JSC [HPC] SYSTEMS

JUWELS, JURECA-DC and JUSUF

30.05.2023 I D. ALVAREZ, S. ACHILLES

Member of the Helmholtz Association

JÜLICH
Forschungszentrum

JSC [HPC] SYSTEMS

- JSC is a multi-system facility

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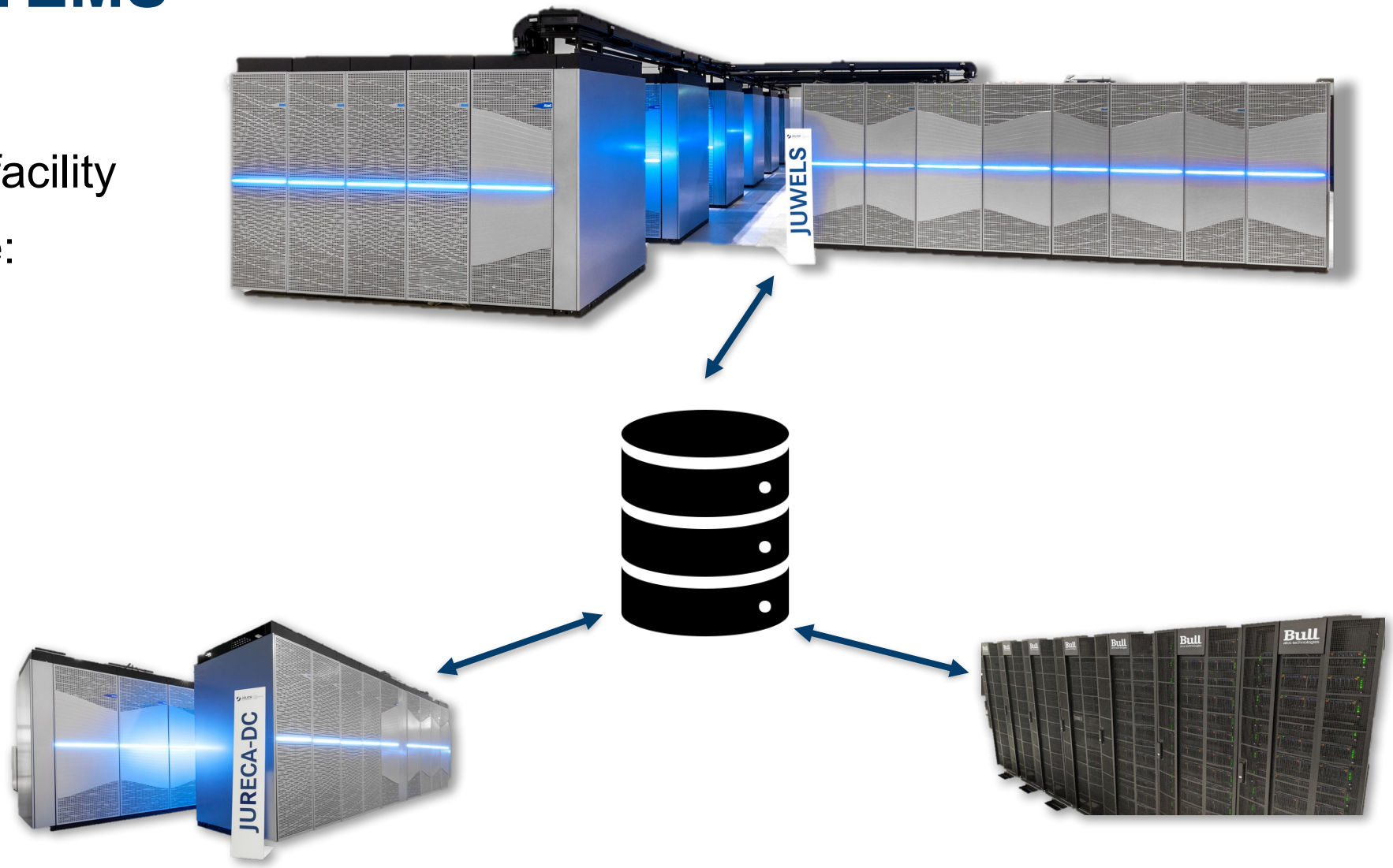
- JSC is a multi-system facility
- Main HPC systems are:
  - JUWELS
  - JURECA-DC
  - JUSUF
- Shared storage!
  - Different talk



BRIEF JUWELS TIMELINE

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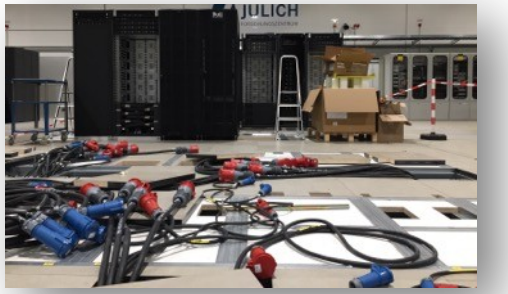

JUWELS Cluster installation begins

2018

2019

2020

2021

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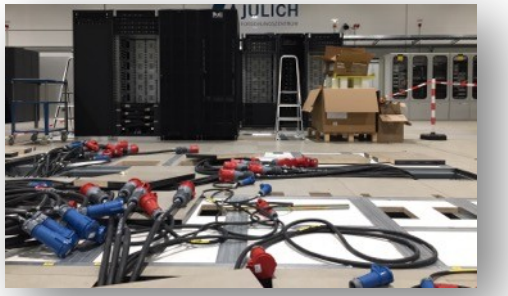

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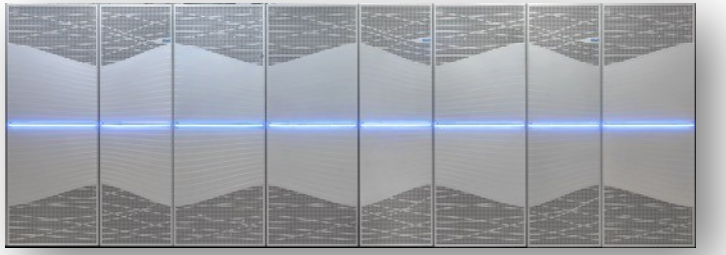

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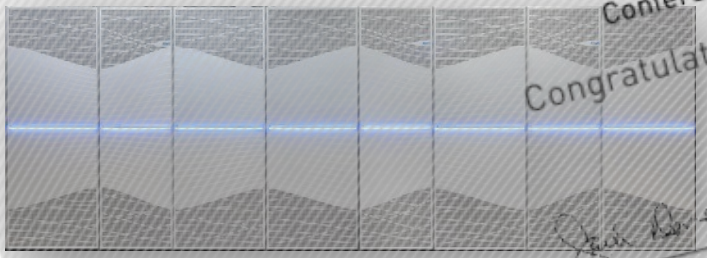


TOP500 CERTIFICATE

JUWELS Module 1 - Bull Sequana X1000, Xeon Platinum 8168 24C 2.7GHz, Mellanox EDR InfiniBand/ParTec ParaStation ClusterSuite Forschungszentrum Juelich (FZJ), Germany

is ranked No. 93 in the List.

among the World's TOP500 Supercomputers with 6.18 PFlop/s Linpack Performance in the 60th TOP500 List published at the SC22 Conference on November 15, 2022.

Congratulations from the TOP500 Editors

Erich Strohmaier NERSC/Berkeley Lab

Jack Dongarra University of Tennessee

Horst Simon NERSC/Berkeley Lab

Martin Meuer Prometeus

The GREEN500 CERTIFICATE

JUWELS Module 1 - Bull Sequana X1000, Xeon Platinum 8168 24C 2.7GHz, Mellanox EDR InfiniBand/ParTec ParaStation ClusterSuite Forschungszentrum Juelich (FZJ), Germany

is ranked No. 99 among the World's TOP500 Supercomputers with 4.539 GFlops/watts Performance in the Green500 List published at the SC22 Conference on November 15, 2022.

Congratulations from the Green500 Editors

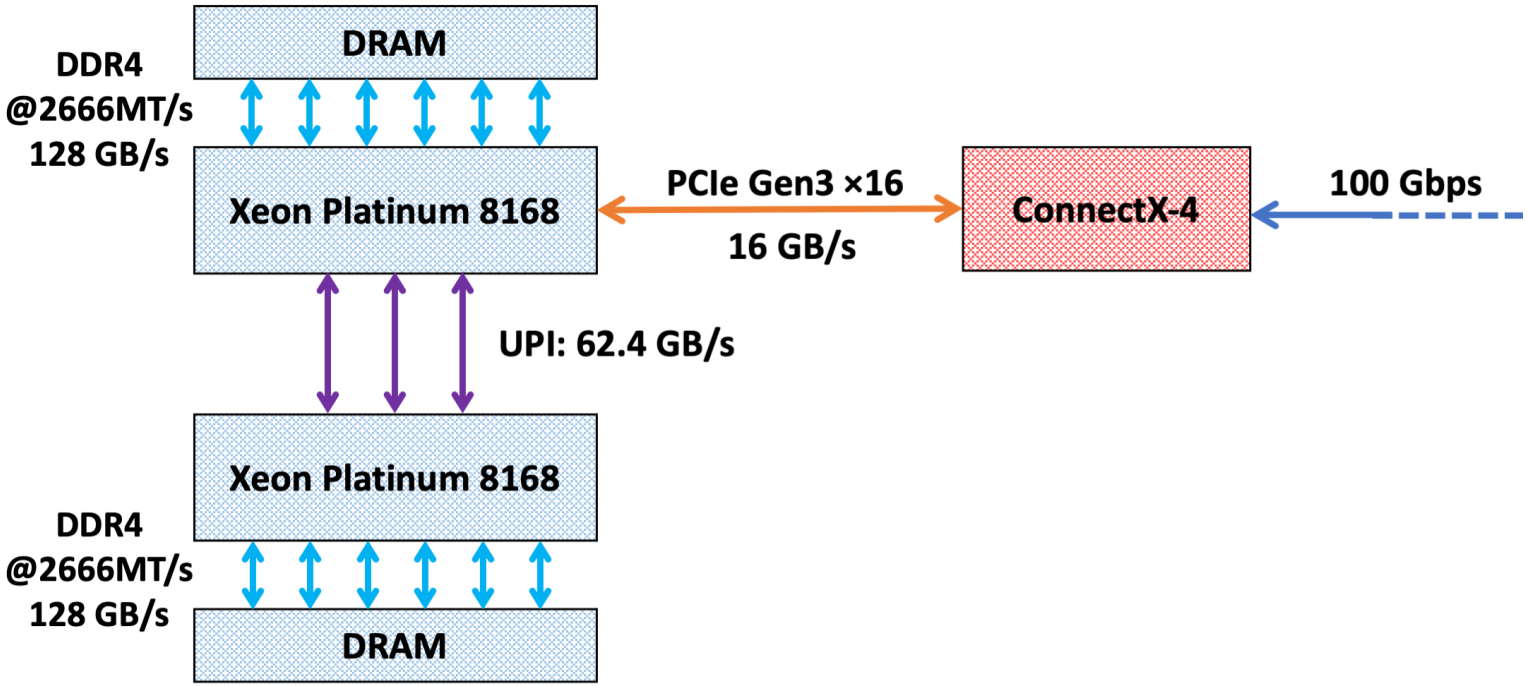
Wu-chun Feng Virginia Tech

Kirk Cameron Virginia Tech

JUWELS CLUSTER NODES

- 2511 compute nodes
  - 2× 24-core Intel Xeon Platinum 8168
    - 2x 6 memory channels
    - 2x 48 GB DDR4 @ 2.666 GHz
      - 240 nodes with 2x 96 GB DDR4 @ 2.666 GHz
    - PCIe Gen3
  - 1x EDR InfiniBand adapter (100Gbps)

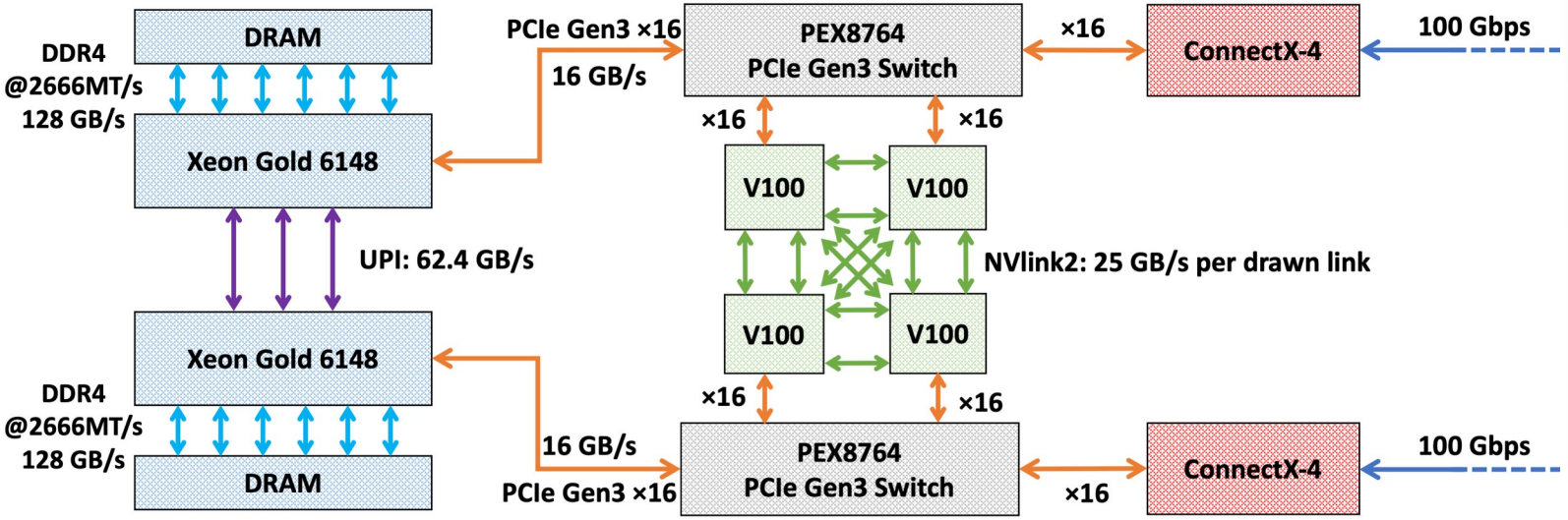
JUWELS CLUSTER NODES



JUWELS CLUSTER GPU NODES

- 56 compute nodes
  - 2× 20-core Intel Xeon Gold 6148
    - 2x 6 memory channels
    - 2x 96 GB DDR4 @ 2.666 GHz
    - PCIe Gen3
  - PCIe Switch
  - 4× Nvidia V100 GPUs
    - 7.8 TF/s peak
    - 16 GB HBM2
    - 900 GB/s memory performance
    - NVLink2 full mesh
      - 2 links (100GB/s bidir) between GPU pairs
    - PCIe Gen3 x16 (32 GB/s bidir)
  - 2x EDR InfiniBand adapter (100 Gbps)

JUWELS CLUSTER GPU NODES



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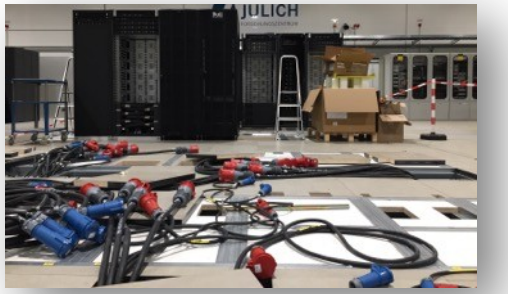

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JUWELS Booster kick-off

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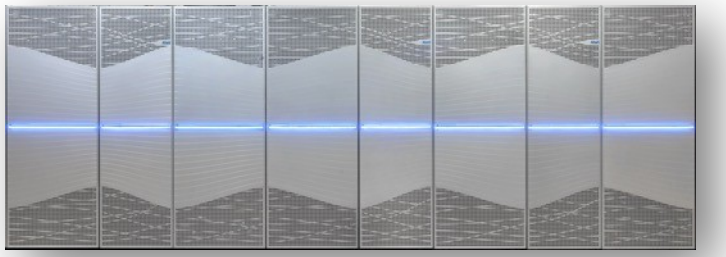

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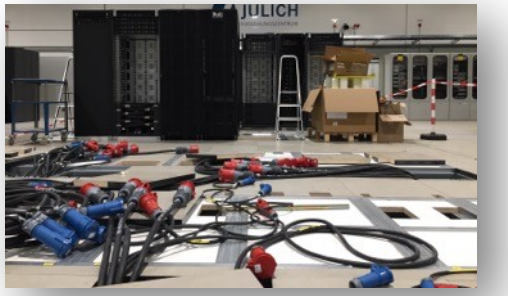

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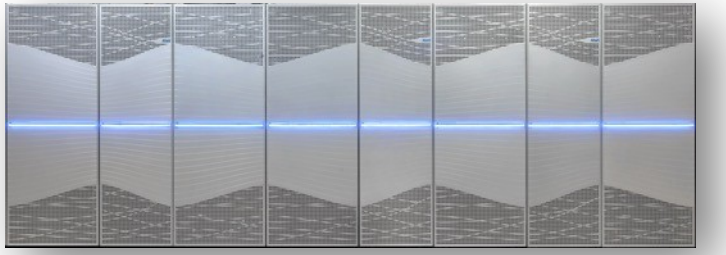

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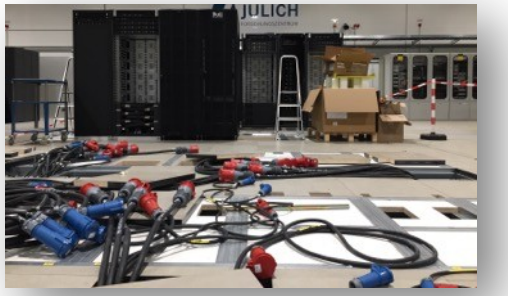

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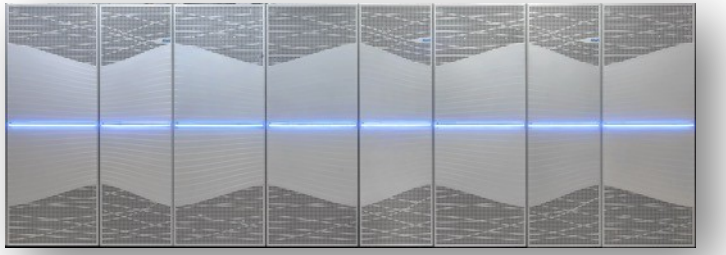

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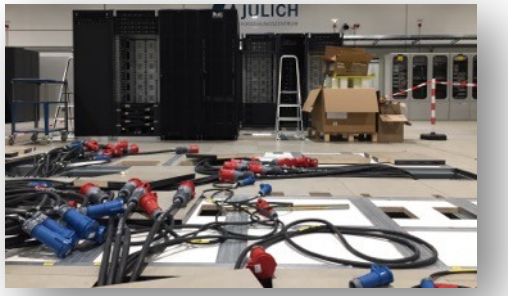

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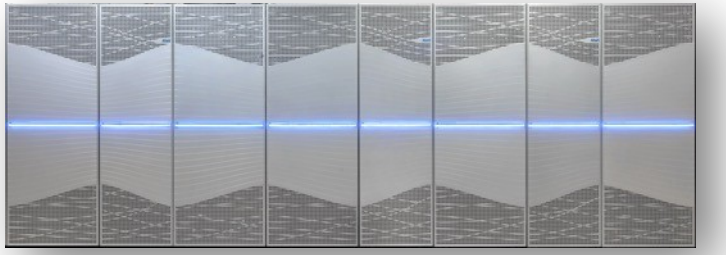
JUWELS Booster installation begins

2021

JUWELS Cluster-Booster merge



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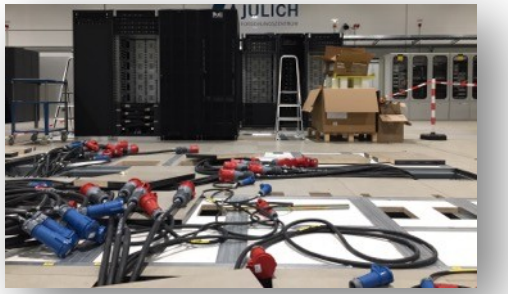

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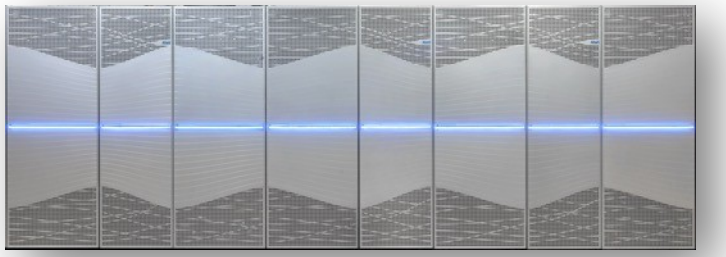


BRIEF JUWELS TIMELINE

TOP 500

The List.

CERTIFICATE

JUWELS Booster Module - Bull Sequana XH2000 , AMD EPYC 7402 24C 2.8GHz, NVIDIA A100,
Mellanox HDR InfiniBand/ParTec ParaStation ClusterSuite
Forschungszentrum Juelich (FZJ), Germany

is ranked

No. 12

among the World's TOP500 Supercomputers

with 44.12 PFlop/s Linpack Performance

in the 60th TOP500 List published at the SC22

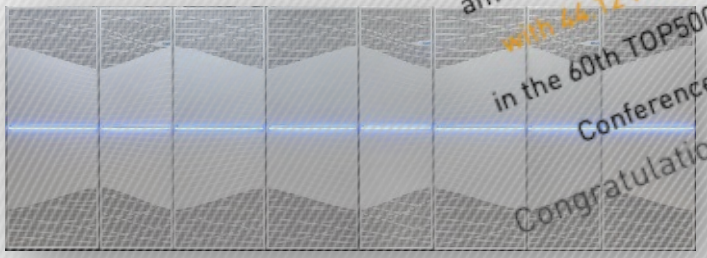
Conference on November 15, 2022.

Congratulations from the TOP500 Editors

Horst Simon
NERSC/Berkeley Lab

Martin Meuer
Prometeus

Jack Dongarra
University of Tennessee



The GREEN 500

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Forschungszentrum Juelich (FZJ), Germany

is ranked

No. 25

among the World's TOP500 Supercomputers

with 25.008 GFlops/watts Performance

in the Green500 List published at the SC22

Conference on November 15, 2022.

Congratulations from the Green500 Editors

Wu-chun Feng
Virginia Tech

Kirk Cameron
Virginia Tech

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JUWELS installation begins

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JUWELS Cluster enters production

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JUWELS Booster kick-off

2021

JUWELS Booster production

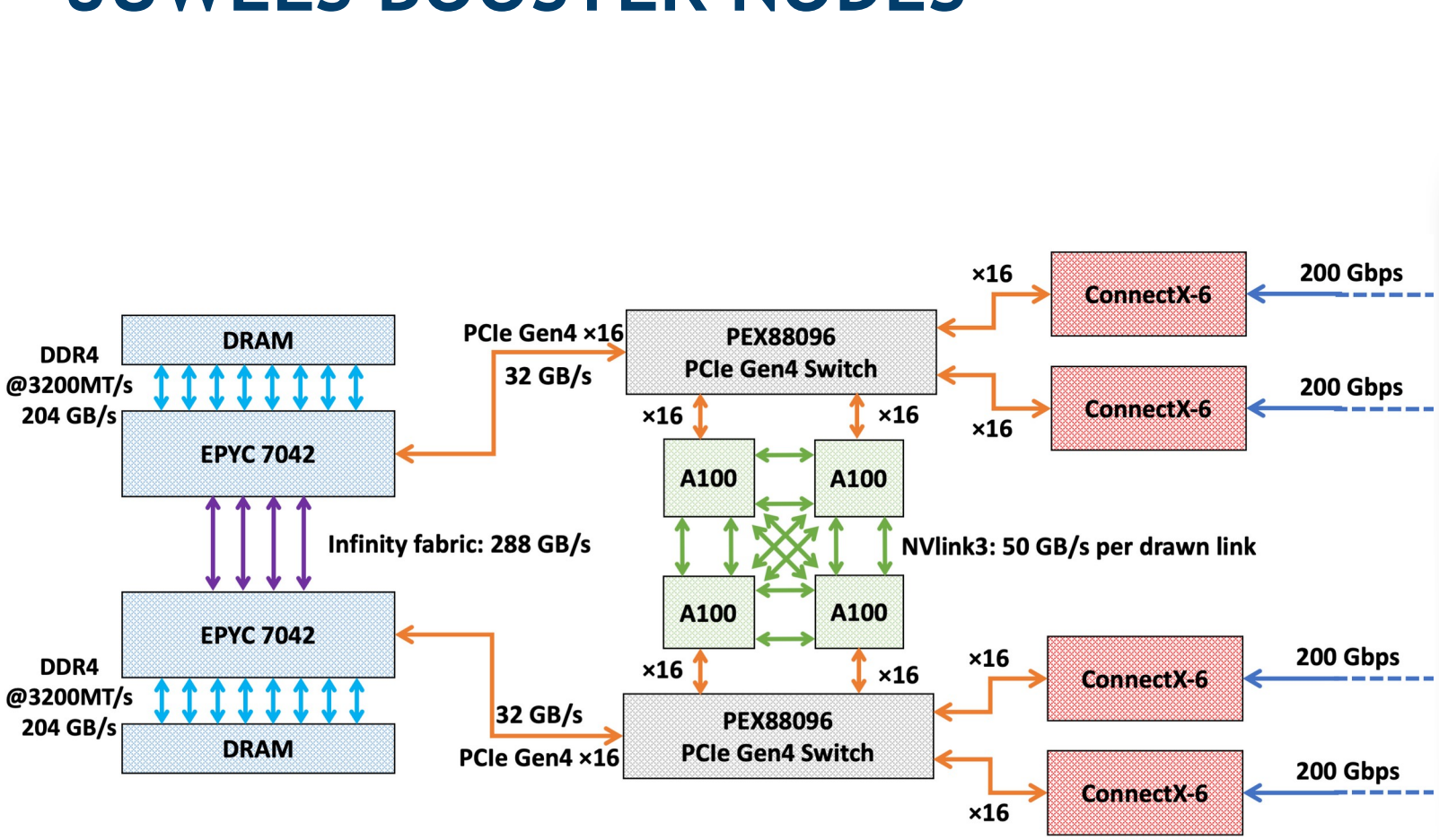
JUWELS Booster installation begins

JÜLICH Forschungszentrum

JUWELS BOOSTER NODES

- 936 compute nodes
  - 2× 24-core AMD Epyc 7402 Rome CPUs
    - 2x 8 memory channels
    - 2x 256 GB DDR4 @ 3.2GHz
    - 2x 4 NUMA domains
    - 96 PCIe Gen4 lanes
  - 512 GB DDR memory
  - 4× Nvidia A100 GPUs
    - 9.7 / 19.5 TF/s peak
    - 40 GB HBM2
    - 1.5 TB/s memory performance
    - NVLink3 full mesh
      - 4 links (200GB/s) between GPU pairs
    - PCIe Gen4 x32 (64 GB/s)
  - 4x HDR200 InfiniBand adapter (1 per GPU)

JUWELS BOOSTER NODES



CLUSTER VS BOOSTER: KEY FACTS

CLUSTER VS BOOSTER –NODE VIEW– (1/2)

JUWELS Cluster (w/o GPU nodes)			JUWELS Booster	
Processors	Intel	-	AMD	Processors
Cores	48	x1	48	Cores
Vector width (CPU)	512	x0.5	256	Vector width (CPU)
Memory (main)	96/192 GB	x5.33/2.66	512 GB	Memory (main)
Memory BW (main)	256 GB/s	x1.59	408 GB/s	Memory BW (main)
GPUs	0	xNaN	4	GPUs
Memory (GPU)	0	xNaN	160 GB	Memory (GPU)
Memory BW (GPU)	0	xNaN	6 TB/s	Memory BW (GPU)
HCAs	1	x4	4	HCAs
Link BW	100 Gbps	x2	200 Gbps	Link BW
Network BW	100 Gbps	x8	800 Gbps	Network BW
TFLOPs	4.15	x18.8	78	TFLOPs (GPUs)

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CLUSTER VS BOOSTER –GLOBAL VIEW– (2/2)

JUWELS Cluster (w/o GPU nodes)			JUWELS Booster	
Peak performance	10.6 PF	x6.88	73 PF	Peak performance
Concurrency	240 K	x216	**»52 M**	Concurrency
Total memory	96 TB	x6.5	629 TB	Total memory
Total memory BW	0.6 PB/s	x9.3	5.6 PB/s	Total memory BW
Gb per TF	24.1	x0.42	10.3	Gb per TF
Injection BW	251 Tb/s	x2.98	749 Tb/s	Injection BW
Topology	Prun. FT	-	DF+	Topology
Global network bandwidth	63 Tb/s	x3.17	200 Tb/s	Global network bandwidth
Routing	Detem.	-	Adaptive	Routing

JUWELS CLUSTER LOGIN NODES

- 9 + 2 standard login nodes
  - 2× 20-core Intel Xeon Gold 6148
  - 756 GB DDR4 @ 2.666 GHz
  - 100 GigE external network
- 4 visualization nodes
  - 2× 20-core Intel Xeon Gold 6148
  - 756 GB DDR4 @ 2.666 GHz
  - 100 GigE external network
  - 1x Nvidia P100 GPU
    - Different compute capabilities than in compute nodes!
- Used for:
  - Compile/submit jobs
    - Careful with `make -j`!
  - Small pre- and post-processing/visualization
- Shared nodes!

JUWELS BOOSTER LOGIN NODES

- 4 login nodes
  - 2× 24-core AMD Epyc 7402 Rome CPUs
  - 512 GB DDR4 @ 3.2 GHz
  - 100 GigE external network
  - No GPUs!
- Used for:
  - Compile/submit jobs
    - Careful with `make -j` !
  - Small pre- and post-processing/visualization
- Shared nodes!

JURECA-DC

DC = Data Centric

- Intended for mixed capacity and capability workloads
  - Designed with big-data science needs in mind

JURECA-DC

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- Intended for mixed-capacity and capability workloads
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JURECA-DC CPU NODES

- 576 compute nodes
  - 2× 64-core AMD Epyc 7742 Rome CPUs
    - 2x 8 memory channels
    - 2x 256 GB DDR4 @ 3.2 GHz
      - 96 nodes with 2x 512 GB DDR4 @ 3.2 GHz
    - 2x 4 NUMA domains
    - PCIe Gen4
  - 1x HDR100 InfiniBand adapter (100Gbps)

JURECA-DC GPU NODES

- 192 compute nodes
  - 2× 64-core AMD Epyc 7742 Rome CPUs
    - 2x 8 memory channels
    - 2x 256 GB DDR4 @ 3.2GHz
    - 96 PCIe Gen4 lanes
  - 512 GB DDR memory
  - 4× Nvidia A100 GPUs
    - 9.7 / 19.5 TF/s peak
    - 40 GB HBM2
    - 1.5 TB/s memory performance
    - NVLink3 full mesh
      - 4 links (200GB/s) between GPU pairs
    - PCIe Gen4 x32 (64 GB/s)
  - 2x HDR200 InfiniBand adapter (1 per GPU)

JURECA-DC LOGIN NODES

- 12 login nodes
  - 2× 64-core AMD Epyc 7742 Rome CPUs
  - 1024 GB DDR4 @ 3.2 GHz
  - 100 GigE external network
  - 2x Nvidia RTX8000 GPUs
    - Different compute capabilities than in compute nodes!
- Used for:
  - Compile/submit jobs
    - Careful with `make -j` !
  - Small pre- and post-processing/visualization
- Shared nodes!

JURECA-DC PROTOTYPE/TEST NODES

- 2x MI250X nodes
  - 2× 24-core AMD Epyc 7443 Milan CPUs
  - 512 GB DDR4 @ 3.2 GHz
  - 2x HDR200 InfiniBand adapter
  - 4x AMD MI250X GPUs
- 2x NVIDIA ARM HPC DevKit nodes
  - 1x Ampere Altra Q80-30
  - 512 GB DDR4 @ 3.2 GHz
  - 2x HDR200 InfiniBand adapter
  - 2x NVIDIA A100 GPUs
- 1x Sapphire Rapids HBM node
  - 2× 56-core Intel Xeon Max 9480 CPUs
  - 1 TB DDR5 @ 4.8 GHz
  - 2x 64 GB HBM2
  - 1x BlueField-2 InfiniBand adapter
- 1x Sapphire Rapids + NVIDIA H100 node
  - 2× 36-core Intel Xeon Platinum 8452Y CPUs
  - 512 GB DDR5 @ 4.8 GHz
  - 4x NVIDIA H100 GPUs
  - 1x BlueField-2 InfiniBand adapter
- 1 Graphcore IPU-M2000 node
  - 4x GC200 IPUs

JUSUF

- Serves the ICEI project (Interactive Computing E-Infrastructure for the Human Brain Project)
- Contains 2 partitions
  - HPC
  - Cloud
- Air-cooled, less dense than other systems

JUSUF HPC PARTITION

- 124 compute nodes Atos
  - 2× 64-core AMD Epyc 7742 Rome CPUs AMD
    - 2x 8 memory channels
    - 2x 128 GB DDR4 @ 3.2 GHz
    - 2x 4 NUMA domains
    - PCIe Gen4
  - 1x HDR100 InfiniBand adapter (100Gbps)
  - 1x 40 GbE adapter (for storage)
  - 1TB NVMe local scratch
- 49 GPU nodes Atos
  - Same config as CPU nodes. Additionally:
  - 1× Nvidia V100 GPUs
    - 7.8 TF/s peak
    - 16 GB HBM2
    - 900 GB/s memory performance
    - PCIe Gen3 x16 (32 GB/s bidir)

JUSUF CLOUD PARTITION

- 4 compute nodes
  - 2× 64-core AMD Epyc 7742 Rome CPUs
    - 2x 8 memory channels
    - 2x 128 GB DDR4 @ 3.2 GHz
    - 2x 4 NUMA domains
    - PCIe Gen4
  - 1x HDR100 InfiniBand adapter (100Gbps)
  - 1x 40 GbE adapter (for storage)
  - 1TB NVMe local scratch
- 12 GPU nodes
  - Same config as CPU nodes. Additionally:
  - 1× Nvidia V100 GPUs
    - 7.8 TF/s peak
    - 16 GB HBM2
    - 900 GB/s memory performance
    - PCIe Gen3 x16 (32 GB/s bidir)


FURTHER INFORMATION

MAINTENANCE HANDLING

- JSC systems go on maintenance for any of the following reasons:
  - JUST (storage cluster) needs maintenance
  - Compute node updates (OS and/or FW and/or configuration changes)
  - Admin node updates (OS and/or FW and/or configuration changes)
  - Emergencies
- Frequency
  - Depends on pending issues
  - Typically decreases as system ages
- Days and duration
  - Typically on Tuesdays
  - Whole working day
  - Announced with at least 1 week in advance
- Communicated through MOTD and status page

IMPORTANT LINKS

- Status page:
  - https://status.jsc.fz-juelich.de/
- General system information
  - https://go.fzj.de/JUWELS
  - https://go.fzj.de/juwels-known-issues
  - https://go.fzj.de/JURECA
  - https://go.fzj.de/jureca-known-issues
  - https://go.fzj.de/JUSUF
  - https://go.fzj.de/jusuf-known-issues
- User documentation:
  - https://apps.fz-juelich.de/jsc/hps/juwels/index.html
  - https://apps.fz-juelich.de/jsc/hps/jureca/index.html
  - https://apps.fz-juelich.de/jsc/hps/jusuf/index.html
- Job reporting:
  - https://go.fzj.de/llview-juwels
  - https://go.fzj.de/llview-juwelsbooster
  - https://go.fzj.de/llview-jureca
- User support at FZJ
  - sc@fz-juelich.de
  - Phone: 02461 61-2828


THANK YOU