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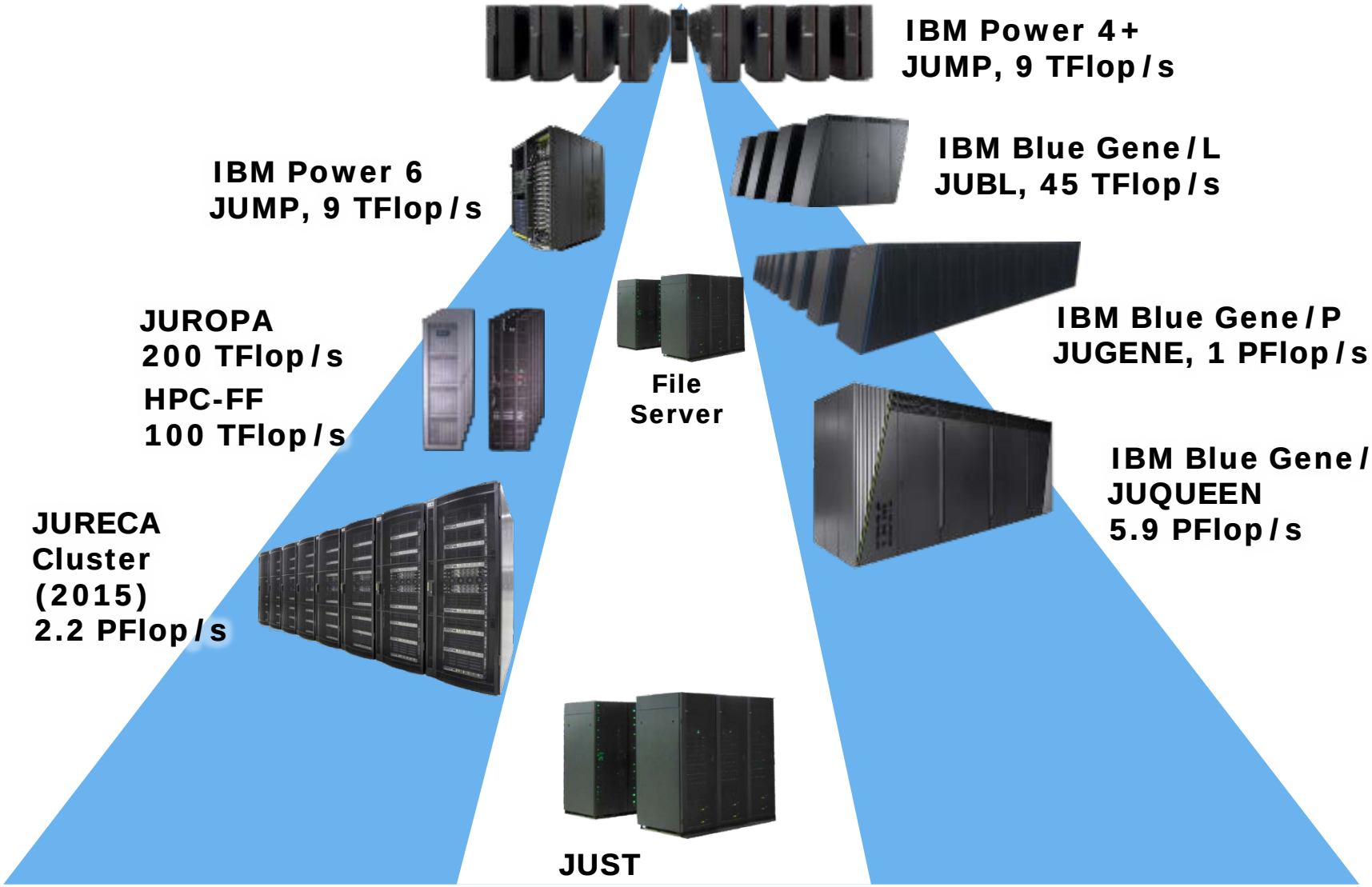
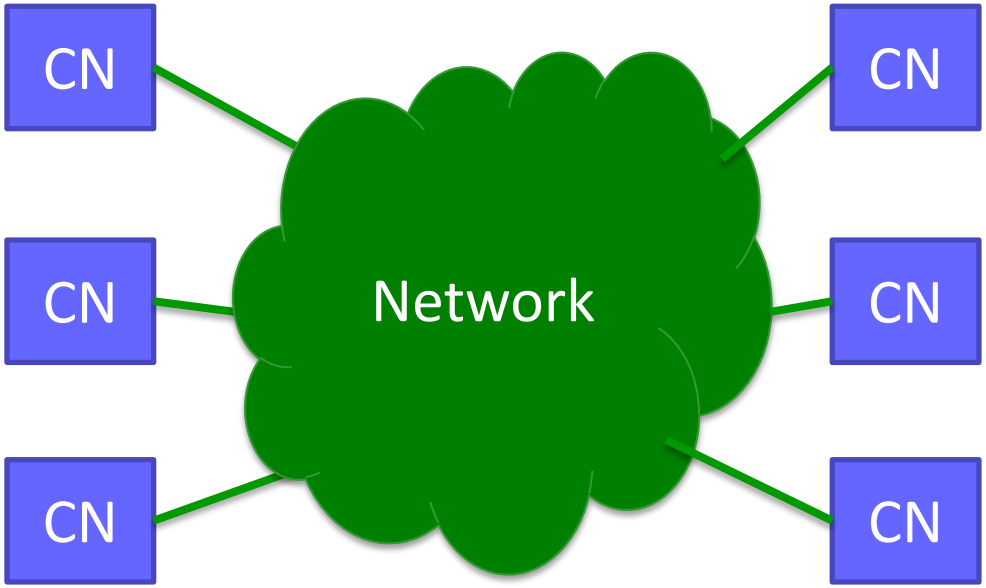
Towards Modular Supercomputing with Slurm

2017-09-25 | Dorian Krause et al.,
Jülich Supercomputing Centre, Forschungszentrum Jülich

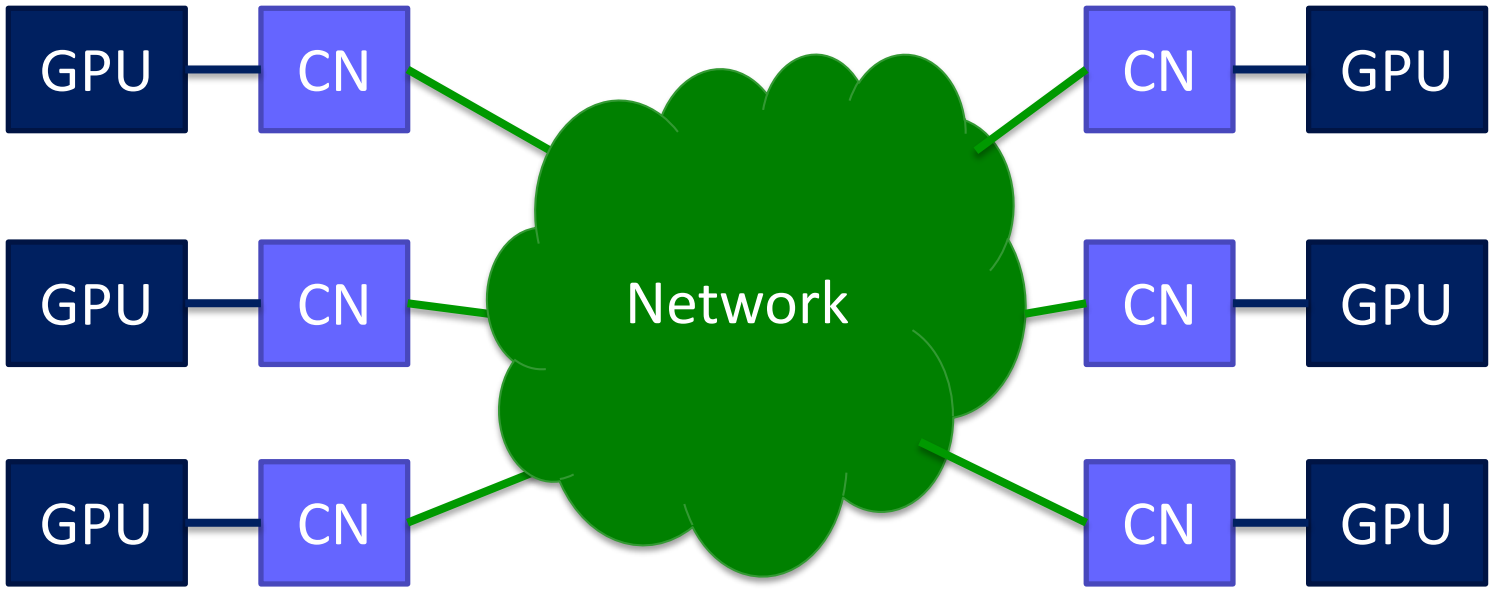
Dual-Architecture Supercomputing Facility



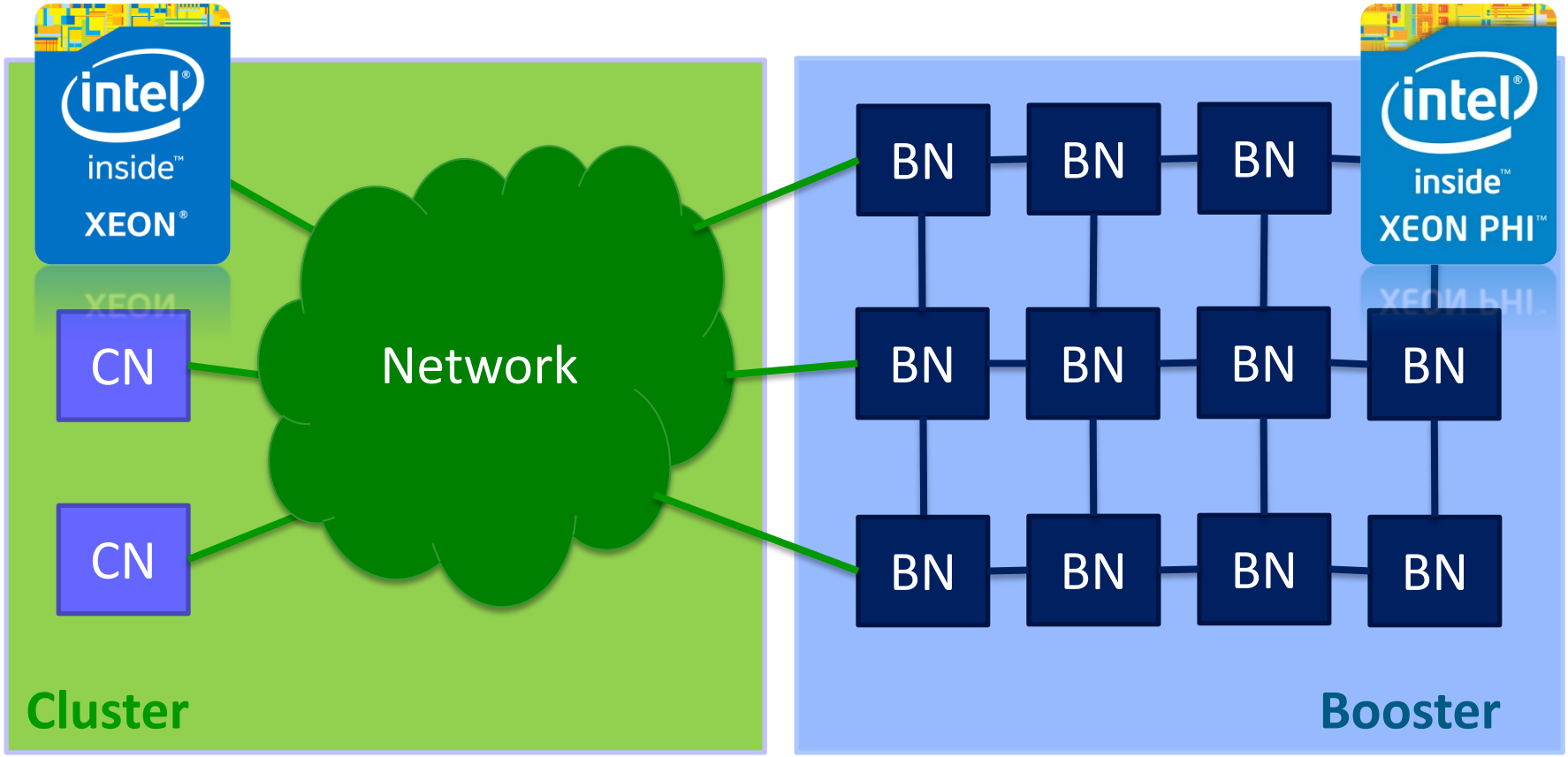
Homogeneous Cluster



Heterogeneous Cluster



Cluster-Booster Architecture



The DEEP projects: DEEP, DEEP-ER, DEEP-EST

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www.deep-projects.eu

EU-Exascale projects

27 partners

Total budget: 44 M€

EU-funding: 30 M€

Nov 2011 – Jun 2020

All combine:

- Hardware
- Software
- Applications

in a strong co-design

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All combin

- Hardwa
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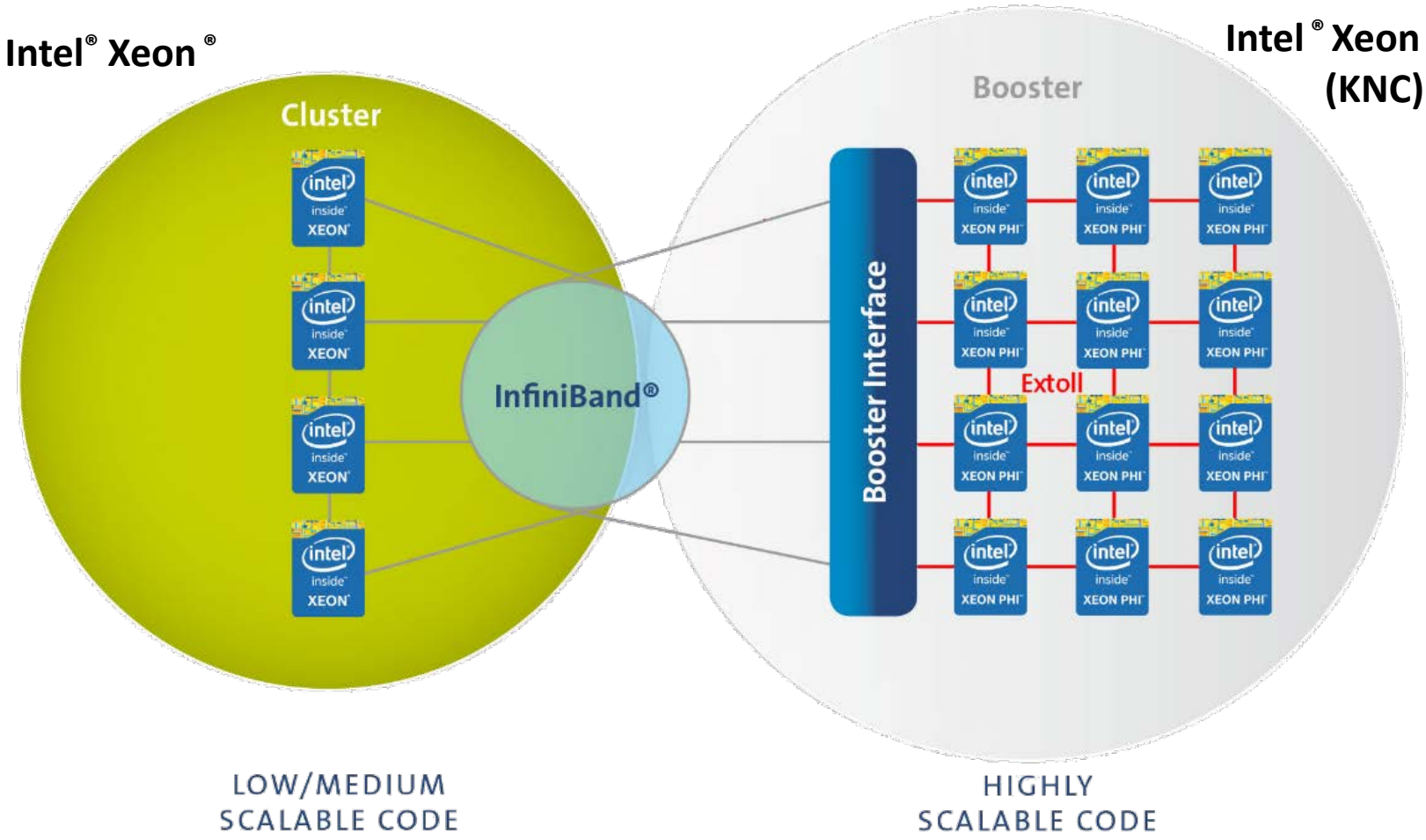
DEEP:
Cluster-Booster Architecture + Software Environment

DEEP-ER:
I/O + Resiliency

DEEP-EST:
Modular Supercomputing

DEEP Architecture



DEEP Prototype

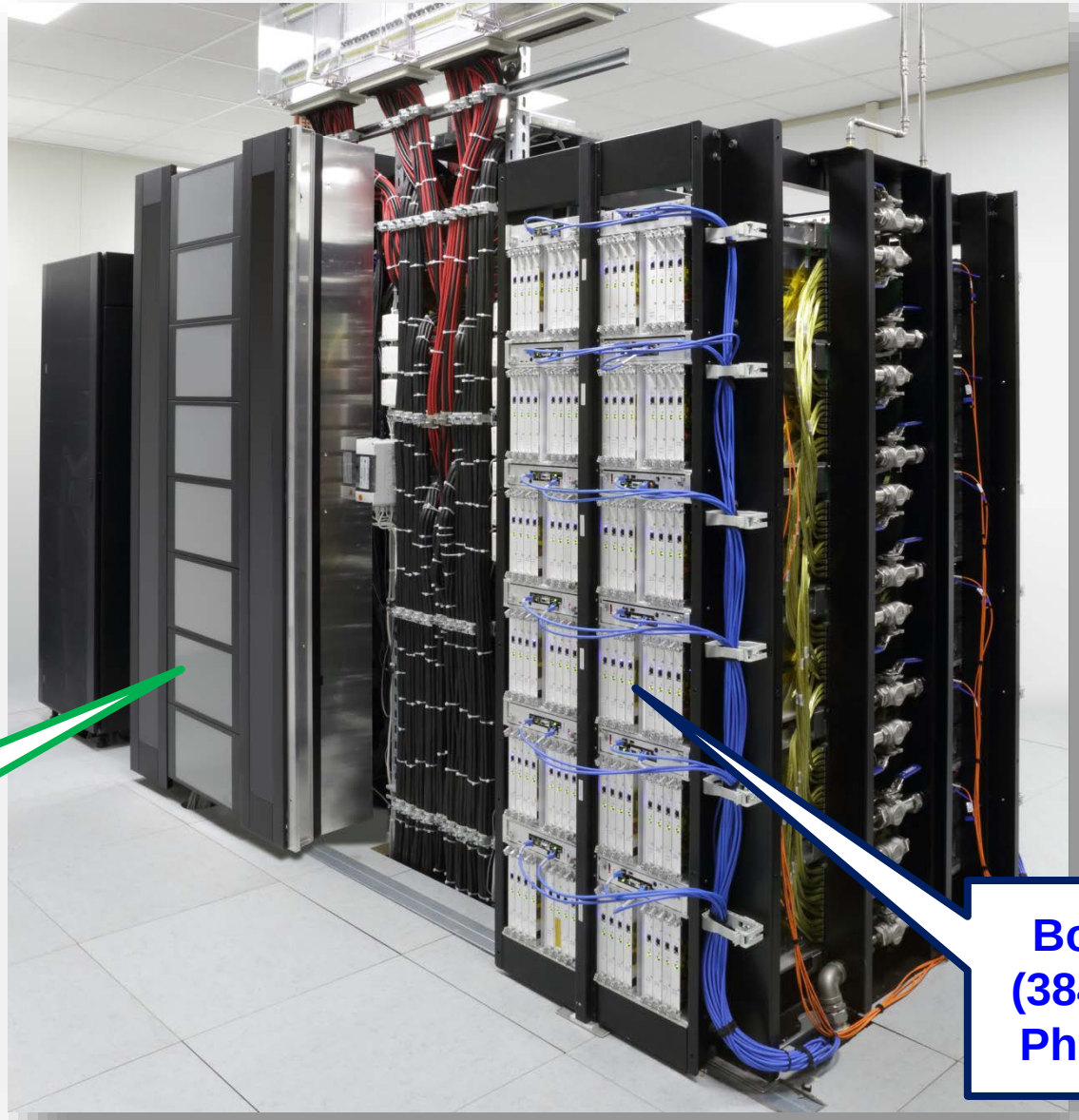
Installed at JSC

1,5 racks

500 TFlop/s peak

3.5 GFlop/s/W

Water cooled



Application-Driven Approach

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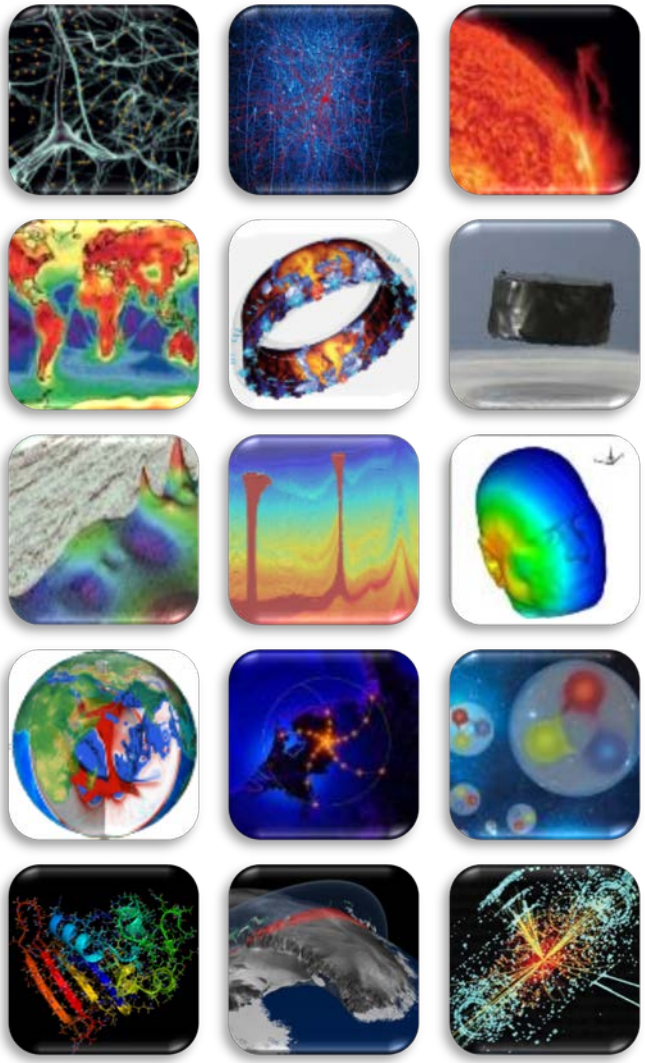
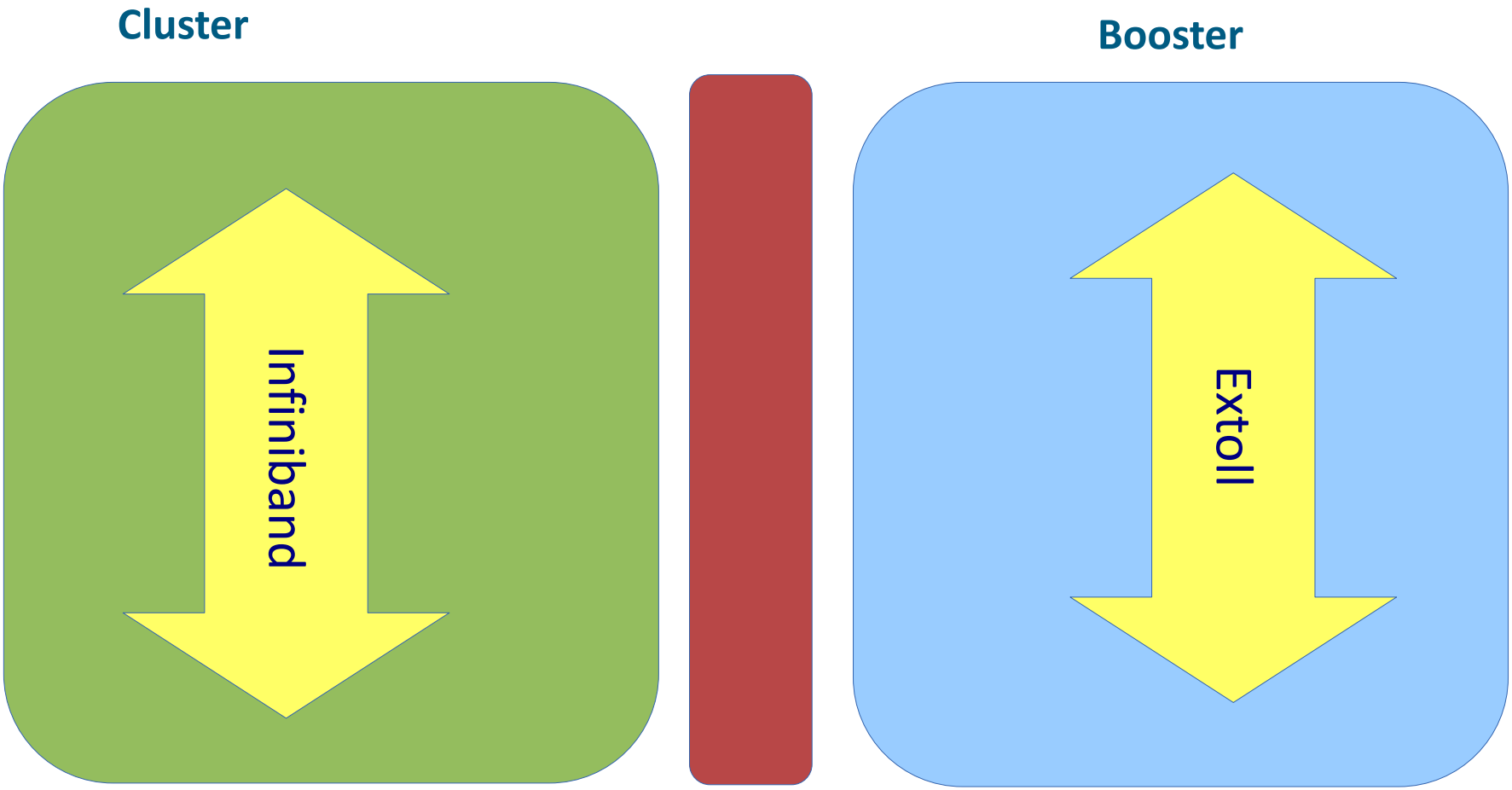
DEEP projects applications (15):

- Brain simulation (EPFL + NMBU)
- Space weather simulation (KU Leuven)
- Climate simulation (Cyprus Institute)
- Computational fluid engineering (CERFACS)
- High temperature superconductivity (CINECA)
- Seismic imaging (CGG + BSC)
- Human exposure to electromagnetic fields (INRIA)
- Geoscience (LRZ)
- Radio astronomy (Astron)
- Lattice QCD (University of Regensburg)
- Molecular dynamics (NCSA)
- Data analytics in Earth Science (UoI)
- High Energy Physics (CERN)



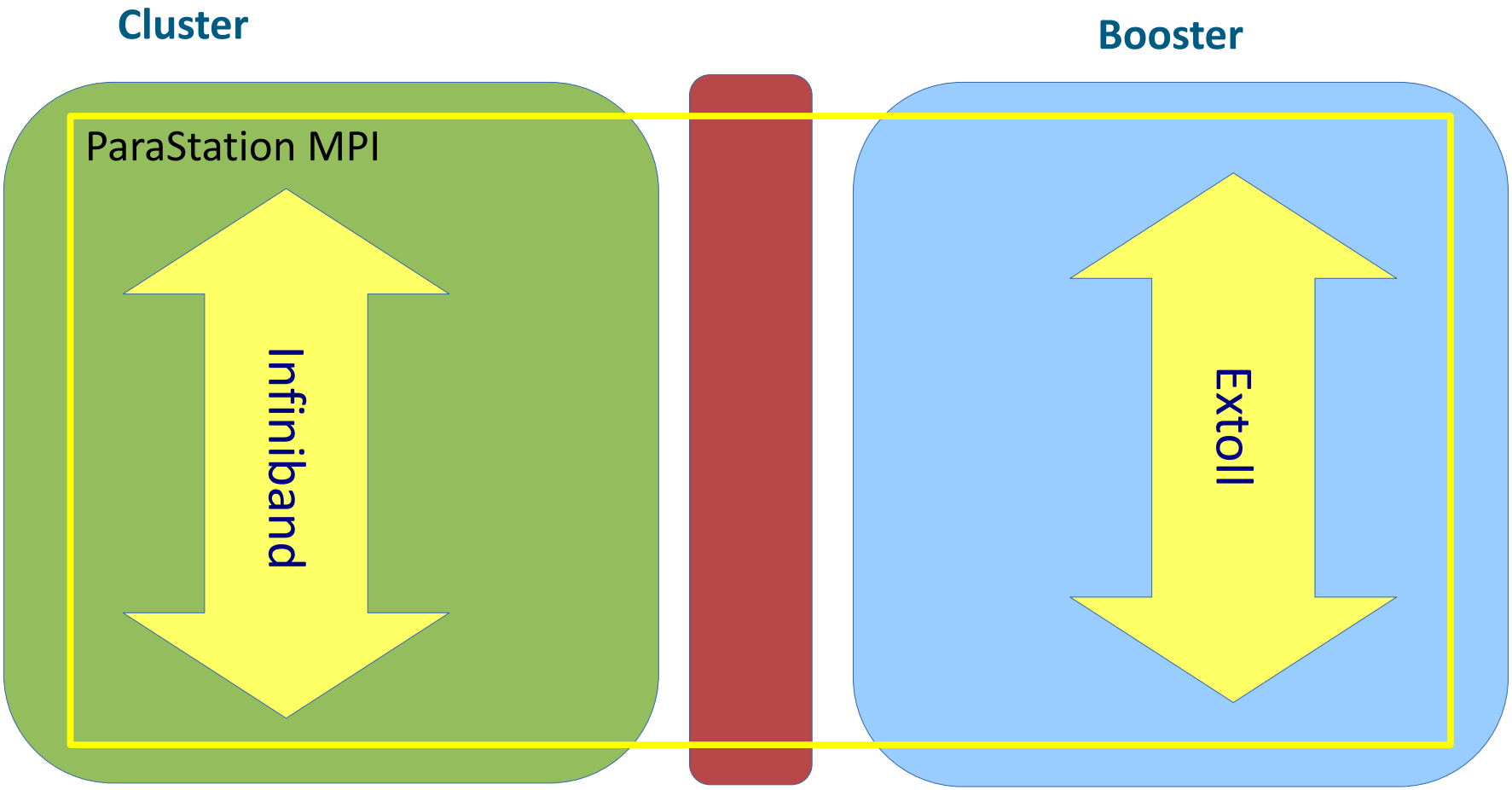
CO-DESIGN

Programming Environment



OmpSs on top of MPI provides pragmas to ease the offload process

Programming Environment



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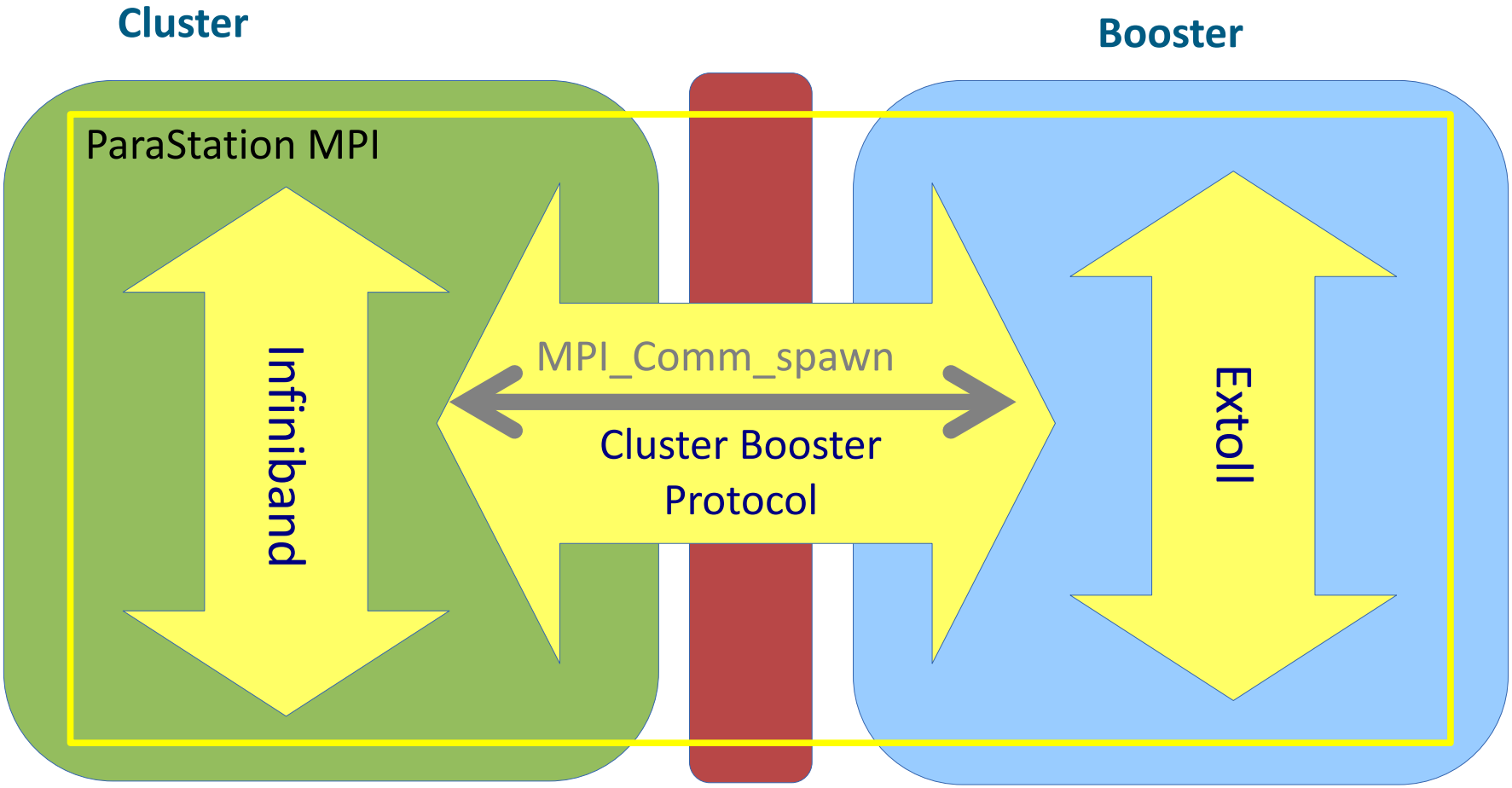

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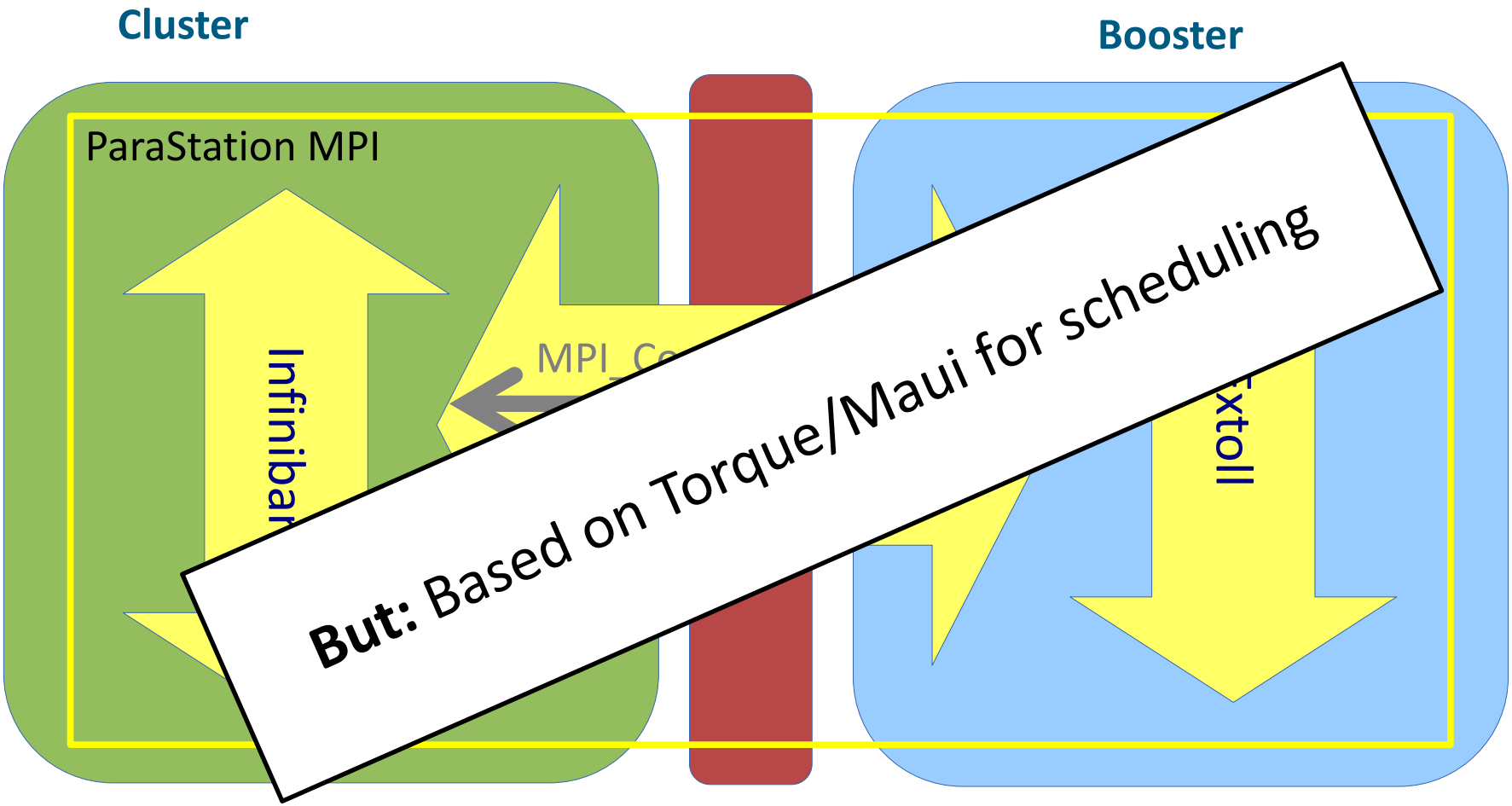

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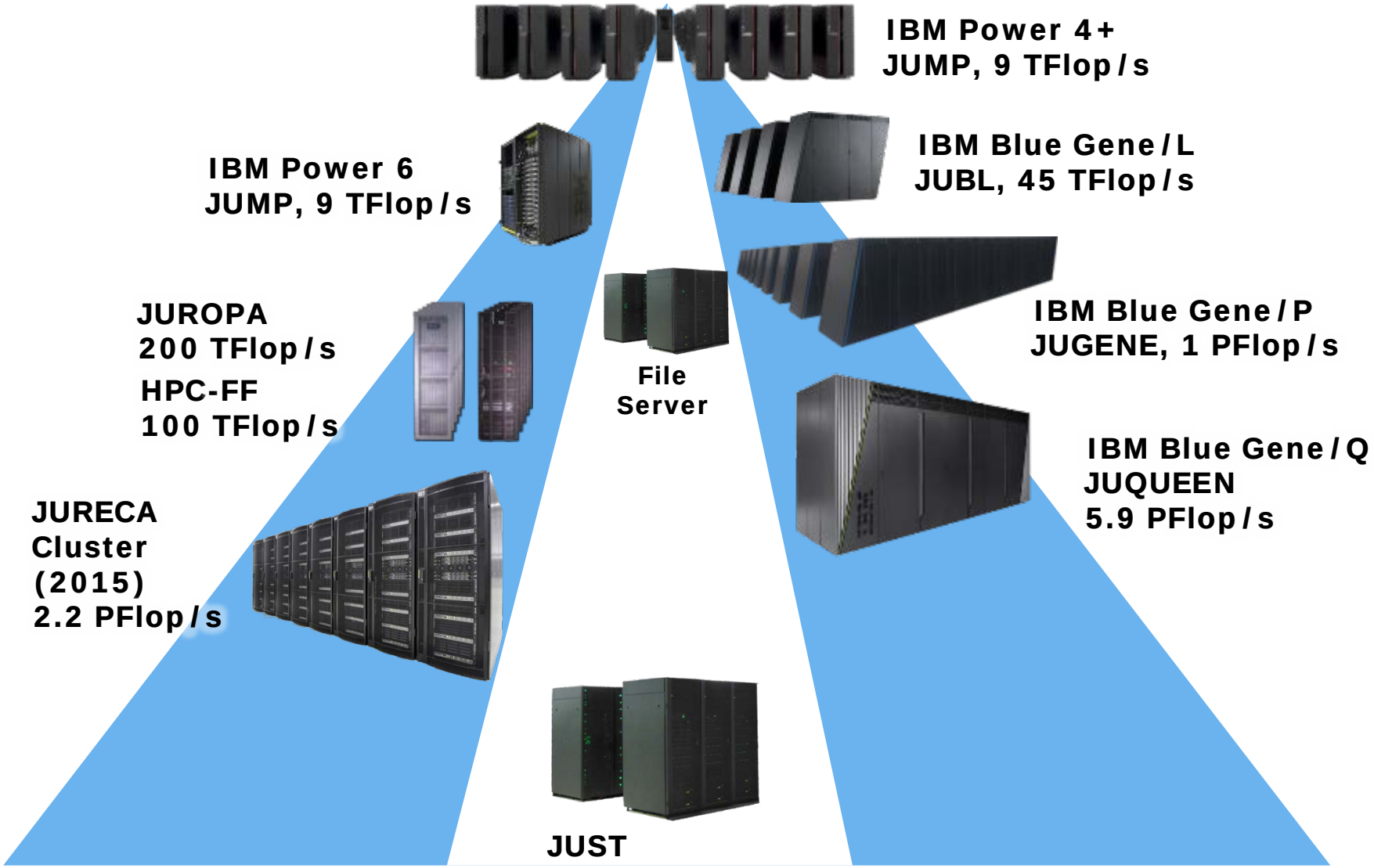
Dual-Architecture Supercomputing Facility



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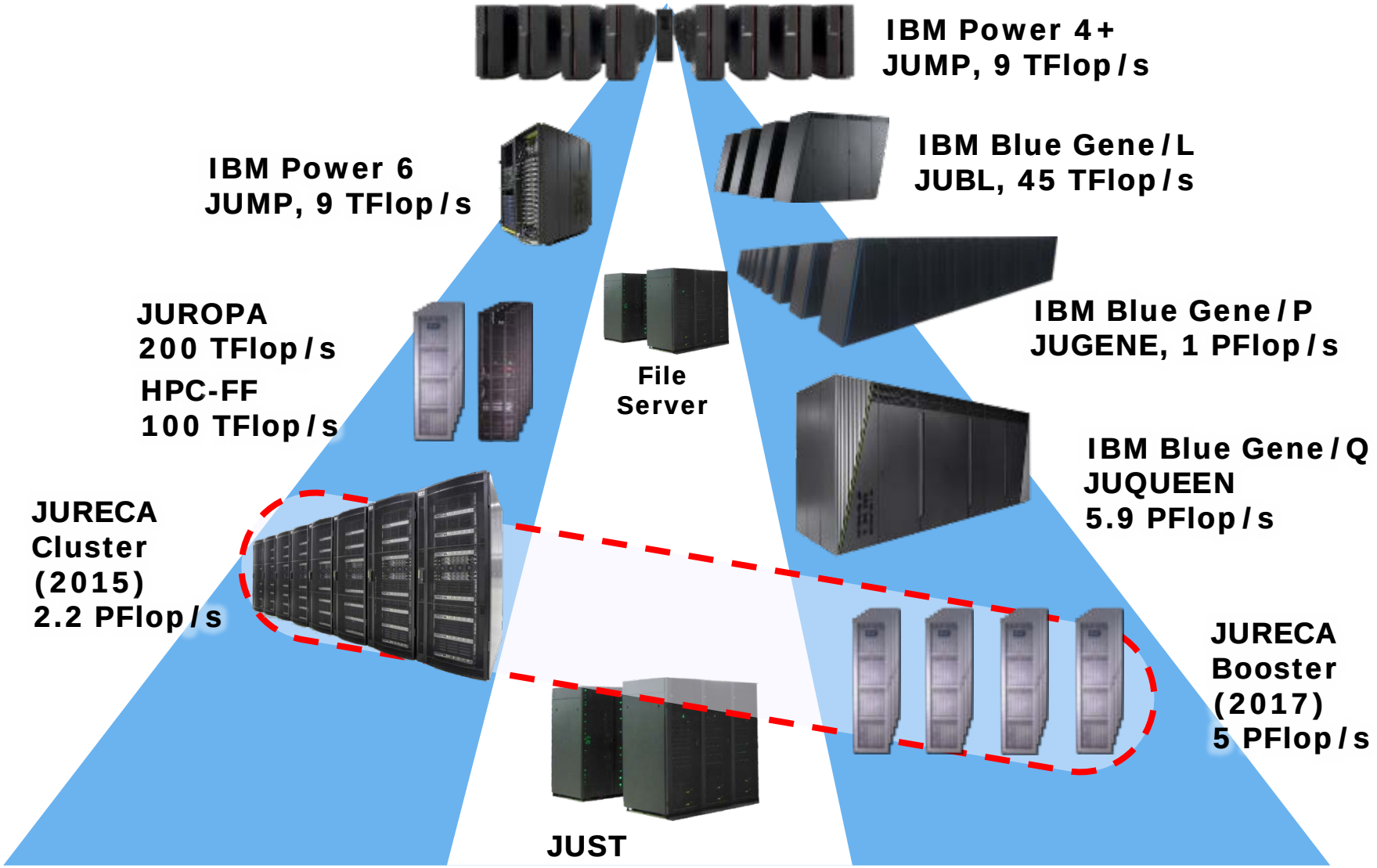


JURECA Cluster-Booster System

JURECA Cluster

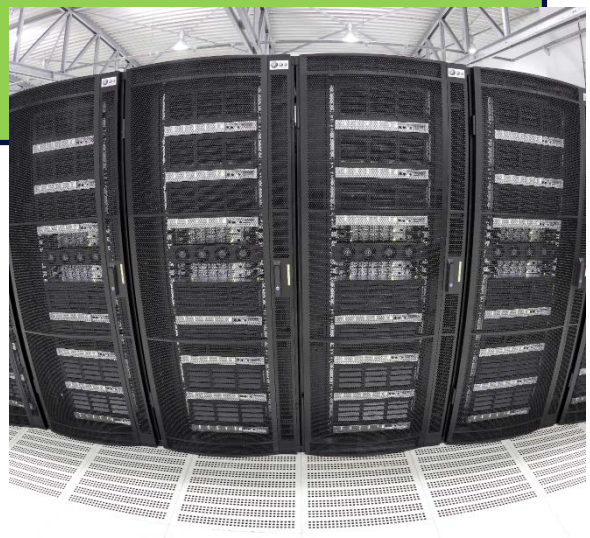
1884 nodes
Dual-Socket Xeon
Mellanox EDR IB
2.2 PF/s peak

Bridging: 20 Tb/s

Booster

1640 nodes
Xeon Phi 7250-F
Intel OPA full fat-tree
5 PF/s peak

198 bridge nodes



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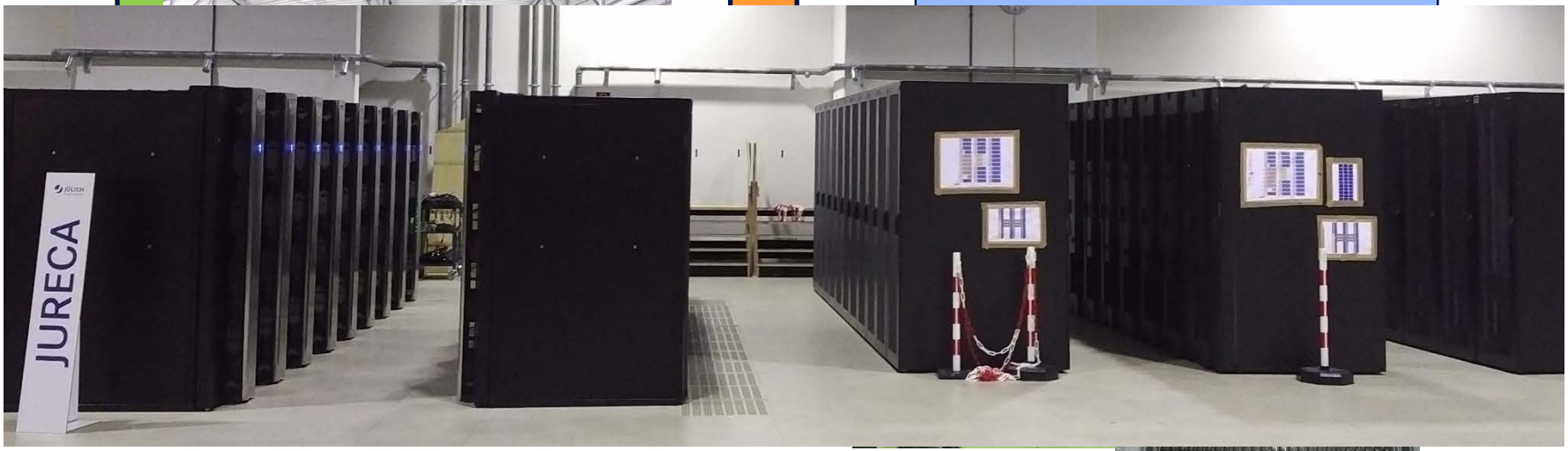

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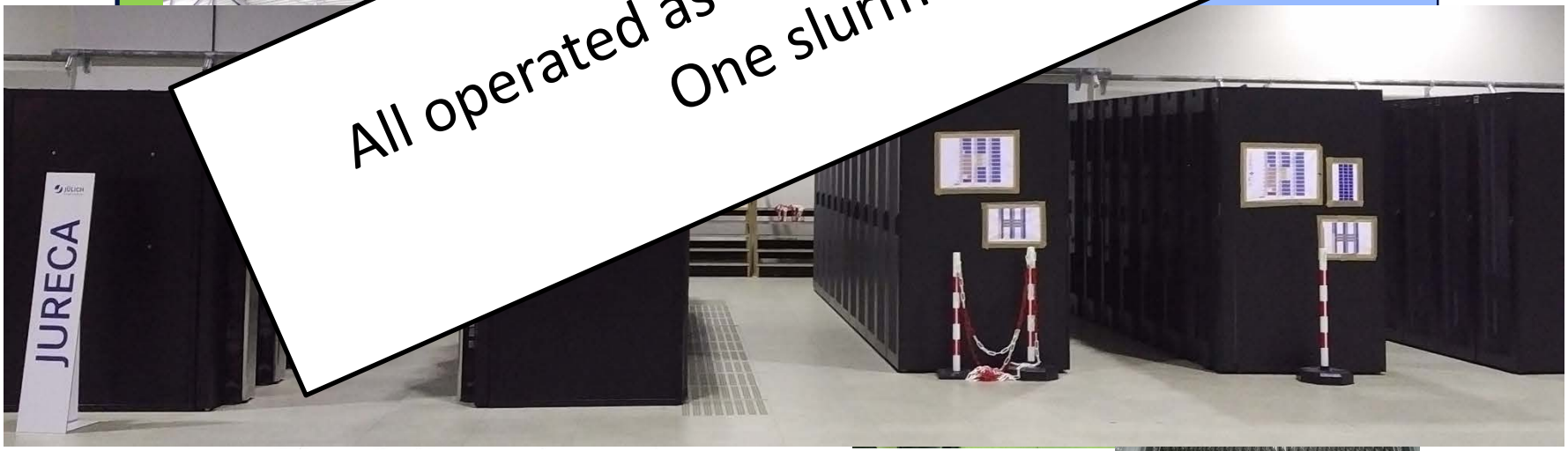
All operated as one system with Slurm:
One slurmctld!



JURECA Cluster-Booster System

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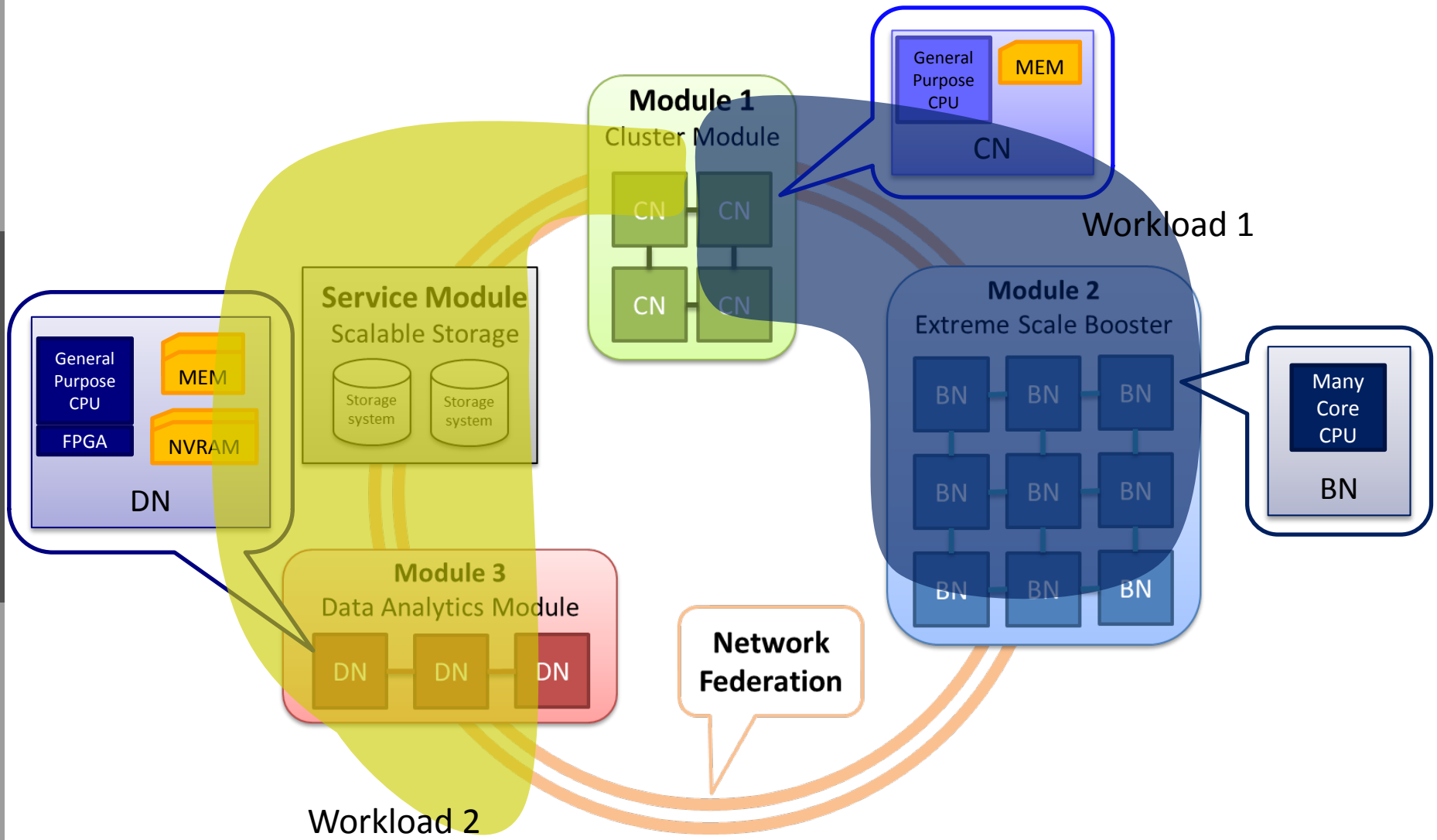
Building blocks

Cluster Hardware	✓
Cluster Software	✓
Booster Hardware	✓
Booster Software	✓
Cluster-Booster Bridging for MPI	✓
Workload Management	✓

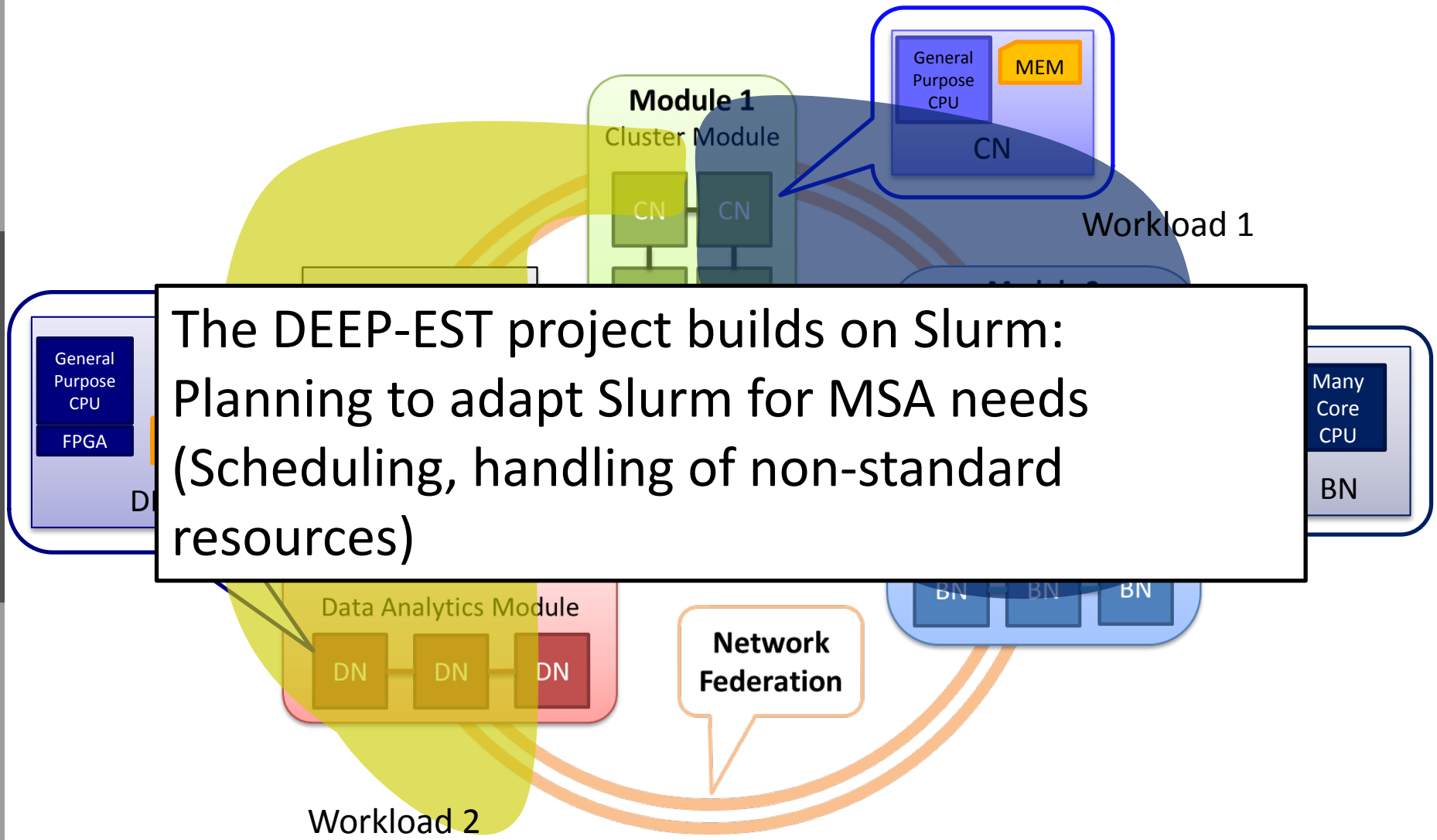
Slurm requirements

- Support for heterogeneity, QoS per partition ✓
- Support for flexible heterogeneous jobs across partitions

Next step: Modular Supercomputing



Next step: Modular Supercomputing



The DEEP-EST project builds on Slurm: Planning to adapt Slurm for MSA needs (Scheduling, handling of non-standard resources)

Summary

- Cluster-Booster Architecture combines multi- and many-core (or other accelerator) technologies in one system and enables a flexible resource selection.
- JURECA is currently extended to realize the Cluster-Booster Architecture in a 7.2 PF/s production system.
- Slurm is a key building block of our software stack. The community and SchedMD help us achieve our goal.
- Working towards Modular Supercomputing Architecture in DEEP-EST using Slurm. We hope to be able to contribute back.