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CERN openlab

Heterogeneous Architectures Testbed at CERN

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What we do

- Reception, installation, configuration and benchmarking of new hardware
- Project and User Support: access grant and system administration
- Support for Intel tools on CVMFS
- Hardware and Software maintenance
- Organisation and support for workshops, training courses...
  - Latest event: Intel Software Tools training, March 2-3 2022

Some numbers

- 118 unique users and 321 accounts
- ~ 92 systems: mostly bare-metal nodes + some VMs
- Different operating systems in use:
  - Mainly CentOS7, CentOS8 (being decommissioned) and CentOS Stream 8
  - RHEL8 for special use-cases
- SNOW FE support (requests and incidents):
  - 230+ tickets handled in 2021
  - 48 tickets in 2022 and counting...

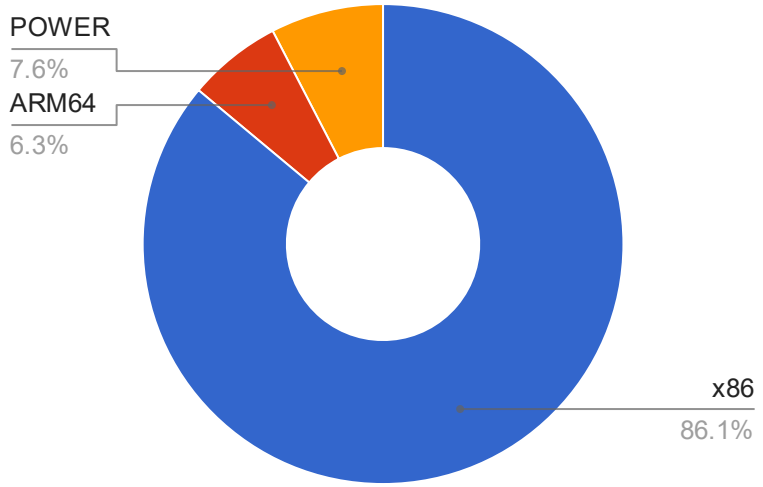
Hardware: CPU Systems

- x86 (Intel Xeon)
  IceLake, **CascadeLake**, **SkyLake**
  Haswell, **Broadwell**
  Ivy Bridge

- ARM64
  Cavium ThunderX and **ThunderX2**

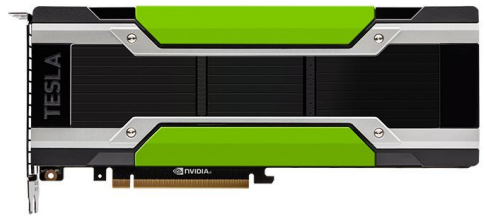
- IBM Power
  POWER8 and **POWER9**

FULLY IN USE	
FEW AVAILABLE	
AVAILABLE	



Hardware: Accelerators

- openlab ML projects - NVIDIA Tesla V100, Tesla P100 and NVIDIA T4
- openlab QTI - NVIDIA Tesla V100S
- Older accelerators – AMD Vega 10, Alveo U200, Altera Arria 10



Hardware: other technologies

- ATOS QLM – Quantum Learning Machine
- Intel Optane Memories
- NVIDIA Blue-Field 2 DPU
- Intel Omni-Path
- InfiniBand
- Intel Xeon Phi KNL, one Xeon-D node

PROJECTS AND ACTIVITIES

Overview

Projects and activities

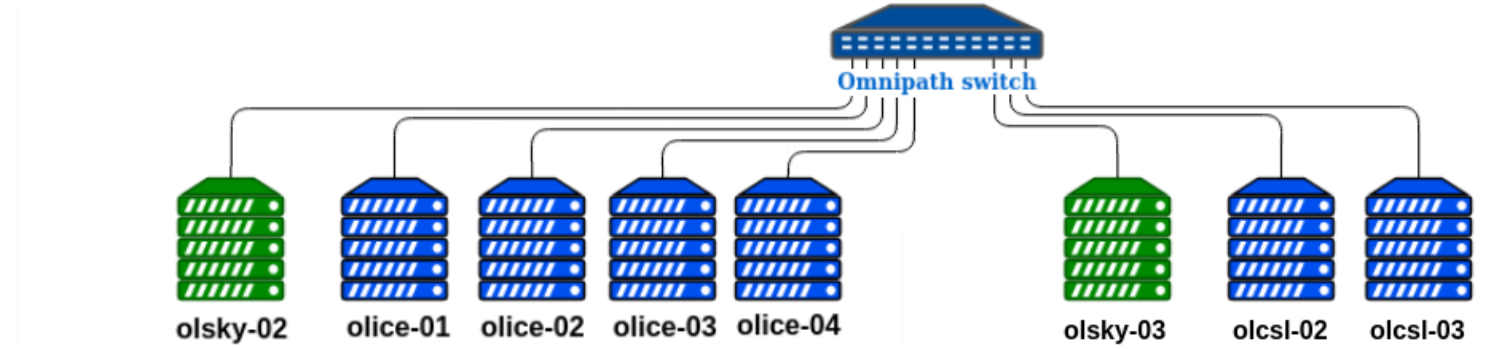
- **Intel** (DAOS, oneAPI)
- **IBM** (Machine Learning, SW builds)
- GPU support for ML
- Quantum Technology Initiative
- Benchmarking new platforms
- General user support

Main orchestration technologies

- **Puppet**, Ansible
- Docker, Singularity
- Production-like approach using most of the IT dept infrastructure tools
  - Foreman
  - Linux ai-admin tools
  - Gitlab
  - …and many more

DAOS (Distributed Asynchronous Object Storage)

- Open-source high performance storage
- Relying on distributed Intel Optane persistent memories and PCIe NVMe
- New IceLake cluster (v2.0.1) recently configured and integrated together with Cascade Lake cluster

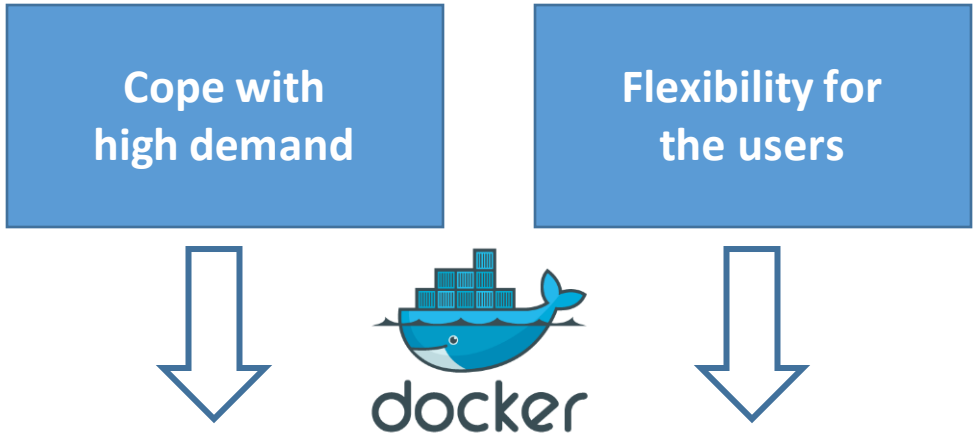


DAOS Agent	Yes	No	No	No	No
DAOS Server	No	Yes	Yes	Yes	Yes
DAOS Head Node	No	No	No	No	Yes

DAOS Agent	Yes	No	No
DAOS Server	No	Yes	Yes
DAOS Head Node	No	No	Yes

- Omni-Path fabric interface with Performance Scaled Messaging 2 (PSM2) (ofi+psm2)
- Main use-cases:
  - ROOT
  - ATLAS
  - Summer Student project

GPU - Machine Learning activities



- Jupyter notebooks

- Support for CUDA versions, TensorFlow and other packages

- Plan for the future use of Kubernetes

IBM Machine Learning activities

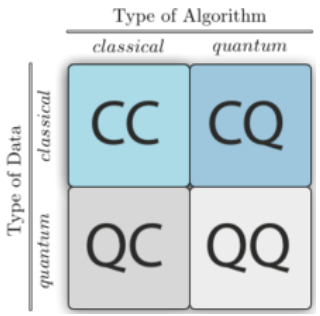
- OpenCE + Kubeflow (coming soon)
- Used technologies:
  - xCAT
  - IBM spectrum computing
  - WMLA
  - Spark

Quantum Technology Initiative

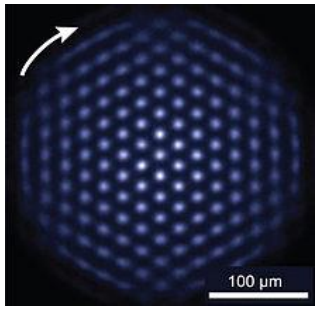
- Four project-dedicated GPU nodes with quantum environments: **Cirq**, **PennyLane, Qibo, Qiskit**
- See our documentation

- ATOS QLM Appliance
- Remote access to IBM Quantum resources

QML for High Energy Physics



Quantum Classifiers



Quantum Simulations

Quantum Machine Learning

Quantum Neural Networks

Free energy based reinforcement learning FERL

Quantum Key Distribution

Multi science environments

Some examples:

- Benchmarking (HS06, hepscore,…)
- Among the first to try IT infrastructure support on **ARM** – big thanks to the Linux team!
- Support to experiments building software on IBM Power architecture

LivingLab

oneAPI development

ROOT

What happens in our nodes?

BioDynaMo

Deep learning, cryptography

3DGAN + Quantum GAN

oneAPI and Intel tools

- **oneAPI** → Latest available version: **2022.1.2**

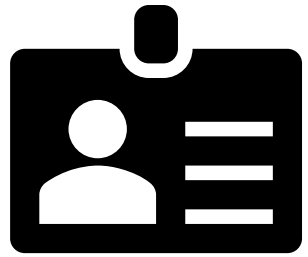
Available on CVMFS:

```
$ source /cvmfs/projects.cern.ch/intelsw/oneAPI/linux/x86_64/2022/setvars.sh
```

- **Parallel Studio** (still available for compatibility) → Latest available version: 2020.4 **No upgrades foreseen**

More information: see our documentation.
Register to the **intel-tools-announcements** e-group to get the latest updates!

How to contact us



- Open a SNOW ticket here
- Check our website: https://openlab-systems.web.cern.ch/
- ...or write directly to us!

openlab-systems@cern.ch

Thank you!