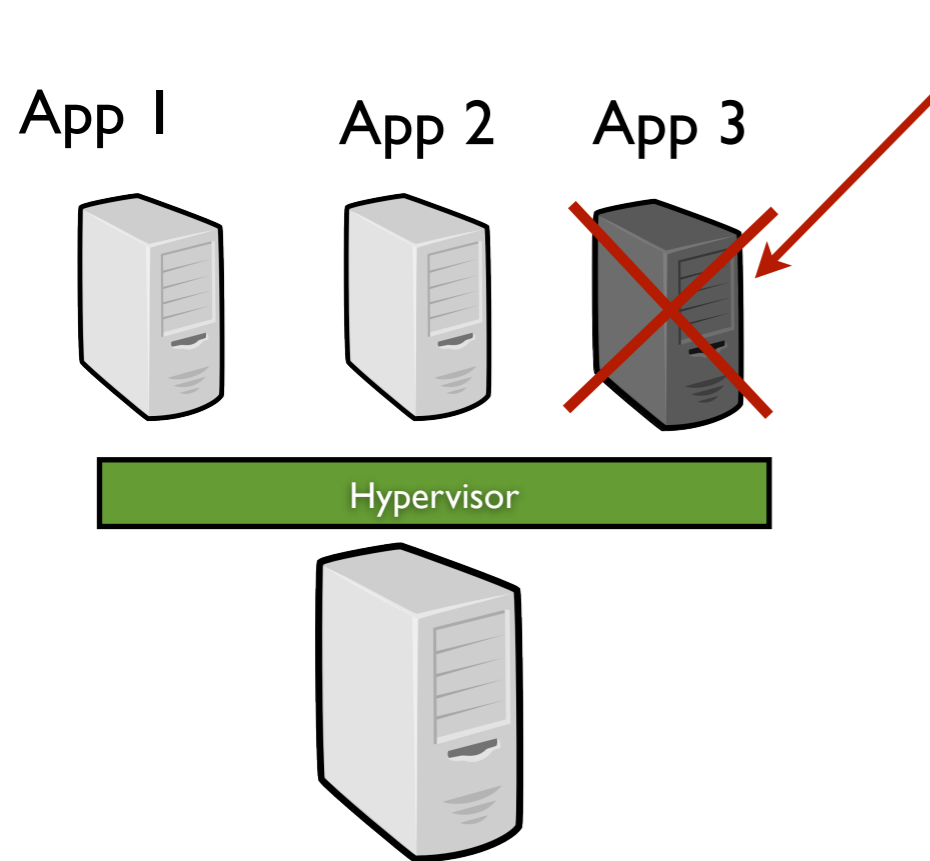
Physical Machine (PM)

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Physical Machine (PM)

VM Capabilities

App 1 App 2 App 3

Hypervisor

- Isolation ("security" between each VM)

VM Capabilities

Virus / Invasion / Crash

App 1   App 2   App 3

Hypervisor

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VM Capabilities
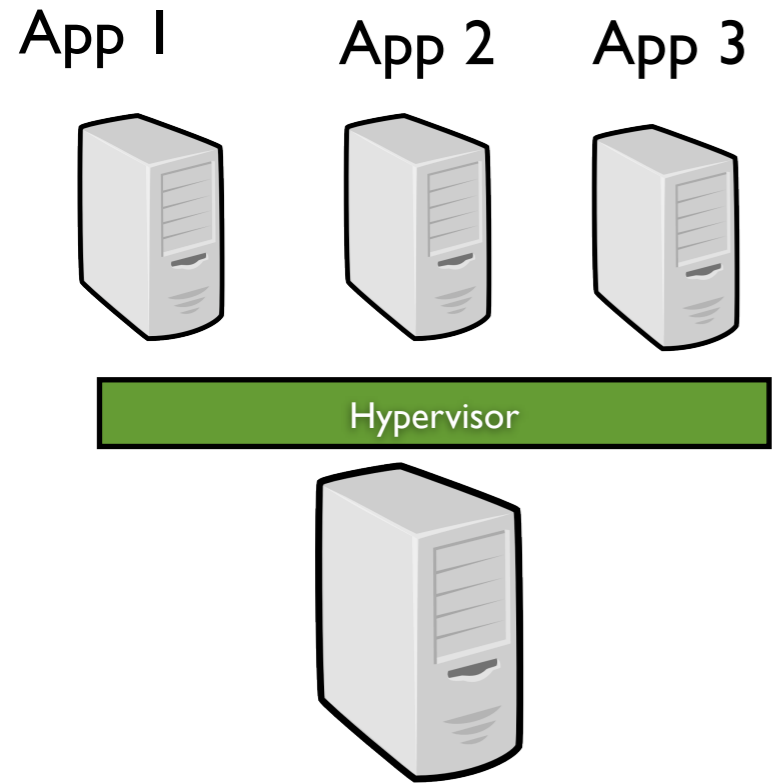

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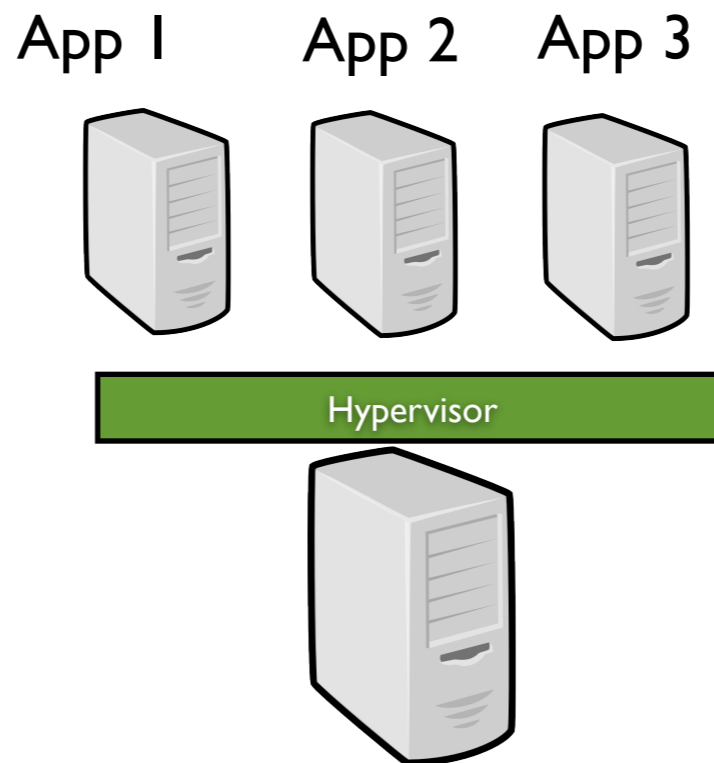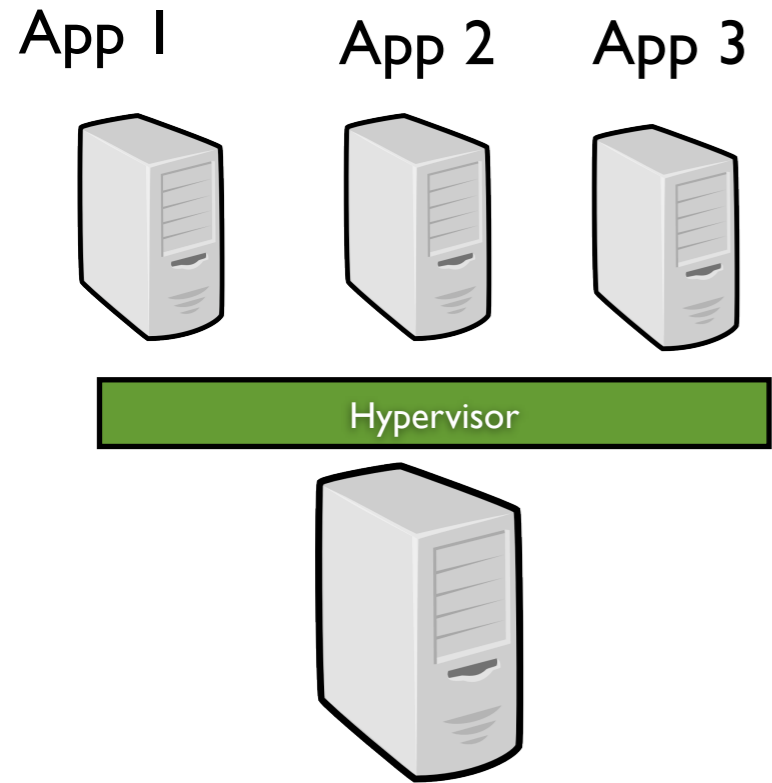- Snapshotting (a VM can be easily resume from its latest consistent state)

VM Capabilities

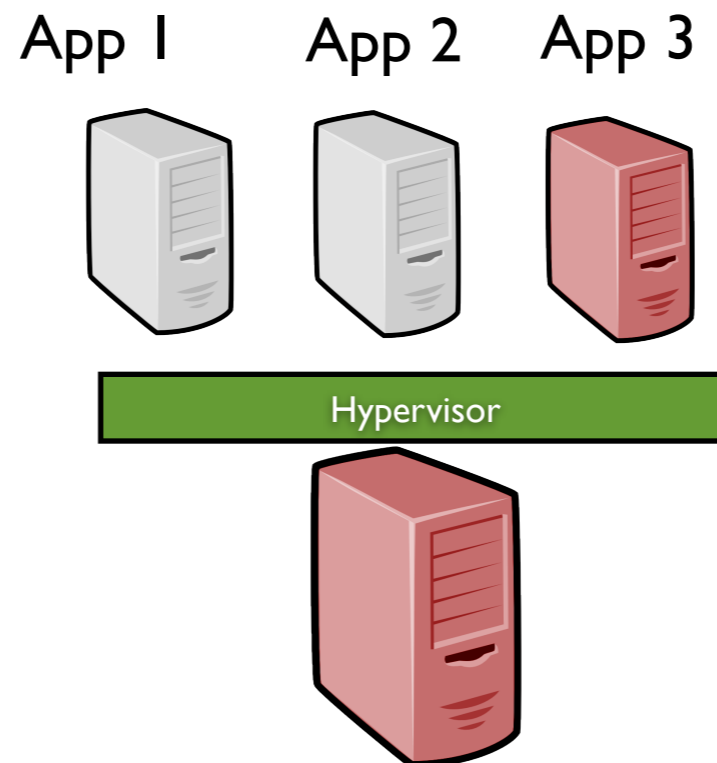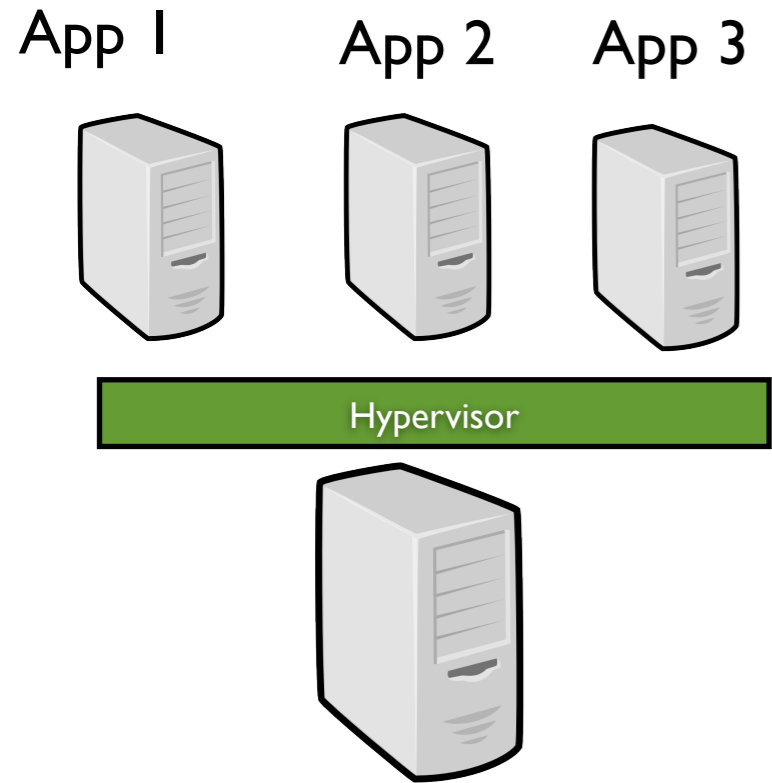App 1 App 2 App 3

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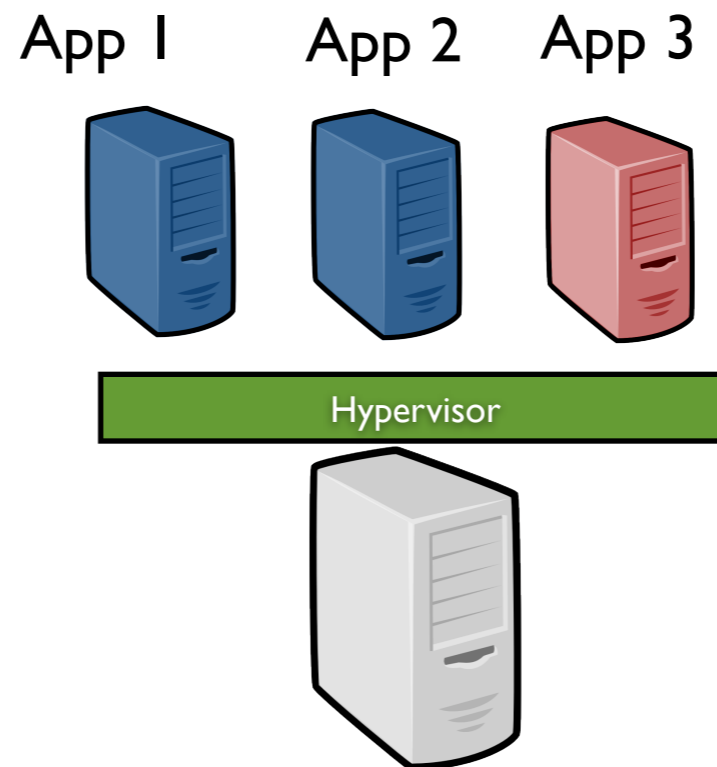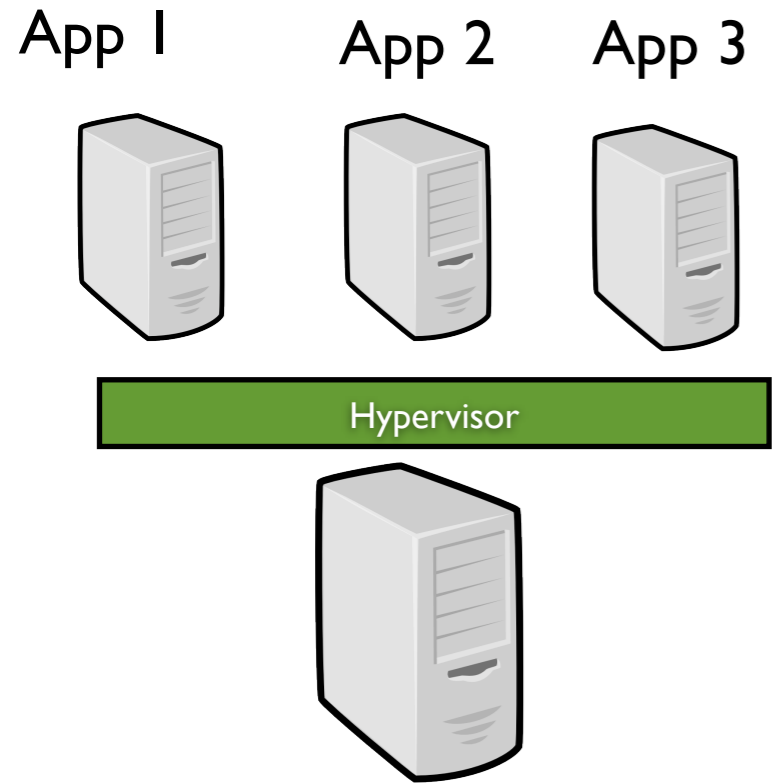- Snapshotting (a VM can be easily resume from its latest consistent state)

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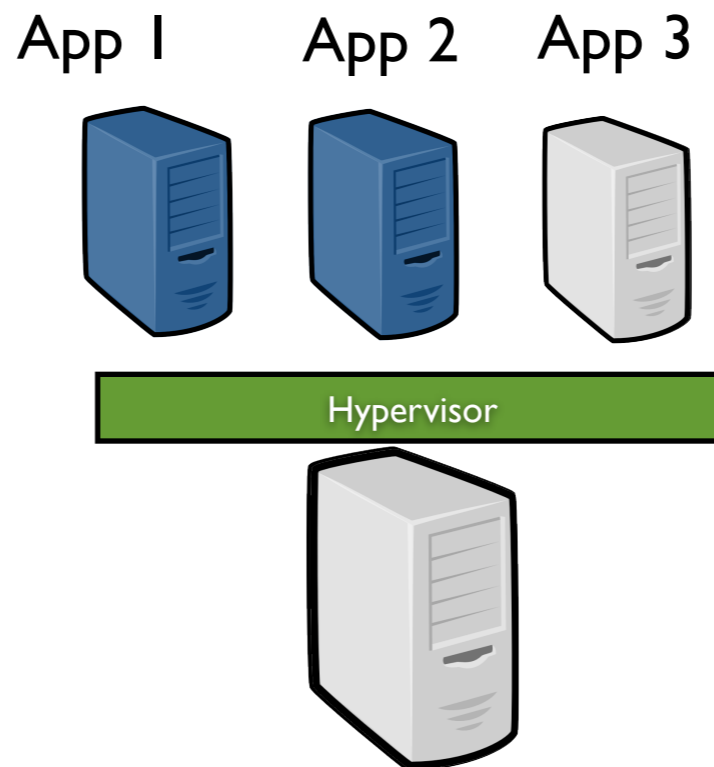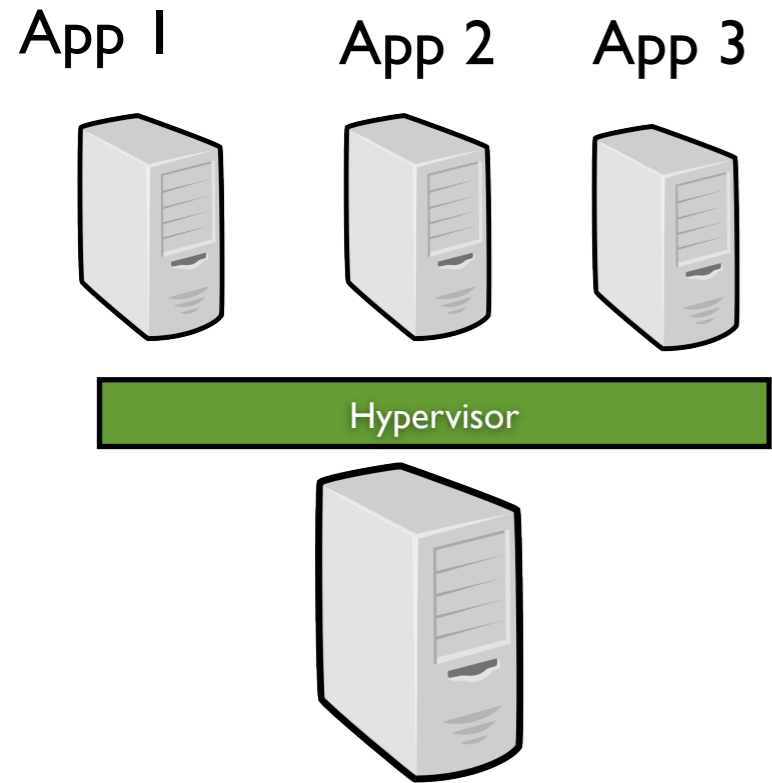- Snapshotting (a VM can be easily resume from its latest consistent state)

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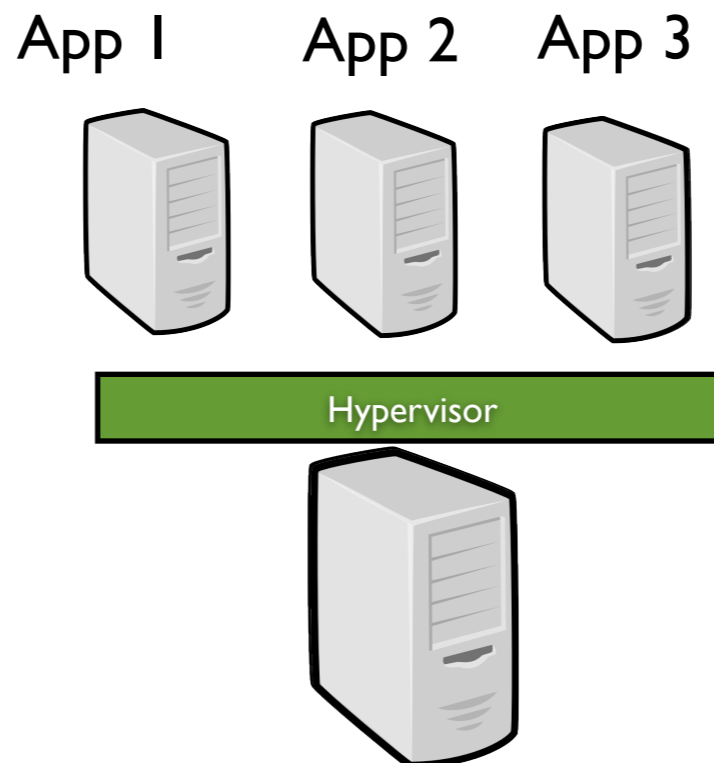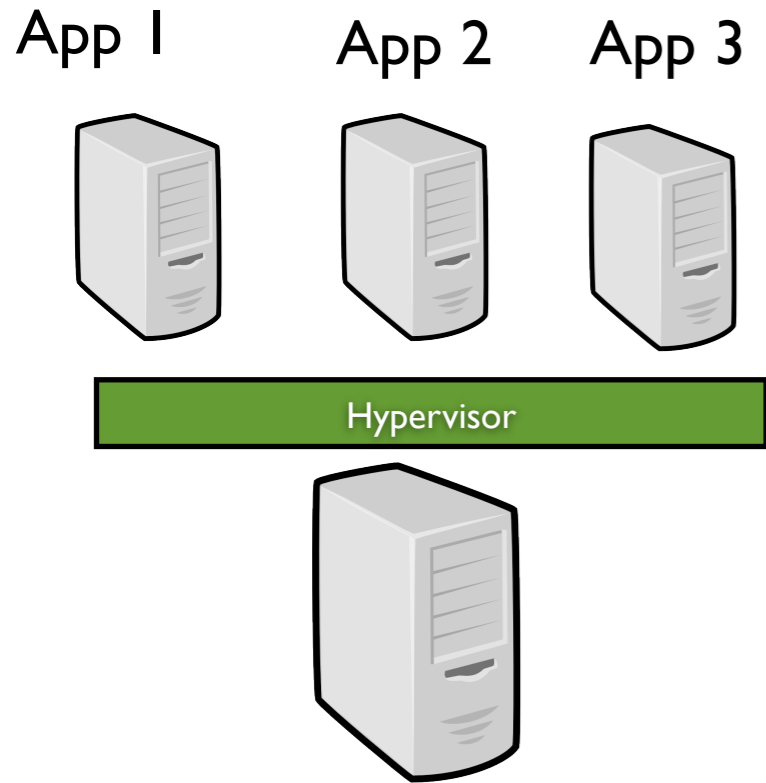Hypervisor

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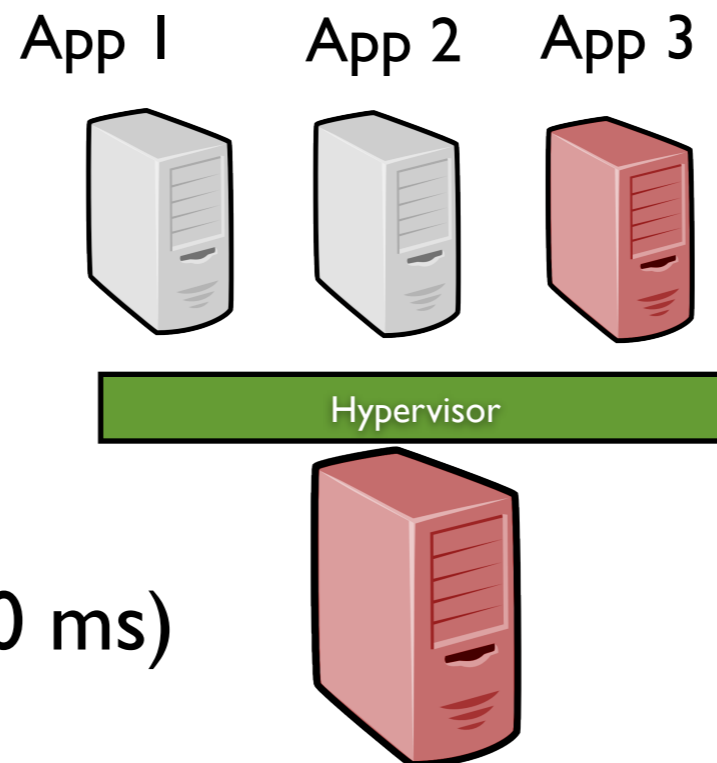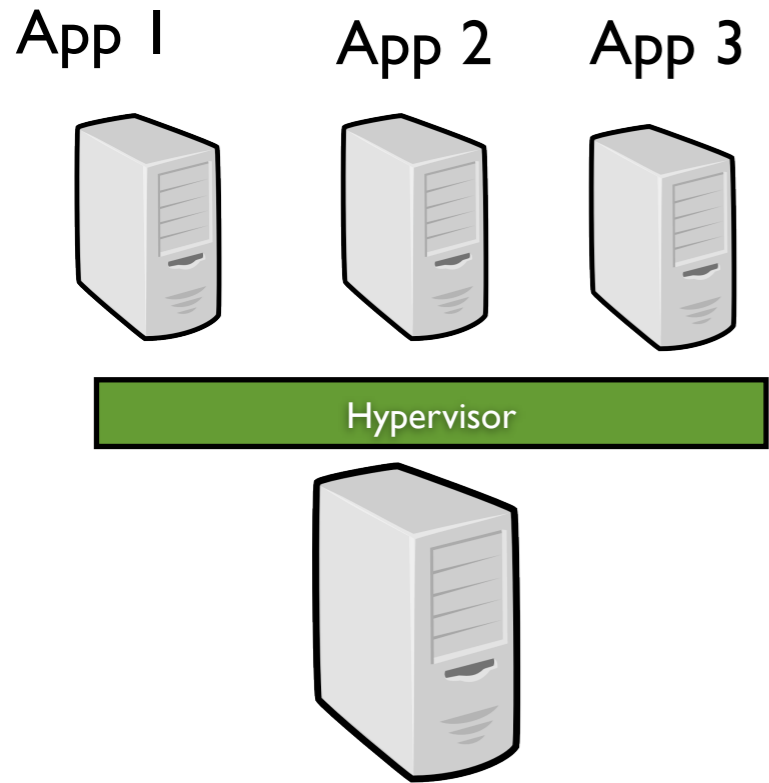- Snapshotting (a VM can be easily resume from its latest consistent state)

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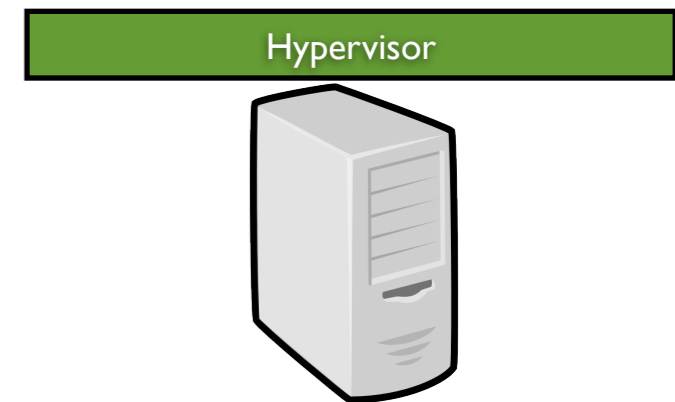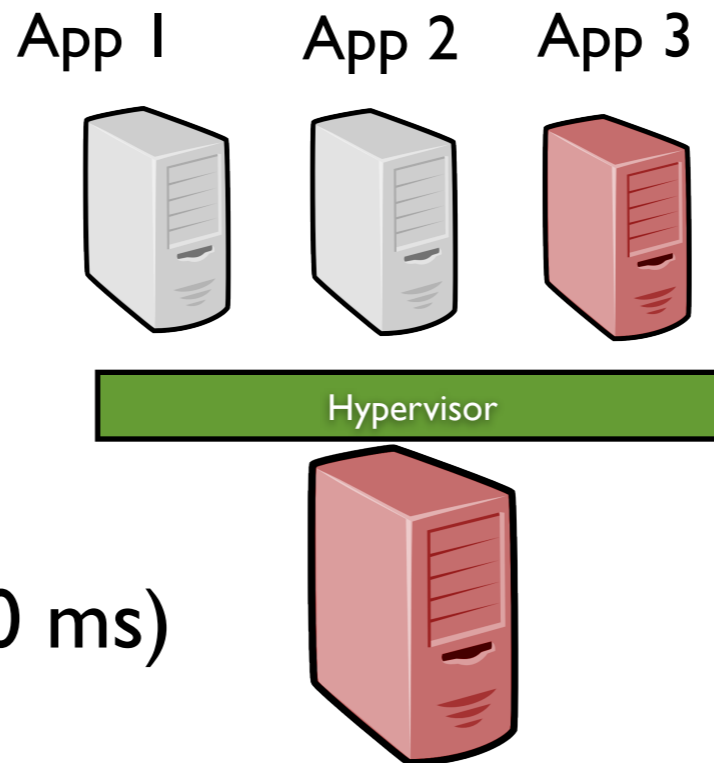- Snapshotting (a VM can be easily resume from its latest consistent state)

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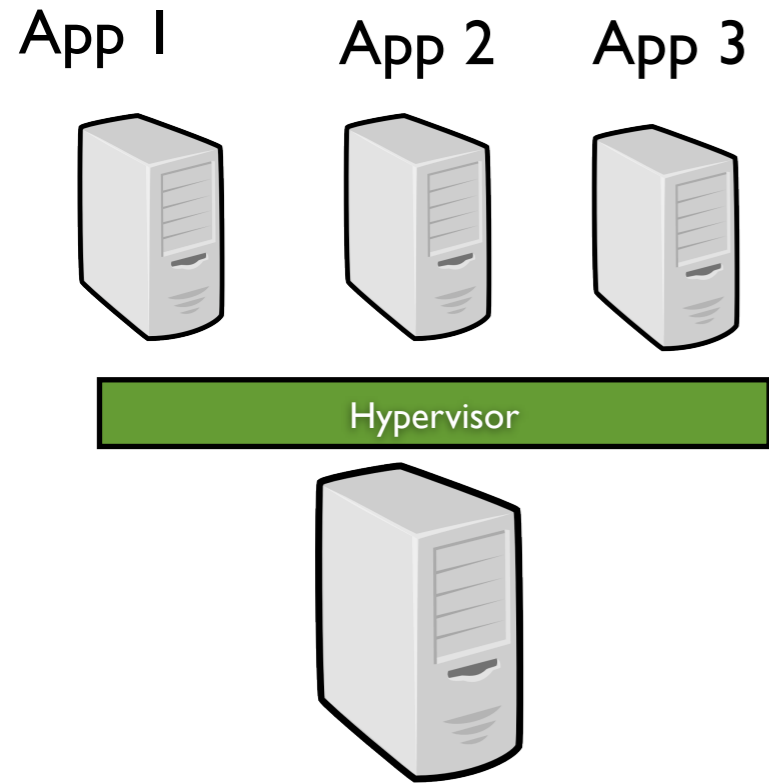Hypervisor

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Hypervisor

- Suspend/Resume

- Live migration
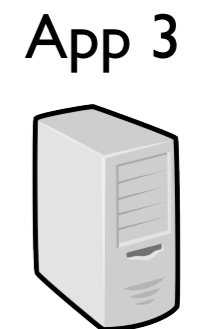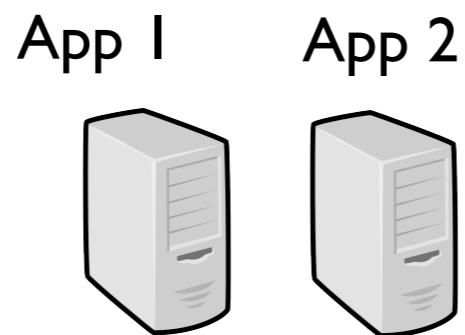(negligible downtime ~ 60 ms)
Post/Pre Copy

VM Capabilities

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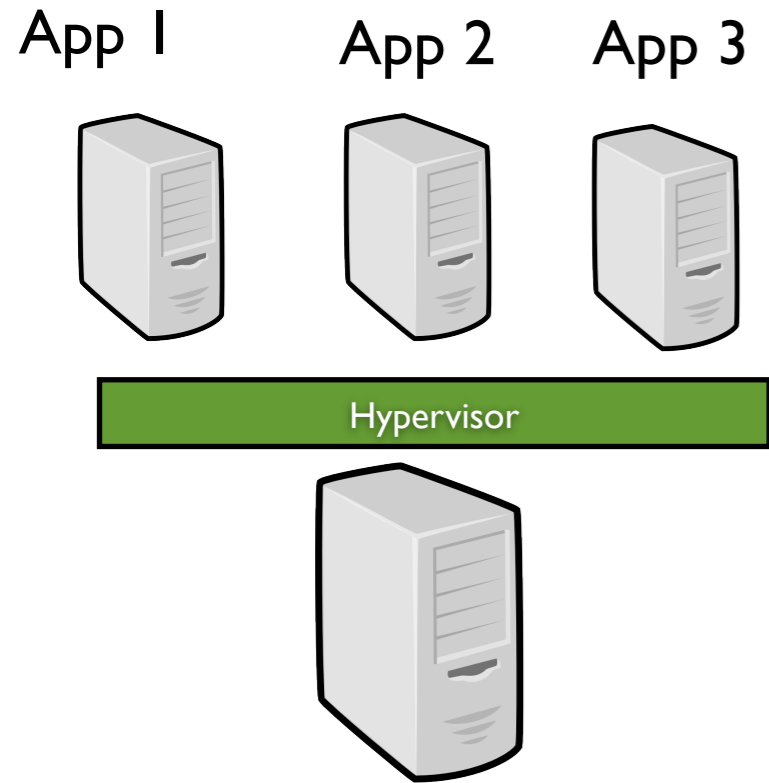
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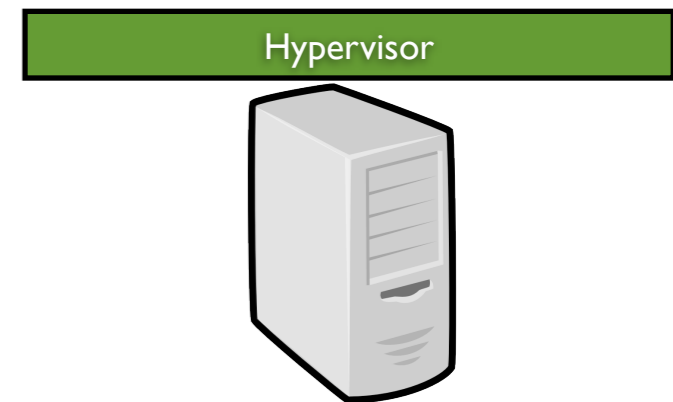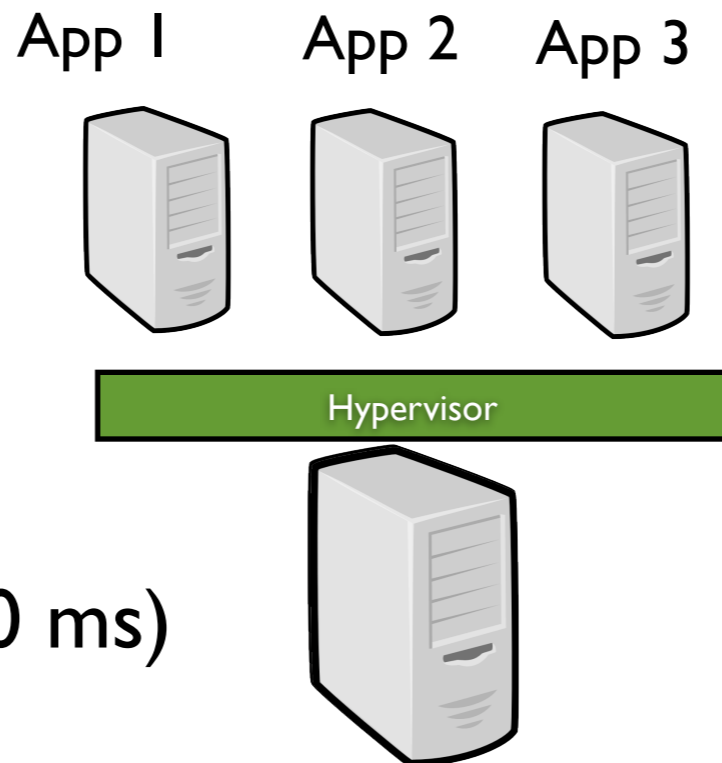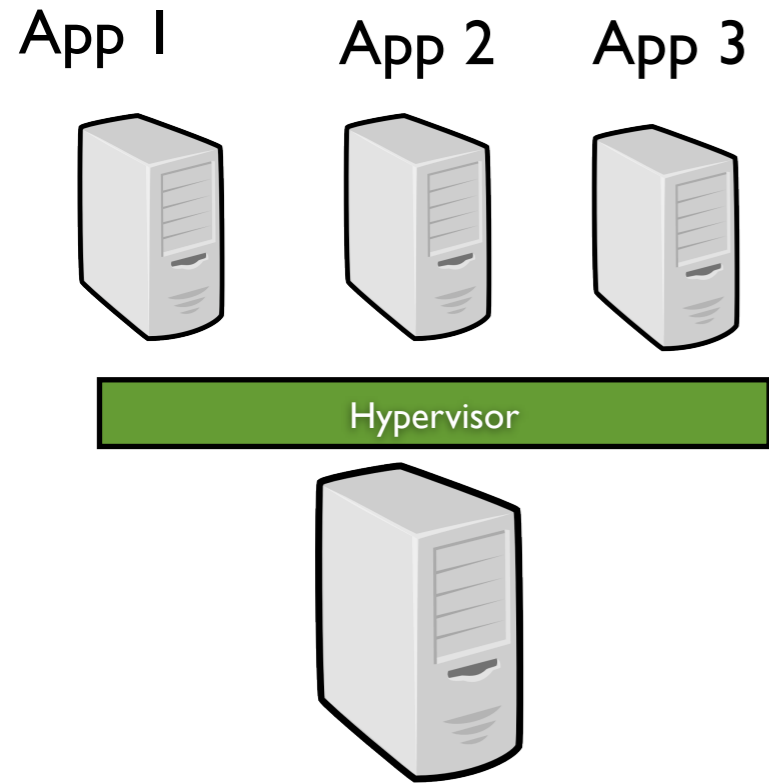App 1   App 2   App 3

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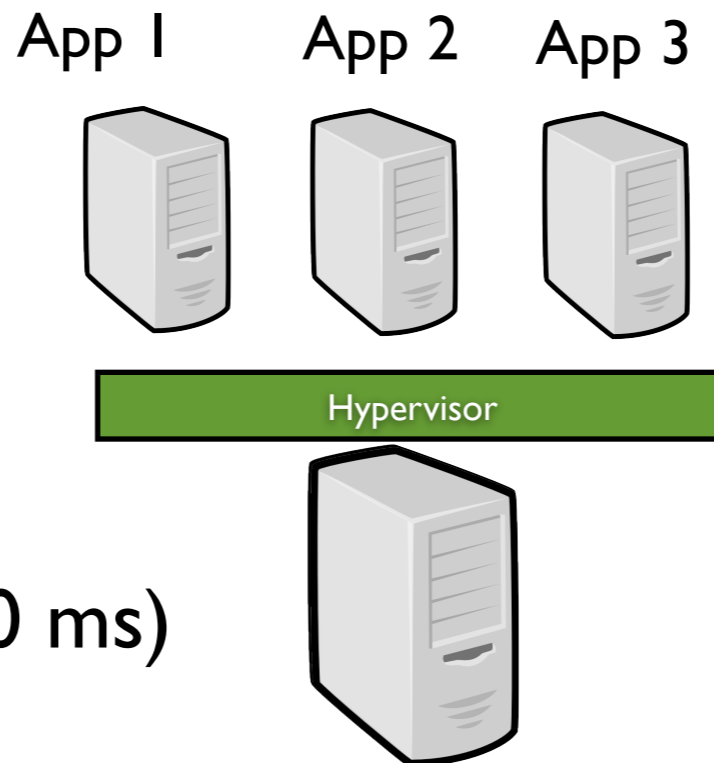
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VM Capabilities

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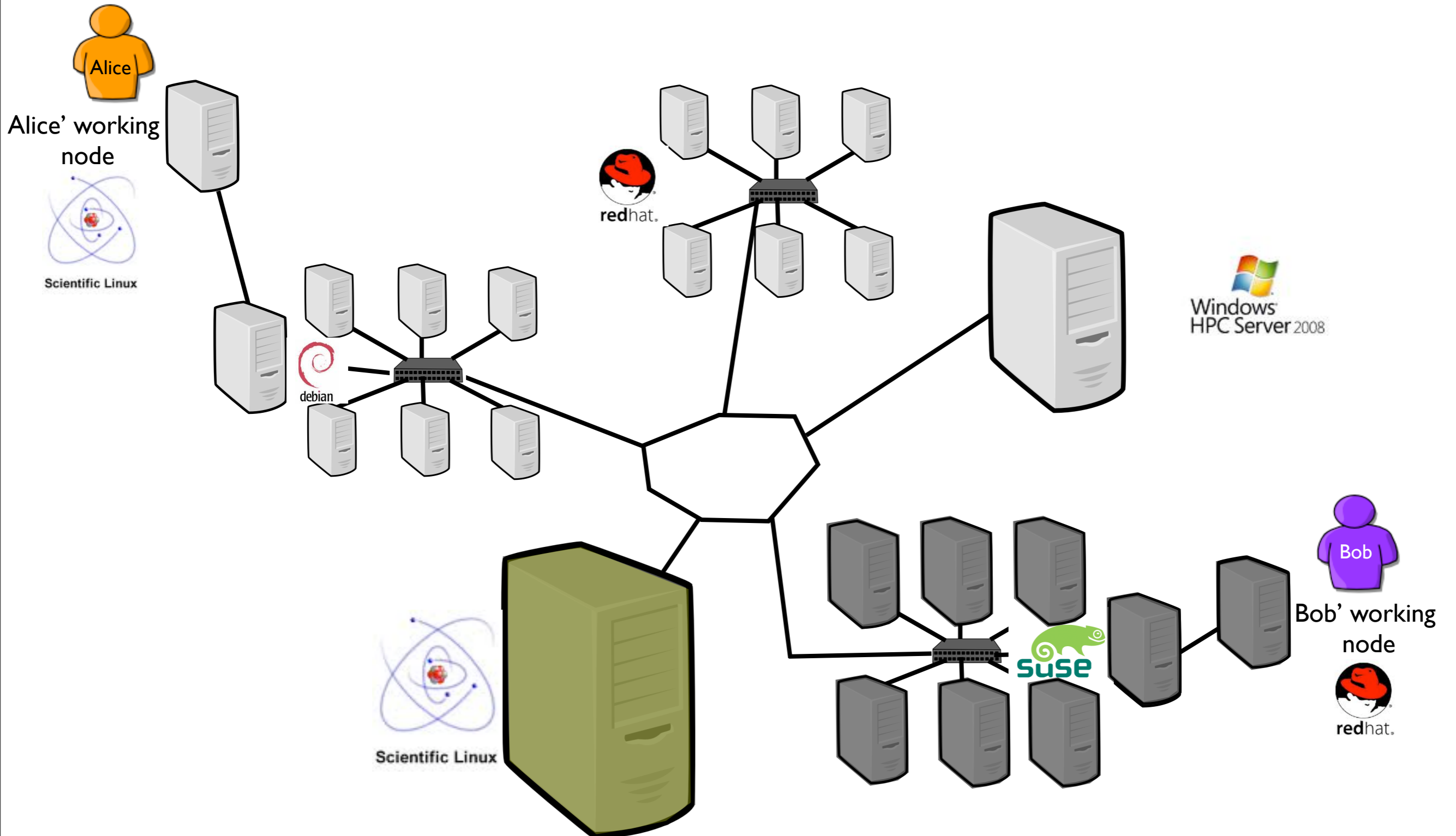 (negligible downtime ~ 60 ms)
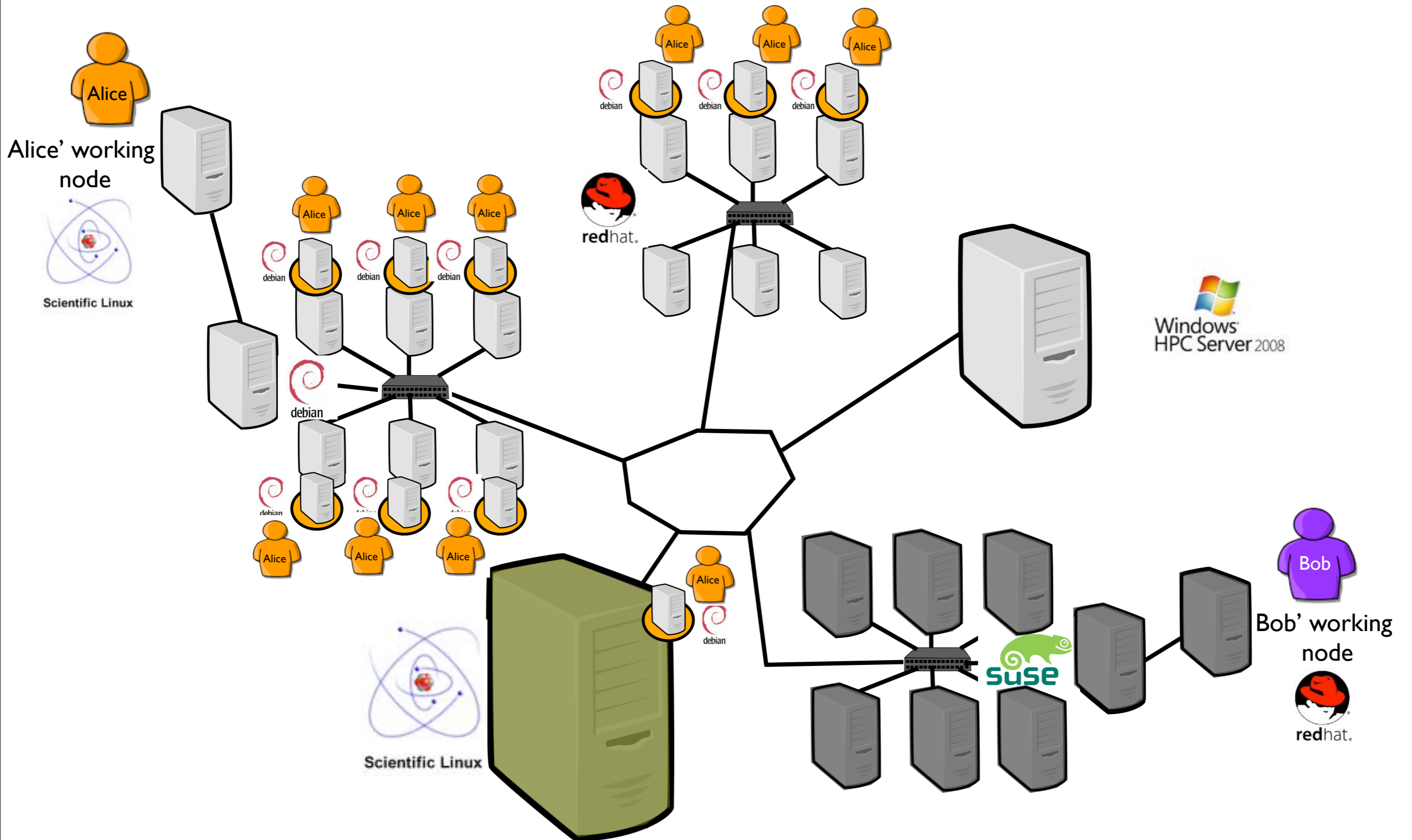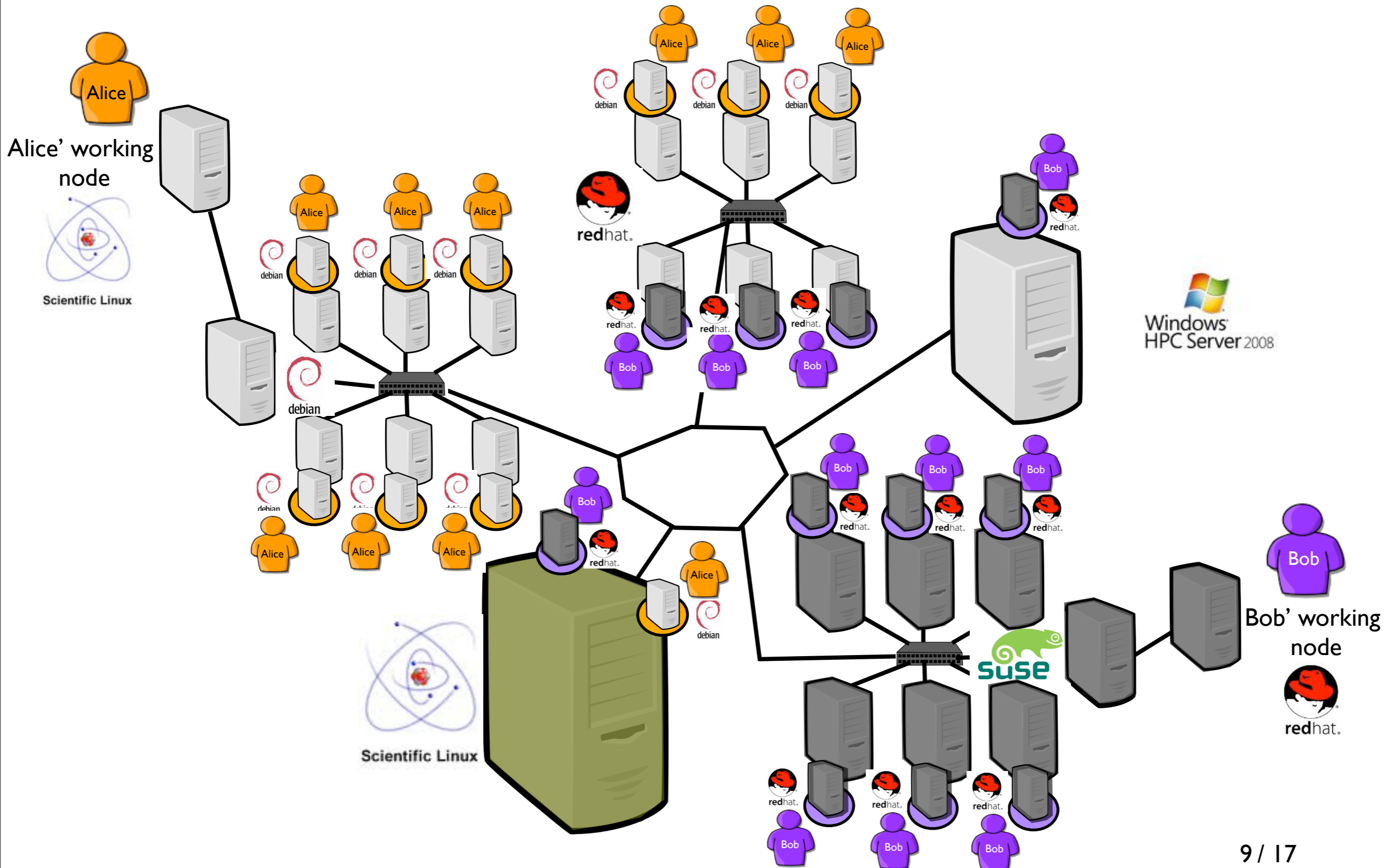 Post/Pre Copy

Where we are - going - ?
The Alice and Bob Example
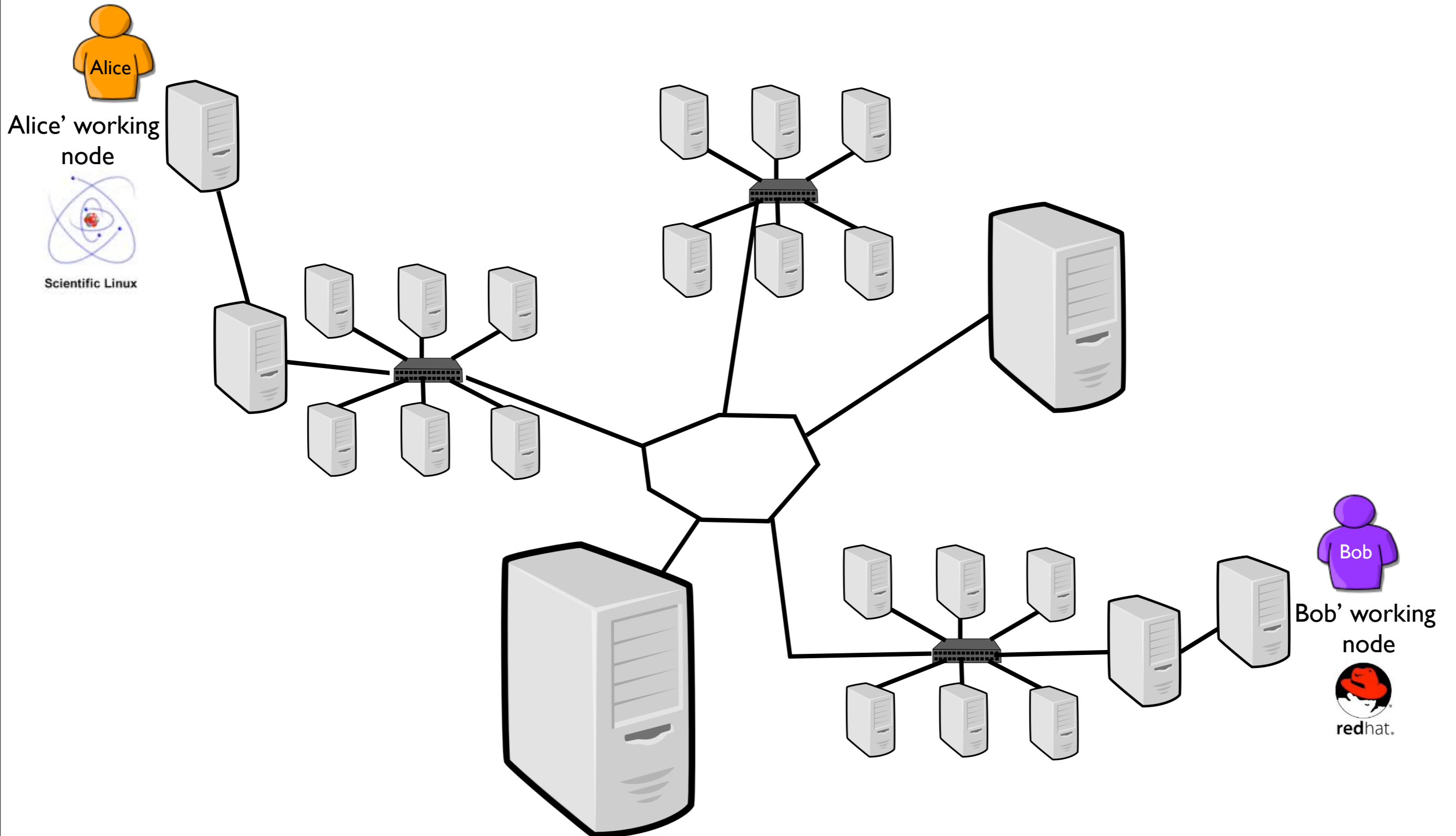
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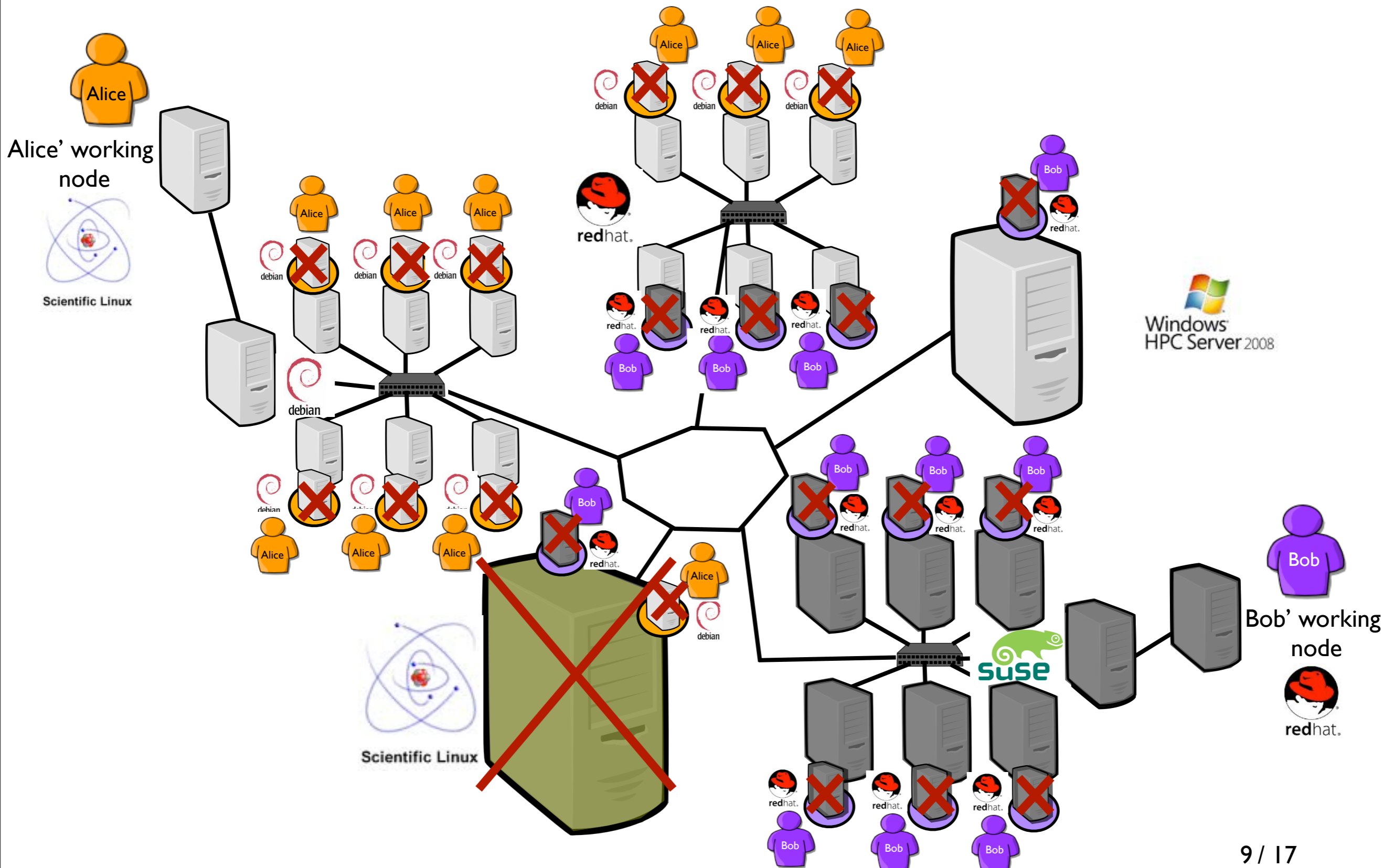
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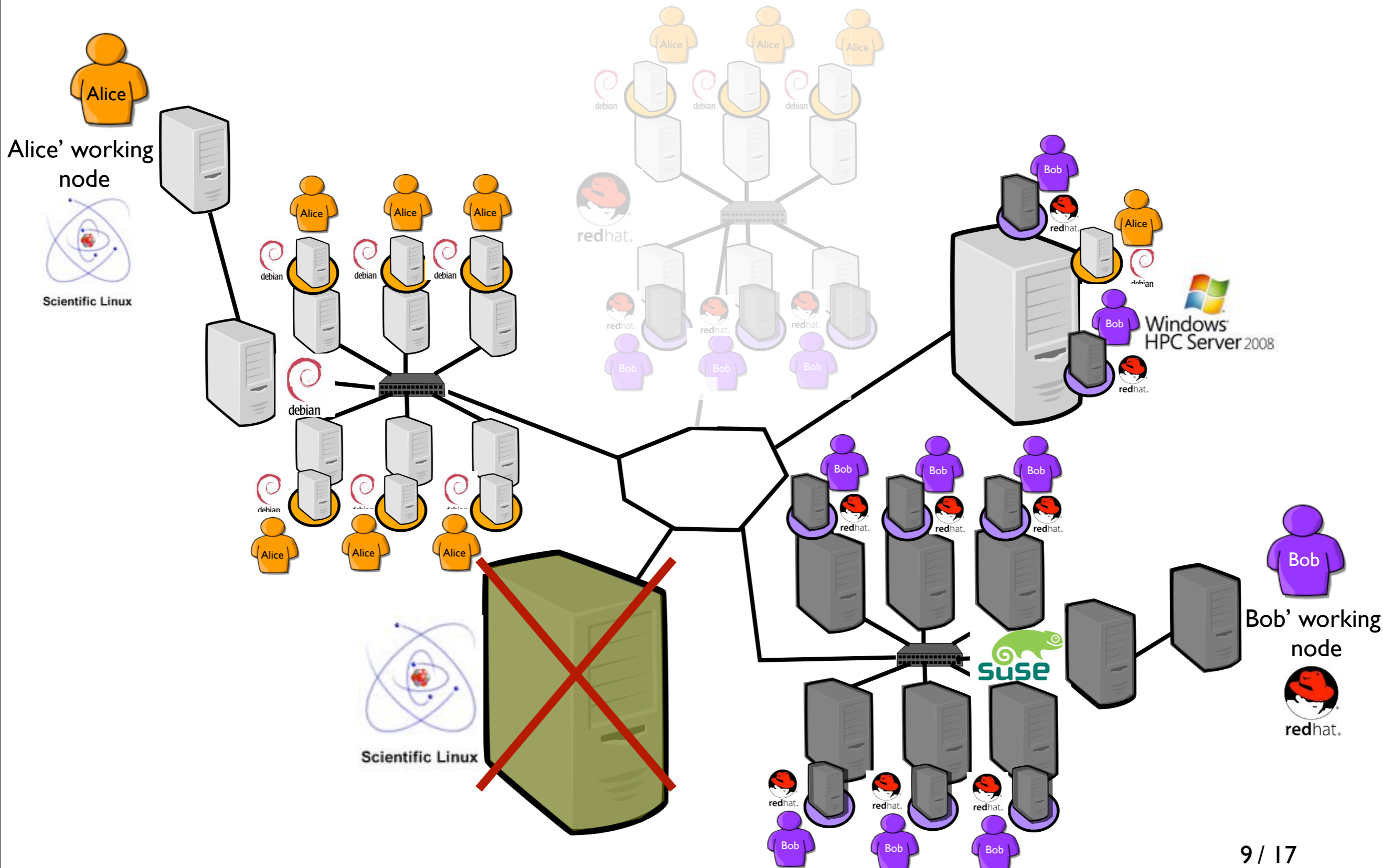
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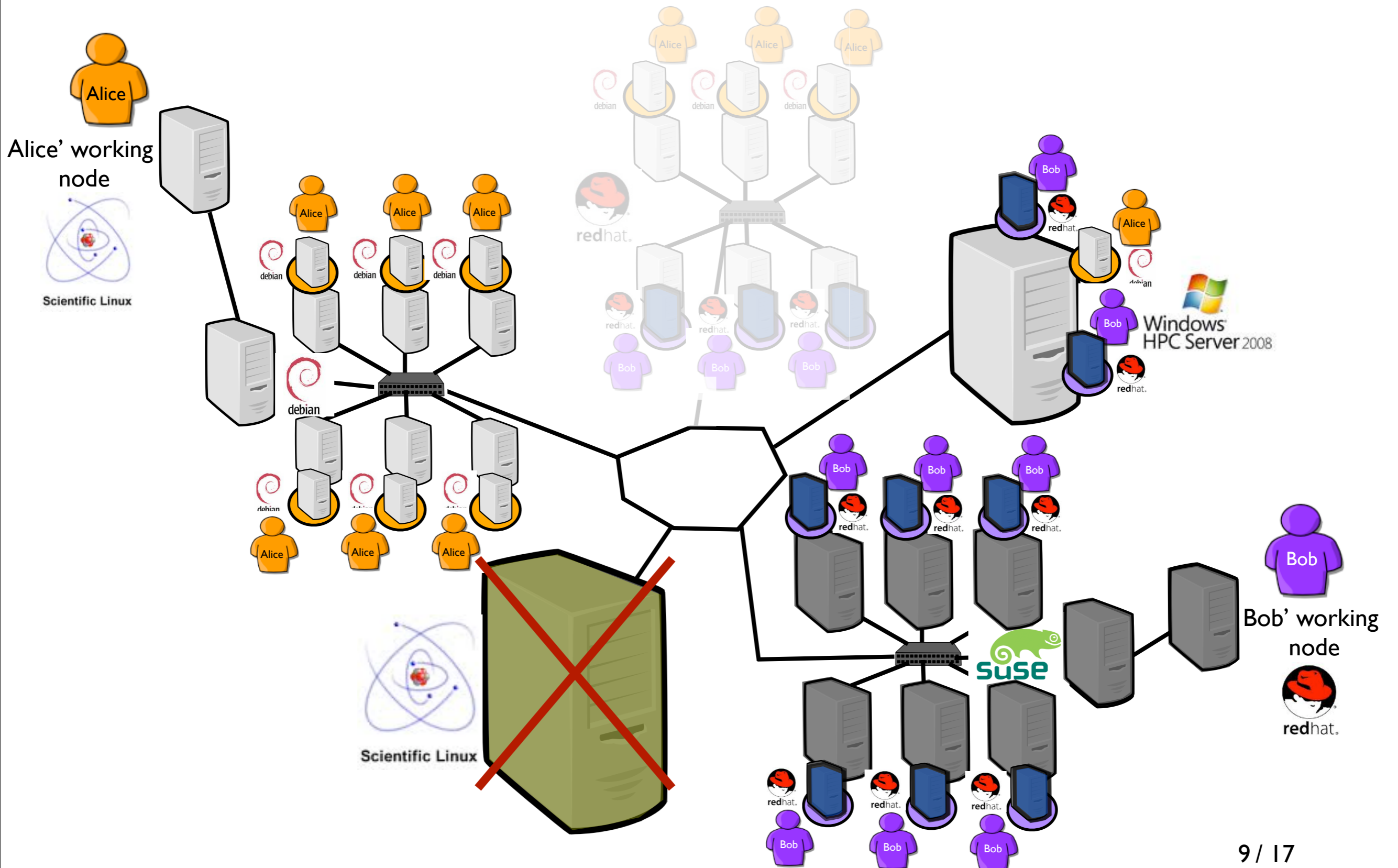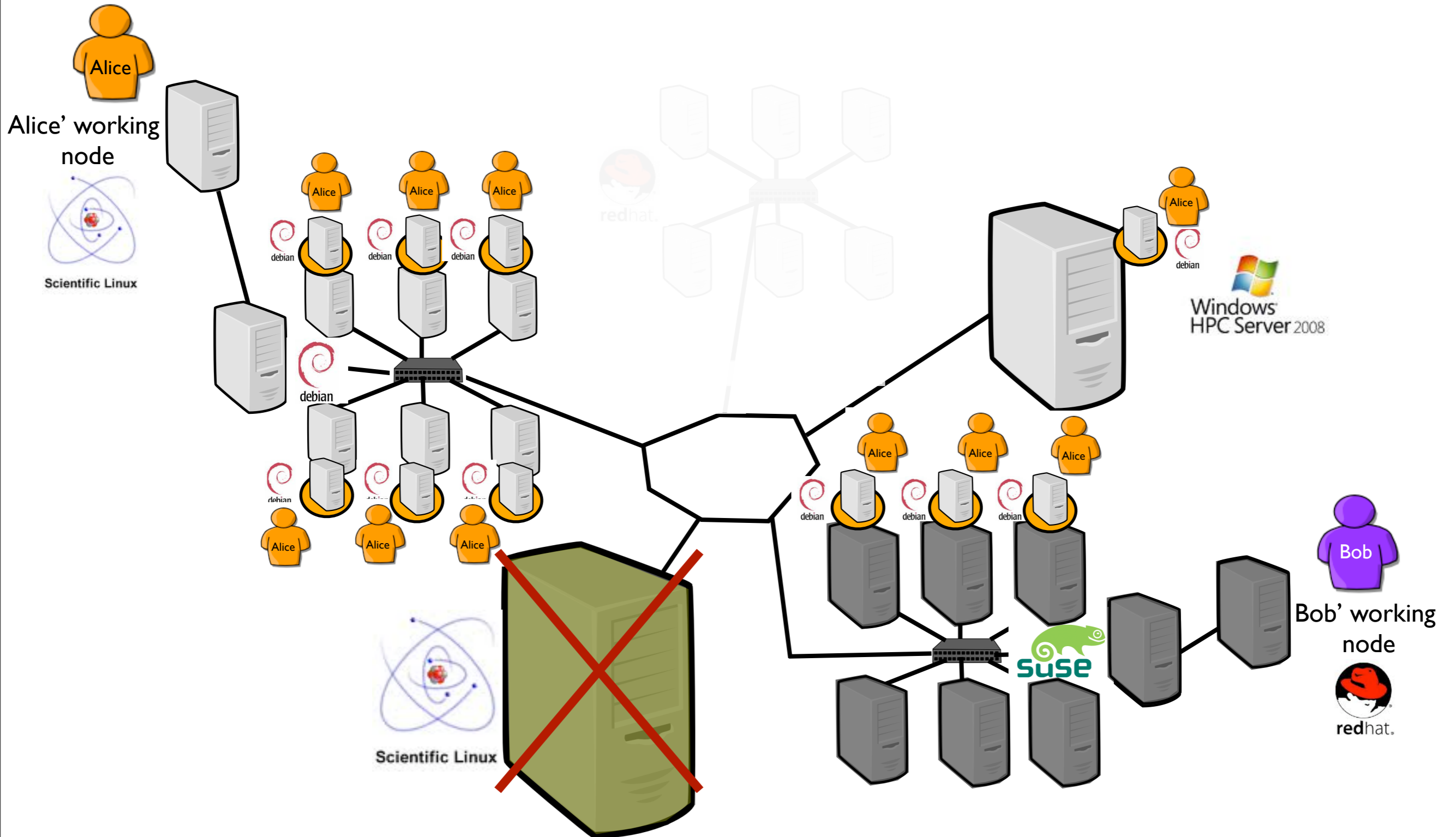## The Alice and Bob Example

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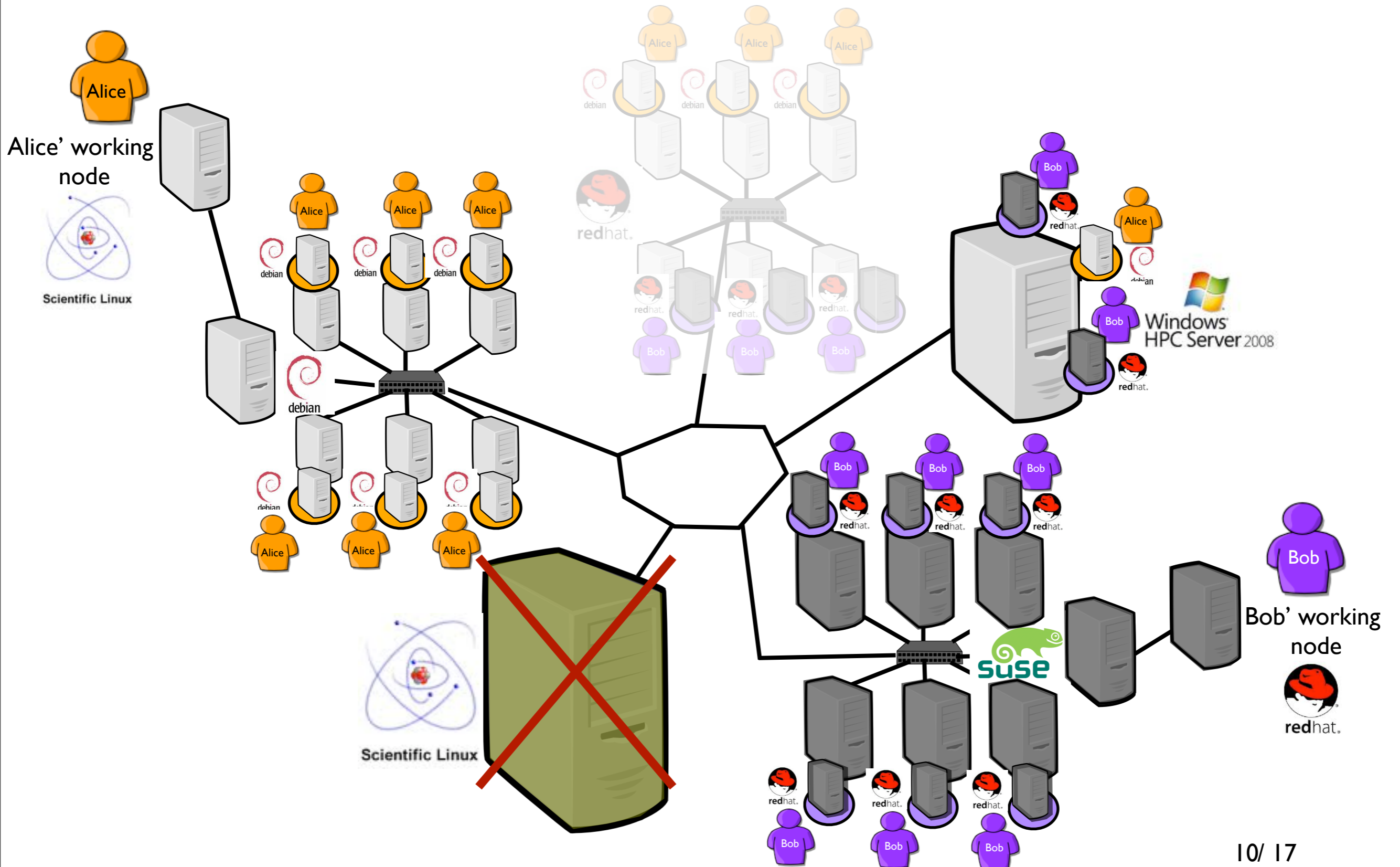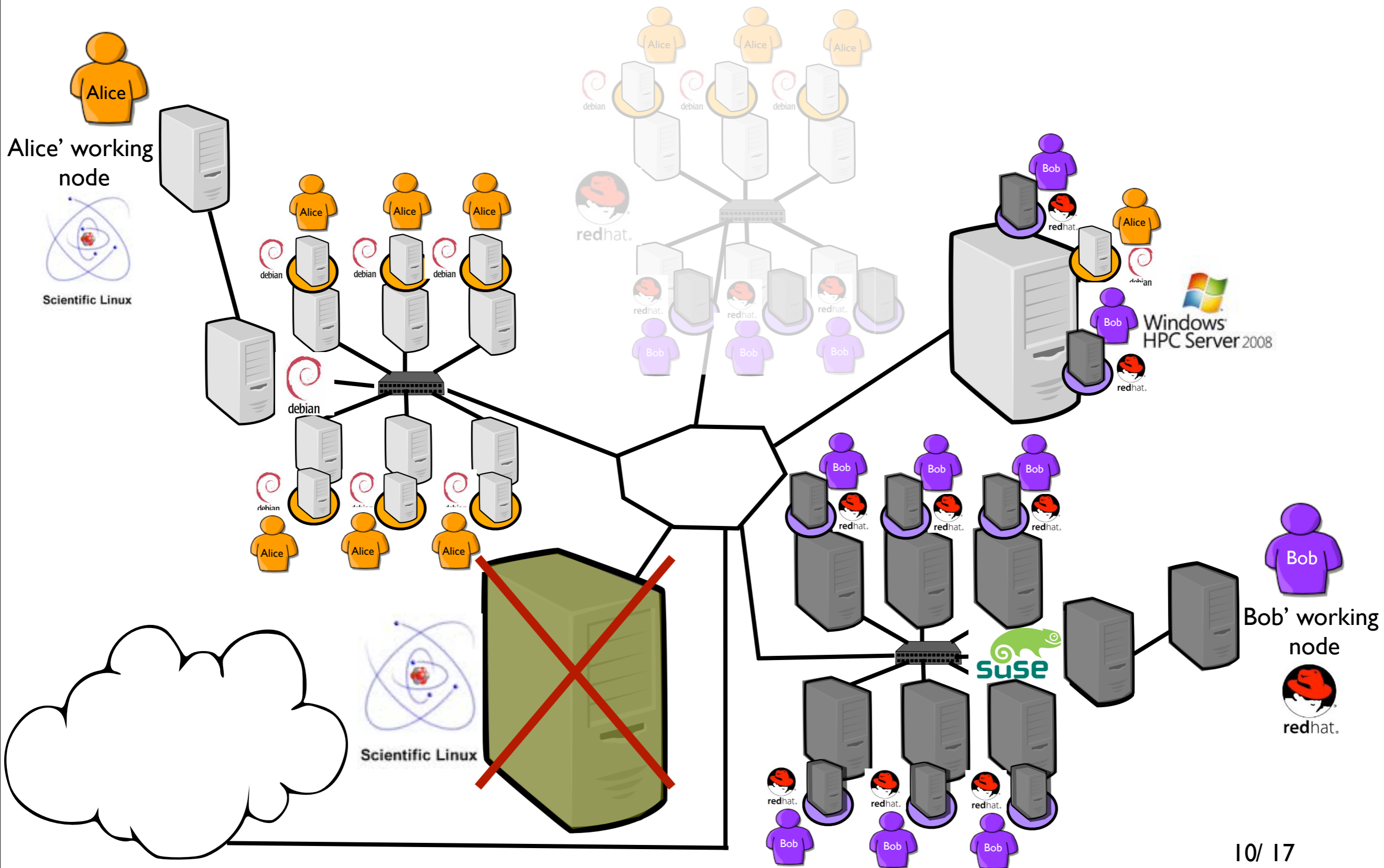## The Alice and Bob Example

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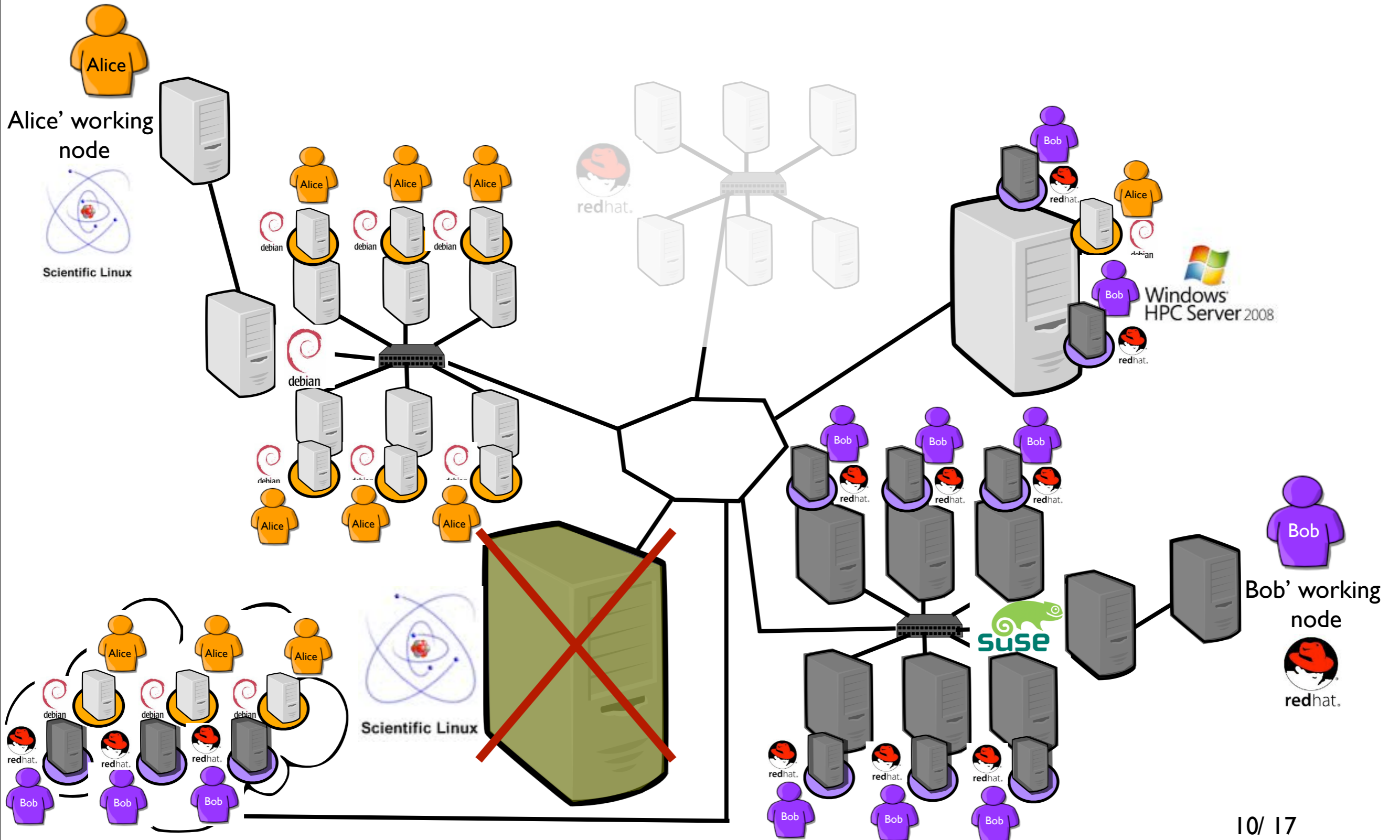## The Alice and Bob Example

Where we are - going - ?
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The Alice and Bob Example

IaaS Usage

- IaaS frameworks(2008-2010)

    Configuration of Virtual Environments (VEs) (contextualization, network...)

    Images management/deployment

    "Secure" accesses to the VEs

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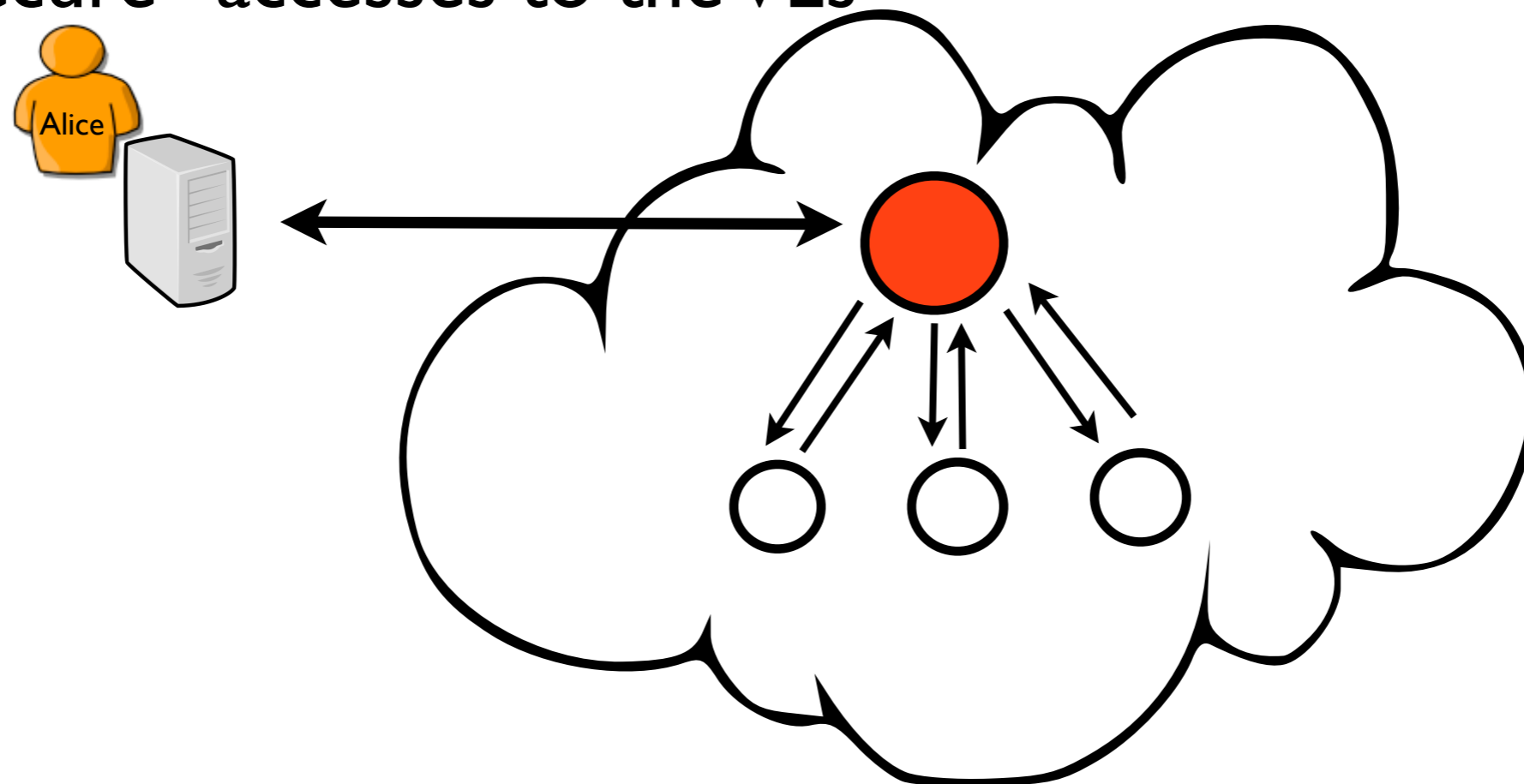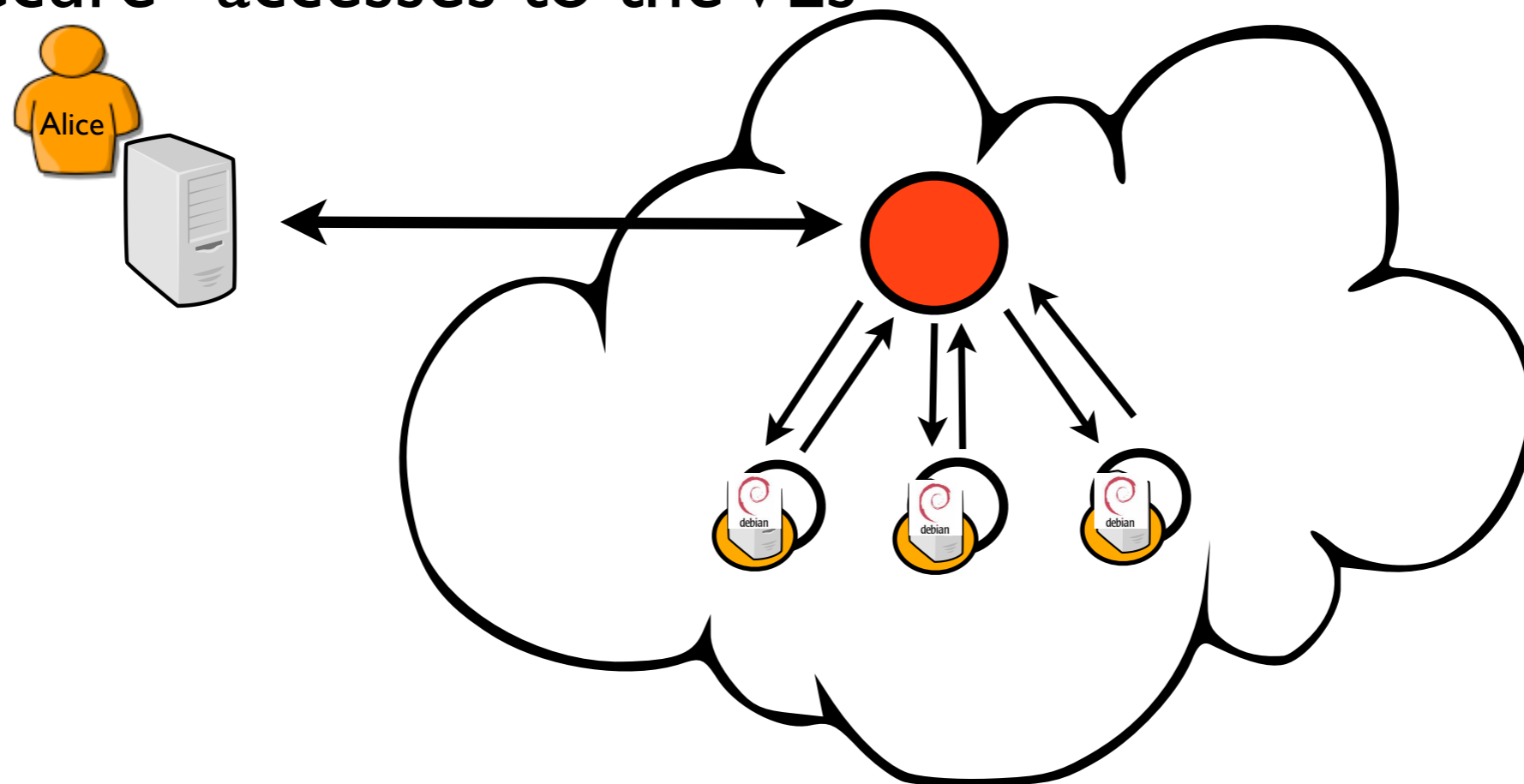
  "Secure" accesses to the VEs
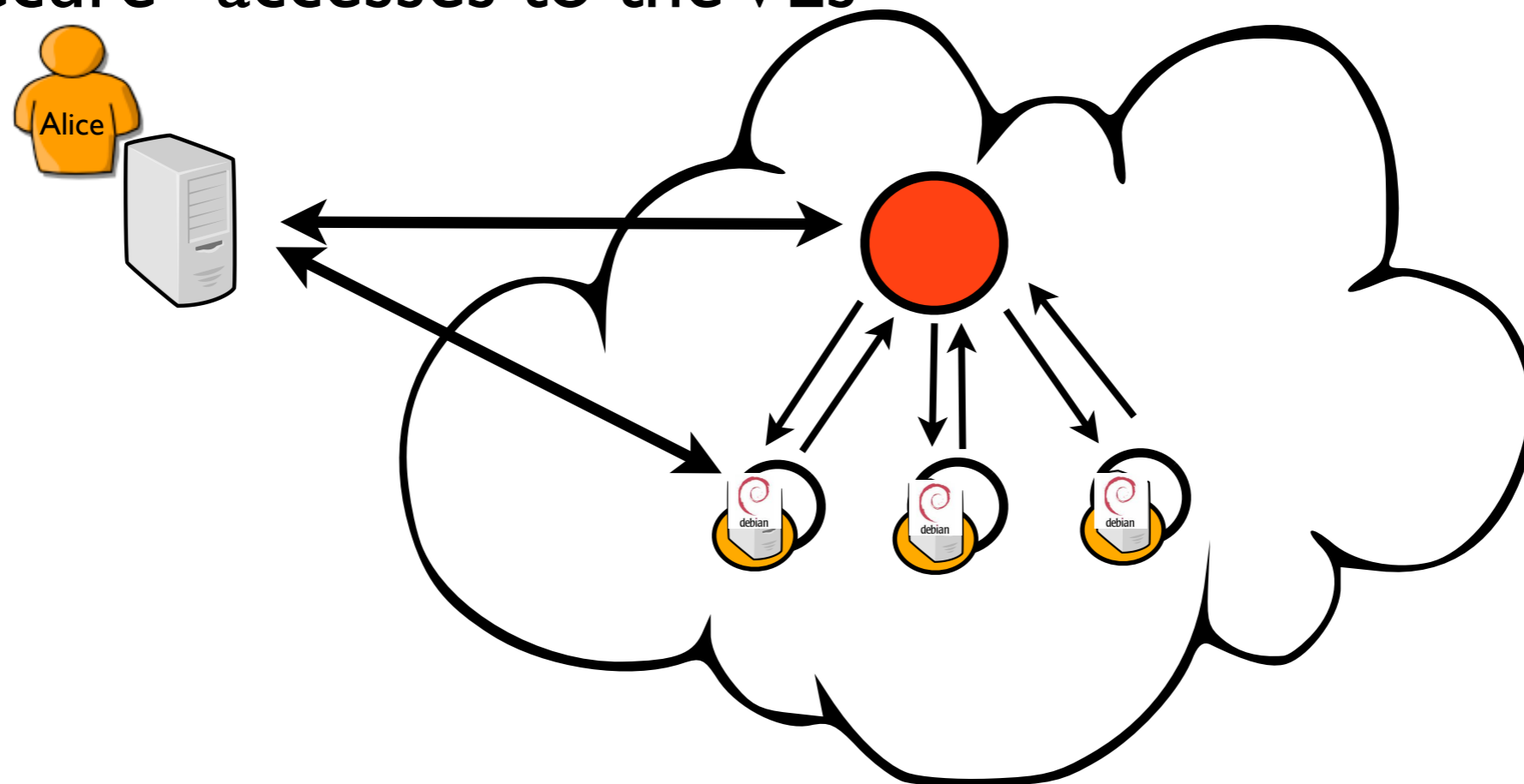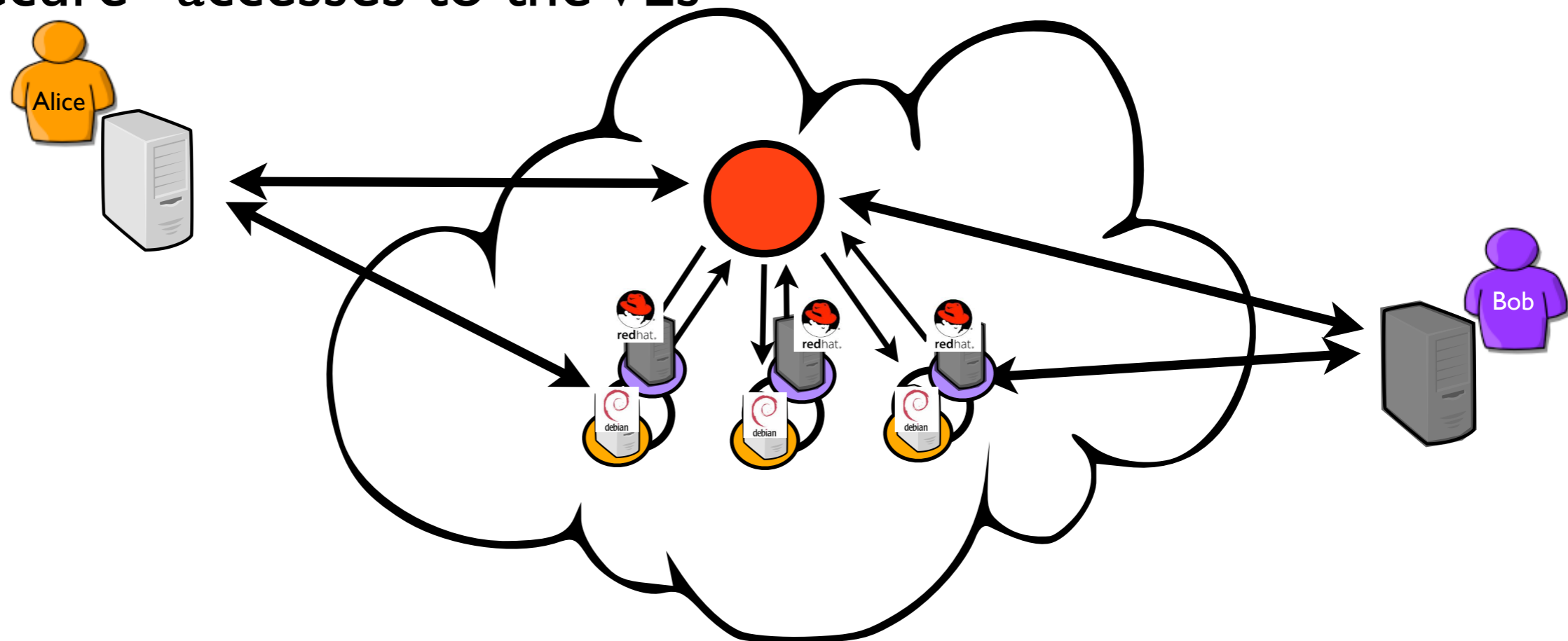
IaaS Usage

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Managing IaaS - OpenSource solutions

- Nimbus (Freeman and Keahey, University of Chicago)

  Based on GT4 and the Globus Virtual Workspace Service
  Target: cloud for science
  Tutorials and documentation in "grid space"

- Open Nebula (Montero & Llorente, DSA-Research at UCM)

  Support for the Xen, KVM and VMware
  Access to Amazon EC2 (cloud bursting)
  Probably, the most deployed

- Eucalyptus (Wolsky, University of Santa Barbara)

  Web services based implementation of elastic/utility/cloud
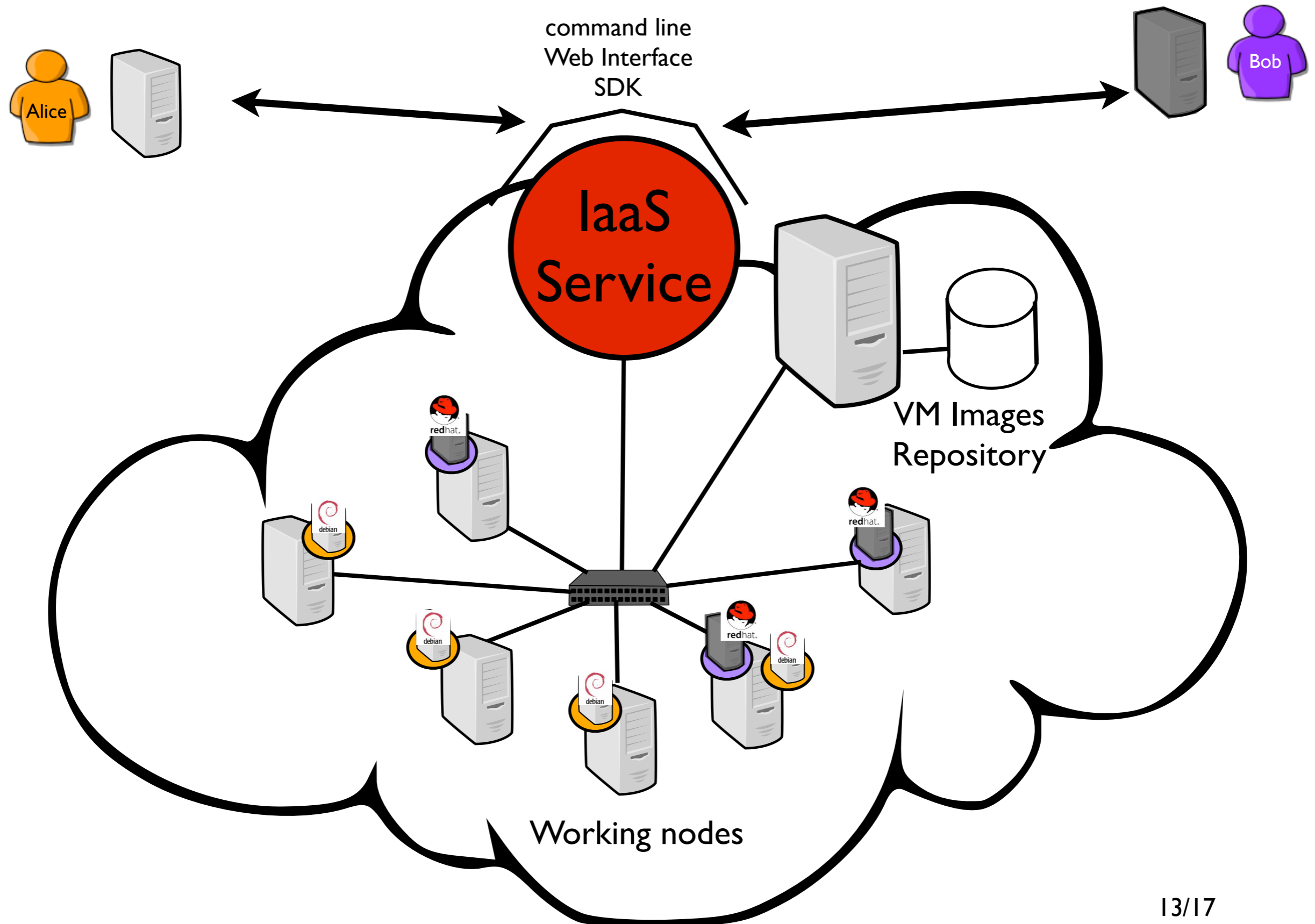 computing infrastructure

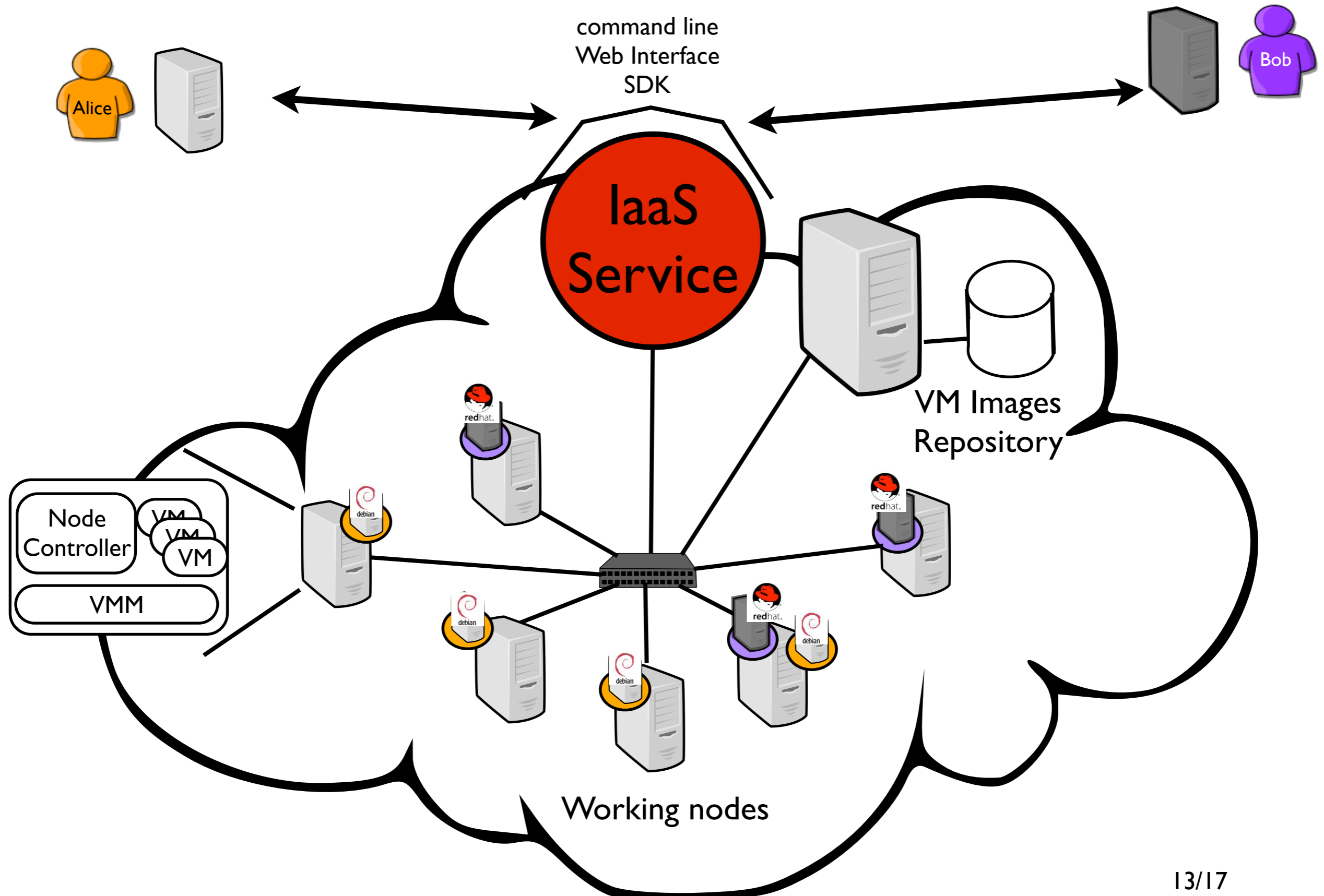- Open Stack

  Supported by several industrials
  Recently selected by Ubuntu for the core of their cloud proposal

An Overview of the IaaS Internals

command line
Web Interface
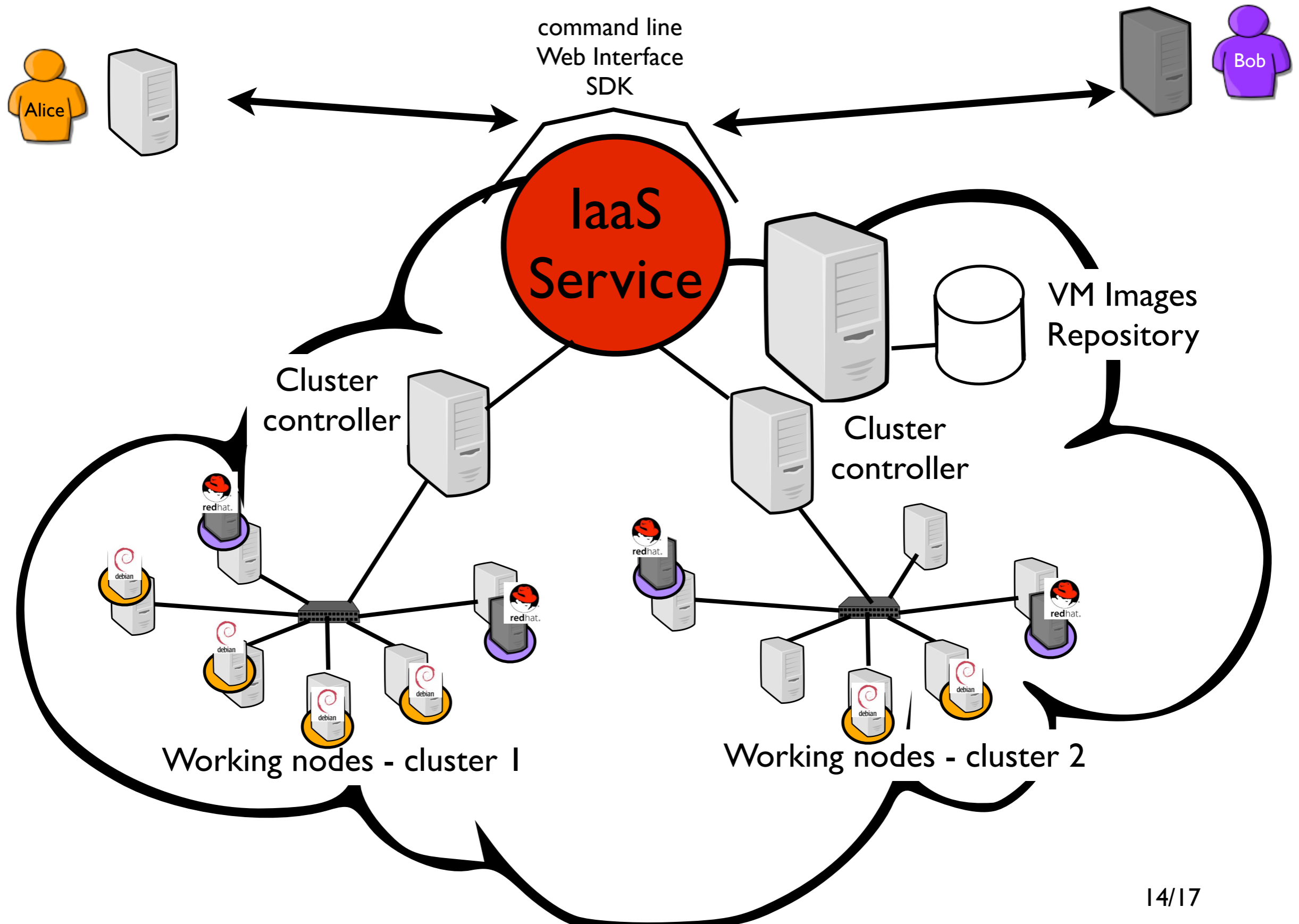SDK

Alice

Bob

IaaS
Service

VM Images
Repository

Working nodes

An Overview of the IaaS Internals

command line
Web Interface
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Alice

Bob

IaaS
Service

VM Images
Repository

Node
Controller

VM
VM
VM

VMM

Working nodes

13/17

An Overview of the IaaS Internals

command line
Web Interface
SDK

Alice

Bob

IaaS
Service

Cluster
controller

VM Images
Repository

Cluster
controller

Working nodes - cluster 1
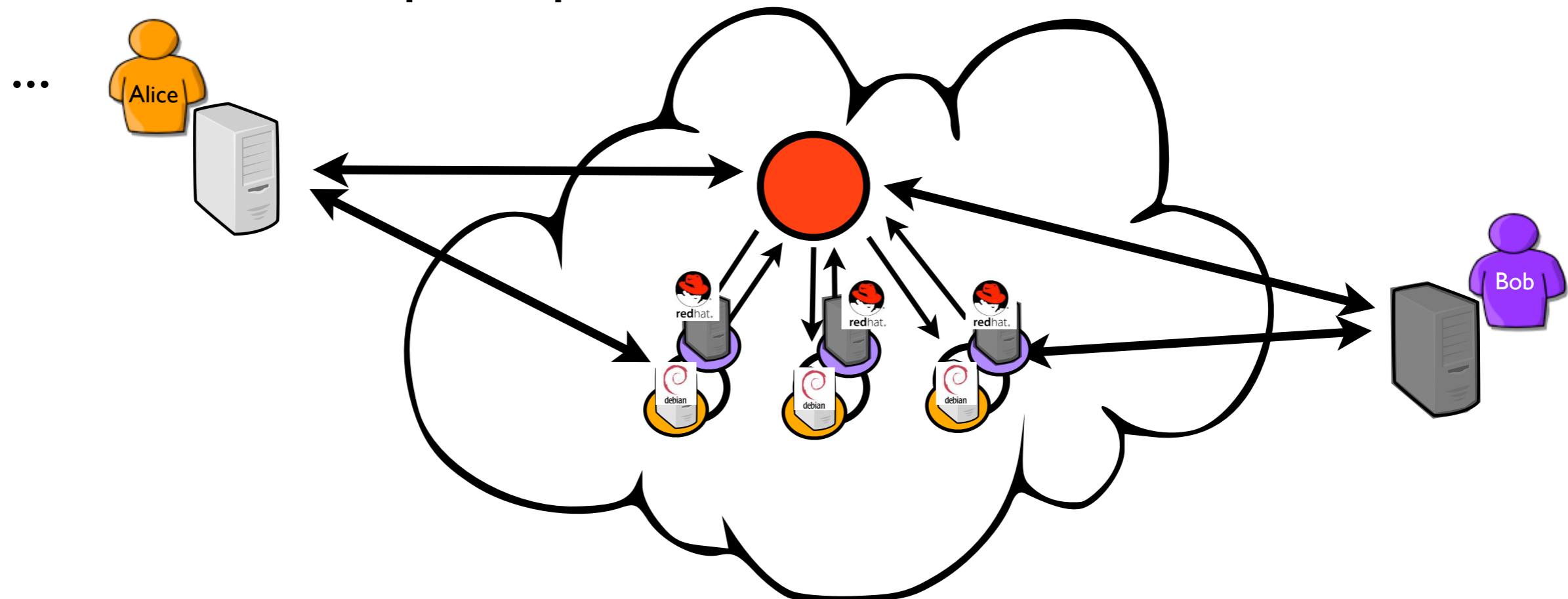
Working nodes - cluster 2

14/17

Conclusion - Where we are ?

- IaaS solutions

  Mature for one site !

  More flexibility ! ?
  Infinite resources ! ?

  Virtualize IT impacts performances !

  ...

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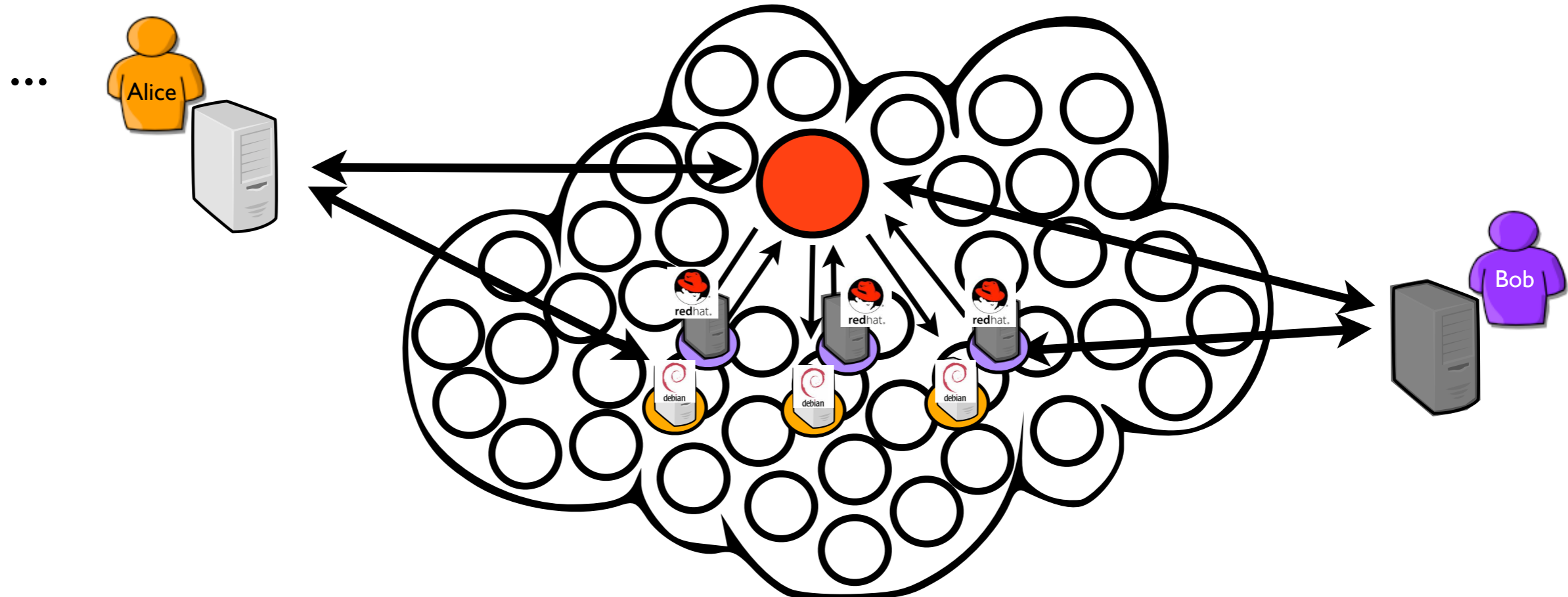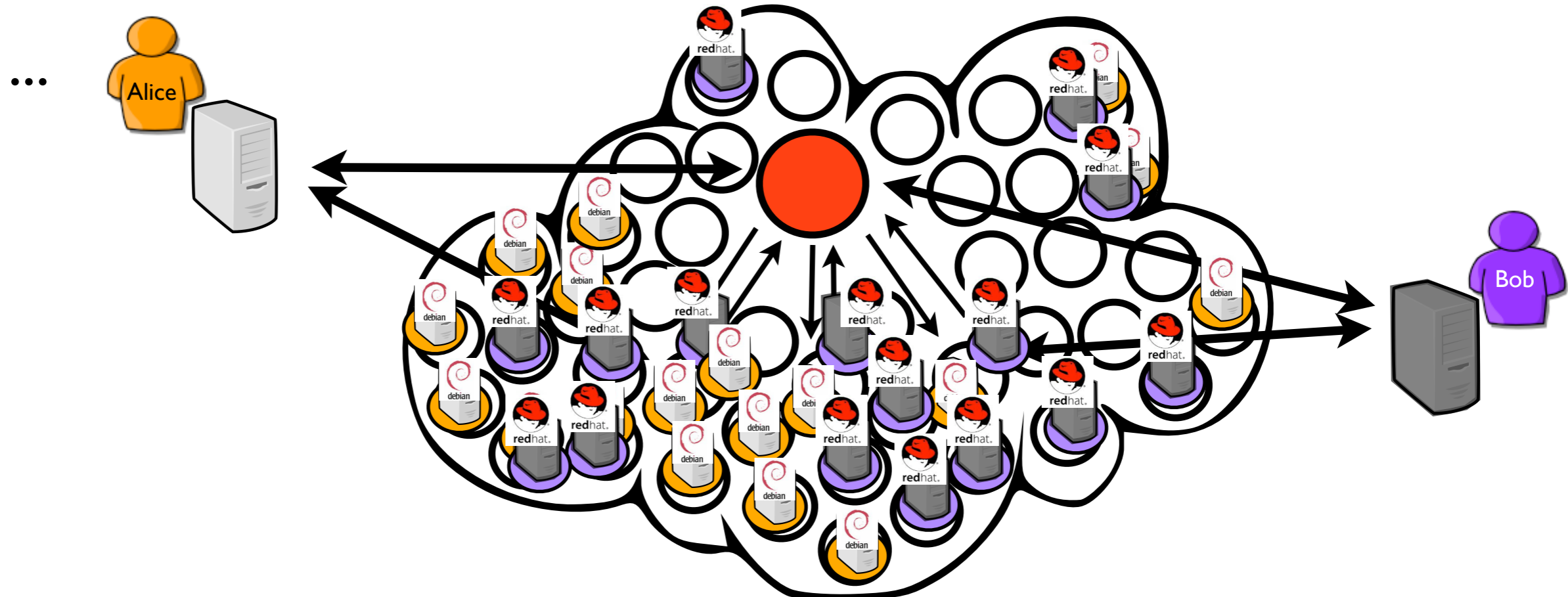   Virtualize IT impacts performances !

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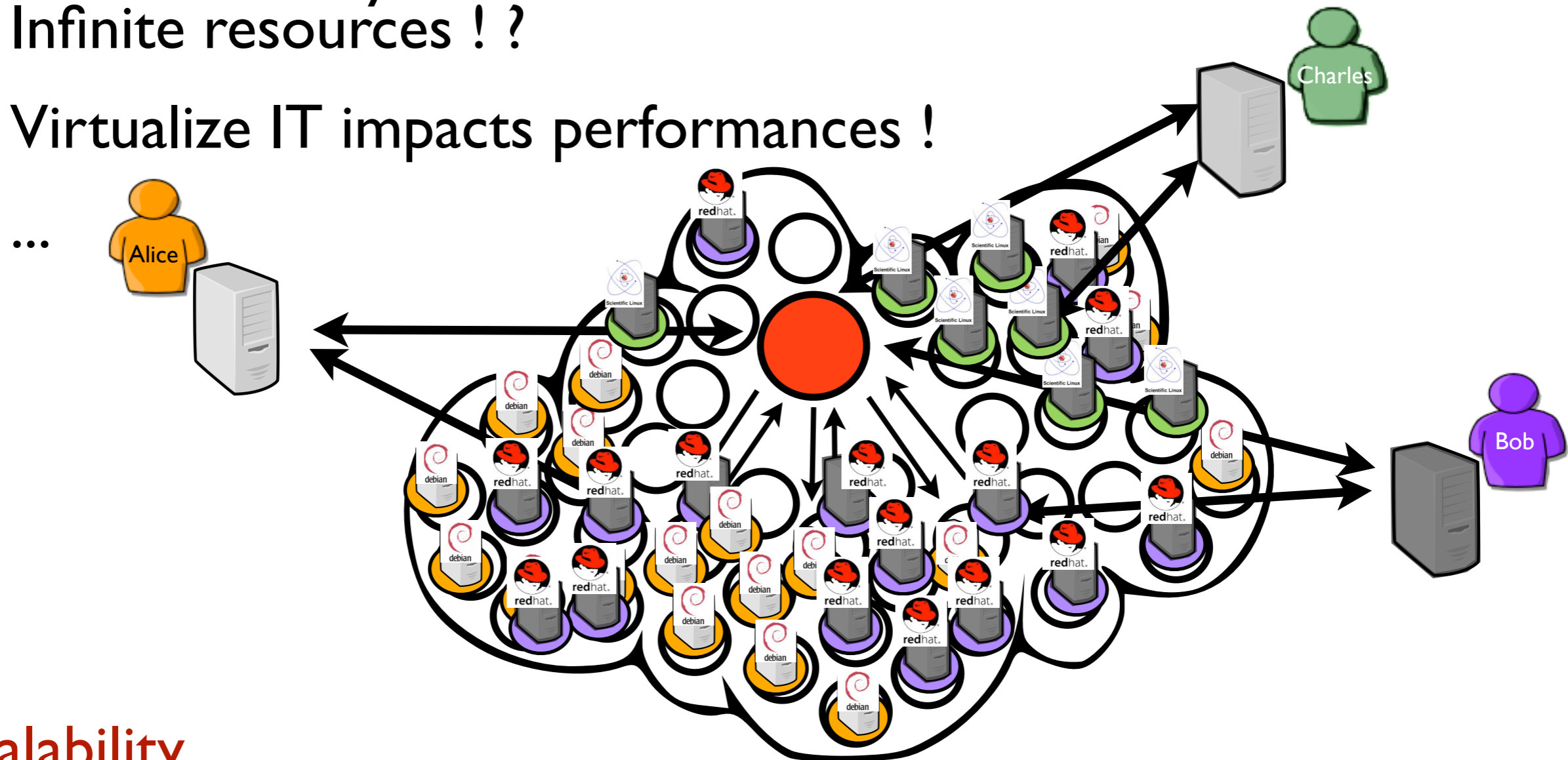
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Scalability

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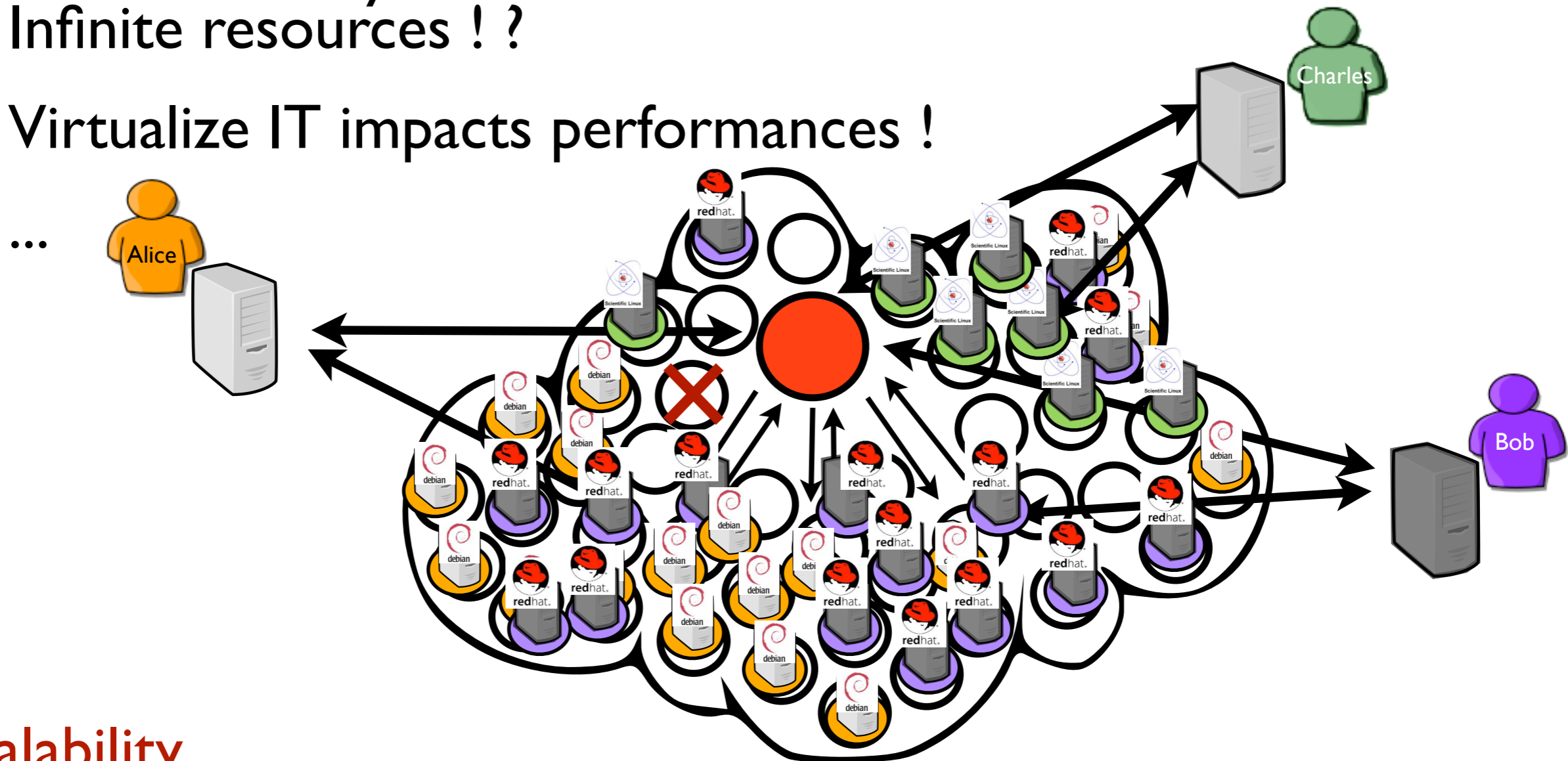   ...

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  Virtualize IT impacts performances !

  ...

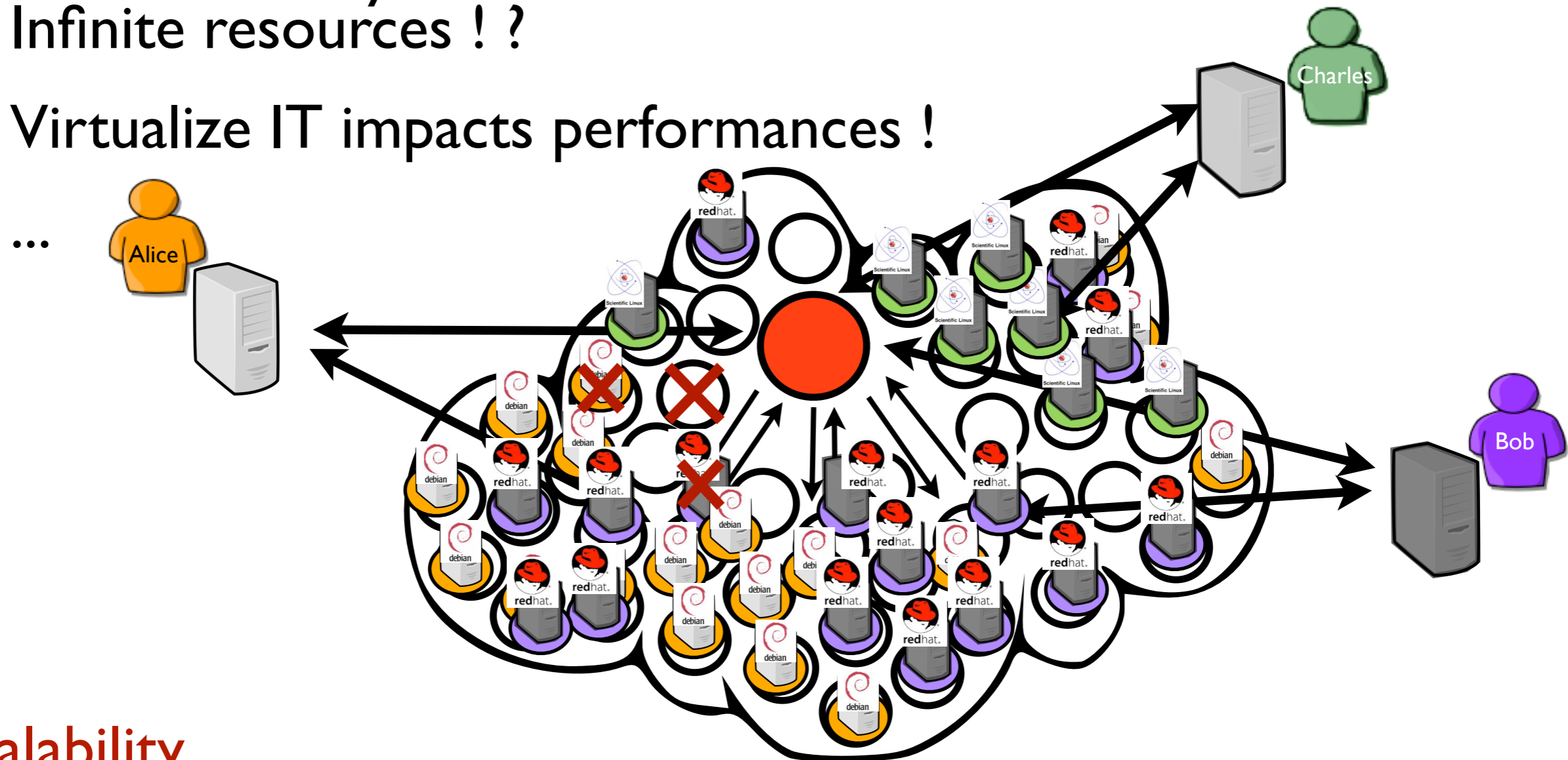
Scalability

Conclusion - Where we are ?

- IaaS solutions

    Mature for one site !

    More flexibility ! ?
    Infinite resources ! ?

    Virtualize IT impacts performances !

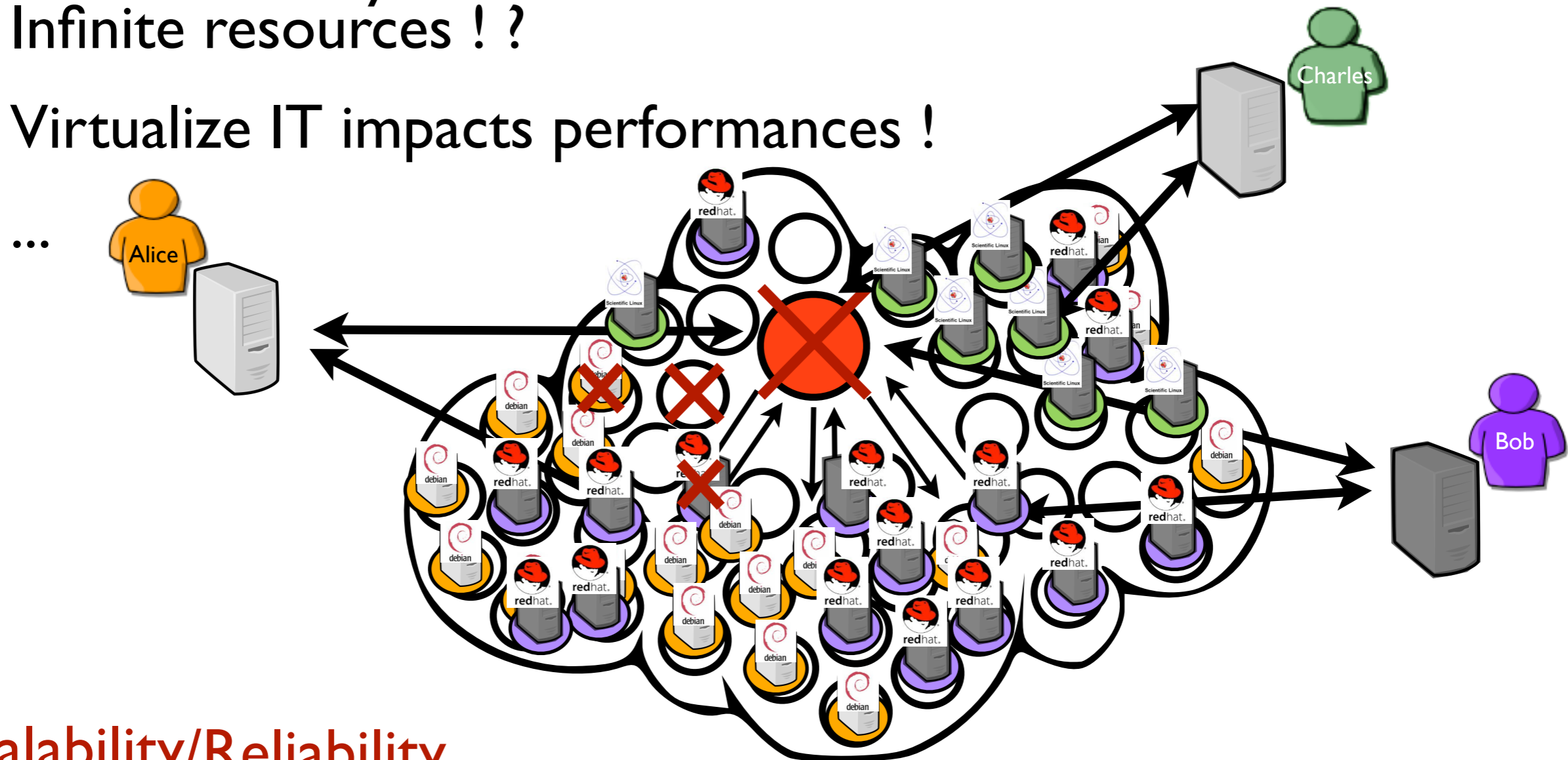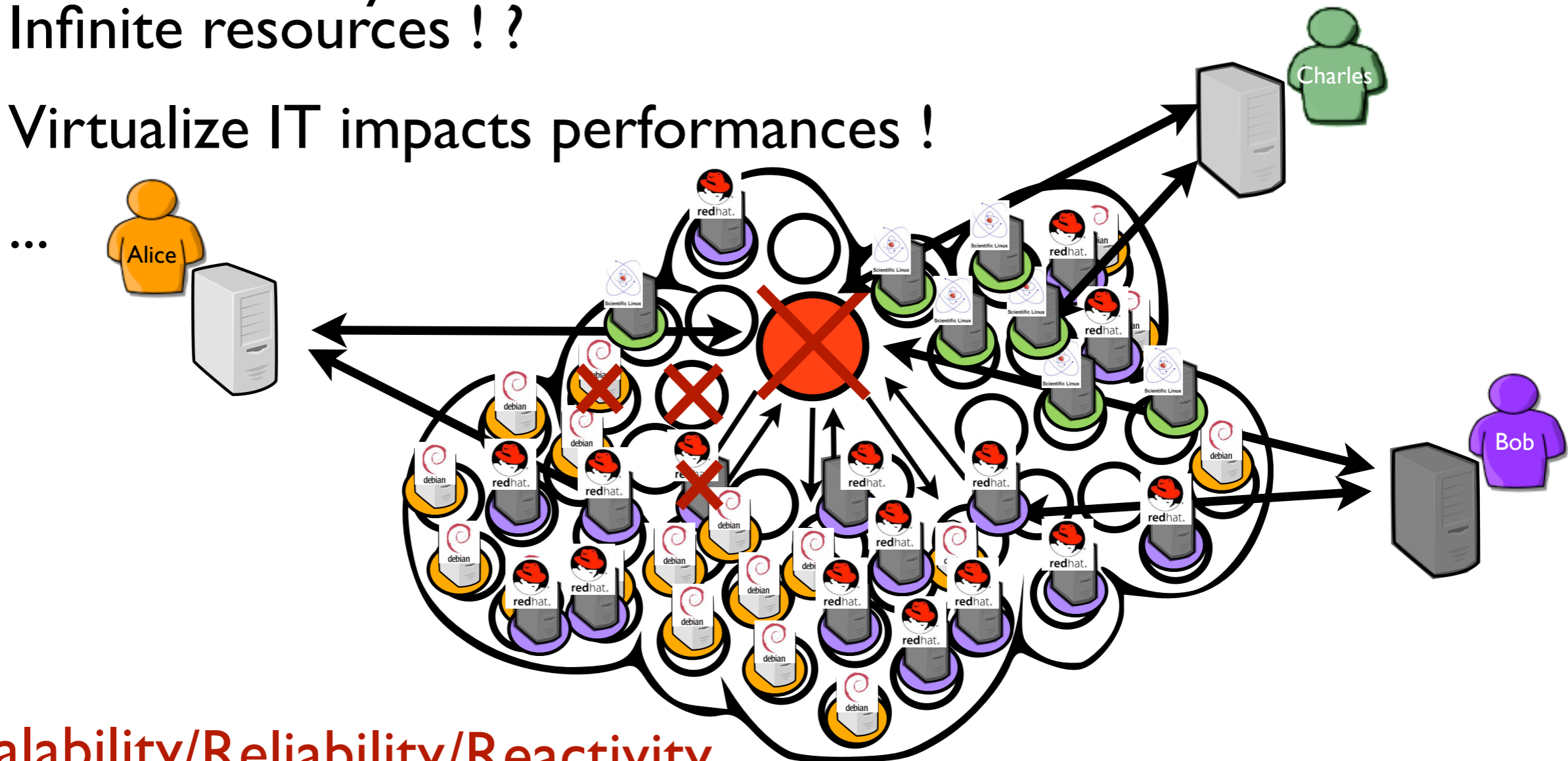   ...

Scalability/Reliability

Conclusion - Where we are ?

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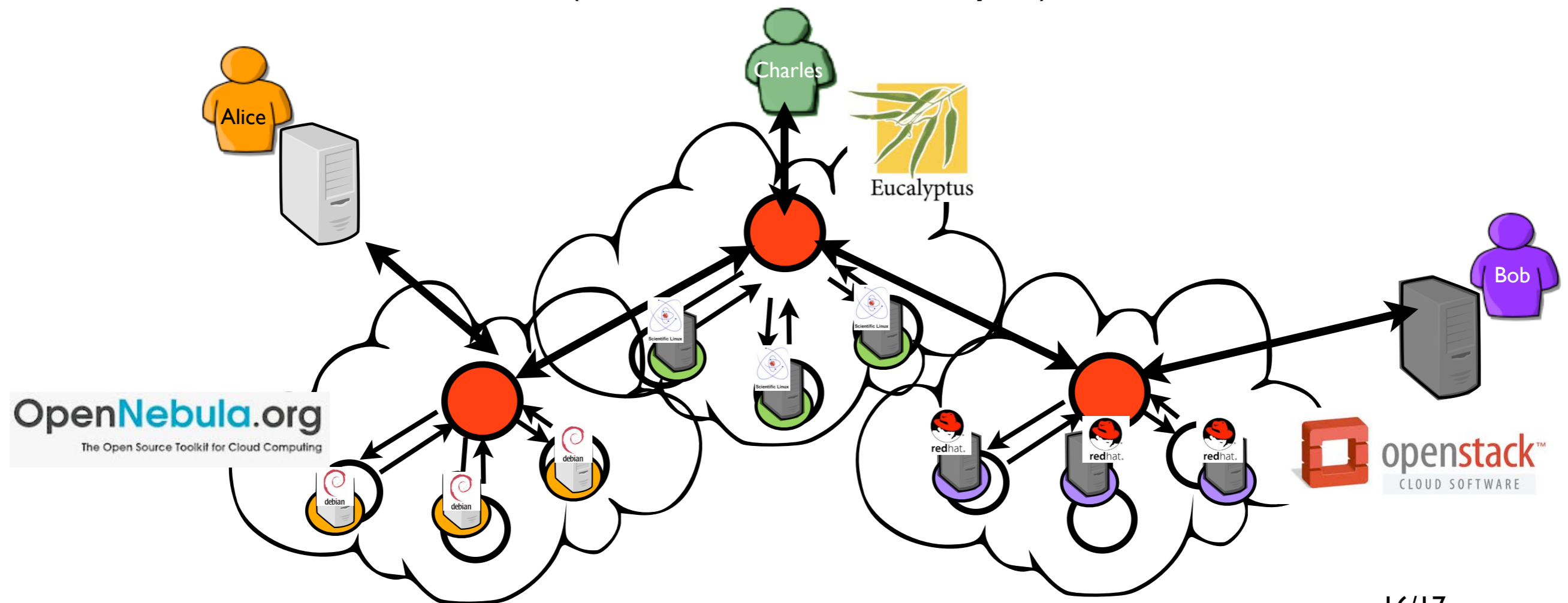 Infinite resources ! ?

  Virtualize IT impacts performances !

  ...

Scalability/Reliability/Reactivity

Conclusion - Current Challenges

- Grid: federation of cluster
  "federation of clouds": sky computing

Sporadic (hybrid computing/cloud bursting) almost ready for production
Standards are coming (OCCI, OVF, ...)

Several concerns (network issues, latency, ...)

Last but not the least

- Data is probably the main issue !

  Performance !
  Security !
  Reliability !

Thank you

Questions ?