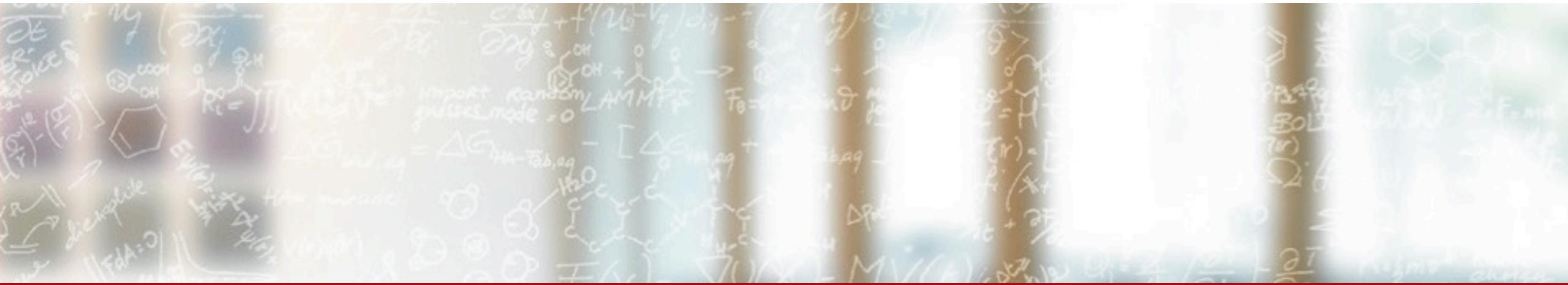




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# Alps Infrastructure

CSCS User Lab Day 2023

Miguel Gila, CSCS

September 04, 2023



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# A bit of history

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# Piz Daint

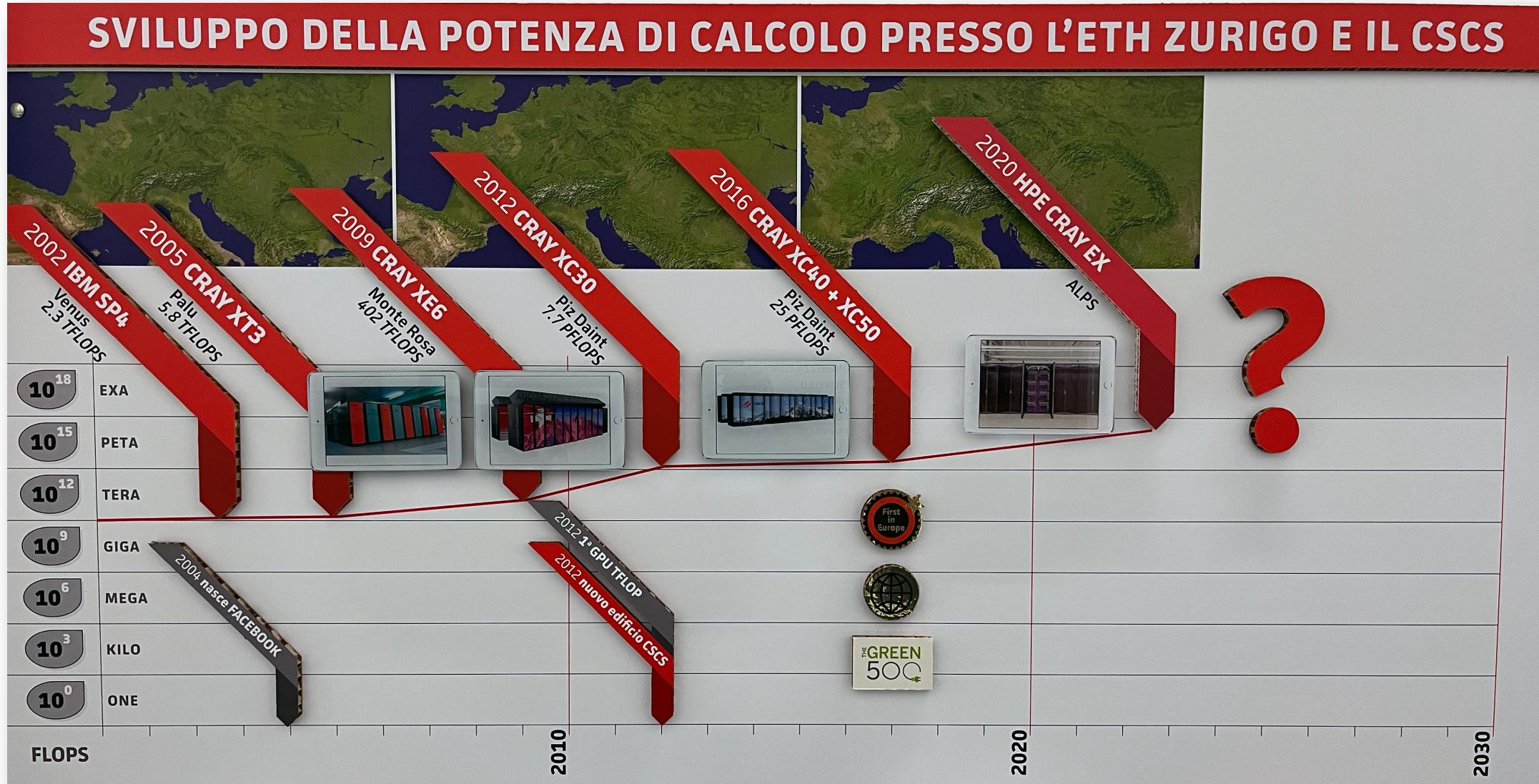
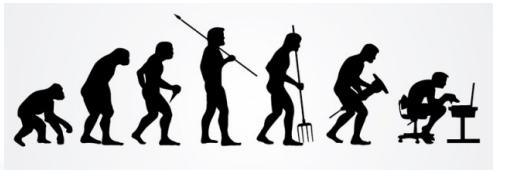
- Piz Daint is a Cray XC 40/50 with 7517 compute nodes
- It was commissioned in 2012 with a major upgrade/extension in 2016
- It's been our flagship system... since then, 7 years and counting!
- So far it has lived thru a lot of things:
  - 111M MC node-hours
  - 349M GPU node-hours
  - ~2800 users
  - ~50M user jobs

## Specifications

Model	Cray XC40/XC50
XC50 Compute Nodes	Intel® Xeon® E5-2690 v3 @ 2.60GHz (12 cores, 64GB RAM) and NVIDIA® Tesla® P100 16GB - 5704 Nodes
XC40 Compute Nodes	Two Intel® Xeon® E5-2695 v4 @ 2.10GHz (2 x 18 cores, 64/128 GB RAM) - 1813 Nodes
Login Nodes	Intel® Xeon® CPU E5-2650 v3 @ 2.30GHz (10 cores, 256 GB RAM)
Interconnect Configuration	Aries routing and communications ASIC, and Dragonfly network topology
Scratch capacity	8.8 PB

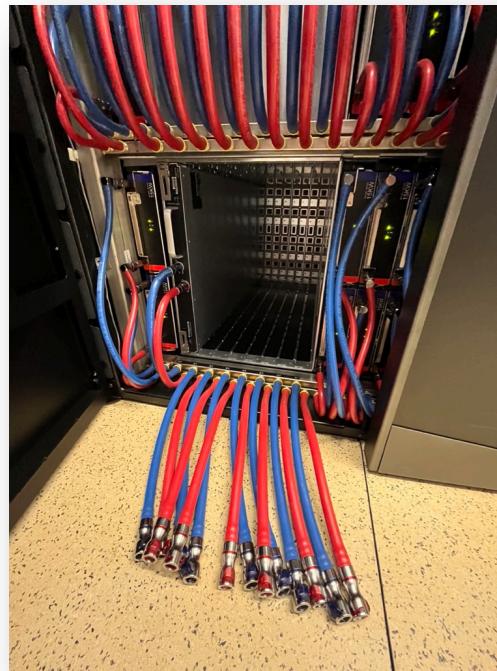


# Evolution



# Alps

- Alps is an HPE Cray EX supercomputer meant to be our new flagship infrastructure
- Multi-phase installation started in 2020
- Some specs
  - 1024x MC nodes (AMD Rome 7742)  
256/512GB RAM
  - 144x nVIDIA A100 GPU nodes
  - 32x AMD MI250x GPU nodes
  - *Some thousands of GraceHopper modules (soon)*
  - Slingshot network
  - Two available zones (HA, non-HA)
  - 100% liquid cooled (to the chips themselves)



Water cooled blades

# Installation



Big delivery

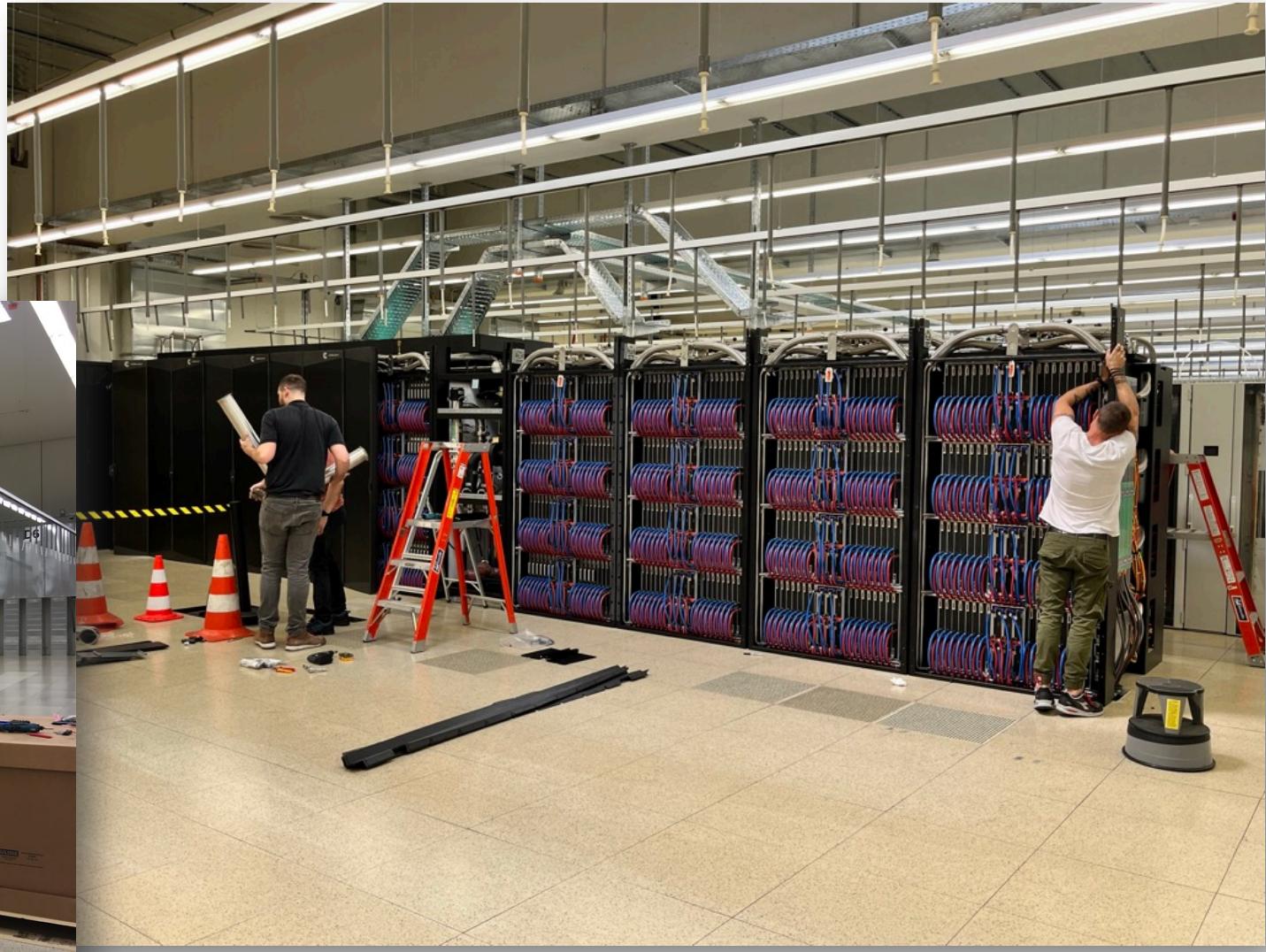


Moving the first racks

# Installation



Some boxes



Front: water cooling

# More pictures

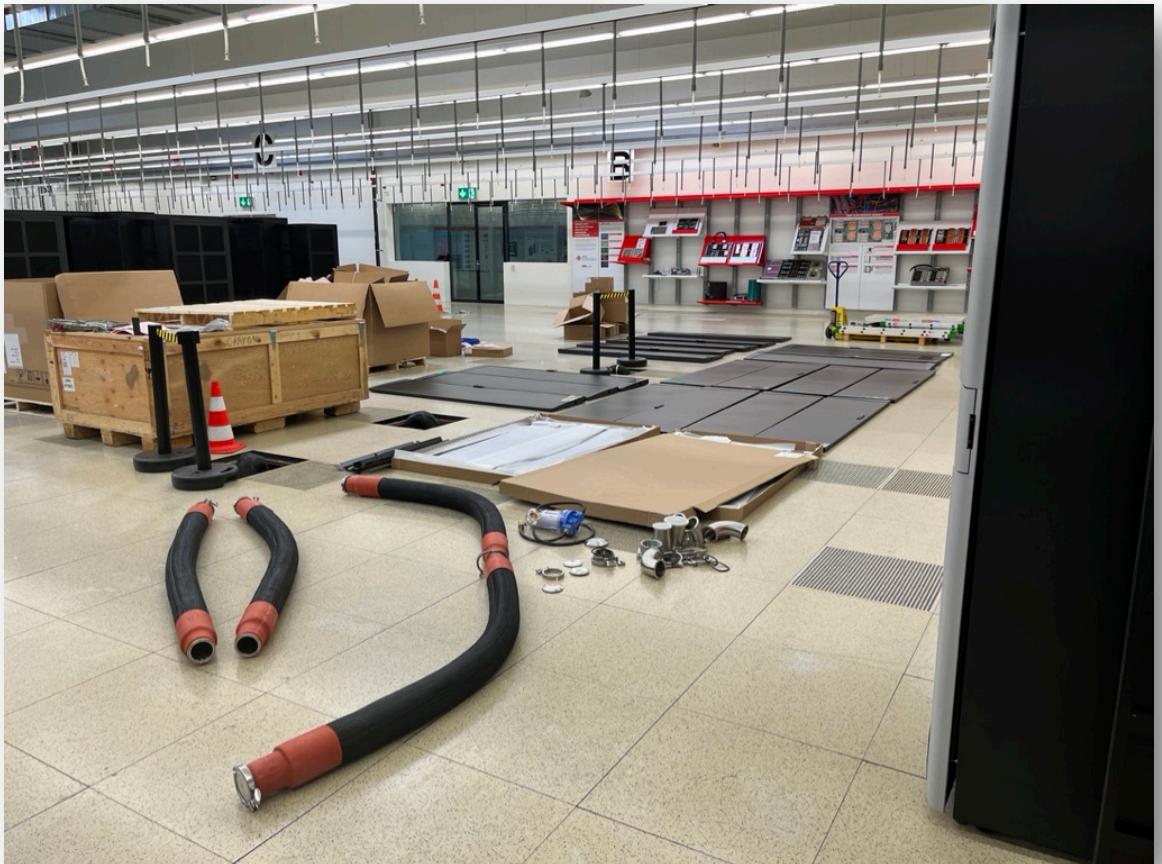


Front: HA zone (compute + mgmt.)

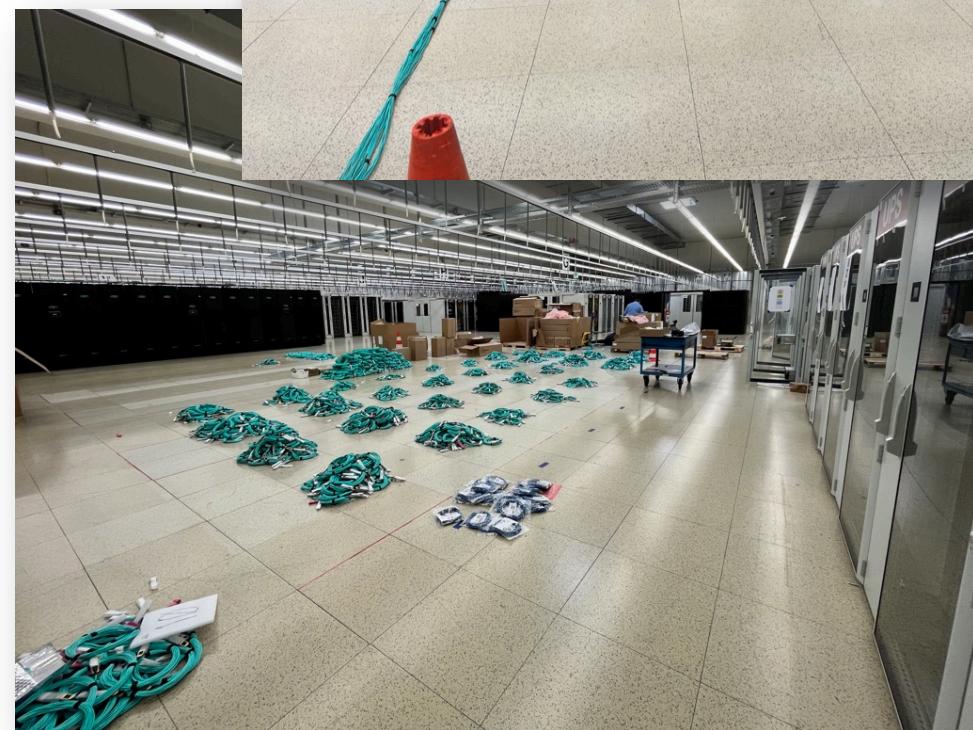


Back: Slingshot network

# What's below, in front, and on top



Internal pipes and doors and panels



Some Slingshot fiber cables



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# A change in paradigm

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# Our mission

Founded in 1991, CSCS, the Swiss National Supercomputing Centre, develops and provides the key supercomputing capabilities required to solve important problems to science and/or society. The centre enables world-class research with a scientific user lab that is available to domestic and international researchers through a transparent, peer-reviewed allocation process. CSCS's resources are open to academia, and are available as well to users from industry and the business sector. The centre is operated by ETH Zurich and is located in Lugano with additional offices in Zurich.

- To achieve this, CSCS has been running supercomputers and clusters for years, using logical abstractions (projects, Slurm queues, POSIX permissions, etc.) to partition and distribute computing power to the different groups of users
- But, as the numbers of science domains and projects grows
  - Provisioning dedicated clusters becomes expensive (cost, manpower, management, etc.)
  - Integrating completely different workloads on a single system is complex (e.g., Slurm on Piz Daint, WLCG HTC vs. UL HPC queues)

# HPC and Cloud convergence



- Science and engineering requires more and more computer assisted experiments
  - Simulation of physical phenomena and behaviours
  - Digital Twins
  - Design engineering products
  - AI/ML statistic solutions
- HPC offers high-performance compute and data access
  - Improves Time to Solution
  - Managed efficiently data to compute
  - Bare-metal performance, fixed amount of resources
- Cloud offers high flexibility for business needs
  - XaaS – business logic as a service
  - Economy of scale – oversubscription of resources
  - Virtualized resources, scalable to the infinite (and beyond)



Can we  
combine both  
worlds??



To infinity  
and beyond...

# How to achieve best of both worlds?

- We're in a multi-year effort to converge and get the best of both worlds
- Introducing extensive changes across the organization
- All units and groups are embracing this revolution, generating new tools, processes and products to help us achieve our goals
- ... but on a technical front, how are we going to do this?

# How to achieve best of both worlds?

- Performance and Flexibility
  - Use container as a virtualization layers with OCI hooks
    - Keep OS near bare metal – Accelerators and High-speed network drivers
    - Bring low-level libraries in the container with OCI Hooks
  - Bring your own User Environment
    - Decouple HPC programming environments from underlying layers
    - UE can potentially become “just” an artifact mounted in the container
- Separation of concerns with layers
  - Platforms
    - Provisioning of services with Nomad and/or Kubernetes
    - Container as an abstraction layer for compute nodes
  - Infrastructure as code
    - APIs and configuration management
    - Multi-tenancy: exclusive compute, network and storage segregation
- HPC business logic
  - Web-facing API to access HPC resources (submit jobs, move data)
  - Web gateway



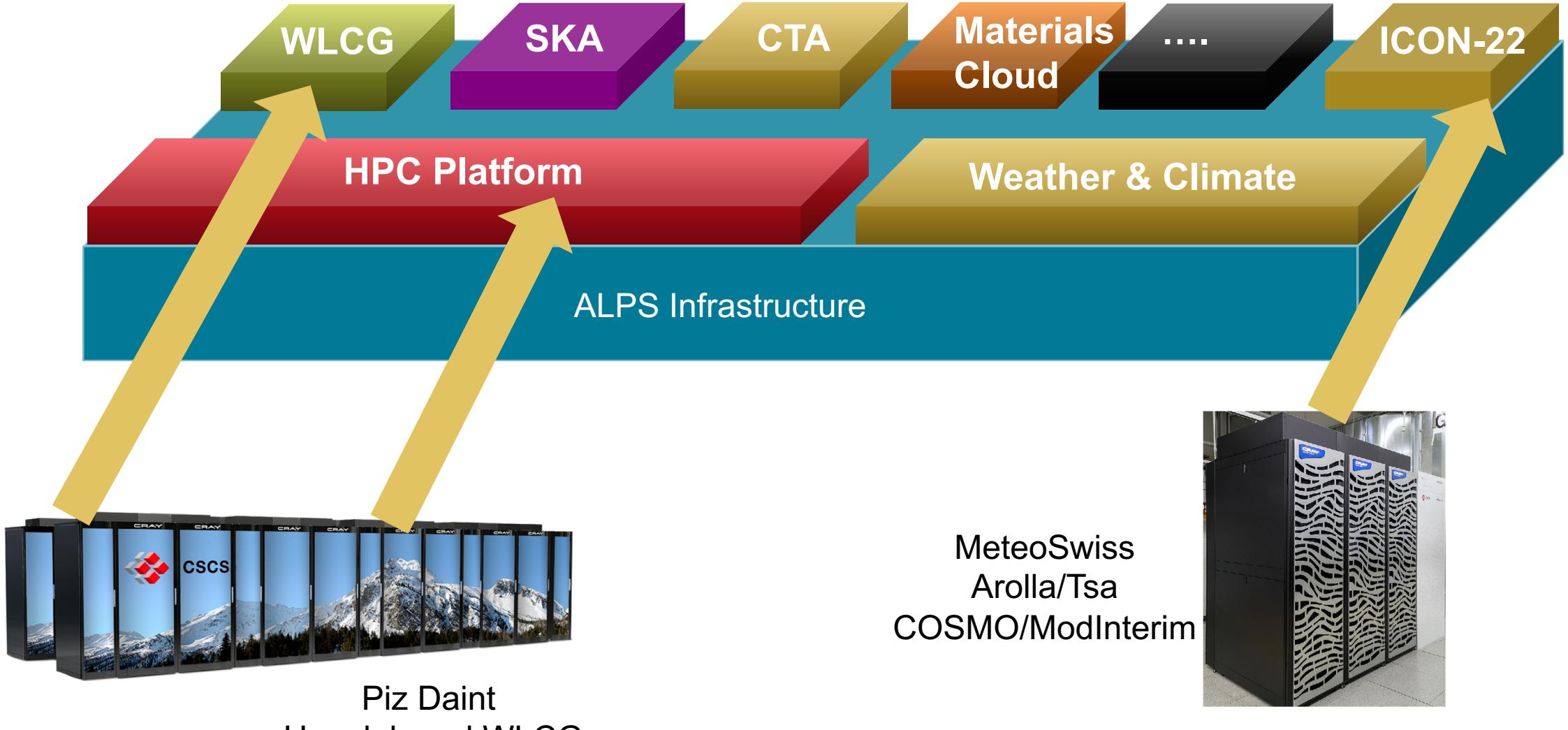
**Versatile  
software-defined  
cluster**



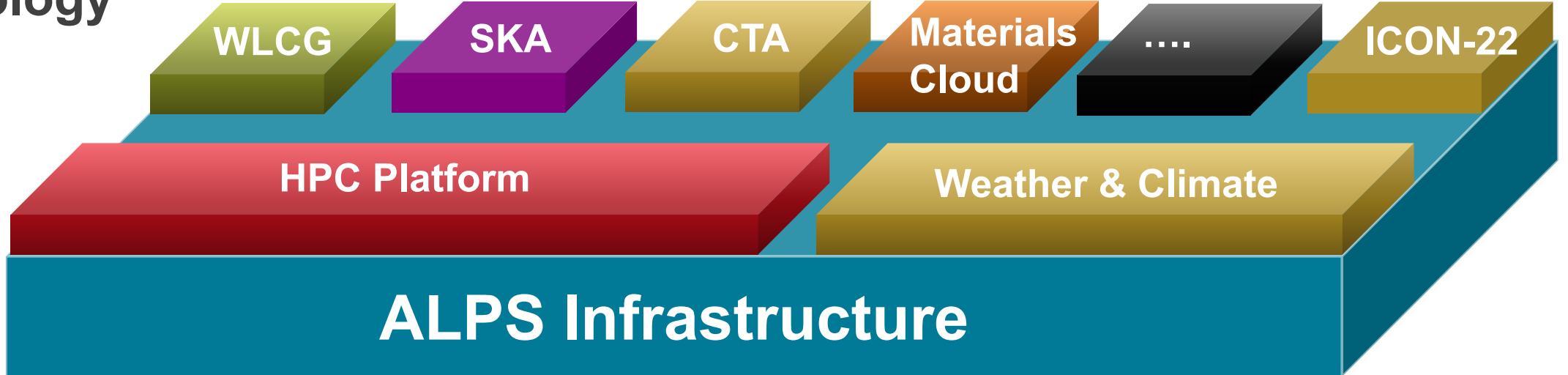
# Versatile software-defined cluster (vCluster)

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# Consolidation of platforms



# Technology



User environments  
management



Platforms and services  
management



Infrastructure as Code

## Versatile software-defined cluster (vCluster)

- Custom user environments
- Manage platform services, provisioning of clusters
- Tenant: network and storage isolation

# vClusters currently in operation on Alps

Platform	vCluster name	Scope
MCH	Balfrin	R&D
	Tasna	Production
HPC Platform	Eiger	Production
	Pilatus	Staging
	Rigi	R&D
WLCG Platform	Fort	Production
	Gele	R&D
	Noir	Production (CTA)
AI/ML Platform	Clariden	AI/ML
Testbeds	Rosa	K8s testing
	Adula	HW validation
	Zinal	Internal development
	Bar	Internal development
	Hohgant	Internal development
PSI	PSI-dev	R&D
	PSI-tds	Pre-production



# Ease of management

- Each vCluster has its own set of platform administrators, users and configuration/policies, etc.
- Having a common infrastructure to operate hardware, and embracing new IaaS and PaaS + DevOps technologies reduces time to solution
- More flexibility in terms of hardware and software choices
- Resource elasticity and scalability: growing or shrinking vClusters is easier



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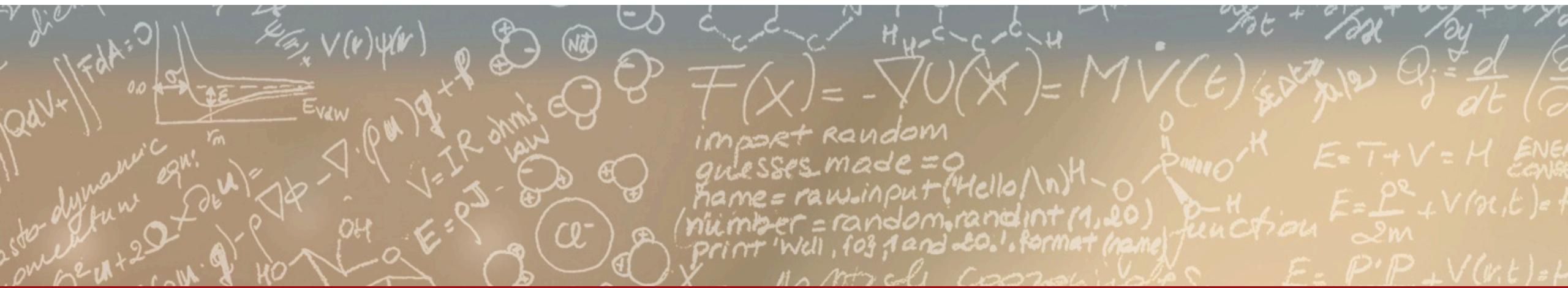
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# What changes for you?

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# What changes for you?

- At first sight... nothing!
- Eiger was engineered to look and feel close to Daint
- In the future (spring 2024), with the commissioning of GH the user environment will change significantly
  - Work in progress, but how the UE is deployed/used will change
  - Still have modules, but looking at using container-like, release-based, binary artifacts
- Eventually Daint will be decommissioned



## Q&A

Thank you for your attention