Merging Openstack based private clouds: the case of CloudVeneto.it

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The CloudAreaPadovana is, since 2014, a scientific IaaS cloud, spread across two different sites: the INFN Padova Unit and the INFN Legnaro National Labs. The entire computing facility, owned by INFN, satisfies the computational and storage demands of more than 100 users afferent to about 30 research projects, mainly related to HEP and Nuclear Physics.

CLOUD AREA PADOVANA / openstack™
about 1100 Logical Cores
almost 50TB of Storage
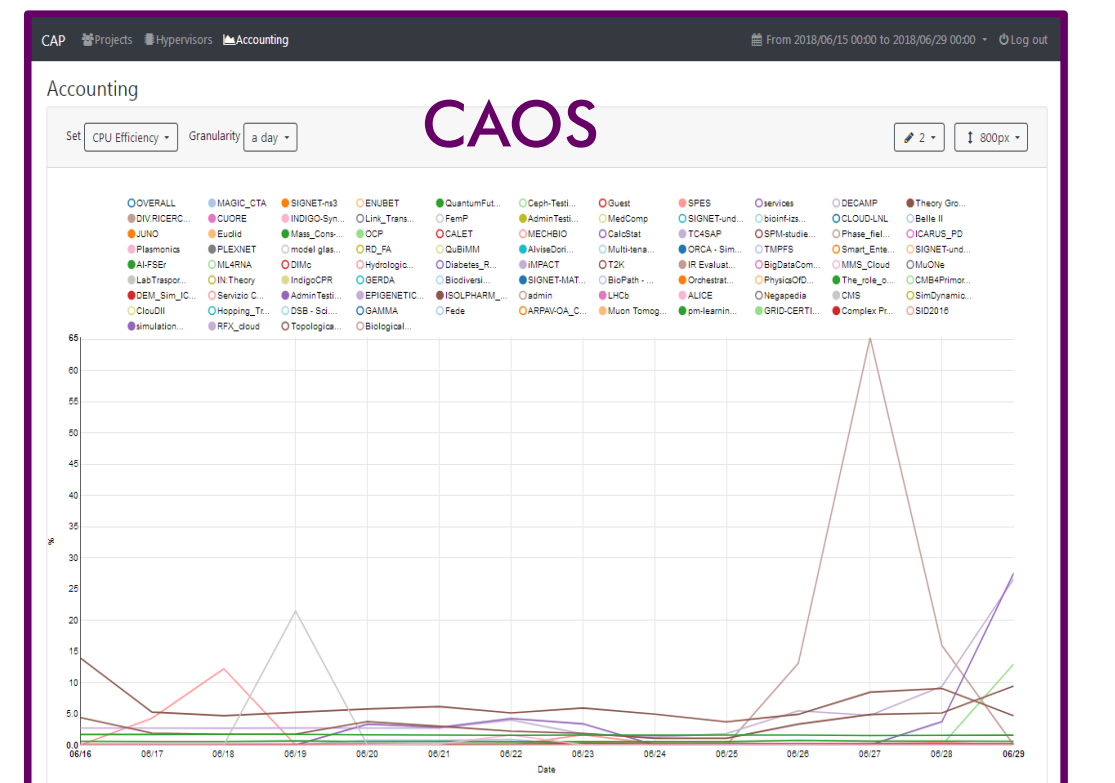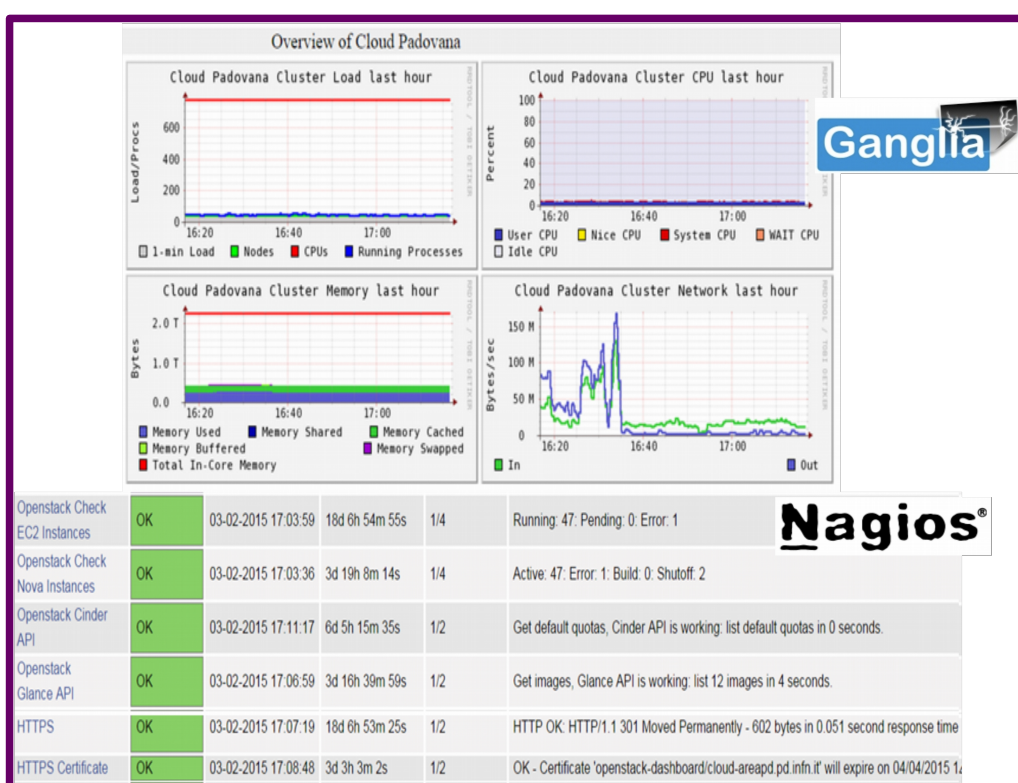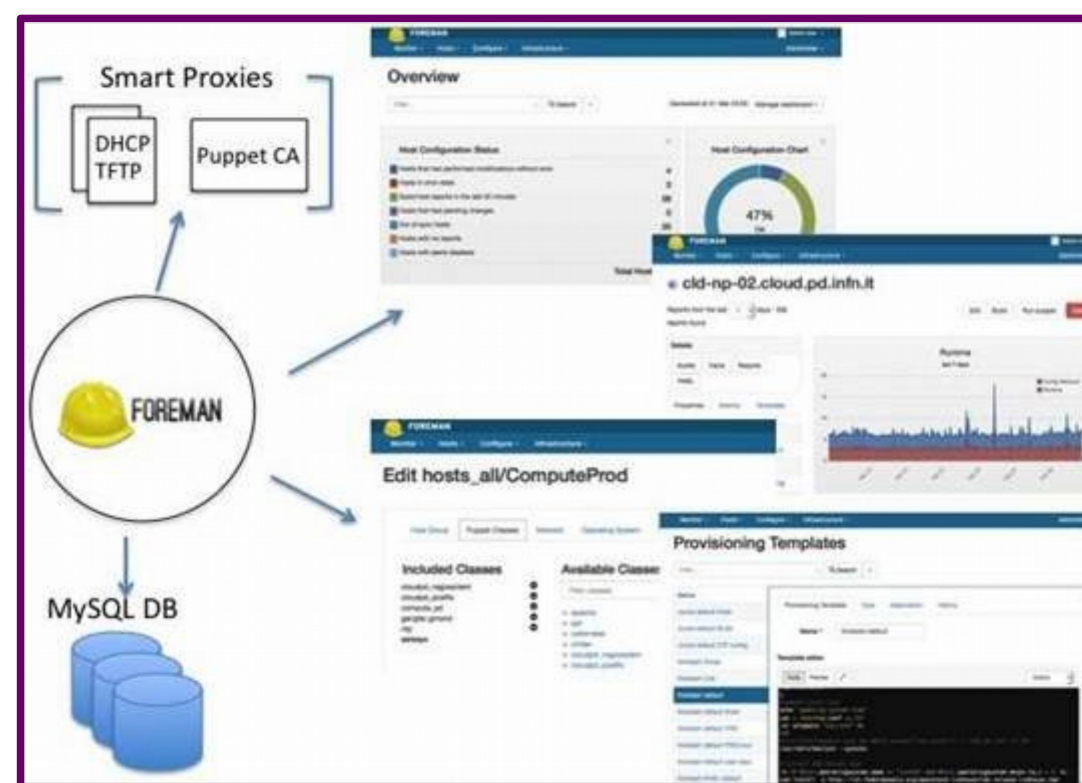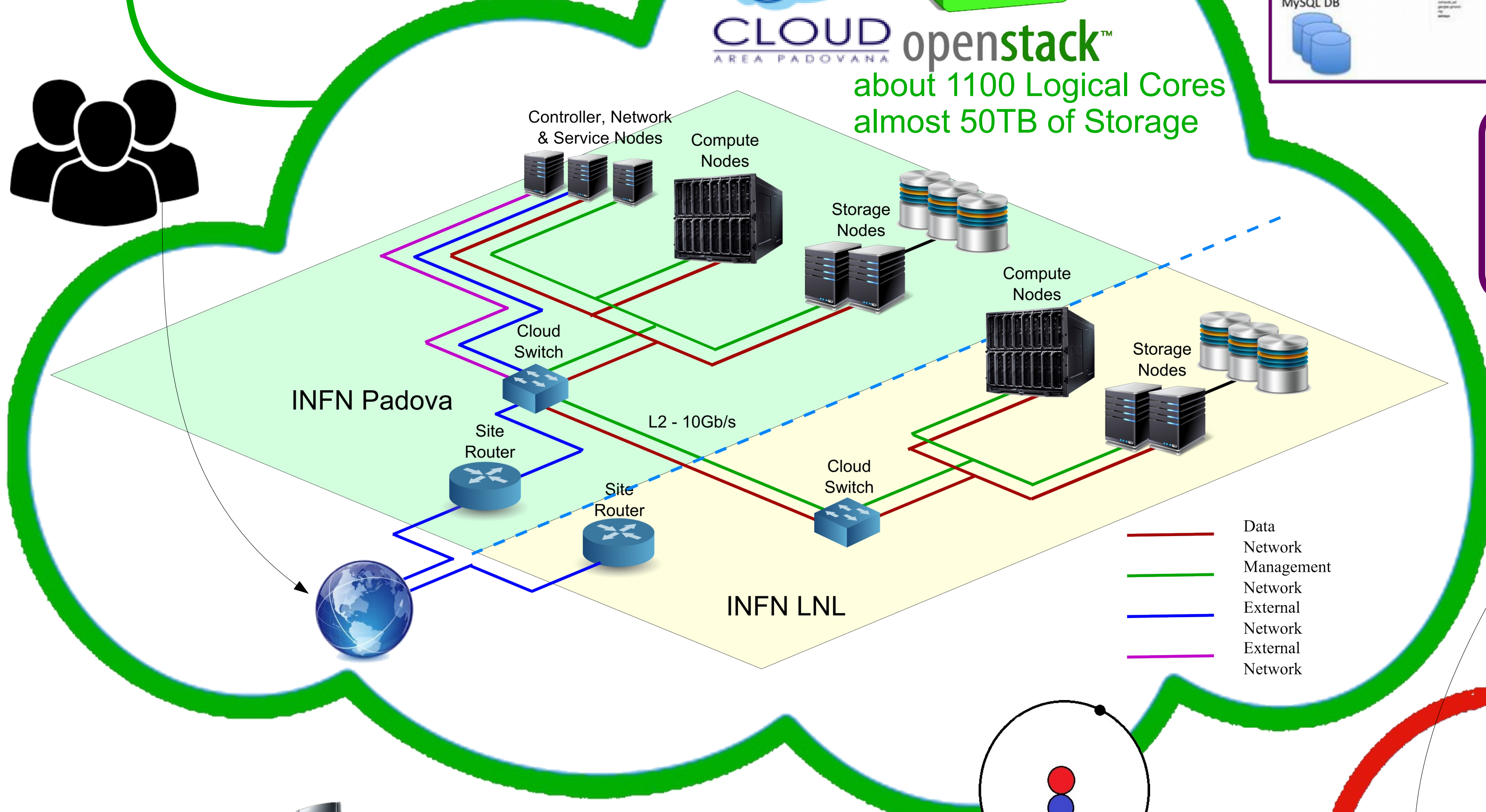
These two clouds shared only a limited set of ICT services and tools (mainly for configuration, monitoring and accounting), whereas their daily operations and maintenance were carried out separately by INFN and University personnel.

The Padova data centre also hosts and operates since 2015 an independent IaaS cloud managing network, storage and computing resources owned by 10 departments of the University of Padova, spawning a broader range of scientific and engineering disciplines.

INFN Padova
Controller, Network & Service Nodes
Compute Nodes
Storage Nodes
Cloud Switch
Site Router
L2 - 10Gb/s
Cloud Switch
Compute Nodes
Storage Nodes
INFN LNL

Data Network
Management Network
External Network
External Network

University of Padova
Controller, Network & Service Nodes
Compute Nodes
Storage Nodes
Cloud Switch
Site Router

about 480 Logical Cores
almost 90TB of Storage

Data Network
Management Network
External Network
External Network

At the end of 2017 we started the integration the two infrastructures to optimise the use of resources (both human and ICT) and to avoid needless duplication of services. This unique infrastructure is called **CouldVeneto**.

Before:
2 private clouds:
- 2 Openstack controllers in HA Active/Passive with Pacemaker/Corosync
- 3 hosts with Rabbitmq cluster
- 3 host with Mysql-Percona cluster

- 2 Openstack controllers in HA Active/Active with HA-Proxy and Keepalived
- 3 hosts with Ha-Proxy and Keepalived
- 3 hosts with Rabbitmq cluster
- 3 host with Mysql-Percona cluster

After:
1 private cloud:
- 2 controllers in HA Active/Active with HA-Proxy and Keepalived
- 3 hosts with Ha-Proxy & Keepalived
- 3 hosts with Rabbitmq
- 3 host with Mysql/Percona cluster

Employees
The cloud administrators are the same number of the previous situation, but with less services to manage. (Just 2 Openstack Controllers/Network Nodes) No more different High Availability services.
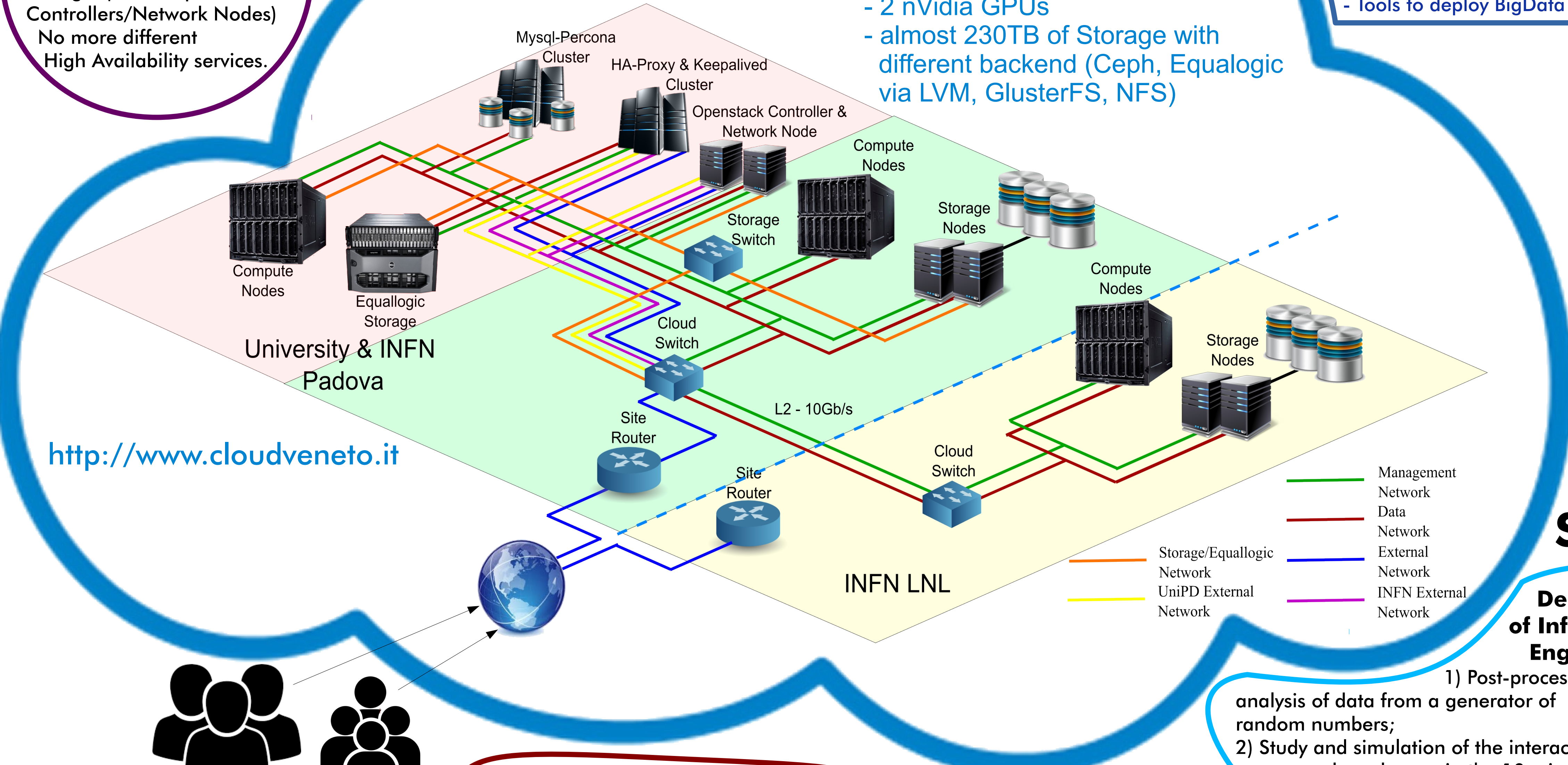
cloudveneto / openstack™
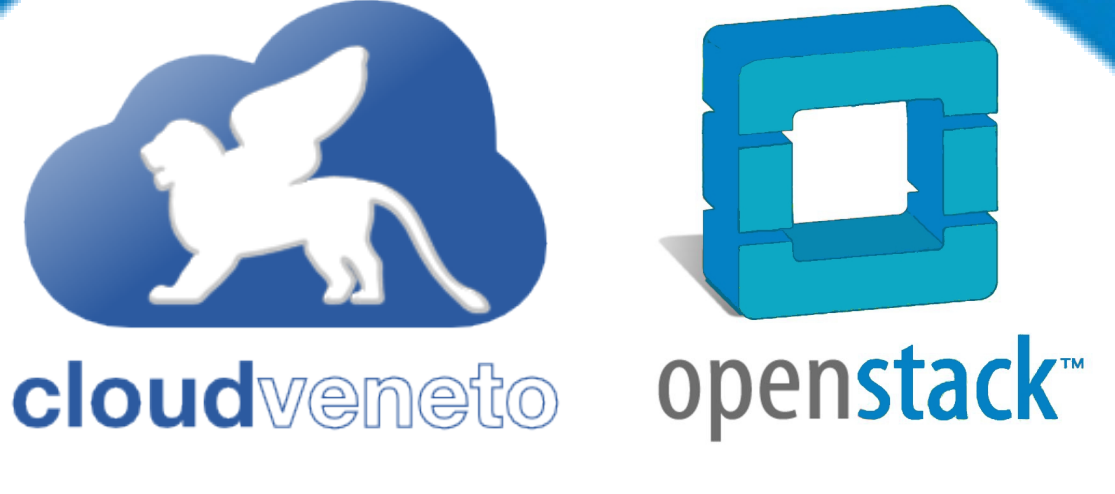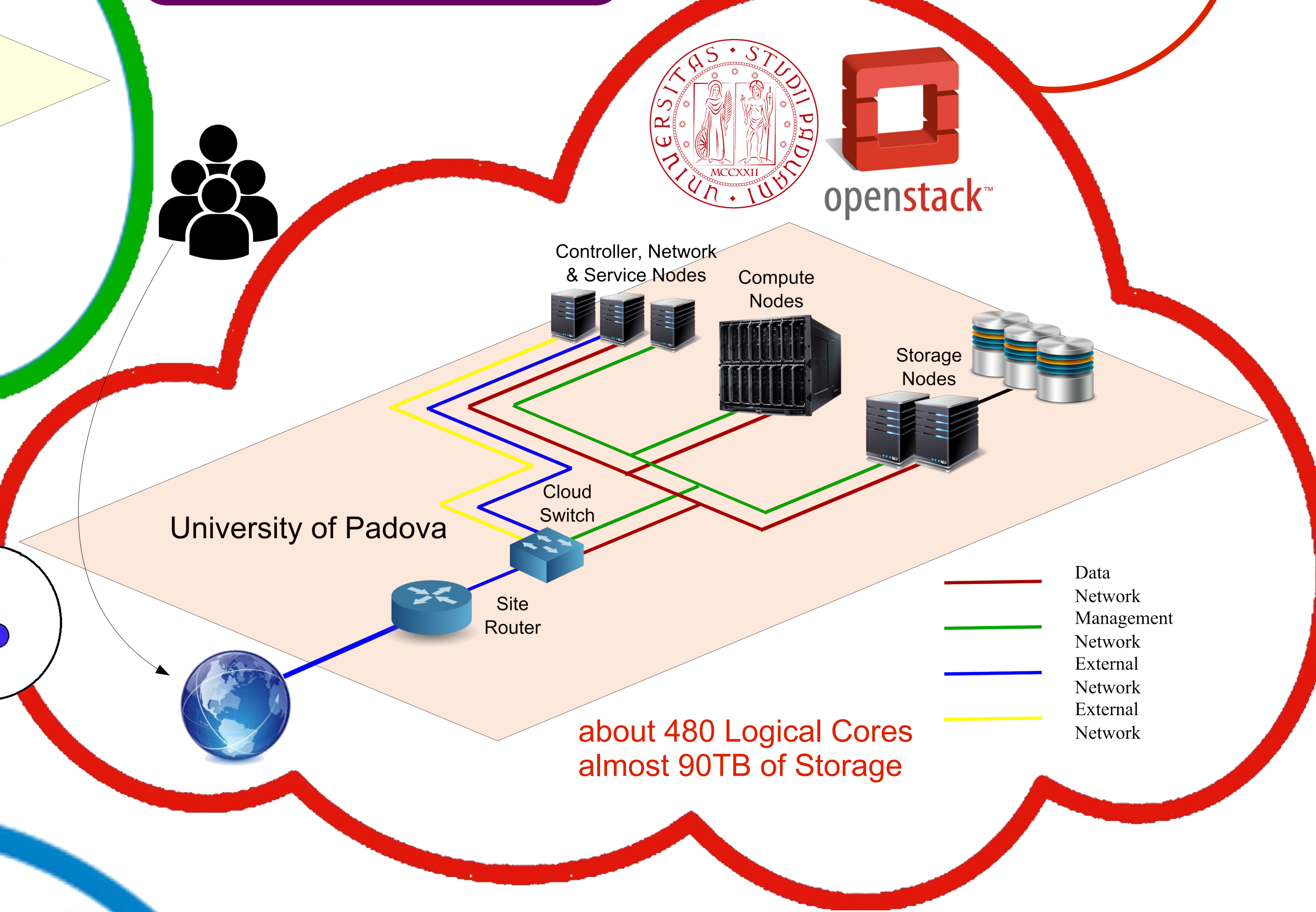
- 45 Compute Nodes with about 1800 Logical Cores
- 2 nVidia GPUs
- almost 230TB of Storage with different backend (Ceph, Equalogic via LVM, GlusterFS, NFS)

Integrated also some other services (some are in-house developments) to complement the functionality provided by OpenStack:
- Authentication through identity provided
- Support for user and project registration
- Support for account renewal
- Management of accounting and monitoring data
- Dynamic Batch Cluster As a Service
- Tools to deploy BigData clusters

Two different virtual hosts to access the customized Openstack dashboard (one for INFN and other for University users):
• https://cloud-areapd.pd.infn.it/dashboard
• https://cloudveneto.ict.unipd.it/dashboard

Supporting Single Sign On (SSO) and INFN AAI based on SAML v2.
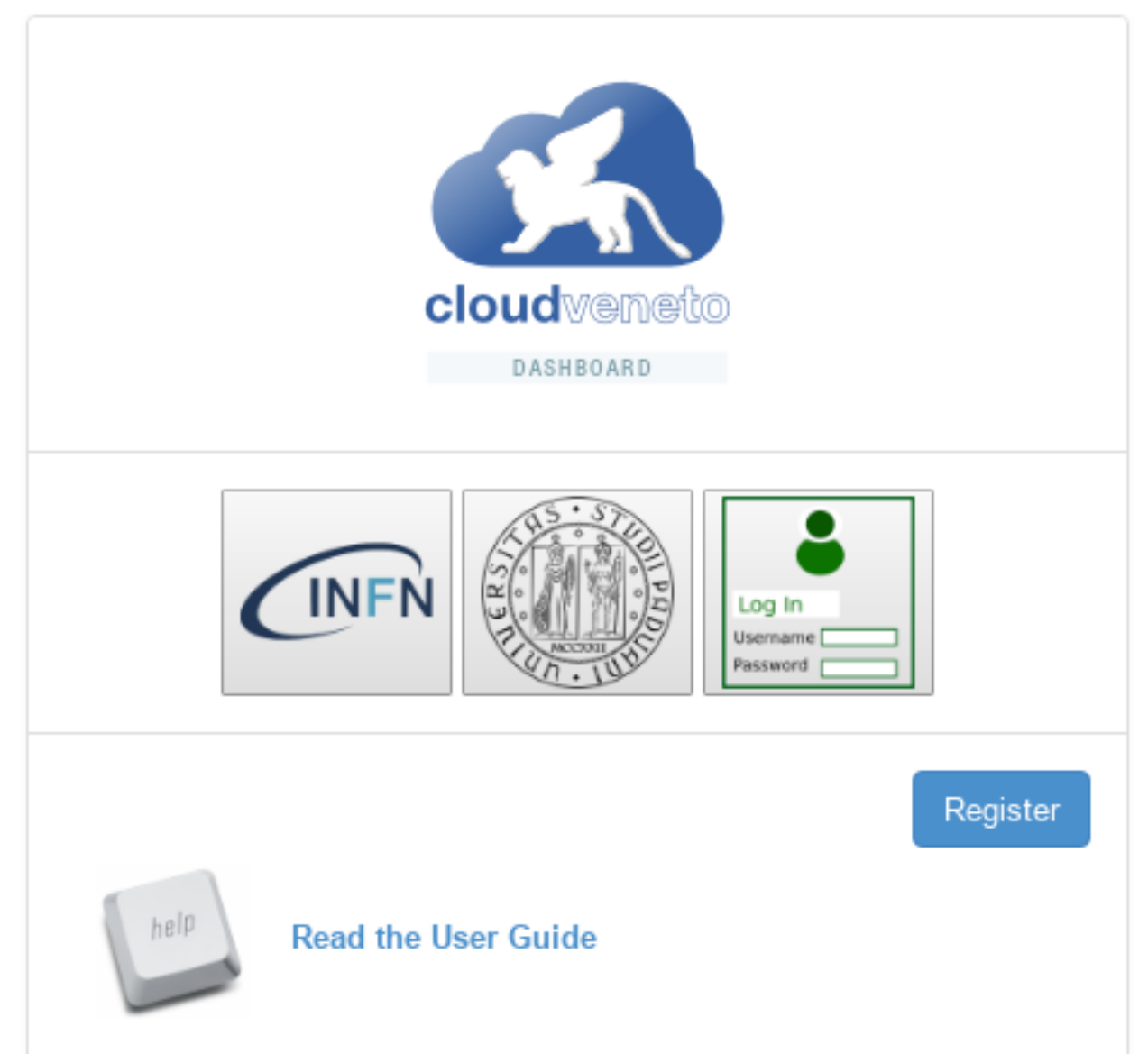
Pointing to the same authorizing service: Keystone via tokens.
Customized authorization system where group leaders are given full control for their projects..

http://www.cloudveneto.it

University & INFN Padova
Mysql-Percona Cluster
HA-Proxy & Keepalived Cluster
Openstack Controller & Network Node
Compute Nodes
Compute Nodes
Equallogic Storage
Storage Switch
Storage Nodes
Cloud Switch
Compute Nodes
Storage Nodes
Site Router
L2 - 10Gb/s
Cloud Switch
Site Router
INFN LNL

Management Network
Data Network
Storage/Equallogic Network
External Network
UniPD External Network
INFN External Network

Some use Cases:

Department of Information Engineering
1) Post-processing and analysis of data from a generator of quantum random numbers;
2) Study and simulation of the interaction of high power laser beams in the 10 micron band with glass material to optimize the process of drilling glass vials for medical purposes.

Department of Physics and Astronomy
1) Deploy of Mesos/Spark clusters with Hadoop file-system to optimize the data analysis of the high energy physics community as CMS, that has decided to probe the cutting edge methodologies and machine learning algorithms.

2) Systematic Monte Carlo simulations dedicated to the study of materials for applications in the field of photonics. The simulations aim to reproduce the charge transport in Lithium Niobate as the concentration of defects present in the material, of the temperature and other microscopic parameters vary.

Department of Math
Containerization applied to the experimentation and evaluation of micro-services architectures, and to dynamic orchestration solutions.

Department of Civil Construction and Environmental Engineering
1) Uses data assimilation techniques (DA), whose main purpose is to directly integrate information derived from experimental observations into hydrological models.
2) Run Finite Element simulations on cracking due to drying using the poromechanical and the phase-field formulation. Basically we use Ubuntu system and install the deal.II open source software.
3) Perform particle simulations of granular soils. In particular, it exploits the resources available to perform batch triaxial cyclic tests on virtual soil samples in order to model ratcheting phenomena

Department of Pharmaceutical Sciences
Simulation of the recognition process between chemical compounds and target proteins

INFN SPES Experiment
The experiment is planning an accelerator machine and needs a lot of simulations to study its behavior by varying a large number of parameters. TraceWin client-server system:
- remote servers are installed and managed elastically as a service on the Cloud, listening on a UDP port
- a main local client sends asynchronous commands for N runs
- at the end the client collects all the artefacts
- total run time cut down to about 2 months

Department of Biomedical Sciences
1) Blast (sequence alignments) of plant genomes. Parallelizing the study sequence similarity in a database of plant protein sequences.
2) The departments maintains a resource that provides structural annotations about flexible regions in protein sequences. CloudVeneto has been used to parallelize the annotation pipelines.
3) Validation of BOOGIE2, the software for the prediction of blood groups from genetic data, a platform for bootstrap analysis was prepared to generate 10,000 virtual patients on which to test the aforementioned code.