Mathis Bode
Executive Coordinator JUPITER AI Factory
Head of JUPITER Research and Early Access Program
ATML Extreme-scale AI and Simulation
Jülich Supercomputing Centre

Thomas Lippert

Kristel Michielsen

EUROPEAN EXASCALE ERA

JUPITER and its applications

2025-09-16 I JUPITER TEAM (PRESENTER: MATHIS BODE) | JÜLICH SUPERCOMPUTING CENTRE

Member of the Helmholtz Association

EuroHPC Joint Undertaking

Bundesministerium für Bildung und Forschung

Ministerium für Kultur und Wissenschaft des Landes Nordrhein-Westfalen

GCS Gauss Centre for Supercomputing

JÜLICH Forschungszentrum

Shaping Change

Exascale Systems

JUPITER | Jülich Supercomputing Centre, Jülich
1 exaFLOP/s

Alice Recoque | CEA/GENCI, Bruyères-le-Châtel

Pre-Exascale Systems

LUMI | CSC, Kajaani
~0.54 exaFLOP/s

Leonardo | CINECA, Bologna
~0.32 exaFLOP/s

MareNostrum 5 | Barcelona Supercomputing Centre, Barcelona
~0.3 exaFLOP/s

Petascale Systems

MeluXina | LuxProvide, Bissen
~0.02 exaFLOP/s

Karolina | IT4Innovations National Supercomputing Center, Ostrava

Discoverer | Sofia Tech Park, Sofia

Vega | IZUM, Maribor

Deucalion | Univ. Minho, Riba de Ave

JÜLICH SUPERCOMPUTING CENTRE

~340 Employees
(~310 FTE)

225 Scientists

22 PhD Students (+ externals)
27 Students (Bachelor/Master)

fz-juelich.de/jsc

also some JSC

also some JSC

JSC

THE PATHFINDER

Implementing the Modular Supercomputing Architecture

Modular Supercomputing Architecture (MSA)

MSA Pre-Exascale @Lux, @It

2× MSA pilots

FP7 - H2020

DEEP Projects

EuroHPC

SEA Projects

EU PEX

HPC|QS

LEONARDO

MELUSINA

2011

2020

2021

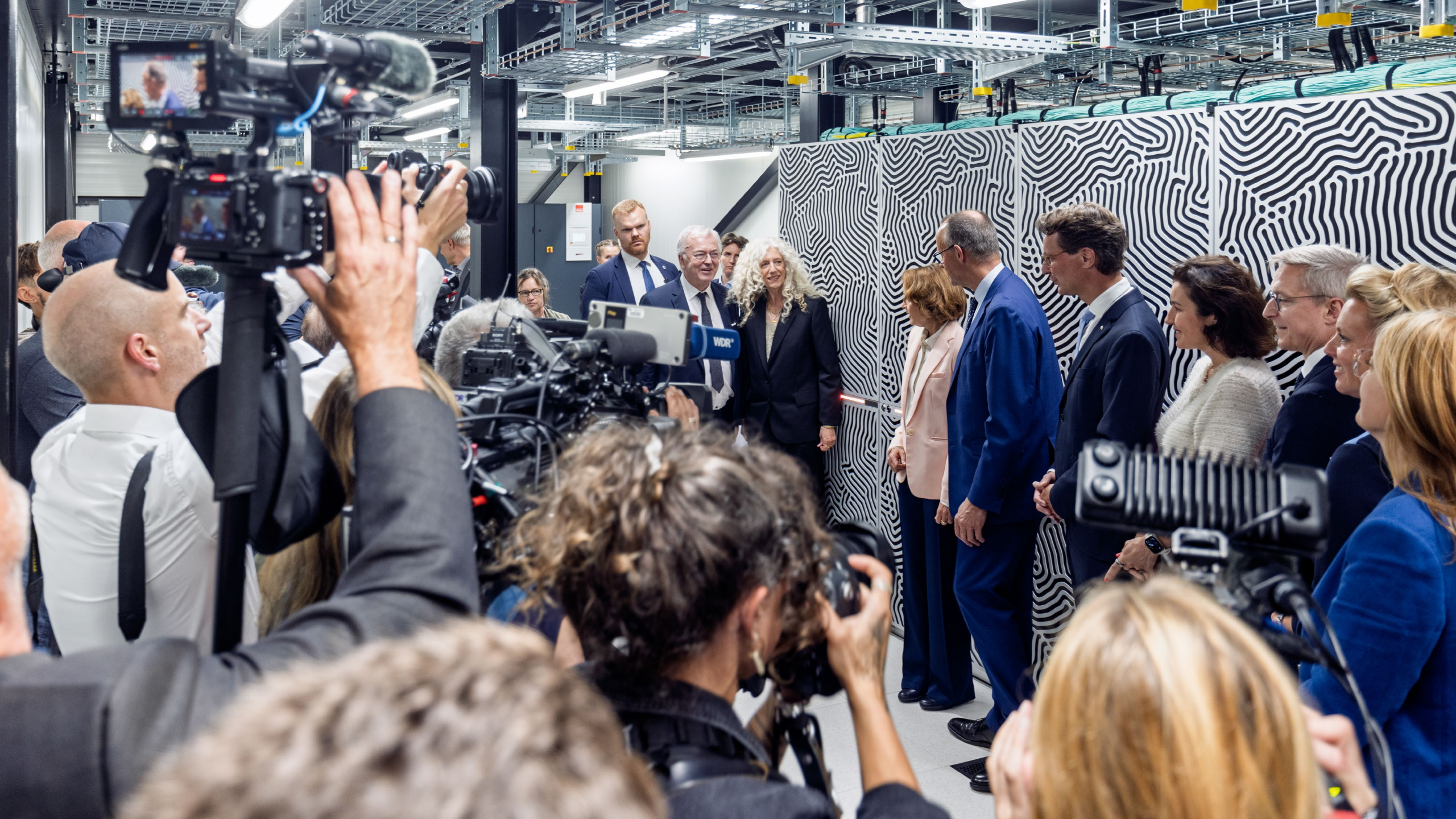
2022

2023

LUMI
Fastest supercomputer in Europe
550 PetaFLOP/s

JÜLICH Forschungszentrum

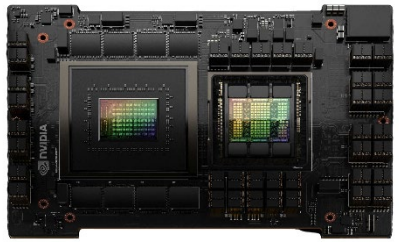
Jülich, 7th September 2025


WDR

JUPITER MODULES

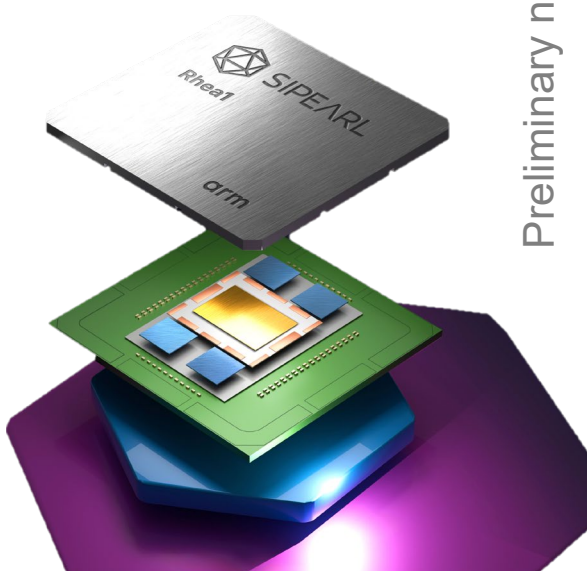
JUPITER Booster

- ~125 Racks BullSequana XH3000
- Node design
  - ~6000 nodes
  - 4× NVIDIA CG1 per node
- CG1: NVIDIA Grace-Hopper
  - 72 Arm Neoverse V2 cores (4×128b SVE2); 120 GB LPDDR5
  - H100 (132 SMs); 96 GB HBM3
  - NVLink C2C (900 GB/s)



JUPITER Cluster

- ~14 Racks BullSequana XH3000
- Node design
  - ~1300 nodes
  - 2× SiPearl Rhea1 per node
- Rhea1
  - 80 Arm Neoverse V1 cores (2×256b SVE)
  - 256 GB DDR5, 64 GB HBM2e

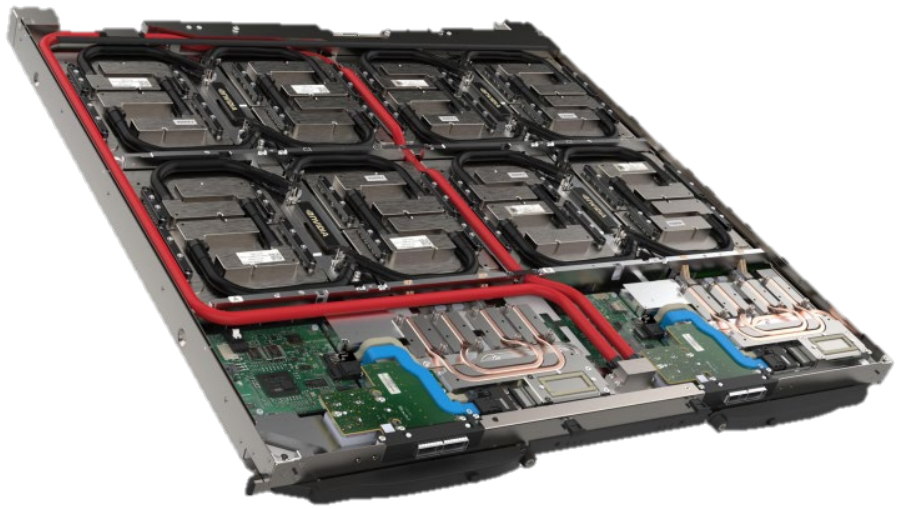


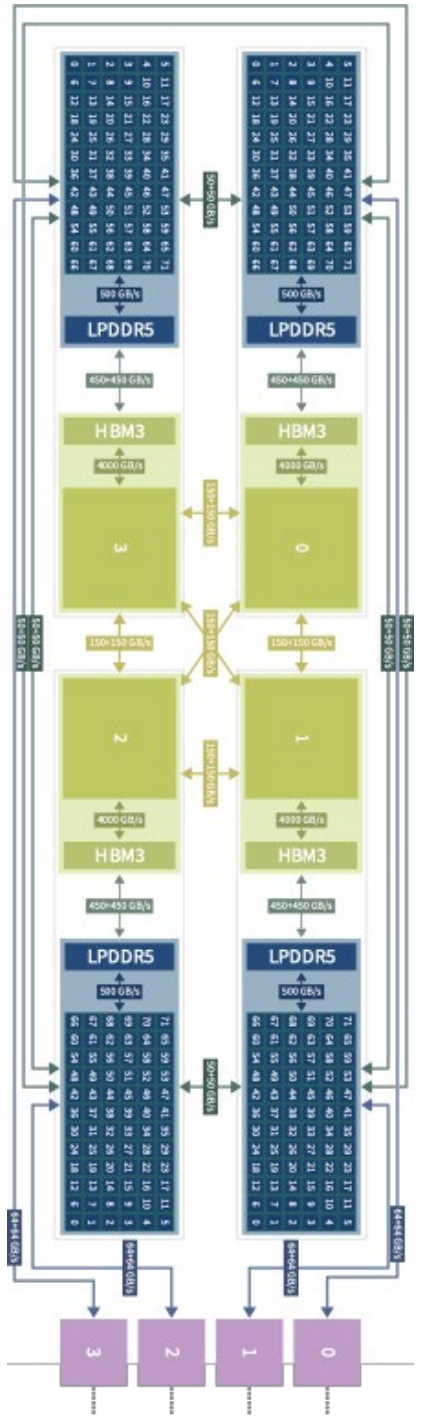
Preliminary numbers, might change during installation

JUPITER – THE BOOSTER

Highly-Scalable Module for HPC and AI workloads

- **1** ExaFLOP/s (FP64, HPL)
- NVIDIA Grace-Hopper CG1
  - ~6000 compute nodes
  - **4×** CG1 chips per compute node
- NVIDIA Mellanox NDR
  - **4×** NDR200 NICs per compute node
- BullSequana XH3000
  - Direct Liquid Cooled blades
  - **2× compute node per blade**





JUPITER – INTERCONNECT

One Network to Rule Them All

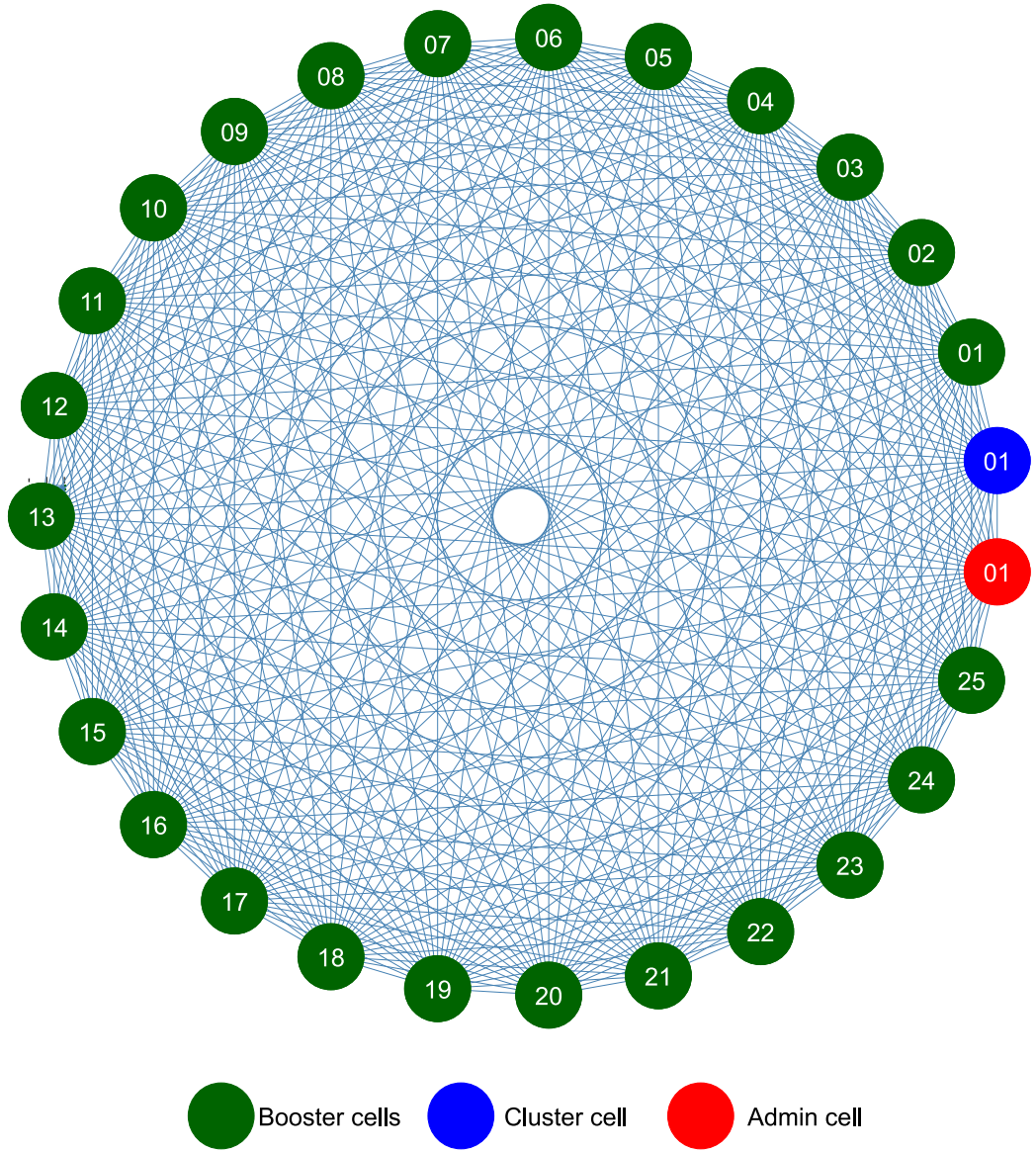
- NVIDIA Mellanox InfiniBand NDR/NDR200
  - NVIDIA Quantum-2 switches
  - NVIDIA Connect-X7 HCAs
- Dragonfly+ topology
  - 27 Dragonfly groups
  - Within each group: full fat tree
- 51000 links, 102000 logical ports, 25400 endpoints, 867 switches
- Adaptive Routing
- In-network processing on switch level (SHARPv3), tentatively

JUPITER – INTERCONNECT

One Network to Rule Them All

EVIDEN
an atos business

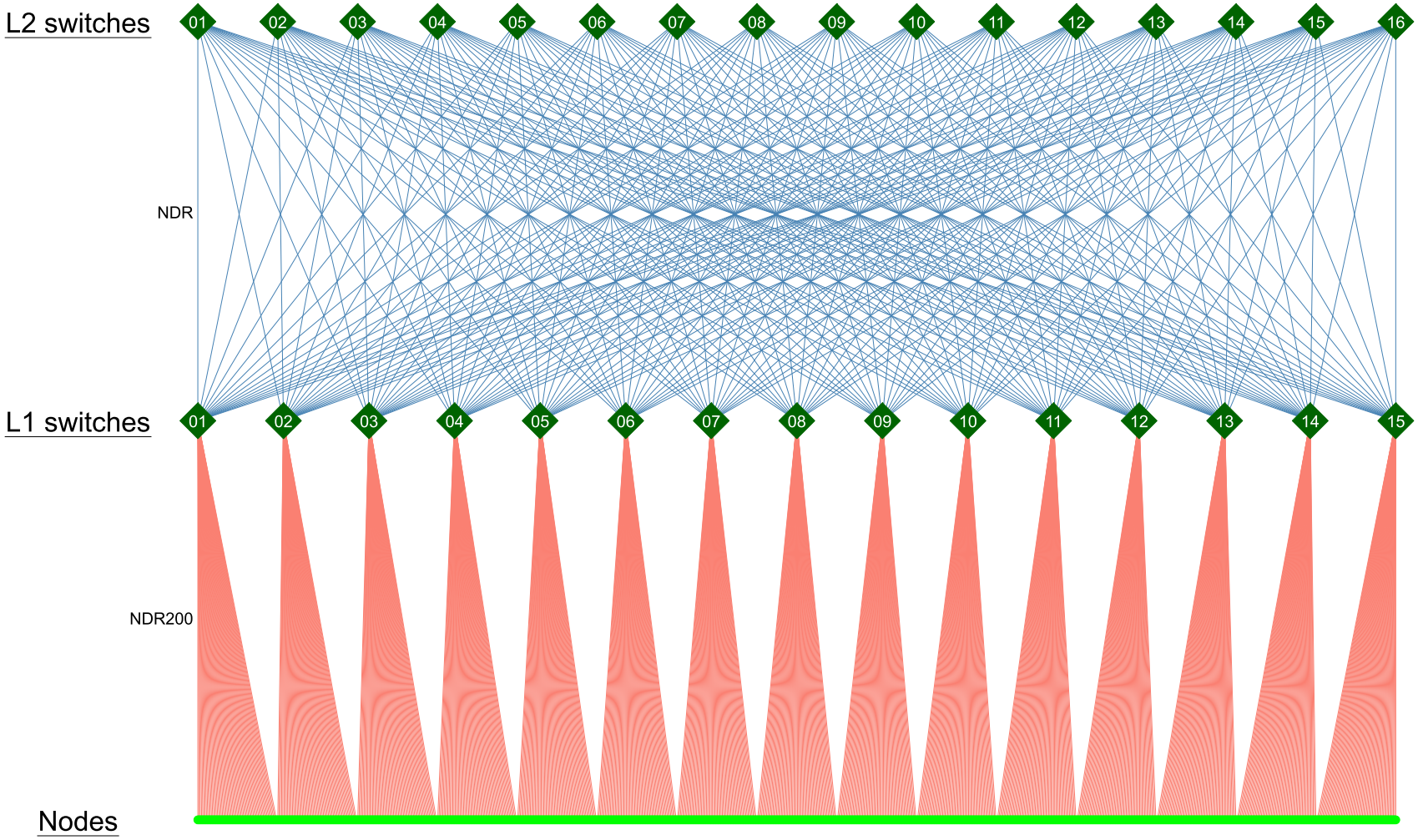
NVIDIA



JÜLICH
Forschungszentrum

JUPITER – INTERCONNECT

One Network to Rule Them All



JUPITER MANAGEMENT STACK

”Power is nothing without control"

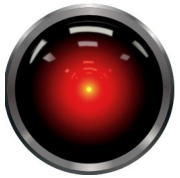
- Eviden SMC xScale
- ParaStation Modulo
  - Resource management
  - ParaStation MPI
- Ansible as provisioning system
- SLURM as scheduler
- EasyBuild as scientific software package management
- RedHat Enterprise Linux 9

ParaStation MODULO

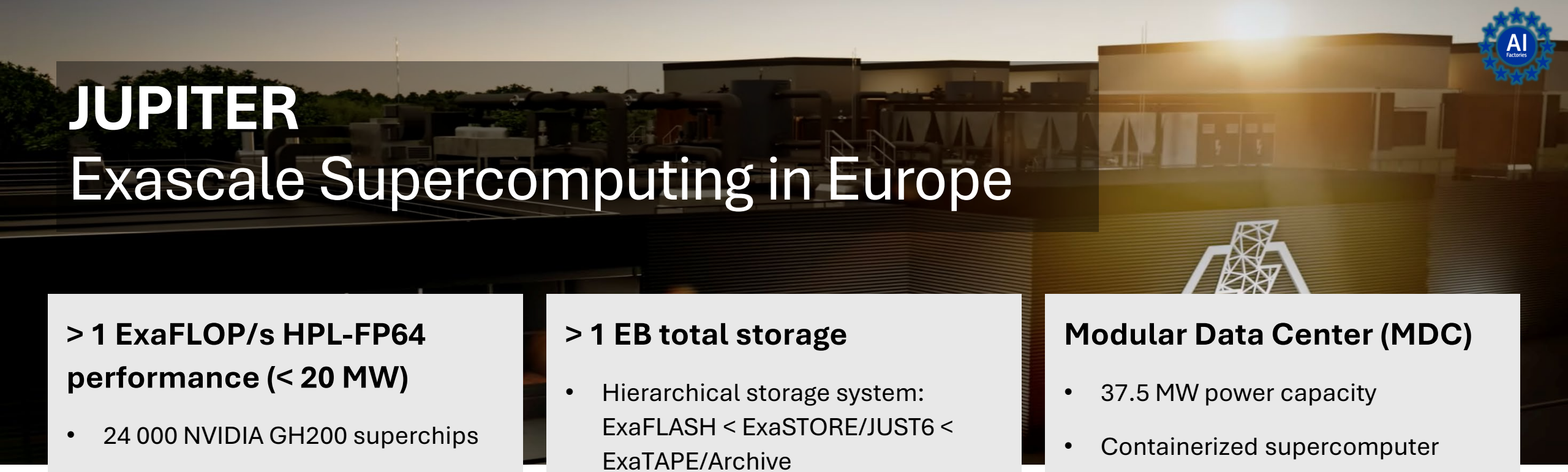
slurm workload manager

EASYBUILD.io building software with ease

ANSIBLE



ceph



JUPITER
Exascale Supercomputing in Europe

> 1 ExaFLOP/s HPL-FP64 performance (< 20 MW)

- 24 000 NVIDIA GH200 superchips
- 2880 TB CPU memory (LPDDR5)
- 2304 TB GPU memory (HBM3)
- NVLink C2C (900 GB/s)
- NVIDIA Mellanox InfiniBand NDR/NDR200
- Dragonfly+ topology

> 1 EB total storage

- Hierarchical storage system: ExaFLASH < ExaSTORE/JUST6 < ExaTAPE/Archive
- ExaFLASH: 29 PB NVMe storage integrated into InfiniBand fabric
- ExaSTORE/JUST6: > 500 PB disk storage
- ExaTAPE/Archive: > 800 PB tape storage

Modular Data Center (MDC)

- 37.5 MW power capacity
- Containerized supercomputer
- Flexible and scalable concept
- Hot water cooling
- Utilization of waste heat
- High reliability
- Fast data connectivity

JÜLICH Forschungszentrum RWTH AACHEN UNIVERSITY Fraunhofer hessian.AI

JUPITER AI FACTORY

JUPITER and its applications:

JUPITER Research and Early Access Program (JUREAP)

JUPITER AI Factory (JAIF)

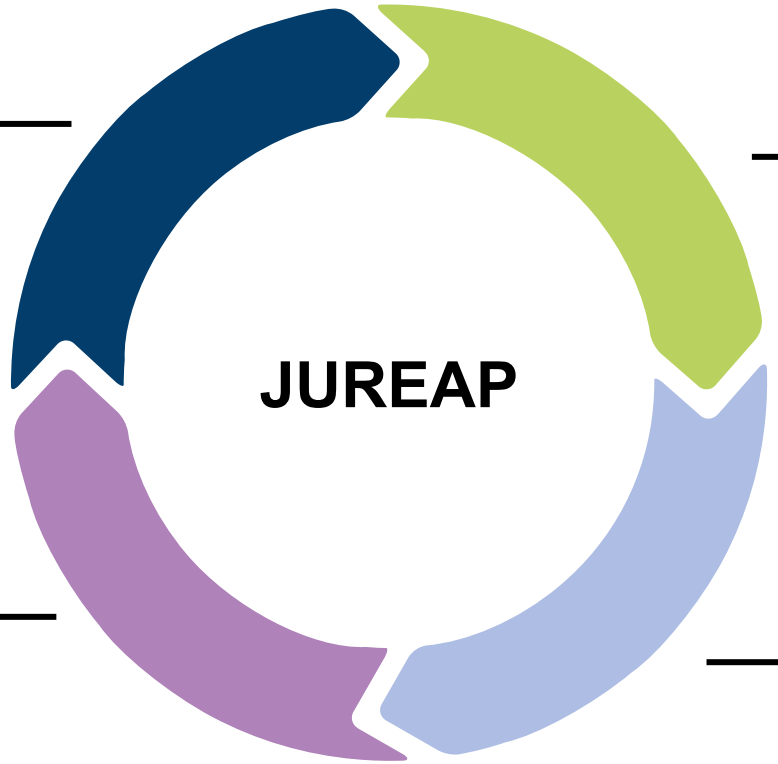
Associated partners:

JUREAP OVERVIEW

Application-centric focus for JUPITER

Smooth start-up
Working and full machine (from day one!)

Visibility
Highlighting applications and exascale computing



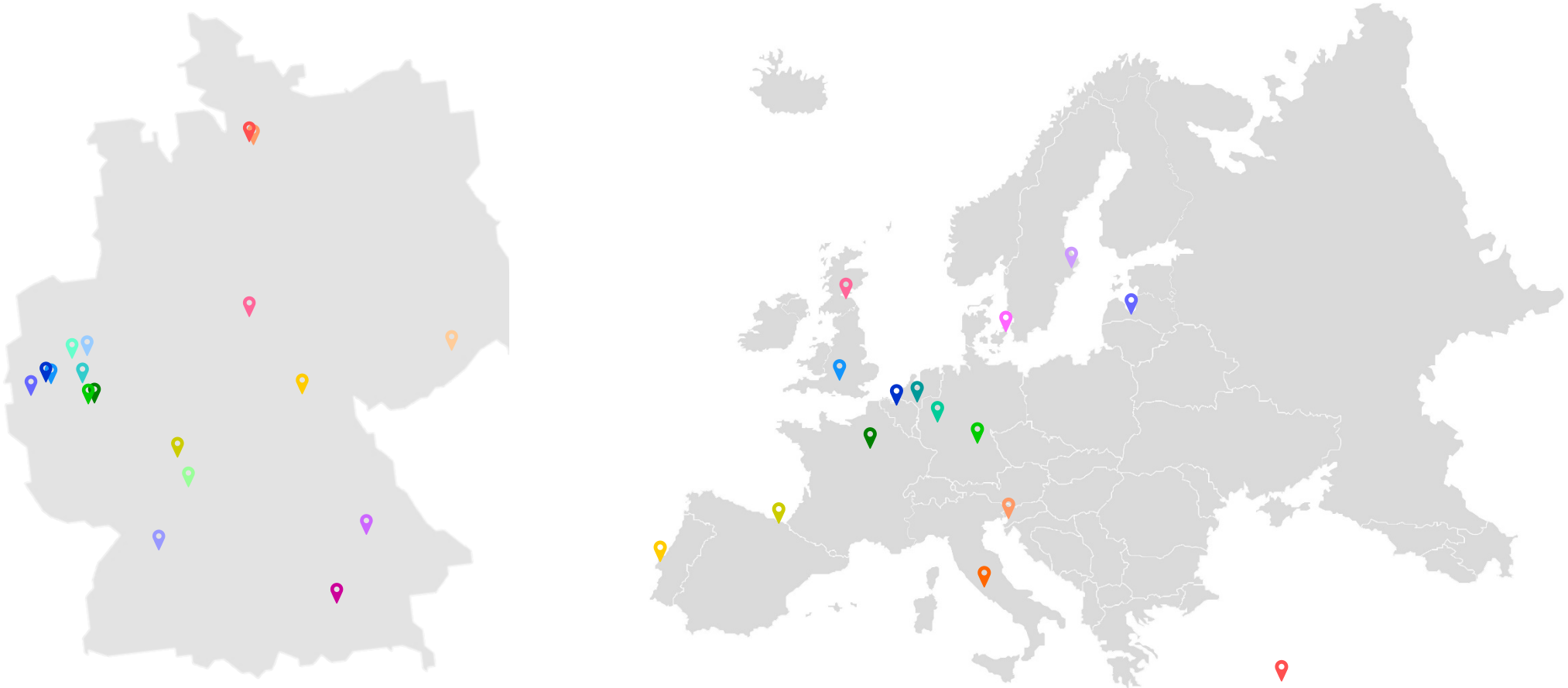
Productive structures
CI/CD infrastructure and systematic monitoring

Scientific output
Groundbreaking publications

JUREAP LIGHTHOUSES

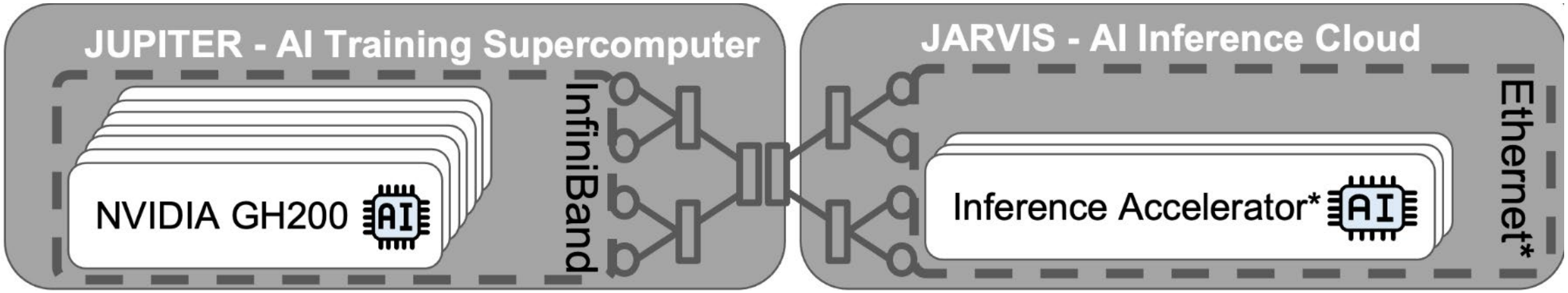
18 GCS (German, left) and 15 EuroHPC (European, right) projects

3x Climate/Weather



ECMWF only institution with GCS AND EuroHPC project!

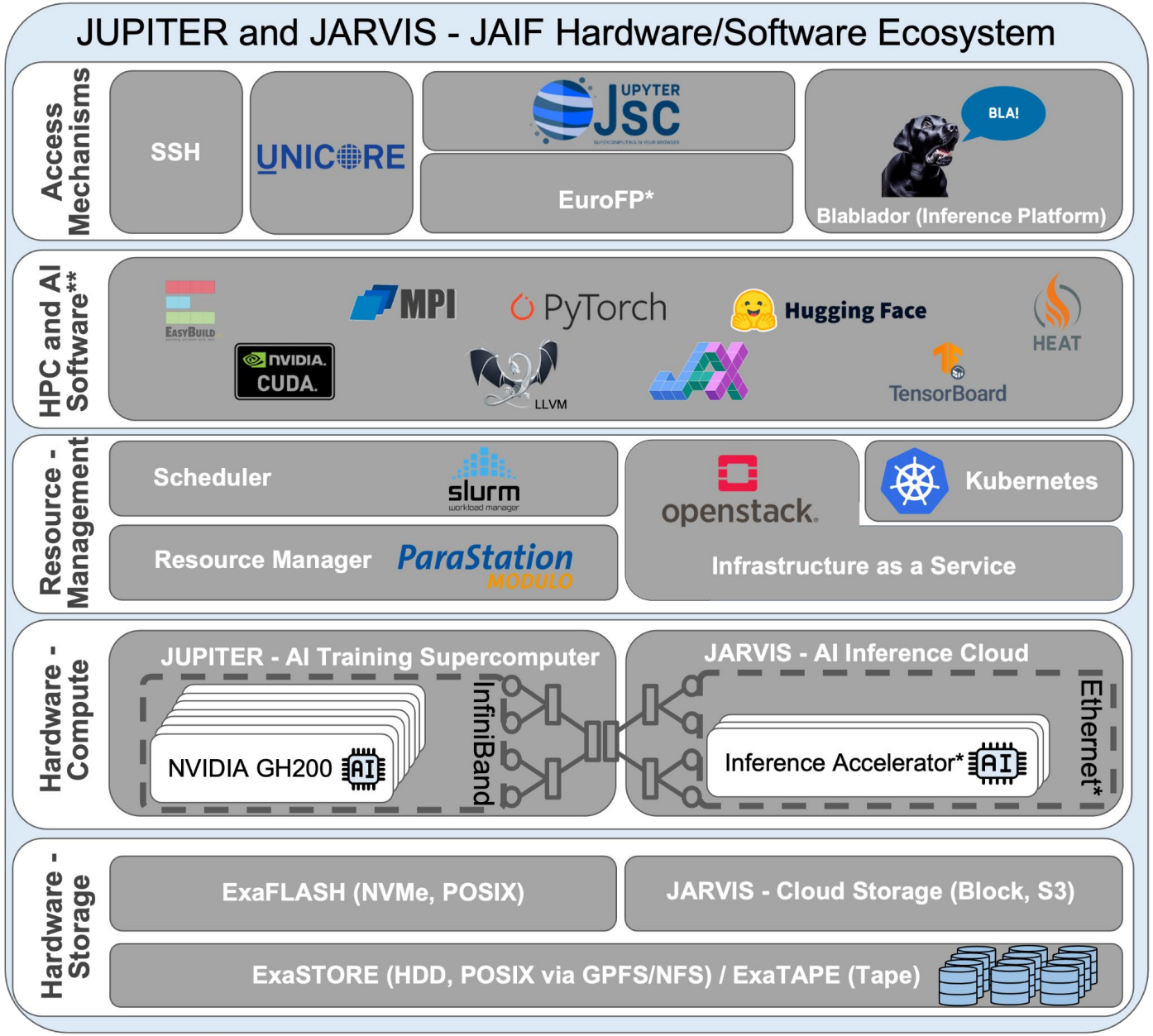
JUPITER meets JARVIS
Completing AI Supercomputing



40 ExaFLOP/s FP8 AI performance
24 000 NVIDIA GH200 superchips

Scalability, Sovereignty
European (experimental) technology

Software Stack



*Depending on procurements and available functionality

**This is a subset of the available software

JAIF Domains – We Strengthen European Key Sectors and Transfer Competence to Start-ups, SMEs and Industry

Healthcare

Energy

Climate Change and Environment

Education, Culture and Media

Public Sector

Finance and Insurance

Manufacturing

The JUPITER AI Factory (JAIF)

European Commission Executive Vice-President Henna Virkkunen during her visit to Jülich, 23rd April 2025.

"My congratulations to the Jülich Supercomputing Centre as it prepares to host an AI Factory, to be powered by Europe's first exascale supercomputer, one of the most powerful and energy efficient supercomputers in the world. This cutting-edge facility, to be inaugurated in just a few months, is more than just a milestone; together with other AI Factories it is the cornerstone of our AI continent strategy to foster German and European AI innovation and create a step-change in EU competitiveness. As I embark on my tour of Europe's emerging AI factories, starting right here in Jülich, I am inspired by its creativity and transformative potential. The future of Europe as AI Continent is being forged right here, right now."

(Henna Virkkunen)

Climate/Weather @JSC:

Own climate and weather experts for simulation and AI

Long term collaboration with MPIfM and DKRZ (ICON)

Strong collaboration with ECMWF in the fields of IFS and AIFS

DestinE

JUPITER was developed with climate and weather applications in mind!


JUPITER
THE FIRST EXASCALE SYSTEM IN EUROPE

JUPITER is the begin of the **Exascale** era in Europe. Not the #1 in the TOP500 but maybe the **most useable system** for hybrid AI/simulation applications in the world.

We want to predict **climate and weather** faster, more accurate and reliable than ever before.

The combination of accurate climate and weather data and exascale compute will put **AI-driven predictions** to a new level!

JUPITER

The Arrival of Exascale in Europe

fz-juelich.de/jupiter | #exa_jupiter

EuroHPC Joint Undertaking

Federal Ministry of Education and Research

Ministry of Culture and Science of the State of North Rhine-Westphalia

GCS Gauss Centre for Supercomputing