



Enabling Discovery In Research With Cloud Technologies

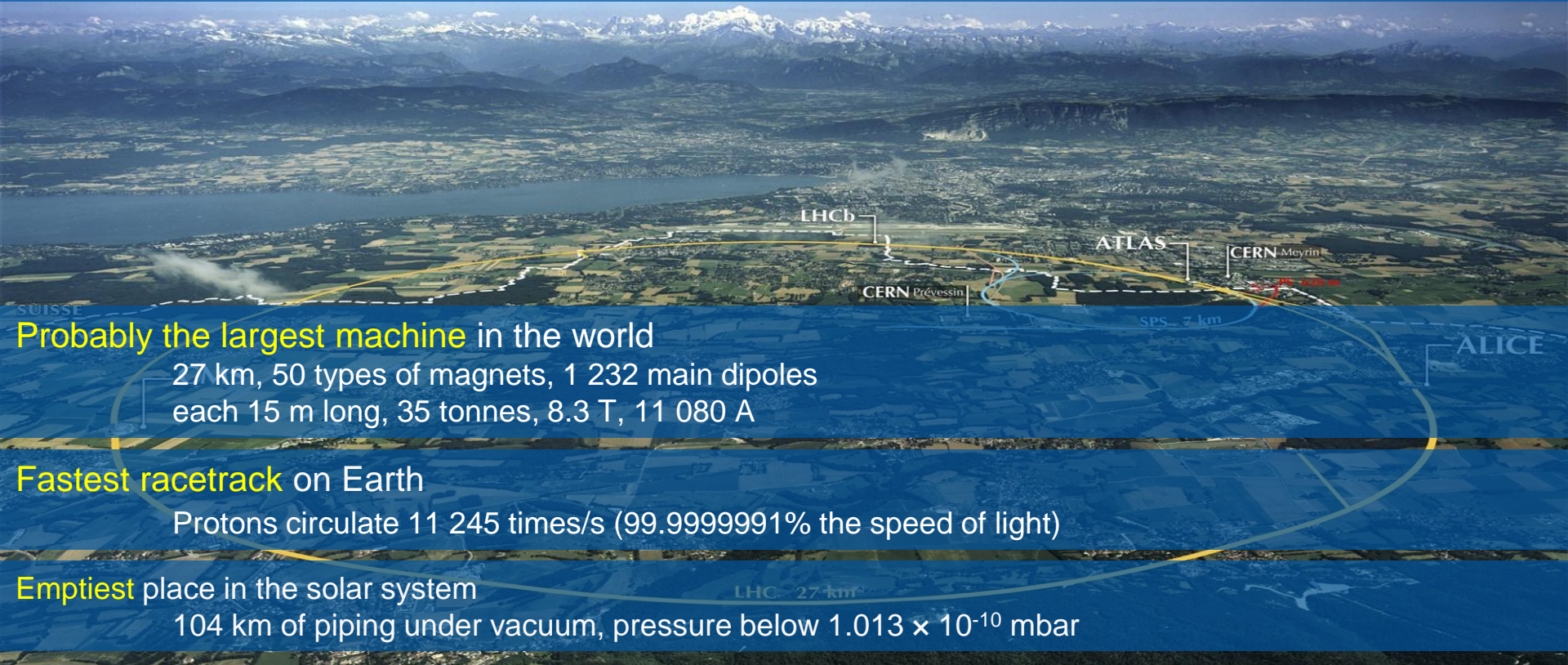
CERN

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Brief introduction to CERN

- European Council for Nuclear Research
- Founded in 1954 for fundamental physics research (initially 12 member states)
- Today 23 members states (see <https://home.cern/about/member-states>) and world-wide collaborations
- Missions:
 - Fundamental research on matter and forces
 - Technological innovation
 - Diversity and bringing nations together
 - Inspiration and Education
 - (More information at <https://home.cern/about>)
- Can be visited, <https://visit.cern/>

The Large Hadron Collider (LHC)



Probably the largest machine in the world

27 km, 50 types of magnets, 1 232 main dipoles
each 15 m long, 35 tonnes, 8.3 T, 11 080 A

Fastest racetrack on Earth

Protons circulate 11 245 times/s (99.9999991% the speed of light)

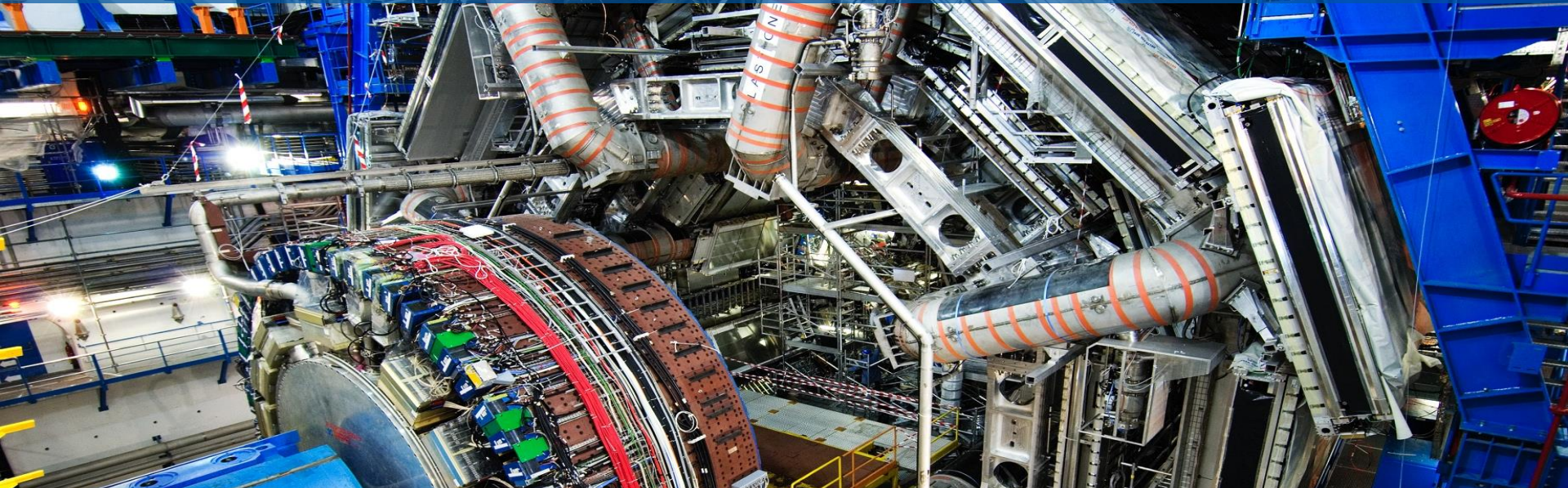
Emptiest place in the solar system

104 km of piping under vacuum, pressure below 1.013×10^{-10} mbar

Hottest spot in the galaxy

During lead ion collisions create temperatures 100 000x hotter than the heart of the sun

The ATLAS detector (as an example for the 4 LHC experiments)

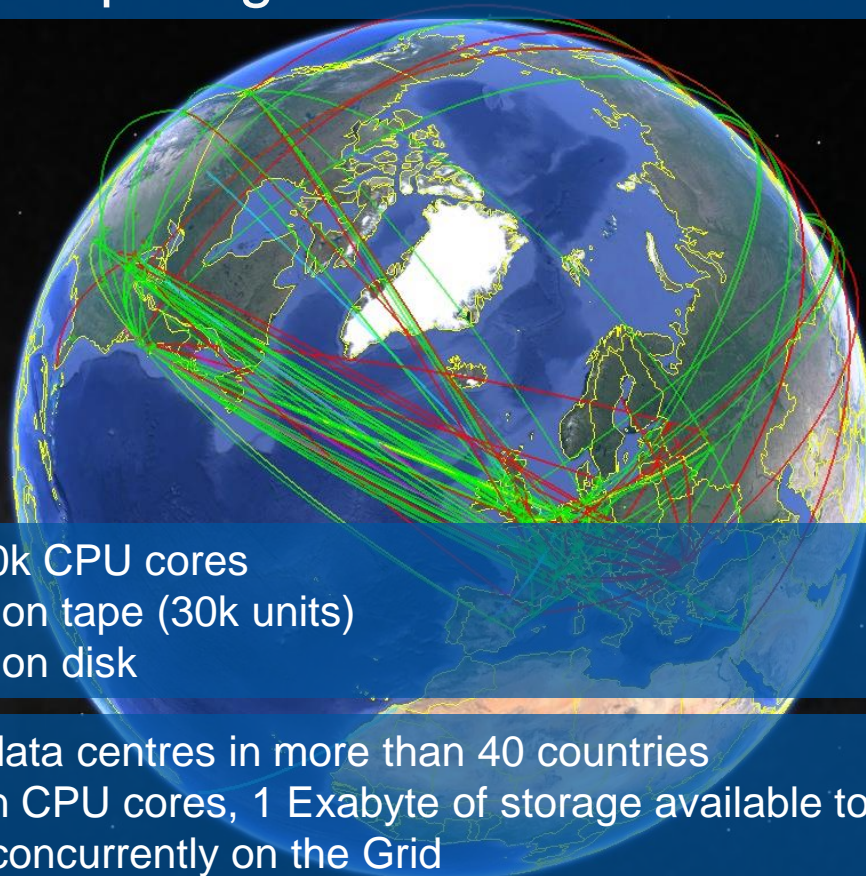


~100 Million electronic channels
Control and detection sensors

Large amount of data
Capturing 40+ million collisions per second
Several layers of filtering
2018: 88 PB of LHC experiments data

Worldwide LHC Computing Grid

Running jobs: 214268
Transfer rate: 42.74 GiB/sec



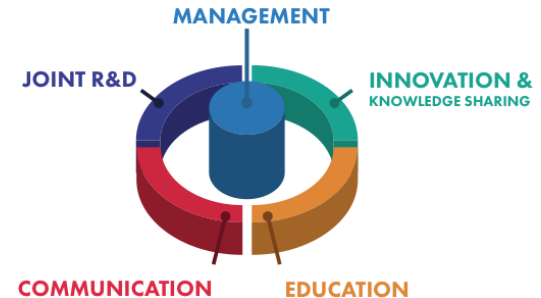
CERN 17k servers, 300k CPU cores
400PB capacity on tape (30k units)
280PB capacity on disk

(February 2020)

WLCG more than 170 data centres in more than 40 countries
close to 1 Million CPU cores, 1 Exabyte of storage available to the LHC experiments
>300k jobs run concurrently on the Grid
Global transfer rates regularly exceed 50GB/s (2019)

CERN openlab

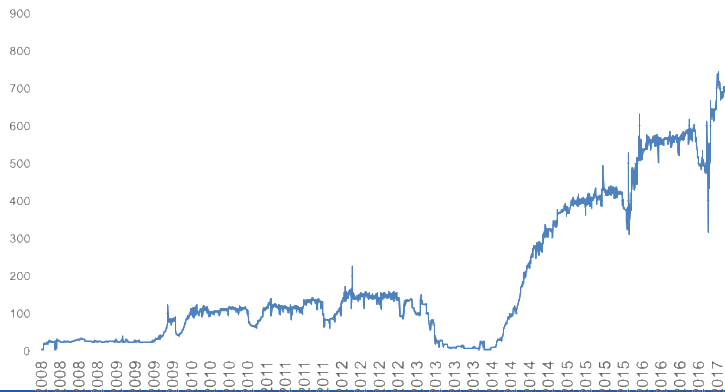
- Public-private partnership, through which CERN collaborates with leading ICT companies and other research organizations
 - Evaluate state-of-the-art technologies in a challenging environment and improve them.
 - Train the next generation of engineers/researchers.
 - Promote education and cultural exchanges.
 - Communicate results and reach new audiences.
- Oracle is a member since 2003



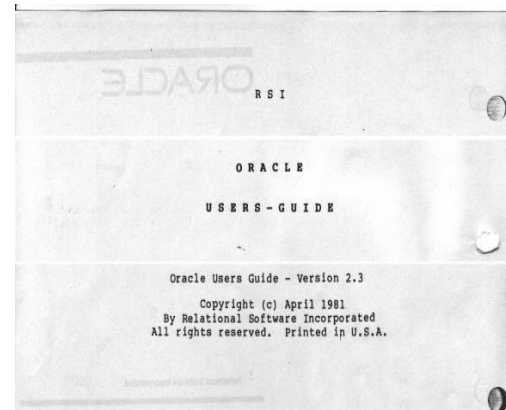
Oracle at CERN

- Since 1982 – version 2.3
 - Initially used for accelerator controls
- Examples of critical production DBs:
 - Quench Protection System: 150'000 changes/s
 - QPSr > 150TB redo / month

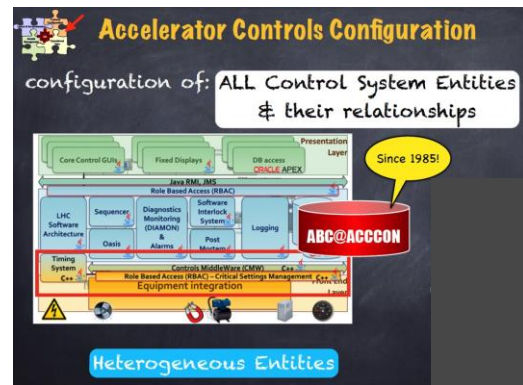
Size in GB/day - LDB



ACCLOG, credit: N. Tsvetkov

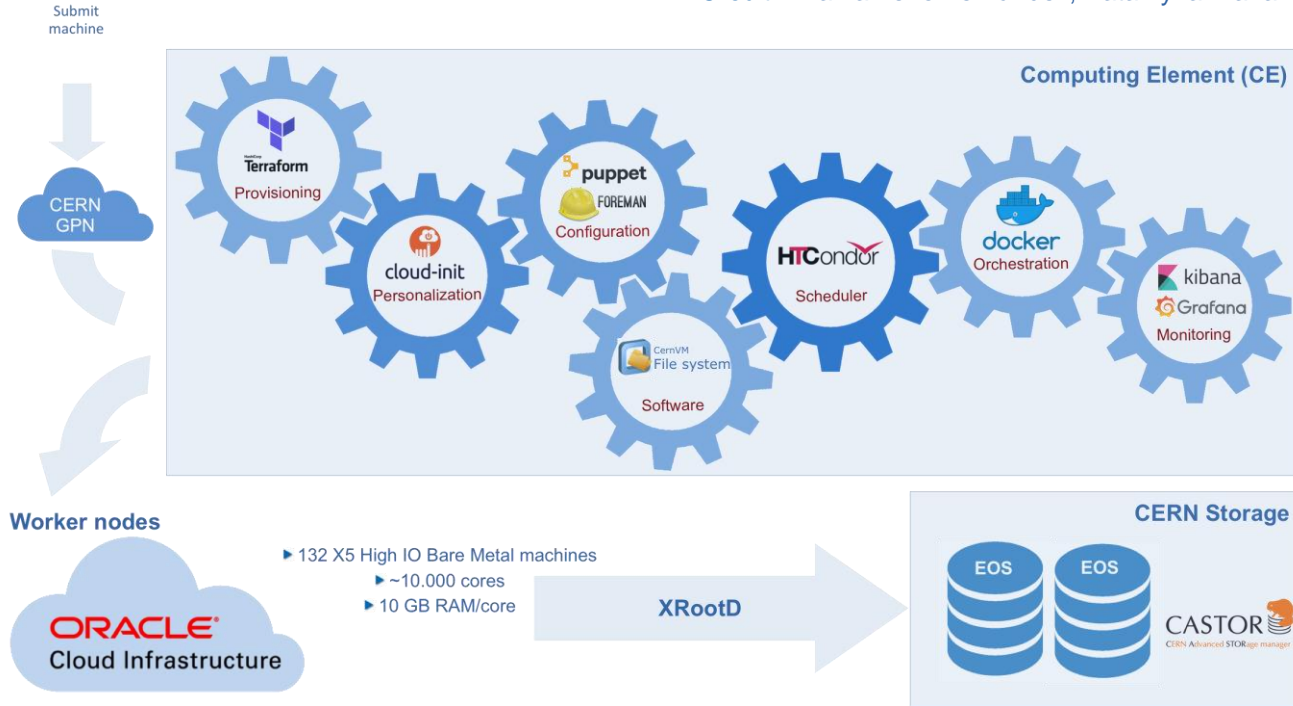


Credit: C. Roderick



Oracle Cloud Infrastructure - WLCG

Credit: Ana Lameiro Fernández, Katarzyna Maria Dzedziniewicz-Wojcik, Eva Dafonte Pérez



Deployment of Oracle Cloud Infrastructure as a site inside Worldwide LHC Computing Grid Proof of concept, 2017Q3

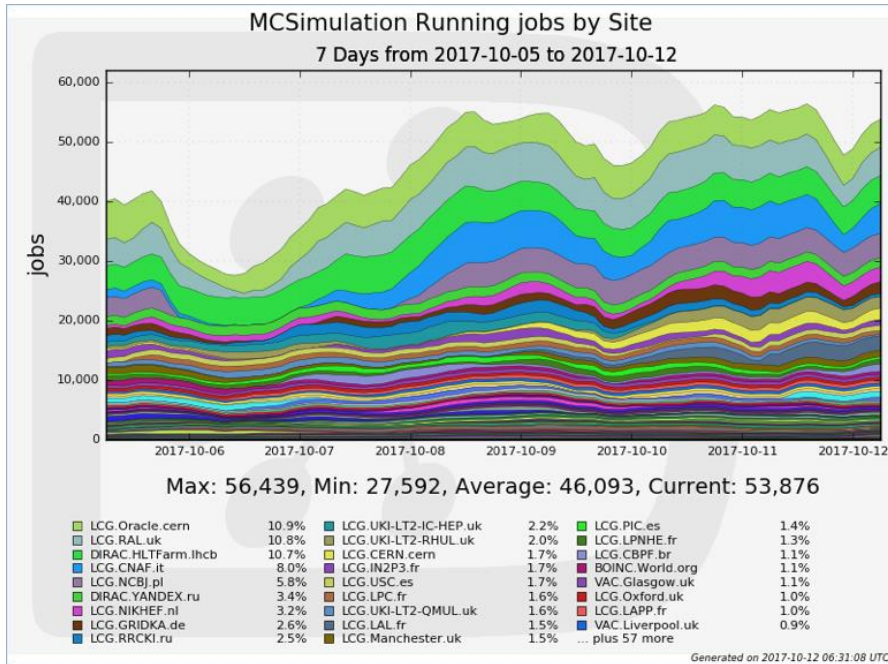
132 X5 High IO Bare Metal Machines.
Around 10 000 cores.
10GB RAM per core

Jobs on OCI

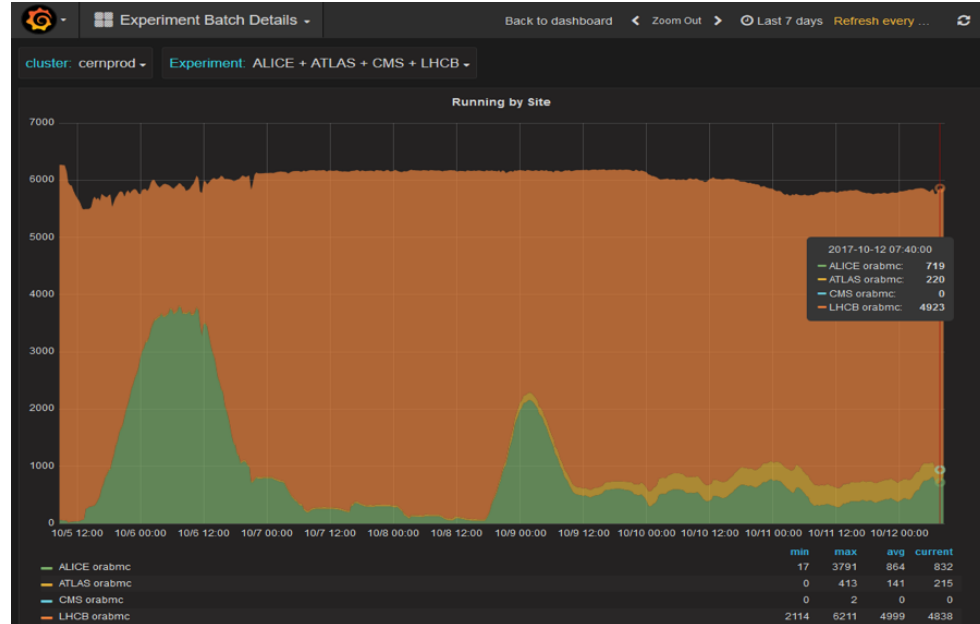
Experiments achieved

~8700 concurrent jobs running on Oracle Cloud Infrastructure

~ 97% success rate, comparable with other grid sites



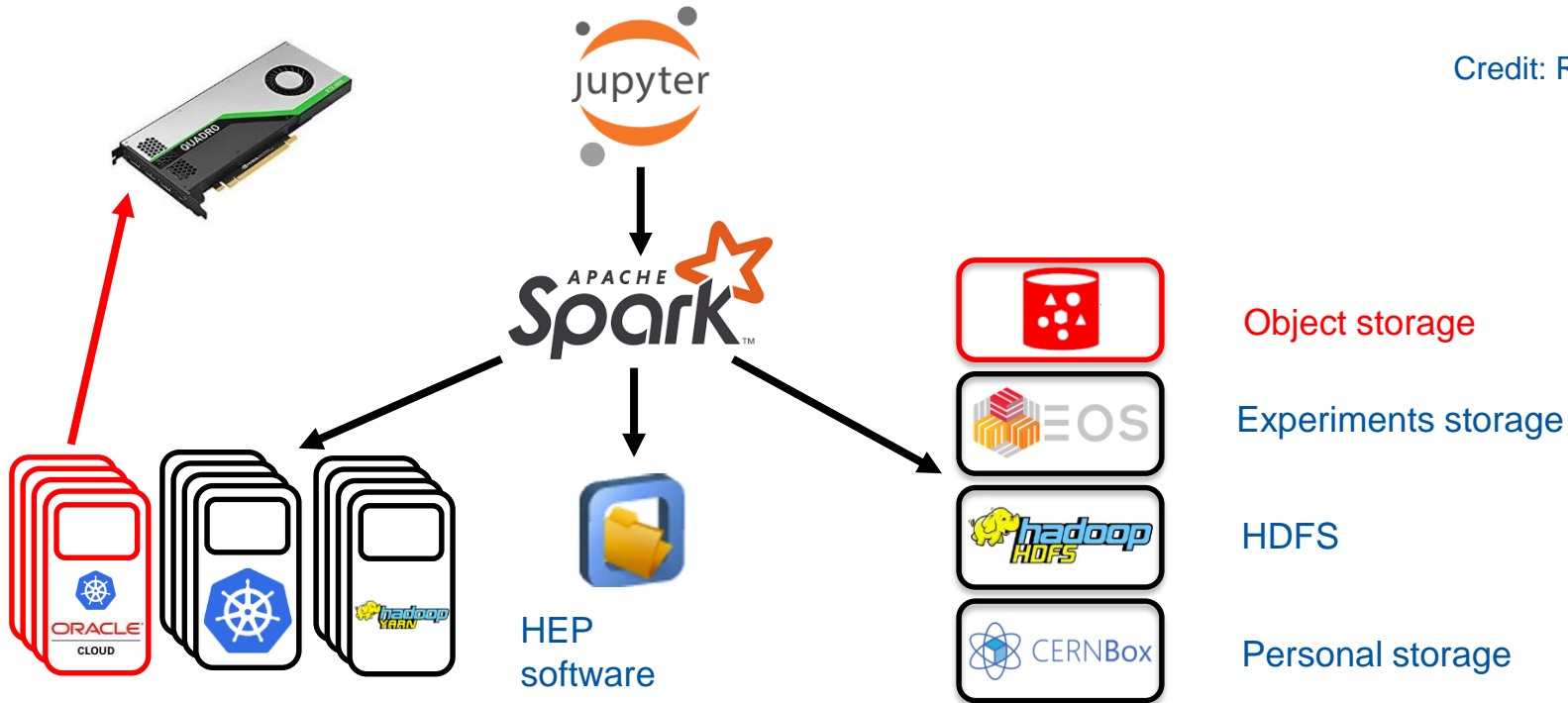
LHCb workload



Credit: Ana Lameiro Fernández, Katarzyna Maria Dzedziniewicz-Wojcik, Eva Dafonte Pérez

Integration OCI GPUs

Credit: Riccardo Castellotti

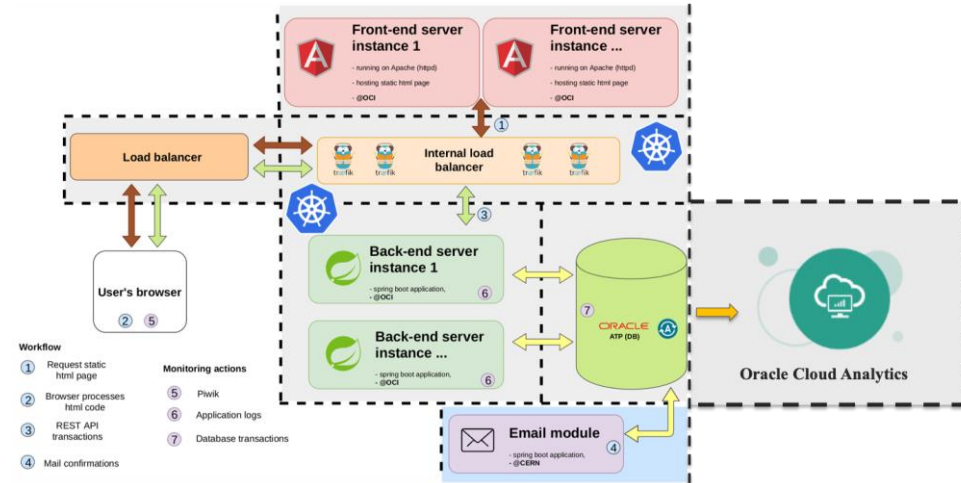


CERN Open Days 2019 registration

Supporting outreach, experience of fast and scalable solutions

- to be able to deploy at the needed scale
- to save time and benefit from automation using cloud services when possible
 - Load balancer aaS, OCI Container Engine for Kubernetes, Autonomous Transaction Processing services, Oracle Management Cloud, Oracle Analytics Cloud
- to ease integration with other interfaces (on site organization) with Oracle database as a common repository
- to gain time and avoid having to deploy new services for the event

Scalability tests built in the different environments.



Credit: Viktor Kozlovsky

ARCHIVER project objective

Credit: João Fernandes

Focus: Archiving and Data Preservation Services using commercial cloud services to be available via the European Open Science Cloud (EOSC)

Total Budget : 4.8M euro ; Procurement R&D Budget: 3.4M euro

Starting Date: 1st of January 2019

Duration: 36 Months

Coordinator: CERN (Lead Procurer)



European Commission



References

- **HEP Software Foundation**
<https://hepsoftwarefoundation.org/>
- **A Roadmap for HEP Software and Computing R&D for the 2020s** <https://doi.org/10.1007/s41781-018-0018-8>
- **European Strategy for Particle Physics**
<https://europeanstrategyupdate.web.cern.ch/>
- **LHC schedule** <https://cern.ch/lhc-commissioning/schedule/LHC-long-term.htm>
- <http://opendata.cern.ch/docs/cms-releases-open-data-for-machine-learning>
- **CERN DB blog** <https://cern.ch/db-blog/>

Thank you

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