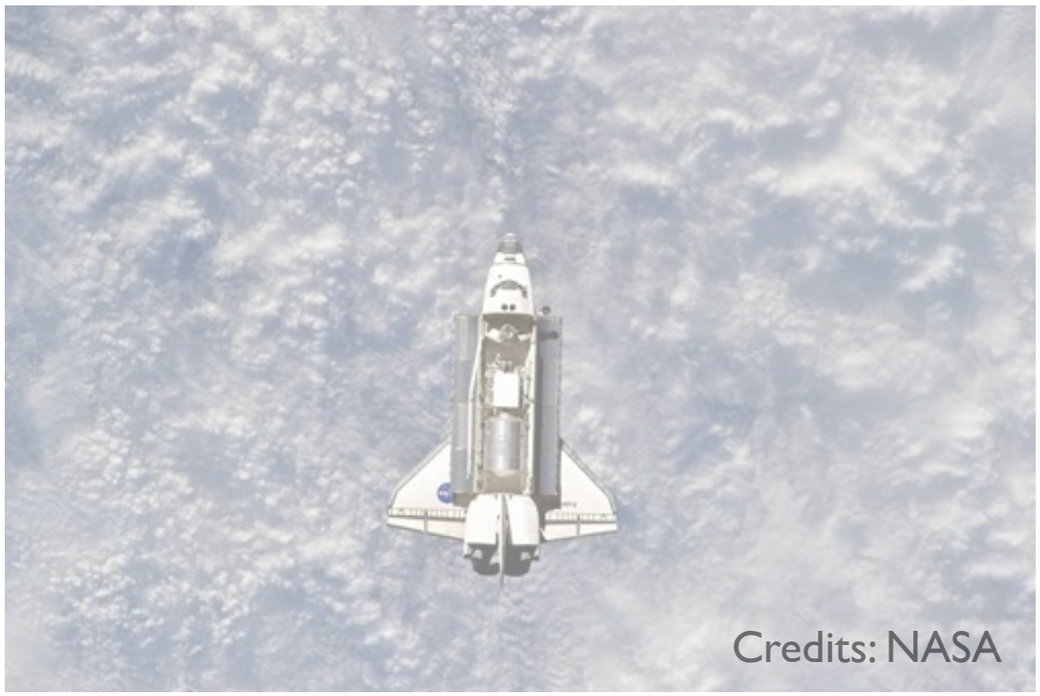
Beyond the Clouds, The Discovery Initiative



How Should Next Generation Utility Computing Infrastructures Be Designed to Solve Sustainability & Efficiency Challenges ?

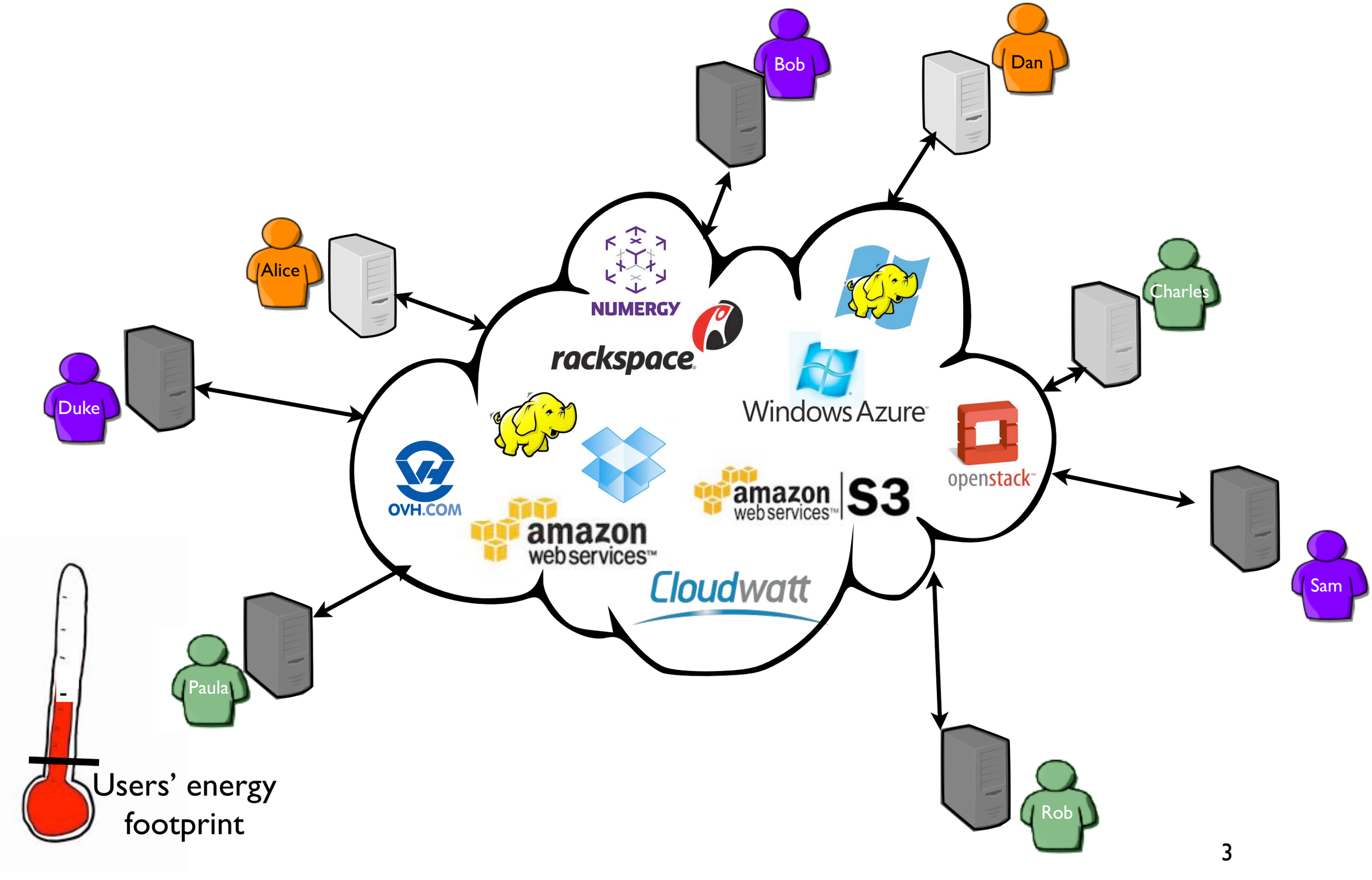
Adrien Lebre
Sept, 2014 - ISC Cloud

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

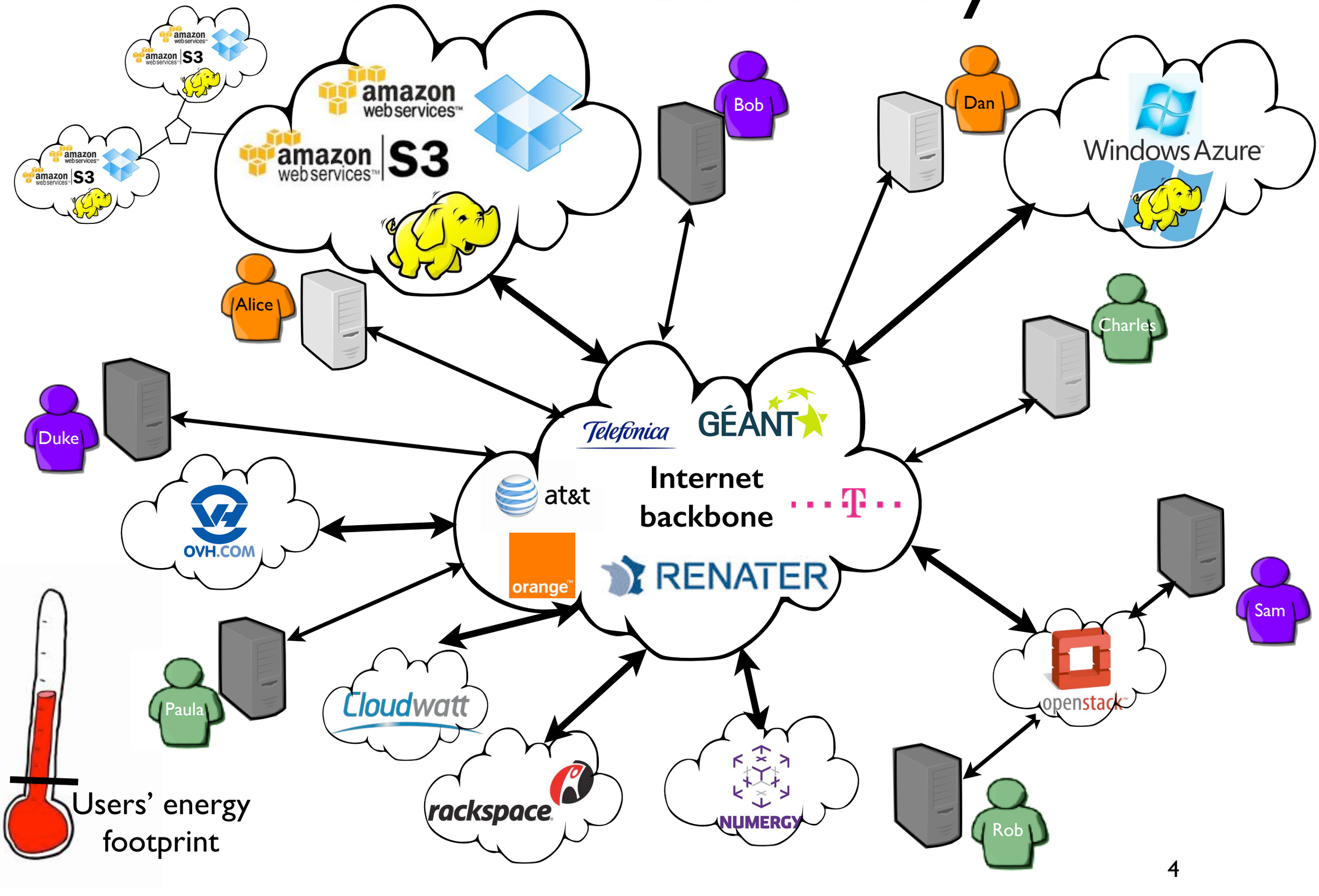
A simple Idea

Bring Clouds back to the cloud

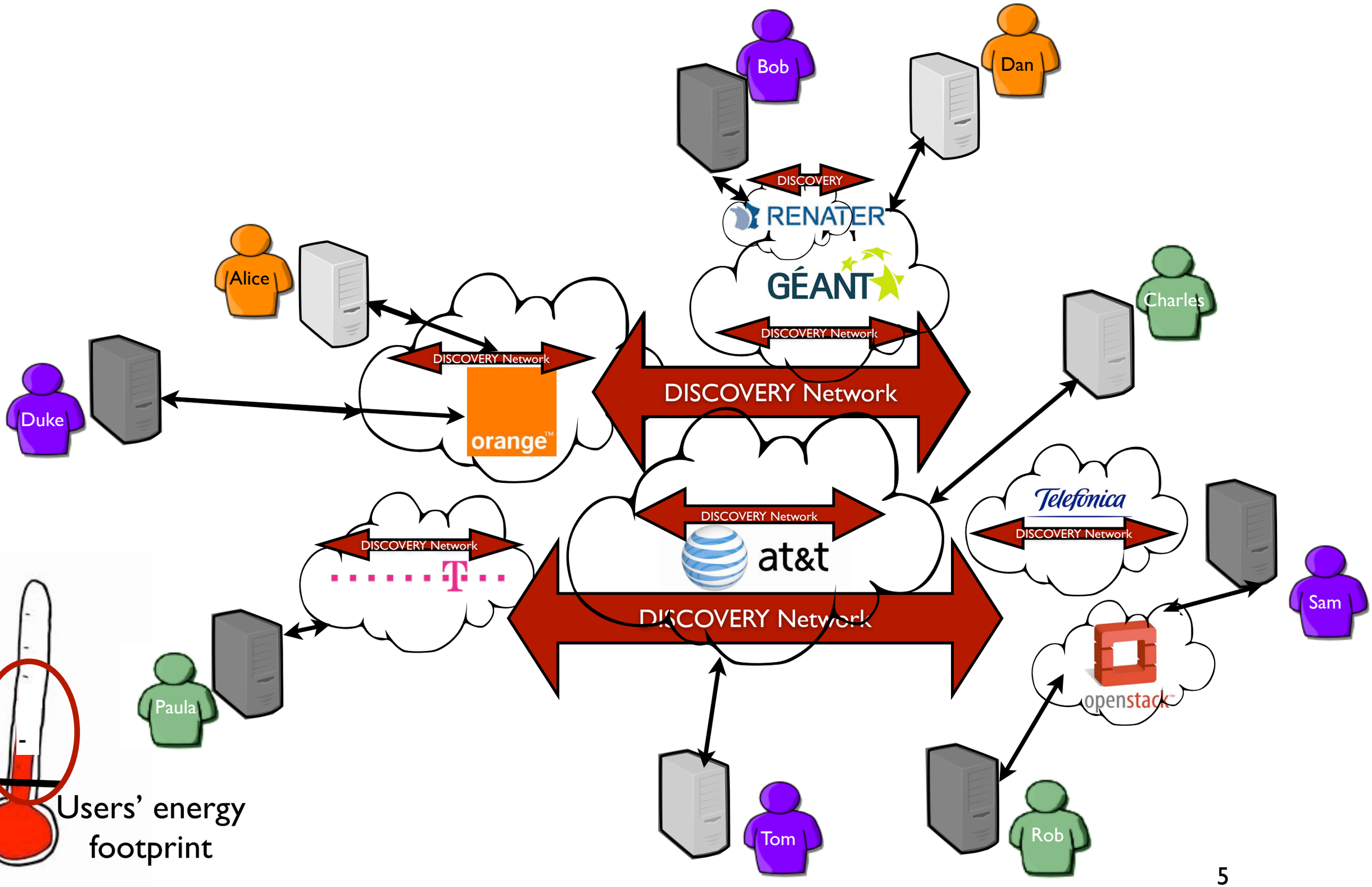
The cloud from end-users



The cloud in reality



The Discovery Initiative



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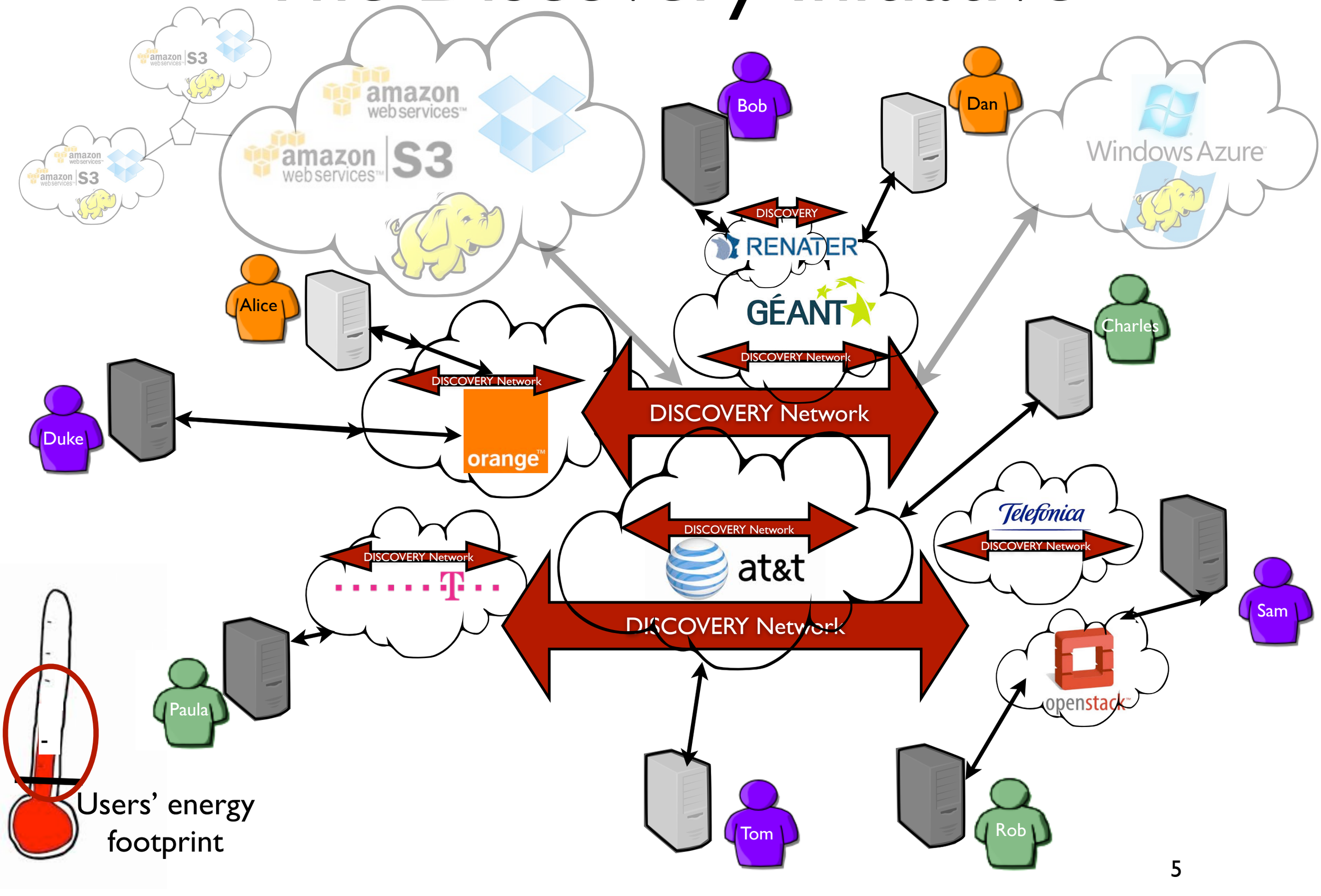

Users' energy footprint

Why ?

Let's give a look to the current situation

The Current Trend: Large off shore DCs

- To cope with the increasing UC demand while handling energy concerns but…

credits: datacentertalk.com - Microsoft DC, Quincy, WA state

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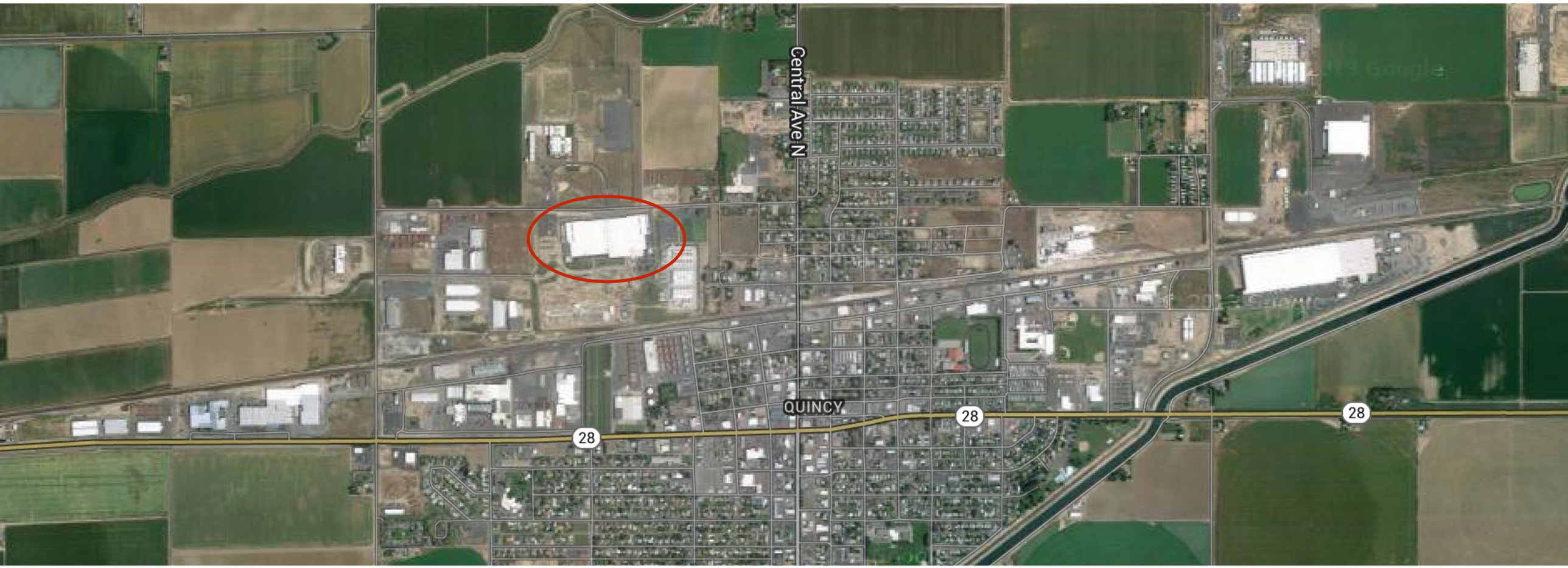

credits: google map - Quincy

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Inherent limitations of current solutions

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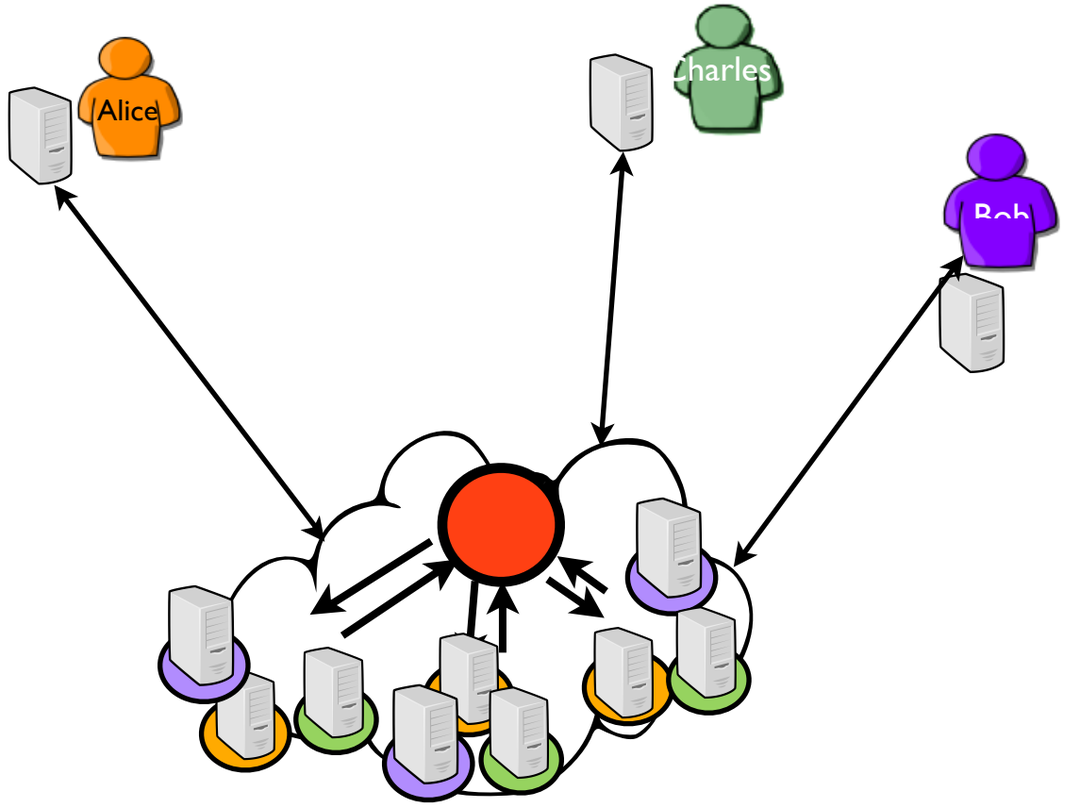
  1. Externalization of private applications/data (jurisdiction concerns, PRISM NSA scandal, Patriot Act)



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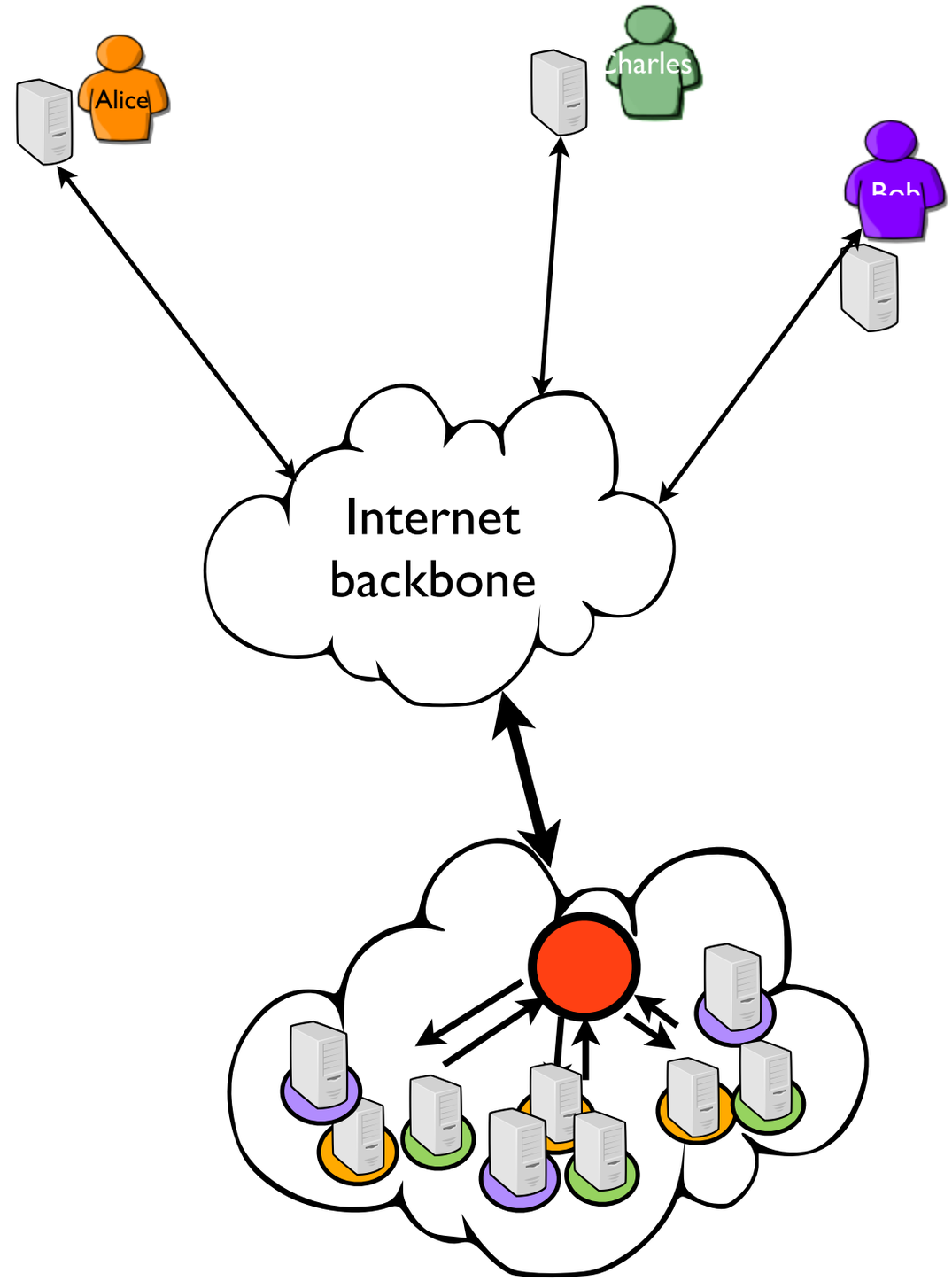

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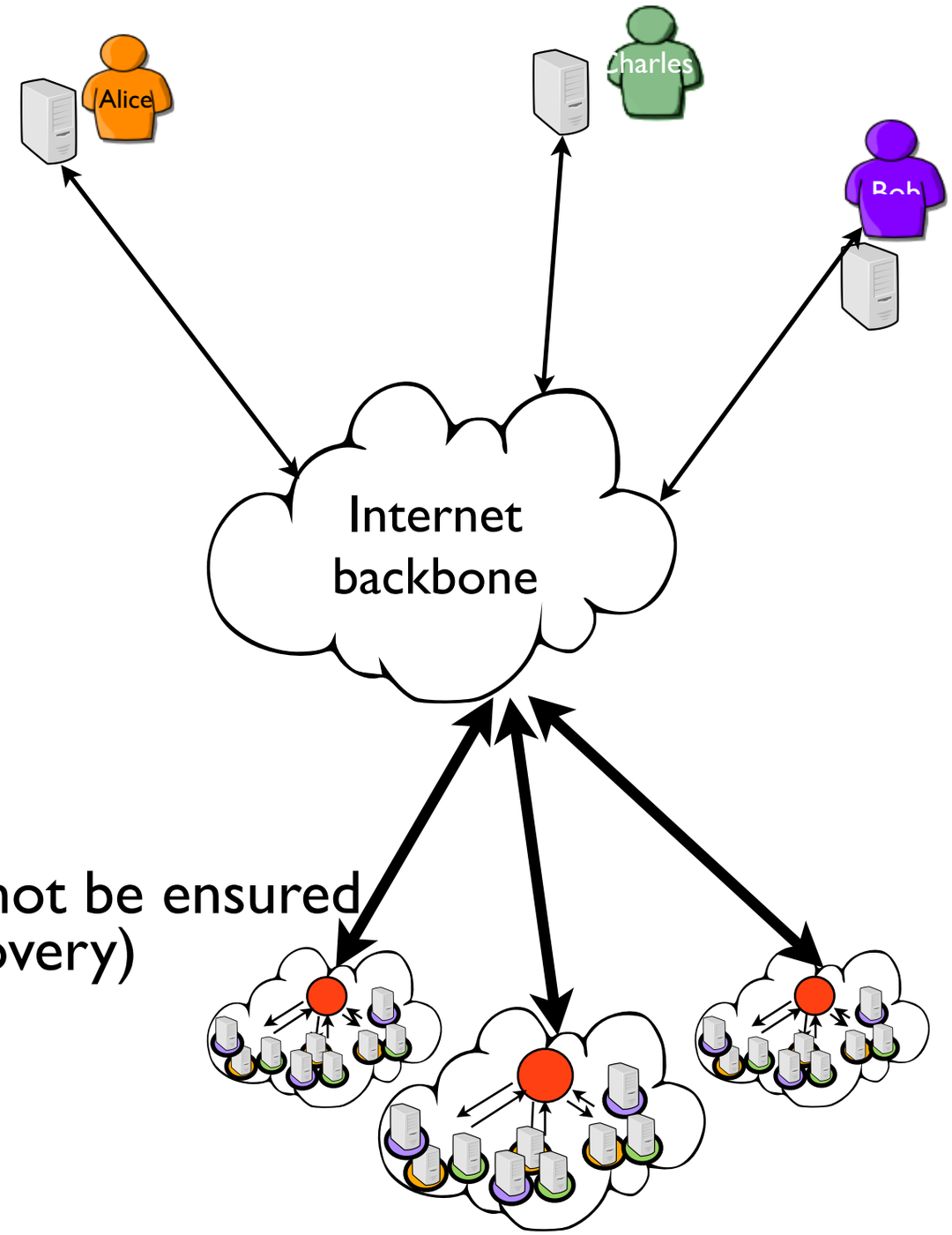

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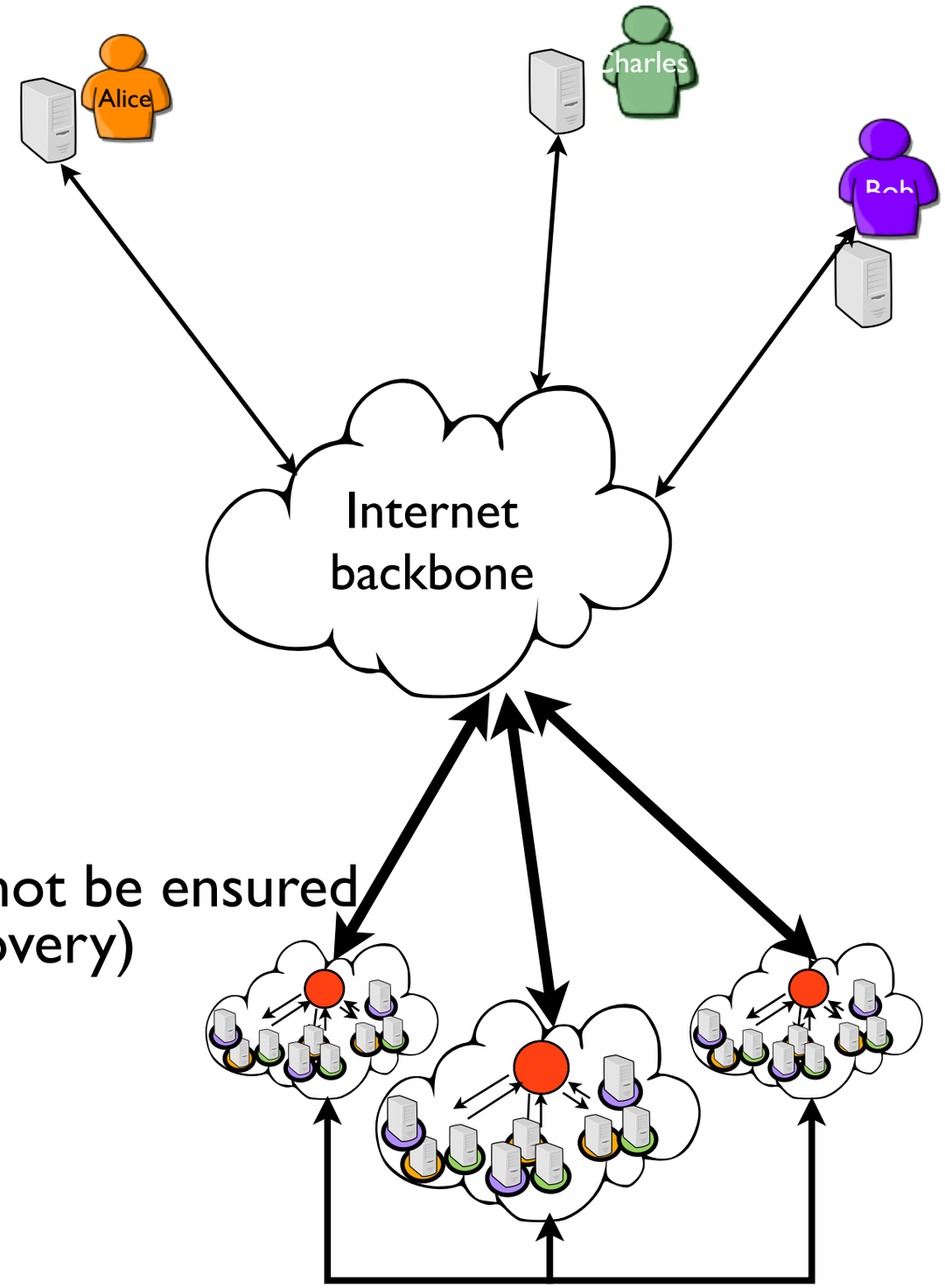

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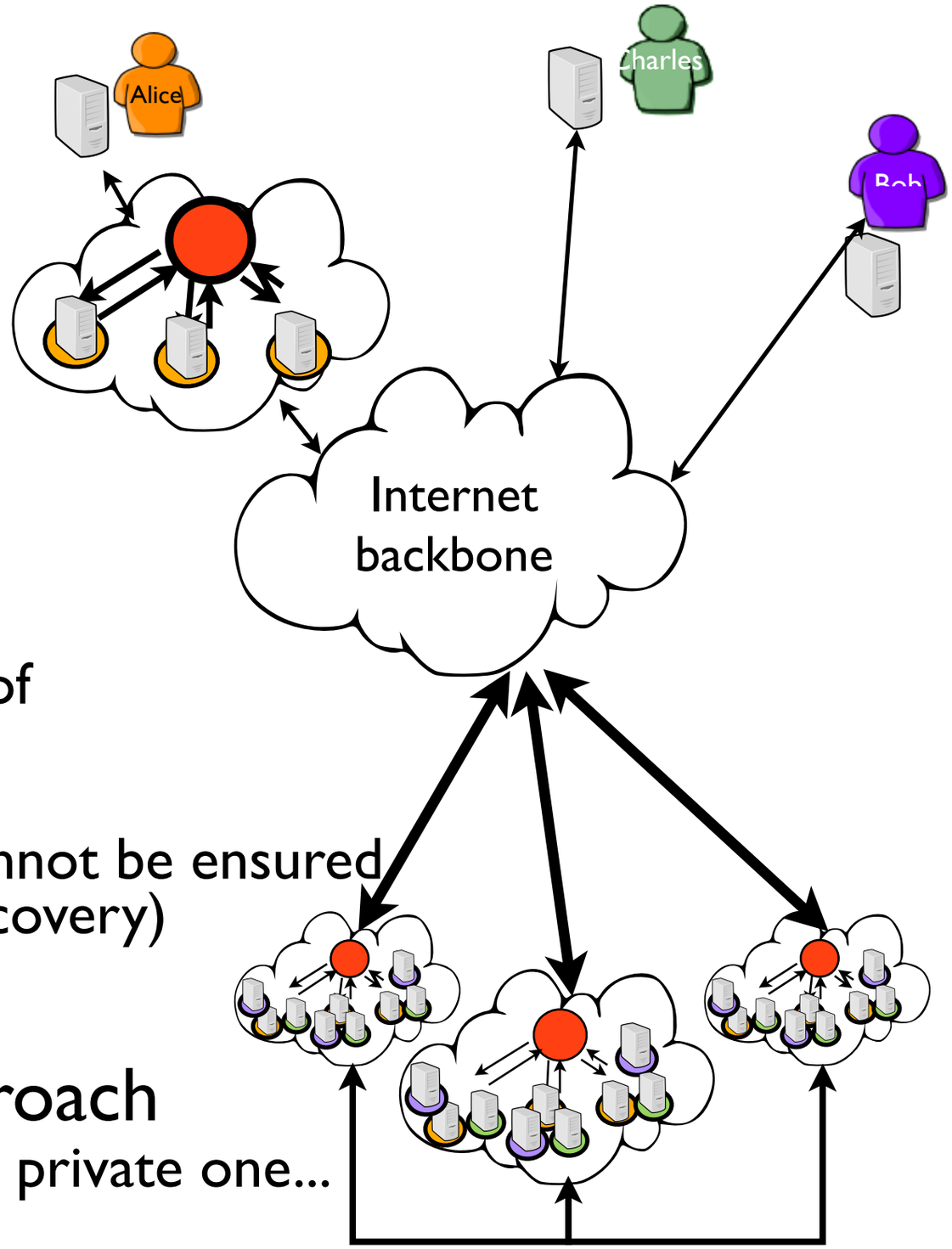


- Hybrid platforms: a promising approach
  It depends how you are going to extend the private one...

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

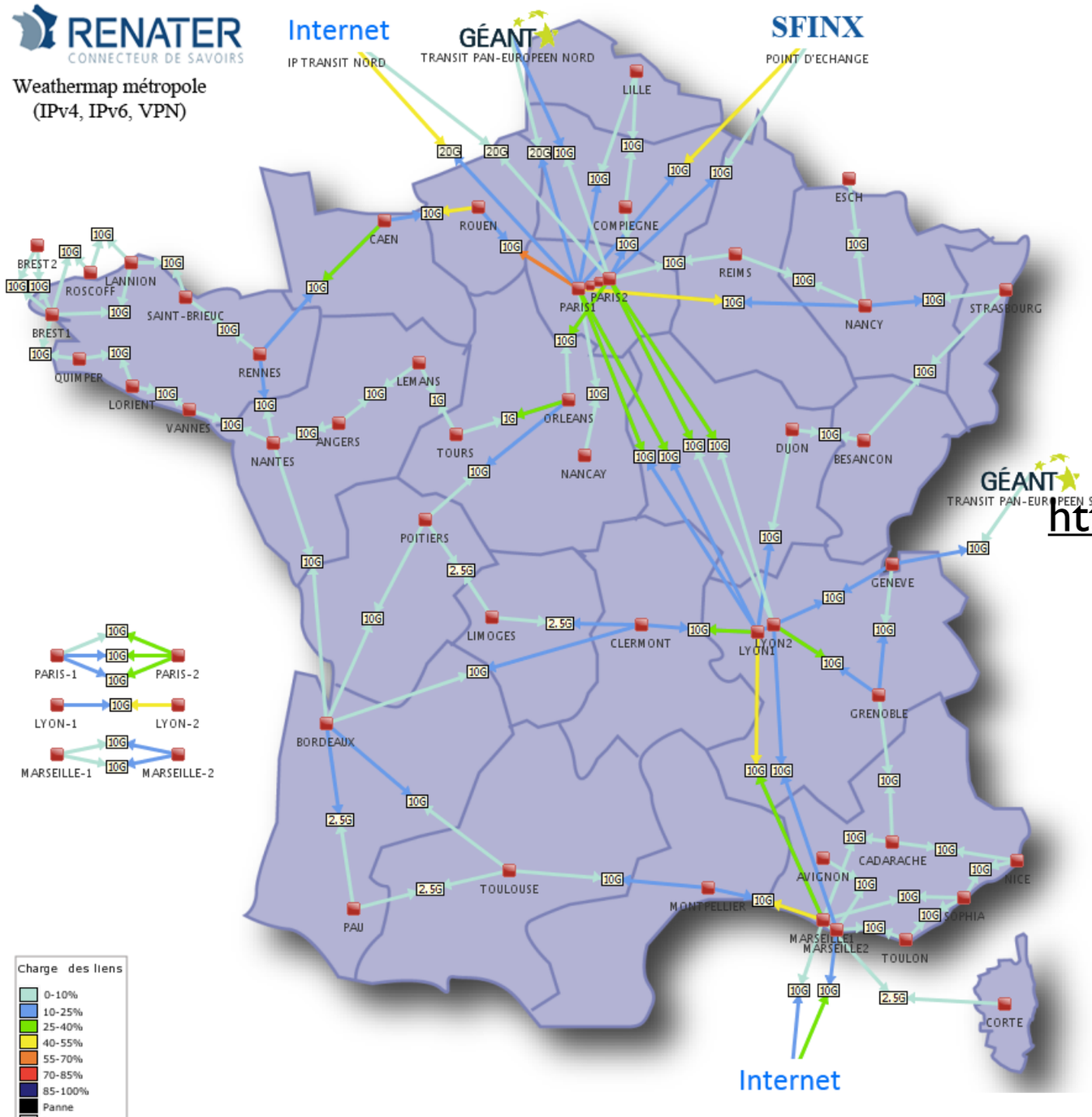
How and where the μDC concept can be deployed ?

Locality Based Utility Computing Toward LUC Infrastructures

Beyond the Clouds, the DISCOVERY Initiative

- Locality-based UC infrastructures

  A promising 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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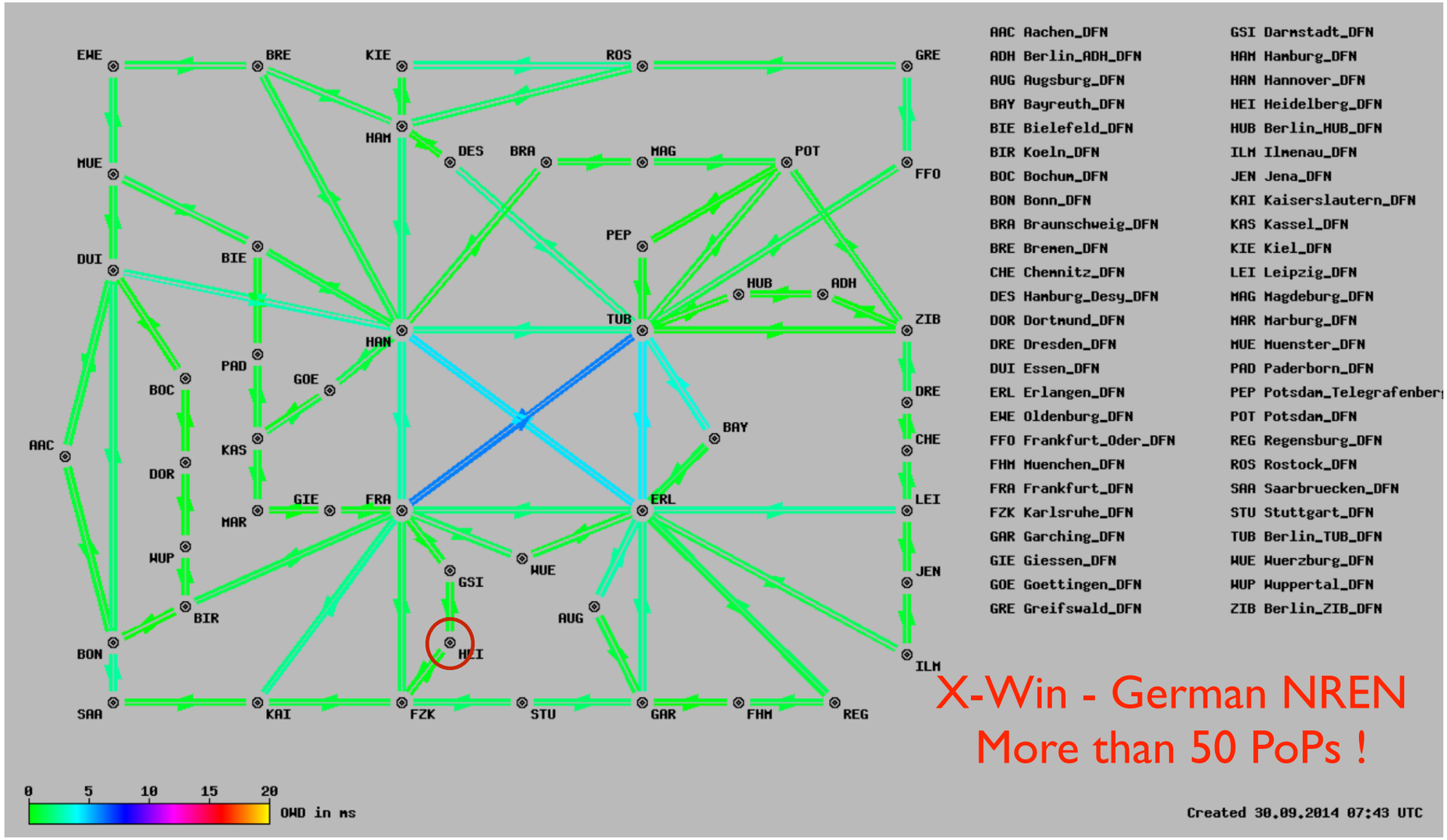

http://www.win-labor.dfn.de/cgi-bin/hades/map.pl?config=win

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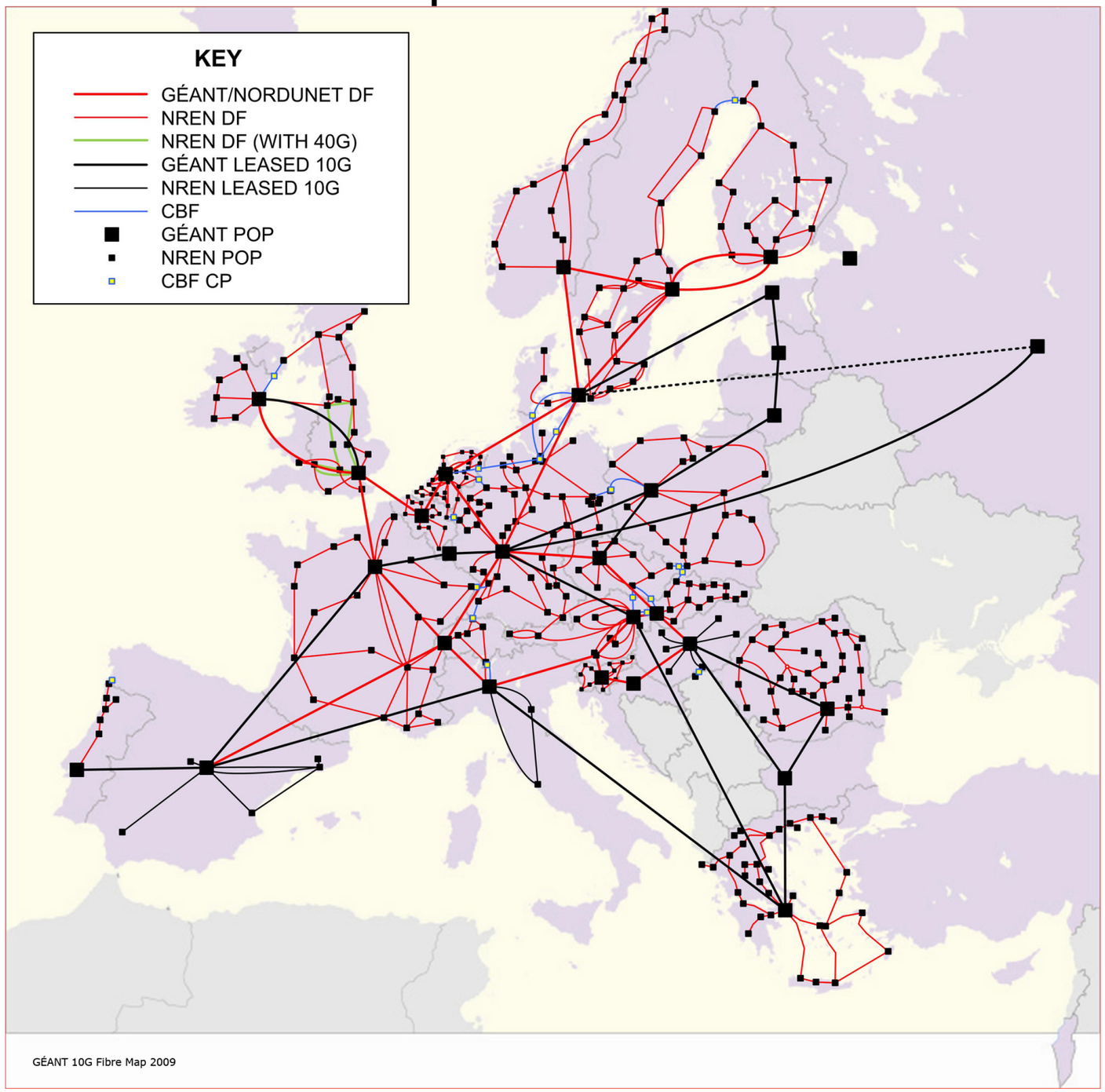

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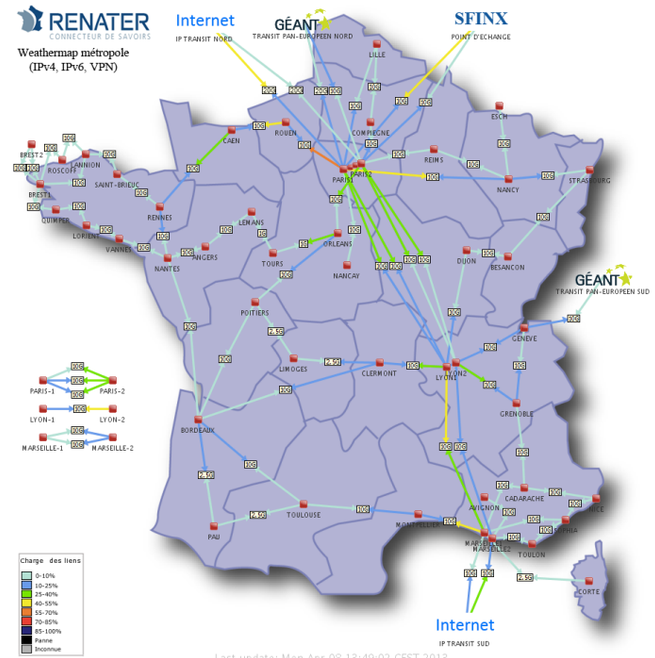
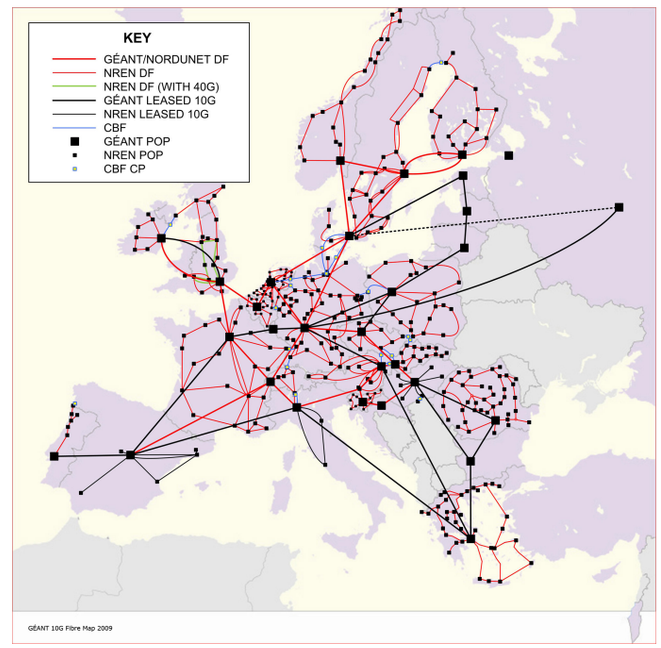


- Leveraging network backbones

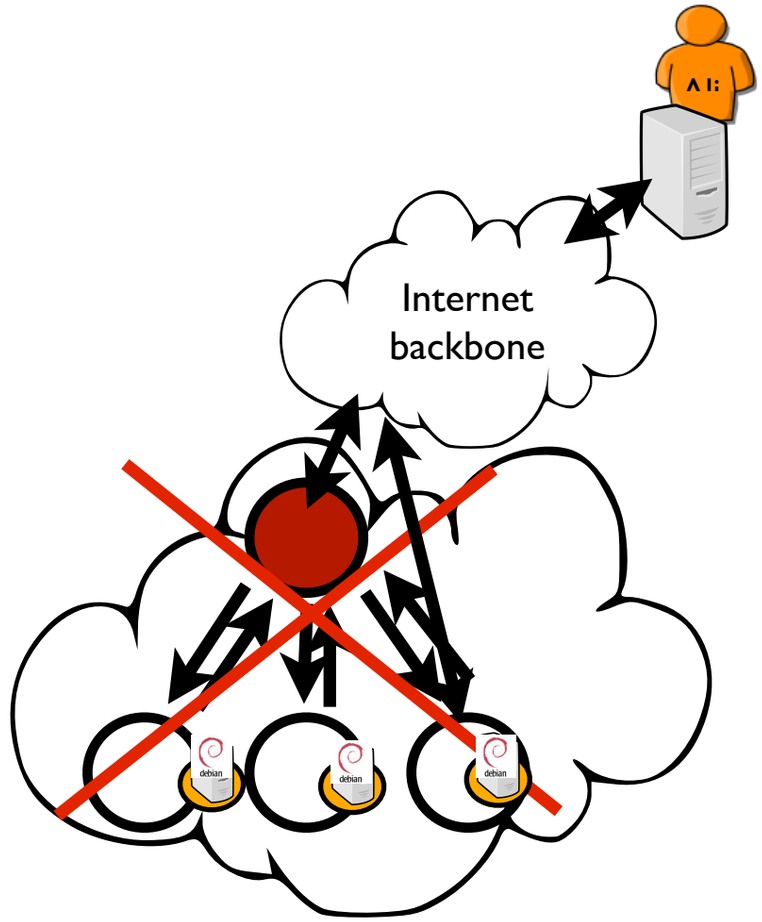
  Extend any point of presence of network backbones with UC servers (from network hubs up to major DSLAMs that are operated by telecom companies and network institutions).



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

The DISCOVERY Proposal

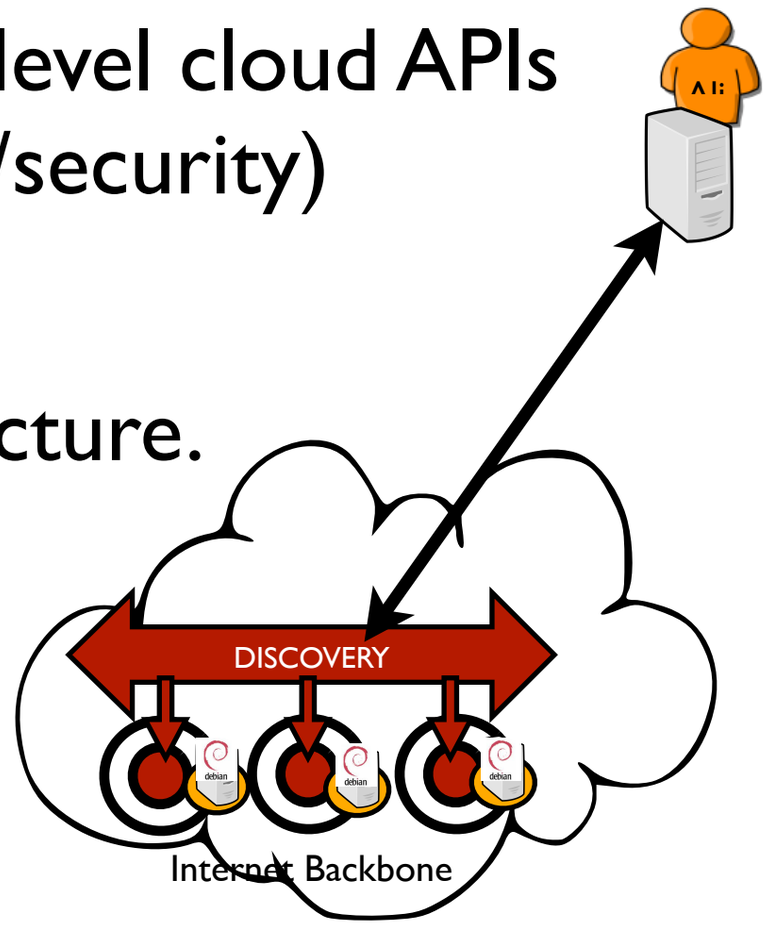
- DIStributed and COoperative framework to manage Virtual EnviRonments autonomously



The DISCOVERY Proposal

- DIStributed and COoperative framework to manage Virtual EnviRonments autonomously
- The LUC OS
  - A fully distributed IaaS system and not a distributed system of IaaS systemS
    We want to/must go further than high level cloud APIs (cross-cutting concerns such as energy/security)
  - Leverage P2P algorithms and self-* approaches to operate a LUC infrastructure.

?? A distributed version of the EGI Core that directly manipulates resources ??



Where We Go (few details)

- 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" (but this is not a BitTorent system !)

  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 ?

Where We Are

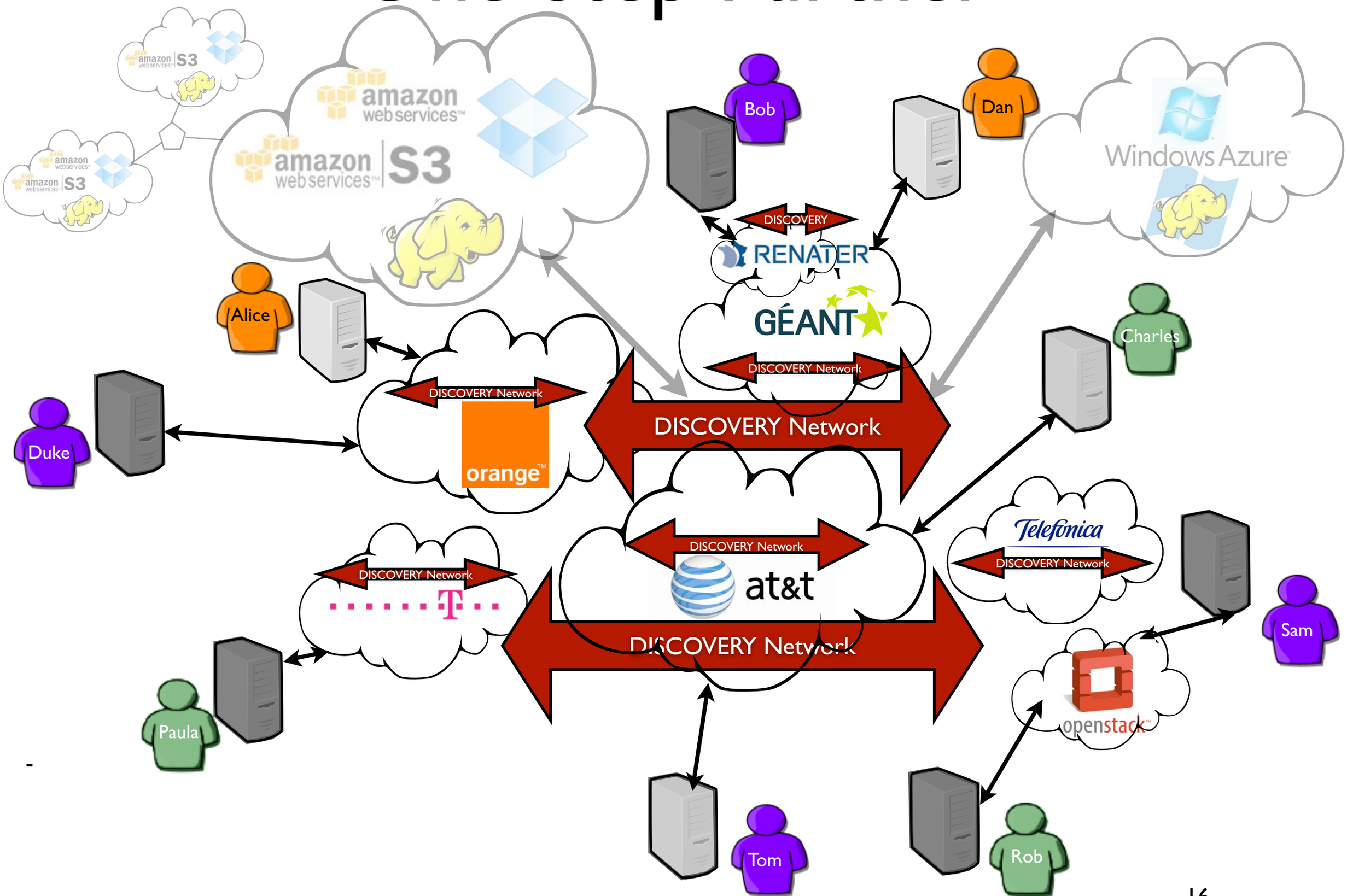
- Validation of the LUC model
  (on-going work with RENATER, the French NREN)
  - From energy/efficiency/economical point of views
  - On a brick basis (100 VMs) and by considering the cost of the network.
- An academic POC for validating the feasibility of major blocks (scheduling of VMs, migration between distinct sites…)
  - Two PhDs, Two PostDocs
  - Managing 10K VMs on top of Grid'5000 like normal processes on a laptop.
- A POC is nice but can we push this idea further ?
  - Revisit OpenStack
    (on-going work with Orange Labs, started 6 months ago)

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!
- 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)
- Important actors to follow:
  Akamai (micro DCs, Akamai/Aspera)
  Amazon (micro DCs at the Edge, cloudFront)

One Step Further



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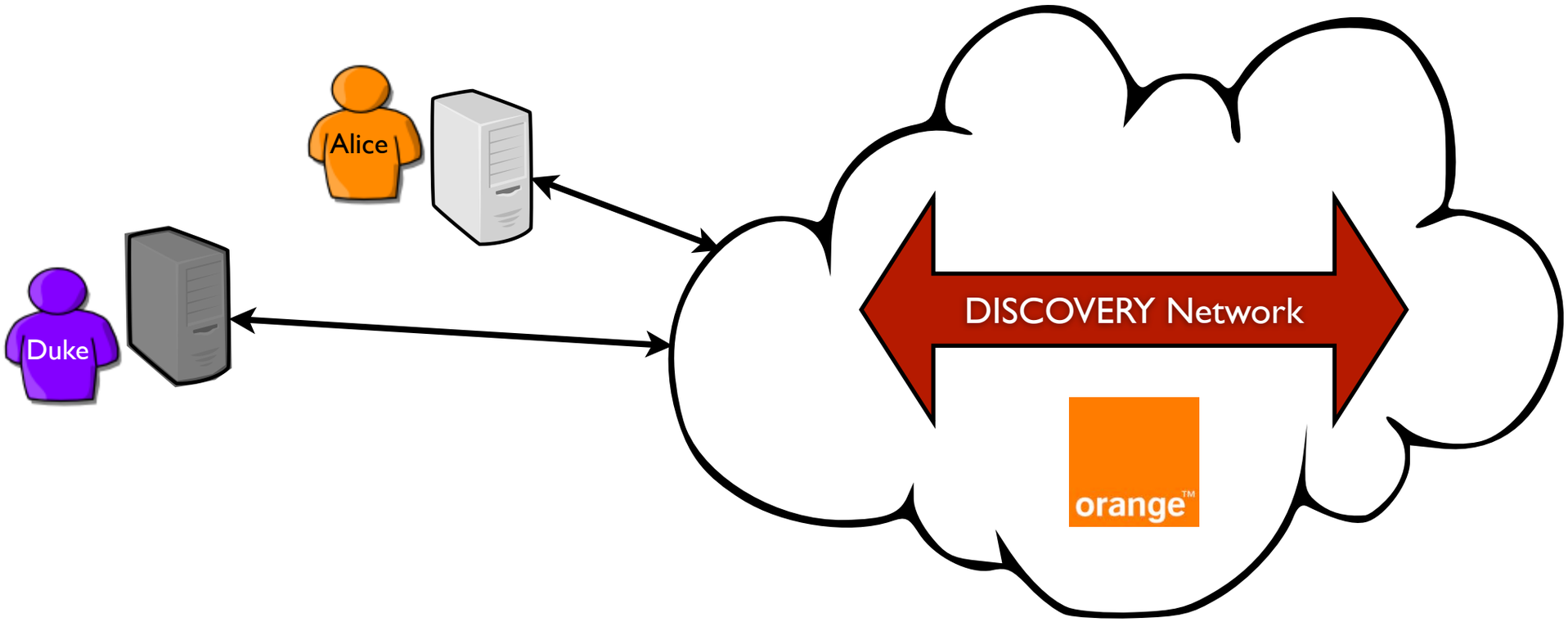

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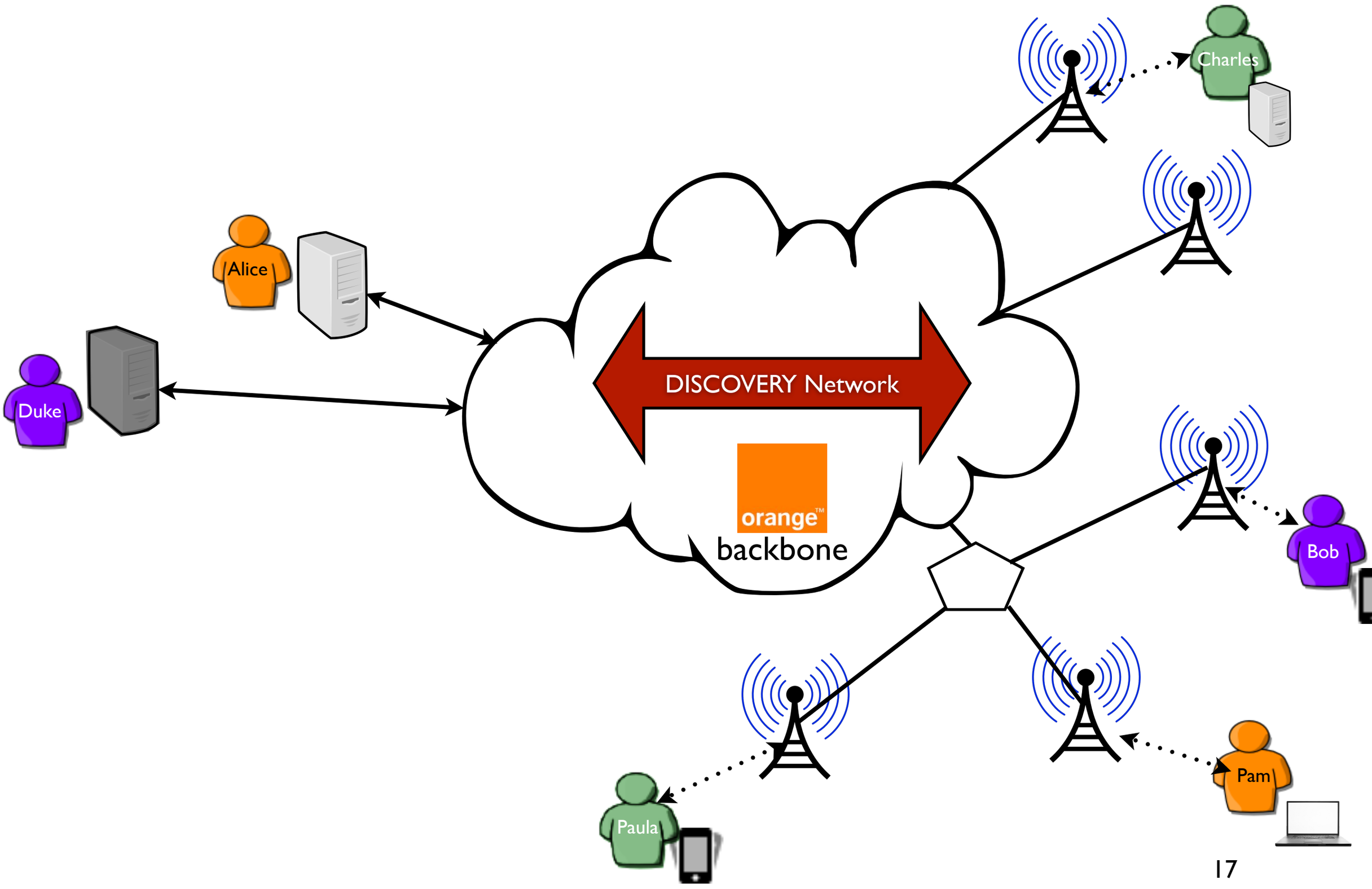
Radio Base Stations



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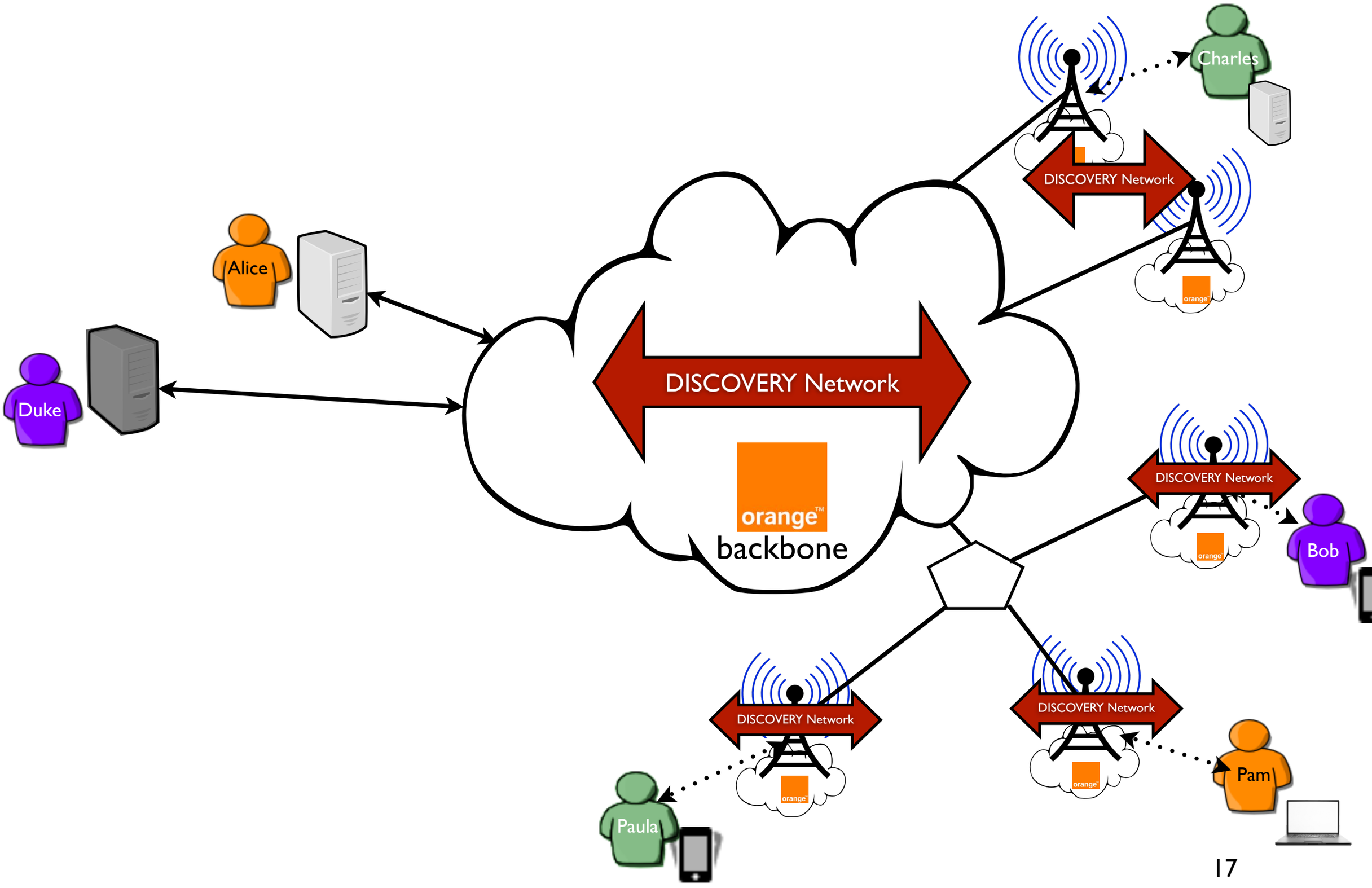

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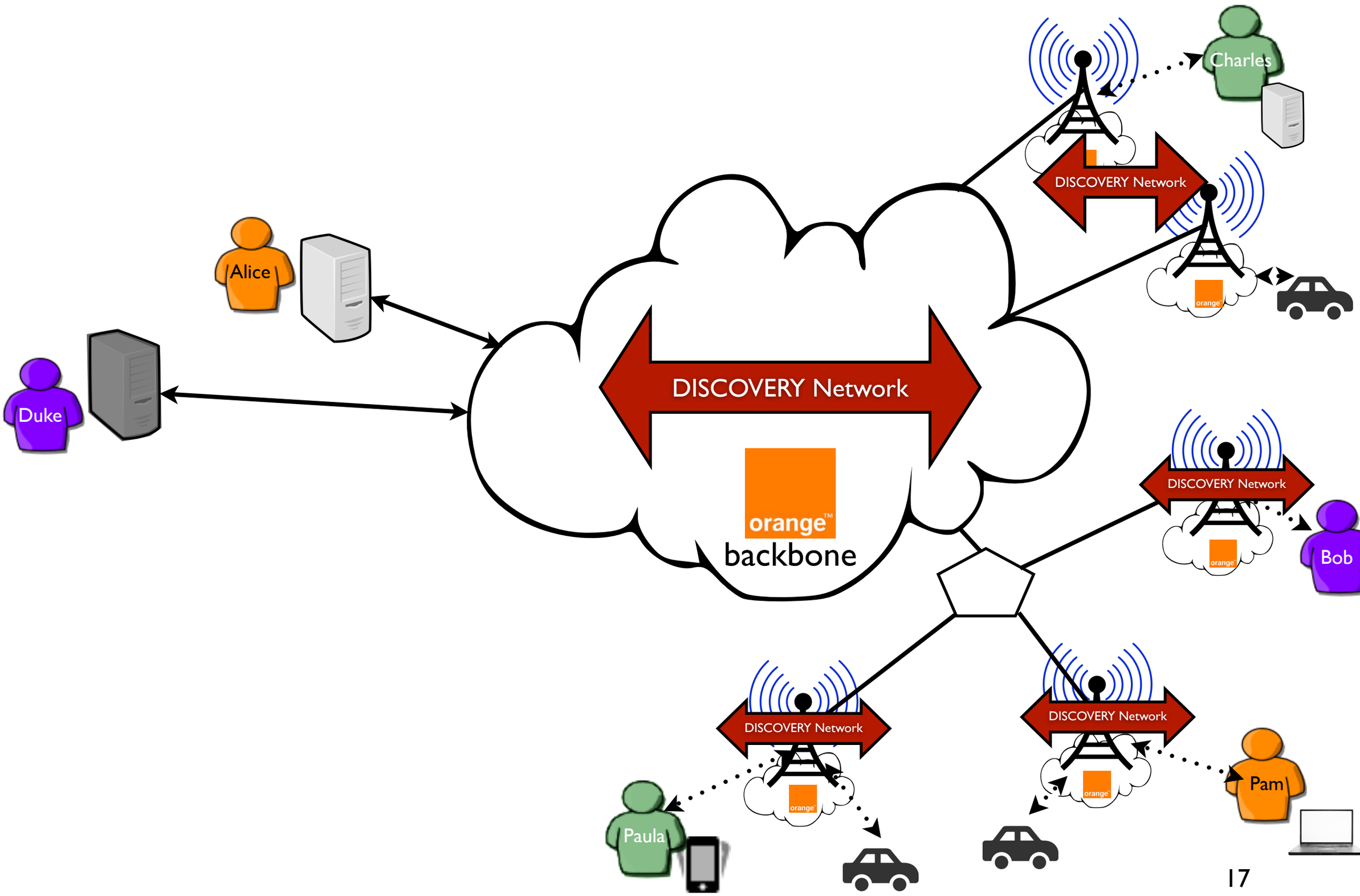


The Discovery Initiative Pros/Cons

- Pros

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

  Reliability/redundancy (no critical point/location/center)
  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

  Not suited for all kinds of applications : Large tightly coupled HPC workloads
  50 nodes/1000 cores, 200 nodes / 4000 cores but up to 5 racks, 1000 nodes …

  Peering agreement / economic model between network operators

Conclusion

- Cloud Computing technology is changing every day

  New features, new requirements (IaaS ++ services)

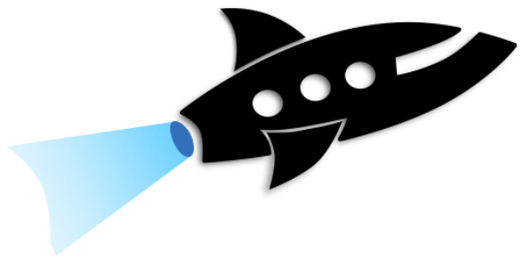
  One more challenge will be to ensure that such new features/ mechanisms can run in a distributed manner.

- Distributed Cloud Computing is happening !

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

  More and more academic papers
  Decentralizing the Cloud: How Can Small Data Centers Cooperate
  IEEE P2P 2014 (three weeks ago)

The DISCOVERY Initiative



- Thank you / Questions ?
- Several researchers, engineers, stakeholders of important EU institutions and SMEs have been taking part to numerous brainstorming sessions (BSC, CRS4, Unine, EPFL, PSNC, Interoute, Orange Labs, Peerialism, TBS Group, XLAB, …)

http://beyondtheclouds.github.io/

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Beyond Discovery !

- From sustainable data centers to a new source of energy

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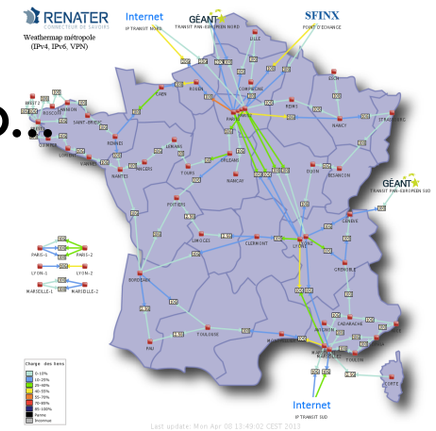


- Leverage "green" energy (solar, wind turbines...)

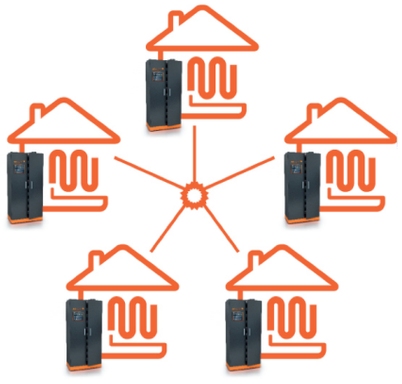
  Transfer the green micro/nano DCs concept to the network PoP

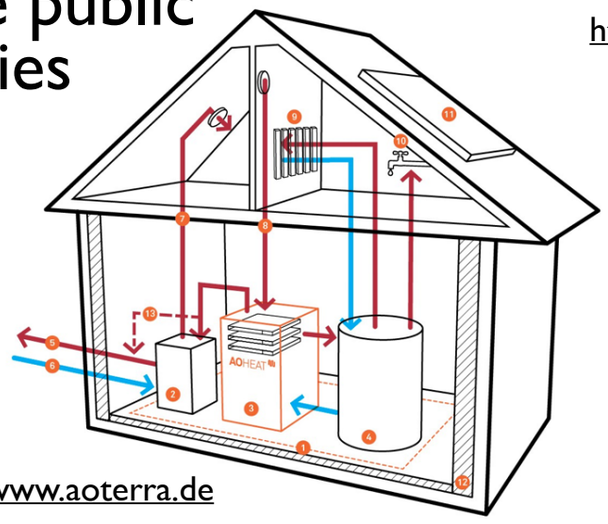
  Take the advantage of the geographical distribution

- 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





https://www.aoterra.de