OLCF Summit Overview

The system includes
- 4,608 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
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 27,648 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 FP_{16} TOPS

- Tensor cores do mixed precision multiply-add of 4x4 matrices

\[ D = AB + C \]

https://docs.olcf.ornl.gov/systems/summit_user_guide.html#tensor-cores
Summit Node
(2) IBM Power9 + (6) NVIDIA Volta V100

256 GB (DDR4) <-> 256 GB (DDR4)
170 GB/s <-> 170 GB/s

CPU 0
0 (0-3) 1 (4-7) 2 (8-11) 3 (12-15) 4 (16-19) 5 (20-23) 6 (24-27)
7 (28-31) 8 (32-35) 9 (36-39) 10 (40-43) 11 (44-47) 12 (48-51) 13 (52-55)
14 (56-59) 15 (60-63) 16 (64-67) 17 (68-71) 18 (72-75) 19 (76-79) 20 (80-83)

CPU 1
22 (88-91) 23 (92-95) 24 (96-99) 25 (100-103) 26 (104-107) 27 (108-111) 28 (112-115)
29 (116-119) 30 (120-123) 31 (124-127) 32 (128-131) 33 (132-135) 34 (136-139) 35 (140-143)
36 (144-147) 37 (148-151) 38 (152-155) 39 (156-159) 40 (160-163) 41 (164-167) 42 (168-171)

64 GB/s

GPU 0 <-> GPU 1 <-> GPU 2
16 GB (HBM2) 16 GB (HBM2) 16 GB (HBM2)

NVLink2
(50 GB/s) <-> (900 GB/s)

GPU 3 <-> GPU 4 <-> GPU 5
16 GB (HBM2) 16 GB (HBM2) 16 GB (HBM2)
Summit Board (1 node) showing the Water Cooling

- **Power Supplies (2x)**
  - 2200W
  - 200VAC, 277VAC, 400VDC input

- **NVidia Volta GPU**
  - 3 per socket
  - SXM2 form factor
  - 300W
  - NVLink 2.0
  - Air/Water Cooled

- **BC Card**
  - IPMI
  - 1 Gb Ethernet
  - VGA
  - 1 USB 3.0

- **Power 9 Processor (2x)**
  - 18, 22C water cooled
  - 16, 20C air cooled

- **PCIe slot (4x)**
  - Gen4 PCIe
  - 2, x16 HHHL Adapter
  - 1, Shared slot
  - 1 x8 HHHL Adapter

- **Memory DIMM’s (16x)**
  - 8 DDR4 IS DIMMs per socket
  - 8, 16, 32, 64, 128GB DIMMs
# Summit Specs

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