



ONE STOP
SYSTEMS

Optimizing Host Servers for High Performance Computing (HPC)

from

One Stop Systems (OSS)

HPC requires

Substantial infrastructure with:

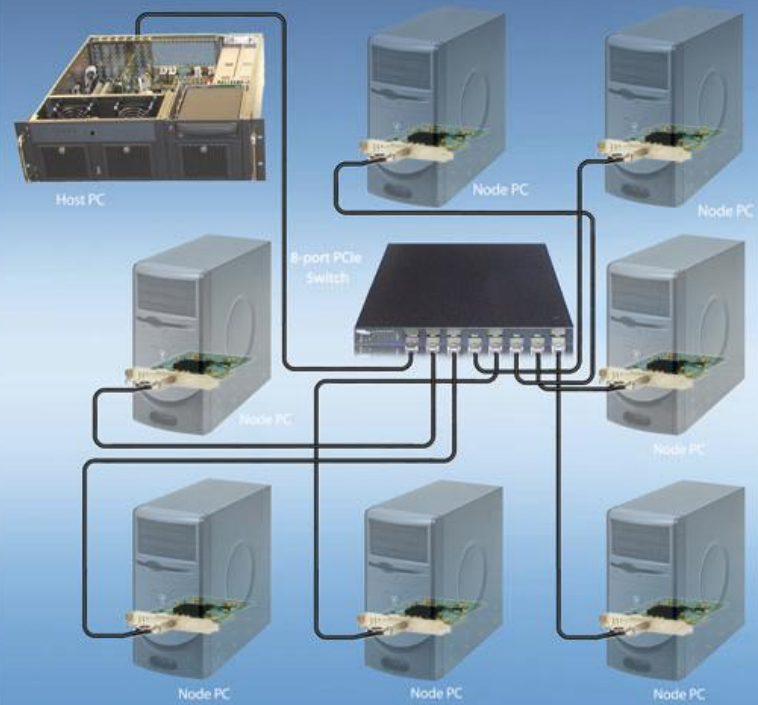
- Redundant servers with **high-speed connectivity**
 - ✓ PCIe over cable provides high performance connectivity at less cost
- **GPU accelerators** for math co-processing
 - ✓ GPUs can be located outside of the server with PCIe over cable
- High speed storage or **Solid State Disk (SSD) appliances**
 - ✓ PCIe expansion chassis can support GPU's and SSD appliances

PCIe Over Cable

I/O EXPANSION



HIGH-SPEED NETWORKING with **SuperSwitch™**



PCIe over cable as I/O expansion

- High performance cable expansion from CPU to I/O device
- No software required
 - ✓ No protocol conversion
 - ✓ Low latency
- Simple to use
- Reliable
- Cost effective



PCIe over cable as high speed networking

- Redundant servers using ExpressNet driver
 - ✓ 20Gb/s connectivity
- CPUs communicate via memory to memory DMA transfers or with TCP/IP
- 1U PCIe switch
 - ✓ One 80Gb upstream interface
 - ✓ Eight 20Gb downstream interfaces

Network connectivity
at 10-20Gb/s



GPU accelerator

- GPUs offload HPC math co-processing functions
- GPU expansion system provides necessary cooling and power not found in servers
- Enclosures support up to eight boards at 80Gb/s each



1U PCIe expansion enclosure



2U PCIe expansion enclosure

Solid State Disk (SSD) appliance

- 1U appliance
 - ✓ One appliance per server
 - ✓ Up to two 5.12TB SSD boards
- 2U appliance
 - ✓ One appliance per two servers
 - ✓ Up to four 5.12TB SSD boards
- 1U or 2U GPU/SSD appliance
 - ✓ Up to 4 GPUs and 4 SSD boards per server
- 80Gb connectivity to each board

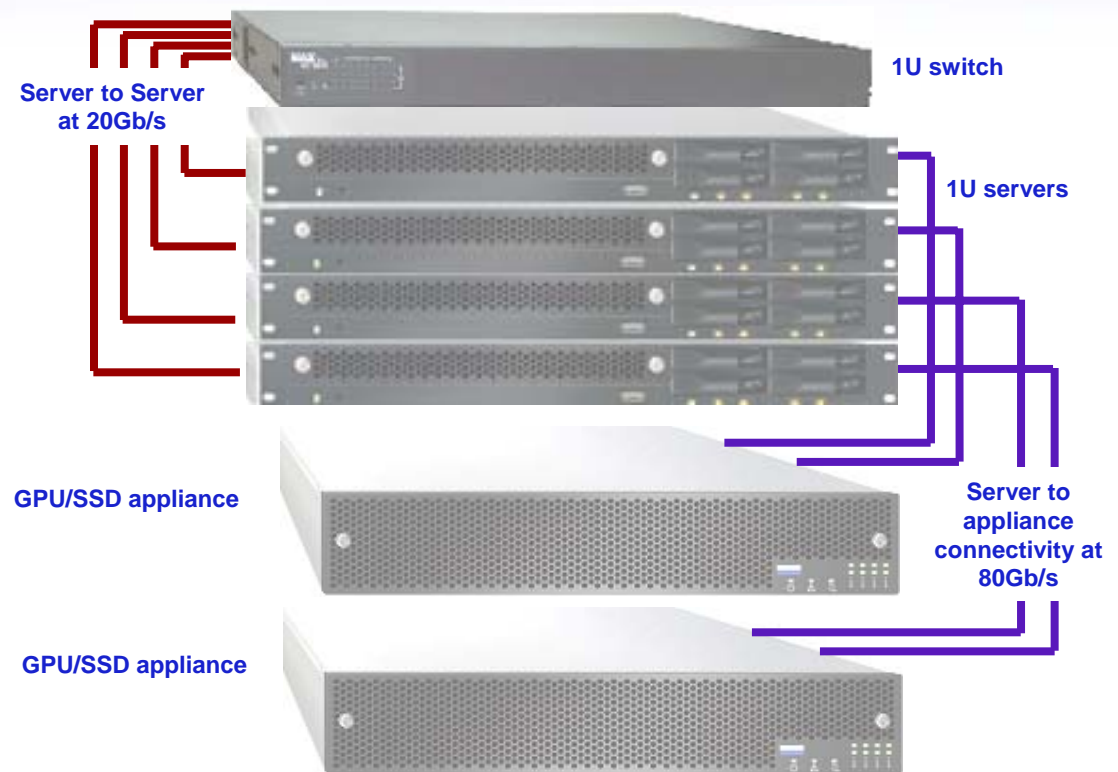


Each appliance can employ from 2 to 4 Fusion-IO ioDrive Octal boards

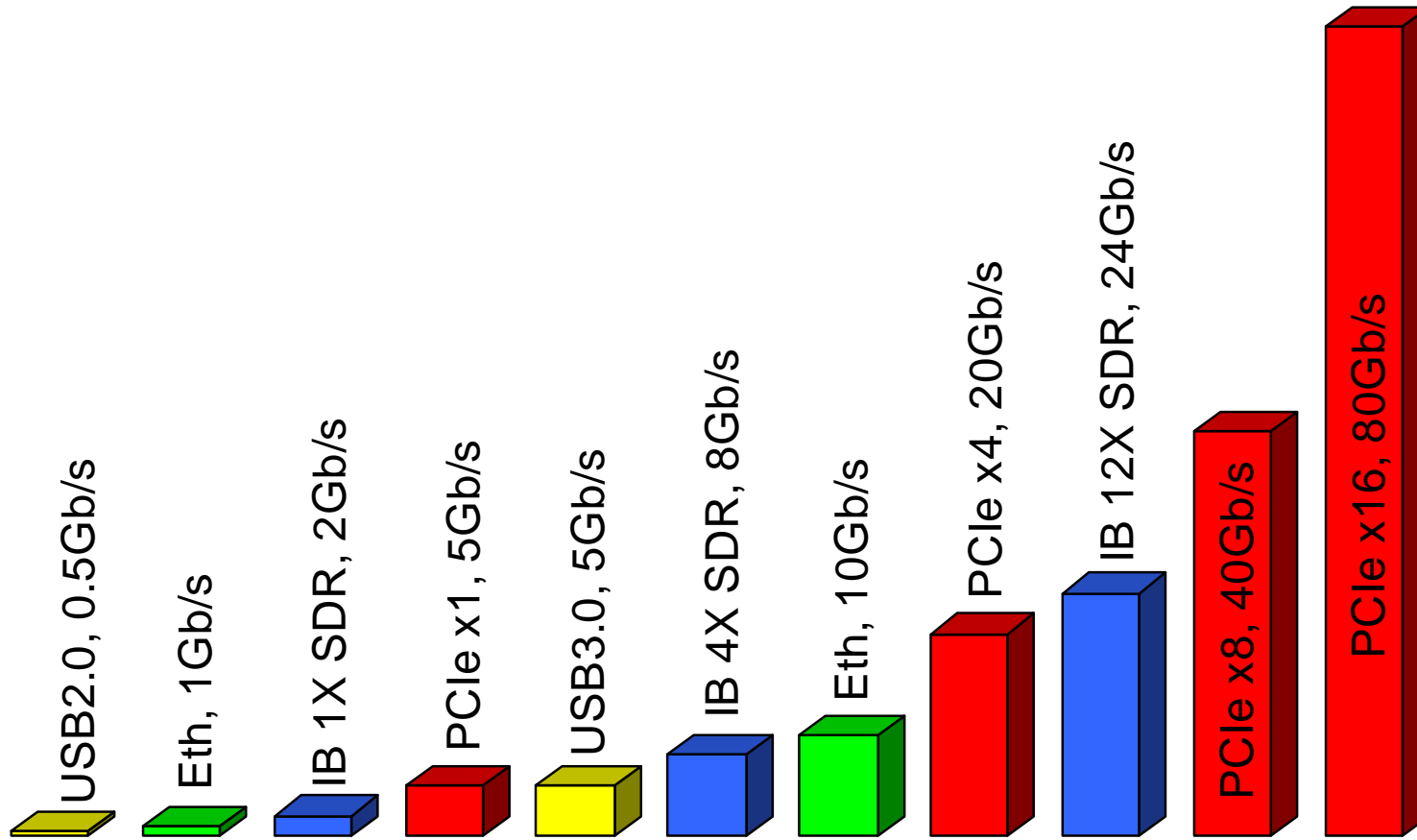


PCIe connectivity

- Lower cost, lower latency, and less overhead than Infiniband
- Greater throughput and lower cost than 10Gb Ethernet
- Server to server communication over 20Gb PCI Express
- 80Gb connectivity between GPU appliance and server



PCIe over cable provides greater performance



PCIe vs Infiniband

- 40Gb/s InfiniBand Bundle
 - ✓ 36-port 40Gb/s InfiniBand switch
 - ✓ 8 Single-Port 40Gb/s PCI Express 2.0 InfiniBand HCA cards
 - ✓ 8 2 meters long, copper cables,
 - ✓ Total Price: \$10K



- 80Gb/s PCIe Bundle
 - ✓ 10-port 80Gb/s PCIe switch
 - ✓ 80Gb host adapter and 2m cable
 - ✓ Eight 20Gb/s PCI Express 2.0 host adapters with 2m cables
 - ✓ Total Price: \$6K



Competitive Price Analysis

Connectivity for 8 users

- 40Gb Infiniband
✓ Includes switch, host adapters, & cables > **\$19,308**
- 10Gb Ethernet
✓ Includes switch, host adapters, & cables > **\$16,711**
- 40Gb PCI Express
✓ Includes switch, host adapters, & cables > **\$6,387**

Applications utilizing PCIe over cable

- Medical – CAT scanners, PET scanners, dental scanners and other imaging
- Office documentation centers – High-end copy centers
- Entertainment – HD cameras, film editing and theater projectors
- Instrumentation – Oscilloscopes and test equipment
- Data Storage – Disk and flash arrays
- HPC – GPU acceleration and inter-CPU communications
- Military – signal acquisition and analysis

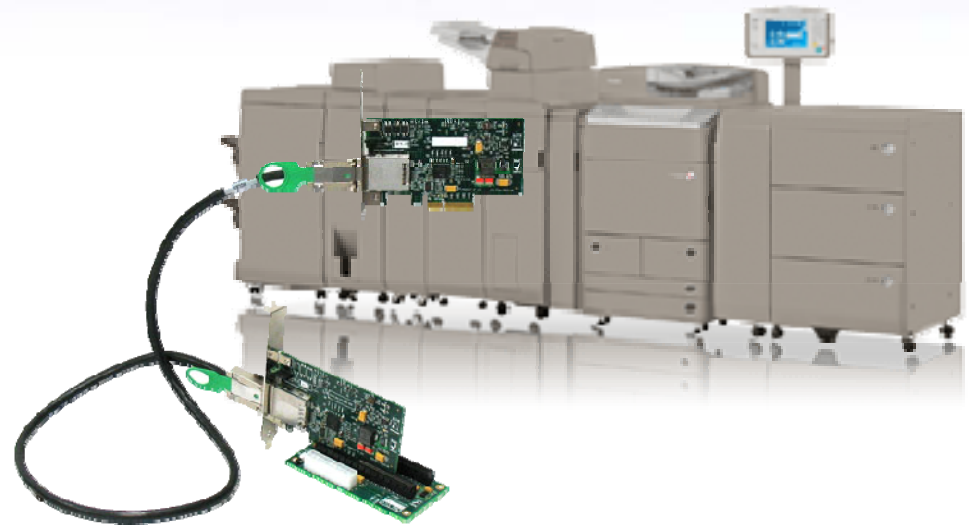
Data Storage

- **Product:** PCIe x8 expansion backplane
 - ✓ **Who:** provider of server and storage enclosure solutions
 - Application: 1U and 3U PCIe-based disk arrays
- **Product:** Host cable adapters, ExpressNet
 - ✓ **Who:** Flash memory array manufacturer
 - Application: 2U and 3U PCIe-based DRAM arrays



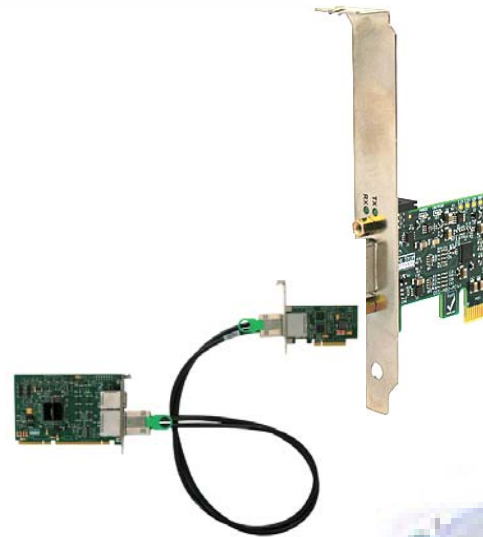
Publishing

- **Product:** PCIe x4 Gen2 expansion kit
 - ✓ **Who:** Printer/copier manufacturer
 - Application: Document center
- **Product:** PCIe x4 Gen2 cable adapter
 - ✓ **Who:** Printer/copier manufacturer
 - Application: Document center

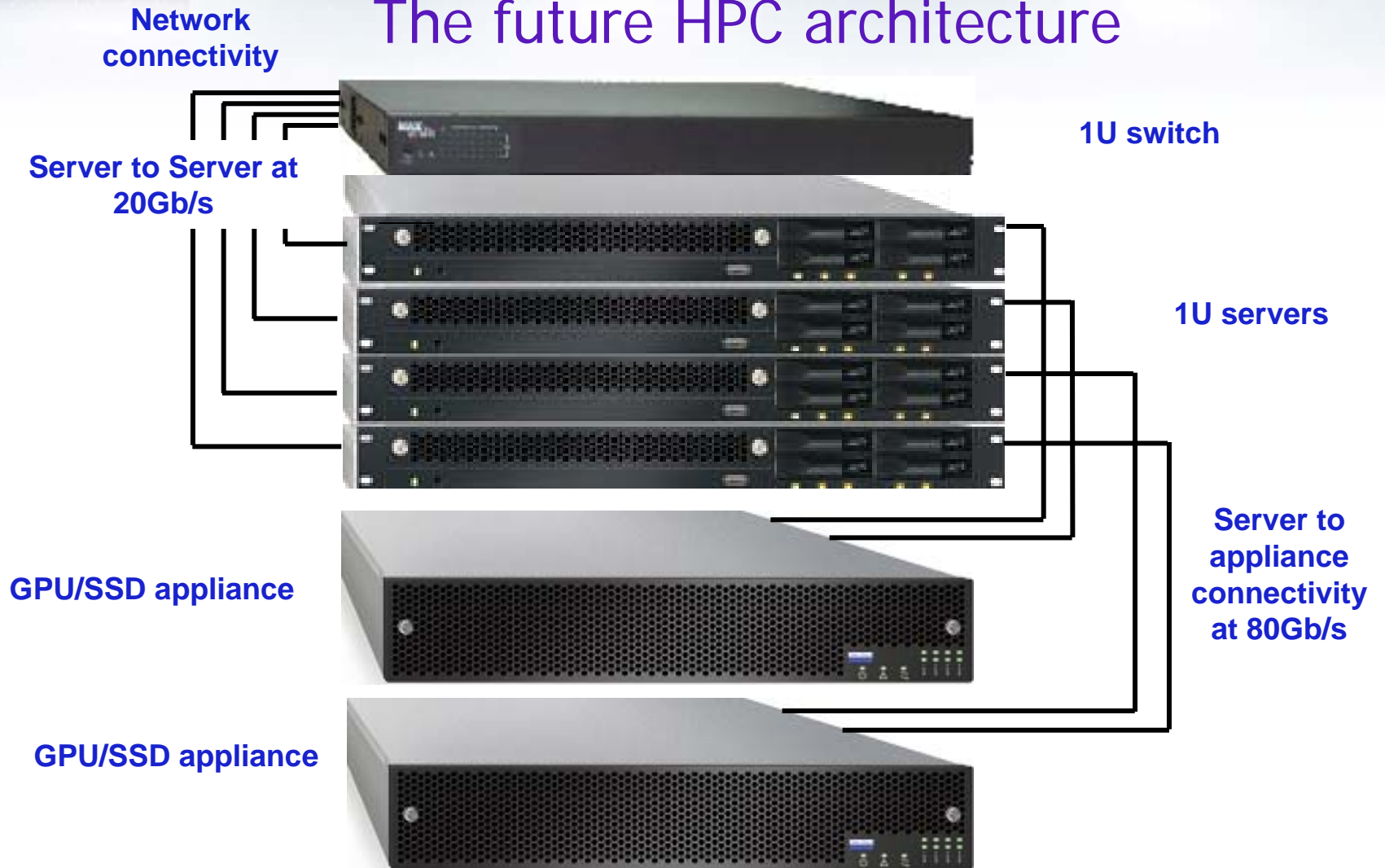


Medical

- **Product:** Host cable adapters
 - ✓ **Who:** Intra-oral digital scanning
Application: PCIe expansion to oral imaging equipment
- **Product:** PCIe x4 cable adapters and cables
 - ✓ **Who:** Medical imaging equipment provider; Application: CT Scanner System
- **Product:** PCIe x4 cable adapter and cable
 - ✓ **Who:** Medical equipment provider
Application: optometric diagnostic instrument



The future HPC architecture



Summary

- PCIe over cable offers the HPC market high performance connectivity that is:
 - ✓ Reliable
 - ✓ Cost effective
 - ✓ Simple to use
- GPUs and SSD's can be located externally to the server
- PCIe over cable is used today across many applications and markets