

Frontier Architecture Overview

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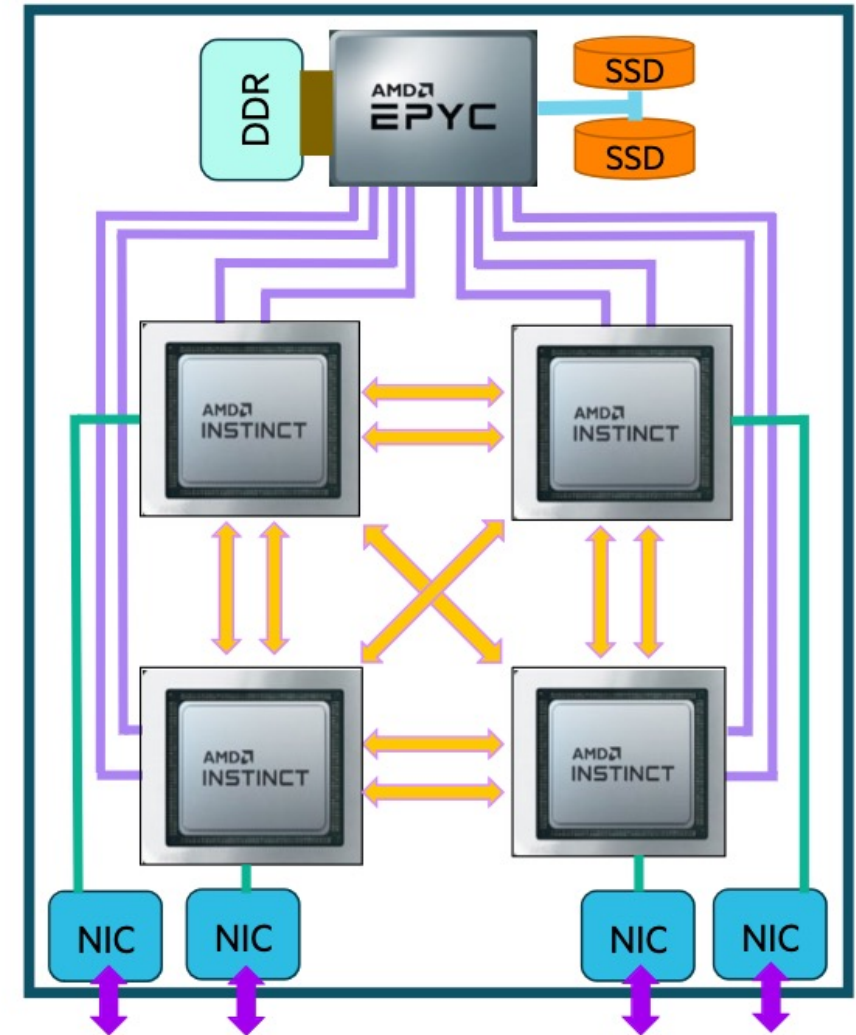
Frontier System Overview

- 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 1.194 Exaflops on HPL benchmark
- Cray, AMD, and GNU software stacks
- Orion - 679 PB multi-tier Lustre filesystem
- NFS storage (/ccs/home, /ccs/proj)



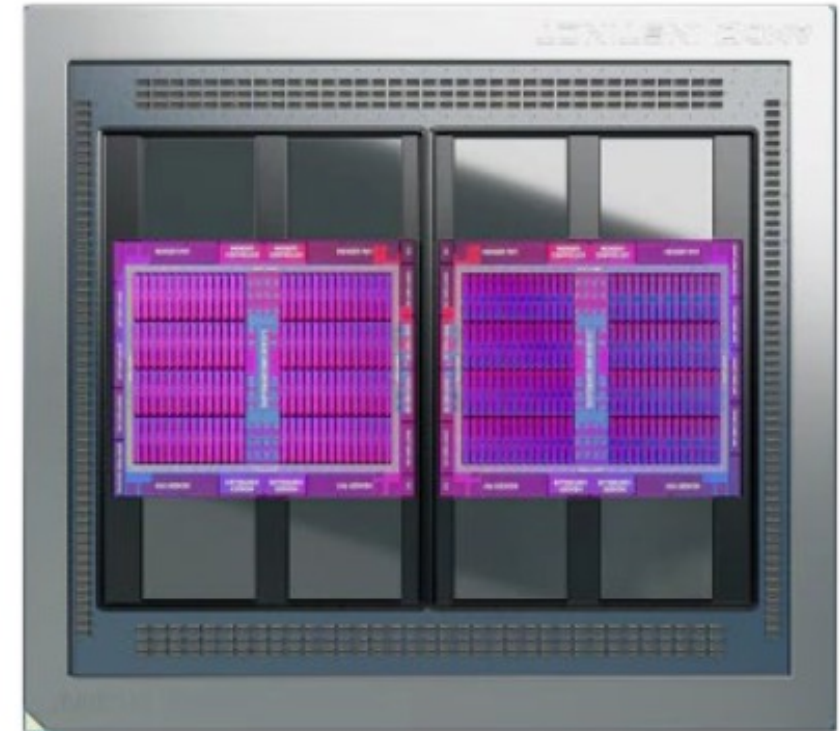
Frontier Compute Node Design

- 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

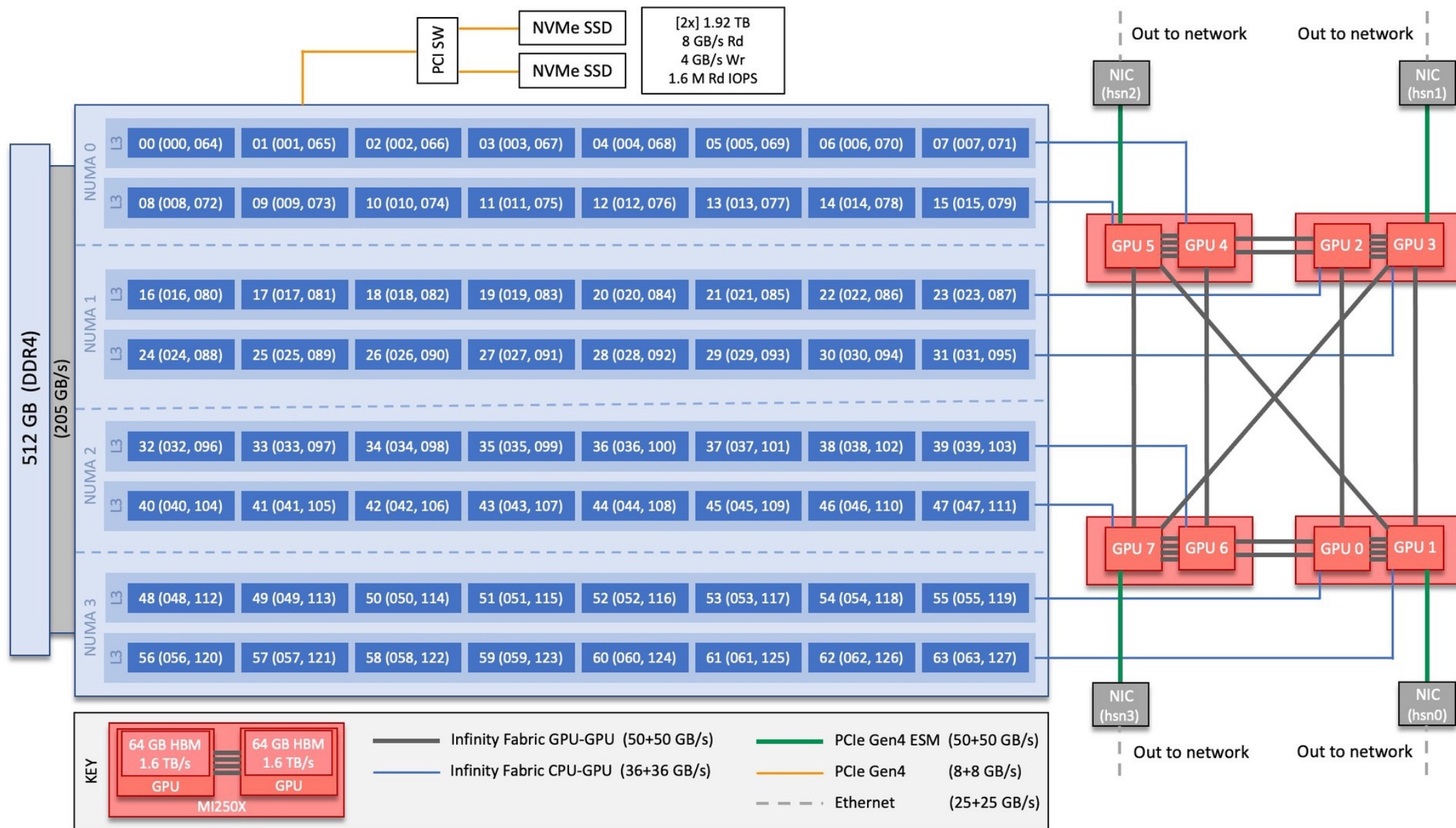


MI250X Accelerators

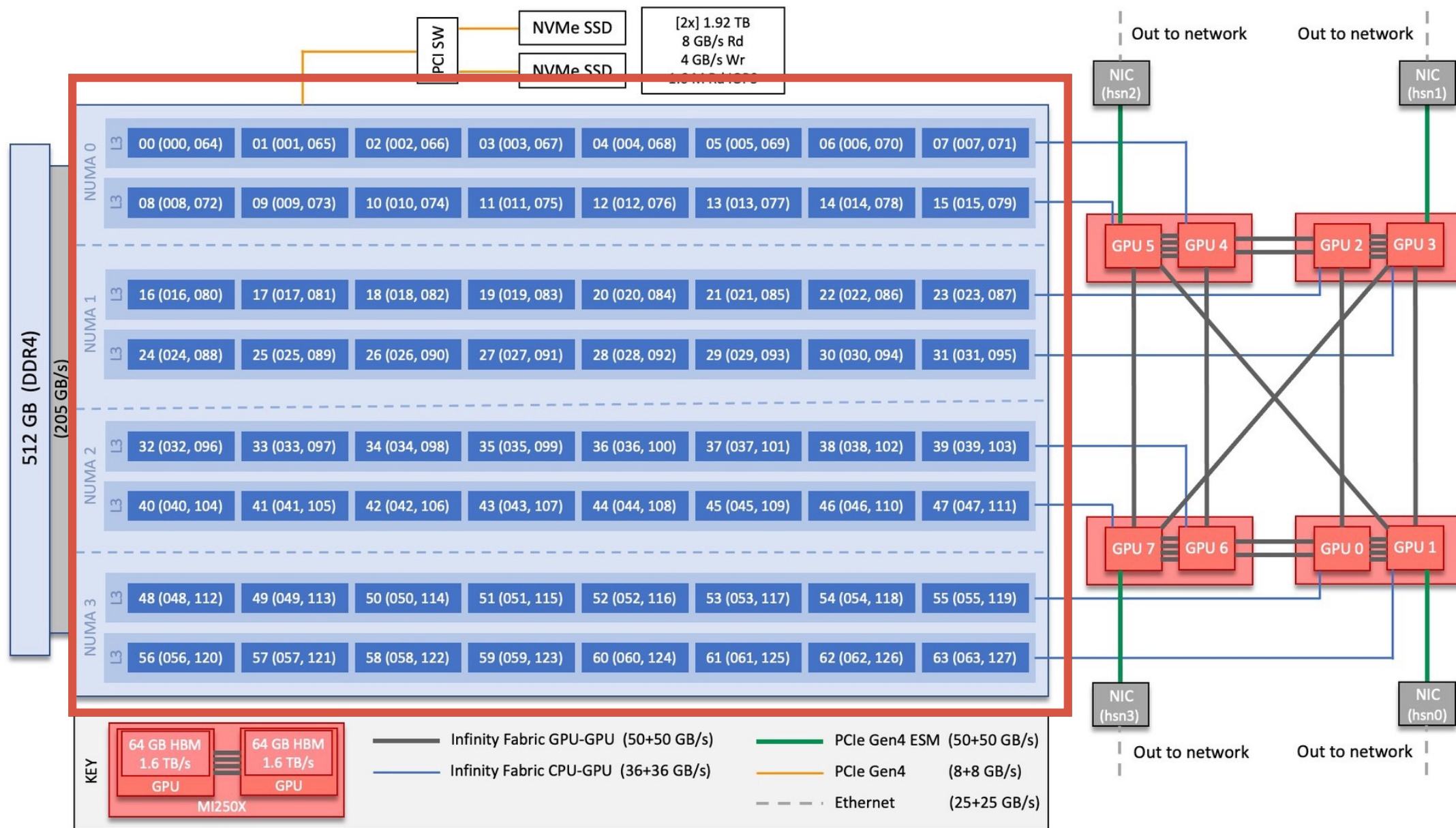
- The AMD MI250X has two Graphic Compute Dies (GCDs) per module
- This gives a total of 8 GCDs per node
- The 8 GCDs show as 8 separate GPUs to the OS, Slurm, and ROCm
- Generally easier to refer to the 8 GCDs as GPUs and arrange programs to run on nodes with 8 GPUs
- Each Node then has 8 GPUs with the 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



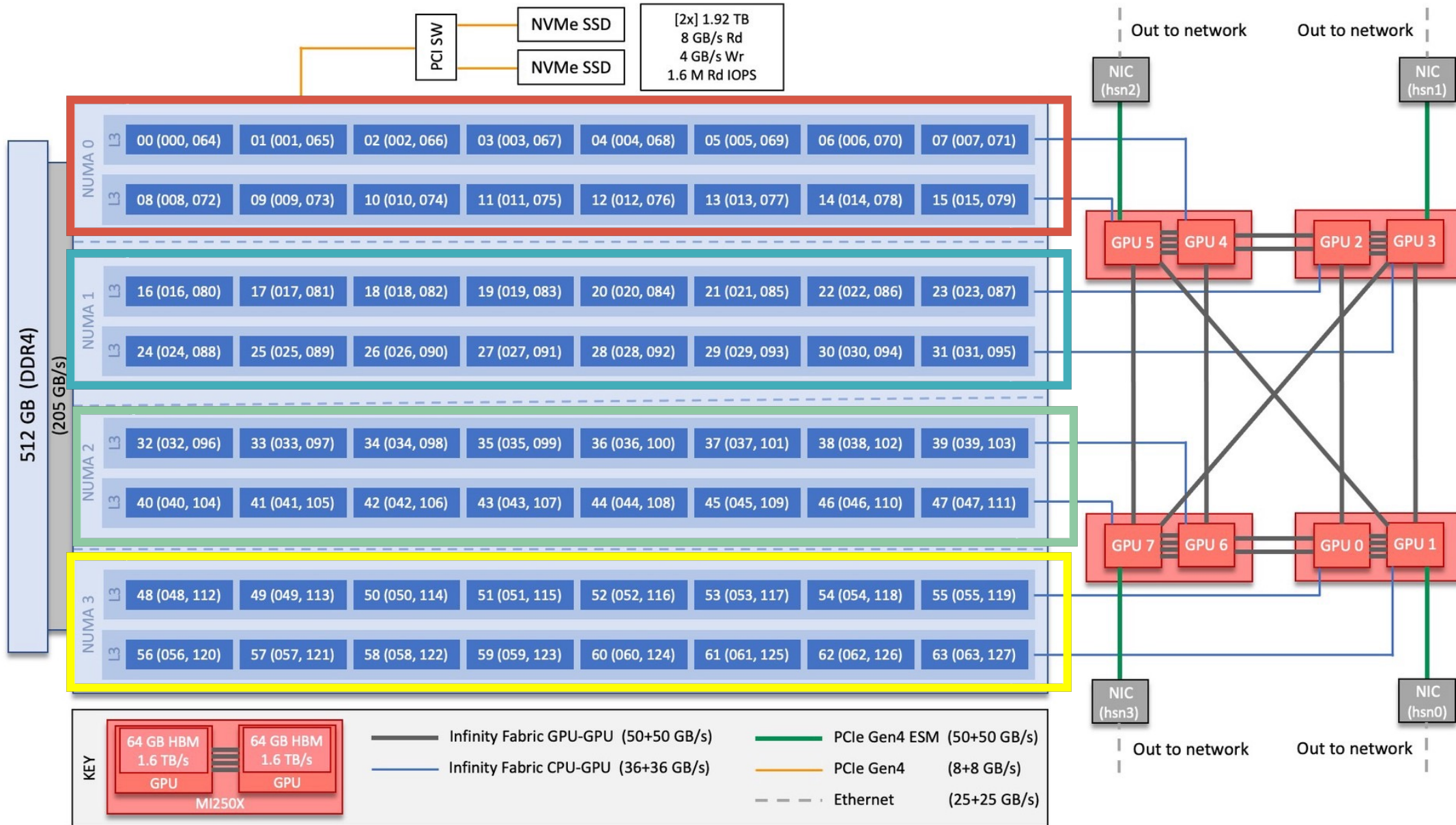
Frontier Compute Node Diagram



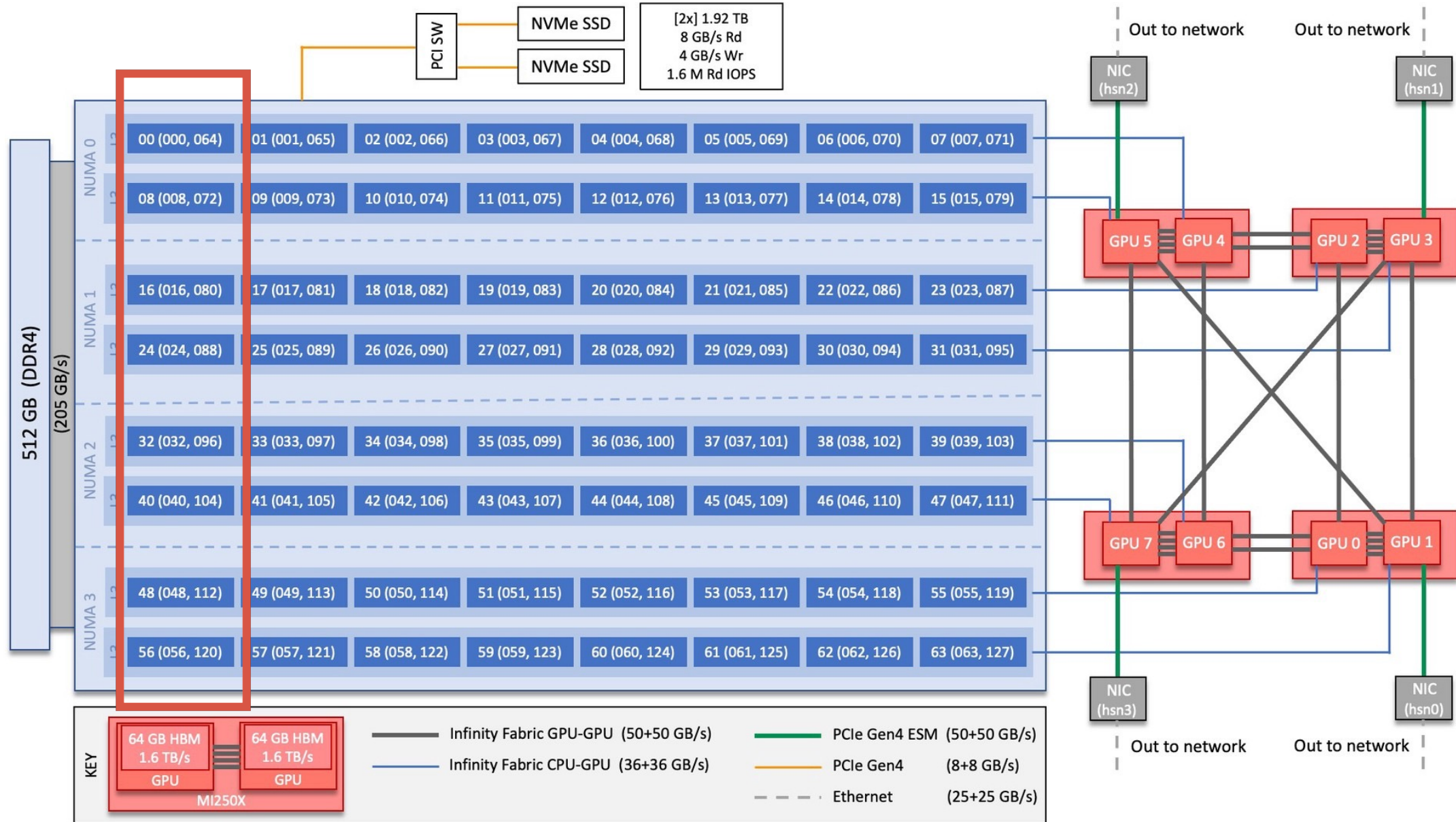
Frontier Compute Node Diagram



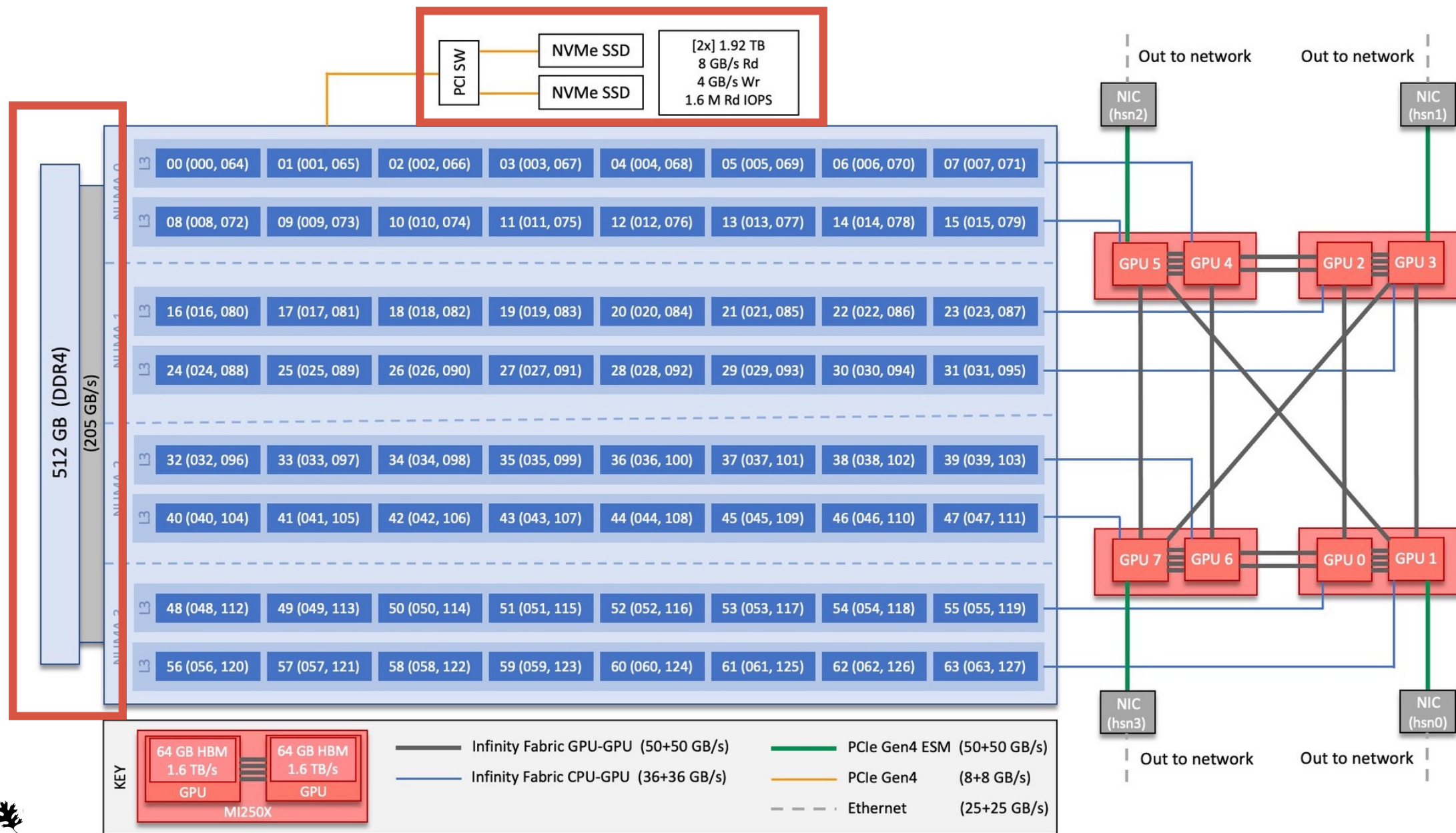
Frontier Compute Node Diagram



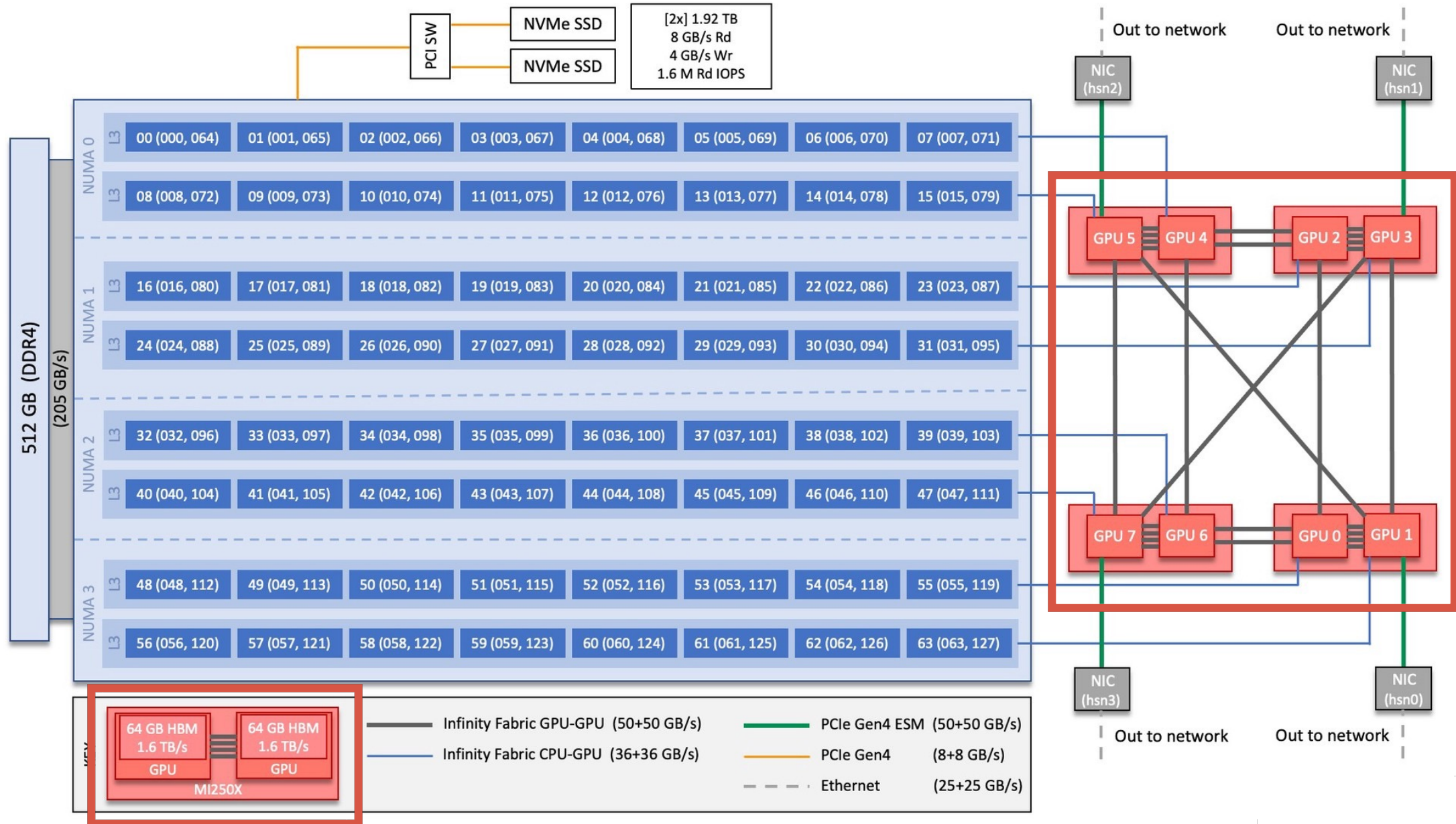
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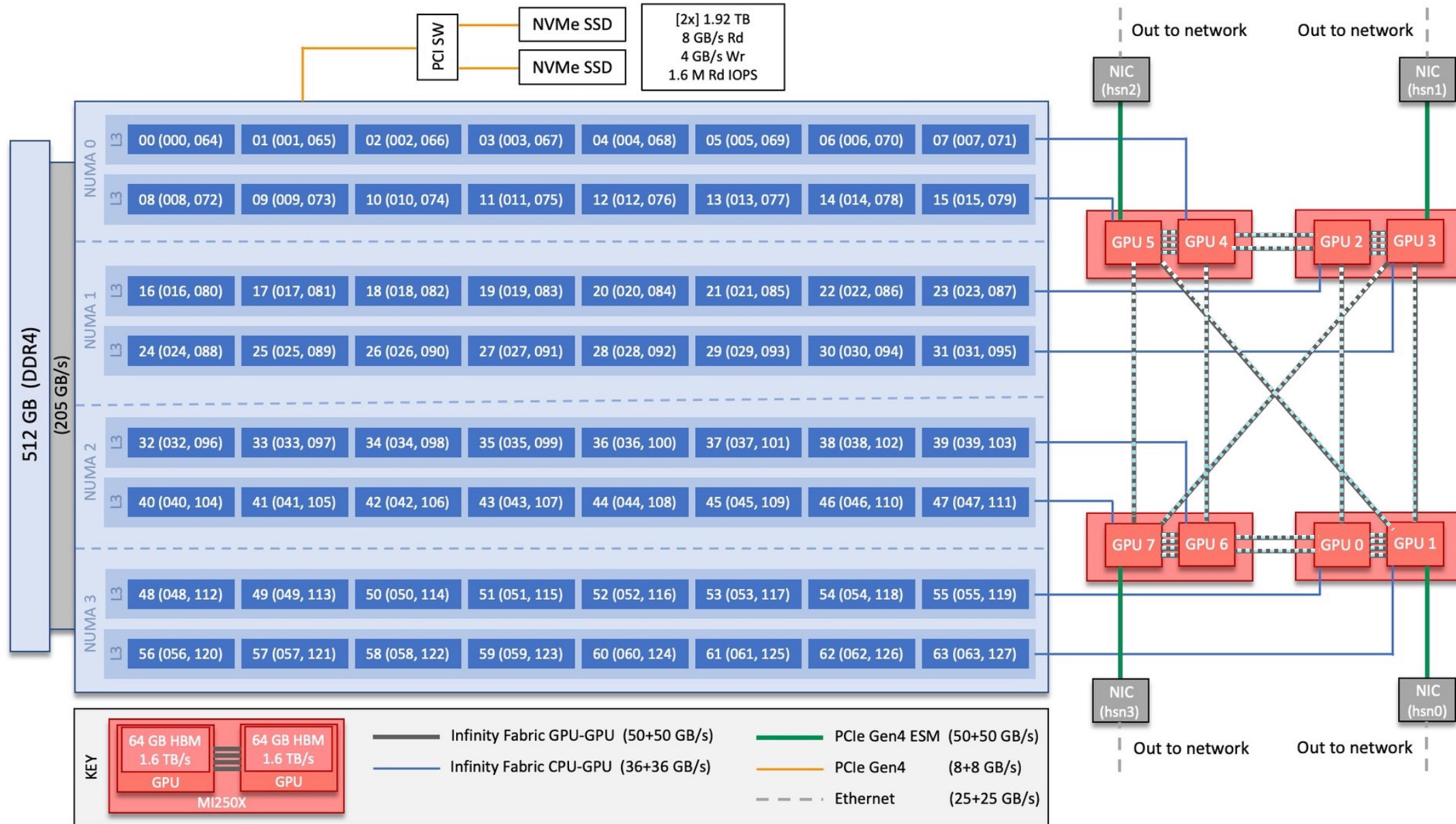
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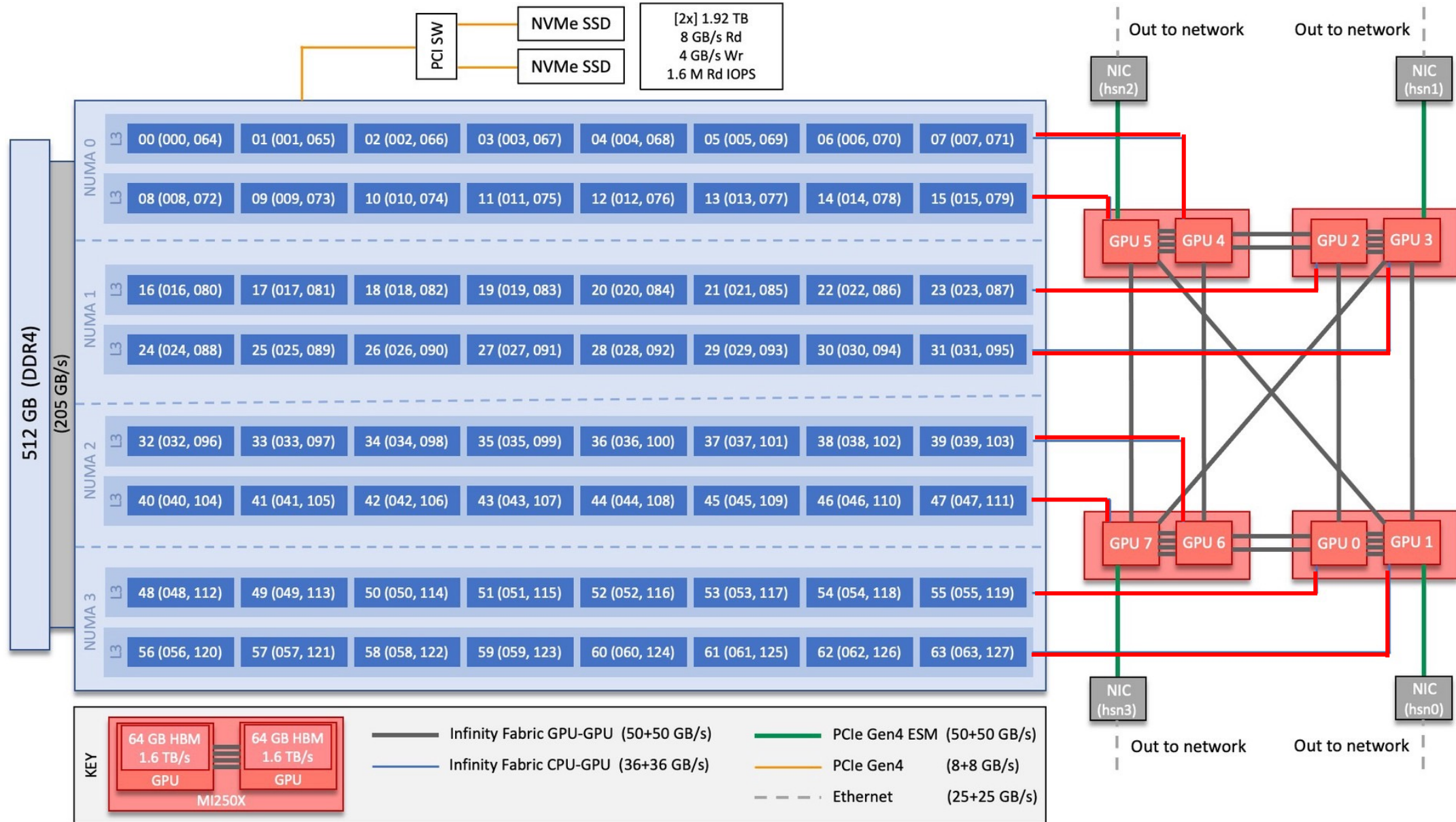
Frontier Compute Node Diagram



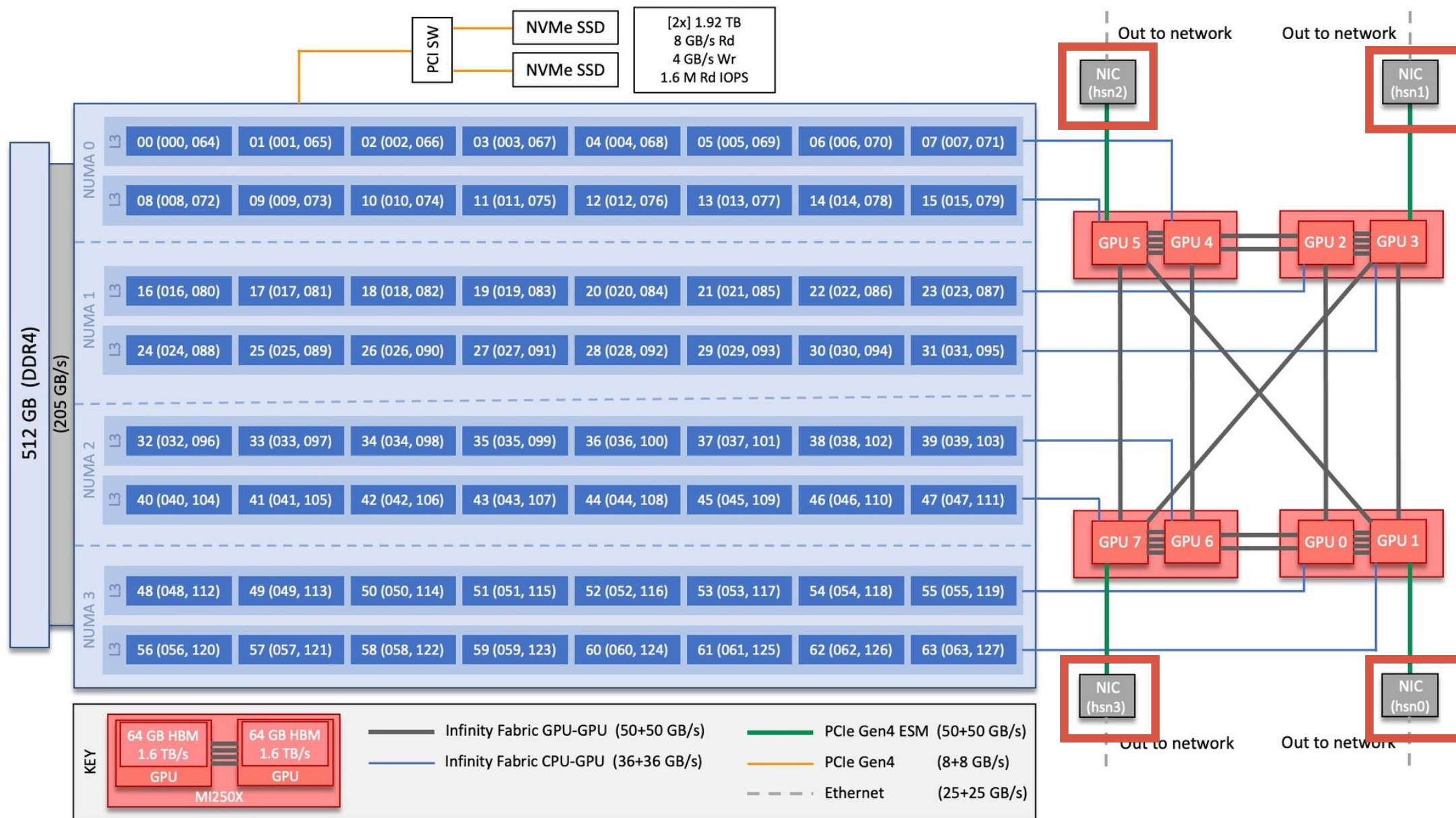
Frontier Compute Node Diagram



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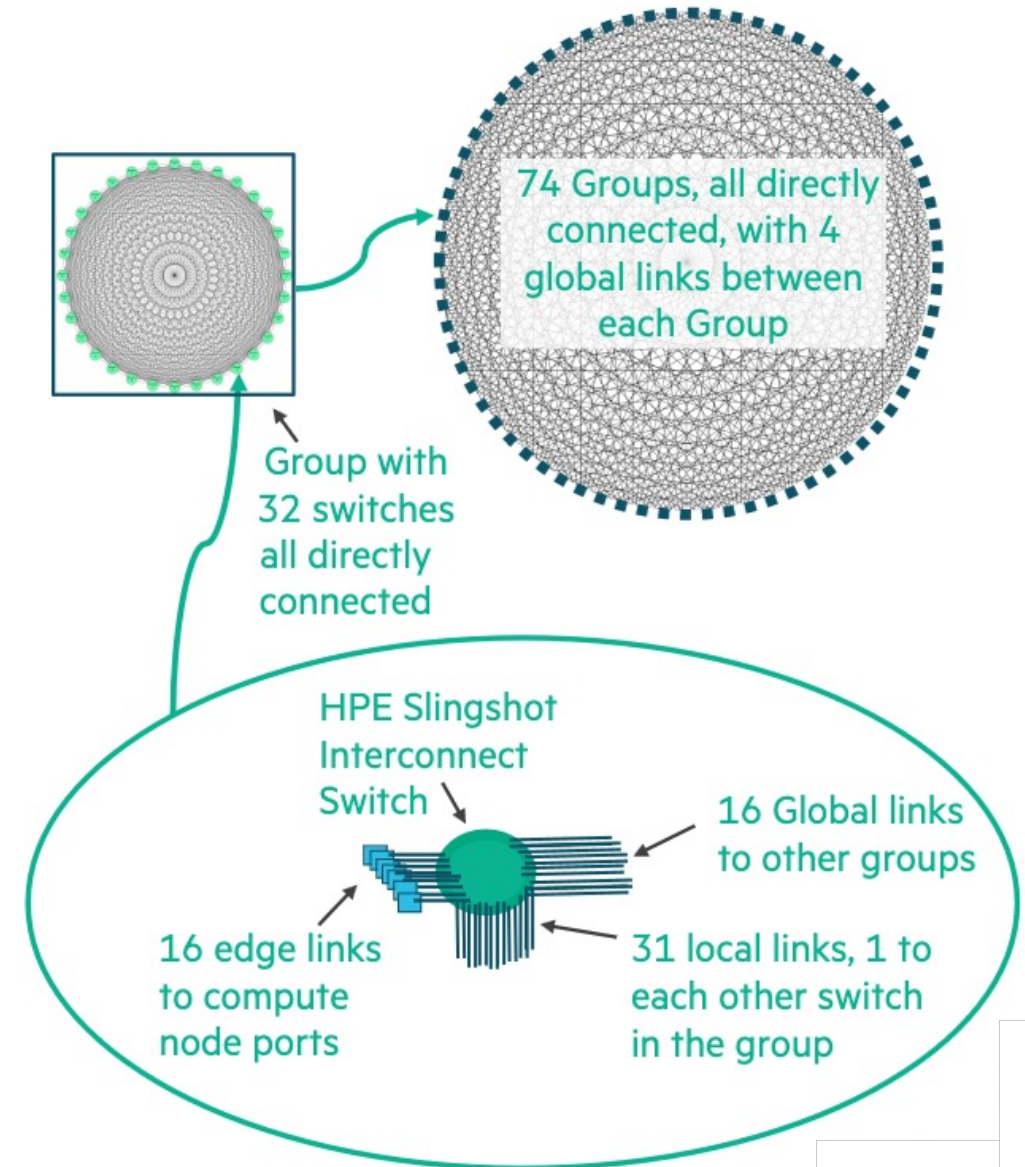


Frontier Compute Node Diagram



Frontier Slingshot Interconnect

- Slingshot 11 with Dragonfly topology
- 74 cabinets (“groups”, 128 nodes per group). Each group has 32 switches
 - High radix, 64-port, 12.8 Tb/s bandwidth switch
- all-to-all connections between groups
 - Any two groups will have 4 links between them.
 - 25 GB/s bandwidth for each link
- Node connections – 4 links from each node to a switch
 - 25 GB/s bidirectional bandwidth per link



For everything we talked about!

Documentation:
docs.olcf.ornl.gov

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