Summit System Overview
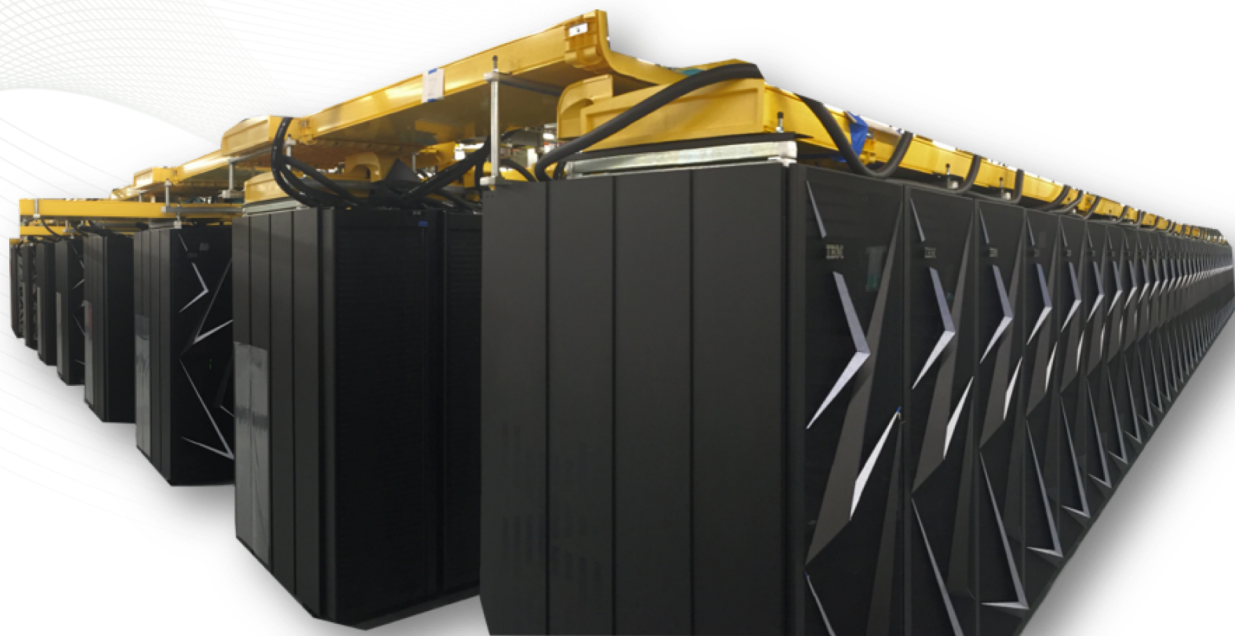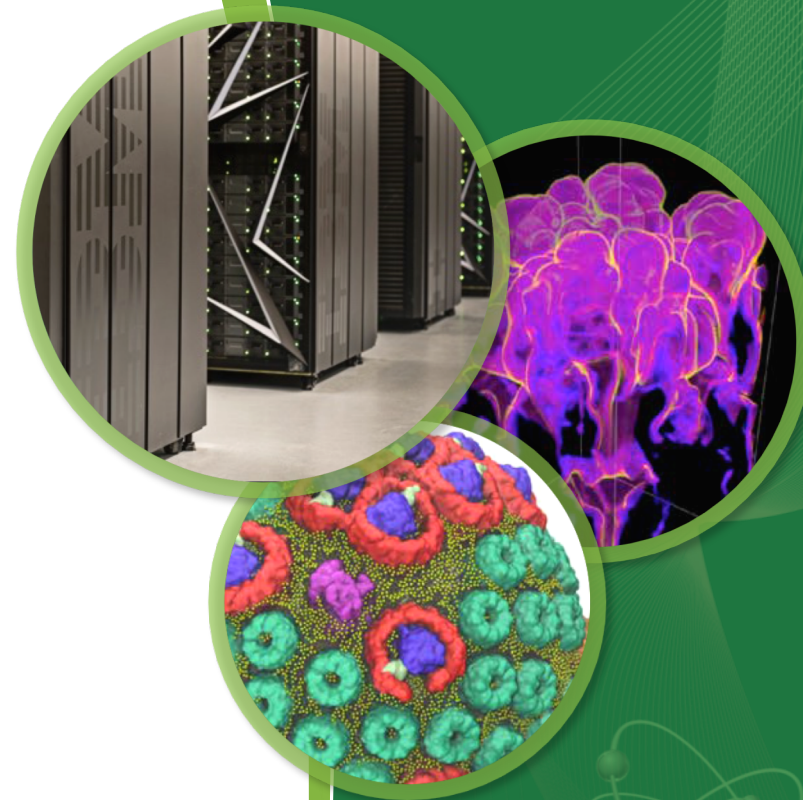

Tom Papatheodore
   Oak Ridge Leadership Computing Facility
   Oak Ridge National Laboratory
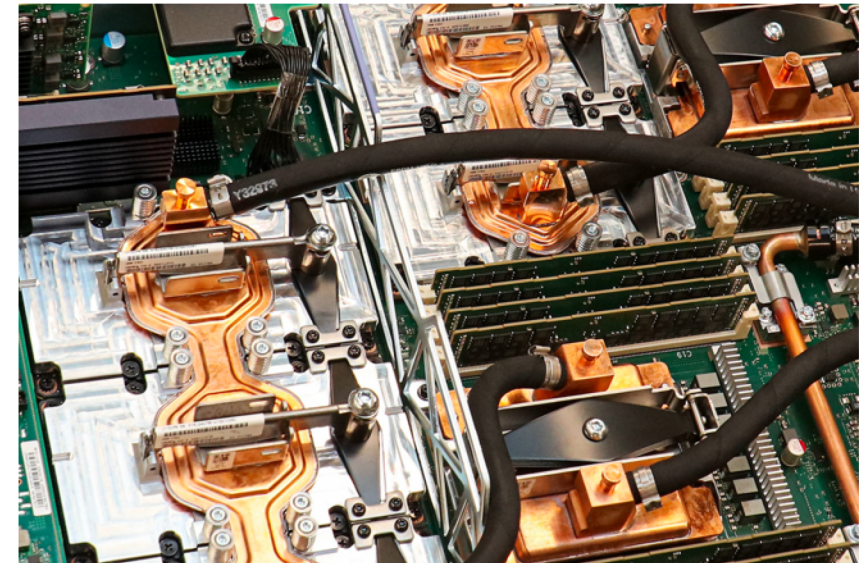
June 1, 2018

OAK RIDGE
National Laboratory | LEADERSHIP COMPUTING FACILITY

Coming in 2018: Summit will replace Titan as the OLCF's leadership supercomputer

Summit, slated to be more powerful than any other existing supercomputer, is the Department of Energy's Oak Ridge National Laboratory's newest supercomputer for open science.
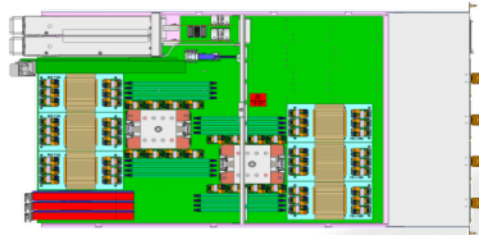
Summit Overview

OpenPOWER™

Compute System

256 compute racks
4,608 compute nodes
Mellanox EDR IB fabric
200 PFLOPS
10.2 PB Total Memory
~13 MW

Compute Rack

18 Compute Servers
Warm water (70°F direct-cooled components)
RDHX for air-cooled components

Compute Node

2 x POWER9
6 x NVIDIA GV100
NVMe-compatible PCIe 1600 GB SSD

25 GB/s EDR IB- (2 ports)
512 GB DRAM- (DDR4)
96 GB HBM- (3D Stacked)
Coherent Shared Memory

39.7 TB Memory/rack
55 KW max power/rack

Components
IBM POWER9

• 22 Cores
• 4 Threads/core
• NVLink

GPFS File System
250 PB storage
2.5 TB/s read, 2.5 TB/s write
(**2.5 TB/s sequential and 2.2 TB/s random I/O)
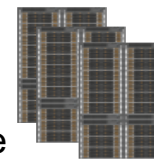
NVIDIA GV100

• 7 TF
• 16 GB @ 0.9 TB/s
• NVLink

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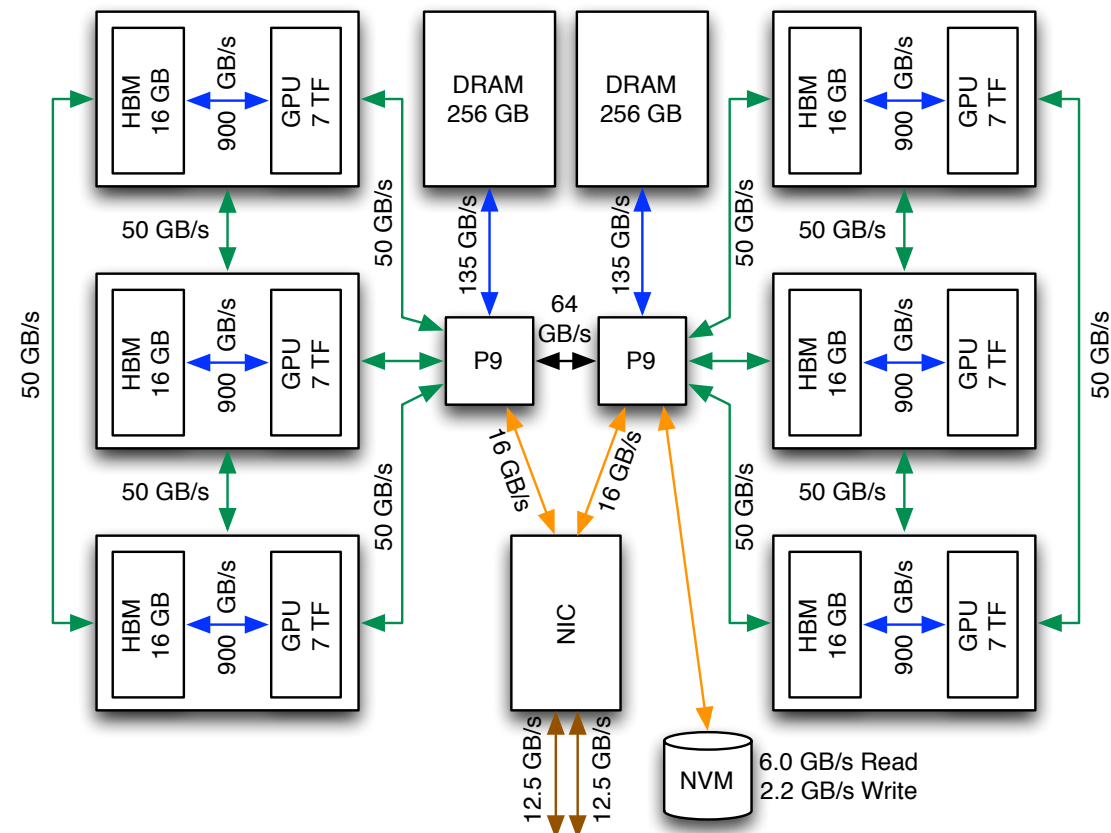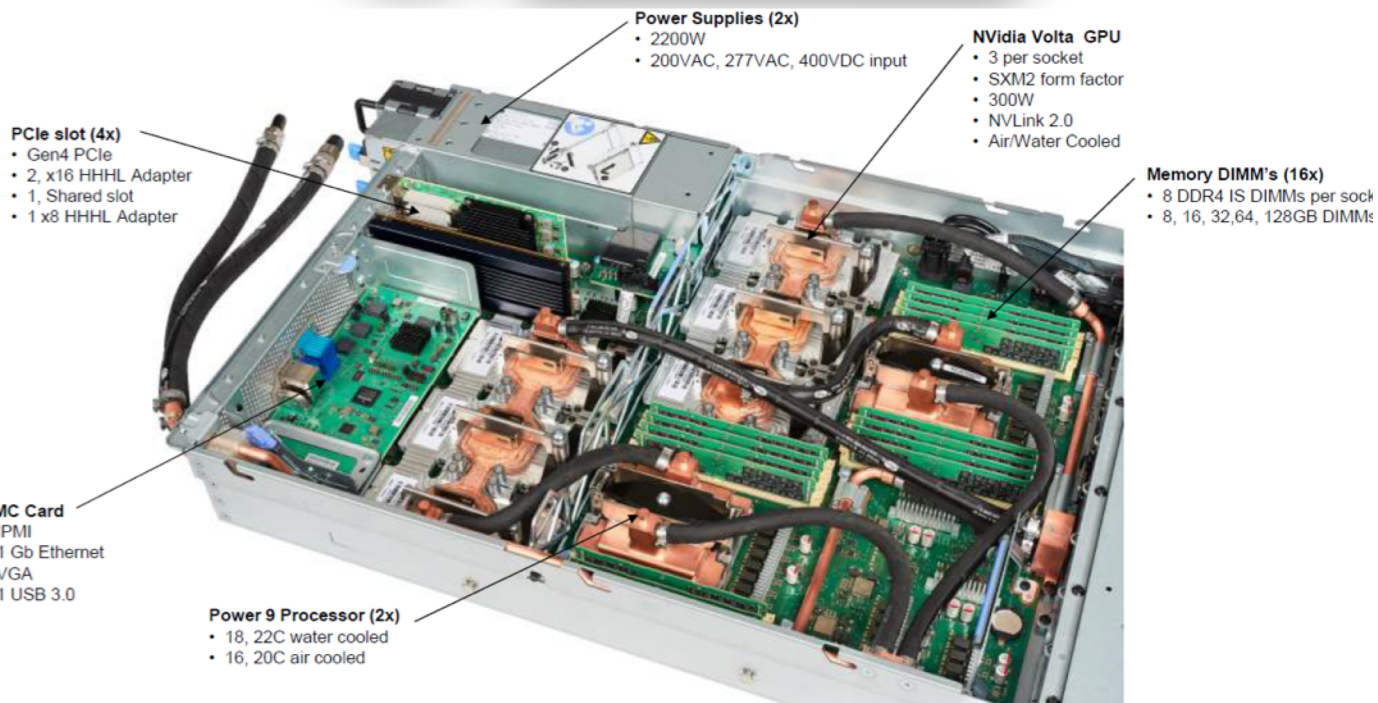
Power Supplies (2x)
- 2200W
- 200VAC, 277VAC, 400VDC input

NVidia Volta GPU
- 3 per socket
- SXM2 form factor
- 300W
- NVLink 2.0
- Air/Water 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 sock
- 8, 16, 32,64, 128GB DIMMs

BMC Card
- IPMI
- 1 Gb Ethernet
- VGA
- 1 USB 3.0

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

TF	42 TF (6x7 TF)	
HBM	96 GB (6x16 GB)	
DRAM	512 GB (2x16x16 GB)	
NET	25 GB/s (2x12.5 GB/s)	
MMsg/s	83	

- ↔ HBM/DRAM Bus (aggregate B/W)
- ↔ NVLINK
- ↔ X-Bus (SMP)
- ↔ PCIe Gen4
- ↔ EDR IB

HBM & DRAM speeds are aggregate (Read+Write).
All other speeds (X-Bus, NVLink, PCIe, IB) are bi-directional.

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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)
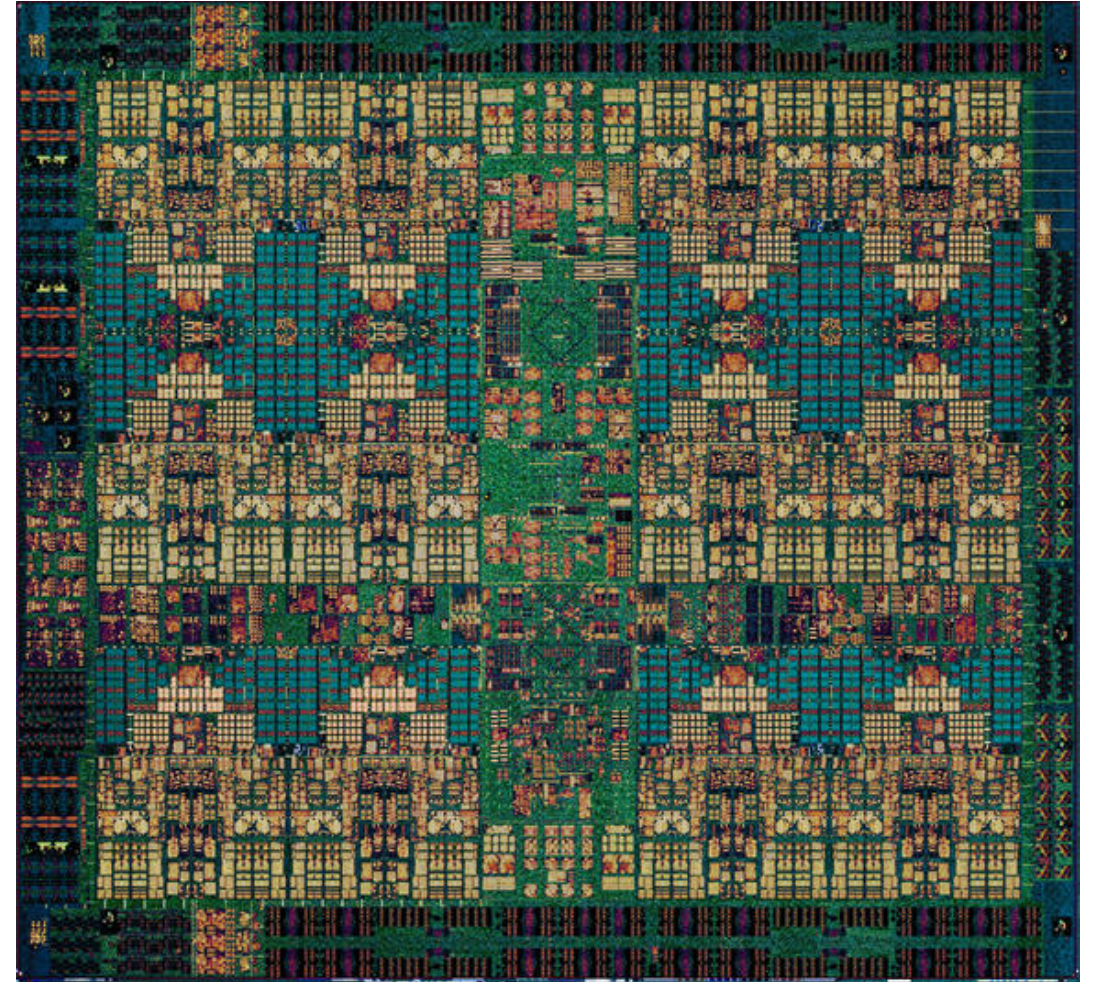
NVIDIA Volta Details

	Tesla V100 for NVLink	Tesla V100 for PCIe
PERFORMANCE with NVIDIA GPU Boost™	DOUBLE-PRECISION **7.8** TeraFLOPS	DOUBLE-PRECISION **7** TeraFLOPS
	SINGLE-PRECISION **15.7** TeraFLOPS	SINGLE-PRECISION **14** TeraFLOPS
	DEEP LEARNING **125** TeraFLOPS	DEEP LEARNING **112** TeraFLOPS
INTERCONNECT BANDWIDTH Bi-Directional	NVLINK **300** GB/s	PCIE **32** GB/s
MEMORY CoWoS Stacked HBM2	CAPACITY **16** GB HBM2	
	BANDWIDTH **900** GB/s	

TensorCores™
Mixed Precision
(16b Matrix-Multiply-Add
and 32b Accumulate)

Note: The performance numbers are peak and not representative of Summit's Volta

Coming in 2018: Summit will replace Titan as the OLCF's leadership supercomputer

- Many fewer nodes

- Much more powerful nodes

- Much more memory per node and total system memory

- Faster interconnect

- Much higher bandwidth between CPUs and GPUs

- Much larger and faster file system

Feature	Titan	Summit
Application Performance	Baseline	5-10x Titan
Number of Nodes	18,688	4,608
Node performance	1.4 TF	42 TF
Memory per Node	32 GB DDR3 + 6 GB GDDR5	512 GB DDR4 + 96 GB HBM2
NV memory per Node	0	1600 GB
Total System Memory	710 TB	>10 PB DDR4 + HBM2 + Non-volatile
System Interconnect	Gemini (6.4 GB/s)	Dual Rail EDR-IB (25 GB/s)
Interconnect Topology	3D Torus	Non-blocking Fat Tree
Bi-Section Bandwidth	112 TB/s	115.2 TB/s
Processors	1 AMD Opteron™ 1 NVIDIA Kepler™	2 IBM POWER9™ 6 NVIDIA Volta™
File System	32 PB, 1 TB/s, Lustre®	250 PB, 2.5 TB/s, GPFS™
Power Consumption	9 MW	13 MW

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Summit is still under construction

- We expect to accept the machine in Summer of 2018, allow early users on this year, and allocate our first users through the INCITE program in January 2019.

Thank You.