



Atos

ddn



The New Aion Supercomputer

Overview, Technical Specifications and Capabilities



Dr. S. Varrette & UL HPC Team

<https://hpc.uni.lu>

Official Inauguration of the Aion Supercomputer

Nov 10th, 2021

LUXEMBOURG
LET'S MAKE IT HAPPEN

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LUXEMBOURG

Summary

1 Introduction

2 RFP 190027 Technical Characteristics

3 Performance Evaluation

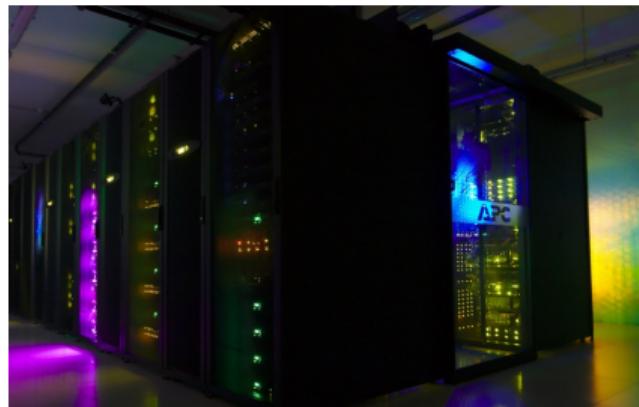
4 Conclusion

Context & Motivations

- 2019: gaia and chaos clusters decommissioned

→ After 8 (resp. 12) years of good & faithful service
✓ 6.2 million jobs were processed, cumulating **13,8 MILLENIUM of CPU Time usage**

Total: 354 nodes



Context & Motivations

- Leaves only **iris** supercomputer to serve the University & its partners (in production since 2017)

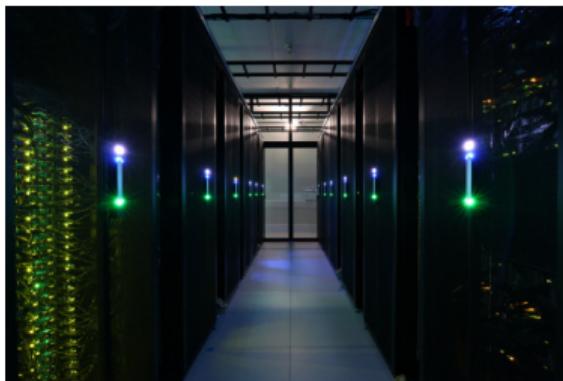


hpc-docs.uni.lu/systems/iris/

- Dell/Intel supercomputer *Air-flow cooling*
 - 196 compute nodes, **5824 cores**, 52.2 TB RAM
 - R_{peak} : **1,07 PetaFlop/s**

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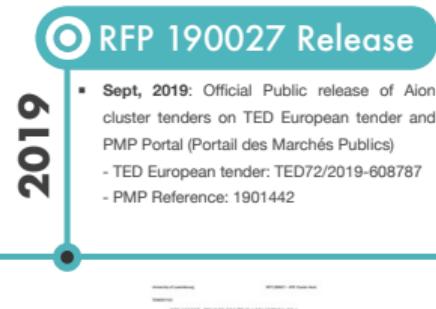


hpc-docs.uni.lu/systems/iris/

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- ⇒ European Tender for acquisition of a new HPC supercomputer **aion** (RFP 190027)
 - to compensate for the 354 decommissioned nodes

RFP 190027 Chronology

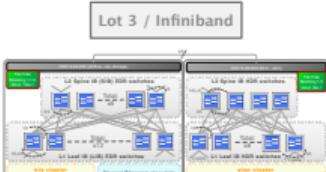
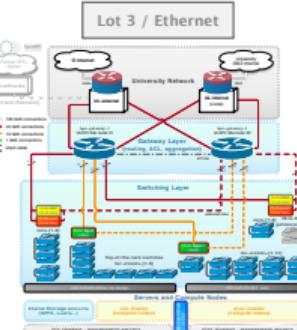
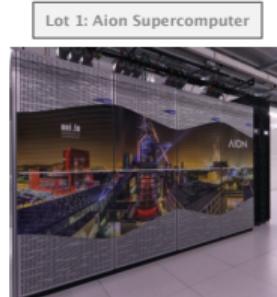


- Sept, 2019: Official Public release of Aion cluster tenders on TED European tender and PMP Portal (Portail des Marchés Publics)
 - TED European tender: TED72/2019-608787
 - PMP Reference: 1901442

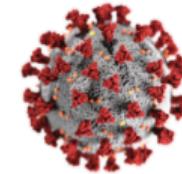
- July-August 2019: RFP 190027 Preparation
 - Tender description (**116 pages**)
 - Criteria Weighting: **~550 evaluated criterias**
 - Budget: **3.5 M€**



RFP 190027 Chronology



RFP 190027 Chronology



RFP 190027 Chronology

2021



Delivery & Install

- Jan-Feb, 2021: Start of installation Lot 1
- Mar, 2021: Installation Lot 2 GPFS/SpectrumScale:
GS7990 expansion installation, setup, and
integration ; Lustre upgrade
Slurm upgrade



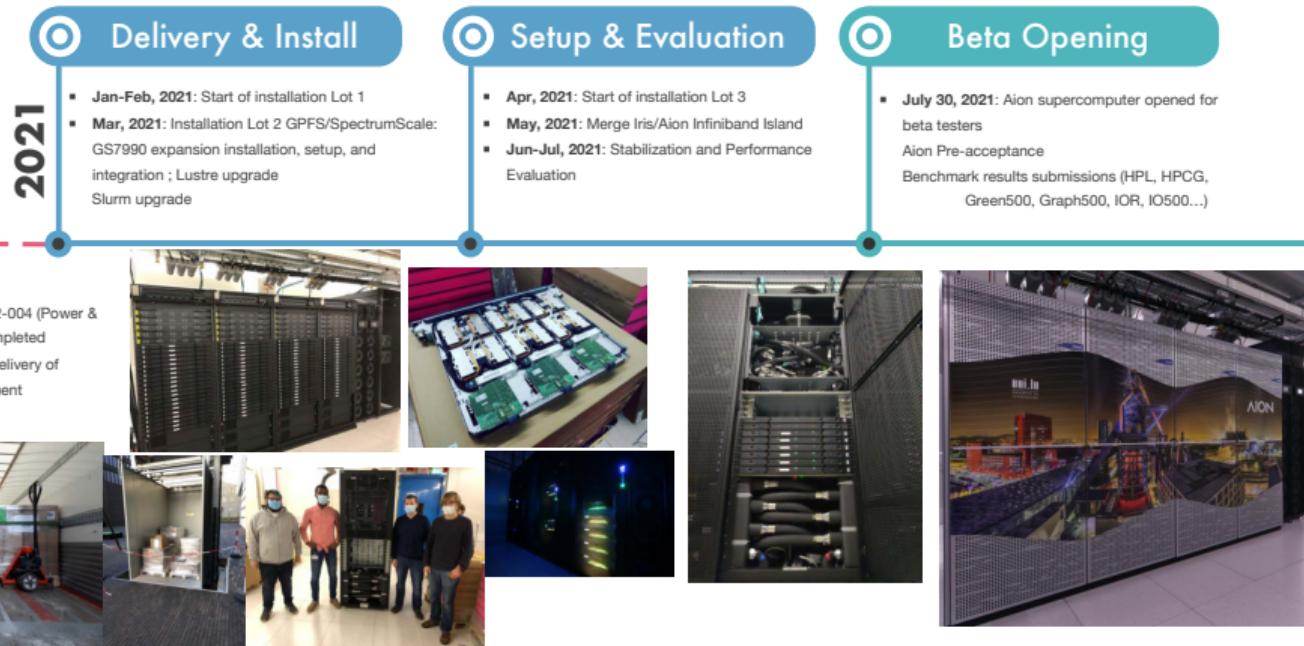
- Oct, 2020: CDC S02-004 (Power & Hydraulic Work) completed
- Dec, 2020: Partial Delivery of intermediate equipment (Servers, DDN part)



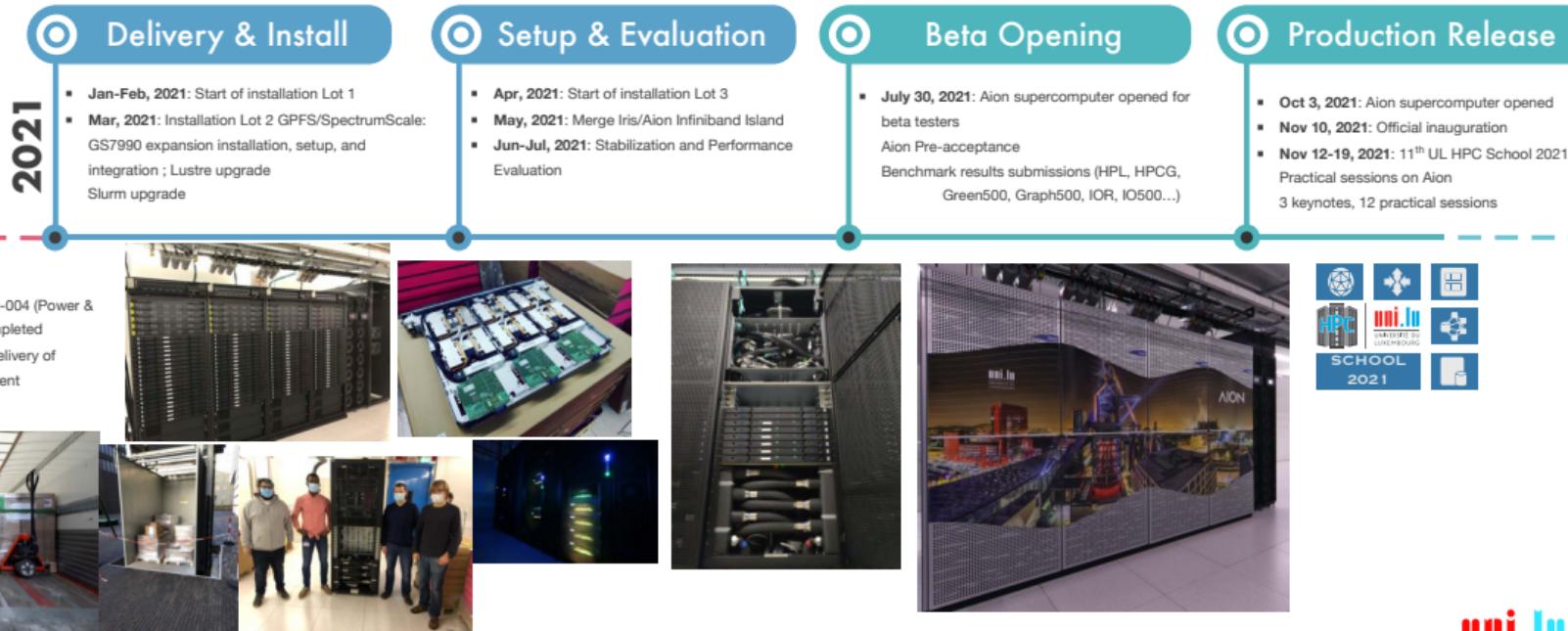
RFP 190027 Chronology



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RFP 190027 Chronology



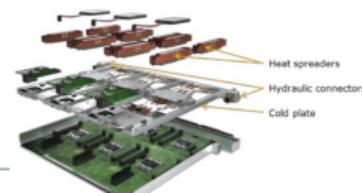
Lot 1: aion supercomputer

hpc-docs.uni.lu/systems/aion/

- Atos/AMD supercomputer

- Bull Sequana XH2000 adjacent racks
 - ✓ Direct-Liquid-Cooling (DLC)
- 318 compute nodes, **40704 cores**, 81.4 TB RAM
- **R_{peak} : 1.7 PetaFlop/s**

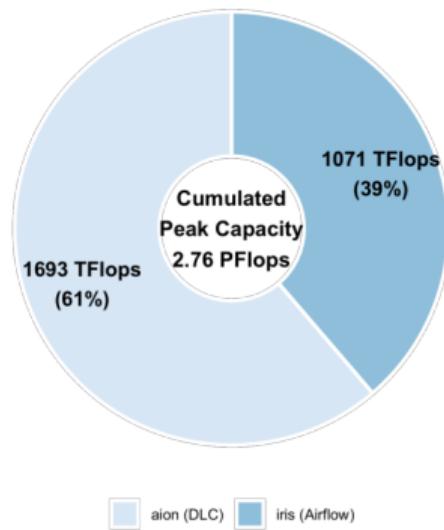
#Nodes	#cores	Processors Type per node	RAM/node
318	40704	2 x AMD Epyc ROME 7H12 @ 2.6 GHz [64c/280W]	256 GB



The New Aion Supercomputer

Increased UL HPC Computing Capacity

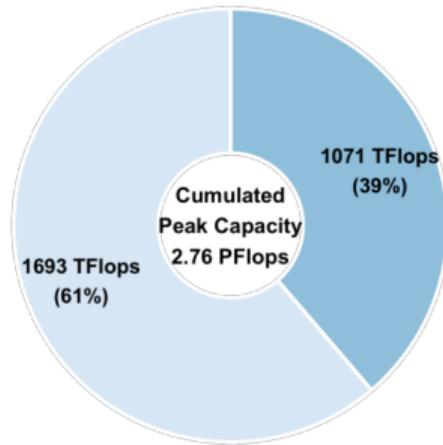
UL HPC Supercomputers (2021)



hpc-docs.uni.lu/systems/

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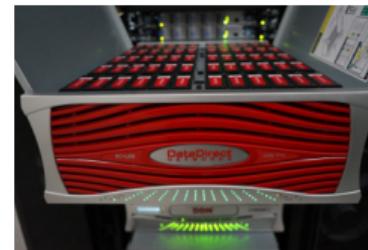
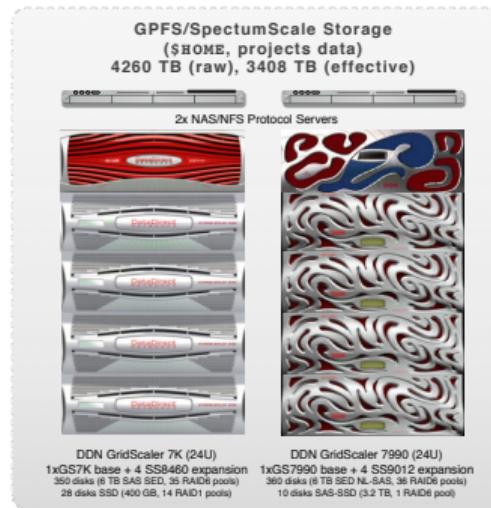
 aion (DLC)  iris (Airflow)

hpc-docs.uni.lu/systems/

	#N	#C	R _{peak}
Uni.lu HPC TOTAL:	514	46528	2764 TFlops
			(incl. 748.8 GPU TFlops)
Cluster	Date	Vendor	Processors Type and Model
aion	2021	Atos	AMD EPYC 7H12 @2.6 GHz 2 × 64c, 256GB
			aion TOTAL: 318 40704 1693.3 TFlops
iris	2017	Dell	Intel Xeon E5-2680 v4@2.4GHz 2 × 14C,128GB
	2018	Dell	Intel Xeon Gold 6132 @ 2.6 GHz 2 × 14C,128GB
	2018	Dell	Intel Xeon Gold 6132 @ 2.6 GHz 2 × 14C,768GB
	2019		Per node: 4x NVIDIA Tesla V100 SXM2 16/32GB
	2018	Dell	Intel Xeon Platinum 8180M @ 2.5 GHz 4 × 28C,3072GB
			96 GPUs 491520 748.8 GPU TFlops
			iris TOTAL: 196 5824 32.97 TFlops
			96 GPUs 491520 1071 TFlops

Lot 2: GPFS/SpectrumScale Storage Extension

- Global high-performance clustered file system
 - ↪ capacity & performance increased

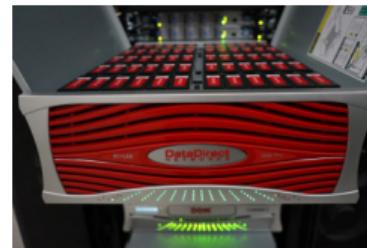
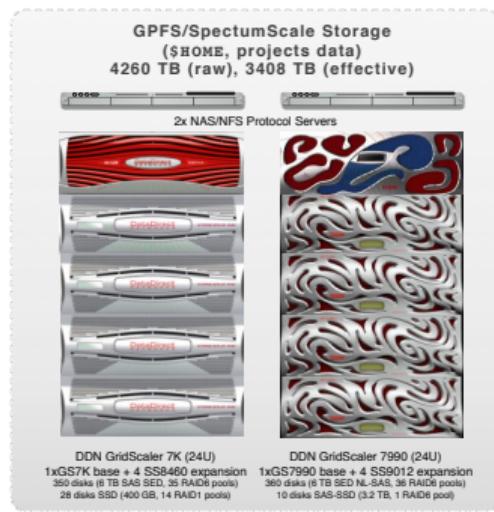


hpc-docs.uni.lu/filesystems/

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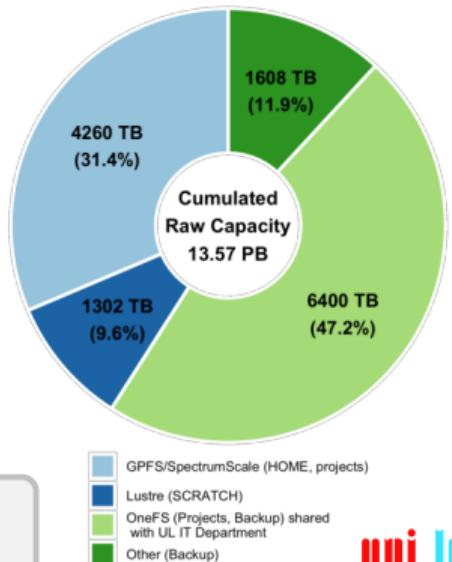
- Global high-performance clustered file system

- capacity & performance increased
- other shared storage solutions available



hpc-docs.uni.lu/filesystems/

UL HPC Storage FileSystems (2021)

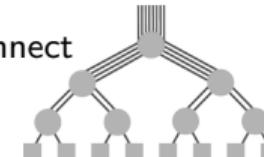


Interconnect Networks (Infiniband and Ethernet)

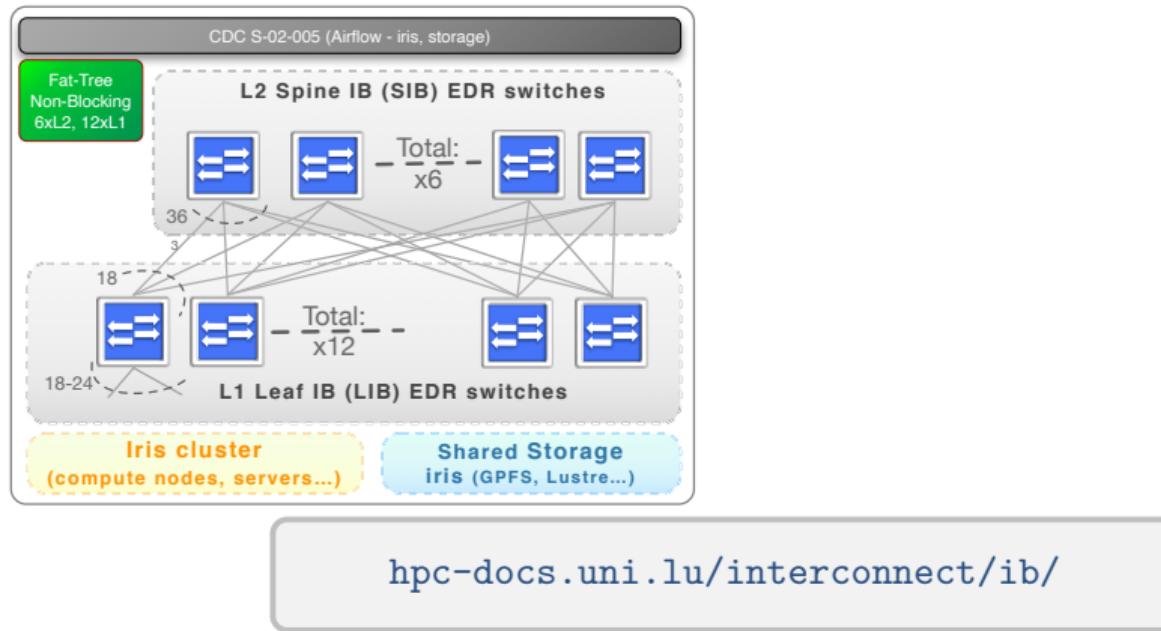
- HPC interconnect technologies nowadays divided into three categories
 - ① **Ethernet**: dominant interconnect standard yet underlying protocol has inherent limitations
 - ✓ preventing low-latency deployments expected in real HPC environment
 - ② **InfiniBand**: predominant interconnect technology in the HPC market
 - ③ Vendor specific interconnects: [Cray/HPC Slingshot](#), Intel Omni-Path, [Bull BXI](#)...

- On ULHPC Supercomputers:

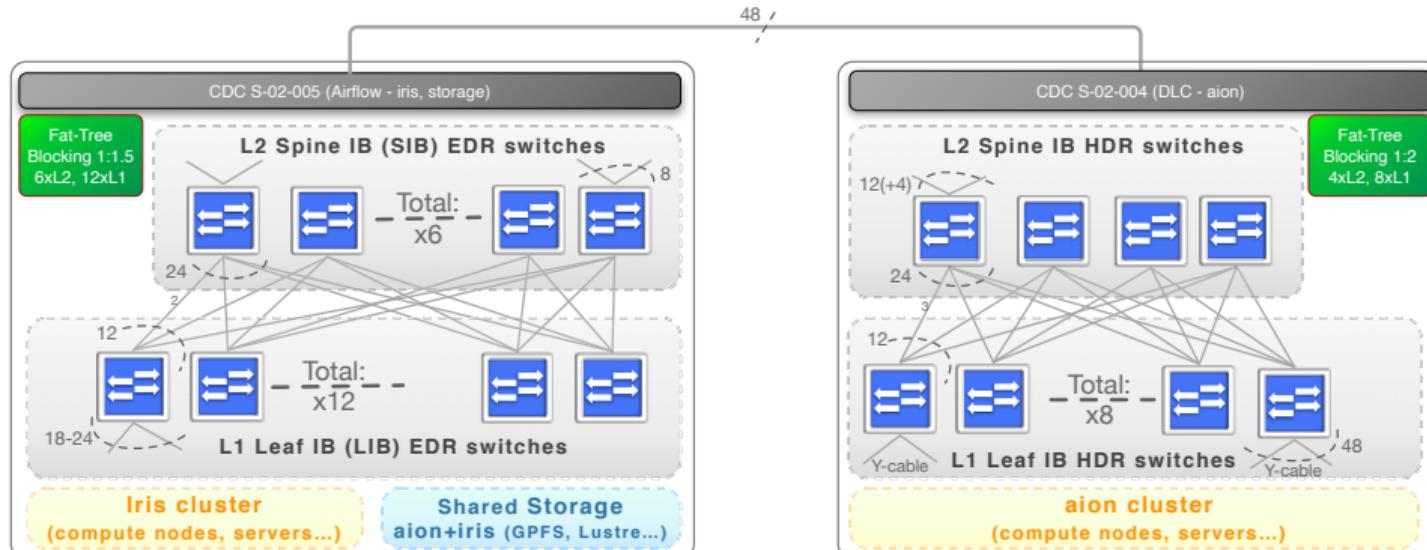
- ↪ **InfiniBand (IB)** in a **Fat-Tree Topology** as *Ultra-Fast* local interconnect
- ↪ Complementary Ethernet network
 - ✓ Consolidated as a 2-layers topology (Gateway / Switching Layers)



Lot 1/3: Fast Infiniband (IB) Network (before)

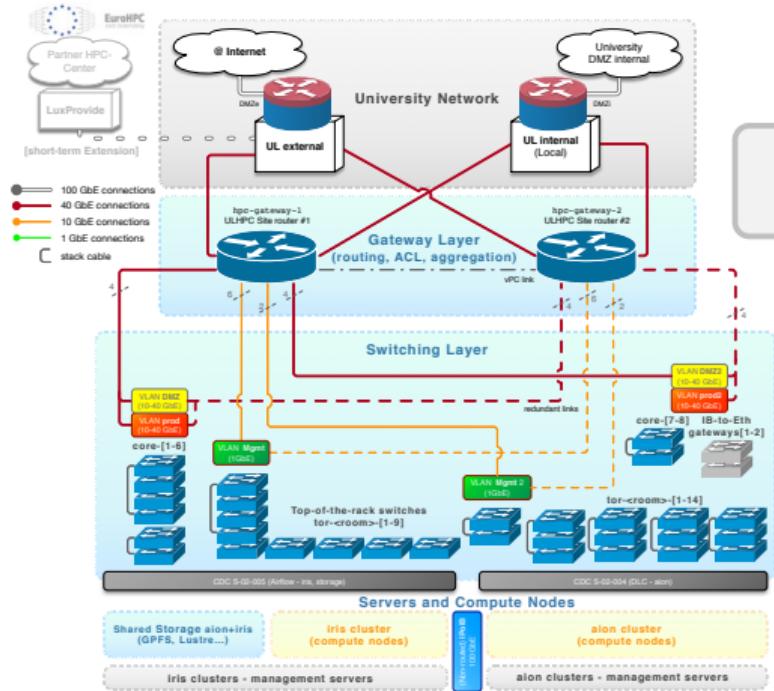


Lot 1/3: Fast Infiniband (IB) Network (now)



hpc-docs.uni.lu/interconnect/ib/

Lot 3: Ethernet Network Adaptation

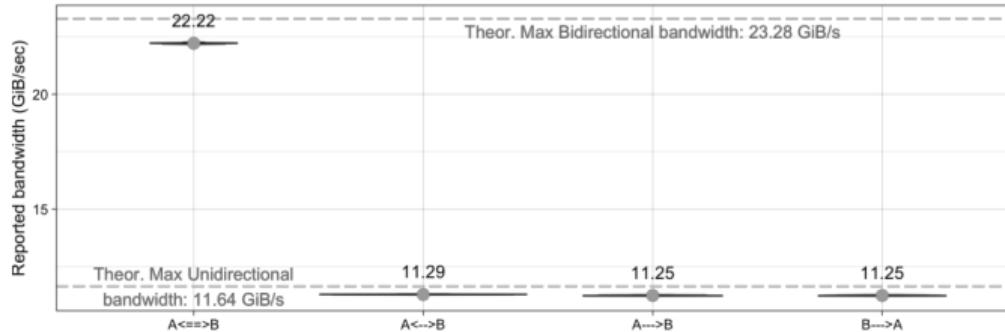


hpc-docs.uni.lu/interconnect/ethernet/

Aion Supercomputer [selected] Performance Evaluations

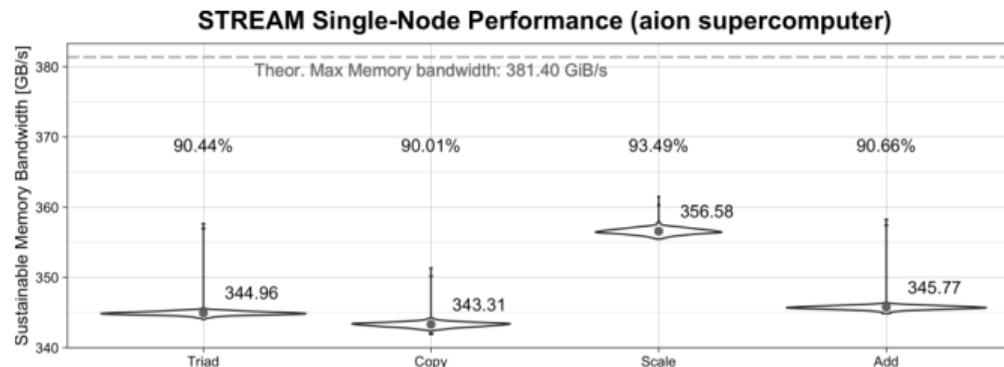
- Bisection Bandwidth (BB) benchmarks: **96,99% efficiency**

MPI Parallel Bisection Bandwidth (BB) benchmark of ULHPC IB Network



Aion Supercomputer [selected] Performance Evaluations

- Bisection Bandwidth (**BB**) benchmarks: **96,99% efficiency**
- **STREAM** sustainable **Memory Bandwidth** performance
 - ↪ above **90,01% efficiency** for 4 highly-intensive memory access pattern



Aion Supercomputer [selected] Performance Evaluations

- Large-scale optimized [full] runs

- ↪ Reference HPC benchmarks: HPL, HPCG, Graph500...
- ↪ Energy-efficiency evaluation: Green500, GreenGraph500...

Benchmark	#Node	Best Performance	Improvement*	Equivalent Worldwide Rank
HPL (Top500)	318	$R_{\max} = 1255.36 \text{ TFlops}$ (74,20% efficiency)	+ 1.9%	> 500 (Nov 2021), #490 (Jun 2020)
Green500	318	5.19 GFlops/W	+ 12,83%	#56 (Jun 2021)
HPCG	318	16.842 TFlops	+ 15,35%	#135 (Jun 2021)
Graph500 BFS	256	975 GTEPS	+ 64%	#23 (Jun 2021)
GreenGraph500	256	6.14 MTEPS/W	+ 180%	#36 (Jun 2021)

*: performance improvement with the minimal acceptance threshold set in the tender

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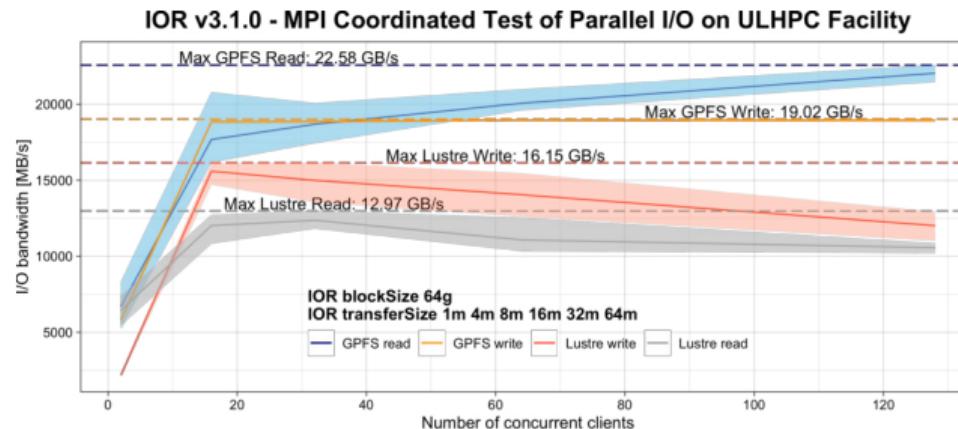
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- In complement: UL HPC Software Set Validation

UL HPC Shared Storage Performance Evaluation

- IOR I/O benchmarks: **2x performance increase with Lot 2 entension**

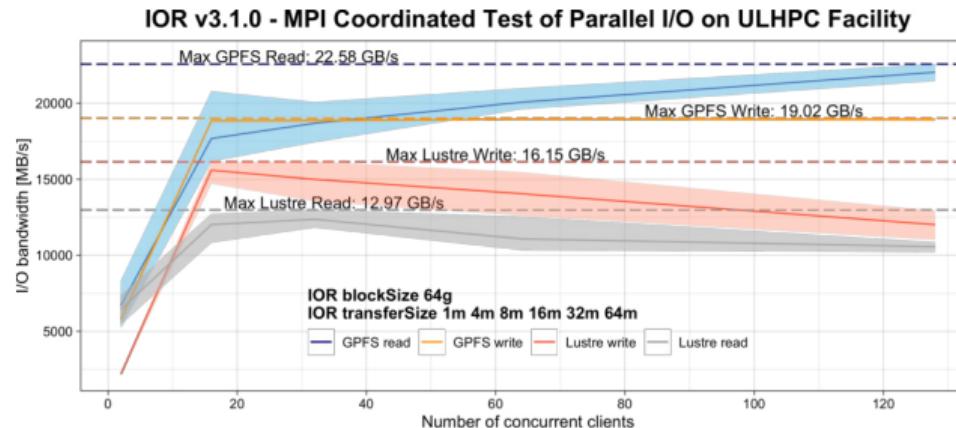
- Max Read: 22.58 GB/s (was 11.33 GB/s on the previous configuration)
- Max Write: 19.02 GB/s (was 9.36 GB/s on the previous configuration)



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- IO500 best score **11.345219**

Would rank ULHPC #42 in the latest IO500 list (Nov 2020)

Aion would NOT be here Today without...



Prof. S. Pallage



Prof. J. Kreisel



Prof. P. Bouvry



Prof. J.M. Schlenker



FSTM (3.33%)



LCSB (3.33%)



SnT (3.33%)

ERC-CoG (3.33%)

Aion would NOT be here Today without...

Procurement



M. Bourcy



Q. Bracaval

Rectorate & Financial Support



Prof. S. Pallage



Prof. J. Kreisel



Prof. P. Bouvry



Uni.lu HPC for research (86.66%)

FSTM (3.33%)



Prof. R. Balling

LCSB (3.33%)



Prof. B. Ottersten

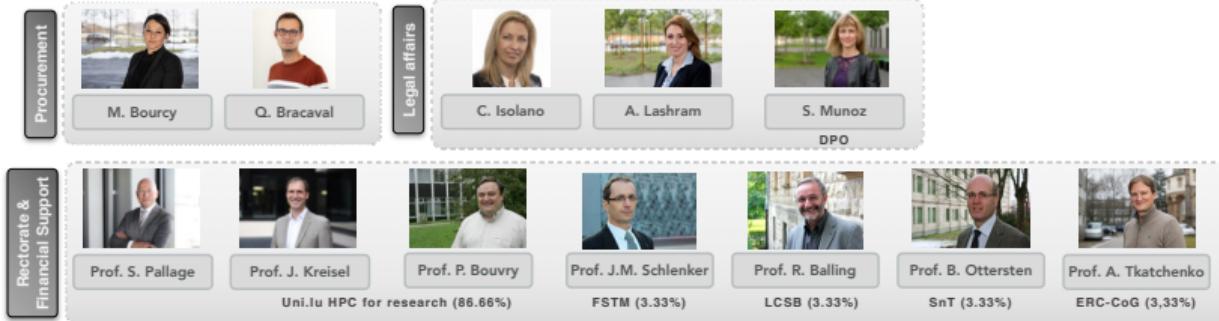
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Prof. A. Tkatchenko

ERC-CoG (3.33%)

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Uni.lu HPC Team
and Experts



Dr. S. Varrette



H. Cartiaux



T. Valette



A. Olloh



S. Peter



Dr. E. Kieffer



Dr. E. Krishnasamy



Dr. X. Besseron



Dr. A. Ginolhac

and all Aion beta-testers
(~15 researchers) !

Research Computing and HPC Operations

HPC Research

HPC Experts

SIU



D. Constant



S. Lassere



M. De Souza



M. Christophe



J. Lorang



M. Reiter

Datacenter Engineers

Uni.lu Network and IT specialists

Procurement



M. Bourcy



Q. Bracaval

Legal affairs



C. Isolano



A. Lashram



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Conclusion

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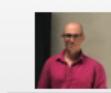
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and all the ULHPC users ! (~ 650 active users)

SIU



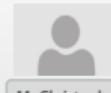
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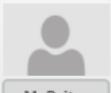
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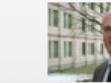
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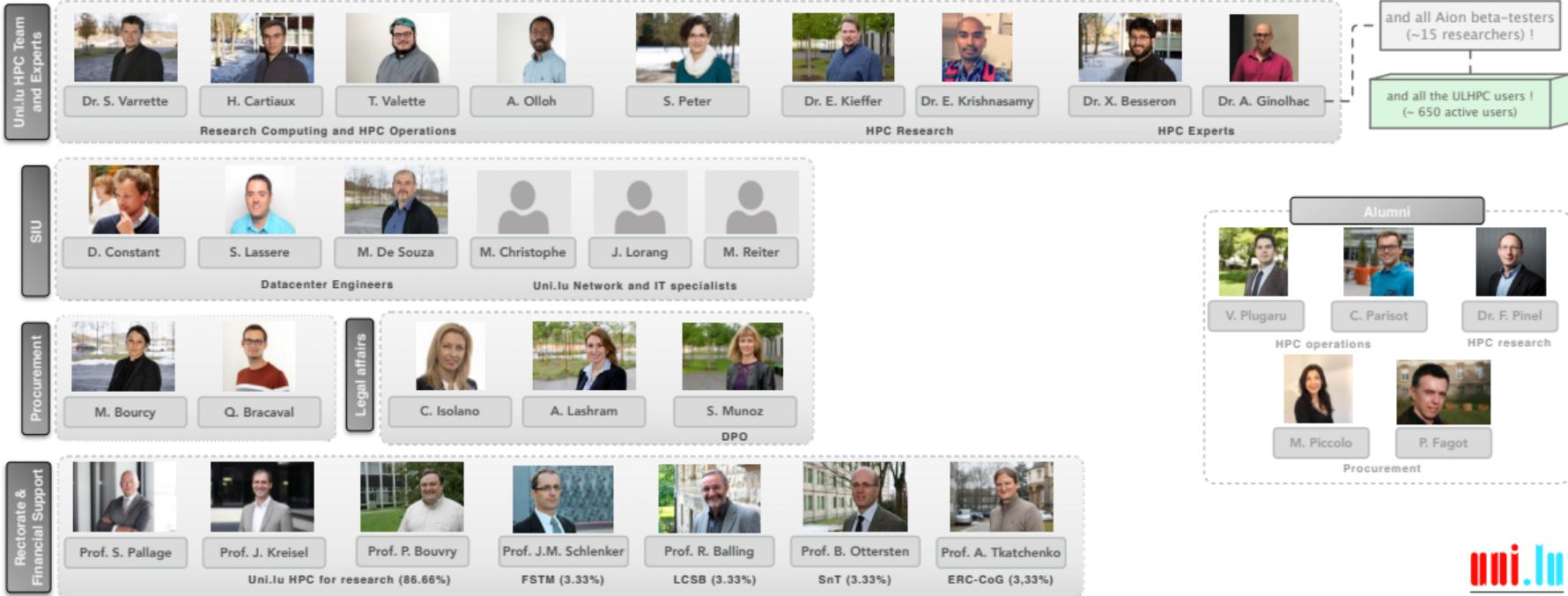
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Conclusion

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Thank you for your attention...



Questions?

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