

# Beyond the Clouds, the DISCOVERY Initiative



Credits: NASA

Localization is a key element to deliver  
**efficient** as well as **sustainable Utility Computing Solutions**



Adrien Lèbre / Ascola Project Team  
November, 2013



# Context

# xxx Computing

- Meta / Cluster / Grid / Desktop / Cloud / Sky / Fog ...
- A common objective: provide computing resources (both hardware and software) in a flexible, transparent, secure, reliable, ... way

⇒ xxx as Utility Computing (UC)

new concept, but rather has quite a long history. Among the earliest references is:

“ If computers of the kind I have advocated become the computers of the future, then computing may someday be organized as a public utility just as the telephone system is a public utility... The computer utility could become the basis of a new and important industry.

—John McCarthy, speaking at the MIT Centennial in 1961<sup>[2]</sup>

# Utility Computing

- Successive generations

Mainframes (time-sharing, database - 1980 / 20xx)

Network of workstations (clusters)  
Grid (clusters federation) ) (1990 / 20xx)

Cloud Computing (SaaS/PaaS/IaaS - 2005 / 20xx)

- Challenges

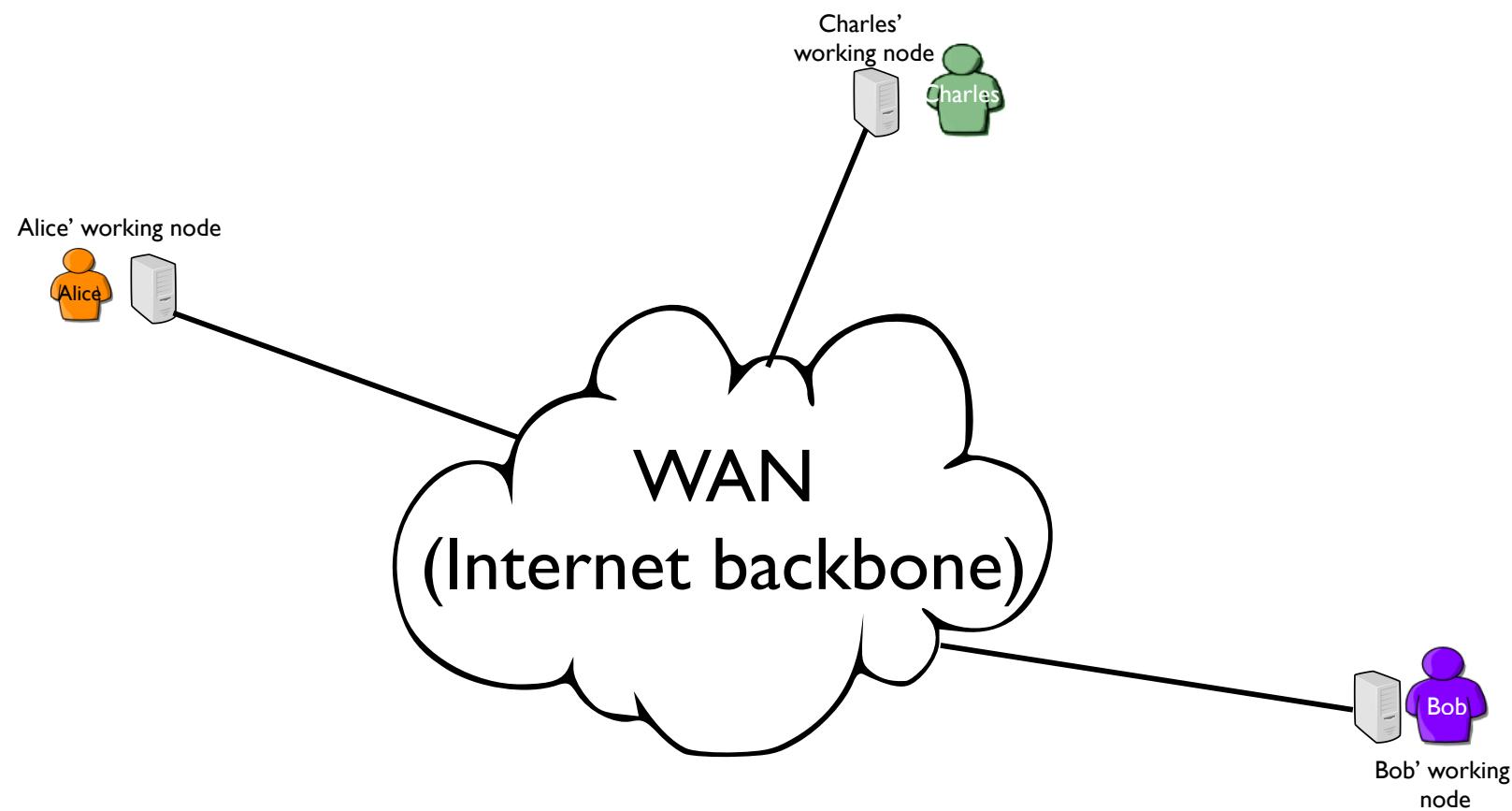
Data Sharing

Software/Hardware heterogeneity

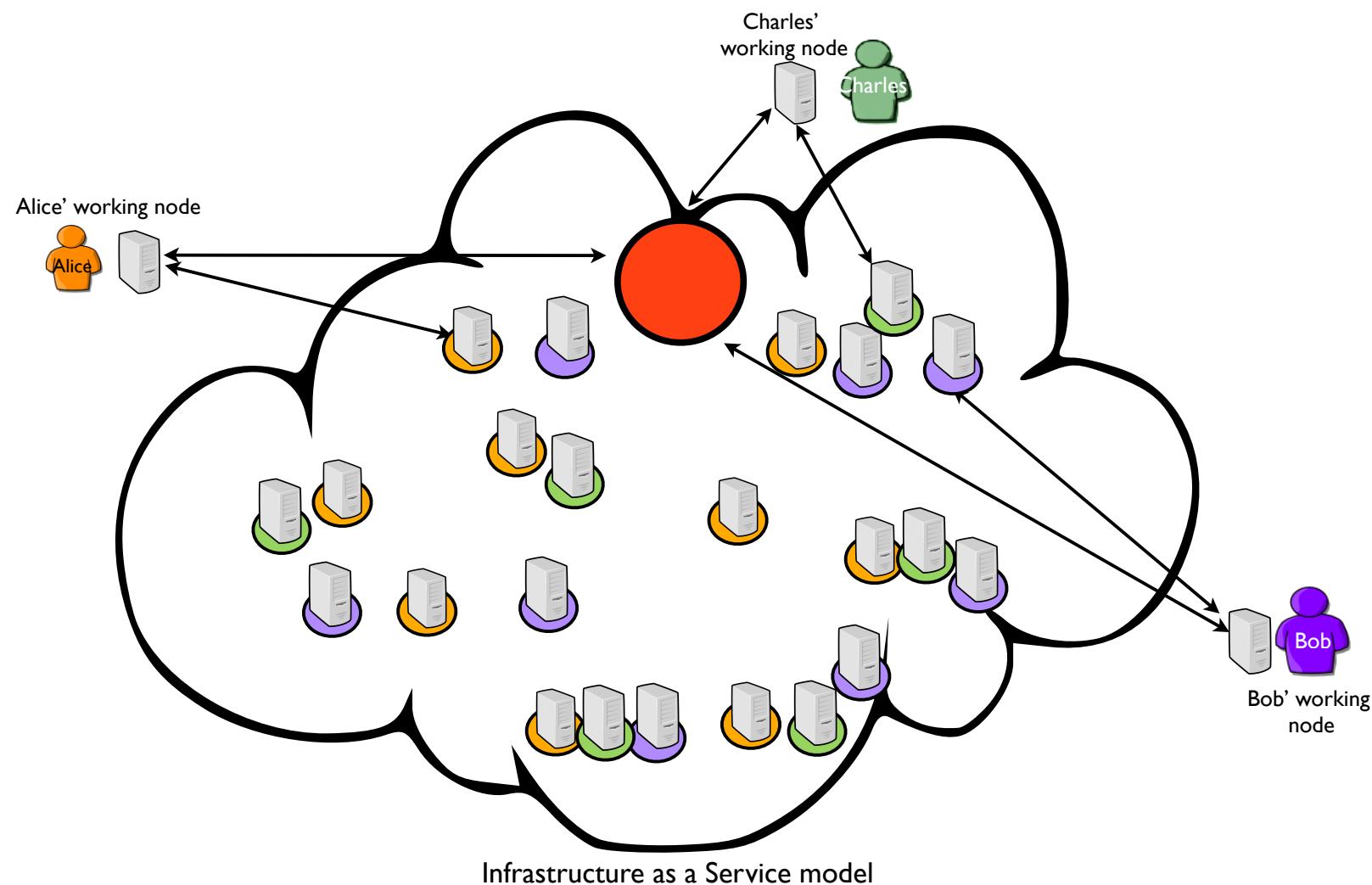
Security (Isolation between applications, ...)

Reachability / Reliability / Resiliency ...

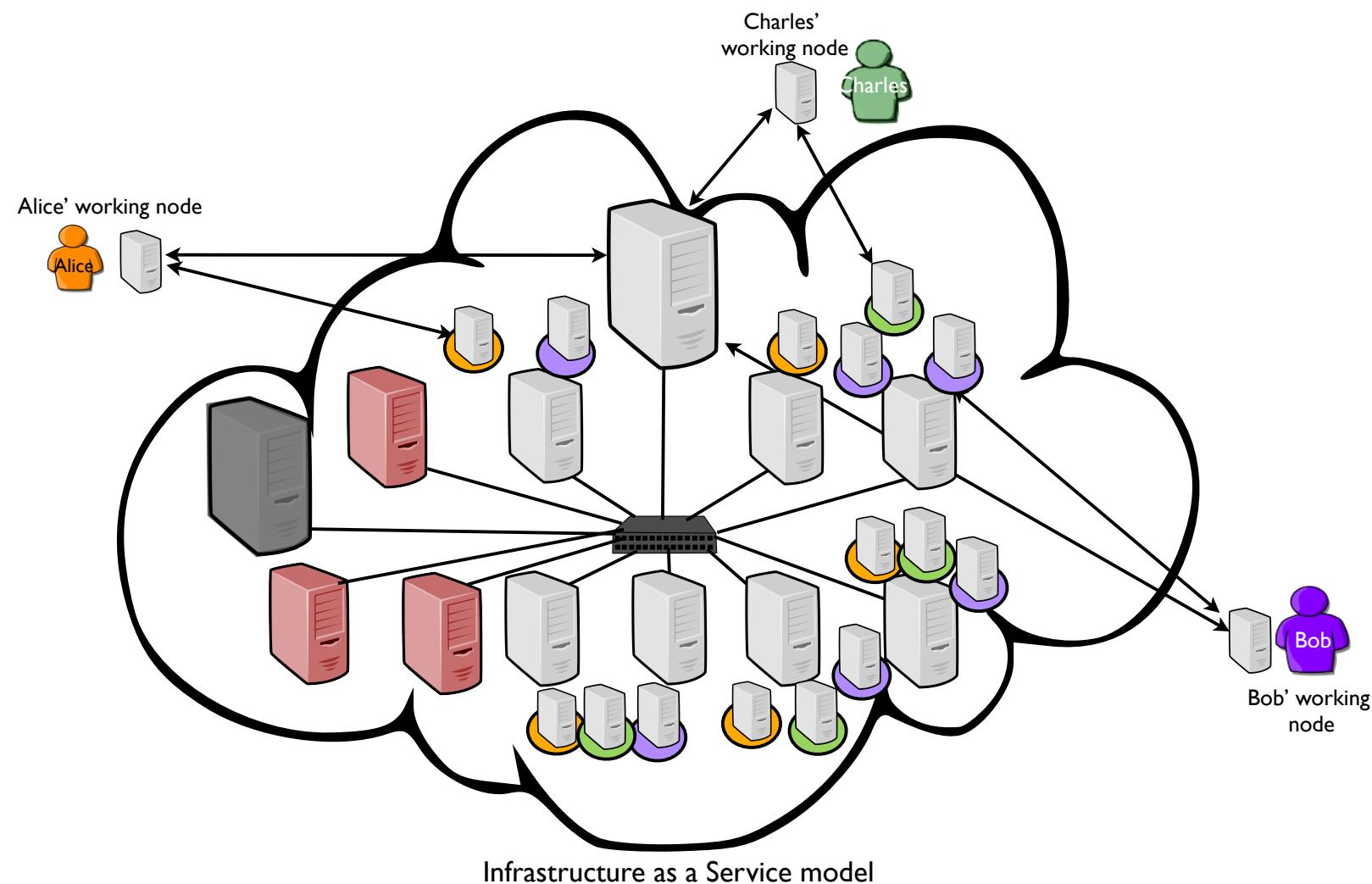
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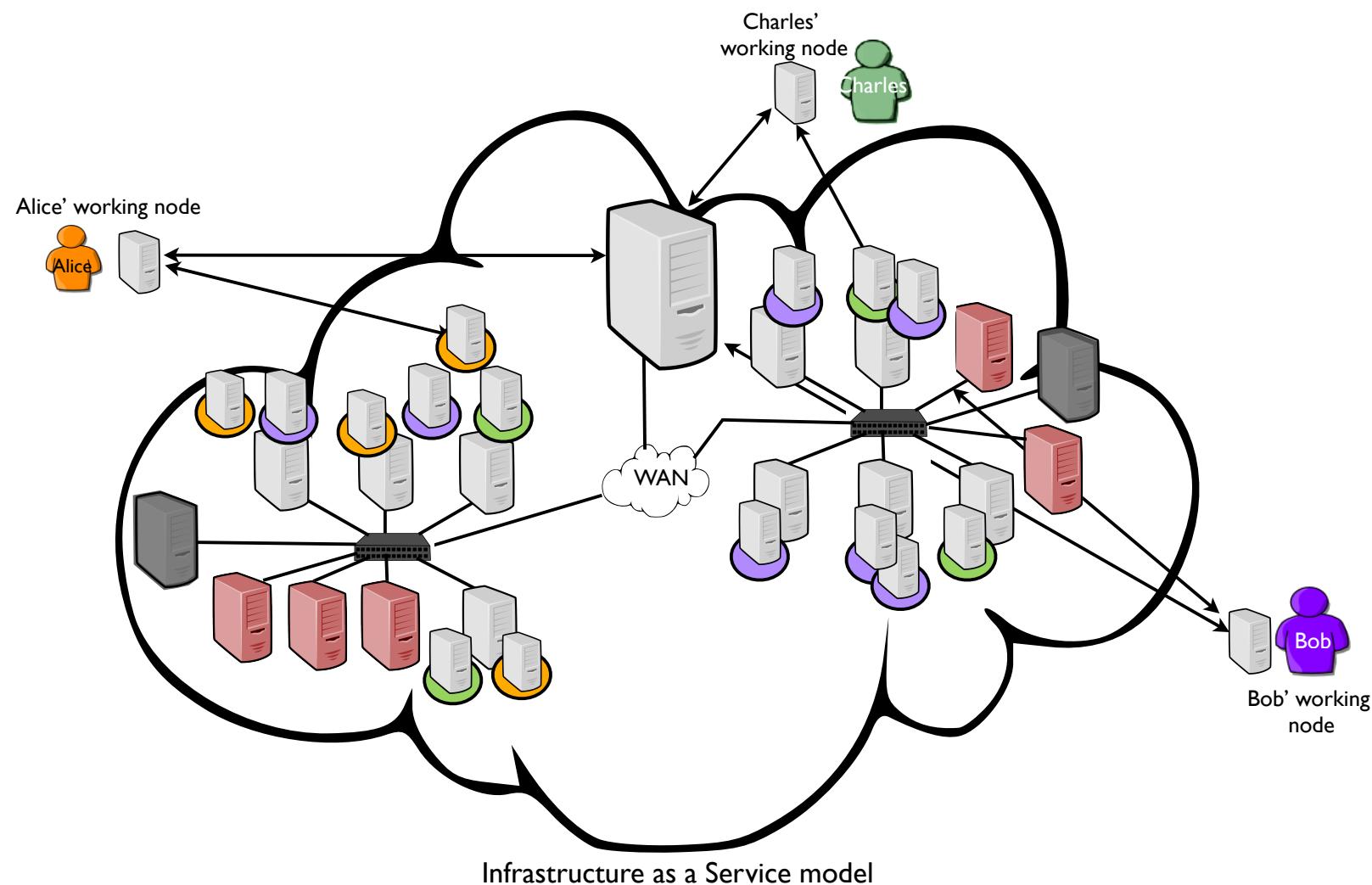
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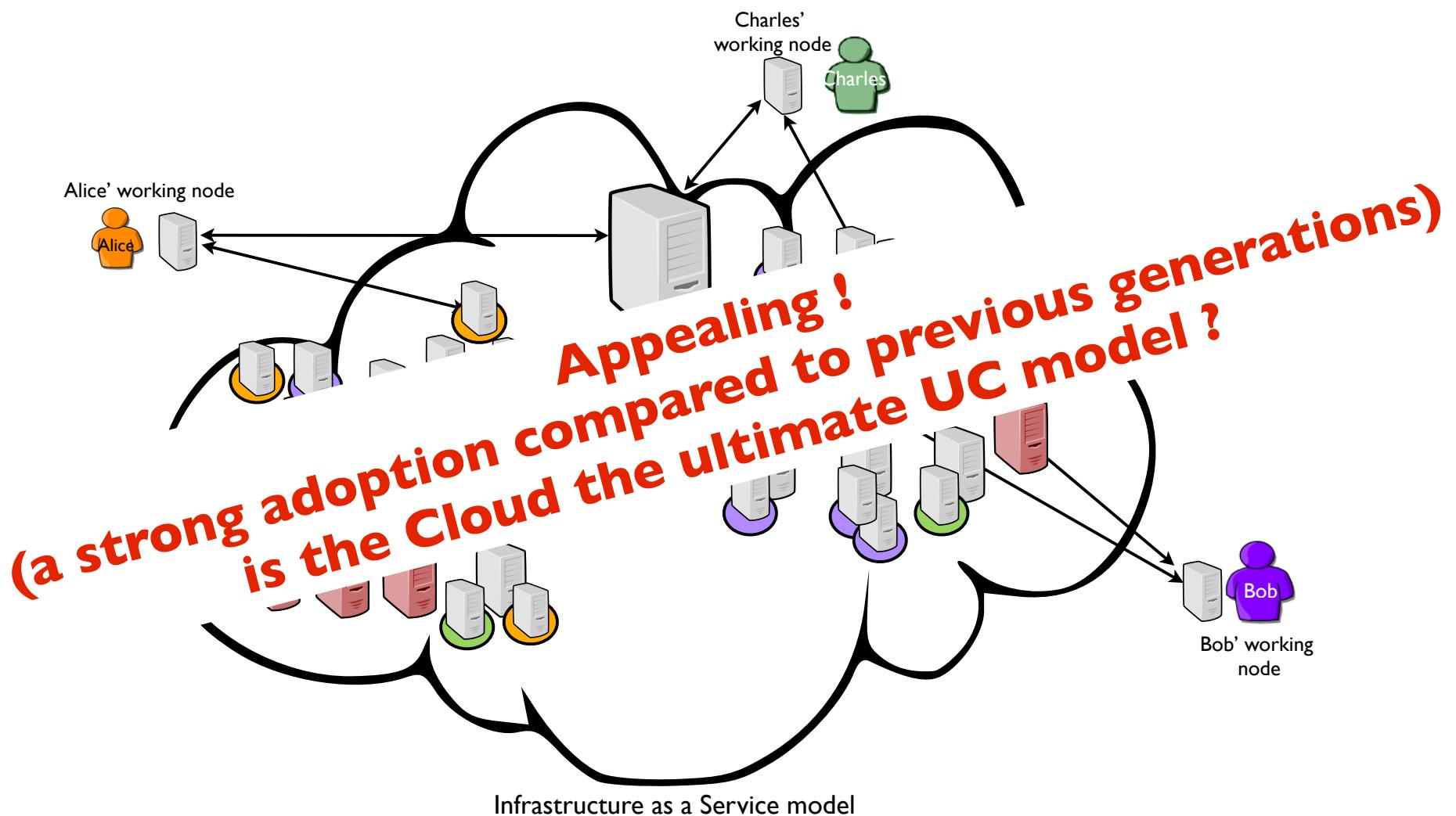
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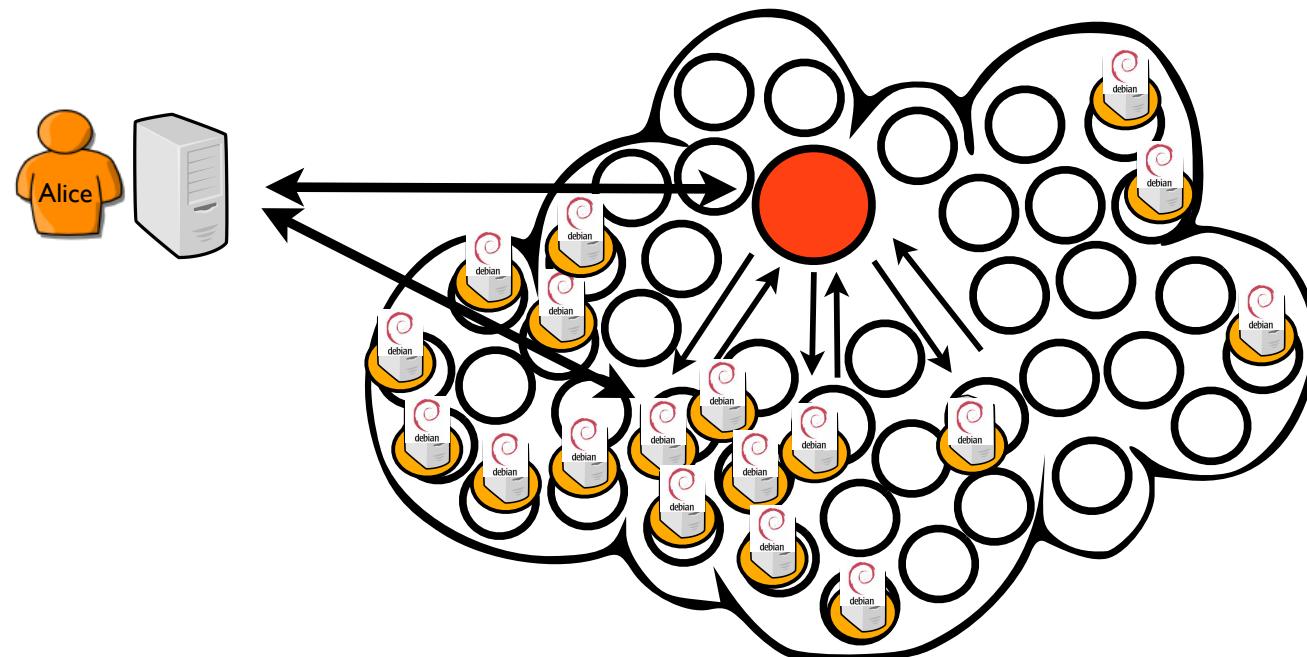
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- Mature for one site/cloud !

Open Nebula, Nimbus... vSphere... CloudStack, OpenStack  
More flexibility ! ? Infinite resources ! ?

- Current concerns

Scalability (VM Sprawl)



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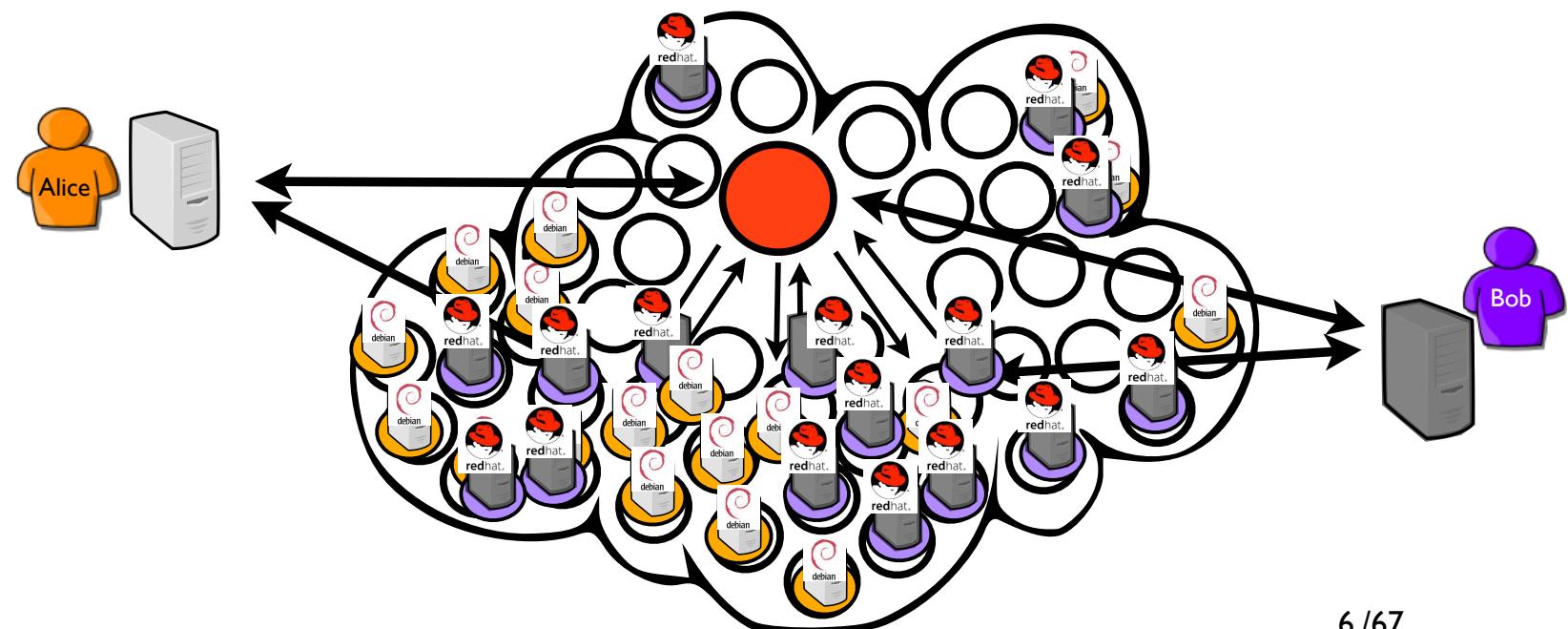
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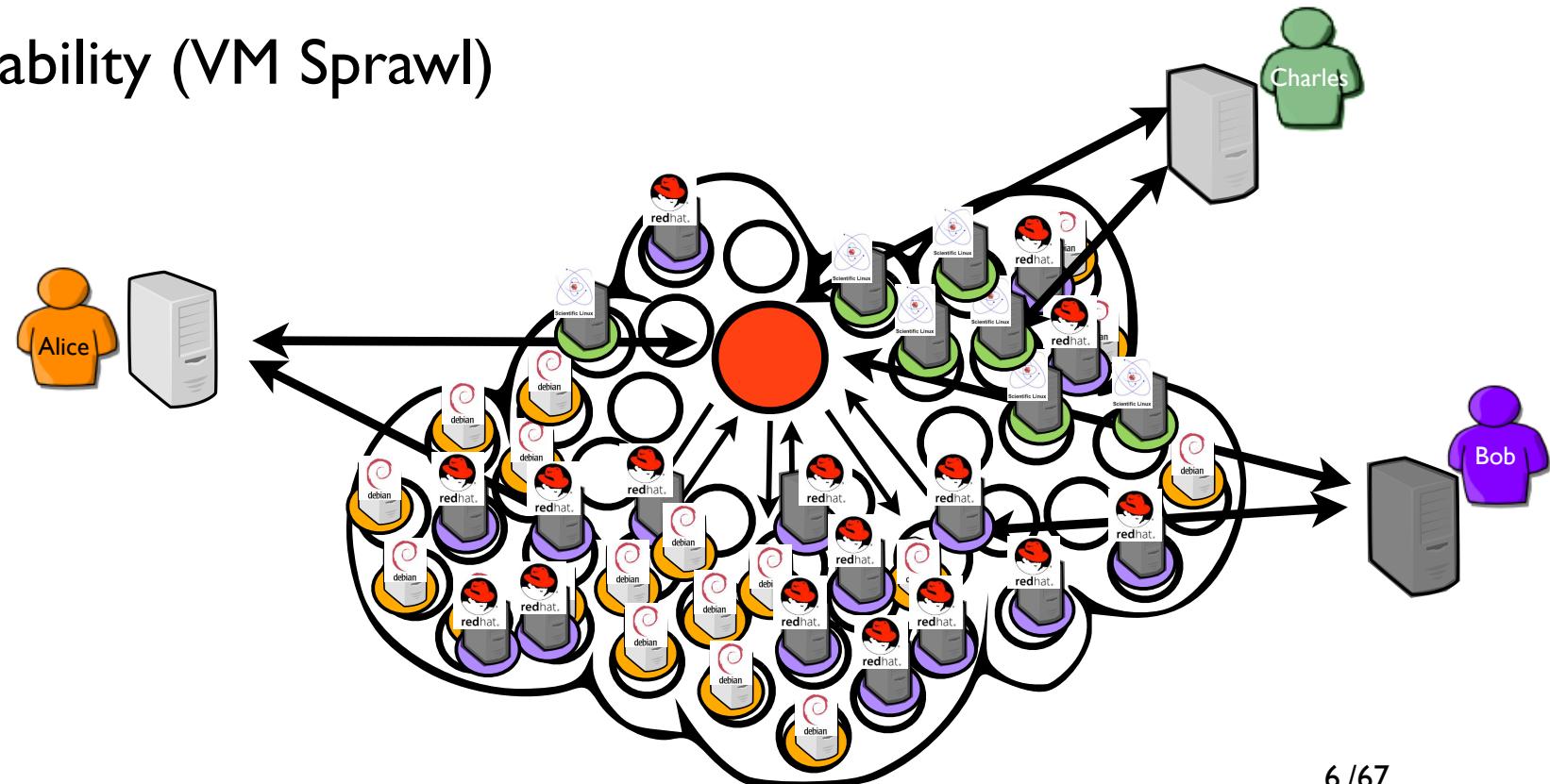
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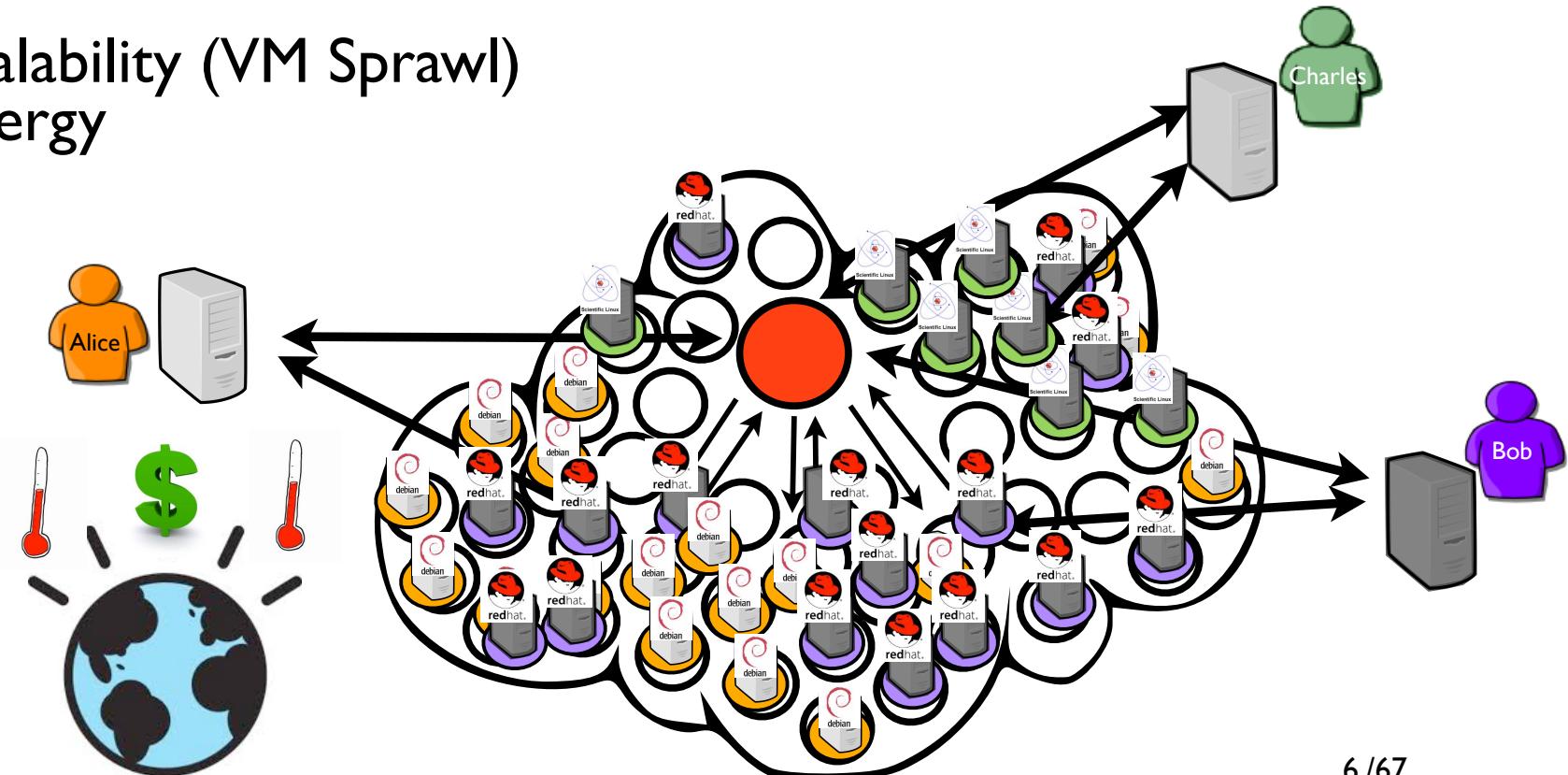
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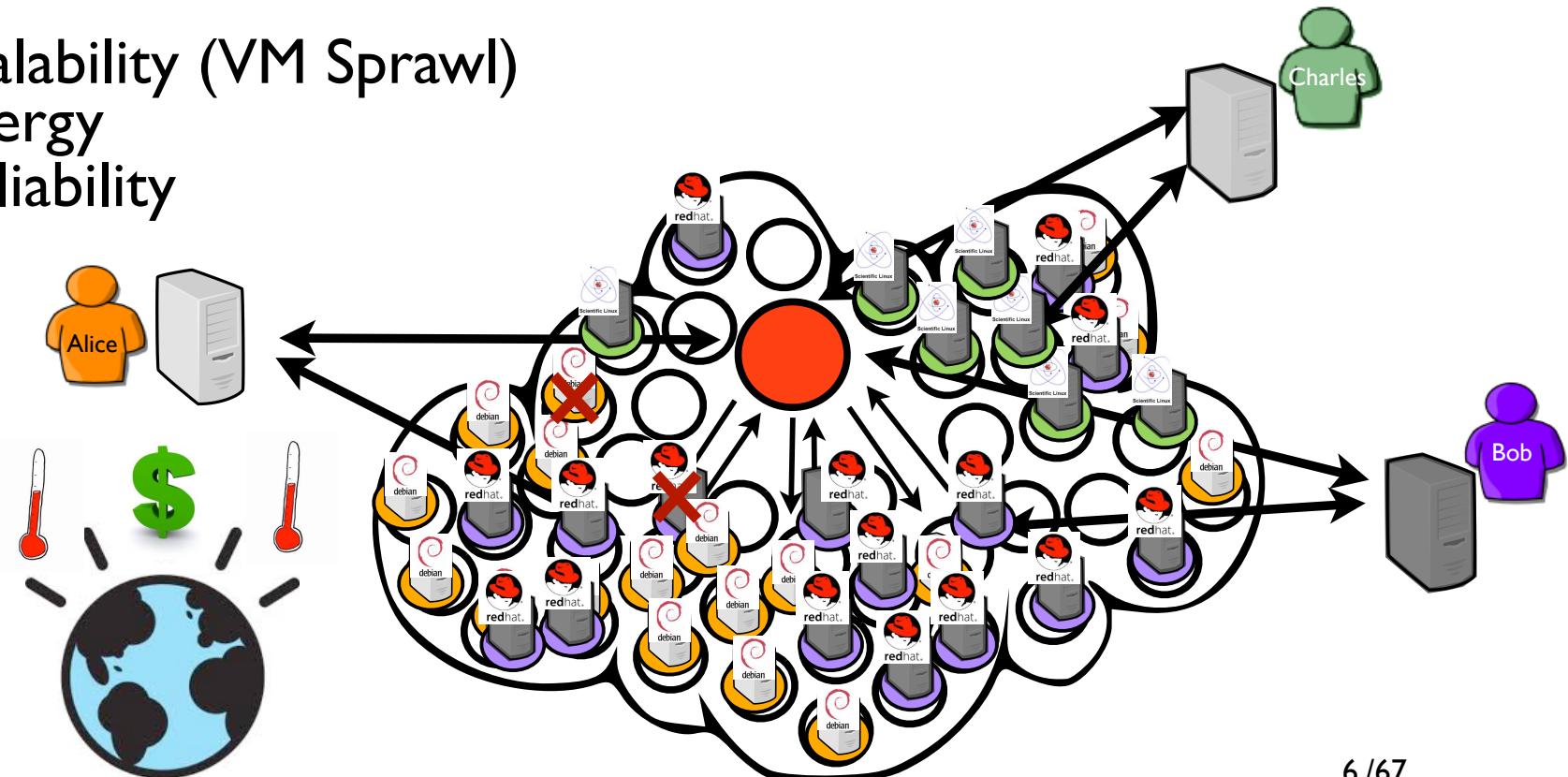
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## Energy

## Reliability



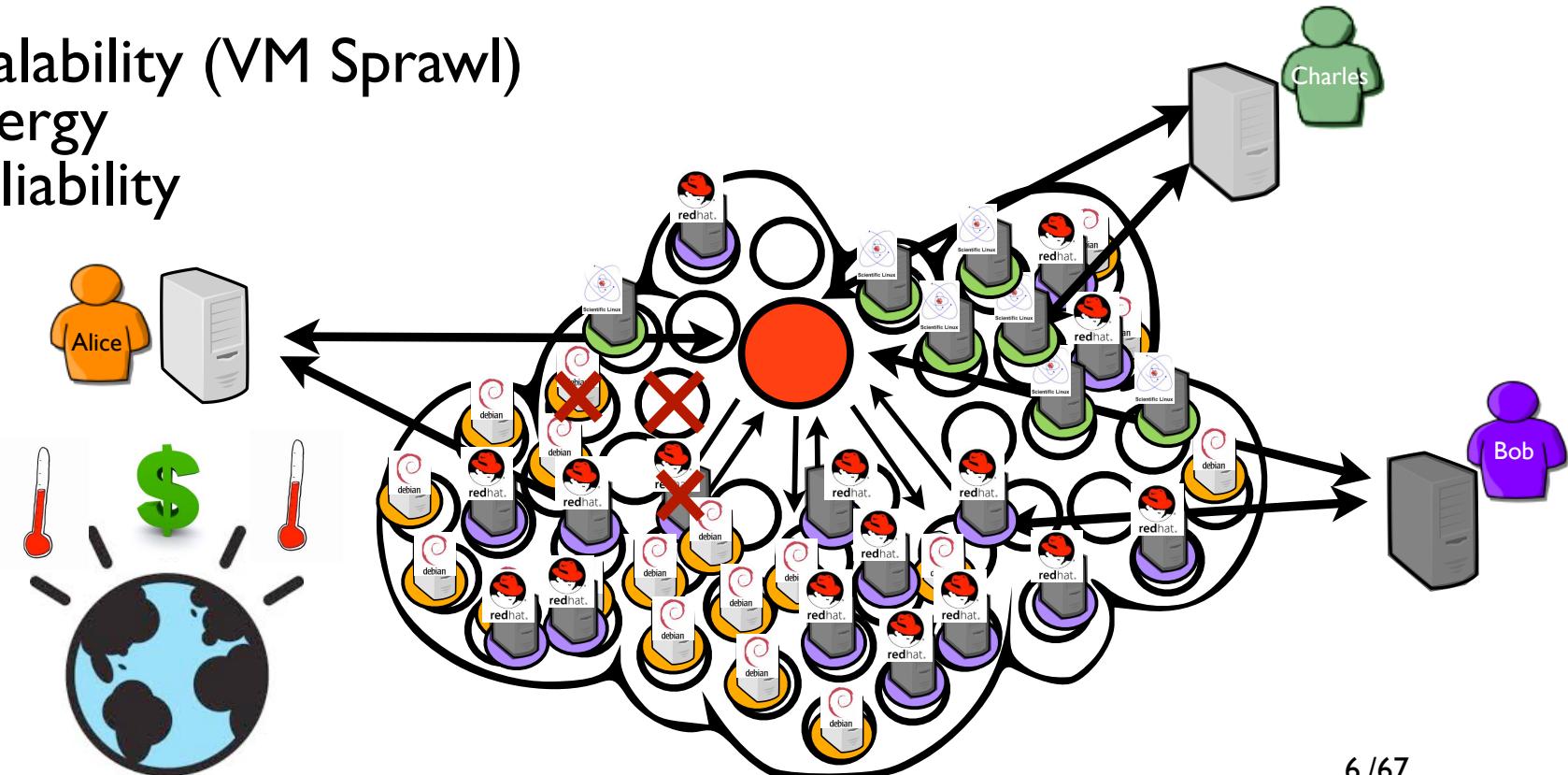
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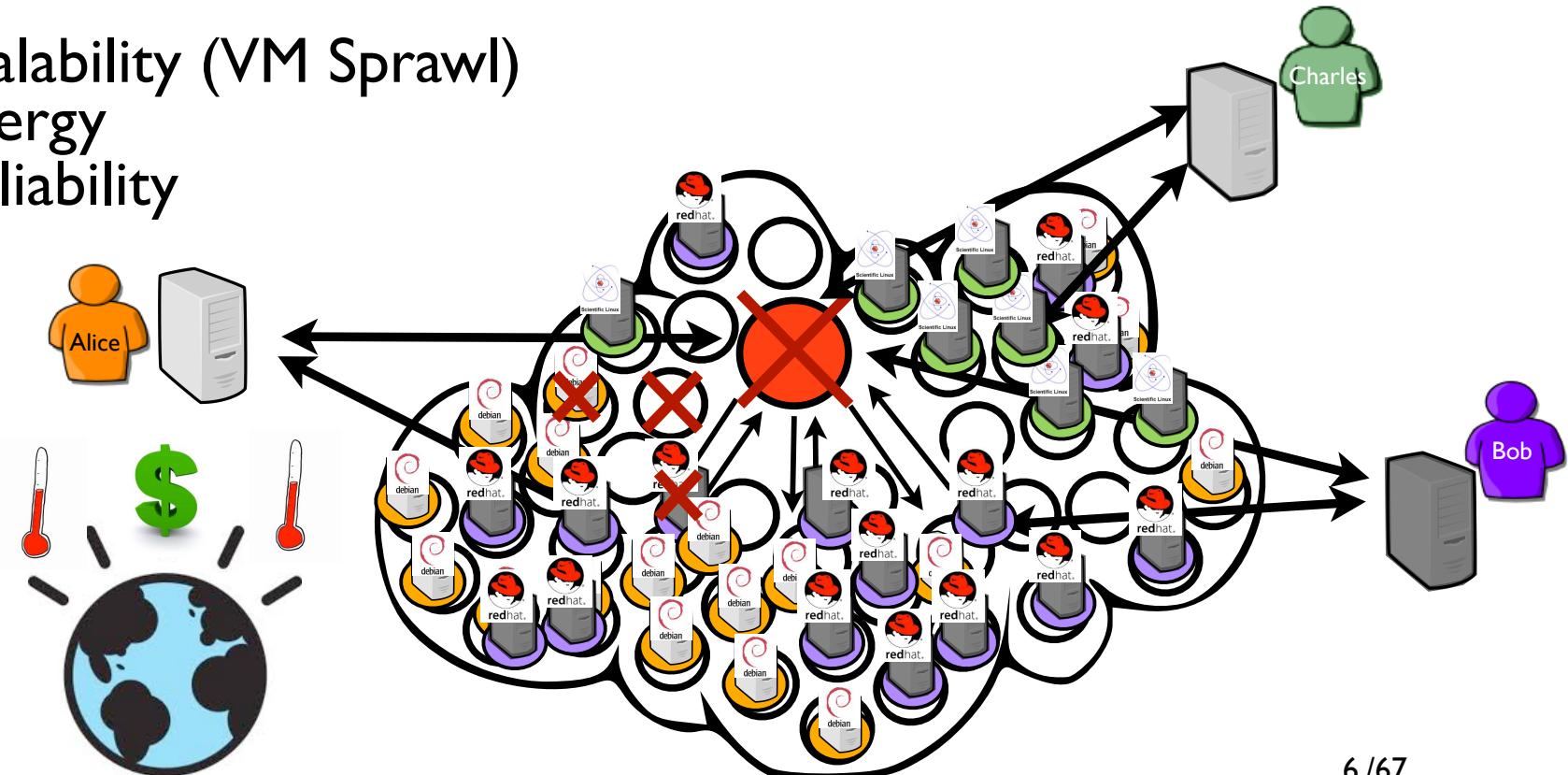
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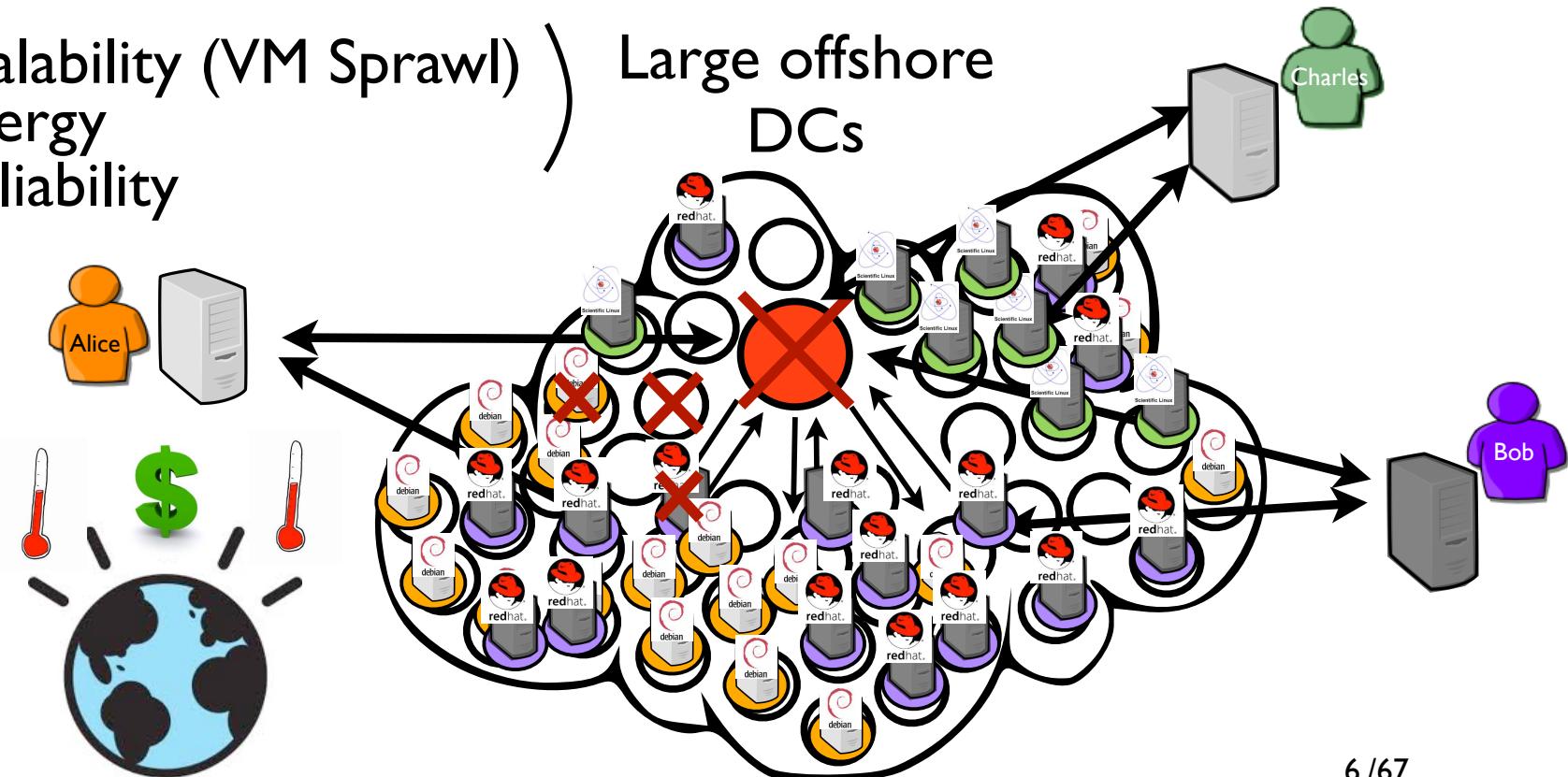
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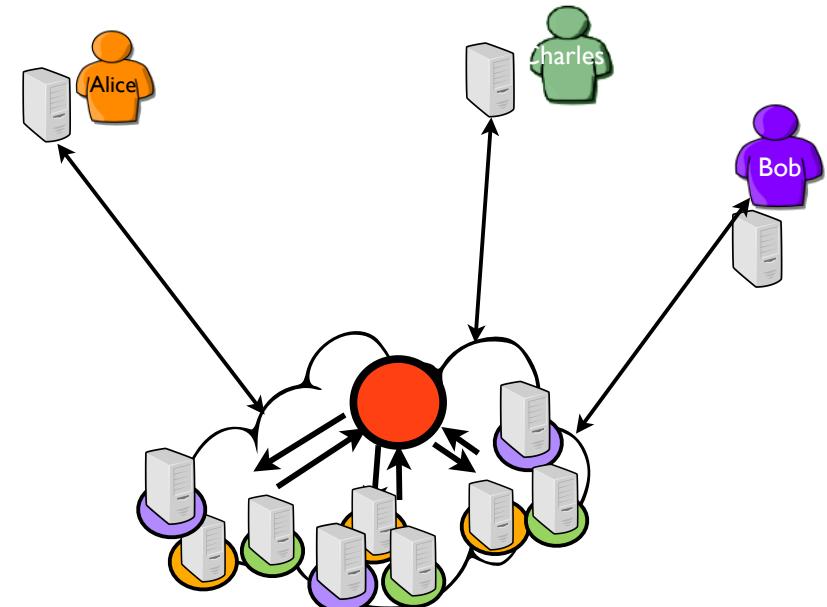


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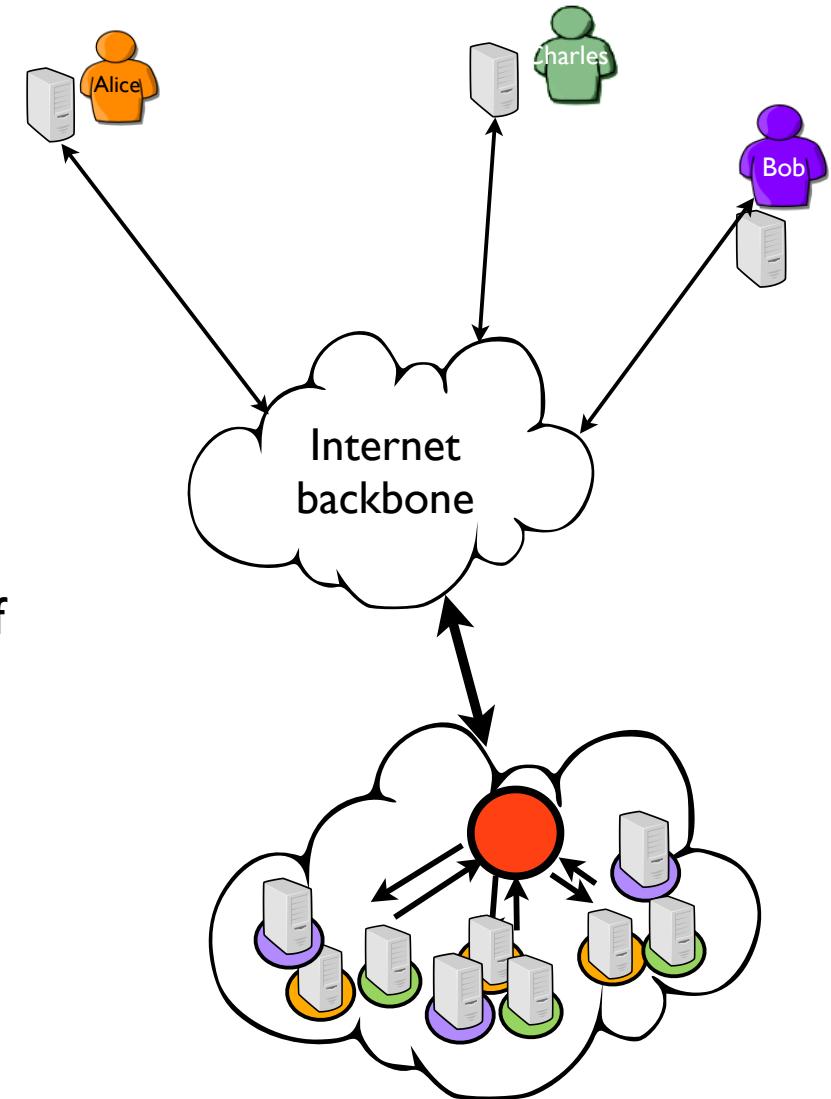
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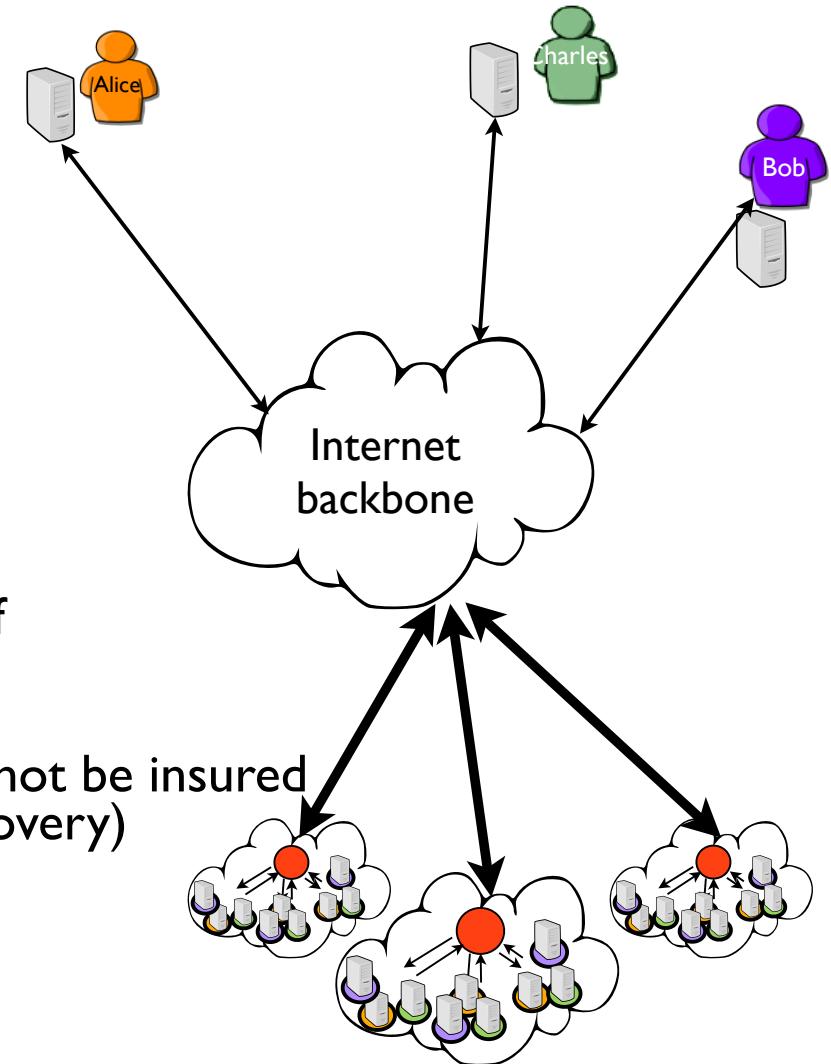
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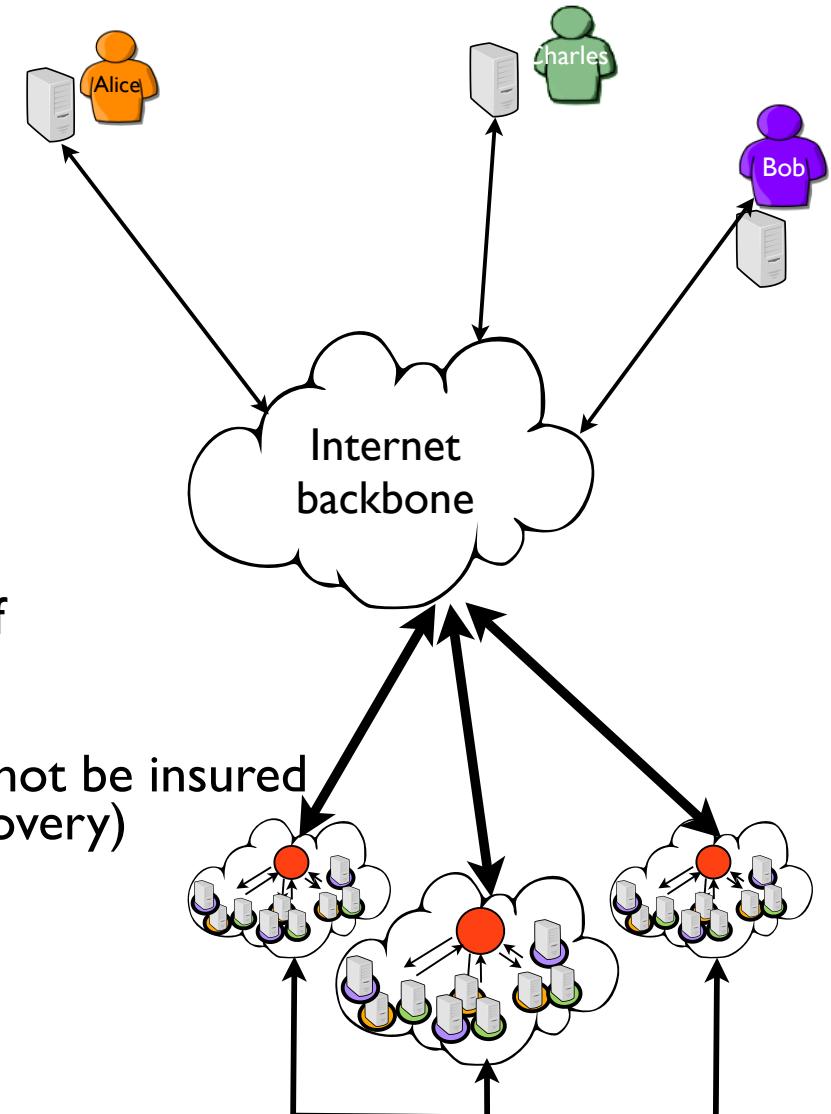
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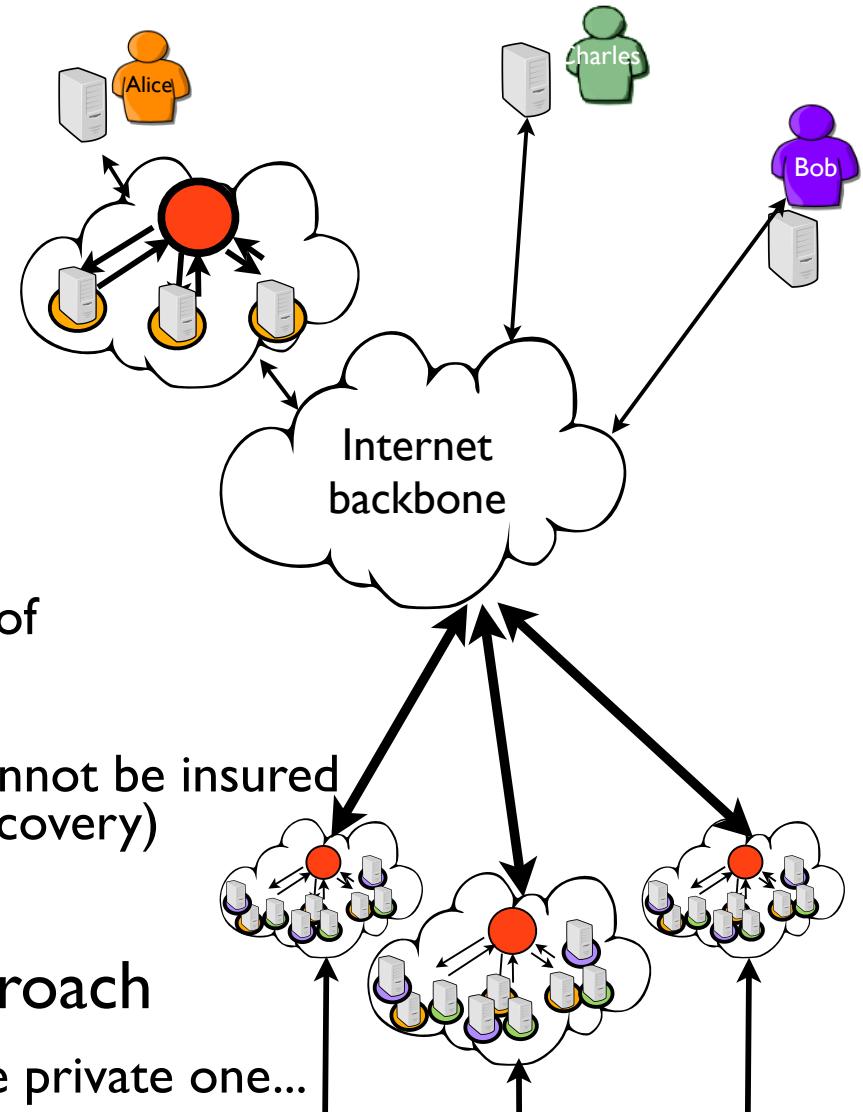


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- Hybrid platforms: a promising approach  
It depends how you are going to extend the private one...



**Can we address these concerns “all in one” ? ?**

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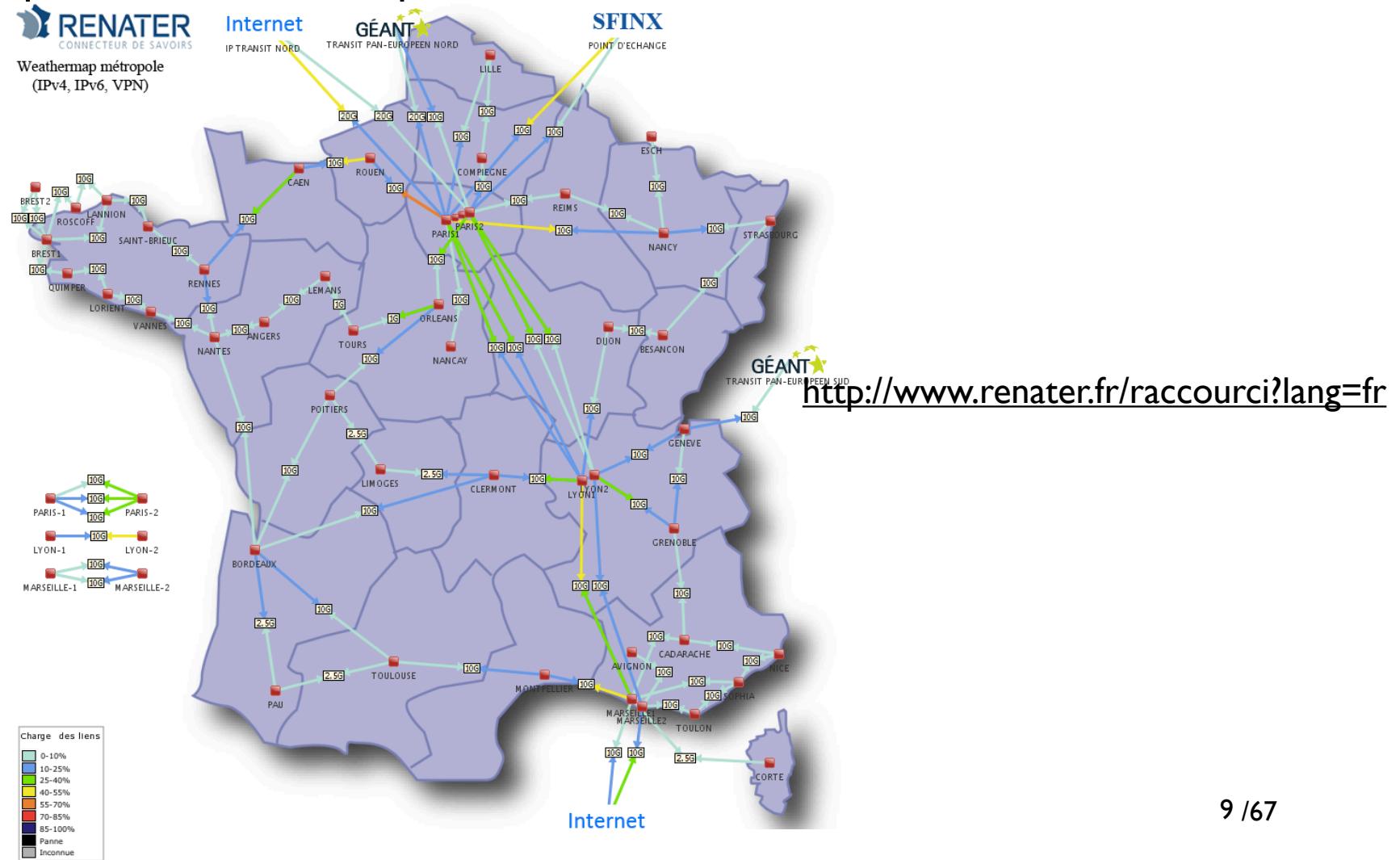
*How can the  $\mu$ DC concept be deployed ?*

# Locality Based Utility Computing Toward LUC Infrastructures

# Beyond the Cloud, the DISCOVERY Initiative

- Locality-based UC infrastructures

The only way to deliver highly efficient and sustainable UC services is to provide UC platforms as close as possible to the end-users.



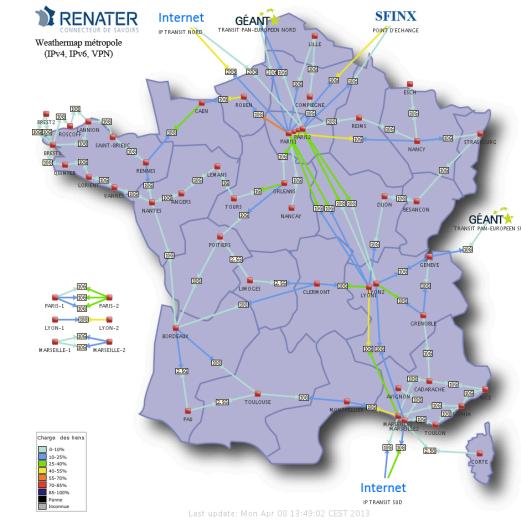
# Beyond the Cloud, the DISCOVERY Initiative

- Locality-based UC infrastructures

The only way to deliver highly efficient and sustainable UC services is to provide UC platforms as close as possible to the end-users.

- Leveraging network backbones

Extend any point of presence of a network backbone with UC servers (from network hubs up to major DSLAMs that are operated by telecom companies and network institutions).



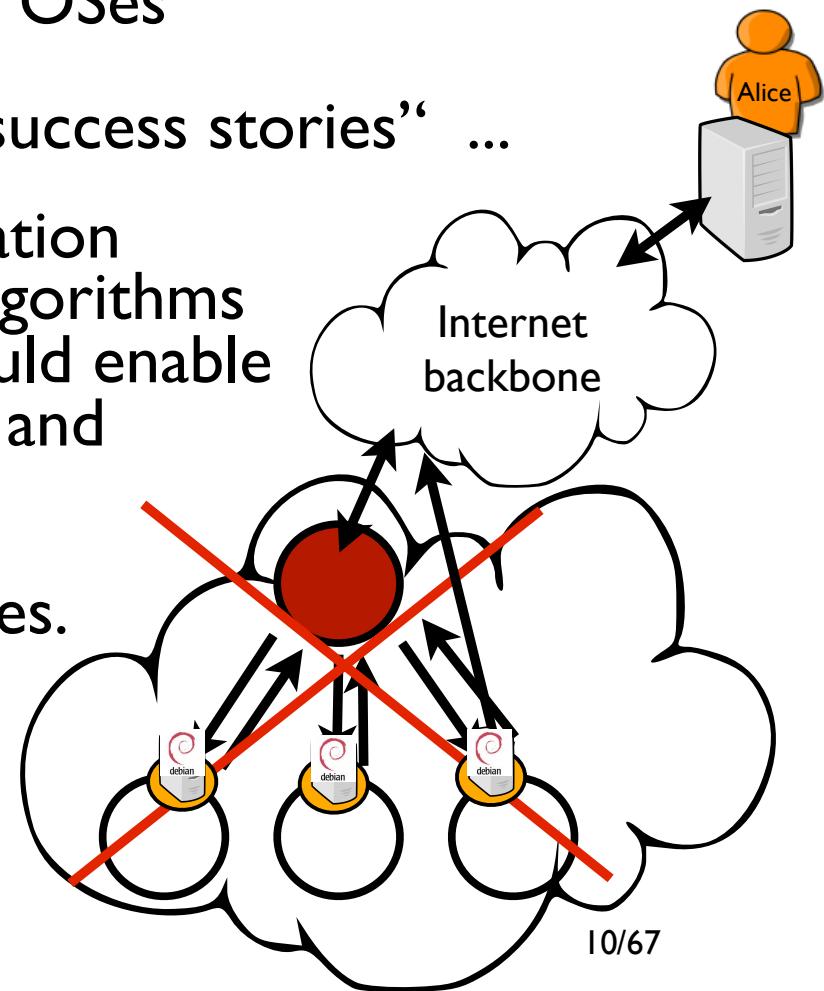
⇒ Operating such widely distributed resources requires the definition of a fully distributed system

# The DISCOVERY Proposal

- DIStributed and COoperative framework to manage Virtual EnviRonments autonomicallY (the LUC OS)
- Designing/implementing Distributed OSes

Deeply investigated with no “real success stories” ...

... But maturity of system virtualization capabilities as well as large scale algorithms and autonomous mechanisms should enable to design and implement a unified and autonomic system manipulating virtual environments (VEs) like traditional OS manipulate processes.



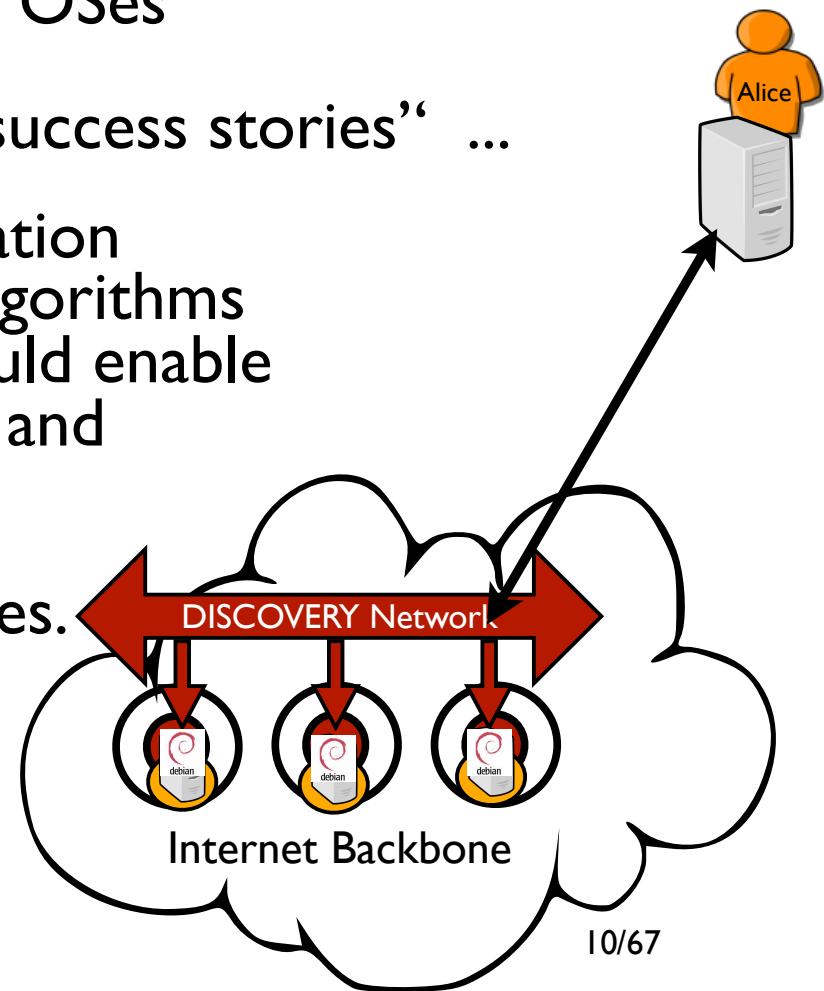
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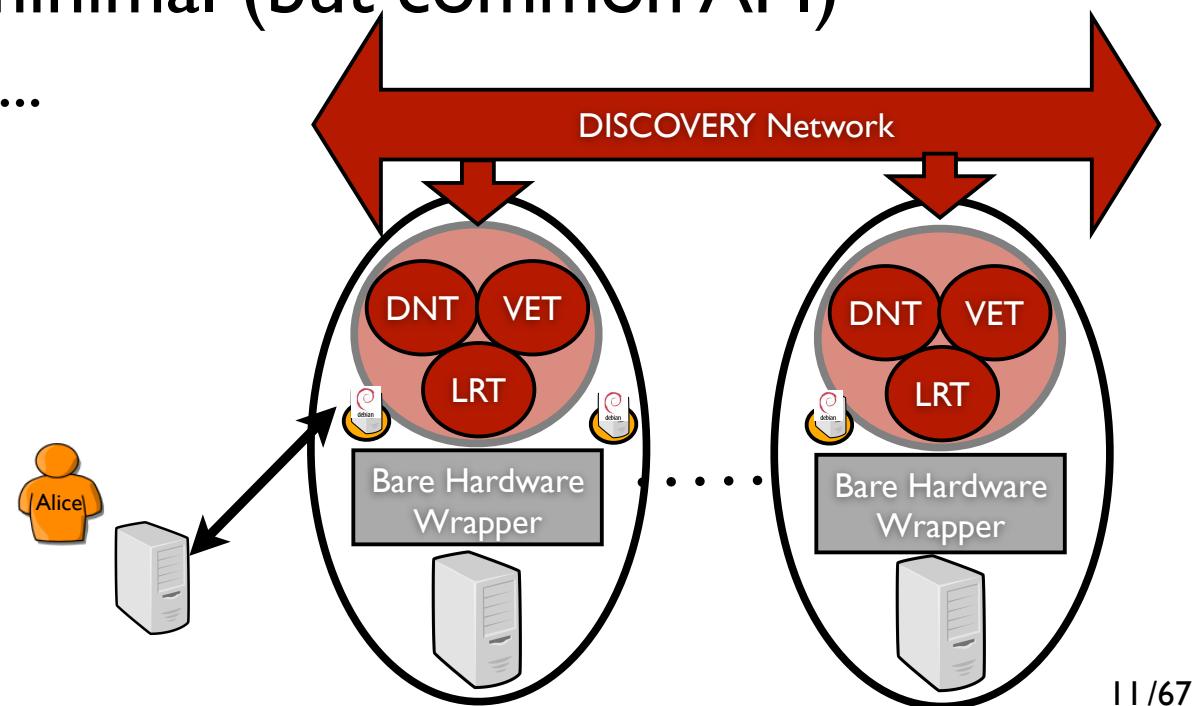
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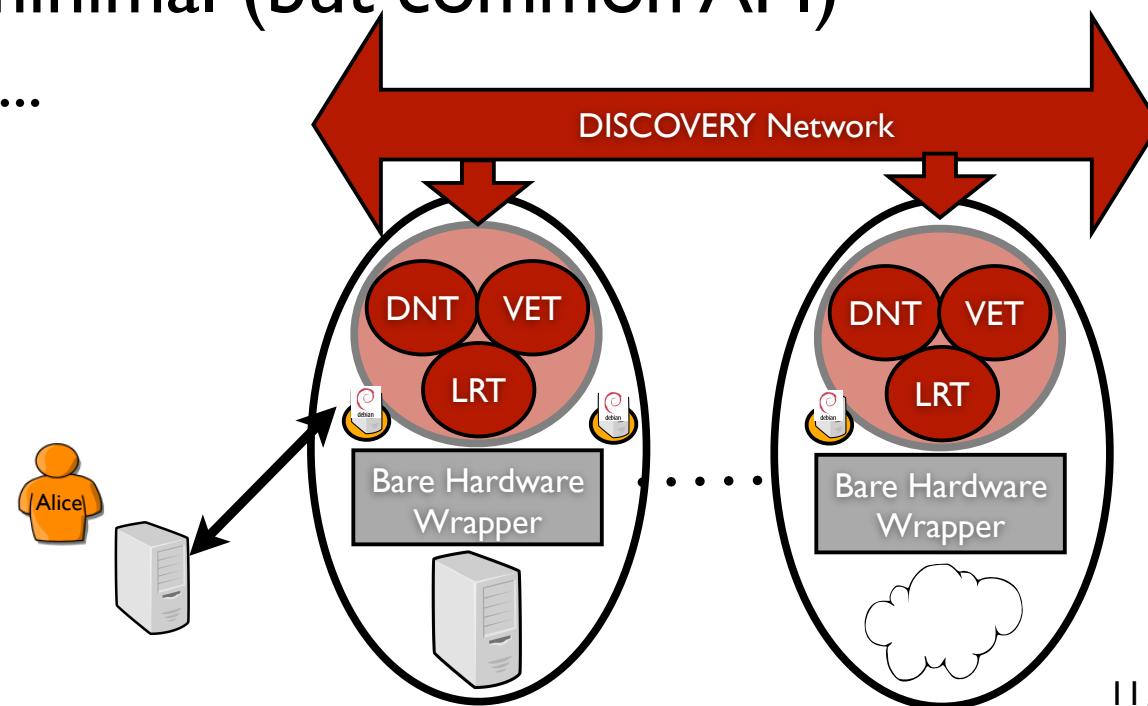
# The LUC OS Agent - Overview

- 3 services
  - Discovery Network Tracker (DNT)
  - Virtual Environments Tracker (VET)
  - Local Resources Tracker (LRT)
- Relying on a minimal (but common API)  
libvirt / OCCI / ...



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# The DISCOVERY Initiative

- Focusing on the design and the implementation of a complete OS for IaaS platforms (i.e. the LUC OS)

The LUC OS

Based on VMs and VEs (group of VMs) as the fundamental granularity

**Scalability**, targeting the management of hundred thousands of VMs upon thousands of physical machines (PMs)

**Reliability**, considering “hardware failures as the norm rather the exception”

**Reactivity**, handling each reconfiguration event as swiftly as possible to maintain VEs' QoS.

- May look simple but lots of scientific/technical challenges

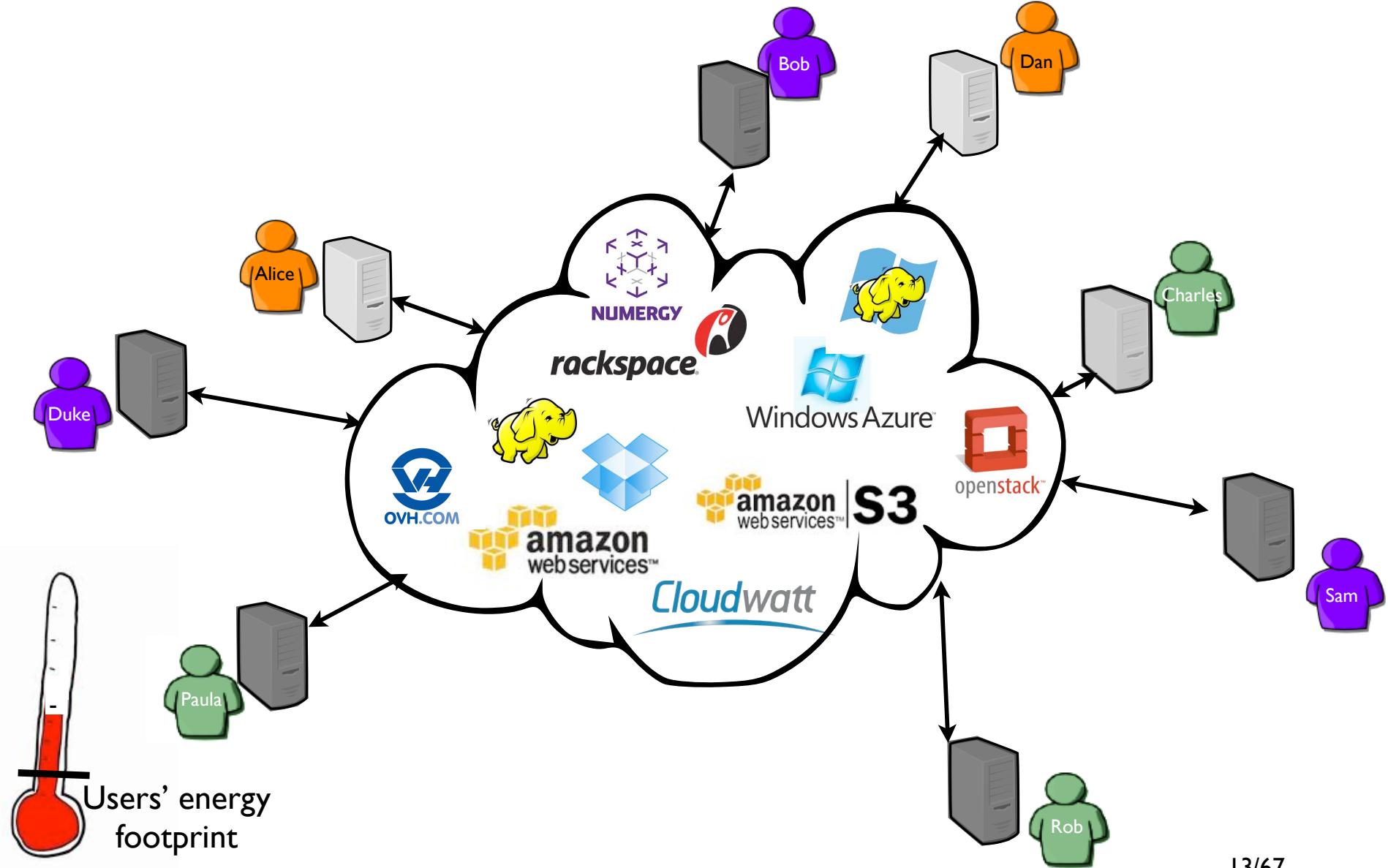
Cost of the DISCOVERY network !? partial view of the system !?

Impact on the others VMs !?, management of VM images !?

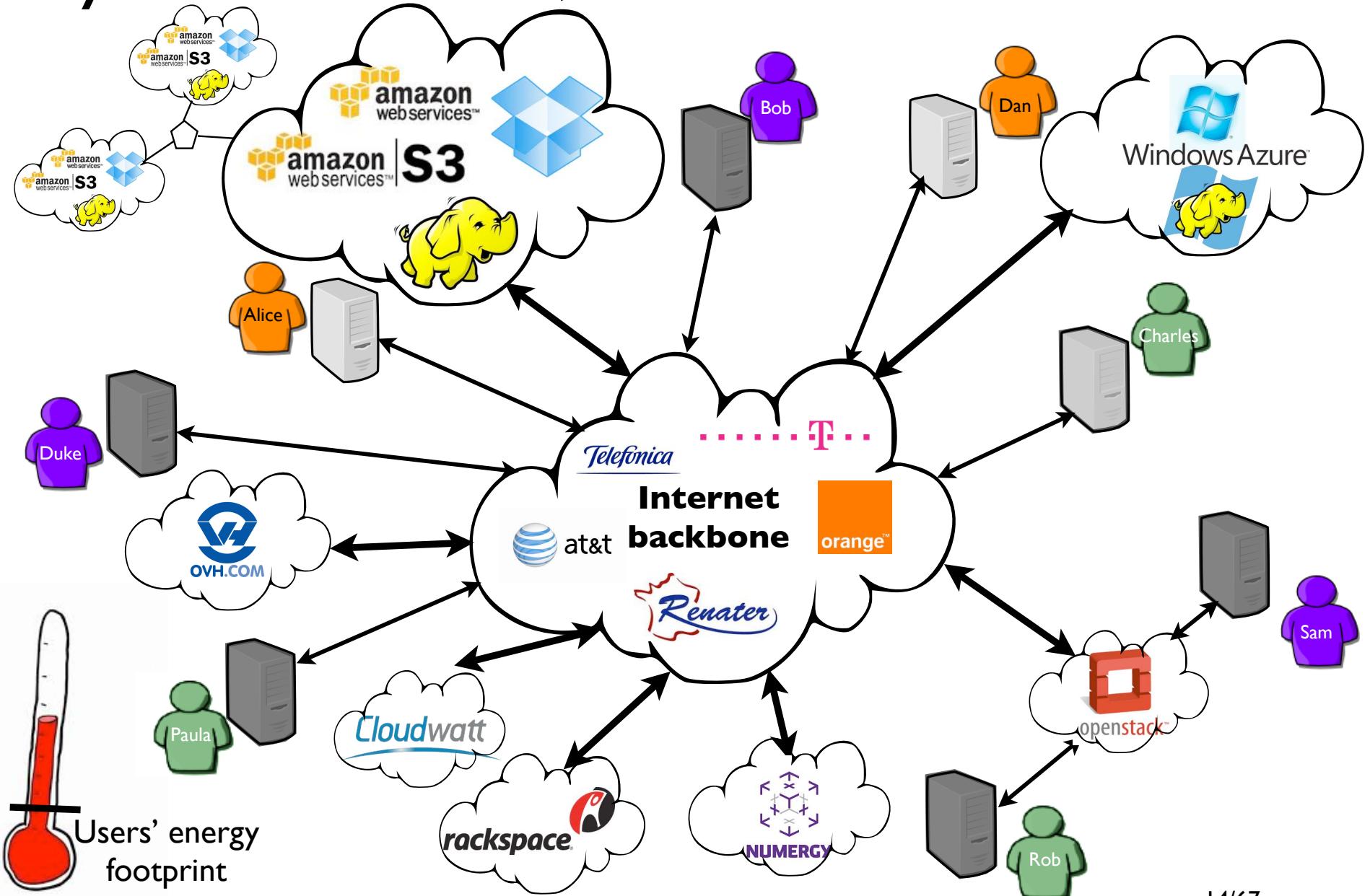
Which software abstractions to make the development easier and more reliable (distributed event programming) ? How to take into account locality aspects ?

- A *Bittorrent* like system ... but with stronger assumptions

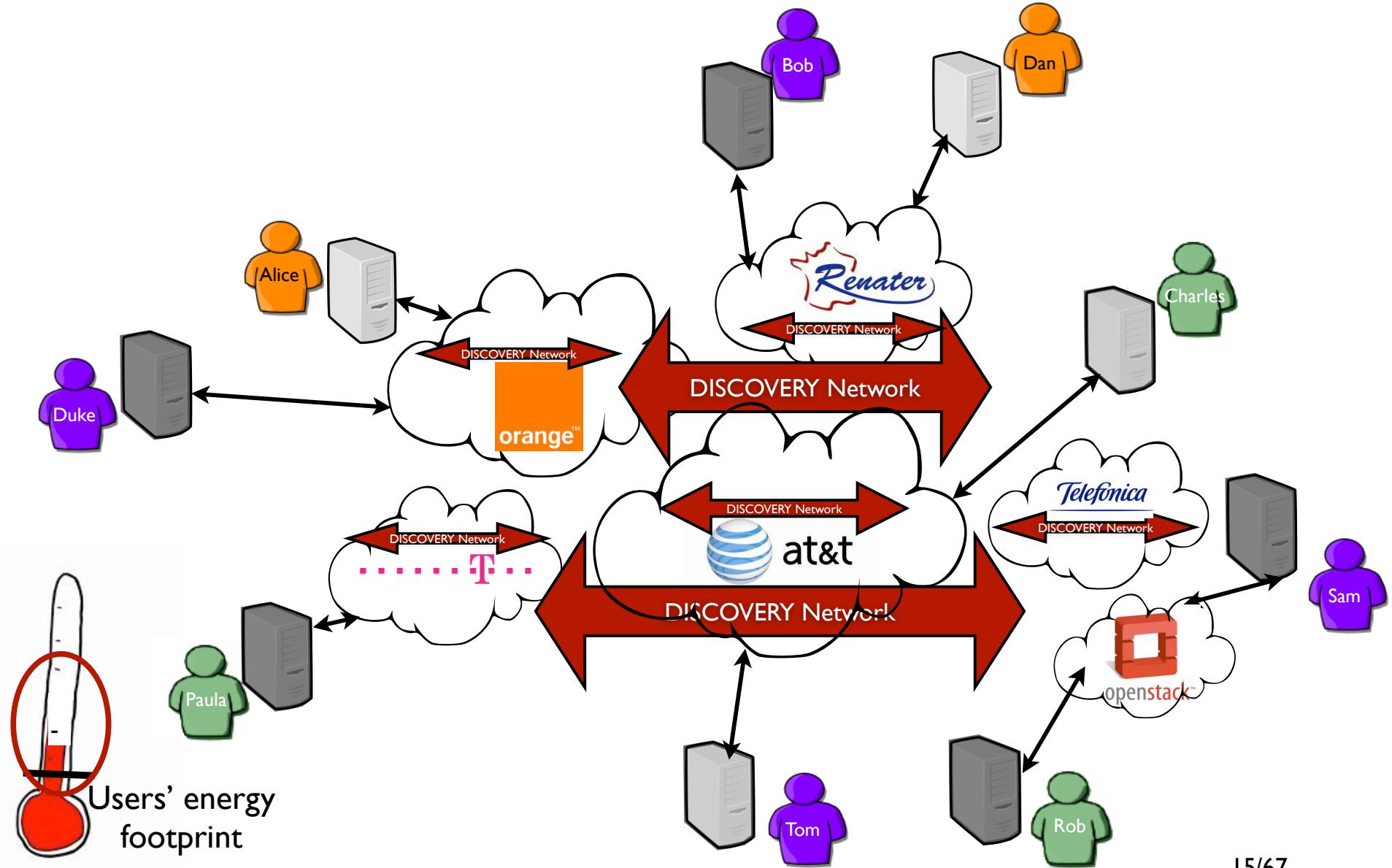
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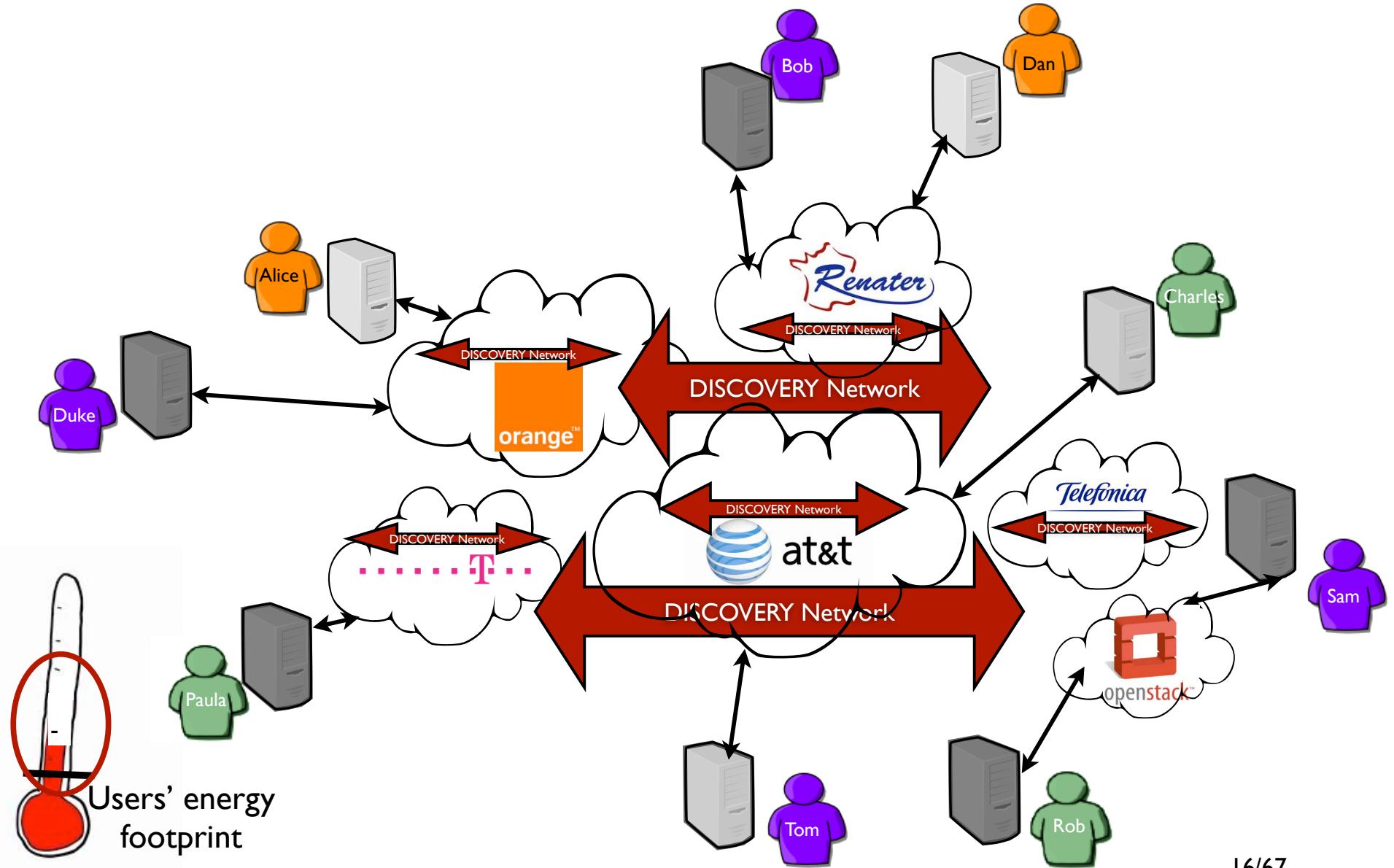
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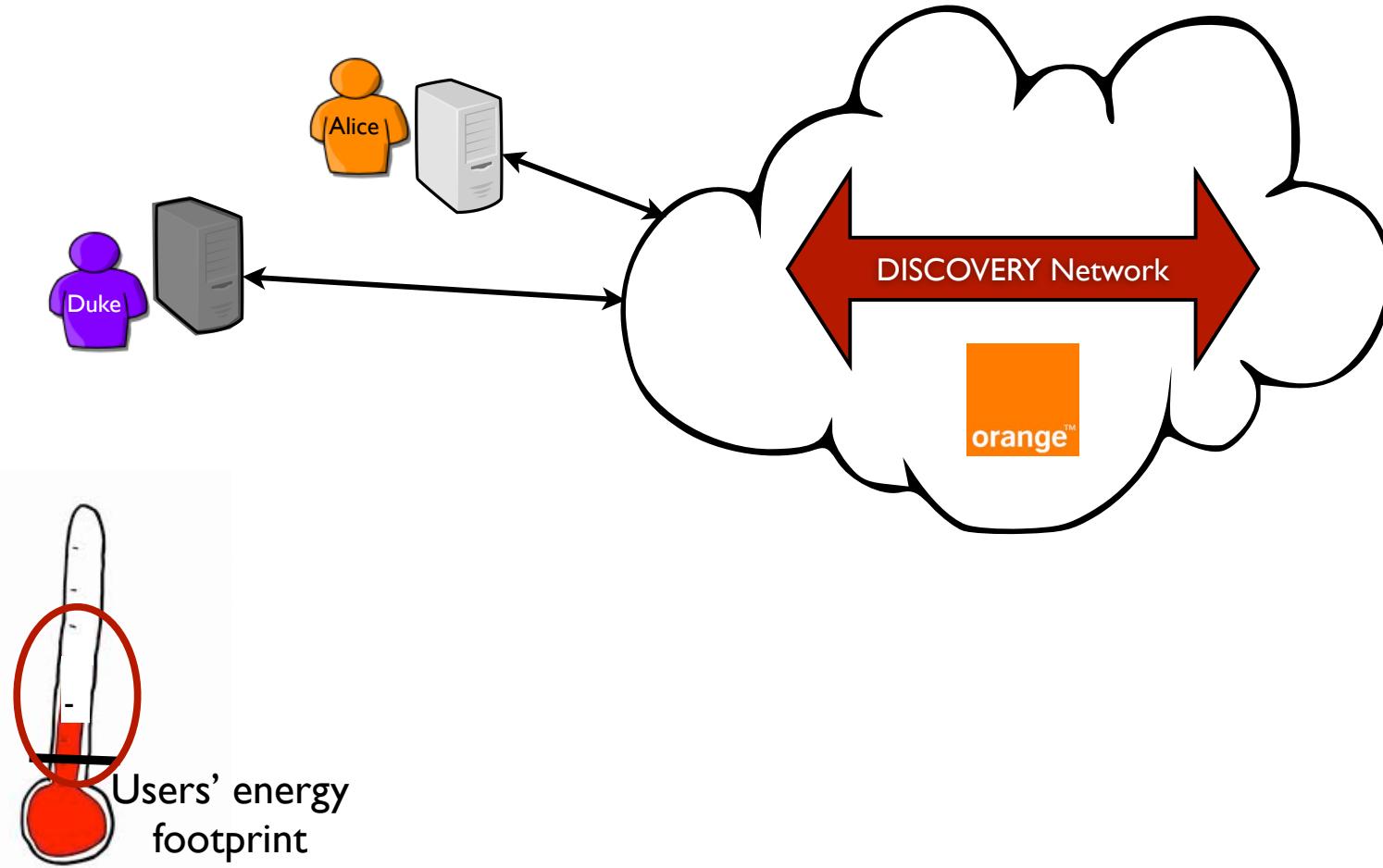
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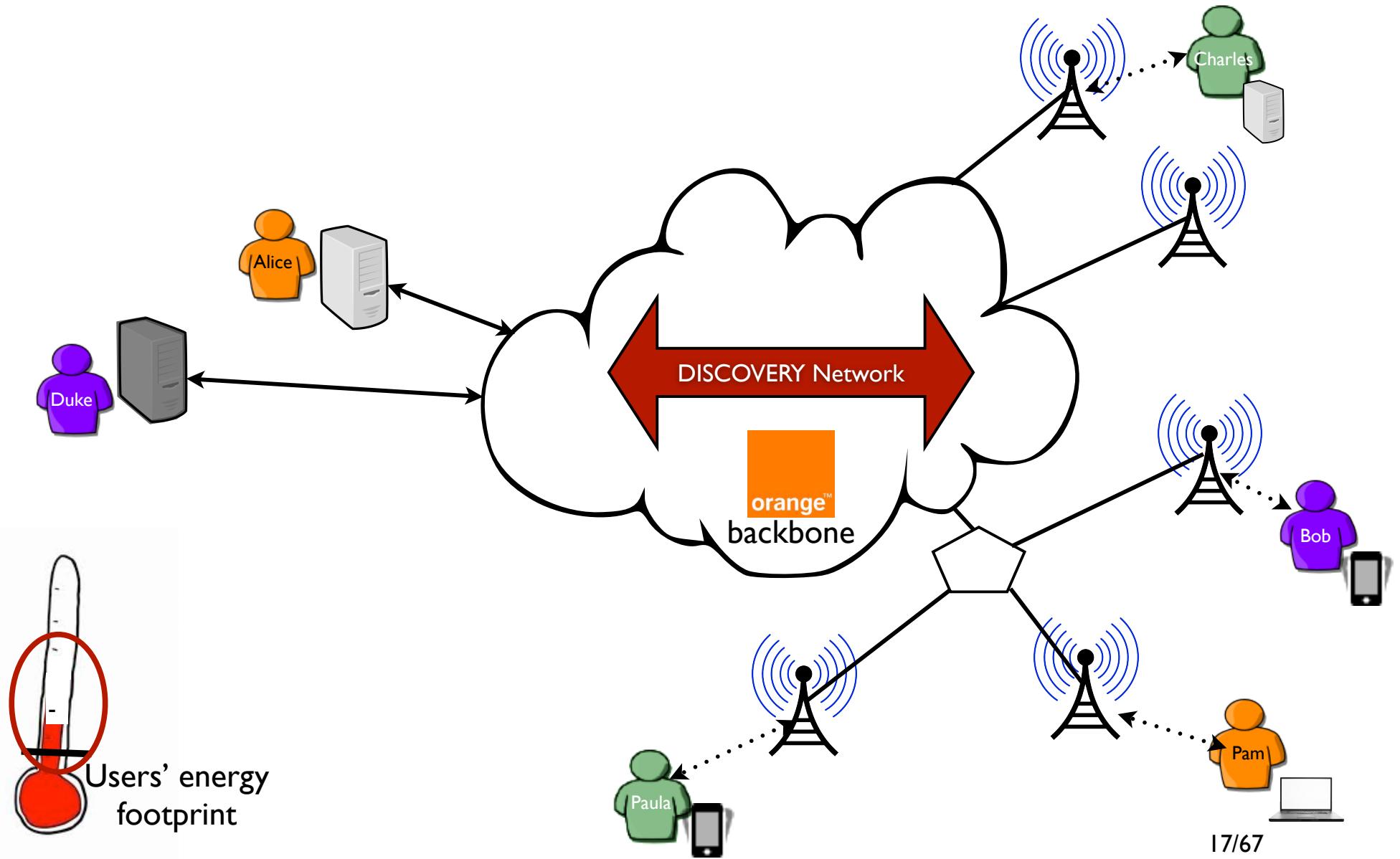


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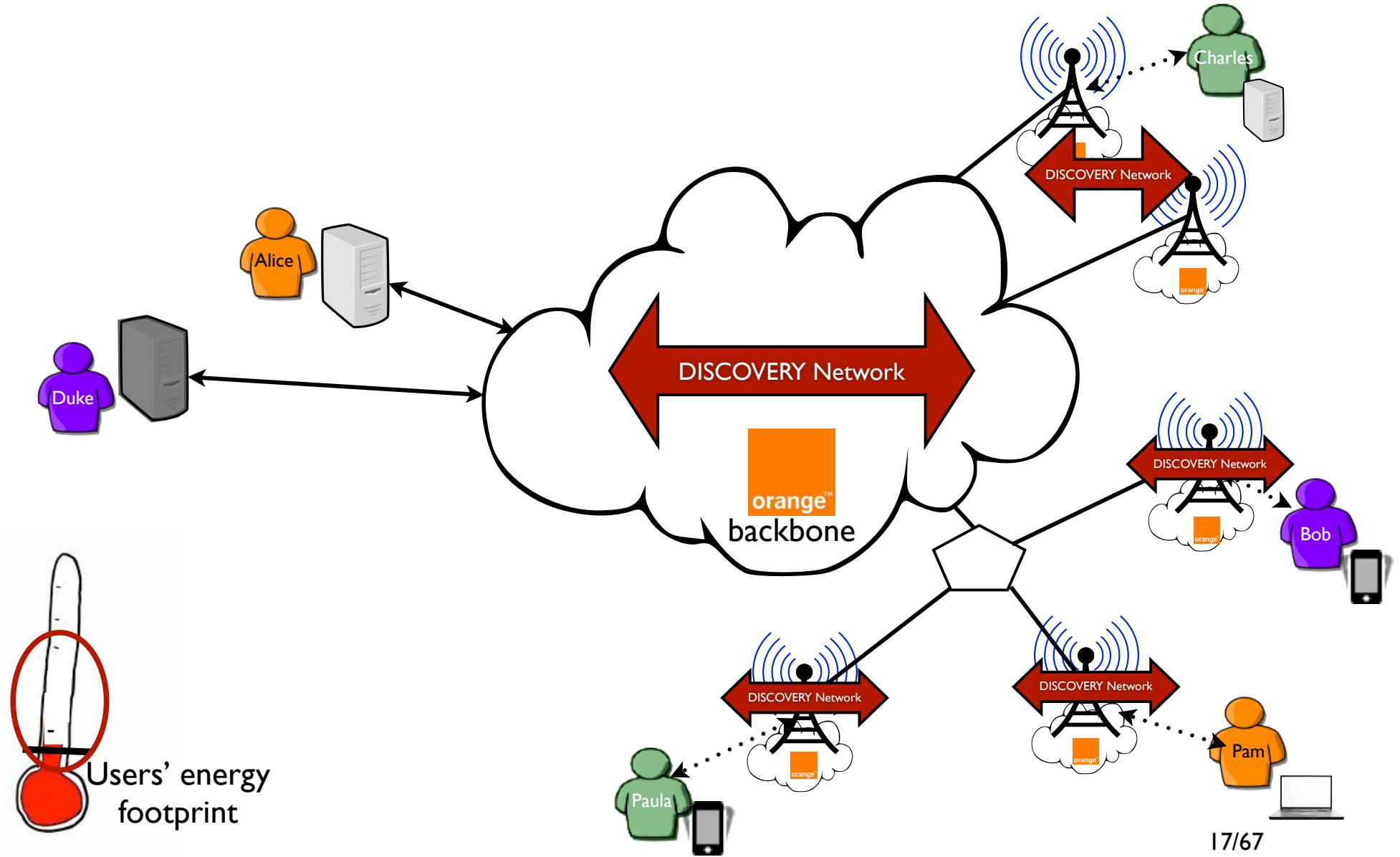


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# Beyond the Cloud, the DISCOVERY Initiative



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# The DISCOVERY Initiative

- Leveraging former projects but still on the starting blocks!
- Strong interests of large companies (SAP, Orange Lab, Citrix, ...)
- RENATER
- An important actor to follow: Akamai (micro DCs)
- Preliminary works with promising results (especially on the LRT: a first POC)
- Long term objective: impact on the design of distributed applications in order to take advantage of the locality (building S3 like system)

# Conclusion

- Cloud Computing technology is changing every day
  - New features, new requirements

The main challenge of the Discovery Initiative is to ensure that such new features/mechanisms can run in a distributed manner.
- But Distributed Cloud Computing is happening !
  - Dist. CC workshop (collocated with IEEE/ACM UCC 2013)
  - FOG Computing workshop (collocated with IEEE ICC 2013)

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## Global Infrastructure

Amazon Web Services serves hundreds of thousands of customers in more than 190 countries.

We are steadily expanding global infrastructure to help our customers achieve lower latency and higher throughput, and to ensure that their data resides only in the Region they specify. As our customers grow their businesses, AWS will continue to provide infrastructure that meets their global requirements.

[See detailed list of offerings at all AWS locations](#)



## Europe / Middle East / Africa



### EU (Ireland) Region

EC2 Availability Zones: 3 Launched 2007

### AWS Edge Locations

Amsterdam,  
The Netherlands (2)

Dublin, Ireland

Frankfurt,  
Germany (3)

London, England (3) Madrid, Spain

Marseille, France

Milan, Italy

Paris, France (2)

Stockholm, Sweden Warsaw, Poland

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- [Pricing](#)
- [Amazon CloudFront SLA](#)
- [What's New?](#)
- [Amazon CloudFront Events](#)

## Amazon CloudFront What's New?

[Back to the CloudFront page.](#)

### What's New:

#### **Announcing New Edge Locations in Manila, Marseille and Warsaw for Amazon CloudFront and Amazon Route 53**

**Date:** Dec 15th, 2013

**Details:** We are excited to announce the launch of three new edge locations – Manila in the Philippines, Marseille in France and Warsaw in Poland. These new locations will improve performance and availability for end users of your applications being served by Amazon CloudFront and Amazon Route 53 and bring the total number of AWS edge locations to 49 worldwide. Learn more by reading our [announcement](#).

#### **Amazon CloudFront Announces Atlanta, GA PoP and Additional Pops in London and Frankfurt**

**Date:** Nov 3rd, 2013

**Details:** We're excited to announce the launch of a new Amazon CloudFront edge location in Atlanta, GA. We have also recently added third edge locations in London, UK and Frankfurt, Germany in order to increase connectivity and to provide even better service for our customers. Learn more by reading our [announcement](#).

#### **Announcing Amazon CloudFront Support for POST/PUT and other HTTP Methods**

**Date:** Oct 15th, 2013

**Details:** We are excited to announce that Amazon CloudFront has added support for five additional HTTP methods: POST, PUT, DELETE, OPTIONS and PATCH. This means you can now use CloudFront to accelerate data uploaded from end users, improving the performance of dynamic and personalized websites that have web forms, comment and login boxes, "add to cart" buttons or other features. Learn more by reading our [announcement](#) or the [Amazon CloudFront Developer Guide](#). You can also attend our webinar "[Using Amazon CloudFront to Accelerate Your Static, Dynamic, and Interactive Content](#)" on November 7, 2013 at 10AM PDT to learn more.

## Developer Resources

- [AWS Management Console](#)
- [Documentation](#)
- [Release Notes](#)
- [Sample Code & Libraries](#)
- [Developer Tools](#)
- [Community Forum](#)

## Streaming Media Awards

Amazon CloudFront receives  
Streaming Media Magazine's

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# Beyond Discovery !

- From sustainable data centers to a new source of energy

The only way to deliver highly efficient and sustainable UC services is to provide UC platforms as close as possible to the end-users and to...

- Leverage “green” energy (solar, wind turbines...)

Transfer the green micro/nano DCs concept to the network PoP

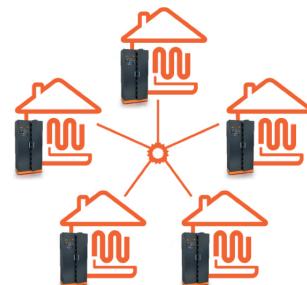
Take the advantage of the geographical distribution

- Leveraging the data furnaces concept

Deploy UC servers in medium and large institutions and use them as sources of heat inside public buildings such as hospitals or universities



<http://parasol.cs.rutgers.edu>

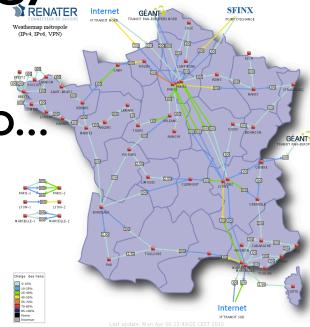


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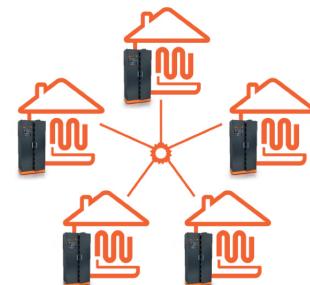
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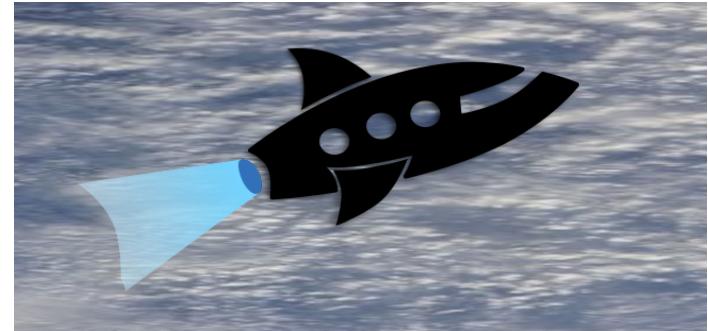


<https://www.aoterra.de>

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# The DISCOVERY Initiative

- Thank you / Questions ?
- Additional materials
  - Focus on LRT (Flavien Quesnel's Phd, ended in Feb 2013)
  - Discovery internals in a nutshell
  - On going work - The discovery framework from the Software Programming viewpoint (Jonathan Pastor's Phd, 2012/2015)



<http://beyondtheclouds.github.io/>

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