

Summit System Overview

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ORNL is managed by UT-Battelle, LLC for the US Department of Energy



U.S. DEPARTMENT OF
ENERGY

OLCF Summit Overview

The system includes

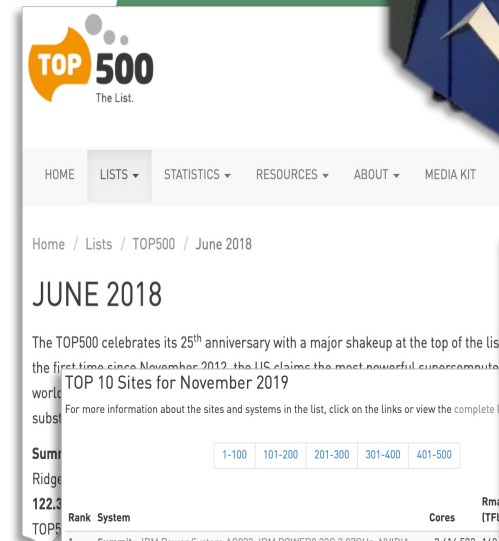
- 4,680 nodes
- Dual-port Mellanox EDR InfiniBand network
- 250 PB IBM file system transferring data at 2.5 TB/s

System Performance

- Peak of 200 Petaflops (FP₆₄) for modeling & simulation
- Peak of 3.3 ExaOps (FP₁₆) for data analytics and artificial intelligence

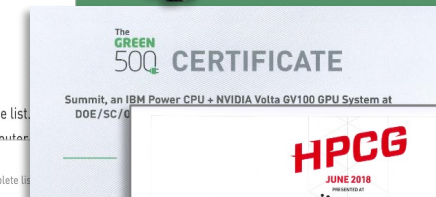
Each node has

- 2 IBM POWER9 processors
- 6 NVIDIA Tesla V100 GPUs
- 608 GB of fast memory (96 GB HBM2 + 512 GB DDR4)
- 1.6 TB of NV memory

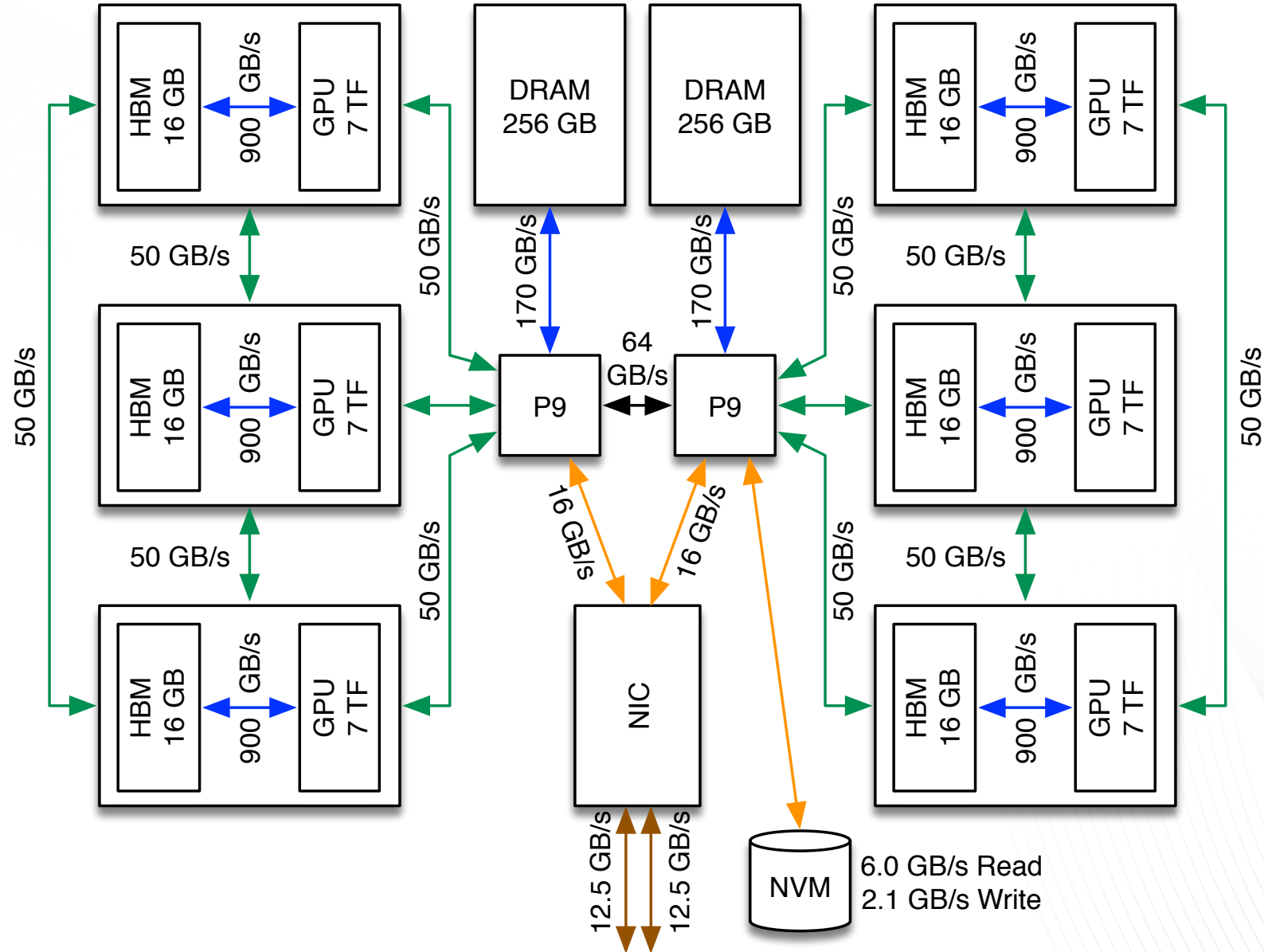


HPCG List for November 2019

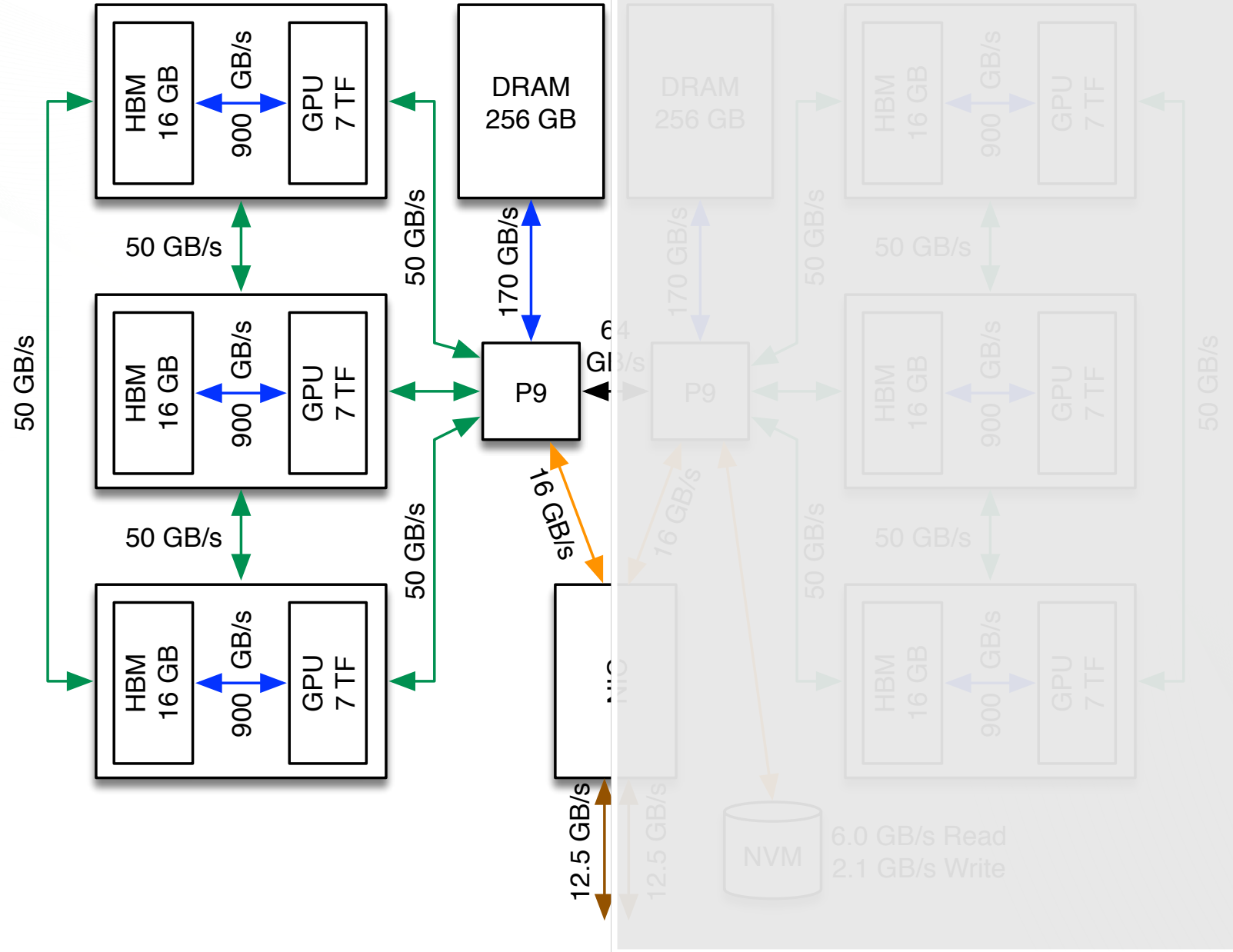
Rank	System	Cores	Rmax (TFlop/s)	HPCG (TFlop/s)
1	Summit - IBM Power System AC922, IBM POWER9 22C 3.07GHz, NVIDIA Volta GV100, Dual-rail Mellanox EDR InfiniBand, IBM DOE/SC/Oak Ridge National Laboratory, United States	2,414,592	148,600.0	2925.75



Summit Node Schematic

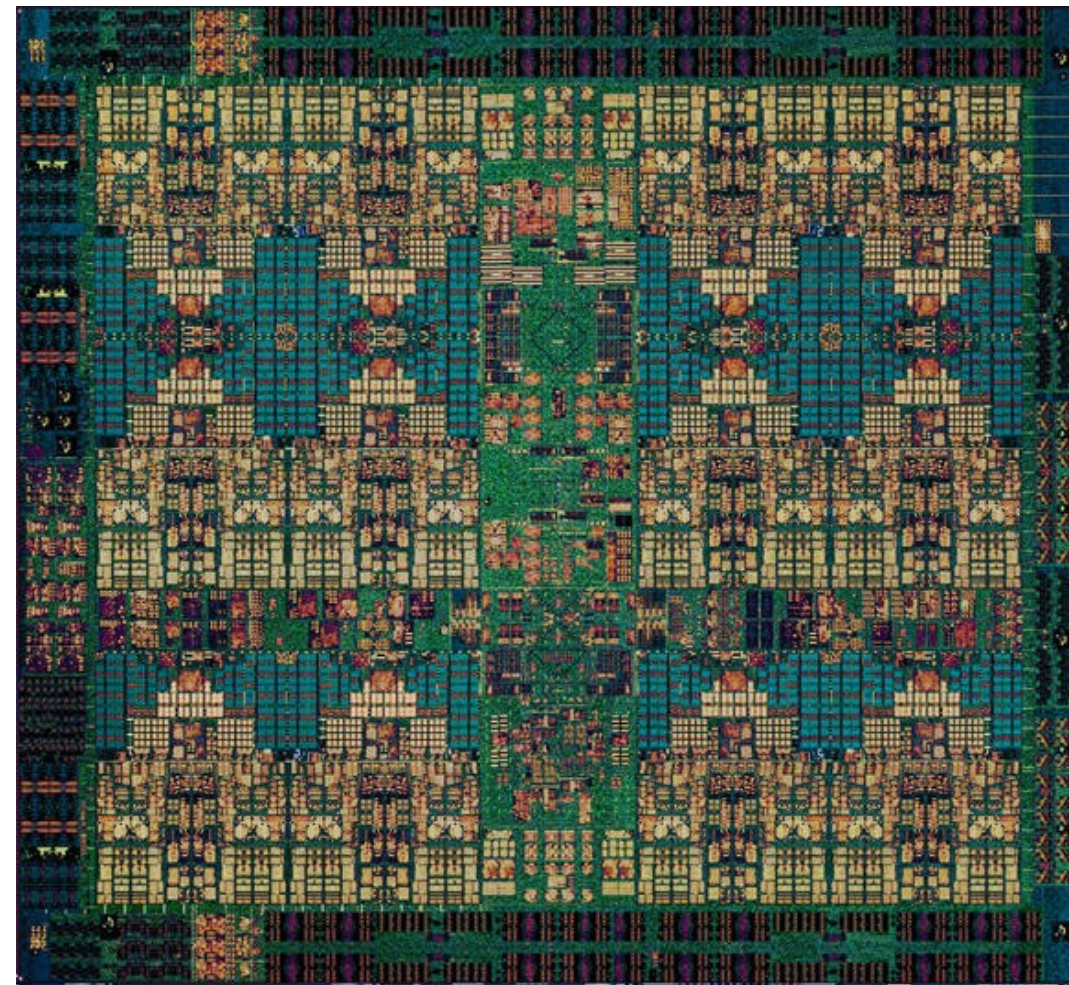


Summit Node Schematic



IBM Power9 Processor

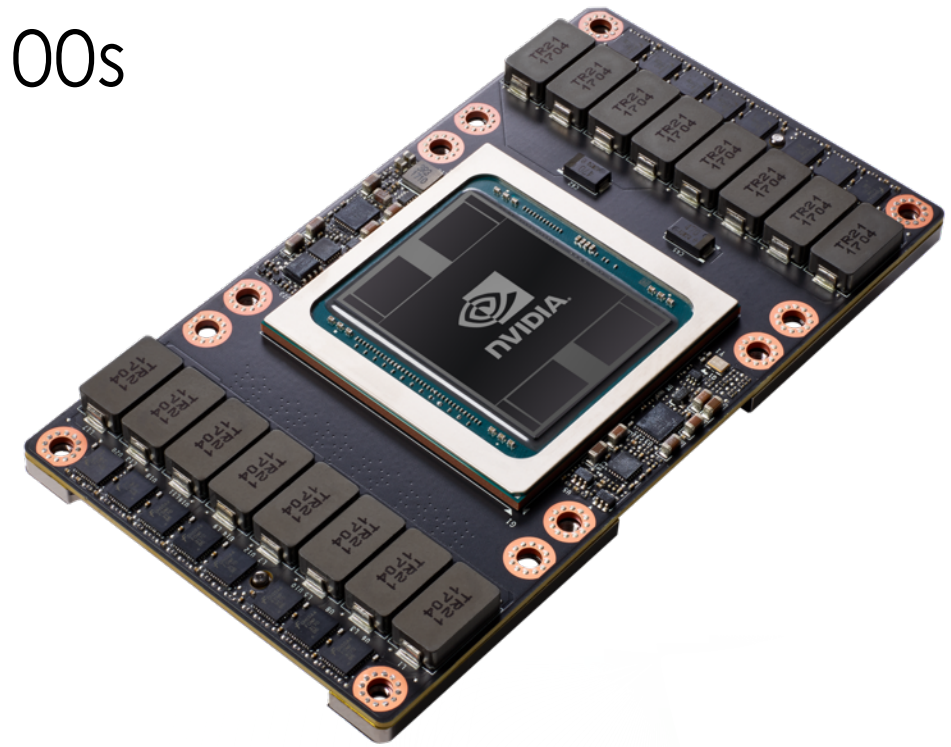
- Summit's P9s: 22 cores (4 hwthreads/core)
- PCI-Express 4.0
 - Twice as fast as PCIe 3.0
- NVLink 2.0
 - Coherent, high-bandwidth links to GPUs
- 14nm FinFET SOI technology
 - 8 billion transistors
- Cache
 - L1I: 32 KiB (per core, 8-way set associative)
 - L1D: 32 KiB (per core, 8-way)
 - L2: 512 KiB (per pair of cores)
 - L3: 120 MiB eDRAM, 20-way (shared by all cores)



Summit Contains 28,080 NVIDIA Tesla v100s

Each Tesla v100 GPU has:

- 150+150 GB/s total BW (NVLink v2.0)
- 5,120 CUDA cores (64 on each of 80 SMs)
- 640 Tensor cores (8 on each of 80 SMs)
- 20MB Registers | 16MB Cache | 16GB HBM2 @ 900 GB/s
- 7.5 DP TFLOPS | 15 SP TFLOPS | 120 FP₁₆ TOPS
- Tensor cores do mixed precision multiply-add of 4x4 matrices



$$\mathbf{D} = \begin{pmatrix} \begin{matrix} A_{0,0} & A_{0,1} & A_{0,2} & A_{0,3} \\ A_{1,0} & A_{1,1} & A_{1,2} & A_{1,3} \\ A_{2,0} & A_{2,1} & A_{2,2} & A_{2,3} \\ A_{3,0} & A_{3,1} & A_{3,2} & A_{3,3} \end{matrix} & \begin{matrix} B_{0,0} & B_{0,1} & B_{0,2} & B_{0,3} \\ B_{1,0} & B_{1,1} & B_{1,2} & B_{1,3} \\ B_{2,0} & B_{2,1} & B_{2,2} & B_{2,3} \\ B_{3,0} & B_{3,1} & B_{3,2} & B_{3,3} \end{matrix} \\ \text{FP16 or FP32} & \text{FP16} \end{pmatrix} + \begin{pmatrix} \begin{matrix} C_{0,0} & C_{0,1} & C_{0,2} & C_{0,3} \\ C_{1,0} & C_{1,1} & C_{1,2} & C_{1,3} \\ C_{2,0} & C_{2,1} & C_{2,2} & C_{2,3} \\ C_{3,0} & C_{3,1} & C_{3,2} & C_{3,3} \end{matrix} \\ \text{FP16 or FP32} \end{pmatrix}$$

$$\mathbf{D} = \mathbf{AB} + \mathbf{C}$$

Type	Size	Range	$u = 2^{-t}$
half	16 bits	$10^{\pm 5}$	$2^{-11} \approx 4.9 \times 10^{-4}$
single	32 bits	$10^{\pm 38}$	$2^{-24} \approx 6.0 \times 10^{-8}$
double	64 bits	$10^{\pm 308}$	$2^{-53} \approx 1.1 \times 10^{-16}$
quadruple	128 bits	$10^{\pm 4932}$	$2^{-113} \approx 9.6 \times 10^{-35}$

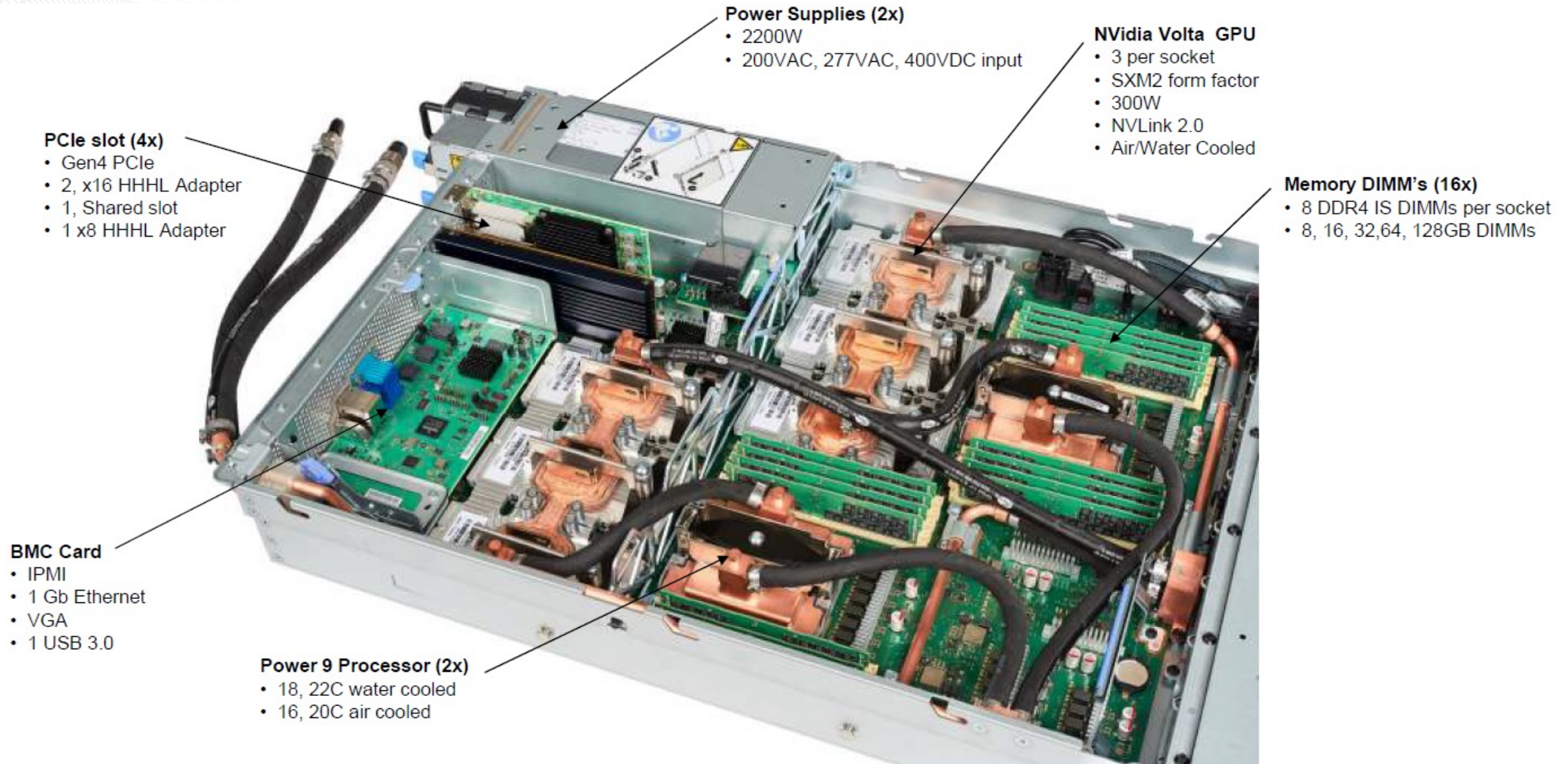
https://docs.olcf.ornl.gov/systems/summit_user_guide.html#tensor-cores

Summit Node

(2) IBM Power9 + (6) NVIDIA Volta V100

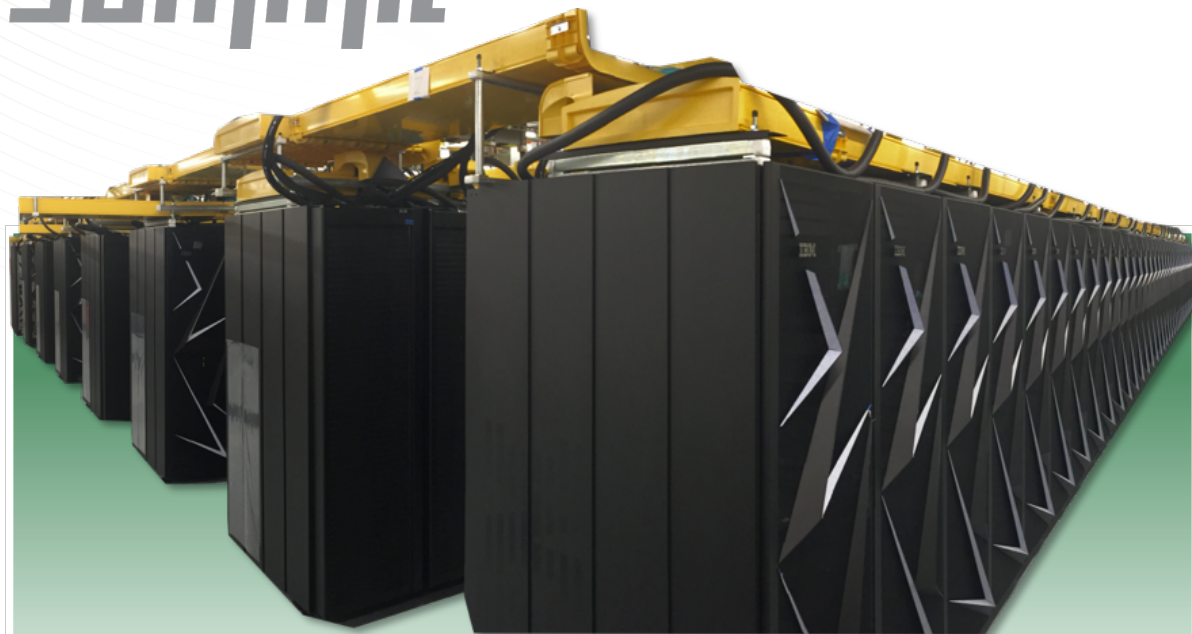


Summit Board (1 node) showing the Water Cooling



Summit Specs

**summit**



Feature	Summit
Peak FLOPS	200 PF
Max possible Power	13 MW
Number of Nodes	4,608
Node performance	42 TF
Memory per Node	512 GB DDR4 + 96 GB HBM2
NV memory per Node	1.6 TB
Total System Memory	2.8 PB + 7.4 PB NVM
System Interconnect	Dual Port EDR-IB (25 GB/s)
Interconnect Topology	Non-blocking Fat Tree
Bi-Section Bandwidth	115.2 TB/s
Processors on node	2 IBM POWER9™ 6 NVIDIA Volta™
File System	250 PB, 2.5 TB/s, GPFS™

Available File Systems / Storage Areas

NFS Directories – This is where you might want to keep source code and build your application.

NOTE: These directories are read-only from the compute nodes!

`/ccs/home/<userid>`

- Your personal home directory

`/ccs/proj/<project_id>`

- Can be accessed by all members of a project

GPFS Directories (parallel file system) – This is where you should write data when running on compute nodes.

`/gpfs/alpine/<project_id>/scratch/<userid>`

- Your personal GPFS scratch directory

`/gpfs/alpine/<project_id>/proj-shared`

- Can be accessed by all members of a project

Questions?

Summit here



Frontier here

