Microway, Inc.
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# QUOTATION

**Quote #**   MWYQ23494

**Date:**   3/22/2018

**Microway Confidential**

| Quote To: | Ship To: | Sales Rep. |
|---|---|---|
| Pomona College | Pomona College | Samantha Wheeler |
| Asya Shklyar | Asya Shklyar | 508-732-5526 |
| 333 N. College Way | 333 N. College Way | swheeler@microway.com |
| Claremont, CA 91711 | Claremont, CA 91711 | |
| (909) 607-9853 | (909) 607-9853 | |
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| Qty | Description | | Your Price | Extended Price |
|---|---|---|---|---|

Microway is a small business, woman owned and operated.  We are building many clusters at any one time and have built thousands of custom clusters for universities, government research labs and agencies, and corporations.  Microway has been in the scientific computing business since 1982.

| 1 | **Microway 1U Xeon + Tesla GPU Server with NVLink** | | $46,399 | $46,399 |

NumberSmasher Dual Intel Xeon 1U 4-GPU NVLink 2.0 Server with
  2000W High-Efficiency "Titanium" Redundant 1+1 Power Supplies
  (power supplies require 208V power for redundancy under full load)
  Two Intel Xeon Scalable Family processors (Socket P - up to 165W)
  Three Intel UPI interconnects between CPU sockets (up to 10.4 GT/s)
  Twelve slots for up to 1.5TB ECC DDR4-2666 memory
  Dual Integrated Intel X540 10 Gigabit Ethernet ports (RJ45, 10GBase-T)
  Integrated Intel C621 chipset and ASpeed AST2500 Graphics Controller
  IPMI 2.0 w/ Virtual Media, KVM and Dedicated LAN Support
  Four SXM2 sockets for NVIDIA NVLink 2.0-enabled GPUs
  Up to 300GB/s Bi-directional Bandwidth between GPUs (6 links per GPU)
  Four PCI-Express 3.0 x16 slots:
    * two full-height, half-length slots (one via PLX; one via CPU)
    * two low-profile, half-length slots (one via PLX; one via CPU)
  Integrated SATA3 6Gbps Controller
  Two hot-swap 2.5" SAS/SATA drive bays
  Two internal 2.5" SAS/SATA drive bays
  Internal ports: two SATA SuperDOM, one M.2 slot (PCIe 3.0 x4 NVMe via PCH), one TPM header, one serial COM header
  Rear ports: two 10G LAN, one IPMI LAN, one VGA and two USB 3.0 ports
  Front I/O: power button and UID button
  Includes 27" to 32" Quick-install Rackmount Rail Kit

Please note that the 35.2" depth of this chassis (894mm) requires a rackmount cabinet with 39.3" mounting depth

(2) Intel Xeon 6126 "Skylake" 2.60 GHz 12-Core 14nm CPU - 125W TDP
  with two AVX-512 units per core, 19.25MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.7-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)

(12) 8GB DDR4 2666 MHz ECC/Registered Memory (Dual Rank)

  **(96GB Total Memory @ 2400MHz)**

(4) NVIDIA Tesla V100 SXM2 16GB "Volta" GPU Accelerator
  SXM2 form factor with 150GB/s NVLink 2.0 interconnect (300GB/s bidirectional)
  GV100 GPU chip with NVIDIA Passive Heatsink
  5,120 CUDA Cores with Enhanced Unified Memory and Cooperative Groups
  640 NVIDIA Tensor Cores optimized for Deep Learning training
  GPU-boost capability allows for increased clock speeds
  16GB High-Bandwidth HBM2 Memory (900 GB/sec peak bandwidth)
  Supports INT8, INT32 integer; IEEE Half-, Single-, and Double-Precision Floating Point operations
  Performance (with GPU Boost): 125 TFLOPS (half), 15.7 TFLOPS (single), 7.8 TFLOPS (double)
  Power Consumption: 300W TDP
  Software Development Tools:
    OpenACC, OpenCL, C/C++ language compiler, debugger, profiler and memory analyzer
    Standard numerical libraries: cuDNN, nvGRAPH, FFT, BLAS, SPARSE, RAND & more:
      https://developer.nvidia.com/gpu-accelerated-libraries

(2) 240GB Intel DC S4500 2.5" SATA 6Gbps 3D NAND SSD
  SATA 6Gb/s Interface (Supports 3Gb/s)
  3D NAND TLC Internal Solid State Drive
  Targeted Lifetime Endurance: ~1 Drive Write Per Day; 0.62 PBW
  Full data path and Power loss protection; 256 bit AES encryption
  Sustained sequential read: up to 500 MB/s
  Sustained sequential write: up to 190 MB/s
  Random 4KB IOPS: up to 69,000 read; up to 16,000 write
  Average Latency: 36µs read, 36 µs write
  2,000,000 Hours MTBF
  Uncorrectable Bit Error Rate (UBER): 1 sector per 10^17 bits read

**(Linux Software RAID1 Mirror Recommended; ~240GB Usable)**

Mellanox ConnectX-3 Pro EN Single-Port QSFP 40G Ethernet Adapter
  PCI-E 3.0 x8 8GT/s;  RoHS (R6) Compliant

LG Slim External USB 2.0 8X DVD/ 24X CD Writer (Black)
    DVD+RW/-RW:  8X/6X
    Also reads and writes DVD-RW/+RW/-RAM, CD-R/-RW
    Buffer Memory: 1.5MB
    Sustained Rate: DVD-ROM (max.) 11.08MB/s, CD-ROM 3.6MB/s

**CentOS 7.x Linux (or your distribution of choice) & NVIDIA CUDA 9.0 installed, configured and tested.**

IPMI management capability is integrated on the motherboard.  IPMI allows administrators to remotely monitor and control each computer individually.  Capabilities include:
* System Power On, Power Off and Reset
* Monitor Fan Speeds, Component Temperatures and Voltages
* Remote Serial Console and KVM Access
* Virtual Media: local devices (CD, USB, etc) appear as directly connected to remote system

Microway Testing Procedure:

Each computer system is network booted to execute low-level memory tests for 12+ hours.

Once passed, operating systems are loaded and Linux stress tests are executed for 48+ hours.  These tests include processor and memory intensive applications that have been shown to cause faults in the field.  A separate set of tests accesses all sectors on each hard drive and runs filesystem-intensive applications to ensure drive and filesystem reliability.

| 4 | **NVIDIA Educational Discount** | -$1,500 | -$6,000 |

$1,500 EDU discount per NVIDIA Tesla V100 16GB SXM2 GPU (restrictions apply)

**Microway's hardware warranty may be extended on an annual basis for up to 5 years total warranty.**

**Microway provides lifetime technical support. Out-of-warranty repairs will be billed at Time and Materials rates.**

**Shipping and Insurance: prepay and add**

| | **Total** | | **$40,399** |

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**The following items are optional, and are not included in the total:**

| ☐ | 1 | **Reduce GPU Count to Minimum Quantity (Optional)** | -$14,946 | -$14,946 |

**Adding GPUs later will require system to be shipped back to facility for GPU installation.**

(-2) NVIDIA Tesla V100 SXM2 16GB "Volta" GPU Accelerator
SXM2 form factor with 150GB/s NVLink 2.0 interconnect (300GB/s bidirectional)
GV100 GPU chip with NVIDIA Passive Heatsink
5,120 CUDA Cores with Enhanced Unified Memory and Cooperative Groups
640 NVIDIA Tensor Cores optimized for Deep Learning training
GPU-boost capability allows for increased clock speeds
16GB High-Bandwidth HBM2 Memory (900 GB/sec peak bandwidth)
Supports INT8, INT32 integer; IEEE Half-, Single-, and Double-Precision Floating Point operations
Performance (with GPU Boost): 125 TFLOPS (half), 15.7 TFLOPS (single), 7.8 TFLOPS (double)
Power Consumption: 300W TDP
Software Development Tools:
  OpenACC, OpenCL, C/C++ language compiler, debugger, profiler and memory analyzer
  Standard numerical libraries: cuDNN, nvGRAPH, FFT, BLAS, SPARSE, RAND & more:
    https://developer.nvidia.com/gpu-accelerated-libraries

$1,500 EDU discount per NVIDIA Tesla V100 16GB SXM2 GPU (restrictions apply)

| ☐ | 1 | **Upgrade SSDs to: (Optional)** | $320 | $320 |

(2) 480GB Intel DC S4500 2.5" SATA 6Gbps 3D NAND SSD
SATA 6Gb/s Interface (Supports 3Gb/s)
3D NAND TLC Internal Solid State Drive
Targeted Lifetime Endurance: ~1 Drive Write Per Day; 0.90 PBW
Full data path and Power loss protection; 256 bit AES encryption
Sustained sequential read: up to 500 MB/s
Sustained sequential write: up to 330 MB/s
Random 4KB IOPS: up to 72,000 read; up to 20,000 write
Average Latency: 36µs read, 36 µs write
2,000,000 Hours MTBF
Uncorrectable Bit Error Rate (UBER): 1 sector per 10^17 bits read

| ☐ | 1 | **Upgrade SSDs to: (Optional)** | $898 | $898 |

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(2) 960GB Intel DC S4500 2.5" SATA 6Gbps 3D NAND SSD
 SATA 6Gb/s Interface (Supports 3Gb/s)
 3D NAND TLC Internal Solid State Drive
 Targeted Lifetime Endurance: ~1 Drive Write Per Day; 1.86 PBW
 Full data path and Power loss protection; 256 bit AES encryption
 Sustained sequential read: up to 500 MB/s
 Sustained sequential write: up to 490 MB/s
 Random 4KB IOPS: up to 72,000 read; up to 30,000 write
 Average Latency: 36µs read, 36 µs write
 2,000,000 Hours MTBF
 Uncorrectable Bit Error Rate (UBER): 1 sector per 10^17 bits read

☐ 1 **Upgrade SSDs to: (Optional)** — $1,862 — $1,862

(2) 1.9TB Intel DC S4500 2.5" SATA 6Gbps 3D NAND SSD
 SATA 6Gb/s Interface (Supports 3Gb/s)
 3D NAND TLC Internal Solid State Drive
 Targeted Lifetime Endurance: ~1 Drive Write Per Day; 3.27 PBW
 Full data path and Power loss protection; 256 bit AES encryption
 Sustained sequential read: up to 500 MB/s
 Sustained sequential write: up to 490 MB/s
 Random 4KB IOPS: up to 72,000 read; up to 33,000 write
 Average Latency: 36µs read, 36 µs write
 2,000,000 Hours MTBF
 Uncorrectable Bit Error Rate (UBER): 1 sector per 10^17 bits read

☐ 1 **Upgrade Memory to 192GB (Optional)** — $936 — $936

(12) 16GB DDR4 2666 MHz ECC/Registered Memory (Dual Rank)

☐ 1 **Upgrade Memory to 384GB (Optional)** — $3,024 — $3,024

(12) 32GB DDR4 2666 MHz ECC/Registered Memory (Dual Rank)

☐ 1 **Upgrade Memory to 768GB (Optional)** — $9,396 — $9,396

(12) 64GB DDR4 ECC LRDIMM 2666MHz Memory

## Options for Best Performance per CPU Core:

☐ 1 **Change Processors to: (Optional)** — -$2,932 — -$2,932

(2) Intel Xeon 4112 "Skylake" 2.60 GHz 4-Core 14nm CPU - 85W TDP
 with one AVX-512 unit per core, 8.25MB L3 Cache, up to 768GB DDR4-2400 memory, up to two 9.6GT/s UPI links
 Supports Hyper-Threading and Turbo Boost up to 3.00 GHz (clock speeds with AVX-512 instructions: 1.1-1.8 GHz)

☐ 1 **Change Processors to: (Optional)** — -$1,240 — -$1,240

(2) Intel Xeon 5122 "Skylake" 3.60 GHz 4-Core 14nm CPU - 105W TDP
 with two AVX-512 units per core, 16.50MB L3 Cache, up to 768GB DDR4-2666 memory, up to two 10.4GT/s UPI links
 Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 2.7-3.5 GHz)

☐ 1 **Change Processors to: (Optional)** — -$156 — -$156

(2) Intel Xeon 6128 "Skylake" 3.40 GHz 6-Core 14nm CPU - 115W TDP
 with two AVX-512 units per core, 19.25MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
 Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 2.3-3.5 GHz)

☐ 1 **Upgrade Processors to: (Optional)** — $1,036 — $1,036

(2) Intel Xeon 6134 "Skylake" 3.20 GHz 8-Core 14nm CPU - 130W TDP
 with two AVX-512 units per core, 24.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
 Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 2.1-3.5 GHz)
 (optional M-SKU with support for up to 1.5TB memory)

☐ 1 **Upgrade Processors to: (Optional)** — $1,542 — $1,542

(2) Intel Xeon 6136 "Skylake" 3.00 GHz 12-Core 14nm CPU - 150W TDP
  with two AVX-512 units per core, 24.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 2.1-3.5 GHz)

## Options for Best Overall CPU Performance:

| | Qty | Description | Your Price | Extended Price |
|---|---|---|---|---|
| ☐ | 1 | **Upgrade Processors to: (Optional)** | -$1,142 | -$1,142 |
| ☐ | 1 | **Upgrade Processors to: (Optional)** | $330 | $330 |

(2) Intel Xeon 6130 "Skylake" 2.10 GHz 16-Core 14nm CPU - 125W TDP
  with two AVX-512 units per core, 22.00MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.3-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $802 | $802 |

(2) Intel Xeon 6132 "Skylake" 2.60 GHz 14-Core 14nm CPU - 140W TDP
  with two AVX-512 units per core, 19.25MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.7-3.5 GHz)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $1,564 | $1,564 |

(2) Intel Xeon 6140 "Skylake" 2.30 GHz 18-Core 14nm CPU - 140W TDP
  with two AVX-512 units per core, 24.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.5-3.5 GHz)
  (optional M-SKU with support for up to 1.5TB memory)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $1,944 | $1,944 |

(2) Intel Xeon 6138 "Skylake" 2.00 GHz 20-Core 14nm CPU - 125W TDP
  with two AVX-512 units per core, 27.50MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.3-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $2,704 | $2,704 |

(2) Intel Xeon 6142 "Skylake" 2.60 GHz 16-Core 14nm CPU - 150W TDP
  with two AVX-512 units per core, 22.00MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.6-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)
  (optional M-SKU with support for up to 1.5TB memory)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $2,936 | $2,936 |

(2) Intel Xeon 6148 "Skylake" 2.40 GHz 20-Core 14nm CPU - 150W TDP
  with two AVX-512 units per core, 27.50MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.6-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $3,090 | $3,090 |

(2) Intel Xeon 8153 "Skylake" 2.00 GHz 16-Core 14nm CPU - 125W TDP
  with two AVX-512 units per core, 22.00MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 2.80 GHz (clock speeds with AVX-512 instructions: 1.2-2.6 GHz)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $3,644 | $3,644 |

(2) Intel Xeon 6150 "Skylake" 2.70 GHz 18-Core 14nm CPU - 165W TDP
  with two AVX-512 units per core, 24.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.9-3.5 GHz)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $4,322 | $4,322 |

(2) Intel Xeon 6152 "Skylake" 2.10 GHz 22-Core 14nm CPU - 140W TDP
  with two AVX-512 units per core, 30.25MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.4-3.5 GHz)

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| ☐ | 1 | **Upgrade Processors to: (Optional)** | $6,708 | $6,708 |

(2) Intel Xeon 8160 "Skylake" 2.10 GHz 24-Core 14nm CPU - 150W TDP
  with two AVX-512 units per core, 33.00MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.4-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)
  (optional M-SKU with support for up to 1.5TB memory)

☐  1  **Upgrade Processors to: (Optional)**  $9,926  $9,926

(2) Intel Xeon 8164 "Skylake" 2.00 GHz 26-Core 14nm CPU - 150W TDP
  with two AVX-512 units per core, 35.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.2-3.5 GHz)

☐  1  **Upgrade Processors to: (Optional)**  $12,870  $12,870

(2) Intel Xeon 8170 "Skylake" 2.10 GHz 26-Core 14nm CPU - 165W TDP
  with two AVX-512 units per core, 35.75MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.70 GHz (clock speeds with AVX-512 instructions: 1.3-3.5 GHz)
  (optional M-SKU with support for up to 1.5TB memory)

☐  1  **Upgrade Processors to: (Optional)**  $15,866  $15,866

(2) Intel Xeon 8176 "Skylake" 2.10 GHz 28-Core 14nm CPU - 165W TDP
  with two AVX-512 units per core, 38.50MB L3 Cache, up to 768GB DDR4-2666 memory, up to three 10.4GT/s UPI links
  Supports Hyper-Threading and Turbo Boost up to 3.80 GHz (clock speeds with AVX-512 instructions: 1.3-3.5 GHz)
  (optional F-SKU with support for 100GBps Intel Omni-Path fabric interconnect)
  (optional M-SKU with support for up to 1.5TB memory)

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|---|---|
| **FOB:** | Destination (freight PPA) |
| **Ship Date:** | 5 - 6 Weeks after receipt of order and documentation |
| **Warranty:** | Two years offsite with replacement components typically cross-shipped within 24 hours of problem determination by Microway Tech Support. |
| **Technical Support** | Lifetime technical support via telephone, fax, or email. |
| **Terms:** | NET 30 |
| **Shipping Method:** | FedEx Freight |
| | The Buyer is responsible for any sales taxes or duties related to the purchase. |

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Since 1982 Microway has been a leader in providing high performance computing solutions. Microway specializes in building complex clusters, servers, and workstations. We are unique in having Linux expertise throughout our organization to provide testing of all systems at our assembly and integration center at our headquarters in Plymouth, Massachusetts.  Our validation suite includes a number of MPI applications and Microway proprietary software, including MPI Link-Checker and InfiniScope.

Microway is classified as a small business - woman owned and operated.

Microway welcomes our customers (and potential customers) to personally visit our manufacturing facility. We value the opportunity to share our understanding of the systems we build, and to demonstrate our dedication to quality in our design, fabrication, final testing and technical support. Please contact me if you plan to be in or near Massachusetts and would like to make an appointment.

Prices subject to review at time of order due to world-wide component price volatility.

**This quote is valid for 30 days.**

# Server Block Diagram
## NumberSmasher 1U Tesla GPU Server with NVLink

NVMe Flash Storage
(or other PCI-E x16 gen 3.0 card)

NVMe Flash Storage
(or other PCI-E x16 gen 3.0 card)

EDR/FDR
InfiniBand

EDR/FDR
InfiniBand

PCI-Express
Switch

PCI-Express
Switch

Intel QPI bus (GPU-Direct RDMA traffic cannot pass)

Quad-channel DDR4 memory (64GB/s per CPU)

PCI-Express x16 (gen 3.0) bus for GPU-Direct RDMA (12.8GB/s)

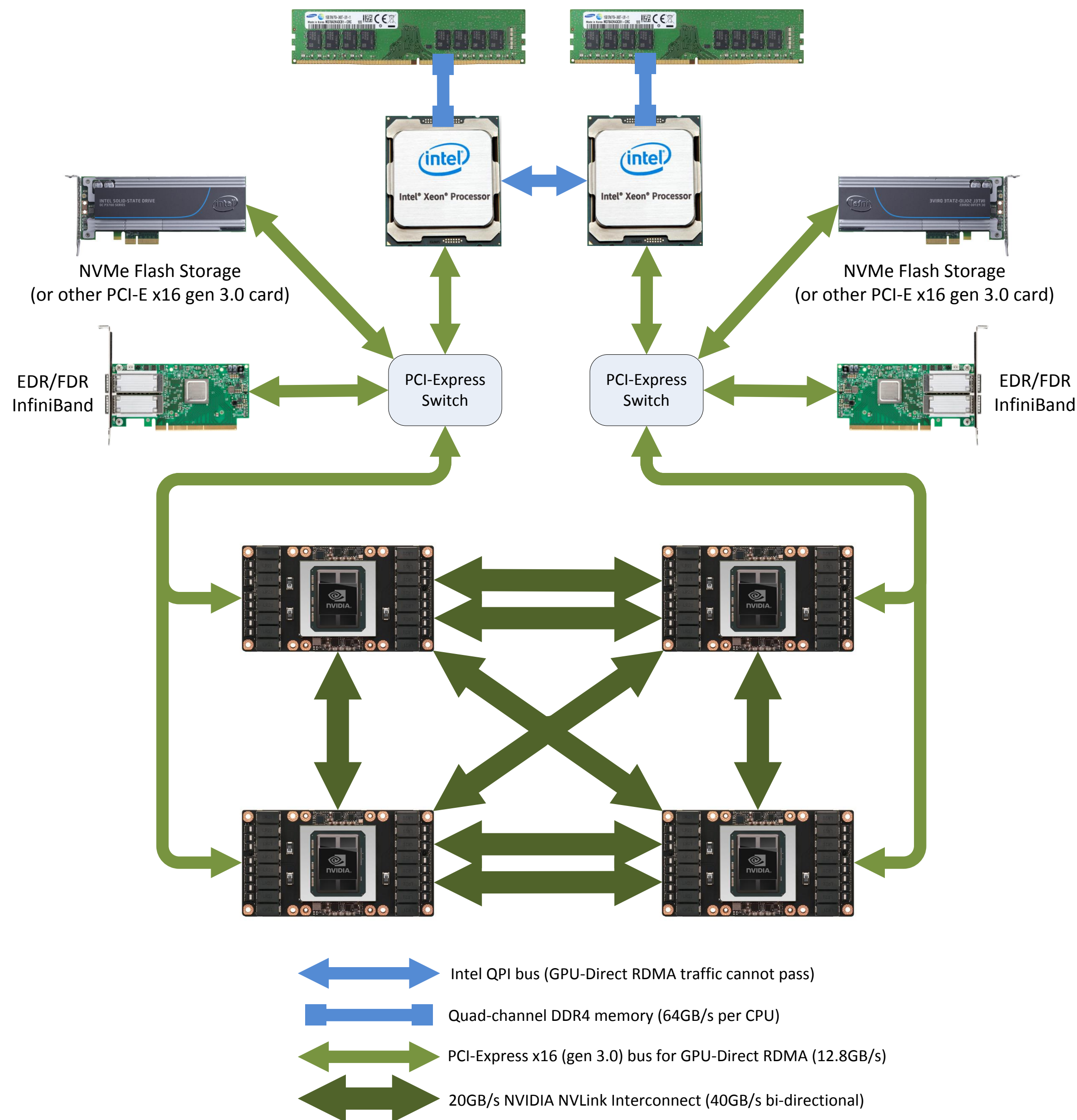20GB/s NVIDIA NVLink Interconnect (40GB/s bi-directional)

Diagram is for reference only. Internal components may vary depending upon your configuration.