openstack®

FROM THE CLOUDS TO THE EDGE

RETOUR D'EXPÉRIENCE SUR LES CAMPAGNES D'EXPÉRIMENTATIONS CONDUITES DANS LE CADRE DE IPL DISCOVERY,

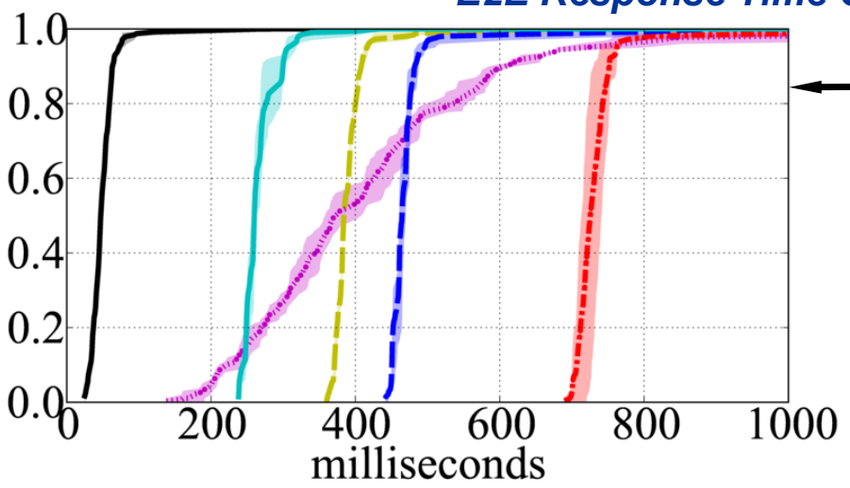
Orange Labs

Inria
inventeurs du monde numérique

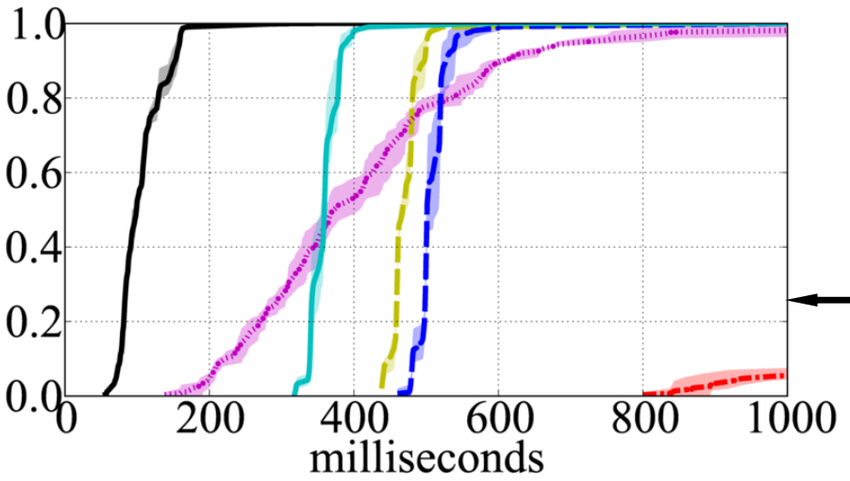
ADRIEN LEBRE, TILECS, JULY 2019

Augmented Reality

E2E Response Time CDF



Wi-Fi
802.11n



Mobile-only
Amazon East
Amazon West
Amazon EU
Amazon Asia
Cloudlet

4G LTE
T-Mobile for Cloud
In-lab Nokia eNodeB for Cloudlet

"The Impact of Mobile Multimedia Applications on Data Center Consolidation"
Ha, K., Pillai, P., Lewis, G., Simanta, S., Clinch, S., Davies, N., Satyanarayanan, M.
Proceedings of IEEE International Conference on Cloud Engineering (IC2E), San Francisco, CA, March 2013

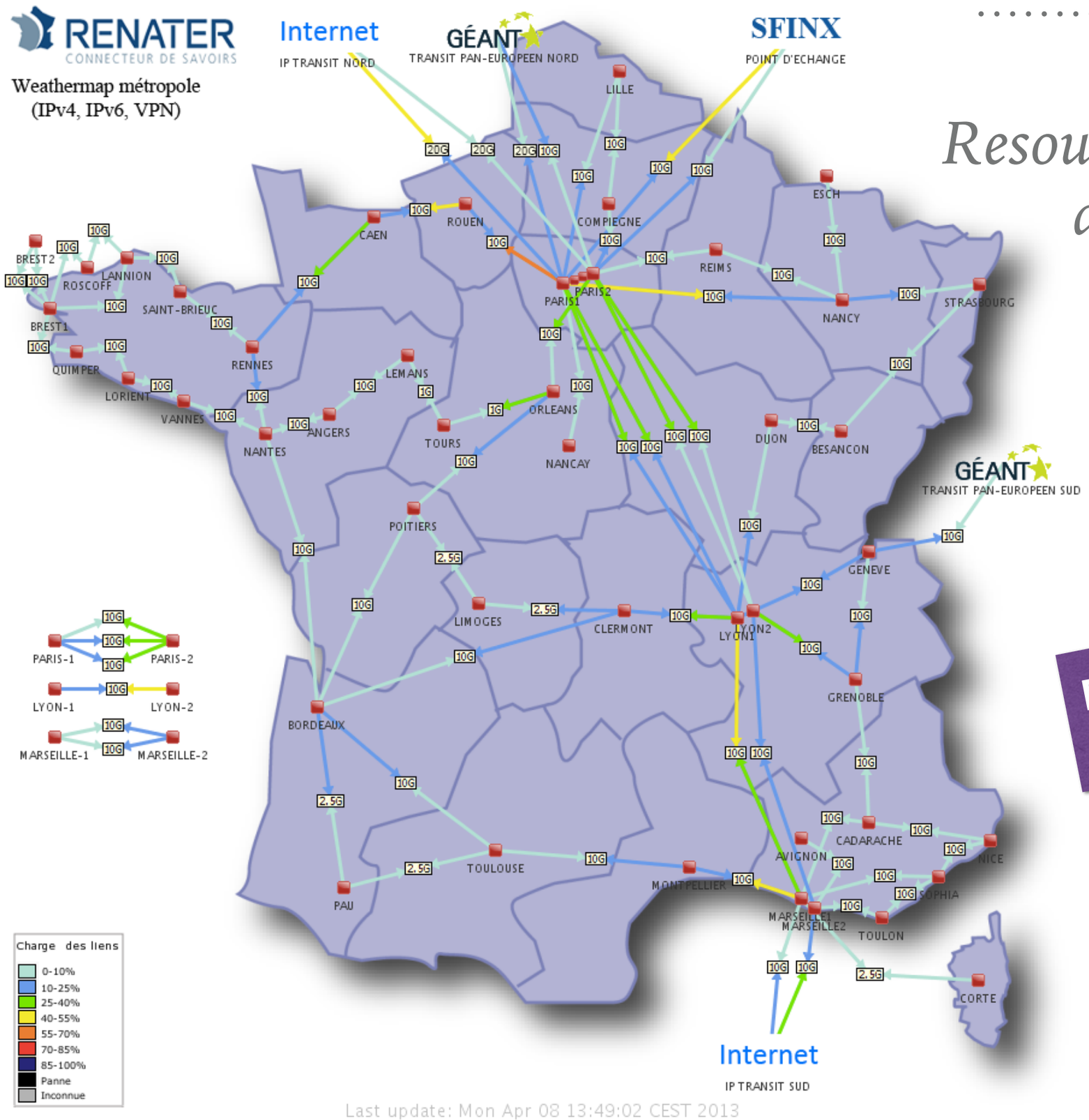
"Quantifying the Impact of Edge Computing on Mobile Applications"
Hu, W., Gao, Y., Ha, K., Wang, J., Amos, B., Pillai, P., Satyanarayanan, M.
Proceedings of ACM APSys 2016, Hong Kong, China, August 2016

Why the edge?
Mahadev Satyanarayanan

DISCOVERY

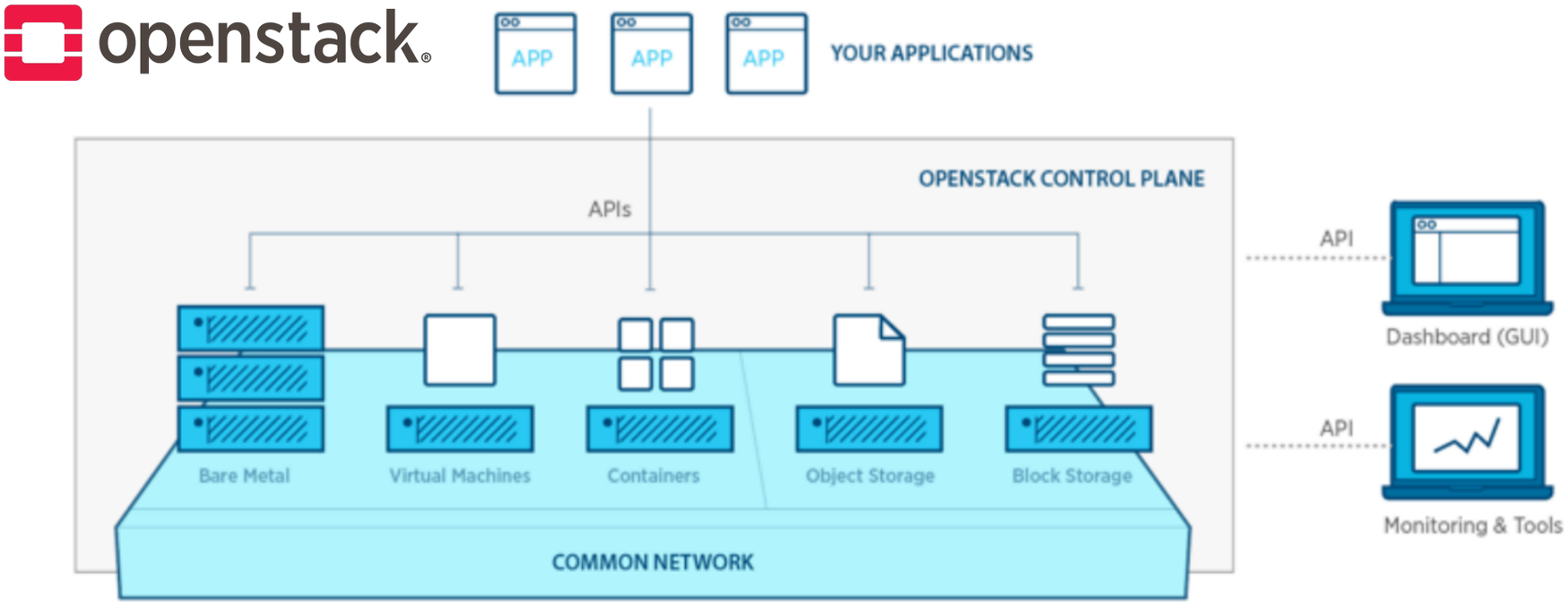
Edge Computing Resource Management System: a Critical Building Block!

HotEdge2018



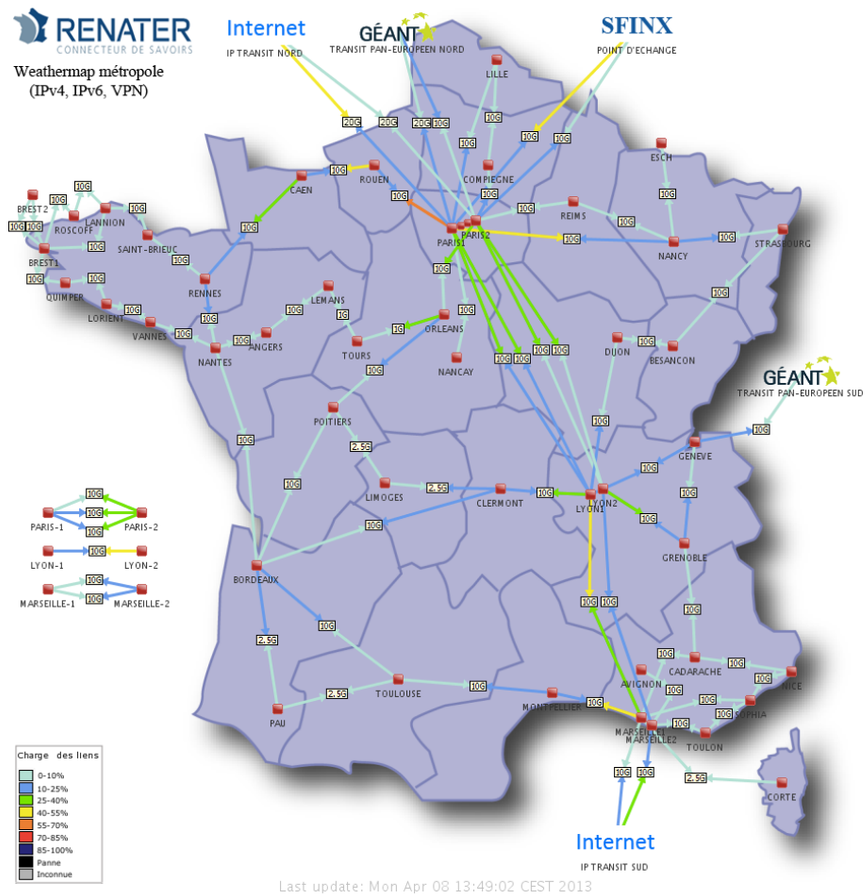
Designing/implementing a RMS for such an infrastructure?

INITIATING THE DEBATE WITH OPENSTACK



Scalability?
Latency/throughput impact?
Network partitioning issues?

...



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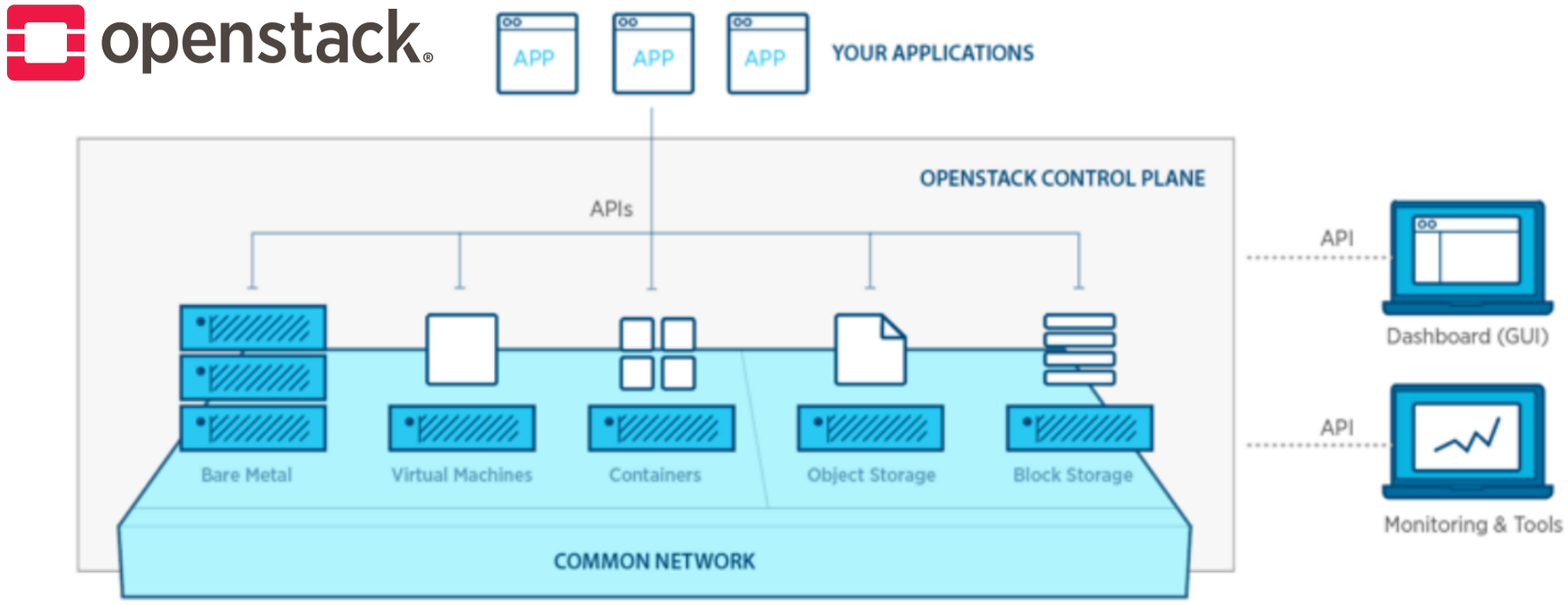

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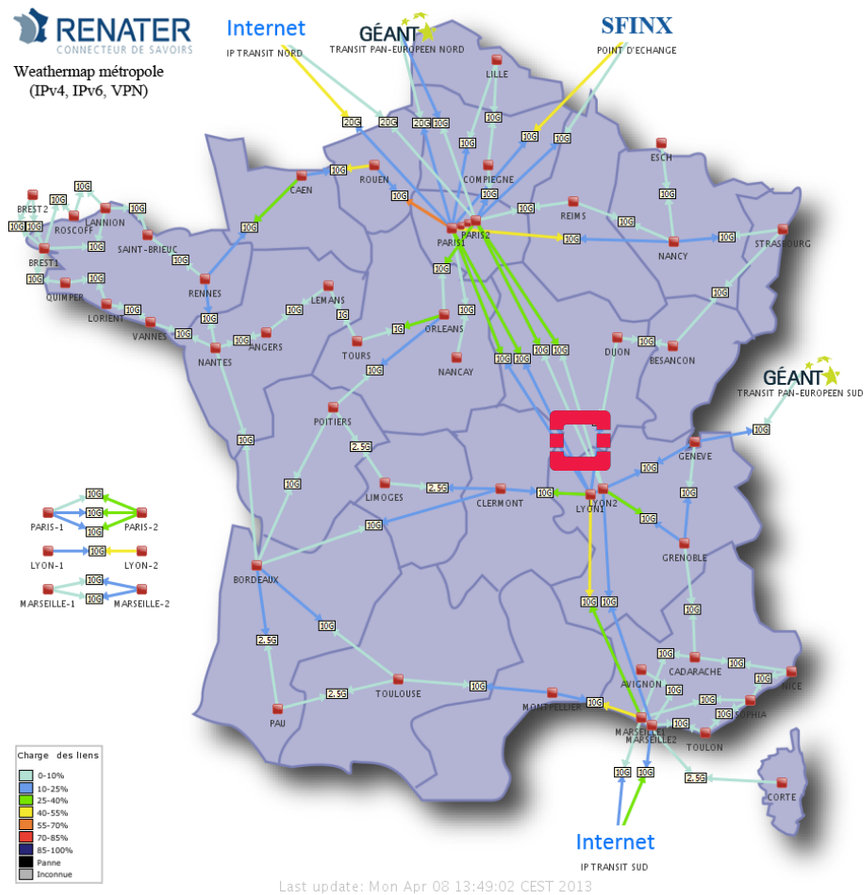
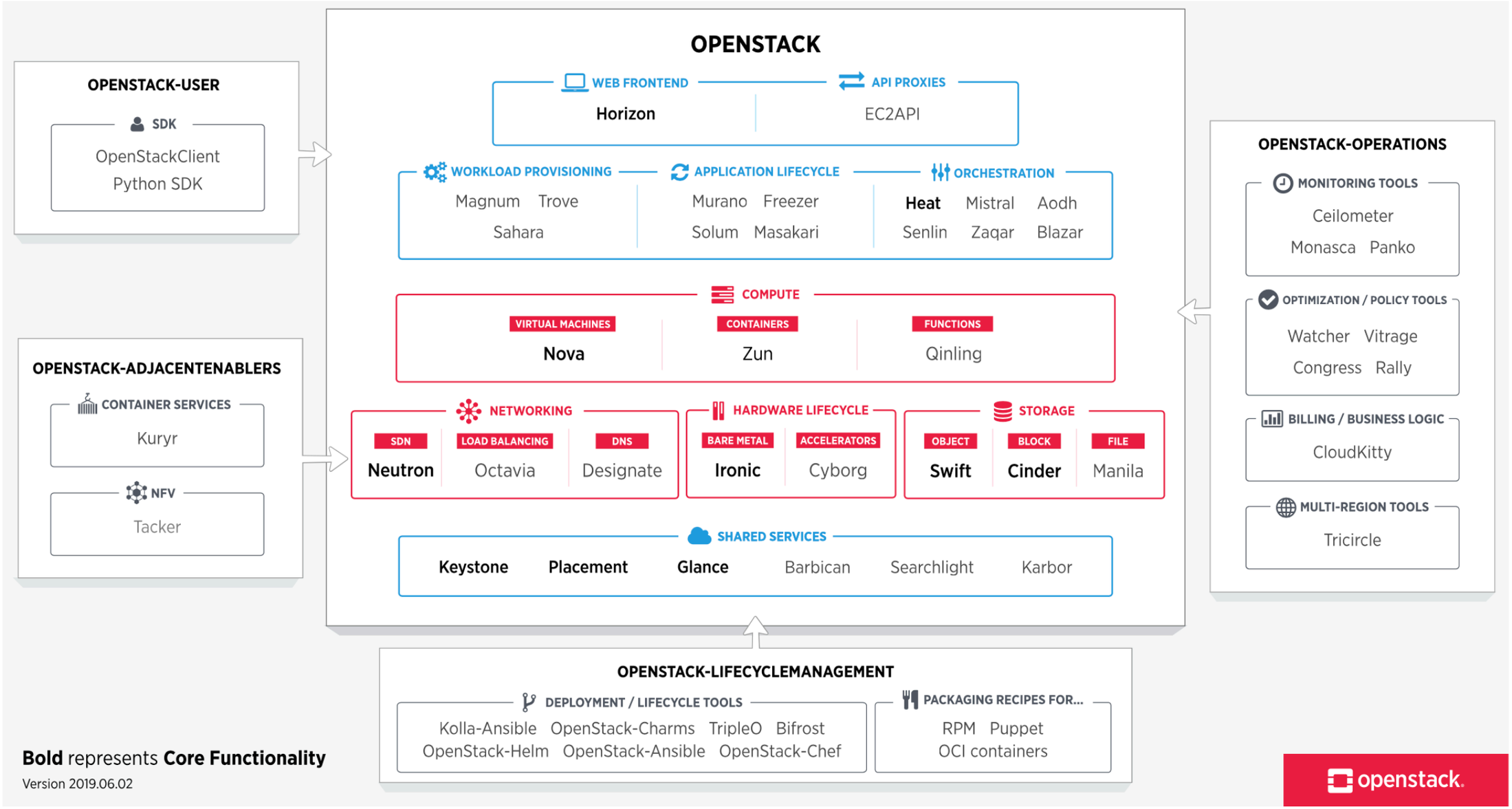
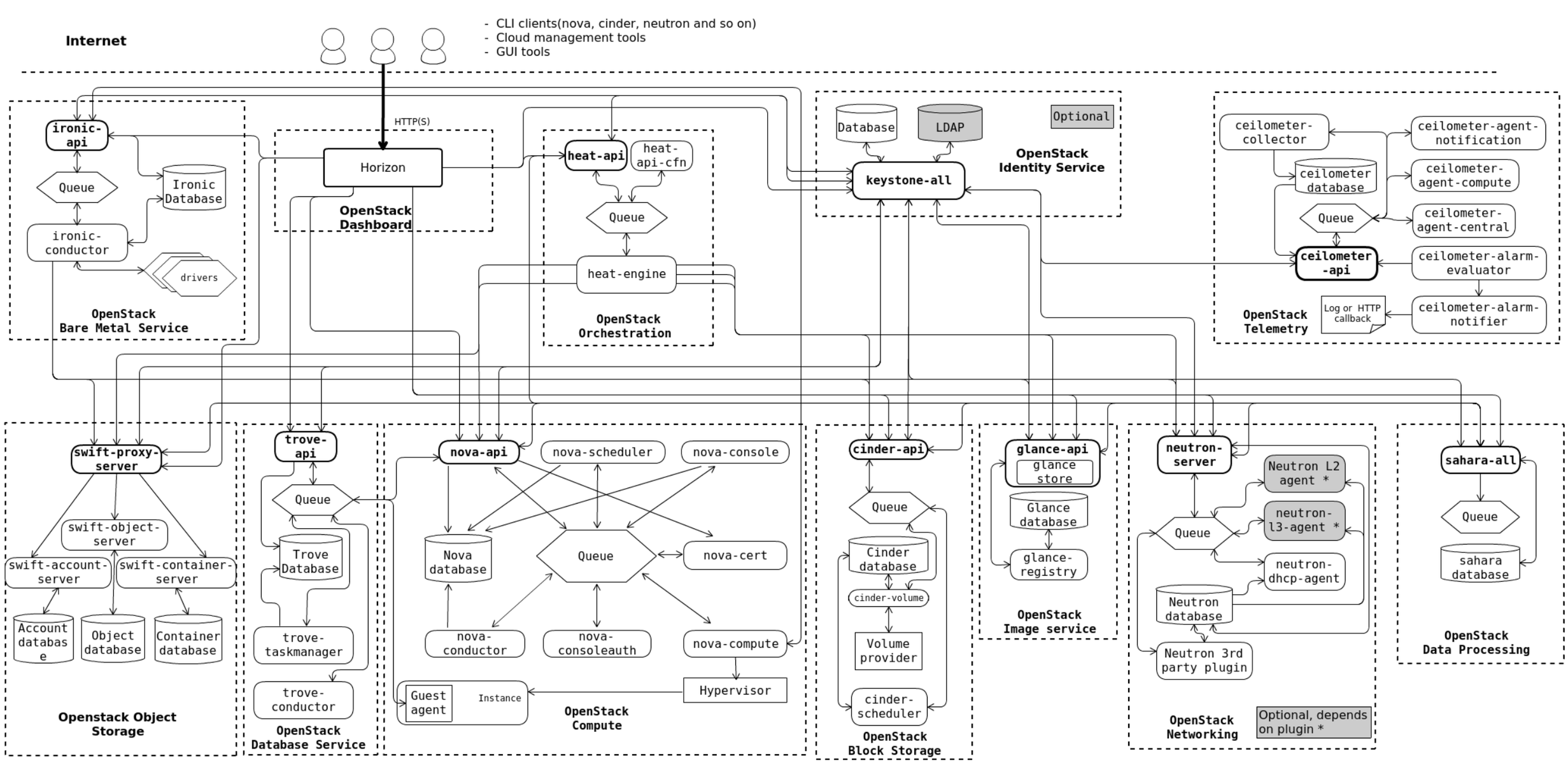




OPENSTACK (THE DEVIL IN DETAILS)

13 Millions of LOCs
186 subservices



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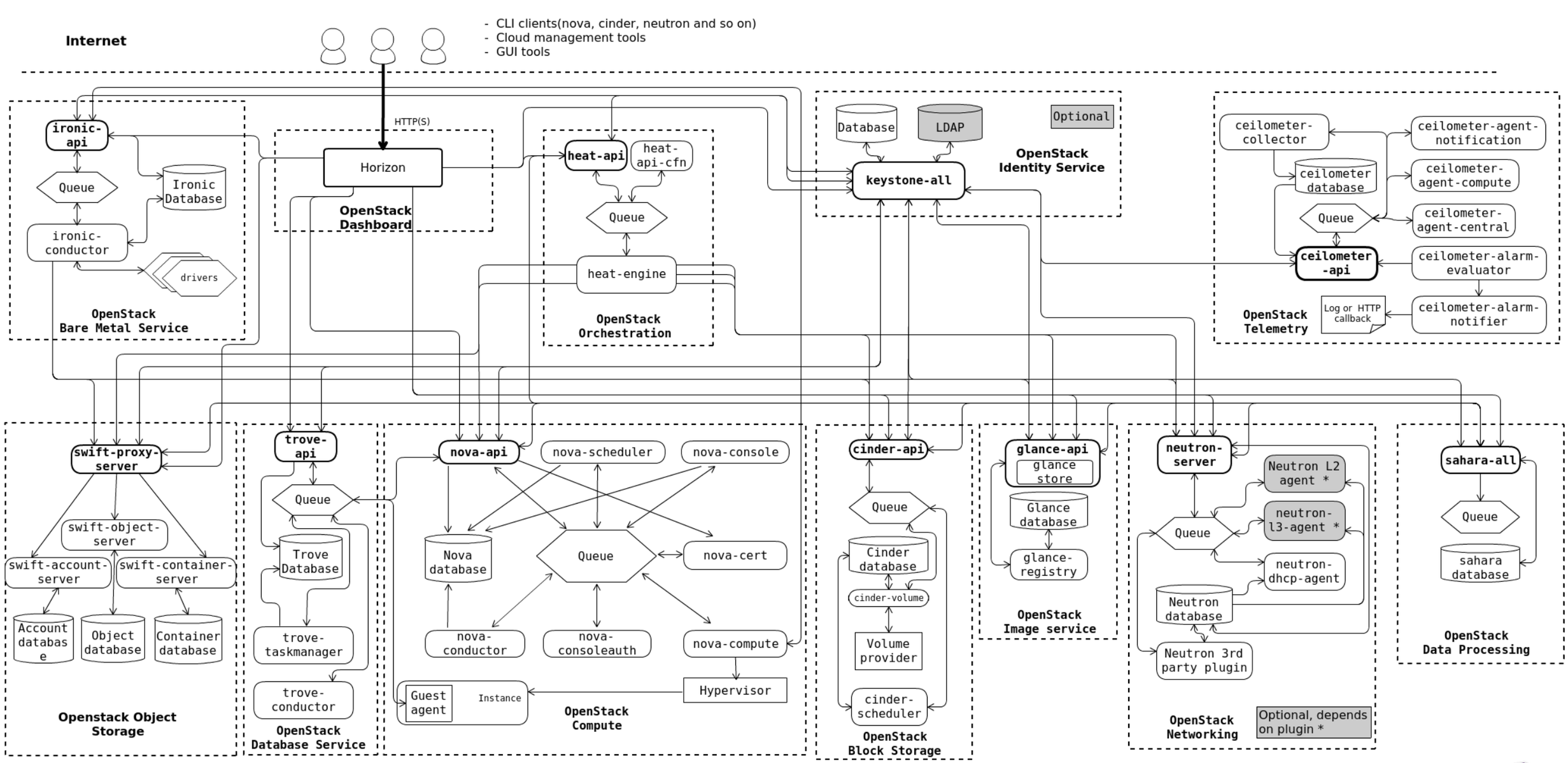

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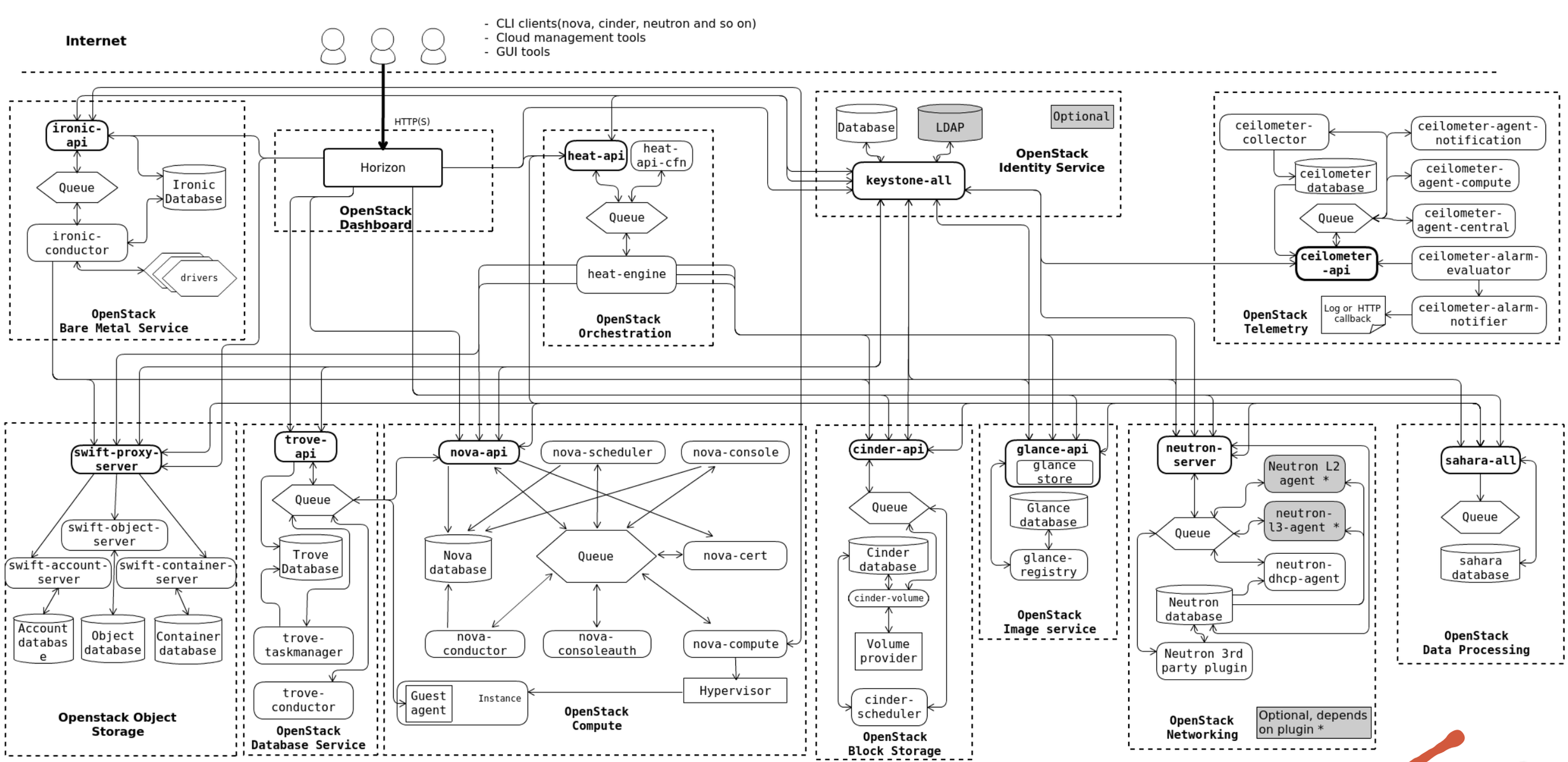
Simulation (a model of OpenStack)
ANR SONGS



OPENSTACK (THE DEVIL IN DETAILS)

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Simulation (a model of OpenStack)
ANR SONGS

Grid'5000

OPENSTACK AND GRID'5000

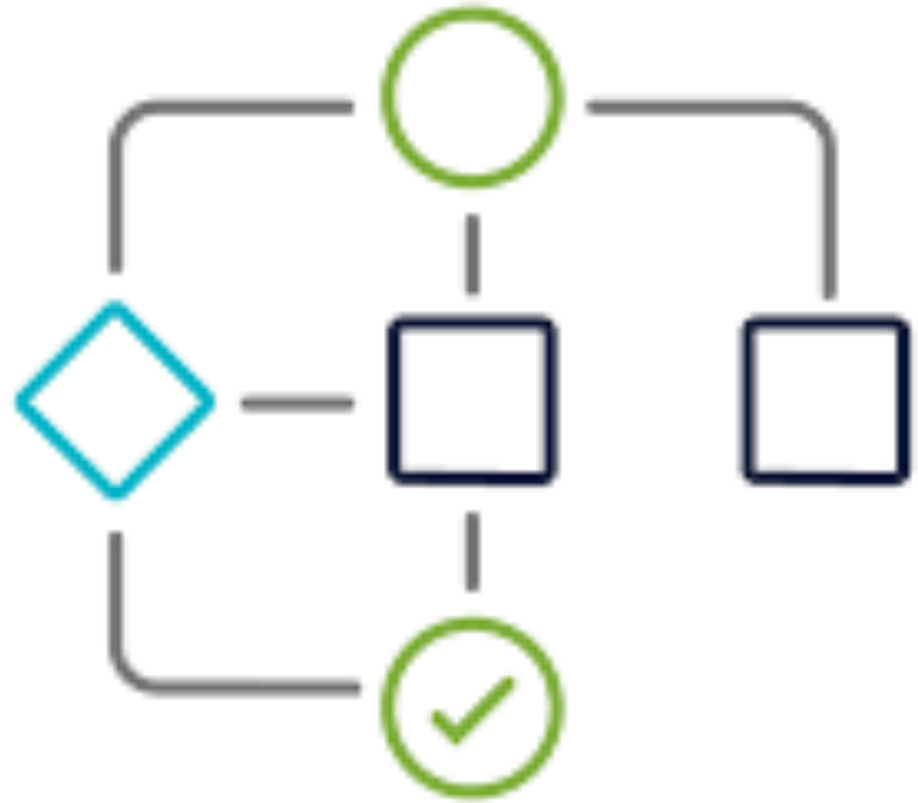
- *Understand how does OpenStack run and identify possible improvements*
- *Make new proposals and evaluate them under multiple setups/topologies*
- *Conducting performance analyses in a scientific and reproducible manner*
  - *Automation*
  - *At small and large-scale*
    Under different network topologies (traffic shaping)
  - *Between different releases*
    With any kind of benchmarks

- *Deploying cloud stacks on top of G5K*
  - *A (long) run started since 2013*
  - *Generally to evaluate Applications (not the stack itself)*

ENOS
EXPERIMENTAL ENVIRONMENT FOR OPENSTACK

➤ *Workflow*

1. Book and provision servers
2. Deploy OpenStack
3. Perform benchmarks
4. Collect and save metrics
5. Visualize & share



$ enos deploy
$ enos bench
$ enos backup

ENOS DEPLOY
RESOURCE/TOPOLOGY DESCRIPTION

```
$ cat ./basic.yml
resources:
  clusterA:
    control: 1
    network: 1
  clusterB:
    compute: 50

$ enos deploy -f basic.yml
```

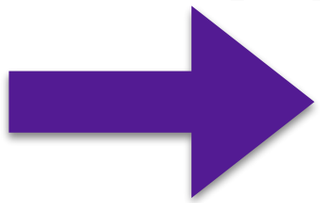
```
$ cat ./advanced.yml
resources:
  clusterA:
    control: 1
    network: 1
    nova-conductor: 5
  clusterB:
    compute: 50

$ enos deploy -f advanced.yml
```

```
$ cat ./network-topo.yml
resources:
grp1:
    clusterA:
      control: 1
      network: 1
      nova-conductor: 5
grp2:
    clusterB:
      compute: 50
network_constraints:
  src: grp1
    dst: grp2
    delay: 100ms
    rate: 10Gbit
    loss: 0%
    symetric: true

$ enos deploy -f network-topo.yml
```

ENOS DEPLOY
UNDER THE HOOD

```
resources:
  grp1:
    clusterA:
      control: 1
      network: 1
  grp2:
    clusterB:
compute: 50
network_constraints:
  delay: 100ms
  rate: 10Gbit
  loss: 0%
```

```
$ enos deploy
```



1. Provider gets 2 nodes on clusterA, 50 nodes on clusterB and returns node's IP addresses
2. EnOS provisions nodes with Docker daemons
3. EnOS installs OpenStack using Kolla
4. EnOS sets up bare necessities (flavors, cirros image, router, ...)
5. EnOS applies network constraints between grp1 and grp2 using tc

---

- *From preliminary scripts to a engine for replicable experiments*
- *Provider to get testbed resources*
  - *Resources: anything running a Docker daemon and EnOS can SSH to + some IPs*
  - *Existing Provider: Vagrant (VBox/Libvirt), Grid'5000, Chameleon, OpenStack (~500 LoC each)*
- *Kolla to deploy OpenStack over testbed resources (containerised based deployment)*
- *TC to apply network constraints (Linux Netem)*

ENOS BENCH

- *Benchmarks description*

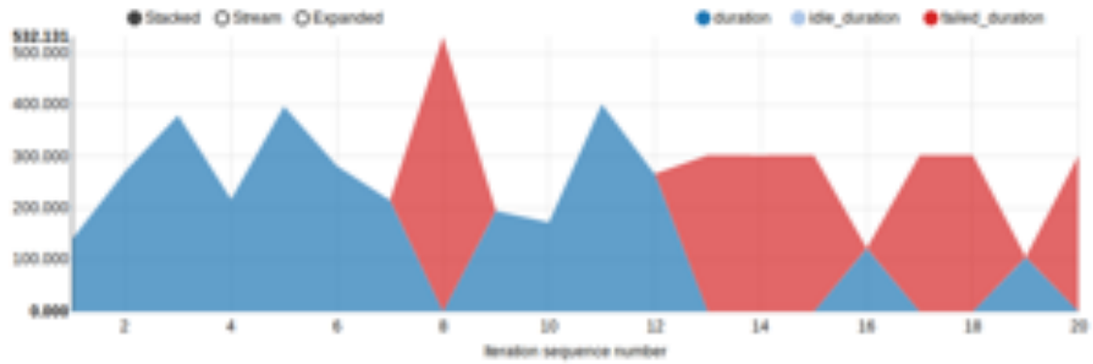
```
$ cat ./run.yml
rally:
  args:
    concurrency: 5
    times: 100
  scenarios:
    - name: boot and list servers
      file: nova-boot-list-cc.yml
      osprofiler: true
    -...
shaker: ...

$ enos bench --workload=run.yml
```

- *Under the hood*
  - *Rally: control plane benchmark*
  - *Shaker: data plane benchmark*
  - *OSProfiler: code profiling*
  - *Monitoring stack: cAdvisor/ Collectd to collect CPU/RAM/ Network consumption per service/ node/cluster*

ENOS BACKUP

- *EnOS backup produces a tarball with*
  - *Rally/Shaker reports*
  - *InfluxDB database with cAdvisor/collectd measures*
  - *OpenStack logs*
  - *OS Profiler traces*

Action	Min (sec)	Median (sec)	90%ile (sec)	95%ile (sec)	Max (sec)	Avg (sec)	Success	Count
nova.boot_server	55.826	205.736	263.908	271.632	279.61	181.196	65.0%	20
nova.delete_server	10.778	40.468	135.245	148.816	162.719	63.336	92.9%	14
total	104.694	217.548	394.025	399.115	401.527	243.532	65.0%	20



https://enos.readthedocs.io/

ENOS BACKUP

- *EnOS backup produces a tarball with*
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https://enos.readthedocs.io/

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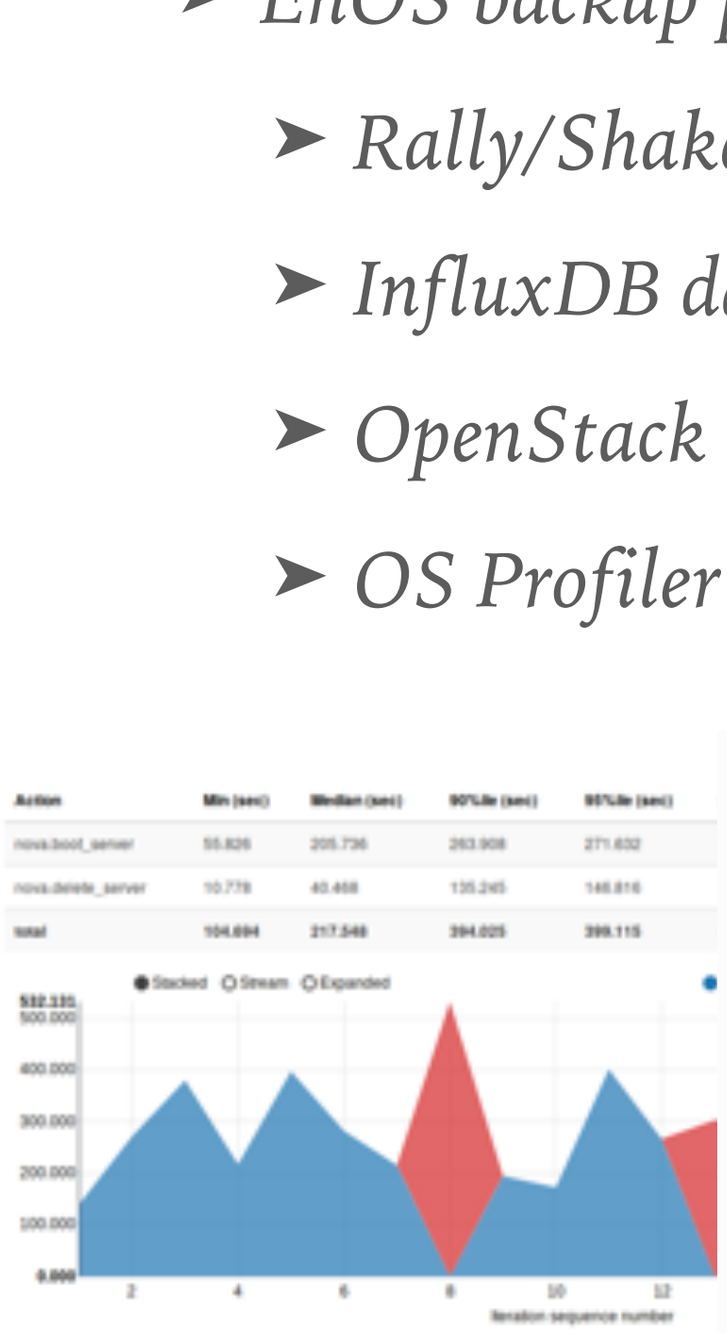
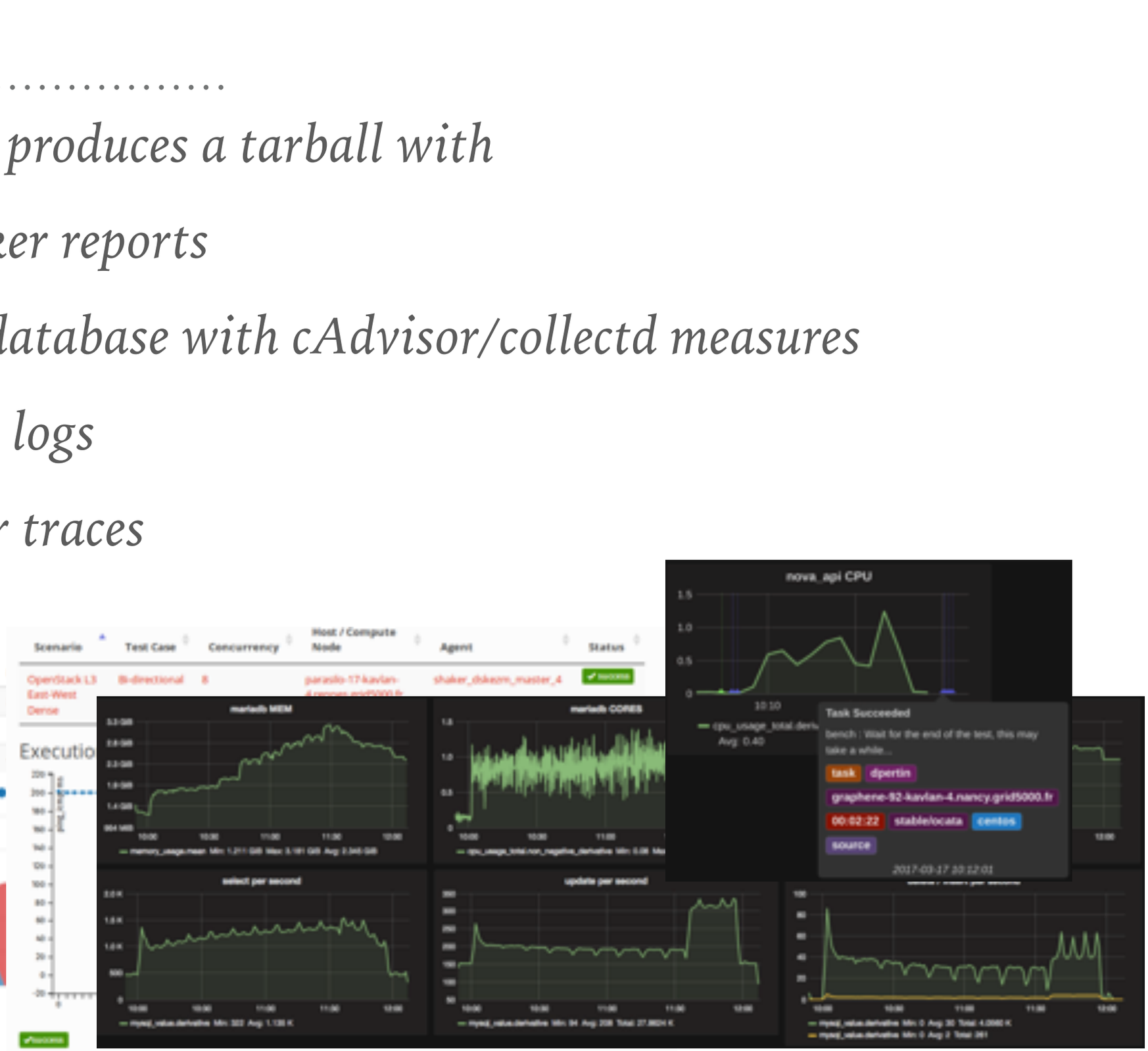
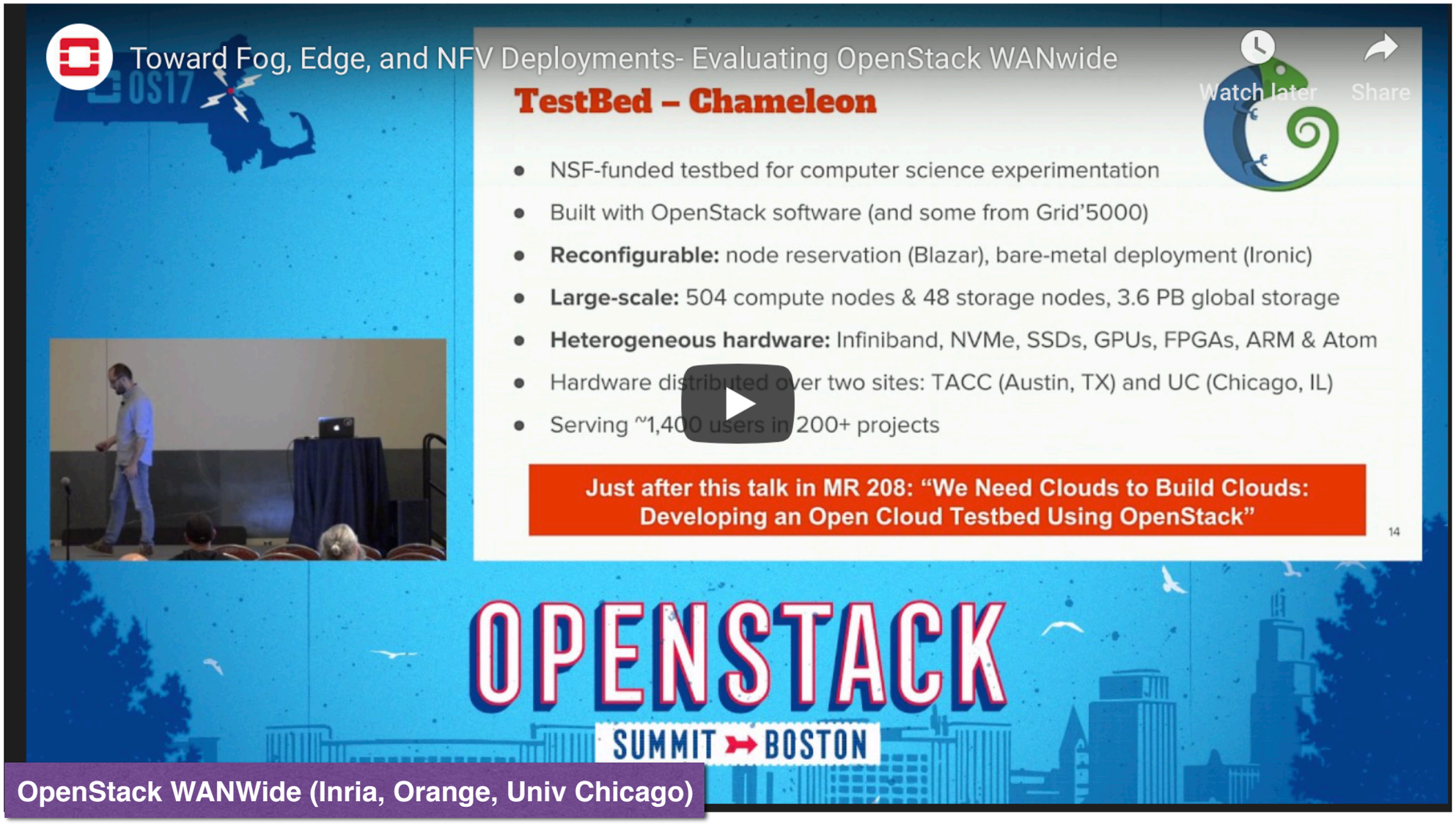


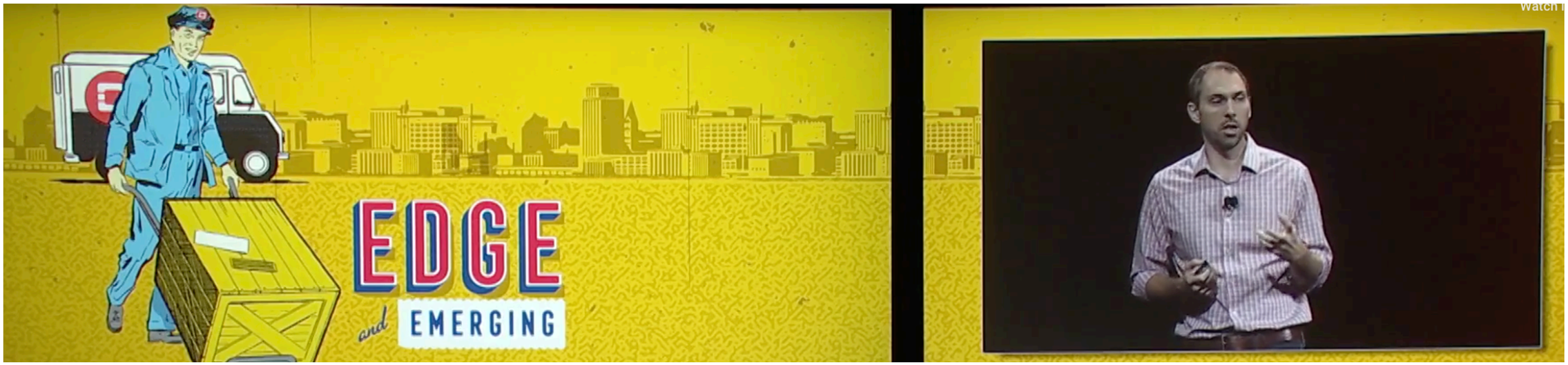


https://enos.readthedocs.io/

Chasing 1000 nodes scale (Inria/Mirantis)



OpenStack WANWide (Inria, Orange, Univ Chicago)

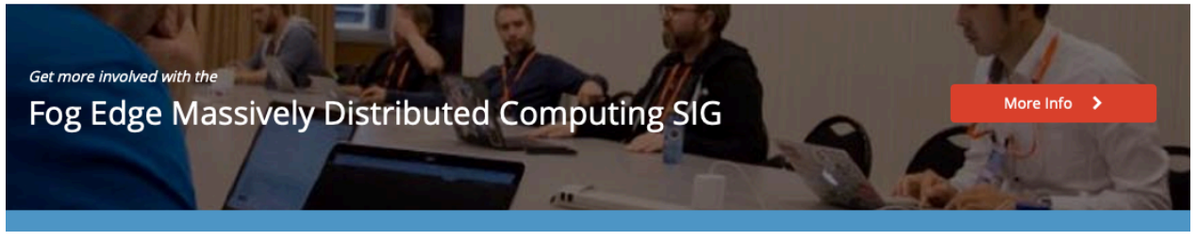


OPENSTACK COLLABORATES WITH OTHER EDGE GROUPS

openEDGEcomputing

ETSI

Discovery
beyondtheclouds.github.io



Fog Edge Massively Distributed Clouds

The goal of the Fog/Edge/Massively Distributed Clouds SIG is to guide the OpenStack community to best address fog/ed
as the supervision and use of a large number of remote mini/micro/nano data centers through a collaborative OpenStack
advances the topic through debate and investigation of requirements for various implementation options.

Status: active
Contact: Adrien Lebre <adrien.lebre@inria.fr> Paul-André Raymond <paul-andre.raymond@b-yond.com> Gergely Csatai

Contents

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Projects User Stories Community Blog Wiki Documentation

Performance Documentation

Abstract

This documentation section aims to introduce ideas and best practices on how OpenStack cloud may be exercised to evaluate its performance, what can be called performance at all and how it can be measured. Here you will find both testing/probing methodologies and test plans, proposed by OpenStack community members (as well as results of their execution against various cloud topologies).

Contents

Inria has a key actor for edge related challenges within the OpenStack framework

Multi-Level Elasticity for Data Stream Processing

Vania Marangozova-Martin, Noël de Palma and Ahmed El Rheddane
Univ. Grenoble Alpes, CNRS, LIG, F-38000 Grenoble France
E-mail: firstName.secondName@imag.fr

Abstract—This paper investigates reactive elasticity in stream processing environments where the performance goal is to analyze large amounts of data with low latency and minimum resources. Working in the context of Apache Storm, we propose an elastic management strategy which modulates the parallelism degree of applications' components while explicitly addressing the hierarchy of execution containers (virtual machines, processes and threads). We show that provisioning the wrong kind of container may lead to performance degradation and propose a solution that provisions the least expensive container (with minimum resources) to increase performance. We describe our monitoring metrics and show how we take into account the specifics of an execution environment. We provide an experimental evaluation with real-world applications which validates the applicability of our approach.

Index Terms—stream processing, multi-level elasticity, Apache Storm

This article has been accepted for publication in a future issue of this journal, but has not been fully edited. Content may change prior to final publication. Citation information: DOI 10.1109/TPDS.2019.2907950, IEEE Transactions on Parallel and Distributed Systems

would need to be deployed in containers with different capacities which in turn call for multi-dimensional-bin-packing-oriented scheduling [45].

ACKNOWLEDGEMENTS

The experimental work presented in this paper would not have been possible without the existence of the Grid'5000 platform and the help of the supporting teams. The authors would also like to thank the *enos* team who made the Openstack deployment process a child's play.

[18] "CoMD," https://gpuopen.com/compute-product/comd/.
[19] Y. Wu and K. L. Tan, "ChronoStream: Elastic Stateful Stream Computation in the Cloud," in *2015 IEEE 31st International Conference on Data Engineering*, April 2015, pp. 723–734.
[20] V. Gulisano, R. Jimenez-Peris, M. Patino-Martinez, C. Soriente, and P. Valduriez, "StreamCloud: An Elastic and Scalable Data Streaming System," *IEEE Trans. Parallel Distrib. Syst.*, vol. 23, no. 12, pp. 2351–2365, Dec. 2012.
[21] L. Neumeyer, B. Robbins, A. Nair, and A. Kesari, "S4: Distributed stream computing platform," in *Data Mining Workshops (ICDMW), 2010 IEEE International Conference on*. IEEE, 2010, pp. 170–177.
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[23] "Grid'5000," http://www.grid5000.fr/.
[24] R. Cherrueau, D. Pertin, A. Simonet, A. Lebre, and M. Simonin, "Toward a Holistic Framework for Conducting Scientific Evaluations of OpenStack," in *2017 17th IEEE/ACM International Symposium*

Not really rocket science but … it is used !

Multi-Level Elasticity for Data Stream Processing

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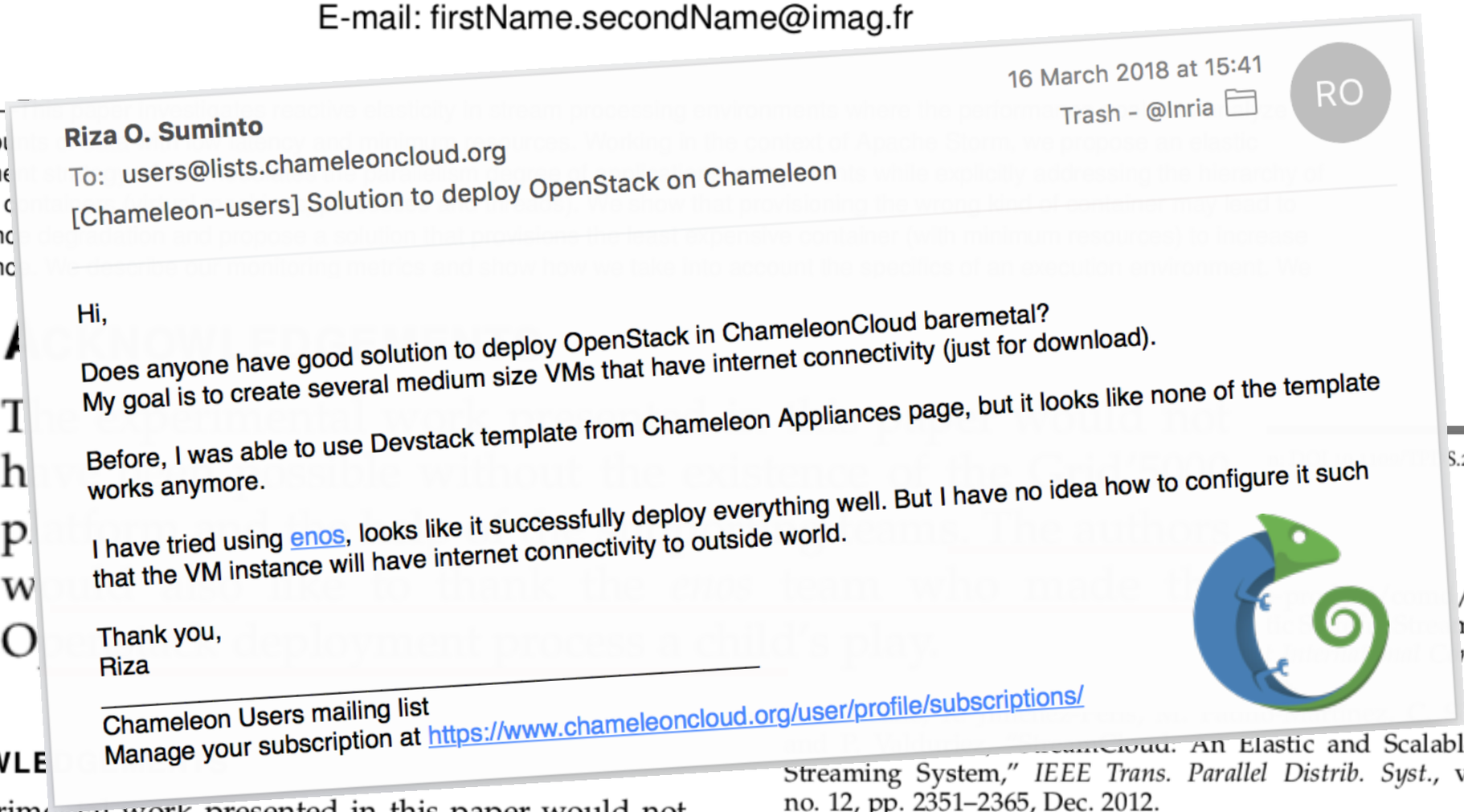


Riza O. Suminto
16 March 2018 at 15:41
Trash - @Inria
RO
To: users@lists.chameleoncloud.org
[Chameleon-users] Solution to deploy OpenStack on Chameleon

Hi,

Does anyone have good solution to deploy OpenStack in ChameleonCloud baremetal?
My goal is to create several medium size VMs that have internet connectivity (just for download).

Before, I was able to use Devstack template from Chameleon Appliances page, but it looks like none of the template works anymore.

I have tried using enos, looks like it successfully deploy everything well. But I have no idea how to configure it such that the VM instance will have internet connectivity to outside world.

Thank you,
Riza

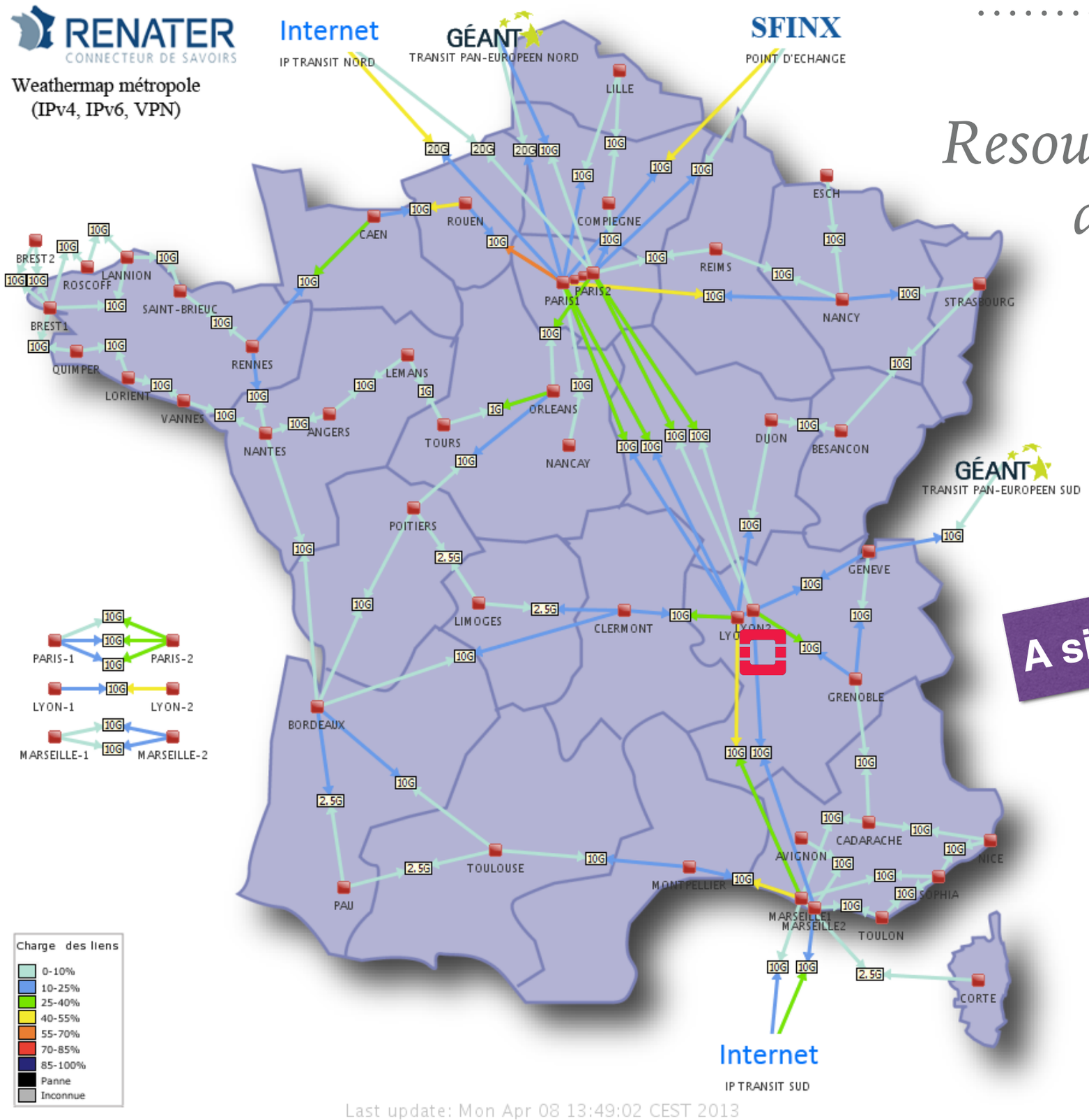
Chameleon Users mailing list
Manage your subscription at https://www.chameleoncloud.org/user/profile/subscriptions/

Not really rocket science but … it is used !

LET'S GO BACK TO DISCOVERY

Edge Computing Resource Management System: a Critical Building Block!

HotEdge2018



A single control plane is not enough !

LET'S GO BACK TO DISCOVERY

Edge Computing Resource Management System: a Critical Building Block!

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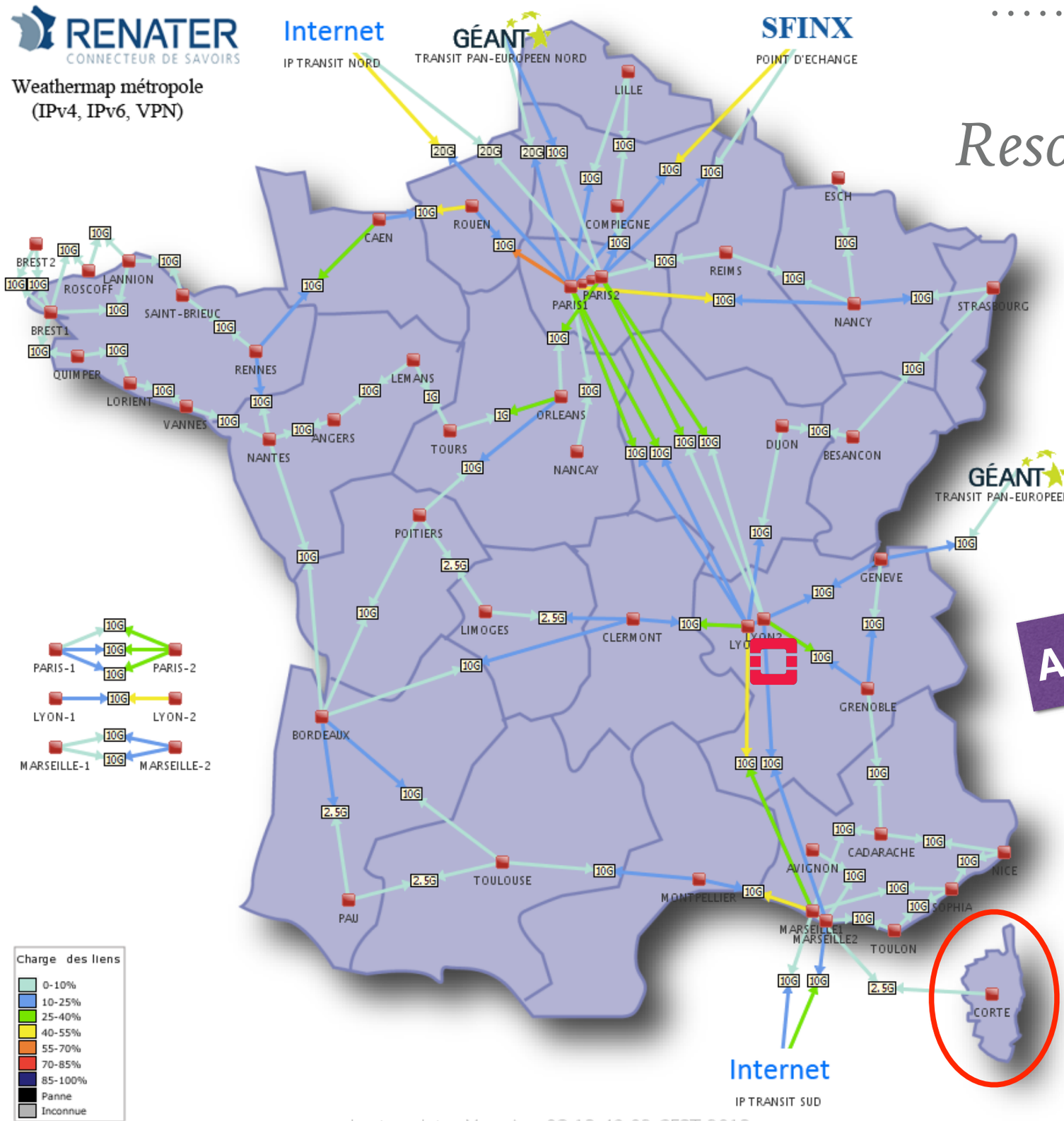

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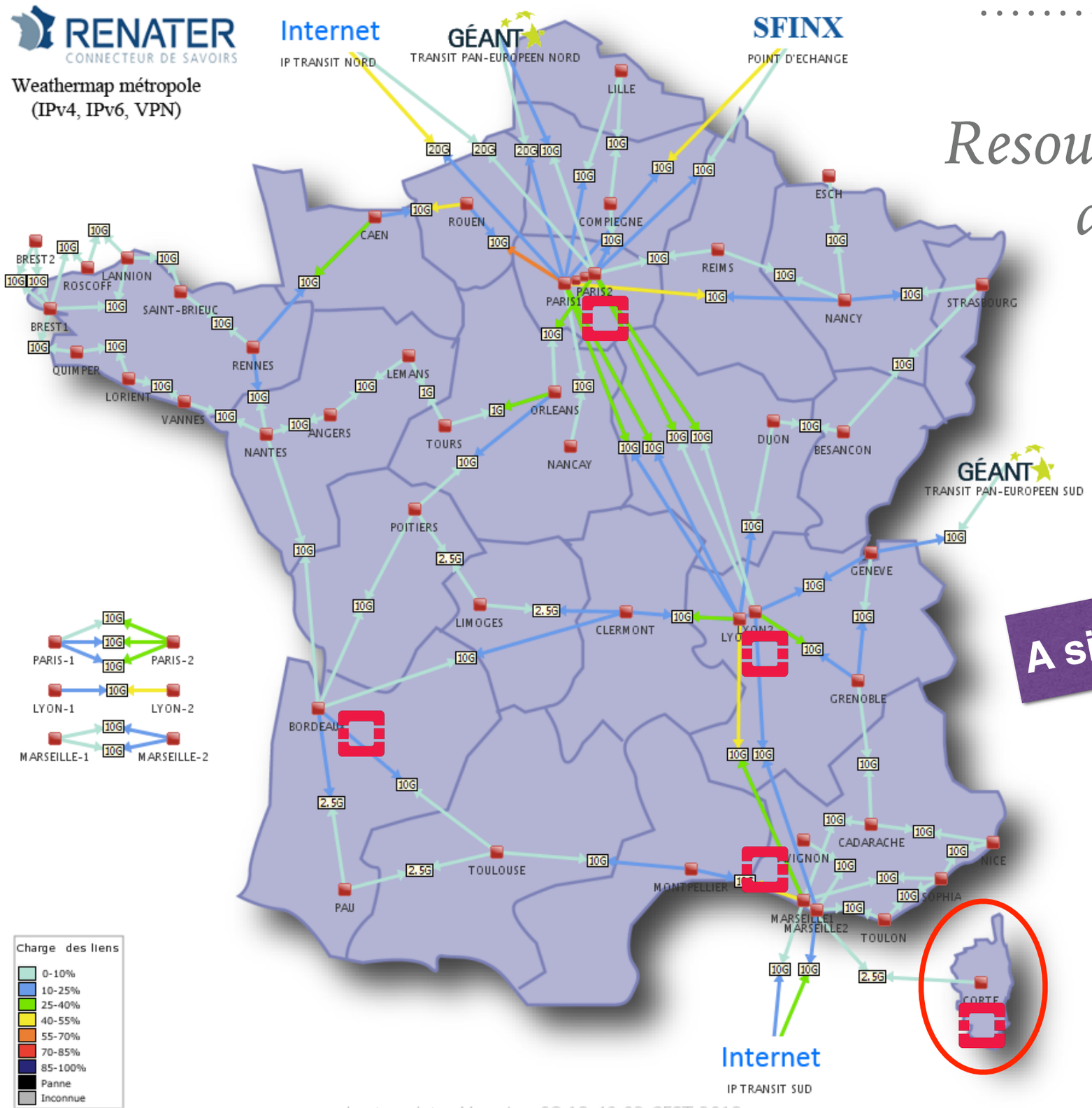

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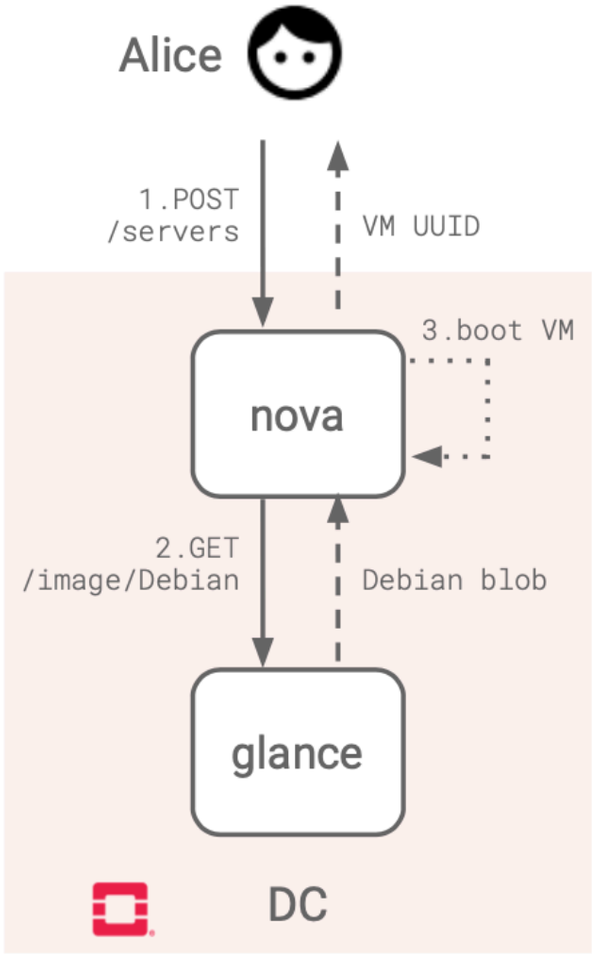
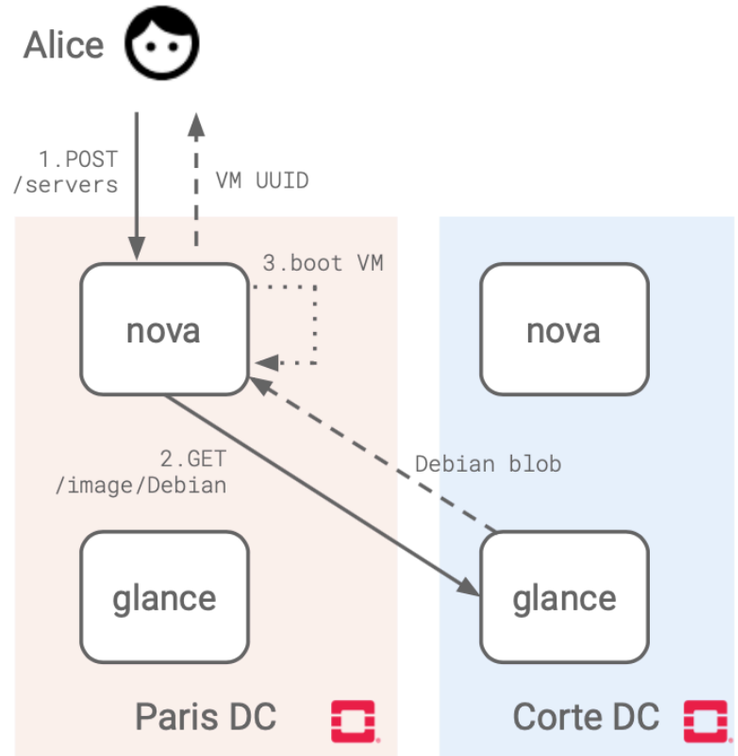


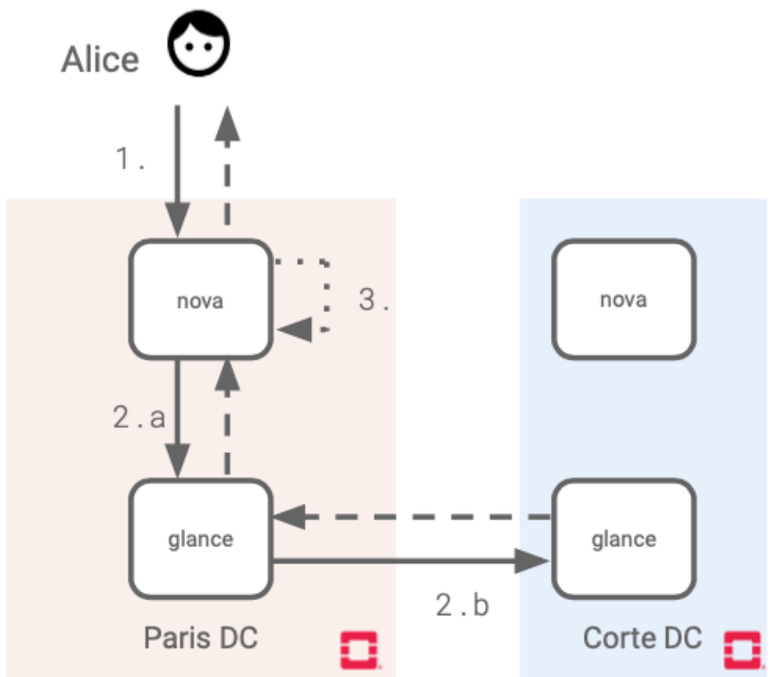
Red thread: Boot a VM with an image (i.e. a disk) from a distinct DC



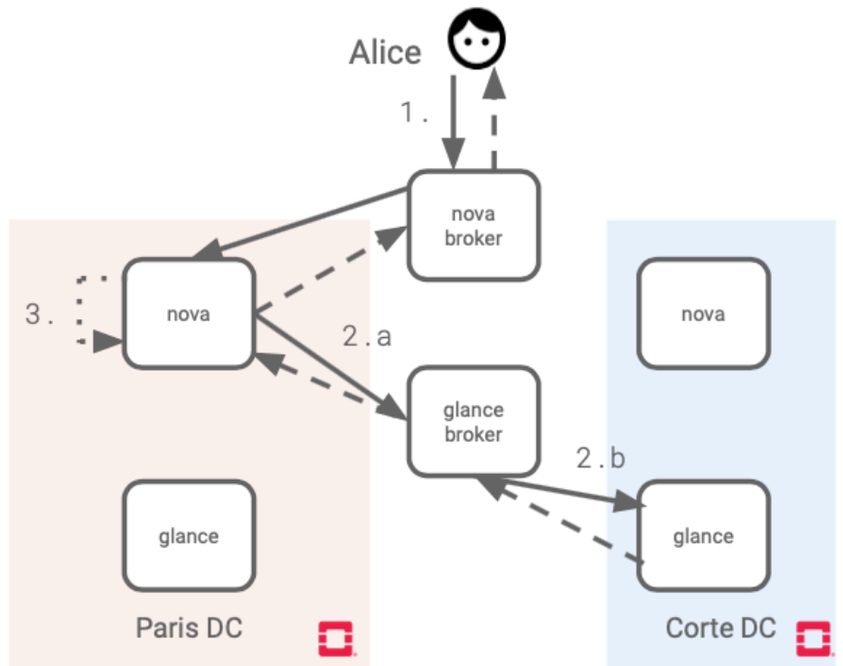
How can we achieve collaborations between multiples OpenStack instances ?

From the OpenStack Vanilla code to ad-hoc pieces of components

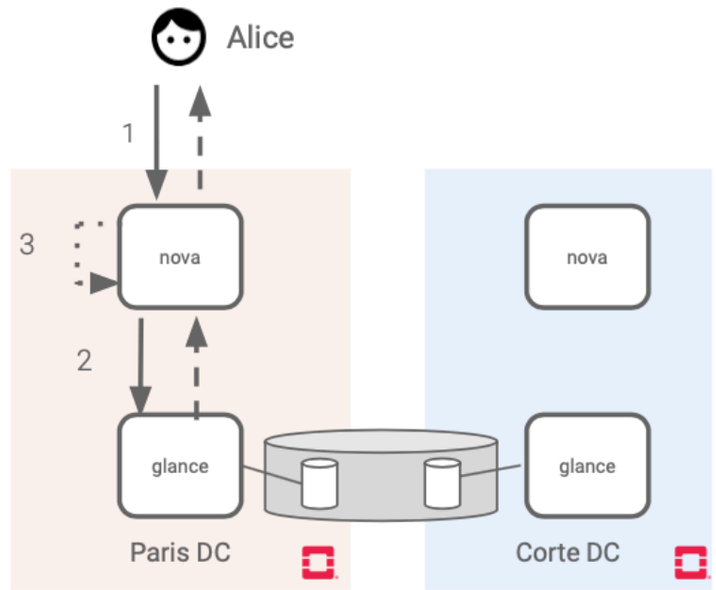
Service-to-service collaboration



Broker-based collaboration



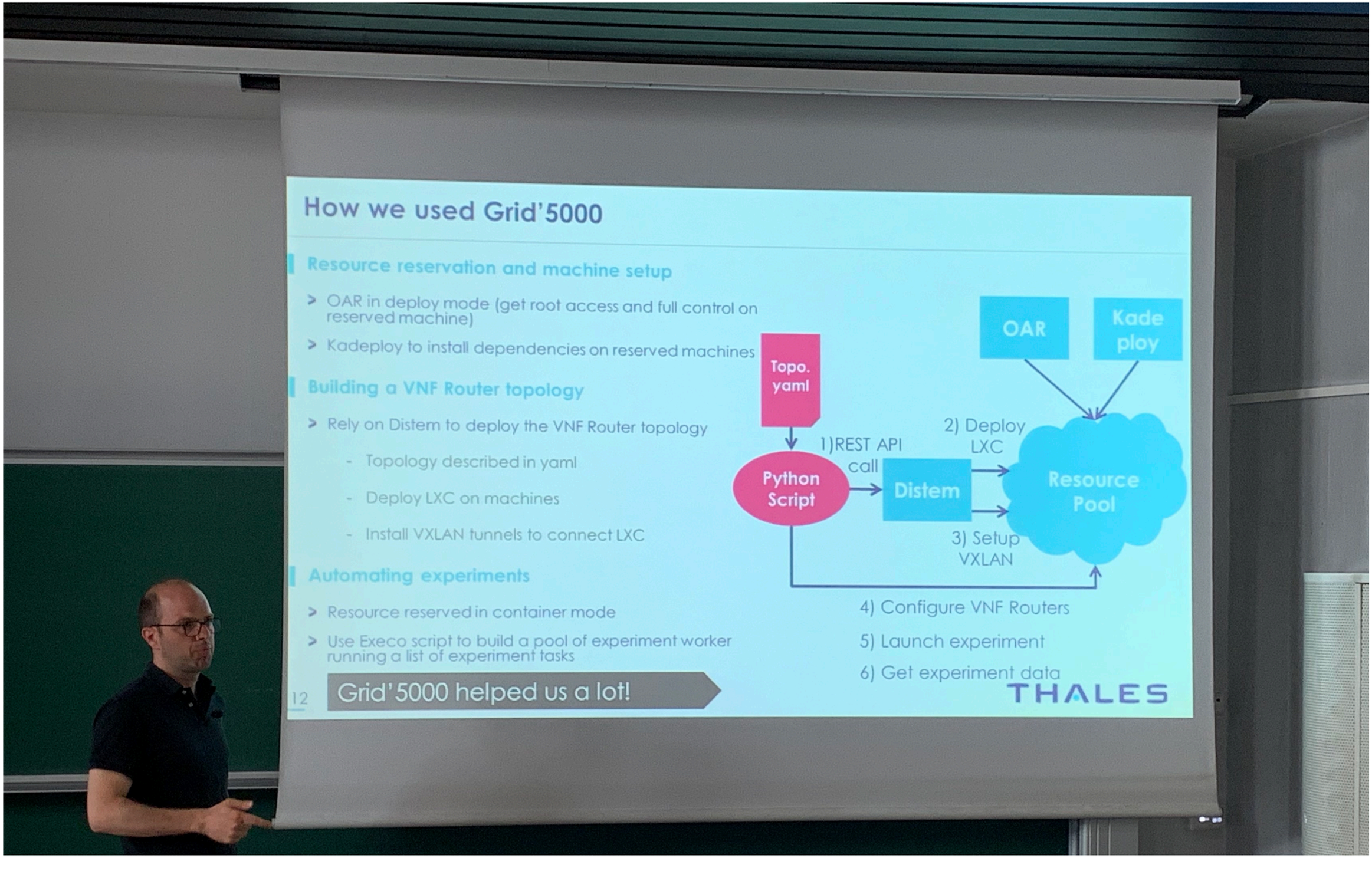
Database collaboration



Pros/Cons of each approach?
Can we evaluate different approaches/building blocks?

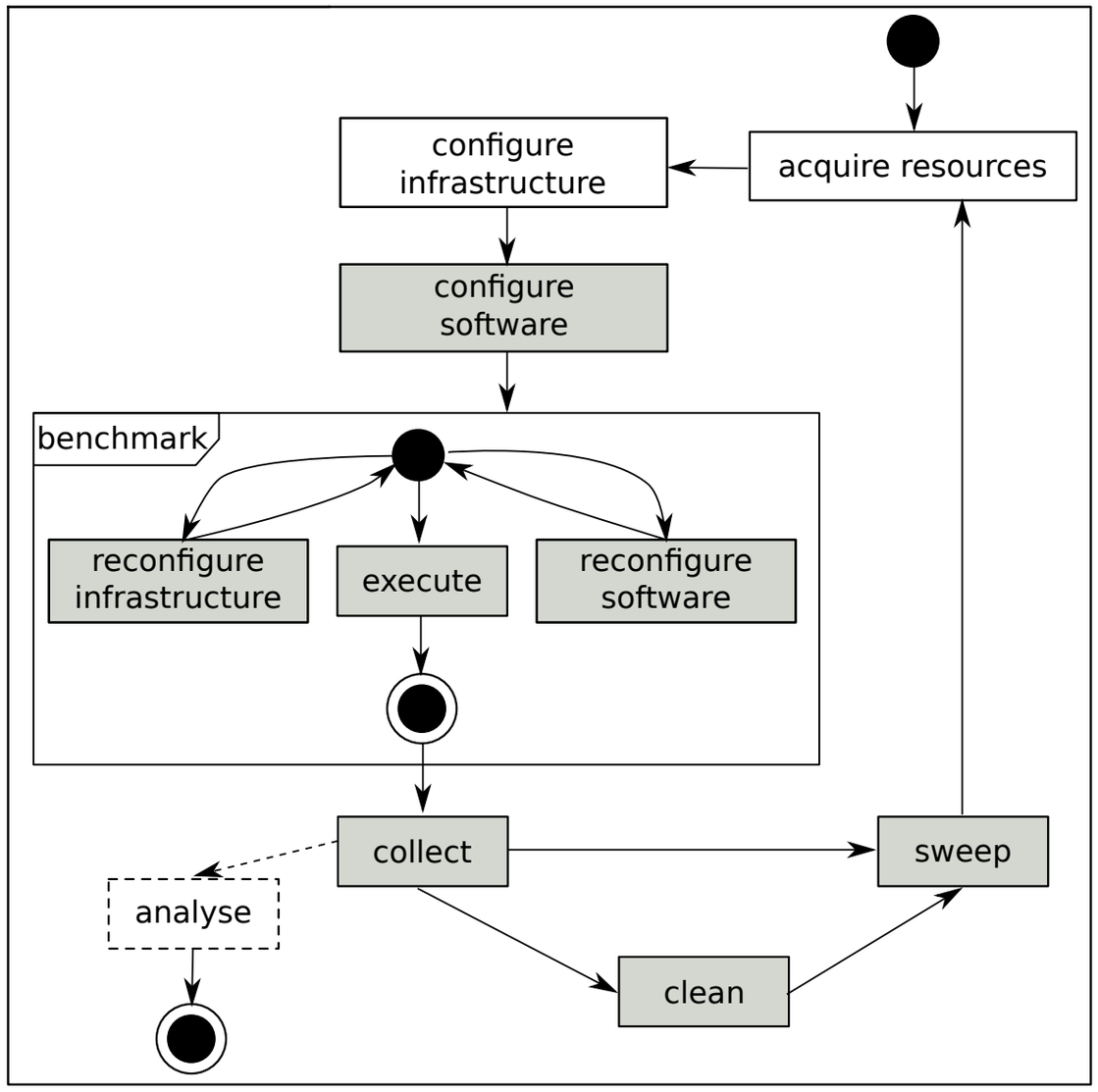
ENOSLIB

Toward a generalisation of the ENOS Concepts



ENOSLIB

Toward a generalisation of the ENOS Concepts

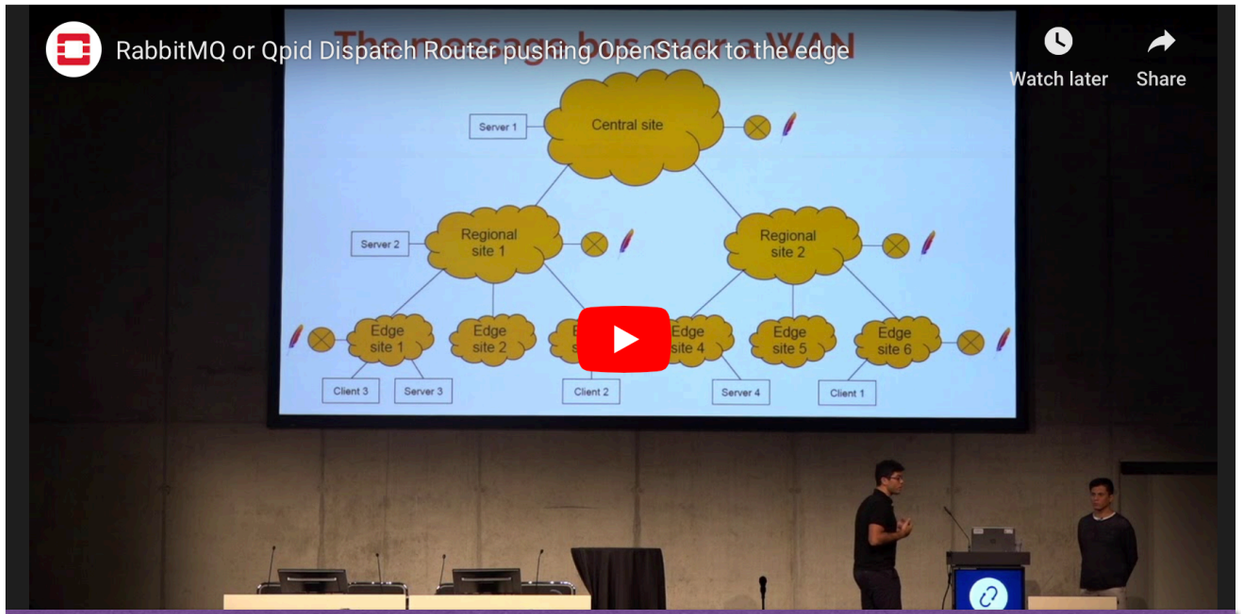


- *Built on top of*
  - *EnOSTask*
  - *Resource (Provider)*
  - *Role (Ansible)*

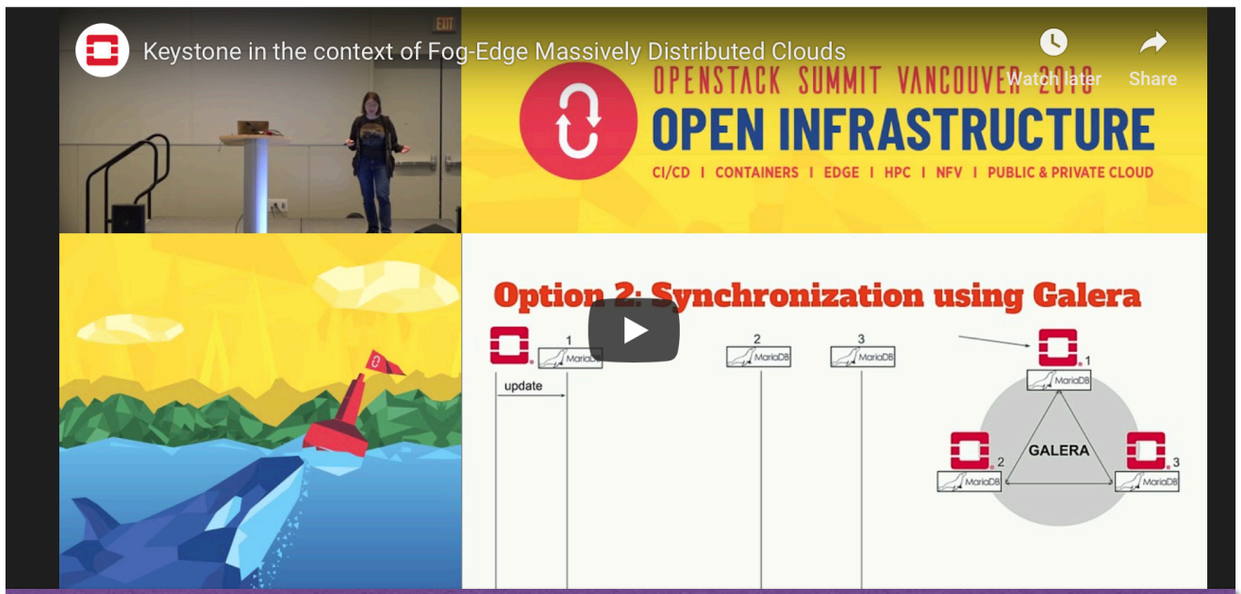
```
machines:
  - flavor: large
    count: 1
    roles:
      - leader
      - database
      - monitoring
    networks:
      - control_network
      - database_network
  - flavor: tiny
    count: 10
    roles:
      - agents
      - database
    networks:
      - control_network
```

```
machines:
  - flavor: parasilo
    count: 1
    roles:
      - leader
      - database
      - monitoring
    networks: [cn, dn]
  - flavor: paravance
    count: 10
    roles:
      - agents
      - database
    networks: [cn]
networks:
  - id: cn
    roles:
      - control_network
    type: prod
  - id: dn
    roles:
      - database_network
    type: kavlan
```

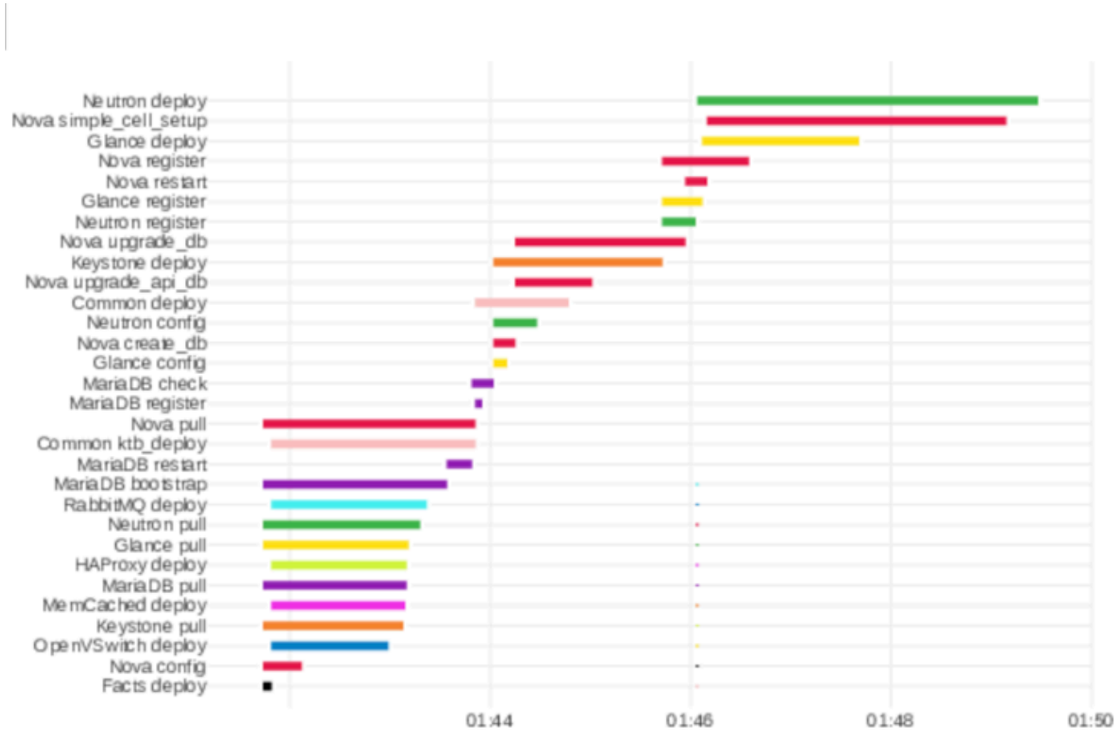
Toward a generalisation of the ENOS Concepts



Communication bus for the edge (Inria/Orange/Redhat)



Active/active replication (Inria)



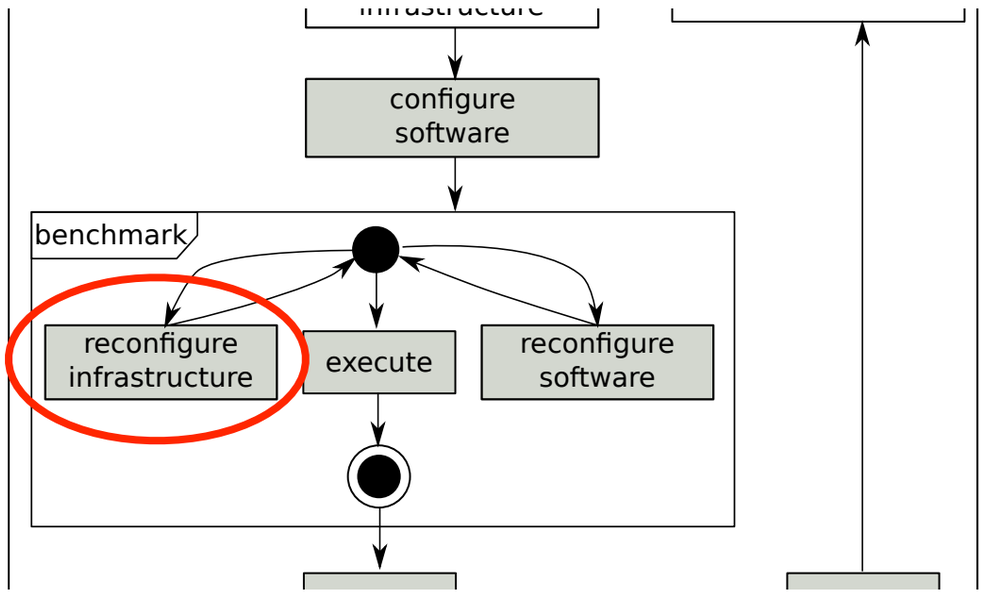
- *MADEUS*
  - *A formal deployment model*
  - *Fine grain modelization of the deployment process*
  - *Performance / Safety*
  - *H. Coullon, C. Perez et al.*

TODAY

- Within the OpenStack ecosystem
  - Several experiment engines
  - Performance regression tests
- Enos-Kubernetes
- EnosLib and IPFS
- EnosLib and blockchain systems

TOMORROW

- Fine monitoring of each role
  - CPU, Memory, I/O (disks and net)
  - Observe and identify applications patterns
- A injector of infrastructure events (representative to edge platforms)



WHISHED LIST

- Emulate small devices/servers (CPU, memory, energy?)
- Wireless/xDSL/… networks
- Plug on-demand external servers/devices (The freebox use-case)


STACK
Informatics mathematics
Inria
IMT Atlantique
Bretagne-Pays de la Loire
École Mines-Télécom
LS2N
LABORATOIRE DES SCIENCES DU NUMÉRIQUE DE NANTES

Le présentateur ;)

LA PRESENTATION EST UN FAKE

*Ronan-Alexandre Cherrueau, **Matthieu Simonin**, Anthony Simonet, Alexandre Van Kempen, Marie Delavergne, Javier Rojas Balderrama, Dimitri Pertin, et les très nombreux beta-testeurs, Pierre Riteau, Jonathan Pastor, Adwait Bauskar, Ali Sanhaji …*

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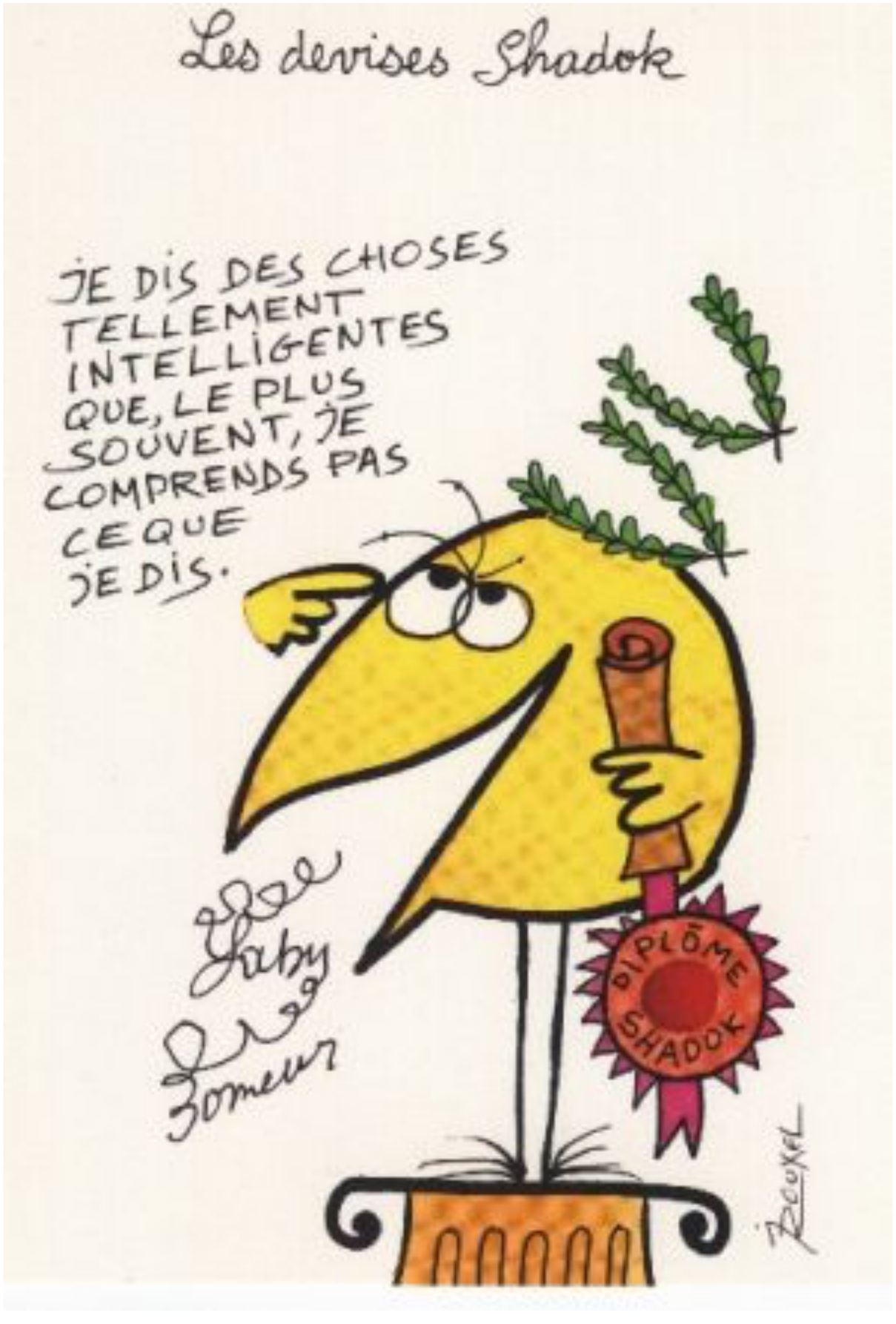
Orange Labs

Inria
inventeurs du monde numérique

QUESTIONS

➤ Merci



QUESTIONS

➤ Merci