Orchestration in a real network: a case study

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Outline

- The multidomain orchestration ride @ POLITO/TIM
  - Steps 1…2…3…4…5
- What we learned
- What to do next?

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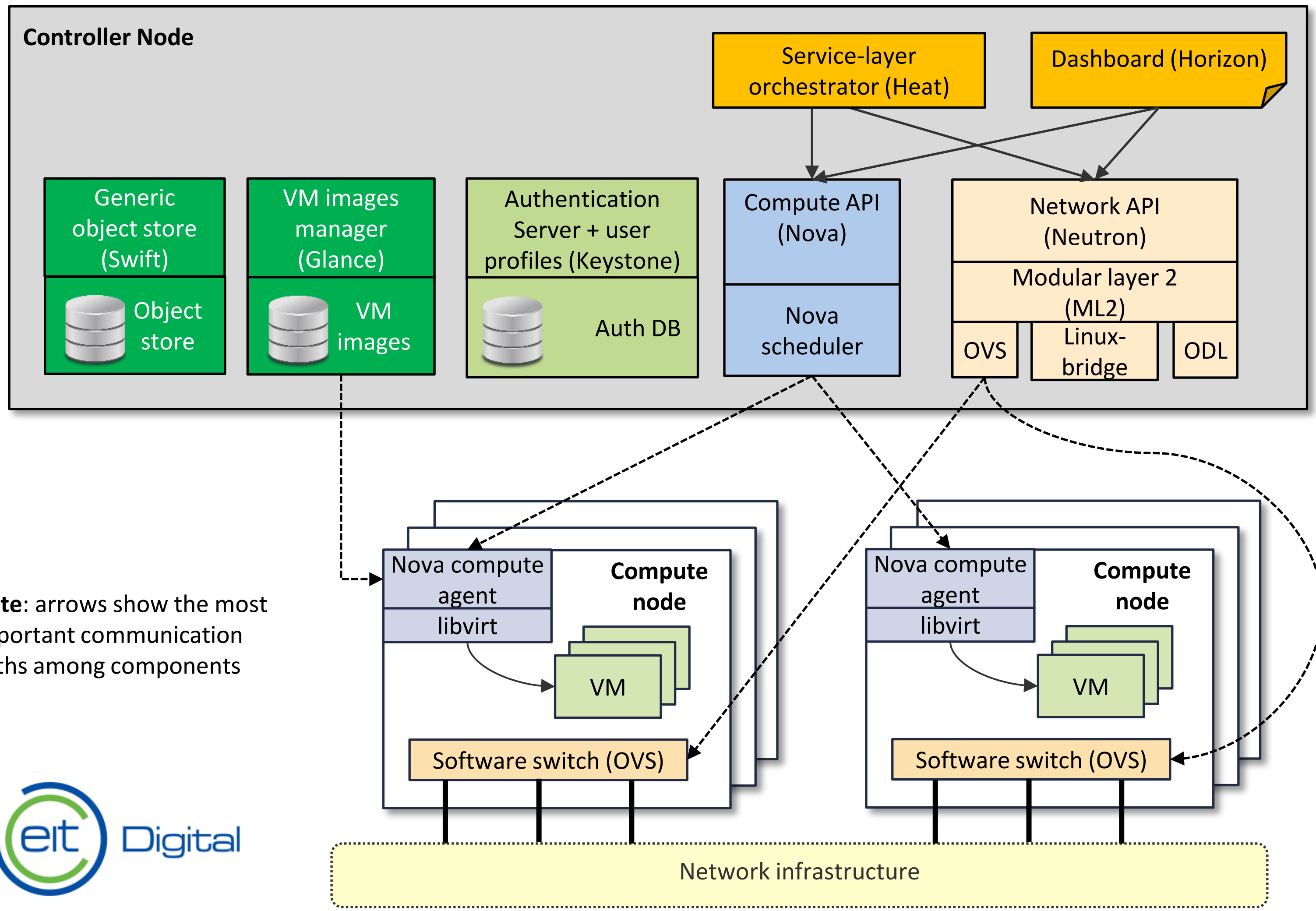
OpenStack overview

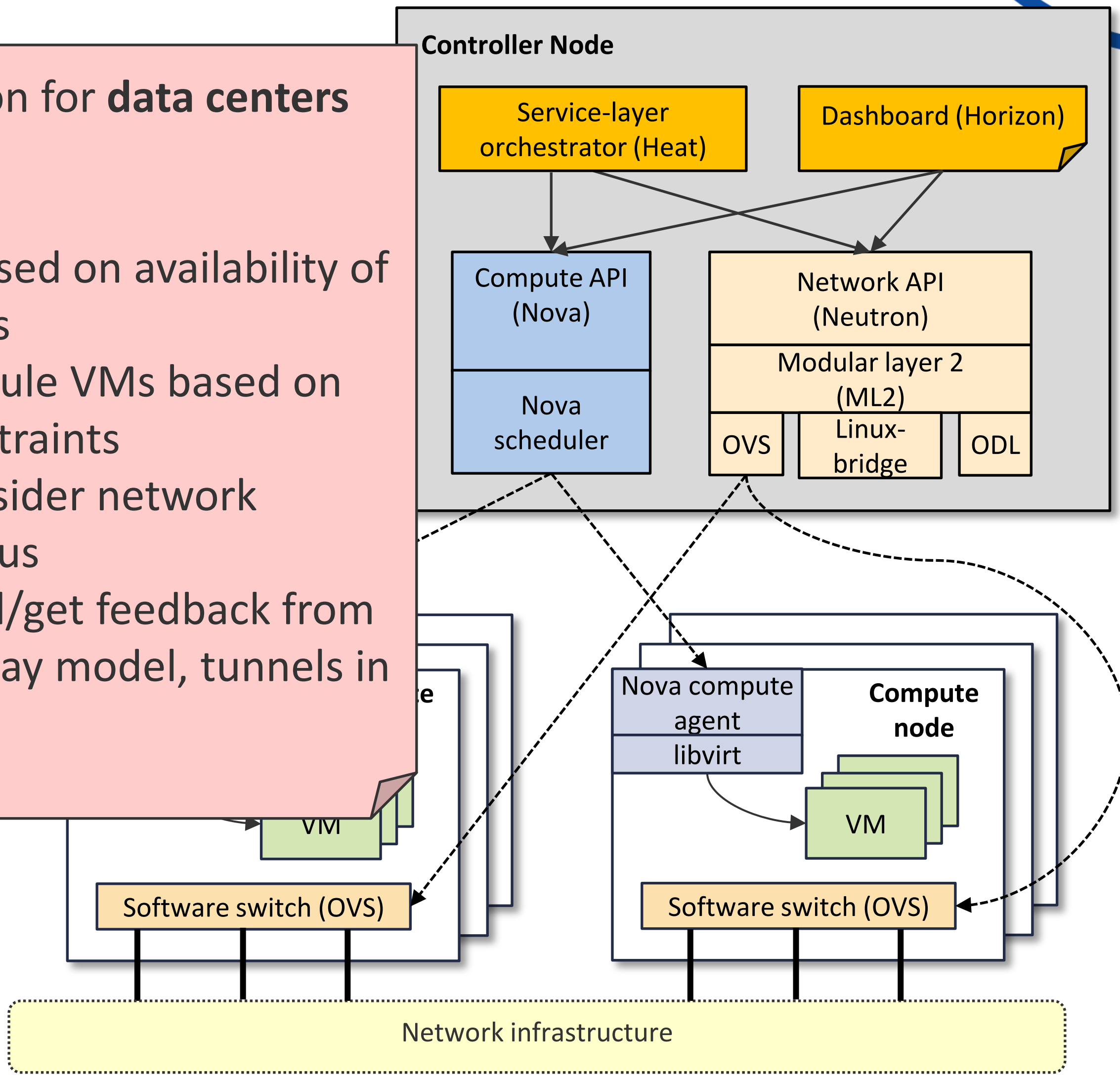


Note: arrows show the most important communication paths among components

Step 1: Pure OpenStack

OpenStack is a solution for **data centers**

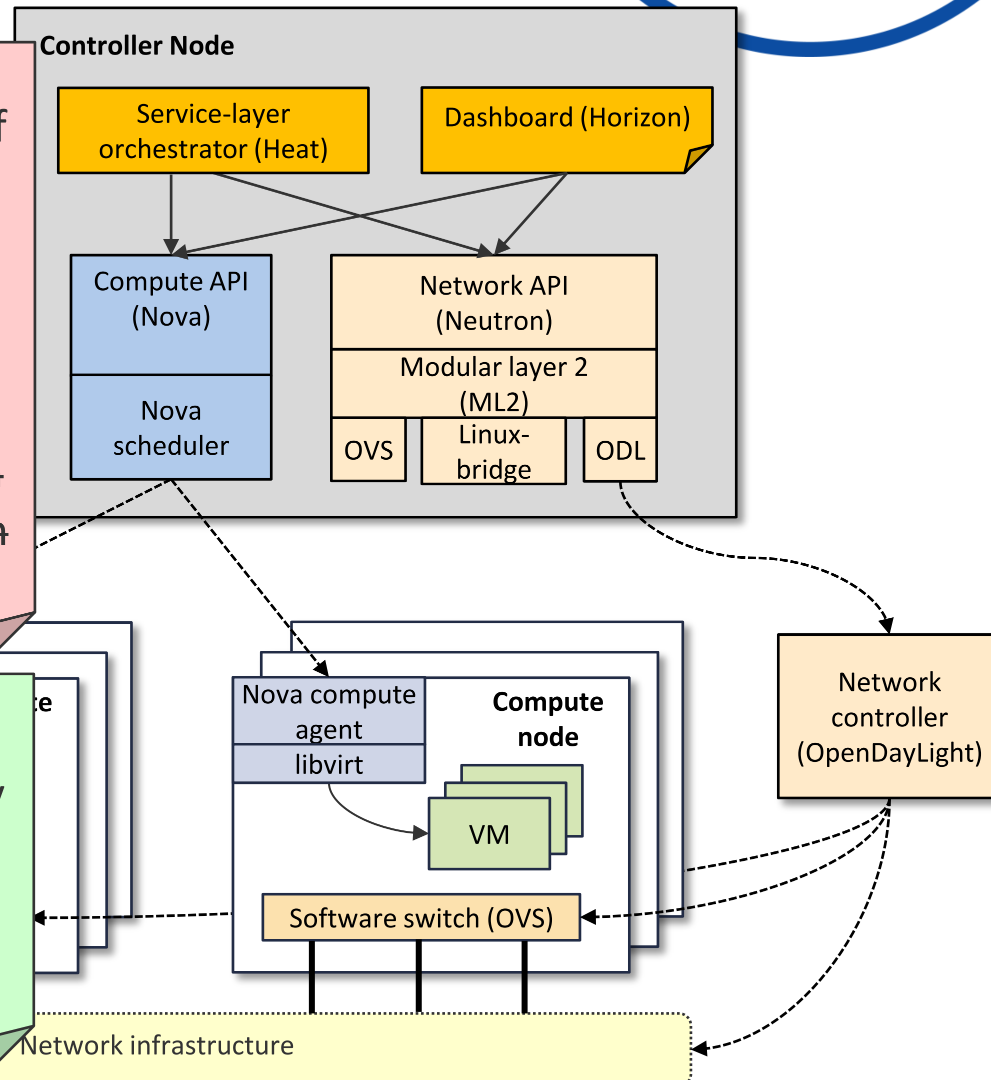
- No traffic steering
- VMs scheduled based on availability of compute resources
  - Cannot schedule VMs based on network constraints
  - Does not consider network topology/status
- Not able to control/get feedback from the network (overlay model, tunnels in the vSwitch)



Step 2: OpenStack + Network Controller

- No traffic steering
- VMs scheduled based on availability of compute resources
  - Cannot schedule VMs based on network constraints
  - Does not consider network topology/status
- ~~Not able to control/get feedback from the network (overlay model, tunnels in the vSwitch)~~

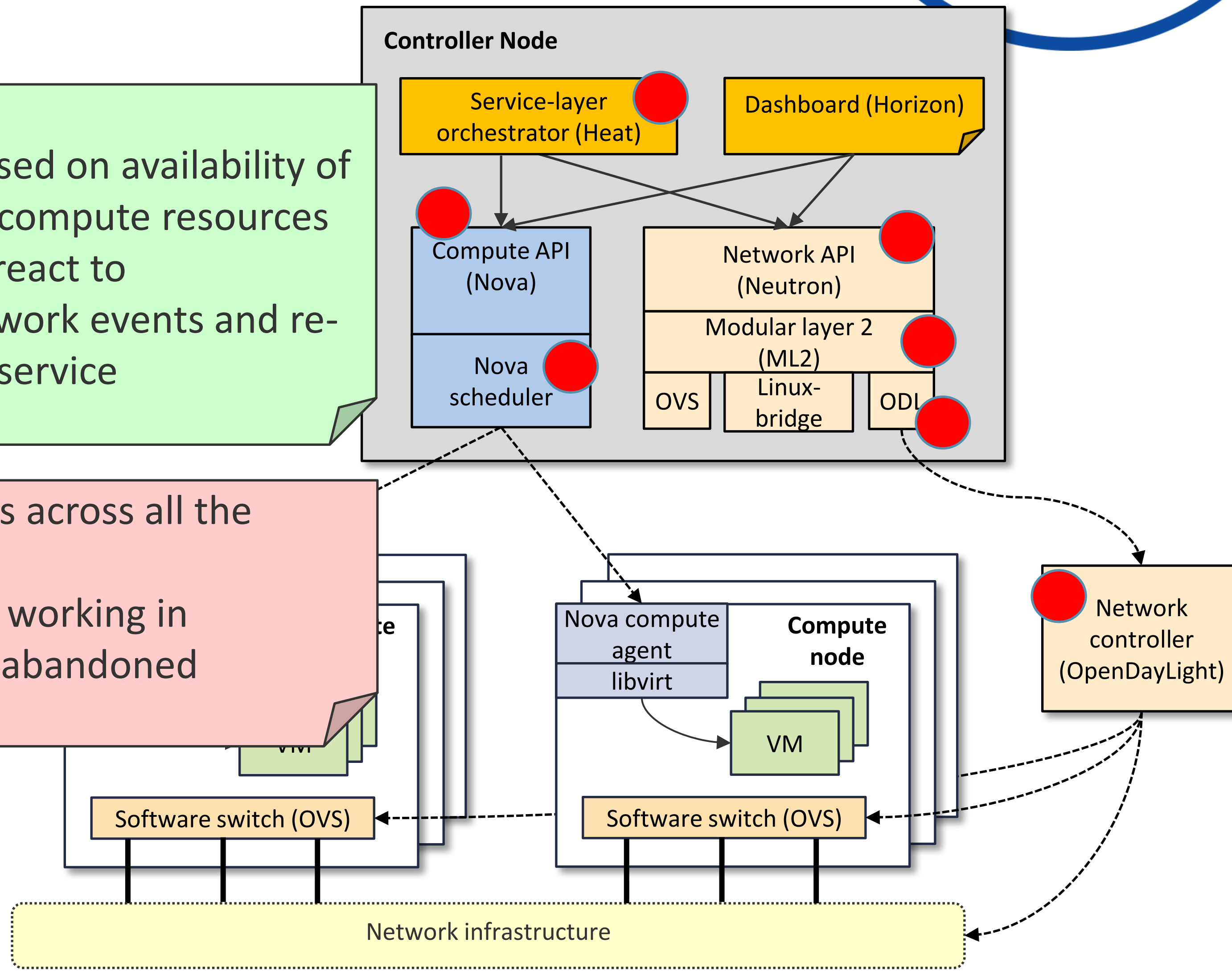
- The network controller can do its best to implement the service requested by OpenStack
  - Better than nothing, but it looks like a "slave" of OpenStack



Step 2b: Deeply modified OS + NC

- Traffic steering
- VMs scheduled based on availability of joint network and compute resources
  - Capability to react to compute/network events and re-schedule the service

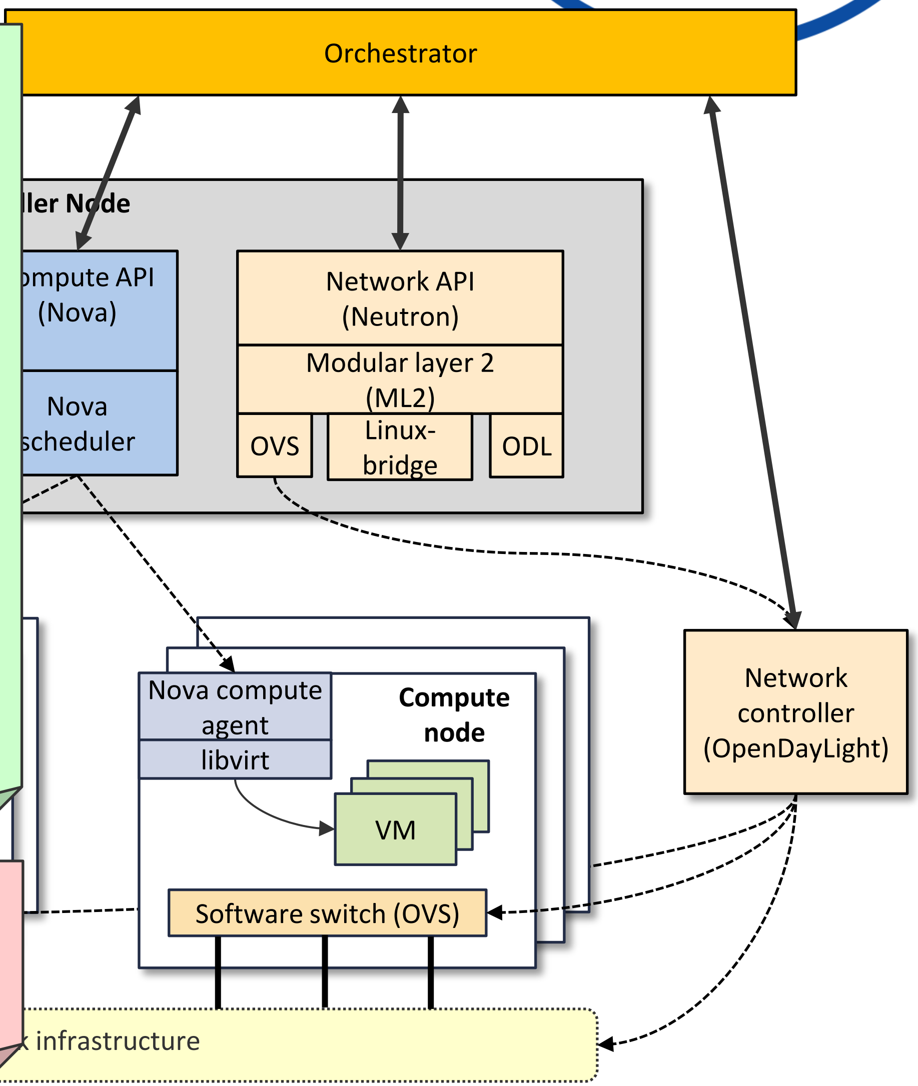
- Deep modifications across all the software stack
- Our “OpenStack+” working in TIM/POLITO, then abandoned



Main points modified

Step 3: An overarching Orchestrator

- The (extended) network controller can be "remotely controlled" to "interpret" the service coming from OpenStack
- Complex service logic can be implemented in the orchestrator, such as
  - Suggesting the proper VM scheduling (e.g., through availability zones) to OpenStack
  - Relocating the service based on network feedback (network-aware scheduling in the orchestrator)
- Now OpenStack becomes the "slave" of the orchestrator



- Rather complex
  - E.g., traffic steering has to be added by the Network Controller

Step 3: other problems arose

- OpenStack probably not appropriate to control the entire infrastructure of a telco
  - Probably OK for the central datacenter and the POP mini-datacenter
  - CPEs does not fit well in the picture
    - Either domestic (almost no compute capabilities) or business (some compute capabilities may be available) CPEs
  - The network infrastructure may need a different controller

- Telecom Italia experimental network (JOLnet) may be controller better by defining multiple domains
  - In order to understand the reason, let’s have a look at the JOLnet infrastructure

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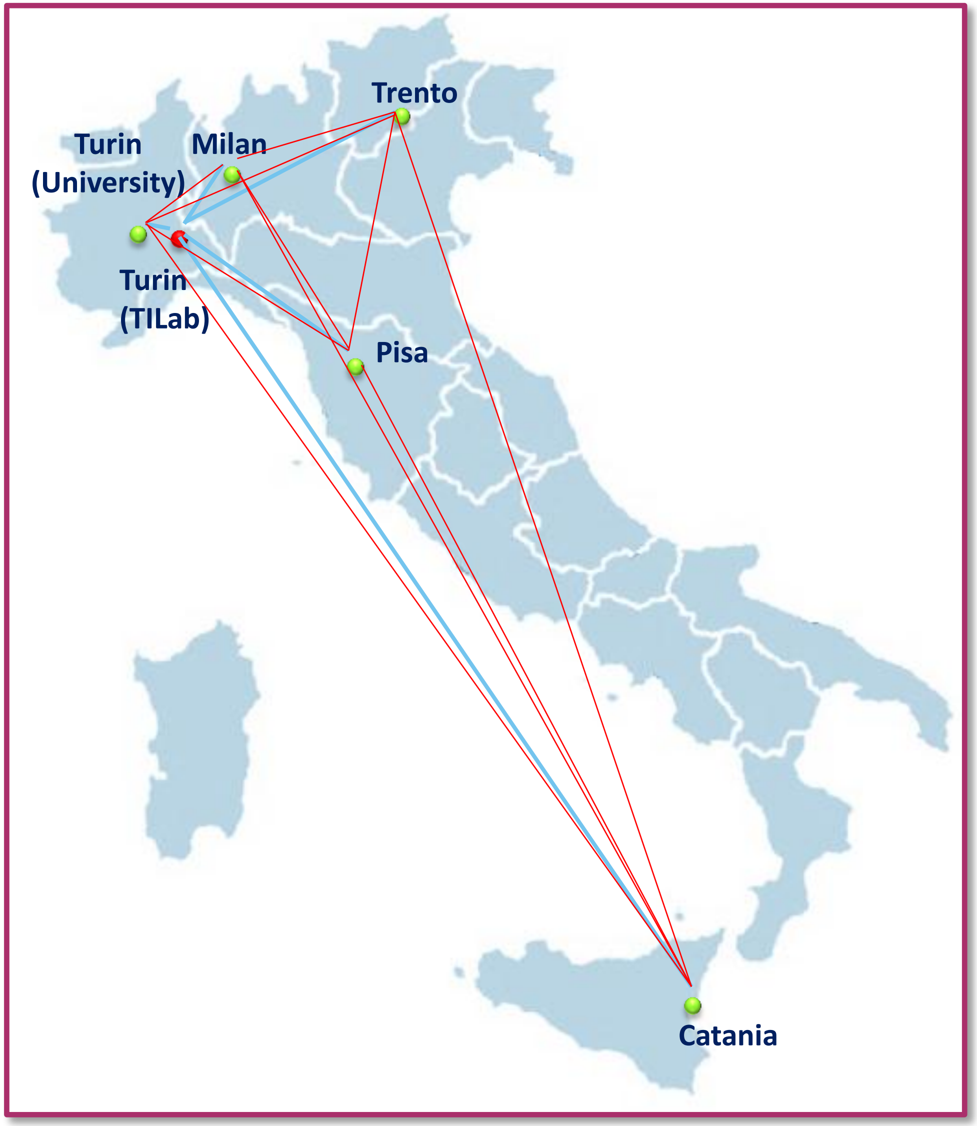
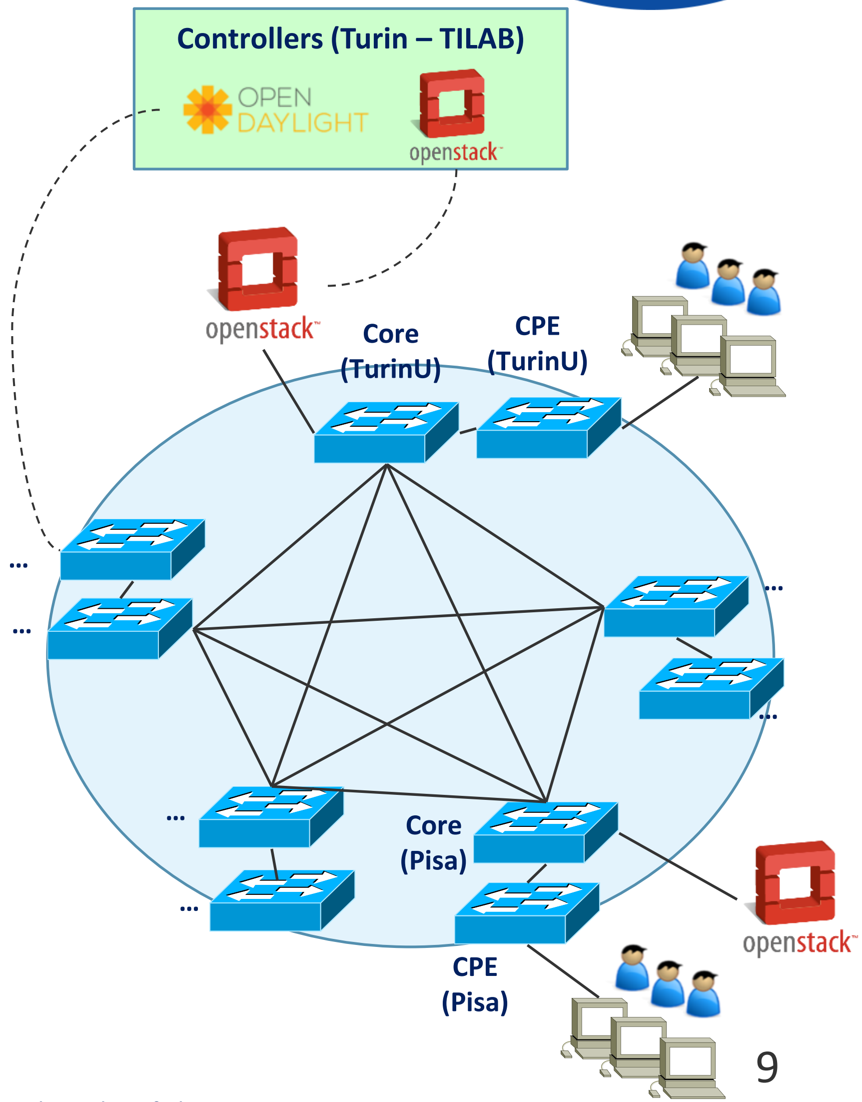
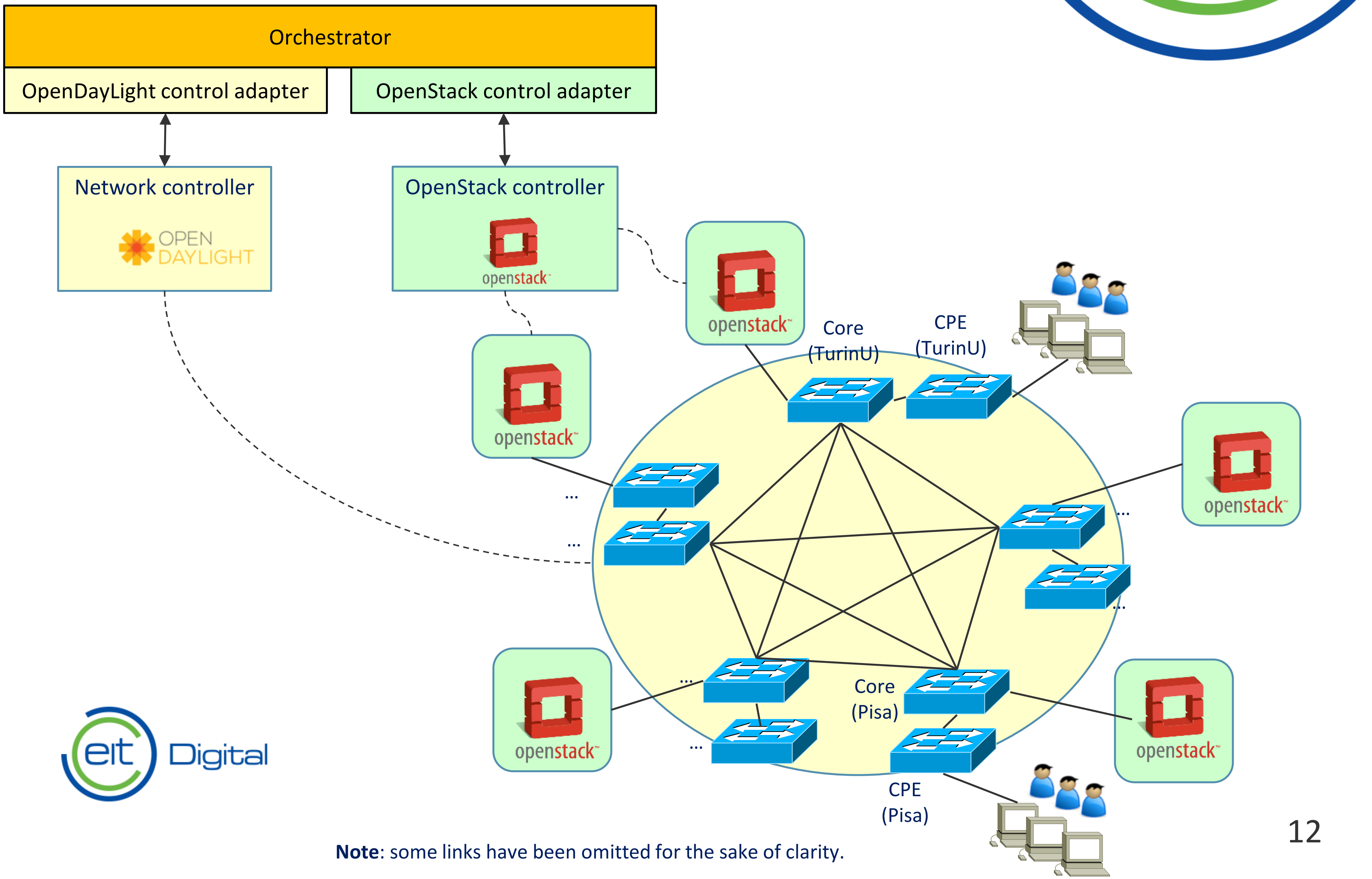
The JOLnet SDN infrastructure





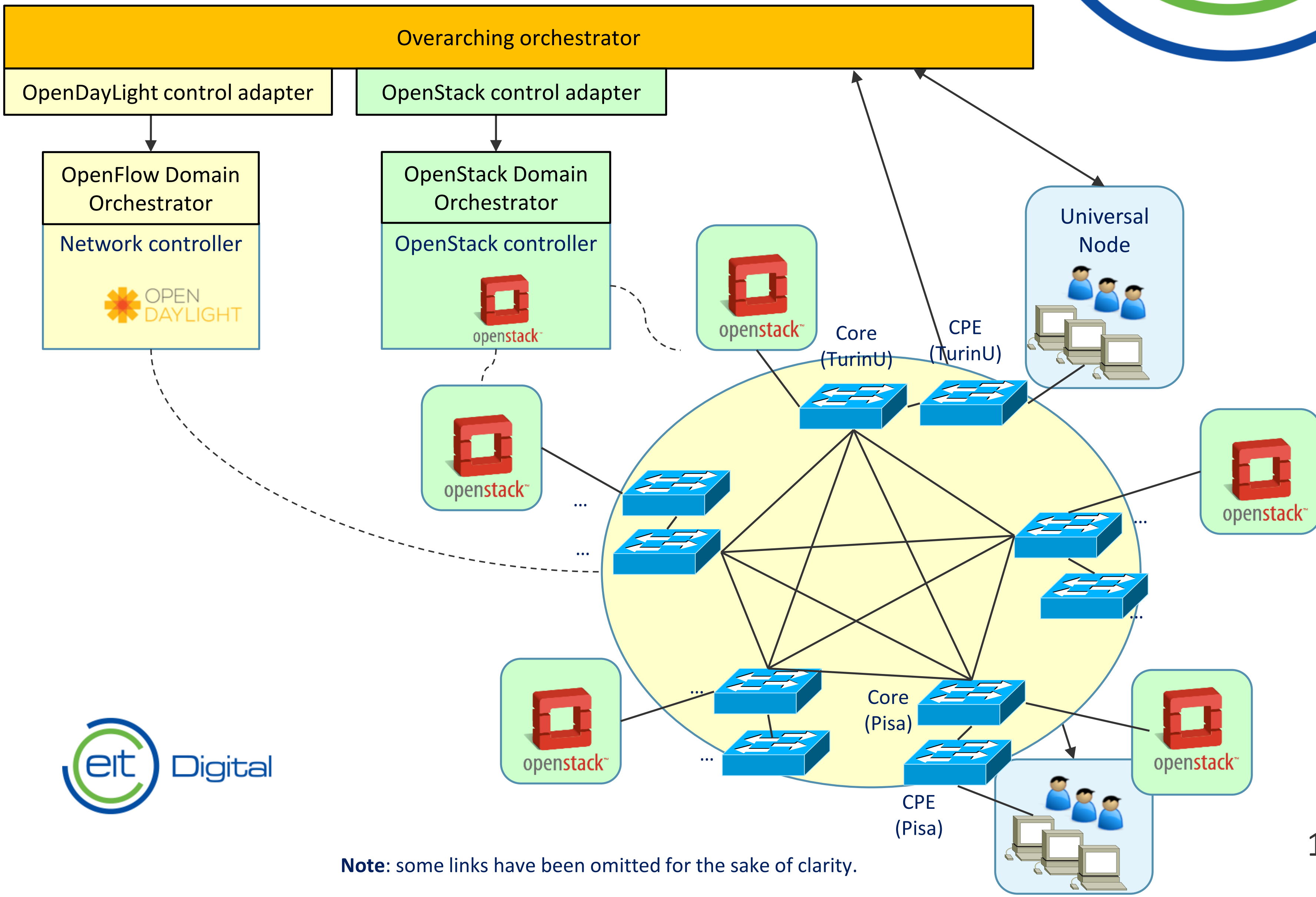
Note: some links have been omitted for the sake of clarity.

Step 3: overarching orchestrator (in JOLnet)



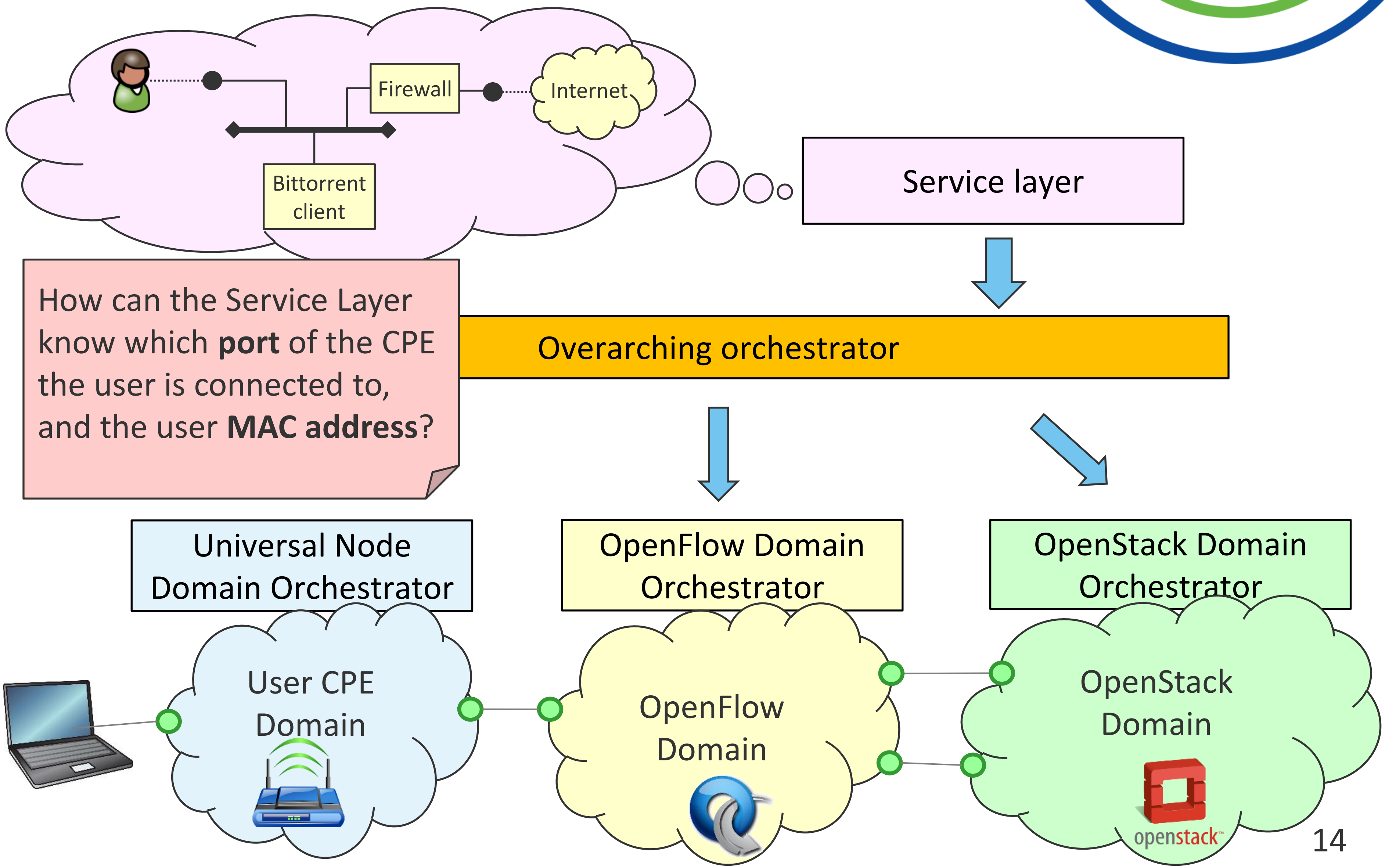
Note: some links have been omitted for the sake of clarity.

Step 4: multi-domain orchestrator

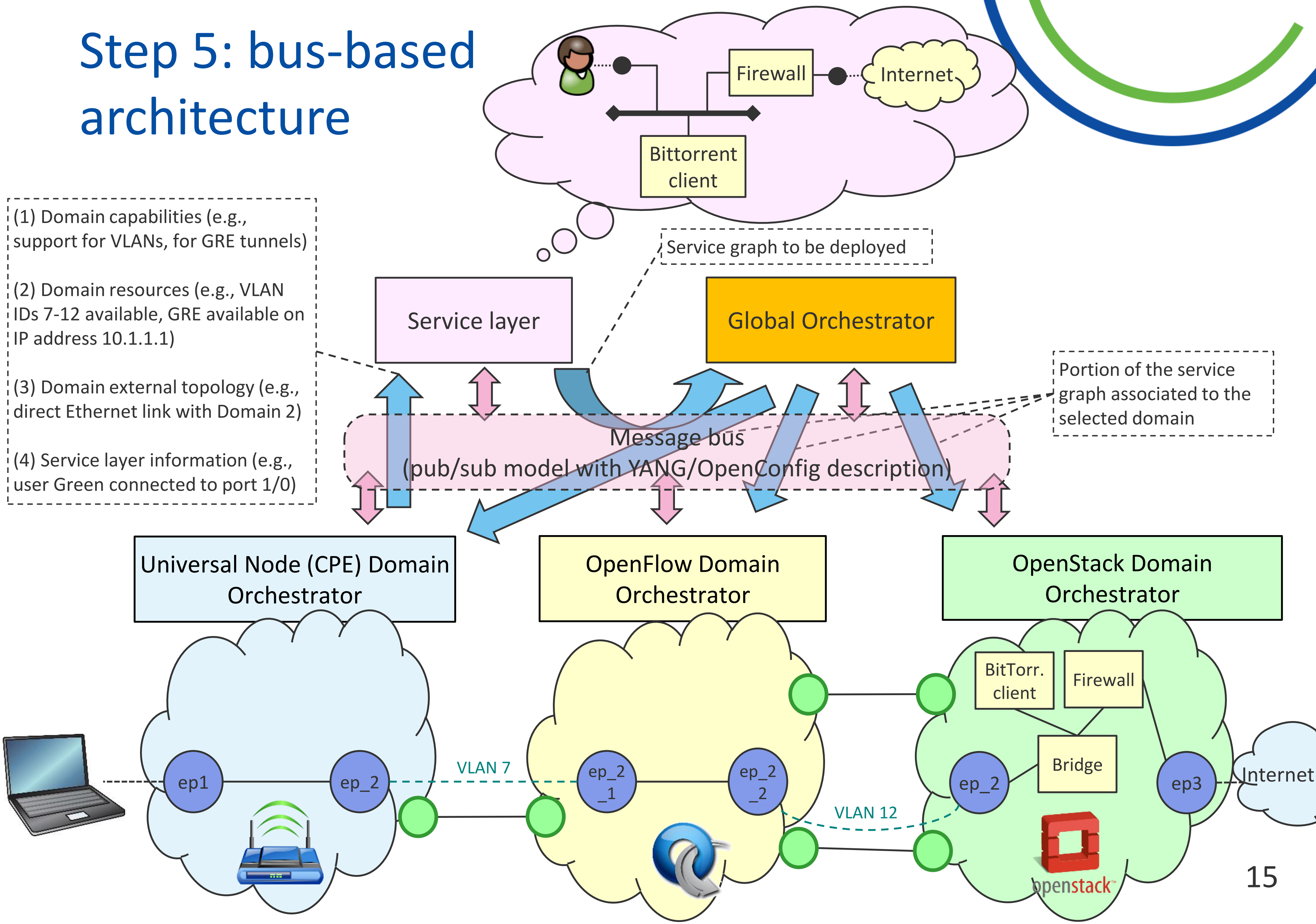


Note: some links have been omitted for the sake of clarity.

Step 4b: where's the Service Layer?



Step 5: bus-based architecture



What we learned

We're hitting the top of the iceberg.

Orchestration is very hard.

Orchestration is not just optimized scheduling.

Orchestration is:
scalability,
multitenancy,
security,
isolation,
multiple technological domains,
multiple administrative domains,
support for Internet of Things

Anything else?

What to do next

- How many orchestrators do we have to design and engineer?
  - One fits all (hence one winner and so many losers) , or should we design domain-specific orchestrators?
    - OpenStack, network-only, …

- Some possible technical actions
  - Define a **detailed** list of technical requirements?
  - Define a common **language** between orchestrators?

- More collaboration among the partners would be helpful
  - The orchestration space is so big!

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Credits

- The people at TIM, who we work with
  - Special thanks to Antonio Manzalini, Mario Ullio, Vinicio Vercellone, Matteo D’Ambrosio, and many others
- The EU FP7 UNIFY project and all the people there
  - Universal Node was born there: http://github.com/netgroup-polito/un-orchestrator
- The crew at POLITO
  - … for their effort in the FROG: http://github.com/netgroup-polito/frog4
  - Ivano Cerrato, Stefano Petrangeli, Roberto Bonafiglia, Sebastiano Miano, Gabriele Castellano, Francesco Benforte, Francesco Lucrezia, Mauricio Vasquez
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- The people at EIT, which are pushing hard for multi-domain orchestration

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Thanks for your attention!