HPCA Performance Analysis Report

In the benchmark tests, we selected three different binary build methods and four types of system architecture. We conducted the tests on both the Aion and Iris clusters using scripts written with the ReFrame framework. The final test results are summarized in the tables below. The meaning of each metric is described as follows:

Metrics	Description
generic	Compiled from source
easybuild	Compiled with EasyBuild
eessi	Binaries loaded from the EESSI distribution

Metrics	Description
intra_numa	both processes are running on the same NUMA node
cross_numa	both processes are running on the same physical socket but different NUMA nodes
cross_socket	both processes are running on the same compute node but different sockets
inter_node	the 2 processes are running on different nodes

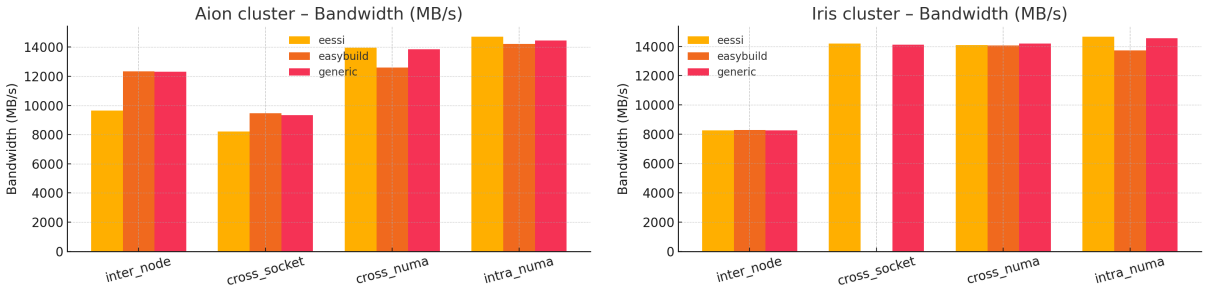

Figure 1: Bandwidth result in Aion & Iris cluster.

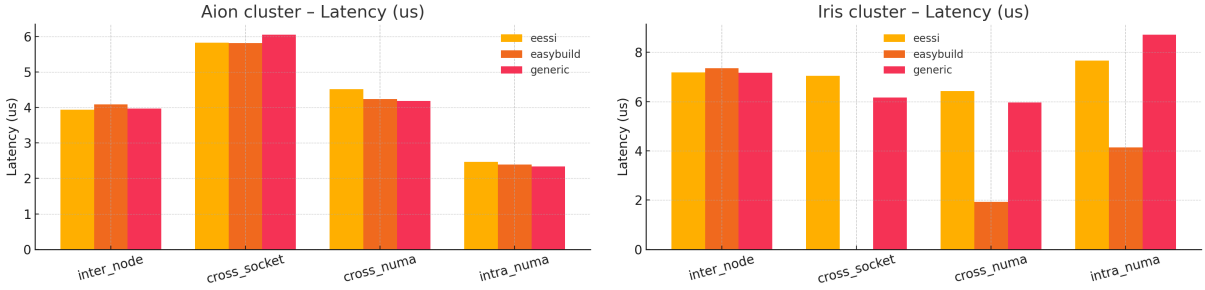

Figure 2: Latency result in Aion & Iris cluster.

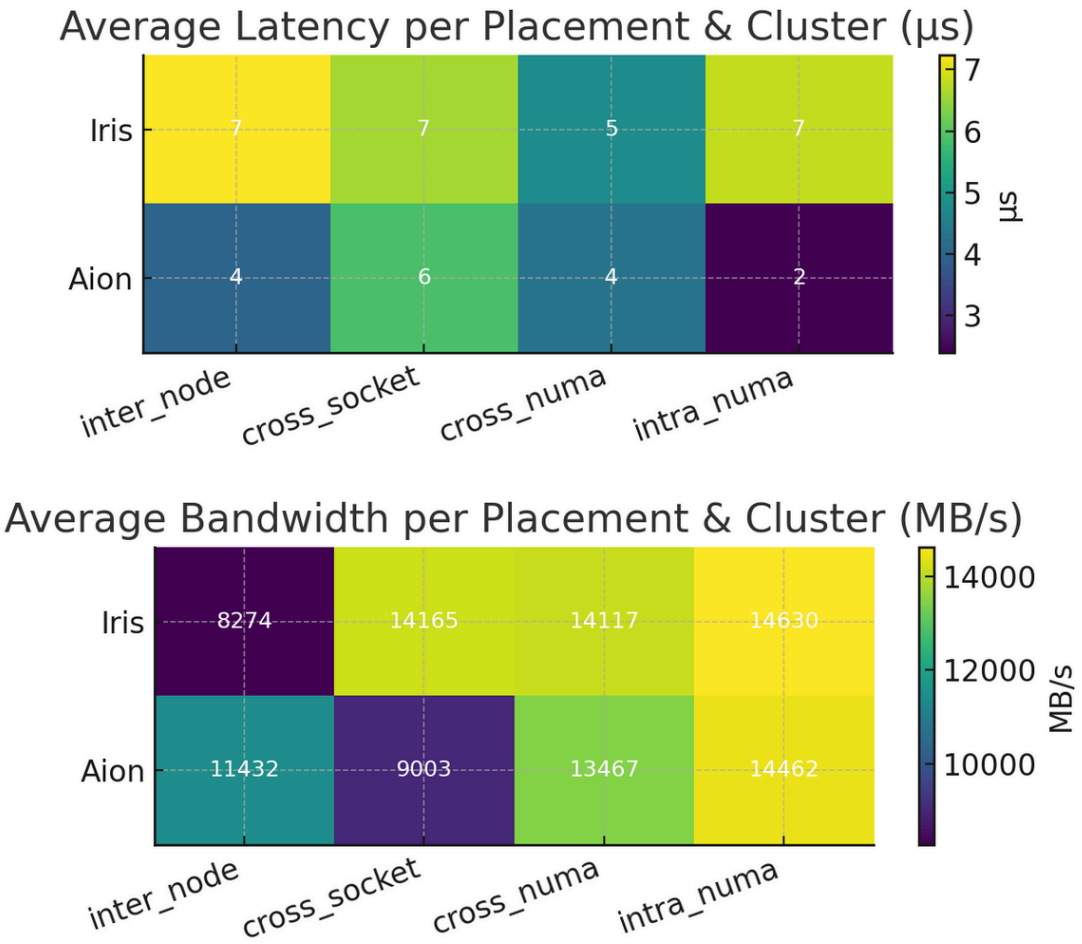

Figure 3: Average Bandwidth & Latency

Reference Value Selection

Reference values for latency and bandwidth were chosen based on:

- Empirical performance observed on Aion (as the primary benchmarking baseline)
- Vendor documentation and prior testing experience
- Cluster architecture: NUMA layout, network interconnect (e.g., InfiniBand)

Thresholds:

- Bandwidth: ±5–20% depending on placement (inter-node less strict)
- Latency: ±20% as small variations can emerge from system jitter, binding strategy, and CPU frequency scaling

These values are expected to remain stable unless:

- Underlying system software (MPI, drivers) is updated
- Network libraries or kernel-level NUMA behaviors are altered

Analysis & Insights

From Figure 1 and Figure 2 we can observation:

1. Iris excels in local bandwidth (especially for cross_socket/cross_numa).
2. Aion shows lower latency, likely due to faster CPU scheduling or better NUMA balancing.

Figure 3 shows that for latency:

1. Iris: Averages 7 µs across most placements.
2. Aion: Significantly faster—down to 2.3 µs in intra_numa.

Also for bandwidth:

1. Iris dominates across all placements, with cross_numa/cross_socket 14.1 GB/s+
2. Aion achieves similar intra_numa bandwidth, but underperforms in inter_node (11.4 GB/s)

Conclusion

Aion cluster shows superior latency performance, especially in intra_numa and cross_numa, making it ideal for latency-sensitive workloads.

Iris cluster dominates bandwidth, especially in cross_socket and inter_node, suggesting better I/O performance and network fabric.

The generic binary often performs best in latency, while easybuild and generic are reliable for bandwidth.

EESSI binaries, while convenient, occasionally underperform—potentially due to instruction set mismatches or less tuned builds.

So, For latency-critical tasks: Use Aion, prefer generic builds.

For data-intensive or communication-heavy jobs: Use Iris, prefer easybuild or generic.