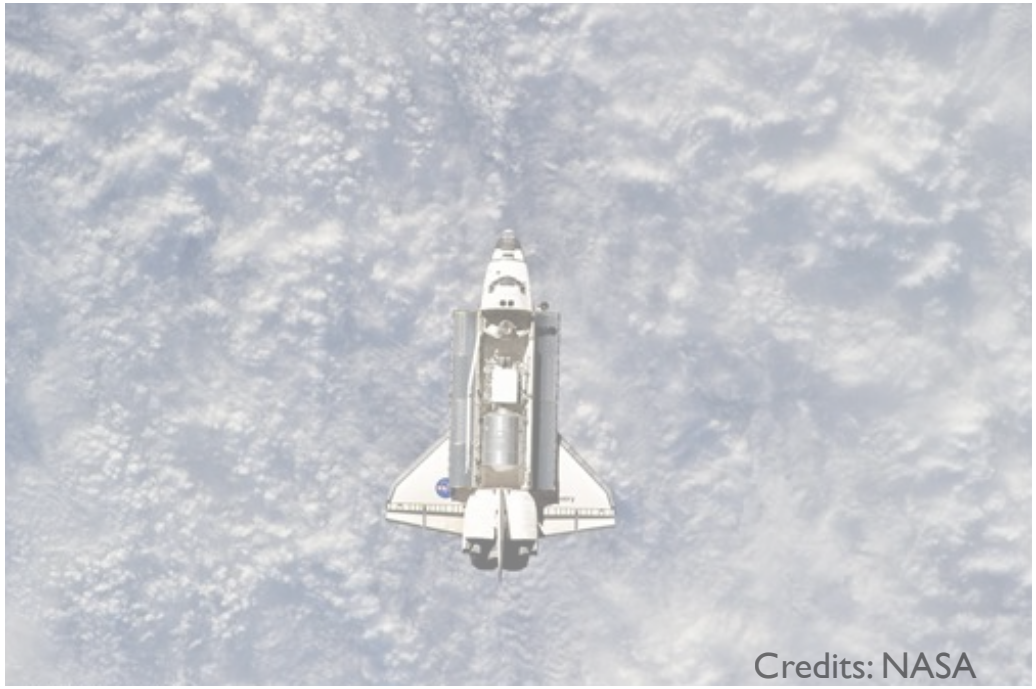
Beyond the Clouds, the DISCOVERY Initiative



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

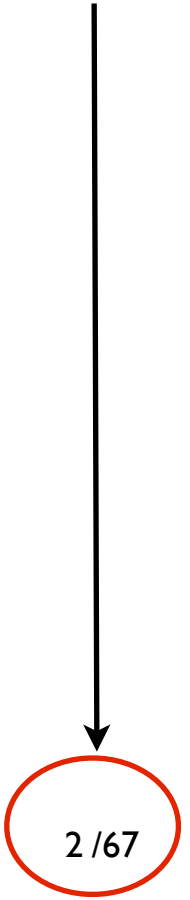
Adrien Lèbre / Ascola Project Team
April, 2014

Preliminary Comment

- Do not worry, we are not going to discuss all slides

Discovery idea, less than - 3 slides
Why such an initiative - ~~18~~ 1 ~~slides~~
Discovery overview - 3 slides

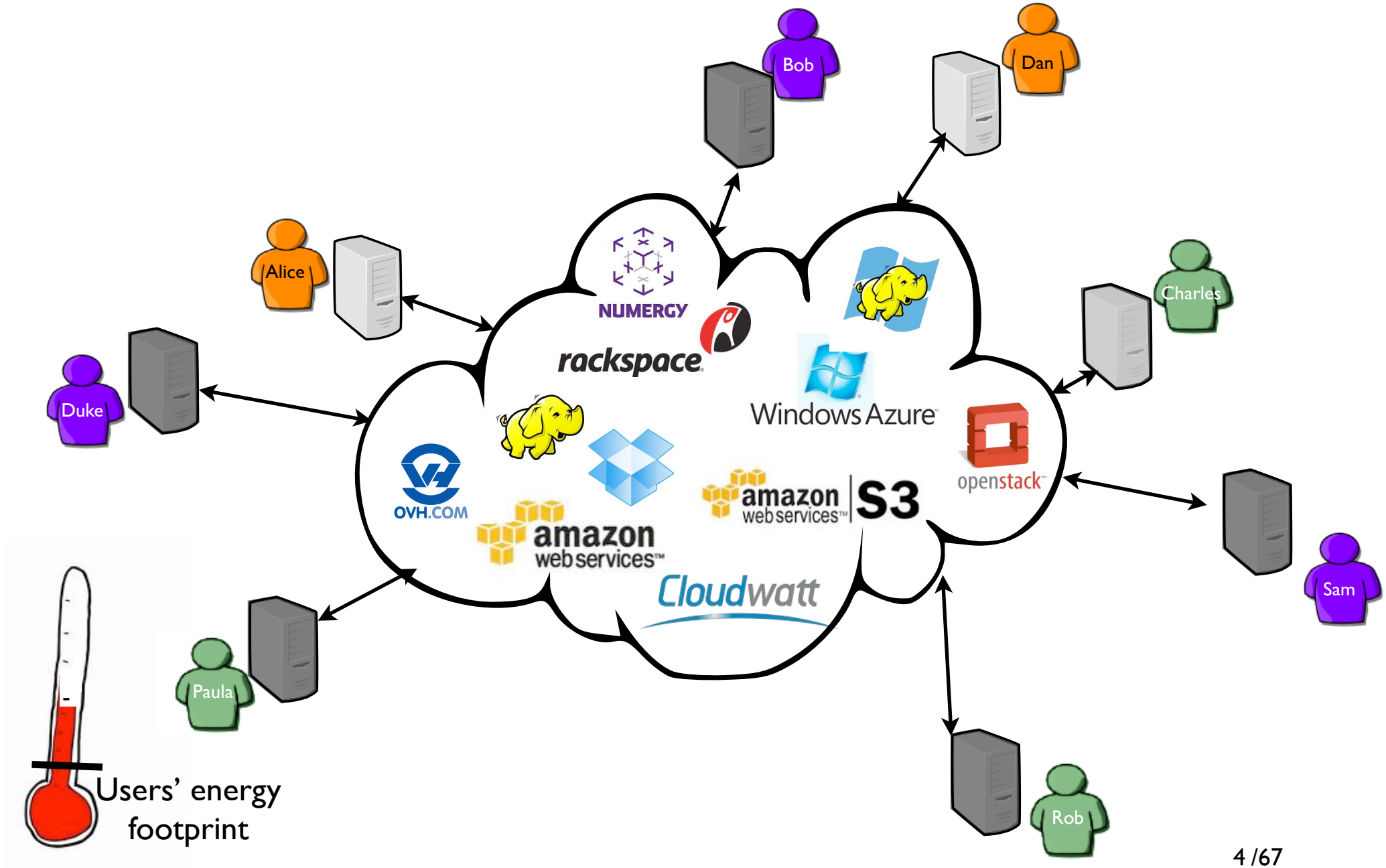
Interesting by additional details
~~Discovery in a nutshell~~
LRT (first POC)
~~What are we doing right now~~



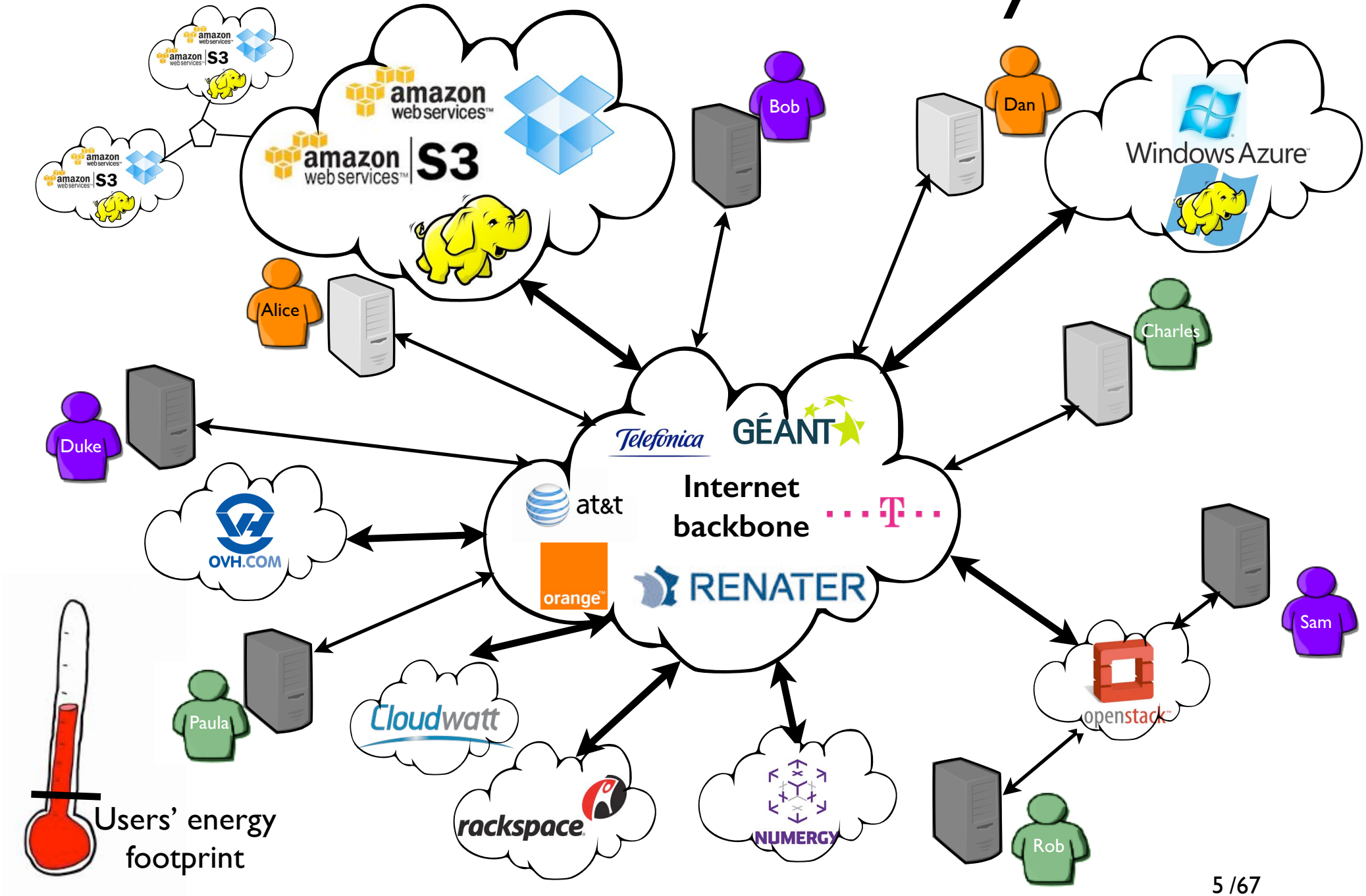
A simple Idea

Bring Clouds back to the cloud

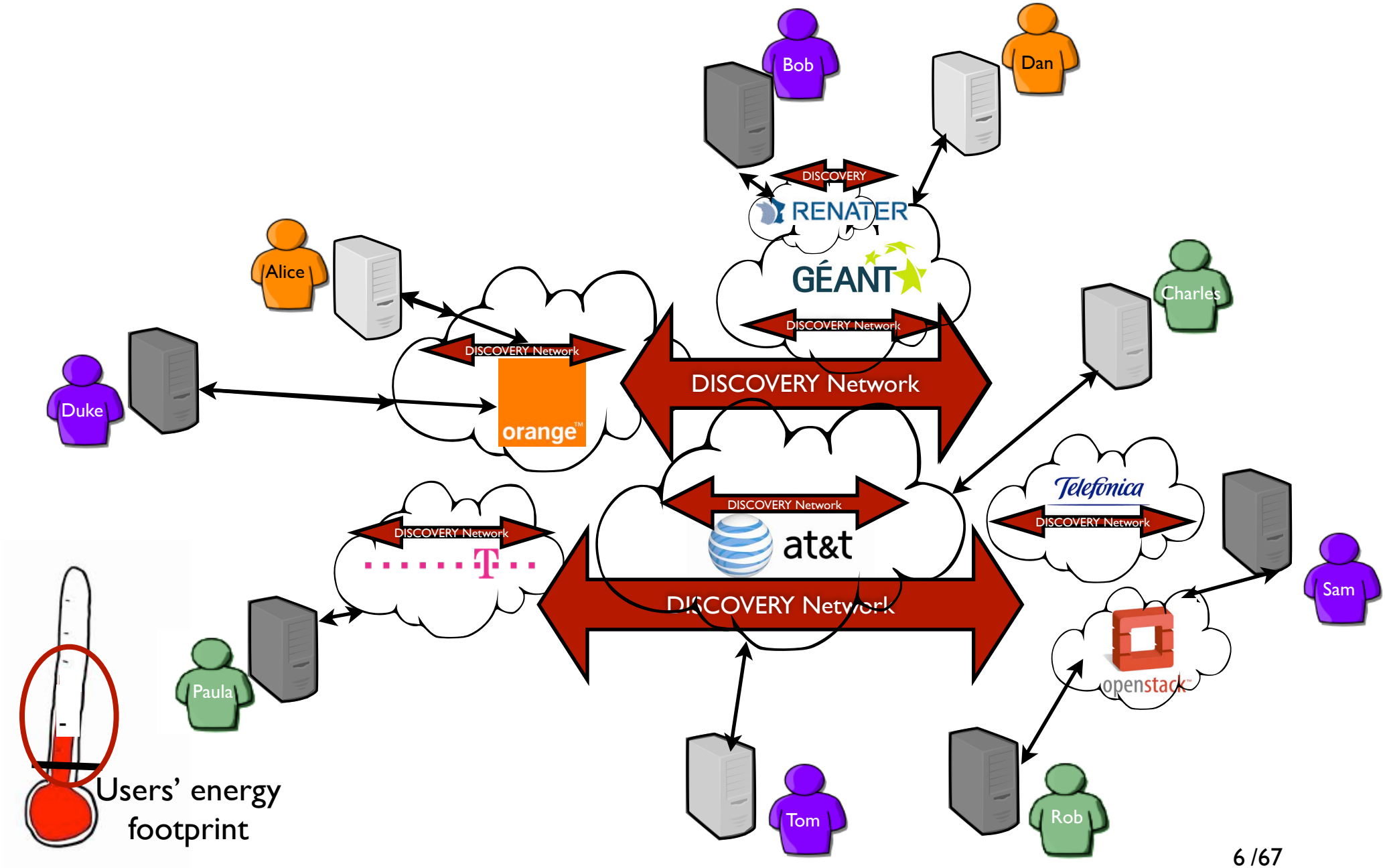
The cloud from end-users



The cloud in reality



The DISCOVERY Initiative



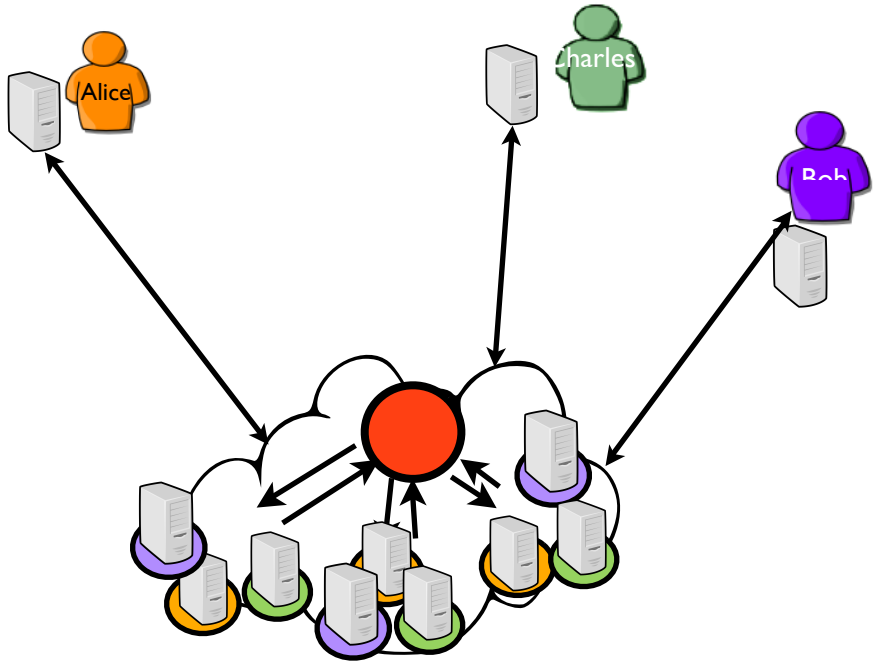
Why ?

Let's give a look to
the current situation

Inherent limitations of current solutions

- Large off shore DCs to cope with the increasing UC demand while handling energy concerns but…

  1. Externalization of private applications/data (jurisdiction concerns, PRISM NSA scandal)



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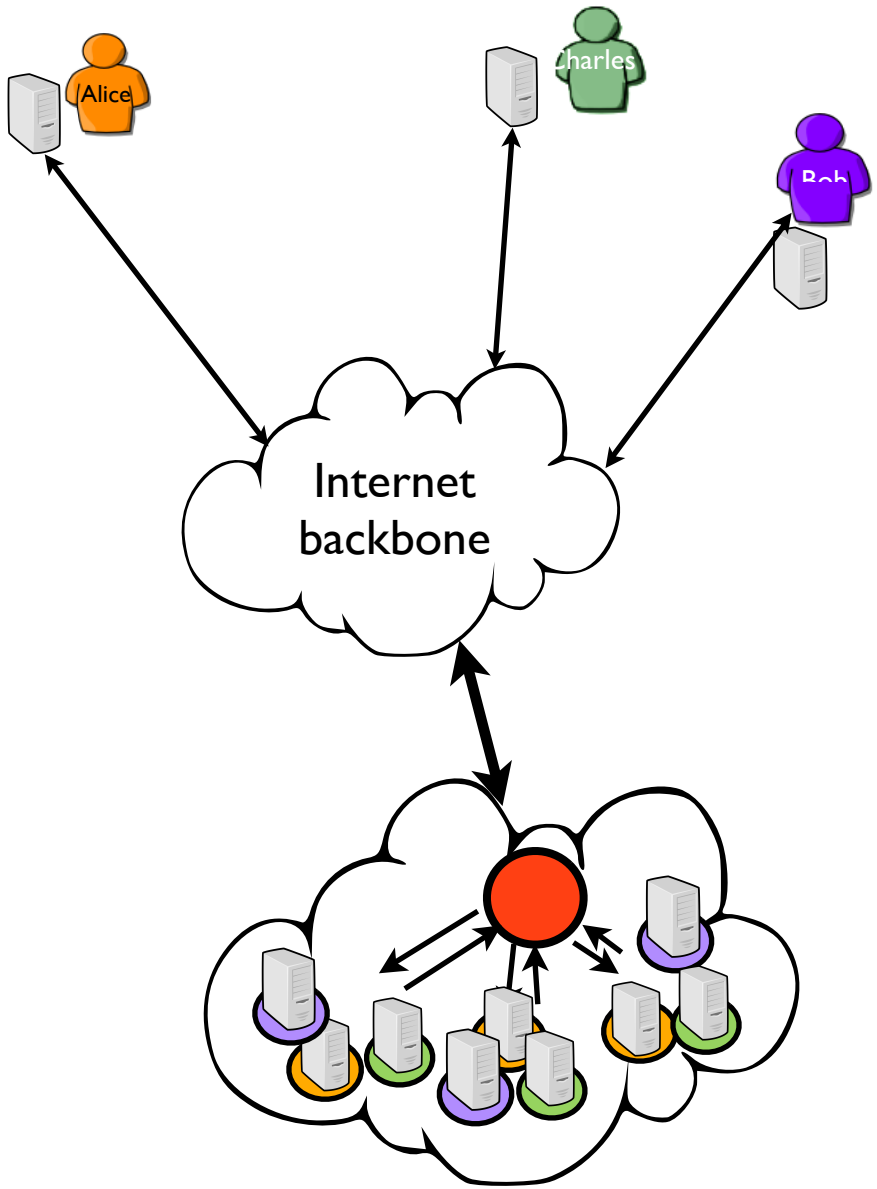

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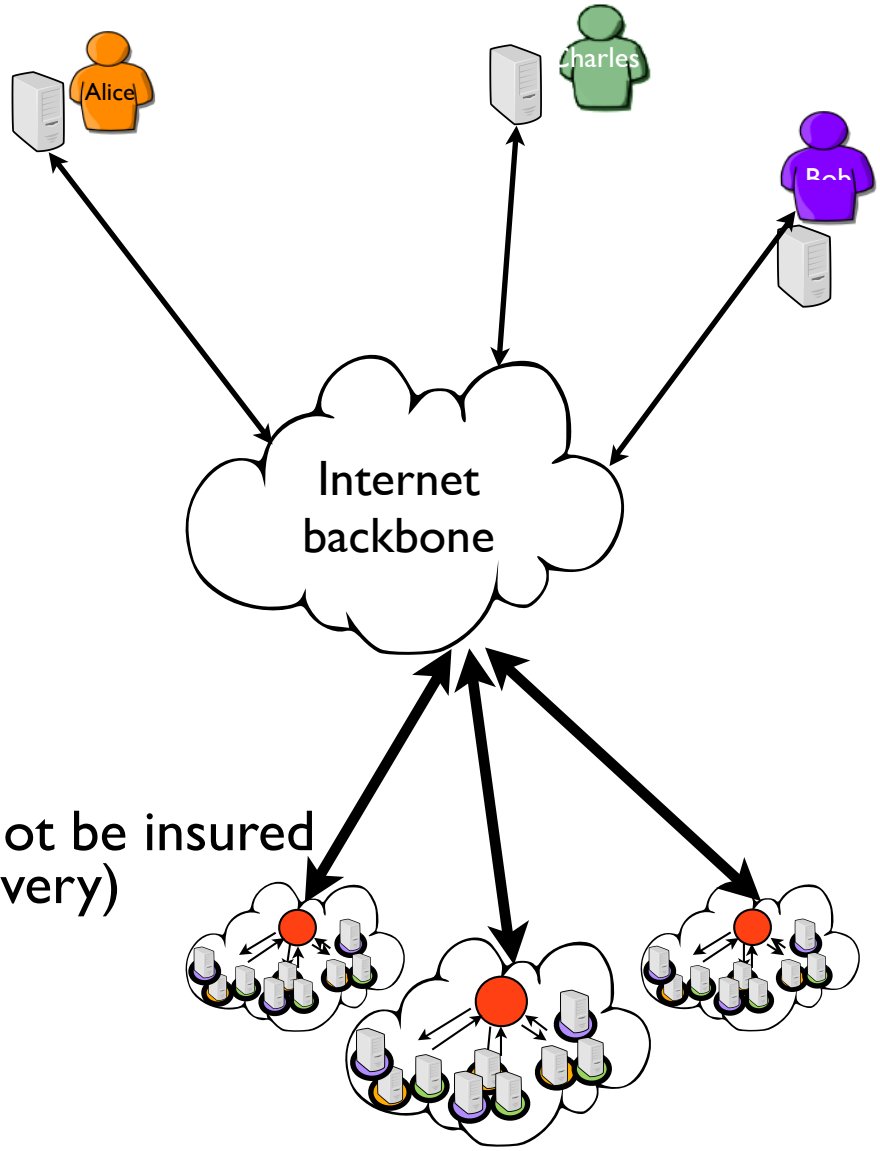

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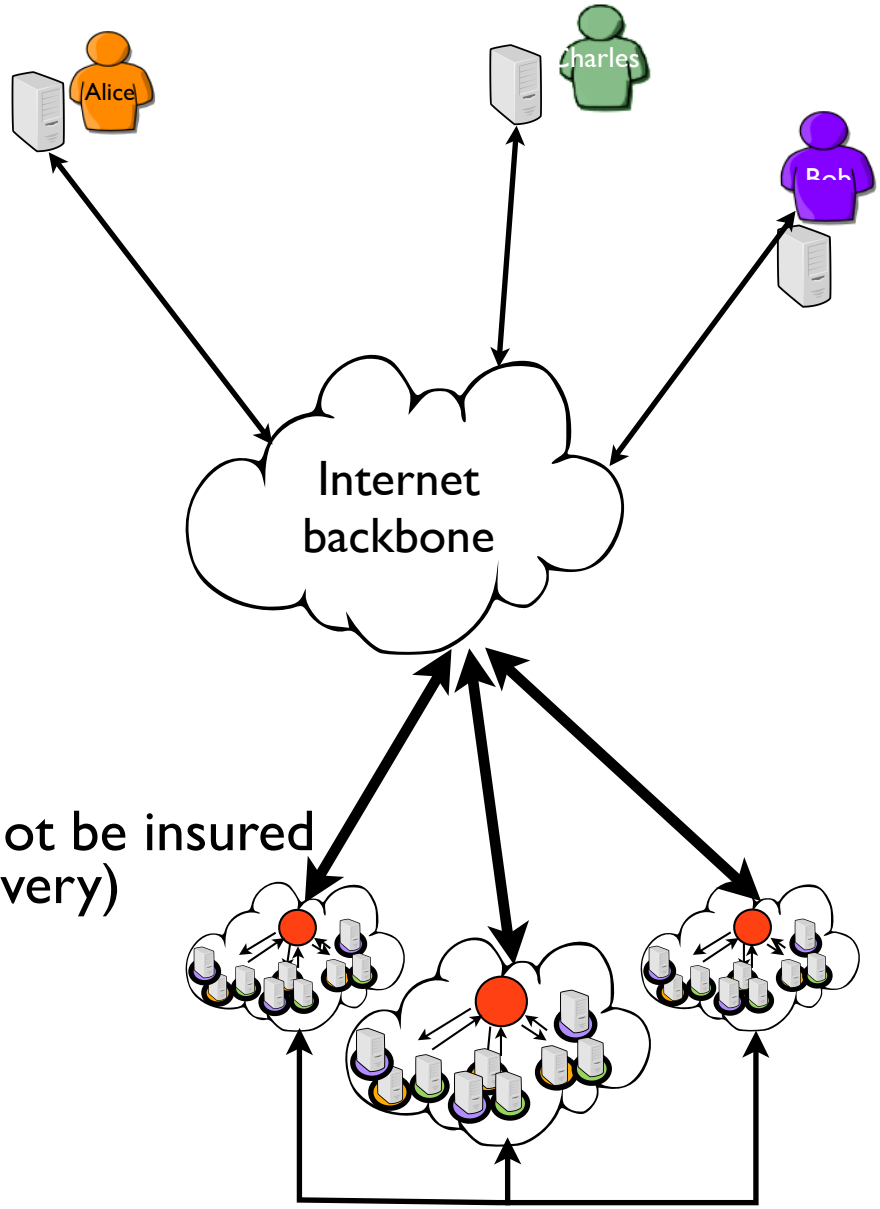

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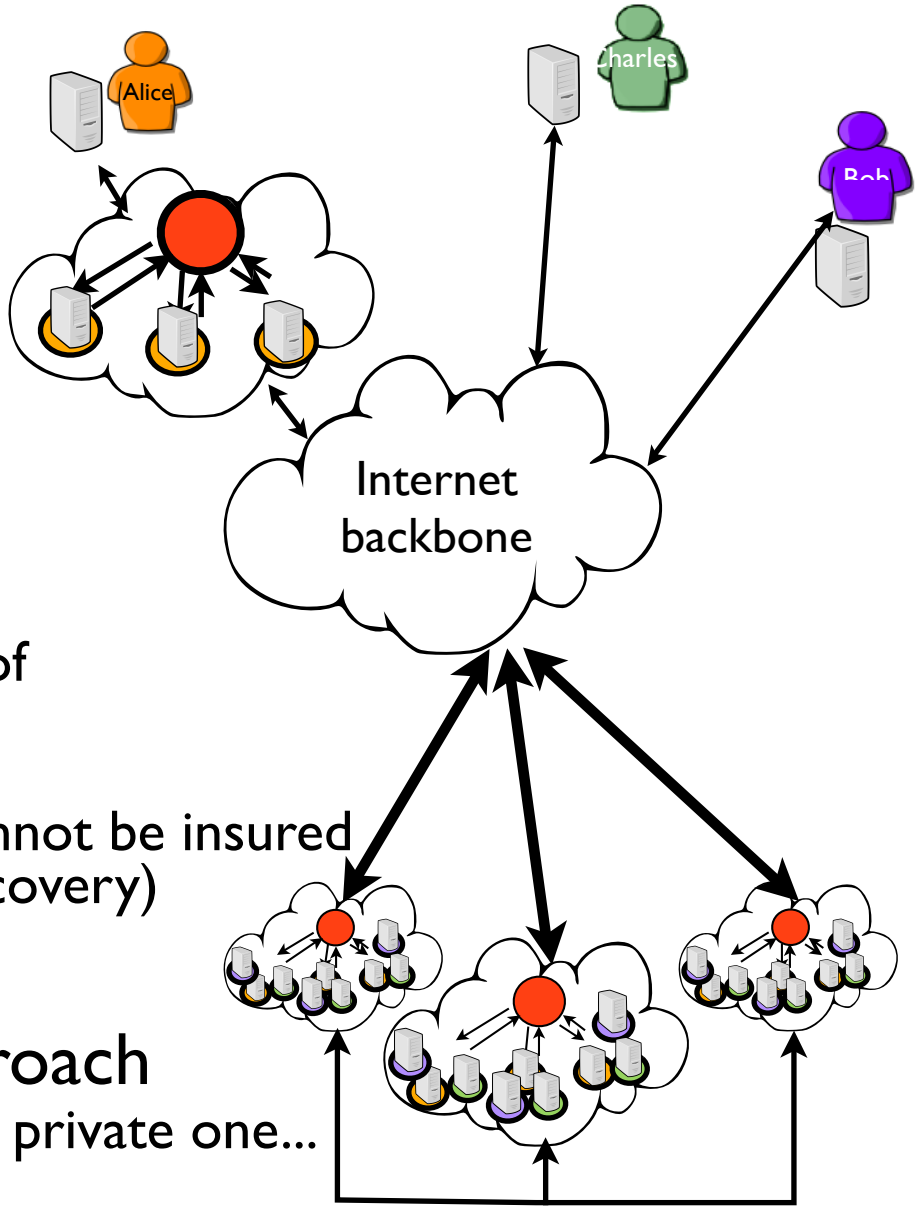


- Hybrid platforms: a promising approach
  It depends how you are going to extend the private one...

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

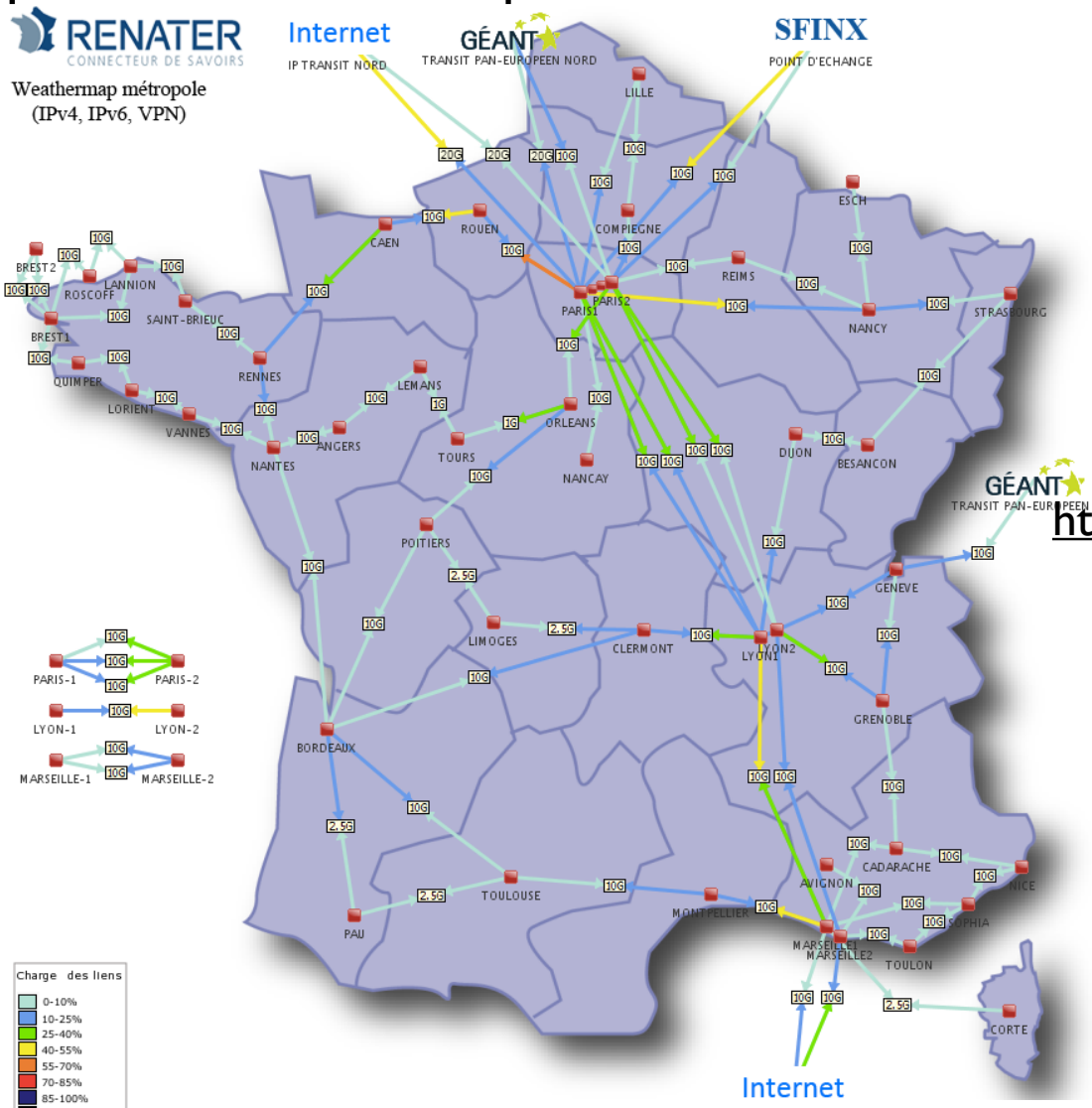
How and where the µDC concept can be deployed ?

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.



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

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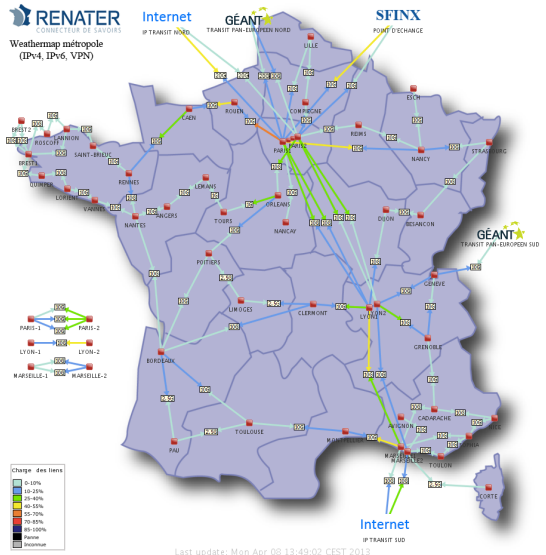


- Leveraging network backbones

  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).

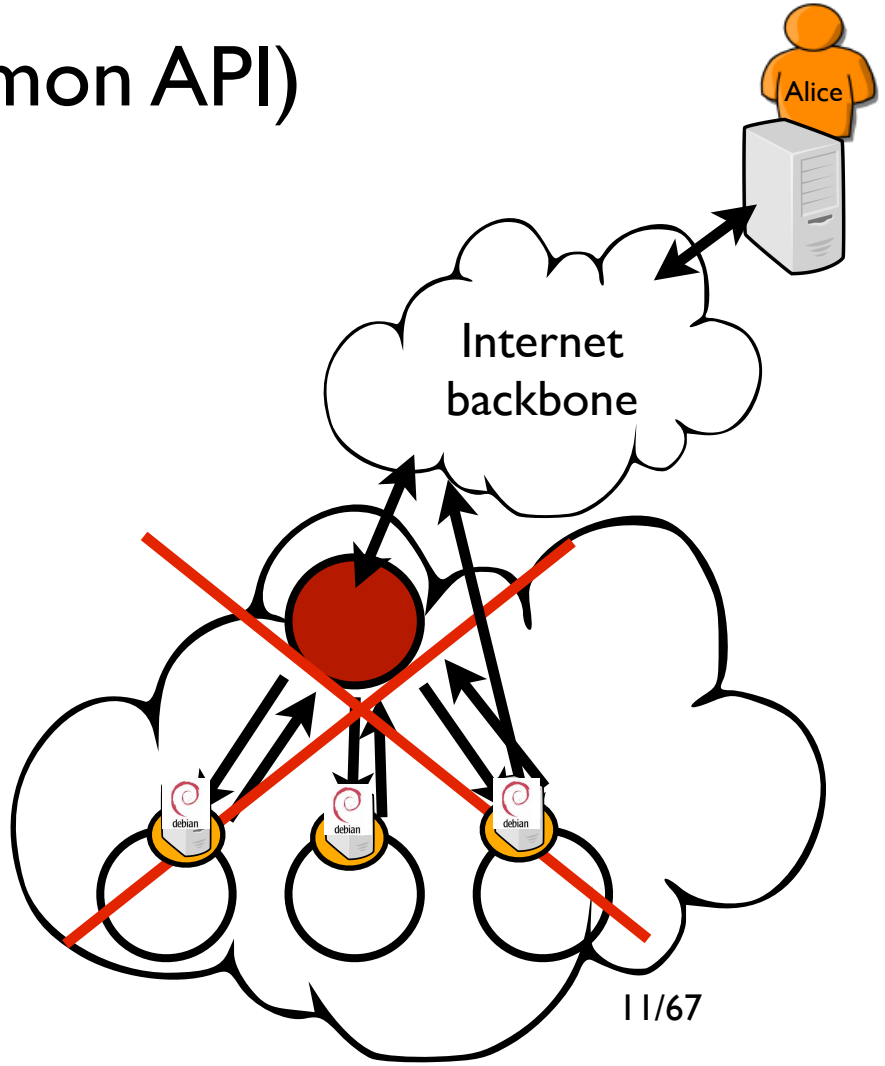
⇒ Operating such widely distributed resources requires the definition of a fully distributed system

The DISCOVERY Proposal

- DIStributed and COoperative framework to manage Virtual EnviRonments autonomicallY (the LUC OS)

- Relying on a minimal (but common API)
  libvirt / OCCI / ...

- 3 services
  Discovery Network Tracker (DNT)
  Virtual Environments Tracker (VET)
  Local Resources Tracker (LRT)



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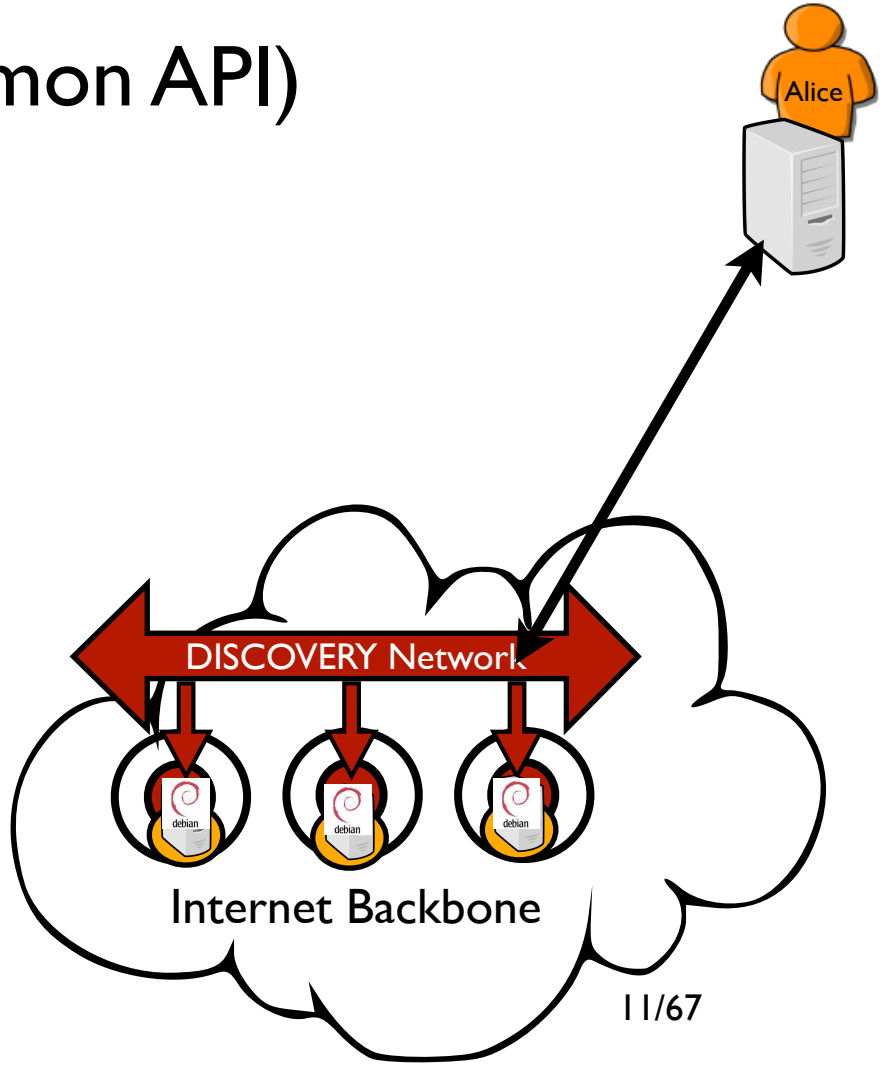

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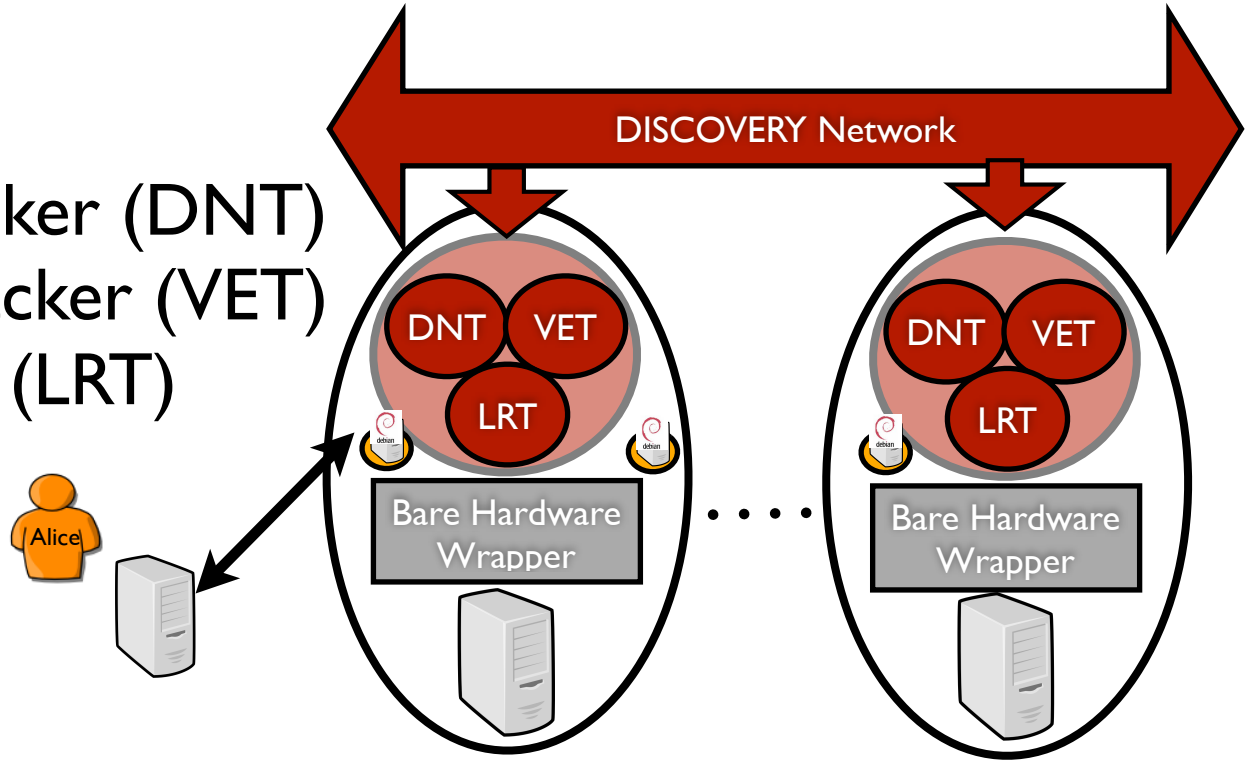

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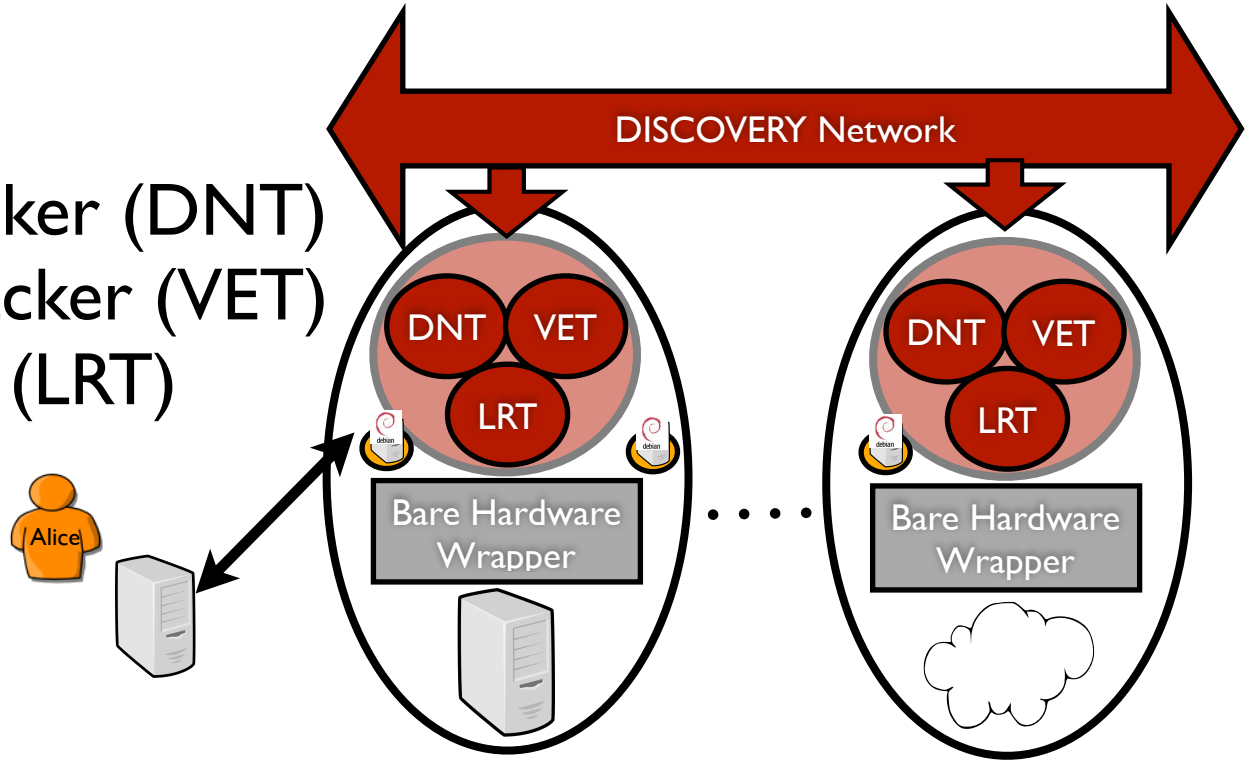


The DISCOVERY Initiative

- Focus on the design/implementation of an OS for IaaS platforms

  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.

  Completely flat
  A fully distributed IaaS system and not a distributed system of IaaS systemS !

- May look simple but lots of scientific/technical challenges

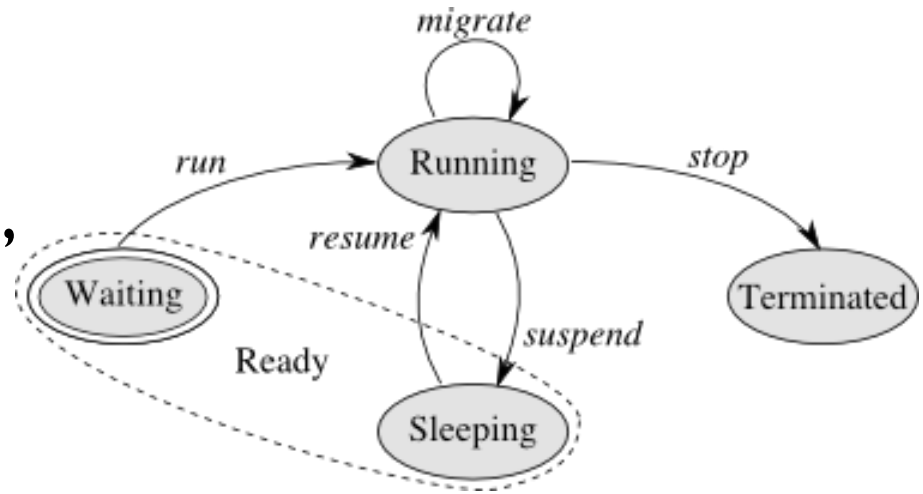
  Cost of the DISCOVERY network !? partial view of the system !?
  Impact on the others VMs !?, management of VM images !?
  Which software abstractions to make the development easier and more reliable (distributed event programming) ? How to take into account locality aspects ?

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

Focus on the LRT

- General idea: manipulate VEs instead of processes
  (a VE is a users' working environment, possibly composed of several interconnected VMs)

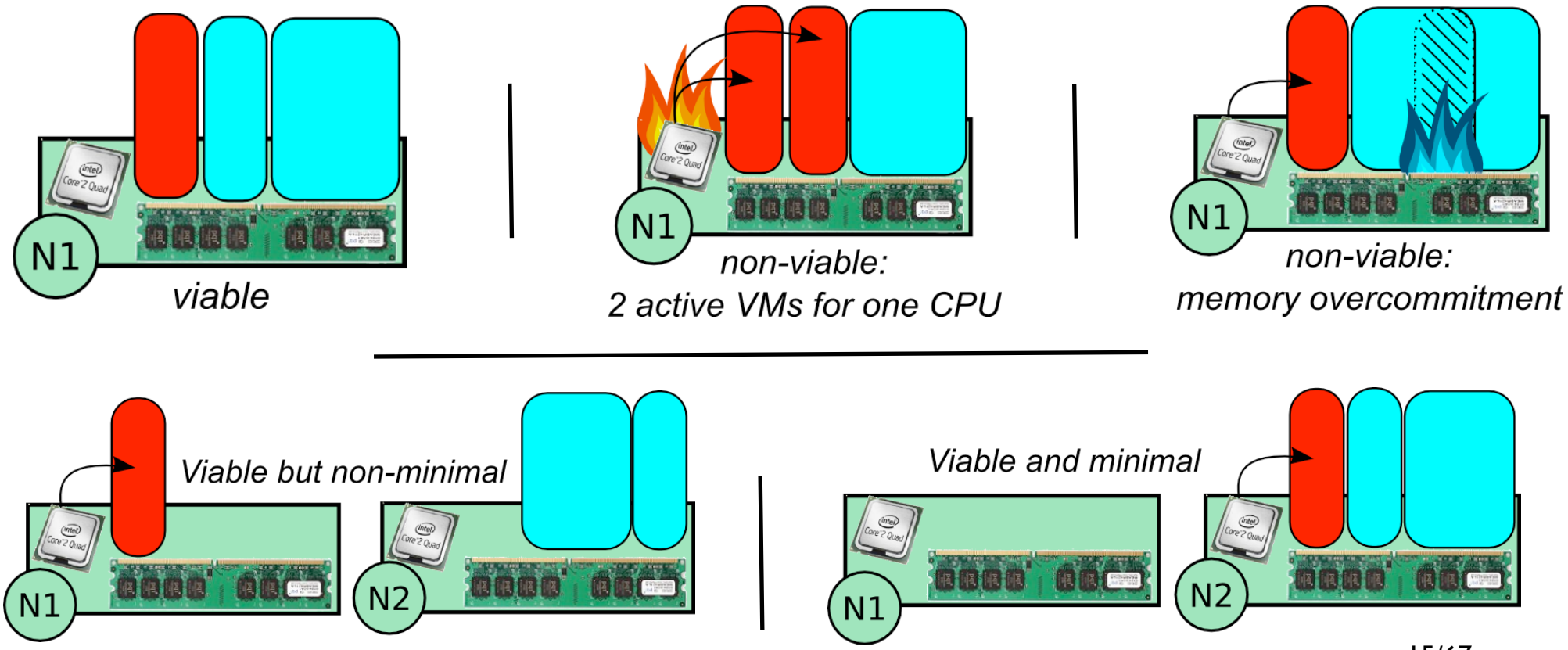
- In a similar way of usual processes, each VE is in a particular state:



- Perform VE context switches (a set of VM context switches) to rebalance the LUC infrastructure according to the:
  scheduler objectives / available resources / waiting queue / ...

Focus on the LRT

- Fine management of resources (efficiency and energy constraints)
- Find the "right" mapping between needs of VMs and resources provided by PMs



credits: F. Hermenier, OSDI poster session 2008

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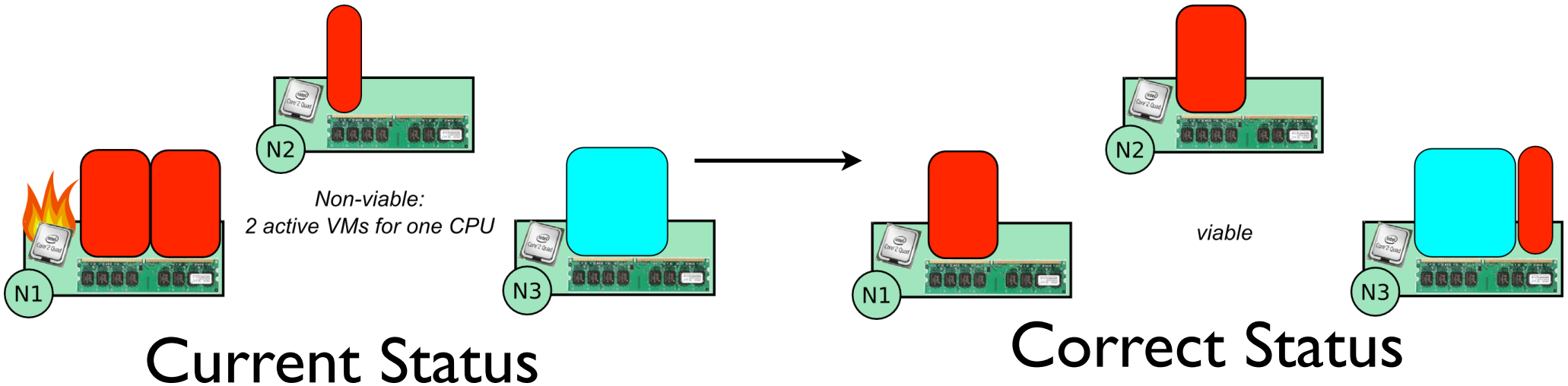
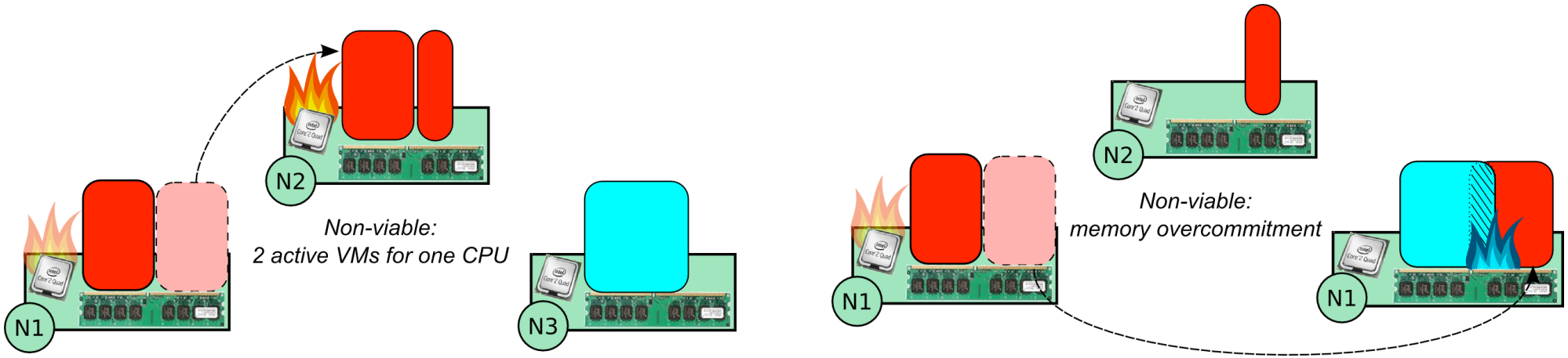


Current Status

Correct Status



Non-viable manipulations

credits: F. Hermenier, OSDI poster session 2008

Entropy / btrPlace

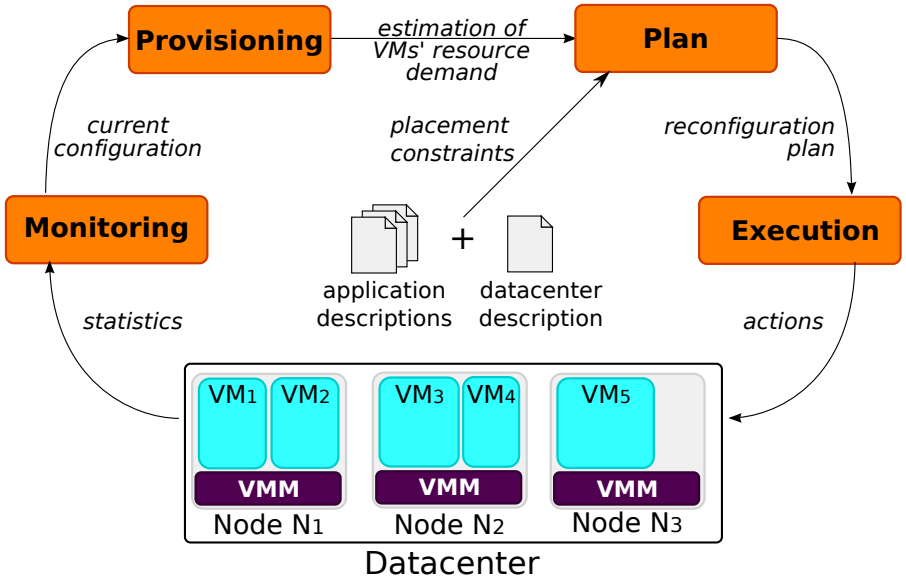
- An autonomic framework to maintain viable VE placements

  ASCOLA Research Group (ANR SelfXL/Emergence, EasyVirt)
  http://www.btrcloud.org/

  Oasis/Scale Research Group (University Of Nice Sophia Antipolis)
  http://btrp.inria.fr

Autonomic but…

….centralized



credits: F. Hermenier, Plasma Control Loop, Feb 2011

Distributed - DVMS

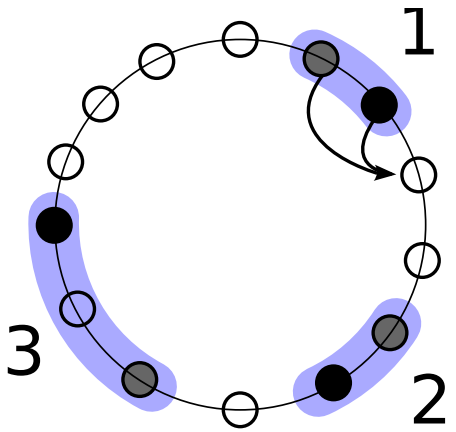
- Cooperation between direct neighbours to solve events

  Nodes have a local view of the system
  Local invocation of the resolution algorithm

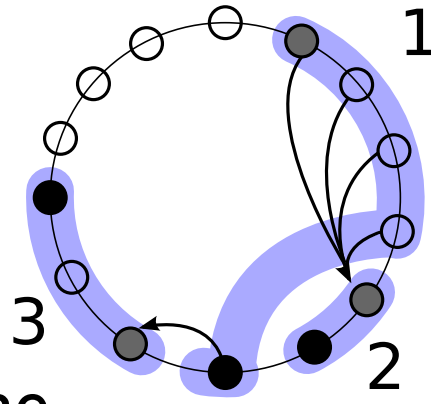
  In vivo (on Grid5000) 500 physical machines, 4500 VMs

  Simulation (using Simgrid) 10K PMs, 80K VMs

  http://beyondtheclouds.github.io/DVMS/



credits: F. Quesnel et al., DVMS April 2012

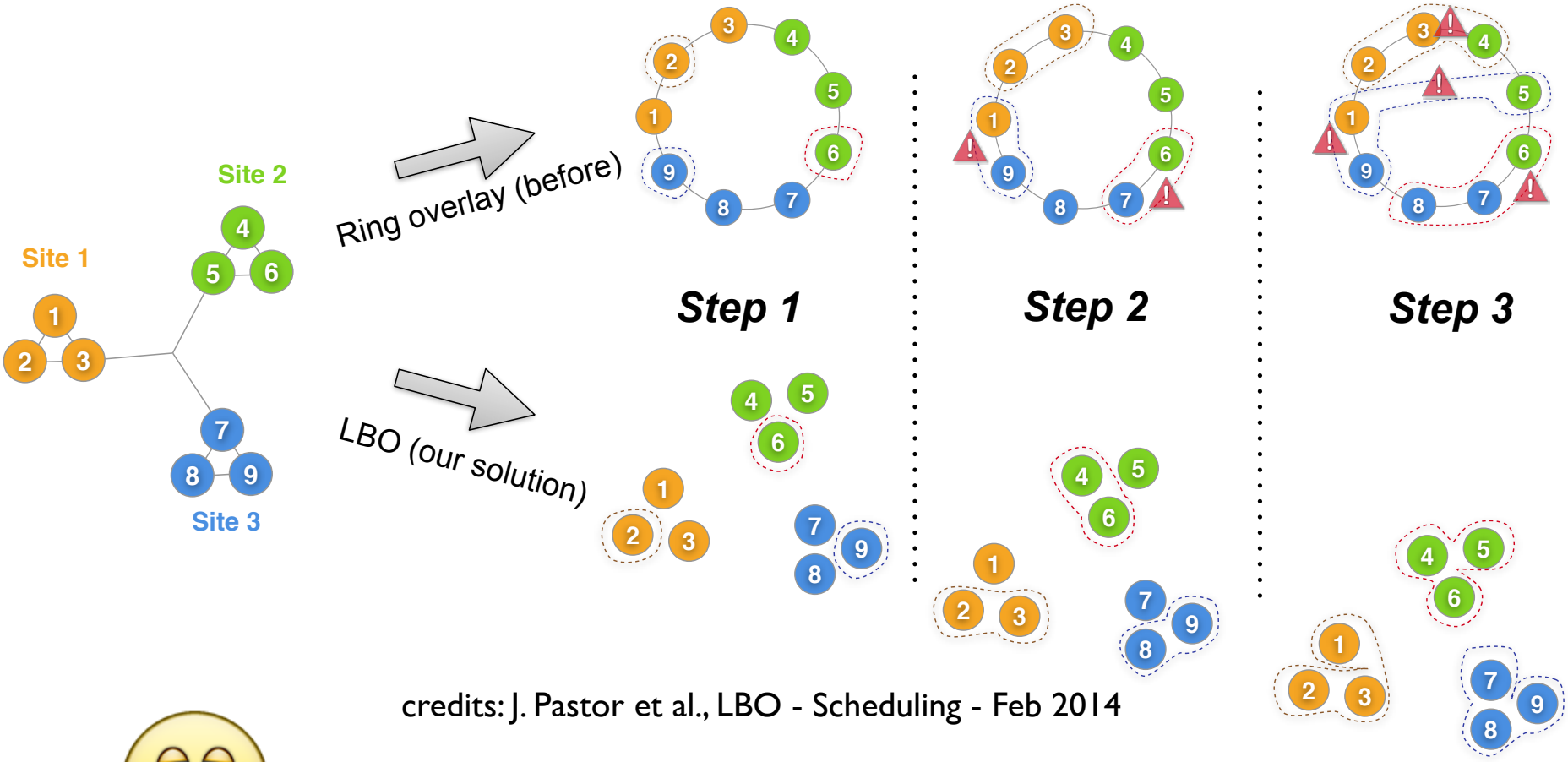


Scalability/reactivity but….

…matching a ring on a real network backbone

Distributed and Locality-aware

- Leverage a locality based overlay (vivaldi) + a shortest path algorithm to favour cooperations between close nodes



credits: J. Pastor et al., LBO - Scheduling - Feb 2014

Next: network and storage dimensions

The DISCOVERY Initiative

- Lots of challenges (network, VM images, security, …) that require to be addressed in a distributed and autonomous way.
- Leveraging former projects but still on the starting blocks!
- Strong interests of large companies (SAP, Orange Labs, Citrix, Interoute,…)
- RENATER, PSNC, …. Dante (GEANT)
- An important actor to follow: Akamai (micro DCs, Akamai/ Aspera)
- Preliminary works with promising results
- Long term objective: impact on the design of distributed applications in order to take advantage of the locality (building S3 like system)

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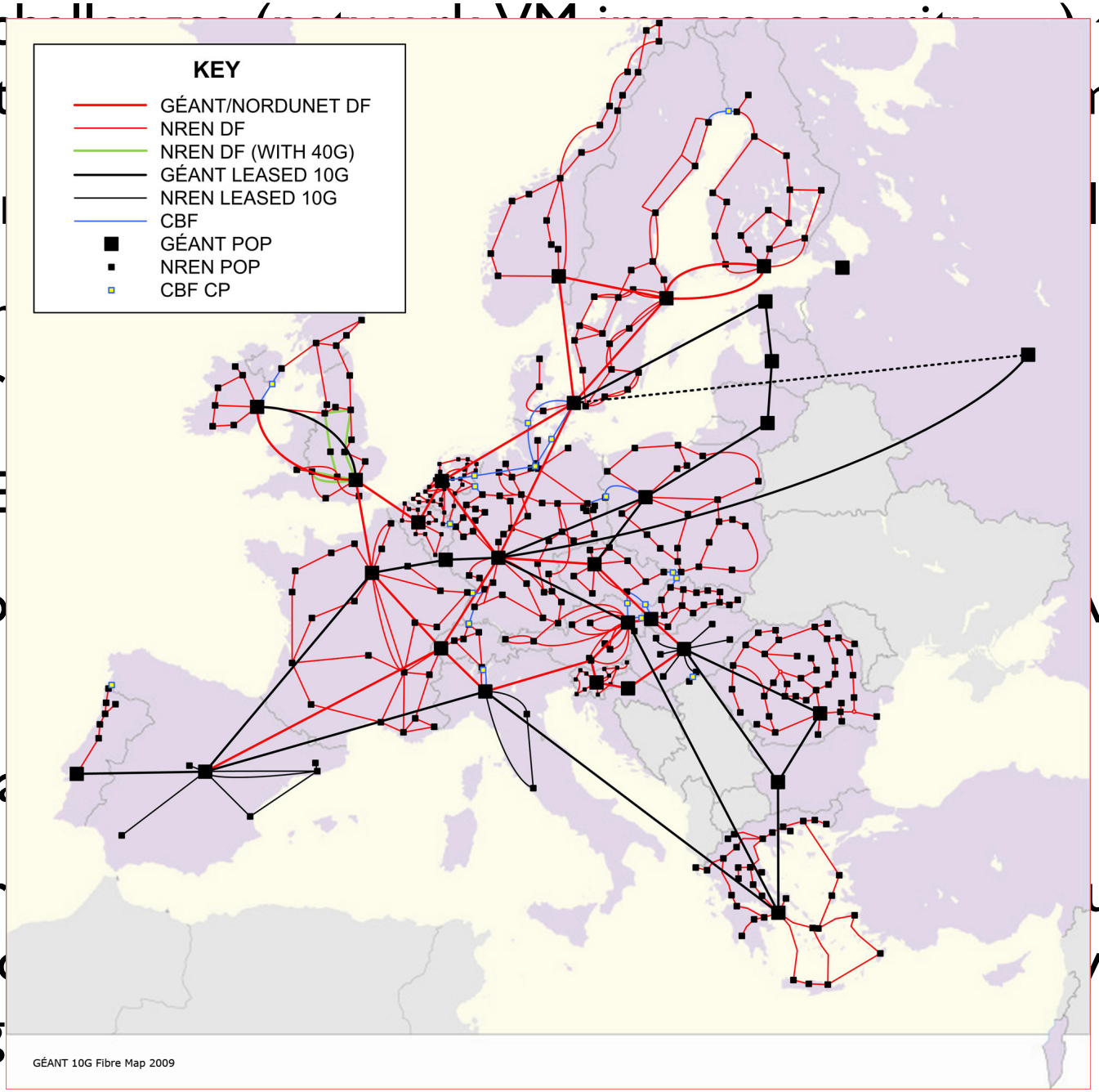

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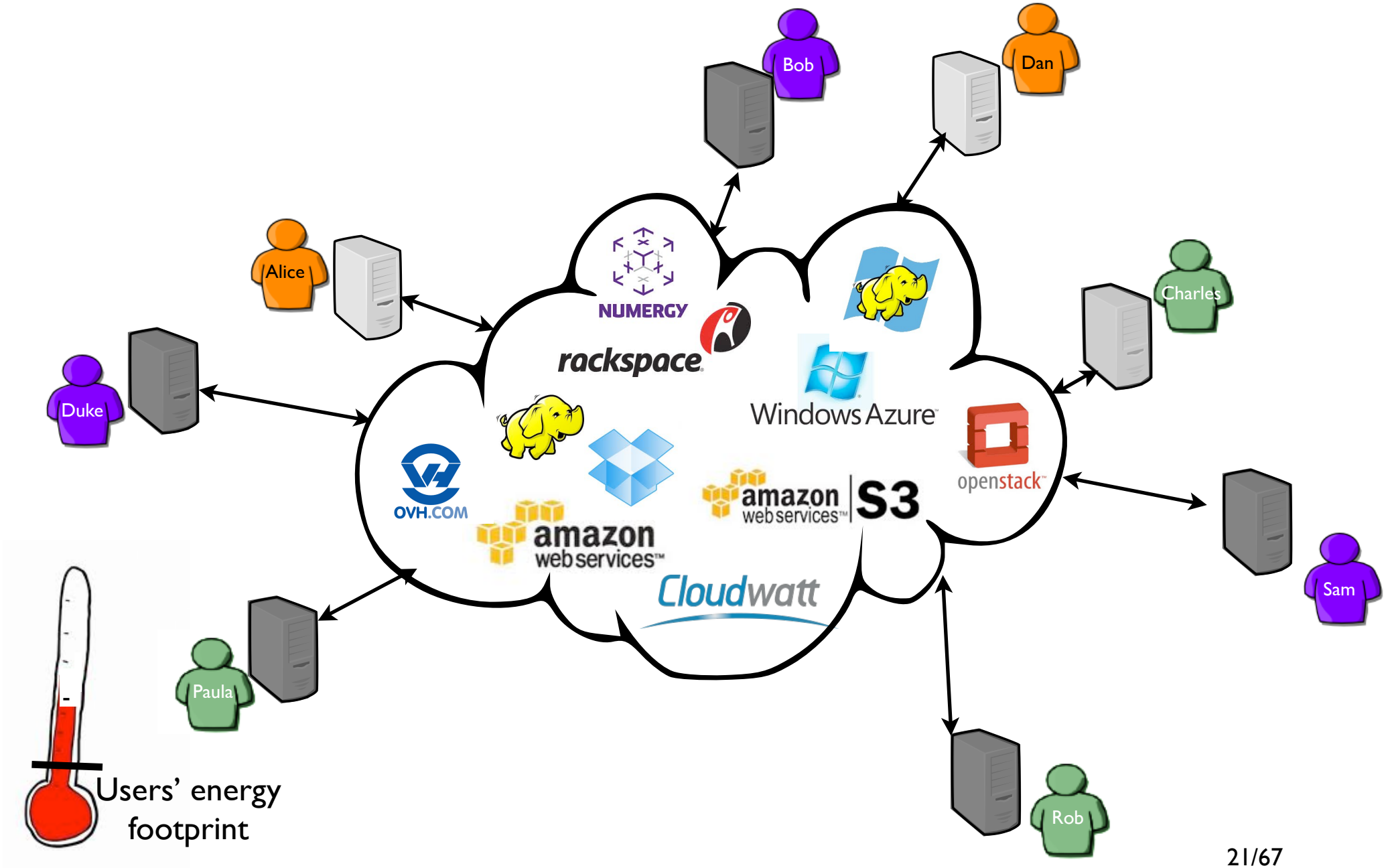

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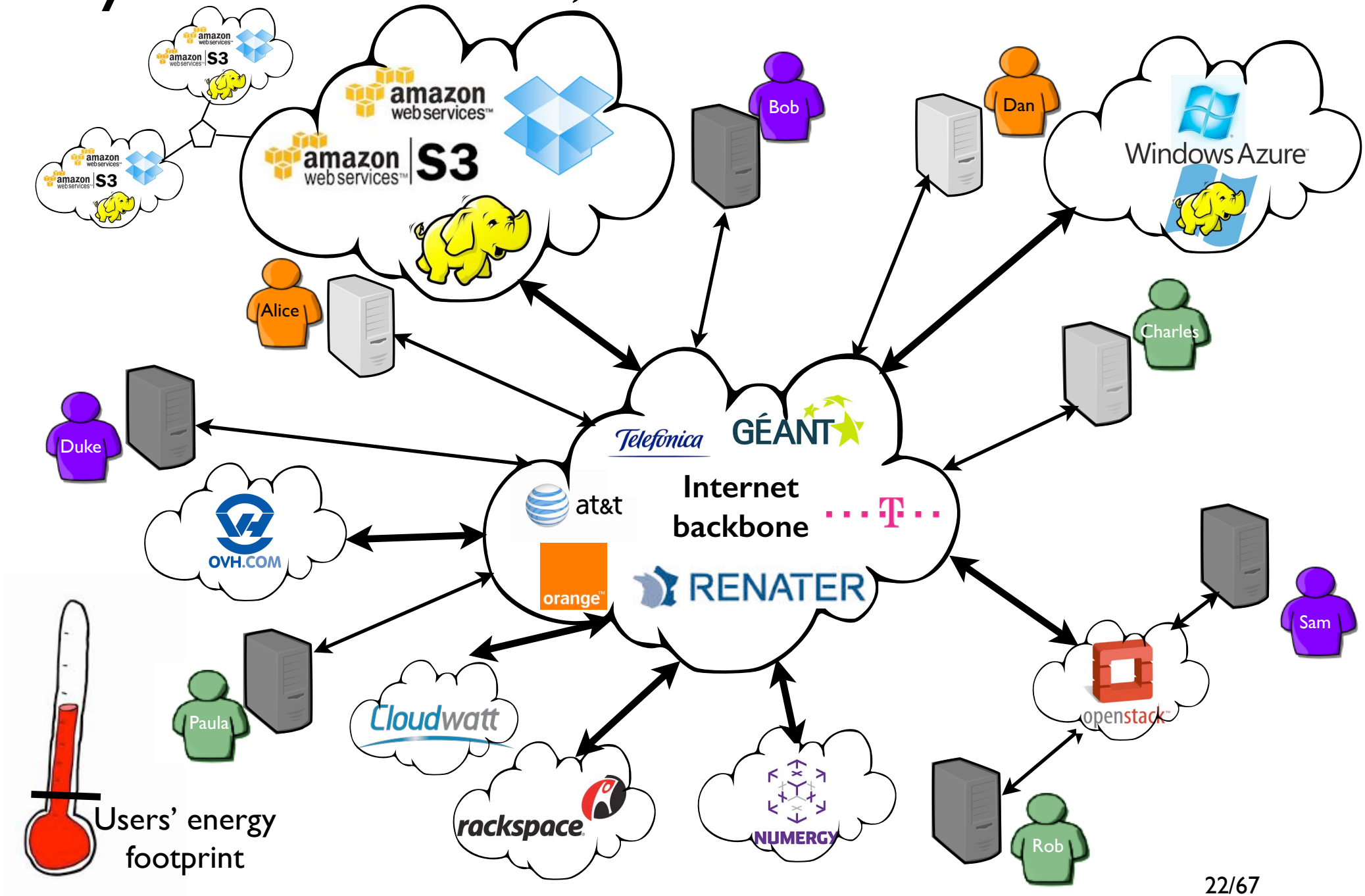

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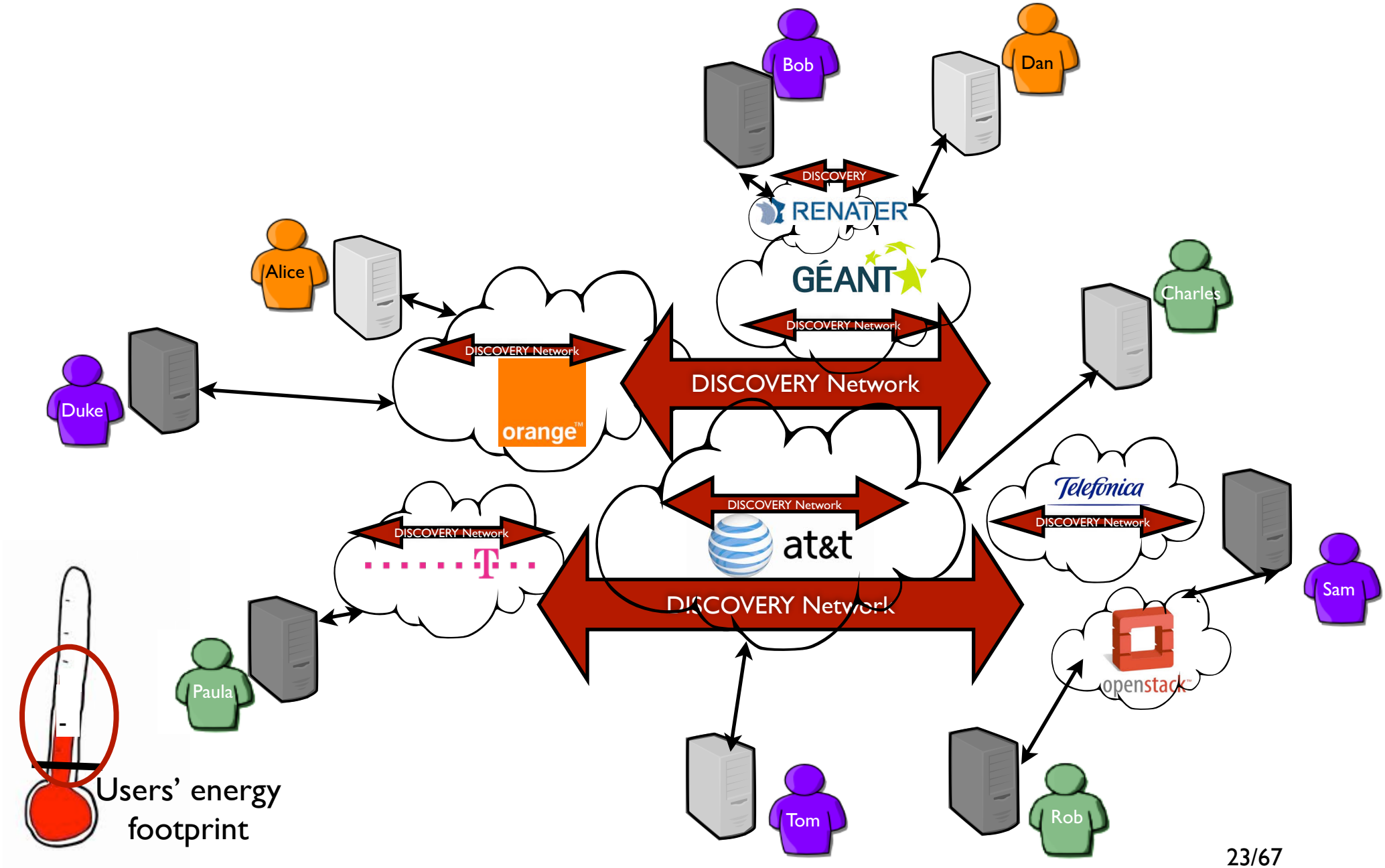

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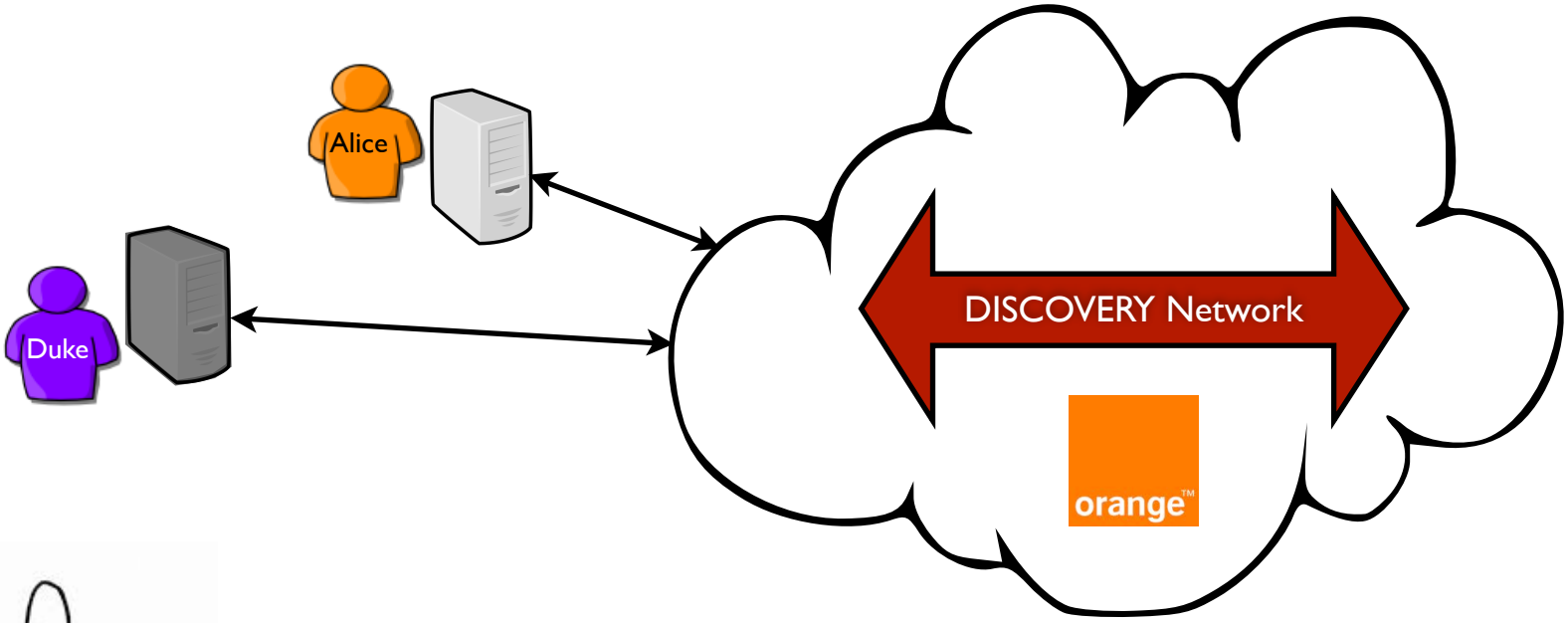
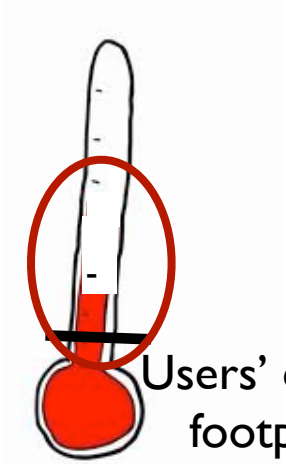
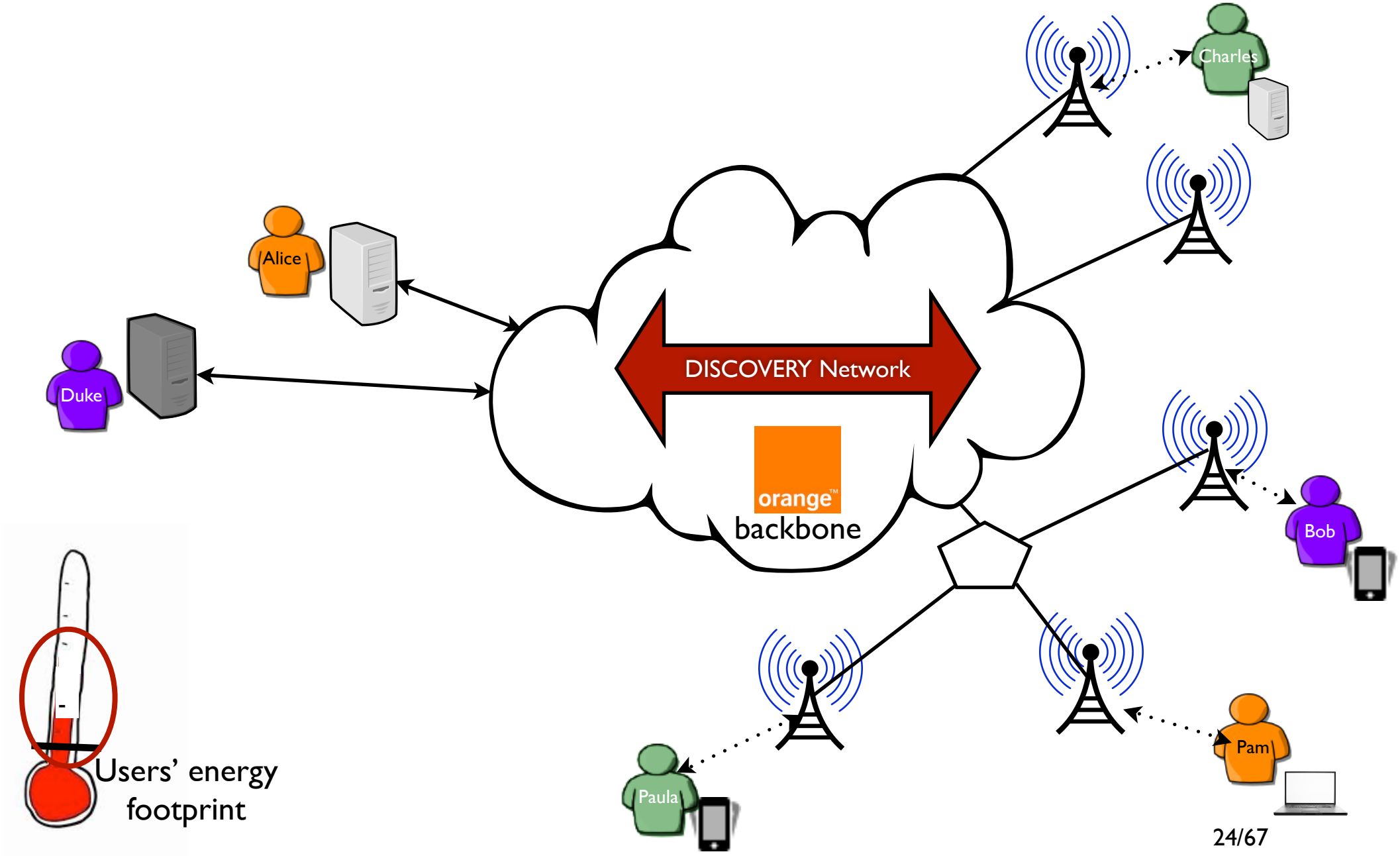




Users' energy footprint

Beyond the Cloud, the DISCOVERY Initiative



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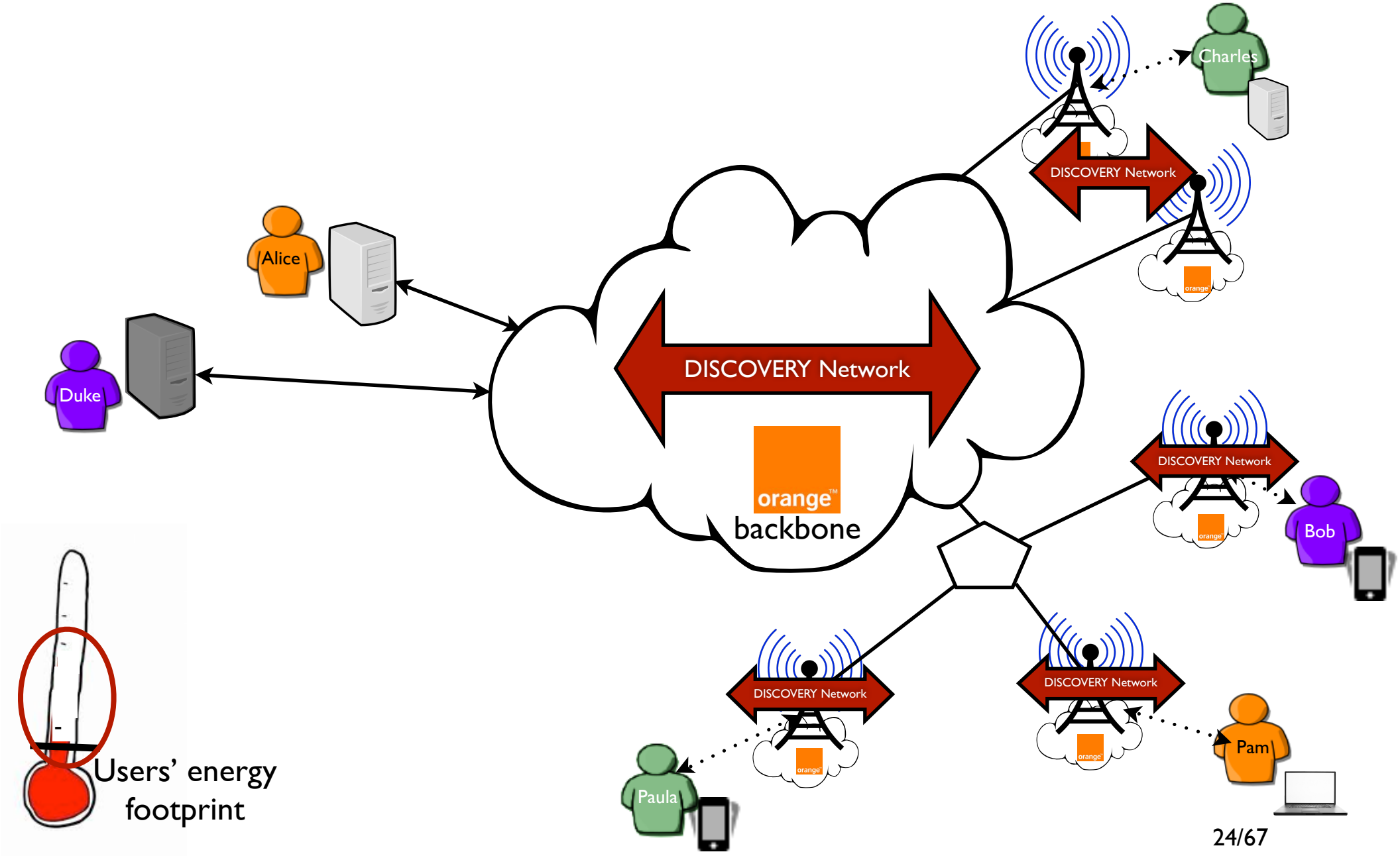

The Discovery Initiative Pros/Cons

- Pros

  Locality
  (jurisdiction concerns, latency-aware apps, minimize network overhead)

  Reliability/redundancy (no critical point/location/centers)
  The infrastructure is naturally distributed throughout multiple areas

  Lead time to delivery
  Leverage current PoPs and extend them according to UC demands

  Energy footprint (to be confirmed)

  Bring back part of the revenue to NRENs/Telcos

- Cons

  Security concerns (in terms of who can access to the PoPs)

  Operate a fully IaaS in a unified but distributed manner at WAN level

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.

- Distributed Cloud Computing is happening !

  Dist. CC workshop (2 editions UCC 2013, SIGCOMM 2014)
  FOG Computing workshop (collocated with IEEE ICC 2013)

- But Inria, Orange jumped on the bandwagon

http://beyondtheclouds.github.io/

Amazon is on the way !

amazon web services

Sign Up | My Account / Console | English

AWS Products & Solutions | AWS Product Information | Developers | Support

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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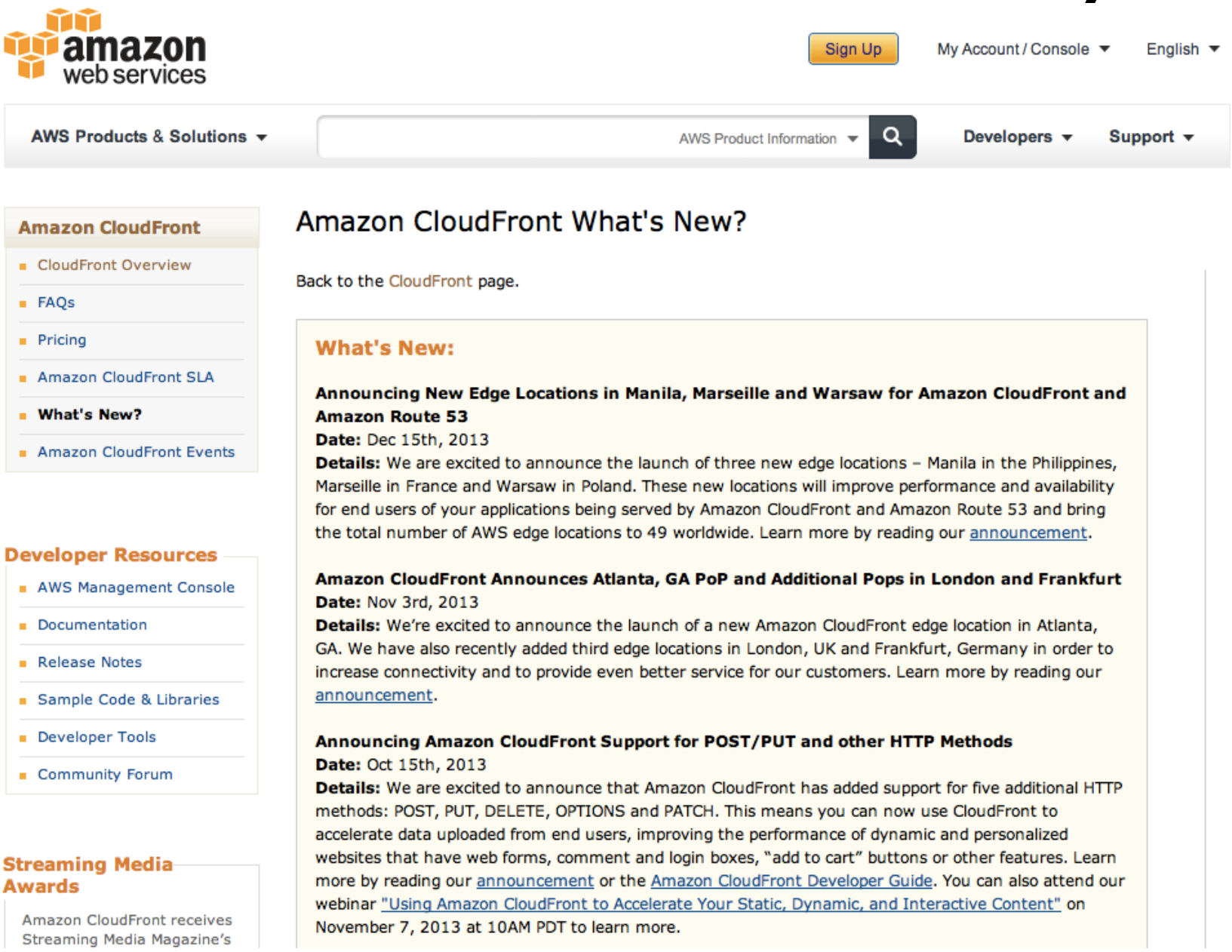


Beyond Discovery !

- 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...

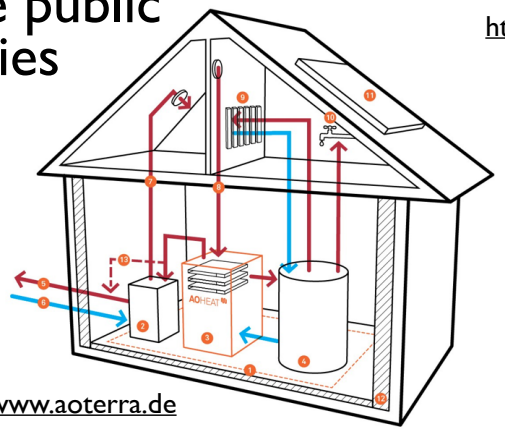
- Leverage "green" energy (solar, wind turbines...)

  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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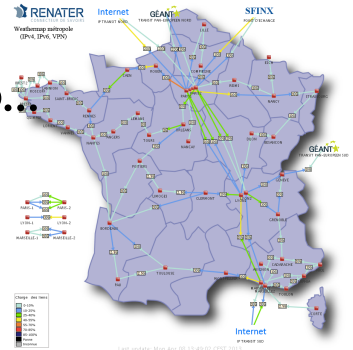

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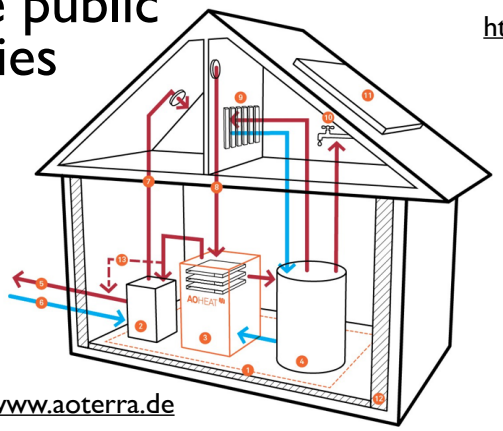

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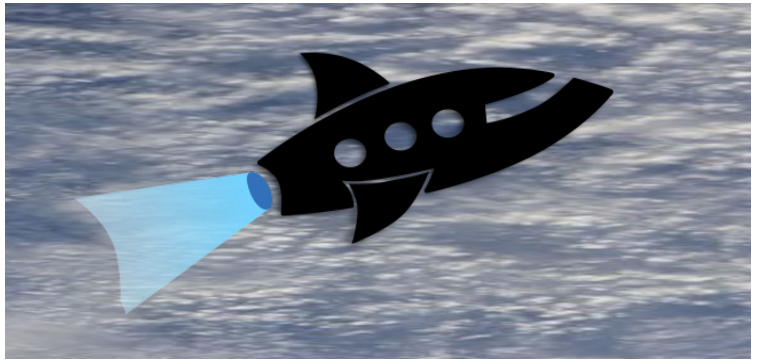

- Thank you / Questions ?
- Additional materials
  - Focus on LRT (Flavien Quesnel's Phd, ended in Feb 2013)
  - Discovery internals in a nutshell
  - On going work - The discovery framework from the Software Programming viewpoint (Jonathan Pastor's Phd, 2012/2015)

CRS4 IDEAS BECOME LIFE

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