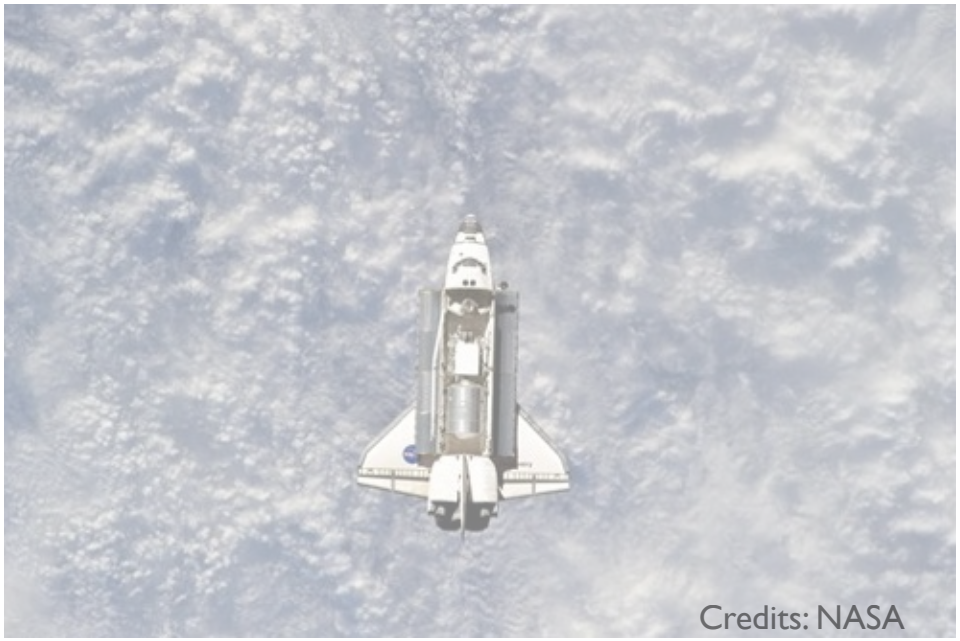
Beyond the Clouds, the DISCOVERY Initiative



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

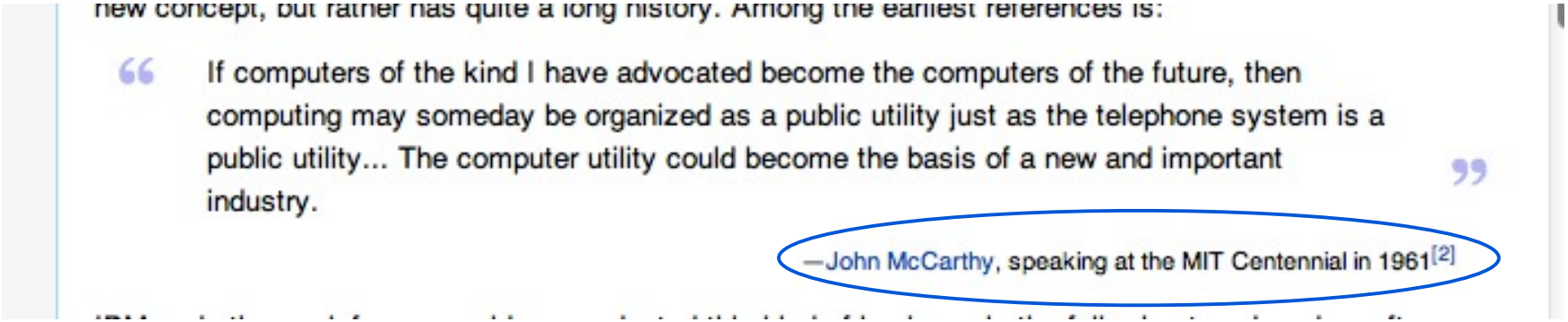
Adrien Lèbre / Ascola Project Team
November, 2013

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[2]

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

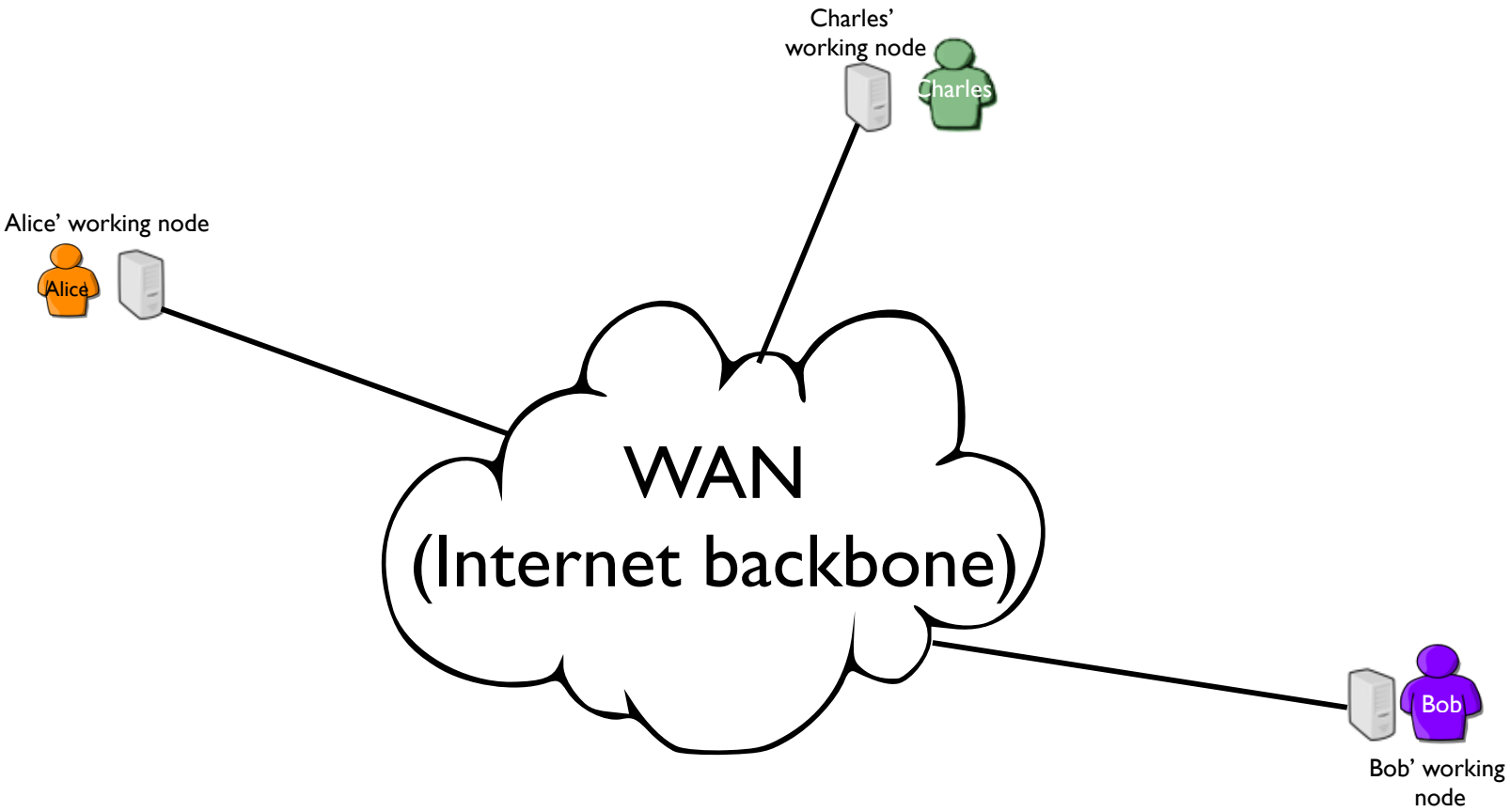
  Data Sharing

  Software/Hardware heterogeneity

  Security (Isolation between applications, ...)

  Reachability / Reliability / Resiliency ...

Utility Computing - The Cloud



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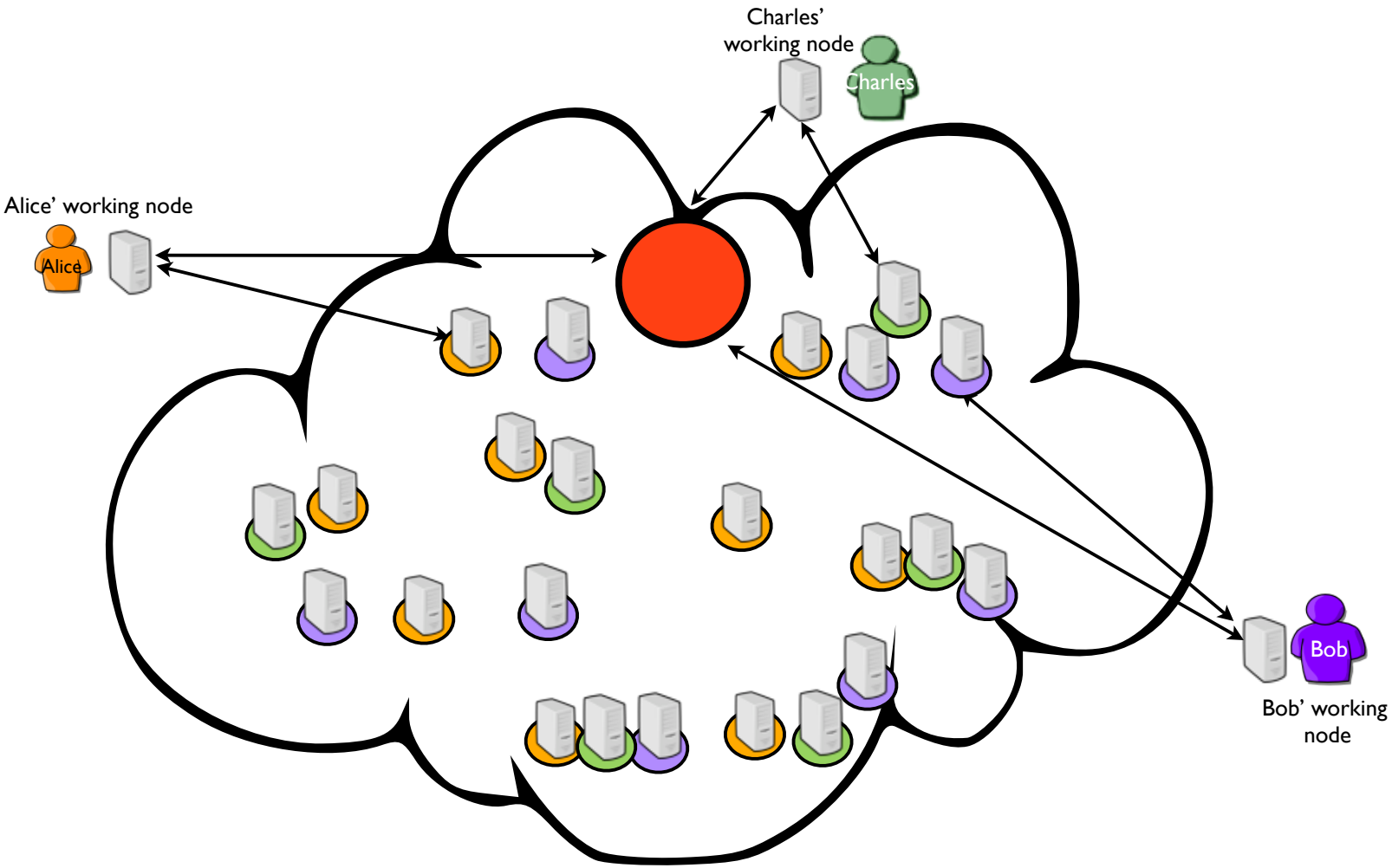
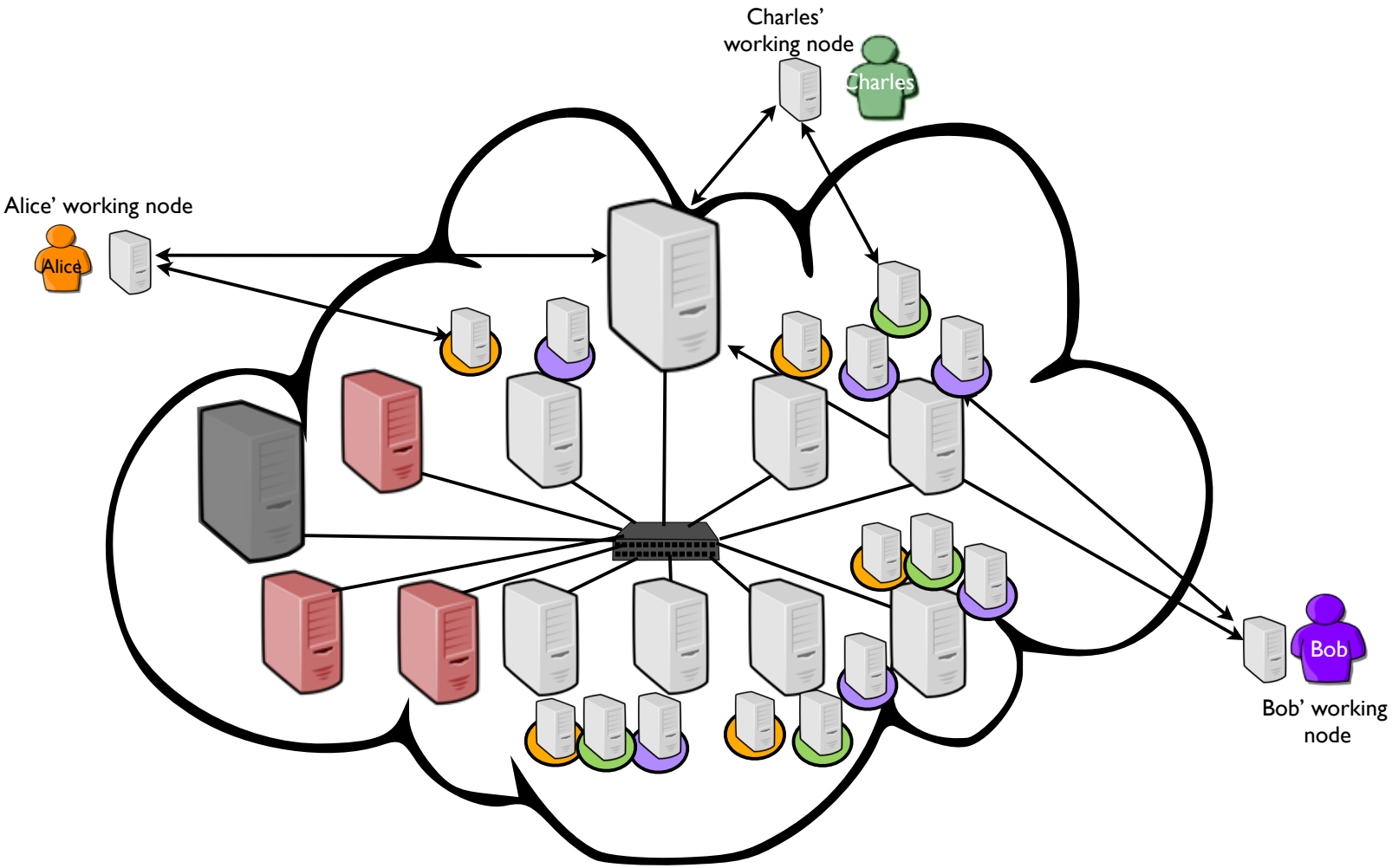


Infrastructure as a Service model

Utility Computing - The Cloud



Infrastructure as a Service model

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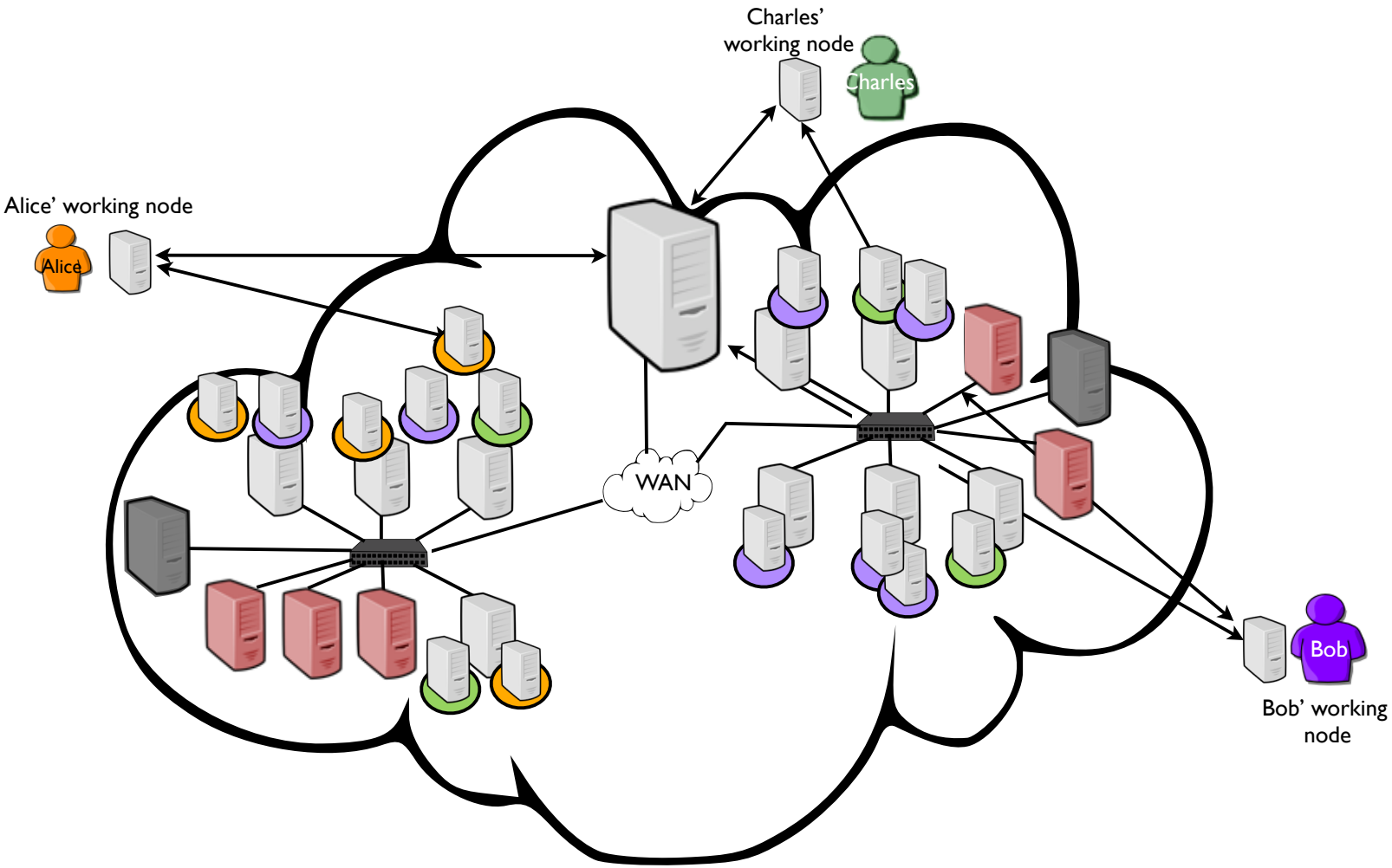

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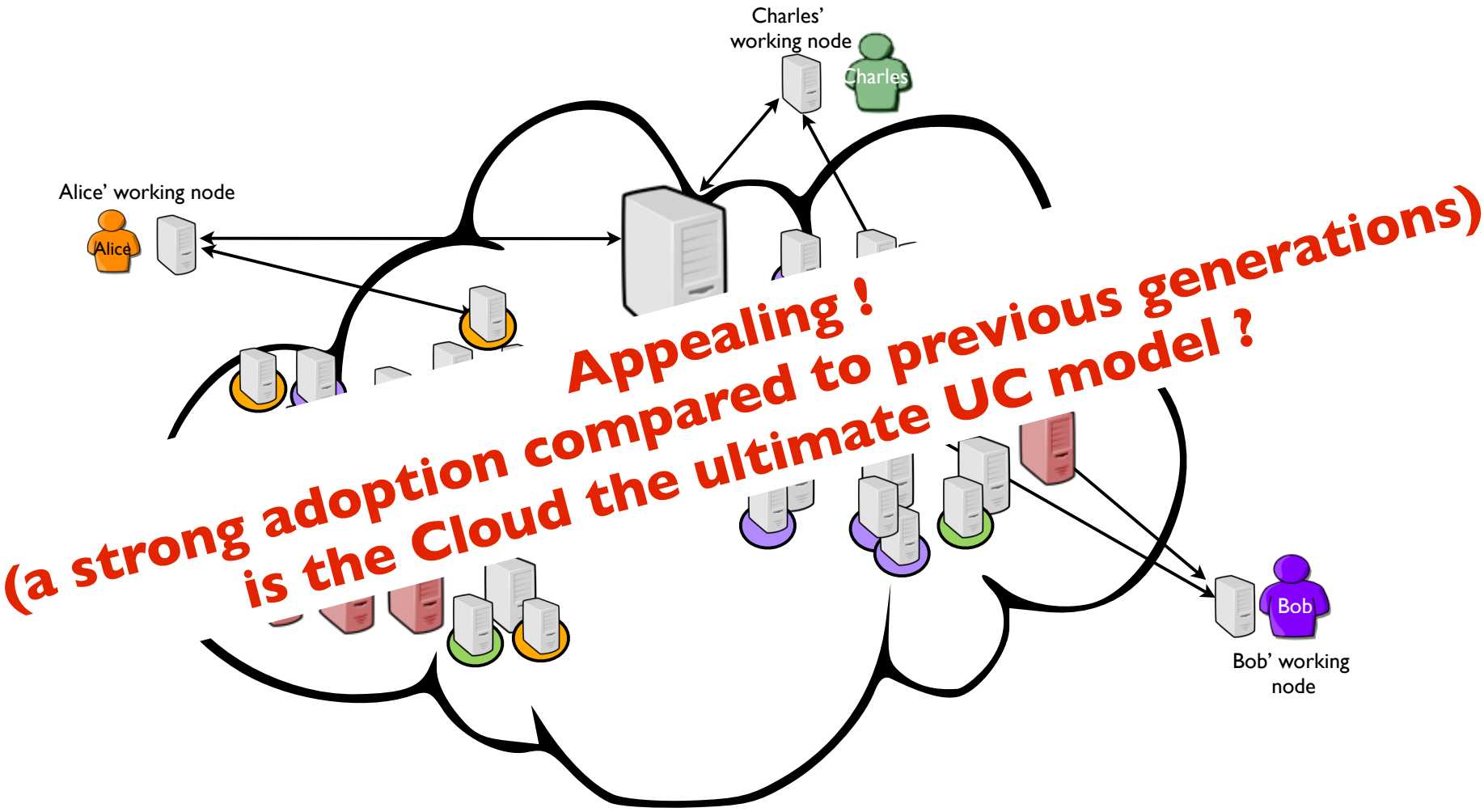


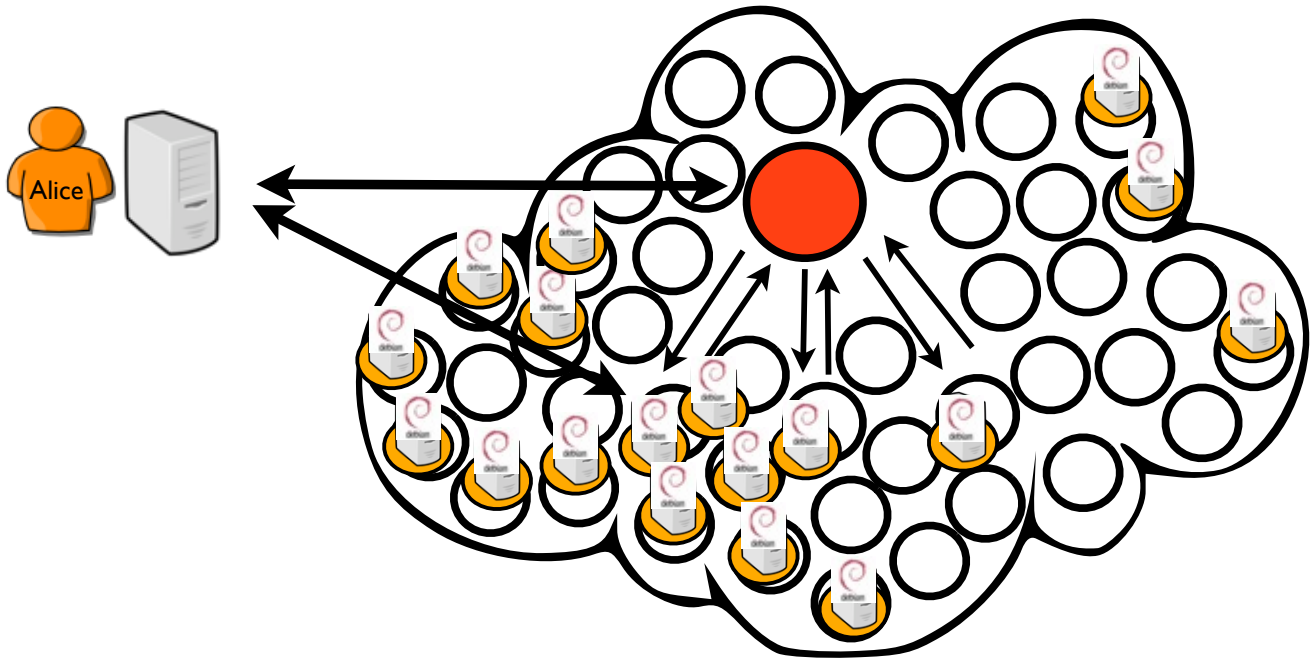
The Cloud the ultimate UC model ...

- Mature for one *site/cloud* !

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

- Current concerns

  Scalability (VM Sprawl)



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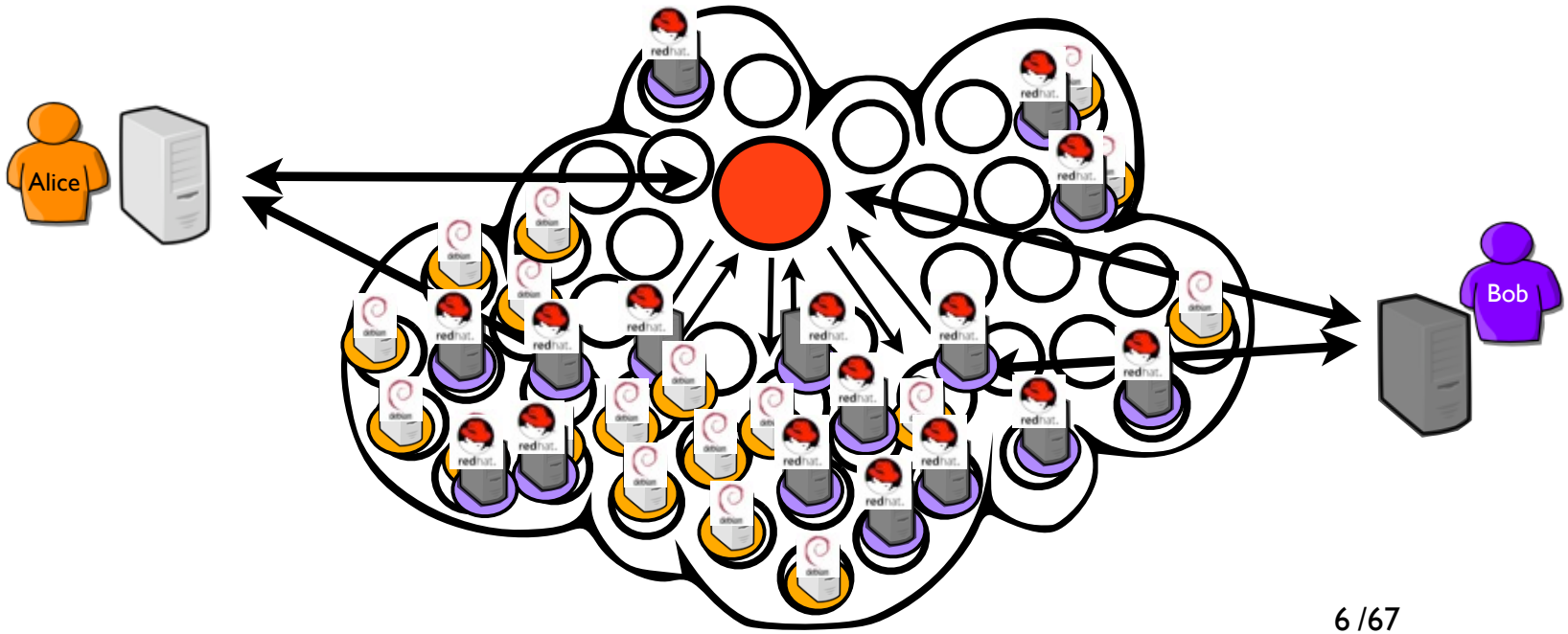

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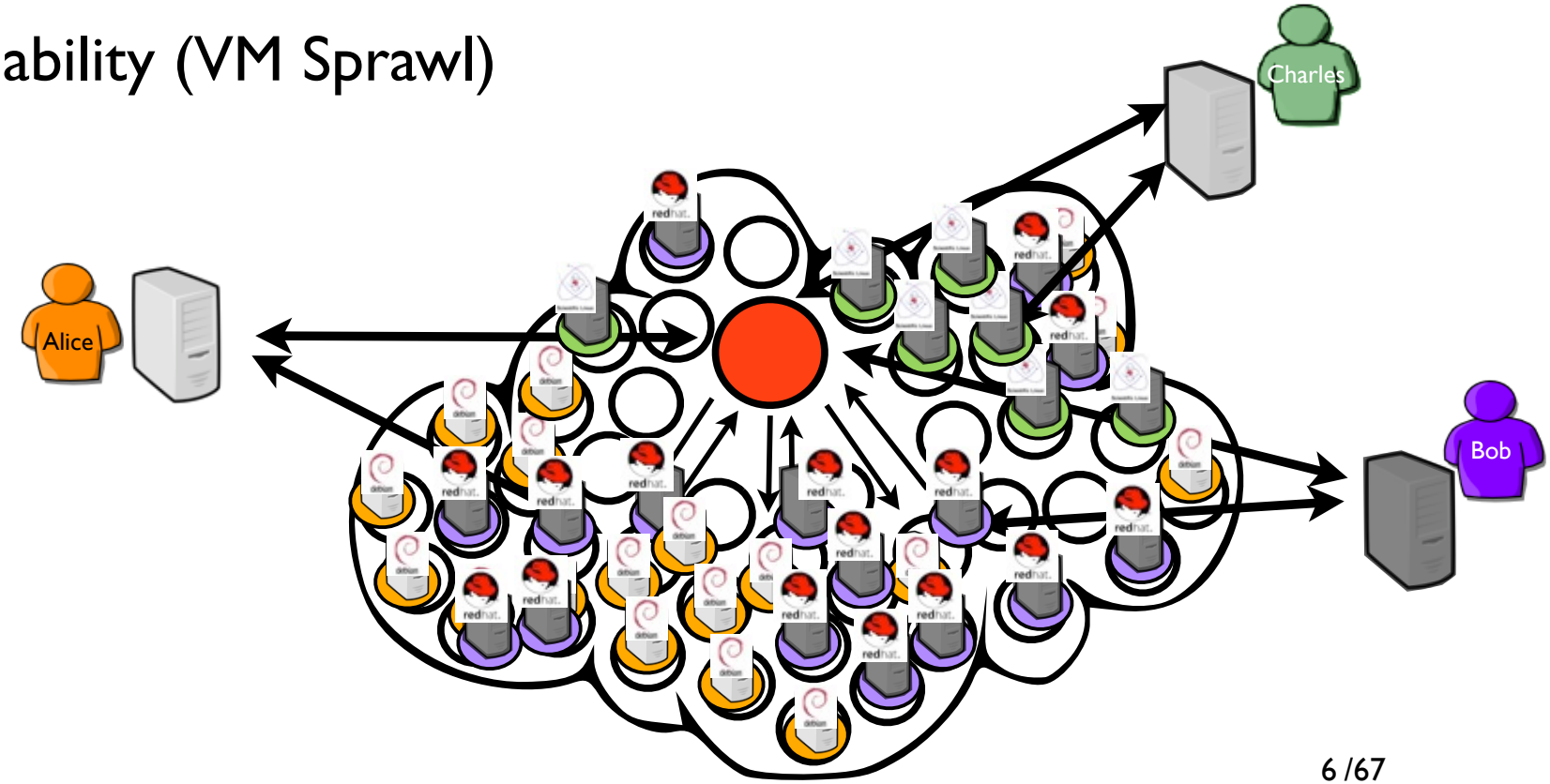

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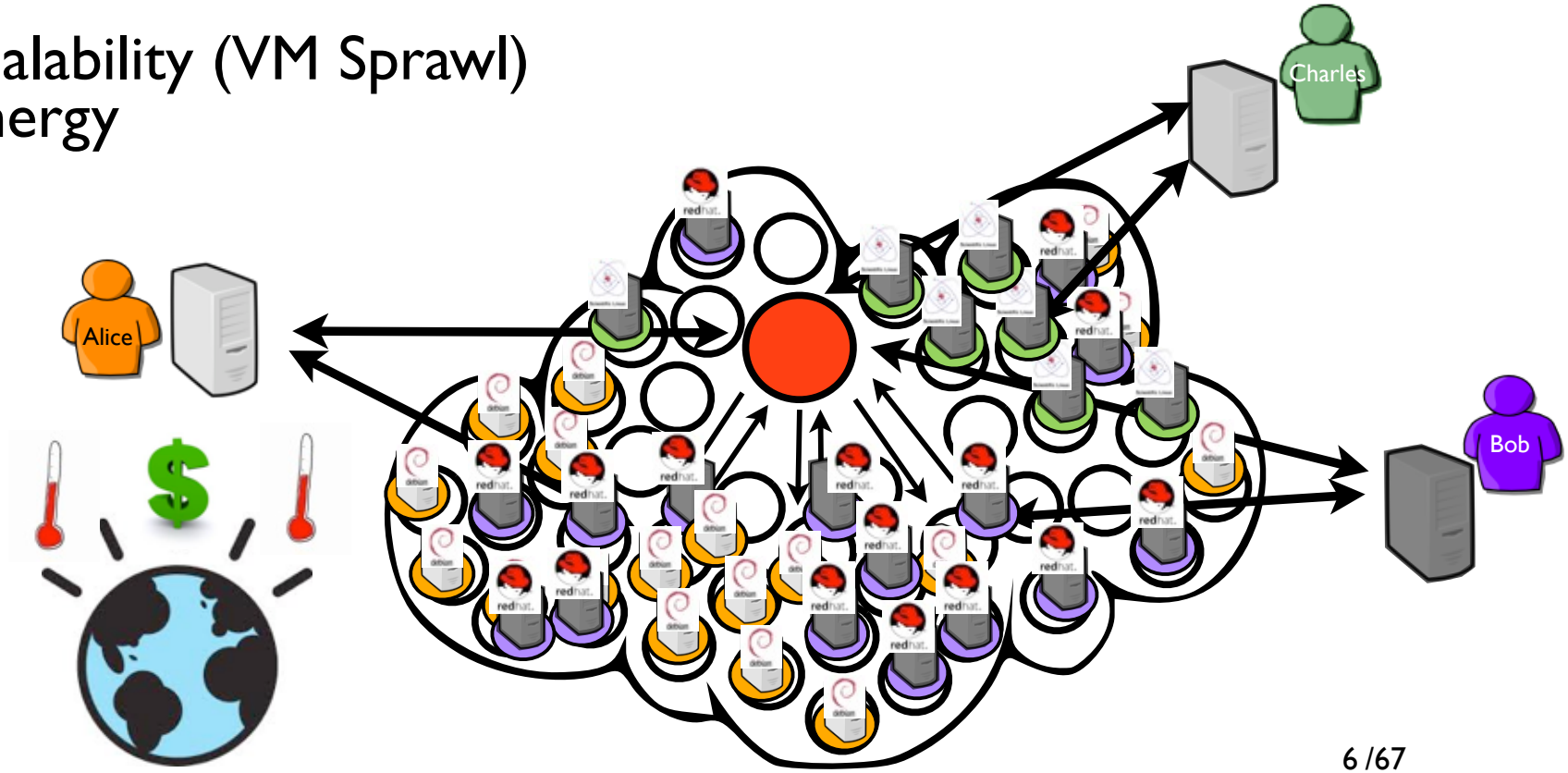

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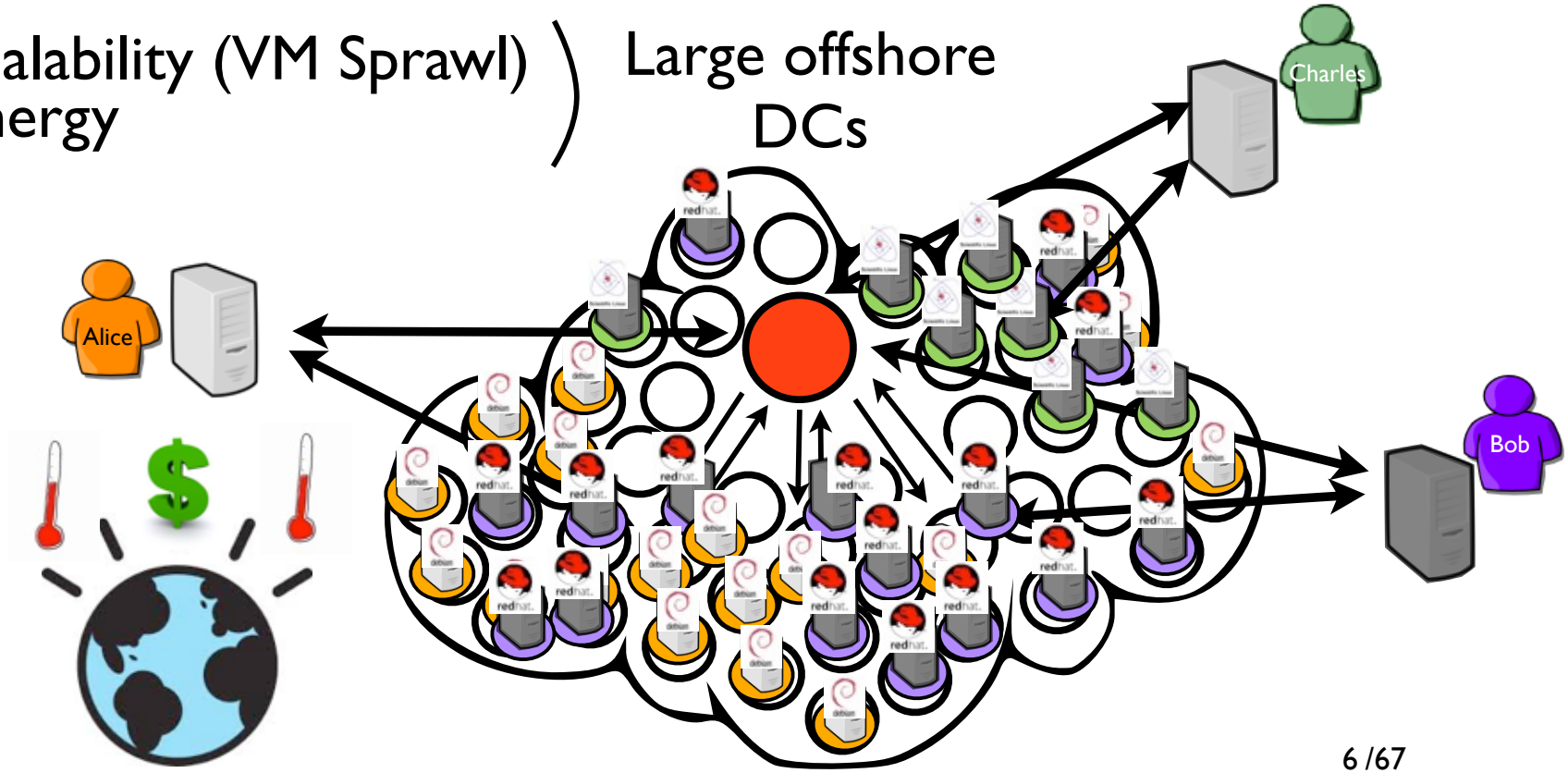

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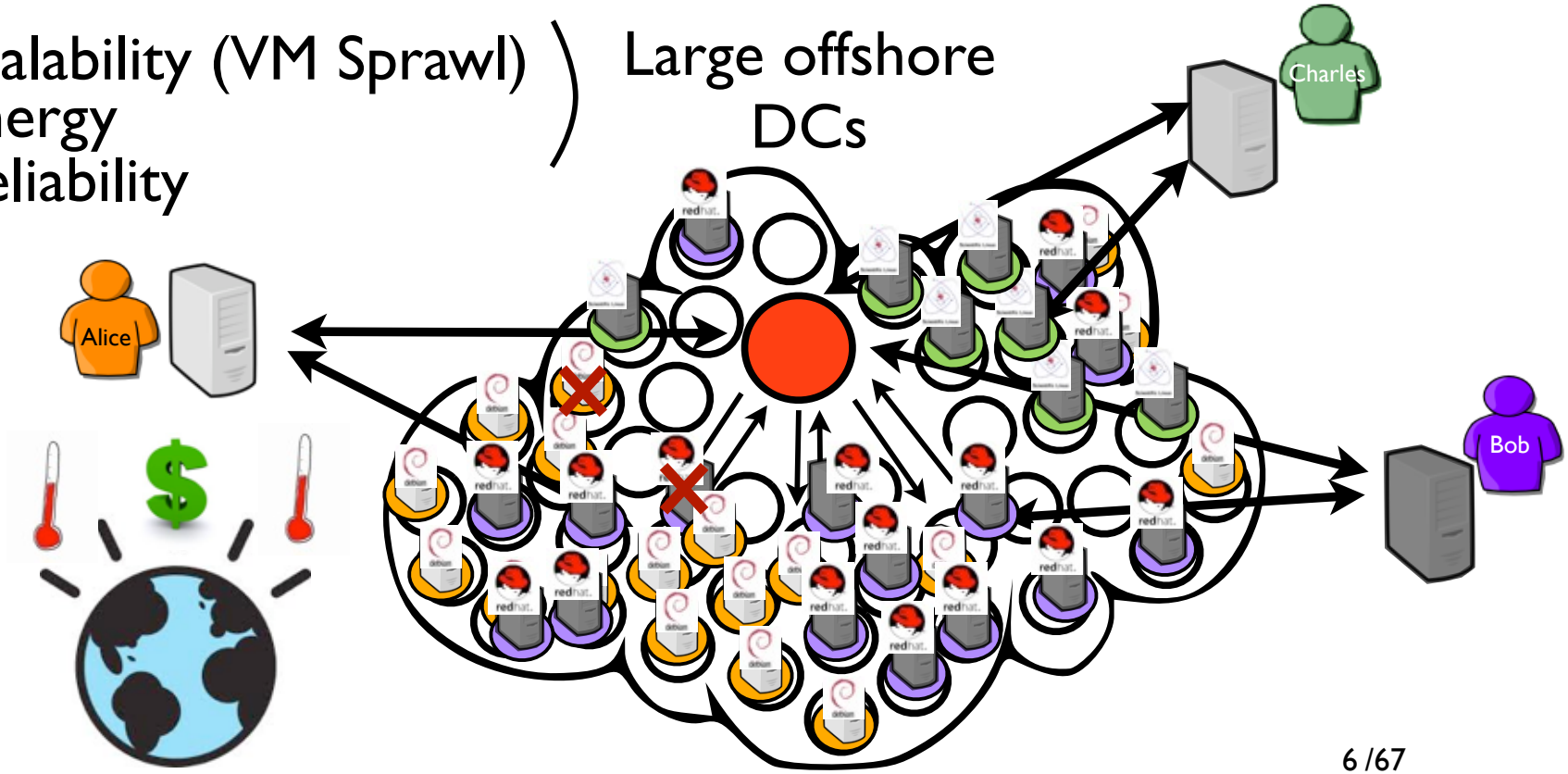

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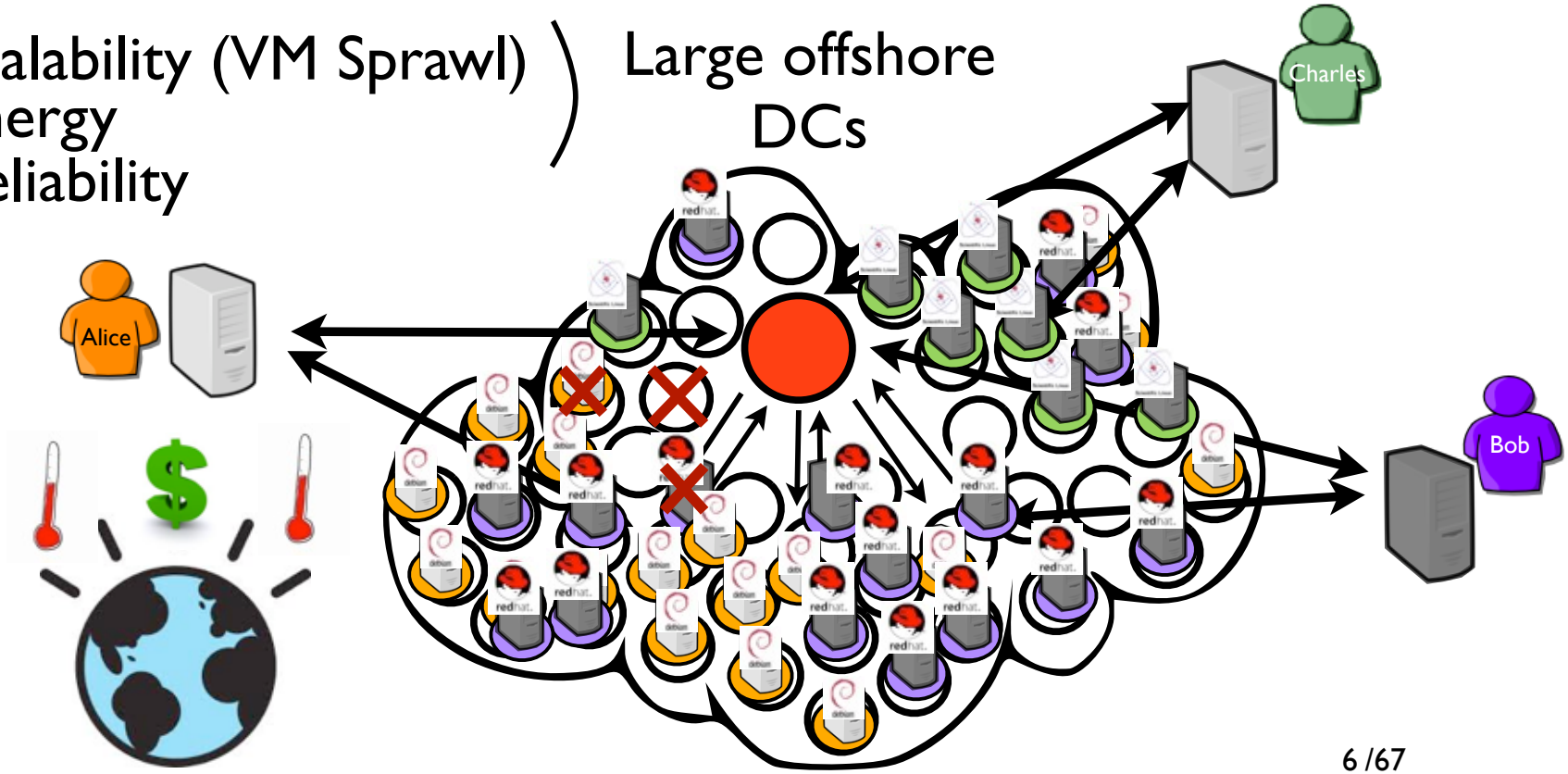

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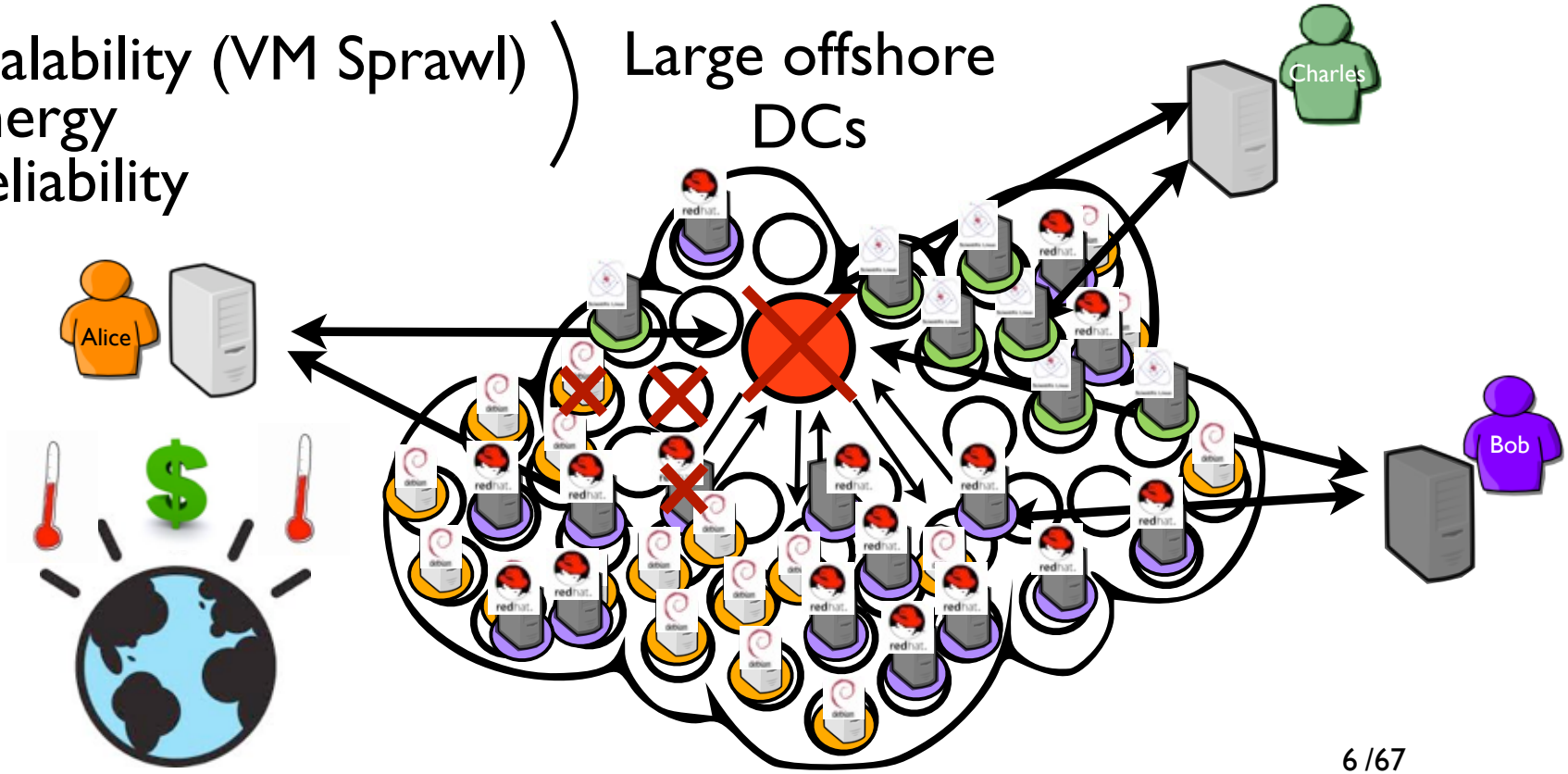

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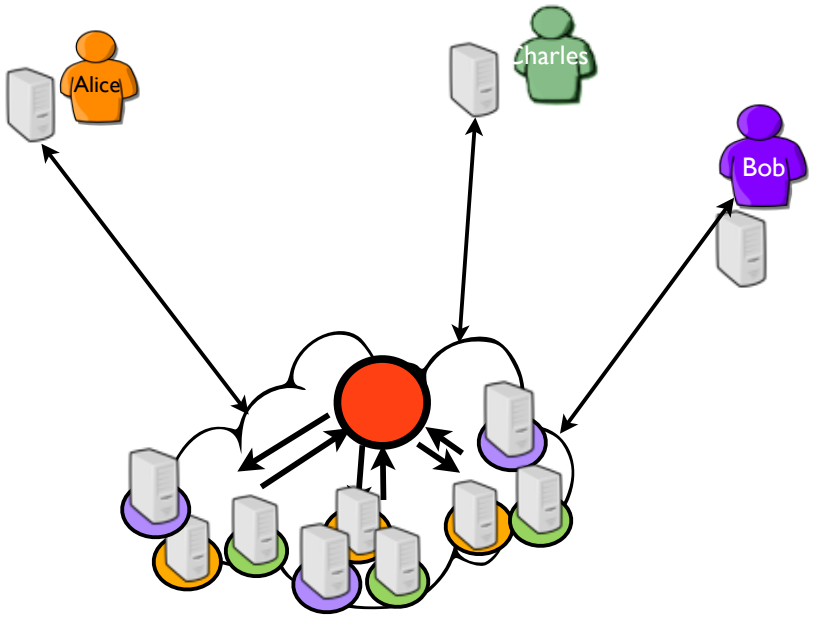

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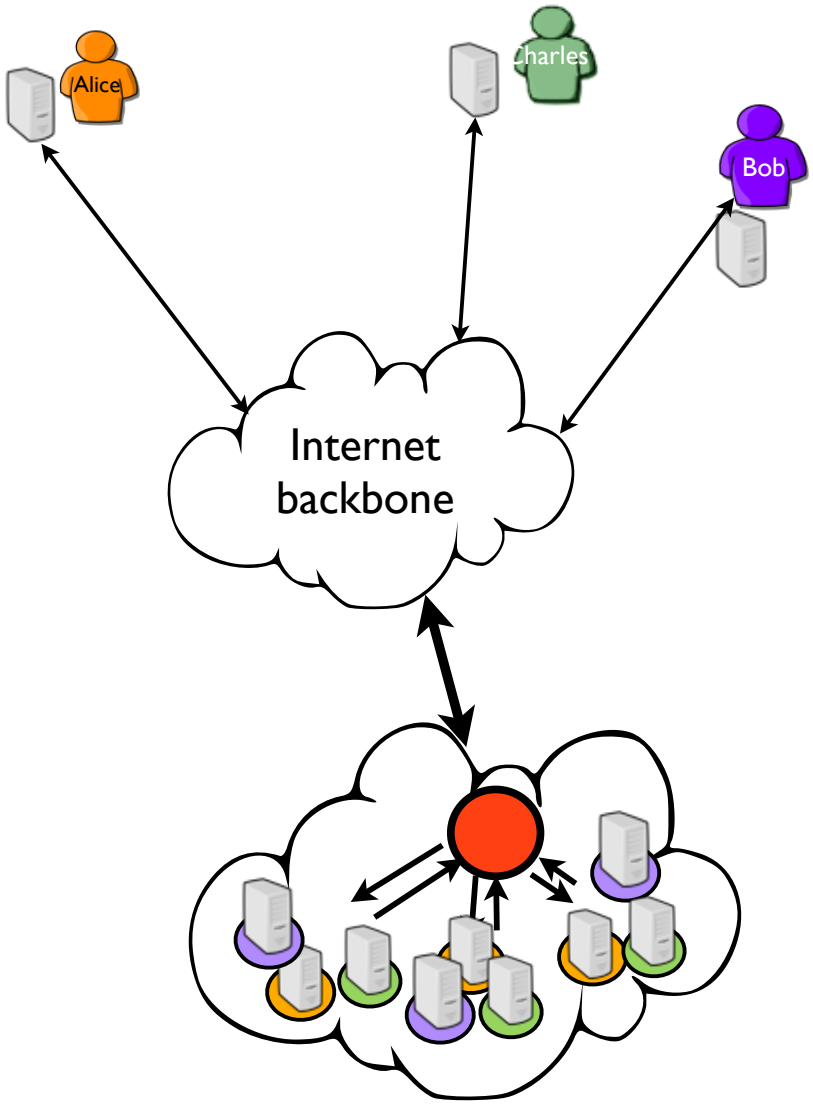

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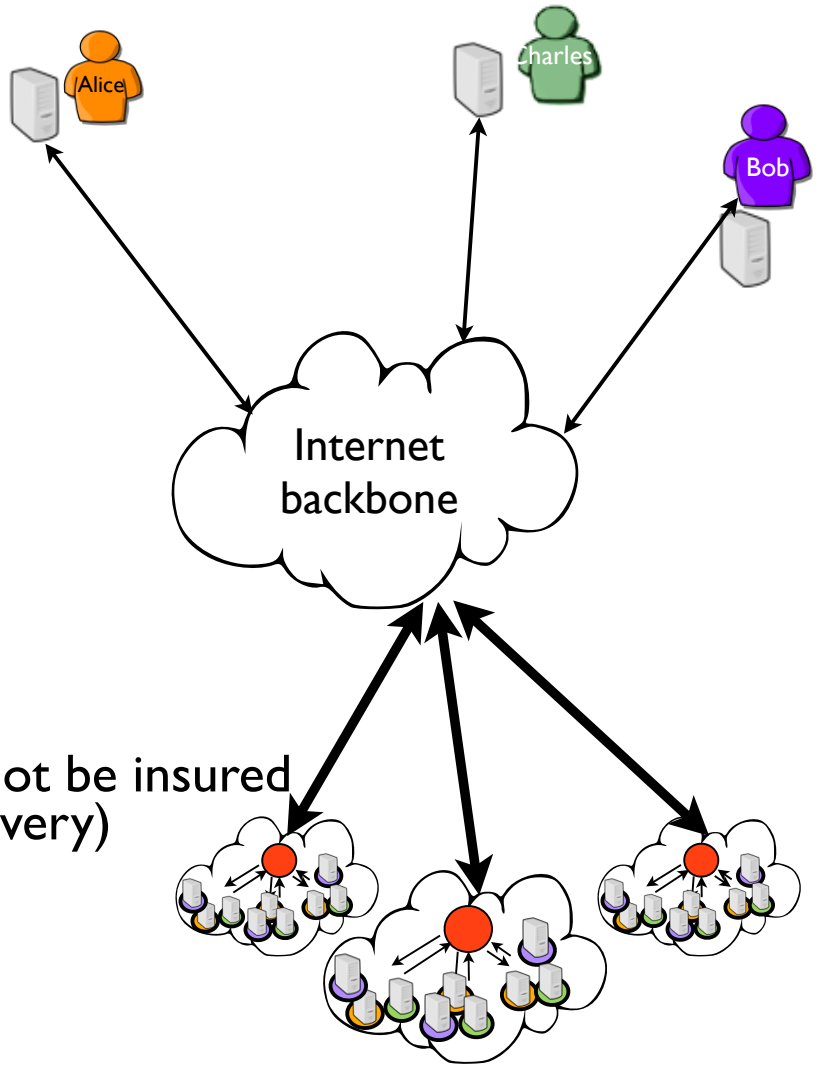

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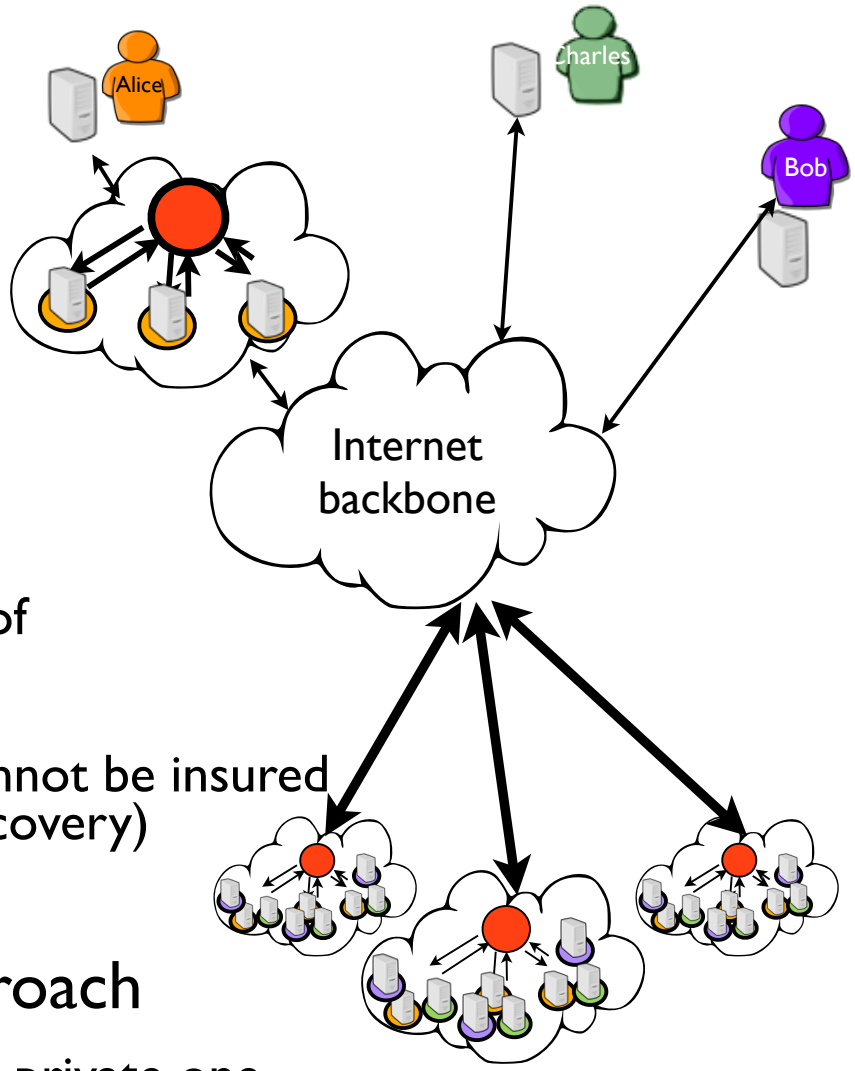

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- Hybrid platforms: a promising approach

  It depends how you are going to extend the private one...

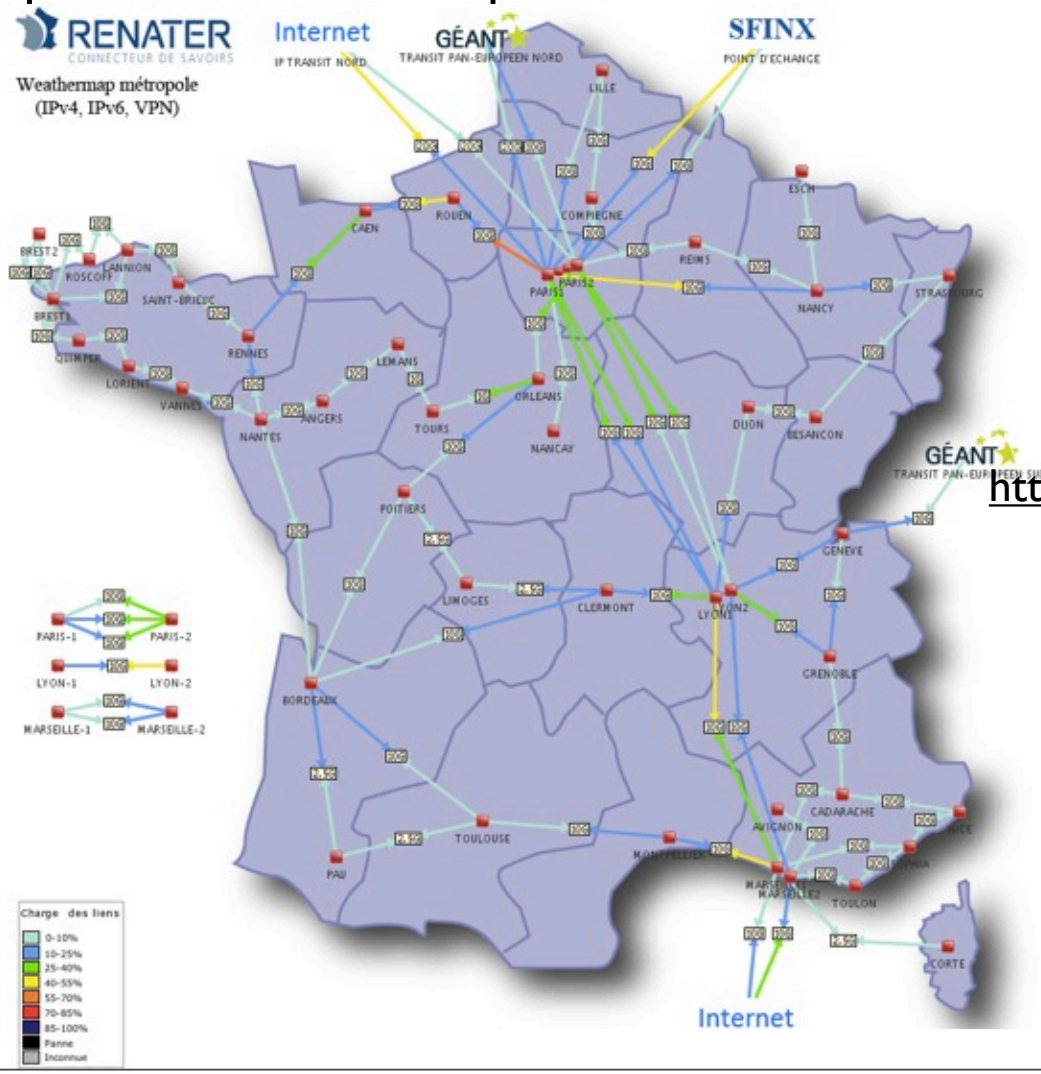
Can we address these concerns "all in one" ? ?

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.



http://www.renater.fr/raccourci?lang=fr

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).

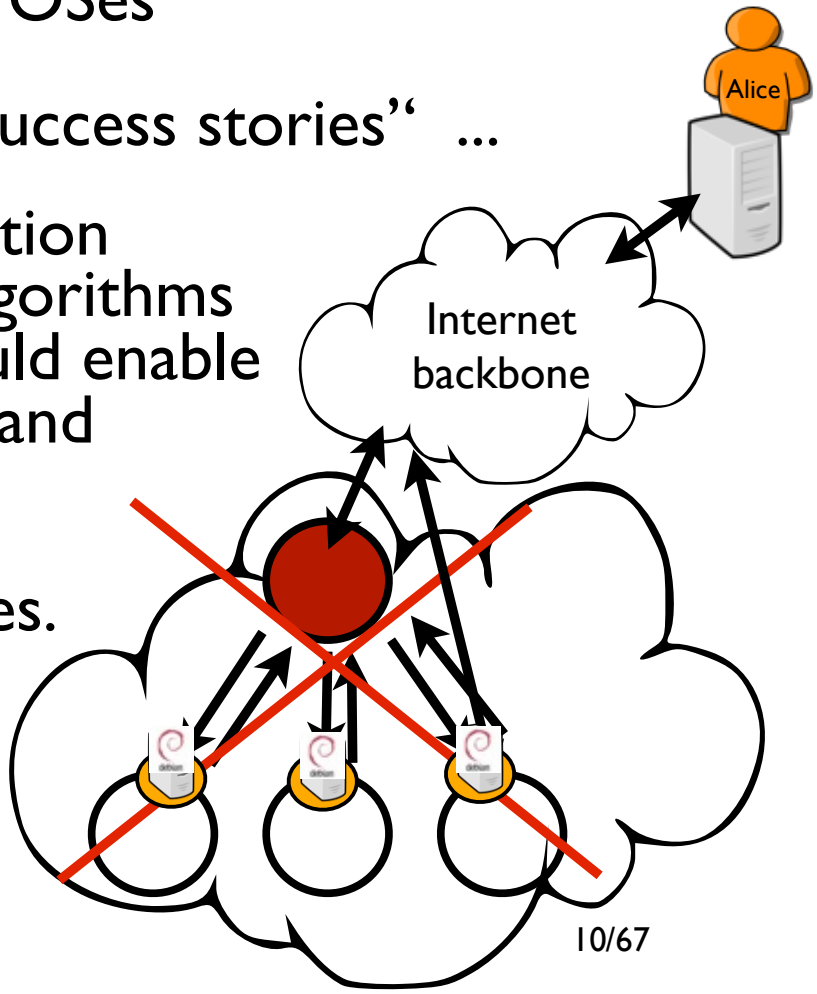
⇒ Operating such widely distributed resources requires the definition of a fully distributed system

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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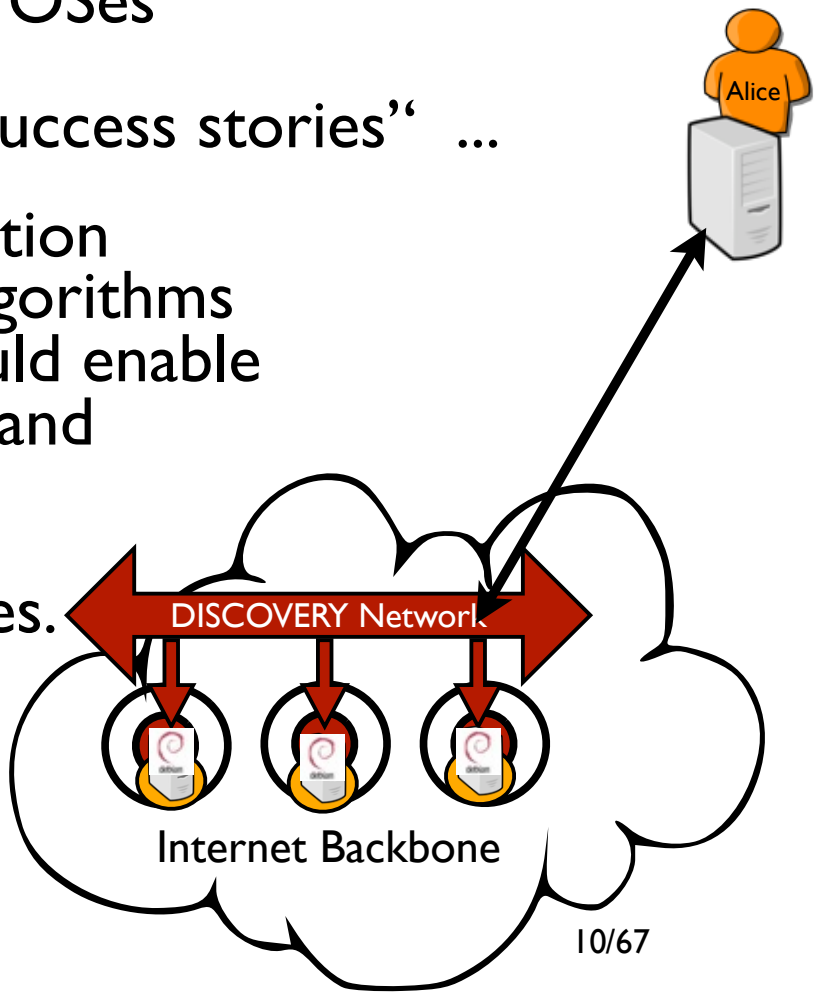
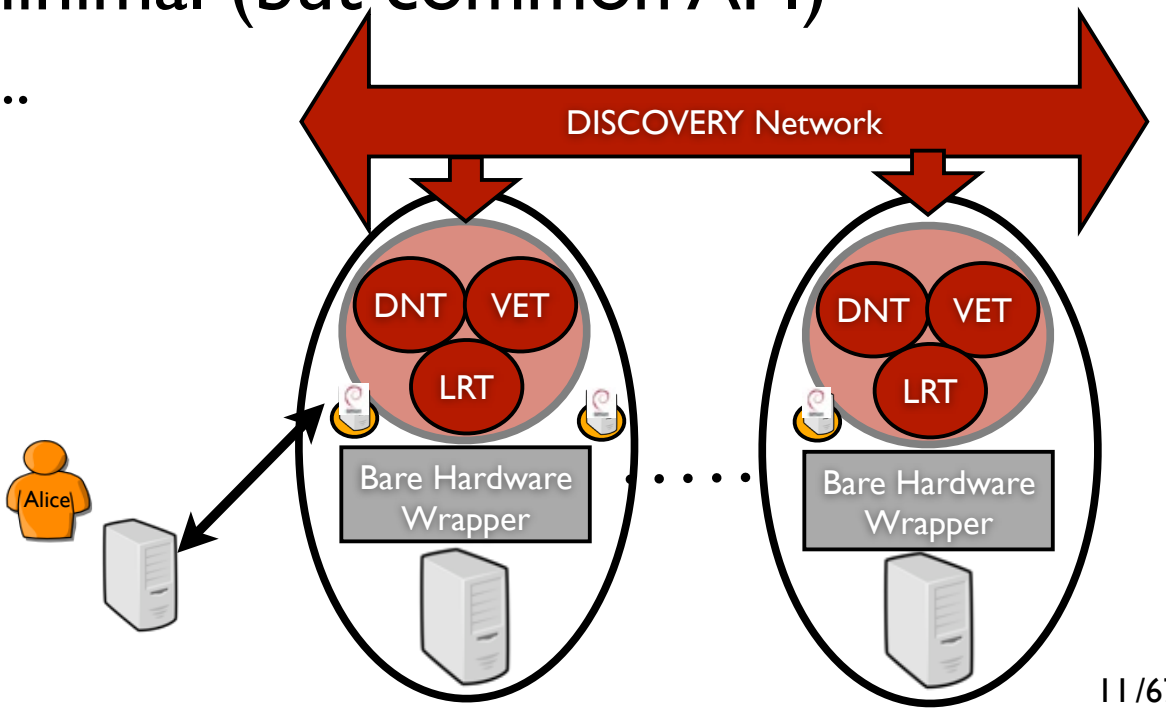


The LUC OS Agent - Overview

- 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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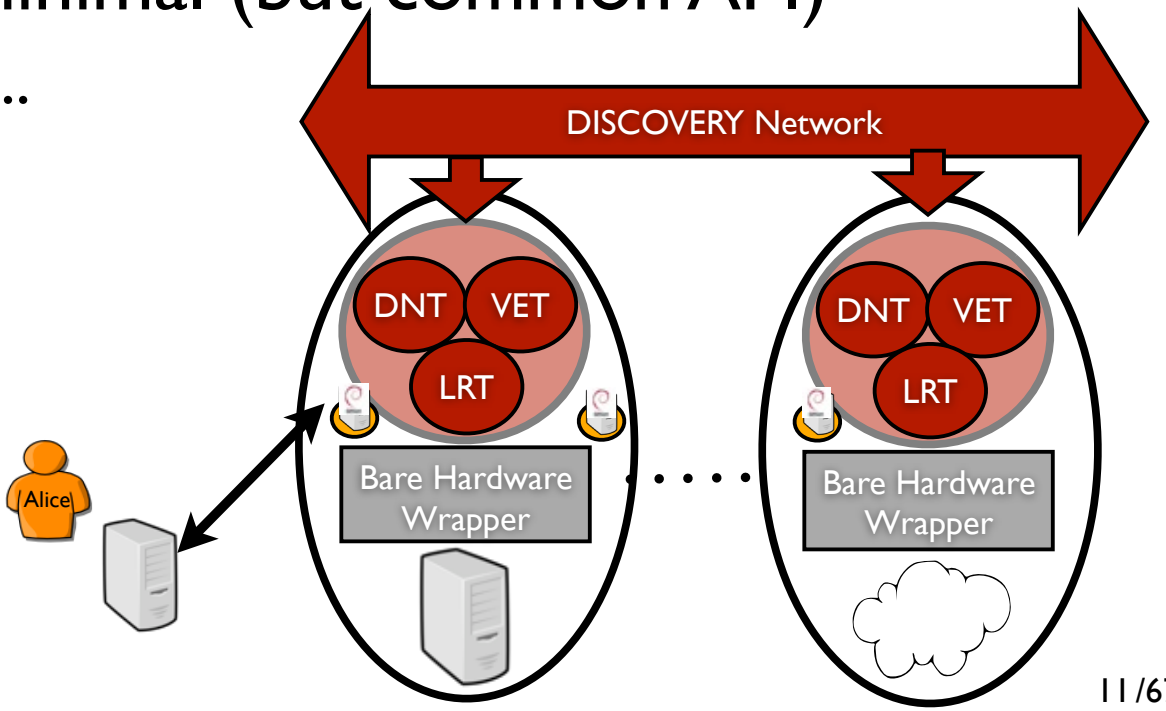


The DISCOVERY Initiative

- 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

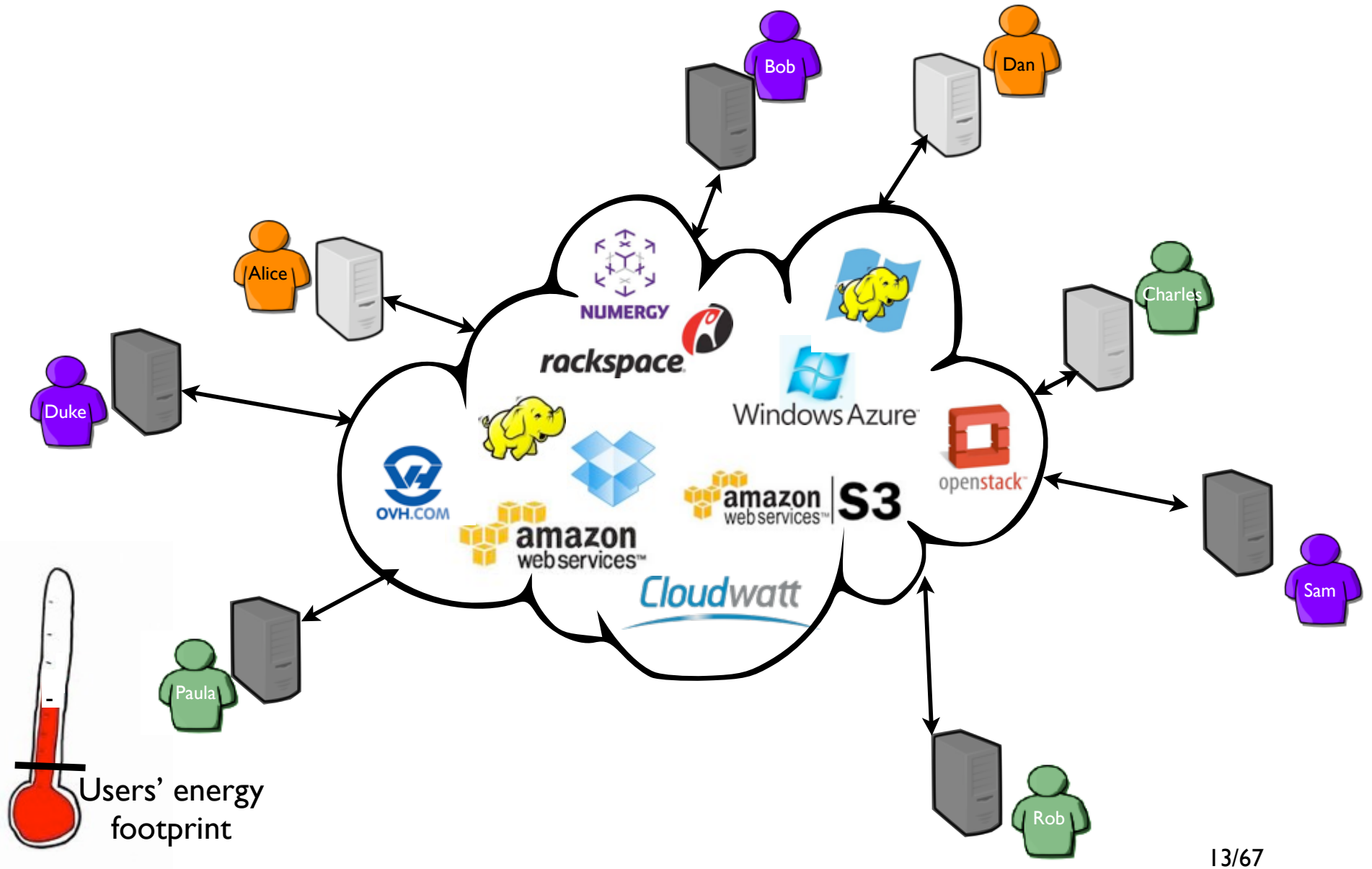
  Scalability, targeting the management of hundred thousands of VMs upon thousands of physical machines (PMs)
  Reliability, considering "hardware failures as the norm rather the exception"
  Reactivity, handling each reconfiguration event as swiftly as possible to maintain VEs' QoS.

- 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 *Bittorent* like system ... but with stronger assumptions

Beyond the Cloud, the DISCOVERY Initiative



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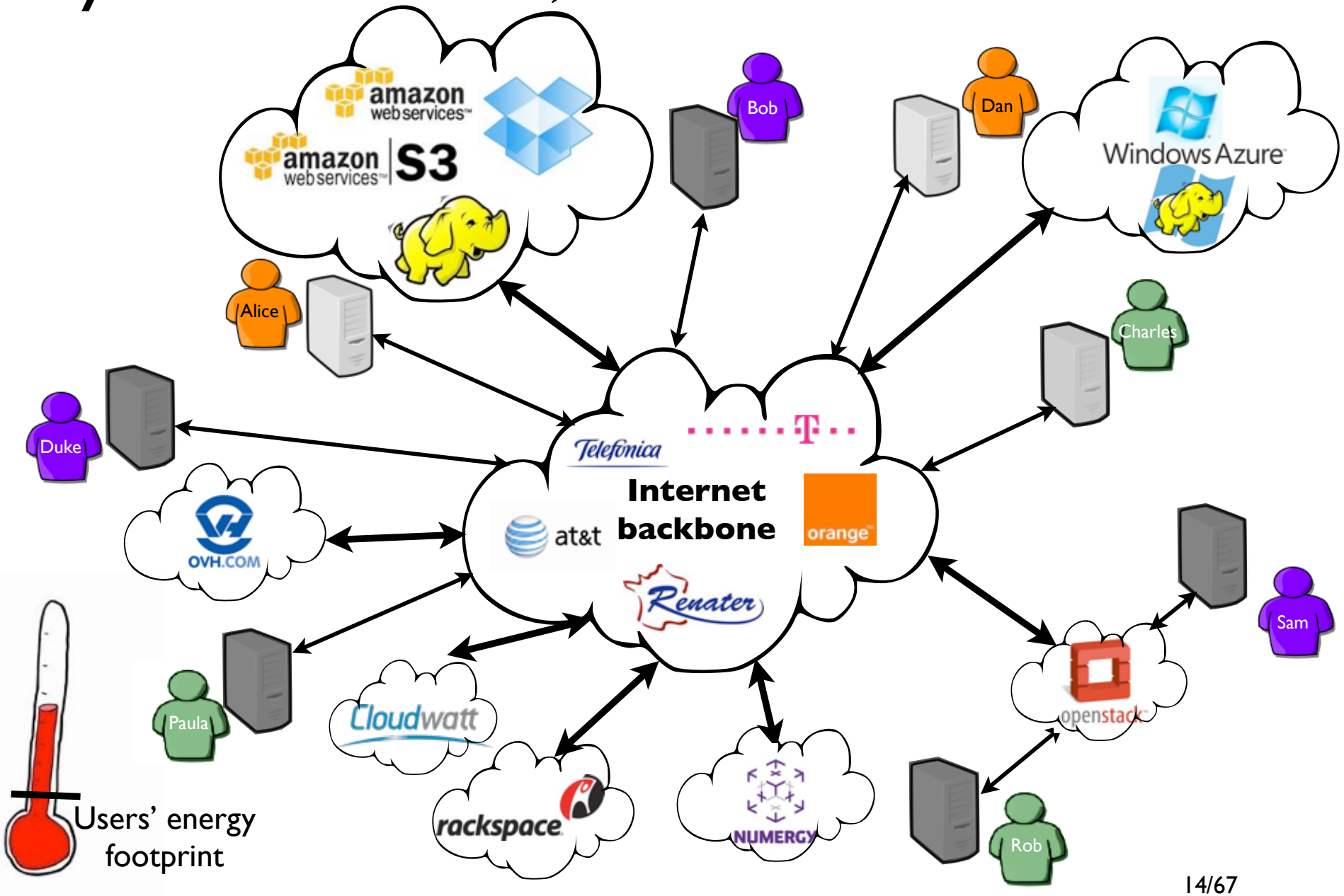

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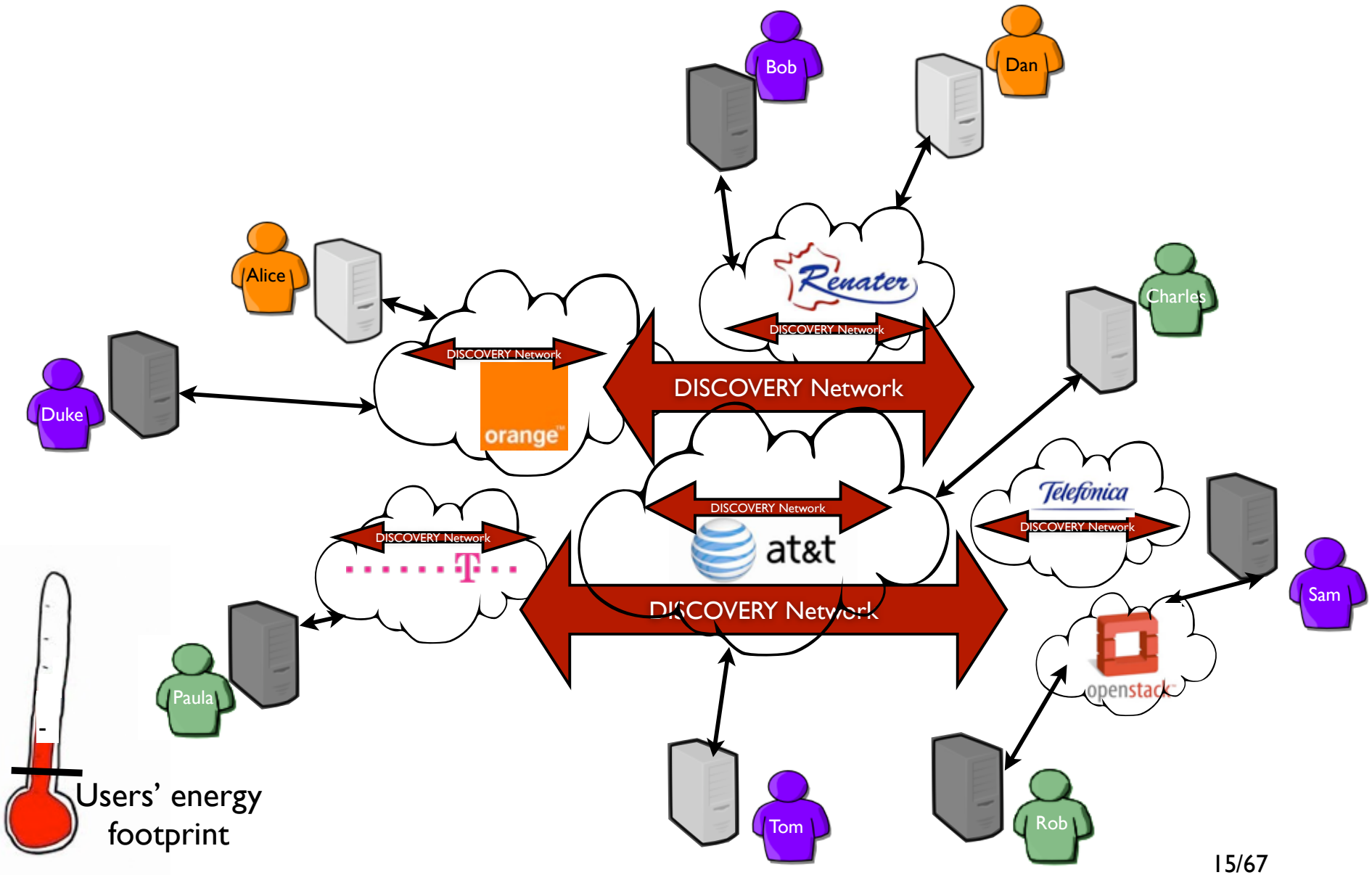

The DISCOVERY Initiative

- 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)

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

http://parasol.cs.rutgers.edu

- 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

https://www.aoterra.de

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Conclusion

- Cloud Computing technology is changing every day

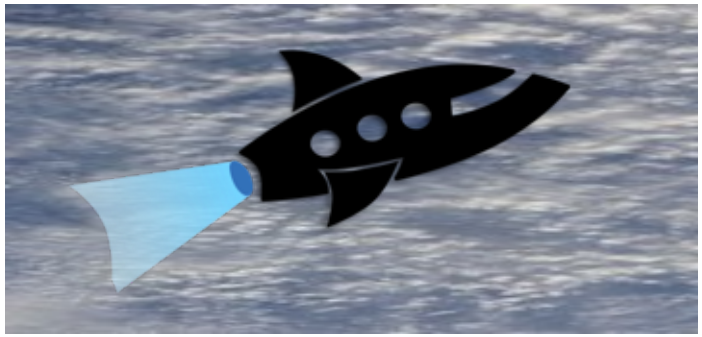
  New features, new requirements

  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 20 13)
  FOG Computing workshop (collocated with IEEE ICC 2013)

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)

CRS4 IDEAS BECOME LIFE

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BSC

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