

Towards Hybrid Computing

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The IFCA Advanced Computing Group

- The Advanced Computing Group of the Institute of Physics of Cantabria (IFCA) (CSIC - UC)
 - was founded at 2010
 - response to the growing scientific needs for powerful computing capabilities and techniques.
- The group has continued expanding its physical and human resources
 - 18 people are currently part of the group
 - Highly qualified staff
- Multidisciplinary applications
 - Cloud computing, HPC, HTC
 - Data Acquisition (analysis of large data volumes)
 - Big Data and Data Science techniques
- Design, implementation and operation of Cloud/HPC/HTC infrastructures,
 - Participation in pan-EU federated e-Infrastructure as EGI



Systems group



- **Milestones**

- Before 2005

- LEP Cluster (80 dual procc IBM Towers) in a room located in the science faculty of the University of Cantabria.

- 2002 - Relocation to the new building

- 2004-2005 - A propietary network is assigned to IFCA

- 2005 - Tier2 de CMS (LHC)

- Several computing machines stored at a diaphnous room
 - Dedicated Class C Network - 1Gbps Uplink
 - Temporary staff hired for different projects
 - No dedicated structural personnel
 - Priorities are those of the projects

- 2007 – Altamira 1 - node enters the RES

- One admin Hired

- 2008-2010 - Grid-CSIC (Grid Infraestructute)

- Storage 1PB
 - 8000 cpus



- 2012 - The University of Cantabria acquires the Altamira II computer
 - TOP 500 (n 356)
 - 158 nodos, dual CPU 16 cores 64GB RAM, IB FRD 40Gbps, 1Gb Ethernet
 - 200TB Storage under GPFS
- 2017 - The CSIC service catalog is created
 - 1 person dedicated to computer infrastructure
 - Without belonging to any project - Structural staff
 - 1.5 Persons from projects dedicated to computer infrastructure
- 2019 – The Computation Service is created
 - The center's management is directly involved in the service.
 - The service is provided with a budget
- 2021 - ISO-9001/27001
- 2023 - Upgrading equipment through Global Health/ITP Climate ITPs
- 2023 - ENS (end 2023)
- 2024 - Computer Room Remodeling

The IFCA computing Service:

– HPC

- Altamira -158 Homogeneous nodes (IBM IdataPlex)
 - Dual CPU 16 cores, 64GB RAM, IB FDR 40Gbps, 1Gb Ethernet
- Meteo Cluster 40 EPYC Nodes (2024)
 - Dual 32 cores, 512 GB RAM, IB HDR 200 (Sobresubscription 1:1)
- IFCA Cluster: 10 EPYC Nodes (2024)
 - Dual 32 cores, 512 GB RAM, IB HDR 200 (Sobresubscription 1:1)
- Arrakhis Cluster
 - > 20 new generation Machines (end of 2024)

– HTC (Grid)

- 40 Heterogeneous nodes (No IB)
 - IaaS - Cloud infrastructure
 - Different brands and models (Lenovo, Fujitsu, HP, Supermicro)
 - 10 New EPYC Nodes on 2024 (IB HDR 200)

– CLOUD

- 65 Homogeneous nodes (Lenovo)
 - Dual CPU 32 cores, 384GB RAM IB HDR 200 (Sobresubscription 1:2)
Ethernet 25Gbps
 - 8320 cores - Hyperthreading Enable (128 cores per machine).
- 30 Heterogeneous nodes GPUs (Lenovo, Supermicro)
 - 40 V100 20 Nodes
 - 80 T4 10 Nodes

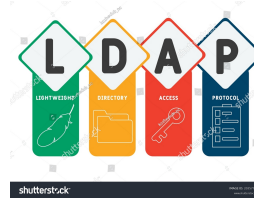


What do we need to provide computing service?

- Software Resources

- User management

- Dozens of users?
 - Users can be treated manually
 - Hundreds of users who also change periodically ?
 - We need a central system
 - » LDAP
 - » Active Directory
 - » SSO
 - » OPENID



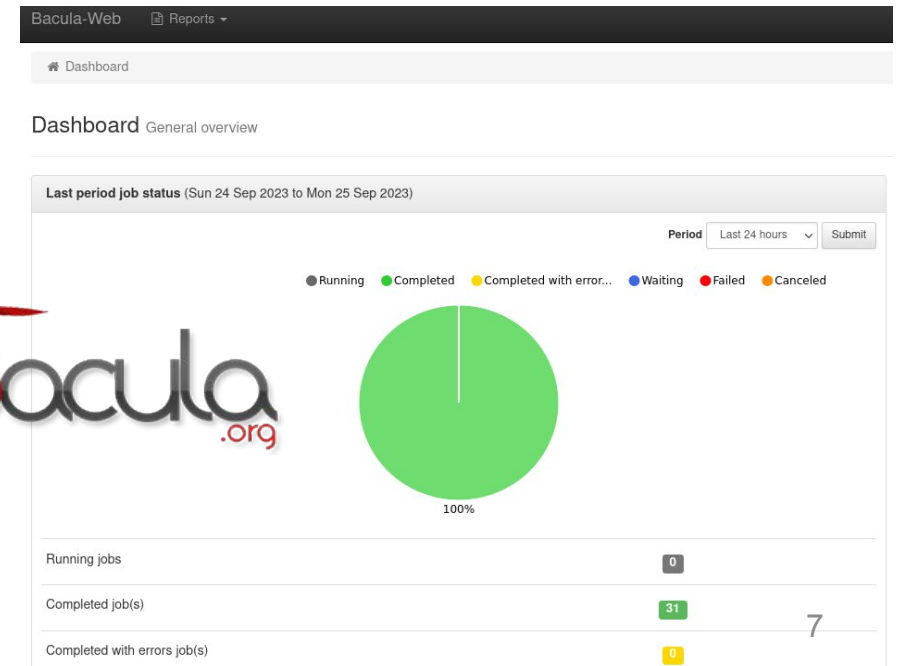
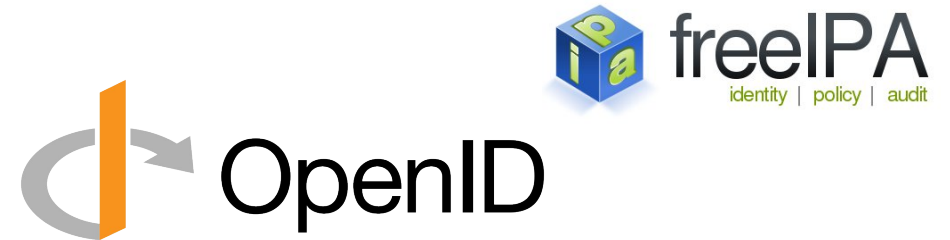
- Users have problems

- We need an incident management system
 - JIRA
 - RT
 - OTRS



- Backup System

- Snapshots
 - Disk image copy (use full for VM)
 - DB backup system: Bacula



– Deploement utility

- Xcat
- Confluent
- Foreman

– Configuration management tool

- Puppet

– Change control tool

- Gerrit

– Monitoring

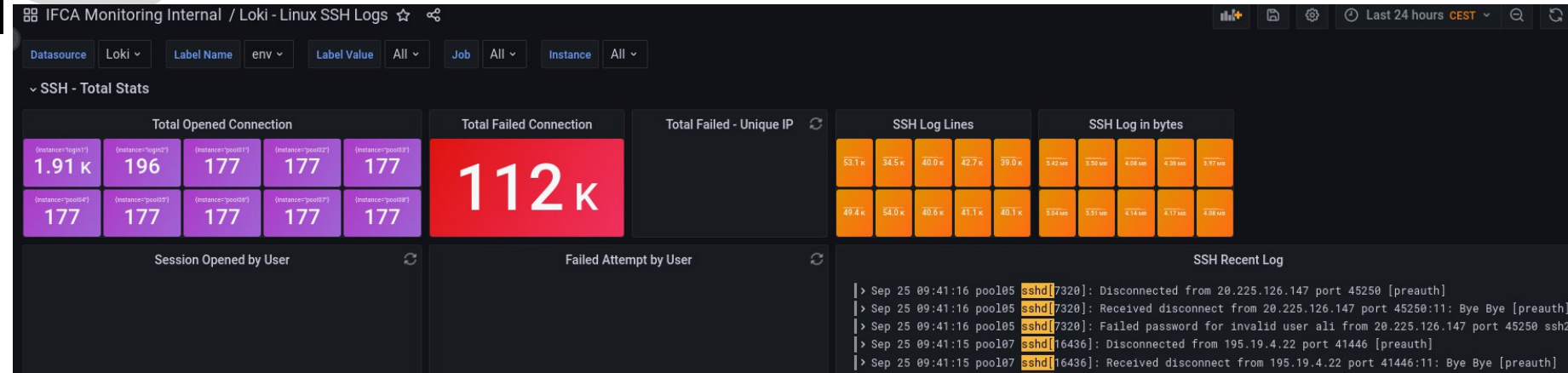
- Nagios
- Icinga
- Grafana
 - Influxdb
 - Loki
 - Collectd

– Document manager

- Alfresco
- confluences

Gerrit interface showing draft comments and merged changes. The table below represents the data visible in the screenshot:

Has draft comments (10 and more)	Owner	Reviewers	Repo	Branch	Updated	Size	Status	CR	V
<input type="checkbox"/> Subject									
<input type="checkbox"/> ☆ Add dss nodes to host	Iban Cabrillo	Miguel	cluster/puppet	master (add_gpfs...	Sep 13	M	Merged	✓	✓
<input type="checkbox"/> ☆ Add right home path for ceph user/group	Iban Cabrillo	Miguel	cluster/puppet	master (fix_wrong...	Aug 10	M	Merged	✓	✓
<input type="checkbox"/> ☆ Add 192.168.20 to DHCP	Iban Cabrillo	Miguel	cluster/puppet	master (add_gestio...	Aug 09	XS	Merged	✓	✓
<input type="checkbox"/> ☆ Add initial conf for cephosd2X nodes	Iban Cabrillo	Miguel	cluster/puppet	master (add_cepho...	Aug 08	M	Merged	✓	✓



<ul style="list-style-type: none"> Operational Procedures <ul style="list-style-type: none"> BCP - Bussiness Continuity Plan (BCP) OP01 - User management OP02 - Configuration Management OP03 - Machines Management OP04 - Boot & Shutdown OP05 - Certificate Management OP06 - Grid Related OP07 - Cloud Related OP08 - Altamira Related OP09 - Backup Related OP10 - Storage Related 	<ul style="list-style-type: none"> OP11 - Other Configuration Apps OP12 - Removable Devices OP13 - Domain Management OP20 - Shift Operations OP21 - Hardware Management SEC01 - Emergency SEC02 - Security Incidents SEC03 - Access Control Templates Tools & Manuals
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- **Hardware Resources**

- **Cooling system**

- It is estimated that 30% of a data center's electricity is used for cooling.
 - Remember : It is the equipment that needs to be cooled
 - Free colling?
 - Hot air reuse

- A good Power Usage Effectiveness (PUE) is a good letter of introduction. (Green CPD)

- **Uninterruptible Power System (SAIs)**

- At least critical systems should be connected
 - Disk systems
 - Router, Core Network
 - Critical admin nodes

- **Fire protection system**

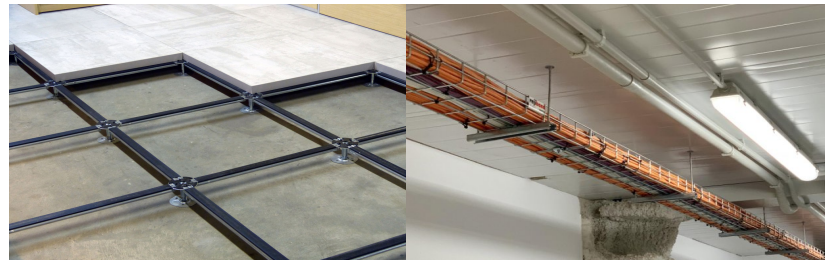
- **Access floor**

- **Rijiband**

- **Generator**

- **Sensors**

- Humidity
 - Temperature

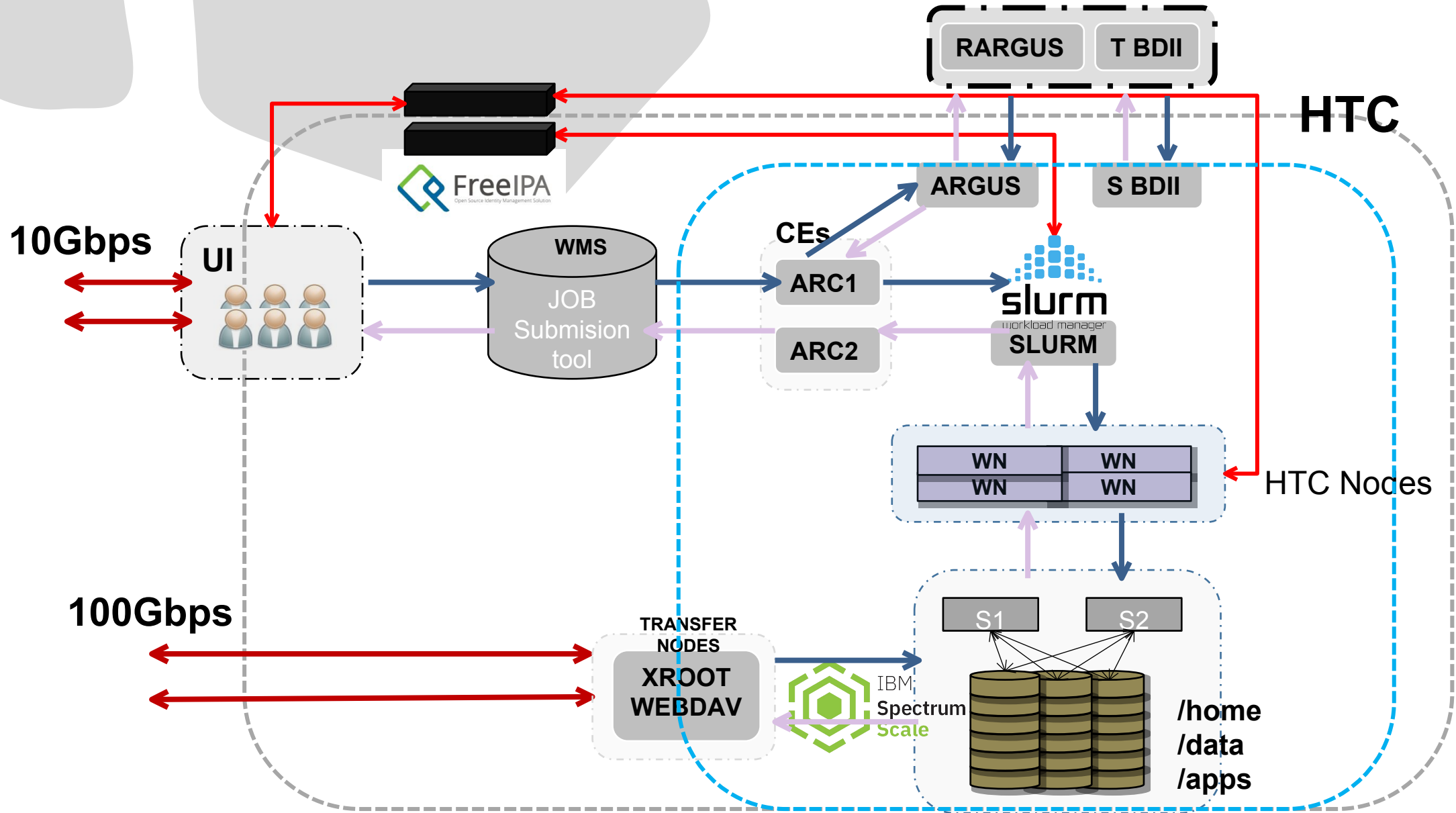


• Staff Resources

- One person for CPD Hardware management
 - System failures
 - Component replacement
 - Machine reinstallation
 - New hardware aggregation
 - Monitorization
- At least one person for the management of the CPD software (It will depend on the size, as well as the number of users and projects to be managed.)
 - User issues
 - Software deploy
 - Library compilations
 - user registration and cancellation
 - Monitorization
- One person to manage the CPD services.
 - Storage
 - Network
 - Other deployments
- In addition, some of the staff will be required to perform administrative tasks.
 - Technical specifications development
 - Purchase management
 - Inventory
 - Documentation + Certifications (ISOs, ENS...)
 - Monitorization
- Not all personnel must be highly qualified.

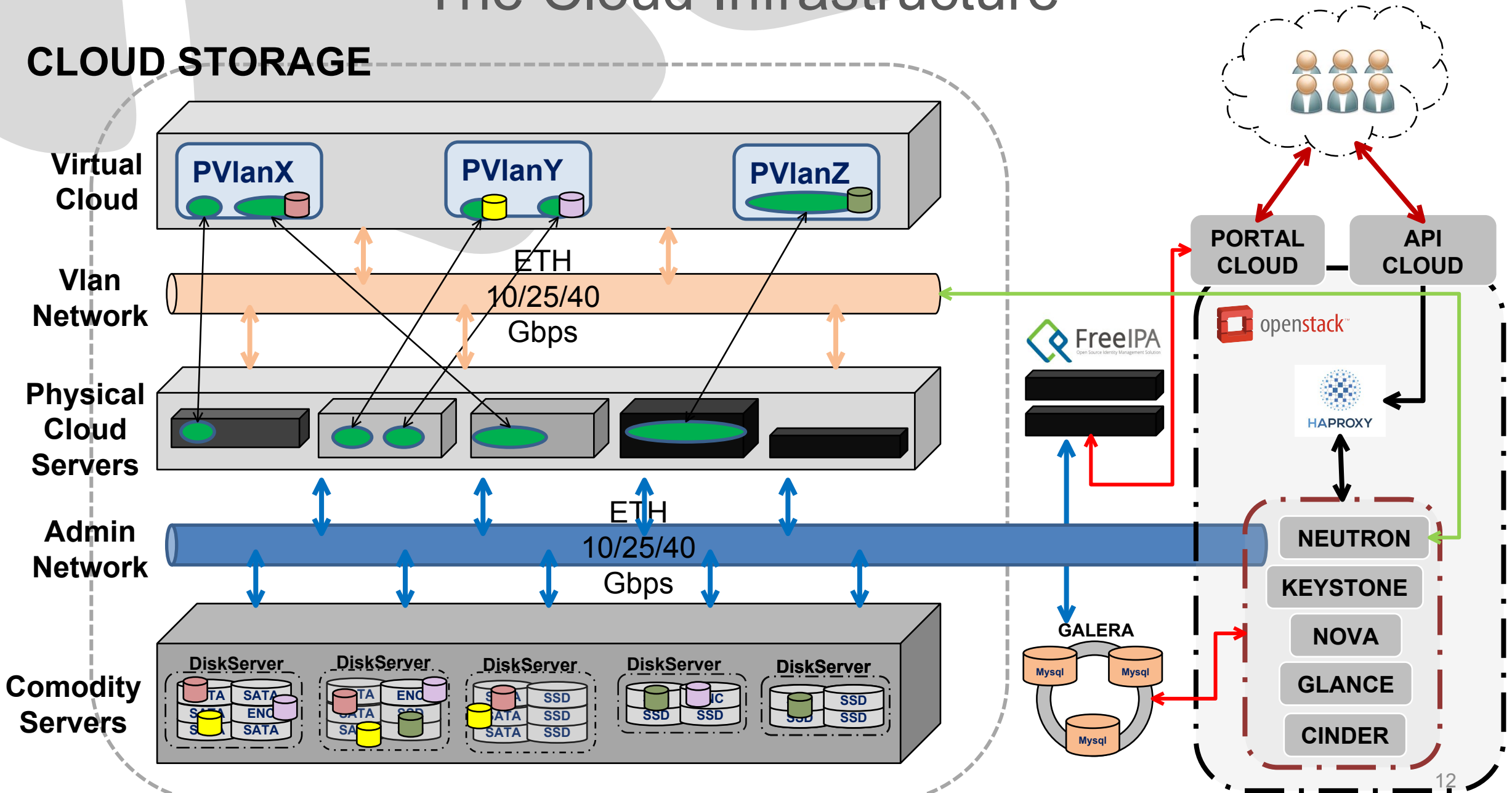


The Grid Infrastructure



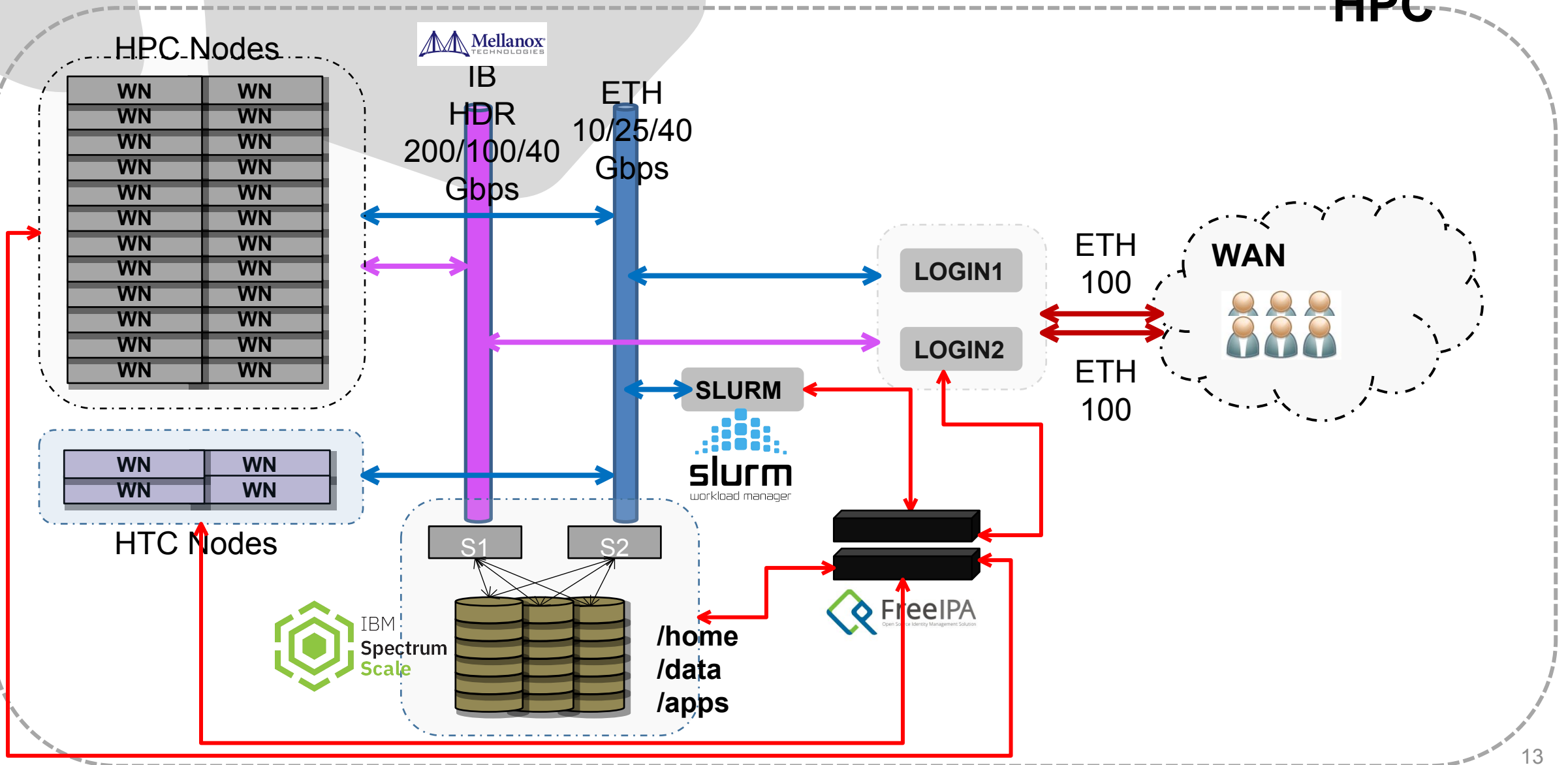
The Cloud Infrastructure

CLOUD STORAGE

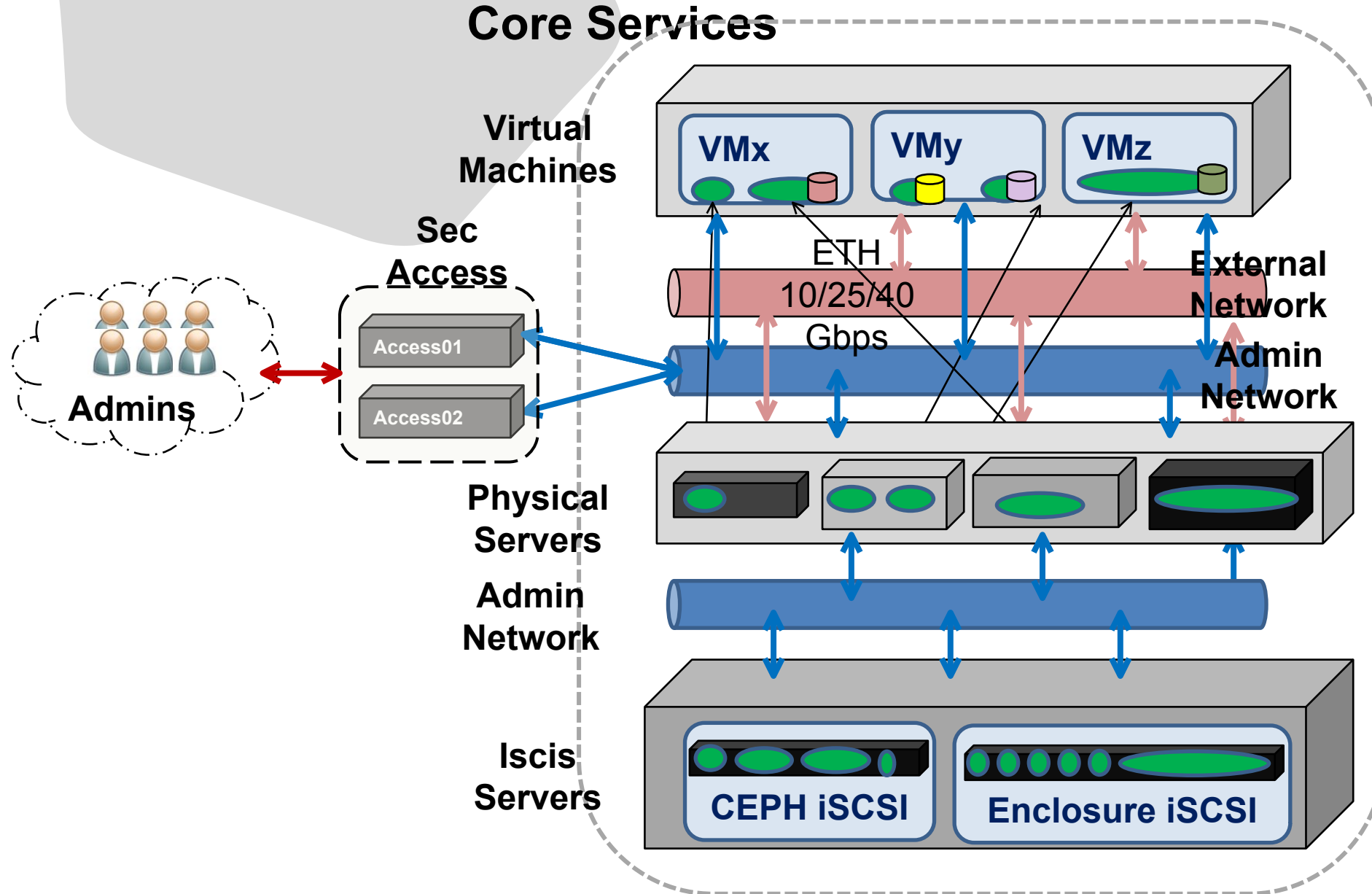


The HPC Infrastructure

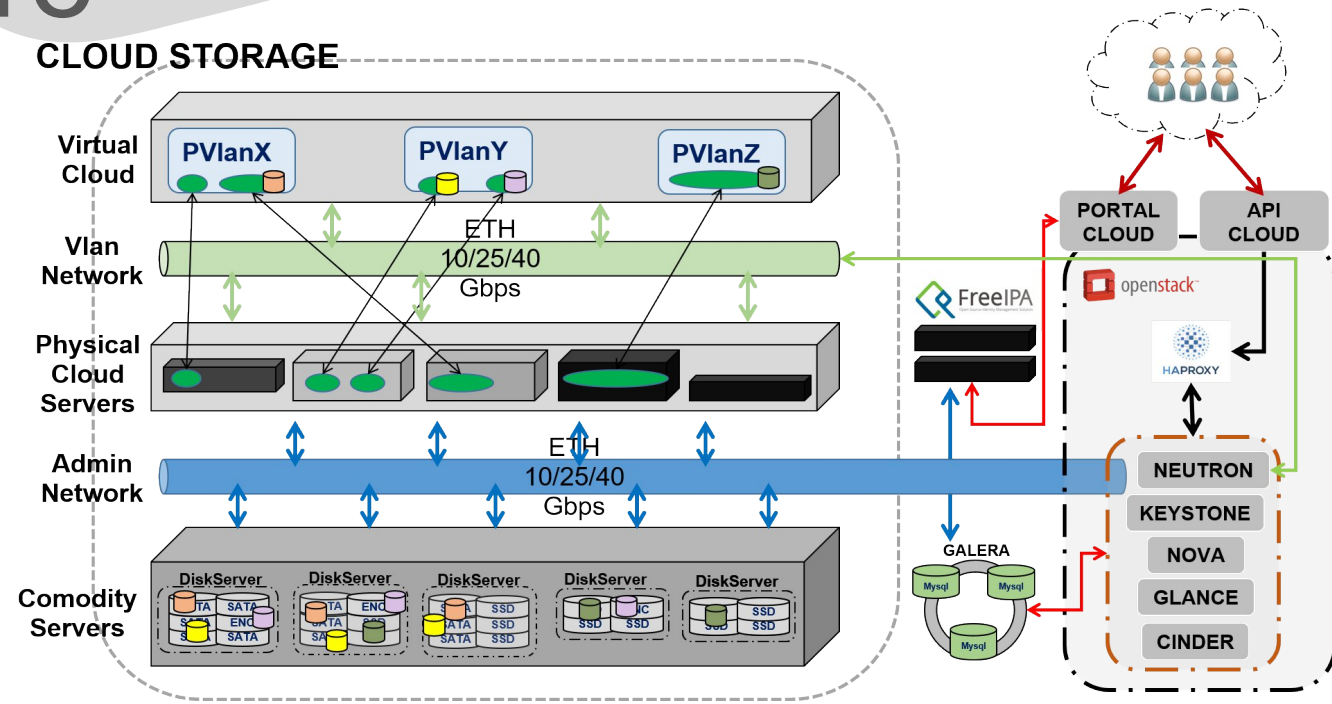
HPC



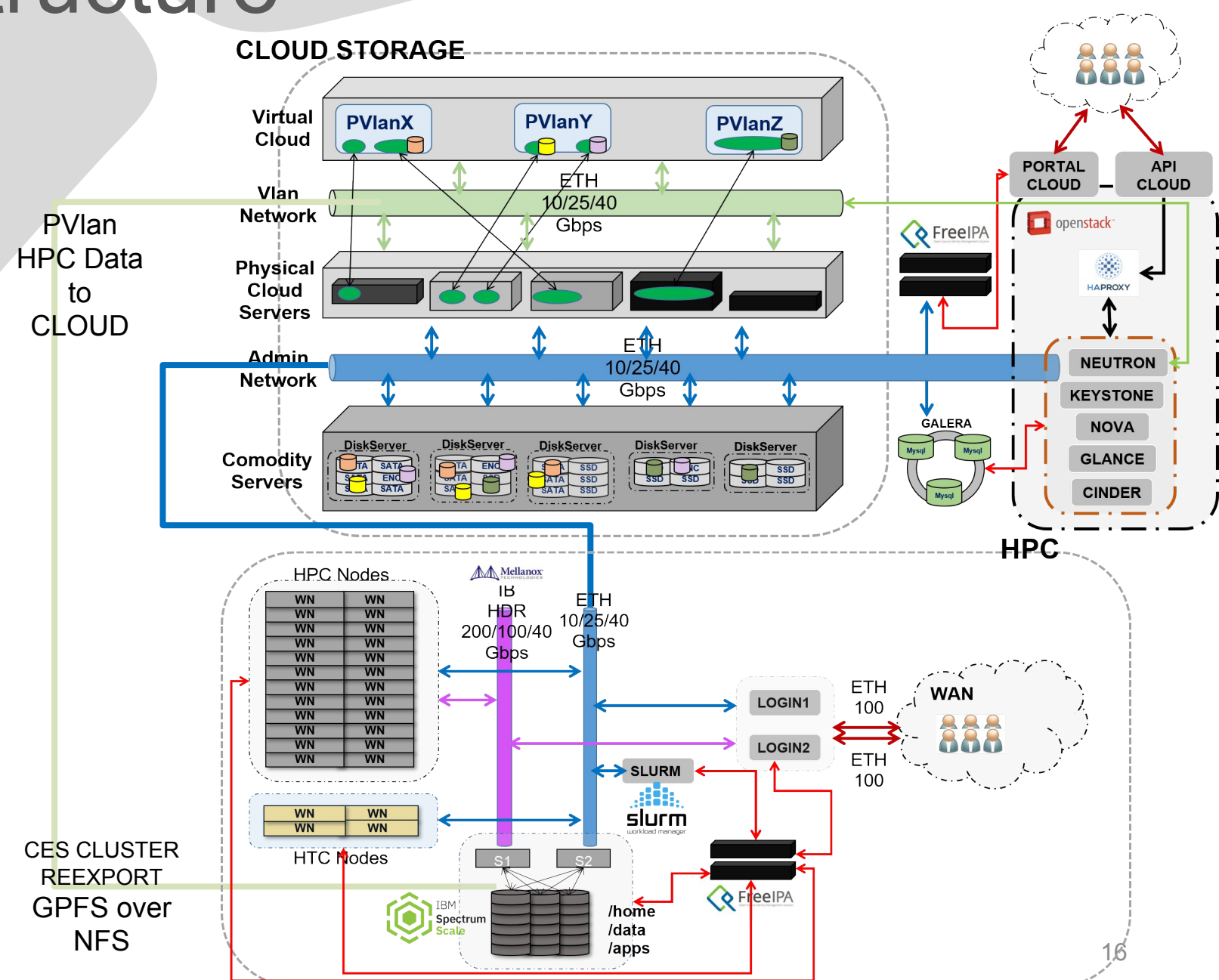
Central Service Infrastructure



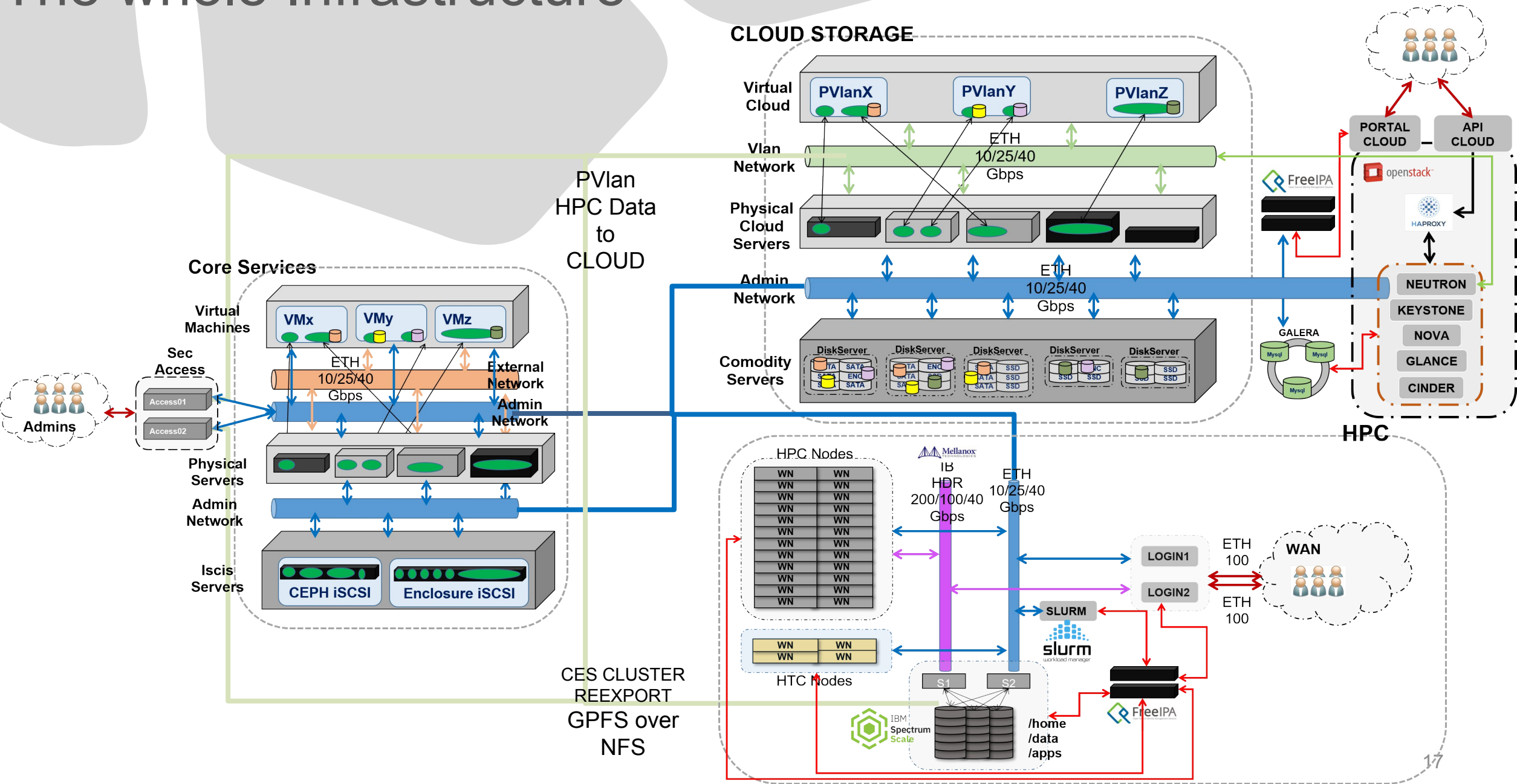
The whole Infrastructure



The whole Infrastructure



The whole Infrastructure



ISO27001: Standard that establishes the **policies** and **procedures** to ensure the Integrity, Confidentiality and Availability of Information, data and all systems involved in the process

1

Background

- Several attempts to try to implement some standard
- Non-standard and non-compliant operational procedures
- Computing service already certified with ISO9001

3

Problem

- **Abandoned developments:** Lack of time/resources or change of activity of the person
- **Individually role assignment:** lack of group-knowledge of the center's operating, management and implementation procedures
- **No Information Security Management:** Resources and tools, in most cases are not managed and/or configured correctly
- **Yearly auditory:** the economic, material and personal resources prolonged in time

5

Good practices: Following ISO27002

- ISO27002:** establishes **14 domains, 35 objectives and 114 controls** -> Use of hardware equipment, software tools (open-source and recycling of the tools already implemented) and admin experience
- **Policies** (e.g. risk assessment, software mngt, Business continuity plan, role assignment, etc.) and **operational procedures** (e.g. use management, storage, backup, mobile devices, access control, etc.)

2

Analysis

- Identify the **assets** of the computing service
- **SWOT analysis** (Strengths, Weaknesses, Opportunities, and Threats) to obtain our both internally and externally asset factors
- Perform a **risk analysis** to plan the response to know, assume and minimize these risks

4

Objectives

- **External:** Promote the quality and prestige of the institution and/or the service to the outside world in a certified manner
- **Internal:** define and organize the service, assigning responsibilities, establishing policies and procedures against the risks faced by a Datacenter in its daily operations

6



Auditing and Certification

National Security Schema (ENS)

- The National Security Scheme (ENS) is regulated by Royal Decree 3/2010, of January 8, 2010, which regulates the National Security Scheme in the field of Electronic Administration in Spain.
- **Mandatory for public administrations**
- Different security levels (basic, medium and high)
- Establishes policies, procedures and controls (<https://ens.ccn.cni.es/ens-html/index.html>)

1

Security governance: Contains controls related to security policy, security responsibility and functions, and security coordination.

Risk management: Procedures for the identification, evaluation and treatment of risks.

Service protection: Controls to ensure service continuity in the event of incidents or adverse situations.

3

Personnel management: Includes aspects such as selection, training, awareness and responsibilities of personnel in relation to security.

Procurement of products and services: Controls to ensure that purchased products and services comply with security requirements.

Security incident management: Procedures for responding to security incidents, from detection to resolution.

2

Integrity: Measures to ensure that information and services are not altered without authorization.

Confidentiality: Measures to protect information against unauthorized disclosure.

Availability and robustness: Ensuring that information and services are available when needed, and that systems are resilient.

Traceability: Ensuring that relevant activities related to information and services can be reconstructed.

4

Business recovery: Measures and procedures to restore services and information after an incident.

Technical security measures: Technical controls for the protection of information and services, including authentication, access control, cryptography, malware protection, network security and other technical aspects.

Maintenance and costs

- Critical equipment that must be maintained
 - After your warranty the maintenance cost is around 10-30% of the value per year.
 - SAIs : 2 SAIs 30KVAs 50000€ (maintenance 5000 €)
 - Network: 3 SW + Router 65000€ (maintenance 12.000€)
 - Refrigeration systems: 2 equipment 80.000€ (maintenance 6.000€)
 - Fire extinguishing system (maintenance UC)
 - Storage System: ~2PB 250.000€ (maintenance 30.000€)
 - Other general Services: 50.000€
- Staff
 - **Should be structural** and not paid on a project basis.
 - 1 E2 - 18k€ (+30%)
 - 1 M2 - 26K€ (+30%)
 - 1 M3 - 31K€ (+30%)
- Compute Nodes
 - Bidding documents and centralized purchasing can be your friend
 - 50 nodes HPC (including switches, cabling, dual power supply etc.): ~500.000€
 - Should be replaced every 3 - 5 - 7 years (depending on funding)
- Power
 - 100Kwh ~ 15.000€ month ~ 180K€ year

Thank you all very much!

