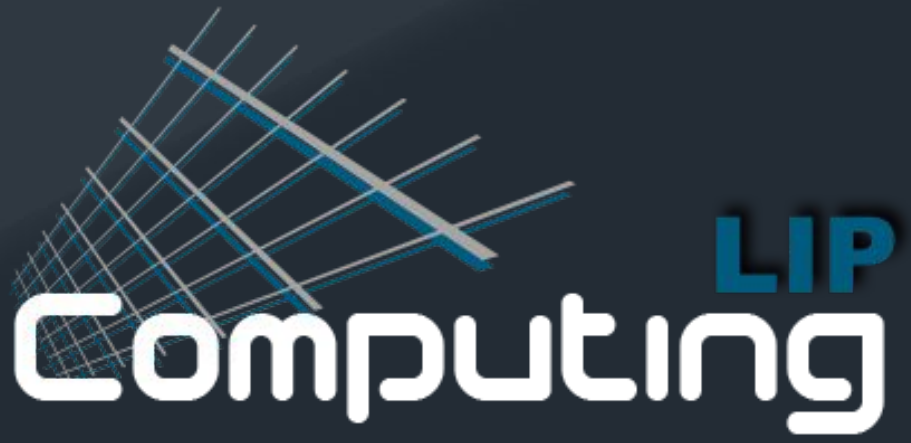



Joao Pina (jpina@lip.pt)

# LIP

- Portuguese scientific research laboratory
  - Associated  laboratory created in 1986
  - Mainly funded by the Portuguese public funding agency (FCT)
  - Private non-profit association
  - Rated as “Excellent” in 3 successive evaluations from international advisory committee
- More than 170 collaborators
  - 70 PhDs (university professors and independent researchers)
  - Multidisciplinary engineers and technical staff (physics, IT mechanics, electronics, etc…)

# LIP Partnerships and Activities

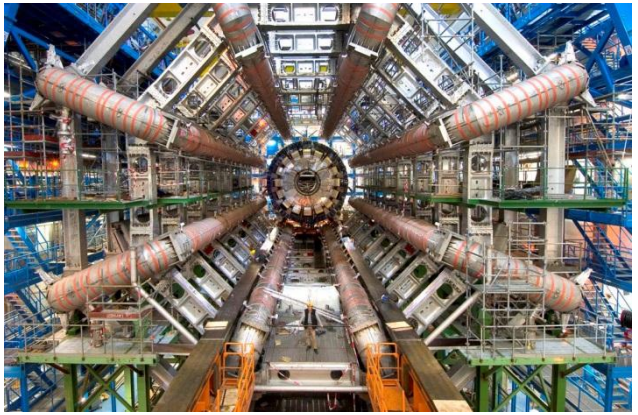
- CERN (European Laboratory for Nuclear Research)
  - ATLAS, CMS, Compass research programs
  -
- Pierre Auger Cosmic Ray Observatory
  - Auger  research program
- ESA (European Space Agency)
  - Contracts focused on “Space Radiation Environmental Effects”

# LIP Partnerships and Activities

- Dark Matter / Dark Energy Collaborations
  - AMS, Zeppelin research programs
- EGI and Advanced Computing
    - Operation of  HTC / HPC services
    - E-Science Research (Workflows, Grid Computing, Big Data, green technologies)
- Other Activities
  - Data acquisition systems, particle detectors, detectors R&D, medical physics, Monte Carlo simulations (GEANT4)
  - Electronics, precision mechanics

# Computing @ LIP

- The LIP computing group provides IT services to LIP and its research groups
  - Integrated management of all scientific computing resources
  - Typical IT services for users and administrative services
  - Support LIP physics research projects
- R&D mostly in distributed computing
  - e-Science and e-Infrastructures
  - Grid Computing (driven by WLCG)
  - Cloud Computing
- Technical coordination of INCD



# IT Competence

## GRID

- Batch systems (SGE, Torque, MAUI)
- Parallel computing
- Infrastructure planning deployment and coordination
- High Performance Filesystems (Lustre, GPFS)
- Middleware management
- Datacenter power management

## CLOUD

- Implementations (OpenNebula, OpenStack)
- Federated Clouds

## General IT

- Systems management (Linux, FreeBSD, Windows)
- Network Management and Security
- Virtualisation (KVM and Xen)
- Security, Incident and Vulnerability management (GRID CSIRT)
- Authentication, Authorization, digital certificates (IGTF and EugridPMA)
- Databases and information systems
- Web applications
- Open Source Software and Solutions

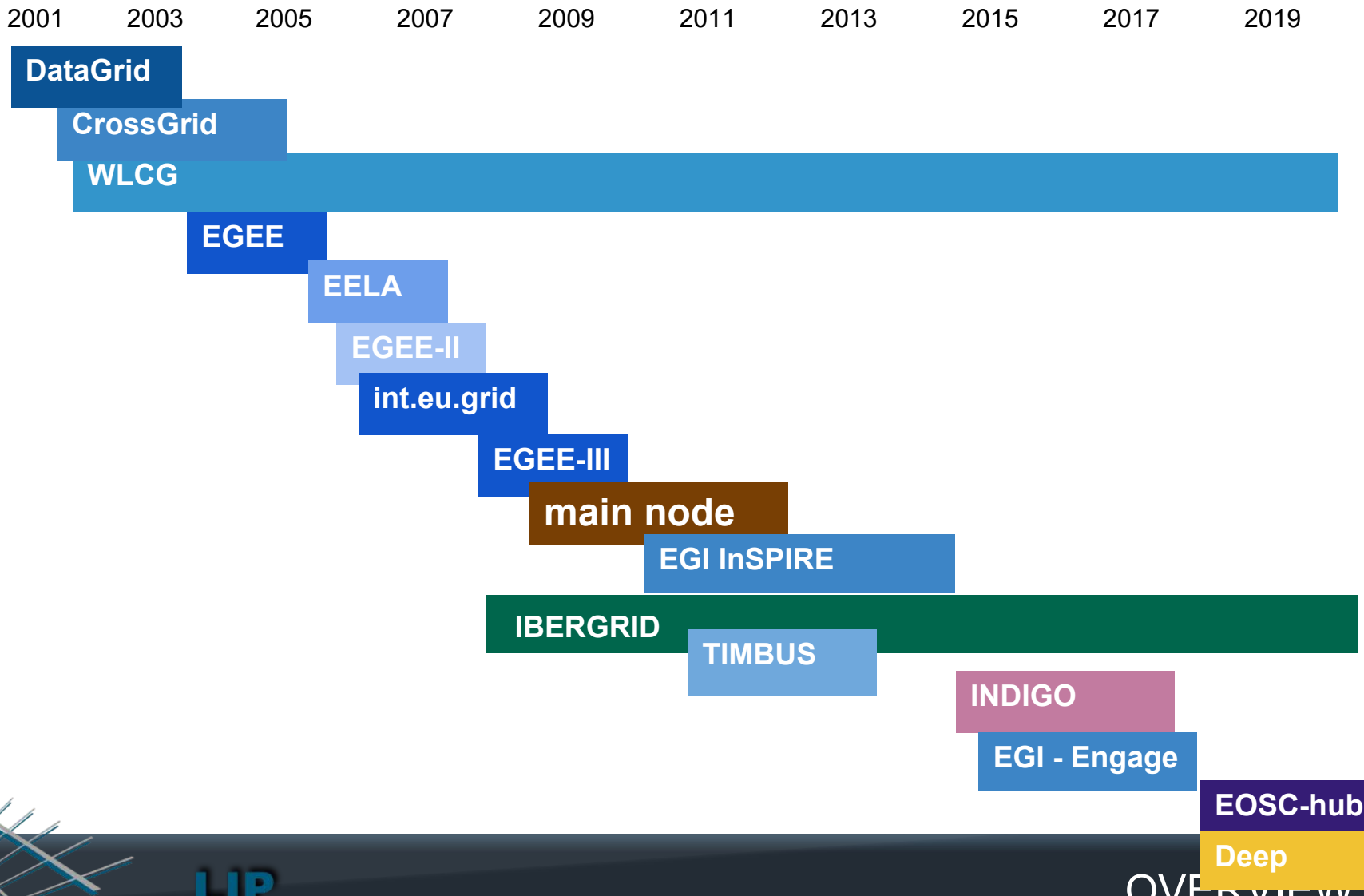
# Projects and Initiatives

# E-science research activities

- Participation in several national and international Distributed Computing Infrastructure (DCI)

- General interests:
  - Data management and  big data challenges
  - Application profiling
  - Grid middleware development and testing
  - Operation and monitoring of distributed resources
  - Redundancy and failover of services at global scale
  - Cloud / Grid Interoperability and standards

# History of Projects and Initiatives

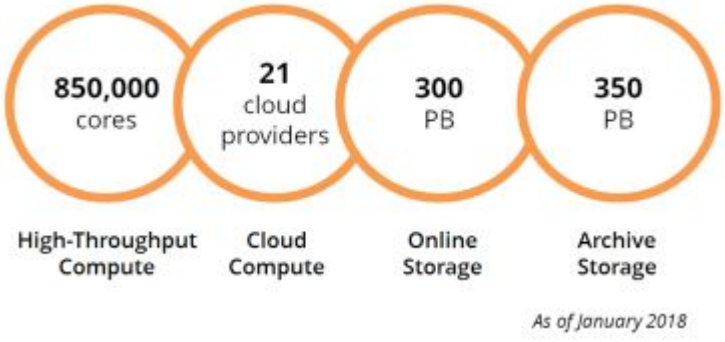


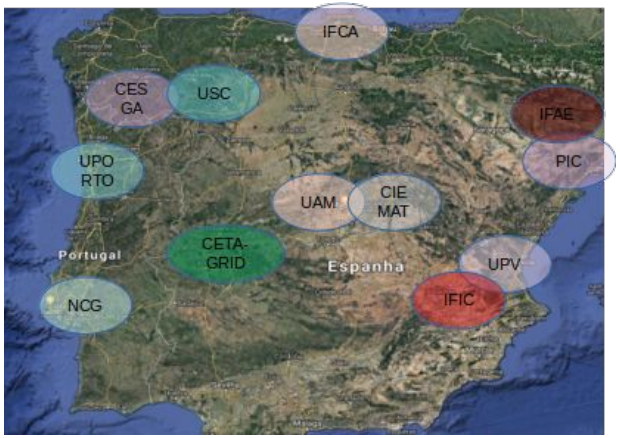
# EGI

## European Level

- Federation of cloud providers and data centers to deliver computing service to research
  - Biomed, chemistry, oceanography, fusion…
- Leading edge grid infrastructures
- Integrating computing resources
- Infrastructure coordination

- Users: 21,700 grouped into 233 Virtual Organisations (VOs)



# LIP in the EGI

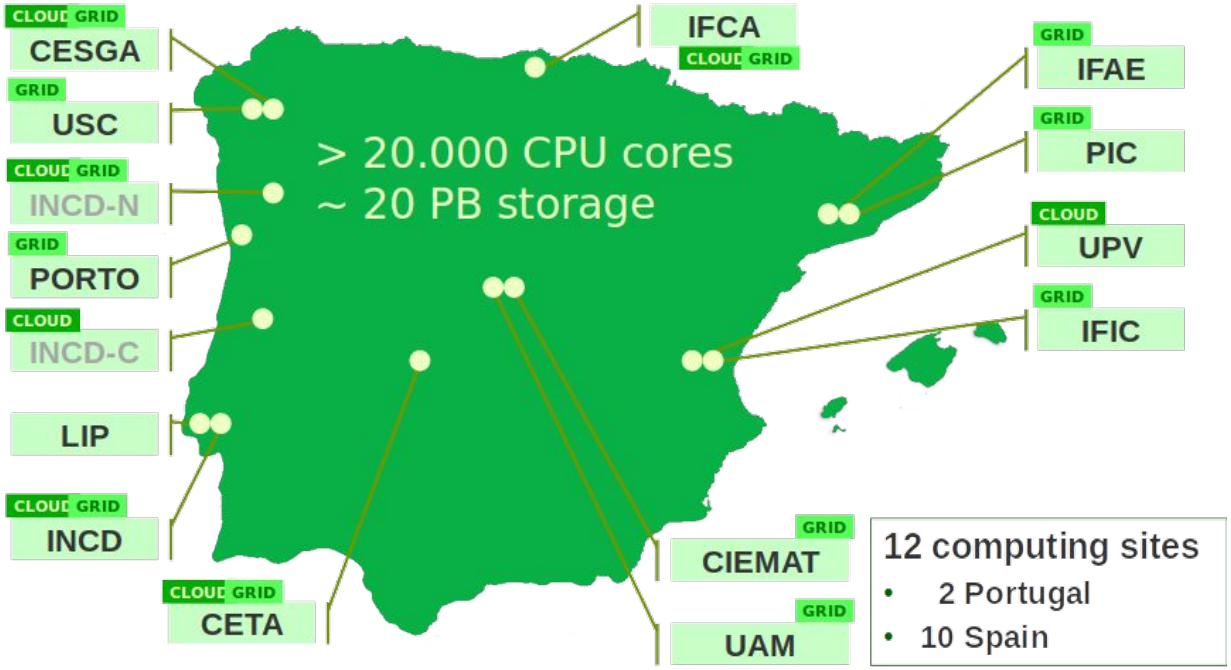
- LIP is partner in many EGI projects
- Main tasks:
  - Global Coordination of the middleware rollout process
  - Quality criteria definition and validation for the middleware (SQA)
  - Coordination/management vulnerabilities and intrusions both in the region and at European level
  - Regional support for users and sites  for all Iberian region

# EOSC

- LIP is the responsible for the Change Manager, Release and Deployment and Configuration management roles in EOSC
- Thematic service (OpenCoast) in partnership with LNEC

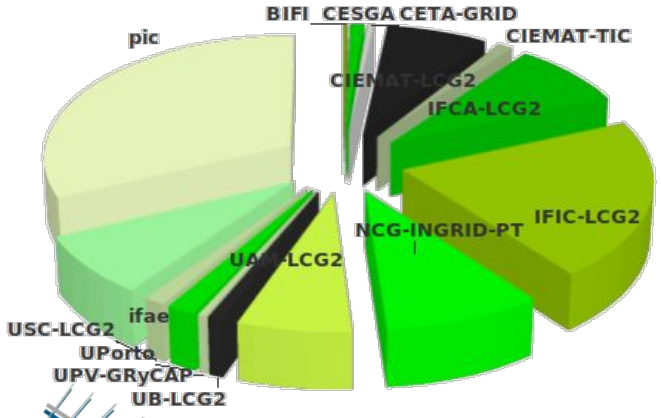
# IBERGRID

## Joins PT + ES science datacenters:




LIP

Shared Infrastructure coordination together with policy, training, dissemination and relations with user communities




## GRID JOBS

- From 2006 to 2018

# LIP IT infrastructure

- LIP has the largest scientific computing infrastructure in the country:
  - Owns two computer centres in Lisbon and Coimbra
  - Operates a third centre (trough INCD) in partnership with FCCN (NREN) and LNEC
  - Provides the baseline infrastructure for a national service for multidisciplinary research.

# LIP Centre's

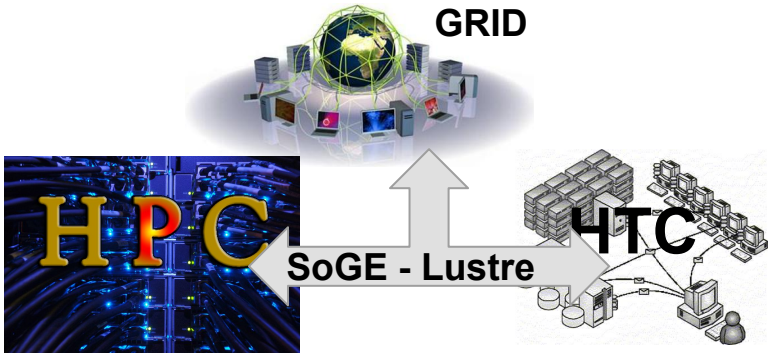
- LIP-Lisbon
  - Storage Lustre, NFS, AFS, OCFS, GFS
  - Offline storage (tape libraries)
  - Standard IT services for the LIP users
- LIP-Coimbra
  - Computing Farm (Torque+Maui)
  - Storage Lustre, NFS
  - Simulation and data analysis for local projects

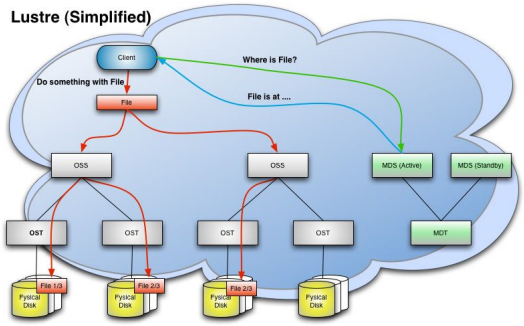
# INCD - Infraestrutura Nacional de Computação Distribuída

- Goals:
  - Provide **computing** and **data services** for the research community.
  - Support participation:
    - **All national researchers.**
    - **Large international projects.**
    - **Infrastructures** (including CERN/LHC, ESFRIs).
    - **Other** research projects.

# INCD - Computing Services

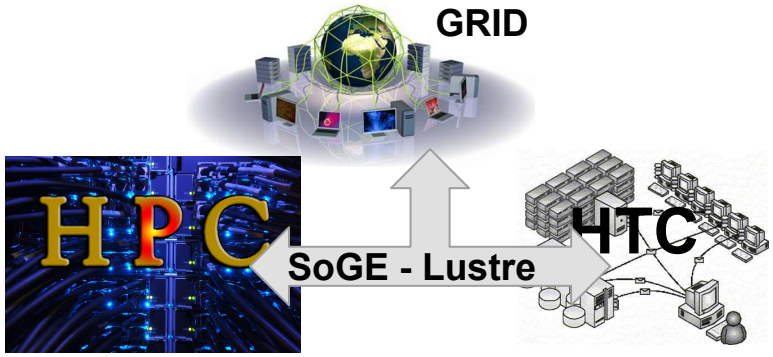
- **Cloud computing** - Virtualization, highly customizable environments (Operating Systems, Software and libraries), services and platforms.
- **HTC** - High Throughput Computing - Applications that run inside a single node, single core, multicore, large memory (>500GB), applications for GPUs (CUDA). (Use of a batch cluster).
- **Grid** - federates geographically distributed data centers
- **HPC** - High Performance Computing - applications that use several nodes, parallel (MPI). (**Use of a batch cluster**).
  - Use “Low Latency Interconnects” such as Infiniband for fast communication between processes running in different nodes.

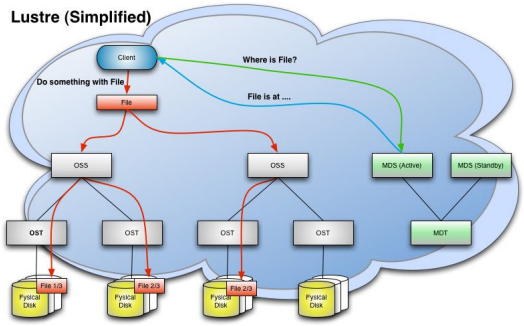



# INCD - Data Services


- **Cloud -** CEPH filesystem: block and object storage. Highly redundant. Provides large storage for cloud instances.
- **HTC and HPC:**
  - Lustre distributed and parallel file system, for users input and output data, visible in all compute nodes.
  - NFS for users homes and Software area.

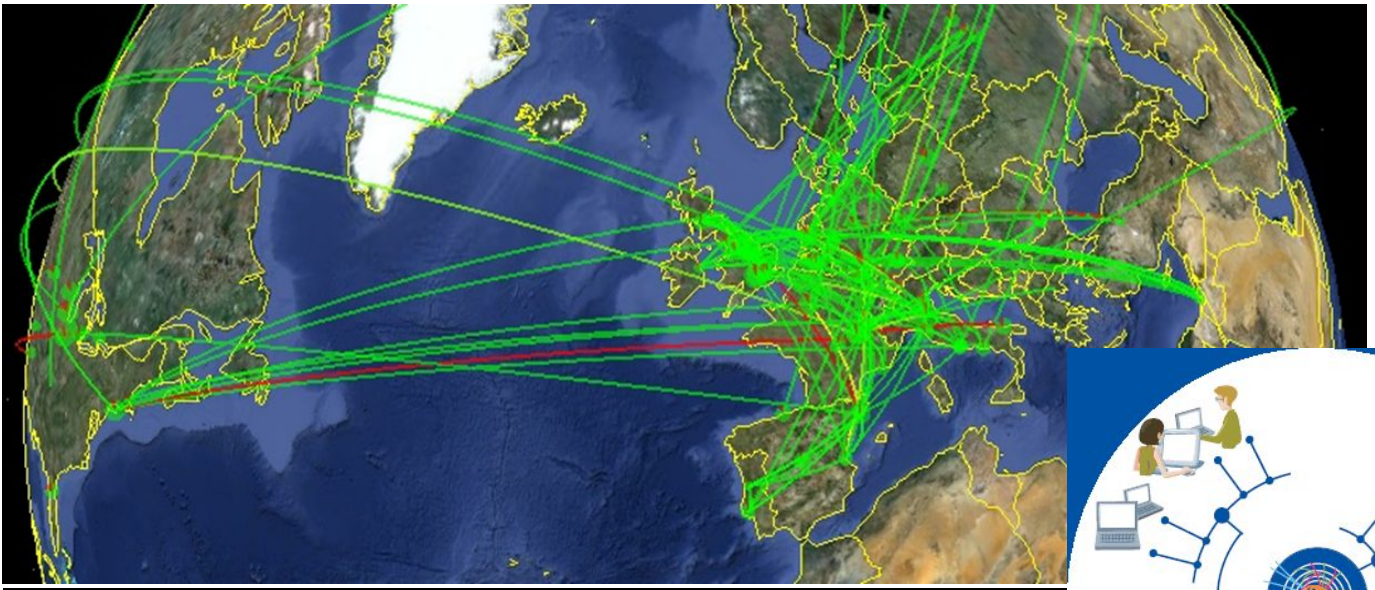


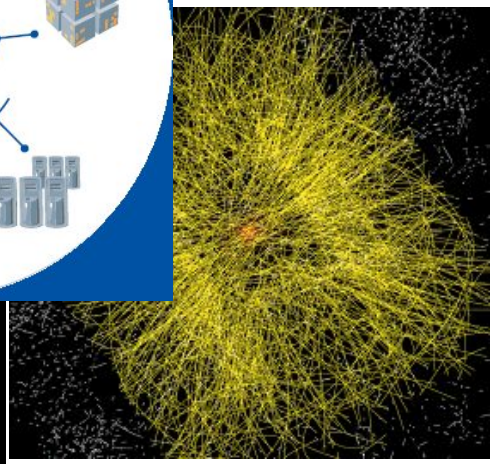



# LIP - use cases

- LIP Tier-2 (High Energy Physics) WLCG
- OpenCoast (Earth Science) EOSC
- CoastNet (Environmental Sciences) Portuguese e-infrastructure roadmap
- udocker (Scientific Computing) INDIGO
- DevOps for Containers (Computing) INDIGO

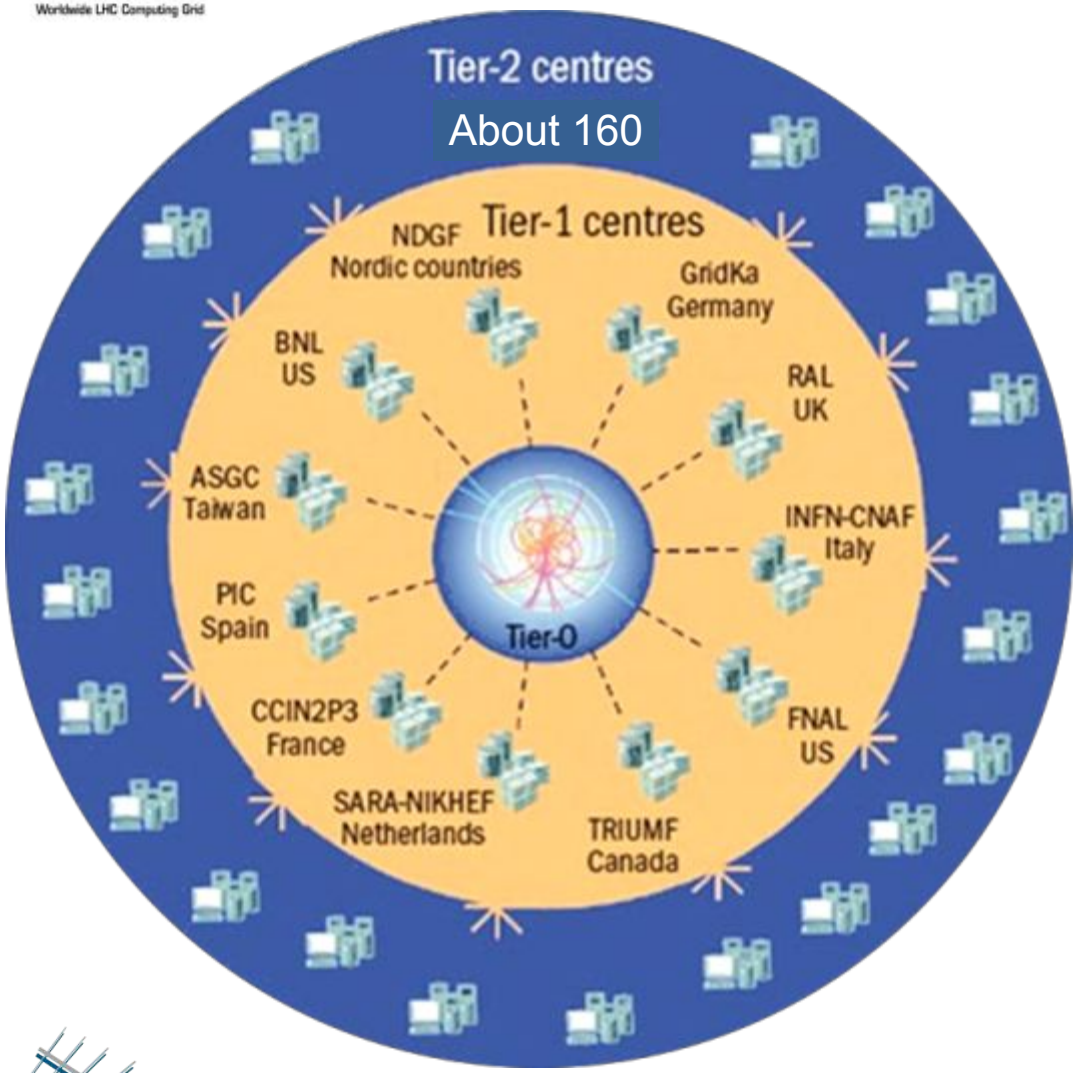
# Worldwide LHC Computing Grid





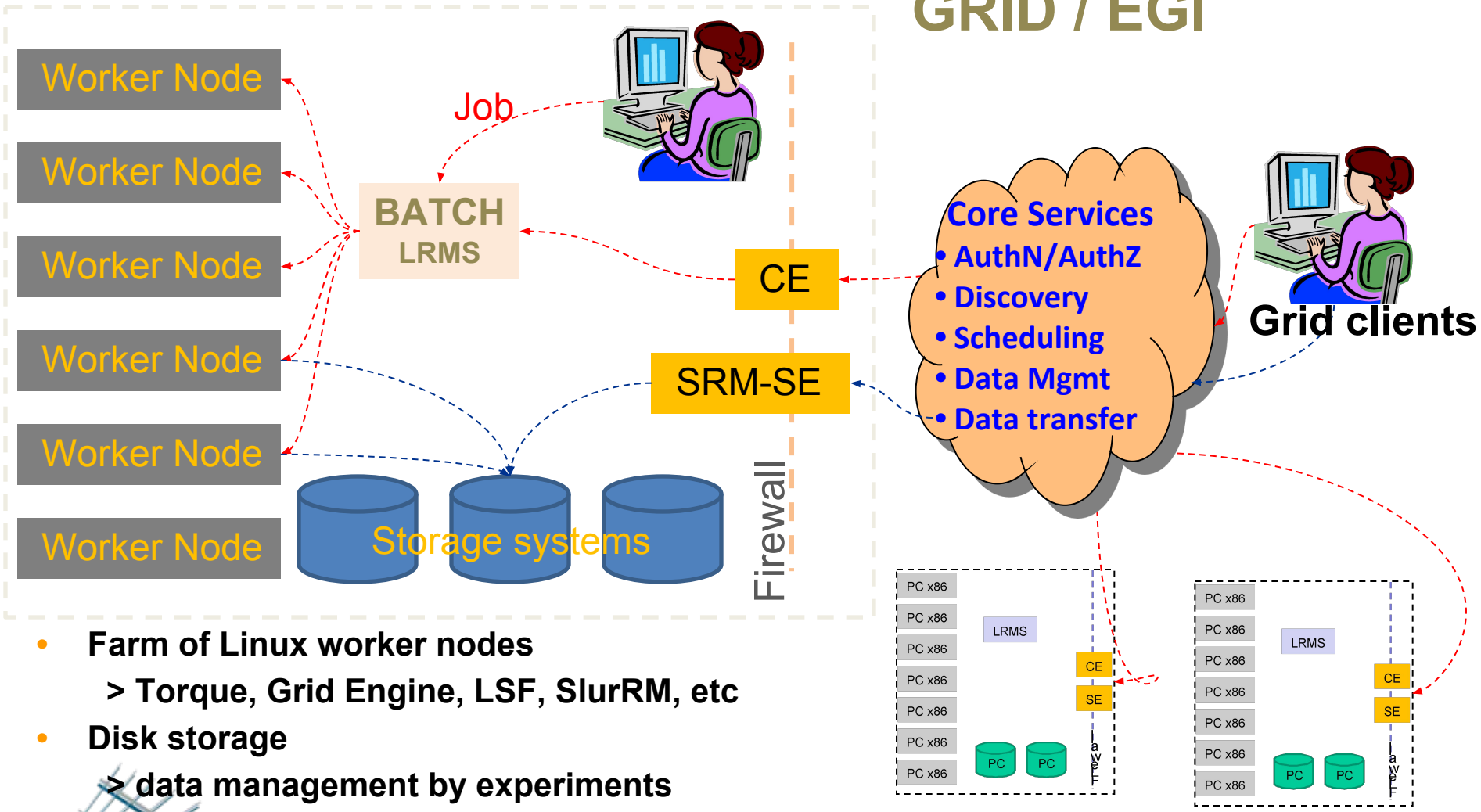
- **Data complexity:**
  - **4 experiments (ATLAS, CMS, ALICE, LHCb)**
  - **Total 15 PetaBytes per year**
- **Global scale**
  - **36 countries**
  - **170 data-centre's with more than 10000 users and 300.000 CPUs**
  - **Distributed analysis and simulation**
  - **Grid Computing**

# WLCG architecture





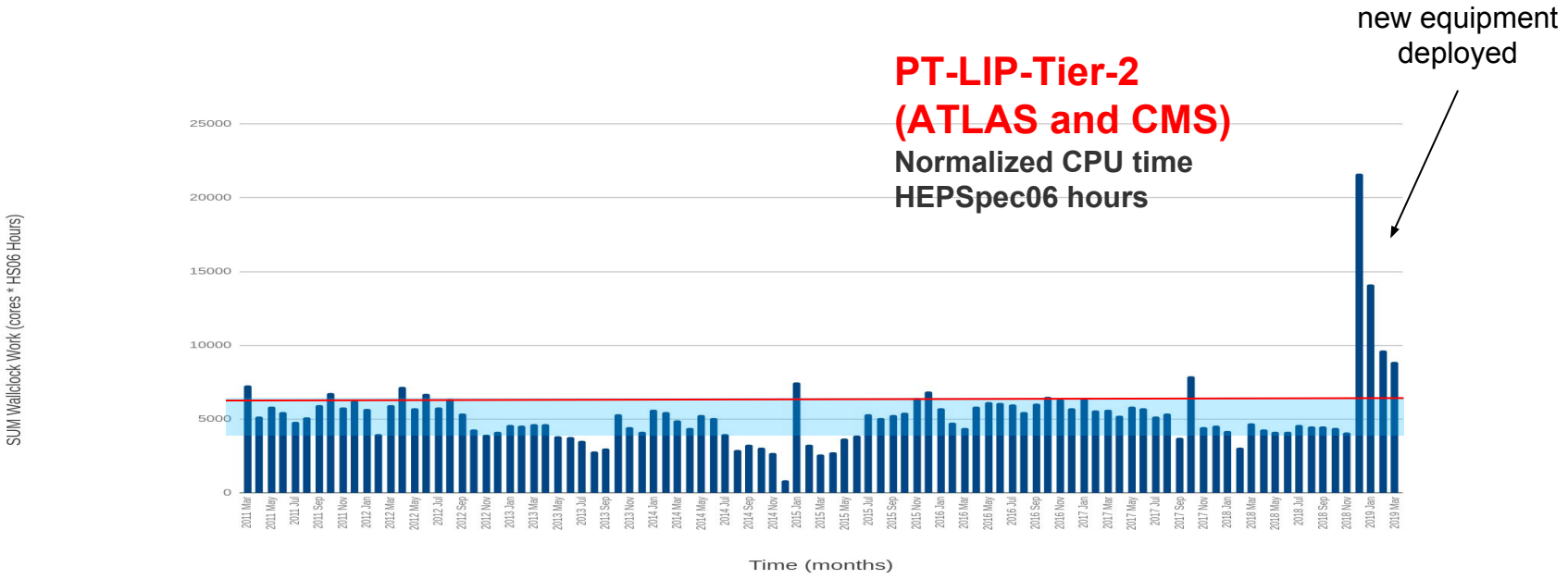

# Grid Concept




- **Farm of Linux worker nodes**
  - **> Torque, Grid Engine, LSF, SlurRM, etc**
- **Disk storage**
  - **> data management by experiments**

# LIP in the WLCG

- **LIP federated Tier-2:**
  - **Operation, provisioning of resources and services together with user support**
- **Development of the distributed computing infrastructure**
  - **architecture and benchmarking**
- **Authentication and Authorization**



# OPENCoastS

**OPENCoastS provides on-demand forecasts and simulation of ocean waves and circulation in the European Atlantic coast**

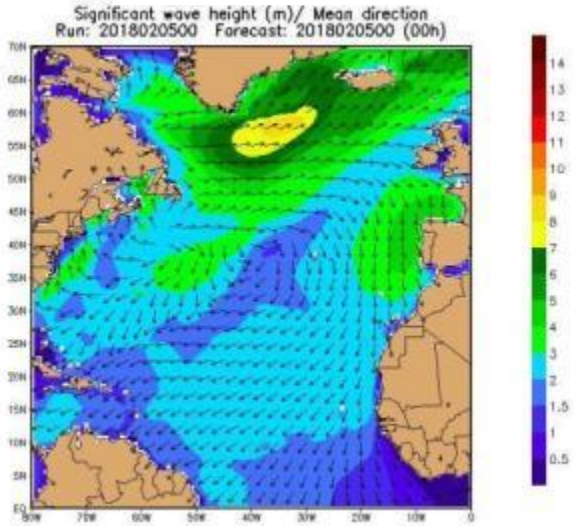
- Selected for the European Science Open Cloud
- **LIP**, **LNEC**, Univ of Cantabria, Univ of la Rochelle
- Research, authorities, engineering, planning

**Technologies:**

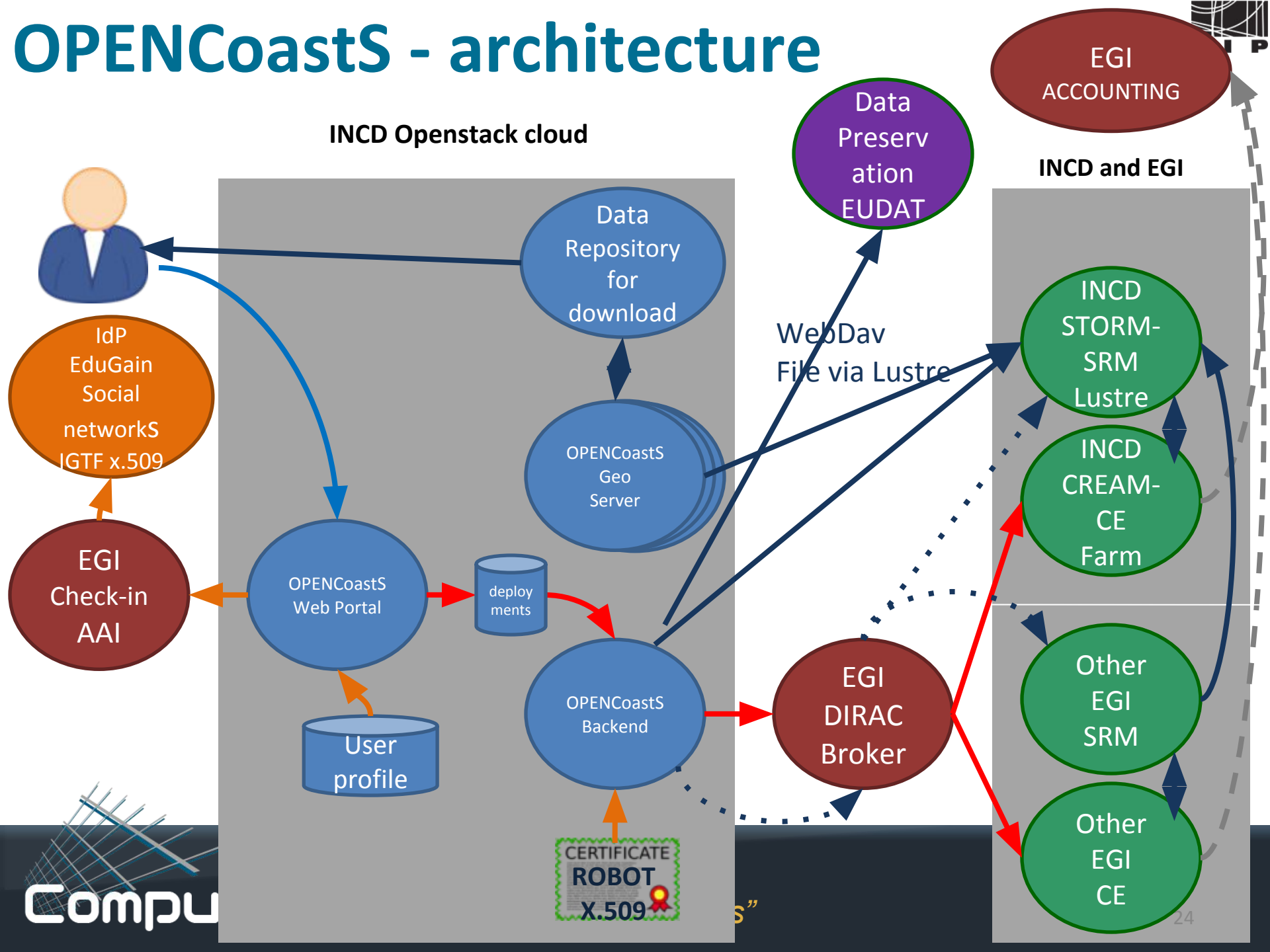
- SCHISM model
- Cloud Computing
- Grid computing
- Parallel computing
- Data management
- Big data

**Data:**

- Buoy sensors
- Satellite images
- Weather info
- etc

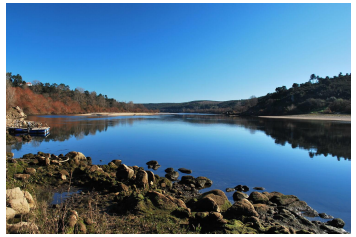


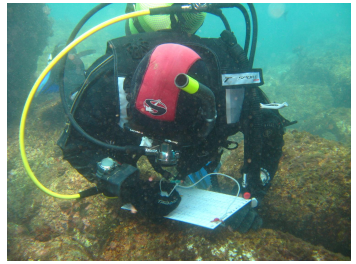
# OPENCoastS - architecture



# CoastNet

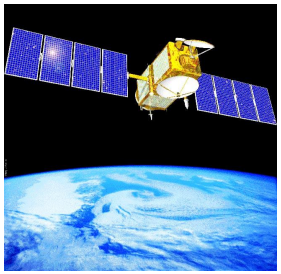
- COASTNET: research infrastructure for coastal marine ecosystems and part of the portuguese roadmap for infrastructures
  - Coastal remote monitoring
    - Physical constants
    - environmental and ecological
    - Fauna migrations
- all data aggregated in platform available for all scientific community and public administration

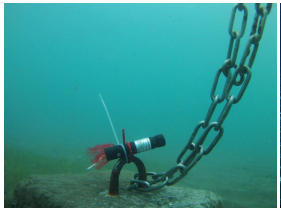


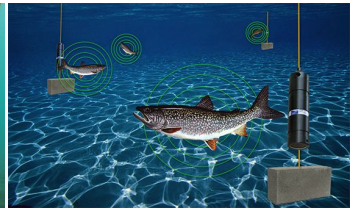


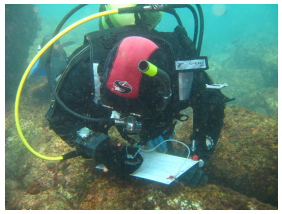
4) a plataforma web que integrará e processará os dados recolhidos

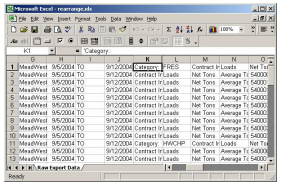
CoastNet









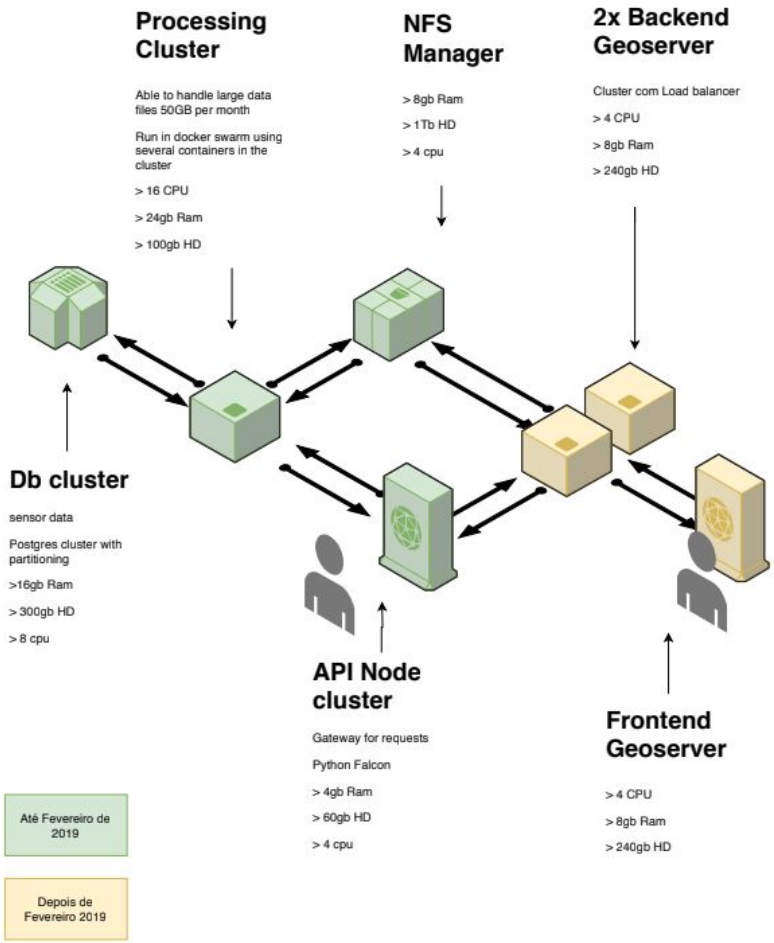


Platform for data aquisition, processing and long term storage

webUI

Researchers
Students
Public Administrations
Private sector

# CoastNet - architecture



# udocker - Rootless Containers

## Execute Docker containers everywhere

- INDIGO, EOSC, DEEP HybridDataCloud
- Execute Docker in batch systems, HPC and HTC transparently
- no docker, no installation, no privileges, download and run
- Open source available in: https://github.com/indigo-dc/udocker

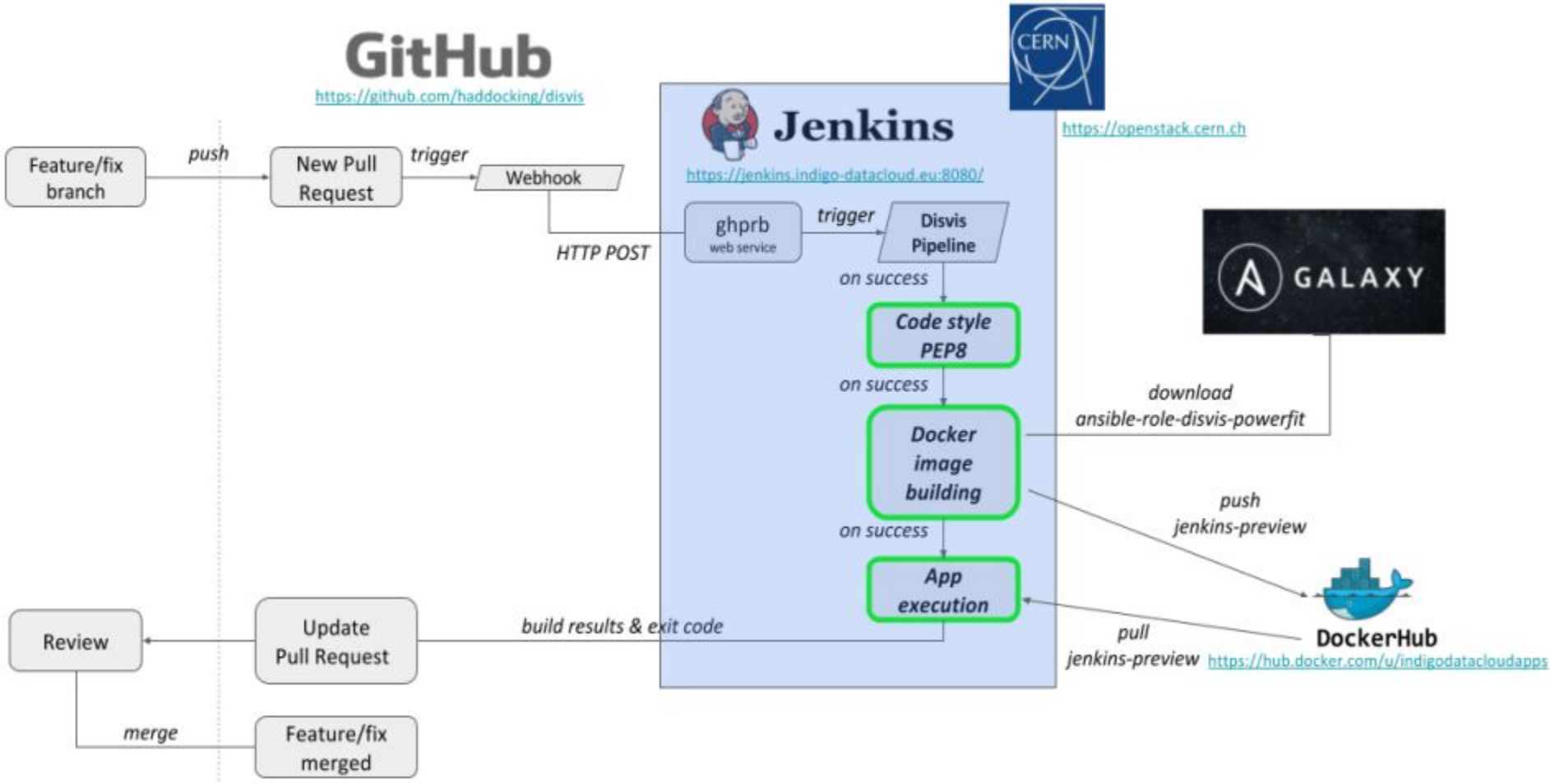
**Technologies:**

- Docker containers
- PTRACE, SECCOMP
- Library interception
- OpenContainers
- etc

**Usage:**

- Many communities
- DEEP HybridDataCloud
- INDIGO-DataCloud
- EOSC

# DevOps for containers



# Links

- LIP – www.lip.pt
- INCD - www.incd.pt
- EGI – http://www.egi.eu/
- WLCG - http://wlcg.web.cern.ch/
- IBERGRID http://ibergrid.lip.pt http://www.ibergrid.eu/
- LIP-COMPUTING - https://www.lip.pt/computing/
- EOSC https://www.eosc-portal.eu/