NIAGARA
Russian Supercomputers

Niagara/Supermicro Innovation Technologies

NEC-2017, Budva, Montenegro

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LHC and GRID

GRID technologies are one of the three main parts of Higgs boson CERN success - along with the LHC accelerator and detectors.

Russian segment of LHC GRID

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- Server systems based on Twin, SuperBlade and SuperStorage Supermicro platforms
- Storage system with best price/performance value in the industry

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Data-center of Russian LHC GRID segment, JINR, Dubna

Data-center of Russian LHC GRID segment, Kurchatovsky Institute , Moscow

Supercomputer Center of 570 TFlops of the University of Nizhni Novgorod

Supercomputer 100TFlops of Keldysh Institute of Applied Mathematics

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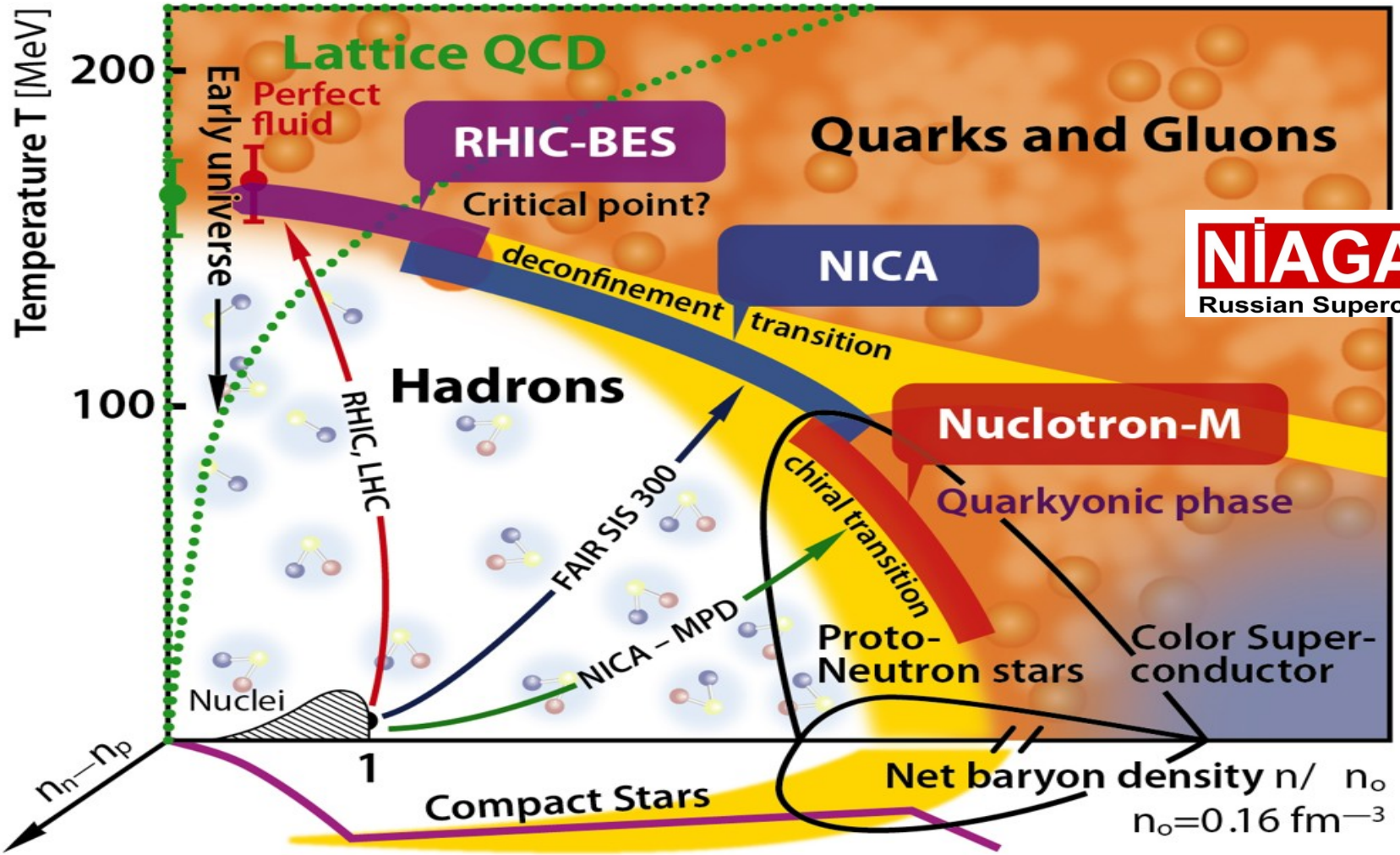
Petersburg Nuclear Physics Institute of NRC «Kurchatov Institute». High performance system with: 496 CPU, 9024 compute cores, 59 TB of RAM and 100Gbit/s InfiniBand

IN PROGRESS: Data-center and and Communications Network for heavy ion collider project NICA, JINR, Dubna



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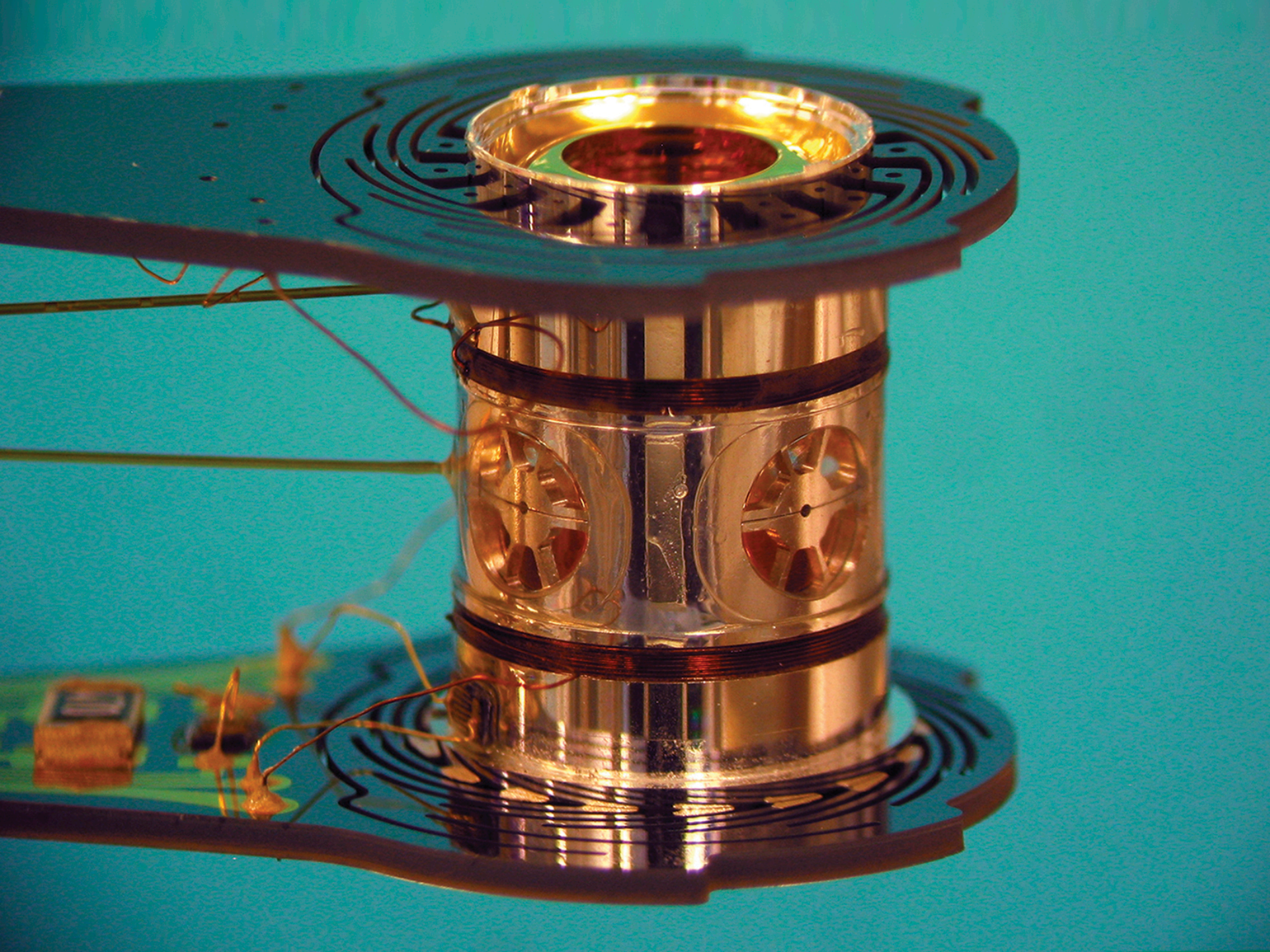

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Supermicro New Generation high performance solutions. Outline.

- New CPU Generations
- Speedup of Accelerators
  - Especially in Deep Learning
- NVMe fast non-volatile storage
- High Performance Server Products
  - Compute Server
  - Accelerated Computing
- High Performance Networks
  - OmniPath
  - SDN
- Software Defined Storage and Scalable Parallel Filesystem

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New CPU Generations.
Intel Skylake

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New CPU Generations.
AMD EPYC

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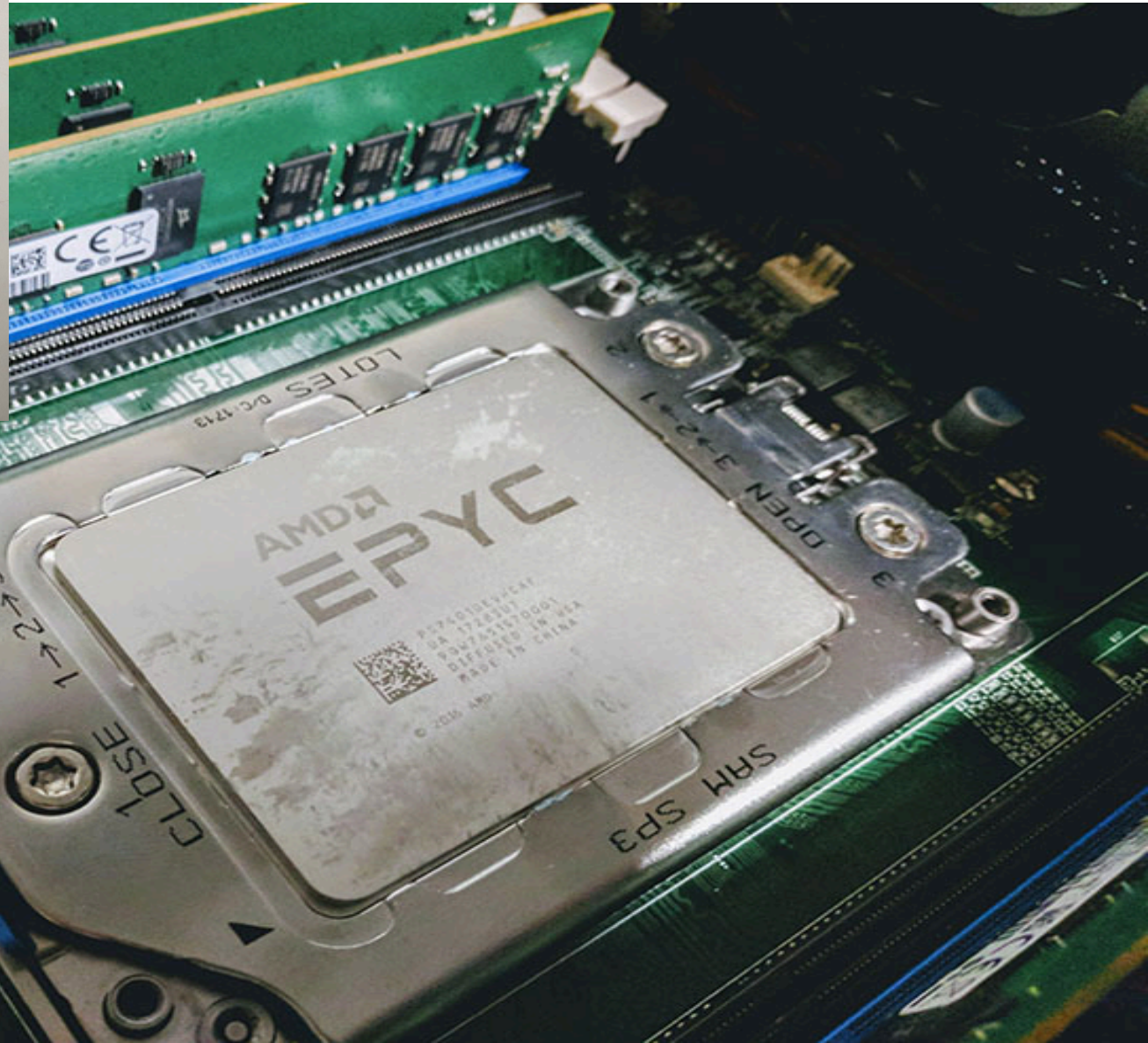

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Broadwell and Skylake Comparisons

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Spec	Grantley with Broadwell-EP CPU (22 nm)	Purley with Skylake CPU (14 nm)
CPU TDP	55-145W	45-205W
Socket	Socket R3	Socket P
Scalability	2S	2S, 4S, 8S
Cores	Up to 22C with Intel® HT Technology	Up to 28C with Intel® HT Technology
Memory	4 channels DDR4 per CPU	6 channels DDR4 per CPU
	1DPC=up to 2400, 2DPC= up to 2400	2133, 2400, 2666 2DPC
Intel® UPI interconnect	Intel® QPI: 2 v1.1 channels per CPU 9.6 GT/s	UPI: 2-3 channels per CPU (9.6, 10.4 GT/s)
PCIe*	PCIe* 3.0 (2.5, 5.0, 8.0 GT/s)	PCIe* 3.0 (2.5, 5.0, 8.0 GT/s)
	40 lanes per CPU	48 lanes per CPU

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Intel Xeon Scalable Processor Family

- New Brand and Processor Number scheme starting with Skylake-SP processor
- The family will be referred to as the **Intel Xeon Processor Scalable Family**
- The Intel® Xeon® processor Scalable family will have **4 named shelves – Platinum, Gold, Silver, Bronze -** that signal increasing capability as you move from Bronze to Platinum level SKUs

Intel® Xeon® Platinum	8	1	#	#	α	α	processor
Intel® Xeon® Gold	6	1	#	#	α	α	processor
Intel® Xeon® Gold	5	1	#	#	α	α	processor
Intel® Xeon® Silver	4	1	#	#	α	α	processor
Intel® Xeon® Bronze	3	1	#	#	α	α	processor

SKU Level
- 8 = Platinum
- 6, 5 = Gold
- 4 = Silver
- 3 = Bronze

Processor Generation
- 1 = 1st Gen (Skylake)

Processor SKU
- (ex. 20, 34…)

Integrations and Optimizations
(if applicable)
- P = FPGA
- F = Fabric
- T = High Tcase/Extended Reliability

Memory Capacity
- No Suffix = 768GB per socket
- M = 1.5TB per socket

AMD EPYC (Naples) Processor

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COMPUTE

- 16 to **32** AMD "Zen" x86 cores (32 to 64 threads)
- TDP range: 120W-180W
- Process: 14 nm

MEMORY

- **8 channel DDR4 with ECC up to 2666 MHz**
- 2 DIMMs/channel capacity of 2TB/socket

INTEGRATED I/O – NO CHIPSET

- **128 lanes PCIe Gen3**
  - Used for PCIe, SATA, and Coherent Interconnect
  - Up to 32 SATA or NVMe devices

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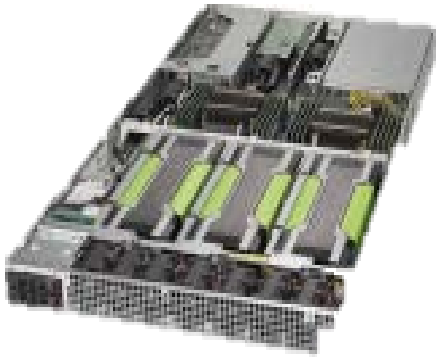
H11 Server A+ (AMD) Product Family

Product Family
Ultra Architecture 1U & 2U Ultra systems Optimize Thermal design & Flexible I/O
Twin Architecture The original Twin architecture innovator
WIO Platform Resource optimized systems
GPU Optimized Solutions Full line of GPU vs Nvidia / AMD
UP Systems UP Mainstream, Storage systems

Big Twin

Ultra Server

WIO



GPU optimized

UP Systems

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Nvidia Volta V100 accelerator. Internally

21B transistors
815 mm^2

80 SM
5120 CUDA Cores
640 Tensor Cores

16 GB HBM2
900 GB/s HBM2
300 GB/s NVLink

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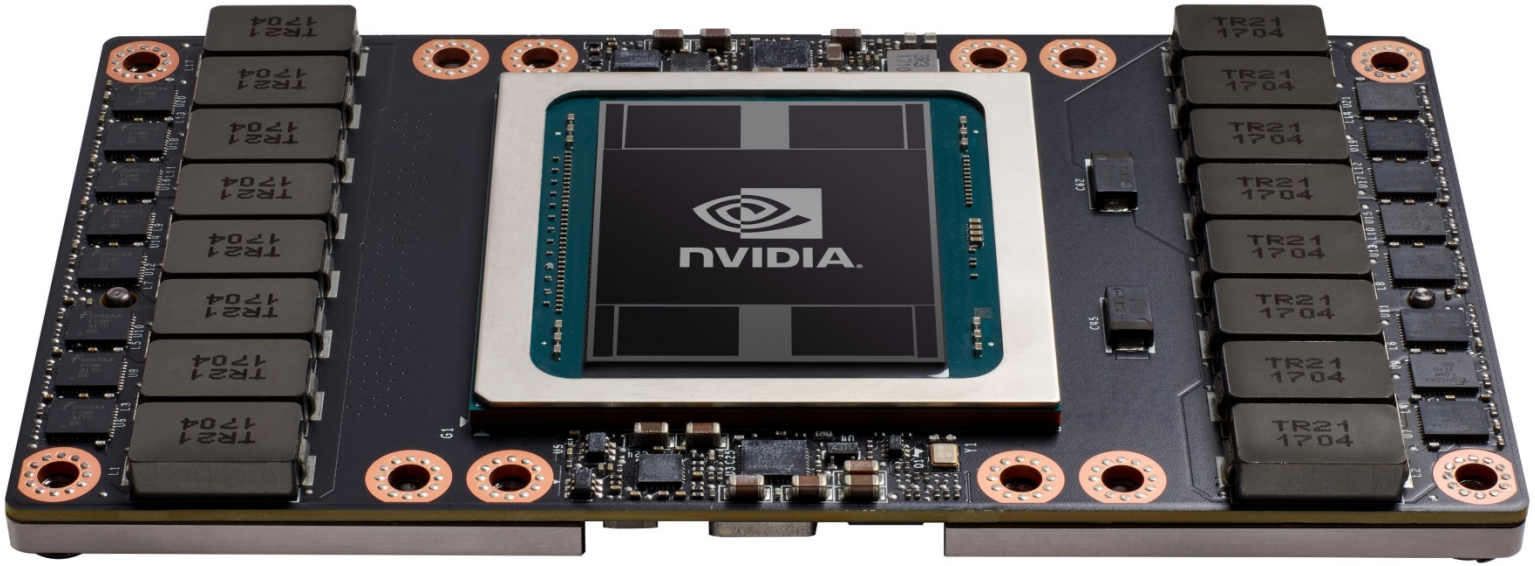
Nvidia Volta V100 accelerator. Externally



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Pascal P100 and Volta V100 accelerators comparison

	P100	V100	Ratio
Training acceleration	10 TOPS	120 TOPS	12x
Inference acceleration	21 TFLOPS	120 TOPS	6x
FP64/FP32	5/10 TFLOPS	7.5/15 TFLOPS	1.5x
HBM2 Bandwidth	720 GB/s	900 GB/s	1.2x
NVLink Bandwidth	160 GB/s	300 GB/s	1.9x
L2 Cache	4 MB	6 MB	1.5x
L1 Caches	1.3 MB	10 MB	7.7x

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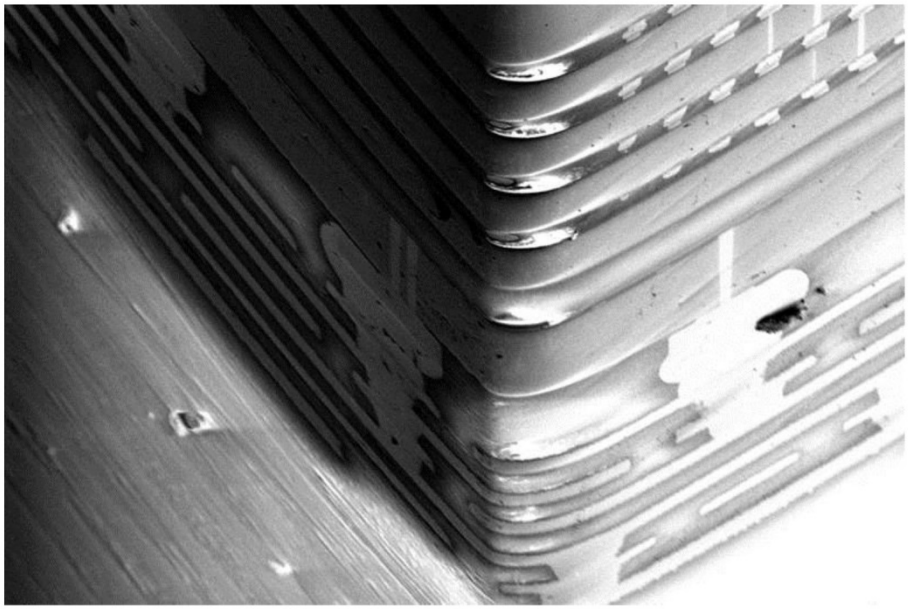
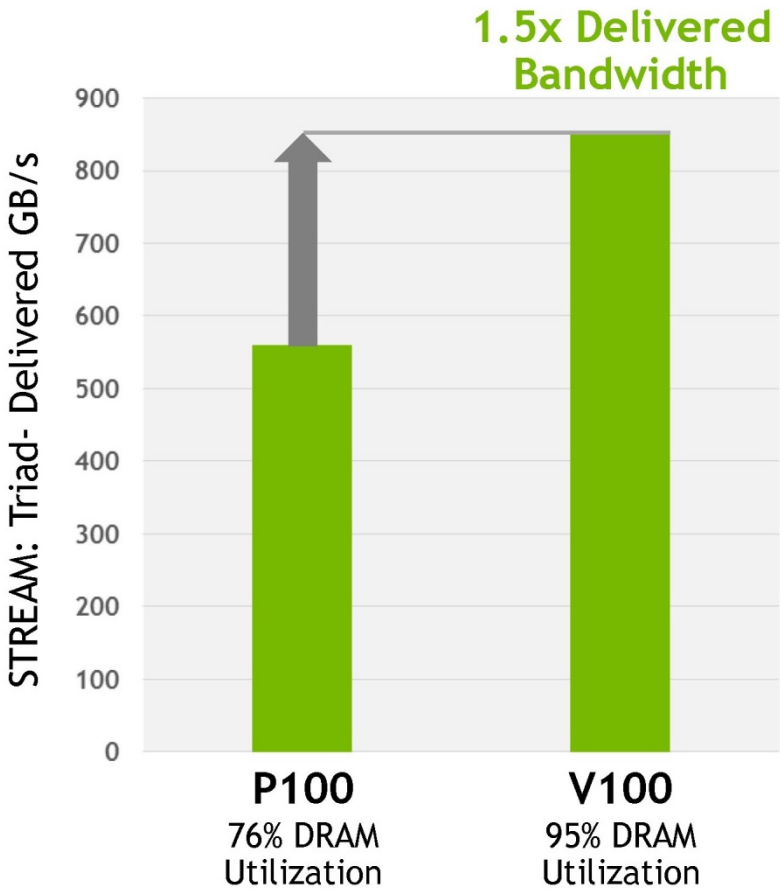
Nvidia new HBM2 memory architecture



HBM2 stack



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NVMe: Breakthrough IOPS, QoS, Latency

	Throughput (IOPS)	Quality of Service (QoS)	Achieving Lower Latencies
Apache Pass			
Optane	500,000+	99%	<10 µs.
nvm EXPRESS	450,000	95%	20 – 70 µs
SSD	85,000	75%	55 µs.
HDD	140	92%	15.5 ms.

Breakthrough Performance

Predictably Fast Service

Responsive All the Time

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All Flash NVMe Performance

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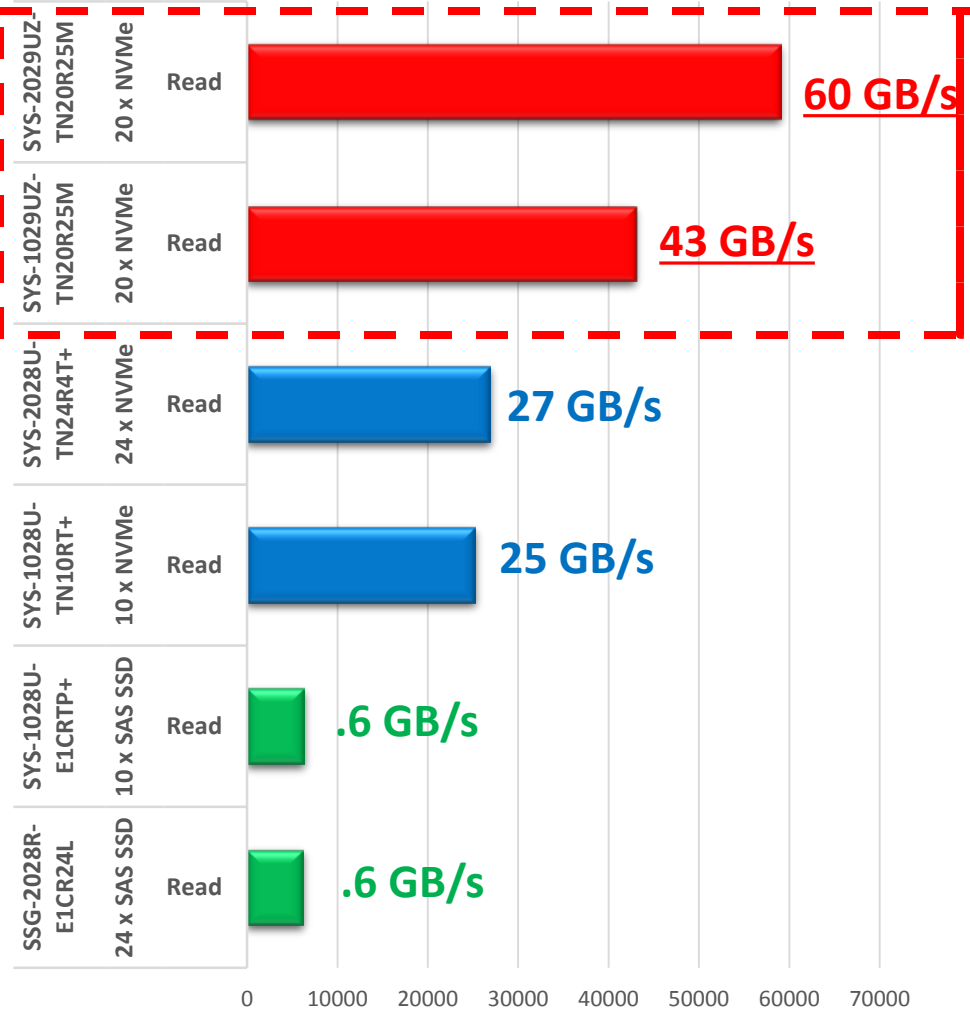
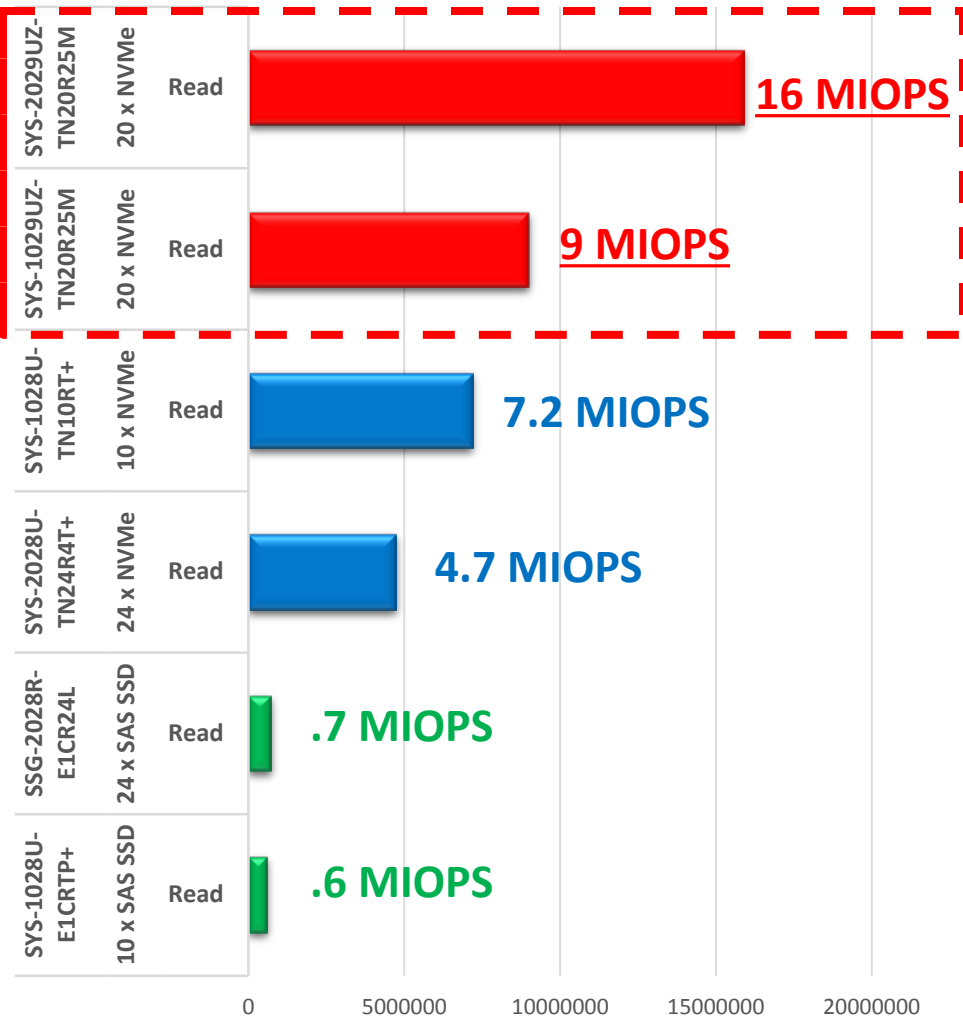
Throughput



IOPS



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X11 Skylake Solutions Shipping Today

BigTwin

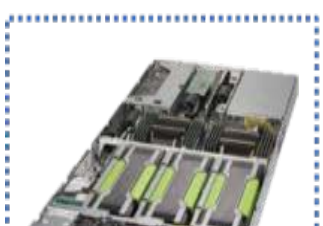
TwinPro

FatTwin

Ultra

WIO

DCO



GPU

Storage

SuperBlade

Workstation

UP Solution

MP Solution

100+ Optimized X11 SKUs ready today

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BigTwin

- No-Compromise 2U high density system with 4 hot-swappable DP nodes
- Each node supports dual processors up to 205W and 3TB memory in 24 DIMMs
- Up to 6 all-flash NVMe per node or SAS3 Hybrid / SATA3 drive bays for application flexibility. 2x M.2 per node support
- 3 PCI-E 3.0 expansion options including one SIOM slot for flexible networking selection and two standard PCI-e 3.0 x16

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FatTwin

4U 4-Node

4U 8-Node

- Cold isle serviceability for all compute nodes with hot-swappable key components such as HDD and power supply
- 8 x 3.5” Hot-swap HDD in 1U or 2/4/6 NVMe options in 0.5U
- 2 PCI-E 3.0 expansion options including SIOM card for best networking performance up to 100G Ethernet/Omni-Path, or InfiniBand

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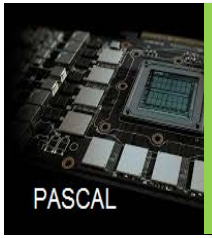
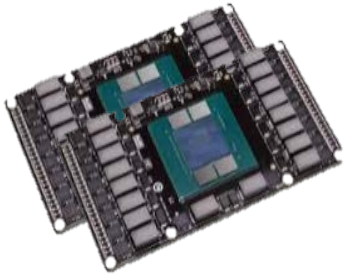
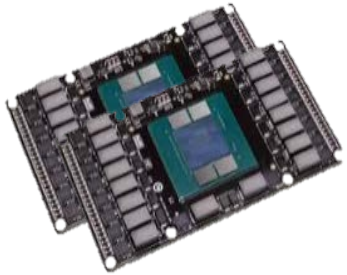
Nvidia Volta V100 SXM Server



PASCAL/VOLTA GPU READY

- Performance – 10/15 TFLOPs FP32
- NVLink – 5x PCIe
- 3D Memory - 2x Memory Bandwidth





SUPERMICRO ADVANTAGE

- PERFORMANCE: 4/8x PASCAL/VOLTA with GPUs
- NVLINK: 80GB/s High Bandwidth GPU Interconnect
- RDMA FABRIC: 4/8x Direct Low Latency Data Access
- EFFICIENCY: Titanium-rated Power Supply
- DESIGN: No GPU preheating

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High Density GPU Server

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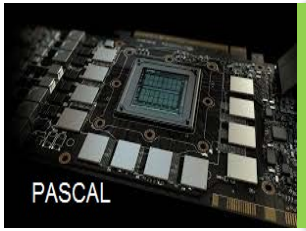
SYS-4028GR-TR2(T)

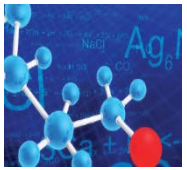


MAXWELL/PASCAL READY
- Active/Passive GPU Support
- Support latest Maxwell/Pascal GPUs
- Distributed training across eight GPUs

SUPERMICRO Value Proposition
- THROUGHPUT: Highest GPU Parallelism
- FLEXIBILITY: Enterprise or Active GPU
- RELIABILITY: 2+2 94% Efficiency Level PSUs
- BALANCED: Balanced GPU architecture
- DESIGN: No GPU preheating

Key Features:
- **All GPUs and NICs under single CPU root**
- **GPU Peer-to-Peer optimized architecture**
- **GPU Direct RDMA support**
- **Support up to 160W CPU**

APPLICATIONS:



RESEARCH

MACHINE LEARNING TRAINING

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SuperBlade®

- Lower Initial Acquisition Cost and a low Total Cost of Ownership(TCO)
- 8U, 6U and 4U form factors. Blades are available in UP, DP (2-socket half-height) and 4-socket full-height. Fabric choices include 100G EDR InfiniBand,100G Intel Omni-Path or 25Gb/s Ethernet
- Unique optional Battery Backup Power Module provides adequate power to the enclosure in case of power trip or failure

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8U SuperBlade®

- Highest Performance 205W Intel® Xeon® Skylake-SP processors
- 10x 4-socket (48 DIMM + 14 NVMe), 20x 2-socket (16 DIMM + 7 NVMe) blades
- 100G EDR IB, 100G Intel Omni-Path, 25G/10G Ethernet switches
- Redundant Platinum (96% efficiency) AC or DC power supplies
- Battery Backup Power (BBP) modules
- Free Air Cooling

10x 4S Blades

20x 2S Blades

Mixed Blades

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Highest Density – 100x 2S or 50x 4S Blade Servers per 42U Rack

8U SuperBlade ® Servers

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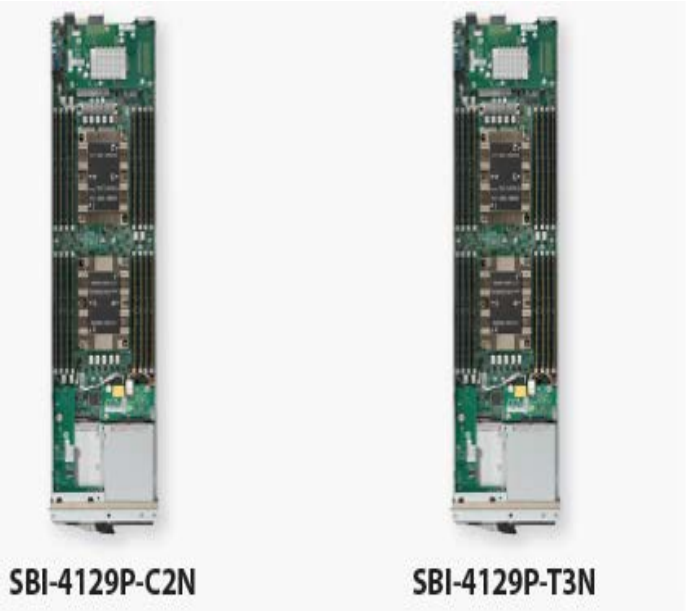
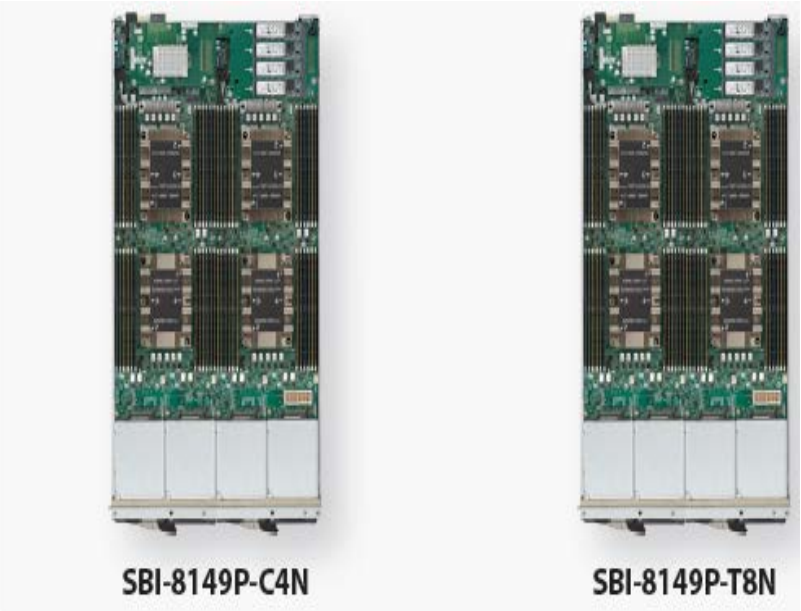
2-Socket Blade Server
16 DIMM, 2 hot-plug NVMe
10GbE + 100G IB/100G OPA/25GbE

4-Socket Blade Server
48 DIMM, 8 hot-plug NVMe
10GbE + 100G IB/100G OPA/25GbE



NVMe/SAS3 NVMe/SATA3



NVMe/SAS3 NVMe/SATA3

100G Omni-Path
AOC-OPH-WFR

100G EDR IB
AOC-IBH-X4ES

25GbE
AOC-B25G-M2S

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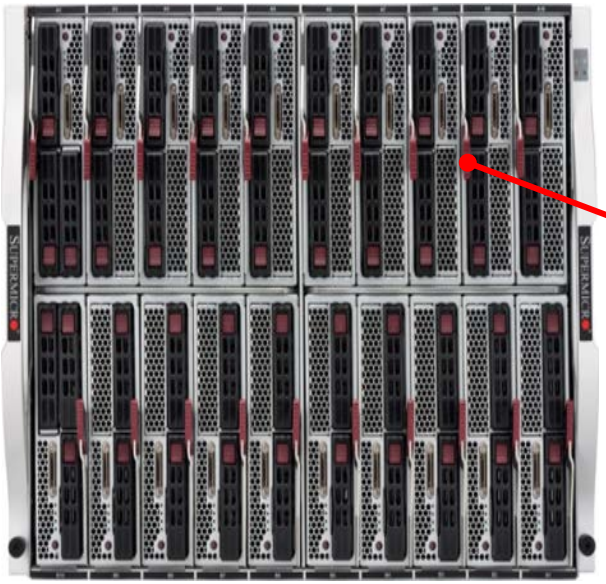
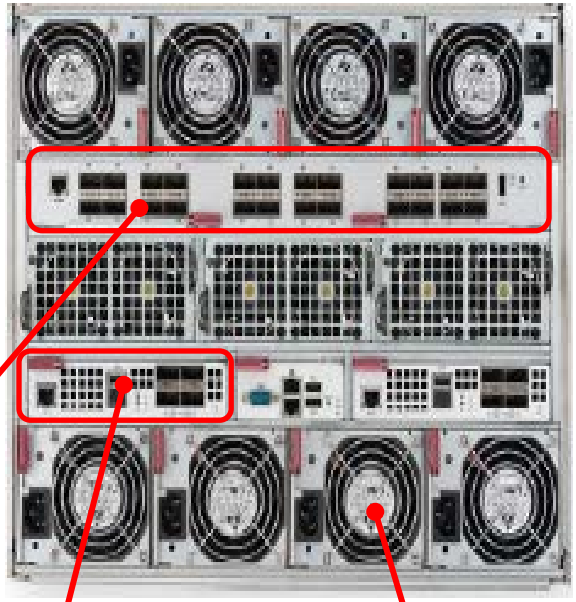
8U SuperBlade® Enclosure



Blade Servers

- 20x 2S blade servers
- 10x 4S blade servers



100G EDR IB switch

100G OPA switch

Ethernet switch

Power Supplies/Battery Backup

- 8/6/4x PSU
- 4x PSU + 4 x 1200W BBP

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6U SuperBlade®

- 14x Intel® Skylake-SP blade servers per enclosure
- 2-socket blade server
  - 24 VLP DDR4 DIMMs
  - 3x hot-plug NVMe/SAS3/SATA3
- 1-socket blade server
  - 12 VLP DDR4 DIMMs
  - 3x hot-plug NVMe/SAS3/SATA3
- 2x 25G/10G Ethernet switches
- Redundant AC or DC PSU

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4U SuperBlade®

- 14x 2-socket blades
- 2x 25G/10G switches
- Redundant AC or DC power supplies
- Free Air Cooling

SBE-414E Series

- 14x 2-socket blades
- 16x DDR4-2666 memory
- 2x hot-plug U.2 NVMe/SATA3
- 1x M.2 NVMe
- 2x 10GbE
- 2x 25GbE (coming soon)

SBI-4429P-T2N

Lowest Initial HW Acquisition Cost
Highest Density – 140x 2S Blade Servers per 42U Rack

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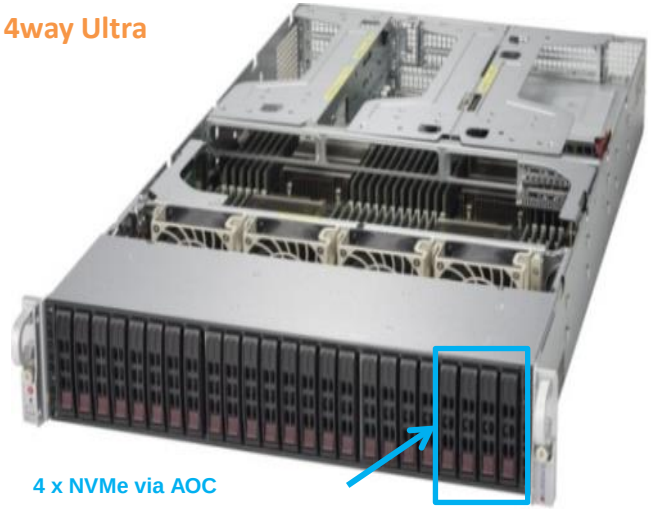
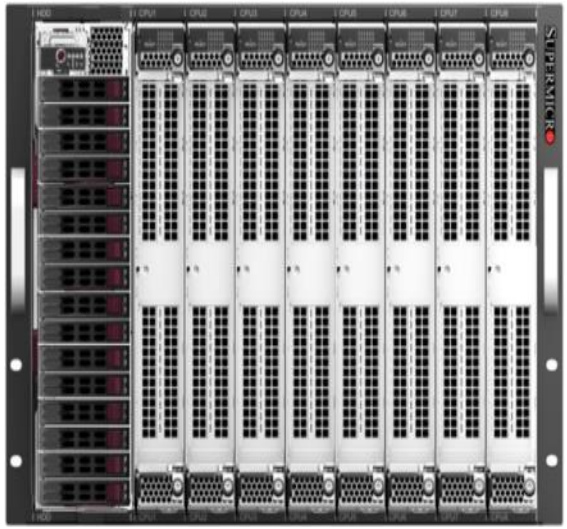
MP Solutions

2U 4way Ultra



7U 8way



- 4way: 112 cores, 8x U.2 NVMe, 6TB @ 2666Mhz
- 8way: 224 cores, 32x U.2 NVMe, 12TB @ 2666Mhz
- UPI up to 10.4 GT/s and Cross Bar Architecture, support multiple message per request more efficient than QPI
- Extensive RAS features: Advanced Error Detection and Correction (AEDC), SDDC, Adaptive DataCorrection (SR) and Local Machine Check (LMCE) based Recovery

Omnipath interconnect ecosystem

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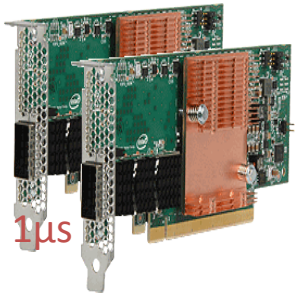
Supermicro Omni-Path High Performance Network

SSH-C48Q

- High Performance/Low latency
- 100-Gigabit Omni-Path Architecture
- Meets most demanding HPC requirements
- **Dual Power Supply**
- Optional OOB management card
- 48x 100Gb/s switching capacity
  - 1152 ports non-blocking in 2-level fabric
  - 1536 ports 2:1 blocking in 2-level fabric
- 48x 100Gb/s switching capacity

SSH-C48Q



- 100Gbps link speed
- Single QSFP28 Connector
- **PCI Express 3.0 x16**
- Standard Low-Profile
- Scalable, low latency MPI < 1µs
- High MPI message rates (160mmps)

AOC-MHFI-i1C coming soon

- 100Gbps link speed
- Single QSFP28 Connector
- **SIOM Form Factor**
- Scalable, low latency MPI < 1µs
- High MPI message rates (160mmps)

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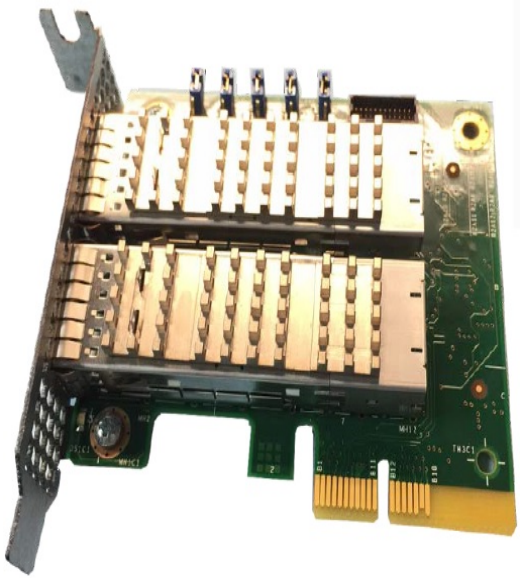
Omni-Path Integrated Fabric

Signal Pass-Through



Intel Fabric Through (IFT) Carrier Card

Intel Fabric Passive (IFP) Cable

CPU with integrated Fabric

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Software Defined Network. Ethernet Bare Metal switches

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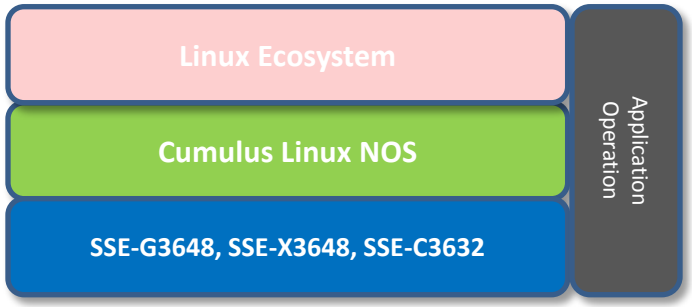
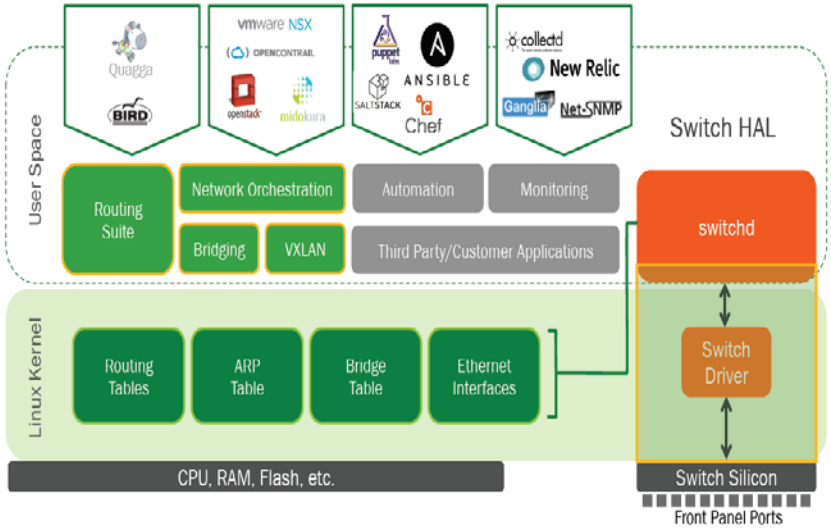
Linux based network deployment

- Consistent server/network provisioning



- Data Center operation



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1Gb Ethernet Bare Metal Switch

SSE-G3648B/BR

- 48x RJ45 1G Ports
- 4x SFP+ 10G Ports
- 1x RJ45 Management Port
- 1x Console Port
- Switching Capacity 176 Gb/s
- Broadcom Helix4 Switch Chip
- Wire-speed Layer 3 Routing
- 1:1 Non-blocking connectivity
- Intel Rangeley CPU
- ONIE installed
- Compatible with Cumulus Software
- Efficient, Hot-Swappable Power Supplies; optional second redundant PS available.

Cumulus Linux
Ready

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10Gb Ethernet Bare Metal Switch

SSE-X3648S/SR

- 48x SFP+ 10G Ports
- 6x QSFP+ 40G Ports
- 1x RJ45 Management Port
- 1x Console Port
- Switching Capacity - 1440 Gbps
- Broadcom Trident 2 Switch Chip
- Wire-speed Layer 3 Routing
- 1:1 Non-blocking connectivity
- Intel Rangeley CPU
- ONIE installed
- Compatible with Cumulus Software
- Redundant, Efficient, Hot-Swappable Power Supplies (80 Plus-Platinum)

Cumulus® Linux®
Ready

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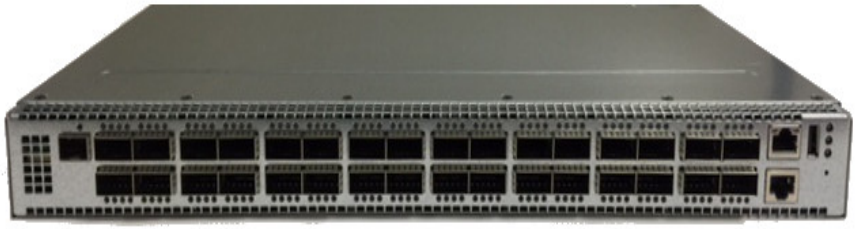
40/100Gb Ethernet Bare Metal Switch

SSE-C3632S/SR



- 32x 40GbE/100GbE QSFP28 Ports
- 1x USB Port
- 1x RJ45 Management Port
- 1x Console Port
- Full Duplex 3.2Tbps Switching Capacity
- Broadcom Tomahawk Switch Chip
- Wire-speed Layer 3 Routing
- 1:1 Non-blocking connectivity
- Intel Rangeley CPU
- ONIE installed
- Compatible with Cumulus Software
- Redundant, Efficient, Hot-Swappable Power Supplies (80 Plus-Platinum)

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Supermicro Lustre Storage Solution

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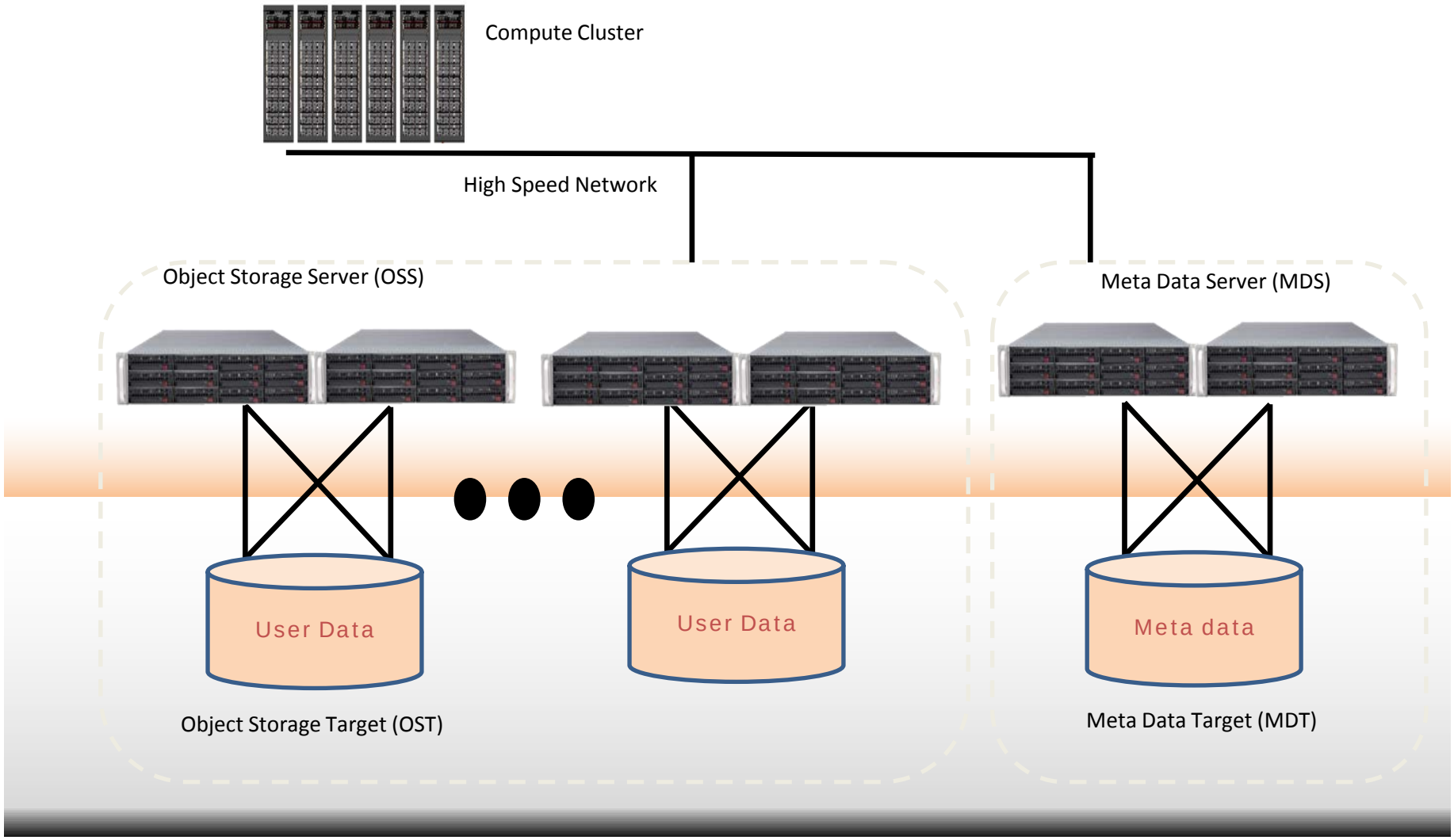
Software Defined Storage for Lustre



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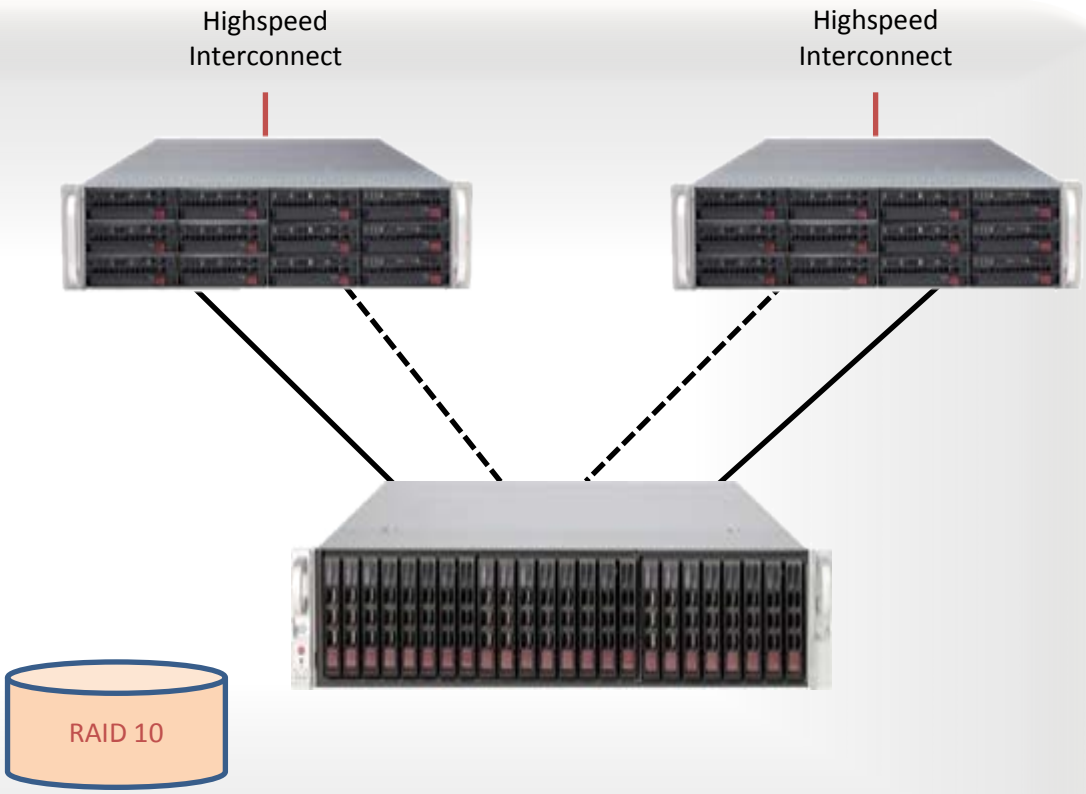
Supermicro Lustre Solution Metadata Storage

MDS Configuration

- Mirrored OS drive (HW RAID1)
- Avago 9380-8e Syncro RAID
- Highspeed Interconnect HCA

MDT Configuration

- Shared 24 bay SAS3 JBOD
- RAID 10 using SSD



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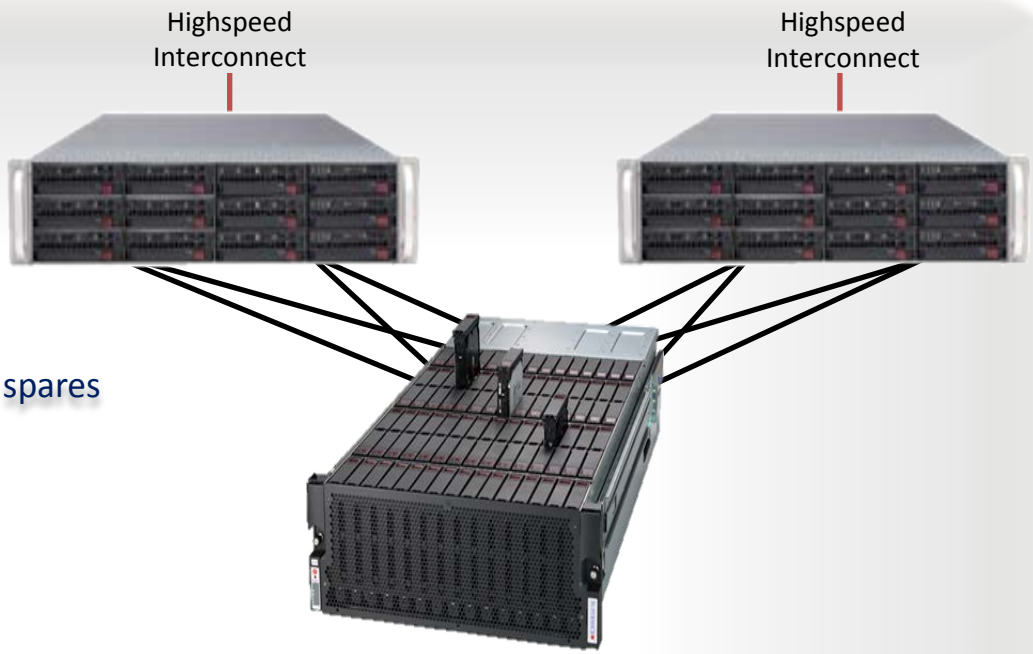
Supermicro Lustre Solution Object Storage

OSS Configuration

- Mirrored OS drive (HW RAID1)
- Redundant ITmode controllers
- Highspeed Interconnect HCA

OST Configuration

- 90 Bay JBOD configured
- 8x RAIDZ2 parity groups + 2x hot spares



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MDS Configuration based on SBB

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SSG-2028R-DN2R40

Two Serverboards in Single Chassis with shared Storage

- 2x Dual Socket R3 (LGA 2011 up to 145W) supporting Intel® Xeon® E5-2600 v4 family
- 2x 16 DIMM, 1TB Reg. ECC DDR4 up to 2400MHz
- 2x High Speed network (via SIOM) Support
- 40x NVMe + 8x SAS/SATA
- Node-to-Node Heartbeat
- 2000W Redundant Power Supplies Titanium Level (96%)

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Future

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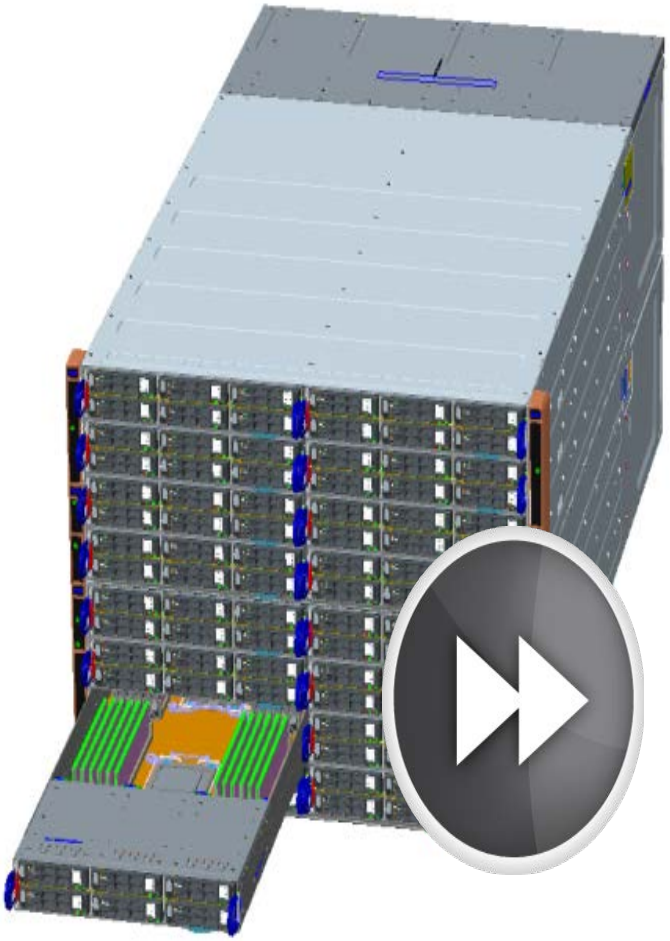
Further into the Future

- Next Generation SuperRack
  - **80%** system fan power savings
  - Fully optimized for Skylake/Purley and Tinsley
  - **1 PB hot-swap NVMe per 1U (JBOF support)**
  - Battery backup power support
  - **Superset of 1U, OCP, OCS, OpenX and Redfish/RSD**
  - Production: Q1 2018
- Cascade Lake Processor
  - Higher Performance
  - Higher Cores
  - Less Power Consumption
  - Apache Pass Technology



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Questions and Answers

Backup

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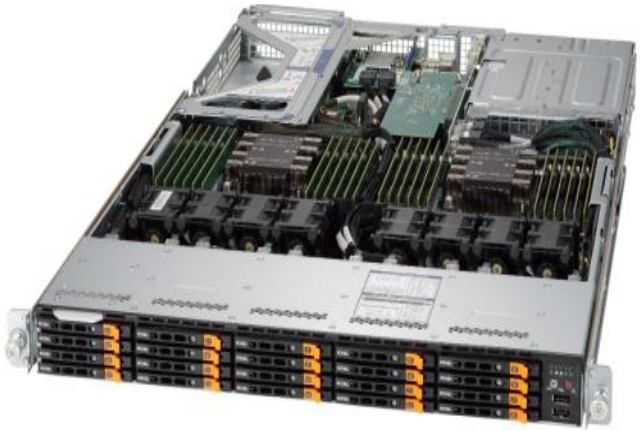
Ultra



- 2U Ultra with 20 direct attached NVMe SSDs over 80 PCIe lanes
- 2U Ultra achieves up to 60GB/s throughput and 16 million IOPS
- 1U Ultra with 20 directly attached 7mm NVMe drives
- 1U Ultra achieves up to 43GB/s throughput and 9 million IOPS

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SuperStorage

- Supporting up to 6 NVMe SSDs, 24 DIMMs, high performance CPU and wide range networking choices with SIOM cards
- Short depth, easy to deploy 45 Bay, mainstream 60 bay and extreme density 90 bay
- Delivers more than 10PB storage in one standard 42U data center rack

45-Bay Server

60-Bay Storage Server + JBOD

90-Bay Storage Server + JBOD

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Nvidia NVLINK Technology

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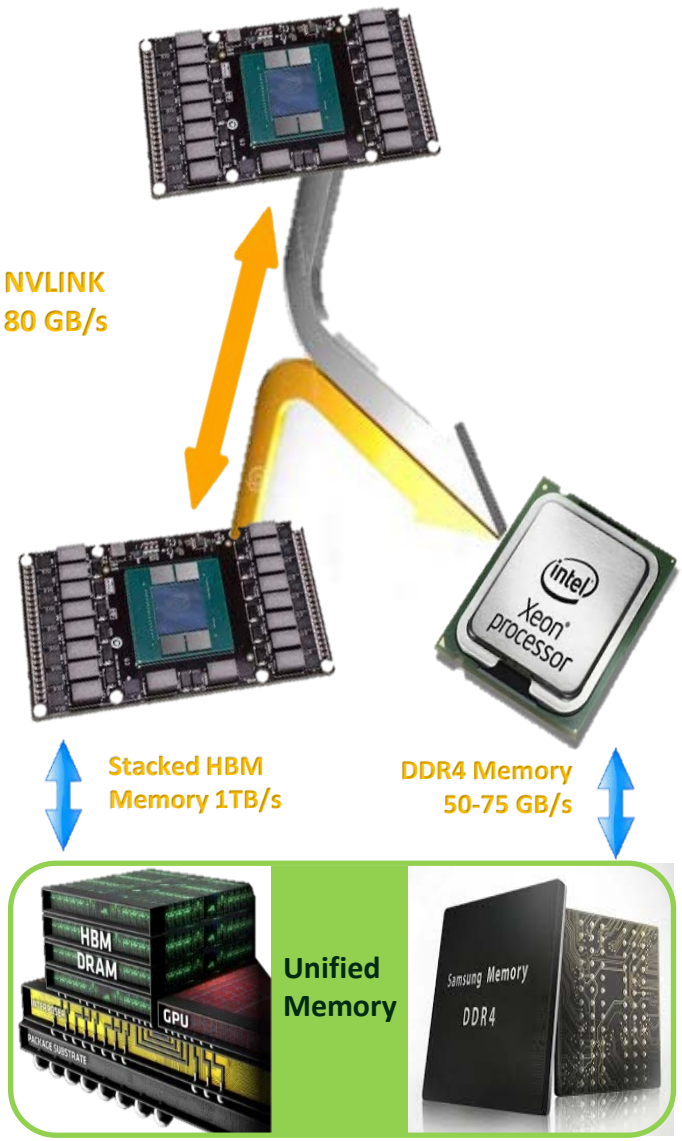

NVLink

- **Interconnect at 80 GB/s (Speed of CPU Memory)**

Stacked 3D Memory

- **4x Higher Bandwidth – 1 TB/s (2.5x Capacity, 4x more Efficient)**

Unified Memory

- **Lower level of Development (Available today in CUDA 6)**

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