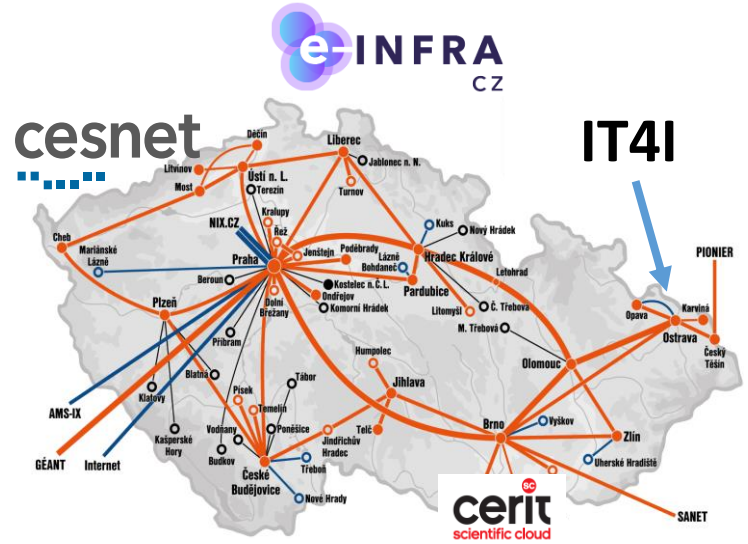
VSB TECHNICAL UNIVERSITY OF OSTRAVA | IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

IT4INNOVATIONS NATIONAL SUPERCOMPUTING CENTER

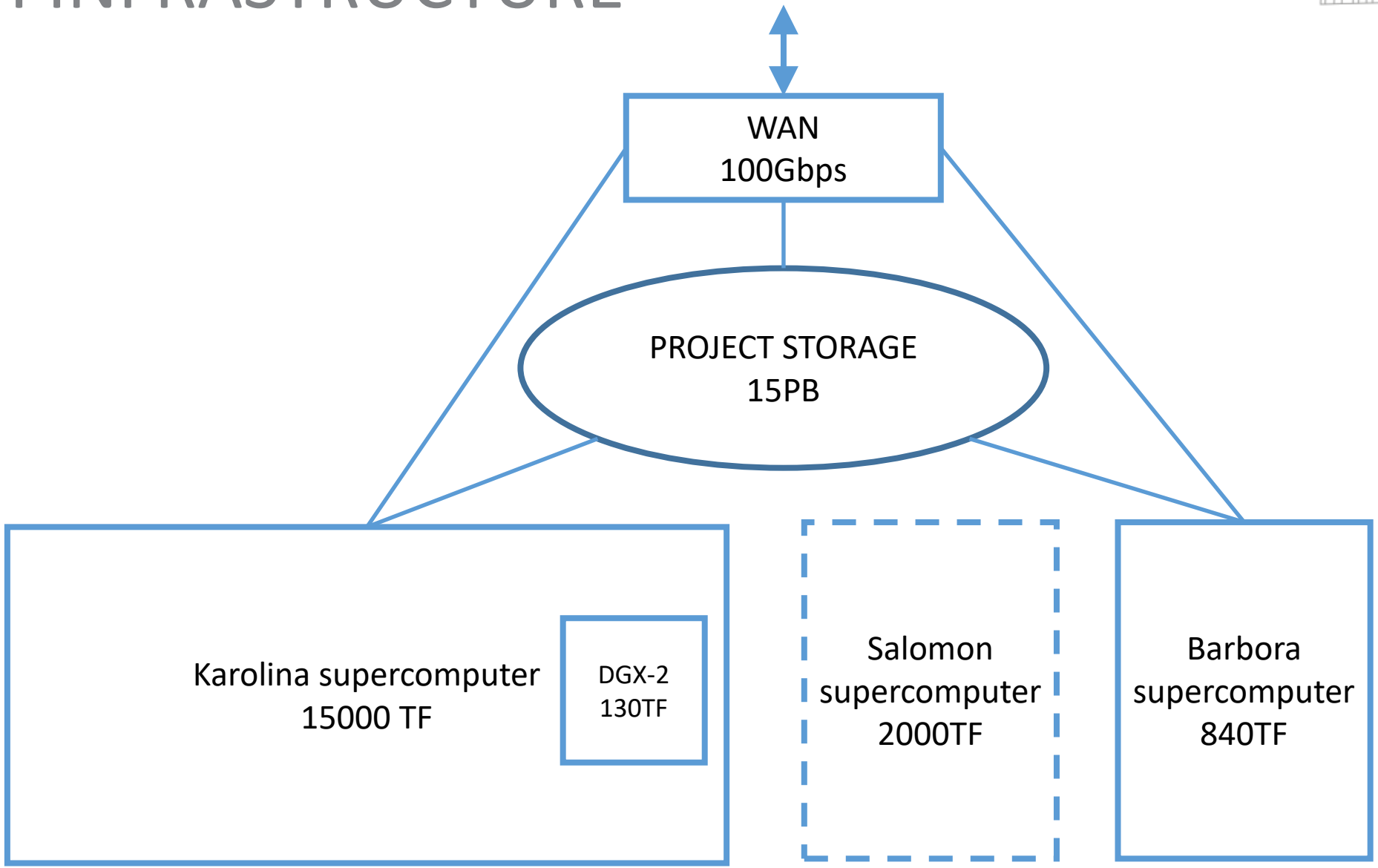
CZECH REPUBLIC

IT4I INTRODUCTION

- Established in 2011 in Ostrava, Czech Republic
- Unit of the VSB – Technical University of Ostrava
- Member of e-INFRA CZ,
  a strategic research infrastructure
- Operating 3 supercomputers
  Salomon, Barbora, Nvidia DGX-2)
  Provider of HPC resources for CR and EU
- 5 research laboratories, over 130 FTE
- Participating in EU HPC initiatives
  - EuroHPC, PRACE, EUDAT, ETP4HPC, BDVA
- Strong international collaboration,
  14 H2020 projects, cooperation with industry
- Training and educational activities



IT4I INFRASTRUCTURE

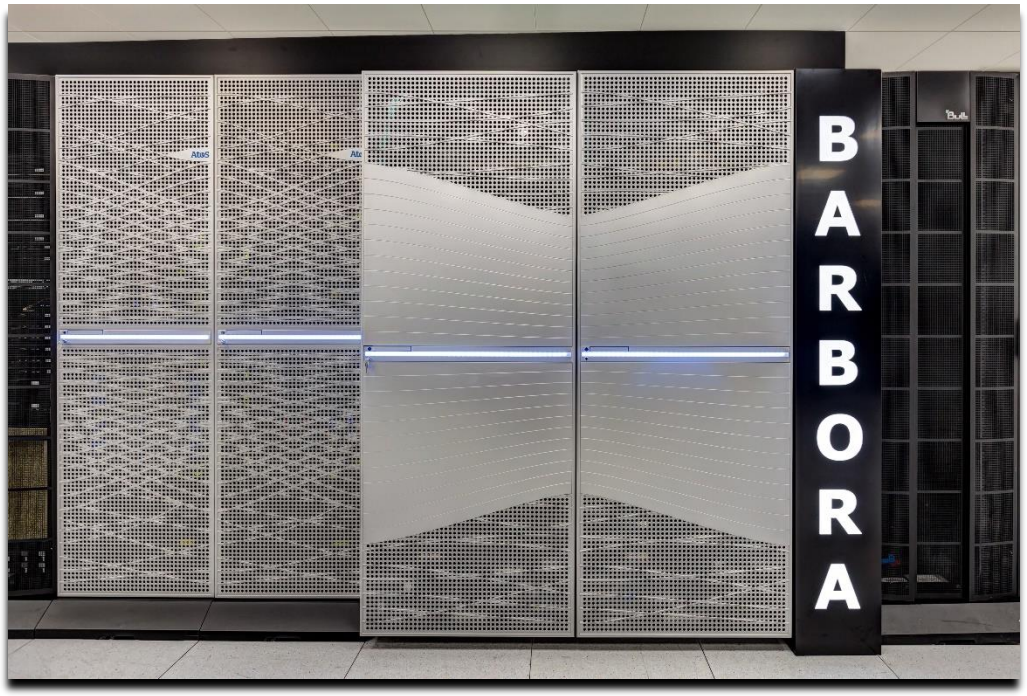


NVIDA DGX-2

- Intel Xeon Platinum 8168 processor, 2x24, AVX-512
- 1.5 TB RAM, 512GB HBM
- 16x2560 Volta V100 GPGPU
- Unified Address space
- NVME SSD storage 30TB
- **130TF Peak!**

THE BARBORA SUPECROMPUTER

- **192x Compute nodes**
- **1x SMP node**
- **8x GPU nodes, 4x Nvidia V100**
- **Infiniband HDR network**
- **SCRATCH storage**
  Burst buffer, 310TB, 28GB/s
- **14x NVMe**, accesible remotely
- **2x Remote vizualization**, NVidia Quadro
- **840TF Peak**

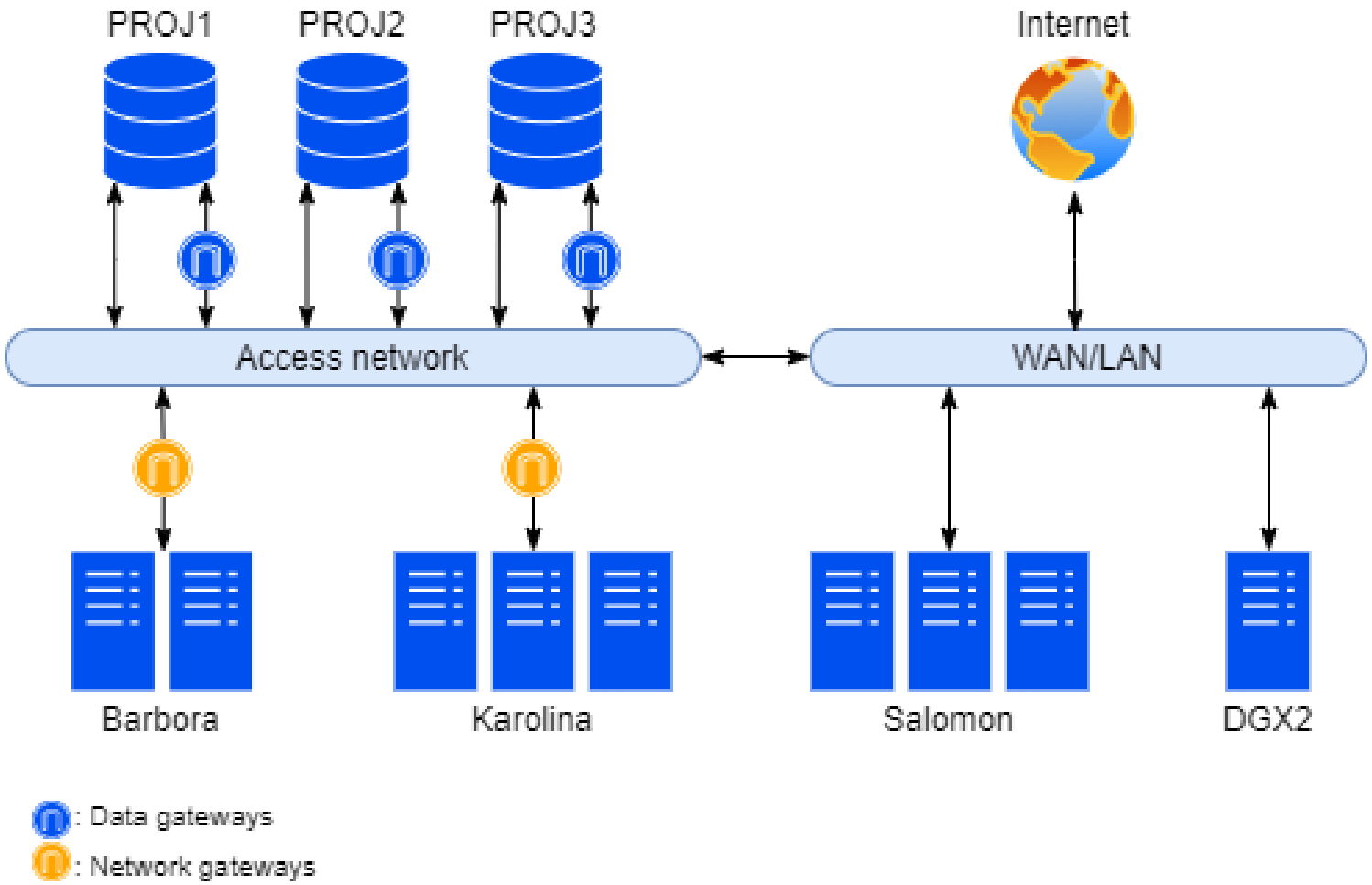


THE PROJECT STORAGE

- Independent
- Extendable
- Scalable
- Redundant

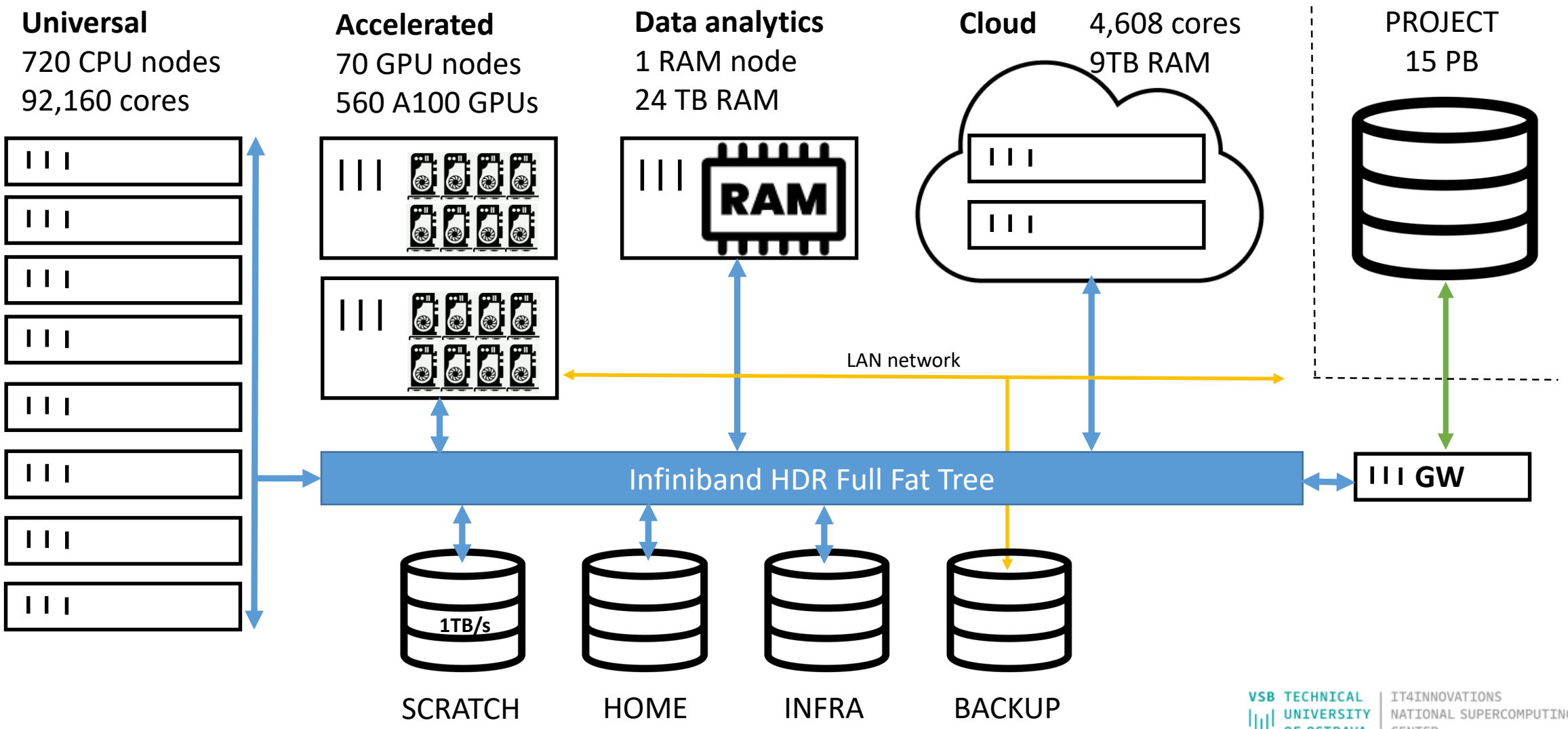
- 3x5 PB
- 39GB/s agregated
- NFS protocol
- Data gateways (GridFTP, RSYNC, etc)

THE PROJECT STORAGE



- 3x3 GPFS/NFS servers
- 3x2 Data gateways protocol
- 3x7 Disk arrays IBM Storwize V5030E
- 3x39TB SSD for small files

KAROLINA ARCHITECTURE

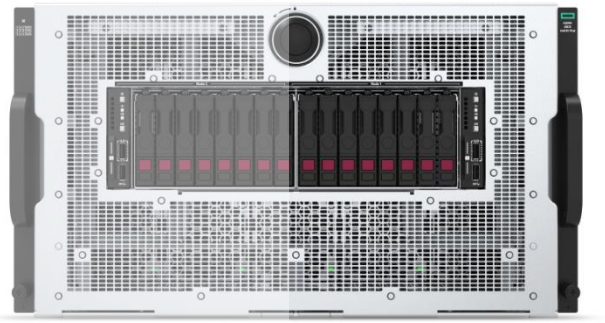


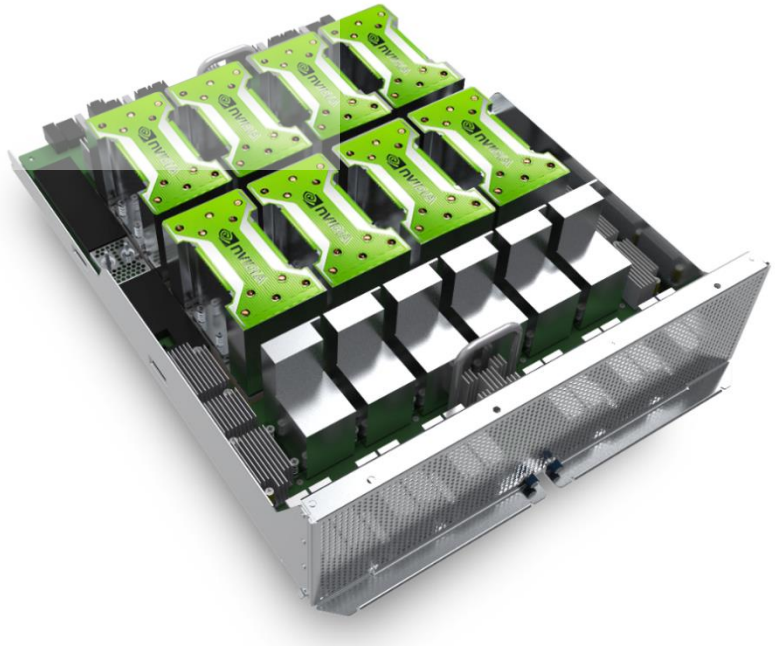
UNIVERSAL PARTITION

- **720x HPE Proliant XL225n server 1x SMP node**
- **2x AMD EPYC 7H12, 2x64 cores**
- **256GB RAM DDR4**
- **100Gb/s (HDR100)**
- **CentOS 7**
- **5.3 TF Peak**

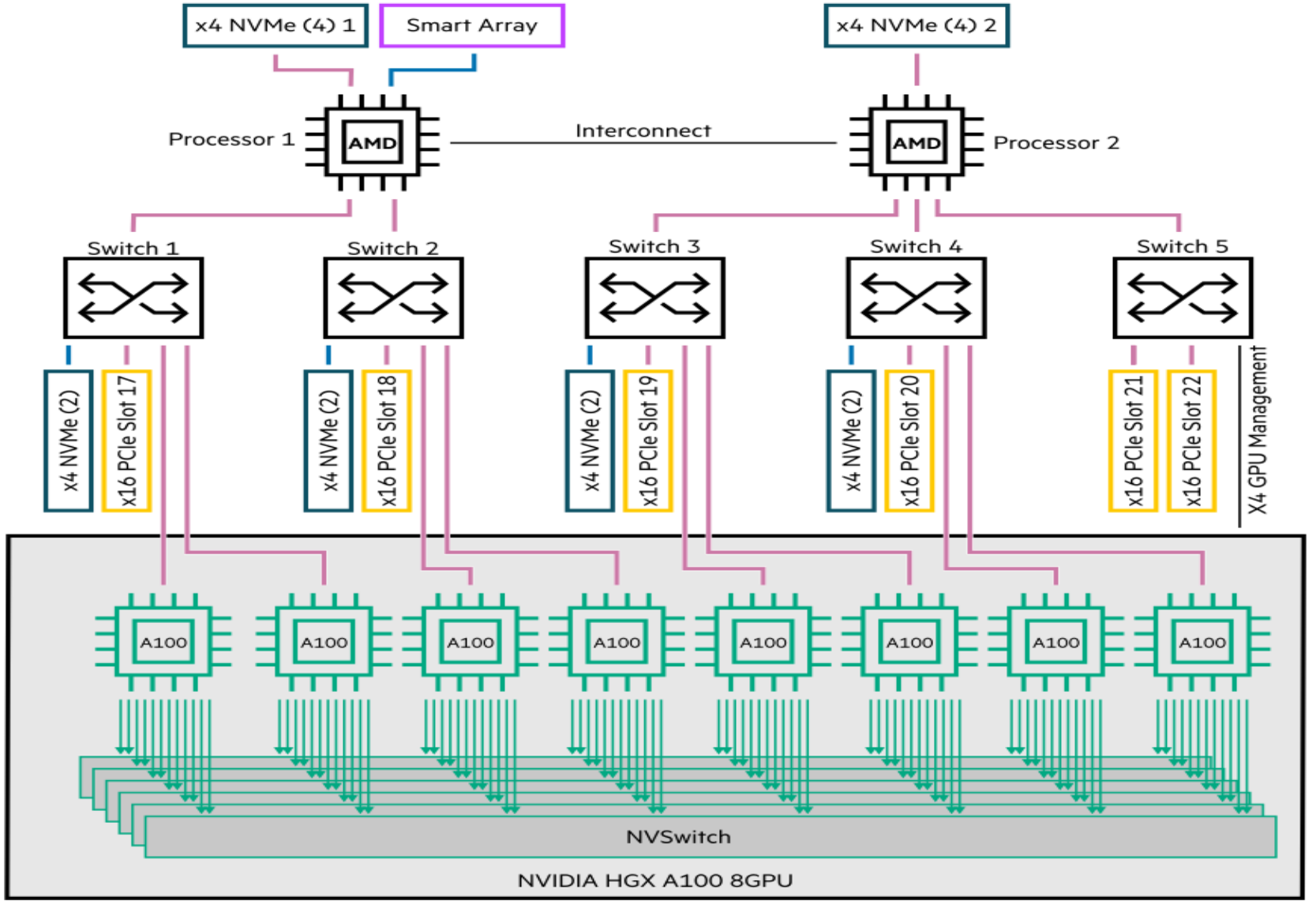
ACCELERATED PARTITION

- **70x HPE Apollo 6500 G10+**
- **2x AMD EPYC 7452, 2x32 cores**
- **512GB RAM DDR4**
- **4x200Gb/s HDR**
- **CentOS 7**
- **158.4 TF Peak**





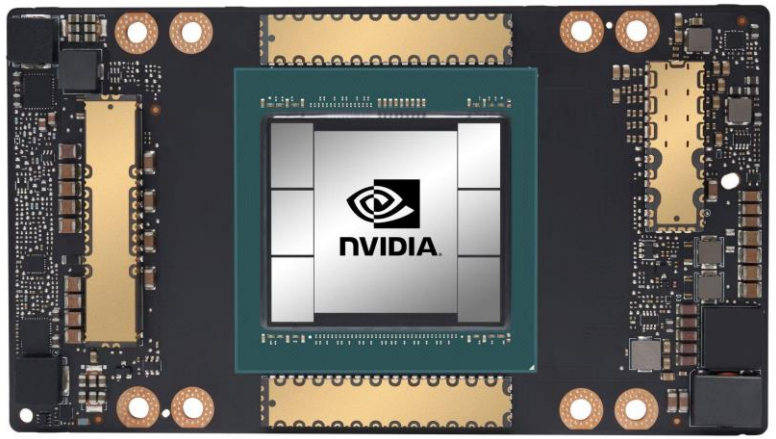
NVIDIA A100 GPU

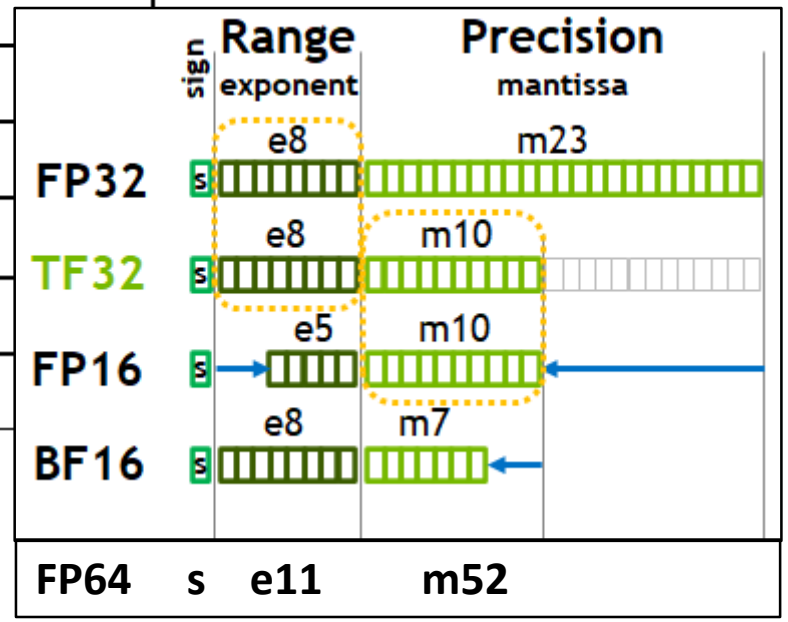


600GB/s GPU to GPU bandwidth

NVIDIA A100 GPU, 108SM

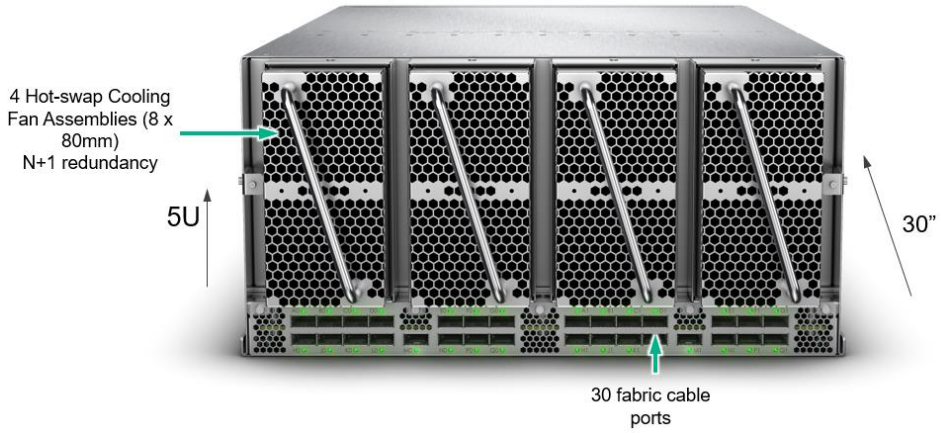
Peak FP64[1]	9.7 TFLOPS
Peak FP64 Tensor Core[1]	19.5 TFLOPS
Peak FP32[1]	19.5 TFLOPS
Peak FP16[1]	78 TFLOPS
Peak BF16[1]	39 TFLOPS
Peak TF32 Tensor Core[1]	156 TFLOPS | 312 TFLOPS[2]
Peak FP16 Tensor Core[1]	312 TFLOPS | 624 TFLOPS[2]
Peak BF16 Tensor Core[1]	312 TFLOPS | 624 TFLOPS[2]
Peak INT8 Tensor Core[1]	624 TOPS | 1,248 TOPS[2]
Peak INT4 Tensor Core[1]	1,248 TOPS | 2,496 TOPS[2]

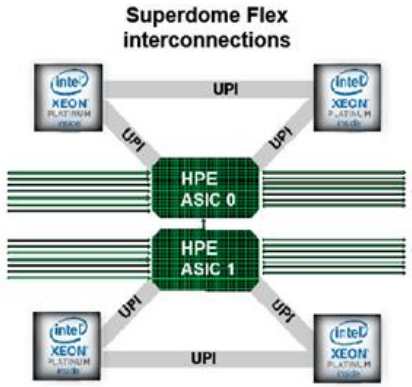


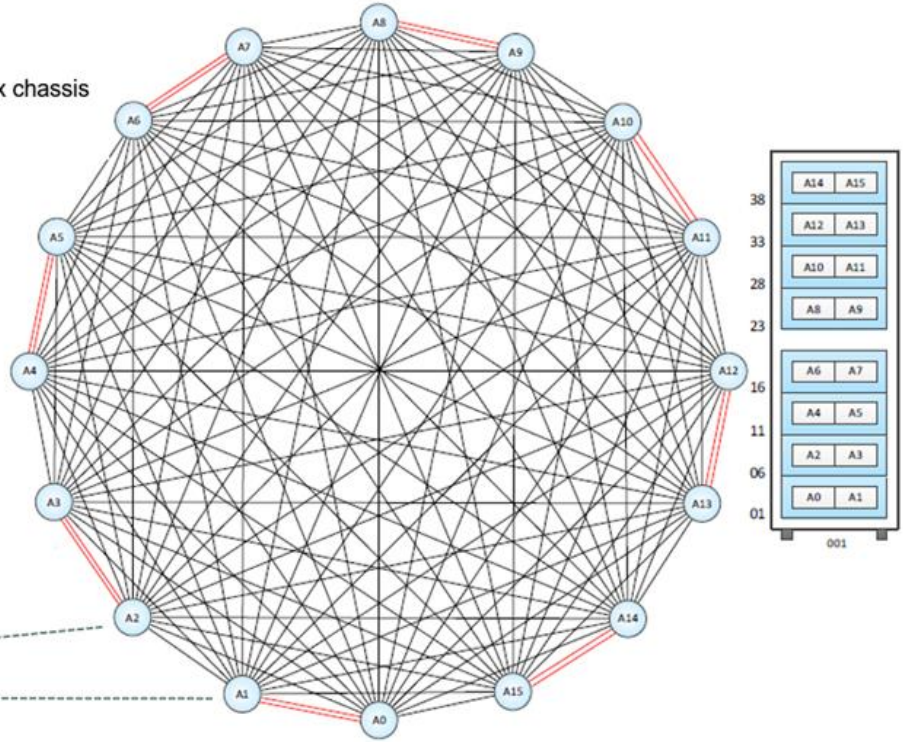


DATA ANALYTICS PARTITION

- **1xHPE Superdome Flex**
- **32x Intel Xeon 8268, 32x24 (768 cores)**
- **24576GB RAM DDR4**
- **2x200Gb/s HDR**
- **RedHat 7**
- **41 TF Peak**

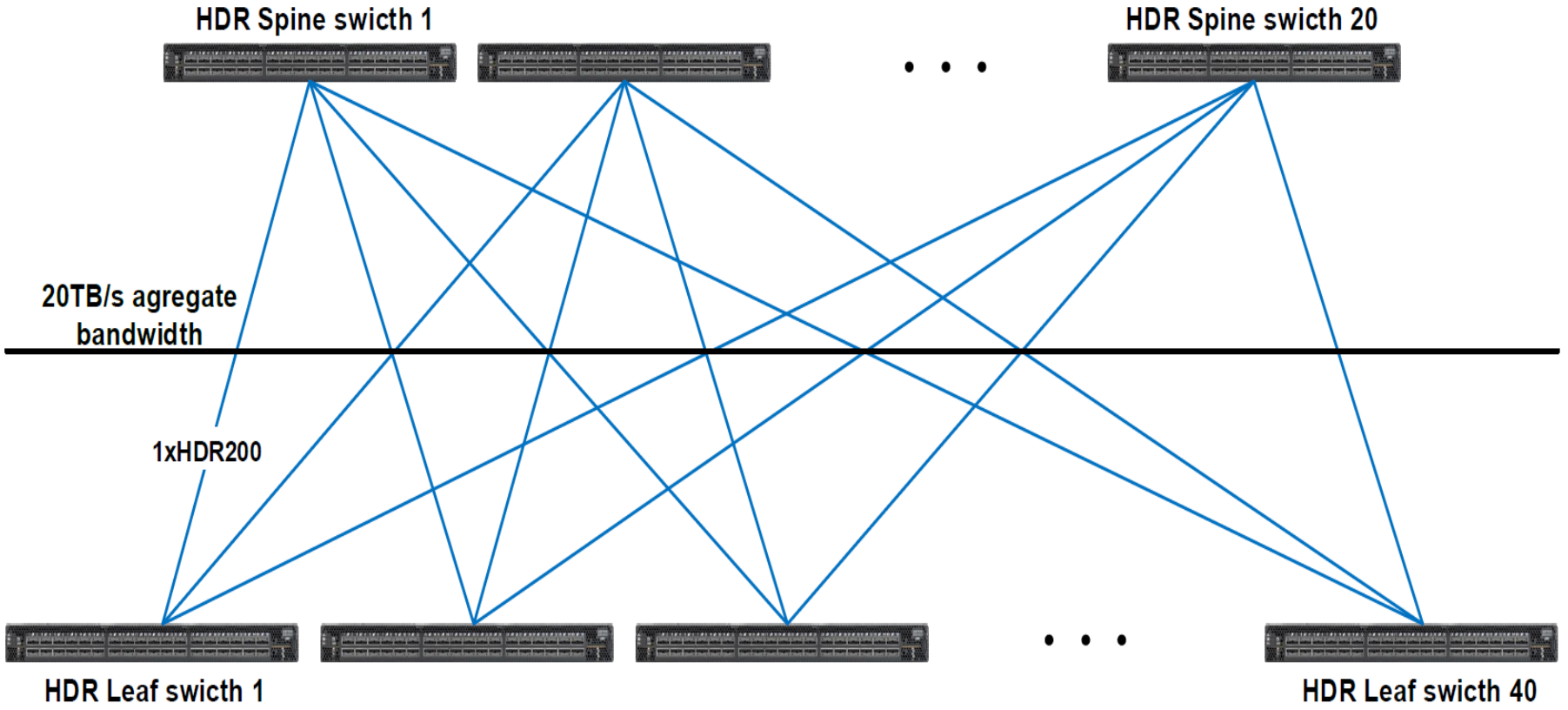






COMPUTE NETWORK

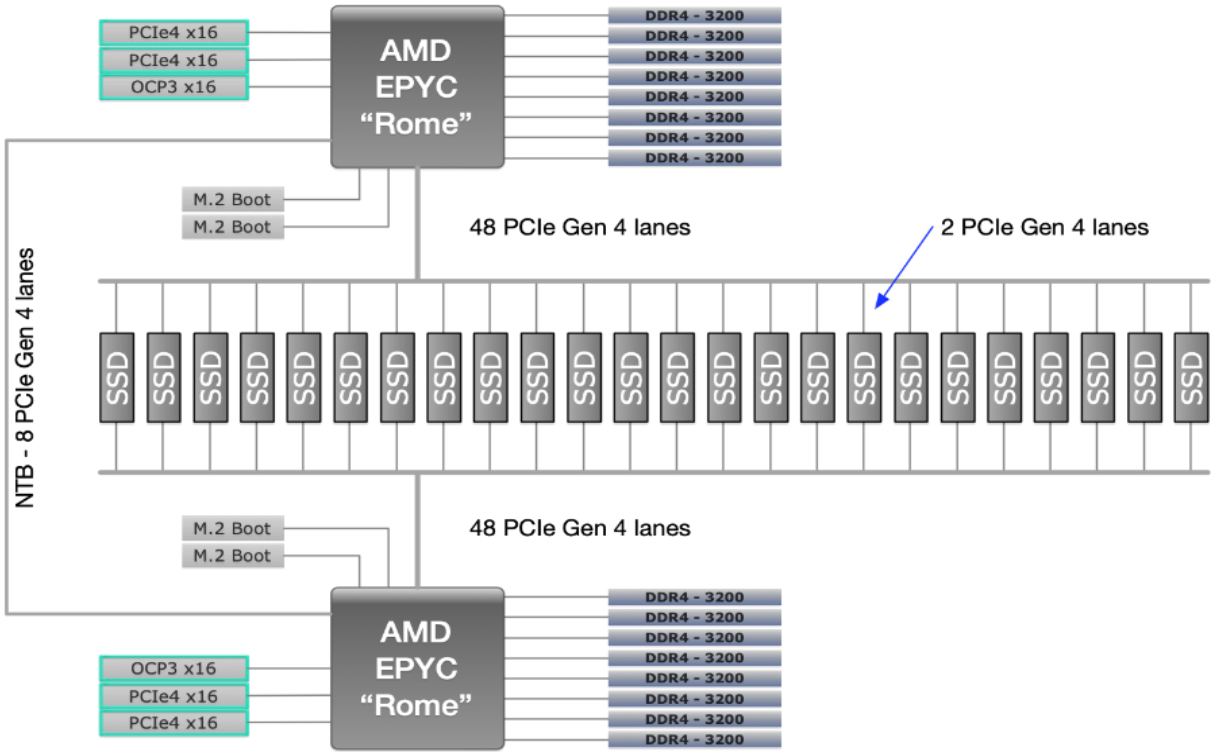
Technology: HDR
Toplogy: Non-Blocking Fat Tree
Throughput: 200Gb/s for HDR200 connection, 100Gb/s for HDR100 connection
Latency: Expected less than 3 microseconds



SCRATCH STORAGE

- **ClusterStor E1000 All Flash**
- **1xSMU (system mgmt)**
- **1xMDU (metadata ctl)**
- **24xSSU-F (storage unit)**
- **Size 1330TB**
- **Throughput 1200GB/s** All flash
- **LUSTRE Filesystem**

SSU-F

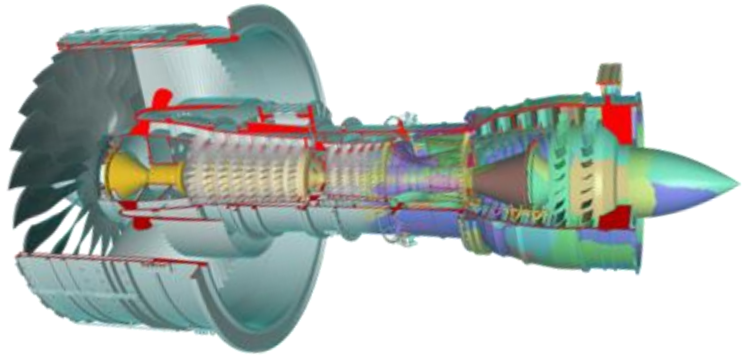


KAROLINA EXPECTED PERFORMANCE

Performance to be installed:

- **R_Peak: 15.2 PFlop/s**
- **R_Max: 9.1 PFlop/s (LINPACK)**
- **R_AI: 350 PFlop/s (DeepLearning)**

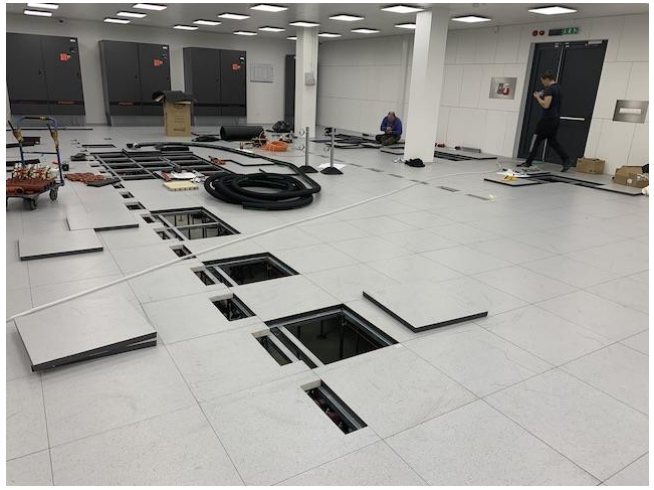
- **Universal partition**: 2.3 PFlop/s (LINPACK) (720 nodes)
- **Accelerated partition**: 6.6 PFlop/s (LINPACK) (70 nodes)
  350 PFlop/s (DeepLearning)
- **Data analytics partitition**: 41 TFlop/s (LINPACK)
- **Cloud partitition**: 131 TFlop/s (LINPACK) (36 nodes)

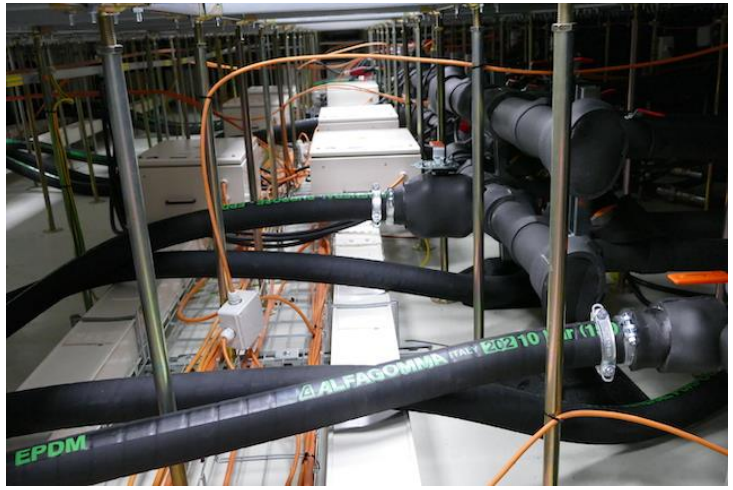


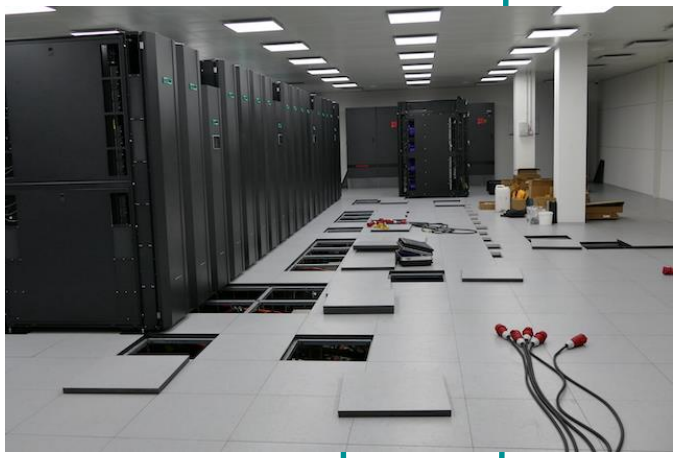
Estimated TOP500 ranking:

- **Estimated ranking (1H2021):**
  around **#40** (worldwide) **#10** (Europe)

KAROLINA TIMELINE







December 2020

January 2021

February 2021

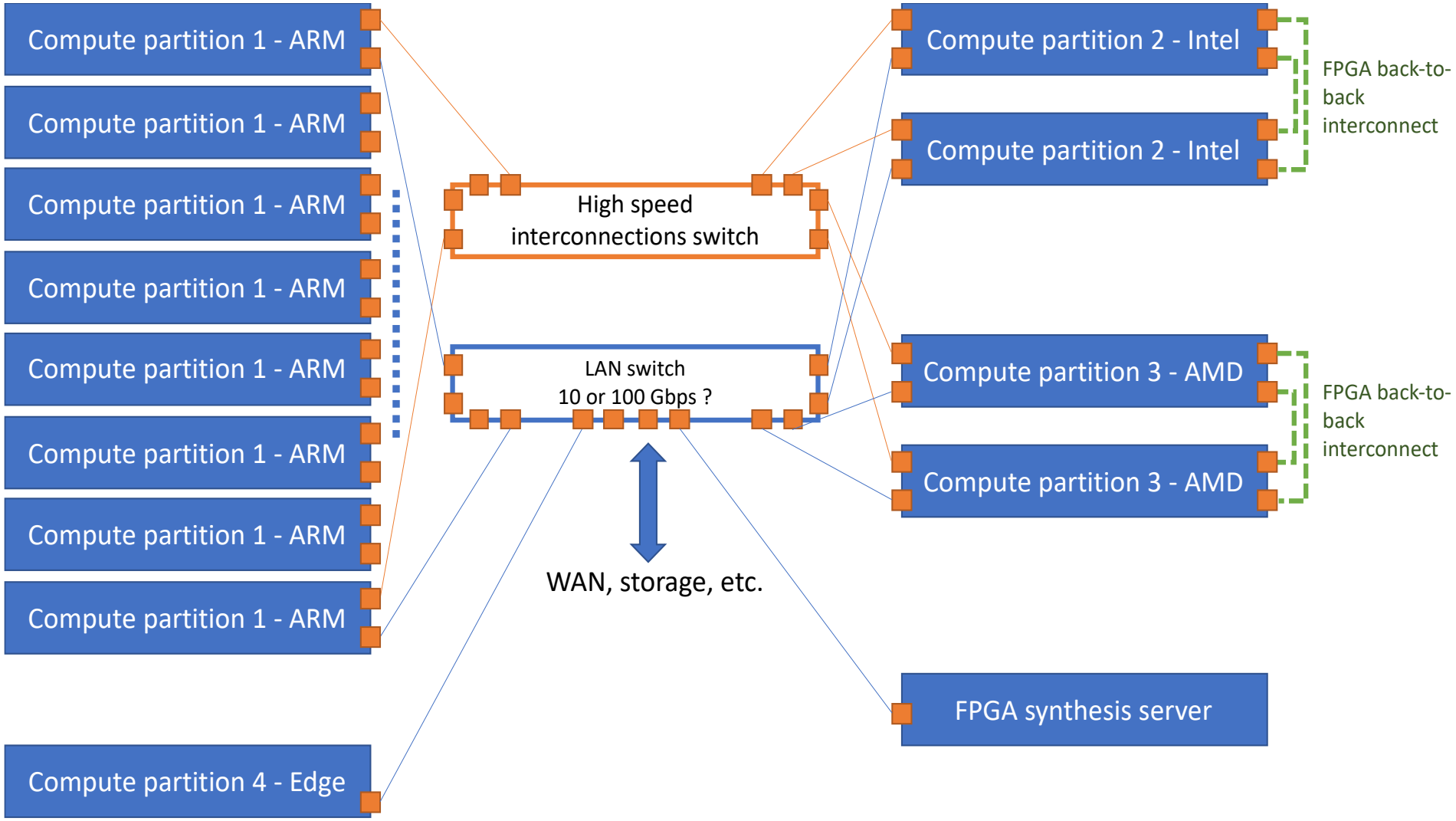
Partial Acceptance

April 2021

Final Acceptance

June 2021

COMPLEMENTARY SYSTEM I



LUMI CONSORTIUM

- Unique consortium of 10 countries with strong national HPC centers
- The resources of LUMI will be allocated per the investments
- The share of the EuroHPC JU (50%) will be allocated by a peer-review process (cf. PRACE Tier-0 access) and available for all European researchers
- The shares of the LUMI partner countries will be allocated by local considerations and policies – seen and handled as extensions to national resources

DATACENTER IN KAJAANI

100% hydroelectric energy up to 200 MW

Very reliable power grid: Only one 2 min outage in 38 years

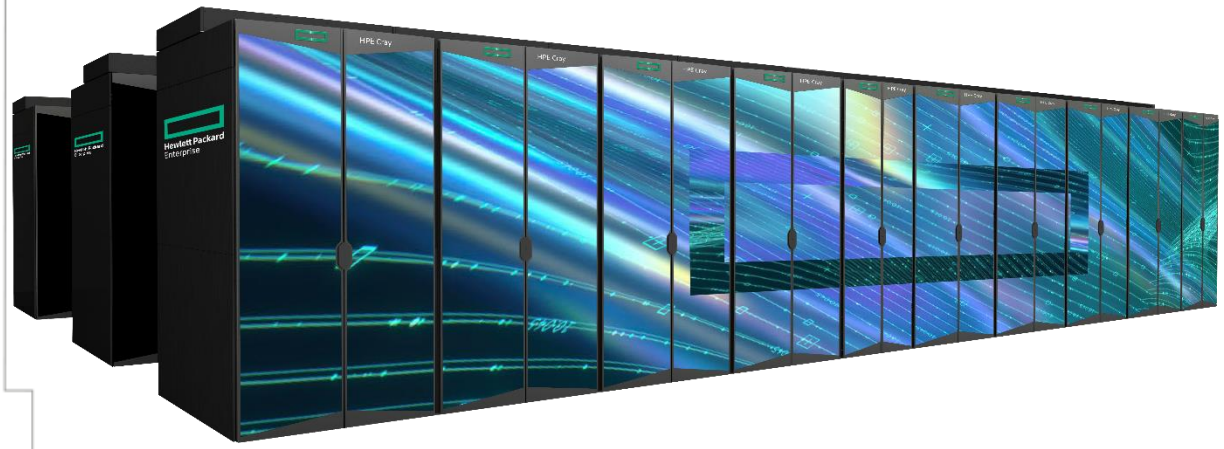
100% free cooling available, PUE 1.03

Waste heat reuse: effective energy price 35 €/MWh,
negative CO_2 footprint: 13500 tons reduced every year

Extreme connectivity: Kajaani DC is a direct part of the Nordic backbone.
4x100 Gbit/s to GÉANT in place, can be easily scaled up to multi-terabit level

Elevated security standards guaranteed by ISO27001 compliancy

DATACENTER IN KAJAANI



- LUMI will be an **HPE Cray EX** supercomputer manufactured by **Hewlett Packard Enterprise**
- Peak performance over **550 petaflop/s** makes the system one of the world's fastest
  - Fastest today is Fugaku supercomputer in Japan with 513 petaflop/s, second fastest Summit in USA with 200 petaflop/s)

1 system

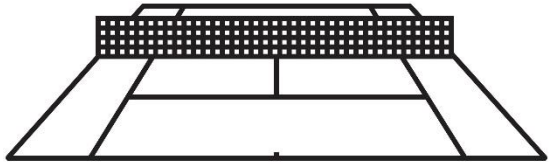
550 Pflop/s

Peak Performance

Computing power equivalent to

1 500 000

Modern laptop computers



Size of a tennis court

Modern platform for

High-performance computing, Artificial intelligence, Data analytics

Based on GPU technology

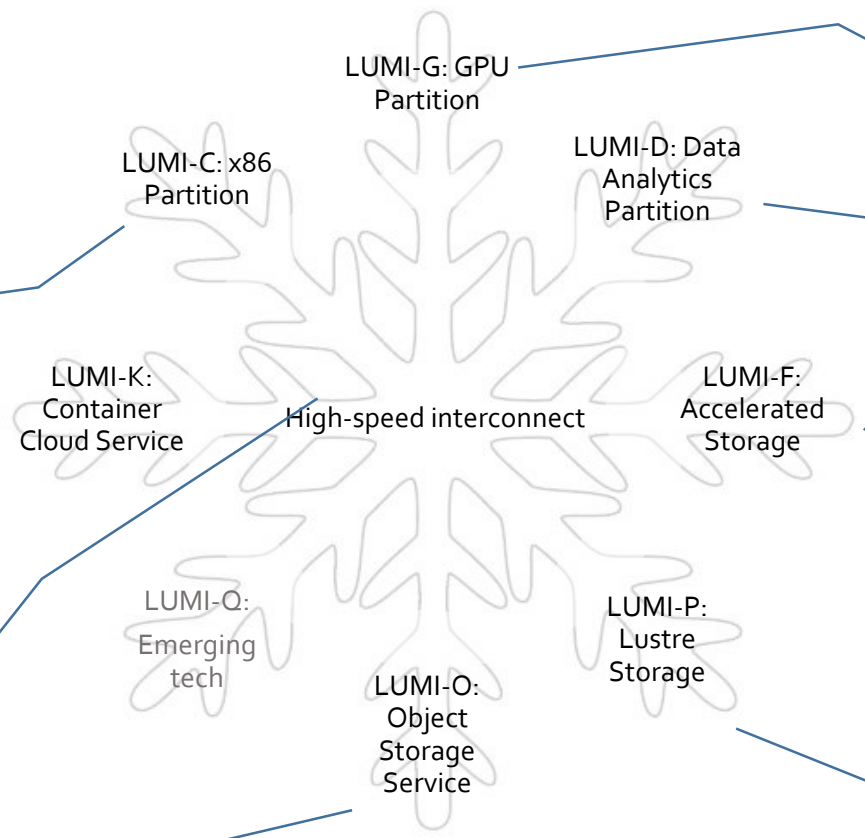
LUMI SUPERCOMPUTER

LUMI is a Tier-0 ***GPU-accelerated supercomputer*** *that enables the convergence of* ***high-performance computing***, ***artificial intelligence***, *and* ***high-performance data analytics.***

- Supplementary CPU partition
- ~200,000 AMD EPYC CPU cores

Possibility for combining different resources within a single run. HPE Slingshot technology.

30 PB encrypted object storage (Ceph) for storing, sharing and staging data



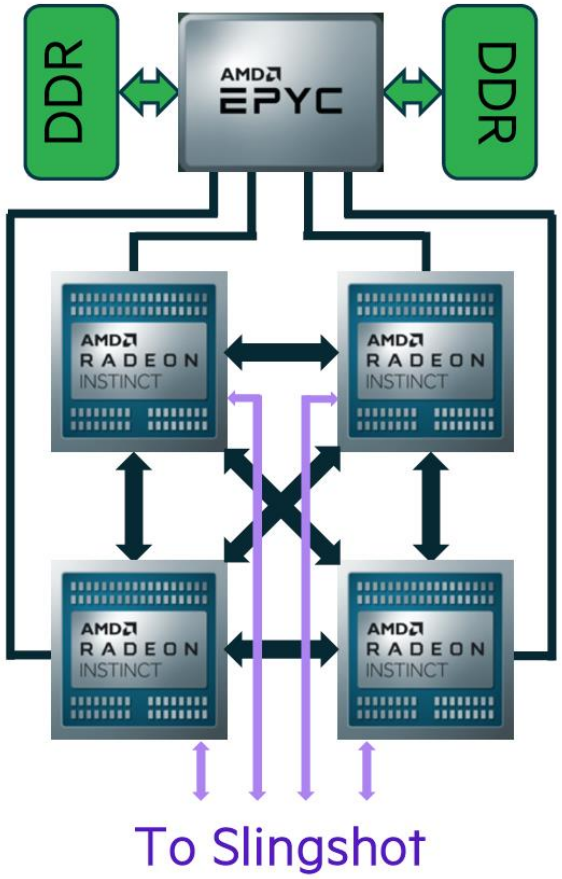
Tier-0 GPU partition: over 550 Pflop/s powered by AMD Instinct GPUs

Interactive partition with 32 TB of memory and graphics GPUs for data analytics and visualization

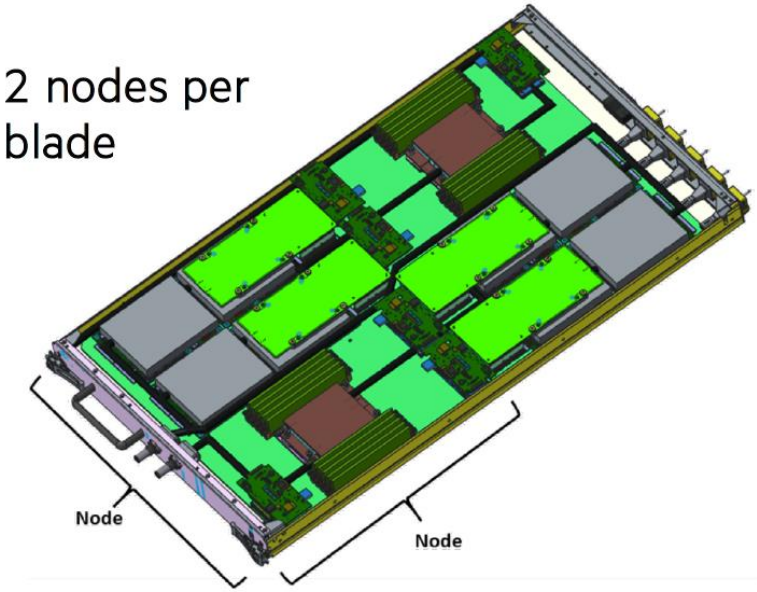
7 PB Flash-based storage layer with extreme I/O bandwidth of 2 TB/s and IOPS capability. Cray ClusterStor E1000.

80 PB parallel file system

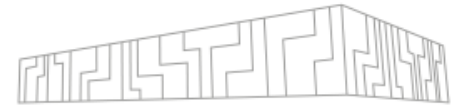
LUMI NODE



2 nodes per blade



SUMMARY



- IT4INNOVATIONS – Czech national supercomputing center

- **Karolina EUROHPC supercomputer** - 9.1 PFlop/s Linpack
- Massively accelerated - 8x Nvidia Ampere A100 per node (6.6 PFlop/s)
- Partial acceptance April 2021, full acceptance June 2021

- LUMI – Most powerful supercomputer in Europe, Dedicated share for CR

Our supercomputers support science, industry, and society

Branislav Jansík
branislav.jansik@vsb.cz

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IT4Innovations National Supercomputing Center
VSB – Technical University of Ostrava
17. listopadu 2172/15
708 00 Ostrava-Poruba, Czech Republic
www.it4i.cz