OAK RIDGE National Laboratory

Odo Architecture Overview

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U.S. DEPARTMENT OF ENERGY

Frontier System Overview

- HPE Cray EX Supercomputer architecture
- 74 cabinets, 128 nodes per cabinet (9408 nodes)
- 3rd Gen AMD EPYC 64-core CPU
- 4 AMD Instinct MI250X GPUs
- HPE Slingshot interconnect
- Peak 1.206 Exaflops on HPL benchmark
- Cray, AMD, and GNU software stacks
- Orion - 679 PB multi-tier Lustre filesystem
- NFS storage (/ccs/home, /ccs/proj)

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- [illegible] CPU

Odo is 30 Frontier nodes, and uses the GPFS filesystem (/gpfs/alpine2), and NFS on the Open Enclave for home areas (/ccsopen/home, /ccsopen/proj)

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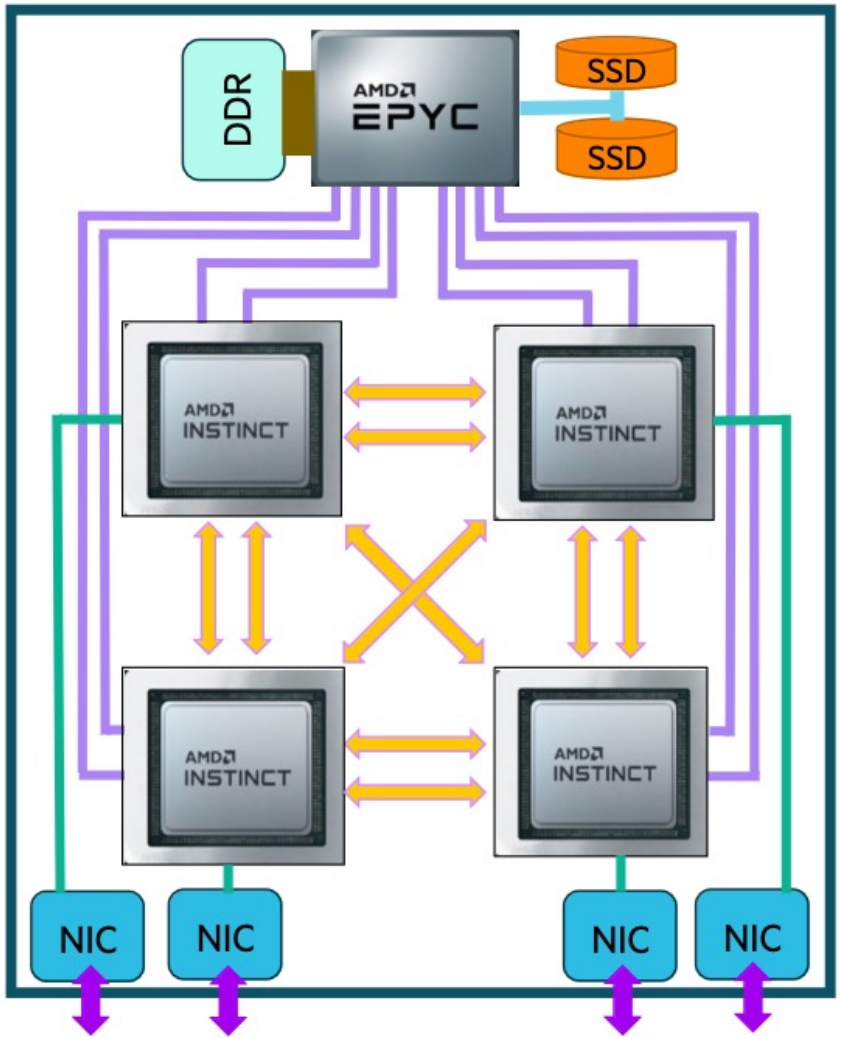
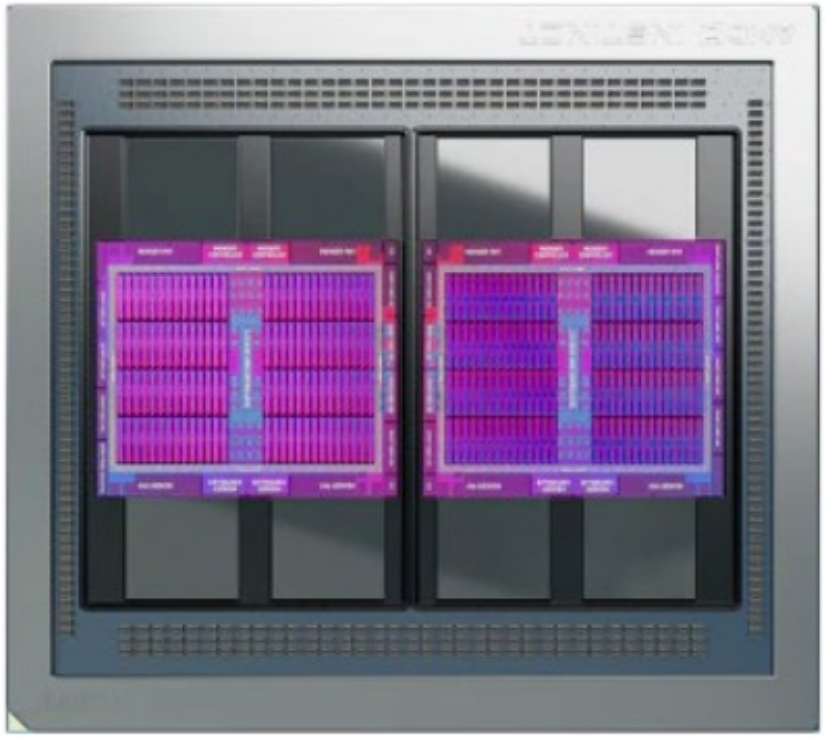
Frontier Compute Node Design

- 1x AMD Optimized 3rd Gen EPYC 64 core processor
  - 2 hardware threads per physical core,
  - 2.0GHz base clock, 3.7GHz boost clock
- 512 GB DDR4 memory with 205 GB/s peak bandwidth
- 2x NVMe 2TB SSDs, peak 8 GB/s R, 4 GB/s W, >1.5M IOPs
- 4x AMD MI250X Instinct GPUs
  - 128 GB High-Bandwidth Memory (HBM2E)
  - 3.2 TB/s peak bandwidth
  - 53 TFLOPS double-precision peak for modeling & simulation
  - 2 Graphic Compute Dies (GCDs)
- AMD Infinity Fabric between CPU and GPUs
  - Peak host-to-device (H2D) and device-to-host (D2H) data transfers of 36+36 GB/s per link
- AMD Infinity Fabric between MI250Xs
  - Peak device-to-device bandwidth of 50+50 GB/s per link, low latency
- 4x HPE Slingshot Interconnect 200 GbE NICs
  - Provides 100 GB/s to other nodes, 25 GB/s per port

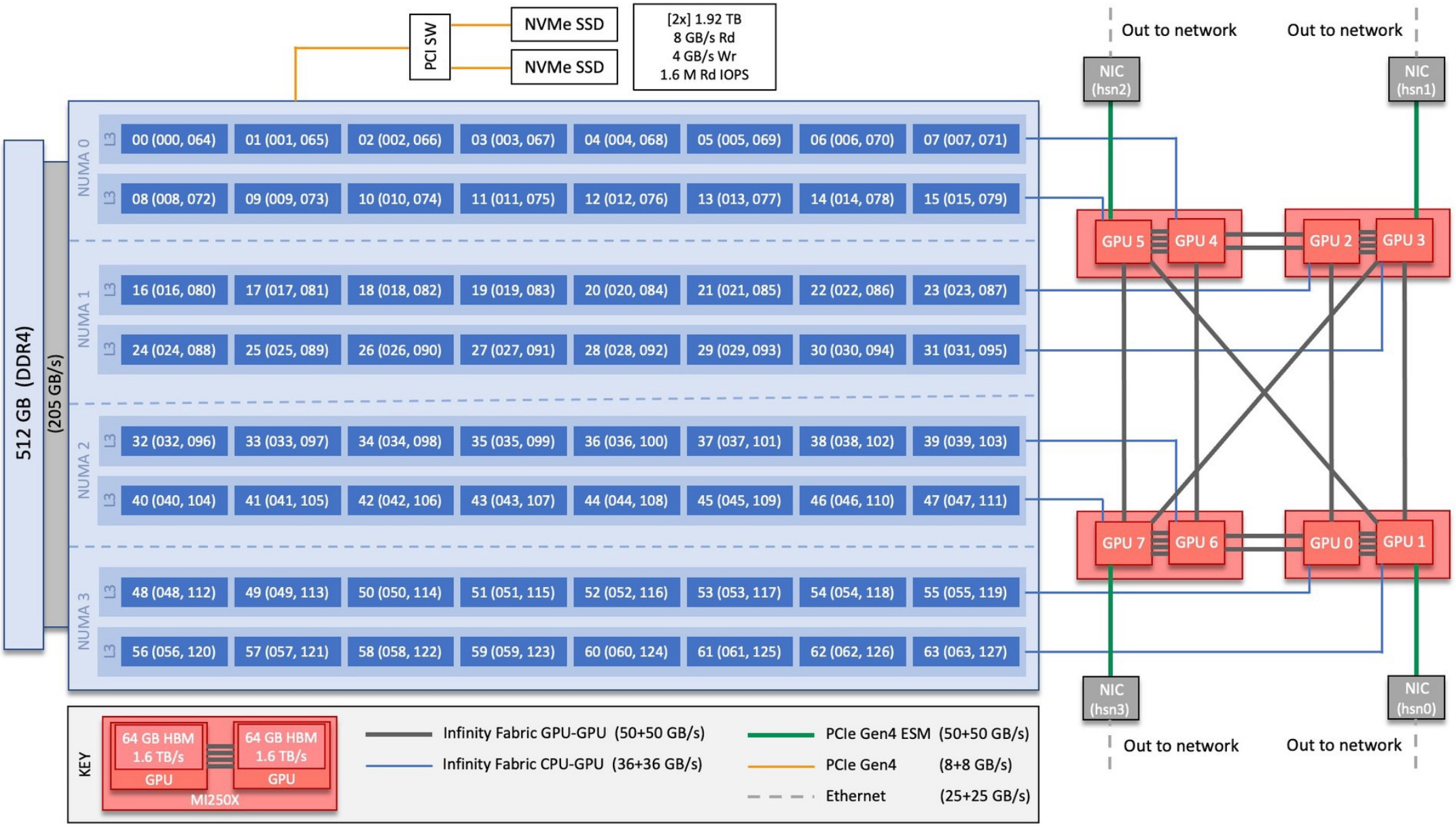


MI250X Accelerators

- The AMD MI250X has two Graphic Compute Dies (GCDs) per module
- This gives a total of 8 GCDs per node
- The 8 GCDs show as 8 separate GPUs to the OS, Slurm, and ROCm
- Generally easier to refer to the 8 GCDs as GPUs and arrange programs to run on nodes with 8 GPUs
- Each Node then has 8 GPUs with the following specifications:
  - HBM Capacity: 64 GB
  - HBM Peak Bandwidth: 1.6 TB/S
  - Compute Units: 110
  - 26.5 TFLOPS double-precision peak
- The 8 GPUs are each associated with one of the 8 CPU L3 cache regions
- All 8 GPUs are connected to each other and to the CPU via AMD Infinity Fabric links
- The two GCDs in the same MI250X have a higher bandwidth Infinity Fabric connection between them, with 200 GB/s peak



Frontier Compute Node Diagram



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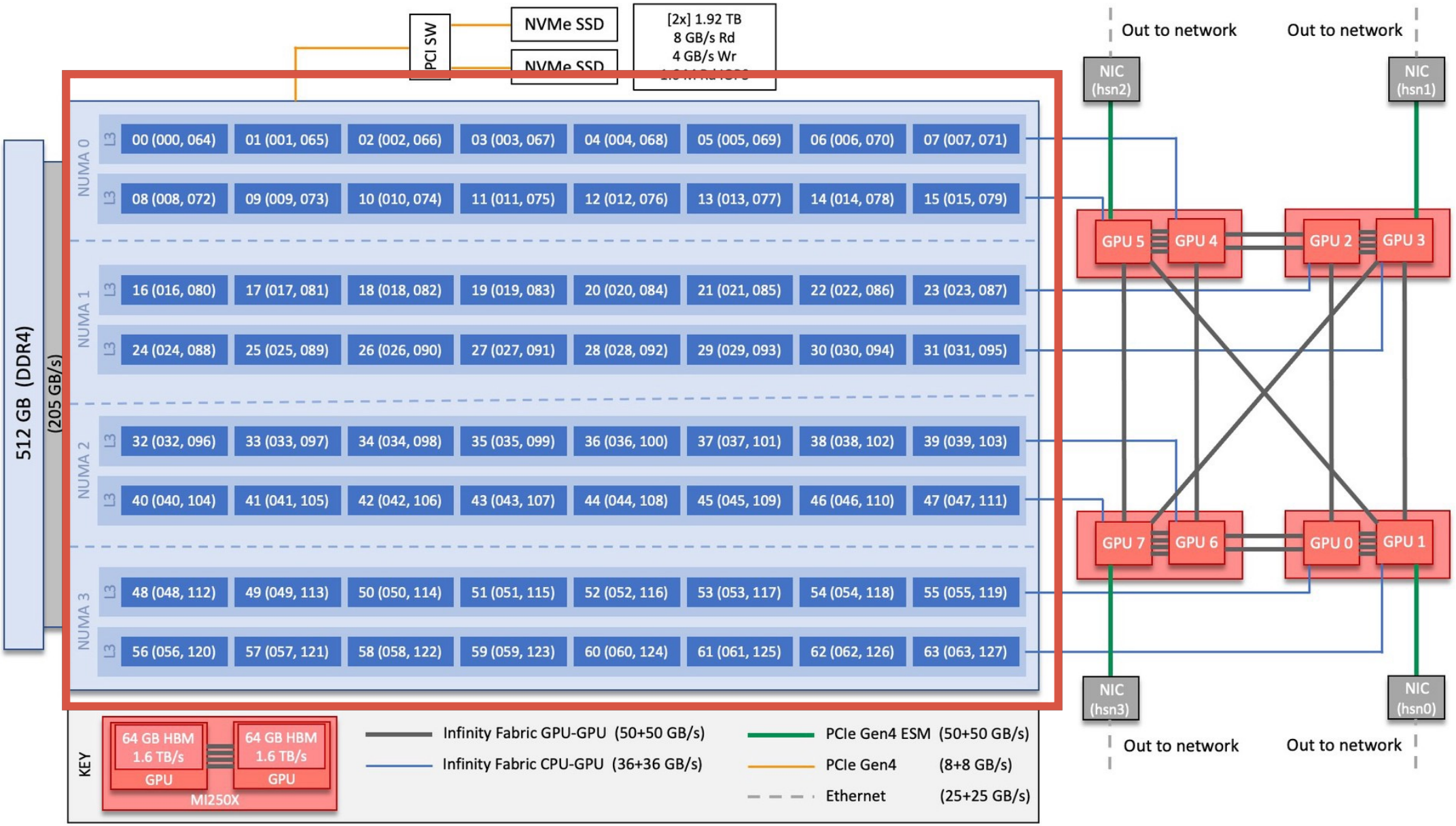

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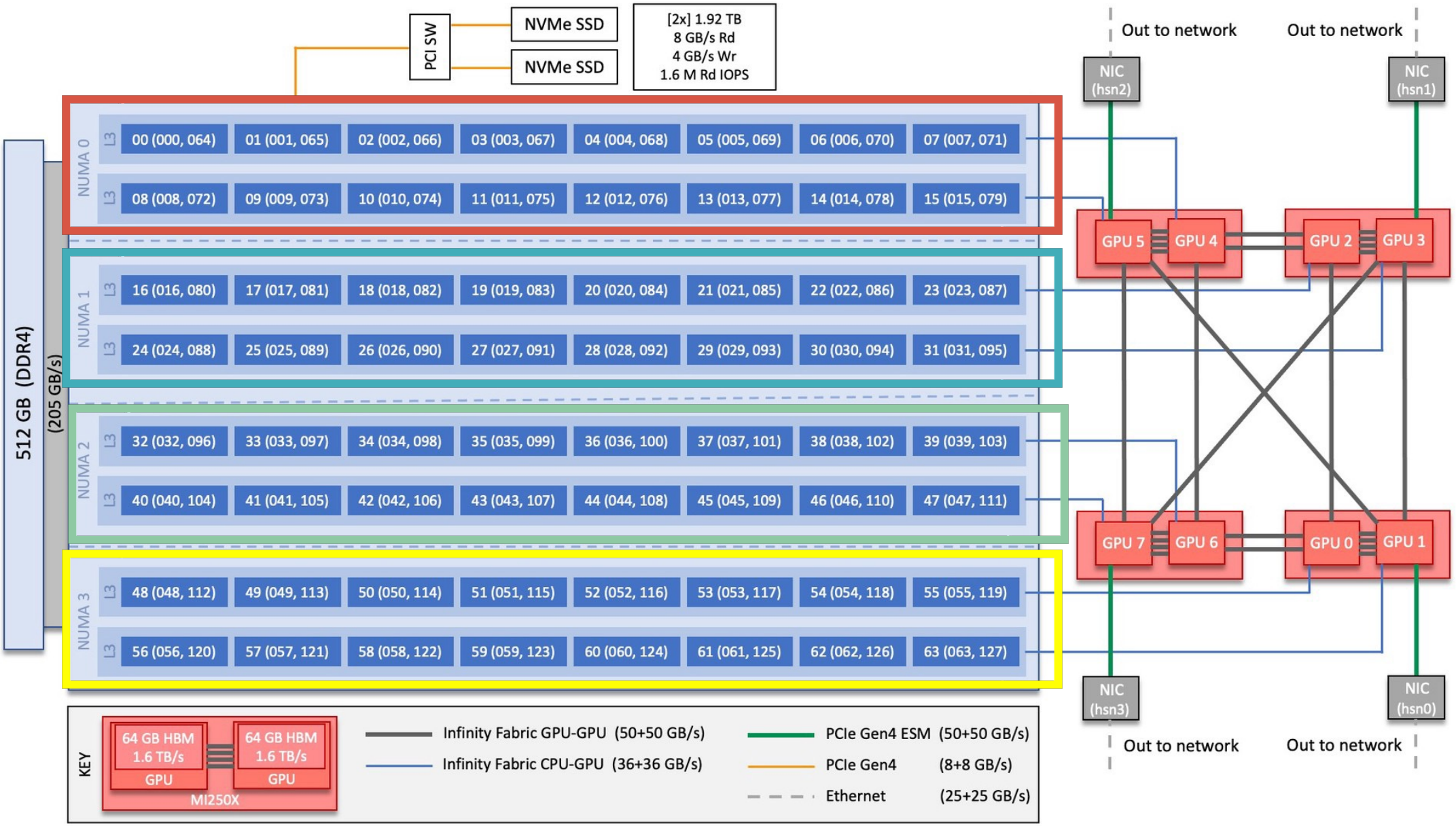

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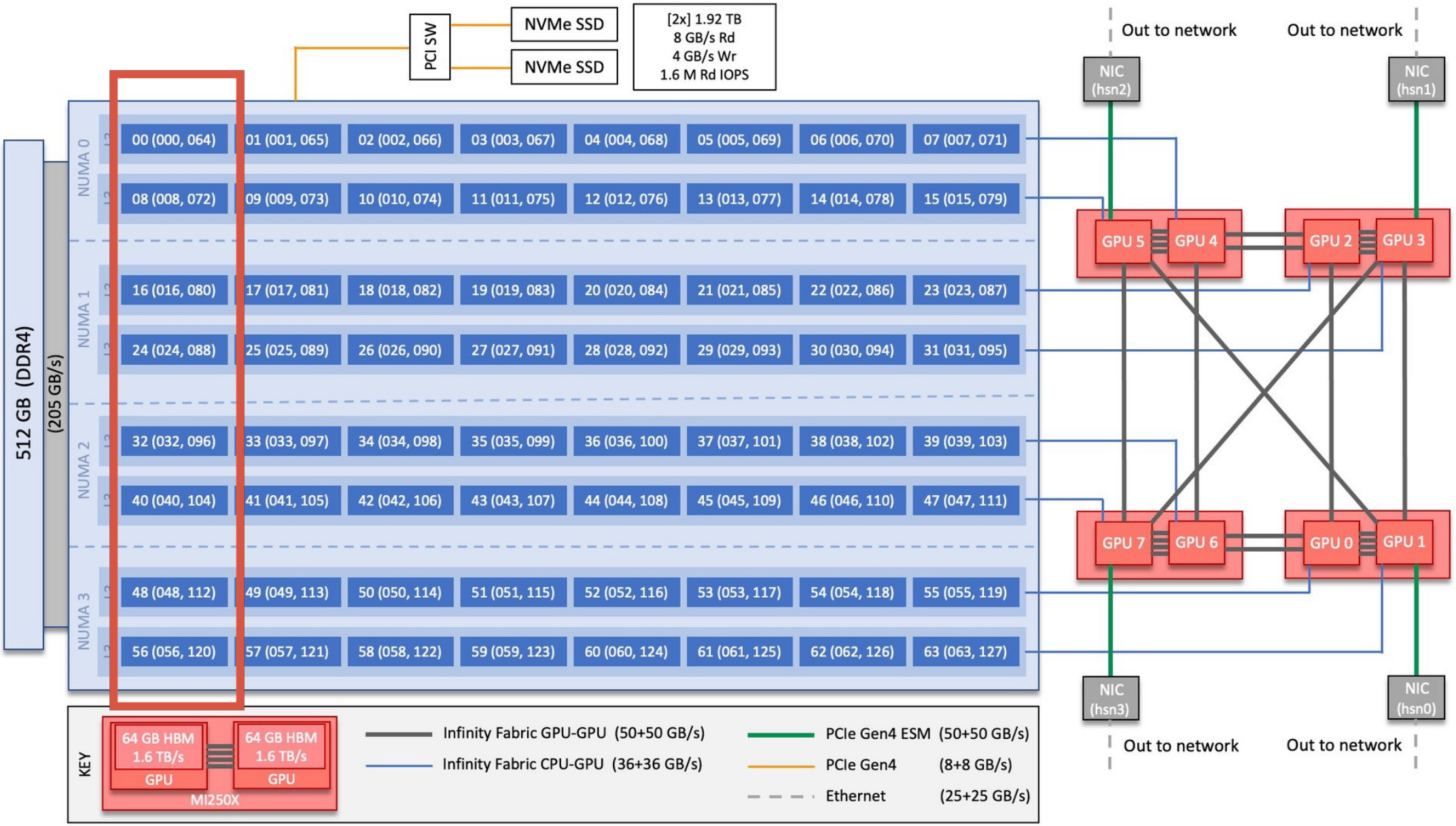

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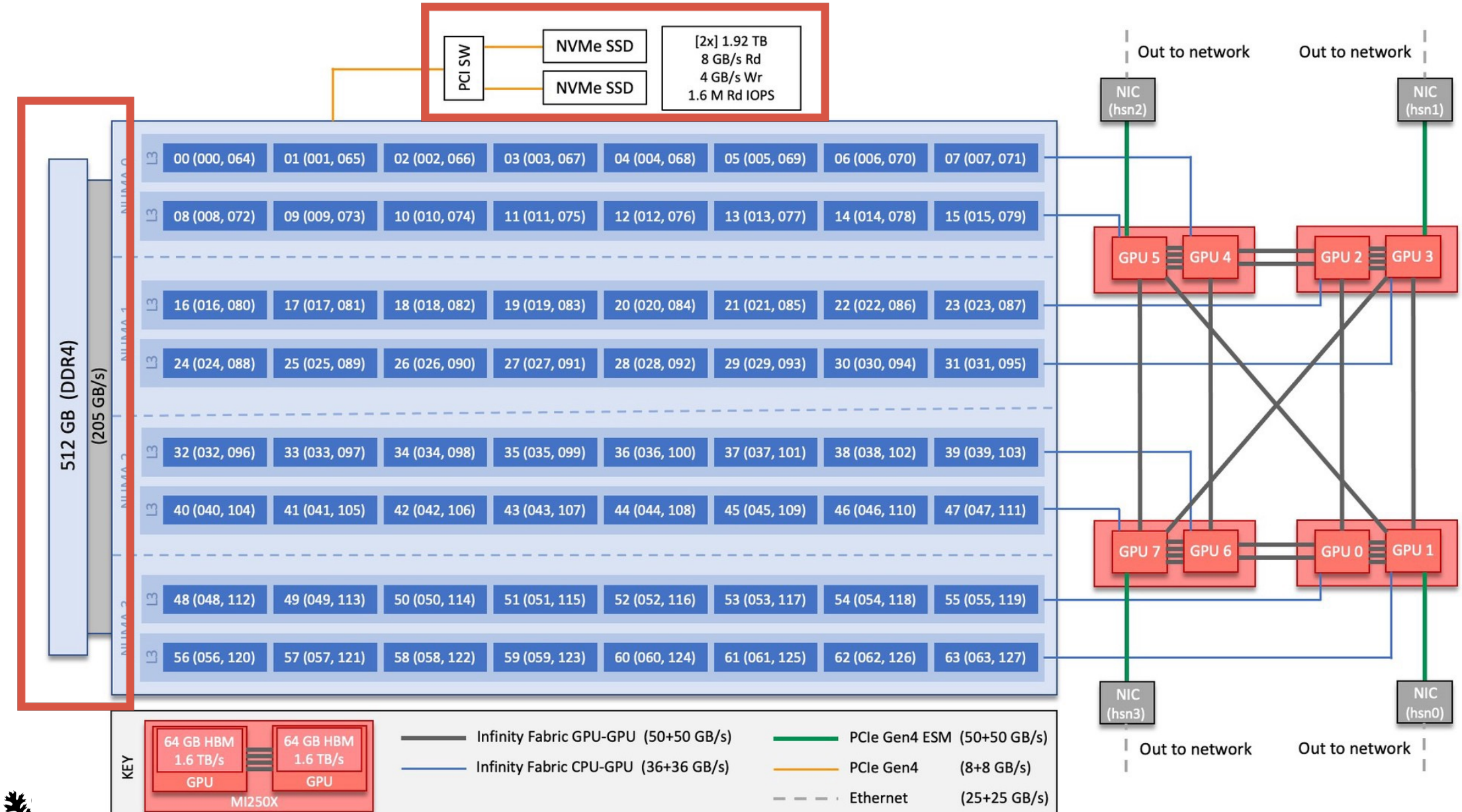

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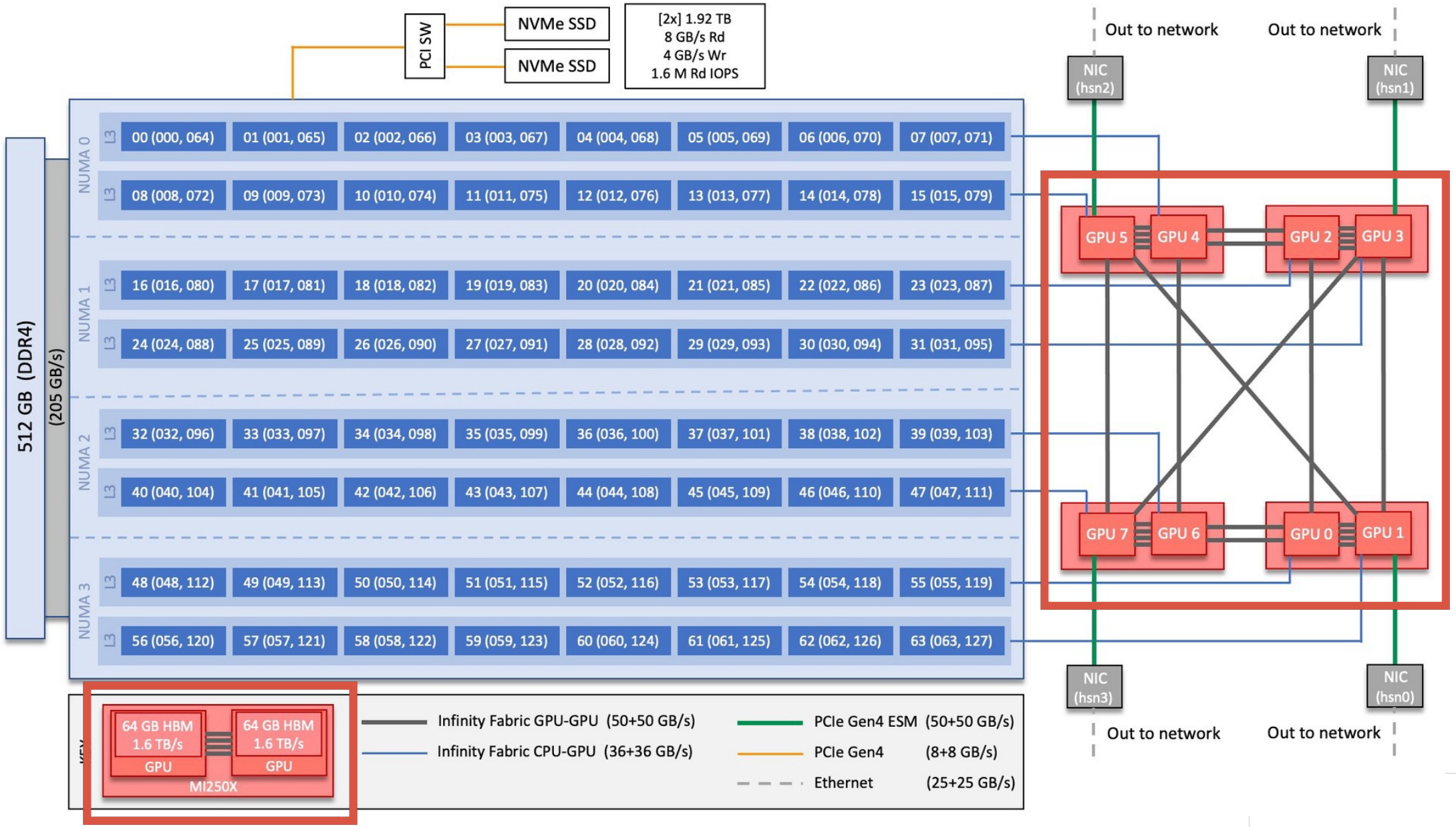

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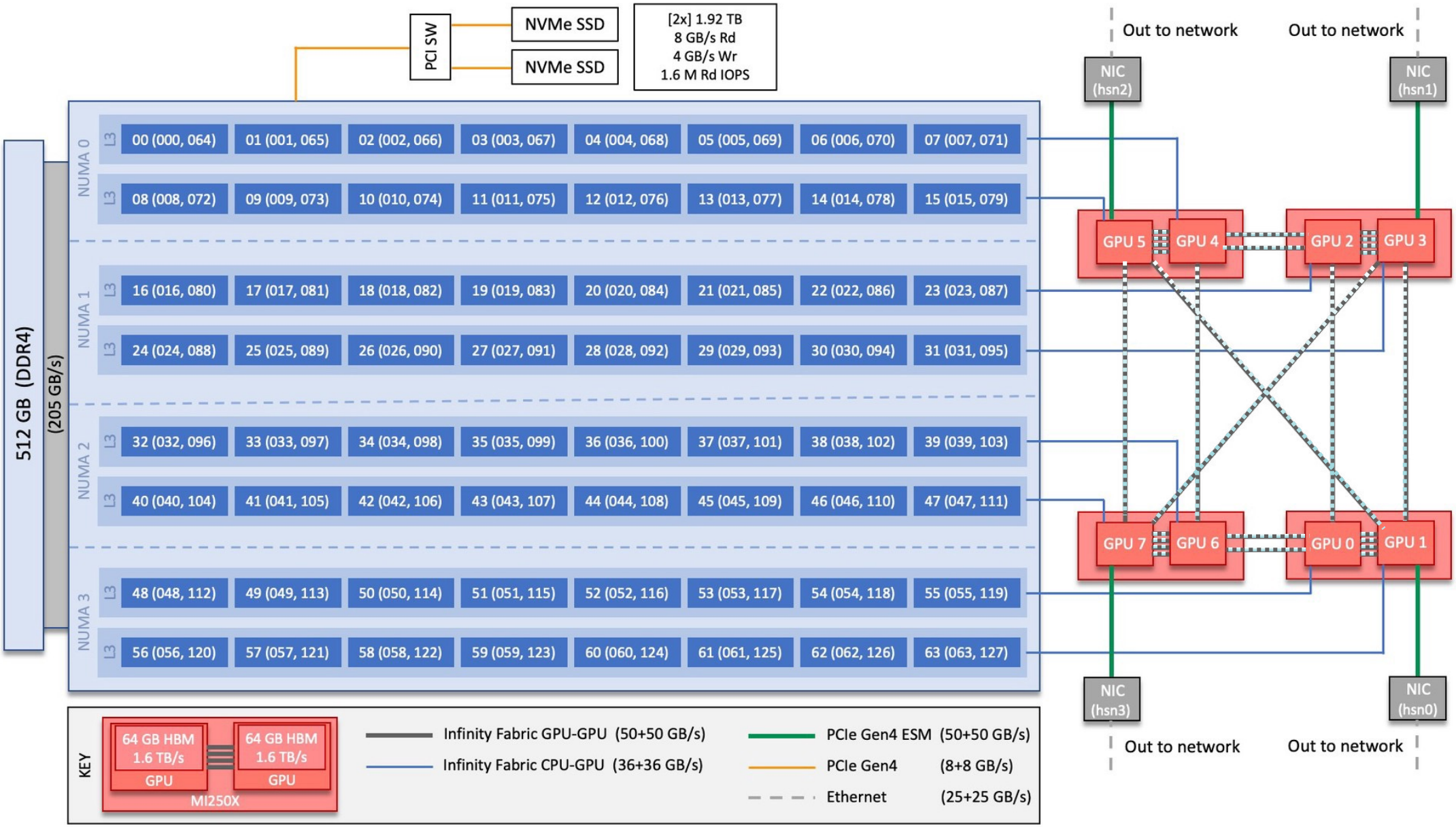

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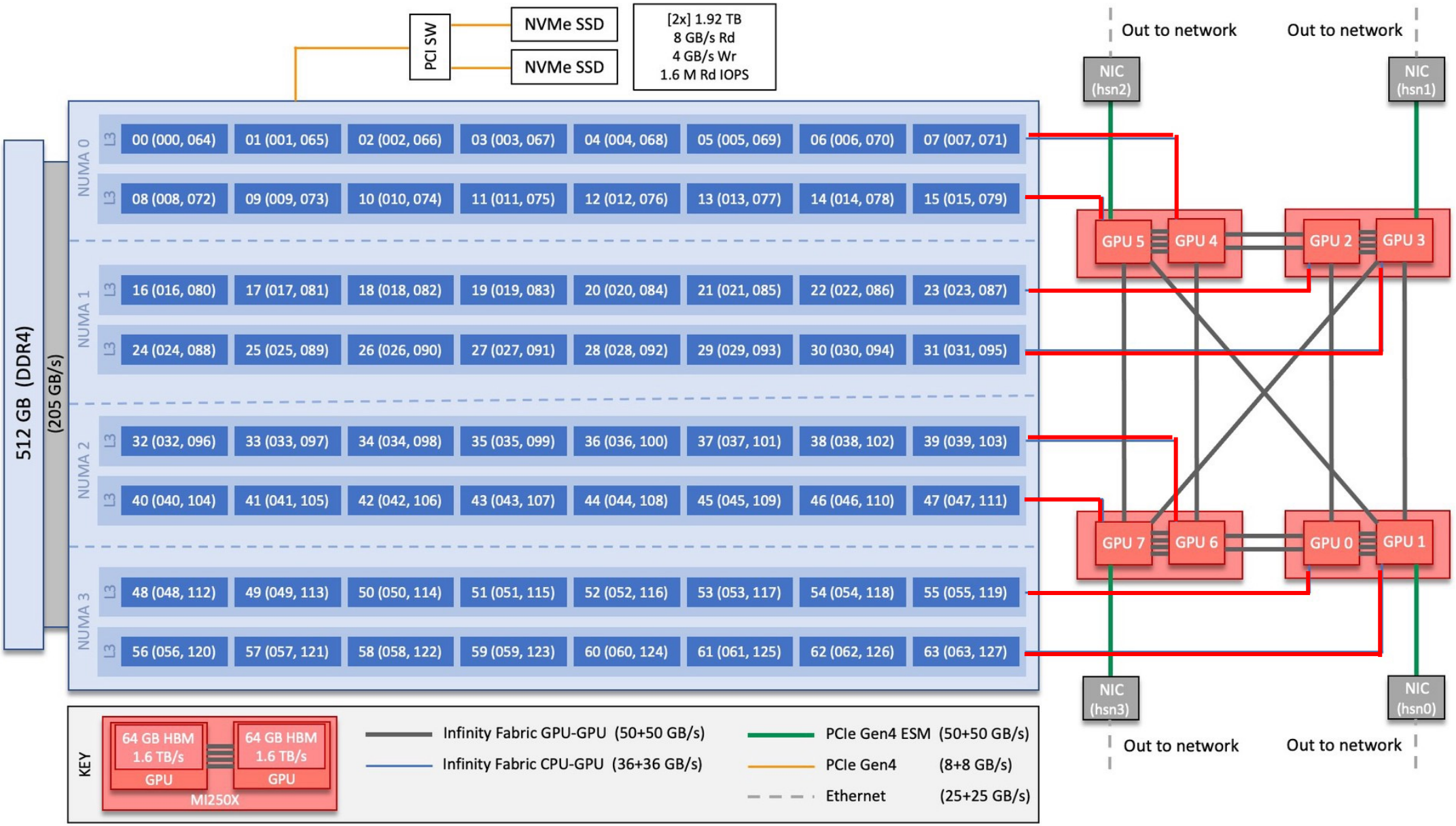

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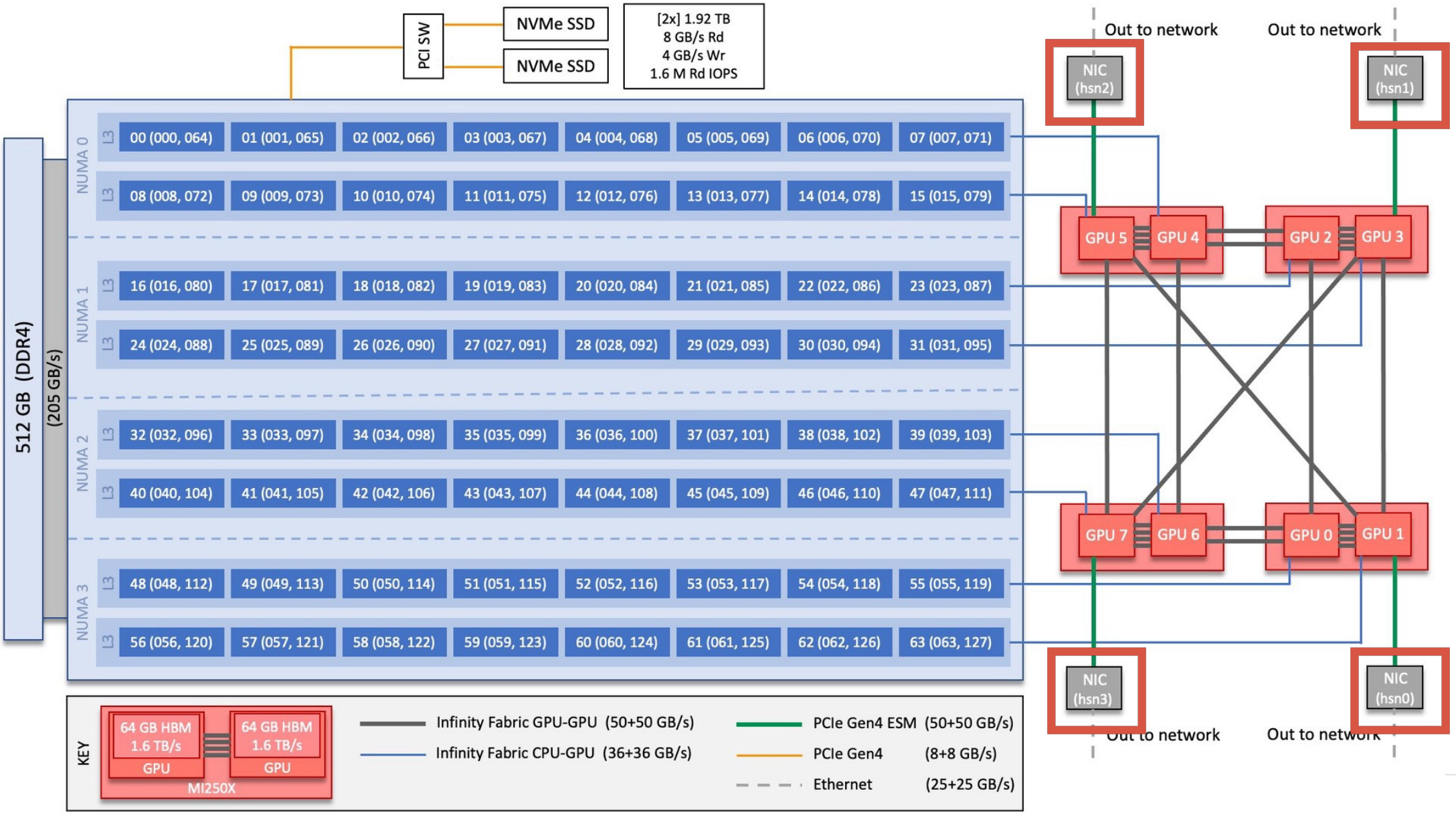

For everything we talked about!

Documentation:
docs.olcf.ornl.gov

Joe Glenski's 30 minute talk:
https://vimeo.com/840551316